User manual for T-TEC Software

Version 15B for Windows

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Contents

User manual for T-TEC Software
- Acknowledgments vii
- Preface viii
- Warranty ix
- Liabilities ix

About data loggers xi
- Multiple loggers can work together xi
- Erasure of data in memory xii

Information for IT staff xiii
- Installing xiii
- Driver problem xiii
- Software key xiii
- Downloading xiii
- Battery change xiv
- Installing/using a T-TEC WiFi Gateway xiv
- Gateway xv
- Specific to-TEC RF xvii
- MQTT xviii

Installation 1
- Upgrades 1
- Installing the T-TEC Software 2
- Installing from CD 2
- In case of errors 8

T-TEC RF 10
- To start the program 11
- In case of errors 11
- Operating a T-TEC RF data logger 11
- Wake up 12

Communication with the data logger 14
To start the T-TEC RF data logger 14
To read the T-TEC RF data logger 16
Data updates 17
Logger Security 18
Setting logger security permissions 21
Defective Sensors 23
Alarms 23
Relay output for T-TEC RF Loggers 24
Data compression 25
Number of measurements for a logger 25
Logging Intervals 25
Logging duration at different intervals 26
The Files - T-TEC RF Logger 27
Stop logging 27
Battery 27
Access to the battery 28
Settings 29
Viewing the Graph 37

T-TEC logger 38
Program configuration 39
Communication with the data logger 40
To read the T-TEC logger 40
To start the logger 43
Tutorial 44
The files 45
Data Compression 45
Data logger with external sensor 46
Sensor files (.SDA files) 46
Defective Sensors 46
Alarms 46
Relay output 47
Number of measurements for a logger 47

Logging duration at different intervals 48
Wrap around 48
Stop logging 48
Battery 49
Logger reset 50
Viewing the Graph 50

iButton logger 51
To start the program 52
Communication with the data logger 52
In case of errors 52
The files 52
To read the data logger 53
To start the data logger 54
Viewing the Graph 55
The files 55
Logging intervals for iButtons 56
Battery 56
To stop the logger 56
Alarms 57

TempTec Reader (TempTecR) 58
Communication with the data logger 59
To open the software 59
To read the TempTec Reader 60
Viewing the Graph 61
The files 61
To reset the reader 61
Battery 62
Replacing the battery 62
Access to the battery 62

TempTec 816 63
Battery 64
Current battery voltage 64
Replacing the battery 64
Access to the battery 64

Graph Viewer 65
To start the program 65
Open a file 65
Printing and export of files 65
Saving the graph for inclusion in reports or email 66
Introduction 66
'Zoom' & 'Plot' 67
Measurements from a freezer 69
Example 4: Store room temperatures 78

Acknowledgments

Some names used in this manual are trademarks. The text and pictures contained within this manual have been made with care but the authors and editors can take no legal responsibility for any omissions, errors or their consequences.

The installation program is kindly supplied by JRSoftware.

The software package includes the TempReport program for RF data loggers.
All its utilities are protected according to Australian and international laws and remain the property of Temperature Technology. A valid licence is required to use the programs. The details of the licence are included with the distribution material.

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Preface

Version 15 is the Windows version of the T-TEC program for data loggers and contains improvements over the former versions.

It supports data loggers types: T-TEC, T-TEC RF, and units with serial numbers starting with A, B, C, E, F, G, H, Y, P, Q and V.

This software also supports the iButton data logger models DS1921, DS1922 and DS1923 as well as the TempTec Reader for iButtons. DS1921, DS1922 and DS1923 are trademarks of Maxim Integrated.

We would like to thank our customers for their proposed improvements to the program. These suggestions have been most helpful and have been implemented as far as possible.

Any further suggestions to improve the program will be most welcome.

This manual contains instructions for installation and configuration of the T-TEC program and some notes and examples for the use of the program. There is no detailed description of the functions in the printed manual as the program contains an extensive 'Help' file with all details. This manual is also on the supplied CD and is downloadable from our website. The help file also contains a small tutorial, on basic functions.

Any new information not available at the printing of this manual is included in a text file, 'Readme.txt', on the supplied CD.

Version 15 is confirmed to work with XP, Win2000, Vista and Windows 7, Windows 8 and Windows 10.

Warranty

Your T-TEC data logger is guaranteed against any defects in materials and workmanship for a period of one year from the date of the original purchase of the data logger from the distributor. In this period, any part will be replaced or repaired at our discretion if proved to be defective, free of charge.

This warranty does not cover accidental damage, misuse, negligence, shipping or any alteration whatsoever in the form or content of the data logger.

Data loggers to be serviced must be handed to the distributor or shipped carefully packed in a suitable container to the distributor or to Temperature Technology. We are not responsible for freight charges or losses in transit.

Liabilities

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

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are often placed on Temperature Technology products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Temperature Technology's terms and conditions of purchase, including but not limited to the warranty expressed therein.

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About data loggers

Data loggers are stand-alone units for the measure and recording of temperature, and related physical qualities.

A data logger contains a measuring circuit to measure the value from a sensor, a microprocessor to convert the measurements to numerical data and a memory to store the measurement.

A data logger is set-up with a T-TEC software installation on a computer and the interval between recording of measurements is selected by the user.

A logger can be set to either collect data until the memory is full and then stop, keeping all data, or it may be set to use **'Wrap Around'** where it will overwrite the oldest data while continuing to collect data.

The logger is then placed into position and will work as a stand alone unit, measuring with the set interval and storing the collected data.

The logger can be re-connected to the computer and the collected measurements read from the logger to the computer where they may be displayed. A RF logger connects wirelessly via the Gateway.

Both the interface cable and the Gateway contain electronics which make it possible for a standard PC to communicate with the T-TEC logger and read the data stored in the data logger's memory.

Multiple loggers can work together

Sometimes one logger may tell what happened and another may tell why it happened.

Example Ex2-2 in chapter 'Graph Viewer', shows results from two loggers working together. One logger is placed with the goods and another logger is placed to read the ambient temperature.

The first logger shows the temperature of the goods, the second shows why the temperature of the goods varied.

Graph Viewer can show up to eight graphs at the same time. When calendar time is selected as the time scale, all loggers show what happened at the same time - six o'clock for one logger is also six o'clock for the other loggers. The loggers will then work together as a multichannel logger. There is no need to interconnect the loggers. Neither do the loggers need to be started at precisely the same time, as long as the measurements overlap in time. The computer synchronises all graphs to the computer's clock at the time of start of the loggers with a tolerance of ± 1 second.

Erasure of data in memory

When the data logger starts a new measuring cycle, the microprocessor in the logger resets all references to the existing data in the memory and the old data cannot be recovered. The new data then simply overwrites the old.

Information for IT staff

Installing

Please be aware that installation does involve the installation of drivers which are necessary for the successful operation of the relevant devices. Installation does require administrator access for the successful installation of the drivers. If you are required to perform the installation, we strongly advise your presence on site, as the process involves hardware that may need to be plugged in and out.

Driver problem

Sometimes drivers don't install as expected. If you are having trouble running the software, check the drivers. Open up 'Device Manager' and have a look for anything with a yellow exclamation mark. If present, unplug the device from the computer and see if that entry in 'Device Manager' consequently disappears. If so, re-plug the device in and see if the driver can be re-installed. Most drivers are copied to C:\T-TECW and can be found there. Sometimes it helps to turn the computer off and back on again. If you don't know how to update a driver, please call, we'll talk you through it.

The drivers can be found in these folders:

1. iButton drivers can found in the WinUSB_Driver
2. T-TEC Gateway drivers can be found in the T-TEC_GATEWAY_DRIVER
3. Older USB drivers can be found in T-TEC_USB_DRIVER

Software key

The software requires a licence to operate Graph Viewer more than ten times, or for TempReport to operate at all. If the software version number that was installed includes a 'K', then the key is already installed. If a key is needed, please email sales@t-tec.com.au, and include with your request what name you would like the software registered to.

Downloading

Please be aware that these devices create files that need to be downloaded to the computer, normally C:\T-TECW. Users will need permissions to download to the computer from these external devices.

Battery change

Devices will need their batteries changed on a regular basis. Each device has a relevant chapter that describes this process.

Installing/using a T-TEC WiFi Gateway

These instructions are for installing and using a T-TEC WiFi Gateway that can be accessed via the local area network (LAN) and thus does not need to be directly connected to a computer.

How to connect a T-TEC W-USB WiFi Gateway to your network

1. Connect your Gateway to your computer via a USB port.
2. Open TempReport, and find the drop down list for the Gateway at the bottom of the main screen. Select 'USB Gateway'. It should have a green dot next to it. If, after waiting 10 seconds, it does not have a green dot, please contact Temperature Technology.
3. Go to 'Check Gateway'. If you have not yet registered the Gateway in TempReport, press 'Register gateway'. Give the Gateway a relevant name.
4. In the 'WiFi' tab, please enter the details for your wireless LAN, and press 'Submit'.
5. Press 'Close'.
6. At this stage, you can install the Gateway to the desired location.

Installing a Gateway in TempReport

These instructions are for Gateways not yet registered to TempReport. The instructions above already include registration. Once registered, Gateways are available over the LAN or cloud.

1. In TempReport, go to 'Settings' > 'Gateway Management' and press 'Add'.
2. In 'Enter Gateway MAC address', enter the MAC address.
3. In 'Enter Gateway name', please give the Gateway a name you like and can remember, and enter it into this field.
4. Please leave the last field as 'Autodetect' and press 'Confirm'.
5. Then press 'Close'

Using the WiFi Gateway

Once the instructions for 'How to connect a T-TEC W-USB WiFi Gateway to your network' or 'Telling TempReport the details of the Gateway' , and the Gateway has been installed in the desired location that is within reach of the wireless LAN, then you should be able to select that Gateway in the main screen of TempReport.

1. Open TempReport (if not already open)
2. In the main screen, click on the drop down list for the Gateways, at the bottom of the screen on the information- or right-hand -side.
3. If all is working as it should, then an entry should appear with a green dot with the name that was given to the Gateway, with the prefix (LAN).
4. Select that Gateway to be able to receive data from it.

Gateway attached directly to a computer

The Gateway should have a powered port so that it can wake the computer up if it receives an alarm. See the section 'Wake up' on page 12.

A way of extending the distance between the data logger and the PC can be to plug the Gateway into a USB sharing server that is connected to your LAN. These devices are sold with their own software, please follow their guides for installation of these devices. This method can mean that the distance between the data loggers and the Gateway can fit requirements and the computer that connects the USB sharing server can be far away from the computer.

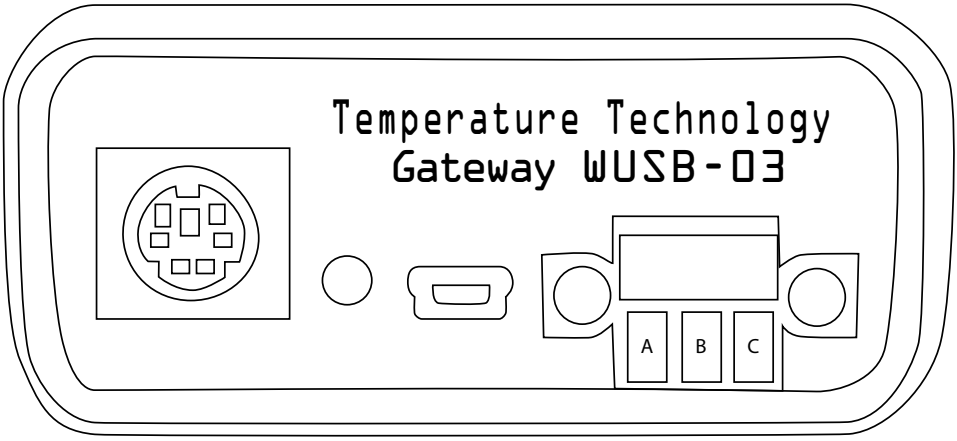
T-TEC Gateway with relay output

Relay output is an optional extra on the gateway. The relay is a change-over type. Max 1A 30V DC/ 0.5A 125V AC resistive load. Gold plated silver contacts. Expected life at 1A 30V DC resistive load: 20,000 operations.

The T-TEC Gateway with relay output can be used with a normally open or normally closed circuit. In case of alarm the relay changes over. The gateway comes complete with green Phoenix™ connector for the alarm contact. The connector has two parts. The male part of the connector can be detached. It can connect the 3 wires necessary to connect to a building alarm system, a dialler or other alert system. After connecting the wires, the male connector may be securely screwed into the gateway.

Normally open A, B will close contact when alarm arrives. Normally closed B, C will open contact when alarm arrives. Current relay behaviour is normally off.

Please contact the factory for a Gateway with opposite relay behaviour.



The gateway has no power in itself; it requires an external power source to operate. When the PC is on, the USB port provides sufficient power for the gateway. If your computer is able and set up to do so, it can provide power via USB while the computer is off. This may require changing settings on the motherboard — most

modern motherboards have this capacity which may be switched off for power management and/or efficiency reasons. Please see your IT administrator for this. When the PC does not provide power, or when the Gateway is not connected to a PC, auxiliary power is needed. This can be provided by a power source of 5VDC (max 6.5VDC), 100mA. A connector cable for power supply is available from Temperature Technology. A mini USB cable to a USB wall charger is sufficient.

Specific to-TEC RF

For outgoing alarm messages via server or cloud, please see page SMS setup on page 29 in TempReport and cloud subscription service in TempReport on page 31.

For manual data backups, see page 31.

MQTT

Please see page 32 for information relating to MQTT and exporting data to other systems.

Installation

When you have purchased your software, please fill out and return the registration form to receive your key by return email. In some cases, the key file has already been incorporated into the CD and the CD will be marked with an additional 'K'. To receive your software key, please provide the serial number of the software and the name you would like the software licensed to and we will forward a key to you.

The key is a small file which should be copied to the same directory where the T-TECW program resides.

Version 15 is supplied on a CD with an installation program to make the installation easier. The CD also has a copy of this manual in PDF.

Upgrades

When you have your licence key, you can upgrade the software to a new version. Please log on to our website to download and install the new version over your existing program to update it. Logger and key files are preserved during this process.

The user can choose to install programs to support one or more of the devices. We recommend to install all programs.

Installing the T-TEC Software

Please close all other programs first.

Do not connect cables to your computer yet.

It is possible to install the software either from the supplied CD or from a download via the website (www.t-tec.com.au) . Installing from the download from the website begins from the 'Install Now' section below, after double clicking on the file to run it.

Installation is divided into three parts: Installation of software, installation of necessary drivers and configuring of the programs.

The installation program will work for Win XP/VISTA/7/8/10.

Installing from CD

When the CD is inserted, the CD will produce a window similar to the one on the right, and will highlight 'Run SetupT.exe'. Click on 'Run SetupT.exe'.

If the dialog box does not appear, go to 'Start'. Click 'Computer' in the right field. Select DVD/CD drive and double click on the program, 'SetupT.exe'.

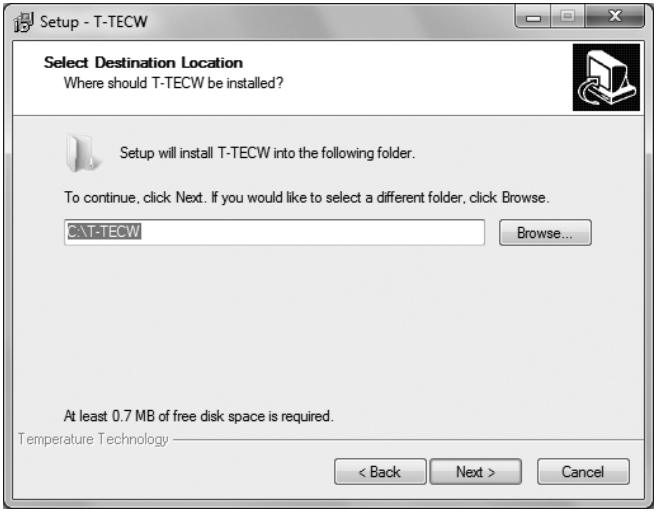
This will install the software — please continue to 'Install Now' later in this section.

If a dialog box titled 'User Account Control' appears that asks you, "Do you want to allow the following program from an unknown publisher to make changes to this computer? Program name: SetupT.exe", click on 'Yes'.

Install Now
Installation starts with a Welcome screen.

Click 'Next'.

Select Destination
Choose Drive to install the program in:



The default is the C Drive.

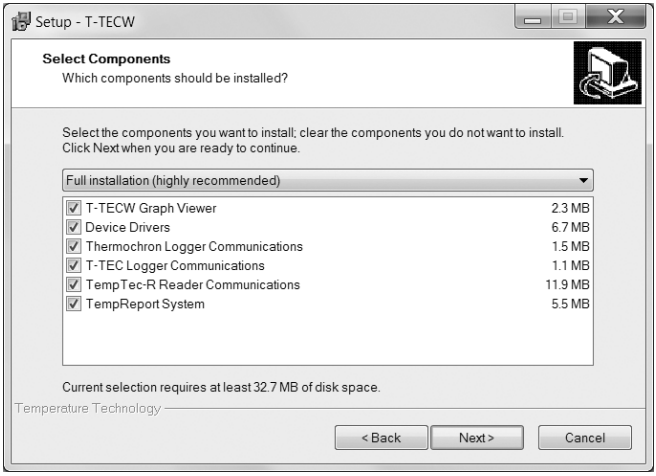
Click 'Next'.

Select components

The T-TEC program has 5 components.
You will need:

The T-TEC Graph viewer
The Device drivers

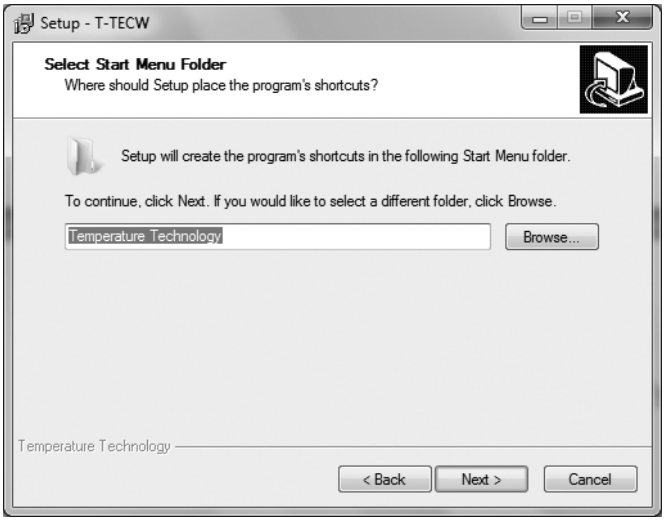
and **at least one** of the following communications programs:



T-TEC Logger communications
T-TEC RF Logger communications
iButton communications
TempTec-R Reader communications

It is easiest to just install them all.

Start menu folder

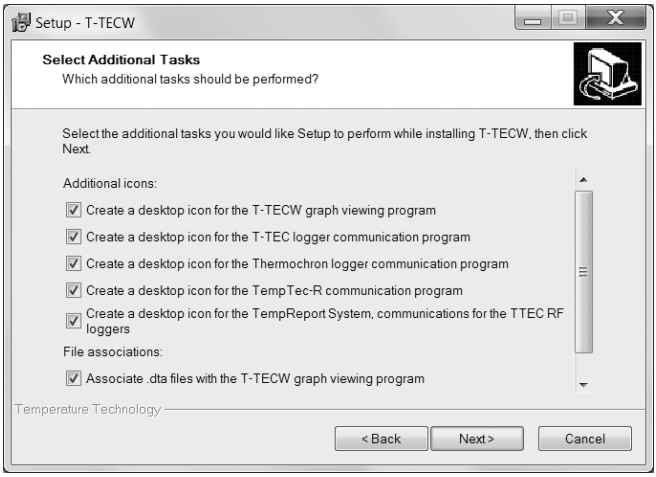


Click 'Next'.

Additional tasks
Select icons for your desk top. Icons you will need:

T-TECW Graph Viewer. From there you can access both iButton and T-TEC data logger communications programs.

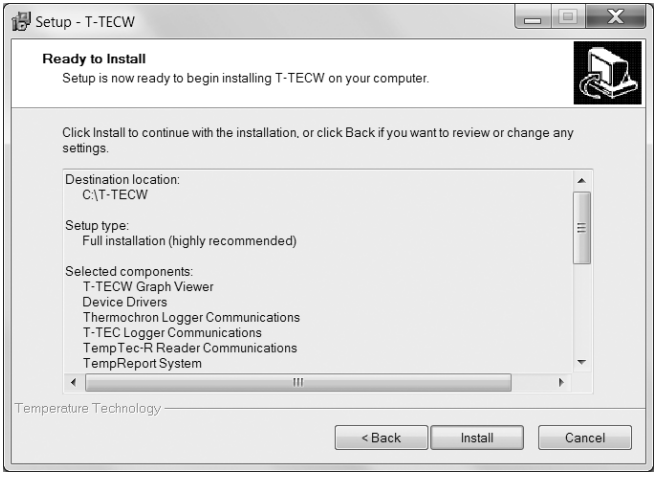
If you have the TempTec Reader, you will need the icon for it.



If you have wireless data loggers, you will need the icon for TempReport also.

We recommend staying with the default, where all options are checked.

Ready to install
Click: 'Install' if you are happy with your choices or 'Back' if you want to change something.



USB Gateway 06

The T-TEC USB Gateway 06 is a new cable, replacing the T-TEC USB 02 cable. It looks very similar but needs a new version of software to operate.

Should you have this cable and wish to install it, you will need to plug in the cable at this point and click 'Yes'. This options only appears for Windows 7 and older.

If you have already installed this driver or don't have this cable, you do not need to install and so may click 'No'.

WUSB-03 installation
If you are installing the larger gateway (WUSB-03) for the wireless loggers and are running Windows 7 or older, please choose 'yes' for this option.

Device Driver Installation

Device Driver Installation Wizard will appear each time to install the drivers for the new USB cable, the older USB cables and the iButton drivers.

Click 'Next'

Device Driver Installation Completion

This dialog box appears each time one of the drivers has finished installing.

Click 'Finish'.

Completing set-up

Click: 'Finish'

For cables other than the T-TEC USB Gateway 6, please connect the interface adaptor to the computer now and the device to the interface cable. If you want to install for more than one device, then connect one device at a time and follow prompts as above.

Installation of USB driver for T-TEC USB 02 and older T-TEC USB 06
For or Win XP through to Windows 7, the driver is installed with the software. For later operating systems, connect the cable and the logger/reader to an USB port on the computer. The Windows system will detect the adaptor and either install the drivers automatically or start the 'Add New Hardware Wizard'.

If asked if you want to connect to Windows update, tick 'No'.

Click 'Next' to continue.

The PC will ask you 'What do you want Windows to do?'

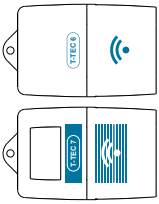
Please select 'Search for the best driver for your device'. For WinXP and newer versions, the driver is now found automatically.

Click 'Next' and the driver will be installed.

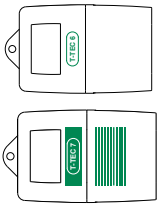
In case of errors

If needed, simply re-install the program(s). There is no need to un-install anything before re-installing.

Compare your datalogger to these images, and go to the chapter that best looks like your datalogger.

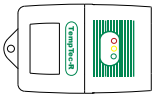


T-TEC RF page 10

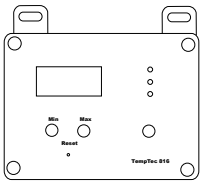


T-TEC logger page 38

iButton logger page 51



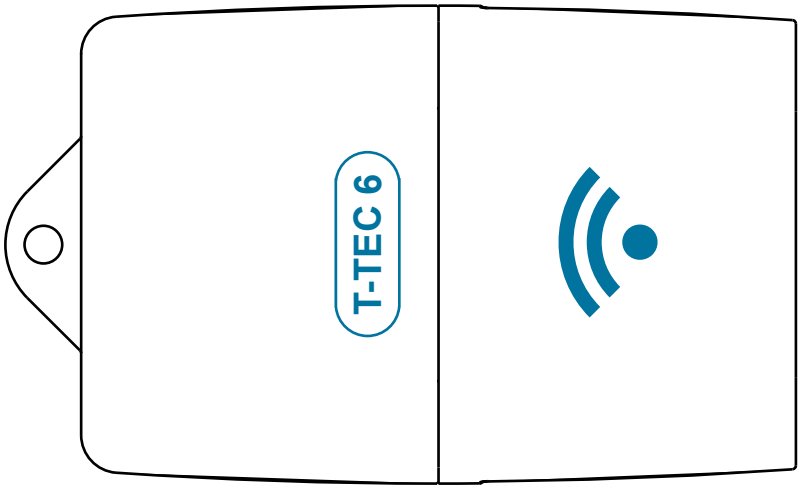
TempTec Reader (TempTecR) page 58

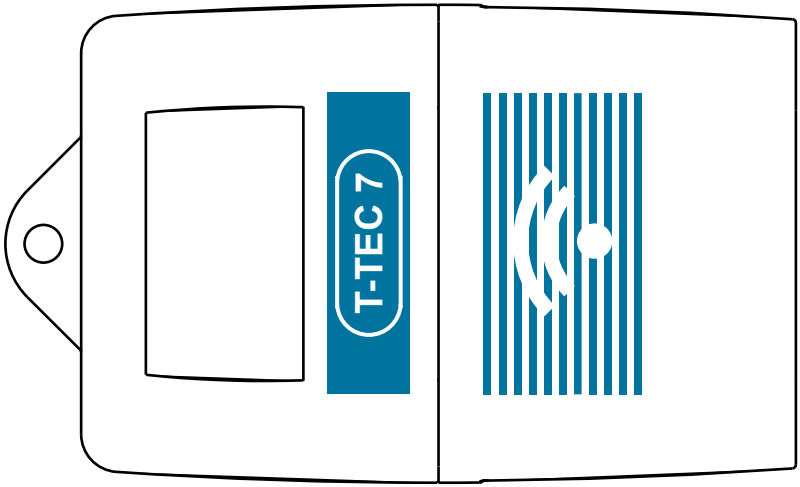


TempTec 816 page 63

T-TEC RF

If your logger looks like below, then read this section. Otherwise, please find the chapter that has a picture that looks like your data logger, listed on page 9.





To start the program

To start the program, double click on the icon for TempReport.

TempReport program is the communications program for the T-TEC RF wireless data loggers.

T-TEC RF Gateway (WUSB-03)

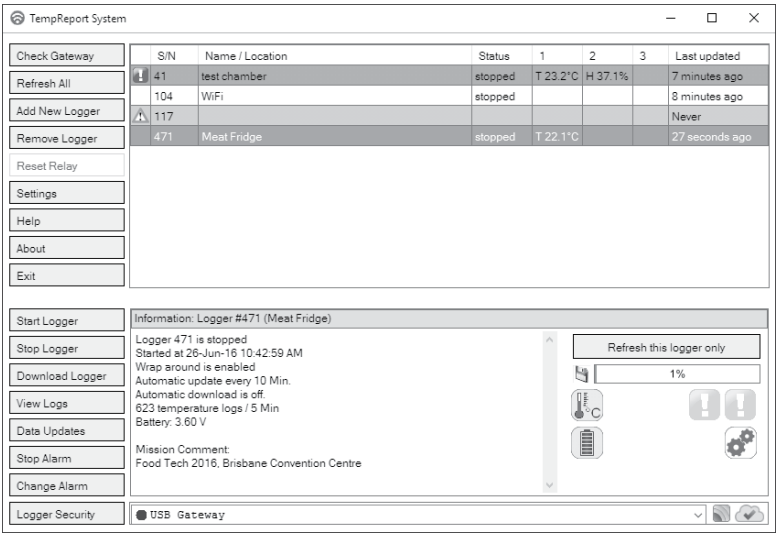
For systems running Windows 7 or older, the drivers can be pre-installed during installation. For systems running Windows 8 and above, the drivers are pre-loaded onto the device and will install directly.

In case of errors

If needed, simply re-install the program(s). There is no need to un-install anything before re-installing.

Operating a T-TEC RF data logger

This section assumes that you have installed the software (see the section on installation on page 1), have a T-TEC RF data logger and a WUSB-03 Gateway, which is connected to the computer.



Screenshot of main screen of TempReport, which is divided into sections: a top half for system administration with a list of all data loggers in the system and their current status, and a bottom half for specific logger information and operation.

Wake up

The Gateway has a wake up function that can wake the computer from standby or sleep when an alarm is triggered. The computer can then send emails and SMSes, and automatically download the logger. If cloud access is enabled, then the data will be transferred to the cloud after a few minutes . Once transferred, the data can be seen on computers with the T-TEC TempReport system and access to the data.

To allow the Gateway to wake the computer, the 'USB Wake up' feature in the computer's BIOS needs to be enabled. Please seek help from your IT support team. For most, this is enabled by default. Check that the motherboard supports standby voltage on the USB bus. It may need a jumper. Not all USB ports may support this feature. Please try different ports. A good way to test the standby voltage is with a half-charged mobile phone. If the phone charges from the USB port while the computer is sleeping, it has standby voltage. If not, try another port, either on the front or back of the computer.

To test the wake up capability, set up an alarm in a logger, eg. a maximum alarm below the current measured value. Set minimum grace time to two minutes. Put the computer to sleep by clicking 'Start' in lower left corner, and then either clicking 'Sleep' or 'Stand by'. The gateway should wake the computer in two minutes.

Otherwise, the computer either must not sleep or be able to automatically logon again after sleep.

To automatically logon after sleep: the operating system feature, 'Prompt for password when computer resumes from standby' needs to be deselected:

Windows 7 and Windows 10
'Start' > 'Control Panel' > 'Power options' > 'Require a password on wakeup' > 'Change settings that are currently unavailable'> 'Don't require a password' > 'Save Settings'

Windows XP

'Start' > 'Control Panel' > 'Power Options' > 'Advanced' > Untick: 'Prompt for password when computer resumes from standby'

Communication with the data logger

To communicate with a T-TEC RF data logger, it must first be registered into the system via 'Add new logger'.

Add new logger

To add a logger into the system, click 'Add New Logger' in the main screen.

When the dialog box appears, type in the data logger's serial number. The serial number can be found on the label on the back of the data logger. The serial number does not include the type letter. For example, if the data logger is a 'T-TEC 6-1C12345', the serial number is '12345'.

When the serial number is entered and 'Register' is clicked, a dialog then asks, 'Do you wish to synchronise the logger?' The software is asking to be allowed to communicate with the data logger to download some details about it. If you say no at this time, it can be performed later. All that is needed is to highlight the logger in question and press the button, 'Refresh this logger only' found in the right hand corner. Once the process is complete, the main screen is displayed.

Once a logger is entered, the logger can be read or started.

To start the T-TEC RF data logger

In the main screen, click on the data logger you wish to start. It will then be highlighted. Then, in the list of buttons to the left, find the button labeled, 'Start logger'. Click on 'Start logger'. A dialog box with various options will appear.

Sensor interval

Each sensor can have a different interval, so each sensor is individually listed along with what type of sensor it is.

Choose how often you want to log (or record) the physical property (eg. temperature, humidity, etc). Please see the later sections on file compression and logging duration on page 25.

Delay start
Do you want to start the logger immediately, or do you want the device to start recording at a later time? If you would like the device to record at a later time, check 'Delay start' and choose the time you would like the device to start recording. This can be useful if you know the exact times you would like recorded. This can be useful if you have set alarms in the data logger but don't want them activated until the logger is placed into position.

Wrap around
The next choice, 'Wrap around', is about what you would like to happen once the memory is full. Do you want the data logger to 'wrap around' back to the beginning, replacing the oldest values with new measurements? If it is the former, check this option, otherwise leave it unchecked and the logger will stop when the memory is full.

Comments
There is an area that allows you to type your own comments. These can be used to help you remember settings, locations, test batches, etc. They can be anything and are not used by the software. This field is limited to 120 characters.

Location/Name
Location/Name is similar to a comment field but is used by the software. For identification purposes in the main screen, it is a good idea to give the data logger a location or name identifier, so you can quickly tell the difference between multiple loggers in the list. It is much easier to differentiate betwen 'Peter's Desk' and 'Joe's Desk' as opposed to 'C-102345' and 'C-102346' in a list. This field is especially important if importing the data into DyMap. Please see the help for Dymap (not in this manual).

Start the logger
Once the setup is as desired, click on the button 'Start logger'. A confirmation dialog box will appear, asking if you want to start the specific logger. Check that it is the correct logger you are starting. If you are still happy with the setup, then

click 'Yes'. If not, then click 'No' and repeat the procedure until you have set up the correct logger with the correct configuration.

The logger can be set up for 'Automatic downloads' or you can manually 'Download' the data once enough data points have been recorded (3 logs).

To read the T-TEC RF data logger

When a wireless T-TEC logger has been started, the system is ready to return data. Note that at least three logs are needed to create a graph, but the current data (even less than three logs) is still available for viewing in TempReport via 'Data updates' on the main screen.

Download logger

Highlight the data logger you wish to download by clicking on it in the data logger list in the main screen. Then press the button, 'Download data'. If the data logger can be contacted, new data will be downloaded and stored in the computer. All the data from the current mission (operation) will be sent to and displayed in 'Graph Viewer'.

In 'Graph Viewer', the data can be analysed statistically and exported to formats that spreadsheets can import. For more information, see 'Graph Viewer' on page 65

Downloading and viewing the data is the best way to see what happened after an alarm that has been set up via 'Change alarms' has occurred.

View logs

To access data not included in the current set, click on, 'View logs'. This allows you to see the recording start date, the date of the last measurement, and the name or location of the data logger of that data set. Sometimes, the record is split into multiple parts due to missing measurements when a logger is set to 'Wrap around'. This becomes apparent when a data set of recordings is selected and 'Open selected logs' is chosen. If the log is split into various parts, the software will produce a numerical list of the parts with an option to choose which section.

Export data
Data can be exported from TempReport by selecting the format you want to export to, and then pressing the 'Export' button.

Data updates

The software can request and receive updates from the data loggers at user-set intervals. Those updates are the current value from the sensor (eg. temperature) and current status of the specified data logger in the main screen of TempReport. To enable this feature and set the interval time, choose 'Data updates' in the main screen and check 'Enable automatic reports'. Go to 'Update every' and set the interval.

The software can also quietly and seamlessly download data from the data logger in the background, reducing the amount of time required to download the data logger as well as reducing the burden on the battery. The three options for this are:

Periodic
Periodic downloads happen at set user-timed intervals, to set a maximum of time for new data to accrue. The intervals range between 30 minutes and 24 hours.

Scheduled
This option allows the time of download to be scheduled. This can be useful if, for example, the data loggers are in the back of trucks carrying loads, but return to the yard at the end of the day. The download can be scheduled to happen at a time when the data logger will be in range. If the scheduled download doesn't occur (eg. the computer was turned off) the download will happen when possible.

Background
Using this setting downloads happen regularly, preventing a build-up of undownloaded data.

Please note, data updates and downloads can only occur when the computer is running and can contact the data logger through the Gateway.

Logger Security

Data loggers can be quite mobile, and there could be many times when data loggers come into the range of other TTEC Gateways that may or may not be your own. 'Logger security', also known as 'User access control', is about what should happen when that occurs. There could be times when you want to prevent all access, and other times when you want to share some data.

Logger security is deciding who, how, what and when others can have access to your various devices, including Gateways. You will need to ask yourself all sorts of different questions. Examples of these are:

Who do you want to access your devices? Within your organisation? Outside of it? How do you want them to access it? Via a Gateway? Or only the data via software? What functions of the data logger do you want them to access? Should they be able to change or stop the alarms?

Terminology

'Registering'

is when a user adds a data logger to their list of data loggers in TempReport

Domain

When Logger Security is changed, the software will stamp the logger with your domain (based on your registration key) depending on your settings. Since domain is based on the registration key, then the registration key needs to be shared to also share the domain.

Dataloggers can be registered without being stamped with a domain but the risk is that a datalogger that has not been stamped with a domain can be stamped by anyone at anytime, when registering that data logger into their software, if they can communicate to the logger. This means potentially someone could secure the logger, and prevent you from accessing it.

To create or modify logger security, highlight the chosen data logger in the main screen, and press 'Logger security'. This brings up a dialog box that is essentially in two halves: Domains and passwords.

The logger security dialog

Domains are split into two: home domain and other domains. Home domain is your own domain based on your software registration key. Other domains have a different software registration key.

There are four password fields, one of which is a master. The master password must be set if the access to the home domain is other than the default full access. This is to prevent you from disabling your own access to your own device.

Home domain

The default setting is 'Full Access', where all Gateways that belong to your domain can access all features. This can be changed to 'Read Only' or 'Custom' where the permissions for various features can be set individually. Either of these two choices mean that a master password that has full access must be set. In order to determine domain, a domain must be stamped aboard the logger by the software. This happens seamlessly and quietly when you change the security settings.

If you change your own domain access to 'Read-only', it means other devices that belong to your domain can only read the device. The computer where the master password was set and stored has full access.

If you change your own domain access to 'Custom' that means that other devices within your domain will only have the permissions that you give them. As per 'Read-only', you will have full access with a master-password.

Other domains
The default factory setting allows access from other domains.

Other domains belong to other people or organisations who may also have TTEC Gateways. You can set which, if any, features you would like them to have access to. It may be that you do not want them to have any access; it may be that you deliberately want them to have read only or custom level of access.

Allowing access to other domains could be useful in some cases, for example, data loggers can be in the back of trucks, and once the truck with the data logger in the back has arrived at the receiver's yard, the receiver's gateway can find and communicate to the data logger, downloading the temperature straight to their computer.

Other options available for other domains include 'no access' where devices from other domains have no access to your device, and 'full access' where devices from other domains have full access and rights to your devices (they can start and stop data loggers, change alarms, and settings).'Read only': means other domains can read the data from your logger, but are unable to control it or give it commands; and 'Custom', so that other people or organisations using a different domain only have the permissions that you have set them.

Passwords
There also can be other situations present where you would want some people or organisations to have different access settings to the set domain level. This can be set with passwords.

The software can have up to four passwords, one of which is a master password, used when the access for your own network/domain is changed from the default. Each of the other three passwords can have their own set of permissions for access to data logger features.

Keys
Keys are passwords that have been encapsulated with other data, such as time limitation, and then encrypted for safe transfer.

To generate a key, go to 'Logger security' as described previously, and click the button 'Generate new key'. In the dialog box, enter which data logger you wish to create a key for, the type of device it is and the password you want to turn into a key. The key is generated in the text field at the bottom. Click and drag to highlight key. Press 'Ctrl' + 'C' to copy it to the clipboard. In your email program, either choose 'Edit' > 'Paste' or press 'Ctrl' + 'V' to paste the key, so it can be sent to your chosen recipient.

Password and key management
Passwords and keys are stored and managed in the 'Local passwords' section of the 'Settings' dialog box.

Setting logger security permissions

Settings permissions for actions
Clicking the button with the three small dots brings up the logger security permission dialog box. This defines what actions that domain or password has access to. The following section explains the security permissions that are customisable.

General Read
Checking this option allows others to register and synchronise the data logger in their system, receiving information about the data logger and displaying it in the main screen only.

Start logger
This option gives permission to start the logger: recording at a specific time interval. This includes the ability to change the comments and the name/location field, delay start and wrap around, as per starting a logger. A logger must be first stopped before it can be started.

Stop logger
Checking this option gives permission to stop the logger so that it no longer records measurements at a set interval. This can be beneficial to extend the life of the data logger battery.

Download logger
Checking this option allows the data on board the logger to be downloaded to another computer.

View logs
This allows access to the past records of the data logger.

Change updates
This option makes 'Automatic downloads' and 'Data updates' available to the user.

Stop alarm
Checking this option allows the recipient to stop the alarm on board the logger and/or in the software. Stopping an alarm stops the alarm temporarily. Should an alarm condition persist beyond the grace period time limit, then the alarm will re-signal.

Change alarm
If checked, then the user can change the alarms, either minimum, maximum, advanced, value, grace period and communication forms (email, SMS and relay). The best way to stop an alarm completely is to remove the alarm through 'Change alarm'.

Change security
Allow the recipient to change logger security settings (for the home domain, for other domains, and to create passwords. Note, that the software cannot see any pre-existing password on board the logger, and so will re-write any pre-existing passwords on board the logger.

Defective Sensors

A data logger with a short circuited sensor will record a very high temperature and a data logger with an open circuit sensor will record -273 °C. If this occurs, please return the unit to the factory for repairs with a note as to what happened.

Alarms

T-TEC RF type 6 and 7 loggers contain an alarm function. Two alarms may be set at any time, either as a maximum (alarm if temperature exceeds a set limit) or as minimum (alarm if the temperature falls below a set limit), and an individual delay time (grace period) may be set for each alarm. Alarms are set by highlighting the specific data logger in the main screen and pressing 'Change alarm'.

If an alarm is triggered, a T-TEC RF 6 data logger will indicate this with 'beeps': one beep if alarm 1 has been triggered, two beeps if alarm 2 has been triggered and three beeps if both alarms have been triggered. A T-TEC RF 7 data logger will show 'A1' if alarm 1 has been triggered, 'A2' if alarm 2 has been triggered and 'A12' if both alarms have been triggered.

Alarms will also appear as notifications in the operating system and within the software. The data logger(s) in question will be highlighted in red and when selected, the information panel will contain information about the alarm status. If set to do so, TempReport will also send SMSes and/or emails. Alarms can be set so that TempReport will send SMS and/or email when alarm events are triggered

The beeping or alarm display may be stopped by choosing **'Stop Alarm'** in the menu in the main screen of TempReport, and then ensuring, 'Stop alarm on logger' is checked, pressing 'Save'.

The alarm notifications and alarms in software may be stopped by choosing **'Stop Alarm'** in the menu in the Communications Program, and then ensuring, 'Stop alarm in software' is checked, pressing 'Save'.

The datalogger can alarm again, after the expiration of a new grace period, if the alarm conditions persist. To permanently stop the alarm, it will need to be either

changed or removed. Choose 'Change alarm' and either change the alarm settings or uncheck the alarm.

Time of alarm condition accumulates until reset
Normally, an alarm with a grace period would start counting from 0 when an alarm condition occurs. The option, 'Time of alarm condition accumulates until reset' means that the first time an alarm condition is generated, the grace period starts counting from zero. Subsequent alarm conditions are treated as an extension of the first alarm condition, so that the grace period countdown is continued from where it left off last time.

For example, if the grace period is set to 10 minutes and the first alarm condition takes up 4 minutes, leaving 6 minutes of grace period left. When the second alarm condition continues for more than 6 minutes, then an alarm is generated. Once the grace period has expired, in possibly multiple events, an alarm is generated immediately, in all subsequent events.

The alarm time accumulation is reset, so that the grace period is returned. This can be customised to times (every hour, 2, 6, 12, 24, 48, 72 hours, 1 or 2 weeks, 1, 2, 3, 6 or 12 months, or infinitely.

As an example: a freezer with automatic defrost is likely to exceed the maximum alarm temperature during the defrost. This is part of the functioning of the freezer and should not create an alarm. If the total time over a 24 hour cycle is too long, then something may be wrong with the function or operation of the freezer.

Relay output for T-TEC RF Loggers

Relay output for the RF loggers is an optional extra on the Gateway. All loggers can send alarms to the Gateway, which in turn can set the relay. The relay can be reset via the software. Once a Gateway is set up, it can be placed into location with its own power source for relay purposes. A second Gateway, attached to a computer, can be used to change the settings on any number of data loggers at any time. Please see 'Gateway' under 'Infomation for IT staff' on page xvi for more information.

Data compression

T-TEC RF loggers use data compression for the data in the memory of the logger. The memory can then contain a greater number of measurements. The more similar the measurements are, the larger number of measurements the logger can keep. This is the reason we cannot give a fixed number of data a logger can contain.

For example, the temperature in a commercial freezer may vary from -23°C to -20°C, a variation of 3 degrees Celsius. Each cycle (top-to-top) may take around one hour. Compared to the logger measuring range of -40 to +70 °C, the variations are small, from top to bottom around 3%. The number of stored measurements will be less with longer intervals as the temperature will vary more between each measurement.

Number of measurements for a logger

The data sheets show the expected minimum number for a specific logger type.

Logging Intervals

See 'Data compression' on page 25 for the explanation of the variable amount of measurements a data logger can store.

The following table may also be used:

Logging duration at different intervals

Interval	3,000 logs	12,000 logs	20,000 logs	100,000 logs‡
1 sec	50 min	3.3 hours	5.6 hours	27 hours
2 sec	1.7 hour	6.7 hours	11 hours	2 days
5 sec	4.2 hours	17 hours	28 hours	5.5 days
10 sec	8.3 hours	33 hours	2.3 days	11.5 days
15 sec‡	N/A	N/A	N/A	17 days
30 sec	25 hours	4.2 days	6.9 days	34 days
1 min	2.1 days	8.3 days	14 days	69 days
2 min	4.5 days	17 days	28 days	138 days
5 min	10 days	42 days	69 days	347 days
10 min	21 days	83 days	169 days	1.9† years
15 min‡	N/A	N/A	N/A	2.5† years
30 min	62 days	250 days	417† days	(5.5† years)
1 hour	125 days	500† days	2.3† years	(11† years)
2 hour	250 days	2.7† years	(4.6† years)	(22.5† years)
6 hour	2.1† years	(8.2† years)	(13.8† years)	(68† years)

† *Battery lifetime may be shorter for some types.*

‡ *T-TEC RF only*

NB. The above table is accurate for the on-board storage of the data logger. T-TEC RF data loggers set to 'wrap-around' that are regularly downloaded can create long, uninterrupted sequences that may contain millions of logs.

Logging intervals for T-TEC RF

The logging intervals for the T-TEC RF are very similar to the standard T-TEC with two additions (15 seconds and 15 minutes intervals). Time lengths in brackets are theoretical only as the battery within the data logger will limit the length of time. The total number of logs in a new RF logger has been very conservatively estimated at 100,000 logs. Due to data compression, the actual number of logs will be different for each recording data set.

The Files - T-TEC RF Logger

The software saves the raw data in an internal database, saving the data to files with extension of 'dta' only when requested, when pressing 'Download logger' or by 'View logs'. 'DTA' files are text files and can be read by Notepad. The data can also be exported from Graph Viewer to Comma-Separated-Values (CSV) for import into spreadsheet software. For more information on exporting data from Graph Viewer, please see the chapter on Graph Viewer on page 65.

Stop logging

The logger stops logging when the memory is full and the logger is set to stop at full memory, or when 'Stop logger' function is selected in the communications program.

The logger does **not** stop when it is communicating with the computer and the memory in the logger is read. All communications happen in the time between the logger recording the measurements. It can be set to log each second and still be read without disturbing the recording (logging).

A T-TEC RF logger needs to be stopped before being restarted. This is a security feature as existing data in the data logger will be lost when restarted. It is important to download the data from the data logger if that data is needed or wanted before restarting the data logger.

Battery

The battery is a ½AA lithium thionyl chloride 3.6v.

How long can the battery last?

This depends upon the type of logger, how often it measures and environmental factors. Frequent downloading of data uses battery power. Frequent downloading of files also uses battery power.

Expected battery life

T-TEC RF 6: 2 years
T-TEC RF 7: 1 year

Current battery voltage
The battery voltage of a T-TEC RF is shown in the information panel for that data logger in TempReport.

Replacing batteries
If the batteries need replacement, it is recommended to change batteries before beginning a long measuring series. Please note that it may take up to three minutes before being able to contact the logger, after replacing a battery.

A logger set to **'Wrap around'** will lose the correct start time if batteries are not replaced before system shut down and show a start time of 1st of January, 2001.

A new battery might be passivated. In that case it might look as a fully discharged battery and it should undergo depassivation prior to long stable use. The best way to do this is to insert the battery and refresh the logger several times, with about 30 sec intervals. During these refreshes, the battery symbol for that specific data logger will appear to refill.

Access to the battery

Type 6 & 7
If the battery is replaced within 30 minutes of battery removal, the logger will continue logging.

Remove the two screws in the sides and pull the two sections apart. When re-assembling the case take great care that the instrument is completely dry and that the o-ring is properly placed in the groove (the data logger is waterproof due to the o-ring). Fasten the screws so the two parts just meet at the sides with the screws — do not over tighten.

The ½AA type is marked '+' and '-'. Check with the markings on the battery holder to ensure the battery is mounted the right way. A battery inserted the wrong way round will be drained quickly but it will not damage the instrument.

Settings

The following is a list of options found under the Settings dialog box.

General settings

Prevent computer from sleeping

Many computers are set to 'sleep' when not in use. This will interrupt updates, automatic downloads and even alarms. To ensure that this does not happen, please check this option and see page 12 for more information.

Start TempReport when Windows starts

This options allows the user to decide if TempReport should be started and open automatically when Windows is started.

Outgoing SMS

T-TEC RF data loggers can send alarm messages back to the software. The software has the ability to contact an external entity to send SMSes, either directly via 'Use personal SMSGlobal account', or via web service.

Directly/Personal SMSGlobal account

To use this option, sign up for an SMSGlobal account at SMSGlobal.com. Once you have an account, you will need the HTTP/SMPP API Key found under 'Tools' > 'API keys'. The username found there goes in the 'SMSGlobal API Key username' field and the password goes in the 'SMSGlobal API Key password'.

Use web service

This is also called cloud. This is in reference to wireless datalogger server software that can either be separately purchased and installed on your own server, or a subscription to access our server can be purchased. Then the information to log onto SMSGlobal is stored on the server software.

Note

Sending an SMS on alarm is data logger specific and can be set for each data logger, under 'Change alarms' > 'SMS alarm message'. If this option is checked, then a dialog will appear where phone numbers should be entered. SMSes will only be sent if recipient phone numbers are entered for an alarm.

Outgoing email server
The software can also send alarm messages via email if an active internet connection is available. To do so, the settings in this area must be filled in. There are two options to choose from and fill in:

Use web service
This is also called cloud. This is in reference to wireless datalogger server software that can either be separately purchased and installed on your own server, or a subscription to access our server which can be purchased. Then the information to send emails is stored with the server software.

Use custom SMTP server
This option allows the software to act as an email client (eg. Microsoft Outlook or Mozilla Thunderbird) to directly contact the email server to send an email. The best starting point may be your IT administrator.

SMTP host: the URI of the email server location (eg. smtp.domain.com)
SMTP port: the port number for sending of emails through that server, typically 587 or 465
From email: the email address you would wish the email to appear from.
Use authentication: enable username and password to send to email server.
Use SSL: encrypt the username and password being sent to the email server.
Username/password: the username and password for the email account.

We recommend you seek out your friendly IT administrator for assistance.

Proxy Server Settings
Some organisations' IT systems have proxy servers. These proxy server configuration details need to be entered into the software so that the software can communicate to external systems outside of the local system, for example, by SMS, email or cloud subscription. There are three possible options:

System default
The software finds the proxy server settings within the operating system (such as used for Internet Explorer) and uses them.

Custom proxy settings
The software will use these custom proxy settings to connect to the Internet. If this option is needed, there is a very high probability that somewhere nearby is an experienced IT administrator who can help you fill these settings in.

No proxy
The software will attempt to communicate directly to the Internet, without the aid of a proxy.

Our recommendations are first to try system default and if that does not work then ask your IT administrator for help with the settings.

Cloud subscription service (Web service)
The cloud subscription service is a storage and delivery mechanism. If you are using this service, data that you have downloaded from data loggers will be automatically sent to the cloud. The data on the cloud can be accessible to other users who also have installed TempReport and have a subscription key to the same cloud. If that access has been allowed, they will be sent the data the next time their computer system is switched on and ready to download. All the data will also be kept online and accessible to those with the cloud subscription key and correct permissions.

Cloud subscription service URI
Please input the URI (address) of the cloud subscription service.

Cloud subscription key
Please input the subscription key for the cloud, if a subscription to the Temperature Technology cloud has been purchased. A cloud subscription key can be purchased from Temperature Technology and renewed on an annual basis.

Backup and restore
In this tab, you can create backups of your logs and settings, either singly or together. The backup can be encrypted with a password.

This can be used to share your data: the data in one installation can be backed up and restored in another installation. In this situation, it is sensible to share only the data and not the settings that contain your passwords.

It can also be used as backup in case of computer failure. In this case, you should store the backups on a different medium than your computer and settings should be included in the backups. It would be wise to encrypt any backup that contains settings with a password. Please memorise or store that password in a safe place.

Local passwords
All passwords (minus the backup passwords) are collected here. The passwords themselves are not visible but you can see information about which device it applies to via the serial number, the device's type (either data logger or gateway) and a description of the password.

In this screen you can delete any or all passwords. Note that you can also delete any Master Passwords you have set, preventing the software from communicating to any data loggers you have secured with that password. So delete with caution.

New passwords sent by others for their data loggers can also be added into this area by clicking on 'Add new'.

This is also the location where you can add keys sent by others. Keys are generated in 'Logger security'.

MQTT
TempReport currently supports MQTT v3.11. The software acts as a client sending data to a broker, and in future, the T-TEC Gateway will also be a client. Currently, in TempReport, under Settings, there is a tab called 'MQTT'. That is where the address of the broker needs to be entered, the client ID and the topic to send to.

Note: there are certain reserved characters that **must not** be used in topic names. These characters are '#' and '+' as they have specific meaning within the MQTT specification.

The broker
The broker can be something already up and running as a test service such as HiveMQ's MQTT Dashboard (http://www.mqtt-dashboard.com/). It can be one that is downloaded and stored on a private host, such as Mosquitto (an open source MQTT broker -- https://mosquitto.org/). All sorts of other more fancy brokers exist such as Apache Active MQ (http://activemq.apache.org/) or RabbitMQ (https://www.rabbitmq.com/) that can receive messages in various formats and transmit them either in the same or different format.

Clients can be anything, including browsers that have support for the Websockets API (W3C standard) which most modern browsers do.

The data
Currently, two types of messages are implemented within TempReport: alarm and data updates. Data updates are used within TempReport to show the last updated temperature measurement on the main screen. When TempReport receives these messages from the Gateway, it sends them on to the locations and topics as entered in the 'MQTT' tab under 'Settings'.

Note: the topic listed in this tab is used as 'root' level. Alarms are sent to topic: root level/alarm/logger/sensor and updates are sent to root level/regular/logger/sensor.

Alarms - topic and message
For an example, 'Smith Corporation' will be used as an example of the topic listed in TempReport under 'Setting' > 'MQTT'. Smith Corporation owns T-TEC RF loggers with serial numbers 71, 72, 73, 74 and 75. So if logger T-TEC 7 RF – 3F (a wireless T-TEC logger with display and two external sensors) with the serial number 73 raises alarm 2 on sensor number 2, once it reaches the software, the alarm will be propagated to the listed MQTT server with the topic:

Smith Corporation/alarm/73/2.

The message that is sent to that topic is in plain text and is in UTF-8, written in JSON format. The time is in UNIX time. The message looks like:

{serial: 19, time: 1465885753, sensor: 2, alarm: 2}

Updates
For regular data updates, the topic is root level/regular/logger/sensor. So updates for data logger number 73 from Smith Corporation appear like:

Smith Corporation/regular/73/1

Smith Corporation/regular/73/2

Note: each sensor has its own topic and a message is sent to each topic only about the individual sensor. The message that is sent to that topic is in plain text and is in UTF-8, written in JSON format. The time is in UNIX time. The message looks like:

{serial:128, time:1465883753, sensor:2, value:19.540}

Security
MQTT can have both security through TLS and identity, authentication and authorisation (IBM, 2016b) although as of July 2016, TempReport doesn't currently support these features.

Quality of Service
Quality of Service is important part of MQTT. It helps to overcome unreliable networks and describes how the communication should be ensured across those networks (HiveMQ, 2016b).

There are three levels of Quality of Service:

1. At most once
2. At least once
3. Exactly once

The QoS TempReport uses when sending messages is QOS_LEVEL_EXACTLY_ONCE. This means that each message is sent once, storing the message until an acknowledgement is received.

Retain
MQTT brokers can retain a message: they can save a message until it is replaced by a new message. This means a new subscriber will receive the last message upon subscription. This is currently set to false by default.

Last will and testament
This is set in the connection settings, and is currently set to false. A last will and testament would send a specific message if the source of the data (in this case, TempReport) fails to send data within a specified time. This means that if data is not sent within, for example, 18 hours, a special pre-prepared message will be sent to subscribed clients.

Clean session and keep alive
TempReport currently keeps a clean session (persistence) and keep alive is set to 60 seconds.

This means TempReport will send a message at least every 60 seconds. If the MQTT broker does not receive a message at least once per that interval, then the broker will assume that the connection is lost.

How to use MQTT
MQTT was introduced to TempReport to help bring the data out of TempReport, and into other systems, eg. Building Management Systems.

The first port of call would be the specifications for MQTT 3.11 http://docs.oasis-open.org/mqtt/mqtt/v3.1.1/mqtt-v3.1.1.html

There are some tutorials online that can assist with building software with MQTT:

1. Thingtastic.com has one for MQTT and Websockets: http://www.thingtastic.com/tutorial/mqtt-with-websockets-and-html/

2. Paho MQTT has an example for C# (M2MQTT): https://github.com/eclipse/paho.mqtt.m2mqtt

There are many libraries, and it wouldn't be possible or reasonable to attempt to make an exhaustive list. Temperature Technology does have demonstration MQTT code. Please enquire.

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Introducing MQTT, HiveMQ, viewed 26 July 2016, http://www.hivemq.com/blog/mqtt-essentials-part-1-introducing-mqtt

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MQTT security: Who are you? Can you prove it? What can you do?, IBM, viewed 27 July 2016, https://www.ibm.com/developerworks/community/blogs/c565c720-fe84-4f63-873f-607d87787327/entry/mqtt_security?lang=en

Quality of Service, HiveMQ, viewed 2 August 2016b, http://www.hivemq.com/blog/mqtt-essentials-part-6-mqtt-quality-of-service-levels

MQTT with Websockets and HTML, Thingtastic.com, viewed 3 August 2017, http://www.thingtastic.com/tutorial/mqtt-with-websockets-and-html/

Gateway management

TempReport will detect one USB Gateway attached directly to a computer. All other Gateways attached to the same computer will not be recognised by the

software. This dialog is for managing Gateways attached to other computers on the same Local Area Network (LAN).

To add another Gateway, click the button that says 'Add'. To change a setting for a Gateway, highlight it in the list and press 'Modify'. Both will produce the same dialog.

Enter Gateway MAC address
Please enter the MAC address of the Gateway. This can be either the MAC address of the Gateway itself, which can be found printed on the casing of the Gateway, or the MAC address of the computer a Gateway is connected to, where the LAN service is running.

Enter Gateway name
Please give the Gateway a human-understandable name. For instance, if it is the only Gateway that will be installed in Building 7, it may make sense to refer to it as Building 7.

Gateway IP address: Autodetect
This setting will look for MAC and IP address broadcasts from Gateways on the LAN, and see if any match the one whose details are entered into this form.

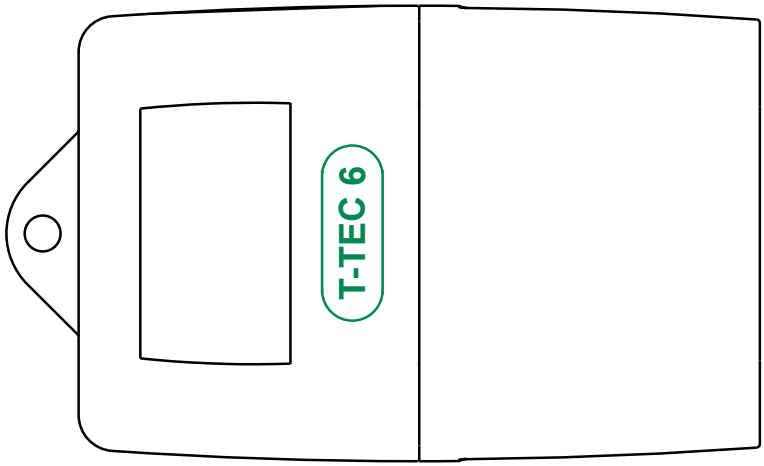
Gateway IP address: Static IP
This setting is meant to speak directly to Gateways across the Internet at specific IP locations. This means the network administrator has assigned a specific IP for that Gateway.

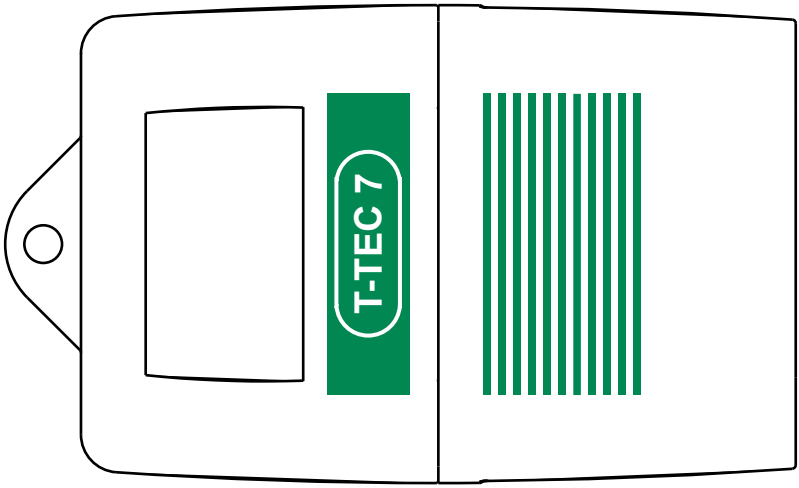
Viewing the Graph

Once a graph is displayed in Graph Viewer, please turn to the chapter on 'Graph Viewer' for instructions on use.

T-TEC logger

If your logger looks like below, then read this section. Otherwise, please find the chapter that has a picture that looks like your data logger, listed on page 9.





Program configuration

All Communications programs must be configured so the program can know which type logger is used and which port the data logger is connected to on the computer. Configuration is most easily done the first time the program is opened.

To start the software, click on the icon for T-TEC Logger

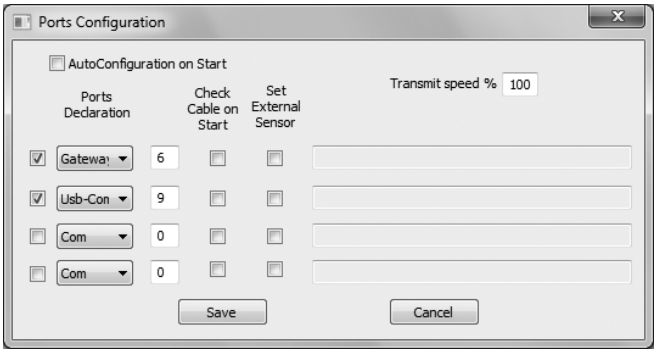
T-TEC Logger is the communications program for the T-TEC logger.

Configuration for a T-TEC data logger

Connect both a T-TEC data logger and a USB cable, and open the T-TEC data logger communications program.

The program will now scan the ports on the computer and try to detect which adaptor is connected to which port.

The result will be shown in the window **'Port Configuration'.** If one of the four small boxes to the left is ticked, then the program has found the adaptor and is configured.



Then un-tick the small box at top: **'Auto configuration at start'** to avoid having the program search for settings each time it is opened.

Click **'Save'**. The program is now ready to use.

If there are no ticks in any of the four boxes at the left then the auto detect procedure could not find the interface adaptor. Please see Troubleshooting in the help file for the T-TEC program for possible solutions. Press 'F1' within the program to bring up the help file.

This section is the same as '**express help'** in the installed manual. It will show how to start the logger and read the logger. Following the tutorial in the on-line manual is recommended.

Communication with the data logger

The T-TEC interface cable must be connected to a USB port which has been configured as described.

Now connect the data logger to the cable. This may be done at any time **unless the red stop sign is displayed in the program.**

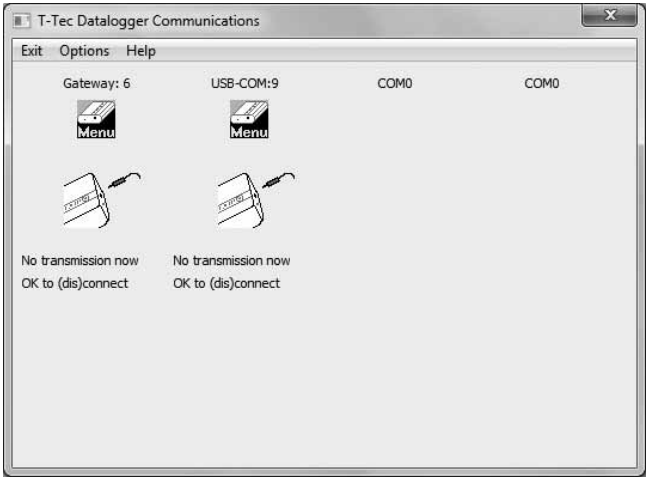
This sign indicates that active transmission between the computer and the data logger is taking place. It is very important to **not** *connect or disconnect the data logger when this sign is shown on the screen. Transmission only takes a few seconds.*

To read the T-TEC logger

In the main window of the graphics program (T-TEC Graph Viewer)

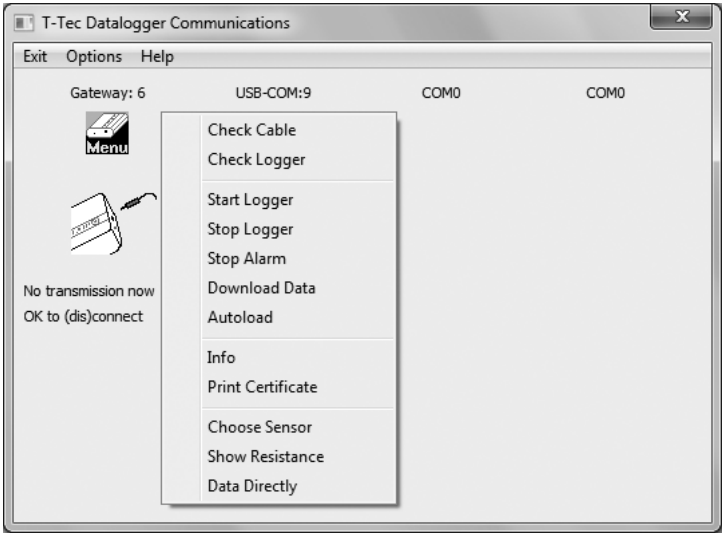
A. Select 'Logger' and 'To T-TEC logger'. The T-TEC Communications screen appears similar to the image below:

B. Connect the logger to the cable.



C. Click on the **'Menu'** icon to pull down the menu.

D. Click 'Check cable'. A message will appear at the bottom of the screen.



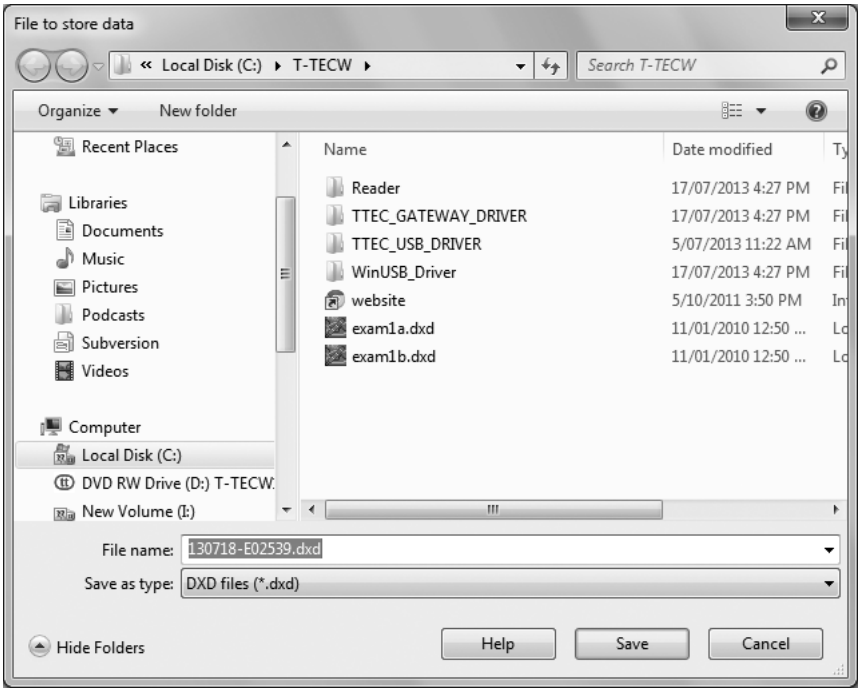
If that message is 'Cable detected', move on to step E. If not, see troubleshooting in the help file in the software, by pressing 'F1' .

E. Click **'Check Logger'**. The stop sign will show for a short while. The identity information held in the data logger will be displayed as well as the current temperature of the T-TEC logger. If your logger has a remote probe, you will get a window up where you are asked to choose a sensor file with the suffix '.sda'. For standar sensors, choose 'sen1.sda'.

F. Click menu again and click **'Autoload'** to download the file of times and measurements from the datalogger memory.
If 'Download data' is used, the file will be saved. To view the file in 'Graph Viewer', click 'File' > 'Load curve' > and find the file manually.

G. The data from the logger must be saved to a file first. A file window will appear. It will show a filename constructed of the year, the month, the date and the logger number. The file name can be changed by the user. Click 'Save' when ready.

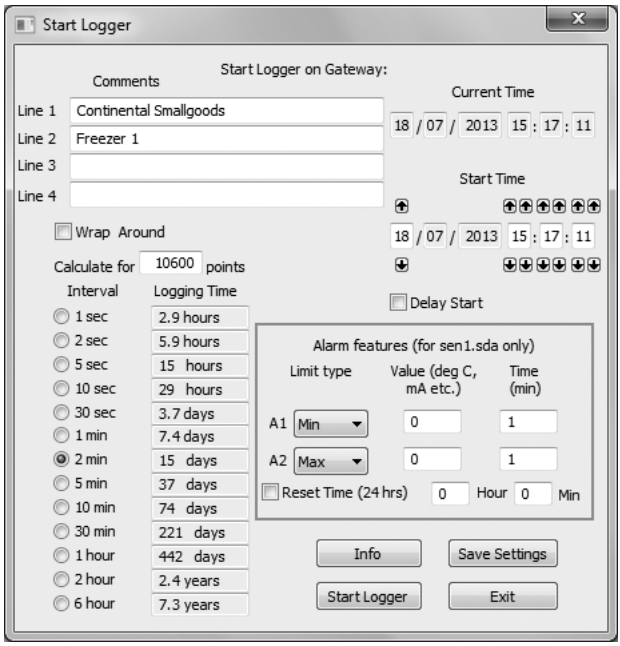
H. The data from the logger will now be converted and shown on the graph as a curve.



To start the logger

Points A. to E. as in previous section, then:

I. Click **'Menu'** and **'Start Logger'**. The **'Start Logger'** window appears.



J. In **'Start Logger'** there is a calculator. If the user types in the expected maximum number of measurements (depending on logger type) the calculator will show how long a time a data logger can log at various time intervals. Data loggers with data compression can contain more measurements if the measurements are very similar or only vary slowly.

K. In this window set logging interval, start time and wrap around / stop when memory is full. Under comments you may type specific information for the new file the logger is going to log. (Tasks, names and places may be useful for identification later).

L. **Current time:** The logger reads the internal clock of the computer at the time of start of the data logger. To get precise timing in real time, the

computer's clock should be adjusted at regular intervals - eg., bi-monthly, depending on the accuracy of the clock.

M. **Start time:** The logger may be started with a delayed start. Using the arrows a later time for the start may be specified up to a delay of 1 week from start.

N. Alarms may be set as either minimum or maximum alarms.
Time: Grace period before alarm is triggered must be minimum 1 minute.

O. **Alarm reset:** Setting the daily time that the alarm(s) and grace period(s) reset. Optional.

P. Click **'Start Logger'** and **'Yes'** to start the logger. The logger beeps when it receives the new setting.

Q. Wait until the stop sign disappears and exit this screen. The data logger is now logging as instructed. You can click 'Info' to check the new settings in the data logger.

R. **'Save Settings'** is useful if you have many data loggers to start up with almost identical settings. Once clicked, the start screen will come up with the same settings preloaded each time.

S. If you would like a hard copy of the set-up details, pull down the **'Menu'** again and click on **'Print certificate'**. The details will now appear in your text editor (eg. Notepad) and may now be printed.

T. When the stop sign disappears, disconnect the data logger from the cable. It is either now started or in delay start mode.

For loggers with a display, once started under delay start, it will display a target sign. Once the data logger starts to record, the target sign will blink.

Tutorial

The 'tutorial' in the on-line manual will take you through some of the many facilities this program offers. To access the Tutorial select **'Help'** from the top bar in the graphics screen, then **'Contents'** and **'Tutorial'**.

The help-text and the tutorial can stay on top of the T-TEC program so it is readable when working with the program. The tutorial will take about thirty minutes to an hour and is strongly recommended for new users.

The tutorial and any other topic in the **'Help/Manual'** can be printed out by clicking the printer icon.

The files

When the computer reads the memory in the T-TEC logger, it creates a small 2 to 32 kB file with the extension 'DXD'. This is a complete copy of the data in the logger's memory and is in compressed format. To access the data, it must be converted to a more readable format ('DTA') and the T-TEC program has facilities for this with the **'Convert'** procedures in the **'Logger'** menu.

For convenience, the **'Autoload'** procedure will automatically convert new DXD files and create a file with the same name as the DXD file but with the extension '.DTA'.

Both DXD files and DTA files are saved on the computer's hard disk and remain until they are removed by the user.

Files with extension '.DTA' are much larger and may be up to 700 kB long. The program stores both file types from a T-TEC logger. It is easy for a user to make a backup copy of the DXD files. DTA data files can always be re-created from the 'DXD' file with the **'Convert'** procedures.

Data Compression

T-TEC loggers use data compression for the data in the memory of the logger. The memory can then contain a greater number of measurements. The more constant the measurements are, the larger number of measurements the logger can keep. This is the reason we cannot give a fixed number of data a logger can contain. The exception to this are the C-loggers which do not work with data compression and can only store a fixed number of measurements (3,100 sets for older loggers and 10,600 sets for newer loggers) and F-loggers which can store a maximum of 21,000 measurements.

Data logger with external sensor

Different thermistor sensors will give different measuring ranges for the T-TEC data loggers. For example, a standard sensor (Type 1) will measure from -40 to +85 degrees Celsius and a T-TEC type 2 sensor from -100 to +20 °C.

If the datalogger has a fixed or Pt100 sensor, the program will detect the type of sensor. If the logger uses an external thermistor sensor, then the sensor must be specified in the program.

See **'Choose Sensor'** in the help file.

Sensor files (.SDA files)

The sensor is defined with values kept in a sensor file, e.g.,

sen1.sda for the standard temperature sensor (T1) range -40 +85°C
sen2.sda for the low temperature sensor (T2) -100 +20°C
sen6.sda for the high temperature sensor (T6) +20 +160°C

You can use your own thermistors if you so desire and create a sensor definition file yourself - see **'Help'** in the program under **'Advanced Topics'** > **'Thermistor sensors'**.

Defective Sensors

A data logger with a short circuited sensor will record a very high temperature and a data logger with an open circuit sensor will record -273 °C. Please return to manufacturer for repairs.

Alarms

T-TEC Type 6 and 7 loggers (except loggers for humidity) contain an alarm function. Two alarm temperatures may be set when the logger is started, either as a maximum (alarm if temperature exceeds a set limit) or as minimum (alarm if the temperature falls below a set limit), and an individual delay time may be set for each alarm (grace period).

If an alarm is triggered, a T-TEC 6 data logger will indicate this with 'beeps': one beep if alarm1 has been triggered, two beeps if alarm2 has been triggered and three beeps if both alarms have been triggered. A T-TEC 7 data logger will show 'A1' if alarm1 has been triggered, 'A2' if alarm 2 has been triggered and 'A12' if both alarms have been triggered.

The beeping may be stopped by connecting the logger to the PC and choosing **'Stop Alarm'** in the menu in the 'T-TEC Logger' software.

Relay output

If you have a T-TEC data logger with relay output, please refer to the instruction note supplied with the data logger for the specific function.

A 3-wire cable for relay connection is provided. The relay connects the black and blue wires in reset and the black and brown wires in alarm.

Maximum load (resistive) for the relay: 1A 30V DC, 0.5A 125V AC.

Number of measurements for a logger

The data sheets show the expected number for a specific logger type.

Logging duration at different intervals

Interval	3,000 logs	12,000 logs	20,000 logs	100,000 logs‡
1 sec	50 min	3.3 hours	5.6 hours	27 hours
2 sec	1.7 hour	6.7 hours	11 hours	2 days
5 sec	4.2 hours	17 hours	28 hours	5.5 days
10 sec	8.3 hours	33 hours	2.3 days	11.5 days
30 sec	25 hours	4.2 days	6.9 days	34 days
1 min	2.1 days	8.3 days	14 days	69 days
2 min	4.5 days	17 days	28 days	138 days
5 min	10 days	42 days	69 days	347 days
10 min	21 days	83 days	169 days	1.9 years
30 min	62 days	250 days	417 days	(5.5 years)
1 hour	125 days	500 days	2.3 years	(11 years)
2 hour	250 days	2.7 years	(4.6 years)	(22.5 years)
6 hour	2.1 years	(8.2† years)		(68 years)

† *Battery lifetime may be shorter for some types.*

Wrap around

If the data logger is set to 'Wrap around' and the memory becomes full, then the oldest data stored is replaced by the newest. The oldest data is lost. This may be useful to you if only the most recent data is of interest.

Stop logging

The logger stops logging when the memory is full and the logger is set to stop at full memory, or when 'Menu' > 'Stop logger' function is selected in the communications program.

The logger does **not** stop when it is connected to the computer and/or the memory in the logger is read. All communications happens in between the logger recording measurements. It can be set to log each second and still be read without disturbing the recording (logging).

It is not necessary to stop logging when a T-TEC logger is read or restarted.

Battery

How long can the battery last?

This depends upon the type of logger, how often it measures and environmental factors.

Expected battery life

T-TEC 6: 3.5 to 4 years
T-TEC 7: 2+ years.

Current battery voltage

The **'Check Logger'** function in the communications program will display the actual battery voltage.

T-TEC 501 series uses two batteries, 3v lithium manganese batteries type CR2450. Type 6 and 7 use one battery, ½ AA 3.6v lithium thionyl. TempTec 816 uses one battery, AA 3.6v Lithium

Replacing batteries

If the batteries need replacement, it is recommended to change batteries before beginning a long measuring series.

A change of batteries in a logger containing data may result in loss of some of the newest data but the majority may be read after a change of batteries.

Note

A logger set to 'Wrap around' will lose the correct start time when reset is pressed or batteries are replaced and show a start time of 1st of January, 1970.

Access to the batteries

Type 6 & 7

Remove the two screws in the sides and pull the two sections apart. The ½AA type is marked '+' and '-'. Check with the markings on the battery holder to secure the battery is mounted the right way. A battery inserted the wrong way round will be drained quickly but it will not damage the instrument.

When assembling the case: take great care that the instrument is completely dry and that the o-ring is properly placed in the groove. Fasten the screws so the two parts just meet at the sides with the screws — do not over tighten.

Logger reset

When a new battery is inserted, the logger responds with 3 beeps. If you do not hear the beeps, it is necessary to press the switch marked reset inside the logger. The logger then resets, checks its batteries and makes three beeps or blinks if all is OK.

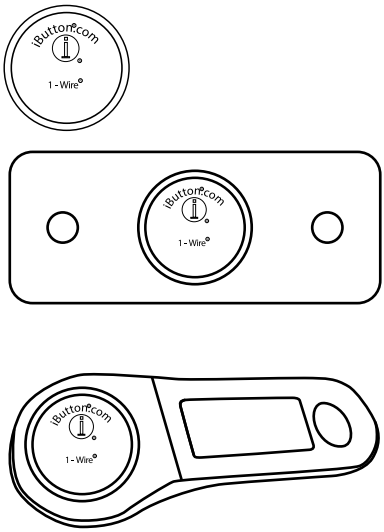
More recent data loggers have 2 reset pins instead of the switch. A reset is done by removing the battery and then shorting the two pins. Reset — and three beeps — will then be executed. This also will happen when the battery is mounted.

Viewing the Graph

Once a graph is displayed in Graph Viewer, please turn to the chapter on 'Graph Viewer' for instructions on use.

iButton logger

If your logger looks like below, then read this section. Otherwise, please find the chapter that has a picture that looks like your data logger, listed on page 9.



These dataloggers connect to the computer through a USB port via a USB Adaptor connected to a Blue Dot Reader.

To start the program

To start the program, double click on the icon for 'Thermochron logger'.

Thermochron Logger is the communications program for iButton loggers. *Note:* iButton data logger communications programs can be accessed from the T-TECW program and this may be the most convenient way.

To open the iButton Communications software, either double click the icon on the desktop, or go to **'Start'** > **'All Programs'** > **'Temperature Technology'** > **'Thermochron Logger'** or go to 'Graph Viewer' > 'Logger' > 'To Thermochron'.

The program will automatically detect the presence of the adaptor and attached iButton data logger. If this does not occur, please see the section on 'Troubleshooting' or contact Temperature Technology for technical support.

Communication with the data logger

The Blue Dot Reader must be connected to an adaptor and USB port before communication.

In case of errors

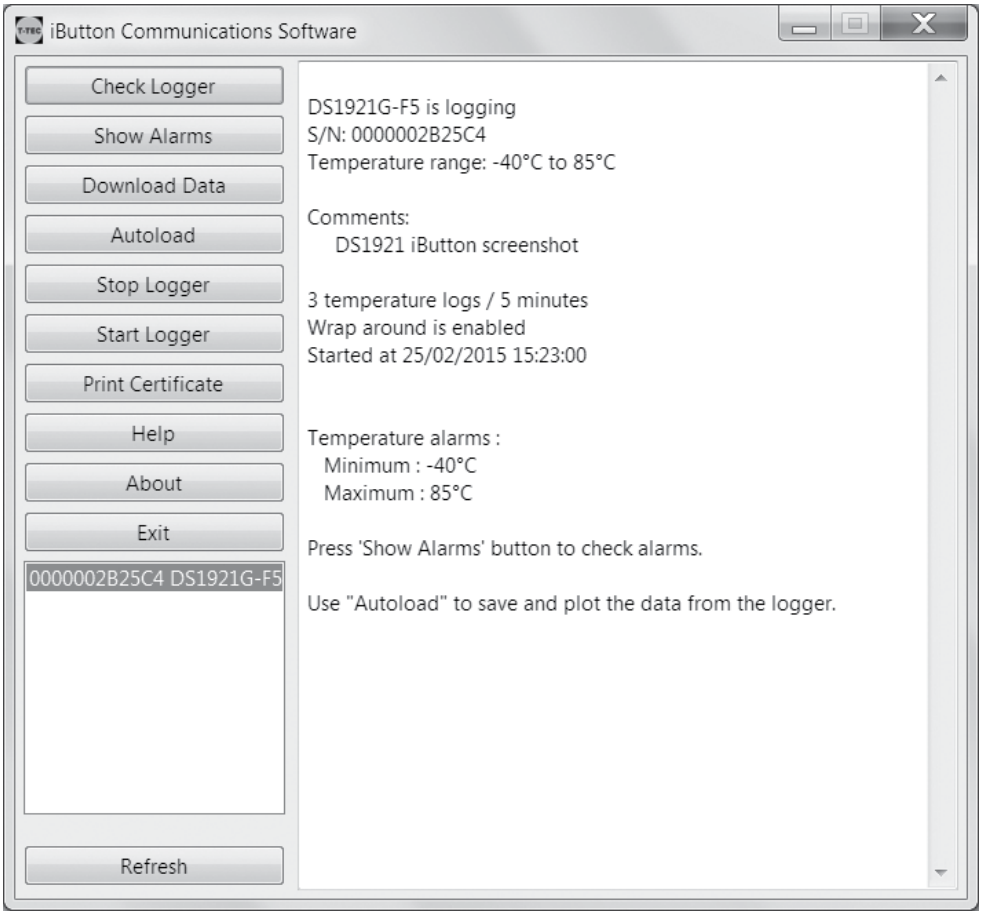
If needed, simply re-install the program(s). There is no need to un-install anything before re-installing.

The files

Data from the iButton will be converted to a DTA file directly. This is true for both the iButton or TempTec Reader Communications software. Files from TempTecR Communication software must be saved by the user.

To read the data logger

A. The iButton Communications screen appears similar to:

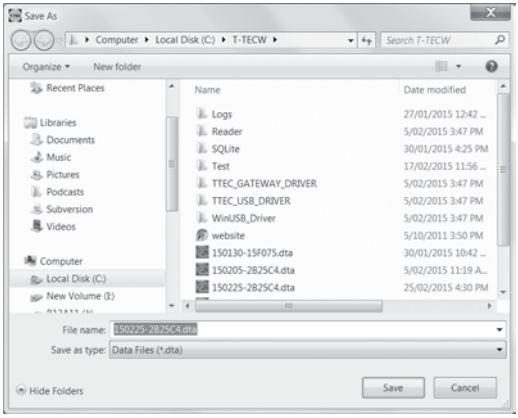


B. Select the iButton you wish to operate from the list by clicking on it (in the list under the 'Exit' button). It should appear highlighted once selected.

C. Click **'Check Logger'**. The identity information held in the data logger will be displayed.

D. Click **'Autoload'** to download the file of times and measurements held in the datalogger.

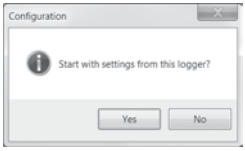
E. The data from the logger must be saved to a file before opening and a file window will appear. It will show a filename constructed of the year, the month, the date and the logger number. This name may be used or another name chosen with no blanks and no special characters. Click 'Save' when ready.



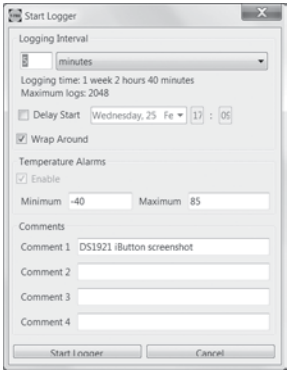
F. The data from the logger will now be converted and shown in 'Graph Viewer', as a curve.

To start the data logger

A. Click the button 'Start logger'. A dialog will appear asking if you wish to start this logger with the same settings it was started with previously. Enter either yes or no. The default settings for 'No' are the settings entered for the last iButton started on this computer, which may or may not be this particular data logger.



B. In this window set logging interval, optional delay start with start time, wrap around / stop when memory is full and temperature alarms. In the comment fields you may type (optional)



specific information for the new file the logger will log (tasks, names and places may be useful for identification later).

C. The logger reads the internal clock of the computer at the time of start of logger.

D. **Delay start:** the logger may be started with delayed start. Click on the down arrow and with the date selector, a later time for the start may be specified but not more than 44 days from the current time.

E. DS1921 iButtons must have alarms set and other iButton types may have optional alarms. A list of alarms are accessed via 'Show alarms' on the main screen.

F. Click **'Start Logger'** and **'Yes'** to start the logger.

G. The program will confirm the logger has been started. The new settings will be displayed.

H. The software will store these new settings and may display them next time a data logger is set up.

I. If you would like hard copy of the set-up details, click on **'Print certificate'**. The details will appear in your default text editor, from where it can be printed.

The manual is pre-installed. Click 'Help' or press 'F1' in the menu bar to open it. The help-text can stay on top of the program so it is readable when working with the program and any topic in the **'Help/Manual'** can be printed out by clicking the printer icon.

Viewing the Graph

Once a graph is displayed in Graph Viewer, please turn to the chapter on Graph Viewer for instructions on use.

The files

When the computer downloads the memory in the iButton data logger, it creates a file with the extension 'DTA'. This is a readable text format of the data in the logger's memory. DTA files are saved on the computer's hard disk and remain until they are removed by the user. DTA files are used for creating files suitable for export to spreadsheet programs.

Logging intervals for iButtons

A DS1921 Thermochron can store 2048 measurements. DS1922s can store either 4,096 or 8,192 measurements, depending on resolution. Similarly, DS1923s can store either 2,048 or 4,096 measurement pairs (temperature and humidity).

Battery

How long can the battery last?

This depends upon the type of logger, how often it measures and environmental factors.

Expected battery life

Batteries in iButtons are not replaceable.

DS1921: 5-10 years, depending on the use and the temperatures:

In a freezer 2-3 years
In a refrigerator 5-6 years
In room temperatures 6-8 years.

DS1922 and DS1923: **2 days** to 10 years.

VERY IMPORTANT NOTE

The DS1922 and DS1923 will have a very short life period (2 days) if set to log at fast intervals (less than 60 seconds) and at a high resolution. We recommend that low resolution and longer intervals are chosen.

To stop the logger

Stops the data logger measuring or storing any more data. Data stored in the data logger can be read later.

Note

If the logger is started in 'wrap around' mode, it will start writing new samples over the oldest logs. If the logger is started with 'stop when memory is full', the logger will stop writing to the memory and keep the file. However, the logger will continue to sample temperature and update internal registries accordingly. The

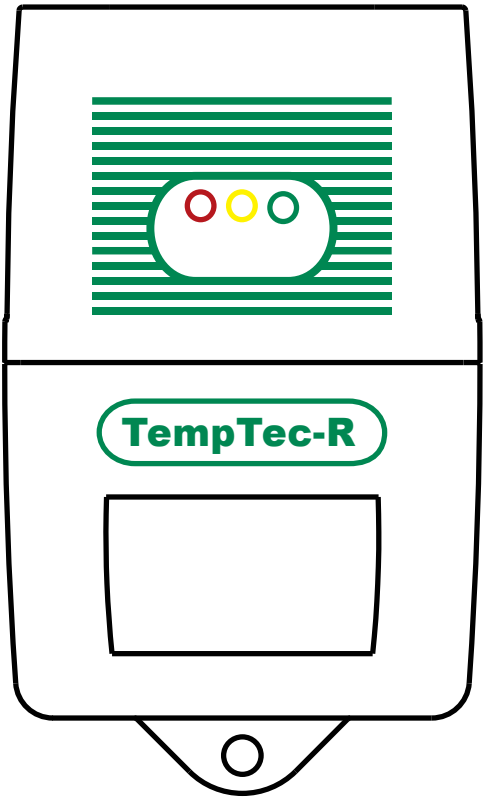
'Stop Logger' function will save battery and is recommended if the logger will not be used for some time.

Alarms

Although the small iButtons are not able to give out a signal when an alarm point is triggered, it does record the start time and duration of each event, which can be seen as a list when 'Show alarms' is clicked.

TempTec Reader (TempTecR)

If your logger looks like below, then read this section. Otherwise, please find the chapter that has a picture that looks like your data logger, listed on page 9.



Communication with the data logger

Connect the TempTec-R to the computer with a USB A to USB B cable.

To open the software

TempTec-R communications program is the communication program for the TempTec Reader.

Either double click on the TempTec-R Communications software icon on your desktop or in the Start Menu go to 'All Programs' > 'Temperature Technology' > 'TempTec-R Communciations'.

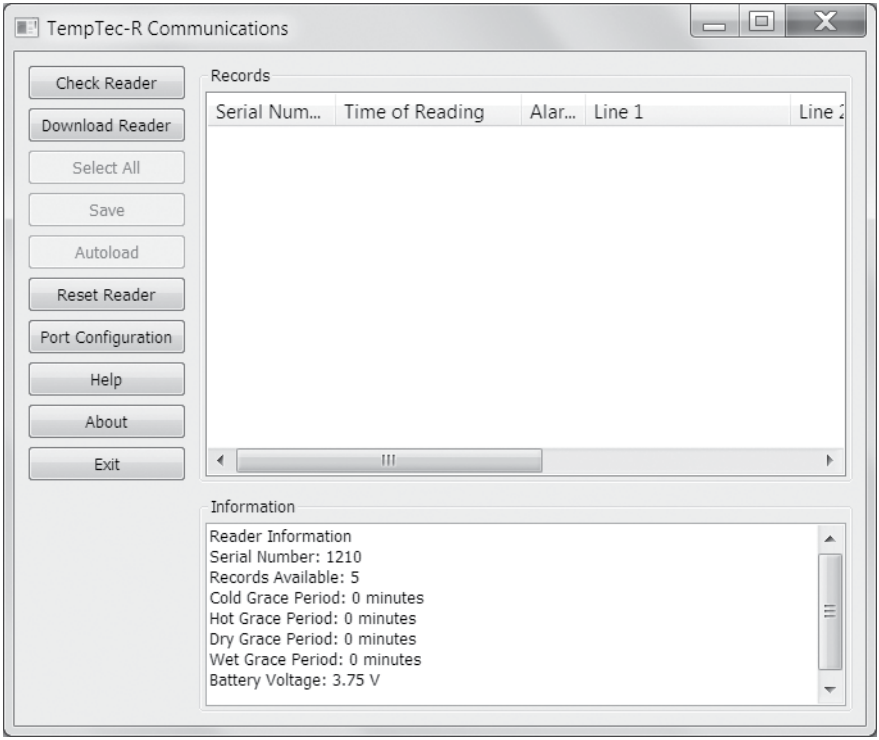
The software will automatically find the port that the TempTec-R is connected to. If not, try using 'Port Configuration' and check if there is another port listed.

If the plugged in TempTec-R cannot be found, please see the section 'Troubleshooting' in the help file within the software, or contact technical support at Temperature Technology.

To read the TempTec Reader

A. Connect the TempTec-R to the computer with a USB A to USB B cable.

B. Open the software. The TempTec-R Communications screen appears similar to the below image:



C. Click **'Check Reader'**. The identity information held in the Reader will be displayed in the 'Information' area.

D. Click **'Download Reader'**. The files stored in the Reader will be listed in the 'Records' area. The records are **not** saved to the computer at this time.

E. Click on a record in the **'Records'** area to display information about that record in the 'Information' area.

F. To save the data from a specific record, click on that record and click **'Save'**. A file window will appear. It will show a filename constructed of

the year, the month, the date and the logger number. This filename can be changed, ensuring the file extension of '.dta' remains.

G. Click 'Save' when ready.

To save all the files simultaneously, click 'Select all', then click 'Save'.

To display the data in a curve in **'Graph Viewer'**, click **'Autoload'**. To see up to 8 files displayed as curves on a graph, select up to 8 graphs individually (using 'Ctrl' or 'Shift') then click 'Autoload'.

Viewing the Graph

Once a graph is displayed in 'Graph Viewer', please turn to the chapter on 'Graph Viewer' for instructions on use.

The files

Data stored on the Reader is only saved to the computer when 'Save' has completed successfully. Each record correlates to each instance an iButton was downloaded to the Reader. Each record results in a file.

Successfully saved files are stored in a proprietary text-format with extension of '.DTA'. This is a readable text format of the data in the logger's memory. DTA files are saved on the computer's hard disk and remain until they are removed by the user. Data from the DTA files can be used to export to spreadsheet programs in 'Graph Viewer'.

To reset the reader

To delete all the files on the Reader, and to change the grace periods, click 'Reset Reader'. Before resetting the Reader, ensure all data that should be saved has been copied to another location.

The manual is pre-installed. Click 'Help' or press 'F1' in the menu bar. The help-text can stay on top of the program so it is readable when working with the program. Any topic in the **'Help/Manual'** can be printed out by clicking the printer icon.

Battery

The battery will normally last more than one year, depending on use.

Current battery voltage

The **'Check Reader'** function in the communications program will display the actual battery voltage.

Replacing the battery

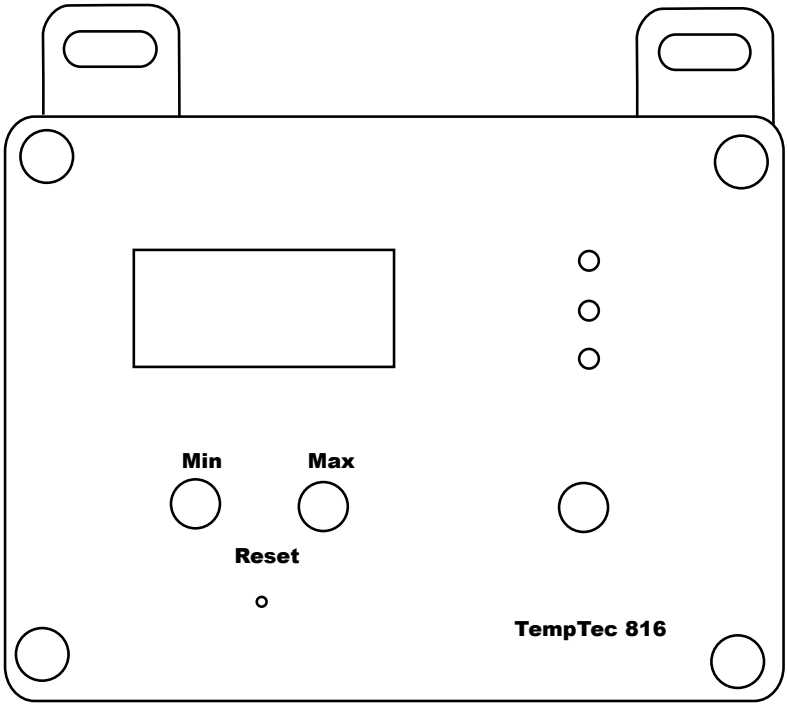
If the battery needs replacement, it is recommended to change batteries before beginning a long downloading process. A change of batteries in a TempTecR containing data will not result in data loss.

Access to the battery

Remove the two screws in the sides and pull the two sections apart. When assembling the case: take great care that the instrument is completely dry and that the o-ring is properly placed in the groove. Fasten the screws so the two parts just meet at the sides with the screws — do not over tighten.

TempTec 816

If your logger looks like below, then read this section. Otherwise, please find the chapter that has a picture that looks like your data logger, listed on page 9.



The older TempTec 816 (pre 2016) is a T-TEC data logger. Please follow the instructions for the T-TEC data logger for this model. Special comments for the battery are found on the next page.

The newer TempTec 816 (2016 and onwards, not yet released) is a wireless T-TEC RF version. Please follow the instructions for the T-TEC RF loggers for this model.

Battery

The battery is AA 3.6V, and will last at least one year, depending on how often it measures and environmental factors.

Expected battery life

The battery should be changed once a year.

Current battery voltage

The **'Check Logger'** function in the communications program will display the actual battery voltage.

Replacing the battery

If the batteries need replacement, it is recommended to change batteries before a long measuring series.

Access to the battery

Battery cover is found at the side of the casing. The + side of the battery must face the battery cover.

Graph Viewer

To start the program

Double click the icon for the required program:

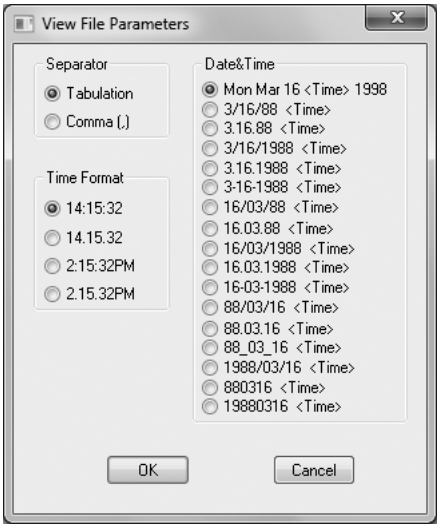
T-TECW Graph Viewer is the graphic program for handling of data from the data loggers and the TempTec Reader.

Open a file

To open a file, go to 'File' > 'Load Curve', or if you have downloaded the raw data from a standard T-TEC data logger, 'File' > 'Autoload select'. Files are downloaded and constructed within their respective Communications programs.

Printing and export of files

To get a list of measurements and times go to: 'File' > 'List File' This creates a list which includes all the data from the file. The data will appear on the screen using 'Notepad', 'Write' or 'Wordpad', depending on the operating system.



To limit the amount of data it is recommended to first zoom in on the important part of the file and then use 'List curve'.

'File' > 'List Curve' makes a list where only data seen on the screen are included.

The lists can be printed or saved to a file for later printing. The filename of a list has the same filename as the datafile with the extension .txt instead of .DTA. This file may be opened by spreadsheet programs. You will be given the option of where to save the .txt file.

Please be aware that the graphs for the new T-TEC RF loggers can contain **many** datapoints and thus may result in a large exported file. Please check the requirements of your spreadsheet software to ensure it can handle the data size.

Saving the graph for inclusion in reports or email

For inclusion in reports or emails you may want to design the looks of the graph using 'zoom', 'add comments', 'add y-line' etc.

To save the graph as it looks on the screen in a graphic format that may be inserted into word processor programs or sent as attachments to emails, go to:

'File' > 'Export as .PNG'

You will be given the option of where to save the file.

PNG stands for Portable Network Graphic and is an ISO standard. It is similar to a normal image and can be used in email, web browsers, word processors, and so forth, just like any other image.

Introduction

The following examples show measurements from 2 data loggers and how the graphic program may be used to extract relevant information from the data.

Example 1 shows how to use the 'zoom' and the 'plot' function to set the graph as required.

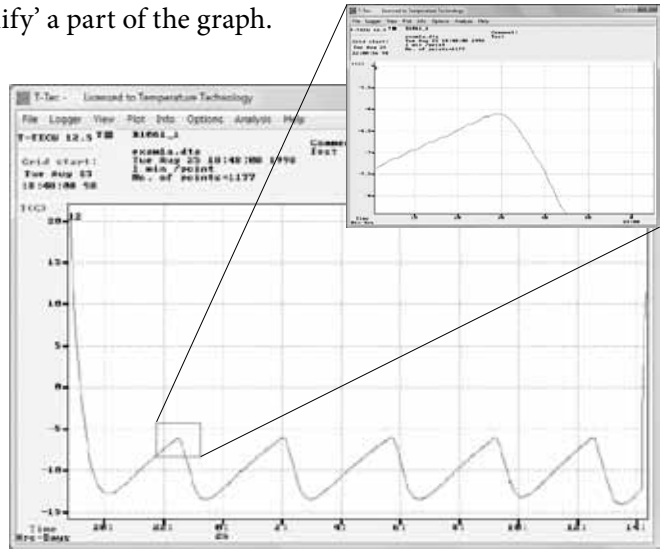
Example 2 is a simple measurement on a domestic freezer. It shows the use of two loggers, one with internal sensor and one with fixed external sensor. This example is based on the two files (Exam1a and Exam1b) supplied with the distribution disk.

Example 3 shows the result from a shipment of meat from Adelaide to Geneva in Switzerland. Two logger are used. One logger measures the temperature of the goods, the other measures ambient temperatures see why the temperatures in the goods change during shipment.

Example 4 is based on measurements in our store room for a period of eight months and shows use of 'Smooth curve' or moving average.

'Zoom' & 'Plot'

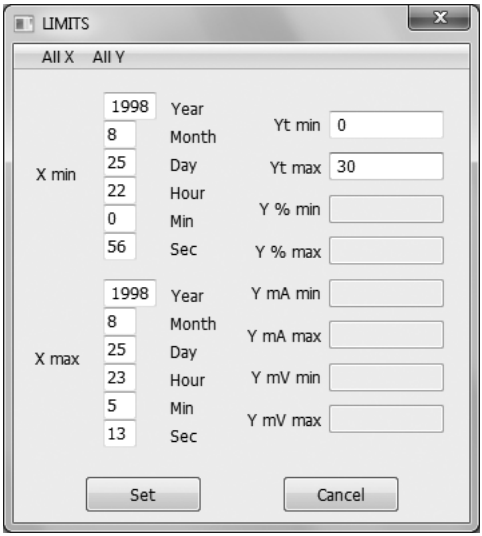
'View' > 'Zoom' can 'magnify' a part of the graph.



Select 'Zoom'. Move the cursor to a point on the graph that should be the left bottom corner of the zoomed graph, press the left mouse button and hold it down. Drag the mouse until the box contains the part to be magnified. Then release the mouse button. The area of the graph inside the box is now magnified and it is easier to see the exact degrees and measurement times.

Plot

This function is used to design the graph for printing. The program auto-scales the graph to fit the curve/s that are currently on the screen.



For comparison between printed curves, it may be preferable to have all the graphs using the same scales.

To do so, we first clear the graph of data, noting that the data is still stored within the software. We will bring the data back up later.

Click 'Plot', then 'Clear'.

Click 'Limits'. In 'Limits', as shown on the right, you can set the scale (in the example minimum 0 and maximum 30°C) and the time range you want displayed on the graph.

Click 'Set', and you are returned to the 'Plot' menu. From here, click 'Scale X' and 'Scale Y' to display the X and Y graph axes. Click 'Plot Curve' and individually select each curve you would like displayed on the graph. The graph will appear as you have designed it.

Measurements from a freezer

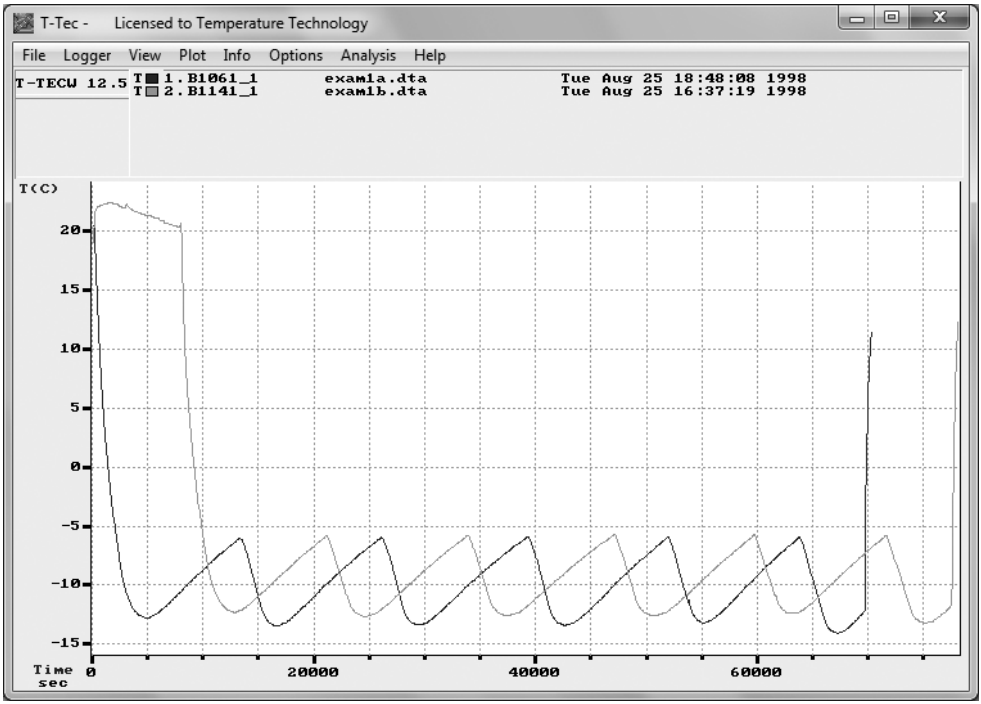


Figure 2.1

Two loggers were used used: B1061 has a fixed external sensor and B1141 an internal sensor. Logger B1141 is started approximately 2 hours after logger B1061. Both loggers are set to measure once each minute.

After both loggers were started, they were placed side-by-side inside a domestic freezer and left there overnight. When the loggers were read the next day, the files were called Exam1A and Exam1B.

The two files are included in the distribution disk and may be used to try some of the features of the program.

The graph in figure 2.1 shows the raw data — the graph you will get when the files are first loaded to the graph. To get these curves on to your screen, click 'File' > 'Load Curve' for Exam1A.dta and 'File' > 'Autoload first 8' to get the Exam1B file

onto the screen. Exam1A is converted on the distribution disk, Exam1B is not (see the online manual (press 'F1') regarding file types).

Understanding the graph
The graph shows the temperatures to the left and the time for measurements along the bottom.

At the top of the graph there is a line with the words 'File', 'Logger', and so on, which are pull-down menus. A click on any of these words will give access to groups of functions.

Below this line is a field to the left divided in two parts: the top part shows the software version and the second is blank.

To the right is another field which shows the file names and data logger identifications for the curves on the screen.

In case of one curve only, this field will show all details from the logger with time interval, number of points, etc. With more than one curve on the screen, the information is reduced as shown in Figure 2.1.

Full information about the curves can be found under 'Info' in the top bar.

The reduced information includes a small colour-coded rectangle with either T for temperature or H for humidity, next to the serial name, number and date of each curve.

A format with the time scale in seconds, minutes or hours, from the start of the logger is very useful if measurements taken at different times are to be compared, eg. before and after a repair, or summer compared to winter.

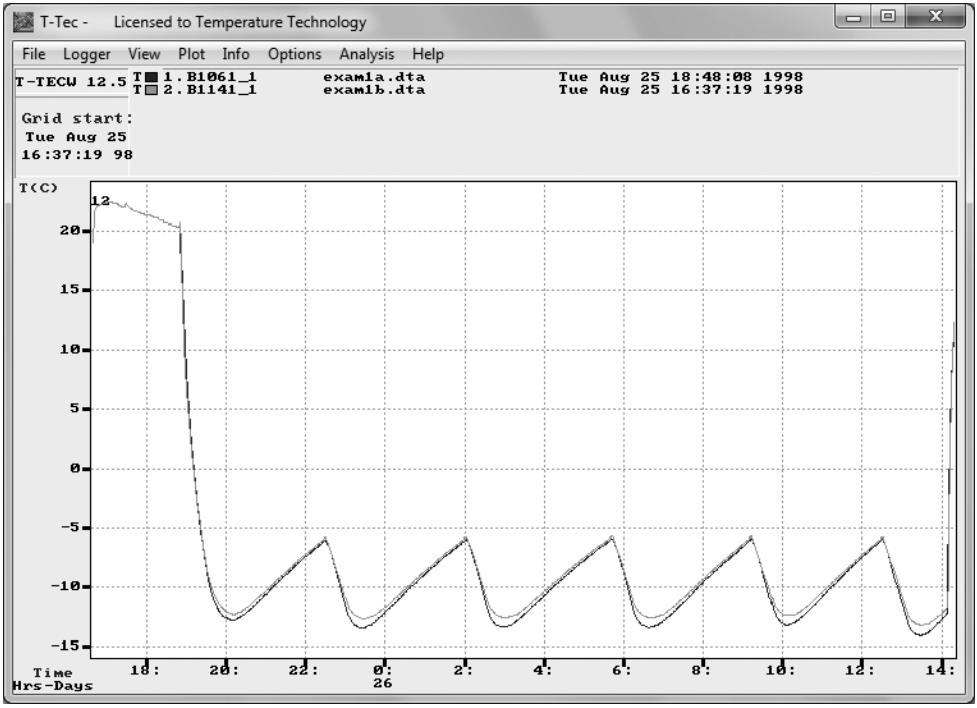


Figure 2.2

To get calendar time (month, day, hour, etc) click on 'View' in top bar and then 'Time Scales ' > 'Calendar'. The graphs may not overlap in time.

The graph will change to look like Figure 2.2. The bottom of the top left field will now show the time for the start of the graph.

The numbers just under the graph show the time of the day in 24-hour format. The line below shows the day in the month as shown by the legend to the left.

The time intervals on the graph will be set so the graph can show all data from the data logger. It could be months, days, minutes or seconds.

When the graph is changed to calendar time then six o'clock for one logger is also six o'clock for another logger. The loggers will therefore be synchronised in time and more loggers can work together as a multichannel logger.

As shown on figure 2.2, it is not necessary that the loggers start at the same time. One logger in this example was started several hours after the first. The software in the computer is able to synchronise the graphs as long as the measurements overlap in time.

Up to 8 curves may be shown together on the graph.

'Analysis' > 'Statistics'
This will drop a window with minimum, average and maximum values for the part of the curves that can be seen on the graph. Measurement values not shown on the graph are not included in the calculation.

Here, the average shows to be very close for the two loggers and the difference in minimum and maximum values shows the difference in time constants for the two loggers.

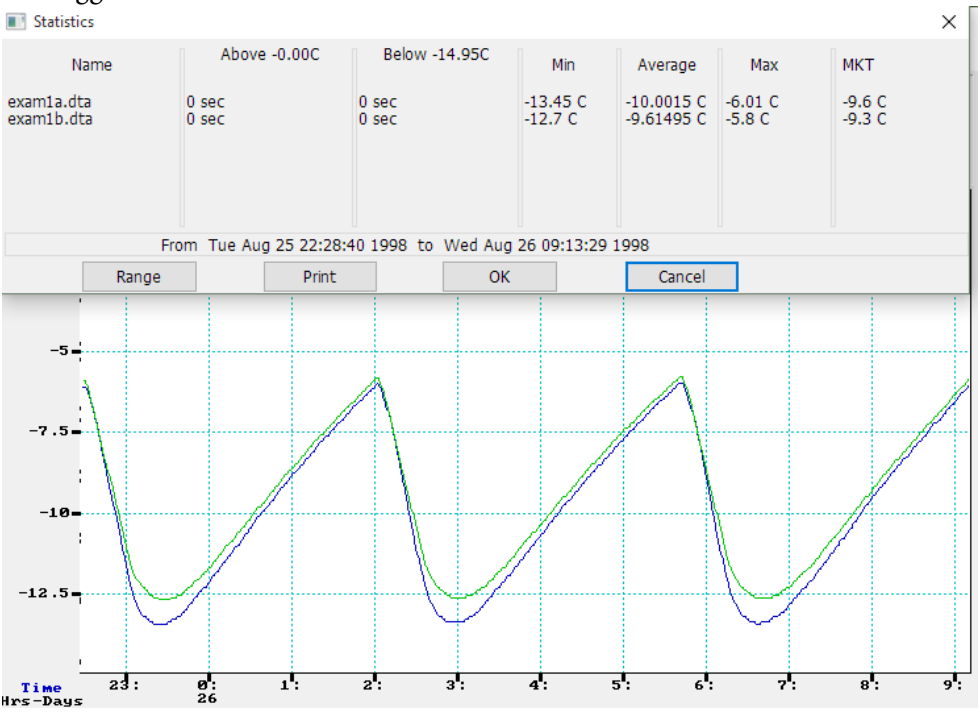


Figure 2.3 Screen shot of 'Statistics'

In figure 2.3 is a dialog box with various statistics. These statistics are for the parts of the curves currently displayed on the graph. One of the fields is 'MKT'. MKT stands for 'Mean Kinetic Temperature', which is a weighted average, used in the pharamceutical industry, See the online help for more information.

In figure 2.4, the curve Exam1B has been removed to get a simpler picture. ('File' > 'Close Curve'), the curve has been zoomed again and 'Analysis' > 'Load Factor' chosen.

The curve is now overlaid with another curve made of straight lines which averages the cycles. As described in the on-line help (Press 'F1' and use key word 'Load Factor'), the overlaid curve can be manipulated to follow the original curve.

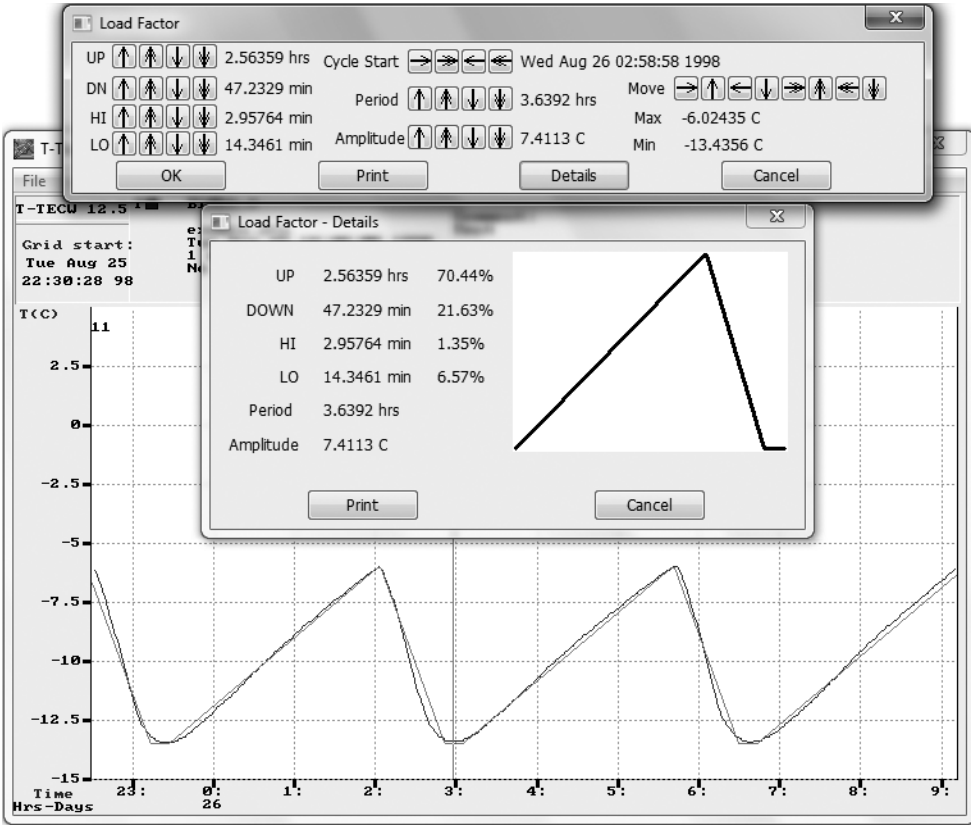


Figure 2.4

In figure 2.4, the overlaid curve is now modified to follow the cycle from 3 to 6.30 AM and 'Details' is used to get further information about the behaviour of the freezer.

The period time (from top to top) is 3.6 hours and the amplitude (difference between warmest and coldest point) is 7.4 °C. If the compressor starts when the temperature stops rising and stops when the temperature stops falling, then the compressor has been on for 23% (21.63+1.35) of the time and off for 77% of the time.

Example 3: A shipment of chilled meat

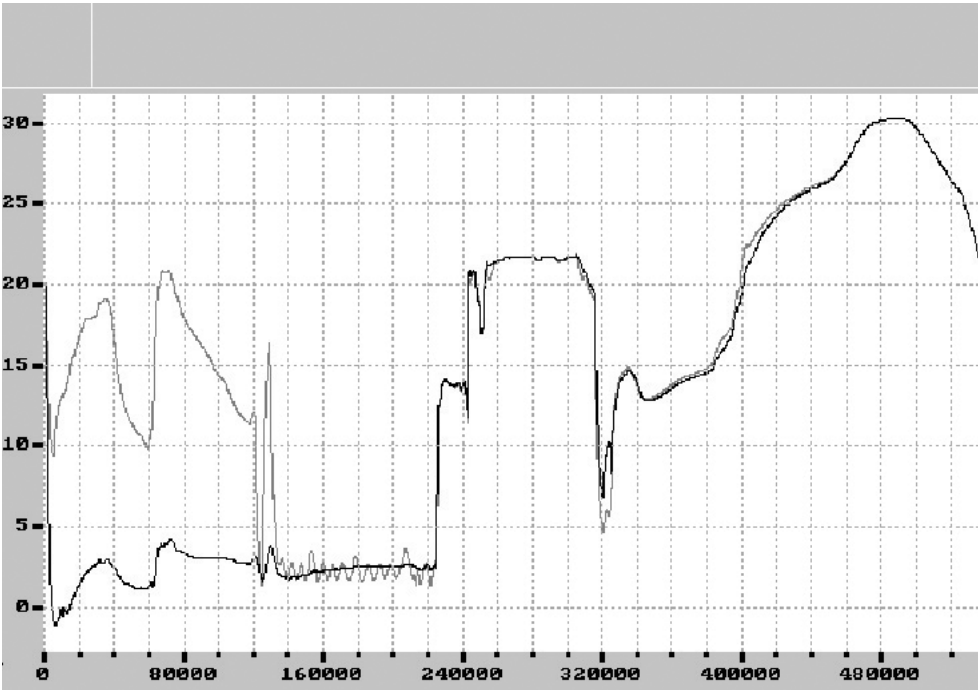


Figure 3.1

<---------- Shipment ----------->|<---------- Return of loggers by mail --------->

Meat packed into an insulated aircraft container. Two loggers were used. One outside on a box inside insulation (B236) and another outside insulation (B237). Figure 3.1 displays raw data as read from logger after return in a jiffy bag. Time scale is seconds from the start of loggers.

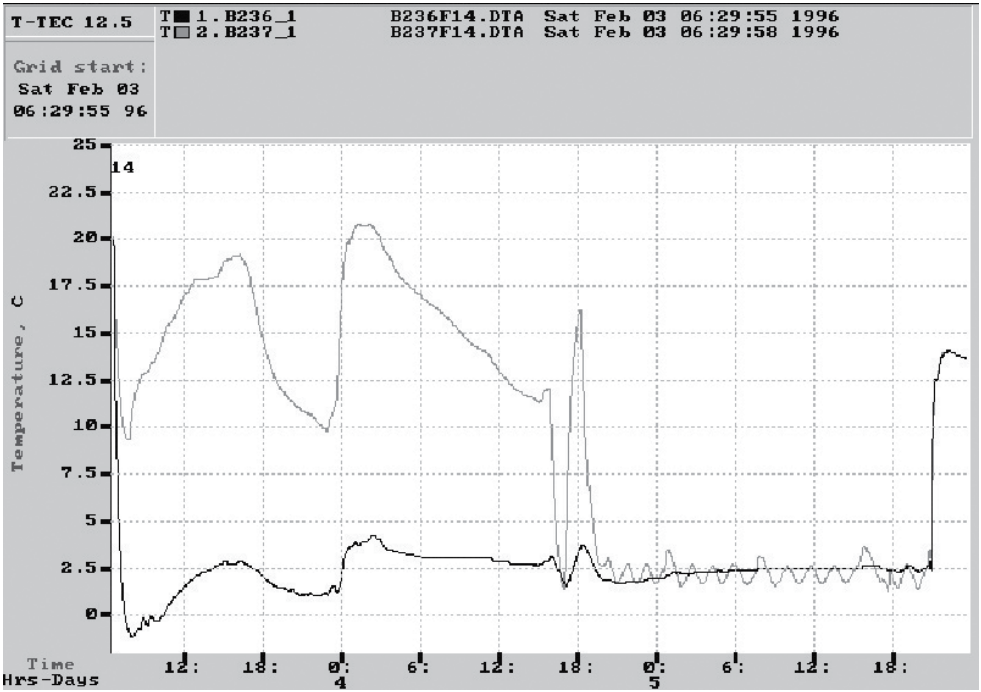


Figure 3.2

A. 'View' > 'Time Scales' > 'Calendar' to change to real time with days and hours.

B. 'View' > 'Zoom' to cut off information from the return mail.

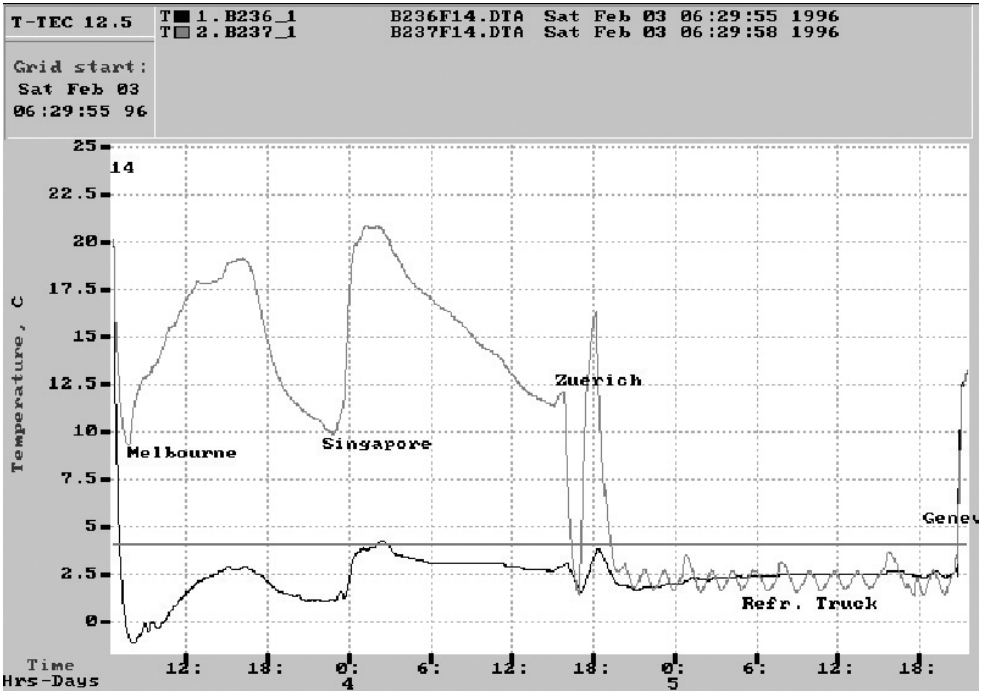


Figure 3.3

C. 'View' > 'Add Y line', 4 °C

D. 'View' > 'Add Comments' for locations. (matched with data from airlines.)

The shipment leaves Adelaide for Melbourne (temperature falls during flight) and the cargo is left on the tarmac in Melbourne for approximately 10 hours. The next flight goes to Singapore where it is quickly loaded into a plane on its way to Zurich, where it is cold and wintery. The meat is loaded onto a refrigerated truck in a warehouse and driven to Geneva.

Example 4: Store room temperatures

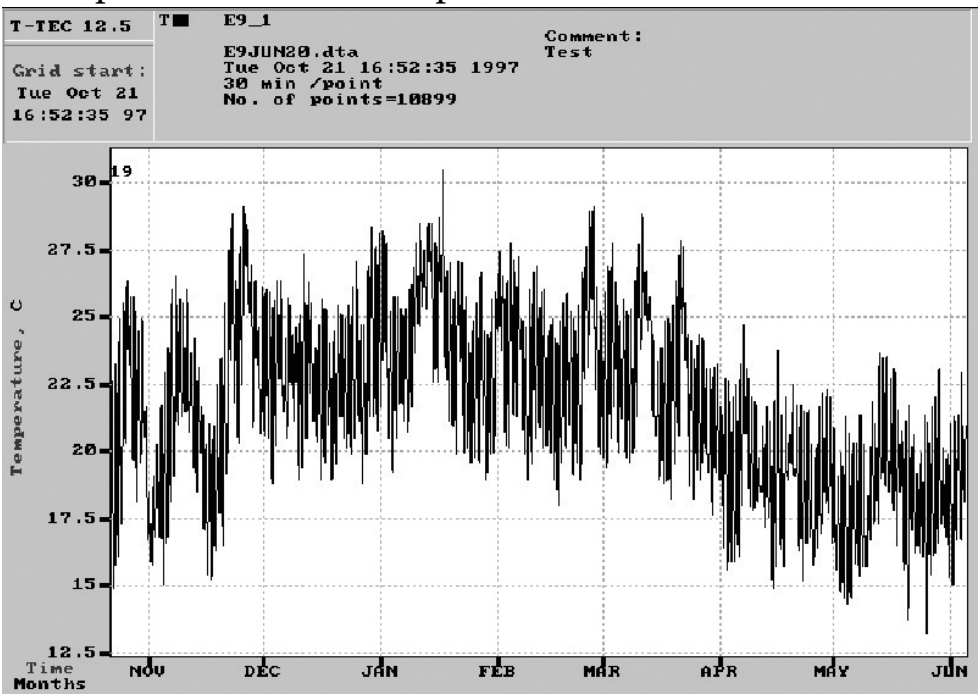


Figure 4.1

Temperatures in store room over eight months. 'Time Scale' set to 'Calendar' time, otherwise this is raw data.

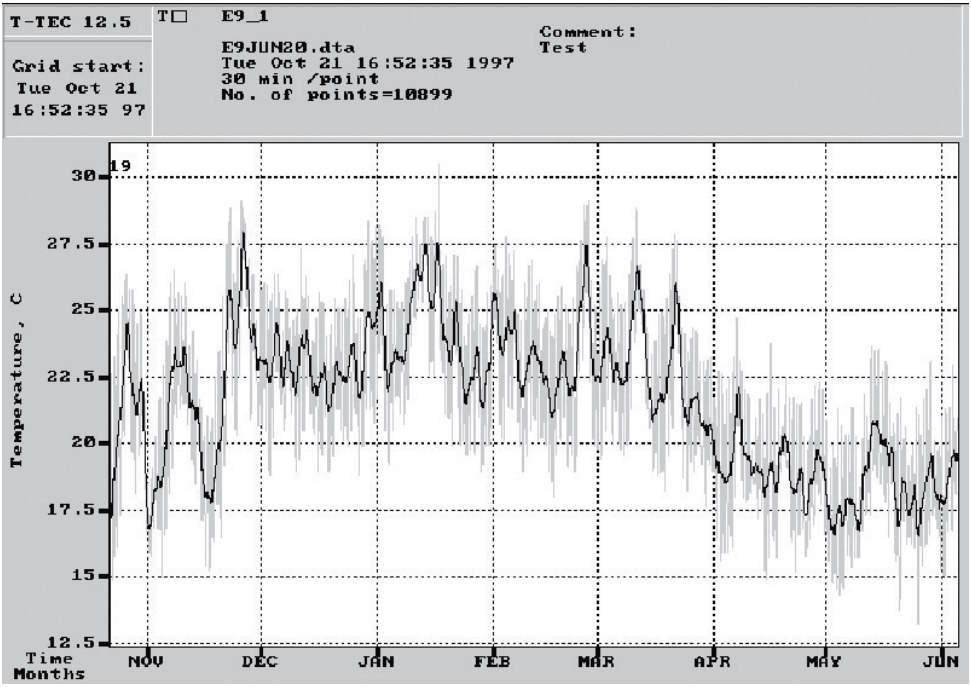


Figure 4.2

A. 'Options' > 'Graph Colours' used to change curve to light grey.

B. 'View' > 'Smooth' used to show moving average (or trend). Smooth factor set to 24, which with 30 minutes between measurements gives a 24-hour moving average.

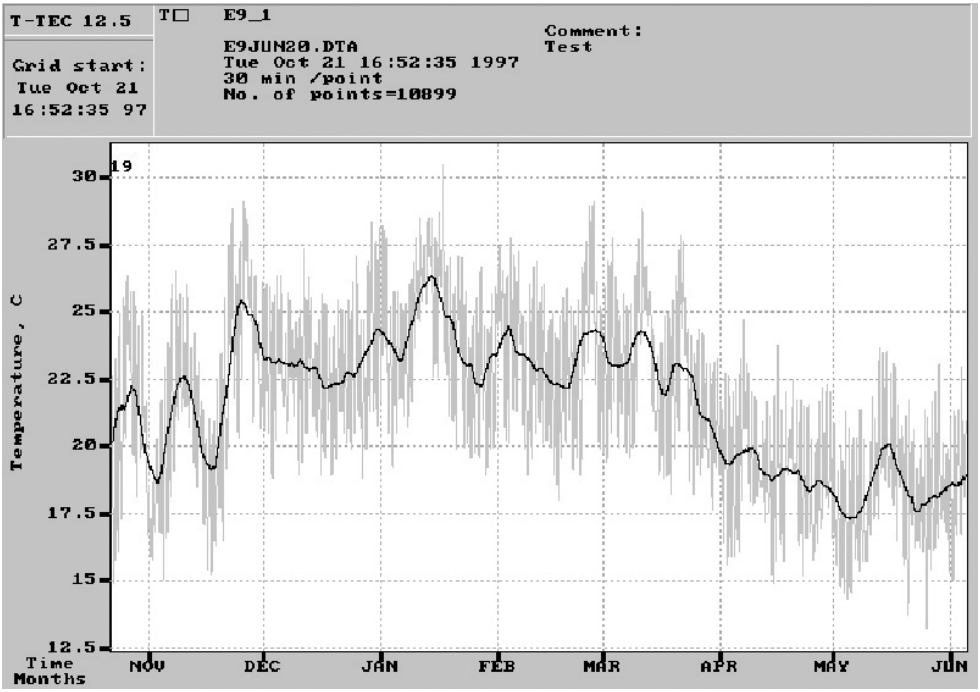


Figure 4.3

As Figure Example 4.2 but 'Smooth' factor set to 168 to give a weekly moving average.