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A Comparison of the NBC12429 and MC12429 Programmable PLL Clock Synthesizers

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APPLICATION NOTE

INTRODUCTION

ON Semiconductor, recognizing that companies need to focus their engineering resources on new products instead of re-engineering products already in production, has created direct drop-in replacements for three Motorola clock synthesizers.

Motorola recently announced their decision to migrate the MC12429, MC12430, and MC12439 to a new process. This migration means that existing customers will need to do a complete evaluation of Motorola's new parts to insure compatibility with existing designs.

This paper presents a side-by-side comparison of key specifications for the ON Semiconductor NBC12429 and the Motorola MC12429 (at the time this paper was written the NBC12430 and NBC12439 had not been released; however, they should also be very similar to their Motorola counterparts).

Process Technology

Motorola's MC12429 uses a process called BIC75, which is an older BiCMOS process, while Motorola's new part uses a completely different SiGe process. The control section of the EOL'ed MC12429 is CMOS but the PLL portion, the heart of the chip, is bipolar.

ON Semiconductor decided to create a drop in part using their highly successful MOSAIC V (M5) process, the same bipolar process that is used to produce some of the fastest ECL available, ECLinPS Plus (see www.onsemi.com for more details on the EP and LVEP families). It was also decided to create this part as a fully differential design to decrease noise generation and increase power supply rejection.

ON Semiconductor could have produced this part in SiGe as well but an all silicon bipolar approach made duplication of the existing critical timing much easier to achieve.

Timing Comparison

At a lower level, process technology is a good way to compare parts, but the real test comes in the performance comparison.

Table 1 compares some of the key timing parameters for the parts. As can be seen, the silicon-based parts are nearly identical, leading to high confidence of a drop-in solution; the same cannot be said of Motorola's SiGe part.

Note that the jitter performance of the ON Semiconductor part is significantly better than the Motorola parts. Figure 1 shows both the cycle-to-cycle RMS jitter and the cycle-to-cycle peak-to-peak jitter for the silicon parts. Not only is the NBC12429 jitter significantly lower than the MC12429, but there is also less jitter variation over the VCO range.

When it comes to PLL performance these data sheet specifications only tell part of the story. A great deal of engineering effort was also expended on the two most difficult attributes of the Motorola part to duplicate, the crystal oscillator and the loop dynamics.

The crystal oscillator is very flexible; it will accept low Q, medium Q, and high Q crystals from 10MHz to 20MHz. Achieving this took several iterations, but it is important for a drop-in replacement to be able to operate equally well from any reasonable crystal. A replacement clock synthesizer should not have the engineer hunting for a new crystal as well.

Loop dynamics are characterized by lock time (loop bandwidth) and overshoot. Table 2 contains laboratory measurements of the two silicon devices (taken from several lots and several date codes) showing how closely they compare. Figures 5 and 6 illustrate graphically that lock time and overshoot are very similar, with no ringing. It is important to note that both Table 2 and Figures 5 and 6 depict a very large frequency step, from 200MHz to 400MHz.

Table 1

Specification	ON	Motorola	Motorola
Part Number	NBC12429	MC12429	MPC9229
Package	28-Lead PLCC and 32-Lead LQFP	28-Lead PLCC and 32-Lead LQFP	28-Lead PLCC and 32-Lead LQFP
Supply Voltage Range	3.3V - 5V	3.3V – 5V	3.3V
Maximum Input Frequency, XTAL (MHz)	20	20	20
Maximum Input Frequency, S_Clock (MHz)	10	10	10
Output Frequency Range (MHz)	25 - 400	25 – 400	25 - 400
Maximum PLL Lock Time (ms)	10	10	10
Jitter, Cycle to Cycle, Peak-to-Peak (ps)	±20	±25	±95
Setup Time (ns)	20	20	20
Hold Time (ns)	20	20	20
Min/Max Rise/Fall Time (ps)	175 - 425	300 – 800	50 - 300
Output Duty Cycle, Min/Max (%)	47.5/52.5	Not Spec'ed	45/55
I_{CC}, Including PLL (mA)	96	120	120

Table 2

Specification (Sample lot, 3.3V, 25C)	ON NBC12429	Motorola MC12429
Lock Time (ms)	1.09	1.04
Overshoot (%)	1.25	1.00
Duty Cycle @ 200MHz/400MHz (%)	50.1/49.6	48.9/48.6
Tr @ 200MHz/400MHz (ps)	293/296	446/426
Tf @ 200MHz/400MHz (ps)	319/297	397/415

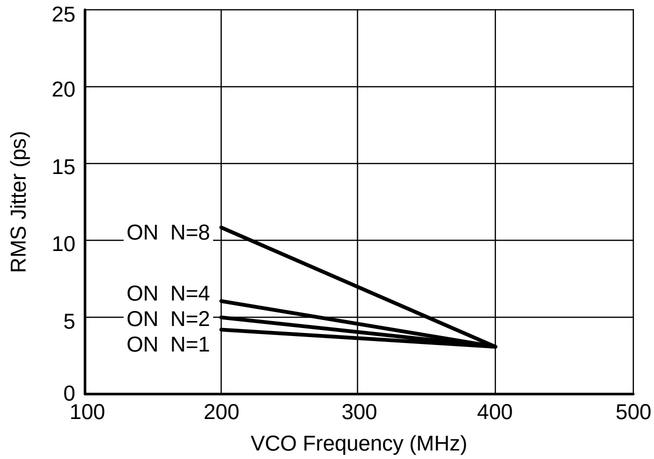


Figure 1. NBC12429 Cycle to Cycle RMS Jitter vs. VCO Frequency

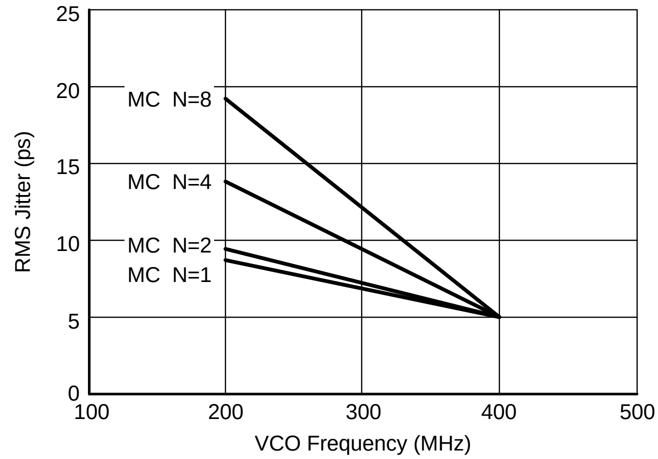


Figure 2. MC12429 Cycle to Cycle RMS Jitter vs. VCO Frequency

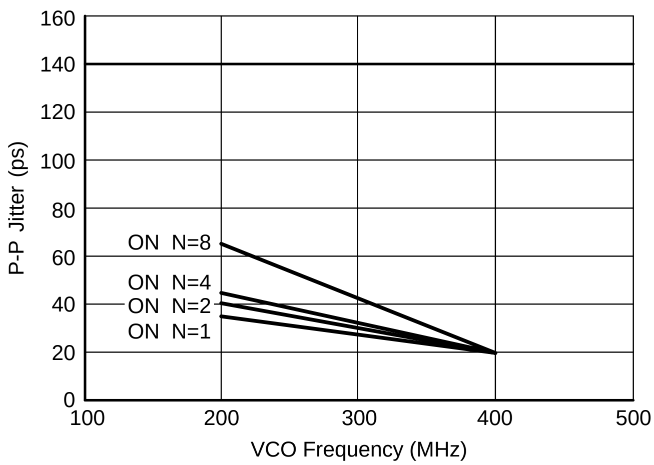


Figure 3. NBC12429 Cycle to Cycle Peak-Peak Jitter vs. VCO Frequency

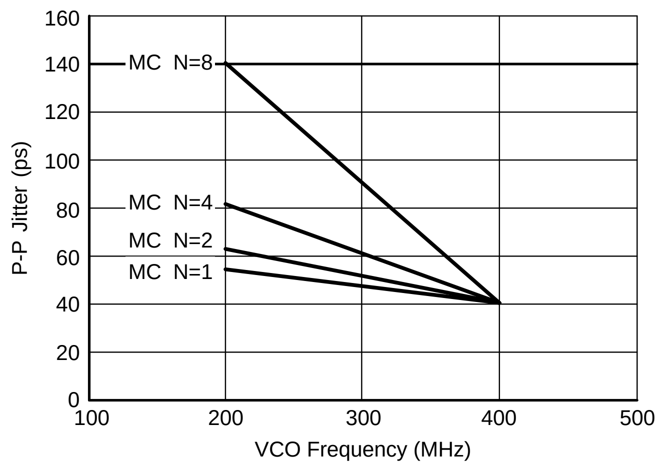
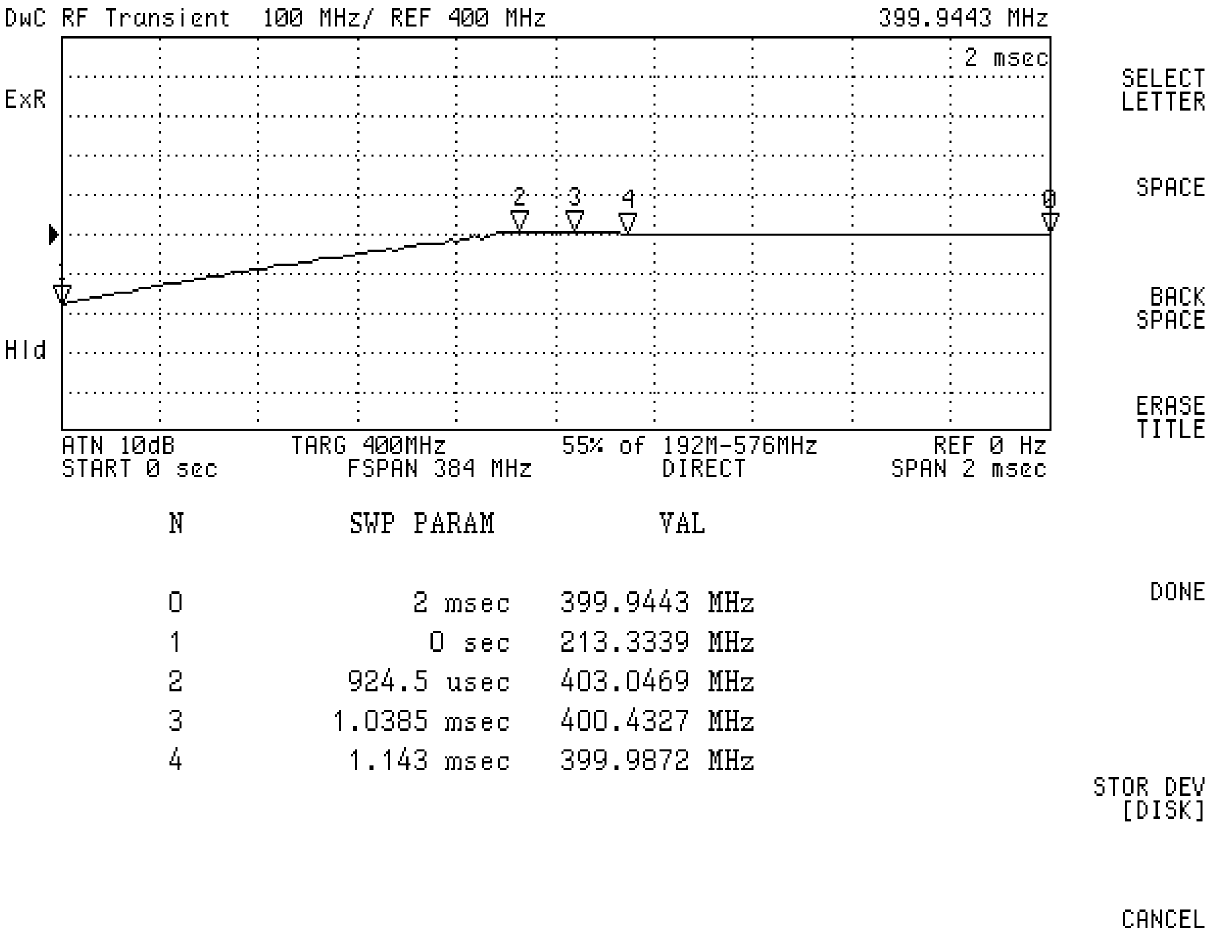


Figure 4. MC12429 Cycle to Cycle Peak-Peak Jitter vs. VCO Frequency



N	SWP PARAM	VAL
0	2 msec	399.9443 MHz
1	0 sec	213.3339 MHz
2	924.5 usec	403.0469 MHz
3	1.0385 msec	400.4327 MHz
4	1.143 msec	399.9872 MHz

Figure 5. NBC12429

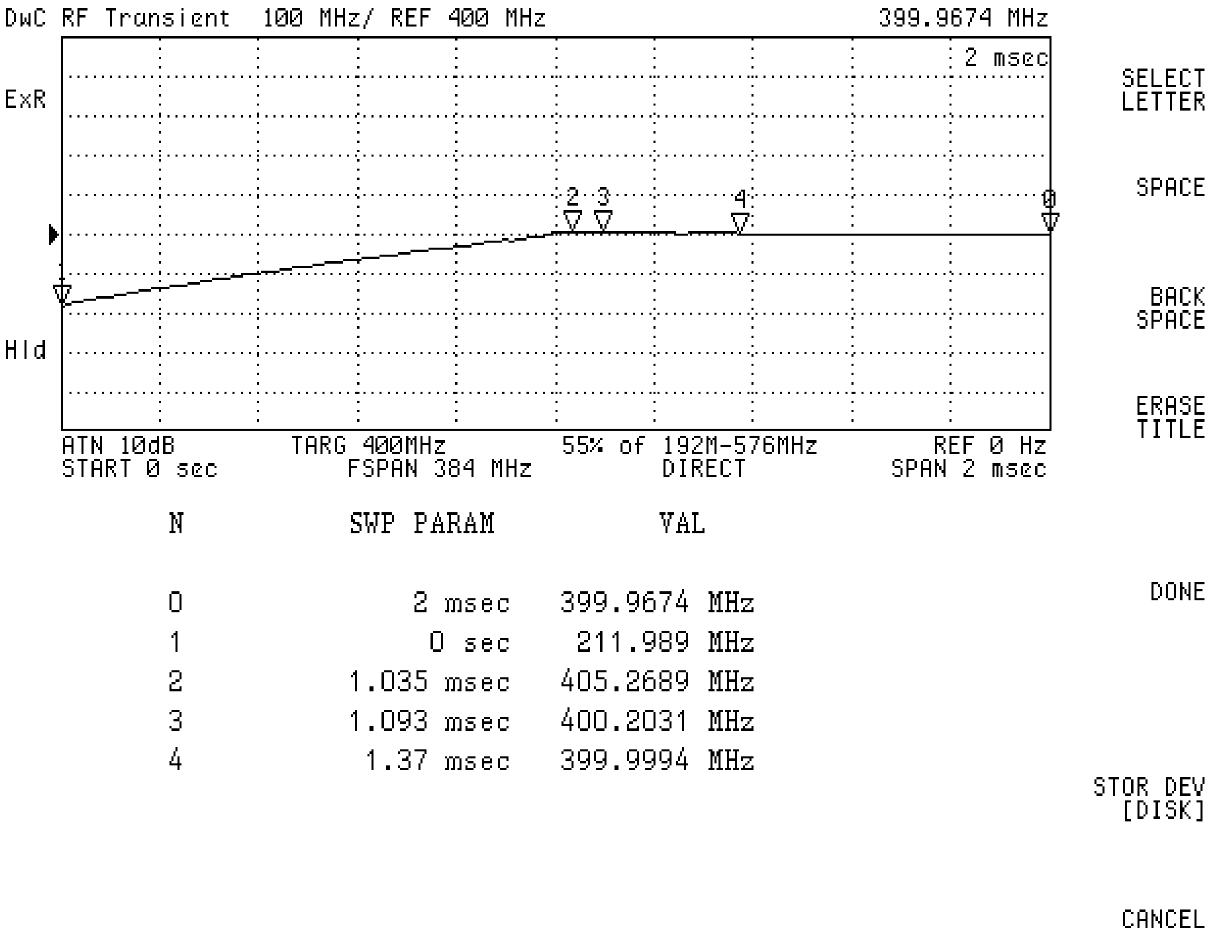


Figure 6. MC12429

Conclusion

In order to have a high degree of confidence in a drop-in solution, a clock synthesizer must have both similar timing and similar dynamics to the part it is replacing. The NBC12429 compares very favorably to the MC12429 on both counts, and should require a minimum of engineering effort.

The NBC12429 is produced at ON Semiconductor's fab in Phoenix, Arizona and is available today in sample or production quantities from your local distributor. The NBC12429 is available in either a 28 pin PLCC (NBC12429FN) or a 32 pin LQFP (NBC12429FA).

For more information click on:
https://www.onsemi.com/productSummary/0,4317,NBC12429,00.html.

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