Documentation for the

VAISALA METEOROLOGICAL STATION

Contract 52203/VPO/97/9160/STJ

between ESO-Garching

and

Vaisala Oy., P.O. Box 26, FIN00421 Helsinki

MAY 25, 1998

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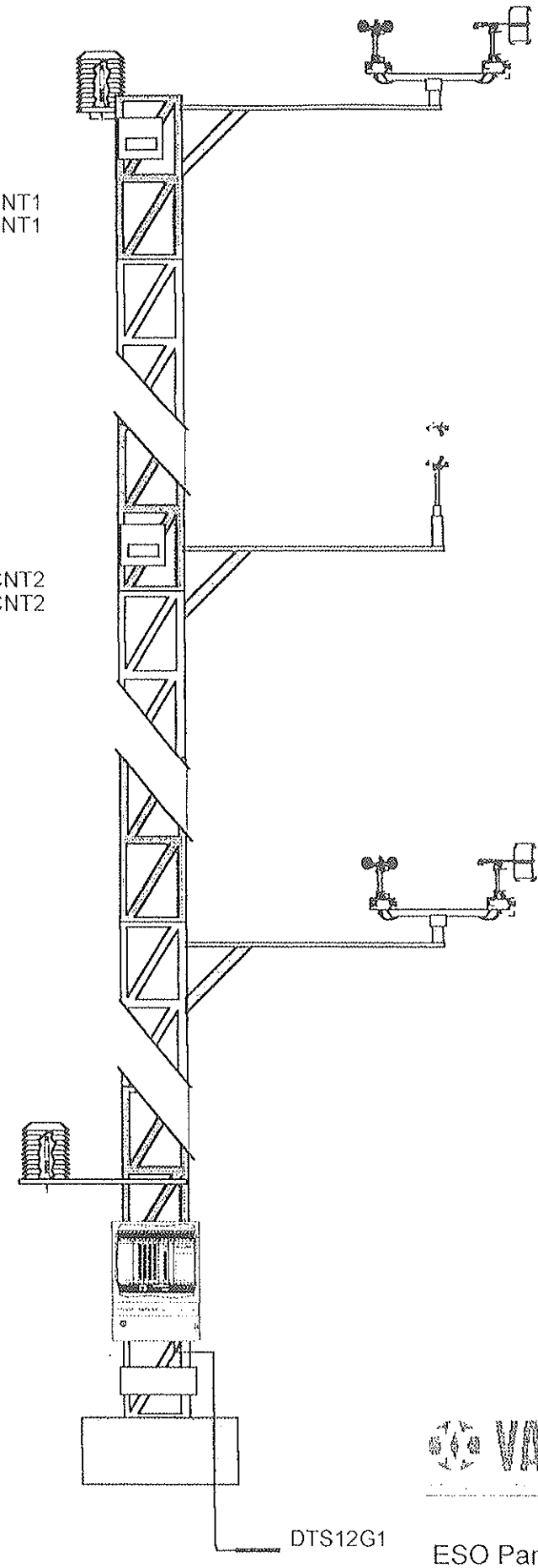
MILOS 500 AUTOMATIC WEATHER STATION FOR THE ESO VLT PROJECT

Technical Notice

23 November 1997

VAISALA



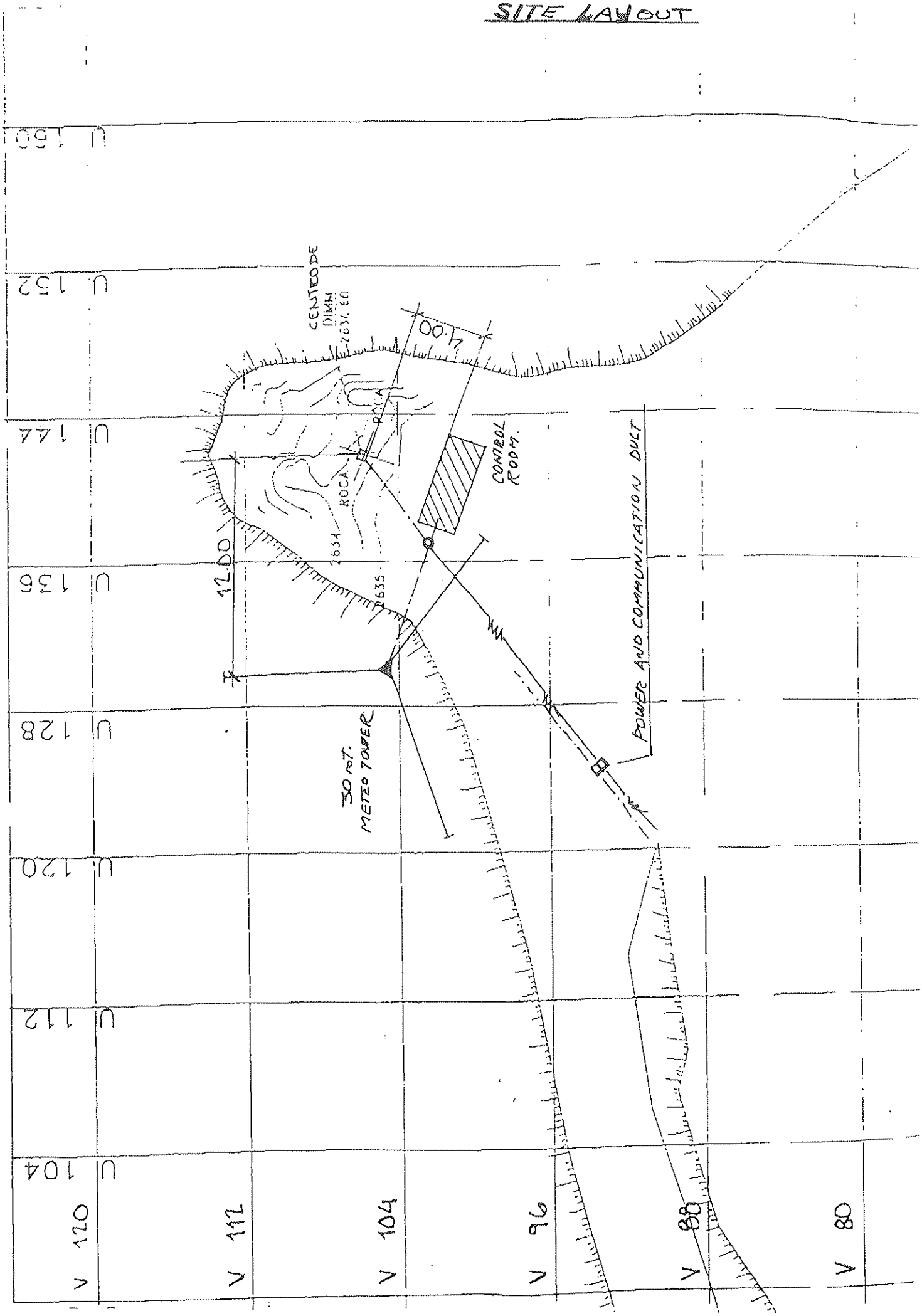
VAISALA

01.05.1998

ESO Paranal
Milos 500 / Measurement variables

Ref. MT 4700600

SITE LAYOUT


POSICION 'L'
U 150
U 152
U 144
U 136
U 128
U 120
U 112
U 104
V 120
V 112
V 104
V 96
V 88
V 80
CENTRO DE DIBUJO
00.17
ROCA
ROCA
2634
2635
12.00
CONTROL ROOM.
POWER AND COMMUNICATION DUCT
30 mt. METEO TOWER

Markku Helin / MHE

1998-05-01

ESO VLT project
VAISALA ref.: MT4700600
Recommendation for Maintenance and Calibration

Wind sensors:

The delivered wind sensors WAA151 and WAV151 as well the already existing wind sensors WAA14 and WAV15 should be maintained once a year. The maintenance procedure is to change the two bearings each sensor and, if needed, also the gaskets.

The procedure for changing the bearings and gaskets is described in detail in the Quick Reference Guide of WAA151 and WAV151.

The sensitivity of the Vaisala wind sensors can be verified any time comparing the wi. speed values of the two sensors with each other or with the readings of the ultrasonic anemometer.

Humidity sensors:

The humidity sensors should be checked and, if necessary, calibrated once a year. For verifying the readings of the humidity sensors a calibrated HMP45D with a hand-held display is recommended.

For a more comprehensive calibration a humidity calibrator HMK15 with salt solutions of low humidities is recommended.

Generally the readings of the humidity sensors can be verified any time comparing the readings of the two sensors with each other.

Other sensors:

All the other sensors i.e. temperature, ultrasonic wind, and air pressure are maintenance free and thus need no regular maintenance.

If, however, the readings of one of the a.m. sensors starts to indicate values not in-line with the other parameters the sensor could be verified by temporarily exchanging the measurement channel of two similar sensors in Milos 500.

For the maintenance of the MetOne particle counters, please refer to the Handbook of the sensor.

VAISALA

WOBS
MHE

QUOTATION No:
DATE: 4/23/98

Reference:

ESO

Contact details:

Attention:
Telefax:

Time of delivery:

Last day of validity:
1998-12-31

Terms of Delivery:

Terms of payment:

Spares for VLT Weather Station

Item	Type	Description	Qty	Unit price DEM	Total price DEM
Set of Spares for WAA151					
1	WAA151	Anemometer	1	890.00	890.00
2	7150WA	Cup Assembly	1	140.00	140.00
3	16644WA	Set of Bearings and Gasket	2	87.00	174.00
Set of Spares for WAV151					
4	WAV151	Wind Vane	1	990.00	990.00
5	6389WA	Standard Tail	1	130.00	130.00
6	16644WA	Set of Bearings and Gasket	2	87.00	174.00
Set of Spares for HMP45D					
7	HMP45D	Temperature and Humidity Sensor	1	890.00	890.00
8	2787HM	Membrane filter	2	27.00	54.00
Set of Spares for Milos 500					
9	DMC50B	Central Processor Unit	1	2,950.00	2,950.00
10	DPS50	DC/DC Converter	1	1,520.00	1,520.00
11	DMI50	Sensor Interface Unit	1	1,250.00	1,250.00
Calibration Equipment for Humidity					
12	HMK15	Humidity Calibrator, code HMK15A1001B0B with two salt chambers, calibrated T-meter salt bag for 12 % RH (LiCL) and 97 % RH (K2SO4) and ion exchanged water	1	750.00	750.00

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1. SENSORS

1.1. Measurements at the level of 30m

1.1.1. Wind Measurement

Vaisala WAA151 Anemometer and WAV151 Wind Vane shall be used for the wind measurement at the height of 30m.

WAA151 Anemometer and WAV151 Wind Vane are installed to the WAC151 cross arm. The installation bar, where the sensors are to be installed, shall be made by ESO. Vaisala shall supply a special connecting piece that shall be mounted between the ESO installation bar and Vaisala WAC151 Cross Arm. The additional connecting piece makes adjustments in the installation direction possible.

The sensor signals are taken to the Milos 500 Weather Station over the DMI50 Sensor Interface Unit with the standard Wind Sensor Cable (35m).

The two WA-type of wind sensor pairs (at 30m and 10m level) are powered from Milos 500. Should there be a need for sensor shaft heating (below +5 degC) the heating shall be powered with the WHP25. The WHP25 will also be used for powering the whole system.

Sensor	Parameter	Range	Sampling Interval
WAA151	Wind Speed	0..75 m/s	2s (by Milos 500)
WAV151	Wind Direction	0..360 deg	2s (by Milos 500)

1.1.2. Temperature, Humidity and Dew Point

A HMP45D Humidity/Temperature Probe shall be installed inside a DTR13 radiation shield. The radiation shield shall be mounted on a installation bar made by ESO.

The sensor element for the temperature is Pt-100, which is hooked up to MILOS 500 DMI50 Sensor Interface Board through a 4-wire connection.

The sensor element for relative humidity is a HUMICAP sensor and the signal output of 0..1 V corresponds to the relative humidity of 0..100 %RH.

By every measurement sequency the dew point temperature is calculated in Milos 500 from the temperature and humidity values with the following formula:

$$TD = \frac{c \times b}{c \times \frac{a}{2} + b} - 273.16$$

Where:

$$a = \ln \frac{100}{RH}$$

$$b = 15.0 \times a - 2.1 \times TA + 2711.5$$

$$c = TA + 273.16$$

$TA = Actual\ air\ temperature\ [°C]\ measured\ by\ Milos\ 500$

$RH = Actual\ relative\ humidity\ [\%RH]\ measured\ by\ Milos\ 500$

Sensor	Parameter	Range	Sampling Interval
HMP45D	Air Temperature	-40..+60 degC	60s (by Milos 500)
	Relative Humidity	0..100 %RH	60s (by Milos 500)
	Dew Point Temp.		60s calculated by Milos

1.1.3. Particle Measurement

The MetOne particle counters (model R4815) shall be used for measuring the amount of particles in a certain volume of air. The particle counter has two channels, one for particles for size of 0.5 microns and one for 5.0 microns.

The particle counters require a vacuum source for the flow control. This source shall be arranged by ESO.

The data shall be transmitted over a RS485 serial line. Attaching several particle counters on one communication loop is possible. The Milos 500 will be polling the information from each sensor with a certain interval.

The powering of the counters will be done with a separate nonrecurring power supply.

Sensor	Parameter	Range	Sampling Interval
MetOne particle counter	amount of 0.5 micron particles in a cubic feet of air		10s (by Milos 500)
	the same for 5.0 micron particles		10s (by Milos 500)

1.2. Measurements at the level of 20m

1.2.1. Ultrasonic Anemometer

For the wind measurement at the height of 20m an ultrasonic anemometer is used. The Sonic is installed on a similar type of cross arm than the wind sensors at the height of 30m.

The sensor is hooked up to Milos 500 through an RS-485 serial line. The Milos 500 polls the sensor once a second achieving the following data:

Sensor	Parameter	Range	Sampling Interval
Wind Master	Wind Direction	0..360°	39/s (internal)
	Wind Speed (Horiz.)	0..60m/s	(data transmission for
	Wind Speed (Vert.)	0..60m/s	Milos 500 1/s)
	Sensor status		
	or optionally:		
	wind vectors u,v,w	0..60m/s	

The gust analyse is done in Milos 500 due to the reason, that there is no gust analyse in WindMaster (as in earlier versions).

There is also a model available (type "Logger"), that is capable of analysing the gusts and calculating standard deviations with a sampling rate of 4Hz. The price of the "Logger" is DM 11.225,00 (+MwSt). (The price of Wind Master is DM 6.445,00).

The powering of the sensor is done from Milos 500. All the necessary cables are delivered with the sensor.

1.2.2. Particle Measurement

The particle measurement in the height of 20m is identical to the one at 30m level.

1.3. Measurement at the level of 10m

The already excisting wind sensors of type WAA15 and WAV15 are to be used at the level of 10 meters. The existing installation accessories can be used. From the type of signal and performance the wind sensors are compatible with the models WAA151 and WAV151 (see sensors at the level of 30m).

1.4. Measurements at ground level (2m)

1.4.1. Temperature, Humidity and Dew Point

The temperature, Humidty and Dew Point measurement is identical to the one at the height of 30m.

1.4.2. Barometric pressure

A PTB220A digital barometer is installed in the MILOS 500 installation enclosure BOX50S and connected to Milos 500 via RS-232 serial line.

The PTB220A sensor is as standard delivered with one sensor module. For an improved redundancy the PTB220A sensor can be ordered with one or two additional sensor modules.

Sensor	Parameter	Range	Sampling Interval
PTB220A	Barometric Pressure	600..1100hPa	1s (60s by Milos 500)
	QNH		60s calculated by Milos
	3h Pressure Trend		60s calculated by Milos

2. CALCULATIONS

2.1.1. Wind measurements

1 and 20 minute averages, minimum and maximum values, and standard deviations are calculated from each wind sensor pair. The same applies for the data acquired from the optional ultrasonic anemometer (wind direction, wind speed, vertical wind speed or u,v,w).

For the wind data 1 and 20 minute average, maximum and minimum values are calculated in the separate wind task. 1 minute data is calculated twice a minute and 20 minute data once a minute.

2.1.2. Other measurements

A dew point is calculated from the temperature and humidity measurements of the HMP45D sensors at levels of 2m and 30m.

A QNH value (pressure at sea level) is calculated from the atmospheric pressure reading. Also the 3h pressure trend is calculated.

20 minute averages, minimum and maximum values, and standard deviations are calculated from the following values:

parameter	sensor level
air temperature	30m
rel. humidity	30m
dew point	30m (calculated value)
air temperature	2m
rel. humidity	2m
dew point	2m (calculated value)
barom. pressure	2m
QNH	2m (calculated value)
3h pressure trend	2m (calculated value)
ground temp.	-1m
0.5u particles	30m
5.0u particles	30m
0.5u particles	20m
5.0u particles	20m

3. CHECKING OF THE MEASURED DATA

3.1. Gross error limit checks

The configuration parameters (in Your Way) include the minimum and maximum limits for each measurement. If the measured value exceeds the preset limit more than 1 % of the whole range the status of the data item is set to old.

This prevents invalid data to be updated e.g. in reports. In this case instant data is presented as ///// in the reports.

3.2. Step error checks

The configuration parameters include the maximum rate of change between consecutive measurements. If the "step error check routine" exceeds the preset limit, the status of the data item is set to old.

This prevents invalid data to be updated e.g. in reports. When this happens the instant data is presented as ///// in the reports.

Step error limits are following (example) :

	max. change	Measuring interval
air temperature	2°C	1 min
rel. humidity	50%	1 min
air pressure	0.3 hPa	1 min
groung temperature	2°C	1 min
wind speed	50 m/s	2 s

4. REPORTS

The automatic weather station Milos 500 generates several different types of messages and message outputs. As standard the system generates four different reports; Total, Tabular, System and Spreadsheet. Additionally, ESO can define two report formats. The operator can select the report which is sent out via serial line 1 at an interval also set by the operator.

The reports are generated once a minute, directly after all the measurements and calculations have been completed.

NOTE I

The reports in this example are shown without the calculation of the standard deviation. The standard deviation values are shown in additional column after the MIN-values.

NOTE II

The sensor selection affects the lenght of the Total, Spreadsheet and Tabular reports. This means that if e.g Wind Speed sensor is not set ON, the data correponding Wind Speed is not included in the reports.

If some of the sensors included in the basic configuration are not connected to the system but the sensor states are set ON, the fields in the reports indicating these values are reported as ////.

The reports can be viewed by the operator by giving a command in the Application Command set presented with prompt M500>

```
M500>SHOW  TOTAL
           TABULAR
           SYSTEM
           SPREADSHEET
```

4.1. Total

The Total report contains all the sensor information except values polled from the Weather Sensor (example).

```
SHOW TOTAL
MILOS 500 TOTAL 1994-03-23 07:07                    STATION : VAISALA

                                         INST        AVE         MAX          MIN
AIR TEMPERATURE              C :         22.4:       22.4:       22.5:        22.4:
GROUND TEMPERATURE           C :         -0.1 :      0.1 :       -0.1 :       -0.1 :
RELATIVE HUMIDITY            % :         14 :        14 :        14 :         14 :
DEW POINT TEMPERATURE        C :         -6.1 :      -6.2 :      -6.1 :       -6.4 :
AIR PRESSURE               HPA :         1003.8 :    1003.8 :    1003.9 :     1003.7 :
QFE                        HPA :         1004.1 :    1004.2 :    1004.3 :     1004.1 :
QNH                        HPA :         1033.6 :    1033.7 :    1033.8 :     1033.6 :
QFF                        HPA :         1034.6 :    1034.7 :    1034.8 :     1034.7 :
WIND A SPEED        2M     M/S :         12.8 :      12.7 :      12.8 :       12.7 :
                   10M     M/S :                     12.6 :      12.8 :       0.0 :
WIND A DIRECTION    2M     DEG :         141 :       138 :       141 :        135 :
                   10M     DEG :                     138 :       141 :        135 :
SUN RADIATION             W/M2 :         898.3 :     898.3 :     898.3 :      898.3 :
PRECIPITATION SUM           MM :         0.0 :       0.0 :
RAIN DURATION              MIN :         0 :         0 :
OPERATING VOLTAGE            V :         13.4 :
```

4.2. Tabular

The Tabular message contains the same information as the total message. The sensors are presented with the sensor identifiers, not with the name as in the Total report (below an example).

```
M500> SHOW  TABULAR
1994-03-23 07:07          MILOS 500 TABULAR MESSAGE

                  INTV    INST      AVE       MAX       MIN
TA1       C       01H     22.4      22.4      22.5      22.4
TG1       C       01H     -0.1      -0.1      -0.1      -0.1
RH1       %       01H     14        14        14        14
TD1       C       01H     -6.1      -6.2      -6.1      -6.4
PA1       hPa     01H     1003.8    1003.9    1004.0    1003.8
QNH       hPa     01H     1034.3    1034.4    1034.5    1034.3
QFE       hPa     01H     1004.1    1004.2    1004.3    1004.1
QFF       hPa     01H     1033.6    1033.7    1033.8    1033.6
WS1       m/s     02M     12.8      12.7      12.8      12.7
                  10M               12.6      12.8      0.0
WD1       DEG     02M     135       138       141       135
                  10M               138       141       135
SR1       W/m2    01H     898.3     898.3     898.3     898.3
PR1       mm      D06     0.0       0.0
RO1       mm      D06     0         0
```

4.3. System

The System message contains hardware information of MILOS 500, battery charging state, operating voltage and external current, etc.

```
M500>SHOW SYSTEM
MILOS 500 SYSTEM MESSAGE 1994-03-23 07:08     STATION: VAISALA

CPU TEMPERATURE              DEG :  28
OPERATING VOLTAGE              V :  13.4
CHARGE/DISCHARGE CURRENT      mA :  11.5
EXTERNAL VOLTAGE               V :  12.5
EXTERNAL CURRENT               A :  0.14
LITHIUM VOLTAGE                V :  3.06
BATTERY CHARGING               %:  100.1
CHARGING STATE                 :   Full Charge
```

Explanations of the message parameters:

CPU TEMPERATURE is temperature measured from the surface of the DMC50A, can be up to 70 °C

OPERATING VOLTAGE is system battery voltage. Value can vary from +10.5 to 14.5 VDC depending on charging state of system backup battery.

CHARGE/DISCHARGE CURRENT indicates how much MILOS 500 itself consumes from the system battery. This value contains consumption of MILOS 500 and sensors connected and powered from MILOS 500.

EXTERNAL VOLTAGE is measured from the rectifier after power supply input. Value is the power supply value coming into MILOS 500 from external power supply. It can vary from +10.5 to 80 VDC or from 12 to 50 VAC.

EXTERNAL CURRENT is measured also from external power supply input. Value informs how much system is consuming current from external power supply.

LITHIUM VOLTAGE is voltage level of the lithium battery of the CPU static RAM, installed on the mother board of the DMF50 card frame. Value has to be between 2.7 V... 3.3 V. If value is 2.7 V or less the lithium battery has to be changed because battery is almost empty. If value is more than 3.3 V (= no battery installed), please check that battery is placed properly to its socket on the mother board.

BATTERY CHARGING is indication about battery charging level.

CHARGING STATE is indication about the internal charger state of MILOS 500. The internal charger is controlled ON due to the software internal alarm checking.

4.4. Spreadsheet

The Spreadsheet message has all the measured and calculated data without any names or sensor identifiers. The Spreadsheet message is stored into the memory unit (if available) and its format is designed so that it can be edited directly with MS- Excel program to further process the data (below an example).

```
MSOO>SHOW SPREADSHEET

1994-03-23 07:07 VAISALA      22.4   22.4   22.5   22.4   -0.1   -0.1   -0.1   -0.1   14
14       14      14      -6.1   -6.2   -6.1   -6.4   1003.8 1003.9 1004   1003.8 1004.1
1004.2   1004.3  104.1   1034.3 1034.4 1034.5 1034.3 1033.6 1033.7 1033.8 1033.6 12.8
12.7     12.8    12.7    12.6   12.8   0      135    138    141    135    138    141    135
898.3    898.3   898.3   898.3  0.0    0.0    0      0      13.4
```

Contents of the Spreadsheet (from the example) → see end. 1

```
1994-03-23  Time of the report generation, year, month and date
07:07       Local time of the report generation, hours and minutes
Vaisala     Name of the station

22.4        TA1, Air temperature, instant value in °C
22.4        TA1, Air temperature, 1 hour average in °C
22.5        TA1, Air temperature, 1 hour maximum in °C
22.4        TA1, Air temperature, 1 hour minimum in °C

-0.1        TG1, Ground temperature, instant value in °C
-0.1        TG1, Ground temperature, 1 hour average in °C
-0.1        TG1, Ground temperature, 1 hour maximum in °C
-0.1        TG1, Ground temperature, 1 hour minimum in °C

etc.
```

5. DATA STORAGING

No data storaging in this application

6. SERIAL LINES

The serial lines of MILOS 500 have different types of configurations to perform several specified tasks; polling sensor information from remote devices, sending reports out to remote displays or terminals, to view measured or calculated data. Serial line 1 is reserved for maintenance operations.

6.1. Serial line 1

Serial line 1 can be used by the following ways:

a) Command line interpreter mode (CLI)

This means that the user can operate MILOS 500 through this serial port. The following commands are needed in order to enter the CLI mode:

CLI<CR>

```
SYSTEM<CR>   (or OPEN<CR>)
```

b) The operator can set the following reports to be sent via the serial port; Total, System, Spreadsheet, Tabular or either of the two reports defined by ESO. The transmission interval can be set by the user, too.

To select the report, the following command is used:

```
M500>SET SEND REPORT_NO X     ; where X is

1= TOTAL
2= SYSTEM
3= SPREADSHEET
4= TABULAR
5= ESO_1
6= ESO_2
```

To define the output interval the following command is used.

M500>SET SEND interval MINUTES ; e.g. SET SEND INTERVAL 10

The operator may specify the interval from 1 minute to 1440 minutes (= once a minute to once a day).

c) The user can also poll the reports from MILOS 500. The following command is needed for making the polling:

```
MES1<CR>        ; MES1 will cause the Total report to be sent out
```

The polling characters for each report are:

MES1= TOTAL
MES2= SYSTEM
MES3= SPREADSHEET
MES4= TABULAR
MES5= ESO_1
MES6= ESO_2

NOTE: The line must be "closed" before sending the polling characters.

The default line parameters for this serial channel are: 9600 baud, 8 data bits, 1 stop bit, No parity

6.2. Serial line 2

Serial line 2 is reserved for communication between the PTB220A pressure sensor and the Milos 500. The communication type is RS232. Milos 500 is polling the data from the sensor.

6.3. Serial line 3

Serial line 3 is reserved for communication between the Ultrsonic Anemometer and the Milos 500. The communication type is RS485. Milos 500 is polling the data from the sensor.

6.4. Serial line 4

Serial line 4 is reserved for communication between the two particle counters and Milos 500. The communication type is RS485. Milos 500 is polling the data from the sensors.

```
S 2 4 - 1 1 - 1 9 9 7 _ 1 1 : 3 0 : 0 0 _ M I L O S _ 5 0 0 _ M E S S A G E _ 0 1 C L
_ _ _ _ _ U N I T _ I N T E R V A L _ _ I N S T A N T _ _ A V E R A G E _ _ M A X I M U M _ _ M I N I M U M _ _ S T D . D E
T A 1 S _ C _ _ _ _ _ _ _ _ _ _ 6 0 _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1
T A 1 L _ C _ _ _ _ _ _ _ _ _ 1 2 0 0 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1
R H 1 S _ % _ _ _ _ _ _ _ _ _ _ 6 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0
R H 1 L _ % _ _ _ _ _ _ _ _ 1 2 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0
T D 1 S _ C _ _ _ _ _ _ _ _ _ _ 6 0 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4
T D 1 L _ C _ _ _ _ _ _ _ _ _ 1 2 0 0 _ _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4
T A 2 S _ C _ _ _ _ _ _ _ _ _ _ 6 0 _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1
T A 2 L _ C _ _ _ _ _ _ _ _ 1 2 0 0 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1 _ _ _ _ _ 3 3 . 1 1
R H 2 S _ % _ _ _ _ _ _ _ _ _ _ 6 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0
R H 2 L _ % _ _ _ _ _ _ _ _ 1 2 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0 0 _ _ _ _ _ _ _ 1 0
T D 2 S _ C _ _ _ _ _ _ _ _ _ _ 6 0 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4
T D 2 L _ C _ _ _ _ _ _ _ _ 1 2 0 0 _ _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4 5 _ _ - 1 2 3 . 4
T G 1 S _ C _ _ _ _ _ _ _ _ _ _ 6 0 _ _ _ - 2 1 . 8 8 _ _ _ - 2 1 . 8 8 _ _ _ - 2 1 . 8 8 _ _ _ - 2 1 . 8 8 _ _ _ - 2 1 . 8
T G 1 L _ C _ _ _ _ _ _ _ _ 1 2 0 0 _ _ _ - 2 1 . 8 8 _ _ _ - 2 1 . 8 8 _ _ _ - 2 1 . 8 8 _ _ _ - 2 1 . 8 8 _ _ _ - 2 1 . 8
P A 1 S _ h P a _ _ _ _ _ _ _ _ _ 6 0 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5
P A 1 L _ h P a _ _ _ _ _ _ _ 1 2 0 0 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5
Q N H S _ h P a _ _ _ _ _ _ _ _ _ 6 0 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5
Q N H L _ h P a _ _ _ _ _ _ _ 1 2 0 0 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5 6 _ _ 1 0 1 3 . 5
P T 3 _ _ h P a _ _ _ _ _ _ _ 1 0 8 0 0 _ _ _ _ + 3 . 5 6 _ _ _ _ _ + 3 . 5 6 _ _ _ _ _ + 3 . 5 6 _ _ _ _ _ + 3 . 5 6 _ _ _ _ _ + 3 . 5
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W S 1 L _ m / s _ _ _ _ _ _ _ 1 2 0 0 _ _ _ 1 1 1 . 4 5 _ _ _ 1 1 1 . 4 5 _ _ _ 1 1 1 . 4 5 _ _ _ 1 1 1 . 4 5 _ _ _ 1 1 1 . 4
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C L
```

where

S start of heading <SOH>
C carriage return <CR>
L line feed <LF>
_ space character

naming principle

T A 1 S temperature 1, short calculation period (one minute)
T A 1 L temperature 1, long calculation period (twenty minutes)

ESO Spreadsheet - End.1

2 MILOS 500 Subsystem Data Sheets

1. MILOS 500 Data Collection System
2. DMC50 CPU Board
3. DMI50 Sensor Interface Unit
4. DPS50 DC/DC Converter
5. BOX50S Equipment Enclosure
6. Your Way Milos 500 Configuration Program
7. Cross Arm WAC151, Anemometer WAA, Wind Vane 151WAV151
8. HMP45D Humidity and Temperature Probe
9. DTR13 Radiation Shield
10. DTS12G Soil Temperature Probe
11. PTB220 digital barometer
12. GILL 3 axis ultrasonic anemometer
13. R4815 Met One Particle Counter

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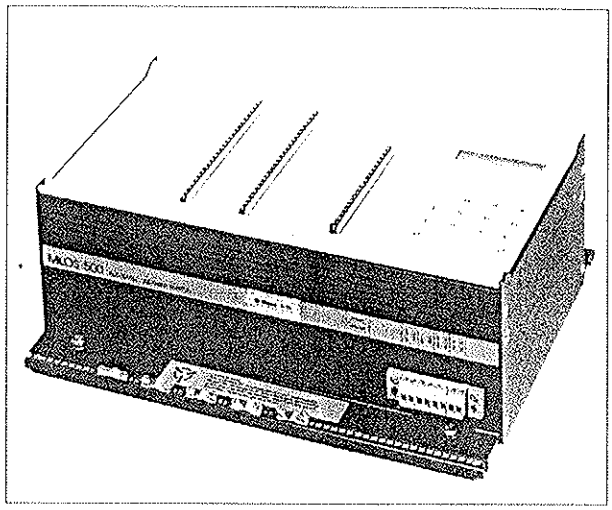
MILOS 500
Data Collection System



Today's data collection applications require flexibility and easy configuration of sensor interfaces, data processing algorithms and new output reports and formats. With MILOS 500 you can have everything "Your Way". The MILOS 500 is an intelligent, fully automated data collection, archiving and reporting system. Designed for extreme environments at remote unmanned sites, the MILOS 500 brings you features never met before in utomatic Weather Stations.

FLEXIBILITY AND OPEN ACCESS

MILOS 500 sensor interfaces support the standard automated weather parameters, such as Wind, Temperature, Relative Humidity, Pressure, Cloud Height, and Visibility. Additional parameters supported include Precipitation, Radiation, Rain detection, Surface conditions, COx, NOx and SOx. Practically any analog or digital sensor can be interfaced to MILOS 500 using the individually programmable interfaces.

The set-up of MILOS 500 has been simplified by using the "Your Way" configuration program. The sensor settings, command sets, measuring algorithms, calculations, and report formats can be selected from predefined parameter library. The user has the freedom to modify these default settings, use his own preferred values or create completely new ones.

The "Your Way" program guides the user through the set-up procedure using full screen menus to create a system set-up file. This file can be downloaded directly from your PC, even to a remote site or by using a small and secure FLASH EPROM memory card. New parameters can be downloaded without any interruption to ongoing measurements. the MILOS 500 can be supplied either fully configured or together with the "Your Way" program. Data processing capabilities also support message coding in WMO formats, such as SYNOP, METAR, and SPECI, as well as user defined formats. Alarm limits can be set for any input or calculated parameter.

PERFORMANCE

Vaisala has combined a 16-bit Intel 80C188EB processor, Surface Mounted Technology, fast true 12-bit A/D converters and minimum 1 MByte of FLASH EPROM to create a most reliable and powerful Automatic Weather Station. In the basic version of MILOS 500 you already have four serial I/O ports, with the possibility to "daisy-chain" several devices through one serial port. The number of serial ports can be increased to ten, each individually programmable.

RELIABILITY

The MILOS 500, including its sensor and data transceiving interfaces, DC power supplies and optional display unit, is housed in a rugged aluminium profile case that is easy to install in a variety of outdoor enclosures. The operating power for MILOS 500 can be supplied from various sources, such as unregulated solar panels, wind power generators, DC batteries or from the Mains supply.

MILOS 500 is designed and built to withstand extreme environmental conditions. It has been tested against the impressive set of MIL and IEC standards.

MILOS 500 has a modern modular design based on the building block principle. The basic MILOS 500 can easily be expanded by the user with various optional plug-in units, sensors, software modules and data communication devices. The applications are not only limited to measurement. Also programmable analog and digital outputs are provided.

The MILOS 500 Basic Set consists of

- Frame DMF50
- CPU Board DMC50
- Sensor Interface Board DMI50
- DC/DC Converter DPS50

DMF50 FRAME

Custom design aluminum profile case for housing the MILOS 500 basic card set and optional units. Includes the motherboard DMB50 carrying the internal bus and card connectors.

Total capacity	5 + 2 slots (optional 8 + 2)
Dimensions	310 × 242 × 111 mm
Weight with basic set	3 kg
Installation	With four screws (M5)

DMC50A CPU BOARD

Powerful processor board with very low power consumption. The program code, application configuration and calibration data are located in secure FLASH EPROMs. Static RAM memory is used for the database and variables.

Processor		16-bit 80C188EB Intel
Clock speed		24 MHz
Memory:	FLASH EPROM	5 × 256 kB
	SRAM	128 kB
Real-time clock:		
Accuracy		15 seconds per month
Correction		Software compensation once per day
Back-up battery		Lithium battery
A/D Converter:		± 12 bits
Accuracy		0.05 % of FSR
Gain control		Automatic and programmable
Full scale ranges		± 2.5 V, ± 250 mV, ± 25 mV, ± 7.5 mV
Zero adjust		Once per minute or if CPU's temperature drift >1 °C
Four I/O ports:		
2 channels		RS-232C
2 configurable channels		RS-232C, RS-422, RS-423, RS-485 or MIL-STD-188-114
Data transfer rate		300 to 19200 baud, programmable rate and frame
ESD protection		8 kV per each I/O pin
Overvoltage protection		Bipolar 30 A (1 ms) TRANSZORBS™

DPS50 DC/DC CONVERTER

Combined floating DC power supply and battery charger. Operation is controlled by CPU board and is fully configurable. DPS50 has its own 8-bit A/D converter for internal measurements and control.

Input voltage range	11.5 to 80 VDC 12 to 50 VAC (47 to 400 Hz)
Overcurrent protection	Electrically shortcircuit protected
Overvoltage protection	Electrically shortcircuit protected
Mains voltage	80 to 288 VAC using DMP50 Mains Power Supply

ENVIRONMENTAL

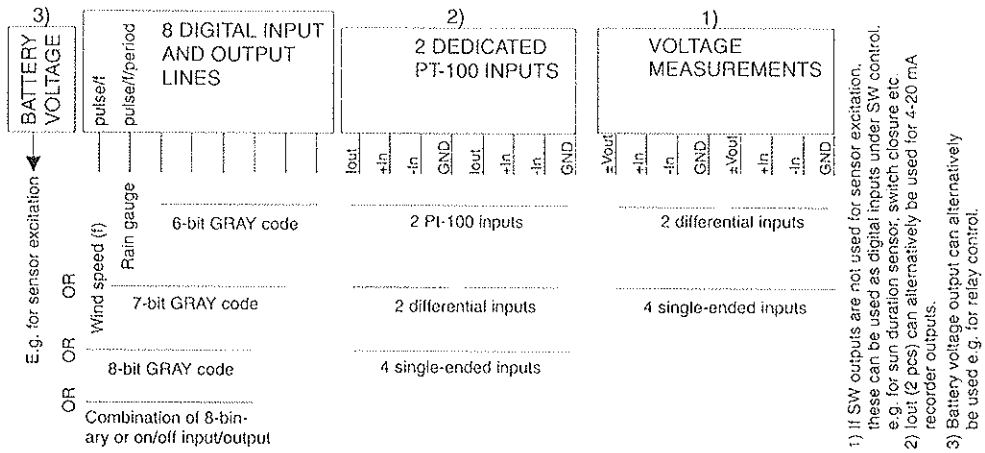
Temperature	MIL-STD-810D, 501.2 & 502.2 –50 to +70 °C
Humidity	MIL-STD-810D, 507.2 0 to 100 % RH, non-condensing
Vibration	IEC-68-2-6 Fc 10 to 500 Hz, up to 2.2 G
Electromagnetic compatibility	IEC-801-4
Conducted emissions	MIL-STD-461C, CE03
Conducted susceptibility (power leads)	MIL-STD-461C, CS02
Conducted susceptibility (fast transient burst)	IEC-801-4
Radiated emissions	MIL-STD-461, RE02
Radiated susceptibility	MIL-STD-461, RS03

DMI50 SENSOR INTERFACE BOARD

Multipurpose interface for measuring different types of analog and digital sensors. Provides also sensor excitation.

ESD protection	5 kV at each I/O pin
Overvoltage/current	Electrically shortcircuit protected

The following drawing gives an example of the sensor interfacing possibilities:



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Ref. B227en 1994-08

FEATURES

D HARDWARE FOR VIRTUALLY

OPERATING SYSTEM PROVIDES FULL

WLEDGE IS REQUIRED IN SETTING UP
ND RELIABILITY
RY SPECIFICATIONS
FOR HARSH ENVIRONMENTS

DMA50 Analog inter... board, 16 single-ended/8 differential inlets
All boards have removable cable connectors

DMI50 Interface board for analog and digital sensors
Software controllable outputs - currents/voltages/digital outputs.

DMX55 300 - 600 - 1200 bits/sec modem for radio and multipoint operations, 2/4-wire capability.

Additional boards or Vaisala's DPA21 Three Aneroid Barometric Pressure Transducer

DMX50 V.42 bis modem for leased and dial-up lines
Error correction and data compression allows for 9600 bits/sec, full duplex
Approved type

DMM50 Up to two 64 MBytes PCMCIA/JEIDA compatible DOS format memory cards

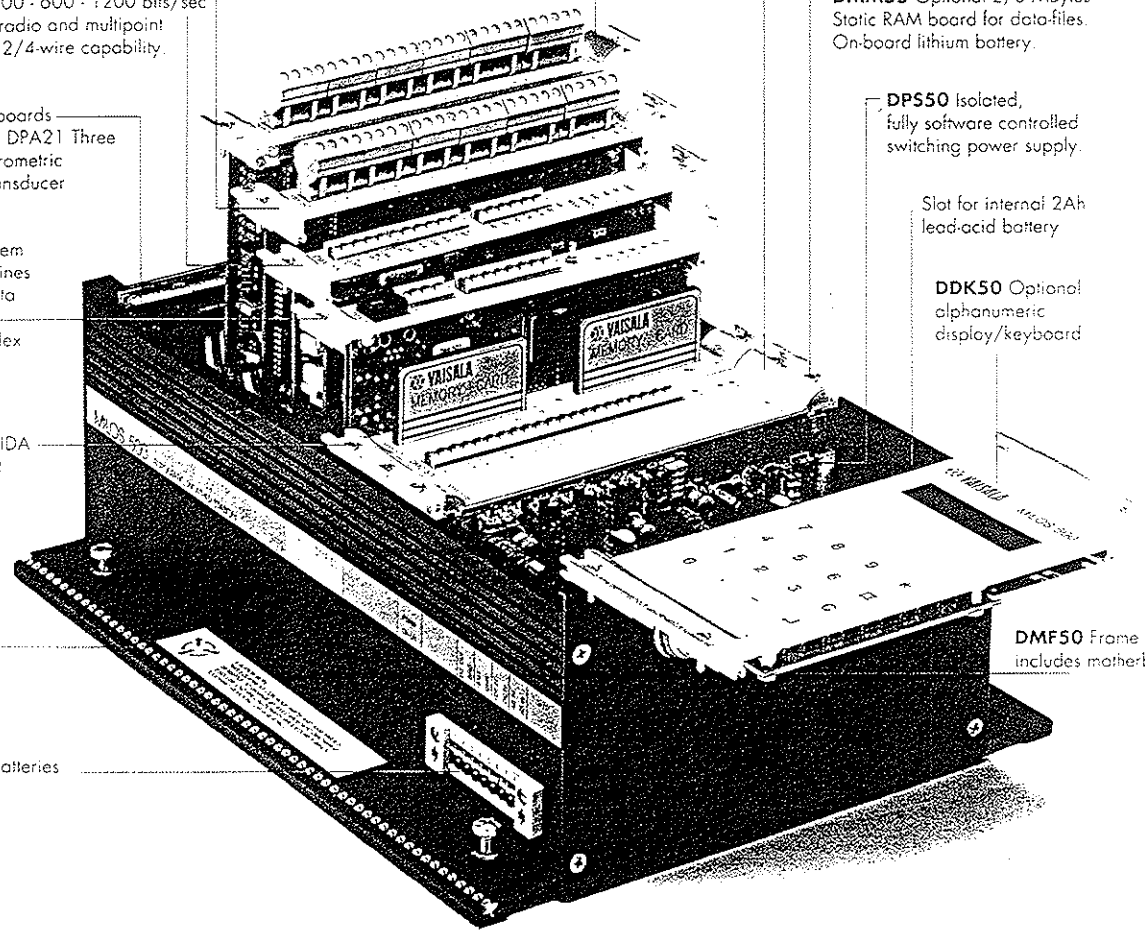
DMC50A 16-bit CPU, up to 1 MByte FLASH memory for operating system and truly non-volatile application software files
4 serial communications channels

DMM55 Optional 2/8 MBytes Static RAM board for data-files.
On-board lithium battery.

DPS50 Isolated, fully software controlled switching power supply.

Slot for internal 2Ah lead-acid battery

DDK50 Optional alphanumeric display/keyboard



Screw-rail for proper termination of cable shields.

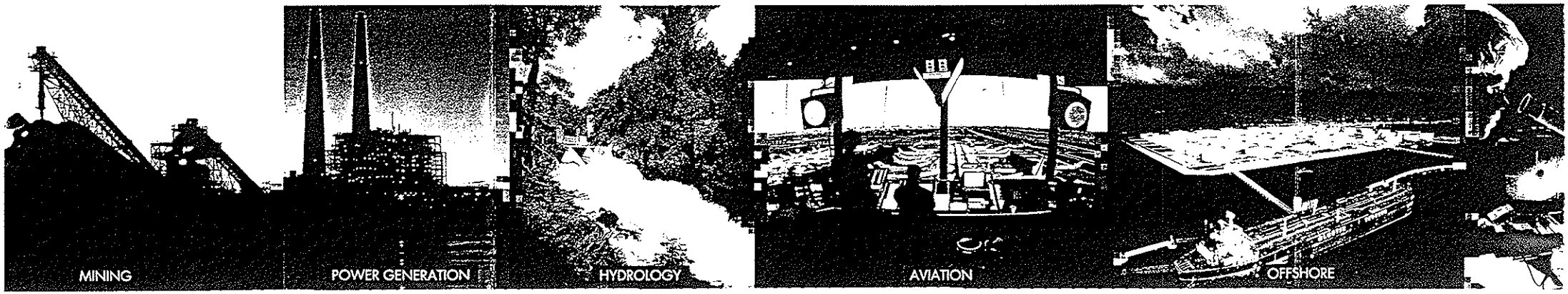
Power input/output connectors
Solar panel, mains transformer, batteries

DMF50 Frame for up to 12 system boards and options, includes motherboard with powering connections

- LOW POWER CONSU
- CUSTOMER SELECTED
- MEASURES DOZENS
  CONFIGURATION
- CUSTOMER CREATED
- MULTIPLE ANALOG A
- SUPPORTS SPECIAL RE
  FORMATS SUCH AS S
- LARGE MEMORY OPT
- EXTENSIVE ON-LINE S

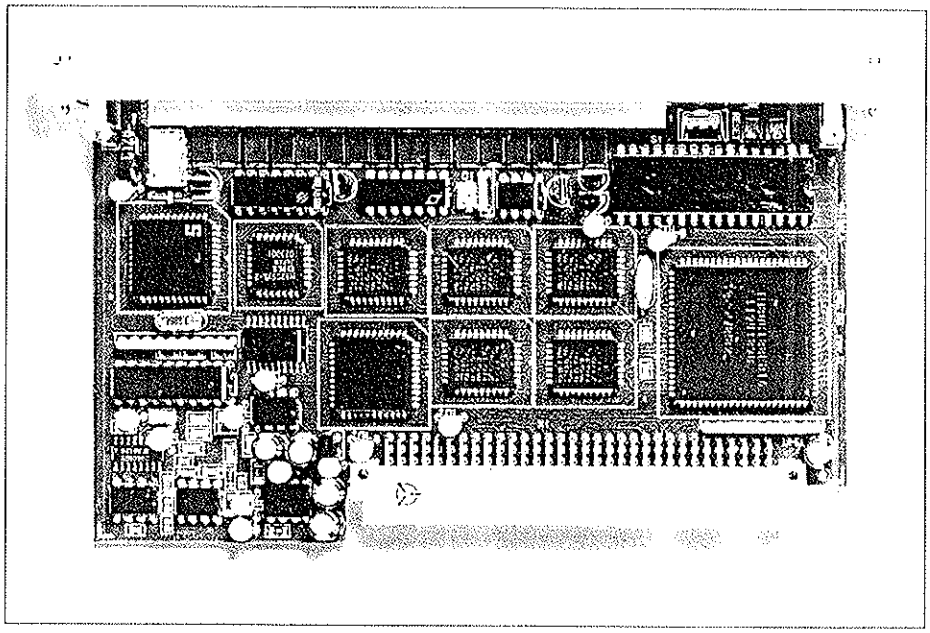
R WAY

APPLICATIONS



VAISALA

DMC50
CPU Board



The DMC50 CPU Board is the heart of the MILOS 500 Automatic Data Collection System. It performs the following functions:

- Control and communication with other MILOS 500 units
- A/D conversion of signals from the sensor interfaces
- Data acquisition and processing under powerful real-time operating system
- Serial communication with external devices and intelligent sensors
- Built-In-Tests (BIT) for the complete MILOS 500 system

The DMC50 is based on the Intel 16-bit, fully static CMOS processor type 80C188EB. This processor is especially designed for very low power applications and has the capability to be switched by software to its low power idle mode between tasks.

FLASH EEPROM memory is used for storage of the real-time operating system and application specific code files. The battery backed SRAM stores the variables and intermediate database. The memory capacity can be easily expanded from the standard 1 MByte configuration up to 10 MBytes by using the DMM50 Memory Unit or the DMM55 Static RAM Board.

The master clock for the MILOS 500 is based upon a lithium battery backed Real-Time Clock (RTC) calendar. The high accuracy is achieved by software compensation based on known board temperature. Timed events can have a precision of 5 milliseconds.

A watchdog timer is employed to assure a complete system reset in the event of system malfunction.

Analog data is digitized by the fast ± 12-bit A/D Converter (A/DC) which is also located on the DMC50 board. The A/DC has software controllable gain, SW and HW filtering. The accuracy is 0.05 % of the Full Scale Range over the entire temperature range. The A/DC is also used for various BIT purposes.

In the basic version of the MILOS 500 you already have four serial ports, with the possibility to "daisy-chain" several devices through one serial port. The number of serial ports can be increased to ten, each individually configurable by the user. Two of these serial ports are RS-232C, and the other two can be set to meet several standards.

The DMC50 board can be used to coordinate and control data exchange between several intelligent devices such as sensors, communication devices and other MILOS units, via its programmable serial interfaces. The "Your Way" configuration program is used for setting up the MILOS 500 system. The sensor settings, command sets, measuring algorithms, calculations and report formats can be selected from predefined parameter libraries, without the need to write actual program code. The user can freely create custom configuration files without being tied to those found in the library.

The "Your Way" program runs on any IBM PC or compatible computer. It provides the facilities to configure the MILOS settings, compile the actual program code and download the new configuration to the MILOS 500. The configuration program generates a number of parameter files for the MILOS 500, and these may be downloaded to the MILOS 500 via a serial communications port on the CPU board. Alternative downloading methods are the credit-card-sized PCMCIA FLASH cards in conjunction with the DMM50 Memory Unit or the DMX50 Modem Board for remote loading and control. The "Your Way" program also provides general file housekeeping functions.

The DMC50 has an ID-EEPROM memory to store serial number, revision, manufacturing and calibration dates, fail status and date etc. This data can also be accessed remotely via MILOS 500 serial ports.

The DMC50 board is a multi-layer board using Surface Mounted Technology on both sides. It has no jumpers or IC-sockets. The DMC50 is conformally coated for the harshest conditions. The specifications are valid over the entire temperature range of –50 °C to +70 °C.

TECHNICAL DATA

PROCESSOR

Processor		16-bit 80C188EB, Intel
Clock speed		24 MHz (12 MHz bus)
Memory	standard	optional
FLASH EEPROM	5 128 kB	5 256 kB
STATIC RAM	128 kB	512 kB
	1 MB continuous memory addressing	

REAL-TIME CLOCK

Accuracy	15 seconds per month
Correction	Software compensation once per day at midnight
Back-up battery	3 V lithium battery for RTC and SRAM

A/D CONVERTER

	± 12 bits
Accuracy	0.05 % of FSR
Gain control	Automatic and programmable
Full scale ranges	±2.5 V, ±250 mV, ±25 mV, ±7.5 mV
Filtering	By hardware, software or both
Zero adjust	Once per minute or if CPU's temperature drift > 1 °C

SERIAL COMMUNICATION PORTS

RS-232C	2 ports, RTS and CTS
Multistandard ports	2 configurable ports to comply with RS-232C, RS-422, RS-423, RS-485 or MIL-STD-188-114
Data transfer rate	110 to 19200 baud, programmable rate, frame, handshake and port standard
ESD protection	8 kV per each RS-port pin
Overvoltage protection	bipolar 30 A (1 ms) TRANSZORBS™

Typical CPU board current consumption with no RS-port output loads:

	18 V	+5 V	–5 V
CPU power-down mode A/DC & RS-232C drivers inactive	0.2 mA	12 mA	0.2 mA
CPU 90 % in idle mode (typical operation mode) A/DC & RS-232C drivers active	3 mA	55 mA	6 mA
CPU 100 % in run mode (heavily loaded) A/DC & RS-232C drivers active	3 mA	100 mA	6 mA
During data storage into FLASH EPROM (a couple of seconds at a time)	50 mA	100 mA	2 mA

ENVIRONMENTAL

	Specifications for the MILOS 500
Temperature	MIL-STD-810D, 501.2 & 502.2 –50 °C to +70 °C
Humidity	MIL-STD-810D, 507.2 0 to 100 % RH, non-condensing
Vibration	IEC-68-2-6 Fc 10...500 Hz, up to 2.2 G
Electromagnetic compatibility	IEC-801-4
Conducted emissions	MIL-STD-461C, CE03
Conducted susceptibility	MIL-STD-461C, CS02 (power leads)
Conducted susceptibility	IEC-801-4 (fast transient burst)
Radiated emissions	MIL-STD-461, RE02
Radiated susceptibility	MIL-STD-461, RS02

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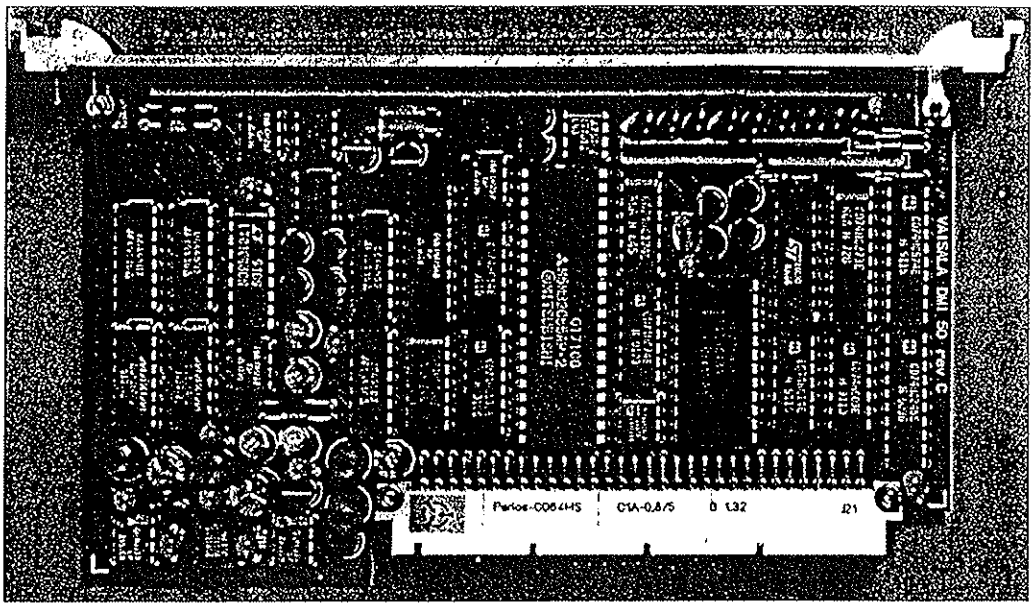
Ref. B229en 1994-08

VAISALA

SENSOR INTERFACE UNIT DMI50

FOR THE MILOS 500



GENERAL

The DMI50 is a multipurpose interface board for the MILOS 500. It can measure several types of parameters, including DC voltages; resistances and bridges; Pt-100 sensors; frequency and period measurements; parallel digital input. In addition to this, it has an 8-bit parallel, open collector output port.

OPERATING TEMPERATURE RANGE AND ACCURACY

All specifications below are valid for ambient temperature range of -50...+70 °C when the DMI50 board is used in conjunction with the ± 12-bit A/D converter on the DMC50 CPU board. Accuracy of voltage and current measurements over the range -50...+70 °C is 0.05 % of FSR.

ANALOG VOLTAGE AND CURRENT OUTPUTS

These include two software controllable voltage outputs and two true current generators for sensor excitation. All these outlets may be simultaneously active having continuous or pulsed output not depending on each other. An on-board ± 12-bit D/A converter is used to produce the selected output levels.
Besides for sensor excitation, the software controllable analog outputs can be configured e.g. for use as output signals for driving analog recorders. For example, two 4 to 20 mA current signals may be configured, giving outputs relative to wind speed and direction.
In addition to above, the DMI50 has one software controllable 12 V high-side voltage output switch, capable of delivering 180 mA.

DEDICATED Pt-100 CHANNELS

Two of the 4 differential input channels, together with the current generator outputs are optimised for Pt-100 temperature sensor measurement in 4-wire mode. Programmable current (typically 1 to 1.6 mA, 100 ms pulse) is fed via two wires through the sensor and the remaining two wires are used for differential voltage measurement across the sensor.

CALIBRATION

The DMI50 board needs no calibration.

BUILT-IN TEST (BIT) FEATURES

On-board power supplies are automatically monitored by the BIT software. Also all the sensor excitation output levels are measured after setting. The on-board D/A converter is verified internally before setting the selected value to the desired output. This is to prevent any improper output levels from entering the external devices.

ON-BOARD NON-VOLATILE MEMORY

Serially controlled ID-EEPROM for storing the data for board type, HW revision, serial number, manufacturing date, FAIL/OK status and date/time. This data may be accessed remotely via the MILOS 500 serial lines.

COUNTER/TIMER CHANNELS

The DMI50 has two externally and one internally clocked 16-bit counters. The time/counter channels share two input pins with the parallel input port. These pins are G6 and G7. Both counter channels have their own programmable gain selection bit either for digital square-wave or zero-crossing sinewave input.

TECHNICAL DATA

ESD AND CONTINUOUS OVERVOLTAGE SURVIVABILITY:

All input/output pins	± 5 kV ESD
One input pair or pin at a time	+15 V to -6 V DC
Excitation current outputs	+15 V to -6 V DC
Excitation voltage outputs	± 15 V DC
+VB output	-0.5 to + battery voltage level

DC VOLTAGE MEASUREMENTS:
8 single-ended or 4 differential analog inputs, software selectable.

DC VOLTAGE MEASUREMENT ACCURACY:
Over the full temperature range 0.05 % of FSR in conjunction with the DMC50 CPU board ± 12-bit A/D converter.

DC VOLTAGE MEASUREMENT RANGES:

Full Scale Input	CMRR	Resolution
± 2.5 V	+7.5 V to -5.0 V	600 µV
± 250 mV	+7.5 V to -5.0 V	60 µV
± 25 mV	+7.5 V to -5.0 V	6 µV
± 7.5 mV	+7.5 V to -5.0 V	2 µV

DEDICATED Pt-100 CHANNELS:

Internal reference resistors for Pt-100	100.000 Ohm, 0.01 %, 2 ppm/°C
Temperature measurement resolution	0.01 °C at ± 40 °C 0.02 °C at ± 80 °C
Temperature measurement accuracy	0.05 °C at ± 40 °C 0.1 °C at ± 80 °C
Max. Pt-100 sensor cable loop resistance for best resolution and accuracy	≤ 120 Ohm

Pt-100 linearization is performed by the software.

INPUT LEAKAGE CURRENT, all inputs 1 nA maximum.

BATTERY (+VB) OUTPUT:	Software controllable on/off
Hardware current limiting	min. 180 mA max. 280 mA
Thermal limit	Automatic, recovery time <10 s
Software verification	Automatic measurement after setting

VOLTAGE EXCITATION OUTPUTS: (2 independent channels)

Output voltage range	± 12 V
Output setting resolution	12 bits
Output setting accuracy	± 6 mV up to ± 12.0 V level ± 600 µV up to ± 1.2 V level ± 60 µV up to ± 120 mV level
Max. load current	± 15 mA/channel
Max. short circuit current	± 50 mA/channel
Max. short circuit duration	unlimited

In addition to the digital input channels, both voltage outputs can be configured as contact closure input (e.g. sun or rain detector channel).

CURRENT EXCITATION OUTPUTS: (2 independent channels)

Output current range	0 to +2 mA or 0 to 20 mA	
(100 Ohm resistor to be added for 0 to 20 mA range)		
Output setting resolution	12 bits	
Output setting accuracy	12 µA up to 20.0 mA level 1.2 µA up to 2.00 mA level	
Minimum output voltage	at 2 mA	8.5 V
	at 20 mA	7.0 V
Max. output voltage at zero current	12.5 V	
Zero level leakage current	10 µA maximum	

PARALLEL DIGITAL INPUT/OUTPUT:
The DMI50 has 8-bit input/output for Gray code or binary or on/off type input/output.

Programmable 33 kOhm pull-up or pull-down (all 8 bits simultaneously).

Input high level	min. 5.5 V	max. 30 V
Input low level	min. -1 V	max. 1.5 V
Input resistance	27 kOhm nominal	

Open collector output pins can be used bytewise or independently.

Output current	400 mA max. (pull-down/open collector)
Output voltage range	-1 V to +30 V DC (pins G0, G1, G2, G3, G4, G5) ± 30 V DC (pins G6, G7)

Output low level voltage when used as output:

Pins G0 to G7	< 1.5 V at 400 mA load

HIGH-LEVEL COUNTER/TIMER INPUT MODE:

Input high level	min. 3.5 V	max. 30 V
Input low level	min. -30 V	max. 1.5 V
Input hysteresis	0.5 V min.	
Input resistance	27 kOhm nominal	
Maximum frequency	10 kHz	

LOW-LEVEL COUNTER/TIMER INPUT: (zero crossing)

Input hysteresis	10 mV
Min. AC input level	6 mV RMS 0 to 400 Hz 20 mV RMS 0 to 1 kHz 50 mV RMS 0 to 4 kHz 150 mV RMS 0 to 10 kHz
Max. AC input level	20 V RMS
Max. DC offset	± 20 % of Uin p-p value
Input resistance	27 kOhm nominal

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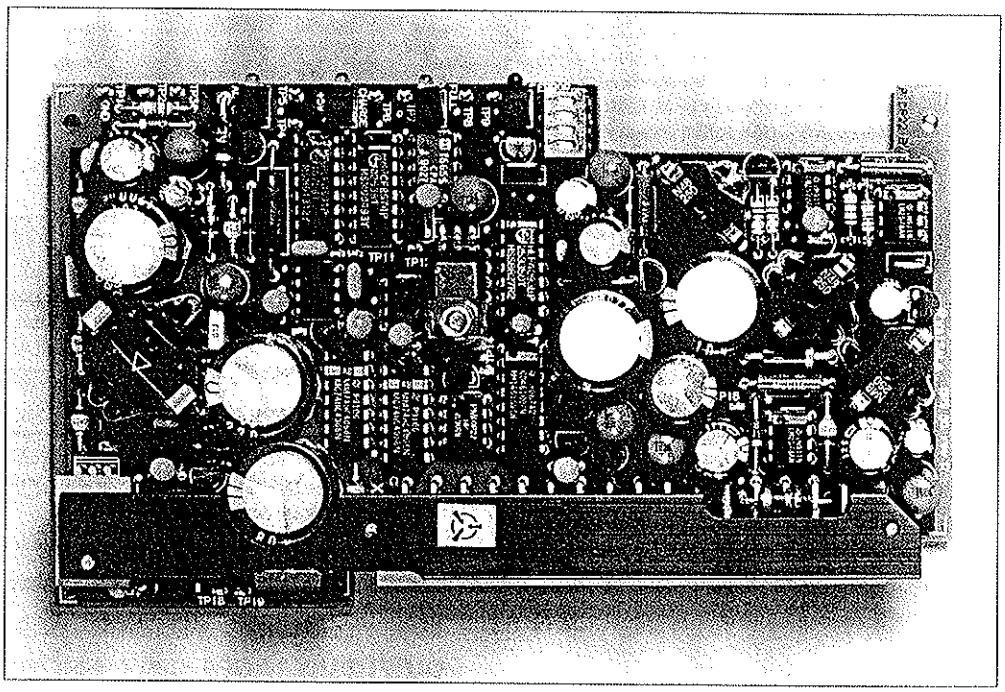
VAISALA

DPS50
DC/DC Converter



DPS50 is a multi-function switcher power supply board for the MILOS 500 Data Collection and Processing System. It carries four independent supplies. The primary battery charger switcher is isolated and floats. The three secondary supplies provide the necessary voltage levels for the MILOS 500 electronics.

FULLY SOFTWARE CONTROLLABLE

All the main functions are software controllable via a serial, addressable I²C bus. The floating charger supply has preset hardware based operating parameters in use until the CPU starts to control the charge process.

DPS50 contains an on-board 8-bit D/A converter which is automatically used to control the battery charge current and voltage levels. A 4-channel, 8-bit A/DC is used for other Built-In-Test (BIT) purposes.

The user may define the battery type and capacity. The CPU uses its own temperature sensor in order to compensate the float charge level. The ± 12 bit A/D converter in the CPU board is used to measure the battery voltage and current levels. By these means the software can predict the actual remaining battery capacity.

The user may define an automatic battery test cycle in minutes. If set to 60, software disables the charge process once per hour in order to monitor the battery voltage behaviour. Program then automatically executes the required recharge phase back to normal level.

FULL MALFUNCTION PROTECTION

All power supplies are protected against overcurrent and shortcircuit. Recovery is automatic.

Deep-charge state of battery is prevented by an on-board hardware, which shall shut down the whole system if battery voltage level goes too low.

All battery charger states, currents and voltages may be read remotely via a CPU serial port.

In order to protect the battery and the electronics, the software stops battery charging if the temperature falls below –25 °C or if the MILOS 500 internal temperature exceeds +70 °C.

ON-BOARD NON-VOLATILE MEMORY

Serially controlled ID-EEPROM for storing the data for board type, hardware revision, serial number, manufacturing date, FAIL/OK status and date/time. This data may be accessed remotely via the MILOS 500 serial lines.

TECHNICAL DATA DPS50 DC/DC CONVERTER

USER SELECTABLE PARAMETERS

Battery type setting	Lead-Acid; NiCd Non-rechargeable batteries No batteries
Battery capacity setting	0 to 100 Ah
Battery test period	In minutes
Temperature compensation sensor	CPU on-board sensor External Pt-100 sensor

SOFTWARE CONTROLLED CHARGE STATES

START CHARGE STATE: Software finds the best input voltage/current combination (important at remote powering of MILOS 500 via long cables). If enough power is available, charge current is limited to approx. 700 mA to the battery. If battery capacity is 2 Ah, max. charge current is set to 500mA.

BULK CHARGE STATE: Full charge on. If max. available current is limited due to high feeding impendance of power line or otherwise, CHARGING LED is blinking.

OVERCHARGE STATE: Battery has reached full (temperature compensated) voltage level, but is overcharged acc. to battery manufacturer's specifications.

FLOAT CHARGE STATE: Battery full. Charge complete. Battery current adjusted to zero. Battery voltage floating at temperature compensated level.

NO CHARGE STATE: All LED indicators on DPS50 are blank. MILOS 500 is running on the battery.

ERROR STATE: Charge process in error state. No charge. MILOS 500 running on external AC/DC or, if not present, on battery. The ERROR LED is blinking.

LED INDICATORS

- Battery empty/Charge process ERROR
- Battery FULL
- CHARGING
- AC ON (directly powered from AC source)

POWER DOWN STATES

The MILOS 500 CPU may shut off all power supplies. This leads to software stop, but RTC may wake up +5 V supply at a preprogrammed event. This can be used for low duty-cycle measurement and communication, where power consumption is highly critical. The DC OUT pin at the MILOS 500 frame is also inactive in shut-down state.

Current draw from 12 V battery at shut-down	3 mA typ.

WAKE-UP TIME

Wake-up time from shut-down or at power-up	3 sec

SOFTWARE ON/OFF CONTROLS

Software control for	–18 V and –5 V power supplies LED indicators

INTERNAL A/D CONVERTER

Internal 8-bit, 4-channel A/D converter measuring

• Floating input DC or rectified AC level	12 to 80 VDC
Resolution/Accuracy	0.3 V/± 1 V
• Primary power supply output current	0 to 1.0 A
Accuracy and resolution	± 10 mA
• DC OUT voltage level at MILOS 500 frame power connector	0 to 17 V
Accuracy and resolution	± 200 mV
• 3 V lithium battery voltage level	0 to 5 V
Accuracy and resolution	± 50 mV

INPUT VOLTAGE RANGES

Floating AC input	12 to 50 VAC
Floating DC input	+11.5 to +80 VDC

NOTE: Floating AC & DC inputs are internally connected to each other. Charger section is using the source having a higher rectified voltage level. Floating limited to 250 V (peak) with varistor mounted on MILOS 500 motherboard.

BATTERY CONNECTIONS

Battery voltage	10 V to 15.5 V typical
Abs. max. input voltage level	17.5 V continuously
Shut-down battery voltage level	8.5 V typ. (7.8 V min., 9.2 V max.)
Start-up battery voltage level	9.3 V typ. (8.5 V min., 10.1 V max.)
Hysteresis	0.5 V min.

OUTPUT VOLTAGES AND CURRENTS

+5 V output	+5.5 V, 800 mA min.
+18 V output	+18 V, (–16.6 to +19.1V), 400 mA min.
–5 V output	–5.5 V, 450 mA min.
+VB output	Software adjust from +10 to +15.5 V

DPS50 IDLE CURRENTS (TYPICAL)

+DC IN	5 mA (no charge state)
AC IN	5 to 22 mA for the AC ON LED

From 12 V battery

- 3 mA (+5 V power supply active, no load)
- 4.5 mA (± 5 V power supplies active, no loads)
- 5.0 mA (± 5 V and +18 V supplies active, no loads)

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Ref. B232en 1994-11

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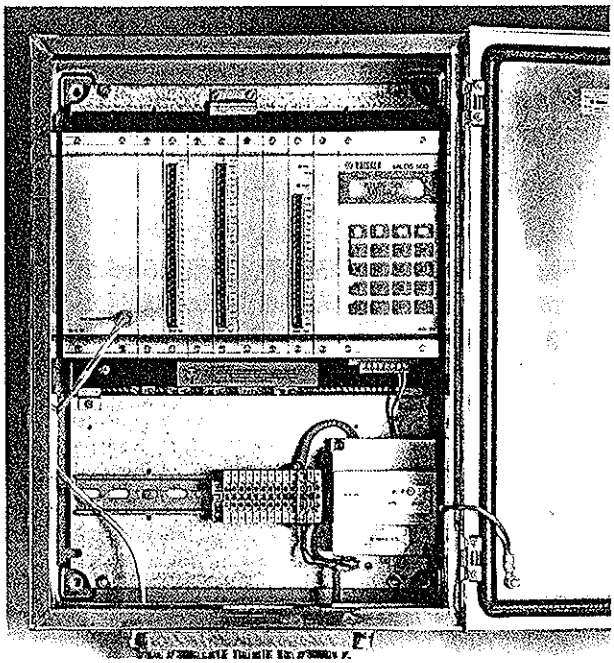
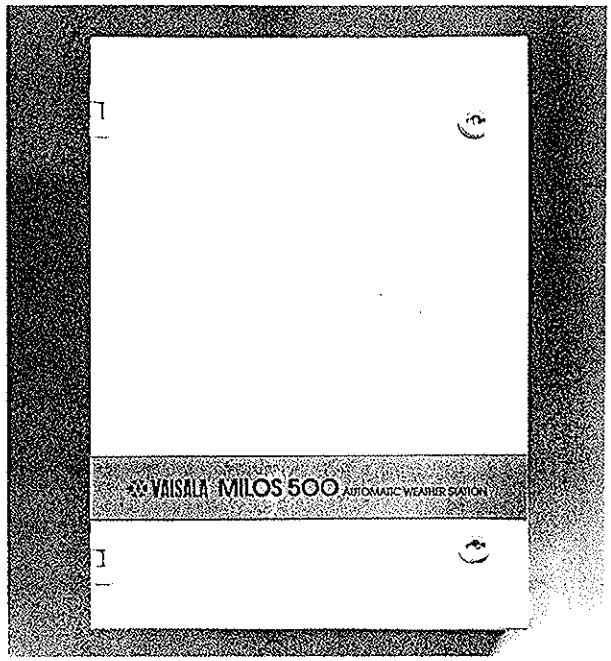
EQUIPMENT ENCLOSURES
BOX 50S & BOX 50P

FOR MILOS 500





The BOX 50S and BOX 50P are rugged equipment enclosures for the Milos 500 Automatic Data Collection System. They provide protection against water, dust and environmental pollutants. The protection rating is IP 65; i.e. dusttight and sealed against water jets. The enclosures can be equipped with an optional white painted steel shield to provide additional protection against e.g. bird droppings and ice particles. Mast mounting accessories for pole and stacked masts are also available.

The BOX 50P is a steel enclosure which is iron-phosphated and painted with oven dried, polyester type paint. As an extra treatment the enclosure is sprayed with stoving epoxyprimer. BOX 50P is suitable for demanding, non-corrosive environments.

The BOX 50S is a stainless steel enclosure with an electropolished finish, providing excellent protection in harsh and corrosive environments. The enclosure is manufactured from steel with 18% Cr, 9% Ni and 0.05% C. It conforms to several international standard classifications, e.g. AISI 304 (USA), B.S. 970 304 S 15 (GB) and Werkstoff-Nr. 1.4301 (Germany).

The enclosure body is seamwelded steel. The over-folded front frame serves as a gutter. There are four fixing holes pressed out by 4 mm from the rear panel. The door is hinged and can be configured to open to the left. The removable pin hinges allow a 180 degree opening. The sealing is ensured by using an extruded polyurethane foam gasket.

The cable entry for both sensor and data cables is provided through a removable flange fitted in the bottom of the enclosure. The flange is made of painted AlSi 12 aluminium. The standard configuration has bushings installed for 7 cables. Additional 7 bushings can be installed into the same flange. It also has a pressure sensor vent fitting. The flange is sealed by an EPDM gasket.

The enclosures house the Milos 500 Card Frame with optional modules, pressure sensor, optional mains transformer and the screw terminal for cable connections. There is also space for a back-up battery and for auxiliary devices such as communication equipment. All of these devices are installed on the easy-to-remove mounting plate.

Although most of the Milos 500 configuration can be accommodated in these boxes, larger enclosures with the same specifications are also available.

SPECIFICATIONS

	BOX 50 P	BOX 50S
Material	1.2 mm steel plate	Body: 1 mm stainless steel Door: 1.5 mm stainless steel
Finish:		Electro-polished
Primer:		
Color:	grey	
Layer thickness:	20—30 μm	
Stoving time:	20 min., at 180°	
Paint finish:	silicon grey, oven dried	
Color	RAL 7032	
Layer thickness	23—35 μm	
Stoving time:	20 min. at 180°	
Protection rating:	IP 65	IP65
Grouding:	Equipment enclosures should normally be grounded to a point which is less than 10 Ω average impedance to true ground. Earth point for a 16 mm² copper grounding wire is provided inside the enclosure.	
Cable Bushings:	5 pcs (optionally max. 10 pcs) 2 pcs (place for 2 pcs	max. dia. 9 mm max. dia. 12.5 mm max. dia. 11 mm)
	1 pc Pressure sensor vent fitting	
Dimensions (h × w × d): (excluding bushings)	480 × 360 × 150 mm (18.9 × 14.2 × 5.9 in)	
Weight (enclosure only):	8.7 kg (19.2 lbs)	10.7 kg (23.6 lbs)
Weight with mast installation accessories and the protective shield:	12.7 kg (28 lbs)	14.7 kg (32.4 lbs)
Wall mounting:	by 4 pcs M6 screws	
Mast mounting:		
Mounting frame:		p/n 30605
Pole mast, dia. 102 mm	mounting clamps (2 pcs)	p/n 10885
Stacked mast	mounting clamps (2 pcs)	p/n 10388
	mounting screws	p/n 11324
Optional radiation shield:		p/n 30604

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B0225/0292

VAISALA

Your Way

for Windows

MILOS 500 CONFIGURATION PROGRAM

Your Way for Windows helps you master your MILOS 500 faster.

Your Way is already familiar to many users in its DOS-based form. Vaisala's MILOS 500 Data Collection and Processing systems have been successfully implemented all over the world, often with Your Way. The software has enabled flexible configuration of the measurement systems for the needs of many different applications.

The new Your Way software package is designed for the Windows operating system. In addition to all the benefits achieved with the user-friendly approach of Windows, the new Your Way also includes several improvements to the MILOS 500 configuration concept: the program operation is more intuitive; the hierarchy for accessing information is simplier (just one mouse click away); printing and reporting features as well as tools for analysing and modifying the whole configuration have been added; and now also automatic data validity checking is included.

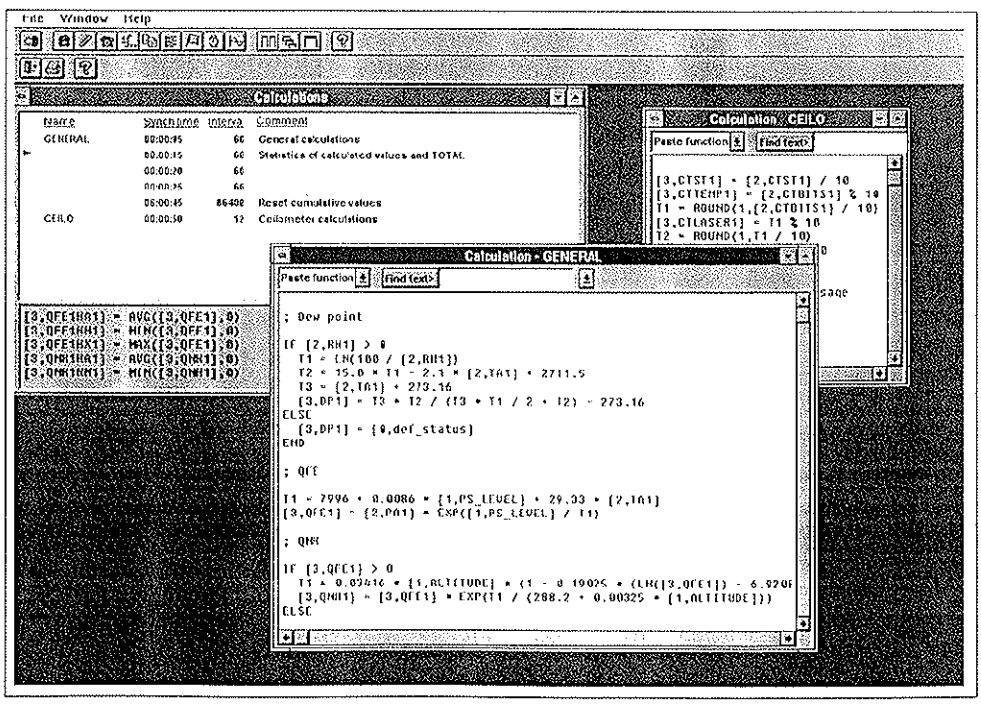
DRAG & DROP DATA ITEMS

Your Way allows the users to configure and modify automatic weather station functions over a serial interface line using an ordinary desktop or laptop PC.

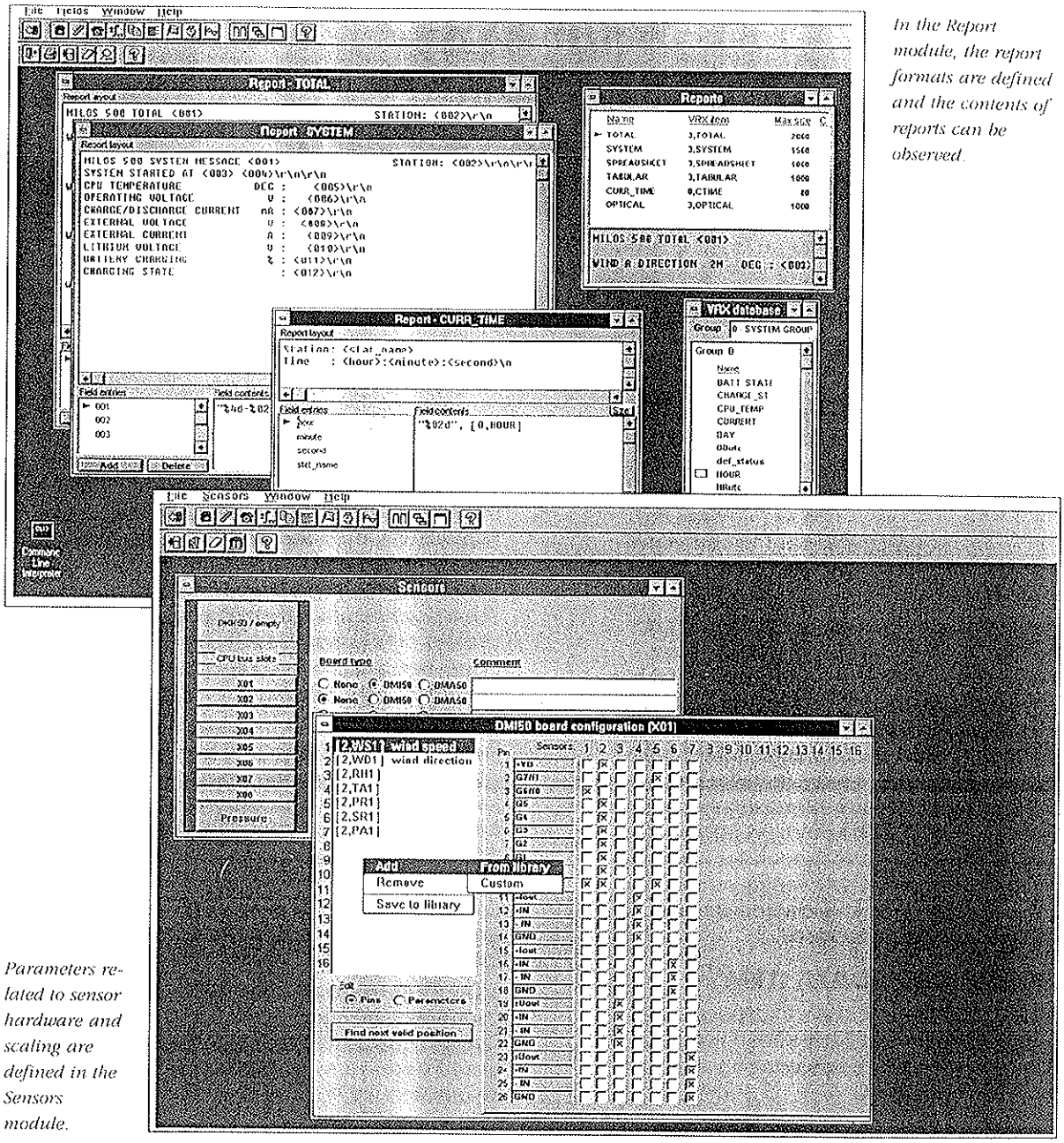
The software runs in Windows (version 3.1 or later) environment offering a graphical user interface with icons, pop-up and pull-down menus, floating dialog boxes, mouse-clicking and drag-&-drop functions. This means that the user's textual input – often found cumbersome – is reduced to a minimum. Several active windows can be open simultaneously which makes configuration swift: just 'drag' data items from one module to another and 'drop' them into their new locations.

An important feature is the built-in context sensitive on-line Help that gives guidance during the configuration. Also, when pointing to a tool icon with the mouse, a 'ToolTip' on the tool's function is displayed. Pop-up windows with warnings appear when user input is contradictory to valid settings. Knowledge of a programming language structure or syntax is not required. The results of the whole configuration or a part of it can be printed.

The DOS-based and Windows-based Your Way softwares are compatible: a MILOS 500 configuration originally made by Your Way for DOS can be easily imported to and modified by Your Way for Windows.



The Calculation module of Your Way allows you to define mathematical and statistical functions.



In the Report module, the report formats are defined and the contents of reports can be observed.

Parameters related to sensor hardware and scaling are defined in the Sensors module.

ALL TOOLS IN ONE KIT

Your Way has tools to perform all steps from configuration to downloading new parameters into the MILOS 500 system memory. The MILOS 500 software contains independent configurable modules for database management, measurements, calculations, reports, serial line communication, timed and interrupt events and data logging. The Winds module for wind calculations includes, among other features, also statistical calculation in vector and scalar formats.

For each function, a number of parameters can be set or selected from a pre-defined library to form the system set-up file that is downloaded to MILOS 500. When a function is taken into use by the operating system, the function's parameters are obtained from the parameter file.

SYSTEM REQUIREMENTS

- PC with at least 80486 processor, 33 MHz
- 8 MB RAM, 10 MB free hard disk space
- Microsoft Windows 3.1 or later
- Windows compatible mouse
- Preferrably a SVGA colour monitor

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Ref. B27Jun 1995-05

CROSS ARM
WAC151
Technical Reference

WAC151-T648en-1.1
25 September 1996

CE

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Contents

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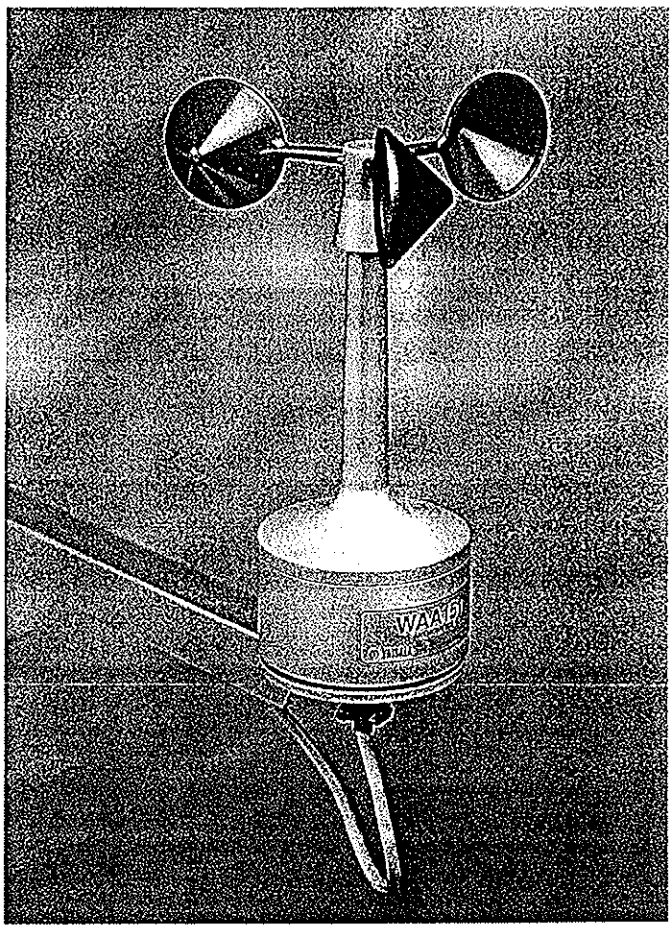
WAA151
Anemometer

- Optoelectronic sensor
- Low inertia and starting threshold
- Excellent linearity up to 75 m/s
- Shaft heating



The WAA151 is a fast-response, low-threshold anemometer. In the cup wheel it has three light-weight conical cups providing excellent linearity over the entire operating range, up to 75 m/s. Rotated by the wind, a chopper disc attached to the cup wheel's shaft cuts an infrared light beam 14 times per revolution, generating a pulse output from a phototransistor.

The output pulse rate can be regarded directly proportional to wind speed (e.g., 246 Hz = 24.6 m/s). For best available accuracy, however, the characteristic transfer function should be used (see technical data), for compensating for starting inertia and slight overspeeding.

A heating element in the shaft tunnel keeps the bearings above the freezing level in cold climates. Nominally it provides 10 W of heating power.
A thermostat switch in the sensor cross arm WAC151 keeps heating on below +4 °C.

The WAA151 complies with the following performance and exploratory tests standards:

- Wind tunnel tests per ASTM standard method D 5096-90 (for starting threshold, distance constant, transfer function; see technical data)
- Exploratory vibration test per MIL-STD-167-1
- Humidity test per MIL-STD-810E, Method 507.3
- Salt fog test per MIL-STD-810E, Method 509.3

TECHNICAL DATA WAA151 ANEMOMETER

Sensor/Transducer type		Cup anemometer/Opto-chopper
Measuring range		0.4 ... 75 m/s
Starting threshold		< 0.5 m/s[1]
Distance constant		2.0 m
Transducer output	For wind speeds 0 ... 75 m/s	0 ... 750 Hz square wave
Characteristic transfer function	(U_f = wind speed; R = o/p pulse rate)	$U_f = 0.4054 + 0.09853 \times R$
Accuracy (within 0.4 ... 60 m/s)	With characteristic transfer function	± 0.17 m/s[2]
	With transfer function $U_f = 0.1 \times R$	± 0.5 m/s[3]
Transducer output level	With I_{out} < +5 mA	High state ≥ U_{in} –1.5 V
	With I_{out} > –5 mA	Low state < 2.0 V
Settling time after power turn-on		< 30 µs
Operating power supply		U_{in} = 9.5 ... 15.5 VDC, 20 mA typical
Heating power supply	AC or DC	20 V, 500 mA nom.
Electrical connections	MIL-C-26482 type plug	6-wire cable through cross arm
Operating temperature	With shaft heating below +0 °C	–50 ... +55 °C
Storage temperature		–60 ... +70 °C
Material	Housing	AlMgSi
	Cups	PA, reinforced with carbon fibre; black
Dimensions and weight	(Swept radius of cup wheel: 91 mm)	240 (h) × 90 (Ø) mm; 570 g

[1] Measured with cup wheel in position least favoured by flow direction.
Optimum position gives approx. 0.35 m/s threshold.
[2] Standard Deviation
[3] Typical error distribution:

Range	Error	Range	Error
0–3 m/s	–0.4 m/s	31–37 m/s	+0.1 m/s
3–10 m/s	–0.3 m/s	37–44 m/s	+0.2 m/s
10–17 m/s	–0.2 m/s	44–51 m/s	+0.3 m/s
17–24 m/s	–0.1 m/s	51–58 m/s	+0.4 m/s
24–31 m/s	±0.0 m/s	58–65 m/s	+0.5 m/s

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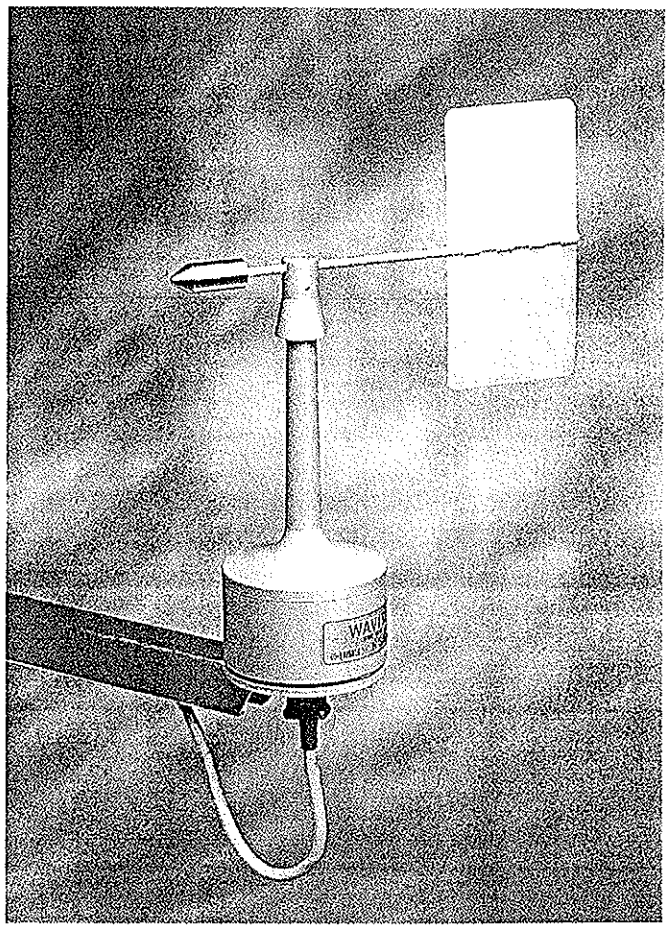
Ref. B300en 1997-07

VAISALA

WAV151
Wind Vane

- Counter-balanced optoelectronic sensor
- Low inertia and starting threshold
- Shaft heating



The WAV151 is a counter-balanced, low-threshold optoelectronic wind vane. Infrared LEDs and phototransistors are mounted on six orbits on each side of a 6-bit GRAY-coded disc. Turned by the vane, the disc creates changes in the code received by the phototransistors. The code is changed in steps of 5.6°, one bit at a time to eliminate any ambiguities in the coding.

A heating element in the shaft tunnel keeps the bearings above the freezing level in cold climates. Nominally it provides 10 W of heating power (14 W in conjunction with the WAA251 Heated Anemometer). A thermostat switch is included in the sensor cross arm WAC151, for switching power on below +4 °C.

The WAV151 is designed to be mounted to the northern end of Vaisala's standard cross arm with a regular 10-pin connector.

The WAV151 Wind Vane complies with the following performance and exploratory tests standards:

- Wind tunnel tests per ASTM standard method D5366-93 (for starting threshold, distance constant, transfer function: see technical data)
- Exploratory vibration test per MIL-STD-167-1
- Humidity test per MIL-STD-810E, Method 507.3
- Salt fog test per MIL-STD-810E, Method 509.3

TECHNICAL DATA WAV151 WIND VANE

Transducer type		Optical code disc
Measuring range	At wind speed 0.4 ... 75 m/s	0 ... 360°
Threshold		0.4 m/s
Resolution		5.6°
Damping ratio		0.14
Overshoot ratio		0.65
Delay distance		0.4 m
Accuracy		better than ± 3°
Operating power supply	U_{in} = 9.5 ... 15.5 VDC	20 mA typical
Heating power supply	AC or DC	20 V, 500 mA nom.
Output code		6-bit parallel GRAY
Output levels	With I_{out} < +5 mA With I_{out} > –5 mA	High state ≥ U_{in} –1.5 V Low state ≤ 1.5 V
Settling time after power turn-on		< 100 µs
Plug		MIL-C-26482 type
Cabling		10-wire cable through cross arm
Operating temperature	With shaft heating below +0 °C	–50 ... +55 °C
Storage temperature		–60 ... +70 °C
Housing material		AlMgSi
Dimensions	Swept radius of vane 172 mm	300 (h) × 90 (Ø) mm
Weight		660 g

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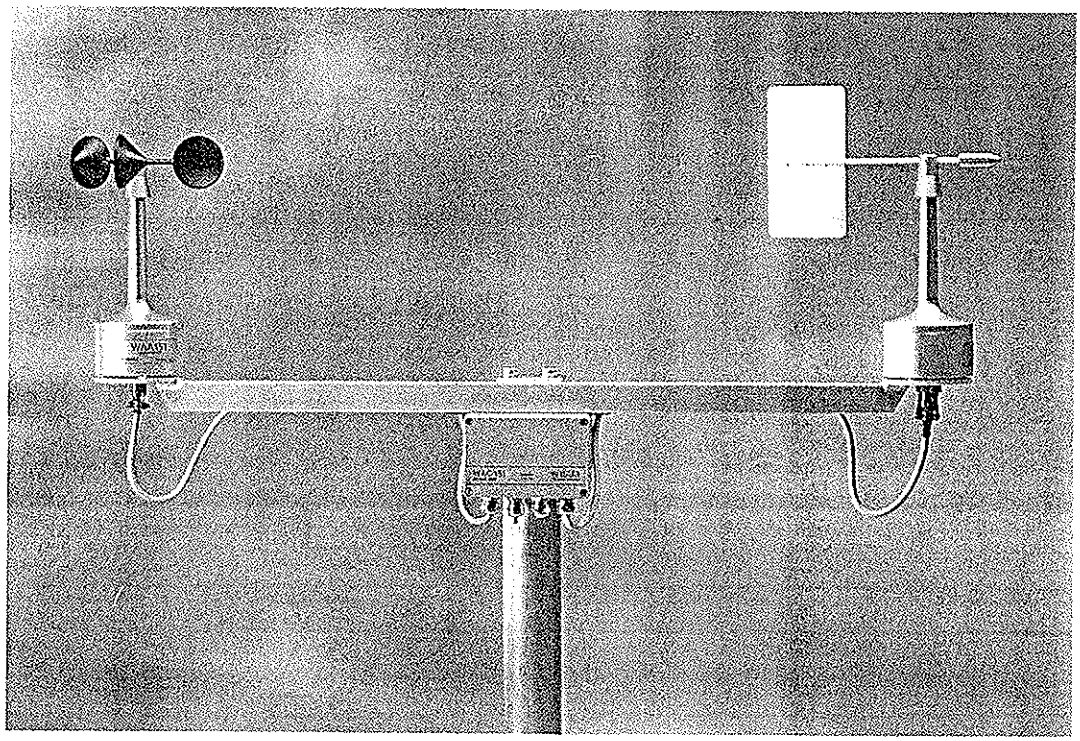
Ref. B301en 1997-06

VAISALA

WAC151
Cross Arm



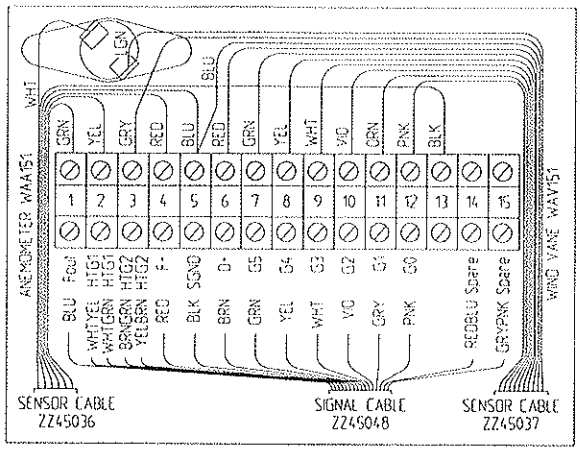
The WAC151 is a cross arm assembly to support the Vaisala WAA151 Anemometer, WAA251 Heated Anemometer and WAV151 Wind Vane. The assembly consists of an anodized aluminium tube construction with a mounting clamp for installation on top of a mast.

A watertight junction box is fitted to the cross arm, including a screw terminal block for connection of the power and signal cables. Inside the junction box, there is also a thermostat switch for controlling the sensor heating.

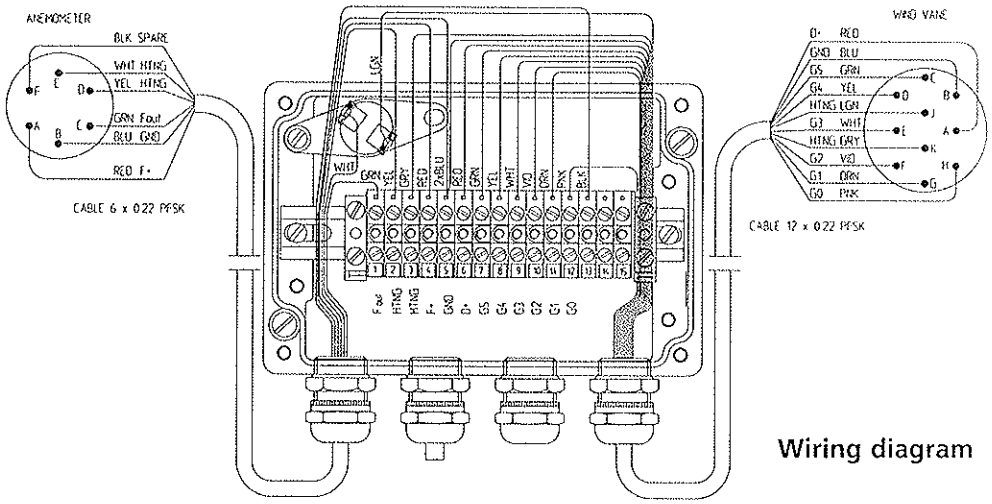
The cross arm is installed in the north-south direction, with the wind vane pointing to the north.

TECHNICAL DATA

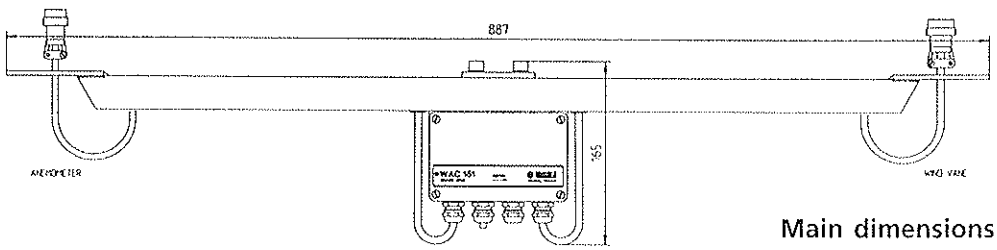
Length	800 mm
Mast tube outer diameter	max. 60 mm
Cross arm material	Aluminium
Weight	1.5 kg
Thermometer switch (part no. 12576)	
Connects heating at	+4 °C (±3 °C)
Disconnects heating at	+11 °C (±3 °C)



Instruction label inside the box



Wiring diagram



Main dimensions

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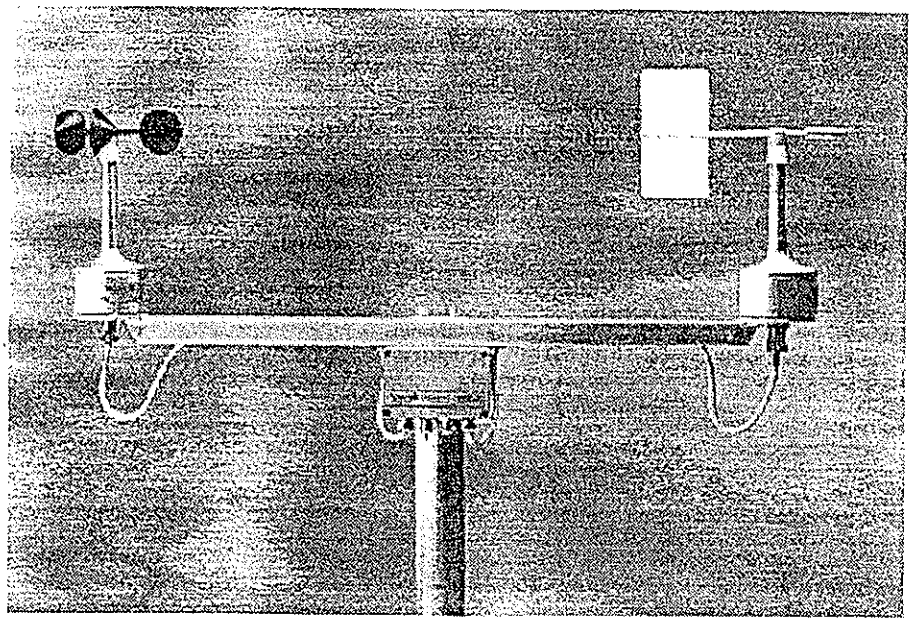
Ref. B305en 1997-11

1. INTRODUCTION



The WAC151 is a cross arm assembly to support the Vaisala WAA151 Anemometer, WAA251 Heated Anemometer and WAV151 Wind Vane. The assembly consists of an anodized aluminum tube construction with a mounting clamp for installation on top of a mast.

A water tight junction box is fitted to the cross arm, including a screw terminal block for connection of the power and signal cables. Inside the junction box, there is also a thermostat switch for controlling sensor shaft heating for the standard '151-series sensors.

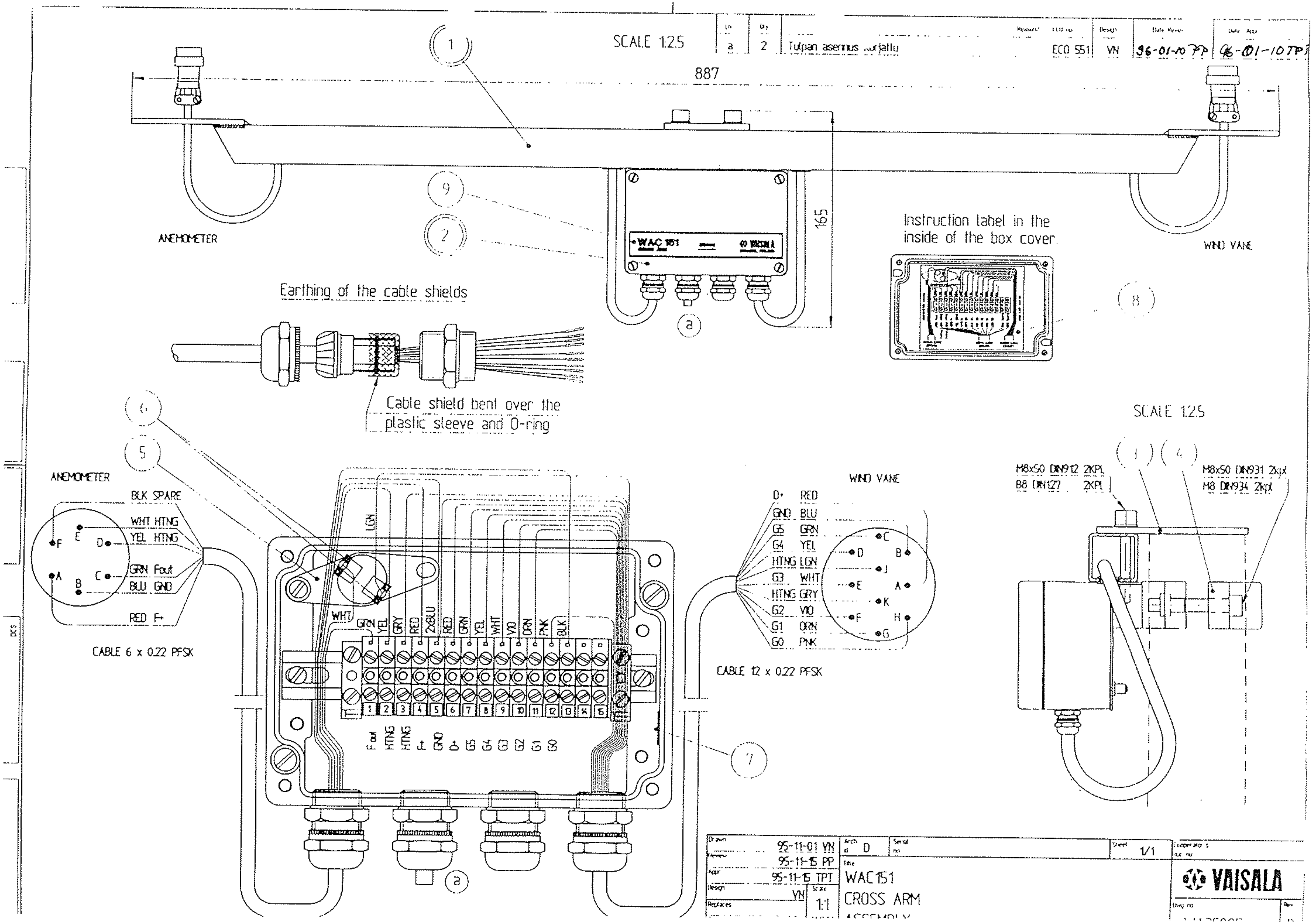
The junction box is equipped with four cable glands offering easy way for earthing different cables. Typically, three cable glands are in use; two for sensor cables one for signal cables. To ensure accurate wind speed measurement in extreme winter conditions, WAA251 Heated Anemometer as well as WHP25 Outdoor Mains Power Supply are recommended. The fourth gland is reserved for the cable supplying heating power for heated anemometer system.

It is important to notice that wiring instruction label inside the junction box is for the standard '151-series sensors. However, when WAC151 is used with WAA251 Heated Anemometer, small wiring changes are necessary. Please, refer to the drawing WA35172.

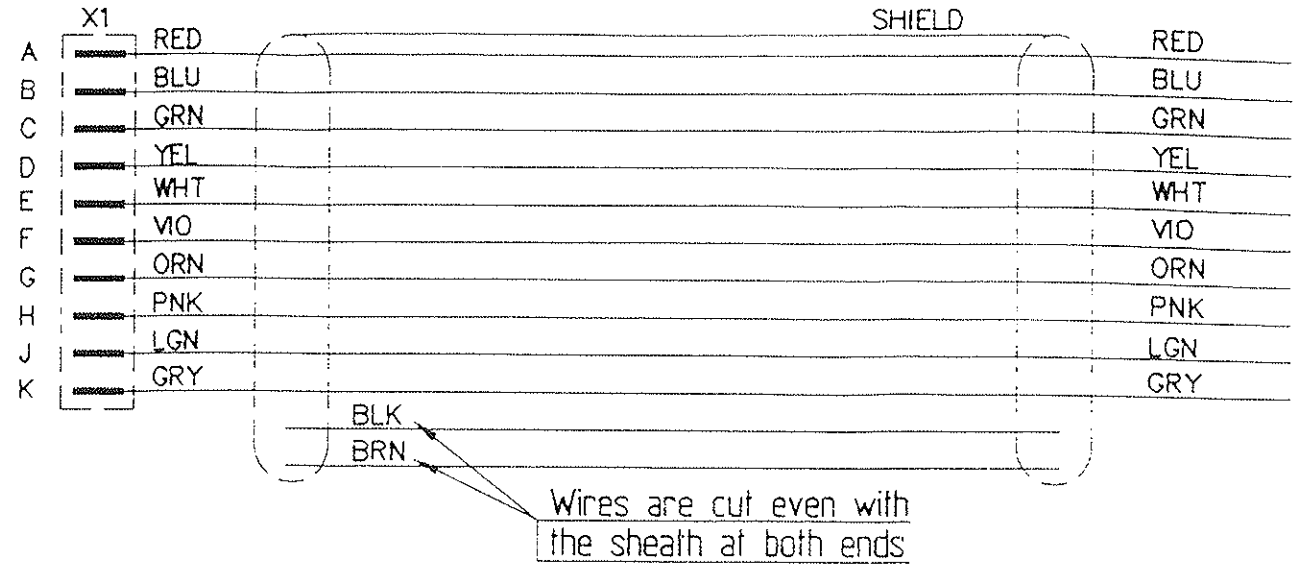
The cross arm is installed in the north-south direction, with the wind vane pointing to the north. The cross arm supports just one way to fix the sensors to it ensuring correct assemblage.

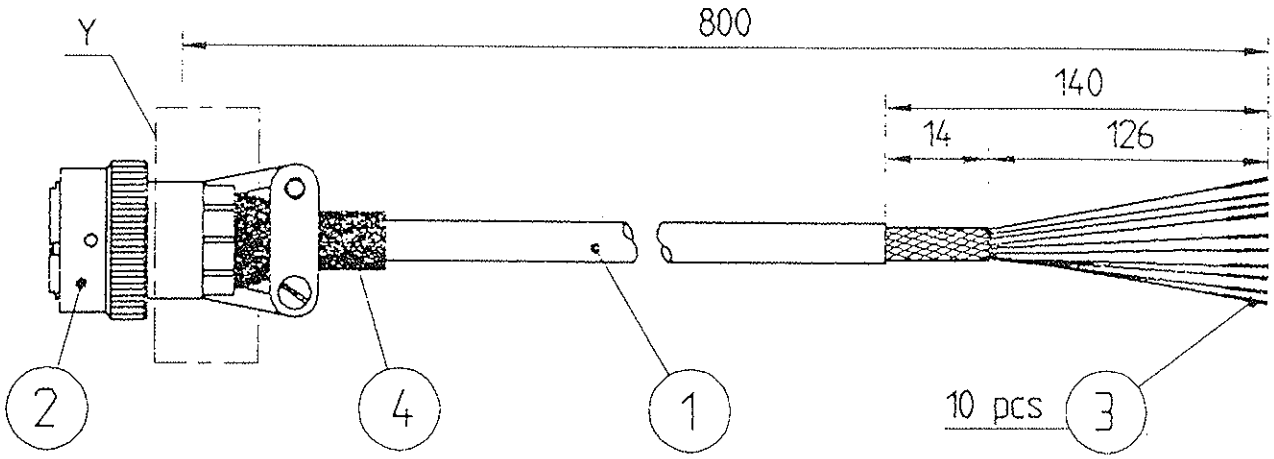
3. TECHNICAL DATA

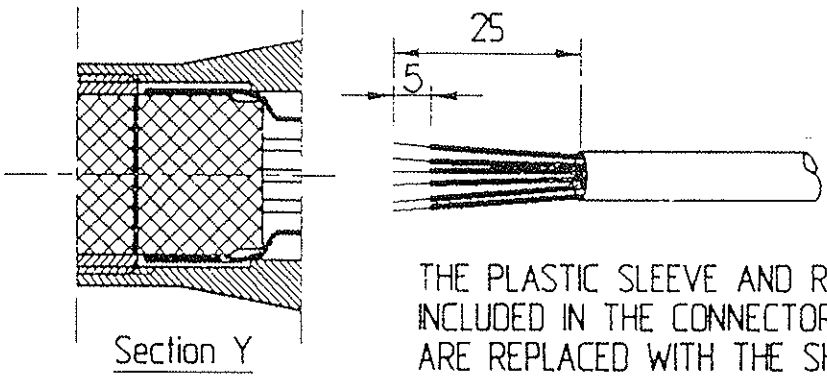
Type & Function	Cross Arm for Vaisala wind sensors.
Mechanical	
Dimensions	Junction Box 125 x 80 x 57 mm^3 Cross Arm length 800 mm
Mounting	To a pole mast with a nominal outside diameter 60 mm. The cross-arm supports the WAA151, WAA251 and WAV151 sensors.
Material	Cross Arm Al, anodized Junction Box Al, painted
Weight	1.5 kg (without sensors)
Electrical connections	
Cable entries	Line cable entry through a gland (for cable diam. 7...10mm) with coaxial connectability of the cable screen, for proper RF shielding. Sensor cables enter through two rubber glands.
I/O connectors	Screw terminal connectors (15 pcs) for the sensors and power lines.
Thermostat switch	connects at + 4°C ($\pm$3°C) disconnects at +11°C ($\pm$3°C)


SCALE 1:2.5
a 2 Tulpan asennus korjattu ECO 551 VN 96-01-10 PP 96-01-10 TPT
887
165
ANEMOMETER
WIND VANE
WAC 151
Instruction label in the inside of the box cover
Earthing of the cable shields
Cable shield bent over the plastic sleeve and O-ring
ANEMOMETER
BLK SPARE
WHT HTNG
YEL HTNG
GRN Fout
BLU GND
RED F+
CABLE 6 x 0.22 PFSK
LGN
WHT
GRN YEL GRY RED 2xBLU RED GRN YEL WHT VIO ORN PNK BLK
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Fout HTNG HTNG F+ GND D+ G5 G4 G3 G2 G1 G0
WIND VANE
D+ RED
GND BLU
G5 GRN
G4 YEL
HTNG LGN
G3 WHT
HTNG GRY
G2 VIO
G1 ORN
G0 PNK
CABLE 12 x 0.22 PFSK
SCALE 1:2.5
M8x50 DIN912 2KPL
B8 DIN127 2KPL
M8x50 DIN931 2kpl
M8 DIN934 2kpl
95-11-01 VN
95-11-15 PP
95-11-15 TPT
VN
Scale 1:1
D
WAC151
CROSS ARM
ASSEMBLY
Sheet 1/1
VAISALA

Ltr	Qty	Change	Reason/ ECO no	Design	Date Review	Date Appr
a						







THE PLASTIC SLEEVE AND RUBBER TUBE INCLUDED IN THE CONNECTOR ACCESSORIES ARE REPLACED WITH THE SHRINKABLE TUBING

Part	Title	Qty	Specification	Material	Preform dimensions
4	Shrinkable Tubing	35 mm	Atum 12/4 Black		
3	Connector Bushing	10 pcs	488 Abiko/PH 0.5-6		
2	MS-Connector	1 pc	MS3116F12-10P		
1	Cable	0.8 m	PFSK 12x0.22		Φ6.8

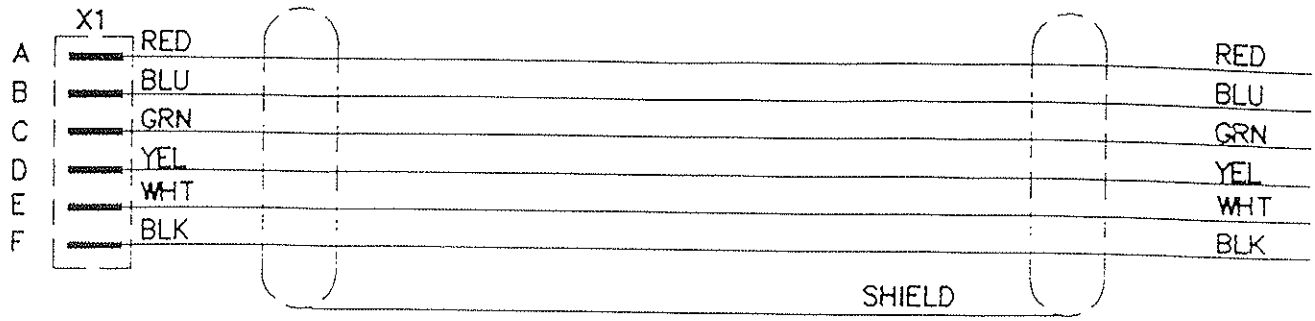
Drawn 950821 SEM	Arch id D	Serial no	Sheet 1/1	Cooperator's doc no
Review 95-11-14 PP	Title SENSOR CABLE WIND VANE ASSEMBLY			VAISALA
Appr 95-11-15 JA				Dwg no ZZ45037
Design SEM	Scale			Rev A
Replaces				
Replaced by				

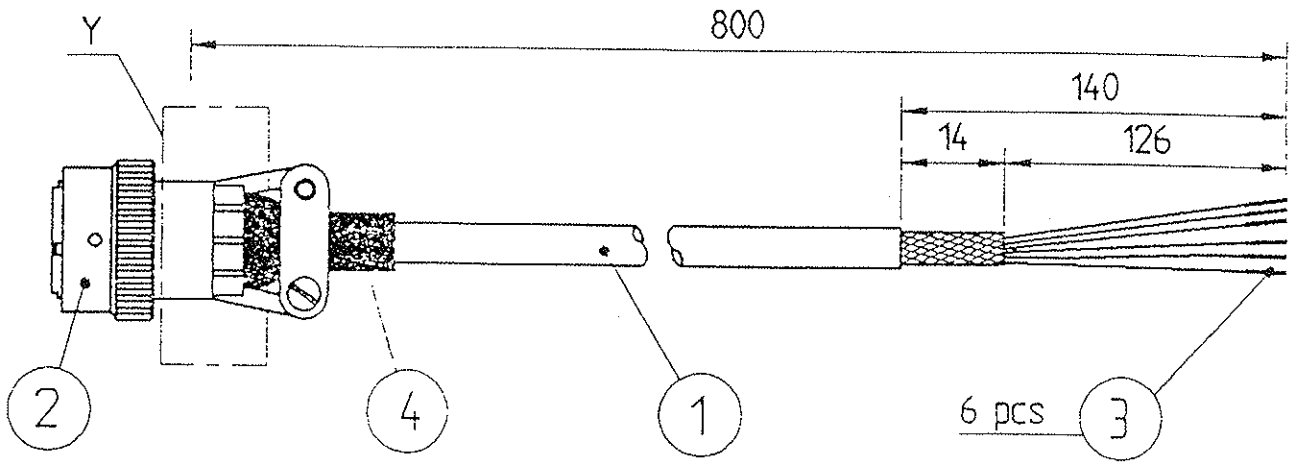
Tool

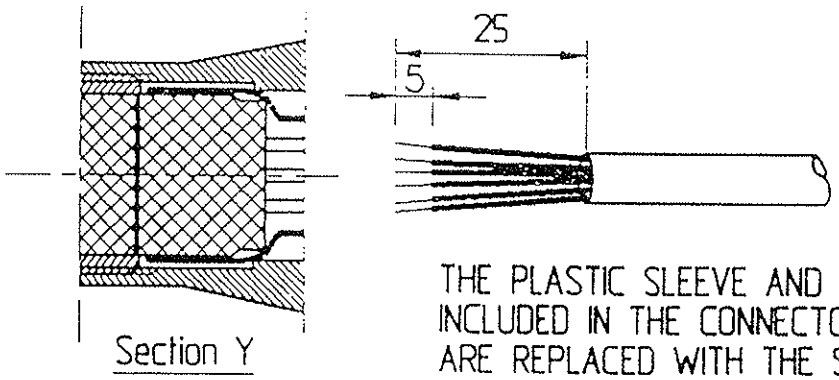
Qty pcs

Work order

Ltr	Qty	Change	Reason/ ECO no	Design	Date Review	Date Appr
a						







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3	Connector Bushing	6 pcs	488 Abiko/PH 0.5-6		
2	MS-Connector	1 pc	MS3116F10-6P		
1	Cable	0.8 m	PFSK 6x0.22		ϕ5.4

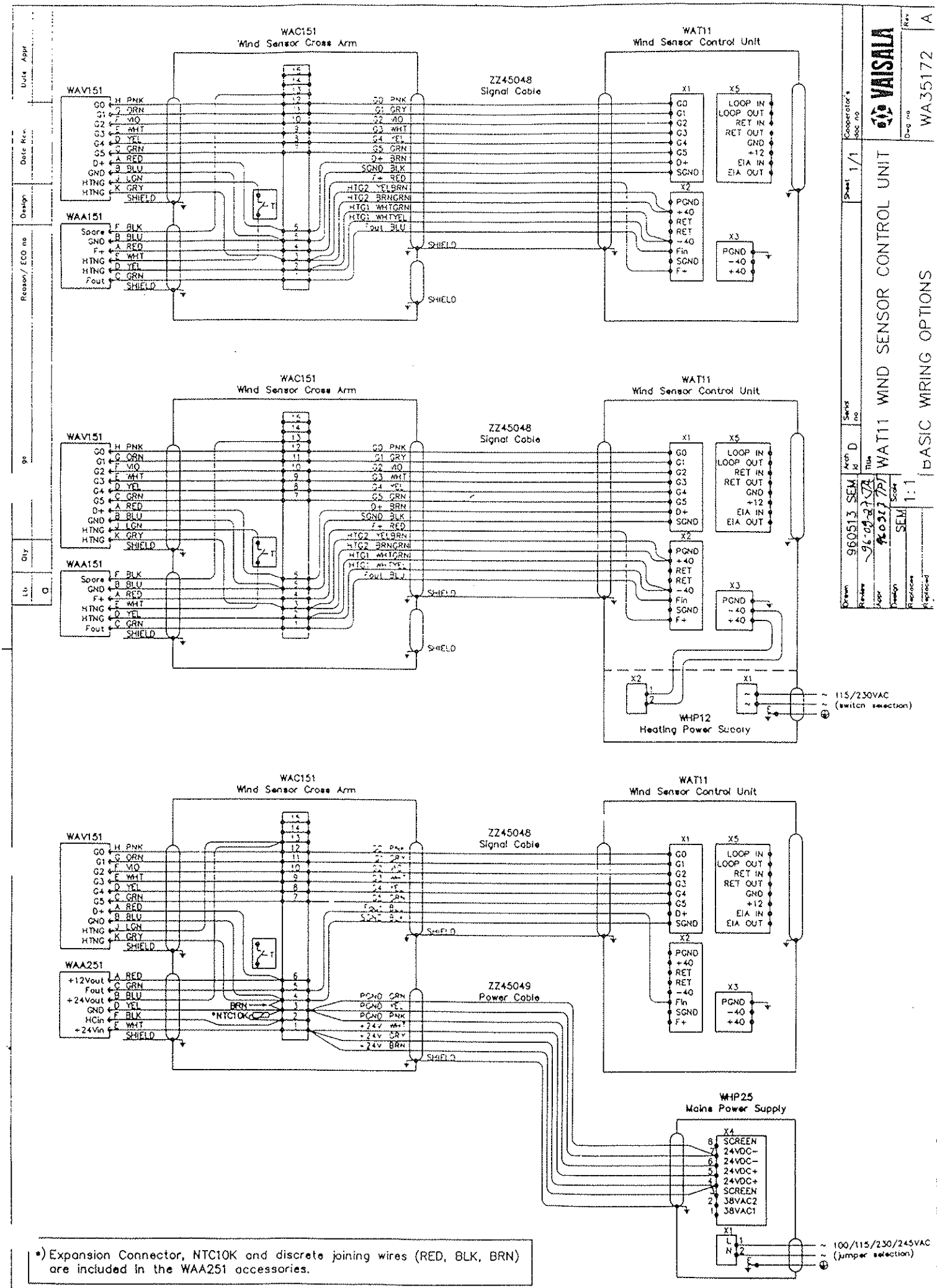
Drawn 950821 SEM	Arch Id D	Serial no	Sheet 1/1	Cooperator's doc no
Review 95-11-14 PP	Title SENSOR CABLE ANEMOMETER ASSEMBLY			VAISALA
Appr 95-11-15 JA				
Design SEM	Scale			Dwg no 7745036 Rev A
Replaces				
Replaced				

Tool

pcs

Qty

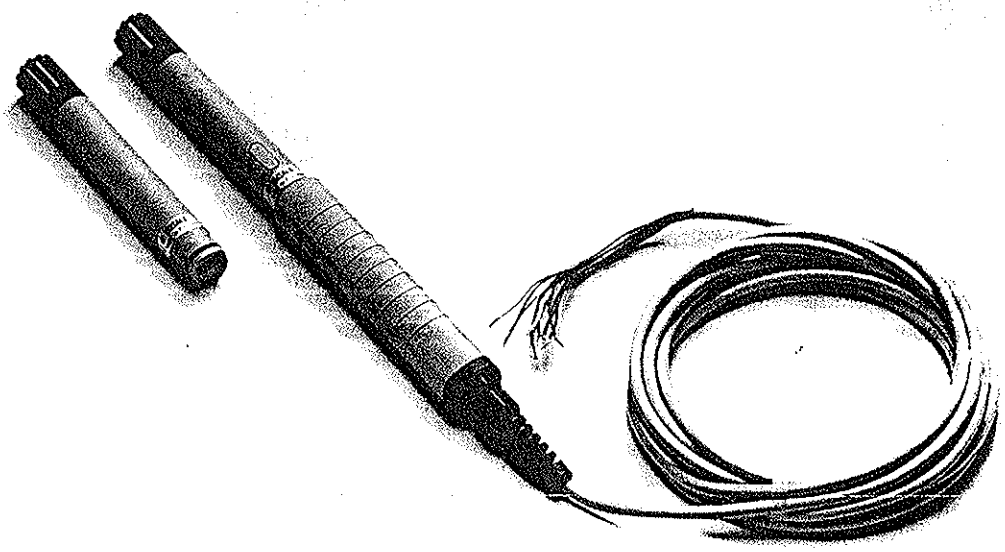
ork order



*) Expansion Connector, NTC10K and discrete joining wires (RED, BLK, BRN) are included in the WAA251 accessories.

VAISALA

HMP45A & HMP45D
Humidity and Temperature Probes



VERSATILE PROBES

The HMP45A and HMP45D humidity and temperature probes for OEM's and single users are designed for use with a wide range of instrumentation e.g. recorders, dataloggers, laboratory equipment and weather stations*. The probes can be interfaced simply and easily to the instruments and are very easy to service.

Each probe is delivered from the factory with a calibration certificate with a traceability to international standards.

HIGH PERFORMANCE

The HMP45A/D probes are fitted with the new HUMICAP®180 sensor. The HUMICAP® has been constantly improved over a quarter century and is one of the most reliable sensor on the market. The sensor can be used in a wide range of environments and has high accuracy, negligible hysteresis and excellent long-term stability even in very high humidities. It is insensitive to dust and has very good tolerance against chemicals.

NEW FEATURES

Field calibration is easy to carry out with one or two references. The probe head containing the sensor and electronics can be quickly removed from the probe body, a replacement installed and the measurements continued while the other sensorhead is calibrated in a laboratory. Or if neccessary, the humidity and temperature readings in HMP45A can be checked with Vaisala's HM141 humidity indicator on site. This feature means routine check and calibrations can be made without interrupting the measurements for long periods of time.

The combined performance of the HUMICAP®180 sensor and improved IP65 protected probe enables you to make accurate and repeatable humidity and temperature measurements with confidence. The HMP45A/D probes can be operated from a wide range of supply voltages and have low power consumption. Combine these features with the probes' wide temperature range, temperature compensation and full-scale humidity range and you have a versatile solution for many applications.

* The HMP45A/D is an excellent solution for measuring humidity in weather stations. However in some locations where the condensation continuously disturbs the measurement and causes delay the HMP243 transmitter with warmed sensor head is recommended.

TECHNICAL DATA HMP45A & HMP45D

RELATIVE HUMIDITY

HMP45A & HMP45D

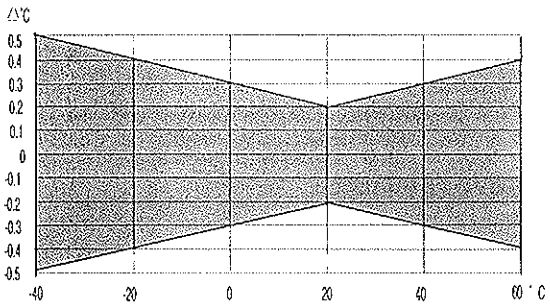
Measurement range	0.8...100 %RH
Output scale	0-100 %RH equals 0-1 VDC
Accuracy at +20 °C (incl. nonlinearity and hysteresis)	
against factory references	±1 %RH
field calibration against references	
	±2 %RH (0...90 %RH)
	±3 %RH (90...100 %RH)
Typical long-term stability	< 1 %RH / year
Temperature dependence	±0.05 %RH/ °C
Response time (90%)	
at +20 °C	15 s with membrane filter
Humidity sensor	HUMICAP® 180

TEMPERATURE

HMP45A

Measurement range	-39.2...+60 °C
Output scale	-40...+60 °C equals 0...1 VDC
Accuracy at +20 °C	±0.2 °C

Accuracy over measurement range:



Temperature sensor	Pt 1000 IEC 751
	1/3 Class B

HMP45D

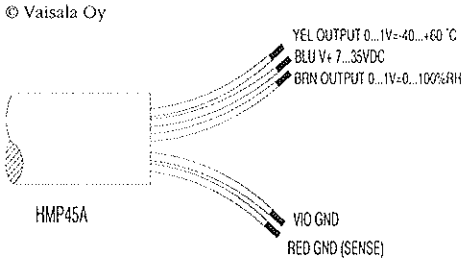
Measurement range	-40...+60 °C
Output signal	resistive four wire connection
Temperature sensor	Pt 100 IEC 751
	1/3 Class B

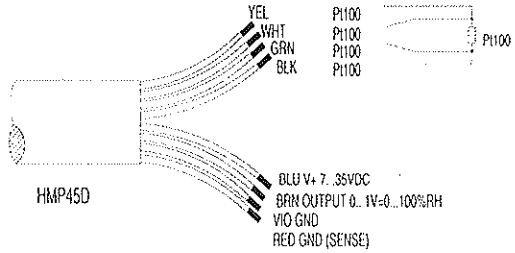
GENERAL

Operating temperature range	-40...+60 °C
Storage temperature range	-40...+80 °C
Supply voltage	7...35 VDC
Settling time	500 ms
Power consumption	<4 mA
Output load	>10kohm (to ground)
Weight	350 g (incl. package)
Cable length	3.5 m
Housing material	ABS plastic
Housing classification (electronics)	IP 65 (NEMA 4)
Sensor protection	
standard	membrane filter, part no. 2787HM
option	sintered filter 37 µm, part no. 6685
	sintered filter 216 µm, part no. 6686
	grid, part no. 6597

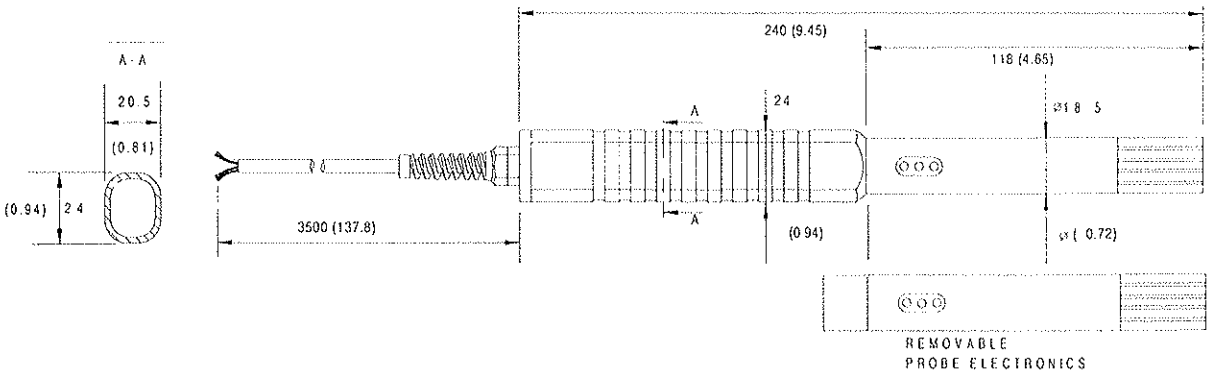
CE

Specifications subject to change without prior notice.
HUMICAP® is a registered trademark of Vaisala





Dimensions in mm (inches)



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Ref. A0599en 1997-01

HMP45A&HMP45D HUMIDITY AND TEMPERATURE PROBES Operating Manual

U274en-1.2
29 September 1997

1. GENERAL

The HMP45A and HMP45D probes are designed for the measurement of relative humidity and temperature. Humidity measurement is based on the capacitive thin film polymer sensor HUMICAP®180. Temperature measurement is based on resistive platinum sensors (Pt 100 and Pt 1000). Both the humidity and temperature sensors are located at the tip of the probe and in standard version protected by a membrane filter. The HMP45A and HMP45D have a similar humidity output, but the temperature output is active in HMP45A (voltage output 0-1V) and passive in HMP45D (resistive output Pt 100).

2. CONNECTIONS

The cable wires are connected as shown in Figure 1.

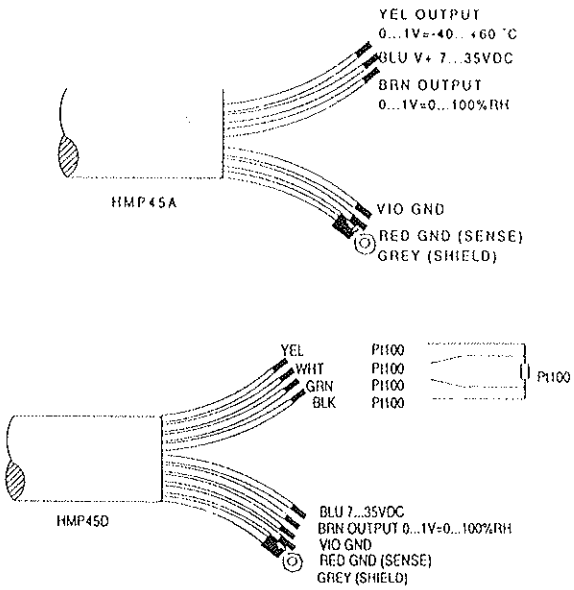


Figure 1 Wire colours

SIGNAL GROUND is used for output signal in a differential measurement. With SIGNAL GROUND, the cable can be extended up to 100 metres without disturbing the measurement accuracy. When outputs are not measured against SIGNAL GROUND, connect GROUND and SIGNAL GROUND to the same point.

3. CALIBRATION AND MAINTENANCE

Calibration and maintenance of the probes should be performed at regular intervals, depending on the conditions of use and desired accuracy. The recommended calibration interval is one year.

The HMP45A/D probes are easy to maintain and calibrate. The probe consists of a probe head and a handle with cable. All calibration electronics are in the probe head which can be disconnected from the handle without disconnecting the wires (see Figure 2). The handles of all HMP45A and HMP45 probes are fully interchangeable. If you wish to continue the measurement immediately, you can insert a calibrated probe head in place of the disconnected one; this way, the measurement is interrupted for less than a minute.

3.1 Reading the outputs during calibration

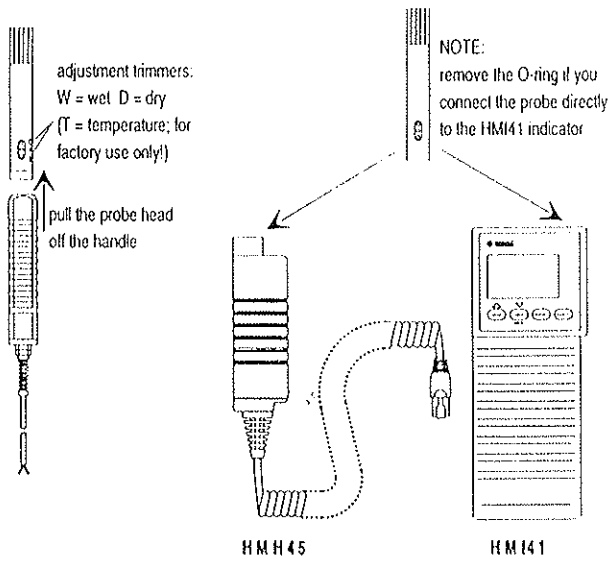


Figure 2 Adjustment trimmers and probe head connection/disconnection

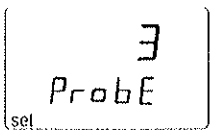
In calibration, the HMP45A/D output is normally read from the output cables. The HMP45A probe head can also be checked with Vaisala's HMI41 indicator (see Figure 2); the probe head can be connected either to the HMH45 handle, or directly to the HMI41 indicator. However, note that if you connect the probe head directly to the HMI41, you must first remove the O-ring. Measured humidity and temperature appear on the HMI41 display.

A simple field check can also be performed when there seems to be something wrong with the measurement system. It is sufficient to compare the HMP45A

reading with the reading measured by a calibrated reference probe head. Check the ambient relative humidity and temperature level with the reference probe head, and then connect the HMP45A probe head on the HMH45 handle and check the output readings.

Prepare the HMI41 indicator for measurements with the HMP45A probe head as follows: turn the HMI41 indicator on and within 1-2 seconds press simultaneously buttons ENTER and MODE until the text **SEtUP** appears on the display.

Wait a few seconds, and the text **Unit** appears; press ENTER repeatedly until a text similar to the following appears on the display:



Select PROBE TYPE 3 with buttons ▲ (number up) or ▼ (number down) and turn the indicator off. Turn it on again by pressing the ON/OFF button. After a few seconds, the relative humidity and temperature readings appear automatically on the display.

The HMP45D cannot be used with the HMI41 indicator as the passive temperature signal results in error messages on the HMI41.

3.2 Humidity calibration

For a high-accuracy two-point calibration use a Vaisala HMK15 or HMK13B calibrator and saturated salt solutions as described in the respective manuals.

Leave the calibrator, the HMI41 and the probe head in the same space for at least four hours so that their temperatures have time to equalize. Unscrew the plastic grid of the probe.

The calibration is done first for the dry end and then for the wet end by adjusting trimmer potentiometers marked "D" (dry, <50 %RH) and "W" (wet, >50 %RH). The potentiometers are located under a protective plug; see Figure 2. Use a ceramic screw driver with 2.5 mm blade for adjusting the potentiometers. Note: if zero point is calibrated in Nitrogen (N_2), the minimum output signal of 0.008 V corresponds to a relative humidity of 0.8 %RH.

Greenspan's calibration table

Temperature	°C	15	20	25	30	35
LiCl	%RH	*)	11.3	11.3	11.3	11.3
NaCl	%RH	75.6	75.5	75.3	75.1	74.9
K_2SO_4	%RH	97.9	97.6	97.3	97.0	96.7

*) Do not use or store the LiCl solution in temperatures below +18°C as its humidity equilibrium may change permanently

As the D (dry) and W (wet) adjustments may affect each other, check again the humidity reading at the low end. If necessary, repeat the adjustments in both the low and the high humidity points until the reading is correct.

3.3 Changing the HUMICAP®180 humidity sensor

Unscrew the filter. Remove the damaged sensor and mount a new HUMICAP®180 humidity sensor in its place. Handle the sensor with care. Calibrate the probe using a two-point calibration procedure. Note that if the probe is not calibrated, the accuracy is still better than ±7 %RH.

4. SPARE PARTS AND ACCESSORIES

Order code	Description
HUMICAP®180	Humidity sensor
18921	Temperature sensor Pt 1000 IEC 751 1/3 Class B (HMP45A)
19159	Temperature sensor Pt 100 IEC 751 1/3 Class B (HMP45D)
2787HM	Membrane filter (standard)
6685	Sintered filter 37 µm
6686	Sintered filter 216 µm
6597	Plastic grid
HMP45ASP	HMP45A probe head
HMP45DSP	HMP45D probe head
HMH45ASP	Probe handle for HMP45A and HMP45D
HMI41	Humidity and temperature indicator
HMH45	Probe handle for HMP45A with a connector to HMI41
HMK11	Humidity Calibrator
HMK13B	Humidity Calibrator

5. TECHNICAL DATA

5.1 Humidity (HMP45A & HMP45D)

Measurement range	0.8...100 %RH
Output scale	0...100 %RH equals 0-1 VDC

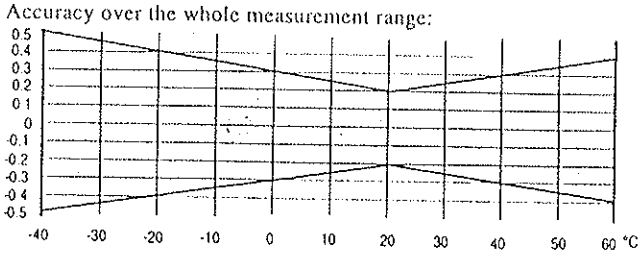
Accuracy at +20 °C (including non-linearity and hysteresis):	
against factory references	±1 %RH
field calibration against references	±2 %RH (0...90 %RH)
	±3 %RH (90...100 %RH)
Typical long-term stability	better than 1 %RH per year
Temperature dependence	±0.05 %RH/°C
Response time (90%) at +20 °C	15 s with membrane filter
Humidity sensor	HUMICAP®180

5.2 Temperature

HMP45A

Measurement range	-39.2...+60 °C
Output scale	-40...+60 °C equals 0...1 VDC
Accuracy at 20°C	±0.2 °C

Accuracy over the whole measurement range:



Temperature sensor	Pt 1000 IEC 751 1/3 Class B

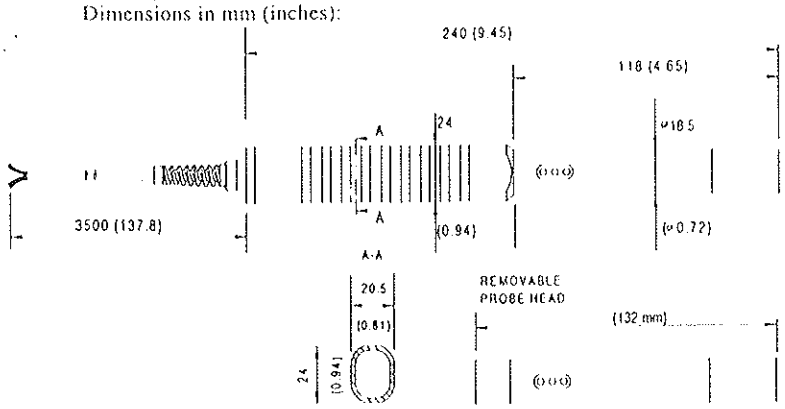
HMP45D

Measurement range	-40...+60 °C
Output signal	resistive four wire connection
Temperature sensor	Pt 100 IEC 751 1/3 Class B

5.3 General

Operating temperature range	-40...+60 °C
Storage temperature range	-40...+80 °C
Supply voltage	7...35 VDC
Settling time	500 ms
Power consumption	< 4 mA
Output load	>10 kohm (to ground)
Weight	350 g (including package)
Cable length	3.5 m
Housing material	ABS plastic
Housing classification (electronics)	IP 65 (NEMA 4)

Sensor protection (standard) membrane filter, part no. 27871HM
Dimensions in mm (inches):



5.4 Electromagnetic compatibility

5.4.1 Emissions

Radiated interference, test setup according to EN55022

5.4.2 Immunity

Test:	Test setup according to:	Performance:
Radiated interference	IEC 1000-4-3	HMP45A level 1 (3V/m) HMP45D level 3 (10 V/m)
Electrostatic discharge	IEC 801-4	level 4 (HMP45A&D)

CE

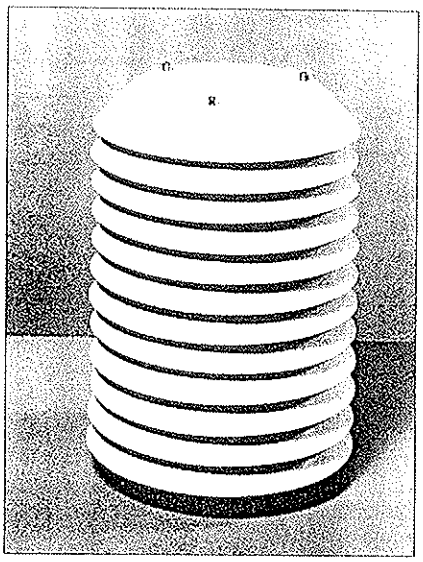
GUARANTEE

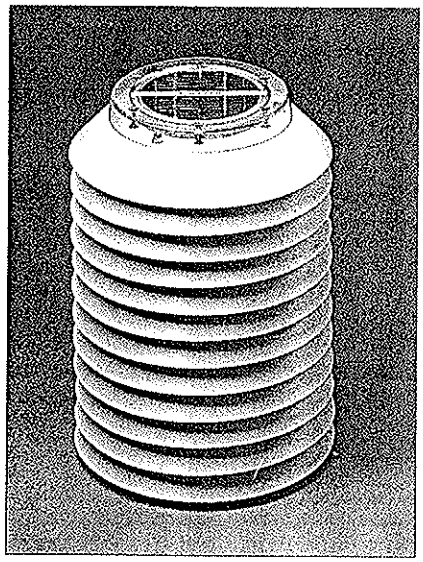
Vaisala issues a guarantee for the material and workmanship of this product for one (1) year from the date of delivery. Damage due to exceptional operating conditions, careless handling or misapplication will void the guarantee. Detailed warranty information is given in the Warranty and the Standard Conditions of Sale of Vaisala Oy.

VAISALA

DTR13, DTR13F and DTR15 Radiation Shields

- Fiberglass-filled polyester
- UV-proof
- Excellent ventilation
- Does not absorb water





The naturally ventilated maintenance-free **DTR13 Radiation Shield** provides protection from scattered as well as direct solar radiation and rain. The material is specially designed fiberglass-filled polyester to offer excellent thermal characteristics and durable UV-proof construction. The outer surface is painted white to reflect radiation while the inside is black to absorb accumulated heat.

The design of the DTR13 enables easy installation and sensor mounting. Not only Vaisala's sensors, such as the HMP35D Temperature & Humidity Probe or the DTS12A Air Temperature Probe can be used with the shield, but also environmental sensors of other manufacturers.

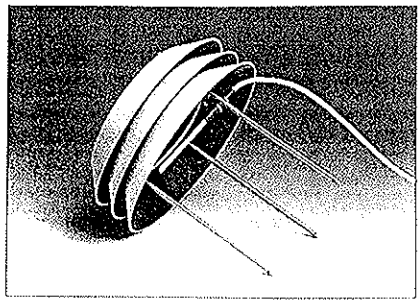
The radiation shield is tested to withstand vibration according to IEC 6-2 (Fc, sinusoidal vibration).

The **DTR13F Radiation Shield** is made of the same material as the DTR13 to withstand wind driven saltwater, rain and sunlight. In addition to natural ventilation, a solar powered fan provides extra ventilation to guarantee correct ambient temperature readings during calm days and nights.

A solar panel element, an integrated battery back-up and the fan are attached to the top part of the shield. 4-inch solar cells produce electricity for the fan's DC motor and recharge the NiCad battery. A fully charged battery has enough capacity to run the fan for a couple of cloudy days.

The installation and sensor mounting are identical to those of the DTR13 Radiation Shield.

The **DTR15 Ground Radiation Shield** is designed to reflect the sun's direct radiation by means of its highly reflective white surface. It is used to protect the DTS12G Grass/Soil Temperature Probe from solar radiation and rain. The shield is fastened to its location by inserting its three stainless steel spikes into the ground.



DTR13 RADIATION SHIELD

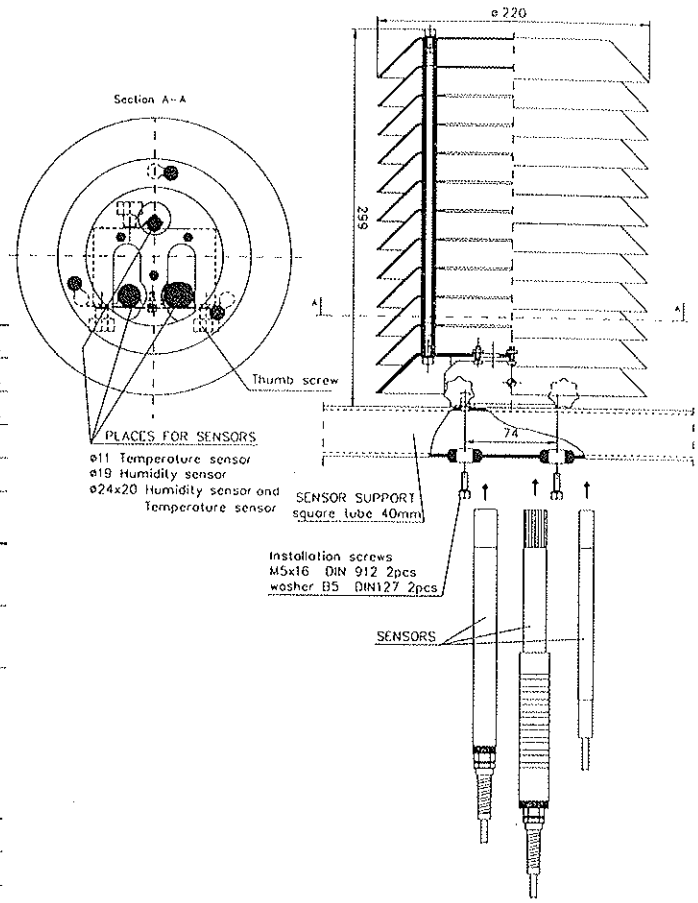
DIMENSIONS

Outer diameter	220 mm
Outer height	300 mm
Inner diameter	110 mm
Inner height	223 mm
Weight	1.9 kg

INSTALLATION

With screws to sensor support arm (square tube 40 mm)

With installation clamp (part number 16215) to round tube



DTR13F RADIATION SHIELD

DIMENSIONS

Outer diameter	220 mm
Outer height	310 mm
Inner diameter	110 mm
Inner height	200 mm
Weight	2.1 kg

INSTALLATION

With screws to sensor support arm (square tube 40 mm)

FAN

Operates when the battery charge is sufficient. The battery is charged by a solar cell.

Battery	NiCad, 1150 mAh
Operating temperature	–20 °C to +60 °C
Storage temperature	–20 °C to +35 °C

DTR15 RADIATION SHIELD

DIMENSIONS

Outer diameter	220 mm
Outer height	110 mm (+ 180 mm spikes)
Inner diameter	110 mm
Inner height	50 mm
Weight	1.4 kg

INSTALLATION

Spikes inserted into ground

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Ref. B304en 1996-04

VAISALA
MET SYSTEMS

INSTRUCTION MANUAL

for

Automatic Weather Station

Radiation Shield DTR 13

EDITION DTR13I0.1-1

DATE JULY 1990

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1 GENERAL

The DTR 13 Radiation Shield protects environmental transducers against solar radiation and precipitation. Though originally designed for applications where Vaisala relative humidity sensors HMP 30 and HMP 35 as well as temperature sensor, DTS 12 are used, it may also be used with any environmental temperature and humidity transducers which have the same fixing dimensions.

The mechanical construction of the DTR 13 permits easy maintenance and installation of the sensors. The user can install and calibrate the sensors without dismantling the Radiation Shield from its support. The shield is made of fiber glass reinforced polyester. The surface is UV-stabilized to withstand exposure to the sun. The surfaces receiving direct radiation are white to reflect the energy while inner surfaces are black in order to absorb accumulated heat.

DTR 13 has been tested in accordance with the vibration test program (Vibration, sinusoidal IEC 68-2-6 test Fc).

2 SPECIFICATIONS

2.1 Mechanical

Outside dimensions
- diameter 220 mm
- height 299 mm

Inside dimensions
- diameter 110 mm
- height 220 mm

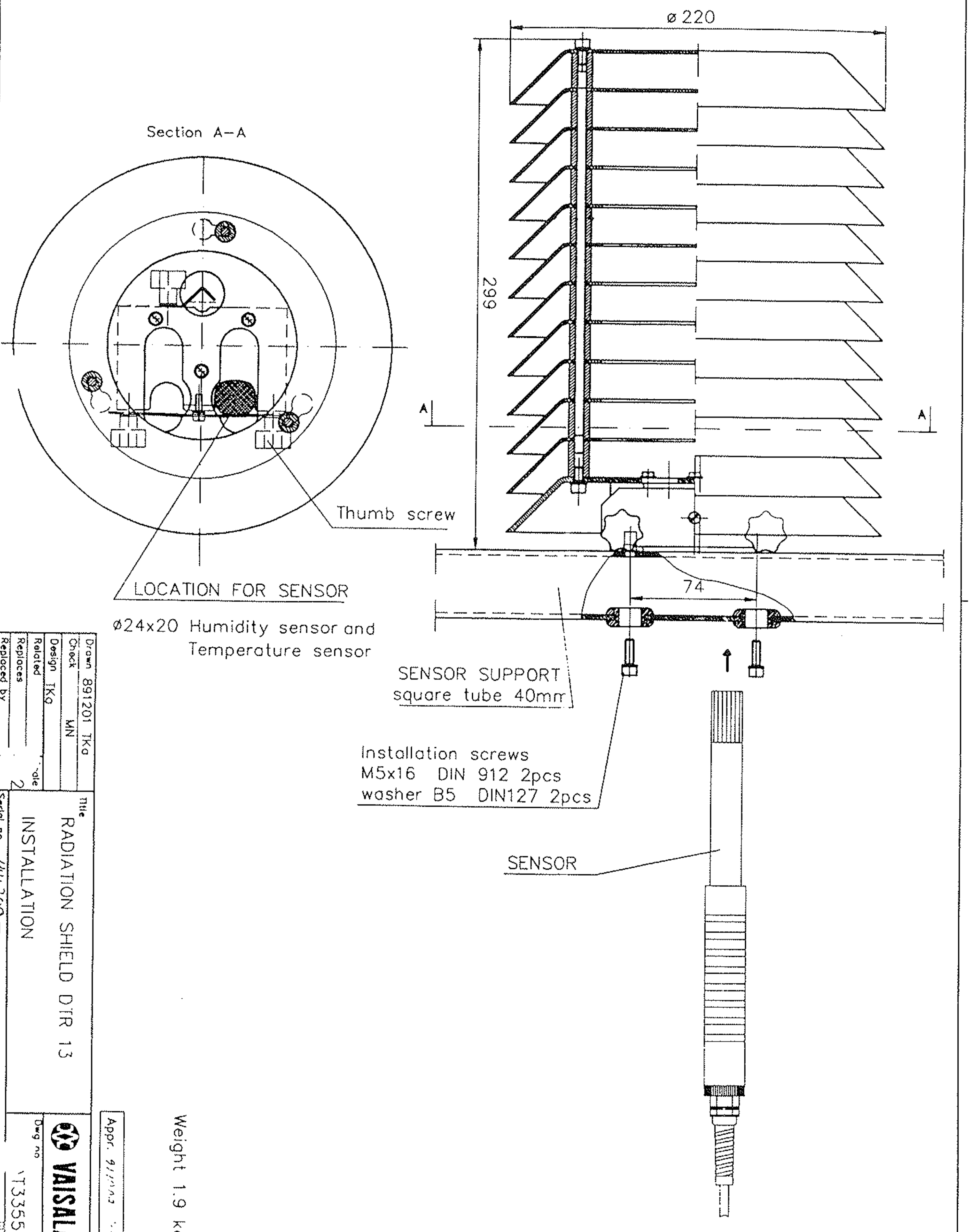
Weight
- 1.9 kg

Installation
- with screws to sensor support (square tube 40 mm)

Material
- fiber glass
- aluminium bracket

Työ nro

Valm. määrä kpl



Drawn 891201 TKa
Check MN
Design TKa
Related
Replaces
Replaced by
Scale 2

Title RADIATION SHIELD DTR 13
INSTALLATION

Serial no. 441709 –

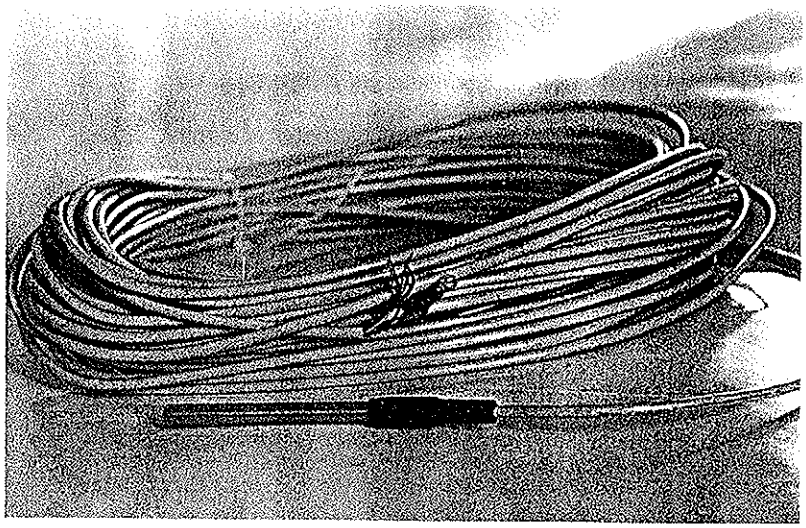
Appr.

VAISALA

Dwg no ?T3355

VAISALA

TEMPERATURE PROBE
DTS 12G



PLATINUM RESISTANCE ELEMENT
ACCURACY 1/4 DIN 43760
WEATHER RESISTANT DESIGN

The DTS 12G Ground/Soil Temperature Porbe is specially designed for automatic weather stations. Road weather stations use the sensor to measure the temperature beneath the road surface, at e.g. 150 mm or 300 mm depth. In ice prediction systems the information on road depth temperature is utilized when producing the 24-hour road surface temperature forecast.

Soil temperature measurement is an important parameter e.g. in soil heat flow measurements and in agrometeorological applications. DTS 12G can be used to measure the temperature at different levels beneath the surface.

The main body of the housing is made of stainless steel and has a maximum diameter of 8 mm. The sensing element is located in the tip part of the assembly. The length of the probe is 100 mm.

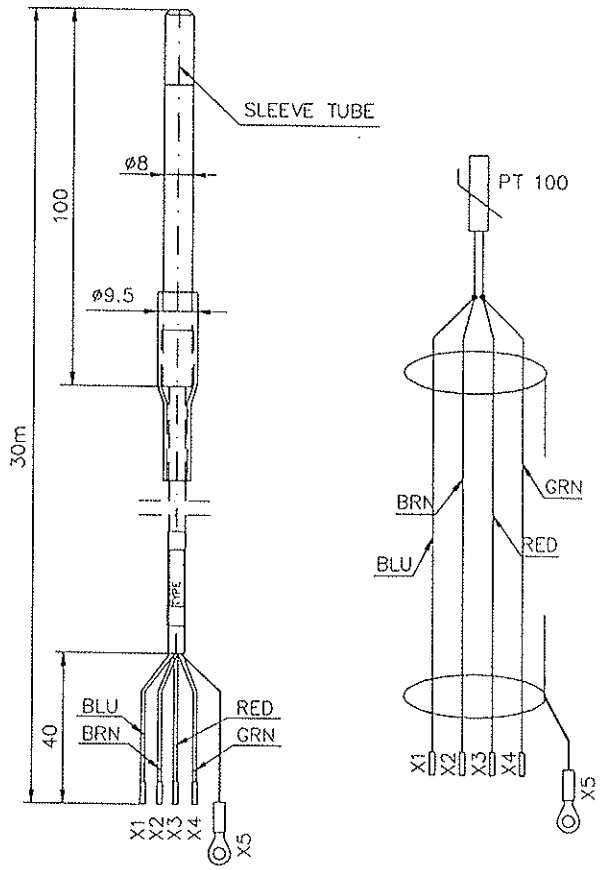
DTS 12G can be used with equipment operating with the resistor bridge principle or constant current principle.

TECHNICAL DATA

Sensing element	Platinum resistance element (Pt 100)
Accuracy	1/4 DIN 43760

0°C	Ω	°C
-100	±0.08	±0.18
0	±0.05	±0.08
+100	±0.06	±0.15

Sensitivity	0.385 Ω/°C
Housing material	Stainless steel AISI 316
Dimensions	Maximum diameter ø 8 mm Length 100 mm
Cable length	30 m (standard)
Cable	4 × 0.22 mm + shield outer diameter ø 5 mm



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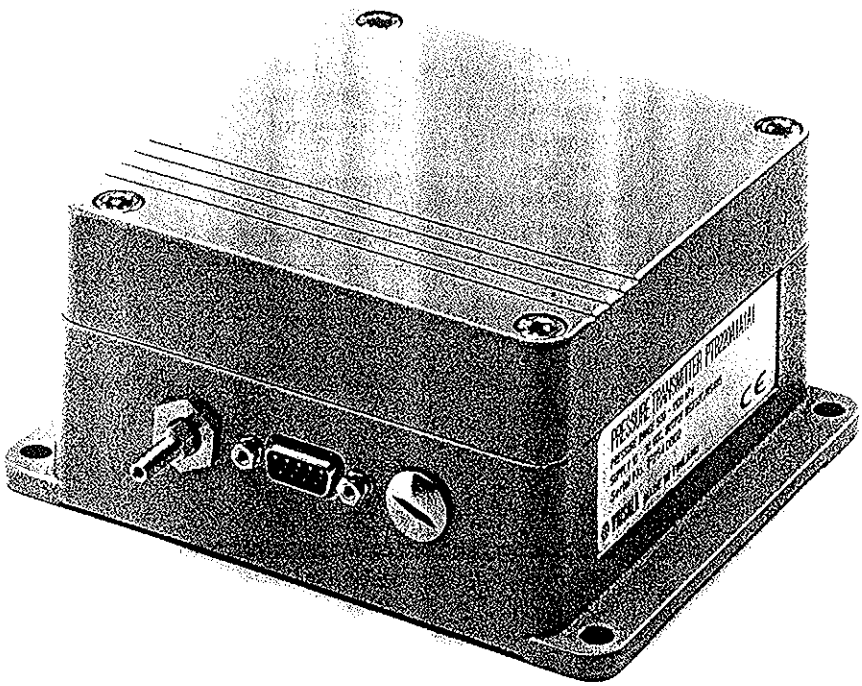
VAISALA

PTB220 series digital barometers



FEATURES

- total accuracy including one year drift
  - class A ±0.20 hPa
  - class B ±0.3 hPa
  - class C ±0.4 hPa
- 500...1100 hPa pressure range
- -40...+60 °C temperature range
- available with one, two or three barometric pressure transducers
- available with RS 232C/TTL level or RS 485/RS 422 serial interfaces
- fast measurement mode
- flexible pulse output mode
- meets CE requirement for EMC/ESD

APPLICATIONS

- barometric transfer standard
- barometric working standard
- weather stations
- data buoys and ships
- laser interferometers

PERFORMANCE AND VERSATILITY

The PTB220 series digital barometers are designed for a wide environmental pressure and temperature range. The class A barometers are fine adjusted and calibrated against a dead-weight tester. The class B and class C barometers are adjusted and calibrated by using electronic working standards.

A single barometer can have one, two or three pressure transducers. Two or three transducers provide redundancy which is particularly important in airport and remote weather station installations.

In the fast measurement mode the barometers can make 10 measurements per second. The pulse output mode settings — pressure offset, pulse rate and pressure resolution — can be set by the user.

The PTB220 series barometers use the BAROCAP® silicon capacitive absolute pressure sensor developed by Vaisala. The Barocap sensor has excellent hysteresis and repeatability characteristics and outstanding temperature and long-term stability.

TECHNICAL DATA — PTB220 SERIES DIGITAL BAROMETERS

OPERATING RANGE

Pressure range	500...1100 hPa
Temperature range	
operating	-40...+60 °C
storage	-60...+60 °C
Humidity range	non-condensing

ACCURACY

	class A	class B
Linearity *	±0.05 hPa	±0.10 hPa
Hysteresis *	±0.03 hPa	±0.03 hPa
Repeatability *	±0.03 hPa	±0.03 hPa
Calibration uncertainty **	±0.08 hPa	±0.15 hPa
Accuracy at +20 °C ***	±0.10 hPa	±0.20 hPa

	class C
Linearity *	±0.25 hPa
Hysteresis *	±0.05 hPa
Repeatability *	±0.05 hPa
Calibration uncertainty **	±0.15 hPa
Accuracy at +20 °C ***	±0.30 hPa

Temperature dependence****	±0.1 hPa
Long-term stability	±0.1 hPa/year
Total accuracy including one year drift	
class A	±0.20 hPa
class B	±0.3 hPa
class C	±0.4 hPa

* Defined as ±2 standard deviation limits of end-point non-linearity, hysteresis error or repeatability error.

** Defined as ±2 standard deviation limits of inaccuracy of the working standard at 1000 hPa including traceability to NIST.

*** Defined as the root sum of the squares (RSS) of end-point non-linearity, hysteresis error, repeatability error and calibration uncertainty at room temperature.

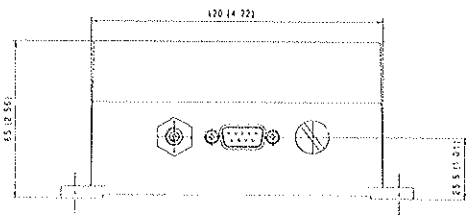
**** Defined as ±2 standard deviation limits of temperature dependence over the operating temperature range.

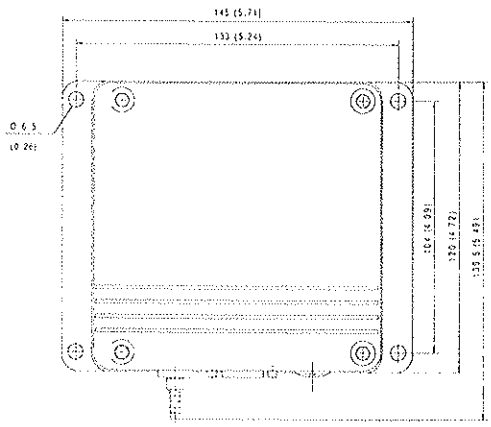
CE

GENERAL (factory setting •)

Supply voltage	10...30 VDC reverse polarity protected
Supply voltage sensitivity	negligible
Current consumption	
continuous operation mode	less than 25 mA
hardware shutdown mode	less than 0.1 mA
Serial I/O	RS 232C• full duplex or bidirectional TTL level or RS 485/422 half duplex
code	ASCII
parity	none, even•, odd
data bits	7• or 8
stop bits	1• or 2
Pulse output	TTL level pulse output at 5 kHz or 50 kHz
Pressure units	hPa•, mbar, kPa, Pa, inHg, mmH_2O, mmHg, torr, psia
Baud rates	300, 600, 1200, 2400, 4800, 9600•
Resolution	
class A	0.01 hPa•
class B & C	0.1 hPa•
Settling time at power-up (one sensor)	
class A	3 s•
class B & C	2 s•
Response time (one sensor)	
class A	2 s•
class B & C	1 s•
fast measurement mode	0.2 s•
Acceleration sensitivity	negligible
Pressure connector	M5 (10-32) internal thread
Pressure fitting	barbed fitting for 1/8" I.D. tubing
Maximum pressure limit	5000 hPa abs.
Electrical connector	female 9-pin subD
Electrical connections	
excitation	supply, GND, CTRL (for shutdown)
serial communication	TXD, RXD, GND RS485/422+, RS485/422-
pulse output	PULSE, PULSE TRIG, GND
Housing	epoxy painted aluminium
Weight	1 kg

Dimensions in mm (inches)





VAISALA

Vaisala Oy
P.O.Box 26
FIN-00421 Helsinki
FINLAND

Phone: (+358 0) 894 91
Telefax: (+358 0) 894 9485
Telex: 122832 vsala fi

Ref. B288en 1996-05

GILL

INSTRUMENTS

3 Axis Ultrasonic Meteorological Anemometer

* **High reliability, zero maintenance - decreased down time and service costs.**
* **Software configurable - reduces set up and installation time.**
* **8 measurement modes - flexible & easy to use.**

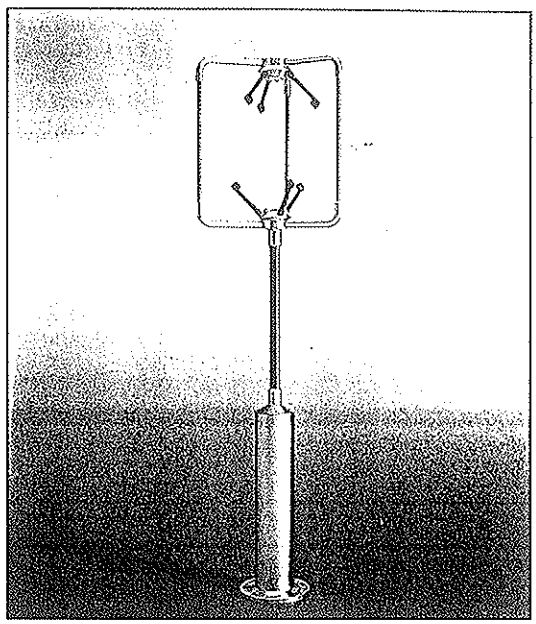
WindMaster

The WindMaster ultrasonic anemometer represents the latest technological advances in MET applications for wind measurement from the world leader, Gill Instruments Ltd.

From its simplified mounting arrangement to its fully software configurable operation the WindMaster is the best solution on the market for serious 3 axis wind measurement.

The anemometer can be driven by the users own software, a proprietary comms package or via ANEMCOM - the latest communications package from Gill Instruments, supplied free with every anemometer. This allows the user to operate the anemometer in various modes, permitting measurement of U, V & W vectors or windspeed plus direction and W and in NMEA configuration.

Communication is via an RS485 bi-directional link allowing up to 26 units to be networked together and data to be logged either on demand (polled) or to be streamed continuously.



The WindMaster has 4 analogue outputs which can be configured to allow 0 - 5V, ±2.5V or 4 - 20mA operation and 3 analogue inputs.

Applications
* Meteorological
* Transport
* Tunnels
* Motorways
* Marine
* Military
* Aviation

Features
* 8 operating modes
* 1 or 4 outputs/sec, user selectable
* 3 analogue inputs
* 4 analogue outputs
* RS485 digital serial output
* Self diagnostics
* Free communications software

SOLENT

GILL

INSTRUMENTS

WindMaster

SOLENT

Specification

Measurement	
Ultrasonic sampling rate	39/sec (1 output/sec), 9/sec (4 outputs/sec)
Parameters	UVW, Polar, NMEA, Tunnel
Units	m/s, Knots, MPH, KPH
Averaging	3 sec, 5 sec, 10 sec
Windspeed	
Range	0 - 60m/s (0 - 134mph)
Accuracy	0 - 20m/s - 1.5% rms
	20 - 35m/s - 1.5% to 3% rms
	35 - 60m/s - 3% rms
Resolution	0.01m/s
Offset	± 0.01m/s
Direction	
Range	0 - 360°
Accuracy	< 25m/s ± 2°, >25m/s ± 4°
Resolution	1°
Power requirement	
Anemometer	9 - 30Vdc at 150mA max
Digital Output	
Communications	RS485 full duplex, network up to 26 anemometers
Baud rate	1200, 2400, 4800, 9600, 19200, 38400
Output rate	1 or 4 outputs/sec
Format	8 data, odd, even or no parity
Analogue Outputs	
Quantity	4
Scale	Multiples of ± 10m/s up to ± 70m/s
Type	± 2.5V, 5V or 4 - 20mA(2 channels only)
Frequency response	0.5Hz (1 output/sec), 2 Hz (4 outputs/sec)
Impedance	470 Ohms
Analogue Inputs	
Quantity	3
Type	-2.5V to 5V
Resolution	11 bits over 5V
Dimensions	
Size	750mm x 240mm
Weight	1Kg
Environmental	
Moisture protection	IP65
Operating temperature	- 40° to + 60°C
Humidity	5% to 100% RH
Precipitation	Operation maintained to 300mm/Hr
EMC	BS EN 50081-1:1992 (Emmisions class B)
	BS EN 50082-1:1992 (Immunity)
	FCC class A
General	Suitable for exposure to a marine environment

Accuracy specification applies between 5°C and 35°C and wind incidence ±10° to the horizontal with respect to the anemometer.

The SOLENT range is in continuous development and so specifications may be subject to change without prior notice.

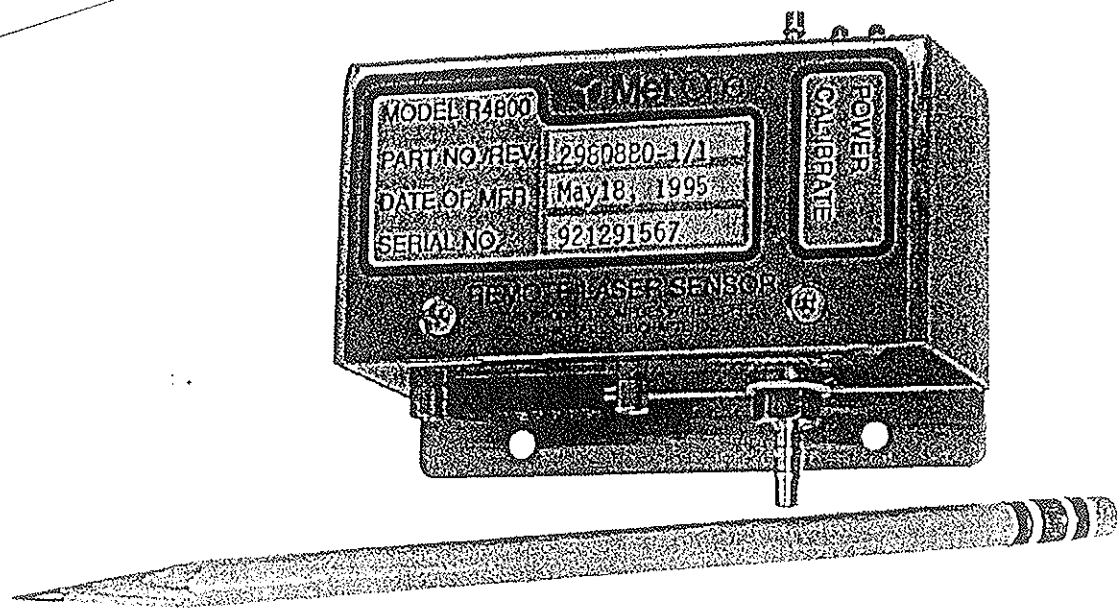
Manufactured by

GILL INSTRUMENTS LTD
Solent House, Cannon St
Lymington, Hampshire
SO41 9BR, England
Intl Tel: +44 (0)1590 671754
Intl Fax: +44 (0)1590 676409

Distributor

Model R4800 Series

Remote Airborne-Particle Counters



Monitor Multiple Process Areas

- 0.3µm minimum threshold setting at 0.1 cfm
- 0.1 or 1.0 cfm flow rate
- Two size channels
- RS485 serial communications

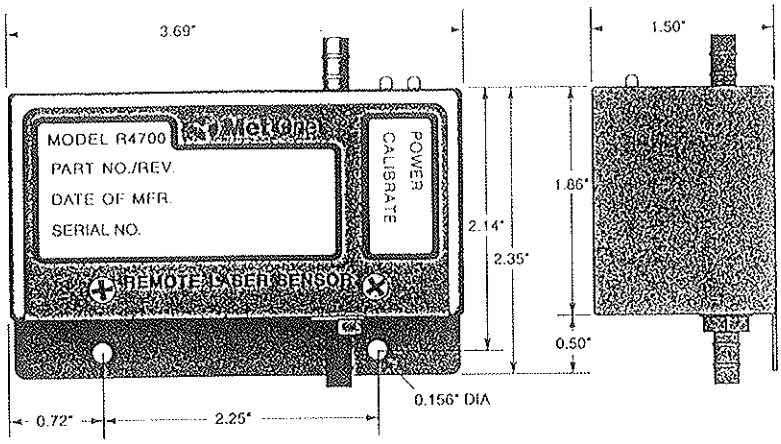
CONNECTING REMOTE PARTICLE COUNTERS to your computer system has never been easier than with Met One's R4800 Series of miniature particle counters. These counters, approximately the size of a stick of butter, can be mounted at many locations around the cleanroom. All you need to provide is a vacuum source and a communication line.

The R4800 Series uses standard RS485 serial communications, allowing daisy-chained wiring between particle counters, up to 4000 feet. The particle counters will respond to simple ASCII command instructions including commands to START count, STOP count, REPORT count, location number, etc. The information reported includes the status of the counters along with the particle counts in two size ranges.

A user-programmed alarm level can be set for high counts on the first channel. When high counts trigger an alarm, the LED on the counter flashes and an alarm signal is set at the connector. The alarm will automatically reset at the start of the next count cycle.

Met One
A Subsidiary of Pacific Scientific Company

Dimensions



Power LED illuminates when counter is powered.

Calibrate LED illuminates when sensor calibration needs checking and flashes when the count exceeds the alarm level.

Connector

1	Ground
2	Alarm, open drain FET
3	N/C
4	N/C
5	N/C
6	RS485A
7	N/C
8	RS485B
9	Reserved
10	Reserved
11	Reserved
12	Reserved
13	Ground
14	Reserved
15	+VDC Power

DB-15 (female) connector

Specifications

Minimum Threshold Setting	
4803	0.3 µm
4805	0.5 µm
4815	0.5 µm
Flow Rate	
4803/4805	0.1 cubic feet per minute
4815	1.0 cubic feet per minute
Flow Control	critical orifice requires 18" Hg vacuum
Size Channels	
Ch 1/Ch 2	0.3/0.5 micron (R4803)
Ch 1/Ch 2	0.5/5.0 micron (R4805, R4815)
Light Source	laser diode (30,000 hours mean time between failure)
Coincidence Loss	5% at 2,000,000 particles per cubic foot
Inlet Pressure	ambient to 0.1" Hg vacuum
Indicators	power and calibration/alarm LEDs
Power	6 Vdc (+/-10%) at < 250 mA
Alarm Output	open collector FET max sink current (on) 150 mA; Max V.C. voltage (off) 30 VDC
Weight	10.7 ounces (0.30 kg.)
Port Sizes	1/8 inch ID inlet (0.1 cfm) 1/4 inch ID inlet (1.0 cfm) 1/4 inch ID outlet (all)
Environment	
Operating	55 to 105°F (12 to 41°C) 20 to 95% R.H., noncondensing
Storage	-40 to 160°F (-40 to 70°C) up to 98% R.H., noncondensing

Options

Switching power supply (supports up to 16 sensors, 6 Vdc, 5 A).

Power adapter for 8 - 30Vdc input (use one power adapter for each sensor).

Class One™ Monitoring/Data Acquisition Software, PC-Based

Specifications subject to change without notice

Met One 481 California Avenue, Grants Pass, Oregon 975

A Subsidiary of Pacific Scientific Company

Pacific Scientific

HIAC/ROYCO

Pacific Scientific GmbH
Postfach 16 44 · D-71206 Leonberg
Mollenbachstraße 14 · D-71229 Leonberg
Telefon (0 71 52) 90 42 66-69 · Telefax (0 71 52) 90 42

Büro Nord:
Hans-Böckler-Str. 59 · 59348 Lüdinghausen
Telefon (0 25 91) 30 91-92 · Telefax (0 25 91) 50 14

VAISALA

MILOS 500

Data Collection System

DELIVERY DOCUMENTS

DELIVERY DOCUMENTS

CONTENTS:

DELIVERY DOCUMENTS

SECTION 1

Quality Certificate

QUALITY CERTIFICATE

MODEL DMF50 Serial No. S39413

We hereby certify that the instrument described above has been carefully inspected and tested and found to meet it's published specifications when it was shipped from the factory.

DMF50 consists of the following tested units:

TYPE	PRODUCT	SERIAL NO.
DMB51/50	Mother Board	S394
DMC50B	Central Processing Unit	S49525
DPS50	DC/DC-Converter	743187
DMI50	Sensor Interface Unit	752539 752538
DMA50	Analog Interface Unit	
DDK50	Display/Keyboard Unit	
DMM50	Memory Unit	
DMM55B	Memory Unit 2Mb	
DMM56B	Memory Unit 128kb	
DMX50	Modem Unit	
DMX55	Modem Unit	
DPA21	Pressure Transducer	

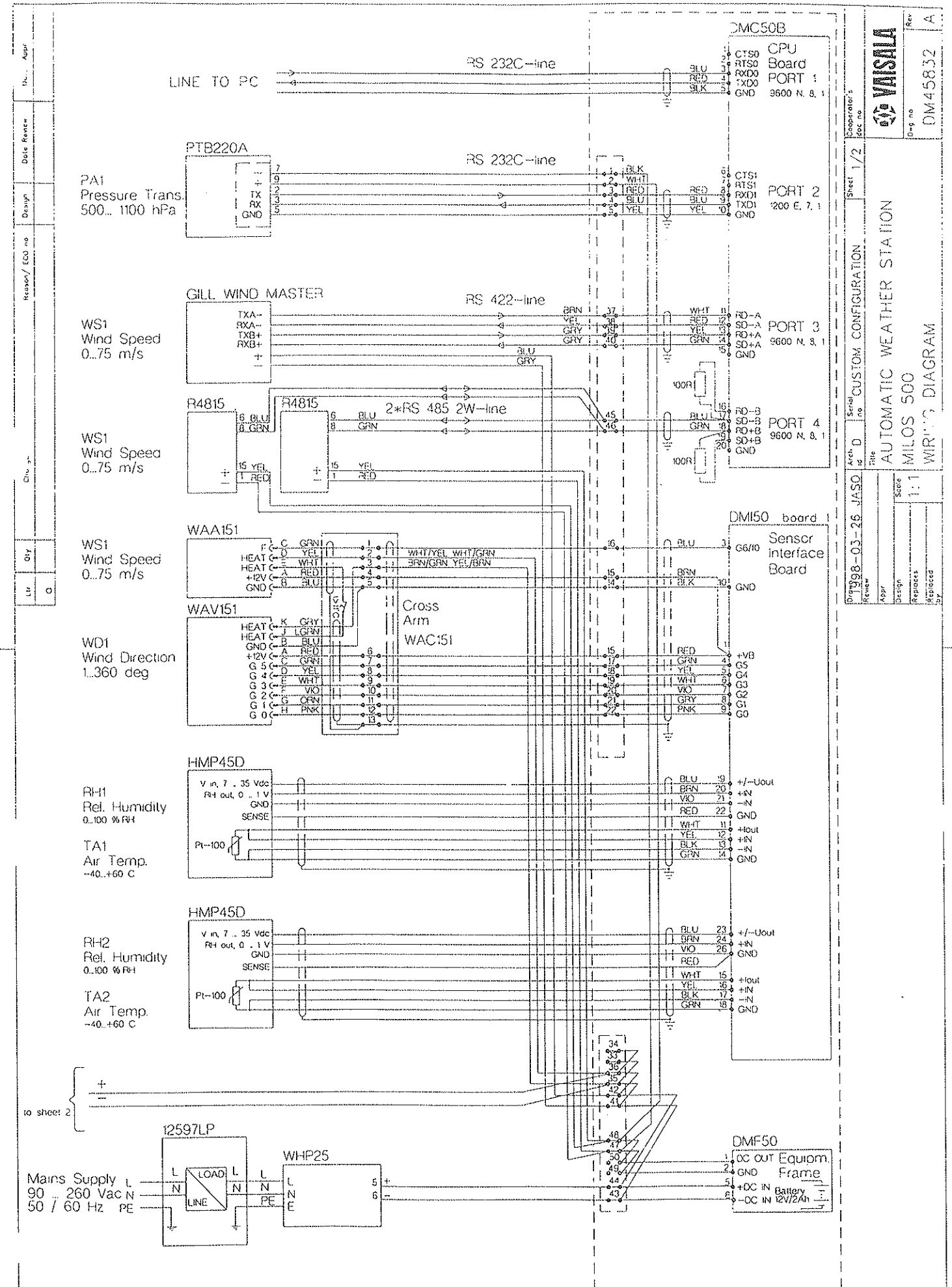
for VAISALA OY

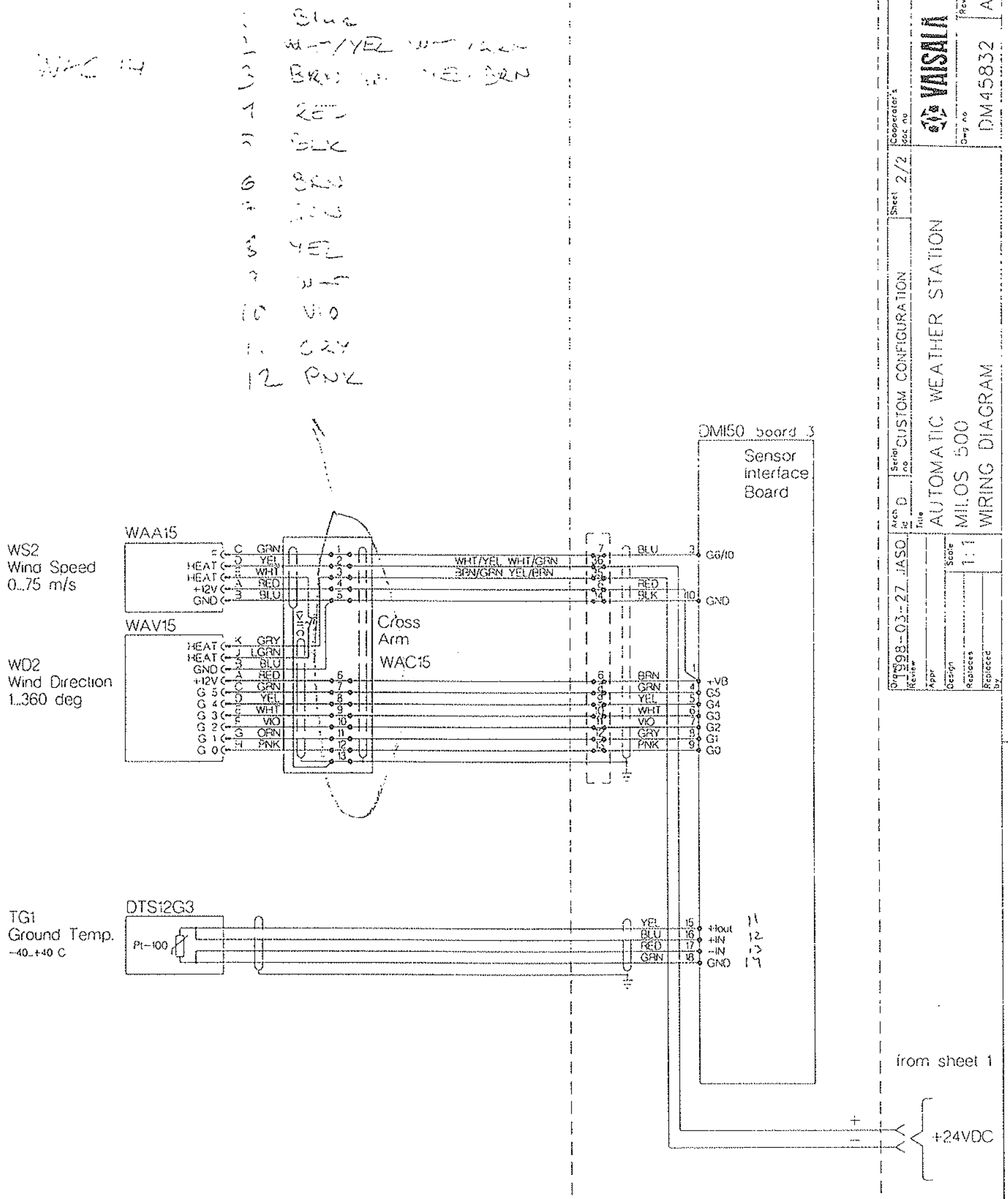
Jaana Sorvari Date 1998-03-25

DELIVERY DOCUMENTS

SECTION 2

Drawings


LINE TO PC
RS 232C-line
DMC50B
CPU Board
PORT 1
9600 N, 8, 1
PTB220A
PA1
Pressure Trans.
500... 1100 hPa
RS 232C-line
PORT 2
1200 E, 7, 1
GILL WIND MASTER
WS1
Wind Speed
0...75 m/s
RS 422-line
PORT 3
9600 N, 8, 1
R4815
2*RS 485 2W-line
PORT 4
9600 N, 8, 1
100R
WAA151
WS1
Wind Speed
0...75 m/s
WAV151
WD1
Wind Direction
1...360 deg
Cross Arm
WAC151
DMI50 board 1
Sensor interface Board
HMP45D
RH1
Rel. Humidity
0...100 %RH
TA1
Air Temp.
-40...+60 C
HMP45D
RH2
Rel. Humidity
0...100 %RH
TA2
Air Temp.
-40...+60 C
to sheet 2
12597LP
Mains Supply
90 ... 260 Vac
50 / 60 Hz
WHP25
DMF50
Equipm. Frame
Battery 12V/2Ah
VAISALA
AUTOMATIC WEATHER STATION
MILOS 500
WIRING DIAGRAM
CUSTOM CONFIGURATION
Dwg no DM45832
Rev A
Sheet 1/2
1998-03-26 JASO



Custom configuration: AUTOMATIC WEATHER STATION

MILOS 500

WIRING DIAGRAM

Sheet 2/2

VAISALA

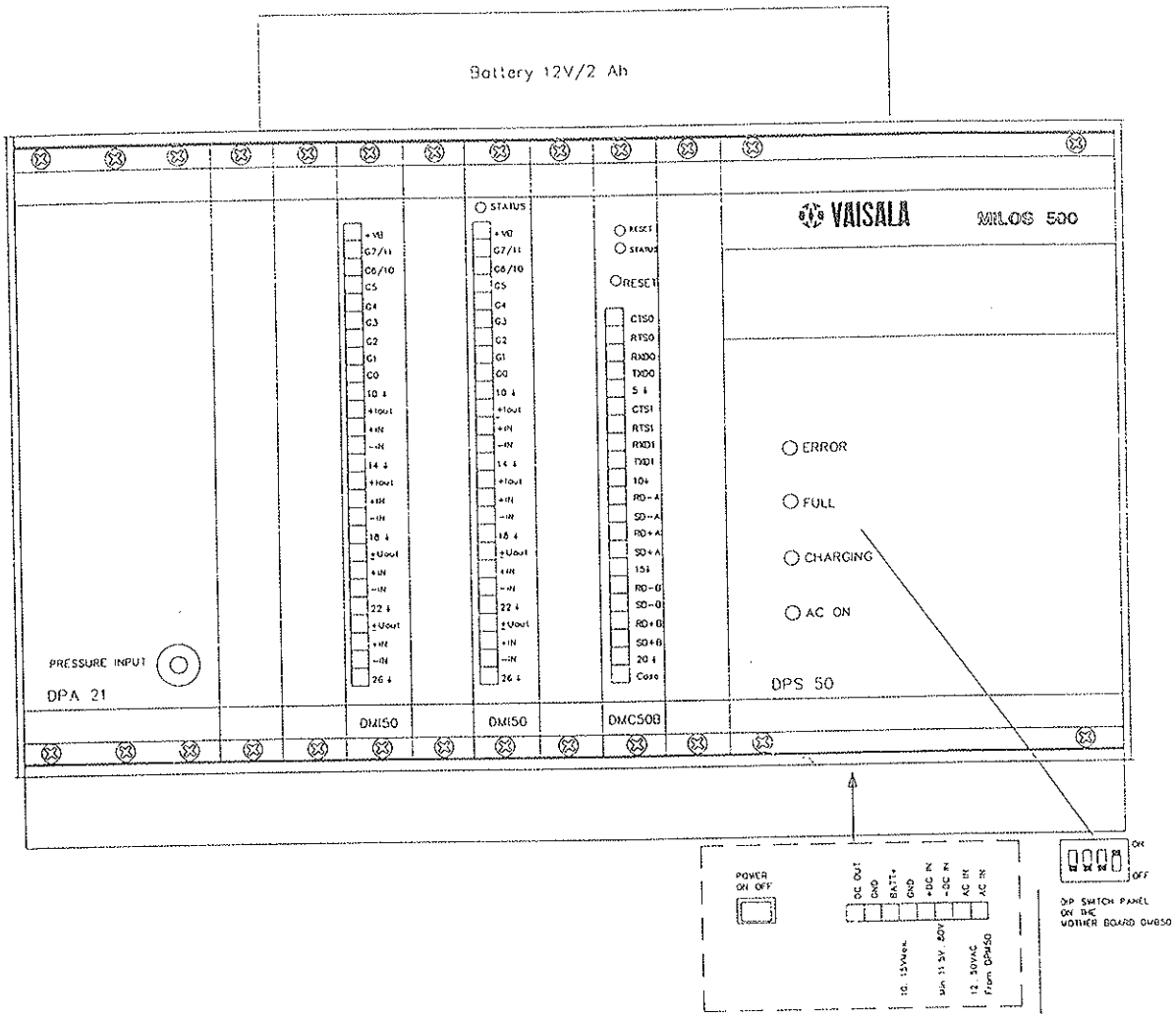
Dwg no: DM45832

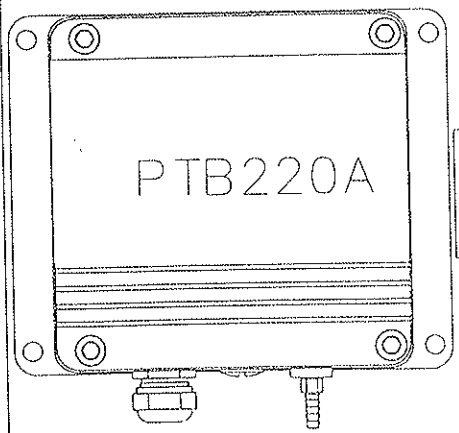
Rev: A

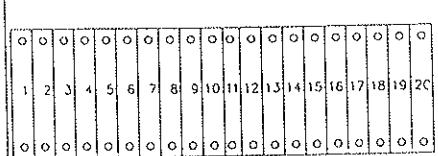
Orig: 1998-03-27 JASO

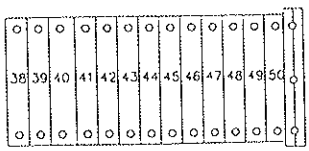
Scale: 1:1

Ltr	Qty	Change	Reason/ ECO no	Design	Date Review	Date Appr
a						







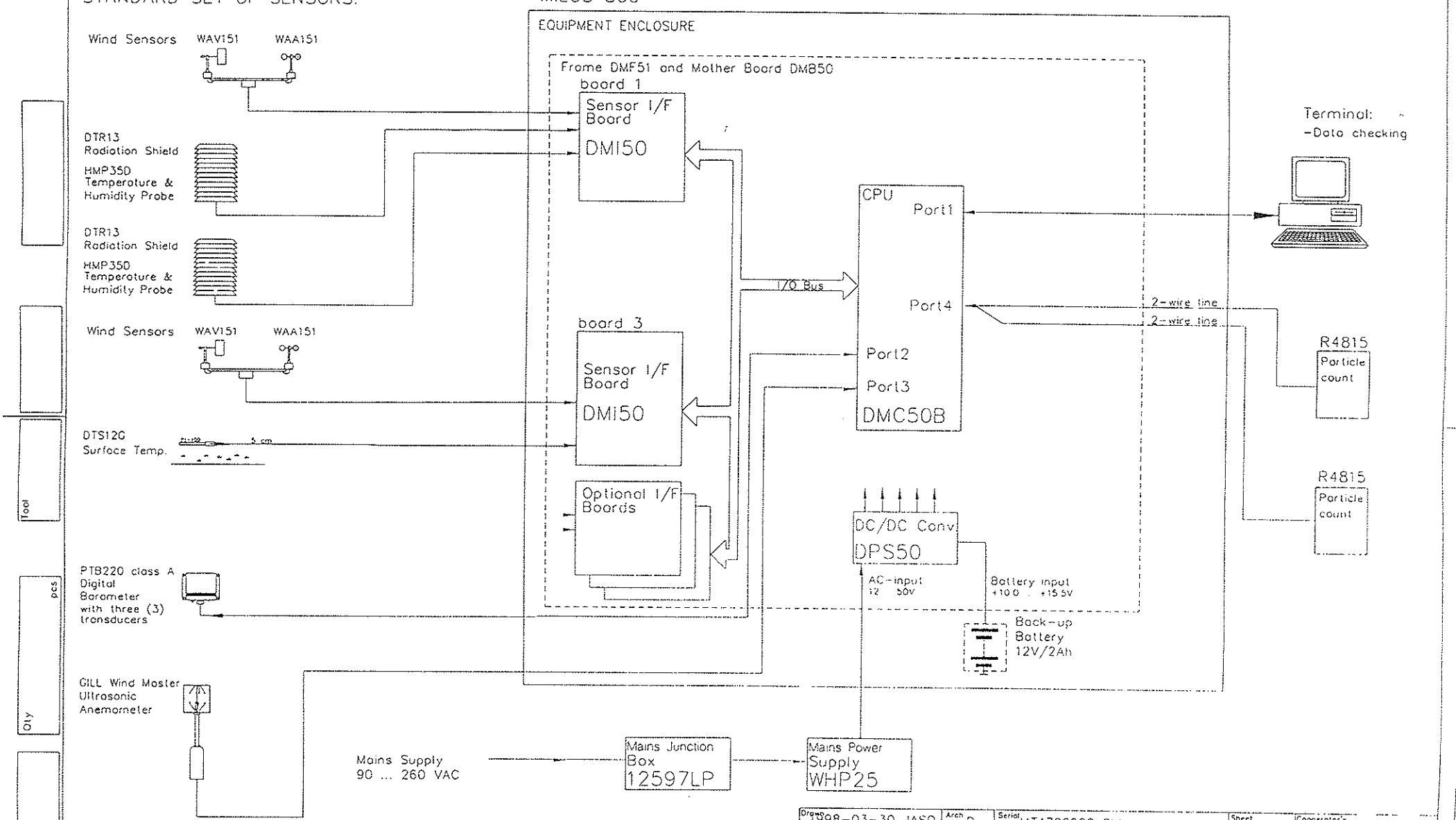


Drawn 1998-03-30 JASO	Archid D	Serial no MT 4700600 Chile	Sheet	Cooperator's doc no
Review	Title: AUTOMATIC WEATHER STATION MILOS 500 MEASURING UNIT LAYOUT			VAISALA
Appr				
Design	Scale 1:1			Dwg no DM45834 Rev A
Replaces				
Replaced by				

Work order | Qty pcs | Tool

Ltr	Qty	Change	Reason/ ECO no	Design	Date Review	Date Appr
A						

STANDARD SET OF SENSORS:



Tool

Qty pcs

Work order

Orgn 1998-03-30 JASO	Arch id D	Serial no MT4700600 Chile	Sheet
Review			
Appr			
Design	Scale 1:1		
Replaces			
Replaced by			

Title
AUTOMATIC WEATHER STATION
MILOS 500 BLOCK DIAGRAM
CUSTOM CONFIGURATION

Cooperator's doc no

VAISALA

Dwg no DM45833 | Rev A

DELIVERY DOCUMENTS

SECTION 3

Basic Configuration

- Serial Numbers
- Hardware Configuration
- Software Versions
- Software Configuration
- Sensor Configuration

Milos 500 Serial Numbers

DM50:	Type	Serial No.
MILOS 500 Frame	DMF50	S39413
MILOS 500 Mother Board	DMB51/50	S394
Central Processing Unit	DMC50B	S49525
DC/DC Converter Unit	DPS50	743187
OPTIONS:	**Type**	**Serial No.**
Sensor Interface Board	DMI50	752539 752538
Analog Interface Board	DMA50	
Display/Keyboard Unit	DDK50	
Memory Unit	DMM50	
Memory Unit 2Mb	DMM55B	
Memory Unit 128kb	DMM56B	
Modem Board	DMX50	
Modem Board	DMX55	
Pressure Transducer	DPA21	

Hardware Configuration

DIP Switch Settings:

DMC50B:

S2/1 = OFF Disconnect digital GND from CASE
S2/2 = ON Enable watchdog timer
S2/3 = OFF Disable down-load of operating system
S2/4 = 0N Enable SRAM battery back-up

DPS50:

S1/1 = OFF Software controlled [+Vb]
S1/2 = OFF Software controlled [charge current]
S1/3 = OFF Software controlled [+18V]
S1/4 = OFF Software controlled [-5V]

DMB51:

S1/1 = OFF Disconnect digital GND from CASE
S1/2 = OFF Disconnect digital GND from CASE
S1/3 = OFF Disconnect digital GND from CASE
S1/4 = ON Connect 3 V lithium battery

DMM55B: NOT INCLUDED !

S1/1 = OFF
S1/2 = ON Memory backupped by G1 [3V battery]
S1/3 = ON Memory backupped by G1 [3V battery]
S1/4 = OFF

Factory Setting of jumpers:

DMM50: NOT INCLUDED !

X2 1-2	SRAM / FLASH chip socket
X3 1-2	A18 / A19 to chip socket pin 1
X4 1-2	1 Mbit SRAM chip socket
X5 1-2	SRAM chip socket
X6 2-3	No batt.backup voltage chip socket
X7 1-2	BSEL 16 used
X8 1-2	Boot to chip

DMX55: NOT INCLUDED !

X1 2-3	No RTS relay control
X2 2-3	For factory test use only
X3 2-3	Relay operates as on/off hook (line relay), (when controller D6 is installed
X4 1-2	Modem power software controlled
X5 2-3	22 VAC level interrupt
X6/X7 2-3	Standard 2-wire connection
X8 2-3	Electrical holding coil off
X9 2-3	LOOP power supply 48 V
X10 2-3	Carrier out software controlled
X11 1-2	LOOP power software controlled

DPA21 Settings: NOT INCLUDED !

Baud rate	300
RAM select	5564
Device address	FDh [253d]
Output voltage	[-6...+10]V
EPROM select	27C256
DPA21	Slave

Software Versions

Service:[SERVICE.HEX]	V 2.56 19-12-1997
Application:[M500.HEX]	V 2.56 13-11-1997
Configuration files:	Custom Configuration

Update

Software Configuration

Serial ports:	Parameters:					
PORT1 RS232	9600 Baud	8 Data	No	Parity	1 Stop	Total, System, ESO messages
PORT2 RS232	1200 Baud	7 Data	Even	Parity	1 Stop	PTB220A data
PORT3 RS422	9600 Baud	8 Data	No	Parity	1 Stop	Gill Wind Master data
PORT4 RS485 2W	9600 Baud	8 Data	No	Parity	1 Stop	Both of particle counters data

Sensors:

WAA151	Wind speed
WAV151	Wind direction
HMP45D/1	Humidity1 / Temperature1
HMP45D/2	Humidity2 / Temperature2
DTS12G3	Surface / Ground Temperature
PTB220	Pressure Transmitter
Gill Wind Master	Wind speed and direction
2*R4815	Particle counters

ESO VLT project
VAISALA ref.: MT4700600

Milos 500 configuration definitions

Analog and Digital measurements:

DMI50 / 1			
Height 30 m			
Sensor	Parameter	Range	Interval
HMP45D	TA1	-50 ... + 50 C	10 s
	RH1	0 ... 100 %	10 s
	DP1 (calc.)		10 s
WAA151	WS1	0 ... 75 m/s	2 s
WAV151	WD1	0... 360 deg.	2 s
Height 2 m			
Sensor	Parameter	Range	Interval
HMP45D	TA2	-50 ... + 50 C	10 s
	RH2	0 ... 100 %	10 s
	DP2 (calc.)		10 s
DMI50 / 2			
Height 10 m			
Sensor	Parameter	Range	Interval
WAA151	WS2	0 ... 75 m/s	2 s
WAV151	WD2	0... 360 deg.	2 s
Height 2 m			
Sensor	Parameter	Range	Interval
PTB220A	PA1	600 ... 1100 hPa	10 s
	QNH1 (calc.)		10 s
	Ptrend 3h (calc.)		10 s
Height –1m			
Sensor	Parameter	Range	Interval
DTS12G3	TG1	-40 ... + 60 C	10 s

Serial lines:

PORT 1			
Parameters:	RS232	9600	8N1
Functions:	Data polling and/or automatic transmission and CLI mode		
Polling	Poll command	Message to be sent	
	MES1<CR>	Total message	
	MES2<CR>	System message	
	MES3<CR>	ESO message	
Automatic transmission	Command		
	M500>SET SEND MESX MM<CR>		
	Command defines the report MESX to be sent out with an interval of MM minutes.		
CLI mode	Command	Action	
	CLI<CR>	"Password"	
	SYSTEM<CR>	System mode (system spesific settings)	
	OPEN<CR>	Application mode (configuration spesific settings)	
PORT 2			
Parameters:	RS232	9600	8N1
Functions:	Maintenance line		
CLI mode	Command	Action	
	CLI<CR>	"Password"	
	SYSTEM<CR>	System mode (system spesific settings)	
	OPEN<CR>	Application mode (configuration spesific settings)	
PORT 3			
Parameters:	RS422	9600	8N1
Functions:	Data acquisition from Gill Ultrasonic Wind Master		
Height 20 m			
Sensor	Parameter	Range	Interval
WindMaster	GILL_U	-70...+70m/s	1 s
	GILL_V	-70...+70m/s	1 s
	GILL_W	-70...+70m/s	1 s

PORT 4			
Parameters:	RS485-2W	9600	8N1
Functions:	Data acquisition from MetOne Particle Counters		
Height 30 m			
Sensor	Parameter	Measurement	Interval
R4815	MET_CH1_CNT1	ppcf / 0.5 um	60 s
	MET_CH2_CNT1	ppcf / 5.0 um	60 s
Height 20 m			
Sensor	Parameter	Measurement	Interval
R4815	MET_CH1_CNT2	ppcf / 0.5 um	60 s
	MET_CH2_CNT2	ppcf / 5.0 um	60 s

Reports:

Possible to poll or set automatic output for the following reports:
TOTAL, SYSTEM, ESO

The TOTAL report includes the following data:

Instant, 1 hour average, maximum, minimum and std. deviation for the following items:	
30 m:	TA1, RH1, DP1
2 m:	TA2, RH2, DP2, PA1, QNH1
-1 m:	TG1
2 and 10 minutes average, maximum, minimum and std. deviation for the following items:	
30 m:	WS1, WD1
10 m:	WS2, WD2

The ESO report includes the following data:

Instant, 1 minute and 20 minutes average, maximum, minimum and std. deviation values for the following items:	
30 m:	TA1, RH1, DP1, WS1, WD1, MET_CH1_CNT1, MET_CH2_CNT1
20 m:	MET_CH1_CNT2, MET_CH2_CNT2, GILL_U, GILL_V, GILL_W
10 m:	WS2, WD2
2 m:	TA2, RH2, DP2, PA1, QNH1
-1 m:	TG1
3 hour pressure trens for the item:	
2 m:	PA1 (named as PTREND1) Note: the same value in every column

Database size setting:

Required size reservation 65kB

DELIVERY DOCUMENTS

SECTION 4

Factory-set Parameters

- Set of Commands

```
MILOS 500 SERVICE MODE

SHOW BOARDS
SHOW:
BOARD TABLE
Pos Type      Serial Ver Mdate       Cdate       Fail Fdate       FTime
P03 DMC50B    306310  F  27-02-1998 27-02-1998 0000 -- -- ----- -- -- --
P01 DPS50     743187  C  11-12-1997 11-12-1997 0000 -- -- ----- -- -- --
X01 DMI50     752539  E  20-01-1998 20-01-1998 0000 -- -- ----- -- -- --
X03 DMI50     752538  E  20-01-1998 20-01-1998 0000 -- -- ----- -- -- --


SERVICE>SHOW CHARGE
SHOW:
CHARGE PARAMETERS
Sealed lead-acid battery 3 Ah
  Battery checking interval 60 minutes
  5  attempts to charge before charge blocking
        Current  279 mA
        Voltage 14.71 V
  State of charging <OVER CHARGING>
  Battery available capacity  85 %
  CPU board temperature  27 degrees C


SERVICE>TASK SHOW
APPLICATION TASKS:

No Tag     State     No Tag     State     No Tag     State     No Tag     State
 1 KBDP    Enabled    2 LCDP    Enabled    3 BATP    Enabled    4 COM5    Enabled
 5 COM6    Enabled    6 COM7    Enabled    7 COM8    Enabled    8 COM1    Enabled
 9 COM2    Enabled   10 COM3    Enabled   11 COM4    Enabled   12 OPT1    Enabled
13 OPT2    Enabled   14 OPT3    Enabled   15 OPT4    Enabled   16 OPT5    Enabled
17 OPT6    Enabled   18 OPT7    Enabled   19 OPT8    Enabled   20 STAT    Enabled
21 CALC    Enabled   22 FMGR    Enabled   23 REP     Enabled   24 CLI     Enabled
25 WIND    Enabled   26 AMXHR   Enabled   27 MOBI    Enabled   28 PBUS    Enabled
29 TIMER   Enabled   30 LOG     Enabled   31 INTHR   Enabled


SERVICE>SHOW DATABASE_S
SHOW:
VRX DATABASE SIZE = 51200 BYTES


SERVICE>SHOW EV_Q_LEN
SHOW:
VRX TIMED EVENT QUEUE LENGTH = 50 EVENTS


SERVICE>SHOW CLIPORT
SHOW:
COM1, Command line interface enabled
COM2, Command line interface disabled
COM3, Command line interface disabled
COM4, Command line interface disabled


SERVICE>SHOW ACT_TIMEOUT
SHOW:
NO ACTIVITY TIMEOUT 10 MINUTES


SERVICE>
```

Contents:

Service Commands:	Description:
SHOW BOARDS	- displays units type, serial numbers, revisions, manufacturing and calibration dates
SHOW CHARGE	- displays charge parameters and state
TASK SHOW	- displays application tasks
SHOW DATABASE_S	- displays the amount of memory allocated for the VRX database
SET CLIPORT 1...4	- sets cliport enabled/disabled
SHOW ACT_TIMEOUT	- displays no activity timeout in minutes

Application Commands:

Examples of messages and
CLI commands

Check: Jorma Sorsa Date 1998-03-25

DELIVERY DOCUMENTS

SECTION 5

Calibration Parameters

VAISALA

CALIBRATION CERTIFICATE

Instrument	Humidity and temperature probe
Model	HMP45D
Serial number	T1030019
Manufacturer	Vaisala Oy
Date	1998-03-04

The humidity and temperature outputs of the device above were compared to two factory working standards at values given below. The comparisons were made at room temperature at Vaisala factory. All results are traceable in terms of dewpoint to NPL (National Physical Laboratory, United Kingdom) and NIST (National Institute of Standards and Technology, USA) and in terms of temperature to CMA (Finnish National Laboratory for Temperature).

Measurement results

Humidity	reference humidity	observed output
	73.2 %RH	73.2 %RH
	44.3 %RH	43.9 %RH
	0.4 %RH	1.3 %RH
Temperature	reference temperature	observed output
	22.61 °C	22.60 °C

For Vaisala Oy

Technician

VAISALA

CALIBRATION CERTIFICATE

Instrument	Humidity and temperature probe
Model	HMP45D
Serial number	T1030020
Manufacturer	Vaisala Oy
Date	1998-03-04

The humidity and temperature outputs of the device above were compared to two factory working standards at values given below. The comparisons were made at room temperature at Vaisala factory. All results are traceable in terms of dewpoint to NPL (National Physical Laboratory, United Kingdom) and NIST (National Institute of Standards and Technology, USA) and in terms of temperature to CMA (Finnish National Laboratory for Temperature).

Measurement results

Humidity	reference humidity	observed output
	73.5 %RH	73.6 %RH
	45.2 %RH	44.9 %RH
	0.4 %RH	1.3 %RH
Temperature	reference temperature	observed output
	22.61 °C	22.59 °C

For Vaisala Oy

Technician

VAISALA

CALIBRATION CERTIFICATE

Instrument	Digital barometer
Model	PTB220 Class A
Serial number	T0330002
Manufacturer	Vaisala Oy, Finland
Calibration date	1998-01-13

The barometric pressure transmitter PTB220 has been compared at room temperature with Ruska 2465 pressure balance working standard at the Vaisala Measurement Standards Laboratory. The Ruska 2465 pressure balance has been calibrated on 21th of November 1997 at Vaisala Measurement Standards Laboratory (Certificate no. E11200). All results are traceable to NIST.

Measurement results Reference pressure [hPa]	Observed output [hPa]	Correction [hPa]
499.54	499.56	-0.02
599.02	599.03	-0.01
698.51	698.51	0.00
800.92	800.92	0.00
900.39	900.38	0.01
947.21	947.19	0.02
999.87	999.85	0.02
1099.35	1099.33	0.02

To obtain the true pressure, add the correction to the barometer reading. Interpolated corrections may be used at intermediate readings of the scale of the barometer.

For Vaisala Oy

Technician

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>V
VAISALA DIGITAL BAROMETER
PTB 220
500.00 to 1100.00 hPa
>?

Software version	PTB220 / 3.03
Serial number	T0330002
Configuration	1
Linear adjustments	OFF
Multipoint adjustments	ON
Calibration date	1998-01-13
Baud Parity Data Stop Dpx	9600 E 7 1 F
Echo	ON
Sending mode	STOP
Measurement mode	NORMAL
P 'e mode	OFF SLOW LOW 0.0
Address	0
Output interval	0 s
Output format	4.2 P " " UUUU #r #n
Error output format	
SCOM format	
Pressure unit	hPa
Temperature unit	'C
Averaging time	1.0 s

>PSTAB
Stab. level : 0.50 hPa
>PLARM
Hi alarm : 1100.00 hPa
Lo alarm : 500.00 hPa
>SEND
1^^9.09 hPa
>LIC
:00 Nothing special to report
>CORR
inear adjustments OFF
ultipoint adjustments ON

Reading	Correction
499.570	-0.010
599.040	-0.010
698.500	0.010
800.870	0.050
900.340	0.060
947.180	0.040
999.860	0.020
1099.290	0.060

alibration date 1998-01-13

VAISALA

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Germany

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Chile

Country of origin
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Country of destination
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Carriage by/via From/via

Terms of delivery
CIP SANTIAGO(INCOTERMS 90)

Case	Specification	Gross weight, kg	Net weight, kg	Dimensions cm/total m
1/3	PLYW.	40.0	24.0	80 * 60 * 52 cm
2/3	PLYW.	60.0	37.0	90 * 70 * 50 cm
3/3	PLYW.	20.0	6.0	216 * 22 * 22 cm
	Total	120.0kg	67.0kg	0.669m^3

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Telefax (+358 9) 894 9227

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Postipankki Ltd. Helsinki

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Santiago 9
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Carriage by/via

Terms of delivery
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The whole of the supplies detailed hereon, unless otherwise stated, are made of the best materials and conform in all respects to the specifications, drawings and contract/order relative thereto. All items have been subject to Vaisala Oy's quality system requirements and have successfully passed the applicable inspection, test and calibration procedures. The quality system of Vaisala Oy is certified to meet the requirements of ISO 9001.
Hannu Patrikainen Quality Director

Pos	Description	Unit	Ordered	Delivered	Case
	Order 4700600/Your Order 52303/VPO/97/9160STJ				
5	WAA151 Anemometer	EA	1	1	1
10	WAV151 Wind Vane	EA	1	1	1
15	WAC151 Cross Arm for Wind Sensors (w. Thermostat)	EA	1	1	2
20	ZZ45048S Cable 35 meters	EA	1	1	2
25	INSTALLATION TUBE Installation tube	EA	1	1	3
30	HMP45D Humidity And Temperature Probe	EA	1	1	2
35	DTR13 Radiation Shield DT2353	EA	1	1	1
40	CONNECTION CABLE connection cable to Milos 500 (signal & power) Length: 35 meters	ea	1	1	2

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Pos	Description	Unit	Ordered	Delivered	Case
45	CABLE CONNECTION Connection Cable for HMP45D	ea	1	1	2
50	WIND MASTER Ultrasonic Anemometer	ea	1	1	2
55	WIND SENSOR CABLE Cable for Windmaster	m	25	25	2
60	CONNECTOR TO Connector to Wind master	ea	1	1	3
65	INSTALLATION TUBE	ea	1	1	3
70	ZZ45048S Wind Sensor Cable Length: 15 meters	ea	1	1	2
75	INSTALLATION TUBE	ea	1	1	3
80	HMP45D Humidity And Temperature Probe	EA	1	1	2
85	DTR13 Radiation Shield DT2353	EA	1	1	1
90	PTB220 Pressure Transmitter	EA	1	1	2
95	SERIAL & POWER Cable for PTB220	ea	1	1	2
100	DTS12G3 Soil/Grass Temperature Probe, 30 m cable	EA	1	1	2
105	DM50 Automatic Weather Station	EA	1	1	2
106	4592 Battery NP2.1-12	EA	1	1	2
108	16069DM BATTERY MOUNTING KIT 16069 DM	EA	1	1	2
110	SYSCONFIG MILOS500 Basic System Configuration	EA	1	1	2
115	DMI50 Sensor Interface Board	EA	2	2	2
120	12597LP Mains Junction Box	EA	1	1	1
125	WHP25 Outdoor Mains Power Supply (e.g. for WAA251)	EA	1	1	1
130	BOX51S Enclosure (480x480x150 Stainless)	EA	1	1	2
135	30714BO Fixture for Rad. Shield BO3464	EA	1	1	2

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Pos	Description	Unit	Ordered	Delivered	Case
140	30709BO Radiation Shield BOX51S BO2465	EA	1	1	2
145	PARTICLE COUNTER Particle Counter	EA	2	2	1
150	ONE POWER SUPPLY One Power Supply for two sensors NRENG, Nonrecurring EngRg Fee	ea	1	1	2
155	MODIFICATION OF Modification of R4815 Sensor in NEMA enclosure, MIL connector to outside, bulkhead fitting for sample inlet	EA	2	2	2
160	Serial cables 35m	ea	1	1	2
165	serial cables 25m	ea	1	1	2

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