Application Report
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Low Supply TRF3765 Performance Evaluation

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ABSTRACT

This report provides the measurement results obtained during TRF3765 performance evaluation using low supply. TRF3765 is a Texas Instruments integrated wideband voltage-controlled oscillator (VCO) and Integer-N/Fractional-N frequency synthesizer. This application report provides phase noise and output power performance of TRF3765 using low supply (V_{CC} as low as 2.1 V DC). Under nominal temperature conditions, TRF3765 provides about –1 dBm output power at 900 MHz along with good phase noise using supply power of only 160 mW. Measurements done over temperature are also shown.

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1 Introduction

One of the most important criteria in IC design is 'power' consumption. Rising requirement of portable electronics along with computational complexities undoubtedly resulted in growing demand for 'lower power electronics'. Considering this demand, this application report highlights the TRF3765 performance operating at a power level lower than its nominal range. Figure 1 shows the block diagram of the TI high performance integrated wideband PLL and VCO TRF3765. It operates from 300 MHz to 4.8 GHz and provides four programmable buffered outputs without the need of external splitters. TRF3765 is applicable to the wireless infrastructure stands such as CDMA, TDMA, and LTE. It can also be used in wireless point-to-point access and wireless local loop communication links.

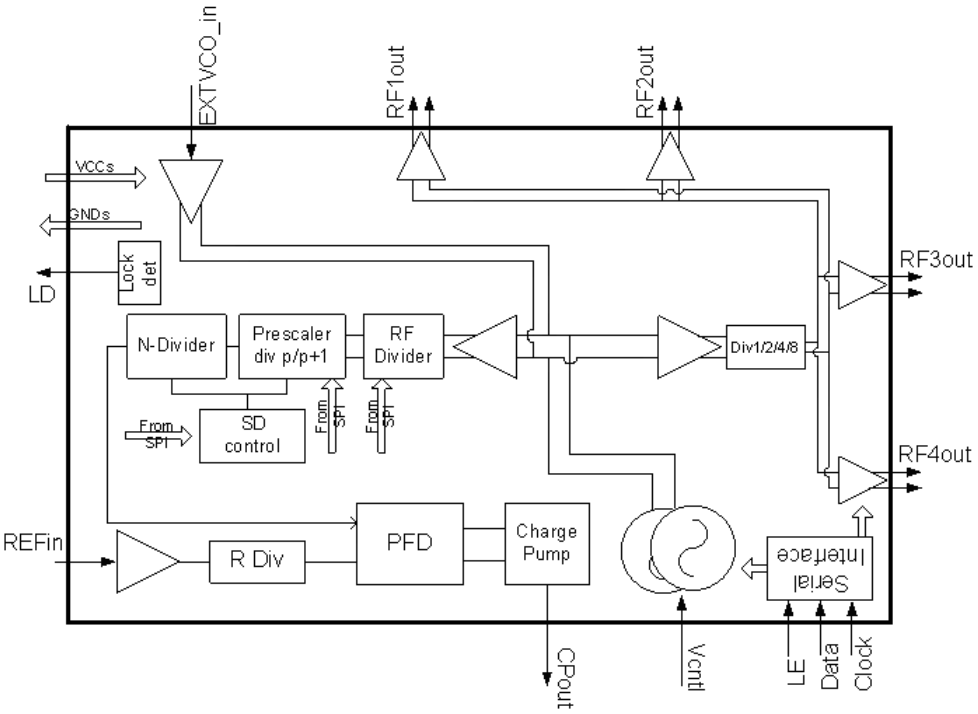


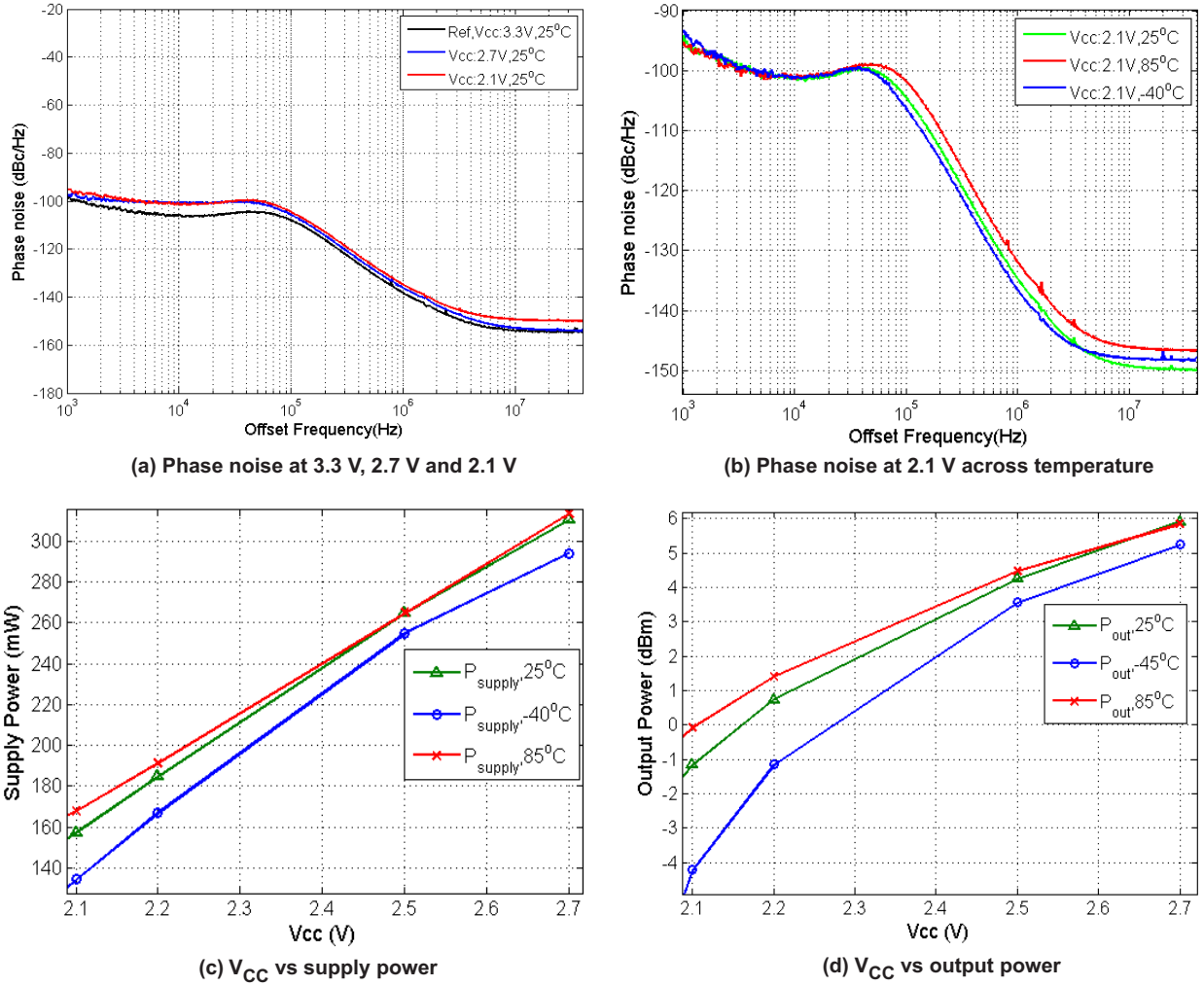
Figure 1. TRF3765 Block Diagram

2 Measurement Description

All the measurements in this report were performed using TRF3765 in integer mode with phase frequency detector frequency equal to 1.6 MHz. A goal of this application report is to observe phase noise performance of TRF3765 at minimum possible power supply over temperature; hence, only one output buffer is turned on. Due to the use of a lower supply rail, the output 50 Ω bias resistor is replaced with a 36 nH inductor (0402CS-36NXJLU). The inductor has a SRF (self resonance frequency) of 2.32 GHz, which is approximately the center of the operating frequencies of TRF3765, and a DCR (DC resistance) of 0.44 Ω. The reference frequency used the onboard 40 MHz crystal oscillator. Other key device parameters were set as follows: Output buffer bias current 600 µA, VCO bias current 400 µA, LO divider bias current 25 µA, and VCO bias control voltage 1.35 V.

3 Measurement Results

To evaluate the TRF3765 performance at lower supply, the supply voltage has been reduced from its nominal supply voltage of 3.3 V DC. Figure 2(a) shows the phase noise performance of TRF3765 at room temperature for the supply voltages 2.7 V DC and 2.1-V DC, compared with the reference at 900 MHz. Phase noise measured at room temperature with nominal supply voltage 3.3 V DC and 50 Ω bias resistor is considered as the reference. TRF3765 was operated in divide by 4 mode i.e., 3600 MHz fundamental is divided down by 4 to get 900 MHz output. Figure 2(b) shows the phase noise response for 900 MHz at 2.1 V DC for room, hot and cold temperatures. Figure 2(c) shows supplied voltage V_{CC} vs. the supply power and Figure 2(d) shows the power consumption vs. supplied voltage across temperatures for 900 MHz. From Figure 2(a) it could be seen that at lower supplies in-band phase noise of TRF3765 is degraded by about 3-4 dB. At 2.1 V DC and nominal room temperature, TRF3765 provides an output power of –1 dBm by only consuming 160 mW of supply power and is shown in Figure 2(c) and Figure 2(d).



(a) Phase noise at 3.3 V, 2.7 V and 2.1 V

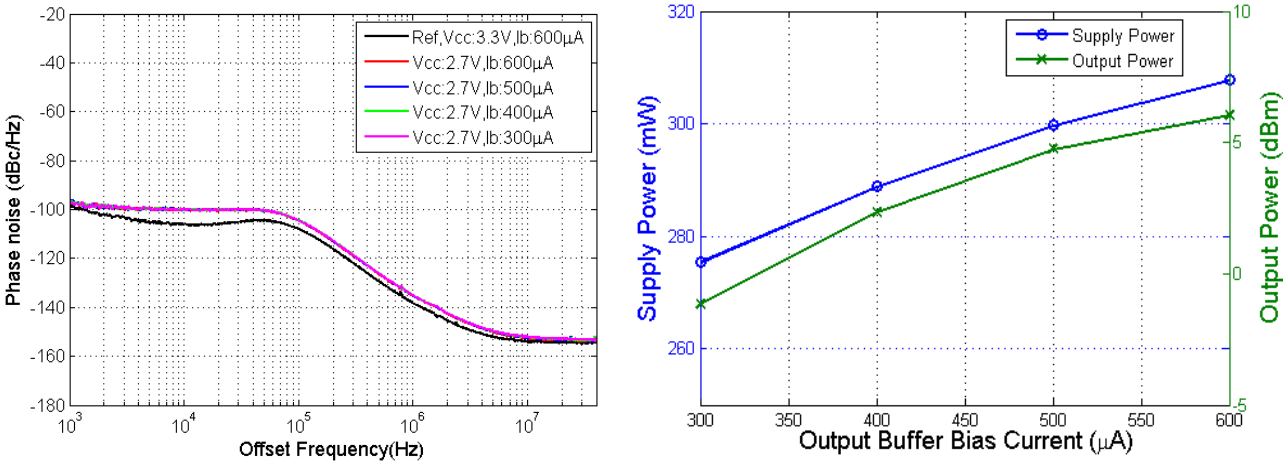
(b) Phase noise at 2.1 V across temperature

(c) V_{CC} vs supply power

(d) V_{CC} vs output power

Figure 2. Phase Noise Response for 900 MHz Output, and V_{CC} vs Supply and Output Power

2.7 V being is a one of the common rail voltages Figure 3(a) shows the phase noise response of TRF3765 using supply voltage 2.7 V across different output buffer supply current at room temperature. Figure 3(b) shows the supply power dissipation and output power across different output bias current at V_{CC} equal to 2.7 V.



(a) Phase noise

(b) Bias current vs P_{supply} and $P_{out\ power}$

Figure 3. (a) Phase Noise Response at V_{CC} 2.7 V for 900 MHz and Different Output Buffer Bias Current Supply.
(b) Supply Power and RF Output Power vs Output Buffer Bias Current at 900 MHz and V_{CC} 2.7 V

4 Conclusion

The TRF3765 performance at low supply level and across temperature is illustrated in this application report. Low power consumption is one of the important criteria in portable electronics. The TRF3765 low supply mode of operation provides power savings for wideband devices with relaxed phase noise performance used in such portable and low power applications.

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