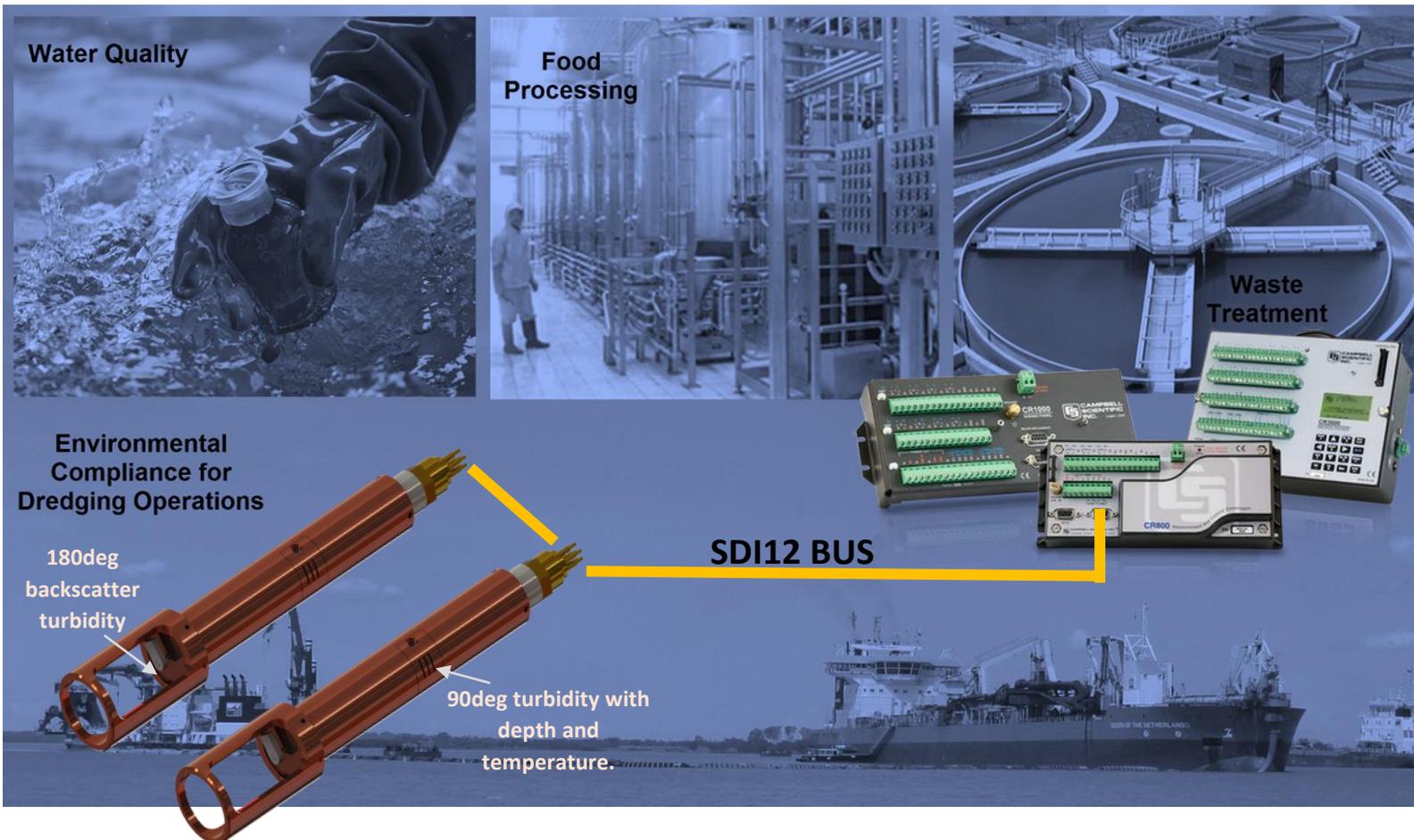


NEP50xx SDI12 turbidity sensors integration with Campbell scientific loggers.

(Application notes)



This document describes integration of NEP50xx family sensors with Campbell scientific loggers.

1.0 NEP50xx family sensors offers comprehensive list of functionalities using SDI12 interface. Configuration of the sensor with PC configuration software and Campbell scripting will be discussed for following scenarios.

Basic operations.

- **1.1** Simple reading of Turbidity (General use).
- **1.2** Reading of turbidity using auto rage after optical wipe (Recommended option).

Advance operations.

- **1.3** Reading statistical view of turbidity in fixed periods of time.
- **1.4** Reading of turbidity using 180deg sensor with 90deg sensor.
- **1.5** Reading turbidity, temperature and pressure (depth) using NEP50xx pressure and depth options.

Impotent notes –

- All the example and its procedures discussed in this document based on version number C2.027 and above.
- User may request NEP50xx settings from the factory according to above scenarios during time of ordering.
- All the sensor configurations below require user to connect the sensor to calibration software. Please refer to the NEP50xx manual (page 10 and onwards).
(<http://download.observator.com/files/?dir=User%20manuals/NEP50XX>).
-

1.1 Simple reading of Turbidity (General use).

Setting up your NEP50xx family turbidity sensor for simple turbidity readings (general use).

This setup required user to have following items.

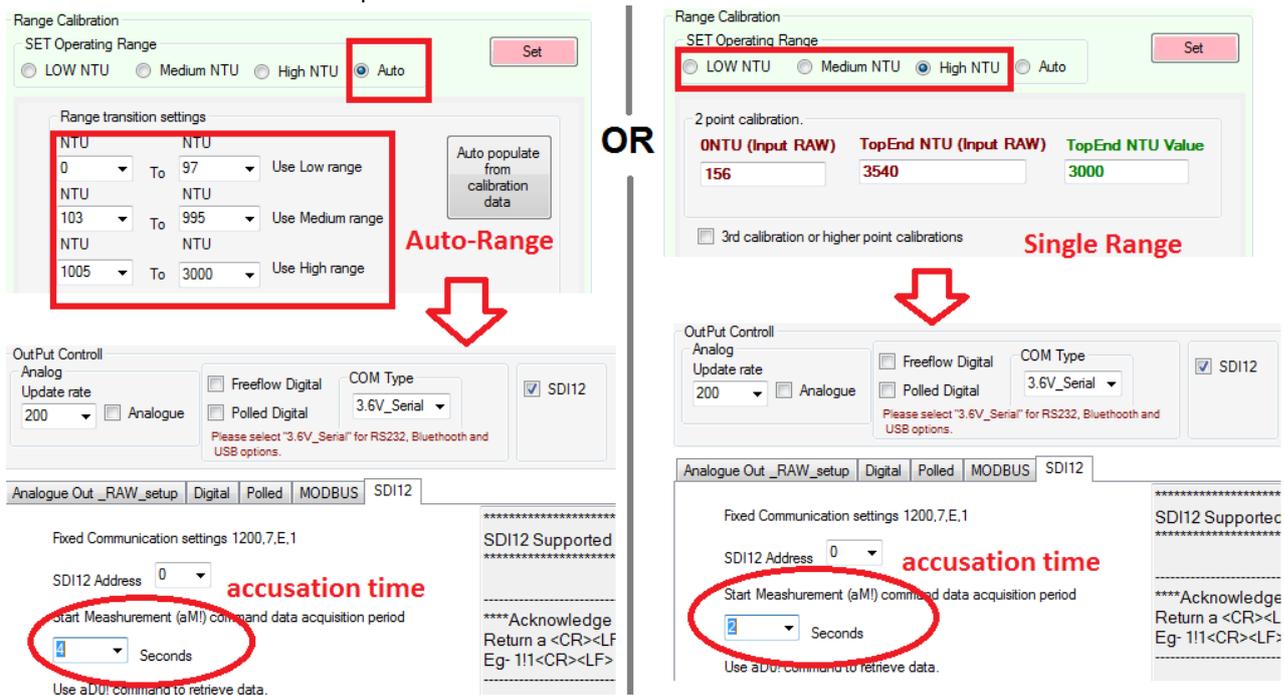
- ✓ NEP50xx family sensor.
- ✓ NEP50xx calibration module (calibration kit) (Or request these settings during time of ordering).
- ✓ 12V DC Power supply.
- ✓ NEP50xx user manual
(<http://download.observator.com/files/?dir=User%20manuals/NEP50XX>).

Mode of operation.

- ✚ Logger powers up the sensor using one of its power control switch and wait for the sensor boot up time of about 20 seconds to accommodate the power on wipe feature. Once the sensor finish booting up the logger will automatically carryout an optical clean (Wipe). Once the 16 seconds of boot up time has elapse the logger issues a measure command(aM!) followed by read command(aD0!) to retrieve the newly measured turbidity value.
- ❖ Using PC configuration software the following settings must be applied.

All the sensor configurations below require user to connect the sensor to calibration software. Please refer to the NEP50xx manual (page 10 and onwards).

- ✓ Turbidity measuring range = Auto or desired single range.
In calibration software under "Sensor Stage" > "Sensor calibration"
- ✓ Data accusation time = 4 seconds or more if Auto range is selected and 2 seconds when single range is selected.
In calibration software under "Output Stage" > "SDI12 tab"
- ✓ SDI12 address = 0(Default) or any desired address.
- ✓ Communication protocol of the sensor = SDI12.



Range Calibration

SET Operating Range: LOW NTU Medium NTU High NTU Auto

Range transition settings:

NTU	To	NTU	Use
0	To	97	Use Low range
103	To	995	Use Medium range
1005	To	3000	Use High range

Auto-Range

OR

Range Calibration

SET Operating Range: LOW NTU Medium NTU High NTU Auto

2 point calibration:

ONTU (Input RAW)	TopEnd NTU (Input RAW)	TopEnd NTU Value
156	3540	3000

Single Range

OutPut Control

Update rate: 200

COM Type: 3.6V_Serial

SDI12

Fixed Communication settings 1200,7,E,1

SDI12 Address: 0

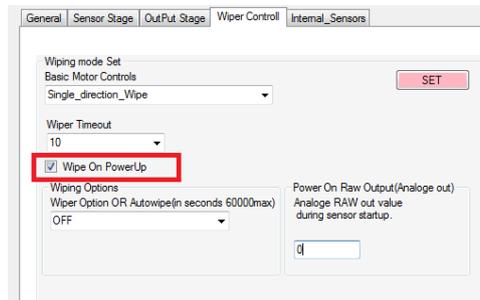
Start Measurment (aM!) command data acquisition period: 2 Seconds

accusation time

SDI12 Supported

****Acknowledge Return a <CR><LF> Eg- 1!1<CR><LF>

- ✓ Wiper operation set to power on wipe.
In calibration software under "Wiper Control" .



Campbell scientific logger script for "1.1 Simple reading of Turbidity (General use).

```
'CR200/CR200X Series
'Declare Variables and Units
Public BattV
Public SDI12(1)
Public SDI12_2(1)

Alias SDI12(1)=Turbidity
Alias SDI12_2(1)=Wipe_stats

Units BattV=Volts
Units Turbidity=NTU
Units Wipe_stats=Units

'Define Data Tables
DataTable(Table1,True,-1)
    DataInterval(0,2,Min)
    Sample(1,Turbidity)
    Sample(1,Wipe_stats)
EndTable

DataTable(Table2,True,-1)
    DataInterval(0,2,Min)
    Minimum(1,BattV,False,False)
EndTable

'Main Program
BeginProg
    'Main Scan set 40 second. User may select appropriate logging time.
    Scan(40,Sec)
        'Default CR200 Series Datalogger Battery Voltage measurement 'BattV'
        Battery(BattV)
        SWBatt(1) ' Power ON. This command is unique to each logger's model number.
        Delay(16,Sec)
        'Generic SDI-12 Sensor measurements 'Turbidity'
        SDI12Recorder(SDI12(),"0M!",1,0)
        'Call Data Tables and Store Data
        CallTable Table1
        CallTable Table2
        SWBatt(0) ' Power OFF. This command is unique to each logger's model number.
    NextScan
EndProg
```

1.2 Reading of turbidity using auto range after optical wipe (Recommended option).

Setting up your NEP50xx family turbidity sensor for stable turbidity readings and allowing wiper to control via SDI12.

This setup required user to have following items.

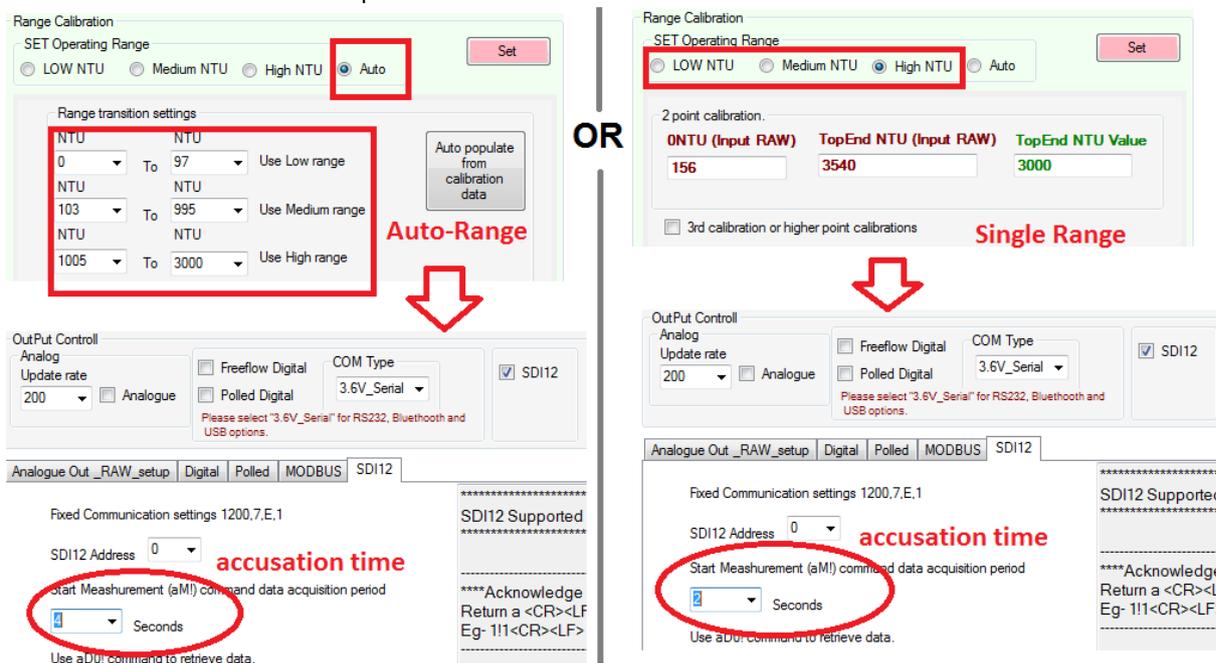
- ✓ NEP50xx family sensor.
- ✓ NEP50xx calibration module (calibration kit) (Or request these settings during time of ordering).
- ✓ 12V DC Power supply.
- ✓ NEP50xx user manual
(<http://download.observator.com/files/?dir=User%20manuals/NEP50XX>).

Mode of operation.

- ✚ Logger powers up the sensor using one of its power control switch and wait for the sensor boot up time of 4 seconds. Once the sensor finish booting up the logger will send SDI12 wipe command (0M1!). Then the 16 seconds of wipe completion time has elapse the logger issues a measure command(aM!) followed by read command(aD0!) to retrieve the newly measured turbidity value.
- ❖ Using PC configuration software the following settings must be applied.

All the sensor configurations below require user to connect the sensor to calibration software. Please refer to the NEP50xx manual (page 10 and onwards).

- ✓ Turbidity measuring range = Auto or desired single range.
In calibration software under "Sensor Stage" > "Sensor calibration"
- ✓ Data accusation time = 4 seconds or more if Auto range is selected and 2 seconds when single range is selected.
In calibration software under "Output Stage" > "SDI12 tab"
- ✓ SDI12 address = 0(Default) or any desired address.
- ✓ Communication protocol of the sensor = SDI12.

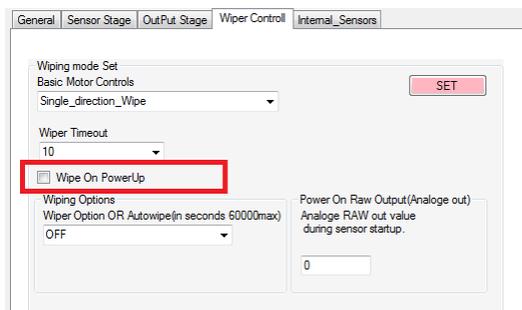


The image displays two alternative configurations for the Range Calibration software. The left configuration is for 'Auto-Range', where the 'SET Operating Range' is set to 'Auto'. Below this, a table defines the range transition settings:

NTU	To	NTU	Use
0	97		Use Low range
103	995		Use Medium range
1005	3000		Use High range

The right configuration is for 'Single Range', where the 'SET Operating Range' is set to 'High NTU'. It shows 2-point calibration values: ONTU (Input RAW) = 156, TopEnd NTU (Input RAW) = 3540, and TopEnd NTU Value = 3000. Both configurations show the 'OutPut Control' section with 'SDI12' selected and the 'accusation time' set to 4 seconds.

- ✓ Wiper operation set NOT (untick) to power on wipe.
In calibration software under "Wiper Control".



Campbell scientific logger script for 1.2 Reading of turbidity using auto rage after optical wipe (Recommended option).

```
'CR200/CR200X Series
'Declare Variables and Units
Public BattV
Public SDI12(1)
Public SDI12_2(1)

Alias SDI12(1)=Turbidity
Alias SDI12_2(1)=Wipe_stats

Units BattV=Volts
Units Turbidity=NTU
Units Wipe_stats=Units

'Define Data Tables
DataTable(Table1,True,-1)
    DataInterval(0,2,Min)
    Sample(1,Turbidity)
    Sample(1,Wipe_stats)
EndTable

DataTable(Table2,True,-1)
    DataInterval(0,2,Min)
    Minimum(1,BattV,False,False)
EndTable

'Main Program
BeginProg
    'Main Scan set 40 second. User may select appropriate logging time.
    Scan(40,Sec)
        'Default CR200 Series Datalogger Battery Voltage measurement 'BattV'
        Battery(BattV)
        SWBatt(1) ' Power ON. This command is unique to each logger's model number.
        Delay(4,Sec)
        'Generic SDI-12 Sensor measurements 'Wipe_stats'
        SDI12Recorder(SDI12_2(),"0M1!",1,0)
        Delay(1,Sec)
        'Generic SDI-12 Sensor measurements 'Turbidity'
        SDI12Recorder(SDI12(),"0M!",1,0)

        'Call Data Tables and Store Data
        CallTable Table1
        CallTable Table2
        SWBatt(0) ' Power OFF. This command is unique to each logger's model number.

    NextScan
EndProg
```

Setting up your NEP50xx family turbidity sensor for long exposure turbidity readings (Advance use).

This setup required user to have following items.

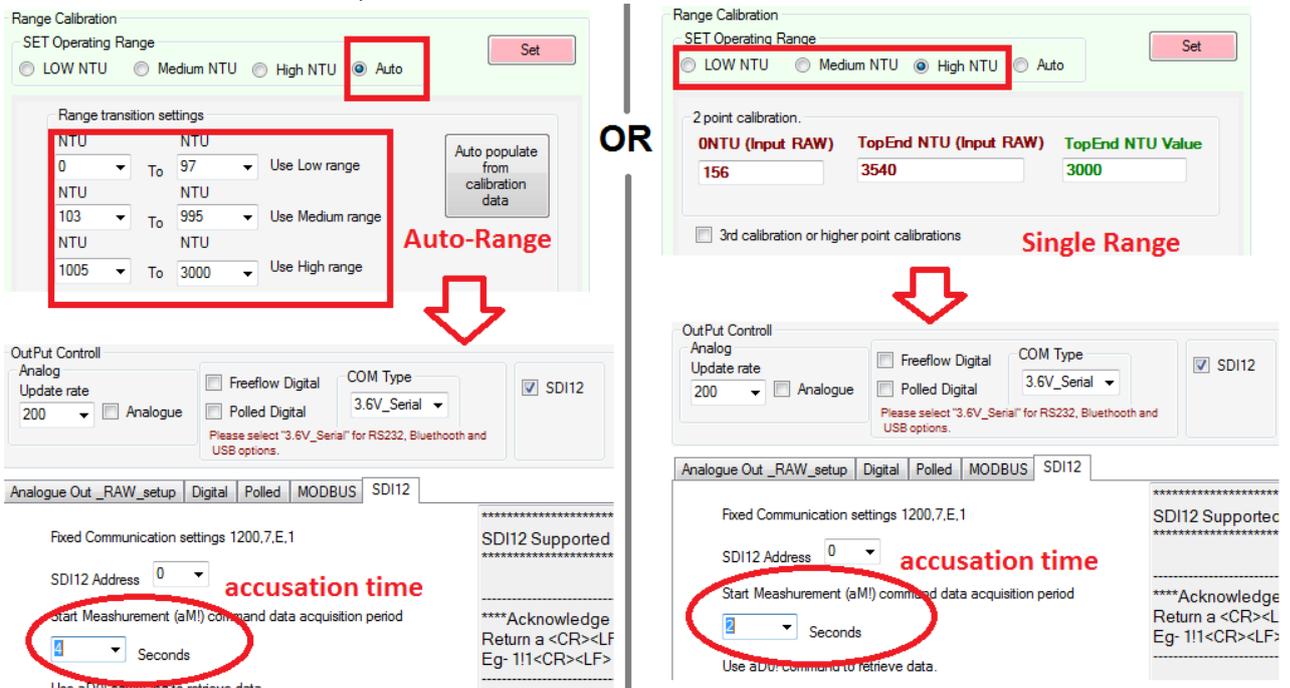
- ✓ NEP50xx family sensor.
- ✓ NEP50xx calibration module (calibration kit) (Or request these settings during time of ordering).
- ✓ 12V DC Power supply.
- ✓ NEP50xx user manual
(<http://download.observator.com/files/?dir=User%20manuals/NEP50XX>).

Mode of operation.

- ✚ Logger powers up the sensor using one of its power control switch and wait for the sensor boot up time of About 4 seconds. Ones the sensor finish booting up the logger will send SDI12 wipe command (0M1!). Ones the 16 seconds of wipe completion time has elapse the logger issues a statistical data measure command (aM6!) followed by read command (aD0! And aD1!). To retrieve the newly measured statistical turbidity measurements.
- ❖ Using PC configuration software the following settings must be applied.

All the sensor configurations below require user to connect the sensor to calibration software. Please refer to the NEP50xx manual (page 10 and onwards).

- ✓ Turbidity measuring range = Auto or desired single range.
In calibration software under "Sensor Stage" > "Sensor calibration"
- ✓ Data accusation time = 4 seconds or more if Auto range is selected and 2 seconds when single range is selected.
In calibration software under "Output Stage" > "SDI12 tab"
- ✓ SDI12 address = 0(Default) or any desired address.
- ✓ Communication protocol of the sensor = SDI12.



Range Calibration

SET Operating Range: LOW NTU Medium NTU High NTU Auto

Range transition settings:

NTU	To	NTU	Use Low range
0	To	97	
NTU	To	NTU	Use Medium range
103	To	995	
NTU	To	NTU	Use High range
1005	To	3000	

Auto populate from calibration data

Auto-Range

OR

Range Calibration

SET Operating Range: LOW NTU Medium NTU High NTU Auto

2 point calibration:

ONTU (Input RAW)	TopEnd NTU (Input RAW)	TopEnd NTU Value
156	3540	3000

3rd calibration or higher point calibrations

Single Range

OutPut Control

Analog Update rate: 200 Analogue Polled Digital

COM Type: 3.6V_Serial

SDI12

Analogue Out _RAW_setup | Digital | Polled | MODBUS | SDI12

Fixed Communication settings 1200,7.E,1

SDI12 Address: 0

Start Measurement (aM!) command data acquisition period: 4 Seconds

accusation time

*****SDI12 Supported*****

****Acknowledge Return a <CR><LF> Eg- 1!1<CR><LF>

Fixed Communication settings 1200,7.E,1

SDI12 Address: 0

Start Measurement (aM!) command data acquisition period: 2 Seconds

accusation time

*****SDI12 Supportec*****

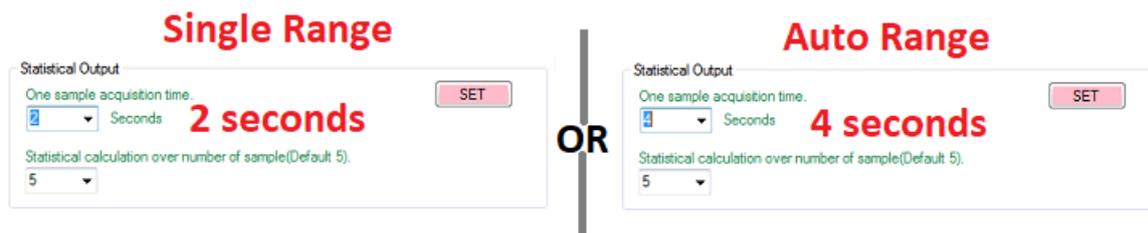
****Acknowledge Return a <CR><LF> Eg- 1!1<CR><LF>

- ✓ Setup statistical settings that suits your needs.

There are mainly two parts to consider when selecting the appropriate statistical settings for your requirements. There are two values (Settings) displays in PC configuration software (Sensor stage > Sensor operating parameters).

The first setting "Sample acquisition time" describes data accusation time of each measurement when populating statistical data set before calculating its final results.

The second setting "Number of sample" describes number of samples that user required before making final statistical calculation.



- ✓ Selecting optimal "Sample acquisition time"

When selecting a data acquisition time one of the main consideration is whether you wish to have ranging options are in auto-range or single range.

When selecting **auto range** user must allow enough time sensor to select ranges. The default and recommended value for **Auto range** is **4seconds**.

When selecting **single range** user must may use 1 seconds and up to 4 seconds. Recommended value for **single range** is **2seconds**.

- ✓ Selecting optimal "Number of samples"

When selecting this setting the user must consider how longer turbidity observation is required.

Final statistical sample time is calculated by "**Sample acquisition time**" multiplied by "**Number of samples**". Hence above example takes about $2 \times 5 = 10s$ and $4 \times 5 = 20$ seconds respectively to complete the full statistical estimate by the sensor to execute aM6! Command.

Campbell scientific logger script for 1.3 Reading statistical view of turbidity in fixed periods of time.

'CR200/CR200X Series

'CR200/CR200X Series

'Declare Variables and Units

Dim N_2

Public BattV

Public SDI12(1)

Public SDI12_2(6)

Alias SDI12(1)=Wiper_stat

Alias SDI12_2(1)=Turbidity

Alias SDI12_2(2)=Temperatur

Alias SDI12_2(3)=Median

Alias SDI12_2(4)=Average

Alias SDI12_2(5)=Minimum

Alias SDI12_2(6)=Maximum

Units BattV=Volts

Units Wiper_stat=stats

Units Turbidity=NTU

Units Temperatur=C

Units Median=NTU

Units Average=NTU

Units Minimum=NTU

Units Maximum=NTU

'Define Data Tables

DataTable(Table1,True,-1)

 DataInterval(0,2,Min)

 Sample(1,Wiper_stat)

 Sample(1,Turbidity)

EndTable

DataTable(Table2,True,-1)

 DataInterval(0,1440,Min)

 Minimum(1,BattV,False,False)

EndTable

'Main Program

BeginProg

 'Main Scan set 60 seconds. **User may select appropriate logging time.**

 Scan(60,Sec)

 'Default CR200 Series Datalogger Battery Voltage measurement 'BattV'

 Battery(BattV)

 SWBatt(1) '**Power ON. This command is unique to each logger's model number.**

 Delay(4,Sec)

 'Generic SDI-12 Sensor measurements 'Wiper_stat'

 SDI12Recorder(SDI12(),"0M1!",1,0)

 Delay(1,Sec)

 'Generic SDI-12 Sensor measurements 'Turbidity', 'Temperatur', 'Median',

 'Average', 'Minimum', and 'Maximum'

 SDI12Recorder(SDI12_2(),"0M6!",1,0)

 'Call Data Tables and Store Data

 CallTable Table1

 CallTable Table2

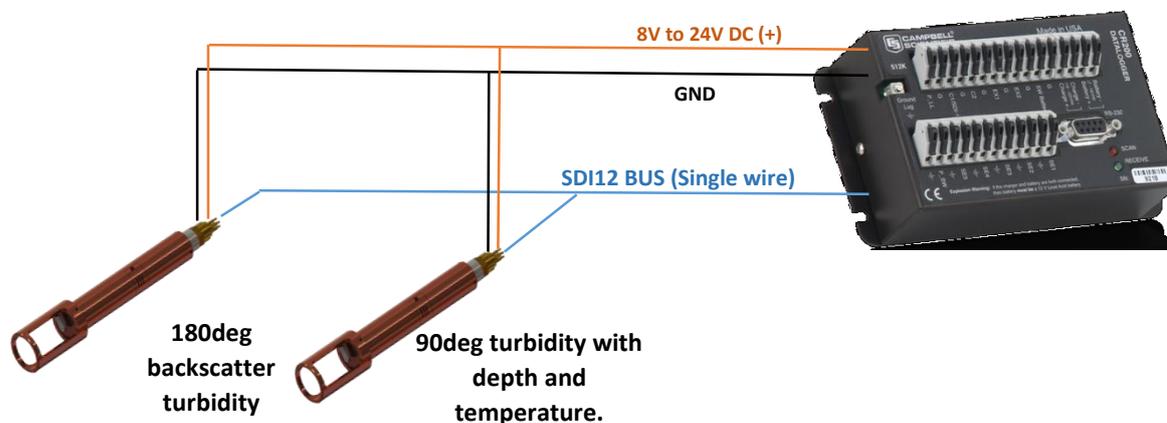
 SWBatt(0) '**Power OFF. This command is unique to each logger's model number.**

 NextScan

EndProg

1.4 Reading of turbidity using 180deg sensor with 90deg sensor.

Setting up two NEP50xx family turbidity sensors (180deg and 90deg) to automatically measures total 6 range turbidity proving seamless, high accuracy and stable measurements between ONTU to 30,000NTU. The logger script will manage the transition between 90deg and 180deg sensors. Note that both sensors are configured to operate in auto-range.



This setup required user to have following items.

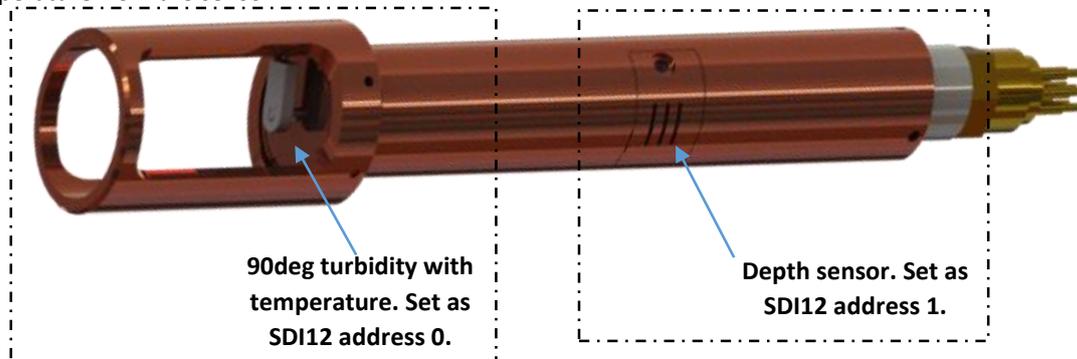
- ✓ NEP50xx family sensor.
- ✓ NEP50xx calibration module (calibration kit) (Or request these settings during time of ordering).
- ✓ 12V DC Power supply.
- ✓ NEP50xx user manual (<http://download.observator.com/files/?dir=User%20manuals/NEP50XX>).

Mode of operation.

- ✚ Logger powers up the sensor using one of its power control switch and wait for both sensors boot up time of 4-6 seconds. Once both sensor finish booting up then the logger will send SDI12 wipe command to both sensors using two address (0M1! and 1M1!). Once the 16 seconds of wipe completion time has elapse the logger issues a measures commands (0M! and 1M!) to both sensors and then retrieve the data using (0D1! And 1D1!). The both results then logically compared and if 90deg sensor result is larger than sensors top range maximum then assumed that 90deg sensor has clipped and 180deg result may put forward as the final result. Otherwise 90deg sensor result put forward as the final liquid's turbidity value. Note that both sensors are configured to operate in auto-range.

1.5 Reading turbidity, temperature and pressure (depth) using NEP50xx pressure and depth options.

Setting up your NEP50xx family turbidity sensor with pressure option to acquire Turbidity, Depth and temperature from the sensor.



This setup required user to have following items.

- ✓ NEP50xx family sensor.
- ✓ NEP50xx calibration module (calibration kit) (Or request these settings during time of ordering).
- ✓ 12V DC Power supply.
- ✓ NEP50xx user manual
(<http://download.observator.com/files/?dir=User%20manuals/NEP50XX>).

Mode of operation.

- ✚ Logger powers up the sensor using one of its power control switch and wait for the sensor boot up time of about 4 seconds. Once the sensor has finish booting up the logger will send SDI12 wipe command (0M1!). Once the 16 seconds of wipe completion time has elapse the logger issues a statistical data measure command (aM6!) followed by read command (aD0! And aD1!) To retrieve the newly measured statistical turbidity measurements including temperature. To access the depth measurements the logger may issue single measure command to the second address of the sensor.