ICT INTERNATIONAL

Automatic Weather Stations Manual

(AWS200, AWS300, AWS500)

Contents

1. Introduction

This manual detailed describes the installation, use and maintenance of the ICT AWS series weather stations. It also describes the software protocols and common sensor settings for weather stations, as well as the hardware connection method and protocol interface.

The AWS Weather Station Series

The AWS weather station uses the most advanced meteorological sensor technology in the industry, integrating the main meteorological parameters. These include air temperature, humidity, atmospheric pressure, wind direction, wind speed. The IMS (Industrial Meteorological Station) series adds to this range the measurements of particulate matter pm2.5, pm10 and noise.

Application areas: traffic, agriculture, meteorology, environmental protection, electricity and water conservancy and many other fields.

2. AWS Safety & Maintenance

2.1 Safety, Designated use and Incorrect Use

Installation and commissioning must only be done by designated qualified professionals:

- Do not measure or touch live parts.
- Attention must be paid to the technical parameters of the device as well as the storage and operating conditions.
- The device must be operated within the specified technical parameters. The operating conditions and purpose of the equipment cannot violate the original intention of the design.
- Modifications or modifications to the device will not ensure their safety and uptime.
- If the device is not installed correctly, it may not work and/or it may become permanently damaged.
- If any equipment falls, there is a risk the fall may cause danger or injury.

2.2 Guarantee

Warranty period is 12 months, effective from the date of delivery. If the user uses the device for an unspecified purpose, the warranty will no longer be valid

2.3 Maintenance

In general, the equipment does not require maintenance. However, it is recommended to perform a functional test once a year. When performing a functional test, please note the following:

- Visually check whether the equipment has sludge
- Issue measurement request signal, check sensor

It is recommended that the humidity sensor be calibrated once a year. Since the customer cannot disassemble and reinstall the humidity sensor, the entire micro weather station must be sent to the manufacturer for testing.

2.4 Repair / Correct Maintenance

Do not open the device and do not repair the device by self under any circumstances. Be sure to contact the manufacturer for inspection and repair of the faulty equipment (if necessary). Regarding product warranty and repair, etc. Please contact:

ICT International Pty Ltd
Phone Number: +61 2 6772 6770
Email: sales@ictinternational.com.au
Website: www.ictinternational.com

3. Instrument Visual Checks & Maintenance

3.1 Selecting the Installation Location

In order to extend the service life of the equipment and to ensure the normal operation of the equipment, please pay attention to the following matters when selecting the installation position of the equipment.

- Sensors should be working in an open environment, where the location is easy to maintain.
- Please note that buildings, bridges, dams and trees may affect the wind speed and other measurement parameters. For example, wind gusts caused by passing vehicle could affect wind measurements.
- The frame or pole to which the sensor is attached should be firm and stable.
- Installation of the sensor should be of a height that is at least 1.5 meters from the ground
- The power supply should be stable and reliable to meet long-term operation requirements.

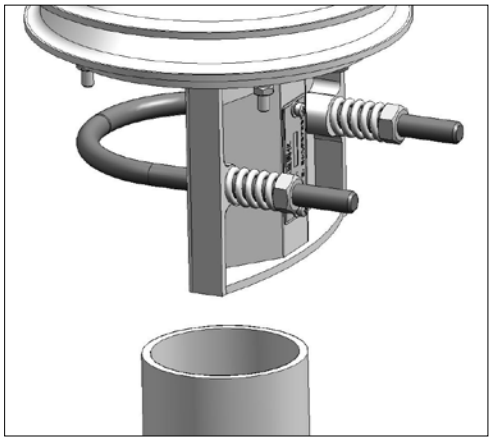
3.2 North Alignment

In order to correctly display the wind direction, the sensors must be aligned to the North; whether the installation is in the Northern or Southern hemisphere. There are multiple arrows on the sensor to indicate the direction, and N arrows indicate the north direction. Note: The magnetic north pole and the geographical north pole indicated by the compass are not exactly the same. Therefore, the deviation (error) of the position must be considered when arranging the sensors.

3.3 Sensor Mounting and Pole Fixture

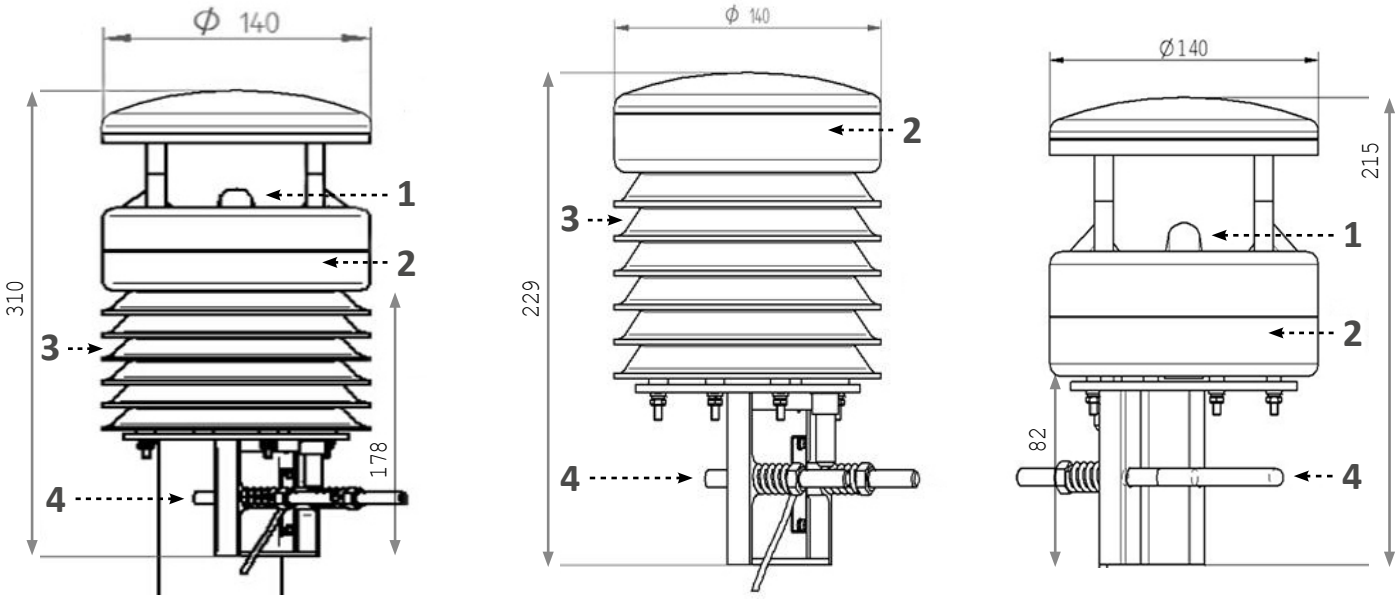
The sensor bracket is designed to be mounted on a mast with an outside diameter of between 48-75mm. The following tools are required for installation:

- Open end wrench or plum wrench - ½" imperial spanner
- Compass, used to adjust the N to point to the north, for wind direction measurement accuracy.



5. AWS Components, Parameters, Power

5.1 Automatic Weather Station Components



AWS500 **AWS300** **AWS200**

Model	Description
AWS500	Wind Direction & Speed (1), Atmospheric Pressure (2), Air Temperature & Relative humidity (3), Pole Fixture (4)
AWS300	Atmospheric Pressure (2), Air Temperature & Relative humidity (3), Pole Fixture (4)
AWS200	Wind Direction & Wind speed (1), Pole Fixture (4)

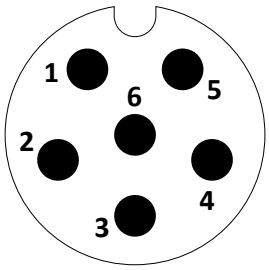
5.2 AWS Technical Parameters

Dimensions	**Diameter:** 178mm; **Height:** AWS200=215mm, AWS300=229mm, AWS500=310mm; **Weight:** about 1.5 kg;
Wind Direction	**Principle:** ultrasonic; **Measuring range:** 0 to 360°; **Accuracy:** ± 3°; **Sampling frequency:** up to 10Hz;
Wind Speed	**Sensor Size:** 100; **Principle:** Ultrasonic; **Measuring range:** 0 to 60 m/s; **Accuracy:** ±0.3m/s or ±3%; **Sampling frequency:** up to 10Hz;
Atmospheric Pressure	**Measuring range:** 10 to 1300 HPa; **Accuracy:** ±1 hPa;
Air Temperature	**Measuring range:** -40 to 60°C (extension: -50 to 80°C); **Accuracy:** ±0.3°C; **Long-term stability:** ±1°C/Year;
Relative Humidity	**Measuring range:** 0 to 100%RH*; **Accuracy:** ±2%RH*; **Long-term stability:** ±1%RH*/Year; *RH=Relative Humidity;
Operating Range	**Temperature:** -30 to 60°C; **Humidity:** 0 – 100%

Interface SDI-12	**Baud Rate:** 1200;
Power Supply Voltage	9 to 30VDC;
Average Current	(AWS500) is less than 10mA, maximum 20mA (12VDC)
Operating Humidity Range	0~100%RH
Operating Temperature	-40 to 60 ° C (standard), extended to: -50 to 80 ° C
Protection	IP66

5.4 Electrical Interface

There is a 6-pin electrical connector underneath the unit that allows for the breakout of power supply. SDI-12 and RS485 and various interfaces via the supplied cable. (The cable marking is in accordance with DIN 47100). The 6-pin diagram shows the cable end of the pin assignment:



1 (Red) -	Supply voltage positive
2 (Black) -	Supply voltage negative / Data Ground
3 (Yellow) -	RS485_A
4 (Blue) -	RS485_B
5 (Green) -	SDI-12
6 Unassigned	

6. SDI-12 Commands (ASCII Protocol)

6.1 Configuration Commands & Returns

The AWS Automatic Weather Station series is compatible with SDI-12 version 1.3 as described in the documents on http://sdi-12.org/archives.php, except for continuous measurements (aR0 - aR9 or aRC0 - aRC9). The following tables list the relevant Measurement (M), Concurrent (C) and Data (D) commands, when necessary.

The first character of all commands and responses is always a device address. The last character of a command is the "!" character, which terminates each command. In some interfaces, after a command is processed and/or the information is returned by the device, the device signals the response is complete by returning with <cr><lf>. These last two bytes of a response are a carriage return <cr> and line feed <lf>.

6.1.01 Debug / Reset Command – $reset

Example Command Input: | `$reset`
Example Response/Return: | `OK`

Parameter Term	Fixed Character Length	Example	Return Order	Description
`$reset`	6	`$reset`	(command)	This command is used for a software restart.
`OK`	2	`OK`	1	Returns confirmation (Example: OK)

6.1.02 Ask for address Command – ?

Example Command Input: | `?`
Example Response/Return: | `0`

Parameter Term	Fixed Character Length	Example	Return Order	Description
`?`	1	`?`	(command)	This command is used to query the address of the device on the bus (a = the device address).
`a`	1	`0`	1	Returns device address (a = the device address; example: the device address is '0').

6.1.03 Device Online Confirmation Command – a

Example Command Input: 1
Example Response/Return: 1

Parameter Term	Fixed Character Length	Example	Description
a	1	1	This command is used to confirm whether the device with the device address is currently on the bus (where a = the address of the device to be confirmed).
a	1	1	If the device is online, returns device address (where a = the device address; example: the device at address '1' is confirmed as being on the bus).

6.1.04 Retrieve the Device Settings Command – aXU

Example Command Input: 0XU
Example Response/Return: 0XU, A=0, M=P, T=1, C=2, I=0060, B=019200, D=8, P=N, S=1, L=00000, N=G128-406, V=FWS_20171227A

Parameter Term	Fixed Character Length	Example	Description
aXU	3	0XU	This command is used to retrieve the device settings, where a = address of the device.
A=?	3	A=0	A is the device address setting.
M=?	3	M=P M=A	M is the communication mode setting. A is automatic reporting P is manual query.
T=?	3	T=1	?
C=?	3	C=2	?
I=????	6	I=0060	I is the automatic reporting interval setting (Example shows the default as 60 seconds).
B=??????	8	B=019200	B is the communication baud rate setting (Example shows the default as 19200).
D=?	3	D=8	?
P=?	3	P=N	?
S=?	3	S=1	?
L=?????	7	L=00000	?
N=????-???	10	N=G128-406	?
V=???_?????????	15	V=FWS_20171227A	?

...The hexadecimal is 0Dh, 0Ah, the following is the same.

6.1.05 Modify the Device Address Command – aXU A=a

Example Command Input: `0XU A=1`
Example Response/Return:

Parameter Term	Fixed Character Length	Description
`aXU A=a`	7	This command is used to change the device address, where a = address of the device (Example device at address '0' was requested to be modified to address '1')
`aXU`	3	This command is used to retrieve the device settings, where a = address of the device (Example device address = '0'). It can also be used to confirm a command such as an address has been modified.

...The hexadecimal is 0Dh, 0Ah, the following is the same.

6.1.06 Modify the Baud Rate Command – aXU B=bbbb

Example Command Input: `1XU B=01200`
Example Response/Return:

Parameter Term	Fixed Character Length	Description
`aXU B=bbbbb`	11	This command is used to change the baud rate, where a = address of the device (Example device at address '1' was requested to modify the baud rate to '1200'). After the modification is successful, you need to restart the device, and then use the 9600 baud rate for query and other functions.
`aXU`	3	This command is used to retrieve the device settings, where a = address of the device (Example device address = '0'). It can also be used to confirm a command such as an baud rate has been modified.

After the modification is successful, you need to restart the device, and then use the 9600 baud rate for query and other functions.

6.1.07 Key for ...Element?... Measurement Values

Please note that characters such as 'Dn' (i.e. 'D' and 'n') in the message occupy two bytes. Minimum, average and maximum wind direction take an integer, while minimum, average and maximum wind speed take one decimal.

Weather Variable Parameter Format	Fixed Character Length	Description
Dn=000D	7	Wind direction (minimum value) in degrees
DM=000D	7	Wind direction (average value) in degrees
Dx=000D	7	Wind direction (maximum value) in degrees
Sn=000.0M	9	Wind speed (minimum value) in m/s
Sm=000.0M	9	Wind speed (average value) in m/s
Sx=000.0M	9	Wind speed (maximum value) in m/s
Ta=013.2C	**9**	Atmospheric temperature in ^{O}Celsius
Ua=035.8P	**9**	Atmospheric relative humidity in % Rh
Pa=000993.5H	**12**	Atmospheric pressure in hPa

Note: The sensor response message is fixed length. When the temperature value is negative, the first "0" of the temperature value represents "-" as follows:

6.1.08 Each Element Measurement Data Report Command – aR

Example Command Input: `1R`

Example Response/Return:
```
1R,Dn=000D,DM=000D,Dx=000D,Sn=000.0M,Sm=000.0M,Sx=000.0M,
Ta=023.6C,Ua=014.2P,Pa=001026.6H
```

Parameter Format	Fixed Character Length	Description
`aR`	2	This command is used to get all the measured values (a = device address, R = command for collective reporting of all device-components' measurement data).
`aR, Weather Variables`	Variable	Returns all of the measured values available from the device address in a uniform format, where a = device address. Example = Device at address '0' returns the following available values: Dn (min. wind direction) = 000 degrees; Dm (average wind direction) = 000 degrees; Dx (max. wind direction) = 000 degrees; Sn (min. wind speed) = 000.0 m/s; Sm (average wind speed) = 000.0 m/s; Sx (max. wind speed) = 000.0 m/s; Ta (atmospheric temperature) = 13.2 °Celsius; Ua (atmospheric relative humidity) = 35.8% Rh; Pa (atmospheric pressure) = 993.5 hPa.

6.1.09 Each Element Measurement Data Report Command – aR0

Example Command Input: `1R0`

Example Response/Return:
```
1R1,Dn=000D,DM=000D,Dx=000D,Sn=000.0M,Sm=000.0M,Sx=000.0M
1R2,Ta=023.6C,Ua=014.2P,Pa=001026.6H
```

Parameter Format	Fixed Character Length	Description
`aR0`	3	This command is used to get the measured values of multiple elements (a = device address, R = command for collective reporting of all device-components' measurement data).
`Variable`	Variable	Returns all of the measured values available in a message format of aR1 (wind elements) and then on a new line aR2 (atmospheric elements), where a = device address. Example = Device at address '0' returns the following available values: Dn (min. wind direction) = 000 degrees; Dm (average wind direction) = 000 degrees; Dx (max. wind direction) = 000 degrees; Sn (min. wind speed) = 000.0 m/s; Sm (average wind speed) = 000.0 m/s; Sx (max. wind speed) = 000.0 m/s; Ta (atmospheric temperature) = 13.2 °Celsius; Ua (atmospheric relative humidity) = 35.8% Rh; Pa (atmospheric pressure) = 993.5 hPa.

6.1.10 Wind Elements Data Aquisition Command – aR1

Example Command Input: `0R1`
Example Response/Return: `0R1,Dn=000D,DM=000D,Dx=000D,Sn=000.0M,Sm=000.0M,Sx=000.0M`

Parameter Format	Fixed Character Length	Description
`aR1`	3	This command is used to obtain measurement data of wind elements (a = device address, R1 = acquisition command for wind element data).
`aR1, Weather Variables`	3 then Variable	Returns the device address (a = device address; example = device at address 0), then returns the available wind-related measurements from this device address: Example = Device at address '0' returns the following available wind measurements: Dn (min. wind direction) = 000 degrees; Dm (average wind direction) = 000 degrees; Dx (max. wind direction) = 000 degrees; Sn (min. wind speed) = 000.0 m/s; Sm (average wind speed) = 000.0 m/s; Sx (max. wind speed) = 000.0 m/s;

6.1.11 Atmospheric Elements Data Aquisition Command – aR2

Example Command Input: `0R2`
Example Response/Return: `0R2,Ta=013.2C,Ua=035.8P,Pa=000993.5H`

Parameter Format	Fixed Character Length	Description
`aR2`	3	The command is used to obtain measurement data of the atmospheric pressure, atmospheric temperature, and atmospheric humidity (a = device address, R2 = acquisition command for Atmospheric Pressure, temperature, humidity).
`aR2, Weather Variables`	3 then Variable	Returns the device address (where a = device address; example = device at address 0), then returns the available atmospheric measurements from this device address: Example = Device at address '0' returns the following available atmospheric measurements: Ta (atmospheric temperature) = 13.2 °Celsius; Ua (atmospheric relative humidity) = 35.8% Rh; Pa (atmospheric pressure) = 993.5 hPa.

6.1.12 Retrieve Wind Settings Command – aWU

Example Command Input: `0WU`

Example Response/Return: `0WU,R=0011111100111111,I=0060,A=0060,G=1,U=M,D=000,N=W,F=4`

Parameter Term	Fixed Character Length	Example	Description
aWU	3	0WU	This command is used to retrieve the device wind settings, where a = address of the device (Example shows the (default) device address as '0').
R=???????????? ????	1	R=001111110011 1111	
I=????	6	I=0060	I is the automatic reporting interval setting (Example shows the default as 60 seconds).
A=????	6	A=0060	A is the setting for the average period of wind, where the unit is in seconds.
G=?	3	G=1	?
U=?	3	U=M	M is the communication mode setting. A is automatic reporting P is manual query.
D=???	5	D=000	?
N=?	3	N=W	?
F=?	3	F=4	?

Note:

The acquisition interval of the ultrasonic wind probe is 1 second, that is, one pulse is sent and received every second. It is used to detect the maximum and minimum wind speeds during this 1 second period, so the interval of data update must be greater than 1 second, otherwise the maximum and minimum winds will be the same. The default time of Sm average wind speed and Dm average wind direction is 60 seconds, and the average wind speed and average wind direction are the moving average values (ie, the first acquisition instantaneous value divided by 60 is the first second average value. The instantaneous value of the first second is added to the 60 second instantaneous value is divided by 60, which is the average value calculated after 60 seconds. The average value of the 61st second is (the instantaneous value of the 2nd second is added to the 61 second instantaneous value and divided by 60). The current average is always calculated by taking the instantaneous value of the sixty seconds before the current time point.

6.1.13 Set / Reset Average Wind Command – aWU A=???

Example Command Input: `0XU A=001`
Example Response:

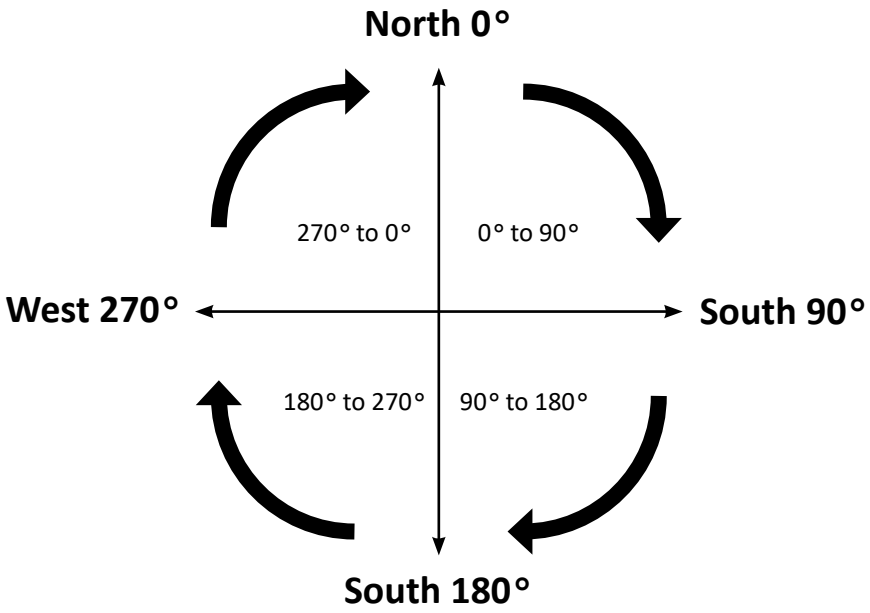
In the standard case, the average wind value is an average period of 1 minute, and the special condition can modify the average period of the wind. Note: After the command is successfully sent, the device won't return with a confirmation. You can send 0WU command to query whether the modification was successful.

Parameter Term	Fixed Character Length	Description
`aWU A=????`	7	This command is used to change the average period of wind, where a = address of the device (Example: At device at address '0', modify the average wind period to '0001' seconds). After the command is successfully sent, the device doesn't reply with any information. To query whether the modification is successful, use the aWU command.
`aWU`	3	This command is used to retrieve the device wind settings, where a = address of the device (Example device address = '0'). It can also be used to confirm whether a command has been successfully modified.

Wind direction value introduction:

0° = positive north wind
90° = positive east wind
180° = positive south wind
270° = positive west wind

0° to 90° = northeast wind
90° to 180° = southeast wind
180° to 270° = southwest wind
270° to 0° = northwest wind



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