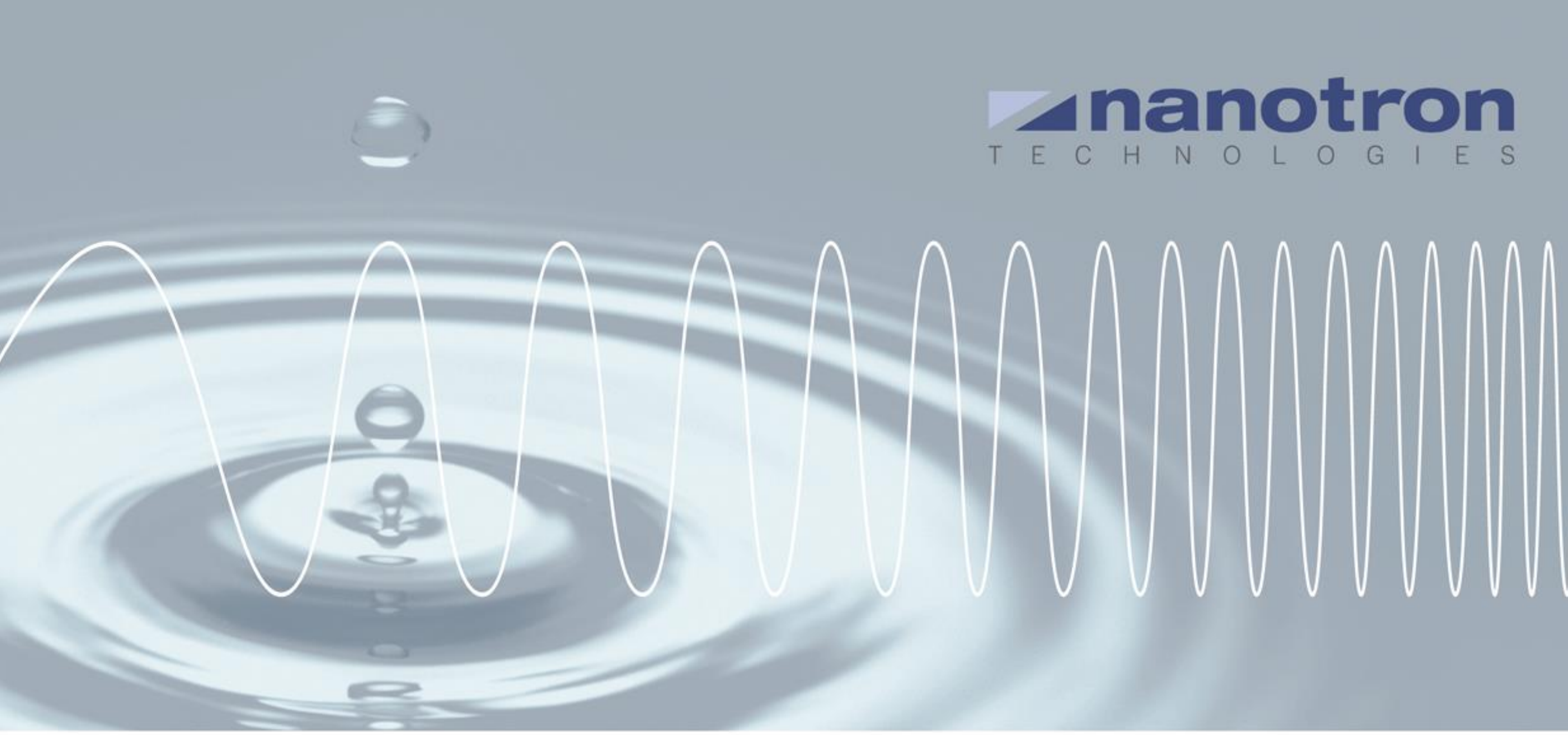

AN0508 How to Adjust and Measure the RF Power on *swarm* bee LE

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Contents

1. Introduction 4
2. Changing the transmitted power 4
3. Measuring the transmitted power 5

1. Introduction

The power radiated by the swarm bee can be tuned and adapted to the needs of each application. Two factors define this radiated power: the transmitted power provided at the RF port (for simplicity we will call it transmitted power) and the gain factor of the antenna selected by the user.

This application note explains how to set the required value of the transmitted power. The user should be aware that to know the final radiated power, the antenna gain should be added.

2. Changing the transmitted power

The transmitted power is set to 16 dBm by default; however, it can be tuned in the range from -20 dBm up to 16 dBm. To do so, the user should utilize the API command:

STXP <parameter>.

<parameter> is not the power in dBm but the value of the register containing the power data, This value is in the range from 00 up to 63. The value 00 represents the minimum transmitted power, -20 dBm, and 63 represents the maximum transmitted power, 16 dBm.

Figure 1 shows the relation between the value of the register and the measured transmitted power. The measurement has been done connecting a spectrum analyzer directly at the RF port of the swarm bee.

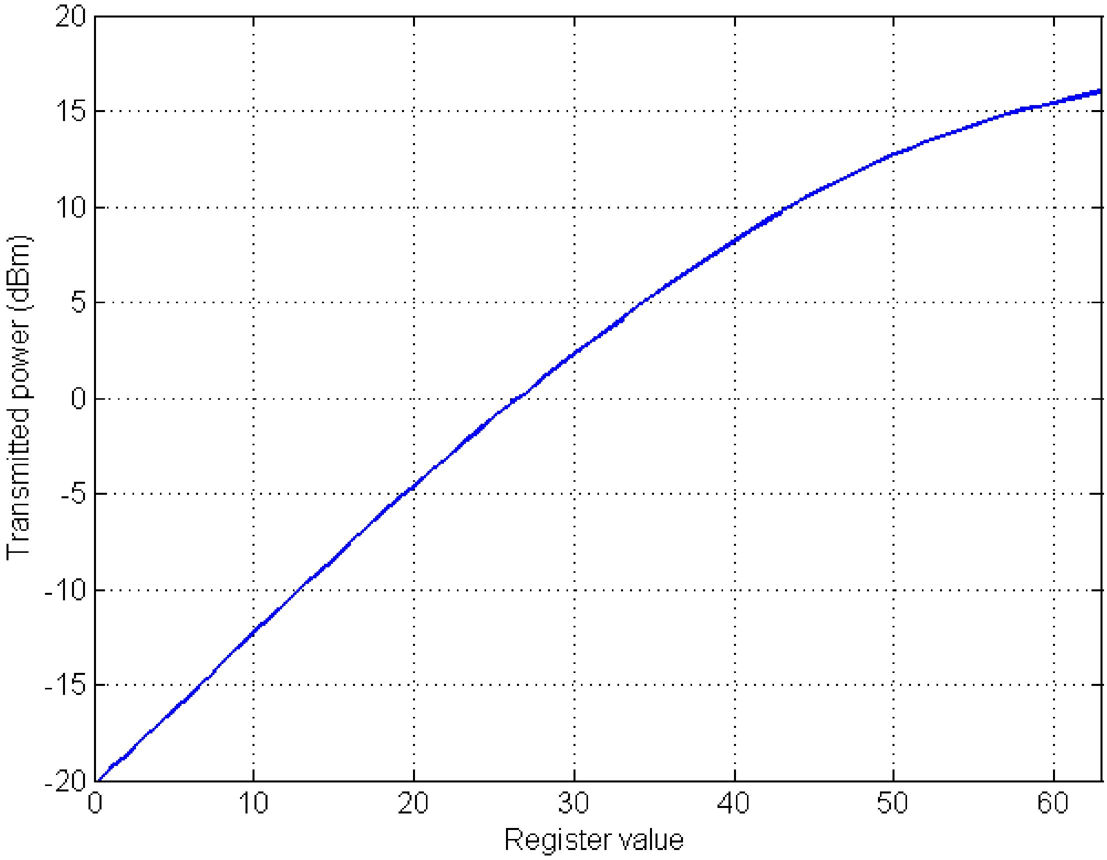

Figure 1 Measured transmitted power versus register value

3. Measuring the transmitted power

The default behavior of the swarm bee consist on periodically sending blinks, which are narrow-time chirp signals. That makes difficult to accurately measure and verify the transmitted power. In order to make the process easier a test mode is provided. This allows setting the *swarm* bee in continuous chirp transmission mode. To access this mode or go back to normal mode the user should use the commands '***test 1***' and '***test 0***' respectively. These are ASCII commands that should be sent through the UART interface, the same way as any other command of the API.

test 1 → continuous chirp transmission mode

test 0 → normal transmission mode

Once the module is in continuous chirp transmission mode, it can also be set in normal transmission mode by resetting it.

Commonly the user is interested in measuring either the peak power or the power density. The easiest way to do so is connecting the RF port of the swarm to a spectrum analyzer, opening a serial connection with the swarm (through the COM port) and sending the command ***test 1***, so that the signal is a during the measurement.

To see the power density, the user should decide in what units he want to have the density, for instance dBm/MHz. Then the resolution bandwidth should be adjust to, in this case, 1MHz. Figure 2 shows that the transmitted power density (this is, measured at the RF port) is -1.106 dBm/MHz when transmitting with maximum power.

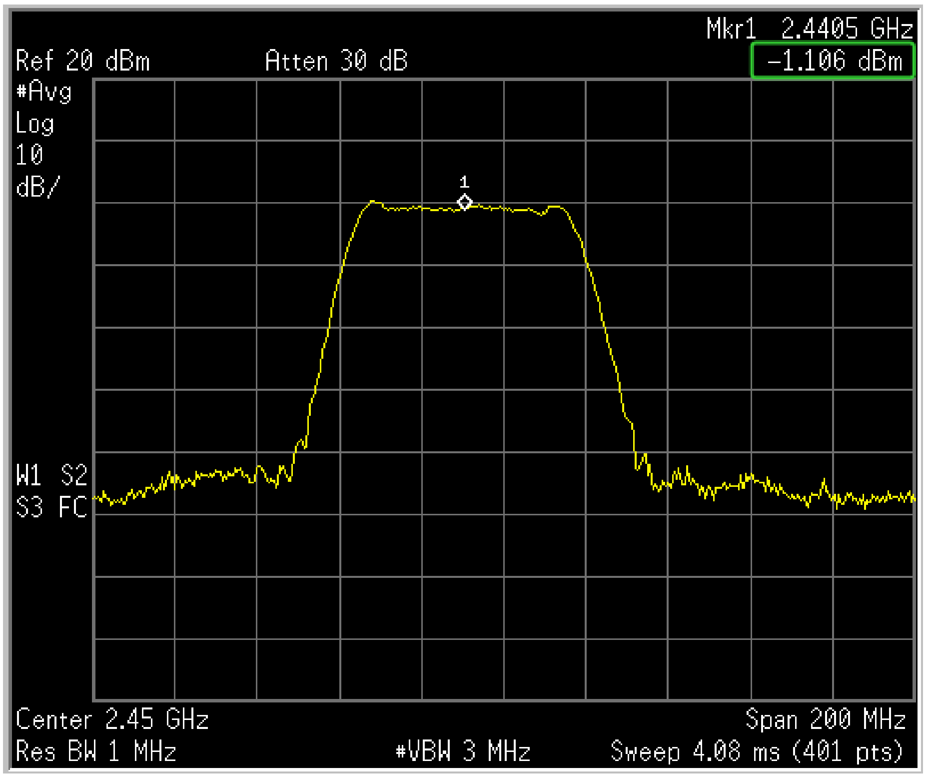

Figure 2 Transmitted power density of 1.973 dBm/MHz for a transmitted power of 16 dBm

The total transmitted power, or peak power, is the addition of the power transmitted in the whole bandwidth; it would be the result of integrating the area below the maximum density (yellow line in Figure 2). A faster way to calculate the total transmitted power is extrapolating the power per MHz measured to the real signal bandwidth. In our case, the total bandwidth is 80 MHz, but as the signal is not a perfect rectangular pulse, it is more realistic to use, for the estimation, the 3dB bandwidth: 50 MHz, Then we have:

Measured bandwidth: 1MHz

Signal bandwidth: 50MHz → bandwidth ratio: 50/1 = 50

The bandwidth ratio is equal to the power ratio; thus, we can pass it to dB: 10 log 50 = 17 dB

Then, according to our estimation the total transmitted power is: -1.1 dBm + 17 dB =+15.9 dBm

Most spectrum analyzers nowadays have a 'band power' function to calculate total power in between two points. These two points should define the signal bandwidth and are set by the user (usually with markers). This function can also be used to measure the total power. In this case, we set the markers defining a bandwidth of 80 MHz so that the spectrum analyzer measures all the power inside the band. Figure 3 shows that the total power in between the two markers that define the signal bandwidth id 16.12 dBm. As we can see, the measured value is quite similar to the estimation, so both methods can be used.

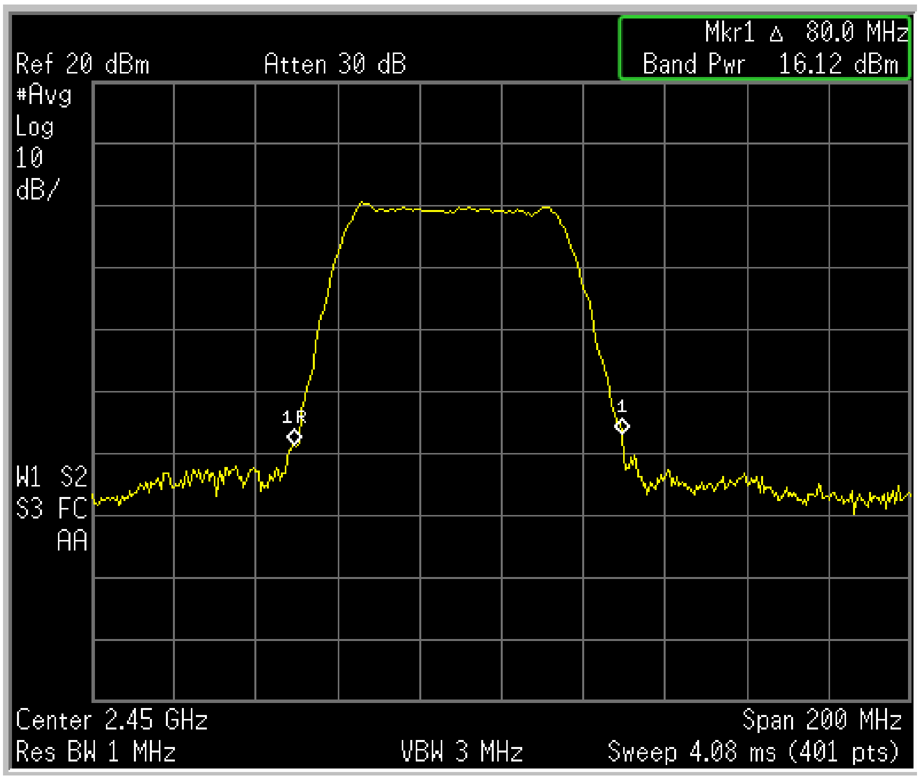

Figure 3 Transmitted peak power of 16.13 dBm when transmitting the maximum power.

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Document History

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For more information about products from nanotron Technologies GmbH, contact a sales representative at the following address:

nanotron Technologies GmbH
Alt-Moabit 60
10555 Berlin, Germany
Phone: +49 30 399 954 – 0
Fax: +49 30 399 954 – 188
Email: sales@nanotron.com
Internet: www.nanotron.com