Installation &

Commissioning Report

Client:

XXXX

Site:

XXXX

City: XXXX

Provinces: XXXX

Country: XXXX

Ge:Net GmbH confirms that all facts in this installation report are written to the best of one's knowledge.

XXXXXXX Date	xxxxxxxxx Author
XXXXXXX Date	xxxxxxxxx Project Manager

Table of Content

1 Sensors

The provided raw data files already consider all slope and offset parameters.

Project	*XXXX*		Installation Date	*xx.xx.xxxx*
Localization	*xxxxx* - City *xxxxx- xxxxxx*			
Site Elevation	172 m			
Nominal Tower Height	85 m			
Magnetic Declination[1]	4° 95' W		Time Zone	UTC +0
WGS84: Longitude	E xx°xx´xx.x"		Latitude N	xx°xx´xx.x"
WGS84: Easting	35 T *xxxxxxx*		Northing	4.*xxxxxxx*
Logger Model	Campbell CR850		Logger Serial No.	5892
Data Sampling	0.5 Hz		Recording Interval	10 min
Sensor				
V1	Type	Thies First Class	Height	85,80 m
	Model	4.3350.00.000	Serial No.	1108382
	Slope	0,04816	Offset	0,211
	Calib. No.	08_4722	Calib. Date	14.11.2008
	Distance[2]	Top	Direction	Top
V2	Type	Thies First Class	Height	83,70 m
	Model	4.3350.00.000	Serial No.	1108394
	Slope	0,04800	Offset	0,240
	Calib. No.	08_4723	Calib. Date	14.11.2008
	Distance[2]	1.45m	Direction	270°
V3	Type	Thies First Class	Height	61,30 m
	Model	4.3350.00.000	Serial No.	1108387
	Slope	0,04798	Offset	0,243
	Calib. No.	08_4724	Calib. Date	14.11.2008
	Distance[2]	1.45m	Direction	270°
V4	Type	Thies First Class	Height	39,90 m
	Model	4.3350.00.000	Serial No.	1108386
	Slope	0,04813	Offset	0,221
	Calib. No.	08_4725	Calib. Date	14.11.2008
	Distance[2]	1.45m	Direction	270°
D1	Type	Thies compact	Height	83,60 m
	Model	4.3129.10.712	Serial No.	1208099
	Slope	360	Offset[3]	270°
	Distance[2]	1.45m	Direction	90°

[1] All stated angles **does not** consider the Magnetic Declination.
[2]The distance is measured from the centre of the tower

D2	Type	Thies compact	Height	61,20 m
	Model	4.3129.10.712	Serial No.	0209155
	Slope	360	Offset[3]	270°
	Distance[2]	1.45m	Direction	90°
T1	Type	Thies Hygro-Thermo Transmitter	Height	6,50m
	Model	1.1005.54.173	Serial No.	72730
	Slope	20	Offset	-30
H1	Type	Thies Hygro–Thermo Transmitter	Height	6,50m
	Model	1.1005.54.173	Serial No.	72730
	Slope	20	Offset	-30
P1	Type	P-GE 8/11 economy	Height	3,40m
	Calib. Date	11.09.2008	Serial No.	08083-1087
	Slope	75.1	Offset	781.2

2 Data Format

1	2	3	4	5	6	7	8
Time & Date	**Num**	**V1**	**V1sig**	**V1min**	**V1max**	**V2**	**V2sig**
2009-08-11 18:40:00	0	6.946	1.109	0	8.52	7.004	1.146
2009-08-11 18:50:00	1	6.578	1.18	4.332	8.67	6.593	1.218
2009-08-11 19:00:00	2	7.054	0.621	5.554	8.86	7.067	0.632
2009-08-11 19:10:00	3	6.563	0.623	4.835	7.998	6.591	0.647
2009-08-11 19:20:00	4	6.009	0.482	4.811	7.183	6.013	0.511
2009-08-11 19:30:00	5	6.242	0.42	5.339	7.207	6.257	0.434
2009-08-11 19:40:00	6	6.24	0.315	5.315	7.087	6.248	0.298
2009-08-11 19:50:00	7	6.9	0.407	5.578	7.806	6.908	0.419
2009-08-11 20:00:00	8	6.885	0.314	6.033	7.71	6.888	0.315
2009-08-11 20:10:00	9	6.812	0.314	5.913	7.518	6.817	0.318
2009-08-11 20:20:00	10	6.975	0.324	6.057	7.806	6.974	0.331
2009-08-11 20:30:00	11	7.265	0.302	6.416	8.19	7.271	0.319
2009-08-11 20:40:00	12	7.308	0.323	6.297	8.02	7.3	0.31
2009-08-11 20:50:00	13	7.473	0.301	6.632	8.17	7.467	0.308
2009-08-11 21:00:00	14	6.909	0.379	5.794	7.998	6.924	0.392
2009-08-11 21:10:00	15	7.359	0.357	6.369	8.14	7.342	0.389

9	10	11	12	13	14	15	16	17	18
V2min	**V2max**	**V3**	**V3sig**	**V3min**	**V3max**	**V4**	**V4sig**	**V4min**	**V4max**
0	8.76	6.732	1.055	0	8.46	6.409	1.028	0	8.38
4.385	8.66	6.109	1.194	3.562	8.55	5.604	0.961	3.453	8.17
5.707	9.03	6.546	0.667	4.737	8.22	5.786	0.711	3.621	7.331
5.01	7.895	5.924	0.709	3.993	7.544	5.19	0.856	3.094	7.666
4.769	7.294	5.666	0.478	4.401	7.112	4.979	0.46	3.645	6.086
5.226	7.15	5.742	0.342	4.713	6.656	5.078	0.381	3.908	6.254
5.443	6.958	5.702	0.298	5.049	6.416	5.032	0.367	4.052	5.967
5.707	7.823	6.064	0.441	5.049	7.28	5.069	0.39	4.004	6.182
5.9	7.727	6.062	0.323	5.313	7.016	5.035	0.43	3.669	6.062
5.779	7.559	5.935	0.37	4.929	6.968	5.05	0.374	3.812	6.014
6.02	7.847	5.92	0.415	4.953	7.04	4.749	0.349	3.956	5.655
6.453	8.23	6.192	0.323	4.905	6.992	5.088	0.359	4.195	6.038
6.332	7.991	6.232	0.403	5.049	7.352	5.087	0.404	4.171	6.35
6.525	8.14	6.397	0.41	5.169	7.52	5.141	0.395	3.98	6.23
5.876	8.04	5.816	0.39	4.713	6.752	4.794	0.268	4.171	5.608
6.212	8.21	6.164	0.345	5.409	7.232	4.954	0.347	4.148	5.823

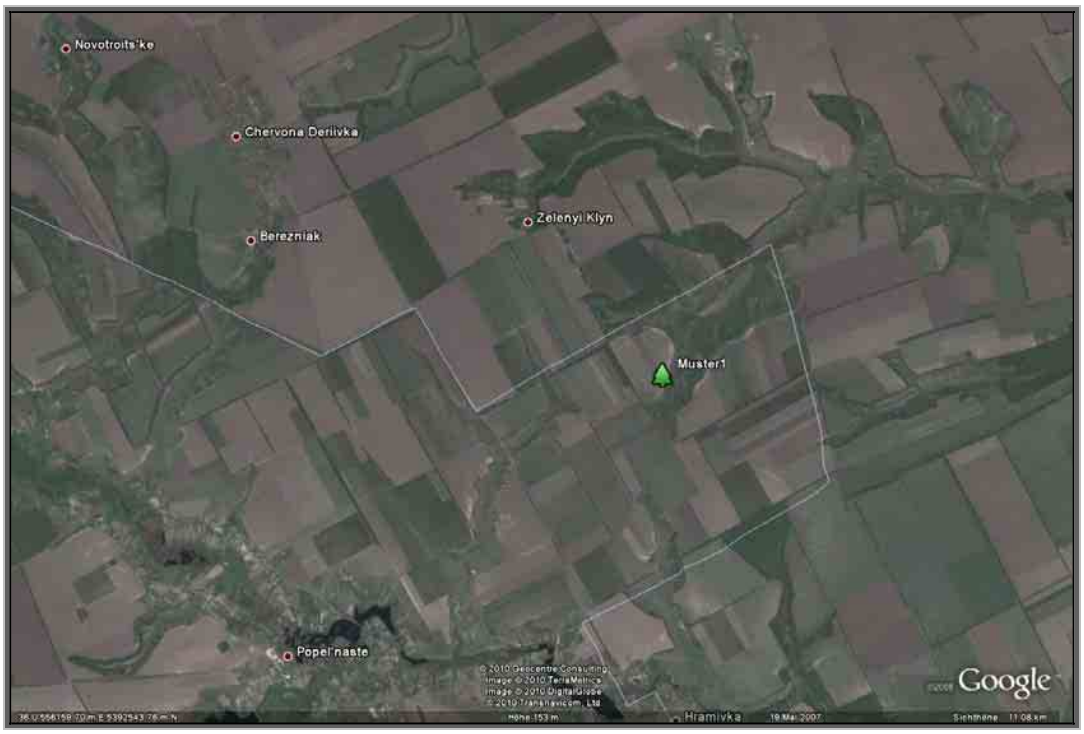
19	20	21	22	23	24	25	26
D1	**D2**	**T1**	**P1**	**Roh**	**Ubatt**	**PTemp**	**H1**
7.364	129.1	20.86	985	1.166	12.92	23.74	49.25
5.433	130.1	20.65	985	1.167	12.92	23.42	49.78
4.712	129.2	20.35	985	1.168	12.9	22.94	50.53
4.843	136	20.01	985	1.17	12.89	22.39	52.04
4.2	135.6	19.72	985	1.171	12.88	21.86	53.22
3.096	138.2	19.41	985	1.172	12.87	21.38	54.55
3.023	136.1	19.06	984	1.173	12.87	20.89	56.02
2.719	137.7	18.79	984	1.174	12.87	20.44	57.3
2.808	141	18.56	985	1.175	12.86	20.01	58.44
2.184	145	18.29	985	1.176	12.86	19.62	59.5
2.594	144.7	18.16	985	1.177	12.85	19.26	60.03
2.504	143.2	17.98	985	1.178	12.85	18.92	60.72
2.297	143.9	17.81	985	1.178	12.84	18.6	61.25
2.418	145.2	17.62	985	1.179	12.84	18.31	61.95
2.525	147.3	17.49	985	1.18	12.83	18.05	62.39
3.125	145.1	17.5	985	1.18	12.83	17.82	62.36

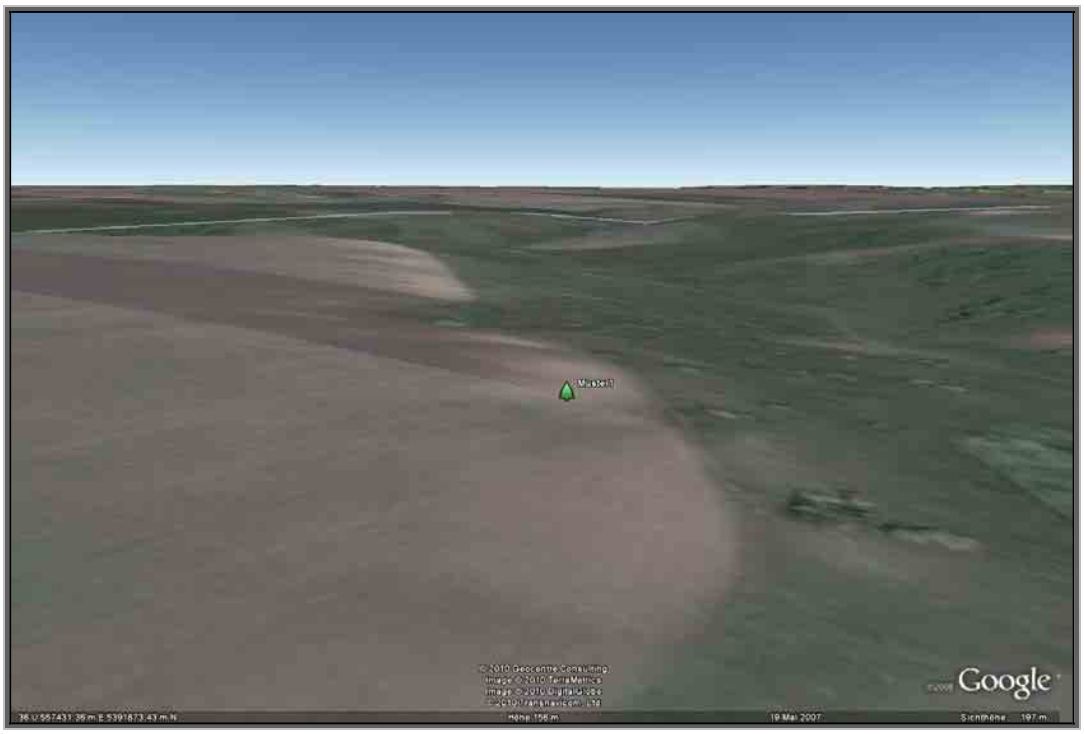
2.1 Calibration Settings

```
' Name of the Site
StationName (XX_X)

'#################################################################################
' Calibration Data of used Sensors
'#################################################################################

Const v1_faktor = 0.04816          ' SN: xxxxxxx       Slope:  [1/m/s]
Const v1_offset = 0.211            '                    Offset: [m/s]

Const v2_faktor = 0.04800          ' SN: xxxxxxx
Const v2_offset = 0.240

Const v3_faktor = 0.04798          ' SN: xxxxxxx
Const v3_offset = 0.243            '

Const v4_faktor = 0.04813          ' SN: xxxxxxx
Const v4_offset = 0.221            '

Const d1_offset = 313              'value between 0 -359, if Wind Vane 1 is installed not direct to north
Const d1_faktor = 360

Const d2_offset = 313              'value between 0 -359, if Wind Vane 2 is installed not direct to north
Const d2_faktor = 360

Const t1_faktor = 20               ' (t1_max - t1_min) / (V_max - V_min)
Const t1_offset = -30              ' t1_min

Const p1_faktor = 75.1             ' (p1_max - p1_min) / (V_max - V_min))
Const p1_offset = 781.2            ' p1_min

Const h1_factor = 19.6             ' (h1_max - h1_min) / (V_max - V_min) = (100 - 0) / (5-0)
Const h1_offset = 0                ' h1_min
```

3 Overview of the Site

3.1 Arial view





3.2 Tower Configuration 85m

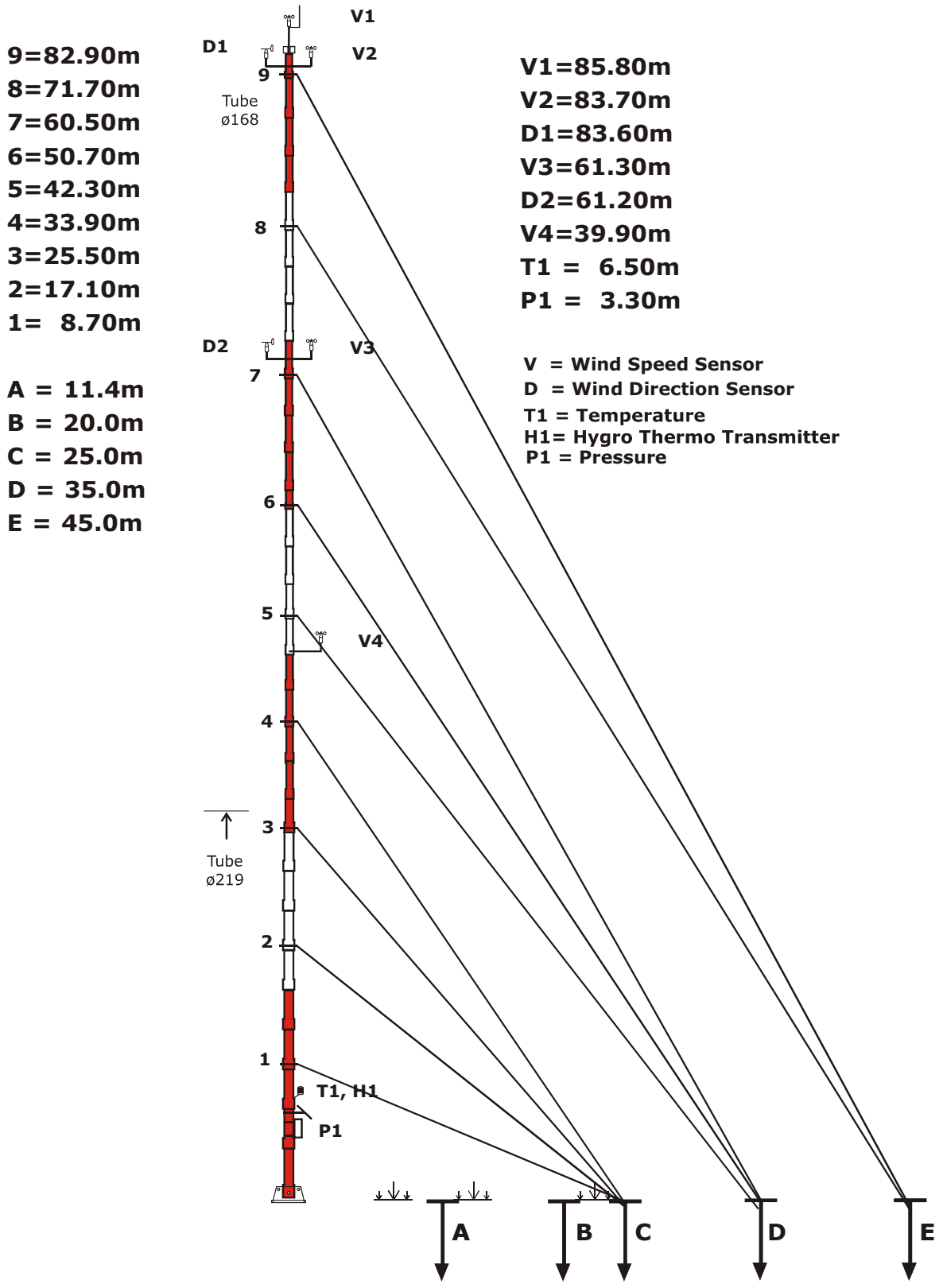


Figure 1: Configuration of Tower and Sensors.

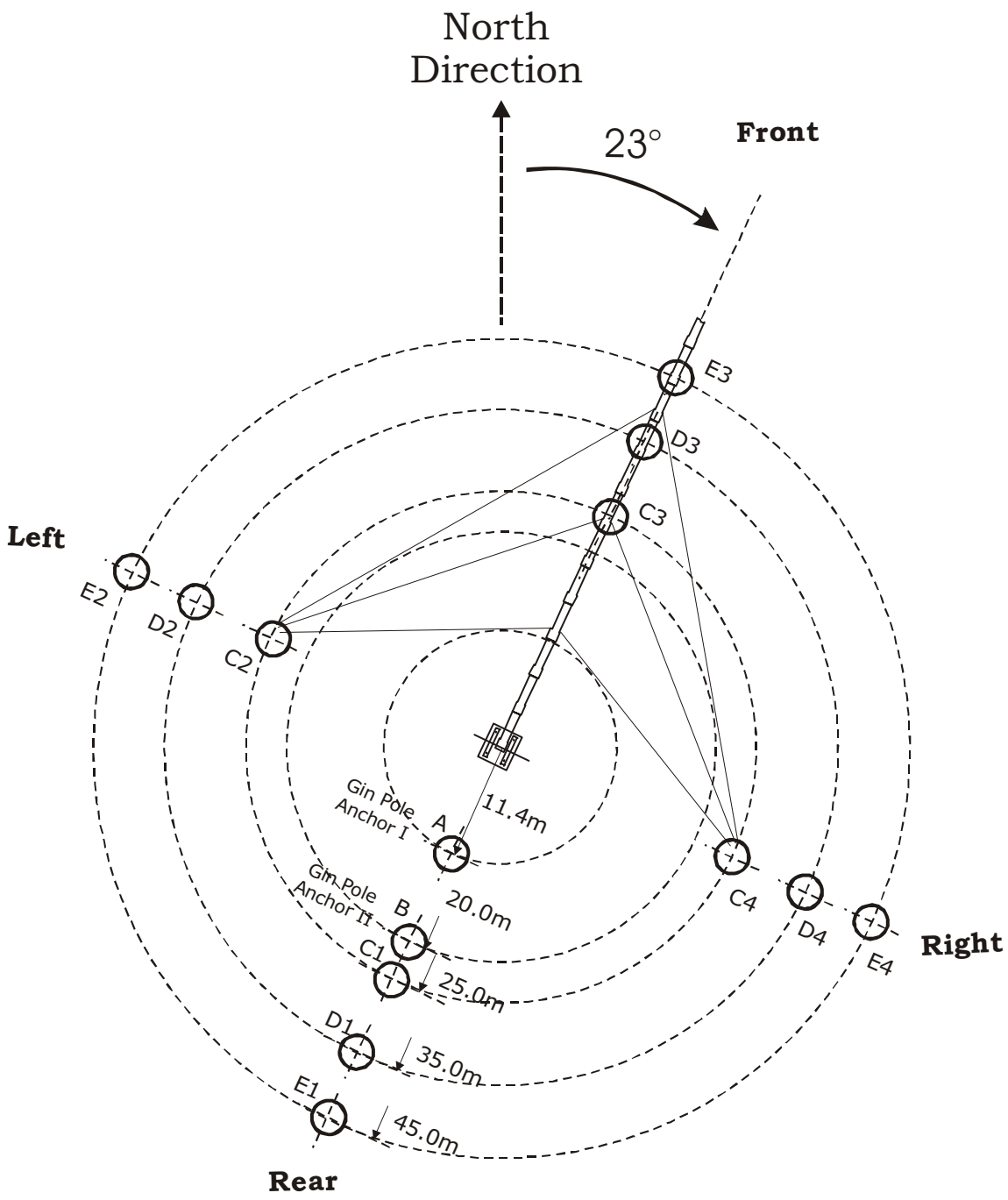


Figure 2: Plan of anchor configuration.

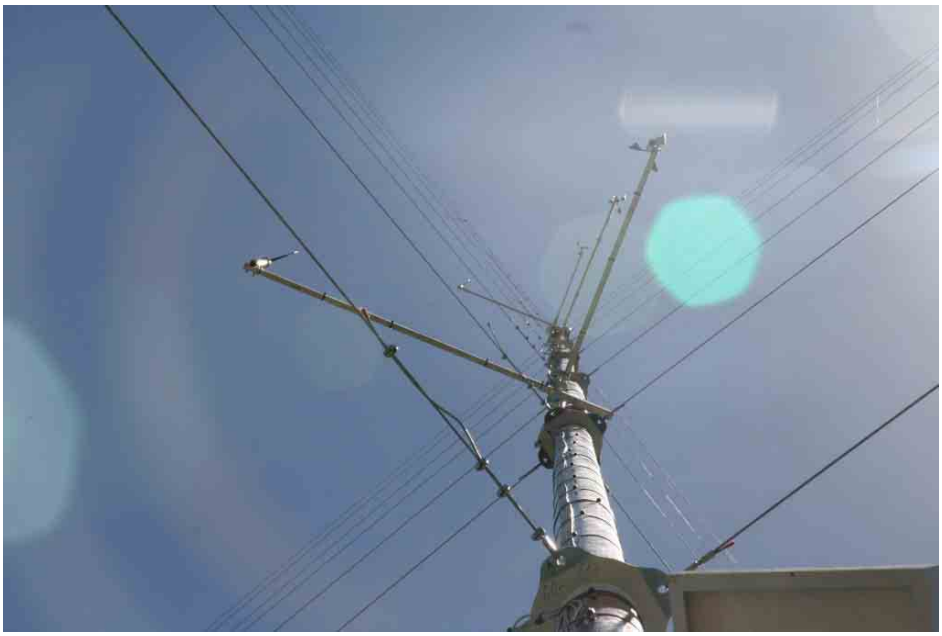


Figure 3: View bottom of tower to top of tower.

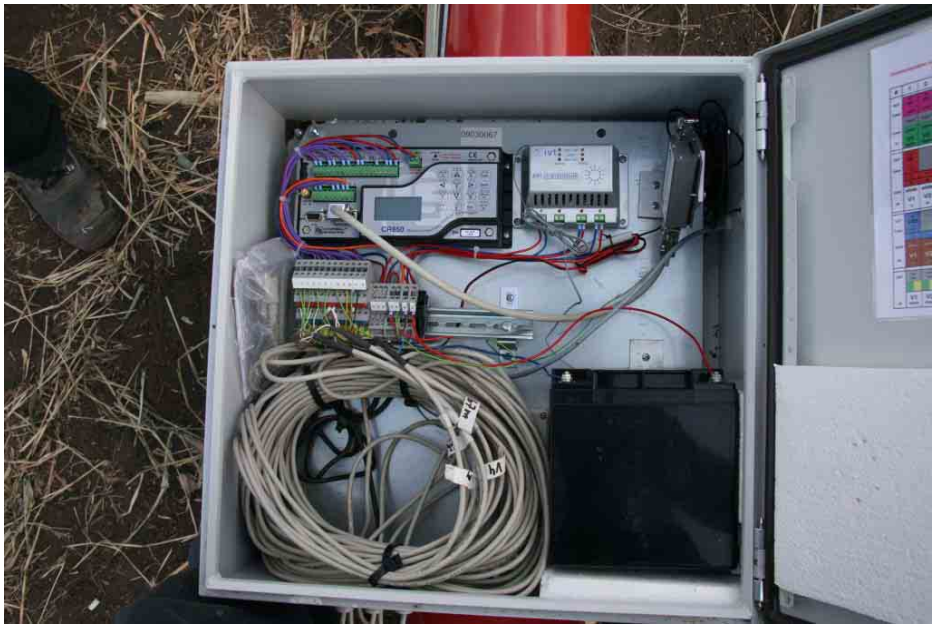


Figure 4: Instrument box with battery, data logger, charge regulator, barometric sensor and satellite modem.

3.3 Side Booms Configuration

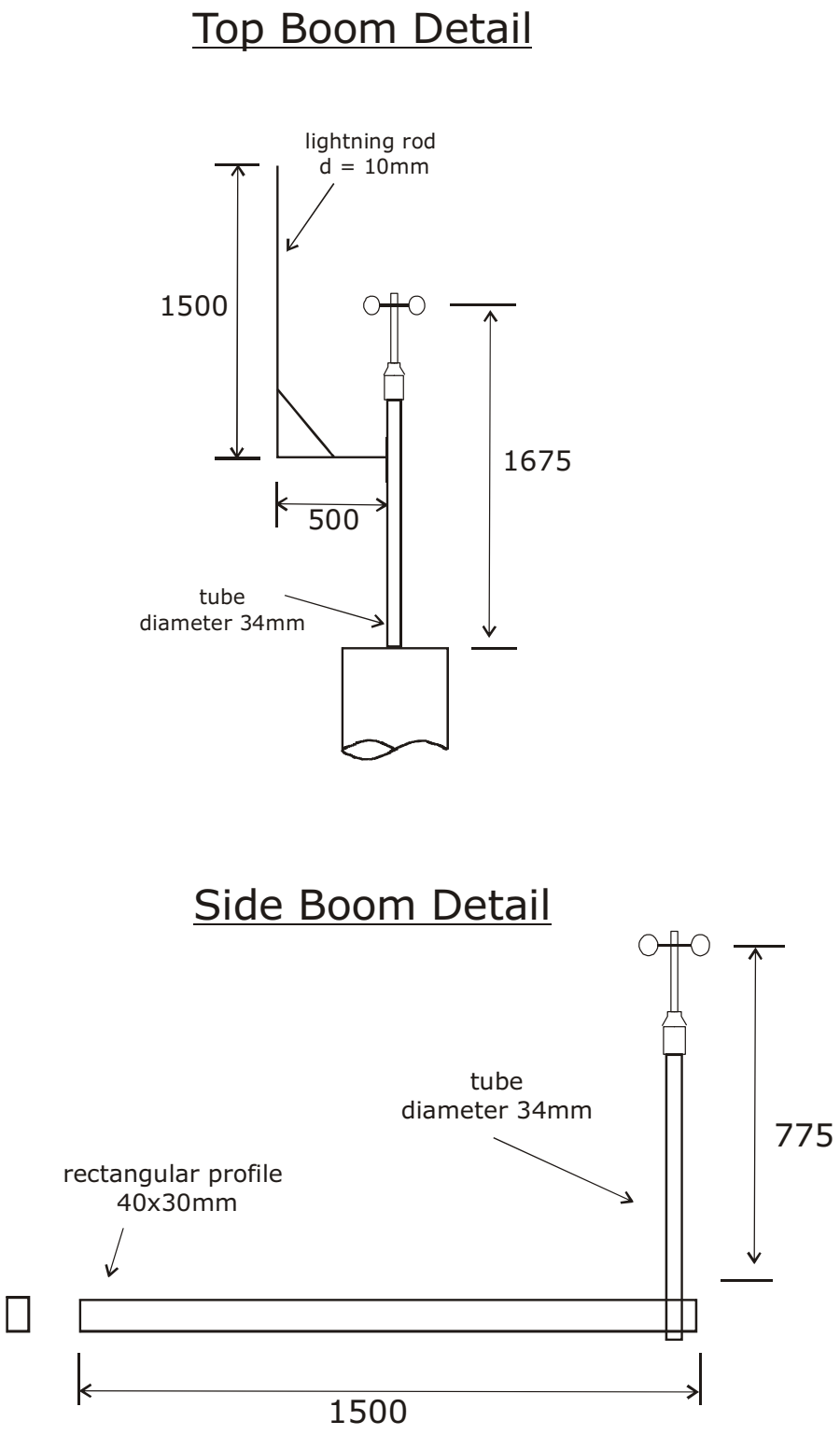
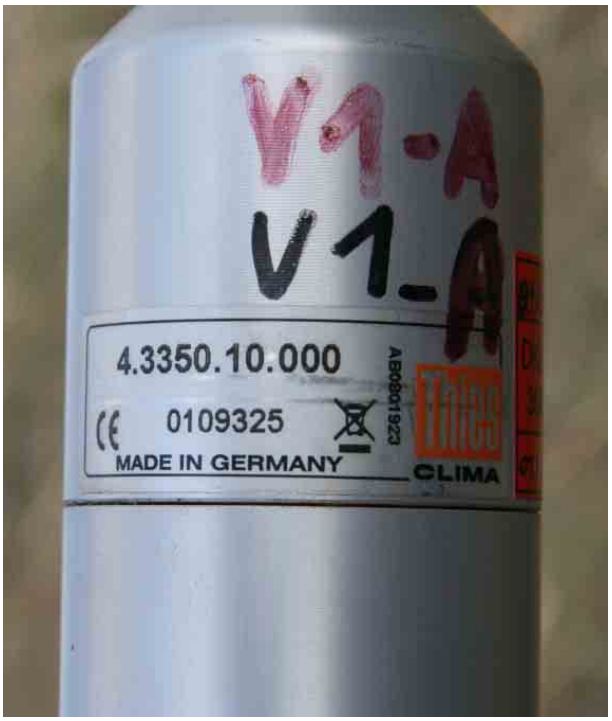


Figure 5: Details of top and side boom.

3.4 Side Booms

Figure 6: Installation of Wind Speed Sensor V1 (85,80m), V2 (83,70m), Aviation light (83,80m) and Wind Direction Sensor D1 (83,60m).




V2-A
V2_A
4.3350.10.000
0109338
MADE IN GERMANY
Thies
CLIMA


A D1
4.3129.10.712
1208084
MADE IN GERMANY
Thies
CLIMA

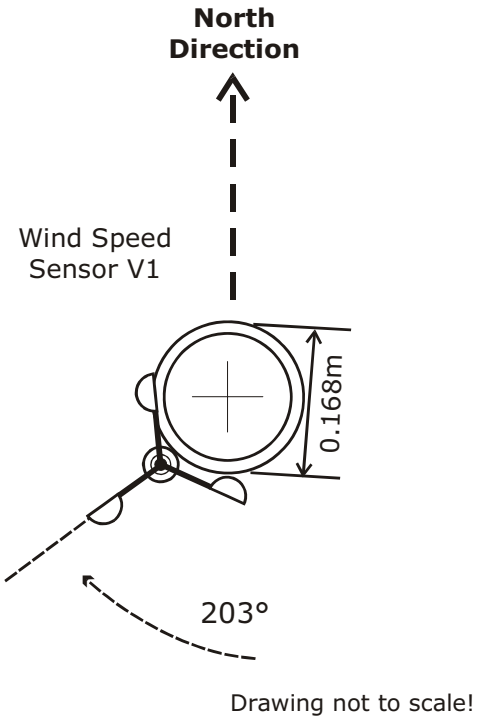


Figure 7: Tower configuration Sensor V1.

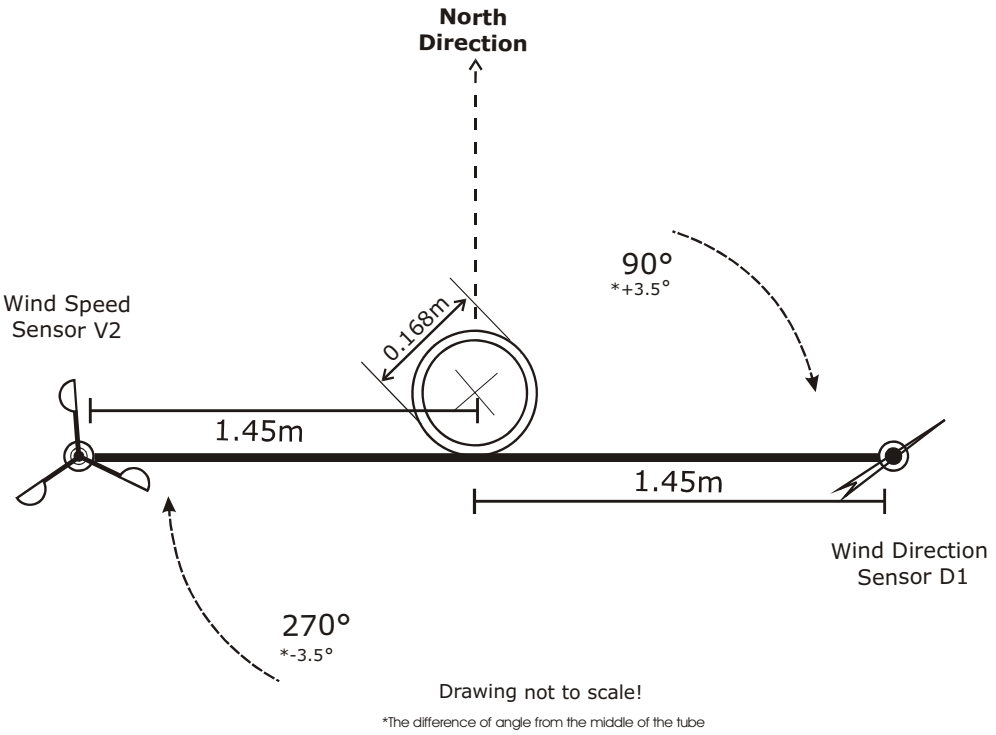


Figure 8: Tower configuration Sensor V2 and D1.

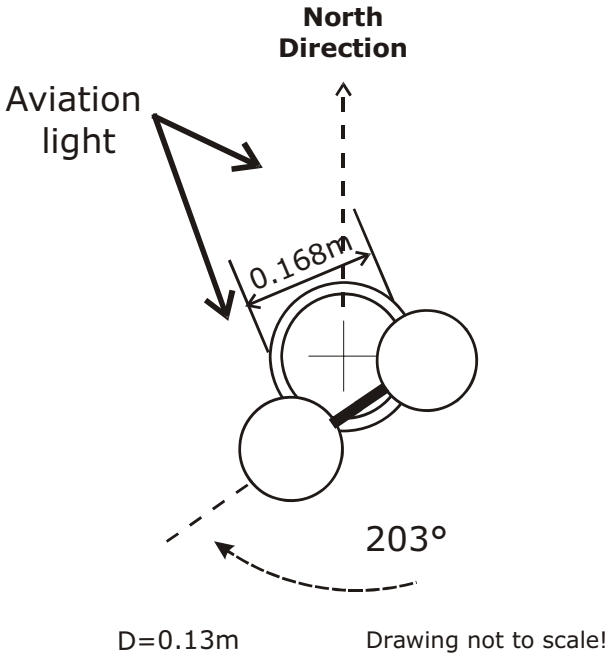


Figure 9: Tower configuration Aviation light.

Figure 10: Installation of Wind Speed Sensor V3 (61,30m) and Wind Direction Sensor D2 (61,20m).

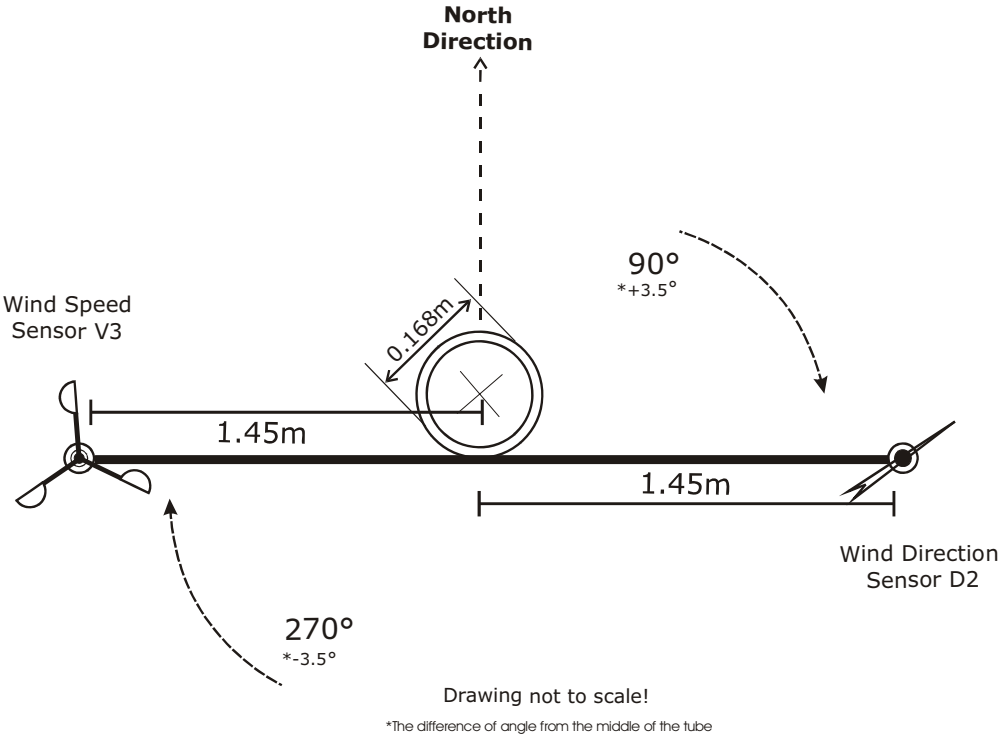


Figure 11: Tower configuration Sensor V3 and D2.

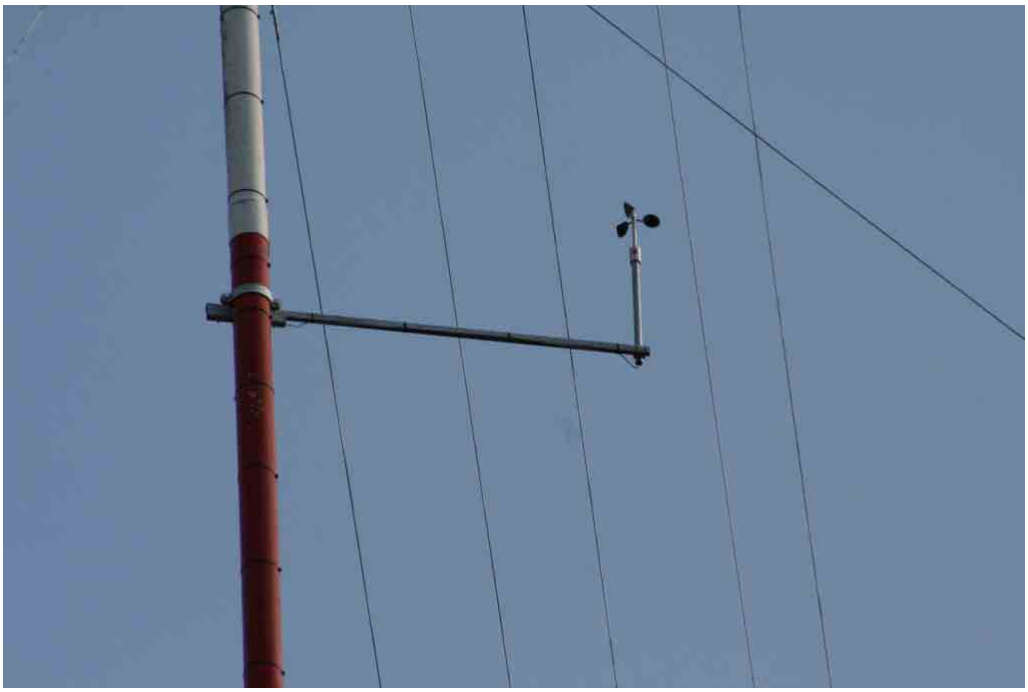
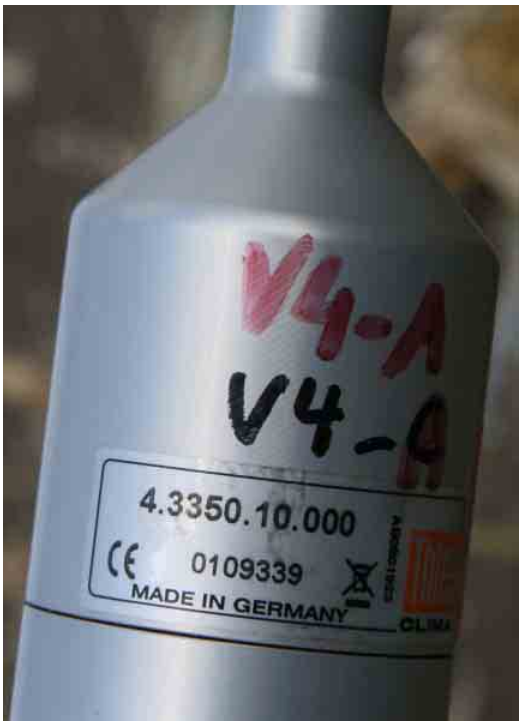


Figure 12: Installation of Wind Speed Sensor V4 (39,90m).



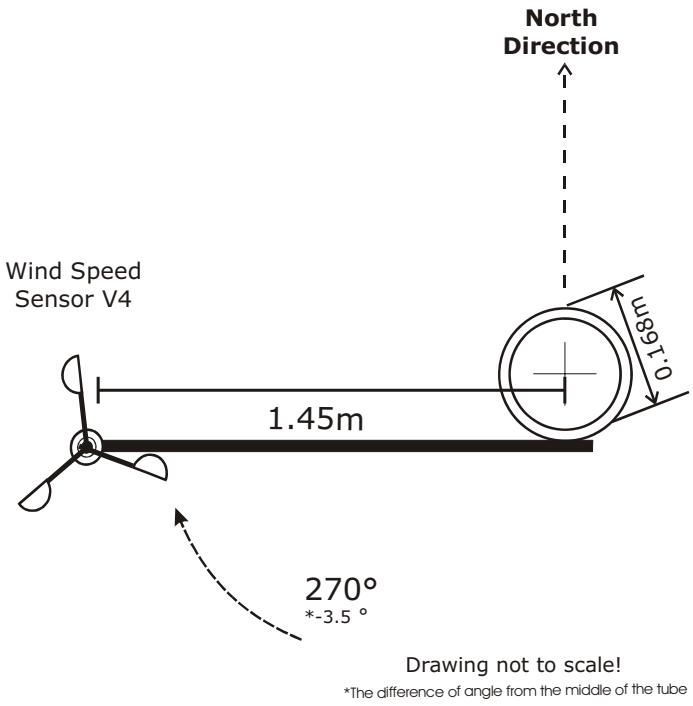


Figure 13: Tower configuration Sensor V4 and D2.

4 Landscape around the Tower

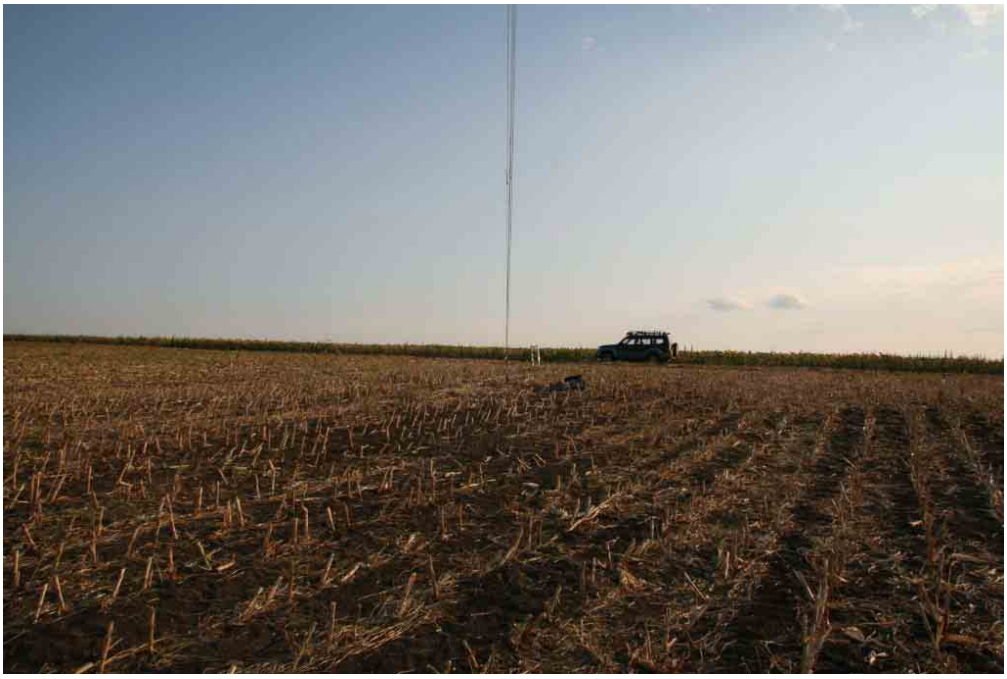


Figure 14: View from the base of the tower. Direction ca. 105°, f ≈ 35mm.

Figure 15: View from the base of the tower. Direction ca. 150°, f ≈ 35mm.

Figure 16: View from the base of the tower. Direction ca. 195°, f ≈ 35mm.

Figure 17: View from the base of the tower. Direction ca. 240°, f ≈ 35mm.

Figure 18: View from the base of the tower. Direction ca. 285°, f ≈ 35mm.

Figure 19: View from the base of the tower. Direction ca. 330°, f ≈ 35mm.

Figure 20: View from the base of the tower. Direction ca. 15°, f ≈ 35mm.

Figure 21: View from the base of the tower. Direction ca. 60°, f ≈ 35mm.

5 Installation Record

Installation Record

Date of installation: ____________________

Name of the site: ____________________

Name of client: ____________________

Assembling

Tower	done by	checked by	result	remark
anchors left fixed				
anchors right fixed				
anchors front fixed				
anchors rear fixed				
anchor ginpole fixed				
baseplate fixed and checked horizontal				
all tubes merged complete				
connection of wire ropes at ginpole				
temporary eyelets at left wire ropes fixed				
temporary eyelets at right wire ropes fixed				
front site wire ropes fixed				
top boom mounted				
1st side boom mounted				
2nd side boom mounted				
3rd side boom mounted				
additional side booms mounted				
Measurement System				
orientation of tower noticed				
wind speed sensors assembled				
wind direction sensors assembled				
wind speed sensors mounted				
wind direction sensors mounted				
wind direction sensors adjusted				
Solar panel mounted				
switchboard mounted				
datalogger: cables connected				
datalogger: checked function of all sensors				
ALL sensors: pictures taken				
ALL sensors: noticed serial and calibration No.				
fixing cables along the tower with cable ties				
fixing cables along the side booms with cable ties				
orientation of sidebooms noticed				

Erection

specification of responsibilities for each task	name
supervisor for the erection must read installation manual complete and understand everything	
lifting winch 1	
lifting winch 2	
checking strengthness of wire ropes, left site	
checking strengthness of wire ropes, right site	
base plate and ginpole	
linearity of main tower (left-right direction)	
linearity of main tower (front-rear direction)	
alignment of tower	
wire ropes at inner front anchor	
wire ropes at middle front anchor	
wire ropes at outer front anchor	

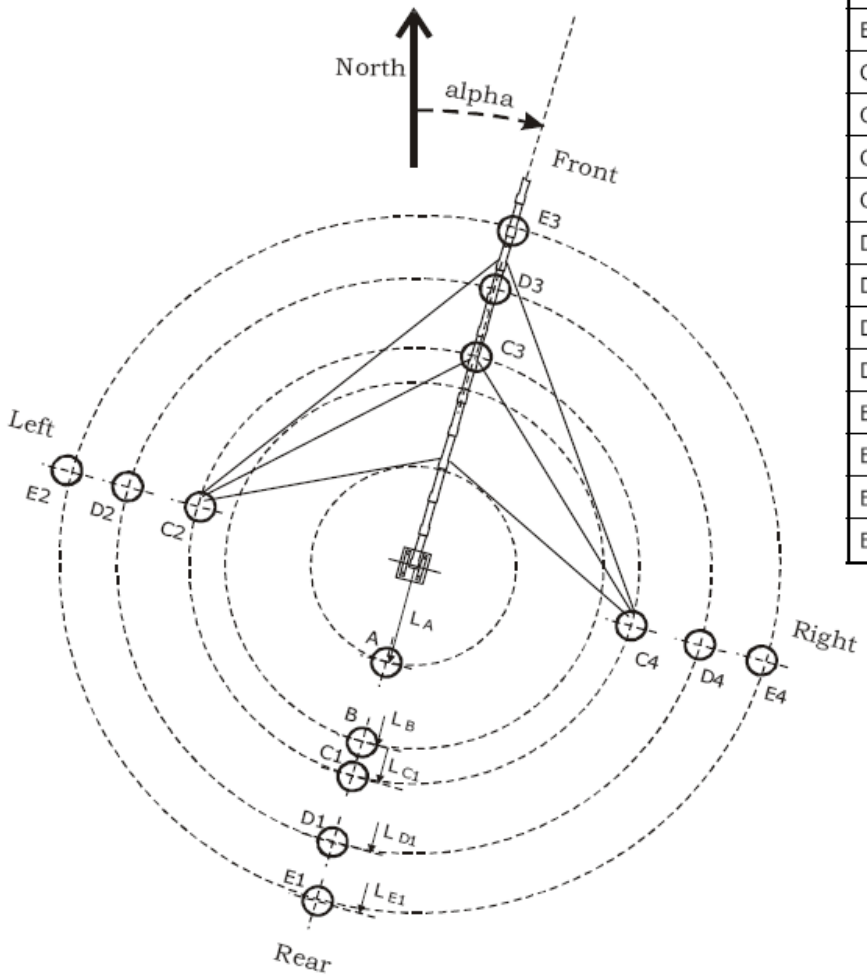
before Erection

	Serial No.	Kalib No.	Height	Boom Direction
Logger				
V1				
V2				
V3				
V4				
D1		-----		
D2		-----		
T1		-----		
P1		-----		-----
Direction of Tower (alpha)				

after erection	done by	checked by	result	remark
alignment of guy rings left-right				
alignment of guy rings front-rear				
left site: fixing of three cable clamps at each guy wire				
right site: fixing of three cable clamps at each guy wire				
front site: fixing of three cable clamps at each guy wire				
rear site: fixing of three cable clamps at each guy wire				
Solar panel adjusted (south and 45°)				
Checked function of GSM Connection				
Cable for datalogger connection placed in switchbox				
Pictures: 360° view a 45°/ compl. Tower / bottom view				
Pictures: each side boom, switchbox + solar panel				

inspected and approved by client _____

Supervisor of the Erection _____



No	Distance [m]	Type	Length	Modified	Fixing	Load	Distance to Surface	Pic Inst	Pic Erect
A	L_A :								
B	L_B :								
C1	L_{C1} :								
C2	L_{C2} :								
C3	L_{C3} :								
C4	L_{C4} :								
D1	L_{D1} :								
D2	L_{D2} :								
D3	L_{D3} :								
D4	L_{D4} :								
E1	L_{E1} :								
E2	L_{E2} :								
E3	L_{E3} :								
E4	L_{E4} :								

Type:	S = Srew In Anchor, H = Srew/Hammer Anchor G = Glue In Anchor C = Concrete Foundation O = Other
Length:	length of the anchor
Modified:	state if modification was necessary y= yes n = no
Fixing:	5 = took long time and hard ... 4 ... 3 ... 2 ... 1 = quick and easy
Load:	5 = highest possible force ... 4 ... 3 ... 2 ... 1 = probably sufficient
Dist. to Surf:	Measure distance from highest point of the anchor to the surface. If anchor above ground positive values if anchor below surface negative value
Pic Inst.	State if a pictures was taken during and/or after the installation of the anchor, Useful if specialties occur.
Pic Erect.	State if a pictures was taken after the erection of the tower. It is recommended that a picture of all anchors is taken in order to enable a comparison on maintenance.

6 Calibration Certificate

6.1 Wind Speed Sensor V1

DEUTSCHER KALIBRIERDIENST **DKD**

Kalibrierlaboratorium / Calibration laboratory
Akkreditiert durch die / *accredited by the*
Akkreditierungsstelle des Deutschen Kalibrierdienstes

Deutsche WindGuard
Wind Tunnel Services GmbH
Varel

DKD-K- 36801

	08_4722
Kalibrierschein *Calibration Certificate*	Kalibrierzeichen *Calibration label* DKD-K-36801 **11.2008**

Gegenstand *Object*	Anemometer
Hersteller *Manufacturer*	Thies Clima D-37083 Göttingen
Typ *Type*	4.3350.00.000
Fabrikat/Serien-Nr. *Serial number*	Body: 1108382 Cup: 1108382
Auftraggeber *Customer*	GE:NET GmbH 38678 Clausthal-Zellerfeld
Auftragsnummer *Order No.*	VT08449
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	3
Datum der Kalibrierung *Date of calibration*	14.11.2008

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DKD is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Akkreditierungsstelle des DKD als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.
This calibration certificate may not be reproduced other than in full except with the permission of both the Accreditation Body of the DKD and the issuing laboratory. Calibration certificates without signature and seal are not valid.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Deutscher Kalibrierdienst DKD-K- 36801	14.11.2008	Dipl. Phys. D. Westermann	Dipl.-Ing. (FH) M. Meyer zu Himmern

Deutsche WindGuard Wind Tunnel Services GmbH
Oldenburger Str. 65
26316 Varel ; Tel. ++49 (0)4451 9515 0

Ge:Net

08_4722
DKD-K-36801
11.2008

Kalibriergegenstand *Object*	Anemometer		
Kalibrierverfahren *Calibration procedure*	IEC 61400 12 1 - Wind Turbine Power Performance Testing 12 2005 MEASNET - Cup Anemometer Calibration Procedure – 09 1997 ISO 3966 – Measurement of fluid in closed conduits - 1977		
Ort der Kalibrierung *Place of calibration*	Windtunnel of Deutsche WindGuard, Varel		
Messbedingungen *Test Conditions*	wind tunnel area [1]	10000 cm²	
	anemometer frontal area [2]	230 cm²	
	diameter of mounting pipe [3]	34 mm	
	blockage ratio [4]	0.023 [-]	
	blockage correction [5]	1.000 [-]	
	average WindGuard reference [6]	203.8 1/s (Thies First Class)	
	present WindGuard reference [7]	203.8 1/s	
Umgebungsbedingungen *Test conditions*	air temperature	20.8 deg	± 1.0 K
	air pressure	1021.2 hPa	± 1.0 hPa
	relative air humidity	43.7 %	± 2.5 %
Dateiinformation *File info*		C:\ak\aktuell\08_4722.kor	
Anmerkungen *Remarks*		-	
Auswertesoftware *Software version*		3.0	

[1] Querschnittsfläche der Auslassdüse des Windkanals
[2] Vereinfachte Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Durchmesser des Montagerohrs
[4] Verhältnis von 2) zu 1)
[5] Korrekturfaktor durch die Verdrängung der Strömung durch den Prüfling
[6] Referenzwert des Referenzanemometers bei 10 m/s (Mittelwert)
[7] Aktueller Wert des Referenzanemometers

Dieser Kalibrierschein wurde elektronisch erzeugt
This calibration certificate has been generated electronically

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Deutsche WindGuard Wind Tunnel Services GmbH

Seite 3
Page

08_4722
DKD-K-36801
11.2008

Kalibrierergebnis:
Result:

Anzeige Pruefling	Stroemungs-geschwindigkeit	Erweiterte Messunsicherheit
1/s	m/s	m/s
83.141	4.204	0.10
123.576	6.160	0.10
163.554	8.079	0.10
201.548	9.915	0.10
242.527	11.908	0.10
284.260	13.895	0.10
325.654	15.879	0.11
303.313	14.815	0.10
263.112	12.899	0.10
221.952	10.896	0.10
181.788	8.961	0.10
140.967	7.010	0.10
102.652	5.160	0.10

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert der Messgröße liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Wertintervall.

Der Deutsche Kalibrierdienst ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die weiteren Unterzeichner innerhalb und außerhalb Europas sind den Internetseiten von EA (www.european-accreditation.org) und ILAC (www.ilac.org) zu entnehmen.

The expanded uncertainty assigned to the mea-surement results is obtained by multiplying the standard uncertainty by the coverage factor k = 2. It has been determined in accordance with DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.

The DKD is signatory to the multilateral agree-ments of the European co-operation for Accredita-tion (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.

Anhang
Annex

08_4722

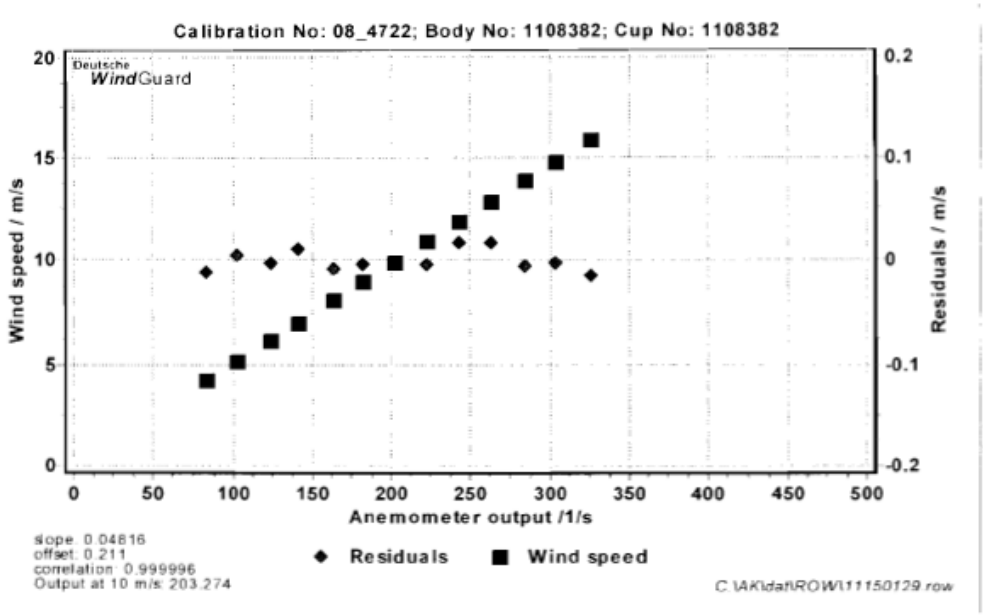
1 Detailed MEASNET[1] Calibration Results

DKD calibration no.	08_4722
Body no.	1108382
Cup no.	1108382
Date	14.11.2008
Air temperature	20.8 deg
Air pressure	1021.2 hPa
Humidity	43.7 %

Linear regression analysis

Slope	0.04816 (m/s)/(1/s) ±0.00004 (m/s)/(1/s)
Offset	0.211 m/s ±0.008 m/s
St.err(Y)	0.008 m/s
Correlation coefficient	0.999996

Remarks no



[1]) According to MEASNET Cup Anemometer Calibration Procedure 09/1997.
Deutsche WindGuard Wind Tunnel Services is accredited by MEASNET and by the Deutscher Kalibrierdienst – DKD (German Calibration Service). Registration: DKD – K – 36801

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Oldenburger Str. 65
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Anhang
Annex

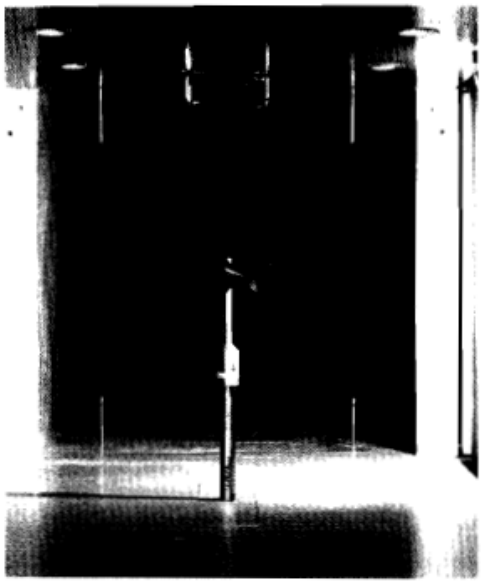
08_4722

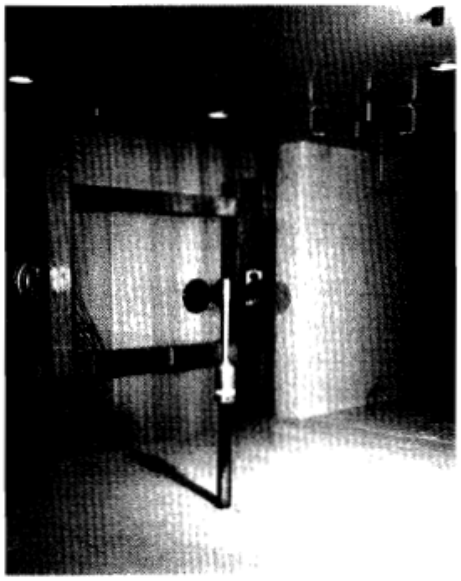
2 Instrumentation

Pos.	Sensor	Manufa	Identification	Year	Calibration
1	Pitot static tube	Airflow	483/8 Nr. 000142	02	06/02
2	Pitot static tube	Airflow	483/8 Nr. 000143	02	06/02
3	Pitot static tube	Airflow	483/8 Nr. 000144	02	06/02
4	Pitot static tube	Airflow	483/8 Nr. 000145	02	06/02
5	Pressure transducer	Setra	C 239 Nr. 1688081	02	DWG12/07
6	Pressure transducer	Setra	C 239 Nr. 1688082	02	DWG12/07
7	Pressure transducer	Setra	C 239 Nr. 1688083	02	03/07
8	Pressure transducer	Setra	C 239 Nr. 1688084	02	03/05
9	El. Barometer	Vaisala	100 A Nr. X2010004	02	DWG12/07
10	El. Thermometer	Galltec	KPK 1/6-ME	02	DWG12/07
11	El. Humidity sensor	Galltec	KPK 1/6-ME	02	DWG12/07
12	Wind tunnel control	-	-	-	-
13	CAN-BUS / PC	esd	-	04	05/04
14	Anemometer		-		
15	Universal Isolator	Knick	P2700 - 582/85/8198430	05	01/06

Table 1 Description of the data acquisition system

3 Photo of the calibration set-up





Calibration set-up of the anemometer calibration in the wind tunnel of Deutsche WindGuard, Varel.
The anemometer shown is of the same type as the calibrated one.
Remark: The proportion of the set-up are not true to scale due to imaging geometry.

4 Deviation to MEASNET procedure

The calibration procedure is in all aspects in accordance with the IEC 61400-12-1 Procedure

5 References

[1] J. Mander, D. Westermann, 12/2007 - Verfahrensanweisung DKD-Kalibrierung von Windgeschwindigkeitssensoren
[2] IEC 61400-12-1 12/2005 - Wind Turbine Power Performance Testing
[3] ISO 3966 1977 - Measurement of fluid flow in closed conduits
[4] MEASNET 09 1997 - Cup Anemometer Calibration Procedure

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6.2 Wind Speed Sensor V2

DEUTSCHER KALIBRIERDIENST DKD

Kalibrierlaboratorium / Calibration laboratory
Akkreditiert durch die / *accredited by the*
Akkreditierungsstelle des Deutschen Kalibrierdienstes

Deutsche WindGuard
Wind Tunnel Services GmbH
Varel

DKD-K- 36801

Kalibrierschein
Calibration Certificate

Kalibrierzeichen / *Calibration label*: **08_4723** | DKD-K-36801 | **11.2008**

Gegenstand *Object*	Anemometer
Hersteller *Manufacturer*	Thies Clima D-37083 Göttingen
Typ *Type*	4.3350.00.000
Fabrikat/Serien-Nr. *Serial number*	Body: 1108394 Cup: 1108394
Auftraggeber *Customer*	GE:NET GmbH 38678 Clausthal-Zellerfeld
Auftragsnummer *Order No.*	VT08449
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	3
Datum der Kalibrierung *Date of calibration*	14.11.2008

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DKD is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Akkreditierungsstelle des DKD als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.
This calibration certificate may not be reproduced other than in full except with the permission of both the Accreditation Body of the DKD and the issuing laboratory. Calibration certificates without signature and seal are not valid.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Deutscher Kalibrierdienst DKD-K- 36801	14.11.2008	Dipl. Phys. D. Westermann	Dipl.-Ing. (FH) M. Meyer zu Himmern

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Seite 2
Page

08_4723
DKD-K-36801
11.2008

Kalibriergegenstand
Object Anemometer

Kalibrierverfahren
Calibration procedure
IEC 61400 12 1 - Wind Turbine Power Performance Testing 12 2005
MEASNET - Cup Anemometer Calibration Procedure – 09 1997
ISO 3966 – Measurement of fluid in closed conduits - 1977

Ort der Kalibrierung
Place of calibration Windtunnel of Deutsche WindGuard, Varel

Messbedingungen
Test Conditions

wind tunnel area [1]	10000 cm²	
anemometer frontal area [2]	230 cm²	
diameter of mounting pipe [3]	34 mm	
blockage ratio [4]	0.023 [-]	
blockage correction [5]	1.000 [-]	
average WindGuard reference [6]	203.8 1/s (Thies First Class)	
present WindGuard reference [7]	203.8 1/s	

Umgebungsbedingungen
Test conditions

air temperature	20.7 deg	± 1.0 K
air pressure	1021.2 hPa	± 1.0 hPa
relative air humidity	43.7 %	± 2.5 %

Dateiinformation
File info C:\ak\aktuell\08_4723.kor

Anmerkungen
Remarks -

Auswertesoftware
Software version 3.0

[1] Querschnittsfläche der Auslassdüse des Windkanals
[2] Vereinfachte Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Durchmesser des Montagerohrs
[4] Verhältnis von 2) zu 1)
[5] Korrekturfaktor durch die Verdrängung der Strömung durch den Prüfling
[6] Referenzwert des Referenzanemometers bei 10 m/s (Mittelwert)
[7] Aktueller Wert des Referenzanemometers

Dieser Kalibrierschein wurde elektronisch erzeugt
This calibration certificate has been generated electronically

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Seite 3
Page

08_4723
DKD-K-36801
11.2008

Kalibrierergebnis:
Result:

Anzeige Pruefling	Stroemungs-geschwindigkeit	Erweiterte Messunsicherheit
1/s	m/s	m/s
82.734	4.203	0.10
123.371	6.161	0.10
163.290	8.076	0.10
202.033	9.927	0.10
242.802	11.905	0.10
284.746	13.906	0.10
326.243	15.878	0.11
303.622	14.821	0.10
263.818	12.899	0.10
221.862	10.894	0.10
181.104	8.966	0.10
140.885	7.007	0.10
102.726	5.156	0.10

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert der Messgröße liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Wertintervall.

Der Deutsche Kalibrierdienst ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die weiteren Unterzeichner innerhalb und außerhalb Europas sind den Internetseiten von EA (www.european-accreditation.org) und ILAC (www.ilac.org) zu entnehmen.

The expanded uncertainty assigned to the mea-surement results is obtained by multiplying the standard uncertainty by the coverage factor k = 2. It has been determined in accordance with DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.

The DKD is signatory to the multilateral agree-ments of the European co-operation for Accredita-tion (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.

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26316 Varel ; Tel. ++49 (0)4451 9515 0

Anhang
Annex

08_4723

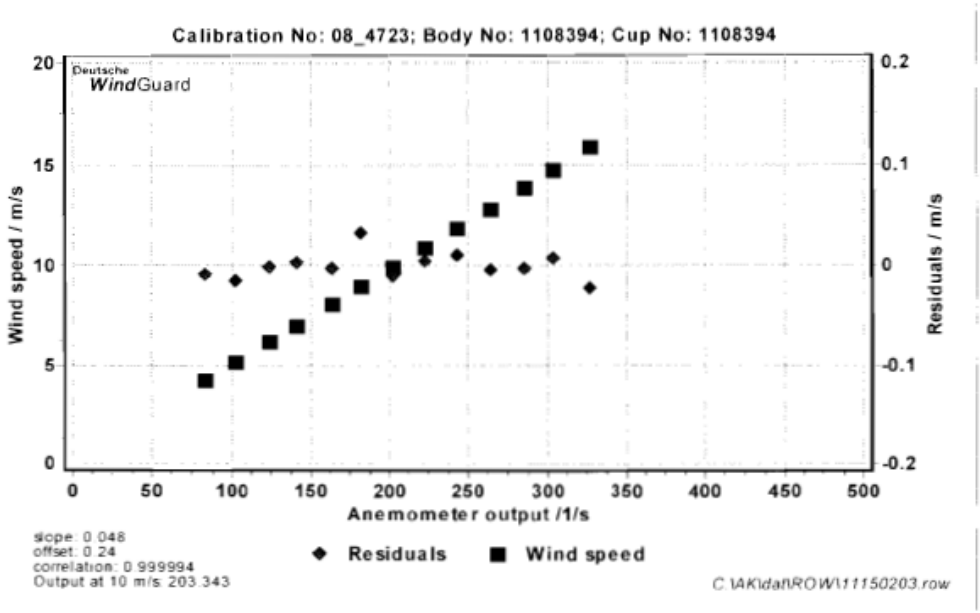
1 Detailed MEASNET[1] Calibration Results

DKD calibration no.	08_4723
Body no.	1108394
Cup no.	1108394
Date	14.11.2008
Air temperature	20.7 deg
Air pressure	1021.2 hPa
Humidity	43.7 %

Linear regression analysis

Slope	0.04800 (m/s)/(1/s) ±0.00005 (m/s)/(1/s)
Offset	0.240 m/s ±0.011 m/s
St.err(Y)	0.012 m/s
Correlation coefficient	0.999994

Remarks no



[1]) According to MEASNET Cup Anemometer Calibration Procedure 09/1997.
Deutsche WindGuard Wind Tunnel Services is accredited by MEASNET and by the Deutscher Kalibrierdienst – DKD (German Calibration Service). Registration: DKD – K – 36801

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Anhang
Annex

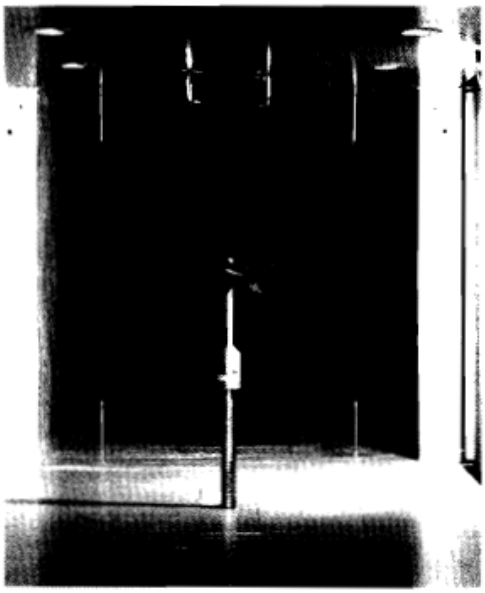
08_4723

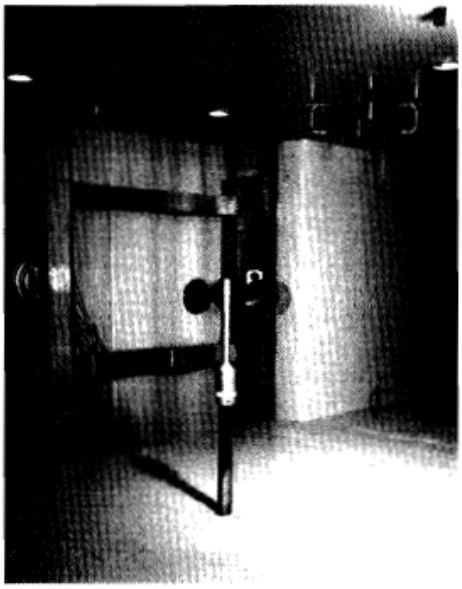
2 Instrumentation

Pos.	Sensor	Manufa	Identification	Year	Calibration
1	Pitot static tube	Airflow	483/8 Nr. 000142	02	06/02
2	Pitot static tube	Airflow	483/8 Nr. 000143	02	06/02
3	Pitot static tube	Airflow	483/8 Nr. 000144	02	06/02
4	Pitot static tube	Airflow	483/8 Nr. 000145	02	06/02
5	Pressure transducer	Setra	C 239 Nr. 1688081	02	DWG12/07
6	Pressure transducer	Setra	C 239 Nr. 1688082	02	DWG12/07
7	Pressure transducer	Setra	C 239 Nr. 1688083	02	03/07
8	Pressure transducer	Setra	C 239 Nr. 1688084	02	03/05
9	El. Barometer	Vaisala	100 A Nr. X2010004	02	DWG12/07
10	El. Thermometer	Galltec	KPK 1/6-ME	02	DWG12/07
11	El. Humidity sensor	Galltec	KPK 1/6-ME	02	DWG12/07
12	Wind tunnel control	-	-	-	-
13	CAN-BUS / PC	esd	-	04	05/04
14	Anemometer		-		
15	Universal Isolator	Knick	P2700 - 58285/8198430	05	01/06

Table 1 Description of the data acquisition system

3 Photo of the calibration set-up





Calibration set-up of the anemometer calibration in the wind tunnel of Deutsche WindGuard, Varel.
The anemometer shown is of the same type as the calibrated one.
Remark: The proportion of the set-up are not true to scale due to imaging geometry.

4 Deviation to MEASNET procedure

The calibration procedure is in all aspects in accordance with the IEC 61400-12-1 Procedure

5 References

[1] J. Mander, D. Westermann, 12/2007 - Verfahrensanweisung DKD-Kalibrierung von Windgeschwindigkeitssensoren
[2] IEC 61400-12-1 12/2005 - Wind Turbine Power Performance Testing
[3] ISO 3966 1977 - Measurement of fluid flow in closed conduits
[4] MEASNET 09 1997 - Cup Anemometer Calibration Procedure

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6.3 Wind Speed Sensor V3

DEUTSCHER KALIBRIERDIENST DKD

Kalibrierlaboratorium / Calibration laboratory
Akkreditiert durch die / *accredited by the*
Akkreditierungsstelle des Deutschen Kalibrierdienstes

Deutsche WindGuard
Wind Tunnel Services GmbH
Varel

DKD-K- 36801

	08_4724
Kalibrierzeichen *Calibration label*	DKD-K-36801
	11.2008

Kalibrierschein
Calibration Certificate

Gegenstand *Object*	Anemometer
Hersteller *Manufacturer*	Thies Clima D-37083 Göttingen
Typ *Type*	4.3350.00.000
Fabrikat/Serien-Nr. *Serial number*	Body: 1108387 Cup: 1108387
Auftraggeber *Customer*	GE:NET GmbH 38678 Clausthal-Zellerfeld
Auftragsnummer *Order No.*	VT08449
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	3
Datum der Kalibrierung *Date of calibration*	14.11.2008

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
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This calibration certificate may not be reproduced other than in full except with the permission of both the Accreditation Body of the DKD and the issuing laboratory. Calibration certificates without signature and seal are not valid.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Deutscher Kalibrierdienst DKD-K- 36801	14.11.2008	Dipl. Phys. D. Westermann	Dipl.-Ing. (FH) M. Meyer zu Himmern

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Seite 2
Page

08_4724
DKD-K-36801
11.2008

Kalibriergegenstand
Object
Anemometer

Kalibrierverfahren
Calibration procedure
IEC 61400 12 1 - Wind Turbine Power Performance Testing 12 2005
MEASNET - Cup Anemometer Calibration Procedure – 09 1997
ISO 3966 – Measurement of fluid in closed conduits - 1977

Ort der Kalibrierung
Place of calibration
Windtunnel of Deutsche WindGuard, Varel

Messbedingungen
Test Conditions

wind tunnel area [1]	10000 cm²	
anemometer frontal area [2]	230 cm²	
diameter of mounting pipe [3]	34 mm	
blockage ratio [4]	0.023 [-]	
blockage correction [5]	1.000 [-]	
average WindGuard reference [6]	203.8 1/s (Thies First Class)	
present WindGuard reference [7]	203.8 1/s	

Umgebungsbedingungen
Test conditions

air temperature	20.7 deg	± 1.0 K
air pressure	1020.9 hPa	± 1.0 hPa
relative air humidity	43.7 %	± 2.5 %

Dateiinformation
File info
C:\ak\aktuell\08_4724.kor

Anmerkungen
Remarks
-

Auswertesoftware
Software version
3.0

[1] Querschnittsfläche der Auslassdüse des Windkanals
[2] Vereinfachte Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Durchmesser des Montagerohrs
[4] Verhältnis von 2) zu 1)
[5] Korrekturfaktor durch die Verdrängung der Strömung durch den Prüfling
[6] Referenzwert des Referenzanemometers bei 10 m/s (Mittelwert)
[7] Aktueller Wert des Referenzanemometers

Dieser Kalibrierschein wurde elektronisch erzeugt
This calibration certificate has been generated electronically

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26316 Varel ; Tel. ++49 (0)4451 9515 0

Deutsche WindGuard Wind Tunnel Services GmbH

Seite 3
Page

08_4724
DKD-K-36801
11.2008

Kalibrierergebnis:
Result:

Anzeige Pruefling	Stroemungs-geschwindigkeit	Erweiterte Messunsicherheit
1/s	m/s	m/s
82.656	4.202	0.10
123.146	6.162	0.10
163.315	8.084	0.10
201.896	9.930	0.10
243.079	11.906	0.10
284.590	13.897	0.10
325.598	15.874	0.11
304.037	14.820	0.10
263.701	12.897	0.10
222.147	10.894	0.10
181.450	8.958	0.10
141.688	7.041	0.10
102.498	5.157	0.10

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert der Messgröße liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Wertintervall.

Der Deutsche Kalibrierdienst ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die weiteren Unterzeichner innerhalb und außerhalb Europas sind den Internetseiten von EA (www.european-accreditation.org) und ILAC (www.ilac.org) zu entnehmen.

The expanded uncertainty assigned to the mea-surement results is obtained by multiplying the standard uncertainty by the coverage factor k = 2. It has been determined in accordance with DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.

The DKD is signatory to the multilateral agree-ments of the European co-operation for Accredita-tion (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.

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Oldenburger Str. 65
26316 Varel ; Tel. ++49 (0)4451 9515 0

Anhang
Annex

08_4724

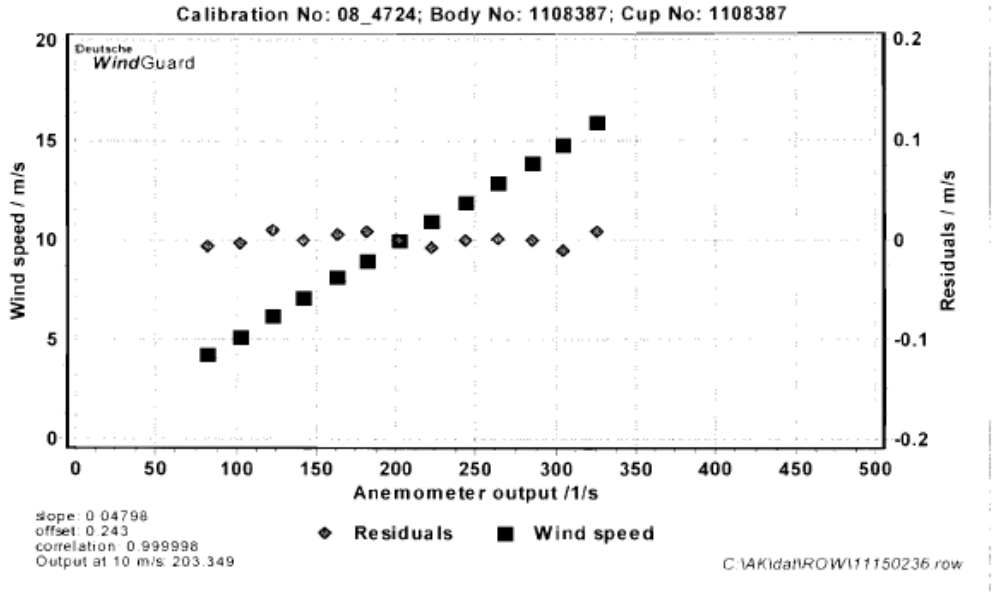
1 Detailed MEASNET[1] Calibration Results

DKD calibration no.	08_4724
Body no.	1108387
Cup no.	1108387
Date	14.11.2008
Air temperature	20.7 deg
Air pressure	1020.9 hPa
Humidity	43.7 %

Linear regression analysis

Slope	0.04798 (m/s)/(1/s) ±0.00003 (m/s)/(1/s)
Offset	0.243 m/s ±0.005 m/s
St.err(Y)	0.007 m/s
Correlation coefficient	0.999998

Remarks no



[1]) According to MEASNET Cup Anemometer Calibration Procedure 09/1997.
Deutsche WindGuard Wind Tunnel Services is accredited by MEASNET and by the Deutscher Kalibrierdienst – DKD (German Calibration Service). Registration: DKD – K – 36801

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Anhang
Annex

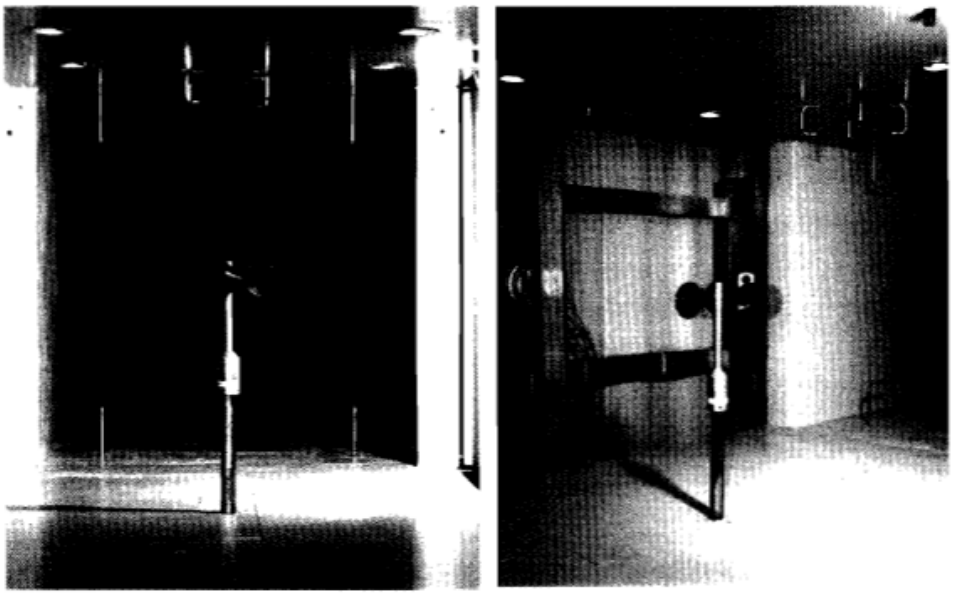
08_4724

2 Instrumentation

Pos.	Sensor	Manufa	Identification	Year	Calibration
1	Pitot static tube	Airflow	483/8 Nr. 000142	02	06/02
2	Pitot static tube	Airflow	483/8 Nr. 000143	02	06/02
3	Pitot static tube	Airflow	483/8 Nr. 000144	02	06/02
4	Pitot static tube	Airflow	483/8 Nr. 000145	02	06/02
5	Pressure transducer	Setra	C 239 Nr. 1688081	02	DWG12/07
6	Pressure transducer	Setra	C 239 Nr. 1688082	02	DWG12/07
7	Pressure transducer	Setra	C 239 Nr. 1688083	02	03/07
8	Pressure transducer	Setra	C 239 Nr. 1688084	02	03/05
9	El. Barometer	Vaisala	100 A Nr. X2010004	02	DWG12/07
10	El. Thermometer	Galltec	KPK 1/6-ME	02	DWG12/07
11	El. Humidity sensor	Galltec	KPK 1/6-ME	02	DWG12/07
12	Wind tunnel control	-	-	-	-
13	CAN-BUS / PC	esd	-	04	05/04
14	Anemometer		-		
15	Universal Isolator	Knick	P2700 - 58285/8198430	05	01/06

Table 1 Description of the data acquisition system

3 Photo of the calibration set-up



Calibration set-up of the anemometer calibration in the wind tunnel of Deutsche WindGuard, Varel.
The anemometer shown is of the same type as the calibrated one.
Remark: The proportion of the set-up are not true to scale due to imaging geometry.

4 Deviation to MEASNET procedure

The calibration procedure is in all aspects in accordance with the IEC 61400-12-1 Procedure

5 References

[1] J. Mander, D. Westermann, 12/2007 - Verfahrensanweisung DKD-Kalibrierung von Windgeschwindigkeitssensoren
[2] IEC 61400-12-1 12/2005 - Wind Turbine Power Performance Testing
[3] ISO 3966 1977 - Measurement of fluid flow in closed conduits
[4] MEASNET 09 1997 - Cup Anemometer Calibration Procedure

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6.4 Wind Speed Sensor V4

DEUTSCHER KALIBRIERDIENST DKD

Kalibrierlaboratorium / Calibration laboratory
Akkreditiert durch die / *accredited by the*
Akkreditierungsstelle des Deutschen Kalibrierdienstes

Deutsche WindGuard
Wind Tunnel Services GmbH
Varel

Deutscher Akkreditierungs Rat
DAR
DKD-K- 36801

Kalibrierschein
Calibration Certificate

Kalibrierzeichen
Calibration label

08_4725
DKD-K-36801
11.2008

Gegenstand *Object*	Anemometer
Hersteller *Manufacturer*	Thies Clima D-37083 Göttingen
Typ *Type*	4.3350.00.000
Fabrikat/Serien-Nr. *Serial number*	Body: 1108386 Cup: 1108386
Auftraggeber *Customer*	GE:NET GmbH 38678 Clausthal-Zellerfeld
Auftragsnummer *Order No.*	VT08449
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	3
Datum der Kalibrierung *Date of calibration*	14.11.2008

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DKD is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Akkreditierungsstelle des DKD als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.
This calibration certificate may not be reproduced other than in full except with the permission of both the Accreditation Body of the DKD and the issuing laboratory. Calibration certificates without signature and seal are not valid.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Deutscher DKD-K- 36801 Kalibrierdienst	14.11.2008	Dipl. Phys. D. Westermann	Dipl.-Ing. (FH) M. Meyer zu Himmern

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08_4725
DKD-K-36801
11.2008

Kalibriergegenstand *Object*	Anemometer		
Kalibrierverfahren *Calibration procedure*	IEC 61400 12 1 - Wind Turbine Power Performance Testing 12 2005 MEASNET - Cup Anemometer Calibration Procedure – 09 1997 ISO 3966 – Measurement of fluid in closed conduits - 1977		
Ort der Kalibrierung *Place of calibration*	Windtunnel of Deutsche WindGuard, Varel		
Messbedingungen *Test Conditions*	wind tunnel area [1]	10000 cm²	
	anemometer frontal area [2]	230 cm²	
	diameter of mounting pipe [3]	34 mm	
	blockage ratio [4]	0.023 [-]	
	blockage correction [5]	1.000 [-]	
	average WindGuard reference [6]	203.8 1/s (Thies First Class)	
	present WindGuard reference [7]	203.8 1/s	
Umgebungsbedingungen *Test conditions*	air temperature	20.7 deg	± 1.0 K
	air pressure	1020.8 hPa	± 1.0 hPa
	relative air humidity	43.7 %	± 2.5 %
Dateiinformation *File info*		C:\ak\aktuell\08_4725.kor	
Anmerkungen *Remarks*		-	
Auswertesoftware *Software version*		3.0	

[1] Querschnittsfläche der Auslassdüse des Windkanals
[2] Vereinfachte Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Durchmesser des Montagerohrs
[4] Verhältnis von 2) zu 1)
[5] Korrekturfaktor durch die Verdrängung der Strömung durch den Prüfling
[6] Referenzwert des Referenzanemometers bei 10 m/s (Mittelwert)
[7] Aktueller Wert des Referenzanemometers

Dieser Kalibrierschein wurde elektronisch erzeugt
This calibration certificate has been generated electronically

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Seite 3
Page

08_4725
DKD-K-36801
11.2008

Kalibrierergebnis:
Result:

Anzeige Pruefling	Stroemungs-geschwindigkeit	Erweiterte Messunsicherheit
1/s	m/s	m/s
82.928	4.198	0.10
123.327	6.159	0.10
163.075	8.077	0.10
201.851	9.930	0.10
243.112	11.903	0.10
283.852	13.895	0.10
325.567	15.882	0.11
303.555	14.819	0.10
263.247	12.899	0.10
221.151	10.896	0.10
181.550	8.969	0.10
141.007	7.011	0.10
102.650	5.158	0.10

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert der Messgröße liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Wertintervall.

Der Deutsche Kalibrierdienst ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die weiteren Unterzeichner innerhalb und außerhalb Europas sind den Internetseiten von EA (www.european-accreditation.org) und ILAC (www.ilac.org) zu entnehmen.

The expanded uncertainty assigned to the mea-surement results is obtained by multiplying the standard uncertainty by the coverage factor k = 2. It has been determined in accordance with DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.

The DKD is signatory to the multilateral agree-ments of the European co-operation for Accredita-tion (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.

Anhang
Annex

08_4725

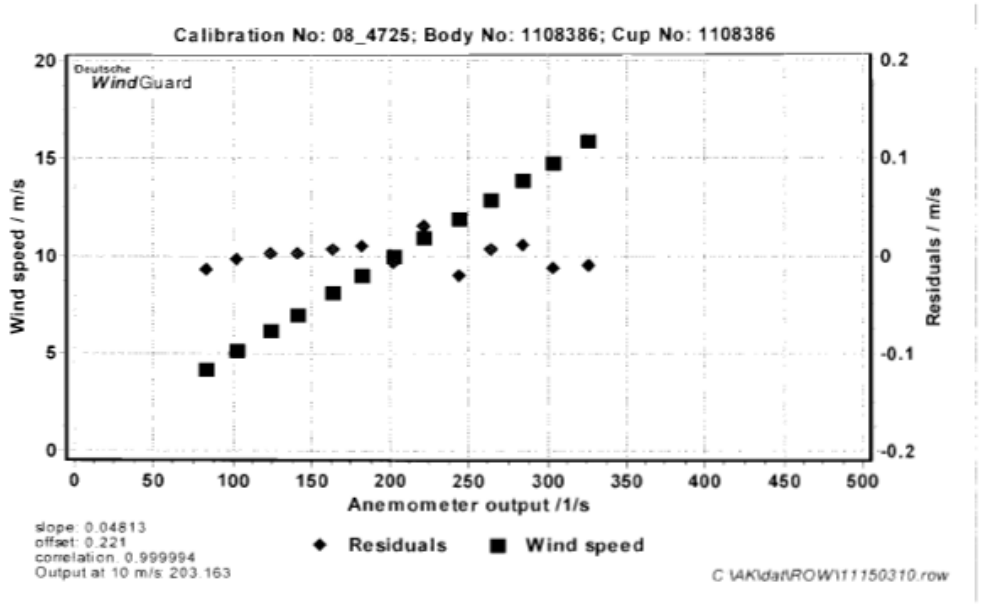
1 Detailed MEASNET[1] Calibration Results

DKD calibration no.	08_4725
Body no.	1108386
Cup no.	1108386
Date	14.11.2008
Air temperature	20.7 deg
Air pressure	1020.8 hPa
Humidity	43.7 %

Linear regression analysis

Slope	0.04813 (m/s)/(1/s) ±0.00005 (m/s)/(1/s)
Offset	0.221 m/s ±0.011 m/s
St.err(Y)	0.013 m/s
Correlation coefficient	0.999994

Remarks no



[1]) According to MEASNET Cup Anemometer Calibration Procedure 09/1997.
Deutsche WindGuard Wind Tunnel Services is accredited by MEASNET and by the Deutscher Kalibrierdienst – DKD (German Calibration Service). Registration: DKD – K – 36801

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Anhang
Annex

08_4725

2 Instrumentation

Pos.	Sensor	Manufa	Identification	Year	Calibration
1	Pitot static tube	Airflow	483/8 Nr. 000142	02	06/02
2	Pitot static tube	Airflow	483/8 Nr. 000143	02	06/02
3	Pitot static tube	Airflow	483/8 Nr. 000144	02	06/02
4	Pitot static tube	Airflow	483/8 Nr. 000145	02	06/02
5	Pressure transducer	Setra	C 239 Nr. 1688081	02	DWG12/07
6	Pressure transducer	Setra	C 239 Nr. 1688082	02	DWG12/07
7	Pressure transducer	Setra	C 239 Nr. 1688083	02	03/07
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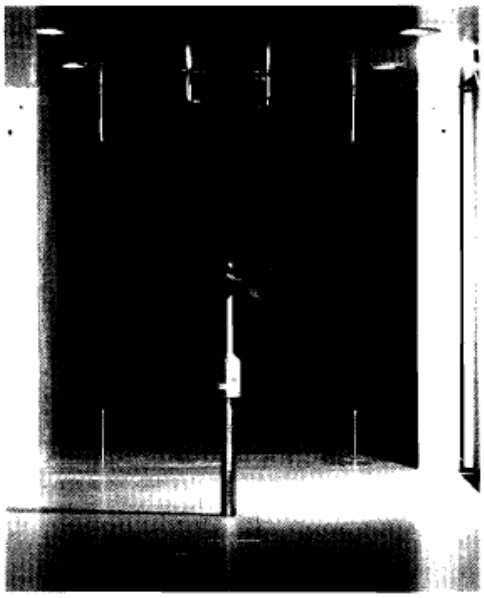
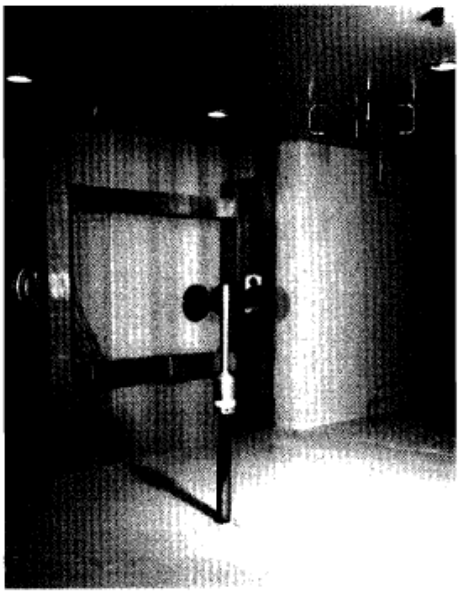
9	El. Barometer	Vaisala	100 A Nr. X2010004	02	DWG12/07
10	El. Thermometer	Galltec	KPK 1/6-ME	02	DWG12/07
11	El. Humidity sensor	Galltec	KPK 1/6-ME	02	DWG12/07
12	Wind tunnel control	-	-	-	-
13	CAN-BUS / PC	esd	-	04	05/04
14	Anemometer		-		
15	Universal Isolator	Knick	P2700 - 58285/8198430	05	01/06

Table 1 Description of the data acquisition system

3 Photo of the calibration set-up





Calibration set-up of the anemometer calibration in the wind tunnel of Deutsche WindGuard, Varel.
The anemometer shown is of the same type as the calibrated one.
Remark: The proportion of the set-up are not true to scale due to imaging geometry.

4 Deviation to MEASNET procedure

The calibration procedure is in all aspects in accordance with the IEC 61400-12-1 Procedure

5 References

[1] J. Mander, D. Westermann, 12/2007 - Verfahrensanweisung DKD-Kalibrierung von Windgeschwindigkeitssensoren
[2] IEC 61400-12-1 12/2005 - Wind Turbine Power Performance Testing
[3] ISO 3966 1977 - Measurement of fluid flow in closed conduits
[4] MEASNET 09 1997 - Cup Anemometer Calibration Procedure

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6.5 Specific report

Werkszeugnis / *Specific report*

nach DIN 50 049-2.2 *acc. to DIN 50 049-2.2*

Benennung	*Name*	**Hygro-Thermogeber / *Hygro-Thermo Transmitter***
Bestell-Nr.	*Type-No.*	**1.1005.54.173**
Geräte-Nr.	*Instrument-No.*	KPC 8/5-H95 Nr.:72730 CE Art.-Nr.: 1.1005.54.173
Auftraggeber	*Customer*	
Auftrags-Nr.	*Order-No.*	
Messbereich	*Measuring range*	0 ... 100 % rel, F. / – 30 ... + 70 °C
Elektr. Ausgang	*Electr. Output*	2 x 0... 5 V

Hiermit bestätigen wir, dass das oben bezeichnete Messgerät unter Beachtung eines dokumentierten Werks-Standard gefertigt und geprüft wurde.

Die für die Prüfung verwendeten Referenz-Prüfmittel unterliegen einer regelmäßigen Kalibrierung und sind rückführbar auf nationale oder internationale Normale. Wo keine nationalen Normale existieren, entspricht das Meßverfahren den derzeit gültigen technischen Regeln.

We hereby confirm that the above-mentioned instrument was produced and tested according to the manufaction standard.

The measuring installations used for testing are regularly calibrated and are based on the national or international standards.
Should no national standards exists, the measuring procedure corresponds with the technical regulations and norms valid at the time of the measurement.

Bestätigung

Die standardisierte Bauform des Gerätes führt zu einem Standardverhalten dieses Messgerätes.

Genauigkeit

Temperatur ± 0,2 K
Feuchtigkeit ± 2 % rel. F.
(bei 5 ... 95 % rel.F., 10 ... 40 °C)
bei Luftgeschwindigkeit ≥ 1 m/s

Confirmation

The standard reaction of the transmitter is caused by the standardized type of the measuring instrument.

Accuracy

Temperature : ± 0,2 K
Humidity : ± 2 % rel. h.
(at 5 ... 95 % rel.h., 10 ... 40 °C)
at wind speed ≥ 1 m/s

26. Aug. 2008
Datum /*Date*

Unterschrift /*Signature*
- Qualitätssicherung -

ADOLF THIES GmbH & Co.KG
Hauptstraße 76 37083 Göttingen Germany
Postfach 3536 + 3541 37025 Göttingen
Tel. (0551) 79001-0 Fax (0551) 79001-65
Internet http://www.thiesclima.com eMail info@thiesclima.com

TÜV CERT DIN EN ISO 9001

030416/08/07

6.6 Data and Calibration Sheet

P-GE 8/11 economy

Barometric pressure sensor

Data and Calibration Sheet

1 Specification

Measuring range	: 800 … 1100 hPa
Nominal output voltage	: 0.25 … 4.25 V
Supply voltage range	: 9.0 … 15 V
No load current consumption @ 12 V	: 0.7 mA
Operating temperature range	: 0 … +85°C (with internal compensation)
	: -25 … +85°C (without internal compensation)
Wire colours	: brown – GND
	: white – supply voltage
	: green – output signal

Power supply and measuring output are protected against reverse voltage and over voltage up to 30 V.

2 Calibration report

Serial Number (on printed circuit board)	: 08083-1087
Date of calibration	: 11.09.08
Reference Sensor	: Thies CLIMA Barogeber B-278-T1
By (signature)	: .....
Ambient temperature	: 25 °C

Data points

Pressure 1	: 933,6 hPa
Output voltage	: 2,03 V
Pressure 2	: 1035,0 hPa
Output voltage	: 3,38 V

Resulting parameters (in mV for Campbell Scientific data logger)

Gain	: 0,0751
Offset	: 781,2

Ge:Net GmbH, Am Rollberg 1, D-38678 Clausthal

7 Data sheets of the used Equipment

7.1 Datalogger

CR800-series Measurement & Control Systems

The CR800 and CR850 dataloggers provide precision measurement capabilities in a rugged, battery-operated package. Both models consist of measurement electronics encased in a plastic shell and an integrated wiring panel.

The power consumption and packaging of the CR800-series dataloggers are optimized for unattended network applications. The CR800 and CR850 are similar, except the CR850 has a keyboard display as part of its integrated package.

Features

- 4 Mbytes* of battery-backed SRAM
- Program execution rate of up to 100 Hz
- CS I/O and RS-232 serial ports
- 13-bit analog to digital conversions
- 16-bit microcontroller with 32-bit internal CPU architecture
- Temperature compensated real-time clock
- Background system calibration for accurate measurements over time and temperature changes
- Single DAC used for excitation and measurements to give ratio metric measurements
- Gas Discharge Tube (GDT) protected inputs
- Data values stored in tables with a time stamp and record number
- Battery-backed SRAM and clock that ensure data, programs, and accurate time are maintained while a CR800-series datalogger is disconnected from the main power source
- One program-status LED

Model Descriptions

The models differ in their keyboard display. The CR800 uses an external keyboard display, the CR1000KD, which connects to the CR800 via its CS I/O port. The CR850 includes an on-board keyboard display as part of its integrated package.

Storage Capacity*

The CR800-series has 2 Mbytes of FLASH memory for the Operating System, and 4 Mbytes of battery-backed SRAM for CPU usage, program storage, and data storage. Data is stored in a table format.

Operation in Harsh Environments

The standard operating range is -25° to +50°C. An extended range of -55° to +85°C for the CR800 or -30° to +80°C for the CR850 is also available. A datalogger housed in an environmental enclosure with desiccant is protected from humidity and most contaminants.

Input Output Terminals

Analog Inputs: Three differential (6 single-ended) channels measure voltage levels. Resolution on the most sensitive range is 0.67 µV.

Pulse counters: Two pulse channels can count pulses from high level (5 V square wave), switch closure, or low level ac signals.

Switched voltage excitations: Two outputs provide precision excitation voltages for resistive bridge measurements.

Digital I/O ports: Four ports are provided for frequency measurements, digital control, and triggering. Three of these ports can also be used to measure SDM devices. The I/O ports can be paired as transmit and receive for measuring smart serial sensors.

Switched 12 Volt: This unregulated 12 V terminal can be switched on and off under program control.

RS-232 port: A PC or laptop can be connected to this 9-pin port via an RS-232 cable.

CS I/O port: Data transfer peripherals that require power from the datalogger can be connected to this port via a cable. The port is also used for connecting the datalogger to a PC via an SC32B interface when optical isolation is required.

**Campbell Scientific is increasing the data storage memory from 2 Mbytes to 4 Mbytes. Dataloggers with a serial number greater than or equal to 3605 will have a 4 Mbyte memory. The 4 Mbyte dataloggers will also have a sticker on the canister stating "4M Memory".*

CR800-series Specifications

Electrical specifications are valid over a -25° to +50°C range unless otherwise specified; non-condensing environment required. To maintain electrical specifications, Campbell Scientific recommends recalibrating dataloggers every two years. We recommend that you confirm system configuration and critical specifications with Campbell Scientific before purchase.

PROGRAM EXECUTION RATE

10 ms to 30 min. @ 10 ms increments

ANALOG INPUTS

3 differential (DF) or 6 single-ended (SE) individually configured. Channel expansion provided by AM16/32 and AM25T multiplexers.

RANGES and RESOLUTION: Basic resolution (Basic Res) is the A/D resolution of a single conversion. **Resolution of DF measurements with input reversal is half the Basic Res.**

		Input Referred Noise Voltage
Input Range (mV)[1]	*DF Res (µV)*[2]	*Basic Res (µV)*
±5000	667	1333
±2500	333	667
±250	33.3	66.7
±25	3.33	6.7
±7.5	1.0	2.0
±2.5	0.33	0.67

[1]Range overhead of ~9% exists on all ranges to guarantee that full-scale values will not cause over-range.

[2]Resolution of DF measurements with input reversal.

ACCURACY[3]:
±(0.06% of reading + offset), 0° to 40°C
±(0.12% of reading + offset), -25° to 50°C
±(0.18% of reading + offset), -55° to 85°C

[3]The sensor and measurement noise are not included and the offsets are the following:
Offset for DF w/input reversal = 1.5·Basic Res + 1.0 µV
Offset for DF w/o input reversal = 3·Basic Res + 2.0 µV
Offset for SE = 3·Basic Res + 3.0 µV

INPUT NOISE VOLTAGE: For DF measurements with input reversal on ±2.5 mV input range; digital resolution dominates for higher ranges.
250 µs Integration: 0.34 µV RMS
50/60 Hz Integration: 0.19 µV RMS

MINIMUM TIME BETWEEN VOLTAGE MEASUREMENTS: Includes the measurement time and conversion to engineering units. For voltage measurements, the CR800-series integrates the input signal for 0.25 ms or a full 16.66 ms or 20 ms line cycle for 50/60 Hz noise rejection. DF measurements with input reversal incorporate two integrations with reversed input polarities to reduce thermal offset and common mode errors and therefore take twice as long.
250 µs Analog Integration: ~1 ms SE
1/60 Hz Analog Integration: ~20 ms SE
1/50 Hz Analog Integration: ~25 ms SE

COMMON MODE RANGE: ±5 V

DC COMMON MODE REJECTION: >100 dB

NORMAL MODE REJECTION: 70 dB @ 60 Hz when using 60 Hz rejection

SUSTAINED INPUT VOLTAGE W/O DAMAGE: ±16 Vdc max.

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C; ±90 nA @ 85°C

INPUT RESISTANCE: 20 Gohms typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION THERMISTOR (for thermocouple measurements):
±0.3°C, -25° to 50°C
±0.8°C, -55° to 85°C (-XT only)

ANALOG OUTPUTS

2 switched voltage, active only during measurement, one at a time.

RANGE AND RESOLUTION: Voltage outputs programmable between ±2.5 V with 0.67 mV resolution.

ACCURACY: ±(0.06% of setting + 0.8 mV), 0° to 40°C
±(0.12% of setting + 0.8 mV), -25° to 50°C
±(0.18% of setting + 0.8 mV), -55° to 85°C (-XT only)

CURRENT SOURCING/SINKING: ±25 mA

RESISTANCE MEASUREMENTS

MEASUREMENT TYPES: The CR800-series provides ratiometric measurements of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Precise, dual polarity excitation using any of the 3 switched voltage excitations eliminates dc errors.

RATIO ACCURACY[3]: Assuming excitation voltage of at least 1000 mV, not including bridge resistor error.

$\pm(0.04\% \text{ of voltage reading} + \text{offset})/V_x$

[3]The sensor and measurement noise are not included and the offsets are the following:
Offset for DF w/input reversal = 1.5·Basic Res + 1.0 µV
Offset for DF w/o input reversal = 3·Basic Res + 2.0 µV
Offset for SE = 3·Basic Res + 3.0 µV

Offset values are reduced by a factor of 2 when excitation reversal is used.

PERIOD AVERAGING MEASUREMENTS

The average period for a single cycle is determined by measuring the average duration of a specified number of cycles. The period resolution is 192 ns divided by the specified number of cycles to be measured; the period accuracy is ±(0.01% of reading + resolution). Any of the 6 SE analog inputs can be used for period averaging. Signal limiting are typically required for the SE analog channel.

INPUT FREQUENCY RANGE:

Input	*Signal (peak to peak)*[4]		*Min.*	*Max*[5]
Range	*Min*	*Max*	*Pulse W.*	*Freq.*
±2500 mV	500 mV	10 V	2.5 µs	200 kHz
±250 mV	10 mV	2 V	10 µs	50 kHz
±25 mV	5 mV	2 V	62 µs	8 kHz
±2.5 mV	2 mV	2 V	100 µs	5 kHz

[4]The signal is centered at the datalogger ground.

[5]The maximum frequency = 1/(Twice Minimum Pulse Width) for 50% of duty cycle signals.

PULSE COUNTERS

Two 24-bit inputs selectable for switch closure, high frequency pulse, or low-level ac.

MAXIMUM COUNTS PER SCAN: 16.7×10^6

SWITCH CLOSURE MODE:
Minimum Switch Closed Time: 5 ms
Minimum Switch Open Time: 6 ms
Max. Bounce Time: 1 ms open w/o being counted

HIGH FREQUENCY PULSE MODE:
Maximum Input Frequency: 250 kHz
Maximum Input Voltage: ±20 V
Voltage Thresholds: Count upon transition from below 0.9 V to above 2.2 V after input filter with 1.2 µs time constant.

LOW LEVEL AC MODE: Internal ac coupling removes dc offsets up to ±0.5 V.
Input Hysteresis: 16 mV @ 1 Hz
Maximum ac Input Voltage: ±20 V
Minimum ac Input Voltage:

Sine wave (mV RMS)	*Range (Hz)*
20	1.0 to 20
200	0.5 to 200
2000	0.3 to 10,000
5000	0.3 to 20,000

DIGITAL I/O PORTS

4 ports software selectable, as binary inputs or control outputs. They also provide edge timing, subroutine interrupts/wake up, switch closure pulse counting, high frequency pulse counting, asynchronous communications (UART), SDI-12 communications, and SDM communications.

HIGH FREQUENCY MAX: 400 kHz

SWITCH CLOSURE FREQUENCY MAX: 150 Hz

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low <0.1

OUTPUT RESISTANCE: 330 ohms

INPUT STATE: high 3.8 to 5.3 V; low -0.3 to 1.2 V

INPUT HYSTERISIS: 1.4 V

INPUT RESISTANCE: 100 kohms

SWITCHED 12 V

One independent 12 V unregulated sources switched on and off under program control. Thermal fuse hold current = 900 mA @ 20°C, 650 mA @ 50°C, 360 mA @ 85°C.

SDI-12 INTERFACE SUPPORT

Control ports 1 and 3 may be configured for SDI-12 asynchronous communications. Up to ten SDI-12 sensors are supported per port. It meets SDI-12 Standard version 1.3 for datalogger mode.

CE COMPLIANCE

STANDARD(S) TO WHICH CONFORMITY IS DECLARED: IEC61326:2002

CPU AND INTERFACE

PROCESSOR: Renesas H8S 2322 (16-bit CPU with 32-bit internal core)

MEMORY: 2 Mbytes of Flash for operating system; 4 Mbytes of battery-backed SRAM for CPU usage, program storage and data storage

SERIAL INTERFACES: CS I/O port is used to interface with Campbell Scientific peripherals; RS-232 port is for computer or non-CSI modem connection.

BAUD RATES: Selectable from 300 bps to 115.2 kbps. ASCII protocol is one start bit, one stop bit, eight data bits, and no parity.

CLOCK ACCURACY: ±3 min. per year

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc

TYPICAL CURRENT DRAIN:
Sleep Mode: ~0.6 mA
1 Hz Scan (60 Hz rejection)
w/RS-232 communication: 19 mA
w/o RS-232 communication: 4.2 mA
1 Hz Scan (250 µs integration)
w/RS-232 communication: 16.7 mA
w/o RS-232 communication: 1 mA
100 Hz Scan (250 µs integration)
w/RS-232 communication: 27.6 mA
w/o RS-232 communication: 16.2 mA

CR1000KD OR CR850'S ON-BOARD KEYBOARD DISPLAY CURRENT DRAIN:
Inactive: negligible
Active w/o backlight: 7 mA
Active w/backlight: 100 mA

EXTERNAL BATTERIES: 12 Vdc nominal; reverse polarity protected.

PHYSICAL SPECIFICATIONS

DIMENSIONS: 9.5" x 4.1" x 2" (24.1 x 10.4 x 5.1 cm); additional clearance required for serial cable and sensor leads.

WEIGHT: 1.5 lbs (0.7 kg)

WARRANTY

Three years against defects in materials and workmanship.

815 W. 1800 N. | Logan, Utah 84321-1784 | USA | phone (435) 753-2342 | www.campbellsci.com
Australia | Brazil | Canada | England | France | Germany | South Africa | Spain | USA (headquarters)

7.2 Wind Speed Sensor

Cup Anemometer *first class*

Description

Rugged and very precise sensor for the measurement of the horizontal component of the wind speed.

Driven by the flow, the cups are set into rotation. A light barrier scans an optical disc in the interior of the sensor and provides a frequency linearly dependent on the wind speed.

A built-in electronical heating prevents the bearings and the rotating part of the sensor from being blocked by icing.

The sensor meets the latest requirements of MEASNET and IEC for the assessment of wind resources and wind turbine power characterics.

Technical Data

Sensor

Sensing element	Cup rotor
Transducer	Optoelectronical transmitter with frequency output
Output signal	0..50 m/s = 0..1000 Hz
Pulse level	LO = < 0.5 V HI = V_{supply} (max. 15 V)
Resolution	0.05 m wind run
Accuracy	0..15 m/s ± 0.3 m/s > 15 m/s ± 2% of reading
IEC 61400-121-CD classification	The anemometer meets in flat terrain all aspects of the requirements for a Class 1 anemometer.
Starting threshold	0.3 m/s

Rotor

Type	3 conical cups
Material	Plastic
Outside diameter	ø240 mm
Distance constant	< 3 m (for 63% recovery)
Bearings	Stainless steel ball bearings

Power Supply

Operating voltage	3.3..42 VDC
Current consumption	0.5 mA typical at 5 V, unloaded
Power-up time	50 ms

7.3 Wind Direction Sensor

THE WORLD OF WEATHER DATA - THE WORLD OF WEATHER DATA - THE WORLD OF WEATHER DATA

Wind Direction Transmitter - compact

- with Poti– Output -

4.3129.xx.712

ADOLF THIES GmbH & Co. KG

Hauptstraße 76 — 37083 Göttingen Germany
Box 3536 + 3541 — 37025 Göttingen
Phone ++551 79001-0 — Fax ++551 79001-65
www.thiesclima.com — info@thiesclima.com

1 Models available

Order-No.	Meas. range	Electr. Output	Operating Voltage Potentiometer	Heating	Connection
4.3129.00.712	0...360°	Potentiometer: 2 kΩ	0…24 V DC	24V, 20W	7 pol. plug
4.3129.04.712	0...360°	Potentiometer: 2 kΩ	0…24 V DC	24V, 20W	7 pol. plug
4.3129.10.712	0...360°	Potentiometer: 2 kΩ	0…24 V DC	w/o heating	7 pol. plug

2 Application

The wind direction transmitter is designed for the acquisition of the horizontal wind direction. The measuring value is output proportionally to wind direction as analogue voltage in case the potentiometer is supplied by a constant voltage. The measuring data available are ideally adapted to the supply in display instruments, recording instruments, datalogger, as well as process control systems.

For winter time use the instrument is optionally equipped with an electronically regulated heating, in order to guarantee a smooth-running of the ball bearing, and to prevent a blocking of the gap between the external rotation parts by ice aggregation.

Power for the heating system could be provided for instance by our Power Supply Unit, Order No. 9.3388.00.000

3 Installation

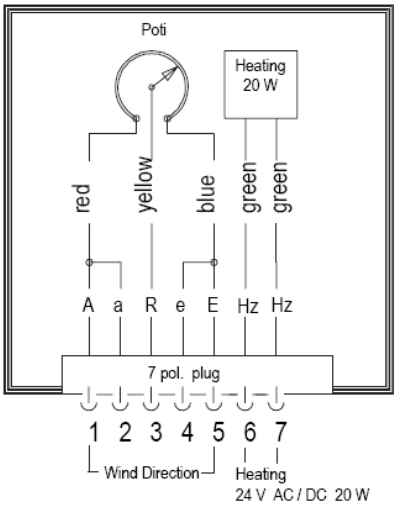
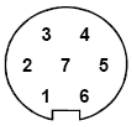
Attention:

Storing, mounting and operation under weather conditions is permissible only in vertical position, as otherwise water can get into the instrument.

4 Connecting Diagrams

Attention:

When the wind vane rotates over the north point (0 / 360°) the potentiometer slider connects beginning and end of the potentiometer. Therefore, the supply voltage of the potentiometer must show a current limitation of max. 20 mA. When using power supply units temporary current peaks with the power control might lead to damages. Therefore, an additional protective resistance Is strongly recommended .

Order – No.		View on the soldered joint of the counter plug
4.3129.00.712 4.3129.04.712 4.3129.10.712 *		
*Order-no. 4.3129.**10**.xxx (w/o heating) PIN 6 and 7 are not connected		

5 Technical Data

Meas. range	0 ... 360° (0 Ohm in the North point)
Resolution	0,5°
Accuracy	± 2°
Measuring principle	Potentiometer
Potentiometer output	2 KOhm
Electrical supply for potentiometer	Voltage U_s: 0V DC ... 24 V DC, **The supply must guarantee a current limiting to max. 20mA – short cut at the North point !**
Operating voltage heating	24 V DC/AC, max. 20 W
Ambient temperature *	-40°C ... 70°C
Survival speed	maximally 80 m/s, 30 minutes
Connection	7 pol. Stecker
Dimensions	see dimensional drawing
Montage	For ex. onto a mast tube with receptacle thread PG 21 or boring ∅ 29 mm
Protection	IP 55
Weight	ca. 1,10 kg

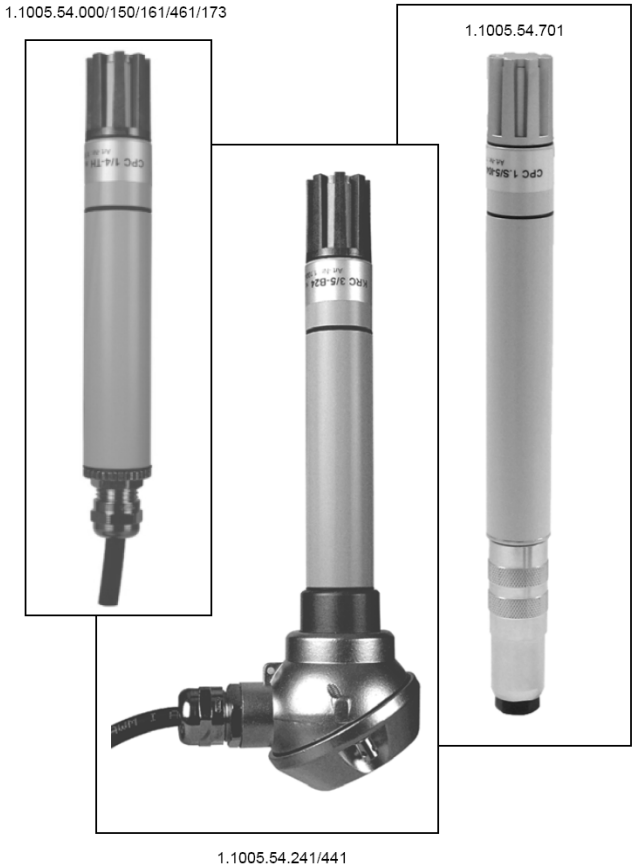
* The ambient temperature, stated for wind direction transmitters without heating, is possible only in ice-free condition.

7.4 Thermo-Hygro Sensor-compact

THE WORLD OF WEATHER DATA - THE WORLD OF WEATHER DATA - THE WORLD OF WEATHER DATA

Instruction for use
020891/08/07

Hygro-ThermoTransmitter-compact
1.1005.54.xxx



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2 Application

The Hygro-Thermo Transmitters of our compact series with connected cable are designed to measure relative humidity, the temperature of the air and other non-aggressive gases.

The use of capacitive humidity sensors is a guarantee for:

- a high degree of long-term stability
- nearly linear characteristics
- good dynamic behaviour
- dewing stability
- low temperature coefficients
- low hysteresis

The standard equipment of the Hygro-Thermo-Transmitter includes a *teflon*-filter ZE20 (order-no. 1.1005.54.901) for field work. It protects the instrument against dust and wind speeds up to 10m/s.

For filed work, it is advisable to use a „Weather and Thermal Radiation Shield". It is optionally available as accessory.

3 Mounting

For correct measurements, the Hygro-Thermo Transmitter should be mounted at a site in the room which is representative of the climate within the room. The mounting position itself is arbitrary. Mount the sensor such that water cannot penetrate the inside of the sensor. Dewing and sprinkling water do not damage the sensor.

Moreover, please make sure to keep the operating voltages as well as a good recirculation ventilation of the instrument. Deviations might lead to measurement errors (for example: due to instrument warming).

Preferably, the sensor should be mounted vertically facing downwards to a wall (indoor application), and should be mounted horizontally facing backwards in canals.

4 Maintenance

The Hygro-Thermo Transmitter is supplied already calibrated and its characteristics remain stable for years.
Dust does not damage the humidity sensor but does influence the dynamic behaviour negatively. If the instrument is very dirty, the sensor element can be cleaned or carefully rinsed in distilled water. Make sure you do not touch the highly-sensitive sensor element.
Before cleaning the sensor elements please remove the protecting filter; it should be cleaned, as well.

> ***Attention***
> ***The instrument housing with the electronics included should be opened only in the factory.***

6 Technical Data

Humidity			
Measuring element	Capacitive		
Measuring range	0...100 % rel. humidity		
Deviation (mr 5...95% rel.h. at 10...40 °C)	± 2 % rel. humidity		
Add. Error (<10°C, >40°C)	< 0,1%/K		
Response Time (T 90)	< 20 s	(at v = 1,5 m/s)	w/o filter
Response Time (T 90)	< 1,5 min.	(at v = 1,5 m/s)	with Teflon filter ZE 20
Response Time (T 90)	< 1,5 min.	(at v = 1,5 m/s)	with Sinter filter ZE 21
Temperature			
Measuring element	Pt 100 Class B, 1/3 DIN tolerance		
Measuring range	See models available		
Deviation			
with output 0- 1 V	± 0,2 K		
with output 0-10 V	± 0,2 K		
with output 4-20 mA	± 0,3 K		
Add. error (<10°C, >40°C)	± 0,0073 K/K		
Response time (T 90)	< 20 s	(at v = 1,5 m/s)	w/o filter
Response time (T 90)	< 1,5 min.	(at v = 1,5 m/s)	with Teflon filter ZE 20
Response time (T 90)	< 1,5 min.	(at v = 1,5 m/s)	with Sinter filter ZE 21
Additional Specifications			
Ambient temperature	-40...+80°C -40... +100°C (model. ...000)		
Degree of protection sensor	IP 30		
Degree of protection electronics, connecting head	IP 65		
Operating voltage			
I-output	12...30 V DC		
U-output (0...10 V / 0...5 V)	15…30 V DC		
U-output (0...1 V)	6...30 V DC		
Load resistor			
I-output	See diagram RL		
U-output (0...10 V / 0...5 V)	≥ 10 kΩ		
U-output (0...1 V)	≥ 2 kΩ		
Instrument current requirements			
Humidity/Temperature (0..10V / 0..5V)	< 5 mA		
Humidity(0...1V)	< 1 mA		
Housing model for 1005.54.000 / 150 / 161 / 461 / 173 with connected cable			
Diameter	20 mm		
Shaft length	122 mm		

Total length	145 mm
Housing model for 1.1005.54.241 / 441 with aluminum connection head and connected cable	
Diameter	20 mm
Shaft length	122 mm
Total length	180 mm
Housing model for 1.1005.54.701 / 761 with plug connection and mating plug	
Diameter	20 mm
Shaft length	155 mm
Total length	195 mm
Housing model for 1.1005.54.700 with plug connection without mating plug	
Diameter	20 mm
Shaft length	155 mm

7 Accessories (optional)

Weather and Thermal Radiation Shield The use of the Weather and Thermal Radiation Shield in an appropriate combination with suitable temperature and humidity sensors reduces to a minimum the possibility of influencing the data in a negative manner by radiation, precipitation or damage. More exactly measuring results are achieved by using the ventilated Weather and Thermal Radiation Shield (mod. 1.1025.55.10x with ventilation). The ventilation reduces those errors which might occur during the measurements in a weather hut caused by the so-called „proper climate" .	1.1025.55.00x .10x .xx0 .xx1	w/o ventilator with ventilator 12 V DC / 2,5 W , incl. 5 m cable for mast tube mounting ∅ 30 - 50 mm for mast tube mounting ∅ 55 – 60 mm dimensions: ∅ 120 x 290 mm **Remark:** It is recommendable to use the weather and thermal radiation shield-compact with ventilation order-no. 1.1025.55.10x for Hygro-Thermo Transmitter model ..241/441(4-20 mA)

Sinter Filter ZE21 The fine-pore sinter filter serves to protect the sensor elements of the Hygro-Thermo-Transmitter *compact* against high wind speeds (>5m/s) and dust...	1.1005.54.902	Material: stainless steel Dimensions: ∅ 20 x 25 mm

7.5 Barometric Pressure Sensor

Barometric Pressure Sensor

P-GE 8/11 economy

Ge:Net GmbH
Am Rollberg 1
D-38678 Clausthal-Zellerfeld
+49 5323 948655
info@genetworld.com

Description

Cheap, reliable and rugged sensor for the measurement of barometric pressure.
The atmospheric pressure deforms a piezo-electrical element. A transmitter transforms the raw signal and provides a voltage linearly dependent on the barometric pressure.

Technical Data

Sensor

Sensing element.....Piezo crystal
Transducer.....Electronical trabsducer with voltage output
Measuring range.....800...1100 hPa
Nominal output voltage.....0.25...4.25 V
Supply voltage range.....9.0...15 V
No load current consumption @ 12 V.....0.7 mA

Environmental Conditions

Operating temperature range.....0...+85°C (with internal compensation)
.....-25...+85°C (without internal compensation)

Casing

Material.....Plastic
Protection class.....IP 54
Dimensions.....50 x 53 x 37 mm
Weight.....0.1 kg

Wiring

Brown.....GND
White.....supply voltage
Green.....output signal

Power supply and measuring output are protected against reverse voltage and over voltage up to 30 V.

Gain..... ~ 0.075
Offset..... ~ 780

For details see calibration report.

7.6 Solar Aviation Light

SOLAR POWERED • SELF-CONTAINED • MAINTENANCE FREE • RUGGED

Model A601

360° Two Mile[1] Aviation Marking Light

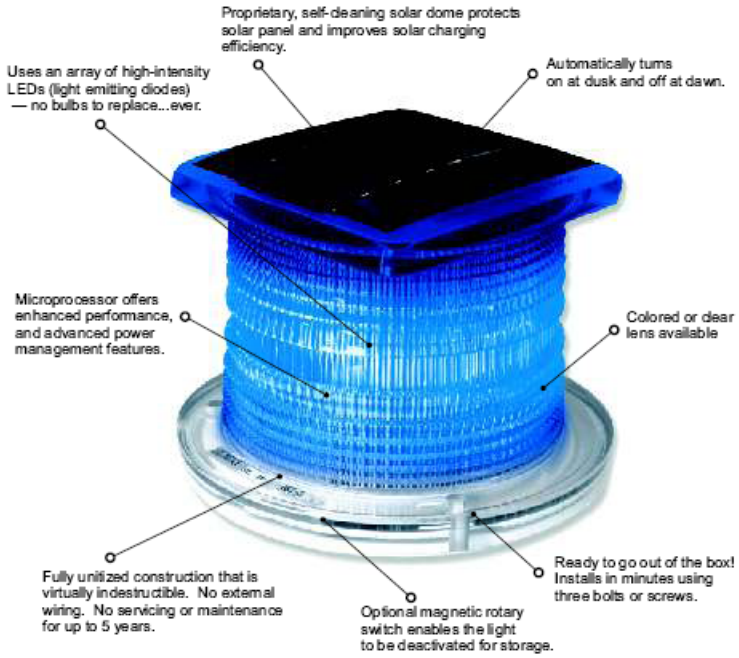
SOLAR AVIATION LIGHT

Typical Applications

- Taxiway edge lighting
- Obstruction lighting
- Apron edge lighting
- Heli-pad perimeter lighting
- Barricade lighting
- Emergency & portable lighting
- Parking compounds
- Security lighting
- Building, tower & fence lighting
- Wind cone lighting

Features & Benefits

- Meets the requirements of ICAO Annex 14, Volume I, Sections 5.3.16.6 and Appendix I, 2.1.1 for taxiway edge lighting.
- Also acceptable for use for barricade & construction applications at Commercial Part 139 Airports under FAA Advisory Circular AC 150/5370-2E.
- Improves airport safety
- Installation takes minutes and requires minimal technical expertise
- Provides up to five years of operation with no maintenance, servicing or infrastructure costs
- Completely self-contained and watertight. Designed to operate reliably in harshest of environmental conditions
- Will charge under nearly all weather conditions
- Up to 200 hours of operating capacity from a full charge
- Polycarbonate/polymer encapsulated construction is non-corrosive and virtually indestructible
- Distance of visibility up to 2 miles (3.6 kilometers)
- Available in red, green, amber, white and blue
- Any flash pattern available from the factory. Can also be programmed by the user using optional infrared remote control
- Manufactured under ISO:9001 Quality Assurance Practices
- 30 day satisfaction guarantee and three year warranty



Certified compliant to ICAO Annex 14, Vol 1, Para 5.3.16

The Carmanah Model A601 is the world's most advanced solar LED (light emitting diode) aviation marking light. Ideal for all types of taxiway, obstruction, heli-pad perimeter, barricade and general airfield lighting applications. The A601 installs in minutes and requires no maintenance or servicing for up to five years.

Typical Applications

Designed as a cost effective, maintenance-free lighting solution for commercial, military, private and general aviation airfields. The Model A601 is a completely integrated, self-contained unit that does not require any external electrical source or bulb/battery replacement for its entire 5 year lifespan. It is also designed to be extremely durable, waterproof and virtually indestructible.

The Model A601 offers cost-effective performance. Based on an independent cost analysis, they will pay for themselves within their first year of operation - in the form of reduced installation, maintenance and servicing costs.

The Technology

Utilizing an innovative combination of solar power and LED (light emitting diode) technology, the Model A601 charges during the day, even under cloudy conditions.

The Model A601 also features sophisticated microprocessor intelligence that enables advanced light output control and battery power management.

30-Day Risk-Free Evaluation

Order a Model A601 today and evaluate the product's quality, performance and reliability for yourself. If you are not fully satisfied, you can return the unit within 30 days for a refund of the purchase price.

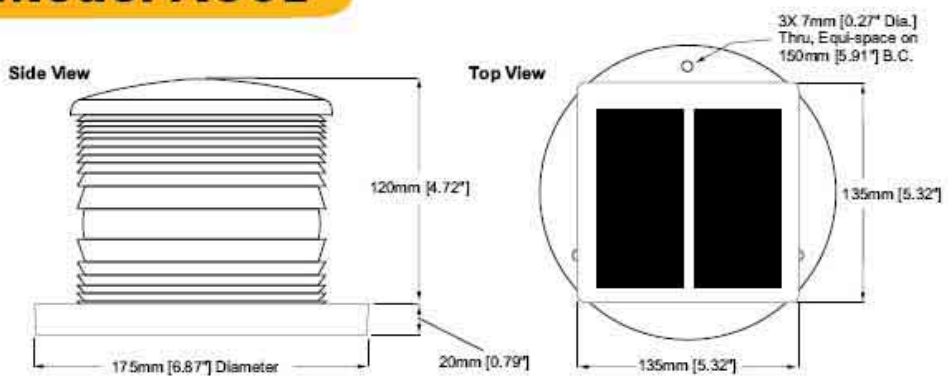
No external wiring, no battery or bulb replacement, no maintenance, no worries...

Carmanah THE LEADER IN SOLAR LED LIGHTING SOLUTIONS

SOLAR POWERED • SELF-CONTAINED • MAINTENANCE FREE • RUGGED

Model A601

360° Two Mile[1] Aviation Marking Light



Optional mount fits standard 1.5" coupling or 1.5" column to 2" NPT adapter (NPT adapter not included)

Obstruction Light

Taxiway Edge Light

Apron Edge Light

SPECIFICATIONS

LIGHT OUTPUT	FLASHING[2]	STEADY ON
Effective Intensity *(Transmissivity constant of 0.74)*		
Green	~ 11 Candela	~ 4 Candela
Red, Amber, White, Blue	~ 6 Candela	~ 2 Candela
Nominal Night Range *(Employs Method of Schmidt-Clausen)*		
Green	~ 2.9 NM	~ 2.0 NM
Red, Amber, White, Blue	~ 2.3 NM	~ 1.5 NM
Vertical Divergence	0 to 6 degrees	
Horizontal Output	360°	

OPERATION		
Minimum Autonomy[3]	300 Hours	150 Hours
Minimum Equivalent Peak Sun Hours to Maintain Minimum Autonomy	1.5 Hours	3 Hours
Latitude Range[4]	55° S to 55° N	
On / Off Level	70 / 100 Lux	
Illumination Technology	8 or 16 LEDs, depending on color	
Lifespan of LEDs	Up to 100,000 Hours	
Available Standard Flash Patterns *(Custom patterns available)*	208 including "steady-on"	

SOLAR PANELS	
Type	Mono-Crystalline Potted with UV-protected polyurethane and domed for higher efficiency
Maximum Power	1.4 Watts
Efficiency	14%

BATTERY	
Type	Pure-lead thin plate with starved-electrolyte
Nominal Voltage	4 Volts
Capacity	5 Amp-hr at 10-hr discharge rate

CONSTRUCTION	
Lens Material	Polycarbonate
Battery Venting	Vent at the bottom of the lantern
Sealing	Self-contained unit, potted with polyurethane
Weight	2.2 kg (4.85 lbs)

ENVIRONMENTAL and ELECTRICAL	
Temperature Range[5]	-40° to +80° C (-40° to 176° F)
Waterproof	As per IP67 (NEMA 6)
CE Approval	As per EN 60945:1997

TRADEMARKS and PATENTS	
Trademarks and Patents	US Patents: 5,782,552 & 6,013,985 European Patent Application: 96925627.0 Other Patents Pending

[1] *Actual range is dependant on flash pattern, intensity, and LED color.*
[2] *All "Flashing" light specifications are based on 100% intensity setting at 12.5% duty cycle (code 064 - 15 flashes per minute).*
[3] *Actual figures for autonomy depend on the intensity level setting.*
[4] *Lights will function reliably at higher latitudes than 55° North or South if intensity/autonomy is properly adjusted to suit operating environment by an Authorized Carmanah Representative.*
[5] *Consistent ambient temperatures above +25°C (+77°F) may affect overall battery life. Temperatures above +60°C (+140°F) may affect output.*

All specifications are subject to change without notice.

REPRESENTED BY

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Carmanah

THE LEADER IN SOLAR LED LIGHTING SOLUTIONS