Geothermal Energy Studies

Data Logging Solutions

MADGETECH

WE BUILD DATA LOGGERS

Simplifying How the World Measures & Records Data

MadgeTech, Inc. is a global company, based in New England and founded on old-fashioned principles, customer service, quality, and trust. MadgeTech's President, Norman Carlson, started the company in 1996 and charted the growth of the product lines and services while maintaining those solid core principles.

Our Can Do team of engineers and technical staff consistently incorporate new and innovative ideas into our data loggers. In short, we push the envelope, raising the bar in innovation and quality. Our competitors have praised us by adopting many of our ideas as their own. Over time, MadgeTech has become the industry standard in the data logger market.

MadgeTech continuously develops new, cutting-edge products, creating solutions for our customers around the world in industries across the board. Our growing network of distributors has expanded our presence to markets far beyond our home-headquarters in New Hampshire, our products are now sold in over 100 countries around the world.

Our employees are committed to quality and customer satisfaction. Behind the full range of MadgeTech's products and services is the cumulative expertise of experienced engineers, manufacturing and electronic professionals and technicians. Our knowledgeable sales team can offer technical advice to assist in selecting the right product for each application, as well as providing after-sales support.

MadgeTech is dedicated to providing customers with reliable, affordable products, hassle-free ordering, and excellent service, saving customers time and money. It is our goal to earn your trust in meeting your needs and providing innovative solutions. The products and services that bear the MadgeTech name come with quality assurance and the best support in the industry today.

Norman E. Carlson,

Founder & President

Data Logging Solutions for Pressure & Temperature Critical Geothermal Applications

Geothermal energy is an ever expanding industry relying on renewable resources from the earth's core. The process of converting pressurized water into steam requires specific temperature and pressure conditions to be maintained and monitored consistently.

Historically, strip chart recorders have been used in the field to monitor flow rates and pressure levels on wellheads and pipes. These outdated tools require high maintenance and can introduce problems. Paper and ink need frequent replenishing and are unable to withstand being exposed to harsh weather conditions.

Data loggers provide a durable, simple and reliable process for monitoring temperature, pressure and flow rate without the maintenance and data loss risk associated with strip chart recorders. MadgeTech data loggers are rugged enough to survive even the harshest weather conditions and feature long battery lives to allow for long term deployment. With a variety of styles and options available, MadgeTech data loggers offer an ideal solution for monitoring and recording geothermal energy data collection and conversion.

Geothermal Energy Studies

Geothermal Well Testing

Orifice Plate Monitoring

Absolute, Gauge & Differential Pressure Logging

Wellhead Monitoring

High Temperature Logging

Pressure & Temperature Data Loggers

MadgeTech data loggers are an ideal choice for measuring and recording water and steam pressure. Rugged and easy to use in the field, they are available in multiple ranges from 30 PSI to 5000 PSI.

PRTemp1000

Rugged Pressure & Temperature Data Logger

The PRTemp1000 is a pressure and temperature data logger that accurately records data at user programmable reading rates, over long periods of time. The device can be deployed in the field to record data for weeks or even months based on the user selected reading rate. The rugged stainless steel design allows it to be placed in harsh environments which makes it well suited for steam pressure systems. The PRTemp1000 comes standard with a ¼ inch NPT fitting, which allows it to be connected to almost any pressure adapter. The submersible logger is also available in an intrinsically safe option, known as the PRTemp1000IS.

Intrinsically Safe version also available!

PRTemp1000 Pressure Range (PSIA)

Range	0 to 30	0 to 100	0 to 300	0 to 500	0 to 1000	0 to 5000
Resolution	0.002	0.005	0.02	0.05	0.05	0.2

Intrinsically Safe version also available!

PRTrans1000

Rugged Transient Pressure Data Logger

The PRTrans1000 is a transient pressure data logger with a stainless steel enclosure. It is designed to monitor and record transitory pressure drops or spikes within a three day window of time. The device samples constantly at 100 Hz, but only records to memory when the user selectable trigger settings are exceeded, only capturing the transient pressure event. The device also records pre and post trigger pressure data to memory for in depth analysis.

PRTrans1000 Pressure Range (PSIA)

Range	0 to 30	0 to 100	0 to 300	0 to 500	0 to 1000	0 to 5000
Resolution	0.02	0.1	0.2	0.5	1.0	5.0

PRTC210

Process Pressure & Temperature Data Logger

The PRTC210 is a compact pressure and thermocouple temperature data logger with a ⅛ inch NPT fitting. The device accepts one thermocouple input which allows customers to measure process pressure and temperature. In addition, the PRTC210 also measures ambient temperature, allowing for a complete pressure and temperature analysis.

PRTC210 Pressure Range (PSIA)

Range	0 to 30	0 to 100	0 to 300	0 to 500	0 to 1000	0 to 5000
Resolution	0.002	0.005	0.02	0.05	0.05	0.2

Thermocouple Range

Thermocouple	Range (°C)	Resolution	Accuracy
J	-210 °C to +760 °C	0.1 °C	±0.5 °C
K	-270 °C to +1370 °C	0.1 °C	±0.5 °C
T	-270 °C to +400 °C	0.1 °C	±0.5 °C
E	-270 °C to +980 °C	0.1 °C	±0.5 °C
R	-50 °C to +1760 °C	0.5 °C	±2.0 °C
S	-50 °C to +1760 °C	0.5 °C	±2.0 °C
B	+50 °C to +1820 °C	0.5 °C	±2.0 °C
N	-270 °C to +1300 °C	0.1 °C	±0.5 °C

Differential Pressure Data Logger

MadgeTech data loggers are a perfect solution for monitoring and recording orifice plates on geothermal sites. Our differential pressure and temperature data logger was designed specifically for the harsh conditions of geothermal monitoring.

PRTemp1000D

Differential Pressure & Temperature Data Logger

The PRTemp1000D is a rugged, submersible data logger that records ambient temperature and differential pressure. The device is designed to record over long periods of time at the user selected reading rate and has a pressure accuracy of ±.25 % over the Full Scale Range, making the device extremely accurate. The stainless steel enclosure allows it to withstand harsh environments and the flexible cable is equipped with dual ¼ inch NPT connections for easy installation.

The PRTemp1000D is available in four pressure ranges. The pressure range determines the amount of differential pressure the device will measure between the dual ¼ inch NPT connections.

PRTemp1000D Pressure Range (PSIA)

Range	0 to 30	0 to 100	0 to 300	0 to 500
Resolution	0.002	0.005	0.02	0.05

Customer Testimonial

Chevron Geothermal Philippines is installing MadgeTech PRTemp1000 pressure data loggers and PRTemp1000D differential pressure data loggers at remote locations in the MakBan and Tiwi geothermal fields, Philippines to record data from orifice plate installations used to measure hot water and steam flow rates. The MadgeTech units are replacing circular paper chart recorders, from which the differential pressure data must presently be read manually, and are expected to improve the monitoring of changes in flow rates by providing digital data at preset time intervals that can be downloaded directly to an Excel spreadsheet for analysis. The small size of the units also simplifies installation while battery operation, which a service life of over one year, means that it will not be necessary to provide external power sources at the measurement locations.

- Chevron Geothermal Philippines Holding, Inc.

Real-Time Pressure Data Logger

PR2000

Real-Time Pressure Data Logger

The PR2000 is a pressure data logger equipped with an LCD screen. The 8 button key pad and large LCD provide convenient access to current data and recorder setup. Available on-screen data include: statistics (min, max and average), recording status (start, stop and recording rate), and calibration information (data calibrated, date for recalibration). The LCD also displays a graph of the last 100 readings to show data trends.

This rugged, splash-proof (IP65) device has one of the largest memory capacities of any similar data recorder on the market, logging up to 262,143 readings. The non-volatile memory will retain recorded data, even when battery power is lost. The PR2000 is ideal for applications requiring precise displayed pressure readings, such as the real-time monitoring of outdoor geothermal pipelines.

PR2000 Pressure Range (PSIA)

Range	0 to 30	0 to 100	0 to 300	0 to 500	0 to 1000	0 to 5000
Resolution	0.002	0.005	0.02	0.05	0.05	0.2

High Temperature Data Loggers

MadgeTech offers a wide variety of rugged, data loggers to monitor and record high temperatures for geothermal processes. Featuring a one year typical battery life and user replaceable battery, the HiTemp140 is ideal for long deployments and has an IP68 rating, meaning it is completely submersible.

HiTemp140

High Temperature Data Logger

The **HiTemp140** data logger is MadgeTech's solution for precise high temperature monitoring. These data loggers can indefinitely withstand temperatures of up to 140 °C (284 °F) and have an accuracy of ±0.1 °C (0.18 °F). The HiTemp140 features a rigid external RTD probe capable of measuring extended temperatures, up to 260 °C (500 °F). Varied probe lengths are available up to 7 inches.

HiTemp140 shown in vented and flush-top Thermal Shield models.

Thermal Shield

For Extended High Temperature Monitoring

For applications above 140 °C (284 °F), a Thermal Shield is available for most models of the HiTemp140 series data loggers. The Thermal Shield extends the operating temperature of the data logger, allowing it to be exposed to higher temperatures for a longer amount of time. Flush-top and vented models are available to help provide probe protection.

Time vs Temperature Chart

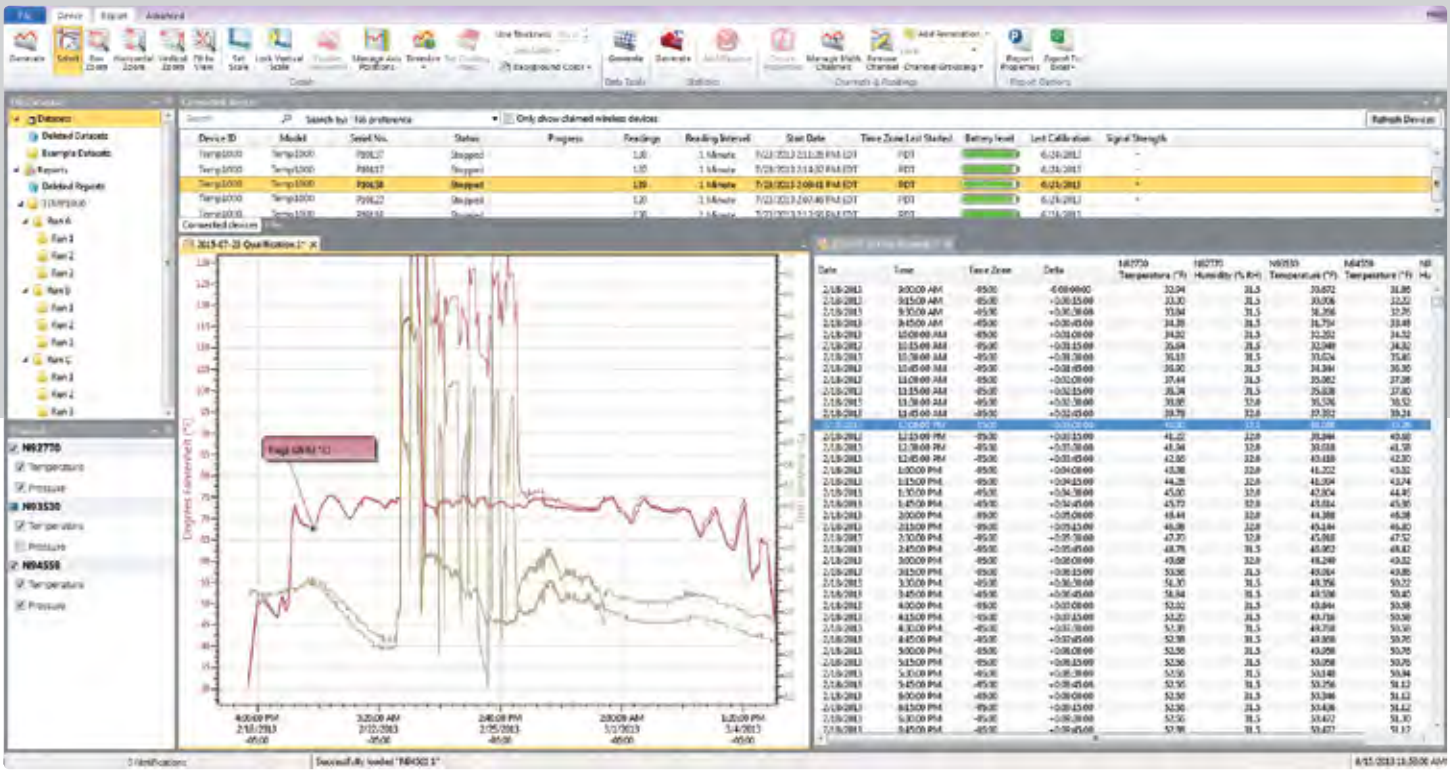
**Please consult the measurement range of your data logger for temperatures over 250 °C (482 °F). (The thermal barrier extends the operating temperature of the data logger up to, but not exceeding the measurement range).*

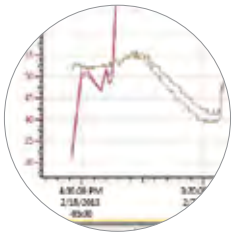
Temperature	Exposure Time in Air (minutes)
Ambient	**Thermal Shield**
-40 °C to +140 °C	Indefinitely
150 °C	88
200 °C	45
250 °C	32
300 °C	n/a
350 °C	n/a

MadgeTech Data Logger Software

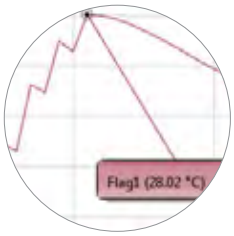
This simple, easy-to-use, Windows-based software enables the user to effortlessly collect, display, and analyze data. A variety of powerful tools can be used to examine, export, and print professional quality reports with just a click of the mouse. The user-friendly MadgeTech software is available for free download from www.madgetech.com.

Simple, Easy-to-use, Windows-based Software



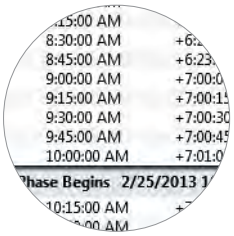


Customizable Graphs

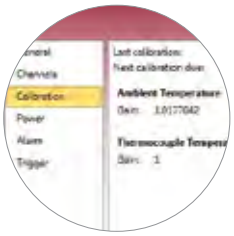


Cooling Flags

Tabular Data View



Automatic Statistics Calculation



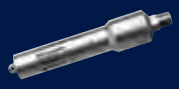
Digital Calibration

Copy to Excel

Software Features

- Multiple Graph Overlay
- Statistics
- Digital Calibration
- Zoom In / Zoom Out
- Timeslice
- Lethality Equations (F0, PU,Fh, Fd)
- Mean Kinetic Temperature
- Full Time Zone Support
- Data Annotation
- User Friendly File Management
- Min / Max. / Average Lines
- Cooling Flags
- Data Table View
- Automatic Report Generation
- Summary View

Matrix



Product	PRTemp1000	PRTrans1000	PRTC210
Measurement Range	-40 °C to +80 °C (-40 °F to +176 °F), 0 to 30, 100, 300, 500 PSIA/G; 1000 and 5000 PSIA	0 to 30, 100, 300, 500 PSIA/G; 0 to 1000 or 5000 PSIA	Thermocouple Dependent 0 to 30, 100, 300, or 500 PSIA/G; 0 to 1000 or 5000 PSIA
Resolution	0.1 °C (0.18 °F) Refer to Table on Page 4 for Pressure Resolution	Refer to Table on Page 5 for Pressure Resolution	Thermocouple Dependent Refer to Table on Page 5 for Pressure Resolution
Calibrated Accuracy	±0.5 °C (±0.9 °F), 2 %FSR, 0.25 % at 25 °C (77°F) typical	2 %FSR, 0.25 % at 25 °C (77 °F) typical	Thermocouple Dependent 2 %FSR, 0.25 % at 25 °C (77 °F) typical
Operating Range	-40 °C to +80 °C (-40 °F to +176 °F) 0 %RH to 100 %RH	-40 °C to +80 °C (-40 °F to +176 °F) 0 %RH to 100 %RH	-20 °C to +80 °C (-4 °F to + 176 °F), 0 %RH to 95 %RH non-condensing
Memory	32,766 Readings	262,143 Readings	10,922 Readings
IP Rating	IP68	IP68	IP20
Material	303 Stainless Steel	303 Stainless Steel	Delrin®
Required Interface Cable	IFC110 or IFC200	IFC200	IFC200
Probe	Internal Sensor	Internal Sensor	External Thermocouple Probe Types J, K, T, E, R, S, B ,N
More Details	Refer to page 4	Refer to page 4	Refer to page 5

Data Logger Calibration

Why Calibrate?

All physical sensors become less accurate due to the environment, usage, stress, and even time. The degree to which these changes occur varies from device to device. For example, a voltage device will drift very little over the years whereas a humidity sensor can drift significantly in several weeks if subjected to a corrosive environment.

Calibration Certificates

The calibration certificates are generated at the end of the manufacturing process. Each certificate indicates the date and conditions of calibration. These certificates provide the documentation needed to satisfy most requirements, certifying that a product has been properly calibrated. The calibration certificate also provides traceability back to National Institute of Standards and Technology (NIST) standards on select models, non-NIST available for all other models.

Calibration Services

MadgeTech's calibration laboratory offers a variety of standard and customized calibration services. The scope of MadgeTech's services covers the following parameters temperature, humidity, pressure, voltage, current, shock and more.

Standard calibration values and pricing can be found on the Product Information Card for each data logger. The Product Information Card can be found on the website page for that product. The standard calibration is normally a one or two point correction of the reported values, depending on the type of device being calibrated. Additional or nonstandard points incur an additional fee.

PRTemp1000D	PR2000	HiTemp140	HiTemp140-TSK
-20 °C to +80 °C (-4 °F to +176 °F) 0 to 30, 100, 300, or 500 PSID	0 to 30, 100, 300, and 500 PSIA/G 0 to 1000 and 5000 PSIA	-200 °C to +260 °C (-328 °F to +500 °F)	-200 °C to +260 °C (-328 °F to +500 °F)
0.1 °C (0.18 °F) Refer to Table on Page 6 for Pressure Resolution	Refer to Table on Page 7 for Pressure Resolution	0.1 °C (0.18 °F)	0.1 °C (0.18 °F)
±0.5 °C (±0.9 °F) ±0.25 %FSR, 0.1 % at 25 °C (77 °F) typical	2 %FSR, 0.25 % at +25 °C (+77 °F) typical	±0.1 °C/±0.18 °F (20 °C to +140 °C/68 °F to +284 °F) ±0.3 °C/±0.54 °F (-20 °C to +19.99 °C/-4 °F to +67.98 °F) ±0.4 °C/±0.72 ºF (-40 °C to -20.01 °C/-40 °F to +-4.02 °F)	±0.1 °C/±0.18 °F (20 °C to +140 °C/68 °F to +284 °F) ±0.3 °C/±0.54 °F (-20 °C to +19.99 °C/-4 °F to +67.98 °F) ±0.4 °C/±0.72 ºF (-40 °C to -20.01 °C/-40 °F to +-4.02 °F)
-20 °C to +80 °C (-4 °F to +176 °F) 0 %RH to 100 %RH	-20 °C to +60 °C (-4 °F to +140 °F) 0 %RH to 95 %RH non-condensing	-40 °C to +140 °C (-40 °F to +284 °F) 0 %RH to 100 %RH	-200 °C to +250 °C (-328 °F to +482 °F) 0 %RH to 100 %RH
32,766 Readings	262,143 Readings	32,700 Readings	32,700 Readings
IP65	IP65	IP68	IP68
303 Stainless Steel	Black Anodized Aluminum Case, NPT Steel	316 Stainless Steel	316 Stainless Steel Enclosure: PTFE
IFC110 or IFC200	IFC200	IFC400 or IFC406	IFC400 or IFC406
Internal Sensor	Internal Sensor	External RTD Probe	External RTD Probe
Refer to page 6	Refer to page 7	Refer to page 8	Refer to page 8

NIST Calibration Certificates

MadgeTech's calibration laboratory offers a variety of standard and customized calibration services. The scope of MadgeTech's NIST Calibration Services include the following parameters:

- **Temperature**
- **Humidity**
- **Pressure**
- **Voltage**
- **Current**

A certificate of conformance is of offered for the Pulse, Event and State data loggers which do not require calibration.
For details on MadgeTech's calibration services, please contact the services department.

ISO 17025/A2LA Accredited Calibration Certification

MadgeTech can supply A2LA accredited calibrations to ISO 17025 standards. Please contact a sales representative for details on calibration abilities and pricing. *Note: This certification must be requested prior to sending the device in for recalibration.*

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