

Tpaq21 Data Logger

USER MANUAL

for Datapaq®
Tracker Systems
with

insight
software

Issue 3

MA5500B



A Fluke Company

Tpaq2I Data Logger

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

User Manual

Issue 3



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 itself.



Indicates **potential hazard**.

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



Warns of **high temperatures**.

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

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Manual set in 10 pt Gill Sans.

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



The following product types

TPaq21 Thermocouple Data Logger

manufactured by Datapaq Ltd.

Lothbury House, Cambridge CB5 8PB, UK

comply with the requirements of European Union directives as follows.

Directive 2004/108/EC Electromagnetic Compatibility (EMC)

Standards Applied

EN61326-1: 2006 – Group 1, Class B equipment (emissions section only),
and Industrial Location Immunity (immunity section only).

CFR47: 2007 Class A – Code of Federal Regulations: Part 15 Subpart B,
Radio Frequency Devices, Unintentional Radiators.

RoHS Compliance Datapaq temperature monitoring equipment is exempt from EU Directive 2002/95/EC (restriction of the use of certain hazardous substances in electrical and electronic equipment) under category 9 Monitoring and Control Instruments. This Datapaq product nevertheless uses RoHS-compliant components and manufacturing processes.



Conforms to relevant South Korean EMC Standards.

Electromagnetic Compatibility *Applies to use in Korea only.* Class A Equipment (Industrial Broadcasting & Communication Equipment). This product meets requirements for industrial (Class A) electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and is not to be used in homes.



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Introduction

Datapaq® Tracker systems, incorporating Insight™ software, are a complete solution for monitoring and analyzing the performance of your heat-treatment process – the temperature profiles of products within it, and the performance of the furnace or kiln itself; 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).

In addition, the optional TM21 radio-telemetry system is available for remote monitoring.

This manual is for Furnace Tracker® and Kiln Tracker® systems supplied with a **Tpaq21 data logger**, and focuses on all aspects of using the logger, including its operation in real-time monitoring by hardwired telemetry (p. 35). 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 step-by-step instruction on how to use the logger and other system hardware components to collect temperature data during your process, see the dedicated system manual supplied.

Logger Specifications and Operation

The Tpaq21 is at home in a wide range of furnace and kiln applications where long-duration runs at high ambient temperatures call for large memory capacity and rugged electronics. Its capacity for 130,000 data-readings over 10 selectable channels makes it a supremely powerful, accurate and in-depth analysis tool. Variable sampling intervals and multiple-event programming provide detailed analysis in cases where – such as in gas or water quenches – heat-treatment processes are followed by fast-moving sections of the product temperature profile. Combined with a built-in transmitter to see these processes in real time, this is an ideal data logger for all applications.

The logger's key features are:

- Ten thermocouple channels for maximum data collection on each run.
- Huge memory capacity: 130,000 data points for detailed process analysis.
- Short sampling intervals to collect maximum data in minimum time.



10-channel Tpaq21 logger, showing LEDs and stop/start buttons (upper surface), communications port (front edge) and thermocouple and transmitter aerial sockets (right).

- High accuracy: to $\pm 0.3^{\circ}\text{C}/0.5^{\circ}\text{F}$ for compliance to tight specifications.
- Hot data protected by non-volatile memory or software warning if reset is attempted before download.
- USB and serial RS232 communication capability.
- Hardwired or (on I/O-channel logger only) radio (RF) telemetry for monitoring in real time with full analysis functions and alarms to alert if the process is out of specification.
- Four status LEDs to show the exact logger activity after disconnection from the computer.
- Start and stop buttons for easy user control.
- Two battery types for operation in normal and high ambient temperatures.
- Rugged industrial case and electronics allow operation in harsh furnace and kiln environments of dust, pressure and vacuum.
- ‘Multiple-event’ facility allows sampling interval change during the run, ideal for water- and gas-quench processes.
- Reset by start button after download for speed and simplicity.

16 versions are available: with eight or ten data channels, suitable for normal or high operating temperatures, and for use with type K, N, R, S, B or J thermocouples (see specifications, below).

Tpaq2I Logger Specifications

General Specifications

High-temperature loggers (using lithium batteries) are identified by a red label on the base.

Length 200 mm/7.87 inches **Width** 98 mm/3.86 inches **Height** 20 mm/0.79 inches

Data-collection start	Start/stop button, temperature rise/fall, time
Programmable events	Up to eight sampling interval changes possible per run, trigger by rising or falling temperature after first event
Hot-data protection	By non-volatile memory, and software warning if reset attempted before download
Real-time monitoring	Hardwired telemetry as standard, via communications lead. Compatible with TM2I radio-telemetry system (available separately).
Logger reset	Normally via Insight software. After download, reset is possible by start button (using previous run parameters; p. 31).
Communications	USB or serial RS232 (COM port)
Battery charger	CH0070B power-supply unit: input 90–264 V AC, 50–60 Hz, 400 mA

Specifications for Specific Thermocouple Types

	Type K	Type N	Type R
Measurement range	-100°C to 1,370°C -148°F to 2,498°F	-100°C to 1,300°C -148°F to 2,372°F	0°C to 1,760°C 32°F to 3,200°F
Accuracy*	±0.3°C ±0.5°F	±0.4°C ±0.7°F	±1.0°C at 200°C ±0.7°C at 1,000°C ±1.8°F at 392°F ±1.3°F at 1,832°F
Resolution	0.1°C/0.2°F	0.1°C/0.2°F	0.1°C/0.2°F
Socket color (IEC 584)	Green	Pink	Orange

	Type S	Type B	Type J
Measurement range	0°C to 1,760°C 32°F to 3,200°F	55°C to 1,815°C 131°F to 3,299°F	0°C to 800°C 32°F to 1,472°F
Accuracy*	±1.0°C at 200°C ±0.8°C at 1,000°C ±1.8°F at 392°F ±1.4°F at 1,832°F	±1.0°C at 1,500°C ±3.0°C at 400°C ±1.8°F at 2,732°F ±5.4°F at 752°F	±0.2°C ±0.4°F
Resolution	0.1°C/0.2°F	0.1°C/0.2°F	0.1°C/0.2°F
Socket color (IEC 584)	Orange	Gray	Black

* Using sample interval > 0.8 s over temperature range shown. For more details, contact Datapaq.

Specifications for Specific Logger Models

Data for type K thermocouple loggers only.

	Normal operating temp.		High operating temp.	
Model	TP2086	TP2016	TP2186	TP2116
Channels	8	10	8	10
Storage	130,000 data points			
Max. operating temp.	70°C/158°F		110°C/230°F	

cont.

cont.

	Normal operating temp.		High operating temp.	
Model	TP2086	TP2016	TP2186	TP2116
Battery type	NiMH rechargeable		VHT Lithium	
Max. battery life ¹	170 hours between charges		370 hours	
Sample interval ²				
No telemetry	0.1 s to 50 min	0.1 s to 50 min	0.1 s to 50 min	0.1 s to 50 min
Hardwired telemetry	1 s to 50 min	1 s to 50 min	1 s to 50 min	1 s to 50 min
RF telemetry	–	2 s to 50 min	–	3 s to 50 min
Max. operating pressure at 20°C/68°F	20 bar/290 psi			

¹ Max. battery life depends on sample interval, operating temperature and use of RF telemetry (see p. 14).

² Minimum interval with 10 thermocouples in use, 0.3 s; 0.1-s interval requires maximum 3 thermocouples used; 0.2-s interval requires maximum 9 thermocouples.

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

Stop/Start Button Actions

Action	Results	Notes
Press GREEN button.	Starts logging.	In telemetry mode also starts sending data.
Press RED button.	Stops logging.	Data retained in memory. Logger cannot be restarted until data downloaded. Red LED flashes every 5 s 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 3 s.	Turns logger off.	Data retained in memory.
Press GREEN button after downloading data.	Starts logging.	Last re-set conditions (sample interval, probe selection, etc.) used as default.

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.

Battery Status LEDs

Yellow	Red	Meaning
On	On	Battery on fast charge.
On	Off (after being on)	Fast charge complete. Can also occur if battery overheats during fast charge.
On	Flashing once per second	On applying charger power when battery is too hot/cold or too deeply discharged. Battery is charged at 1/16 of fast-charge rate, until safe to start fast charging.
Off	Off	Charger not connected or no power connected.
Flashing once per second – for loggers with firmware version* earlier than 3.20	Off	Battery being depassivated (only for lithium battery, when first fitted), or battery is at 20% or less of maximum charge.
Flashing once per second – for loggers with firmware version* 3.20 or later	Off	Battery is at 20% or less of maximum charge.
2 rapid flashes every second – for loggers with firmware version* 3.20 or later	Off	Battery being depassivated (only for lithium battery, when first fitted).

* To check the firmware version in use, connect the logger to the PC and, in the Insight software, select Logger > Setup > Diagnostic.

Logger Status LEDs

Red	Green	Meaning
5 flashes, alternating with green LED	5 flashes, alternating with red LED	Logger successfully reset.
Flashing, alternating with green LED, at sample interval	Flashing, alternating with red LED, at sample interval	Logger awaiting trigger.
On	Flashing at sample interval	Logger awaiting trigger but one or more thermocouples is open circuit.

cont.

cont.

Red	Green	Meaning
Flashing together with green LED	Flashing together with red LED	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 (once per second)	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.

Batteries

Models of the Tpaq21 logger for operation at **normal temperatures** (up to 70°C/158°F) use NiMH rechargeable batteries. **High-temperature** loggers (used up to 110°C/230°F) are powered by non-rechargeable lithium batteries. The two battery types cannot (and must not) be interchanged.

Service life of the rechargeable NiMH batteries is about three years or 500 charge/discharge cycles. The logger must be returned to Datapaq for battery replacement.

Battery Life

For a given battery type, battery life is affected by the following factors.

- **Operating Temperature** – Essentially, the higher the ambient temperature the battery operates in, the lower 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. This is less critical for NiMH rechargeable batteries than for replaceable batteries.
- **Operating with RF Telemetry** – Sending data to a receiver outside the furnace or kiln requires almost double the power needed to simply 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. This is only the case with lithium batteries however, as the rechargeable NiMH batteries will be able to charge via the communications cable.

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. The data below applies only to batteries when used in the Tpaq21 logger.

Lithium Batteries BP0021A

No Radio Telemetry Used

Sample Interval	Logger Peak Temp.	No. of Channels	Battery Life (hrs)
< 1 s	100°C/212°F	10	160
3 s	100°C/212°F	10	300
1 min	100°C/212°F	10	330

Radio Telemetry Used

Sample Interval	Logger Peak Temp.	No. of Channels	Battery Life (hrs)	
			Older Telemetry Systems	TM21 System
3 s	25°C/77°F	10	130	175
3 s	50°C/122°F	10	130	175
3 s	100°C/212°F	10	30	100
30 s	100°C/212°F	10	170	230
3 min	25°C/77°F	10	335	370
3 min	50°C/122°F	10	310	370
3 min	100°C/212°F	10	180	240

NiMH Rechargeable Batteries

No Radio Telemetry Used

Sample Interval	Logger Peak Temp.	No. of Channels	Battery Life (hrs)
< 1 s	70°C/158°F	10	80
3 s	70°C/158°F	10	160
1 min	70°C/158°F	10	170

Radio Telemetry Used

Sample Interval	Logger Peak Temp.	No. of Channels	Battery Life (hrs)	
			Older Telemetry Systems	TM21 System
3 s	70°C/158°F	10	50	90
30 s	70°C/158°F	10	150	150
3 min	70°C/158°F	10	160	160

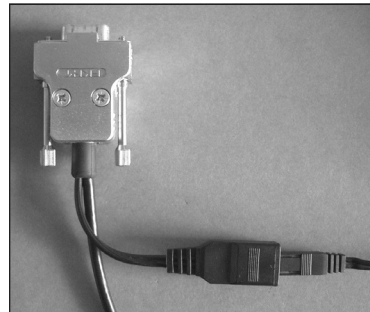
Charging NiMH Rechargeable Batteries

Recharge the batteries 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 2–3 hours.

Indication of battery/charging status is provided by colored LEDs on the logger (see p. 13).



A COM port communications lead, showing the charger lead (far right) attached to the charger connector.

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 for **hardwired telemetry** (p. 35), 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.

Where batteries are too cold (below 0°C/-32°F), too hot (over 45°C/113°F) or too deeply discharged, they must be **pre-conditioned** 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.

Low Battery Level

When the battery's charge drops to 20% of the full level, this will be shown by the logger LEDs (p. 13) and (if connected to the PC) by the Insight software.

Removing/Replacing Lithium Batteries BP0021A

When the logger ceases to operate due to exhausted batteries, they should be immediately removed and disposed of.

WARNING

Lithium batteries – Fire, explosion and severe burn hazard

*Lithium batteries are potentially dangerous and require great care in handling and storage. You **must** read the section 'Handling Lithium Batteries' (below) and the Safety Data Sheet supplied with the batteries.*

Remove and replace the batteries as follows.

1. Select a clean, dry, non-conductive work surface; do not use a metallic surface or anti-static matting. Take off any conductive jewellery and put it out of the way. Wear eye protection.
2. Remove the four screws retaining the battery cover.
3. Carefully remove each of the old batteries, one at a time, from the battery compartment.

Ensure that the battery terminals cannot be short-circuited in any way – to each other, to the logger or to any tools. There is risk of explosion.

4. Place each battery separately on the work surface, maintaining good separation between them. Mark the work surface area into which they are placed, in order to identify them as the old batteries. Ensure the battery compartment is clean and dry, and carefully wipe the battery contacts with a

dry lint-free cloth or tissue with attention to the contact area. Do not bend or distort the contacts.

5. Remove the new batteries from their protective UN-compliant packaging, and retain this for later use.
6. Carefully install each new battery one at a time into the battery compartment.

Observe the polarity of the batteries and of the contacts within the battery compartment.

Ensure that the battery terminals cannot be short-circuited in any way – to each other, to the logger or to any tools. There is risk of explosion.

Always replace all of the batteries at the same time.

Never use batteries other than BP0021A supplied by Datapaq.

Do not mix BP0004 and BP0021A batteries, or batteries of any other type; this could lead to an explosion.

7. BP0021A batteries must be depassivated before they are used for the first time, as follows.
 - Place batteries in the Tpaq2I logger and depassivation will begin.
 - Yellow LED produces two rapid flashes every second. (For loggers with firmware version earlier than 3.20, LED flashes once per second.)
 - After 20 minutes, yellow LED stops flashing.
 - Logger is ready for use.
8. Re-check that batteries are installed with correct polarity, then refit the battery cover and retaining screws.
9. Carefully place the old batteries one at a time into the empty packaging. Do not allow them to be short-circuited.

See below for disposal of lithium batteries.

Handling Lithium Batteries

WARNING

Lithium batteries – Fire, explosion and severe burn hazard

Lithium batteries are potentially dangerous and require great care in handling and storage.

- **Do not short-circuit • Do not attempt to recharge •**
- **Do not reverse-connect • Do not open batteries •**
 - **Do not expose battery contents to water •**
- **Do not solder anything to the battery • Do not incinerate •**
- **Do not mix cells • Do not leave discharged cells in the logger •**

These instructions must be carefully read in full, and understood, by any person likely to handle, replace or dispose of lithium thionyl chloride batteries.

Do not open, crush or deform the battery cells. If the lithium metal within the cell is exposed to the air and moisture, an explosion or fire may result. The contents are flammable, corrosive and extremely irritating to the lungs and respiratory system. Lithium metal and thionyl chloride cause chemical burns on contact with skin.

The inorganic lithium thionyl chloride batteries BP0021A supplied by Datapaq will, when used correctly, provide a safe and dependable source of power. They represent the only current battery technology that can meet the demands of high-temperature operation. Unlike more conventional batteries, lithium cells contain flammable materials, and consequently safety precautions must be taken during transport, storage, handling and disposal. If lithium batteries are mistreated there is a risk of leakage of the flammable contents or an explosion resulting in a fire.

Each battery is marked as follows:

Warning: Fire, explosion, and severe burn hazard.

Do not recharge, disassemble, heat above 145°C, incinerate or expose contents to water.

To meet the requirements of the Control of Substances Hazardous to Health Regulations 2002 (COSHH), each battery consignment includes a Safety Data Sheet. Any person likely to handle, replace or dispose of lithium thionyl chloride batteries must be made aware of this data sheet. The sheet should be passed to your Health and Safety officer for future reference; extra copies are available from Datapaq. The sheet contains details of **first-aid and firefighting procedures**.

Transport, and Storage Before Use

Due to the flammable content, lithium thionyl chloride batteries are classified as Dangerous Goods under UN transport regulations. The packaging used to supply the cells is UN-compliant and is labeled accordingly. The batteries must be transported only within this packaging.

Packages containing lithium batteries should be handled with care. Rough handling may result in batteries becoming damaged which may cause leakage, explosion or fire.

On receipt **do not remove** the lithium batteries from their UN-compliant packaging. Store the batteries within their original packaging until required.

The lithium batteries should be stored apart from all other flammable materials.

The storage area should be cool, dry, ventilated and weatherproof. Temperatures generally should be below 35°C/95°F. Do not store next to radiators or boilers or in direct sunlight. Avoid storage temperatures above 75°C/167°F.

Disposal of Used Lithium Batteries

The used batteries should be disposed of as soon as possible. Even though no longer capable of powering the logger, the batteries remain flammable and have sufficient energy to cause a fire or to explode if short-circuited. The UN-compliant packaging should thus be used to store the used batteries after removal from the logger and at disposal. Under the European Union Batteries and Accumulators Directive, the used batteries which are removed from the logger by the user should be disposed of at an appropriate recycling centre.

Disposal of the batteries at permitted waste-treatment and disposal sites may be by burial or incineration – but otherwise **do not dispose of in fire and do not incinerate**. The BP0021A lithium batteries do not contain mercury, cadmium or any other heavy metal or other hazardous material according to EU Directives 91/157/EEC and 93/86/EEC.

Testing and Calibration

It is recommended that the logger is tested and calibrated by Datapaq at least once a year. To comply with the AMS 2750D standard, loggers should be calibrated every three months. 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 national calibration standards.

No other company can offer this degree of in-depth testing as well as a full calibration service. To calibrate your logger, please return it to the Service Department at Datapaq (see title page for contact details).

It is possible for users to check calibration of the logger themselves if they have a secondary standard instrument that complies with the requirements of AMS 2750D Table 3.

For processes of **testing your logger's operation** with thermocouples attached, see p. 42.

Store the logger in a dry, dust-free environment.

Disposal of 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 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 supplied 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 an instrumented product and the logger/barrier assembly through your furnace or kiln.

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 furnace or kiln, you will then:

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

These stages are described below.

Installing/Removing Insight

Datapaq Insight 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 COM (serial) port or USB port.
- Microsoft Windows™ XP, Vista, 7, 8 or above.
- Microsoft Internet Explorer 4 or above.

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.

The logger can be connected to the PC by either a COM (serial) port or a USB port. Only one logger at a time can be connected to the PC's USB ports: it is not possible to connect simultaneously more than one logger to the PC using USB ports and then to choose which one to use.

1. Using the communications lead supplied, connect the logger to a free COM (serial) port or to a 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.

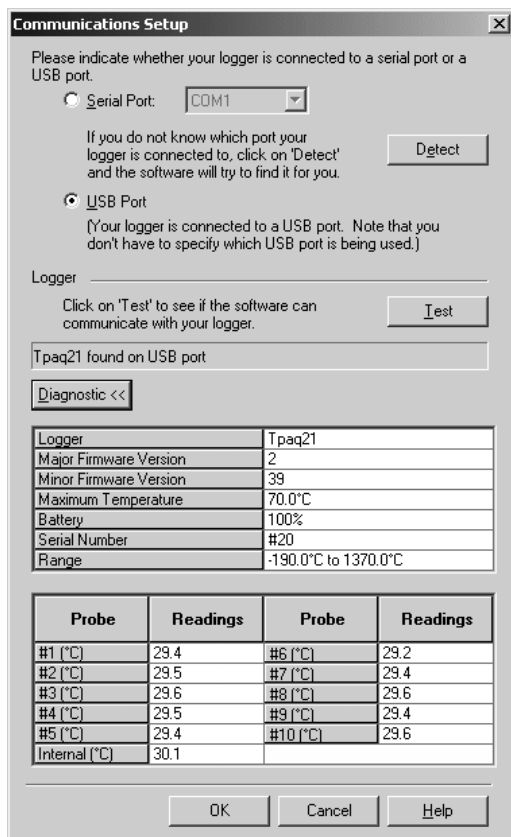
If using USB, and if the PC is having a Datapaq logger connected for the first time, Windows will display a 'Found New Hardware' message. After a few seconds, Windows will display 'Datapaq Paq21 Logger', and, after a further few seconds, 'Your hardware is installed and ready to use'. If any warnings 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

- **Damaged communications lead or connectors** – Check for breaks and other damage. Replace the lead.
- **Communications lead not fully inserted** – Check correct sockets are being used.
- **Wrong COM port selected** – Follow the procedure below to select the correct port.
- **Battery not charged** – Recharge the battery, ensuring the charging LEDs are illuminated.

2. On the Insight software's menu bar, select Logger > Setup to open the Communications Setup dialog.
3. Select the type of port to which the logger is connected: USB port or COM (serial or RS232) port. For a COM port, select the port number, or click Detect to auto-detect the port in use.
4. Click Test.

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



The Communications Setup dialog for the Tpaq21 logger, with Diagnostic section expanded.

SHORTCUT

Pressing F4 on the keyboard opens the Communications Setup dialog, looks for the port currently in use, and displays the port and logger type (equivalent to clicking Detect 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.



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. 31). (To run a profile using hardwired telemetry, see p. 35.)


*If carrying out a **temperature uniformity survey** of a furnace to ensure compliance with the AMS 2750D or other standards, temperature profiles (using telemetry or not) will be run with **Insight Furnace Surveying** software using its Temperature Uniformity Survey Wizard, and not as described below. To use the wizard, run Insight Furnace Surveying and click  or  – or select Tools > Wizards, or File > New > Temperature Uniformity Survey, or Furnace Surveying > Temperature Uniformity Survey. For details, see the **Furnace Surveying User Manual** and that software's **Help system**.*

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. 31.

*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. 34).*


*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 or COM (serial) 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. 25).

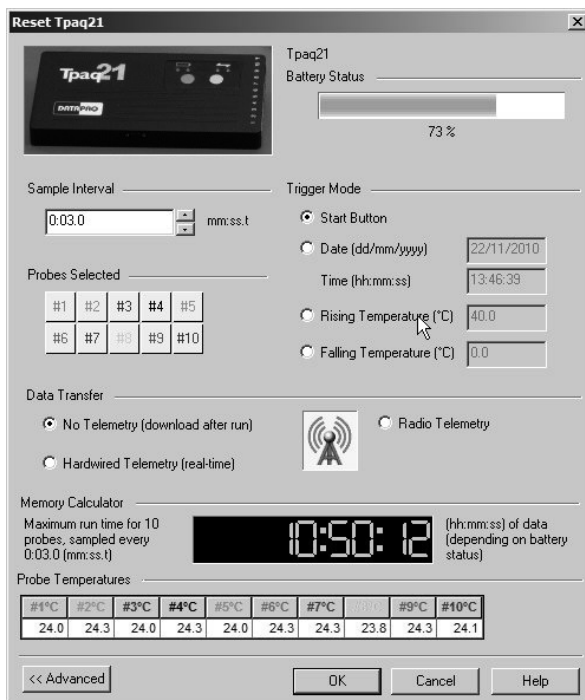
The red LED on the logger should flash five times to confirm that the connection between the communications lead and the logger has been made (if it does not, see ‘Communications Setup’, p. 25). If the logger uses rechargeable batteries and is not already charged, connect the battery charger lead to 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. For limitations on number of probes allowed when using short sample intervals, see p. 12.

Probes Selected To conserve memory in the logger, 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.* For limitations on number of probes allowed when using short sample intervals, see p. 12.

Data Transfer Select ‘No Telemetry’. (To reset the logger for use with hardwired telemetry, see p. 35.)



The Reset dialog for the Tpaq21 logger.

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

Probe Temperatures 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. (Probe temperatures, and the logger's internal temperature, are also shown in the Communications Setup dialog, p. 26.).

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. The display is invalid for lithium batteries.

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

Rechargeable nickel-metal-hydride batteries discharge slowly even when not in use and will need charging (p. 16) if left for more than three weeks.

A full charge takes 2–3 hours. For battery-life data, see p. 14.

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

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.

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

Mode Click 'Advanced' to setup **multiple events**, i.e. to have different sample intervals and trigger modes for different stages of the profile run.

Two events are enabled by default. Click 'Add' to define an additional event.

To remove an event which has been set up, select the event number and click 'Remove'; subsequent events are then renumbered.

For event 1 – any trigger mode can be selected; the telemetry mode (which will apply for the whole of the profile run) must also be chosen while event 1 is selected.

For event 2 onwards – the only trigger modes which can be selected are rising temperature and falling temperature; select also the sample interval required for each event; telemetry selection is disabled.

Settings made for probe selection apply to all events, regardless of the event that is currently selected in the dialog.

The maximum possible duration of a run with multiple events cannot be predicted, so the memory calculator (see below) is not available.

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.
5. Plug the **thermocouples** into the logger's numbered sockets. If you are using a process file (see p. 32), ensure that the probe/socket numbers on the logger correspond to those used to define probe numbers and locations in that file.
6. 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.

7. If the trigger mode is **Start Button**, press and hold the logger's start button for about 1 s until the green LED starts to flash at the sample interval.
8. 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*.

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).


Downloading Data

Recover the system from the 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 or COM (serial) 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. 25).

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**.*

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. 41.*

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

6. If enabled, the **Select Process** dialog or the **Select Furnace/Kiln, 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 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: Furnace/Kiln, 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 (see p. 32).
- Specify the furnace/kiln start position in the data.
- Record any notes specific to the profile run.

Specifying Furnace/Kiln Start

If you have not applied a process file, or if the process file you applied did not specify that the **furnace/kiln start position** be adjusted, you may want to adjust the furnace/kiln start position now: from the menu bar, select Process > Adjust 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 furnace/kiln start at this point, you may still do so at any time subsequently.

For an explanation of furnace/kiln start, and how to adjust it, click Help in the Adjust 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/113°F).
- Frequency of the local electricity supply.
- Ability to download and display data for the logger's internal temperature which is gathered while it is logging (only when used with TM21 radio-telemetry system).

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.

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 furnace or kiln (a batch process).

Thus, with thermocouples trailing from the furnace or 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 kiln 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.

For processes requiring more than the eight or ten data channels available with a single Tpaq21 logger, Insight has the capability to gather and analyze data by hardwired telemetry from up to three loggers simultaneously (see p. 38).

To use multiple loggers with hardwired telemetry, all loggers must be connected to the PC via USB (not by COM port).

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.

*If carrying out a **temperature uniformity survey** of a furnace to ensure compliance with the AMS 2750D or other standards, temperature profiles (using telemetry or not) will be run with **Insight Furnace Surveying** software using its Temperature Uniformity Survey Wizard, and not as described below. To use the wizard, run Insight Furnace Surveying and click  or  – or select Tools > Wizards, or File > New > Temperature Uniformity Survey, or Furnace Surveying > Temperature Uniformity Survey. For details, see the **Furnace Surveying User Manual** and that software's **Help system**.*

Running a profile in real time is performed in essentially the same way as a normal (non-telemetry) run (see p. 27, 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. 27), except that:

- In the Reset dialog, select **Hardwired Telemetry**.
- After completing your selections in the Reset dialog, **leave the communications lead attached** to the logger and PC.
- The **Select Process** dialog then appears in order that you may choose a process file to apply to the results as they are being gathered and displayed. If the process file and its components have been given names, these are shown when you select the process file in the list. Click 'No Process' if you do not want to apply a process file. (A process file allows you to see the temperature profile in relation to the 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: Furnace/ Kiln, Recipe, Product'.)
- If you are using a process file, when plugging the **thermocouples** into the logger's numbered sockets, ensure that the probe/socket numbers on the logger correspond to those used to define probe numbers and locations in that process file.

*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. 38).*

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 p. 38). You may instead, however, open the other paqfile as an overlay while still in real time mode, as above.*

You may adjust the **furnace/kiln start** position while a real-time run is in progress (select Process > Adjust 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. 31), though it should normally be adequate simply to save, as a new paqfile, the data already received.

Using Multiple Loggers



The use of **multiple loggers**, each attached to a separate USB port on the PC, permits data to be gathered from a greater number of thermocouple channels than can be achieved with a single logger. Up to three Tpaq21 loggers can be used simultaneously.

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** from the menu). You must first enable the use of multiple loggers in the Global Options dialog (select **Tools > Options**).

Data from multiple loggers used in a single profile run is displayed all together in a single window by Insight. The data can be stored in a single paqfile, or as individual paqfiles, each containing data from one of the loggers.

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 and 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.

*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.*

Troubleshooting

Logger Communications Problems

- **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.
- **Wrong COM port selected** – See ‘Communications Setup’ (p. 25) to select the correct port.
- **Batteries not charged** – NiMH batteries only: recharge the batteries, ensuring the charging LEDs are illuminated; if batteries need replacing, the logger must be returned to Datapaq.

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 p. 42).
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	Replace or recharge the battery as appropriate, then repeat the profile run.
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 (see 'Resetting the Data Logger', p. 27).

Checking the Data

Thermocouple probes are generally reliable, but damage resulting from inappropriate use or handling can produce erroneous readings. If you suspect that invalid data may have been introduced into your temperature profile (paqfile), select the View Data tab in the Insight software'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. 20), 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. 29) or the Diagnostic section of the Communications Setup dialog (p. 26); this shows current probe temperatures – or . . .
- Set up the system as if to monitor a profile run using hardwired telemetry (see p. 35 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 > Print Setup.
- Check printer cable connections.

Datapaq Service Department

If you cannot resolve your problem, please contact the Service Department at Datapaq (see title page for contact details).

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