INSTRUCTION MANUAL

CS120A Visibility Sensor

Revision: 10/15

®

Limited Warranty

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Assistance

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To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. After an application engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our website at *www.campbellsci.com/repair*. A completed form must be either emailed to *repair@campbellsci.com* or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

Safety

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.com or by telephoning (435) 227-9000 (USA). 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, 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.

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CS120A Visibility Sensor

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 42º 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. Note that CS120A operating systems cannot be loaded onto a CS120.

Dew heaters are provided to keep the sensor optics clear of condensation and more powerful hood heaters to prevent the build up of snow or ice.

1.1 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:

WARNING	**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.**

CAUTION	Cautions warn of potential hazards. Ignoring these cautions could result in the sensor being damaged and data being lost.

NOTE	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.

1.2 Sensor Unit Safety

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

WARNING	**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.**

WARNING	**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.**

CAUTION	Ensure that the correct voltage supply is provided to the sensor.

1.3 Recommended Tools

The following tools are recommended for installation:

10 mm open spanner (for grounding boss, must be open)

13 mm spanner

18 mm open spanner (for cable glands, must be open)

2 mm flat screwdriver

Number 2 cross head screwdriver.

2. Technical specification

	Minimum Value	Nominal Value	Maximum Value
Visibility characteristics			
Reported Visibility (metric)	10 metres	-	75,000 metres
Reported Visibility (imperial)	33 feet	-	246,000 feet/46 miles
Visibility accuracy up to 10,000 m	-	+/-10%	-
Visibility accuracy over 10,000 m	-	+/-15%	-
Visibility accuracy over 15,000 m	-	+/-20%	-
Visibility resolution		1 metre	
Optical characteristics			
LED centre wavelength	-	850nm	-
LED spectral bandwidth	-	+/-35nm	-
Pulse characteristics			
Light pulse rate	-	1KHz	-

3. Electrical specification

	Minimum Value	Nominal Value	Maximum Value
Main power supply for DSP and dew heaters			
Power supply, +12V connection (DC only)	7V	12V	30V
Current consumption sampling continuously with dew heaters active (at 12V DC)	-	200mA	248mA
Current consumption sampling continuously with dew heaters disabled (at 12V DC)	-	110mA	151mA
Current consumption without any sampling occurring and dew heaters disabled (at 12V DC)	-	21mA	30mA
Active power consumption with dew heaters and RS232 communications interface active[5] (at 12V DC)	-	200mA	250mA
Hood heater power supply			
Hood heater voltage (AC or DC)	-	24V[1]	30V[1]
Hood heater wattage (at 24V AC or DC)	-	60W[2]	-
RS232 Communications[4]			
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 3KΩ)	4.4V	-	-
RS485 Communications			
RS485 input threshold voltage	-0.2V	-	+0.2V
RS485 output (Unloaded)	-	-	5V
RS485 output (Load 50Ω)	2V	-	-
Maximum voltage at any terminal[3]	-7V	-	+7V
User alarm outputs			
User output high level (at 85ºC)	3.8V	-	-
User output high level (at 25ºC)	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 ground of any RS485 equipment cannot be further apart than this voltage. The CS120A ground (pin 1 on connector B, see page 11) can be connected to the ground of the host equipment. This will reduce any parasitic currents and bring the two grounds 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
Sensor temperature ranges			
Operating temperature	-25°C	-	+60°C
Extended operating temperature	-40°C	-	+70°C [1]
Storage temperature	-40°C	-	+85°C
Sensor humidity ranges			
Operating humidity range	0%	-	100%
Sensor heater thresholds			
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

6.1 Dimensions

Dimensions in mm
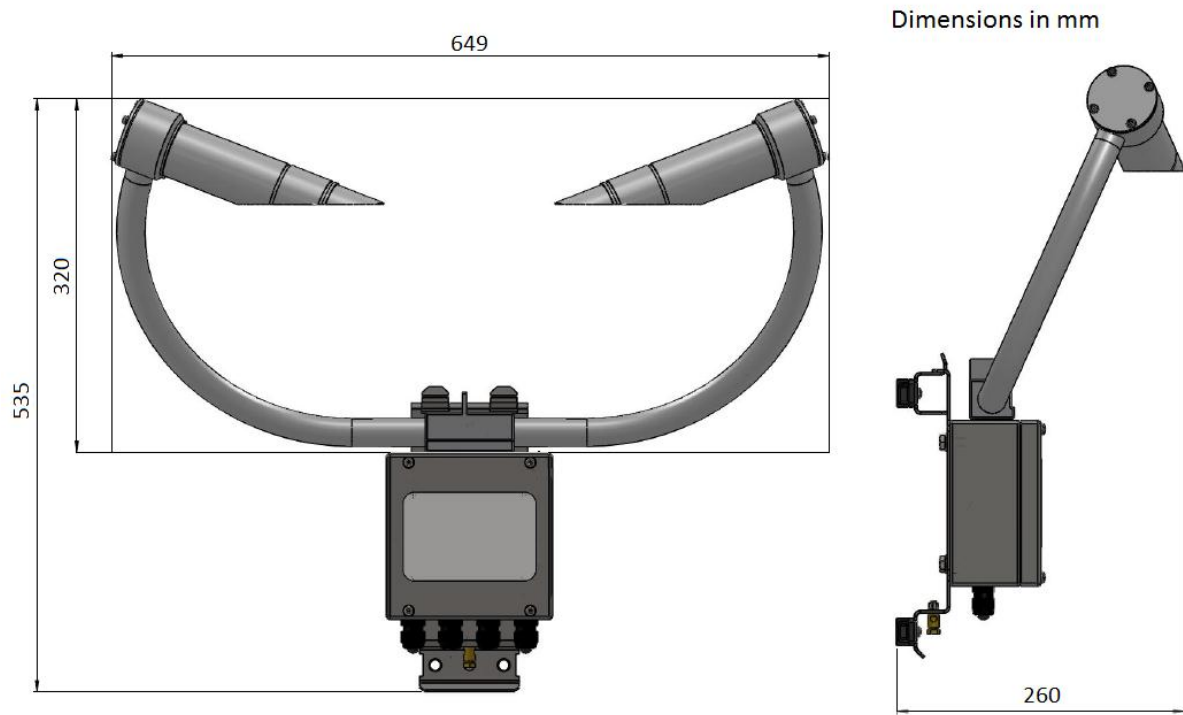
6.2 Weights

Sensor weight: 3 Kg
Shipping weight: 6 Kg (including packing box)

6.3 Sensor mounting

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

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.
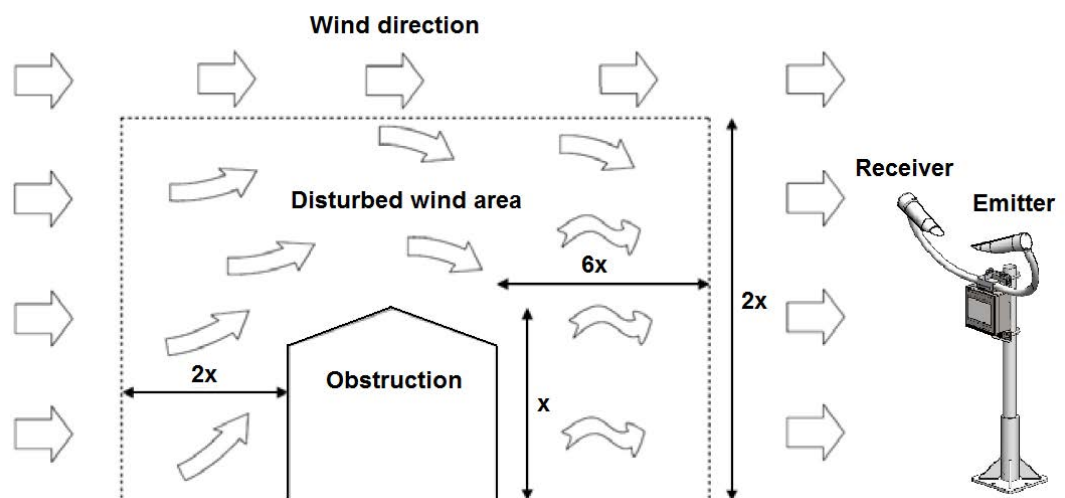
Figure 7-1. Airflow

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.

NOTE	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.

NOTE	If carrying out simple checks, blocking a lens or the sample volume will simulate an INCREASE in visibility not a decrease.

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 grounding boss is supplied to allow this.

A ground wire with a mimimum cross section of 6 mm^2 and maximum length of 5 m should be used.

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.
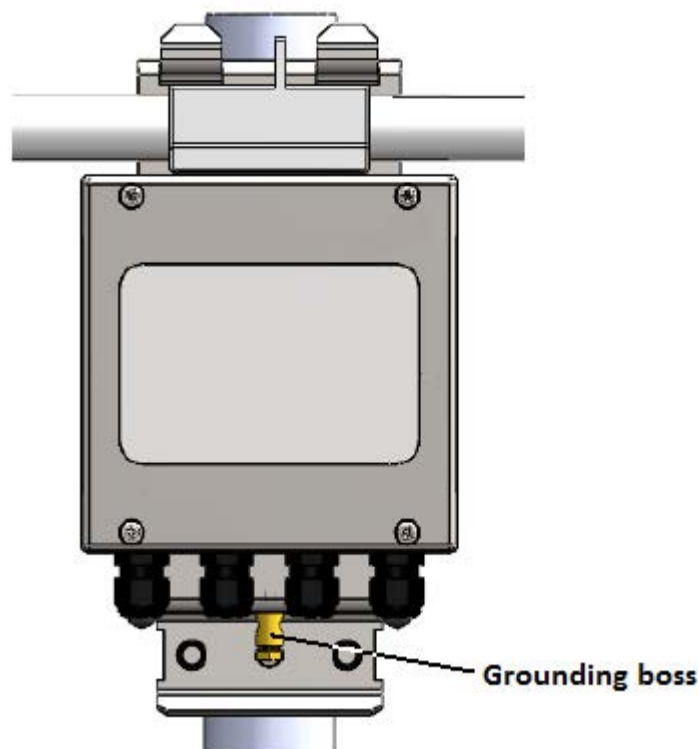
Figure 7-2. Grounding boss

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.

CAUTION   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.

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

CAUTION   Ensure that the CS120A is mounted according to the figure below. Do not reposition, once fixings are tightened, by forcing the arms of the unit as this can cause damage.

Slots are provided to allow band clamps to be used with larger diameter masts.
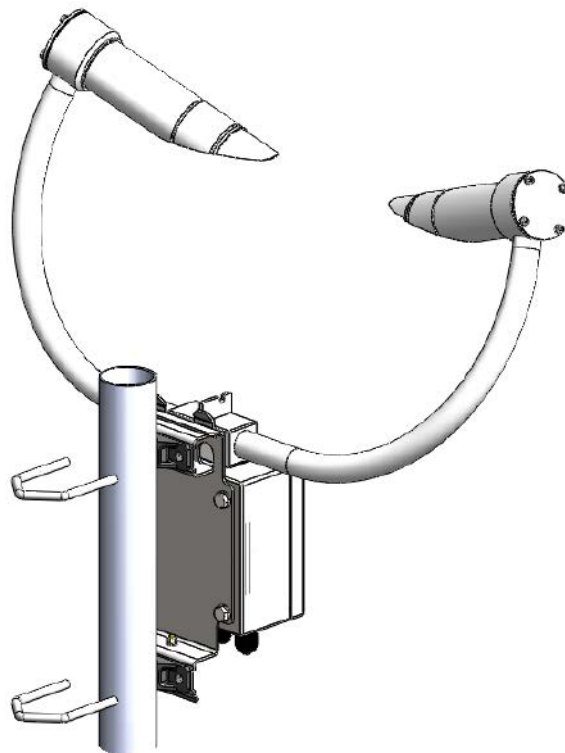
Figure 7-3. Mounting arrangement

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', 7th Edition, Section 9.3.4.
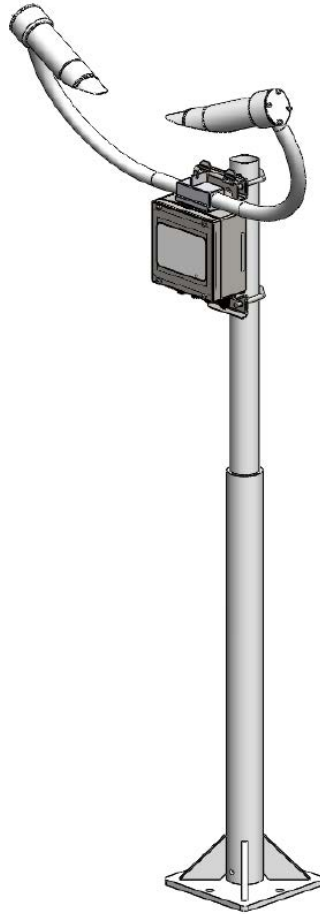
Figure 7-4. Optical sensor mast

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.
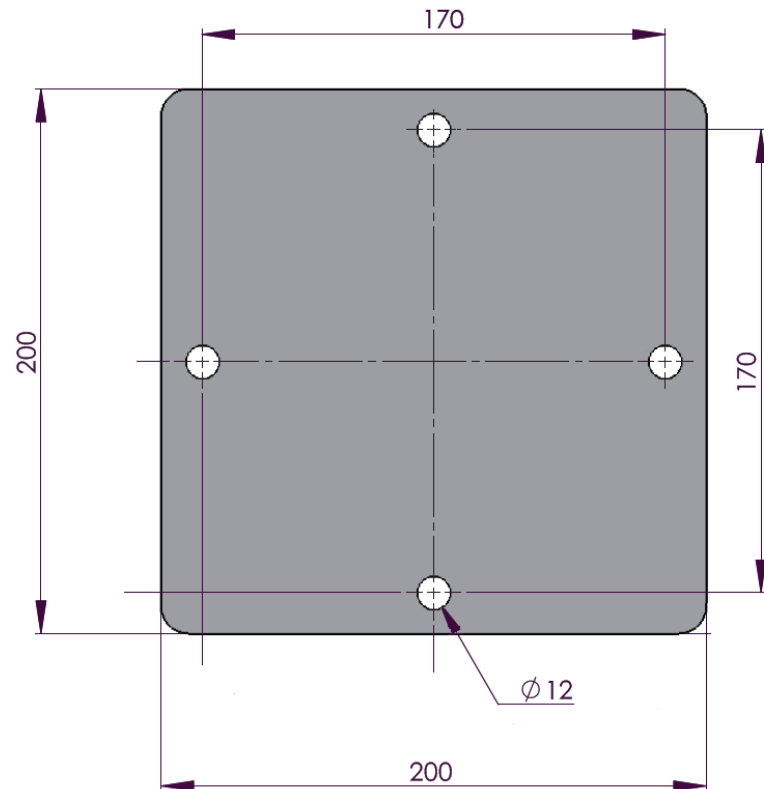
Figure 7-5. Mounting footprint

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 four standard IP66 rated glands. The first gland is by default used by the power/communications line. This comprises the 7-30V for the main electronics, and the serial communications wires. This 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 and fourth glands are spare and can be used to connect to user alarms on connector C.

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

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.

Figure 8-1. Connections

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.

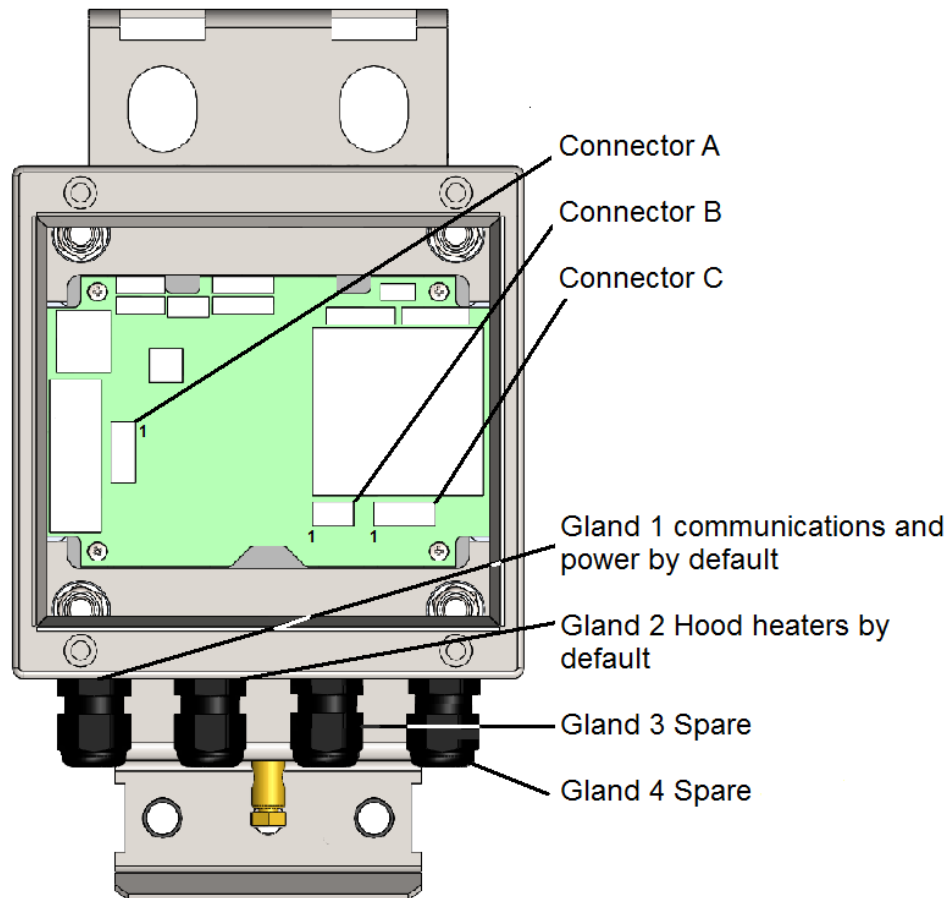| Connector A		
Five way connector		
Pin number	**Description**	**Notes**
Pin 1	+ve supply	Main electronics +ve supply input
Pin 2	0V	Auxiliary Electronics 0V. Common with the main electronics 0V.
Pin 3	Hood low	This is for the hood heater power supply. If the hood heater supply is DC it should be the negative connection and if it is AC it should be the `neutral' or `ground' connection if there is one.
Pin 4	0V	Auxiliary Electronics 0V. Common with the main electronics 0V.
Pin 5	Hood high	This is for the hood heater power supply. If the hood heater supply is DC it should be the positive connection.

CAUTION	To avoid damage to noise filters on the hood heater inputs if the heater voltage is DC the –ve connection should be made to pin 3 and the +ve to pin 5. If the heater voltage is AC with a ground or neutral wire then this should be connected to pin 3. Pin 3 should not be more than 5 volts from the main electronics 0V.

Connector B		
Three way connector		
Pin number	**Description**	**Notes**
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

It may be necessary to use a 120 ohm termination resistor to reduce signal distortion when using RS485 for cable runs over about 500 m and baud rates above 38400. It should be connected between pins 2 and 3.

Connector C – USER ALARMS		
Four way connector		
Pin number	**Description**	**Notes**
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.

COMMUNICATIONS AND POWER CONNECTIONS
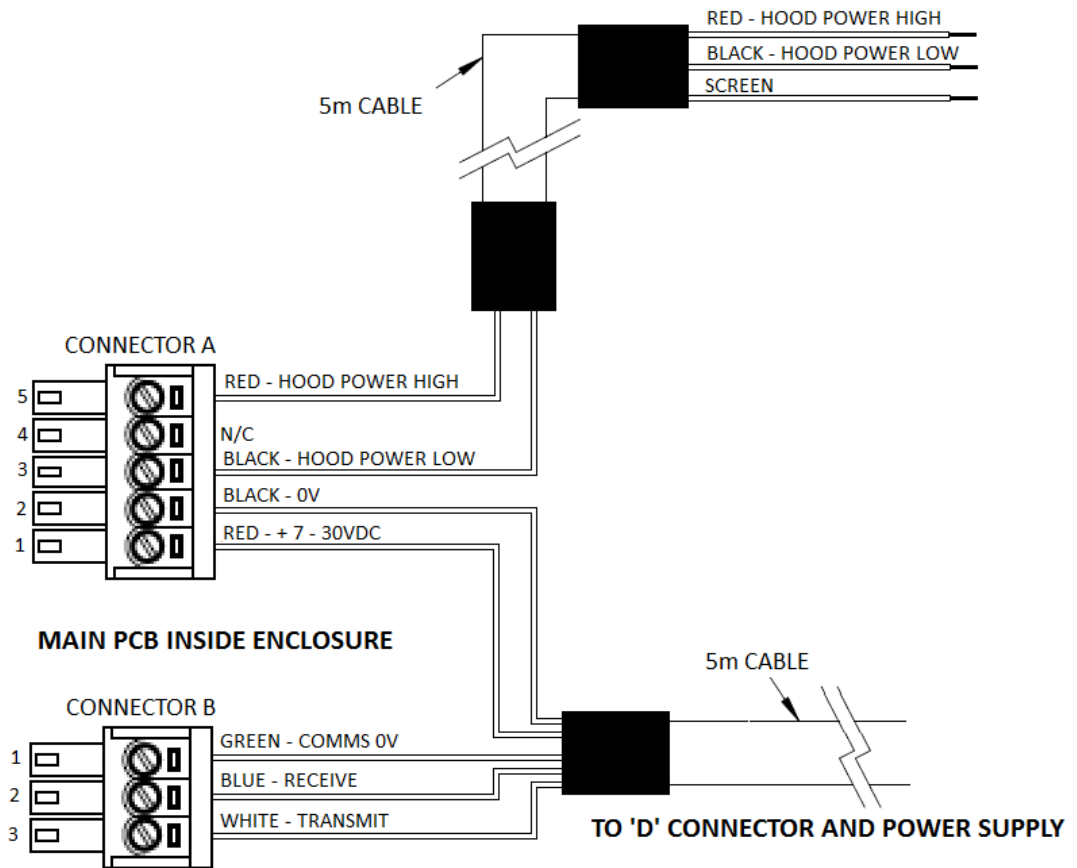
Figure 8-2. CS120A Comms & Power

COMMUNICATIONS AND POWER CONNECTOR
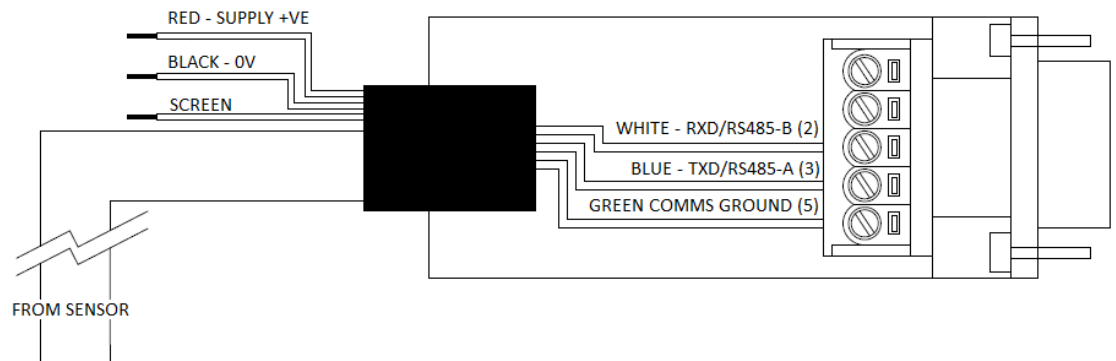
Figure 8-3. CS120A Comms & Power cable connector

CONFIGURATION CABLE
PART NUMBER 010817
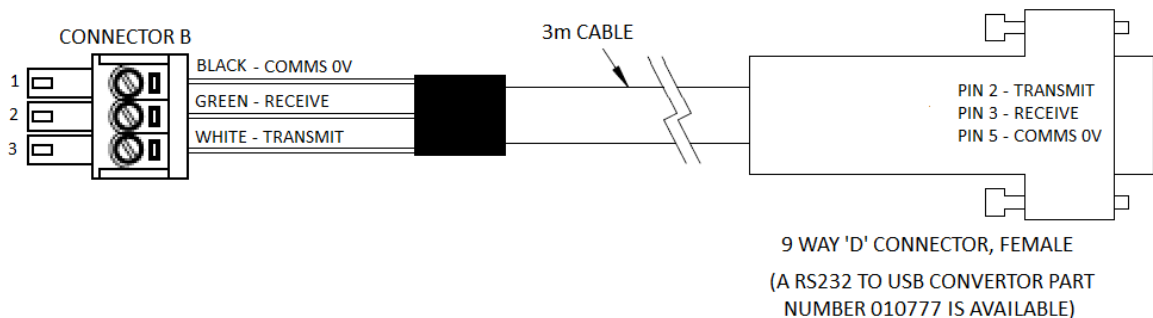
Figure 8-4. CS120A Configuration Cable

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.
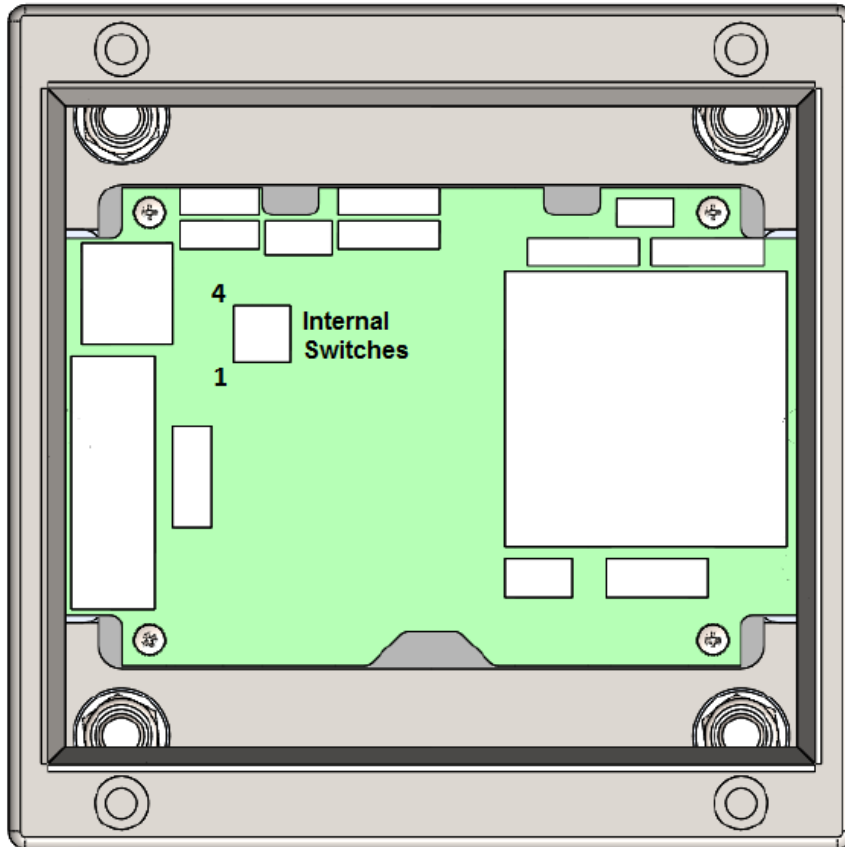
Figure 9-1. Internal switches

Internal switch functions	
Switch number	**Function**
4	*Reserved for future use*
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. When switched to the ON position and the CS120A is power cycled this switch temporarily sets the CS120A communications port to a default RS232 communication state at 38400 baud. 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. 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	*Reserved for future use, set to OFF.*
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. Note: to use this the power supply must be stable. Do not leave this switch set permanently.

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. Useful for RS485 networks. Operates as an address in RS485 mode

System status break down[1]	
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
0-75,000 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 [2]	Definition
Emitter failure	0-2[1]	3	The emitter hoods main LED output power level. 0 = Everything is within normal parameters 1 = Light output level too low 2 = Light output level too high
Emitter lens dirty	0-3	1	0 = OK. The reported attenuation is below 10%. 1 = Reported window signal value is too low (Possible sensor fault) 2 = Slight dirt build up (10% signal attenuation or higher) 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 1 = Too low. Less than -40°C. 2 = Too high. Over 80°C. 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%. 1 = Reported window signal value is too low (Possible sensor fault) 2 = Slight dirt build up (10% signal attenuation or higher) 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. 1 = Too low. Less than -40°C. 2 = Too high. Over 80°C. 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. 0 = Within limits 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. 1 = Too low. Less than -40°C. 2 = Too high. Over 80°C. 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 1 = Signature does not match previous readings
Flash read error	0-1	3	0 = No errors 1 = One or more errors reading user variables from flash occurred
Flash write error	0-1	3	0 = No errors 1 = One or more errors writing user variables to flash occurred

[1]The emitter power level reporting too high will cause the CS120A to shutdown and go into low power mode.

[2]The severity of the alarm. The higher the number the more serious the error is considered to be.

Errors are checked every 10 seconds and the next message output is updated with the following exceptions:

Signature error is checked and reset at power up.

Flash read and write errors are checked when flash memory is updated, for example when changes are made through the memory structure. They are also reset on power up.

Particle limit is checked every minute and reset when read.

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 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 Scientifics' 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 0=Alarm one disabled 1=Alarm one enabled	0
3	User Alarm 1 Active	0-1	0=Check if distance is *less than* 'User alarm 1 Distance' 1=Check if distance is *greater than* '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 0=Alarm two disabled 1=Alarm two enabled	0
6	User Alarm 2 Active	0-1	0=Check if distance is *less than* 'User alarm 2 Distance' 1=Check if distance is *greater than* '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 0 = 115200 bps 1 = 57600 bps 2 = 38400 bps 3 = 19200 bps 4 = 9600 bps 5 = 2400 bps 6 = 1200 bps	2
9	Serial Number	0-32000	Internal serial number for the CS120A. (*Read only*)	-
10	Visibility Unit	M or F	Unit the visibility value will be presented as. M = Metres 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. 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'. 0 = Continuous mode 1 = Polled mode	0
13	Message Format	0-2	Level of detail outputted by polled or continuous modes 0 = Basic 1 = Partial 2 = Full	2
14	Serial port protocol	0-1	Selects the physical serial interface 0 = RS232 mode 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: 1 = Sample every second 2 = Sample one second in every two 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 1=Turn the dew heaters off	0
18	Hood heater override[1]	0-1	0=Allow the CS120A to automatically control the hood heaters 1=Turn the hood heaters off	0
19	Dirty window compensation	0-1	0 = No compensation applied 1 = Compensation for dirt on lenses applied. 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[2] 1 = Enable command line CRC checking Note: this does not affect communications via DevConfig or terminal emulator.	0
21	Sensor power down voltage	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.

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[1]	STX ^ B[2]
SET	SET
:	Delimiting character
	Current Sensor ID
:	Delimiting character
	Sensor ID (may be a new 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
	Sensor serial number (read only)
	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[1]	ETX ^ C[2]
0x0D[1]	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[1]	STX (^B)[2]
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[1]	ETX (^C)[2]
0x0D[1]	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[1]	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
	Sensor serial number (read only)
	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
XXXX	Checksum
0x04[1]	EOT
0x0D[1]	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[1]	STX, ^B[2]
POLL	POLL
:	Delimiting character
0	Address based on Sensor ID
:	Delimiting character
0	Reserved for future use, zero default
:	Delimiting character
XXXX	Checksum[3]
:	Delimiting character
0x03[1]	ETX, ^C[2]
0x0D[1]	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 2003
 (1) Message output menu
 (2) User alarm menu
 (3) Calibrate CS120A
 (4) System information
 (5) Communications setup
 (6) System Configuration

 (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 1006
 (1) Perform calibration
 (2) Restore the factory calibration
 (3) Perform dirty windows zero offset calibration
 (4) Restore dirty windows 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 6: Configuration

```
CS120A CONFIGURATION - MENU 6
 ID 0
 S/N 2003
 (1) Dew heater override:  AUTOMATIC
 (2) Hood heater override:  AUTOMATIC
 (3) Dirty window compensation: NO COMPENSATION
 (4) Command line CRC Checking: DO NOT CHECK
 (5) Sensor power down voltage: 7.0V


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

This menu sets dew and hood heaters to automatic or off, dirty window compensation and CRC checking. In addition it allows the sensor power down voltage to be set. If set this will shut down the CS120A before the battery voltage has fallen low enough to damage a back-up battery.

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/CS125 high grade calibration kit part number 010815. 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 between 0ºC and 50ºC

- 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 1006
(1) Perform calibration
(2) Restore the factory calibration
(3) Perform dirty windows zero offset calibration
(4) Restore dirty windows 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 ->E2002
Is E2002 correct? (Y/N)?
Input the CS120A calibrator constant ->28.8
Is 28.8 correct? (Y/N)?


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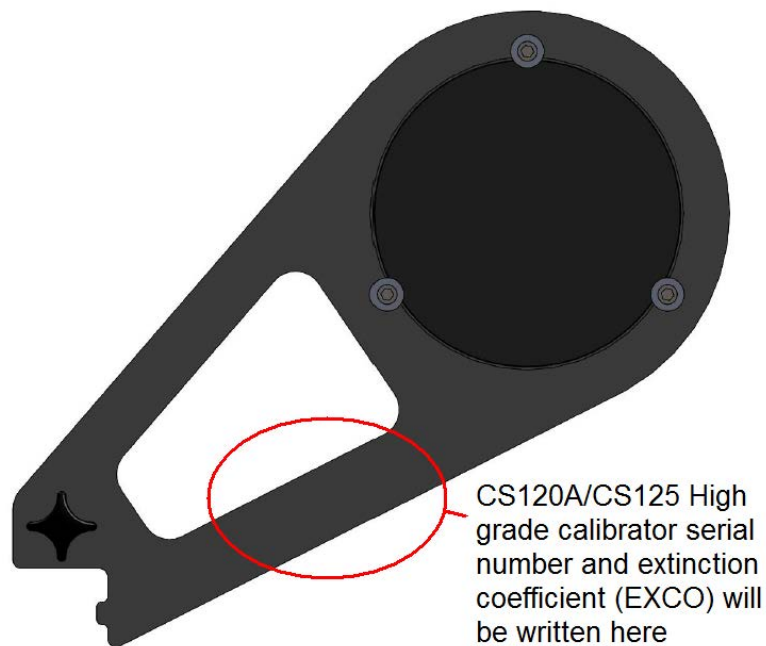```

*Figure 15-1. CS120 Calibration disk*

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.

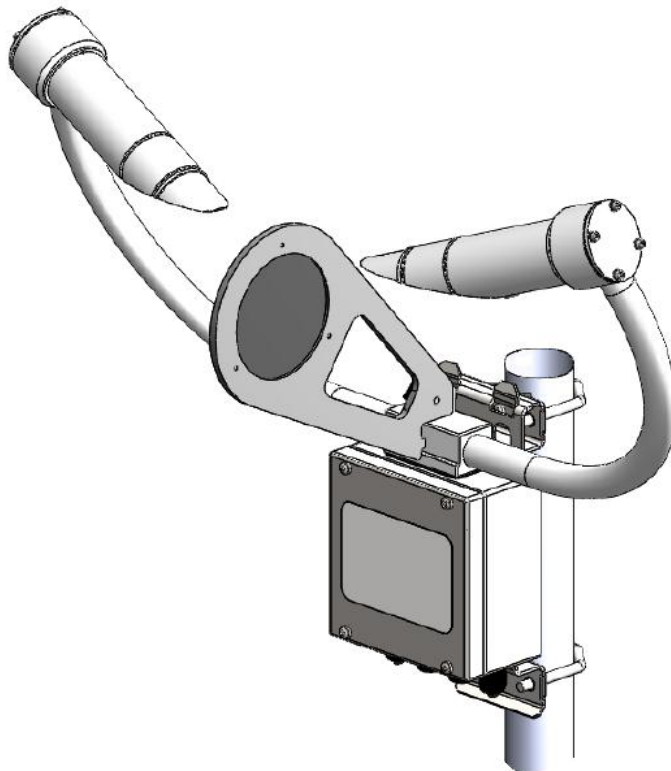| **NOTE**	At this stage it is advisable to clean the lenses. Refer to Section 18 `Cleaning' for more information. A simple visual check may be enough to confirm the lenses are clean.

Figure 15-2. Mounting of calibration disk

```
 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.

15.1 Dirty window zero calibration

Option 3 in the calibration menu allows the user to reset the zero contamination level for dirty windows detection (option 4 allows a return to the factory value if something goes wrong with the calibration process.)

To carry out the dirty window zero offset calibration make sure the windows are very clean. Temperature should ideally be in the range 15 – 30°C.

```
 CS120A CALIBRATION - MENU 3
 ID 0
 S/N 1006
 (1) Perform calibration
 (2) Restore the factory calibration
 (3) Perform dirty windows zero offset calibration
 (4) Restore dirty windows factory calibration

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

Typing '3' returns text similar to the following:

```
Current values EO=3200 DO=4649 DD=995
Cal DW offset? Y/N?
```

Then type 'Y'. The CS120A responds in a similar way to the following:

```
Calibrating dirty window system...Please wait

DD=990 DO=4535
DD=1000 DO=4531
DD=1010 DO=4373
DD=1020 DO=4206
DD=1030 DO=3886
DD=1110 DO=2675
DD=1120 DO=2682
DD=1130 DO=2530
DD=1140 DO=2392
EO=3230 ES=371 DO=2251 DS=234 DD=1140
Press any key to exit (Not return)
```

Press any key and the dirty window zero offset calibration is complete.

16. Performing an operating system update

Operating system updates for the CS120A visibility sensor are performed using Campbell Scientifics' Device Configuration Utility (DevConfig) software. Note that CS120A operating systems cannot be installed on CS120 sensors. The pictures below show the procedure using DevConfig.
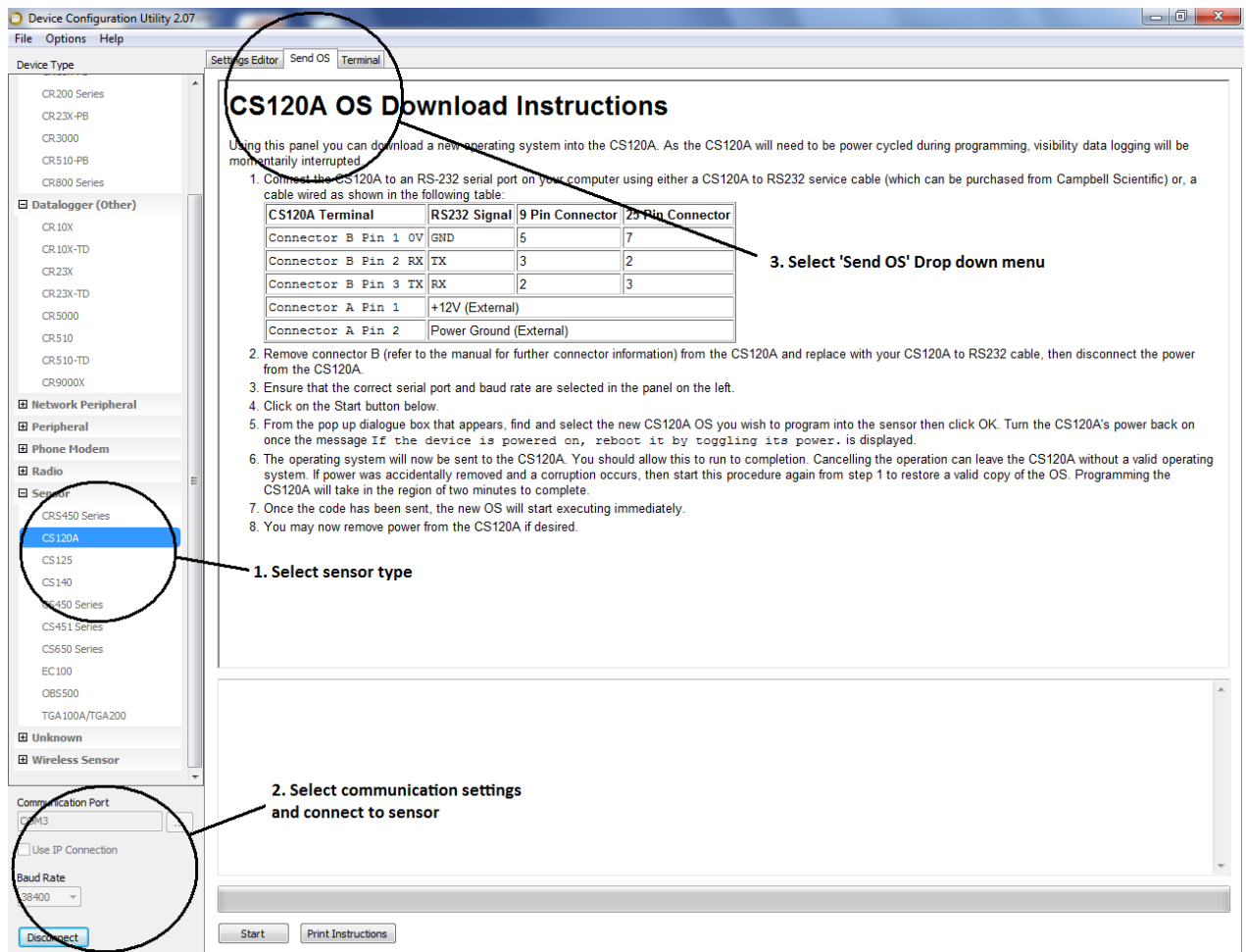

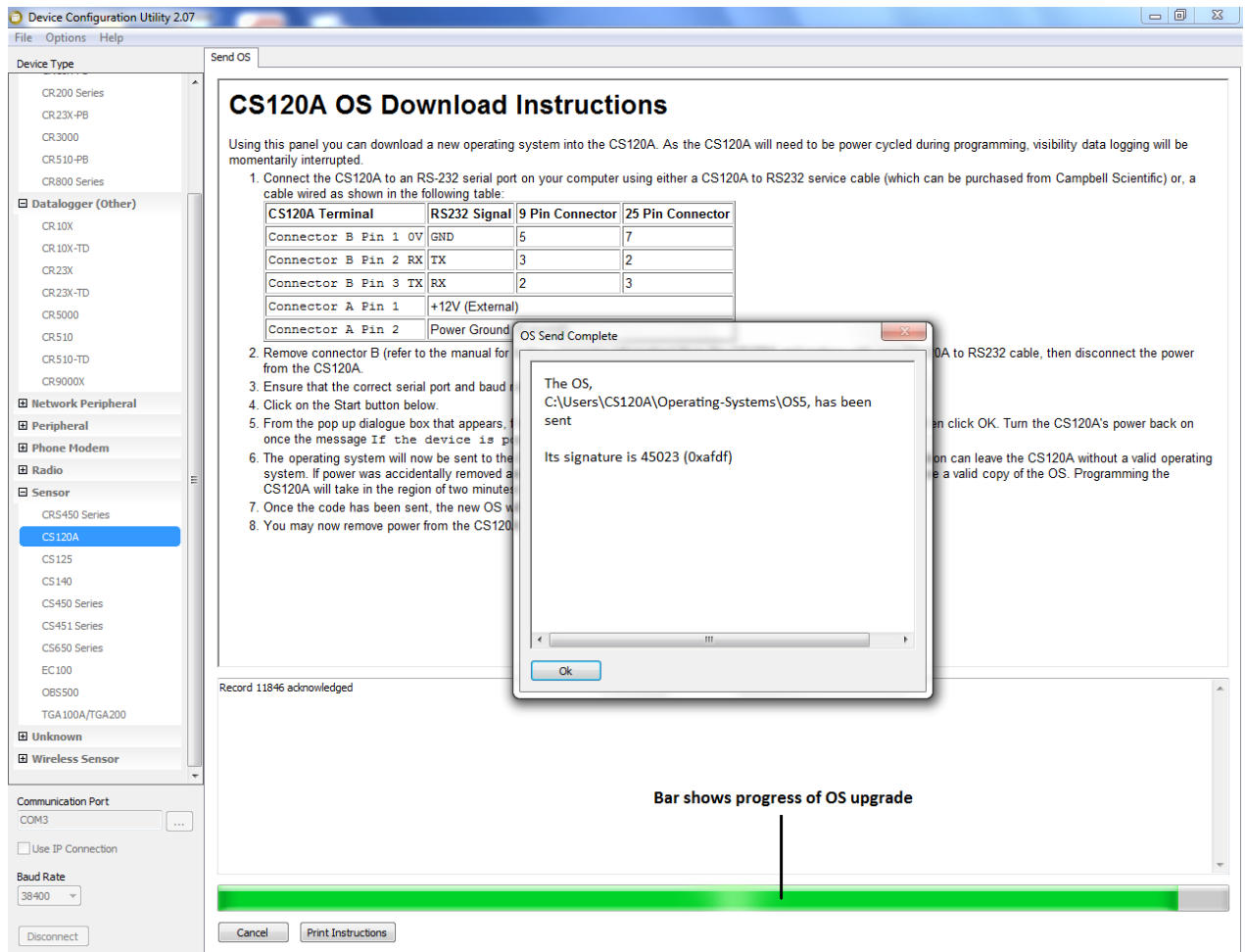*Figure 16-1. CS120A DevConfig download instructions*

Figure 16-2. CS120A DevConfig screen when OS update is complete

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
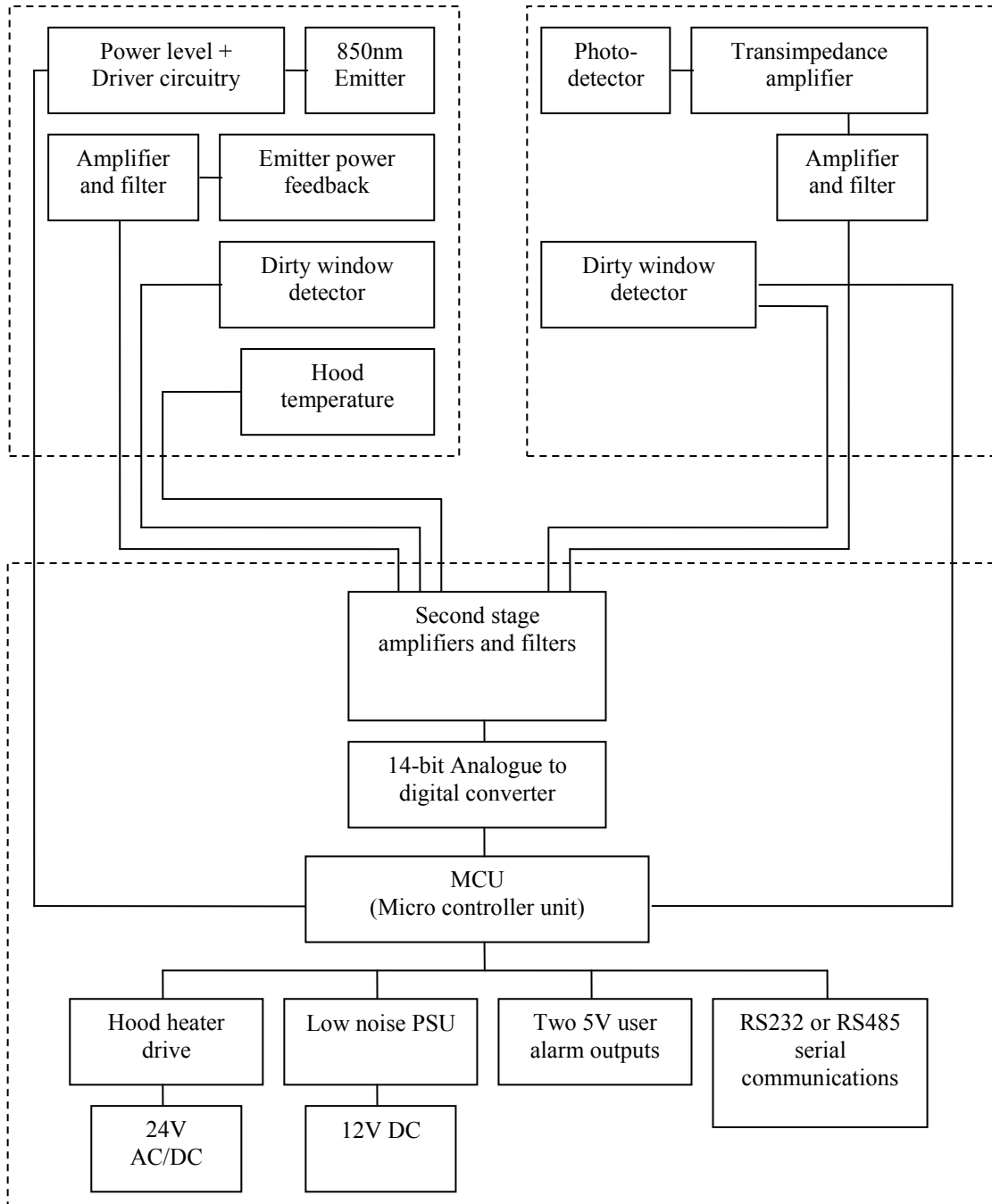
Appendix B. Example C code of the CCITT CRC

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 "CS120ACommandString"
' 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 CS120ACommandString 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 "CS120ACommandString"
    ' 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
```

```
      '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_SETNCCommand()
        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 = CS120_SETNCCommand()
        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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