Comparative testing of windmeasuring equipment

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COMPARATIVE TESTING OF
WINDMEASURING EQUIPMENT
part I: inventory and selection

HANS SCHOTTE
August 1986  
R-814-D

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Technical University Eindhoven
SUMMARY

This report is the result of the first part of a comparative study of wind measuring equipment. It contains an overview of commercially available systems, based on documentation.

There has been made a division into four classes, according to the measuring possibilities of each instrument. The characteristics of the systems belonging to each class are listed in tables.

After the documentation study quotations were asked for several systems, which has led to the selection of some equipment which will be purchased in order to carry out the second part of the study: the testing of interesting equipment.

Together with some systems that were already available the testing program will include the following wind measuring equipment:

- Windruncounters: ART Windwatch, Datak WP4A, Ekopower 2F, Natural Power A22;
- Systems processing frequency distributions, etc.: Ekopower 3N, Datak WP16, NEW Windlogger, Secondwind AI-2000;
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1. **INTRODUCTION**

CWD promotes the interest for windenergy in developing countries and aims to help governments, institutions and private parties in the Third World with their efforts to utilize wind energy. In relation to these activities CWD is interested in wind measuring equipment and their suitability for various types of measurements. In the past an overview of commercially available systems was made (ref.1). Several systems were purchased and tested (ref.2). In the last few years new types of dataloggers have appeared, which store information sequentially in solid state memories, that were hardly available some years ago. Besides, some important manufacturers (like Aeolian Kinetics and Helion) have ceased business and others made their appearance on the market. In order to keep the (practical) knowledge about wind measuring systems within CWD up to date a proposal has been made for comparative testing of wind measuring equipment. In this proposal two phases were described:

. as a first step the available commercial documentation will be organized and completed and a selection of interesting devices to be tested will be made;

. the second phase involves windtunnel tests, climate chamber tests and outdoor, functional tests.

This report contains the results of the first phase. The knowledge can be used for consulting, selection of equipment for CWD projects and/or backstopping of projects using the equipment. Also the results will be published as part of CWD's transfer of knowledge efforts.
In this report the following chapter shortly describes the way of classification of the equipment. It is followed by chapter 3 which contains information about the various wind measuring systems. In the last chapter the selection of some interesting types which will be purchased is presented.
2. CLASSIFICATION

Wind measuring equipment can be subdivided into 4 classes, according to Wegley e.a. (ref.3), based on their data storage capability. This storage capability walks along with the application of the instrument.

<table>
<thead>
<tr>
<th>class nr.</th>
<th>data storage capability</th>
<th>primary application</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>none (instantaneous wind speed meters)</td>
<td>comparison of current wind speeds with WECS output</td>
</tr>
<tr>
<td>II</td>
<td>single storage register (wind run counters)</td>
<td>siting studies, determine weekly and monthly average wind speeds</td>
</tr>
<tr>
<td>III</td>
<td>processed information (frequency distributions)</td>
<td>measurement of frequency distribution; calculation of e.a.) is stored in more energy output of wind than one storage register; machines; estimation of short-time averages are Weibull parameters lost</td>
</tr>
<tr>
<td>IV</td>
<td>short-time averages (during a set period) are sequentially stored; distributions can be calculated (by means of a computer, for example)</td>
<td>making wind surveys over large areas; professional siting studies for larger systems</td>
</tr>
</tbody>
</table>

*Table 1: classification of wind measuring equipment (ref.3)*
Classes I to III are specific for wind measurements, but this doesn't count for class IV-instruments: all kind of dataloggers which have the appropriate input-port (e.g. pulse-counting) can be used, the necessary calculations can be made afterwards on a computer.

Therefore class IV is divided into 2 subclasses:

- IV-a contains dataloggers which are specially designed for wind measurements;
- IV-b contains more general dataloggers which can monitor various instruments (e.g. other meteorological sensors and windmills or wind turbines).
3. COMMERCIAIIY AVAILABLE WIND MEASURING SYSTEMS

Before overviewing the available equipment it should be noted that all kind of documentation has been studied, but only "outdoor-models" (systems that are supposed to be resistant against rain, sunshine, dust, etc.) were taken into account (this means for example that equipment using strip-chart recorders is not considered in this report). Also the equipment belonging to class I (limited possibilities) and class IV-b is not considered. The latter because these dataloggers are too extensive and in most cases also too expensive. It is also too cumbersome to prepare this equipment for wind measurements, because it cannot be delivered completely and "ready for use".

In the next paragraphs a listing of the commercially available equipment is made, followed by a table in which the main characteristics of each instrument are presented (in order to ease the comparison of the various systems).

3.1 Class II-systems

These systems usually consist of two main parts, the anemometer and the counter unit. Sometimes these two elements are combined to a "totalizing anemometer". The counter unit can have electric counters (LCD, LED) or mechanical counters.

1. Atmospheric Research & Technology - Windwatch

To the counter unit belongs a Maximum anemometer (AC-type). The panel of the Windwatch has no switches or buttons, only an 8 digit LCD display, which shows the wind run and the instantaneous wind speed (sampled every second).
The storage capability is doubled by the use of an overflow indicator which shows that the counter has returned to zero. Also battery indicators are present.

2. **Belfort - 5-349C**

This totalizing anemometer has a counter which is connected directly to the anemometer by a spindle and gear system. There is also an electrical pulse output, but Belfort doesn't deliver an accumulator which can be connected to it.

3. **Casella - W1224**

This also is a totalizing anemometer, which works on the same principle as the Belfort-type. There is, however, no electrical output, so reading the mechanical counter (which is only just beneath the anemometer) is necessary.

4. **Datak Systems - WP4A**

The WP4A is delivered with a Datak Systems anemometer. The LCD display shows the wind run through a transparent display window. A magnetically activated switch allows the display to be reset without opening the enclosure.

5. **Ekopower - Wind monitor EKO2F**

The wind monitor EKO2F, which uses the Maximum AC-generating anemometer, can measure wind run which in the standard form is shown on an electromechanical counter that can be read without opening the case. This type has many options, like a LCD counter, wind speed indication (analogue or LCD), maximum gust indication, other type anemometer, recorder output, operation time counter.
6. **Natural Power - A22**

This system also uses a Maximum anemometer (AC-type). It has a 7 digit LED, which can be read by pushing a non-fixable switch.

7. **NRG Systems - Wind Totalizer 2800**

The 2800 has an internal lithium battery, providing 10 years or more of operation without changing batteries. The present wind speed is displayed with a blinking colon (:); the blinkrate equals the wind speed.

8. **Parkway Energy Products - Wind run accumulator**

This accumulator uses a contact anemometer. The mechanical counter which is resettable shows the total wind run. The instantaneous fastest mile of wind to pass can be read when using a special module (optional).

9. **Summit Controls - Wind run Totalizer WGC-100**

This system uses an AC-generating anemometer. The wind run is accumulated in an 8 digit counter and continuously displayed on a LCD readout. There are no pushbuttons, switches or doors. The total count can be reset by momentarily removing the battery pack.

10. **Weathermeasure/Weathertronics - Totalizing anemometer**

The totalizing anemometer is of the same type as the Belfort product. A mechanical counter is driven directly by the rotating anemometer. It has an electrical contact output (no special counter for remote use available).
<table>
<thead>
<tr>
<th>CLASS II</th>
<th>Bel-</th>
<th>fort</th>
<th>Datak Eko-</th>
<th>Nat.</th>
<th>Power</th>
<th>NRG</th>
<th>Park-</th>
<th>Sum-</th>
<th>Weath.</th>
</tr>
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<tbody>
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<td>Syst.</td>
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<td>-</td>
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<td>Li-cel</td>
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<td>6</td>
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<td>120</td>
<td>1</td>
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<td>+</td>
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<td>+</td>
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<td>?</td>
<td>45</td>
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<td>23</td>
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<td>2315</td>
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<td>372</td>
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<td>$100</td>
<td>$195</td>
</tr>
</tbody>
</table>

* = days at 5 m/s  
 m.c. = mechanical counter  
 o = optional  
 max40 = Maximum type #40
3.2 Class III-systems

When using one of these instruments it is not necessary to make use of more dataprocessing apparatus: all the necessary calculations to obtain output like frequency distributions, etc. take place inside the system itself.

1. Berewoud Energie - Wind classifier "Windwijs"

The Windwijs is the Dutch trade-name for the Wuwikl from Wuseltronick. It is available in three versions. The standard version offers a frequency distribution in 20 classes, a calm-duration distribution in 8 classes and measurement of the maximum wind speed. The LCD display allows operation checks, delivers data output and offers the actual wind speed every minute. Another way of data reading is by use of a printer (optional).

2. Datak Systems - WP16

This wind frequency analyzer stores a frequency distribution in 16 bits. The bin width is factory programmable. The readout of the data goes by 6 digit LCD's (16x) which can be read continuously.

3. Ekopower - Windregime Analyzer EKO3N

The EKO3N also stores a frequency distribution in 7 non-volatile wind class counters (options: 10 or 13 classes). Furthermore the wind run and the operation time are counted. More options are the instantaneous wind speed (analogue or LCD), maximum gust indication, other type anemometer (instead of Maximum), recorder output.
4. **Environdata - Anemometer Analyzing Recorder (Anarec)**
The Anarec can in fact also be compared with class IV instruments, because it is possible to retrieve hourly wind speed averages covering a 5 week period. The data can be read manually or transferred to an Apple computer. The main function, however, is storing wind speeds in an 18 bin frequency distribution which can be read from a 4 digit display. It is also possible to read the present wind speed. When the anemometer is not connected to the recorder for more than one hour, the Anarec will enter a "sleep" mode. Then a control box is needed to reactivate the system.

5. **G.T.S. - Anemometer Euclide Pw**
The Euclide prints out hourly wind speed averages and there is an analogue indication of the instantaneous wind speed. It is necessary to operate the system by means of a solar panel.

6. **M.A.N. - Wind Classifier**
This wind classifier stores the wind speed in 5 classes (displayed by mechanical counters). There is also a total counter. The present wind speed is shown on an analogue display. It is not possible for the system to operate on batteries: a choice can be made between a solar panel or 220V-AC.

7. **Northumbrian Energy Workshop - Windlogger**
The Windlogger has a 30-bin frequency distribution. It must be read by a 16 digit LCD display, which also gives the present wind speed and the total elapsed time (when reading the data). Reading the distribution can be done at any time by using a single switch.
8. **NRG Systems - Wind Challenger 7010**

The Wind Challenger continuously computes and displays several functions: present wind speed, average wind speed, peak wind gust, hour of peak wind gust, elapsed time, power density, hours above cut-in speed and duration of wind energy lull below setpoint (cut-in speed and setpoint are user selectable).

These functions all have instantane values (because the Wind Challenger has a volatile memory) which can be displayed by using a select button.

9. **Parkway Energy Products - Wind Site Analyzer**

The Wind Site Analyzer records wind run counts over distinct periods of time. Each of 4 mechanical counters can be pre-programmed to record wind counts during a special period. These periods are automatically repeated on a specific day, for an entire week, a month or a year.

10. **Secondwind - Al 2000**

The Al 2000 system stores a wind speed frequency distribution, a 2 hour diurnal distribution and a wind direction distribution. It also memorises the maximum wind speed, the duration of the longest energy lull and their time of occurrence, on a monthly basis. Furthermore it is possible to read the present wind speed. The stored data can be accessed directly from the front panel of the instrument by using the selection keyboard.
### CLASS III

<table>
<thead>
<tr>
<th></th>
<th>Bere-woud</th>
<th>Datak Eko-Syst.</th>
<th>Env. power data</th>
<th>GTS</th>
<th>MAN</th>
<th>NEW</th>
<th>NRG</th>
<th>Park-way</th>
<th>Sec. wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>dimensions (cm.cm.cm)</td>
<td>? 22.12 17.13 14.12</td>
<td>? 16.8 32.22 20.17</td>
<td>? 25.20</td>
<td>.8</td>
<td>.9</td>
<td>.11</td>
<td>.6</td>
<td>.5</td>
<td>.14</td>
</tr>
<tr>
<td>weight (kg) batteries</td>
<td>+ + + + + + + + + + +</td>
<td>0.9</td>
<td>1.5</td>
<td>0.7</td>
<td>?</td>
<td>?</td>
<td>0.8</td>
<td>?</td>
<td>?</td>
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<td>batterylife (months)</td>
<td>6 12 6 1 ?</td>
<td>12 12 ?</td>
<td>12</td>
<td>6</td>
<td>7</td>
<td>0.3</td>
<td>6</td>
<td>7</td>
<td>0.3</td>
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<tr>
<td>anemometer included</td>
<td>+ - max40 + + + + max40 max40 max40</td>
<td>45 45</td>
<td>60</td>
<td>60</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>max.speed (m/s) display</td>
<td>LCD 9xLCD 9x.m.c. ?</td>
<td>- 6x.m.c. LCD LCD 4x.m.c. LED+ LCD LCD LCD</td>
<td></td>
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<td>digits</td>
<td>? 6 5 4</td>
<td>4 16 4 5 ?</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>instant. speed</td>
<td>+ - o - - + + + + ? +</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>peak wind speed</td>
<td>+ - o - - - - - + - +</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>diurnal distrib.</td>
<td>+ - - - + - - - - + +</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>direction distrib.</td>
<td>- - - - - - - - + + +</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>calm distrib.</td>
<td>+ - - - - - - - + - +</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>standard deviation data retrieval</td>
<td>D,Pr D D D Pr D D D D D D</td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

* = days at 5 m/s  
m.c. = mechanical counter  
o = optional  
max40 = Maximum type #40  
D = display  
Pr = printer
3.3 Class IV - systems

These dataloggers can be subdivided into:

IV-a: sequential dataloggers for wind speed and/or direction;
IV-b: sequential dataloggers for wind turbine performance and more general purpose multifunctional dataloggers.

Characteristic of both classes is that only averages are stored: in order to obtain frequency or diurnal distributions, etc. more data processing apparatus is necessary (computer, processing software, interface between datalogger and computer).

3.3.1 IV-a: dataloggers for wind measurements only

1. Atmospheric Research & Technology - Windwatch II/squirrel
   The Windwatch II is the same as the Windwatch, except that it offers the possibility to install a squirrel memory module, which can store 30 or 60 minute wind speed averages (for 42 or 85 days). To read the data the squirrel must be interfaced to a computer by means of an RS-232 converter for squirrel-data, which can be purchased from ART. There is also software available (for IBM computers) to calculate daily, diurnal, wind speed and power distributions.

2. Ekopower - Wind datalogger EKO10
   There are several Ekopower wind dataloggers available. In table 4 the main features of the EKO10B are listed. The recording interval of the EKO10 dataloggers offers various possibilities: one can choose between freely programmable intervals (1 sec. to 100 min.), 10/60 min. intervals (front selectable) and 10/20/.../100 min. intervals (internally
adjustable). Recording the maximum gust is optional. The datalogger unit can be taken separately to a computer or a portable computer can be taken to the field. Data are read into the computer by use of a data transfer program which is delivered with the datalogger. Some standard software for data analysis can be purchased from Ekopower (appropriate for IBM, Epson and compatibles).

3. **Environdata - Easidata**

The Easidata system can measure wind speed and wind direction averages and wind speed peak values over any interval, which must be specified at order. The datalogger is delivered with the user specified program contained in an EPROM. Data can be read on site by means of a portable computer or printer or by direct cable link to a central (office) computer.

4. **Natural Power - Compilator A30-501**

The sample period of the Compilator is selectable from 1 sec. to 8 hrs. Data can be read by means of cassette tape (which can be directly unloaded into Apple and IBM computers without need of a tape recorder), by means of the standard printer output, or manually by display. There is software available for data analysis. Besides speed averages also peak wind speed, time of occurrence and present wind speed and direction can be displayed.

5. **Omnidata - Wind recorder DP214**

The Datapod 214 measures wind speed and direction averages over one of 8 user setable recording intervals. Data are stored in an EPROM. This can be read manually by display, or by the use of a
special EPROM reader which can be connected to a computer by means of an RS-232-c serial interface.

It is possible to transmit data directly on command of the reader, so no data retrieving software is needed. There is no data processing software available.

In order to erase the EPROM a UV erasing lamp can be purchased from Omnidata.

6. **Secondwind - Al-2000S**

The Al-2000S is an extended version of the Al-2000. In addition to the data sets maintained by the Al-2000, the S-version records hourly average wind speeds in series. It is possible to read the data by display, but there also is a special EPROM reader available (and an EPROM eraser), as well as transferring and processing software for IBM computers.

7. **Summit Controls - Datalogger system WGC-110**

The WGC-110 collects data in an EPROM memory. The recording period is switch selectable (15, 30 or 60 min.). There are pushbuttons and indicators for control of batteries and sensors. Data retrieving goes by means of an EPROM reader which is not directly available at Summit Controls. Also an erasing lamp and software cannot be ordered directly.
<table>
<thead>
<tr>
<th>CLASS IVa</th>
<th>ART</th>
<th>Eko-data</th>
<th>Nat.data</th>
<th>Omni-data</th>
<th>Sec.wind</th>
<th>Summit</th>
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<td>-30</td>
<td>-25</td>
<td>-10</td>
<td>-40</td>
<td>-35</td>
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<td></td>
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<td>65</td>
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<td>70</td>
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<tr>
<td>anemometer</td>
<td>max40</td>
<td>max40</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>max40</td>
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<td>max.speed (m/s)</td>
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<td>45</td>
<td>?</td>
<td>?</td>
<td>?</td>
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<td>display</td>
<td>LCD</td>
<td>LCD</td>
<td>LED</td>
<td>LCD</td>
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<td>-</td>
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<tr>
<td>digits</td>
<td>8</td>
<td>?</td>
<td>8+2</td>
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<tr>
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<td>4kb</td>
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<td>retrieval processing software</td>
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</tr>
<tr>
<td>price *</td>
<td>$790</td>
<td>$6250</td>
<td>$3340</td>
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<td>**</td>
<td>$2485</td>
<td>$7045</td>
<td>$5250</td>
<td>$1800</td>
<td>$2025</td>
<td>$3050</td>
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</tbody>
</table>

* = standard  
** = complete (+ reader and software)  
o = optional  
var = variable (user settable)  
max40 = Maximum type #40  
D = display  
C = cassette recorder  
M = module reader  
E = EPROM reader  
P = portable computer
3.3.2 IV-b: more extensive dataloggers

It should be noted that this report describes specific wind measuring equipment. Therefore no attempt was made to make the class IV-b list complete.

1. Bottemanne - DP100 Dataprocessor
   There are several extensions (more inputs, analogue or digital) available for the DP100, which has 30 analogue and digital input channels. The standard way of data control and retrieval is by means of an Epson portable computer (storage on microcassette), but it is also possible to order an RS-232 interface and control and retrieve software for other computers.

2. Campbell Scientific - 21X Micrologger
   The standard 21X includes 32 inputs (analogue, digital). There is a connector on the front panel for serial data communication to cassette tape, memory module, modem, or printer. It can also be used for system programming (data processing, etc.) via remote terminal or computer. Data can also be read from display.

3. Data Electronics - Datataker 100F
   The datataker must be programmed with a computer. Then it can read up to 54 channels. The DT100F communicates with any computer via an RS-232/RS-422/RS-423 interface. It can be connected directly to a computer, there are no extra modules needed and no special software is necessary.
4. **Dulas Engineering - Datalogger**

There are 24 input channels available in this datalogger. In order to operate it with wind sensors special input modules are needed which can be delivered by Dulas. Communication to a computer goes by the BASIC computer language.

5. **Ekopower - EKO10C**

The EKO10C is another datalogger from the EKO10 family. It is designed for windpower evaluation. Recording channels are wind speed, wind direction, wind power output and density of air. There are no options for instantaneous speed indication or peak wind speed. Furthermore signal conditioning, data processing, etc. are the same as for the EKO10B.

6. **Grant - Squirrel meter/logger**

There are a lot of Squirrel models available, including some which can be used for wind measurements. The Squirrel can be used as a meter or recorder, or both at the same time. When used as a logger, recordings are taken from each channel and stored at user selected intervals. Recording is unaffected by use as a meter. Data can be read by display, by RS-232-c output, or as 8-bit parallel, under control of pushbuttons. There is standard software available for a number of computers (Epson, Apple, Hewlett Packard, e.g.) to carry out data transfer and analysis.
7. **New Energy Systems - Datalogger Modas 12**

The Modas 12 has 23 input channels. It uses plug-in memories for data storage. Data can be read by the use of a special transmitter unit with RS-232/V24-interfaces (transfer software included). Direct transferring and processing software can only be delivered for Commodore computers.
<table>
<thead>
<tr>
<th>CLASS IVb</th>
<th>Bottemanne</th>
<th>Camp-bell</th>
<th>Data Electr. Dulas</th>
<th>Grant</th>
<th>NES</th>
<th>Eko-power</th>
</tr>
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<tr>
<td>dimensions (cm.cm.cm)</td>
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<td></td>
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<td></td>
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<td>temp.range (deg.C)</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>display</td>
<td>LCD</td>
<td>LCD</td>
<td>-</td>
<td>-</td>
<td>LCD</td>
<td>LCD</td>
</tr>
<tr>
<td>digits</td>
<td>?</td>
<td>8</td>
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<td>?</td>
<td>4</td>
<td>?</td>
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<td>?</td>
<td>2</td>
<td>8</td>
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<td>18</td>
<td>46</td>
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<td>$2000</td>
<td>1600</td>
<td>f2700</td>
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</table>

* = kb RAM
var = variable (user settable)
D = display
M = modulereader (RAM)
C = cassette recorder
P = portable computer
4. SELECTION OF INTERESTING EQUIPMENT FOR TESTING

In a first stage a rough selection (based on documentation) has been made to decide for which instruments quotations should be asked for. Based on these quotations it was decided which instruments will be purchased for testing.

As a result of the first selection 4 class II systems, 6 class III systems and 1 class IVa system were taken out of consideration:

- **class II**: 3 of the 4 drop-outs are totalizing anemometers (Belfort, Casella, Weathertronics) which are very unpractical;
  furthermore the information about the Parkway accumulator is quite old and a demand for recent documentation was not replied to;
  the Natural Power A22 and the EK02F were already available at WEG.

- **class III**: the Berewoud, the Environdata and the Secondwind products are relatively too expensive for class III instruments;
  the M.A.N. Windclassifier cannot operate on batteries;
  for the Parkway Windsite Analyzer the same story holds as for the other Parkway product;
  the GTS Euclide is not very reliable as some testing on this instrument in Somalia has shown;
  the EK03N was already available.

- **class IVa**: the only datalogging instrument that is not taken into account is another Environdata product (Easidata), which is too expensive;
  again the Ekopower type was already available at WEG.
After the first selection, 7 manufacturers were asked for quotations on one or two of their products: Atmospheric Research & Technology, Datak Systems, Northumbrian Energy Workshop, NRG Systems, Omnidata International, Secondwind and Summit Controls Corporation. One month after sending the quotation inquiries the NRG and the Summit Controls companies had not returned a quotation yet, so these firms were not selected to order equipment from.

For class II this means that 4 wind run counters remain to be chosen from:

- the ART Windwatch is too expensive for just wind measurements;
- the Datak WP4A looks promising, so it will be purchased; the Ekopower 2F and the Natural Power A22 are already available.

In class III only 3 instruments are remaining: the Datak WP16 and the NEW Windlogger will be purchased; the Ekopower 3 is already available.

In class IV-a the only (new) dropout after the quotation inquiries is the Summit Controls WGC-110 (no reply). The other 5 systems seem worthwhile to be tested and 4 of them will be purchased (Ekopower 10B is already available).

It should be noted that the ART Windwatch can also be used as a wind run counter (the wind run version has the same configuration except for the possibility to insert a squirrel module) and that the Secondwind Al-2000S can also be used as the class III version Al-2000 (the only extra feature of the S-version is the recording of hourly averages).
Summarizing, the following instruments will be tested:

<table>
<thead>
<tr>
<th>Class</th>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class II</td>
<td>ART Windwatch, Datak WP4A, Ekopower 2F, Natural Power A22</td>
</tr>
<tr>
<td>Class III</td>
<td>Ekopower 3N, Datak WP16, NEW Windlogger, Secondwind Al-2000</td>
</tr>
<tr>
<td>Class IVa</td>
<td>ART Windwatch/squirrel, Ekopower 10B, Natural Power A30, Omnidata DP214, Secondwind Al-2000S</td>
</tr>
</tbody>
</table>
5. REFERENCES

Eindhoven University of Technology (nr.R-602-D);

[2] Test results of commercially available wind measuring systems, H. Schotte, 1985,
Eindhoven University of Technology (nr.R-725-D);

Windbooks.
ANNEX A: LIST OF MANUFACTURERS

Atmospheric Research & Technology, Inc.
6040 Verner Avenue
Sacramento, CA 95841, U.S.A.

Belfort Instrument Company
727 S.Wolfe Street
Baltimore, MD 21231, U.S.A.

Berewoud Energie
P.O. Box 223
3900 AE Veenendaal, The Netherlands

Bottemanne Weather Instruments
P.O. Box 70411
1007 KK Amsterdam, The Netherlands

Campbell Scientific, Inc.
P.O. Box 551
Logan, Utah 84321, U.S.A.

Casella London Ltd.
Regent House, Britannia Walk
London, N1 7ND, England

Dutch representative:
Hollinda b.v.
Eisenhowerlaan 112
2517 KM 's Gravenhage
The Netherlands
Datak Systems, Inc.
P.O. Box 129
Harmony, RI 02829, U.S.A.

Data Electronics
42 Rutland Road, Box Hill
Victoria, 3128, Australia

Dulas Engineering Ltd.
Llwyngwern Quarry, Machynlleth
SY20 9AZ, Wales

Ekopower
Monarchstraat 46
5641 GJ Eindhoven, The Netherlands

Environdata Australia Pty Ltd.
P.O. Box 395
Warwick, Queensland 4370, Australia

Grant Instruments Ltd.
Barrington
Cambridge CB2 5QZ, England

Dutch representative:
Depex b.v.
Dorpsstraat 85, P.O. Box 27
3730 AA De Bilt
The Netherlands

Dutch representative:
Ahrin Instrumenten b.v.
P.O. Box 80
2280 AB Rijswijk
The Netherlands
G.T.S.
C.P. 1691
20101 Milano, Italy

M.A.N.
Neue Technologie, Abt.EA
Dachauerstrasse 667
D-8000 Muenchen 50, West-Germany

N.A.T.
Dr. Falk Auer, Berliner Strasse 6
D-6456 Langenselbold, West-Germany

Natural Power Inc.
Francestown Turnpike
New Boston, NH 03070, U.S.A.

N.E.S.

Northumbrian Energy Workshop Ltd.
Tanners Yard, Gilesgate, Hexham
Northumberland NE46 3NJ, England

NRG Systems
Church Hill Road
Charlotte, VT 05445, U.S.A.

Dutch representative:
Rollo b.v.
P.O. Box 275
2501 CG's Gravenhage
The Netherlands
Omnidata International Inc.
P.O. Box 3489
Logan, Utah 84321, U.S.A.

Parkway Energy Products
22 Parkway Road, Suite 2
Brookline, MA 02146, U.S.A.

Secondwind, Inc.
7 Davis Square
Somerville, MA 02144, U.S.A.

Summit Controls Corporation
1215 High Street, Suite 103
Auburn, CA 95603, U.S.A.

Weathermeasure/Weathertronics
P.O. Box 41039
Sacramento, CA 95841, U.S.A.

Wuseltronick
Gneisenaustrasse 2
1000 Berlin 61, West-Germany

Dutch representative:
Intechmij b.v.
P.O. Box 43068
2504 AB 's Gravenhage
The Netherlands
## ANNEX B: DOCUMENTATION

**CLASS II:**

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<thead>
<tr>
<th>Manufacturer</th>
<th>Number of Pages</th>
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<td>Atmospheric Research &amp; Technology</td>
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<tr>
<td>Belfort Instrument Company</td>
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<tr>
<td>Casella London</td>
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</tr>
<tr>
<td>Datak Systems</td>
<td>1</td>
</tr>
<tr>
<td>Ekopower</td>
<td>2</td>
</tr>
<tr>
<td>Natural Power</td>
<td>1</td>
</tr>
<tr>
<td>NRG Systems</td>
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</tr>
<tr>
<td>Parkway Energy Products</td>
<td>1</td>
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<tr>
<td>Summit Controls Corporation</td>
<td>1</td>
</tr>
<tr>
<td>Weathermeasure</td>
<td>1</td>
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<tr>
<td>Specification</td>
<td>Details</td>
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<tr>
<td>---------------------------------------</td>
<td>---------------------------------------------</td>
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<tr>
<td>Display</td>
<td>8-digit LCD</td>
</tr>
<tr>
<td>Range</td>
<td>Wind distance: 0 to 199.999 km (0 to 125)</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>Wind speed: 0 to 99.999 km/h (0 to 60 mph)</td>
</tr>
<tr>
<td>Battery Voltage</td>
<td>4 alkaline C-cells</td>
</tr>
<tr>
<td>Battery Capacity</td>
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<tr>
<td>Battery Life</td>
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<tr>
<td>Operating Temperature Range</td>
<td>Dual low-battery indicators</td>
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<tr>
<td>Enclosure</td>
<td>Non-corrosive, weatherproof design.</td>
</tr>
<tr>
<td>Size</td>
<td>Height: 294 mm (11.6 in)</td>
</tr>
<tr>
<td>Weight</td>
<td>Width: 178 mm (7 in)</td>
</tr>
<tr>
<td>Weight</td>
<td>Depth: 152 mm (6 in)</td>
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<tr>
<td>Weight</td>
<td>Net: 2.7 kg (6 lb)</td>
</tr>
<tr>
<td>Weight</td>
<td>Shipping: 5.5 kg (12 lb)</td>
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<tr>
<td>Anemometer</td>
<td>Black Lexan, rotating magnet with long-life sensor</td>
</tr>
<tr>
<td>Accuracy</td>
<td>2% above 14 m/s (45 mph)</td>
</tr>
<tr>
<td>Accessories</td>
<td>Distance 1% toward 2%</td>
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<tr>
<td>Options</td>
<td>Included</td>
</tr>
<tr>
<td>Warranty</td>
<td>Units: Metric or English</td>
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<td>Warranty</td>
<td>15 days guarantee</td>
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<tr>
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<td>Concrete</td>
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<tr>
<td>Price</td>
<td>$5 (plus tax)</td>
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</table>

**Windwatch Specifications**

**Display**
- 8-digit LCD

**Range**
- Wind distance: 0 to 199.999 km (0 to 125)
- Wind speed: 0 to 99.999 km/h (0 to 60 mph)

**Power Requirements**
- Battery voltage: 4 alkaline C-cells
- Battery capacity: 0.200 mAh maximum (at 25°C)
- Battery life: 6 months minimum

**Battery Voltage**
- Dual low-battery indicators

**Operating Temperature Range**
- Dual low-battery indicators
- -40°C (-40°F) to 80°C (176°F)
- -30°C (-22°F) to 80°C (176°F)
- -40°C (-40°F) to 150°F (66°C)

**Enclosure**
- Non-corrosive, weatherproof design.
- Black Lexan, rotating magnet with long-life sensor

**Size**
- Height: 294 mm (11.6 in)
- Width: 178 mm (7 in)
- Depth: 152 mm (6 in)

**Weight**
- Net: 2.7 kg (6 lb)
- Shipping: 5.5 kg (12 lb)

**Anemometer**
- Black Lexan, rotating magnet with long-life sensor

**Accuracy**
- 2% above 14 m/s (45 mph)
- Distance 1% toward 2%

**Accessories**
- Included

**Options**
- Units: Metric or English
- Warranty: 15 days
- Parts and Labor: Concrete

**Price**
- $5 (plus tax)

**Customer Satisfaction Guarantee**
- Art is dedicated to high quality products and customer satisfaction. We are confident that our wind indicator is the finest available, and once you purchase a Windwatch indicator, we will refund your money if you are not satisfied with our product. Offer good for 15 days after purchase or delivery.

**Parts List**
- Windwatch indicator
- 4 Eveready ENERGIZER alkaline C-cells installed
- Maximum Type 40 anemometer
- Anemometer mounting tube and cotter key
- 50 ft twisted-pair 20 gage anemometer cable with terminals
- 6 black nylon cable ties
- 4 spare cable connectors
- 4 ft grounding wire
- 2 No. 20 hose clamps
- 4 4½" x 1/4" carriage bolts
- 4 sleeves for bolts
- 4 nuts (stainless steel)
- 2 1½" H.W. mast straps
- Operator's manual
- Log sheets

**Atmospheric Research & Technology, Inc.**
- 6040 Verner Ave
- Sacramento, CA 95841
- (916) 332-2255 (916) 332-2373
- Telex 171627 Twx 9103790029
WINDWATCH® SETS NEW STANDARDS FOR WIND DISTANCE MEASUREMENT

Mean wind speed is a standard climatological wind measurement and the single most important rate, for estimating energy output of wind machines. The WINDWATCH® digital distance and speed indicator shows you the accumulated wind distance and the instantaneous wind speed. To get mean wind speed, divide elapsed distance by elapsed hours. The Windwatch indicator can be used either as an independent recorder or in area wide studies in association with a separate nearby time-resolved recorder.

Dual battery holders each hold four C-cells. Made of non-corrosive stainless steel, they maintain high pressure on the battery terminals and meet MIL Spec 17919. Only one battery holder (four C-cells) is necessary to operate the Windwatch. The second holder allows you to load new batteries before removing old batteries. This keeps the wind distance accumulator operating continuously. Polarized terminals (red caps) allow battery contact only when the positive terminal is up. Each holder has a sign showing the positive battery direction. Velcro straps retain the batteries during shock or vibration.

Extremely low power consumption extends battery life, reduces operating cost and increases reliability. Each Windwatch indicator is shipped with four alkaline C-cells installed. When you open your Windwatch, the display will be operating. Four alkaline C-cells provide approximately five times the battery capacity needed for 12 months of normal operation. Alkaline C-cells are economical, readily available and provide extended temperature operation.

Tough fiberglass enclosure has NEMA (National Electrical Manufacturers' Association) Type ratings 4, 4X and 13 for corrosion-resistant, weather-tight, dust-tight and oil-tight performance. Hinges and quick-release latches are corrosion-resistant stainless steel. A lockable hasp allows you to add your lock. Battery wires are 16x30 18g tinned copper with vinyl insulation, rated -40°C to +80°C for high flexibility, toughness and outdoor durability.

100% high-quality components are rated to operate from -40°C (-40°F) to +80°C (176°F). The LCD dims below -30°C (-22°F) but data is not lost. The circuit board is rubber mounted for shock resistance. All components and cables are soldered for high reliability. All cable exits are strapped. Corrosion inhibitor tape is used behind the circuit board. Built in lightning resistant circuitry includes a gas surge arrester, a power absorbing diode and a self-healing capacitor. The Windwatch is designed to withstand large voltage surges and continue operating without data loss.

Four mounting holes, access only when the door is open, are corrosion-resistant stainless steel bolts for durability and easy attachment. The left bolt is for a grounding wire. The other two bolts are the anemometer cable.

Dual battery holders each hold four C-cells. Made of non-corrosive stainless steel, they maintain high pressure on the battery terminals and meet MIL Spec 17919. Only one battery holder (four C-cells) is necessary to operate the Windwatch. The second holder allows you to load new batteries before removing old batteries. This keeps the wind distance accumulator operating continuously. Polarized terminals (red caps) allow battery contact only when the positive terminal is up. Each holder has a sign showing the positive battery direction. Velcro straps retain the batteries during shock or vibration.

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Four mounting holes, access only when the door is open, are corrosion-resistant stainless steel bolts for durability and easy attachment. The left bolt is for a grounding wire. The other two bolts are the anemometer cable.
Large, ½ inch high liquid crystal display (LCD) is easy to read even in bright sunlight and operates continuously. The attractive panel has no switches, buttons or controls. Their absence increases reliability and simplifies operation.

Wind distance (six digits) is shown in miles (or kilometers), with resolution to 0.1 and zero return at 100,000. Like an automobile distance indicator, it operates without being reset. This increases data usefulness and reliability.

Wind speed (two digits) is shown from 0 to 99 mph (or m/s) and is updated approximately each second. Quartz crystal timing assures that speed calculations are accurate and stable and are not affected by changes in voltage or temperature. The metric model shows wind distance in kilometers and wind speed in meters per second.

Distance overflow indicator (shown by the left-most decimal point) changes from off to on and vice-versa each time the distance accumulator returns to 00000.0. This provides a non-redundant distance range of 200,000 miles or km, which will take 10,000 hours, or more than a year, to accumulate in 20 mph mean wind. (The kilometer distance used in the metric model will take 1078 hours in a 9 m/s mean wind to return to zero.)

Built-in battery indicators show “good”, “warning” and “low” voltage conditions by one (), two (::) and three (::::) colons, respectively. You do not need a voltmeter. Sufficient warning time is used to assure that you will not lose data. These indicators also test new batteries before you remove the old ones.

The anemometer used with the Windwatch is the Maximum Type 40 which has proven its durability in extreme weather conditions. Made of lexan, the Maximum Type 40 uses a rotating magnet and long-life electric coil sensor to produce a sine-wave voltage at the terminals. The circuit board may be reset to accommodate switch-closure anemometers and different distance and speed scales.

To collect data enter date, time, Windwatch readings on the log sheets and instructions which show how to calculate elapsed hours and calculate mean wind speed (in mph or kph). Useful time periods for data collection are monthly, weekly or daily. If the Windwatch is not reset, several periods may be used simultaneously.

The collection of monthly records is done by reading the Windwatch during a specified 12-hour interval at the beginning of a month. An hour is the first day of each month from 6 AM to 6 PM.

Good mountings for the anemometer are 40 ft “TV” masts, poles or towers. Good exposure usually requires being 30 to 40 ft above the terrain and vegetation.
Totalizing Anemometer

Cat. No. 5-349C

- Measures wind passage
- Supplied to measure in nautical miles, statute miles, or kilometers.

The totalizing anemometer measures wind passage with both digital display and electrical pulse output. The instrument consists of a three cup rotor connected by a spindle and gear system to a five digit counter and two switches. The housing is an aluminum casting. The rotor is driven by the wind; the counter displays tenths and units of wind passage; the switches close momentarily for each unit and each 1/60 unit of wind passage.

The instrument is supplied to measure either nautical miles, statute miles, or kilometers.

The unit switch is available in two forms; where the anemometer is to be used with the triple quadruple register, or the E-A type operat recorder, pins nine and ten are bridged so as to give a longer closure signalling the passage of units of wind; for other applications, all pins alike and produce the same closure period.

The anemometer mounts on 1/4" IPS pipe pin for use in evaporation station the pintle fixes height of the cups 7" above the edge of the evaporation pan. Where mounting on a taper pintle is required, adapter (#16699) is available.

**SPECIFICATIONS**

| NET WEIGHT: | 3 lb. 15 oz. |
| SHIPPIng WEIGHT: | 8 lb. |
| CONTACT RATING: | 0.6 amps at 24 volts A.C./D.C. |
| SWITCH CLOSURE: | each unit and 1/60 |
| FINISH: | Aluminum lacquer |

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>EQUIPMENT DESCRIPTION</th>
<th>SPECIFY CAT. NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counter and Contact with bridge</td>
<td>5-349C-1</td>
</tr>
<tr>
<td>Counter and Contact without bridge</td>
<td>5-349C-2</td>
</tr>
<tr>
<td>Counter Only</td>
<td>5-349C-3</td>
</tr>
<tr>
<td>Contact Only with bridge</td>
<td>5-349C-4</td>
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<tr>
<td>Contact Only without bridge</td>
<td>5-349C-5</td>
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</table>

*SPECIFY: Nautical Miles-N; Statute Miles-M; Kilometers-K; and whether taper adapter (#16699) is required.*

**RELATED EQUIPMENT**

- Evaporation Station ........................................... #6066
- Pintle ............................................................. #16602
- Taper: Pedestal Type ........................................... #2985

Bulletin 30 (1/85)
Cup Counter Anemometer

This instrument indicates on a mechanical counter the total run of wind past the observation point. By observing the counter reading at the beginning and end of any period of interest, the average wind speed during the interval can be calculated. The anemometer is made to a British Meteorological Office specification.

CONSTRUCTION

Three conical beaded-edged cups 5 inch (12.7 cm) in diameter, attached by arms to a central boss, drive a vertical spindle at a rotary speed proportional to the linear wind speed. The spindle is connected by worm gearing to a train of counters, the gear ratio being such that the counters indicate the linear run of wind directly in nautical miles, statute miles or kilometres. The counter wheels are made of a self-lubricating styrene-based plastic. The instrument terminates in an external 1-inch British Standard Pipe thread for screwing to a mast, and the counter observing window is angled downwards at 45° to facilitate reading from below or vertically for reading when the anemometer is sited close to an evaporation tank.

Brass, copper, stainless steel and plastics are used throughout the instrument to ensure freedom from corrosion and a long working life. The only maintenance required is annual lubrication of the top spindle bearing; all other bearings are self-lubricating. A conical shield protects the upper spindle bearing from rain.

GENERAL SPECIFICATION

Counter range 0 to 9999.9 nautical miles, statute miles or kilometres

Accuracy (wind speed) Better than 1 kt from 5 to 80 kt

Dimensions 12 in high × 9 in radius 30.5 × 23 cm

Weight 8 lb 3.6 kg

CATALOGUE REFERENCES

Cup counter anemometer, British Meteorological Office pattern
W 1200/2 Inclined window, nautical miles
W 1204/2 Inclined window, statute miles
W 1208/2 Inclined window, kilometres
W 1220 Vertical window, nautical miles
W 1222 Vertical window, statute miles
W 1224 Vertical window, kilometres
Welcome to the world of the WP4A, the Wind Prospector that sets new standards for ease of operation and versatility.

**Easy to Install!**
The WP4A comes complete with:
- 25 ft. of shielded cable
- 1 ft. stub mast
- 1 desiccant capsule
- 1 magnetic reset key (odometer only)
- External mounting brackets
- Full instructions
- 6 month limited warranty

**Easy to Operate!**
The easy to read LCD display makes logging a breeze. All data is read through the transparent display window. A unique magnetically activated switch allows the display to be reset without opening the enclosure. Each WP4A can be factory programmed to display one of the following read-outs.

- **MILES - KILOMETERS - KNOTS** as an odometer, for short or long term measurements of average wind speed.
- Instantaneous read-out of MILES - KILOMETERS - KNOTS as a speedometer.

**Easy to Maintain!**
The WP4A is enclosed in its own waterproof enclosure and operates for up to two years using only four “AA” alkaline penlight batteries. Desiccated with a replaceable indicating silica gel capsule that can be viewed from its own window located below the large, easy to read serial number.

**High Reliability!**
Extensively field tested, the WP4A can operate in the harshest of environments. Every unit is calibrated, computer tested, and is run for 48 hours before leaving the factory to insure reliable long term operation.

**SPECIFICATIONS:**
- Size and weight: 3.5” x 2.3” x 6.25” — 13.5 oz.
- Operating temperature: -30°F to 158°F
- Power: 4 “AA” alkaline batteries provide 2 years operation — polarity protected (batteries not included)
- Display: 6 digit LCD
- Odometer: 1/100 to 9,999.99 units
- Speedometer: 0 - 100 MPH, 0 - 160 KPM, 0 - 87 Knots
- Anemometer: 3 cup polycarbonate
- Threshold: 2 - 3 MPH.

**TPM 101:** Response time less than $10^{-12}$ seconds - discharge current 200 Amps per line.

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**PRICE AND ORDERING INFORMATION**

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<thead>
<tr>
<th></th>
<th>Odometer</th>
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<th>Read-out</th>
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<td><strong>Odometer only</strong></td>
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<td>Read-out units</td>
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<tr>
<td>1/100 to 9,999.99</td>
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<tr>
<td>1/10 to 99,999.9</td>
<td></td>
<td></td>
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</tbody>
</table>

**WP4A** ................. $275.00
100 ft. shielded cable .. 15.00
50 ft. shielded cable .. 10.00
4 "AA" alkaline batteries 7.50
Replacement desiccant capsules (each) . 3.00
TPM 101 ..................... 70.00
Replacement fuses for TPM 101, box of 5 10.00
Additional reset keys ..................... 1.00

All Prices in U.S. Dollars

**Design Excellence ...**
The WP4A was designed with your needs in mind, and incorporates the same design standards reflected in Datak Systems' other sophisticated products for wind and solar research — systems employed by utilities, universities, and a wide range of research groups around the world.
Windmeters van EKOPOWER
nauwkeurige apparatuur voor:

* METEOROLOGIE  * MILIEUTECHNIEK  * WINDENERGIE  * SCHEEPVAART
* ZEILEN EN SURFEN  * (ZWEEF)-VLIEGEN  * EDUKATIE  * ONDERZOEK

EKOPOWER heeft een doordachte serie windmeters ontwikkeld met vele mogelijkheden voor een aantrekkelijke prijs. De kwaliteit en nauwkeurigheid van de instrumenten voldoen ruimschoots aan de internationale normen van de Wereld Meteorologische Organisatie (WMO) en van de International Energy Agency (IEA).

Het model EKO 2 WD kan zowel windsnelheid als windrichting meten en biedt tevens een groot aantal interessante uitbreidingsopties, als optie:
- windrun (voor de bepaling van gemiddelde snelheid en windkracht volgens de schaal van Beaufort)
- max. windsnelheid
- recorder uitgang
- windalarm

De EKO 2 WD kan zelfs worden uitgebreid tot WEERSTATION door ook temperatuur en vochtigheid te meten. De meetgegevens worden van een Liquid Crystal Display (LCD) afgelezen. Het apparaat is in een kleine waterdichte kast gebouwd en kan gevoed worden met 12 tot 24 volt DC of 220 volt AC.

Het model EKO 2A is een geavanceerde draagbare handwindmeter met microprocessor besturing. Met dit instrument kan zowel de momentane als de gemiddelde windsnelheid worden gemeten en tevens kan de windkracht volgens de schaal van Beaufort worden bepaald.

De EKOPOWER techniek in binnen- en buitenland. Tevens ontwikkelen wij apparatuur volgens uw specifieke nood gevolg van wij."
WIND MONITOR EKO 2F

Windmonitor EKO 2F has been designed for the determination of short and long term average wind speeds at remote sites. The instrument is standard fieldproof and tropical resistant.

Typical applications are:

FEATURES:

* simple feasibility studies for wind power
* environmental studies
* battery powered
* ultra low power
* meets WMO/IEA accuracy
* waterproof cabinet
* tropical resistant

STANDARD FUNCTION:

* windrun
* instantaneous wind speed
* operation time counter
* max. gust memory
* recorder output
* other type anemometer

READ OUT: windrun/ time counter : standard electromechanical counters; optional LCD-counter

(optional) windspeed indication : analog meter (scale 0-30 m/s)

ACCESSORIES: longer sensor cable, cable connectors, weatherscreen,
(not standard) alkaline-, lithium- or NiCd-batteries, additional recorder

READ OUT: windrun/ time counter : standard electromechanical counters; optional LCD-counter

ACCESSORIES: longer sensor cable, cable connectors, weatherscreen,
(not standard) alkaline-, lithium- or NiCd-batteries, additional recorder

READ OUT: windrun/ time counter : standard electromechanical counters; optional LCD-counter

ACCESSORIES: longer sensor cable, cable connectors, weatherscreen,
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ACCESSORIES: longer sensor cable, cable connectors, weatherscreen,
(not standard) alkaline-, lithium- or NiCd-batteries, additional recorder

READ OUT: windrun/ time counter : standard electromechanical counters; optional LCD-counter

ACCESSORIES: longer sensor cable, cable connectors, weatherscreen,
AN ACCUMULATOR records the total passage of wind, showing calculation of the average wind speed — the most common measurement used for windmill siting.

The A21/22 Series provides:

- Long term average wind speed. A basic measurement commonly used for preliminary site analysis.
- Low cost, high reliability wind analysis. Computer aided testing for the ultimate in reliability and cost effectiveness.
- Indoor or outdoor operation. Engineered for harsh, remote operation. Useful in any environment. Your choice of power sources: alkaline & lithium battery, 120 or 240 VAC line.

The anemometer head sends wind speed information as a variable frequency AC signal to the Accumulator. The input is protected against lightning induced line surges and high static potentials. The circuitry permits separation of several thousand feet between the sensor and the calculating unit.

The Accumulator translates the anemometer signal into distance units equaling 160 mile. Upon command the display indicates the number of units counted "accumulated" during the test period. Dividing that number by the number of minutes in the test period yields the average wind speed.

- Average wind speed = \[
\frac{\text{display number}}{\text{time of test (in minutes)}}
\]
- Current wind speed = \[
\frac{\text{number of counts}}{\text{1 minute}}
\]
- Wind Run (Miles of Wind) = \[
\frac{\text{display number}}{160,000}
\]

The current wind speed may be monitored by taking two consecutive readings 1 minute apart. The number of counts during the minute is the current average wind speed.

The memory may be erased to begin a new test period by momentarily turning the power off, or a running total may be monitored.

Model A21 Indoor Accumulator comes complete with an internal nickel-cadmium battery which is maintained in a charged state by the rechargeable AC adapter (optional). The NiCd batteries will run the Accumulator for up to several days if the AC power source should fail. Longer periods of unattended battery operation can be achieved through the use of an external battery of greater capacity connected through the power jack. This instrument is housed in a miniature instrument case for display in benign environments.

Model A22 Outdoor Accumulator is for unsheltered, remote installation. The outdoor enclosure is engineered for harsh environments, protecting against rain, sleet, snow, dust and salt conditions, and includes provision for locking. Using alkaline or lithium C size battery cells, the A22 provides years of trouble-free operation. Standard alkaline batteries are suitable where temperatures do not fall below freezing. Lithium cells are recommended specifically for long shelf life and low temperature operation. The A22 comes complete with AZS-104 Anemometer Head and 60 feet of interconnecting cable.

---

**WIND DATA ACCUMULATOR**

**SERIES A21/22**

**SPECIFICATIONS**

**Operating Power:** Model A21, 115 VAC or 240 VAC, 50-60 Hz adapter, specify at time of order. Model A22, Alkaline C cell (4 required) or Lithium C cell (2 required). Batteries are not included.

**Input Devices:** A75-104 cup anemometer (included).

**Display:** 7-digit LED (9,999,999).

**Controls:** Power ON/OFF (reset); Display; Accuracy: Anemometer, ±5% of reading, 10-100 mph.

**Resolution:** 1/100 mile of wind.

**Response Time:** see sensor spec.

**Unattended Operating Period:** 1,600,000 miles of wind approx.

**Model A21, 12 hours backup power. Model A22, 1 year alkaline battery life OR 2 years lithium battery life.**

---

**Natural Power Inc.**

Specialists in Electronics for the Renewable Energy Industry

FRANCETOWN TNPK, NEW BOSTON, NEW HAMPSHIRE 03070 803-487-8512

Specifications subject to change.
We're dedicated to making wind power work for you.

The manufacturing of wind instruments and related equipment is our only business. And we take it very seriously. An NRG instrument must be accurate, and it must be dependable. So our designs are careful and thorough, we stay on top of innovations in the field, and our instruments are fully field-tested. If your serious about an investment in wind power, begin with precise instruments from NRG.

Careful siting is the key to wind power success. NRG can help.

A careful analysis of your site can help you avoid unpleasant surprises in the future. NRG's instruments allow you to predict wind power performance before you invest in expensive equipment. And after installation, they'll keep your wind system running efficiently.

Whenever wind is at work, NRG precision and durability can help. These instruments are ideal for wind site surveys for residential, farm, and small business wind power applications, including wind turbines. Wind turbine owners will find them invaluable for monitoring turbine generation, power production and wind variations. They're also useful in tracking wind farm operations. And more.

Wind power can be a wise investment. If you approach it wisely, before you leap, look to NRG.

Quality and durability you can count on...precisely.

We take great pride in the precision and overall high quality you'll find in every NRG instrument. Each unit features extremely accurate digital or microprocessor electronics that will provide continuous operation and data retention even during power failures. The wind-tunnel tested sensor is one of the market's most reliable. And each indoor model features a unique, handcrafted solid mahogany case (outdoor models feature fiberglass weatherproof enclosures.)

And to make sure you get the most out of your NRG's instrument, each unit is covered by a full one-year limited warranty and the support of a growing worldwide dealer network. Contact us for the NRG dealer nearest you.

NRG Systems

Church Hill Road
Charlotte, Vermont 08445
(802) 453-4062

The unique Wind Challenger #7010 is the newly updated version of NRG's popular model 7000. Some of the refinements in the new state-of-the-art 7010 include: Wind Power Density (wattmeter squared) recalculated with each new sample; Hour of Peak Wind Gust readings; user-selectable cut-in windspeed; full set point and units; duration of longest "energy lift" and more...8 functions in all. Features a rugged, weather-tight fiberglass enclosure with stainless steel latches and hardware. Complete with 3-cup sensor, 60' cable, stub mast, battery and instructions. PRICE: $450

MODEL NO. 7010
#7010
- Present Windspeed-updated every second
- Peak Wind (cut-in to 219 mph)
- Average Windspeed—true average calculated from wind run
- Power Density—total wind energy received (V-ideal)
- Daily Time—hours since last reset (9,9999 hrs.)
- Hour of Peak Wind Gust—time gust occurred
- Cabins Speed Limit Above柜——user selected
- Duration of Wind Energy Lift—continuous hours below 9 mph

Wind Challenger Models

Wind Explorer

MODEL NO. 5000
$5000
- Present Windspeed—updated every second
- Total Average Windspeed—true average calculated from wind run
- Total Gusts—hours since last reset
- Average Windspeed (day, week or monthly) shows site daily, weekly or monthly averages for last display

Wind Totalizer

MODEL NO. 2800
$2800
- Displays Total Wind Run—10,000,000 miles (1 mile increments)
- Displays Windspeed with Reversing Column (——mile rates equals windspeed)

RG's Wind Explorer #5000 collects, stores, and displays present and average windspeed and time. It can be set to start recording nine daily, weekly or monthly averages at any time, as well as recording the total average windspeed and total elapsed time...12 data points in all, without you being there! The Wind Explorer requires very little power (8 months of operation on one 9-volt alkaline transistor battery), has an ultra-wide temperature range (-40°F to 180°F) and features our rugged fiberglass and stainless steel enclosure. Includes 3-cup sensor, 60' cable, stub mast, battery and instructions. PRICE: $360

NRG Systems

WIND CHALLENGER

WIND EXPLORER

WIND TOTALIZER

WIND CHALLENGER

WIND EXPLORER

WIND TOTALIZER

FOR SPECIFICATIONS AND OPTIONS, SEE BACK PANEL
PARKWAY'S WIND RUN ACCUMULATOR

This attractive low cost, multi-digit resettable counter and complementary contact anemometer provides you with the total mileage and hence average wind speed at your site and the instantaneous fastest mile of wind to pass. Intended to operate in your home, a six-digit remote battery operated version is available which may be left unattended at strong wind sites for one month intervals. Three year batteries, wire and mounting hardware included.
SUMMIT CONTROLS CORPORATION

AVERAGE WIND SPEED/TOTAL WIND

The Wind Run Totalizer is an outdoor instrument which records total wind at remote locations. The unit is an essential tool for surveying prospective wind energy conversion sites. When used alone or in conjunction with other recording instruments, the Wind Run Totalizer provides a reliable, low-cost method of measuring long-term average wind speed and total wind. The unit can operate for one year from its battery pack, and is impervious to even severe outdoor conditions.

Wind speed is detected via a 3-cup magnetic anemometer, which provides an electrical frequency proportional to wind speed. This data is accumulated in an 8-digit counter and continuously displayed on the 4" high LCD readout. The average wind speed and total wind can be calculated from the wind run total, according to the following equations:

\[
\text{average wind speed (MPH)} = \text{wind run total x 1.7 / time (seconds)}
\]
\[
\text{total wind (miles) = wind run total / 2117}
\]

The total count can be reset by manually removing the battery pack.

The Totalizer is a hermetically-sealed module, as is the battery pack, allowing the unit to withstand outdoor environments without the need for shelter or enclosure. Because there are no pushbuttons, switches, or doors, the system reliability is optimized. The Wind Run Totalizer system is shipped as a complete package, including totalizer, anemometer, cable, battery pack, and mounting hardware. The Summit Controls standard one-year warranty applies to this product.

FEATURES:
- Weather-tight, totally encapsulated
- Plug-in battery pack, one year operation
- Average wind speed, total miles of wind
- 8-digit display, 4" high
- Continuous display
- No buttons, switches, or doors
- Complete package, ready to install

SPECIFICATIONS:

- Power Requirements: (one-year operation)
  - one model WGC-521 sealed battery pack
  - (included with system)
- Sensors/Transducers:
  - one model WGC-212 3-cup magnetic anemometer with variable frequency output.
  - MPH = frequency x 1.7
    - (included with system)
- Data Accumulation:
  - Display: 8-digit liquid crystal display
  - Reset: to reset total, remove battery pack
  - Scaling: average wind speed (MPH)
  - = Wind Run x 1.7/time (seconds)
  - = miles of wind + Wind Run/2117
  - Speed range: 0 to 100 MPH
  - Operating Temperature: -20 to 160 degrees F
- Terminations:
  - 2-core, 18-gauge cable with circular lugs
  - 55' of cable supplied with totalizer
- Housing: Weather-tight, totally encapsulated
- Weight: 3 lbs., complete package

ORDERING INFORMATION:

Model WGC-100 Wind Run Totalizer System
- (includes WGC-521 8-digit totalizer with 55' of cable and presold lugs, WGC-321 sealed battery pack with batteries, WGC-212 magnetic anemometer, L2' anemometer post with mounting hardware)
- accessories:
  - Model WGC-521 Sealed Battery Pack

SUMMIT CONTROLS CORPORATION
1215 HIGH ST., SUITE 103
AUBURN, CALIFORNIA 95603
PHONE (916) 823-9329
TOTALIZING
ANEMOMETER

- 6-digit mechanical counter
- Electrical contact output
- English or metric models
- Predrilled mounting base

The Model 2510 totalizing anemometer is equipped with a counter to provide a simple, yet precise, method of determining average wind speed and total air passage. An internal gear train converts cup rotation to counter input (669 revolutions per mile). Average wind speed can be calculated from the difference between successive counter readings divided by the time interval between readings. The 6-digit counter is not manually resettable. The anemometer can typically accumulate wind run for a year or longer (up to 99,999.9 miles or kilometers) before automatically resetting to zero.

The totalizing anemometer also provides an electrical contact output by means of a magnet-activated reed switch. The switch furnishes one closure per 0.1 mile or kilometer. This contact can be used to advance an event recorder or a remote digital counter (described in detail in the Precipitation section). A 33-foot length of 2-conductor cable is included to make the necessary connections.

The 4-inch-diameter brass cups have a threshold of approximately 1 mph. The cups are beaded and are attached to the hub by sturdy arms. The turning radius is 6 inches. Self-lubricating stainless steel bearings support the anemometer shaft.

The flanged base of the instrument is predrilled, permitting mounting on a wooden, metal, or concrete support. In an evaporation station the anemometer is typically mounted on the platform supporting the evaporation pan. A mast adapter is available for mounting to a 1.5-inch (38 mm) O.D. mast.

ORDERING INFORMATION

Model 2510 Totalizing Anemometer with Electrical Contact, output in miles; includes 33' (10 m) of cable
Model 2511 Totalizing Anemometer with Electrical Contact, output in km; includes 33' (10 m) of cable
Model 25101 Mast Adapter to mount 2510 or 2511 on 1.5" (38 mm) O.D. mast
Model T60502 2-conductor, 20 AWG shielded cable

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor</td>
<td>3-cup assembly, brass, 4&quot; dia. cups</td>
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<tr>
<td>Transducer</td>
<td>Spindle and gear train</td>
</tr>
<tr>
<td>Output</td>
<td>Counter increment and reed switch closure</td>
</tr>
<tr>
<td>Counter type</td>
<td>6-digit mechanical</td>
</tr>
<tr>
<td>Counter range:</td>
<td>Model 2510: 0 to 99,999.9 miles</td>
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<tr>
<td></td>
<td>Model 2511: 0 to 99,999.9 km</td>
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<tr>
<td>Contact rating</td>
<td>0.4 A at 24 VDC resistive load</td>
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<td>Resolution (counter and contact)</td>
<td>0.1 mile or 0.1 km</td>
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<tr>
<td>Sensor range</td>
<td>0 to 100 mph</td>
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<tr>
<td>Threshold</td>
<td>1 to 2 mph</td>
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<tr>
<td>Cup constant</td>
<td>669 revolutions/mile, 540 revolutions/km</td>
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<tr>
<td>Materials</td>
<td>Cast aluminum and brass</td>
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<tr>
<td>Mounting</td>
<td>Predrilled flanged base</td>
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<tr>
<td>Size</td>
<td>12&quot; dia. x 16&quot; H (305 x 400 mm)</td>
</tr>
<tr>
<td>Weight/Shipping</td>
<td>5 lbs./9 lbs. (2.3 kg/4 kg)</td>
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CLASS III:

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<tr>
<td>Secondwind Al-2000</td>
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</table>
Wind classifier I (scientific version)

* 20 wind classes from 0 to 20+ m/s
* 2 x 8 calm duration classes or diurnal pattern over 20 days
* maximum wind velocity
* time of measurement
* data output by Kansas City Standard Interface to cassette recorder or printer
* actual wind speed every minute by display

Wind classifier II (standard version)

* 20 wind classes from 0 to 20+ m/s
* 1 x 8 calm duration classes
* maximum wind velocity
* average wind velocity
* actual wind speed every minute by display

Wind classifier III (home model)

* 23 wind classes from 0 to 23+ m/s
* 1 x 8 calm duration classes (freely programmable)
* maximum wind velocity
* average wind velocity
* time of measurement
* maximum lull duration time
* actual wind speed every minute by display
* data output by printer automatically in a preprogrammed interval or by pressing the key CL

Hardware

* watertight housing
* ambient temperatures -20° C to +70° C
* quartz-controlled time base
* exceptionally easy handling by magnetic reed contacts
* battery change after up to 1 year - normally once a 1/2 year (depends on what kind of batteries are being used)
* liquid crystal display allows operation checks, delivers data output and offers the actual wind speed every minute.

All Wind classifiers are supplied complete with anemometers, a set of batteries for one year and the requisite post-bracing facilities.

Supplementary units

The following optional extras are available:

Interface
Printer
**WIND PROSPECTOR 16**

**Features:**
- Battery operated
- Waterproof-desiccated enclosure
- Magnetically activated display latch and reset switches
- Low temperature operation
- Instructions-aneometer with 50 ft. of connecting cable-1 ft. stub mast-6 month limited warranty included
- Optional lightning protection available (TPM-101)

**Factory Programmable**
- Bin width
- Time in minutes
- Time in seconds
- Miles
- Kilometers
- Dead bin

**Specifications:**
- Size Width: 8.8"x4.6"x3.0" 2 Lbs.
- Operating Temp: -30°F to 158°F
- Power: 4 "C" Alkaline batteries provide 1 year operation-polarity protected (batteries not included)
- Display: 6 Digit LCD x 16
- Time Base: Quartz crystal accurate to +/- 2 seconds/day
- Enclosure: Polycarbonate
- Anemometer: 3 Cup Polycarbonate
- Threshold: 2-3 MPH

**WP/16 PRICE $725.00**

---

**WIND PROSPECTOR 4B**

**Features:**
- Battery operated
- Waterproof-desiccated enclosure
- Magnetically activated reset switch
- Low temperature operation
- Instructions-aneometer with 25 ft. of connecting cable-1 ft. stub mast-6 month limited warranty included
- Optional lightning protection available (TPM-101)

**Factory Programmable**
- Miles
- Kilometers

**Specifications:**
- Size Width: 5.9"x3.2"x3.1" 13.5 oz.
- Operating Temp: -30°F to 158°F
- Power: 4 "AA" Alkaline Penlight batteries provide 1 year operation-polarity protected (batteries not included)
- Display: 6 Digit LCD
- Output: Form C Mercury Wetted Relay (KYI)
- 100 Transitions/Unit
- 10 Transitions/Unit (same as display)
- Enclosure: Polycarbonate
- Anemometer: 3 Cup Polycarbonate
- Threshold: 2-3 MPH

**WP/4B PRICE $335.00**

---

DATAK SYSTEMS, INC.
P.O. Box 129
Harmony, Rhode Island 02829 U.S.A.
Tel. (401) 949-4099
**WIND REGIME -**

**ANALYZER EKO 3N**

Windregime-analyzer EKO 3N has been designed for the determination of the frequency distribution and average wind speeds at remote sites. This fieldproof instrument is standard tropicalized.

The control and the readings are very simple; there is no need for training the user.

The EKO 3N can be used for:
- output predictions of wind energy systems
- choosing the most suitable windturbine
- feasibility studies for wind power
- site analysis for wind power
- simple (windpower) performance evaluation
- determination of Weibull parameters
- meteorological and environmental studies (e.g., air pollution).

For application notes refer to our leaflet "Introduction to measurements of wind speed and wind power".

The used windclass-counters are non-volatile, so the collected data will not be lost when the batteries are exhausted or disconnected.

EKOPower can assist you for processing the collected data.

**STANDARD FUNCTIONS:**

- recording frequency distribution of windspeed in 7 windclasses (bins)
- windrun counter
- operation time counter

**FEATURES:**

- battery powered
- ultra low power
- meets WMO/IEA accuracy
- non-volatile memory
- waterproof cabinet
- tropicalized

**OPTIONS:**

- number of windclasses 10 or 15
- instantaneous windspeed
- max. gust memory
- recorder output
- other type anemometer
- 220 V AC supply voltage

**READ OUT (optional): windspeed indication**

- analog meter (range 0-30 m/s) or
- LCD or LED (range 0-50,0 m/s)

**ACCESSORIES:**

- sensor cable, cable connectors, weather screen,
- (not standard) alkaline-, lithium- and NiCd- batteries, additional recorder or datalogger.

**SPECIFICATIONS EKO 3N**

- batteries: 1 x type IEC LR 6 (1.5 V), alkaline (AA cell)
- battery life: at least 6 months
- windspeed display: range 0...50 m/s (LED or LCD display); 0..30 m/s (analog meter, class 1.5)
- accuracy: windspeed typical deviation 0.2 m/s (v > 1 m/s), meets the standards of WMO and IEA (refer to our leaflet "Introduction to measurements of windspeed and windpower"
- windspeed typical 1 % of reading (v > 1 m/s)
- operation time counter; several seconds a month (quartz controlled)
- max. gust memory: range 50 m/s resolution 0.2 m/s
- windrun: 5 digit non-volatile counter, each 100 meter 1 count
- operation time 1): 5 digit non-volatile counter, each 10 min. 1 count
- windclasses: 1) windclass nr., windspeed interval (m/s)
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- sample time 3): (time over which the windspeed is averaged and classified in windclass counter) 10 minutes (standard)
- anemometer: 1) maximum
- anemometer cable: 10 meter; longer possible
- cabinet: waterproof, IP 557, polycarbonate with transparent front and mounting brackets
- dimensions: 170x130x85 mm (standard)
- 245x130x85 mm (with option 10 or 13 windclasses)
- weight: approx. 1.5 kg.
- environmental: temperature range: -25 to +65 C (standard)
- -10 to +60 C (with LED display)
- -10 to +50 C (with LED display or analog meter)
- humidity: max. 100 %, with condensation
- (meets IEC 68-2-30)
- recorder output: 2 volts at 30 m/s
- transient protection: solid state
- guarantee: 1 year

1) The operation time counter is activated after each sample time; the standard value is 10 minutes, see also note 3.
2) The windspeed intervals of the windclasses may be specified at order, the number of windclasses can (optionally) be increased to 10 or 13.
3) The sample time can be adjusted (at factory) between 1 and 60 minutes
4) separate datashet available; if desired other type possible

EKOPower reserves the right to change specifications without notice.

For general information about other EKOPower products please refer to the "Guide to products, services and applications".
ANAREC
ANEMOMETER ANALYSING RECORDER

This low cost recorder has been designed by the University of Queensland to produce a simple monthly summary of Average Wind Speeds and their durations. An average is measured over a one hour period and converted into one of 18 wind speed ranges. The recorder is used with a commercially available anemometer which closes a contact every 1/60th of a wind-run.

FEATURES

Battery Powered - Operates unattended for 5 weeks

Two readout displays from a four digit display can be read anytime.

Simple Display - gives an 18 value summary for the 5 weeks to enable the graph overleaf to be drawn.

Detailed Display - gives the average windspeed for each hour covering the full 5 weeks.

This data can be read manually or transferred to an Apple computer using programs written in the "Pascal" language.

APPLICATIONS INCLUDE:

- FEASIBILITY STUDIES for wind generation
- BEST LOCATION for wind generators/windmills
- WIND EROSION STUDIES
- AIR POLLUTION STUDIES
- CLIMATIC STUDIES

OPERATION

Recording is commenced by plugging the Anemometer into the Recorder and is stopped by disconnecting the Anemometer from the Recorder. If the Anemometer is not reconnected within the next hour, the ANAREC will enter a dormant or "sleep" mode. This mode is a low power mode that does not record data, but will retain data already recorded for long periods. This mode is recognised by a single digit showing continuously in the display window. Once the "sleep" mode is reached, a control box is needed to reactivate the ANAREC and readout the data.

ANAREC

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE: 140 mm x 120 x 110</td>
</tr>
<tr>
<td>WEIGHT: 0.7 Kg</td>
</tr>
<tr>
<td>DURATION: Data capture for 37 days</td>
</tr>
<tr>
<td>DATA RETENTION: Up to 80 days in sleep mode</td>
</tr>
<tr>
<td>SAMPLES: Records hourly average wind speed</td>
</tr>
<tr>
<td>SIMPLE DISPLAY: 18 values summarising wind speed against duration for the recording period</td>
</tr>
<tr>
<td>DETAILED DISPLAY: Almost 900 values showing average windspeed hour by hour</td>
</tr>
<tr>
<td>18 SPEED RANGES: 0 to 10 metres/second in 1 m/s steps, 10 to 20 m/s in 2 m/s steps, 20 to 30 m/s in 5 m/s steps, 30 m/s and above - all one range</td>
</tr>
<tr>
<td>FREQUENCY INPUT: 0.0375 per second per m/sec</td>
</tr>
<tr>
<td>OPERATING TEMP: 0-50 C battery excluded</td>
</tr>
<tr>
<td>POWER SUPPLY: 3 x 9 volt Batteries, type 216 rectangular</td>
</tr>
<tr>
<td>OTHER FEATURES: Indicator showing contact closures from anemometer</td>
</tr>
</tbody>
</table>

Price: ANAREC $450, Connector & Cable $30, Control Box $35, Anemometer $95

For further information, please contact Mr. Peter Rodeck, ENVIRODATA, P.O. BOX 395, WARWICK. Q. 4370. (076)61 4450

Environdata Australia Pty. Ltd. reserves the right to change specifications without notice.
Anemometer Euclide Pw autonomous system

Anemometer Euclide Pw is an instrument for windspeed data surveying. Such data are required to determine the type of aeromotor to be installed on place.

Any aeromotor take its right position toward automatically. Therefore data on wind direction are unnecessary. So only windspeed data are required with particular attention to hourly average as shown in Weibull theory.

The instrument has a very short energy consumption, therefore it can operate without troubles in lonely areas powered by an hermetic battery and a photovoltaic panel.

The optimal operating height of the probe is about 10 m.

For that purpose a demountable inox steel pole equipped with wind-bracing cables has been projected. Before pole installation it is required the construction of foundation plinths (dimensions can vary in relation to ground characteristics). The plinths are four: a central plinth where fixing the hinged plate and three plinths placed at 120 degrees where fixing wind-bracing cables.

The printing gives the following data:

000 000.000 km/h
001 026.765 km/h

The first three numbers indicate the hourly progressive survey. The second group of numbers indicate the average windspeed in km/h, with three decimal numbers, of the specified hour.

The supplied paper reel, length 40 mt height 57mm, lasts about 10 months.

The analogic display in front of the instrument gives instantaneous windspeed in meter/second.

The power consumption of the instrument is 0.300 Ah, about 86.4 Watt/day.

Installed battery is 12V, 36 Ah.
Wind Classifier
zur Bestimmung von Windgeschwindigkeitsverteilungen

<table>
<thead>
<tr>
<th>Technische Daten</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Einsatztemperaturbereich</strong></td>
</tr>
<tr>
<td><strong>Wartungsfreie Betriebszeit</strong></td>
</tr>
</tbody>
</table>

**Windaufnehmer**
- Schalensternanemometer: 130 mm / 60 m/s
- Ausgangssignal: Gleichstrom
- Schalenstern, Material: ABS
- Masse: 0,65 kg
- Messwertkabel: 15 m

**Auswertegerät**
- Gehäuse: Aluminium, korrosionsgeschützt
- Schutzart: IP 65
- Windklassen:
  - 3-5 m/s
  - 5-7 m/s
  - 7-9 m/s
  - 9-12 m/s
  - >12 m/s
- Ablesung: Stundenzähler, rücksetzbar
- Anzeige der Windgeschwindigkeit (analog): 0-15 m/s
- Messzeitakt: 1,4 s

**Stromversorgung**
- Speisung: Solarzellen o. Netzanschluss (220 V/50 Hz)
- Akkumulator-Pufferung: elektronisch geregelt

**Elektronik (C-MOS)**
- Betriebsspannung: 6 V Gleichstrom
- Stromaufnahme: ca. 11 mA

**Berechnungsbeispiel für AEROMAN 11/14 auf PELLWORM**

(Deutsches Testfeld für kleine Windenergieanlagen)

- Cut-out-Geschwindigkeit Vco: 24,0 m/s
- Rotorleistung: 17,8 kW
- Install. Generatorleistung: 14,0 kW
- Cut-in-Geschwindigkeit Vol: 3,2 m/s
- Nenn-Geschwindigkeit VN: 10,1 m/s
- Rotorumdrehzahl: 88,0 U/min
- Jahresenergieerzeugung: 55,1 MWh/a
- Vollastbereich: 25,5 MWh/a
- Teillastbereich: 29,6 MWh/a
- Betriebsstunden, gesamt: 7550 h/a
- Vollaststunden: 1825 h/a
- Teillaststunden: 5725 h/a
- Stillstandsnacht: 1210 h/a
- Nutzungsgrad der Anlage: 44,9%
Choosing a wind system depends on the wind available at your site. How much power will it produce? This is what determines whether the investment will be worthwhile. Power output estimation requires two things:

- details of the wind turbine
- details about the wind at your site

Manufacturers provide the first, the Windlogger will produce the second.

What wind data do you need? The average wind speed is not enough. You need the wind speed distribution or what percentage of the time the wind is strong enough to provide full output from the wind turbine, what percentage at half output, etc.

The Windlogger is purpose built for this job. It processes the results as it collects them. The latest distribution is available at any time at the flick of a switch. No further processing of the wind data is normally required.

**QUALITY**

Windlogger is built up to standard, not down to a price.

Windlogger offers:

- 30 bins
- 12 month battery life
- Range of 0-30 m/s
- Accuracy of 0.5 m/s
- Timekeeping to ± 2 min/month
- CMOS integrated circuitry for maximum reliability
- Operating temperature range of -20° to +60°C

Windlogger comes equipped with its own 3 cup anemometer, and 15m of signal cable.

Compact, reliable and easy to use Windlogger comes complete with a comprehensive guide to wind system selection. Windlogger enables you to make the right wind system decision first time. Windlogger is a lot cheaper than the wrong decision!
Windlogger has been developed by Northumbrian Energy Workshop as a compact, reliable and easy to use binning data logger system for less than a wind run anemometer.

Choosing a wind system depends on the wind speed distribution at your site. Every minute, Windlogger records the windspeed in the memory appropriate to that particular wind speed band. At the flick of a switch Windlogger's visual display cycles through the recorded data showing the speed bands and cumulative times logged for each band in hours and minutes, along with current windspeed and total elapsed logging time.

Windlogger offers
- 30 Bins
- 12 month battery life
- Range of 0 - 80 m/s
- Accuracy of 0.5 m/s
- Time keeping to ± 2 min/month
- CMOS integrated circuitry for maximum reliability
- Operating temperature range of -20 to +60°C

Windlogger comes complete with its own 3 cup anemometer and 15m of signal cable.

Windlogger reliability
Low power requirements, a wide range of operating temperatures, CMOS integrated circuits and rigorous quality control combine to guarantee Windlogger's tremendous reliability.

Windtogg ••• ellability
Low power requirements; a wide range of operating temperatures; CMOS integrated circuits and rigorous quality control combine to guarantee Windtogger's tremendous reliability.

Specifications:
- Dimensions: 220mm (w) x 320mm (h) x 50mm (d)
- Weight: 0.75kg unpacked
- Operating Temperature: display off -20°C to +60°C display on -10°C to +60°C
- Anemometer: 3 cup, UV stabilized plastic
- CMOS integrated circuits used throughout
- Switch mode power supply
- Power Requirements:
  - Source: Lithium Tadiran TL 5137/7 battery
  - Consumption: less than 2mA at 5V DC
- Sampling:
  - windspeed: every minute count integrated
  - range: 0 to 60 m/s
  - resolution: 0.1 m/s
  - accuracy: 0.5 m/s
- Timekeeping:
  - Accuracy: ± 2 minutes per month

Northumbrian Energy Workshop are leading specialists in the design and installation of renewable energy systems. Our reputation for innovation and technical excellence is maintained today by the incorporation of only the best technology into our systems.

Every effort has been made to ensure the accuracy of this data sheet at the time of going to press. However, because of a policy of continued development and improvement N.E.W. Ltd. reserves the right to alter specification without notice.
The Wind Challenger #7010

The unique Wind Challenger #7010 adds the power of a low power microchip to precision wind measurement. Now you can gather data for small wind turbine siting, monitor wind turbine performance, track wind farm operations, or conduct wide area studies for wind mapping... with all the precision and reliability of state-of-the-art computer technology.

NRG Systems
Church Hill Road, Charlotte, VT 05445 USA
(802) 453-4662
PARKWAY'S WIND SITE ANALYZER

A microprocessor-based wind recording system to tally wind counts over user programmable time periods. Permits optimal machine siting, wind energy, and economic analysis. Also ideally suited to a community network of farmers, chain stores, libraries, schools, churches, etc. Battery or AC operation, complete with anemometers, adapter, cable and instructions. Get the most out of your WECS.
**AL-2000 SPECIFICATIONS**

**AL-2000**

**PHYSICAL:**
- **Size:** 8" x 10" x 4"
- **Weight:** 10 lbs. w/ 1 year battery
- **Case:** 14 gauge steel NEMA-4 weatherproof
- **Temperature:** -40° to +160°F operating

**GENERAL OPERATIONS:**
- **Sampling and Display:**
  - Wind Speed: every 2 seconds, count integrated
  - Range: 0 - 255.5 MPH
  - Resolution: 0.5 MPH
  - Accuracy: ± 5, - 0 MPH
- **Wind Direction:** every 2 seconds, modulo-360° filtered in software where appropriate
- **Display:**
  - Resolution: ± 0.1° (internal)
  - Eight points of compass (displayed) per 2 hour period (24 data points per month)
- **Auto Leap-year correction**
- **Daylight Savings Time correction**
- **User-Selectable Data Storage:**
  - **Permanent Storage:** Industrial Temp rated 2532 EPROM
  - **Maximum Storage:** 13 months of data

**Power Requirements:**
- Less than 2mA average at >BDVDC, 500mA max instantaneous

**Inputs:**
- Wind Speed: interfaces directly to any AC anemometer with 300 < MPH Ha < 9000
- Wind Direction: interfaces directly to potentiometer-type wind vanes
- All inputs: Electrostatic Discharge protected

**FUNCTIONS:**

- **Diurnal Trends:**
  - One average wind speed & day-to-day standard deviation data pair per 2 hour period (24 data points per month)

- **Wind Rose:**
  - Eight points of compass, 4 wind speed ranges per heading, Hours under 6 MPH recorded separately (2 data points per month)
  - Ranges: 6-12, 12-18, 18-24, 24 and greater MPH
  - Resolution: 1 hour
  - Accuracy: ± 5 hour

- **Velocity Distributions:**
  - 4 distributions, 1 total and 3 sub-distributions corresponding to "slow," "moderate," and "fast" MPH ranges, Angular rates based on modulo-360° filtered wind direction
  - Hours under 6 MPH and over 38 MPH recorded separately (66 data points per month)

- **Velocity Ranges:**
  - 2 MPH intervals, from 6 to 28 MPH
  - Resolution: 1 hour
  - Accuracy: ± 5 hour

- **Peak Wind Speed:**
  - Peak speed updated every 2 seconds.
  - Peak speed and time of occurrence (day, hour and minute) recorded
  - Range: 255.5 MPH
  - Resolution: 5 MPH
  - Accuracy: ± 5 MPH - 0 MPH

- **Lull:**
  - Moving average updated every minute:
    - N = 60, x = 1 minute.
  - End of full determined by moving average velocity < 6 MPH.
  - Maximum lull duration each month is recorded as well as day, hour, and minute when lull ended.
  - Range: 255 hours
  - Resolution: 1 hour
  - Accuracy: ± 5 hour

- **Hourly Averages ("S" Versions):**
  - Average wind speed from 60 1-minute samples, written to EPROM on the hour.
  - Range: 615.0 MPH
  - Resolution: 0.5 MPH
  - Accuracy: ± 125 MPH

**AL-2002**
Same as AL-2000, except:
1. Two complete sets of data, one for each anemometer & wind sensor pair.
2. Data storage on Industrial Temp rated 2532 EPROM

**AL-2000S**
Same as AL-2000, except:
1. Records 5 months of summarized data and 3264 hourly averages on

**AL-2002S**
Same as AL-2002, except:
1. Records 3 months of summarized data and 1520 hourly averages for each sensor pair.

Special thanks to the user for their contribution.
HOW USABLE IS THE WIND AT YOUR SITE?

Economic installation of a Wind Energy Conversion System (WECS) requires a detailed understanding of the wind regime at a particular site. It is important to determine:
- How much wind energy is available at a site,
- How much of that energy can be captured by a particular wind turbine, and
- How much of that energy will be available when it is needed.

Second Wind can provide these answers with its AL-2000 series of stand-alone wind resource data logging systems. Every two seconds the AL-2000 samples wind speed and direction to provide instantaneous readings, hourly averages, and monthly WECS-oriented statistical summaries. Each element of the summaries has quantitative validity based on wind energy economics, engineering and common sense.

Velocimeter

Four velocity distributions are generated each month from two-second wind velocity samples. These indicate energy availability and turbulence at each wind speed. Only the combination of this information and WECS performance data can provide a true indication of how much energy can be generated by a particular WECS.

Diuonal Data

The diurnal data section of the monthly wind summary describes the average wind speed as it varies over an average day. The daily day standard deviation of wind speed is also compiled for each time slot. This function facilitates a direct comparison of available wind energy to the demands of proposed applications. The data is especially useful in determining the value of the wind energy to both the user and the utility where interconnection and "buy-back" are being considered.

Peaks and Lulls

A major source of stress on a WECS is high wind speed. The AL-2000 records the maximum wind speed, and when it occurred, on a monthly basis. Data on periods of little or no wind are also important. The "fuss" function records the duration of the longest "energy full" and its time of occurrence, every month. This function can establish reliability of the data for energy production, as well as help to size storage systems.

Wind Rose

The AL-2000 gives an enhanced form of the traditional eight-point wind rose. The total amount of time the wind blows from each direction is sub-divided into each of four wind speed ranges. The wind data can be especially useful in determining the effect of obstructions and topography on prevailing winds at the site.

Hourly Averages

Some wind studies require a serial record of hourly average wind velocities. AL-2000 "S" series data loggers record time series wind speed data, in addition to the summarized monthly data. This information is particularly useful in correlation studies where historical data is typically in the form of hourly averages.

THE AL-2000 SYSTEM

AL-2000 series data loggers are cost-effective solutions to siting equipment needs. The AL-2000 is offered in a complete package that includes sensors, battery and data storage medium, eliminating the search for matching components. Minimal training is required for effective installation and data retrieval.

A typical AL-2000 system can be operated for up to a year without changing the internal battery pack or memory chip. The stored data can be accessed easily in the field directly from the front panel of the instrument. NO ADDITIONAL EQUIPMENT IS NECESSARY. The same information can be processed on a computer by Second Wind or by users with appropriate hardware and software.

Computer Interface

All data is available at the front panel; however, the removable memory-chip containing the data is also well suited for other means of examination. Users who have access to data processing facilities or "personal" computers will find that the contents of the chip can be transferred easily via commercially available peripheral devices. Second Wind can provide the AL-2000 data storage, allowing further processing as desired. Application software for the IBM PC is also offered.

A COMPLETE SERIES

AL-2002

AL-2002 records hourly average wind speeds in series. In ADDITION to the data sets maintained by the AL-2000. The AL-2002S incorporates this feature for two sensor pairs. Each average and its hour-index is accessible from the front panel. There is even "Fast Forward" and "Fast Reverse" feature to make scanning the data quick and easy. In memory-chip to-computer applications, users appreciate the real-time stamping and serial number that is automatically stored with the data.

ADDITIONAL PRODUCTS AND SERVICES

Data Processing Services

Second Wind provides full data processing support for those who desire further analysis of stored data. A low cost, rapid turnaround computer protocol service is available. In addition, high quality full-color computer-generated graphics (examples of which are shown in this brochure) can be supplied for professional presentations.

Optional Equipment and Accessories

AL-2000 series data logger packages are offered complete with the data logger, batteries (either alkaline or lithium memory chip, anemometer) and wind sensor(s). A wide variety of accessories are available including: mounting brackets, cable, coating of the circuit boards for humid climates, case variations, a rugged prop-vane anemometer, memory chip eraser,... as well as all standard replacement parts...

Custom Engineering Services

Second Wind specializes in both wind power and electronic instrumentation. Services range from complete wind energy system studies to custom electronics design and manufacturing. Second Wind has provided harsh-environment control devices and data loggers for the wind power industry and government agencies. Please call for further information. Second Wind, Inc., 7 Dawes Square Somervile, MA 02144 USA (617) 276-1560 Fax: 71596017
CLASS IVa:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Number of Pages</th>
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</thead>
<tbody>
<tr>
<td>Atmospheric Research &amp; Technology</td>
<td>0 (see class II)</td>
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<tr>
<td>Secondwind</td>
<td>0 (see class III)</td>
</tr>
<tr>
<td>Summit Controls Corporation</td>
<td>1</td>
</tr>
</tbody>
</table>
ENERGY SYSTEMS

1. General description EKO 10 - line field datalogger-systems version 86.2

1.1 Introduction

EKOPOWER designed several types of complete field datalogger-systems, appropriate for a number of applications:

(remote) datalogging for e.g.:  
* meteorology  
* wind recording  
* wind energy evaluation  
* environmental technology  
* process monitoring  
* ecology  
* agriculture  
* hydrology  
* pollution monitoring  
* product testing  
* engineering  
* energy management

FEATURES:
* ultra low power (batt. life 1/2 year)  
* field proof (tropicalized)  
* complete system  
* multi-functional  
* easy operation (no programming)  
* non-volatile solid-state memory  
* multi channel (expandable)  
* full stand-alone operation  
* data-processing with standard Personal Computer; possible a portable PC  
* software available  
* modular subsystems  
* record-check possibilities  
* low cost  
* remote control options

EKOPOWER has developed several standard types. Each type is identified by a suffix:

EKO 10 A : wind datalogger for windspeed only. During a preset interval of time (usually 10 minutes or 1 hour) the average windspeed is recorded. Recording the max. gust is an option. The system meets the WMO/IEA 1) accuracy standards and is tropical resistant. Range: 0 - 50 m/s.

EKO 10 B : extended version of EKO 10 A with logging of the average winddirection. The average winddirection is determined from an effective electrical angle of 3x 360 degrees. The system meets the WMO/IEA accuracy standards and is tropical resistant.

EKO 10 C : datalogger system for wind turbine testing and evaluation, following the IEA-recommendations. Four channels are recorded: windspeed (0-25 m/s), wind direction, power-output and density of air.

EKO 10 D : extended version of EKO 10 C: up to 16 channels are possible.

EKO 10 E : universal automatic weather station: logging of wind speed, wind direction and a choice between temperature, humidity, pressure, precipitation and radiation. Meets WMO recommendations.

Combination of different models is possible (master/slave operation). For each application a system can be designed according to customer specifications; contact our application engineers to discuss your specific datalogging problem.

For general information about EKOPOWER products please refer to:
* Guide to products, services and applications  
* Introduction to measurements of wind speed and wind power

EASIDATA
Environmental Recording System

EASIDATA is a computerised system for recording weather and environmental information. Sensors to measure rainfall, temperature and other key climatic factors are available as plug-in units. The complete system is solar powered, self contained and sealed for outdoor use.

ADAPTABLE RECORDING SYSTEM
An Interchangeable part, the 'program' module, determines which climatic factors are to be recorded, the way in which they are recorded and how often. For example, an air temperature sensor can record daily average figures, along with minimum and maximum readings and specific values for morning (9 a.m.) and afternoon (3 p.m.). As well as standard weather station program modules, user defined systems can be supplied.

EASY TO USE
EASIDATA has been designed with ease of use in mind. Technical knowledge is not required. It is easy to install, it collects information unattended, and resulting data is easy to read.

COLLECTING THE INFORMATION
(a) On Site Collection
A portable computer or printer can receive the stored information at the EASIDATA recording site. Only one readout device is needed for any number of EASIDATA stations.

(b) Office Collection
EASIDATA can be connected via a direct cable link, or through the telephone network, or radio link to a central computer to give direct access to stored information.

EASIDATA is a carefully designed and engineered product which was developed to provide accuracy, reliability and ease of use.
WIND SPEED/DIRECTION COMPILATOR Y

MODEL ASO-501 COMPILATOR combines wind speed/direction data measurement capabilities with advanced data logging and data retrieval techniques providing measurement and processing to exactly match your requirements.

FEATURES:  Up to seven anemometers

- User selectable sampling period one second to eight hours.
- 750 sample capacity for average wind speed and direction time series data, expandable to 30,000.
- All data can be transferred directly from ASO-501 to cassette tape in field.

The information provided by the COMPILATOR Y can be used to:

* Determine suitability of a site for Wind Energy Conversion. Data collected is used to calculate available kinetic energy.
* Select the most suitable WECS for a particular site. Data collected is used to calculate energy production of specific wind turbines.
* Determine pollution and topographical effects, study environmental impacts, monitor wind velocities for safety considerations.

Cassette tapes are directly compatible with computers such as the IBM PC and allow the COMPILATOR Y data set to be manipulated to exactly meet the end user’s requirements, whether it be energy computations, or compatibility with other equipment.

Custom programs are available for the COMPILATOR Y to meet your special requirements, contact the Factory for assistance.

SPECIFICATIONS: ASO-501

- Operating Power: 105 to 127 Vac, 60 Hz; 5 to 15 Vac 220v accumulate mode.
- 4800 display mode. Optional photovoltaic powered perpetual battery.
- Input Devices: A75-201 optically encoded direction head. A75-104 cup anemometers.
- Other high performance sensors on special order.
- Displays: 8 digit LED data display, 2 digit LED bin number display.
- Outputs: Audio Cassette, RS232C.
- Accuracy: Time, ± 0.05%, Data: ± 1%.
- Resolution: 1 to 800 bin width, user adjustable, eight direction sectors, 1 second sample rate, eight 3-hour time sectors.
- Dimensions: 131/4 x 9 1/2 x 7 1/2".
- Weight: 0 lbs.
- Connectors: Sensor inputs, barrier strip to accept M4 5772 or smaller wires; three prew AC power, 25 pin AMP connector, Serial 1/2.
- Special Requirements: External lightning protection recommended for sensor protection.
INTRODUCTION

WHAT IS THE DATAPOD?

The DATAPOD Digital Recorder is a miniature, battery-operated data logger designed to replace strip chart recorders in many applications. Rather than continually recording a trace on paper as does a strip chart recorder, the DATAPOD processes sensor readings under program control of a microprocessor, and records values such as averages, event counts, or time of event in a solid state memory module. Data can be read from the DATAPOD case when data is stored and the DATAPOD logs data to a storage module. The model 217 Reader receives and transmits data with or without day and time information.

DATAPOD ACCESSORIES

CAN DATA BE REVIEWED IN THE FIELD?

Pressing a button on the side of the DATAPOD case causes stored data to be recalled to the display. The short display mode shows how much space is left in the DSM and whether or not any errors have been made in storing the data. A long display mode retrieves data from the DSM and shows it on the display. Although it would be time consuming, the entire contents of the Data Storage Module can be retrieved using this method.

HOW CAN THE DATAPOD BE USED?

The DATAPOD Digital Recorder is housed in a 2 3/4" x 3 3/4" x 6 3/4" polycarbonate case with an O-ring gasket, sealed connectors, and sealed switches. It needs no protection from the environment except for a sun shade during the warmest months. It operates in temperatures down to -35 degrees C and in humid environments to 100 percent relative humidity.

WHAT IS THE BATTERY LIFE?

The DATAPOD Digital Recorder typically operates for 9 months on one set of batteries. Some models of the DATAPOD are programmable to do more munals. The following pages describe the various models and programs used in these models for many applications. If you still have only one or two input channels. If you still have questions on which unit to use after having studied this manual, our engineers will be happy to discuss your data recording problem with you. Omindata manufactures other lines of recording equipment to handle multi-channel applications.

WHAT KINDS OF SENSORS CAN BE USED WITH THE DATAPOD?

There are either one or two rubber connector cables that may be used. A set of 8 alkaline "AA" cells for power. A battery life indicator on the display indicates when remaining battery life is less than 2 to 3 months.

HOW DO I DECIDE WHICH DATAPOD MODEL IS RIGHT FOR MY APPLICATION?

Omindata manufactures several models of DATAPOD Recorders for a variety of applications. All models record data from either one or two input channels. The following pages describe the various models and programs used in these models for many applications. If you still have questions on which unit to use after having studied this manual, our engineers will be happy to discuss your data recording problem with you. Omindata manufactures other lines of recording equipment to handle multi-channel applications.

217 DATAPOD/CASSETTE RECORDER

Omnidata International, Inc. manufactures a line of data loggers that record data on either a Data Storage Module or on audio cassette tape. The model 217 Reader removes data from these media and transmits it to a terminal or computer or both. Two 25 pin "D" connectors on the rear panel connect the reader to the computer and minimal. RETRIEving DATA FROM A DATA STORAGE MODULE

A full Data Storage Module from a DATAPOD is inserted into the 24 pin socket on the 217 Reader panel. Upon command from the reader control panel or the terminal, the reader transmits data from the Data Storage Module to the serial interface. The reader can be set to transmit data with or without day and time information.

RETRIEVING DATA FROM AN AUDIO CASSETTE RECORDER

The Model 217 Reader retrieves data from cassette through the cassette inputs on the rear of the case. A control signal from the "REMOTE" jack turns the cassette motor on and off. The data from the cassette is transmitted to the reader over a cable which plugs into the "MOlITOR" jack. The Reader activates the cassette, reads a block of data into memory, then shuts down the cassette motor, processes the data, and transmits it to the computer and/or terminal.

CONTROLS

The panel controls on the 217 Reader simplify interfacing to computer and terminal equipment. A MODE switch selects data retrieval for either audio cassette type or a Data Storage Module. The "F" button allows for the MODULE mode, initiates a check which shows whether the DSM has been completely erased and read-end for field use. In the CASSETTE mode, the TEST function allows adjustment of the volume level of the playback recorder for optimum signal output. Red and green LED's on either side of the mode switch indicate status resulting from the test. A TRANSMIT RAW DATA button initiates data retrieval without any commands from a terminal.

CONTROLLERS

The terminal and computer or modem communicate with the 217 Reader through serial ports. Location is on either side of the panel.

The Model 217 Reader accepts commands over the RS-232-C port from the computer or terminal. The main set of commands tell the reader to transmit data continuously, to transmit just one line, or to stop data transmissions. Protocol characters for transmission and system initialization are user definable.

Specifications

CASSETTE: Audio cassette recorded in ASCII (8th bit parity)

DATA STORAGE MODULE: 2048 byte EPROM with polarized carrier.

BAUD RATES: Switch selectable at 300, 1200, 2400, 4800 & 9600.

INTERFACE: Two 25 pin subminiature "D" connectors, one for the computer or modem, and the other for the terminal, both conforming to the EIA RS-232-C specification.

DATA RETRIEVAL CONNECTORS: For the audio cassette, one 3.5 mm standard audio jack for the mic cable, and one 2.5 mm standard audio jack for cassette recorder remote control. One 24 pin socket on the panel for the Data Storage Module.

POWER: 110 volts AC, 50 or 60 Hz, 5 watts

The 217 Reader includes the model SC254 RS-232-C accessory cable.
DP214—TWO CHANNEL
WIND RECORDER

Includes: WSD321 Wind Speed & Direction Package w/Zapnot Lightning Protection w/50 foot cable

DESIGN FEATURES:
1. Wind speed and direction
2. Anemometer and wind vane
3. Maximum wind speed and direction
4. True vector average of direction
5. 359 to 0 degree transition
6. Lightning protection system

RECOMMENDED ACCESSORIES
2 ea. DSM1000 Data Storage Module
1 ea. UV511E Data Storage Module Eraser
1 ea. 2170 Datapod Reader w/SC254 RS232 cable
1 ea. 517 Small Instrument Shelter (Optional)

DESCRIPTION
The Datapod Model DP214 is a rugged electronic Data-logger with reliable solid state Data Storage Module (DSM1000). The Datapod is powered by 8 self-contained penlight cells (batteries not included). Data Storage Modules are interchangeable and computer compatible when read with Omndata Model 2170 Reader. The 4½ digit LCD display is for user prompts and data display. LED indicator flashes when data is stored in DSM1000. Low Battery indicator, self-test functions, totally sealed case. No moving parts. Easy to read even in bright sunlight. Crystal controlled clock.

SENSOR CONNECTION DIAGRAM

USER SETTABLE RECORDING INTERVALS

<table>
<thead>
<tr>
<th>Recording Interval</th>
<th>Scan Interval</th>
<th>Reading Type</th>
<th>Service Interval</th>
<th>Service Interval w/Max Min</th>
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</thead>
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<tr>
<td>1 minute</td>
<td>1 minute</td>
<td>inst</td>
<td>17 hours</td>
<td>8.5 hours</td>
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<td>1 minute</td>
<td>ave</td>
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<td>ave</td>
<td>7 days</td>
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<td>ave</td>
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<tr>
<td>24 hours</td>
<td>10 minutes</td>
<td>ave</td>
<td>battery life</td>
<td>battery life</td>
</tr>
</tbody>
</table>

MECHANICAL SPECIFICATIONS
Case Material: Sealed polycarbonate, O-Ring gasketed case
Connector: Rubber sealed, 3 pin
Control Button: O-ringed, sealed
Weight: 1.2 lbs / 0.54 kg
Dimensions: 2.3" x 3.3" x 0.5" / 6.8 x 8.4 x 1.3 cm

ELECTRICAL SPECIFICATIONS

GENERAL:
Function: Record average and wind speed and direction; Max. wind speed with its direction.
Number of Channels: Two—Chn. 1 = Wind Speed; Chn. 2 = Wind Direction.
Clock Accuracy: +15°C to +60°C, 100% RH

INPUT:
Sensor Input: WSD321 Wind speed and direction package with Zapnot lightning protection.
Sensor Resistance: Maximum=100K ohms. Minimum=5K ohms (Wind direction only)

DATA RECORDING:
Data Storage: Non-volatile, UV erasable, no back-up battery needed.
Recording Time: 2 sec. typ.
Data Storage Capacity: 1023 recordings per channel; 511 when recording maximum wind speed.

Scan Interval: 1.5, or 10 minutes
Recording Interval: User selectable
Recording Resolution: Speed to nearest 0.1 mph. Direction to nearest 6 degrees

POWER SUPPLY:
Power Supply: 8 "AA" Alkaline penlight batteries
Battery Life: 6 months typ. (function of scan interval)
The MGC-110 Remote Data Logger System is a battery-powered data acquisition system specifically designed for collecting and recording wind data. The unit is an essential site analysis tool for those who must make reliable economic projections involving wind energy conversion. The MGC-110 provides a complete data collection package, including sensors, data storage equipment, and batteries.

Data is collected and permanently stored in an EPROM memory within the unit. This data can be retrieved by removing the EPROM and having its contents read by a computer with the appropriate capabilities. Data printout and report generation services are available through Summit Controls or associated consulting firms.

The unit contains a low-power microcomputer, mounted in a weather-tight enclosure, and operates from standard commercial batteries. Wind speed and direction are sensed via a pair of precise, optical sensors. These two sensors are mounted and prewired on a bracket for convenient installation. An attached 55' cable with connector is included with the sensor pair. The system is shipped complete and operational with cable, connectors, and batteries fully assembled. The Summit Controls standard one-year warranty applies to this product.

FEATURES:
- Complete data acquisition system
- Permanent EPROM data storage
- Records average wind speed and wind direction at selectable intervals
- Precise, digital, optical sensors
- Rugged, weather-tight enclosure
- 16-segment direction data
- Convenient, ready to install
- Includes lightning protection

SPECIFICATIONS:
- Power Requirements: (1 month operation)
  - 7 cell alkaline batteries
  - Three 9-volt alkaline batteries
  - Complete set of batteries included with system
- Sensors/Transducers:
  - Digital, optical anemometer with 0.1 MPH resolution, from 3 to 100 MPH
  - Digital, optical direction sensor with 16-segment resolution
  - Both sensors included with system
- Data Storage:
  - Data (wind speed and direction) stored on
  - 4096 bytes (57,262)
  - Switch selectable recording period - 15, 30, or 60 minutes
  - 42-day data storage at 30 minute recording period
  - Data storage EPROM included with system
- Operator Controls/Indicators:
  - Pushbuttons: "anemometer test", "direction test", "battery test"
  - Indicators: "sensors good", "9V batteries good", "12V batteries good"
- Operating Temperature: -20 to 160 degrees F.
- Terminations:
  - 6-pin bayonet connector 1/4" diameter
  - Connector and plug with 55' of cable prewired and included with system
- Housing: weather-tight, fiber glass enclosure
- Weight: 12 lbs.

ORDERING INFORMATION:
- Model WGC-110 Remote Data Logger System
  - Includes WGC-111 weather-tight data logger, WGC-240 anemometer/direction sensor pair preassembled on bracket with 55' of cable and connector, WGC-322 battery pack with batteries, and WGC-531 EPROM
- Accessories:
  - Model WGC-531 EPROM Memory Module
  - Model WGC-522 Battery Pack
  - Does not include batteries
- Model WGC-322 Wind Speed and Direction Indicator
  - Used with WGC-240/241 sensor pair

SUMMIT CONTROLS CORPORATION
1215 HIGH ST., SUITE 103
AUBURN, CALIFORNIA 95603
PHONE (916) 823-9329
CLASS IVb:

<table>
<thead>
<tr>
<th>Manufacturers</th>
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<td>Bottemanue</td>
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<td>Campbell Scientific</td>
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<td>Data Electronics</td>
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<td>Dulas Engineering</td>
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<td>Ekopower</td>
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<td>Grant</td>
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<td>NES</td>
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</tbody>
</table>
SPECIFICATIONS DP 100  Data Processor

Housing
Water proof cabinet with
Radiation/rain shield
Euroboard mounting shield
LCD and Hex-keyboard
Cabinet connectors
Cabinet heating

Processor
8 bit microprocessor
Real-time clock
4 Kb EPROM
4 Kb RAM
RS 232C

Data storage
16 and 32 Kb static RAM
Data storage in engineering units
with 16 bit precision

Input channels
Up to 30 analog and digital channels

Digital input
Up to 6 channels per board
5 digit counter

Analog input
Up to 6 channels per board
8 and 12 bit ADC
20 mV to 5 V range

Pt-100 input
Up to 6 channels per board
0.05 °C resolution

Control and Retrieval
Input of parameters and
Retrieval of records with
Epson HX 20 portable computer
through RS 232C, ASCII
Baud rate 4800 max.
Storage on microcassette
Optional connection to any
RS 232 compatible computer

Operating temperature
0 to +60 °C, without heating
-30 to +60 °C, with heating

Protection
Transient suppression using
fast switching diodes

Power supply
Rechargeable lead acid batteries
+ 6 and - 6 VDC

Recharging circuitry
42, 110 or 220 VAC (field power)
12 VDC (solar panel)
21X MICROLOGGER

A Rugged, Powerful Little Datalogger

The 21x is a sophisticated D.C. power and sub-Microvolt sensivity. The microcomputer's microprocessor, clock, memory, controller, calculator, frequency counter, controller, and signal generator all in one small box. Small, size, power, weight and the ability to operate in extreme environments were primary design objectives for product, remote operation.

SIGNIFICANT FEATURES

PERFORMANCE VERSUS COST: Measurement and processing throughout in tens of hundreds of channels and at least one microvolt at 25 percent per second at a remarkably low price.

PERFORMANCE VERSUS PRICE: Steepest slope ever, 21X offers a cost of $195.00 per channel, all the features, including mains/48VDC powered. Your choice, smaller package, and lighter (including batteries) than the CRSC Handbook of Chemistry and Physics.

PERFORMANCE VERSUS POWER CONSUMPTION: Scanning and processing all channels at 1 minute intervals, the 8560D 21X only needs 0.75 watts. The rechargeable batteries in the 21X provide 2 month operation per charge under the same conditions.

SENSITIVITY AND MEASUREMENT SPEED: Fourteen-bit precision on 50 channels selectable ranges. 0.25-microvolt resolution at 57 milliseconds per channel with 100 microamp RMS input noise. 1.2 microamp per channel the input noise is 1.2 microamp RMS.

SENSOR COMPATIBILITY WITHOUT EXTERNAL SIGNAL CONDITIONING: Uncalibrated transducers with 0-1.5 VAC or 0-150VDC per channel results in 0.5% C.O. Bridge excitation voltage selectable within ± 5% of ± 150VDC. Bridge excitation voltage is adjustable from 0 to ± 7.5VDC with 2% error. 

 REAL-TIME DATA: A microcomputer is connected directly to the printer or via the serial communications port from a remote computer or terminal.

FLEXIBLE DATA STORAGE AND TRANSFER: Data is stored immediately for the display, the cassette, printer, modem, or directly to a computer. Expansion of 21X memory above storage up to 19,200 data values. The cassette recorder stores up to 180,000 values on one side of a Cassette.

ANALOG AND DIGITAL CONTROL OUTPUTS: Two continuous analog outputs with 14-bit resolution are available for analog chart recorders or proportional control. Six digital outputs can be set on or off processed input levels.

PROTECTED INPUTS AND OUTPUTS: All panel protected connections are electrically isolated from transducer going through the 21X.

OPERATION IN HARSH ENVIRONMENTS: 25 to -100°C, 5 to 99% RH.

TRANSPORTATION: The 21X Micrologger is designed for maximum 215 channels using the Model AM23 Relay Scanner. Up to 56 channels can be added for an additional 192 analog channels maximum 215 channels with 256 types of memory to a total of 64k bytes. An expanded system with 248 bytes of ROM and 480 types of RAM can store 192,000 values in the final storage area.

EXPANSIBILITY: Analog inputs are expandable in 215 channel increments using the Model AM23 Relay Scanner. Up to 56 channels can be added for an additional 192 analog channels maximum 215 channels with 256 types of memory to a total of 64k bytes. An expanded system with 248 bytes of ROM and 480 types of RAM can store 192,000 values in the final storage area.

SPECS

SPECIFICATIONS

The following electrical specifications are for an ambient temperature range of -25 deg C to +50 deg C unless otherwise specified.

ANALOG INPUTS

| NUMBER OF CHANNELS: 8 differential or up to 15 single ended using one differential channel for each full bridge output provided the maximum
| CHANNEL EXPANSIBILITY: The Model AM23 Relay Scanner adds additional channels through a single 21X differential channel. Up to 15 additional channels can be added for a total of 160 additional channels
| VOLTAGE MEASUREMENT TYPES: Single-ended or Differential. A thermocouple input terminals provide reference junction compensation for linearization of excitation voltage and output to eliminate ambient temperature errors. AC resistance and conductivity measurements use a 500uA excitation pulse with the signal integration occurring over the last 250us. An applied frequency pulse of opposite polarity is used for de-convolution.
| RESISTANCE AND CONDUCTIVITY MEASUREMENTS AND ANALOG OUTPUT VOLTAGES: 0 to 1% of FSR, 0.001% of FSR or 40 to 200 VDC.
| RANGE AND RESOLUTION: Ranges are software selectable for any channel. Resolution for single ended measurements is dependent on the value shown.
| FULL RANGE Resolution: 5 volts 33.3 microvolts 3.33 microvolts 30 microvolts 0.3 microvolts 0.03 microvolts
| INPUT SAMPLE RATES: The last A/D conversion uses a 250ks sample integration time and the slow conversion uses a 180kHz sample integration time (one power cycle period). Different measurement rates may be selected by reversing input polarity to reduce thermal offset and common mode noise. The following intervals do not include the self-calibration measurement which occurs once per measurement input sample rate should not be confused with system timeclock measurement.
| FAST single-ended voltage: 2.2 milliseconds 125 microvolts 1.25 microvolts 125 nvolts 0.125 nvolts
| FAST Differential voltage: 2.2 milliseconds 125 microvolts 1.25 microvolts 125 nvolts 0.125 nvolts
| SLOW single-ended voltage: 5 seconds 0.67 microvolts 67 nvolts 6.7 nvolts 0.67 nvolts
| SLOW Differential voltage: 5 seconds 0.67 microvolts 67 nvolts 6.7 nvolts 0.67 nvolts
| INPUT NOISE VOLTAGE: Fast R 0.83 _ RMS
| INPUT NOISE RESISTANCE: Default is 0.83 micro Resistance (Micro ohms)
| COMMON MODE RANGE: ±5 volts

PULSE COUNTERS

NUMBER OF PULSE COUNTER CHANNELS: 4 bits or 2 half bits, software selectable.

MAXIMUM COUNT RATE: 2500 Hz, 8 bit binary count. 250 kHz, sixteen bit counts. Pulse counter channels are scanned at a maximum rate of 100 kHz.

MODES: Programmable modes are switch closed, high frequency and low AC current.

SWITCH COUNTER MODE
| MINIMUM CLOSED TIME: 1 microsecond closed without being counted
| MINIMUM OPEN TIME: 1 microsecond open without being counted
| HIGH FREQUENCY PULSE MODE
| MAXIMUM PULSE WIDTH: 250 kHz.
| MAXIMUM INPUT FREQUENCY: 250 kHz.

VOLTAGE MEASUREMENTS AND ANALOG OUTPUTS:

The counter is incremented when the input voltage changes from below 1.5 volts to above 5.5 volts. MAXIMUM INPUT VOLTAGE: 120 volts.

LOW LEVEL AC MODE
| This mode is used for counting frequency of AC signals from low frequency square wave inputs or other low voltage, low AC levels.
| MAXIMUM INPUT VOLTAGE: 500 microvolts
| INPUT RESISTANCE: 2000 ohms

ANALOG OUTPUTS

NUMBER OF ANALOG OUTPUTS: 4 switched, 2 constant output.

DESCRIPTION: Switched and continuous. A switched output is active only during a measurement and is latched off following the measurement. Only one switched output can be active at a time. The two continuous outputs hold a preset voltage output activated by an analog output command.

RANGE: ± 5 volts
RESOLUTION: 0.067 millivolt
ACCURACY: Same as voltage input.

OUTPUT VOLTAGES (no load): High — 5 volts, 1 volt, Low — .5 volt.

OUTPUT RESISTANCE: 400 ohms.

PROCESSOR: HITACHI 6803 CMOS 8 bit microprocessor.

MEMORY: 256 bytes of RAM, expandable to 544 bytes of RAM or 164 bytes of 21X 80A low resolution memory. An expanded system with 256 bytes of RAM and 4096 bytes of RAM can handle 32,000 data points in final memory, 18,200 data points with fully digitized data.

DISPLAY: 8 x 16 LCD (0.95 deg)

PERIPHERAL INTERFACE: Two Phoenix connector on the front panel for connection to printer, modem, or RS232C. The serial data interface supports data rates of 300, 1200, 2400, and 4800 baud.

CLOCK ACCURACY: ±1 minute per month.

PROGRAMMING EXECUTATION RATES: The 21X Programming Table can be executed in sync and asynchronous at a maximum rate of 85 per second. Typical throughput rates show 1 measurement with bursts and transition rate at the no interruption rate. The 21X uses dual 16-bit counters and 32-bit microprocessors.

SYSTEM THROUGHPUT: Data throughput is determined at which a signal can be measured, processed, and transmitted at maximum accuracy. The throughput is determined by additional processing or when data is transferred to analog chart recorders or through the 21X serial ports and the input and output samples per second. Dustin input and output samples per second can usually be increased by 100 percent to maximum 90 percent if the input program requirements less than 7% of the CPU time.

AC INPUT: 16 channels (16 channels per channel) can be monitored via the serial port at the maximum rate of 85 per second. The charge circuit is measured with the internal backup battery capable of charging 16 channels for approximately 16 hours, including a few minutes in rechargeable

VOLTAGE: 9-15 volts

TYPICAL CURRENT DRAIN: 1.0 milliamp per channel during processing, and 80 mA during analog measurements.

INTERNAL BATTERIES: 8 Alkaline cells with 7 amp hour capacity, The 21X delivers 80 mA, 2.5 amp hour capacity per charge.

EXTERNAL BATTERIES: Any 12 volt external battery can be connected as a primary power source during processing or the external batteries providing backup while changing external batteries.

OPERATION FROM OTHER SOURCES: The 21X includes a battery charging circuit that can be connected to 15 to 30 VDC to allow the 21X to maintain a full charge on the batteries without degrading the system. The charging circuit provides a temperature compensation for maintaining operating condition at temperatures between -5 to +70 deg C. A 110 VAC to 16 VDC wall transformer is provided with the 21X.

PHYSICAL SPECIFICATIONS

SIZE: 8.2” x 5.5” x 3.2”

WEIGHT: 6.2 lbs

Cover Photograph: The 21X is shown with 9 data cables and some of the compatible sensors including a lead cell platinum-resistance thermometer, thermocouple, silicon pyrometer and a pressure transducer. Background material is the official campbell of aerta.
Specifications

Analog Input Channels
Number: 23 differential or 46 single ended or any mix, internal temperature and zero reference
Ranges
Voltage: ±25 mV, ±250 mV, ±2.5 VDC
Current: ±2.5 mA, ±25 mA, ±250 mA via 100 Ohm shunts
Resistance: 250 Ohm, 2.5 KOhm, 25 KOhm
Frequency: 40 Hz to 20 KHz
Period: 25 mSec to 5 uSec

Analog to Digital Converter
Type: Voltage to Frequency
Resolution: 15 bit (±5 V)
13 bit (±4 V) stored data
Sample Rate: 6 to 30 samples/sec.
Accuracy: 0.15% standard,
2% attenuated voltage, 1% current
Linearity: < 0.05%
Input Resist: > 100 MOhm
Common Mode
Range: ± 4 V
Rejection: > 80 dB
Line Reject: > 100 dB
Series Mode
Line Reject: > 35 dB

Digital Input Channels
Number: 8. TTL and CMOS compatible

Counter Channels
Number: 8 low speed (share digital inputs), 1 high speed
Upcounters - 32767 to 32768, presettable, generate event on zeroth count
Count Rate: Low speed 130 Hz, High speed 2 MHz

Analog Output Channels
Number: 1, expandable to 2
12 bit, 4 quadrant multiplying
Programmable range (± 5V max)

Digital Output Channels
Number: 8. Open collector type, ±30 V, 200 mA maximum

Computer/Terminal Interface
Type: RS232C/RS422/RS423, full duplex, isolated
Baud Tx: 150, 300, 600, 1200, 2400, 4800
Baud Rx: 75 or equal to Tx baud rate
Protocol: XOR checksum with ACK/NAK
Handshake: XON/XOFF, ACK/NAK

Real Time Clock
Format: Time hh:mm:ss
Day number ddddd
Resolution: 1 sec, 2 secs stored data

Data Storage
Battery backed 24K CMOS RAM, approx 11000 readings

Power Supply
Voltage: 9-15 VAC, 11-18 VDC
Line/Mains: Via adaptor
Battery: 12 VDC external
Backup: NiCd, internally recharged
Current Draw: < 20 mA low power mode, approx 40 mA normal mode

Accessories
110VAC/240V AC adaptor, wire-wrap kit, RS232 cable, I/O plugs, temperature probe, batteries, users manual

Instant data logging arrives.

Programming Functions

Scanning: Single Scan, Poll Scan, Repeat Scan, Event Scan, Averaging Scan, Conditional Scan, Channel Inspection, Store to Memory, Unstore Memory

Input Channels: Volts, Current, Resistance, Frequency, Period, Temperature, Digital Bit, Digital Byte, Accumulating Counter, Resetting Counter, Time, Day

Output Channels: Analog Volts, Digital Bit, Digital Byte, Digital Pulse, Control, Alarm

System Configuration: Data Format, Calibration, Gain lock, ADC Parameters, Low Power, Thermocouple/RTD Reference Channels, Communications Protocol, Memory Management, Echo, Set Time, Status, Reset, Clear Memory, Self Test, Network Identify

Data Logger's versatile wire wrap I/O system simplifies many test procedures.
Set up a system in minutes

If you connect three J type thermocouples and want to read them every 2 seconds, then send this simple command from your computer.

Datataker will read the thermocouples and display the data:

![Datataker Readouts](image)

**Datataker handles complex operations just as easily.**

To log the line frequency and voltage every ten minutes, the 10 minute average of each of 5 thermocouples and the time that each sample was taken, simply send the following command.

```
Repeat every day
Day number
Real time
Frequency on channel 1
Voltage on channel 2
Read every second for averaging
EVERY 10 MINUTES
Log all data to memory
Type J thermocouples on channels 5 to 10
```

The Datataker incorporates a real time clock, allowing data to be collected at regular intervals. The data number and time of data collection may also be recorded.

Data may also be collected in response to external events.

**Operation**

Once programmed the Datataker operates independently of the computer, and inputs may be scanned at intervals ranging from seconds to months.

The link between the computer and the Datataker may be either direct or via modems, and is necessary only during command or data transfer.

Up to 7300 readings can be stored in the Datataker for later recovery.

Using modems and the public telephone network, Datatakers in remote sites can be queried.

**Communications**

The Datataker communicates with any computer via an RS232/RS422/

RS423 interface, at up to 4800 baud. All communications are in standard ASCII.

**I/O Connections**

I/O lines connect to the Laboratory and Field versions of the Datataker via 25 pin and 5 pin sockets in the rear panel. The Industrial Logger has screw terminals for I/O.

The Datataker has in excess of 200 connection points on a wire-wrap panel, which are used to connect the I/O sockets or screw terminals to required channels. This innovative feature provides considerable flexibility, and allows convenient configuration of the Datataker for any application. A utility area with I.C. socket is also provided for the installation of custom circuits.

**Networks**

Up to 15 Datatakers may be networked via an inexpensive twisted pair cable.

**Power Supply**

The Datataker may be powered from a variety of sources, including mains or line voltage, batteries, solar panels, wind generators, etc.

The internal batteries are automatically recharged from the external power source. During periods of low activity, the Datataker switches to a low power mode to reduce power consumption.

**Models**

All three models have identical data handling capabilities.

<table>
<thead>
<tr>
<th>Models</th>
<th>DT100 Laboratory Logger</th>
<th>DT100F Field Logger</th>
<th>DT100I Industrial Logger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Backup</td>
<td>450 mAh 2 days</td>
<td>4 Ah 15 days</td>
<td>4 Ah 15 days</td>
</tr>
<tr>
<td>Width</td>
<td>210 mm/8.25 in</td>
<td>241 mm/9.5 in</td>
<td>250 mm/9.8 in</td>
</tr>
<tr>
<td>Height</td>
<td>70 mm/2.75 in</td>
<td>76 mm/3.0 in</td>
<td>155 mm/6.1 in</td>
</tr>
<tr>
<td>Depth</td>
<td>165 mm/6.5 in</td>
<td>267 mm/10.5 in</td>
<td>155 mm/6.1 in</td>
</tr>
<tr>
<td>Weight</td>
<td>1.1 kg/2.6 lb</td>
<td>3.0 kg/6.6 lb</td>
<td>3.0 kg/6.6 lb</td>
</tr>
<tr>
<td>I/O Sockets</td>
<td>2 DB25 &amp; 2 DIN</td>
<td>2 DB25</td>
<td>Screw terminals</td>
</tr>
<tr>
<td></td>
<td>Sockets</td>
<td>Wire-wrap Panel</td>
<td>Wire-wrap Panel</td>
</tr>
<tr>
<td></td>
<td>Wire-wrap Panel</td>
<td>Wire-wrap Panel</td>
<td>Wire-wrap Panel</td>
</tr>
<tr>
<td>Case</td>
<td>PVC &lt; 80% RH</td>
<td>Stainless Steel</td>
<td>Polyester</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weatherproof</td>
<td>Splashproof</td>
</tr>
<tr>
<td>Environment</td>
<td>-20 to 55 Deg C</td>
<td>-20 to 55 Deg C</td>
<td>-20 to 55 Deg C</td>
</tr>
</tbody>
</table>

**Warranty**

All critical components are protected against overloads and shorts. Datataker is backed by a twelve month warranty and service is available worldwide.

The Datataker is a truly flexible tool. A wire-wrap panel is provided so input and output connector can be configured to exact requirements.
INTRODUCTION

The Dulas Data Logger was specifically designed to monitor small renewable energy systems, either in the field or laboratory. It has, however, found other applications such as remote weather stations and environmental monitoring. The logger is based upon a pocket sized personal computer to which interchangeable input signal conditioning modules are attached. The hardware has been designed to ensure that all the inputs are easy to read by a BASIC program, allowing users familiar with BASIC to write their own data collection and analysis programs. Data may be stored either in battery backed RAM, on cassette tape, or displayed using the computer's miniature colour graphics plotter. It can also be transmitted serially via a cable or radio link. The system's low power consumption (typically 300mA) enables it to run for at least two weeks from an optional rechargeable battery pack, or indefinitely when being charged from a small photovoltaic array.

The computer's data and address busses are extended to a mother board which can accept up to 8 dual input analogue cards, 8 digital input cards, and a battery charging regulator card. The mother board also accommodates two 8 bit 8 channel Analogue to Digital convertors that give a resolution of 1 part in 256.

INPUT OPTIONS

The data logger can accept up to 18 analogue and 8 digital inputs. Signal conditioning modules are interchangeable, and may be easily installed by the user. Analogue input modules are available for:

- Solarimeters
- Platinum Resistance Thermometers
- Thermocouples
- Semiconductor temperature sensors (type AD590)
- D.C. voltages (from 5mV full scale upwards)
- D.C. currents (for 60mA, or 200mA shunts)
- Humidity sensors
- Pressure transducers
- Strain gauges

2 digital input modules are available, either pulse counting or 8 bit parallel inputs. These 2 modules will accept inputs from:

- Shaft encoders
- Contact closures
- Anemometers (opto-coupled, or reed relay)
- Flow meters
- Wind direction vanes

COMPUTER PROGRAMMING

All input channels are "memory mapped" to appear to the computer as extra RAM, each input having a unique address. These addresses may be interrogated from BASIC using the standard "PEEK" command. No software initialization of the inputs is required. This approach, coupled with comprehensive programming manuals allow most users to write their own data logging programs. We will, however, be pleased to undertake programming if required. For high speed data sampling, machine code routines can be used to rapidly dump data into RAM. It can then be easily processed or output with a simple BASIC programme. This technique can be used to provide detailed "snapshots" of transient occurrences. The computer can be programmed to monitor a variable or a combination of variables to determine when such a "snapshot" should be taken, e.g. the study of winddirection blade dynamics during periods of high yaw rate.

POWER CONSIDERATIONS

Power supply voltage: 8V nom (5.8 - 7.3)
Power supply current: 50mA nom, but dependent on the number of input modules and the frequency of printouts.

A 25Ah, 6V sealed lead acid battery pack is available to ensure at least 2 weeks continuous operation between charges. Data and programs in RAM will be retained for up to 12 months by the computer's own dry cells. Regulator modules are available to charge the batteries from existing higher voltage supplies, or from photovoltaic arrays available from Dulas.

PACKAGING

The method of enclosing the logger is dependent upon the application. We have supplied loggers as "bare board", systems to suit customer's housings, in "desk top" enclosures, or in fully environmentally sealed boxes. This last option measures approx 200x300x400mm without the external battery pack.

Dulas Engineering is based at the Centre for Alternative Technology, where the practical problems of integrating electronics into renewable energy systems have been experienced first hand over the last 10 years. We are a small company, happy to adapt our products to individual customers requirements. Please consult us for further information about this, and other products.
This SQUIRREL not only displays measurements but stores them and talks to your computer

The new Squirrel from Grant Instruments is a meter with a memory. According to how its microprocessor has been programmed, it will measure any one of a range of variables from voltage to windspeed, gas consumption to solar radiation. In every case, the digital display gives second-by-second readings in appropriate units.

Squirrel will also log the results — from one, two or four inputs. Interval models store readings at user-set intervals between 1 second and 100 minutes. Event models store readings each time a user-selected event occurs.

The Squirrel SQ2 stores 2,000 readings, the Squirrel SQ8 stores 8,000. Date and time are also stored.

Then there is RS232C serial or 8-bit parallel playback for plugging directly into your computer. A portable Epson computer can be used to collect the data or analyse it in the field. Standard analysis programs are available for many types of microcomputer.

Among the things you can measure are:
- Voltage
- Current
- Temperature
- Humidity
- Pressure
- Flow
- pH and other ions
- Dissolved O2
- Wind direction
- Wind speed or run
- Rainfall
- Pulse counts
- Solar radiation
- Net radiation
- Light intensity
- Electricity consumption
- Gas consumption

It adds up to an effort-saving, high-precision method of taking measurements, logging the results and transferring data directly to computer.

General Description

A Squirrel Meter/Logger can be used as a meter or a recorder, or both at the same time. It can take a reading from each input every second and display or record readings as selected by the user-set controls.

When used as a meter, the reading from a selected channel is shown on the display, and is updated every second.

When used as a logger, readings are taken from each channel and stored in the memory at user-selected intervals (interval models) or whenever a user-selected event occurs (event models). The word “record” flashes on the display three times a minute during a recording run. Recording is unaffected by use as a meter.

Memory size Model SQ2 can store up to 3,000 8-bit readings. Model SQ8 up to 8,000. On multi-channel models the total memory capacity is shared between the channels.

Power supply The small non-rechargeable battery is easily available throughout the world. Battery life in the recording mode is about six months: the display shows the number of recording days remaining in the battery.

Controls

Apart from the on-off switch the only controls are three push-buttons, recessed to reduce the risk of accidental operation. The three push-buttons allow the user to start or stop recording or carry out all other functions, including:
- meter, displaying any channel
- review all stored readings, displayed at a rate of 1 per second
- set real-time and date
- set recording; interval (interval models) between 1 second and 100 minutes
- select significant events to trigger a recording (event models)
- display battery life in recording days
- set format for output to computer

Data storage and transfer

As well as the readings themselves, the following information is stored for later transfer to a computer:
- recorder reference number
- number of channels, with input type and range for each channel
- date and time of first reading
- recording interval (interval models) or which events are significant (event models)
- number of readings recorded
- checksum (of all readings)

The push-buttons enable the output to be set as 8-bit parallel, or as RS232C serial with a baud rate of 300, 600, 1200, 2400 or 4800. At a baud rate of 4800, all data is transferred in less than half a minute. A signal flashes on the display while data transfer is taking place.

Guarantee

Squirrel MeterLoggers are guaranteed against faulty materials or workmanship for THREE YEARS. Within the United Kingdom we make no charge for labour, materials or carriage when equipment is repaired under guarantee.

Inputs and Ranges

Inputs and ranges are factory-set and cannot be altered after manufacture.

Squirrels can have direct inputs of the type and range described below. Sensors for other variables listed on the front cover cannot be connected directly to a Squirrel: their output must be converted to voltage, current or pulses before being fed to a suitable Squirrel input.

Combinations of input types and ranges

Many different combinations of input type and range are available within the following overall limits:

All-analogue Squirrels One to four inputs. These can all be of a single type recording on a single range, or they can be split into two groups. All inputs of the same group must be of a single input type and range.

Pulse-counting Squirrels One pulse-counting input, with the option of one analogue input.

Event/digital Squirrels Eight event inputs (which can also be used as a single 8-bit digital input), with the option of four analogue inputs. These can be split into two groups as described for all-analogue Squirrels.

Consult the latest price list for details of combinations currently available.
Technical Specifications

Memory
SQ2 2000 8-bit bytes
SQ8 8000 8-bit bytes

Readings stored in the memory are retained for over a year.

Conditions of use
Ambient temperature -30 to +65°C
Ambient humidity up to 95% r.h. (non-condensing)

Battery
Standard 9V alkaline (Duracell MN1604, etc). Recording life about six months.

Accuracy

Analogue ranges
Resolution: 1 bit (0.4% span)

Accuracy:
- ±1 bit (0.4% span) on V and C ranges
- ±2 bits (0.8% span) on other ranges

On thermocouple ranges there can also be a cold-junction compensation error of up to 0.07°C/°C above or below 20°C Squirrel ambient.

Pulse-counting ranges
Count mode – max error 1 pulse (32 pulses for readings above 32,768)
Rate mode – max error 1 pulse
Event/digital range
Event-initiated mode – No error on “State” reading. Max error 1 time unit on time readings (non-cumulative)
Interval mode – No error

Computer output specification
Output socket 15-pin D
Format (user selected)
either 8-bit parallel or RS232C with user-selected baud rate of 300, 600, 1200, 2400 or 4800 (no hardware handshaking).

Data transfer rate At a baud rate of 4800, all readings from SQ2 are transferred in not more than 8 sec, from SQ8 in not more than 32 sec.

Further details on data transfer are given in “Notes on interfacing Squirrels with computers” available on request. (These notes are also incorporated in the user manual supplied with every Squirrel.)

Input specifications

<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
<th>Socket</th>
<th>Input</th>
<th>Input Impedence</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Voltage (d.c.)</td>
<td>3.5mm 0 jack (yellow)</td>
<td>Common ground</td>
<td>1MΩ</td>
<td>Depends on range. 100 Ω up to 3mA</td>
</tr>
<tr>
<td>C</td>
<td>Current (d.c.)</td>
<td>3.5mm 0 jack (silver)</td>
<td>Common ground</td>
<td></td>
<td>33 Ω over 3mA to 10mA</td>
</tr>
<tr>
<td>U</td>
<td>Mini-thermistor</td>
<td>3.5mm 0 jack (red)</td>
<td>Common ground</td>
<td></td>
<td>10 Ω over 10mA to 30mA</td>
</tr>
<tr>
<td>S</td>
<td>Micro-thermistor</td>
<td>3.5mm 0 jack (green)</td>
<td>Common ground</td>
<td></td>
<td>3.3 Ω over 30mA</td>
</tr>
<tr>
<td>P2</td>
<td>Pt 100 (2 wire)</td>
<td>3.5mm 0 jack (blue)</td>
<td>Common ground</td>
<td></td>
<td>Depends on range.</td>
</tr>
<tr>
<td>P3</td>
<td>Pt 100 (3 wire)</td>
<td>min 3-pin (blue)</td>
<td>Common ground</td>
<td></td>
<td>Depends on range.</td>
</tr>
<tr>
<td>K</td>
<td>Chromel-Alumel t/c</td>
<td>ISA min t/c (yellow)</td>
<td>Floating</td>
<td>1MΩ</td>
<td>Floating and common ground</td>
</tr>
<tr>
<td>T</td>
<td>Cu-Constantan t/c</td>
<td>ISA min t/c (blue)</td>
<td>Floating</td>
<td>1MΩ</td>
<td>Floating and common ground</td>
</tr>
<tr>
<td>J</td>
<td>Fe-Constantan t/c</td>
<td>ISA min t/c (black)</td>
<td>Floating</td>
<td>1kΩ</td>
<td>Floating and common ground</td>
</tr>
<tr>
<td>L</td>
<td>Rel. humidity</td>
<td>6-pin DIN</td>
<td>Floating</td>
<td>100kΩ</td>
<td>Floating and common ground</td>
</tr>
<tr>
<td>A</td>
<td>Pulse-count</td>
<td>5-pin DIN</td>
<td>Common ground</td>
<td></td>
<td>22kΩ</td>
</tr>
</tbody>
</table>
| D    | Event digital    | 9-pin D           | Common ground   |                 | 0.5V, high level 4 to 20V. Inputs can be from contacts (max frequency 100Hz for pulse-count) or voltages with low level less than

Wt: 0.5kg
Material: Grey Nextel-coated ABS
Mobile Data Logger MODAS 12

with semiconductor plug-in memory

MODAS 12 is particularly useful for long-term data acquisition in difficult operating conditions in the factory or in the field, for example:
- Decentralised monitoring of operating data in the fields of energy supply engineering and energy consultancy, for machinery and process sequences
- Performance measurement in pilot and demonstration projects
- Unmanned stations for weather and environmental measurements, site appraisals
- Mobile application in vehicle testing

In the specialist fields of energy technology, engineering, vehicle technology and geo-sciences (meteorology, geophysics, geography and geodetic surveying).

Features:
- Measurement, monitoring and reduction of all physical parameters
- Semiconductor data store ensuring a high degree of security for data even in unfavourable environmental conditions (no moving parts)
- 16 analogue and 7 impulse inputs with 12 bit resolution, built-in signal conditioning cards for all the usual sensors, internal data reduction by means of mean values; high degree of flexibility
- Very low power consumption of only 0.5 watt; autonomous supply by means of solar cells
- Robust and good value, low sensitivity to vibration or dust; developed and manufactured in West-Germany, reference installations in Kenya, Peru and the Philippines

1. Data logger MODAS 12
- 16 analogue and 7 impulse channels; programming of channel allocation, amplification and mean value interval by means of a key board
  Analog: 0.1, 0.5, 2 and 8 volt, with signal conditioning card 5 and 20 mV full scale deflection (12 bit resolution); connection to all usual sensors without the need for any external power supply. Impulse: contact (built-in bounce prot.) or voltage signal, counters 0 - 4095
- Scanning of the occupied channels every 2 s, data reduction by means of formation of mean values (1 min to 1 h); display of current values, data formatting, storage place, time and date
- Up to four 8 KB or 32 KB plug-in memories can be connected to the MODAS 12 (max. 128 KB = 130 000 values a 12 bit); measurement period with an 8 KB memory and 16 channels occupied (hourly mean values) is almost three weeks, with a 32 KB memory nearly 3 months; data security approx. 10 years due to integral LiCl battery
- Voltage supply: built-in 12 V/9.5 Ah battery, charging by internal power pack or solar charge regulator; power consumption only about 0.5 watt
- 19 inch rack mounting, 3 height units, working range -20 to 55°C, up to 90% r.H. non-cond.

2. Readout and transmitter unit DLU
- Readout of the RAM memory and delivery of the measured values to a personal computer
- Serial (RS 232C V.24) or parallel (IEEE 488, IEC-Bus) interfaces

3. Accessories
- Hardware: 8 KB and 32 KB plug-in memories, built-in signal conditioning cards for all usual sensors, aluminium case for transport and installation of MODAS 12 in the field, solar cell module to provide an independent power supply for MODAS 12 in the field; personal computer, floppy and printer for laboratory and office, hand-held computer for provisional evaluation in the field
- Software: transfer software for serial and parallel interfaces, processing software (at present only available for Commodore personal computer); conversion to physical parameters, storage, printout, collation into monthly files, statistics, graphics

4. Optional extras
- Expert advice on the selection of necessary sensors and adaptability of MODAS 12 to the available hardware
- System selection and integration: MODAS 12 - sensors - personal computer - software
- Leasing of MODAS 12: contract measurements with install. and dismantl., evaluation and report
- A wide range of special requirements can be met, e.g. storage of min/max values, standard deviation; direct storage of measurements without formation of mean values; multiplication of the instantaneous values of two channels for measurement of power and heat quantities; 9 further channels possible for digital purposes (e.g. status, BCD)

5. References
References from areas of application at home and abroad such as those mentioned overleaf. Extreme, all-year round operation without connection to the grid including high mountain ranges (Peru 3,800 m, France and Switzerland 2,500 - 3,200 m, Austria 2,600 m) and developing countries (Kenya, Peru and the Philippines); genuinely mobile application. In vehicle testing

Further technical details, examples of software and prices from: