Transmission Dynamics®

SmartStep® Escalator Monitoring

OVERVIEW

Transmission Dynamics has developed the SmartStep® system, an advanced in-service data logger that monitors escalator performance, automatically reporting potentially damaging events in real time. The system consists of a battery-powered data logger with wireless communication, integrated into a standard escalator step. It operates autonomously for up to a year (between battery changes), alerting operators to abnormal conditions.

SmartStep® monitors critical escalator operating parameters, detecting common issues, such as:

- Drive chain imbalance
- Uneven chain wear
- Excessive dynamic loads
- Step misalignment
- Stick-slip motion
- Smoothness of operation
- Upper/lower D section misalignment
- Track issues and discontinuities

This powerfully diagnostics tool can be used to verify the effectiveness of maintenance ('before and after' maintenance data comparison), in addition to supporting predictive maintenance. The system can accurately diagnose faults, improving maintenance efficiency.

Continuous tracking of step skewing due to differential chain elongation enables proactive planning of major refurbishments, such as replacing worn chains before the chain reaches a critical state requiring urgent attention. This replaces the need for additional system to measure chain elongation, which are difficult to implement and notoriously problematic.

OPERATION

SmartStep® continuously acquires data from strain gauges mounted in critical locations around the step. The system is also equipped with tri-axial accelerometer and a 3-axis gyroscope designed to monitor smoothness of operation and provide additional information at the flip over.

The system operates in two modes:

1. Predictive Maintenance Mode - Uses a traffic light system (Green: Normal, Amber: Attention Required, Red: Urgent) for quick escalator status checks, with routine updates and reports for quality assurance.
2. Alarm Mode - Instantly alerts predefined recipients via email or SMS in case of rapid deterioration of critical escalator parameters (e.g. missing track sections, significant high load, etc.)

The system enables wireless communication with the internet-enabled receiver, ensuring real-time monitoring without interrupting escalator operations. Engineers can also interrogate the system locally via a wireless transceiver.

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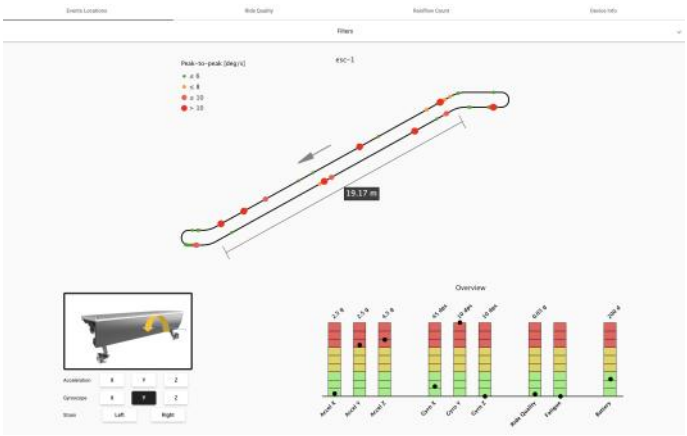
DATA ANALYSIS

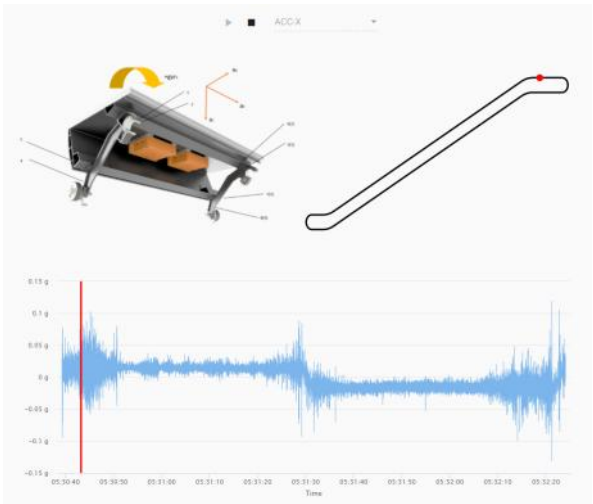
Time-domain data analysis enables identification of escalator events, such as passenger load variations and track impacts. SmartStep® detects fatigue cycles, assisting in long-term performance monitoring and predictive maintenance.

Escalator time-domain data follows a consistent pattern with repeating cycles, allowing easy identification of transient behaviour and lthe detection of long-term changes.

Each SmartStep® unit develops a unique 'fingerprint' of its escalator, providing a comprehensive asset monitoring solution.

AI-driven pattern recognition further refines passenger behaviour analysis, identifying trends that impact escalator wear and maintenance.





SIGNAL CONDITIONING

Bridge Excitation	3.0 VDC
Input Filtering	Low-pass noise and anti-aliasing filter, 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 MBit flash
Communication	2.4 GHz license-free band
Range	50 m typical (in free space)

ELECTRICAL

Sensors	3 axis accelerometer sensor; 3 axis gyroscope sensor; 1 internal temperature sensor; 8 channels with strain gauge capability (quarter, half & full bridge); Real Time Clock (on board).
Power Supply	3.5 – 5.5 VDC
Reverse Polarity	Protected
Operation Temp.	-10°C to +70°C

EVALUATION

Events Mode	Available on the GDN®
Time Domain Mode	Available on the GDN®
Rainflow Counting	Available on the GDN®
Time at Level	Available on the GDN®

MECHANICAL

Size	65 x 58 x 29 mm. (transmitter) 189 x 144x 56 mm (battery housing)
Weight	~0.145 kg (transmitter) ~1.4 kg (battery housing & batteries)
Mounting	Fastenings, structural adhesive, customisable

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