

# USER GUIDE

## **CS120A** *Visibility Sensor*



*Issued: 30.9.14*



# Guarantee

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This equipment is guaranteed against defects in materials and workmanship. This guarantee applies for twelve months from date of delivery. We will repair or replace products which prove to be defective during the guarantee period provided they are returned to us prepaid. The guarantee will not apply to:

- Equipment which has been modified or altered in any way without the written permission of Campbell Scientific
- Batteries
- Any product which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific will return guaranteed equipment by surface carrier prepaid. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This guarantee and the Company's obligation thereunder is in lieu of all other guarantees, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

Please inform us before returning equipment and obtain a Repair Reference Number whether the repair is under guarantee or not. Please state the faults as clearly as possible, and if the product is out of the guarantee period it should be accompanied by a purchase order. Quotations for repairs can be given on request. It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment, in support of this policy a "Declaration of Hazardous Material and Decontamination" form will be issued for completion.

When returning equipment, the Repair Reference Number must be clearly marked on the outside of the package. Complete the "Declaration of Hazardous Material and Decontamination" form and ensure a completed copy is returned with your goods. Please note your Repair may not be processed if you do not include a copy of this form and Campbell Scientific Ltd reserves the right to return goods at the customers' expense.

Note that goods sent air freight are subject to Customs clearance fees which Campbell Scientific will charge to customers. In many cases, these charges are greater than the cost of the repair.



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# Precautions

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**DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.** FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at [www.campbellsci.eu](http://www.campbellsci.eu) or by telephoning +44(0) 1509 828 888 (UK). You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

## General

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

## Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, or 20 feet, or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.

## Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

## Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.



# PLEASE READ FIRST

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## About this manual

Some useful conversion factors:

**Area:** 1 in<sup>2</sup> (square inch) = 645 mm<sup>2</sup>

**Length:** 1 in. (inch) = 25.4 mm  
1 ft (foot) = 304.8 mm  
1 yard = 0.914 m  
1 mile = 1.609 km

**Mass:** 1 oz. (ounce) = 28.35 g  
1 lb (pound weight) = 0.454 kg

**Pressure:** 1 psi (lb/in<sup>2</sup>) = 68.95 mb

**Volume:** 1 UK pint = 568.3 ml  
1 UK gallon = 4.546 litres  
1 US gallon = 3.785 litres

## Recycling information



At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.



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# CS120A Visibility Sensor

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## 1. Introduction

The CS120A is an infrared forward scatter visibility sensor for automatic weather stations including road, marine and airport based stations. The CS120A uses the well established forward scatter system for visibility measurement, utilising a 42° scatter angle. The CS120A uses high speed sampling to reduce missed events such as rain and hail and improves response to other suddenly changing conditions.

The CS120A is a development of the CS120. Functionally they are identical. The CS120A has a more powerful processor and can be upgraded to a CS125 with a present weather capability. This User Guide will be suitable for CS120s but note that CS120A operating systems cannot be loaded onto a CS120.



### 1.1 Version Information

| Manual Version | Revisions           |
|----------------|---------------------|
| 1.0            | CS120A OS Version 1 |

## 1.2 General Safety

This manual provides important safety considerations for the installation, operation and maintenance of the CS120A. These safety considerations are classified into three levels:

|                |  |
|----------------|--|
| <b>WARNING</b> | <b>Warnings alert the installer or user to serious hazards. Ignoring these warnings could result in injury or death and/or irrevocable damage to the sensor unit.</b>                              |
| <b>CAUTION</b> | Cautions warn of potential hazards. Ignoring these cautions could result in the sensor being damaged and data being lost.  |
| <b>NOTE</b>    | Notes highlight useful information in the installation, use and maintenance of this product. These should be followed carefully in order to gain the maximum benefit from the use of this product. |

## 1.3 Sensor Unit Safety

The CS120A sensor has been checked for safety before leaving the factory and contains no internally replaceable or modifiable parts.

|                |   |
|----------------|---|
| <b>WARNING</b> | <b>Do not modify the CS120A unit. Such modifications will lead to damage of the unit and could expose users to dangerous light levels and voltages.</b>                   |
| <b>WARNING</b> | <b>In unusual failure modes and environmental conditions the sensor hood could become hot. In normal operation they will be at ambient temperature or slightly above.</b> |
| <b>CAUTION</b> | Ensure that the correct voltage supply is provided to the sensor.   |

## 2. Technical specification

|                                    | Minimum Value | Nominal Value | Maximum Value |
|------------------------------------|---------------|---------------|---------------|
| <b>Visibility characteristics</b>  |               |               |               |
| Reported Visibility (metric)       | 10 metres     | -             | 32,000 metres |
| Reported Visibility (imperial)     | 33 feet       | -             | 104,985 feet  |
| Visibility accuracy up to 10,000 m | -             | +/-10%        | -             |
| Visibility accuracy over 10,000 m  | -             | +/-20%        | -             |
| <b>Optical characteristics</b>     |               |               |               |
| LED centre wavelength              | -             | 850nm         | -             |
| LED spectral bandwidth             | -             | +/-35nm       | -             |
| <b>Pulse characteristics</b>       |               |               |               |
| Light pulse rate                   | -             | 1KHz          | -             |

## 3. Electrical specification

|  | Minimum Value | Nominal Value      | Maximum Value      |
|--|---------------|--------------------|--------------------|
| <b>Main power supply for DSP and dew heaters</b>   |               |                    |                    |
| Power supply, +12V connection (DC only)  | 7V            | 12V                | 30V                |
| Current consumption sampling continuously with dew heaters active (at 12V DC)                                  | -             | 180mA              | 228mA              |
| Current consumption sampling continuously with dew heaters disabled (at 12V DC)                                | -             | 100mA              | 150mA              |
| Current consumption without any sampling occurring and dew heaters disabled (at 12V DC)                        | -             | 8mA                | 12mA               |
| Active power consumption with dew heaters and RS232 communications interface active <sup>(5)</sup> (at 12V DC) | -             | 184mA              | 232mA              |
| <b>Hood heater power supply</b>  |               |                    |                    |
| Hood heater voltage (AC or DC)   | -             | 24V <sup>(1)</sup> | 30V <sup>(1)</sup> |
| Hood heater wattage (at 24V AC or DC) <sup>(6)</sup>   | -             | 60W <sup>(2)</sup> | -                  |
| <b>RS232 Communications</b>  |               |                    |                    |
| RS232 input threshold Low  | 0.8V          | 1.5V               | -                  |
| RS232 input threshold High   | -             | 2.0V               | 2.4V               |
| RS232 input absolute maximum   | -15V          | -                  | +15V               |
| RS232 input resistance   | 12KΩ          | -                  | -                  |
| RS232 output voltage low   | -             | -                  | 0.4V               |

|  |       |   |       |
|--|-------|---|-------|
| RS232 output voltage high (into 3K $\Omega$ )  | 4.4V  | - | -     |
| <b>RS485 Communications</b>                    |       |   |       |
| RS485 input threshold voltage                  | -0.2V | - | +0.2V |
| RS485 output (Unloaded)                        | -     | - | 5V    |
| RS485 output (Load 50 $\Omega$ )               | 2V    | - | -     |
| Maximum voltage at any terminal <sup>(4)</sup> | -7V   | - | +7V   |
| <b>User alarm outputs</b>                      |       |   |       |
| User output high level (at 85°C)               | 3.8V  | - | -     |
| User output high level (at 25°C)               | 4.13V | - | -     |
| User output low (All temperatures)             | 0.25V | - | 0.55V |
| User output current                            | -     | - | 32mA  |

(1) It is recommended that the hood heaters are run at 24V AC/DC. It's possible to run the heaters at any voltage below 24V but the heaters will generate proportionally less heat reducing their ability to prevent ice build-up.

(2) Each hood takes 30W, 60W is the total for both hoods on the sensor together.

(3) The ground of the CS120A and the earth of any RS485 equipment cannot be further apart than this voltage. A 100 $\Omega$  resistor can be used to connect the CS120A RS485 earth to other equipment. This will reduce any parasitic currents and bring the two earths closer together if a direct connection cannot be made.

(4) The RS232 communications interface will automatically turn itself off when not transmitting.

(5) If hood heaters are not being used ensure 'Hood heater override' (details in Section 13) is set to off.

## 4. Supported data rates for RS232 and RS485

**Serial setting**      8N1

### Supported data rates

- 1200 bps
- 2400 bps
- 9600 bps
- 19200 bps
- 38400 bps - default
- 57600 bps
- 115200 bps

**Supported formats**

- RS232 (Full duplex only), default
- RS485 (Half duplex)
- 8 bit data bytes
- 1 stop bit
- Parity checking is not supported as most communication protocols used by the CS120A have built in checksums as well as checks that communications have been understood

## 5. Environmental specifications

|                                  | Minimum Value | Nominal Value | Maximum Value        |
|----------------------------------|---------------|---------------|----------------------|
| <b>Sensor temperature ranges</b> |               |               |                      |
| Operating temperature            | -25°C         | -             | +60°C                |
| Extended operating temperature   | -40°C         | -             | +70°C <sup>(1)</sup> |
| Storage temperature              | -40°C         | -             | +85°C                |
| <b>Sensor humidity ranges</b>    |               |               |                      |
| Operating humidity range         | 0%            | -             | 100%                 |
| <b>Sensor heater thresholds</b>  |               |               |                      |
| Dew heater Turn On               | -             | <35°C         | -                    |
| Dew heater Turn Off              | -             | >40°C         | -                    |
| Hood heater Turn On              | -             | <5°C          | -                    |
| Hood heater Turn Off             | -             | >15°C         | -                    |

(1) Extended temperature ranges are only guaranteed if the sensor has been tested by Campbell Scientific and verified within this temperature range. Some degradation of absolute accuracy can be expected at the extremes of the extended ranges.

## 6. Mechanical specifications

**Main body including base mount**

Height: 447 mm

Width: 640 mm

Depth: 245 mm

Sensor weight: 3 Kg

Sensor mounting : Bracket mounts on a vertical pole 32-52.5 mm diameter. The mounting bracket has cut-outs for band clamps for larger diameter masts.

Shipping weight: 6 Kg (including packing box)

## 7. Installation procedure

The CS120A measures environmental variables and is designed to be located in harsh weather conditions. However there are a few considerations to take into account if accurate and representative data from a site are to be obtained.

**NOTE**

The descriptions in this section are not exhaustive. Please refer to meteorological publications for further information on locating weather instruments

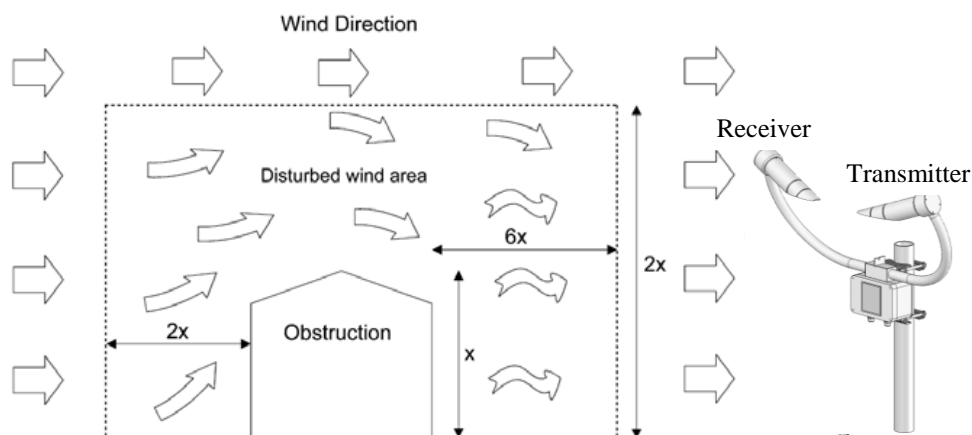
The CS120A should be sited in a position representative of local weather conditions and not of a specific microclimate (unless the analysis of microclimate weather is being sought).

The CS120A has good resistance to background light but it is a good idea to avoid locations where the transmitter is pointing at a light scattering or reflecting surface. Ideally, the receiver should point north in the northern hemisphere but this is not critical if the field of view does not include a bright and scattering surface.

To give non-microclimatic measurements the CS120A should be sited away from possible physical obstructions that could affect the fall of precipitation. The CS120A should also be positioned away from sources of heat, electrical interference and in such a position as to not have direct light on the sensor lenses. Whenever possible, the CS120A should be located away from windbreaks.

Several zones have been identified upwind and downwind of a windbreak in which the airflow is unrepresentative of the general speed and direction. Eddies are generated in the lee of the windbreak and air is displaced upwind of it. The height and depth of these affected zones varies with the height and to some extent the density of the obstacle.

Generally, a structure disturbs the airflow in an upwind direction for a distance of about twice the height of the structure, and in a downwind direction for a distance of about six times the height. The airflow is also affected to a vertical distance of about twice the height of the structure. Ideally, therefore, the CS120A should be located outside this zone of influence in order to obtain representative values for the region.



In order to reduce the service frequency with the unit, the CS120A should be placed away from sources of contamination, in the case of roadside monitoring; larger mounting poles can be used. More regular maintenance will be required when the instrument is placed in areas where contamination is unavoidable or where measurements may be safety critical.

The WMO recommend a sample volume height of 1.5 m. However, for applications such as aviation or road visibility other heights may be appropriate.



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|             |  |
|-------------|--|
| <b>NOTE</b> | If operating a CS120A indoors it is likely that there will be sources of light and/or reflections that will create false readings and erratic results. |
|-------------|--|

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|             |   |
|-------------|---|
| <b>NOTE</b> | If carrying out simple checks, blocking a lens or the sample volume will simulate an INCREASE in visibility not a decrease. |
|-------------|---|

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## 7.1 Equipment grounding

The CS120A must be properly grounded. It is sufficient to ground the mounting bracket and if the CS120A is connected to a grounded metal mast, and in electrical contact with it, then this will be sufficient. Otherwise, the mounting bracket should be earthed and a length of cable is supplied to allow this.

The cable is fitted with an 'eye' which should be fitted on the mounting bolts. The other end should be cut to length and go to a suitable grounding point.

Note older CS120 sensors were provided with a grounding boss and in this case it should be used as electrical contact between CS120 enclosure and the mounting bracket is not guaranteed.

The pole and foundations of a pole mounted installation will provide some basic lightning protection and protection against radio frequency interference and should also be correctly grounded.

## 7.2 Mounting the CS120A

A pole mounting kit is supplied with the CS120A.

If a power supply enclosure has been supplied with the sensor it can be mounted on the pole, near its base using the brackets supplied with the enclosure. Alternatively the power supply can be mounted elsewhere, e.g. on a wall at some distance from the sensor. The power supply enclosure should be mounted away from the sensor head to avoid wind flow disturbance or rain drops bouncing back up into the sensor's sensing volume.

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|                |  |
|----------------|--|
| <b>CAUTION</b> | Take care not to overtighten the nuts on the bolts, as it may be possible to distort and/or damage the brackets by doing so, and/or the nuts may seize up. Only tighten the nuts to a degree necessary to hold the CS120A firmly in place. |
|----------------|--|

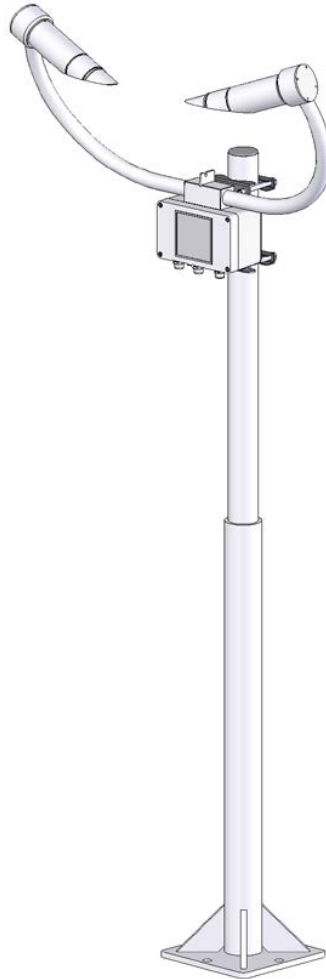
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Where the CS120A is to be mounted onto another type of mast, please refer to the manual for that mast for mounting details.

Slots are provided to allow band clamps to be used with larger diameter masts.

## 7.3 Optional Campbell Scientific Mount

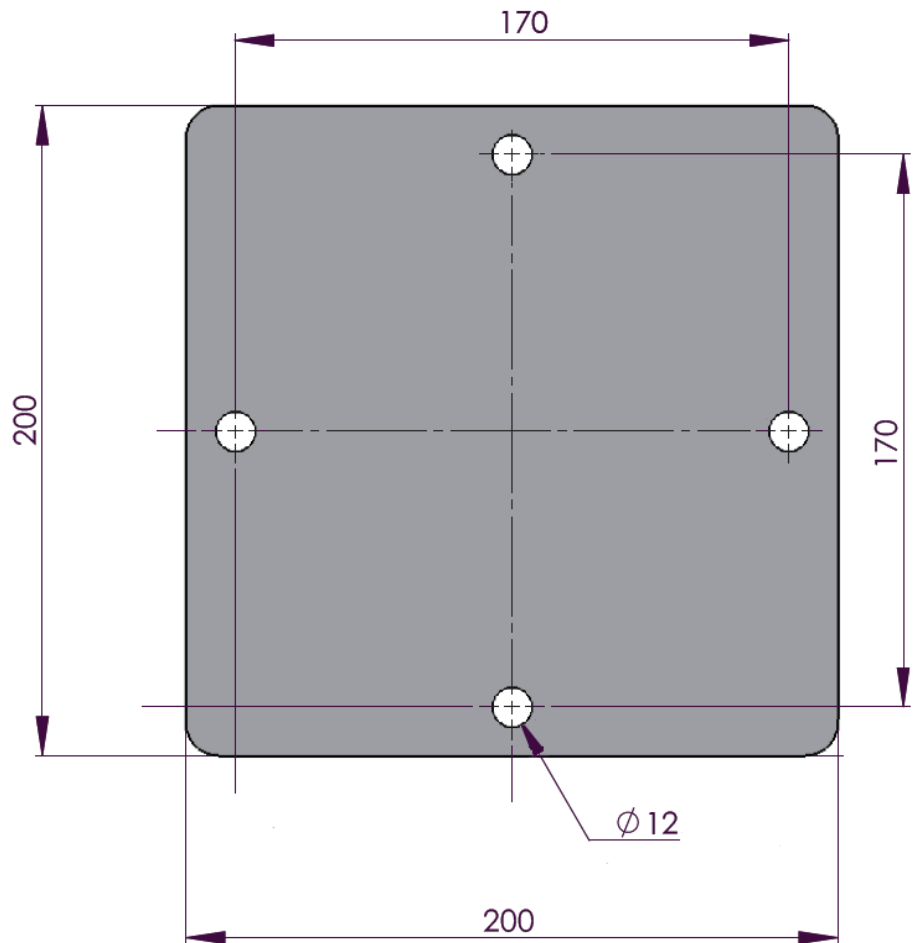
A Campbell Scientific 'optical sensor mount', part number 009354, is available. This will put the sample volume at about 1.5 m in compliance with the WMO 'Guide to Meteorological Instruments and Methods of Observation', 7<sup>th</sup> Edition, Section 9.3.4.



If one is to be used, follow the installation instructions below.

The mount should be installed on a concrete foundation. If one does not already exist then a concrete foundation should be constructed at least 600 mm square and 600 mm deep. Ensure the ground consistency is not too loose and will be able to support the mount and concrete foundation.

Drill four 12 mm diameter holes using the mount base as a template or following the drawing below to a depth of 77 mm.



Clean the holes of all debris.

Place washers and nuts on the ends of the wedge anchors supplied (to protect the threads during installation).

Hammer the wedge anchors into the holes until the start of the threads are below the surface.

Tighten the nuts until about 25 mm of thread protrudes above the surface.

Remove the washers and nuts from the protruding length screw. Then lower the mount into place.

Finally secure the mount with the washers and nuts.

If the surface is not level and flat it may be necessary to add washers under the base on one or more of the foundation screws.

## 8. CS120A internal connectors' description

The CS120A has three standard IP66 rated glands. The first gland is by default used by the power/communications line. This comprises the +12V/24V for the main electronics, and the serial communications wires. The CS120A is supplied with 5 m cable already connected.

The second gland is used for the 24 V feeds for the hood heaters fitted with a 5 m cable.

The third gland is spare and can be used to connect to user alarms on connector C.

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**CAUTION** If the power cable is incorrectly wired to the CS120A then irrevocable damage can be done to the unit.

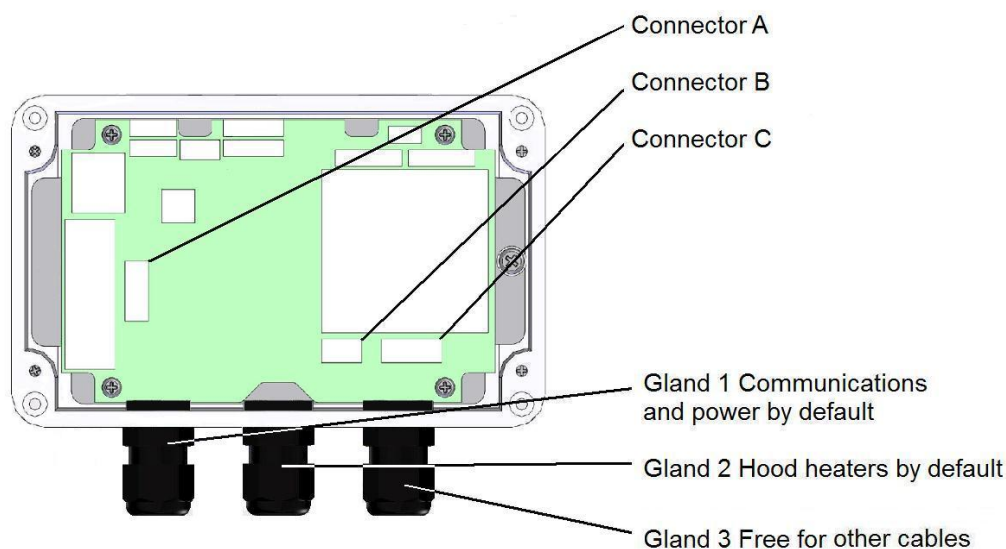
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**CAUTION** 10 m is the longest length of the cable type supplied recommended. In particular, additional RS485 communication should be twisted pair. Please contact Campbell Scientific if you wish to use a longer length of cable.

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A configuration cable, part number 010817, is available from Campbell Scientific that plugs directly into connector B, in place of the normal connector and cable. The configuration cable is fitted with a 9-way D connector for use with a PC serial port or USB to serial adaptor.

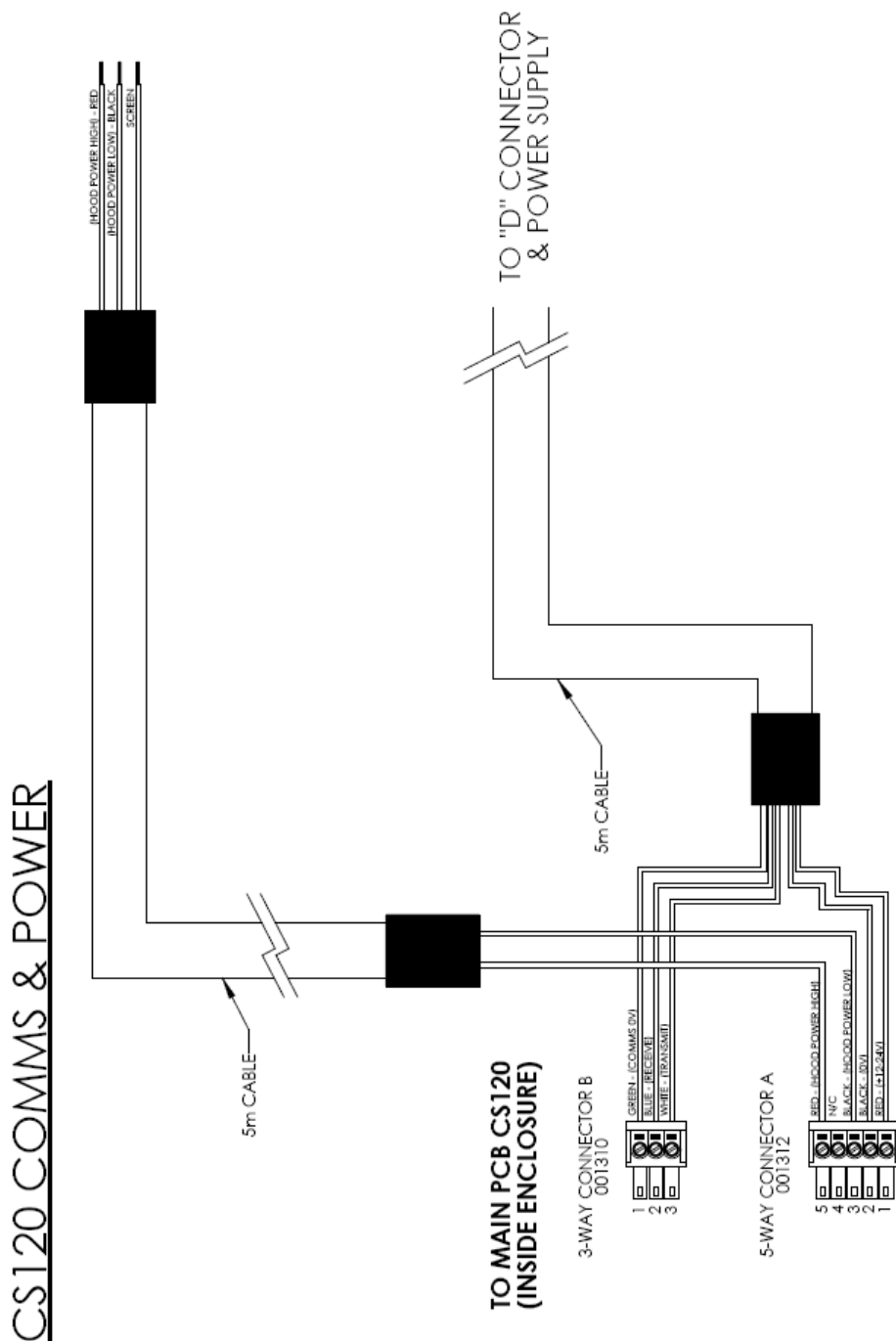
| <b>Connector A</b><br>Five way connector |                    |  |
|--|--------------------|--|
| <b>Pin number</b>                        | <b>Description</b> | <b>Notes</b>   |
| Pin 1                                    | +12V               | Main electronics 12V supply input (also supports 24V DC)   |
| Pin 2                                    | 0V                 | Auxiliary Electronics 0V. Common with the main electronics 0V.   |
| Pin 3                                    | Hood low           | Hood heater –V input, this input is totally separate to the main electronics 0V within the sensor so can be connected to a separate power supply. However, this pin should not be more than 5V different from the main electronics 0V. |
| Pin 4                                    | 0V                 | Auxiliary Electronics 0V. Common with the main electronics 0V.   |
| Pin 5                                    | Hood high          | Hood heater +V input (Normally 24V)  |

| <b>Connector B</b><br>Three way connector |                    |   |
|---|--------------------|---|
| <b>Pin number</b>                         | <b>Description</b> | <b>Notes</b>  |
| Pin 1                                     | 0V                 | 0V connection for serial communications. This connection is common with the main electronics 0V (Connector A, pin 2). |
| Pin 2                                     | Receive            | RS232 receive line. Also, acts as the Y transmit line in RS485 half duplex mode and the A receive line                |
| Pin 3                                     | Transmit           | RS232 transmit line. Also, acts as the Z transmit line in RS485 half duplex mode and the B receive line               |

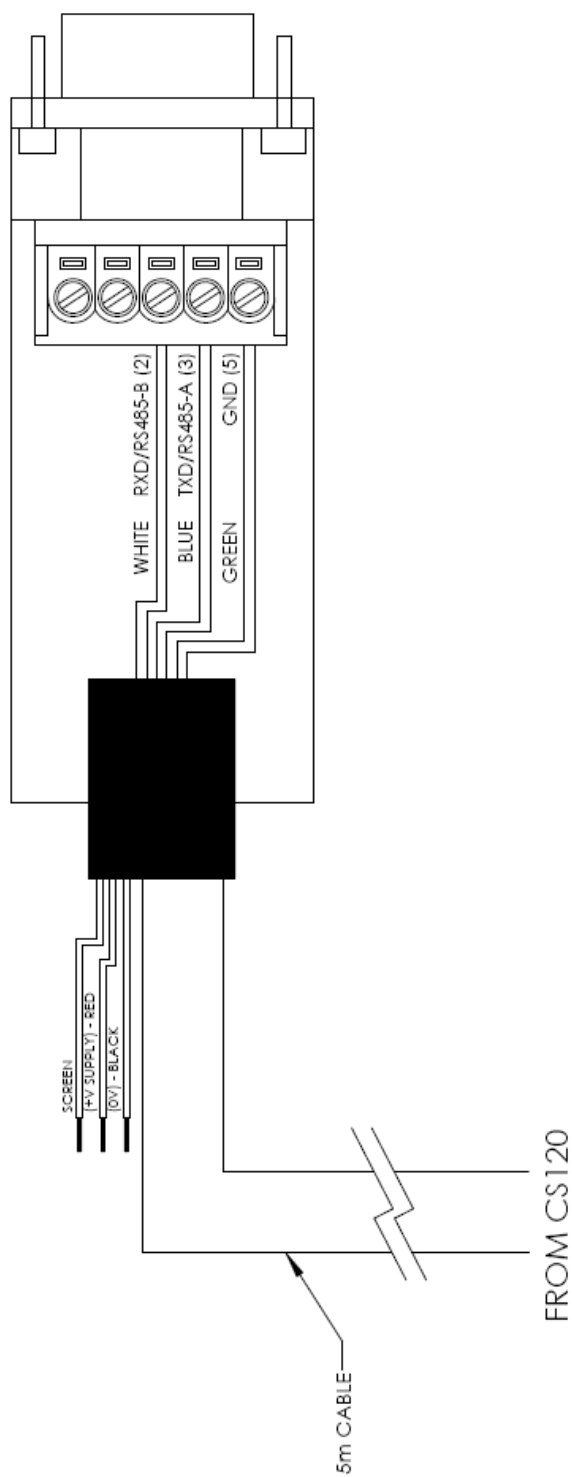
| <b>Connector C – USER ALARMS</b><br>Four way connector |                    |   |
|--|--------------------|---|
| <b>Pin number</b>                                      | <b>Description</b> | <b>Notes</b>  |
| Pin 1  | 0V                 | 0V connection for user alarms. This connection is common with the main electronics 0V (Connector A, Pin 2). |
| Pin 2  | User 2             | Output for user alarm 2   |
| Pin 3  | 0V                 | 0V connection for user alarms. This connection is common with the main electronics 0V (Connector A, Pin 2). |
| Pin 4  | User 1             | Output for user alarm 1   |

## 8.1 CS120A recommended wiring using Campbell Scientific cables (this cable is supplied already connected as standard)

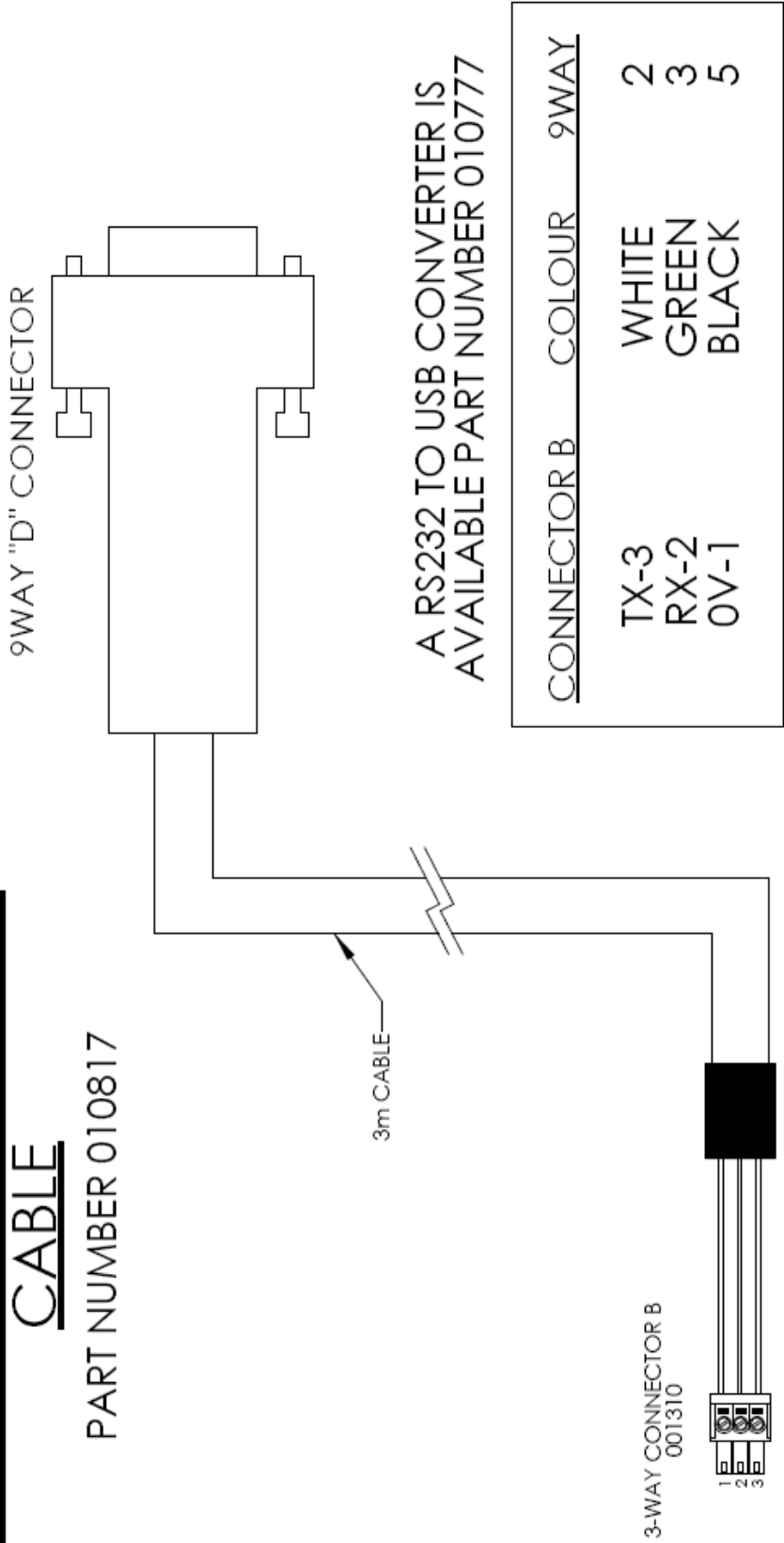
The CS120A is provided pre-wired with a default 5 m power and communications cable which is terminated at one end with a 9 pin D-connector (DB9). The D-connector can be connected directly to a PC or to a datalogger such as the Campbell Scientific CR1000 using a suitable interconnecting cable such as the SC110. If another type of connection is required then the D-connector should be removed.



## CS120 COMMS & POWER CABLE CONNECTOR



CS120 CONFIGURATION  
CABLE  
PART NUMBER 010817



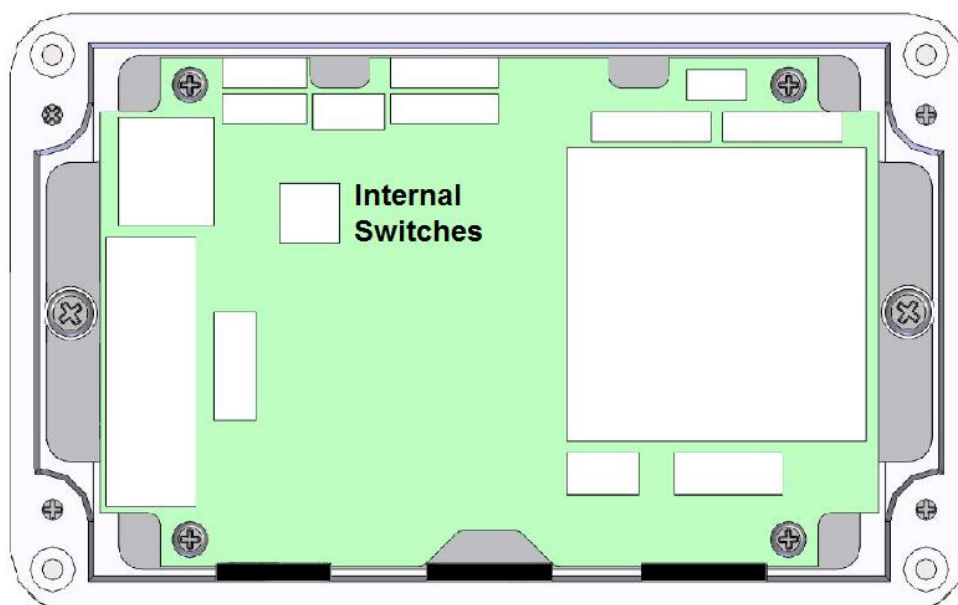


## 9. Functions of the internal switches

The CS120A is equipped with four switches located within the main enclosure. These switches perform certain functions at power up, their functions are detailed below.

### IMPORTANT

The switches are only read during the power up sequence of the CS120A. This means that if the switches are pressed whilst the CS120A is running nothing will happen, the sensor will need to be power cycled leaving at least 10 seconds with the sensor off for any of their functions to be performed.



| Internal switch functions |   |
|---------------------------|---|
| Switch number             | Function  |
| 4                         | <i>Reserved for future use</i>  |
| 3                         | When switched to the ON position this switch temporarily sets the CS120A communications port to a default RS232 communication state (38400 bps). This is useful during field tests or maintenance when the CS120A has been remotely configured for RS485 mode or a baud rate your PC does not support. This change is temporary and will not be stored to flash. However, if the menu system is accessed and a 'Save and exit' command is performed these new data rate settings will be committed to flash.<br>Once this switch is returned to its OFF position and the CS120A is power cycled the CS120A will return to its previous communications settings. |
| 2                         | <i>Reserved for future use, set to OFF.</i>   |
| 1                         | When switched to the ON position this switch will reset the CS120A to its factory default values. This reset will affect all communication setting and will replace the user calibration settings with the factory defaults. This will take immediate effect upon power up.   |

## 10. Message Formats: A breakdown of the different default outputs of the CS120A – Basic/Partial/Full

The CS120A has three different standard message formats available to the user. These three outputs are named Basic, Partial and Full. All three standard outputs parameters are space delimited with a unique start and end character allowing easy storage into any logger (see Section 15 on how to set default outputs). The Full Format message is the default message.

**NOTE**

STX and ETX are hexadecimal command characters.

**NOTE**

Refer to Appendix B for the checksum algorithm.

**Basic format**

| STX  | Message ID | Sensor ID | System status | Visibility distance | Visibility units | Checksum (CCITT) | ETX  | Carriage return | Line feed |
|------|------------|-----------|---------------|---------------------|------------------|------------------|------|-----------------|-----------|
| 0x02 | 0          |           |               |                     | M or F           | XXXX             | 0x03 | 0x0D            | 0x0A      |

**Partial format**

| STX  | Message ID | Sensor ID | System status | Message interval | Visibility distance | Visibility units | User alarms | Checksum (CCITT) | ETX  | Carriage return | Line feed |
|------|------------|-----------|---------------|------------------|---------------------|------------------|-------------|------------------|------|-----------------|-----------|
| 0x02 | 1          |           |               |                  |                     | M or F           | 0 0         | XXXX             | 0x03 | 0x0D            | 0x0A      |

**Full format**

| STX  | Message ID | Sensor ID | System status | Message interval | Visibility distance | Visibility units | Averaging duration | User alarms | System alarms | Checksum (CCITT) | ETX  | Carriage return | Line feed |
|------|------------|-----------|---------------|------------------|---------------------|------------------|--------------------|-------------|---------------|------------------|------|-----------------|-----------|
| 0x02 | 2          |           |               |                  |                     | M or F           |                    | 0 0         | 0 0 0...      | XXXX             | 0x03 | 0x0D            | 0x0A      |

| Message ID break down |   |
|-----------------------|---|
| ID                    | Definition  |
| 0                     | Basic format. Contains only distance and system information |
| 1                     | Partial format. Contains user alarm outputs                 |
| 2                     | Full format. Contains all system alarms codes               |

| Sensor ID break down |  |
|----------------------|--|
| ID                   | Definition   |
| 0-9                  | Unit number defined by the user to aid identification of data. Zero by default.<br>Useful for RS485 networks. Operates as an address in RS485 mode |

| System status break down <sup>(1)</sup> |                               |
|---|-------------------------------|
| Status level                            | Definition                    |
| 0                                       | No fault                      |
| 1                                       | Possible degraded performance |
| 2                                       | Degraded performance          |
| 3                                       | Maintenance required          |

(1) System status break down reflects the highest level of severity of any active alarm.

| Message interval |  |
|------------------|--|
| Time             | Definition   |
| 1-3600           | The amount of time, in seconds, between outputs in continuous mode |

| Visibility distance break down |  |
|--------------------------------|--|
| ID                             | Definition   |
| 0-32,000 metres                | Current visibility distance being detected by the sensor |

| Visibility units break down |            |
|-----------------------------|------------|
| ID                          | Definition |
| M                           | Metres     |
| F                           | Feet       |

| Averaging duration break down |                    |
|-------------------------------|--------------------|
| ID                            | Definition         |
| 1                             | One minute average |
| 10                            | Ten minute average |

In accordance with WMO requirements the CS120A produces measurement that are either one or ten minute rolling averages that are updated at the chosen output interval or when the sensor is polled. Those averages are not direct averages of MOR measurements but are averages of extinction coefficient and that average is then used to calculate the MOR for that period. As the relationship between extinction coefficient and MOR is not linear it is possible to see quite rapid changes in MOR that might not be expected if the result was a rolling average of MOR. Please consider this, especially when testing the sensor with artificial obscurants or using the calibration disc.

| User alarms |       |   |
|-------------|-------|---|
| Alarm       | Range | Definition  |
| 1           | 0-1   | Visibility either less or greater than a user specified threshold |
| 2           | 0-1   | Visibility either less or greater than a user specified threshold |

| System alarms break down     |                    |                         |   |
|------------------------------|--------------------|-------------------------|---|
| Alarm                        | Range              | Severity <sup>(2)</sup> | Definition  |
| Emitter failure              | 0-2 <sup>(1)</sup> | 3                       | The emitter hoods main LED output power level.<br>0 = Everything is within normal parameters<br>1 = Light output level too low<br>2 = Light output level too high   |
| Emitter lens dirty           | 0-3                | 1                       | 0 = OK. The reported attenuation is below 10%.<br>1 = Reported window signal value is too low (Possible sensor fault)<br>2 = Slight dirt build up (10% signal attenuation or higher)<br>3 = High level of dirt build up (The hood could be blocked) |
| Emitter temperature          | 0-3                | 1 or 2                  | 0 = Temperature is within operating conditions<br>1 = Too low. Less than -40°C.<br>2 = Too high. Over 80°C.<br>3 = Sensor fault (No sensor detected or below -54°C) (Severity 2)  |
| Detector lens dirty          | 0-3                | 1                       | 0 = OK. The reported attenuation is below 10%.<br>1 = Reported window signal value is too low (Possible sensor fault)<br>2 = Slight dirt build up (10% signal attenuation or higher)<br>3 = High level of dirt build up (The hood could be blocked) |
| Detector temperature         | 0-3                | 1 or 2                  | 0 = Temperature is within operating conditions.<br>1 = Too low. Less than -40°C.<br>2 = Too high. Over 80°C.<br>3 = Sensor fault (No sensor detected or below -54°C) (Severity 2)   |
| Detector DC saturation level | 0-1                | 1                       | The amount of background light as seen by the detector hood.<br>0 = Within limits<br>1 = Saturated. The CS120A no longer has enough head room to perform visibility readings in most circumstances.   |
| Hood temperature             | 0-3                | 1 or 2                  | 0 = Temperature is within operating conditions.<br>1 = Too low. Less than -40°C.<br>2 = Too high. Over 80°C.<br>3 = Sensor fault (No sensor detected or below -56°C) (Severity 2)   |
| Signature error              | 0-1                | 3                       | 0 = Signature of entire flash was checked and matches the stored version<br>1 = Signature does not match previous readings  |
| Flash read error             | 0-1                | 3                       | 0 = No errors<br>1 = One or more errors reading user variables from flash occurred  |
| Flash write error            | 0-1                | 3                       | 0 = No errors<br>1 = One or more errors writing user variables to flash occurred  |

<sup>(1)</sup>The emitter power level reporting too high will cause the CS120A to shutdown and go into low power mode.

<sup>(2)</sup>The severity of the alarm. The higher the number the more serious the error is considered to be.

## 10.1 Example CS120A message outputs

Example outputs from the CS120A.

### Basic output

```
0 1 0 12345 M XXXX
```

### Partial output

```
1 1 0 60 12345 M 0 0 XXXX
```

### Full output (default)

```
2 1 0 60 12345 M 1 0 0 0 0 0 0 0 0 0 0 0 XXXX
```

## 11. Interface methods – Device Configuration Utility/Command line/Menu

The CS120A can be setup and controlled in one of three ways.

The first method is by using Campbell Scientific's Device Configuration Utility Software (DevConfig) which is included with each delivery on the manuals/resource disk. This software allows an easy menu driven interface for configuring the CS120A on any Microsoft™ based personal computer. All settings can be accessed using this program.

The program includes online help instructions that describe its general use with the CS120A and also how to load an operating system.

The Device Configurator can also be used as a terminal emulator to use the built-in menu system of the CS120A and to access its calibration menu.

Note that the CS120A is listed on DevConfig as a different sensor to the CS120. If only the CS120 is listed then you should update your version of Devconfig. This is available free on the Campbell Scientific website. If this is not possible, please contact Campbell Scientific.

The second method is by using the command line interface where discrete commands are sent without response from the sensor. This would be the preferred method of setting up a CS120A if it was connected to a logger for instance. The configuration setting commands can be sent via a logger to the CS120A removing the need for a local PC to set up the unit.

The third method is by using the simple menu interface built into the CS120A communicating via RS232 or RS485, using a terminal emulator program. This menu system gives access to the more common settings.

All three of these methods use the CS120As serial port A to communicate with the sensor. Configuration cable part number 010817, described in Section 8.1 can be used.

## 11.1 Configuring a PC for talking to the CS120A

Described below is the procedure for setting up communications using a terminal emulator program. The terminal emulators built into many Campbell Scientific software products can also be used.

The following settings should then be used by default:

Bits per second: 38400  
Data bits: 8  
Parity: none  
Stop bits: 1  
Flow control: none

Ensure that if the baud rate of the unit has been adjusted and then the corresponding bits per second value is entered in the port settings of the terminal emulator. The CS120A should now be ready to accept commands.

It is possible to set the CS120A into the default communication state via one of the internal switches on the CS120A main board. See Section 9.

## 12. Definition of the variables that can be set by the user on the CS120A

Both DevConfig and the command line interface can access all the user configurable variables within the CS120A. The acceptable range and the identification number for these variables are listed below along with a short description.

| ID | Name                  | Range   | Description  | Factory default |
|----|-----------------------|---------|--|-----------------|
| 1  | Sensor ID             | 0-9     | Separate ID used as an extra identifier for a particular CS120A on a network.  | 0               |
| 2  | User Alarm 1 Enabled  | 0-1     | User alarm one activation state<br>0=Alarm one disabled<br>1=Alarm one enabled   | 0               |
| 3  | User Alarm 1 Active   | 0-1     | 0=Check if distance is <i>less than</i> 'User alarm 1 Distance'<br>1=Check if distance is <i>greater than</i> 'User alarm 1 Distance'                  | 0               |
| 4  | User alarm 1 Distance | 0-60000 | Distance value that alarm one will trigger against. This value will correspond to metres or feet depending upon which is selected in 'Visibility Unit' | 10000           |
| 5  | User Alarm 2 Enabled  | 0-1     | User alarm two activation state<br>0=Alarm two disabled<br>1=Alarm two enabled   | 0               |

|    |                                     |         |  |       |
|----|-------------------------------------|---------|--|-------|
| 6  | User Alarm 2 Active                 | 0-1     | 0=Check if distance is <i>less than</i> 'User alarm 2 Distance'<br>1=Check if distance is <i>greater than</i> 'User alarm 2 Distance'  | 0     |
| 7  | User alarm 2 Distance               | 0-60000 | Distance value that alarm one will trigger against. This value will correspond to metres or feet depending upon which is selected in 'Visibility Unit'   | 10000 |
| 8  | Baud rate                           | 0-6     | Baud rate for the main RS232/RS485 interface<br>0 = 115200 bps<br>1 = 57600 bps<br>2 = 38400 bps<br>3 = 19200 bps<br>4 = 9600 bps<br>5 = 2400 bps<br>6 = 1200 bps  | 2     |
| 9  | Serial Number                       | 0-32000 | Internal serial number for the CS120A.<br>(Read only)  | -     |
| 10 | Visibility Unit                     | M or F  | Unit the visibility value will be presented as.<br>M = Metres<br>F = feet  | M     |
| 11 | Message Interval                    | 1-3600  | Interval in seconds between outputs in continuous mode. This value has no effect if polled mode has been selected in 'Measurement mode'  | 60    |
| 12 | Measurement mode                    | 0-1     | Selects polled or continuous modes.<br>In continuous mode the sensor will output a string in the format as set by 'Message Format' at regular intervals as defined by 'Continuous Interval'.<br>0 = Continuous mode<br>1 = Polled mode   | 0     |
| 13 | Message Format                      | 0-2     | Level of detail outputted by polled or continuous modes<br>0 = Basic    1 = Partial    2 = Full  | 2     |
| 14 | Serial port protocol                | 0-1     | Selects the physical serial interface<br>0 = RS232 mode<br>1 = RS485 mode  | 0     |
| 15 | Averaging period                    | 1 or 10 | The period of time that the visibility value should be averaged over. Either one minute or ten.  | 1     |
| 16 | Sample timing                       | 1-60    | Used to define the time interval between sampling the volume. It is recommended that this value is left at one except when very low power demands are needed. For example:<br>1 = Sample every second<br>2 = Sample one second in every two<br>3 = Sample one second in every three etc. | 1     |
| 17 | Dew heater override                 | 0-1     | 0=Allow the CS120A to automatically control the dew heaters<br>1=Turn the dew heaters off  | 0     |
| 18 | Hood heater override <sup>(1)</sup> | 0-1     | 0=Allow the CS120A to automatically control the hood heaters<br>1=Turn the hood heaters off  | 0     |
| 19 | Dirty window compensation           | 0-1     | 0 = No compensation applied<br>1 = Compensation for dirt on lenses applied.<br>The CS120A will compensate for up to 10% signal loss due to dirt per lens.  | 0     |

|    |  |      |   |     |
|----|--|------|---|-----|
| 20 | Use CRC                                  | 0-1  | 0 = Disable command line CRC checking <sup>(2)</sup><br>1 = Enable command line CRC checking<br>Note: this does not affect communications via DevConfig or terminal emulator. | 0   |
| 21 | Sensor power down voltage <sup>(3)</sup> | 7-30 | PSU Input voltage level below which the CS120A will enter low power mode. This is usually used to protect batteries.  | 7.0 |

(1) Hood heater override needs to be set to '1' (off) when either no hood heaters are installed or the hood heaters have no power connected to them. This will save power as the relay is not enabled at low temperatures in this mode.

(2) If disabled the sensor does not check the validity of received data against the checksum sent. It is, however, recommended that checksum checking is enabled to remove any chance of the CS120A being configured incorrectly by accident.

(3) Only available if the sensor is running firmware version 4 or later and only functional for sensors with serial number greater than E1029.

## 13. Command line mode

The command line interface is broken down into three major commands. These are GET, SET and POLL. The GET command is used to request all current user settable values from the CS120A. The SET commands sets user settable values and the POLL command is used to request the current visibility and/or alarm conditions from the sensor.

The CS120A can be configured to expect any commands sent to it to include a valid checksum. For simple commands, e.g. GET and POLL, fixed value checksums can be used (see the example programs). For more complex SET commands the checksum needs to be calculated (see Appendix B). The use of the checksum is disabled by default. It is recommended that the checksum functionality is enabled where possible, especially when long cable runs are used, or in electronically noisy environments.

### 13.1 The SET command

The set command is used to configure the CS120A via the command line. The SET command is a single space delimited string that can be sent from any data logger or PC equipped with an RS232 or RS485 port. The SET command and the 'Device Configuration Utility' software access identical settings within the CS120A, please refer to the 'Device Configuration Utility' section of this document for a more detailed breakdown of the setting available here. This command is used to change the default power up state of the sensor. See Section 14.2 if a setting is going to be changed on a regular basis e.g. heater controls.

See Section 12 for more information on the values used by the 'SET' command.



| SET transmitted data |  |
|----------------------|--|
| Example              | Description                                  |
| 0x02 <sup>(1)</sup>  | STX ^B <sup>(2)</sup>                        |
| :                    | Delimiting character                         |
| SET                  | SET  |
| :                    | Delimiting character                         |
| 0                    | Address based on Sensor ID                   |
| :                    | Delimiting character                         |
|                      | Sensor ID                                    |
|                      | User Alarm 1 Set                             |
|                      | User Alarm 1 Active                          |
|                      | User Alarm 1 Distance                        |
|                      | User Alarm 2 Set                             |
|                      | User Alarm 2 Active                          |
|                      | User Alarm 2 Distance                        |
|                      | Serial Baud Rate                             |
|                      | <i>Sensor serial number (read only)</i>      |
|                      | Visibility Units                             |
|                      | Message interval                             |
|                      | Polling Or Continuous modes                  |
|                      | Message Format (Basic/Partial/Full)          |
|                      | RS232 or RS485 serial communications enabled |
|                      | Averaging Period                             |
|                      | Sample timing                                |
|                      | Dew heater override                          |
|                      | Hood heater override                         |
|                      | Dirty window compensation                    |
|                      | CRC checking on received commands            |
|                      | Sensor power down voltage                    |
| :                    | Delimiting character                         |
| XXXX                 | Checksum (use the valid CCITT checksum)      |
| :                    | Delimiting character                         |
| 0x03 <sup>(1)</sup>  | ETX ^C <sup>(2)</sup>                        |
| 0x0D <sup>(1)</sup>  | Carriage return                              |
| 0x0A                 | Line feed                                    |

(1) These values are shown in hexadecimal format not ASCII.

(2) As entered on a keypad.

### 13.1.1 Example of a SET Command

```
•SET:0:0 1 1 1000 1 0 15000 2 0 M 60 1 2 0 1 1 0 0 0 1 7 :68A3:•
```

## 13.2 The SETNC Command

The format of the SETNC command is nearly exactly the same as the SET command. The only functional difference is that the SETNC command does not commit the values set into flash memory. This means that the next time the CS120A is power cycled it will revert back to its previous settings. This command should be used when a setting in the sensor is changed regularly, e.g. heater functions, as this command avoids the risk of wearing out the flash storage memory. Note: this includes communication data rates as well.

### 13.2.1 Example of a SETNC Command

```
•SETNC:0:0 1 1 1000 1 0 15000 2 0 M 60 1 2 0 1 1 0 0 0 1 7 :D82D:•
```

## 13.3 The GET Command

The GET command retrieves settings data from the CS120A, including message format data and user alarm settings amongst others. This command does not retrieve visibility or environmental information from the CS120A. To retrieve visibility data refer to the POLL command.

### The GET request

| GET transmitted data |                                       |
|----------------------|---------------------------------------|
| Example              | Description                           |
| 0x02 <sup>(1)</sup>  | STX (^B) <sup>(2)</sup>               |
| GET                  | GET                                   |
| :                    | Delimiting character                  |
| 0                    | Address based on Sensor ID            |
| :                    | Delimiting character                  |
| 0                    | Reserved for future use, zero default |
| :                    | Delimiting character                  |
| XXXX                 | Checksum                              |
| :                    | Delimiting character                  |
| 0x03 <sup>(1)</sup>  | ETX (^C) <sup>(2)</sup>               |
| 0x0D <sup>(1)</sup>  | Carriage return                       |
| 0x0A                 | Line feed                             |

(1) These values are shown in hexadecimal format not ASCII.

(2) As entered on a keypad

### Example of a GET command

```
GET:0:0:XXXX:
```

**Example data returned by the GET command** – See Section 12 for more information on values returned by the 'GET' command

| GET returned data   |                  |
|---------------------|------------------|
| Example             | Description      |
| 0x02 <sup>(1)</sup> | STX              |
|                     | Sensor ID        |
|                     | User Alarm 1 Set |

|                     |  |
|---------------------|--|
|                     | User Alarm 1 Active                          |
|                     | User Alarm 1 Distance                        |
|                     | User Alarm 2 Set                             |
|                     | User Alarm 2 Active                          |
|                     | User Alarm 2 Distance                        |
|                     | Serial Baud Rate                             |
|                     | <i>Sensor serial number (read only)</i>      |
|                     | Visibility Units                             |
|                     | Message interval                             |
|                     | Polling Or Continuous modes                  |
|                     | Message Format (Basic/Partial/Full)          |
|                     | RS232 or RS485 serial communications enabled |
|                     | Averaging Period                             |
|                     | Sample timing                                |
|                     | Dew heater override                          |
|                     | Hood heater override                         |
|                     | Dirty window compensation                    |
|                     | CRC checking on received commands            |
|                     | Sensor power down voltage 7.0                |
| :                   | Delimiting character                         |
| XXXX                | Checksum                                     |
| :                   | Delimiting character                         |
| 0x04 <sup>(1)</sup> | EOT  |
| 0x0D <sup>(1)</sup> | Carriage return                              |
| 0x0A                | Line feed                                    |

(1) These values are shown in hexadecimal format not ASCII.

#### Example of a GET returned data

|   |
|---|
| 0 0 0 10000 0 0 10000 2 1009 M 30 0 2 1 1 1 0 0 0 1 11.5 D4FD |
|---|

Explanation: -

Sensor ID = 0

User Alarm 1 not set

User Alarm 1 not active

User Alarm 1 distance = 10000 metres

User Alarm 2 not set

User Alarm 2 not active

User Alarm 2 distance = 10000 metres

Serial baud rate 2 (=38400Bd)

Serial number = 1009

Visibility Units = M

Continuous mode output interval = 30 seconds

Polling mode = 0 (continuous mode)

Message format = 2 (full message)

RS232 or RS485 serial communications = 1 (RS485)

Averaging period = 1 minute

Sample timing = 1 sample per second

Dew heater override = 0 (CS120A will automatically control the dew heaters)

Hood heater override = 0 (CS120A will automatically control the hood heaters)

Dirty window compensation = 0 (dirty window compensation off)

CRC checking on received commands = 1 (CRC checking enabled)

Sensor power down voltage = 11.5V

Checksum = D4FD

## 13.4 The POLL command – Polling the CS120A

The POLL command requests the current visibility and/or alarm conditions from the CS120A. The output format of this command depends on how the CS120A is configured using the SET command or the menu interfaces.

### The POLL request

| POLL transmitted data |                                       |
|-----------------------|---------------------------------------|
| Example               | Description                           |
| 0x02 <sup>(1)</sup>   | STX, ^B <sup>(2)</sup>                |
| POLL                  | POLL                                  |
| :                     | Delimiting character                  |
| 0                     | Address based on Sensor ID            |
| :                     | Delimiting character                  |
| 0                     | Reserved for future use, zero default |
| :                     | Delimiting character                  |
| XXXX                  | Checksum <sup>(3)</sup>               |
| :                     | Delimiting character                  |
| 0x03 <sup>(1)</sup>   | ETX, ^C <sup>(2)</sup>                |
| 0x0D <sup>(1)</sup>   | Carriage return                       |
| 0x0A                  | Line feed                             |

(1) These values are shown in hexadecimal format not ASCII.

(2) As entered on a keypad.

(3) Not case sensitive.

### Example of a POLL request

```
POLL:0:0:XXXX:
```

**NOTE**

---

The maximum response time to a poll command is 100 ms.

---

If the setting to check the checksum on received commands is enabled the checksum varies with the Sensor ID value.

## 14. Entering the CS120A menu system

The user can enter the menu system by typing 'open *id*' into their terminal program then pressing the return key on their keyboard. The *id* corresponds to the sensor ID number. The Sensor ID number can be in the range of 0 to 9. The factory default is 0.

**NOTE**

---

The 'open 0' command is not normally echoed.  
The terminal menu only gives access to more common settings.

---

The following text should now be displayed:

```
WELCOME TO THE CAMPBELL SCIENTIFIC LTD CS120A SETUP
MENU
ID 0
S/N 1009
(1) Message output menu
(2) User alarm menu
(3) Calibrate CS120A
(4) System information
(5) Communications setup

(9) Exit and save
(0) Exit and don't save
```

The displayed options are accessed simply by typing the corresponding number then pressing return. No changes will take effect until you 'Exit and Save'. The exception to this is the calibration menu, but you will be informed before any changes are made.

Typing '1' opens the message menu containing settings relating to the CS120A's outputs.

**Menu 1: The message output menu**

```
CS120A MESSAGE - MENU 1
ID 0
S/N 1009
(1) Toggle message format:FULL
(2) Toggle units:METRES
(3) Toggle polled or continuous mode:CONTINUOUS
(4) Set continuous mode output interval:6 second(s)
(5) Toggle output averaging period: 1 minute(s)
(6) Sampling interval:1 second(s)

(9) Refresh
(0) Return to main menu
```

For example, typing `2` will toggle the units through the options `METRES` and `FEET` and typing `4` will allow the message interval to be entered.

Option (2) allows the User Alarms to be set, again by toggling through options or changing values.

**Menu 2: The user alarm menu**

```
CS120A ALARM - MENU 2
ID 0
S/N 1009
(1) Toggle user alarm one: DISABLED
(2) Toggle alarm one threshold: LESS THAN
(3) Set new user alarm one activation point: 10000 m
(4) Toggle user alarm two: DISABLED
(5) Toggle alarm two threshold: LESS THAN
(6) Set new user alarm two activation point: 10000 m

(9) Refresh
(0) Return to main menu
```

Option (3) is the calibration menu

**Menu 3: The calibration menu**

```
CS120A CALIBRATION - MENU 3
ID 0
S/N 1009
(1) Perform calibration
(2) Restore the factory calibration

(9) Refresh
(0) Return to main menu

->
```

Consult the `calibration` section of this manual for information on how to calibrate the CS120A visibility sensor.

**NOTE**

Once a calibration is finished changes are immediate, but factory calibrations can be restored if needed using Option `(2)` in the calibration menu. The disk constants however remain as the last disk used.

Option (4) gives the systems information menu containing useful information such as temperature and system alarms.

**Menu 4: The system information menu**

```

CS120A INFORMATION - MENU 4
ID 0
S/N 1009
OS version: CS120Av7

Alarm      Value
- Last visibility reading:    -      5017M
- Overall system status:     0      No faults
- Emitter dirty window alarm: 0      -4%
- Emitter internal temperature: 0      33.3
- Detector dirty window alarm: 0      0%
- Detector internal temperature: 0      28.9
- Detector DC light saturation: 0      -
- Hood heater temperature:    0      24.9
- CS120A Calibrator Serial No: -      1000
- CS120A Calibrator Constant: -      30.5
- Calibration value Fac offset: -      -0.136
- Calibration value Fac scale: -      0.02724
- Calibration value Cal offset: -      -0.136
- Calibration value Cal scale: -      0.02724
- Signature fault:           0      -
- Flash write errors:         0      0
- Flash read errors:          0      0
- Supply voltage:             <9.0V  12.5V

(8) Get debug
(9) Refresh
(0) Return to main menu

```

If either of the dirty window alarms are set it is recommended you follow the cleaning section of this manual (Section 18).

If there is a flash error or signature error it is recommended that you contact Campbell Scientific.

The sensor power down voltage shown before the supply voltage is only available if the sensor is running firmware version 4 or later and only functional for sensors with serial number greater than E1029.

**Menu 5: The communication menu**

```

CS120A COMMUNICATIONS - MENU 5
ID 0
S/N 1009
(1) Set sensor ID
(2) Set RS232/RS485 baud rate:38400
(3) Toggle RS232/RS485 modes:RS232

(9) Refresh
(0) Return to main menu

->

```

The communications menu is used to set baud rates and the mode of operation (RS232/RS485).

**NOTE**

No change will take effect until you `exit and save`.

**Menu 9 and 0: Exiting the menu system**

Options `9` and `0` exit from the menu system. Note that typing `0` will lose all changes made including communications settings.

```
CAMPBELL SCIENTIFIC LTD CS120A menu exited.
```

## 15. Calibrating the CS120A

The CS120A can be checked and adjusted using the optional CS120A calibrator part number 010816. The calibration must be run using the onboard menu system. If you have Campbell Scientific's Device configuration program a terminal emulation screen is provided in the CS120A screens to let you access this function. To perform the calibration you will need a CS120A calibrator disk and a computer with a standard serial port compatible with the CS120A. If your CS120A is not currently configured for RS232 communications you can set the internal switch, switch three, to temporarily set the sensor to RS232 mode 38400bps. If the sensor is already set in RS232 mode it should not be necessary to change any internal switches. (See Section 10 for more information on the CS120A internal switches.)

The test should ideally be performed in the following conditions:

- Ambient temperature should be 20°C +/-10°C
- The local visibility should be approximately 10,000 metres or higher.

The system is self-regulating. However, it is recommended that the CS120A is calibrated every two years.



The calibration is performed from menu item 3 on the main terminal screen. Please refer to the menu section (Section 13) of this manual for further information on how to access this menu.

Once you have selected menu item 3 you should be presented with the following screen.

```
CS120A CALIBRATION - MENU 3
ID 0
S/N 1009
(1) Perform calibration
(2) Restore the factory calibration

(9) Refresh
(0) Return to main menu

->
```

Select option 1 to start the calibration. You will then be asked to confirm that you would like to perform a calibration. Please note, once you have entered yes at this point you will not be able to exit until the test is complete. However, power cycling the unit at this point will have no adverse effect on the sensor.

```
Do you want to perform a calibration Y/N?
```

Once you have started the tests you will be asked for the CS120A calibrator serial number and coefficient with a confirmation at each step giving you the chance to correct typing mistakes.

---

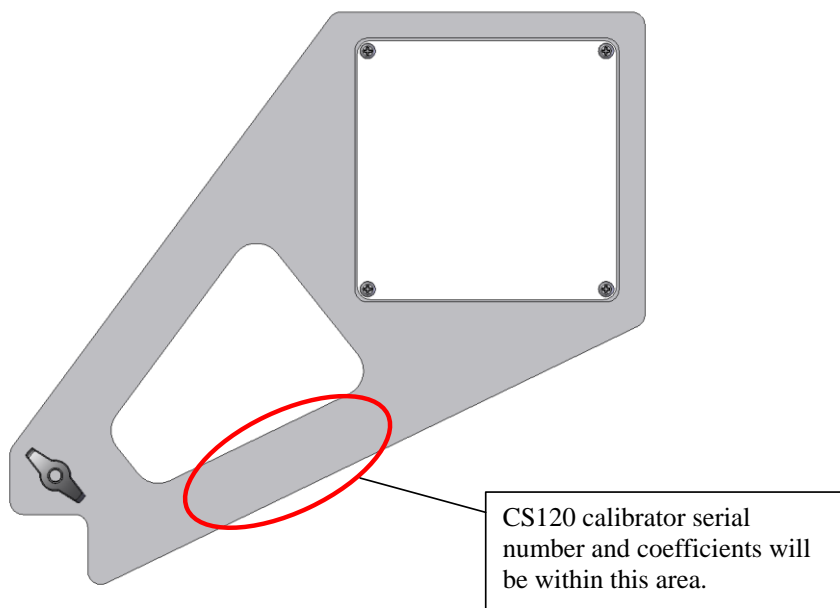
**NOTE**

When asked for confirmation you do not need to press return after you type 'y'.

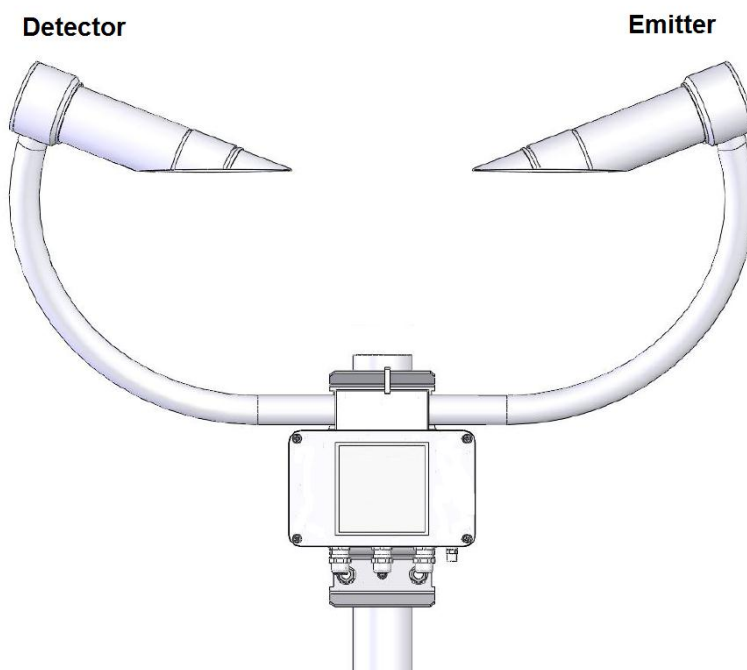
---

```
Starting calibration.
Input the CS120A calibrator serial number ->12345
Is 12345 correct? (Y/N)?
Input the CS120A calibrator constant ->10000
Is 10000 correct? (Y/N)?
```

```
Place one calibration bung into each hood, then
press any key.
```



When you have entered the calibrator information the sensor will wait for you to place the foam bungs into the sensor hoods. The bungs are designed to block all light from the outside reaching inside the head. Place one bung into each hood. If either of the bungs are damaged or appear to have any gaps around the edge please contact Campbell Scientific.



Starting dark level calibration.  
This test will take approximately two minutes

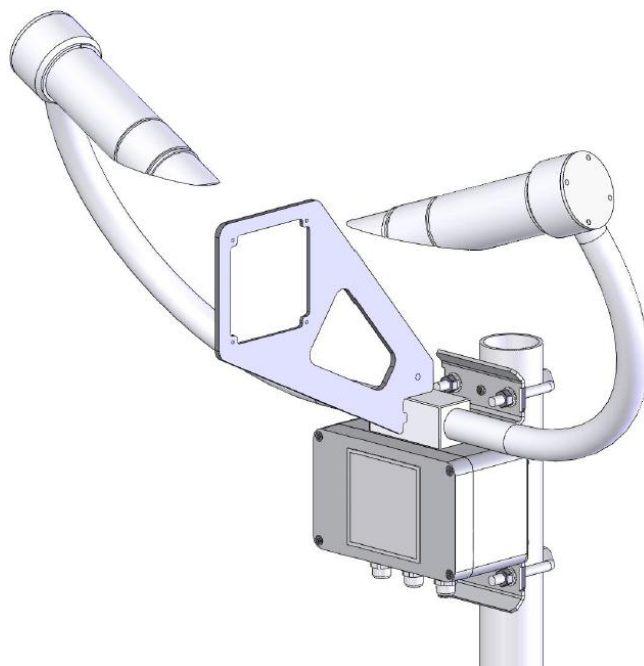
This part of the test will take approximately two minutes. Every ten seconds a dot should appear indicating that the test is progressing as normal.

Dark level test complete. Please remove the bungs.  
Now place the CS120A calibrator into the sampling  
volume.  
Press any key once this is done.

Remove the bungs once the sensor instructs you to. Place the CS120A calibrator into the volume by fastening it to the central mounting point.

**NOTE**

At this stage it is advisable to clean the lenses. Refer to Section 18 'Cleaning' for more information. A simple visual check may be enough to confirm the lenses are clean.



Starting light level calibration.  
This test will take approximately two minutes.

This part of the test will take approximately two minutes. Every ten seconds a dot should appear indicating that the test is progressing as normal.

Calibration is now complete.  
Saving user settings  
Press any key to exit.

Once the second stage of the test has been completed the new calibration constants will be saved automatically. All calibration constants including both the user and the factory setting can be viewed from menu item 4 from the main menu once the test is completed.

## 16. Performing an operating system update

Operating system updates for the CS120A visibility sensor are performed using Campbell Scientific's Device Configuration Utility (DevConfig) software. Please refer to the help built into the DevConfig software for full instructions on how to update the CS120A operating system. Note that CS120A operating systems cannot be installed on CS120 sensors.

## 17. Cleaning

The CS120A visibility sensor is a robust instrument that will provide years of uninterrupted weather monitoring. Calibration of the instrument is carried out at the factory and can be redone easily on site with the optional CS120A calibrator or carried out by Campbell Scientific if required. Only general cleaning of the lenses is required to keep the sensor working efficiently.

Cleaning of the CS120A will be required from time to time to ensure that the lenses are free from contaminants. The frequency of required cleaning depends on the exposure of the instrument to such contaminants. This will vary depending on the site location. The CS120A is capable of self diagnosing dirty lenses and will indicate in its output when the lenses are contaminated to such a degree that its visibility measurements may be affected.

### NOTE

A lower level of contamination than is detected by the dirty window alarms, can affect the visibility measurements. The sensor will attempt to make a correction for contamination although the accuracy of that correction depends on the 'type of dirt'.

In any case we suggest 6 monthly intervals for locations not prone to contaminants and monthly intervals for those prone to contamination (roadside or airport use). In some cases more frequent cleaning may be required where there are high levels of contaminants and high dependency on the instrument output.

### CAUTION

If the lenses require cleaning, it is very important that only a proper lens cloth or lens tissue be used. The use of inappropriate materials to clean the lenses can permanently damage or reduce the effectiveness of the lenses leading to errors in measurement of precipitation and visibility.

It is advisable to use an air duster to blow any loose dust and dirt from the lenses as a first step. Using a lint free lens cloth or lens tissue impregnated with a small

amount of isopropyl alcohol solvent clean the lens surface by dragging the cloth across the lens surface being careful not to apply excessive pressure.

Excessive pressure may lead to some types of contaminant scratching the lens surface. Over time such scratches can lead to reduced sensor accuracy.

#### NOTE

Spiders webs and certain 'fluffy' seeds which get lodged in the optical path can lead to the sensor permanently giving low readings as they can emulate precipitation. Cleaning the contamination away with a duster will return the sensor to normal operation.

If spiders are a persistent problem, using some carefully applied insecticide can deter them.

## 18. Lubricating the enclosure screws

The CS120A enclosure screws should be lubricated with a suitable anti-seize grease (often copper loaded) to protect the threads from corrosion. This should be reapplied when resealing the enclosure at regular intervals, normally after replacing the desiccant. This is of particular importance if using the sensor in corrosive or salt laden atmospheres.

## 19. Desiccant

Two bags of desiccant are supplied. One is inside the enclosure, the other is separate and sealed in a plastic bag. Desiccant use depends on your application but for use in typical temperature conditions one bag is sufficient for a twelve month period. The desiccant should be placed inside the enclosure taking care that it is not trapped between the lid and the enclosure when the lid is replaced.

The second bag of desiccant should be kept in the plastic shipping bag as a replacement for when the initial bag needs to be dried out. The bags can be rotated in this way many times. Desiccant bags can be dried out by the following method:

1. Arrange the bags on a wire tray in a single layer to allow for adequate air flow around the bags during the drying process. The oven's inside temperature should be room or ambient temperature (25°C - 30°C). A convection, circulating, forced air type oven is recommended for this regeneration process. Seal failures may occur if any other type of heating unit or appliance is used.
2. When placed in a forced air, circulating air, or convection oven, allow a minimum of 4 to 5 cm of air space between the top of the bags and the next metal tray above the bags. If placed in a radiating exposed infrared element type oven, shield the bags from direct exposure to the heating element, giving the closest bags a minimum of 40 cm clearance from the heat shield. Excessive surface film temperature due to infrared radiation will cause the Tyvek material to melt and/or the seals to fail. Seal failure may also occur if the temperature is allowed to increase rapidly. This is due to the fact that the water vapour is not given sufficient time to diffuse through the Tyvek material, thus creating internal pressure within the bag, resulting in a seal rupture. Temperature should not increase faster than 0.1°C to 0.3°C per minute.

3. Set the temperature of the oven to 118°C, and allow the bags of desiccant to reach equilibrium temperature.

---

**CAUTION**

---

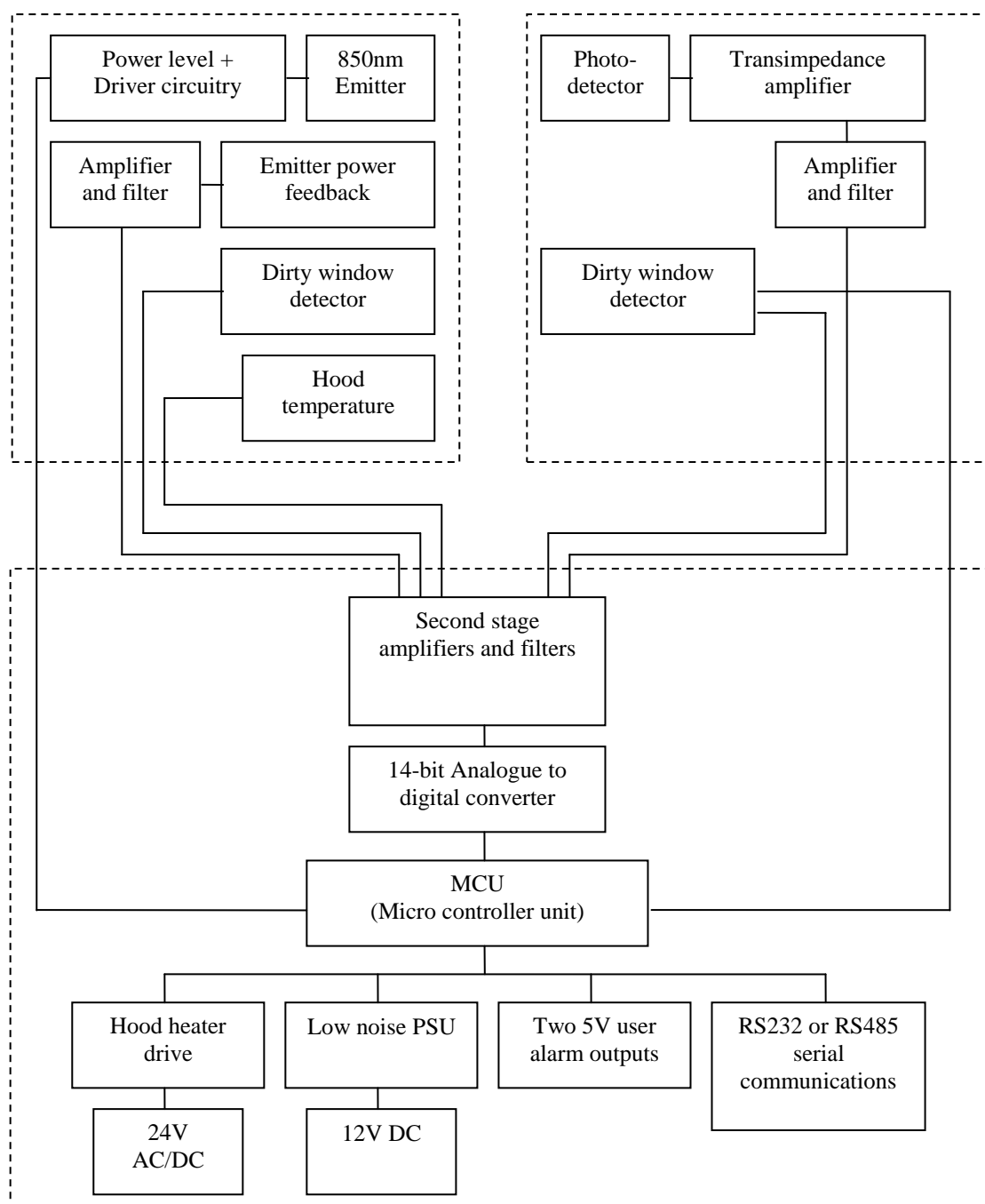
Tyvek has a melting temperature of 121°C - 127°C.

---

(NON MIL-D-3464E activation or reactivation of both silica gel and Bentonite clay can be achieved at temperatures of 104°C).

4. Desiccant bags should be allowed to remain in the oven at the assigned temperature for 24 hours. At the end of this period, the bags should be immediately removed and placed in a desiccators jar or dry (0% relative humidity) air tight container for cooling. If this procedure is not followed precisely, any water vapour driven off during reactivation may be re-adsorbed during cooling and/or handling.
5. After the bags of desiccant have been allowed to cool in an airtight desiccator, they may be removed and placed in either an appropriate type polyliner tightly sealed to prevent moisture adsorption, or a container that prevents moisture from coming into contact with the regenerated desiccant. Some care should be taken when re-activating desiccant bags. If heated in an oven which is too hot, the bags may burst. If in any doubt, we recommend purchasing new desiccant packs instead of oven drying. Failure to use or exchange the desiccant may lead to condensation inside the enclosure. Not only will this lead to corrupted data but, in the long term, can also cause corrosion which is expensive to repair.

## Appendix A. CS120A block diagram







# Appendix B. Example C code of the CCITT CRC

---

The code below is provided as an example for programmers implementing their own code to communicate with the sensor. Users using Campbell loggers can use the Checksum command in CRBasic to generate a CCITT checksum. Command: Checksum/ChkSumString,1,0).

The checksum includes all characters excluding the SOT, EOT and the checksum itself.

The SET and SETNC commands also exclude the two delimiting ':' characters, one on each side of the checksum itself.

```
//-----  
// Creates a CCITT CRC16 checksum seeded with 0x0000 (XModem style) using a  
// fast non table based algorithm.  
// Pass in the data to convert into a CRC in the form of a NULL terminated  
// character array (a string).  
// Returns the CRC in the form of an unsigned 16 bit integer value  
// Note: This algorithm has only been tested on a native 16-bit processor with  
//       a hardware barrel shifter  
//       All integers are 16-bits long  
//-----  
unsigned int CRC_CCITT(char LineOfData[]){  
  
    unsigned int crc; // returned CRC value  
    unsigned int i;   // counter  
  
    crc = 0x0000;  
  
    // create a check sum for the incoming data  
    for(i=0;i < strlen(LineOfData); i++){  
        unsigned crc_new = (unsigned char)(crc >> 8) | (crc << 8);  
        crc_new ^= LineOfData[i];  
        crc_new ^= (unsigned char)(crc_new & 0xff) >> 4;  
        crc_new ^= crc_new << 12;  
        crc_new ^= (crc_new & 0xff) << 5;  
        crc = crc_new;  
    }  
  
    return(crc);  
}
```



# Appendix C. Example CRBasic programs

## C.1 CRBasic read program

```
'CR800
'Demonstration program to read data from a CS120A set to continuous output
'with the default message being transmitted
'This is the default behaviour of the CS120A.

Public Visibility
'These variables could be defined as DIM in a final program

Public InString As String * 100 'Incoming string
Public SerialIndest(20) As String, NBytesReturned
Public ChecksumOK As Boolean

Public lngCRCCalc As Long, lngCRCMsg As Long
'Define the aliases for the full message
Alias SerialIndest(1)=Message_ID '0..2
Alias SerialIndest(2)=Sensor_ID '0..9
Alias SerialIndest(3)=System_status '0..3
Alias SerialIndest(4)=Interval_time '1..3600
Alias SerialIndest(5)=Visibilitystr '0..32000 metres
Alias SerialIndest(6)= VisibilityUnits 'M or F for Metres or Feet
Alias SerialIndest(7)=Averaging_duration '1 or 10 minutes
Alias SerialIndest(8)=User_alarm_1 '0..1 - Visibility compared to Threshold One
Alias SerialIndest(9)=User_alarm_2 '0..1 - Visibility compared to Threshold Two
Alias SerialIndest(10)=Emitter_failure '0..2 - Emitter Failure
Alias SerialIndest(11)=Emitter_lens_dirty '0..3 - Emitter Lens Dirty
Alias SerialIndest(12)=Emitter_temp_error '0..3 - Emitter Temperature
Alias SerialIndest(13)=Detector_lens_dirty '0..3 - Detector Lens Dirty
Alias SerialIndest(14)=Detector_temp_error '0..3 - Detector Temperature
Alias SerialIndest(15)=Detector_saturated '0..1 - Detector DC Saturation Level
Alias SerialIndest(16)=Hood_temp_error '0..3 - Hood Temperature
Alias SerialIndest(17)=Signature_error '0..1 - Signature Error
Alias SerialIndest(18)=Flash_read_error '0..1 - Flash Read Error
Alias SerialIndest(19)=Flash_write_error '0..1 - Flash Write Error
Alias SerialIndest(20) = checksumrx 'CCITT Checksum
'Define the serial port to which the CS120A is connected - amend as needed
Const CS120A_Comport = COM1

'Main Program
BeginProg
'Open the logger serial port to which the CS120A is connected
SerialOpen (CS120A_Comport,38400,3,0,1000)

Scan(10,Sec,1,0)
'Default behaviour is for the CS120A to send a message every 60 seconds
'so this will fail 5 times out of 6
SerialInRecord(CS120A_Comport,InString,&h02,0,&h03,NBytesReturned,01)
'Check that a message has been received first
If NBytesReturned > 0 Then
    SplitStr (SerialIndest(),InString," ",20,5)
    'Check the received checksum is valid
    'Calculate the expected checksum
    lngCRCCalc = CheckSum(InString,1,NBytesReturned-5)
    'Extract the checksum from the message & convert it for comparison
    lngCRCMsg = HexToDec(checksumrx)
    ChecksumOK = ( lngCRCMsg = lngCRCCalc)
    'In critical applications the visibility can be set to NaN if the system status
    'is degraded or a critical error flag is set.
    If ChecksumOK Then Visibility = Visibilitystr Else Visibility =NaN
EndIf
'Call data storage commands here
NextScan
EndProg
```

## C.2 CRBasic POLL program

```
'CR800
'Demonstration program to read data from a CS120A set to polled output
'with the full (default) message being transmitted
'Note: the sensor needs to be preconfigured to behave like this, it is not setup by
this program.

Public Visibility
'These variables could be defined as DIM in a final program

Public InString As String * 100 'Incoming string
Public SerialIndest(20) As String, NBytesReturned
Public ChecksumOK As Boolean

Public lngCRCCalc As Long, lngCRCMsg As Long
'Define the aliases for the full message
Alias SerialIndest(1)=Message_ID '0..2
Alias SerialIndest(2)=Sensor_ID '0..9
Alias SerialIndest(3)=System_status '0..3
Alias SerialIndest(4)=Interval_time '1..3600
Alias SerialIndest(5)=Visibilitystr '0..32000 metres
Alias SerialIndest(6)= VisibilityUnits 'M or F for Metres or Feet
Alias SerialIndest(7)=Averaging_duration '1 or 10 minutes
Alias SerialIndest(8)=User_alarm_1 '0..1 - Visibility compared to Threshold One
Alias SerialIndest(9)=User_alarm_2 '0..1 - Visibility compared to Threshold Two
Alias SerialIndest(10)=Emitter_failure '0..2 - Emitter Failure
Alias SerialIndest(11)=Emitter_lens_dirty '0..3 - Emitter Lens Dirty
Alias SerialIndest(12)=Emitter_temp_error '0..3 - Emitter Temperature
Alias SerialIndest(13)=Detector_lens_dirty '0..3 - Detector Lens Dirty
Alias SerialIndest(14)=Detector_temp_error '0..3 - Detector Temperature
Alias SerialIndest(15)=Detector_saturated '0..1 - Detector DC Saturation Level
Alias SerialIndest(16)=Hood_temp_error '0..3 - Hood Temperature
Alias SerialIndest(17)=Signature_error '0..1 - Signature Error
Alias SerialIndest(18)=Flash_read_error '0..1 - Flash Read Error
Alias SerialIndest(19)=Flash_write_error '0..1 - Flash Write Error
Alias SerialIndest(20) = checksumrx 'CCITT Checksum
'Define the serial port to which the CS120A is connected - amend as needed
Const CS120A_Comport = COM1

'Preload the poll command for a sensor for address 0, in this example
'If the sensor has a different address uncomment the relevant line
Const CS120A_Poll = CHR(2) & "POLL:0:0:3A3B:" & CHR(3) & CHR(13) 'address 0
'Const CS120A_Poll = CHR(2) & "POLL:1:0:0D0B:" & CHR(3) & CHR(13) 'address 1
'Const CS120A_Poll = CHR(2) & "POLL:2:0:545B:" & CHR(3) & CHR(13) 'address 2
'Const CS120A_Poll = CHR(2) & "POLL:3:0:636B:" & CHR(3) & CHR(13) 'address 3
'Const CS120A_Poll = CHR(2) & "POLL:4:0:E6FB:" & CHR(3) & CHR(13) 'address 4
'Const CS120A_Poll = CHR(2) & "POLL:5:0:D1CB:" & CHR(3) & CHR(13) 'address 5
'Const CS120A_Poll = CHR(2) & "POLL:6:0:889B:" & CHR(3) & CHR(13) 'address 6
'Const CS120A_Poll = CHR(2) & "POLL:7:0:BFAB:" & CHR(3) & CHR(13) 'address 7
'Const CS120A_Poll = CHR(2) & "POLL:8:0:939A:" & CHR(3) & CHR(13) 'address 8
'Const CS120A_Poll = CHR(2) & "POLL:9:0:A4AA:" & CHR(3) & CHR(13) 'address 9

'Main Program
BeginProg
'Open the logger serial port to which the CS120 is connected
SerialOpen (CS120A_Comport,38400,3,0,1000)
Scan(10,Sec,1,0)
'This will poll every 10 seconds.
SerialOut(CS120A_Comport,CS120A_Poll,"",0,100)
SerialInRecord(CS120A_Comport,InString,&h02,0,&h03,NBytesReturned,01)
'Check that a message has been received first
If NBytesReturned > 0 Then
  SplitStr (SerialIndest(),InString," ",20,5)
  'Check the received checksum is valid
  'Calculate the expected checksum
  lngCRCCalc = CheckSum(InString,1,NBytesReturned-5)
```

```
        'Extract the checksum from the message & convert it for comparison
lngCRCMsg = HexToDec(checksumrx)
ChecksumOK = ( lngCRCMsg = lngCRCCalc)
'In critical applications the visibility can be set to NaN if the system status
'is degraded or a critical error flag is set.
If ChecksumOK Then Visibility = Visibilitystr Else Visibility =NaN
EndIf
'Call data storage commands here
NextScan
EndProg
```

## C.3 Example CRBasic SET program

```

'-----
' CS120A Visibility
'
' Program to test the SET command part of the command line interface on the CS120A
' Do not run this script for extended periods of time (days!) as it writes
' to flash over and over and will eventually wear the flash out
' Logger:CR1000
'-----

Public InString As String * 200
Public TempString As String *100

' Variables for the SET command subroutine
Dim CS120ACArray(21) As String * 6 ' CS120A Command Array

'-----
' This function creates a SET command string for the
' CS120A visibility sensor. Including all delimiting
' characters and checksums
' then returns the string in "CS120ACCommandString"
' Array variable order is as follows:
' 1. Sensor ID
' 2. User Alarm 1 Set
' 3. User Alarm 1 Active
' 4. User Alarm 1 Distance
' 5. User Alarm 2
' 6. User Alarm 2 Active
' 7. User Alarm 2 Distance
' 8. Serial BaudRate
' 9. Serial number (Read only so not used)
' 10. Visibility Units
' 11. Continuous mode output interval
' 12. Polling Or Continuous modes
' 13. Message Format (Basic/Partial/Full)
' 14. RS232 or RS485 serial communications enabled
' 15. Averaging Period
' 16. Sample timing
' 17. Dew heater override
' 18. Hood Heater override
' 19. Dirty window compensation
' 20. Use CRC checking
' 21. PSU input voltage shutdown level
Function CS120A_SETCommand As String *100
    Dim TempStringFunc As String * 100
    Dim CS120ACCommandString As String * 100
    Dim i As Long
    Dim CheckVal As Long

    ' Create a string containing the values going out to the CS120A
    TempStringFunc = "SET:0:"
    For i = 1 To 21
        TempStringFunc = TempStringFunc + CS120ACArray(i) + " "
    Next
    ' Create a check sum of the values going out

```

```

    CheckVal = CheckSum (TempStringFunc,1,0)    ' Use the CCITT CRC16 checksum
    ' Create final string going out to CS120A including start characters and end
characters
    CS120ACommandString = CHR(2) + TempStringFunc + ":" + FormatLong (CheckVal,"%04X")
+ ":" + CHR(3) + CHR(13) + CHR(10)
    'CS120ACommandString = CHR(2) + TempStringFunc + CHR(3) + CHR(13) + CHR(10) ' Use
this line if no checksum is desired
    Return (CS120ACommandString)
EndFunction
'-----

'Main Program
BeginProg

    ' open port to the visibility sensor using Com1
    SerialOpen (Com1,38400,3,0,10000)

    ' Note: Change the following array variable to suit your own application
    ' load example/dummy values into the array
    CS120ACArray(1) = 0        ' Set ID to 0
    CS120ACArray(2) = 1        ' Enable alarm 1
    CS120ACArray(3) = 1        ' Set alarm 1 to if greater than
    CS120ACArray(4) = 1000     ' Set alarm 1 trigger distance to 1000
    CS120ACArray(5) = 1        ' Enable alarm 2
    CS120ACArray(6) = 0        ' Set alarm 2 to if less than
    CS120ACArray(7) = 15000    ' Set alarm 2 trigger distance to 15000
    CS120ACArray(8) = 2        ' Set serial baud rate to 38400bps
    CS120ACArray(9) = 0        ' Read only so dummy value added here, but not needed
    CS120ACArray(10) = "M"     ' Set unit type to metres (use upper case)
    CS120ACArray(11) = 60      ' Set output period to 60 seconds
    CS120ACArray(12) = 1       ' Polling mode
    CS120ACArray(13) = 2       ' Set FULL output message format
    CS120ACArray(14) = 0       ' Set RS232 serial mode
    CS120ACArray(15) = 1       ' Set averaging over one minute
    CS120ACArray(16) = 1       ' Set sample timing to one second
    CS120ACArray(17) = 0       ' Set dew heaters to automatic
    CS120ACArray(18) = 0       ' Set hood heaters to automatic
    CS120ACArray(19) = 0       ' Don't use dirty window compensation
    CS120ACArray(20) = 1       ' Use CRC checking on incoming command line data
    CS120ACArray(21) = 7.0     ' Set Low voltage battery shutdown to a very low value so
it doesn't trigger

    ' Send information once every 10 seconds
    Scan (10,Sec,0,0)

    TempString = CS120A_SETCommand()           ' Create the outgoing string
    SerialOut (Com1,TempString,"",0,100)       ' Send SET command to the CS120A

    Delay (1,1,Sec)

    SerialIn (InString,Com1,100,0,1000)        ' Grab retuned data from the CS120A
                                                ' Returned data is identical to the
                                                ' data a GET command would return

    NextScan
EndProg

```

## C.4 Example CRBasic SETNC Command

```

'-----
' CS120A Visibility
'
' Program to test the SETNC command part of the command line interface on the
CS120A
' This command does not commit the settings to flash so settings will be lost if
' the sensor is power cycled
' This example uses a CS215 temperature and humidity probe to determine dew point.
' The CS120As hood heaters are then turned on only when needed, this is to save
power.
' Logger:CR1000
'-----

'Declare Public Variables
Public InStringSETNC As String * 200
Public InStringGET As String * 200
Public TRHData(2)
Public OutString As String * 40, CheckVal

Dim CS120ACArray(21) As String * 6 ' CS120A Command Array
Dim TempDewPoint
Dim StatusDewHeater
Dim TempString As String * 100

Alias TRHData(1)=AirTC
Alias TRHData(2)=RH

'-----
' This function creates a SETNC command string for the
' CS120A visibility sensor. Including all delimiting
' characters and checksums then returns the string
' in "CS120ACCommandString"
' Array variable order is as follows:
' 1. Sensor ID
' 2. User Alarm 1 Set
' 3. User Alarm 1 Active
' 4. User Alarm 1 Distance
' 5. User Alarm 2
' 6. User Alarm 2 Active
' 7. User Alarm 2 Distance
' 8. Serial BaudRate
' 9. Serial number (Read only so not used)
' 10. Visibility Units
' 11. Continuous mode output interval
' 12. Polling Or Continuous modes
' 13. Message Format (Basic/Partial/Full)
' 14. RS232 or RS485 serial communications enabled
' 15. Averaging Period
' 16. Sample timing
' 17. Dew heater override
' 18. Hood Heater override
' 19. Dirty window compensation
' 20. Use CRC checking
' 21. PSU input voltage shutdown level
Function CS120A_SETNCCommand As String *100

```



```

    Dim TempStringFunc As String * 100
    Dim CS120ACommandString As String * 100
    Dim i As Long
    Dim CheckVal As Long

    ' Create a string containing the values going out to the CS120A
    TempStringFunc = "SETNC:0:"
    For i = 1 To 21
        TempStringFunc = TempStringFunc + CS120ACArray(i) + " "
    Next
    ' Create a check sum of the values going out
    CheckVal = CheckSum (TempStringFunc,1,0) ' Use the CCITT CRC16 checksum
    ' Create final string going out to CS120A including start characters and end
    characters
    CS120ACommandString = CHR(2) + TempStringFunc + ":" + FormatLong (CheckVal,"%04X") +
    ":" + CHR(3) + CHR(13) + CHR(10)

    'CS120ACommandString = CHR(2) + TempStringFunc + CHR(3) + CHR(13) + CHR(10) ' Use this
    line if no checksum is desired
    Return(CS120ACommandString)
EndFunction
'-----

'Main Program
BeginProg

    ' Open port to the visibility sensor using Com1
    SerialOpen (Com1,115200,3,0,10000)

    ' Note: Change the following array variable to suit your own application
    ' load example/dummy values into the array
    ' Loading the array is not strictly necessary, but is done as a fail safe in
    ' case the GET command does not return data
    CS120ACArray(1) = 0      ' Set ID to 0
    CS120ACArray(2) = 0      ' Disable alarm 1
    CS120ACArray(3) = 1      ' Set alarm 1 to if greater than
    CS120ACArray(4) = 10000  ' Set alarm 1 trigger distance to 10000
    CS120ACArray(5) = 0      ' Disable alarm 2
    CS120ACArray(6) = 0      ' Set alarm 2 to if less than
    CS120ACArray(7) = 10000  ' Set alarm 2 trigger distance to 10000
    CS120ACArray(8) = 0      ' Set serial baud rate to 115200bps
    CS120ACArray(9) = 0      ' Read only so dummy value added here, but not needed
    CS120ACArray(10) = "M"   ' Set unit type to metres (use upper case)
    CS120ACArray(11) = 60    ' Set output period to 60 seconds
    CS120ACArray(12) = 1     ' Polling mode
    CS120ACArray(13) = 2     ' Set FULL output message format
    CS120ACArray(14) = 0     ' Set RS232 serial mode
    CS120ACArray(15) = 1     ' Set averaging over one minute
    CS120ACArray(16) = 1     ' Set sample timing to one second
    CS120ACArray(17) = 0     ' Set dew heaters to automatic
    CS120ACArray(18) = 0     ' Set hood heaters to automatic
    CS120ACArray(19) = 0     ' Don't use dirty window compensation
    CS120ACArray(20) = 1     ' Use CRC checking on incoming command line data
    CS120ACArray(21) = 7.0   ' Set Low voltage battery shutdown to a very low value so it
    doesn't trigger

    StatusDewHeater=False

```

Scan (10,Sec,0,0)

```

'CS215 Temperature & Relative Humidity Sensor measurements AirTC and RH
SDI12Recorder(TRHData(),5,"0","M!",1,0)

'Calculate DewPoint
DewPoint(TempDewPoint,AirTC,RH)

' Gather the current settings from the CS120A
SerialFlush (Com1)
TempString = "GET:0:0"
CheckVal = CheckSum (TempString,1,0) ' Use the CCITT CRC16 checksum
OutString = CHR(2) + TempString + ":" + FormatLong (CheckVal,"%04X") + ":" +
CHR(3) + CHR(13) + CHR(10)
SerialOut (Com1,OutString,"",0,100) ' Send GET command to the CS120A
Delay (1,1,Sec)
SerialIn (InStringGET,Com1,100,0,200) ' Save the data returned from the GET
command
If Len(InStringGET) > 1 Then ' Check data was returned
    SplitStr (CS120ACArray(1),InStringGET, " ",21,5) ' Strip the settings from the
returned data string
    CS120ACArray(1) = Right (CS120ACArray(1),1)' Trim the SOT from the first data
point
EndIf

'Enable Dew Heaters if AirTC < DewPoint
If AirTC <= TempDewPoint AND StatusDewHeater=False Then
    CS120ACArray(17)=0
    SerialFlush (Com1)
    TempString = CS120A_SETNCCCommand()
    SerialOut (Com1,TempString,"",0,100)
    Delay (1,1,Sec)
    SerialIn (InStringSETNC,Com1,100,0,1000)
    StatusDewHeater=True
EndIf

'Disable Dew Heaters if AirTC > DewPoint+3
If AirTC > TempDewPoint+3 AND StatusDewHeater=True Then
    CS120ACArray(17)=1
    SerialFlush (Com1)
    TempString = CS120A_SETNCCCommand()
    SerialOut (Com1,TempString,"",0,100)
    Delay (1,1,Sec)
    SerialIn (InStringSETNC,Com1,100,0,1000)

StatusDewHeater=False
EndIf

NextScan
EndProg

```

## C.5 Example CRBasic GET program

```

'-----
' CS120A Visibility
'
' Program to test the GET command part of the command line interface on the CS120A
' Connecting to serial port one on a CR1000 logger
' Logger:CR1000
'
' Example outputs including checksums (varies with sensor ID)
' GET:0:0:2C67:
' GET:1:0:1B57:
' GET:2:0:4207:
' GET:3:0:7537:
' GET:4:0:F0A7:
' GET:5:0:C797:
' GET:6:0:9EC7:
' GET:7:0:A9F7:
' GET:8:0:85C6:
' GET:9:0:B2F6:
'-----

Public OutString As String * 40 ' Outgoing string
Dim CheckVal As Long           ' Checksum value
Public InString As String * 200 ' Incomming string
Dim TempString As String * 16

'Main Program
BeginProg

    SerialOpen (Com1,38400,3,0,10000) ' open port to the visibility sensor

    ' Send a request for information once every 10 seconds
    Scan (10,Sec,0,0)

    ' Create the basic GET string for the CS120A
    TempString = "GET:0:0"
    CheckVal = CheckSum (TempString,1,0) ' Use the CCITT CRC16 checksum
    OutString = CHR(2) + TempString + ":" + FormatLong (CheckVal,"%04X") + ":" + CHR(3)
+ CHR(13) + CHR(10)

    SerialOut (Com1,OutString,"",0,100) ' Send GET command to the CS120A

    Delay (1,1,Sec)

    SerialIn (InString,Com1,100,0,200) ' Save the data returned from the GET command

    NextScan
EndProg

```

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