C-12
BLACK CARBON MONITOR
OPERATION MANUAL

C-12-9800 REV A

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1 INTRODUCTION

1.1 About This Manual

This document is organized with the most important information toward the front of the manual. All users should read and understand the sections on setup, operation, and field audits. Toward the back are sections that provide in-depth information on subjects such as diagnostics and accessories. These sections should be consulted as needed.

This manual is periodically revised for maximum accuracy and to incorporate new features or updates. User feedback is welcome. An electronic version of this manual is available upon request.

1.2 Technical Service

Should support still be required after consulting the printed documentation, contact one of the expert Met One Instruments, Inc. Technical Service representatives during normal business hours of 7:00 a.m. to 4:00 p.m. Pacific Time, Monday through Friday. In addition, technical information and service bulletins are often posted on our website. Please contact us and obtain a Return Authorization (RA) number before sending any equipment back to the factory. This allows us to track and schedule service work and to expedite customer service.

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Please have the instrument serial number available when contacting the manufacturer. On most models manufactured by Met One Instruments, it will be located on a silver product label on the unit, and also printed on the calibration certificate. The serial number will begin with a letter and be followed by a unique four or five digit number such as U15915.

1.3 C-12 – Black Carbon Monitor

The Met One Instruments, Inc. model C-12 Portable Carbon Monitor is a one-wavelength black carbon monitor. It automatically measures and records optical transmission across filter media onto which particulate matter has been deposited. The industry standard wavelength of 880 nm is used to determine the concentration of black carbon “BC”. Measurement results are sent to a customized web page dashboard where data can be viewed and downloaded. A geographical map is included on the dashboard.

Figure 1-1 The C-12

Ambient air is drawn into the instrument at a controlled flow rate. The sampled air is subsequently drawn through a heated inlet section and then through special glass fiber filter tape, capturing ambient particulate matter. Optical transmission is measured through the filter tape allowing BC mass concentrations to be calculated. The filter tape will advance when sufficient particulate matter has been deposited on the tape to cause the attenuation of the selected channel to exceed a factory recommended level.

The C-12 also has the option to add a 370 nm illumination channel. Data from the 370 nm and 880 nm channels may be used for source apportionment. Source apportionment allows one to determine if the measured BC originates from fossil fuel combustion or from biomass combustion.

1.4 Safety Warnings

Optical Warnings: The C-12 monitor employs an LED light source in the near IR (880 nm) and an optional source in the near UV (370 nm). Both wavelengths are outside the range of normal human vision and could present a potential invisible ocular exposure hazard. The near infrared light source is a 7 mW IR LED emitting at 880 nm. Appropriate precautions should be employed. The optional UV light source is a 15 mW LED emitting at 370 nm.

A protective housing with this warning symbol fully encapsulates the light source and optics system during normal operation. Whenever the optical module is disassembled for service, the power cord must be disconnected to prevent accidental exposure to IR radiation.

Electrical Warnings: The C-12 is a 12 Volt DC powered system, and there are no hazardous live voltages located anywhere inside the instrument. It is equipped with an external desktop power supply module with a 100-240 VAC 50/60 Hz input range, and a 12 VDC, 3.34 A output. The C-12 instrument is housed in a weather-proof case for deployment outdoors.

NOTE: Use ONLY Factory Power Supply. NO SUBSTITUTIONS!

1.5 C-12 Instrument Specifications

PARAMETER	SPECIFICATION
Measurement Principle:	Optical Absorption Wavelength 880 nm BC 370 nm UV (optional)
Measurement Range:	0.01 µg/m^3 to 100 µg/m^3 BC
Data Resolution	0.1 ng/m^3
LLD:	≤ 70 ng/m^3 with 1 minute sample time
Measurement Interval:	15 minutes, 15 one-minute samples sent to the cloud
Sample Rate:	1.0 LPM
Filter Tape:	Proprietary treated glass fiber
Operating Temperature:	-20 to +50°C
Internal Data Storage:	2,816 records
Data Download:	Comet Cloud Modem
User Interface:	4 LEDs and toggle switch
Mounting Options:	Pole Mount and Tripod available
Unit Weight:	16 lb 11 oz (7.57 kg)
Unit Dimensions:	15 in (38.1 cm) width x 12 in (30.48 cm) height (to top of sun shield) x 12 in (30.48 cm) depth
Input Power:	100 to 240VAC, 6 W

Specifications may be subject to change without notice. See C-12 datasheet for latest published specs.

2 SITE SELECTION AND POSITIONING CRITERIA

There are basic installation requirements for the C-12. There should be adequate cell phone coverage and an AC power outlet. It can simply be positioned in the area containing the air to be sampled based on local monitoring needs.

3 SETUP & DEPLOYMENT

The C-12 is designed for easy setup and simple configuration for most applications. This section describes the basic assembly, setup, and start-up of the instrument.

3.1 Unpacking

Unpack the carbon monitor and accessories and compare them to the packing list to make sure all items are present.

Any damages to the equipment during shipping are the responsibility of the carrier. If any damage to the shipment is noticed before unpacking, **a claim must be filed with the commercial carrier immediately**. Follow any special unpacking instructions provided by the carrier as all items are carefully removed from the containers and each component inspected. It is recommended to document and photograph all damaged packages and items before, during, and after unpacking them. Contact Met One Instruments (see Section 1.2 of this manual) to arrange for any replacement items needed.

The instrument is supplied with one of each of the following standard accessories:

- TSP Inlet (part number 9441)
- Inlet Tube (part number 83799)
- USB Cable, A-B male (part number 500784)
- Span Check Membrane (part number 83011)
- Filter Tape, two rolls (part number 83599)
- Operation manual (part number C-12-9800)

Optional Accessories include:

- Mounting Stand (part number 83598)
- Pole Mount (part number 83597)
- Flow Meter (part number Swift 6.0)

3.2 Electrical Service

The C-12 uses an internal DC power supply which can be supplied with 100 - 240 VAC, 50 or 60 Hz input power. The sampler is rated at 6 Watts maximum continuous power with the sample pump running. There are no hazardous live voltages located anywhere inside the instrument. The power supply provides a 12 VDC, 3.34 A output.

NOTE: Use ONLY Factory Power Supply. NO SUBSTITUTIONS!

The sample site needs to be equipped with AC power and a standard weatherproof outdoor electrical outlet.

For critical applications, where possible sample invalidations due to power failures are unacceptable, the sampler should be equipped with an uninterruptable power supply (UPS). The supply must be rated for the electrical load and must be appropriately configured for an outdoor application. Consult a qualified electrical contractor.

3.3 Shelter & Mounting Options

The C-12 is a weatherproof monitor designed to be mounted on a stand and then deployed in the outdoors without the need for a shelter or other housing. However, if it is desired, it may also be installed in an indoor location such as a walk-in shelter, a trailer or mobile lab, a mini outdoor shelter, or inside of a permanent structure.

Benchtop Mounting: The C-12 may be installed on a table-top. Make sure the mounting surface is level, and that the instrument is secured so that it won't "walk" due to vibration.

3.4 Sample Inlet Configurations

The TSP inlet mounts atop the inlet tube. See Figure 3-3.

3.5 Assembling the C-12

The C-12 is designed for easy setup and deployment. This allows it to be used for either permanent long-term sampling at a fixed site or for portable audit sampling for temporary applications.

Figure 3-1 The C-12 Shown with Optional 83598 Stand

The following describes the standard method of setting up the C-12.

1. **Insert the inlet tube:** Pull out the lanyard connected fitting from the inlet mount in the top radiation shield opening. Insert the inlet tube.
2. **Connect the TSP Inlet to the inlet**: Slide the TSP inlet onto the top of the inlet. Be certain the TSP inlet is fully seated onto the inlet.
3. **Apply power:** Plug in the AC power cable.
4. **Load filter tape**: Open the enclosure and load filter tape into the unit. Filter tape installation is described in Section 3.7. Close the enclosure.

The C-12 monitor is now ready to begin sampling. See Section 3.8 for initial operation steps

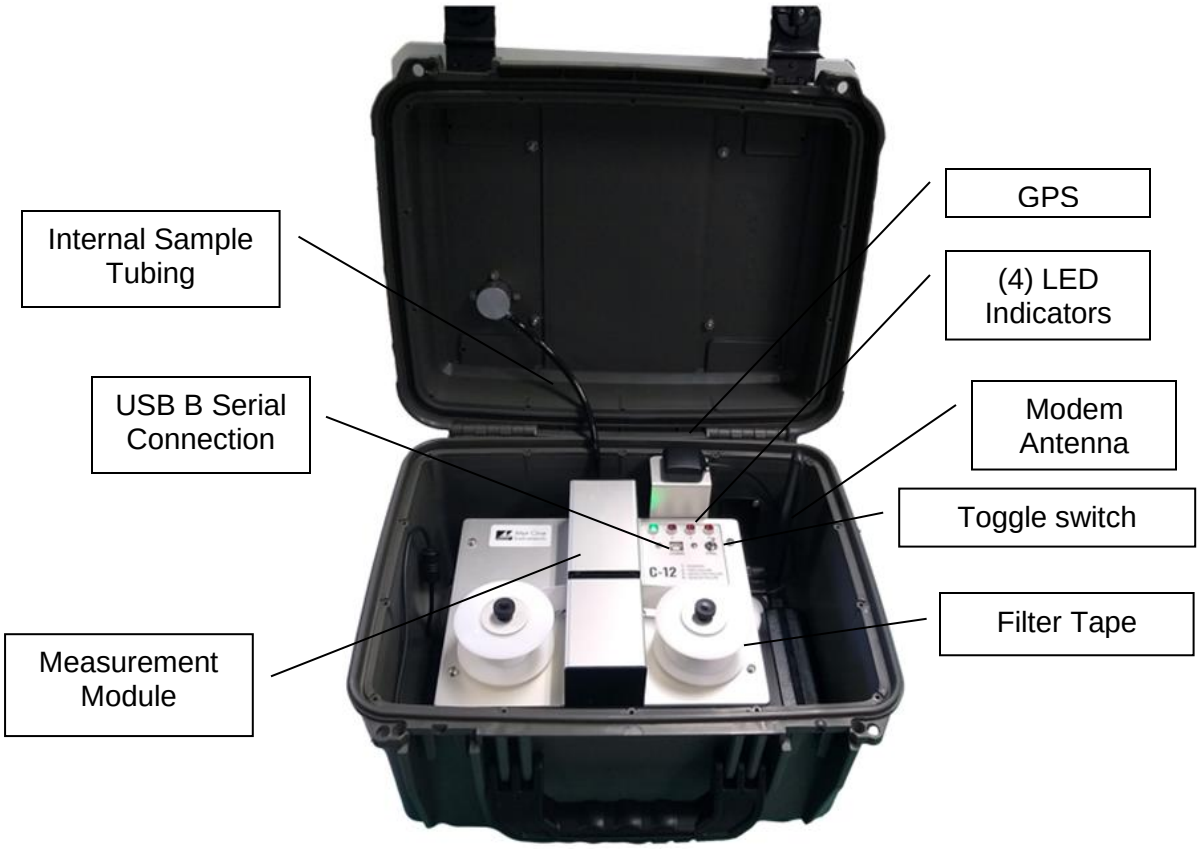


Figure 3-2 C-12 Internal View

Figure 3-3 C-12 External View

3.6 LED and Toggle Switch User Interface

The C-12 has a simple user interface on the inside of the unit composed of four LED lights, a toggle switch (CTRL), and a USB type B serial port (COMM). The LED lights indicate if the sample is running or not, as well as if there are any errors within the device. The toggle switch can start or stop the measurement, as well as move the tape.

Figure 3-4 LED and Toggle Switch Interface

3.6.1 LED Interface

Table 3-1 describes the LED light functionality when on and off.

Table 3-1 LED Definitions

LED	OFF	ON	FLASHING
1	Not sampling	Sampling	N/A
2	Transport OK	Failure	Nozzle, Tape Break failure
3	Detector OK	Failure	Detector failure
4	Sensors OK	Failure	Flow, LED T, DET T, AT, or FT out of range

3.6.2 Toggle Control Switch Interface

Table 3-2 below describes how to move tape, start, and stop a sample with the toggle switch.

Table 3-2 Toggle Control Switch Definitions

Case	Description
	How to Start and Stop sample operation
Start	Unit is **not** Sampling. Toggle up and hold for >five (5) seconds. This will start sampling and LED 1 will turn ON. Release the toggle switch when LED 1 is ON. Note: LED 2 will turn on first after 2 seconds then turn off. Continue to toggle up until LED 1 lights up.
Stop	Unit is Sampling. Toggle up and hold for >five (5) seconds. This will stop sampling and LED 1 will turn OFF. Release the toggle switch when LED 1 is OFF. The unit will Auto Restart after 30-minutes.
	How to move the tape
Tape	Unit is **not** Sampling. Toggle up and hold for >two (2) seconds. When LED 2 turns ON release the toggle switch. The tape move process will begin.

3.7 Filter Tape Installation, Loading, and Filter Material Notes

The C-12 carbon monitor uses treated glass fiber filter tape rolls, available from Met One Instruments under part number 83599. It is essential that this tape be used in the C-12 in order to maintain proper instrument calibration and reproducibility. Since the filter tape advance frequency depends upon filter-loading, the frequency with which the tape needs to be replaced is variable. A roll of filter tape is expected to last anywhere from 2 to 12 months, depending on the sampling conditions.

Note: The C-12 tape transport system runs the filter tape from left to right. Notice that this places the clean roll on the left side of the monitor. This is the opposite of the configuration used in the Met One Instruments BAM-series monitors.

Warning: The filter tape is rolled with the checker pattern on the outside of the roll, and the softer side on the inside.

3.7.1 Installing Filter Tape

1. Apply power to turn the instrument ON.
2. Hold the toggle switch up for about 2 seconds until the Transport LED turns on, then release the toggle switch. This will open the measurement module, and a tape move process will momentarily move the take up reel.
3. Loosen and remove the two tape reel knobs.
4. Install the new filter tape roll onto the left (supply) reel, with the tape coming off the right side of the roll. Route the tape exactly as shown in Figure 3-5. It should go through the slot in the measurement module and then to the take-up reel on the right side of the instrument. Fasten the loose end of the tape to the right edge of an empty spool installed on the take-up reel, with cellophane tape. **Make sure that the softer side is DOWN,** and the textured side is **UP**.
5. Align the filter tape and take up the slack by turning the left (supply) reel counterclockwise.
6. Hold the toggle switch up for about 2 seconds until the Transport LED turns on, then release the toggle switch to initiate a tape move. Verify that the tape spools correctly. Repeat this tape advance sequence until the take up spool rotates at least one full turn.

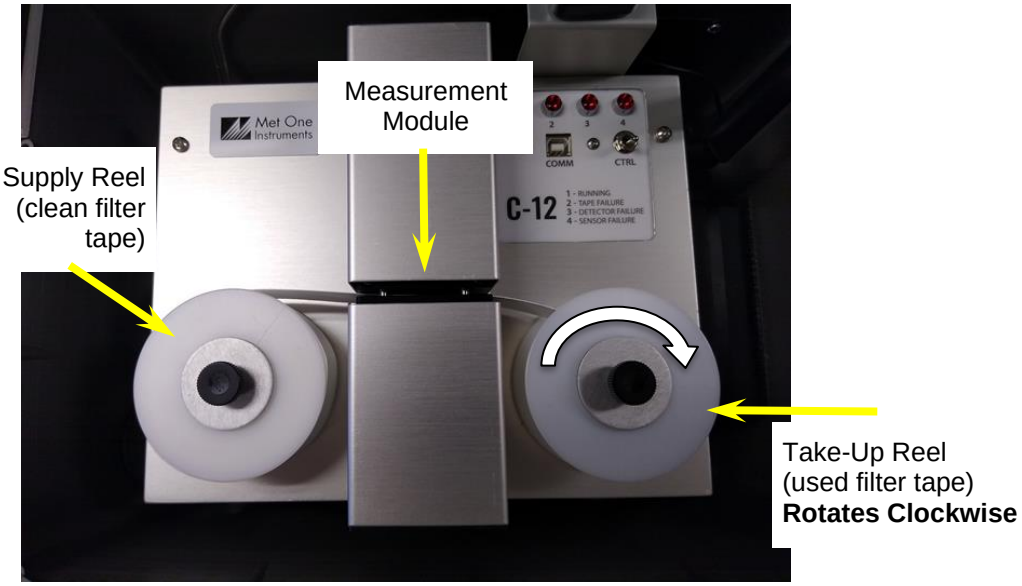


Figure 3-5 C-12 Filter Tape Routing

3.7.2 Replacing Used Filter Tape

1. Use the toggle switch to open the measurement module, if not already open. See Step 2 above.
2. Loosen and remove the two tape reel knobs.
3. Remove the used tape and spools from the tape reels.
4. Install the new filter tape roll onto the left (supply) reel, with the tape coming off the right side of the roll. Route the tape exactly as shown in Figure 3-5. It should go through the slot in the measurement module and then up to the take-up reel on the right side of the instrument. Fasten the loose end of the tape to the right edge of an empty spool installed on the take-up reel, with cellophane tape. **Make sure that the softer side is DOWN,** and the textured side is **UP**.

5. Align the filter tape and take up the slack by turning the left (supply) reel counterclockwise.
6. Hold the toggle switch up for about 2 seconds until the Transport LED turns on, then release the toggle switch to initiate a tape move. Verify that the tape spools correctly. Repeat this tape advance sequence until the take up spool rotates at least one full turn.

3.8 Starting and Stopping Sample Operation

When 12 VDC power is applied to the unit, the C-12 will boot up and get ready to immediately begin sampling.

3.8.1 Starting Initial Sample Operations

After powering up and starting sampling, the C-12 takes 1 – 3 hours to warm up and equilibrate before optimal measurement stability is achieved.

The C-12 carbon monitor is factory configured with an array of default settings that are appropriate for most sampling requirements. The operator may consider changing some of these settings depending on specific requirements. See Section 4 for details about the remote user interface and the instrument settings.

To start a sample when the unit is stopped, hold the toggle switch up for at least 5 seconds until the green Sampling LED turns on. The transport LED will briefly turn on after 2 seconds. Continue to hold the toggle switch up until Sampling LED turns on.

3.8.2 Stopping and Resuming Sample Operations

To stop a sample, hold the toggle switch up for at least 5 seconds until the Sampling LED turns off.

After 30 minutes of inactivity, the unit will automatically resume sampling.

4 DOWNLOADING and VIEWING DATA

Currently, Met One offers two options for downloading and viewing the data from a C-12 system: a Web interface and a windows application. This section will cover both options.

4.1 Web Interface

The first method for downloading and viewing the data is through the Web portal. Each customer will be sent a private link to a custom dashboard in which users can view, chart, and download/export their data.

4.1.1 How the Cloud Works

The C-12 uses a cloud service for storing and viewing data. After the C-12 collects the data, it connects to the internet and designated secure Cloud site via its internal cell modem. Once connected it will push the data to the cloud site. Users may then go to their dashboard and view their data in gauge, chart, and tabular formats.

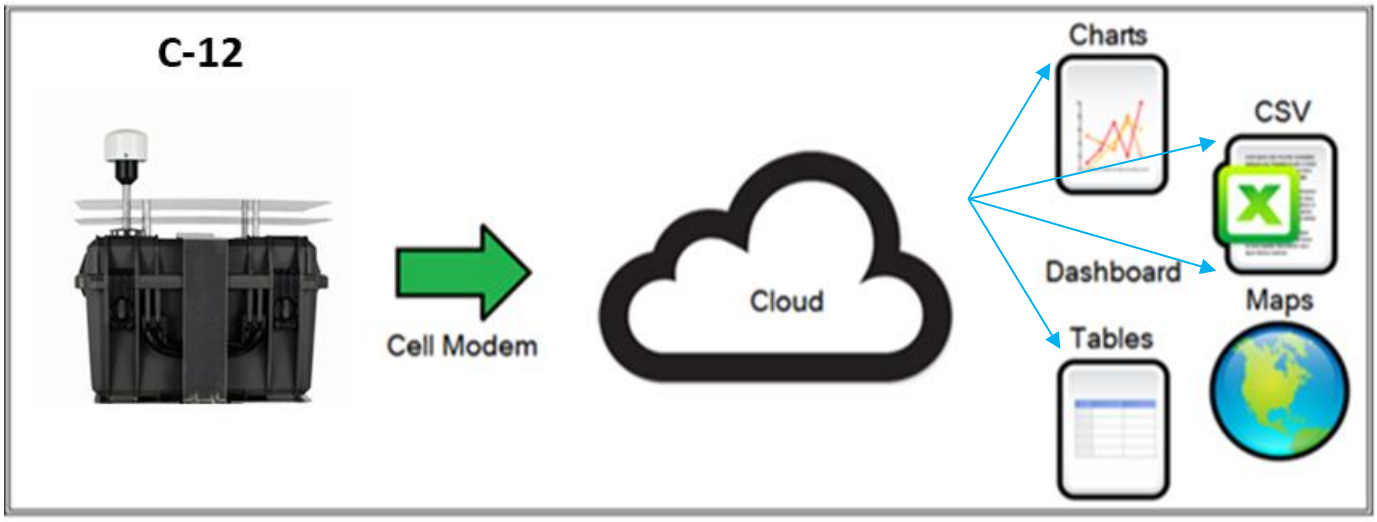


Figure 4-1 - C-12 Cloud

Below is an example dashboard setup:

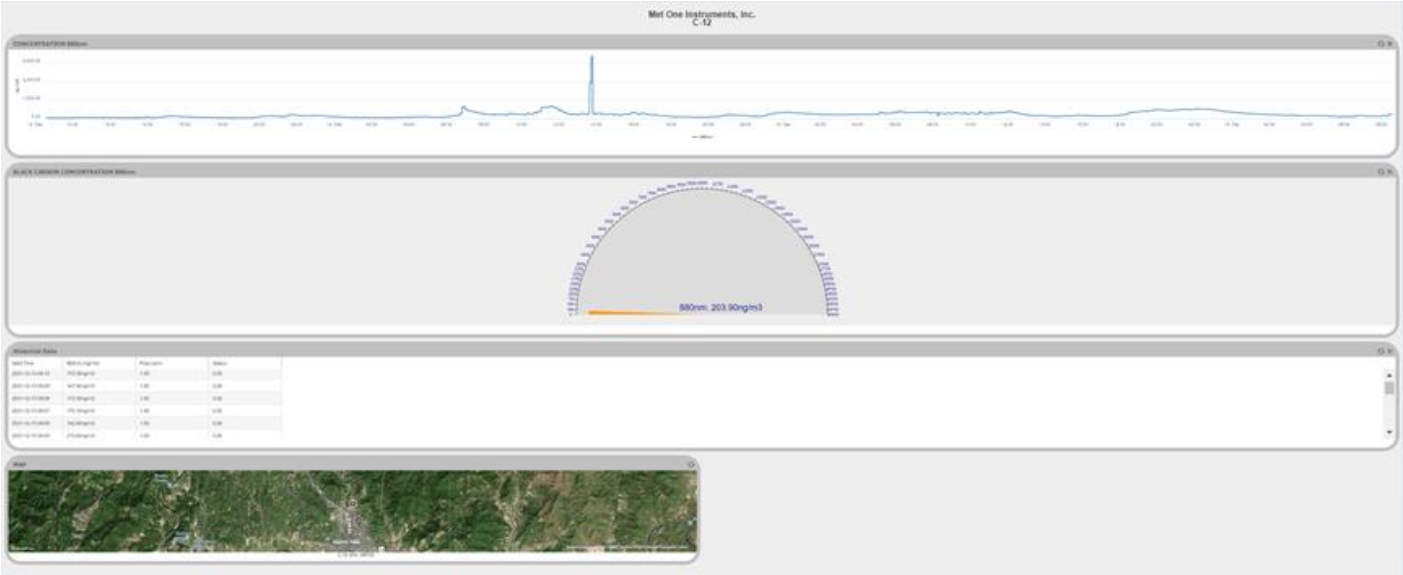


Figure 4-2 C-12 Website Data Dashboard

Note: Customers are sent a unique web link with their system.

4.1.2 Data Retention

The cloud site stores data for a minimum of 2 years, after which the oldest records may be over-written. Met One recommends using the Comet utility program to routinely download data and store the data on a local computer or network. Comet automatically creates a time-stamped, comma separated CSV data file when data is downloaded. The CSV file can be found in the My Documents folder. The C-12 unit itself holds 2,816 data records in case of a cloud modem failure.

4.2 Comet Software

The C-12 is compatible with the free copy of the Comet™ program. Comet is a simple, Windows-based, communications terminal program developed by Met One Instruments, Inc. Comet allows the user to connect to the cloud and download the data from each cloud service webpage.

The Comet software also contains a comprehensive pdf user's manual for the program. Install the program onto the computer you will be using and review the manual for more operational details.

A link to the Comet software is available at https://metone.com/software/.

Comet is a communications terminal program which can retrieve data from the C-12 using a direct local connection or a remote connection via an IP address or a variety of modem options.

Warning: A Silicon Labs CP210x Driver for the USB connection must be installed before connecting to the USB Type B port. Driver download weblink: https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers

4.2.1 Comet Installation

Download the Comet software onto a PC and run the Windows Installer Package. Follow the on-screen instructions until Comet is successfully installed, then run it from the Programs directory. Create a new station for the C-12 and use it to retrieve the data from the monitor.

4.2.2 Setting up a Cloud Station

The first time the Comet program is opened it prompts the user to create a new station for your Cloud site. If Comet does not prompt you, go to the top left menu and select Add New Station to create a new station.

Select the Cloud Device Product Type and click next. Refer to Figure 4-3.

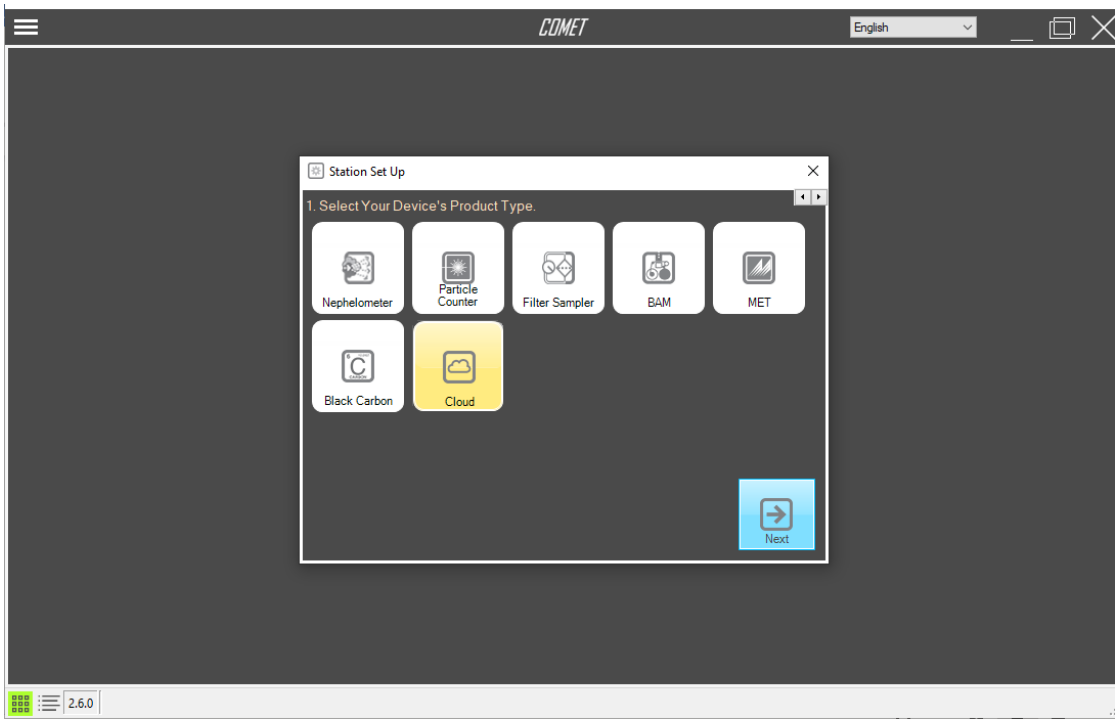


Figure 4-3 Comet Station Setup

Select the Met One Cloud Product Type and click next.

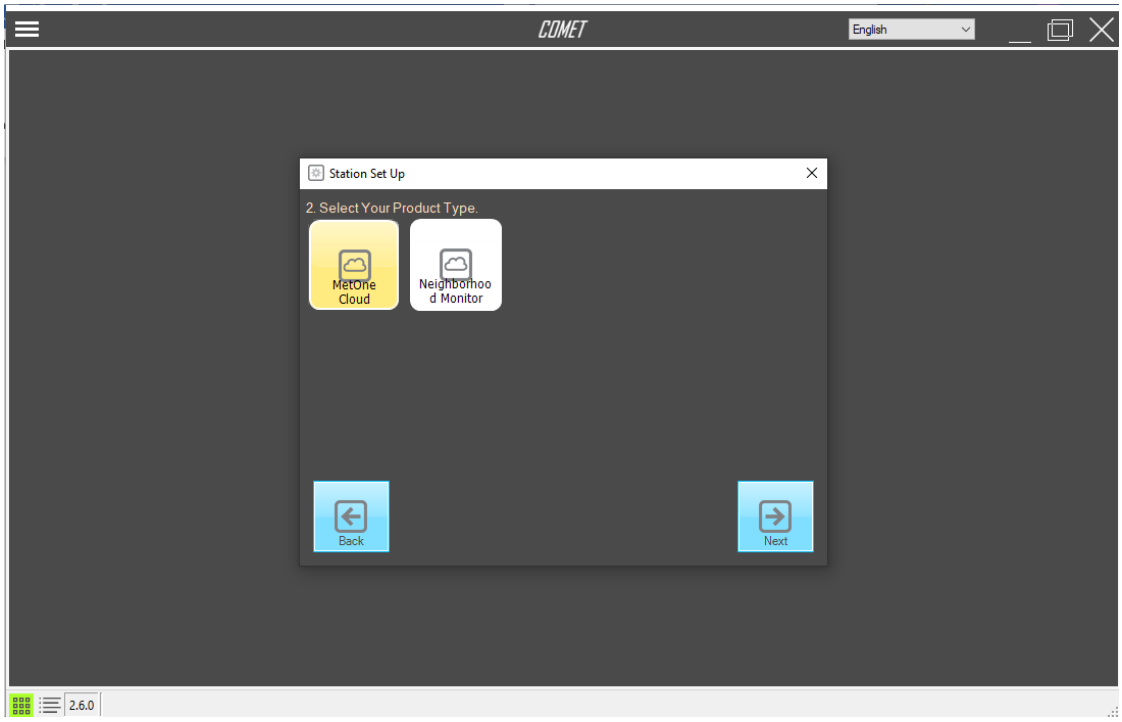


Figure 4-4 Comet Product Type Screen

Enter a Station ID, API key, and Serial Number for the C-12.

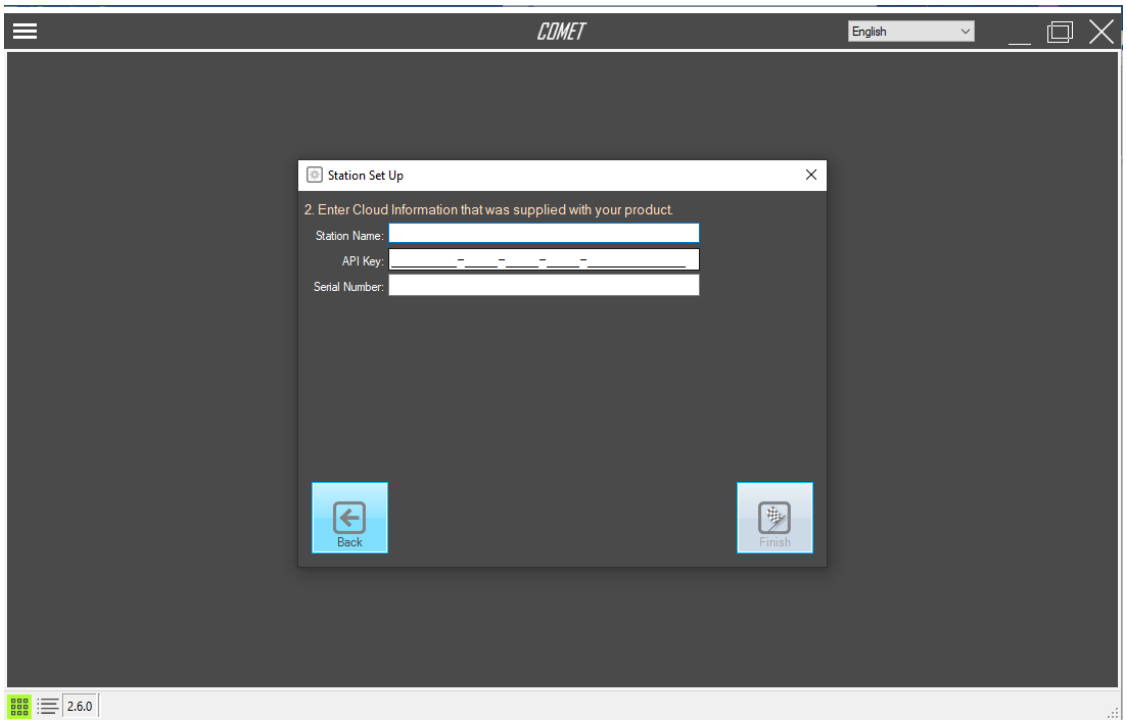


Figure 4-5 Comet Cloud Information Screen

Note: Customers will receive an API on the provided configuration sheet; a digital copy can be obtained from the Met One Instruments Service department.

Press the Retrieve button to open the Retrieve Data menu screen. When prompted, enter a data range and press OK to download your station's data from the cloud.

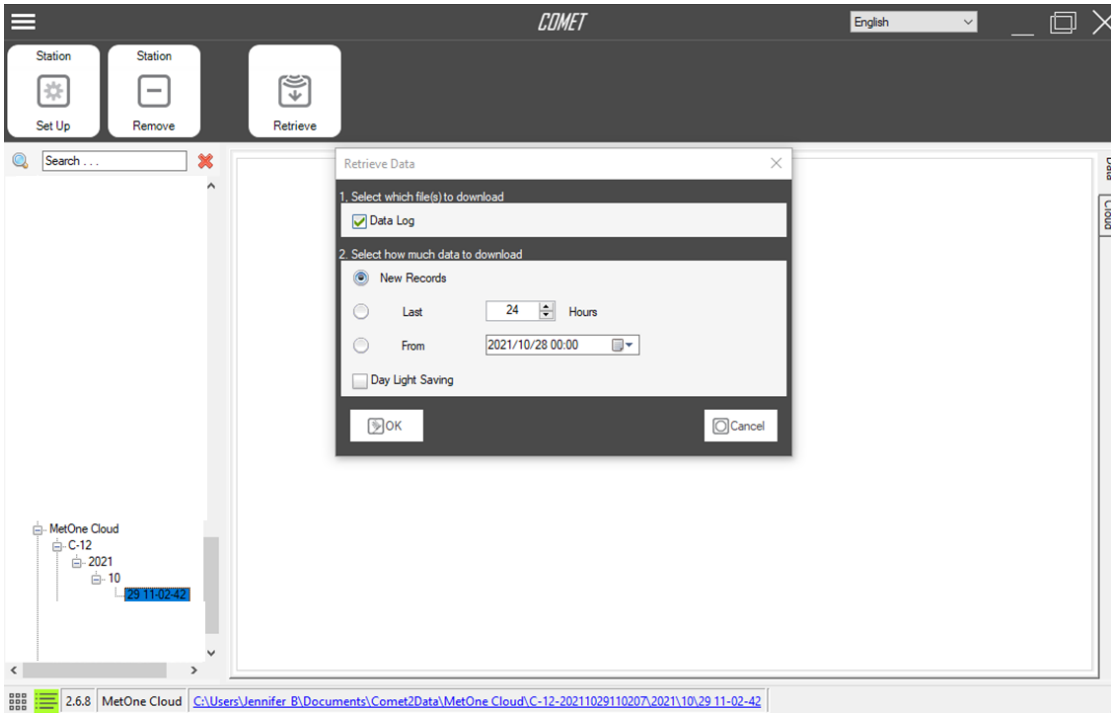


Figure 4-6 Comet Retrieve Data Screen

Comet will connect to the cloud site and download the device's data. Users can use the data tab and chart tab to view the data. When Comet downloads the data, a CSV file is created in the users My Documents folder.

5 DATA PLANS AND RENEWALS

The C-12 includes one year of cellular data and website hosting at no extra charge. The cloud service can be renewed by contacting the Met One Service department at service@metone.com or 541-471-7111.

The following yearly data plans are available:

680785	CCS Data Plan, 15 Min USA
680786	CCS Data Plan, 5 Min USA
680783	CCS Data Plan, 60 Min Global
680784	CCS Data Plan, 15 Min Global

6 REMOTE USER INTERFACE and MENU SYSTEM

The C-12 does not have a physical screen. A remote user interface is available by connecting the USB serial port of the unit to a PC or laptop with Met One Instruments, Inc. Comet software. Create a new C-12 black carbon product with a serial connection baud rate of 115200 within the Comet software. The remote interface allows the user to perform maintenance on the unit. Figure 6-1 illustrates the remote user interface.

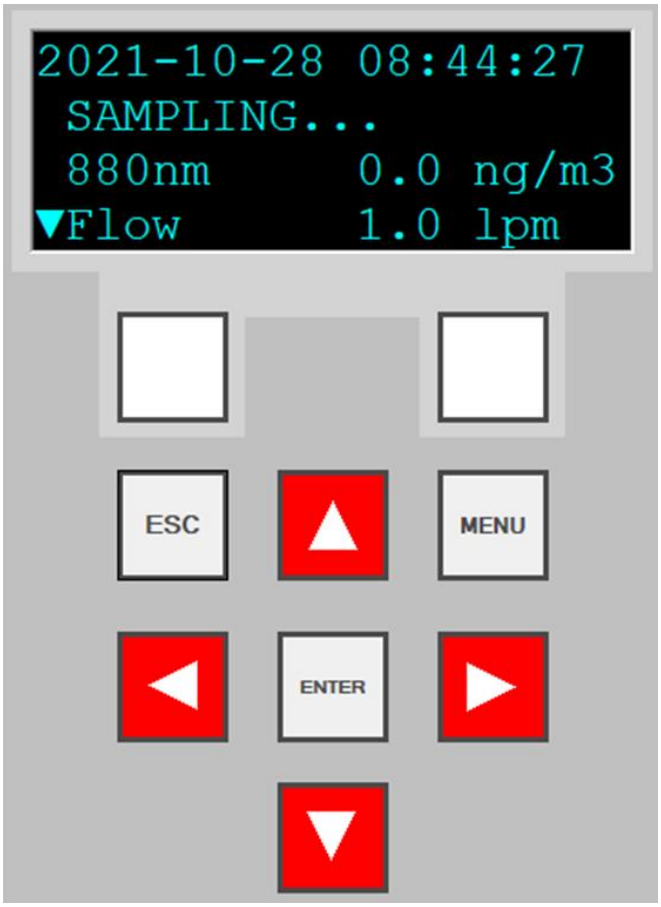


Figure 6-1 C-12 Remote User Interface

The C-12 remote user interface software consists of a display and a dynamic keypad. The two white keys under the display are called “softkeys” or “hot keys”. These are dynamic keys which change in response to a menu option displayed directly above them on the bottom row of the display. The function of these keys depends on which menu is shown on the display.

The four arrow (cursor) keys are used to scroll up, down, left, and right, to navigate in the menu system, and to select items or change fields on the screen. The arrow keys are also often used to change parameters or increment/decrement values in the menu system.

The MENU key is used to enter the main menu. The ESC key is used to escape or exit out of a screen or menu. The ENTER key enters parameters in a selected field or selects an item in a list.

This section describes the C-12 remote user interface system, and describes the functions of the main menu options, including how to view data and errors.

6.1 Main Sampling Screens

The C-12 main sampling/operation screens are shown in Figure 6-2. The current date and time are always fixed at the top line of the display in these screens. The up/down arrow keys can be used to scroll to additional viewable parameters.

Figure 6-2 Main Sampling Screen order

Figure 6-3 shows the screens with the optional 370 nm illumination wavelength.

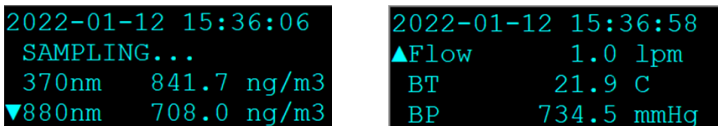


Figure 6-3 Main Sampling Screen order with optional 370 nm wavelength

The definitions of the fields shown in Figure 6-2 are as follows:

Parameter	Description
370nm	Optional. Previous sample period result of the UV particulate concentration. Nanograms per cubic meter.
880nm	Previous sample period result of the black carbon concentration. Nanograms per cubic meter.
FLOW	Previous sample period result of the actual sample flow rate (through the sample filter). Liters per minute.
BT	Previous sample period result of the temperature of the inside of the C-12 enclosure. Celsius.
BP	Previous sample period result of the real-time ambient barometric pressure. mmHg.

Table 6-1 Main Display Parameter Descriptions

6.2 Menu Hierarchy and Navigation

The C-12 menu structure is outlined in the following table:

Main Menu	Sub Menu Options	Overview
Sampling Screen Section 6.1	No sub menu	Displays date, time, operational mode, carbon concentration, flow rate, and internal conditions.
Start/Stop Sample Section 6.3	No sub menu	Start and stop sampling operations
Load Tape Section 3.6	No sub menu	Install the filter tape, verify tape movement.
View Alarm Log Section 0	No sub menu	View alarms
Setup Menu Section 6.6	Clock Sample Memory	Set the date and time Configure sample settings and set Location Clear stored data and alarm logs
Calibrate Menu Section 0	Calibrate Flow Calibrate Audit	Calibrate sample flow rate or restore default settings Verify the attenuation calibration
Test Menu Section 0	Self-Test Tape Test Leak Test	Verify tape movement, flow and optical system operation Verify tape movement Check the flow system for leaks
Advanced Menu Section 6.9	Calibrate Menu Test Menu	Test LED Setpoint Test LED operation
About Section 6.10	No sub menu	View the current model, serial, and firmware revision numbers

Table 6-2 C-12 Menu Hierarchy

Menu selections and instructions are detailed in the following sections of this operating manual as assigned in the Main Menu column of Table 6-2 above.

Field editing in the C-12 is slightly different than the methods used in some of the other similar Met One Instruments, Inc. products.

The flashing cursor ■ is moved to the field to be changed with the ▼▲ keys. Once the desired field is highlighted, the ENTER key must be pressed to open it for editing.

A ▼ symbol will appear next to opened fields where a pick list is available and the ▼▲ arrow keys can then be used to cycle through the available choices. Once the preferred option is highlighted, press the ENTER key again to select it and lock the field. To return to the previous menu, press ESC.

If a numeric field is opened for editing, the cursor will be positioned at the leftmost digit. Use the ◄► keys to move the cursor to the digit to be modified and then use the ▼▲keys to increment/decrement the value. Once all the digits have been set to the required value, press the ENTER key again to lock the field. To return to the previous menu, press ESC.

Use the ESC key to cancel any edit that may be in progress. The ESC and MENU keys are used to exit the current menu and return to the previous menu level. If the Main Menu is currently selected, the monitor will exit to the Main Sampling Screen.

6.3 Start or Stop Sample

This screen is used to begin or end the C-12 sampling operations. It will be labeled on the main menu as either START SAMPLE or STOP SAMPLE. The label indicates the action that can be taken when entering this screen. Once selected, press the START or STOP softkey (shown in the START mode in Figure 6-4) to begin or end sampling.

Figure 6-4 The Start Sample Screen

If the START softkey is pressed, the monitor will advance to a fresh spot of filter tape, turn on the pump, and display WAIT TOP-OF-MIN in the status field. Then the status field will change to SAMPLING… It will take two full minutes before BC concentrations will appear if Sample Time is set to 1 minute. If Sample Time is set for a longer period, the C-12 will display concentrations after 1 full sample period.

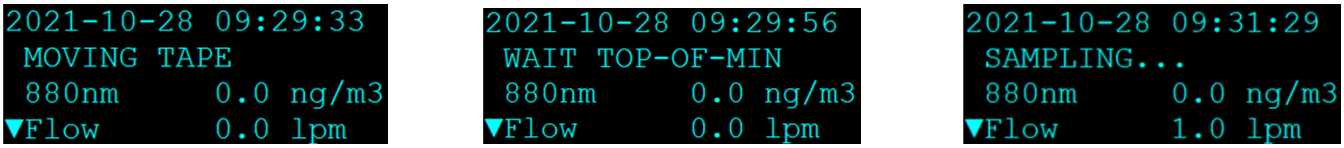


Figure 6-5 C-12 Startup Screens

To stop sampling, press either the ESC or MENU button while on the main screen. This will exit the main screen and enter the main menu. Place the flashing cursor next to the STOP SAMPLE option at the top of the menu and press the ENTER key. The C-12 will ask the user to confirm if the sample should be stopped. If confirmed, the C-12 will stop running and return to the main menu.

To resume sampling after the unit has been stopped for any reason, return to the main menu. The top option of the menu will now read START SAMPLE. Place the cursor on this option and press the ENTER key. The C-12 will ask the user to confirm if the sample should be started. If confirmed, the C-12 will begin the startup sequence and return to the Sampling Screen.

The Start/Stop Measurement screen can also be accessed by pressing the ENTER key from the main menu.

Figure 6-6 C-12 Stop/Start Sample Screens

6.4 Load Tape

This screen enables operation of the Measurement Module assembly and tape spools. Use the OPEN softkey to lower the bottom of the measurement module and open the tape path. When opened, the OPEN softkey will read as CLOSE, indicating that when pressed, the key will close the measurement module assembly. Use the MOVE button to advance the tape one sample space. If the measurement module is closed when the MOVE key is pressed, the C-12 will automatically open it and then advance the tape. See Section 3.6 for instructions on loading the filter tape.

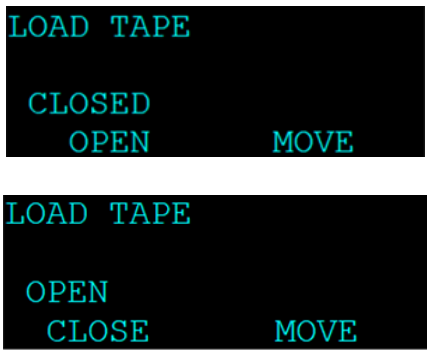


Figure 6-7 The Load Tape Screen

6.5 View Alarm Log

This screen is used to view time-stamped alarm events with the most recent alarm displayed first. To view earlier alarms, use the arrow keys to navigate through the list. The ◄ and ▲ keys will scroll to the previous alarm in the list (earlier time stamps) and the ► and ▼keys will scroll to the next alarm (later time stamps). This information is also reported in the Alarm File (see Section 8.1).

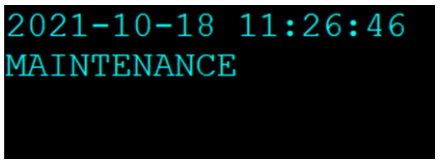


Figure 6-8 The View Alarm Log Screen

6.6 The SETUP MENU

The C-12 setup menu contains the settings and configuration parameters used by the instrument. The factory default values will be correct for most applications but can be reviewed and altered to suit the specific needs of the local monitoring program, as needed. The settings will not be lost if the unit is unplugged or powered down.

Use the ▲▼ keys to select the desired sub-menu and press the ENTER key to enter. The SETUP menu is shown below:

Figure 6-9 The C-12 Setup Menu

6.6.1 The CLOCK Setup Screen

The CLOCK setup screen is used to change the instrument date and time.

Press the ENTER key to open the fields for editing. Once open, use the arrow keys to set the desired date and time and then press the ENTER key again to lock the field. Press the SET softkey to set the clock and exit out to the SETUP menu screen. It is recommended to exit the menu system to the main sampling screen and verify that the date and time are correct.

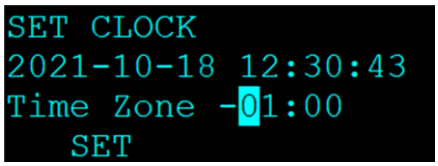


Figure 6-10 The C-12 Clock Setup Screen

The Time Zone setting is used to configure the CCS Modem. Enter your time zone offset from UTC, the time at zero degrees longitude. A list of UTC time offsets can be found here: https://en.wikipedia.org/wiki/List_of_UTC_time_offsets .

6.6.2 The SAMPLE Setup Screen

The SAMPLE setup screen allows users to set the Location ID of the unit.

The location ID is a simple ID number that will appear in the data files. When using multiple monitors, it can be used as a Unit ID number to indicate a data collection location independent of serial number. The range is 001 to 999.

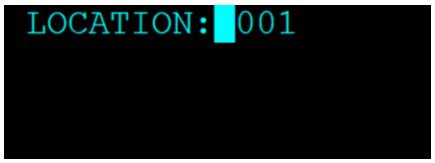


Figure 6-11 The Sample Setup Menu

6.6.3 The MEMORY Setup Screen – Clearing the Memory

The MEMORY screen is used to clear/erase files in the C-12 memory. CAUTION: This menu function will permanently delete the selected files from the instrument memory!

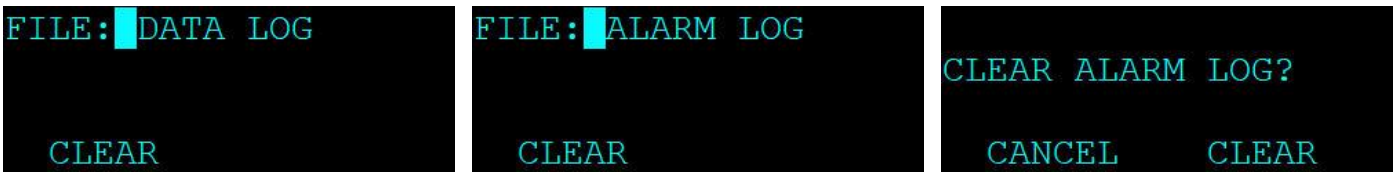


Figure 6-12 The C-12 Clear Memory Menus

The FILE value can be set to the DATA LOG, ALARM LOG, or ALL LOGS. Pressing the CLEAR softkey will cause the confirmation screen to appear before the selected files are cleared as shown in Figure 6-12.

6.7 The CALIBRATE MENU

The C-12 CALIBRATE menu provides access to a system of calibration menus which allow the operator to audit or calibrate various system parameters for optimal performance. This menu provides a means to calibrate the Barometric Pressure (BP) and sample flow rate (FLOW). The CALIBRATE AUDIT menu allows verification of the optical system calibration.

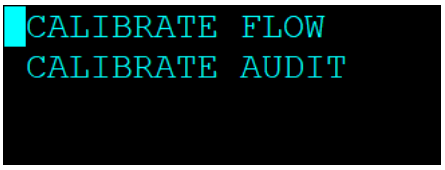


Figure 6-13 The C-12 Calibrate Menu

6.7.1 The CALIBRATE FLOW Screens

The CALIBRATE FLOW screen is used for field audits and calibrations of the sample flow measurement of the C-12.

In Figure 6-14, the first screen allows for verifying and then setting the zero flow condition, if needed. The second screen is used for verification and calibration of the actual sample flow rate. Press the CONTINUE button on the zero flow screen to advance to the sample flow rate screen.

Figure 6-14 C-12 Calibrate Flow Screens

The SET POINT field is the target flow rate the monitor should be maintaining. The FLOW field indicates the current flow rate being measured by the internal flow sensor. The STANDARD field is where the value from the traceable flow standard is entered, if necessary. See Section 7.4.1 for details on using this screen for performing periodic flow audits and calibrations

6.7.2 The CALIBRATE AUDIT Screens

This series of screens is used to verify the optical measurement system of the C-12 monitor. A neutral density filter calibration tool is used in conjunction with these screens to perform the calibration audit. See Section 7.4.3 for full details on using these screens and verifying the monitor's calibration.

6.8 The TEST MENU

The C-12 TEST menu allows the operator to perform various diagnostic tests, both for troubleshooting and verification of proper system operation.

Use the ▲▼ keys to select the desired sub-menu and press the ENTER key to enter. The TEST menu is shown below:

Figure 6-15 C-12 Sample Screen

6.8.1 The SELF TEST Screen

The SELF TEST screen is used to activate an automatic test of most of the C-12 subsystems to verify that the instrument is in operational condition.

Once the test is initiated, the instrument will test for properly loaded filter tape and test the function of all tape control hardware. The pump, flow sensor, LED light sources and detectors are also tested, and any detected failures are shown on the display.

Upon entering the screen, the start option will appear as shown in Figure 6-16. Press the START softkey to begin the sequence. The tape and flow detectors are tested first, as shown in Figure 6-17.

Figure 6-16 The Self Test Start Screen

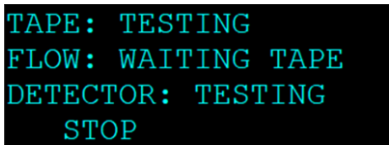


Figure 6-17 Tape and Detector Testing

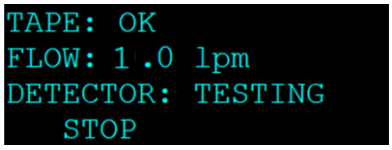


Figure 6-18 Flow Testing

Figure 6-19 Self Test Complete

After about 25 seconds, the pumps should turn on and the flow tests should commence. After the pump has been running for about a minute, the flow rate should be stable as shown in the FLOW field (see Figure 6-18). The test should take about another minute from that point to complete. The results will be displayed and the option to run the test again will be provided (see Figure 6-19). Press the ESC key to return to the Test menu.

6.8.2 The TAPE TEST Screen

The TAPE TEST menu is used to manually advance the filter tape to spool up the end of a new roll of tape, or to test the tape motor and encoder. Press the MOVE softkey to advance the tape. The amount of travel, as measured by the encoder, is displayed in the TRAVEL field. Figure 6-20 shows a typical tape movement result.

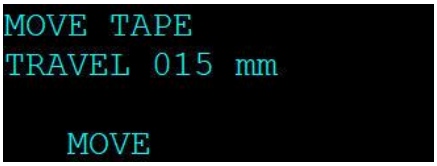


Figure 6-20 The Tape Test Screen

Each time the MOVE softkey is pressed, the displayed travel distance is reset to 000 mm before moving the tape and the new result is displayed.

6.8.3 The LEAK TEST Screen

See Section 7.5 for a detailed explanation of the LEAK TEST screen and its use.

6.9 The ADVANCED Menu

The ADVANCED menu provides access to advanced setup, calibration, and test features. Settings are configured for most sampling environments and will only need to be accessed in special situations. Attempting to enter this menu displays the warning message shown in Figure 6-21

Figure 6-21 The Advanced Menu Warning

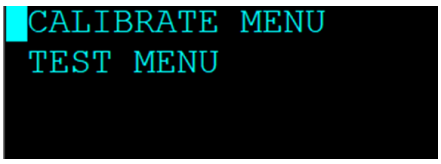


Figure 6-22 Advanced Menu Screen

6.9.1 The CALIBRATE MENU Screen

The CALIBRATE MENU screen allows the operator to select the LED SET POINT Screen to adjust the nominal operating current for the BC LED. This should only be used if a detector or LED board is replaced. Select the 880 ON softkey to turn on the 880 nm LED. An option will be available to 370 nm if this option is employed in the C-12. Contact service (Section 1.2) for more information.

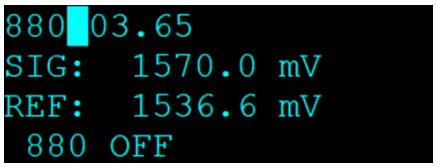


Figure 6-23 – LED SET POINT Screen

6.9.2 The TEST MENU Screen

The TEST menu allows the operator to select the LAMP TEST Screen to review the detector voltage. Press the 880nm ON softkey to turn on the LED and check the detector voltage. If the 370 nm wavelength option is employed in the unit, it will have its own softkey, as shown in Figure 6-24.

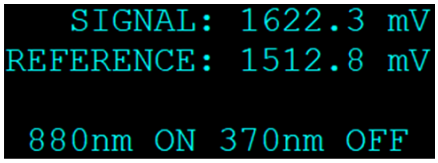


Figure 6-24 – LAMP TEST Screen

6.10 The ABOUT Screen

This screen is used to view the C-12 firmware part numbers and revision levels. The instrument's serial number is displayed on the third line as shown in Figure 6-25.

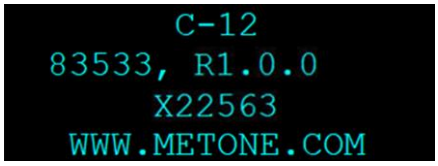


Figure 6-25 The About Screen

7 MAINTENANCE and TROUBLESHOOTING

This section provides information about routine maintenance of the C-12, and for performing more detailed diagnostic tests if a problem is encountered. The instrument generates error in the data log if a failure or other problem is detected. Many times, there is a simple solution. Persistent errors often signify a failure that will require investigation.

7.1 C-12 Error and Alarm Event Descriptions

The C-12 contains a system of error and alarm codes that are used to alert the operator to problems with the unit. The errors are stored in the digital alarm log with the time and type of the error. Corresponding alarm codes are stored in the data array.

The Alarm field is reported in data files by a numeric code. If multiple alarms are generated for a single data record, the reported alarm value is the sum of the alarm codes. The general alarm events are described in Table 7-1. Certain alarm events may not be posted to the data array if an alarm condition terminates operation before the end of a sample. Please consult the Alarm Log for more detailed information when an error is encountered.

Code	Description	Causes	Corrective action
0	**No Alarm**	System fully functional	None
1	**Power Failure**	Caused by a power cycle or a microprocessor reset.	Power off/on event logged. Ensure unit is provided with stable power
2			
4	**Tape Move Failure**	Tape roll exhausted Tape break Tape loose, not turning encoder Encoder wheel turns, but not measuring tape movement	Install new roll of tape (Section 3.6) Re-attach tape (Section 3.6) Tighten tape (Section 3.6) Optical encoder fault. Contact Met One Instruments service department for assistance (Section 1.2).
8	**Maintenance**	Stop for maintenance during normal operation. Operation terminated because of an error condition.	"Stop Sample" logged. Not an error condition. See additional error messages in the Alarm log (Section 0) to determine cause.
16	**Flow Failure**	Failure when the flow is 10% out of regulation for more than one minute, or when the flow is 5% out of regulation for more than five minutes. 1. Inlet hose kinked or other blockage on inlet 2. Bad pump 3. Bad flow sensor	1. Un-kink hose or remove blockage, clean impactor, clean TSP inlet 2. Replace pump* 3. Replace Flow Sensor* * Contact Met One Instruments service department for assistance (Section 1.2).
32	**Automatic Tape Advance**	The tape was advanced because of tape loading.	Automatic tape advance logged. Not an error condition.
64	**Detector Failure**	Mis-installed tape Blocked Reference or Sample port Light leak Hardware Failure	Verify tape is installed correctly (Section 3.6). Clear obstructions in the ports below the tape (Contact Met One Instruments service department for assistance (Section 1.2).) Contact qualified service technician (Section 1.2).
128	**N/A**		

Code	Description	Causes	Corrective action
256	**Sensor Range**	A sensor is outside its designated limits. Check Alarm log for abbreviation BT, BP, FLOW, LED T, or DET T.	1. If BT, replace internal temperature sensor. 2. If FLOW, LED T, DET T contact qualified service technician (Section 1.2).
512	**Nozzle Move Failure**	Set when nozzle failed to move up or down.	1. Lift motor not turning: Verify connection in nozzle motor cable. 2. Lift motor turning, lift bearing not moving: Lift bearing slipping on shaft, or shaft broken. Refer to qualified service technician (Section 1.2). 3. Lift motor turning, lift arm moving, nozzle not moving: lift bearing broken. Refer to qualified service technician (Section 1.2). "UP" and/or "DOWN" optical sensor not functioning. Refer to qualified service technician (Section 1.2).
1024	**N/A**		
2048	**Calibration Audit**	A user Calibration Audit was being performed.	Calibration Audit activity logged. Not an error condition.
4096	**N/A**		
65536	**Tape Move**	System advances the filter tape.	Tape advance logged. Not an error condition.

Table 7-1 Alarm Triggers

Detector Alarm Events: The detector alarm events are detailed in Table 7-2. Any detector failure event will stop machine operation, force a tape advance, and then attempt to resume normal sampling. Detector *warnings* will be logged but will not interrupt operation. The IR and UV detector range is 0.0 to 2500 mV. The limits are as follows:

Saturation Limit = 2450 mV Detector Limit = 100 mV Zero Limit = 5 mV

Description	Causes
LED Failure	While the IR LED is ON, the signal and reference detector readings are below the Detector Limit.
Signal Detector Failure	While the IR LED is ON, the signal detector reading is below the Detector Limit and reference detector reading is above the Detector Limit.
Reference Detector Failure	While the IR LED is ON, the signal detector reading is above the Detector Limit and reference detector reading is below the Detector Limit.
Signal Zero Warning	When the signal zero is above the Zero Limit.
Reference Zero Warning	When the reference zero is above the Zero Limit.
Signal Saturation Failure	When the IR LED Signal reading is above the Saturation Limit.
Reference Saturation Failure	When the IR LED Reference reading is above the Saturation Limit.

Table 7-2 Causes for Detector Alarms

Sensor Outside Range Alarm Events: This alarm occurs if one of the sensor parameters registers a value outside of its measurement range, indicating a possible sensor failure. It is intended to filter out and catch full scale readings which can occur from the ambient sensors.

Sensor	Minimum	Maximum
Flow	-3.0 LPM	11.0 LPM
LED Temperature	-21.0 C	110.0 C
DET Temperature	-21.0 C	110.0 C
BT Sensor	-40.0 C	60.0 C
BP Sensor	304 mbar	1090.6 mbar

Table 7-3 Set Points for Out of Range Alarms

7.2 Basic Problem Causes/Solutions Table

The following table contains information on some of the more common C-12 problems that may be encountered, and some steps to identify and remedy the problems. Met One Instruments welcomes user suggestions for new items to include in this section of future manual revisions.

Problem:	**The instrument doesn't appear to be turning on or starting.**
Cause/Solution:	• Make sure the power supply and power cord are properly connected to a good electrical outlet. • If the instrument is ON, the hum of the internal pump should be audible. • The C-12 should start sampling within 1 minute after power-up. • After using the STOP SAMPLE function, sampling will resume after 30 minutes.

Problem:	**Flow failures or low flow.**
Cause/Solution:	• Make sure that the tape is properly advancing the dirty spots. See Section 6.8.2 • DEFAULT the flow sensor calibrations and re-calibrate the flow. If corrupted flow calibration parameters are entered into the flow calibration, it may appear that the flow system is not working. See Section 7.4. • Verify the BT and BP sensor function. Failed sensors will affect the flow. • The sample pump itself will eventually wear out and need to be replaced. It should last at least two years under normal conditions. Check the other possibilities first. See Section 9 for replacement parts.

Problem:	**Leak check failures**
Cause/Solution:	• There is always a small amount of leakage at the filter tape interface. • Make sure the upper and lower nozzles are completely clean. • The filter tape can be replaced with a small rubber sheet with a small hole positioned under the nozzle. This will eliminate the tape as the leak point to help isolate the leak source. • Note: nothing down-stream of the flow sensor is leak tested during the standard leak test procedure.

Problem:	**Optical system alarms and failures**
Cause/Solution:	• A Detector Failure will occur if no filter tape is installed in the measurement module. • Detector Failure will occur if an LED has failed, if either the Reference or Signal Detectors have failed or if there is a ZERO failure (high background). First, ensure tape is properly installed.

Problem:	Data download timestamp does not match webpage data
Cause/Solution:	• Check that the time zone offset is properly set in the clock setup screen. Refer to Section 6.6.1.

Problem:	Calibration Audit failures
Cause/Solution:	• A Calibration Audit Failure can occur if the filter tape is moved during the Calibration Audit procedure. Care should be exercised to not move or damage the tape when performing the calibration audit. • A Calibration Audit Failure can occur if the Calibration Audit Membrane (83011) is inserted incorrectly. The Membrane should be fully seated and the open holes on the LEFT. • A Calibration Audit Failure can occur if the ND filter membrane in the 83011 span check membrane is damaged. A replacement 83011 membrane can be purchased from the Met One Instruments Service Department.

Table 7-4 Common Problems and Solutions

7.3 Suggested Periodic Maintenance Intervals

Table 7-5 shows the Met One Instruments recommended periods for routine maintenance items. Some of these items will need to be performed more or less often depending on local conditions. Local monitoring program administrators may need to review these items and establish SOPs appropriate for local applications.

Maintenance Item	Minimum Period	Manual Section
Replace filter tape	As Required (2-12 Months Typical)	3.6
Flow audit	1 Months	7.4.2
Span check	3 Months	7.4.3
Leak test	3 Months	7.5
Flow full calibration	3 Months	7.4.1
Replace main pump	As Required	Contact qualified service technician (Section 1.2).
Factory service	As Required	7.6

Table 7-5 C-12 Maintenance Schedule

7.4 Flow Audit and Calibration

The C-12 has a system of calibration menus which allow the operator to audit or calibrate various system parameters for optimal performance. It is recommended that airflow control parameters be audited monthly and calibrated quarterly during continuous operation. The exact frequency may vary depending on local conditions and the data validation requirements established by the sampling program administrator.

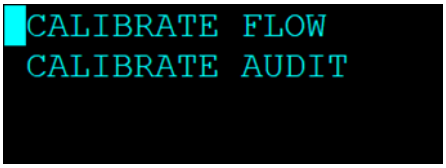


Figure 7-1 The C-12 Calibrate Menu

The CALIBRATE MENU option is in the main C-12 menu. The CALIBRATE MENU is described below:

7.4.1 Flow Sensor Calibration

The CALIBRATE FLOW screen is used for field audits or calibrations of the sample flow measurement of the C-12. The leak status must be checked before performing any flow calibrations. See Section 7.5 for more details on this prerequisite.

Flow calibrations require a traceable flow audit calibration device. The Met One Instruments, Inc. Swift 6.0 and similar particulate sampler flow calibrators work well. Attach the flow meter to the C-12 sample inlet. The nominal flow rate for the C-12 is 1 lpm. Flow calibration devices should be selected accordingly.

Figure 7-2 The C-12 Flow Calibration Screens

All flow values are in Q_a actual volumetric conditions.

The screen will first display the zero-flow mode with the pump OFF. The measured flow will be displayed at the top of the screen.

Press the ZERO softkey to zero the flow sensor. Then press CONTINUE to proceed to the main flow calibration screen and automatically turn the pump ON.

The SET POINT parameter is the target flow rate that the C-12 will attempt to maintain. The FLOW parameter is the current flow reading from the C-12 flow sensor. The instrument should automatically regulate to the SET POINT value within a few moments.

The DEFAULT softkey may be pressed to clear out all previous field calibrations and restore the factory calibration for the sensor if difficulties are encountered.

The STANDARD field is where the correct flow value from the traceable flow meter should be entered if the flow does not match within ± 5% of the traceable standard. To correct the FLOW reading, enter the value shown on the reference meter in the STANDARD field (see Section 0) and then press the CALIBRATE softkey. The FLOW value should change to match the STANDARD value when the CALIBRATE softkey is pressed. The monitor will then attempt to regulate the FLOW value to match the SET POINT.

Audit-Only Flow Checks: see Section 7.4.2. No flow calibrations are changed if the ZERO and CALIBRATE softkeys are not pressed.

7.4.2 Flow Audits

To audit any of the flow parameters, without making any calibration changes, enter the corresponding calibration menu and allow the reading to stabilize. Verify the value is correct and matches the flow standard. Record the results and press ESC to exit to the Calibration menu.

7.4.3 The CALIBRATE AUDIT Menu – Performing Optical Span Tests

The CALIBRATE AUDIT menu is used to perform the optical span calibration verification test on the instrument using a neutral density filter. This will introduce a known and consistent amount of optical attenuation into the measurement system. The 83011 Span Check Filter tool will be required to perform this test.

Note: No changes to the instrument calibration are made with this process. This is a span check only.

Press the MENU key. Highlight the CALIBRATE MENU item and select the ENTER key. Scroll to the CALIBRATE AUDIT option and select the ENTER key again.

When entering the CALIBRATE AUDIT menu, the Measurement Module should be in the OPEN position. If it is not, or if the state is unknown, press the MOVE button (see Figure 7-3) to open the measurement module and advance the tape one position.

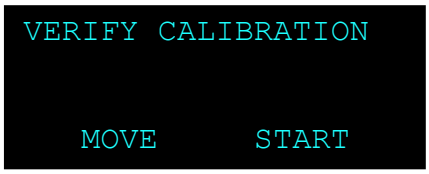


Figure 7-3 Entering the CALIBRATE AUDIT Menu

Press the START button to advance to the Zero measurement. Verify the filter tape is installed and press the CONTINUE softkey. The measurement module will close, and the zero measurement will begin as shown in Figure 7-4.

Figure 7-4 Performing the Zero Test

Once the zero test is complete, the span test must be performed using the 83011 neutral density (ND) filter. The measurement module will open, and the screen will display instructions to insert the ND Filter as shown in Figure 7-5.

Hold the 83011 ND Filter so that the label is UP (filter element is on the right-hand side) and insert it above the tape. Be certain it is fully inserted and seated squarely against the pins at the front of the measurement module. See Figure 7-8.

CAUTION: Be very careful not to move the tape as this will affect the measurement!

Figure 7-5 The Span Test Start Screen

Figure 7-6 The Span Test in Progress Screen

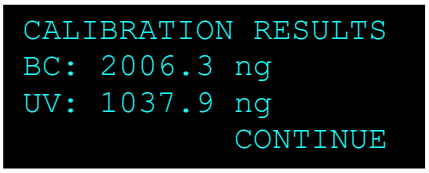


Figure 7-7 The Span Test Completed Screen

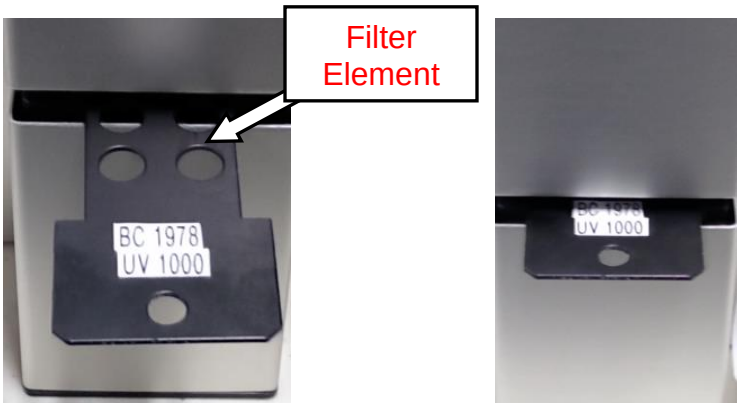


Figure 7-8 Inserting the Neutral Density Span Membrane

The measurement module will close and the display will show the completion time remaining (see Figure 7-6) for the span filter portion of the test. At the end of the test, the measurement module will open and the results will be displayed as shown in Figure 7-7.

Note: Figure 7-7 and Figure 7-8 display results with the optional C-12 BRC 370 UV option. Standard configuration CALIBRATE AUDIT results will only display BC results.

The values should be within ± 5% of the values indicated on the label of the 83011 ND Filter. Record the results and then press the CONTINUE button.

The measurement module will open and the display will indicate when it is safe to remove the ND filter as shown in Figure 7-9.

Remove the filter and then press the EXIT button to return to the CALIBRATE menu.

Figure 7-9 The Calibration Audit Exit Screen

Should the values fail to be within ± 5%, the most likely reason is inadvertent tape movement during the test. The test should be repeated, paying particular attention to maintaining the tape stationary. If the test still fails, contact the Met One Instruments, Inc. service department for assistance. See Section 1.2 for contact details.

7.5 Flow System Leak Checks

NOTE: Leak check should be performed with the tape installed.

The tape interface nozzles in the optical measurement module should be checked and cleaned on a routine basis, in order to prevent flow leaks at the filter tape interface. This requires removing the filter tape. With the measurement module open, the parts can be inspected and cleaned with a cotton-tipped applicator if needed. Be sure to replace the tape prior to beginning the leak check.

The C-12 flow contains an easy to maintain flow system. To perform a leak test, remove the TSP cap from the sample inlet and place the vinyl cap (pn: 770025) over the inlet tube. Navigate to the TEST MENU > LEAK TEST menu as shown in Figure 7-10. The FLOW value is the output from the internal flow sensor.

Press the PUMP ON softkey. This will turn on the pump at a fixed control point while the vinyl cap is in place. The FLOW value should be 0.5 LPM or less for the leak test to be considered passing.

Figure 7-10 The C-12 Leak Test Menu

Once complete, press the PUMP OFF key to turn off the pump. **Slowly release the vacuum** in the system (by easing off the vinyl cap) ***before*** exiting this screen. The warning screen shown in Figure 7-10 will be displayed when exiting the Leak Test screen. Exiting the Leak Test screen before releasing the vacuum will cause the vacuum to be released rapidly. This can damage the tape and suck debris into the sample chamber which may require returning the monitor to the factory for service.

Reconnect the TSP cap to the inlet sample tube and resume sampling operations.

7.6 Factory Service Interval

The C-12 recommended factory service interval is once every two years.

Factory service primarily consists of optical system cleaning, optics/detector checks, and a calibration check (and recalibration if needed) against a factory standard. As-found calibration checks can also be requested. Contact the Met One technical service department to schedule service. A Return Authorization number must be obtained before the unit is returned. See Section 1.2 for contact details.

8 DATA RETRIEVAL and COMMUNICATIONS

This section describes the methods used to retrieve data from the C-12 carbon monitor. The unit has a single serial data output which can be routed through the USB serial converter port. This is used for all data transfer and may be used with a local computer and Comet software.

The default serial settings are as follows:

Baud Rate: 115,200

Data Bits: 8

Parity: None

Stop Bits: 1

Flow Control: None

8.1 C-12 Data Outputs and Data Examples

The SETTINGS File:

The settings file contains most of the setup menu parameters for the C-12. This file should be reviewed periodically to ensure that no settings have been incorrectly changed. It also serves as a good data validation record. An example of a C-12 settings text file is shown in Figure 8-1.

The settings file also contains encrypted Factory Settings at the end of the Settings file report.

```
C-12 Settings Report
2021-12-02 14:34:47

      Firmware, 83533, R1.0.0.10
 Serial Number, I98765
      Location, 1
 Sample Period, 1 MIN
Cloud Output Type, CELL

  Name, Offset,  Slope
  Flow,  0.000,  1.000

Factory Settings
DQogICAgICBQYXNzd29yZCwgMA0KICAgICAgICAgIEJhdWQsIDExNTIwMA0KICAg
IFRpbWUgU3RhbXAsIEVORElORw0KICAgICAgIElTZXR0bGUsIDENCiAgICAgIElB
dmVyYWdlLCA5DQogICAgICBDLUZhY3RvciwgMi42MTANCiAgICAgICAgVVYgQWJz
LCAxOC4yMzM2DQogICAgICAgIEJDIEFicywgNy43NzAwDQogICBVViBLLUZhY3Rv
ciwgMS4wMDANCiAgIEJDIEstRmFjdG9yLCAxLjAwMA0KICAgICBVViBBZXJvIEss
IDEuMDAwDQogICAgIEJDIEFlcm8gSywgMS4wMDANCjM3MG5tIEstRmFjdG9yLCAx
LjAwMA0KODgwbm0gSy1GYWN0b3IsIDEuMDAwDQozNzBubSBLLUxvYWRpbmcsIDAu
NzEwDQo4ODBubSBLLUxvYWRpbmcsIDEuMTcwDQogICAgQm94IFAtR2FpbiwgMTAu
MDAwDQogICAgQm94IEktR2FpbiwgMC41MDANCiAgICAgRlQgUC1HYWluLCAxMC4w
MDANCiAgICAgRlQgSS1HYWluLCAwLjUwMA0KICAgICAgICBGVCBQV00sIDEwMC4w
DQogICBGbG93IFAtR2FpbiwgMTUwMDANCiAgIEZsb3cgSS1HYWluLCA1MDAwDQog
IDM3MG5tIFNldCBQdCwgOS40OA0KICA4ODBubSBTZXQgUHQsIDMuNzUNCiAgICAg
U2F0IExpbWl0LCAyNDUwDQogICAgIERldCBMaW1pdCwgMTAwDQogICAgWmVybyBM
aW1pdCwgNQ0KICAgVGFwZSBQZXJpb2QsIEFVVE8NCiAgICAgVGFwZSBTcG90LCAx
DQogICBMb2FkIEVuYWJsZSwgT04NCiAgICBMb2FkIExldmVsLCAzMA0KICAgTG9h
ZCBDYXJib24sIDg4MG5tDQpJbnRlcnZhbCBPdXRwdXQsIE9GRg0KQ2xvdWQgUmF0
ZSBMaW1pdCwgMTAgTUlODQogIE5hbWUsIE9mZnNldCwgIFNsb3BlDQogICAgQlQs
ICAwLjAwMA0KICAgIEJQLCAgMC4wMDANCj==
```

Figure 8-1 Settings File

The ALARM LOG File:

The C-12 alarm log contains the date, time, and type of each alarm or error encountered during data collection.

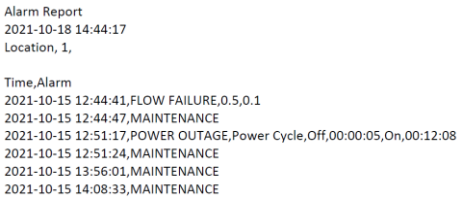


Figure 8-2 Alarm Log

The User Data File:

The top of the C-12 User Data file contains the header information for the file, including the name of the report, the time stamp at which the report was requested, the location id and the serial number of the device.

Below the file header is the csv column header names which describe the data from each field. Below is a description for each header. See Figure 8-3 for an example.

Time is the date and timestamp for the data record. See Section 0 for details.

370nm(ng/m3) is the reported UV particulate concentration for the near UV channel. This field is an optional upgrade.

880nm(ng/m3) is the reported black carbon concentration for the near IR channel.

Flow(lpm) is the average sample flow rate for the last sample period.

BT(C) is the average box temperature inside the enclosure for the last sample period.

BP(mmHg) is the average barometric pressure for the last sample period from the internal BP sensor.

Status is the alarm status (see Section 7.1).

Time	BC (ng/m3)	Flow (lpm)	BT (C)	BP (mmHg)	Status
10/15/2021 16:39	120.2	1.0	27.5	733.6	0

Figure 8-3 User Data File Report

8.2 Flash Firmware Upgrades

The C-12 has the capability for flash firmware upgrades. This allows the field operator to reprogram or update the instrument operating system through the front panel USB port using the Firmware Update Utility program. A Met One Instruments technician may supply the firmware update files by e-mail if a bug fix is released, or if additional features are added to the firmware program.

Ensure that the power source to the C-12 and the computer will not be interrupted during the update process! This may cause the firmware to become inoperative. If this happens the unit will have to be returned to the factory. Make sure the USB cable connection cannot come loose during the update.

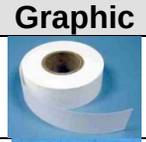
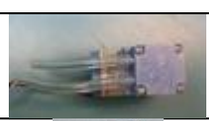
The following must be performed to update the firmware:

1. It is advisable to download and save the data log and alarm log from the instrument before proceeding. Note: The firmware update process does not clear the instrument memory.

2. A PC or laptop with a USB port must be available and the USB drivers for the C-12 installed. Install the Firmware Update Utility program onto the computer by following the prompts after following the e-mail link to the Met One FTP site.
3. Connect the instrument USB serial port to the computer.
4. Run the Firmware Update Utility. From the computer “Start” menu, go to: Programs/Met One/c-12/C-12 Master Program Installer (or similar directory). The program may prompt to press ENTER to begin the update.
5. A “Done!” message will be displayed at the end of the update process. Execution time is approximately five to fifteen minutes.

9 ACCESSORIES and PARTS

The following parts are available from Met One Instruments for maintenance, replacement, service, and upgrades. If unsure about a part, please contact the technical service department. Some of these parts may require technical skills or special instructions before use or installation.

Description	Part Number	Graphic
Filter Tape Roll	**83599**	
Span Check Membrane	**83011**	
Cap, Vinyl, 1/2" ID x1/2" Long, Black	**770025**	
TSP Inlet	**9441**	
Optional Pole Mount	**83597**	
Optional Mounting Stand	**83598**	
Flow Sensor Assembly	**82180-4**	
Pump Module, Sample Flow	**83812**	
USB Cable	**500784**