Telemeter Electronic

narda
Safety Test Solutions

Datasheet | Probe BFD-400-1

Isotropic measurement of magnetic fields from 1 Hz to 400 kHz

Conforms to EMF Directive 2013/35/EU

The new BFD-400 magnetic field probe from the Narda FieldMan family enables effective detection and evaluation of radiation exposure in the frequency range from 1 Hz to 400 kHz. The automatic exposure assessment, using the Weighted RMS (WRM) and Weighted Peak (WPM) methods, ensures accurate measurements that comply with standards like IEC/EN 62311 and 62233.
Measured values are displayed and further evaluated on the FieldMan basic unit.
The BFD-400 can also be connected to a PC via USB, enabling full access to all operation modes through the Narda-TSX software, including the Live Mode option for real-time data monitoring.

- Isotropic (non-directional) measurement with standard-compliant 100 cm² sensor
- Shaped time domain assessment STD (WPM and WRM) for all relevant international standards and regulations such as Directive 2013/35/EU
- Fast gapless real-time spectral analysis
- Spectrum mode with displayed limit value curve for all 3 measuring axes
- Scope mode offers triggered time signal analysis
- Adjustable selective filters (band pass or band stop)
- Digital probe interface - no basic unit calibration is necessary
- Integrated probe self-test at startup
- Streaming of raw data with the probe connected to a PC via USB (no FieldMan basic unit necessary)

Use and benefit

- The BFD-400-1 is an innovative probe for measuring exposure to magnetic fields in the workplace and in public spaces.
  It is designed for health and safety professionals in industry, occupational health and safety associations and service industries.
- Display of field exposure in percentage of standard limits such as Directive 2013/35/EU for workers
- Exposure evaluation of arbitrary waveforms in compliance with Weighted RMS (WRM) and Weighted Peak (WPM) methods (IEC/EN 62311 and 62233 compliant)
- Supports multiple international standards
- Easy software update for future standard modifications, other limits or new standards
- In addition to the field strength and exposure values, the Spectrum and Scope modes offer in-depth signal analysis in the frequency and time domain
- Probe calibration and integrated probe and sensor self-test ensure the highest accuracy and reliability regardless of the frequency range. No basic unit calibration necessary due to digital probe interface

How it works:

The probe consists of three orthogonally and concentrically arranged coils that detect changes in the magnetic field based on the law of induction. The generated voltage is then amplified and pre-conditioned by electronics, depending on the measurement range or the selected standard. A powerful FPGA handles digital processing to ensure phase-correct signal evaluation, providing accurate readings of both field strength and exposure indices. The data is then transmitted to a receiver via USB, either a FieldMan basic unit or any computing device running the TSX software.

Applications

Examples of measurement environments are:

- Industry and production areas (Assessment of workers' exposure acc. FCC, IEEE, ICNIRP or EMF Directive 2013/35/EU)
- Induction heating and melting (e.g. EN 50519)
- Household appliances (e.g. IEC/EN 62233)
- Electric welding equipment (e.g. IEC/EN 62822)
- Railroad operations (e.g. EN 50500)
- Automotive operations (e.g. IEC 62764)
- Energy supply systems (e.g. IEC/EN 62110)
- Electrical medical devices (e.g. IEC/EN 60601)

Industry

The BFD-400 is an essential tool for assessing magnetic fields generated by various industrial facilities. In many manufacturing environments, machinery produces non-sinusoidal signals, particularly in resistance welding systems using pulse waveforms and phase angle control within traditional 50/60 Hz systems, as well as in modern medium frequency switching units.

To ensure worker safety, exposure to magnetic fields must be continuously monitored and evaluated across a broad range of industrial applications. These include, among others, induction heating, welding, melting, electrolysis, and hardening.

Automotive

The BFD-400 provides a comprehensive solution for measuring and assessing magnetic field exposure in automotive environments, including electric vehicles and their components.

Modern vehicles contain numerous electrical and electronic systems that generate low-frequency magnetic fields, exposing both drivers and passengers to EMF. To safeguard vehicle occupants from excessive exposure, comprehensive assessments are essential. The BFD-400 enables EMF exposure levels to be analyzed in accordance with various industry standards, ensuring compliance with national and international electromagnetic compatibility (EMC) regulations. Automotive manufacturers and international regulatory bodies have established specific guidelines to verify that vehicles meet these safety requirements.

Electronic Article Surveillance (EAS)

Those systems are widely used in public areas, emitting complex fields.

Most of these technologies operate within the low-frequency range, generating electromagnetic fields that vary depending on the type of surveillance system. Many electromagnetic and magneto-acoustic security gates function within the frequency range covered by the BFD-400, making it a valuable tool for measuring and assessing exposure in such environments.

Household appliances

Household appliances and other electrical devices generate magnetic fields that must be assessed for compliance with safety standards. Regulations such as IEC/EN 62233 outline procedures for evaluating these products before they enter the market.

With its EXPOSURE STD (Shaped Time Domain) mode, the BFD-400 significantly simplifies the assessment process. This mode sets a standard for reliable magnetic field assessments, even in environments with complex field conditions.

By providing accurate and efficient measurements, the BFD-400 ensures that home appliances meet regulatory requirements before reaching consumers.

Definitions and Conditions

Conditions

Unless otherwise noted, specifications apply within the specified environmental conditions and the product is within the recommended calibration cycle.

Specifications with limits

These describe product performance for the given parameter covered by warranty. Specifications with limits (shown as <, ≤, >, ≥, ±, max., min.) apply under the given conditions for the product and are tested during production, considering measurement uncertainty.

Specifications without limits

These describe product performance for the given parameter covered by warranty. Specifications without limits represent values with negligible deviations, which are ensured by design (e.g. dimensions or resolution of a setting parameter).

Typical values (typ.)

These characterize product performance for the given parameter that is not covered by warranty. When stated as a range or as a limit (shown as <, ≤, >, ≥, ±, max., min.), they represent the performance met by approximately 80% of the instruments. Otherwise, they represent the mean value. The measurement uncertainty is not taken into account.

Nominal values (nom.)

These characterize expected product performance for the given parameter that is not covered by warranty. Nominal values are verified during product development but are not tested during production.

Uncertainties

These characterize the dispersion of the values attributed to the measurands with an estimated confidence level of approximately 95%. Uncertainty is stated as the standard uncertainty multiplied by the coverage factor k=2 based on the normal distribution. The evaluation has been carried out in accordance with the rules of the “Guide to the Expression of Uncertainty in Measurement” (GUM).

Specifications [1,3]

Key Product Features	
Frequency range [2]	1 Hz to 400 kHz
Damage Level	300 mT at 50 Hz (see Figure 1)
Filters	Lowpass, High pass filters, 6th order Bandpass and Band stop filters (see Figure 2 and 3)
Implemented Standards	2013/35/EU, ICNIRP1998, ICNIRP2010, EMFV2016, GB8702, TREMF, IEEE C95
Integrated real time FFT	up to 4096 points
Raw data streaming	Flat (Field) and shaped (WPM) waveforms up to 1.024 MSps with direct link to PC
Sensor type	Isotropic coils (3-axis) for magnetic (B) field (sensor area 100 cm^2)
Spatial assessment	3 separate axes
Self-test	Signal path and coil functional test

Operating Modes		
Mode description	Field Strength	Broadband field measurements. Numerical results with time curve or bar graph display.
	Spatial Average	Procedure of broadband measurements over several measurement positions.
	Timer Logging	Time-controlled broadband measurement of the field strength in a definable period.
	Spectrum	FFT analysis with spectrum display, marker evaluation and display of the broadband level.
	Shaped Time Domain	Time domain assessment (WPM, WRM) with digital filtering related to a selected safety limit.
	Scope	Triggered measurement of the field curve over time with pre-trigger feature.

1 Unless otherwise noted specifications apply at reference conditions: Ambient temperature 23±3 °C; relative humidity 25% to 75 %
2 Cutoff frequency at typ. -3 dB.
3 All values are measured with sinusoidal fields

Field Strength					
Measurement	Frequency Span	1 kHz, 10 kHz, 100 kHz, 400 kHz			
	Range	80 µT	800 µT	8 mT	80 mT
	Overload (typ., single axis)	160 μT_{RMS}	1.6 mT_{RMS}	16 mT_{RMS}	160 mT_{RMS}
	Noise level (typ., RSS)	38 nT_{RMS} (10 Hz - 400 kHz)	350 nT_{RMS} (10 Hz - 400 kHz)	3.2 μT_{RMS} (10 Hz - 400 kHz)	30 μT_{RMS} (10 Hz - 400 kHz)
	Resolution (4 digits)	0.1 nT	0.1 nT	0.1 µT	0.1 µT
	Detectors	RMS, Peak			
	Detector time constant	1 s (integration time for RMS, hold time for Peak)			
	Units	Tesla, Gauss			
	Low Cut Filters	1 Hz, 10 Hz, 30 Hz (digital filters, see Figure 3), Butterworth, 6^{th} order			
	Band pass/ Band Stop filters	Bessel characteristic (digital filters, see Figure 2)			
	Time Span (Interval)	4 min (1 s between consecutive data points) to 24 h (360 s between consecutive data points)			
	Averaging Time	1 s to 24 h			

Spatial Average		
Measurement	Detector	RMS
	Measurement Time	Manual, 5 s to 360 s
	All other corresponding Parameters	According to Field Strength mode

Timer Logging		
Measurement	Storage Interval	1 s to 360 s
	All other corresponding Parameters	According to Field Strength mode

Spectrum (real-time FFT)					
Measurement	Frequency Span	1 kHz	10 kHz	100 kHz	400 kHz
	Resolution (FFT Point setting: High)	0.625 Hz	6.25 Hz	62.5 Hz	250 Hz
	Range	According to Field Strength mode			
	Noise Level	According to Field Strength mode			
	Frequency Scale	Linear, Logarithmic			
	FFT Points	Low=1024, Medium=2048, High=4096			
	Detectors	RMS, Peak			
	Detector Time	1 s (integration time for RMS, hold time for Peak)			
	Units	Tesla, Gauss			
	Result Types	Actual, Maximum, Average			
	Low Cut Filters	1 Hz, 10 Hz, 30 Hz			
	Number of Averages	4, 8, 16, 32, 64			

Shaped Time Domain				
Method		WPM-TD Weighted Peak Method (acc. IEC/EN 62311) WRM-TD Weighted RMS Method (acc. IEC/EN 62233)		
Standards/Limits		Measurement Range [4]	Typ. Noise WRM	Typ. Noise WPM
	2013/35/EU/ LAL	700 %	0.18 %	0.55 %
	2013/35/EU/ HAL	700 %	0.18 %	0.55 %
	2013/35/EU/ Limbs	700 %	0.15 %	0.47 %
	EMFV 2016 LAL	800 %	0.18 %	0.56 %
	EMFV 2016 HAL	800 %	0.18 %	0.57 %
	EMFV 2016 Limbs	700 %	0.14 %	0.47 %
	GB 8702-2014 GP	1700 %	1.20 %	3.30 %
	ICNIRP 1998 GP	1200 %	0.60 %	1.90 %
	ICNIRP 1998 Occ	1200 %	0.60 %	1.75 %
	ICNIRP 2010 GP	2500 %	0.70 %	1.80 %
	ICNIRP 2010 Occ	700 %	0.18 %	0.55 %
	IEEE 2019 Unrest NS	800 %	0.18 %	0.60 %
	IEEE 2019 Restrd NS	1000 %	0.22 %	0.78 %
	TREMF NF	1200 %	0.40 %	1.35 %
Measurement	Time Span (Interval)	4 min (1 s between consecutive data points) to 24 h (360 s between consecutive data points)		
	Detectors (Method)	WPM-TD (IEC/EN 62311), WRM-TD (IEC/EN 62233) – for pulsed fields consider measurements according to IEC/EN62311 as underestimation of the exposition may occur when using WRM-TD.		
	Units	%		
	Low Cut Filter	1 Hz, 10 Hz, 30 Hz		
	Frequency Span	400 kHz (-3 dB)		
	All other corresponding Parameters	According to Field Strength mode		

Scope (not yet available)		
Measurement	All other corresponding Parameters	According to Field Strength mode
	Sample counts	tbd.
	Trigger Type	Free run, Single, Multiple
	Trigger Modes	Positive transition, negative transition, high active, low active
	Trigger Level	tbd.
	Trigger sources	tbd.
	Pre-Trigger	tbd.
	Recording Time	1 ms to 30 s

4 The measurement range is the minimum value in the entire frequency range from 1 Hz to 400 kHz with the field in direction of one single coil. Due to the frequency shaping of the specific standards the device can display much higher values.

Raw Data Streaming (not yet available)	
Interface	USB 2.0, 480 Mbit/s (Probe directly connected to PC)
Data transfer rates	1.28 kSps, 2.56 kSps, 25.6 kSps, 256 kSps,1024 kSps
Frequency Span	According to Field Strength mode
Range	According to Field Strength mode

Uncertainty[5]	
Field Strength, all ranges	5 Hz … 200 kHz: 3.0 %, above 200 kHz: 5.0 %
Linearity deviation (nominal) 56 Hz	1.0 %
Isotropy deviation	5 Hz … 200 kHz: 2.0 %, above 200 kHz: 4.0 %
E-field immunity (nominal) 50 Hz	0.03 nT / (V/m)

General Specifications		
Accredited calibration (not yet available)		DAkkS, ILAC-MRA (DIN EN ISO/IEC 17025, IEC Std. 61786) For measurands outside the scope, factory calibration is performed.
Recommended calibration interval		24 months
Operating temperature		-20 °C to +50 °C
Humidity		< 29 g/m³ (< 93 % RH at +30 °C), non-condensing
Ingress Protection		IP54 (probe attached to FieldMan or Cable)
Climatic conditions	Storage	-40 °C to +70 °C
	Operation	-20 °C to +50 °C
Size		296 mm x 125 mm Ø
Weight		240 g
Country of origin		Germany

5 The systematic error of -3 dB and the slope of the low pass filter at the band edge is not part of this error.

Characteristics

Damage field level

The damage level is determined by power dissipation of internal components, and thus frequency dependent. Figure 1 shows the damage level for constant field. Because of the thermal nature of the damage level at higher frequencies, it is permissible to apply higher fields with a suitable duty cycle considering the average power, however, those fields must not exceed the limit for non-repetitive fields.

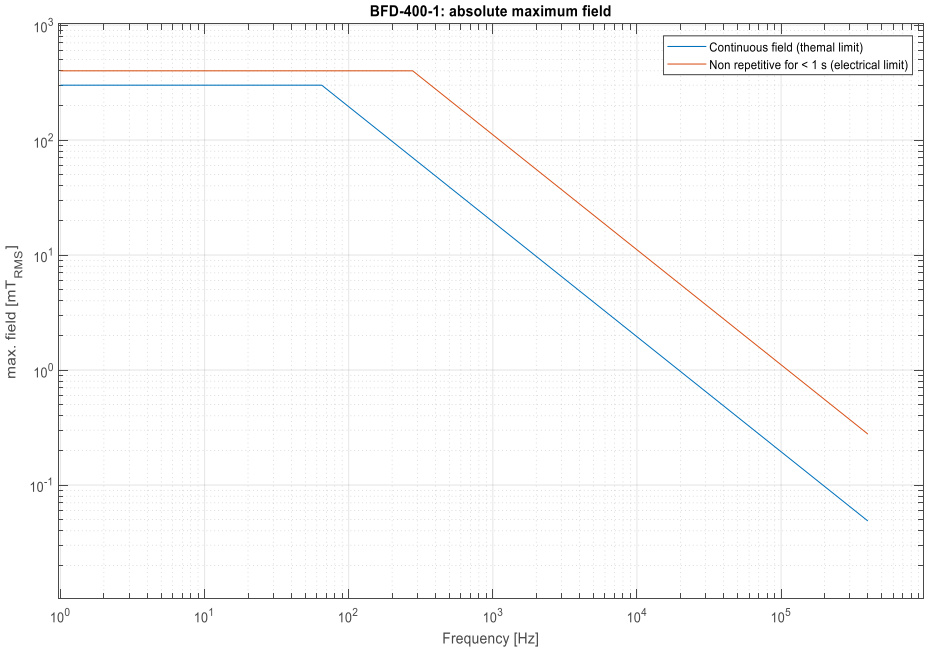

Figure 1: Damage field level versus frequency

Bandpass and Bandstop Filters

Bandpass filters are min. 4th order Bessel characteristic filters with a bandwidth that is 10 % of the center frequency.
Bandstop filters are min. 4th order Bessel characteristic filters with a bandwidth that is app. 5 % of the center frequency.
Figure 2 shows the frequency response of the 1 kHz bandpass and bandstop filter.

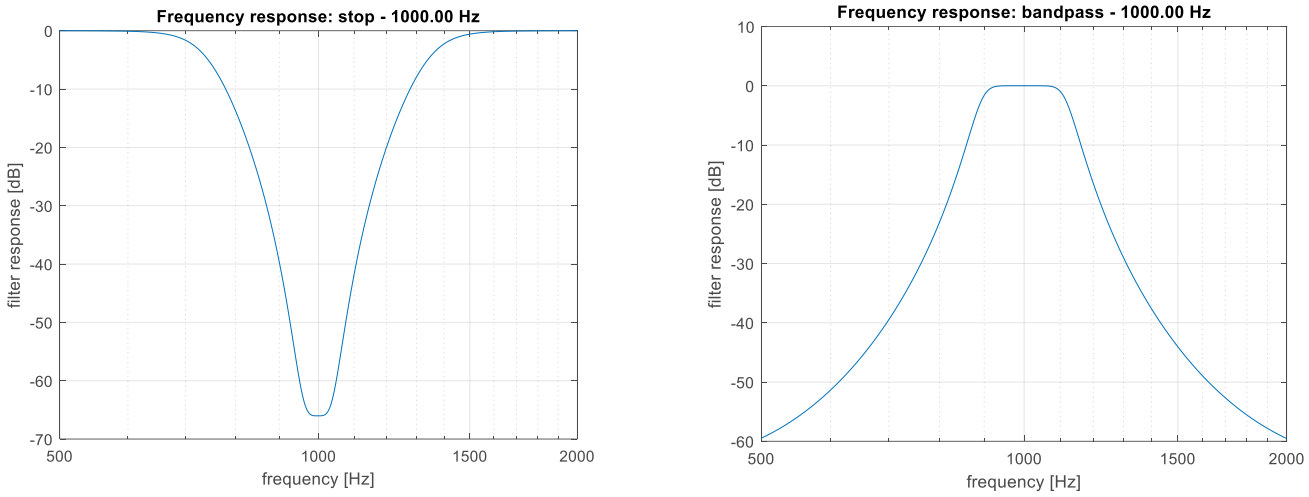

Figure 2: Example frequency response of the digital Bandstop and Bandpass filters

Low-Cut Filters

Low cut filters are 6th order Butterworth filters. See Figure 3 for example frequency responses.

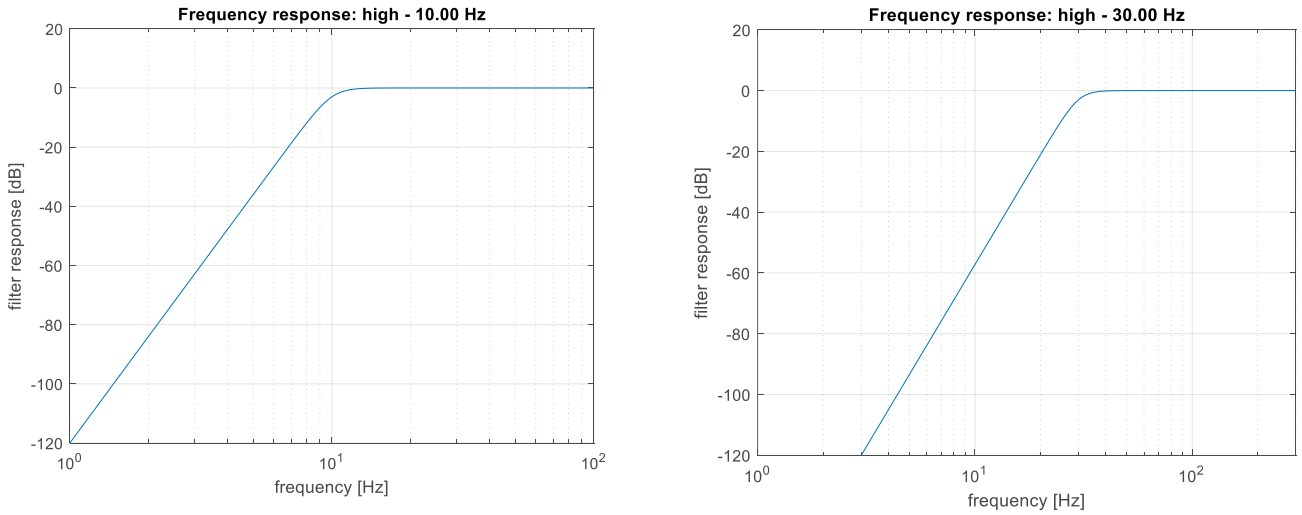

Figure 3: Example frequency response of Low-cut filters

Ordering information

Your local Narda sales representative can provide further information and will be pleased to offer advice.

Digital Low Frequency	Part number
Probe BFD-400-1, B-Field, 100 cm^2, 1 Hz – 400 kHz, selective	**2463/01**

Optional Accessories	Part number
Cable, Digital Probe Extension, 2 m	**2460/90.02**
Cable, Digital Probe to USB 2.0, 3 m	**2460/90.03**
Cable, Digital Probe to USB 2.0, 5 m	**2460/90.08**
Narda-TSX Live Measurement	**2460/95.01**

Telemeter Electronic

Germany

Telemeter Electronic GmbH
Joseph-Gaensler-Straße 10
86609 Donauwoerth
Phone +4990670693-0
Fax +4990670693-50
info@telemeter.de
www.telemeter.info

Switzerland

Telemeter Electronic GmbH
Wilerstrasse 73
9200 Gossau SG
Phone +41716992020
Fax +41716992024
info@telemeter.ch
www.telemeter.info

Czech Republic

Telemeter Electronic s.r.o.
České Vrbné 2364
370 11 České Budějovice
Phone +420385310637
Phone +420385510143
info@telemeter.cz
www.telemeter.cz