

MOOS Mooring Power System Telemetry Software Guide

Description

Scheduler Description

The MOOS mooring power system has data acquisition capabilities to sample sensors at various rates. A sampling scheduler driven by a timer interrupt is used to sample all of the power system sensors. The interrupt produces a scheduler tick that causes the scheduler to sample any of the sensor channels that are ready. The scheduler can also assert digital outputs as necessary for certain sensor channels.

ADC Channel Description

The MOOS mooring power system can have up to 50 ADC channels configured to sample analog sensors at different rates. The scheduler checks every channel at regular intervals to see if it is time to sample that channel. The rate at which the scheduler checks on the channels is referred to as the scheduler tick rate. Each channel must be configured with the following information in order to be sampled.

Slot – The backplane slot where the ADC is located.

Channel – The specific ADC channel on the backplane slot.

Period – The period in milliseconds to sample the ADC channel at.

Start Time – When to start sampling an ADC channel after a scheduler reset. This can be used to stagger or group ADC samples in time.

DO channel - A digital output to assert or de-assert while the ADC channel is being sampled.

Log channel - A logging channel that is used to log all sampled data of that sensor to compact flash.

The ADC channel can use the digital out channel zero if no digital output is required for that channel. Digital output channels need to be configured with the following information.

Slot – The data acquisition system backplane slot where the digital output is located.

Channel – The specific digital output to use.

Output state – The state the output should be in when the ADC channel that uses it is being sampled (i.e. 1 for asserted, 0 for de-asserted).

The ADC channel can be configured to use logging channel zero if logging is not desired, otherwise channels one through four can be used for data logging all samples.

Serial Interface

The serial interface uses a simple command response protocol. When a command is issued the acquisition system will attempt to execute that command. Upon successful execution the acquisition system will return the characters

RDY<CR><LF>

Where <CR> is a carriage return character and <LF> is a linefeed character. This indicates that the acquisition system is ready for the next command. If the acquisition system is unable to execute the command successfully it will issue the characters

ERR ####<CR><LF>
RDY<CR><LF>

Where the '####' is a four digit error code. If the command is a request for information then the command will return the information requested followed by the characters

RDY<CR><LF>

In all cases the acquisition system will terminate a transaction with the characters

RDY<CR><LF>

at which point it is ready for another command to be issued.

Serial ADC Commands

DATA CAPTURE - Capture averaged data to memory and reset the scheduler.

DATA FETCH - Return the last set of averaged data that was captured.

GET SAMPLE - Get an ADC sample from a configured channel.

GET ADC - Get the configuration for an ADC channel.

GET DO - Get the configuration for a digital out channel.

GET WS - Get the configuration for a water sampler channel.

GET BP - Get the configuration for a benthic power status channel.

GET CONFIG - Get the current configuration for the data acquisition system.

GET CALIBRATION - Get the stored calibration data for a particular ADC card.

GET GF - Get the sampling parameters for all GF channels.

SET ADC - Set configuration parameters for an ADC channel.

SET DO - Set configuration parameters for a digital out channel.

SET WS - Set configuration parameters for a water sampler channel.

SET BP - Set configuration parameters for a benthic power status channel.

SET GF - Set the sampling parameters for GF channels.

SET ENV - Set the sampling parameters for environmental sensors.

CLEAR ADC - Clear the configuration of an ADC channel.

CLEAR DO - Clear the configuration of a digital out channel.

CLEAR WS - Clear the configuration of a water sampler channel.

CLEAR BP - Clear the configuration of a benthic power status channel.

BIN 400VSW - Enable high voltage benthic switch.

BIN BACKUP - Benthic battery/capacitor backup enable/disable.

HIGH VOLTAGE - Enable high voltage surface switch.

SCHED START - Start the data acquisition system sampling.

SCHED STOP - Stop the data acquisition system from sampling.

SCHED RESET - Reset the sampling schedule to its initial conditions.

STORE - Store the configuration to nonvolatile memory.

RESTORE - Set the configuration stored in nonvolatile memory to the current configuration.

ECHO - Put the data acquisition system's serial port into an echo mode.

STDEV - Enable or disable standard deviation mode

COUNTS MODE - Enable or disable counts mode

EXIT - Exit the data acquisition application

VERS - Return the current version of the data acquisition firmware.

Command Descriptions

DATA CAPTURE [ADC | GF | WS | BP | ENV | ALL]

Description

This command captures the data average for the active channels of the specified sensors. The command stores the captured data in RAM. All channels that are captured are set back to their initial conditions (i.e. the average is cleared, the number of samples is cleared, etc.). While the data is being captured the sample scheduler will temporarily be suspended. The DATA CAPTURE command requires at least one of the following parameters but may have more specified in any order.

ADC – capture data for ADC sensors
GF – capture data for ground fault sensors
WS – capture data for water sensors
BP – capture data for BIN power status
ENV – capture data for environmental sensors
ALL – capture data for all of the above

DATA FETCH [ADC | GF | WS | BP | ENV | ALL]

Description

This command returns the data that was captured by the last call to DATA CAPTURE. This command may be repeated multiple times between calls to DATA CAPTURE and will return the same data until a new call to DATA CAPTURE is made. The DATA FETCH command requires at least one of the following parameters but may have more specified in any order.

ADC – fetch data for ADC sensors
GF – fetch data for ground fault sensors
WS – fetch data for water sensors
BP – capture data for BIN power status
ENV – fetch data for environmental sensors
ALL – fetch data for all of the above

Returns

ADC sensor format

```
ADC## A+#.####e+## N##### L+#.####e+## H+#.####e+## E#<CR><LF>
```

with special processing enabled

```
ADC## A+#.####e+## N##### L+#.####e+## H+#.####e+## D+#.####e+## E#<CR><LF>
```

where,

ADC – is followed by the channel number

A – is the average sample value since the last time the data was retrieved

N – is the total samples taken since the last time the data was retrieved
 L – the lowest sample taken since the last time the data was retrieved
 H – the highest sample taken since the last time the data was retrieved
 D – the standard deviation of all of the samples since the last time the data was retrieved
 E – a flag indicating an error occurred during sampling

Ground fault sensor format

```
GFZ## A+#.#####e+## N##### L+#.#####e+## H+#.#####e+## E#<CR><LF>
GFT## A+#.#####e+## N##### L+#.#####e+## H+#.#####e+## E#<CR><LF>
GFL## A+#.#####e+## N##### L+#.#####e+## H+#.#####e+## E#<CR><LF>
GFH## A+#.#####e+## N##### L+#.#####e+## H+#.#####e+## E#<CR><LF>
```

where,

GFZ – is the zero ground fault reading followed by the ground fault channel
 GFT – is the test ground fault reading followed by the ground fault channel
 GFL – is the low ground fault reading followed by the ground fault channel
 GFH – is the high ground fault reading followed by the ground fault channel
 A – is the average sample value since the last time the data was retrieved
 N – is the total samples taken since the last time the data was retrieved
 L – the lowest sample taken since the last time the data was retrieved
 H – the highest sample taken since the last time the data was retrieved
 E – a flag indicating an error occurred during sampling

Environmental sensor format

```
PRES A+#.#####e+## N##### L+#.#####e+## H+#.#####e+## E#<CR><LF>
TMP1 A+#.#####e+## N##### L+#.#####e+## H+#.#####e+## E#<CR><LF>
HUMI A+#.#####e+## N##### L+#.#####e+## H+#.#####e+## E#<CR><LF>
TMP2 A+#.#####e+## N##### L+#.#####e+## H+#.#####e+## E#<CR><LF>
```

where,

PRES – is the power can pressure
 TMP1 – is the temperature of the power can from the pressure/temperature sensor
 HUMI – is the power can humidity
 TMP2 – is the temperature of the power can from the humidity/temperature sensor
 A – is the average sample value since the last time the data was retrieved
 N – is the total samples taken since the last time the data was retrieved
 L – the lowest sample taken since the last time the data was retrieved
 H – the highest sample taken since the last time the data was retrieved
 E – a flag indicating an error occurred during sampling

Water sensor format

```
WS## N##### A## B## C## D##<CR><LF>
```

where,

WS – is followed by the water sensor channel
 N – is the total samples taken since the last time the data was retrieved
 A – is followed by the number of water alarms for sensor A since the last capture
 B – is followed by the number of water alarms for sensor B since the last capture
 C – is followed by the number of water alarms for sensor C since the last capture
 D – is followed by the number of water alarms for sensor D since the last capture

BIN power status format

BP## N##### A## B## C## D## E## F## G## H##<CR><LF>

where,

BP – is followed by the BIN power status channel

N – is the total samples taken since the last time the data was retrieved

A through H – are followed by the number of HI samples since the last capture

GET SAMPLE [channel | ALL]

Description

This command returns a sample from a configured ADC channel or samples all of the configured ADC channels if the ALL parameter is used. The samples taken are not part of the averaged data nor is the sampled data logged. While a channel is being sampled the scheduler will be temporarily suspended.

Returns

ADC sensor format

ADC## A+#.####e+## E#<CR><LF>

where,

ADC – is followed by the channel number

A – is the average sample value since the last time the data was retrieved

E – a flag indicating an error occurred during sampling

GET ADC [channel]

Description

This command returns the current configuration of an ADC channel. While the channel configuration is being determined the sample scheduler will be temporarily suspended.

Returns

ADC## S## C## P##### T##### D# L# A#<CR><LF>

where,

ADC – is followed by the channel number

S – the slot in the data acquisition system backplane where the ADC is located

C – the channel of the ADC with in a specific slot

P – the period in milliseconds that the scheduler will sample the channel

T – the initial sample time in milliseconds that the scheduler will use upon reset

D – the digital out channel associated with this ADC channel

L – the logging channel associated with this ADC channel

A – a flag indicating whether this channel is configured (0 not configured, 1 configured)

GET DO [channel]

Description

This command returns the current configuration of a digital out channel. While the channel configuration is being determined the sample scheduler will be temporarily suspended.

Returns

DO## S## C## E##### D##### O# A#<CR><LF>

where,

DO – is the channel number

S – the slot in the data acquisition system backplane where the digital output is located

C – the digital output with in the specific slot

E – time in milliseconds to assert the digital output before the ADC event

D – time in milliseconds to de-assert the digital output after the ADC event

O – output state during sample time (i.e. 1 for asserted, 0 for de-asserted)

A – a flag indicating whether this channel is configured (0 not configured, 1 configured)

GET WS [channel]

Description

This command returns the current configuration of a water sampler. While the channel configuration is being determined the sample scheduler will be temporarily suspended.

Returns

WS## S## C## P##### A#<CR><LF>

where,

WS – is the channel number

S – the slot in the data acquisition system backplane where the water sampler is located

C – the water sampler channel with in the specific slot

P – the period in milliseconds that the scheduler will sample the channel

A – a flag indicating whether this channel is configured (0 not configured, 1 configured)

GET BP [channel]

Description

This command returns the current configuration of a BIN power status channel. While the channel configuration is being determined the sample scheduler will be temporarily suspended.

Returns

BP## S## C## P##### A#<CR><LF>

where,

BP – is the channel number

S – the slot in the data acquisition system backplane where the status register is located

C – the status register channel with in the specific slot

P – the period in milliseconds that the scheduler will sample the channel

A – a flag indicating whether this channel is configured (0 not configured, 1 configured)

GET CONFIG

Description

The GET CONFIG command returns the current configuration of all active ADC and DO channels. If the optional ALL parameter is used the command will return the state of all ADC and DO channels whether active or not. While the channel configuration is being determined the sample scheduler will be temporarily suspended.

Returns

ADC## S## C## P##### T##### D# L# A#<CR><LF>

...

DO## S## C## E##### D##### O# A#<CR><LF>

where,

ADC – is the ADC channel number

DO – is the digital output channel number

S – the slot in the data acquisition system backplane where the ADC is located

S – the slot in the data acquisition system backplane where the ADC is located

C – the channel of the ADC with in a specific slot

P – the period in milliseconds that the scheduler will sample the channel

T – the initial sample time in milliseconds that the scheduler will use upon reset

D – the digital out channel associated with the ADC channel, or

D – time in milliseconds to de-assert the digital output after the ADC event

E – time in milliseconds to assert the digital output before the ADC event

L – the logging channel associated with the ADC channel

O – output state during sample time (i.e. 1 for asserted, 0 for de-asserted)

A – a flag indicating whether this channel is configured (0 not configured, 1 configured)

GET CALIBRATION

Description

This command returns the stored calibration values for the ADC channels. These are the calibration values used to convert the counts returned by an ADC channel to volts, milliamps, etc depending on the type of sensor the ADC is sampling. The GET CALIBRATION command is not currently implemented.

Returns

GET CALIBRATION NOT IMPLEMENTED<CR><LF>

GET GF

Description

This command returns the current sampling parameters for the ground fault channels. These channels are configured as a group so they share a common sampling period, and settling delay time.

Returns

GF P##### S##### A#<CR><LF>

where,

P – the period in milliseconds that the scheduler will sample the ground fault channels

S – the settling delay in milliseconds for all GF channels

A – a flag indicating whether the scheduler is sampling GF channels (0 not sampling, 1 sampling)

```
SET ADC N[adc_channel] S[slot] C[channel] P[period] T[start_time] D[dig_out] L[log channel]
```

Description

This command sets the configuration of an ADC channel. The sample scheduler will be reset to its initial state when an ADC channel is set. The SET ADC command requires the following parameters

N – is the channel number

S – the slot in the data acquisition system backplane where the ADC is located

C – the channel of the ADC with in a specific slot

P – the period in milliseconds that the scheduler will sample the channel

T – the initial sample time in milliseconds that the scheduler will use upon reset

D – the digital out channel associated with this ADC channel (enter 0 for no digital output)

L – the logging channel associated with the ADC channel (enter 0 for no logging)

Returns

none

```
SET DO N[do_channel] S[slot] C[channel] E[enable time] D[disable time] O[output]
```

Description

This command sets the configuration of a DO channel. The sample scheduler will be temporarily suspended while the DO channel is being set. The SET DO command requires the following parameters

N – is the channel number

S – the slot in the data acquisition system backplane where the digital output is located

C – the channel of the digital output with in a specific slot

E – time in milliseconds to assert the digital output before the ADC event

D – time in milliseconds to de-assert the digital output after the ADC event

O – output state during sample time (i.e. 1 for asserted, 0 for de-asserted)

Returns

none

```
SET WS N[ws_channel] S[slot] C[channel] P[period]
```

Description

This command sets the configuration of a WS channel. The sample scheduler will be temporarily suspended while the WS channel is being set. The SET WS command requires the following parameters

N – is the channel number

S – the slot in the data acquisition system backplane where the water sampler is located

C – the channel of the water sampler with in a specific slot

P – the period in milliseconds that the scheduler will sample the channel

Returns

none

```
SET BP N[bp_channel] S[slot] C[channel] P[period]
```

Description

This command sets the configuration of a BIN power status channel. The sample scheduler will be temporarily suspended while the BIN power status channel is being set. The SET BP command requires the following parameters

N – is the channel number

S – the slot in the data acquisition system backplane where the status register is located

C – the channel of the status register with in a specific slot

P – the period in milliseconds that the scheduler will sample the status register

Returns

none

```
SET GF P[period] S[settle time] A[active]
```

Description

This command sets the parameters for ground fault sampling. All ground fault channels are sampled on the same interval, and with the same settling time. The SET GF command requires the following parameters

P – the period in milliseconds that the scheduler will sample the ground fault channels

S – the settling delay in milliseconds for all GF channels

A – a flag indicating whether the scheduler is sampling GF channels (0 not sampling, 1 sampling)

Returns

None

SET ENV P[period] A[active]

Description

This command sets the parameters for environmental sensor sampling. Both environmental sensors (humidity and pressure) are sampled at the same interval. The SET ENV command requires the following parameters

P – the period in milliseconds that the scheduler will sample the environmental sensors
A – a flag indicating whether the scheduler is sampling the environmental sensors (0 not sampling, 1 sampling)

Returns

none

CLEAR ADC [channel | ALL]

Description

This command clears the configuration of an ADC channel and puts that channel in an in-active state. If the ALL parameter is used all of the configured ADC channels will be cleared. While the channel configuration is being cleared the sample scheduler will be temporarily suspended.

Returns

none

CLEAR DO [channel | ALL]

Description

This command clears the configuration of a DO channel and puts that channel in an in-active state. If the ALL parameter is used all of the configured DO channels will be cleared. While the channel configuration is being cleared the sample scheduler will be temporarily suspended.

Returns

None

CLEAR WS [channel | ALL]

Description

This command clears the configuration of a WS channel and puts that channel in an in-active state. If the ALL parameter is used all of the configured WS channels will be cleared. While the channel configuration is being cleared the sample scheduler will be temporarily suspended.

Returns

None

CLEAR BP [channel | ALL]

Description

This command clears the configuration of a BIN power status channel and puts that channel in an in-active state. If the ALL parameter is used all of the configured BIN power status channels will be cleared. While the channel configuration is being cleared the sample scheduler will be temporarily suspended.

Returns

None

BIN 400VSW [?ON | ?OFF | ALLON | ALLOFF]

Description

This command enables or disables the BIN power switches. The BIN 400VSW command can accept a variable number of arguments to enable or disable the BIN power switches. If conflicting arguments are used the BIN 400VSW command will use the last argument in the list. If no arguments are given the current state of the BIN power switches will be returned.

?ON – turn on a BIN power switch where '?' is 0, 1, 2, or 3
?OFF – turn on a BIN power switch where '?' is 0, 1, 2, or 3
ALLON – turn on all BIN power switches
ALLOFF – turn off all BIN power switches

Returns

BPS 0### 1### 2### 3###<CR><LF>

where,

0 – is the state of power switch '0' and will be followed by 'ON' or 'OFF'
1 – is the state of power switch '1' and will be followed by 'ON' or 'OFF'
2 – is the state of power switch '2' and will be followed by 'ON' or 'OFF'
3 – is the state of power switch '3' and will be followed by 'ON' or 'OFF'

BIN BACKUP [?EN | ?DI | ALLEN | ALLDI]

Description

This command enables or disables the BIN battery/capacitor backup. The BIN BACKUP command can accept a variable number of arguments to enable or disable the BIN battery/capacitor backup. If conflicting arguments are used the BIN BACKUP command will use the last argument in the list. If no arguments are given the current state of the BIN battery/capacitor backup will be returned.

?EN – enable the backup where '?' is 'B' for battery or 'C' for capacitor
?DI – disable the backup where '?' is 'B' for battery or 'C' for capacitor
ALLEN – enable battery and capacitor backup
ALLDI – disable battery and capacitor backup

Returns

BBS B## C##<CR><LF>

where,

B – is the state of battery backup and will be followed by 'EN' or 'DI'
C – is the state of capacitor backup and will be followed by 'EN' or 'DI'

HIGH VOLTAGE [ON | OFF]

Description

This command enables the high voltage output from the power can.

Returns

None

SCHED START

Description

The SCHED START command starts the data acquisition system sample scheduler sampling.

Returns

none

SCHED STOP

Description

The SCHED STOP command stops the data acquisition system sample scheduler from sampling.

Returns

none

SCHED RESET

Description

The SCHED RESET command resets the data acquisition system sample scheduler to its initial conditions.

Returns

none

STORE

Description

This command stores the current configuration of ADC and DO channels to non-volatile memory.

Returns

none

RESTORE

Description

This command sets the ADC and DO channels to the configuration stored in non-volatile memory.

Returns

none

ECHO [ON | OFF]

Description

This command sets the state of echo mode. When echo mode is set all characters sent to the data acquisition system serial port will be echoed back. This command is for the convenience of humans when accessing the data acquisition system via a terminal program. The data acquisition will always start from reset with the echo mode set to OFF.

Returns

none

STDEV [ON | OFF]

Description

This command sets the state of the standard deviation processing mode. When stdev mode is ON all ADC channels will include the standard deviation of the last set of samples as well as the minimum and maximum value.

Returns

none

COUNTS MODE [ON | OFF]

Description

This command puts calibration into counts mode. When calibration is in counts mode all ADC derived data will be returned as ADC counts as opposed to having the calibration factors applied. This command is for debugging purposes and is therefore not saved in the configuration. When the controller starts COUNTS MODE is OFF.

Returns

none

EXIT

Description

This command exits the data acquisition systems application and gives control to the underlying OS.

Returns

none

VERS [ALL]

Description

This command returns the current version of the data acquisition firmware. If the optional ALL parameter is used the build data and time of the firmware will also be displayed.

Returns

MOOS POWER SYSTEM DAQ #.#<CR><LF>

with the ALL parameter,

MOOS POWER SYSTEM DAQ #.#<CR><LF>
built on *month day year* at HH:MM:SS<CR><LF>

Error Code Description

ERR 0001 – General failure.

ERR 0004 – No command match.

ERR 0005 – No sub-command match.

ERR 0100 – ADC index parameter required.

ERR 0101 – DO index parameter required.

ERR 0102 – Slot parameter required.

ERR 0103 – Channel parameter required.

ERR 0104 – Sample period parameter required.

ERR 0105 – Start time parameter required.

ERR 0106 – Digital out channel parameter required.

ERR 0107 – Digital out sample state parameter required.

ERR 0200 – Slot channel combination already in use.

ERR 0201 – Slot requested out of range.

ERR 0202 – Channel requested out of range.

ERR 0203 – Sample period requested out of range.

ERR 0204 – Sample start time requested out of range.

ERR 0205 – ADC channel index requested out of range.

ERR 0206 – Digital out channel index requested out of range.

ERR 0207 – ADC index requested already in use.

ERR 0208 – Digital out channel requested already in use.

ERR 0209 – Digital out sample state requested invalid(i.e. 1 for asserted, 0 for de-asserted)

ERR 0210 – ADC channel requested not active.

ERR 0211 – GF enable bit is out of range.

ERR 0212 – Invalid GF state entered.

ERR 0213 – GF delay value is out of range.

ERR 0214 – GF period requested is out of range.

ERR 0215 – GF active flag is set to an invalid value.

ERR 0216 – GF channel requested is out of range.

ERR 0224 – GF settle time requested is out of range.

ERR 0225 – GF active flag set to invalid value.

ERR 0226 – Environmental sensor set to an invalid range.

ERR 0227 – The water sampler channel requested out of range.

ERR 0228 – The BIN power status channel requested out of range.

ERR 0300 – Bad channel configuration.

ERR 0301 – Failure opening configuration file.

ERR 0302 – Failure reading configuration file.

ERR 0303 – Bad checksum on configuration file.

ERR 0304 – Failure while attempting to write configuration file.

ERR 0305 – Failure while attempting to create configuration file.

ERR 0306 – Failure initializing filesystem.

ERR 0307 – Failure formatting filesystem.