



WSD-1 (Wind Speed-Direction) Sensor Manual

57-6017 Rev H

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I.0 NOTICES

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Dyacon WSD-1™, WSD™ are trademarks of Dyacon, Inc.

All other trademarks are property of their respective owners.

1.1.2 Manufacturer

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

1.1.3 Declarations

Dyacon WSD-1™ is a low-power electronic industrial device.

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.

1.1.4 Warranty Information

Limited Hardware Warranty

Dyacon, Inc. warrants that all Dyacon products and components shall be free from defects in materials and workmanship for a period of two (2) year from the date of shipment when installed according to instruction manuals accompanying said hardware and used for the purpose for which said hardware was designed. In the event a defect in materials or workmanship is discovered and reported to Dyacon within the warranty period, Dyacon will at its option repair the defect or replace the defective product. This warranty does not apply where the product has been operated outside the specifications of the product. Dyacon's obligation hereunder will be limited to such repair or replacement. Customers shall have the responsibility to ship the defective equipment to Dyacon at its (customer's) expense, with all cost of shipment prepaid. Dyacon will ship the repaired or replaced item at its (Dyacon's) expense using the preferred shipment method of Dyacon.

Disclaimer of Warranties

The warranties set forth above are in lieu of all other warranties of Dyacon, whether written, oral, or implied. Dyacon makes no warranties regarding its products (hardware or software), including without limitation warranties as to merchantability, fitness for a particular purpose, any warranty arising from course of performance, course of dealing or usage of trade whether any of the foregoing warranties are either expressed or implied. Dyacon specifically makes no warranties as to the suitability of its products for any particular application. Dyacon shall in no event be liable for performance, or use of any product covered by this agreement whether such claim is based upon warranty contract (express or implied), strict liability, negligence, or otherwise. Any responsibility and/or liability of Dyacon shall, in connection with a warranted product, be limited in maximum amount to the original purchase price of that product.

Removal of Serial Number

Removal of the original serial number label or reprogramming of the electronic serial number voids any warranty on the device. Dyacon will not repair or update products if the serial number label missing or legitimate ownership cannot be verified. Dyacon may not return equipment that is missing serial numbers or where legitimate ownership is in question.

Updates or Modifications

Dyacon shall be under no obligation to update or modify its products except as herein noted to correct defects or errors. Customer agrees that all representation and warranties contained herein shall be immediately null and void in the event of any incorrect installation, modification,

alteration, or change in or to any product affected by or on behalf of customer except for a change made by Dyacon or other direct supervision thereof.

2.0 WSD-1 INTRODUCTION

2.1 Scope

The content of this document is intended for integrators, installers, and users of WSD-1™, hereinafter referred to as WSD or “wind sensor”.

This document includes installation instructions, technical specifications, electrical requirements, and data protocol information. Some aspects of the equipment operation may be covered in other documents. Please contact Dyacon or visit the Dyacon.com website.

2.2 Technical Support

2.2.1 Contact Information

Dyacon, Inc.

1770 Research Park Way, Suite 168
Logan, UT 84341

Phone: (435) 753-1002

Email: support@dyacon.com

Internet: www.dyacon.com

Normal business hours are from 8:00 am to 5:00 pm. (Mountain Time Zone, GMT -0700)

2.2.2 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.

3.0 PRODUCT OVERVIEW

3.1 Product Description

Dyacon WSD-1™ is a 3-cup anemometer and wind vane. The wind sensor may be used as a standalone sensor, a component of Dyacon weather station, or integrated into other automated equipment.

WSD-1 is a digital sensor, sending instrument data and receiving control commands via a digital serial port using Modbus-RTU protocol over TIA-485-A (RS-485). Consequently, there is no measurement degradation due to cable length.

WSD-1 is easily mounted on the end of a vertical 3/4" pipe with no additional hardware. Alternatively, it may be attached to 1" pipe using standard structural pipe fittings.

Sensor Protocol Descriptions

Modbus-RTU (RS-485) is an electrically robust protocol used in automation systems, such as programmable logic controllers (PLCs). WSD uses a default data rate of 19200 bps, ensuring adequate data throughput while extended cable length capability.

Additional firmware and customization options are also available to VARs. Contact Dyacon, Inc. for more information.

Design Objectives

The design for WSD-1 was designed to meet the following objectives.

- Minimize installation hardware and complexity – The mounting adapter fits over 3/4" pipe or can be used with 1" structural pipe fittings.
- Flexible cable routing – The cable can be routed inside or outside of the mounting pipe.
- Reduce wear components – Magnetic direction sensor is used in WSD-1. Wind vanes typically use a potentiometer.
- No wind direction dead spots – Unlike potentiometer wind vanes, the magnetic direction sensor in WSD-1 provides high resolution with no dead spots.
- Durable construction – Anodized aluminum components ensures accurate and rugged performance whether used for mobile or stationary applications.
- Field serviceable – Anemometer cups and vane components can be easily replaced in the field.

3.2 What Do You Get?

WSD-1 ships with:

- Instrument assembly

- 5 m (20 ft) cable

- Cable ties



Image 3.1: As Shipped

3.3 What You Need

In order to utilize the WSD-1 you will need the following.

- 3/4" diameter mounting pipe (aluminum, steel, or PVC, 1.04 inch (26.7 mm) actual outer diameter). Or, a 1" structural pipe fitting.

- 5 to 24 VDC power supply and Modbus host device.*

- * Not required if using the WSD-1 with a Dyacon control module.

3.4 Accessories

Dyacon Crossover

Dyacon crossover can be used for mounting the wind sensor to a horizontal pipe or on a flat surface.



Structural Pipe Fittings

Standard structural pipe fittings for 1" schedule 40 pipe are available from hardware suppliers and manufacturers.

Hollaender Nu-Rail	www.nurail.com
J.C. Denier	www.denierco.com
Easyfit	www.easyfit.com
Diamond Aluminum	www.diamond-aluminum.com
KEE Systems	www.keesystems.com
McMaster-Carr	www.mcmaster.com
Grainger	www.grainger.com



Image 3.2: Sample Structural Pipe Fittings.

4.0 ASSEMBLY INSTRUCTIONS

4.1 Required Tools

Phillips #2 screw driver to attach vane and secure mounting screw on 3/4" pipe.

Wire cutters to trim cable ties.

4.2 Assembly

1. Remove the Vane axis screw.
2. Insert the vane and counter weight with the end pointing away from the set screw hole.
3. Insert and tighten the axis screw.



Image 4.1: Vane orientation.

4.3 Mounting

The mounting adapter is designed to fit on a 3/4" schedule 40 pipe, 1.06" (26.9 mm) OD. It may also be mounted using 1" (1.315") structural pipe fittings.

WSD-1 fits on the end of the Dyacon tripod and snaps into the locking button without any tools. (See Image 3.)

The data cable may be passed through the center of the mounting pipe or outside of the mounting pipe. (See Image 2.)



Image 4.2: Internal and external cable route. North direction indicator.

When re-routing the cable through the mounting adapter, be careful to avoid damaging the cable jacket.

1. Slide the mounting adapter over the pipe.
2. Align the clamping screw toward south

For convenience, an initial position is calibrated at the factory. However, the direction can easily be set to any position using a Modbus instruction. When WSD-1 is used with the Dyacon controller, north is set with a simple button press.

3. Tighten the locking screw.

4. Attach cable ties at about 6 in (15 mm) below the wind sensor and every 24 in to 36 in (45 to 100 mm) along the mast or structure. Route cable to avoid sharp edges or unsupported horizontal spans.

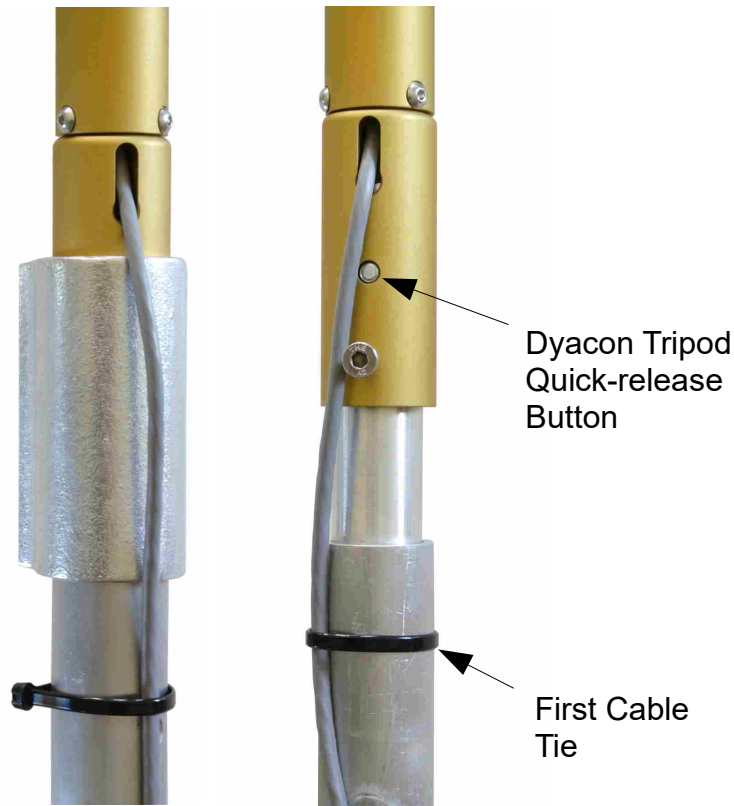


Image 4.3: First cable tie position.

4.4 Wiring

4.4.1 Wiring Configuration

WSD-1 ships with shielded, 4-conductor, outdoor-rated instrumentation cable. The RS-485 (Modbus) connection is a two-wire, half-duplex configuration.

In RS-485 networks, the signal polarity is indicated by a '+' or 'A' and the opposite signal is indicated by a '-' or 'B'. Some systems use a two-wire configuration and other systems use a four-wire configuration. Dyacon sensors use a two-wire configuration.

When connecting a Dyacon sensor to a four-wire device, the transmit and receive signals for each signal polarity are tied together. This means that TX+ and RX+ are tied together on the host controller as are TX- and RX-.

4.4.2 Wiring Table

Red	5 to 24 VDC
Orange	A (+)
Brown	B (-)
Black	Electrical ground
Unshielded	Drain/earth ground

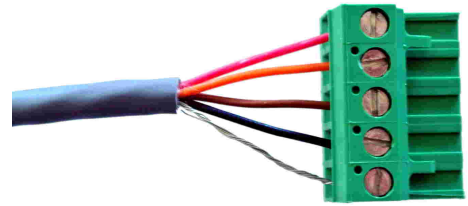


Image 4.4: Wired for Dyacon Control Module

5.0 MODBUS

5.1 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 WSD-1 uses Modbus-RTU over RS-485.

WSD-1 is a slave device and must be connected to a host device, such as a programmable logic controller (PLC), host computer with an RS-485 adapter and Modbus software, or to the DYACON weather station control module.

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.

5.2 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

Only ModBusConstructor and the companion ModbusReader have been tested with the Dyacon product. Contact support@dyacon.com for copies of the constructor files.

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

5.3 Modbus Electrical Connection

5.3.1 Bus Connection

Dyacon devices use a two-wire (half-duplex) electrical connection.

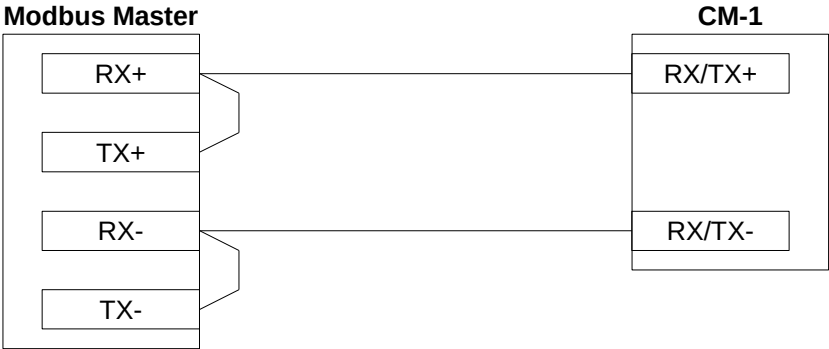
The Modbus port is a slave port that can be connected to a Modbus Host or Master.

Pin 1 – RS-485 RX/TX+ (A)

Pin 2 – RS485 RX/TX- (B)

Connecting to 4-wire Master

When connecting the sensor 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.

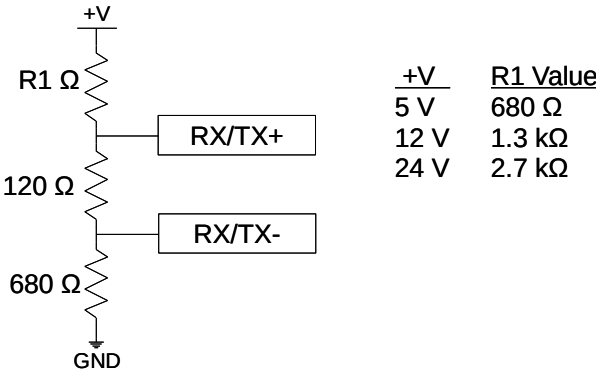


5.3.2 Termination

RS-485 (EIA-485) networks require a termination resistor of 120Ω. A termination resistor is not used on Dyacon sensors. Depending on the bus, a termination resistor may be needed. Additional bias resistors may also 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 if no other device is transmitting. 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. This can be even more important in a noisy environment.

The following would be a common biasing and termination circuit. 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, and the operating voltage.



5.4 Modbus Commands

WSD contains a Modbus slave port, the Modbus host must request data from the sensor.

The following describes the Modbus commands and messages. The basic instructions should be adequate for Modbus host programming. For embedded developers, additional protocol details are contained in the Modbus Appendix.

The default configuration:

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

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.

Sensor Data Requests

Address	Register	Access Type	Response Range	Data Type	Description
200	201	Read	0 to 15†	16-bit Signed Int	System Status†
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.

Basic Configuration Messages

The following commands can be used to change the serial port parameters of the air sensor.

Address	Register	Access Type	Range	Data Type	Description
100	101	Read		16-bit Signed Int	MM = Product ID YY = Product Variation
101	102	Read		16-bit Unsigned Int	Serial Number
102	103	Read		16-bit Signed Int	Firmware Version
103	104	Read/Write	1-247 Default: 1	16-bit Signed Int	Modbus slave address.
104	105	Read/Write	0 = 1200 bps 1 = 2400 bps 2 = 4800 bps 3 = 9600 bps 4 = 19200 bps 5 = 38400 bps Default: 4	16-bit Signed Int	Baud rate.
105	106	Read/Write	0 = None 1 = Odd 2 = Even Default: 0	16-bit Signed Int	Parity

* Refer to Power Saving section for more details.

Calibration Settings

Calibration values are entered as slope and offset (mx+b). The following calibration settings are user accessible.

Address	Register	Access Type	Default	Data Type	Description
110	111+112	Read/Write	1	32-bit Single-precision Float	Speed Slope
112	113+114	Read/Write	0	32-bit Single-precision Float	Speed Offset
114	115+116	Read/Write	0	32-bit Single-precision Float*	Direction Offset**

* 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.

** Direction offset can be used to set the north position. For example, if sensor measures 37.6 degrees pointing north, enter -37.6 degrees in the offset. Offset values will cause the wind direction value to roll over when the maximum value exceeds 359.9°. Due to the absolute positional encoding of the wind direction, no slope value is used.

Error Codes

The following error and acknowledgment codes are supported by the WSD-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	Function not supported or not recognized by the sensor.
02	Illegal Addresses	Incorrect address, address does not exist, 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.

System 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	Decimal	Name
0	0	Direction Invalid
1	1	Direction Error
2	4	Magnetic Field High
3	8	Magnetic Field Low

Hex Values

0x0000 – No Errors

0x0001 to 0x000F – Wind direction sensor error

5.5 Data Format

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

When WSD-1 is used with Dyacon control modules, the instrument data is automatically presented in the form of the selected by the user.

When WSD-1 is used with a PLC or other host device, the instrumentation data will need to be numerically converted to conventional measurement units. The following conversion values can be performed by the host device.

5.5.1 Wind Speed Format

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

The Modbus data range is 0 to 500.

$$\text{Wind Speed (m/s)} = (\text{ModbusData}) / 10$$

5.5.2 Wind Direction Format

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

The Modbus data range is 0 to 3599.

$$\text{Wind Direction (°)} = \text{ModbusData} / 10$$

5.6 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.

5.6.1 Speed Unit Conversions

$$\text{Speed (mile/hr)} = \text{Speed (m/s)} * 2.23694$$

$$\text{Speed (knots)} = \text{Speed (m/s)} * 1.943844$$

$$\text{Speed (km/h)} = \text{Speed (m/s)} * 3.6$$

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.

6.0 THEORY OF OPERATION

6.1 Sensors

6.1.1 Wind Direction Sensing

The wind direction uses a non-contact magnetic sensor. Unlike potentiometer systems, the sensor has no dead spots or wear components.

Wind direction is sampled every 50 ms. A 20 sample running average is calculated in about 1 s and updated every 50 ms.

6.1.2 Wind Speed Sensing

The anemometer uses two magnets, 180° opposite at the perimeter of the anemometer hub. A reed switch is used to detect rotation.

A 4-sample running average of the switch time is used for wind speed. Measurement response is a function of wind speed. At 2.5 m/s, the wind speed response is about 1 s.

The wind speed value is updated with each switch closure or half turn of the anemometer.

A deceleration algorithm is used to ensure the running average is accurate as the wind speed approaches zero.

6.2 Architecture

A range of low power strategies are employed in WSD-1 to ensure optimal low power while providing reliable and accurate measurements across the full environmental range.

A low power microcontroller is central to WSD-1 performance. The microcontroller manages the rotation sensor and reed switch timing, scaling and applying calibration values as required. The microcontroller also manages the Modbus protocol and other internal functions, such as EEPROM interface and bootloader functions.

The microcontroller utilizes low-power strategies, leveraging multiple low power modes and optimized code execution.

7.0 POWER SAVING

7.1 Power Down

Embedded devices and programmable data loggers may have discrete power controls to peripheral devices. If so, power savings may be achieved by disconnecting the supply power to WSD-1. This strategy may be beneficial if the polling period is greater than 10 s.

The time required from power-up to first character is less than 100 ms. Modbus frames sent prior to this may not be received by the sensor.

The wind speed report is a running average. In slow wind conditions, this can require up to 10 s before valid data is present, refer to the Theory of Operation section for more information.

Wind speed measurements requested within 10 second following power up may be incorrect when slow wind speed conditions are present.

8.0 SOFTWARE

8.1 Introduction

WSD-1 is a digital sensor with on-board firmware. The firmware provides critical functions including sensor element interface, sensor value processing, calibration scaling, error detection, power management, and Modbus operation. The firmware also includes a boot loader for in-field firmware changes.

8.2 Boot Loader

WSD-1 firmware may be updated in the field through the RS-485 serial data lines.

8.2.1 Required Equipment

RS-485 to USB (or RS-232) converter, such as FTDI USB-RS485-WE-1800-BT.

12 VDC power supply.

Dyacon Boot Loader PC utility.

8.2.2 Procedure

1. Disconnect WSD-1 from the host equipment.
2. Connect the WSD-1 to the PC with the RS-485 converter.
3. Connect WSD-1 to a 12 VDC power source.
4. Run the Dyacon Boot Loader Utility. Configure the settings and press “Load.”
5. Watch for program completion.
6. Disconnect and return the WSD-1 to service.

9.0 REPAIR AND SERVICE

9.1 Parts List

Part Number	Ref	Description
17-6023		HRD, Retaining Ring, Internal, 0.625, SS
17-6025		HRD, Grommet, Heyco 4014
17-6098		HRD, Bearing, SS, 0.375 ID x 0.625 OD x 0.156 W
17-6029		SCREW, M4 x 6 mm, Btn Hd, Skt, 2.5 mm Hex, 18-8 SS
17-6030		O-RING, 1 in OD, 0.875 in ID, Silicon
17-6032		SCREW, Set, M4 x 6mm, Skt, Knurl Cup, 18-8 SS
17-6071		SCREW, M4 x 14 mm, Ph 2, Pan, 18-8 SS
17-6075		SCREW, M6 x 8 mm, Ph #3, Pan, 18-8, SS
49-6027		CABLE, Outdoor, 4-cond, 24 AWG, Foil Shield, PVC-PVC, Gray
51-6012	03	Vane Axle Assembly
51-6013	02	Cup Assembly Set
51-6014	08	Anemometer Hub Assembly
51-6017	04	Bell Housing Assembly
52-6013		PCBA, Processor, RS485, Wind Sensor 1
75-6013	08	Mounting Adapter Assembly
75-6021	05	Anemometer Axle Assembly
75-6009	01	Vane Assembly
75-6021	06	Vane Hub

9.2 Exploded View

The image below shows the mechanical sub-assemblies of the wind sensor. Bearings, circuit board assemblies, and loose hardware are not show.

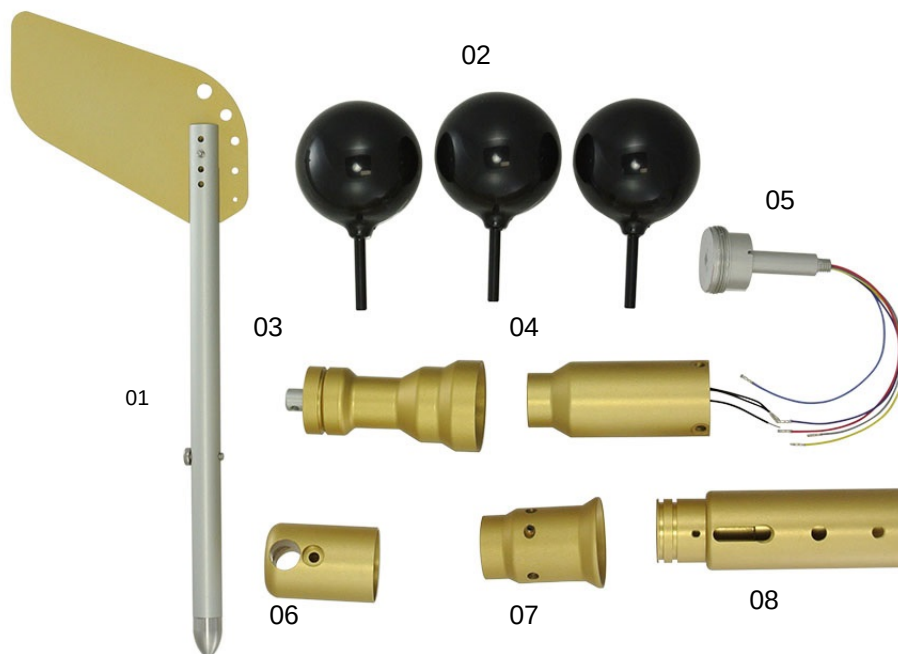


Image 9.1: Part Breakout

9.3 Repair and Calibration

Return Authorization

All equipment sent to Dyacon for calibration, warranty, or service should have a return material authorization (RMA) number indicated on the outside of the package. Include a detailed description of the problem and any to be performed on the returned unit.

An RMA number may be requested by phone or email.

Phone: 1-435-753-1002

Email: support@Dyacon.com

Normal business hours are 8 am to 5 pm. (Mountain Time Zone, GMT -0700)

Address

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

IO.0 SPECIFICATIONS

WIND SPEED

Operational Range	0 m/s to 50 m/s (0 mph to 112 mph)*
Test Range	0 m/s to 60 m/s (134 mph)
Starting Threshold	<1 m/s (2.2 mph)
Resolution	0.1 m/s (0.2 mph)
Operational Range Accuracy	Greater of $\pm 3\%$ or ± 0.3 m/s
Distance Constant	2.1 m (6.7 ft)

WIND DIRECTION

Range	0° to 360°
Threshold	1 m/s (2.2 mph)
Accuracy	+/- 1°
Resolution	0.5°

* Modbus output units are m/s. Miles per hour units are for reference only.)

ELECTRICAL

Power Input	5 to 24 VDC
Current	<2 mA _{avg} at 12 VDC [†]

MECHANICAL

Material	Anodized 6061 Aluminum 306 Stainless steel PC, UV-Stabilized – Cups only
Bearings	Stainless steel
Overall (WxDxH)	15.2 x 32 x 25.5 cm (6 x 12.5 x 10 in)
Cable	4 conductor, 24 AWG, stranded Foil Shield w/ drain wire Outdoor rated cable
Weight w/ Cable	675 g (23.8 oz)
Weight w/o Cable	500 g (17.6 oz)
OEM Options	Custom anodizing color (red, black, blue, or clear)

DATA

Protocols	Modbus slave SDI-12 option (value added resellers)
Min Request Period	20 ms (Modbus at 19200 bps)
OEM Options	Custom packet structure

Temperature

Operating Temperature	-30°C to 60°C
Storage Temperature	-40°C to 80°C

ACCESSORIES

Tripod	Dyacon Tripod-1
Structural Fittings	1" coupler 1" crossover
Mast	Tripod mast segment for attachment to mounting structure.

[†] Continuous full run mode, reading data once per second.

II.0 MODBUS APPENDIX

Dyacon WSD wind sensor uses the Modbus RTU format. The following are the protocol details required for embedded devices to communicate with the Modbus sensor.

Notes:

- Modbus data uses “big-endian” data format, 0x1234 is sent as 0x12 then 0x34.
- The CRC uses “little-endian” data format, 0x1234 is sent as 0x34 then 0x12.
- The idle time between frames must be greater than or equal to 3.5 characters. The frame inter character delay must be less than 1.5 characters.
- The PDU Registers are addressed starting at zero. Therefore a register numbered as 201 is addressed as 200.

The following is an example of a multi-register read of the air temperature, humidity, and pressure starting at register number 202.

Detailed protocol information is available at www.modbus.org.

Request Frame

The following is an example of a read of the wind speed and wind direction with one request.

Field Name	Length (bytes)	Function	Example Data
Slave Address	1	Device address.	0x01
Function	1	Read holding register.	0x03
Register Start Address	2	Sensor address (201).	0x00C9
Quantity of Registers	2	Number of 16-bit registers to read.	0x0002
CRC	2	Error check.	0x3514

TX String (0x): 01 03 00 C9 00 02 14 35

Response Frame

Field Name	Length (bytes)	Function	Example Data
Slave Address	1	Device address.	0x01
Function	1	Read holding register.	0x03
Byte Count	1	Number (N) of data bytes.	0x04
Register Data	N	Register data, upper byte first. Register 202 (Speed): 72 (7.2 m/s) Register 203 (Direction): 3472 (347.2°)	0x0048 0x0D90
CRC	2	Error check.	0xD965

RX String: 01 03 04 00 48 0D 90 65 D9

Error Frame

Field Name	Length (bytes)	Function	Example Data
Slave Address	1	Device address.	0x01
Error Code	1	Error code value.	0x83
Exception Code	1	Error code values (01, 02, 03, 04)	0x01
CRC	2	Error check	0xF080

TX String: 01 83 01 80 F0

I2.0 REVISION HISTORY

Rev	Description	Author	Date
A Prelim	Initial Release	E. Bodrero	19NOV2013
B	Brand change, minor formatting corrections, update specifications. Add 2 min and 10 min averages (firmware Rev C/v4) Update images.	E. Bodrero	30JUN2014
C	Add termination resistor description. Add wind gust register values	E. Bodrero	05SEP2014
D	Update Dyacon address	E. Bodrero	04AUG2015
E	5.3 – New sections on termination and biasing.	E. Bodrero	09SEP2017
F	5.4 – System Status Codes, Added better descriptions.	E. Bodrero	21 Feb 2018
G	Hybrid ceramic ball bearings replaced with Stainless Steel	J. Little	12 Mar 2018
H	Changed cover image. Changed DYACON to Dyacon or dyacon for better readability. 1.1.4 – Changed warranty to 2 years. 3.1 – Removed SDI-12 option. 3.2 – Updated Image 3.1. 9.1 – Updated part table and image. 10.1 – Removed Filament wound... from material description in table.	E. Bodrero	28 Jun 2018