

# Shadow Impact Module SWM

## Manual for Version 3.5

### Software Version 2.1



**Manual for Shadow Impact Module Version 3.5****Software Version 2.1****May 2011****Version 1.0****Sales and Project Coordination:**

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## 1. Product Description

### 1.1 Applications

During sunny times of the day, the operation of wind turbine generators (WTG) may cause annoying periodic shadow impact to adjacent buildings. For this reason, building permits for the erection of WTGs increasingly demand the integration of automatic shut-down devices in order to prevent adjacent buildings from being impacted more than acceptable according to the recommended values. Normally, the authorities specify limit values regarding the maximum permitted daily and annual load.

The shadow impact module introduced herein serves as a technical solution for meeting these demands. A single shadow impact module can monitor up to 50 wind turbine generators in up to 300 places of immission (PI). If the limit values are exceeded in a place of immission, the WTG responsible is shut down for the duration of the shadow impact. Furthermore, the pre-load caused by up to 38 WTGs already existing can be considered.

All shadow impact events are stored in a first-in-first-out memory. The first-in-first-out memory can store up to 412.500 shadow impact events. The data collected include information on theoretical and actual shadow impact in the places of immission (listed with time and date of occurrence) as well as information on whether the limit value exceedances resulted in wind turbine generator shut-downs. Using the network connection of the shadow impact module and the Shadow Memory software, the data collected may be transmitted to a computer on which the information can be displayed or printed out in table format. The software offers various sort features facilitating the search for defined shadow impact events. Modifying the data is not possible.

Furthermore, you can use the Shadow Memory Protocol Viewer software to analyse the periods during which shadow impact has occurred in the places of immission as well as the WTG down times caused by the shadow impact module.

The shadow impact module is configured using the keypad or using the SIM Configuration Manager software. The configuration will then be transmitted via the network interface or using a connected modem.

## 1.2 Installing the Shadow Impact Module

The shadow impact module can be supplied integrated into a switch cabinet (500x500x350mm, HxWxD) or in 19" rack e.g. for installation into a server cabinet. A mains supply (230 V AC /30 W) must be available for voltage supply to the shadow impact module. The light sensor with built-in GPS receiver will be mounted outside of the wind turbine generator to the top of the nacelle or on the tower. For installation to the top of the nacelle you may order mounting brackets for various types of generators. For installation on the tower, the light sensor will be supplied pre-mounted on a cantilever. The cantilever will be secured to the south side of the tower. Depending on the tower type, it can be mounted using stainless clamps or heavy-duty dowels (bolts).

If desired, the light sensor can be supplied mounted on a mast. In this case, the mast must be erected south of the wind turbine generator in order to exclude shadowing effects on the light sensor caused by the wind turbine generator tower.

In principle, when choosing a location for the light sensor, you should make sure that shadowing effects on the light sensor caused by wind turbine generator components, trees or other kinds of obstacles are avoided.

Communication between the shadow impact module and the light sensor will be achieved using a RS485 interface. For all data connections, you must use shielded 5-wire cables. Communication may also be set up using a wind park network. In this case you must install a converter box for voltage supply to the light sensor and the network connection.

## 1.3 Functionality

Each shadow impact module can take into account the shadow impact occurring in up to 300 places of immission. Since the authorities usually specify limit values for daily and annual shadow impact, there is a daily as well as an annual counter for each place of immission. For each of these counters, you can set a limit value. As soon as theoretical shadow impact is detected in one of the places of immission, the respective counters will be updated cyclically, provided that the WTG responsible for the theoretical shadow impact is actually operating. If one of the counters reaches its limit value, the wind turbine generator causing the shadow impact is shut down. Once the rotor shadow has passed the place of immission or the light intensity has become too low to cause real shadow impact, the wind turbine generator is released. Shadow impact effects at a sun height angle of  $< 3^\circ$  are not taken into account.

The annual period surveyed can be defined for each place of immission individually. In places of immission where shadow impact effects could occur all year round, setting the start of the annual period surveyed to the start of the strong wind period is an obvious choice. This way, shut down hours during the strong wind periods due to exceedance of the maximum permitted annual immission can be reduced. As a result, these shut down events are shifted to the summer months.

### 1.3.1 Shadow Impact Calculation

The shadow impact module cyclically determines the position of the sun. Using the position of the sun as well as the wind turbine generator data entered, the module will calculate the position and the size of the rotor shadow. The calculation can also take into account the position of the WTG rotor with respect to the sun. When the rotor is in a rectangular position to the direction of the sun rays, the shadow ellipse of the rotor reaches its maximum expansion on horizontal level. The more the rotor approaches the direction of the sun rays, the more the expansion of the shadow ellipse decreases until only a narrow bar remains. The results of this calculation will then be compared to the positions of the places of immission. Thus, the shadow impact module will know at any time, whether shadow impact effects are theoretically possible in one or more places of immission.

The exact time of day is a prerequisite for reliable shadow impact calculations. Therefore, the shadow impact module is provided with a GPS receiver built-in to the light sensor.

### 1.3.2 Light Sensors

In order to determine whether shadow impact effects are actually possible, the shadow impact module is provided with one or more light sensors. The light sensors enable the assessment of the light conditions. The rotor shadow will be perceived only if the direct sun radiation is strong enough.



### 1.3.3 Shut-Down of Wind Turbine Generators

A wind turbine generator is shut down only if *real* shadow impact effects occur in a place of immission and actually exceed a shadow impact limit value.

If the shadow impact is eliminated due to cloudiness after a wind turbine generator has been shut down, the wind turbine generator will be released. In order to prevent a wind turbine generator from being shut down and released in short intervals due to unstable weather conditions, you can define a follow-up time. As a result of setting a follow-up time, a wind turbine generator shut down by the shadow impact module will not be released as soon as the sky clouds over. Only after the follow-up time has elapsed or shadow impact is no longer possible (according to the shadow impact calculation), the wind turbine generator will be released. By setting a follow-up time, you can reduce the wear and tear on the wind turbine generators.

## 1.4 Configuration of the Shadow Impact Module

For the shadow impact calculations, the shadow impact module requires data defining the wind turbine generators and the places of immission. The data are entered using the keypad or using the SIM Configuration Manager. For detailed information on how to enter the data using the keypad, please refer to chapters 2.2.1 throughout 2.2.6. In addition, you will find a shadow impact module configuration example in the appendix. The minimum data required for the configuration of a shadow impact module include the following:

### Location of the shadow impact module (Menu 2.3)

- Degree of latitude and longitude (decimal)  
The data must be entered accurate to at least three decimal places.

### Places of immission (Menu 2.4)

Places of immission are defined by walls and/or areas. For each place of immission, you may define up to 5 walls and up to 3 areas.

#### Wall of a place of immission (Menu 2.4.1.2):

- 2 pairs of corner coordinates, e.g. of Gauss-Krueger format (easting and northing)
- Wall height in meters
- Orientation of the wall exterior

#### Area of a place of immission (Menu 2.4.1.3):

- 4 pairs of corner coordinates, e.g. of Gauss-Krueger format (easting and northing)

#### Other data regarding the place of immission

- Height above sea level in meters (Menu 2.4.1.1)
- Maximum permitted daily and annual load times (Menu 2.4.1.4)

### Wind turbine generators (Menu 2.5)

- Hub height (Menu 2.5.1.1)
- Rotor radius (Menu 2.5.1.2)
- Height above Sea Level (Menu 2.5.1.3)
- Coordinates of location, e.g. of Gauss-Krueger format (Menu 2.5.1.4)

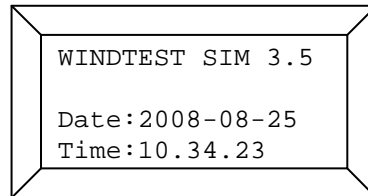
## 1.5 Log Function

The shadow impact module will log all shadow impact events. Each event is assigned a time stamp. The following events are logged:

- **Shadow Impact**  
The corresponding wind turbine generator causes real shadow impact in the corresponding place of immission.
- **Theoretical Shadow Impact**  
Theoretically, shadow impact may occur in the corresponding place of immission. However, the intensity of the direct sunlight is too low to cause actual shadow impact effects.
- **End of Shadow Impact**  
Since the sun has changed its position, the corresponding wind turbine generator can no longer cause actual shadow impact in the corresponding place of immission.
- **Stop WTG**  
The corresponding wind turbine generator was stopped by the shadow impact module.
- **Start WTG**  
The corresponding wind turbine generator was released.

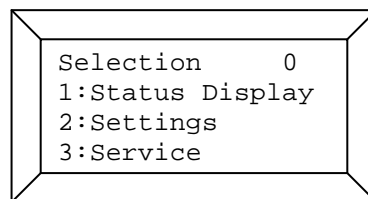
## 2. Menu Navigation

Upon start, the shadow impact module will load the configuration data from memory. After about 20 seconds, date and time will be displayed.



The shadow impact is ready for operation. You can now view the operating parameters or make settings.

After you have turned on the shadow impact module, please press the *Enter* key. The following will be displayed:



To go to the desired menu, please press the corresponding numerical key, e.g. 1 to go to the *Status Display* menu. In the second menu (2) you can configure the shadow impact module. The third menu (3) is for manufacturer setting and adjustment menus which will not be described in detail in this manual.

The number displayed in the upper right represents the menu counter. The menu counter will assist you in navigating through the menu items. To go to a higher-level menu, please press *Clear*. Please note that your settings will only be applied if you confirm the data entered by pressing the *Enter* key.

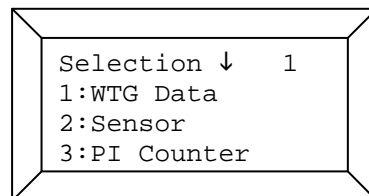
In the upper left of the display you will see a note indicating the menu function. The following menu modes are available: Display, Selection, Entry and Action.

If you press and hold the *Shift* key and then press another key, you will execute the key function indicated by the red symbol on the respective key.

**Note: The information in this chapter is listed in order of the menu items.**

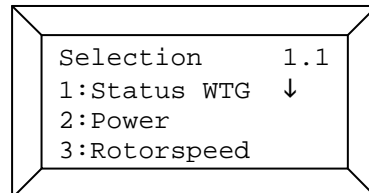
## 2.1 Status Display (Menu 1)

In the Status Display menu, you may view various operating parameters. To go to the desired sub menu, just press the corresponding numerical key. Use the arrow keys to move up and down the selection list.



### 2.1.1 Selecting the WTG data (Menu 1.1)

In this menu, you can select the WTG data you would like to view. To go to the desired sub menu, just press the corresponding numerical key. Use the arrow keys to move up and down the selection list.



The following data are available:

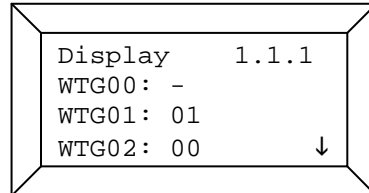
- |                       |  |
|-----------------------|--|
| 1. Status WTG         | 1=WTG in service, 0=WTG out of service   |
| 2. Power              | current WTG power output [kW]  |
| 3. Rotor Speed        | current rotational speed of the WTG rotor [rpm]                                      |
| 4. Nacelle Position   | current position of the nacelle [°], 0°= north, 90° = east etc.                      |
| 5. Azimuth Difference | difference between nacelle azimuth and sun azimuth [°]                               |
| 6. SIM Status         | 0=WTG shut down by SIM, 1=WTG released by SIM  |
| 7. Nacelle Position 2 | current position of the nacelle taking into account the user-settable nacelle offset |

Positions 1 to 5 and 7 will be displayed only if the shadow impact module is provided with the corresponding data, e.g. from the wind park server.

Please press *Clear* to return to the selection menu of the status display.

### 2.1.1.1 Viewing the Operation Status of the WTG (Menu 1.1.1)

This display menu provides information on the operation status of the WTG.

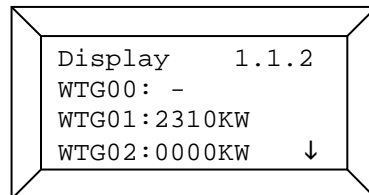


```
Display    1.1.1
WTG00: -
WTG01: 01
WTG02: 00  ↓
```

The display example shows the following: WTG 00 not defined, WTG 01 in service, WTG 02 out of service.

### 2.1.1.2 Viewing the Current WTG Power Output (Menu 1.1.2)

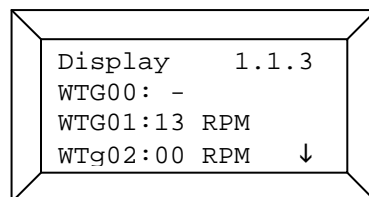
The display menu shows the current power output of the WTG in kW.



```
Display    1.1.2
WTG00: -
WTG01: 2310KW
WTG02: 0000KW  ↓
```

### 2.1.1.3 Viewing the Current Rotor Speed (Menu 1.1.3)

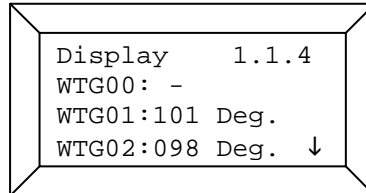
The display menu shows the current rotational speed of the rotor in rpm.



```
Display    1.1.3
WTG00: -
WTG01: 13 RPM
WTG02: 00 RPM  ↓
```

### 2.1.1.4 Viewing the Current Position of the Nacelle (Menu 1.1.4)

The display menu shows the current position of the nacelle.



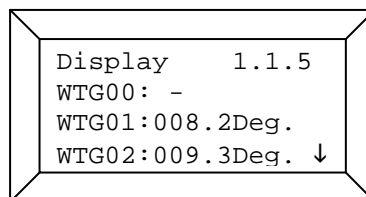
```
Display    1.1.4
WTG00: -
WTG01:101 Deg.
WTG02:098 Deg. ↓
```

0 degree means the rotor is oriented to north, 90 degrees means it is oriented to east, etc.

### 2.1.1.5 Azimuth Difference (Menu 1.1.5)

This menu shows the difference between rotor position and sun azimuth.

If the display shows a difference of 0 degree this means that the shadow impact ellipse of the rotor

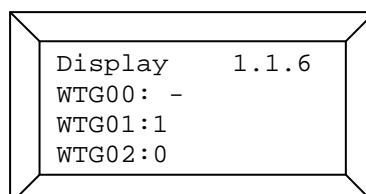


```
Display    1.1.5
WTG00: -
WTG01:008.2Deg.
WTG02:009.3Deg. ↓
```

has reached its maximum expansion since the rotor is in a rectangular position to the sun rays. The higher the azimuth difference, the smaller the horizontal expansion of the shadow impact ellipse.

### 2.1.1.6 Shut Down Status of the WTG (Menu 1.1.6)

This menu shows which of the WTGs is currently shut down due to the shadow impact module.

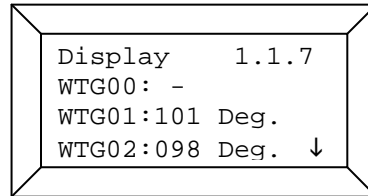


```
Display    1.1.6
WTG00: -
WTG01:1
WTG02:0
```

Status 0 means that the respective WTG was shut down by the shadow impact module. Status 1 means that the WTG was released.

### 2.1.1.7 Viewing the Adjusted Current Position of the Nacelle (Menu 1.1.7)

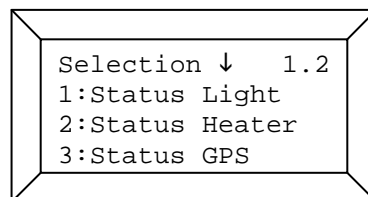
The display menu shows the corrected current position of the nacelle.



The nacelle position transmitted e.g. from the wind park server may be adjusted for each WTG according to a user-settable offset value.

### 2.1.2 Selecting the Light Sensor Data (Menu 1.2)

In this selection menu, you can press a numerical key to navigate to various menus showing light sensor data.



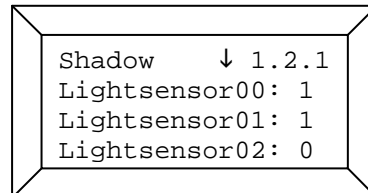
The following data are available:

1. Status Light
2. Status Heater
3. Status GPS
4. Hysteresis
5. RS485 Error
6. Output Status
7. ID



### 2.1.2.1 Viewing the Status of the Light Sensors (Menu 1.2.1)

This menu shows how the light sensors assess the current light conditions.



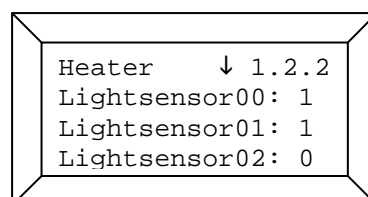
```
Shadow    ↓ 1.2.1
Lightsensor00: 1
Lightsensor01: 1
Lightsensor02: 0
```

The function of the light sensors is to determine the direct portion of the visible sunlight. Actual shadow impact is possible only if the direct portion is high enough. Menu 1.2.1 provides information on the light conditions at the respective light sensor. A status of 1 means that due to the light conditions, actual shadow impact is possible. With a status of 0, this is not possible.

Up to 10 light sensors may be connected to the shadow impact module. Using more than one light sensor is necessary in cases where the wind turbine generators are located far away from each other so that on days with slowly passing clouds there may be longer periods during which the light conditions at the wind turbine generators differ from each other. Employing a second light sensor may also serve the purpose of reducing the failure probability of the shadow impact module due to a damaged or dirty light sensor.

### 2.1.2.2 Viewing the Status of the Light Sensor's Built-in Heater (Menu 1.2.2)

The light sensors are provided with a heater to prevent the photo diodes from icing over. This menu shows the status of the heater (1=on, 0=off).



```
Heater    ↓ 1.2.2
Lightsensor00: 1
Lightsensor01: 1
Lightsensor02: 0
```

### 2.1.2.3 Viewing the Status of the GPS Receiver (Menu 1.2.3)

The light sensors are provided with a GPS receiver. The GPS receiver enables the shadow impact module to retrieve current time and date in any place of the world. This menu shows the status of the GPS module (1=OK, 0= no satellite reception).

```
GPS      ↓  1.2.3
Lightsensor00: 1
Lightsensor01: 1
Lightsensor02: 0
```

In case several light sensors are connected to one shadow impact module, only one light sensor needs to be provided with a GPS module.

### 2.1.2.4 Current Hysteresis Value (Menu 1.2.4)

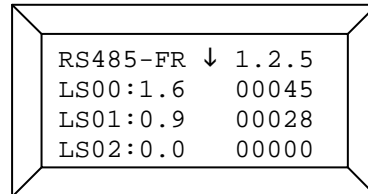
This menu shows the current value of the hysteresis counter of the light sensors.

```
Hysteresis↓ 1.2.4
LS00: 046s
LS01: 060s
LS02: 000s
```

Each light sensor has a hysteresis which can be adjusted. If weather conditions change from cloudy sky to sunshine, the hysteresis counter will increment until it reaches its defined limit value. Only then will the shadow impact module take into account the status message of the light sensor. If weather conditions change from sunshine to cloudy sky, the hysteresis counter will decrement until it reaches zero. Now the shadow impact module will take into account the status change of the light sensor. If the weather conditions return to cloudy sky while the hysteresis counter is decrementing, it will stop decrementing and start incrementing again. This method reduces the frequency of the WTG being shut on and off in unstable weather conditions.

### 2.1.2.5 RS485 Counter (Menu 1.2.5)

This menu shows the error status of RS485 communication between light sensor (LS00 – LS19) and shadow impact module.

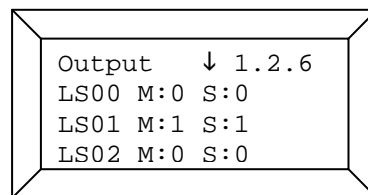


RS485-FR	↓	1.2.5
LS00:1.6		00045
LS01:0.9		00028
LS02:0.0		00000

The number on the left indicates the failure rate (%). The number on the right indicates the number of failed communication attempts.

### 2.1.2.6 Output Status (Menu 1.2.6)

This menu shows the light sensors' (LS00 – LS19) digital output mode and status.

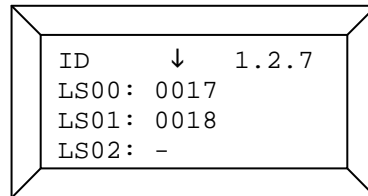


Output	↓	1.2.6
LS00 M:0 S:0		
LS01 M:1 S:1		
LS02 M:0 S:0		

M indicates the digital output mode (0 = shadow impact mode, 1 = switching output mode). S indicates the status of the output (0 = low, 1 = high).

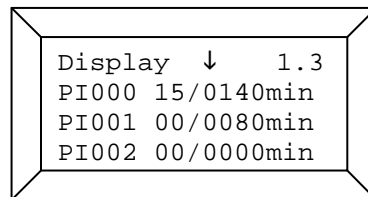
### 2.1.2.7 ID of the Light Sensors (Menu 1.2.7)

This menu shows the ID of the light sensors (LS00 – LS19).



### 2.1.3 Viewing the Daily and Annual Counter (Menu 1.3)

This display menu provides information on the load times of the places of immission.



The load times shown on the display are to be read as follows. On the current day, PI 0 has been impacted for a total of 15 minutes and during the current annual period it has been impacted for a total of 140 minutes. On the current day, PI 1 has not been impacted at all; however, during the current annual period it has been impacted for a total of 80 minutes. PI 2 has not been impacted so far, neither on the current day, nor in the course of the current annual period.

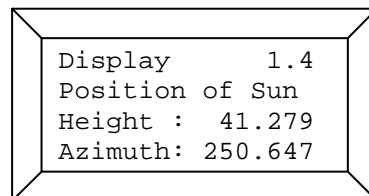
Regarding the load times, the switchable as well as the non-switchable WTGs are taken into account.

The daily counter is reset to zero at midnight. The annual counter is reset to zero at the end of the annual period.

Use the arrow keys to move up and down the counter list.

### 2.1.4 Viewing the Position of the Sun (Menu 1.4)

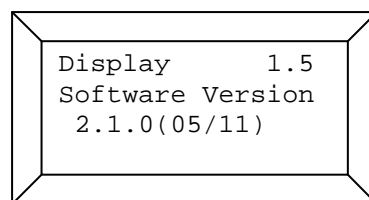
This menu displays the position of the sun continuously determined according to time and date. The height angle and the azimuth (direction angle) of the sun are shown in degrees.



The height angle is measured between the horizontal plane and the sun. When the sun is at the zenith, the height angle is 90°. At the horizon, the height angle is 0°. The azimuth of the sun is measured along the horizon in clockwise direction from north where it is 0°. (East: 90°, south: 180° etc.) In case the position of the sun indicated does not correspond to the actual conditions, you should check date and time and correct these data as necessary (Menu 2.2.1). Another source of error may be a location entered incorrectly. Please check the degree of latitude and longitude entered in Menu 2.3.

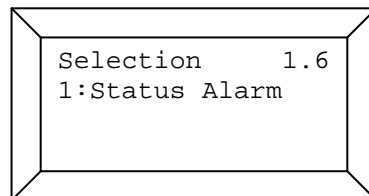
### 2.1.5 Viewing the Software Version (Menu 1.5)

If you have questions regarding the operation of the shadow impact module, please indicate to us the software version displayed in this menu.



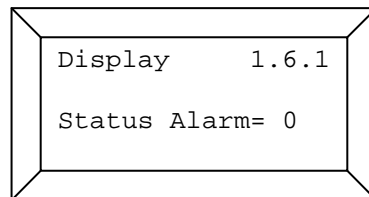
## 2.1.6 Selecting Alarm Parameters (Menu 1.6)

In this menu, you may select the alarm parameters you would like to verify.



### 2.1.6.1 Alarm Status (Menu 1.6.1)

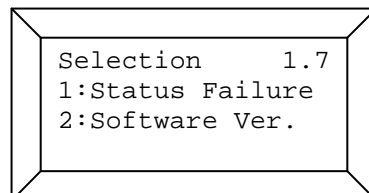
Use this menu to view the alarm status of the shadow impact module. If the operation log records a failure message, the alarm status will change from 0 to 1. After reading out the operation log or



when the shadow impact module is restarted, the alarm status will return to 0.

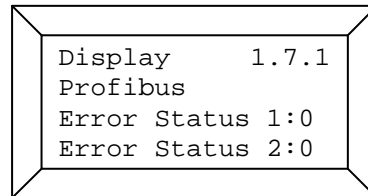
## 2.1.7 Selecting PROFIBUS Parameters (Menu 1.7)

In this menu, you may select the process field bus (PROFIBUS) parameters you would like to verify.



### 2.1.7.1 PROFIBUS Error Status (Menu 1.7.1)

Use this menu to view the error status of the PROFIBUS connection. The PROFIBUS connection between the shadow impact module and the wind turbine generator is optional.



Error status 1 = 0: PROFIBUS data will be updated

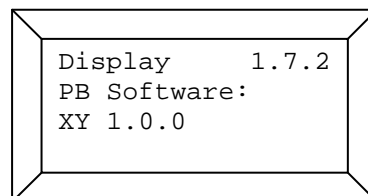
Error status 1 = 1: PROFIBUS data will not be updated

Error status 2 = 0: connection to PROFIBUS gateway OK

Error status 2 = 1: connection to PROFIBUS gateway could not be established.

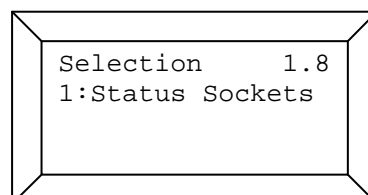
### 2.1.7.2 PROFIBUS Gateway Software Version (Menu 1.7.2)

When you open this menu, the shadow impact module will retrieve the software version of the PROFIBUS gateway and display it.



### 2.1.8 Selecting Network Parameters (Menu 1.8)

In this menu, you may select the network parameters you would like to verify.



### 2.1.8.1 Network Socket Status (Menu 1.8.1)

Depending on the shadow impact module type some communication tasks will be performed via the wind park network. This menu shows the current condition of the various network connections (sockets) available. A value of -1 means that none of the network connections to the respective

```

Display      1.8.1
Sensor Socket:-1
Server Socket:-1
WPS Socket  :-1
  
```

component is active. A value of > 0 means that the network connection is active.

Sensor socket: connection to one of the light sensors

Server socket: connection to a computer application (e.g. Shadow Memory)

WPS socket: connection to the wind park server

PB socket: connection to the PROFIBUS gateway

### 2.1.9 Analogue Measured Values (Menu 1.9)

Depending on the shadow impact module specifications the module can record up to 16 measured values. Use this menu to view the current measured values.

```

Display ↓   1.9
Analogue Values
W0:
W1:
  
```

### 2.1.10 Sunrise/Sunset (Menu 1.10)

This menu shows the times of the next sunrise and sunset. The display shows the wintertime.

```

Display      1.10

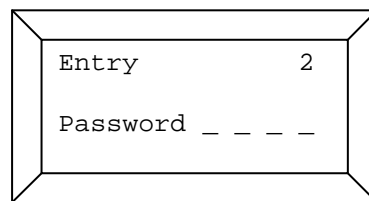
SR: 05:44
SS: 19:29
  
```



## 2.2 Settings (Menu 2)

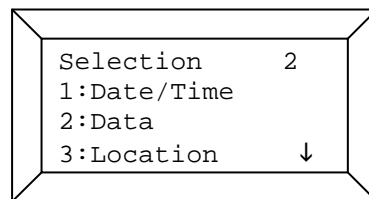
Before you can go to the *Settings* menu, you must enter the four-digit user password. The password is preset to 0000. In Menu 2.8.1 you can change the password as desired. For secure operation of the shadow impact module, we recommend you disclose this password only to those persons authorised to change the settings of the shadow impact module.

Confirm your entry by pressing the *Enter* key. If the password you have entered is correct, you will now see the selection menu for the various setting options.



```
Entry          2
Password _ _ _ _
```

Please select the desired settings menu by pressing the corresponding numerical key. Use the arrow keys to move up and down the selection list.

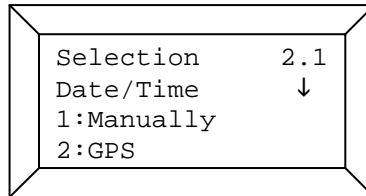


```
Selection      2
1:Date/Time
2:Data
3:Location     ↓
```

Please carefully perform all of the following settings. Incorrect or inaccurate settings may result in malfunction of the shadow impact module. A malfunction will not cause damage; however, it could lead to unnecessary shut downs resulting in loss of earnings.

### 2.2.1 Selecting Setting Options (Menu 2.1)

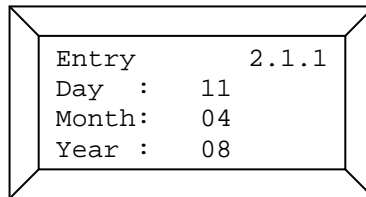
Within this menu, you can specify whether date and time are to be set manually or by time leveling using the GPS module.



Make your selection using the numerical keys.

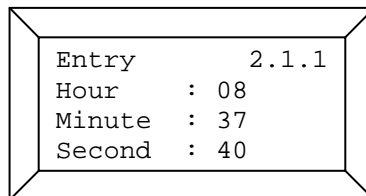
#### 2.2.1.1 Setting Date and Time Manually (Menu 2.1.1)

The date is entered using the numerical keys. Use the arrow keys to navigate through the items. The software's period of validity is from 01.01.2000 to 31.12.2056. If the module detects an incorrect date, such as 30.02.2003, the software will issue an error message. After pressing the *Enter* key, you can correct your entry.



Confirm your entry by pressing the *Enter* key. The display will show a time entry mask.

The procedure for entering the time is identical to the procedure for entering the date. Please note

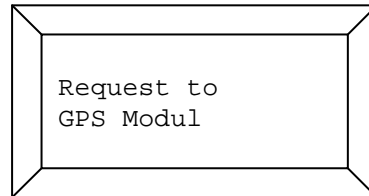


that the time you enter must be the wintertime! After you have confirmed your entry by pressing the *Enter* key, the processor clock adopts the new time data. Please double-check that the new date and time have been entered correctly.

**Note:** Please note that the time you enter must always be the wintertime.

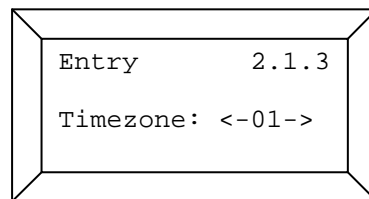
### 2.2.1.2 Setting Date and Time Using the GPS Module (Menu 2.1.2)

At night time, the shadow impact module will synchronise the time of day using the GPS receiver. In Menu 2.1.2 you can manually trigger the GPS receiver to perform the time setting process.



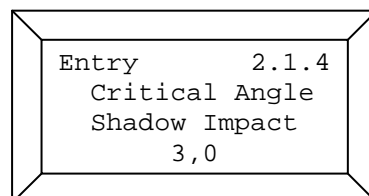
### 2.2.1.3 Setting of the timezone (Menu 2.1.3)

In this menu you can set the timezone in which the shadow impact module will operate. Please use the arrow keys for that. You can set the timezone between -12 and 12. To confirm your entry press the "Enter" key.



### 2.2.1.4 Setting of the critical height angle of the sun (Menu 2.1.4)

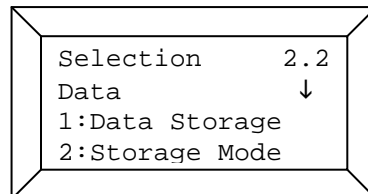
In this menu you can set the critical angle for the sun height. If the height of the sun will fall below this angle the calculation for shadow impact will be interrupted. To confirm your entry press the "enter" key.



## 2.2.2 Selecting Setting Options (Menu 2.2)

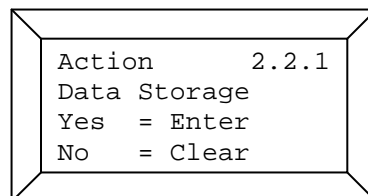
In this selection menu, you may choose menu items regarding data storage.

Make your selection using the numerical keys.



### 2.2.2.1 Data Storage (Menu 2.2.1)

Within this menu, the data entered are saved to permanent memory. In case of power failure, all data which have not been saved to permanent memory are held in a buffer-accumulator-based main memory for about 1 week. After the buffer accumulator is discharged, all data as well as the current time setting will be lost. Data which have been saved to permanent memory will be maintained for at least one year after the power failure.

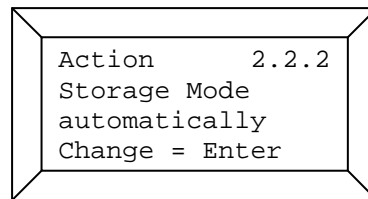


To save the data, please press the *Enter* key. To cancel the process, please press the *Clear* key. During a storage process, the shadow impact module should not be switched off.

**Note: All data regarding the configuration of the shadow impact module should be documented and kept in a secure place.**

### 2.2.2.2 Setting the Storage Mode (Menu 2.2.2)

The shadow impact module has two storage modes. In the pre-set automatic storage mode, all data are saved immediately after they have been entered. This storage mode provides the highest level of data security; however, each storage process may take up to 20 seconds. In cases where a large amount of data has to be entered, this storage mode may be too time-consuming. In the manual storage mode, the data entered are not saved automatically. Instead, saving the data to permanent memory must be performed manually (please refer to Menu 2.2.1).

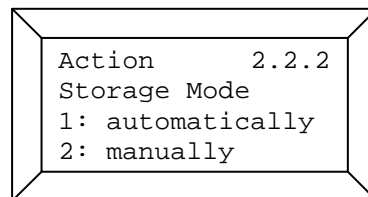


```

Action      2.2.2
Storage Mode
automatically
Change = Enter

```

The current storage mode is displayed in the 3rd line. To change the storage mode, please press the *Enter* key.



```

Action      2.2.2
Storage Mode
1: automatically
2: manually

```

Now select the desired storage mode using the numerical keys.

### 2.2.2.3 Reset to Default Settings (Menu 2.2.3)

To reset the shadow impact module to the default settings, please press the *F9* key. Please note that this will delete all the data you entered and clear all counters.

```

Action      2.2.3
For Reset to
Default Settings
press F9

```

Confirm your selection by pressing the *enter* key. To reject the deleting process, press the *clear* key. The deleting process will take about 45 seconds.

```

Action      2.2.3
Set Defaults
Yes  : Enter
No   : Clear

```

### 2.2.3 Selection for Setting the Location (Menu 2.3)

The location of the shadow impact module is defined by specifying the degrees of latitude and longitude. In this menu you can select whether the geographical location is to be entered manually or will be determined by the GPS receiver.

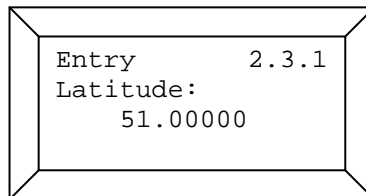
```

Selection    2.3
Geo-Coordinates
1:Manually
2:GPS

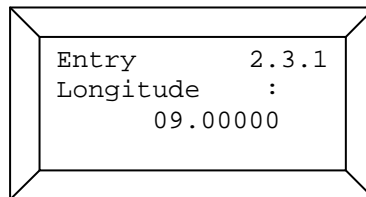
```

### 2.2.3.1 Entering the Geographical Coordinates Manually (Menu 2.3.1)

Always enter these two values accurate to at least three decimal places as these data represent an important basis for the calculation of the position of the sun. The format must be decimal as opposed to specification by minutes and seconds.



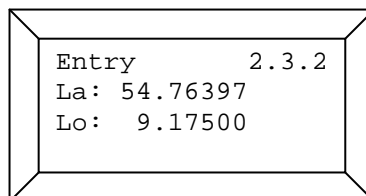
Please start by entering the degree of latitude. The degree of latitude is preset to 51.00000 degrees. Use the arrow keys to change the position of the cursor. Please confirm your entry by pressing the *Enter* key. The display will now show the entry menu for the degree of longitude.



The degree of longitude is preset to 09.00000 degrees. For the degree of longitude you may also enter a negative value. Again, please confirm your entry by pressing the *Enter* key.

### 2.2.3.2 Determination of Geographical Coordinates by the GPS Receiver (Menu 2.3.2)

This menu is used to query the geographical coordinates from the GPS receiver of the light sensor.



To apply the coordinates received, please press the *Enter* key.

## 2.2.4 Selecting the Place of Immission to be set (Menu 2.4)

The shadow impact module calculations can take into account 300 places of immission (0-299). Various settings must be performed for each place of immission. Please start by selecting the number of the place of immission to be set using the numerical keys.

```

Selection      2.4
PI-Number 000
  
```

When the number of the desired place of immission is displayed, please confirm by pressing the *Enter* key. A new selection menu will now be displayed.

### 2.2.4.1 Selecting Setting Options (Menu 2.4.1)

A place of immission must be defined by the following parameters (as a minimum): height above sea level, the coordinates of an area or wall, and the permitted daily and annual load times. Each place of immission may be assigned up to 5 walls and up to 3 areas.

```

Selection 2.4.1
PI-Number 003 ↓
1:Height a.SeaLe
2:Walls
  
```

Please select the desired settings menu by pressing the corresponding numerical key. Use the arrow keys to move up and down the selection list.

#### 2.2.4.1.1 Entering the Height above Sea Level for the Place of Immission (Menu 2.4.1.1)

Please enter the place of immission's height above sea level in meters using the numerical keys. Start by entering an algebraic sign. If you skip this entry, the algebraic sign will remain positive.

```

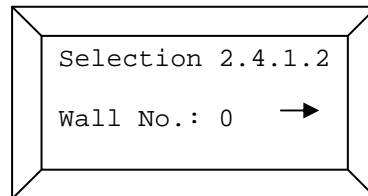
Entry      2.4.1.1
PI-Number 003
Height above
Sea Level
  
```



Confirm your entry by pressing the *Enter* key. You will automatically return to the selection menu for further settings regarding the place of immission selected.

### 2.2.4.1.2 Entering the Wall of a Place of Immission (Menu 2.4.1.2)

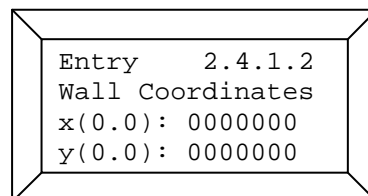
A wall is defined by its corner coordinates, height and orientation.



Start by using the arrow keys to select the number of the wall (wall 0 – wall 4) for which you plan to enter the corresponding parameters.

Please confirm the selected wall number by pressing the *Enter* key.

First you must enter the two pairs of corner coordinates (x and y, i.e. easting and northing) of the wall in 7-digit Gauss-Krueger format. Now enter the first pair of coordinates for the wall using the numerical keys. Use the arrow keys to navigate through the items.



In the 3<sup>rd</sup> line enter the x coordinate (easting); in the 4<sup>th</sup> line enter the y coordinate (northing). The first index of the coordinates defines the wall number (0 – 4). The second index specifies the respective pair of coordinates concerned (0 or 1).

Confirm your entry by pressing the *Enter* key. Now enter the pair of coordinates 1 in the new window and confirm your entry.

Please enter the wall height in meters in the window displayed now.

```
Entry      2.4.1.2
PI-Number 03
Height Wall No.0
           000 m
```

After you have confirmed this entry, you will get to the menu for entering a direction to which the wall exterior is oriented.

```
Entry      2.4.1.2
Wall Orientat.: 0
East
E=1 S=2 W=3 N=4
```

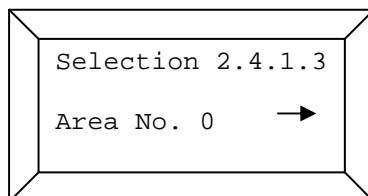
Select the direction using the respective numerical key, e.g. 2 = south. For example if the wall is oriented north-west you can enter either north or west. After you have confirmed your entry, you will get to the last menu item referring to the wall. Here, you can either activate or deactivate the wall. Only activated walls will be taken into account by the shadow impact calculations.

```
Entry      2.4.1.2
Wall No.: 0
Status deactivate
aktive=1
```

To activate the wall, please press the numerical key 1; to deactivate the wall, press 0. Confirm your entry by pressing the *Enter* key. Now you will automatically return to the selection menu for the wall number. If you do not wish to define another wall, you can quit this menu by pressing the *Clear* key.

### 2.2.4.1.3 Entering the Areas of a Place of Immission (Menu 2.4.1.3)

Start by using the arrow keys to select the number of the area (area 0 to 2) for which you plan to enter the corresponding parameters.

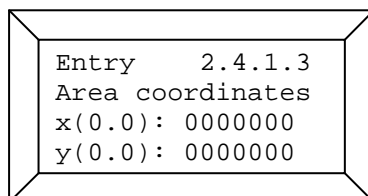


```
Selection 2.4.1.3
Area No. 0  →
```

Please confirm the selected area number by pressing the *Enter* key.

An area is defined by its four pairs of corner coordinates. Just like walls, areas are defined using the Gauss-Krueger format.

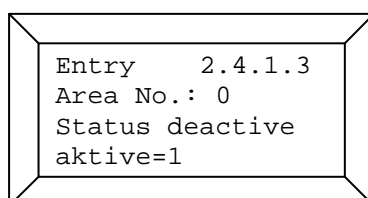
Now enter the first pair of coordinates for the area using the numerical keys. Use the arrow keys to navigate through the items.



```
Entry 2.4.1.3
Area coordinates
x(0.0): 0000000
y(0.0): 0000000
```

In the 3<sup>rd</sup> line enter the x coordinate (easting); in the 4<sup>th</sup> line enter the y coordinate (northing). The first index of the coordinates defines the area number. The second index specifies the respective pair of coordinates (0 to 3) concerned.

Confirm your entry by pressing the *Enter* key. Now enter the next pair of coordinates in the new window and confirm your entry. For each area, you must enter a total of four pairs of coordinates. After you have confirmed the last pair of coordinates, a menu for activating or deactivating the area will be displayed. Only activated areas will be taken into account by the shadow impact calculations.

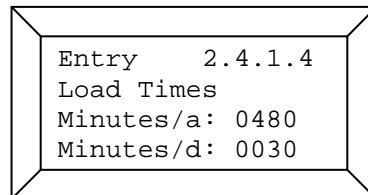


```
Entry 2.4.1.3
Area No.: 0
Status deactive
aktive=1
```

To activate the area, please press the numerical key 1; to deactivate the area, press 0. Confirm your entry by pressing the *enter* key. Now you will automatically return to the selection menu for the area number. If you do not wish to define another area, you can quit this menu by pressing the *Clear* key.

### 2.2.4.1.4 Entering the Permitted Load Times (Menu 2.4.1.4)

The places of immission must be assigned different maximum permitted daily and annual load times according to the limit values specified by the authorities. Use this menu item to enter the corresponding times. The annual load is preset to 480 min (=8 h); the daily load is preset to 30 min.

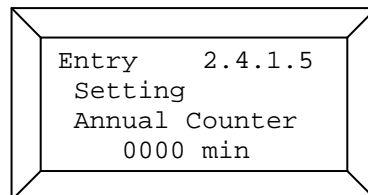


```
Entry      2.4.1.4
Load Times
Minutes/a: 0480
Minutes/d: 0030
```

Use the numerical keys to enter the permitted limit value for the annual load in the 3<sup>rd</sup> line. In the 4<sup>th</sup> line, enter the permitted limit value for the daily load in minutes. Use the arrow keys to navigate through the items. Please confirm your entry by pressing the *Enter* key.

### 2.2.4.1.5 Setting the Annual Counter (Menu 2.4.1.5)

Here you can define how many hours the respective place of immission has been exposed to shadow impact so far during the current year. This setting may be required in cases where the shadow impact module is installed e.g. in the middle of the year if the place of immission has been exposed to shadow impact for several hours prior to the installation.



```
Entry      2.4.1.5
Setting
Annual Counter
          0000 min
```

Set the counter using the numerical keys. Use the arrow keys to navigate through the entry positions. Please confirm your entry by pressing the *Enter* key.

### 2.2.4.1.6 Setting the Beginning of the Year (Menu 2.4.1.6)

This menu item allows you to select the first day of the annual period to be considered. On this day, the annual counters will be reset to zero. The beginning of the annual period is pre-set to 01.09. The ideal date to choose depends on the seasons during which the place of immission can be shadowed. As a general rule, the beginning of the annual period should be set to the beginning of the strong wind period.

```
Entry      2.4.1.6
Begin. of Year
Day:      01
Month:    09
```

Enter the desired date using the numerical keys. Confirm your entry by pressing the *Enter* key.

### 2.2.4.1.7 Selecting the Days of the Week (Menu 2.4.1.7)

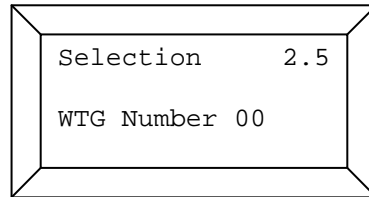
This menu item allows you to select for each place of immission the days of the week on which the shadow impact is to be taken into account. You can choose from Monday to Sunday, Monday to Saturday, Monday to Friday, or Saturday and Sunday. This function enables you to exclude e.g. commercially used places of immission from shut-downs due to shadow impact on weekends.

```
Entry      2.4.1.7
Week Days  0
0=Mo-Su  1=Mo-Sa
2=Mo-Fr  3=Sa+Su
```

Determine the range of weekdays by selecting the corresponding number. The current selection is shown in the second line. Please confirm your selection by pressing the *Enter* key.

## 2.2.5 Selecting the Wind Turbine Generator to be set (Menu 2.5)

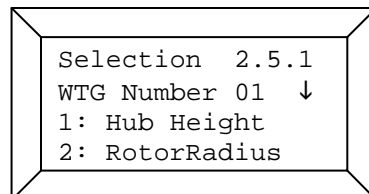
In the shadow impact module, wind turbine generators are defined by their hub height, rotor radius, height above sea level, the respective location coordinates and their identifier. Please start by using the numerical keys to enter the number of the wind turbine generator for which you plan to perform the required settings. The selection ranges from 0 to 49. When the number of the desired wind turbine generator is displayed, please press *Enter*. A new selection menu will now be displayed.



```
Selection    2.5
WTG Number 00
```

### 2.2.5.1 Selecting Setting Options (Menu 2.5.1)

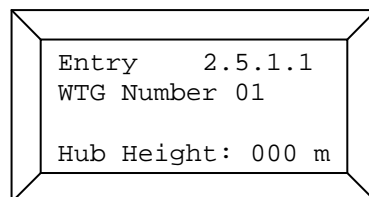
Please select the desired settings menu by pressing the corresponding numerical key. Use the arrow keys to move up and down the selection list.



```
Selection 2.5.1
WTG Number 01 ↓
1: Hub Height
2: RotorRadius
```

#### 2.2.5.1.1 Entering the Hub Height of the Wind Turbine Generator (Menu 2.5.1.1)

Enter the hub height of the wind turbine generator in meters using the numerical keys and confirm your entry by pressing the *Enter* key. Use the arrow keys to navigate through the entry positions.

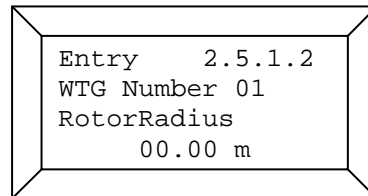


```
Entry    2.5.1.1
WTG Number 01

Hub Height: 000 m
```

### 2.2.5.1.2 Entering the Rotor Radius (Menu 2.5.1.2)

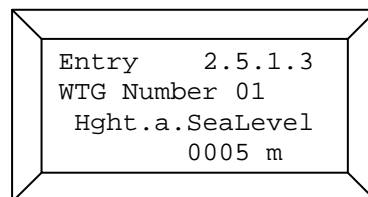
Enter the rotor radius of the wind turbine generator in meters using the numerical keys, and confirm your entry by pressing the *Enter* key. Use the arrow keys to navigate through the entry positions.



```
Entry    2.5.1.2
WTG Number 01
RotorRadius
        00.00 m
```

### 2.2.5.1.3 Entering the Altitude of the Wind Turbine Generator (Menu 2.5.1.3)

Please enter the wind turbine generator's height above sea level in meters using the numerical keys. Start by entering an algebraic sign. If you skip this entry, the algebraic sign will remain positive.

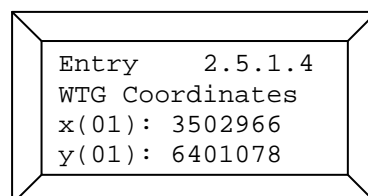


```
Entry    2.5.1.3
WTG Number 01
Hght.a.SeaLevel
        0005 m
```

Confirm your entry by pressing the *Enter* key. Use the arrow keys to navigate through the entry positions.

### 2.2.5.1.4 Entering the Coordinates of the Wind Turbine Generator (Menu 2.5.1.4)

Enter the location coordinates of the wind turbine generator in 7-digit Gauss-Krueger format. In the 3<sup>rd</sup> line, enter the x coordinate (easting); in the 4<sup>th</sup> line, enter the y coordinate (northing). The index of the coordinates indicates the number of the wind turbine generator.

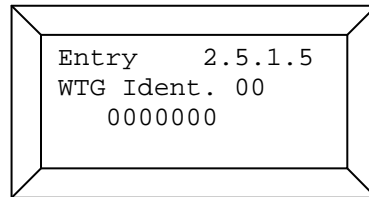


```
Entry    2.5.1.4
WTG Coordinates
x(01): 3502966
y(01): 6401078
```

Enter the coordinates of the wind turbine generator using the numerical keys and confirm your entry by pressing the *Enter* key. Use the arrow keys to navigate through the entry positions.

### 2.2.5.1.5 Identifier of the Wind Turbine Generator (Menu 2.5.1.5)

Entering the WTG identifier is required only for wind turbine generators manufactured by Siemens.

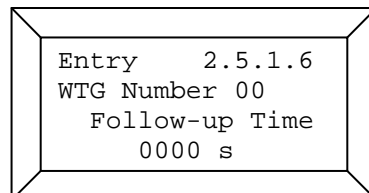


```
Entry      2.5.1.5
WTG Ident. 00
          0000000
```

The WTG identifier is used to allocate the WTG data transferred from the wind park server. The 7-digit WTG identifier is indicated on the tower.

### 2.2.5.1.6 Entering the Follow-up Time for the Wind Turbine Generator (Menu 2.5.1.6)

As a result of setting a follow-up time, a wind turbine generator shut down by the shadow impact module is not released as soon as the shadow impact is interrupted by a short period of cloudiness. This will serve the purpose of preventing wind turbine generators from being shut down and released in short intervals.



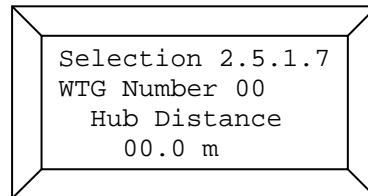
```
Entry      2.5.1.6
WTG Number 00
Follow-up Time
          0000 s
```

Enter the follow-up time using the numerical keys and confirm your entry by pressing the *Enter* key. Use the arrow keys to navigate through the entry positions.



### 2.2.5.1.7 Hub Distance (Menu 2.5.1.7)

The hub distance defines the distance between rotor hub and centre of the tower. This value is important for the calculation of the position of the shadow impact ellipse.

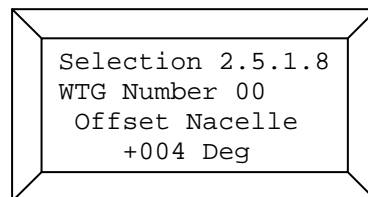


```
Selection 2.5.1.7
WTG Number 00
Hub Distance
00.0 m
```

### 2.2.5.1.8 Nacelle Offset (Menu 2.5.1.8)

In case of insufficiently correct matching of the nacelle position transferred from the park server, the nacelle position may be corrected by entering the nacelle offset.

The nacelle offset should be entered as a signed number (+/-). The nacelle offset will be

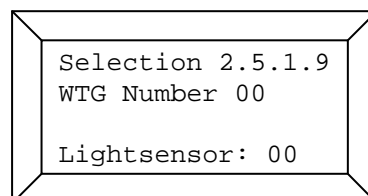


```
Selection 2.5.1.8
WTG Number 00
Offset Nacelle
+004 Deg
```

subtracted from the nacelle position transferred.

### 2.2.5.1.9 Sensor (Menu 2.5.1.9)

Each WTG can be assigned a dedicated light sensor. The default value is light sensor 0. If there is more than one light sensor in the wind park, each WTG should be assigned the nearest light sensor. To assign all existing light sensors to the WTG, enter 99.

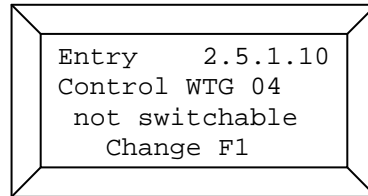


```
Selection 2.5.1.9
WTG Number 00

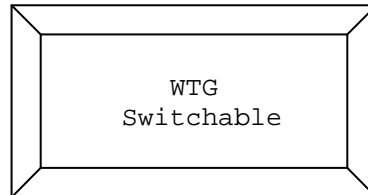
Lightsensor: 00
```

### 2.2.5.1.10 Control (Menu 2.5.1.10)

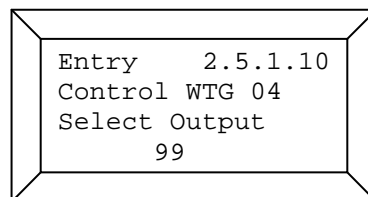
The shadow impact module can be provided with 1 to 12 switching outputs. Each of the existing switching outputs may be assigned to one of the 50 wind turbine generators. By default, all of the wind turbine generators are non-switchable. This condition applies to all those wind turbine generators which do cause shadow impact in a place of immission but are not monitored by a shadow impact module.



To change the mode of the wind turbine generator selected to "switchable", please press the *F1* key. For a short while, the following will be displayed:

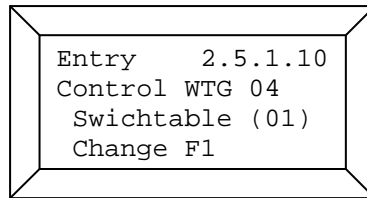


Now, the switching output assigned to the wind turbine generator will be displayed. The switching output is preset to 99. The number of physically existing switching outputs ranges from 0 to 11 (maximum number). Therefore, a shadow impact module for switching e.g. five wind turbine generators will have the physical switching outputs 0 to 4. If you select a switching output with a number exceeding the number of physically existing switching outputs for a wind turbine generator, this wind turbine generator will be regarded as switchable; however, the shadow impact module will not be able to shut down this wind turbine generator. This condition applies to all those wind turbine generators monitored by a different shadow impact module running in parallel.



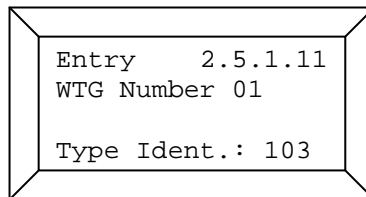
Set the desired switching output using the numerical keys and confirm your entry by pressing the *Enter* key. Please double-check your settings in the following display.

If the settings are correct, you can quit the menu by pressing the *Clear* key. To change the settings, press the *F1* key.



### 2.2.5.1.11 Type Identifier (Menu 2.5.1.11)

For each WTG to be monitored or taken into account by the shadow impact module, you must enter a 3-digit type identifier. On the basis of the type identifier, the shadow impact module will recognise how the WTG can be switched and whether parameters of the WTG are available.

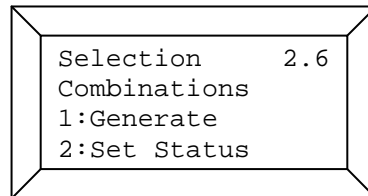


The following type identifiers can be entered:

Type identifier	Manufacturer	Switching type	Parameter
100	Siemens	via WPS (LAN)	via WPS (LAN)
101	Multibrid	via PROFIBUS	via PROFIBUS
102	all	via light sensor	none
103	all	not switchable	none
104	Bard	via WPS (LAN)	via WPS (LAN)
105	all	via relay	none

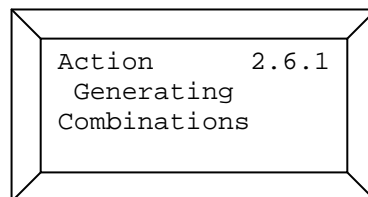
## 2.2.6 Combinations (Menu 2.6)

To ensure that the shadow impact caused by a wind turbine generator will be related to a place of immission, the wind turbine generator and the place of immission must be combined with each other. After entering the place of immission and the wind turbine generators, they are not combined with each other automatically. The combinations will be generated in Menu 2.6.1.



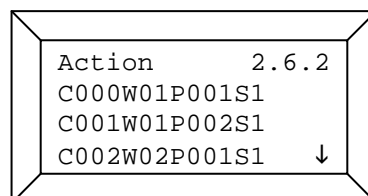
### 2.2.6.1 Generating the Combinations (Menu 2.6.1)

By selecting this menu item, all places of immission will be combined with all wind turbine generators. During this process, the status of all combinations generated is set to *active* (S=1). A list of the combinations is shown in Menu 2.6.2.



### 2.2.6.2 Setting the Status of the Combinations (Menu 2.6.2)

After the combinations have been generated, their status is set to *active* (S=1). This means, that the shadow impact module will assume that each wind turbine generator is able to cause shadow impact in each place of immission. However, if there is an obstacle between a wind turbine

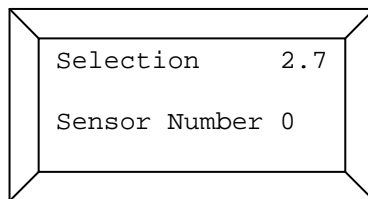


generator and a place of immission, the occurrence of real shadow impact is not possible in this place of immission. Nevertheless, the shadow impact module will detect theoretical shadow impact. In order to avoid this, the corresponding combination should be deactivated. The combinations are listed in Menu 2.6.2. Use the up/down arrow keys to move up and down the list. Use the right/left arrow keys to move to the next/previous 30 combinations. Each list entry includes the sequential number of the Combination (Cxxx), the number of the Wind turbine generator (Wxx), the number of the place of Immission (Pxxx) and the Status of the combination (Sx). The combinations are sorted first in order of the wind turbine generator numbers, then in order of the places of immission's

numbers. To change the status of a combination, the respective list item must be in the first line of the list range displayed. To activate the combination press 0, to deactivate the combination press 1. Please note that your entry will be applied only if you confirm by pressing the *Enter* key.

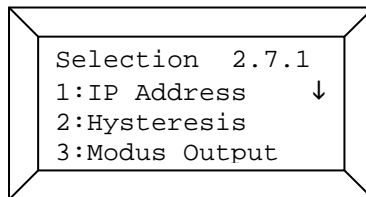
### 2.2.7 Selecting the Light Sensor Settings (Menu 2.7)

Up to 10 light sensors may be connected to the shadow impact module as required. To change the settings of a light sensor, first select the number (0-9) of the light sensor.



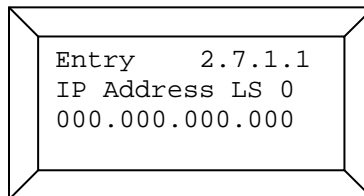
#### 2.2.7.1 Selecting the Settings Menu (Menu 2.7.1)

Now please select the desired settings menu by pressing the corresponding numerical key.



### 2.2.7.1.1 IP Address of the Light Sensors (Menu 2.7.1.1)

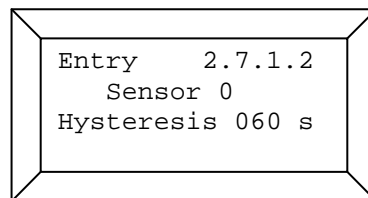
You can use this menu to enter an IP address for the light sensor selected in case this light sensor is connected to the shadow impact module over a network (TCP/IP). Light sensors with IP address 000.000.000.000 will be queried using the RS485 interface.



If a light sensor is removed from the wind park, the IP address should be reset to zero (default) to ensure that the shadow impact module no longer retrieves data from this light sensor.

### 2.2.7.1.2 Entering a Hysteresis (Menu 2.7.1.2)

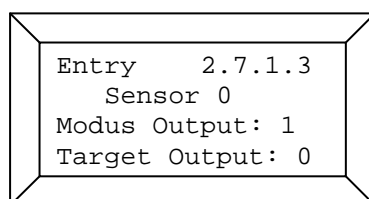
Only after the period defined by the hysteresis has elapsed, a change of condition from "shadow impact" to "no shadow impact" will be taken into account. The hysteresis is preset to 60 seconds. To prevent the wind turbine generators from being shut down and released in short intervals due to unsettled weather conditions, the hysteresis should not be set too low.



Enter the hysteresis using the numerical keys and confirm your entry by pressing the *Enter* key. Use the arrow keys to navigate through the entry positions.

### 2.2.7.1.3 Output Mode (Menu 2.7.1.3)

Each light sensor has a digital output. This menu can be used to set the mode of the output. If the mode is 0, the digital output assumes the condition 'high' provided that the direct portion of the sunlight is high enough to cause shadow impact. In case of cloudy weather, the output assumes the 'low' condition. In mode 1, the output will be driven by the shadow impact module and thus may be used e.g. as switching output for a WTG.

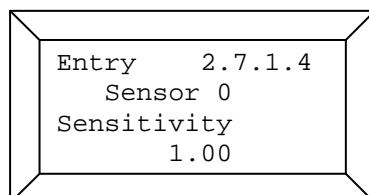


```
Entry    2.7.1.3
Sensor 0
Modus Output: 1
Target Output: 0
```

The third line of the display shows the current mode of the output. Using the numerical keys, you can now enter the desired mode (1 or 0). Confirm your entry by pressing the *Enter* key.

### 2.2.7.1.4 Entering the Sensitivity (Menu 2.7.1.4)

In the Sensitivity menu you can enter the threshold for regarding the light intensity as sufficient. The default value of the light sensor sensitivity is 1.00. By increasing the sensitivity the threshold will decrease.



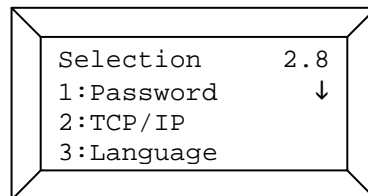
```
Entry    2.7.1.4
Sensor 0
Sensitivity
1.00
```

When you open the menu it may take a few seconds for the light sensor sensitivity to be displayed as it needs to be queried.

Enter the desired sensitivity for the light sensor using the numerical keys and confirm your entry by pressing the *Enter* key.

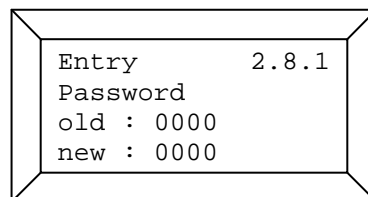
## 2.2.8 Miscellaneous (Menu 2.8)

Use this menu to change the password for the settings menu, set parameters for the network, or select the menu language. Select a menu item by pressing the corresponding numerical key.



### 2.2.8.1 Setting the Password (Menu 2.8.1)

Enter your new password using the numerical keys. Confirm your entry by pressing the *Enter* key.

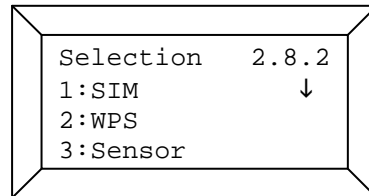


**Note:** The password is required to access the *Settings* menu. Please do not forget your password. The *Display* menu can be accessed without password.



### 2.2.8.2 TCP/IP (Menu 2.8.2)

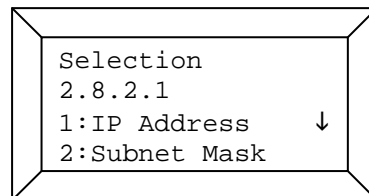
Use this menu to set network parameters. Start by selecting a network area (shadow impact module (SIM), wind park (WPS), light sensors or PROFIBUS gateway).



```
Selection  2.8.2
1:SIM      ↓
2:WPS
3:Sensor
```

#### 2.2.8.2.1 Shadow Impact Module Network Parameters (Menu 2.8.2.1)

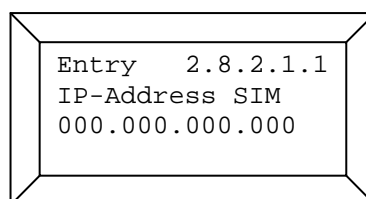
Use this menu item to select the shadow impact module network parameters to be changed.



```
Selection
2.8.2.1
1:IP Address  ↓
2:Subnet Mask
```

##### 2.2.8.2.1.1 Shadow Impact Module IP Address (Menu 2.8.2.1.1)

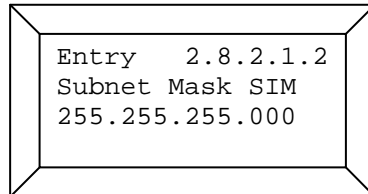
Use this menu to set the IP address of the shadow impact module.



```
Entry  2.8.2.1.1
IP-Address SIM
000.000.000.000
```

### 2.2.8.2.1.2 Shadow Impact Module Subnet Mask (Menu 2.8.2.1.2)

Use this menu to set the subnet mask of the shadow impact module.

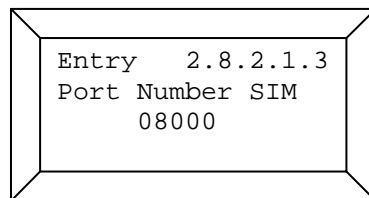


```
Entry 2.8.2.1.2
Subnet Mask SIM
255.255.255.000
```

Usually, the default value (255.255.255.000) should not be changed.

### 2.2.8.2.1.3 Shadow Impact Module Port Number (Menu 2.8.2.1.3)

Use this menu to set the port of the shadow impact module.

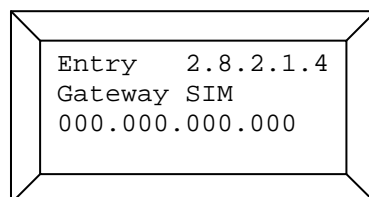


```
Entry 2.8.2.1.3
Port Number SIM
08000
```

Usually, the default value (8000) should not be changed.

### 2.2.8.2.1.4 Shadow Impact Module Gateway (Menu 2.8.2.1.4)

Use this menu to set the gateway of the shadow impact module.

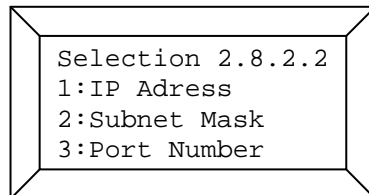


```
Entry 2.8.2.1.4
Gateway SIM
000.000.000.000
```

The gateway must be entered only if a VPN dial-in function is available in the shadow impact module.

### 2.2.8.2.2 Wind Park Server Network Parameters (Menu 2.8.2.2)

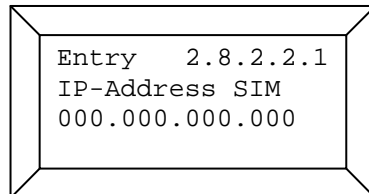
Use this menu item to select the wind park server network parameters to be changed.



```
Selection 2.8.2.2
1:IP Adress
2:Subnet Mask
3:Port Number
```

#### 2.2.8.2.2.1 IP Address of the Park Server (Menu 2.8.2.2.1)

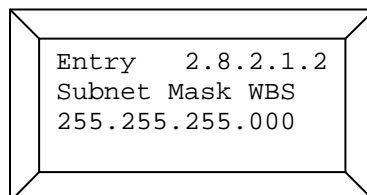
Use this menu to set the IP address of the park server.



```
Entry 2.8.2.2.1
IP-Address SIM
000.000.000.000
```

#### 2.2.8.2.2.2 Park Network Subnet Mask (Menu 2.8.2.2.2)

Use this menu to set the subnet mask of the park network.

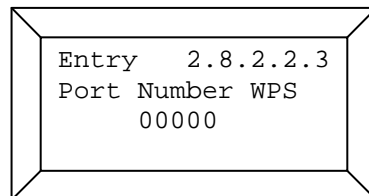


```
Entry 2.8.2.1.2
Subnet Mask WBS
255.255.255.000
```

Usually, the default value (255.255.255.000) should not be changed.

### 2.2.8.2.2.3 Port Number of the Park Server Application (Menu 2.8.2.2.3)

Use this menu to set the port of the park server application.

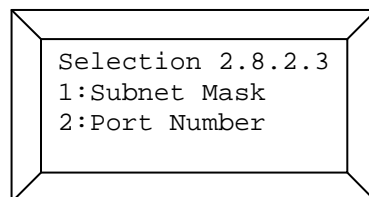


```
Entry 2.8.2.2.3
Port Number WPS
00000
```

### 2.2.8.2.3 Network Parameters of the Light Sensors (Menu 2.8.2.3)

Use this menu item to select the network parameters of the light sensors to be changed.

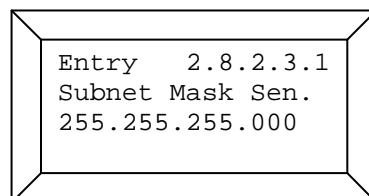
The IP addresses of the light sensors can be set in Menu 2.7.1.1.



```
Selection 2.8.2.3
1:Subnet Mask
2:Port Number
```

#### 2.2.8.2.3.1 Subnet Mask of the Light Sensors (Menu 2.8.2.3.1)

Use this menu to set the subnet mask for the light sensor network.

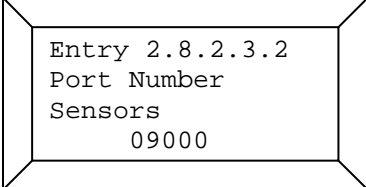


```
Entry 2.8.2.3.1
Subnet Mask Sen.
255.255.255.000
```

Usually, the default value (255.255.255.000) should not be changed.

### 2.2.8.2.3.2 Port Number of the Light Sensors (Menu 2.8.2.3.2)

Use this menu to set the port of the light sensors.

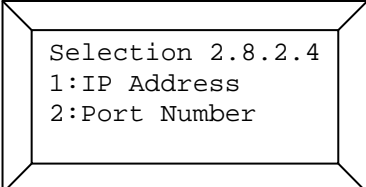


```
Entry 2.8.2.3.2
Port Number
Sensors
09000
```

Usually, the default value (09000) should not be changed.

### 2.2.8.2.4 Network Parameters of the PROFIBUS Gateway (Menu 2.8.2.4)

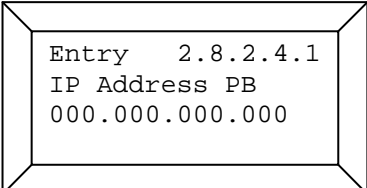
Use this menu item to select the PROFIBUS gateway network parameters to be changed.



```
Selection 2.8.2.4
1:IP Address
2:Port Number
```

#### 2.2.8.2.4.1 IP Address of the PROFIBUS Gateway (Menu 2.8.2.4.1)

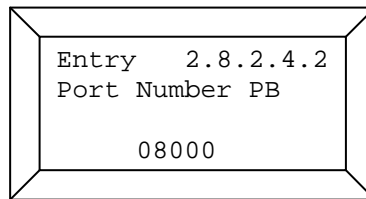
Use this menu to set the IP address of the PROFIBUS gateway.



```
Entry 2.8.2.4.1
IP Address PB
000.000.000.000
```

### 2.2.8.2.4.2 Port Number of the PROFIBUS Gateway (Menu 2.8.2.4.2)

Use this menu to set the port of the PROFIBUS Gateway.

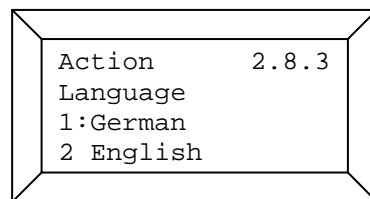


```
Entry    2.8.2.4.2
Port Number PB
        08000
```

Usually, the default value (08000) should not be changed.

### 2.2.8.3 Selecting the Menu Language (Menu 2.8.3)

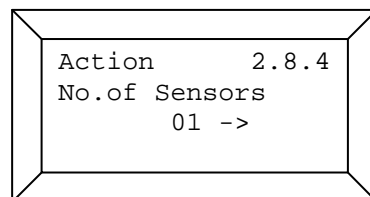
Use this menu to select the menu language by pressing the respective numerical key.



```
Action    2.8.3
Language
1: German
2 English
```

### 2.2.8.4 Entering the Number of Light Sensors (Menu 2.8.4)

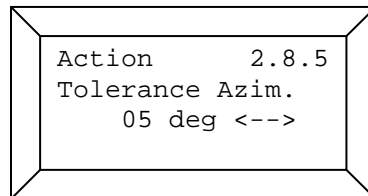
In this menu, you can set the number of light sensor generators by pressing the respective arrow key.



```
Action    2.8.4
No. of Sensors
        01 ->
```

### 2.2.8.5 Entering the Azimuth Tolerance (Menu 2.8.5)

In this menu, you can set the azimuth tolerance by pressing the respective numerical key.



Entering the azimuth tolerance is required only if the shadow impact calculations take into account the nacelle position of the WTG. The range is 0 ° to 15 °. The azimuth tolerance reduces the calculated difference between the sun azimuth and the nacelle position measured. The higher the azimuth tolerance value set, the wider the calculated shadow impact ellipse of the rotor. Thus, the azimuth tolerance can be used to improve security regarding the shadow impact calculations.

## 2.2.9 Control Check (Menu 2.9)

To check whether the wind turbine generators are controlled correctly, you can use this menu to start and shut down the wind turbine generator using the shadow impact module.

```
Selection      2.9
Control Test
WTG Number 03 →
```

Start by using the arrow keys to select the wind turbine generator you wish to switch on/off. Confirm your entry by pressing the *Enter* key. The following will be displayed:

```
Action      2.9.1
Status WTG 03: 1
WTG Stop = F1
WTG Start = F2
```

The current status of the wind turbine generator selected is displayed in the 2<sup>nd</sup> line. Status 1 means that the wind turbine generator has been released by the shadow impact module, status 0 means that the shadow impact module has generated a STOP command for the wind turbine generator. The status displayed does not reflect the actual condition of the WTG.

To shut down the wind turbine generator please press the *F1* key, to start press the *F2* key. To quit the menu, press *Clear*.



### 3. Maintenance of the Shadow Impact Module

The shadow impact module is maintenance-free to a great extent. However, the light sensors should be checked for dirt on a regular basis and be cleaned as necessary.

After commissioning the shadow impact module, you should check the shut down times for plausibility in order to exclude errors in the shadow impact module configuration.

The shadow impact log should be read-out and backed-up on a regular basis.

## 4. Technical Documentation

### 4.1 General Specifications

#### Shadow Impact Module V3.5

Dimensions without switch cabinet:	134 x 483 x 280 mm (H x W x D)
Dimensions including switch cabinet:	500 x 500 x 350 mm (H x W x D)
Weight without switch cabinet:	approx. 1 kg
Weight including switch cabinet:	approx. 25 kg
Supply voltage:	100 - 230 V AC
Max current:	1,3 A
Operating temperature:	-20°C ... 50 °C
Protection class without switch cabinet:	IP 20
Protection class including switch cabinet:	IP 65

#### Light Sensor V5M (metal frame)

Dimensions:	100 x 100 x 81 mm (H x W x D)
Weight:	approx. 1.5 kg
Supply voltage:	24 V DC
Max current:	1 A
Operating temperature:	-20 °C ... 50 °C
Protection class:	IP 66

#### Light Sensor V5 (plastic frame)

Dimensions:	80 x 65 x 80 mm (H x W x D)
Weight:	approx. 1.2 kg
Supply voltage:	24 V DC
Max current:	1 A
Operating temperature:	-20 °C ... 50 °C
Protection class:	IP 66

# Appendix 1

## Example Shadow Log

Date: 08.09.2008 to 08.09.2008

IO: No filter

WEA: No filter

Event: No filter

Entry	Date	Time	IO	WEA	Daycounter	Yearcounter	Wind direction	Wind speed	Rotation speed	Nacelle position	Power	State WEA	Event
1	08.09.2008	13:48:41	8	1	00:00:00	00:30:14			12,0	226	2399	1	Theoretical shadow impact
2	08.09.2008	14:04:43	8	1	00:00:00	00:30:14			13,0	220	3006	1	Shadow impact
3	08.09.2008	14:04:46		1					13,0	220	3006	1	Stop WEA
4	08.09.2008	14:45:15	8	1	00:01:16	00:31:30			0,0	220	0	0	Theoretical shadow impact
5	08.09.2008	14:47:00	8	1	00:01:16	00:31:30			0,0	220	0	0	Shadow impact
6	08.09.2008	14:50:40	8	1	00:01:16	00:31:30			0,0	220	0	0	Theoretical shadow impact
7	08.09.2008	14:55:39		1					0,0	220	0	0	Start WEA
8	08.09.2008	16:08:50	8	1	00:01:16	00:31:30			10,0	228	1670	1	Shadow impact
9	08.09.2008	16:08:53		1					10,0	228	1670	1	Stop WEA
10	08.09.2008	16:14:11	8	1	00:02:25	00:32:39			0,0	228	0	0	Theoretical shadow impact
11	08.09.2008	16:19:10		1					0,0	228	0	0	Start WEA
12	08.09.2008	16:22:35	8	1	00:02:25	00:32:39			8,0	228	1060	1	Shadow impact end

# Appendix 2

## Example Configuration Data

**configuration log**  
**shadow impact module SWM-3.5-0000**

**location 24980 Schafflund**

**Schleswig-Holstein, Germany**

**contractor**

Wind GmbH  
Energiesstr. 7, 20556 Hamburg

**client**

NorthTec GmbH & Co. KG  
Nylanndamm 4, 24980 Schafflund

**general project information**

**module location**

latitude:  
longitude:

WEA 1

9,13200° N

54,76800° E

menu item 2.3

**commissioning**

11.09.2008

**places of immission**

number of PI:

2

**wind turbine generators**

number of monitored WTG:  
number of preloading WTG:  
number of special cutoffs:

1

1

0

**coordinate format**

Gauß-Krüger Bessel

**datasources**

Shadow Forecast by NorthTec GmbH & Co. KG of 04.05.07  
Site Surveys by NorthTec GmbH & Co. KG of 11.09.08

**IO A, house**

Neuer Weg 8, 24980 Schafflund

PI number: 

menu item 2.4

height above sea level: 

menu item 2.4.1.1

**coordinates of walls:**

menu item 2.4.1.2

<b>wall 0:</b>	X (0,0)	<input type="text" value="3456 000"/>	height of wall:	<input type="text" value="3 m"/>
	Y (0,0)	<input type="text" value="5678 000"/>	wall orientation:	<input type="text" value="east"/>
	X (0,1)	<input type="text" value="3456 009"/>	status of wall:	<input type="text" value="active"/>
	Y (0,1)	<input type="text" value="5678 011"/>		
<b>wall 1:</b>	X (1,0)	<input type="text" value="3456 000"/>	height of wall:	<input type="text" value="5 m"/>
	Y (1,0)	<input type="text" value="5678 000"/>	wall orientation:	<input type="text" value="south"/>
	X (1,1)	<input type="text" value="3455 992"/>	status of wall:	<input type="text" value="active"/>
	Y (1,1)	<input type="text" value="5678 007"/>		
<b>wall 2:</b>	X (2,0)	<input type="text"/>	height of wall:	<input type="text"/>
	Y (2,0)	<input type="text"/>	wall orientation:	<input type="text"/>
	X (2,1)	<input type="text"/>	status of wall:	<input type="text"/>
	Y (2,1)	<input type="text"/>		
<b>wall 3:</b>	X (3,0)	<input type="text"/>	height of wall:	<input type="text"/>
	Y (3,0)	<input type="text"/>	wall orientation:	<input type="text"/>
	X (3,1)	<input type="text"/>	status of wall:	<input type="text"/>
	Y (3,1)	<input type="text"/>		
<b>wall 4:</b>	X (4,0)	<input type="text"/>	height of wall:	<input type="text"/>
	Y (4,0)	<input type="text"/>	wall orientation:	<input type="text"/>
	X (4,1)	<input type="text"/>	status of wall:	<input type="text"/>
	Y (4,1)	<input type="text"/>		

**coordinates of areas:**

menu item 2.4.1.3

<b>area 0:</b>	X (0,0)	<input type="text" value="3456 000"/>	X (0,1)	<input type="text" value="3455 995"/>	status of area:	<input type="text" value="active"/>
	Y (0,0)	<input type="text" value="5678 000"/>	Y (0,1)	<input type="text" value="5677 995"/>		
	X (0,2)	<input type="text" value="3455 991"/>	X (0,3)	<input type="text" value="3455 996"/>		
	Y (0,2)	<input type="text" value="5677 998"/>	Y (0,3)	<input type="text" value="5678 003"/>		
<b>area 1:</b>	X (1,0)	<input type="text"/>	X (1,1)	<input type="text"/>	status of area:	<input type="text"/>
	Y (1,0)	<input type="text"/>	Y (1,1)	<input type="text"/>		
	X (1,2)	<input type="text"/>	X (1,3)	<input type="text"/>		
	Y (1,2)	<input type="text"/>	Y (1,3)	<input type="text"/>		
<b>area 2:</b>	X (2,0)	<input type="text"/>	X (2,1)	<input type="text"/>	status of area:	<input type="text"/>
	Y (2,0)	<input type="text"/>	Y (2,1)	<input type="text"/>		
	X (2,2)	<input type="text"/>	X (2,3)	<input type="text"/>		
	Y (2,2)	<input type="text"/>	Y (2,3)	<input type="text"/>		

**load times:**

menu item 2.4.1.4

maximum load per year: maximum load per day: state of annual counter: beginning of the year: 

menu item 2.4.1.6

weekdays: 

menu item 2.4.1.7

## IO C, commercial property

Neuer Weg 14, 24980 Schafflund

PI number:

menu item 2.4

height above sea level:

menu item 2.4.1.1

### coordinates of walls:

menu item 2.4.1.2

<b>wall 0:</b>	X (0,0)	<input type="text" value="3456 100"/>	height of wall:	<input type="text" value="0 m"/>
	Y (0,0)	<input type="text" value="5678 400"/>	wall orientation:	<input type="text" value="east"/>
	X (0,1)	<input type="text" value="3456 110"/>	status of wall:	<input type="text" value="active"/>
	Y (0,1)	<input type="text" value="5678 401"/>		
<b>wall 1:</b>	X (1,0)	<input type="text"/>	height of wall:	<input type="text"/>
	Y (1,0)	<input type="text"/>	wall orientation:	<input type="text"/>
	X (1,1)	<input type="text"/>	status of wall:	<input type="text"/>
	Y (1,1)	<input type="text"/>		
<b>wall 2:</b>	X (2,0)	<input type="text"/>	height of wall:	<input type="text"/>
	Y (2,0)	<input type="text"/>	wall orientation:	<input type="text"/>
	X (2,1)	<input type="text"/>	status of wall:	<input type="text"/>
	Y (2,1)	<input type="text"/>		
<b>wall 3:</b>	X (3,0)	<input type="text"/>	height of wall:	<input type="text"/>
	Y (3,0)	<input type="text"/>	wall orientation:	<input type="text"/>
	X (3,1)	<input type="text"/>	status of wall:	<input type="text"/>
	Y (3,1)	<input type="text"/>		
<b>wall 4:</b>	X (4,0)	<input type="text"/>	height of wall:	<input type="text"/>
	Y (4,0)	<input type="text"/>	wall orientation:	<input type="text"/>
	X (4,1)	<input type="text"/>	status of wall:	<input type="text"/>
	Y (4,1)	<input type="text"/>		

### coordinates of areas:

menu item 2.4.1.3

<b>area 0:</b>	X (0,0)	<input type="text"/>	X (0,1)	<input type="text"/>	status of area:	<input type="text"/>
	Y (0,0)	<input type="text"/>	Y (0,1)	<input type="text"/>		
	X (0,2)	<input type="text"/>	X (0,3)	<input type="text"/>		
	Y (0,2)	<input type="text"/>	Y (0,3)	<input type="text"/>		
<b>area 1:</b>	X (1,0)	<input type="text"/>	X (1,1)	<input type="text"/>	status of area:	<input type="text"/>
	Y (1,0)	<input type="text"/>	Y (1,1)	<input type="text"/>		
	X (1,2)	<input type="text"/>	X (1,3)	<input type="text"/>		
	Y (1,2)	<input type="text"/>	Y (1,3)	<input type="text"/>		
<b>area 2:</b>	X (2,0)	<input type="text"/>	X (2,1)	<input type="text"/>	status of area:	<input type="text"/>
	Y (2,0)	<input type="text"/>	Y (2,1)	<input type="text"/>		
	X (2,2)	<input type="text"/>	X (2,3)	<input type="text"/>		
	Y (2,2)	<input type="text"/>	Y (2,3)	<input type="text"/>		

### load times:

menu item 2.4.1.4

maximum load per year:   
maximum load per day:   
state of annual counter:

beginning of the year:

menu item 2.4.1.6

weekdays:

menu item 2.4.1.7

## WTG 01

number of WTG:	<input type="text" value="01"/>	menu item 2.5
WTG identifier:	<input type="text" value="1"/>	
identifier type of WTG:	<input type="text" value="105"/>	
type of WTG:	<input type="text" value="xy"/>	
name shadow forecast:	<input type="text" value="WTG new"/>	
hub height:	<input type="text" value="100 m"/>	menu item 2.5.1.1
rotor radius:	<input type="text" value="45,80 m"/>	menu item 2.5.1.2
height above sea level:	<input type="text" value="5 m"/>	menu item 2.5.1.3
hub distance:	<input type="text" value="3,00 m"/>	
mean blade depth:	<input type="text" value="3,00 m"/>	
offset nacelle position:	<input type="text" value="0°"/>	
coordinates:		menu item 2.5.1.4
X:	<input type="text" value="3456 700"/>	
Y:	<input type="text" value="5678 200"/>	
switchable:	<input type="text" value="yes"/>	menu item 2.5.1.5
switching output:	<input type="text" value="0"/>	
reference light sensor:	<input type="text" value="0"/>	
follow-up time:	<input type="text" value="300 s"/>	menu item 2.5.1.6

---

## WTG 02

number of WTG:	<input type="text" value="02"/>	menu item 2.5
WTG identifier:	<input type="text" value="1"/>	
identifier type of WTG:	<input type="text" value="103"/>	
type of WTG:	<input type="text" value="xy"/>	
name shadow forecast:	<input type="text" value="WTG old"/>	
hub height:	<input type="text" value="80 m"/>	menu item 2.5.1.1
rotor radius:	<input type="text" value="40,00 m"/>	menu item 2.5.1.2
height above sea level:	<input type="text" value="6 m"/>	menu item 2.5.1.3
hub distance:	<input type="text" value="3,00 m"/>	
mean blade depth:	<input type="text" value="3,00 m"/>	
offset nacelle position:	<input type="text" value="0°"/>	
coordinates:		menu item 2.5.1.4
X:	<input type="text" value="3456 590"/>	
Y:	<input type="text" value="5677 680"/>	
switchable:	<input type="text" value="no"/>	menu item 2.5.1.5
switching output:	<input type="text" value="0"/>	
reference light sensor:	<input type="text" value="0"/>	
follow-up time:	<input type="text" value="0 s"/>	menu item 2.5.1.6

---



combination:

menu item 2.6

menu item:

<b>2.6</b>	<b>2.6.1.1</b>	<b>2.6.1.2</b>	<b>2.6.1.5</b>	
<b>number</b>	<b>WTG</b>	<b>PI</b>	<b>status</b>	<b>power output</b>
00000	01	001	active	deactivated
00001	01	002	active	deactivated
00002	02	001	active	deactivated
00003	02	002	active	deactivated

**communication data:**

**communication SIM:**

IP address:	192.168.001.060
subnet mask:	255.255.255.000
port:	8000
gateway:	192.168.001.254

**communication park server:**

IP address:	000.000.000.000
subnet mask:	255.255.255.000
port:	0

**communication profibus:**

IP address:	000.000.000.000
software version:	-

**data of light sensors:**

number of light sensors:

menu item 2.7.1

**light sensor 00:**

number of light sensor:

IP address:

subnet mask:

port:

hysteresis:

menu item 2.7.2

# Appendix 3

## Declaration of Conformity

## Declaration of Conformity

NorthTec GmbH & Co. KG  
Nylanndamm 4  
24980 Schafflund  
Germany,

hereby declares that the product

### Shadow Impact Module SWM

#### Version 3.5

in the design marketed by us complies with the requirements of the EC Directives.  
Alterations to this product which have not been authorized by us will invalidate this declaration.

Relevant EC directives:

73/23/EEC (Low Voltage Directive)

Amended by

2006/95/EEC

Harmonised standards applied:

DIN EN 55011 (8/03)

DIN EN 55022 (9/03)

DIN EN 61000-3-2 (12/01)

DIN EN 61000-3-3 (5/02)



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Marcus Hartmund, Dipl.-Ing (FH)  
Managing Director  
April 2008