Food Tracker®

USER MANUAL

for use with

insight software

Issue 3

MA5040A

DATAPAQ®

A Fluke Company

Food Tracker®

User Manual

for use with

insight software

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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DATAPAQ PART NO. MA5040A

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.

Manual set in 10 pt Gill Sans.

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

European Union Directives

The following product types

MultiPaq21 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 the temperature profiles of products within a heat-treatment process; accurate data acquisition and powerful analysis techniques are combined with flexibility and ease of use. The Food Tracker® system is designed specifically for product temperature monitoring in the food processing industry: for static or conveyorized cook/chill processes alike, Food Tracker provides a complete historical record of the temperature reached by your product – and by the oven environment – throughout the process, an essential requirement for process validation under HACCP regulations.

- Proving/proofing and baking
- Drying/dehydration
- Steam cook
- Pasteurization
- Sterilization (retorts)
- Roasting
- Flash frying
- Blanching/boiling (full immersion)
- Blast freezing
- Spiral freezing

With accurate, repeatable product temperature guaranteed, achieve clear benefits to your product and process:

Food safety – Create the HACCP documentary proof that your product has achieved the cook/cool temperatures necessary to guarantee the quality and safety of your cooked meats, poultry, bakery products and ready-meals.

Quality – Guarantee texture, taste, color and size through control of the temperature profile.

Productivity – Optimize batch-cook programs or conveyorized line speeds to maximize product throughput.

Product yield – Control processes to prevent overcooking so ensuring maximum product yields and palatability, and eliminating waste.

Reduce downtime – Highlight immediately when and where process problems occur (e.g. hot/cold spots), and have the data to solve them.

Economy – Maximize the operating efficiency of your process to save on oven/freezer running costs.

Datapaq Food Tracker temperature profiling systems travel through the oven or freezer with the food product, making a complete record of the temperatures

reached by the product itself throughout the process. Data gathering is carried out by a MultiPaq21 data logger contained in a protective thermal barrier, and Insight software is used for detailed analysis of the data gathered during the process. Datapaq systems offer the only reliable means of measuring the true product and environmental temperature throughout the process, an essential requirement for process validation under HACCP regulations

A Food Tracker system in use in a typical application.

Datapaq systems are designed for the **harshest environments**, including steam cooking, deep fat fryers and blast freezers. You can monitor the product temperature for the entire cook/freeze cycle in either static or conveyorized ovens.

From one run and one logger, you may collect product/environmental temperatures from up to **eight locations**, profiling your entire process rather than just an isolated part of it (e.g. different racks in a batch oven or locations across a conveyor belt).

Collect data for up to **eight individual profile runs** (multiple lines or repeat optimization runs) in the memory of the data logger before there is any need to transfer data to the computer. You can thus collect all the data you need in one session, with no need to repeatedly scrub and gown-up between runs as you move from production to office in order to access the PC.

With **real-time data monitoring**, you can know immediately what is happening to your product while it is in the oven, and make instant decisions that affect safety, quality and profitability. The optional **TM21 telemetry system** uses a cable-free radio link to send temperature information directly from within the process to the PC running Insight Food Tracker software. Alternatively, the basic Food Tracker system's built-in **hardwired telemetry** capability allows you to monitor conditions inside a batch oven and to watch the temperature profile develop in real time.

The data logger is rated to IP67 with special **waterproofed** thermocouple connections allowing use in the most hostile of environments (steam, water showers and washing procedures) with the confidence of guaranteed reliability.

Select a **thermal barrier** ideally suited to your application. Whether your need is low height clearance, fully-submersible use in a fat fryer, or high temperature protection (300°C/572°F), the MultiPaq21 can be provided with a barrier to suit.

Use **thermocouple sensor types** to suit the product being monitored, and restrict consumable costs to the thermocouples alone – not the entire logger – if damaged.

Using flexible thermocouple cables, the temperature sensor can readily be located **within the product** (core or surface), without the data logger or its mass influencing the response characteristics of the sensor.

Unlike other commercial systems, there is no need to protect the data logger from the process's environmental temperatures by placing it inside the product and thus affecting the product's **heating characteristics**.

This manual contains information for all Food Tracker users, from novice to experienced. The chapters are arranged in logical order, explaining the Food Tracker system and the sequence of events in setting up and conducting a temperature profile run. There is also guidance on setting up the Insight software; after it is installed, complete information on using the software is available in the online Help system.

Insight Setup (p. 13) – How to install, remove and run the Insight software.

Hardware (p. 17) – Describes the system's data logger(s), thermal barriers and thermocouple probes.

Running a Temperature Profile (p. 35) – All the stages of obtaining a profile, from positioning probes to downloading the data into the software.

Using Hardwired Telemetry (p. 51) – Monitoring conditions inside a batch oven and watching a temperature profile develop in real time.

Humidity Measurements (p. 55) – Adding humidity data to your temperature measurements.

Troubleshooting (p. 61) – Lists error messages and describes how to test the data logger and probes.

Insight Setup

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.

Installing/Removing Insight

Datapaq Insight used with the MultiPaq21 logger 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, Vista, 7, 8 or above.
- Microsoft Internet Explorer 4 or above.

The MultiPaq21 logger operates only with Datapaq Insight v.2.0 and 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.

For use of Insight to **reset the logger**, see p. 40.
For **downloading data** from the logger, see p. 48.

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.

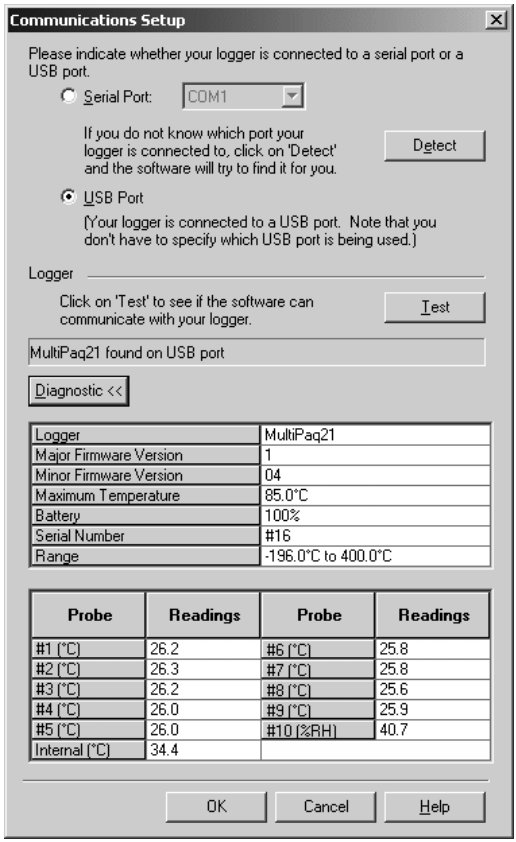
2. On the Insight software's menu bar, select Logger > Setup to open the Communications Setup dialog.
3. Select the type of port to which the logger is connected: USB port or COM (serial or RS232) port. For a COM port, select the port number, or click Detect to auto-detect the port in use.
4. Click Test.

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

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.



The Communications Setup dialog for the MultiPaq21 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 the 'Logger' tab and then 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.

Hardware

The basic Food Tracker system hardware comprises:

- Data logger (including communications lead and charger).
- Thermal barrier.
- Thermocouple probes.

Data Logger – the MultiPaq21

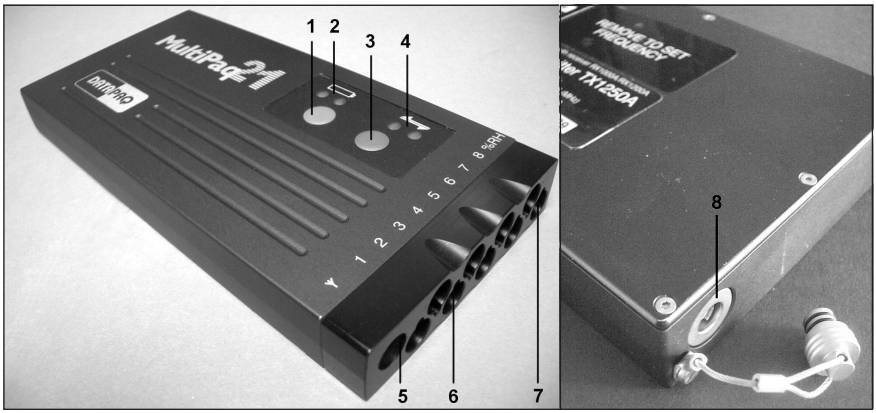
The MultiPaq21 has been designed to withstand the most hostile of food-processing applications and to guarantee operating reliability day after day.

The logger's key features are:

- Temperature and (on 8-channel logger only) humidity profiling.
- Up to eight temperature channels with interchangeable thermocouples.
- Operating temperature −40°C to 85°C/−40°F to 185°F.
- Accuracy to ±0.2°C/0.36°F.
- IP67 water-resistance rating to guarantee reliability/data integrity.
- Programmable (start trigger, sample interval, etc.).
- USB and serial RS232 communication capability.
- Multi-run capability (up to eight separate profiles before download).
- RF telemetry option (on 8-channel logger only).
- Rechargeable NiMH battery (120 hours at 0.5-s sample interval).

Four versions are available: with six and eight data channels, and suitable for type T and type K thermocouples (see specifications, below).

The MultiPaq21 logger achieves **ingress protection standard IP67**, which specifies that, when immersed in water to a depth of 1 m for 30 minutes, water must not enter in any harmful quantity. The rating is achieved in the logger's operational state with thermocouples (or blanking plugs) connected; these are provided with O-ring seals. As an illustration of this (although not recommended for normal use), the unit has been shown to operate successfully submerged in water at room temperature without any protection from a water-resistant thermal barrier.



8-channel MultiPaq21 logger, shown from above and below.

1: Stop button, RED – p. 19
2: Battery status LEDs – p. 20
3: Start button, GREEN – p. 19
4: Logger status LEDs – p. 20
5: Transmitter aerial socket
6: Thermocouple sockets – p. 43
7: Humidity sensor socket – p. 55
8: Communications port with dust-cap – p. 14

*The logger is **not** designed for use without an external barrier in hot-water applications or in an environment of rapidly changing temperature; the accuracy of data cannot then be guaranteed. Although able to record at −40°C/−40°F, it is recommended that, for freezing applications, even above this temperature, a thermal barrier (TB5011) be used to overcome thermal shock errors.*

MultiPaq21 Logger Specifications

Logger Types

DP2162A	6 channels, type T thermocouples.
DP2166A	6 channels, type K thermocouples.
DP2182A	8 channels, type T thermocouples. Humidity option on one channel, and RF telemetry option available.
DP2186A	8 channels, type K thermocouples. Humidity option on one channel, and RF telemetry option available.

Accuracy	±0.2°C/0.36°F
Resolution	±0.1°C/0.18°F
Measurement range	Type T −196°C to 400°C/−320.8°F to 752°F Type K −150°C to 1,370°C/−238°F to 2,498°F
Operating temperature (without thermal barrier)	−40°C to 85°C/−40°F to 185°F
Humidity option	Available on 8-channel system.

Real-time monitoring	Hardwired (serial) telemetry (via communications cable). Optional TM21 radio-telemetry system available for 8-channel loggers.
Protection (without thermal barrier)	IP67 (submersion to 1 m in water for 30 min) with thermocouples fitted.
Sample interval	0.5 s to 50 min (standard use – temperature only). 2.0 s to 50 min (radio telemetry – temperature only). 2.0 s to 50 min (temperature and humidity measurement).
Memory	1.81 Mb = 16 hours data collection (8 thermocouples and 0.5-s sample interval).
Communications	Serial cable (RS232) – CI1025. USB cable – CI1026.
Thermocouple plug shroud	To plug thermocouples into the logger in one action, guaranteeing the correct thermocouple is plugged into the correct channel (see p. 44). 6-channel plug shroud – CS1130 (supplied as option). 8-channel plug shroud – CS1131 (supplied as standard).
Blanking plugs	DPI213A (for thermocouple sockets), DPI920A (for humidity-sensor socket) – inserted into unused channels to give protection to the connector from dirt, etc., and to provide water-resistance.
Operation	Up to 8 individual runs before download.
Data collection start	Start/stop button, temperature rise/fall, date and time.
Battery	Rechargeable NiMH (recharge time 2.5 hours).
Battery life (full charge)	Temperature only (0.5-s sample interval) = 120 hours. Temperature only (10-min sample interval) = 250 hours. Telemetry (2.0-s sample interval) = 65 hours. Humidity (2.0-s sample interval) = 120 hours.
Battery charger	CH0070B power-supply unit: input 90–264 V AC, 50–60 Hz, 400 mA.

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 re-started 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	Off	Battery is at 20% or less of maximum charge

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
Flashing together with green LED	Flashing together with red LED	Probe temperature is above trigger point and cannot trigger (or, if falling trigger is set, temperature is below trigger point)
Off	Flashing at sample interval	Logger acquiring data
Two flashes together with green LED, then pause, then repeat	Two flashes together with red LED, then pause, then repeat	Logger waiting for next run to be started (only during multiple runs)
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

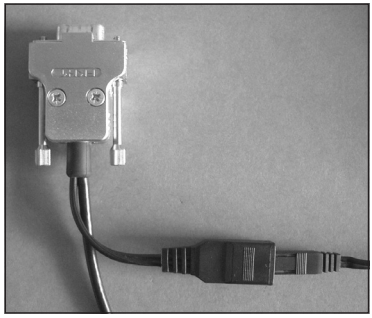
Battery

The logger's battery is rechargeable NiMH. Battery life is about three years or 500 charge/discharge cycles. The logger must be returned to Datapaq for battery replacement.

Charging

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 above). A new battery – or one which has been unused for several months – should be charged for 24 hours before use.



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

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 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).

For processes of **testing your logger's operation** with thermocouples attached, see p. 62.

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.

Thermal Protection – Barriers and Heatsinks

Constructed from stainless steel, with hydrophobic ceramic insulation, the **thermal barrier** provides the thermal and mechanical protection necessary for the data logger to survive in the hostile environment of an industrial oven.

Not all food processes are equal, each having its own demands of space, temperature, duration or environment (steam, submersion in water or oil). For this reason the Food Tracker system has a choice of submersible and non-submersible thermal barriers. Options vary from quick flash-frying, where the whole system is submersed, to long-duration high-temperature bakery processes. Datapaq barriers are quality engineered, designed to give maximum performance with minimum weight and size.

Heatsinks – stainless steel assemblies filled with a non-toxic, non-flammable phase-changing material – provide additional, secondary protection, allowing the system has to operate at high temperatures for extended periods. The phase-changing material absorbs the heat and maintains a temperature of 58°C/136°F until all the material has changed from solid to liquid state. Temperature-sensitive labels on the heatsinks provide indication of the maximum temperature experienced by the data logger, and a warning if the temperature exceeds 77°C/171°F.

The ceramic insulation material will absorb moisture if stored in a damp environment. Although this will not damage the thermal barrier, its performance will be degraded until the moisture is removed.

Food Tracker Barrier Types

Key features of Food Tracker barriers are:

- Heatsink(s) (in long-process barriers).
- Hydrophobic Microtherm insulation.

- Silicone lid seal, providing water resistance yet quick and easy logger access.
- Strong catches.
- Carrying handle.

Thermal durations quoted are based on the barrier being in still air, and will vary depending on the actual environment, i.e. temperature, pressure and moisture levels, and conditions of high air velocity, steam or immersion in liquid. In general, more moisture-rich environments increase the rate at which heat is transferred to the barrier and thus reduce the permissible durations. Please consult Datapaq.

Food Tracker thermal barriers: non-submersible TB5009 (right) and submersible TB5815 (below).

TB5009, TB5010 and TB5011 (below) are standard universal barriers with IP65 rating (resistant to a jet of water), designed for use with any application where full submersion is not required. They withstand water showers and steam.

Additional features:

- Water-resistant probe exit.
- Barrier-lid splash guard to further protect probe exit.
- Attachment point for hanging hook (part no. TB9800) to hang barrier/logger from oven rack, etc.

For secure travel on inclined mesh conveyor belts or in oil baths, use barrier tray (part no. TB9772) with drive pins to engage in mesh.

TB5009 Non-submersible – short bake/roast processes

Temp °C	−100	100	150	200	250
Temp °F	−148	212	302	392	482
Duration (hours)	1.5	3.0	1.75	1.25	1.0
Dimensions	Height 60 mm 2.4 in.	Width 203 mm 8.0 in.	Length 389 mm 15.3 in.	Weight 3.95 kg 8.7 lb	
Heatsink	None				

TB5010 Non-submersible – long bake/roast processes

Temp °C	−100	100	150	200	250
Temp °F	−148	212	302	392	482
Duration (hours)	–	10.0	5.5	3.75	2.5
Dimensions	Height 100 mm 3.9 in.	Width 214 mm 8.0 in.	Length 385 mm 15.2 in.	Weight 6.39 kg 14.1 lb	
Heatsink	TB1001				

TB5011 Non-submersible – freezing and short bake/roast processes

Temp °C	−100	100	150	200	250
Temp °F	−148	212	302	392	482
Duration (mins)	–	150	60	40	35
Dimensions	Height 40 mm 1.6 in.	Width 193 mm 7.6 in.	Length 376 mm 14.8 in.	Weight 3.2 kg 7.1 lb	
Heatsink	None				

TB5016, TB5815, TB5816, TB5817 and TB5821 (below) are barriers with IP67 rating (resistant to submersion).

For secure travel on inclined mesh conveyor belts or in oil baths, attach supplied drive pins to front face of barrier (TB5815 and TB5816 only).

Probe seals for these barriers, for use with different types of thermocouple cable, are color-coded:

TB9760 Black Core probe, short needle probe or fine-wire glass-fiber probe

TB9712 White Standard needle probe, heavy-duty glass-fiber probe, heavy-duty PTFE probe or TX2040 transmitting antenna

TB9714 Blue Blank seal (no probe)

The more severe conditions of chilling by shower or submersion in water or brine immediately after cooking require more robust probe seals and mineral-insulated probes. In this case use MI adaptor kit PA0960 (one kit per probe); see p. 45.

TB5016 Submersible – heavy-duty waterproof (ham cook/chill processes)

Temp °C	100	150	200	250	300
Temp °F	212	302	392	482	572
Duration (hours) **Air**	17	8	5	4	3
Dimensions	Height 120 mm 4.7 in.	Width 206 mm 8.1 in.	Length 401 mm 15.8 in.	Weight 6.3 kg 13.9 lb	
Heatsink	TB1001 × 2				
Thermocouple Finger Screw	TB9763				

TB5815 Submersible, low-height – short fry/steam processes

Temp °C	−100	100	150	200	250
Temp °F	−148	212	302	392	482
Duration (mins) **Air** **Water/Oil**	37 –	120 60	60 30	45 22	40 20
Dimensions	Height 40 mm 1.6 in.	Width 174 mm 6.9 in.	Length 394 mm 15.5 in.	Weight 3.01 kg 6.6 lb	
Heatsink	None				
Conveyor Drive Pin	TB9704A × 2 (optional)				
Thermocouple Finger Screw	TB9763				

TB5816 Submersible – long fry/steam processes

Temp °C	−100	100	150	200	250
Temp °F	−148	212	302	392	482
Duration (hours) Air Water/Oil	 – –	 6.5 3	 3.5 1.5	 2.5 1	 1.75 0.75
Dimensions	Height 65 mm 2.6 in.	Width 238 mm 9.4 in.	Length 380 mm 15.0 in.	Weight 5.66 kg 12.5 lb	
Heatsink	TB9707 × 2				
Conveyor Drive Pin	TB9704A × 2 (optional)				
Thermocouple Finger Screw	TB9763				

TB5817 Submersible and pressure-cook processes

Temp °C	−100	100	150	200	250
Temp °F	−148	212	302	392	482
Duration (hours) Air	 –	 14	 7.5	 4.5	 3.5
Pressure	2 bar/29 psi				
Dimensions	Height 105 mm 4.1 in.	Width 150 mm 5.9 in.	Length 360 mm 14.2 in.	Weight 6.3 kg 13.9 lb	
Heatsink	TB1001 × 2				
Thermocouple Finger Screw	TB9763 – or barrier can be supplied with face-plate with compression fittings for retort applications up to 2 bar				

TB5821 Submersible, low-height – short fry/steam processes

Front-loaded. Supplied with different face-plate plus logger-tray according to use: 6-channel, 8-channel, or 8-channel plus RF antenna.

Temp °C	−100	100	150	200	250
Temp °F	−148	212	302	392	482
Duration (mins) **Air**	–	120	60	45	30
Dimensions	Height 40 mm 1.6 in.	Width 140 mm 5.5 in.	Length 318 mm 12.5 in.	Weight 2.5 kg 5.5 lb	
Heatsink	None				
Accessories	Finger screw, small – TB9569A56 Spanner – TB9569A51 O-ring – SC1220A				

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

Other Barrier Types

A wide range of thermal barrier types is available from Datapaq for use with loggers other than the MultiPaq21.

Thermocouple Probes

Thermocouple probes utilize the Seebeck effect, discovered in the nineteenth century, by which an e.m.f. is produced in any electrically conducting material that is not at uniform temperature. The actual voltage measured is proportional to the temperature difference between the thermocouple's 'hot' and 'cold' junctions (the hot junction being the measurement junction, and the cold junction being the junction of thermocouple and measurement instrumentation).

The practical implementation of thermocouples requires sophisticated electronics to eliminate potential measurement errors which include poor linearity over the measurement range, and inaccuracy due to temperature variations at the cold junction. To accommodate these the electronics in the measuring system must simulate a temperature of 0°C at the cold junction, as well as compensating for any non-linearity over the range of thermocouple operation.

Over the years, 'standard' thermocouples have been developed using materials chosen for sensitivity, linearity (consistency of sensitivity over the useful temperature range), price and availability. Current standards include types K, N,

R, S and T, each type being identified by its connector color. The standard thermocouple probe for food industry use is type T, although in some circumstances type K probes are used.

Thermocouple Specifications

Probe Type	Cable Insulation	Accuracy	Standard
T	Mineral insulation or PTFE	±0.5°C/0.9°F or ±0.4% at -40 to 350°C/-40 to 662°F	BS EN 60584.1 Class 1
K	Mineral insulation or PTFE	±1.1°C/2.0°F or ±0.4% at 0–1,250°C/32–2,282°F	ANSI MC 96.1 Special Limits of Error

Thermocouple Cables

The practical operating temperature of the thermocouple probes is limited by the cable insulation material's temperature characteristics.

Insulation	Upper Temperature Limit
Mineral insulation (MI)	800°C/1,472°F
PTFE	260°C/500°F

Mineral-insulated (MI) probes have an enclosed junction providing protection against carbon and other aggressive atmospheres, and increased immunity to electrical interference. The MI needle probes supplied by Datapaq have a sheath of 316 stainless steel which provides superior protection at high temperature. Mineral insulation can be used when probe cables may be in close proximity to heating elements.

PTFE (polytetrafluoroethylene)-insulated probes are suitable for general-purpose use at temperatures up to 260°C/500°F. PTFE is a robust, flexible, non-stick material. This is the standard insulation for oven use, though it cannot be used when probe cables may be close to heating elements, especially infra-red types.

WARNING

PTFE does not support combustion, but decomposes above 265°C producing small amounts of toxic fumes.

The important products from PTFE thermal decomposition are:

At Temperatures Greater Than	Product
400°C/752°F	See note*
430°C/806°F	Tetrafluoroethylene
440°C/824°F	Hexafluoropropylene
475°C/887°F	Perfluoroisobutylene
500°C/932°F	Carbonyl fluoride*, which, in moist air, converts to the acid gas hydrogen fluoride

* May also be produced if PTFE tape is kept at 400°C/752°F for an extended time.

Health Hazard Data

- Inhalation of decomposition products from PTFE can produce 'polymer fume fever', which has symptoms similar to influenza.
- There is no risk from ingestion or skin contact.
- There are no medical conditions generally aggravated by exposure to PTFE.

Emergency and First-aid Procedures

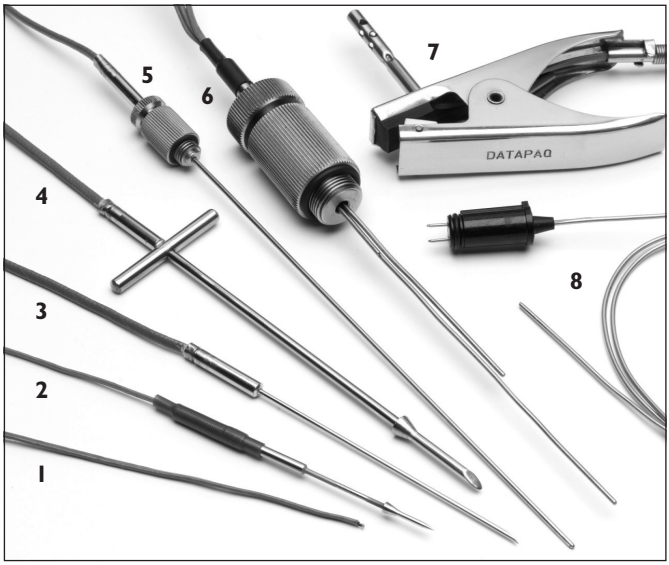
- If there is accidental contact with PTFE fumes, remove the person concerned to clean air.
- Self-contained breathing apparatus and protective clothing should be worn when fire-fighting.

Thermocouple Probes for Food Applications

Type T thermocouple probes having a hot junction combining copper and constantan are the standard probes for use in the food industry. In some cases, type K (combining nickel–chromium alloy and nickel–aluminum alloy) are preferred.

Thermocouples are supplied with water-tight, O-ring-sealed connectors to provide IP67 rating for the logger and to guarantee reliability and accuracy in the most hostile of environments (steam, water, condensation, etc.). Cable lengths can be customized to match the exact requirements of a given process.

Probes are available for the MultiPaq21 logger in a variety of types, as shown below.



1: ***Food Core Probe*** *– PTFE cable with exposed temperature sensor. Used for environmental monitoring or insertion into products in semi-solid/liquid state prior to cooking, e.g. bakery.*

2: ***Short Needle Probe*** *– PTFE cable with insertion probe. Needle length 40 mm (1.6 in.), diameter 1.6 mm (1/16 in.), with location barb to prevent probe movement. Used to measure internal product temperatures for small to medium-sized products or surface temperatures for large products.*

3: ***Standard Needle*** *– PTFE cable with insertion probe. Needle length 90 mm (3.5 in.), diameter 1.6 mm (1/16 in.). Used to measure internal product temperatures for medium to large products.*

4: ***Heavy Duty Probe*** *– PTFE cable with insertion probe. Needle length 125 mm (5 in.), diameter 3.2 mm (1/8 in.), with location barb to prevent probe movement and handle to aid insertion. Used to measure internal product temperatures for large products – typically meat – where probe insertion may be difficult.*

5,6: ***Food Can/Bottle Probe*** *– PTFE cable with long, round-ended needle. Needle length 200 mm (8 in.), diameter 1.6 mm (1/16 in.). Used in combination with can adaptor to measure internal product temperature of sealed can/bottle in pasteurization or sterilization processes. Adaptor is screwed into hole drilled into bottle cap or can top.*

7: ***Air Clip Probe*** *– PTFE cable with air-temperature sensor mounted on clip attachment. Used for environmental monitoring of an oven; fitted to rack or tray used to transport the product.*

8: ***Mineral-insulated Needle Probe*** *– High-temperature probe: ambient or product temperature exceeding 265°C/509°F.*

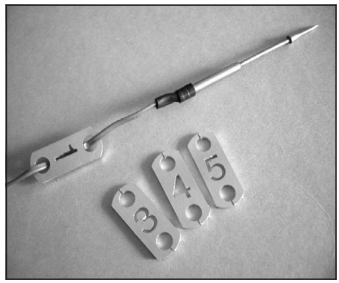
Probe Part Numbers and Compatibility

	Type T	Type K	Barrier Compatibility
MI Needle Probe	PA150x	PA151x	All
Standard Needle Probe	PA146x	PA147x	All
Short Needle Probe	PA144x	PA145x	All
Heavy Duty Probe	PA142x	PA143x	Not TB5817, TB5815, TB5816, TB5821
Air Clip Probe	PA154x	PA155x	Not TB5817, TB5815, TB5816, TB5821
Food Core Probe	PA148x	PA149x	All
Food Can/Bottle Probe	PA152x	PA153x	All
Food Can/Bottle Adaptor	PA0620	PA0620	–

Cable length is shown by last digit (x) of part number: 0 = 0.3 m, 2 = 0.6 m, 3 = 1.0 m, 5 = 2.0 m.

Probe Identity Tags

A bag of eight metal tags to be threaded onto probe cable to allow easy channel identification during product probing (part no. PA2014).



Probe identity tags.

Care of Thermocouples

When **coiling** thermocouple cables for storage, ensure the diameter of the coil is not less than 40 cm (16 in.).

Examine the cables after each profile run, and replace any found to have **damaged insulation**.

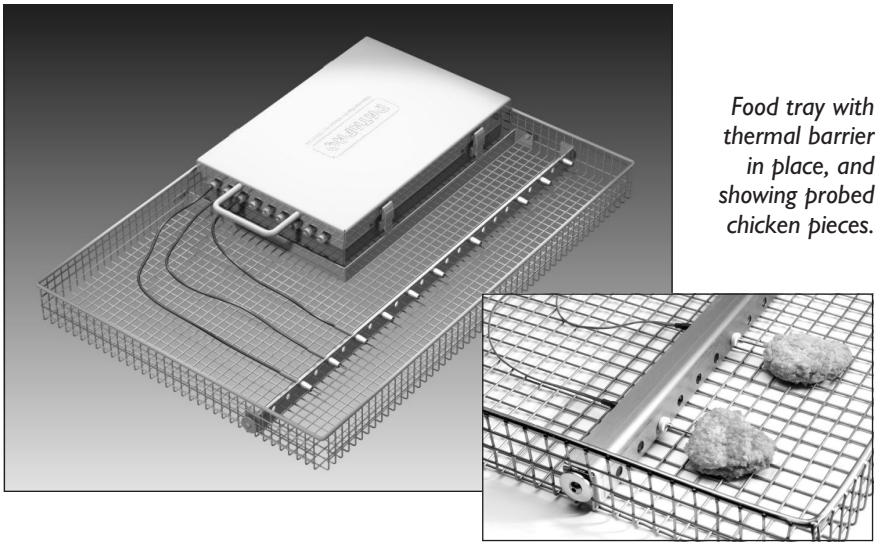
The thermal cycling which the probes experience causes **mineral-insulated cable** to age, and eventually to become brittle. Handle mineral-insulated probes with care, and ensure the minimum bend radius is greater than 25 mm/1 in.

Food Tray

Food Tracker food trays are designed for use in conveyorized processes to ensure repeatability/accuracy of process monitoring without any need to stop the conveyor line or otherwise disturb production. The tray – containing logger/barrier, fixed probes and products already in place – can be positioned quickly and efficiently so that probed products lie uniformly across the mesh belt with a guarantee that the probes remain secure in the product and safe from any risk of probe cables catching. Hot and cold spots in the oven are thus easily identified. The procedure is ideal for small, low-height products (chicken

nuggets, fillets and portions, and beef patties), especially where frequent profiles are required. See p. 39 for use of the food tray.

Part numbers	CS3043A – for use with barrier TB5815 CS3044A – for use with barriers TB5816, TB5009, TB5011
Tray weight	1.45 kg/3.2 lbs
Width	600 mm/24 inches
Depth	407 mm/16 inches
Height, min.	51 mm/2 inches (or barrier height if greater)



Food tray with thermal barrier in place, and showing probed chicken pieces.

Thermocouple Jig

The jig (part no. CS3045) is designed to assist thermocouple positioning across wide conveyor belts used in bake-type processes, making both oven-balancing (via air temperatures) and product-monitoring easy and repeatable. The width of the arm can be easily adjusted, as can the exact lateral position and height of the probes. See p. 39 for use of the thermocouple jig.

Width, max.	2,300 mm/7.5 ft (three bolted sections mounted on three feet).
Width, min.	1,000 mm/3.3 ft (one section mounted on two feet).
Weight, max.	1.6 kg/3.52 lb
Height	Standard minimum oven clearance 50 mm/2 in. (lower heights possible to order).
Standard max. operating temp.	265°C/509°F

Carrying Cases

A soft, lightweight case (part no. CC0048) is available for transporting the logger and accessories (excluding barriers).

Running a Temperature Profile

This chapter describes all the stages of setting up for a temperature profile – from preparing the data logger and thermal barrier, to how and where to place the probes and installing the complete system in the oven. (To run a profile using **hardwired telemetry**, see p. 51.)

SAFETY

Discuss the application of the Tracker system with your Health and Safety officer.
Wear appropriate protective clothing.
The Tracker components will be hot after the test run, so handle with care.
If appropriate, use lifting equipment when loading and recovering the system.

Setting Up

The insulation in your thermal barrier may have absorbed moisture during the manufacturing process. Thus, before using the barrier for the first time, run it (sealed and containing heatsinks if supplied, but excluding the data logger) once through your process to remove the moisture.

Setting the system up for a test requires a definition of the oven's normal operating characteristics. These include:

- Line speed.
- Number of oven zones.
- Maximum temperature of each zone.
- Number, location and method of attachment of thermocouple probes.
- Temperature profile which the thermal barrier is expected to experience.
- Oven height and width restrictions.

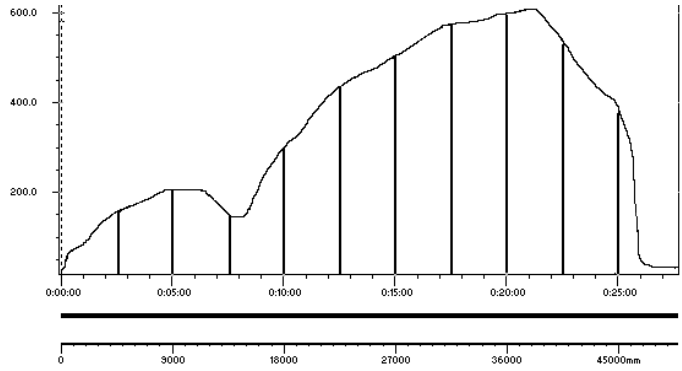
Selecting the Thermal Barrier

In addition to protecting the data logger from the process's extremes of temperature, the thermal barrier may also be required to protect it from moisture. These aspects must therefore both be considered – as well as the process's duration – when selecting the barrier.

The process's average temperature can be calculated as follows.

Dry Environments

1. Plot a graph of the temperature versus time characteristics of the process.
2. Divide the horizontal axis into 10 equal increments and draw verticals. Read the temperature at each vertical.



A typical temperature profile. The average temperature is 350°C.

3. Divide the sum of the temperatures by 10 to calculate the average temperature. Modify this temperature as follows:
4. Add 15% if the maximum temperature is reached in the first third of the process.
5. Add 10% if the maximum temperature is reached in the first half of the process.
6. Taking into account the process height and width restrictions, select a barrier meeting or exceeding this temperature/time profile (see p. 22).

Wet Environments

WARNING

The rate heat is absorbed into the thermal barrier is significantly influenced by the moisture in the process atmosphere.

For wet process environments, calculate the average temperature using steps 1 to 5 above, and then contact Datapaq for advice.

Thermal Barrier Location

During the process, the barrier should if possible be positioned away from the probes or from the product being measured. Where necessary, position at the top level of a rack to avoid dirt, fat, etc., falling on it.

Probe Selection and Placement

Probe Selection

Selection of thermocouple type and insulation (see p. 27 for the range available) is based on the product and the process environment. Product size is a prime consideration. In general, suitability is as follows:

Needle probes – Large meat products, vacuum packed products, canned and bottled products, bread and cakes.

Core temperature probes – Smaller meat products (e.g. chicken parts), fish and all frying processes, small cakes, soft or liquid products, environmental monitoring.

Thermocouples generally suitable for food industry applications are type T or type K; see p. 28 for temperature range and accuracy. For processes below 0°C/32°F (down to −40°C/−40°F), type T probes should be used.

The cable insulation material limits the actual operating temperature. Maximum temperatures are:

Mineral insulation	800°C/1,472°F
PTFE	265°C/509°F

Measurement Type

Measurements will be made of air temperature, product core temperature and/or surface temperature.

An array of air probes providing a view of temperature distribution across the oven enables adjustment of heaters and/or baffles. Measurements in the core or on the surface of the product characterize heat absorption from the air by determining the actual temperature/time profile to which the product is subjected. A combination of air and surface probes enables the rate of heat absorption to be determined, and thus permits adjustments to optimize thermal efficiency and product quality.

Probe Placement

For a reliable, repeatable and comparable assessment of thermal performance it is essential that measurements are made in the same location, using the same type of probe attached in the same way to the same type of product. In some cases it is advisable to use a test fixture to ensure absolute repeatability. Note also the following points essential to accurate and repeatable measurements:

- Probes must be attached and restrained to ensure they remain securely placed in the product throughout the cooking process. The Datapaq food tray and thermocouple jig (see below) are designed to facilitate this.

- Probe needles should be inserted to such a depth that most of the needle lies within the product. This minimizes the effect of heat being conducted along the probe into the product (stem effect).
- Probes should be inserted to the same depth each time.
- Ensure that the probe is positioned exactly as intended within the product. This will normally be at its center; thus take care that the probe tip does not actually reside towards the edge of the product or even stick out of the product and into the air. Note whether or not the probe is intended to be in meat, skin or bone, as each will give different results.
- Probes should be positioned away from the thermal barrier if possible.
- Cables should be kept as short as possible to avoid tangling and catching on the conveyor belt.
- Use of probe identity tags (p. 31) assists in consistent placement.

The probe's location and its method of attachment is dependent on the type of measurement, as follows.

Air Temperature

Choose the probe's location to ensure the measurement is representative of the air temperature the product experiences during the process. In some cases it may be desirable to use an array of air probes attached to a test fixture.

Data acquisition can be triggered at a specified time, on disconnection from the computer or by temperature. When triggering via temperature, the trigger is normally taken from an air probe connected to channel 1 on the data logger.

Core Temperature

Insert a needle or core temperature probe into the center of the product ensuring it is not in contact with any bones. Use an array of probes to confirm that the temperature is consistent across the oven.

Surface Temperature

Use needle or core probes to determine the temperature distribution at the base of the product during cooking, e.g. on the belt or on molds.

*The tip of a thermocouple probe **must** be in good mechanical contact with the product when monitoring surface temperature.*

Use of Food Tray

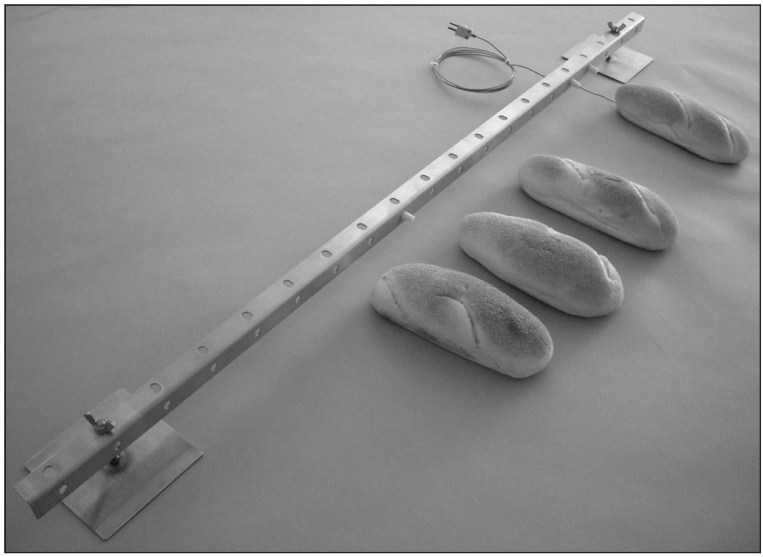
See p. 31 for sepecification.

- Attach thermal-barrier-securing bracket to tray using Allen bolts supplied.
- Using Allen bolts, fix probe-positioning bracket to suit product, i.e. to give appropriate probe height and horizontal or vertical orientation.
- Push probes through rubber bungs in positioning bracket using food-grade lubricant and pliers.

Use of Thermocouple Jig

See p. 32 for sepecification.

- Adjust length of horizontal bracket (in three sections) using Allen bolts supplied.
- Adjust height of bracket using nuts on bracket uprights.
- Push probes through rubber bungs in bracket using food-grade lubricant and pliers. For high-temperature applications, omit rubber bungs and twist mineral-insulated probes around holes in bracket.



Thermocouple jig set up for monitoring bread.

Thermocouples can be damaged during handling, and should be tested after installation as well as during routine use. See p. 62.

Preparing the Data Logger and Thermocouples

The logger should be inspected externally before every profile run, as follows.

- Look for any signs of salt crystals or dirt, particularly in and around the sockets and communications port. Remove carefully with damp tissue or cotton-bud, and dry thoroughly.
- Inspect thermocouple cables for general wear and tear, especially cuts in the insulation and sharp bends that may indicate a break in the wire.
- Inspect each thermocouple's connector, particularly the silver and copper pins. Wipe clean with a warm damp cloth, and then wipe dry. If any corrosion is seen on either pin (e.g. black oxide on the copper pin), remove carefully with very fine sand paper or by scraping gently with a sharp knife.
- After thermocouple probes are connected to the logger, they should be tested. See p. 62.

Resetting the Data Logger

The data logger needs to be reset, as follows, before it can receive fresh data. (To reset the logger for use with hardwired telemetry, see p. 51.)

The procedure described here uses the Insight software's Logger Reset dialog.

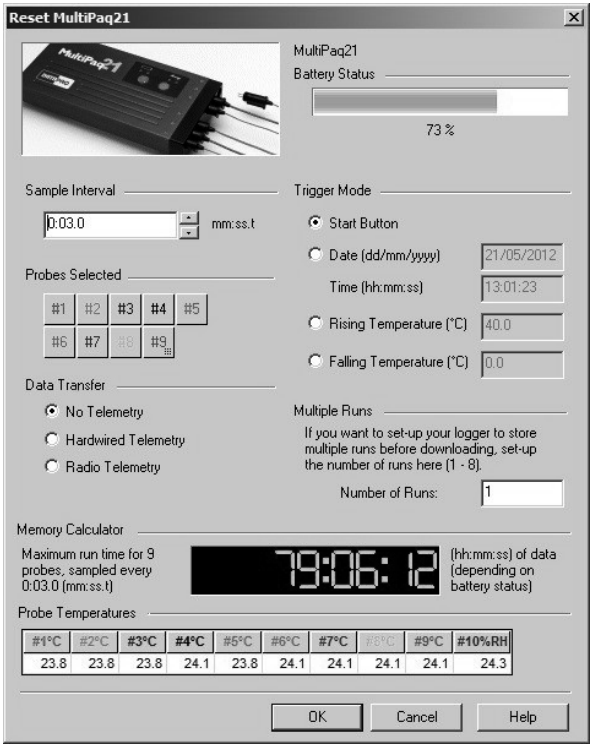
If you are less sure of the process, you can instead use the Logger Reset Wizard to guide you, step-by-step, through this stage of running a profile: click  *on the Insight toolbar, or select Tools > Wizards from the menu.*

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.

1. Use the communications lead supplied to connect the logger to a free COM (serial) port or 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. 14). 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 your temperature regime – but the total recording time available to you will be reduced, and the data will take longer to download to the PC after the run. Restrictions apply to the sample intervals allowed, depending on use of the humidity sensor.



The Reset dialog for the MultiPaq21 logger.

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 and the logger memory size are dependent on the logger used. *Probe 1 must always be one of those selected.* The humidity probe (if used) is indicated by #9.

Data Transfer Select 'No Telemetry'. (To reset the logger for use with hardwired telemetry, see p. 51.)

Memory Calculator Calculates the maximum time for which the logger can collect data in each of the specified number of profile runs (see 'Multiple Runs', below), 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. 16).

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 logger's nickel-metal-hydride batteries discharge slowly even when not in use and will need charging if left for more than three weeks. See p. 21.

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.

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. This trigger mode is not available if the number of runs is set to more than one (see below).

Rising Temperature Data-recording starts when the temperature of probe no. 1 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 probe no. 1 reaches the specified value as it is falling.

Multiple Runs Select the number of profile runs (maximum 8) which you wish to perform before downloading the recorded data. The memory calculator (see above) uses this information, together with the sample interval and the number of probes selected, to work out the maximum duration of each run. *It is not necessary to carry out the full specified number of runs before downloading data from the logger. The recorded data can be downloaded at any time after the first run has been carried out – but the logger must then be reset before further runs can be performed.* The date/time trigger mode (see above) is not available for multiple runs.

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. Replace the dust-cap on the communications port.

Installing the Logger in the Thermal Barrier

For correct selection of a suitable barrier, see p. 22.

Allow for the time taken to recover the Tracker system after the test when calculating the thermal performance requirement for the thermal barrier.

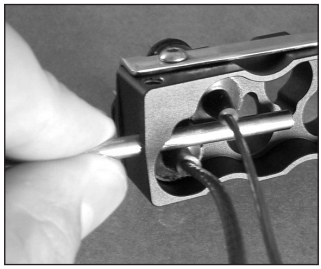
Before proceeding, ensure the thermal barrier has cooled sufficiently since its last use.

1. Plug the thermocouples into the logger's numbered sockets.

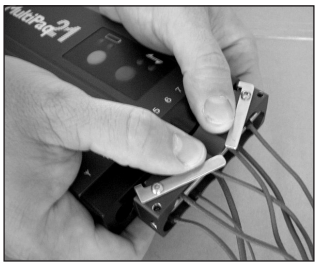
   If any socket – including the humidity-sensor socket – is unused, insert a blanking plug (see p. 19) to guarantee waterproofing.

   If you are using a process file, ensure that the probe/socket numbers on the logger correspond to those used to define probe numbers and locations in that file (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'). Ensure that each probe connector is pushed home completely and all that connectors protrude the same amount from the face of the logger. *For use of a submersible barrier, see below.*
2. Ensure the barrier's mating surfaces are clean and undamaged. A good seal between thermal barrier and thermocouple cables is essential if the data logger is to be protected. Put the logger in place in the barrier – within the heatsink(s) if used – laying the thermocouple cables across the sealing material to exit the barrier at the cutout, and ensuring that they lay side by side and not crossing each other. *For use of a submersible barrier, see below.*
3. If the trigger mode is Start Button, press and hold the start button for about 1 second until the green LED starts to flash at the sample interval.
4. Close the lid ensuring a good seal around the thermocouple cables.
5. Place logger/barrier onto conveyor belt or rack; conveyor should be stopped first if possible.
6. Insert probes into product or oven at required locations (see p. 37).

Use of Thermcouple Plug Shroud



1. Insert thermocouple plugs (and blanking plugs if used) into appropriate positions in shroud.
2. Slide retaining rod through length of shroud to fix plugs in place within shroud. Lock rod with Allen key.
3. With all plugs in place in shroud, align against logger and press firmly into place. If shroud is difficult to install, use a small amount of food-grade lubrication plug O-rings.

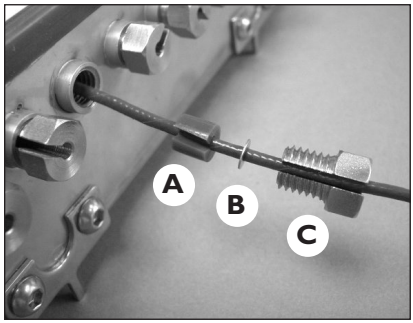


Remove shroud unit from logger by first pushing gently on its ejection levers, and then pull carefully on shroud. Plugs can be left in place in the shroud for easy and rapid re-fitting to the logger on subsequent runs.

Installation in Submersible Barrier

Ensure watertight fit of a thermocouple cable in a submersible barrier's probe port as follows.

1. Feed probe and cable through appropriate probe port of barrier, from the inside; for long needle probe, lift sealing material out of the way temporarily to allow probe to be pushed through.
2. Fit correct type of probe seal (**A** – see p. 24) and finger screw (**C**) onto cable, positioning washer (**B**) between them; use blank seal (blue) and finger screw for ports in which no probe is used. Fit new seals every time the barrier is used.
3. Insert seal into probe port and engage finger screw.
4. Use box spanner SC1157 to tighten finger screw fully home.



To replace a probe, remove existing probe seal by pushing it out of position with an Allen key.

For barriers with a **separate face-plate**, note also the following.

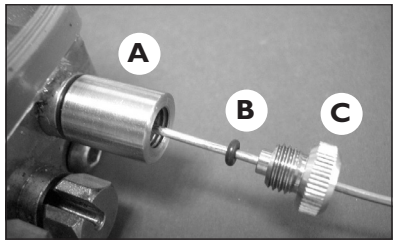
- Both heatsinks are inserted into the barrier before the logger.

- To aid insertion and removal of the logger, a length of adhesive tape can be attached to the logger to act as a simple handle.
- When lowering the logger into the cavity of the barrier, make sure that no thermocouples pull out of their sockets. The length of thermocouple cable between the logger and face-plate should be sufficient to provide some slack when the logger is fully inside the barrier.
- When locating the face-plate over the threaded studs on the barrier's body, ensure that no cables are trapped. Finger-tighten all four screws evenly, finishing with long-nosed pliers. Make sure the gap (which will be *very* small) between the body of the barrier and the face-plate is uniform.

Water/Brine Chill Applications

The more severe conditions of chilling by shower or submersion in water or brine immediately after cooking require more robust probe seals and mineral-insulated probes. In this case use MI adaptor kit PA0960 (one kit per probe), as follows.

1. Attach TB9866 socket body (**A**) to the appropriate port using a large O-ring seal SC1089 between barrier and socket; tighten with long-nose pliers.
2. Feed probe through port from inside.
3. Slide small O-ring SC1090 (**B**) and then clamp nut PA1100 (**C**) onto probe; finger-tighten the nut.



For ports in which no probe is used, use blank socket body PA0961 (with a large O-ring).

Placing the System in the Oven

SAFETY

Discuss the application of the Tracker system with your Health and Safety officer.
Wear appropriate protective clothing.
The Tracker components will be hot after the test run, so handle with care.

Confirm that the minimum height and width through the process is adequate for the Tracker system.

Do not lift the data logger by the thermocouple cables. This will damage the cables and connectors.

Load the product so that it enters the oven before the thermal barrier and logger.

If convenient, use a hanging hook (part no. TB9800) to hang the barrier from the oven rack, etc. If subject to an environment of high-pressure water showers, use a hanging hook to locate the barrier with its probe exit away from the direct water flow.

Where conveyors run on an incline, use a barrier tray (TB9772) or drive pins (TB9704) to secure the barrier.

Checking the Clearance

Check the minimum height and width through the process to ensure the clearance for the system and thermocouple probes is adequate. If necessary, secure the thermocouple cables using high-temperature tape ensuring they do not get too close to heating elements.

Recovering the System

After the run is complete, check that all probes are still in position. While still hot, clean the thermal barrier with a water jet or by wiping; cleaning is easier if done before the barrier cools. Avoid directing water into the thermocouple exits of non-submersible barriers

Recover the system as soon as the test is over, and, if possible, take the system to a dry area before opening the barrier. Remove the heatsinks (where appropriate) and data logger from the thermal barrier as soon as it is safe to do so.

Failure to remove the logger from the hot barrier/heatsink could damage it.

If data acquisition has to be stopped manually, press and hold the logger's red stop button until the red and green status LEDs are on simultaneously.
A flashing red LED indicates data stored in the logger but not yet downloaded to the PC.

If the logger has been set to perform **multiple runs**, the red and green LEDs both do repeated double flashes after the stop button is pressed. Data acquisition for the next run is then started by pressing the start button.

Disconnect the probes – and antenna, if used – from the logger. Place all probes and antenna in a dry place for storage.

If the process involves brine, be sure to keep thermocouple connectors away from any residual liquid that may be on the barrier or in the working area. Salt on the connectors will cause the thermocouples to fail in a very short time.

Allow the barrier (with lid open), heatsinks and logger to cool to ambient temperature before further use; cooling overnight is usually sufficient.

An additional barrier should be purchased if insufficient time is available to allow the barrier to cool between test runs.

Examination of Thermal Barriers and Heatsinks

Once cool, examine the thermal barrier and heatsinks for damage or corrosion. Remove any dirt or salt crystals with a damp cloth, and dry the barrier inside with a dry cloth.

Following any evidence of moisture in the barrier (including, for barriers with a separate face-plate, dampness in the yellow fibrous insulation on the rear of the plate), place in a dry oven at 100°C/200°F for at least 2 hours. Allow to cool to room temperature before next use.

Examine the heatsinks' thermometer strip: if the temperature has exceeded 77°C/171°F, or if there is any dark discoloration on the strip, allow the heatsinks to cool to room temperature (around 15°C/60°F) before placing in a freezer at −20°C/−5°F to cool overnight; this ensures the phase-change material crystallizes. After freezing, allow the heatsinks to return to room temperature and, before further use, replace the thermometer-strip with a new self-adhesive one as supplied.

Contact Datapaq if the heatsink phase-change material leaks. It is a non-toxic wax-like substance that dries hard powdery white and has a slight acidic smell. Wait until it is dry before scraping off any material that has leaked onto the surface of the barrier.

Store the cooled thermal barrier and heatsinks in a dry environment to prevent the insulation from absorbing water.

Check the thermal barrier's seals and closing mechanism, and rectify any damage before further use. Some sealing catches are designed to be set easily by hand, and may require some adjustment after the first four or five runs.

Downloading Data

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.

1. Connect the logger to the PC with the communications lead. 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.
2. 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. For an explanation of any error messages generated during this process, see p. 61.

   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. Contact Datapaq for advice. 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.

3. The Select Process dialog then appears in order that you may choose a process file to apply to the results. If the process file and its components have been given names, these are shown when the process file is selected. Click No Process if you do not want to apply a process file.

   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.

4. The newly downloaded data then appears on screen and can be displayed (numerically and graphically), analyzed and printed as you wish; see Insight's online Help system. Save the data as a 'paqfile' (select File > Save or Save As).

You can set alarms to be triggered during a logger download, to warn you of incomplete data recorded during the profile run (from the menu bar, select Tools > Options > Run Alarms).

Specifying Oven Start

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

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

Completing the Documentation

On the menu bar, select Edit > Notes to enter the operator's name and any **additional information** you may wish to record about the profile run. This will be saved with the paqfile and will also appear in your **printed report** (select File > Print Options).

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).

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** is possible with Insight software when used with an intermittent or periodic oven (a batch process).

Thus, with thermocouples trailing from the oven 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.

As an alternative to hardwired telemetry, and for continuous processes where the logger must travel through the oven, the optional Datapaq TM21 radio-telemetry system is available.

For processes requiring more than the eight data channels available with a single MultiPaq21 logger, Insight has the capability to gather and analyze data by hardwired telemetry from up to three loggers simultaneously (see p. 54).

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.

Running a profile in real time is performed in essentially the same way as a normal (non-telemetry) run (see p. 35), 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.
- 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. 40), 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 oven 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 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 (p. 48).*

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 curves** or other paqfiles on the graph to compare with the data as it is being received (select View > Overlay).

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

You may adjust the **oven start** position while a real-time run is in progress (select Process > Adjust Oven 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 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. 48), 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 MultiPaq21 loggers can be used simultaneously.

Use the **Logger Reset Wizard** to guide you step-by-step through the whole process of multiple resets (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.

Humidity Measurements

The MultiPaq21 data logger makes it possible to complement temperature measurement data with in-process humidity measurements. This is ideal for baking applications such as proving/proofing, and will also be of interest in general food processing where the humidity measurements can be used to validate oven control and to optimize yields and product quality.

Humidity measurement is done with a capacitive humidity sensor, which reads relative humidity (%RH) and temperature, and provides the means to measure moisture levels in processes up to 200°C/390°F.

Humidity sensor positioned in a thermal barrier's mounting bracket. The sensor cap with PTFE filter is fitted.

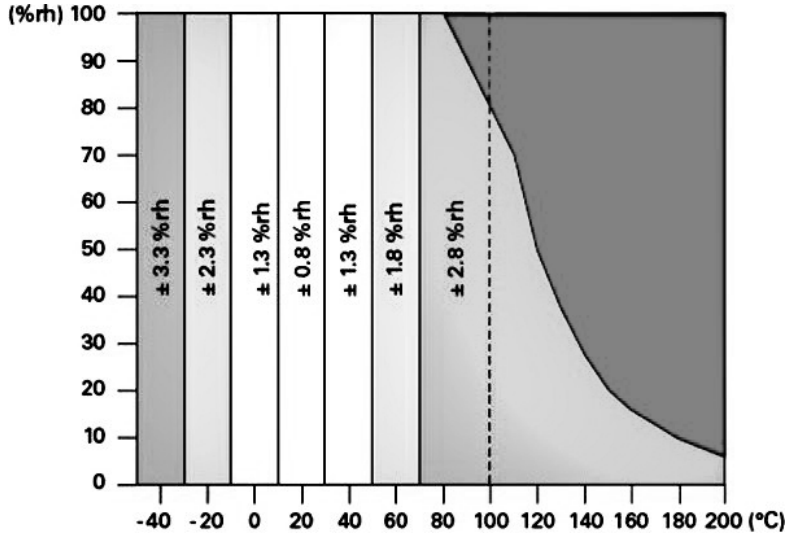
Humidity Sensor Specifications

Rotronic humidity sensor	HygroClip2
Humidity sensor type	Capacitive
Temperature sensor type	Pt100 1/3 Class B
Sensor parameters	Provides humidity and temperature environmental data
Environmental operating conditions	Non-condensing
Capacity	200 pF ±40 pF
Humidity range	0–100%RH

Temperature operating range	
Sensor head	−100 to 200°C/−148°F to 393°F
Sensor electronics	−50 to 85°C/−58°F to 185°F
Humidity units (sensor)	Standard: relative humidity (%RH)
Humidity units (software)	Relative humidity (%RH) Moisture by volume (%Mv) Parts per million (ppm) Dew-point temperature (°C or °F)
Accuracy at 23°C/73°F	±0.8%RH, ±0.1°K
Response time	t63 – <15 s without filter
Logger compatibility	MultiPaq21 – DP2182A, DP2186A

Sensor Accuracy

Although the sensor operates up to 200°C/392°F, the ability to measure moisture content accurately at high temperatures is restricted by the decreasing theoretical %RH values above 100°C/212°F, as shown in the diagram below.



Sensor accuracy at different levels of relative humidity (%RH) and temperature.

Sensor Cap

The humidity sensor is supplied as standard with a metal cap (part no. PA20041) fitted with a removable PTFE filter (PA2041). The sensor filter is provided to protect the sensor but may affect its responsiveness during measurements; thus, if responsiveness is important, the cap without a filter should be used. However, if there is any risk of contamination of the sensor from by-products of the cook process, the PTFE filter should be used. The filter may need to be cleaned and dried regularly; an ultrasonic bath is ideal for this. If the filter becomes excessively dirty it should be replaced.

Components of the humidity sensor cap (PA20041), showing the PTFE filter (left, PA2041) and its fixing screw.

Humidity Sensor in Use

Humidity measurement is not possible in processes where the sensor may be submerged or subject to water showers, etc.

When resetting the logger (see p. 40), note that the humidity sensor is on channel 9. As it records both humidity and temperature, the resultant paqfile will have two sets of data for this single sensor: temperatures measured by the humidity sensor will appear as channel 9, and humidity measurements as channel 10.

Connection and Positioning

Connect the humidity sensor to the logger as follows.

1. Engage the male connector of the humidity connecting cable (PA2030) and the female connector on the humidity-sensor cable (PA2020), and lock together using the threaded connector.
2. On the logger, remove the blanking plug from humidity sensor socket (marked '%RH') and insert the connection cable's plug into the socket.

The humidity sensor can be used only with non-submersible thermal barriers TB5009, TB5010 and TB5011 (see p. 22). The electronics in the sensor should be maintained below 85°C/185°F and are thus carried within the barrier in the humidity probe retainer alongside the logger.

The humidity sensor connection cable, in two sections.

Sensor electronics in position in the thermal barrier's humidity-probe retainer.

The barriers are provided with an external mounting bracket for positioning the sensor, screwed to the barrier-lid splash guard (see photograph p. 55).

When fitting the sensor, ensure that all cables are carefully located through the barrier's probe-exit slot so that they are not trapped under the barrier lid.

Conditioning the Humidity Sensor

If the humidity sensor is moved quickly into a hot, moist oven environment, it is possible for condensation to form on the sensor, resulting in the sensor incorrectly recording 100%RH.

Datapaq's humidity sensor conditioner solves this problem by heating up the sensor prior to insertion in the oven. This reduces the difference between sensor temperature and oven temperature, thus minimizing condensation.

Before using the humidity sensor conditioner, refer to the user documentation supplied with the unit.

To ensure minimum time for the humidity sensor to cool before it enters the oven, it should be heated in the conditioner immediately before the start of the profile run. The sensor should thus be placed in the conditioner's heating chamber with the logger fully assembled in the thermal barrier and the sensor in place in the barrier's mounting bracket. After conditioning, the whole assembly can then simply be picked up and placed on the conveyor or product shelf.

The **display panel** shows the heater's current temperature, factory-set to °C or °F. Press and hold the ✱ button to toggle the display between the temperature units and the heater's target temperature.

Humidity sensor conditioner, CS3050.

To heat the humidity sensor:

1. Switch on the conditioner. It will perform a self-test, then display the current heater temperature.
2. To set the heater's target temperature, hold down the ✱ button while pressing ▲ or ▼. To allow for cooling prior to the run, set the target temperature about 20°C/36°F above the oven temperature; the exact amount of the excess will depend on the temperatures involved and the delay before the system can be placed in the oven.
3. If the temperature set is higher than the current temperature, the status indicator will flash, indicating that the conditioner is heating.
4. Insert the humidity sensor into the heating chamber in the conditioner and wait for the display panel to show the target temperature; the status indicator then stops flashing. The conditioner takes about 30 minutes to reach the maximum temperature of 150°C/300°F.
5. When the conditioner reaches target temperature, leave the sensor in the heating chamber for a further 5 minutes. The sensor is now ready for use, and the run should be started as soon as possible.

Note that the conditioner remembers the last target temperature set, so it is necessary to re-set it only if a new temperature is needed.

WARNING

The inside of the conditioner's heating chamber can get very hot. The conditioner should only be used for heating humidity sensors.

Humidity Compensation

One of the inputs to the relative humidity measurement is temperature. In some conditions, temperature measurements recorded by the humidity probe are not as responsive as a thermocouple measuring air temperature – particularly where the PTFE sensor filter is fitted. If this appears to be the case in a given application, more accurate relative and absolute humidity measurements may be obtained by using the air temperature thermocouple instead of the humidity probe's temperature sensor. If this is done, the thermocouple used for humidity measurements must be measuring the air temperature and must be the vicinity of the humidity sensor.

When the run has been performed and the data downloaded to the Insight software, select the Humidity tab in the analysis window and then click  (or select View > Analysis Options); under 'Humidity Temperature', select the thermocouple that was used to measure the air temperature near the humidity sensor.

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. 14) to select the correct port.
- **Battery not charged** – Recharge the battery, ensuring the charging LEDs are illuminated.

Stopping the Logger

If problems make it necessary to stop the logger after data collection has been started, disconnect the communications lead, and press and hold the stop and start buttons simultaneously for 3 s. Data already collected is retained in memory.

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 probes (see p. 62).
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. 40).

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. 21), 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. 40) or the Diagnostic section of the Communications Setup dialog (p. 16); this shows current probe temperatures – *or* . . .
- Set up the system as if to monitor a profile run using hardwired telemetry (see p. 51 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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