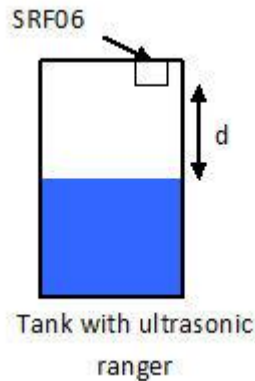


Examples of SpaceLogger A10 Applications

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Recording the level of water in a tank using an ultrasonic ranger

In this example we will use the low cost Devantech SRF06 ultrasonic ranger with 4-20mA output. It has an output current specified as $4\text{mA} + 31.37\mu\text{A}/\text{cm}$



For channel 1 the value output by the logger is given by

$$C1 = (A1 + \text{OFFSET1}) \times \text{SCALE1} \times 10^{\text{POWER1}}$$

Where:

A1 is the measured value in mA x 100

OFFSET1 is the offset in mA x 100

SCALE1 is the scaling factor

POWER1 is the exponent for the power of 10 multiplier

So if we wish to record d the distance from the sensor to the water surface in metres

$$\text{OFFSET1} = -4 \times 100 = -400$$

The scale value we require is the number of meters per 1/100th of a mA

$$\begin{aligned} \text{SCALE1} \times 10^{\text{POWER1}} &= 0.01/3.137 \text{ meters per 1/100th of a mA} \\ &= 0.0031878 \text{ meters per 1/100th of a mA} \end{aligned}$$

The logger uses integer maths and requires a value in the range +/- 32767 for **SCALE1** so we can use 31878 with a multiplier of 10^{-7} to position the decimal point correctly.

$$\text{SCALE1} \times 10^{\text{POWER1}} = 31878 \times 10^{-7}$$

As 1/100th of a mA represents just over 3mm it is adequate to record 2 decimal places so

$$\text{DP1} = 2$$

The following commands could therefore be used to setup the logger

```
SCALE1= 31878
OFFSET1= -400
POWER1= -7
DP1= 2
RATE= 10
MODE= NORMAL
FORMAT= P T C1 U1
TRIGGER= SO
PREFIX="Tank1"
UNITS1="m"
```

The recorded data would look similar to:

```
Tank1,15/03/12,12:44:40,0.22,m
Tank1,15/03/12,12:44:50,0.22,m
Tank1,15/03/12,12:45:00,0.22,m
Tank1,15/03/12,12:45:10,0.22,m
```

Recording GPS data and two analogue channels



If it is required to synchronise readings from a number of loggers in different locations, eliminate any issues with real time clock drift or just know the location of the reading then the ability to connect a GPS to the logger is really useful.

In this example every 10 seconds we will record the RMC sentence from a GPS receiver which provides date, time, position, speed and course over ground information and readings from two 4 – 20mA sensors.

There are a number of GPS receivers that have RS232 outputs that are suitable for connecting to the logger, Garmin produce the GPS 35 HVS or GPS35 PC for example.

The logger needs to operate in slave mode and set to capture the RMC sentence every 10 seconds which is done by specifying a start string that requires the least significant digit of the time (UTC) field must be 0

STX="\$??RMC,?????0"

Question marks represent characters that can have any value.

The carriage return character can be used to identify the end of the RMC sentence and will be replaced by the analogue readings when data is recorded.

The following commands could be used to setup the logger

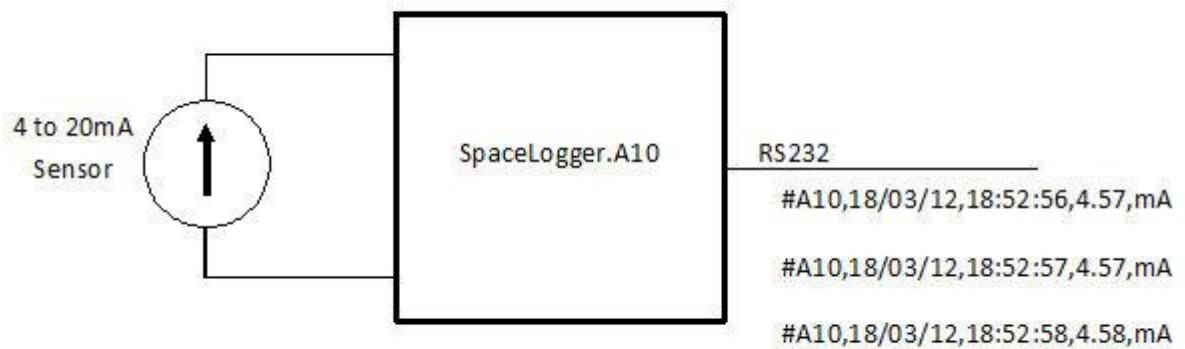
```
SCALE1=1
OFFSET1=0
POWER1= -2
DP1=2
UNITS1="mA"
SCALE2=1
OFFSET2=0
POWER2= -2
DP1=2
UNITS2="mA"
FORMAT= P C1 U1 C2 U2
PREFIX="A10"
MODE= SLAVE
STX="$??RMC,?????0"
ETX=13 // decimal value of ASCII carriage return character
BAUD=4800 //NMEA standard baud rate
OUTPUT= C
```

Example of the recorded data:

```
$GPRMC,110150.739,A,5045.2096,N,00131.6903,W,0.00,,020412,,*05,A10,8.89,mA,9.90,mA
$GPRMC,110200.739,A,5045.2087,N,00131.6868,W,0.00,,020412,,*0F,A10,8.89,mA,9.90,mA
$GPRMC,110210.738,A,5045.2084,N,00131.6883,W,0.00,,020412,,*09,A10,8.89,mA,10.20,mA
$GPRMC,110220.738,A,5045.2085,N,00131.6892,W,0.00,,020412,,*0B,A10,8.89,mA,10.20,mA
$GPRMC,110230.737,A,5045.2088,N,00131.6886,W,0.00,,020412,,*0D,A10,8.89,mA,10.20,mA
$GPRMC,110240.736,A,5045.2102,N,00131.6912,W,0.00,,020412,,*04,A10,8.89,mA,10.20,mA
```

Analogue to RS232 converter

The logger can operate without a memory card just to provide an analogue to RS232 converter function.



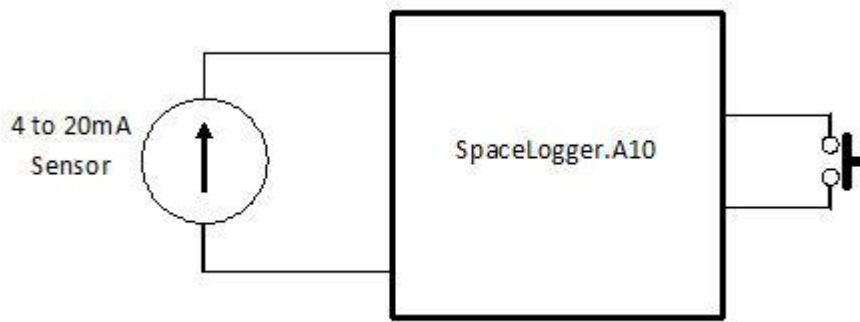
To do this the output should be set to continuous.

For example, the following commands in the SETUP.TXT file would give the output shown above

```
SCALE1=1
OFFSET1=0
POWER1= -2
DP1=2
RATE=1
MODE= NORMAL
FORMAT= P T C1 U1
OUTPUT= C
PREFIX="#A10"
UNITS1="mA"
```

Push button triggered reading

The SpaceLogger can be setup to record a single reading each time a switch is closed.



The switch could be a simple push button or for example some kind of position/object detection switch.

If required there can also be a programmable delay after the switch is closed to allow the sensor to stabilise before recording the reading.

The SpaceLogger **MODE** must be **SINGLE** so repeated readings are not recorded if the button is held closed.

The **RATE** setting has no effect when in single mode. The logger takes a reading every second but only records the single required reading. It will not record readings at more than once a second.

As an example the following commands in the SETUP.TXT file would record a reading 5 seconds after the push button is pressed.

```
SCALE1=1
OFFSET1=0
POWER1= -2
DP1=2
RATE=1
MODE= SINGLE
FORMAT= P T C1 U1
TRIGGER= SC
DELAY=5
PREFIX="#A10"
UNITS1="mA"
```

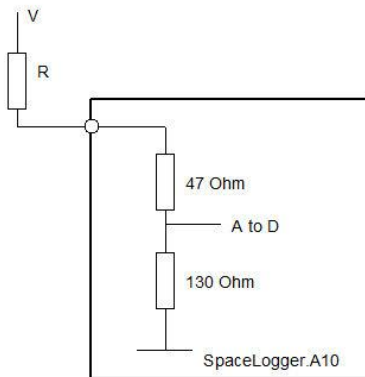
If an indication that a reading has been taken is required a high efficiency led (Avago HLMP-K155 RS 826-521 Farnell 100-3210) can be connected to the alarm output and the alarm condition set to logging by including the following command in the SETUP.TXT file.

```
ALARM=L
```

The LED will come on shortly after the switch is pressed and remain on during the delay until the reading is recorded.

Logging the supply voltage

Often it is useful to record the supply voltage this can be done with a simple resistor between the supply and one of the analogue inputs.



The choice of resistor value will depend on the accuracy required, acceptable current draw and supply voltage range.

The current through the resistors is

$$I = V / (R + 47 + 130)$$

To record the reading in volts we require the volts per 0.01 mA

$$\text{SCALE1} \times 10^{\text{POWER1}} = 0.00001 \times (R + 177)$$

For R = 4700 ohms this would give

$$\text{SCALE1} \times 10^{\text{POWER1}} = 0.04877$$

So we can use

$$\text{SCALE1} = 4877$$

$$\text{POWER1} = -5$$

The maximum voltage V is limited by the maximum allowable voltage across the 130 ohm resistor of 3 volts. Note V must always be positive.

The following commands could be used to setup the logger:

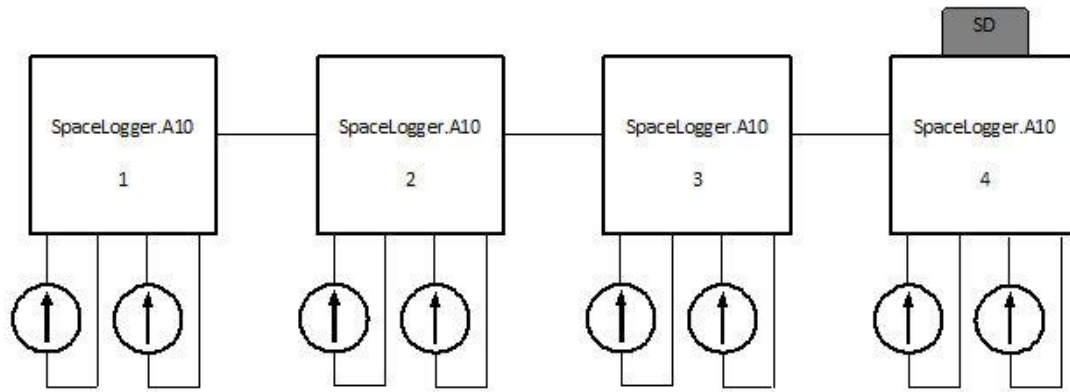
```
SCALE1= 4877
OFFSET1= 0
POWER1= -5
DP1= 1
RATE= 10
MODE= NORMAL
FORMAT= P T C1 U1
TRIGGER= SO
PREFIX="V1"
UNITS1="volts"
```

The recorded data would look similar to

```
V1,15/03/12,12:44:40,13.4,volts
V1,15/03/12,12:44:50,13.4,volts
V1,15/03/12,12:45:00,13.5,volts
V1,15/03/12,12:45:10,13.5,volts
```

Extending the number of analogue channels

If two 4 to 20mA channels is not enough, the number of channels can be extended by daisy chaining SpaceLogger.A10s together.



The first logger in the chain determines the frequency and/or conditions for measurements, the rest of the units operate in slave mode appending their data to the received data. The last unit in the chain stores the data on to the SD card.

Set up commands for the first logger:

```
SCALE1=1
OFFSET1=0
POWER1= -2
DP1=2
UNITS1="mA"
SCALE2=1
OFFSET2=0
POWER2= -2
DP2=2
UNITS2="mA"
RATE=10
MODE= NORMAL
FORMAT= P T C1 U1 C2 U2
OUTPUT= C
TRIGGER= SO
PREFIX="Ch1-8" //will be used to identify the start of the reading by subsequent loggers
```

Set up commands for loggers 2 to 4:

```
SCALE1=1
OFFSET1=0
POWER1= -2
DP1=2
UNITS1="mA"
SCALE2=1
OFFSET2=0
POWER2= -2
DP2=2
UNITS2="mA"
MODE= SLAVE
FORMAT= C1 U1 C2 U2
OUTPUT= C
STX="Ch1-8" // start of string output by logger 1
ETX=13 // decimal value of ASCII carriage return character
```

Data recorded:

```
Ch1-8,15/03/12,12:44:40,8.89,mA,9.90,mA,5.85,mA,9.10,mA,15.19,mA,7.90,mA,8.82,mA,13.64,mA
Ch1-8,15/03/12,12:44:50,8.89,mA,9.90,mA,5.85,mA,9.10,mA,15.19,mA,7.90,mA,8.82,mA,13.64,mA
Ch1-8,15/03/12,12:45:00,8.89,mA,9.90,mA,5.85,mA,9.10,mA,15.19,mA,7.90,mA,8.82,mA,13.64,mA
Ch1-8,15/03/12,12:45:10,8.89,mA,9.90,mA,5.85,mA,9.10,mA,15.19,mA,7.90,mA,8.82,mA,13.64,mA
```