Z-Weather

wind speed - humidity - temperature - barometric pressure - dew point - lightness - wind yield - solar yield

Contents

Quick Start

This QuickStart is intended for experienced users, who don't want to read the complete manual. It focusses on the core configuration parameters of Z-Weather and assumes detailed knowledge of Z-Wave systems. Skip to the "Introduction" chapter on page 4 if you are new to Z-Wave and would like to have a detailed introduction.

Before you can configure and use Z-Weather, the unit needs to be fully charged. In order to charge Z-Weather, place it in a location with direct sunlight exposure for 3-4 hours. Without direct sun light, charging may take 12 hours. To check if Z-Weather has been charged sufficiently, press the button located under the cup anemometer. If the LED blinks after pressing the button, Z-Weather is charged and operational.

Button Functions

Function	Trigger Operation
Battery Check	Push button once
NIF	Push button 3x within 1.5 seconds
Wakeup	Push button 1x within 1.5 seconds
Factory Reset	Hold button for more than 2 seconds, then release

Z-Wave Parameters

Please note: The Wakeup-Interval must be left at default value 17180

Z-Weather will wake up depending on the available energy between every 5 minutes at noon in summer and every 5 hours in the second half of the night at winter solstice.

Parameter	Description
Basic Get	Reads wind speed
Basic Set	sets wind speed action threshold 0 = no wake up on wind speed 1-30 = wake up if more than 1m/s to 30m/s

COMMAND_CLASS_CONFIGURATION

Parameter	Description
Parameter 1	Wind speed action threshold (same as Basic Set) Value between 1 and 30 m/s Default 6m/s 0 means off
Parameter 2	Twilight action threshold Value between 0 and 100% Default value: 37% (street lightning)

At threshold, a BASIC_SET is send to the associated nodes of group 2-4. The basic set value can be changed using the ASSOCIATION_COMMAND_CONFIGURATION.

Group	Description	Detail
Group 1	Lifeline	one node)
Group 2	too much wind	up to 5 nodes, default BASIC_SET 00
Group 3	getting bright	up to 5 nodes, default BASIC_SET 00
Group 4	getting dark	up to 5 nodes, default BASIC_SET FF

COMMAND_CLASS_ POWERLEVEL

| Parameter	Constraint
Timeout	<< 30 seconds
Test frame count	<< 1000

Introduction

Z-Weather is a cup anemometer for Z-Wave installations. It continually measures the wind speed and can, for example, trigger closing of the awning and blinds if it is too windy. It also measures the amount of rotation, enabling calculation of the wind yield per day or per year. In addition, Z-Weather includes sensors for humidity, temperature, pressure and dew point, essentially providing the core sensors of a weather station.

Z-Weather is powered by a solar cell and stores energy on an internal capacitor, enabling continuous operation, even with no wind for a couple of days. It does <u>not</u> use any batteries and is completely maintenance free. Using the built-in solar cell it also measures the ambient light and the solar yield. This information can be used to turn on the outdoor light at dusk time and turn the light off in the morning.

Z-Weather's wind yield and solar yield metering can be used as a calculation base for planning a wind generator or a solar panel on the roof of a house.

Z-Weather can be included and operated in any Z-Wave network with Z-Wave certified devices from other manufacturers and/or other applications. All non-battery operated nodes within the Z-Wave network will act as repeaters regardless of vendor to increase reliability of the network and will enable Z-Weather to be contacted reliably even in larger installations.
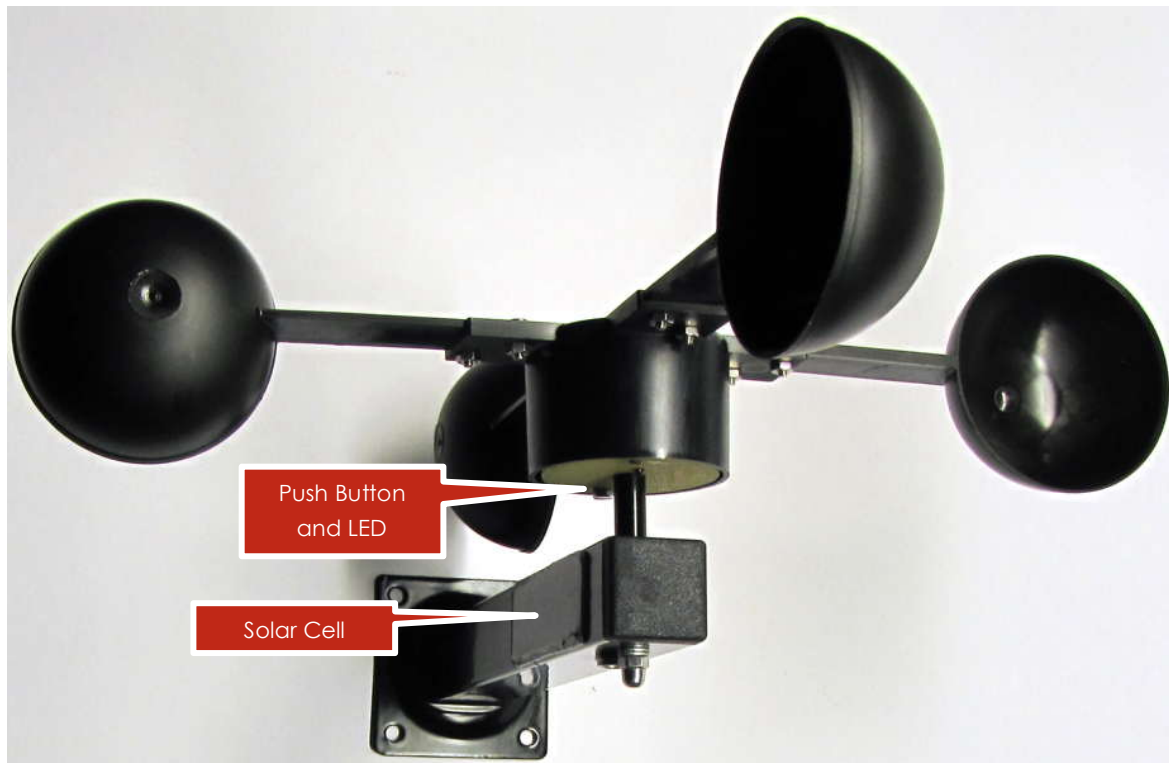
Picture 1: Z-Weather and its operating elements

During normal operation, Z-Weather is limiting continuous measurement to wind speed and solar radiation, other sensors are operating only on demand. This conservative energy management ensures continuous operation with the limited energy harvested from the solar cell powering Z-Weather. The Z-Wave radio frequency transmitter is turned off most of the time and is turned on if there is too much wind, at twilight time and on a continuous base, depending on the energy budget. The wake up interval is between five minutes at noon in summer and five hours in the second half of the night in winter. Z-Weather also wakes up on pushing the button.

Startup

Before you can configure and use Z-Weather, the unit needs to be fully charged. In order to charge Z-Weather, place it in a location with direct sunlight exposure for 4-6 hours. Without direct sun light, the charging may take up to 12 hours. To check if Z-Weather has been charged sufficiently, press the button located under the cup anemometer. If the LED blinks after pressing the button, Z-Weather is charged and operational. Please refer to chapter „ Understanding the Internal Energy Management" on page 6 for more information.

Operating Elements

All electronic components of Z-Weather are positioned inside the ball-bearing cup anemometer. At the bottom of the anemometer a button and a red LED is located. The LED lights up if the button was pressed and Z-Weather has enough energy to wake up and communicate wirelessly via Z-Wave. Using the button, the following commands can be performed:

Button Commands

Push 1x	Wake-up	Push the button once within 1.5 seconds. The LED blinks once indicating that Z-Weather is. Z-Weather sends a Z-Wave Wakeup-Notification if has been added to the network. If Z-Weather has not yet been added to the network, no action is performed.
Push 3x	Add to or remove from network	Push the button 3 times within 1.5 seconds. The LED is blinking 3 times and the Network Information Frame (NIF) is sent to the Z-Wave network, adding Z-Weather to the network or removing it if it was previously added to the network.
Push and Hold	Reset to factory settings	Hold the button longer than 1.5 seconds and then release. The LED blinks longer than when pressing the button once. Z-Weather performs a factory reset and all configuration parameters are reset to their default values.

If the LED is not blinking after releasing the button, Z-Weather has not enough energy and must be charged for several hours in bright sunlight.

Place of Installation

Most of Z-Weather's sensors are placed inside the top of the ball-bearing cup anemometer and they are measuring the environmental parameters inside the black round housing. If the sun is shining and Z-Weather is placed in direct sunlight, the housing will warm up and the temperature is higher than the temperature outside the housing. Thus a place in the shadow is the best choice for placing Z-Weather. Even though Z-Weather is powered by a solar cell, it is not required to place Z-Weather exposed to direct sun light and there is no need to face it south. The solar cell will produce sufficient energy to power Z-Weather, even if the solar cell is facing north and the device is in the shadow all day.

Understanding the Internal Energy Management

Z-Weather is maintenance free and works environmentally friendly using solar power, it does not contain any batteries. The solar cell charges an internal capacitor, which buffers all harvested energy and powers the electronic components during the night.

When first operating Z-Weather after installation, it is required to fully charge the device by placing it in direct sunlight for 4-6 hours. Even though the capacitor is pre-charged at the factory, the capacitor has most likely lost most of its energy and does not provide sufficient power for operating Z-Weather immediately after unpacking. If the capacitor is completely empty it must be charged from 0% to 100% which takes longer than in subsequent charging cycles. Once Z-Weather is installed and operating, it is charged on a day by day base and the capacitor will never be discharged completely.

If the capacitor is completely discharged, which only can happen at time of delivery of if Z-Weather was stored at a dark place for weeks, charging may need up to 6 hours in direct sunlight during summer and up to 2 days during winter solstice and grey sky.

In order to check the functionality of Z-Weather and test whether the device has sufficient energy to operate, press the button located under the anemometer. If the LED blinks, Z-Weather has enough energy to operate.

It is good practice to perform the initial setup of Z-Weather at noon. After the first charging cycle is completed, the device will have stored enough energy for setup and adding the device to the Z-Wave network. However if you want to experiment with settings, or use the power consuming POWERLEVEL command class, Z-Weather may quickly use up all its energy reserve and may need to be charged again. If you configure Z-Weather at noon, the device had the entire morning for a full charge, has strong sun light when it uses the most energy (during configuration) and has the complete afternoon for recharging.

As a rule of thumb: After pressing the button ten times, Z-Weather will have used up the energy stored. When the energy has been used up, the LED does not blink and Z-Weather needs to be charged for approximately 1-2 hours.

Adding and Removing from the Network (Inclusion/Exclusion)

Press the button 3 times within 1.5 seconds to add Z-Weather to the network. Z-Weather sends a NIF (Network Information Frame) and waits 4 seconds for inclusion to the Z-Wave network. If no controller includes Z-Weather, it goes to sleep after 4 seconds. Make sure to first instruct the inclusion controller to add a node and then press the Z-Weather button 3 times to add the device to the network.

Default Function after Adding to the Network

Z-Weather wakes up regularly from time to time, if the button is pressed or unscheduled on the following events:

Wind speed is higher than 6m/s (22km/h)	Association Group 2
At the end of the dawn if it becomes bright	Association Group 3
At the end of the dusk it getting dark	Association Group 4

After wakeup, Z-Weather first serves the associated groups. This is in all cases Group 1 "Lifeline" where it sends all readings to. In case of an unscheduled event, the associated groups 2-4 are also served. Finally it sends a wake up notification and goes to sleep if the controller does not require further communication.

Supported Command Classes

Z-Weather supports the following Z-Wave command classes:

COMMAND_CLASS_BASIC	Version 1
COMMAND_CLASS_ZWAVEPLUS_INFO	Version 2
COMMAND_CLASS_MANUFACTURER_SPECIFIC	Version 2
COMMAND_CLASS_DEVICE_RESET_LOCALLY	Version 1
COMMAND_CLASS_ASSOCIATION_GRP_INFO	Version 1
COMMAND_CLASS_LANGUAGE	Version 1
COMMAND_CLASS_ASSOCIATION	Version 2
COMMAND_CLASS_MULTI_CHANNEL_ASSOCIATION	Version 3
COMMAND_CLASS_POWERLEVEL	Version 1
COMMAND_CLASS_VERSION	Version 2
COMMAND_CLASS_BATTERY	Version 1
COMMAND_CLASS_WAKE_UP	Version 2
COMMAND_CLASS_SENSOR_MULTILEVEL	Version 6
COMMAND_CLASS_METER	Version 3
COMMAND_CLASS_MULTI_CMD	Version 1
COMMAND_CLASS_ASSOCIATION_COMMAND_CONFIGURATION	Version 1
COMMAND_CLASS_CONFIGURATION	Version 1

Functional Description of the Command Classes

Only the command classes with user interaction are described below. Z-Weather supports additional command classes, which are required for the Z-Wave-Protocol but are not described in the following enumeration, because the end user cannot interact with them.

BASIC

Command Class	Description
Basic Get	Reads the wind speed in m/s. The reported wind speed is the maximum speed since the last wake up in meter per second. The unit can be converted to km/h by using the factor 3.6. 1m/s = 3,6km/h; 1km/h = 0,278m/s.
Basic Set	Sets the wind speed alarm threshold in m/s. Value 0 means off. No wakeup depending on the wind speed. Valid values: 1 - 30 m/s. Default value: 6 (means 6m/s, equal 22km/h) Values greater than 30 are interpreted as 30.

LANGUAGE

Sets the language for reporting the ASSOCIATION_GRP_INFO strings. Valid values:

ger	German
eng	English

The country information is not used and will be ignored.

ASSOCIATION and MULTI_CHANNEL_ASSOCIATION

Z-Weather provides 3 groups supporting up to 5 nodes each, sending a single basic set command and one „Lifeline"-group supporting 1 node for reporting all measurements.

Group 1	Lifeline All readings are sent on a regular schedule. The schedule time is set automatically between 5 minutes and 5 hours depending on the available energy. Lifeline is also served after the button was pushed or in case of an unscheduled wakeup (wind speed, twilight).

Group 2	Too windy
	Sends: BASIC SET VALUE 0
	Default action value: 6m/s (22km/h)
	Serves up to 5 group members.
	If the threshold value is exceeded, the basic set is sent to all group members. If the threshold value is exceeded for a long time, e.g. in case of storm for a couple of hours, the basic set value is sent repeatedly upon the scheduled wake up. Because in most cases the sun does not shine in case of storm, the repeated sending schedule may be between every one hour up to every five hours.
	The default values can be changed:
	ASSOCIATION_COMMAND_CONFIGURATION
	Changes the BASIC SET VALUE between 0 and 255.
	COMMAND_CLASS_CONFIGURATION
	Parameter 1 changes the trigger threshold value between 0 (off) up to 30m/s.
Group 3	It is getting bright
	Sends: BASIC SET VALUE 0
	Default value: 37% LUMINANCE (approx. street lightning)
	Serves up to 5 group members.
	ASSOCIATION_COMMAND_CONFIGURATION
	Changes the BASIC SET VALUE between 0 and 255.
	COMMAND_CLASS_CONFIGURATION
	Parameter 2 changes the trigger threshold value between 0% (off) up to 100%.
Group 4	It is getting dark
	Sends: BASIC SET VALUE 255
	Default value: 37% LUMINANCE (approx. street lightning)
	Serves up to 5 group members.
	ASSOCIATION_COMMAND_CONFIGURATION
	Changes the BASIC SET VALUE between 0 and 255.
	COMMAND_CLASS_CONFIGURATION
	Parameter 2 changes the trigger threshold value between 0% (off) up to 100%.

To suppress fast toggling between on and off at light fluctuation, Z-Weather uses a fixed pause interval of one hour between informing group 3 and group 4. In this hour the twilight phase is crossed.

POWERLEVEL

Is used at installation time to rate the transmission reliability. By continuously sending short data packets and evaluating the answers, a reliability factor can be calculated. This can happen at different radio frequency power levels.

In extreme cases 65535 test data packets can be defined which results in 1.5 hours of continuously sending. The timeout for the power level can be set up to more than 4 minutes.

The well balanced energy budget of Z-Weather allows continuous sending of one minute if fully charged. This is more than ever used, except for the POWERLEVEL class.

This in mind, Z-Weather cannot send 1.5 hours continuously. It will turn off, if the energy level is below 5 %. This is identical to a timeout. Thus setting timeout greater than one minute is useless, because Z-Weather has no energy to be in sending state longer than a minute.

If not all data packets are sent when the energy is too low, Z-Weather memorizes the outstanding data packets and continues to send the remaining test data packets on next wakeup until all packets are sent. Depending on the sunshine, it can take more than a day until all 65535 data packets are sent and the transmission reliability can be calculated.

Thus it is strongly recommended to set the following parameters within the boundaries listed (even if Z-Weather is able to serve up to 65535 test frames):

Timeout	<< 30 seconds
Test frame count	<< 1000

If test frame sending is active and Z-Weather needs to power down because of low energy level, it sends a battery status to lifeline as last action.

BATTERY
Reports the energy level of the "Battery" between 0% and 100%. Z-Weather uses a capacitor instead of batteries, which is charged on a daily basis. Thus the "Battery"-Level fluctuates during the day between 100% in the afternoon and 10% early in the morning. Z-Weather has a build in energy management, which sets the wakeup interval depending on the energy level and turns off the push button if energy level is below 30%, so that there is enough energy for emergency situations to report wind and twilight.

WAKE_UP
In normal operation mode, Z-Weather uses it's built in energy manager to set the wake up interval between 5 minutes and 5 hours. A wakeup interval of 5 minutes can be easily reached at noon in summer. At daylight in winter, the automatic wakeup interval is between 1-2 hours. Only early in the morning, if it is dark and during winter time with long nights or if the last day was cloudy, the wake up interval might be up to 5 hours. Thus in most cases the wakeup interval is faster than the default value of 17180.

In order to pass the Z-Wave-Plus compliance test, the wake up interval can be set to 4200 seconds. In this case, the wake up is fixed at 70 minutes and the built in energy manager is turned off, so that Z-Weather constantly wakes up until its energy is 0%. In this case, no reserve energy is held back for emergency wake up on storm and the internal capacitor needs longer to recharge than in normal operation.

It is strongly recommended to leave the wake up interval at default value of 17180.

There will be no negative implication for Z-Wave-Plus, because the wake up interval in most cases is shorter than 70 minutes and only in rare case (in the second half of the night at the winter solstice) up to 5 hours.

SENSOR_MULTILEVEL
Reports the following measurements:

Measurement	Range	Accuracy
Air temperature	-10.0°C to +60.0°C	± 0.4°C
Luminance	0 to 100%	± 7%
Relative humidity	1 to 100%	± 3%
Wind speed	0 to 31 m/s	± 1m/s
Barometric pressure	600 to 1200 mBar	± 1mBar
Dew point	-56.4°C to +60.0°C	± 0,7°C

All readings are at the moment where they are sent, except the wind speed, which is the maximum wind speed since the last wake up time.

METER
Reports the solar and the wind yield.

Z-Weather continuously samples the energy delivered by the solar cell. However, as the built in solar cell only delivers low levels of power (microwatts) and is very small, the measurement is normalized to a solar cell of 1 square meter and reported in kWh. This enables easier comparison of the yield per day or per month in reporting applications.

To calculate the wind yield, every eighth rotation is counted and the total sum reported as Pulse.

Parameter	Description
kWh	Solar yield related to a solar cell with 1 square meter with 16% efficiency
Pulse	Total amount of rotations divided by 8

COMMAND_CLASS_ASSOCIATION_COMMAND_CONFIGURATION
The association groups 2-4 send a basic set value to the associated nodes. The default value in case of too much wind is 0, which could be used to close the awning. In case of nightfall, the value will be 255, which could be used to trigger an action to turn on the light. The basic set values can be changed, to dim - for example - the light to only 20% instead of turning it on completely.

CONFIGURATION
Sets the threshold for triggering wake up on wind or twilight.

Parameter1	Threshold for too much wind. Crossing this parameter on the rising edge, Z-Weather sends a basic set to the associated groups, serves the lifeline and sends a wake up notification. Default value: 6 m/s Valid values: 0-30 m/s, where 0 means no notification on too much wind. Values greater than 30 are interpreted as 30. 1m/s = 3,6km/h ; 1km/h = 0,28m/s
Parameter 2	Threshold for twilight. Crossing this parameter from night to day, association group 3 is informed. Crossing this parameter from day to night, association group 4 is informed. Default value: 37% (approx. street lightning) Valid values: 0-100%, where 0 means off. Values greater than 100 are interpreted as 100. The luminance 0-100% is related to the twilight. Note that 100% does not mean that the sun is shining. In the night, the luminance is 0%, increases with the dawn and is 100% at the end of the dawn. This might not be equal with sunrise and typically is some time before sunrise. In winter, on a cloudy day the luminance may be below 100%. Internally, Z-Weather only distinguishes 7 steps of luminance. It is possible to set every value between 1-100%, but they are mapped internally to the fixed steps.

Technical Data

Dimensions (length x width x height):	33cm x 30cm x 11cm
Weight:	300g
Protection marking:	IP 34 (IEC/EN 60529)
Additional protection:	Against bedewing
Control elements:	1 push button, 1 LED
Maximum wind speed:	160 km/h
Maintenance:	Maintenance free, no batteries to change

Z-Wave-Device-Type:	Non listening Routing Sensor Multilevel
Z-Wave-Plus Role Type:	Reporting sleeping slave
Z-Wave-Plus Node Type:	Multilevel Sensor
Z-Wave-Plus Icon Type:	Multidevice Multilevel Sensor

Z-Wave SDK:	6.51
Explorer Frames:	Yes
FLiRS:	No