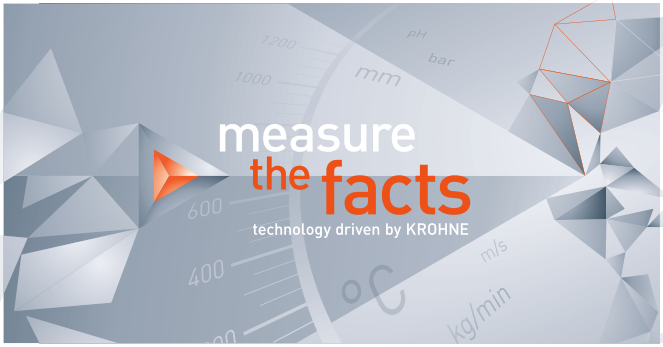
OPTIWAVE series

New 24 and 80 GHz FMCW radar level transmitters for liquids and solids

80 GHz
radar level measurement

KROHNE
measure the facts

- Wide range of level transmitters: 6, 10, 24 and 80 GHz
- Extensive choice of process connections starting from ¾"
- Lens, Drop and Horn antennas to suit all process and installation conditions
- Measuring range from the antenna edge up to 100 m; 328 ft



KROHNE – Measure the facts

Welcome to KROHNE. As a leader in process measuring technology, we are comfortable working in a wide variety of industries worldwide. The name KROHNE has stood for **innovative and reliable solutions since 1921**. The company now offers a whole spectrum of field instruments for flow, level, temperature and pressure measurement as well as process analysis. Our portfolio is completed by comprehensive services and consulting.

Introduced in 1989, the BM 70 from KROHNE was the first 10 GHz FMCW radar transmitter for level measurement in process tanks available on the market. The 2-wire OPTIWAVE series that followed in 2004 featured specific options for liquid and solid applications e.g. OPTIWAVE 6300 with its unique Drop antenna design for measuring solids.

With the OPTIWAVE 1010 (6 GHz), the OPTIWAVE 5200 (10 GHz) and now the **new OPTIWAVE series of 24 and 80 GHz radars,** KROHNE offers the appropriate frequency for each application. The new OPTIWAVE 5400 / 6400 / 7400 (24 GHz) and OPTIWAVE 3500 / 6500 / 7500 (80 GHz) radars are each designed for specific industry needs. They improve our portfolio for **reliable and accurate level measurement of liquids and solids,** even in most difficult applications.

Radar

Continuous radar level measurement is based on the theory of electromagnetic wave propagation by the British physicist James C. Maxwell in 1865. Maxwell postulated that the field lines of a changing magnetic field are surrounded by annular electrical field lines, even in the absence of electrical conductors.

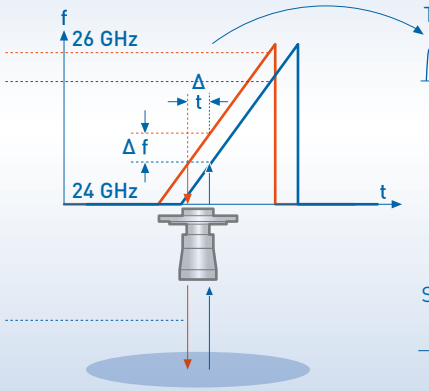
Inspired by this theory, the German physicist Christian Hülsmeyer patented his telemobiloscope, the first radar device of this type in Düsseldorf in 1904. For this innovation, he is rightly known as the inventor of the „original radar".

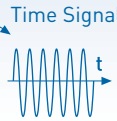
Measuring principle – example 24 GHz

FMCW: Frequency Modulated Continuous Wave

Signal Evaluation

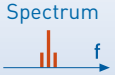
1. Radar wave sweep emitted from 24 to 26 GHz
2. Radar wave received
3. Time delay linked to wave propagation





4. Difference in frequency between emitted and received wave

5. Digital signal processing



6. Level is calculated

6, 10, 24 and 80 GHz OPTIWAVE – 2-wire loop-powered FMCW radar level transmitters for liquids and solids

Highlights

- A first-class design that is the result of 28 years of experience in FMCW radar measurement
- Extensive choice of process connections starting from ¾"
- Lens, Drop and Horn antennas for measuring distances up to 100 m; 328 ft
- Accuracy from ±2 mm; ±0.08"
- Can measure products with dielectric constants as low as 1.4
- Quick setup assistant for easy commissioning
- Empty tank spectrum function for eliminating false reflections
- Large backlit LCD display with 4-button keypad
- Text displayed in 12 languages
- Free PACTware™ DTM with full functionality

In this highlight brochure, we are introducing **six new radar devices** – three operate at 24 GHz and three more at 80 GHz – which complement the existing 6 GHz and 10 GHz devices. They will appeal to a wide range of industries from chemical and petro-chemical to mining, minerals and metals processing and cover liquid and solid applications.

8 radar devices: which one will suit your application best?

The answer is easy: it depends on your application. Parameters such as which product to measure, process conditions and tank geometry will guide you to the right radar device.

The KROHNE OPTIWAVE radars are all **FMCW based and suited for liquids and solids.**

The new OPTIWAVE 6400 and OPTIWAVE 6500 are instruments for measuring solids. The 24 GHz **OPTIWAVE 6400** is equipped with the proven Drop antenna. Insensitive to product build-up, it is designed for **granulates and rocks in silos or bulk storage.** The 80 GHz **OPTIWAVE 6500** has a flush Lens antenna: its narrow radar beam is best suited for **powders and dusty atmospheres.**

The OPTIWAVE liquid radars each have their particular target application:

The **OPTIWAVE 1010** is a 6 GHz FMCW radar that is uniquely suited for **clean liquids in bypass chambers and Magnetic Level Indicators (MLI).** It is welded to the bypass chamber or MLI and measures the position of the float or the liquid level.

The **OPTIWAVE 3500,** one of the new 80 GHz instruments, is aimed at **hygienic applications** in the food, beverage and pharmaceutical markets. It has a wide range of hygienic connections and can measure level right up to the process connection. Thanks to its narrow beam angle (see the illustration for the diameter of the radar beam), it is capable of measuring in small and narrow tanks.

The **OPTIWAVE 5200** uses the proven 10 GHz radar technology and has the **widest range of options,** SIL2 approval and a choice of fieldbus communication protocols such as FOUNDATION™ fieldbus or PROFIBUS PA. The OPTIWAVE 5200 comes in a compact and a remote version, making it an exceptionally flexible radar device for your liquid applications. The measuring range depends on the choice of antenna, with a maximum range of 30 m; 98.4 ft. The diameter of the radar beam is larger due to the lower frequency, so it is best suited for storage and simple process tanks.

The new OPTIWAVE 5400 and OPTIWAVE 7400 are 24 GHz FMCW radars. Due to a high dynamic range, they measure distances up to 100 m; 328 ft. The **OPTIWAVE 5400** is the **entry level device** for most application requirements. The **OPTIWAVE 7400** covers **all applications** and comes with a quick coupling system that makes it possible to remove the housing under process conditions. A wide range of antennas and process connections are available, including a flange plate protection for corrosive applications.

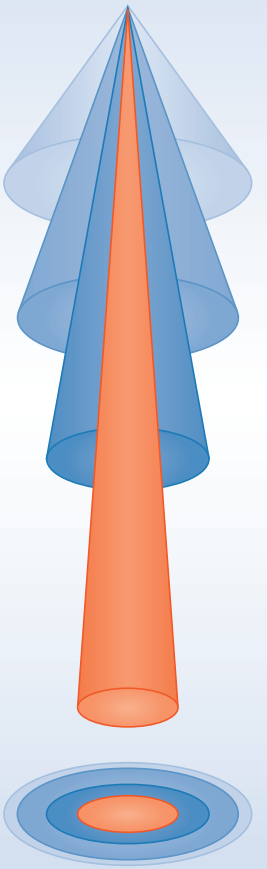
In applications with **narrow tanks or long nozzles,** the new **OPTIWAVE 7500** with 80 GHz FMCW radar technology and its reduced radar beam is the best choice. This radar features a PEEK Lens antenna and measures the level of a product from the flange down to the container bottom over a distance of 100 m; 328 ft.

KROHNE's most important asset is our 28 years' experience in providing superior FMCW radar devices to our customers. This has led us to offer all our new OPTIWAVE devices with a **3-year warranty.** Feel free to contact your local KROHNE representative for more information.

Highlight

There is more to come: A new FMCW radar level transmitter for the Water & Wastewater industry, available beginning of 2018

Radar beam diameter for each frequency over identical distances, with the same antenna size:



OPTIWAVE portfolio

For liquids

	OPTIWAVE 1010	OPTIWAVE 5200
		
Page	6-7	8-9
	For liquids in bypass chambers	For liquids in storage and process applications
Frequency range	C-band / 6 GHz	X-band / 10 GHz
Measurable products	liquids	liquids
Dielectric constant Ɛr	NA (with float), ≥3 (without float)	≥1.8 (TBF 1.1)
Measuring range	0...8 m; 0...26.2 ft	0...30 m; 0...98 ft
Accuracy	±5 mm; ±0.2"	±5 mm; ±0.2"
Repeatability	±2 mm; ±0.08"	±1 mm; ±0.04"
Converter version	C (compact)	C (compact), F (field remote)
Housing material	Aluminium, 316L	Aluminium, 316L
Ingress protection	IP66/67	IP66/67 – NEMA 4X
Antenna installation*	TLPR	TLPR
Antenna type (material), size (beam angle)	Metallic Horn (316L) Ø42.4 mm; 1.67" (for BM26 W1010)	Metallic Horn (316L) DN65; 2.5" (for BM 26) Metallic Horn (316L) DN80...200; 3...8" (32...12°) Wave Horn (PP or PTFE) Ø43 mm; 1.69" (20°) Metallic Wave Guide (316L) Ø30 mm; 1.18"
Process connection	Welded to bypass chamber or Magnetic Level Indicator (MLI)	Thread: G1½, G2, 1½ NPT, 2 NPT Flange: DN50...DN200; 2...8", 50...200 A
Gasket	FKM/FPM, EPDM, Kalrez® 6375	FKM/FPM, Kalrez® 6375, EPDM, PFA
Ambient temperature	–40...+85°C; –40...+185°F	–40...+80°C; –40...+176°F
Process temperature	–40...+150°C; –40...+302°F	–60...+250°C; –76...+482°F (higher on request)
Process pressure	–1...40 barg; –14.5...580 psig	–1...40 barg; –14.5...580 psig (higher on request)
Power supply / x-wire	14.5...30 V DC (Ex i), 14.5...36 V DC (Ex d), 2-wire	11.5...30 V DC (Ex i), 13.5...36 V DC (Ex d), 2-wire
Output	2-wire: 4...20 mA (HART® 6)	2-wire: 4...20 mA (HART® 6), FOUNDATION™ fieldbus, PROFIBUS PA, RS 485 MODBUS RTU**
Accessories	weather protection	antenna extensions of various shapes and lengths, heating/ cooling systems for metallic horn antennas, BM70x adaptor, weather protection
Approvals	ATEX, IECEx, NEPSI, NACE	ATEX, IECEx, cFMus, NEPSI, INMETRO, PESO, EAC, WHG, CRN, NACE
SIL approval	-	SIL 2

* Antenna installation: LPR (Level Probing Radar): The antenna can be installed in a closed tank as well as outside. The antenna needs to point downwards and location restrictions apply (Radio Astronomy Station). TLPR (Tank Level Probing Radar): The antenna must be installed in a closed tank.

** Available by the 2nd quarter of 2018 at the latest

For liquids

	OPTIWAVE 5400	OPTIWAVE 7400
		
Page	10-11	12-13
	For liquids in basic process applications	For agitated and corrosive liquids
Frequency range	K-band / 24 GHz	K-band / 24 GHz
Measurable products	liquids	liquids
Dielectric constant Ɛr	≥1.4 (TBF 1.1)	≥1.4 (TBF 1.1)
Measuring range	0...100 m; 0...328 ft	0...100 m; 0...328 ft
Accuracy	±2 mm; ±0.08"	±2 mm; ±0.08"
Repeatability	±1 mm; ±0.04"	±1 mm; ±0.04"
Converter version	C (compact), F (field remote)**	C (compact), F (field remote)**
Housing material	Aluminium, 316L**, Deep drawn 316L**	Aluminium, 316L**, Deep drawn 316L**
Ingress protection	IP66/68 0.1 barg; 1.45 psig	IP66/68 0.1 barg; 1.45 psig
Antenna installation*	LPR and TLPR	LPR and TLPR
Antenna type (material), size (beam angle)	Metallic Horn (316L) DN40...200; 1.5...8" (17...5°) Drop (PP) DN80; 3" (9°), DN100; 4" (7°), DN150; 6" (5°)	Metallic Horn (316L) DN40...200; 1.5...8" (17...5°) Drop (PEEK) DN80; 3" (9°) Drop (PTFE) DN80; 3" (8°), DN100; 4" (7°), DN150; 6" (4°)
Process connection	Thread: G1, G1½, 1 NPT, 1½ NPT Flange: DN40...200; 1½...8", 40...200 A	Thread: G1½, 1½ NPT Flange: DN40...200; 1½...8", 40...200 A
Gasket	FKM/FPM, EPDM, Kalrez® 6375	FKM/FPM, EPDM, Kalrez® 6375
Ambient temperature	–40...+80°C; –40...+176°F	–40...+80°C; –40...+176°F
Process temperature	–50...+130°C; –58...+266°F	–50...+200°C; –58...+392°F (higher on request)
Process pressure	–1...16 barg; –14.5...232 psig	–1...100 barg; –14.5...1450 psig (higher on request)
Power supply / x-wire	12...30 V DC (Ex i), 16...36 V DC (Ex d), 2-wire	12...30 V DC (Ex i), 16...36 V DC (Ex d), 2-wire
Output	2-wire: 4...20 mA (HART® 7), FOUNDATION™ fieldbus**, PROFIBUS PA**	2-wire: 4...20 mA (HART® 7), FOUNDATION™ fieldbus**, PROFIBUS PA**
Accessories	antenna extensions in metal or PP, purging system, flange plate protection made of PP, weather protection, mounting brackets	antenna extensions in metal or PTFE, purging / heating / cooling systems for metallic horn antennas, flange plate protection made of PTFE or PEEK, weather protection, OPTIWAVE 7300 process connection adaptor, mounting brackets
Approvals	ATEX, IECEx, cQPSus (IS/NI), NACE, cQPSus (XP)**, NEPSI**, EAC**, WHG**, VLAREM II**, API 2350**, CRN - ASME B31.3**	ATEX, IECEx, cQPSus (IS/NI), NACE, cQPSus (XP)**, NEPSI**, EAC**, WHG**, VLAREM II**, API 2350**, DNV-GL**, CRN - ASME B31.3**
SIL approval	Developed acc. to SIL 2/3, IEC 61508 – 2010. The SIL approval is in the process of validation by TÜV Süd, Germany.	Developed acc. to SIL 2/3, IEC 61508 – 2010. The SIL approval is in the process of validation by TÜV Süd, Germany.

For liquids

	OPTIWAVE 7500	OPTIWAVE 3500
		
Page	14-15	16-17
	For liquids in narrow tanks with internal obstructions	For liquids with hygienic requirements
Frequency range	W-band / 80 GHz	W-band / 80 GHz
Measurable products	liquids	liquids
Dielectric constant Ɛr	≥1.4 (TBF 1.1)	≥1.4 (TBF 1.1)
Measuring range	0...100 m; 0...328 ft	0...50 m; 0...164 ft
Accuracy	±2 mm; ±0.08"	±2 mm; ±0.08"
Repeatability	±1 mm; ±0.04"	±1 mm; ±0.04"
Converter version	C (compact), F (field remote)**	C (compact), F (field remote)**
Housing material	Aluminium, 316L**, Deep drawn 316L**	Aluminium, 316L**, Deep drawn 316L**
Ingress protection	IP66/68 0.1 barg; 1.45 psig	IP66/68 0.1 barg; 1.45 psig
Antenna installation*	LPR and TLPR	LPR and TLPR
Antenna type (material), size (beam angle)	Lens (PEEK) DN20; ¾" (15°), DN25; 1" (10°), DN40; 1.5" (8°), DN70; 2.75" (4°)	Lens (PEEK) DN25; 1" (10°), DN40; 1.5" (8°)
Process connection	Thread: G¾, G1, G1½, G3, ¾ NPT, 1 NPT, 1½ NPT, 3 NPT Flange: DN50...200; 2...8", 50...200 A	Tri-Clamp® ISO 2852: 1½", 2" DIN 11851 or DIN 11864-1 Form A: DN40, DN50 VARIVENT® or NEUMO BioControl®: DN50 SMS 1145: DN51
Gasket	FKM/FPM, EPDM, Kalrez® 6375	PEEK
Ambient temperature	–40...+80°C; –40...+176°F	–40...+80°C; –40...+176°F
Process temperature	–50...+150°C; –58...+302°F, –50...+200°C; –58...+392°F**	–40...+150°C; –40...+302°F
Process pressure	–1...40 barg; –14.5...580 psig	–1...25 barg; –14.5...362.6 psig
Power supply / x-wire	12...30 V DC (Ex i), 16...36 V DC (Ex d), 2-wire	12...30 V DC (Ex i), 16...36 V DC (Ex d), 2-wire
Output	2-wire: 4...20 mA (HART® 7), FOUNDATION™ fieldbus**, PROFIBUS PA**	2-wire: 4...20 mA (HART® 7), FOUNDATION™ fieldbus**, PROFIBUS PA**
Accessories	antenna extensions in metal, purging system, flange plate protection made of PEEK, weather protection, mounting brackets	weather protection
Approvals	ATEX, IECEx, cQPSus (IS/NI), NACE, cQPSus (XP)**, NEPSI**, EAC**, WHG**, VLAREM II**, API 2350**, DNV-GL**, CRN - ASME B31.3**	ATEX, IECEx, cQPSus (IS/NI), FDA, EC 1935/2004, EC 2023/2006, EU 10/2011, cQPSus (XP)**, NEPSI**, EAC**, WHG**, VLAREM II**, 3A**, EHEDG**, CRN - ASME B31.3**
SIL approval	Developed acc. to SIL 2/3, IEC 61508 – 2010. The SIL approval is in the process of validation by TÜV Süd, Germany.	Developed acc. to SIL 2/3, IEC 61508 – 2010. The SIL approval is in the process of validation by TÜV Süd, Germany.

For solids

	OPTIWAVE 6400	OPTIWAVE 6500
		
Page	18-19	20-21
	For solids from granulates to rocks	For powders and dusty atmosphere
Frequency range	K-band / 24 GHz	W-band / 80 GHz
Measurable products	solids	powders
Dielectric constant Ɛr	≥1.4 (TBF 1.1)	≥1.4 (TBF 1.1)
Measuring range	0...100 m; 0...328 ft	0...100 m; 0...328 ft
Accuracy	±2 mm; ±0.08"	±2 mm; ±0.08"
Repeatability	±1 mm; ±0.04"	±1 mm; ±0.04"
Converter version	C (compact), F (field remote)**	C (compact), F (field remote)**
Housing material	Aluminium, 316L**, Deep drawn 316L**	Aluminium, 316L**, Deep drawn 316L**
Ingress protection	IP66/68 0.1 barg; 1.45 psig	IP66/68 0.1 barg; 1.45 psig
Antenna installation*	LPR	LPR
Antenna type (material), size (beam angle)	Metallic Horn (316L) DN80...200; 3...8" (9...5°) Drop (PP) DN80; 3" (9°), DN100; 4" (7°), DN150; 6" (5°) Drop (PTFE) DN80; 3" (8°), DN100; 4" (7°), DN150; 6" (4°)	Lens (PEEK) DN40; 1.5" (8°), DN70; 2.75" (4°)
Process connection	Thread: G1, G1½, 1 NPT, 1½ NPT Flange: DN80...200; 3...8", 80...200 A	Thread: G1½, G3, 1½ NPT, 3 NPT Flange: DN50...200; 2...8", 50...200 A
Gasket	FKM/FPM, EPDM, Kalrez® 6375	FKM/FPM, EPDM, Kalrez® 6375
Ambient temperature	–40...+80°C; –40...+176°F	–40...+80°C; –40...+176°F
Process temperature	–50...+130°C; –58...+266°F	–50...+150°C; –58...+302°F, –50...+200°C; –58...+392°F**
Process pressure	–1...16 barg; –14.5...232 psig	–1...40 barg; –14.5...580 psig
Power supply / x-wire	12...30 V DC (Ex i), 16...36 V DC (Ex d), 2-wire	12...30 V DC (Ex i), 16...36 V DC (Ex d), 2-wire
Output	2-wire: 4...20 mA (HART® 7), FOUNDATION™ fieldbus**, PROFIBUS PA**	2-wire: 4...20 mA (HART® 7), FOUNDATION™ fieldbus**, PROFIBUS PA**
Accessories	antenna extensions, slanted flange, purging system, weather protection, OPTIWAVE 6300 process connection adaptor, mounting brackets	antenna extensions, slanted flange, purging system, weather protection, mounting brackets
Approvals	ATEX, IECEx, cQPSus (IS/NI), cQPSus (XP)**, NEPSI**, EAC**, CRN - ASME B31.3**	ATEX, IECEx, cQPSus (IS/NI), cQPSus (XP)**, NEPSI**, EAC**, CRN - ASME B31.3**
SIL approval	Developed acc. to SIL 2/3, IEC 61508 – 2010. The SIL approval is in the process of validation by TÜV Süd, Germany.	Developed acc. to SIL 2/3, IEC 61508 – 2010. The SIL approval is in the process of validation by TÜV Süd, Germany.

* Antenna installation: LPR (Level Probing Radar): The antenna can be installed in a closed tank as well as outside. The antenna needs to point downwards and location restrictions apply (Radio Astronomy Station). TLPR (Tank Level Probing Radar): The antenna must be installed in a closed tank.

** Available by the 2nd quarter of 2018 at the latest

OPTIWAVE 1010 (6 GHz) – for liquids in bypass chambers

Target industries:

- Chemical
- Power
- Water & Wastewater

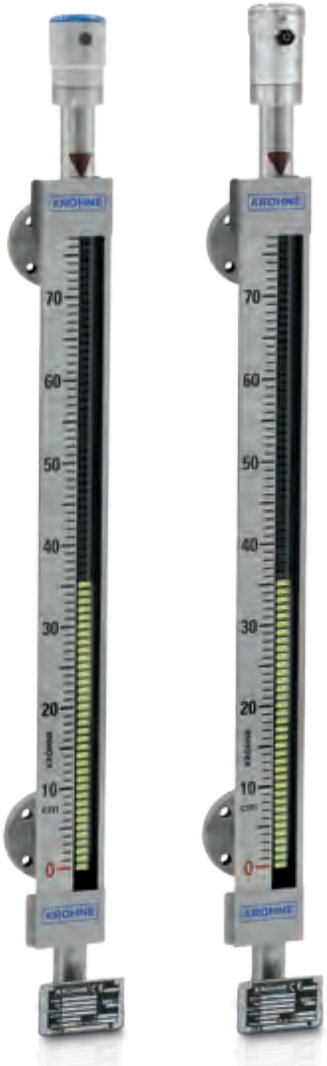
Target applications:

Clean liquids in bypass chambers or Magnetic Level Indicators (MLI) such as solvents, alcohols, bases, condensates, liquified gases, hydrocarbons, hydraulic or motor oil, engine coolants, washing fluids, cooling or drinking water etc.

The **cost-effective** OPTIWAVE 1010 FMCW radar is designed for **continuous level measurement of clean liquids.** It is welded to a bypass chamber or a Magnetic Level Indicator (MLI). For maximum safety, the device features a dual process seal system that permits removal of the converter under process conditions.

- Fits on the BM 26 (MLI) or any bypass chamber with internal Ø38...56 mm; 1.5...2.2"
- Metaglas® or Metapeek seal (dual process seal system)
- IP68 local indication when used with BM 26 (MLI)
- Housing made of aluminium or stainless steel
- Pre-configured in the factory and ready to use (plug & play)
- Measuring distances up to 8 m; 26.2 ft
- ±5 mm; ±0.2" accuracy
- Process conditions up to +150 °C; +302 °F, 40 barg; 580 psig

HART COMMUNICATION PROTOCOL



OPTIWAVE 1010 C welded to a BM 26 Magnetic Level Indicator (MLI)

OPTIWAVE 1010 C welded to a BM 26 Magnetic Level Indicator (MLI) on a buffer tank containing demineralised water at +95 °C; +203 °F, 4 barg; 58 psig

OPTIWAVE 5200 C on a thermal insulated storage tank containing heavy fuel at +120 °C; +248 °F, 2 barg; 29 psig

OPTIWAVE 5200 (10 GHz) – for liquids in storage and process applications

The OPTIWAVE 5200 C/F is available **as compact or,** for installations at the tank bottom, **as remote transmitter**. The **modular housing concept** permits orienting the display/keypad on the side or at the top. It features unique gasket-free PP and PTFE Wave Horn antennas for use on tanks with aggressive liquids.

- Quick coupling system permits removal of the converter under process conditions
- Converter compatible with all BM70x process connections
- Remote converter: up to 100 m; 328 ft away from the antenna
- Measuring distances up to 30 m; 98.4 ft
- SIL2-compliant according to IEC 61508 for safety-related systems
- Extensive choice of process connections: thread ≥1½" and flange ≥DN50; 2")
- ±5 mm; ±0.2" accuracy
- Process conditions up to +250 °C; +482 °F, 40 barg; 580 psig (higher temperatures/pressures on request)

SIL 2 Safety Integrity Level · HART COMMUNICATION PROTOCOL · FOUNDATION · PROFIBUS®

OPTIWAVE 5200 C with PP Wave Horn antenna

OPTIWAVE 5200 F with PTFE Wave Horn antenna

Target industries:

- Chemical
- Oil & Gas
- Power
- Wastewater

Target applications:

Liquid storage or process applications in installations

- with small process connections (≥1½")
- where it is difficult to access the tank roof (remote version recommended)
- requiring SIL2 safety loops

with fertilisers, solvents, alcohols, bases, acids, condensates, hydrocarbons, cooling water, molasses, vegetable oil, flocculent, ferric chloride, molten steel, hydraulic oil, sludge etc.

OPTIWAVE 5400 (24 GHz) – for liquids in basic process applications

Target industries:

- Chemical & Petrochemical
- Oil & Gas
- Power

Target applications:

Measurement of liquids such as solvents, alcohols, acids, bases, condensates, hydrocarbons, phosphorus, fuels, water, hydraulic oil, additives etc.

- in processes with fast changing levels (≤60 m/min; 196.85 ft/min)
- in closed tanks and in the open air (e.g. dams or rivers)
- in storage and process tanks requiring high accuracy

Designed for **basic liquid applications,** this market-entry FMCW radar level transmitter provides accurate readings in closed tanks, in the open air like rivers or dams, and even in fast moving processes. It can be used to upgrade radars in basic applications requiring higher accuracy.

- Proven PP Drop antenna:
  - Insensitive to condensation
  - Small beam angle (5° with DN150; 6" Drop)
  - Ellipsoidal shape and smooth surface to minimise scaling
  - Flange plate protection for corrosive media
  - New DN100; 4" Drop antenna measures up to 80 m; 262.5 ft
- Metallic Horn antenna DN200; 8" for measuring distances up to 100 m; 328 ft
- Purging system for Metallic Horn antenna
- Antenna extensions to suit any nozzle length
- Extensive choice of process connections: thread ≥1" and flange ≥DN40; 1½"
- ±2 mm; ±0.08" accuracy
- Process conditions up to +130 °C; +266 °F, 16 barg; 232 psig

HART COMMUNICATION PROTOCOL

DN80; 3" PP Drop antenna

DN80; 3" Metallic Horn antenna

OPTIWAVE 5400 C on the bypass chamber of a heat exchanger containing butanol at +40 °C; +104 °F, 3 barg; 43.5 psig

OPTIWAVE 7400 (24 GHz) – for agitated and corrosive liquids

Designed for **liquids in harsh environment** such as tanks with agitators containing corrosives or in **non-Ex applications up to +700 °C; +1292 °F** (e.g. molten salt in solar plants), this FMCW radar level transmitter has everything to solve tricky situations and replaces obsolete radars in high-end applications e.g. to obtain extended device features.

OPTIWAVE 7400 C on the stilling well of an insulated oil storage tank at +140 °C; +284 °F; atm

- Proven PTFE and PEEK Drop antennas:
  - Insensitive to condensation
  - Small beam angle (4° with DN150; 6" PTFE Drop)
  - Ellipsoidal shape and smooth surface to minimise scaling
  - Flange plate protection for corrosive media
  - New DN100; 4" PTFE Drop antenna measures up to 80 m; 262.5 ft
- Metallic Horn antenna DN200; 8" for measuring distances up to 100 m; 328 ft
- Purging system for metallic Horn antenna
- Heating / Cooling systems to prevent crystallisation in Metallic Horn antennas
- Antenna extensions to suit any nozzle length
- Metaglas® second sealing barrier for toxic and dangerous products
- Quick coupling system permits removal of the converter under process conditions
- Converter compatible with all OPTIWAVE 7300 process connections
- ±2 mm; ±0.08" accuracy
- Standard process conditions up to +200 °C; +392 °F, 100 barg; 1450 psig (higher on request)

HART COMMUNICATION PROTOCOL

DN80; 3" PTFE Drop antenna

DN80; 3" PEEK Drop antenna

Target industries:

- Chemical & Petrochemical
- Metals
- Oil & Gas
- Power

Target applications:

Measurement of liquids such as solvents, alcohols, acids, bases, condensates, liquefied gases, hydrocarbons, benzene, butadiene, ethylene, propylene, fuels, hydraulic oil, molten salt, molten steel, molten sulphur, additives etc.

- in processes with fast changing levels (≤60 m/min; 196.85 ft/min)
- in process tanks requiring high accuracy
- in harsh environment (e.g. agitated tanks)
- in closed tanks and in the open air (e.g. floating roofs)
- in non-Ex molten salt applications up to +700 °C; +1292 °F (e.g. solar plants)

OPTIWAVE 7500 (80 GHz) – for liquids in narrow tanks with internal obstructions

Target industries:

- Chemical & Petrochemical
- Environment
- Oil & Gas
- Power

Target applications:

Level measurement of liquids such as hydrocarbons, LPG, ethylene, corrosion inhibitors, foaming agent, drilling mud, slop oil, solvents, acids, urea, chlorine, resins, paint, ink, lubricant oil, lime milk etc.

- in small and narrow tanks with internal obstructions (e.g. heating coils or agitators)
- in tanks with long nozzles
- through tank roofs made of non-conductive material (e.g. plastic, fibreglass or glass)

The **small beam angle and negligible dead zone** of this FMCW radar level transmitter makes it the premium choice for liquids in small and narrow tanks with internal obstructions like agitators or heating coils, as well as tanks with long nozzles. It can even measure through tank roofs made of non-conductive material.

- Flush-mounted PEEK Lens antenna (no tank intrusion):
  - Insensitive to deposit
  - Small dead zone and beam angle (4° with DN70; 2.75" Lens)
  - Large measuring range from the antenna up to 100 m; 328 ft
  - Flange plate protection for corrosive media
  - 112 mm; 4.4" antenna extension for long nozzles
- Extensive choice of process connections: thread ≥¾" and flange ≥DN50; 2"
- ±2 mm; ±0.08" accuracy
- Process conditions up to +150 °C; +302 °F, 40 barg; 580 psig

80 GHz radar level measurement

HART COMMUNICATION PROTOCOL

DN70; 2.75" PEEK Lens antenna

DN40; 1.5" PEEK Lens antenna with DN80 flange connection

OPTIWAVE 7500 C on a tank containing corrosives at +50 °C; +122 °F, 3 barg; 43.5 psig

OPTIWAVE 3500 C on a milk tank at +4 °C; +39 °F; atm

OPTIWAVE 3500 (80 GHz) – for liquids with hygienic requirements

This FMCW radar level transmitter for **hygienic liquid applications** is CIP/SIP suitable and offers a wide range of hygienic process connections. Its Lens antenna design enables precise measurement even in small and narrow tanks with agitators, typical of the hygienic industry.

- Flush-mounted PEEK Lens antenna (no tank intrusion):
  - Small dead zone and beam angle (8° with DN40; 1½" Lens)
  - Measuring distances up to 50 m; 164 ft
  - CIP/SIP suitable (Cleaning In Place, Sterilisation In Place)
- Extensive choice of hygienic process connections: ⩾1½" Tri-Clamp® ISO 2852, Tuchenhagen VARIVENT®, SMS, DIN 11851, DIN 11864-1 Form A, NEUMO BioControl®
- ±2 mm; ±0.08" accuracy
- Process conditions up to +150 °C; +302 °F, 25 barg; 362.6 psig

80 GHz radar level measurement

HART COMMUNICATION PROTOCOL

FDA

Target industries:

- Food & Beverage
- Pharmaceutical

Target applications:

Liquid storage or process applications in

- high and narrow tanks
- small storage tanks
- agitated tanks

containing solvents, alcohols, bases, slightly corrosive acids, fruit extract, raw milk, yeast, beer, chocolate, vegetable oil, wine, fruit juice, purified water, soup, cheese etc.

DN25; 1" PEEK Lens antenna with 1½" Tri-Clamp® ISO 2852 connection

OPTIWAVE 6400 (24 GHz) – for solids from granulates to rocks

Target industries:

- Metals, Minerals & Mining
- Chemical
- Agriculture
- Power
- Pulp & Paper
- Wastewater

Target applications:

Solid and granulate storage applications like buffer silos, hoppers, stock piles, bulk storage containers, rock crushers, blast furnace, conveyor belts with rock products of different size (stone, gravel, grid, sand), aggregates (e.g. recycled concrete or slag), iron ore, coal, coke, lime, fertilisers, granulates (PE, PP, PVC), additive fuels (e.g. dried sludge), salt, cereals, animal nutrition, coffee beans, dry yeast, woodchips etc.

By combining high signal dynamics and FMCW radar technology, this **market-entry** radar device accurately and reliably measures the level of **solids** such as stone, plastic granulates or coffee beans. No need for expensive antenna aiming kits or purging systems: the proven Drop antenna design minimises scaling and is unaffected by the angle of repose.

- Built-in configurations for different surface profiles
- Proven PP or PTFE Drop antenna:
  - Small beam angle (4° with DN150; 6″ PTFE Drop)
  - Unaffected by angle of repose – no need for antenna aiming kits
  - Insensitive to product build-up
  - New DN100; 4″ Drop antenna measures up to 80 m; 262.5 ft
- Measuring distances up to 100 m; 328 ft
- Purging system for Metallic Horn antenna
- Antenna extensions to suit any nozzle length
- Converter compatible with all OPTIWAVE 6300 process connections
- Extensive choice of process connections: thread ≥1″ and flange ≥DN80; 3″
- ±2 mm; ±0.08″ accuracy
- Process conditions up to +130 °C; +266 °F, 16 barg; 232 psig

HART COMMUNICATION PROTOCOL

DN80; 3", DN100; 4", DN150; 6" PP Drop antennas

DN150; 6" PP Drop antenna
with G1½ thread and DN150
low-pressure flange

OPTIWAVE 6400 C on a silo filled with mustard seeds amb/atm

OPTIWAVE 6500 C with DN70; 2.75" PEEK Lens antenna and DN100 flange on the lime silo of a water treatment plant

DN70; 2.75" PEEK Lens antenna with G3 thread connection

DN40; 1.5" PEEK Lens antenna with DN80 flange connection

OPTIWAVE 6500 (80 GHz) – for powders and dusty atmosphere

Accurate **continuous level measurement of fine powders** has to deal with a series of issues like dust, low-reflective media, build-up and uneven surfaces. Specific algorithms and the high signal dynamics of this FMCW radar level transmitter are the key to providing reliable and accurate readings despite these challenging conditions. Thanks to the small beam angle of the Lens antenna, this powerful device handles high and narrow silos even in the presence of internal obstructions.

- High dynamics for clear vision despite dusty conditions or low reflective media
- Flush-mounted PEEK Lens antenna (no tank intrusion):
  - Small beam angle (4° with DN70; 2.75″ Lens) for easy installation
  - Measuring distances up to 100 m; 328 ft
  - Unaffected by angle of repose – no need for antenna aiming kits
  - Purging system for flange connection without antenna extension
  - 112 mm; 4.4″ antenna extension for long nozzles
- Extensive choice of process connections: threaded ≥1½″ and flange ≥DN50; 2″
- ±2 mm; ±0.08″ accuracy
- Process conditions up to +150 °C; 302 °F, 40 barg; 580 psig

80 GHz radar level measurement

HART COMMUNICATION PROTOCOL

Target industries:

- Metals, Minerals & Mining
- Chemical
- Agriculture
- Power
- Pulp & Paper
- Wastewater

Target applications:

Solid storage applications with extremely dusty atmosphere in

- high and narrow silos even with internal obstructions
- bulk storage containers
- buffer silos
- hoppers

containing fine powders (building material etc.), cement, lime, filler, silica, gypsum, plastic powder, soap powder, fly ash, coal, flour, milk powder, coffee powder, chocolate powder, sugar, animal flour, starch, saw dust etc.

Surge protection directly at the measuring head

SURGEPROTECT SP-F / EX(I)-24DC and SP-F / 1X2-24DC are surge protective devices for **all common standard signals** that are directly attached to any sensor head via their connecting threads. This type of mounting saves time and money, and there is no need for an additional connection box for installing the surge protection.

SURGEPROTECT SP-F / EX-24DC is corrosion resistant and has complies with IP67, thus it is also suitable for use in **rough industrial environments** and hazardous areas.

SURGEPROTECT SP-F / EX(I)-24DC
Surge protection for measurement and control technology in intrinsically safe power circuits.

SURGEPROTECT SP-F / 1X2-24DC
Surge protection for measurement and control technology in current loops and non-hazardous areas.

SURGEPROTECT SP-F / EX-24DC
Surge protection for measurement and control technology in acc. with protection types Ex d, Ex tD, Ex ia IIC

	SURGEPROTECT SP-F / EX(I)-24DC	SURGEPROTECT SP-F / 1X2-24DC	SURGEPROTECT SP-F / EX-24DC
			
Ambient temperature (operation)	–40...+50°C; –40...+122°F	–40...+85°C; –40...+185°F	–40...+80°C; –40...+176°F (non-Ex)
Degree of protection	IP67	IP67	IP67
Housing material	Zinc die-cast	Zinc die-cast, surface bronzed and nickel-plated	Stainless steel
Mounting type	Direct screw connection	Direct screw connection	M20
Number of positions	3	3	2
Nominal voltage UN	24 V DC	24 V DC	24 V DC
Operating effective current IC at UC	⩽ 10 µA	⩽ 10 µA	-
Voltage protection level Up (core-core)	⩽ 55 V (C2: 5 kA) ⩽ 50 V (C1: 250 A) ⩽ 50 V (C3: 25 A) ⩽ 80 V (D1: 1 kA)	⩽ 80 V (C2: 5 kA)	⩽ 65 V (C3: 10 A)
Voltage protection level Up (core-ground)	⩽ 1.4 kV (C2: 5 kA, direct grounding) ⩽ 1.4 kV (C1: 500 A) ⩽ 1.4 kV (C3: 100 A) ⩽ 1.4 kV (D1: 1 kA)	⩽ 450 V (C2: 5 kA, direct grounding)	⩽ 1.1 kV (C3: 100 A) ⩽ 1.1 kV (C1: 1 kV, 500 A) ⩽ 1.2 kV (C2: 10 kV, 5 kA)
Voltage protection level Up (shield-ground)	⩽ 650 V (C2: 5 kA, optional)	⩽ 600 V (C2: 5 kA, optional)	-
Resistance in series	2.2 Ω ±10 %	2.2 Ω	-
Approvals	Ex ia IIC	-	Ex d, Ex tD, Ex ia IIC

KROHNE – Process instrumentation
and Measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process analysis
- Services

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