

# Nemesis

## FMCW Radar Non-contacting Level Measurement

Versatile, high-power, high accuracy RADAR level measurement from Pulsar Process Measurement, leader in non-contacting measurement technologies and digital signal analysis.



# Nemesis:

## Frequency Modulated Continuous Wave RADAR

### Features

- High performance FMCW radar
- Choice of three transducer types
- 64m (210ft) range
- Dual polarised for consistent performance
- Digital communications
- Self-contained, no need for external controller
- Optional Radar Level Star controller for local display and alarm relays

Pulsar Process Measurement is the world leader in non-contacting level measurement with thousands of installations worldwide. Pulsar's Nemesis system is high power, high performance Frequency Modulated Continuous Wave (FMCW) RADAR level measurement, complementing Pulsar's ultrasonic level and flow measurement equipment and extending opportunities into challenging new applications.

Nemesis is versatile, offering a choice of three transducer configurations depending upon the application and capability required, each offering a 64m (210ft) measurement range. Each transducer can either stand alone, providing extraordinary accuracy and reliable level measurement via current loop or standard digital communication protocols, or team up with Pulsar's Radar Level Star Controller, a sophisticated transceiver that expands the capabilities of the Nemesis system to add a wide range of functions including relays for alarm or control, data logging and volume measurement.

## Why Choose Nemesis Non-contact RADAR Measurement?:

Nemesis uses signal processing techniques previously reserved for military applications, and has a very high power output that allows Nemesis to function without compromise where other systems would fail.

Nemesis excels in applications where extreme process conditions are present or where the properties of the coefficient of reflectivity of the material (dielectric constant) is very low, for example hot pneumatically filled silos or in the case of low

dielectric constant, plastic pellet silos or low bulk density powders such as flour, paint pigment or pulverised fly ash silos.

The combination of high power output, concentrated and focused microwave emissions and cutting edge signal processing provides Nemesis with unrivalled capability; and provides the world with a new benchmark in non contacting level measurement technology.

## Communication and Control:

Any Nemesis transducer can operate as a stand-alone, intelligent measurement device, providing either a mA current loop output or RS485 digital communications with a choice of Modbus RTU, Profibus DPV1 or HART (pending) protocol. Nemesis transducers include Digital Signal Processing and on-board data logging. Programming is via RS232/ASCII, RS485, from a PC or any proprietary protocol programmer.



# Benefits and Special Features:

## Nemesis benefits

- Direct level measurement means no compensation is needed for changing process conditions (such as density, pH, temperature, conductivity, pressure, viscosity, dielectric constant etc.) which results in high application capability.
- Accurate, reliable measurement that requires no re-calibration.
- Non-contacting radar transmitter with no moving parts means minimised maintenance.
- Suitable for dirty, coating, crystallising, and corrosive applications (NB: Contact Pulsar for advice on corrosive application suitability).
- Top down measurement gives simple installation with no empty tank requirements, and minimised risk for leakages.

## Special features

For the most challenging applications:

- 4-wire transmitters with maximum accuracy and performance.
- Suitable for solids, liquids, and slurries in reactors, with rapid level changes and challenging process conditions.
- High pressure and temperature capability
- Handles long measuring ranges
- Application flexibility with a wide selection of materials, process connections, antenna styles, and accessories
- Fast update rate

## Temperature and vapour gradients

Unlike ultrasonic, RADAR is temperature-independent, so materials stored or processed at an elevated temperature where there is a temperature gradient above the surface of the material are ideal applications for measurement with Nemesis. In the same way, radio wave velocity is not affected by varying partial pressures of chemical vapours in the measurement column, for example above a light fraction liquid surface, making Nemesis the perfect answer for fuels or measurement in a tank with a volatile atmosphere (ATEX Pending).

## Foamy surfaces

While it is possible to get a measurement from a foamy surface using a good ultrasonic system, the low dielectric constant of the foam allows Nemesis to 'see' through the foam to the liquid surface underneath. Use Nemesis when it is critical to measure through the foam to the 'true' level.

## Atmospheres other than air, or reduced pressure

Radio waves are not attenuated by variations in the gas above the target, and will travel through a vacuum.

## High accuracy, long range, dusty environments

Nemesis gives a measurement range of 64m (210ft), and gives excellent results when small size, granular materials are being measured. Nemesis's radio frequency signals are strong enough to punch through a heavy load of dust in the atmosphere, providing a reliable way to measure in these difficult environments.

## Dual polarisation

Radio waves can be horizontally or vertically polarised, and there are RADAR level measurement devices on the market polarising in only one axis. Nemesis is polarised in both axes, guaranteeing consistent performance even when angles of repose change, for example, and simplifying installation.



## Radar Level Star:

Team the Nemesis Transducer with Pulsar's Radar Level Star controller to add on-board programming via Pulsar's straightforward menu-driven configuration. Radar Level Star has a multi-function display and the control power that comes from six on-board relays that can be set for a wide range of alarm or control functions, for example: high or low level or rate-of-change; or to provide control for equipment such as drives, blowers or valves.

Digital communications with Modbus RTU and Profibus DPV1 and DPV0 protocols are supported by Radar Level Star.

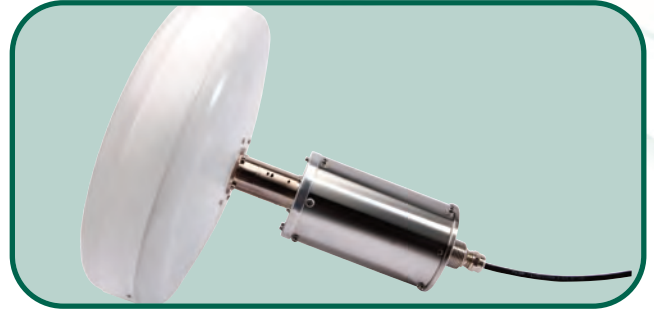


# Transducer Choices:

There is a choice of three Nemesis transducers. All offer 64m range and the high performance customers have come to expect from Pulsar Process Measurement, with variations in beam angle and therefore the application types for which they are best suited. Each of the three antenna types can be supplied with Modbus, Profibus DPV0 or DPV1 or HART (pending).

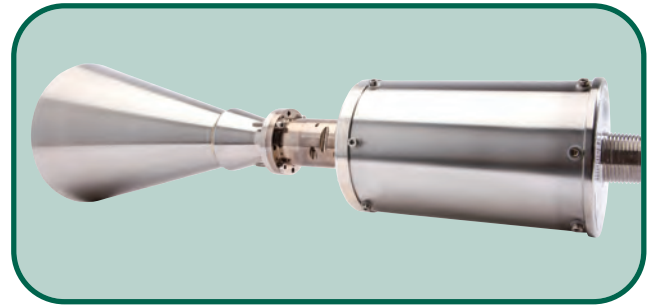
## Reflector:

With a total 6.5° beam angle, ideal for long distance applications, low dielectric coefficient (Dk), steep angles of repose.



## Horn:

The general purpose transducer, with 22dB gain and a total 12° beam angle, also perfect for higher temperature use.



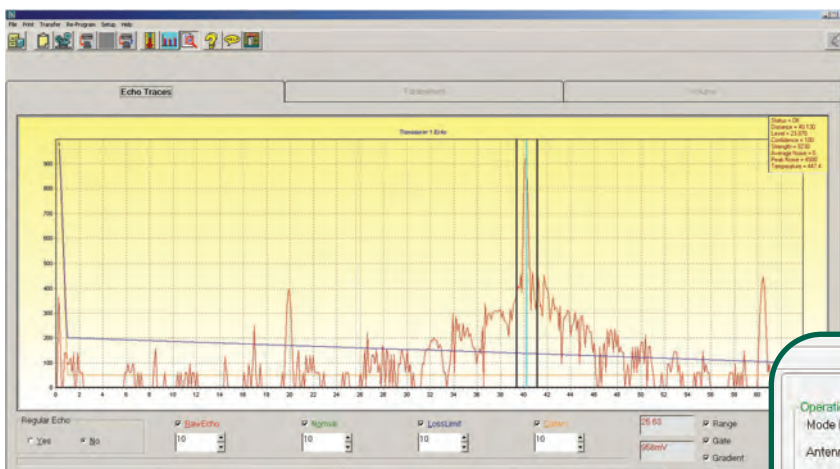
## Rod:

Designed specifically for liquid and slurry level measurement, the rod transducer is easy to install and gives superb flat surface results. Total beam angle 20°.



# Software:

Pulsar's software, Nemesis PC, provides full programming facilities for all Nemesis systems, plus the ability to view signal profiles, clone units and log data.



NEMESIS SIGNAL TRACE IN A NARROW SOLIDS SILO

DETAIL FROM NEMESIS PC PARAMETER SET-UP PAGE

Application		Relays		System	
<b>Operation</b>					
Mode (P100)	2	Display	Displ Units (P800)	1	Displ.Offset (P802)
Antenna (P101)	1		Dec Place (P801)	2	Displ. Conv (P804)
Material Type (P102)	2	<b>mAOutput</b>			
WaveGuide Ext (P103)	0		mA Out Range (P830)	2	High Value (P835)
Meas Unit (P104)	1		mA Out Mode (P831)	0	Fail Mode (P840)
Empty Level (P105)	15		Low Value (P834)	0	Low Limit (P836)
Span (P106)	14.5	<b>EchoProcess</b>			
Near Blanking (P107)	0.5		Xducer 1 Status (P900)	0	Average Noise 1 (P904)
Far Blanking % (P108)	20		Echo Confidence 1 (P901)	100	Peak Noise 1 (P904)
			Echo Strength 1 (P902)	698	
<b>Stability</b>					
Fill Damping (P870)	10	Fixed Dist (P881)	0.2	Offset	Meas. Offset

# Technical Specification: Nemesis

## SENSOR

<b>Sensor weight:</b>	1.8kg (4lbs)
<b>Sensor body dimensions:</b>	110mm (0.36ft) diameter x 296mm (0.97ft) long
<b>Sensor body material:</b>	Stainless steel (grade 304) and Aluminium. Nickel-graphite Fluoro-silicone
<b>Sensor ambient temperature:</b>	-40°C to +70°C (-40°F to +158°F)
<b>Environmental Protection:</b>	IP65
<b>Cable entry:</b>	Cable gland
<b>Maximum cable separation:</b>	85m (280ft) for standard cables (Four core 16/02, 0.5mm <sup>2</sup> , screened). Custom cable options allow separation to 170m (560ft), contact Pulsar for specifications

## PHYSICAL: PARABOLIC REFLECTOR (option AER)

<b>Parabolic reflector dimensions:</b>	360mm (1.18ft) diameter x 130mm (0.43ft) long
<b>Parabolic reflector weight:</b>	1.6kg (3.53lbs)
<b>Parabolic reflector materials:</b>	Polypropylene, Aluminum
<b>Parabolic reflector temperature:</b>	-40°C to +100°C (-40°F to +212°F)
<b>Parabolic reflector characteristics:</b>	Gain: 27dB, effective beam angle <3°

## PHYSICAL: HORN (option AEH)

<b>Horn dimensions:</b>	150mm (0.49ft) diameter x 240mm (0.79ft) long
<b>Horn weight:</b>	0.8kg (1.76lbs)
<b>Horn materials:</b>	Stainless steel (grade 316), PTFE
<b>Horn temperature:</b>	-40°C to +200°C (-40°F to +392°F)
<b>Horn characteristics:</b>	Gain: 22dB, effective beam angle <6°

## PHYSICAL: POLYROD (option AEP)

<b>Polyrod dimensions:</b>	55mm (0.18ft) diameter x 380mm (1.25ft) long
<b>Polyrod weight:</b>	0.4kg (0.88lbs)
<b>Polyrod materials:</b>	Aluminium, PTFE
<b>Polyrod temperature:</b>	-40°C to +200°C (-40°F to +392°F)
<b>Polyrod characteristics:</b>	Gain: 19dB, effective beam angle <10°

## PERFORMANCE:

<b>Accuracy:</b>	For Range: to 16m, accuracy is ±2mm; to 32m, ±4mm; to 64m, ±6mm
<b>Resolution:</b>	0.03% of the measured range or ±2mm, whichever is the greater
<b>Range:</b>	maximum: 64m (210ft), minimum: 0.5m (1.8ft)
<b>Operating frequency:</b>	8.9 - 10.1GHz (X-Band)
<b>Modulation Technique:</b>	FMCW (Frequency Modulated Continuous Wave)
<b>Output power:</b>	1mW (milliwatt) at aerial port

## APPLICATION MATERIAL CHARACTERISTICS:

<b>States and phases:</b>	Liquids including foamy liquids, sludges, powders and solid materials
<b>Material velocity:</b>	Static, vibrating and moving
<b>Dielectric constant:</b>	1.5 and above
<b>Temperature</b>	Any, within individual radar assembly limits

## OUTPUTS:

<b>Analogue output:</b>	4-20mA, isolated (to 150V floating), into 1kΩ. Source or sink
<b>RS232:</b>	ASCII, half duplex RS232
<b>RS485 Modbus:</b>	Modbus ASCII, RTU
<b>RS485 Profibus:</b>	Profibus DPV0 and DPV1, EN 50170
<b>HART:</b>	Version 7.0 pending

## PROGRAMMING:

<b>PC Programming:</b>	Via RS232 or RS 485 Modbus
<b>Programming security:</b>	Via passcode
<b>Programmed data integrity:</b>	Non-volatile memory
<b>PC set-up and monitoring software:</b>	Pulsar Nemesis PC software or Pulsar Handheld Calibrator
<b>Data Logging Capacity:</b>	256KB (NB: provides 128 day capacity at 5 minute logging interval)

## STANDARDS AND APPROVALS:

<b>Tank level probe Radar:</b>	EN 302372
<b>EMC and radio regulations:</b>	EN 61326-1, FCC CFR47 (parts 15 &18), IC RSS-210
<b>Enclosure:</b>	IEC 60529, IP65
<b>Electrical safety:</b>	EN 60950, EN 61010 series

# Technical Specification: Radar Level Star

PHYSICAL	
Outside dimensions:	235 x 184 x 120 mm (0.77 x 0.6 x 0.39ft)
Weight:	1.5kg (3.3lbs)
Enclosure material/description :	Polycarbonate, flame resistant to UL94-5V
Cable entry detail:	10 cable entry knock outs, 5 x M20,1 x M16 underside, 4 x PG11 at rear
ENVIRONMENTAL	
IP rating (wall):	IP65
Max & min temperature (electronics) :	-25°C to +55°C (-13°F to 131°F)
Flammable atmosphere approval:	Controller needs to be in safe area
CE Approval:	See EC declaration of Conformity
OUTPUTS	
Analogue output:	1 off Isolated (to 150V floating) output of 4-20 mA or 0-20 mA into 1kΩ max. (user programmable and adjustable)
Digital output, monitoring:	PC serial, half-duplex, RS232
Volt-free contacts, number and rating:	6 form "C" (SPDT) 5A at 110V AC
Display:	192 x 128 illuminated graphical LCD
Communication bus (optional):	RS485 Modbus RTU/ASCII or Profibus DPV0 or DPV1 (slave device)
Radio Modem (optional):	License exempt frequencies. Maximum range 500m (1640 ft) line of sight
PROGRAMMING	
Local manual programming:	Integrated keypad
PC Programming:	RS232 (ASCII)
Programming security:	Passcode (user selectable and adjustable)
Programmed data integrity:	Non-volatile memory
SUPPLY:	
Power supply, internal:	100 to 240V AC, 50/60Hz
Power supply, external:	20 - 28V DC @ 1A maximum
Power consumption:	30W maximum including RADAR power
Fuse:	2A (T) slow blow, 20mm (0.065ft)

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