Sampling Modes
- **Polled sampling** – On command, run pump, take one sample, and send data to computer. Alternatively, command HydroCAT-EP to transmit last sample in memory while sampling autonomously.
- **Autonomous sampling** (*not compatible with SDI-12 deployments.*) – At pre-programmed intervals, wake up, run pump, sample, store data in FLASH memory, and go to sleep. Data can also be transmitted real-time for RS-232 deployments.

Setup
1. Install batteries:
    A. *Remove connector end cap*: Wipe dry housing/end cap seam. Remove 2 cap screws, twist end cap counterclockwise, and pull out. Disconnect Molex connecting to battery pack. Wipe dry O-ring mating surfaces with lint-free cloth.
    B. *Remove battery pack, install batteries*: Loosen captured screw in battery pack cover. Use handle to lift pack out of housing. Keep handle upright. Unscrew cover plate. Roll 2 O-rings on side of pack out of grooves. Insert batteries, and roll 2 O-rings back into grooves. Align pin on cover plate PCB with post hole, keep handle upright, and screw cover plate onto battery pack.
    C. *Reinstall battery pack and connector end cap*: Align D-shaped opening and pins on shaft. Lower battery pack into housing; push gently to mate. Tighten captured screw to secure battery pack in housing. Remove water from O-rings and mating surfaces with lint-free cloth. Inspect O-rings and mating surfaces for dirt, nicks, and cuts. Clean as necessary. Apply light coat of O-ring lubricant to O-ring and mating surfaces. Plug Molex connector together. Fit end cap into housing. Reinstall 2 cap screws.
2. Install supplied RS-232 data I/O cable on HydroCAT-EP and connect to computer serial port.
3. Double click on UCI.exe; UCI opens.
4. On UCI Dashboard, click **Connect**. In Connect dialog box: select HydroCAT-EP, enter baud rate (default 19200); click *Try All Baud Rates*; and click **Connect**. Connection Mode shows Transition, and then shows Setup when connection established.
5. Via **Transfer Data** in UCI, upload all existing data in UCI.
6. (if desired) Perform sensor checks:
    A. Via **Conductivity Check** in UCI, verify conductivity output stability and accuracy.
    B. Via **Temperature Check** in UCI, verify temperature output stability and accuracy.
    C. Via **Optics Check** in UCI, verify HCO (fluorometer and turbidity sensor) stability and accuracy.
    D. Via **pH Calibration** in UCI, verify pH sensor stability and accuracy / update pH calibration coefficients.
7. Via **HydroCAT-EP Settings** in UCI, establish setup parameters for next deployment.
8. Via **Command Terminal** in UCI, check configuration (**GetCD**) and calibration coefficients (**GetCC**) to verify setup.
9. Via **Start** in UCI, start autonomous sampling and view data to verify setup and operation. Click **Stop** when done.
10. Via **Deployment Wizard** in UCI:
    A. Set Operating Mode (Autonomous or Polled Sampling).
       - For Autonomous Sampling: set sample interval and start date and time.
       - For Polled Sampling: set SDI-12 address and bad data flag.
    B. Set parameters to output and parameter units for real-time data.
    C. Synchronize time in HydroCAT-EP with computer time, and (if desired) make entire memory available for recording.
11. For SDI-12 deployments: Program SDI-12 controller to send periodic requests to run pump and sample (aM!, aMC!, aC!, or aCC! store data in HydroCAT-EP FLASH memory; aM1!, aMC1!, aC1!, or aCC1! do not store data in FLASH memory), and then transmit sample (aD0!, aD1!, aD2!).
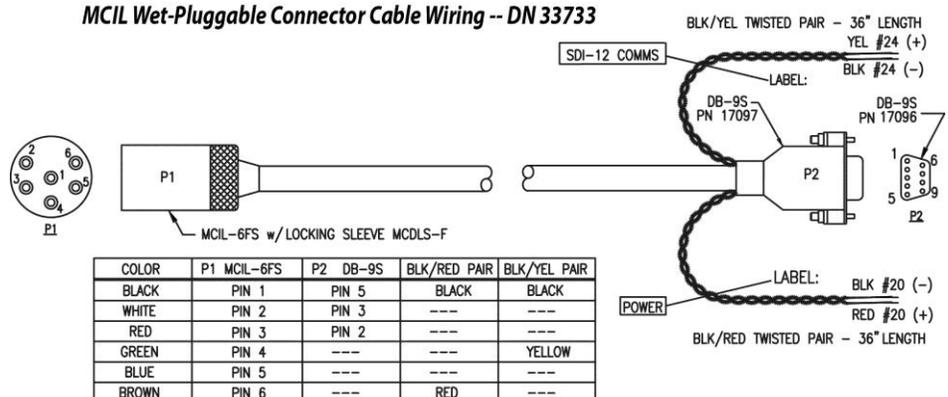
Deployment
1. Wiring – Install cable (not supplied) between HydroCAT-EP and controller. Install locking sleeve on HydroCAT-EP.
2. Remove yellow protective label from intake and exhaust and red vinyl cap from HCO.
3. Verify that Anti-Foulant Devices are installed (see manual for details).
4. Mount HydroCAT-EP **with connector at top (sensors at bottom) for proper operation – see manual for details.**

MCIL Wet-Pluggable Connector Cable Wiring -- DN 33733

COLOR	P1 MCIL-6FS	P2 DB-9S	BLK/RED PAIR	BLK/YEL PAIR
BLACK	PIN 1	PIN 5	BLACK	BLACK
WHITE	PIN 2	PIN 3	---	---
RED	PIN 3	PIN 2	---	---
GREEN	PIN 4	---	---	YELLOW
BLUE	PIN 5	---	---	---
BROWN	PIN 6	---	RED	---

Data Upload
1. Connect to HydroCAT-EP with UCI.
2. Via **Transfer Data** in UCI, upload desired data to .csv file.
3. Review data; you can modify the parameters output and / or the units (via **HydroCAT-EP Settings**) and upload again if desired.

RS-232 Command Instructions and List (see manual for complete list and details)

- Input commands in upper or lower case letters and register commands by pressing Enter key.
- If new command is not received within 2 minutes after completion of command, HydroCAT-EP returns to quiescent (sleep) state.

Category	Command	Description
Status	**GetCD**	Get and display configuration data.
	GetSD	Get and display status data.
	GetCC	Get and display calibration coefficients.
	GetEC	Get and display event counter data.
	ResetEC	Reset event counter.
	GetHD	Get and display hardware data.
	Help	Display list of currently available commands.
	DS	Get and display status.
	DC	Get and display calibration coefficients.
	pHCalHist	Display pH sensor calibration history associated with logged data.
General Setup	**DateTime=x**	**x= mmddyyyyhhmmss** (real-time clock month, day, year, hour, minute, second).
	BaudRate=x	**x= RS-232** communication baud: 600*, 1200*, 2400*, 4800, 9600, 19200, 38400, 57600, 115200 (*600, 1200, 2400 valid only if oxygen sensor not installed). *Default 19200. 1200 baud used for SDI-12 communication, independent of **BaudRate=**.*
	ReferencePressure=x	**x** = reference pressure (decibars) (used when HydroCAT-EP has no pressure sensor).
	***Default**	Reset most user-input settings to factory defaults.
	ReSync	Update HydroCAT-EP with latest information from integrated SBE 63, HCO, and pH sensors.
	QS	Place HydroCAT-EP in quiescent (sleep) state. Logging and memory retention not affected.
RS-232 Setup	**OutputExecutedTag=x**	**x=Y**: Output XML Executed and Executing tags for **RS-232** communications.　　**x=N**: Do not.
	TxRealTime=x	**x=Y**: Output real-time **RS-232** data while sampling autonomously.　　**x=N**: Do not.
SDI-12 Setup	**SetAddress=x**	**x=** address (0-9, a-z, A-Z) for **SDI-12**.
	SetSDI12Flag=x	**x=** out-of-range value (-9999999 to +9999999; must include + or -) for **SDI-12** (**OutputFormat=3**). *Default +9999999*.
Pump Setup	**MinCondFreq=**	**x=** minimum conductivity frequency (Hz) to enable pump turn-on for sampling.
	Preflush=x	**x=** time (sec) for pump to run before taking first sample. Range 300 – 600 sec; *default 300 sec*.
	PreflushStartTime= mmddyyyyhhmm	Delayed pre-flush start month, day, year, hour, minute **for polled sampling**. Set to 0 to disable pre-flush for polled sampling.
	OxNTau=x	**x=** pump time multiplier (0 – 100.0). *Default 7.0.*
	PumpTime=x	**x=** pump on time when DO installed. Range 0-550; *default [OxNTau * SetTau20]*.
	PumpOn / PumpOff	Turn pump on, for testing (pump turns off when **PumpOff** sent or 2 minutes without communications elapse).
SBE 63 Setup	**Send63:command**	Command HydroCAT-EP to send **command** to SBE 63 and receive response.
HCO Setup	**GetOpticsRef**	Get check cap reference values from last calibration; 6 measurements (fluorescence counts at 3 different gain settings followed by turbidity counts at 3 different gain settings) plus calibration date and check cap serial number.
	SetOpticsRef=x	Set HCO check cap reference values; 6 measurements (fluorescence counts at gain settings of 1, 5, and 25 followed by turbidity counts at gain settings of 1, 5, and 25) plus calibration date and check cap serial number.
Memory Setup	**InitLogging**	Initialize logging to make entire memory available for recording and clear pH calibration history.
	RecoverSamples	Restore pointer to last sample in memory and restore pH calibration history; useful if you sent **InitLogging** accidentally.
Output Format Setup	**OutputFormat=x**	**x=0**: Output raw decimal data.　　**x=2**: Output converted decimal data, XML format. **x=1**: Output converted decimal data.　　**x=3**: Output converted decimal data, SDI-12 format.
	OutputTemp=x	**x=Y**: Output temperature (units defined by **SetTempUnits=**).　　**x=N**: Do not.
	SetTempUnits=x	**x=0**: Temperature output °C, ITS-90.　　**x=1**: °F, ITS-90.
	OutputCond=x	**x=Y**: Output conductivity (units defined by **SetCondUnits=**).　　**x=N**: Do not.
	SetCondUnits=x	**x=0**: Conductivity output S/m.　　**x=1**: mS/cm.　　**x=2**: µS/cm.
	OutputPress=x	**x=Y**: Output pressure (units defined by **SetPressUnits=**).　　**x=N**: Do not.
	SetPressUnits=x	**x=0**: Pressure output decibars.　　**x=1**: psi (gauge).
	OutputOx=x	**x=Y**: Output oxygen (units defined by **SetOxUnits=**).　　**x=N**: do not.
	SetOxUnits=x	**x=0**: Oxygen output ml/L.　　**x=1**: mg/L.
	OutputpH=x	**x=Y**: Output pH.　　**x=N**: Do not.
	OutputFl=x	**x=Y**: Output fluorescence.　　**x=N**: Do not.
	OutputTbd=x	**x=Y**: Output turbidity.　　**x=N**: Do not.
	OutputSal=x	**x=Y**: Output salinity (psu).　　**x=N**: Do not.
	OutputSV=x	**x=Y**: Output sound velocity (m/sec).　　**x=N**: Do not.
	OutputSC=x	**x=Y**: Output specific conductivity (units defined by **SetCondUnits=**).　　**x=N**: Do not.
	UseSCDefault=x	**x=0**: Use **SetSpCA=** value.　　**x=1**: Use default (0.020) thermal coefficient (specific conductivity).
	SetSCA=x	*Only applicable if UseSCDefault=0.*　　**x=** thermal coefficient (specific conductivity calculation).
	OutputOxSat=x	**x=Y**: Output oxygen saturation (%).　　**x=N**: Do not.
	TxSampleNum=x	**x=Y**: Output sample number with each polled sample.　　**x=N**: Do not.

Autonomous Sampling (Logging)	**SampleInterval=x**	**x** = interval between samples (10 - 21600 sec).
	StartNow	Start logging now.
	StartDateTime=x	**x**= **mmddyyyyhhmmss** (delayed logging start month, day, year, hour, minute, second).
	StartLater	Start logging at delayed start time.
	Stop	Stop logging or waiting to start logging. Must stop before uploading data.
Polled Sampling	**TS**	**Do not pump.** Take sample, store in buffer, output.
	TPS	Run pump, take sample, store in buffer, output.
	TPSS	Run pump, take sample, store in buffer and in FLASH memory, output.
	TSN:x	**Do not pump.** Take **x** samples (1 - 100) and output data.
	TPSN:x	Run pump continuously while taking **x** samples (1 – 100) and outputting data.
	SL	Output last sample stored in buffer.
	TempCheck:x	Run pump continuously while taking **x** samples (1 – 100) and outputting data. Oxygen and HCO values not valid.
	CondCheck:x	Run pump continuously while taking **x** samples (1 – 100) and outputting data. Oxygen and HCO values not valid.
	T63	**Do not pump.** Take sample from SBE 63, output oxygen data in format set by **SetFormat**= *in SBE 63*.
	TOptics	**Do not pump.** Take **x** samples from HCO, output HCO data in format set *in HCO*.
	OpticsStats	Output average and standard deviation results of previous **TOptics** command.
Data Upload	**GetSamples:b,e**	Upload scan **b** to **e**; format defined by **OutputFormat**=. Send **Stop** before sending. Maximum 5000 samples.
Coefficients	*See manual for calibration coefficient commands.*	

SDI-12 Standard Commands

Note: Responses to Start Measurement commands include:

- a = SDI-12 address
- ttt = maximum amount of time (sec) until data is ready
- n (1digit, for M commands) is number of parameters in data string. **Output is always the following parameters, regardless of which outputs are disabled in UCI or with an RS-232 command** – temperature, pressure (if installed), dissolved oxygen (if installed), pH, fluorescence and turbidity (if installed), specific conductivity, percent oxygen saturation (if oxygen installed), and main power voltage.
- nn (2 digits, for C [Concurrent] commands) = number of parameters in data string. **Output is always the following parameters, regardless of which outputs are disabled in UCI or with an RS-232 command** - temperature, conductivity, pressure (if installed), dissolved oxygen (if installed), pH, fluorescence and turbidity (if installed), fluorescence and turbidity standard deviations (if installed), salinity, sound velocity, specific conductivity, percent oxygen saturation (if oxygen installed), main power voltage, sample number, and error flag.

Command	Response	Description
Break	None; initiate search for valid mark.	12 millisec spacing on line - Wake all HydroCAT-EPs on line. Note: '!' command termination and <CR><LF> do not apply.
a!	a <CR><LF>	Check that HydroCAT-EP 'a' is responding.
aI!	Allccccccccmmmmmmvvvnnnnnoooooooo<CR><LF> *where* ll = SDI-12 version compatibility (13 = 1.3) cccccccc = vendor ID ('SeaBird ') mmmmmm = Instrument name ('HCEP ') vvv = HydroCAT-EP firmware version ('500') nnnnn = HydroCAT-EP serial number oooooooo= up to 8 characters, designation of optional sensors (P if pressure installed, O if oxygen installed, FN if HCO installed) *Example string when SDI-12 address is 0, serial number is HCEP-32345, and pressure, oxygen, and HCO sensors installed:* 013SeaBird HCEP 50032345POFN	Identify instrument. *Notes:* • Serial number is last 5 characters of serial number. • Firmware version in aI! response is limited to number of characters shown, including decimal point. Use aXV! (see SDI-12 Extended Commands) to get full firmware version. For example: - For firmware 5.0.0, aI! returns '500', while aXV! returns '5.0.0'. - For firmware 5.11.0, aI! returns '511', while aXV! returns '5.11.0'.
?!	a<CR><LF>	Get HydroCAT-EP's SDI-12 address; valid only if just 1 HydroCAT-EP online.
aAb!	b<CR><LF>	Change HydroCAT's SDI-12 address from 'a' to 'b'.
aM!	atttn<CR><LF> *(followed by)* a<CR><LF> *(when data is ready)*	Start Measurement **TPSS** (run pump, store data in memory) - Send **TPSS** to HydroCAT-EP (run pump, take sample, store data in buffer, store data in HydroCAT-EP FLASH memory for later upload). Hold results in HydroCAT-EP buffer until another sample taken. Service request issued when data ready.
aMC!	Same as aM!	Start Measurement **TPSS** - Same as aM!, but result in buffer includes 3-character checksum before <CR><LF>.
aC!	atttnn<CR><LF>	Start Measurement **TPSS** - Same as aM!, but service request (a<CF><LF>) not sent.
aCC!	Same as aC!	Start Measurement **TPSS** - Same as aC!, but result in buffer includes 3-character checksum before <CR><LF>.
aM1!	atttn<CR><LF> *(followed by)* a<CR><LF> *(when data is ready)*	Start Measurement **TPS** (run pump, do not store data in memory) - Send **TPS** to HydroCAT-EP (run pump, take sample, store data in buffer). Hold results in HydroCAT-EP buffer until another sample taken. Service request issued when data ready.
aMC1!	Same as aM1!	Start Measurement **TPS** - Same as aM1!, but result in buffer includes 3-character checksum before <CR><LF>.
aC1!	atttnn<CR><LF>	Start Measurement **TPS** - Same as aM1!, but service request (a<CF><LF>) not sent.
aCC1!	Same as aC1!	Start Measurement **TPS** - Same as aC1!, but result in buffer includes 3-character checksum before <CR><LF>.
aM2!	atttn<CR><LF> *(followed by)* a<CR><LF> *(when data is ready)*	Start Measurement **TS** (do not run pump or store data in memory) - Send **TS** to HydroCAT-EP (**do not run pump**; take sample, store data in buffer). Hold results in HydroCAT-EP buffer until another sample taken. Service request issued when data ready.
aMC2!	Same as aM2!	Start Measurement **TS** - Same as aM2!, but result in buffer includes 3-character checksum before <CR><LF>.
aC2!	atttnn<CR><LF>	Start Measurement **TS** - Same as aM2!, but service request (a<CF><LF>) not sent.
aCC2!	Same as aC2!	Start Measurement **TS** - Same as aC2!, but result in buffer includes 3-character checksum before <CR><LF>.
aD0!	a<values><CRC><CR><LF> *where* <values> = parameters in data string (can include T, C, P, salinity, sound velocity, specific conductivity, sample number; dependent on which outputs are enabled). CRC is sent if Start Measurement command included CRC request (aMC!, aMC1!, aCC!, aCC1!, etc.)	Send data from HydroCAT-EP buffer. If string is too long, additional commands (aD1!, aD2!, etc.) required to retrieve remaining data. Number of characters in values plus CRC string is limited to 75 for Concurrent data (sampling command string starts with 'C'), or 35 for non-Concurrent data (sampling command string starts with 'M').

SDI-12 Extended Commands

Note: For all extended commands with an argument (x): If the argument is omitted, the response provides the current setting.

Command	Response	Description
aXV!	av.v.v, mmm dd yyyy hh:mm:ss <CR><LF> *where* v.v.v = firmware version (5.0.0) mm dd yyyy hh:mm:ss = firmware date and time	Get full firmware version string (firmware version and firmware date and time).
aXPx!	ax <CR><LF>	Send **PumpOn (1)** or **PumpOff (0)**. Turn pump on to test or remove sediment; **runs continuously, drawing current**. (pump turns off when **PumpOff** sent or 2 minutes without communications have elapsed)
aXMCFx!	ax<CR><LF>	Send **MinCondFreq=x;** range 0 – 5000. Minimum Conductivity Frequency (Hz) to enable pump turn-on, to prevent pump from running in air. Configuration Sheet lists frequency output at 0 conductivity. Typical **MinCondFreq** values: fresh water: (0 conductivity frequency + 1). salt water & estuarine: (0 conductivity frequency + 500).
aXMR0!	n<CR><LF> *Notes:* Must send twice to prevent accidental reset of memory. Response to first command shows current sample number n (number of samples in memory). Response to second command shows sample number n reset to 0.	Send **InitLogging**. **After all data has been uploaded**, initialize logging before starting to sample again to make entire memory available for recording. If not initialized, data is stored after last sample. HydroCAT-EP requires this command to be sent twice, to prevent accidental reset of memory.
aXUTx!	ax<CR><LF>	Send **SetTempUnits=x**. **x=0**: Temperature output °C, ITS-90. **x=1**: °F, ITS-90.
aXUCx!	ax<CR><LF>	Send **SetCondUnits=x**. **x=0**: Conductivity output S/m. **x=1**: mS/cm. **x=2**: µS/cm.
aXUPx!	ax<CR><LF>	Send **SetPressUnits=x**. **x=0**: Pressure output decibars. **x=1**: psi (gauge).
aXUOx!	ax<CR><LF>	Send **SetOxUnits=x**. **x=0**: Oxygen output ml/L. **x=1**: mg/L.