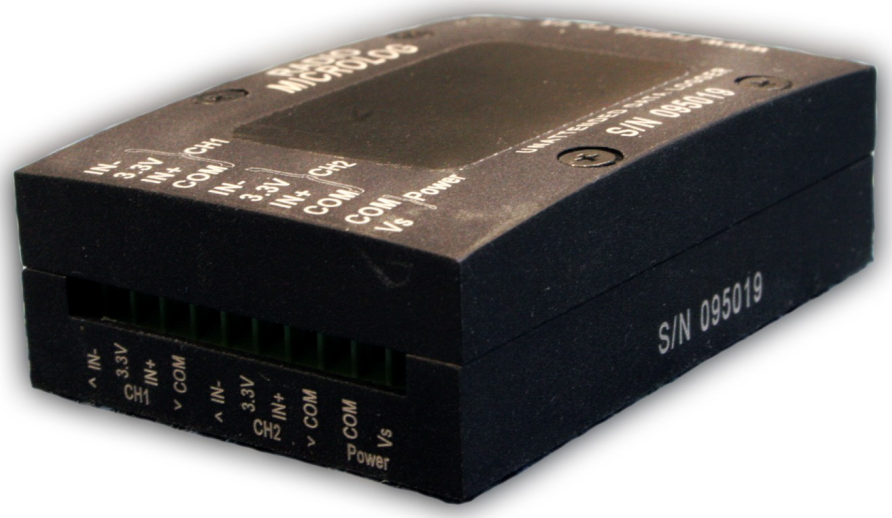


Radio Microlog - Overview

BACKGROUND

Design of new mechanical systems and problem solving of existing systems requires accurate information about static and dynamic in-service loads. JR Dynamics Ltd have developed a comprehensive range of advanced instrumentation, allowing measurement of strain, temperature and acceleration in demanding industrial applications.

MICROLOG DATA LOGGER

Microlog is a miniature instrument designed for long term unattended data logging. Although Microlog is predominantly designed to operate with strain gauges (full, half and quarter-bridge compatible), it can be interfaced with most standard transducers producing an electrical output. Microlog samples at rates of up to 4000 Hz with 16-bit resolution, and can log and evaluate real time stresses and loads on two channels simultaneously. It is programmed for on-line evaluation of Rainflow distribution, a widely used statistical evaluation of fatigue life based on long-term monitoring.

Microlog, equipped with digital radio communication for programming and data downloading, measures 50x34x15 mm and weighs under 35 grams. Microlog is equipped with 2 MB of RAM for storing events and logged data. An additional 256 kB of flash data memory guarantees secure data retention in case of external power supply failure. The control software is activated from a PC via the USB Bluetooth transceiver. An external computer is only used to program Microlog and to download captured data for further post-processing.

Microlog is typically powered from a 3.7 V to 12 V DC power supply. Higher or lower supply voltages can be accommodated with a suitable voltage converter or regulator. The small size of the logger allows it to be positioned in restricted locations, allowing unattended data collection on rotating or reciprocating machinery. Bespoke versions for specific installations in shafts or couplings, etc., can be supplied to suit the available space envelope. Unattended long term stress analysis can be carried out without tying up expensive man-hours or scarce expensive equipment.

- machine dynamics, noise and vibration, NVH
- failure analysis, fatigue and accelerated life testing
- specialised instrumentation, data acquisition and analysis
- rotating machinery design and troubleshooting: gearboxes, shafts, bearings, couplings, belts and chains

JR Dynamics Ltd
Unit 4, Arcot Court,
Nelson Industrial Estate
Cramlington, Northumberland
NE23 1BB, UK

T +44 (0) 191 58 000 58
F +44 (0) 191 58 000 59
E support@jrdltd.co.uk

www.jrdltd.co.uk

GENERAL

Proper understanding of in-service loading is necessary for the design of cost effective mechanical structures and power transmission systems.

It is important that in-service data is acquired during operation covering full spectra of working conditions. Measurements should be carried out for long periods of time so that transmission loads due to extreme conditions and abnormal events can be recorded in a statistically significant way.

Ideally, in-service load measurement should be carried out for periods of 1…10 months on transmission systems with different operating profiles. Such protracted measurements - say typically 1000hrs of continuous measurement - results in a vast amount of data which must be analysed and reduced to a simple data set for design and test purposes. A comprehensive software suit supplied with a standard Microlog allow on-line data analysis and data reduction. In addition to standard data processing, Microlog stores the 100 highest events per channel in time-domain format, including accurate time-stamps.

INSTRUMENTATION

Microlog is a self-contained instrumentation and data analysis system comprising of:

- 2 channel strain gauge signal conditioning, accommodating full-, half- and quarter-bridge gauges or other transducers;
- 4 kHz low pass active filter on each channel (-120 dB roll off per decade);
- Independent signal offset, software gain (1 to 4X) and shunt calibration facility on each channel;
- Temperature and battery level monitoring;
- Comprehensive data handling and storage including:
    1. Rainflow Count (64x32) and Time at level.
    2. Short bursts of time domain data
    3. 100 highest events recorded in time domain, including accurate time stamp

Data is downloaded to a PC over a high-speed, robust Bluetooth pairing, giving a range of up to 100 m.

If required, Microlog's firmware can also be updated remotely over this connection.

DATA ANALYSIS

TIME AT LEVEL

Time at level analysis sums the total time (or the number of shaft revolutions), which is accumulated over the measurement period at each of the 64 load or torque levels. This results in a simple torque or load vs. time histogram.
The 'time at level' load histogram can be used to determine the correct conditions for laboratory testing, using a multiple 'block-load' test.

RAINFLOW COUNTING

Rainflow analysis is often used when the structure is subjected to random loading. The analysis determines the total number of fatigue cycles which occur at 32 levels of mean and 64 levels of range (closed peak to peak fatigue cycles). The output is produced in the form of a 3D matrix defining number of closed fatigue cycles at specific mean vs. range locations.
The Rainflow analysis can be used for the stress analysis or fatigue design of shafts, splines and other structural components. It can also be used as data for block load fatigue testing.
Rainflow Count is ideally suited for fatigue analysis, using one of the linear cumulative damage theories (i.e. Miners Rule).

TIME DOMAIN DATA CAPTURE

Microlog with digital radio communication is capable of logging and accurately time stamping up to 100 highest events in the time domain per channel. Each event is captured with 30% pre-trigger information. The highest time domain events are stored on board the 2 MB RAM memory. This type of memory requires continuous external power supply to avoid data loss. Time at Level and Rainflow Count information is stored on board an internal Flash memory, which is protected in cases of power supply failures.

APPLICATIONS

- Load and stress monitoring of dynamically loaded systems and structures
- Endurance and fatigue life estimation of products and components.

SIGNAL CONDITIONING

Bridge Excitation:	3.3 V fixed—other optional
Input protection:	±40V
Gain:	1 to 10,000 set with fixed resistors, 1 to 4X software gain
Filter:	Butterworth active filter: -3 dB @ 4kHz -120 dB roll off per decade other optional
Bandwidth:	Gain dependant, typ. 2000Hz @ G=1000 - Other available
CMRR:	> 100 dB @ G=1000
Gain Tempco:	< 50 ppm/ ^{o}C

DIGITAL

A/D Converter:	2-channel multiplexed, 16-bit resolution
Sampling rate:	4 kHz per channel
Memory:	4 MB RAM, 256 kB non-volatile flash

ELECTRICAL

Power Supply:	3.7 to 12V - other (1V to 48V) available using external voltage regulator or DC-DC converter. 50 mA @ 3.7 V incl. digital radio power and 2 strain gauges 15 mA @ 3.7 V in radio stand-by mode (between radio access time windows) Inductive Power Supply recommended for long-term monitoring of industrial machinery.
Reverse polarity:	fully protected
Operation temp.:	-40 ^{o}C to +85 ^{o}C

COMMUNICATION

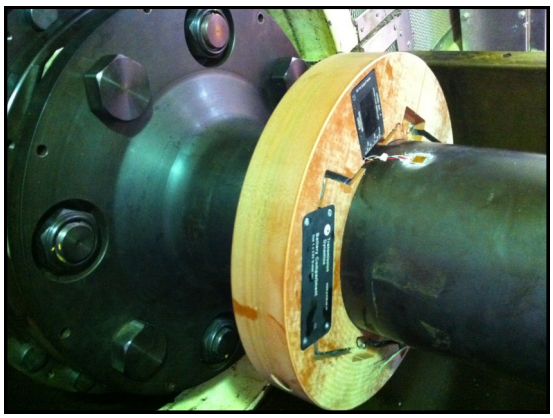
The transceiver connects to Microlog over a robust, high-speed Bluetooth link (up to 100 m range). Data is then streamed to control software on a PC over a USB link (local-mode transceiver), or via. a GPRS/ GSM network (remote transceiver) for unattended applications (optional).

The transceiver offers analogue telemetry output signals for each channel via SMB connections.

The PC application software bundled with Microlog allows hardware configuration, shunt calibration, live streaming mode (telemetry), data logging configuration, data download and analysis in one simple package. A Visual Basic SDK is optionally available for clients wishing to develop their own applications.

EVALUATION

Amplitude analysis:	Rainflow Count, Time Domain, Time at Level
Size:	50x34x15 mm
Weight:	< 35 grams
Mechanical Protection:	Encapsulated to withstand 10,000 g shock



Above: Radio Microlog torque monitoring installation.

Left: USB Bluetooth Transceiver