

Leonova Diamond Expert Package

Technical Data Sheets

Package Features include:

- The instrument has been engineered to meet the demands industrial facilities by meeting IP65/NEMA 4X standards, thus offering an extremely rugged and reliable instrument for plant route readings.
- The Diamond offers Easy-to-Understand condition information – the data is displayed as green, yellow, red results that can easily be interpreted by the maintenance personnel.
- Data logging with Condmaster® software
- SPM HDm/HDc - Shock Pulse Method readings for determining bearing condition and lubrication health. Includes HD Analysis for diagnosing the SPM HDm/HDc signatures.
- ISO 2372 and ISO 10816 vibration monitoring - Overall vibration measurements for determining machine health.
- 3-Channel Simultaneous Vibration Analysis Monitoring capabilities
- Vibration Supreme including EVAM, FFT & Time Signal Vibration analysis. Includes HD Order Tracking and Symptom diagnostic tool for diagnosing the vibration signatures.
- Speed/RPM and Temperature Measurements.
- Stethoscope function.
- Single and Two Plane Balancing.
- Replaceable battery packs ensure no issues with battery needing to be charged while readings are being taken.
- Notes and Comments are easy and quick to add by using the headset and boom microphone for voice recording of them during round readings.
- Package includes all of the transducers, cables, magnetic bases, probes, battery charger and accessories needed to utilize the features and functions listed.
- Recommended annual calibration at a cost of \$759.99 USD. Includes a certificate of calibration good for 12 months.
- The instrument and software can easily have new functions added/ installed at any time without having to return the instrument. This allows you to expand the functionality of the instrument and software without having to buy new.



Leonova®

DIAMOND

Technical data sheets
2019-03



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Leonova Diamond Expert Package includes:

- 1 x DIA300, Leonova Diamond HDm/HDc Platform
- 1 x DIA109, Balancing - Single & Dual Plane, Diamond function
- 1 x DIA140, HD Analysis - Vib/SPM HD Expert, Diamond function
- 1 x DIA192, Multi-Channel Simultaneous Vib, Diamond function
- 1 x DIA133, ISO 10816 + Spectrum, Diamond function
- 1 x 14765, Holding Fixture for TTP10
- 1 x 81319, Magnetic Tool Holder for TTP10
- 1 x CHA03, Battery Charger for DIA/EME
- 1 x CAB94, Communication/Charging Cable
- 1 x TRC150, DuoTech Accelerometer w/Sleeved Quick-Connect
- 1 x TRA78, Shock Pulse Hand Probe
- 3 x CAB83, Measuring Cables 1.5m Straight
- 3 x TRX40, Magnetic Base 29 Lbs Pull
- 3 x SLD144S-UNF, Vib Transducers 2-10,000 Hz Side-Entry
- 1 x CAB88, 3-Channel Vib Cable Splitter
- 1 x TTP10, Temp/Tach Probe with TTP11
- 1 x TAD16, Thins Sheets Reflecting Tape
- 1 x EAR16, Ear Defender Headset w/Microphone
- 1 x CAS35, Wheeled Carrying Case w/Foam Inlay
- 1 x CM-E501, Condmaster ULTIMATE edition
- See Condmaster 2026 Editions Overview PDF

Trademarks

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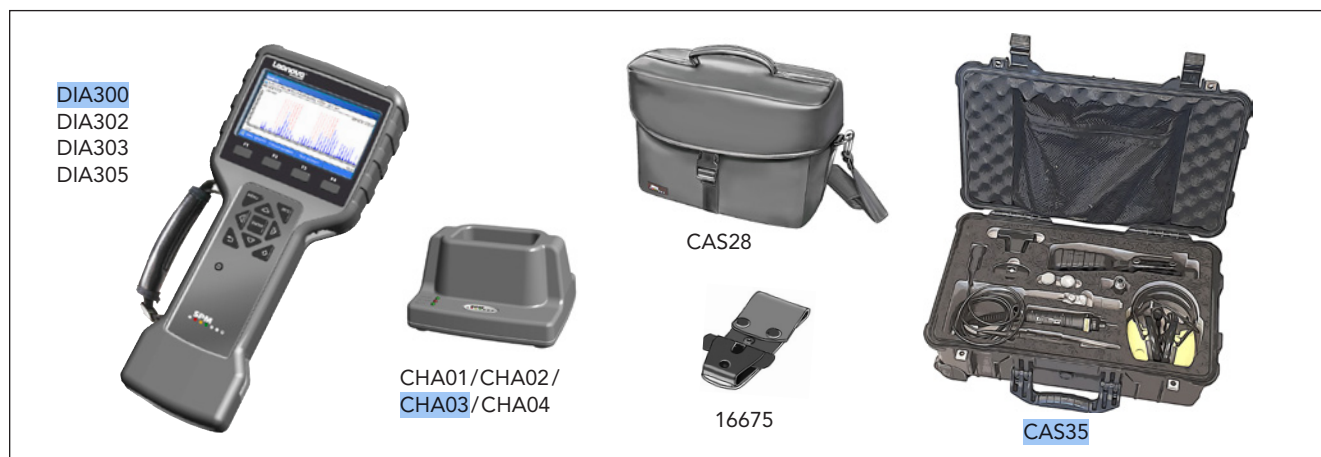
Patents: DE#60304328.3 - US#7,054,761 - US#7,167,814 - US#7,200,519 - US#7,301,616 - US#7,313,484 - US#7,324,919 - US#7,711,519 - US#7,774,166 - DE#60336383.0 - US#7,949,496 - DE#60337804.8 - GB#1474662 - GB#1474663 - DE#60338365.3 - ZA#2011/04946 - SE#0951017-3 - DE#60341502.4 - GB#1474659 - SE#1000631-0 - US#8,762,104 - US#8,812,265 - US#8,810,396 - CN#ZL200980155994.1 - CN#ZL201080019737.8 - KZ#020791 - RU#020791 - AU#2009330744 - RU#021908 - KZ#021908 - US#9,200,980 - US#9,213,671 - CN#ZL201180006321.7 - KZ#022630 - RU#022630 - US#9,279,715 - US#9,304,033 - KZ#024339 - RU#024339 - CN#ZL201380007381.X - AU#2015203801 - AU#2013215672 - RU#201491377 - CN#ZL2012800347548 - US#6,873,931 - DE#602013021988.5 - DK/FI/FR/IT/NL/NO/ES/GB#2810027 - SE#13744257.0 - AU# 2015203361 - RU# 027452 - GB# 2505984 - US# 9,772,219



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Leonova Diamond® – Platform



Leonova Diamond is a three-channel handheld machine condition analyser designed for use in harsh environments. The following functions are always included for unlimited use:

- Data logging with Condmaster® Ruby.
- ISO 2372 vibration monitoring.
- Speed and temperature measurements.
- Analog signals, current, and voltage.
- Automatic recording, up to 50 hours.
- Stethoscope function.
- Reading from and writing to CondID® memory tags.
- Recording of vocal comments.

The main Leonova functions are user-selected, see TD-359. With synchronous measurement, enveloping, true zoom, and up to a 25 600 line spectrum over DC up to 40 kHz, Leonova Diamond has full vibration analysis capacity. The evaluation tables of the ISO 10816 standards for broadband measurement of vibration velocity, acceleration, and displacement are also incorporated. For single and dual plane rotor balancing, a graphical guide calculates balancing weights and their position. For shaft alignment, Leonova Diamond uses advanced laser technique with easy targeting, modulated line laser beam, and automatic precision calculation of shaft positions.

Part numbers

- DIA300** Leonova Diamond, SPM HDm/HDc
DIA302 Leonova Diamond, Balancing, single and dual plane
DIA303 Leonova Diamond, SPM LR/HR
DIA305 Leonova Diamond, SPM HDm/HDc and LR/HR
DIA162 Extra memory, 4 GB
DIA163 Extra memory, 8 GB
BATT02-Std Optional battery pack
16644 Battery adapter unit
CHA01 Battery charger incl. AC adapter, Euro plug
CHA02 Battery charger incl. AC adapter, UK plug
CHA03 Battery charger incl. AC adapter, US plug
CHA04 Battery charger incl. AC adapter, AU plug
93484 Car charger cable 12V
CAB94 Communication cable, USB-miniUSB
16675 Belt clip, complete
16646 Shoulder strap with safety buckle
CAS28 Carrying case, soft with modular insert, 370x200x270 mm
CAS35 Carrying case/trolley case with two wheels, plastic with foam insert, 560x350x230 mm
81468 Code lock, TSA approved, for CAS35

Parts of the Leonova system are specified on the technical data sheets (TD) listed below:

Instrument specifications	TD-357
User-selected functions	TD-359
Shock pulse method SPM HD	
frequency and time domain analysis	TD-361
SPM Shock pulse method dBm/dBc	TD-406
SPM Shock pulse method LR/HR	TD-362
SPM Spectrum®	TD-407
Vibration monitoring ISO 2372	TD-408
Vibration monitoring ISO 10816 with spectrum	TD-363
Vibration monitoring ISO 6954	TD-484
3-channel simultaneous vibration monitoring	TD-364
Vibration Advanced	TD-459
FFT spectrum with symptoms	TD-460
HD ENV	TD-511
Vibration Expert	TD-365
EVAM evaluated vibration analysis	TD-401
HD ENV	TD-511
Run up/Coast down and Bump test	TD-402
HD Order tracking	TD-403
Frequency Response Function, FRF	TD-402
HD Analysis	TD-514
Vibration Expert	TD-365
SPM HD Expert	TD-361
Orbit analysis/Shaft centerline plot	TD-368
Balancing, single and dual plane	TD-369
Shaft alignment	TD-370
Recording function	TD-409
Alignment Sensors	TD-524
Transducers and measuring cables	TD-377
Leonova Service Program	TD-379
Tachometer/Temperature probe	TD-380

Spare parts

- 16645** Protection foil for display
14661 Wrist strap
81469 Silica gel (moisture absorbent) spare for CAS35
90362 AC adapter, Euro plug, 100-240 V AC
90380 AC adapter, UK plug, 100-240 V AC
90379 AC adapter, US plug, 100-240 V AC
90528 AC adapter, AU plug, 100-240 V AC
16574 Battery charger
PRO52 Leonova Service Program
71950 Leonova Diamond User guide

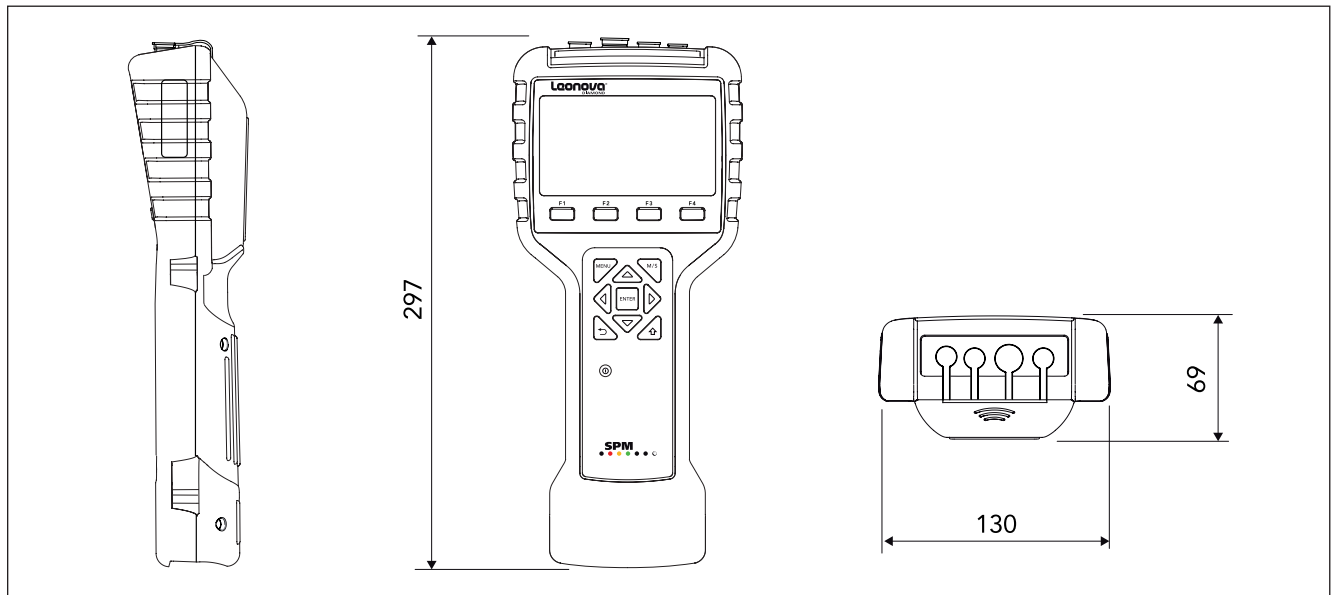
Patents: www.spminstrument.com/patents



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Leonova Diamond® – Instrument specifications



Technical specifications

Housing:	ABS/PC/TPE, IP65
Dimensions:	297 x 130 x 69 mm
Weight:	890 g
Keypad:	Sealed, snap action
Display:	TFT colour, 480 x 272 pixels, 4.3 inch widescreen, adjustable backlight
Main processor:	400 MHz ARM
Memory:	256 MB RAM, 512 MB Flash, SD card 1GB expandable up to 8GB
Operating system:	Microsoft Windows® CE
DSP processor:	375 MHz floating point
Communication:	USB 2.0
Power supply:	Rechargeable Lithium-Ion battery pack, 5200 mAh or power adapter
Battery power:	For min. 16 hours normal use (20°C)
Operating temperature:	-20 to 55 °C , non condensing
Charging temperature:	0 to 45 °C
General features:	Language selection, battery status indication, transducer line test, metric or imperial units
Meas. point identification:	NFC transponder for communication with CondID™ tags, read/write distance max. 50 mm (2 inch)

Vibration monitoring

Vibration channels:	3 simultaneous
Dynamic range:	up to 120 dB, 24 bit A/D converter
Frequency range:	0 (DC) to 40 kHz
Resolution:	Max. 25 600 lines
Vibration transducer input:	< 24 Vpp. Transducer supply of 2,5 mA for IEPE (ICP) type can be set On/Off
Transducer types:	Any transducers (disp., vel. or acc.) with voltage output
Measuring techniques:	ISO 2372, ISO 10816, HD ENV, EVAM Evaluated Vibration Analysis, FFT Spectrum with Symptoms, Orbit analysis, 3 channels simultaneously, balancing

Bearing monitoring

Measuring range:	SPM HD: -30 to 110 dBsv (44000 transducer) dBm/dBc: -9 to 99 dBsv LR/HR: -19 to 99 dBsv
Resolution:	0,2 dB/HD, 1 dB dBm/dBc and LR/HR
Transducer types:	SPM 40000, 42000, 44000, probe and quick connector transducers, DuoTech

Tacho input

Measuring range:	1 to 150 000 PPM
Resolution:	1 pulse
Accuracy:	± (1 pulse + 0.01% of reading)
Transducer types:	TTP10, TTL pulses, keyphasor and proximity switch NPN/PNP.
Output:	TTL output for stroboscope and 12 VDC

Analog signals

Measurement range:	0 to 10 V DC, 0 to 20 mA
Resolution:	18 bit A/D converter
Accuracy:	± 1% of reading + 0,1 V/mA

Output/input

Headphones/microphone:	3.5 mm stereo plug
Communication:	Mini USB

Temperature measurement

Inputs:	TTP10 or via analog input
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Stethoscope

Transducer types:	Shock pulse and vibration transducer
Settings:	Filter, volume and gain



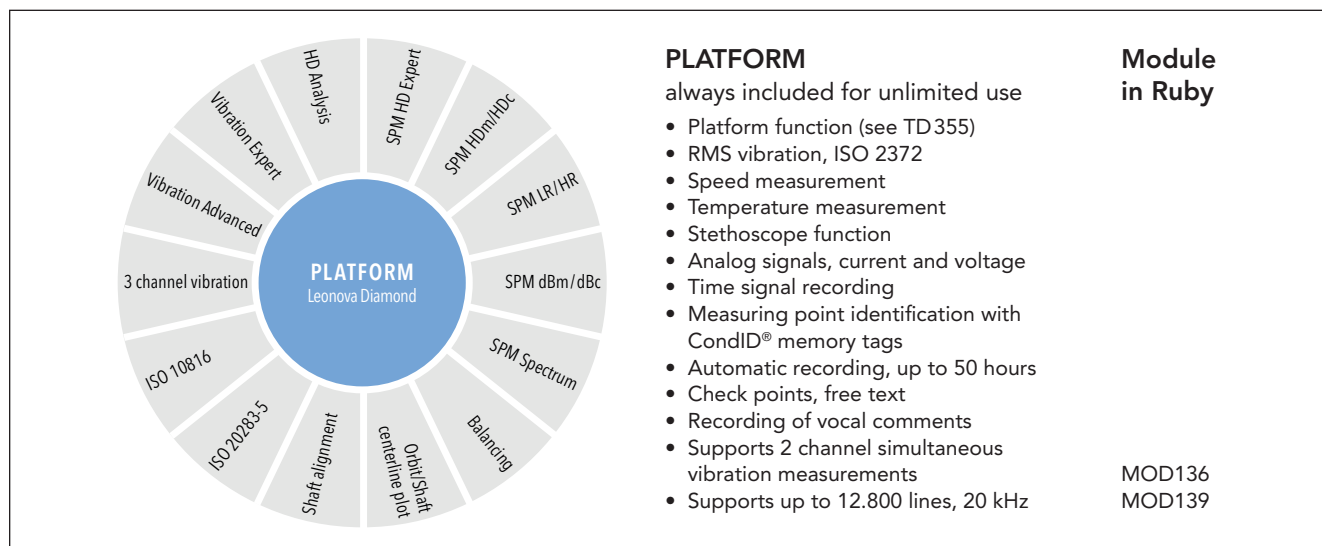
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Leonova Diamond® – User-selected functions



To obtain the optimal performance range and instrument price, Leonova users can select any or all of the condition diagnosis and maintenance functions below, under two alternative conditions of sale. The choice is between unlimited and limited use (Function & Use).

When use is limited, the price for the function itself is much lower. Instead, the user prepays a tankful of 'credits'.

Leonova automatically deducts credits from the tank when its 'Measure' key is pressed. Thus, the user's operating costs depend on the number of measurements taken. Credit tanks are refilled, and/or new functions added, by loading a coded file ordered via the local distributor.

Unlimited and limited functions can be combined at will. Platform functions are always included and their use is unlimited.

Functions for Unlimited Use

Module in Ruby

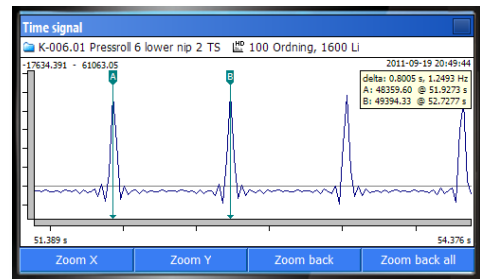
DIA195	SPM HD Expert, time and frequency domain analysis	MOD195
DIA197	Shock pulse method HDm/HDc	(Platform)
DIA130	Shock pulse method dBm/dBc	MOD130
DIA131	Shock pulse method LR/HR	MOD131
DIA132	SPM Spectrum, 12.800 lines/20 kHz	MOD132 MOD139
DIA133	Vibration ISO 10816 with spectrum	MOD133
DIA198	Vibration ISO 20283-5	MOD198
DIA138	Orbit analysis/Shaft centerline plot	MOD138
DIA192	3 channel simultaneous vibration	MOD192
DIA193	Vibration Expert HD ENV EVAM evaluated vibration analysis 25.600 lines/40 KHz HD Order Tracking Time signal, Post trigger Run up/coast down, Bump test and FRF	MOD193
DIA194	Vibration Advanced HD ENV FFT spectrum with symptoms 12.800 lines/20 kHz, Time signal, HD Order Tracking, Post trigger	MOD135+MOD139
DIA140	HD Analysis Vibration Expert SPM HD Expert	MOD140
DIA109	Balancing, single and dual plane	
DIA155	Shaft alignment	

Functions for Limited Use (Function & Use)

DIA295	SPM HD Expert, time and freq. domain analysis (3)
DIA297	Shock pulse method HDm/HDc (2)
DIA230	Shock pulse method dBm/dBc (1)
DIA231	Shock pulse method LR/HR (2)
DIA232	SPM Spectrum (2)
DIA233	Vibration ISO 10816 with spectrum (1)
DIA298	Vibration ISO 20283-5 (1)
DIA238	Orbit analysis (5), Shaft centerline plot (5)
DIA292	3 channel simultaneous vibration (6)
DIA293	Vibration Expert incl. HD Order Tracking, Time signal and 25.600 lines/40 KHz (no credit consumption) HD ENV (3) EVAM evaluated vibration analysis (2) Post trigger (25) Run up / coast down (50) Bump test (25) Frequency Response Function, FRF (25)
DIA294	Vibration Advanced incl. HD Order Tracking, Time signal and 12.800 lines/20 kHz (no credit consumption) HD ENV (3) FFT spectrum with symptoms (2) Post trigger (25)
DIA240	HD Analysis Vibration Expert (3–50) SPM HD Expert (3)
DIA209	Balancing, single and dual plane Single plane (4 runs: 16 / 2 runs: 42) Dual plane (80)
DIA255	Shaft alignment (30)
Credit consumption is stated within brackets.	
DIA290	Credits for limited functions
DIA291	Credits for limited functions, refill



Leonova Diamond® – Shock pulse measurement, SPM HD®



Gear symptoms SPM HD time signal

The signal

Throughout their lifetime, bearings generate shocks in the interface between the loaded rolling element and the raceway. These shocks 'ring' the SPM transducer which outputs electric pulses proportional to the shock magnitude.

Unlike vibration transducers, the shock pulse transducer responds at its carefully tuned resonance frequency of about 32 kHz, enabling a calibrated measurement of the shock pulse amplitudes.

Shock pulse amplitude is due to three basic factors:

- Rolling velocity (bearing size and rpm)
- Oil film thickness (separation between the metal surfaces in the rolling interface). The oil film depends on lubricant supply and viscosity as well as alignment and pre-load.
- The mechanical state of the bearing surfaces (roughness, stress, damage, loose metal particle).

Input data

The effect of rolling velocity on the signal is neutralized by entering rpm and shaft diameter as input data, with 'reasonable accuracy'. This sets an initial value (HDI), the start of the 'normalized' condition scale.

Technical specifications

Measuring range:	–30 to 110 dBsv (44000 transducer)
Resolution:	0.2 dBsv
Accuracy:	± 1 dB
Transducer type:	SPM 40000/42000/44000 probe transducer and quick connector transducer for adapters
Input data:	rpm, plus bearing type and mean diameter (or ISO bearing number)
Output quantity:	HDM, HDC, Time Signal HD SPM Spectrum HD
Spectrum lines:	400, 800, 1600, 3200, 6400, 12800, 25600
Measuring time:	1 to 10000 rev (default same as FFT)
Symptom enhancement factor:	Off, 1-10 (Default = off)

Output data

HDM/HDC (part of platform)

HDM is a scalar value expressed in decibels. It is the primary value to use to determine the severity of a bearing damage. It represents the highest shock pulses found during the measuring cycle. This value is also used for triggering alarms. HDC is a scalar value expressed in decibels. This value represents the level where 200 shocks/second are present. It is useful to determine lubrication condition.

Time Signal HD

Time signal HD is extremely useful to locate where in the bearing a possible damage is located. In many cases it is also possible to determine the nature of the damage (cracked inner race with spalling all around or a single crack etc.). The Time signal HD is a result of highly advanced digital algorithms where repetitive shocks are enhanced and random signals are suppressed.

SPM Spectrum HD

SPM Spectrum HD is the result of applying FFT algorithms on the Time Signal HD. The SPM HD spectrum is useful to determine where a possible bearing damage is located. It is also useful for trending purposes (applying symptom and band values).

High Definition Order Tracking

This function is primarily used for analysis on variable speed machines and adjusts extremely well to quick changes and variations in the RPM during measurement, see TD 403.

Evaluation

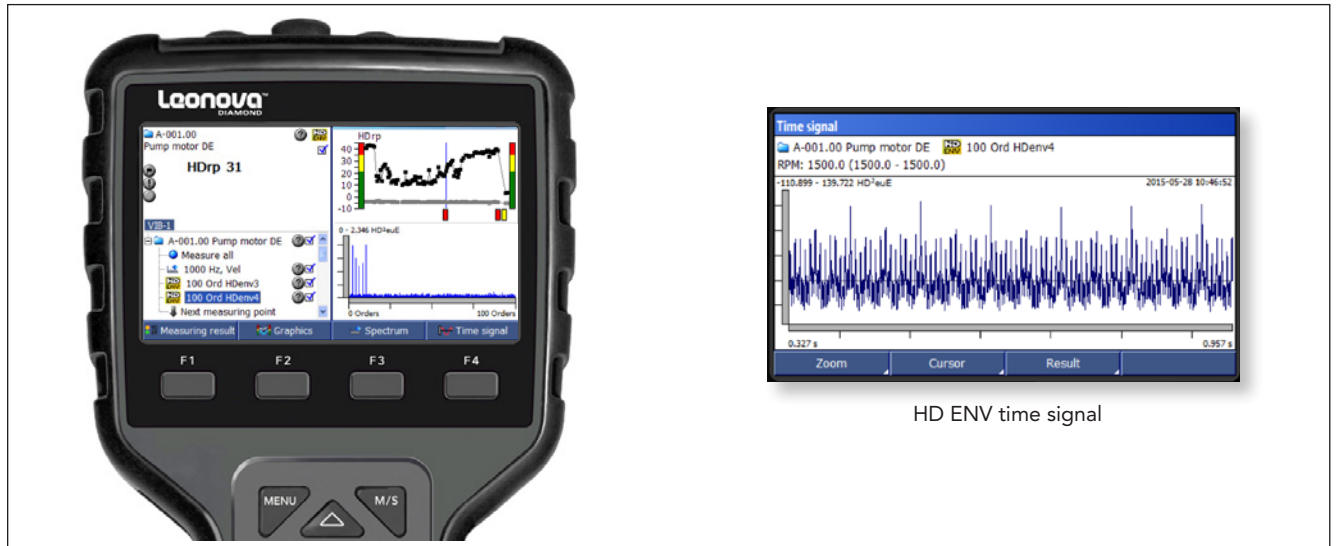
The initial value and the range of the three condition zones (green-yellow-red) was established empirically by testing bearings under variable operating conditions. The maximum value places the bearing into the condition zone. The height of the carpet value and delta (HDM – HDC) indicated lubrication quality or problems with bearing installation and alignment.

Part numbers

DIA195 Shock pulse method SPM HD Expert, unlimited use
DIA295 Shock pulse method SPM HD Expert, limited use
DIA197 Shock pulse method HDM/HDC, unlimited use
DIA297 Shock pulse method HDM/HDC, limited use



Leonova Diamond® – HD ENV



HD ENV time signal

With Leonova, the HD ENV method is offered as an analysing function for either limited or unlimited use. It is a part of the packages Vibration Expert DIA193/293 (TD-365) and Vibration Advanced DIA194/294 (TD-459).

HD ENV is an ideal complement to conventional vibration techniques. Capable of detecting at a very early stage such machine problems which are generally difficult to find in good time with non-enveloping techniques – for example bearing damages and gear damage – the method utilizes cleverly engineered algorithms for digital signal processing to obtain optimal data for trending purposes.

Input data:

A number of predefined filters are available to detect damages or anomalies in different stages of development; two of which are specifically designed for bearing monitoring and two of which are recommended for of non-bearing related problems.

Output data:

HD Real Peak

The unit of measurement is HD Real Peak, a scalar value expressed in decibels. Representing the true highest peak found in the enveloped signal, HD Real Peak is the primary value to use for determining the severity of a bearing or gear damage. It is also used for triggering alarms.

HD Env Time Signal

HD Env Time Signal is extremely useful to locate where in the bearing a possible damage is located. In many cases it is also possible to determine the nature of the damage (a single crack or spalling all around etc.).

HD Env Spectrum

HD Env Spectrum is the result of applying FFT algorithms on the Time Signal HD. The HD Env spectrum is useful to determine where a possible bearing damage is located. It is also useful for trending purposes (applying symptom and band values).

Patented algorithms:

Symptom enhancement

Symptom enhancement is an algorithm that looks for repetitive impacts in the time domain. As a result, random signals are suppressed and repetitive signals enhanced. The output is an HD Env Time signal, where relevant bearing and gear data are displayed.

High Definition Order Tracking

This function is primarily used for analysis on variable speed machines and adjusts extremely well to quick changes and variations in the RPM during measurement, see TD-403.

Random Impact Rejection

Randomly occurring high readings which may cause false alarms are filtered out by means of the random impact rejection algorithm.

Technical specifications

Frequency, upper*:	in orders
Env. high pass filters*:	100, 200, 500, 1000, 2000, 5000, 10000 Hz
Env. band pass filters*:	Filter 1 (5-100 Hz) Filter 2 (50-1000 Hz) Filter 3 (500-10 000 Hz) Filter 4 (5000 - 40 000 Hz)
Averages:	Time synch
Spectrum lines*:	400, 800, 1600, 3200, 6400, 12800, 25600
Frequency units:	Hz, CPM, orders
Saving options:	Full spectrum, time signal and FFT, condition parameters
Transducer types:	Vibration transducer SLD144 or IEPE (ICP®) type transducers with voltage output, or DuoTech accelerometer

*Spectrum lines, frequency and envelope filter limits are regulated by what is included in the above mentioned packages.

Part numbers

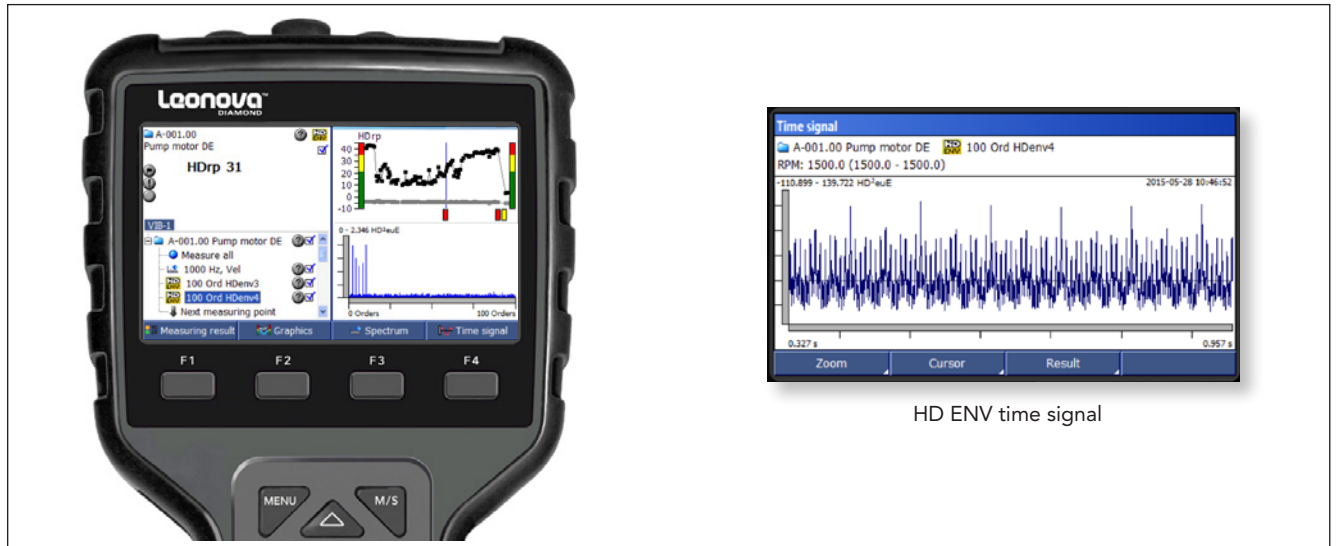
DIA199 HD ENV, unlimited use**

DIA299 HD ENV, limited use**

**Only for upgrading existing Vibration Expert DIA193/293 and Vibration Advanced DIA194/294 packages with HD ENV functionality.



Leonova Diamond® – HD Analysis



The HD Analysis module is a combination of the package Vibration Expert (DIA193/293, TD-365) and SPM HD Expert (DIA195/295, TD-361).

HD ENV

HD ENV is an ideal complement to conventional vibration techniques. Capable of detecting at a very early stage such machine problems which are generally difficult to find in good time with non-enveloping techniques - for example bearing damages and gear damage - the method utilizes cleverly engineered algorithms for digital signal processing to obtain optimal data for trending purposes (see below). Signals buried in machine noise are revealed through high definition digital enveloping, extracting and enhancing the signals of interest from the overall machinery vibration signal while preserving the true highest peaks.

The unit of measurement is HD Real Peak, a scalar value expressed in decibels. Representing the true highest peak found in the enveloped signal, HD Real Peak is the primary value to use for determining the severity of a bearing or gear damage. It is also used for triggering alarms.

See TD-365 for more information about the Vibration Expert package, and TD-511 for more information about HD ENV.

SPM HD

SPM HD Expert is a complement to the SPM HDm/HDc and LR/HR techniques. Advanced digital technique, RPM-based sampling frequency and measuring time automatically adjusted to RPM makes SPM HD particularly well suited for measurement on low speed applications. Extraordinary signal quality and 24 bit A/D conversion provides razor-sharp resolution and exceptional detail in spectrums and time signals.

The SPM HD method produces different types of results:

- **HDm/HDc** are part of the Leonova Diamond platform. For further information, see technical data sheet TD-359.

- **Time Signal HD** is extremely useful to locate where in the bearing a possible damage is located. In many cases it is also possible to determine the nature of the damage (cracked inner race with spalling all around or a single crack etc.). The Time signal HD is a result of very advanced digital algorithms where repetitive shocks are enhanced and random signals are suppressed.
- **SPM Spectrum HD** is the result of applying FFT algorithms on the Time Signal HD. The SPM HD spectrum is useful to determine where a possible bearing damage is located. It is also useful for trending purposes (applying symptom and band values).

For more information about SPM HD, see TD-361.

Patented algorithms

HD ENV and SPM HD both incorporate sophisticated and patented algorithms which contribute to reliable and crystal clear readings:

- **High Definition Order Tracking:** Used primarily for analysis on variable speed machines, HD Order Tracking is capable of handling $\pm 50\%$ RPM variations during data acquisition. The number of orders to be covered is input by the user.
- **Symptom enhancement** looks for repetitive signals in the time domain. As a result, random signals are suppressed and repetitive signals enhanced.
- **Random impact rejection** filters out randomly occurring high readings which may cause false alarms.

Part numbers

DIA140 HD Analysis, unlimited use
DIA240 HD Analysis, limited use



Leonova Diamond® – Vibration ISO 2372



Limits	Class I	Class II	Class III	Class IV	Class V	Class VI	mm/s ² RMS
71	Red	Red	Red	Red	Red	Red	100
45	Red	Red	Red	Red	Red	Red	50
28	Red	Red	Red	Red	Yellow	Yellow	20
18	Red	Red	Red	Yellow	Yellow	Green	10
11	Red	Red	Yellow	Yellow	Green	Green	5
7,1	Red	Yellow	Yellow	Green	Green	Green	2
4,5	Yellow	Green	Green	Green	Green	Green	1
2,8	Yellow	Green	Green	Green	Green	Green	0,5
1,8	Green	Green	Green	Green	Green	Green	
1,1	Green	Green	Green	Green	Green	Green	
0,7	Green	Green	Green	Green	Green	Green	
0,5	Green	Green	Green	Green	Green	Green	
0,3	Green	Green	Green	Green	Green	Green	

Broadband vibration measurement is the most widely used and cost-efficient method for the diagnosis of general machine condition. There are two ISO recommendations concerning this type of machine condition monitoring; the much used ISO 2372 and the more recent ISO 10816, which is a ongoing replacement of the older standard.

In Leonova, vibration measurement according to ISO 2372 is a platform function, always included for unlimited use.

The features are:

- Machine condition is diagnosed on the basis of broadband measurements returning an RMS value of vibration velocity in the frequency range of 10 to 1000 Hz. This is called vibration severity.
- Machines are grouped into six vibration classes.
- A table of limit values is presented for each vibration class, differentiating between acceptable vibration (green range), unsatisfactory vibration (yellow range), and vibration that will cause damage unless reduced (red range).

and vibration that will cause damage unless reduced (red range).

- Measurements are made in three direction (horizontal, vertical, axial). The highest value returned determines machine condition.
- Default limit values for the change from green to yellow and from yellow to red are set automatically when one of the six machine classes is input under the measuring point data.

ISO 10816 is offered as a choice, see TD-363.

Technical specifications

Measurement quantities: Velocity, RMS value in mm/s over 10 to 1000 Hz

Transducer type: Vibration transducer SLD144 or IEPE* (ICP®) type transducers with voltage output

* Integral Electronic PiezoElectric



Leonova Diamond® – Vibration ISO 10816 with spectrum



Broadband vibration measurement is the most widely used and cost-efficient method for the diagnosis of general machine condition.

There are two ISO recommendations concerning machine condition monitoring by this type of measurement; the much used ISO 2372 and the more recent ISO 10816, which is an ongoing replacement of the older standard.

With Leonova, ISO 2372 measurement is a platform function, always included for unlimited use.

ISO 10816 is an option with ordering numbers DIA 133 (unlimited use) and DIA 233 (limited use).

Features of ISO 10816 are:

- Measurements are made in three directions (horizontal, vertical, axial).
- Machine condition is generally diagnosed on the basis of broadband vibration measurements returning an RMS value. ISO 10816 keeps the lower frequency range flexible between 2 and 10 Hz, depending on the machine type. The upper frequency is 1000 Hz.
- ISO 10816 operates with the term vibration magnitude, which, depending on the machine type, can be an RMS value of vibration velocity, acceleration or displacement. If two or more of these parameters are measured, vibration severity is the one returning the relative highest RMS value. For certain machines, ISO 10816 also recognizes peak-to-peak values as condition criteria.
- The standard consists of several parts, each treating a certain type of machines, with tables of limit values differentiating between acceptable vibration (green range), unsatisfactory vibration (yellow range), and vibration that will cause damage unless reduced (red range).

In Leonova, ISO part, machine group and foundation type are input using a multiple choice guide which displays the various ISO definitions and leads to the limit values.

Exceeding the requirements of the ISO standard, Leonova Diamond also provides a 1600 line spectrum up to 10 kHz.

Technical specifications

Measurement quantities:	Velocity, acceleration and displacement
Spectrum unit:	Velocity, mm/s or inch/s
Transducer type:	Vibration transducer SLD144 or IEPE* (ICP®) type transducers with voltage output
Quick mode:	Yes

* Integral Electronic PiezoElectric

Settings

Direction:	Horizontal, vertical, axial
Part:	2, 3, 4, 5, 6
Group:	2, 3, 4, 5, 6
Support:	Rigid, Flexible

Part numbers

DIA133	Vibration ISO 10816 with spectrum, unlimited use
DIA233	Vibration ISO 10816 with spectrum, limited use

Leonova Diamond® – Vibration Expert



EVAM evaluated vibration analysis

- Condition parameters, which are measured and computed values describing various aspects of machine vibration.
- Vibration spectra where significant line patterns are found, highlighted and evaluated with the help of preset fault symptoms.
- Machine specific condition codes (green, yellow, red) and condition values, based on a statistical evaluation of the condition parameters and symptom values.

HD ENV

HD ENV an ideal complement to conventional vibration techniques. Capable of detecting at a very early stage such machine problems which are generally difficult to find in good time with non-enveloping techniques - for example bearing damages and gear damage - the method utilizes cleverly engineered algorithms for digital signal processing to obtain optimal data for trending purposes.

Time signal

This option enables you to see the measured data in the time domain. This is useful in all kinds of analysis. Two cursors are available.

Run up/coast down, Bump test and FRF

Run up/coast down measurements, Bump test and Frequency Response Function (FRF) are three vibration analysis functions offered with Leonova Diamond®, included in the Vibration Expert package. The bump test is employed to check out the typical vibration response of a machine structure at standstill, by hitting it e. g. with rubber mallet (bump test). Run up/coast down records the changes in vibration while the machine is run up to operating speed or after it has been shut off and is slowing to a stop. All of these functions are selected from the menu of an ordinary vibration measurement assignment.

25600 lines/40 KHz

This option expands spectrum resolution to 25600 lines and the upper frequency limit to 40 KHz. Mostly for high speed applications and detection of resonances and harmonies in high frequencies.

Post trigger

This function enables your system to be armed and triggered to measure directly on the trigger point. When this function is enabled on the measurement, the system prepares the measurement with settling time and autogain adjustment, so when the trigger fires, the system can start measuring directly.

Trigger level: 0-1000 mm/s, m/s², μ m

Delay: 0-30 sec

High Definition Order Tracking

High Definition Order Tracking is a part of the Vibration Expert package. For shock pulse measurements, it is included in the SPM HD module DIA195/295. This function is primarily used for analysis on variable speed machines. The method uses multiples of rotational speed (orders), rather than absolute frequency (Hz). The number of orders to be shown is input by the user. Leonova will then automatically set the sampling frequency to an exact multiple of the measured rpm. Order tracking will also minimize the risk of smearing when using FFT averaging.

The package consists of:

- EVAM evaluated vibration analysis (TD-401)
- HD ENV (TD-511)
- 25600 Lines/40 KHz
- Run up/coast down (TD-402)
- Bump test and Frequency Response Function (TD-402)
- High Definition Order Tracking (TD-403)
- Time signal
- Post trigger
- Live Phase
- Cepstrum Analysis
- Time Signal Recording

Part numbers

DIA193 Vibration Expert for unlimited use

DIA293 Vibration Expert for limited use



Leonova Diamond® – EVAM evaluated vibration analysis



With Leonova, the EVAM method is offered as an analysing function for either limited or unlimited use. EVAM is a part of the Vibration Expert package DIA193/293 (TD-365).

The EVAM method generates three sets of machine condition data:

- Condition parameters, which are measured and calculated values describing various aspects of machine vibration.
- Vibration spectra where significant line patterns are found, highlighted and evaluated with the help of pre-set fault symptoms.
- Machine specific condition codes (green, yellow, red) and condition values, based on a statistical evaluation of the condition parameters and symptom values.

For each measuring point, the user can make an individual selection and define the type of data best suited for the surveillance of an individual machine.

Condition parameters

Condition parameters are measured for a selected frequency range. They can be individually activated and are shown in measuring result tables and as diagrams. Available are:

VEL	RMS value of vibration velocity
ACC	RMS value of vibration acceleration
DISP	RMS value of vibration displacement
CREST	Crest value, difference between peak and RMS
KURT	Kurtosis, the amount of transients in the vibration signal
SKEW	Skewness, the asymmetry of the vibration signal
NL1 - 4	Noise level in the four quarters of the frequency range.

Peak and peak-to-peak values are shown in the unit selected for the time signal.

Spectrum analysis with 'symptoms'

For easy pattern recognition in spectra, EVAM supplies a range of predefined 'fault symptoms'. These are instructions to highlight a spectrum line pattern and display the sum of the lines' RMS values as a symptom parameter (which can be evaluated and trended). Most symptoms are automatically configured by using the rpm as a variable. Some require an input, e. g. the number of vanes on a rotor. Suitable symptoms and symptom groups are selected from a menu in Condmaster when the measuring point is set up.

Machine specific condition codes

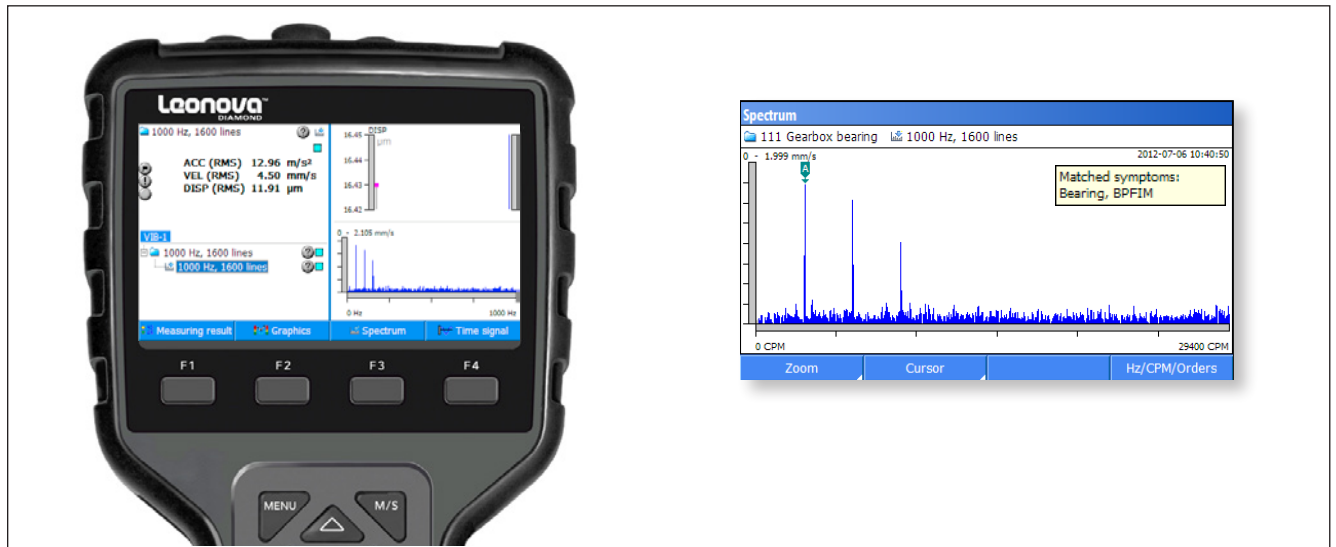
In Condmaster, alarm limits can be set on all active parameters. Once measuring results are collected, an EVAM 'criterion' can be created which compares new parameter values with the statistical mean value and displays a dimensionless condition value against a green - yellow - red scale.

Technical specifications

Frequency limit, lower:	0, 0.5, 2, 3, 5, 10, 20 100 or 200 Hz
Frequency limit, upper:	25, 32, 40, 50, 80, 100, 125, 160, 200, 250, 320, 400, 500, 625, 800, 1000, 1250, 1600, 2000, 2500, 4000, 5000, 8000, 10000, 20000, 40000 Hz
Envelope high pass filters:	100, 200, 500, 1000, 2000, 5000, 10000 Hz
Measurement windows:	Rectangle, Hanning, Hamming, Flat Top
Averages:	Time synch, FFT linear, FFT peak-hold
Spectrum lines:	400, 800, 1600, 3200, 6400, 12800, 25600
Frequency units:	Hz, CPM, orders
Quick mode:	Yes, can be set on/off
Saving options:	Full spectrum, time signal, time signal and FFT, condition parameters
Spectrum types displayed:	Linear, power, PSD, amplitude, cepstrum
Zoom:	True FFT zoom, visual zoom
Transducer types:	Vibration transducer SLD144 or IEPE (ICP®) type transducers with voltage output



Leonova Diamond® – FFT spectrum with symptoms



FFT Spectrum with Symptoms is a vibration analysis function offered with Leonova Diamond, part of DIA194/294.

This function generates three sets of machine condition data:

- Condition parameters, which are measured and calculated values describing various aspects of machine vibration.
- Vibration spectra where significant line patterns are found, highlighted and evaluated with the preset fault symptoms.
- Trending of symptom values. Alarm levels are manually set for evaluation in green - yellow - red.

For each measuring point, the user can make an individual selection and define the type of data best suited for the surveillance of an individual machine.

Condition parameters

Condition parameters are measured for a selected frequency range. They can be individually activated and are shown in measuring result tables and as diagrams. Available are:

VEL	RMS value of vibration velocity
ACC	RMS value of vibration acceleration
DISP	RMS value of vibration displacement
CREST	Crest value, difference between peak and RMS
KURT	Kurtosis, the amount of transients in the vibration signal
SKEW	Skewness, the asymmetry of the vibration signal
NL1 - 4	Noise level in the four quarters of the frequency range.

Peak and peak-to-peak values are shown in the unit selected for the time signal.

Spectrum analysis with 'symptoms'

For easy pattern recognition in spectra, a range of ready made 'fault symptoms' are downloaded from Condmaster. These are instructions to highlight a spectrum line pattern and display the sum of the lines' RMS values as a symptom parameter (which can be trended).

Most symptoms are automatically configured by using the rpm as a variable, for some an input is needed, e. g. the number of vanes on a rotor.

A special symptom group are the bearing symptoms (showing e. g. ball pass frequencies over inner and outer race) for which the Condmaster bearing catalogue contains all need data.

Suitable symptoms and symptom groups are selected from a menu in Condmaster when the measuring point is set up.

Technical specifications

Frequency limit, lower:	0, 0.5, 2, 3, 5, 10, 20, 100 or 200 Hz
Frequency limit, upper:	8, 10, 16, 20, 25, 32, 40, 50, 80, 100, 125, 160, 200, 250, 320, 400, 500, 625, 800, 1000, 1250, 1600, 2000, 2500, 4000, 5000, 8000, 10 000, 20 000 Hz
Band pass filters:	5-100, 50-1000, 500-10000, 5000-40000
Envelope high pass filters:	100, 200, 500, 1000, 2000, 5000, 10 000 Hz
Measurement windows:	Rectangle, Hanning, Hamming, Flat Top
Averages:	time synch, FFT linear, FFT exponential, FFT peak-hold
Spectrum lines:	400, 800, 1600, 3200, 6400, 12800
Frequency units:	Hz, CPM, orders
Quick mode:	Yes, can be set on/off
Saving options:	Full spectrum, time signal, time signal and FFT, condition parameters
Spectrum types:	linear, power, PSD, amplitude, cepstrum
Zoom:	visual zoom
Transducer types:	vibration transducer SLD144 or IEPE (ICP®) type transducers with voltage output

Part numbers

DIA194	Vibration Advanced, unlimited use
DIA294	Vibration Advanced, limited use



Leonova Diamond® – 3 channel simultaneous vibration



Three channel simultaneous vibration monitoring is a Leonova Diamond® function for unlimited use (DIA192) or limited use (DIA292).

This type of measurement allows the user to study machine movement in three dimensions by observing the difference of the phase angles measured on the three channels. It can also save time by measuring three different assignments simultaneously. Three channel simultaneous vibration monitoring requires the Vibration Expert package (DIA193 and DIA293).

Measurement requires the setup of three vibration assignments with identical parameters. The three channel measuring cable CAB88 is used to connect the transducers to the Leonova vibration transducer input. The procedure is the same as for the corresponding measurement with one or two transducer(s).

After measurement, Leonova displays the RMS values for DISP, VEL and ACC for the channels. Three graphs are available for each measurement:

- Spectrum
- Time signal
- Phase spectrum

In the spectrum and time signal, the channels are overlaid in blue, red and green.

Normal setup is:

Z = channel 1

X = channel 2

Y = channel 3

Technical specifications

Frequency limit, lower:	0, 0.5, 2, 3, 5, 10, 20, 100 or 200 Hz
Frequency limit, upper:	25, 32, 40, 50, 80, 100, 125, 160, 200, 250, 320, 400, 500, 625, 800, 1000, 1025, 1600, 2000, 2500, 4000, 5000, 8000, 10000, 20000, 40000 Hz
Envelope high pass filters:	100, 200, 500, 1000, 2000, 5000, 10000 Hz
Envelope band pass filters:	5-100, 50-1000, 500-10000, 5000-40000 Hz
Measurement windows:	Rectangle, Hanning, Hamming, Flat Top
Averages:	time synch, FFT linear, FFT peak-hold
Spectrum lines:	400, 800, 1600, 3200, 6400, 12800, 25600
Saving options for spectrum:	Time signal, peaks only, full spectrum, time signal and FFT, condition parameters
Spectrum types displayed:	linear, power, PSD, amplitude, cepstrum
Zoom:	true FFT zoom, visual zoom
Transducer types:	Vibration transducer SLD144 or IEPE (ICP®) type transducers with voltage output

Part numbers

DIA192	3 channel vibration monitoring, unlimited use
DIA292	3 channel vibration monitoring, limited use
CAB88	3 channel split measuring cable, Lemo, 0.25 m
CAB110	Measuring cable, 8 pin-M12, 1.5 m, straight
CAB93	Measuring cable, 8 pin-2 pin, 1.5 m, straight
CAB82	Measuring cable, 8 pin-2 pin, 1.5 m, spiral



Leonova Diamond® – High Definition Order Tracking



High Definition Order Tracking is part of the modules Vibration Expert, Vibration Advanced, SPM HD Expert and HD Analysis. This function is primarily used for analysis on variable speed machines. The method uses multiples of rotational speed (orders), rather than absolute frequency (Hz). The number of orders to be shown is input by the user. Leonova will then automatically set the sampling frequency to an exact multiple of the measured rpm. Order tracking will also minimize the risk of smearing when using FFT averaging.

The purpose of using orders is to lock the display to the rotational speed (1X) and its multiples, which means that the ordered components in the spectrum always remain in the same position in the display even if the rotational speed varies during measurement.

Two or several spectra from the same machine with variable speed can therefore more easily be compared if they are expressed in orders. Using order tracking, the frequency range will always cover the symptoms of interest, regardless of the rotational speed of the machine.

High Definition Order Tracking adjusts extremely well to quick changes and variations in the RPM during measurement.

In the example shown above, the measuring point is configured for vibration analysis with order tracking. Under 'Measuring point data', Order tracking is marked and the upper frequency is input in orders. The lower frequency is input in Hz or CPM under 'Measuring point data'. 'Variable speed' must be marked and rpm has to be measured.

Leonova displays the spectrum within the selected number of orders. A number of measurements can be displayed in a three dimensional waterfall diagram, where 1X (rpm) and its harmonics remain in the same position in the diagram. The measurements are then saved by the user and can be transferred to Condmaster.



Leonova Diamond® – Recording function



The Recording function is part of the platform, always included for unlimited use. It allows the user to measure and record measuring results over longer periods of time. The recording function is an analysis tool which can show the interaction of various condition parameters over time.

Leonova has six channels on four separate connectors, for

- shock pulse measurement
- speed and temperature measurement
- vibration (three channels)
- analog measurement

Simultaneous measurement can be done on up to four channels.

The recording function for a single quantity, e. g. temperature, is accessed and set up from the default file saved under the respective technique window. To record different quantities at the same time, a measuring point file with all the different techniques activated is required.

Under 'Total' in the recording window, the desired number of measurements is input, alternatively the total recording time in minutes.

Under 'Time between measurements' the interval is input in minutes. 0 minutes means 'as fast as possible'.

The measuring sequence is set by opening the list of available measuring techniques with NEW and selecting techniques in any order. A technique can be used more than once in the sequence.

Recording is started with the M/S key and can be terminated with the 'Cancel' key (F4).

Leonova displays the number of measurements taken and powers down when all are recorded. The batch is then saved by the user and can be transferred to Condmaster.

Leonova Diamond® – Balancing



Single and dual plane balancing are optional Leonova functions for either limited or unlimited use. In case of limited use, credits are deducted for each vibration measurement.

Leonova guides step-by-step through the balancing procedure. One can shift the rotation direction and change the measured parameter from velocity to acceleration or displacement.

Single plane balancing, 4 runs

This method uses one measurement without trial weight to determine the vibration severity (mm/s RMS) of the rotor, followed by three measurements with trial weights at 0°, 120° and 240° to calculate the weight and position of the correction mass.

Single plane balancing, 2 runs

This method uses one measurement without trial weight to determine the vibration severity (mm/s RMS) of the rotor, followed by one measurement with a trial weight to calculate the weight and position of the correction mass. It requires time synchronised vibration measurement (trigger pulse supplied by a pulse from the SPM tachometer probe or a proximity switch) to find the relative phase angle between the two vibration measurements.

Dual plane balancing

The same two run method as used for single plane balancing, but with vibration measurement and weight correction in two planes. These measurements can be made by shifting the vibration transducer or by connecting two transducers.

For all methods, a final run can be made to check the balancing results and, if needed, get the data for further adjustments. Leonova then saves a balancing log file.

In addition to the RMS value, a spectrum is shown to help find the part of vibration that is due to unbalance. For the two run methods, the number of samples for obtaining a time synchronous average is set to 4, minimum.

Leonova calculates a number of alternatives for correcting the unbalance:

- Trial weight: Input rotor diameter, weight and rpm to obtain the suitable trial weight in grams.
- Split the correction mass: Input the number of rotor partitions to distribute the correction mass between two of them.
- Weight removal: Drill hole diameter and depth calculated for various materials.
- Radial displacement: Input the change in radial distance to recalculate the weight.
- Degrees to length: change from angle to length measured along the rotor circumference.
- Keep trial weight: Calculate the correction mass with the trial weight remaining in place.
- Sum up weights: Replace all correction masses on the rotor by one.

Part numbers

- | | |
|--------|---|
| DIA109 | Balancing, single and dual plane, unlimited use |
| DIA209 | Balancing, single and dual plane, limited use |

Leonova Diamond® – Services



The service program Leonova.exe is part of the basic function package for Leonova Diamond. It is used to:

- Print and save balancing and alignment reports
- Load credits and/or functions from the file 'Leonova.txt'
- Upgrade a Leonova software package
- Display and print a credit log containing all events in connection with measurement credits, up to 10000
- Make and reload safety copies of the Leonova files (file extension .lsc)

The operation of the service program is very simple: connect Leonova to the PC, put it in communication mode, then click on the desired service function. Follow the guidance on the screen.

For example, a safety copy of the Leonova file can be sent to SPM for technical advice. Upon reload, you choose which part of your safety copy should be reloaded.

The file 'Leonova.txt' can contain measuring credits and/or Leonova functions that are new for the instrument or changed from limited to unlimited use. It is coded to fit the individual instrument and ordered via the local SPM distributor.

Part numbers

PRO52	Leonova Diamond Service Program
DIA290	Credits
DIA291	Credits refill

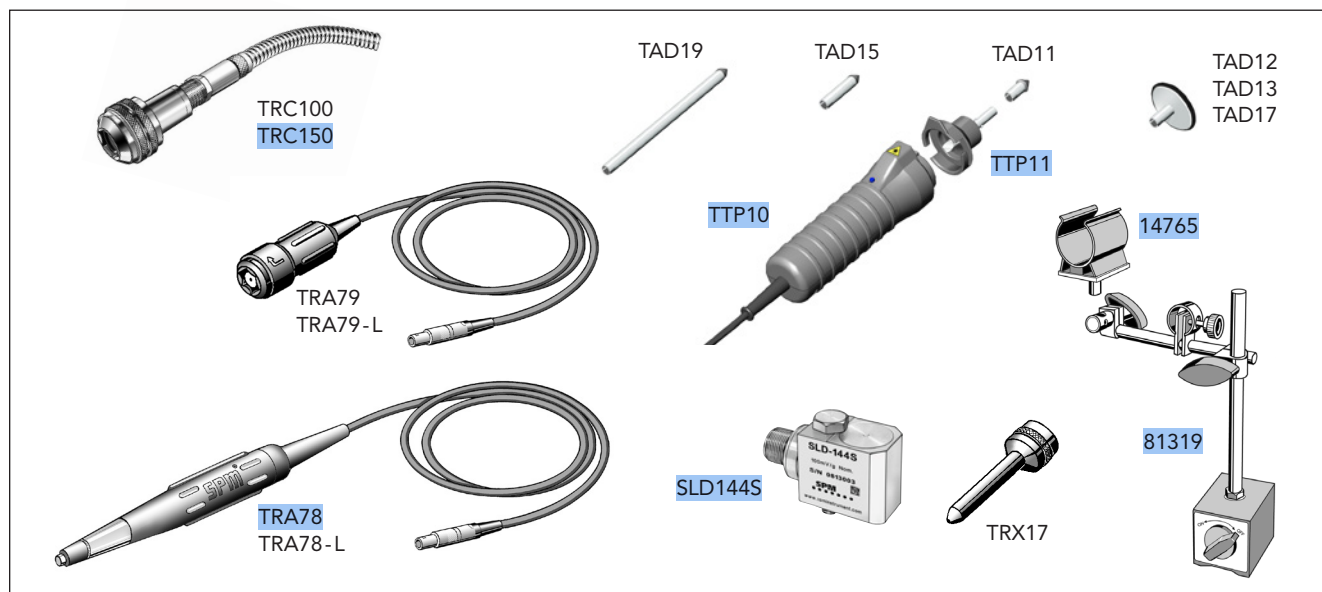
The credits required for a measuring round and the tank status are displayed in Leonova under 'Function and use'. There one can also set the values and time intervals for the 'tank low' warnings.

The amount of credits deducted when the 'Measure' command is given depends on the method used, see table. For balancing, credits are deducted for each vibration reading. The table shows the min. requirement.

Functions with limited use	Credit consumption
SPM HD Expert	2
SPM HDm/HDc	2
Shock pulse method dBm/dBc	1
Shock pulse method LR/HR	2
SPM Spectrum	2
Vibration ISO 10816 with spectrum	1
HD Enveloping	3
EVAM evaluated vibration analysis	2
FFT spectrum with symptoms	2
3-channel vibration measurement	6
Post trigger	25
Orbit analysis / Shaft Centerline Plot	5
Run up / coast down	50
Bump test and Frequency Response Function	25
Balancing, single plain 4 runs	16
Balancing, single plain 2 runs	42
Balancing, dual plane	80
Shaft alignment	30



Leonova Diamond®/Emerald® – Transducers and measuring cables



Shock pulse monitoring

- CAB80 Measuring cable, mini coax - BNC slip on, 1.5 m
- CAB81 Measuring cable, mini coax - BNC 1.5 m
- CAB101 Measuring cable, mini coax - TNC, 1.5 m
- TRA78 Shock pulse transducer with probe, cable length 1.5 m (TD-400)**
- TRA78-L Shock pulse transducer with probe, L=cable length, max. 20 m (TD-400)
- TRA79 Shock pulse transducer with quick connector for measuring adapters, cable length 1.5 m (TD-410)
- TRA79-L Shock pulse transducer with quick connector for adapters, L=cable length, max. 20 m (TD-410)
- EAR12 Headphones with headband (TD-404)
- EAR13 Headphones with helmet brackets (TD-404)
- EAR15 Headphones with neckband (TD-404)
- EAR16 Headset with headband (TD-382)
- EAR17 Headset with helmet brackets (TD-382)
- EAR18 Headset with neckband (TD-382)
- EAS11 Hygiene set for headset and headphones

Vibration monitoring

- SLD144S Vibration transducer with side entry, M8
- TRC100 DuoTech accelerometer excl. cable (TD-518)
- TRC150 DuoTech accelerometer excl. cable (TD-551)**
- TRX17 Probe for SLD vibration transducer, M8
- CAB110 Measuring cable, 8 pin-M12, 1.5 m, straight
- CAB93 Measuring cable, 8 pin-2 pin, 1.5 m, straight
- CAB108-L Measuring cable, 8 pin-M12, L=2, 5, 10 or 20 (length in meter), straight
- CAB109-L Measuring cable, 8 pin-M12, L=2, 5, 10 or 20 (length in meter), angled
- CAB82 Measuring cable, 8 pin-2 pin, 1.5 m, spiral
- CAB83 Measuring cable, 8 pin-2 pin 10 m
- CAB83-L Measuring cable, 8 pin-2 pin (L=length in meter)
- CAB89 2 channel split cable, 8 pin, 0.25 m (Diamond)
- CAB88 3 channel split cable, 8 pin, 0.25 m (Diamond)**
- CAB97 Measuring cable, 8 pin-BNC, 1.5 m, spiral

Vibration transducers, see TD-260.

Magnetic mounting bases, see TD-548.

Current and voltage monitoring

- CAB85 Cable for analog signals, 5 pin -2 x banana, 1.5 m, spiral (Diamond)

Speed and temperature monitoring

- TTP10 Tachometer/Temp. Probe, 1.5m cable (TD-380)**
- TTP12 Tachometer/Temp. Probe, 5m cable (TD-380)
- TAD11 Contact center, rpm, short, 30 mm
- TAD15 Contact center, rpm, long, 60 mm
- TAD19 Contact center, rpm, extra long, 170 mm
- TAD12 Contact wheel m/min.
- TAD13 Contact wheel yd./min
- TAD17 Contact wheel ft./min
- TAD16 Reflecting tape, 5 sheets**
- CAB90 Stroboscope cable 5 pin-phones 3.5 mm, 1.5 m, spiral
- CAB92 Proximity switch cable, 5 pin-M12, 1.5 m, spiral
- CAB95 Keyphasor cable 5 pin-BNC 1.5 m, spiral

Proximity sensors, see TD-383 and TD-384.

Balancing

- 81319 Magnetic base**
- 14765 Holder for tachometer probe TTP10**

Spare parts

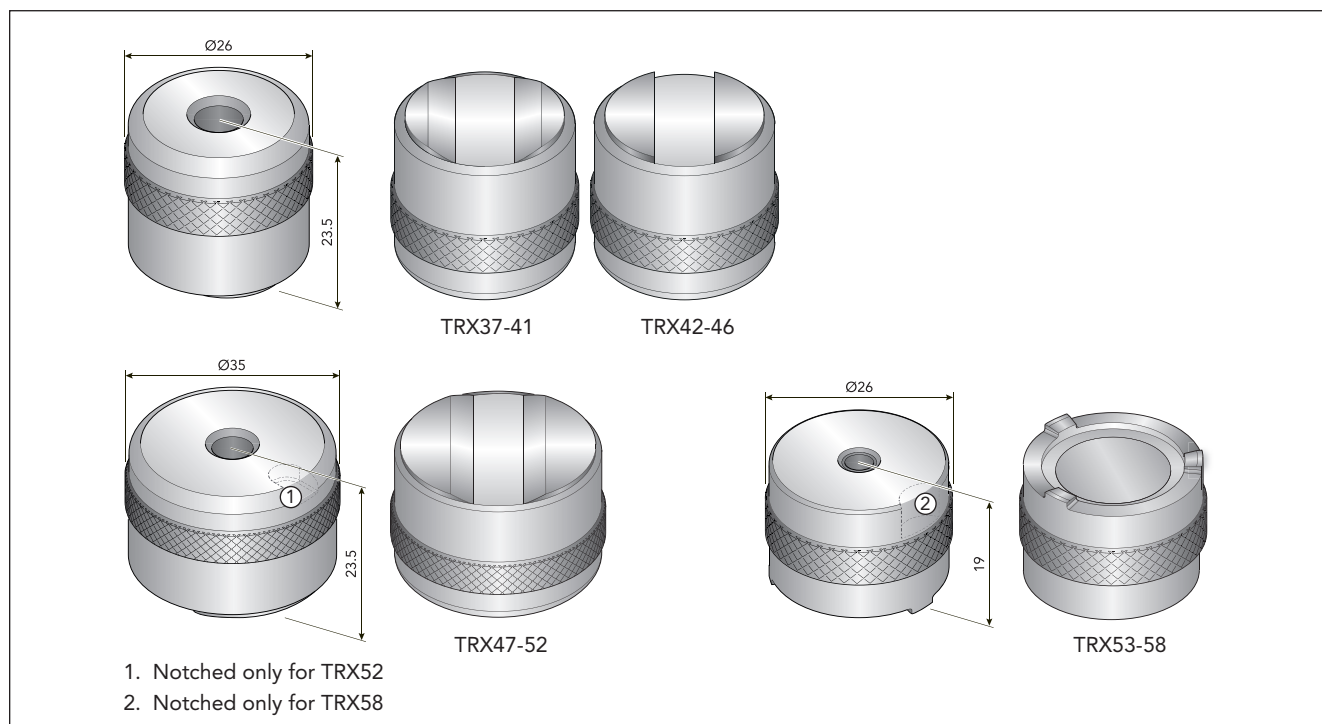
- 13108 Sleeve for probe tip (TRA78)
- TTP11 Contact adapter for TTP10
- CAB79 Cable for TRA78, 1.5 m
- CAB100 Cable for TTP10, 1.5 m, spiral
- CAB103 Cable for TRA79, 1.5 m
- CAB105 Cable for TTP12, 5 m

Others

- CAB94 USB communication cable, 1 m**
- CAB96 Communication cable for 'iLearn'
- LLA450 LineLazer Alignment Kit (TD-525) (Diamond)



Magnetic mounting bases



Two-rail, 25 mm diameter, 13 kg (29 lbs) pull strength

The two rail type magnetic mounting bases are usually utilized on curved surfaces, such as motor and compressor housings, although they are also suitable for flat surfaces.

TRX37	Magnetic mounting base, M6
TRX38	Magnetic mounting base, M8
TRX39	Magnetic mounting base, M10
TRX40	Magnetic mounting base, UNF 1/4
TRX41	Magnetic mounting base, UNC 5/16

Flat, 25 mm diameter, 13 kg (29 lbs) pull strength

The flat magnetic mounting bases are optimal for smooth, flat surfaces.

TRX42	Magnetic mounting base, M6
TRX43	Magnetic mounting base, M8
TRX44	Magnetic mounting base, M10
TRX45	Magnetic mounting base, UNF 1/4
TRX46	Magnetic mounting base, UNC 5/16

Two-rail, 35 mm diameter, 25 kg (55 lbs) pull strength

The two rail type magnetic mounting bases are usually utilized on curved surfaces, such as motor and compressor housings, although they are also suitable for flat surfaces. A large diameter enables magnetic mounting on two heat sinks for an electric motor, for example.

TRX47	Magnetic mounting base, M6
TRX48	Magnetic mounting base, M8
TRX49	Magnetic mounting base, M10
TRX50	Magnetic mounting base, UNF 1/4
TRX51	Magnetic mounting base, UNC 5/16
TRX52	Magnetic mounting base for triaxial transducers, UNF 10-32

Three-rail, 25 mm diameter, 10 kg (22 lbs) pull strength

The three rail type magnetic mounting base are usually utilized on curved or uneven surfaces.

TRX53	Magnetic mounting base, M6
TRX54	Magnetic mounting base, M8
TRX55	Magnetic mounting base, M10
TRX56	Magnetic mounting base, UNF 1/4
TRX57	Magnetic mounting base, UNC 5/16
TRX58	Magnetic mounting base for triaxial transducers, UNF 10-32

Technical specifications

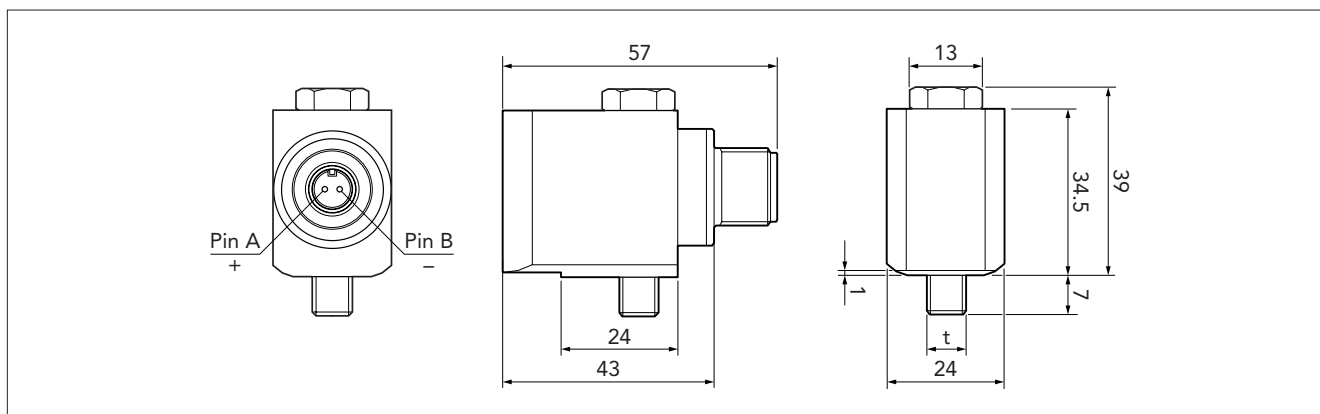
Material:	stainless steel
Temperature:	up to 100 °C
Grip:	knurled edge

Options

16065	Mounting disc for 26 mm diameter magnetic mounting base (TRX37-46 and TRX53-58)
18033	Mounting disc for 35 mm diameter magnetic mounting base (TRX47-52)



Vibration transducer, SLD144S



The vibration transducer SLD144S is a piezo-electric accelerometer of compression type with side entry and built-in electronics, designed for vibration monitoring of industrial machinery. The electrical signal is isolated from the transducer housing.

The transducer is installed on a flat machine surface and connected via a twisted pair cable with a 2-pin connector. The flat machine surface must be min. 30 mm in diameter (min. 16 mm in diameter when using mounting base 15757, 15802, or 17769). The transducer has a captured bolt for installation. For vibration transducers with top entry, see TD-635.

Technical specifications

Nominal sensitivity,	
main axis:	10 mV/m/s ² * =100 mV/g
Transverse sensitivity:	max. 10%
Base strain sensitivity:	0.01 m/s ² /μ strain typical
Linear frequency range:	2 Hz to 10 kHz (± 1 dB)
Max. peak acceleration:	600 m/s ² = 60 g
Settling time:	3 sec
Bias point:	10 to 13 V (typical 12V)
Temperature range:	-40° to +125 °C (-40° to 257 °F)
Power requirements:	24 V, 2 to 5 mA
Isolation:	case isolated, > 10 Mohm
Casing:	stainless acid-proof steel Sandvik 1802, EN:1.4523
Sealing:	IP66/67
Thread (t):	M6x1.0, M8x1.25 or UNF 1/4"-28
Torque limit:	10 Nm (7.4 lbf·ft)
Weight:	200 grams (7 oz)
Connection:	2-pin connector, MIL-C-5015 style
Cable length:	max. 100 m (328 ft)
Cable capacitance:	210 pF/m

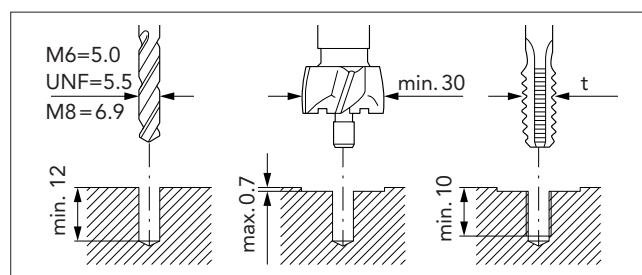
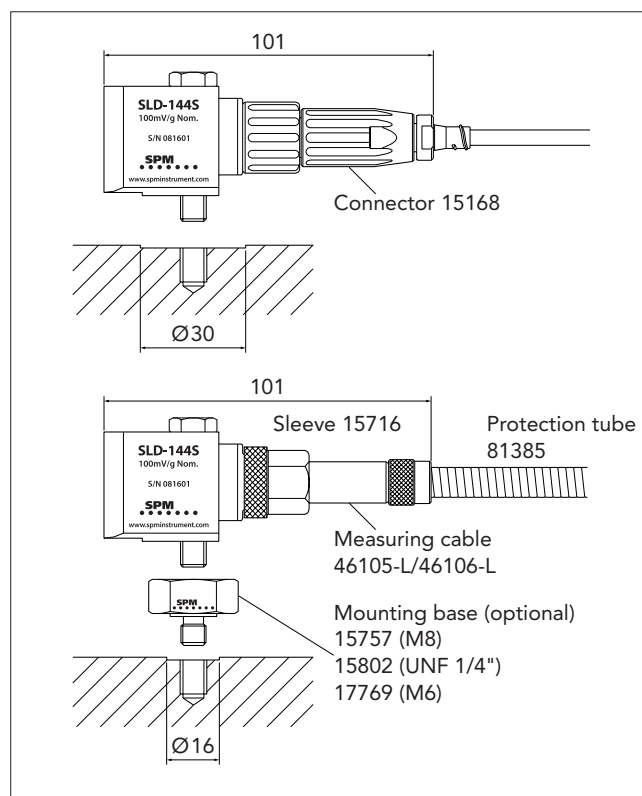
* Individual value given on the calibration chart.

ARTICLE NO: SLD144S - XXX
A B

A. Part number SLD144S
B. Thread (t) M6, M8, or UNF

SERIAL NO: XXXXX
Year Week Number

Installation examples



Installation tools

- 81393 Holder for counterbore
- 81394 Pilot for M6 and UNF 1/4"-28
- 81395 Pilot for M8
- 81396 Counterbore, diameter 30 mm

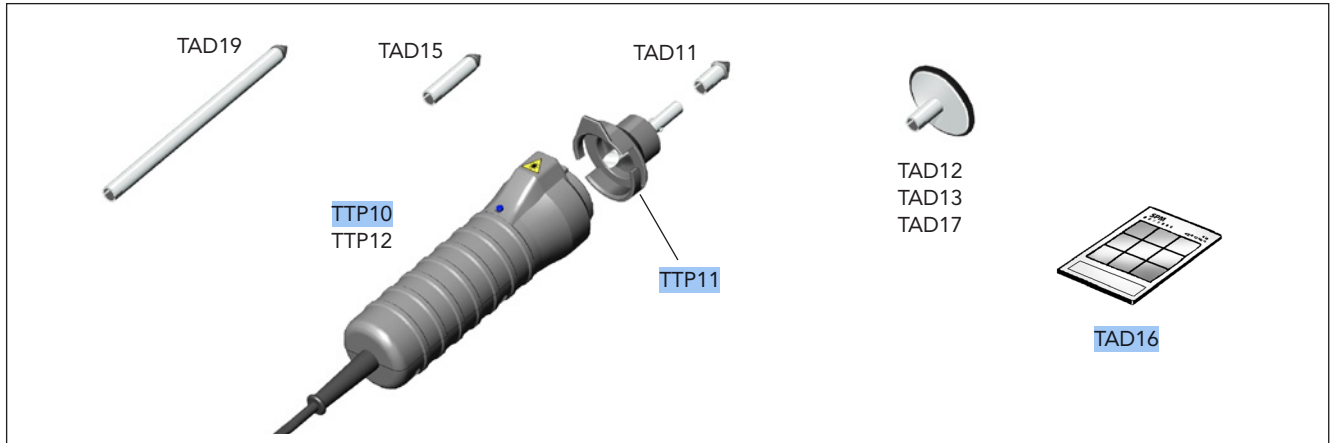


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Tachometer and Temperature Probe TTP10 / TTP12



The Tachometer and Temperature Probe TTP10/12 is used together with Leonova Diamond® and Emerald® instruments for optical or contact measurement of the rate of rotation and for contact measurement of peripheral speed. It also has a built-in temperature sensor.

Optical measurement of the rate of rotation

A laser light beam is directed against a reflecting tape on the rotating object, from a distance of 30-2000 mm and from an angle of 5-75°.

Contact measurement of rpm

The contact adapter TTP11 with a rubber tipped contact center, TAD-11/15/19, is attached onto the probe and then held against the center of a shaft end or a wheel.

Contact measurement of peripheral speed

The contact adapter TTP11 with contact wheel is held against the circumference of a shaft, a belt, etc. The speed is read out in units, depending on which contact wheel is used: TAD-12/13/17.

Temperature measurement

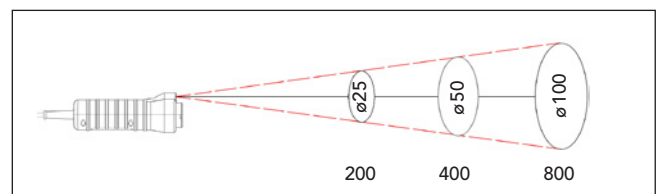
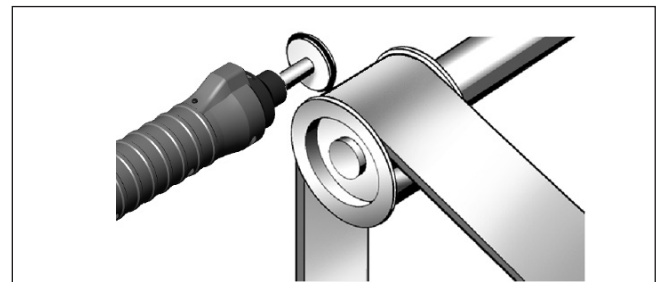
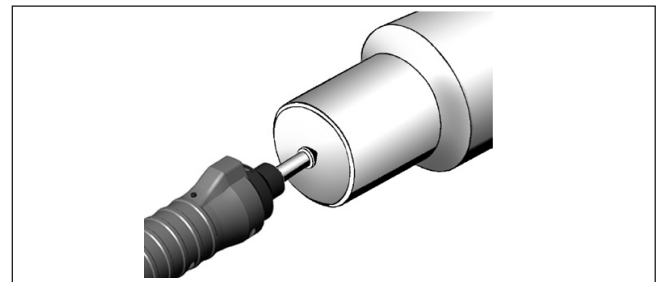
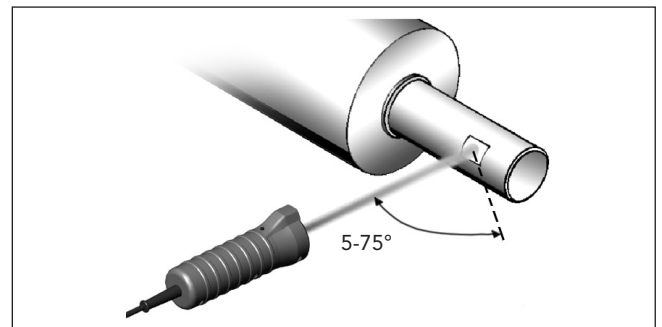
The Tachometer and Temperature Probe TTP10/12 is also used together with Leonova Diamond/Emerald for temperature measurements with a thermopile element in the range -20 to +300 °C.

Part numbers

TTP10	Tachometer and Temperature Probe, incl. TTP11 and cable, spiral 1-2 m
TTP12	Tachometer and Temperature Probe, incl. TTP11 and cable, straight 5 m
TAD11	Contact center, rpm, short, 30 mm
TAD15	Contact center, rpm, long, 60 mm
TAD19	Contact center, rpm, extra long, 170 mm
TAD12	Contact wheel m/min.
TAD13	Contact wheel yd./min
TAD17	Contact wheel ft./min
TAD16	Reflecting tape for thin shafts, 5 sheets
TTP11	Contact adapter (spare part)
CAB100	Cable, spiral (spare part for TTP10)

Technical specifications

Measuring range, rpm	max. 100 000 (pulses) optical
Measuring distance, rpm	30 to 2000 mm
Indicator, rpm	blue LED
Measuring range, temp.	-20 to +300 °C



Measuring accuracy, temp.	± 2,5° C*
Dimensions	137 x 50 mm, 179 x 50 mm incl. TTP11
Operating temperature	0 to + 40 °C
Weight	160 g (TTP10), 300 g (TTP12)
D:S	8:1

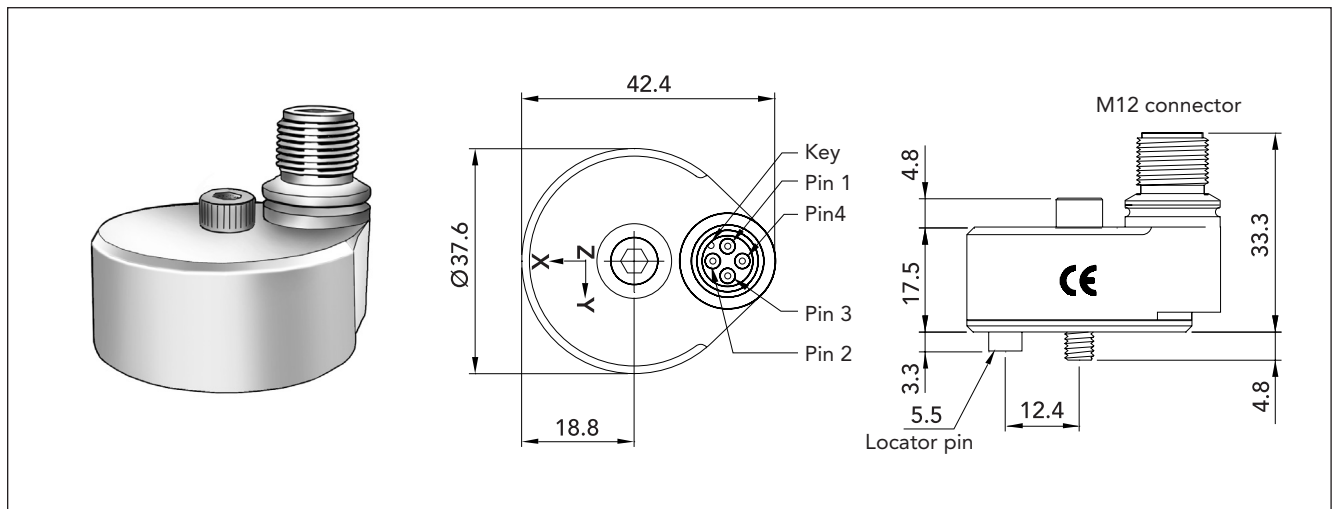
* If RF emission is present at 625MHz to 655MHz, the accuracy is possibly reduced to ±2.5°C – 10% of full scale

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Triaxial Vibration Transducer 90546



SPM 90546 is a low noise triaxial vibration transducer in rugged design with broad frequency response. It features a versatile M12 connector and an external case in a thick shell for high resistance to impact. Designed for both route-based and permanent-mount applications, this triaxial accelerometer hosts three general purpose, 100 mV/g vibration sensors with $\pm 10\%$ sensitivity tolerance. It has EMI/RFI and ESD protection.

Technical specifications

Dynamic

Sensitivity, $\pm 10\%$, 25° C	100 mV/g
Acceleration range	60 g peak
Amplitude nonlinearity	1%
Frequency response:	
Z Axis ± 3 dB	2-10 000 Hz
X and Y axis ± 3 dB	2-7 000 Hz
Transverse sensitivity, max	7% of axial

Electrical

Power requirement:	
Voltage source	18-30 VDC
Current regulating diode	2-5 mA
Electrical noise, equiv. g nominal:	
Broadband 2.5 Hz to 25 kHz	160 μ g
Spectral 10 Hz	10 μ g/ $\sqrt{\text{Hz}}$
100 Hz	2.0 μ g/ $\sqrt{\text{Hz}}$
1000 Hz	1.5 μ g/ $\sqrt{\text{Hz}}$

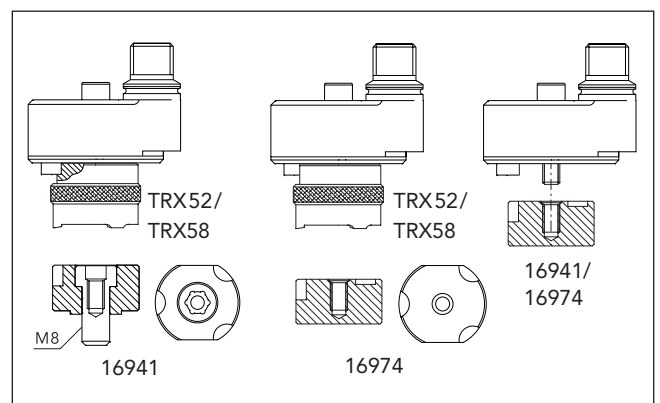
Output impedance, max	400 Ω
Bias output voltage	12 VDC
Grounding	Case isolated, internally shielded
Turn-on time	<1 sec

Environmental

Temperature range	-50 to 120 °C
Vibration limit	500 g peak
Shock limit	5000 g peak
Electromagnetic sensitivity, equiv. g.	100 μ g/gauss
Sealing	Hermetic
Base strain sensitivity, max	0.0005 g/ μ strain

Physical

Weight	124 g
Case material	316L stainless steel
Mounting	UNF 10-32



Output connector	4 pin, M12 male
Mating connector	M12S female
Recommended cabling	4 conductor, shielded
Accessories supplied	Captive screw, calibration data

Connections

Axis X, power/signal	Connector pin 1
Axis Y, power/signal	Connector pin 2
Axis Z, power/signal	Connector pin 3
Common (all channels)	Connector pin 4
Ground	Shell

Part numbers

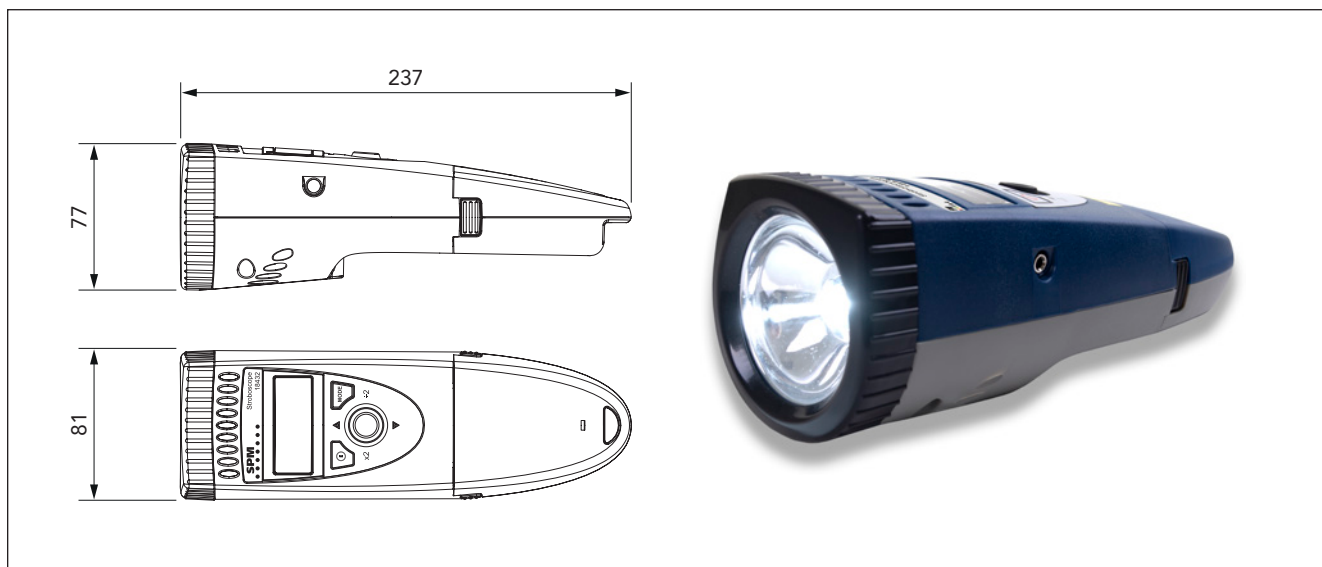
90546	Triaxial vibration transducer
CAB91	Cable for 90546, 8-pin/4-pin M12 connectors
16941	Mounting foot for 90546, screw
16974	Mounting foot for 90546, glue
90510	Connector M12S female, straight

Magnetic mounting bases for triaxial transducers, see TD-54

***Available to add to your package. Ask your SPM representative for pricing.**



Stroboscope 18432



18432 is a sophisticated stroboscope with many functions, yet remains easy to use. The stroboscope provides excellent brightness, exceptional features, robust construction and extra long battery life. The unique one-touch joystick-type button allows simple operation for fast fractional RPM tuning.

The large, bright, backlit, 6-digit alphanumeric LCD display shows the flash rate and operational mode for internal

tuning, external TTL pulse input, tachometer display and $\times 2 \div 2$ functions. Eight memory positions offers rapid recall of user-defined frequencies.

The stroboscope has a removable, rechargeable battery pack that provides up to two hours of continuous use, depending on the flash rate.

Technical specifications

Internal mode

Flash range: 100 to 12500 fpm
Accuracy: the greater of ± 0.5 fpm or $\pm 0.01\%$ of reading
Resolution: 0.1 fpm
Display update: continuous

External/tachometer mode

Flash range: 5.0 to 12500 fpm - external flash rates to 0 are acceptable
Tachometer: 5 to 250000 rpm - no flash
Accuracy: the greater of ± 0.1 fpm or $\pm 0.01\%$ of reading
Display update: approx. 1 second
External input: 0 to 5 volt TTL compatible (12V pk max), 1 μ sec min pulse width, positive edge triggered

General

Flash lamp life: approx. 100 million flashes
Flash duration: 10 to 30 microseconds
Display: 6 digit alphanumeric backlit LCD
Indicators: low battery, on target indicator, locked on, external mode, tachometer mode, $\div 2 \times 2$
Adjustment: four quadrant pressure sensitive joystick button adjusts flash rate, $\times 2$ and $\div 2$
Battery: removable 6Vdc rechargeable NiMH battery pack
Light power: 150 mJ/flash up to 3000 fpm, 7.9 Watts @ 6000 fpm

Memory: saves eight programmable flash rates and last flash rate at power down
Output pulse: 350 μ sec positive pulse, 5 Vdc typical
Operation time: approx. 120 min @ 1800 fpm and 60 min @ 6000 fpm with fully charged batteries
Recharge time: approx. 4 h
Battery charger: 100 to 240 VAC (50 to 60 Hz), incl. four interchangeable adapters
Weight: 544 g (incl. battery)

Part numbers

18432 Stroboscope incl. battery pack and carrying case
CAB90 Stroboscope cable for Leonova Diamond/Emerald 5 pin - phones 3.5 mm, 1.5 m, spiral

Spare parts

90666 Rechargeable NiMH battery pack
90667 Xenon lamps, 2 pcs

***Available to add to your package. Ask your SPM representative for pricing.**



Headset with microphone



EAR16/17/18 are specially selected headsets for Leonova Diamond/Emerald, providing excellent sound reproduction even in noisy environments. The headphones are equipped with microphone for voice recording of comments to the measuring points.

- Individually sprung headband wires of stainless sprung steel provide an even distribution of pressure around the ears. Steel headband wires retain their resilience better than plastic through a wide temperature range.
- Low, two-point fasteners and easy height adjustment with no protruding parts.
- Soft, wide foam and fluid-filled sealing rings with built-in pressure-equalizing channels provide low pressure, effective sealing and ideal comfort.
- Connection cord, 0.75 to 1.4 m, of soft spiral polyurethane with a 3.5 mm stereo plug.

The headsets are tested and approved in accordance with PPE directive 89/686/EEC and EMC directive 89/336/EEC to meet the demands for CE labelling.

Headset with headband, EAR16

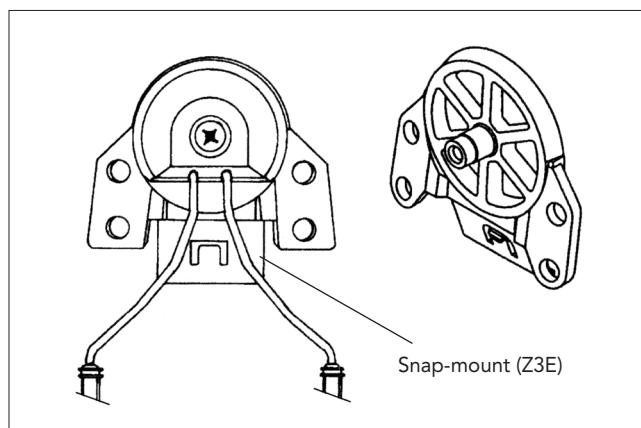
EAR16 is a headset with two parallel connected earphones and a microphone. It has a collapsible headband for convenient storage when you are not using the headset.

Headset, EAR18

EAR18 is a headset with two parallel connected earphones and a microphone. It has a neckband for use with or without helmet. A soft headband with velcro is optional.

Headset for helmet, EAR17

The headset with microphone EAR17 is a headset with two parallel connected earphones and a microphone. The headset fits most safety helmets available in the market today. The headphones have standard snap-mounts (Z3E) and are adapted to a specific helmet by simple manipulation.



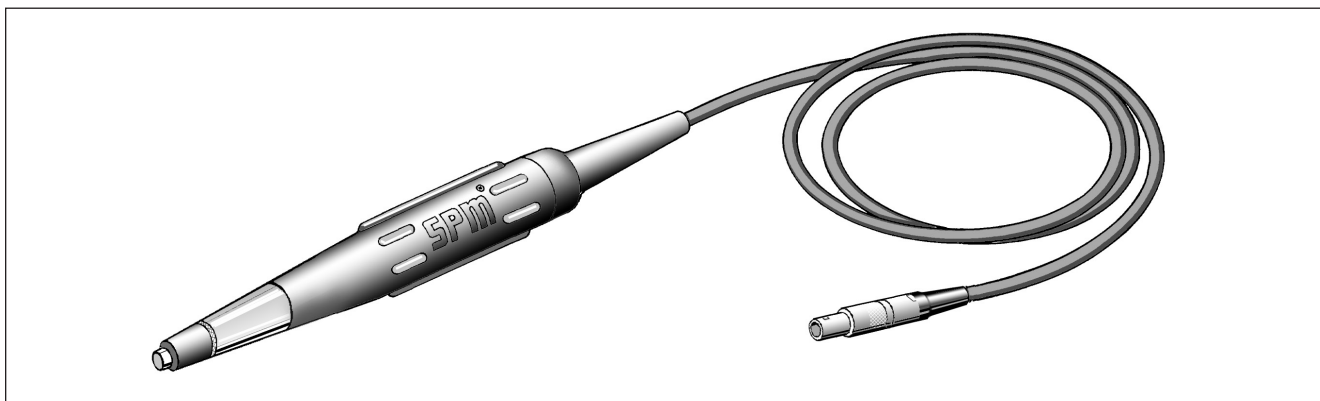
To mount the headphone, snap the helmet attachment into the slot on the helmet. Note! The cups can be set in three positions: working position, ventilation position and parking position. When in use, the cups must be placed in working position. Press the wires inward until you hear a click on both sides. Make sure that the cup and the headband wire in working position are not pressing on the helmet lining or the edge of your hard hat so that leakage can occur. Parking position should not be used if the cups are damp inside after an intense period of use.

Part numbers

EAR16	Headset with headband
EAR17	Headset with helmet brackets
EAR18	Headset with neckband
EAS11	Hygiene set (consists of two sets of attenuating cushions and snap-in sealing rings.)
91015	Headband with velcro for EAR18



Shock Pulse Transducer with Probe TRA78



TRA78 is a handheld probe, used together with Leonova Diamond® and Emerald®. The probe is directionally sensitive and must be held aligned against the bearing and not deviate from this direction by more than $\pm 5^\circ$. The probe tip is spring loaded and moves within a sleeve made of chloroprene rubber (neoprene) and tolerates 110°C (230°F). Standard cable length is 1.5 m. Other lengths up to 20 m can be ordered.

Measuring points for the probe transducer should be located directly on the bearing housing and the signal path should be in a direct line to the contact area. The strongest shock pulses are emitted from the loaded region of the rolling interface in the bearing. The loaded region for radial load covers a sector of $\pm 45^\circ$ from the load direction. For axial load the region is 360° . Since the transfer of shock pulses to the bearing housing is limited by the width of the bearing, direct radiation of pulses will be restricted to a sector of $\pm 60^\circ$ from the perpendicular to the rolling surface. Measuring points should be clearly marked, for instance with the SPM marker BEX19.

To maintain a steady pressure on the tip, press the probe tip against the measuring point until the rubber sleeve is in contact with the surface. Avoid pressing the probe tip against cavities and fillets which are smaller than the probe tip.

Technical specifications

Coaxial cable: PVC, standard length 1.5 m (5 ft) or other length, max 20 m (65.6 ft.)

Measuring range: Max. 85 dBsv

Temp. range: -30° to $+70^\circ\text{C}$

Connector: Mini coax

Dimensions: 260 x 25 mm (10.2 x 1 in)

Weight: 275 g (9.7 oz)

Part numbers

TRA78 Shock pulse transd. with probe, cable length 1.5 m

TRA78-L Shock pulse transd. with probe, L = cable length, max 20 m

BEX19 Measuring point marker

BEX20 Center drill

BEX21 Rotary file

Spare parts

TRA15 Transducer with probe

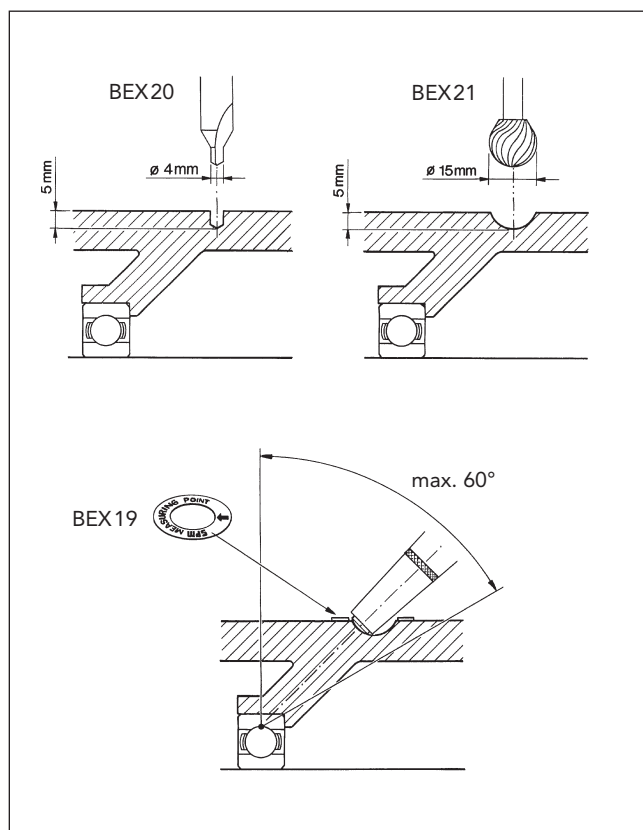
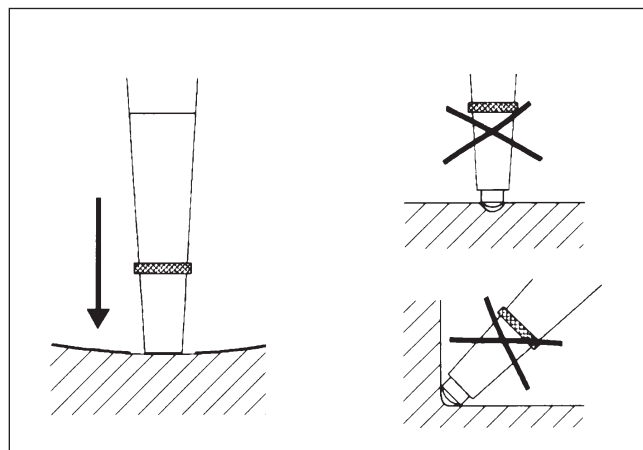
16626 Probe handle

CAB79 Cable for TRA78, mini coax connector, 1.5 m (5 ft)

13108 Sleeve for probe tip

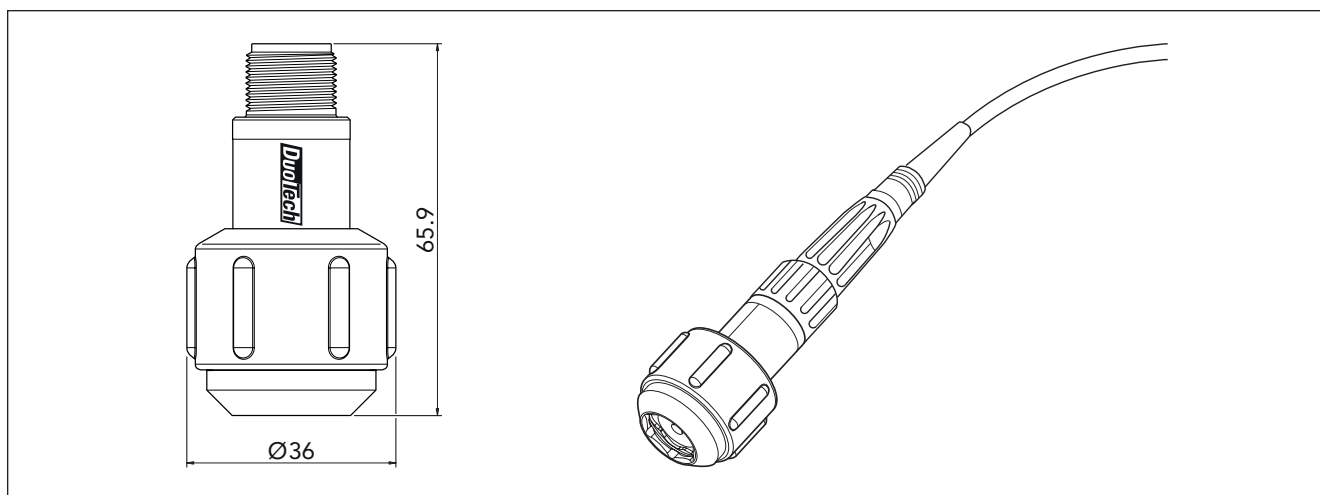


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DuoTech accelerometer with quick connector TRC150



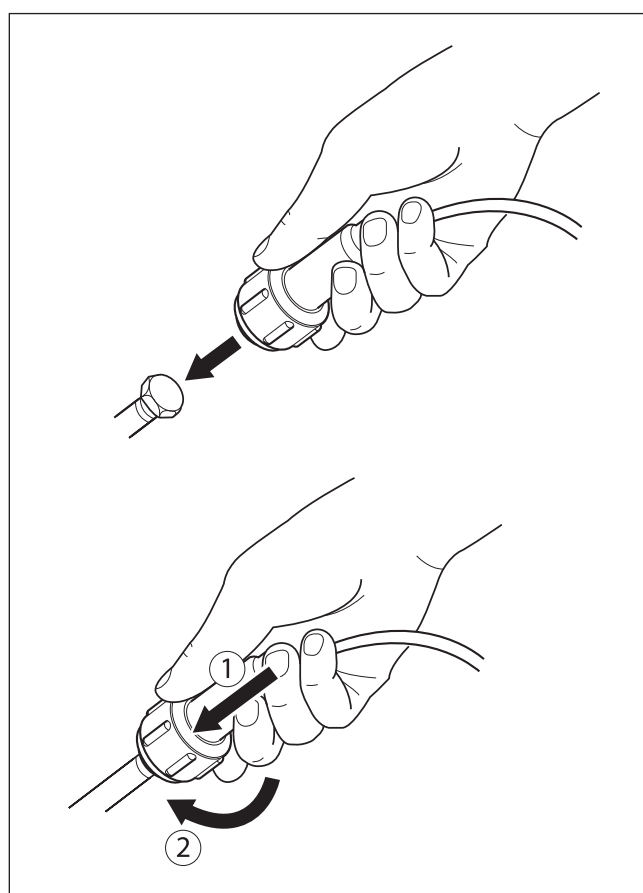
TRC150 is a DuoTech accelerometer with quick connector, used together with the handheld instrument Leonova Diamond and Emerald, for measurements on permanently installed adapters. The quick connector forms a bayonet connection together with the permanently installed adapter. The accelerometer is internally isolated in a Faraday shield providing maximum protection from ground loops and RF interference.

To attach the transducer to an adapter, push the transducer firmly onto the adapter and twist it clockwise. Twist counter clockwise to unfasten the transducer.

Technical specifications

Nom. sensitivity, main axis:	100 mV/g*
Measuring range, vibration:	600 m/s ² = 60 g
Measuring range, shock pulse:	-12 to 75 dB
Transverse sensitivity:	max. 10%
Base strain sensitivity:	0.01 m/s ² /μ strain
Frequency range, vibration:	2Hz to 3 kHz (±3dB)
Settling time:	3 sec.
Bias point:	10 to 13V (typical 12V)
Power supply:	24 V, 4 to 5 mA
Design:	sealed IP66/67
Temperature range:	-40° to +125 °C
Material:	stainless acid proof steel, Sandvik Grade:1802, EN:1.4523
Material, sleeve:	Isothane 3085AU
Sealings:	Viton (fluor rubber)
Connector:	2-pin MIL-C-5015
Cable length:	max. 100m
Weight:	165 g

*Individual value given on the calibration chart.

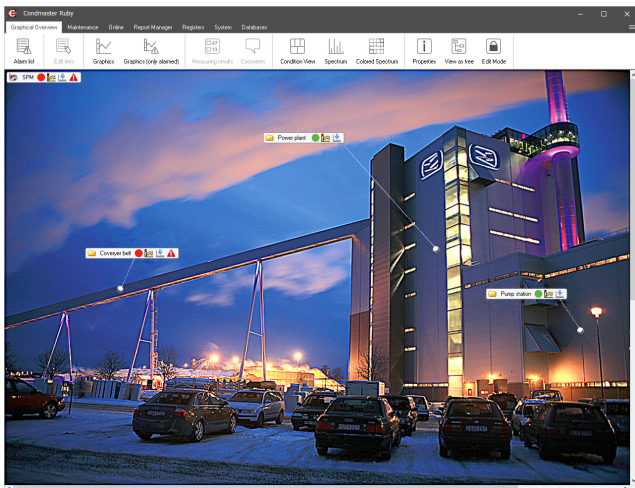


Part numbers

TRC150	DuoTech accelerometer with quick connector for SPM adapters
CAB93	Measuring cable, Lemo 8 pin-2 pin, 1.5m, straight
CAB82	Measuring cable, Lemo 8 pin-2 pin, 1.5m, spiral
CAB83	Measuring cable, Lemo 8 pin-2 pin, 10m
CAB83-L	Measuring cable, Lemo 8 pin-2 pin (L=length in meter), 1.5m



Condmaster[®] RUBY



Technical Data sheets 2026



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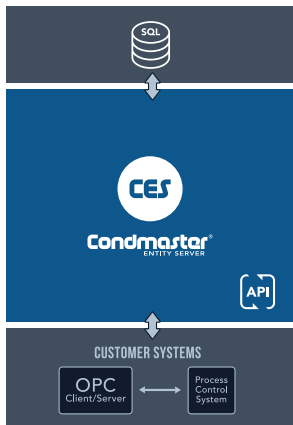
Office: +239 508 1200



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Condmaster Entity Server (CES)



Condmaster Entity Server handles centralized license, database, and user administration, and also supports external user directories such as Microsoft Azure AD and Active Directory Federation Services. This backend centralization means simplified identity management for admins and a streamlined user login experience.

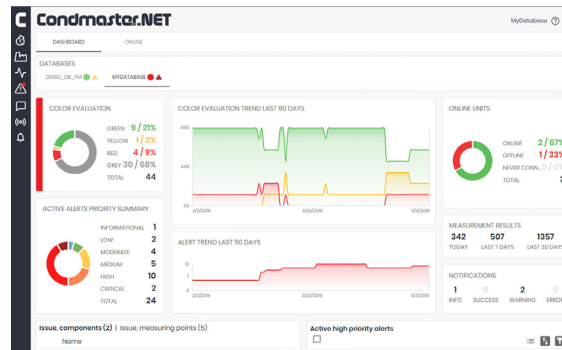
CES Admin Portal is where you perform many of your initial configurations when setting up your condition monitoring system. It is here you activate and manage your license, manage database connections, users, user groups, and perform some of the general system settings, etc.

Condmaster® Ruby

A comprehensive analysis, diagnostics, and troubleshooting software communicating with our portable instruments and online systems for condition monitoring.

Addressing the growing need for interoperability and real-time data integration in the Industry 4.0 age, Condmaster adds options that further simplify the exchange of data with automation assets, IIoT devices, and control systems in smart manufacturing. Condmaster Ruby has an easy-to-implement, Industry 4.0-friendly REST API enabling other resources to access Condmaster data for further processing or analysis.

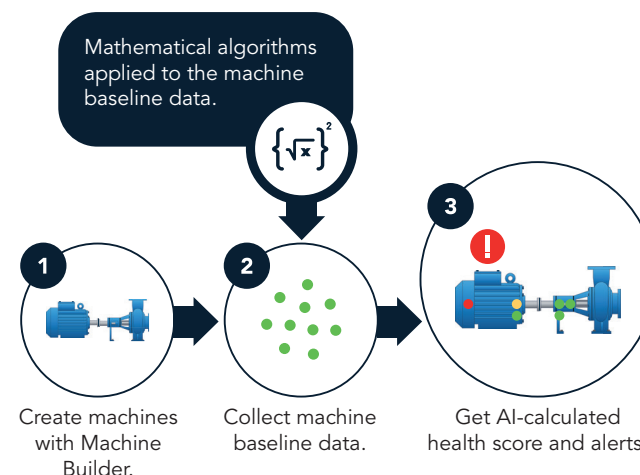
Condmaster.NET



Condmaster.NET is a web application and app for iOS and Android that allows users to access measuring data via web browsers. It presents an intuitive overview of color evaluation and alerts and offers basic analysis functionality. Application-specific, customized dashboards can be created to visualize and monitor process data.

Quickly assess the condition of critical assets, view status, alerts, and issues across all measuring points, components, and machines, and perform fundamental analysis using spectrums, time signals, trends, and alerts.

The Decision Support System (DSS)



DSS provides users with predictions about machine damage and general machine health. The overall purpose of the DSS is to relieve maintenance personnel from having to deal with vast amounts of measurement data to analyze and find insights into root causes and problem-solving. Instead, the DSS uses artificial intelligence, statistical analysis, and other algorithms to mine this data for information, automatically detecting the patterns that most warrant maintenance efforts.

In Condmaster Ruby, these standalone features form DSS:

- Machine Builder
- Signal Quality Test
- Machine baseline
- Health score
- Alerts
- Entity rules

Machine Builder

Complete machines can be created from a component library. The feature generates suitable measuring points, measurement assignments, and machine fault symptoms. Assembled machines are added to the Graphical Overview as illustrations with associated color zones.

Signal Quality Test

Signal Quality Test is a background process that continuously checks for ski slopes and bias problems. The function can also identify issues with faulty or incorrectly connected transducers. The main purpose is to determine if the signal is of good quality.

Machine baseline

Machine baseline is where normal machine behavior can be determined. The machine baseline data, collected during a learning phase, can be used to automatically calculate deviations and potentially raise alerts for the machine fault symptoms and condition parameters.

Health score

Health score is calculated by applying mathematical algorithms to the collected baseline data. The health score is presented in blue-green-yellow-orange-red-dark red colors for a detailed evaluation. The health score corresponds to a normalized floating-point value from 0 to 1, where 0.2 – visualized in green – represents the normal condition of the machine baseline.

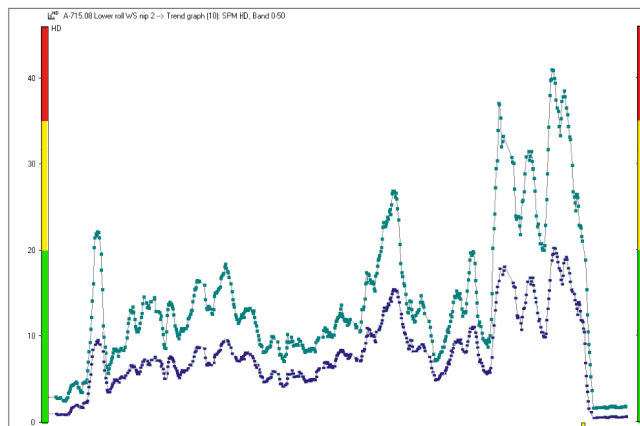
Alert management

Alert management inform users about deviating machine conditions, highlighted DSS predictions, and other device events. Alerts offer flexible handling of actions based on the condition and criticality of the machine, which includes setting priority levels and status indications on individual alerts.

Entity rules

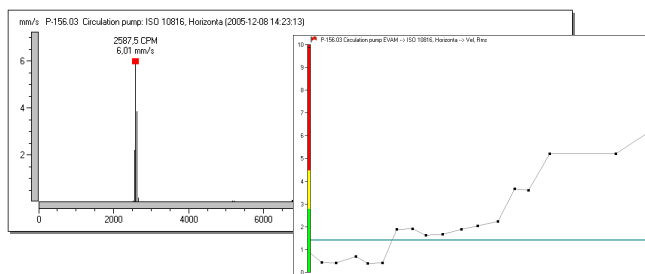
Entity rules is a feature that is used as a hub for expanding and customizing Condmaster with event-driven functions, as well as creating custom integrations with other IIoT systems. With Entity rules, it is possible to monitor a variety of events and automatically invoke actions based on these events.

HDm/HDc



The SPM HD[®] method is a patented further development of the Shock Pulse Method (SPM) in being less sensitive to interference from other signals and therefore unique in its ability to measure from very low rpm (0.1 - 20.000 RPM range). The scalar decibel value HDm represents the highest shock pulses found during the measuring cycle, and is the primary value for determining the severity of bearing damage, and also to trigger alerts. HDc, also a scalar dB value, is useful to determine lubrication conditions.

ISO2372, ISO10816



Broadband vibration measurement is the most widely used and cost-efficient method for the diagnosis of general machine condition. There are two ISO recommendations concerning this type of machine condition monitoring; the much used ISO 2372 and the more recent ISO 10816, which is an ongoing replacement of the older standard.

Features of ISO 10816 are:

- Measurements are made in three direction (horizontal, vertical, axial).
- Machine condition is generally diagnosed on the basis of broadband vibration measurements returning an RMS value. ISO 10816 keeps the lower frequency range flexible between 2 and 10 Hz, depending on the machine type. The upper frequency is 1000 Hz.
- ISO 10816 operates with the term vibration magnitude, which, depending on the machine type, can be an RMS value of vibration velocity, acceleration or displacement. If two or more of these parameters are measured, vibration severity is the one returning the relative highest RMS value. For certain machines, ISO 10816 also recognises peak-to-peak values as condition criteria.

RPM measurement

RPM measurement stands for Revolutions Per Minute measurement, and it refers to the process of determining how many full rotations a rotating component (such as a shaft, motor, or gear) completes in one minute. SPM Instrument offers several methods for measuring rotational speed (RPM) as an integral part of its condition monitoring systems. RPM measurement is essential for correctly evaluating bearing and vibration data, especially when using technologies such as SPM HD and HD Order Tracking.

Temperature measurement

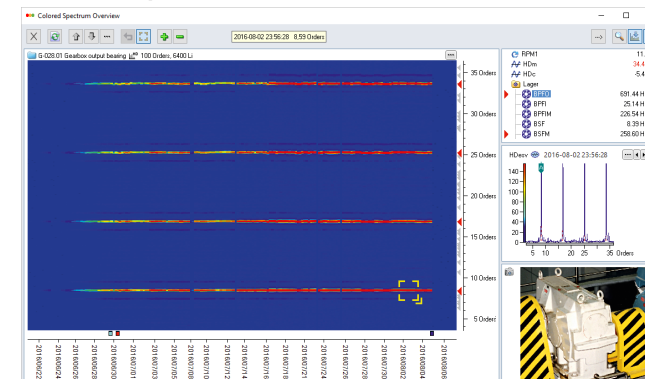
Temperature measurement is a critical component of SPM Instru-

ment's condition monitoring solutions, providing essential data to assess machine health and prevent failures. SPM integrates temperature monitoring across both portable and online systems to enhance predictive maintenance strategies. By incorporating temperature data alongside vibration and shock pulse measurements, SPM Instrument enables comprehensive condition assessments. This integration allows for early detection of issues such as overheating, lubrication failures, or misalignments, thereby supporting proactive maintenance and reducing downtime.

User-defined measurement

User-defined measurement is a flexible feature that allows users to integrate and monitor custom process parameters beyond standard measurements such as vibration, shock pulse, temperature, and RPM. These measurements can include variables like pressure, flow, load, or other analog signals relevant to specific applications. It offer a high level of flexibility, enabling broader and more tailored condition monitoring with SPM Instrument systems, and can be integrated with existing systems using OPC or analog inputs to collect data from installed sensors.

Colored Spectrum Overview (CSO)

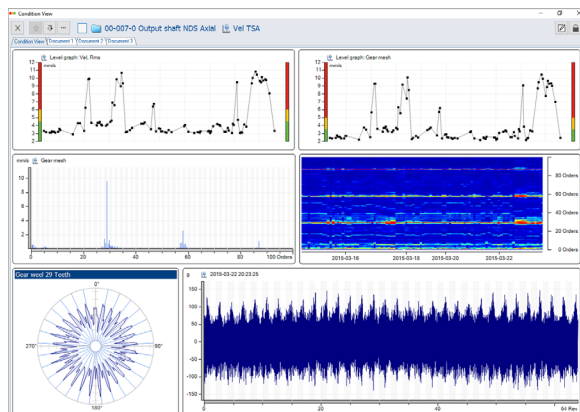


The purpose of Colored Spectrum Overview is to simplify the process of identifying in spectrums the patterns and trends which indicate damages. It clearly distinguishes between signals that are always present in the machine and signals caused by developing damages. The module function provides a good overall picture of the machine condition development. Among many features in

Colored Spectrum Overview are:

- Zooming possibilities in x, y and z axes.
- Logarithmic or power spectrum.
- Symptoms activation to simplify damage identification.

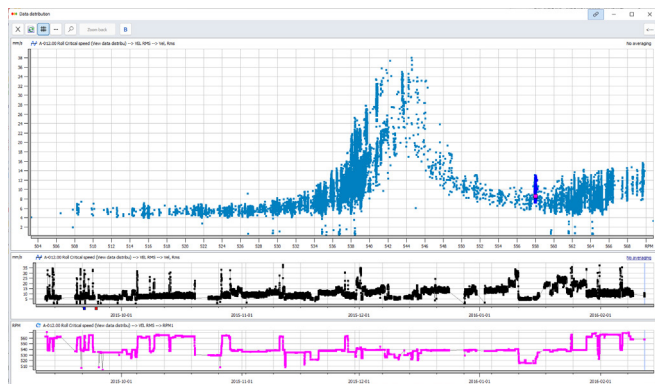
Condition View



Condition View is a powerful tool that combines multiple graph types and measuring assignments in a single window to show current machine condition, recent condition development, or maintenance actions, for example, to clarify or justify planned maintenance activities. It provides a valuable overview of the most interesting condition data and any complementary information for a particular measuring point.

For one or more measuring points, you can freely combine trend graphs, spectrums, time signals, Colored Spectrum Overview graphs, circular plots, and more as desired.

Data distribution



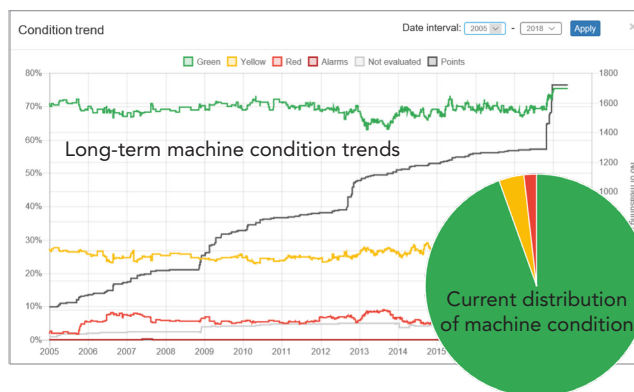
Data distribution is a powerful tool for discovering and analyzing relationships between different variables. This, in turn, is valuable for streamlining work with process optimization and alert limits.

For example, analyzing how the resonance frequencies of a pump or a roll in a paper machine vary with differences in the RPM or other parameters related to the process, such as flow (for a pump), can provide valuable insights to get the most out of your assets.

Online

The online module in Condmaster Ruby connects with Ethernet-compatible systems, including Airius sensors and the CMS online system, to monitor bearings, vibrations, and analog/digital signals. It supports advanced measurement, filtering, and alert functions, ensuring relevant and accurate monitoring. Results are evaluated in Condmaster Ruby and presented using color-coded diagnostics. Module MOD187 also enables Seamless and Time Signal Recording, offering precise, automated condition analysis based on standards and machine data.

Plant performer



Plant performer visualizes technical and economic KPIs (Key Performance Indicators) within the OEE/TEEP area. It demonstrates the benefits of condition monitoring and communicates its technical and economic impact to all levels of the organization. Data entered in Condmaster Ruby is used to monitor machine performance, condition, and maintenance costs. Statistics are shown in lists, charts, or timelines with filtering options. Data can be exported between databases and integrated via API. API examples include MTBF, vibration levels, operating condition, and total loss of contribution.

SAP and AMOS links

The SAP and AMOS links in Condmaster Ruby enable direct communication with SAP/AMOS systems. When an alert is triggered, the user clicks a button to send it to SAP/AMOS, which returns a work order number. Once the task is completed, a comment is sent back to Condmaster, the alert is cleared, and the comment is logged. No extra data input is needed, and standard messages like "Bearing replaced" can be used. Specific functions must be set up in SAP/AMOS, but Condmaster only provides protocol descriptions, not the actual implementations.

LinX

When running the Intellinova Standard/Compact online system, Condmaster offers LinX to handle filtering of the measurement results received from the Commander Unit. The purpose is to dispense with insignificant information. It serves as a middleware platform that enables communication between different software systems, both internal and external. By using Linx, we can streamline workflows, reduce manual data handling, and ensure that critical data is transferred reliably between systems.

For example, Linx is used to:

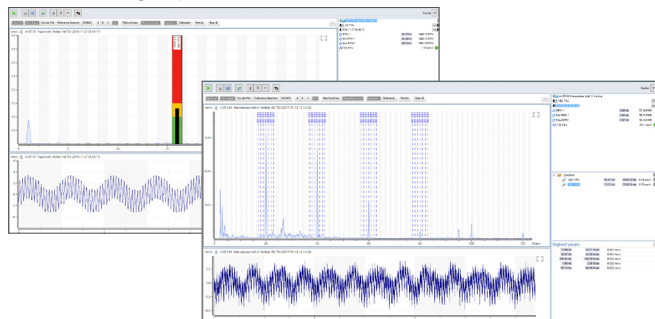
- Connect Condmaster Ruby with other business systems such as ERP, maintenance management systems (CMMS), or cloud platforms.
- Automate tasks, such as transferring machine condition data, generating reports, or sending alerts based on predefined conditions.
- Facilitate custom integrations for customers who require specific data flows or formats.

Voice recording

For each measurement, the user can input a comment as text or voice recording. When implemented, the function 'Recording' can be used to automatically record a stated number of measuring results or measure over a stated time.

LEVEL 1

FFT with symptoms



FFT Spectrum with symptoms is a vibration analysis function offered with Leonova and Intellinova. It is a reduced form of EVAM, lacking the statistical evaluation by means of criteria.

This function generates three sets of machine condition data:

- Condition parameters, which are measured and calculated values from the time domain, describing various aspects of machine vibration.
- Vibration spectra where significant line patterns are found, highlighted and evaluated with preset fault symptoms.
- Trending of symptom values. Alert levels are manually set for evaluation in green – yellow – red.

For each measuring point, users can make an individual selection and define the type of data best suited for the monitoring of an individual machine. Alternatives include

- FFT
- enveloping HD ENV
- time synchronous averaging
- band values and averaging of measurement results for improved alert reliability. Random high readings caused by resonance or other sources of disturbance are filtered out, minimizing the number of false alerts.

Condition parameters are measured for a selected frequency range. They can be individually activated and are shown in measuring result tables and as diagrams. Available are:

VEL	RMS value of vibration velocity
ACC	RMS value of vibration acceleration

DISP	RMS value of vibration displacement
CREST	Crest value, difference between peak and RMS
KURT	Kurtosis, the amount of transients in the vibration signal
SKEW	Skewness, the asymmetry of the vibration signal
NL1 - 4	Noise level in the four quarters of the frequency range

Peak and peak-to-peak values are shown in the unit selected for the time signal. Values can be displayed in dB according to European or US Navy standard as well as user defined.

Spectrum analysis with symptoms: For easy pattern recognition in spectra, a range of ready made 'symptoms' are available in Condmaster Ruby. These are instructions to highlight a spectrum line pattern and display the sum of the lines' RMS values as a symptom parameter (which can be trended). Most symptoms are automatically configured by using the rpm as a variable, for some an input is needed, e.g. the number of vanes on a rotor.

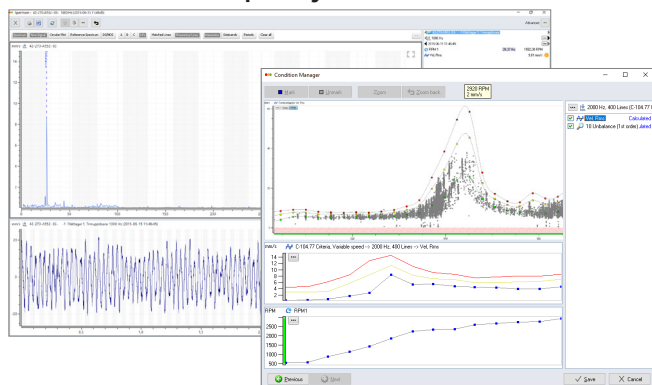
Phase is a time delay expressed in degrees of rotation. Leonova or Intellinova calculates the time delay between the passage of the tachometer pulse and the peak of the frequency component of interest from the vibration transducer at the speed of rotation. The value presented is a relative angle, not an absolute, because there is no compensation for phase lag in the transducer or the electronic circuits. Phase difference in between two signals can also be displayed.

HD ENV is capable of detecting machine problems at a very early stage, which are generally hard to find in good time with non-enveloping technologies – the method utilizes cleverly engineered algorithms for digital signal processing to obtain optimal data for trending purposes.

Order Tracking is primarily used for analysis on variable speed machines. The method uses multiples of rotational speed (orders), rather than absolute frequency (Hz). The number of orders is input by the user. Order Tracking also minimizes the risk of smearing in spectrums.

LEVEL 2

EVAM (incl. Multi-channel measurements, High resolution and frequency, HD ENV)



With Leonova and Intellinova, EVAM (Evaluated Vibration Analysis Method) is offered as an analysing function. The method generates three sets of machine condition data:

- Condition parameters, which are measured and calculated values describing various aspects of machine vibration.
- Vibration spectra where significant line patterns are found, highlighted and evaluated with the preset fault symptoms.
- Machine specific condition codes (green – yellow – red) and condition values, based on a statistical evaluation of the condition parameters and symptom values.

For each measuring point, the user can make an individual selection and define the type of data best suited for the surveillance of an individual machine. Alternatives include

- enveloping HD ENV
- time synchronous averaging
- band values and averaging of measurement results for improved alert reliability. The number of false alerts is minimized by filtering out randomly high readings caused by disturbance.

Condition parameters are measured for a selected frequency range. They can be individually activated and are shown in measuring result tables and as diagrams. Available are:

VEL	RMS value of vibration velocity
ACC	RMS value of vibration acceleration
DISP	RMS value of vibration displacement
CREST	Crest value, difference between peak and RMS
KURT	Kurtosis, the amount of transients in the vibration signal
SKEW	Skewness, the asymmetry of the vibration signal
NL1 - 4	Noise level in the four quarters of the frequency range

Peak and peak-to-peak values are shown in the unit selected for the time signal. Values can be displayed in dB according to European or US Navy standard as well as user defined.

For easy pattern recognition in spectra, EVAM supplies a range of ready-made 'fault symptoms'. These are instructions to highlight a spectrum line pattern and display the sum of the lines' RMS values as a symptom parameter (which can be evaluated and trended). Most symptoms are automatically configured by using the rpm as a variable. Suitable symptoms and symptom groups are selected in Condmaster Ruby when the measuring point is set up. As an alternative, cepstrum analysis can be used for gearboxes.

In Condmaster Ruby, alert limits can be set on all active parameters. Once measuring results are collected, an EVAM 'criterion' can be created that compares new parameter values with the statistical mean value and displays a dimensionless condition value against a green – yellow – red scale.

Phase is a time delay expressed in degrees of rotation. Leonova or Intellinova calculates the time delay between the passage of the tachometer pulse and the peak of the frequency component of interest from the vibration transducer at the speed of rotation. The value presented is a relative angle, not an absolute, because there is no compensation for phase lag in the transducer or the electronic circuits. Phase difference in between two signals can also be displayed.

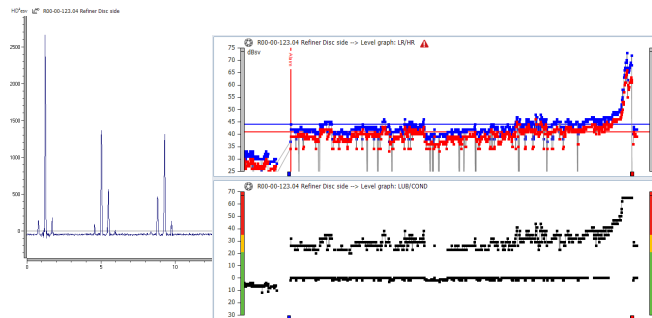
HD ENV is capable of detecting machine problems at a very early stage, which are generally hard to find in good time with non-enveloping technologies – the method utilizes cleverly engineered algorithms for digital signal processing to obtain optimal data for trending purposes.

Order Tracking is primarily used for analysis on variable speed machines. The method uses multiples of rotational speed (orders),

rather than absolute frequency (Hz). The number of orders is input by the user. Order Tracking also minimizes the risk of smearing in spectrums.

LEVEL 3

LR/HR HD and Lubmaster



LR/HR HD combines the LR/HR method with SPM HD Expert to diagnose rolling element bearings and analyze oil film condition with high precision. Like the LR/HR method, it measures both strong individual shock pulses (LR) and the continuous shock carpet (HR), and includes models for calculating optimal lubrication.

Key benefits include:

- 24-bit A/D conversion with HD technology for ultra-high-resolution spectra and time signals.
- High Definition Order Tracking for accurate analysis on machines with variable speed.
- Symptom Enhancement, an algorithm that highlights repetitive impacts while suppressing random noise.

Measurement method:

Uses the same transducer and procedure as the dBm/dBc and LR/HR methods. It identifies:

- LR: Low rate of strong pulses (~40 pulses/sec)
- HR: High rate of weaker pulses (~1000 pulses/sec)

Both are measured in dBsv.

Input data

Requires RPM and bearing type, preferably entered using the ISO bearing number linked to the Condmaster catalogue.

Evaluation output:

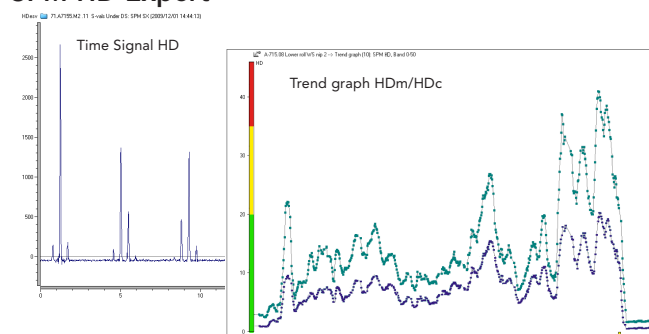
- General bearing condition (CODE)
- Oil film condition (LUB)
- Surface damage level (COND)

LUBMASTER calculates remaining bearing life based on lubricant type, viscosity, load, and temperature, and evaluates the effect of changing lubricant properties.

Calibration

If load is low or signal quality is poor, a compensation factor (COMP) is applied to ensure accurate evaluation by adjusting for unusually weak signals based on bearing and lubricant data.

SPM HD Expert



SPM HD Expert is a complement to SPM HDm/HDc and LR/HR. Advanced digital technique, RPM-based sampling frequency and measuring time automatically adjusted to RPM makes SPM HD particularly well suited for measurement on low speed applications. Extraordinary signal quality and 24 bit A/D conversion provides razor-sharp resolution and exceptional detail in spectrums and time signals.

The signal

Throughout their lifetime, bearings generate shocks in the interface between the loaded rolling element and the raceway. These shocks 'ring' the SPM transducer which outputs electric pulses proportional to the shock magnitude.

Shock pulse amplitude is due to three basic factors:

- Rolling velocity (bearing size and rpm).
- Oil film thickness (separation between the metal surfaces in the rolling interface). The oil film depends on lubricant supply and viscosity as well as alignment and pre-load.
- The mechanical state of the bearing surfaces (roughness, stress, damage, loose metal particle).

Input data

The effect of rolling velocity on the signal is neutralized by

entering rpm and shaft diameter as input data, with 'reasonable accuracy'. This sets an initial value (HDI), the start of the 'normalized' condition scale.

High Definition Order Tracking is a function used with Leonova Diamond, Leonova Emerald and Intellinova, primarily for analysis on variable speed machines. The method uses multiples of rotational speed (orders), rather than absolute frequency (Hz). The number of orders to be covered is input by the user. HD Order Tracking also minimizes the risk of smearing in the spectrums.

Condition Manager enables users to experiment freely in order to find the optimal alert setup for any given application. This "learning phase" can continue until the criteria is saved. When it is saved, the criteria is activated and Condmaster starts to evaluate measuring results according to the criteria setup. If at some later time it turns out the alert settings yield unsatisfactory results, the criteria can be edited.

Output data

The SPM HD method produces different types of results:

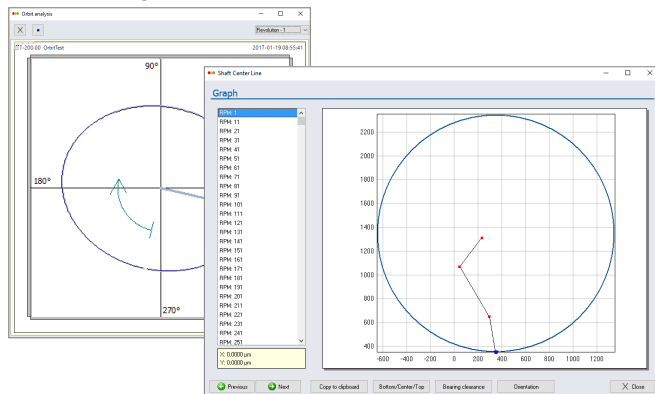
- HDm/HDc is part of the Condmaster Ruby platform.
- Time Signal HD is extremely useful to locate where in the bearing a possible damage is located. In many cases it is also possible to determine the nature of the damage (cracked inner race with spalling all around or a single crack etc.). The Time signal HD is a result of very advanced digital algorithms where repetitive shocks are enhanced and random signals are suppressed.
- SPM Spectrum HD is the result of applying FFT algorithms on the Time Signal HD. The SPM HD spectrum is useful to determine where a possible bearing damage is located. It is also useful for trending purposes (applying symptom and band values).

Evaluation

The initial value and the range of the three condition zones (green – yellow – red) was empirically established by testing bearings under variable operating conditions. The maximum value places the bearing into the condition zone. The height of the carpet value and delta (HDm minus HDc) indicates lubrication quality or problems with bearing installation and alignment.

LEVEL 4

Orbit Analysis and Shaft Centerline Plot



Orbit Analysis is a vibration measurement function offered as a module for Condmaster Ruby. The resulting orbit graph shows the movement of the shaft's centerline and is used to detect failures like rubs, unbalance, misalignment or oil whip on machinery with journal bearings.

Measurements are normally performed with Leonova Diamond, Intellinova Standard or Intellinova Parallel EN on the buffered outputs of a machine protection system. Intellinova Parallel EN requires a Displacement Signal Interface for measurements on buffered outputs of a machine protection system.

Measurements can also be made with e.g. accelerometers to get a two-dimensional graph of the mechanical forces on the bearing housing. Required are two channel simultaneous vibration measurement and two transducers placed at an angle of 90° to each other, plus a trigger signal from a tachometer probe.

Settings include transducer type, signal unit and filter type, either bandpass (default) or lowpass. Orders is set to 1 by default, but the user can select from 1 to 5 orders. The number of revolutions parameter, max. 25, specifies the number of shaft revolutions to acquire and display in the orbit graph.

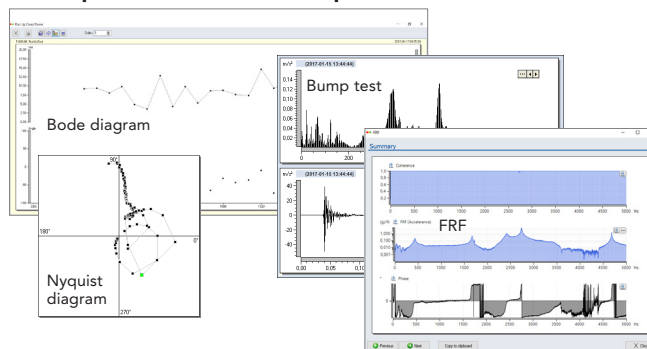
The orbit graph shows an overlay of the graphs for each measured revolution plus their average. The user can select each individual revolution as well as the average of all revolutions.

The selected graph is marked blue, with a blue arrow showing the angle and the x/y values at that angle. The user can move the arrow on the screen in the orbit graph.

When the orbit assignment is set up in Condmaster Ruby, alert limits can be set on the X and Y axis, resulting in an evaluated measurement (green – yellow – red scale).

Shaft Centerline Plot is a function available with Leonova Diamond. Especially useful for assessment of lubrication during start-up of a machine with journal bearings, the plot displays changes in radial rotor position over a range of speed. Settings for Shaft centerline plots are made in Leonova Diamond. The results can be viewed in Condmaster Ruby after the measuring round is uploaded.

Run up/Coast down, Bump test, FRF



Run up/coast down measurements, Bump test and FRF are vibration analysis functions offered as a module for Leonova and Intellinova.

Run up/coast down records the changes in vibration while the machine is run up to operating speed or after it has been shut off and is slowing down.

For this test, both the signal unit and the unit for the spectrum can be selected. The measuring interval can be either time based (interval in seconds) or speed based (interval in rpm). The speed range is also chosen, e.g. 400 to 3000 rpm.

Waterfall diagram can be viewed after the measurement is done. For each individual measurement, a spectrum can be called up.

Nyquist diagram shows the phase angle and amplitude. A phase is a time delay expressed in degrees of rotation. Leonova calculates the time delay between the passage of the tachometer pulse and the peak of the frequency component of interest from the vibration transducer at the speed of rotation. The value presented is a relative angle, not an absolute, because there is no compensation for phase lag in the transducer or the electronic circuits.

Bode diagram can be selected for vibration amplitude and angle, showing all measurements in time sequence. In all diagrams, a blue dot shows the position of the measurement marked on the list.

Bump test is employed to check out the typical vibration response of a machine structure at standstill, by hitting it e.g. with rubber mallet (bump test).

The user sets the measuring range in Hz, which automatically sets the sampling time, e.g. 0.20 seconds for 2000 Hz/400 lines. A pre-triggering time, 5% to 25% of the sampling time, is also chosen. The peak amplitude of the measured signal is displayed (velocity in mm/s) and a trigger level can be set to 1% – 90% of the amplitude.

The actual test returns an FFT spectrum and a time signal (sampling time plus pre-triggering time). The spectrum can be stored as reference spectrum for any measuring assignment.

Frequency Response Function (FRF) is used to measure the vibration response (natural frequencies) of a machine structure, similar to the 'Bump test'. FRF however is more sophisticated, measuring the response resulting from a known applied input by using an impact hammer and a vibration transducer connected to Leonova Diamond's vibration input using a split cable.

The FRF measuring assignment is set up in Leonova Diamond and the settings and measuring results can be viewed in Condmaster Ruby after the measuring round is uploaded.