

# 1 Part 2: Performance of PLLs

## 1.1 Tracking the Frequency of a Sinusoidal Signal

### 1.1.1 Transmitter VI Setup

No narrative required for this section.

### 1.1.2 Receiver VI Setup

No narrative required for this section.

### 1.1.3 Basic Measurements

Loop Type	$f_n$	$\Delta f$	$\sigma$	$\zeta$	Freq. Pull-in	Phase Pull-in
Costas	2kHz	5kHz	0	$1/\sqrt{2}$	1.25ms	1.7ms
Costas	2kHz	10kHz	0	$1/\sqrt{2}$	6.33ms	6.76ms
Standard	5kHz	5kHz	0.1	$1/\sqrt{2}$	61.63us	198.57us
Standard	10kHz	5kHz	0.1	$1/\sqrt{2}$	23.24us	48.59us
Standard	1kHz	5kHz	0.1	$1/\sqrt{2}$	3.19ms	3.99ms

Table 1: Frequency and Phase Pull-in Times for Data Modulated Signals

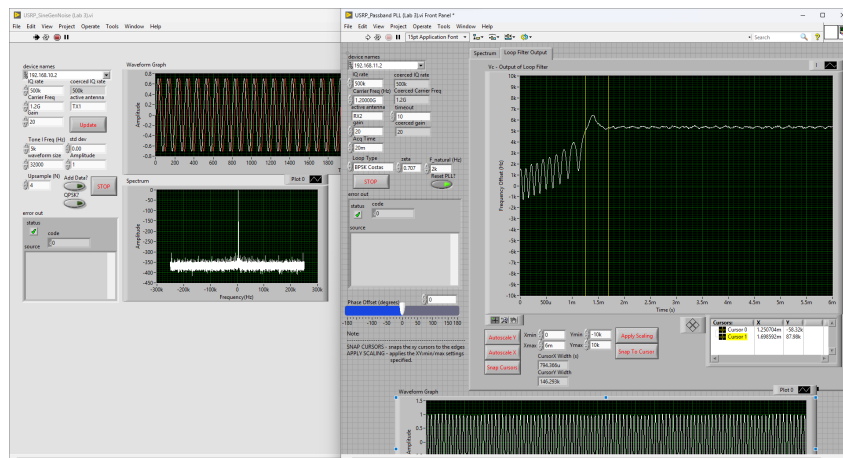


Figure 1: 2.1.3.1 - Costas PLL  $f_n = 2$  kHz,  $\Delta f = 5$  kHz,  $\sigma = 0$ ,  $\zeta = 1/\sqrt{2}$

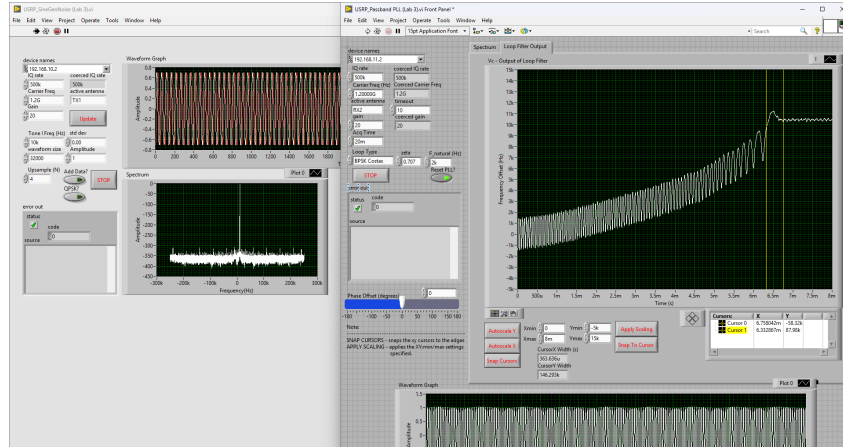


Figure 2: 2.1.3.2 - Costas PLL  $f_n = 2$  kHz,  $\Delta_f = 10$  kHz,  $\sigma = 0$ ,  $\zeta = 1/\sqrt{2}$

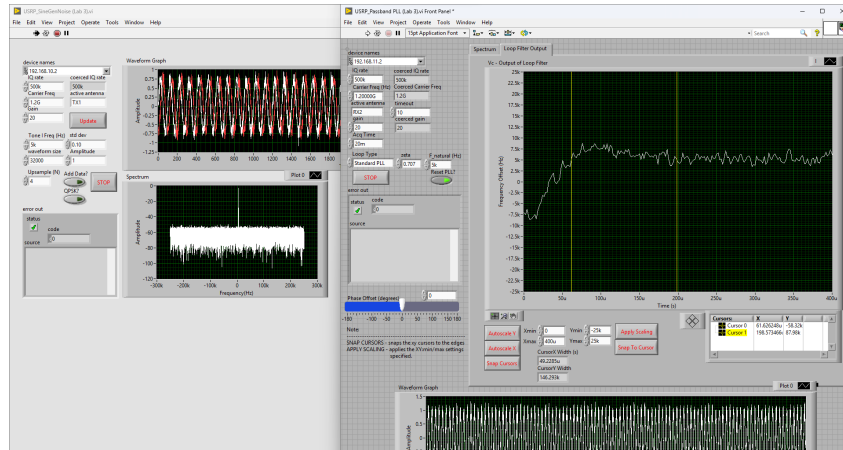


Figure 3: 2.1.3.6 - Standard PLL  $f_n = 5$  kHz,  $\Delta_f = 5$  kHz,  $\sigma = 0.1$ ,  $\zeta = 1/\sqrt{2}$

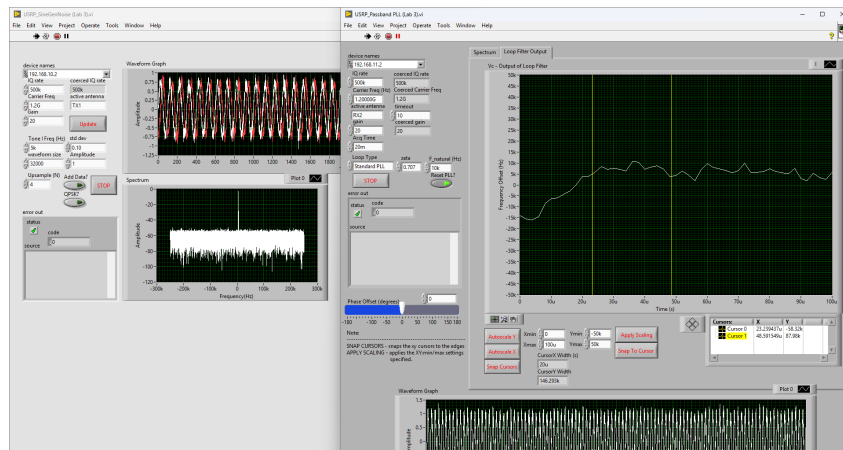


Figure 4: 2.1.3.7 - Standard PLL  $f_n = 10$  kHz,  $\Delta_f = 5$  kHz,  $\sigma = 0.1$ ,  $\zeta = 1/\sqrt{2}$

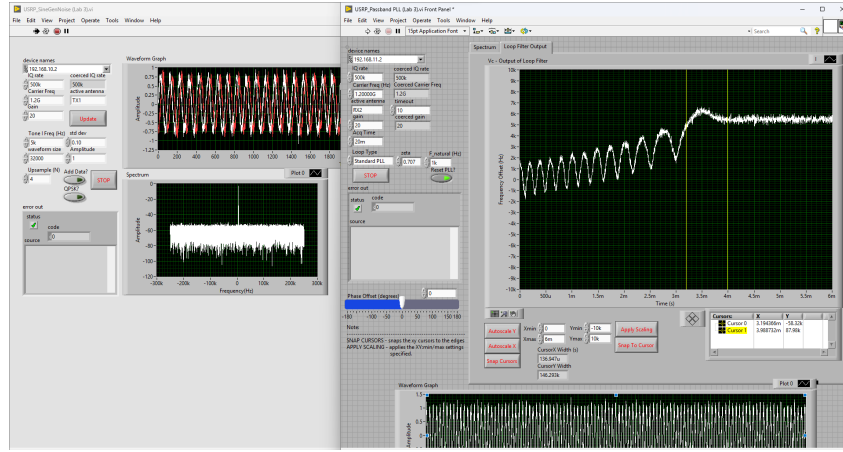


Figure 5: 2.1.3.8 - Standard PLL  $f_n = 1 \text{ kHz}$ ,  $\Delta_f = 5 \text{ kHz}$ ,  $\sigma = 0.1$ ,  $\zeta = 1/\sqrt{2}$

## 1.2 Tracking the Frequency of a Data Modulated Signal

### 1.2.1 Transmitter VI Setup

No narrative required for this section.

### 1.2.2 Receiver VI Setup

No narrative required for this section.

### 1.2.3 Measurements

Loop Type	$f_n$	$\Delta_f$	$\sigma$	$\zeta$	$M$	Freq. Pull-in	Phase Pull-in
Standard	0.5kHz	4kHz	0	$1/\sqrt{2}$	1	NoTrack	NoTrack
Costas	0.5kHz	4kHz	0	$1/\sqrt{2}$	1	62.66ms	65.2ms
Standard	0.5kHz	4kHz	0	$1/\sqrt{2}$	2	NoTrack	NoTrack
Costas	0.5kHz	4kHz	0	$1/\sqrt{2}$	2	59.3ms	67.3ms

Table 2: Frequency and Phase Pull-in Times for Data Modulated Signals

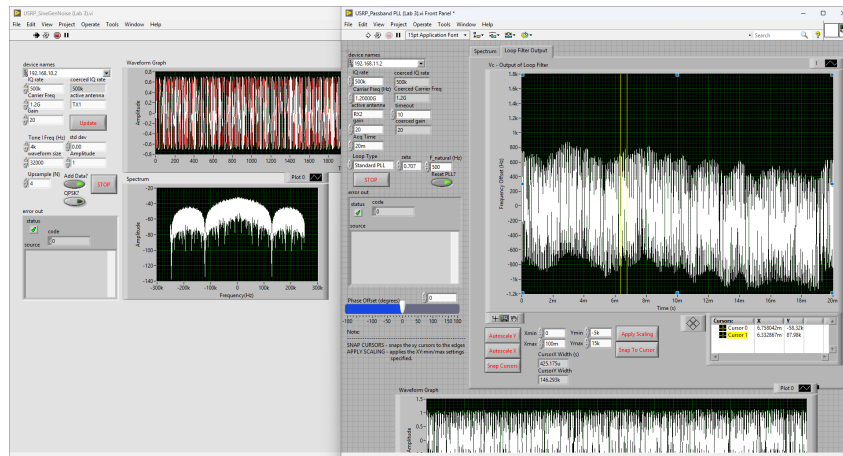


Figure 6: 2.2.3.1 - Standard PLL  $f_n = 0.5 \text{ kHz}$ ,  $\Delta_f = 4 \text{ kHz}$ ,  $\sigma = 0$ ,  $\zeta = 1/\sqrt{2}$ ,  $M = 1$

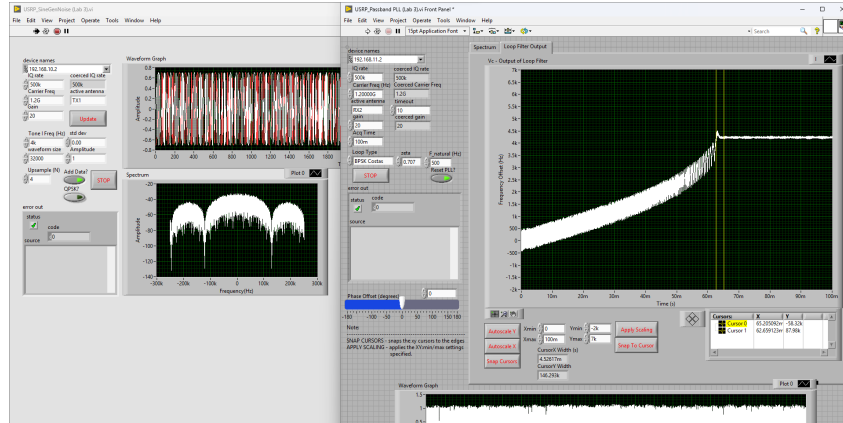


Figure 7: 2.2.3.2 - Costas PLL  $f_n = 0.5$  kHz,  $\Delta_f = 4$  kHz,  $\sigma = 0$ ,  $\zeta = 1/\sqrt{2}$ ,  $M = 1$

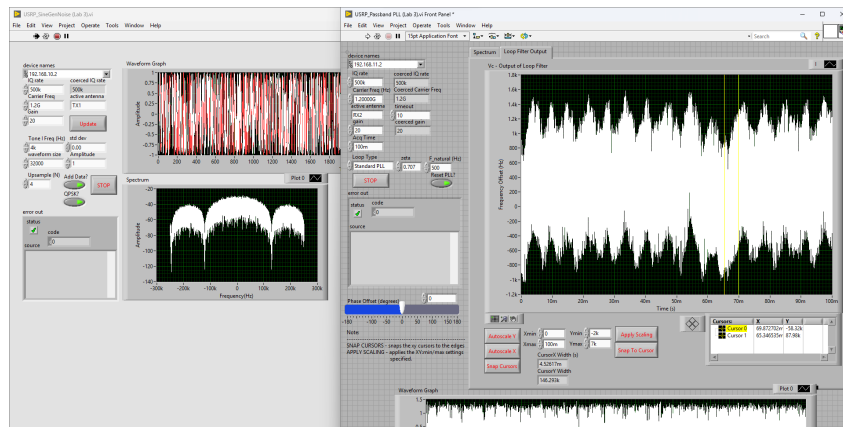


Figure 8: 2.2.3.3 - Standard PLL  $f_n = 0.5$  kHz,  $\Delta_f = 4$  kHz,  $\sigma = 0$ ,  $\zeta = 1/\sqrt{2}$ ,  $M = 2$

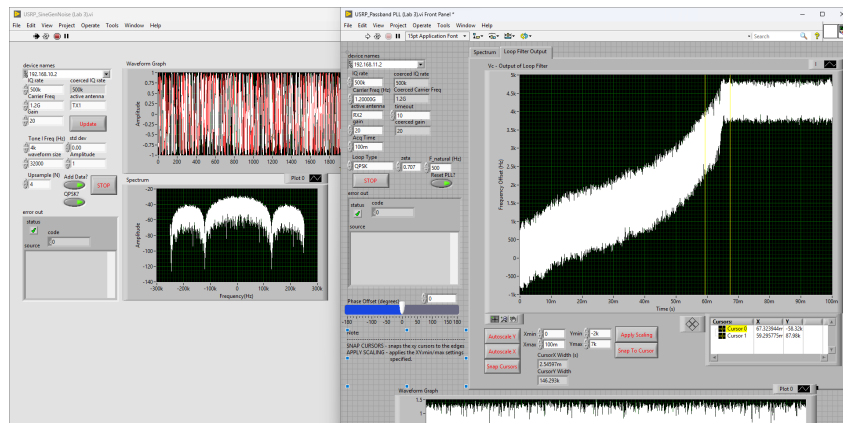


Figure 9: 2.2.3.4 - Costas PLL  $f_n = 0.5$  kHz,  $\Delta_f = 4$  kHz,  $\sigma = 0$ ,  $\zeta = 1/\sqrt{2}$ ,  $M = 2$

What happens when you try and track a data modulated signal with the Standard PLL? Why?  
Insert

### 1.3 Write-Up

- 1 - Insert
- 2 - Insert