

OFV-5000 Vibrometer Controller

The OFV-5000 Controller is the core of Polytec's latest state-of-the-art laser vibrometer systems. Its modular design allows the frequency, velocity and displacement capabilities to be tailored to your applications.

Both analog and digital decoders are available, giving a frequency range from near DC to 24 MHz, with velocities up to ± 10 m/s and displacements from the picometer to meter range.

In combination with an interferometric sensor head OFV-505 for highest signal quality, OFV-534 compact sensor head or OFV-551/552 fiber-optic sensor heads, the OFV Modular Vibrometer is an ultra-precise workhorse for non-contact vibration measurement.



Highlights

- Measure displacement and velocity in real-time
- High resolution and bandwidth
- Flexible and expandable with several sensor heads and decoders
- Simple and comfortable operation with touchscreen and remote control

OFV-5000 Vibrometer Controller

The Versatility in Vibration Measurement
Datasheet



Technical Data



Metrological Specifications

| | |
|------------------------------|---|
| Analog signal outputs | BNC, ± 10 V ¹ : Velocity signal Displacement signal AUX output ² DSP output (velocity with DSP filter) ¹ |
| Digital signal output | S/P-DIF standard 24 bit 48/96 kSa/s |
| Frequency range ³ | DC to 24 MHz |
| Max. velocity ³ | ± 10 m/s |
| Filters | High pass filter: 100 Hz, off Low pass filter: 5 kHz, 20 kHz, 100 kHz, off |
| Tracking filter ¹ | 3 settings: slow, fast, off |
| Adaptive filter module LF-02 | DSP based: suppresses statistic noise, analog and digital signal output, frequency range 0 ... 20 kHz (optional for decoder VD-06) |
| Signal level | Bargraph on touchscreen Output as DC voltage signal (BNC, 0 ... 5 V) |
| PC-Interface | RS-232, Remote control of the instrument settings |

¹ Depends on decoder configuration.

² Velocity or displacement signal, depends on decoder configuration (see page 3).

³ Notice: frequency range, max. velocity and measurement range depend on decoder configuration (see page 3).

Sensor Head Compatibility

| | |
|--------------------------|------------------|
| Sensor heads | OFV-505, OFV-503 |
| Compact sensor head | OFV-534 |
| Fiber optic sensor heads | OFV-551, OFV-552 |

General Specifications

| | |
|-----------------------|--|
| Interface/Display | 7" color touchscreen with interactive menu guidance |
| Dimensions | 19" rack mounting, W x D x H: 450 x 360 x 150 mm (19", 84 HP/3U) without angle brackets |
| Weight | 10 kg |
| Protection class | IP20 |
| Operating temperature | +5 °C ... +40 °C (41 °F ... 104 °F) |
| Storage temperature | -10 °C ... +65 °C (14 °F ... 149 °F) |
| Relative humidity | max. 80%, non-condensing |
| Power supply | 100...240 VAC $\pm 10\%$, 50/60 Hz |
| Power consumption | max. 100 VA |

System Configuration

Different analog and digital decoders ensure that the OFV-5000 Vibrometer Controller fits perfectly to your application. With a combination of up to four decoders the Modular Vibrometer system shows its high flexibility. Therefore the OFV-5000 contains four slots: two for velocity decoders, one for the displacement decoder and one additional auxiliary slot for a velocity or a displacement decoder.

| Velocity Decoders | | | | | |
|--------------------|--|---------------|---------------------------------|---------------|------------------|
| Decoder | Description | No. of ranges | Typical resolution ¹ | Max. velocity | Frequency range |
| VD-02 | Analog, broadband universal decoder | 4 | 0.1 µm/s | 10 m/s | 0.5 Hz - 1.5 MHz |
| VD-05 | Analog decoder for ultrasonic applications | 2 | < 3 µm/s | 2.5 m/s | 0.5 Hz - 10 MHz |
| VD-06 | Digital high-precision velocity decoder | 4 | 0.01 µm/s | 0.5 m/s | 0 Hz - 350 kHz |
| VD-08 ² | Digital high-precision velocity decoder | 8 | 0.005 µm/s | 0.5 m/s | 0 Hz - 25 kHz |
| VD-09 | Digital velocity decoder | 14 | 0.02 µm/s | 10 m/s | 0 Hz - 2.5 MHz |

¹ Noise-limited resolution in the smallest measurement range. The noise-limited resolution is defined as the signal amplitude (RMS) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film).

² In combination with DD-500 only specific measurement ranges of the VD-08 can be used.

| Displacement Decoders | | | | | |
|-----------------------|---|---------------|-------------------------|-------------------|-----------------|
| Decoder | Description | No. of ranges | Resolution ¹ | Max. displacement | Frequency range |
| DD-300 | Analog displacement decoder for ultrasonic applications | 1 | 0.05 pm | ±75 nm | 30 kHz - 24 MHz |
| DD-500 | Digital high-end displacement decoder 16-bit-DSP (requires VD-06) | 16 | 0.05 pm | ±50 mm | 0 Hz - 350 kHz |
| DD-600 ² | I&Q converter for data processing with VibSoft VDD | – | 0.1 pm | – | 0 - 5 MHz |
| DD-900 | Broadband digital displacement decoder (requires VD-09) | 16 | 0.5 pm | ±50 mm | 0 Hz - 2.5 MHz |

¹ Noise-limited resolution in the smallest measurement range. The noise-limited resolution is defined as the signal amplitude (RMS) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film).

² I&Q converter delivering I and Q raw phase signals up to 5 MHz for velocities up to 1.5 m/s for highest displacement resolution. With the PC-based system VibSoft-VDD Data Analysis, frequencies up to 2 MHz and velocities up to 0.81 m/s can be achieved.

Possible configuration of the slots¹

| Slot | Measurand | Possible decoders |
|--------|--------------------------|------------------------|
| Slot 1 | Velocity | VD-02, VD-09 |
| Slot 2 | Velocity | VD-06, VD-08 |
| Slot 3 | Displacement | DD-500, DD-600, DD-900 |
| Slot 4 | Velocity or displacement | VD-05, DD-300 |

¹ Every slot contains one decoder. Not all combinations are possible. Ask your Polytec sales engineer.

Recommended Decoder Combinations

The following table lists recommended decoder combinations for representative applications. The concept of the OFV Modular Vibrometer System accepts further decoders allowing to study even complex vibration phenomena. If you have specific requirements, please contact Polytec's application and sales engineers who will help to choose the appropriate sensor heads, decoders and VibSoft software.

|  Velocity decoder | Displacement decoder | Applications |
|---|----------------------|---|
| VD-09 | | Acquisition of vibrations at frequencies from DC up to 2.5 MHz at high resolution and velocity. For ultrasonics and microstructures. |
| VD-09 | DD-900 | Additional direct displacement output with picometer resolution. Suitable for measurement of signals with DC components like switches or transient behaviour. |
| VD-09 VD-06 | DD-900 | Same as the combination VD-09 + DD-900, but with additional high-precision measurement of velocities up to 0.5 m/s at frequencies up to 350 kHz. |
| VD-06 | DD-500 | Digital, high-precision measurement of velocity and displacement at frequencies up to 350 kHz with a velocity limited to 0.5 m/s. For demanding applications e.g. acoustics, microsystems, precision mechanics. |
| VD-02 VD-06 | DD-500 | Same as the combination VD-06 + DD-500, but vibration frequency range extended up to 1.5 MHz and velocity range extended up to 10 m/s. |
| VD-02 VD-05 | | Measurement of velocity at high frequencies up to 10 MHz. For high-frequency applications like ultrasonics and microsystems. |
| VD-02 | DD-300 | Acquisition of vibrations at frequencies up to 24 MHz. For high-frequency applications like ultrasonics and micro systems. |

Velocity Decoders

VD-02

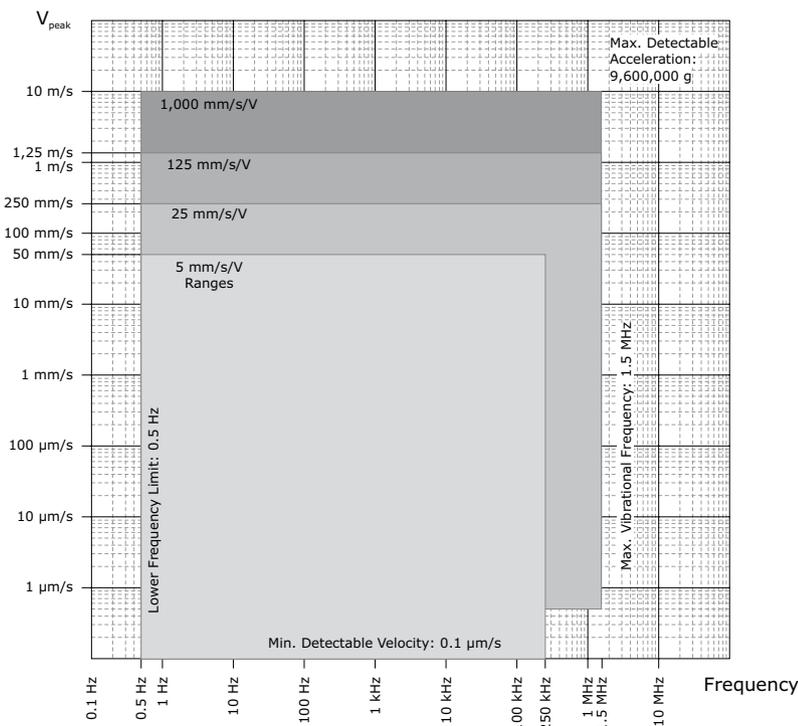


| Measurement range | Full scale output (peak) ¹ | Typical resolution ² | Frequency range | Max. acceleration | Max. linearity error |
|-------------------|---------------------------------------|---------------------------------------|-------------------|-------------------|----------------------|
| mm/s/V | m/s | $\mu\text{m s}^{-1}/\sqrt{\text{Hz}}$ | | g | % |
| 5 | 0.05 | 0.1 | 0.5 Hz - 0.25 kHz | 8,000 | 1.0 |
| 25 | 0.25 | 0.5 | 0.5 Hz - 1.5 MHz | 240,000 | 1.5 |
| 125 | 1.25 | 0.6 | 0.5 Hz - 1.5 MHz | 1,200,000 | 1.0 |
| 1,000 | 10 | 2.5 | 0.5 Hz - 1.5 MHz | 9,600,000 | 1.0 |

¹ The full scale values correspond to the maximum output voltage of 10 V_{peak}.

² The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film). The typical value refers to the center of the operating frequency range.

Range diagram



- Multi-purpose decoder for a wide range of applications
- Large frequency bandwidth and velocity range up to 10 m/s
- Analog decoding for minimum signal delay



VD-05

| Measurement range | Full scale output (peak) ¹ | Resolution ² | Frequency range | Max. acceleration | Max. linearity error |
|-------------------|---------------------------------------|---------------------------------------|-----------------|-------------------|----------------------|
| mm/s/V | m/s | $\mu\text{m s}^{-1}/\sqrt{\text{Hz}}$ | | g | % |
| 100 | 0.5 | < 3 | 0.5 Hz - 10 MHz | 320,000 | 2 |
| 500 | 2.5 | < 3 | 0.5 Hz - 10 MHz | 1,600,000 | 2 |

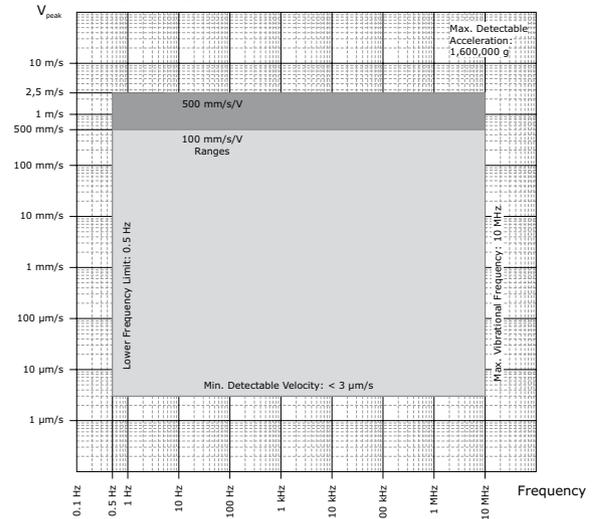
¹ The full scale values correspond to the nominal output voltage of 5 V_{peak}. The range up to 6 V_{peak} can be used at reduced linearity specifications.

² The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film). The attainable resolution is frequency-dependent.



- Precise decoding of highest frequencies up to 10 MHz
- Analog decoding for minimum signal delay
- For applications in the higher ultrasonic frequency range and for fast transient and pulse shaped motions
- Perfectly suited also for MEMS (micro electro mechanical systems)

Range diagram



VD-06

| Measurement range ¹ | Full scale output (peak) ² | Typical resolution ³ | Frequency range | Max. acceleration | Max. linearity error |
|--------------------------------|---------------------------------------|---------------------------------------|-----------------|-------------------|----------------------|
| mm/s/V | m/s | $\mu\text{m s}^{-1}/\sqrt{\text{Hz}}$ | kHz | g | % |
| 1 | 0.01 | 0.01 | 0 - 20 | 128 | 0.1 |
| 2 | 0.02 | 0.05 | 0 - 350 | 4,500 | 0.1 |
| 10 | 0.10 | 0.05 | 0 - 350 | 22,000 | 0.1 |
| 50 | 0.50 | 0.06 | 0 - 350 | 110,000 | 0.1 |

¹ Measurement ranges 2, 10 and 50 mm/s/V each feature an additional low pass range with 100 kHz frequency range, higher resolution but reduced max. acceleration.

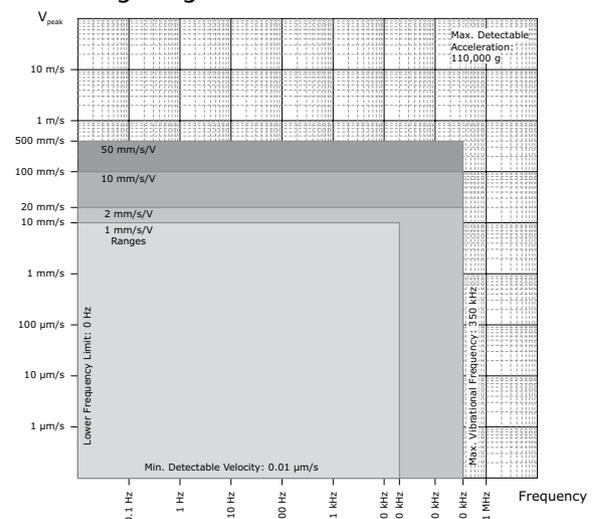
² The full scale values correspond to the maximum output voltage of 10 V_{peak}.

³ The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film). The attainable resolution is frequency-dependent. The typical value refers to the center of the operating frequency range.



- Digital velocity decoder with outstanding resolution covering a wide frequency range up to 350 kHz
- Very low noise
- True DC capability
- Outstanding linearity and frequency response

Range diagram



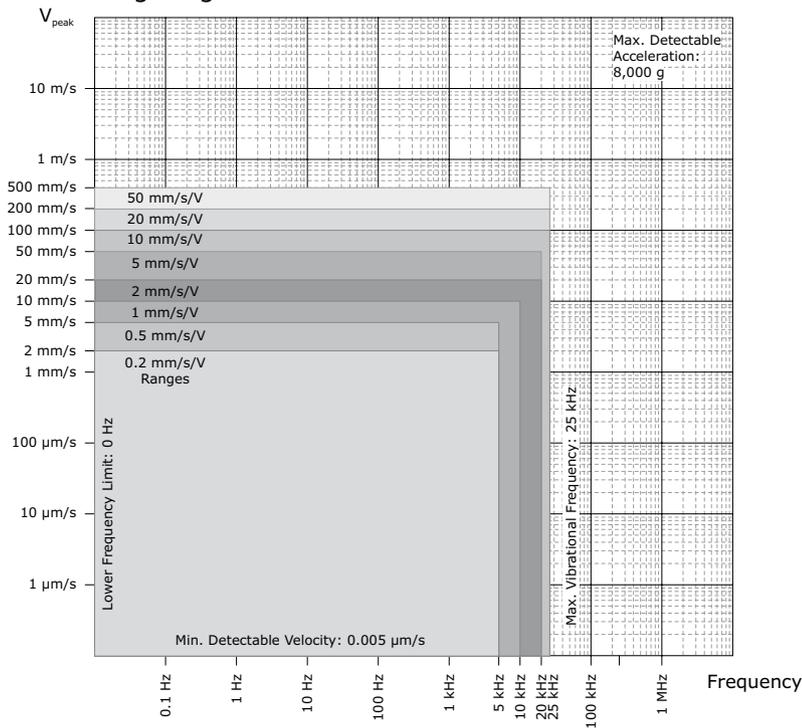
| Measurement range ¹ | Full scale output (peak) ² | Typical resolution ³ | Frequency range | Max. acceleration | Max. linearity error |
|--------------------------------|---------------------------------------|---------------------------------------|-----------------|-------------------|----------------------|
| mm/s/V | m/s | $\mu\text{m s}^{-1}/\sqrt{\text{Hz}}$ | kHz | g | % |
| 0.2 | 0.002 | 0.005 | 0 - 5 | 6.4 | 0.1 |
| 0.5 | 0.005 | 0.005 | 0 - 5 | 16 | 0.1 |
| 1 | 0.01 | 0.01 | 0 - 10 | 64 | 0.1 |
| 2 | 0.02 | 0.01 | 0 - 20 | 256 | 0.1 |
| 5 | 0.05 | 0.01 | 0 - 20 | 640 | 0.1 |
| 10 | 0.1 | 0.02 | 0 - 20 | 1,280 | 0.1 |
| 20 | 0.2 | 0.03 | 0 - 25 | 3,200 | 0.1 |
| 50 | 0.5 | 0.05 | 0 - 25 | 8,000 | 0.1 |

¹ In combination with DD-500 only specific measurement ranges of the VD-08 can be used.

² The full scale values correspond to the maximum output voltage of $10 V_{\text{peak}}$.

³ The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film). The attainable resolution is frequency-dependent. The typical value refers to the center of the operating frequency range.

Range diagram



- Digital velocity decoder dedicated to low frequencies up to 25 kHz with highest resolution
- Highest optical sensitivity for measurement on dark surfaces
- True DC capability
- Outstanding linearity and frequency response



VD-09

| Measurement range ¹ | Full scale output (peak) ² | Typical resolution ³ | Frequency range | Max. acceleration | Max. linearity error |
|--------------------------------|---------------------------------------|---------------------------------------|-----------------|-------------------|----------------------|
| mm/s/V | m/s | $\mu\text{m s}^{-1}/\sqrt{\text{Hz}}$ | MHz | g | % |
| 5 | 0.05 | 0.02 | 0 - 0.1 | 3,200 | 0.5 |
| 10 | 0.1 | 0.04 | 0 - 0.25 | 16,000 | 0.5 |
| 20 | 0.2 | 0.12 | 0 - 1 | 128,000 | 0.5 |
| 50 | 0.5 | 0.18 | 0 - 1.5 | 480,000 | 0.5 |
| 100 | 1 | 0.2 | 0 - 1.5 | 960,000 | 0.5 |
| 200 | 2 | 0.5 | 0 - 2.5 | 3,200,000 | 0.5 |
| 500 | 5 | 0.6 | 0 - 2.5 | 8,000,000 | 0.5 |
| 1,000 | 10 | 0.7 | 0 - 1.5 | 9,600,000 | 0.5 |

¹ Measurement ranges 20 ... 1,000 mm/s/V each feature an additional low pass range with 250 kHz frequency range, higher resolution but reduced max. acceleration.

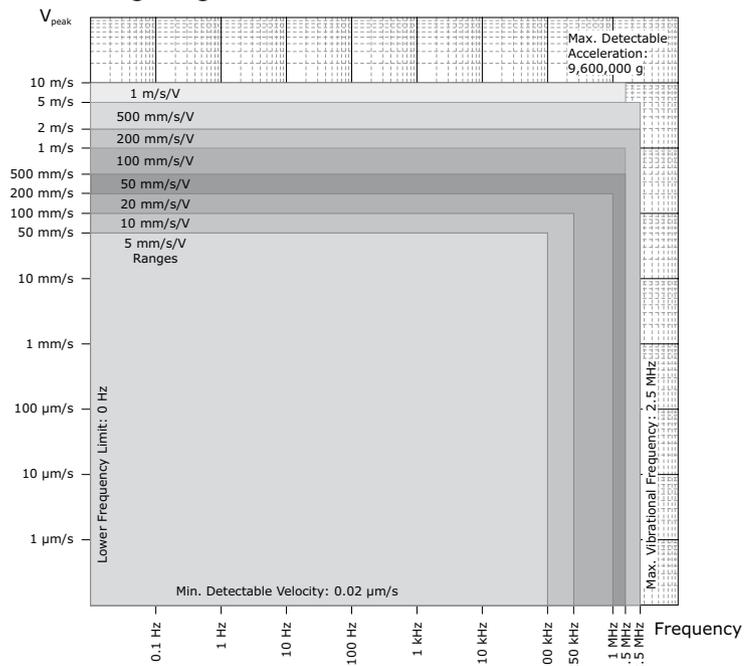
² The full scale values correspond to the maximum output voltage of $10 V_{\text{peak}}$.

³ The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film). The attainable resolution is frequency-dependent. The typical value refers to the center of the operating frequency range.



- Multi-purpose high frequency bandwidth digital decoder with high precision and high resolution
- True DC capability
- Well balanced properties regarding bandwidth, resolution and velocity limits make it the decoder of choice for most measurement applications

Range diagram



Displacement Decoders

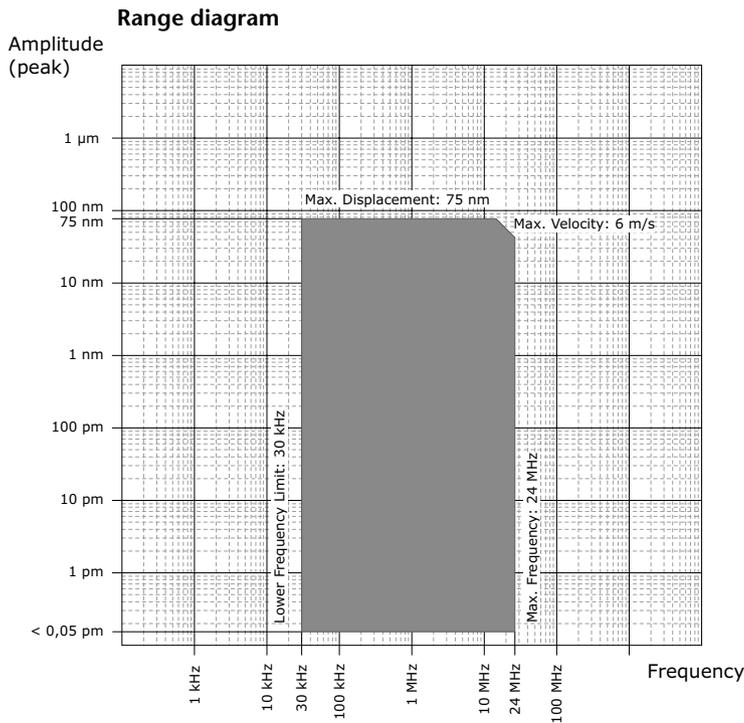
DD-300



| Measurement range | Full scale output (peak) ¹ | Resolution ² | Frequency range | Max. velocity |
|-------------------|---------------------------------------|---|--------------------|---------------|
| nm/V | nm | pm/√Hz | kHz | m/s |
| 50 | ±75 | < 0.02 pm/√Hz at 100% reflectivity < 0.05 pm/√Hz when measuring on reflective film | 30 - 24,000 (-3dB) | 6 |

¹ The full scale value corresponds to the output voltage swing of ±1.5 V at load resistance 50 Ω.

² The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution.



- Displacement decoder for measuring smallest motions up to 75 nm with a large frequency bandwidth from 30 kHz up to 24 MHz
- For measurements on ultrasonic transducers, detection of ultrasonic pulses and to observe fast transient motions of MEMS devices
- Special high-pass filter suppresses low frequency (acoustic) vibrations and allows the detection of smallest high-frequency vibrations even under noisy ambient conditions
- Additional 2 MHz low-pass filter improves resolution performance in lower frequency range



DD-500

Required velocity decoder: VD-06

| Measurement range | Full scale output (peak-to-peak) ¹ | Resolution ² | Frequency range ³ | Max. velocity |
|------------------------|---|-------------------------|------------------------------|---------------|
| $\mu\text{m}/\text{V}$ | μm | nm | kHz | m/s |
| 0.05 | 1 | 0.015 | 0 - 350 | 0.5 |
| 0.1 | 2 | 0.03 | 0 - 350 | 0.5 |
| 0.2 | 4 | 0.06 | 0 - 350 | 0.5 |
| 0.5 | 10 | 0.15 | 0 - 350 | 0.5 |
| 1 | 20 | 0.3 | 0 - 350 | 0.5 |
| 2 | 40 | 0.6 | 0 - 350 | 0.5 |
| 5 | 100 | 1.5 | 0 - 350 | 0.5 |
| 10 | 200 | 3 | 0 - 350 | 0.5 |
| 20 | 400 | 6 | 0 - 350 | 0.5 |
| 50 | 1,000 | 15 | 0 - 350 | 0.5 |
| 100 | 2,000 | 30 | 0 - 350 | 0.5 |
| 200 | 4,000 | 60 | 0 - 350 | 0.5 |
| 500 | 10,000 | 150 | 0 - 350 | 0.5 |
| 1,000 | 20,000 | 300 | 0 - 350 | 0.5 |
| 2,000 | 40,000 | 600 | 0 - 350 | 0.5 |
| 5,000 | 100,000 | 1,500 | 0 - 350 | 0.5 |

¹ The full scale values correspond to $\pm 10\text{ V}$ (peak-to-peak) maximum output voltage.

² The resolution corresponds to the quantization step of approx. 0.4 mV at the analog output.

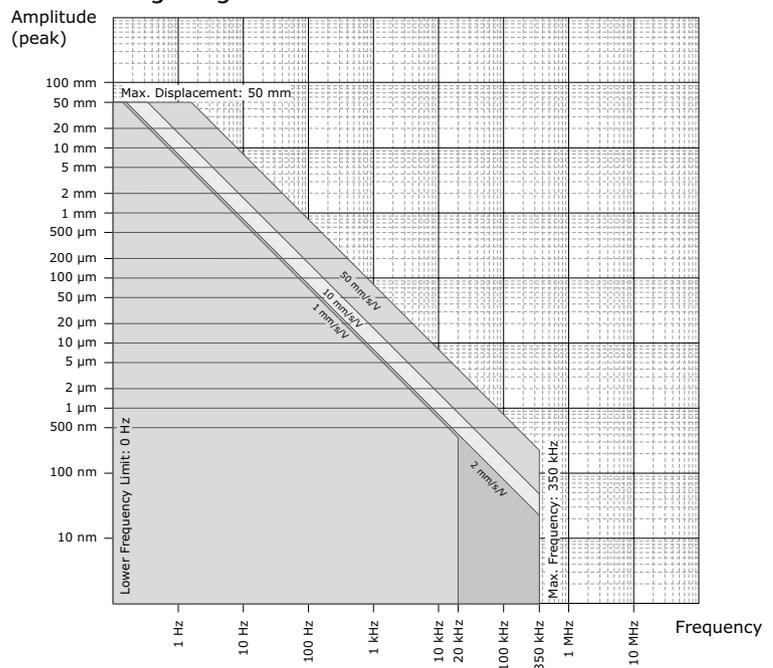
Noise-limited resolution: $< 0.5\text{ pm}/\sqrt{\text{Hz}}$. The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film).

³ When a suitable measurement range has been selected for the digital velocity decoder.



- Best resolution displacement decoding in conjunction with VD-06 for velocities up to 0.5 m/s
- For demanding applications in acoustics, micro systems and precision mechanics
- Analog output as well as digital data stream in S/P-DIF format

Range diagram





- Detects even smallest displacements thanks to very good SNR
- Perfect for MEMS analysis or calibration purposes

DD-600

I&Q converter delivering I and Q raw phase signals up to 5 MHz for velocities up to 1.5 m/s

Highest displacement resolution. With VibSoft-VDD Data Analysis up to 2 MHz and velocities up to 0.81 m/s

DD-900

Required velocity decoder: VD-09

| Measurement range | Full scale output (peak-to-peak) ¹ | Resolution ² | Frequency range ³ | Max. velocity |
|-------------------|---|-------------------------|------------------------------|---------------|
| µm/V | µm | nm | kHz | m/s |
| 0.05 | 1 | 0.015 | 0 - 2,500 | 10 |
| 0.1 | 2 | 0.03 | 0 - 2,500 | 10 |
| 0.2 | 4 | 0.06 | 0 - 2,500 | 10 |
| 0.5 | 10 | 0.15 | 0 - 2,500 | 10 |
| 1 | 20 | 0.3 | 0 - 2,500 | 10 |
| 2 | 40 | 0.6 | 0 - 2,500 | 10 |
| 5 | 100 | 1.5 | 0 - 2,500 | 10 |
| 10 | 200 | 3 | 0 - 2,500 | 10 |
| 20 | 400 | 6 | 0 - 2,500 | 10 |
| 50 | 1,000 | 15 | 0 - 2,500 | 10 |
| 100 | 2,000 | 30 | 0 - 2,500 | 10 |
| 200 | 4,000 | 60 | 0 - 2,500 | 10 |
| 500 | 10,000 | 150 | 0 - 2,500 | 10 |
| 1,000 | 20,000 | 300 | 0 - 2,500 | 10 |
| 2,000 | 40,000 | 600 | 0 - 2,500 | 10 |
| 5,000 | 100,000 | 1,500 | 0 - 2,500 | 10 |

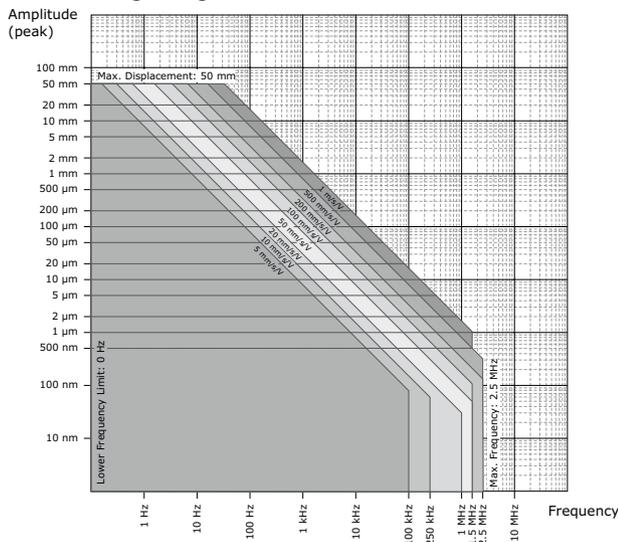
¹ The full scale values correspond to ±10 V (peak-to-peak) maximum output voltage.

² The resolution corresponds to the quantization step of approx. 0.3 mV at the analog output.

³ Noise-limited resolution: < 0.5 pm/√Hz. The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite™ Tape (reflective film).

³ When a suitable measurement range has been selected for the digital velocity decoder.

Range diagram



- Broadband displacement decoder up to 2.5 MHz
- Supplements VD-09 velocity decoder for high precision displacement measurements with resolutions down to 15 pm
- 16 measurement ranges

Compliance with Standards

| | |
|-------------------|---|
| Laser safety | IEC 60825-1:2014 / EN 60825-1:2014 / DIN EN 60825-1:2008-05 (Safety of Laser Products, complies to US 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice no. 50, dated 24 June 2007) |
| Electrical safety | IEC 61010-1:2010 + Cor.:2011 / EN 61010-1:2010 / DIN EN 61010-1:2011-07 (Safety requirements for electrical equipment for measurement, control, and laboratory use) |
| EMC | IEC 61326-1:2012 / EN 61326-1:2013 / DIN EN 61326-1:2013-07 (EMC requirements on Emission and Immunity – Electrical equipment for measurement, control, and laboratory use) Emission: Limit Class B IEC/EN 61000-3-2 and 61000-3-3 Immunity: IEC/EN 61000-4-2 to 61000-4-6 and IEC/EN 61000-4-11 |



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