RH-02 Temperature & Humidity Logger

User's Guide

rh02.en-2

Contents

1 Introduction

1.1 Overview

This document describes the physical and electrical properties of the RH-02, and explains how to use the software drivers. PicoLog and the drivers support up to nine RH-02 units.

The RH-02 is a complete temperature and humidity serial input device for standard PCs and laptops. It is designed to be coupled with the EL030 external humidity and temperature sensors, which are calibrated to give highly accurate readings.The PicoLog data logging program will collect data supplied by the RH-02, or, alternatively, you can use the RH-02 driver software to custom-build your own programs that take advantage of its features.

For more information about using the RH-02 with PicoLog, please consult the following files:

- PLW044.hlp (Windows help file)
- PLW044.pdf (printable PDF file)

1.2 Intended use

The RH-02 is designed for use solely with the EL030 Temperature and Humidity Sensor, pictured below. The RH-02 takes a reading every two seconds from each of two sensors: a humidity sensor and a precision thermistor. The driver software contains everything necessary to convert the sensor readings into temperature and humidity.

Filtering

The RH-02 software includes a filter which reduces errors caused by electrical noise. You can use either the measured or the filtered value: the filtered value is much less prone to electrical noise, but it tends to lag behind if the measured value changes quickly.

1.3 Safety warning

We strongly recommend that you read the general safety information below before using your product for the first time. If the equipment is not used in the manner specified, then the protection provided may be impaired. This could result in damage to your computer and/or injury to yourself or others.

Maximum input range

The RH-02 is designed for use with temperature and humidity sensors supplied by Pico Technology Limited. It should not be used to measure voltages.

Mains (line) voltages

No Pico products are designed for use with mains (line) voltages. To measure mains we recommend the use of a differential isolating probe specifically designed for such measurements.

Safety grounding

The ground of every product is connected directly to the ground of your computer via the provided interconnecting cable. This is done in order to minimise interference. Always use the provided cable to attach the product to your computer.

Take great care when measuring near mains (line-powered) equipment. If a sensor is accidentally connected to mains voltages, you risk damage to your converter or computer - and your computer chassis may become live.

You should assume that the product does not have a protective safety earth. Incorrect configuration and/or use of sensors on voltages outside the maximum input range can be hazardous.

Repairs

The unit contains no user serviceable parts: repair or calibration of the unit requires specialised test equipment and must be performed by Pico Technology Limited or their authorised distributors.

1.4 Legal information

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2 Product information

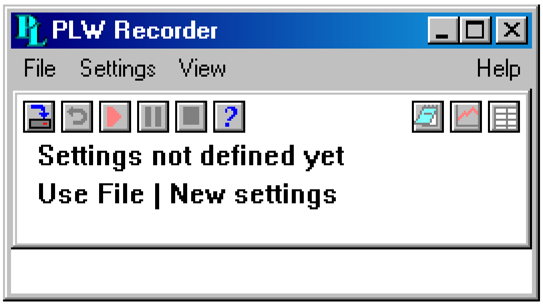
2.1 Specifications

Conversion time	2 seconds (humidity and temp)	
Humidity	Range	0 to 95% (non-condensing)
	Accuracy	±2.5% (0 to 90%)
	Resolution	0.01%
Response time	Slowly moving air	15 secs
	Vigorous motion	~60 secs
	Still air	~60 mins
Temperature	Range	-20 to+70 °C
	Accuracy	±0.2 °C (0 to 70 °C)
	Resolution	0.01 °C
	Response time	10 secs
Connector	D9 female to serial port, cable supplied	
Enclosure	Dimensions	100 x 135 x 35mm
	Material	Grey ABS NOT waterproof

2.2 Connection

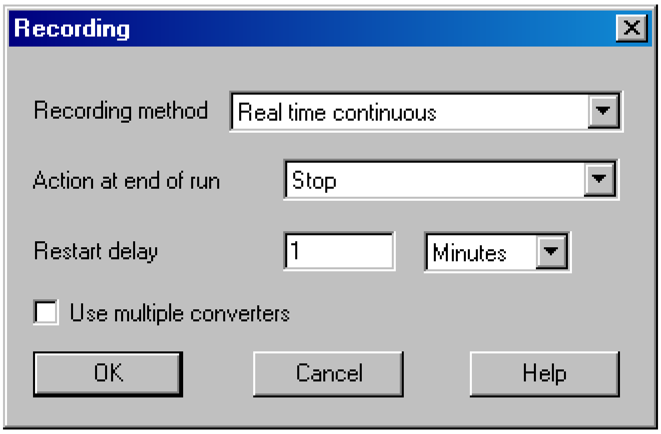
To use the RH-02, you should connect the D-connector on the RH-02 to the serial port on your computer using the cable provided. Connect the cable from your EL030 Temperature and Humidity sensor to the RH-02. To setup the unit with PicoLog, do the following:

1. Open PicoLog Recorder. The application opens at the Recorder view



Settings not defined yet
Use File | New settings

2. Select **New settings** from the **File** menu. PicoLog displays the **Recording** dialog box:



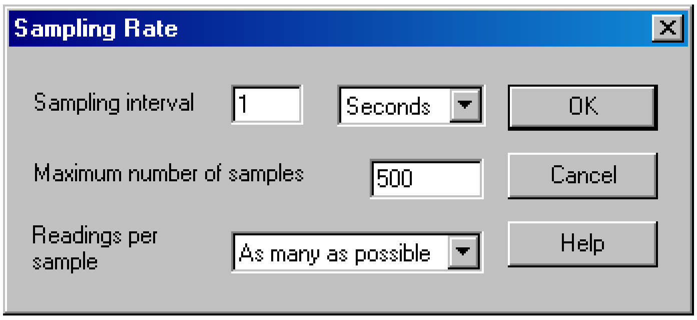
Recording method: Real time continuous

Action at end of run: Stop

Restart delay: 1 Minutes

□ Use multiple converters

3. Click **OK**. The **Sampling Rate** dialog box appears:

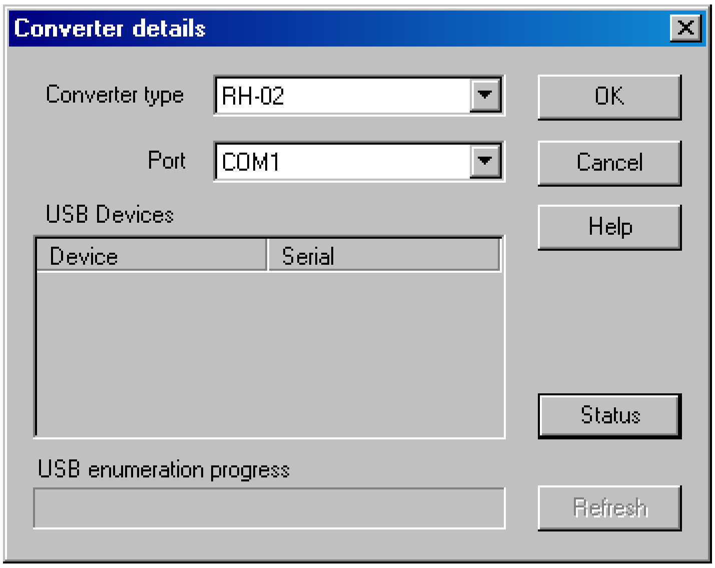


Sampling interval: 1 Seconds

Maximum number of samples: 500

Readings per sample: As many as possible

4. Click **OK**. PicoLog displays the **Converter details** dialog box:



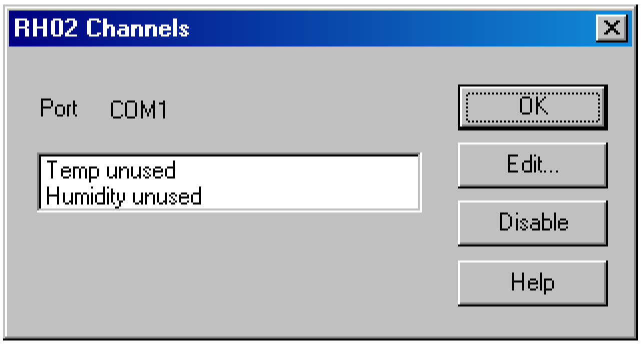
Converter type: RH-02

Port: COM1

5. From the **Converter type** drop-down list, select **RH-02.**

6. From the **Port** drop-down list, select the COM port you are using.

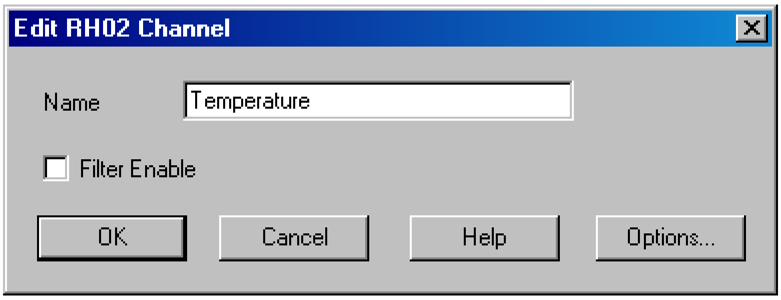
7. Click **OK**. The **RH02 Channels** dialog box appears:



Port COM1

Temp unused
Humidity unused

8. Double-click on **Temp unused**. The **Edit RH02 Channel** dialog box appears:



Name Temperature

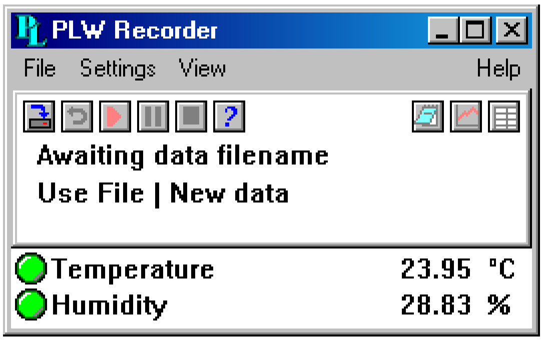
☐ Filter Enable

9. Click **OK**. PicoLog activates the Temperature parameter.

10. Double-click on **Humidity unused**. The **Edit RH02 Channel** dialog box appears.

11. Click **OK**. PicoLog activates the Humidity parameter.

12. At the **RH02 Channels** dialog box, click **OK**. The recorder view should now display the temperature and humidity:



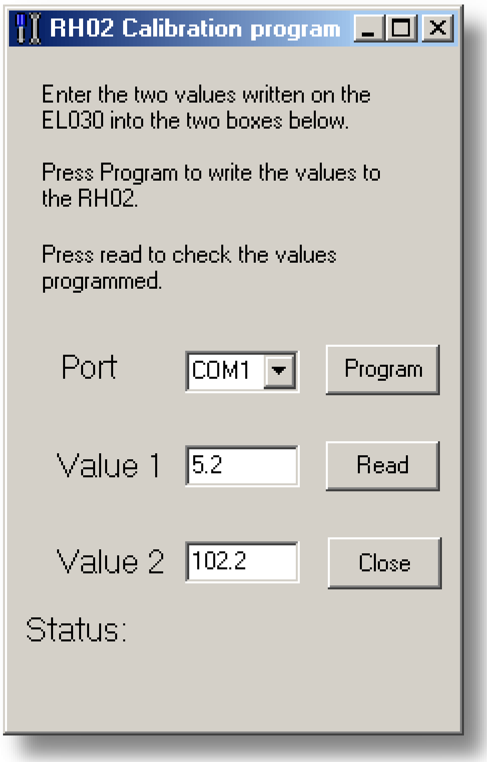
Awaiting data filename
Use File | New data

Temperature 23.95 °C
Humidity 28.83 %

13. Now go to the topic called Sensor calibration.

2.3 Sensor calibration

The RH-02 is supplied with an EL030 Temperature and Humidity sensor. Sensor calibration can vary due to the manufacturing process, therefore Pico supplies a software calibration facility. This software calibrates the RH-02 to work accurately with the attached EL030 sensor.



RH02 Calibration program

Enter the two values written on the EL030 into the two boxes below.

Press Program to write the values to the RH02.

Press read to check the values programmed.

Port COM1

Value 1 5.2

Value 2 102.2

Status:

After the RH-02/EL030 units have been successfully attached and PicoLog has been installed, the calibration facility can be run (please note that you should close down PicoLog before running the calibration program, otherwise it will not work):

1. From the start menu, select **Programs\Pico Technology\RH-02 Calibration**
2. Select the appropriate COM port (usually COM1)
3. Type in figures, written on the bottom of the sensor, into the value fields (as above)
4. Click **Program** then wait for the success message.

Note: To read the calibration values that are currently stored in the RH-02, click **Read.**

2.4 Using USB ports

The USB-to-serial converter allows you to use Pico Technology serial devices such as the RH-02 through the USB port on your PC. To install, do the following:

1. Plug your serial device into the serial port on the USB-to-serial converter
2. Plug the USB-to-serial converter into your computer via its USB port
3. To install the USB-to-serial drivers, run the CD supplied with the converter

With USB technology, there are no IRQ conflicts and no COM port conflicts. Most computers come with serial, parallel and USB style ports. The USB-to-serial converter allows you to use multiple products to be used on the same PC without making any hardware modifications. It also stops you from being prevented from using serial products with standard laptops that are equipped only with USB ports.

Features and benefits

- Add serial devices with the ease of USB
- Free up your existing serial port or use serial devices on a PC without any serial ports available
- Avoid IRQ and COM port conflicts
- No need to install an add-in card or open the computer
- Supports up to 115 kb/s
- LED light indicates power and data transfer
- Bus-powered -- no need for a cumbersome power supply
- 100% USB compliant, guaranteed.
- The future is built in with field-upgradable ROMs

Package

- Xircom USB-to-serial converter
- CD-ROM with USB-to-serial drivers
- Easy-to-understand installation guide

System requirements

- Windows 98, ME or 2000
- Spare USB port

3 Driver information

3.1 Introduction

The RH-02 is supplied with driver routines that allow you to write your own programs. Drivers are supplied for use with the following operating systems:

Windows 95/98/NT/2000
Linux

Once you have installed the software, the `Drivers` directory contains the drivers and a selection of examples of how to use the drivers. It also contains a copy of this manual as a PDF file.

The driver routine is supplied as a Windows DLL.

The Windows DLL can be used with C, Delphi and Visual Basic programs. It can also be used with programs like Microsoft Excel, where the macro language is a form of Visual Basic. More than one application can access the Windows DLL at the same time, as long as the applications do not change the settings for channels that they are not using.

The following table specifies the function of each of the routines that come with the driver:

Routine	Function
rh02_open_unit	Open the driver and specify the serial port or ports
rh02_close_unit	Close the port
rh02_get_cycle	Find out when the driver last took readings
rh02_get_value	Get the most recent temperature or humidity reading
rh02_get_version	Get the version number of the RH-02

The normal calling sequence for these routines is as follows:

1. Open driver
2. While you want to measure temperatures
3. Get temperature and/or humidity
4. End While
5. Close driver

3.2 rh02_open_unit

```
short int rh02_open_unit (
    short int port);
```

This routine opens an RH-02 device connected to a specific serial port number. If you wish to use more than one RH-02, you should call the routine once for each RH-02.

Arguments:	`port`	- the number of the serial port that the RH-02 is connected to (1 for COM1, 2 for COM2, and so on). See Serial port settings for more information.
Returns:		- TRUE if the driver successfully opens the RH-02

3.3 rh02_close_unit

```
void rh02_close_unit (
    unsigned short int port);
```

This routine disconnects the driver from the specified serial port and closes the port.

If you successfully open any serial ports, you MUST call rh02_close_unit for each port before you exit from your program. If you do not, your computer may not operate correctly until you next reboot it.

Arguments:	port	- the number of the serial port that the RH-02 is connected to (1 for COM1, 2 for COM2, and so on). See Serial port settings for more information.
Returns:		- none

3.4 rh02_get_cycle

```
short int rh02_get_cycle (
    long      * cycle,
    short int   port);
```

When you call rh02_get_value, it returns immediately with the most recent reading for the specified channel. If you call it repeatedly, it will return the same reading repeatedly, until the driver takes the next reading from that channel.

If you wish to record values only when the driver has taken a new reading, you can use this routine to find out how many complete cycles of readings the driver has taken, then you can call rh02_get_value only when a cycle has completed.

Note: Each RH-02 is polled independently, so the cycle numbers for multiple RH-02s may not keep in step.

Arguments:	cycle	- a pointer to a long integer where the cycle number is to be stored
	port	- the number of the serial port that the RH-02 is connected to (1 for COM1, 2 for COM2, and so on). See Serial port settings for more information.
Returns:		- the number of complete cycles of readings taken from a particular RH-02

3.5 rh02_get_value

```
short int rh02_get_value (
    long      * value,
    short int   port,
    short int   channel,
    short int   filtered);
```

Once you open the driver, the driver takes readings continuously from the RH-02 unit. When you call rh02_get_value, it immediately assigns value to the most recent reading for the specified channel. The temperature is in hundredths of a degree Celsius, and the humidity in hundredths of a percent.

Arguments:	value	- a pointer to a long integer where the most recent reading for the specified channel is to be stored
	port	- the number of the serial port that the RH-02 is connected to (1 for COM1, 2 for COM2, and so on). See Serial port settings for more information.
	channel	- 1 for channel temperature, 2 for humidity.
	filtered	- If set to TRUE, the driver returns a low-pass filtered value of the temperature. The time constant of the filter depends on the value of filter_factor for this channel, and on how many channels are active
Returns:		- if a reading is available, the routine returns TRUE; otherwise it returns FALSE. It will normally return FALSE for a few seconds after you open the driver, until the driver has taken a reading from the specified channel

3.6 rh02_get_version

```
short int rh02_get_version (
    short int * version,
    short int   port);
```

Arguments:	version	- the version number of the specified RH-02
	port	- the number of the serial port that the RH-02 is connected to (1 for COM1, 2 for COM2, and so on). See Serial port settings for more information.
Returns:		- driver version. The upper byte of the version is always 8 for a RH-02; the lower byte is the two hex digits of the version and release. It provides a useful check that the link to the RH-02 is working correctly

3.7 Windows XP/Vista

The 32-bit Windows driver is the file `RH0232.DLL`, installed in the `Drivers` directory.

3.8 Linux

A Linux driver is also available. Please go to http://www.picotech.com/drivers.html for more information.

4 Writing your own programs

4.1 C / C++

C

The C program provided as an example with the driver is a generic Windows application - meaning it does not use Borland AppExpert or Microsoft AppWizard. To compile the program, create a new project for an application containing the following files:

```
   rh02tes.c
   rh02tes.rc
```

either `rh0232.lib` (Borland 32-bit applications)
or `rh02ms.lib` (Microsoft Visual C 32-bit applications)

The following files must be in the same directory:

```
   rh02.h
   rh0232.dll
```
(All 32-bit applications)

C++

C++ programs can access all versions of the driver. If rh02 is included in a C++ program, the PREF1 macro expands to extern "C": this disables name-decoration, and enables C++ routines to make calls to the driver routines using C headers.

4.2 Delphi

The `Win` subdirectory contains `rh02.dpr`, a simple program which opens the drivers and reads the temperature and humidity. You will need the following files to build a complete program.

```
   rh02fm.dfm
   rh02fm.pas
   rh02.inc
```

The file with the name `RH02.inc` contains procedure prototypes for the driver routines - you can include this file in your application.

This example has been tested with Delphi versions 1, 2 and 3.

4.3 Excel

The easiest way to transfer data to Excel is to use PicoLog.

If, however, you need to do something that is not possible using PicoLog, you can write an Excel macro which calls the driver to read in a set of data values. The Excel macro language is similar to Visual Basic.

`RH0232.XLS`, an example file, reads in 20 values of the channel 1 temperature, one per second, and assigns them to cells A1..A20.

4.4 LabVIEW

The routines described here were tested using LabVIEW for Windows 95 version 4.0.

While it is possible to access all of the driver routines described earlier, it is easier to use the special LabVIEW access routine. The `rh02.llb` library in the `Drivers` subdirectory shows how to access this routine.

To use this routine, copy `rh02.llb` and `rh0232.dll` to your LabVIEW `user.lib` directory.

The rh02 sub-vi will now appear in the user libraries box. You can load the `rh02_example` sub-vi which demonstrate how to use it. The sub-vi accepts the port (1 for COM1) and, optionally, whether to filter the data. It returns the temperature in degrees Celsius and the relative humidity in percent.

4.5 Visual Basic

The `Drivers` subdirectory contains the following files:

```
rh0232.VBP
rh0232.BAS
rh0232.FRM
```

4.6 Agilent VEE

The example program `rh02.vee` is in the `Drivers` directory. It was tested using HP-Vee version 5 under Windows 95. It shows how to collect readings continuously from the RH-02.

You will need to copy the following file to the program directory:

```
rh02.vh
```

5 Communications setup

5.1 Serial port settings

The following table shows the standard serial port settings for COM ports.

Port	Base address	Interrupt	Standard?
COM1	3F8	4	Yes
COM2	2F8	3	Yes
COM3	3E8	4	de facto
COM4	2E8	3	de facto
COM5...			No

Note: On most computers, it is not possible to use the same interrupt for two serial ports at the same time. If, for example, you wish to use COM1 and COM3 at the same time, it is necessary to use a serial port card which can be set to an interrupt other than 4. These can be obtained either from Pico Technology or your computer supplier.

5.2 Serial port connections

The information presented here is necessary only if you wish to connect the RH-02 to the PC in some unusual way (for example, via a radio modem.)

The RH-02 uses the following RS-232 data lines (pin connections as on RH-02):

Pin	Name	Usage
3	TX	Data from the PC to the RH-02
2	RX	Data from the RH-02 to the PC
7	RTS	Held at a positive voltage (> 7 V) to power the RH-02
5	GND	0V line
4	DTR	Held at a negative voltage (< -7 V) to power the RH-02

The driver powers up the RH-02 by enabling RTS and disabling DTR to provide the correct polarity power supply. If these are set incorrectly no damage will occur to either PC or RH-02.

5.3 Protocol information

The RH-02 operates at 2400 baud with 1 stop bit and no parity.

The driver controls the RH-02 using the following sequence:

1. Switch RTS on and DTR off to provide power.
2. Wait for more than 1 second for the RH02 to settle
3. Send a single control byte to the RH02
4. Wait for a response from the RH02

Steps 3 and 4 are repeated for each measurement.

The RH-02 signals the end of conversion by sending a block of bytes. No data should be sent to the RH-02 during the conversion, as it may be lost or corrupted.

The RH-02 accepts the following commands:

Command	Response length	Response
0x01	2	RH-02 Version
0x02	32	RH02_INFO (see below)
0x04	2	Temperature reading
0x05	2	Humidity reading

The RH-02 Version response is made up of a 2 (for RH-02) followed by the version number (currently 1.)

The `RH02_INFO` block contains the following information:

```
typedef struct
unsigned short checksum;
unsigned char version;
unsigned char spare1;
unsigned short ref_low;
unsigned short ref_high;
char batch [6];
unsigned short unit;
char cal_date [8];
char spare2 [8];
RH02_INFO;
```

The temperature reading is converted to a temperature using the following table:

```
static unsigned short humtemp_table [] =
  /* 0000 */ 14522U,
  /* 0001 */ 15142U,
  /* 0002 */ 15776U,
  /* 0003 */ 16425U,
  /* 0004 */ 17087U,
  /* 0005 */ 17754U,
  /* 0006 */ 18441U,
  /* 0007 */ 19139U,
  /* 0008 */ 19849U,
  /* 0009 */ 20569U,
  /* 0010 */ 21290U,
  /* 0011 */ 22028U,
  /* 0012 */ 22774U,
  /* 0013 */ 23527U,
  /* 0014 */ 24287U,
  /* 0015 */ 25042U,
  /* 0016 */ 25811U,
  /* 0017 */ 26584U,
  /* 0018 */ 27360U,
  /* 0019 */ 28138U,
  /* 0020 */ 28905U,
  /* 0021 */ 29684U,
  /* 0022 */ 30461U,
  /* 0023 */ 31236U,
  /* 0024 */ 32009U,
  /* 0025 */ 32768U,
  /* 0026 */ 33532U,
  /* 0027 */ 34292U,
  /* 0028 */ 35046U,
  /* 0029 */ 35794U,
  /* 0030 */ 36523U,
  /* 0031 */ 37255U,
  /* 0032 */ 37979U,
  /* 0033 */ 38693U,
  /* 0034 */ 39398U,
  /* 0035 */ 40082U,
  /* 0036 */ 40766U,
  /* 0037 */ 41439U,
  /* 0038 */ 42101U,
  /* 0039 */ 42751U,
  /* 0040 */ 43379U,
  /* 0041 */ 44005U,
  /* 0042 */ 44618U,
  /* 0043 */ 45219U,
  /* 0044 */ 45808U,
  /* 0045 */ 46373U,
  /* 0046 */ 46936U,
  /* 0047 */ 47485U,
  /* 0048 */ 48022U,
  /* 0049 */ 48545U,
  /* 0050 */ 49047U;
```

The humidity reading is converted to a relative humidity using the following procedure:

```
humidity = (value - rh02_info.ref_low) * 100 / (rh02_info.ref_high -
rh02_info.ref_low);
temp_correction = (temp - 25) * 0.00216;
humidity = humidity / (1 - temp_correction);
```

5.4 Modem operation

The RH-02 is normally connected directly to the computer, but it is also possible to access the RH-02 via a modem using the Windows driver.

It is necessary to provide power to the RH-02, either by instructing the modem to provide power or by connecting a power supply directly to the RH-02. See Serial port connections for more information.

With some radio modems, there is a delay between sending text to the modem and its arrival at the other end, and a similar delay for the response from the RH-02. If, for example, the maximum possible delay is 150 ms each way, 300 ms total, the following text should be added to `Win.ini` so that the driver waits longer for each response.

```
[RH02]
Turnround=300
```

Warning: In order to comply with current legislation, use only radio modems which comply with the RTTE directive.

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Pico Technology Ltd

The Mill House
Cambridge Street
St Neots PE19 1QB
United Kingdom
Tel: +44 (0) 1480 396 395
Fax: +44 (0) 1480 396 296
Web: www.picotech.com

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