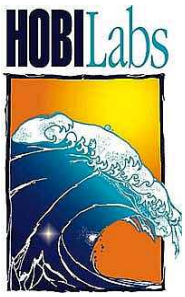
HydroRad Radiometers and Controller / Logging System

Prepared For
Indian Space Research Organisation
Space Application Centre

SYSTEM USER'S MANUAL

Revision C: October 2006



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Lighting the Way in Aquatic Science

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Revision C, October 2006:

Remove post-processing software section to separate manual.

Section 7.6, add details about packet format and correct byte addresses.

Section 6: update description of HydroDAS Console to reflect version 1.21 (add file capture and expand file transfer functions).

Revision B, July 2006:

Add section on post-processing software; minor editorial changes

Table of Contents

1 SYSTEM OVERVIEW

This document describes a hyperspectral radiometer system designed for the Space Applications Centre of the Indian Space Research Organisation. It is to be deployed on a buoy in the Indian Ocean, in order to collect long-term time series data on the spectral properties of light at and near the ocean's surface.

The system is based on HOBI Labs' HydroRad radiometers, and a customized HydroDAS data acquisition and logging controller. Figure 1 shows a block diagram of the major components of the system.

The HydroRads, described further in Section 2, measure downwelling irradiance on the surface and at three depths under the surface, and upwelling radiance at the same three depths. They are equipped with anti-fouling shutters to provide accurate results over long periods in the water.

The HydroDAS controls all the instruments and collects, archives and processes their data. It transfers the processed data to a customer-designed satellite transceiver for relaying to shore. In addition, archive data can be processed on shore after the HydroDAS is retrieved.

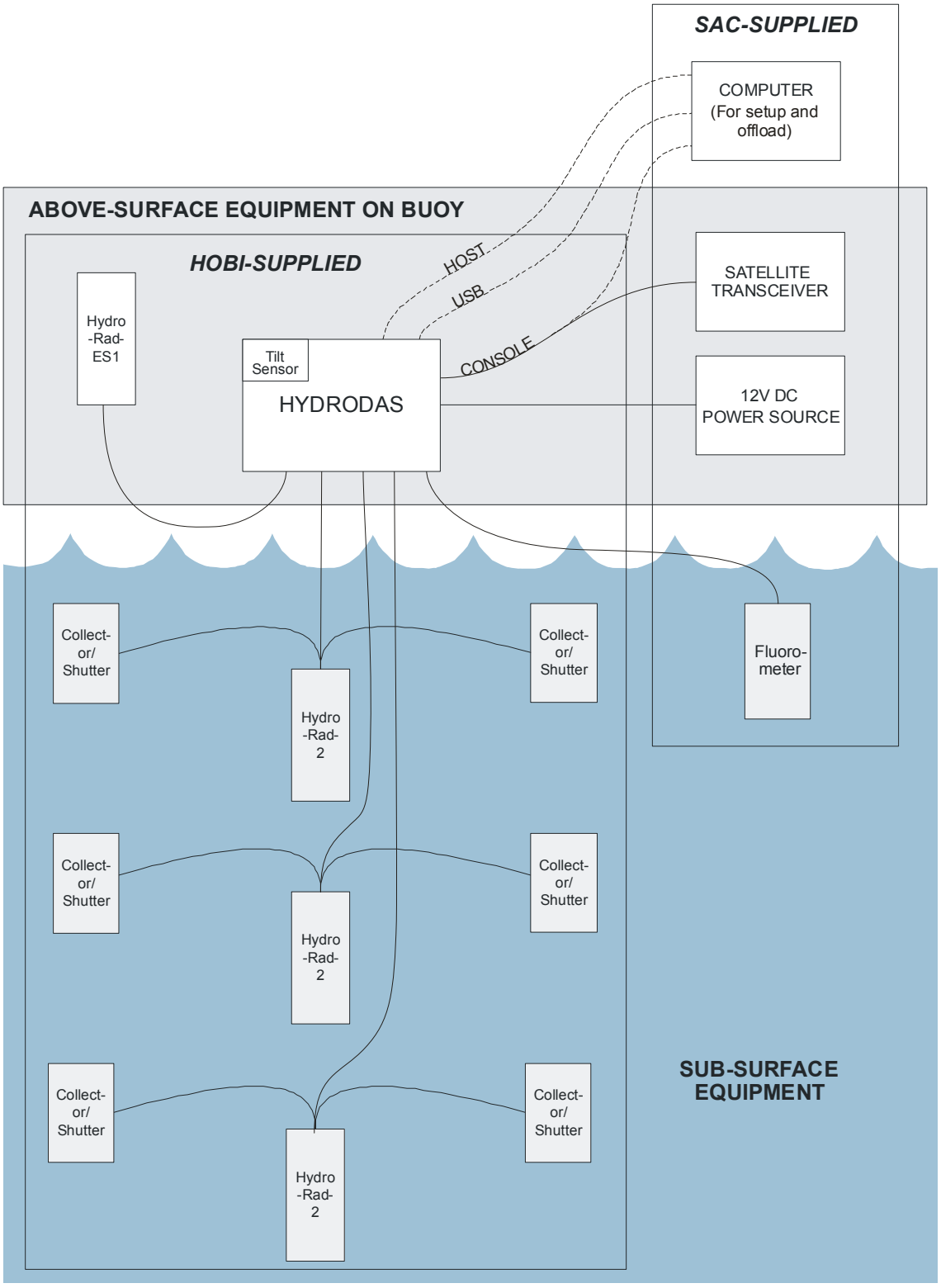


Figure 1 System Block Diagram

2 PRECAUTIONS

2.1 OVERALL

- Protect the equipment from mechanical shocks and severe vibration
- Use redundant attachments to buoy structure
- Do not attempt to open any equipment cases

2.2 HYDRORADS — FIBER OPTICS

- Avoid long-term bends of radius less than 10cm
- Secure the cables against repetitive motions that could occur due to waves, wind and weather at sea.
- Do not apply force to the penetrators where the fiber optic cables enter the HydroRad housings

2.3 SHUTTERS

- Never force the shutter blades to move, or prevent them from moving when powered.
- Corrosion of the copper parts is normal and not harmful

2.4 HYDRODAS

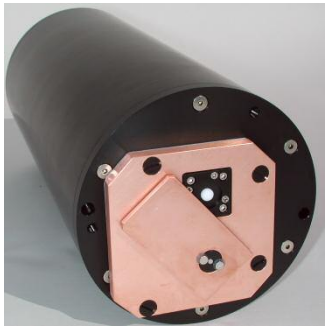
- Do not apply more than 16V to power supply input.

3 HYDRORAD SPECTRORADIOMETERS

3.1 INTRODUCTION

The primary measurements of the SAC system are made by four HydroRad multi-channel hyperspectral radiometers. A HydroRad-ES1 on the surface measures incident solar irradiance, and three HydroRad-2s measure downwelling irradiance (E_d) and upwelling radiance (L_u) at different depths in the water. Except as noted below, these instruments are in standard configurations and the reader is referred to the HydroRad User's Manual for further details.

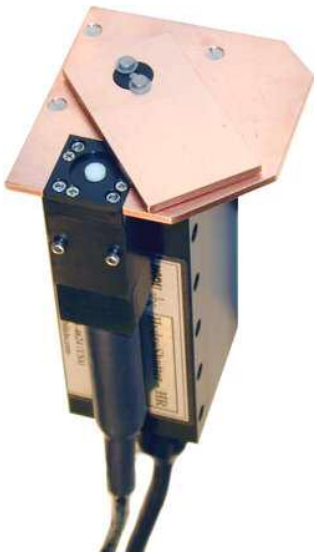
3.1.1 HydroRad Configurations



The HydroRad-ES1 has a single irradiance collector built into the end of its housing. The collector's angular response is optimized for use in air, and its sensitivity is adjusted so that it comfortably accommodates direct sunlight illumination. Although it is expected to be used above the surface and does not have a depth sensor, it is watertight and fully qualified for use at depths up to 150m. It also includes a built-in protective shutter that covers the light collector when it is not active.

The three HydroRad-2s have identical configurations. Among many other features common to all HydroRads, each of the SAC units is equipped with

- Depth transducer (150m range)
- Water-optimized irradiance collector on a 3-meter fiber optic cable, designated as channel A
- Water-optimized radiance collector on a 3-meter fiber optic cable, designated as channel B
- Connector for driving anti-fouling shutters.



Because they will be powered by a SAC-supplied source on the buoy, via the HydroDAS, the HydroRads do not contain batteries. However for testing and use in the laboratory, they are supplied with power/data interface (PDI) cables and battery chargers, which can be used to power them even without batteries installed.

3.1.2 Anti-fouling shutters

Six HydroShutter-HRs are supplied, to retard biological growth on the HydroRad-2's light collectors. The light collectors attach to the shutters such that the copper blade of the shutter rests close to the collector surface when it is not being used. The shutters are controlled by the HydroRad-2,

which switches on the power to open them before collecting data, and to close them afterward. For further details, see the HydroShutter-HR User's Manual.

3.1.3 Mounting cages

Each HydroRad is provided with a mounting cage. Each cage consists of two pairs of plastic clamps that close around the outside diameter of the instrument. The two pairs of clamps are attached with the proper spacing from each other with stainless steel rods. For assembly details, see the illustrations provided with the cage parts. After assembly, the rods can be clamped to parallel structures on the buoy, for example, to hold the instrument rigidly in place. The photo at right shows a HydroRad-2 in its mounting cage.

3.1.4 *RadSoft* Software

During deployment, the HydroRads will interface with a HydroDAS, which will send appropriate commands to them and collect their data. However for laboratory testing and other use, the RadSoft software package provides complete control and data display for the HydroRads. RadSoft also includes functions for supporting tests with the Stable Light Source (SLS), described in the SLS User's Manual.

3.2 SETUP

3.2.1 HydroRad-2 Handling and Mounting

For safest and easiest handling, the HydroRad-2s should be secured in their mounting cages at all times.

For deployment on the buoy, the cages should be securely mounted to buoy structure, with redundant attachment points. The black plastic clamps at the ends of the cages have extra holes for attachment of ropes or brackets, and the metal rods can also be lashed to the buoy structure.

The HydroRad-2s can be mounted in any orientation.

3.2.2 HydroRad-ES1 Handling and Mounting

Because the integrated copper shutter of the HydroRad-ES1 can be damaged by the application of force, or by blocking it while it is moving, it is especially important to keep it in its mounting cage, preferably with a protective cover over the shutter during transportation and handling. The embedded collector attachment adapter provided with the SLS-1 (see the SLS User's Manual) can serve this function. The instrument should be mounted in the cage such that when the cage is set on a flat surface, its "feet" hold the shutter well off the surface.

When it is mounted on the buoy, we recommend that the body of the HydroRad-ES1 be shaded to reduce solar heating.

3.2.3 Cable routing

Although they are armored, the fiber optic cables must be handled and secured with some care, since severe mechanical stress can affect their optical throughput or reduce their reliability. We conservatively recommend they not be bent to a long-term bending radius of less than 10cm. The way they are routed and secured to the buoy structure will require careful planning in order to assure this.

Once routed, the cables should be thoroughly secured to rigid structure. Wind, waves and currents can induce sustained vibrations that can fatigue materials even if they do not appear severe, so no substantial length or loop of cable should be allowed to hang loose in the water.

3.2.4 Mounting of Light Collectors and Shutters

The HydroShutter-HRs have rectangular bodies with multiple ¼" (6.3mm) holes for mounting; the HydroRad light collectors in turn are attached to the shutters using screws supplied for the purpose.

The light collectors should vertical (irradiance collectors pointint up, radiance collectors down).

3.2.5 HydroRad Firmware Settings

The HydroRads include sophisticated programmable controllers capable of independently logging data. However in this system the HydroDAS controls all aspects of the HydroRad data collection. With one exception, the default settings for the HydroRad firmware are appropriate. The one exception is that the "Auto Power Down" option of the INTPARAMS command should be set to 1. The HydroRads were configured this way before leaving HOBI Labs, and should remain so unless their memory needs to be formatted.

3.3 MAINTENANCE

Little routine maintenance is required, other than monitoring the functions of the system, and some cleaning.

- Clean the collector optics by gently wiping them with a non-abrasive cloth. If they are out of the water, alcohol may be applied to assist with cleaning.
- Observe the rotation of the shutters while the system is operating (do not force them to rotate). When powered, they should rotate smoothly and take only a few seconds to move from one position to the other. When closed they should completely cover the collector.
- Corrosion of the copper parts is normal and expected. It is not necessary to clean them.

4 HYDRODAS CONTROLLER/PROCESSOR

4.1 INTRODUCTION

HydroDAS (also known as MiniDAS in some configurations) is a general-purpose data acquisition system with many customizable features to support oceanographic applications like this one. Its standard configurations and features are described in detail in the HydroDAS/MiniDAS User's Manual. However The HydroDASs supplied for this system are highly customized, and therefore much of the description in that manual is superceded here.

HydroDAS's functions in the SAC system are to

- Control power to the four HydroRads and fluorometer
- Measure tilt and roll of the buoy
- Activate and collect raw data from all the sensors
- Archive the raw data on an internal hard disk
- Process data into a compact binary form for transmission over a satellite link.
- Offload data from the hard disk to a Windows computer via USB

4.2 DESCRIPTION

4.2.1 System Components

The SAC HydroDASs include:

- Low-power programmable controller,
- 256 MB flash memory for temporary data storage,

- 8-GB hard disk for archiving raw data,
- Six software-controlled power switches,
- Six RS-232 serial ports,
- Two RS-232 ports for communication with external PCs and the SAC satellite transceiver,
- USB port for offloading data from the hard disk,
- A tilt/roll/compass sensor for measuring buoy orientation during data collection.

Because it is intended for remote and autonomous use, the SAC HydroDAS does not have the external switch referred to in the HydroDAS manual.

4.2.2 Enclosure and Mounting

The SAC HydroDASs are housed in a custom-designed enclosure that provides rugged protection against water and weather on a buoy. Although it is expected to be operated above the water surface and is not operated at great depth, it is completely watertight and will safely withstand prolonged immersion at depths of several meters.

The HydroDAS should be mounted to a flat, level surface, and held in place by four ¼" or 6mm screws through the mounting holes shown in Figure 2. Figure 3 shows the front view of the housing and other key dimensions.

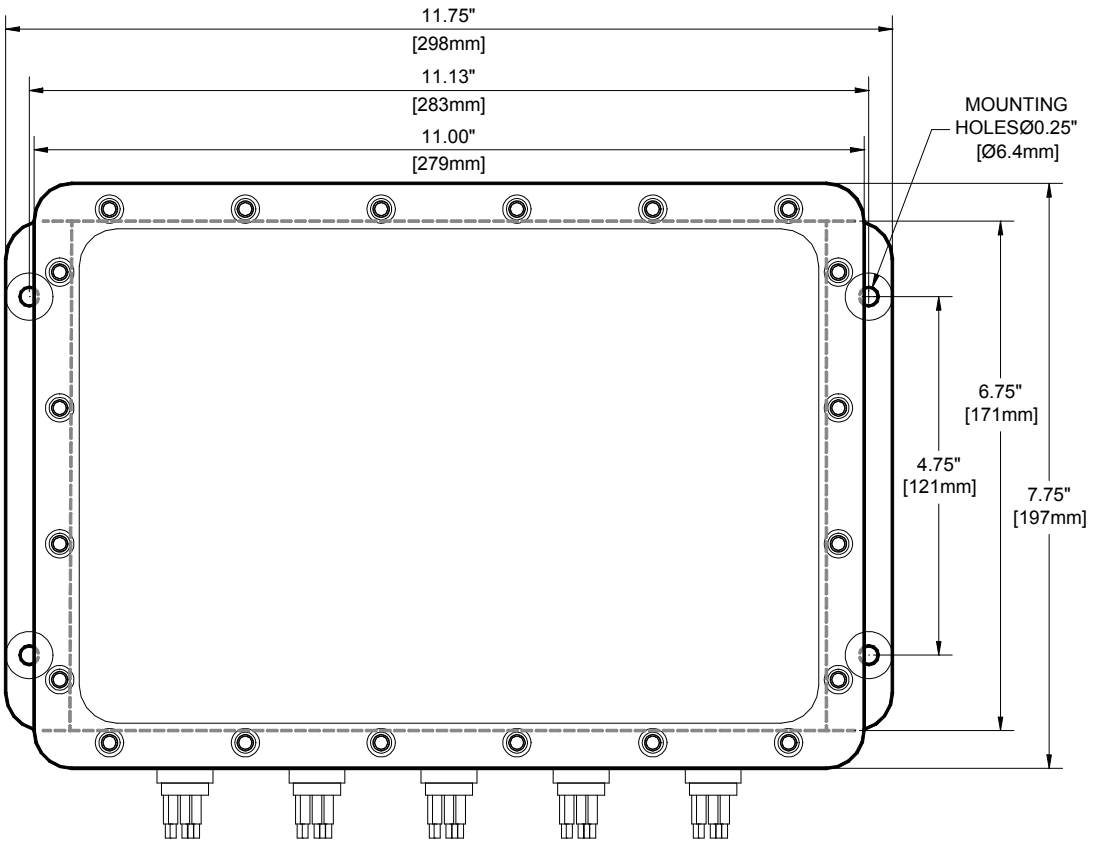


Figure 2 HydroDAS Top View and Dimensions

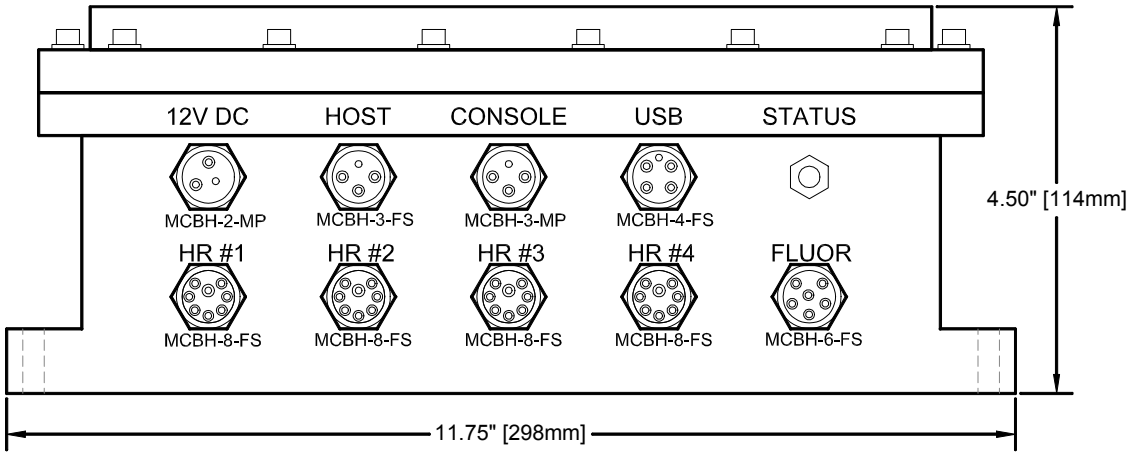


Figure 3 Front View of HydroDAS

4.2.3 Connections

The HydroDAS has nine connectors arranged as shown in Figure 3. The table below lists the connectors and their functions. As delivered by HOBI Labs, the system includes protective dummy plugs for all the connectors, and mating cables for all except the fluorometer, which is to be supplied by the user. Although it was not called for in the

tender, we have also supplied unterminated male connectors for testing the fluorometer port.

The cables supplied for the Host and Console ports are terminated with DB9 connectors for connection to computer COM ports during testing and setup. In actual deployment on the SAC buoy, the host port will not be used, and the console port will be connected to the SAC-supplied satellite transceiver via a cable that also must be provided by SAC.

Label	Function	Connector on HydroDAS	Mating Connector
HR #1	HydroRad-ES1 (on surface)	MCBH-8-FS	MCIL-8-MP
HR #2	HydroRad-2 at 1m depth	MCBH-8-FS	MCIL-8-MP
HR #3	HydroRad-2 at 5m depth	MCBH-8-FS	MCIL-8-MP
HR #4	HydroRad-2 at 10m depth	MCBH-8-FS	MCIL-8-MP
FLUOR	Fluorometer	MCBH-6-FS	MCIL-6-MP
12 VDC	Input power to system	MCBH-2-MP	MCBH-2-FS
HOST	RS-232 connection to *DASHost* software (shore operation only)	MCBH-3-FS	MCIL-3-MP
CONSOLE	RS-232 connection to satellite transceiver on buoy, or Console software on shore	MCBH-3-MP	MCHB-3-FS
USB	Universal Serial Bus connection to PC for data offload	MCBH-4-FS	MCBH-4-MP

4.3 COMMUNICATING WITH THE HYDRODAS

HydroDAS offers multiple modes of communicating with an external computer, some with overlapping functions, but each best suited for certain purposes. Different software is also required on the PC for each of these modes.

4.3.1 Console Port: Primary Connection

The console port is an RS-232 serial port operating at 9600 baud and is for direct communication to the firmware and operating system of the HydroDAS. In the SAC buoy system, the console port should be connected to the satellite transceiver that will be used to send the data to shore, and to receive commands from shore.

On shore, the console port is connected to a Windows computer in order to configure the data acquisition settings using the HydroDAS Console software program, and to perform other special functions such as loading new firmware.

4.3.2 USB Port: Data Offload

Because of the HydroDAS's specialized functions, and especially its emphasis on conserving power, its USB port is not active at all times. It must be activated by

connecting the console port to a PC (normally, but not necessarily, the same one to which the USB is connected) and running the HydroDAS Console software.

4.3.3 Host Port: Secondary Functions

The host port is not used during deployment on the buoy, but is useful for some special functions in the laboratory. It is an RS-232 serial port normally operating at 115200 kBaud, although this rate can be changed, and supporting a special protocol that is compatible only with the DASHost software.

4.4 SOFTWARE

4.4.1 Windows Software

Several software programs that run on the Windows operating system are used to support the HydroDAS.

- HydroDAS Console is the primary means of setting up the HydroDAS for logging in the SAC buoy system. It is described in Section 6.
- HydroDAS USBLink is for offloading and deleting data via the HydroDAS USB port. It is described in Section 8.2.
- DASHost provides complete access to all HydroDAS functions, but requires a high-baud-rate connection that is not practical over the satellite link in the SAC system. DASHost's primary function for this system is to provide additional monitoring of the system during testing on shore.

4.4.2 HydroDAS Firmware and Operating System

The processor in the HydroDAS is a computer in its own right, with an operating system called PicoDOS, and application programs to perform its various functions. The application programs that run on the HydroDAS are collectively referred to as firmware. At most times, the program running on the HydroDAS is the main firmware, which is loaded permanently in its flash memory and starts automatically when the HydroDAS is powered up.

In addition to the normal main firmware, it is also possible (though not normally necessary) to exit the firmware and communicate directly to PicoDOS. A separate firmware program is also used during USB offloads. The HydroDAS Console Windows application properly handles these different programs when necessary.

4.4.3 HydroDAS Scripts

HydroDAS's firmware supports a programming language of its own called HydroScript. Full details of HydroScript are contained in the HydroDAS User's Manual. In the SAC system, the main activities of data collection—turning on the instruments, saving their data and so on—are controlled by a script. Two different but similar scripts are supplied with the system, to support the two modes: autonomous and commanded. These are described in Section 6.5.

Scripts can be loaded into the HydroDAS with the HydroDAS Console software (Section 6). They can also be edited and loaded into the HydroDAS, with the DASHost Windows software.

4.4.4 Custom Firmware Modifications

To support the specific requirements of the SAC system, two commands have been added to the HydroDAS firmware, and are also accessible from within HydroScript: `ISROProcess`, and `Archive`.

`Archive` mounts the HydroDAS's internal hard disk, then copies all the files from a given directory in its flash memory to one of the disk volumes. In order to conserve power during scripted logging, the disk is only powered long enough to perform this function.

`ISROProcess` performs the full processing described in Section 7.4.

4.5 SOFTWARE CONFIGURATION

4.5.1 Required Files

File name	Function	Loading procedure
C:\AUTONO.HDS	Autonomous-mode logging script	Via HydroDAS Console
C:\COMMAND.HDS	Commanded-mode logging script	Via HydroDAS Console
C:\BANDS.CFG	Definitions of spectral averaging bands	Via HydroDAS Console
C:\SEQNUM	Sequence number	Created automatically by HydroDAS firmware
C:\IMPORT.RUN	Program for converting calibrations from CSV to binary format	Via HydroDAS Console
C:\IMPORT.BAT	Batch file for converting and storing a complete set of calibration files	Via HydroDAS Console
C:\USB.RUN	Program for USB data offload	Via HydroDAS Console
C:\TEMP\	Directory for temporary files during data collection (normally empty)	Created by logging scripts
C:\CAL\HR1A.CAL	Binary calibration for HydroRad #1, channel A (E_s)	CSV calibration files loaded via HydroDAS Console, then converted and moved to C:\CAL\ by IMPORT.BAT
C:\CAL\HR2A.CAL	Binary calibration for HydroRad #2, channel A (E_d1)	
C:\CAL\HR2B.CAL	Binary calibration for HydroRad #2, channel B (L_u1)	
C:\CAL\HR3A.CAL	Binary calibration for HydroRad #3, channel A (E_d2)	
C:\CAL\HR3B.CAL	Binary calibration for HydroRad #3, channel B (L_u2)	

File name	Function	Loading procedure
C:\CAL\HR4A.CAL	Binary calibration for HydroRad #4, channel A (E_d3)	
C:\CAL\HR4B.CAL	Binary calibration for HydroRad #4, channel B (L_u3)	

4.5.2 System Variables

The following system variables affect the behavior of the firmware and/or scripts in the ISRO system. These are normally set and read through the HydroDAS Console software, but can also be manipulated with the PicoDOS `SET` command.

Variable Name	Function/Values	Notes
INITSCRIPT	Sets which script (if any) will be loaded automatically when the system is intitialized.AUTONO.HDS for autonomous mode; COMMAND.HDS for commanded mode AUTONO.HDS for autonomous mode; COMMAND.HDS for commanded mode	
DURATION	Data-sampling duration, in seconds	
INTERVAL	Data-sampling interval, in format HH:MM:SS, for example 01:00:00 for 1-hour interval (autonomous mode only)	Autonomous mode only
NIGHTSTART	Time at which to stop collecting data (autonomous mode only), in the format HH:MM:SS, for example 19:30:00	Autonomous mode only
NIGHTEND	Time of day at which to start collecting data (autonomous mode only), in the format HH:MM:SS, for example 07:15:00	Autonomous mode only
MAXTILT1	Maximum allowable tilt for HydroRad #1 (degrees)	
MAXTILT2	Maximum allowable tilt for HydroRad #2 (degrees)	
MAXTILT3	Maximum allowable tilt for HydroRad #3 (degrees)	
MAXTILT4	Maximum allowable tilt for HydroRad #4 (degrees)	
AUTORUN	Nonzero to run script upon firmware startup	

Variable Name	Function/Values	Notes
INFO.LEVEL	Controls which types of messages are sent to the console port by data collection scripts. 0 to send only scripted messages 1 to send scripted and error messages 2 to send scripted, error and informational messages 3 to send scripted, error, information, and debugging messages 4 or higher to send all messages	
NIGHTSTART	Time at which to stop collecting data (autonomous mode only), in the format HH:MM:SS, for example 19:30:00	Autonomous mode only
NIGHTEND	Time of day at which to start collecting data (autonomous mode only), in the format HH:MM:SS, for example 07:15:00	Autonomous mode only

5 QUICK START

5.1 HYDRODAS QUICK START

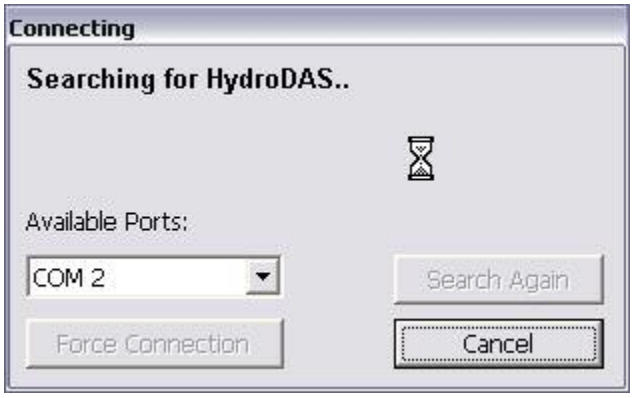
Use this procedure to test and familiarize yourself with the basic functions of the HydroDAS.

5.1.1 Requirements:

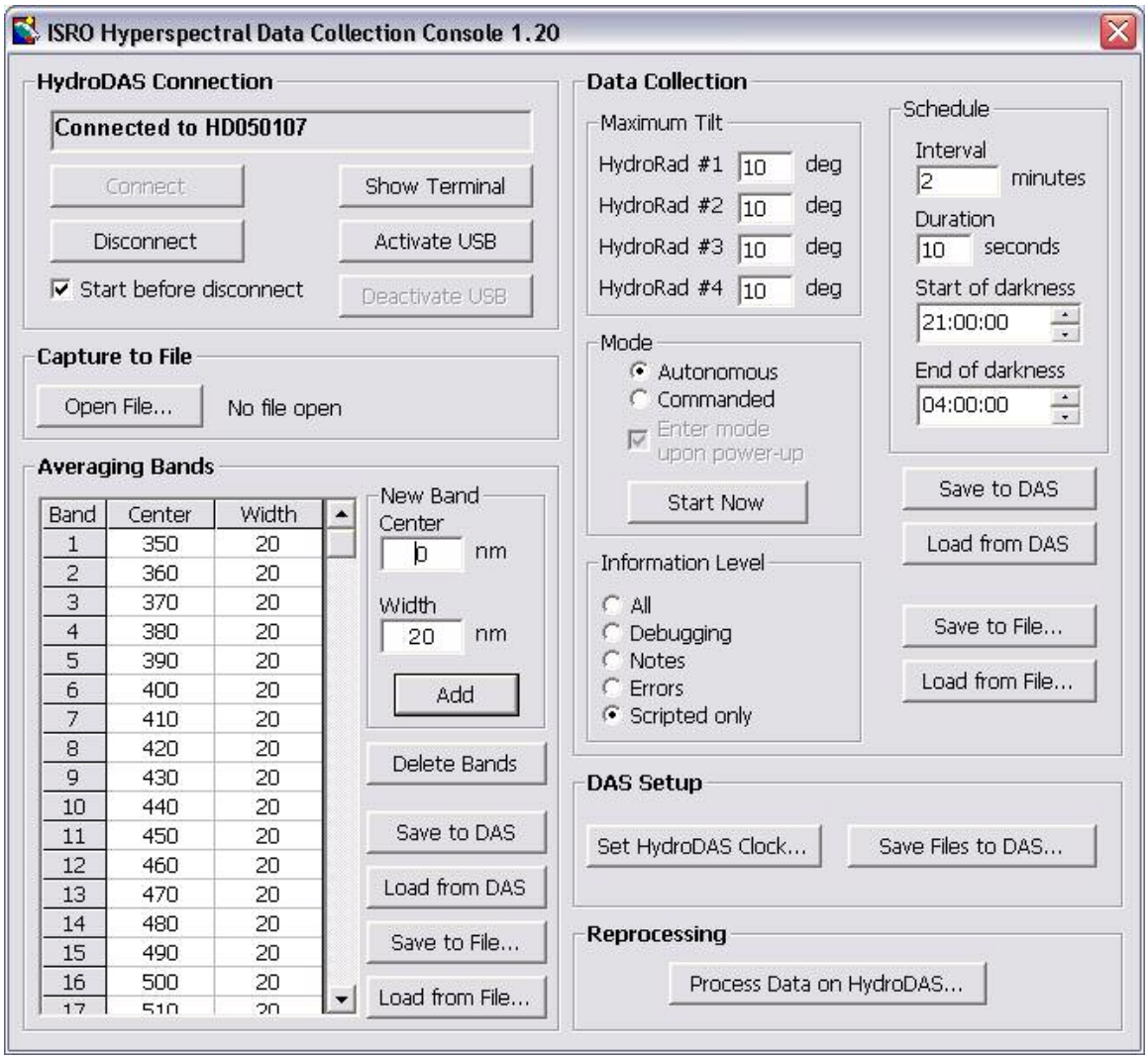
- Windows PC with one available serial port (or a USB-to-serial port adapter)
- 12V nominal power supply (10V minimum, 16V maximum). Start with the 12V supply turned off.
- Console port cable (supplied with system): 3-conductor female underwater connector to female DB9 serial port.
- Power cable (supplied with system): 2-pin male underwater connector to red and black wires.
- HydroDAS Console Windows program installed on the PC.

5.1.2 Procedure

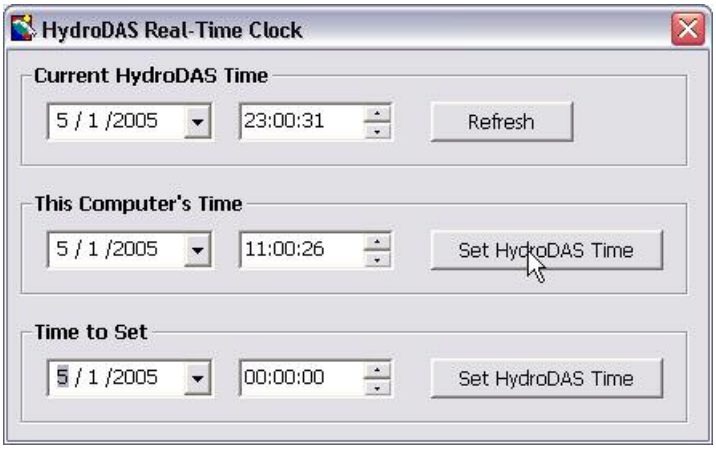
- Connect the console port on the HydroDAS to a serial port on a Windows PC, using the supplied cable.
- Verify that the power supply produces no more than 16V, including any transients when it is turned on. Turn it off.
- Connect the red wire from the power cable to the positive terminal of the power supply and the black wire to the negative.
- Turn on the power supply.
- Start HydroDAS Console
- The following dialog box should appear briefly, and disappear when the connection is completed.



- If the connection fails, check all connections and try again. For more troubleshooting tips, see Section 6.1.1.
- Upon successful connection, a window like the following appears:



- If necessary, click Load from DAS in the Averaging Bands and Data Collection sections to retrieve all current settings from the HydroDAS.
- Click Set HydroDAS Clock… under Data Collection.



- To set the HydroDAS clock to match the clock of the computer, click Set HydroDAS Time under This Computer's Time. Close the clock dialog box.
- To see the text messages being exchanged between the Console program and the HydroDAS, click Show Terminal under HydroDAS Connection.
- Feel free to experiment with the other controls in the main window.

5.2 SYSTEM QUICK START

5.2.1 Requirements

In addition to the setup from above,

- HydroRads
- HydroRad mounting cages
- 15-meter HydroRad extension cables: 8-conductor female to 8-pin male (supplied)
- Shutter Y-cables: 2-pin male to 2 branches with 2-conductor females (supplied)

5.2.2 Procedure

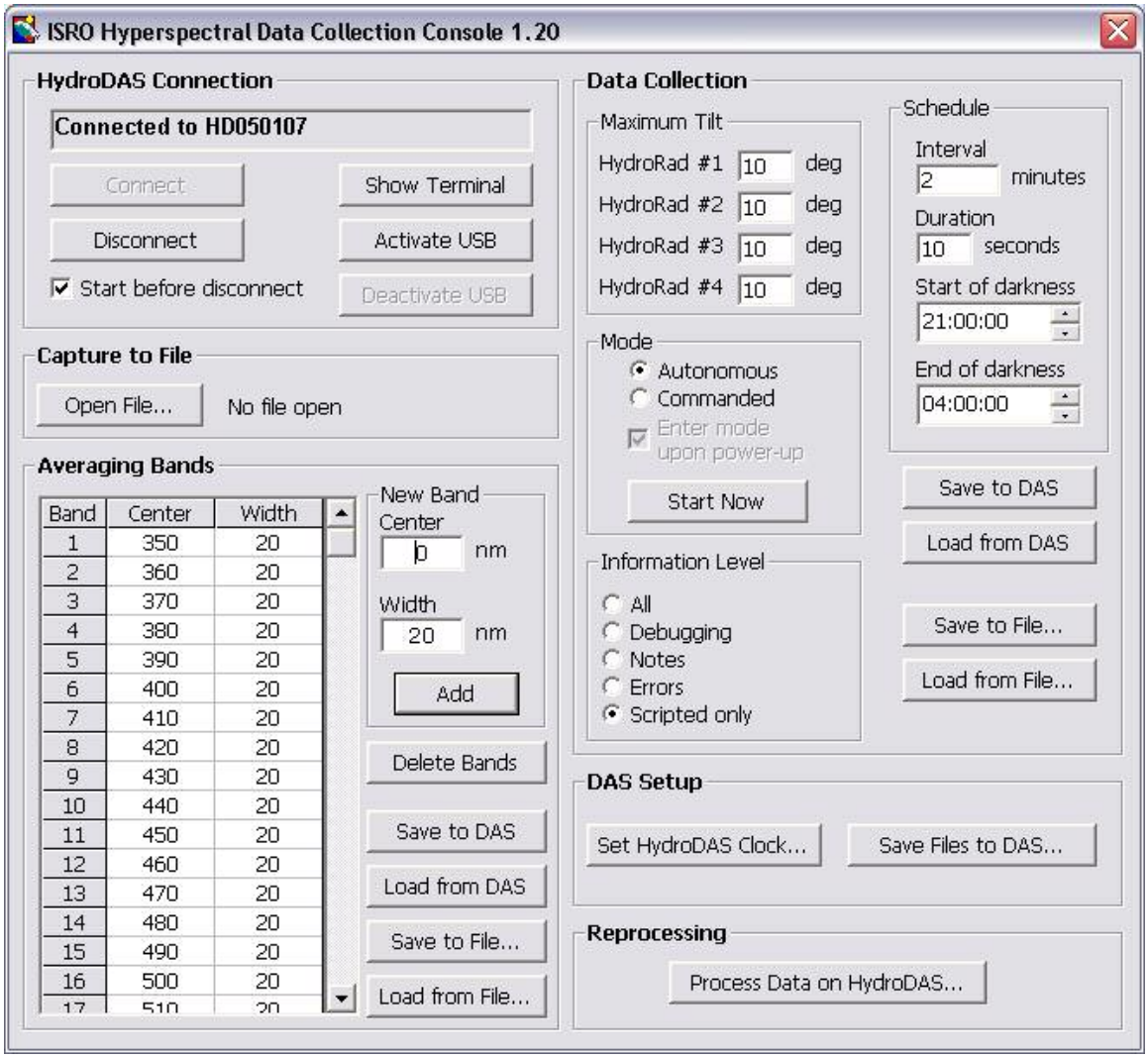
- Assemble the HydroRad mounting cages, using the photographs supplied with the HydroRad manuals as a guide. Mount the HydroRads in the cages. Mount the HydroRad-ES1 so that its shutter blade is prevented from contacting any other solid object.
- After testing the HydroDAS as above, connect the HydroRad-ES1 to the HR#1 connector on the HydroDAS, the first HydroRad-2 to HR#2, etc, using the 15-meter cables

- Connect the male stem of a Y-cable to the 2-conductor female connector on each HydroRad-2.
- Connect one female branch of each Y-cable to a HydroShutter-HR
- Lay the shutters sideways on a flat stable surface such that nothing will interfere with the free travel of their rotating blades.
- In the DAS console program, set
    - sampling interval to 1 minute
    - duration to 15 seconds (for purposes of demonstration),
    - mode to autonomous
    - information level to "Notes".
- Click Load to DAS to apply these settings.
- Open the terminal window by clicking Show Terminal.
- Click Test Script.
- The indicator light on the HydroDAS should briefly turn red, then turn off, indicating it has gone to sleep. This should also be indicated by a message in the terminal window.
- When it wakes, within 1 minute, the shutters of all the HydroRads should open and you will see the system go through its entire collection and processing cycle, including a stream of binary data being produced in the terminal window at the conclusion of the processing.
- After observing the system to your satisfaction, wait until it sleeps, then click Stop Script (Note: to protect the data, it is not possible to stop the script at all points during its processing, so you may need to wait for processing to finish).

6 *HYDRODAS CONSOLE* SOFTWARE

The HydroDAS Console application for Windows communicates through the HydroDAS's console port, via an RS-232 COM port on the PC. If the PC is not equipped with COM ports, a USB-to-serial port adapter should serve equally well. The only restriction is that the COM port must be numbered in the range 1 to 16.

HydroDAS Console is customized for the SAC system, to provide easy control over the specific data collection parameters it requires. Its primary functions are accessible through the following dialog box.



6.1 HYDRODAS CONNECTION

As soon as it is launched, HydroDAS Console will search any available serial ports for a HydroDAS. If a HydroDAS connected to a serial port on the computer and

powered up, it should be detected automatically. If no HydroDAS is available at the time the software is launched, you can click the connect button after connecting one.

6.1.1 Connection Troubleshooting

If the Console program cannot connect to the HydroDAS, check the following:

- Check that the HydroDAS is properly powered and connected.
- Click Search Again, if it is enabled. Occasionally the first connection attempt may not work if the HydroDAS is in its "sleep" state.
- If there are no available ports listed in the connect dialog box, check whether other programs are using the computer's ports.
- If you are using a USB-to-serial adapter, check its driver software to see what COM numbers are being assigned to its ports. Console can only detect ports numbered 1 through 16.

6.1.2 Disconnect

Click Disconnect to close the COM port being used for the HydroDAS. Typically you should select the Start Before Disconnect option. This option ensures that any settings you saved to the HydroDAS will take immediate effect, and it will be ready to collect data in the mode you selected. This will introduce a delay of about 5 seconds to the disconnection process.

The HydroDAS will automatically be disconnected, including a reset if that option is selected, when you quit the Console program (by clicking the close box of the main window).

6.1.3 Show Terminal

The terminal window (accessible by clicking Show Terminal) provides a direct view of the commands and responses exchanged between the console software and HydroDAS. It also allows directly typing commands for special situations that are not accommodated by the standard controls.

Starting with version 1.20, you can use the File Capture function to record all terminal communications in a file on the PC. See Section 6.6 for details. The terminal window is not required to be open in order to use the File Capture function.

6.1.4 Activate/Deactivate USB

In order to conserve electrical power, memory, and processing speed, HydroDAS's USB port is active only when specifically enabled, and during that time some other functions are inhibited. Therefore to perform USB transfers you must use connect to the HydroDAS Console and click the Activate USB button. The separate USBLink software must also be started. Normally HydroDAS Console will start USBLink automatically when it activates the USB interface. While the USB is active, most of the other console controls are disabled. Click Deactivate USB to restore the console functions. For more about USB functions, see Section 8.

6.2 AVERAGING BANDS

The HydroRad data collected by this system are extensively processed before transmission to the satellite transceiver (see Section 7.4), and one of the key steps in this processing is averaging the data within a user-defined set of spectral bands.

6.2.1 Editing Bands

To add bands to the table, enter the desired center wavelength and width in the New Band fields and click Add. Up to 50 bands will be accepted, and they will automatically be sorted by ascending center wavelength.

To delete a band, click on it in the table and click Delete Bands. You may select a number of contiguous bands for simultaneous deletion by click-dragging or shift-clicking in the table.

6.2.2 Loading and Saving Bands

You can save the entire set of bands to, or load them from, either the HydroDAS or to a file on the PC by clicking the appropriate button next to the band table.

6.3 DATA COLLECTION CONTROLS

6.3.1 Maximum Tilt Settings

It is desirable for data quality to exclude data collected when the buoy is undergoing excessive tilt. Depending on the physical configuration of the sub-surface HydroRads, however, a given tilt will not affect all them equally. Therefore the software supports a separate tilt limit for each of the instruments. HydroRad #1 is the HR-ES1 on the surface (the instrument most sensitive to tilt); HydroRad #4 is the deepest underwater instruments.

The tilt limit may be effectively turned off by setting it to 90 degrees.

6.3.2 Schedule

In autonomous mode, data are collected at a regular interval, set in minutes. If for example the interval is set to 30 minutes, and the HydroDAS is started at 08:40:00, it would go to sleep until 09:00:00, collect and process data, and then go to sleep until 09:30:00 for the next sample time.

The duration of sample is set in seconds and may take any value although 20 to 30 seconds is a practical minimum for the HydroRads to achieve their full sensitivity.

The autonomous mode also includes provision for a “dark” time during which no data will be collected. The Console allows the user to enter times for the start and end of this dark period. The times are in 24-hour format. This feature may be disabled by setting the start and end to the same time.

In commanded mode, only the duration parameter takes effect.

6.3.3 Mode

The Mode setting controls how each sample period is initiated. In autonomous mode the HydroDAS runs strictly according to its own clock and the scheduling parameters.

In commanded mode, it initiates each collection cycle only upon receipt of a signal from the satellite transceiver or other device connected to the console port. In this mode, Duration is the only schedule parameter that has any effect.

The Enter mode upon power-up option determines what state the HydroDAS assumes when power is first applied to it. If the option is not checked, the HydroDAS will simply start its full-power mode and be ready to accept commands. If it is checked, it will immediately run the script that is appropriate to the selected mode, which typically means it will go to sleep and await a wake-up signal either from its own clock or from an external command.

The Start Now button starts the script that corresponds to the selected mode, for testing purposes. When the script is started, the name of this button changes to Stop, and clicking it will halt the script. While the script is running, none of the other functions that involve writing to or reading from the HydroDAS are accessible.

6.3.4 Information Level

In the SAC system the HydroDAS sends processed binary data through the console port to the satellite transceiver. It is also capable of sending informational and debugging messages. While these messages can be useful diagnostics and state of health indicators, they may also consume bandwidth. Therefore we allow the user to control the quantity of messages sent. At the lowest setting, only processed binary data, and messages that are explicitly included in the data processing script are sent (and as delivered, the only scripted message is one at the very start of the autonomous mode).

Note that the Console software automatically sets the information level to its maximum during its communication with the HydroDAS, but it will return to specified level when the HydroDAS is reset, either by turning off its power, or by disconnecting it with the Start before Disconnect option selected.

6.3.5 Loading and Saving Settings

All the data collection settings may be saved or loaded as a group, to and from either the HydroDAS or the PC, using the Load from DAS..., Save to DAS..., Load from File..., and Save to File... buttons.

6.3.6 Loading Scripts

The modes described in Section 6.3.3 are controlled by scripts (programs written in the HydroDAS's HydroScript command language—also see Section 4.4.3). These scripts are stored as files on the HydroDAS, and the appropriate files must be loaded in order for the data collection to function properly. Each time you change modes within HydroDAS Console, it checks that the appropriate script file is present. However in order to rebuild

or upgrade the system, you can install new or upgraded scripts using the Save Files to HydroDAS... button. See Section 6.5.2 for details on this command.

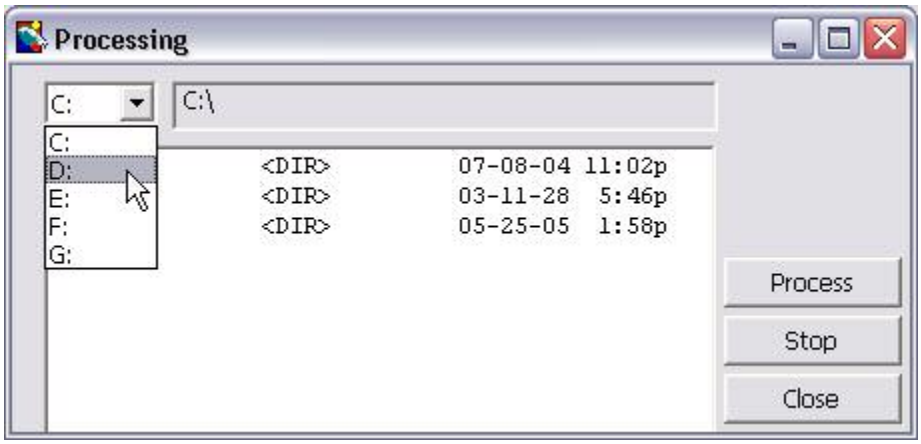
Normally you should install new or upgraded scripts only with instructions from HOBI Labs.

6.4 REPROCESSING

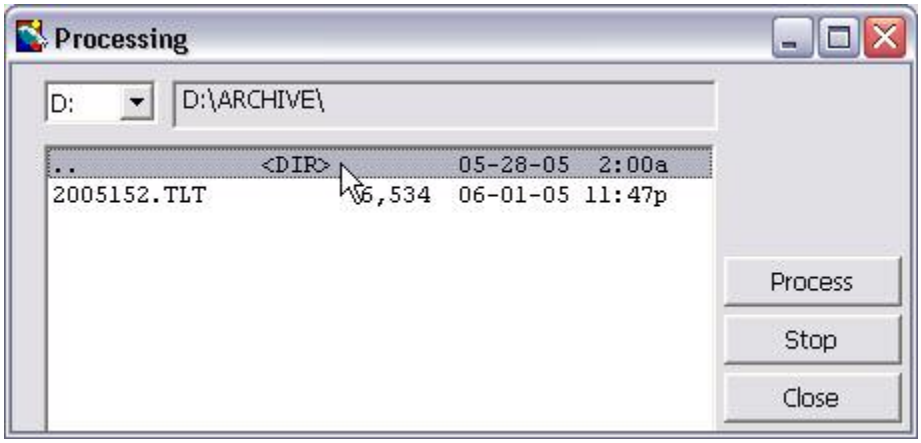
The process data on HydroDAS... command allows the user to reprocess raw data on the HydroDAS's hard disk, using the same algorithms as are used in real time, but with the ability to apply different tilt limits and wave bands.

This command opens a dialog box in which the user can browse the files on the HydroDAS hard disk. When it is first opened there is normally a delay of 5 to 10 seconds while the disk is powered up to operating speed.

The disk is partitioned into four volumes labeled D: through G:. Volume C:, which is the flash memory of the central processor, is also shown, but should only contain raw data files if the hard disk is full. Only subdirectories and files with the TLT extension are shown, because the TLT files list all the samples that were collected.



To navigate into a subdirectory, double-click on its name; to move up to a higher directory, double-click on the line that starts with "..".



To process one or more files, select them with the mouse (shift-click, click-drag and/or control-click to select multiple files), the click Process. If processing large or numerous files, it is advisable to open the terminal window first in order to have access to the informational messages about the status of the processing.

The binary files produced by the processing will be stored in the same directory as the source files, with the same basename but the OUT extension. In other words in the example shown above, the output file would be D:\ARCHIVE\2005152.OUT.

6.5 DAS SETUP CONTROLS

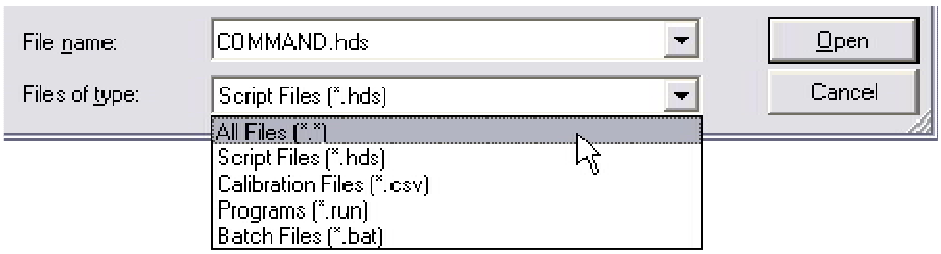
6.5.1 Clock Setting

Especially in autonomous mode, the setting of the HydroDAS real-time clock is critical. This command displays the current setting of the clock and allows the user to set it either to match the clock of the PC, or to an arbitrary date and time.

6.5.2 Saving Files to the HydroDAS

As of HydroDAS Console version 1.20, the Save Files to DAS... button allows you to save any type of file, and to select multiple files to save. In prior versions the command only handled single script files.

Save Files to DAS... presents a typical Windows Open File dialog in which to select the files on the PC. To assist in locating files of the appropriate type, you can limit the displayed files to a specific type, or show all types.



To select multiple files to transfer, you can hold down the shift or control keys while clicking on files you wish to select or exclude. Once you select files and approve the transfer, a progress indicator will appear throughout the transfer.

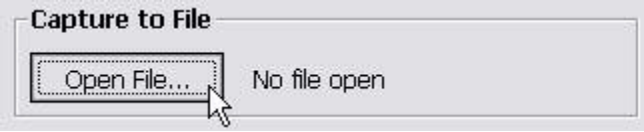
Files are always transferred to the C:\ directory on the HydroDAS. Files are transferred at the normal console baud rate of 9600, or about 1 kByte per second. Calibration files may therefore take several minutes each to transfer.

NOTE: If files of the same name already exist on the HydroDAS, they will be overwritten.

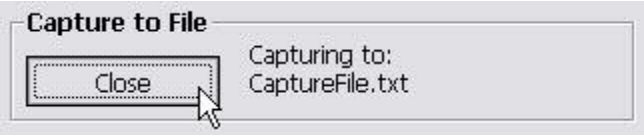
6.6 FILE CAPTURE

The File Capture function, if you choose, stores all console port communications in a file on the PC. This is useful for troubleshooting, testing, and recordkeeping. For example, you may wish to capture a record of changes you make to the DAS configuration. This is often used in conjunction with the Terminal Window (Section 6.1.3), although that is not required. File Capture was not present in HydroDAS Console versions prior to 1.20.

To start file capture, click on the Open File... button under Capture to File.



This will open a standard Windows File dialog box, allowing you to select a name and location for the captured file. If you specify the name and location of a file that already exists, you will be warned that that file will be overwritten. After the file is open, its name will appear under Capture to File, and the button name will change to Close. To stop capture, simply click the Close button.



7 DATA COLLECTION AND PROCESSING

Data are collected and processed by the HydroDAS, and the processed data transmitted to a SAC-supplied satellite transmitter or transceiver. In the transmitter case, data can only be sent from the buoy to shore and the HydroDAS must operate autonomously. In the transceiver case, commands can be sent to the HydroDAS for greater control over its activities.

In either case, the HydroDAS operates primarily under the control of one of two programs written in its HydroScript language. HydroScript is described in full detail in the HydroDAS User's Manual.

Data collection proceeds in one of two modes, autonomous or commanded, depending whether a satellite transmitter or transceiver is available in the system. In each case, the HydroDAS is responsible for turning on power to the instruments, collecting their data for a specified length of time, then archiving, processing and sending the data, and going back to sleep until the next sample data collection even.

The parameters for data collection are set through the HydroDAS Console program, as described in Section 6.3.

7.1 AUTONOMOUS MODE

In autonomous mode, the data collection is timed strictly by the HydroDAS's on-board real-time clock. The HydroDAS wakes at each integral multiple of the designated data collection interval, and collects data for the designated duration. If the interval is set to 30 minutes, for example, the HydroDAS would wake and collect data at the beginning of each hour and half-hour. It collects data for the specified duration, which does not include processing time.

The script for autonomous mode also provides for a period of darkness during which no data will be collected. If a dark period is specified (which is not required), the system will remain in low-power sleep through that period.

In autonomous mode the HydroDAS is normally configured to initialize its script as soon as power is applied, but not to collect data until the next integral multiple of the sampling interval.

Even in autonomous mode, it is possible to wake the HydroDAS from sleep by sending it two or more control-C characters approximately 1 second apart, and in that case it would immediately sample, then return to its regular schedule.

7.2 COMMANDED MODE

Commanded mode is appropriate to the case in which bidirectional communication is available and commands can be sent to the HydroDAS. The data collection sequence is identical to that of autonomous mode, but does not start until the HydroDAS is wakened by two control-C characters sent to the console port. When thus wakened, it will execute one data collection sequence, then return to sleep until wakened again.

7.3 DATA COLLECTION PROCEDURE

In either mode, each sample proceeds as follows:

- Apply power to HydroRads and allow them to initialize
- Apply power to the tilt/roll/heading sensor and fluorometer
- Send commands to the HydroRads to open their shutters
- Open files to collect data from all instruments
- Send commands to the HydroRads to start data collection
- While the HydroRads are collecting, sample the tilt/roll/heading once per second
- After the specified interval has passed, stop data from all sensors and close their files.
- Send shutter-close commands to the HydroRads
- Turn off power to all instruments
- Process HydroRad data (as described in Section 7.4)
- Send processed data to the transceiver/transmitter
- Archive raw and processed data to hard disk.
- Go to sleep.

7.4 DATA PROCESSING PROCEDURE

Raw data are processed as follows:

- Full calibration to radiometric units on all channels
- Average and maximum tilt (and heading) are calculated for each spectrum
- Spectra within the tilt limits are averaged together
- Averaged spectra are averaged within the user-specified wavebands
- Spectral magnitudes at different depths are compared for quality control
- Data are saved in a binary file
- The file is transmitted to the console port.

7.5 INTERFACE WITH SATELLITE TRANSCEIVER

The Satellite transmitter or transceiver interfaces with the HydroDAS via a 9600-baud RS-232 interface with 8 data bits, 1 stop bit, no parity and no flow control.

In autonomous mode, the satellite transmitter must be prepared to accept data from the HydroDAS at any time, as it proceeds on its own schedule.

In commanded mode, the HydroDAS waits to be wakened by the transceiver, and performs the data collection and processing procedure each time it wakes. To wake the HydroDAS, the transceiver only has to send 2 control-C characters 1 second apart. The HydroDAS will transmit data after the suitable sampling duration and processing. Note that, depending on the sampling duration and the light levels (because low light levels

dictate longer integration times, fewer spectra will be collected), the processing of data could take several minutes.

The HydroDAS console port may produce various informational and debugging messages in addition to the raw data, depending on the setting of its "information level" (see also Section 6.3.4). If the satellite transmitter/transceiver cannot tolerate additional information being sent via the console port, the information level can be set to zero. However the extra messages can be very useful for diagnostic purposes, so a non-zero information level is recommended if possible within the constraints of the system.

7.6 TRANSMITTED DATA FORMAT

At the conclusion of each sampling and processing cycle, a packet of information is sent to the transmitter/transceiver, as well as stored in a file with the extension OUT. The overall form of the packet is as follows.

Item	Length (bytes)
<start tag><sequence number>	17
<HR#1 channel A data>	136 + 8 * number of spectral bands†
<HR#2 channel A data>	136 + 8 * number of spectral bands†
<HR#2 channel B data>	136 + 8 * number of spectral bands†
<HR#3 channel A data>	136 + 8 * number of spectral bands†
<HR#3 channel B data>	136 + 8 * number of spectral bands†
<HR#4 channel A data>	136 + 8 * number of spectral bands†
<HR#4 channel B data>	136 + 8 * number of spectral bands†
<fluorometer data>	14
<end tag>	5
Total Length	988 + 56 * number of spectral bands (maximum†)
† If a specific instrument channel does not report any valid spectra during a given sample period, the packet will be formatted with the number of spectral bands set to zero, and the length reduced accordingly.	

The start tag and sequence number are
`[STARTDATA][0000]`

where 0000 is replaced by a sequence number that is incremented in each sample packet. The sequence number is included merely as an aid for viewing the data and aligning the data from different instruments. It can roll over, or even be out of sequence, without disturbing normal processing.

The end tag has the form
`[END]`

The fluorometer data are in the form of 7, 2-byte integers, in the following order:

Name	Size	Description
Size	2	number of bytes in this structure
N	2	number of samples averaged
ChRef	2	raw chlorophyll reference reading
ChSig	2	raw chlorophyll signal reading
NTURef	2	raw NTU reference reading
NTUSig	2	raw NTU signal reading
FLTherm	2	raw fluorometer thermistor signal

The 7 sub-packets corresponding to the 7 radiometer channels have identical formats. The overall length of each sub-packet depends on the number of spectral averaging bands selected at the time the packets were produced, as indicated by the *numPix* parameter. Also, if an instrument is disconnected or its data not included because of excessive tilt, the *numPix* parameter will be set to zero and no spectral data or band definitions will be included in the packet.

Name	Description	Size	Byte Address	Type	Notes
PacketType	Identifies packet format	2	0	unsigned int	0x0FF0 = binary, 0x0CC0 = binary-CRC
model	Model of HydroRad	4	2	char array	
serial	Serial Number of HydroRad	12	6	char array	
channel	Channel#	1	18	byte	0 to 4
filtType	Type of bandwidth filtering	1	19		0 = none, 1 = boxcar, 2 = gaussian
filtSize	Spectral width of filter	2	20	short	0x7FFF means band averages
calSource	Name of file containing calibration data	12	22	char array	path of cal source file (on HydroRad)
chanName	Name of the channel	8	34	char array	E.g. Ed, Lu
chanUnits	Measurement units of calibrated data	12	42	char array	E.g. W/m^2/sr/nm
wave0	Wavelength calibration, first coefficient	4	54	int	coefficient * 10 * 2^6

Name	Description	Size	Byte Address	Type	Notes
wave1	Wavelength calibration, second coefficient	4	58	int	coefficient * 10 * 2^16
wave2	Wavelength calibration, third coefficient	4	62	int	coefficient * 10 * 2^26
depthOffset	atmospheric offset of depth transducer (meters)	4	66	float	
depthCoeff	meters per count of depth transducer output	4	70	float	
SampleTime	Time of data sample	4	74	unsigned int	Seconds since 1/1/1970
temp	HydroRad temperature at time of sample	4	78	float	degrees C
voltage	supply voltage at time of sample	4	82	float	V
depth	calibrated depth	4	86	float	m
process	Degree of processing applied to data	2	90	int	0=raw, 1=pixel-adjusted, etc. (see HydroRad Manual)
N	Number of spectra averaged	2	92	int	May be zero if all spectra were rejected due to excessive tilt/roll
scale	Reserved	4	94	float	always 1.0-reserved for future use
Do	Electronic dark offset	4	98	float	
Dt	Dark pixels offset	4	102	float	
intTime	integration time for spectrum (average if N > 1)	4	106	int	milliseconds
firstPix	index of first pixel included in output	2	110	int	ignored for band averages
pixInc	increment between successive output pixels	2	112	int	ignored for band averages

Name	Description	Size	Byte Address	Type	Notes
numPix	total number of pixels (or bands) in packet	2	114	int	If an instrument is not connected, or if all its data were rejected due to excessive tilt/roll, this value will be zero
spectral data	*numPix* pixels; size of each pixel depends on type of data	*num Pix* * pixel Size	116	Array of short or float	if *process* < 2, pixel size = 2 (short integer); if *process* >= 2, pixel size = 4 (single-precision float). In ISRO HydroDAS, *process* and pixel size normally both equal 4
CRC	16-bit cyclic redundancy check	2	116 + *numPix* * pixel size	unsigned int	16-bit cyclic redundancy check
addSize	size of additional information below, not including bands or CRC. Allows for future expansion.	2	118 + *numPix* * pixel size		Presently set to zero
avgHeading	Average magnetic compass heading of buoy	2	120 + *numPix* * pixel size	int	
minHeading	Most westerly heading relative to average	2	122 + *numPix* * pixel size	int	0 - 360 degrees of heading
maxHeading	Most easterly heading, relative to average	2	124 + *numPix* * pixel size	int	
TiltAvg	Average magnitude of tilt during integration	1	126 + *numPix* * pixel size	unsigned int	Divide value by 5 for 0 - 51 degrees (0.2 resolution)
TiltMax	Maximum range of tilt during integration	1	127 + *numPix* * pixel size	unsigned int	0 - 51 degrees (0.2 resolution)
tiltExcluded	Number of spectra excluded because of tilt	1	128 + *numPix* * pixel size	unsigned int	
QCFlags	Quality control flags	1	129 + *numPix* * pixel size	unsigned int	

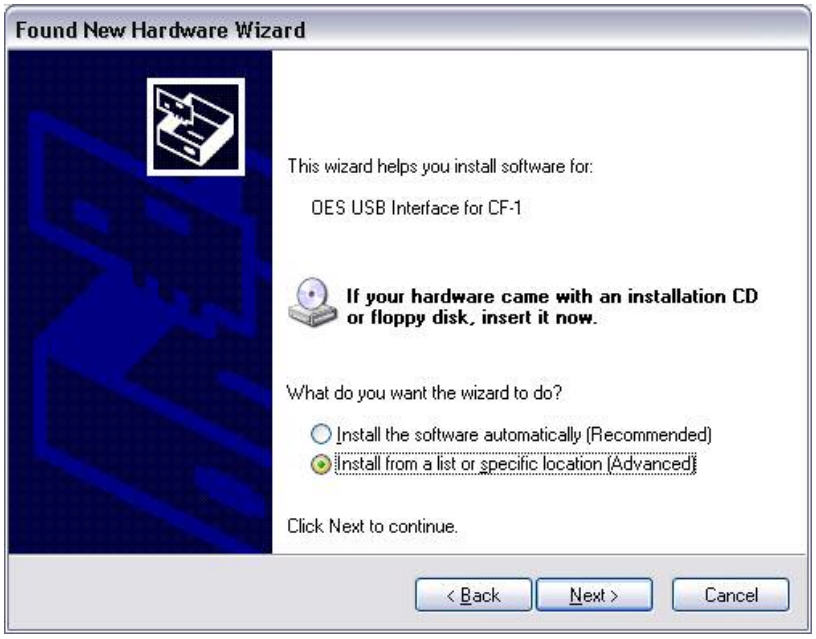
Name	Description	Size	Byte Address	Type	Notes
Reserved		2	130 + *numPix* * pixel size	undefined	Presently set to zero
N	number of samples of heading and tilt data	2	132 + *numPix* * pixel size	unsigned int	
bands	*numPix* band descriptions	4 * num Pix	134 + *numPix* * pixel size		Each band description consists of two 2-byte unsigned integers. The first is the band center in tenths of nm, and the second is the width in tenths of nm.
CRC	CRC on *addSize* through *bands*, inclusive	2	134 + *numPix* * (pixel size + 4)		

8 USB OFFLOAD

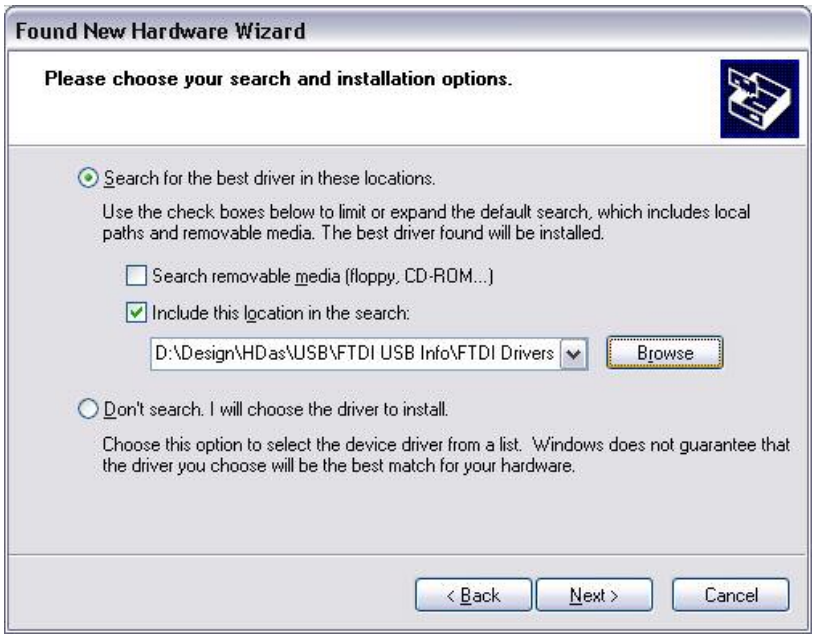
8.1 USB DRIVER INSTALLATION

- Follow the procedure in Section 6.1 for connecting to the HydroDAS with the HydroDAS Console software.
- In the Console software, click the Activate USB button.
- If this is the first time you have connected this HydroDAS to this computer (even if you have connected a different HydroDAS before) Windows will detect it as new hardware and present you with an appropriate dialog box. If it offers to connect you to Windows Update, as in the dialog box below, select "No, not this time".

- When prompted regarding automatic installation, select the option to install from a specified location rather than automatically:



- Select the option to search for the driver, but in a location you specify. Browse to the drive and directory containing the drivers supplied by HOBI Labs.

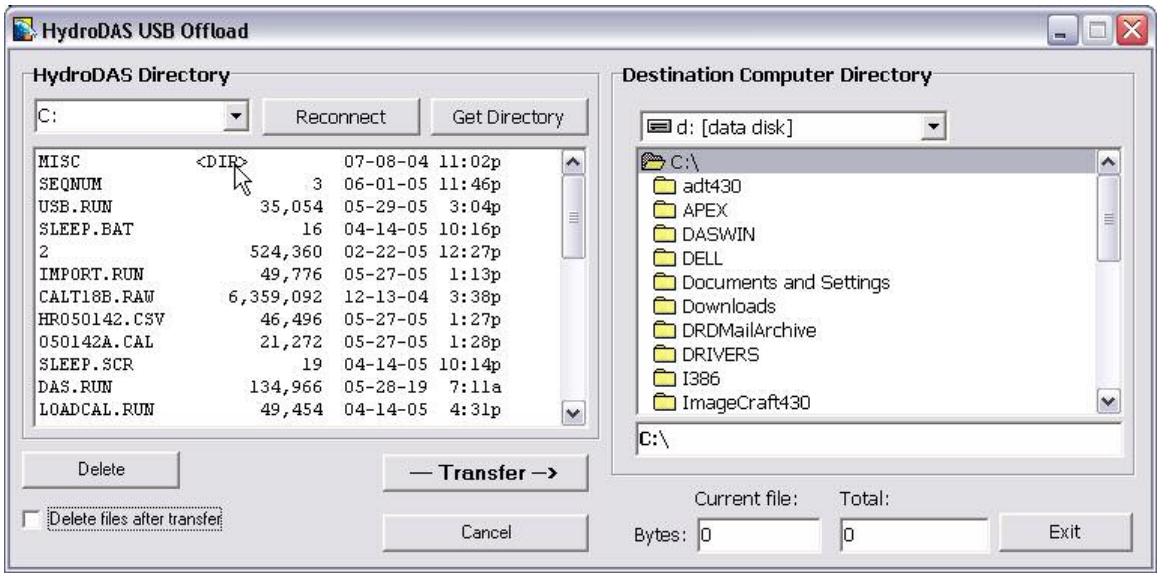


- In Windows XP you may receive a warning that the driver has not undergone Windows "Logo testing." However this driver is from a reputable, major manufacturer of USB integrated circuits and has been widely used on Window XP.

8.2 HYDRODAS *USBLINK*

To use the USBLink program you must have connected the HydroDAS via the Console software, and installed the USB driver as described above.

If the HydroDAS is connected and its USB port activated when you start the USBLink program, it should immediately connect and display a directory of the C:\ drive (which is the flash memory portion of the HydroDAS's file system). If the HydroDAS USB was not active at the time of startup, you will need to click the Connect button.



Once connected, the program gives access to the drives and files on the HydroDAS. In the HydroDAS directory panel on the left side of the screen, navigate down into a directory by double-clicking on its name, and navigate up to the next-higher level by double-clicking on the ".." at the top of the directory list. Select any number of files for transfer, and a destination for them on the PC. The program will warn you if any of the selected files already exist in the destination directory.

If you select the Delete files after transfer option, each file will be deleted from the HydroDAS after it is copied to the destination directory.

The transfer rate is about 200 kB/second, or 720 MB/hour.

9 SPECIAL PROCEDURES

9.1 FIRMWARE INSTALLATION

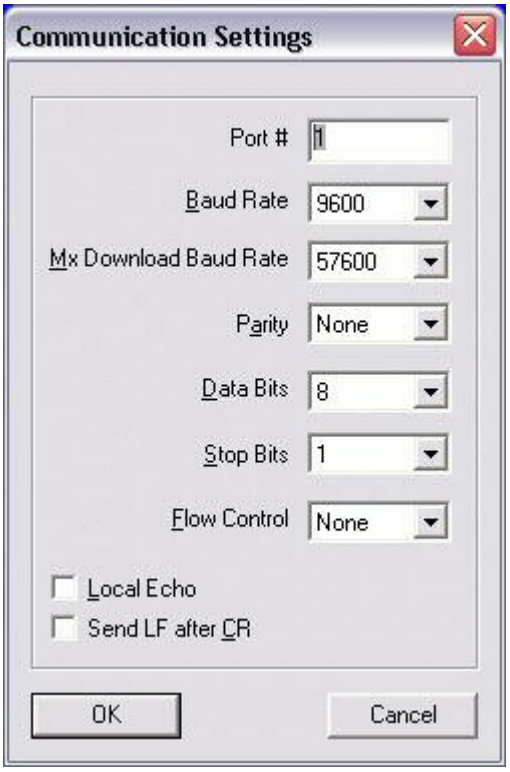
9.1.1 Requirements

- HydroDAS Console, HydroDAS Firmware, and Motocross installed on your computer
- Familiarity with the basic operation of the HydroDAS and Console software. For details, see the System Manual.
- One COM port available on your computer
- 12V power source for the HydroDAS
- Power cable (supplied with HydroDAS)
- Host port connector (supplied with HydroDAS)

9.1.2 Procedure

- If not already installed, install HydroDAS Console, HydroDAS Firmware, and Motocross on your computer
- Connect the power source to the HydroDAS
- Connect the HydroDAS console port to the COM port on your computer
- Turn on the 12V power source
- Start HydroDAS Console
- After HydroDAS Console has established a connection, uncheck the Start before disconnect option, and click Disconnect:

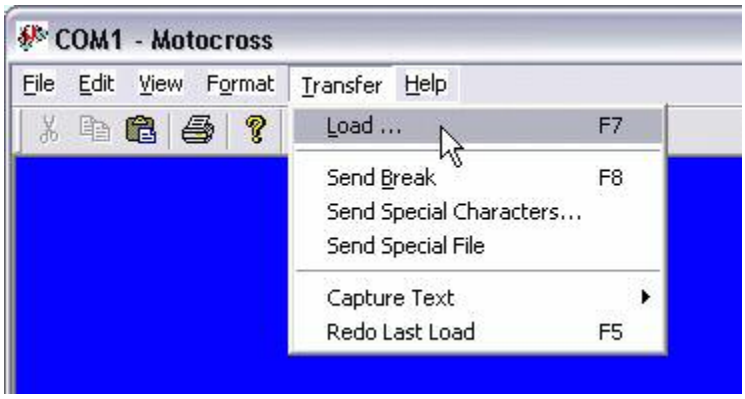
- Open Motocross
- Select Communication Settings from the File menu, and enter the following settings (except the port number, which may not be 1 on your computer).



- Click in the Motorcross window and type EXIT followed by the enter key. You should see approximately (the number may be different):

```
------------------------------------------------------------------
Persistor CF11M   SN 51863    PicoDOS V2.28r4      PBM V2.27
(C) 1998-2004 Persistor Instruments Inc. - www.persistor.com
------------------------------------------------------------------
c:\>
```

- On the Transfer menu, select Load...



- Select the file MDASXXX.APP where XXX is the version number (for example, 320), and click Open. You should see a progress window like the following, for about 30 seconds.

- When the transfer is complete, you should see approximately (the numbers may be different)

```
C:\>
###MX Load: CRC E40000 E6FFFF = 1BD2E9AF
G
```

- Press the enter key. You should then see

```
-->"??" @ E40000
```

- Additional messages may follow, depending on the exact settings of the HydroDAS.
- Exit Motocross (select Exit from the File menu).
- Return to the HydroDAS Console window.
- Click Connect. The HydroDAS should now respond normally to the controls in the Console.

9.2 AUTO-START OVERRIDE

9.2.1 Purpose

Use this procedure if the HydroDAS automatically reboots into a firmware program or script that crashes, leading to an infinite loop. Note that this is a rare circumstance. We recommend you contact HOBI Labs if you suspect this will be necessary.

9.2.2 Requirements

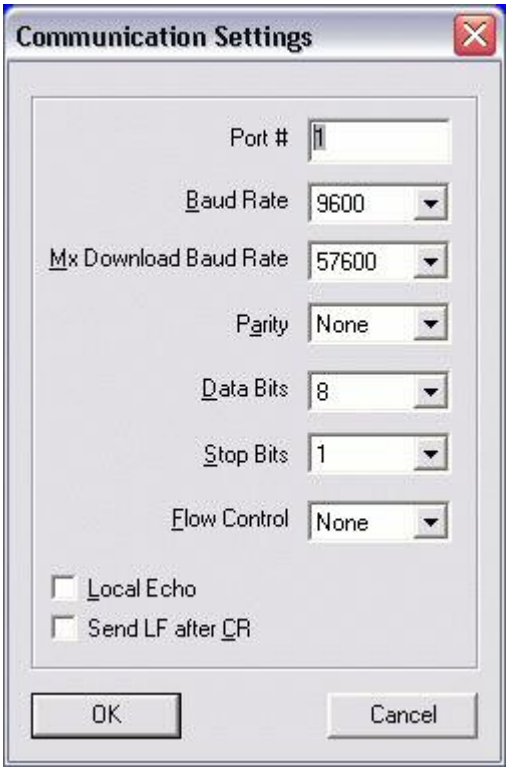
- Motocross software installed on your computer
- Familiarity with the basic operation of the HydroDAS and Motocross software. For details, see the System Manual.
- One COM port available on your computer
- 12V power source for the HydroDAS
- Power cable (supplied with HydroDAS)
- Host port connector (supplied with HydroDAS)

9.2.3 Procedure

- If not already installed, install Motocross on your computer .

- Connect the power source to the HydroDAS (but do not turn it on yet).
- Connect the HydroDAS console port to the COM port on your computer.
- Connect the special 4-pin male Override Plug (pictured below) to the HydroDAS USB port.

- Open Motocross
- Select Communication Settings from the File menu, and enter the following settings (except the port number, which may not be 1 on your computer). The click OK to close this dialog box.



- Turn on the 12V power source
- The following should be displayed in Motocross as soon as power is applied. If not, leave power on and select **Send Break** from the **Transfer** menu.

```
-------------------------
CF1 Persistor Boot Monitor
(C) 2000 Peripheral Issues
www.persistor.com V2.27
-------------------------I
== FLASH WRITES DISABLED =
=== TIMEOUTS ACTIVATED ===
```

```
PBM>60>50
```

- The numbers after the PBM> prompt show a 60-second countdown. At any time during the countdown, type PICO followed by the Enter key. You should see approximately the following (the numbers may be different):

```
-------------------------------------------------------------
Persistor CF11M   SN 51863    PicoDOS V2.28r4      PBM V2.27
(C) 1998-2004 Persistor Instruments Inc. - www.persistor.com
-------------------------------------------------------------
c:\>
```

- To turn off automatic running of a script, type SET AUTORUN=0 followed by the enter key, then type SET INITSCRIPT= followed by the enter key.
- Disconnect the Override Plug from the HydroDAS USB port.
- To turn off automatic running of the HydroDAS firmware porgram, type BOOT PICO followed by the enter key.
- Remove power from the HydroDAS.
- Consult HOBI Labs on how to restore the correct firmware and scripts.

9.3 UPDATING HYDRORAD CALIBRATION FILES ON HYDRODAS

This procedure assumes you will install a complete set of 4 calibration files, and that the four HydroRad serial numbers are HR050142, HR050143, HR050144 and HR050145. If different instruments are to be used, the serial numbers must be changed accordingly in the procedure.

9.3.1 Preparations on the PC

Make copies of the appropriate CSV calibration files and place them together in a folder on the PC. If necessary, shorten their names to [serial number].CSV, for example HR050142.CSV.

In the same folder, make a copy of the file IMPORT.BAT, or create one with the following contents (where the serial numbers match those of the instruments to be used).

```
del *.cal
import hr050142.csv
ren 050142a.cal HR1A.cal
import hr050143.csv
ren 050143a.cal HR2A.cal
ren 050143b.cal HR2B.cal
import HR050144.csv
ren 050144a.cal HR3A.cal
ren 050144b.cal HR3B.cal
import HR050145.csv
ren 050145a.cal HR4A.cal
ren 050145B.cal HR4B.cal
mkdir cal
del c:\cal\*.cal
del c:\cal\*.csv
copy *.cal c:\cal\
copy *.csv c:\cal\
```

```
del *.cal
del *.csv
```

9.3.2 Installation

Connect the HydroDAS console port to a serial port on your computer, and connect a 12V power supply to the HydroDAS. Start the HydroDAS Console software. HydroDAS Console should automatically connect to the HydroDAS. If not, see Section 6.1.1 for troubleshooting help.

Click Save Files to DAS..., and select the following files to download:

- HR050142.CSV
- HR050143.CSV
- HR050144.CSV
- HR050145.CSV
- IMPORT.BAT
- IMPORT.RUN

The download process will take several minutes.

After the download completes, click Show Terminal. In the terminal window, type `exit` followed by the enter key. You should see a prompt similar to

```
------------------------------------------------------------------
  Persistor CF11M   SN 51863    PicoDOS V2.28r4      PBM V2.27
  (C) 1998-2004 Persistor Instruments Inc. - www.persistor.com
------------------------------------------------------------------
C:\>
```

Type `IMPORT.BAT` followed by the enter key. This will start a series of actions that take about 6 minutes. Status messages will be displayed in the terminal window throughout the process, concluding with the following lines:

```
del *.cal
del *.csv

C:\>
```

In the HydroDAS Console window, uncheck the Start before disconnect option. Click Disconnect, then click Connect. The HydroDAS is now ready for use.