120 dB: Why is the dynamic range of a radar sensor important?

Why does a large dynamic range improve visibility?

For most of us, the bat species Microchiroptera is not the first thing that springs when trying to think of examples of the astounding achievements of evolution. But with its echo-locating system, it is the top performer among mammals when it comes to seeing in the dark, which means it can more easily locate the smallest of insects for food. Radar sensors function according to a similar principle. The better they can hear their "locating sounds" – or, if figuratively applied to radar sensors, the greater the dynamics, – the better the visibility of the level echo.

The dynamic range makes the difference in level measurement with radar. For example, when condensation and buildup on the antenna literally block the view, or   in poorly reflecting media, this is where the sensors dynamic range provides the sensitivity required to reliably detect even the smallest signals. In this way, 80 GHz radar sensors from VEGA, with their uniquely high 120 dB, achieve a full view – under all process conditions.

And by the way: also among the many bat species there are considerable differences in dynamics. The loudest of their echo-locating calls – just like the 80-GHz radar sensors VEGAPULS 64 – can reach up to 120 dB.

80-GHz radar sensors

VEGA Americas, Inc.
3877 Mason Research Pkwy
45036 Mason, OH United States
Tel.: +1 513-272-0131
Fax: +1 513-272-0133
americas@vega.com
www.vega.com

Which media need an extra quantum of dynamics?



Whether viscous, coarse-grained, aqueous or powdery: A wide variety of liquids and bulk solids ensure reliable supplies of raw materials for production – provided that the operators know the exact filling levels. Sometimes, however, exact measurement is extremely difficult. For example, when the measured media have a low dielectric constant (DK). Until recently, the 'rule' was that a microwave or radar measurement in an obstacle-free tank only functioned reliably when the medium had a dielectric constant of at least 2.

However, due to their unique, high 120 dB dynamics, the 80-GHz radar sensors VEGAPULS 64 and 69 can reliably detect and measure liquids and bulk solids that have a significantly lower dielectric constant.
This is great news for the following widely used media, among others:

- Polystyrene foam (better known as Styropor®): DK value 1.03
- Plastic powder: DK value from 1.2
- Palm oil: DK value 1.8
- Glass fiber powder: DK value 1.1
- Flax meal, bran, chaff: DK values from 1.3 to 1.5
- Lime and gypsum: DK values 1.5 and 1.8
- Coffee and cocoa beans: DK values 1.5 and 1.8
- ... and even wood chips: DK value 1.1

P.S.: This means all that searching through long DK value lists is becoming a thing of the past, thanks to VEGAPULS 80-GHz radar sensors with 120 dB.

VEGA Americas, Inc.
3877 Mason Research Pkwy
45036 Mason, OH United States
Tel.: +1 513-272-0131
Fax: +1 513-272-0133
americas@vega.com
www.vega.com

Why do these sensors, with their high dynamics, handle difficult measuring tasks better?

The 80-GHz radar sensors **VEGAPULS 64** and **VEGAPULS 69** have a very wide dynamic range, which allows them to measure media with poor reflective properties considerably better than standard radar sensors. Thanks to their unique 120 dB, these high-frequency measuring instruments can also handle extremely challenging measuring situations, including foam, turbulent product surfaces, condensate or buildup on the antenna.

But how exactly do the dynamics affect a measurement application? The following 3 facts explain the basics:

1. dB, or decibels, are not a measure, but a "ratio" that describes the level of power, by comparing two number quantities with each other.
2. dB are not linear, but logarithmic. Thus, each additional dB multiplies the total value exponentially. This means: an additional 3 dB doubles the power, and an additional 60 dB increases the power by one million-fold.
3. The following rule of thumb helps to understand the dynamic range in level measurement: 26-GHz standard sensors, like many 80-GHz sensors, operate with a dynamic range of around 90 dB. By contrast, 80-GHz radar sensors from VEGA, such as VEGAPULS 64 and 69, reach 120 dB. The difference of 30 dB corresponds in practice to a 1000-fold improvement in the dynamic performance!

And by the way: a dynamic range of 120 dB makes it possible to detect the tiniest of reflections. This makes it easy to measure media with low dielectric constants, like polystyrene beads or fine-particle silica.

VEGA Americas, Inc.

3877 Mason Research Pkwy

45036 Mason, OH United States

Tel.: +1 513-272-0131
Fax: +1 513-272-0133

americas@vega.com
www.vega.com

Why do sensors with a large dynamic range measure through glass vessels and windows that much better?

Lets compare it to sunglasses, which are available with lenses in countless shades – but which one is right for you? The brighter the light source you want to protect yourself from, the darker the tint of the lenses you choose should be. Or figuratively: In the case of a weak light bulb, lightly tinted lenses are sufficient; however, if you're facing a flood-light system, you will need significantly darker lenses.

The "view" of a standard radar sensor looking through glass is comparable to the eye's view through sunglasses – it is "darkened." Glass has a certain dielectric damping factor, a "darkening" effect on radar. That means: With glass in the way, the microwaves from radar sensors meet resistance on their journey to and from the surface of the measured medium. Glass reflects a considerable portion of the radar signal at its surface and also attenuates it as it passes through. This has the detrimental effect that the remaining emitted radar energy is no longer sufficient for standard radar sensors to reliably detect the level that needs to be measured. In much the same way that a weak light source will hardly be able to penetrate tinted lenses that are too dark.

VEGA Americas, Inc.
3877 Mason Research Pkwy
45036 Mason, OH United States
Tel.: +1 513-272-0131
Fax: +1 513-272-0133
americas@vega.com
www.vega.com

Why do these sensors with high dynamics measure better through foam?

There are many 80-GHz radar sensors for level measurement, but only one that measures with the high dynamic range of 120 dB: **VEGAPULS**. This means that it has a head start when measuring applications with foam. Because, "dreams are like foam", bursting quickly like soap bubbles: Of course, that's just a saying. Surprisingly, foam is quite resistant when we try to measure through it. This applies especially to industrial foams such as those found in chemical and mining processes. But those allegedly fragile bubbles in detergents or shaving creams also do a good job: They can weaken measurement signals or block them completely.

The effect of foam is correlated to the frequency range of the radar sensors: The higher the frequency, the shorter the wavelength of the radar signal. The shorter the wavelength, the more the radar signal is attenuated by the foam. A radar sensor with 26 GHz has a wavelength of 12mm, by contrast, the wavelength of an 80-GHz radar sensor is only 4 mm. Due to the 3 times smaller wavelength of the 80-GHz radar sensor, the radar signal is more strongly attenuated by a factor of 3. With the 80-GHz radar sensor VEGAPULS, however, this effect is offset by the dynamic range. With its high 120 dB, the sensor manages to reliably detect the weaker level measurement signals attenuated by foam.

Conventional sensors for liquids operate with approx. 90 dB; **VEGAPULS 64**, in contrast, operates with 120 dB. Thus, with signals are 1000 times larger, and the sensor copes significantly better with damping by foam.