Rhein Tech Laboratories
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Client: VEGA Grieshaber KG
Model: VEGAPULS 69
ID's: O6QPS60XW1/3892A-PS60XW1
Standards: FCC 15.256/IC RSS-211
Report Number: 2016249-256

Appendix F: Description of Changes

Please refer to the following page.

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February 6, 2017   VEGAPULS 69
                        FCC: O6QPS60XW1
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1. General

The VEGAPULS 69 FMCW radar sensor is mainly deployed for continuous, non-contact level measurement of solids. A frequency sweep over a defined bandwidth in a certain time is sent from the antenna, reflected at the surface of the respective material and received from the antenna again. The frequency shift between the transmit signal and the received signal is proportional to the distance between the sensor and the surface and is evaluated. A corresponding level signal can be calculated.

2. Necessity of the Frequency Shift

The VEGAPULS 69 was originally designed to operate in the frequency range from 78.5 GHz to 79.5 GHz. The transmit signal is a linear frequency up-ramp from the starting point 78.5 GHz. It is generated on a lower frequency by means of a VCO (voltage controlled oscillator) which is stabilized in a phase locked loop (PLL) and multiplied in order to reach the wanted frequency band for transmission and reception.

The multiplier circuit however produces more additional noise in this high frequency range from 78.5 GHz to 79.5 GHz than expected. The additional noise contribution is directly fed into the downconversion mixer in the receiver and thus is eventually downconverted to the intermediate frequency (IF) signal chain. This effect results in an increased noise floor in the IF path and as a consequence in a reduced sensitivity of the whole Radar sensor.

One possibility to overcome this negative effect is to shift down the transmit frequency range for example to 76.5 GHz to 77.5 GHz. In this lower frequency range the multiplier produces significantly less noise especially over temperature. Consequently through this measure, the sensitivity of the sensor and thus the performance of the measurement can be improved without increasing the power of the transmit signal.

Finally for the VEGAPULS 69 sensor there would be two frequency ranges optionally available within the allowed frequency band of operation of 75 to 85 GHz (see CFR §15.256).

3. Conducted Changes

The shift of the transmit frequency range is solely realized by a change of the sensor software. No hardware changes are necessary. The software change procures the programming of the new VCO frequency sweep starting point in the registers of the PLL circuit. This new starting point corresponds to a frequency ramp start of 76.5 GHz. All other transmit signal parameters like sweep time and occupied bandwidth remain the same. The programming of the PLL circuit is executed by a DSP (digital signal processor).

It is important to mention that only the original equipment manufacturers VEGA Grieshaber KG and VEGA Americas, Inc. are able to change the frequency band by means of a software update. Furthermore the device is only able to operate in one frequency band simultaneously and it is not possible to change the frequency band without conducting a software update. The manufacturer decides at the time of production which frequency band is used in the VEGAPULS 69 sensor. The end user however is neither able to implement new frequencies nor to change any other radio parameter of the device.