Coperion K-Tron Smart Force Transducer
Weighing Technology for Gravimetric Feeding, Batching and Metering

Accurate feeding, batching and metering of bulk solids begins with precision weighing. Coperion K-Tron pioneered vibrating wire technology for the process industries, and today continues its leadership with the Smart Force Transducer II and III.

The SFT-II/III represent the leading edge of process weighing technology and form a solid foundation for the continuing evolution of the art and science of weighing.

Features:

> 100% digital design, no calibration required
> Advanced single wire weighing technology
> Resolution of 1:8,000,000 in 20 ms
> Weight captured, linearized and temperature compensated 450 times per second
> Zero data loss measurement
> Digital low-pass filter reduces effect of plant vibration
> Waterproof and dust tight
> Stand-alone RS485 network connected for multiple load cell systems
> On-board microcontroller, custom frequency processor, calibration memory and voltage regulator
> Hazardous area models available for European (ATEX) and North American (NEC) standards
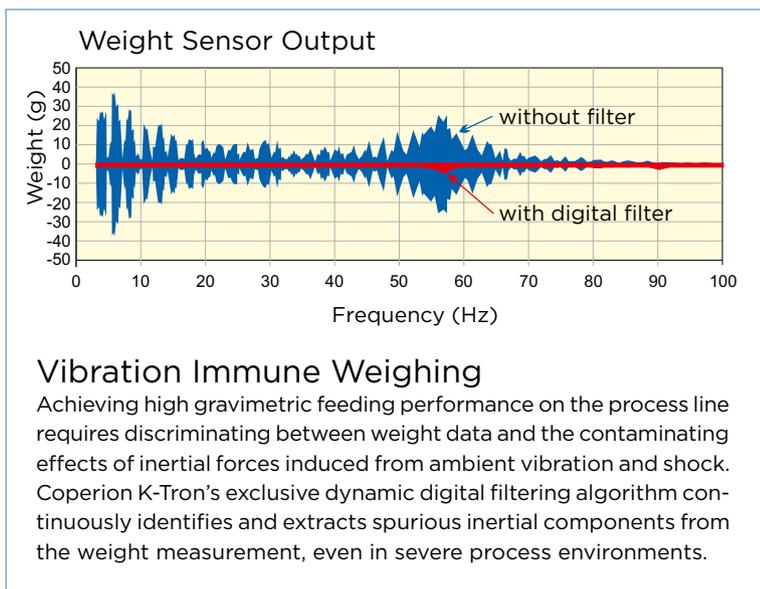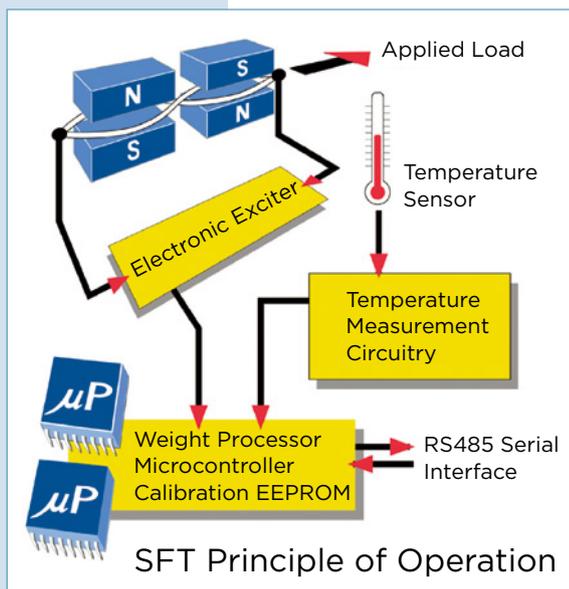
SFT-II-L

SFT-II-M

SFT-III

Three Decades of Innovation

In 1976 Coperion K-Tron introduced the process industry's first truly digital load cell. After three decades and five generations of innovation and development, Coperion K-Tron's Smart Force Transducer technology continues to set the standard for the industry. Advanced single-wire design, high resolution, internal force reduction, and 90% fewer parts combine to provide the highest possible levels of performance and reliability.

The SFT-II Medium and Large are employed in all Coperion K-Tron's platform and three-point suspension scale loss-in-weight feeding systems.

The SFT-III is optimized for direct, single-point weighing and is used in Coperion K-Tron's Smart Weigh Belt Feeders, K4G Blender, and Smart Flow Meters.

SFT Principle of Operation

Weight Sensor Output

Vibration Immune Weighing
Achieving high gravimetric feeding performance on the process line requires discriminating between weight data and the contaminating effects of inertial forces induced from ambient vibration and shock. Coperion K-Tron's exclusive dynamic digital filtering algorithm continuously identifies and extracts spurious inertial components from the weight measurement, even in severe process environments.

How Coperion K-Tron SFT Technology Delivers High-Precision Weighing - Even in Difficult Plant Environments
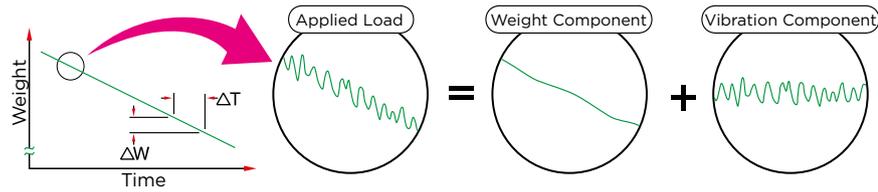
Consider a loss-in-weight feeder operating in a typical plant environment. Feed rate control is achieved by continuously weighing the entire feeding system, then controlling the rate at which the system loses weight. In the above plot of feeder system weight vs time, the desired feed rate is represented as the change in system weight per unit time, or simply the negative slope of the weight signal. The total load applied to the weighing system is a composite of the actual system weight plus the variable force contributed by in-plant vibration.

1 **Load Measurement** - The total applied load (A) causes wire (B) to change its resonant frequency (10-15 KHz measurement range). The signal (C) is converted to a square wave (D).
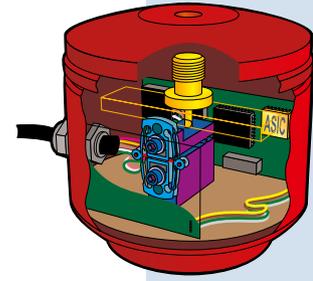
2 **Impulse Counting** - Impulse counting begins at the left edge of a square wave and continues until the first left edge of the next sample group is detected. During each measurement period, counts of wire vibration are recorded in one register while clock pulses are simultaneously counted in separate registers. To obtain all data without loss, the detection of the end of a sample group triggers the entry of the impulse count total and elapsed time into a set of capture registers and a new sample group begins.

3 **Frequency Calculation** - While counting continues uninterrupted in the primary registers, an on-board microcomputer then determines the frequency for each sample group to high computational resolution using 32-bit floating point calculations.
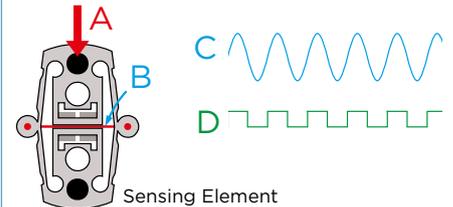
4 **Temperature Compensation** - Temperature dependence of the load/ frequency relationship is minimized by careful choice of the materials from which the wire and other sensor elements are manufactured. The small residual temperature effect is mathematically compensated via application of zero and span coefficients determined during manufacture, and stored in the SFT's EEPROM. A highly responsive temperature sensor is thermally coupled to the wire system. Output frequency is between 18 and 30 kHz. Temperature measurement is highly linear and resolution is better than 0.001°C.

5 **Linearization** - The relationship between the applied load and the wire's frequency is very nearly parabolic where wire frequency is proportional to the square root of the applied load. Polynomial coefficients for the linearization are determined for each SFT during manufacture, and are stored in the SFT's EEPROM. Coefficients retain their validity throughout the sensor's life, eliminating the need for periodic recalibration.
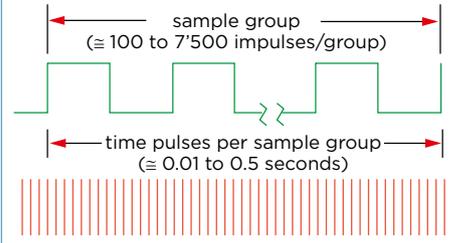
6 **Digital Filtering** - The continuous stream of weight samples is then digitally filtered. The digital filter can be adjusted for different cut off frequencies (0.1 - 10 Hz) depending on the individual feeder configuration.
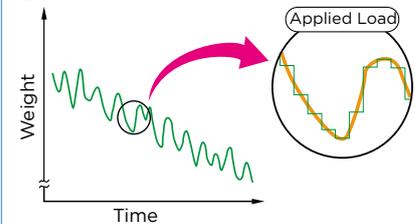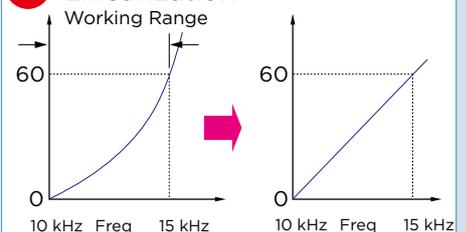
1 Load Measurement

Sensing Element

2 Impulse Counting

sample group
(≅ 100 to 7'500 impulses/group)

time pulses per sample group
(≅ 0.01 to 0.5 seconds)

3 Frequency Calculation

Applied Load

Weight — Time

4 Temperature Compensation

5 Linearization

Working Range

60 — 60

10 kHz   Freq   15 kHz   10 kHz   Freq   15 kHz

6 Digital Filtering

0.5 Hz   1 Hz   2 Hz
0.2 Hz

Transfer Ratio — Frequency (Hz)