DYACON®

CM-1
Weather Station
Control Module
Manual

57-6032 Rev O

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Manufacturer

Dyacon, Inc.
1770 Research Park Way
Suite 168
Logan, UT 84341-1959
USA

Declarations

Dyacon WSD-1™, TPH-1™, and CM-1™ are low-power electronic industrial devices.

RoHS

All electronic and mechanical components conform to RoHS, Directive 2002/95/EC.

FCC CFR Part 15

This equipment complies with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation.

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1.0 CM-1 Introduction

1.1 Scope

Dyacon meteorological (met) stations are based on a control unit, or data logger, that acts as the "brains" of the weather station. All sensors, power, and I/O devices connect to the control module (CM).

CM-1 is a component of MS-120, MS-130, MS-140, and MS-150. These stations differ principally by the sensors that are pre-configured with the control module. Users may add, remove, or replace sensors as their needs change.

This manual covers the operation of CM-1 and particularly describes the configuration and features of the control module as a weather station controller. Detailed sensor information is provided in the respective sensor manuals.

1.2 Technical Support

1.2.1 Contact Information

Dyacon, Inc.

> 1770 Research Park Way
> Suite 168
> Logan, UT 84341-1959

Phone: (435) 753-1002

Email: support@dyacon.com

Internet: www.Dyacon.com

Normal business hours are from 9:00 am to 5:00 pm. (Mountain Time Zone)

1.2.2 Phone / Email Support

If you need technical support via the phone or email, please have the following information ready:

> Product name, model number, and serial number.
>
> Your name and name of the purchaser of the equipment.
>
> Name of company, institution, or agency.
>
> Phone number, email address.
>
> Billing and Shipping address.
>
> A clear description of the question or problem.

2.0 QUICK-START GUIDE

A separate document covering site selection, mechanical installation, and brief configuration information is available from Dyacon.

3.0 SITE SELECTION

Refer to the Quick-start Guide.

4.0 PRODUCT INTRODUCTION

4.1 Product Description

Dyacon CM-1 is what other weather station integrators may call a "data logger." Dyacon meteorological (met) stations are composed of a control module and peripheral sensors.

CM-1 is more highly integrated than other data logger solutions, which employ a number of different external components which must be wired together. CM-1 combines these common features into a single, easy-to-use device that end users can install, configure, and maintain.

Technically, the control module consists of a 16-bit microcontroller, a highly-efficient, multi-threaded operating system (TNKernel®), and circuit peripherals. The microcontroller is responsible for all digital communications, power management, analog port control, data logging, user interface, radio communications, measurement conversions, and a many other functions. The integration of all "data logger" functions allows for power optimization of the whole system while maintaining a high level of measurement sophistication and operational simplicity.

Optional modules include GPS receiver and wireless transceivers, such as GPRS, 1xRTT, and HSPA cell phones.

4.2 Other Technical Notes

CM-1B includes an external real-time clock (RTC) with backup capacitor. The RTC time is kept in sync with the cell phone or GPS time and is updated once daily or if a discrepancy is detected.

During cold boots in environments with temperatures lower than -20°C, the boot time is extended to allow for all peripherals to initialize.

4.3 Sensor Inputs

The listed inputs are available for sensor connections.

4.3.1 Wind and Temp/Humidity/Pressure Sensor

Modbus RS-485, 2-wire, half-duplex.

Preconfigured for Dyacon wind sensor (WSD-1) and temp/pressure/humidity sensor (THP-1).

4.3.2 Analog Ports 1 and 2

24-bit, single-ended, 2.5 Vref.

Preconfigured for Dyacon thermistor, solar sensor, and soil moisture sensor.

Other analog output sensors may be used. See the Analog Port Configuration section for more information.

4.3.3 Pulse Counter

Switch input, internal pull-up.

Available for tipping bucket rain gauges, including Dyacon RGTB-4 and RGTB-6. Selectable for Inch or Millimeter.

Other reed switch type, tipping bucket rain gauges may be used.

4.4 Control Module Features

CM-1 is loaded with all of the features listed below. All features are fully functional in all units.

	CM-1-000	**CM-1-xx1**	**CM-1-xx2**	**CM-1-xx4**
Cell Phone	Not installed.	GPRS	1xRTT	TBD
Lightning Detection	X	X	X	X
Logging Memory	X	X	X	X
Solar Charge Controller	No battery included	X	X	X
GPS	Option	Option	Option	Option
USB Device	X	X	X	X
Modbus Slave	X	X	X	X
Aspiration Fan Control	X	X	X	X

4.5 Weather Station Options

CM-1 is the central component for Dyacon weather stations.

The table below summarizes pre-configuration options for Dyacon MS-100 series weather stations. Other custom configurations are available upon request or may be done by the user.

	Description	MS-120	MS-130	MS-140	MS-150
WSD-1	Wind sensor	X	X	X	X
TPH-1	Temp/Pressure/Humidity	X	X	X	X
Lightning	Integrated Lightning Detector	X	X	X	X
RGTB-4	Rain Gauge	*	*	*	X
PSP-110	Pyranometer/Solar Sensor	*	*	*	X
SMEC-5	Soil Moisture	*	*	X	*
TSSP-1	Soil/submersible Temp	*	*	X	*
GT-1	Globe Temperature Sensor	*	*	*	*
Solar Module	Solar Power Module	*	X	X	X
Cell Phone	Integrated Cell Phone	*	X	X	X
GPS	Integrated GPS Receiver	*	*	*	*

* Option can be configured or changed in the field. A maximum if two analog sensors can be installed.

WSD-1
Wind speed
Wind direction

CM-1
Control Module includes:
  LCD display
  Lightning detection
  Data logging
  USB device port

Modbus
Sensor Input

TPH-1
Temperature
Pressure
Humidity

Modbus
Sensor Input

Solar
Power

Solar power
module

Cell Phone
SMS and Data

Rain
Gauge

RGTB-6
Rain Gauge

Two Analog
Inputs

Modbus
Sensor Input

Only two of three

SMEC-5
Soil Moisture

PSP-110
Solar sensor

TSSP-1
Soil (submersible)
temperature

Modbus host
device such as
PLC or
personal computer

4.6 Sensor and Peripheral Descriptions

Integrated Cell Phone

MS-130, 140, and 150 include an integrated cell phone module. The module transmits SMS text message reports directly to the users cell phone. The cell phone may also be used to upload data to the Weather Underground (wunderground.com) server. Refer to the Weather Underground section for more information.

A cell phone service account is required.

Units sold for US operation are pre-configured with service. Foreign units are provided with unprovisioned GPRS, or HSPA phone modules.

WSD-1

WSD-1 provides wind speed and direction digital data. Constructed of machined aluminum, hybrid ceramic-stainless bearings, WSD-1 is superior to plastic wind sensors on the market. WSD-1 uses a non-contact direction sensor that does not have any dead spots.

The sensor is a Modbus slave device and does not suffer signal degradation in electrically noisy environments.

TPH-1

Air temperature, barometric pressure, and relative humidity are transmitted by Modbus to the control module.

PSP-110

A solar sensor is technically knows as a pyranometer. PSP-110 is made in the US by Apogee Instruments. PSP-110 uses a silicone photo diode to measure incident solar energy.

PSP-110 may be connected to one of two 24-bit analog ports and is included with MS-150.

SMEC-5

A relative measure of soil moisture content is provided by SMEC-5. The sensor is manufactured in the US by Decagon Devices. The sensor provides a relative measure of volumetric water content of the soil, which growers can use to manage irrigation resources.

The soil moisture probe may be connected to one of two 24-bit analog ports. It is included with MS-140.

TSSP-1

Whether liquid, soil, or surface, TSSP-1 provides a rugged solution to accurate temperature measurements.

The swaged stainless steel temperature probe is made in the US to Dyacon specified parameters. TSSP-1 is a precision thermistor, designed to be interchanged without the need to recalibrate.

TSSP-1 may be connected to one of two 24-bit analog ports. It is included with MS-140.

RGTB-6

The convention for unattended rain measurements is a tipping bucket rain gauge. A simple switch closure occurs with each 0.01" (0.25 mm) of rain depth that is captured.

The rain gauge is the only instrument in the Dyacon line-up that is not manufactured in the US. Made in Australia by Hydrological Services, RGTB-6 is a high-quality instrument with the practical feature set and attention to detail that we expect.

RGTB-6 connects to the counter input. The rain gauge is included in MS-150.

If you require precision measurements at high precipitation rates, please request the siphon control version, RBTB-4.

Solar Power Module

MS-130, 140, and 150 include the integrated cell phone. When used with the Dyacon tripod, these met stations are easy to install and may be relocated without concern for running wires for data or power.

The 10 W solar power module is adequate for most applications. The adjustable mounting bracket allows the angle of the panel to be positioned for best seasonal solar input.

4.7 Port Descriptions

CM-1 control module has several electrical connection ports used for connecting sensors, power, and other devices. The following is a summary of these digital I/O and instrument ports.

Port	Direction	Description	Connects to...
USB Device	Input and Output	Computer interface	Windows computer.
RS-485 Slave	Input and Output	Modbus slave to external devices	External PLC, data logger, or computer host.
RS-485 Host – Sensor Port	Input and Output	Modbus host to Dyacon sensors	WSD-1, TPH-1
Analog 1	Input	24-bit analog	Thermistor, solar sensor, soil moisture sensor, and other analog sensors.
Analog 2	Input	24-bit analog	Thermistor, solar sensor, soil moisture sensor, and other analog sensors.
Counter	Input	Switch counter	Tipping bucket rain gauge.
Fan	Output	Smart Fan™ power	Air sensor aspirator fan.
Battery	Input and Output	Battery	12 VDC sealed lead-acid battery.
Solar	Input	Solar panel input	12 VDC solar panel 5 W to 10 W.

5.0 USER INTERFACE

5.1 LCD and Buttons

CM-1 was designed to be easy to use. Rather than requiring a computer to configure and monitor the weather station, users can view system operation, settings, and sensor readings using the LCD and 4-button interface. All sensor and system configuration settings call also be controlled through this interface, no PC required.

The LCD is backlit, allowing operation even in full darkness. The backlight automatically turns on when a button is pressed and turns off after approximately five minutes of inactivity, in order to minimize power drain.

5.2 Modes

The user interface has two modes, Acquisition Mode and Setup Mode.

5.2.1 Acquisition Mode

When initially powered, CM-1 initializes the system components and begins operating. Data from attached sensors is collected, logged, and displayed. If a cell phone module is installed, SMS text message reports will be sent in response to requests. Weather Underground will also show measurement data once an account is configured.

All sensor input measurements may be viewed in the acquisition mode pages. This allows users to verify system configuration and make manual observations while the instrument is in full operation.

Additional information is contained in the Acquisition Mode section.

5.2.2 Setup Mode

The user interface on CM-1 may be used to configure all sensors and operating modes, a PC is not required. This simplifies configuration and maintenance in the field.

A full description of setup options in described in the Feature and Sensor Setup section.

6.0 ACQUISITION MODE

When ordered as part of an MS-100 series weather station, CM-1 is pre-configured. If wired correctly, the system and sensors should begin to function immediately when the unit is powered.

The default operating mode, is the data acquisition mode. In this state, the buttons have the following functions.

Select – Enter Setup mode.

Cancel – Return to home page.

▲ **(Up)** – Move up one page.

▼ **(Down)** – Move down one page.

The following are the typical LCD messages that are accessible.

Each page or screen is show below with typical information.

6.1 Page Order

Acquisition display pages are arranged in the following order.

Page	Description
Home	Communication status and clock.
Current Wind	Current wind speed, wind direction, and last gust.
Average Wind	2 minute and 10 minute averages for wind speed and wind direction.
Air Temp and Dew	Air temperature and dew point.
Humidity and Pressure	Relative humidity and barometric pressure.
Analog Ports	Analog ports 1 and 2. Custom label and measurement units are shown.
Rain	Rain accumulation and precipitation rate.
Lightning Detection	Shows status of lightning detector and detection values.
Battery	Battery voltage, internal temperature, and battery charge voltage
System	CM-1 serial number and firmware versions of CM-1, and the connected TPH-1 and WSD-1 sensors.

The pages do not wrap, when you reach the bottom page, you must press the **Up** button. Pressing the **Cancel** button at any time will return to the home page.

6.2 Home Page

The Home Page shows radio module status, time, and current communication operation.

Un-provisioned GSM/GPRS Module

Error 310 indicates that no SIM is installed.

Time and date are acquired from the cell phone network or GPS. Displayed time may not be accurate if the module is not installed or activated.

```
Reg Net 0  21:20:32
+CMS ERROR: 310
```

Connected to Home Network

Home network, signal strength is 14.

"Idle" indicates that the phone is in a low power state, not actively communicating. "SMS: 22" indicates that 22 valid text messages have been sent since the last system reset.

```
Home Sig 14 15:27:33
Idle, SMS: 22
```

Checking SMS

CM-1 is notified of incoming SMS messages as they are received. The phone also checks for incoming SMS text messages every 60 s to make sure any SMS messages are processed in a timely manner. If a message has been received, the requesting phone number is displayed, the message is decoded, and a response is sent to a valid request.

```
Home Sig 14 15:27:33
Checking SMS
```

6.3 Current Wind Page

Wind measurements are shown when Dyacon WSD-1 is connected.

The wind speed and direction measurements in the selected units. See the Setup section on unit selection.

Wind Measurement

Last recorded gust is shown along with a sensor status code. (St: 0 indicates no errors.)

```
3.2 m/s @ 25.3 deg
Gust: 0.0 St: 0
```
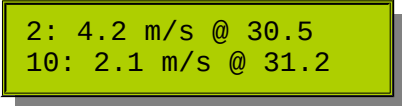
Sensor not installed

```
Error Wind Sensor
-4
```

6.4 Average Wind Page

2 minute and 10 minute averages are generated by the wind sensor, WSD-1.

```
2: 4.2 m/s @ 30.5
10: 2.1 m/s @ 31.2
```
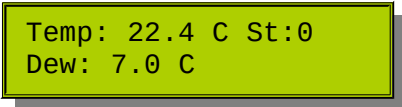
Units may be configured in Setup mode.

6.5 Air Temp and Dew Page

Air temperature, pressure, and humidity measurements are obtained from Dyacon TPH-1. These values are contained in two pages.

Current temperature and dew point are displayed as well as the sensor status code. (St: 0 indicates no errors.)

```
Temp: 22.4 C St:0
Dew: 7.0 C
```

Units may be configured in Setup mode.

6.6 Humidity and Pressure Page

Relative humidity as well as barometric pressure are show.

A pressure trend indicator is also given. Any of the following trend values may be displayed, Falling Fast, Falling, Steady, Rising, Rising Fast.

The measurements and trend values are generated on the connected Dyacon TPH-1.

```
36.9%
871.7 mbar Steady
```

Units may be configured in Setup mode.

6.7 Analog Ports Page

Analog port functions are configurable and may be used for many different sensors. CM-1 has pre-loaded settings for soil temperature, soil moisture, and solar radiation. Other sensors may also be used. Please refer to the Setup mode section for more information.

Sample screens for each of the pre-loaded Dyacon sensors are shown.

Solar sensor, PSP-110, and thermistor, TSSP-1, are installed.

```
Solar: 452 W/m^2
Soil: 17.1 C
```

Soil moisture sensor, SMEC-5, and thermistor, TSSP-1 are installed.

```
Soil: 27.3 %
Soil: 17.1 C
```

Temperature units are configurable.

6.8 Rain Page

Rain accumulation is for a one day period beginning at 12 am, midnight.

Precipitation rate is based on the interval between switch closures.

```
Rain Acc: 0.02 in
Rate: 0.01 in/hr
```

Rain gauge resolution and units are configurable. Please refer to the Setup Mode section.

If the rain gauge feature has not been configured the display will show:

```
Rain: No Bucket
```

6.9 Lightning Detection

LD-1 Lightning Detector tracks lightning, noise, and disturber values.

Lightning strikes are accumulated in 10 min, 30 min, and 60 min registers. New strikes are added to each register and retained for the duration of the accumulating register.

Similarly, noise and disturber values are accumulated in 60 min registers.

For detected signals that are determined to be lightning strikes, a distance estimate is given.

```
Strikes: 0 3 10
Dist:5km N:5 D:6
```

The above example shows the following:

    Strikes, 10 min count: 0

    Strikes, 30 min count: 3

    Strikes, 60 min count: 10

    Distance of last strike: 5 km

    Noise, 60 min count: 5

    Distruber, 60 min count: 6

Please read LD-1 Lightning Detector Manual for more information.

If the lightning detector is not enabled or is enabled, but not attached, the user will see one of the following messages.

```
Lightning not
   installed
```

```
Error Lightning
```

6.10 Battery Page

A routine maintenance check should include a battery check and solar charge check. A fully charged battery should be at around 12.9 V, when it is not connected to a charger.

CM-1 integrates a solar charge controller. The input voltage from the solar panel or charging source is shown as well as the charge status, Off, Fast, Fast Top, or Float.

Temperature affects battery performance and the charge algorithm. A temperature sensor is built onto the CM-1 circuit board that provides feedback to the charge controller function.

```
Batt: 12.82V 23C
Vin: 11.8V Off
```

The units on this page are not configurable.

6.11 System Page

Serial number of CM-1 and firmware numbers are found on this last page.

FW is the version of CM-1 firmware.

A is the firmware for the "air sensor," TPH-1, that is currently connected to CM-1.

W is the firmware for the wind sensor, WSD-1, that is currently connected to CM-1.

```
SN: 15000001
FW: 68 A: 5 W: 5
```

7.0 CONNECTION DIAGRAM

A diagram similar to the following is attached to the inside of the CM-1 enclosure. The diagram shows common sensors that may be supplied as part of MS-100 series weather stations. This diagram may be reproduced should the version in the station become damaged.
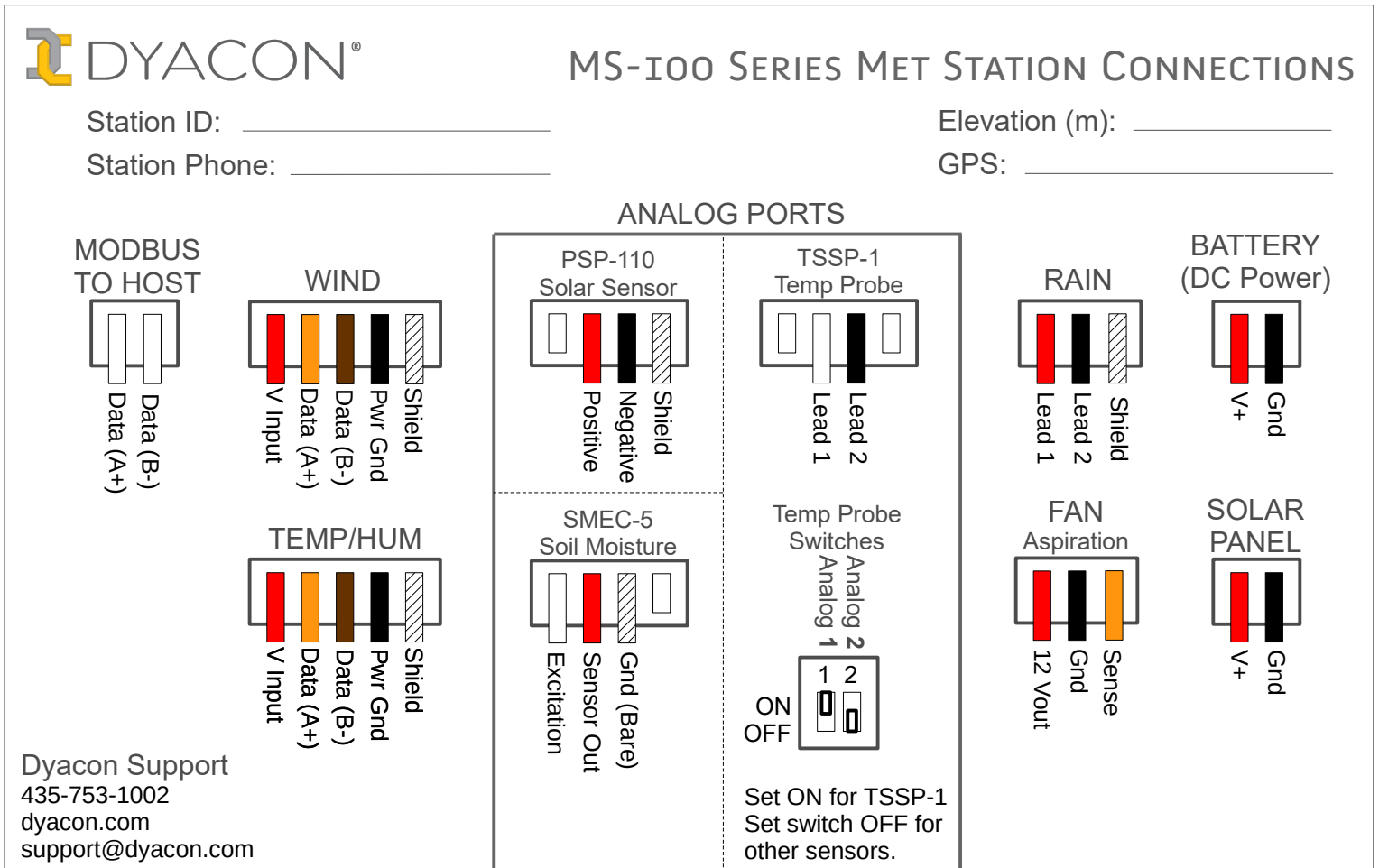
8.0 SETUP MODE AND SENSOR CONFIGURATION

Control Module CM-1 may be configured using SMS text message commands, Control Module Utility (computer software), or with the LCD interface on the unit. The following are instructions for using the LCD and 4-button interface.

Setup mode is entered by pressing the **Select** button. The setup mode is identified by "˃Setup" that is displayed on the first line. The cursor "˃" shows what item will be selected when pressing the **Select** button.

Once in setup mode, the buttons have the following functions.

> **Select** – Enter Setup step shown.
>
> **Cancel** – Exit setup step without changing settings.
>
> **▲ (Up)** – Move up one page, character, or option.
>
> **▼ (Down)** – Move down one page, character, or option.
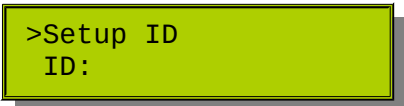
The following sections describe the sensors, configuration options, and settings for each setup page.

8.1 Setup ID

Each station can be configured with a station identifier. This identifier will appear in SMS text message reports. The field is nine (9) characters.

This is **not** the same as the Weather Underground station ID.

```
>Setup ID
 ID:
```

Pressing **Select** will enter the edit screen

```
Enter Station ID
Dya█
```

Press ▲ and ▼ to advance to the desired character.

Once the character is found, press **Select**.

After nine (9) characters have been entered, pressing **Select** will return to the setup page.

```
>Setup ID
  ID:  DyaconWst
```

8.2 Setup Temperature (TPH-1)

Temperature, pressure, and humidity measurements are received from the Dyacon TPH-1 Modbus sensor. TPH-1 ships as a standard component of Dyacon MS-100 series weather stations.

Image 8.1: TPH-1, Mounted

8.2.1 TPH-1 Wiring

TPH-1 uses a shielded, 4-conductor, outdoor-rated instrumentation cable.

Wires should be **stripped to about 7 mm (0.25 inch)**.

Red	5 to 24 VDC
Orange	A (+)
Brown	B (-)
Black	Electrical ground
Unshielded	Drain/earth ground
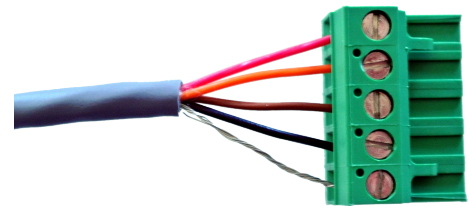
Image 8.2: TPH-1 Connection

8.2.2 Temperature Configuration

Temperature units, slope, and offset may be configured for TPH-1

Air temperature units may be selected as either F or C, for Fahrenheit or Celsius. (Thermistor temperature units are selected under the Analog port configuration.)

```
>Setup Temperature
  Units: F
```

Press **Select** to enter edit mode.

```
>Units: F
  Slope: 1
```

8.2.3 Air Temp Units

Press **Select** again to edit the units.

```
Set Temp Units
F
```

Press ▲ (Up) or ▼ (Down) to move to F or C.

Select will enable the measurement unit and return to the previous screen.

The selected units will be used in text message reports. Logging uses the default SI units and METAR reports always use C.

8.2.4   Air Temp Slope and Offset

The slope and offset of the temperature measurement may be adjusted by using a slope and offset arithmetic adjustment. The operation is applied to the measurement prior to logging, displaying, or sending to Weather Underground.

Press ▼ (Down) to move to the slope or offset setting.

```
>Slope: 1
 Offset: 0
```

Press **Select** to enter the edit mode for the desired parameter.

Press ▲ (Up) and ▼ (Down) to advance to the desired value. ('0-9', 'E', and '.') are all legal characters.

Press **Select** to enter the value and move to the next position. Pressing **Cancel** will leave the edit mode and **not** save the value.

Press **Select** without a value entered (black box displayed over cursor) will save the entry and return.

```
Temp Offset
0.012_
```

32-bit single-precision floating point (IEEE-754) numbers are restricted to about 7 significant decimal figures.

Slope and offset values are applied to the measurement (in SI units) before unit conversions take place.

8.3 Setup Humidity (TPH-1)

Humidity measurements are received from TPH-1.

8.3.1 TPH-1 Wiring

Refer to TPH-1 Wiring under the Setup Temperature and TPH-1 section.

8.3.2 Humidity Unit

Relative humidity units are always in percent (%), however, slope and offset may be configured.

```
>Setup Humidity
```

8.3.3 Humidity Slope and Offset

Pressing **Select** will enter the configuration mode for this parameter.

```
>Slope: 1
 Offset: 0
```

Slope and offset may be changed. Refer to Change Air Temperature Slope and Offset for information on these values.

Slope and offset values are applied to the measurement (in SI units) before unit conversions take place.

8.4 Setup Pressure (TPH-1)

Pressure measurements are received from TPH-1.

8.4.1 TPH-1 Wiring

Refer to TPH-1 Wiring under the Setup Temperature and TPH-1 section.

8.4.2 Pressure Configuration

Pressure units, altitude, slope, and offset may all be configured.

```
>Setup Pressure
   Units: mbar
```

Pressing **Select** will enable the configuration mode.

```
>Units: mbar
 Altitude: 0 m
```

8.4.3 Pressure Units

Press **Select** with Units in the edit position.

```
Set Press Units
mbar
```

Using the ▲ (Up) and ▼ (Down) buttons, select the desired units:

mbar, kPa, hPa, mmHg, or inHg

Press **Select** when the desired units are displayed. The page will return to configuration mode.

The selected units will be used in text message reports. Logging uses the default SI units.

8.4.4 Altitude

For meteorological purposes, barometric pressure is normalized to sea level. CM-1 uses Babinet's formula

Barometric Pressure (mbar) = $P*((16000+64*T)+Z)/((16000+64*T)-Z)$

where:

P = atmospheric pressure (mbar)

Z = altitude (m)

T = temperature (°C)

This simple formula will give good results within up to 1000 m (3280 ft) and within 1% to much greater heights.

```
>Altitude: 0 m
 Slope: 1
```

Press **Select** to edit the altitude. The value must be in meters elevation, not feet.

```
Pressure Altitude
1427_
```

Pressing **Select** for a blank character will save the value and return to the configuration page.

```
>Altitude: 1427 m
 Slope: 1
```

8.4.5 Pressure Slope and Offset

Pressing **Select** will enter the edit mode for these parameters.

```
>Slope: 1
 Offset: 0
```

Refer to Change Air Temperature Slope and Offset for information on these values.

Slope and offset values are applied to the measurement (in SI units) before unit conversions take place.

8.5 Setup Wind Speed (WSD-1)

Dyacon WSD-1, a Modbus sensor, is used for wind speed and direction. WSD-1 is included in all Dyacon MS-100 series weather stations.

Illustration 1: WSD Wind Sensor

8.5.1 WSD-1 Wiring

The sensor includes a shielded, 4-conductor, outdoor-rated instrumentation cable.

It is connected to CM-1 using a five position pluggable terminal block.

Red	PWR
Orange	A +
Brown	B -
Black	GND
Unshielded	SHIELD
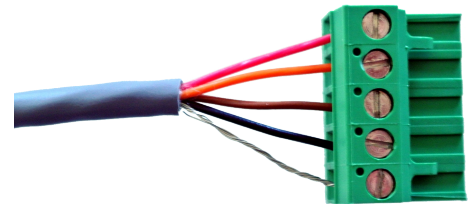
Image 8.3: Wired for Dyacon Control Module

8.5.2 Wind Speed Configuration

Speed units, slope, and offset may all be configured for wind speed.

```
>Setup Wind Speed
  Units: m/s
```

8.5.3 Wind Speed Units

Press **Select** to enter configuration mode.

```
>Units: m/s
 Slope: 1
```

Press **Select** to edit the measurement units.

```
Set Speed Units
m/s
```

Any of the following speed units may be selected:

m/s, Knots, km/h, or mph.

The selected units will be used for SMS text message reports. Logging uses the default SI units and METAR units are always in knots.

8.5.4 Wind Speed Slope and Offset

Pressing **Select** will enter the edit mode for these parameters.

```
>Slope: 1
 Offset: 0
```

Refer to Change Air Temperature Slope and Offset for information on these values. Slope and offset can also be used to convert units if the desired scale is not among the options, however, the units abbreviation cannot be changed.

Slope and offset values are applied to the measurement (in SI units) before unit conversions take place.

8.5.5 Wind Speed and Gust Measurement Method

Wind speed is measured continuously by WSD-1, not just sampled periodically. This allows for real-time gust detection. The gust detection, 2 minute average, and 10 minute average are calculated directly on the sensor, reducing overall system power.

Gust values are provided by the WSD-1 sensor and are available in text message weather reports (standard and METAR), uploaded to WeatherUnderground™, and saved in the log record.

Gust is defined as a 9 knot increase in wind speed over the 2 minute average. The maximum gust value is retained for 10 minutes.

8.6 Setup Wind Direction – Set North (WSD-1)

8.6.1 WSD-1 Wiring

Refer to Setup Wind Speed for information on wiring WSD-1 for wind speed measurements.

8.6.2 Wind Direction Configuration

Press **Select** will enable configuration of wind direction parameters.

```
>Setup Wind Dir
```

8.6.3 Set North

The only parameter that can be configured for wind direction is the north position. This can be set to any direction. WSD-1 has no dead spots. Wind sensors that utilize a potentiometers cannot use an arbitrary north position due to the inherent transition between the high and low resistance portions of the potentiometer.

Orient the wind vane to the desired "north" direction. Depending on the application, this may be magnetic north, grid north, polar north, or some other direction that the user wishes to reference as "zero".

Press **Select** to enter the Set New North configuration.

```
>Set New North
```

With the vane in the desired position, press **Select**.

```
North Set
```

The display will show "North Set" momentarily, then return to the configuration page.

```
>Set New North
 Clear Setting
```

Continue to hold the vane in the north position to validate the setting.

Pressing **Cancel** twice will exit Setup mode and return to Acquisition mode. By paging down one position, users will see the wind measurements. The wind direction should show 0.0 deg +/- 0.5°.

Acquisition page after setting north.

```
1.2 m/s @ 0.1 deg
Gust: 0.0 st: 0
```

8.7 Setup Analog 1 and 2 Type

Both analog ports operate identically. "Analog 1" will be used in the examples for convenience, but Analog 2 operates identically.

Each port may use several pre-configured sensors available for Dyacon, or the ports may be customized for other analog sensors (voltage or current output) available from other sources.

The configuration for each pre-configured sensor is described below along with the wiring. The final section describes other customizations available for other analog sensors.

8.7.1 Analog Port Sensor Type Selection

The configuration options for the analog ports are dependent on the type of sensor selected. The following sensor type options are available:

> None (Analog port measurements are not reported.)

> Solar Radiation (PSP-110)

> Soil Moisture (SMEC-5)

> Soil Temp (TSSP-1)

> Globe Temperature (GT-1)

> Custom (User configures all parameters.)

Enter Analog port configuration by pressing **Select**

```
>Setup Analog 1
  Type: None
```

Press ▲ (Up) and ▼ (Down) to show the desired sensor type.

```
Set Analog 1 Type
None
```

Press **Select** when the desired sensor is displayed.

```
Set Analog 1 Type
Soil Temp
```

This will save the sensor type and page to the specific sensor settings.

8.8 Setup Soil Temperature (TSSP-1)

Soil temperature (TSSP-1 thermistor) utilizes either Analog 1 or Analog 2. Refer to Setup Analog 1 and 2 Type for information on selecting the port type for soil temperature.

8.8.1 Soil Temperature Wiring

TSSP-1 is a two-lead component. Each lead connects to opposing sides of the thermistor element. TSSP-1 does not contain a series resistor.

Wires should be **stripped to about 7 mm (0.25 inch)**.

    White   IN

    Black   GND
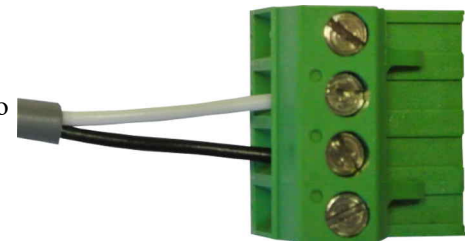
Image 8.4: TSSP-1 Wire Connection

The component is not polarized and wire order is not critical.

8.8.2 Soil Temperature Configuration

Soil Temp is a pre-loaded configuration for Dyacon TSSP-1, a thermistor with a stainless steel cover. This sensor may be used for gas, liquid, soil, or surface temperature measurements.

The preloaded configuration will label the temperature input as "Soil" in all text message reports and transmit the temperature data to Weather Underground as a soil temperature value.

The measurement units may be set as C or F (Celsius or Fahrenheit). The A, B, C, and D parameters of the Steinhart-Hart equation may also be individually set.

```
>Type: Soil Temp
Units: C
```

Use ▼ (Down) to select Units if the default units are not desired.

```
>Units: C
A: 01001116
```

Press **Select** to edit the temperature units, using the ▲ (Up) and ▼ (Down) buttons to display either C or F.

```
Set Temp Units
F
```

Press **Select** to save and exit.

```
>Units: F
A: 01001116
```

8.8.3 Series Resistor Switch

The switch corresponding to the analog port must be enable for the thermistor sensor. **The numbering on the switch is opposite from the port number.** Please use the diagram as a guide.

The *Illustration 1* shows that Analog 2 is selected for TSSP-1.

The switch must be turned off when other sensors are used.

This switch is located on the lower connector row, near Analog 2.
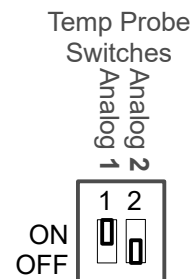
Illustration 2: Thermistor Series Resisitor Switches

Electrical Details

Those who have worked with thermistors before will recognize that a series resistor of a known value must be used for determining the resistance of the thermistor. See *Illustration 2*.

CM-1 uses a high precision 10 kOhm integrated series resistor, Rref.

The DIP switch is used to connect this reference resistor to the circuit.
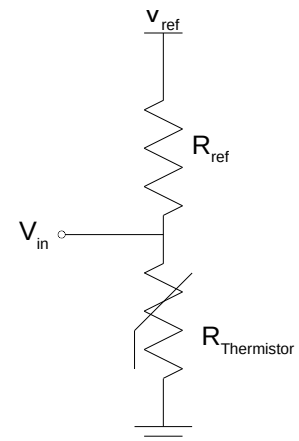
Illustration 3: Thermistor Series Resistor.

Note: If a thermistor from a different manufacturer is used, the equation constants may need to be changed as well as the use of an external resistor wired between Vref and Vin.

8.8.4 Setting Equation Values

Users of TSSP-1 need not worry about the equation values. The following information is included for users that may employ thermistors from different manufacturers.

Thermistors are special electrical resistors that change their value with respect to temperature. This change is not linear and must be corrected so that temperature information may be extracted. The most commonly accepted equation for this purpose is the Steinhart-Hart equation.

Steinhart-Hart Equation

The Steinhart-Hart equation models the resistance of the thermistor at different temperatures.

$$°C = -273.15 + \left[\frac{1}{A + B \cdot \ln(r) + C \cdot \ln(r)^2 + D \cdot \ln(r)^3} \right]$$

Where:

    r = $R_{Thermistor}$ (Ω)

    A = 0.001116401465500

    B = 0.000237982973213

    C = -0.000000372283234

    D = 0.000000099063233

The above values are the associated with TSSP-1 and pre-loaded into CM-1. The significant fixtures far exceed those needed for CM-1 calculations, so they are truncated in the configuration settings.

Users can load custom values when a different series resistor is used.

First select sensor type as Soil Temp.

```
Set Analog 1 Type
Soil Temp
```

Scroll to the equation coefficients.

```
>A:  0.001116
 B:  0.000238
```

Press **Select** and edit the values that you wish to change.

8.8.5 Setting Series Resistor

Some manufacturers include a series resistor in the probe with the thermistor. This resistor may differ from the 10 kOhm value used for CM-1 calculations. This resistor value may also be changed.

After selecting the analog sensor type as Soil Temp, scroll past the thermistor coefficients. The reference resistor value is the last parameter.

```
 D: 0
>REF: 10000
```

The value may be changed by pressing **Select** and using the ▲ (Up) and ▼ (Down) buttons to set the desired value.

8.9 Setup Soil Moisture (SMEC-5)

CM-1 includes pre-configured settings for Dyacon Soil Moisture probe SMEC-5. Dyacon MS-140 weather stations include SMEC-5 as a standard component. Like other Dyacon sensors, it may also be purchased separately and added to an existing station.

8.9.1 SMEC-5 Wiring

SMEC-5 uses a 2-conductor shielded cable.

Wires should be **stripped to about 7 mm (0.25 inch)**.

White	VREF
Red	IN
Bare/Shield	GND
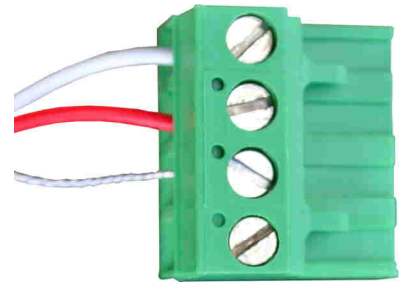
Image 8.5: Soil Moisture Sensor Connections

8.9.2 Soil Moisture Configuration

The units for soil moisture are percent (%) and cannot be changed. This value reflects a ratio of water volume to soil volume. 100% would indicate that the water volume was equal to the soil volume.

Slope and offset, which may be used for calibration purposes, are the only editable parameters for the soil moisture sensor.

Select sensor type as described in Setup Analog 1 and 2 Type section.

```
>Setup Analog 1
  Type: Soil Moistur
```

Pressing **Select** will enter Soil Moisture configuration.

```
>Type: Soil Moisture
 Units: %
```

The units cannot be changed, but by scrolling down, the slope and offset values can be edited.

```
>Slope: 1.19
 Offset: -0.4
```

These values are edited like other numeric values in the control module.

```
Analog 1 Slope
1.19_
```

8.10   Setup Solar Radiation (PSP-110)

Solar radiation (insolation) may be measured with Dyacon PSP-110, a silicon pyranometer. This sensor is included with Dyacon MS-150 weather stations. However, it can easily be added to existing weather stations.

PSP-110 may be installed on either Analog 1 or Analog 2 ports. Refer to Setup Analog 1 and 2 Type section for information on selecting the port type for soil temperature.

Image 8.6: PSP-110 Pyranometer

8.10.1   PSP-110 Solar Sensor Wiring

PSP-110 uses a shielded, 2-conductor cable.

Wires should be **stripped to about 7 mm (0.25 inch)**.

Red   IN

Black   GND

White   SHIELD
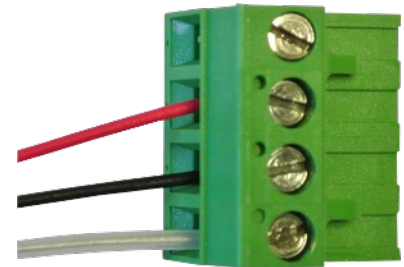
Image 8.7: PSP-110 Wire Connections

8.10.2   Solar Radiation Sensor Configuration

CM-1 is pre-loaded with configuration settings for PSP-110 solar radiation sensor.

Sensor units are set to W/m^2 and cannot be changed. Only the slope and offset values can be changed. These values will not need to be changed for most applications.

```
>Setup Analog 1
  Type: Solar Radiat
```

Press **Select** to enter sensor configuration.

```
>Type: Solar Radiati
 Units: W/m^2
```

Scrolling ▲ (Up) or ▼ (Down) will display the units, slope, and offset settings.

```
>Units: W/m^2
 Slope: 5000
```

Scroll to the desired parameter and press **Select** to edit, just as with other editable values.

8.11   Setup Rain (RGTB-4 and RGTB-6)

CM-1 is compatible with all tipping bucket rain gauges that use a switch output. Dyacon MS-150 weather station is pre-configured with RGTB-6, a 0.01" resolution rain gauge with a 200 mm orifice.

Image 8.8: RGTB Rain Gauge

RGTB-4 is also available. This version adds a siphon flow control to improve measurement accuracy in high-rate conditions. Refer to the specific data sheets for more information.

8.11.1   RGTB Wiring

A 2-conductor, outdoor rated cable is used for Dyacon RGTB rain gauges.

Wires should be **stripped to about 7 mm (0.25 inch)**.

Polarity is not critical.

    Red   PULSE

    Black   GND

Image 8.9: RGTB Connections

8.11.2   Rain Gauge Configuration

Tipping bucket rain gauges are available in many different resolutions. Dyacon RGTB-4 and RGTB-6 rain gauges are 0.01" resolution. RGTB-6 is included with MS-150 weather stations. CM-1 is pre-configured for this resolution.

CM-1 can be configured for any measurement resolution and inch or millimeter units.

```
>Setup Rain
  Type: None
```

8.11.3   Select Rain Gauge Units

```
>Type: None
```

Pressing **Select** will open the rain gauge type (inch or millimeter) configuration.

When set to None, precipitation measurements are not included in reports.

```
Set Bucket Type
None
```

Pressing the ▲ (Up) and ▼ (Down) buttons will switch between None, Inch, Millimeters.

When the desired measurement unit is displayed, press **Select** to advance to the resolution selection parameter.

```
>Type: Inch
  Inc: 0.01
```

Scroll down to the Increment value and press **Select**.

This will open the tipping bucket resolution parameter for editing. 0.01 is the default value.

```
Set Bucket Inc
0.01
```

Use the ▲ (Up) and ▼ (Down) arrow buttons. When the desired character is displayed, use **Select** to advance to the next digit. Pressing select on a blank digit will save the resolution value. Pressing **Cancel** will leave the page without saving changes.

8.12 Setup Lightning Detector

The lightning detector, LD-1, is an external sensor. The sensor must be attached in order to configure the sensor.

LD-1 is not a lightning protection device.

LD-1 will not detect all lightning strikes.

LD-1 cannot predict lightning strikes or the potential for lightning strikes.

The probability and efficiency of strike detection is dependent on the installation, environment, user settings, and the capabilities of the equipment to which LD-1 is connected. Unit-to-unit variation may also result in differences in detection efficiency.

LD-1 should be considered an advisory instrument only, the instrument is intended to augment knowledge, skill, understanding, and judgment of the users.

Dyacon assumes no liability for damage resulting from improper use of the instrument, improper configuration, or the failure of the instrument to detect lightning strikes.

8.12.1 Lightning Detector Enable
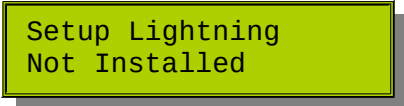
```
>Setup Lightning
   Not Installed
```

Pressing **Select** will enter the sensor configuration mode.

```
>Inst: Not Installed
```
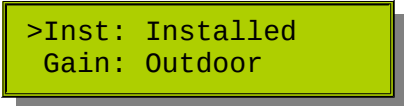
Press **Select** to enable the sensor.

```
Setup Lightning
Not Installed
```

Use the ▲ (Up) or ▼ (Down) arrow buttons to enable LD-1 lightning detector.

Press **Select** to save the setting.

```
>Inst: Installed
  Gain: Outdoor
```

Press **Cancel** to return to Acquisition Mode.

8.12.2 Lightning Detector Settings

Setting states shown on the weather station controller are actually settings read from the sensor itself. If the sensor is enabled, but not installed, the settings will show all zero (0) values.

Similarly, settings are written to the sensor. If the installed LD-1 sensor is exchanged with another one, the settings will need to be reconfigured.

While in Lightning Detector configuration mode, press **Select** configure sensor parameters.

```
>Inst: Installed
 Gain: Outdoor
```

▼ (Down) arrow button to select the desired parameter.

```
 Inst: Installed
>Gain: Outdoor
```

Pressing **Select** on any parameter will open that parameter for editing.

Set Lightning Detector Gain

```
Set Gain
Outdoor
```

Use the ▲ (Up) or ▼ (Down) arrow buttons to select Outdoor or Indoor mode based on the environment where the sensor is installed.

Press **Select** to save the selection and return to parameter navigation.

Set Other Lightning Parameters

Use the ▲ (Up) or ▼ (Down) arrow buttons to navigate to other sensor parameters.

LD-1 has the following parameters. Please refer to LD-1 manual for full explanations.

Gain: Indoor, Outdoor (Default Outdoor)

Noise Floor Level: 0 to 7 (Default 2)

Watchdog Threshold: 0 to 10 (Default 4)

Minimum Number Lightning Strikes: 0 to 3 (Default 0, corresponding to 1 strike.)

Spike Rejection: 0 to 11 (Default 2)

8.13 Setup Aspirator Fan

Dyacon TPH-1 air temperature, pressure, humidity sensor has an optional aspirator module. The aspirator draws air away from the radiation shield so that the effects of solar heating of the radiation shield are minimized. This is an effective solution for installations where wind speed may be low.

The aspirator has three different modes, Off, On, and Daylight.

Fan Mode	Notes
Off	Fan control output is disabled. Fan does not operate.
On	Fan runs continuously. This should only be used when the weather station is line powered or adequate solar charging provisions have been made to support the additional power usage.
Daylight	Fan operates only when input has been detected on the solar panel and the solar charge controller turns on.

8.13.1 Fan Mode Configuration

```
>Setup Fan
   Fan Mode: Off
```

Pressing **Select** will enter the fan configuration mode.

```
Set Fan Mode
Off
```

Use the ▲ (Up) and ▼ (Down) arrow buttons to select the desired fan mode.

Press **Select** to save the setting.

Press **Cancel** to return to Acquisition Mode.

8.14 Setup Data Logging

Data logging record intervals can be set from 1 min to 1 hr, or turned off.

The data log can downloaded using the USB port and the Dyacon Control Module Utility.

Data logs can also be transmitted as an email attachment or sent to an FTP server. These transfer methods can be enabled and the upload interval set under as described below.

Note: The email and FTP settings are configured under the Setup Email and Setup FTP menus.

8.14.1 Data Logging Configuration

```
>Setup Logging
   Rate: 1 Hr
```

Pressing **Select** will enter the data logging configuration mode.

```
>Rate: 1 Hr
 Email: Off
```

8.14.2 Logging Rate

Press **Select** to change the logging interval.

```
Set Log Rate
15 Min
```

Use the ▲ (Up) and ▼ (Down) arrow buttons to select the desired logging interval. The default interval is 1 hr.

Options include:

Off	1 Min	2 Min	5 Min	10 Min	15 Min	20 Min	30 Min	1 Hr

The logging interval will affect how quickly the data log is filled. A 1 Min interval will record all sensor data every minute and fill the log in about 30 days. A 1Hr interval will fill the log memory in 4 years.

Refer to the Data Logging section of this manual for more information on data logging capabilities, data format, log retrieval, and memory capacity.

8.14.3   Email Data Log Enable and Interval

Dyacon Control Module is capable of sending the log data as a CSV file attachment to an email.

Press **Select** to enable the email data log transmission and set the interval.

```
>Email: Off
 FTP: Off
```

Use the ▲ (Up) and ▼ (Down) arrow buttons to select the desired log transmission interval. The default interval is Off.

```
Log Email Rate
Off
```

The following transmission intervals are available.

Interval	Transmission Time	Notes
Off		Data log is not transmitted.
Hourly	xx:01 each hour.	
Daily	12:01 AM each day.	Transmission time is according to clock as displayed on CM-1 LCD.
Weekly	12:01 AM on Sunday.	
Monthly	12:01 AM on 1st day of the month.	

The email settings must be configured for this feature to work.
Refer to the Setup Email section.

8.14.4   FTP Data Log Enable and Interval

Logged data may also be transmitted via FTP (File Transfer Protocol).

The server settings are configured under the Setup FTP section.

```
 Email: Off
>FTP: Off
```

Press **Select** to enable FTP data log transmission.

```
Log FTP Rate
Off
```

The following transmission intervals are available.

Interval	Transmission Time	Notes
Off		Data log is not transmitted.
Hourly	xx:01 each hour.	
Daily	12:01 AM each day.	Transmission time is according to clock as displayed on CM-1 LCD.
Weekly	12:01 AM on Sunday.	
Monthly	12:01 AM on 1st day of the month.	

8.15 Setup Weather Underground

MS-130, MS-140, and MS-150 weather stations utilize a CM-1 that contains an embedded cell phone module. When appropriately provisioned, CM-1 will send data to WeatherUnderground.com where users can view weather station data in a chart format.

Refer to the Weather Underground section for more information on this feature.

8.15.1 Weather Underground Configuration

The Weather Underground feature can be enabled or disable, the update rate specified, and the WU station ID and account password programmed.

```
>Setup Wunderground
 Rate: Off
```

Pressing **Select** will enable configuration of Weather Underground settings.

```
>Update Rate: Off
 Username
```

8.15.2 Weather Underground Interval

Press **Select** to edit the on/off status and set reporting interval.

```
Set Update Rate
Off
```

Use the ▲ (Up) and ▼ (Down) buttons to turn the feature on at the desired interval, 10 min, 15 min, 20 min, 30 min, or 1 hr. Longer intervals may be helpful at reducing system power and data usage.
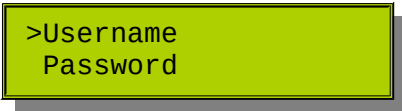
A 10 min interval will require approximately 2 MB of data per month to operate.

Press **Select** to save.

8.15.3 Weather Underground Username and Password

Each Weather Underground station requires a unique station ID. This station ID is different from the CM-1 ID. Weather Underground automatically assigns a station identifier when a station location is setup.

Refer to the Weather Underground section for more details.

```
>Username
 Password
```
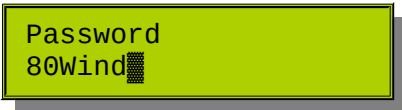
Press **Select** to edit the Username.

```
Username
KWYPINDA▓
```

Pressing **Select** on a blank character (black box displayed over cursor) will save the value. Pressing **Cancel** will leave the page without saving the username.

The same process is used for setting the Password

```
Password
80Wind▓
```

Note: As the password is the same password as the log in of the website, once password is entered, it cannot be viewed. It must be completely reentered.

Once enabled, CM-1 will automatically report the following parameters to the Weather Underground server:

- Wind Speed
- Wind Direction
- Gust
- Air Temperature
- Humidity
- Mean Sea Level Barometric Pressure
- Soil Temperature (if installed)
- Solar Radiation (if installed)

8.16 Setup Email

Data log files may be emailed periodically to the specified email address. Refer to the Data Logging section for details on data log file format and data format.

Users may find it helpful to setup and test the email configuration using computer email client before configuring CM-1.

8.16.1 Email Configuration

Pressing **Select** will enter the email configuration options.

```
>Setup Email
```
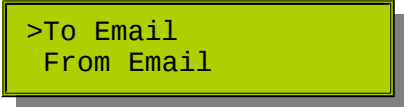
Sending data log files by email requires setting the following.

- To Email Address
- From Email Address

- Username
- Password
- Server
- Port

8.16.2   To Email Address

Press **Select** to configure the e-mail address that will receive the data log files.

```
>To Email
  From Email
```

Set the email address.

```
To Email
to@domain.com▓
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.

Pressing **Select** on a blank character will save the entry.

Pressing **Cancel** will leave the page without saving the address.

8.16.3   From Email Address

The From Email is used for the email "From" field.

After entering the Setup Email configuration, use the ▲ (Up) and ▼ (Down) buttons to scroll down to From Email.

Press **Select** to configure the e-mail address that will receive the data log files.

```
>From Email
  Username
```

Enter the email address that will identify the source of the email.

```
From Email
station@domain.com▓
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.

Pressing **Select** on a blank character will save the entry.

Pressing **Cancel** will leave the page without saving the address.

8.16.4   Server Username

The server username is used for the e-mail server login. This may be the same as the "From" email address.

Press **Select** to edit the configuration.

```
>Username
 Password
```

Enter the username for the server. Often this will be the same as the email address.

```
Email Username
station@domain.com▓
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.
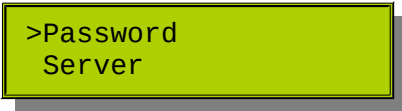
Pressing **Select** on a blank character will save the entry.

Pressing **Cancel** will leave the page without saving the address.

8.16.5 Email Password

A password for the account is required to send email through a mail server.

Press **Select** to edit the password.

```
>Password
 Server
```

Enter the password.

```
Email Password
pass123▓
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.

Pressing **Select** on a blank character will save the entry.

Pressing **Cancel** will leave the page without saving the address.

Please notice that for security reasons the password is not shown after saving. The password field will appear blank.

8.16.6 Email Server

Press **Select** to enter the email server name.

```
>Server
 Port
```

Enter the full sever name.

```
Email Server
smtp.domain.com▓
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.

Pressing **Select** on a blank character will save the entry.

Pressing **Cancel** will leave the page without saving the address.

NOTE: Servers that require a secure connection (SSL or TLS) are not supported at this time.

8.16.7 Email Port

Email servers can use a variety of different ports. If you used an email client to set up a test account, refer to the server settings to check the port number.

Press **Select** to enter the port configuration mode.

```
 Server
>Port
```

Set the port to the designed number.

```
Email Server Port
25▓
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.

Pressing **Select** on a blank character will save the entry.

Pressing **Cancel** will leave the page without saving the address.

8.16.8 Test Email Setup

To test email setup, send the following SMS text message command to the weather station.

   test data

The command is not case sensitive, "Test data" will also work.

The weather station will confirm the request with a "Testing Data Upload" message.

An email message will be sent to the configured account. Depending on the server, cell phone network load and the size of the log file, the email may take several minutes to be received.

The Test Data command also sends an FTP upload at the same time, if it is configured.

8.17 Setup FTP

File Transfer Protocol (FTP) may be a convenient method of handling data logs. FTP will upload files directly to the server directory where they can be conveniently aggregated for automatic parsing and analysis.

Users may find it convenient to test the FTP login user a computer client before attempting to setup the account on CM-1.

Configure FTP

Press **Select** to enter FTP configuration.

```
>Setup FTP
```
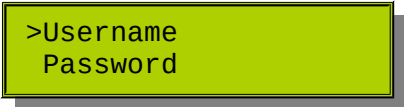
Sending data log files by FTP requires setting the following.

- Username
- Password
- Server

Default ports are used for FTP upload.

8.17.1 FTP Username

Press **Select** to edit the configuration.

```
>Username
 Password
```

Enter the username for the server.

```
FTP Username
user▓
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.
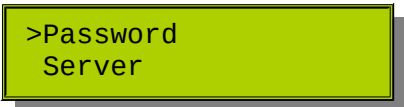
Pressing **Select** on a blank character will save the entry.

Pressing **Cancel** will leave the page without saving the address.

8.17.2 FTP Password
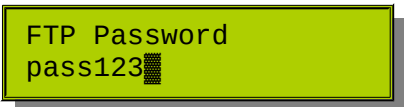
A password for the account is required to login to the server.

Press **Select** to edit the password.

```
>Password
 Server
```

Enter the password.

```
FTP Password
pass123▓
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.
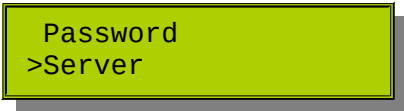
Pressing **Select** on a blank character will save the entry.

Pressing **Cancel** will leave the page without saving the address.

Please notice that for security reasons the password is not shown after saving. The password field will appear blank.

8.17.3 FTP Server

Press **Select** to enter the FTP server name.

```
  Password
 >Server
```

Enter the full sever name.

```
 Email Server
 ftp.domain.com█
```

Use the ▲ (Up) and ▼ (Down) buttons to select each character of the email address.

Pressing **Select** on a character will advance to the next space.

Pressing **Select** on a blank character will save the entry.

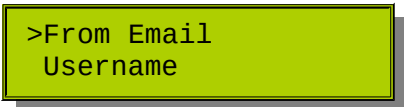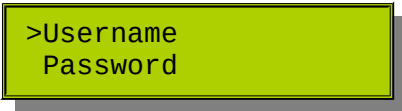**Pressing Cancel will leave the page without saving the address.**

8.17.4   Test FTP Setup

To test FTP setup, send the following SMS text message command to the weather station.

   test data

The command is not case sensitive, "Test data" will also work.

The weather station will confirm the request with a "Testing Data Upload" message.

A test file will be sent to the configured account. Depending on the server, cell phone network load and the size of the file, the transfer may take several minutes to be received.

The Test Data command also sends an email with file attachment at the same time, if email is configured.

8.18   Setup Cell Phone

Although they cannot be changed, the cell phone number and electronic serial number (MEID) or SIM card ID may be required for identifying the weather station, configuring the account, and provisioning account parameters.

The cell phone module firmware can also be displayed.

```
 >Cell Phone Settings
```

8.18.1   Cell Phone APN Settings (Added in firmware v90.)

Control Modules may be shipped with one of two cell phone technologies, GSM or CDMA.

The Access Point Name (APN) applies only to GSM cell phone networks. Typically, this setting is provided automatically by the cell phone network, but manual setting may be required in some cases.

This setting does not apply to Control Modules purchased from Dyacon for US domestic use. These units use a Verizon (CDMA) cell phone module.

Press **Select** to enter the cell phone settings.

```
>APN: Automatic
Num: 4355551212
```

Press Select to enter the APN configuration.

```
Cell APN Setting
data-link.apn█
```

Use the ▲ (Up) and ▼ (Down) buttons to enter the characters of the cell phone network APN.

Restoring Automatic

To restore the automatic setting, enter a blank value for the APN. With the cursor on the first character, use the ▲ (Up) and ▼ (Down) buttons to select the clear "character". You will notice when the full line of text disappears. Entering **Select** at this point will delete the APN.

8.18.2 View Cell Phone Number and MEID/IMEI

Press **Select** to enter the cell phone settings and use the ▲ (Up) and ▼ (Down) buttons to view the cell phone information. The following is typical information

For GSM

```
(612) 555-1212
IMEI: 3562470500699
```

```
IMEI: 3562470500699
FW: 16.00.303
```

For CDMA

```
(612) 555-1212
MEID: A0000312DBEA2
```

```
MEID: A0000312DBEA2
FW: 18.02.021
```

8.19 Setup Clock

Weather stations equipped with cell phone will automatically set the clock from the cell phone network.

If a different time zone is preferred or a specific offset from UTC is required, this may be set manually.

8.19.1 Clock Settings Configuration

Press **Select** will enter the Clock configurations

```
>Clock Settings
```

8.19.2 Time Zone

The time zone may be set to **Auto** or quarter-hour increments from

-11.75 to 0   to   Auto   to   0.25 to 14

(Setting the value to 60 is equivalent to Automatic setting.)

Press **Select** to edit the Time Zone setting.

```
>Time Zone: Auto
```

The value may be changed by using the ▲ (Up) and ▼ (Down) buttons to set the desired value.

```
Time Zone
0.25
```

Press **Select** to save the Time Zone setting.

Press **Cancel** to leave the page and discard changes.

8.20 Setup Modbus Slave (Added in firmware v90.)

Dyacon Control Module may be connected as a slave device to automation controllers and other equipment that uses Modbus RTU (RS-485).

The Dyacon Control Module Modbus Slave port is half-duplex (2-wire). The host device must be configured to half-duplex operation connecting to Dyacon Control Module.

8.20.1 Modbus Slave Wiring

The half-duplex connection (Modbus to Host) is next to the USB connector.

The port includes a 120 Ohm termination resistor.

2-Wire Host

Host	Dyacon Control Module
RX/TX+	A+
RX/TX-	B-

4-Wire Host

Host must operate in half-duplex mode, send and receive cannot occur simultaneously.

Host	Dyacon Control Module
RX (+)	A+
TX (+)	A+
RX (-)	B-
TX (-)	B-

8.20.2 Modbus Slave Port Configuration

Default Settings:

> Address: 1
> Baud Rate: 19200
> Parity: None

The above settings may be changed in the Modbus Slave screen.

```
>MODBUS Slave
```
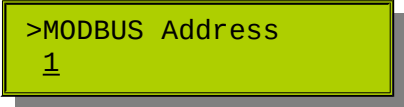
8.20.3 Modbus Slave Address

Press **Select** to enter the slave settings options.

```
>Address: 1
 Baud Rate: 19200
```

Press **Select** to edit the slave address.

```
>MODBUS Address
  1
```

The value may be changed by using the ▲ (Up) and ▼ (Down) buttons. Advance to the next character by pressing **Select**.

When the desired address is entered, press **Select**.

Use **Cancel** to escape the screen and return to the Modbus Slave configuration screen.

The address range is 1 to 247.

8.20.4 Modbus Slave Baud Rate

Use the ▲ (Up) and ▼ (Down) buttons to advance to the Baud Rate option. Press **Select** to edit the baud rate.

```
>Baud Rate: 19200
 Parity: None
```

The value may be changed by using the ▲ (Up) and ▼ (Down) buttons.

```
>Set Baud Rate
 19200
```

The following values are available:

> 9600
> 19200
> 38400

When the desired value is visible, press **Select**.

Use **Cancel** to escape the screen and return to the Modbus Slave configuration screen.

8.20.5   Modbus Slave Parity

Use the ▲ (Up) and ▼ (Down) buttons to advance to the Parity option. Press **Select** to edit the parity.

```
 Baud Rate: 19200
>Parity: None
```

The value may be changed by using the ▲ (Up) and ▼ (Down) buttons.

```
>Set Parity
 None
```

The following values are available:

> None
> Even
> Odd

When the desired value is visible, press **Select**.

Use **Cancel** to escape the screen and return to the Modbus Slave configuration screen.

8.21 Reset To Defaults

All settings may be returned to their factory default using this setup option.
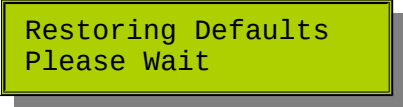
```
>Reset To Defaults
```

Press **Select** to reset.

```
WARNING! Settings
Will Be Lost! Up=Yes
```

Pressing the ▲ (Up) button will remove the station ID, all custom settings, Weather Underground settings, and any slope and offset values. Units and logging interval will be restored to their default values.

```
Restoring Defaults
Please Wait
```

The control unit will automatically reset after approximately 20 seconds.

9.0 WEATHER UNDERGROUND

9.1 Introduction

Dyacon CM-1 can be equipped with an embedded cell phone module. Not only does this allow for users to receive reports via text messages, but it may also be configured to send data to Weather Underground, wunderground.com, a web interface for private weather stations. Weather Underground is a Weather Channel company.

Weather Underground aggregates thousands of weather stations from all over the world. The "Wundermap" shows the locations of each station.

9.2 Weather Underground Account

Users can create a free account on Weather Underground. The account may be used for one or more unique private weather stations. Users specify the location of the weather station and each station is assigned a unique station identifier.

Specific instructions for setting up and operating Weather Underground accounts is outside of the scope of this manual. Please refer to the website for more information.

Dyacon maintains several stations, such as KUTNEWO4 and KUTGARDE4. These station identifiers may change if they are relocated as circumstances warrant, but they are examples of the typical station IDs assigned by Weather Underground.

9.3 Weather Station Configuration

The Weather Underground Station ID and account password is entered into Dyacon CM-1. CM-1 then automatically uploads data to the Weather Underground server.

The account information may be loaded into the control module using one of the following methods:

- LCD user interface
- Dyacon control module computer utility
- SMS commands

Each of these methods is discussed in the respective sections.

10.0 SMS Text Message Reports and Alerts

For control modules equipped with a cell phone module, a number of different reports can be requested directly from the weather station.

SMS text messages have several advantages over smart phone apps and web portals:

- Text messages require less bandwidth, generally meaning lower cost.

- SMS text messages can be received and transmitted in marginal (weak) signal conditions.

- Text messages can be used with any phone, a smart phone is not required.

- Apps have to be changed and updated as phones change. SMS is universally compatible. This ensures a long, useful product life with less user maintenance.

- Sending and receiving text messages is the most power efficient method for real-time data.

For those desiring a web interface, refer to the Weather Underground section of this manual.

10.1 Message Format

SMS text messages are technically limited to 160 characters. The phone screen size may wrap messages differently than the examples shown.

Some reports may exceed 160 characters. Depending on the cell phone network, these messages may be broken into two separate messages by the network. The message title and station ID will only be contained in the first message.

10.2 Current Condition Report

The Current Condition Report provides a basic "now" report, measurements readings from the time the request is made. Analog port measurements are not included in this report. Refer to the Extended Current Condition report.

SMS Text: **C** or **c**

Response	Description
Current Conditions	Message Title
Red Cliff	Station ID
2:00 pm Nov 5 14	Time and Date
1.6 m/s 239.9 deg WSW	Wind speed and direction
Gust 0	Maximum gust from the previous 10 minutes
14.5 C, 0.3 C	Air temperature and dew point
38.4% RH	Relative humidity
875.0 mbar Steady	Barometric pressure
Rain: 0.00 in, 0.00 in/hr	Rain accumulation and rate

The measurement units may be configured. Refer to the Setup Mode section for each of the respective sensors.

10.3 Extended Current Condition Report

The Extended Current Condition Report provides a "now" report, measurements readings from the time the request is made. It included the analog port measurements and additional calculated values such as heat index.

SMS Text: **X** or **x**

Response	Description
Current Conditions	Message Title
D1	Station ID
847 am Mar 18 15	Time and Date
1.6 mph 325.2 deg NW	Wind speed and direction
Gust 0	Maximum gust from the previous 10 minutes
43.9 F, 31.7 F14.5 C, 0.3 C	Air temperature and dew point
Wind Chill: 43.9 F	Wind chill or heat index, depending on conditions
62.5% RH	Relative humidity
764.37 mmHg Steady	Barometric pressure
Rain: 0.00 in, 0.00 in/hr	Rain accumulation and rate
--	– Second Message –
Soil: 44.9 F	Analog 1 (Example configured for soil temperatures.)
Solar: 199 W/m^2	Analog 2 (Example configured for solar radiation sensor.)

Due to the length of this report and limitations of SMS messages, the X-report may be received as two separate text messages. The hyphens, '-', above indicate the typical message break.

Heat index will show when temp is greater than 27°C or humidity is greater than 40%.

Wind chill will show when temp is less than 10°C.

10.4 METAR

Weather information for aviation applications utilizes a format defined by the International Civil Aviation Organization. The format is compact, but familiar to pilots.

This information is Advisory only. As with any Advisory information, pilots must use their own judgment and caution when evaluating the information and it's implications on their flight plans.

SMS Text: **M** or **m**

    *** Advisory ***
    METAR Red Cliff
    070101Z AUTO 31003KT 09/00 RMK AO1=

Response	Description
*** Advisory *** METAR Red Cliff 15235Z AUTO 23012G23KT 07/M00 RMK AO1 SLP159 EstCB027 DA044=	Nature of the message Red Cliff – Station ID 15235Z – UTC Time AUTO – Automatically generated weather report 23012G23KT – Wind, 230 degrees at 12 kts with 23 kts gust 07/M01 – Temperature, 07 C with -1 C dew point RMK AO1 – Remarks, Automatic station type 1 SLP159 – Sea level pressure, 1015.9 mbar EstCB027 – Estimated cloud base, 2700 ft DA044 – Density altitude, 4400 ft.

The wind values reported are a 2 minute moving average. If the wind speed reaches 9 knots over that 2 minute average, the gust value will show in the METAR message.

For example: 31015G26KT.

The gust value is valid for 10 minutes and the highest one will be reported.

10.5 Debug Report

Technicians can request a "debug" report to assess system status and data characteristics.

SMS Text: **debug** or **Debug**

Response	Description
12:00 Nov 7 14	UTC Time
3.4 m/s 301.4 deg S:0	Current wind and WSD-1 sensor status
2.2 m/s 312.5 deg	2 min average
2.0 m/s 336.7 deg	10 min average
0.0 m/s 226.1 deg	Gust
16.7 C, 2.3 C	Temperature and dew point
38.4% S:0	Relative humidity and TPH-1 sensor status
871.5 mb 0 17.6 C	Air pressure, trend, and pressure sensor temperature
Rain: 0.00 in, 0.00 in/hr	Rain accumulation and rate
Solar: 525 w/m2	Analog 1 measurement
Soil: 15.5 C	Analog 2 measurements
12.13V 19C 0.0V Off	Battery voltage, temperature, charge input, charge status
SMS: 2 FW:63 A:5 W:5	SMS count and firmware versions

10.6 Lightning Detection Report

Lightning detection is provided by a separate and optional sensor, Dyacon LD-1. The sensor must be connected and enabled or this message will not be valid.

SMS Text: **L or l**

Response	Description
Lightning	Report title
My Station Goes Here	Station ID
2:30 pm Aug 23 16	Time
Strikes 10 min: 2	Strikes in last 10 min.
Strikes 30 min: 8	Strikes in last 10 min.
Strikes 60 min: 9	Strikes in last 10 min.
Distance: 5 km	Estimated distance of last strike.
Energy: 15638	Relative energy value of last strike.
Noise: 12	Noise events in last 60 min.
Disturber: 5	Disturber events in last 60 min.

10.7 Heat Stress Report

Heat stress report gives measurements and derived values that are applicable assessing human heat injury risk. Wet-bulb Globe Temperature (WBGT) is included in the report if the sensor is installed.

SMS Text: **H or h**

Response	Description
Heat Stress	Report title
UT06	Station ID
1:01 pm Jul 1 17	Time
80.7 F	Current Temperature
70.9% RH	Current Relative Humidity
Humidex: -4.0 C	Humidex
Heat Index: None	Heat Index
Solar: 638 W/m^2	Insolation Energy
WBGT: 75.9	WBGT value (if GT-1 is installed)

10.8 Low Battery Alert

Battery problems can be a significant challenge. Dyacon CM-1 provides a low-battery alert and a data preservation mode.

When CM-1 battery reaches about 11.7 V, the controller will send a text message to the "Service Tech" SMS phone number.

```
Low Battery
```

The Service Technician Cell phone number can be configured with the Set SC command. See Section 11.5.11.

Low-battery mode turns off the cell phone, reducing total system (MS-130 configuration) current from 35 mA average to about 12 mA at 11.5 V. Data logging continues until the battery is exhausted.

The solar charger remains active. The control module will return to normal operation when the battery voltage goes above 12.3 V. In the case of a bad battery, the service technician may receive one or more Low Battery messages each day, depending on sun exposure and battery conditions.

11.0 SMS COMMANDS

Many weather station settings may be verified or changed by using a simple SMS text message. This allows for users to remotely reconfigure weather stations.

The codes are not the easiest method for users and a reference (magic decoder ring) will be required to send and receive SMS configuration settings.

SMS is only available on weather stations equipped with an embedded cell phone that is provisioned for SMS and data features. Contact Dyacon for more information on data services available for the weather station.

11.1 Reset Command

Sending "reset" or "Reset" in an SMS text message to the weather station will cause a rebooting of the system.

11.2 Test Weather Underground

With an upload interval of 10 minutes, checking Weather Underground (WU) settings can be tedious. A test command is included that will immediately validate the login settings.

Sending "test wu" will test the connection to WeatherUnderground.com.

An acknowledgement text message is sent: "Testing Weather Underground connection."

If the settings are correct the weather station will send a response text message: "Weather Underground upload successful."

11.3 Get Command

Weather station settings may be validated by sending a "get" request to the weather station using a text message.

11.3.1 Get Settings Format

The "get" command is followed by the setting code or multiple codes that are desired.

```
get {s1} {s2} … {s10}
```

- or -

```
Get {s1} {s2} … {s10}
```

Setting codes are separated by a space. Do not use a tab or carriage return.

Limit requests to 10 settings per SMS message.

Send only one Get request at a time. Wait for the response before sending another Get request.

Examples

Send	Description	Response	Description
`get al up`	Check altitude and pressure units	`Settings 1383 1`	Altitude: 1383 m Units: inHg
`get wu`	Get the WeatherUnderground user name	`Settings KUTNEWTO2`	Username: KUTNEWTO2

11.4 Set Command

All weather station settings can be configured through the text message interface.

Settings are password protected to prevent unauthorized users or accidental text messages from corrupting the weather station configuration.

11.4.1 Set Command Format

The "set" or "Set" command is preceded by a passcode and followed by the parameters and values to be changed.

```
set {passcode} {s1} {val1} {s2} {val2} … {s10} {val10}
```

The passcode is case sensitive, the commands are not.

Each code is separated by a space. Do not use a tab or carriage return.

Limit requests to 10 settings per SMS message.

Send only one Set request at a time. Wait for the response before sending another Set request.

Values that use alphabetic characters should use quotation marks.

Send	Description	Response	Description
`set a5 al 1384 up 2`	Set altitude and pressure units	`Settings 1384 2`	Altitude: 1384 m Units: mmHg
`set a5 wu "KTNOUTT1" wp "My2Stations"`	Set username and password	`Settings KTNOUTT1 (null)`	Username: KTNOUTT1 Password: not shown for security reasons.

11.5 Set Codes

11.5.1 System Settings

Setting Description	Code	Setting Values		Notes and Examples
Fan Setting	fs	Off On Day	0 1 2	set a5 fs 1 get fs
Station ID	id	[20 characters]		set a5 id "My Station"

11.5.2 Standard Weather Measurements

Setting Description	Code	Setting Values		Notes and Examples
Altitude	al	Integer in meters altitude.		set a5 al 1140 get al
Humid Offset	ho	Floating point value.		set a5 ho -0.6
Humid Slope	hs	Floating point value.		set a5 hs 1.005
Pressure Offset	po	Floating point value.		set a5 po 13.5
Pressure Slope	ps	Floating point value.		set a5 ps 0.958
Pressure Units	up	mbar inHg mmHg hPa kPa	0 1 2 3 4	set a5 up 2
Rain Gauge Increment	bi	Floating point value.		set a5 bi 0.01
Rain Gauge Type (Units)	bt	None mm inch	0 1 2	set a5 bt 2
Temperature Offset	to	Floating point value.		set a5 to 0.2
Temperature Slope	ts	Floating point value.		set a5 ts -0.915
Temperature Units	ut	Degrees C Degrees F	0 1	set a5 ut 1
Wind Direction Offset	do	Floating point value.		set a5 do 256.5
Wind Speed Offset	wo	Floating point value.		set a5 wo 0.125
Wind Speed Slope	ws	Floating point value.		set a5 ws 1.015
Wind Speed Units	uw	mps mph kph knots	0 1 2 3	set a5 uw 1

11.5.3 Analog Port Settings

Setting Description	Code	Setting Values		Notes and Examples
Analog 1 Item 1	z1	Floating point value.		set a5 1.2345
Analog 1 Item 2	z2	Floating point value.		set a5 1.2345
Analog 1 Item 3	z3	Floating point value.		set a5 1.2345
Analog 1 Item 4	z4	Floating point value.		set a5 1.2345
Analog 1 Item 5	z5	Floating point value.		set a5 1.2345
Analog 1 Units (Custom Mode Only)	zs	[6-character unit]		set a5 "mm"
Analog 1 Sensor Type	zt	None Soil Temp Soil Moisture Solar Radiation Custom	0 1 2 3 4	set a5 zt 2
Analog 2 Item 1	x1	Floating point value.		set a5 1.2345

Setting Description	Code	Setting Values		Notes and Examples
Analog 2 Item 2	x2	Floating point value.		set a5 1.2345
Analog 2 Item 3	x3	Floating point value.		set a5 1.2345
Analog 2 Item 4	x4	Floating point value.		set a5 1.2345
Analog 2 Item 5	x5	Floating point value.		set a5 1.2345
Analog 2 Units (Custom Mode Only)	xs	[6-character unit]		set a5 "cm"
Analog 2 Sensor Type	xt	None Soil Temp Soil Moisture Solar Radiation Custom	0 1 2 3 4	set a5 xt 3

11.5.4   Log Settings and Commands

Setting Description	Code	Setting Values		Notes and Examples
Logging Rate	lr	Off 1 min 2 min 5 min 10 min 15 min 20 min 30 min 60 min	0 1 2 3 4 5 6 7 8	set a5 lr 5
Logging Email	le	Off Hourly Daily Weekly Monthly	0 1 2 3 4	set a5 le 2
Logging FTP	lf	Off Hourly Daily Weekly Monthly	0 1 2 3 4	set a5 lf 0
Test data connection	test data			Stand alone command, "set" not required. Tests the data connection for ftp and email log transmission.
Force log data send	get data			Forces the immediate sending of the log data rather than the normal interval sending. Emailed log data will not be reset at the regularly scheduled interval.
Erase data logs	erase log a5			Erases the data log flash memory.

11.5.5   WeatherUnderground Settings

Setting Description	Code	Setting Values	Notes and Examples
WeatherUnderground Station ID	wu	[20 characters]	set a5 wu "KUTSUMIT4" get wu

Setting Description	Code	Setting Values	Notes and Examples
WU User ID/Station ID	wu	[station ID]	set a5 wu "KUTMYTOWN1" The user ID is created when a new personal weather station is registered at WeatherUnderground.com.
WU Password	wp	[20 characters]	set a5 wp "password"
WU Update Rate	wr	Off 0 10 min 1 15 min 2 20 min 3 30 min 4 60 min 5	set a5 wr 10
Test WU Connection	test wu		Stand-alone command. 'set' not required.

11.5.6   Email Configuration

Setting Description	Code	Setting Values	Notes and Examples
Email To	et	[40 characters]	set a5 et "johndoe@gmail.com" get et
Email From	ef	[40 characters]	set a5 ef "station@domain.com"
Email Username	eu	[40 characters]	set a5 eu "station@domain.com"
Email Password	ep	[40 characters]	set a5 ep "password"
Email Server	es	[40 characters]	set a5 es "smtp.domain.com"
Email Port	eo	Integer	set a5 eo 2525
Test Data	test data	none	Sends email to the configured address. Also, sends ftp file.
Test Email	test email		

11.5.7   FTP Configuration

Setting Description	Code	Setting Values	Notes and Examples
FTP Username	fu	[40 characters]	set a5 fu "user1" get fu
FTP Password	fp	[40 characters]	set a5 fp "password"
FTP Server	fs	[40 characters]	set a5 fs "ftp.domain.com"
Test Data	test data	none	Sends file to the configured ftp server. Also, sends test email.
Test FTP	test ftp		

11.5.8   Cell Phone Configuration and Test Commands

Setting Description	Code	Setting Values	Notes and Examples
APN (GSM only)	ca	[40 characters] (null value sets to automatic)	set a5 ca "mynetwork.mvno.apn" get ca
Test data connection	test data		Stand alone command, "set" not required. Tests the data connection for ftp and email log transmission.
Force log data send	get data		Forces the immediate sending of the log data rather than the normal interval sending. Emailed log data will not be reset at the regularly scheduled interval.
Cell Phone ID	debug cell		Returns cell phone type, MEID, firmware version.

11.5.9   Clock Commands

For controllers with an embedded cell phone, the weather station time zone is automatically set from the cell phone time. If necessary, the time zone can be set manually.

Setting Description	Code	Setting Values	Notes and Examples
Time Zone	tz	60 – Automatic ¼ hour increments. -6 UTC would be -24.	set a5 tz 60 get tz
Real-time Clock Mode	rtc		

Depending on the CM-1 revision, two different internal clocks may be used. The following command may be used for system debugging in case of a clock error. The clock is selected automatically after system reset. It cannot be changed.

Description	Code	Return Message	Notes and Examples
Check real-time clock selection	rtc check	RTC Internal - or - RTC External	This command merely indicates which RTC is being used.

11.5.10   Lightning Detection Commands

The following are applicable to units with the optional, external LD-1 lightning detector. Due to the operational characteristics of LD-1, the commands are structured somewhat differently.

Setting Description	Command	Notes and Examples
Set LD-1 Parameters	Lightning Set Settings a5 0 2 4 0 2	All parameters must be set with one command. (Defaults shown.) Lightning Set Settings {Gain} {Noise} {Watchdog} {Min #} {Spike} Refer to LD-1 sensor manual for more information on operating parameters.
Get LD-1 Parameters	Lightning Get Settings	Lightning Settings 0 2 4 0 2

11.5.11 Service Tech Cell Phone Number

The Service Cell phone number is the phone number to which operational alerts and alarms will be sent.

Setting Description	Code	Setting Values	Notes and Examples
Service Tech Cell Phone Number	SC	1{Phone Number}	set a5 sc 15551234567 get sc

11.5.12 Other Operational Commands

The following commands may be useful in system troubleshooting.

Description	Code	Return Message	Notes and Examples
Operational Info	debug	[sensor readings, firmware version, battery voltage, charger state.]	See section 8.5 for more information.
Soft reset	reset	Resetting	Soft reset command
Serial number request	info	[CM-1 ID] SN: [CM-1 Serial Number]	
Station Parameters	email info	Station ID: My Station UTC: 6:38 LOC: 2:38 M: 60 A: -16 SN: 130027 CDMA MEID:A10000459Cxxx FW: 18.12.023 Phone Num: 804xxxxxxx	Command response is made using the system mail settings. UTC time, local time, manual and auto time zone adjustment, phone ID, phone firmware, phone number.
Reset Defaults	reset defaults		Restores factory defaults.

12.0 DATA LOGGING

12.1 What are Data Loggers?

Data loggers are often standalone devices used to record measurement data over a long period of time. Data loggers are usually attached to one or more sensors for measuring such things as pressure, temperature, conductivity or other parameters that may be of interest to observers, scientists, engineers, or weather data users. The data can reveal trends or patterns that help users understand equipment operation, environmental conditions, or biological processes.

Such data loggers typically require custom programming in order to record basic instrument measurements. Often, an application engineer must be hired to setup the data logger for the end user. These types of general purpose data loggers are beyond the capability of many end users to configure and maintain, especially if using such systems is not their main occupation.

Dyacon CM-1 was designed specifically for weather station control. It includes data logging capability, but the interface is easy to use. It can easily be set up by the end user and changed as necessary using the LCD interface or a Windows™ utility.

Dyacon CM-1 contains non-volatile flash memory for data acquisition and logging. All measurement parameters and system operating events are logged.

Logging is active by default. Measurements are recorded at 10 minute intervals. System events are logged when they occur.

The log can be retrieved using a USB-equipped computer and Windows utility.

12.2 Data, Format, and values

Slope and offset and factory calibration corrections are applied to the measurement data before it is logged.

All measurements for standard Dyacon sensors and pre-configured sensors utilize default, SI units (C, m/s, mbar). Actual air pressure is used, this value is not adjusted for mean sea level.

This allows users to adjust values as required for their specific applications.

Data is available as a comma separated file format.

All data inputs are logged. The data fields include:

Data Category	Values Logged
Field Information	Index, Date/Time,
Wind	Wind Speed, Wind Direction, Wind Speed 2 min Average, Wind Direction 2 min Average, Wind Speed 10 min Average, Wind Direction 10 min Average, Gust, Gust Direction, Wind Sensor Status
Air Conditions	Temperature, Humidity, Pressure, Pressure Temperature, Pressure Trend, TPH Sensor Status
Rain	Rain Increments, Rain Accumulation for Day, Rain Rate
Analog	Analog Value 1, Analog Value 2
System	Battery Voltage, Input Voltage, Charger Status, Internal CM-1 Temperature

12.3 Data Logging Interval

Users may configure data logging for 1, 2, 5, 10, 15, 20, 30, and 60 minute intervals. Refer to the Setup Mode, Data Logging Setup section for information on changing the interval.

12.4 Data Capacity

A total of 49,000 entries can be logged. (Specifically, there are 49,152 data records available for both measurement data and system events.) When expanded to CSV format, the maximum log file is approximately 5 MB.

The memory is structured as a circular table. This means that the log entries will wrap, overwriting the oldest values once the memory is filled.

The logging interval rate will affect the duration available before old data is overwritten.

A 15 minute to 60 minute duration is typical for most environmental applications. These settings will allow for greater that one year of measurement data to be preserved on CM-1.

Users typically service weather stations twice per year. Down loading logged data would be part of this routine activity.

The following table shows estimated log duration.

	Logging Interval (minutes)							
	1	**2**	**5**	**10**	**15**	**20**	**30**	**60**
Log Entries/Day	1450	730	298	154	106	82	58	34
Log Duration (days)	33.9	67.3	164.9	319.2	463.7	599.4	847.4	1445.6
Log Duration (months)	1.11	2.21	5.42	10.49	15.23	19.69	27.84	47.50
Log Duration (years)	0.09	0.18	0.46	0.89	1.30	1.68	2.37	4.05

The above estimates allow for 10 system events to be logged per day.

12.5 Accessing Data Log

The data log may be retrieved by one of three methods. Additional details on each method are provided in the following sections.

Computer Utility

The Dyacon CM Utility program can be used to configure station settings and download log data through the USB port on the control module.

Email

For stations equipped with an embedded cell phone and data service, the control module can automatically email the log files as CSV attachments. A poor cellular data connection can cause failure or corruption of emailed data.

FTP

Similar to email, CM-1 uploads the CSV log files to the specified server on a regular basis. A poor cellular data connection can cause failure or corruption of ftp data.

12.6 CM Utility – Data Log Download

Logged data may be retrieved by using Dyacon CM Utility. Control Module Utility™ runs on Windows™ computers and is a free download from dyacon.com
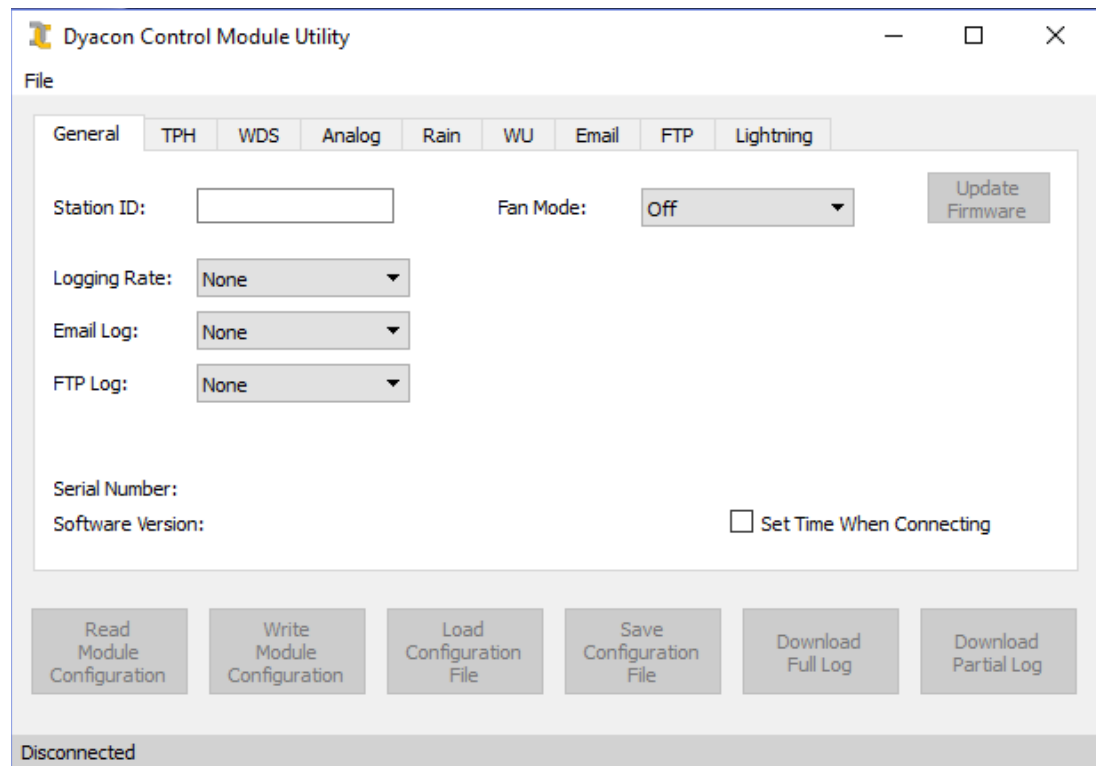
CM-1 includes a USB device port that can be plugged directly into a host computer. Control Module Utility can then be used to download the newest data or all of the log data. The utility also retrieves the system log data. These files are saved into unique comma-separated data files on the host computer.

Specifics instructions regarding the operation of this utility may be found in the software manual. The manual is available for download from dyacon.com.

12.7 Email – Data Log Attachment

The data log may be emailed at one of the following intervals.

Interval	Transmission Time	Notes
Off		Data log is not transmitted.
Hourly	xx:01 each hour	
Daily	12:01 AM each day.	Transmission time is according to clock as displayed on CM-1 LCD.
Weekly	12:01 AM on Sunday.	
Monthly	12:01 AM on 1st day of the month.	

The log email is enabled and the interval configured in the Setup Data Logging menu.

The data log and system log are both included as separate CSV attachments to the email.

Refer to Setup Email in the Setup section of this manual for instructions on configuring the email account, server, and other settings.

12.7.1   SMS Log Commands

Test Data

The data connection to the server can be tested using the following command.

Test Data

A test email will be sent using the email settings. No data will be attached to the email.

This will also test the FTP settings by placing a file on the server.

If the settings are not configured, an error will show on the LCD.

Get Data

Log data may be emailed on command by sending an SMS text message with the following command.

Get Data

CSV log data will immediately be emailed. Log transmission may take several minutes, depending on the size of the file. Emailed log data will not be retransmitted at the next scheduled

Erase Log

All log data can erased by sending the following command.

Erase Log A5

12.8   FTP – Data Log Upload

Similar to email, the data log will be uploaded periodically to the configured server. The following upload schedules are available.

Interval	Transmission Time	Notes
Hourly	xx:01 each hour	
Daily	12:01 AM each day.	Transmission time is according to clock as displayed on CM-1 LCD.
Weekly	12:01 AM on Sunday.	
Monthly	12:01 AM on 1st day of the month.	

The data log and system log are both included as separate CSV attachments to the email.

Refer to the Setup FTP in the Setup section of this manual.

12.9 Data Log File Format

The log files, whether downloaded using CM Utility or when received as an email attachment, will have a CSV (Comma Separated Variable) format. This is a portable format that can be easily imported into spreadsheet programs or parsed by custom software.

Each comma represents a different column. The titles in the first line correlate to the data in the rows that follow. Each new line, represents a new row of data. Automatic line wrapping in a text editor may complicate the appearance of the data.

A typical log file will look like the following:

```
Index,Date/Time (UTC),Wind,Direction,Wind 2 min,Direction 2 min,Wind 10 min,Direction 10 min,Gust,Gust
Direction,WDS Status,Temperature,Humidity,Pressure,Pressure Temperature,Trend,TPH Status,Rain Inc,Rain
Day,Rain Rate,Analog 1,Analog 2,Battery Voltage,Input Voltage,Charger Status,CM Temperature,Lightning
Strikes,Lightning Distance,Lightning Noise,Lightning Disturber
172720,2016-08-22 06:05:00,1.1,351,1.2,3,0.8,352,0.0,0,0,15.3,47.7,858.5,15.3,0,0,0.00,0.00,0.00,
0.000,0.047,13.1,0.0,0,17,0,0,0,0
172721,2016-08-22 06:10:00,1.6,11,1.6,6,1.0,354,0.0,0,0,15.1,47.5,858.5,15.0,0,0,0.00,0.00,0.00,
0.000,0.047,13.1,0.0,0,16,0,0,0,0
172722,2016-08-22 06:15:00,1.7,8,1.3,10,1.2,3,0.0,0,0,15.3,48.2,858.5,15.1,0,0,0.00,0.00,0.00,
0.000,0.047,13.1,0.0,0,16,0,0,0,0
172723,2016-08-22 06:20:00,1.7,5,1.5,4,1.3,8,0.0,0,0,15.8,44.7,858.5,15.5,0,0,0.00,0.00,0.00,
0.000,0.000,13.1,0.0,0,16,0,0,0,0
```

The file contains a header line that corresponds to each comma separated value. Each value is described in the table below.

Header	Description	Source Instrument	Notes
Index	Unique identifier.	Control Module	The value increments from 1 to maximum value then restarts.
Date/Time (UTC)	Date and time	Control Module	YYYY-MM-DD HH:MM:SS
Wind	Wind speed (m/s)	WSD-1	
Direction	Wind direction	WSD-1	
Wind 2 min	2 min average wind speed	WSD-1	
Direction 2 min	2 min average wind direction	WSD-1	
Wind 10 min	2 min average wind speed	WSD-1	
Direction 10 min	2 min average wind direction	WSD-1	
Gust	Maximum gust	WSD-1	Over previous 10 min period.
Gust Direction	Gust gust direction	WSD-1	
WDS Status	Sensor status	WSD-1	**Not a weather value.**
Temperature	Air temperature (°C)	TPH-1	
Humidity	Relative humidity (°)	TPH-1	
Pressure	Air pressure (mbar)	TPH-1	Uncorrected for elevation.
Pressure Temperature	Aux. air temperature (°C)	TPH-1	**Not a weather value.**
Trend	Pressure trend	TPH-1	-2, -1, 0, 1, 2 corresponding to falling, steady, rising pressure.

Header	Description	Source Instrument	Notes
TPH Status	Sensor status	TPH-1	**Not a weather value.**
Rain Inc	Rain increment	RGTB	Rain gauge resolution.
Rain Day	Accumulated rain	RGTB	This value accumulates Rain Inc count. It resets at 00 hrs local time (not UTC).
Rain Rate	Precipitation rate	RGTB	Increments/hour
Analog 1	Analog voltage value	TSSP-1, SMEC-5, PSP-1	Analog voltage after slope and offset are applied.
Analog 2	Analog voltage value	TSSP-1, SMEC-5, PSP-1	Analog voltage after slope and offset are applied.
Battery Voltage	CM-1 battery voltage	CM-1	In Volts.
Input Voltage	CM-1 solar panel voltage	CM-1	In Volts.
Battery Charging Status	CM-1 battery charger status	CM-1	0 – Off 1 – Fast Charge 2 – Top Off 3 – Float
CM Temperature	Internal temperature of CM-1	CM-1	Enclosure temperature of weather station controller.
Lightning Strikes	Number of lightning strikes since last log entry.	LD-1	
Lightning Distance	Estimated distance of last lightning strike.	LD-1	
Lightning Noise	Number of noise detections since last log entry.	LD-1	
Lightning Disturber	Number of disturbers detected since last log entry.	LD-1	

13.0 CELL PHONE

CM-1 can be configured with an embedded cell phone module. MS-130, MS-140, and MS-150weather stations include the cell phone feature.

The embedded cell phone can be used to request SMS text instrument data as well as upload data to Weather Underground.

13.1 Cell Phone Accounts and Provisions

Dyacon offers two different cell phone technologies. These are generically known as GSM and CDMA. Specifically, MS-130, 140, and 150 weather stations utilize an internal GSM/GPRS cell phone module. These configuration at typically sold internationally.

For US domestic stations, Dyacon integrates a CDMA module. These stations are designated MS-131,141, and 151. These weather stations are typically provisioned when configured at the factory and no user action is required.

Customers wishing to use GPRS, will need to provision a micro-SIM card from their selected GSM network provider. Text message service will be required for SMS text message weather reports. Typically, 200 SMS messages would be used per user per month. If users wish to upload data to Weather Underground or take advantage of over-the-air software upgrades, data service of at least 2 MB/month is required.

14.0 MODBUS SLAVE PORT

Dyacon Control Module CM-1 is used for all weather station configurations, including MS-120, -130, -140, and -150. CM-1 can be connected directly to automation controllers (programmable logic controllers) using the Modbus RS-485 slave port.

14.1 Modbus Summary

Modbus is a simple protocol that can be transmitted over several modes including TCP/IP, TIA-232-A (RS-232), TIA-485-A (RS-485), TCP/IP, SMS, and many others.

Dyacon CM-1 weather station controller is both a Modbus slave and Modbus host device.

Dyacon WSD-1 and TPH-1 sensors are slave devices. These connect to the Wind and Temperature sensor ports. CM-1 acts as the Modbus host for these and other Dyacon Modbus sensors.

CM-1 also has a two-pin Modbus connection. This slave port can be connected to Modbus host equipment, such as PLCs, SCADA, dataloggers, and computers that are equipped with a Modbus RTU (RS-485) input.

RS-485 is a robust, differential pair electrical protocol that is noise immune and capable of long cable runs. With twisted pair cabling, such as CAT-5, distances over 1200 m (4,000 ft) can be achieved. WSD-1 can be configured for 1200 bps or 2400 bps to extend the range. Relatively long runs are achievable even without twisted pair cables.

The wide operating voltage range and low power of WSD-1 allows for power to be injected over the same data cable without concern for excess voltage drop. (Two wires for power and two for data.)

For example, 1200 m (4000 ft) of Cat-5 cable (24 AWG) will result in a voltage drop of less than 0.2 V at an operating current of 2 mA.

WSD-1 ships standard with 20 ft (5 m) of non-paired, outdoor-rated cable.

14.2 Modbus Utilities

The address of the sensor and other parameters are configurable. A Modbus computer utility may be required to change these settings. A number of utilities are available including:

ModBus Constructor	www.kurysoft.com
Simply Modbus	www.simplymodbus.ca
ModbusTools	www.modbustools.com

Dyacon uses ModBus Constructor. ModBus Reader is free. Reader allows Dyacon customers to validate and configure Dyacon sensors. Project files are available for each Dyacon Modbus devices. Contact support@Dyacon.com for copies of the ModBus Reader project files.

A list of Modbus software can be found at: www.modbus.org/tech.php14.2 Modbus Utilities

14.3 Modbus Electrical Connection

14.3.1 Bus Connection

Dyacon CM-1 uses a two-wire (half-duplex) electrical connection.

CM-1 "Modbus to Host" port is a slave port that can be connected to a Modbus Host or Master.

Pin 1 – RS-485 RX/TX+   (A)
Pin 2 – RS485 RX/TX-   (B)

Connecting to 4-wire Master

When connecting CM-1 to a 4-wire master, install a jumper between the RX+ and TX+ as well as between RX- and TX-. The Master device may have to be configured to operate in half-duplex mode. Refer to the instructions for your equipment for half-duplex and full-duplex settings.

Modbus Master   **CM-1**

| RX+ | | RX/TX+ |

| TX+ |

| RX- | | RX/TX- |

| TX- |

14.3.2 Termination

RS-485 (EIA-485) networks require a termination resistor of 120Ω. A termination resistor is included on-board CM-1.

Depending on the connected device, additional bias resistors may be needed.

Modbus is based on a bi-directional RS-485 data bus. Since the bus is bi-directional, anytime either the master or slave is not driving the bus, the bus floats. If the bus has termination resistors on it (as it should) the two lines will be at the same voltage when no transceiver is driving the line. While Dyacon equipment utilizes full fail-safe (Open, Short, Terminated/Floating) RS-485 transceivers, this is not the case with all equipment. Some equipment needs a bias on the RS-485 lines to prevent the bus from being interpreted as being active while it floats.

The intent of the bias resistors is to keep the positive signal above the negative signal. The following diagram shows a common biasing and termination circuit and should be located on the master node, if needed. The 120 Ω resistor may be eliminated if the bus is terminated internally to the host. When biasing to a 5 V supply the R1 (pull-up) and lower (pull-down) resistor should be the same value. At 12 V, R1 would be doubled. At 24 V, R1 would be doubled again. Standard 5%, ¼ W resistors are adequate.

While this circuit works well in most situations, adjusting the resistors may be needed depending on the bus configuration, other termination resistors on the bus, cable capacitance, cable length, and operating voltage.

The values in the following diagram may service as a starting point.

+V

R1 Ω   +V   R1 Value
                        5 V   680 Ω
RX/TX+   12 V   1.3 kΩ
                        24 V   2.7 kΩ
120 Ω

RX/TX-

680 Ω

GND
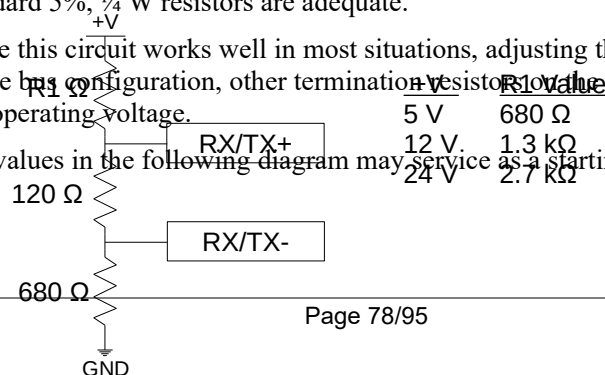
14.4 Modbus Commands (Firmware v92 and above)

CM-1 contains a Modbus slave port, the Modbus host must request data from the weather station.

Refer to the Modbus Slave section under the Setup Mode and Sensor Configuration Section for instructions on configuring the address and port parameters.

The default configuration:

Modbus address   01
Serial Data Parameters 19200, 8-bit data, no parity, 1 stop bit

14.4.1 Supported Functions and Exception Codes

Function	Description	Supported Error and Exception codes*
3	Read Holding Register	0x83: 01, 02, 03, 04
4	Read Input Register	0x84: 01, 02, 03, 04
6	Write Single Register	0x86: 01, 02, 03, 04
16	Write Multiple Registers	0x90: 01, 02, 03, 04

* See Error Code table below for more information.

14.4.2 System Parameters

Time and date are required for proper daily rain calculations. For systems with an active cell phone, the time and date are automatically set to the cell phone network time.

MS-120 stations, which do not include a cell phone, or systems where the cell phone service has expired require that the time and date be set using the Modbus command given below.

Address	Register	Access Type	Range	Data Type	Description
100	101	Read	Default: 0x03YY	16-bit Signed Int	Product ID
101	102	Read		16-bit Unsigned Int	Firmware Version
102	103+104	Read		32-bit Unsigned Int	Serial Number
104	105+106	Read/Write		32-bit Unsigned Int	Time in HHMMSS format.
106	107+108	Read/Write		32-bit Unsigned Int	Date in YYMMDD format.

Battery and Solar Charge Controller

CM-1 contains and integrated solar charge controller. The

Address	Register	Access Type	Format	Data Type	Description
108	109	Read	0 to 50000 (multiply register by 0.001)	16-bit Signed Int	Battery Voltage
109	110	Read	0 to 50000 (multiply register by 0.001)	16-bit Signed Int	Solar Charge Voltage

Address	Register	Access Type	Format	Data Type	Description
110	111	Read	0 = Off 1 = Fast 2 = Fast Top 3 = Float Charge	16-bit Signed Int	Charger Status Fast – Current limited Fast Top – Voltage limited Float – Low V charge

14.4.3   Wind Data Requests (WSD-1 Sensor)

Address	Register	Access Type	Response Range	Data Type	Description
200	201	Read	-1 to 15†	16-bit Signed Int	Wind Sensor Status† -1 indicates "No Sensor."
201	202	Read	0 to 500*	16-bit Signed Int	Wind speed (m/s)
202	203	Read	0 to 3599*	16-bit Signed Int	Wind direction (°)
203	204	Read	0 to 500	16-bit Signed Int	2 min avg wind speed
204	205	Read	0 to 3599	16-bit Signed Int	2 min avg wind direction
205	206	Read	0 to 500	16-bit Signed Int	10 min avg wind speed
206	207	Read	0 to 3599	16-bit Signed Int	10 min avg wind direction
207	208	Read	0 to 500	16-bit Signed Int	Wind gust speed
208	209	Read	0 to 3599	16-bit Signed Int	Wind gust direction

† See System Status Code section below.

* See Data Format section for numeric conversions.

14.4.4   Temperature-Pressure-Humidity Requests (TPH-1 Sensor)

Address	Register	Access Type	Response Range	Data Type	Description
220	221	Read	-1 to 3	16-bit Signed Int	TPH Sensor Status† -1 indicates "No Sensor."
221	222	Read	-400 to 1250*	16-bit Signed Int	Temperature (Celsius)
222	223	Read	0 to 1000*	16-bit Signed Int	Relative Humidity (%)
223	224	Read	0 to 13100*	16-bit Signed Int	Pressure (mbar)
224	225	Read	-2, -1, 0, 1, 2*	16-bit Signed Int	Pressure Trend
225	226	Read	-40 to 125	16-bit Signed Int	Temperature (Celsius) from pressure sensor

† See System Status Code section below.

* See Modbus Data Formats section below for numeric conversions.

TPH-1 requires about 70 ms to read sensor elements and respond.

14.4.5   Rain Requests

Rain (precipitation) is accumulated throughout at 24 hour period. The time and date must be set for this feature to work properly.

Rain rate is calculated every 10 min at even 10 minute clock intervals, such as 10, 20, and 30 minutes past the hour. The calculated value will be reported for 10 minutes until a new value is calculated based on the rain received during the previous 10 minutes.

The accumulated rain fall is reset at 0000 hrs. (12 am). Historical data is not available through Modbus, but is stored in the log file, it this feature is enabled. See the Setup Data Logging section for more information.

The "Units" of the rain is the tipping bucket resolution of the gauge. A 0.01 inch rain gauge will show 3 for 0.03" inches of accumulation.

Address	Register	Access Type	Response Range	Data Type	Description
242	243	Read	0 to 1000	16-bit Signed Int	Daily rain total (units)
243	244	Read	-400 to 1250	16-bit Signed Int	Rain rate (units/hr)

14.4.6 Analog Port Measurement Requests

The analog ports can be configured for soil (submersible) temperature probe, solar sensor, or soil moisture.

The pre-configured slope and offset values for each sensor option are applied to the values before they are populated in the Modbus registers. This means that no scaling is required. However, the value is presented in the base units, °C, W/m^2, and m/m for the preconfigured sensors.

The same is true for custom analog sensors. The slope and offset are applied prior to populating the measured voltage in the Modbus registers.

Note: When using Dyacon TSSP-1 thermistor, ensure that the corresponding DIP switch is in the ON position to switch in the matched 10 kohm precision resistor. If a thermistor from a different manufacturer is used, the equation constants may need to be changed as well as the use of an external resistor wired between Vref and Vin.

Address	Register	Access Type	Response Range	Data Type	Description
244	245+246	Read		32-bit Single precision float*	Analog Port 1
246	247+248	Read		32-bit Single precision float*	Analog Port 2

* 32-bit single-precision floating point (IEEE-754) numbers are restricted to about 7 significant decimal figures. 32-bit values are transmitted most significant word (MSW) first.

14.4.7 Calculated Data Requests

The following values are modeled or calculated from other direct measurements. These values may only be applicable for a range of temperatures. For example, Heat Index is not valid in cold temperatures and Wind Chill is not valid for warm temperatures. When the existing conditions don't support a valid calculated result, a response of -999 is given.

-999 will be shown on the slave modbus port for the following situations:

Heat index when temperature is less than 27°C or humidity is less than 40% or a sensor read error.

Wind chill when temperature is greater than 10°C or a sensor read error.

The dewpoint and wetbulb will show -999 for a sensor read error only.

Address	Register	Access Type	Response Range	Data Type	Description
240	241	Read	-400 to 1250, -999	16-bit Signed Int	Heat Index (°C) -999 indicates "Out of Range."
241	242	Read	-400 to 1250, -999	16-bit Signed Int	Wind Chill. Based on 2- min average wind speed. -999 indicates "Out of Range."
248	249	Read	-400 to 1250, -999	16-bit Signed Int	Dewpoint (°C) -999 indicates "Out of Range."
249	250	Read	-400 to 1250, -999	16-bit Signed Int	Wet-bulb (°C) -999 indicates "Out of Range."

See Modbus Data Formats section below for numeric conversions.

14.4.8 Lightning Detection Requests

Lightning detection requires the connection of Dyacon Lightning Detector LD-1.

LD-1 is not a lightning protection device.

LD-1 will not detect all lightning strikes.

LD-1 cannot predict lightning strikes or the potential for lightning strikes.

The probability and efficiency of strike detection is dependent on the installation, environment, user settings, and the capabilities of the equipment to which LD-1 is connected. Unit-to-unit variation may also result in differences in detection efficiency.

LD-1 should be considered an advisory instrument only, the instrument is intended to augment knowledge, skill, understanding, and judgment of the users.

Dyacon assumes no liability for damage resulting from improper use of the instrument, improper configuration, or the failure of the instrument to detect lightning strikes.

Address	Register	Access Type	Response Range	Data Type	Description
280	281	Read	0 to 4	16-bit Signed Int	Sensor Status†
281	282	Read	0 to 32767	16-bit Signed Int	Strike Count since last read.
282	283	Read	0 to 32767	16-bit Signed Int	Noise Count since last read
283	284	Read	0 to 32767	16-bit Signed Int	Disturber Count since last read
284	285	Read	0 to 40 63 is out of range.	16-bit Signed Int	Distance Estimate (km)
285	286+287	Read	0 to 2,147,483,647	32-bit Signed Int	Energy of Last Strike
287	288	Read	0 to 32767	16-bit Signed Int	Strike Count 10 minute
288	289	Read	0 to 32767	16-bit Signed Int	Strike Count 30 minute
289	280	Read	0 to 32767	16-bit Signed Int	Strike Count 60 minute
290	291	Read	0 to 32767	16-bit Signed Int	Noise Count 60 minute

Address	Register	Access Type	Response Range	Data Type	Description
291	292	Read	0 to 32767	16-bit Signed Int	Disturber Count 60 min

† See System Status Code section below.

14.4.9 Error and Status Codes

Lightning Detector Error Codes

The following error and acknowledgment codes are supported by the LD-1. Not all codes are relevant to each request or command. Supported command error codes are listed for each command.

Function	Name	Description
01	Illegal Function	No sensor detected, function not supported or not recognized by the sensor.
02	Illegal Addresses	Incorrect address, address does not exist, sensor disabled, or address does not support write function.
03	Illegal Data Value	Data value is outside of allowed range.
04	Device Failure	Error occurred while attempting to perform the requested action.

Ligthning Sensor Status Codes

System status codes are unique to the sensor, not Modbus protocol exceptions. System codes are bit codes representing internal functional errors. A clear (0) bit indicates no errors were detected. A set (1) bit indicates an error.

Contact customer support if system errors are encountered.

Bit	Hexadecimal	Name
0	0x0001	Calibration on TRCO failed
1	0x0002	Calibration on SRCO failed
2	0x0004	Cal on LCO failed, too slow
3	0x0008	Cal on LCO failed, too fast
4	0x0010	Internal communication error
7	0x0080	Lightning sensor not found

Temperature-Pressure-Humidity (TPH) Status Codes

System status codes are unique to the sensor, not Modbus protocol exceptions. System codes are bit codes representing internal functional errors. A clear (0) bit indicates no errors were detected. A set (1) bit indicates an error.

Contact customer support if system errors are encountered.

Bit	Name
0	Temperature/Humidity sensor error
1	Pressure sensor error

Hex Values

0x0000 – No Errors
0x0001 – Temp sensor error
0x0002 – Pressure sensor error
0x0003 – Temp and pressure sensor errors

Lightning Detector Status Codes

System status codes are unique to the sensor, not Modbus protocol exceptions. System codes are bit level codes representing internal functional errors. A clear (0) bit indicates no errors were detected. A set (1) bit indicates an error.

Contact customer support if system errors are encountered.

Hex Values

0x0001 – Calibration on TRCO failed
0x0002 – Calibration on SRCO failed
0x0004 – Cal on LCO failed, too slow
0x0008 – Cal on LCO failed, too fast
0x0010 – Internal communication error
0x0080 – Lightning sensor not found

14.5 Modbus Data Formats

CM-1 delivers instrumentation measurement data as signed integers. Consequently, numeric conversion is required to determine the decimal values.

The following conversion values can be performed by the host device.

14.5.1 Wind Speed Format

The measured wind speed range is 0.0 to 50.0 m/s.

The Modbus data range is 0 to 500.

Wind Speed (m/s) = (ModbusData) / 10

14.5.2 Wind Direction Format

The measured wind direction range is 0° to 359.9°.

The Modbus data range is 0 to 3599.

Wind Direction (°) = ModbusData / 10

14.5.3 Temperature Format

The measured temperature range is -40.0°C to 125.0°C.

The Modbus data range is -400 to 1250.

Temperature (°C) = (ModbusData) / 10

14.5.4 Humidity Format

The measured relative humidity range is 0.0% to 100.0%.

The Modbus data range is 0 to 1000.

Relative Humidity (%) = ModbusData / 10

14.5.5 Pressure Format

The measured atmospheric pressure range is 0.0 mbar to 1300.0 mbar

The Modbus data range is 0 to 13000.

Atmosphereic Pressure (mbar) = ModbusData / 10

Refer to the Barometric Pressure at Mean Sea Level for more information.

14.5.6 Pressure Trend

Pressure trend indicates the direction of change over the last three hours.

The trend value is assigned according to the following rules:

Value	Indication	Description
-2	Falling rapidly	Decrease of more than 2 mbar (0.06 inHg)
-1	Falling slowly	Decrease of 1 mbar to 2 mbar (0.02 inHg to 0.06 inHg)
0	Steady	Change of less than 1 mbar (0.02 inHg)
1	Rising slowly	Increase of 1 mbar to 2 mbar (0.02 inHg 0.06 inHg)
2	Rising fast	Decrease of more than 2 mbar (0.06 inHg)

14.5.7 Battery and Solar Voltage

Battery and solar charge controller input voltages are given in integers.

The Modbus range is 0 to about 25000.

Battery Voltage = ModbusData/1000

14.6 Measurement Unit Conversions and Calculations

Unit conversion may also need to be done by the host device in order to present the data in the convention preferred by equipment users.

14.6.1 Speed Unit Conversions

Speed (mile/hr) = Speed (m/s) * 2.23694

Speed (knots) = Speed (m/s) * 1.943844

Speed (km/h) = Speed (m/s) * 3.6

Conversion Tip

WSD-1 contains calibration registers that can be used for conversion. Just enter the desired conversion value above in the "slope" register for wind speed.

Please be aware, that this may complicate any calibration adjustments that may have to be applied later. However, most users will find that the calibration is not necessary.

14.6.2 Barometric Pressure at Mean Sea Level

For comparative measurements, barometric pressure given in weather reports is normalized to mean sea level (MSL).

To determine the barometric pressure relative to mean sea level, Babinet's formula can be used:

Barometric Pressure (mbar) = P*((16000+64*T)+Z)/((16000+64*T)-Z)

where:

P = atmospheric pressure (mbar)

Z = altitude (m)

T = temperature (°C)

This simple formula will give good results within up to 1000 m (3280 ft) and within 1% to much greater heights.

14.6.3 Pressure Unit Conversion

Pressure (inHg) = Pressure (mbar) * 0.02953

14.6.4 Temperature Conversion

Unit conversion can be done by utilizing the slope and offset feature or applying the following formulas to the TPH-1 formatted data.

Temperature (°F) = Temperature°C * 1.8 + 32

Conversion Tip

TPH-1 contains calibration registers that can be used for conversion. Just enter the desired conversion values shown above into the slope and offset registers for pressure or temperature.

Please be aware, that this may complicate any calibration adjustments that may have to be applied later. However, most users will find that the calibration is not necessary.

14.7 Modbus Low-level Frame Example

The following is given for those programming embedded devices or computer utilities.

The command to read all of the system parameters with a single request would be:

01 03 0064 000B 45D2 (hexadecimal values)

[addr 0x01] [read function 0x03] [start address 0x0064 (100)] [read register count 0x000B (11)] [CRC 0xD245]

The response from the device would be:

01 03 0301 0080 0001FBE7 00100817 00150101 2FE2 0000 0000 81DA

[addr 01] [read 03] [product ID] [firmware version] [time] [date] [batt V] [solar panel V] [charge status] [CRC 0xDA81]

When reading registers in the 200 range, a latency of 4 seconds should be allowed.

15.0 CONTROL MODULE UTILITY

Control Module CM-1 may be configured using SMS text message commands, Control Module Utility (computer software), or with the LCD interface on the unit. The following is a brief introduction to the Control Module Utility. A separate manual is available for the software.

15.1 Hardware Requirements

Windows XP or later, 32- or 64-bit.

USB port

USB A to USB B cable

15.2 Overview

Control Module Utility is an easy, fast method for changing, backing up, and duplicating weather station configuration. All sensor parameters, units, calibration, WeatherUnderground configuration, and log file email and ftp can be done using the simple utility.
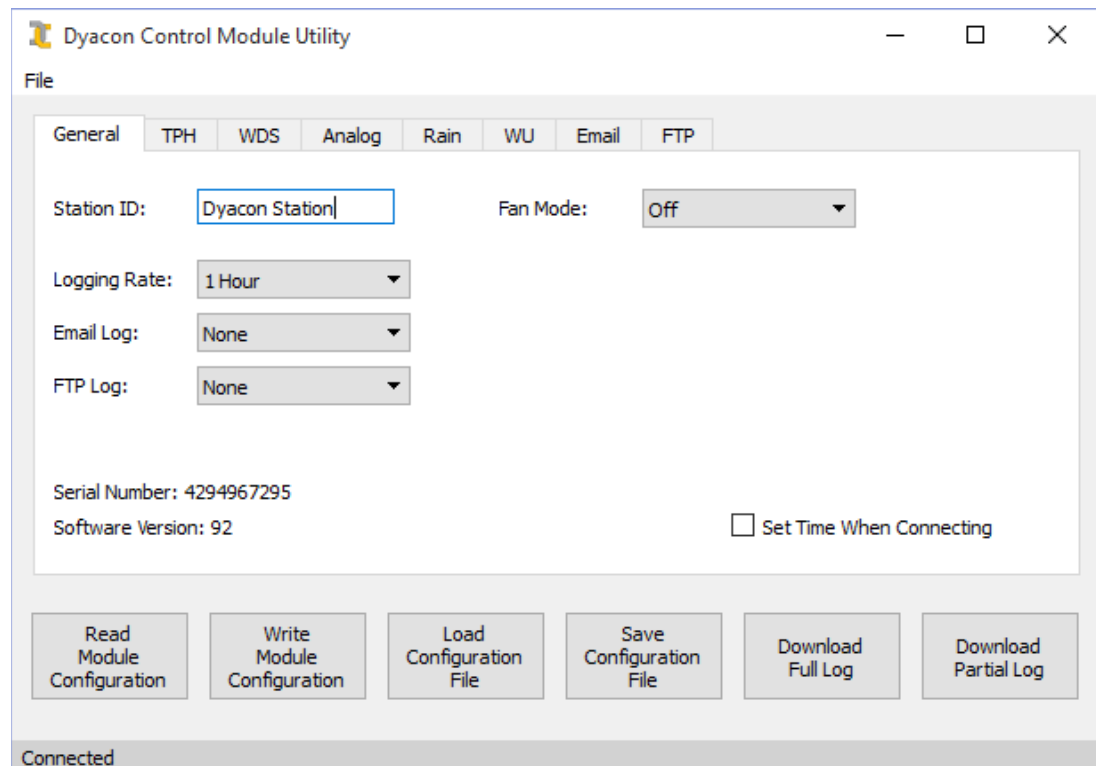
The utility will automatically "Connect" when a CM-1 Control Module is plugged into a USB port.

15.2.1 Functions

Set Time When Connecting – See the following section for more information.

Read Module Configuration – Downloads all of CM-1 settings.

Write Module Configuration – Uploads the current configuration to the connected CM-1.

Load Configuration File – Loads a previously saved configuration file so that it can be changed or uploaded to a connected CM-1.

Save Configuration File – Saves the current configuration to a file on the computer. The file can be used to restore or duplicate configuration settings.

Download Full Log – All data log memory is downloaded. Two log files are created, a measurement log file and a "Syslog" file, which contains any system messages.

Download Partial Log – Downloads only those entries which have not yet been downloaded.

15.3 Set Time When Connecting

Weather station controllers with a built-in cell phone will automatically pull the time from the cell phone network. However, "cabled" versions, such as MS-120, do not have an embedded cell phone. Consequently, the time must be set externally.

Users of cabled weather stations may occasionally plug into the USB port to download system logs. When the "Set Time When Connecting" check box is enabled, CM Utility will automatically update the weather station controller with the computer time.

15.4 Firmware Compatibility

While every practical effort is made to maintain compatibility between CM Utility and the CM-1 firmware, feature changes expansion of the weather station controller, CM-1, require updates to CM Utility.

The following is a brief list of cross compatibility.

CM Utility Version	CM Utility Change Description	CM-1 Firmware Version
0.7.2		up to v86
0.7.6		v87 to v96
0.7.7	Add system time update when CM Utility is connected to a CM-1	v97 to v112
0.7.8	Corrected email settings error.	v97 to v112
0.7.9	Allow for hourly transmission of email and FTP log transmission.	v113 to v120
0.8.0	Add USB firmware update capability.	v121 to v124
0.8.2	Add lightning sensor enable/disable.	v126 to Current

16.0 Maintenance

Routine maintenance of weather station equipment is recommended. The nature of the maintenance will be somewhat dependent on the operating environment and conditions. Insects, dust, debris, snow, large animals, rodents, and other factors can differ dramatically from site to site.

The following are suggestions that users might consider as part of their maintenance and inspection.

16.1 Battery

CM-1 uses a 12 V seal lead-acid battery. This battery technology has been proven highly reliable in solar charging applications where exposure to high and low temperatures are common.

Nevertheless, the batteries will wear out.

The aging of the battery will reduce the autonomous operation, the time that the station will operate without recharging. Normally, the control module will operate a weather station for at least four days without charging. As the battery ages, the capacity will be reduced.

Replacement after three years of normal use is recommended. Locations that experience extreme cold and frequent cloud cover may need to replace the battery annually.

The recommended replacement battery is:

Panasonic LC-R127R2P1

These batteries or tested equivalent batteries are available from Dyacon.

16.2 Cables

Inspect all cables for damage from rodents.

Check cable ties. All cable ties should be outdoor rated to prevent degradation due to sunlight and cold. Replace as necessary.

Cable ties should be positioned to minimize movement of the cable during storms and damage due to snow accumulation. The ties should prevent undue strain on the instruments.

16.3 Terminal Blocks

Check the torque on each of the screw terminal blocks.

Tinned wires can collapse under the pressure of the screw clamp. For this reason, Dyacon uses ferrules on all new shipments and recommends stripped, bare wires when doing repairs and field service.

16.4 Rain Gauge

The rain gauge will accumulate dirt and debris in the collection funnel. Users should check this routinely and also remove the top to examine the tipping bucket and mechanism.

16.5 WSD-1

Inspect the wind sensor for damage to the anemometer cups and wind vane. Both of these components can easily be replaced in the field.

3-5 year interval, depending on environment, return the sensor to Dyacon for bearing cleaning.

16.6 TPH-1

The radiation shield can easily be removed without tools. Check the radiation shield for accumulation of dust, debris, or insects.

Inspect the mounting pipe/duct for obstacles.

16.7 Tripod and Mounting

Inspect and tighten all mounting hardware.

If a field tripod is used, ensure that the stakes or bolts are secure.

Inspect and tighten all guy wires.

17.0 FIRMWARE REVISION HISTORY

Version	Description of Changes	Date
v87	Add "test wu" SMS command to test WeatherUnderground connection.	29 May 2015
v90	Add manual cell phone APN. Add Modbus Slave port settings.	08 Jun 2015
v91	Adds Modbus Slave functionality, including time setting register. Add manual setting of time to calculate daily rain values w/o cell phone connection.	16 Jun 2015
v92	Add web-bulb temperature to Modbus slave and SMS "X" message.	23 Jun 2015
v93	Implemented HTTP 1.1 for improved Weather Underground connectivity through GSM networks.	10 Jun 2015
v94 and v95	Change Modbus wind direction register to use corrected value.	30 Jul 2015
v96	Corrected rain gauge rounding error	28 Aug 2015
v97	Add system time update sync option when using CM Utility	
v101	Add estimated cloud base and density altitude to the METAR report.	Sep 2105
v102	Fixed email log transmission rounding error.	Nov 2015
v103	Fixed a rounding error that was causing temperature values between 0 and -1 to show as positive.	Nov 2015
v105	Corrects a glitch in the analog that would show large negative values when nothing was connected.	Dec 2015
v107	Add support for real-time clock on CM-1 Rev B.	Mar 2016
v114	Add support for HSPA cell phone modules. Fixed wind gust direction Modbus register. Added support or external real-time clock. Added battery voltage and solar charge controller Modbus registers. Added 1 hour interval for email and FTP log uploads.	Apr 2016
v118	Increased cell phone interface speed. Added firmware write validation to bootloader. Allow for padded OTA update files to workaround phone error. Allow for data-only phone accounts that do not have a phone number. New OTA update command format for FW <= v114 and >= v115 units.	19 May 2016
v121	Add firmware update capability through USB port. (This is in addition to the previous over-the-air capability.)	02 Jun 2016
v122	Improve status messages during USB firmware update.	07 Jun 2016
v123	Limit RH to 100% max.	15 Jul 2016
v125	Force wind gust direction to zero when wind gust speed is zero. Add support for external Modbus lightning detector, including LCD and SMS configuration and data logging. Fix bug that occasionally affected log.	22 Aug 2016
v126	Move Lightning Modbus registers to 200 range	27 Aug 2016

Version	Description of Changes	Date
v128	Added code to handle non international format numbers. Added passwords over SMS show **** and NULL if blank. Increased SMS incoming buffer length. Added Log Info SMS command. Calculations now use RH as a double instead of int. Corrected wind chill calculation error. Fixed repeated cell status updates.	22 Nov 2016
v131	Added WBGT and Humidex and SMS "h" message and globe temp support. Fixed reading lightning sensor from modbus slave when lightning sensor is disabled.	17 Jan 2017

18.0 Document Revision History

Rev	Description	Author	Date
A	First release. Applicable to firmware version v81.	E. Bodrero	22 Jan 2015
B	Added SMS email/FTP test command. SMS Command Table.	E. Bodrero	18 Mar 2015
C	v87 Firmware – Add "test wu" SMS command to test WeatherUnderground connection. v90 Firmware – Add manual cell phone APN (6.17), Modbus Slave settings (6.19).	E. Bodrero	12 Jun 2015
D	v92 Firmware – Add Modbus Slave registers (12.3). Added section 13, Control Module Utility.	E. Bodrero	25 Jun 2015
E	2.4 – Updated connection label. 2.5.2 – Added Extended Condition SMS message. 9.5.8 – Add cell phone configuration commands. 12.3.5 – Corrected Rain Rate calculation description. 13.3 – Added firmware compatibility table. Minor changes to language in several sections.	E. Bodrero	31 Aug 2015
F	13.2 – Update CM Utility image. 13.3 – Add "Set Time When Connected" section 13.4 – Update firmware compatibility	E. Bodrero	30 Oct 2015
G	2.0 – Expand Quick-Start Guide section	E. Bodrero	26 Jan 2016
H	12.3.5, .6, and .7 – Corrected Modbus registers.	E. Bodrero	29 Feb 2016
I	2.4 – Updated connections label for CM-1 Rev B. 8.4 – Updated METAR text message. 9.5.8 – Added Get Data and Erase Data commands. 10.7.1 – New section, SMS Log Commands 12.3.7 – Removed duplicate register descriptions.	E. Bodrero	18 Mar 2016
J	3 – Various updates and clarifications. 6.13.3 and .4 – Added hourly email option. 9.5.7 and .8 – Added "test data" command. 9.5.9 – Added Other Operational Commands section. 12.3.2 – Added battery and charging registers. 12.3.6 – Expanded description. 12.4.7 – Added Battery and Solar Voltage format. 13.4 – CM Utility compatibility table updated. 15 – Updated firmware history.	E. Bodrero	15 Apr 2016
K	9.5.5 – Added WU set command. Removed Getting Started information and created new Quick-start Guide as new document. Fixed minor graphic and pagination errors.	E. Bodrero	19 May 2016

Rev	Description	Author	Date
L	Update trademark acknowledgments and warranty. 6.1 – Add lightning detection to Page Order. 6.9 – Added Lightning Detection Page. 8.12 – Insert Setup Lightning Detector section. (All subsequent 8.0 section shifted.) 8.13 – Update Setup Aspirator Fan section. 10.6 – Add Lightning Detection SMS report. 11.5.9 – Add Clock command section. 11.5.10 – Lightning set command inserted. 11.5.11 – Add "Info" command to read serial number. Add "Station Parameters" command. 12.9 – Update log file with lightning detection. 14.3 – New section, Modbus Electrical Connections 14.4.8 and .9 – Added Modbus Lightning detection. 15.4 – Update CM Utility revisions. 17.0 – Update firmware revisions.	E. Bodrero	24 Aug 2016
M	14.4.8 – Adjust lightning detection registers.	E. Bodrero	31 Aug 2016
N	8.7.1 – Add GT-1 option. 10.3 and 14.4.7 – Describe ranges for which heat index and wind chill are shown. 10.5 – Added Heat Stress report. 12.4 – Update CM Utility image (v0.8.2) 12.7 & .8 – Add hourly upload option 14.1 & .2 – Minor changes for clarification. 14.4.2 & .4 – Minor changed for clarification. 14.4.8 – Fixed error for register 290. and other table information. 14.5 – Minor changes for clarification. 14.7 – Add section on low-level Modbus frame. 17.0 – Update firmware.	E. Bodrero	01 Feb 2017
O	11.5 – Added several SMS commands, including Debug Cell, Test Email, Test FTP, Test DY, Service Cell. 10.8 – Added Low Battery Alert section.	E. Bodrero	