

Q4 & Q18 Data Loggers

USER MANUAL

for Datapaq®
Tracker Systems
with

insight
software

Issue 4



Fluke Process Instruments

Q4 and QI8 Data Loggers

for Datapaq® Tracker Systems with **insight**
software

User Manual

Issue 4



Datapaq is the world's leading manufacturer of process temperature-monitoring instrumentation. The company maintains this leadership by continual development of its advanced, easy-to-use Tracker systems.

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SAFETY WARNINGS

For safe use of Datapaq equipment, always:

- Take care to follow its supplied instructions.
- Observe any warning signs shown on the equipment.



Indicates **potential hazard**.

On Datapaq equipment this normally warns of high temperature, but, where you see the symbol, consult the manual for further explanation.



Warns of **high temperatures**.

Where this symbol appears on Datapaq equipment, its surface may be excessively hot (or excessively cold) and may thus cause skin burns.

The following product types

Q4 and Q18 Thermocouple Data Loggers
manufactured by Datapaq Ltd.,
Lothbury House, Cambridge CB5 8PB, UK
comply with the requirements of regional directives
as follows.

European Union

Directive 2014/30/EU – ElectroMagnetic
Compatibility (EMC).

EN 61326-1:2013 – Group I, Class B equipment



(emissions section only), and Industrial Location
Immunity (immunity section only).

Directive 2011/65/EU – Restriction of the use of
certain hazardous substances in electrical and
electronic equipment (RoHS).

Federal Communications Commission, USA

Electromagnetic Compatibility Directive for digital
devices

CFR47 Class A – Code of Federal Regulations:
Part 15 Subpart B, Radio Frequency Devices,
Unintentional radiators.



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Manual set in 10 pt Gill Sans.

User manuals are available in other languages; contact Datapaq for details.

CONTENTS

- 7 Introduction**
- 9 *Logger Specifications and Operation***
 - 10 Specifications**
 - 12 Logger LEDs**
 - 13 Start/Stop Button Actions**
 - 13 Battery**
 - 17 Testing and Calibration**
 - 18 Disposal of Batteries and Loggers**
- 19 *Using the Logger with Insight Software***
 - 19 Installing/Removing Insight**
 - 21 Communications Setup**
 - 23 Running a Temperature Profile**
 - 28 Preparing the Data for Analysis**
 - 29 Logger Defaults and Details**
- 31 *Using Hardwired Telemetry***
 - 31 Running a Temperature Profile Using Hardwired Telemetry**
 - 34 Multiple Loggers**
- 35 *Troubleshooting***
 - 35 Logger Communications Problems**
 - 36 Logger Download Error Messages**
 - 36 Checking the Data**
 - 36 Testing the Logger and Thermocouples**
 - 37 Printing Problems**
 - 37 Datapaq Service Department**
- 38 INDEX**

Introduction

Datapaq® Tracker systems, incorporating Insight™ software, are complete systems for monitoring and analyzing the temperature profiles of products within your heat-treatment process; accurate data acquisition and powerful analysis techniques are combined with flexibility and ease of use. The Tracker system's power and flexibility make it a perfect tool for process-temperature monitoring, from commissioning and troubleshooting to process optimization, ensuring consistent quality of product and maximum efficiency.

Current temperature characteristics can quickly be compared with previously stored reference curves to detect operating abnormalities – and innovative analysis techniques help in identifying problems, fine-tuning the process and reducing running costs.

A powerful and flexible printing option allows the user to generate and customize reports, including any or all of the analysis results or raw temperature data.

The basic Tracker system hardware comprises:

- Data logger (including communications lead and charger) (p. 9).
- Thermal barrier and thermocouple probes (not covered here; see the relevant manual supplied with your system).
- Optional telemetry equipment.

This manual is for Tracker systems supplied with a **Q4 or Q18 data logger**, and focuses on all aspects of using those loggers. There is also guidance on setting up the Insight software; complete information on using the software is contained in the online Help system available when it is installed. For information on choosing and using the logger's thermal protection (barriers and heatsinks) and thermocouple probes, as well as step-by-step instruction on how to collect temperature-profile data on a product as it runs through your process, see the relevant manual supplied with your system.

Logger Specifications and Operation

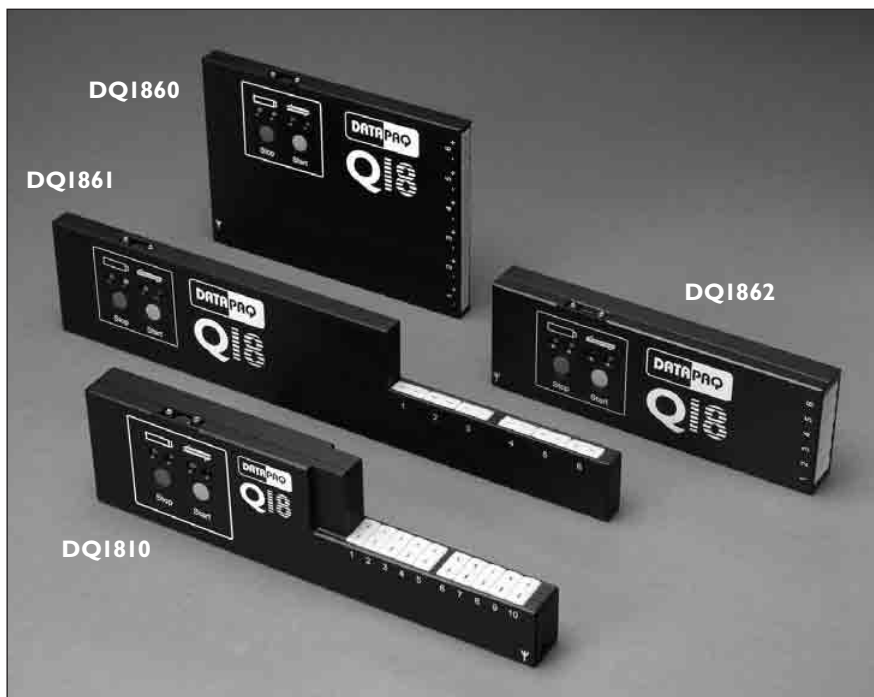
The Q4 and Q18 data loggers are at home in a wide range of heat-treatment applications. The Q18's capacity for 19,000 data readings over each data channel makes it a supremely powerful, accurate and in-depth data-collection tool; combined with a built-in transmitter to see temperature profiles developing in real time, this is an ideal data logger for all applications.

The loggers' key features are:

- Four, six, ten or 12 thermocouple channels (depending on model) for maximum data collection on each run.
- A range of model sizes, including narrow and low-height versions, to suit different ovens and applications.
- Huge memory capacity: 19,000 data points (Q18) on each channel for detailed process analysis.
- Short sampling intervals to collect maximum data in minimum time.
- High accuracy: $\pm 0.5^{\circ}\text{C}/0.9^{\circ}\text{F}$ (Q18) for compliance to tight specifications.
- Hot data protected by non-volatile memory or software warning if reset is attempted before download.
- USB communication capability.
- Hardwired or (Q18 only) radio (RF) telemetry for monitoring in real time with full analysis functions and alarms to warn the user if the process is out of specification.
- Four LEDs to show the exact status of the logger's activity and its batteries.
- Start and stop buttons for easy user control.
- Powered by rechargeable NiMH batteries.
- Rugged case and electronics allow operation in harsh environments of dust, pressure and vacuum.
- Reset by start button after download for speed and simplicity.

The Q18 is available in several variants, including types with an aluminum or steel case:

- Standard case format – wide and low-height; six channels.
- Narrow format – primarily for use in reflow ovens with narrow conveyors or where space is otherwise restricted; four, six, ten or 12 channels.
- Super-slim – narrow and low-height; six channels.
- Micro – reduced size; four channels.



Aluminum-cased Q18 loggers, showing LEDs and stop/start buttons (on logger's front surface), communications port (on upper edge), thermo-couple sockets (on right) and transmitter-aerial socket (on left or right depending on model).

DQ1860 Standard 6-channel

DQ1861 Super-slim 6-channel

DQ1862 Narrow 6-channel

DQ1810 10-channel (12-channel similar)



Q18 micro logger, DQ1804.

Specifications

	Q18 Standard 6-channel DQ1860	Q18 Narrow 6-channel DQ1862	Q18 10-channel DQ1810	Q18 12-channel DQ1812
Height	11.7 mm/0.46 in.	20 mm/0.8 in.	20 mm/0.8 in.	20 mm/0.8 in.
Width	106 mm/4.2 in.	57 mm/2.2 in.	60 mm/2.4 in.	60 mm/2.4 in.
Length	150 mm/5.9 in.	165 mm/6.5 in.	221 mm/8.7 in.	237 mm/9.3 in.
Telemetry option	Yes	Yes	Yes	Yes

	Q18 Super-slim 6-channel DQ1861	Q18 6-channel DQ1863	Q18 Steel case 4-channel DQ1840	Q18 Steel case 10-channel DQ1842
Height	11.7 mm/0.46 in.	11.7 mm/0.46 in.	9 mm/0.35 in.	9 mm/0.35 in.
Width	61.5 mm/24.2 in.	131 mm/5.2 in.	85 mm/3.3 in.	122 mm/4.8 in.
Length	302 mm/11.9 in.	111 mm/4.4 in.	210 mm/8.3 in.	220 mm/8.7 in.
Telemetry option	Yes	No	No	No

	Q18 Steel case 6-channel DQ1800	Q18 Steel case 10-channel DQ1850	Q4 4-channel DQ0441	Q18 Micro 4-channel DQ1804
Height	11.7 mm/0.46 in.	11.7 mm/0.46 in.	11.7 mm/0.46 in.	17.3 mm/0.68 in.
Width	106 mm/4.1 in.	85 mm/3.3 in.	106 mm/4.2 in.	35 mm/1.4 in.
Length	150 mm/5.9 in.	215 mm/8.5 in.	150 mm/5.9 in.	149 mm/5.9 in.
Telemetry option	No	Yes	No	No

Thermocouples Type K.

Measurement range

Q4: -100°C to 400°C/-180°F to 752°F.
Q18: -200°C to 1,370°C/-328°F to 2,498°F.

Accuracy

Q4: ±1.0°C/1.8°F Q18: ±0.5°C/0.9°F (above -100°C/-148°F).

Resolution

Q4: 0.5°C/0.9°F Q18: 0.1°C/0.2°F.

Operating temperature
(of the logger itself)

-40°C to 85°C/-40°F to 185°F.

Humidity range

0–85% non-condensing.

Real-time monitoring

Hardwired (serial) telemetry via comms cable as standard
Radio (RF) telemetry (Q18 only) via optional built-in transmitter.

Sample interval

50 ms to 10 min.

Data capacity

Q4: 9,000 data-points per channel.
Q18 6-channel: 26,000 data-points per channel.
Q18 10-channel: 19,000 data-points per channel.
Q18 micro 4-channel: 32,000 data-points per channel.

Data-collection start

No trigger, Start button, Temperature rise, Temperature fall (Q18 only), Date/time (Q18 only).

Pre-trigger data stored

Yes (configurable; see p. 29).

Hot-data protection

By non-volatile memory, and software warning if reset attempted before download.

Communications

USB.

PC/software compatibility

See p. 19.

Logger reset

Possible after download by start button (using previous run parameters).

Battery

Datapaq NiMH rechargeable battery-pack. In DQ1860 (only from DQ1860C onwards) and in DQ1804, battery-pack can be replaced by user; see p. 17.

cont.

cont.

Battery life

Up to 75 hrs continuous use (see p. 13), depending on sample interval, operating temperature and use of RF telemetry.

Battery charger

CH0070B power-supply unit: input 90–264 V AC, 50–60 Hz, 400 mA.

Due to continuing product development, specifications are subject to change without notice.

Logger LEDs

The logger is equipped with two sets of LEDs: two LEDs show the status of the battery, and two show the status of the logger and its memory.

Logger Status LEDs

Red	Green	Meaning
Red and green LEDs each give 5 flashes, alternating with each other		Logger successfully reset.
Red and green LEDs flash continuously, alternating with each other, at sample interval *		Logger awaiting trigger.
On	Flashing at sample interval *	Logger awaiting trigger, but one or more thermocouples is open circuit.
Red and green LEDs flash together, at sample interval *		All probes are above trigger temperature, and thus data-recording cannot be triggered by rising temperature (or, if falling trigger is set, all probes are below trigger point).
Off	Flashing at sample interval *	Logger acquiring data.
Flashes 5 times	Off	Connection between communications lead and logger has been made.
Flashing every second	Off	Internal error.
Flashing every 5 seconds	Off	Logger has data in memory which has not been downloaded.
2 quick flashes every second	Off	Logger too hot to start logging (after pressing Start button).

* Flashing interval will actually fall in range 0.5–5 s.

Battery Status LEDs

Yellow	Red	Meaning
Off	Off	Battery has at least 20% of full charge (charger not connected).
Flashing every 5 seconds	Off	Battery low (charger not connected).
On	On	Battery charging.
On	Off	Charging complete (charger connected). <i>Also shows immediately on connecting charger if battery has a problem.</i>
On	Flashing once per second	Battery being preconditioned due to being too hot, too cold or too deeply discharged (see p. 16).
Flashing rapidly for 2 seconds	On or off	Logger has stopped recording data due to a low battery. Proceed as described on p. 16.

Start/Stop Button Actions

Action	Results	Notes
Press GREEN button (after data from previous run has been downloaded and/or logger has been reset).	Starts logging.	If logger was not reset after previous run, the last reset options (sample interval, probe selection, etc.) are used as default. In telemetry mode, logger also starts sending data.
Press GREEN button after downloading data.	Starts logging.	Last re-set conditions (sampling interval, probe selection, etc.) used as default.
Press RED button.	Stops logging.	Data retained in memory. Logger cannot be restarted until data downloaded. Red LED flashes every 5 seconds to warn of data in memory. If in telemetry mode, will also send 'end of run' signal to end real-time run.
Press GREEN and RED buttons together and hold for 5 seconds.	Turns logger off.	Data retained in memory.

Battery

The logger uses a pack of three rechargeable 1.2 V nickel-metal-hydride (NiMH) cells. Only battery-packs supplied by Datapaq are suitable.

For the service life and replacement of the battery, see p. 17.

Battery Life

Battery life (discharge time) of NiMH rechargeable batteries is affected by the following factors.

- **Operating Temperature** – Essentially, the higher the ambient temperature the battery operates in, the shorter will be the life. Batteries that operate for a large part of the process cycle at relatively low temperatures will have a longer life than those that operate for the majority of the process cycle at the maximum operating temperature.
- **Sample Interval** – The shorter the sample interval, the shorter will be the battery life. This is because power is being consumed each time the logger takes a reading. A short sample interval will achieve the maximum amount of information, but this must be balanced against the greater battery charge required.
- **Operating with RF Telemetry** – Sending data to a receiver outside the oven, furnace or kiln requires more power than that needed simply to read and store the data.
- **Programming and Downloading the Data** – When these operations are carried out it is necessary to connect to the computer via a communications cable, and power is consumed as soon as the cable is plugged into the logger. The software warns the user to disconnect from the PC, but if the logger is left connected this will affect battery life.

Given the factors that can affect the life of a battery it is obviously difficult to predict accurately. The LEDs on the logger will give the best indication of when the battery is low. In the user's own conditions, experience will quickly indicate typical battery life, and a log should be kept for the first few runs, noting sample interval and whether telemetry was used. The following data can serve as a guide – though values given here are no more than an indication of the battery life that can be expected.

Full-size Q18 models

Sample Interval (sec.)	Logger Temperature	Battery Life (hrs)	
		No Radio Telemetry	Radio Telemetry Used
0.05	25°C/77°F	10	–
0.05	75°C/167°F	10	–
1.0	25°C/77°F	30	10
1.0	75°C/167°F	20	10
5.0	25°C/77°F	60	25
5.0	75°C/167°F	40	20
20.0	25°C/77°F	75	40
20.0	75°C/167°F	45	30

Q18 micro (radio telemetry not possible)

Sample Interval (sec.)	Logger Temperature	Battery Life (hrs)
0.5	25°C/77°F	20
0.5	80°C/176°F	13
5.0	25°C/77°F	75
5.0	80°C/176°F	42
10.0	25°C/77°F	85
10.0	80°C/176°F	45
20.0	25°C/77°F	90
20.0	80°C/176°F	55

Charge Level of Batteries

When the battery's charge drops to 20% of the full level, this will be shown by the **logger LEDs** (p. 12). Data-recording cannot then start until the battery is charged or replaced.

When connected to the PC, the **Insight software** shows the logger's battery-charge level as a percentage of full charge, as follows:

- In the main Logger Rest dialog (p. 23).
- When using wizards which reset the logger.
- During communications setup (p. 22).
- When using the Real Time Tool dialog as part of the optional TM21 radio-telemetry system.

Auto Power-off

When the logger contains data from a previous run which has not been downloaded, or is indicating an error, the logger-status red LED will be flashing. If the logger is left in this state there is potential for the battery to flatten, and the logger will therefore power-off automatically after five minutes. On subsequent power-up, the logger will either return to its pre-power-off state or, if the communications lead is connected, be ready to communicate with the PC.

Charging

Recharge the battery as follows.

1. Plug the charger into the electricity supply.
2. Plug the communications lead into the logger (the lead can also be plugged into the PC or not).

3. Connect the charger lead to the charger connector on the communications lead.

A full charge is delivered in about 2 hours. Indication of battery/charging status is provided by colored LEDs on the logger (see p. 12).

The logger intelligently monitors the battery, ensuring it is never overcharged. Thus, by leaving the charger connected to the logger, the logger will always be on charge and ready for use. This will not damage the battery or reduce its service life. If the logger's battery is low when the logger is required quickly, it can be connected to the electricity supply via the charger and used immediately. The battery will then charge while the logger is running. However, to ensure the highest level of accuracy, it is recommended that the logger is not connected to mains electricity during data-collection.

New batteries – or ones which have been unused for several months – should be charged for 24 hours before use.

NiMH batteries discharge slowly even when not in use and will need charging if left for more than three weeks.

WARNING

*If the logger is not in regular use, **the battery should be charged at least every 3 months**. If this is not done, the battery may drain to a level where it cannot successfully be recharged.*

Where batteries are too cold (below 0°C/32°F), too hot (over 45°C/113°F) or too deeply discharged, they must be **preconditioned** before fast charging can begin. Pre-conditioning (slow charging) occurs automatically if it is required, and is shown by the battery status LEDs (steady yellow + flashing red). If the battery is still being pre-conditioned after 5 hours, there may be a fault; contact Datapaq.

If the **logger has stopped recording data due to a low battery**, the logger may not operate at all (yellow LED will flash rapidly for 2 seconds). If this happens:

1. Disconnect the communications lead from the logger.
2. Turn the logger off (press green and red buttons together, and hold for 3 seconds).
3. Plug the charger into the electricity supply and connect the charger lead to the charger connector on the communications lead.
4. Plug the communications lead into the logger (the lead can also be plugged into the PC or not).

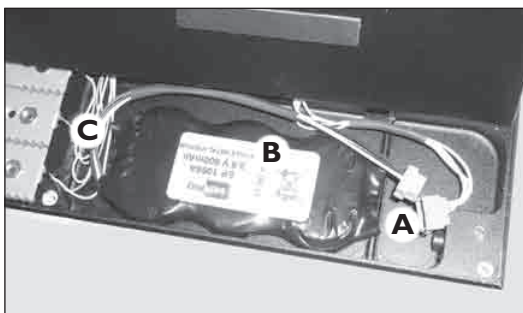
The logger should then operate normally while recharging – though pre-conditioning may be necessary, as above.

Replacing Batteries

Service life of the rechargeable NiMH battery is about three years or 1,000 charge/discharge cycles.

For the Q4 logger and all full-size Q18 logger models except new versions of the DQ1860, *the logger must be returned to Datapaq for battery replacement* – but, **in Q18 logger model DQ1860, from DQ1860C onwards only, and in the Q18 micro DQ1804**, the battery pack is easily replaced by the user, as follows.

1. Ensure the logger is powered off: press green and red buttons together, and hold for 5 seconds.
2. On the rear of the logger, undo the two screws (marked by arrows) which secure the battery cover.
3. Carefully squeeze the metal clips on the side of the battery-pack connector and pull the two halves of the connector apart (**A**, shown separated).
4. Remove the old battery-pack (**B**) and dispose of it appropriately (see p. 18).
5. Connect the new battery-pack and place it in the battery compartment. Take care not to disturb or damage the thermocouple wiring (**C**) or to leave any debris in the battery compartment as this could cause malfunction.



*Use only the correct Datapaq battery-packs:
for DQ1860, BP1066 (three cells); for DQ1804, BP1077 (two cells).*

6. Close the cover of the battery compartment and secure it with the two screws.
7. Charge for 24 hours before first use (see p. 15).

Testing and Calibration

It is recommended that the logger is tested and calibrated by Datapaq at least once a year. The Datapaq calibration procedure comprises:

- Inspection of the logger, externally and internally.
- Battery- and charge-testing.
- Heat-cycle test of up to 14 hrs in Datapaq's own ovens.
- Stability testing, using a stable temperature source and varying ambient temperatures.
- Calibration and updating of the logger's firmware.
- Issue of certificate, which can be traced back to UKAS or NIST calibration standards.

To calibrate your logger, please return it to the Service Department at Datapaq (see p. 37).

To carry out your own basic testing of the operation of the logger and its thermocouples, see p. 36

Disposal of Batteries and Loggers

Always adhere to the applicable statutory regulations for recycling and waste disposal. For details of recycling Datapaq products within the European Union, see www.fluke.co.uk.



Under the European Union WEEE Directive, users should return **all NiMH batteries and all loggers** (whether or not containing batteries) to Datapaq for disposal at the end of their useful life.



Using the Logger with Insight Software

See your dedicated system manual for full details on:

- Choosing appropriate thermal barriers and thermocouple probes.
- Installing the logger into the barrier.
- Conducting a temperature-profile run of your process.

Before the logger is used for the first time, you must:

1. **Install** Insight software.
2. Establish **communication** between the logger and the computer/software.

Before each profile run, you will:

3. **Reset** the logger to prepare it to receive fresh data.

After the logger/barrier assembly is recovered from the oven/furnace/kiln, you will then:

4. **Download** the data from the logger.

These stages are described below.

Installing/Removing Insight

Datapaq Insight used with the Q4 and Q18 loggers requires the following minimum **computer specification**.

- 1 GHz processor.
- 2 Gb RAM.
- Monitor resolution 1024 × 768, 256 colors.
- 100 Mb free hard disk space.
- DVD drive.
- 1 free USB port.
- Microsoft Windows™ XP SP3, Vista, 7, 8, 10 or above.
- Microsoft Internet Explorer 4 or above.

*The Q4 and Q18 loggers operate only with Datapaq Insight v.3.5 and above.
The Q4 logger operates only with Insight Reflow Lite, Insight Lite and
Insight EasyTrack.*

Installation

Ensure you are logged into Windows in Administrator mode.

For most systems, installation will start automatically on placing the Insight DVD in the drive. (If installation does not start, click the Windows Start button and select Run; browse to your DVD drive, and run Setup.exe.)

Follow the on-screen instructions. You will need your license number to hand, which is to be found on:

- Your license agreement.
- The outside of the DVD case.
- The outside of the system packaging.

Insight's link with the logger must also be made while Windows is in Administrator mode, and it is thus best to do this now, as part of the Insight installation: connect the logger to the PC and follow the procedure under 'Communications Setup' (below). Once this has been done, an operator will be able to use Insight with the logger connected to the PC without being in Administrator mode.

Upgrading

It is not necessary to remove an existing version of the software before installing a new one. Settings and data files used with the current installation will be maintained.

Removal

From the Windows Start button menu, select Settings and then Control Panel. Double-click Add/Remove Programs, select Datapaq Insight and click Add/Remove.

Using the Software

Full details on using the Insight software are contained entirely within its online Help system: access this by clicking Help, and then Contents, on Insight's main menu. Then, within Help, click on Contents headings and topics to expand and read them.

You may also click the Help button in any dialog – or press the F1 key – to bring up help information relevant to the task being performed.

Communications Setup

After Insight has been installed, it is necessary to establish communication between the data logger and the PC, as follows.

Only one logger at a time can be connected to the PC. It is not possible to connect simultaneously more than one logger to different USB ports on the PC and then to choose which logger to use.

1. Using the communications lead supplied, connect the logger to a free USB port on the PC (to minimize communications problems, connect the lead first to the PC and then to the logger). The red LED on the logger should flash five times to confirm that the connection between the communications lead and the logger has been made.

If the PC is having a Datapaq logger connected for the first time, Windows will display a 'Found New Hardware' message and the PC is then ready to work with the logger. If any warnings are displayed about driver-signing, confirm them (Datapaq drivers have been tested, and were installed when Insight was installed).

Typical sources of problems with establishing communication

- **Communications lead not fully inserted** – Check correct sockets are being used.
- **Damaged communications lead or connectors** – Check for breaks and other damage. Replace the lead.
- **Battery not charged** – Recharge the battery, ensuring the charging LEDs are illuminated (see p. 12).

2. On the Insight software's menu bar, select Logger > Setup to open the Communications Setup dialog.
3. Click Test.

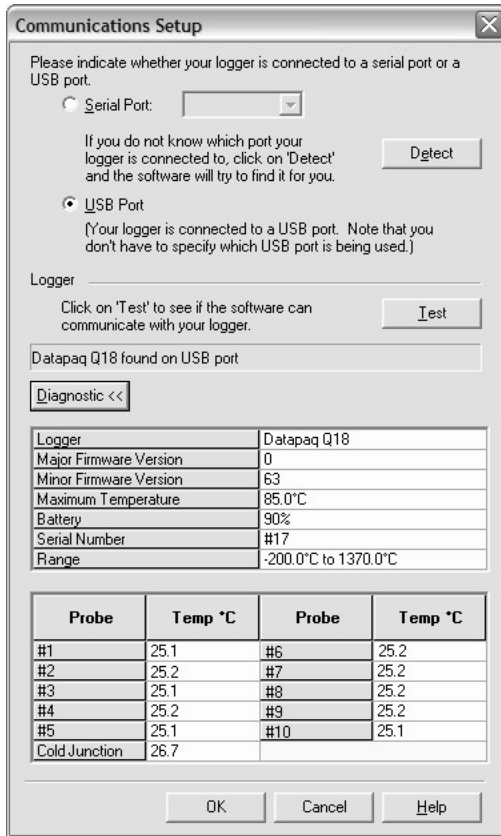
If the logger is detected, its type and the port to which it is connected are displayed.

SHORTCUT

Pressing F4 on the keyboard opens the Communications Setup dialog, tests for communication with a logger, and displays the logger type and other data (equivalent to clicking Test in the dialog).

For more information on the logger in use, click the Diagnostic button which now appears. Additional data shown covers firmware version, maximum permitted internal logger temperature, battery charge status, serial number and

temperature recording range. Current temperature of the probes (updated every 5 seconds) is also shown – or open circuit (*OC*) if no probe is attached; the temperature of the thermocouple cold junction is effectively the current internal temperature of the logger.



The Communications Setup dialog for the Q18 logger, with Diagnostic section expanded.

Setting Frequency of Electricity Supply

To increase the efficiency of the logger’s noise rejection, and thereby provide more stable measurements, select the frequency of the local electricity supply as follows.

1. In the Insight software, select Tools > Options and click on the Logger tab and then on the Advanced button.
2. Select 50 or 60 Hz frequency. 50 Hz is most widely used, but 60 Hz is used in North America, several countries in South America, and in Japan and Korea.

Running a Temperature Profile


By following this procedure you will use the Logger Reset and Logger Download dialogs to run a temperature profile **without telemetry**, i.e. data is collected by the logger and stored internally – until it is downloaded to the PC after the run is completed and then saved as a new ‘paqfile’ (p. 26). (To run a profile using hardwired telemetry, see p. 31.)

Resetting the Data Logger


The data logger needs to be reset, as follows, before it can receive fresh data.

It is not necessary to go through the reset procedure if the previous reset options are to be re-used: see p. 25.

*If the logger is **too hot** from the previous run, Insight will (by default) display a warning message – showing the logger’s current internal temperature – until it cools; Insight can also be set to prevent reset in these circumstances (this feature is configurable; see p. 29).*

The procedure described here uses the Insight software’s Logger Reset dialog. If you are less sure of the process, you can instead use the Logger Reset Wizard to guide you, step-by-step, through this stage of running a profile: click  on the Insight toolbar, or select Tools > Wizards from the menu.

Any data stored in the logger but not yet analyzed must be downloaded before proceeding, as resetting the logger will permanently erase all data stored in it. If the reset process is started on a logger which contains data from a previous run which has not been downloaded, a warning message will show this (and the logger-status red LED will be flashing every 5 s).

1. Use the communications lead supplied to connect the logger to a free USB port on the PC. (To minimize communications problems, connect the lead first to the PC and then to the logger.) The red LED on the logger should flash five times to confirm that the connection between the communications lead and the logger has been made (if it does not, see ‘Communications Setup’, p. 21). If the logger is not already charged, connect the battery charger lead to the charger connector on the communications lead.
2. Open the Logger Reset dialog (click  on the Insight toolbar, or press function key F2, or select Logger > Reset from the menu bar) and specify your reset options.

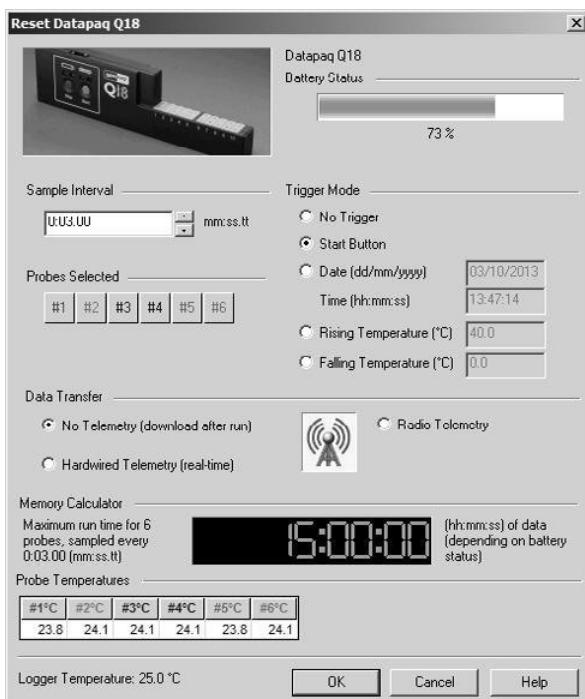
Sample Interval Set the time which is to elapse between each set (sample) of data points (one data point for each probe) that the logger will collect. The shorter the sample interval the better you will be able to record short-term variations in the temperature regime – but the total recording time available will be reduced, data will take longer to download to the PC

after a run, and battery life could be shortened so much that it will not be enough for a particularly long process. For longer processes, a rule of thumb is to set sample interval at 1 minute per day of operation, e.g. use 3-minute interval for a 3-day process, 15-s interval for a 6-hour process.

Probes Selected To exclude them from the temperature profile, click on the relevant buttons to deselect those probes which will not be used. The number of probes available is dependent on the model of logger used. *Probe 1 must always be one of those selected.*

Data Transfer Select 'No Telemetry'.

Memory Calculator Calculates the maximum time for which the logger can collect data, given the sample interval and the logger's memory size. The time available may be further limited by the level of battery charge.



The Reset dialog for the Q18 logger.

Battery Status The charge indicator gives both the current percentage of full charge held by the logger battery, and a color-coded report:

- GREEN** Sufficient charge to perform a run.
- YELLOW** May be enough charge for a run, but battery getting low.
- RED** Insufficient battery charge: recharge immediately.

The battery charge level will not be displayed if the logger is on charge: disconnect the charger to verify battery status.

NiMH batteries discharge slowly even when not in use and will need charging if left for more than three weeks.

If in any doubt, abort the procedure by clicking 'Cancel', and recharge the logger.

Trigger Mode Select here a means to start the logger recording data.

No Trigger Data-recording starts immediately the reset is complete and the communications lead has been disconnected from the logger.

Start Button After reset, data-recording starts when the logger's green start button is pressed and held for 1 second.

Date and Time Data recording starts at a specified date and time. The current date appears by default.

Rising Temperature Data-recording starts when the temperature of any probe rises to the specified value. (If rising or falling temperature trigger mode is set, the logger records data from the time it is disconnected from the PC – but, once the trigger temperature has been reached, the logger keeps only a maximum of 60 data points before the trigger point and discards any others.)

Falling Temperature Data-recording starts when the temperature of any probe reaches the specified value as it is falling.

Probe Temperatures The current temperature measured on each of the logger's channels is shown, updated every 5 seconds. This serves as a useful check that thermocouples are working properly.

Logger Temperature The current internal temperature of the logger is shown.

3. After clicking OK, the logger is reset and a message box confirms the sample interval and trigger mode you have set.
4. Disconnect the communications lead from the logger; the logger's status LEDs briefly flash red and green alternately to confirm logger reset.

Using Previous Reset Options

The logger retains the last-programmed set of reset options, even if the battery has been removed in the meantime. Thus it is not necessary to go through the reset procedure if the same reset options are to be re-used. Instead, simply press the start button to start data-collection with the same reset options as before (if trigger mode was set to date and time, logging will nevertheless start immediately). Temperature data which is still held in the logger and which has been downloaded will then be overwritten (if the logger contains data which

has not been downloaded, a run cannot be carried out unless the data is downloaded or the reset procedure is performed).

Starting the Run

1. Plug the thermocouples into the logger's numbered sockets. If you are using a process, oven, recipe or product file (see Insight's Help system), ensure that the probe/socket numbers on the logger correspond to those used to define probe numbers and locations in that file.
2. Ensure the sealing surfaces of the thermal barrier are clean and undamaged. Good barrier seals, including those between the barrier and the thermocouple cables, are essential if the logger is to be protected.
3. If the trigger mode is start button, press and hold the logger's start button for about 1 second until the green LED starts to flash at the sample interval.
4. Put the logger into the barrier, seal it, and place the logger–barrier assembly into your process together with your instrumented product or test-piece. For guidance specific to your application, see your system's *User Manual*.

Data-recording cannot start until the logger has cooled sufficiently from the previous run. If it is still too hot, pressing the start button will cause the logger-status red LED to give two quick flashes every second.

Downloading Data


Recover the system from the oven/furnace/kiln as soon as the run is over.

WARNING

*The logger will be **hot**. Use protective gloves.*

*Failure to remove the logger quickly from the hot thermal barrier could damage the logger. See the dedicated *User Manual* for your Datapaq Tracker system.*


1. Open the thermal barrier. Placing it on a cold surface will increase its rate of cooling. (An additional thermal barrier should be purchased if insufficient time is available to allow it to cool between test runs.)
2. If data acquisition has to be stopped manually, press and hold the logger's red stop button until the red and green logger-status LEDs are on simultaneously. A red logger-status LED flashing every 5 seconds indicates data stored in the logger but not yet downloaded to the PC.

The procedure described here uses the Insight software's Logger Download dialog. If you are less sure of the process, you can instead use the Logger Download Wizard to guide you, step-by-step, through this stage of running a profile: click  on the Insight toolbar, or select Tools > Wizards from the menu.

3. Remove the logger from its thermal barrier.
4. Use the communications lead supplied to connect the logger to a free USB port on the PC.

To minimize communications problems: a) connect the lead first to the PC and then to the logger; b) always use the same USB port – the one which was first used to set up communications (p. 21).

The red LED on the logger should flash five times to confirm that the connection between the communications lead and the logger has been made.

5. Open the Logger Download dialog (click  on the toolbar, or press function key F3, or select Logger > Download from the menu bar) and wait while the data is downloaded to the PC.

If you see the message

Logger stopped due to going over temperature

the data logger's maximum-permitted internal temperature has been exceeded, and it may have suffered damage. The reason for the excessive temperature – which may be the result of process operational problems or the use of an inappropriate thermal barrier – must be resolved before further profile runs take place; contact Datapaq for advice.

*A warning message will also be shown if the logger has stopped recording data due to a **low battery** (and the yellow battery LED may flash; see p. 16).*

In all cases, data recorded up to the point of error will have been preserved.

*For **recommended actions** to take in response to error messages, see p. 36.*

To disable these alarms, select Tools > Options > Run Alarms.

6. If enabled, the **Select Process** dialog or the **Select Oven, Recipe and Product** dialog then appears in order that you may choose a process, oven, recipe or product file which will be applied to the results. Click 'No Process' or 'Cancel' if you do not want to apply one.

*A **process file** allows you to see the temperature profile in relation to the oven/furnace/kiln zones as the profile appears on screen during the run. See the Insight software for an introduction to process files: press function key F1, or select Help > Contents from the menu bar, and click the section 'Process Files: Oven, Recipe, Product'.*

If you will normally not wish to apply a process file to the results, you can opt not to have the Select Process dialog displayed immediately after a download (from the menu bar, select Tools > Options > Process File); a process file may still be applied subsequently.

7. The newly downloaded data then appears on screen numerically and graphically. Save the data as a 'paqfile' (select File > Save or Save As).

The data from your profile run can now be displayed, printed and analyzed as you wish; see Insight's online Help system for full details.

Open Circuits

An open circuit can occur during a profile run if a thermocouple becomes damaged. The logger will then continue sampling on that channel, but, by default, an alarm will be registered – giving the relevant probe number – when the data is downloaded (see above). To disable the alarm, select Tools > Options > Run Alarms.

Preparing the Data for Analysis

For full details of Insight's powerful analysis capabilities, see the online Help system: on Insight's menu bar, select Help > Contents > Data Analysis. Before starting full analysis of the downloaded data, it may be advisable to:

- Apply a process file, if not already done (see p. 27).
- Specify the oven/furnace/kiln start position in the data (see below).
- Record any notes specific to the profile run (see below).

Specifying Oven/Furnace/Kiln Start

If you have not applied a process file, or if the process file you applied did not specify that the **oven/furnace/kiln start position** be adjusted, you may want to adjust the oven/furnace/kiln start position now: from the menu bar, select Process > Adjust Oven/Furnace/Kiln Start, or use the right-click menu.

This can be valuable as it permits different paqfiles, i.e. data from different temperature profile runs, to be compared with each other. If you do not wish to adjust the oven/furnace/kiln start at this point, you may still do so at any time subsequently.

For an explanation of oven/furnace/kiln start, and how to adjust it, click Help in the Adjust Oven/Furnace/Kiln Start dialog.

If using Insight for Kiln Tracker, and if no kiln zones are set up, you may select Process > Adjust Kiln Start (or use the right-click menu) to enter a duration for the process; this will add a marker on the graph to show the **kiln end**. To remove the marker, set the duration to zero.

Information about the logger and the data-collection process for the paqfile (including time/date, trigger mode and maximum internal logger temperature) can be seen in the **Paqfile Properties** dialog (select File > Properties, or right-click on the graph and select from the pop-up menu).

Storing Notes and Printing a Report

To use Insight to store any **notes or photos** which you may wish to associate with the profile-run data, select Edit > Notes.

To select options for **printing a customized report** of the profile-run data and its analysis results, select File > Print Options.

Logger Defaults and Details

Defaults for several of the logger's variables can be set using Insight. Select Tools > Options > Logger (and click 'Advanced' for some features):

- Default number of probes.
- Use of warning message if the logger is too hot.
- Ability to disable reset if the logger is too hot.
- Maximum temperature permitted if reset is to be allowed (default 45°C).
- Frequency of the local electricity supply.
- Ability to download and display pre-trigger data (see below).
- Ability to download and display data for the logger's internal temperature which is gathered while it is logging, and then stored in the paqfile when the profile data is downloaded.

On this Logger tab of the Global Options dialog you can also find the **model** and **identification number** of the logger, and enter **calibration** information and be warned when re-calibration is due. For full details of using the dialog, see Insight's online Help.

Pre-trigger Data

If a temperature trigger (see p. 25) is used to start data-logging, the logger also records data before this point is reached. The most-recent c. 100 of these data-points are retained by the logger. You can download this pre-trigger data by setting a default (see above), and it will then form part of the temperature profile, falling before the zero time point.

If the logger does not reach the temperature required to start data-logging, Insight will always download the pre-trigger data, in order to aid the user in determining why triggering did not occur.

For further features of the Insight software – particularly data analysis and the use of process files – see the online Help system (on Insight's menu bar, select Help > Contents).

Using Hardwired Telemetry

In addition to the standard off-line analysis, real-time analysis by **hardwired telemetry** (serial telemetry) is possible with Insight software when used with an intermittent or periodic oven/furnace/kiln (a batch process).

Thus, with thermocouples trailing from the oven/furnace/kiln and attached to the logger outside it, data being gathered by the logger is transmitted via the communications lead directly to the PC, and the temperature profile can be watched developing in the Insight software as data is received, i.e. in real time.

Telemetry is not available with Insight Lite software.

Some processes can have long durations. In these instances telemetry can allow you to identify possible problems during the process, and make adjustments. You can then use a second system to confirm that the remedial action has been satisfactory.

Running a Temperature Profile Using Hardwired Telemetry

By following the procedure in this chapter, you will use the Logger Reset and Logger Download dialogs to run a temperature profile using hardwired telemetry.

Running a profile in real time is performed in essentially the same way as a normal (non-telemetry) run (see p. 23, and the dedicated *User Manual* for your Datapaq Tracker system), but, in addition:

- The **communications lead** is left in place, connecting the PC to the logger.
- A **process file** can be applied before the run starts in order that the data can be understood more readily as it appears on screen (not available with Insight Furnace Surveying software).
- There will normally be no need to use a thermal barrier to protect the logger.
- While the run is in progress, the **real-time display** of incoming data can be customized as preferred, and the logger's status can be checked.

Resetting and Starting the Logger When Using Hardwired Telemetry

The logger is reset and started exactly as for a normal (non-telemetry) profile run (see p. 23), except that:

- In the Reset dialog, select **Hardwired Telemetry**.
- After clicking OK in the Reset dialog:
 - If enabled, the **Select Process** dialog or the **Select Oven, Recipe and Product** dialog then appears in order that you may choose a process, oven, recipe or product file which will be applied to the results as the profile appears on screen during the run. Click 'No Process' or 'Cancel' if you do not want to apply one. (A process file allows you to see the temperature profile in relation to the oven/furnace/kiln zones as the profile appears on screen during the run. See p. 27.)
 - If enabled, the **Apply Correction Factors** dialog then appears in order that you may choose a logger and/or thermocouple correction factor file to apply to the results. Click **No Factor** if you do not want to apply a correction factor file.
- **Leave the communications lead attached** to the logger and PC.

*It is possible to have **power connected** during hardwired telemetry, but beware that this may affect accuracy of the data. The charger should thus be disconnected unless the profile run being conducted is a practice one.*

*You may specify that a **password** is required when an attempt is made to close Insight while a real-time telemetry run is in progress: select Tools > Options > General.*

*If the **logger's memory becomes full** during hard-wired data-collection, the logger will continue gathering data, but excess data will be passed to the PC and not stored by the logger. When the profile run is complete, the full data can then be saved as a paqfile within Insight (see p. 26).*

Real-time Display During the Run

After the first few data packets have been received, the data starts to be displayed in the Graph and Analysis Windows, scrolling in real time as new data is received. You may change the way the data is displayed with the Axes tab of the Graph Options dialog (from the right-click menu, or from the main menu select View > Graph Options): under Telemetry, specify how much of the recently received data is displayed, and whether you wish to see only a certain temperature (y-axis) range, centered on a the latest data.

You may **zoom** the display as when viewing a paqfile (see the online Help system), except that:

- Double-clicking on the graph (or selecting Real Time Zoom from the View menu or right-click menu) shows only the most recently received portion of the data on the scrolling graph (see above).
- Saved zoom modes are not available.

If the **y-axis** is not set to be centered (see above), the default y-axis zoom changes as more data is received, in order to accommodate all received data.

To **move the graph** across the viewing area, hold Shift and drag the mouse pointer.

You may **overlay** one or more **tolerance/ideal curves** or other paqfiles on the graph to compare with the data as it is being received (select View > Overlay) (not available with Insight Furnace Surveying software).

*If you wish to **open another paqfile** and view it in a separate tab while the logger is in listen mode, i.e. while data is being received and viewed in real time, you must first stop real time mode (see below). You may instead, however, open the other paqfile as an overlay while still in real time mode, as above.*

You may adjust the **oven/furnace/kiln start** position while a real-time run is in progress (select Process > Adjust Oven/Furnace/Kiln Start, or use the right-click menu).

Calculations shown in the **Analysis Window** for the chosen data-analysis mode update continuously as new data is received. As for non-real-time runs, calculations are performed only on the currently zoomed area shown on the graph. However, if the graph is scrolling and showing just the most recently received portion of the results, the analysis calculations will be performed as if on the full zoom view.

Ending the Run

To **end or pause data-collection** while a telemetry run is still in progress, select Logger > Stop Real Time Mode. Data then continues to be collected by the logger, but it is no longer received in real time by Insight (download from the logger after the run is finished to retrieve the full data). The graphical and numerical data received up to that point remain on screen, available for viewing and analysis, and can be saved as a paqfile.

While the logger is still operating, you may **resume the collection of data** by Insight: select Logger > Logger Listen Mode. This second bout (and any subsequent bouts) of data-collection can also be ended and saved as a separate paqfile, as above.


If **autosave** is enabled (select Tools > Options > General), the data being gathered is automatically saved during a telemetry run. If the PC system fails during the run, the autosaved version of the data is displayed automatically when Insight is next run, and you may then choose to save it as a paqfile.

When the run is complete, ensure that data received by Insight has been **saved as a paqfile**. If you wish, you may download the data held in the logger (p. 26), though it should normally be adequate simply to save, as a new paqfile, the data already received.

Multiple Loggers



Using multiple loggers permits data to be gathered from a greater number of thermocouple channels than can be achieved with a single logger.

*When using the **Furnace Surveying** module of Insight, the use of multiple loggers is handled entirely by the Temperature Uniformity Survey Wizard which is available within that module.*

Use the **Logger Reset Wizard** to guide you step-by-step through the whole process of resetting multiple loggers: click  on the Insight toolbar, or select Tools > Wizards (with hardwired telemetry, multiple loggers cannot be reset using the Logger Reset dialog). You must first enable the use of multiple loggers in the Global Options dialog: select Tools > Options > General.

Data from multiple loggers used in a single profile run is stored by default in a single paqfile. The whole of the data contained in that paqfile is then displayed and analyzed just as for a single-logger paqfile.

Insight's floating **logger toolbar** controls the display of data from each logger, and allows data from any one logger to be saved as a separate paqfile. The logger number – shown in the logger toolbar – allows duplicate probe numbers from the multiple loggers to be separately identified in the Analysis Window, in the probe toolbar, and in the probe key to the right of the graph.

The **sort order** of the duplicate probe numbers in the Analysis Window is changed by the  and  buttons.

Troubleshooting

Logger Communications Problems

Typical sources of problems with establishing communication:

- **Communications lead not fully inserted** – Check correct sockets are being used.
- **Damaged communications lead or connectors** – Check for breaks and other damage. Replace the lead.

In addition:

- **Check the logger and battery status from the LEDs** – See p. 12. If necessary, recharge the battery (NiMH), ensuring the charging LEDs are illuminated – or replace (if alkaline or lithium).
- **Try restarting the logger** (any data present in the logger's memory is retained):
 1. Disconnect communications lead from logger.
 2. Turn logger off (press green and red buttons together, and hold for 5 seconds); all four LEDs flash together, once.
 3. Reconnect communications lead to logger.
 4. Red logger-status LED will flash five times to confirm connection.

To minimize communications problems:

- **Connect the lead first to the PC** and then to the logger.
- **Always use the same USB port** – the one which was first used to set up communications (p. 21).

In case of communications problems, the user may easily download and **email key diagnostic information** to Datapaq:

1. Connect the logger to the PC with Insight running.
2. Select Logger > Setup > Advanced.
3. Select a name and location for the downloaded file, and a destination for the email.

The file created is accessible to Datapaq but is not designed to be opened by the user.

Logger Download Error Messages

Error Message	Action
There are insufficient readings in the logger	Check trigger set point (time or temperature). Check logger's battery for charge. Check date/time settings on computer. Check probes and their connections. Reset logger, and test thermocouples (see below).
Logger stopped due to going over temperature	The logger's maximum-permitted internal temperature has been exceeded and it may have suffered serious damage: contact Datapaq for advice.
Logger stopped due to low battery	Recharge the battery, then repeat the profile run. See also p. 16.
Logger memory full	Data collection may have stopped before the run was completed: check the data collection period and sample interval before resetting the logger for another run (p. 23).

Checking the Data

If you suspect that invalid data may have been introduced into your temperature profile (paqfile), perhaps by damaged thermocouples (see below), select the View Data tab in Insight's Analysis Window to view the raw data as downloaded from the logger. The various types of invalid data which may be contained in a paqfile are shown in the analysis grid as follows.

- *OC* Open circuit.
- *NA* Telemetry data not received.
- *LO* Temperature measured was below the range of the logger.
- *HI* Temperature measured was above the range of the logger.
- *** Calculation cannot be performed (not necessarily because the data are invalid). Does not appear in View Data analysis mode.

Probes with an intermittent open circuit may produce spiky, erratic profiles. Note that spikes are inevitable when probes are disconnected from a running data logger. Typical causes of invalid or interrupted data are:

- Thermocouple becoming detached from the logger.
- Faulty connection.

Readings which are inconsistent with those of other probes may be caused by a short circuit (see below). The probe concerned must be replaced.

Testing the Logger and Thermocouples

Although thermocouples are generally robust, they can be damaged during handling. Use the following procedure to confirm the operation of logger and

thermocouples after installation. Note that this test is not an alternative to calibration (p. 17), but will highlight a malfunctioning logger or faulty probes and thus avoid a wasted profile run.

Do one of the following:

- With a full set of thermocouples attached to the logger, and the logger connected to a PC running Insight, open the Logger Reset dialog (p. 23) or the Diagnostic section of the Communications Setup dialog (p. 22); this shows current probe temperatures – *or...*
- Set up the system as if to monitor a profile run using hardwired telemetry (see p. 31 for details), and note the temperatures registered by the thermocouples as they are displayed in Insight – *or...*
- To test the thermocouples alone, use a digital thermometer (of a type to match the thermocouple type) and attach it to each thermocouple in turn.

Proceed as follows.

1. Note readings first at ambient temperature: thermocouples registering no data in Insight, or an open circuit with a digital thermometer (*OC* in the Communications Setup dialog), may be broken. Inconsistent readings may indicate an intermittent short circuit.
2. If a satisfactory ambient reading is recorded, apply heat to the thermocouple-tip via fingers or other heat source. An increased temperature should register:
 - If the reading does not change, the thermocouple is short circuit and must be replaced.
 - If the probe measures air temperature, the cable may have damage which has created a new hot junction.
 - If the thermometer shows a decrease, the thermocouple connections are reversed.
3. Confirm correct operation at 100°C/212°F by placing the thermocouple-tip in freshly-boiled water.
4. Replace any damaged cables.

Printing Problems

- Check correct printer selected: on menu bar, select File > Printer Setup.
- Check printer cable connections.

Datapaq Service Department

If you cannot resolve your problem, please contact the Service Department at Datapaq. For contact details, see back page or www.datapaq.com – or email as follows:

UK service@datapaq.co.uk
Germany service@datapaq.de
China service@datapaq.com.cn
USA auto-rma-us@fluke.com

To generate an email containing important diagnostic information about your system and the logger's recent performance, see p. 35.

INDEX

- Battery 13
 - charging 12, 15
 - disposal 18
 - life 13
 - preconditioning 16
 - replacing 17
 - service life 17
 - status 13, 24
- Calibration. See Data logger.
- Charging. See Battery.
- Communication with computer
 - problems 21, 35
 - setup 21
- Computer specification 19
- Data
 - analysis 28
 - capacity. See Data logger.
 - checking 36
 - invalid 36
 - pre-trigger 30
 - raw 36
 - real-time display 32
 - View Data 36
- Data logger
 - accuracy 11
 - battery. See Battery.
 - buttons, stop/start 13
 - calibration 17, 29
 - charging. See Battery.
 - data capacity 11
 - defaults 29
 - disposal 18
 - download error messages 36
 - downloading data from 26
 - humidity range 11
 - LEDs 12
 - measurement range 11
 - memory 11
 - Memory Calculator 24
 - multiple loggers, using 34
 - pre-trigger data 30
 - reset for non-telemetry run 23
 - reset for telemetry run 32
 - reset multiple loggers 34
 - reset, warn/disable if logger too hot 23
 - reset with previous options 25
 - resolution 11
 - sample interval 11, 23
 - servicing 37
 - specifications 10
 - temperature, internal 21, 22, 23, 25, 27, 29
 - temperature, operating range 11
 - testing 17, 36
 - trigger mode 25
 - troubleshooting 35
- Downloading data. See Data logger.
- Electricity supply, frequency 22
- Error messages 23, 27, 36
- Furnace Surveying. See Insight.
- Insight 19
 - analysis 28
 - autosave 34
 - Communications Setup dialog 21, 22
 - computer specification 19
 - Furnace Surveying 31, 33, 34
 - graph, move 33
 - graph, overlay 33
 - graph, zoom 33
 - Help system 20
 - installing 19
 - logger compatibility 19

- logger listen mode 33
- Logger Reset Wizard 34
- notes 29
- paqfile 23, 28
- password 32
- printed report 29
- printing problems 37
- process file 27, 28, 32
- removal 20
- save 28
- shortcut keys 20, 21
- start position, oven/furnace/kiln 28, 33
- upgrading 20
- View Data 36
- LEDs. See Data logger.
- Logger. See Data logger.
- Memory. See Data logger.
- Paqfile. See Insight.
- PC. See Computer specification.
- Power-off, auto 15
- Printing. See Insight.
- Probe. See Thermocouple probe.
- Process file. See Insight.
- Resetting logger. See Data logger.
- Sample interval. See Data logger.
- Start position, oven/furnace/kiln.
See Insight.
- Telemetry, hardwired 31
 - data-collection, pause/resume/end 33
 - logger listen mode 33
 - real-time display 32
- Temperature, logger, internal. See Data logger.
- Temperature profile
 - erratic 36
 - running without telemetry 23
 - running with telemetry 31
- Thermocouple probe
 - open circuit 36
 - select 24
 - short circuit 36
 - temperature 22, 25
 - temperature, current 36
 - testing 36
 - type II
- Trigger mode. See Data logger.
- Troubleshooting 35
 - email diagnostic information 35
- USB setup and drivers 21

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