TN1203.01
Technical Note

XE1203 ISM Band Operation & FCC Rules

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1 INTRODUCTION

The new wideband operation and high data rate capability of XE1203 RF transceiver IC makes it a suitable candidate for low cost applications. In most of the low cost applications the program memory and CPU power of the microcontroller is very limited especially if it is battery operated. The main concern in such applications is to make protocol and accessing methods as simple as possible to let the program memory and data memory run the application program. Most of these applications establish communication for a limited time a few hundred microseconds and then go into sleep mode to save power. During active time these applications try to send as much data as possible in short period of time. The high data rate operation and low power consumption of the XE1203 makes it a perfect fit for these applications.

The main problem in high data rate and long range communication systems not using Spread Spectrum Techniques in USA is the maximum output power limitation but this rule has been changed recently and FCC started to permit 8 dBm in 3 kHz bandwidth output power for the system that uses digital modulation techniques and having an occupied 6 dB bandwidth of more than 500 kHz [1]. This output power limit can go up to 11 dBm for systems that use data whitening. The data whitening process distributes 1 and 0 FSK patterns equally on spectrum. The programmable frequency deviation facility and output power of the XE1203 lets it easily fit these criteria. In this report systems not using frequency hopping techniques which are suitable for these new FCC DTS regulations are measured and compared.

2 MEASUREMENT RESULTS

The performance of the XE1203 is measured according to the requirements of the FCC rules. These new FCC regulations are described in Section ***15.247 a.2*** and Section ***15.247 d.*** As shown in figure 2.0, these new regulations can be easily satisfied by the XE1203. With a frequency deviation of 235 kHz, the required minimum bandwidth of the regulation is achieved without problem.

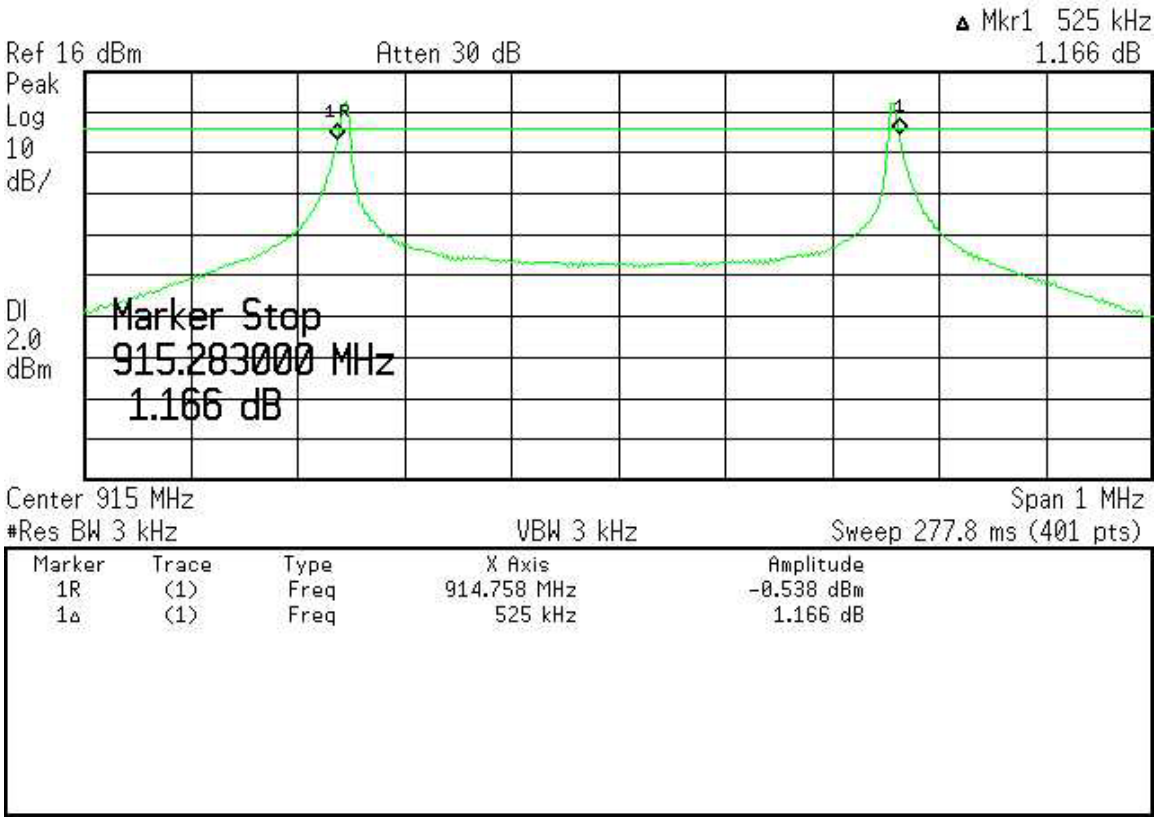

Figure 2.0: Occupied 6 dB BW

The results of the sensitivity measurements made with a deviation frequency of 235 kHz are tabulated in **Table 2.0 and Table 2.1.** The performance of XE1203 using 55 kHz frequency deviation for low data rate applications suitable for FCC Section ***15.249*** is also tabulated in **Table 2.2**.

Data Rate	Sensitivity@ Δf=235 kHz		XE1203 BW	Occupied BW (6dB)	FCC DTS Permitted Power	Mode A Link Budget
	Mode A	Mode B				
4.8 kbps	-108.5 dBm	-98.5 dBm	600 kHz	508 kHz	8 dBm	116.5 dB
32.7 kbps	-104 dBm	-94.5 dBm	600 kHz	508 kHz	8 dBm	112 dB
152.3 kbps	-102 dBm	-91.5 dBm	600 kHz	508 kHz	8 dBm	110 dB

Table 2.0: High Deviation Performance Results without data whitening

Data Rate	Sensitivity@ Δf=235 kHz		XE1203 BW	Occupied BW (6dB)	FCC DTS Permitted Power	Mode A Link Budget
	Mode A	Mode B				
4.8 kbps	-108.5 dBm	-98.5 dBm	600 kHz	508 kHz	11 dBm	119.5 dB
32.7 kbps	-104 dBm	-94.5 dBm	600 kHz	508 kHz	11 dBm	115 dB
152.3 kbps	-102 dBm	-91.5 dBm	600 kHz	508 kHz	11 dBm	113 dB

Table 2.1: High Deviation Performance Results with data whitening

Data Rate	Sensitivity@ Δf=55 kHz		XE1203 BW	FCC Permitted Power	Link Budget
	Mode A	Mode B			
4.8 kbps	-115 dBm	-104 dBm	200 kHz	0 dBm	115 dB
32.7 kbps	-109 dBm	-97dBm	200 kHz	0 dBm	109 dB

Table 2.2: Normal Deviation Performance Results

The measurement results show that for low data rate applications such as 4800 bits/sec using high frequency deviation and maximum output power allowed by the new regulation gives 1.5 dB higher link budget than with low frequency deviation and the power permitted by the basic regulation. Using data whitening gives additional 3 dB gain with wide band modulation and 11 dBm output power, resulting in 119.5 dB link margin which solves most of the range problem faced in ISM Band applications not using frequency hopping.

Even better benefits of high deviation can be obtained with higher bit rates; as an example, at 32 kbits/sec with data whitening, the link budget is 115 dB, which gives a 6 dB gain compared to low deviation with same date rate. Besides that for a given number of bits the system will consume less power. For example instead of transmitting N bits at 4.8 kbits/sec if 32.7kbits data rate is used the system will consume about 4-times less.

The high data rate applications using 2–level FSK modulation requires wide-bandwidth, and because of this wide bandwidth the noise starts to increase and this causes loss in sensitivity. In this case increasing output power can preserve the link budget.

The new FCC regulation permits 11 dBm output power with data whitening. Using this power level and a high data rate allow to keep good communication range and to save power for short packet data transfers by reducing overall transmission time.

3 CONCLUSION

This document shows that the XE1203 can be used for increasing the output power above the classical limitation of 0 dBm without using complex spread spectrum techniques like the frequency hopping. This report shows that the higher the bit rate the higher the advantage of using the XE1203 in DTS conditions in term of link budget. Another advantage of XE1203 is the programmable output power (up to 15 dBm), which allows this output power to be dynamically adjusted depending on the received signal level in order to minimize the power consumption of the system.

4 REFERENCES

[1] FCC PART15 Regulations, http://ftp.fcc.gov/oet/info/rules/part15/part15_7_22_02.pdf