Kipp & Zonen

INSTRUCTION MANUAL

UVS SERIES

UV RADIOMETERS

PLEASE NOTE:

This manual refers to instruments bought before December 2007.

On newer instruments the connector type and the colour of the cables have changed and therefore require the new manual.

IMPORTANT USER INFORMATION

Reading this entire manual is recommended for full understanding of the use of this product**.**

Should you have any comments on this manual we will be pleased to receive them at:

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Kipp & Zonen reserve the right to make changes to the specifications without prior notice.

WARRANTY AND LIABILITY

Kipp & Zonen guarantees that the product delivered has been thoroughly tested to ensure that it meets its published specifications. The warranty included in the conditions of delivery is valid only if the product has been installed and used according to the instructions supplied by Kipp & Zonen.

Kipp & Zonen shall in no event be liable for incidental or consequential damages, including without limitation, lost profits, loss of income, loss of business opportunities, loss of use and other related exposures, however caused, arising from the faulty and incorrect use of the product.
User made modifications can affect the validity of the CE declaration.

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Kipp & Zonen

CE

DECLARATION OF CONFORMITY

According to EC guideline 89/336/EEC 73/23/EEC

We **Kipp & Zonen B.V.**
Delftechpark 36
2628 XH Delft
The Netherlands

Declare under our sole responsibility that the product

Type: **UV-S-X-X**
Name: **UV Sensors**

To which this declaration relates is in conformity with the following standards

Imissions	EN 50082-1	Group standard
Emissions	EN 50081-1 EN 55022	Group standard
Safety standard	IEC 1010-1	

Following the provisions of the directive

B.A.H. Dieterink
President
KIPP & ZONEN B.V.

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1. GENERAL INFORMATION

1.1 INTRODUCTION

The sensors of the UV Series (UV-S-E-T, UV-S -B-T, UV-S-A-T, UV-S-AE-T, UV-S-AB-T) are designed for precise measurements of atmospheric ultraviolet radiation in three different spectral ranges. All models measure global UV radiation, i.e. the sum of direct solar radiation and the radiation which has been scattered at particles or molecules in the air. The angular response follows the cosine of the zenith angle as with an ideal Lambertian surface.

The internal filter optics, detector and electronic preamplifier of the UV Series are thermoelectrically kept at a temperature of 25°C, independent of the external temperature. This eliminates variations of the spectral sensitivity caused by changing ambient temperatures. In order to allow monitoring the internal temperature, an analog voltage output is available, which is generated by an independent control circuit.

The spectral sensitivity of the UV-S-E-T corresponds to that of the human skin with regard to erythemal action (CIE 1987). The analog output voltage is a direct measure of the erythemal active irradiance in the unit MED/h (Minimum Erythema Doses per hour), which can also be expressed in W/m^2 of UV irradiance after weighting with the erythemal action spectrum CIE 1987. This irradiance can also be expressed in the unit UV Index.

The sensors UV-S-B-T and UV-S-A-T allow precise measurements of atmospheric UV-B and UV-A irradiance. The analog output voltage is proportional to the UV-B and UV-A band irradiances in W/m^2.

The dual band sensors UV-S-AE-T and UV-S-AB-T have two separate outputs, one for UV-A band irradiance and one for erythemal active UV irradiance (UV-S-AE-T), or one for UV-A and one for UV-B band irradiance (UV-S-AB-T). The spectral and angular

characteristics correspond to those of the respective single band sensors.

2 TECHNICAL DATA

	UV-S-E-T	UV-S-B-T	UV-S-A-T	UV-S-AB/AE-T
Optical				
Spectral response see figures	Single band			Dual band
Spectral response optimized for measurement of	Erythemal active UV irradiance (EAI)	UV-B irradiance	UV-A irradiance	UV-A + B irradiance/ UV-A + Erythemal active UV irradiance
Contribution at wavelengths > 400 nm	<0.1% of output			
Cosine response	< 4% between 0°and 70° zenith angle			

	UV-S-E/B/A-T		UV-S-AB/AE-T
Electrical			
Output	analog voltage proportional to irradiance		
Control output for internal temperature	2.5 V ~ 25 °C		2.5 V ~ 25 °C
Operation temperature range[(7)]	-25 to +50°C, full spec. -40 to +50°C, reduced spec.		-25 to +50°C, full spec. -40 to +50°C, reduced spec.
Supply voltage	7-18 V 8 W		7-18 V 8 W
Mechanical			
Material	Case: protected aluminium, polyester coated; Dome: quartz		
Connector	LEMO 1E Series, 6 pole		LEMO 1E Series, 6 pole
Height Diameter	145 mm 122 mm		145 mm 122 mm, without mounting platform
Weight	< 1kg		< 1kg

3 INSTALLATION

When installing the sensors, you must consider:

1. The sensors should be installed as high as possible to minimize obscuration by trees, buildings, etc. This includes the obscuration of the indirect, scattered radiation coming from the whole upper hemisphere. A large portion of the received UV radiation does not reach the sensor directly from the direction of the sun but is scattered at molecules and particles.

2. The sensors should be carefully levelled in the horizontal plane. Use the built-in levelling spirit to find the correct position.

3. The installation of the sensor must ensure a sufficient natural ventilation. This natural ventilation must be able to sink the solar radiative heating of the sensor case and the electrical power dissipation. An excess of the allowable case temperature may cause damages.

3.1 PIN CONNECTION OF ALL UV VERSIONS

Pin connection scheme at the connector
[color code of connection cable]:

1 - V+: positive supply voltage for signal circuit, 7 - 18 V, 8 W
[red]

2 - M: Signal ground, circuit and analog outputs
[black]

3 - UVE or UVB: output 0 - 3 V,
[green]

4 - AT: temperature output, see table in Appendix III
[yellow]

5 - UVA: output 0 - 3 V,
[white]

6 - MT: supply ground (thermostat and electronics)
[brown]

Voltage drop over connection wires:
For a correct operation of the sensor it is required that the power supply and the connection cable have a total resistance which does not exceed a critical value $R_{max.}$ This is to prevent that the voltage drop over the connection wires will reduce the supply voltage beyond the lower limit of the sensor electronics.

The formula for R_{max} reads

$$R_{max} = ([VT+] - 6\ V) / 1.2\ A$$

where [VT+] is the supply voltage and R_{max} is the sum of the total wire resistance and the internal resistance of the power supply.

Example 1: The supply voltage is 12 V. The internal resistance of the power supply is 1 Ω (i.e. voltage drop of 1 V at 1 A load). Then the allowable total wire resistance (sum of positive and negative supply wire) is 4 Ω.

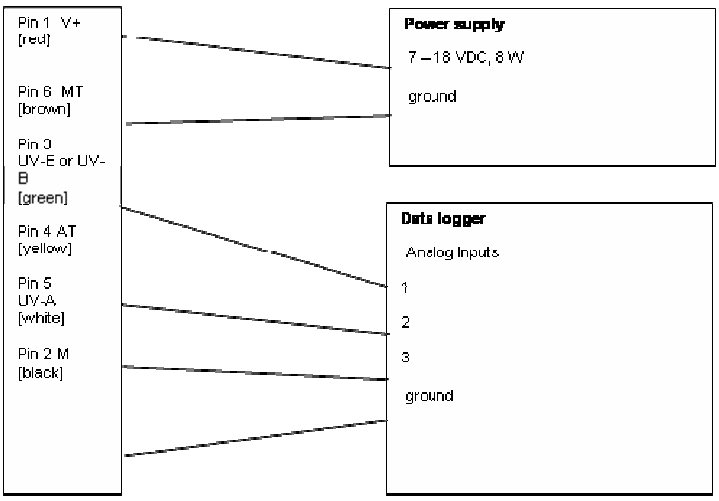
Example 2: To calculate the minimum voltage that is required for a correct operation of the sensor with the standard cable of 10 meters the above equation has to be reformulated as follows.

$$[VT+] = 1.2A \bullet R_{tot} + 6V$$

where R_{tot} is the sum of the resistances (internal resistance of the power supply and total wire resistance). With the wire resistance of 0.15Ω/m a total wire resistance of 2 x 1.5Ω = 3Ω for the standard 10 meters cables is obtained. With an internal resistance of 1Ω (power supply) the sum of the resistances is 4Ω (equals R_{tot}). To compensate the voltage drop over the wires and the power supply, the voltage supply [VT+] must be set to at least 10.8V. Hence, with a power supply (internal resistance 1Ω) that provides at least 10.8V the sensors operates correctly.

Data logger input channels:
To prevent earth loops that influence the data signal of the sensor it is recommended to use floating inputs to measure the sensor data output signals. If the input of the data logger is not floating it may be useful to test the sensor signal on noise due to earth loops over the datalogger input channels.

Connection scheme: UV series



4 MAINTENANCE AND RECALIBRATION

The quartz dome should regularly be cleaned. You may use a mild window cleansing agent which must be generously rinsed with clear water and wiped dry with a clean cloth.

The quartz dome can be replaced when damaged. In order to replace the dome, loosen the 6 screws in the outer ring and remove the ring and the dome with flange. Take care not to touch the diffuser. Check the condition of the O-ring and replace it when necessary. Re-assemble in reverse order.

Another periodic check should ensure that the instrument is level and that the silica gel is still coloured orange. When the orange silica gel in the drying cartridge is turned completely transparent (normally after several months), it must be replaced by active silicagel as supplied in the small refill packs. The content of one pack is sufficient for one complete refill.

Periodical recalibration of the sensors is recommended and provided by Kipp & Zonen according to ISO standards. We recommend a recalibration interval of 12 months.

5 CALIBRATION

The calibration of the UVS radiometer series is performed with a Xe-lamp system, a monochromator (ORIEL Cornerstone MS257), and a calibrated Si-photodiode detector. The Si-photodiode detector and the UVS radiometer series, mounted behind the exit slit of the monochromator, measure the spectral irradiance between 280nm and 400nm with increments of 1nm. The spectral measurements are performed sequentially as the monochromator has one output slit only. To keep the monochromator output identical for both detectors the sensitive surface of both detectors is positioned at the same distance from the output slit. From the spectral measurement performed with the UVS radiometer series the “raw output” (in units of Volts) is obtained according to $U_{UVS}=\int u_{UVS}(\lambda)\bullet d\lambda$, where $u_{UVS}(\lambda)$ is a single spectral measurement. The measurement with the Si-photodiode is used to determine the UVS radiometer-weighted irradiance (in units of W/m^2) according to $E_{UVS}=(\int e_{Si}(\lambda)\bullet S_{UVS}(\lambda)\bullet d\lambda)/A_{eff}$, where $e_{Si}(\lambda)$ is the irradiance (in Watts) of the monochromator output (measured with the Si-photodiode), $S_{UVS}(\lambda)$ is the normalized spectral response function of the UVS radiometer, and A_{eff} is the effective surface area (in m^2) of the UVS radiometer. Finally, the radiometric calibration factor of the UVS radiometer is obtained according to $r=U_{UVS}/E_{UVS}$ which is represented in units of V/(W/m2). To account for the spectral mismatch error, based on a radiative transfer model (for various atmospheric conditions), the mean sensitivity (χ) is determined.

6 PART NUMBERS / SPARE PARTS / OPTIONS

PARTS		
UV RADIATION SENSORS		Part No.
UV-S-E-T*	(erythemal active)	0354930
UV-S-B-T*	(UV-B)	0354925
UV-S-A-T*	(UV-A)	0354920
UV-S-AE-T*	(dual band)	0354945
UV-S-AB-T*	(dual band)	0354940

OPTIONS	Part No.
Extra connector without cable for UV-S-X-T	2524993
Power supply 230V, 50Hz for sensors UV-S-X-T (others on request)	03494101

APPENDIX I: ERYTHEMA ACTION SPECTRUM ACCORDING TO CIE 1987 (DIN 5050)

λ[nm]	Weighting	λ[nm]	Weighting	λ[nm]	Weighting
290	1.000E+00	327	0.188E-02	364	0.422E-03
291	1.000E+00	328	0.151E-02	365	0.407E-03
292	1.000E+00	329	0.141E-02	366	0.394E-03
293	1.000E+00	330	0.136E-02	367	0.380E-03
294	1.000E+00	331	0.132E-02	368	0.367E-03
295	1.000E+00	332	0.127E-02	369	0.355E-03
296	1.000E+00	333	0.123E-02	370	0.343E-03
297	1.000E+00	334	0.119E-02	371	0.331E-03
298	1.000E+00	335	0.115E-02	372	0.320E-03
299	0.805E+00	336	0.111E-02	373	0.309E-03
300	0.649E+00	337	0.107E-02	374	0.299E-03
301	0.522E+00	338	0.104E-02	375	0.288E-03
302	0.421E+00	339	0.100E-02	376	0.279E-03
303	0.339E+00	340	0.966E-03	377	0.269E-03
304	0.273E+00	341	0.933E-03	378	0.260E-03
305	0.220E+00	342	0.902E-03	379	0.251E-03
306	0.177E+00	343	0.871E-03	380	0.243E-03
307	0.143E+00	344	0.841E-03	381	0.234E-03
308	0.115E+00	345	0.813E-03	382	0.226E-03
309	0.925E-01	346	0.785E-03	383	0.219E-03
310	0.745E-01	347	0.759E-03	384	0.211E-03
311	0.600E-01	348	0.733E-03	385	0.204E-03
312	0.483E-01	349	0.708E-03	386	0.197E-03
313	0.389E-01	350	0.684E-03	387	0.191E-03
314	0.313E-01	351	0.661E-03	388	0.184E-03
315	0.252E-01	352	0.638E-03	389	0.178E-03
316	0.203E-01	353	0.617E-03	390	0.172E-03
317	0.164E-01	354	0.596E-03	391	0.166E-03
318	0.132E-01	355	0.575E-03	392	0.160E-03
319	0.106E-01	356	0.556E-03	393	0.155E-03
320	0.855E-02	357	0.537E-03	394	0.150E-03
321	0.689E-02	358	0.519E-03	395	0.145E-03
322	0.555E-02	359	0.501E-03	396	0.140E-03
323	0.447E-02	360	0.484E-03	397	0.135E-03
324	0.360E-02	361	0.468E-03	398	0.130E-03
325	0.290E-02	362	0.452E-03	399	0.126E-03
326	0.233E-02	363	0.437E-03	400	0.122E-03

APPENDIX II: CONVERSION OF OUTPUT VOLTAGE FOR INTERNAL TEMPERATURE

Relation between the voltage at the temperature output (pin 4 AT) and the internal sensor temperature for all models UV-S-E-T, UV-S-B-T, UV-S-A-T, UV-S-AE-T, UV-S-AB-T:

V	°C
0.5	-23
0.6	-19
0.7	-16
0.8	-13
0.9	-10
1.0	-7
1.1	-5
1.2	-2
1.3	0
1.4	2
1.5	5
1.6	7
1.7	9

V	°C
1.8	11
1.9	13
2.0	15
2.1	17
2.2	19
2.3	21
2.4	23
2.5	25
2.6	27
2.7	29
2.8	31
2.9	34
3.0	36

APPENDIX III: RECALIBRATION SERVICE

Pyranometers, UV-meters, Pyrgeometers & Sunshine duration sensors

Kipp & Zonen solar radiation measurement instruments comply with the most demanding international standards. In order to maintain the specified performance of these instruments, Kipp & Zonen recommends calibration of their instruments annually.

This can be done at the Kipp & Zonen factory. Here, recalibration to the highest standards can be performed at low cost. Recalibration can usually be performed within four weeks. If required, urgent recalibration can be accomplished in three weeks or less (subject to scheduling restrictions). Kipp & Zonen will confirm the duration of recalibration at all times. Please note that special quantity recalibration discounts are available.

For your convenience we added three fax forms to schedule the recalibration of your instrument(s) at Kipp & Zonen.

Kipp & Zonen

RECALIBRATION FORM

NAME :
COMPANY/INSTITUTE :
ADDRESS :
POSTCODE +CITY :
COUNTRY :
PHONE :
FAX :

☐ **I would like to receive a price list for recalibration**

☐ **I would like to submit my instruments for recalibration**

Type/Model:	Qty:	Requested delivery time
		I intend to send the instruments to Kipp & Zonen on: . . . . . ./. . . . . ./. . . . .
		I would like to receive the instrument(s) back on: . . . . . ./. . . . . ./. . . . .

Conformation by Kipp & Zonen
☐ Yes, the dates are acceptable to us ☐ No, unfortunately the dates do not fit into our calibration schedule. We suggest the following dates: . . . . . ./. . . . . ./. . . . ./. . . . . ./. . . . . .

Fax +31-15-2620351

or mail to:

Kipp & Zonen P.O. Box 507 2600AM
Delft The Netherlands

Kipp & Zonen

RECALIBRATION FORM

NAME :
COMPANY/INSTITUTE :
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POSTCODE +CITY :
COUNTRY :
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