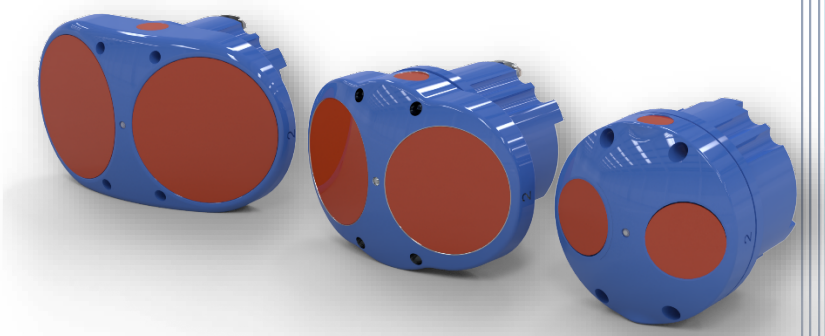
ChannelMaster

SDI-12 Guide



TELEDYNE MARINE
Everywhereyoulook™

P/N 95B-6132-00 (September 2023)

https://www.teledynemarine.com

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How to Contact Teledyne RD Instruments

If you have technical issues or questions involving a specific application or deployment with your instrument, contact our Field Service group:

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For all your customer service needs including our emergency 24/7 technical support, call +1 (858) 842-2700

Self-Service Customer Portal

Use our online customer portal at https://www.teledynemarine.com/support/RDI/technical-manuals to download manuals or other Teledyne RDI documentation.

Teledyne Marine Software Portal

Teledyne RD Instruments Firmware, software, and Field Service Bulletins can be accessed only via our Teledyne Marine software portal.

To register, please go to https://tm-portal.force.com/TMsoftwareportal to set up your customer support account. After your account is approved, you will receive an e-mail with a link to set up your log in credentials to access the portal (this can take up to 24 hours).

Once you have secured an account, use the Teledyne Marine software portal to access this data with your unique username and password.

If you have an urgent need, please call our Technical Support hotline at +1-858-842-2700.

Connecting to the ChannelMaster

To set up the ChannelMaster:

1. Connect the I/O cable to the ChannelMaster. Do so by pushing straight in against the connector. Roll the retaining strap over the connector.

> To protect the connector from damage, place a light amount of silicone lubricant on the connector pins (rubber portion only). Silicone lubricate is included in the Spare Parts kit.

2. Attach the I/O cable to the computer's communication port. The standard communications settings are 9600-baud, no parity, 8 data bits and 1 stop bit.
3. Connect a battery or DC power supply to the power connectors.
4. Connect the SDI-12 black and blue wires to the datalogger (see example, Figure 2. ChannelMaster Connected to Port 8 on the CR10X).

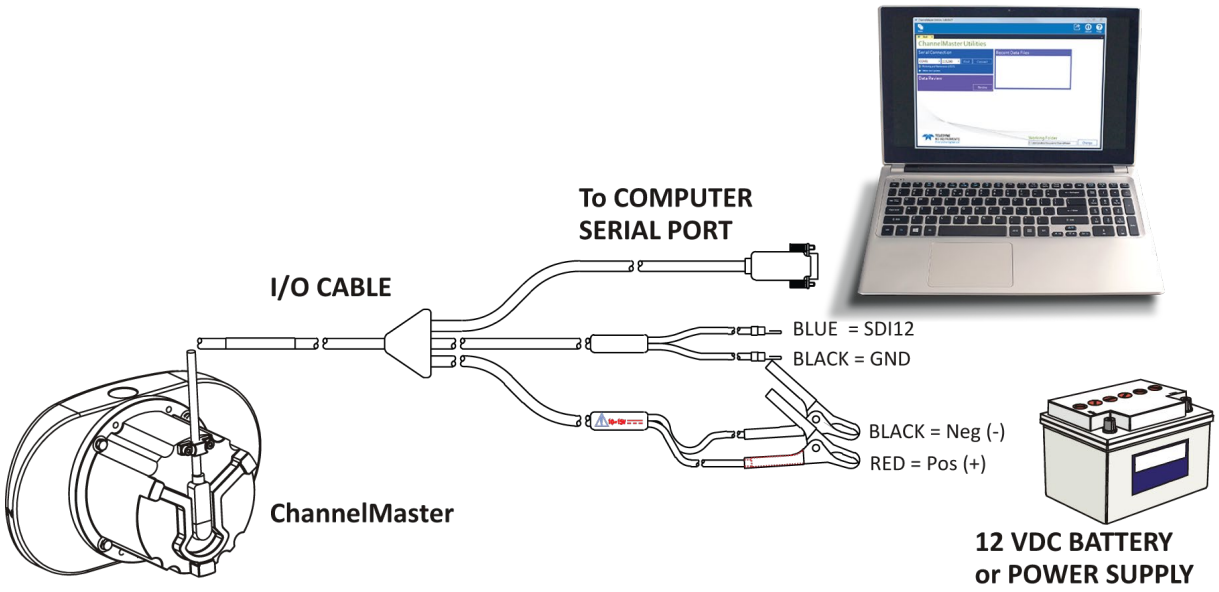


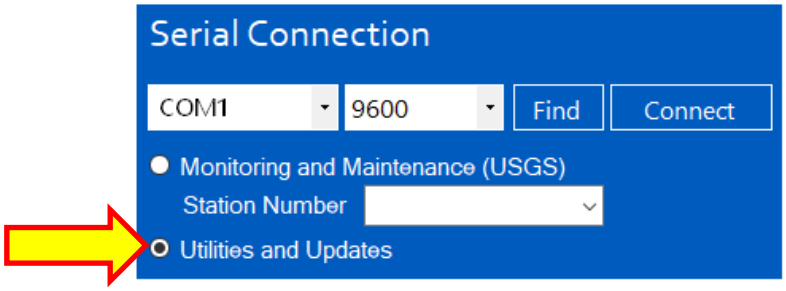
Figure 1. ChannelMaster Connections with SDI12

Using ChannelMaster Utilities

To connect to the ChannelMaster using the ChannelMaster Utilities software:

connect to the ChannelMaster using the ChannelMaster Utilities software:

1. Start the *ChannelMaster Utilities* software.
2. Select the **Utilities and Updates** radio button.

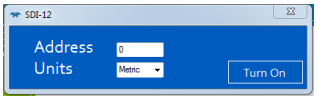


3. Enter the ChannelMaster's communication settings by selecting the **COM Port** the cable is connected to and **Baud Rate** from the drop-down lists.
4. Click the **Connect** button.

If you are unsure of the ChannelMaster's Baud rate or have trouble connecting, click the **Find** button. This will try different Bauds until it can connect, but not different COM ports.

For more information on *ChannelMaster Utilities*, click the Help icon (Help) to open the ChannelMaster Utilities Software help file.

SDI-12 Communications



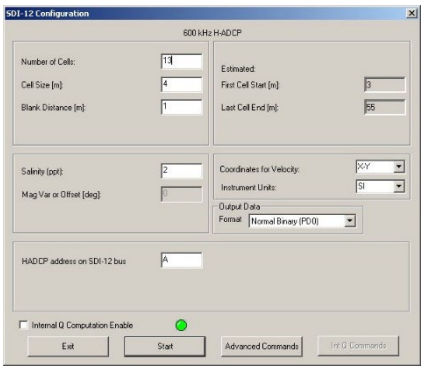
To use SDI-12 with ChannelMaster Utilities:

1. Start *ChannelMaster Utilities*.
2. Click on the **Utilities and Updates** button.
3. Establish communications to the ChannelMaster by clicking on the **Connect** button.
4. On the **SDI-12** box, click **Turn ON**.
5. Set the ChannelMaster address and units, and then click **Turn On**.

SDI-12 will not function while the *ChannelMaster Utilities* software is connected.

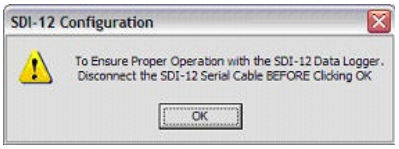
To use SDI-12 with WinH-ADCP:

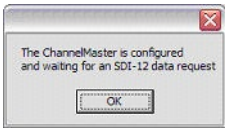
1. Start *WinH-ADCP*. On the **Communications Settings** dialog box, select the COM Port, Baudrate, Databits, and Stopbits that the ChannelMaster is connected to.
2. Click **OK** to continue to the SDI-12 Configuration screen. Set the ChannelMaster's configuration and SDI-12 address and click **Start**.
3. Disconnect the SDI-12 Serial Cable. Click **OK** at each message box.



To use SDI-12 with a deployment configuration file created with PlanCV:

1. Edit the deployment configuration file with a text editor and add the CJ command.





SDI-12 Overview

A ChannelMaster can communicate to a data logger using SDI-12 protocol. The ChannelMaster supports an output of up to 27 X and Y velocities using the standard measurement commands and up to 64 X component velocities and 64 Y component velocities (64 bins of data), and 64 bins Receiver Signal Strength Indicator (RSSI), using the concurrent measurement commands. Since the default number of bins for the ChannelMaster is 25, the below examples will correspond to that configuration. The below section corresponds to ChannelMaster Product v2.15 and higher.

- SDI-12 M commands support a maximum of ten commands (0-9) with up to nine values per command.
- SDI-12 C commands support a maximum of ten commands (0-9) with up to 99 values per command.

ChannelMaster Utilities does not use the SDI-12 protocol and does not directly participate in SDI-12 data logging. See **Table 1**, **Table 2**, and Appendix B for a list of SDI-12 commands. See the SDI-12 specifications on the web – http://sdi-12.org/

The following are some important notes about the SDI-12/ChannelMaster interface.

- Configure the ChannelMaster prior to connecting to the SDI-12 network.
- All measurements are controlled by the datalogger. If the datalogger never sends any commands, the ChannelMaster will never collect any data.
- Each instrument on the SDI-12 network must have a unique address.
- SDI-12 will not function while the *ChannelMaster Utilities* software is connected.

The basic protocol for using SDI-12 M measurement commands to collect a measurement from a ChannelMaster configured for address 0 (zero) is:

1. The data logger sends a **0M!** command to initiate a measurement.

The full command would be **0M0!** The. The first "0" is the address, the "M" is the make a measurement command, the second "0" is understood, the "!" is the command termination.

2. The ChannelMaster sends a message back saying how long the measurement will take to complete and how many values will be returned (this is automatic and not seen by the user).
3. At the end of the measurement time, the data-logger sends a **0D0!** command to read the first portion of the data.
4. The ChannelMaster sends back four values; temperature, pressure, a placeholder, and vertical beam range to surface.
5. The data-logger then sends a **0D1!** command to read the remaining data.
6. The ChannelMaster then sends back the remaining five values; pitch, roll, Index velocity, voltage, and a Built in Test.
7. To get the X component velocity data, the user must program the data-logger to then send a **0M1!** command to request the first portion of the X velocity component data. The ChannelMaster will immediately reply with a message indicating that in two seconds, up to nine velocities from the first nine cells of the X velocity component profile data will be available. The logger will then send **0D0!** and **0D1!** commands to retrieve those values. To request the remaining X velocities, **0M3!** and **0M5!** commands each followed by **0D0!** and **0D1!** commands must be sent. These commands will return the X component velocity data for bins 10-18 and 19-27 respectively. The format of the data is the format required by the SDI-12 protocol definitions; the data logger reads and stores the data.
8. To get the Y component velocity data, the user must program the data-logger to then send a **0M2!** command to request the Y velocity component data. The ChannelMaster will immediately reply with a message indicating that in two seconds, up to nine velocities from the first nine cells of the Y velocity component profile data will be available. The logger will then send **0D0!** and **0D1!** commands to retrieve those values. To request the remaining Y velocities, **0M4!** and **0M6!** commands each followed by **0D0!** and **0D1!** commands must be sent. These commands will return the Y component velocity data for bins 10-18 and 19-27 respectively.
9. To get internally computed discharge data the user must program the data-logger to then send a **0M9!** command. The ChannelMaster will immediately reply with a message indicating that in 2 seconds, 6 values will be available. The logger will then send **0D0!** and **0D1!** commands to retrieve those values.

The 0M1! through 0M9! commands must be preceded by an 0M! command to obtain new measurement data

Table 1. SDI-12 M Command Output – 0M1! To 0M4!

0M0! Command:		0M1!:	0M2!	0M3!	0M4!
Value #	Description	Description	Description	Description	Description
1	Temp	X-Vel 1	Y-Vel 1	Y-Vel 10 (or -100)	Y-Vel 10 (or -100)
2	Pressure	X-Vel 2	Y-Vel 2	Y-Vel 11	Y-Vel 11
3	<not used> (-100)	X-Vel 3	Y-Vel 3	Y-Vel 12	Y-Vel 12
4	Range to Surface	X-Vel 4	Y-Vel 4	Y-Vel 13	Y-Vel 13
5	Pitch	X-Vel 5	Y-Vel 5	Y-Vel 14	Y-Vel 14
6	Roll	X-Vel 6	Y-Vel 6	Y-Vel 15	Y-Vel 15
7	X Velocity (Index)	X-Vel 7	Y-Vel 7	Y-Vel 16	Y-Vel 16
8	Voltage (0.6 V lower than supply)	X-Vel 8	Y-Vel 8	Y-Vel 17	Y-Vel 17
9	BIT (Built-In Test)	X-Vel 9	Y-Vel 9	Y-Vel 18	Y-Vel 18

Table 1. continued SDI-12 M Command Output – 0M5! To 0M9!

	0M5!	0M6!	0M7!	0M8!	0M9!
Value #	Description	Description	Description	Description	Description
1	X-Vel 19 (or -100)	Y-Vel 19 (or -100)	<not used> (-100)	<not used> (-100)	Mean X Velocity
2	X-Vel 20	Y-Vel 20			Stage
3	X-Vel 21	Y-Vel 21			Area
4	X-Vel 22	Y-Vel 22			Discharge
5	X-Vel 23	Y-Vel 23			Upper Accum Volume
6	X-Vel 24	Y-Vel 24			Lower Accum Volume
7	X-Vel 25	Y-Vel 25			
8	X-Vel 26	Y-Vel 26			
9	X-Vel 27	Y-Vel 27			

1. The voltage is 0.6 VDC less than the external voltage.
2. A single 'BadValueMarker' (-100, with variable number of decimal places) is returned for each **0Mn!** command without valid data. Bad Value Markers of -100 may be output where data was not successfully measured, e.g. for Range to Surface, individual bin velocities, Index Velocity, or internally computed discharge parameters.
3. The SDI-12 specification allows a variable number of values to be output in response to each **0Dx!** Command, with a limit on the number of characters which can be returned for each command. The logger will sequentially issue **0D0!** through **0D9!** commands until the expected number of values has been received. The above table indicates the expected values to be returned for the **0D0!** and **0D1!** Commands for each **0Mx!** command.

Concurrent SDI-12

If the data-logger supports concurrent SDI-12, then instead of the **0M!** command, the data-logger may send **0C!** (A second **0** is implied; the full command is **0C0!**) and **0C1!** to **0C4!** commands each followed by **0Dx!** commands as needed. The ChannelMaster will return the same data as the **0M!** and **0M9!** commands plus additional data values for **0C!;** up to 64 X or Y velocities respectively for **0C1!** and **0C2!**, and up to 64 Beam 1 or Beam 2 Receiver Signal Strength Indicator (RSSI) values for **0C3!** and **0C4!**.

The **0Dx!** send data commands can return data values totaling up to 75 characters each for concurrent measurements compared to the maximum of 35 characters for the standard **0Mx!** measurement commands.

Table 2. SDI-12 C Concurrent Command Output

	0C0!	0C1!	0C2!	0C3!	0C4!
Value #	Description	Description	Description	Description	Description
1.	Temp	X-Vel 1	Y-Vel 1	Bm1 RSSI 1	Bm2 RSSI 1
2.	Pressure	X-Vel 2	Y-Vel 2	Bm1 RSSI 2	Bm2 RSSI 2
3.	<not used> (-1000)	X-Vel 3	Y-Vel 3	Bm1 RSSI 3	Bm2 RSSI 3
4.	Range To Surface	X-Vel 4	Y-Vel 4	Bm1 RSSI 4	Bm2 RSSI 4
5.	Pitch	X-Vel 5	Y-Vel 5	Bm1 RSSI 5	Bm2 RSSI 5
6.	Roll	X-Vel 6	Y-Vel 6	Bm1 RSSI 6	Bm2 RSSI 6
7.	X Velocity (Index)	X-Vel 7	Y-Vel 7	Bm1 RSSI 7	Bm2 RSSI 7
8.	Voltage (0.6 V lower than supply)	X-Vel 8	Y-Vel 8	Bm1 RSSI 8	Bm2 RSSI 8
9.	BIT (Built In Test)	X-Vel 9	Y-Vel 9	Bm1 RSSI 9	Bm2 RSSI 9
10.	Mean X Velocity (vel model result)	X-Vel 10	Y-Vel 10	Bm1 RSSI 10	Bm2 RSSI 10
11.	Stage	X-Vel 11	Y-Vel 11	Bm1 RSSI 11	Bm2 RSSI 11
12.	Area	X-Vel 12	Y-Vel 12	Bm1 RSSI 12	Bm2 RSSI 12
13.	Discharge	X-Vel 13	Y-Vel 13	Bm1 RSSI 13	Bm2 RSSI 13
14.	Upper Accum Volume	X-Vel 14	Y-Vel 14	Bm1 RSSI 14	Bm2 RSSI 14
15.	Lower Accum Volume	X-Vel 15	Y-Vel 15	Bm1 RSSI 15	Bm2 RSSI 15
16.	Y Velocity (Index)	X-Vel 16	Y-Vel 16	Bm1 RSSI 16	Bm2 RSSI 16
17.	Bm1 Avg Corr (Index)	X-Vel 17	Y-Vel 17	Bm1 RSSI 17	Bm2 RSSI 17
18.	Bm2 Avg Corr (Index)	X-Vel 18	Y-Vel 18	Bm1 RSSI 18	Bm2 RSSI 18
19.	Avg Corr (Index)	X-Vel 19	Y-Vel 19	Bm1 RSSI 19	Bm2 RSSI 19
20.	Bm1 Avg RSSI (Index)	X-Vel 20	Y-Vel 20	Bm1 RSSI 20	Bm2 RSSI 20
21.	Bm2 Avg RSSI (Index)	X-Vel 21	Y-Vel 21	Bm1 RSSI 21	Bm2 RSSI 21
22.	Avg RSSI (Index)	X-Vel 22	Y-Vel 22	Bm1 RSSI 22	Bm2 RSSI 22
23.	Bm1 Noise	X-Vel 23	Y-Vel 23	Bm1 RSSI 23	Bm2 RSSI 23
24.	Bm2 Noise	X-Vel 24	Y-Vel 24	Bm1 RSSI 24	Bm2 RSSI 24
25.	Avg Noise	X-Vel 25	Y-Vel 25	Bm1 RSSI 25	Bm2 RSSI 25
26.	Bm1 Avg SNR (Index)	X-Vel 26	Y-Vel 26	Bm1 RSSI 26	Bm2 RSSI 26
27.	Bm2 Avg SNR (Index)	X-Vel 27	Y-Vel 27	Bm1 RSSI 27	Bm2 RSSI 27
28.	Avg SNR (index)	X-Vel 28	Y-Vel 28	Bm1 RSSI 28	Bm2 RSSI 28
29.		X-Vel 29	Y-Vel 29	Bm1 RSSI 29	Bm2 RSSI 29
30.		X-Vel 30	Y-Vel 30	Bm1 RSSI 30	Bm2 RSSI 30
31.		X-Vel 31	Y-Vel 31	Bm1 RSSI 31	Bm2 RSSI 31
32.		X-Vel 32	Y-Vel 32	Bm1 RSSI 32	Bm2 RSSI 32
33.		X-Vel 33	Y-Vel 33	Bm1 RSSI 33	Bm2 RSSI 33
34.		X-Vel 34	Y-Vel 34	Bm1 RSSI 34	Bm2 RSSI 34
35.		X-Vel 35	Y-Vel 35	Bm1 RSSI 35	Bm2 RSSI 35
36.		X-Vel 36	Y-Vel 36	Bm1 RSSI 36	Bm2 RSSI 36
37.		X-Vel 37	Y-Vel 37	Bm1 RSSI 37	Bm2 RSSI 37
38.		X-Vel 38	Y-Vel 38	Bm1 RSSI 38	Bm2 RSSI 38
39.		X-Vel 39	Y-Vel 39	Bm1 RSSI 39	Bm2 RSSI 39
40.		X-Vel 40	Y-Vel 40	Bm1 RSSI 40	Bm2 RSSI 40
41.		X-Vel 41	Y-Vel 41	Bm1 RSSI 41	Bm2 RSSI 41
42.		X-Vel 42	Y-Vel 42	Bm1 RSSI 42	Bm2 RSSI 42
43.		X-Vel 43	Y-Vel 43	Bm1 RSSI 43	Bm2 RSSI 43
44.		X-Vel 44	Y-Vel 44	Bm1 RSSI 44	Bm2 RSSI 44
45.		X-Vel 45	Y-Vel 45	Bm1 RSSI 45	Bm2 RSSI 45
46.		X-Vel 46	Y-Vel 46	Bm1 RSSI 46	Bm2 RSSI 46
47.		X-Vel 47	Y-Vel 47	Bm1 RSSI 47	Bm2 RSSI 47
48.		X-Vel 48	Y-Vel 48	Bm1 RSSI 48	Bm2 RSSI 48
49.		X-Vel 49	Y-Vel 49	Bm1 RSSI 49	Bm2 RSSI 49
50.		X-Vel 50	Y-Vel 50	Bm1 RSSI 50	Bm2 RSSI 50
51.		X-Vel 51	Y-Vel 51	Bm1 RSSI 51	Bm2 RSSI 51
52.		X-Vel 52	Y-Vel 52	Bm1 RSSI 52	Bm2 RSSI 52
53.		X-Vel 53	Y-Vel 53	Bm1 RSSI 53	Bm2 RSSI 53
54.		X-Vel 54	Y-Vel 54	Bm1 RSSI 54	Bm2 RSSI 54
55.		X-Vel 55	Y-Vel 55	Bm1 RSSI 55	Bm2 RSSI 55
56.		X-Vel 56	Y-Vel 56	Bm1 RSSI 56	Bm2 RSSI 56
57.		X-Vel 57	Y-Vel 57	Bm1 RSSI 57	Bm2 RSSI 57
58.		X-Vel 58	Y-Vel 58	Bm1 RSSI 58	Bm2 RSSI 58

	0C0!	0C1!	0C2!	0C3!	0C4!
Value #	Description	Description	Description	Description	Description
59.		X-Vel 59	Y-Vel 59	Bm1 RSSI 59	Bm2 RSSI 59
60.		X-Vel 60	Y-Vel 60	Bm1 RSSI 60	Bm2 RSSI 60
61.		X-Vel 61	Y-Vel 61	Bm1 RSSI 61	Bm2 RSSI 61
62.		X-Vel 62	Y-Vel 62	Bm1 RSSI 62	Bm2 RSSI 62
63.		X-Vel 63	Y-Vel 63	Bm1 RSSI 63	Bm2 RSSI 63
64.		X-Vel 64	Y-Vel 64	Bm1 RSSI 64	Bm2 RSSI 64

1. The voltage is 0.6 VDC less than the external voltage.
2. The **0C5!** through **0C9!** commands will return a value of 'a00000' indicating that no data is available for those commands, and the data logger thus should not issue any subsequent **0Dx!** send data commands.
3. Bad Value Markers of -100(with varying numbers of decimal places) may be output where data was not successfully measured, e.g. for Range to Surface, individual bin velocities, or Index Velocity.
4. The SDI-12 specification allows a variable number of values to be output in response to each **0Dx!** Command, with a limit on the number of characters which can be returned for each command. The logger will sequentially issue **0D0!** through **0D9!** commands until the expected number of values has been received. The above table indicates the expected values to be returned for the **0D0!** and **0D1!** Commands for each **0Cx!** command.

Example SDI-12 Output

ChannelMaster setups will have different timing for the **0M!** command based on other deployment requirements. Comments (##) have been inserted to help explain what is happening. See **Table 4. SDI-12 M Command Output**.

Enter SDI-12 Command: **0M0!** ## Initiate a measurement.
`> 00079`
Wait 7 seconds and then 9 data fields will be available

Enter SDI-12 Command: **0D0!** ## Get the first 4 data fields
`> 0+23.900+0.041-100.000+0.339`
Address, Temperature, Pressure, a Placeholder, and Vertical Range returned

Enter SDI-12 Command: **0D1!** ## Get the 5 remaining data fields
`> 0-28.110+27.830-1000.000+11.4+0`
Address, Pitch, Roll, Index Velocity, Voltage, and a Built in Test returned (0 = Pass, >0 = Faults occurred; see BIT result field in variable leader data type for details)

Enter SDI-12 Command: **0M1!**
`> 00029`
Wait two seconds for 9 X velocity values

Enter SDI-12 Command: **0D0!**
`> 0-1.572-2.034+1.684-0.373+1.203`
Address + first 5 values returned

Enter SDI-12 Command: **0D1!**
`> 0+2.705-0.053+0.060-0.507`
Address + remaining 4 values returned

Enter SDI-12 Command: **0M2!**
`> 00029`
Wait two seconds for 9 Y velocity values

Enter SDI-12 Command: **0D0!**
> 0-0.146-0.329+0.842-0.383+0.853
Address + first 5 values returned

Enter SDI-12 Command: **0D1!**
> 0+0.497+1.657+0.963+1.589
Address + remaining 4 values returned

Enter SDI-12 Command: **0M3!**
> 00029

Enter SDI-12 Command: **0D0!**
> 0+0.664-0.588+4.663+0.775+1.466

Enter SDI-12 Command: **0D1!**
> 0+2.336+2.839+2.699+1.941

Enter SDI-12 Command: **0M4!**
> 00029

Enter SDI-12 Command: **0D0!**
> 0+0.031+0.510+0.192+0.578+0.667

Enter SDI-12 Command: **0D1!**
> 0+0.706-0.410-0.896+0.664

Enter SDI-12 Command: **0M5!**
> 00027

Enter SDI-12 Command: **0D0!**
> 0+4.261+1.048+4.482-0.969+3.338

Enter SDI-12 Command: **0D1!**
> 0-0.599+4.655

Enter SDI-12 Command: **0M6!**
> 00027

Enter SDI-12 Command: **0D0!**
> 0-0.214-0.588+0.170+1.002-0.385

Enter SDI-12 Command: **0D1!**
> 0+1.175-0.073

Enter SDI-12 Command: **0M7!**
> 00021

Enter SDI-12 Command: **0D0!**
> 0-1000.000
A single 'BadValueMarker' is outputted for each **0Mn!** command without valid data

Enter SDI-12 Command: **0M8!**
> 00021

Enter SDI-12 Command: **0D0!**
> 0-1000.000
A single 'BadValueMarker' is outputted for each **0Mn!** command without valid data
Enter SDI-12 Command: **0M9!**
> 00026

Enter SDI-12 Command: **0D0!**

```
> 0-1000.000-100.000-100.000-100.000+0
```
Address, Average Velocity, Stage, Area, and Discharge (Q) returned

Enter SDI-12 Command: **0D1!**
```
> 0-100+2.0
```
Address, Upper Volume, and Lower Volume returned

See Appendix B, SDI-12 Command Responses for a list of SDI-12 commands.

Built in Test results are shown in the Variable Leader Data, bytes 13 and 14.

Example Concurrent SDI-12 Output

```
0C!       000728<CR><LF>
0D0!      0+76.568-0.186-100.000-100.000-31.600+2.300-100.000+11.6+0-100.000-0.057<CR><LF>
0D1!      0+0.000-100.000+0+0.0-100.000+5.0+8.7+6.8+29.0+29.6+29.3+0.0+0.0+0.0-100.0<CR><LF>
0D2!      0-100.0-100.0<CR><LF>
0C1!      000364<CR><LF>
0D0!      0-0.279+2.031-0.243-2.497+2.802-2.766+0.659+4.948+2.264+1.896-3.802-5.423<CR><LF>
0D1!      0-4.180+4.738-5.738-0.305-1.759+3.632+5.673+1.070-0.896+3.671+5.673-4.426<CR><LF>
0D2!      0-5.344+3.130+4.813+3.911+1.683-0.538+5.033+1.624-1.220-3.045+2.470-5.128<CR><LF>
0D3!      0+1.368+0.610-2.215+5.791-1.736-1.122+2.484-0.568-2.277+2.657-0.427-6.217<CR><LF>
0D4!      0-3.819+4.767-3.097-3.720+1.355+3.862-5.994+3.219-2.408-1.191-3.802+2.247<CR><LF>
0D5!      0+1.043-1.161-2.470+3.566<C
0C2!      000364<CR><LF>
0D0!      0+3.169+3.786+4.249+0.751-0.663+5.105-5.997+5.489-4.892-3.081-5.745+3.258<CR><LF>
0D1!      0+4.111+1.706+1.339+3.770+2.260-3.212-4.370+3.163-2.995+3.481-0.804-0.551<CR><LF>
0D2!      0-4.423+2.434+3.629+1.086+2.854-1.020+1.325+1.890+5.351+4.970+3.734+1.093<CR><LF>
0D3!      0+3.156-2.208-3.566+3.058-4.442+0.171-3.891+3.524+1.112-0.082-0.541+1.473<CR><LF>
0D4!      0-0.571-1.496+1.821-2.743-3.051+4.236+1.132-1.788+3.990-0.919-4.150-0.115<CR><LF>
0D5!      0-1.158-5.568-3.625-4.616<CR><LF>
0C3!      000364<CR><LF>
0D0!      0+29.0+28.9+29.1+29.3+29.2+28.8+28.7+28.9+28.8+28.1+28.6+28.9+29.0+28.7+28.8<CR><LF>
0D1!      0+29.0+28.8+28.5+29.0+29.4+28.9+29.0+28.9+28.9+28.9+28.9+29.3+28.7+29.3+29.0<CR><LF>
0D2!      0+29.2+28.3+28.7+29.0+28.8+28.7+29.4+29.1+29.0+29.4+28.9+28.8+29.4+29.0+28.8<CR><LF>
0D3!      0+29.3+29.1+28.6+29.0+29.0+29.2+28.7+29.2+29.0+29.1+28.7+28.5+29.2+28.8+29.1<CR><LF>
0D4!      0+29.2+28.6+28.7+28.8<CR><LF>
0C4!      000364<CR><LF>
0D0!      0+29.5+29.7+29.6+29.4+29.4+29.7+29.6+29.7+29.9+29.8+29.6+29.7+29.6+29.9+29.2<CR><LF>
0D1!      0+29.3+30.0+29.5+29.8+29.6+29.0+29.4+29.7+29.8+30.0+29.8+29.3+29.9+30.4+29.2<CR><LF>
0D2!      0+29.5+30.1+29.4+29.4+29.9+30.0+29.9+29.6+30.0+29.6+29.5+30.8+29.3+30.2+29.9<CR><LF>
0D3!      0+29.6+29.6+29.8+29.8+29.8+29.8+30.3+30.1+29.5+29.7+29.4+30.0+30.4+29.7+30.2<CR><LF>
0D4!      0+29.4+29.7+30.1+29.5<CR><LF>
0C5!      000000<CR><LF>
0C6!      000000<CR><LF>
0C7!      000000<CR><LF>
0C8!      000000<CR><LF>
0C9!      000000<CR><LF>
```

Common SDI-12 Commands

The first character of all commands and responses is a device address “a”. The last character of a command is the "!" character. The “!” can only be used in a command as the last character. For additional information on the SDI-12 protocol and the commands, please go to www.sdi-12.org**.**

Send Acknowledge Command

The Send Acknowledge Command returns a simple status response that includes the address of the sensor. Any measurement data in the sensor’s buffer is not disturbed.

Command Response

```
a! a<cr><lf>
```

Where:

a is the sensor address (“0-9”, “A-Z”, “a-z”, “*”, “?”).

Change Sensor Address

The Change Sensor Address Command allows the sensor address to be changed. The address is stored in non-volatile EEPROM within the sensor. The ChannelMaster will not respond if the command is invalid, the address is out of range, or the EEPROM programming operation fails.

Command format:

```
aAn! n<cr><lf>
```

Example to change sensor address from “a” to “2”:

```
aA2! 2<cr><lf>
```

Where:

a	is the current (old) sensor address (“0-9”, “A-Z”, “a-z”, “*”, “?”). An ASCII “*” may be used as a “wild card” address if the current address is unknown and only one sensor is connected to the bus.
A	is an upper case ASCII character.
n	is the new sensor address to be programmed (“0-9”, “A-Z”, “a-z”, “*”, “?”). Note: To verify the new address, use the Send Identification Command.

Send Identification Command

The Send Identification Command responds with sensor vendor, model, and version data. Any measurement data in the sensor’s buffer is not disturbed.

Command format:

```
aI! abbccccccccmmmmmmvvvxx…xx<cr><lf>
```

Example of a ChannelMaster `aI!` command:

```
aI!       a13TRDI    28.37 208<CR><LF>
```

Where:

a	is the sensor address (“0-9”, “A-Z”, “a-z”, “*”, “?”).
bb	is the SDI-12 version compatibility level (e.g., version 1.3 is represented as “13”).
cccccccc	is an 8-character vendor identification to be specified by the vendor and usually in the form of a company name or its abbreviation.
mmmmmm	is an optional 6-character field specifying the sensor model number.
vvv	is a 3-character field specifying the sensor firmware version number.
xx…xx	is an optional field of up to a maximum of 13 characters to be used for serial number or other specific sensor information not relevant to operation of the data recorder.

Using SDI-12 Data-Loggers

This section presents basic information on configuring data loggers to collect ChannelMaster data using the SDI-12 protocol. Please refer to the ChannelMaster SDI-12 Guide for more details and sample programs. Implementation of the SDI-12 protocol will vary between logger manufacturers and thus detailed instructions cannot be provided for every possible logger. Some general notes on implementation considerations are as follows: The ChannelMaster should be installed and configured, and the data quality verified using internally logged data, prior to initiating SDI-12 data logging. This can be accomplished using *ChannelMaster Utilities* and the Utilities and Updates workflow with SDI-12 operation disabled, or by using the Monitoring and Maintenance workflow and reviewing the data collected during the 'Discharge Measurement' portion of that workflow. In all cases, the Utilities and Updates workflow should be used to set the initial configuration of the ChannelMaster.

- Transmission of PD0 data over the serial port lines can create noise and/or interference on the SDI-12 data lines, interfering with proper SDI-12 operation. Therefore, *ChannelMaster Utilities* software will disable serial output (CF command) when SDI-12 operation is enabled.
- The SDI-12 protocol imposes additional overhead into the measurement and data logging process. The ChannelMaster will report a slightly conservative time interval required before data will be available, and the get data and additional measurement commands will add to the required time. Thus, the averaging interval in the ChannelMaster will need to be shorter than the data interval (scan rate) in the data logger. TRDI suggests allowing a timing buffer of at least 5% of the ChannelMaster averaging interval plus 30-45 seconds between the averaging interval and the data logger scan rate. Experimentation may be required to develop the optimum averaging interval for a given logger scan rate.
- Variable types used by the data logger must have sufficient range and resolution for the parameter being recorded. IEEE 4-byte floating point variables or the equivalent are recommended for most ChannelMaster output parameters as it corresponds closely to the 7-digit limitation for SDI-12 data. The Campbell Scientific FP2 data type does NOT have sufficient range and resolution for many ChannelMaster output parameters.
- The ChannelMaster in some configurations can be sensitive to the timing of SDI-12 commands, particularly when using the C (concurrent measurement) commands. A 1-second or longer delay between sequential C-measurement commands is recommended to improve reliability of operation.
- The SDI-12 concurrent measurement commands allow the logger to communicate with other SDI-12 devices, or perform other actions, while waiting for the ChannelMaster to complete its measurement. Some loggers, specifically the Campbell Scientific CR-300, by default will attempt to send multiple concurrent measurement commands to the ChannelMaster without waiting to obtain the results between each command. This obviously violates the intent of the concurrent measurement commands (a sensor cannot be expected to execute multiple measurement commands simultaneously and per the specification, sending a new command cancels the prior one). The workaround for this issue is to set the 'WaitonTimeout' parameter to 1 in the SDI12Recorder() command, forcing the concurrent measurement command to behave identically to the standard measurement command.
- Please contact TRDI to discuss any additional SDI-12 logger issues identified

SDI-12 will not function while the *ChannelMaster Utilities* software is connected.

Using a Campbell Scientific CR10X Data-Logger

This example will help the user to log temperature, pressure, vertical beam range to surface, and up to 9 cells of X & Y component velocity data from a ChannelMaster using a Campbell Scientific CR10X data-logger. The below example is for a ChannelMaster prior to the additional aM1 commands being added.

Equipment Required:

- ChannelMaster H-ADCP with SDI-12 communications option, *ChannelMaster Utilities*
- Campbell Scientific CR10X with serial interface module and *LoggerNet* software
- Computer running Windows, two serial ports preferred
- 12V DC power for the ChannelMaster and CR10X
- Suitable site for testing/deployment

Setup the ChannelMaster

Connect the ChannelMaster to the computer, power, and the CR10X. Refer to the Campbell Scientific CR10X data-logger documentation and the ChannelMaster Operation Manual for detailed instructions.

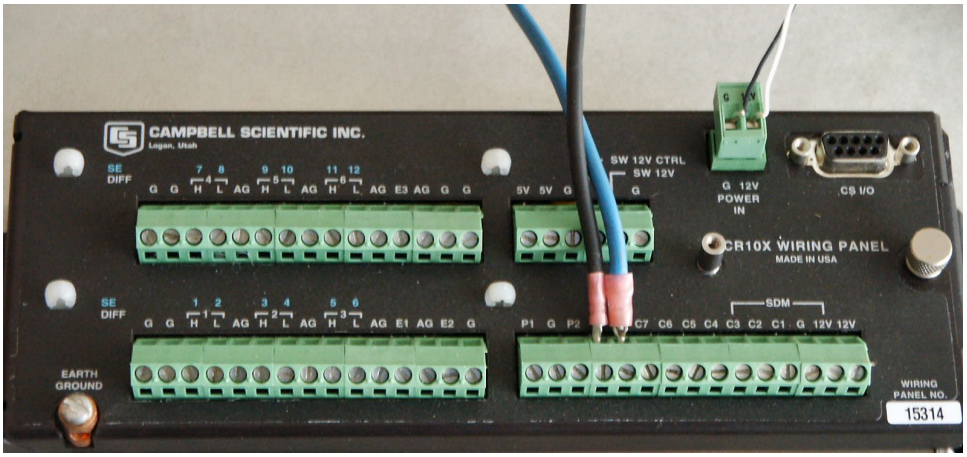
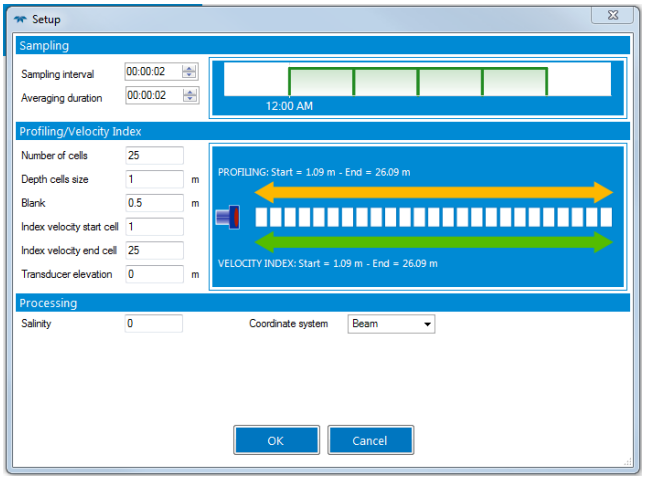


Figure 2. ChannelMaster Connected to Port 8 on the CR10X

Configure the ChannelMaster

Use the following steps to verify that the ChannelMaster is setup correctly:

1. Start *ChannelMaster Utilities*.
2. Check the ChannelMaster's pitch and roll. Set them both as close to zero as possible. For more information, see Orientation and Tilt, Chapter 2 in the ChannelMaster ADCP Guide.
3. Click on the **Utilities and Updates** button.
4. Establish communications to the ChannelMaster by clicking on the **Connect** button.
5. Make sure the SDI-12 is on (see SDI-12 Communications).
6. On the **Setup Data Collection** box, click **Start**.
7. On the Setup dialog, set the **Sampling interval** and **Averaging duration** to 00:00:02.



8. Click **OK** to collect real-time data to verify that the ChannelMaster is taking good data. Record typical values of temperature, pressure, vertical beam range, and velocities.
9. Exit *ChannelMaster Utilities*.

SDI-12 will not function while the *ChannelMaster Utilities* software is connected.

Check the SDI-12 Communication through the CR10X

1. Run *LoggerNet* and setup communications to the CR10X.

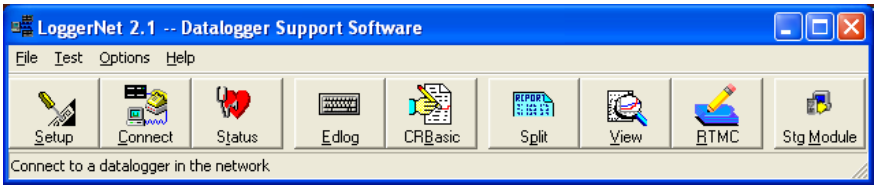


Figure 3. LoggerNet Software

2. Connect to the CR10X.
3. Start the terminal mode by using the menu and selecting **Test**, **Terminal Emulator.**
4. Enter **8X** at the * prompt to go directly to the SDI-12 communications.
5. Send commands to the ChannelMaster and view the results.

- **aM!** tells ChannelMaster to take data (the "a" denotes the address that you set for the Channel-Master in the SDI-12 configuration screen (see SDI-12 Communications).
- The response a0094 indicates that in nine seconds, the ChannelMaster will have four values ready to send. They are (in order):

  Temperature (Centigrade or Fahrenheit)
  Depth (Meters or feet)
  Reserved for now (always –100.000), and
  Corrected depth - range to surface (Meters or Feet)

The SDI-12 Configuration Screen is used to select metric or English units.

- **aD0!** Reads sensor data from ChannelMaster.
- **aM1!** Tells ChannelMaster to ready x-component velocity data
- The response a0019 indicates that in one second, the ChannelMaster will have nine values ready to send. Since the ChannelMaster has already done the velocity measurement after the **aM!** command was sent, only a one second delay is necessary to allow the ChannelMaster to format the velocity data for output.
- **aD0!** Reads out the first few cells
- **aD1!** Reads out the remaining cells
- **aD2!** May be required to read the last cells if the data strings are too long for aD0! and aD1! to get all of the available data
- **aM2!** Tells ChannelMaster to ready Y-component velocity data
- **aD0!** Reads out first few cells
- **aD1!** Reads out remaining cells
- **aD2!** May be required to read the last cells if strings too long for aD0! and aD1! to get them all

A screen capture of a manually executed measurement is shown in the figure below with the ChannelMaster address set to 1.

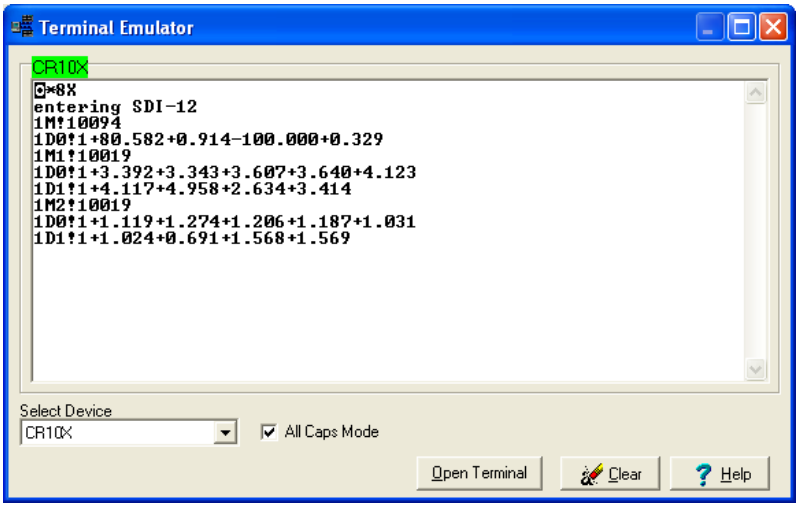


Figure 4. *LoggerNet* Terminal Mode

The amount of data returned is dependent on the number of bins selected with *ChannelMaster Utilities* or *WinH-ADCP*.

Setup the CR10X to Log Data

Run **Edlog** in *LoggerNet*. Set up a data table for use when writing a program for the CR10X. A data table for use with a program listing below is shown in the next figure.

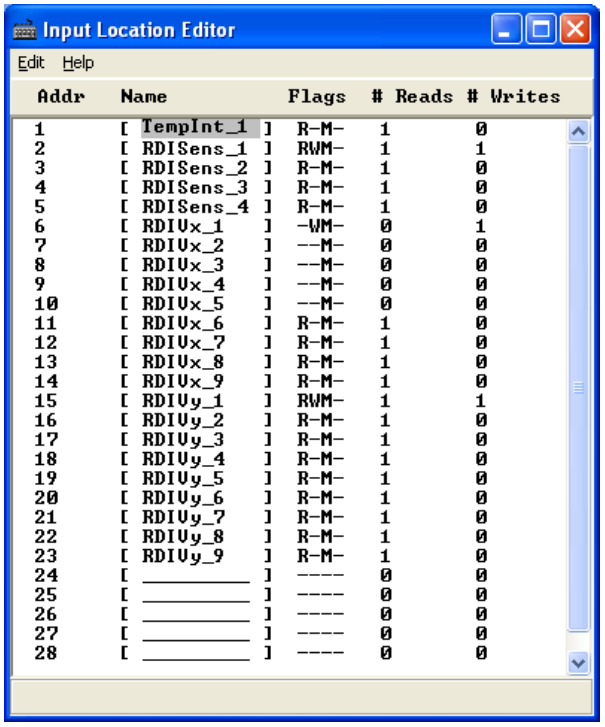


Figure 5. *LoggerNet* Data Table

Example Program to Log Data

Below is a sample program for the CR10X to acquire the CR10X internal temperature, acquire ChannelMaster data for nine cells, and output the day and time, logger temperature, and the ChannelMaster sensor, and the first nine cells of x-velocities and y-velocities to final storage.

```
;{CR10X}
;Simple program to acquire SDI-12 data from
;an Teledyne RD Instruments ChannelMaster
;ChannelMaster is setup for SDI-12 address 1
;ChannelMaster connected to port 8
;also get internal temp from logger

;set execution interval
*Table 1 Program
  01: 60        Execution Interval (seconds)

;get internal CR10X temperature

1:  Internal Temperature (P17)
 1: 1        Loc [ TempInt_1 ]


;send 1M! to start ChannelMaster
;this will get back 4 sensor values
;temp, pressure, undefined, vertical beam range

2:  SDI-12 Recorder (P105)
 1: 1        SDI-12 Address
 2: 0        Start Measurement (aM0!) ;
 3: 8        Port
 4: 2        Loc [ RDISens_1 ]
 5: 1.0      Mult
 6: 0.0      Offset

;send 1M1! to get up to 9 x-velocity components

3:  SDI-12 Recorder (P105)
 1: 1        SDI-12 Address
 2: 1        Start Measurement (aM1!)
 3: 8        Port
```

```
 4: 6        Loc [ RDIVx_1   ]
 5: 1.0      Mult
 6: 0.0      Offset

;send 1M2! to get up to 9 y-velocity components
4: SDI-12 Recorder (P105)
1: 1 SDI-12 Address
2: 2 Start Measurement (aM2!)
3: 8 Port
4: 15 Loc [ RDIVy_1 ]
5: 1.0 Mult
6: 0.0 Offset

;get day and time, put in final storage
;put internal temp and ChannelMaster data
;in final storage as well

5:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)

6:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 1        Array ID

7:  Real Time (P77)
 1: 110      Day,Hour/Minute (midnight = 0000)


8:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)

9:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 2        Array ID

10:  Sample (P70)
 1: 1        Reps
 2: 1        Loc [ TempInt_1 ]

11:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)

12:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 3        Array ID

13:  Sample (P70)
 1: 4        Reps
 2: 2        Loc [ RDISens_1 ]

14:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)

15:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 4        Array ID

16:  Sample (P70)
 1: 9        Reps
 2: 6        Loc [ RDIVx_1   ]

17:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)

18:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 5        Array ID

19:  Sample (P70)
 1: 9        Reps
 2: 15       Loc [ RDIVy_1   ]

*Table 2 Program
  02: 0.0000    Execution Interval (seconds)

*Table 3 Subroutines

End Program
```

1. Download the program to the CR10X
2. Using *LoggerNet*, download the program into the CR10X. Execution should begin immediately.
3. View the data coming in to the CR10X
4. In *LoggerNet* from the **Connect** window you may set up a numeric view to observe data as it is being acquired from the ChannelMaster or other devices attached to the CR10X.
5. Watch data as it is being acquired to be sure that the correct data is being logged into the correct locations in the data table.

6. Download and view the data from the CR10X
7. Use *LoggerNet* to recover the data recorded in the CR10X. For the program listing above, if the data is recovered in comma-separated format, using **Viewer** in *LoggerNet*, the data should be formatted like the data shown in the next figure.

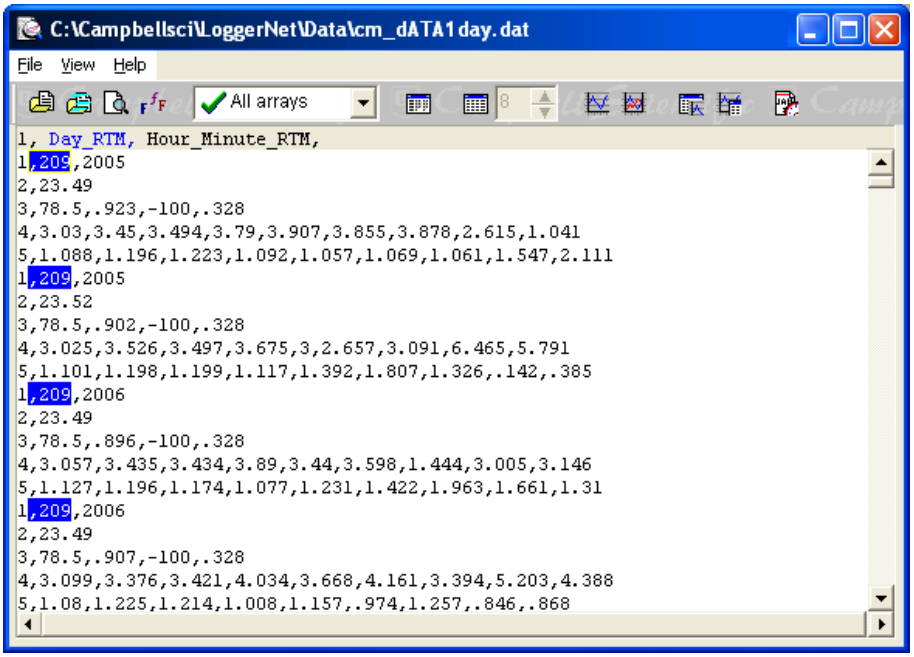


Figure 6. Viewing ChannelMaster Data with *LoggerNet*

CR300 C Measurement Example

Attached is an example CRBasic programs for the CR300 for C measurements. The file captures all available data; users should modify them to correspond to their system of units, number of bins, and desired data values. The file is ASCII text, but the logger expects the .CR300 extension.

Sample CM SDI-12 C measurements.CR300

```
'CR300 Series

'Declare Variables and Units
Public BattV
Public PTemp_C

Public SDI12c(28)
Public SDI12c_2(64)
Public SDI12c_3(64)
Public SDI12c_4(64)
Public SDI12c_5(64)

Alias SDI12c(1)=Temperature
Alias SDI12c(2)=Pressure
Alias SDI12c(3)=spare
Alias SDI12c(4)=RangeToSurface
Alias SDI12c(5)=Pitch
Alias SDI12c(6)=Roll
Alias SDI12c(7)=Xvelocity
Alias SDI12c(8)=Voltage
Alias SDI12c(9)=BITresult
Alias SDI12c(10)=MeanXVelocity
Alias SDI12c(11)=Stage
Alias SDI12c(12)=Area
Alias SDI12c(13)=Discharge
Alias SDI12c(14)=UpperVolume
Alias SDI12c(15)=LowerVolume
Alias SDI12c(16)=Yvelocity
Alias SDI12c(17)=Bm1AvgCorr
Alias SDI12c(18)=Bm2AvgCorr
Alias SDI12c(19)=AvgCorr
Alias SDI12c(20)=Bm1AvgRSSI
Alias SDI12c(21)=Bm2AvgRSSI
Alias SDI12c(22)=AvgRSSI
Alias SDI12c(23)=Bm1Noise
Alias SDI12c(24)=Bm2Noise
Alias SDI12c(25)=AvgNoise
Alias SDI12c(26)=Bm1AvgSNR
Alias SDI12c(27)=Bm2AvgSNR
Alias SDI12c(28)=AvgSNR
Alias SDI12c_2(1)=Xvel_1
Alias SDI12c_2(2)=Xvel_2
Alias SDI12c_2(3)=Xvel_3
Alias SDI12c_2(4)=Xvel_4
Alias SDI12c_2(5)=Xvel_5
Alias SDI12c_2(6)=Xvel_6
Alias SDI12c_2(7)=Xvel_7
Alias SDI12c_2(8)=Xvel_8
Alias SDI12c_2(9)=Xvel_9
Alias SDI12c_2(10)=Xvel_10
Alias SDI12c_2(11)=Xvel_11
Alias SDI12c_2(12)=Xvel_12
Alias SDI12c_2(13)=Xvel_13
Alias SDI12c_2(14)=Xvel_14
Alias SDI12c_2(15)=Xvel_15
Alias SDI12c_2(16)=Xvel_16
Alias SDI12c_2(17)=Xvel_17
Alias SDI12c_2(18)=Xvel_18
Alias SDI12c_2(19)=Xvel_19
Alias SDI12c_2(20)=Xvel_20
Alias SDI12c_2(21)=Xvel_21
Alias SDI12c_2(22)=Xvel_22
Alias SDI12c_2(23)=Xvel_23
Alias SDI12c_2(24)=Xvel_24
Alias SDI12c_2(25)=Xvel_25
Alias SDI12c_2(26)=Xvel_26
Alias SDI12c_2(27)=Xvel_27
Alias SDI12c_2(28)=Xvel_28
Alias SDI12c_2(29)=Xvel_29
Alias SDI12c_2(30)=Xvel_30
Alias SDI12c_2(31)=Xvel_31
Alias SDI12c_2(32)=Xvel_32
Alias SDI12c_2(33)=Xvel_33
Alias SDI12c_2(34)=Xvel_34
Alias SDI12c_2(35)=Xvel_35
Alias SDI12c_2(36)=Xvel_36
Alias SDI12c_2(37)=Xvel_37
```

```
Alias SDI12c_2(38)=Xvel_38
Alias SDI12c_2(39)=Xvel_39
Alias SDI12c_2(40)=Xvel_40
Alias SDI12c_2(41)=Xvel_41
Alias SDI12c_2(42)=Xvel_42
Alias SDI12c_2(43)=Xvel_43
Alias SDI12c_2(44)=Xvel_44
Alias SDI12c_2(45)=Xvel_45
Alias SDI12c_2(46)=Xvel_46
Alias SDI12c_2(47)=Xvel_47
Alias SDI12c_2(48)=Xvel_48
Alias SDI12c_2(49)=Xvel_49
Alias SDI12c_2(50)=Xvel_50
Alias SDI12c_2(51)=Xvel_51
Alias SDI12c_2(52)=Xvel_52
Alias SDI12c_2(53)=Xvel_53
Alias SDI12c_2(54)=Xvel_54
Alias SDI12c_2(55)=Xvel_55
Alias SDI12c_2(56)=Xvel_56
Alias SDI12c_2(57)=Xvel_57
Alias SDI12c_2(58)=Xvel_58
Alias SDI12c_2(59)=Xvel_59
Alias SDI12c_2(60)=Xvel_60
Alias SDI12c_2(61)=Xvel_61
Alias SDI12c_2(62)=Xvel_62
Alias SDI12c_2(63)=Xvel_63
Alias SDI12c_2(64)=Xvel_64
Alias SDI12c_3(1)=Yvel_1
Alias SDI12c_3(2)=Yvel_2
Alias SDI12c_3(3)=Yvel_3
Alias SDI12c_3(4)=Yvel_4
Alias SDI12c_3(5)=Yvel_5
Alias SDI12c_3(6)=Yvel_6
Alias SDI12c_3(7)=Yvel_7
Alias SDI12c_3(8)=Yvel_8
Alias SDI12c_3(9)=Yvel_9
Alias SDI12c_3(10)=Yvel_10
Alias SDI12c_3(11)=Yvel_11
Alias SDI12c_3(12)=Yvel_12
Alias SDI12c_3(13)=Yvel_13
Alias SDI12c_3(14)=Yvel_14
Alias SDI12c_3(15)=Yvel_15
Alias SDI12c_3(16)=Yvel_16
Alias SDI12c_3(17)=Yvel_17
Alias SDI12c_3(18)=Yvel_18
Alias SDI12c_3(19)=Yvel_19
Alias SDI12c_3(20)=Yvel_20
Alias SDI12c_3(21)=Yvel_21
Alias SDI12c_3(22)=Yvel_22
Alias SDI12c_3(23)=Yvel_23
Alias SDI12c_3(24)=Yvel_24
Alias SDI12c_3(25)=Yvel_25
Alias SDI12c_3(26)=Yvel_26
Alias SDI12c_3(27)=Yvel_27
Alias SDI12c_3(28)=Yvel_28
Alias SDI12c_3(29)=Yvel_29
Alias SDI12c_3(30)=Yvel_30
Alias SDI12c_3(31)=Yvel_31
Alias SDI12c_3(32)=Yvel_32
Alias SDI12c_3(33)=Yvel_33
Alias SDI12c_3(34)=Yvel_34
Alias SDI12c_3(35)=Yvel_35
Alias SDI12c_3(36)=Yvel_36
Alias SDI12c_3(37)=Yvel_37
Alias SDI12c_3(38)=Yvel_38
Alias SDI12c_3(39)=Yvel_39
Alias SDI12c_3(40)=Yvel_40
Alias SDI12c_3(41)=Yvel_41
Alias SDI12c_3(42)=Yvel_42
Alias SDI12c_3(43)=Yvel_43
Alias SDI12c_3(44)=Yvel_44
Alias SDI12c_3(45)=Yvel_45
Alias SDI12c_3(46)=Yvel_46
Alias SDI12c_3(47)=Yvel_47
Alias SDI12c_3(48)=Yvel_48
Alias SDI12c_3(49)=Yvel_49
Alias SDI12c_3(50)=Yvel_50
Alias SDI12c_3(51)=Yvel_51
Alias SDI12c_3(52)=Yvel_52
Alias SDI12c_3(53)=Yvel_53
Alias SDI12c_3(54)=Yvel_54
Alias SDI12c_3(55)=Yvel_55
Alias SDI12c_3(56)=Yvel_56
Alias SDI12c_3(57)=Yvel_57
Alias SDI12c_3(58)=Yvel_58
Alias SDI12c_3(59)=Yvel_59
Alias SDI12c_3(60)=Yvel_60
Alias SDI12c_3(61)=Yvel_61
Alias SDI12c_3(62)=Yvel_62
Alias SDI12c_3(63)=Yvel_63
Alias SDI12c_3(64)=Yvel_64
Alias SDI12c_4(1)=RSSI_1_1
Alias SDI12c_4(2)=RSSI_1_2
Alias SDI12c_4(3)=RSSI_1_3
Alias SDI12c_4(4)=RSSI_1_4
```

```
Alias SDI12c_4(5)=RSSI_1_5
Alias SDI12c_4(6)=RSSI_1_6
Alias SDI12c_4(7)=RSSI_1_7
Alias SDI12c_4(8)=RSSI_1_8
Alias SDI12c_4(9)=RSSI_1_9
Alias SDI12c_4(10)=RSSI_1_10
Alias SDI12c_4(11)=RSSI_1_11
Alias SDI12c_4(12)=RSSI_1_12
Alias SDI12c_4(13)=RSSI_1_13
Alias SDI12c_4(14)=RSSI_1_14
Alias SDI12c_4(15)=RSSI_1_15
Alias SDI12c_4(16)=RSSI_1_16
Alias SDI12c_4(17)=RSSI_1_17
Alias SDI12c_4(18)=RSSI_1_18
Alias SDI12c_4(19)=RSSI_1_19
Alias SDI12c_4(20)=RSSI_1_20
Alias SDI12c_4(21)=RSSI_1_21
Alias SDI12c_4(22)=RSSI_1_22
Alias SDI12c_4(23)=RSSI_1_23
Alias SDI12c_4(24)=RSSI_1_24
Alias SDI12c_4(25)=RSSI_1_25
Alias SDI12c_4(26)=RSSI_1_26
Alias SDI12c_4(27)=RSSI_1_27
Alias SDI12c_4(28)=RSSI_1_28
Alias SDI12c_4(29)=RSSI_1_29
Alias SDI12c_4(30)=RSSI_1_30
Alias SDI12c_4(31)=RSSI_1_31
Alias SDI12c_4(32)=RSSI_1_32
Alias SDI12c_4(33)=RSSI_1_33
Alias SDI12c_4(34)=RSSI_1_34
Alias SDI12c_4(35)=RSSI_1_35
Alias SDI12c_4(36)=RSSI_1_36
Alias SDI12c_4(37)=RSSI_1_37
Alias SDI12c_4(38)=RSSI_1_38
Alias SDI12c_4(39)=RSSI_1_39
Alias SDI12c_4(40)=RSSI_1_40
Alias SDI12c_4(41)=RSSI_1_41
Alias SDI12c_4(42)=RSSI_1_42
Alias SDI12c_4(43)=RSSI_1_43
Alias SDI12c_4(44)=RSSI_1_44
Alias SDI12c_4(45)=RSSI_1_45
Alias SDI12c_4(46)=RSSI_1_46
Alias SDI12c_4(47)=RSSI_1_47
Alias SDI12c_4(48)=RSSI_1_48
Alias SDI12c_4(49)=RSSI_1_49
Alias SDI12c_4(50)=RSSI_1_50
Alias SDI12c_4(51)=RSSI_1_51
Alias SDI12c_4(52)=RSSI_1_52
Alias SDI12c_4(53)=RSSI_1_53
Alias SDI12c_4(54)=RSSI_1_54
Alias SDI12c_4(55)=RSSI_1_55
Alias SDI12c_4(56)=RSSI_1_56
Alias SDI12c_4(57)=RSSI_1_57
Alias SDI12c_4(58)=RSSI_1_58
Alias SDI12c_4(59)=RSSI_1_59
Alias SDI12c_4(60)=RSSI_1_60
Alias SDI12c_4(61)=RSSI_1_61
Alias SDI12c_4(62)=RSSI_1_62
Alias SDI12c_4(63)=RSSI_1_63
Alias SDI12c_4(64)=RSSI_1_64
Alias SDI12c_5(1)=RSSI_2_1
Alias SDI12c_5(2)=RSSI_2_2
Alias SDI12c_5(3)=RSSI_2_3
Alias SDI12c_5(4)=RSSI_2_4
Alias SDI12c_5(5)=RSSI_2_5
Alias SDI12c_5(6)=RSSI_2_6
Alias SDI12c_5(7)=RSSI_2_7
Alias SDI12c_5(8)=RSSI_2_8
Alias SDI12c_5(9)=RSSI_2_9
Alias SDI12c_5(10)=RSSI_2_10
Alias SDI12c_5(11)=RSSI_2_11
Alias SDI12c_5(12)=RSSI_2_12
Alias SDI12c_5(13)=RSSI_2_13
Alias SDI12c_5(14)=RSSI_2_14
Alias SDI12c_5(15)=RSSI_2_15
Alias SDI12c_5(16)=RSSI_2_16
Alias SDI12c_5(17)=RSSI_2_17
Alias SDI12c_5(18)=RSSI_2_18
Alias SDI12c_5(19)=RSSI_2_19
Alias SDI12c_5(20)=RSSI_2_20
Alias SDI12c_5(21)=RSSI_2_21
Alias SDI12c_5(22)=RSSI_2_22
Alias SDI12c_5(23)=RSSI_2_23
Alias SDI12c_5(24)=RSSI_2_24
Alias SDI12c_5(25)=RSSI_2_25
Alias SDI12c_5(26)=RSSI_2_26
Alias SDI12c_5(27)=RSSI_2_27
Alias SDI12c_5(28)=RSSI_2_28
Alias SDI12c_5(29)=RSSI_2_29
Alias SDI12c_5(30)=RSSI_2_30
Alias SDI12c_5(31)=RSSI_2_31
Alias SDI12c_5(32)=RSSI_2_32
Alias SDI12c_5(33)=RSSI_2_33
Alias SDI12c_5(34)=RSSI_2_34
Alias SDI12c_5(35)=RSSI_2_35
```

```
Alias SDI12c_5(36)=RSSI_2_36
Alias SDI12c_5(37)=RSSI_2_37
Alias SDI12c_5(38)=RSSI_2_38
Alias SDI12c_5(39)=RSSI_2_39
Alias SDI12c_5(40)=RSSI_2_40
Alias SDI12c_5(41)=RSSI_2_41
Alias SDI12c_5(42)=RSSI_2_42
Alias SDI12c_5(43)=RSSI_2_43
Alias SDI12c_5(44)=RSSI_2_44
Alias SDI12c_5(45)=RSSI_2_45
Alias SDI12c_5(46)=RSSI_2_46
Alias SDI12c_5(47)=RSSI_2_47
Alias SDI12c_5(48)=RSSI_2_48
Alias SDI12c_5(49)=RSSI_2_49
Alias SDI12c_5(50)=RSSI_2_50
Alias SDI12c_5(51)=RSSI_2_51
Alias SDI12c_5(52)=RSSI_2_52
Alias SDI12c_5(53)=RSSI_2_53
Alias SDI12c_5(54)=RSSI_2_54
Alias SDI12c_5(55)=RSSI_2_55
Alias SDI12c_5(56)=RSSI_2_56
Alias SDI12c_5(57)=RSSI_2_57
Alias SDI12c_5(58)=RSSI_2_58
Alias SDI12c_5(59)=RSSI_2_59
Alias SDI12c_5(60)=RSSI_2_60
Alias SDI12c_5(61)=RSSI_2_61
Alias SDI12c_5(62)=RSSI_2_62
Alias SDI12c_5(63)=RSSI_2_63
Alias SDI12c_5(64)=RSSI_2_64

Units BattV=Volts
Units PTemp_C=Deg C
Units Temperature=degC
Units Pressure=kpa?
Units RangeToSurface=m
Units Pitch=deg
Units Roll=deg
Units Xvelocity=m/s
Units Voltage=volts
Units Xvel_1=m/s
Units Xvel_2=m/s
Units Xvel_3=m/s
Units Xvel_4=m/s
Units Xvel_5=m/s
Units Xvel_6=m/s
Units Xvel_7=m/s
Units Xvel_8=m/s
Units Xvel_9=m/s
Units Xvel_10=m/s
Units Xvel_11=m/s
Units Xvel_12=m/s
Units Xvel_13=m/s
Units Xvel_14=m/s
Units Xvel_15=m/s
Units Xvel_16=m/s
Units Xvel_17=m/s
Units Xvel_18=m/s
Units Xvel_19=m/s
Units Xvel_20=m/s
Units Xvel_21=m/s
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Units Xvel_27=m/s
Units Xvel_28=m/s
Units Xvel_29=m/s
Units Xvel_30=m/s
Units Xvel_31=m/s
Units Xvel_32=m/s
Units Xvel_33=m/s
Units Xvel_34=m/s
Units Xvel_35=m/s
Units Xvel_36=m/s
Units Xvel_37=m/s
Units Xvel_38=m/s
Units Xvel_39=m/s
Units Xvel_40=m/s
Units Xvel_41=m/s
Units Xvel_42=m/s
Units Xvel_43=m/s
Units Xvel_44=m/s
Units Xvel_45=m/s
Units Xvel_46=m/s
Units Xvel_47=m/s
Units Xvel_48=m/s
Units Xvel_49=m/s
Units Xvel_50=m/s
Units Xvel_51=m/s
Units Xvel_52=m/s
Units Xvel_53=m/s
Units Xvel_54=m/s
Units Xvel_55=m/s
Units Xvel_56=m/s
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```
Units Xvel_57=m/s
Units Xvel_58=m/s
Units Xvel_59=m/s
Units Xvel_60=m/s
Units Xvel_61=m/s
Units Xvel_62=m/s
Units Xvel_63=m/s
Units Xvel_64=m/s
Units Yvel_1=m/s
Units Yvel_2=m/s
Units Yvel_3=m/s
Units Yvel_4=m/s
Units Yvel_5=m/s
Units Yvel_6=m/s
Units Yvel_7=m/s
Units Yvel_8=m/s
Units Yvel_9=m/s
Units Yvel_10=m/s
Units Yvel_11=m/s
Units Yvel_12=m/s
Units Yvel_13=m/s
Units Yvel_14=m/s
Units Yvel_15=m/s
Units Yvel_16=m/s
Units Yvel_17=m/s
Units Yvel_18=m/s
Units Yvel_19=m/s
Units Yvel_20=m/s
Units Yvel_21=m/s
Units Yvel_22=m/s
Units Yvel_23=m/s
Units Yvel_24=m/s
Units Yvel_25=m/s
Units Yvel_26=m/s
Units Yvel_27=m/s
Units Yvel_28=m/s
Units Yvel_29=m/s
Units Yvel_30=m/s
Units Yvel_31=m/s
Units Yvel_32=m/s
Units Yvel_33=m/s
Units Yvel_34=m/s
Units Yvel_35=m/s
Units Yvel_36=m/s
Units Yvel_37=m/s
Units Yvel_38=m/s
Units Yvel_39=m/s
Units Yvel_40=m/s
Units Yvel_41=m/s
Units Yvel_42=m/s
Units Yvel_43=m/s
Units Yvel_44=m/s
Units Yvel_45=m/s
Units Yvel_46=m/s
Units Yvel_47=m/s
Units Yvel_48=m/s
Units Yvel_49=m/s
Units Yvel_50=m/s
Units Yvel_51=m/s
Units Yvel_52=m/s
Units Yvel_53=m/s
Units Yvel_54=m/s
Units Yvel_55=m/s
Units Yvel_56=m/s
Units Yvel_57=m/s
Units Yvel_58=m/s
Units Yvel_59=m/s
Units Yvel_60=m/s
Units Yvel_61=m/s
Units Yvel_62=m/s
Units Yvel_63=m/s
Units Yvel_64=m/s
Units RSSI_1_1=counts
Units RSSI_1_2=counts
Units RSSI_1_3=counts
Units RSSI_1_4=counts
Units RSSI_1_5=counts
Units RSSI_1_6=counts
Units RSSI_1_7=counts
Units RSSI_1_8=counts
Units RSSI_1_9=counts
Units RSSI_1_10=counts
Units RSSI_1_11=counts
Units RSSI_1_12=counts
Units RSSI_1_13=counts
Units RSSI_1_14=counts
Units RSSI_1_15=counts
Units RSSI_1_16=counts
Units RSSI_1_17=counts
Units RSSI_1_18=counts
Units RSSI_1_19=counts
Units RSSI_1_20=counts
Units RSSI_1_21=counts
Units RSSI_1_22=counts
Units RSSI_1_23=counts
```

```
Units RSSI_1_24=counts
Units RSSI_1_25=counts
Units RSSI_1_26=counts
Units RSSI_1_27=counts
Units RSSI_1_28=counts
Units RSSI_1_29=counts
Units RSSI_1_30=counts
Units RSSI_1_31=counts
Units RSSI_1_32=counts
Units RSSI_1_33=counts
Units RSSI_1_34=counts
Units RSSI_1_35=counts
Units RSSI_1_36=counts
Units RSSI_1_37=counts
Units RSSI_1_38=counts
Units RSSI_1_39=counts
Units RSSI_1_40=counts
Units RSSI_1_41=counts
Units RSSI_1_42=counts
Units RSSI_1_43=counts
Units RSSI_1_44=counts
Units RSSI_1_45=counts
Units RSSI_1_46=counts
Units RSSI_1_47=counts
Units RSSI_1_48=counts
Units RSSI_1_49=counts
Units RSSI_1_50=counts
Units RSSI_1_51=counts
Units RSSI_1_52=counts
Units RSSI_1_53=counts
Units RSSI_1_54=counts
Units RSSI_1_55=counts
Units RSSI_1_56=counts
Units RSSI_1_57=counts
Units RSSI_1_58=counts
Units RSSI_1_59=counts
Units RSSI_1_60=counts
Units RSSI_1_61=counts
Units RSSI_1_62=counts
Units RSSI_1_63=counts
Units RSSI_1_64=counts
Units RSSI_2_1=counts
Units RSSI_2_2=counts
Units RSSI_2_3=counts
Units RSSI_2_4=counts
Units RSSI_2_5=counts
Units RSSI_2_6=counts
Units RSSI_2_7=counts
Units RSSI_2_8=counts
Units RSSI_2_9=counts
Units RSSI_2_10=counts
Units RSSI_2_11=counts
Units RSSI_2_12=counts
Units RSSI_2_13=counts
Units RSSI_2_14=counts
Units RSSI_2_15=counts
Units RSSI_2_16=counts
Units RSSI_2_17=counts
Units RSSI_2_18=counts
Units RSSI_2_19=counts
Units RSSI_2_20=counts
Units RSSI_2_21=counts
Units RSSI_2_22=counts
Units RSSI_2_23=counts
Units RSSI_2_24=counts
Units RSSI_2_25=counts
Units RSSI_2_26=counts
Units RSSI_2_27=counts
Units RSSI_2_28=counts
Units RSSI_2_29=counts
Units RSSI_2_30=counts
Units RSSI_2_31=counts
Units RSSI_2_32=counts
Units RSSI_2_33=counts
Units RSSI_2_34=counts
Units RSSI_2_35=counts
Units RSSI_2_36=counts
Units RSSI_2_37=counts
Units RSSI_2_38=counts
Units RSSI_2_39=counts
Units RSSI_2_40=counts
Units RSSI_2_41=counts
Units RSSI_2_42=counts
Units RSSI_2_43=counts
Units RSSI_2_44=counts
Units RSSI_2_45=counts
Units RSSI_2_46=counts
Units RSSI_2_47=counts
Units RSSI_2_48=counts
Units RSSI_2_49=counts
Units RSSI_2_50=counts
Units RSSI_2_51=counts
Units RSSI_2_52=counts
Units RSSI_2_53=counts
Units RSSI_2_54=counts
```

```
Units RSSI_2_55=counts
Units RSSI_2_56=counts
Units RSSI_2_57=counts
Units RSSI_2_58=counts
Units RSSI_2_59=counts
Units RSSI_2_60=counts
Units RSSI_2_61=counts
Units RSSI_2_62=counts
Units RSSI_2_63=counts
Units RSSI_2_64=counts

'Define Data Tables
DataTable(ADCP_c15Min,True,-1)
                                        DataInterval(0,15,Min,10)
                                        Sample(1,Temperature,IEEE4)
                                        Sample(1,Pressure,IEEE4)
                                        Sample(1,spare,FP2)
                                        Sample(1,RangeToSurface,IEEE4)
                                        Sample(1,Pitch,IEEE4)
                                        Sample(1,Roll,IEEE4)
                                        Sample(1,Xvelocity,IEEE4)
                                        Sample(1,Voltage,IEEE4)
                                        Sample(1,BITresult,FP2)
                                        Sample(1,MeanXVelocity,IEEE4)
                                        Sample(1,Stage,IEEE4)
                                        Sample(1,Area,IEEE4)
                                        Sample(1,Discharge,IEEE4)
                                        Sample(1,UpperVolume,IEEE4)
                                        Sample(1,LowerVolume,IEEE4)
                                        Sample(1,Yvelocity,IEEE4)
                                        Sample(1,Bm1AvgCorr,IEEE4)
                                        Sample(1,Bm2AvgCorr,IEEE4)
                                        Sample(1,AvgCorr,IEEE4)
                                        Sample(1,Bm1AvgRSSI,IEEE4)
                                        Sample(1,Bm2AvgRSSI,IEEE4)
                                        Sample(1,AvgRSSI,IEEE4)
                                        Sample(1,Bm1Noise,IEEE4)
                                        Sample(1,Bm2Noise,IEEE4)
                                        Sample(1,AvgNoise,IEEE4)
                                        Sample(1,Bm1AvgSNR,IEEE4)
                                        Sample(1,Bm2AvgSNR,IEEE4)
                                        Sample(1,AvgSNR,IEEE4)
                                        Sample(1,Xvel_1,IEEE4)
                                        Sample(1,Xvel_2,IEEE4)
                                        Sample(1,Xvel_3,IEEE4)
                                        Sample(1,Xvel_4,IEEE4)
                                        Sample(1,Xvel_5,IEEE4)
                                        Sample(1,Xvel_6,IEEE4)
                                        Sample(1,Xvel_7,IEEE4)
                                        Sample(1,Xvel_8,IEEE4)
                                        Sample(1,Xvel_9,IEEE4)
                                        Sample(1,Xvel_10,IEEE4)
                                        Sample(1,Xvel_11,IEEE4)
                                        Sample(1,Xvel_12,IEEE4)
                                        Sample(1,Xvel_13,IEEE4)
                                        Sample(1,Xvel_14,IEEE4)
                                        Sample(1,Xvel_15,IEEE4)
                                        Sample(1,Xvel_16,IEEE4)
                                        Sample(1,Xvel_17,IEEE4)
                                        Sample(1,Xvel_18,IEEE4)
                                        Sample(1,Xvel_19,IEEE4)
                                        Sample(1,Xvel_20,IEEE4)
                                        Sample(1,Xvel_21,IEEE4)
                                        Sample(1,Xvel_22,IEEE4)
                                        Sample(1,Xvel_23,IEEE4)
                                        Sample(1,Xvel_24,IEEE4)
                                        Sample(1,Xvel_25,IEEE4)
                                        Sample(1,Xvel_26,IEEE4)
                                        Sample(1,Xvel_27,IEEE4)
                                        Sample(1,Xvel_28,IEEE4)
                                        Sample(1,Xvel_29,IEEE4)
                                        Sample(1,Xvel_30,IEEE4)
                                        Sample(1,Xvel_31,IEEE4)
                                        Sample(1,Xvel_32,IEEE4)
                                        Sample(1,Xvel_33,IEEE4)
                                        Sample(1,Xvel_34,IEEE4)
                                        Sample(1,Xvel_35,IEEE4)
                                        Sample(1,Xvel_36,IEEE4)
                                        Sample(1,Xvel_37,IEEE4)
                                        Sample(1,Xvel_38,IEEE4)
                                        Sample(1,Xvel_39,IEEE4)
                                        Sample(1,Xvel_40,IEEE4)
                                        Sample(1,Xvel_41,IEEE4)
                                        Sample(1,Xvel_42,IEEE4)
                                        Sample(1,Xvel_43,IEEE4)
                                        Sample(1,Xvel_44,IEEE4)
                                        Sample(1,Xvel_45,IEEE4)
                                        Sample(1,Xvel_46,IEEE4)
                                        Sample(1,Xvel_47,IEEE4)
                                        Sample(1,Xvel_48,IEEE4)
                                        Sample(1,Xvel_49,IEEE4)
                                        Sample(1,Xvel_50,IEEE4)
                                        Sample(1,Xvel_51,IEEE4)
                                        Sample(1,Xvel_52,IEEE4)
                                        Sample(1,Xvel_53,IEEE4)
```

```
Sample(1,Xvel_54,IEEE4)
Sample(1,Xvel_55,IEEE4)
Sample(1,Xvel_56,IEEE4)
Sample(1,Xvel_57,IEEE4)
Sample(1,Xvel_58,IEEE4)
Sample(1,Xvel_59,IEEE4)
Sample(1,Xvel_60,IEEE4)
Sample(1,Xvel_61,IEEE4)
Sample(1,Xvel_62,IEEE4)
Sample(1,Xvel_63,IEEE4)
Sample(1,Xvel_64,IEEE4)
Sample(1,Yvel_1,IEEE4)
Sample(1,Yvel_2,IEEE4)
Sample(1,Yvel_3,IEEE4)
Sample(1,Yvel_4,IEEE4)
Sample(1,Yvel_5,IEEE4)
Sample(1,Yvel_6,IEEE4)
Sample(1,Yvel_7,IEEE4)
Sample(1,Yvel_8,IEEE4)
Sample(1,Yvel_9,IEEE4)
Sample(1,Yvel_10,IEEE4)
Sample(1,Yvel_11,IEEE4)
Sample(1,Yvel_12,IEEE4)
Sample(1,Yvel_13,IEEE4)
Sample(1,Yvel_14,IEEE4)
Sample(1,Yvel_15,IEEE4)
Sample(1,Yvel_16,IEEE4)
Sample(1,Yvel_17,IEEE4)
Sample(1,Yvel_18,IEEE4)
Sample(1,Yvel_19,IEEE4)
Sample(1,Yvel_20,IEEE4)
Sample(1,Yvel_21,IEEE4)
Sample(1,Yvel_22,IEEE4)
Sample(1,Yvel_23,IEEE4)
Sample(1,Yvel_24,IEEE4)
Sample(1,Yvel_25,IEEE4)
Sample(1,Yvel_26,IEEE4)
Sample(1,Yvel_27,IEEE4)
Sample(1,Yvel_28,IEEE4)
Sample(1,Yvel_29,IEEE4)
Sample(1,Yvel_30,IEEE4)
Sample(1,Yvel_31,IEEE4)
Sample(1,Yvel_32,IEEE4)
Sample(1,Yvel_33,IEEE4)
Sample(1,Yvel_34,IEEE4)
Sample(1,Yvel_35,IEEE4)
Sample(1,Yvel_36,IEEE4)
Sample(1,Yvel_37,IEEE4)
Sample(1,Yvel_38,IEEE4)
Sample(1,Yvel_39,IEEE4)
Sample(1,Yvel_40,IEEE4)
Sample(1,Yvel_41,IEEE4)
Sample(1,Yvel_42,IEEE4)
Sample(1,Yvel_43,IEEE4)
Sample(1,Yvel_44,IEEE4)
Sample(1,Yvel_45,IEEE4)
Sample(1,Yvel_46,IEEE4)
Sample(1,Yvel_47,IEEE4)
Sample(1,Yvel_48,IEEE4)
Sample(1,Yvel_49,IEEE4)
Sample(1,Yvel_50,IEEE4)
Sample(1,Yvel_51,IEEE4)
Sample(1,Yvel_52,IEEE4)
Sample(1,Yvel_53,IEEE4)
Sample(1,Yvel_54,IEEE4)
Sample(1,Yvel_55,IEEE4)
Sample(1,Yvel_56,IEEE4)
Sample(1,Yvel_57,IEEE4)
Sample(1,Yvel_58,IEEE4)
Sample(1,Yvel_59,IEEE4)
Sample(1,Yvel_60,IEEE4)
Sample(1,Yvel_61,IEEE4)
Sample(1,Yvel_62,IEEE4)
Sample(1,Yvel_63,IEEE4)
Sample(1,Yvel_64,IEEE4)
Sample(1,RSSI_1_1,IEEE4)
Sample(1,RSSI_1_2,IEEE4)
Sample(1,RSSI_1_3,IEEE4)
Sample(1,RSSI_1_4,IEEE4)
Sample(1,RSSI_1_5,IEEE4)
Sample(1,RSSI_1_6,IEEE4)
Sample(1,RSSI_1_7,IEEE4)
Sample(1,RSSI_1_8,IEEE4)
Sample(1,RSSI_1_9,IEEE4)
Sample(1,RSSI_1_10,IEEE4)
Sample(1,RSSI_1_11,IEEE4)
Sample(1,RSSI_1_12,IEEE4)
Sample(1,RSSI_1_13,IEEE4)
Sample(1,RSSI_1_14,IEEE4)
Sample(1,RSSI_1_15,IEEE4)
Sample(1,RSSI_1_16,IEEE4)
Sample(1,RSSI_1_17,IEEE4)
Sample(1,RSSI_1_18,IEEE4)
Sample(1,RSSI_1_19,IEEE4)
Sample(1,RSSI_1_20,IEEE4)
```

```
Sample(1,RSSI_1_21,IEEE4)
Sample(1,RSSI_1_22,IEEE4)
Sample(1,RSSI_1_23,IEEE4)
Sample(1,RSSI_1_24,IEEE4)
Sample(1,RSSI_1_25,IEEE4)
Sample(1,RSSI_1_26,IEEE4)
Sample(1,RSSI_1_27,IEEE4)
Sample(1,RSSI_1_28,IEEE4)
Sample(1,RSSI_1_29,IEEE4)
Sample(1,RSSI_1_30,IEEE4)
Sample(1,RSSI_1_31,IEEE4)
Sample(1,RSSI_1_32,IEEE4)
Sample(1,RSSI_1_33,IEEE4)
Sample(1,RSSI_1_34,IEEE4)
Sample(1,RSSI_1_35,IEEE4)
Sample(1,RSSI_1_36,IEEE4)
Sample(1,RSSI_1_37,IEEE4)
Sample(1,RSSI_1_38,IEEE4)
Sample(1,RSSI_1_39,IEEE4)
Sample(1,RSSI_1_40,IEEE4)
Sample(1,RSSI_1_41,IEEE4)
Sample(1,RSSI_1_42,IEEE4)
Sample(1,RSSI_1_43,IEEE4)
Sample(1,RSSI_1_44,IEEE4)
Sample(1,RSSI_1_45,IEEE4)
Sample(1,RSSI_1_46,IEEE4)
Sample(1,RSSI_1_47,IEEE4)
Sample(1,RSSI_1_48,IEEE4)
Sample(1,RSSI_1_49,IEEE4)
Sample(1,RSSI_1_50,IEEE4)
Sample(1,RSSI_1_51,IEEE4)
Sample(1,RSSI_1_52,IEEE4)
Sample(1,RSSI_1_53,IEEE4)
Sample(1,RSSI_1_54,IEEE4)
Sample(1,RSSI_1_55,IEEE4)
Sample(1,RSSI_1_56,IEEE4)
Sample(1,RSSI_1_57,IEEE4)
Sample(1,RSSI_1_58,IEEE4)
Sample(1,RSSI_1_59,IEEE4)
Sample(1,RSSI_1_60,IEEE4)
Sample(1,RSSI_1_61,IEEE4)
Sample(1,RSSI_1_62,IEEE4)
Sample(1,RSSI_1_63,IEEE4)
Sample(1,RSSI_1_64,IEEE4)
Sample(1,RSSI_2_1,IEEE4)
Sample(1,RSSI_2_2,IEEE4)
Sample(1,RSSI_2_3,IEEE4)
Sample(1,RSSI_2_4,IEEE4)
Sample(1,RSSI_2_5,IEEE4)
Sample(1,RSSI_2_6,IEEE4)
Sample(1,RSSI_2_7,IEEE4)
Sample(1,RSSI_2_8,IEEE4)
Sample(1,RSSI_2_9,IEEE4)
Sample(1,RSSI_2_10,IEEE4)
Sample(1,RSSI_2_11,IEEE4)
Sample(1,RSSI_2_12,IEEE4)
Sample(1,RSSI_2_13,IEEE4)
Sample(1,RSSI_2_14,IEEE4)
Sample(1,RSSI_2_15,IEEE4)
Sample(1,RSSI_2_16,IEEE4)
Sample(1,RSSI_2_17,IEEE4)
Sample(1,RSSI_2_18,IEEE4)
Sample(1,RSSI_2_19,IEEE4)
Sample(1,RSSI_2_20,IEEE4)
Sample(1,RSSI_2_21,IEEE4)
Sample(1,RSSI_2_22,IEEE4)
Sample(1,RSSI_2_23,IEEE4)
Sample(1,RSSI_2_24,IEEE4)
Sample(1,RSSI_2_25,IEEE4)
Sample(1,RSSI_2_26,IEEE4)
Sample(1,RSSI_2_27,IEEE4)
Sample(1,RSSI_2_28,IEEE4)
Sample(1,RSSI_2_29,IEEE4)
Sample(1,RSSI_2_30,IEEE4)
Sample(1,RSSI_2_31,IEEE4)
Sample(1,RSSI_2_32,IEEE4)
Sample(1,RSSI_2_33,IEEE4)
Sample(1,RSSI_2_34,IEEE4)
Sample(1,RSSI_2_35,IEEE4)
Sample(1,RSSI_2_36,IEEE4)
Sample(1,RSSI_2_37,IEEE4)
Sample(1,RSSI_2_38,IEEE4)
Sample(1,RSSI_2_39,IEEE4)
Sample(1,RSSI_2_40,IEEE4)
Sample(1,RSSI_2_41,IEEE4)
Sample(1,RSSI_2_42,IEEE4)
Sample(1,RSSI_2_43,IEEE4)
Sample(1,RSSI_2_44,IEEE4)
Sample(1,RSSI_2_45,IEEE4)
Sample(1,RSSI_2_46,IEEE4)
Sample(1,RSSI_2_47,IEEE4)
Sample(1,RSSI_2_48,IEEE4)
Sample(1,RSSI_2_49,IEEE4)
Sample(1,RSSI_2_50,IEEE4)
Sample(1,RSSI_2_51,IEEE4)
```

```
                                        Sample(1,RSSI_2_52,IEEE4)
                                        Sample(1,RSSI_2_53,IEEE4)
                                        Sample(1,RSSI_2_54,IEEE4)
                                        Sample(1,RSSI_2_55,IEEE4)
                                        Sample(1,RSSI_2_56,IEEE4)
                                        Sample(1,RSSI_2_57,IEEE4)
                                        Sample(1,RSSI_2_58,IEEE4)
                                        Sample(1,RSSI_2_59,IEEE4)
                                        Sample(1,RSSI_2_60,IEEE4)
                                        Sample(1,RSSI_2_61,IEEE4)
                                        Sample(1,RSSI_2_62,IEEE4)
                                        Sample(1,RSSI_2_63,IEEE4)
                                        Sample(1,RSSI_2_64,IEEE4)
EndTable

'Main Program
BeginProg
                                           'Main Scan
                                      Scan(15,Min,1,0)
                                                'Default CR300 Datalogger Battery Voltage measurement 'BattV'
                                                Battery(BattV)
                                                'Default CR300 Datalogger Processor Temperature measurement
'PTemp_C'
                                                PanelTemp(PTemp_C,60)

'Concurrent Measurement
                                                'Initialize SDI-12 structures to NAN
                                                Move(SDI12c(),28,NAN,1)
                                                Move(SDI12c_2(),64,NAN,1)
                                                Move(SDI12c_3(),64,NAN,1)
                                                Move(SDI12c_4(),64,NAN,1)
                                                Move(SDI12c_5(),64,NAN,1)

                                                SDI12Recorder(SDI12c(),C1,"0","C!",1,0,-1,1)
                                                Delay (0,1,Sec)
                                                SDI12Recorder(SDI12c_2(),C1,"0","C1!",1,0,-1,1)
                                                Delay (0,1,Sec)
                                                SDI12Recorder(SDI12c_3(),C1,"0","C2!",1,0,-1,1)
                                                Delay (0,1,Sec)
                                                SDI12Recorder(SDI12c_4(),C1,"0","C3!",1,0,-1,1)
                                                Delay (0,1,Sec)
                                                SDI12Recorder(SDI12c_5(),C1,"0","C4!",1,0,-1,1)

                                                'Call Data Tables and Store Data
                                                CallTable ADCP_c15Min
                                             NextScan
EndProg
```

CR300 M Measurement Example

Attached is an example CRBasic programs for the CR300 for M measurements. The file captures all available data; users should modify them to correspond to their system of units, number of bins, and desired data values. The file is ASCII text, but the logger expects the .CR300 extension.

Sample CM SDI-12 M measurements.CR300

```
'CR300 Series

'Declare Variables and Units
Public BattV
Public PTemp_C
Public SDI12(9)
Public SDI12_2(9)
Public SDI12_3(9)
Public SDI12_4(9)
Public SDI12_5(9)
Public SDI12_6(9)
Public SDI12_7(9)
Public SDI12_8(1)
Public SDI12_9(1)
Public SDI12_10(6)

Alias SDI12(1)=mTemperature
Alias SDI12(2)=mPDepth
Alias SDI12(3)=mUnused
Alias SDI12(4)=mRangeToSurf
Alias SDI12(5)=mPitch
Alias SDI12(6)=mRoll
Alias SDI12(7)=mIndexVel
Alias SDI12(8)=mVoltage
Alias SDI12(9)=mBITresult
Alias SDI12_2(1)=mXvel_1
Alias SDI12_2(2)=mXvel_2
Alias SDI12_2(3)=mXvel_3
Alias SDI12_2(4)=mXvel_4
Alias SDI12_2(5)=mXvel_5
Alias SDI12_2(6)=mXvel_6
Alias SDI12_2(7)=mXvel_7
Alias SDI12_2(8)=mXvel_8
Alias SDI12_2(9)=mXvel_9
Alias SDI12_3(1)=mXvel_10
Alias SDI12_3(2)=mXvel_11
Alias SDI12_3(3)=mXvel_12
Alias SDI12_3(4)=mXvel_13
Alias SDI12_3(5)=mXvel_14
Alias SDI12_3(6)=mXvel_15
Alias SDI12_3(7)=mXvel_16
Alias SDI12_3(8)=mXvel_17
Alias SDI12_3(9)=mXvel_18
Alias SDI12_4(1)=mXvel_19
Alias SDI12_4(2)=mXvel_20
Alias SDI12_4(3)=mXvel_21
Alias SDI12_4(4)=mXvel_22
Alias SDI12_4(5)=mXvel_23
Alias SDI12_4(6)=mXvel_24
Alias SDI12_4(7)=mXvel_25
Alias SDI12_4(8)=mXvel_26
Alias SDI12_4(9)=mXvel_27
Alias SDI12_5(1)=mYvel_1
Alias SDI12_5(2)=mYvel_2
Alias SDI12_5(3)=mYvel_3
Alias SDI12_5(4)=mYvel_4
Alias SDI12_5(5)=mYvel_5
Alias SDI12_5(6)=mYvel_6
Alias SDI12_5(7)=mYvel_7
Alias SDI12_5(8)=mYvel_8
Alias SDI12_5(9)=mYvel_9
Alias SDI12_6(1)=mYvel_10
Alias SDI12_6(2)=mYvel_11
Alias SDI12_6(3)=mYvel_12
Alias SDI12_6(4)=mYvel_13
Alias SDI12_6(5)=mYvel_14
Alias SDI12_6(6)=mYvel_15
Alias SDI12_6(7)=mYvel_16
Alias SDI12_6(8)=mYvel_17
Alias SDI12_6(9)=mYvel_18
Alias SDI12_7(1)=mYvel_19
Alias SDI12_7(2)=mYvel_20
Alias SDI12_7(3)=mYvel_21
Alias SDI12_7(4)=mYvel_22
Alias SDI12_7(5)=mYvel_23
Alias SDI12_7(6)=mYvel_24
Alias SDI12_7(7)=mYvel_25
```

```
Alias SDI12_7(8)=mYvel_26
Alias SDI12_7(9)=mYvel_27
Alias SDI12_8(1)=mDummy
Alias SDI12_9(1)=mDummy2
Alias SDI12_10(1)=mAvgVelocity
Alias SDI12_10(2)=mStage
Alias SDI12_10(3)=mArea
Alias SDI12_10(4)=mDischarge
Alias SDI12_10(5)=mUpperVolume
Alias SDI12_10(6)=mLowerVolume

Units mTemperature=Deg C
Units mPDepth=m
Units mRangeToSurf=m
Units mPitch=Degrees
Units mRoll=Degrees
Units mIndexVel=m/s
Units mVoltage=Volts
Units mXvel_1=m/s
Units mXvel_2=m/s
Units mXvel_3=m/s
Units mXvel_4=m/s
Units mXvel_5=m/s
Units mXvel_6=m/s
Units mXvel_7=m/s
Units mXvel_8=m/s
Units mXvel_9=m/s
Units mXvel_10=m/s
Units mXvel_11=m/s
Units mXvel_12=m/s
Units mXvel_13=m/s
Units mXvel_14=m/s
Units mXvel_15=m/s
Units mXvel_16=m/s
Units mXvel_17=m/s
Units mXvel_18=m/s
Units mXvel_19=m/s
Units mXvel_20=m/s
Units mXvel_21=m/s
Units mXvel_22=m/s
Units mXvel_23=m/s
Units mXvel_24=m/s
Units mXvel_25=m/s
Units mXvel_26=m/s
Units mXvel_27=m/s
Units mYvel_1=m/s
Units mYvel_2=m/s
Units mYvel_3=m/s
Units mYvel_4=m/s
Units mYvel_5=m/s
Units mYvel_6=m/s
Units mYvel_7=m/s
Units mYvel_8=m/s
Units mYvel_9=m/s
Units mYvel_10=m/s
Units mYvel_11=m/s
Units mYvel_12=m/s
Units mYvel_13=m/s
Units mYvel_14=m/s
Units mYvel_15=m/s
Units mYvel_16=m/s
Units mYvel_17=m/s
Units mYvel_18=m/s
Units mYvel_19=m/s
Units mYvel_20=m/s
Units mYvel_21=m/s
Units mYvel_22=m/s
Units mYvel_23=m/s
Units mYvel_24=m/s
Units mYvel_25=m/s
Units mYvel_26=m/s
Units mYvel_27=m/s
Units mDummy=unit
Units mDummy2=unit
Units mAvgVelocity=m/s
Units mStage=m
Units mArea=sq m
Units mDischarge=m3s
Units mUpperVolume=m3
Units mLowerVolume=m3

'Define Data Tables
DataTable(ADCP_m15Min,True,-1)
                                        DataInterval(0,15,Min,10)
                                        Sample(1,mTemperature,IEEE4)
                                        Sample(1,mPDepth,IEEE4)
                                        Sample(1,mUnused,FP2)
                                        Sample(1,mRangeToSurf,IEEE4)
                                        Sample(1,mPitch,IEEE4)
                                        Sample(1,mRoll,IEEE4)
                                        Sample(1,mIndexVel,IEEE4)
                                        Sample(1,mVoltage,IEEE4)
                                        Sample(1,mBITresult,FP2)
                                        Sample(1,mXvel_1,IEEE4)
                                        Sample(1,mXvel_2,IEEE4)
```

```
                                        Sample(1,mXvel_3,IEEE4)
                                        Sample(1,mXvel_4,IEEE4)
                                        Sample(1,mXvel_5,IEEE4)
                                        Sample(1,mXvel_6,IEEE4)
                                        Sample(1,mXvel_7,IEEE4)
                                        Sample(1,mXvel_8,IEEE4)
                                        Sample(1,mXvel_9,IEEE4)
                                        Sample(1,mXvel_10,IEEE4)
                                        Sample(1,mXvel_11,IEEE4)
                                        Sample(1,mXvel_12,IEEE4)
                                        Sample(1,mXvel_13,IEEE4)
                                        Sample(1,mXvel_14,IEEE4)
                                        Sample(1,mXvel_15,IEEE4)
                                        Sample(1,mXvel_16,IEEE4)
                                        Sample(1,mXvel_17,IEEE4)
                                        Sample(1,mXvel_18,IEEE4)
                                        Sample(1,mXvel_19,IEEE4)
                                        Sample(1,mXvel_20,IEEE4)
                                        Sample(1,mXvel_21,IEEE4)
                                        Sample(1,mXvel_22,IEEE4)
                                        Sample(1,mXvel_23,IEEE4)
                                        Sample(1,mXvel_24,IEEE4)
                                        Sample(1,mXvel_25,IEEE4)
                                        Sample(1,mXvel_26,IEEE4)
                                        Sample(1,mXvel_27,IEEE4)
                                        Sample(1,mYvel_1,IEEE4)
                                        Sample(1,mYvel_2,IEEE4)
                                        Sample(1,mYvel_3,IEEE4)
                                        Sample(1,mYvel_4,IEEE4)
                                        Sample(1,mYvel_5,IEEE4)
                                        Sample(1,mYvel_6,IEEE4)
                                        Sample(1,mYvel_7,IEEE4)
                                        Sample(1,mYvel_8,IEEE4)
                                        Sample(1,mYvel_9,IEEE4)
                                        Sample(1,mYvel_10,IEEE4)
                                        Sample(1,mYvel_11,IEEE4)
                                        Sample(1,mYvel_12,IEEE4)
                                        Sample(1,mYvel_13,IEEE4)
                                        Sample(1,mYvel_14,IEEE4)
                                        Sample(1,mYvel_15,IEEE4)
                                        Sample(1,mYvel_16,IEEE4)
                                        Sample(1,mYvel_17,IEEE4)
                                        Sample(1,mYvel_18,IEEE4)
                                        Sample(1,mYvel_19,IEEE4)
                                        Sample(1,mYvel_20,IEEE4)
                                        Sample(1,mYvel_21,IEEE4)
                                        Sample(1,mYvel_22,IEEE4)
                                        Sample(1,mYvel_23,IEEE4)
                                        Sample(1,mYvel_24,IEEE4)
                                        Sample(1,mYvel_25,IEEE4)
                                        Sample(1,mYvel_26,IEEE4)
                                        Sample(1,mYvel_27,IEEE4)
                                        Sample(1,mDummy,FP2)
                                        Sample(1,mDummy2,FP2)
                                        Sample(1,mAvgVelocity,IEEE4)
                                        Sample(1,mStage,IEEE4)
                                        Sample(1,mArea,IEEE4)
                                        Sample(1,mDischarge,IEEE4)
                                        Sample(1,mUpperVolume,IEEE4)
                                        Sample(1,mLowerVolume,IEEE4)
EndTable

'Main Program
BeginProg
                                           'Main Scan
                                      Scan(15,Min,1,0)
                                                'Default CR300 Datalogger Battery Voltage measurement 'BattV'
                                                Battery(BattV)
                                                'Default CR300 Datalogger Processor Temperature measurement
'PTemp_C'
                                                PanelTemp(PTemp_C,60)

'M measurements
                                                'Initialize SDI-12 structures to NAN
                                                Move(SDI12(),9,NAN,1)
                                                Move(SDI12_2(),9,NAN,1)
                                                Move(SDI12_3(),9,NAN,1)
                                                Move(SDI12_4(),9,NAN,1)
                                                Move(SDI12_5(),9,NAN,1)
                                                Move(SDI12_6(),9,NAN,1)
                                                Move(SDI12_7(),9,NAN,1)
                                                Move(SDI12_8(),1,NAN,1)
                                                Move(SDI12_9(),1,NAN,1)
                                                Move(SDI12_10(),6,NAN,1)

                                                SDI12Recorder(SDI12(),C1,"0","M!",1,0,-1)
                                                SDI12Recorder(SDI12_2(),C1,"0","M1!",1,0,-1)
                                                SDI12Recorder(SDI12_3(),C1,"0","M3!",1,0,-1)
                                                SDI12Recorder(SDI12_4(),C1,"0","M5!",1,0,-1)
                                                SDI12Recorder(SDI12_5(),C1,"0","M2!",1,0,-1)
                                                SDI12Recorder(SDI12_6(),C1,"0","M4!",1,0,-1)
                                                SDI12Recorder(SDI12_7(),C1,"0","M6!",1,0,-1)
                                                SDI12Recorder(SDI12_8(),C1,"0","M7!",1,0,-1)
                                                SDI12Recorder(SDI12_9(),C1,"0","M8!",1,0,-1)
                                                SDI12Recorder(SDI12_10(),C1,"0","M9!",1,0,-1)
```

```
                                        'Call Data Tables and Store Data for M measurement
                                        CallTable ADCP_m15Min

                                    NextScan
EndProg
```

SDI-12 Command Responses

Use the following link to view the SDI-12 specification:
http://www.sdi-12.org/specification.php

Command Start Bit	Response of the Response	Result	Time Until the
0!	0<CR><LF>	pass	8.63 ms
0I!	013TRDI 28.39 208<CR><LF>	pass	8.86 ms
0V!	00000<CR><LF>	pass	9.07 ms
0M!	00079<CR><LF>	pass	9.10 ms
0D0!	0+76.568-0.261-100.000-100.000<CR><LF>	pass	9.47 ms
0D1!	0-31.600+2.300-100.000+11.6+0<CR><LF>	pass	9.45 ms
0M1!	00039<CR><LF>	pass	9.01 ms
0D0!	0-2.631+4.285-9.075+1.906+6.969<CR><LF>	pass	9.50 ms
0D1!	0+0.449-1.444-4.406+6.027<CR><LF>	pass	9.38 ms
0M2!	00039<CR><LF>	pass	9.02 ms
0D0!	0+0.108-4.386-4.587-5.154+0.000<CR><LF>	pass	9.50 ms
0D1!	0+0.761+4.042-4.462+0.354<CR><LF>	pass	9.38 ms
0M3!	00039<CR><LF>	pass	9.01 ms
0D0!	0+2.362-2.362-3.560-0.413+0.748<CR><LF>	pass	9.49 ms
0D1!	0+4.941-1.194+0.909-3.593<CR><LF>	pass	9.38 ms
0M4!	00039<CR><LF>	pass	9.02 ms
0D0!	0+6.014+4.012-0.574-2.270-2.172<CR><LF>	pass	9.49 ms
0D1!	0+2.772-2.572+2.362-0.820<CR><LF>	pass	9.38 ms
0M5!	00039<CR><LF>	pass	9.02 ms
0D0!	0+0.407+3.432+2.972+4.803+2.562<CR><LF>	pass	9.50 ms
0D1!	0+4.734-4.019-3.510+4.875<CR><LF>	pass	9.38 ms
0M6!	00039<CR><LF>	pass	9.02 ms
0D0!	0-2.930-4.688+2.579+3.871-4.823<CR><LF>	pass	9.49 ms
0D1!	0+2.969-1.821+4.780-3.173<CR><LF>	pass	9.38 ms
0M7!	00021<CR><LF>	pass	9.09 ms
0D0!	0-100.000<CR><LF>	pass	9.07 ms
0M8!	00021<CR><LF>	pass	9.10 ms
0D0!	0-100.000<CR><LF>	pass	9.07 ms
0M9!	00026<CR><LF>	pass	9.10 ms
0D0!	0-100.000-0.080+0.000-100.000+0+0.0<CR><LF>	pass	9.58 ms
0C!	000728<CR><LF>	pass	9.60 ms
0D0!	0+76.568-0.186-100.000-100.000-31.600+2.300-100.000+11.6+0-100.000-0.057<CR><LF>	pass	10.28 ms
0D1!	0+0.000-100.000+0+0.0-100.000+5.0+8.7+6.8+29.0+29.6+29.3+0.0+0.0+0.0-100.0<CR><LF>	pass	10.31 ms
0D2!	0-100.0-100.0<CR><LF>	pass	9.15 ms
0C1!	000364<CR><LF>	pass	9.60 ms
0D0!	0-0.279+2.031-0.243-2.497+2.802-2.766+0.659+4.948+2.264+1.896-3.802-5.423<CR><LF>	pass	10.29 ms
0D1!	0-4.180+4.738-5.738-0.305-1.759+3.632+5.673+1.070-0.896+3.671+5.673-4.426<CR><LF>	pass	10.30 ms
0D2!	0-5.344+3.130+4.813+3.911+1.683-0.538+5.033+1.624-1.220-3.045+2.470-5.128<CR><LF>	pass	10.29 ms
0D3!	0+1.368+0.610-2.215+5.791-1.736-1.122+2.484-0.568-2.277+2.657-0.427-6.217<CR><LF>	pass	10.29 ms
0D4!	0-3.819+4.767-3.097-3.720+1.355+3.862-5.994+3.219-2.408-1.191-3.802+2.247<CR><LF>	pass	10.30 ms
0D5!	0+1.043-1.161-2.470+3.566<CR><LF>	pass	9.38 ms
0C2!	000364<CR><LF>	pass	9.60 ms
0D0!	0+3.169+3.786+4.249+0.751-0.663+5.105-5.997+5.489-4.892-3.081-5.745+3.258<CR><LF>	pass	10.29 ms
0D1!	0+4.111+1.706+1.339+3.770+2.260-3.212-4.370+3.163-2.995+3.481-0.804-0.551<CR><LF>	pass	10.29 ms
0D2!	0-4.423+2.434+3.629+1.086+2.854-1.020+1.325+1.890+5.351+4.970+3.734+1.093<CR><LF>	pass	10.29 ms
0D3!	0+3.156-2.208-3.566+3.058-4.442+0.171-3.891+3.524+1.112-0.082-0.541+1.473<CR><LF>	pass	10.28 ms
0D4!	0-0.571-1.496+1.821-2.743-3.051+4.236+1.132-1.788+3.990-0.919-4.150-0.115<CR><LF>	pass	10.30 ms
0D5!	0-1.158-5.568-3.625-4.616<CR><LF>	pass	9.38 ms
0C3!	000364<CR><LF>	pass	9.59 ms
0D0!	0+29.0+28.9+29.1+29.3+29.2+28.8+28.7+28.9+28.8+28.1+28.6+28.9+29.0+28.7+28.8<CR><LF>	pass	10.34 ms
0D1!	0+29.0+28.8+28.5+29.0+29.4+28.9+29.0+28.9+28.9+28.9+28.9+29.3+28.7+29.3+29.0<CR><LF>	pass	10.34 ms
0D2!	0+29.2+28.3+28.7+29.0+28.8+28.7+29.4+29.1+29.0+29.4+28.9+28.8+29.4+29.0+28.8<CR><LF>	pass	10.34 ms
0D3!	0+29.3+29.1+28.6+29.0+29.0+29.2+28.7+29.2+29.0+29.1+28.7+28.5+29.2+28.8+29.1<CR><LF>	pass	10.34 ms
0D4!	0+29.2+28.6+28.7+28.8<CR><LF>	pass	9.30 ms
0C4!	000364<CR><LF>	pass	9.60 ms
0D0!	0+29.5+29.7+29.6+29.4+29.4+29.7+29.6+29.7+29.9+29.8+29.6+29.7+29.6+29.9+29.2<CR><LF>	pass	10.34 ms
0D1!	0+29.3+30.0+29.5+29.8+29.6+29.0+29.4+29.7+29.8+30.0+29.8+29.3+29.9+30.4+29.2<CR><LF>	pass	10.34 ms
0D2!	0+29.5+30.1+29.4+29.4+29.9+30.0+29.9+29.6+30.0+29.6+29.5+30.8+29.3+30.2+29.9<CR><LF>	pass	10.34 ms
0D3!	0+29.6+29.6+29.8+29.8+29.8+29.8+30.3+30.1+29.5+29.7+29.4+30.0+30.4+29.7+30.2<CR><LF>	pass	10.34 ms
0D4!	0+29.4+29.7+30.1+29.5<CR><LF>	pass	9.30 ms
0C5!	000000<CR><LF>	pass	9.21 ms
0C6!	000000<CR><LF>	pass	9.21 ms
0C7!	000000<CR><LF>	pass	9.20 ms
0C8!	000000<CR><LF>	pass	9.21 ms
0C9!	000000<CR><LF>	pass	9.21 ms