VIBRATION/COLLISION AND UNBALANCED TOOL MONITORING

Excessive vibration and collisions inside machine tools have a detrimental effect on working life, tool life and the quality of the end product.

Imbalance, resonance, misalignment, loosening and stress, caused typically by tools that are unbalanced, incorrectly positioned or worn are all contributing factors.

According to industry standards, rms vibration in the 10 to 1000Hz frequency band may be considered the best operating parameter for evaluating these component, structural and rotational problems.

The use of sensors, such as accelerometers, makes it possible to detect machine events like collisions (by measuring acceleration, in g) and excessive vibration (by measuring rms speed, in mm/s). These measurements provide an overall indication of the state of the machine. See ISO 10816-1 Table on page #4.

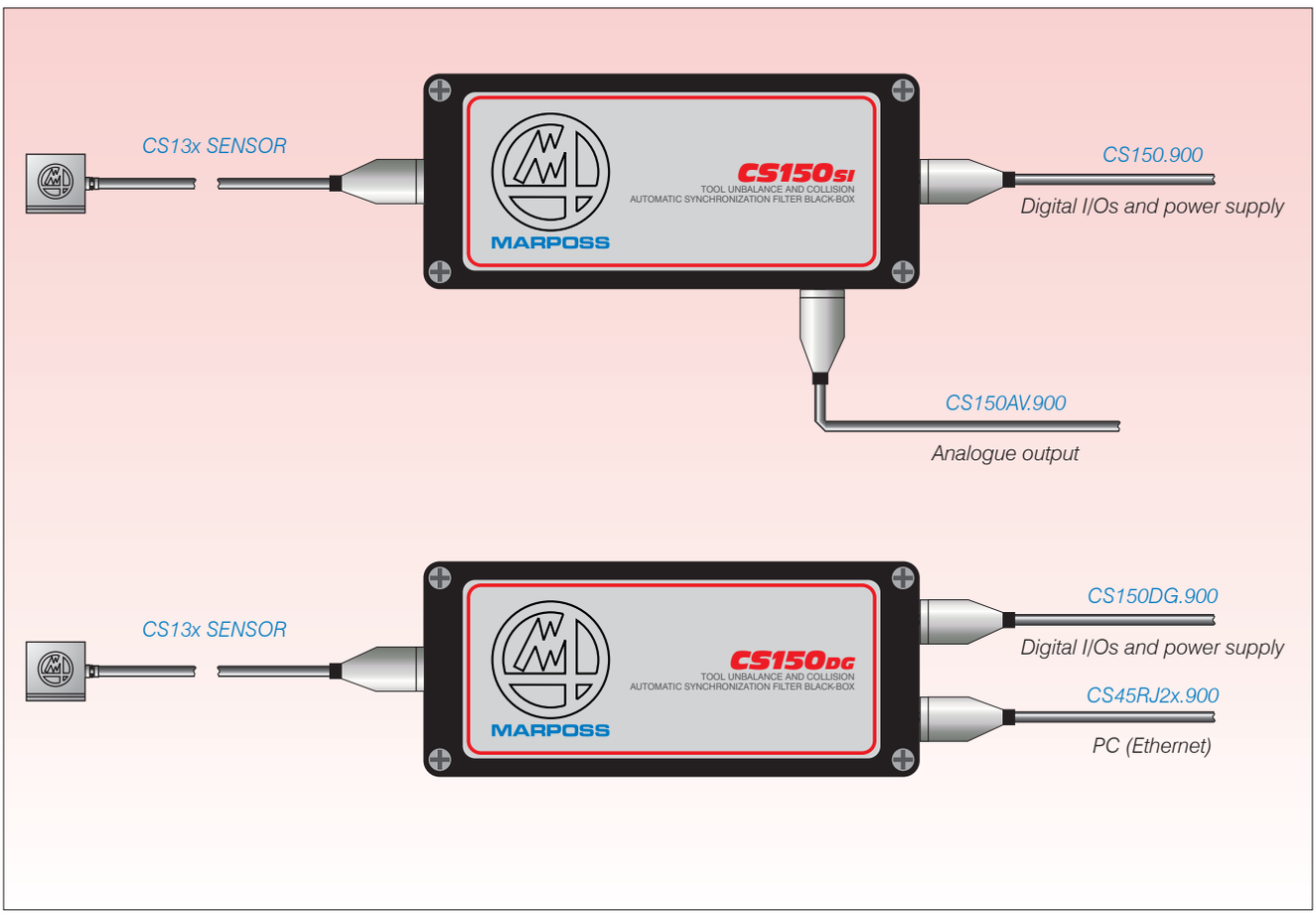
Typical applications

- Detecting excessive machine vibration levels
- Detecting accidental collisions during manoeuvres
- Detecting unbalanced tools
- Detecting worn tools
- Detecting chips between the cone and the tool holder

Benefits

- In-process vibration level control
- Reduces damages caused by collision
- Conserves machine bearings thereby extending spindle working life
- Improves product quality
- Gets the maximum use out of the tool

The system



The CS150 range, complete with optional accelerometer sensors, is capable of monitoring machine vibration levels and collisions by setting up acceleration (g) and rms speed (mm/s) measurement thresholds. When the measurements exceed these values, corresponding alarm signals are sent to the machine tool for processing. The CS150 systems are compatible with both monoaxial and biaxial accelerometers. In the case of biaxial accelerometers, the acceleration measurement, used for monitoring collisions, is obtained by calculating the module of the sum of the contributions from both axes. This guarantees maximum sensitivity for special applications monitoring collisions along the Z axis. Conversely, vibration controls are performed exclusively in the direction perpendicular to the accelerometer mounting plane (indicated by an arrow on the sensor).

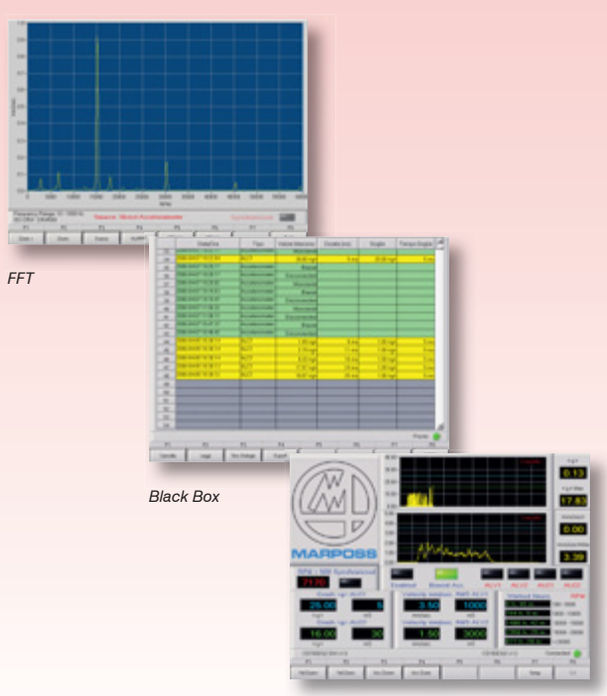
CS150SI-2	• Allows the user to set up 1 collision alarm (in g) and 1 excessive vibration alarm (in mm/s) • The thresholds can be set up using a series of dedicated micro-switches on the interface • Frequency filter for analysing vibration, can be tuned to the spindle rpm • Outputs: Digital I/Os and analogue output
CS150DG-2	• Allows the user to set up 2 collision alarms and 2 excessive vibration alarms in amplitude and time • The thresholds are set up using the CS150DG2.SW software via an Ethernet connection to a PC (see next page) • Frequency filter for analysing vibration, can be tuned to the spindle rpm • Working time statistics • Real time graphic and numerical displays • Black box function (2000 events) • FFT function • Output: Digital I/Os

The sensors

CS130AC *Monoaxial - 100 mV/g**	
CS130-M16 *Monoaxial - 100 mV/g**	
CS132CON *Biaxial - 100 mV/g**	
CS133 *Monoaxial - 10 mV/g**	
CS134 *Biaxial - 10 mV/g**	

(*) g = gravitational field strength, ≈ 10 ms^{-2}

The software



FFT

Black Box

Real time graph

The application

Technical characteristics

Technical specifications (hardware)

Number of sensors that can be connected		1	
Sensor types		CS13x Monoaxial/biaxial accelerometers	
Min. alarm duration		100 ms	
Sensitivity		10-100 mV/g*	
Measurement ranges		Acceleration: 40 g max Rms speed: 35 mm/s max	
Measurement mode V rms [mm/s]		• Synchronised measurement 800÷45000 rpm Bandwidth ±1.34% (constant Q) • Wide band measurement 10÷1000 Hz ISO 2954	
Inputs/ outputs	CS150SI-2	Digital I/O	• 1 vibration alarm output (mm/s) • 1 collision alarm output (g*) • rpm input for filter synchronisation
		Analogue	• Rms speed (mm/s) • 100 mV/(mm/s) - F.S. 35 mm/s • 1 V/(mm/s) - F.S. 10 mm/s • Acceleration(g*) • 0.1 V/g - F.S. 35 g*
	CS150DG-2	Digital I/O	• 2 vibration alarm outputs (mm/s) • 2 collision alarm outputs (g*) • Enable rms speed input (mm/s) • Signal input for filter synchronisation and working hours statistics
		Analogue input	Rpm for working hours statistics
Black box	CS150SI-2	/	
	CS150DG-2	• Data registration • 2000 events • Date, time (hh-mm-ss) • Max. amplitude reached • Duration exceeded threshold • Record of date sensor was disconnected and reconnected • Data storage: Min. 10 years	
Dimensions	CS150SI-2	150 × 64 × 34 mm	
	CS150DG-2	175 × 80 ×57 mm	
Power supply		24 Vdc (18÷30 V)	
Protection class		IP65	
Sensors protection class		IP67**	
Galvanically isolated I/O with sink/source type settings		Output: 50 mA max Input: 10 mA max	
Working temperature		60°C max	

(*) = gravity acceleration value, equivalent to approx. ≈ 10 ms^{-2}
(**) = see data sheet

Technical specifications (software)

System requirements

Operating system	Windows NT4/98/ME/2000/XP
Free disk space	20 MB
Minimum memory	32 MB
Ethernet port	

Specifications

Real time graphical and numerical display	• Acceleration (g) • Rms speed (mm/s)
Displays	• Working hours statistics • Accelerometer connected • Type of accelerometer connected (mono/biaxial) • FFT • Black box (with data handling)
Amplitude and time threshold alarm settings	• ALV1, ALV2 Rms speed (mm/s) • ALC1, ALC2 Acceleration (g)
Multilingual	I - UK - D - E - F - S

ISO 10816-1 table

Vibration Vrms (mm/s)	Class I	Class II	Class III	Class IV
0.28	A	A	A	A
0.45				
0.71				
1.12	B			
1.8		B		
2.8	C		B	
4.5		C		B
7.1	D		C	
11.2		D		C
18			D	
28				D
45				

A - Vibration level normal for new machines (GOOD)
B - Vibration level acceptable for long-term, non-restrictive use (USABLE)
C - Vibration level satisfactory for continuous, short-term use (ACCEPTABLE)
D - Vibration level high enough to damage the machine (UNACCEPTABLE)

CLASS I small machines up to approximately 15 kW
CLASS II medium sized machines without special foundations from 15 to 75 kW
CLASS III large machines over 75 kW with rigid foundations and an operating frequency greater than the system resonance threshold
CLASS IV large/turbo machines with flexible foundations and an operating frequency below the system resonance threshold