SquareBug® Overview

Creating new mechanical systems and resolving issues with existing ones necessitates precise data regarding both static and dynamic loads during operation. Transmission Dynamics has pioneered an extensive array of cutting-edge instrumentation, enabling the measurement of strain, vibration, gyroscopic roll and/or temperature simultaneously in challenging industrial scenarios.

SquareBug® is a compact, self-sufficient data logging device designed for various applications. The device contains an internal high-capacity C-cell battery which enables continuous monitoring for several weeks, and/or periodic sampling for monitoring of asset health over extended periods of time (10+ years). Connected to a Gateway up to 50m range and the compact size facilitates placement in confined spaces for unattended data collection and is designed to enable mounting to almost any surface using either fasteners, structural adhesive and/or using the integrated magnetic base. Customised versions are available for specific installations.

SquareBug® wirelessly communicates with the gateway, and forwards information to our Global Data Network (GDN®) for data visualisation and interrogation. Data is autonomously analysed using a combination of human-derived engineering analytics techniques and AI & ML techniques (where appropriate) to extract added value by identifying deviations in signals over time and/or deviations in signals across sensor arrays which are often in-perceivable to the human eye, or too complex for a human to naturally identify correlations. The system allows automated emails and/or SMS notifications to be sent out to key stakeholders if a pre-defined limit is reached, allowing maintenance personnel to promptly investigate any issues which can otherwise lead to catastrophic failures, asset down-time, and/or have safety implications.

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Logging Modes

SquareBug® offers 3 styles of logging modes, all of which can be activated to log individually or simultaneously depending on the specific application. All data is stored on the Global Data Network (GDN®) ready for data visualisation and interrogation.

Events mode (.sqbe)

SquareBug® can log all channels simultaneously and accurately time stamping events file. Each channel offers low noise, high resolution data with sampling rate up to 1,666 Hz on each channel. The event configuration can be set with a pre trigger time to ensure the moments leading up to the trigger can be captured. Events mode offers unattended condition-based monitoring, often deployed for several months per battery cycle.

Figure 1 – Example of SquareBug® Event mounted on a low speed shaft.

Time Domain mode (.sqbd)

Time domain logging can be activated alongside other modes for continuous or periodic data logging, with all the channels activated and sampling up to 3,332 Hz. This mode is often deployed for short term continuous logging up to several hours, or periodically for a set duration at a given time, as per client requirements.

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Time at Level and Rainflow Counting File (.sqbs)

Time at Level and Rainflow Count information is stored on board an internal flash memory. Time at level analysis sums the total time (or the number of cycles), 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 Count analysis is often used when the structure is subjected to variable 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 2D colour 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 life evaluation of shafts, splines and other structural components. Rainflow Count is ideally suited for fatigue analysis, using cumulative damage theories such as Miners Rule.

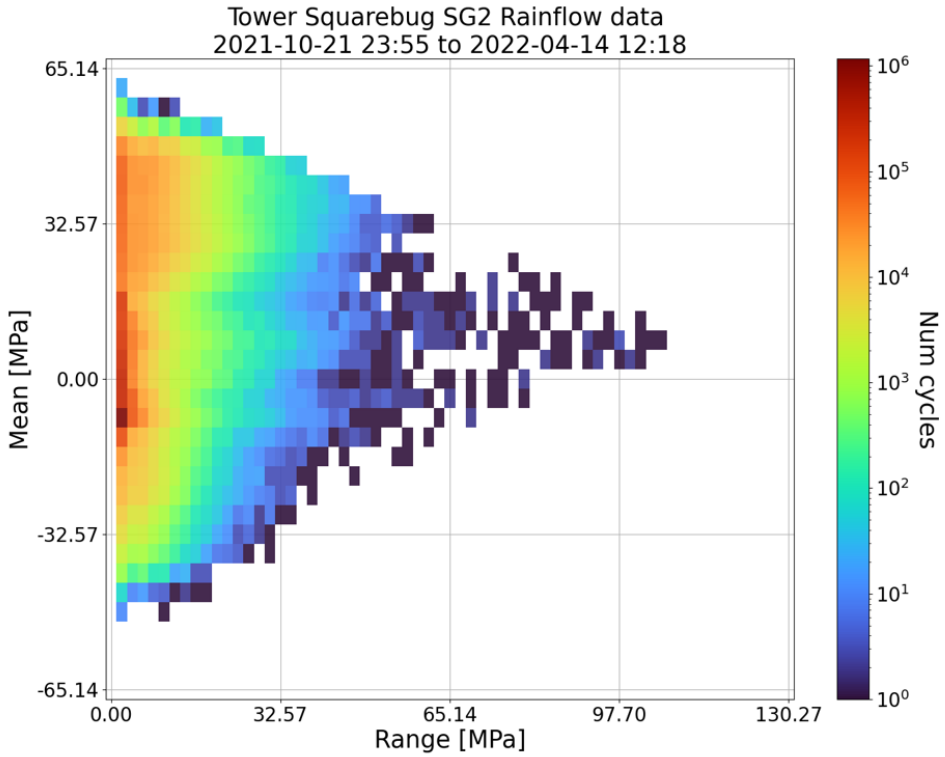

Figure 2 – Example of Time at Level and Rainflow Count file.

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Signal Conditioning	
Bridge Excitation	3.0 VDC
Input filtering	Low-pass noise and anti-aliasing filter, fc customisable to suit client's requirements (typically 1 kHz).
Gain	1-1,000 X, customisable to suit client's requirements (typically 1,000).
CMRR	Min. 120 dB @ gain of 100, from DC to 60 Hz.
Gain Temp. co	35 ppm/°C
Digital	
A/D Converter	16-bit
Sampling Rate	12, 26, 52, 104, 208, 416, 833, 1666 (Events mode only). 12, 26, 52, 104, 208, 416, 833, 1666 & 3332 (time domain mode only).
Memory	512 MB flash.
Communication	Bluetooth.
Range	50 m typical (in free space).
Electrical	
Sensors	3 axis accelerometer sensor; 3 axis gyroscope sensor; 1 internal temperature sensor; 1 external temperature sensor; 4 channels with strain gauge capability (quarter, half & full bridge).
Power Supply	3.5 – 5.5 VDC.
Reverse polarity	Protected.
Operational temperature	-40°C to +85°C
Evaluation	
Events Mode	Available on the Global Data Network (GDN®).
Time Domain Mode	Available on the Global Data Network (GDN®).
Rainflow Counting	Available on the Global Data Network (GDN®).
Time at Level	Available on the Global Data Network (GDN®).
Mechanical	
Size	75 x 49 x 40 mm.
Weight	~0.22kg (incl. fastenings and battery).
Mounting	Fastenings, structural adhesive or magnetic mounting, customisable.

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

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Company registered in England No. 3284935