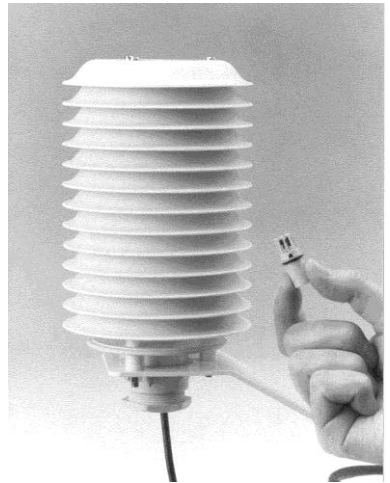

User Manual for the

RH and Air Temperature Sensors

types RHT2 and AT2



RHT2-UM-1.1

AT

Delta-T Devices Ltd

Notices

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CE conformity

RHT2

The sensors described in this document are CE marked by the manufacturer.

AT2

The sensor described in this document is a passive component as defined by the EU EMC Directive 89/336/EEC, and is not CE marked.

When used with Delta-T logging systems according to the instructions contained in this document, the sensor does not significantly affect the EMC performance when assessed under EN 50081 and EN 50082.

If the sensor is used with any other measuring equipment, it is the responsibility of the user to ensure the EMC compliance of any such measuring systems.

Design changes

Delta-T Devices Ltd reserves the right to change the designs and specifications of its products at any time without prior notice.

This manual applies to RHT2V serial numbers 433 and later, supplied from June 2009, when the sensor wire colours were changed

User Manual Version: 1.1 May 2009

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Introduction

Summary of Features

The RHT2 and AT2 sensors are designed for weather station measurements of relative humidity and air temperature.

They are lower cost replacements for the former Delta-T RHA1 and AT1 sensors, with superior specifications and reduced maintenance cost for the RH sensor.

Solar Radiation Shield

The common feature of the RHT2 and AT2 sensors is the solar radiation shield that protects the sensors from solar radiation and rain when they are mounted outdoors.

The features include:

- 13-plate naturally aspirated shield
- UV stabilised thermoplastic plates
- Good solar radiation shielding
- Protection from long wave ground thermal radiation
- Simple mounting bracket for vertical or horizontal masts or poles up to 50 mm diameter

RHT2

The RHT2 comprises an RH and air temperature transducer housed in the solar radiation shield. The transducer requires power and provides two output signals for the RH and air temperature.

The RH and air temperature sensing elements are contained in a plug-in module. The module is interchangeable and can be replaced at routine maintenance intervals.

The modules come in two versions depending on the precision of temperature measurement required:

- The RHT2nl gives highest temperature precision of ± 0.1 °C with non-linear thermistor output.
- The RHT2v temperature precision is ± 0.5 °C, with a linear 0-1V output derived from a PRT temperature element.

The features are:

- High RH accuracy and stability.

- Simple 0-1V linear outputs for easy interfacing.
- High temperature accuracy with thermistor sensors, if required.
- Interchangeable plug-in replacement sensor modules. Avoid the need to return sensor for recalibration.
- Low transducer power requirement 5.5 to 32V DC, 2 mA.

AT2

This is a high accuracy, shielded, air temperature probe for weather station measurements.

- High accuracy thermistor sensor.
- Stainless steel sheathed probe (125 mm long x 4.8 mm diameter).
- Output easily logged as temperature with Delta-T loggers.
- No sensor power requirement.

Scope of This Manual

This manual contains the specifications and performance of the RHT2nl, RHT2v, and AT2 sensors, and describes their installation with Delta-T data loggers.

You may also need to refer to the appropriate Delta-T logger or Weather Station manual or on-line Help.

Installation

Unpacking

Check for any damage that may have occurred to the consignment in transit. Check that the contents of the consignment agree with the Packing List.

If any damage or shortage is apparent, notify the agents and the carriers immediately.

Make a note of the sensor(s) serial number(s), and check that the cable supplied is the length that was ordered. The serial numbers will be needed in any subsequent warranty claims, repairs or recalibration

Additional The parts supplied may also include:

RHT2 (nl or v)

- Solar Radiation Shield and bracket.
- RH Sensor with cable attached, and housing sleeve.
- Spare plug-in sensor module(s).
- User Manual for RHT2 and AT2.

AT2

- Solar Radiation Shield and bracket.
- Temperature probe with cable attached, and housing sleeve.
- User Manual for RHT2 and AT2.

Solar Radiation Shield

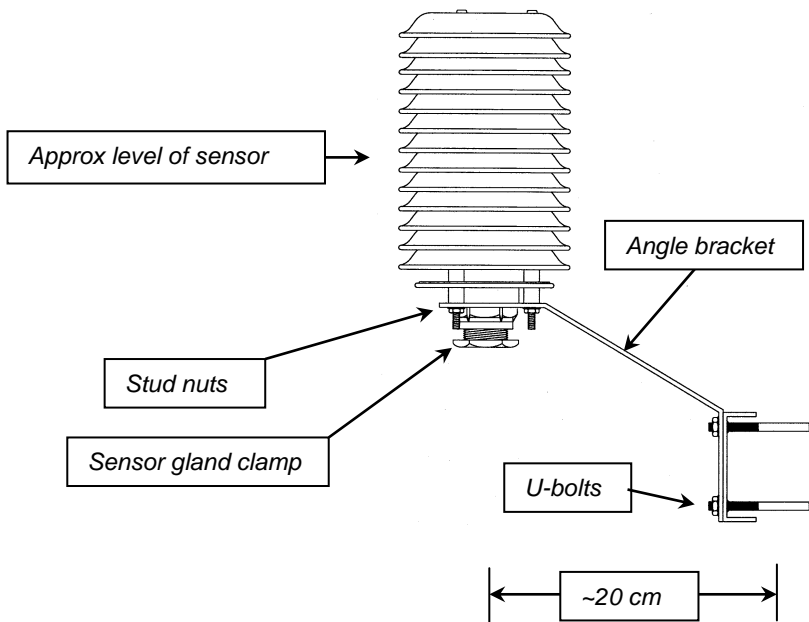
Mounting the Shield

If the shield has not been pre-assembled, fix the angle bracket to the shield using the three stud nuts. You can then attach the angle bracket to a horizontal or vertical pole or mast using the U-bolts provided.

After the shield has been mounted, you can fit either the RHT2 sensor or the AT2 temperature probe through the sensor gland clamp, from below. A housing sleeve is provided with each sensor to enable you to position the sensor element within the shield at the approximate level shown.

You can subsequently remove the sensors easily for inspection without dismantling the shield from the mast.

Figure 1



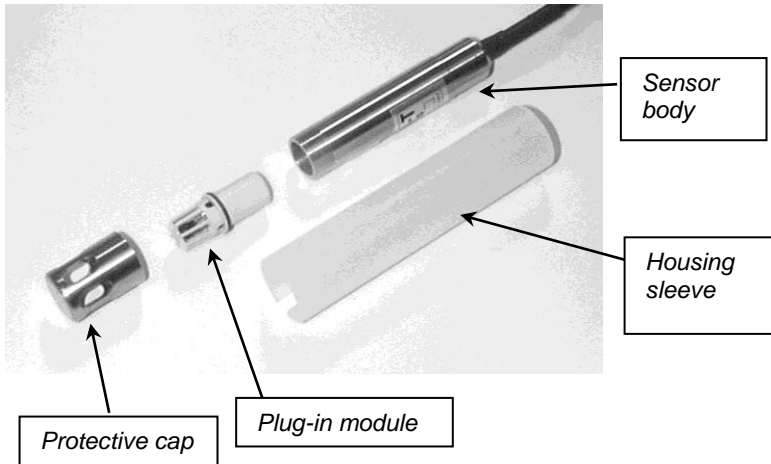
Shield Specifications

Parameter	Value
Overall height	22 cm
Diameter	12 cm
Plate spacing	11 mm
Top plates	3
Lower plates	10
Material	UV stabilised thermoplastic
Radiation temperature error at 1 kW.m ⁻² irradiance level:	0.4°C @ 3 m.s ⁻¹ 0.65°C @ 2 m.s ⁻¹ 1.4°C @ 1 m.s ⁻¹ or slower

RHT2

Description

Figure 2



The RHT2 sensor has a removable protective cap. When this is unscrewed, the sensing element module is exposed. It can be unplugged for inspection or replacement.

The module contains both the RH and air temperature sensing elements.

Mounting the Sensor

A plastic housing sleeve is provided. This is slotted so that it you can place it over the cable and then around the body of the sensor before insertion in the Radiation Shield.

Position the RH sensor so that the sensing elements are approximately at the level shown in the fig 1.

RHT2nl - Sensor Connections

Outline Specs

RHT2nl:	Value
RH Output	10mV per %RH 0-1 V for 0-100%RH
Temperature Output (thermistor)	2 k Ω at 25°C, non-linear

Sensor Wiring

The RHT2nl sensor is fitted with 2m of cable with bare wire ends as standard.

RHT2nl:	Function	Notes
White	RH Signal HI	
Green	RH Signal LO	Common with Power 0V at the sensor
Blue	Thermistor HI	
Yellow	Thermistor LO	
Red	Power V+	
Black	Power 0V	
Screen	screen	Connected to body of sensor

Power Requirements

RHT2nl (RH transducer only)	5.5-32 V dc, unswitched. <2mA
Power warm up time	1 second

Cable

Up to 100m of cable can be fitted at time of ordering.

The RH voltage output is not sensitive to the cable length within this limit.

The Air Temperature thermistor reading may be slightly affected by long cable lengths. See the AT2 sensor section for further details.

Data Requirements

Typical common usage:

RH, and Air Temperature	Sample every minute. Average every hour or half-hour.
-------------------------	--

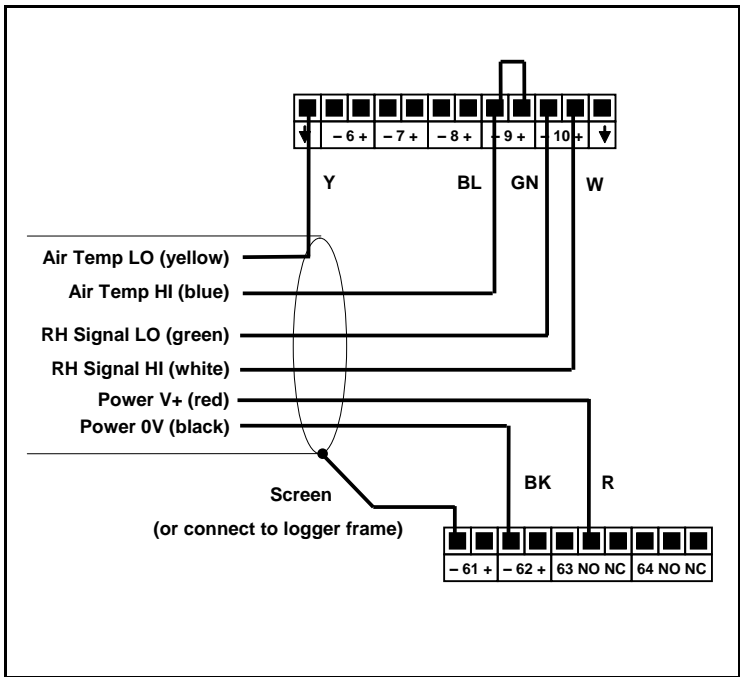
RHT2nl - Logger Connections

DL2e Logger

Use with LAC1

This diagram shows the wiring connections for the LAC1 analogue input card. For use with other cards, please refer to DL2e Logger User Manual

RHT2nl Wiring Schematic for DL2e



Settings

The example shows the RH sensor output connected to analogue channel number 10, and the Air Temperature (thermistor) output connected to channel number 9 in the DL2e logger.

The LAC1 input card is used in its 15-channel (differential) mode, with the 15-30 slider set to "15".

Power for the RH transducer is shown routed through relay channel 63. Power from the logger's own battery is connected to terminal 63 using the internal jumper in the DL2e logger. Alternative sources of power can be used, if preferred (see the DL2e User Manual).

Note: The cable screen is connected to channel 61- or 62- terminals for electrical screening purposes. These are the digital earth/frame connections of the DL2e, and are also used for the Power 0V return.

DL2e Sensor Codes

RHT2nl – Relative Humidity

When creating your DL2e logger configuration with the LS2Win software, you can use the RH2 sensor code provided.

Note: you can download the latest version of LS2Win from <http://www.delta-t.co.uk/software-download.html>

Alternatively, you can create a sensor code using the correct value of conversion factor (10.0 mV per %RH).

Warning! Do not use the sensor code “%RH” for the former RHA1 humidity sensor. It has a different conversion factor that will give incorrect results if used with the RHT2.

All that remains is to choose suitable sampling and logging intervals (see *data requirements*) in your logging configuration.

RHT2nl – Air Temperature

Use the TM1 sensor code.

Relay warm up for powered channels

The RH transducer needs power warm-up. Specify one of the relay channels 63 or 64 and configure it for the warm-up function with a warm-up time of 1 second.

RHT2v - Sensor Connections

Outline Specs

RHT2v:	Value
RH Output	10mV per %RH 0-1 V for 0-100%RH
Air Temperature Output (voltage)	10mV per °C 0-1 V for -20 to +80 °C

Sensor Wiring

The RHT2v sensor is fitted with 2m of cable with bare wire ends as standard.

The preferred wiring avoids possible errors caused by long cable runs.

RHT2v:	Function	Notes
White	RH Signal HI	
Blue	Air Temp Signal HI	
Red	Power V+	
Black	Power 0V RH Signal LO Air Temp Signal LO	
Green	Not used	No connection to black within the sensor.
Yellow	Not used	
Screen	Screen	Connected to body of sensor

Power Requirements

RHT2v:	
RH Output, and Air Temp (voltage) Output	5.5-32 V dc, unstabilised. 2mA max
Power warm up time	1 second

Cable

Up to 100m of cable can be fitted at time of ordering.

Data Requirements

Typical common usage:

RH, and Air Temperature	Sample every minute. Average every hour or half-hour.
----------------------------	--

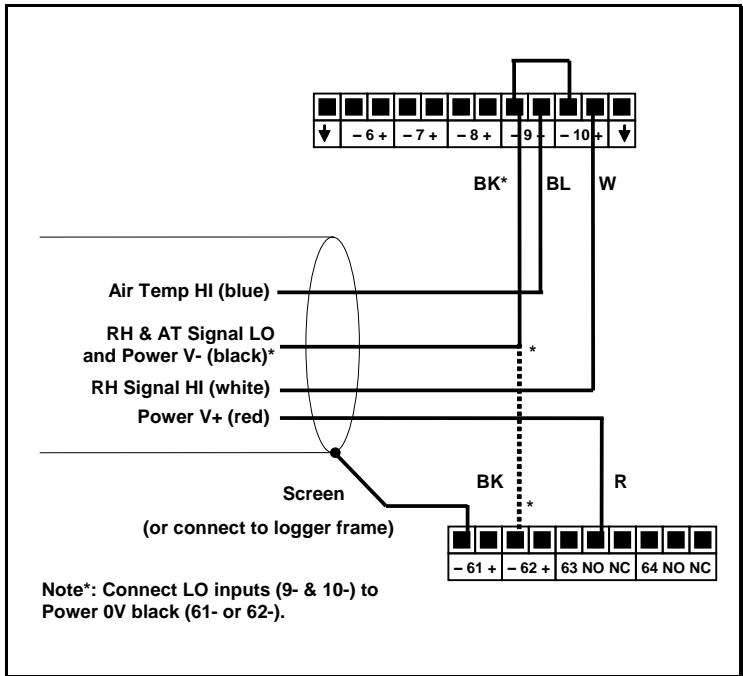
RHT2v - Logger Connections

DL2e Logger

Use with LAC1

This diagram shows the wiring connections for the LAC1 analogue input card. For use with other cards, please refer to DL2e Logger User Manual.

RHT2v Wiring Schematic for DL2e



Settings

The example shows the RH sensor output connected to analogue channel number 10, and the Air Temperature voltage output connected to channel number 9 in the DL2e logger.

The LAC1 input card is used in its 15-channel (differential) mode, with the 15-30 slider set to "15".

Power for the RH and Air Temperature transducers is shown routed through relay channel 63. Power from the logger's own battery is connected to terminal 63 using the internal jumper in the DL2e logger. Alternative sources of power can be used, if preferred (see the DL2e User Manual).

Note: The cable screen is connected to channel 61- or 62- terminals for electrical screening purposes. These are the digital earth/frame connections of the DL2e, and are used also for the Power 0V return.

DL2e Sensor Codes

RHT2v – Relative Humidity

When creating your DL2e logger configuration with the Ls2Win software, you can use the RH2 sensor code provided.

Note: you can download the latest version of LS2Win from <http://www.delta-t.co.uk/software-download.html>

Alternatively, you can create a sensor code using the correct value of conversion factor (10.0 mV per %RH).

Warning! Do not use the sensor code "%RH" for the former RHA1 humidity sensor. It has a different conversion factor that will give incorrect results if used with the RHT2.

All that remains is to choose suitable sampling and logging intervals (see *data requirements*) in your logging configuration.

RHT2v – Air Temperature

Create a new sensor code (for example "ATV") in your logger configuration using the following values:

SENSOR code	ATV
signal	V
UNITS Base	mV
UNITS Eng'ng	deg C
CONVERSION Factor	10 mV per deg C
Offset	-20.0 deg C
VALID RANGE Minimum	-20 deg C
VALID RANGE Maximum	80 deg C

All that remains is to choose suitable sampling and logging intervals (see *data requirements*) in your logging configuration.

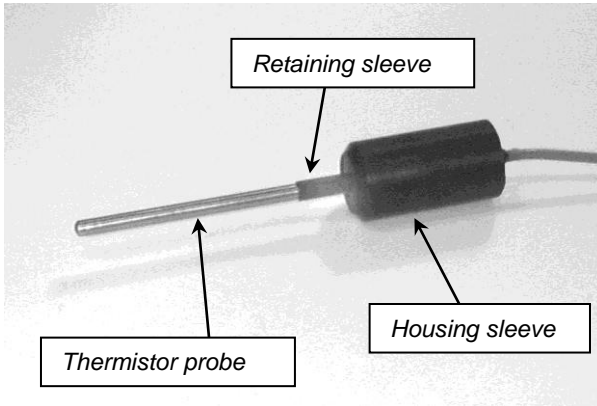
Relay warm-up for powered channels

The RH and Air Temperature transducers need power warm-up. Specify one of the relay channels 63 or 64 and configure it for the warm-up function with a warm-up time of 1 second.

AT2

Description

Figure 3



The AT2 sensor is a precision thermistor mounted in a stainless steel housing (125 mm long, 4.8 mm diameter; identical to the Delta-T type ST2 thermistor probe).

The probe is located within the housing sleeve simply by a piece of heat shrink sleeve. The housing sleeve fits in the bottom of the solar radiation shield.

AT2 - Sensor Connections

Outline Specs

Parameter	Value
Resistance output	Thermistor 2K ohm at 25°C; ±0.1°C precision over 0 to 70°C. See Appendix for R-T characteristic.

Wiring

Conductor	Function	Notes
Red	Thermistor HI	
Screen	Thermistor LO	Do not use as electromagnetic screen.

Cable

2m of single core screened cable with bare wire ends is supplied as standard. Up to 100m of cable can be fitted at time of ordering.

The AT2 sensor output when used with the TM1 sensor code *is* slightly affected by cable resistance (0.005°C per metre, at 50°C; less at lower temperatures).

Generally, this effect can be ignored, but it can be compensated for by a variety of means if required. The DL2e logger manual p13-60 *Using thermistors with the logger* gives more details.

If you need to remove excess cable, simply cut off the excess. If you need to extend the cable length, add extra cable of similar type with a waterproof joint or junction box. In either case, bear in mind the accuracy considerations above.

Data Requirements

Typical common usage:

RH, and Air Temperature	Sample every minute. Average every hour or half-hour.
-------------------------	--

AT2 - Logger Connections

DL2e Logger

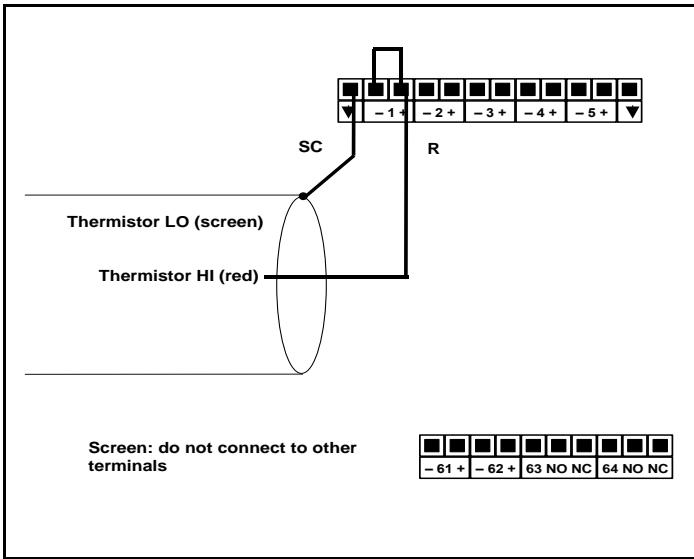
Use with LAC1

This diagram shows the wiring connections for the LAC1 analogue input card. For use with other cards, please refer to DL2e Logger User Manual.

AT2 Wiring Schematic for DL2e

Settings

The example shows the AT2 sensor output connected to analogue channel number 1. The LAC1 input card is used in its 15-channel (differential) mode, with the 15-30 slider set to "15".



Do not connect the cable screen to the logger digital ground or frame. Connect it only to the analogue ground on the screw terminal connectors of the DL2e.

AT2 – Air Temperature

Use the TM1 sensor code in your logger configuration, and choose appropriate sampling and logging intervals.

Other Loggers

Any logger with a 0 to 1000 mV input range can be used for the RH and Air Temperature (voltage) outputs. Follow the general principles laid out above.

For the thermistor temperature output (RHT2nl and AT2), the logger will require resistance measurements with non-linear lookup table capability.

Specifications

RHT2 and AT2 summary

Relative Humidity	RHT2nl & v Voltage Output
RH Output range	0 to 100%RH
Sensitivity	10 mV per %RH; 0 to 1 V
Ageing characteristic	Typical: ~-1.5 to -2% first year; ~-1% second year; ~-0.5% third year.
Accuracy at 23°C	± 2% RH (5 to 95% RH) ± 2.5% RH (RH<5% and >95%) (hysteresis and non linearity included)
Humidity linearisation	7 points, 6 segments, memorised in the module EEPROM
Air Temperature	RHT2v Voltage Output
Output range	-20 to +80°C
Sensitivity	10 mV per °C; 0 to 1 V
Accuracy	± 0.2°C (-10 to +50°C)
Air Temperature	RHT2nl and AT2 Thermistor Resistance
Output range	-50 to +150°C (thermistor only) -20 to +60°C using logger TM1 code
Thermistor resistance	2K ohm at 25°C, non-linear See Appendix for R-T characteristic
Accuracy	± 0.1°C over 0 to 70°C
AT2 probe dimensions	125 mm x 4.8 mm dia
RHT2nl & v units	
Operating conditions	0 to 100% RH, -20 to +80°C
Storage conditions	-40 to +85°C
Response time	t < 10 s (90% of a step from 11% to 75% RH).
Load impedance	> 10 kΩ.
Voltage supply	5 to 32 VDC, ≤ 2 mA
Size and Weight	length 90 mm, Ø 18 mm, 150 g
Enclosure rating	IP65

Certification

CE Conformity

See inside front cover

Calibration Certificates

No individual Calibration Certificates for the RH or Air Temperature sensors are available separately. The units as supplied will perform to the specifications included in this manual.

Maintenance

Routine Maintenance

Keep the plates of the solar radiation shield clean. Do not allow dirt or cobwebs to build up.

From time to time, remove the sensor body from the radiation shield for visual inspection, cleaning, and calibration checks.

The protective cap for the RH sensor contains a gauze screen to prevent airborne particles settling on the elements.

Do not touch the sensor elements in the sensor module. If dust or dirt is present, remove it with a gentle application of compressed air (such as is used for cleaning computer components).

Recalibration

Routine checking at least once every year is the minimum for RH sensing elements. If there is any doubt about the readings being obtained, the readings of the sensors should be compared with other certified standards for humidity and temperature (for example, an Assmann Psychrometer, or saturated salt solutions).

RHT2

The thermistor, and the PRT element used for the voltage output of the RHT2v, is very stable, and the temperature outputs should not drift significantly with time.

The RH element may show some ageing with time. This is a common feature of all capacitative polymer type sensors. The drift reduces with

age. Typical drift figures may be ~-1.5 to -2% in the first year, ~-1% in the second year, and ~-0.5% in the third year.

The general recommendation for the replacement interval is every two or three years, in clean atmospheric conditions. If atmospheric pollutants like solvents (alcohols, ketones, or aldehydes etc) are present, or if the atmosphere is acidic (SO₂, NO_x, Chlorine etc), then the replacement must be made every year.

No adjustment of the RH or temperature element calibration is possible. Inaccurate sensors must be replaced with a new module.

Plug-in Replacement Modules

These minimise the cost and delay of maintenance. They are interchangeable and can be fitted and used without any further calibration.

In view of the ageing characteristics mentioned above, it is better to purchase replacement modules at the time they are needed.

Modules for the two versions of the RHT2 have similar order codes:

- RHT2nl-chp (RH and high accuracy thermistor temperature output)
- RHT2v-chp (RH and air temperature voltage outputs).

Storage

Store the RH sensors in a clean atmosphere at medium humidity (say 30-70% RH), and avoid any possibility of contact with organic solvent vapours (e.g. acetone, benzaldehyde, chloroform, ethyl acetate, propane, sulphuric acid, ethylene oxide).

If modules are being stored for more than one year, they should be packed in a sealed container with desiccant.

Observe the storage temperature limitations (see Specifications).

Warranty and Service

Terms and Conditions of Sale

Our Conditions of Sale (ref: COND: 1/00) set out Delta-T's legal obligations on these matters. The following paragraphs summarise Delta-T's position but reference should always be made to the exact terms of our Conditions of Sale, which will prevail over the following explanation.

Delta-T warrants that the goods will be free from defects arising out of the materials used or poor workmanship for a period of **twelve months** from the date of delivery.

Delta-T shall be under no liability in respect of any defect arising from fair wear and tear, and the warranty does not cover damage through misuse or inexpert servicing, or other circumstances beyond our control.

If the buyer experiences problems with the goods they shall notify Delta-T (or Delta-T's local agent) as soon as they become aware of such problem.

Delta-T may rectify the problem by supplying faulty parts free of charge, or by repairing the goods free of charge at Delta-T's premises in the UK, during the warranty period,

If Delta-T requires that goods under warranty be returned to them from overseas for repair, Delta-T shall not be liable for the cost of carriage or for customs clearance in respect of such goods. However, we much prefer to have such returns discussed with us in advance, and we may, at our discretion, waive these charges.

Delta-T shall not be liable to supply products free of charge or repair any goods where the products or goods in question have been discontinued or have become obsolete, although Delta-T will endeavour to remedy the buyer's problem.

Delta-T shall not be liable to the buyer for any consequential loss, damage or compensation whatsoever (whether caused by the negligence of the Delta-T, our employees or agents or otherwise) which arise from the supply of the goods and/or services, or their use or resale by the buyer.

Delta-T shall not be liable to the buyer by reason of any delay or failure to perform our obligations in relation to the goods and/or services, if the delay or failure was due to any cause beyond the Delta-T's reasonable control.

Service and Spares

Users in countries that have a Delta-T Agent or Technical Representative should contact them in the first instance.

Spare parts for our own instruments can be supplied from our works. These can normally be despatched within a few working days of receiving an order.

Spare parts and accessories for sensors or other products not manufactured by Delta-T, may have to be obtained from our supplier, and a certain amount of additional delay is inevitable.

No goods or equipment should be returned to Delta-T without first obtaining the agreement of Delta-T or our agent.

On receipt at Delta-T, the goods will be inspected and the user informed of the likely cost and delay. We normally expect to complete repairs within a few working days of receiving the equipment. However, if the equipment has to be forwarded to our original supplier for specialist repairs or recalibration, additional delays of a few weeks may be expected.

Troubleshooting

Technical Support

Technical Support is available on Delta-T products and systems. Users in countries that have a Delta-T Agent or Technical Representative should contact them in the first instance.

Technical Support questions received by Delta-T will be handled by our Tech Support team. Your initial enquiry will be acknowledged immediately with a “T number” and an estimate of time for a detailed reply (normally 2-3 working days). Make sure to quote our T number subsequently so that we can easily trace any earlier correspondence.

In your enquiry, always quote instrument serial numbers, software version numbers, and the approximate date and source of purchase where these are relevant.

Contact details:

Tech Support Team
Delta-T Devices Ltd
130 Low Road, Burwell, Cambridge CB25 0EJ, U.K.
email: tech.support@delta-t.co.uk
email: repairs@delta-t.co.uk
Web site: www.delta-t.co.uk
Tel: +44 (0) 1638 742922
Fax: +44 (0) 1638 743155

Problems

Uncertainties relating to the accuracy of the RH or temperature readings can usually be resolved by comparison with other RH or temperature standards.

Incorrect readings are most likely to be caused by hardware problems. The following notes may help locate and correct the fault.

Temperature (Thermistor) Output

Symptom	Possible cause
Extreme low or high temperature reading	Either open circuit or short circuit of thermistor connections
Wildly variable readings	Intermittent contact or broken wire.

- Disconnect the sensor from the logger.
- Check the thermistor with a resistance meter.
- Inspect the cable for damage.
- Re-make logger connections.

RH and Temperature Voltage Outputs

Symptom	Possible cause
False zero RH reading (or -20°C temperature reading)	No power connected to sensor
Wildly variable readings	Intermittent contact or broken wire.

- Disconnect the sensor from the logger.
- Connect an independent source of power to the sensor.
- Using an electronic test meter check the voltage output(s).
- If the outputs are correct, re-make the logger connections.
- Re-check the logger channel configuration. Ensure that the warm-up function is correctly configured.

Symptom	Possible cause
Reading 100 to 105% RH	Sensor and/or its protective cap is saturated with water.

- Wait for sensor to dry out. This can take a day or more with the fine metal mesh screen. If this delay is unacceptable consider replacing the metal mesh with a PTFE screen. This is not so rugged but dries out more quickly. Contact Delta-T for details.

Appendix

Thermistor R-T Characteristic

Notes

The resistance-temperature table below contains values for the 2K3A1 thermistor. These values are virtually identical to the former UUA32J2 thermistor. The difference over the range -20 to +80°C is <0.03°C, which can be ignored for practical purposes.

Some probes do not cover the full -50 to +150°C range of the thermistor itself, owing to the physical construction of the sensor.

Some logger sensor codes cover a restricted range of temperature because of constraints on linearisation tables; for example the TM1 code covers the range -20 to +60°C.

Thermistor resistance tolerance can be specified independently, e.g.

±0.1°C	RHT2nI, AT2, ST2
±0.2°C	ST1

°C	ohm	°C	ohm	°C	ohm	°C	ohm
-50	133,177	0	6530.3	50	720.13	100	135.79
-49	124,068	1	6206.3	51	693.33	101	131.89
-48	115,640	2	5900.3	52	667.66	102	128.12
-47	107,838	3	5611.1	53	643.07	103	124.47
-46	100,611	4	5337.7	54	619.53	104	120.94
-45	93,914	5	5079.2	55	596.96	105	117.53
-44	87,704	6	4834.7	56	575.34	106	114.24
-43	81,945	7	4603.4	57	554.61	107	111.05
-42	76,599	8	4384.5	58	534.73	108	107.96
-41	71,635	9	4177.3	59	515.67	109	104.98
-40	67,023	10	3980.9	60	497.38	110	102.09
-39	62,738	11	3794.9	61	479.84	111	99.29
-38	58,753	12	3618.6	62	463.00	112	96.59
-37	55,044	13	3451.6	63	446.85	113	93.97
-36	51,595	14	3293.2	64	431.34	114	91.43
-35	48,382	15	3142.9	65	416.44	115	88.98
-34	45,388	16	3000.3	66	402.14	116	86.60
-33	42,598	17	2865.1	67	388.40	117	84.29
-32	39,997	18	2736.6	68	375.20	118	82.06
-31	37,571	19	2614.6	69	362.51	119	79.90
-30	35,306	20	2498.8	70	350.32	120	77.80
-29	33,192	21	2388.7	71	338.60	121	75.77
-28	31,217	22	2284.0	72	327.33	122	73.80
-27	29,372	23	2184.5	73	316.49	123	71.89
-26	27,647	24	2090.0	74	306.07	124	70.04
-25	26,034	25	2000.0	75	296.03	125	68.25
-24	24,524	26	1914.4	76	286.38	126	66.51
-23	23,111	27	1832.9	77	277.10	127	64.82
-22	21,789	28	1755.4	78	268.16	128	63.18
-21	20,549	29	1681.5	79	259.55	129	61.59
-20	19,388	30	1611.2	80	251.26	130	60.05
-19	18,299	31	1544.1	81	243.28	131	58.56
-18	17,278	32	1480.3	82	235.59	132	57.10
-17	16,320	33	1419.4	83	228.17	133	55.69
-16	15,421	34	1361.3	84	221.04	134	54.32
-15	14,576	35	1306.0	85	214.15	135	53.00
-14	13,783	36	1253.2	86	207.52	136	51.70
-13	13,038	37	1202.8	87	201.12	137	50.45
-12	12,337	38	1154.7	88	194.96	138	49.23
-11	11,678	39	1108.8	89	189.01	139	48.05
-10	11,058	40	1064.9	90	183.27	140	46.90
-9	10,475	41	1023.0	91	177.73	141	45.79
-8	9926.0	42	983.02	92	172.39	142	44.70
-7	9408.8	43	944.78	93	167.24	143	43.65
-6	8921.8	44	908.25	94	162.26	144	42.62
-5	8462.6	45	873.31	95	157.46	145	41.63
-4	8029.8	46	839.90	96	152.82	146	40.66
-3	7621.7	47	807.95	97	148.34	147	39.72
-2	7236.7	48	777.37	98	144.01	148	38.80
-1	6873.2	49	748.12	99	139.83	149	37.91
0	6530.3	50	720.13	100	135.79	150	37.04