

## Introduction to

# Data Recorders



### History of data recorders

Data recording instruments have a long history that dates back to the 1800s when Charles Babbage incorporated a mechanical instrument called a dynamometer into a railcar to record over a dozen parameters. Babbage described his prototype as a roll of paper one-thousand feet in length that slowly unraveled itself upon a long table. The model had roughly a dozen pens connected with a bridge crossing the center of the table, each marking an independent curving ink mark. Technology has since advanced to the point where we can record an extensive number of sensors on a small portable instrument.



### How data recorders compare to Digital Multimeters and Oscilloscopes

Older data recorders tended to be limited to recording only signals having values that changed relatively slowly. That was because they had response times that were limited by the electromechanical pen and paper system used to archive data. Today, such limitations are no longer in place, particularly for the latest generation of recorders. Today's data recorders feature fast sampling rates, large internal memory, touch displays, and a wide range of input capabilities. Data recorders can replace several instruments and provide additional options such as thermal printing and communication bus analysis.

Digital multimeters are used primarily for measuring voltage, resistance and current. Data Recorders on the other hand are capable of measuring the same parameters, but can also monitor temperature, humidity, vibration, strain, and revolutions per minute (rpm) to name a few. Unlike typical DMMs, recorders excel in performing these measurements on multiple channels simultaneously. The data can be analyzed on-screen with built-in cursors to select specific waveform details or the data can be transferred to a computer. Recorders also support more complex operations such as writing of custom equations for performing mathematical calculations between two or more channels.

Digital storage oscilloscopes (DSO) have become a widely used means of capturing and storing waveform data, and have evolved to include triggering capabilities along with fast sampling intervals. In comparison, data recorders offer more channels, greater vertical resolution, and more memory which allows recording and comparing of more signals over a longer period of time. When using a DSO, the trigger event might be missed, but a data recorder will capture it because it is recording continually. All B&K Precision recorders feature a pre-trigger option to set a percentage of time to capture before the trigger event, ensuring valuable data is not lost.

It is not unusual for data recorders to feature the same kind of triggering mechanisms available on scopes, including triggers based on the leading and falling edges of the signal being recorded. Additionally, it is relatively easy to find recorders providing the same kind of analysis available on specialized instrumentation such as power line quality monitors. X-Y displays as long found on oscilloscopes are also available on data recorders.

## Applications where recorders are used

Users who need to acquire data for longer periods of time across multiple channels or from a variety of input signals will benefit from using a data recorder. These instruments have been designed to enable direct input and measurement of a wide variety of voltage, current, frequency, temperature, strain gauge, and logic signals with voltage inputs ranging from millivolts to kilovolts. This allows a single instrument to simultaneously measure small sensor signals and high-voltages in an electrical system while reducing the challenges configuring several instruments.

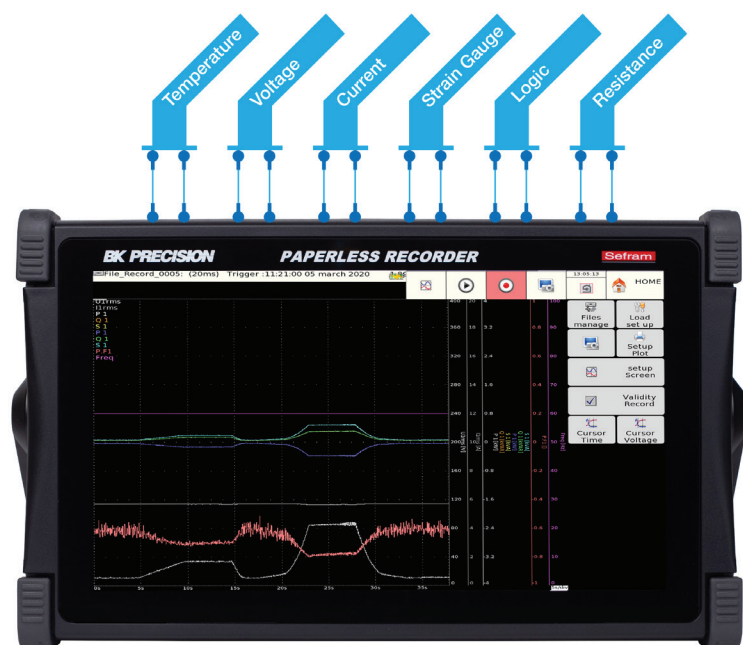


Figure 1: Example of common signals measured with data recorders



Top view of DAS1700

A common application for data recorders is in environmental testing where several sensors are required to monitor parameters such as temperature, humidity, wind speed and direction, as well as barometric pressure at a weather station. These environmental tests may also be performed in an environmental chamber to verify how the device under test responds to changes in environmental parameters while monitoring the DUT voltage and current.

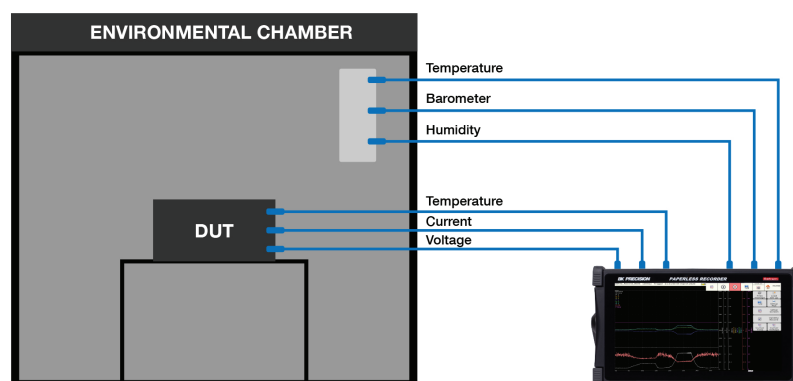


Figure 2: Environmental chamber with data acquisition system monitoring the device under test and environmental sensors

Recorders are also widely used in the automotive industry. Motor vehicles contain numerous sensors, electronic controls and systems which the instrument can monitor simultaneously. Key measurements include voltage and current, force, pressure, stress/strain, speed, and temperature. Many recorders offer the additional capability to monitor and analyze traffic on the CAN or LIN bus, which are widely used interfaces in this industry.

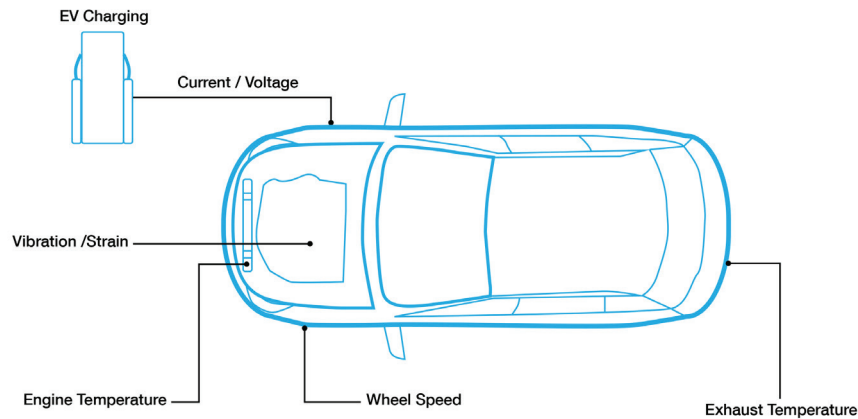


Figure 3: Example of motor vehicle measurements

Data recorders are capable of monitoring systems in industrial settings. Portable recorders aid in preventative maintenance measures which in turn help maximize productivity. They can be used to monitor voltage, current, temperature, strain, and vibration signals of industrial equipment, to detect abnormalities and to record data that will allow conveniently scheduled maintenance.

### Specifications and features that are important to users and reasons why

When considering data recorders, the high-level specifications are:

- Number of input channels
- Measurement types (i.e. voltage, current, frequency)
- Minimum and/or maximum input voltage
- Sampling rate
- Memory size
- Modes of operation

The above specifications help determine which instrument(s) will meet individual needs. The number of channels is a trade-off with portability. As the number of channel increases, so does the weight of the unit.

Measurement types and voltage input ranges are fixed numbers that need to be met, but sampling rate and memory size require more consideration. Although a faster sampling rate may seem desirable, it will reduce maximum recording time, given a fixed memory size. For this reason, it is important to have a good understanding of the nature of the signals to be captured when selecting a data recorder. Many data acquisition systems have multiple modes of operation: One mode for recording over longer periods of time at a lower sampling rate and another mode for recording at a higher sampling rate for a shorter period of time to capture intermittent events.

Additionally, some recorders provide the ability to synchronize to an external time base such as IRIG (Inter-range instrumentation group) time codes or GPS signals.

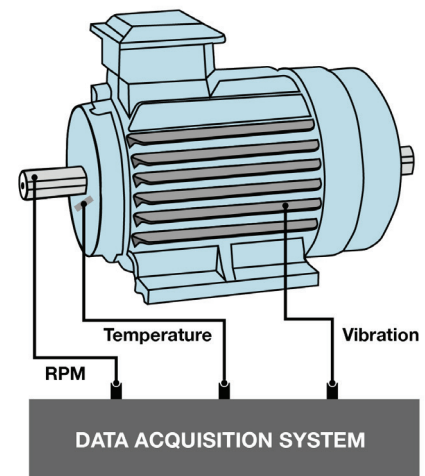


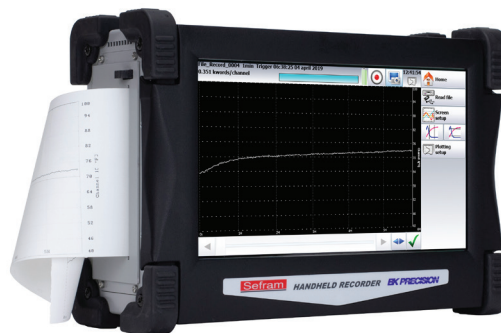
Figure 4 Data acquisition system monitoring typical electric motor parameters



### How B&K Precision is meeting the needs of the customer

*B&K Precision offers a full line of data acquisition recorders and loggers with large touchscreen displays, built-in batteries and multiple channel counts.*

The DAS220-BAT and DAS240-BAT data recorders are lightweight and portable with built-in batteries that provide up to 15 hours of continuous recording from 10 to 200 channels with a sampling interval of 1 ms, 16-bit vertical resolution and 100 VDC maximum input voltage. Its long-lasting battery life makes it beneficial for process-control applications where power sources are unavailable. The DAS30/50/60 series offers 2, 4 and 6 channels, with a built-in battery for up to 9.5 hours of recording time and an optional thermal printer. This series offers a sampling interval of 1  $\mu$ s in memory mode, built-in SSD up to 64 GB as well as 500 V maximum input. The power analysis application included with this series allows for recording and analysis of single or three phase power networks. This series is a good fit for industrial applications that require measurement capabilities of high voltages and faster sampling rates.



DAS60 with thermal printer

The newest addition to our data recorder family is the DAS1700, a configurable data acquisition system. This instrument features 4 types of measurement boards that can be installed in any combination of up to 3 in the base unit of the recorder or up to 6 with an optional expansion. These boards include a universal input board with a maximum voltage of up to 500 V and 6 channels, a high voltage board for up to 1,000 V and 6 channels, a strain gauge board with 6 channels, and a multiplexed board with 12 channels.

The DAS1700 is capable of streaming measurement data directly to the internal solid-state drive at a 1  $\mu$ s sampling interval and record continuously for extended periods of time, with the recording length only limited by the size of the SSD. This instrument is also capable of recording two files simultaneously. When recording starts, the low speed file captures data at a lower sampling rate for a long period of time. An event trigger starts recording to the high-speed file which captures data at a high sampling rate for a shorter period of time. This ensures that not only is the event captured, but the state before and after are captured as well while maximizing memory space.

The DAS1700 expands the measurement range to a maximum input of  $\pm 1,000$  VDC or 1000 VAC. It also includes the power analysis tool of the DAS30/50/60 series along with a function editor. This user interface allows building custom functions to preform mathematical calculations between multiple channels. The result is displayed on a separate virtual channel for easy analysis. Factory options like CAN/LIN and GPS/IRIG timing further expand the capabilities. This data acquisition system is capable of measuring signals ranging from small sensors to large electrical systems and used in aerospace, industrial, automotive, and energy production applications.

### Conclusion

Data recorders have a long history and continue to advance, to keep pace with the applications of today. It is clear that these instruments are essential tools in many industries and B&K Precision provides complete data recorder solutions for customers in these industries. For more information about B&K Precision data recorders, visit their data recorder page linked here.