

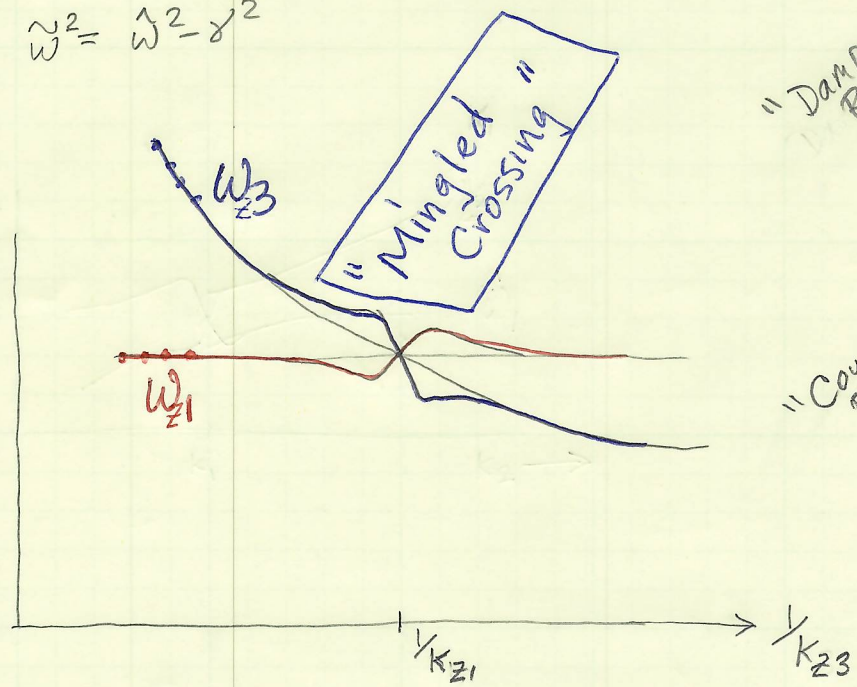
# Damped, Coupled Oscillators : Frequency Crossing

17-Jan-2022

CFD

$$\begin{aligned}
 X_1(t) & \quad \overset{m=1}{X_1} + \overset{\text{damp}}{b_1 \dot{X}_1} + \overset{\text{spring}}{K_1 X_1} = \overset{\text{Couple}}{K_3(X_2 - X_1)} + \overset{\text{Ext Couple}}{E_1(X_e^{(1)} - X_1(t))} \\
 X_2(t) & \quad \ddot{X}_2 + b_2 \dot{X}_2 + K_2 X_2 = K_3(X_1 - X_2) + E_2(X_e - X_2)
 \end{aligned}$$

$$\begin{aligned}
 \hat{\omega}^2 & \equiv k \\
 \gamma & = b/2 \\
 \tilde{\omega}^2 & = \hat{\omega}^2 - \gamma^2
 \end{aligned}$$

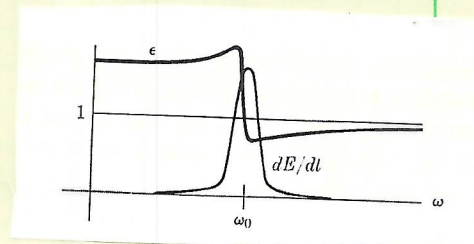
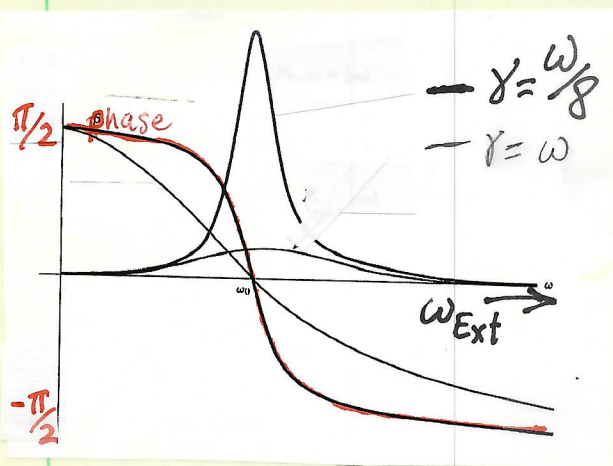


"Damped Resonance"

$$\frac{1}{(\omega_E^2 - \omega_0^2) + \left(\frac{b}{2}\right)^2}$$

"Coupled Resonance"

$$\frac{1}{(\omega_2^2 - \omega_1^2) + K_3^2}$$



$$\sin \beta = \frac{\omega_0^2 - \omega^2}{[(\omega_0^2 - \omega^2)^2 + 4\gamma^2 \omega^2]^{1/2}}$$

$$P_{av} = \frac{1}{2} F_0 \dot{x}_m \cos \beta$$

$$\epsilon = 1 + \frac{4\pi N e^2}{m} \frac{\omega_0^2 - \omega^2}{(\omega_0^2 - \omega^2)^2 + 4\gamma^2 \omega^2}$$

$$\frac{dE}{dt} = \frac{N e^2 E_0^2}{m} \frac{\gamma \omega^2}{(\omega^2 - \omega_0^2)^2 + 4\gamma^2 \omega^2}$$

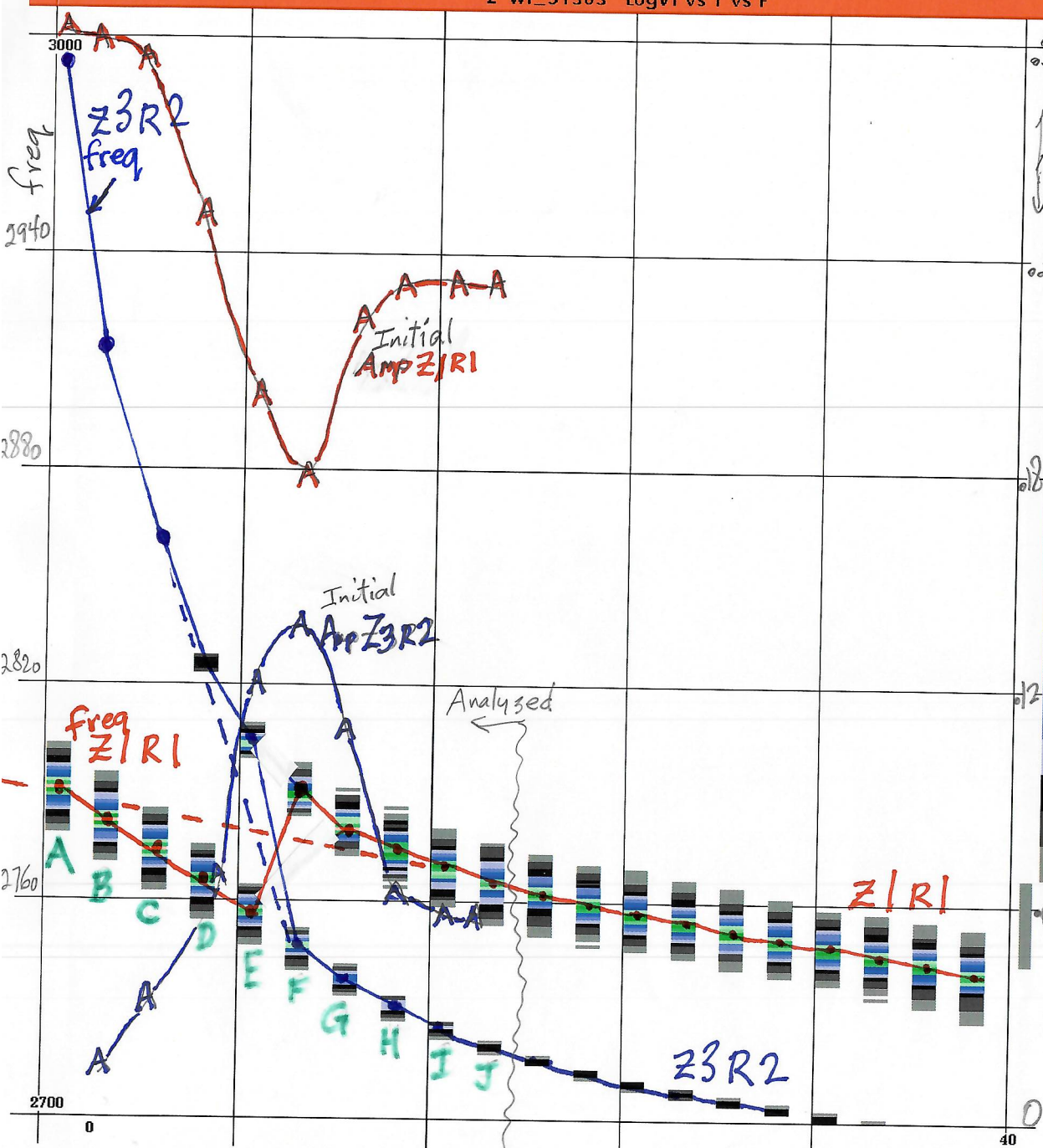
National Brand

43-381 50 SHEETS EYE-GAUGE SQUARES  
43-382 100 SHEETS EYE-GAUGE SQUARES  
43-383 200 SHEETS EYE-GAUGE SQUARES

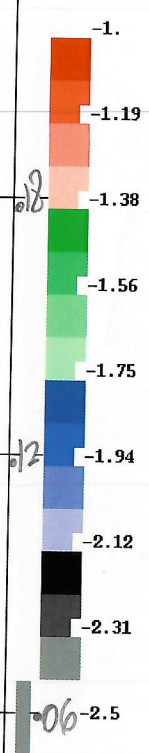
16-JAN-2022 13:27:41  
14:27:49  
wf\_91363 LogVf vs T vs F

2-wave "Mingled  
Coupled Freq Crossing"

wf\_91363



Amplitude





# 2-wave Coupled Freqs Crossing

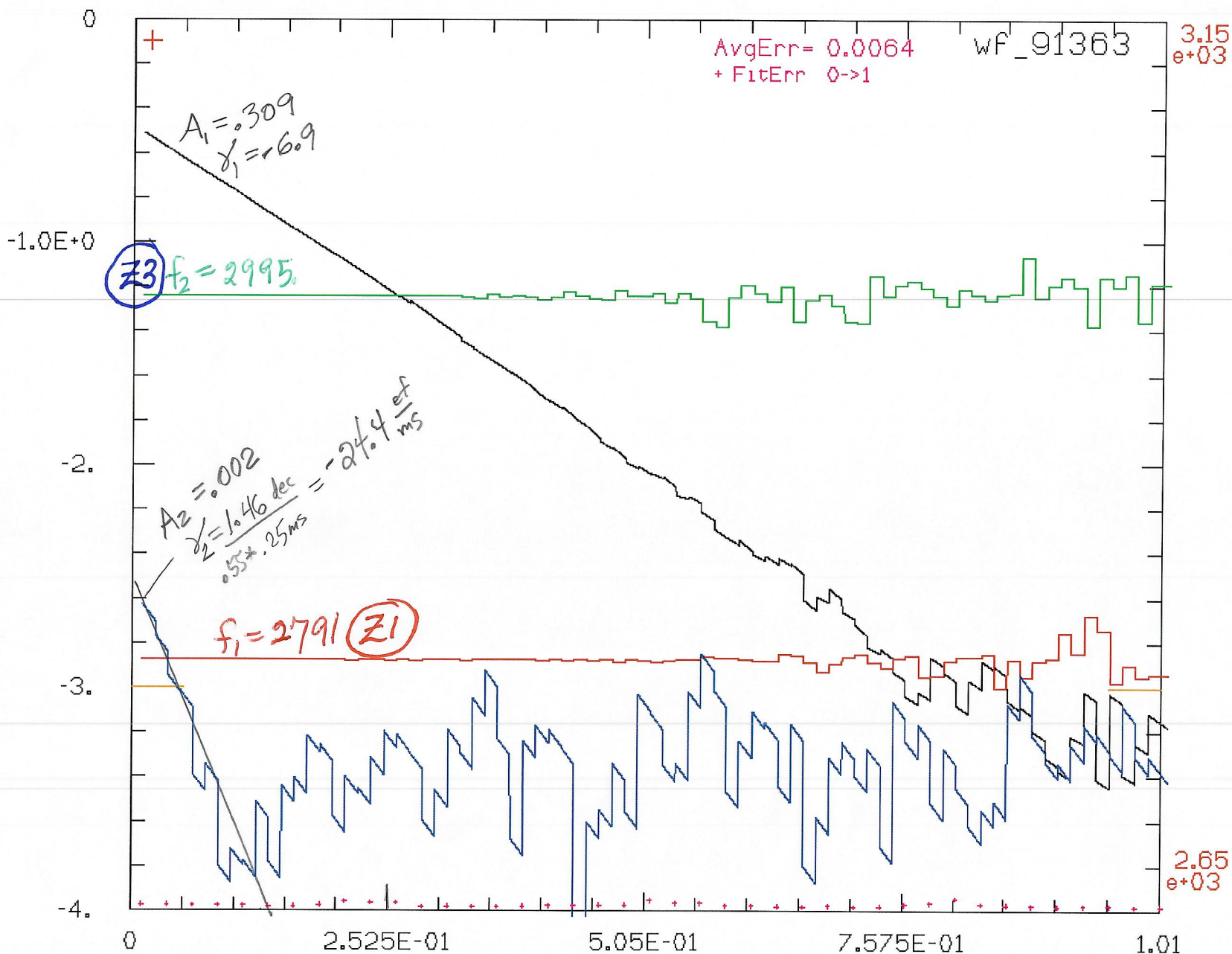
AAK.91363

16-Jan-2022  
CFD

	Z1 R1			Z3 r2		
	$f_1$	$A_1$	$\delta_1$	$f_2$	$A_2$	$\delta_2$
A	2791	.31	-6.9	2995	.002	-24.
B	2782	.30	-6.8	2916	.01	-16.
C	2774.	.29	-6.7	2859	.03	-16.
D	2766.	.25	-7.	2826	.06	-7 ~>-14 small A <sub>1</sub>
E	2757	.20	-7.	2803	.12	-4.6 ~>-8
<hr/>						
	Z3 R2			Z1 R1		
F	2747	.14	-7.	2789	.18	-4. ~>-6.2
G	2739	.10	-7. ~>-8.8	2781.	.22	-5.1 osc
H	2736.	.07	-6.7 ~>-15.	2774	.25	-5. <u>OSC</u>
I	2724	.056	-8.	2769.	.25	-5.1 OSC
J	2720	.05	-6.7	2765.	.25	-6.7 osc

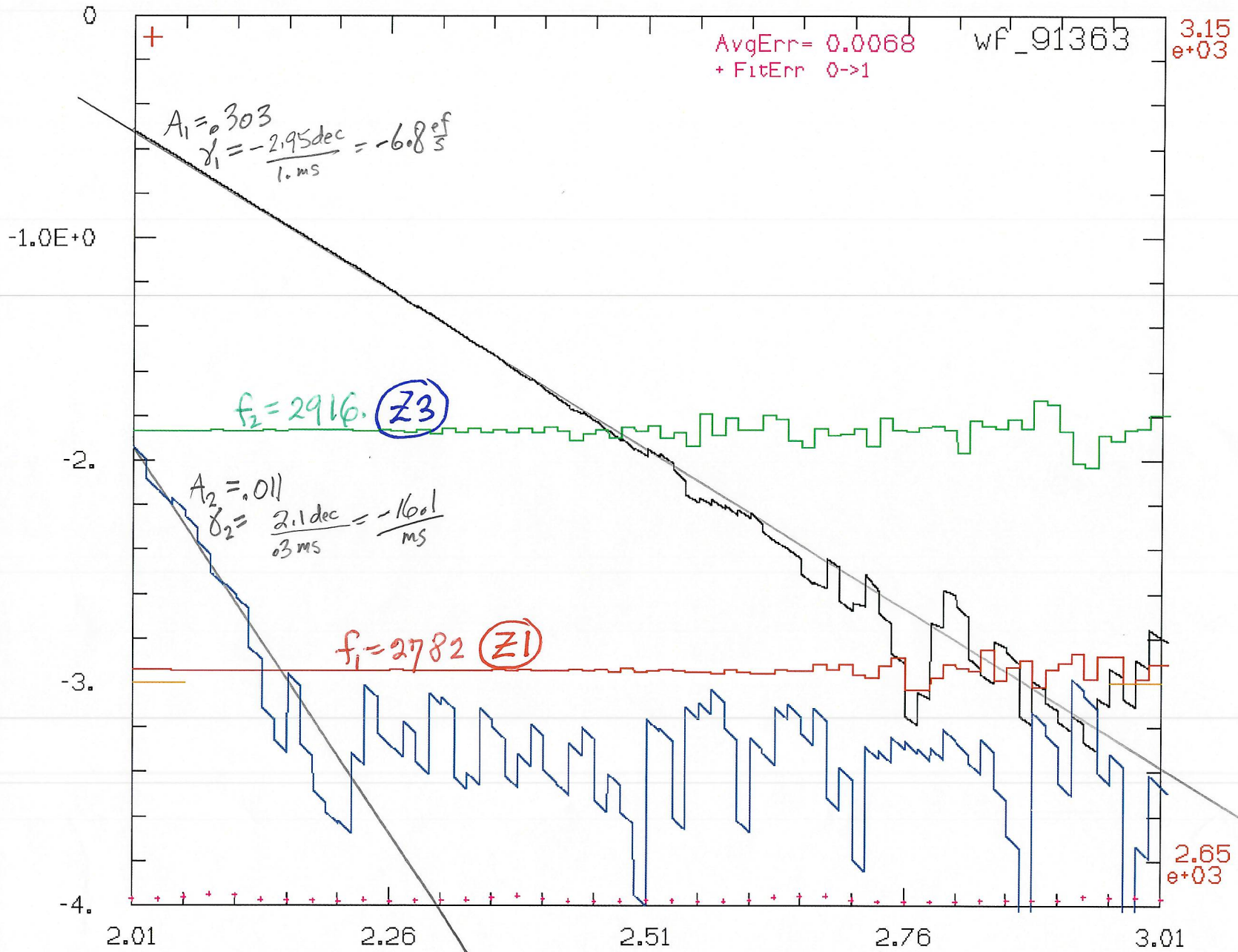
A2w8

Amplg1 Frq1 Amplg2 Frq2



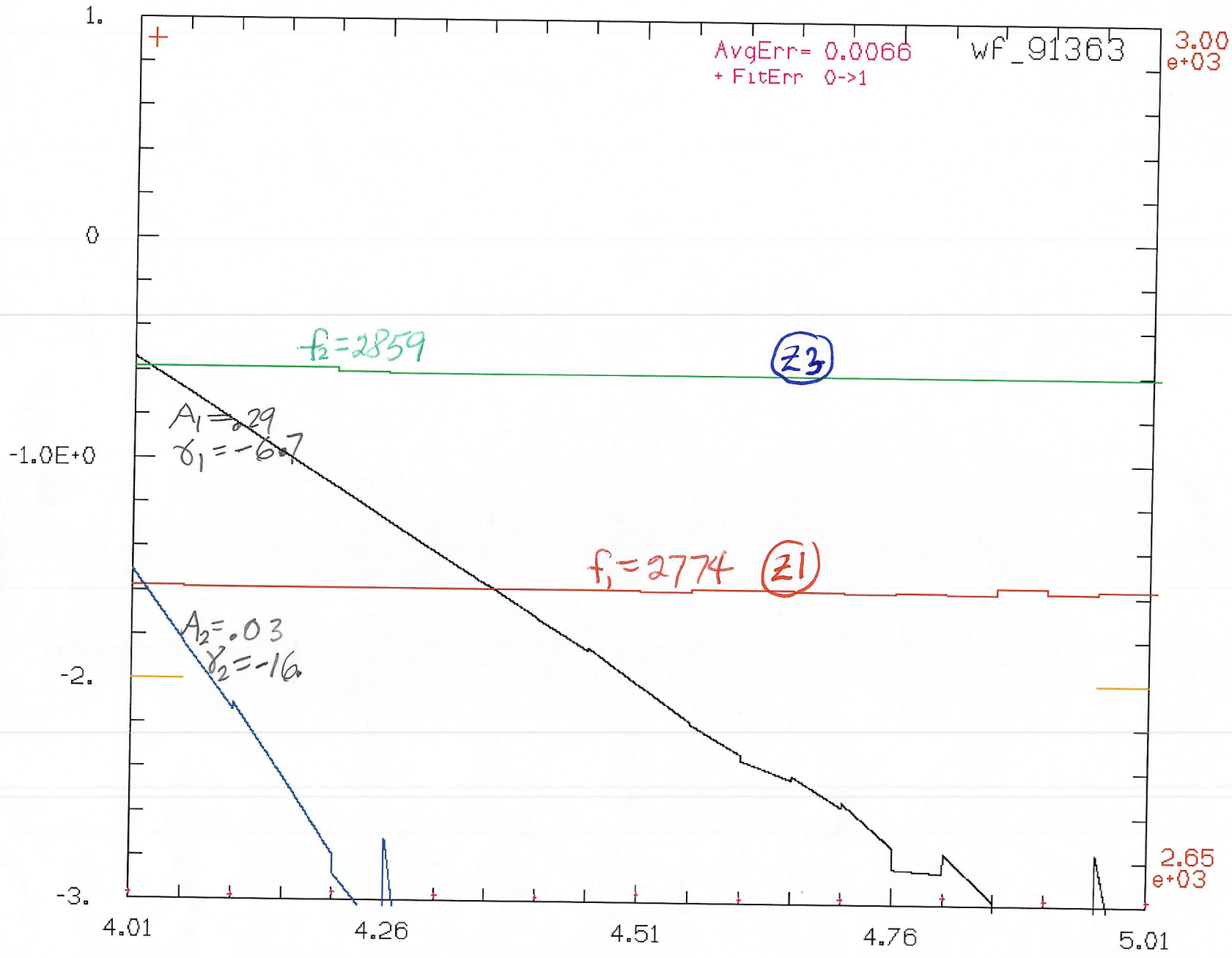


AmplG1 Frq1 AmplG2 Frq2



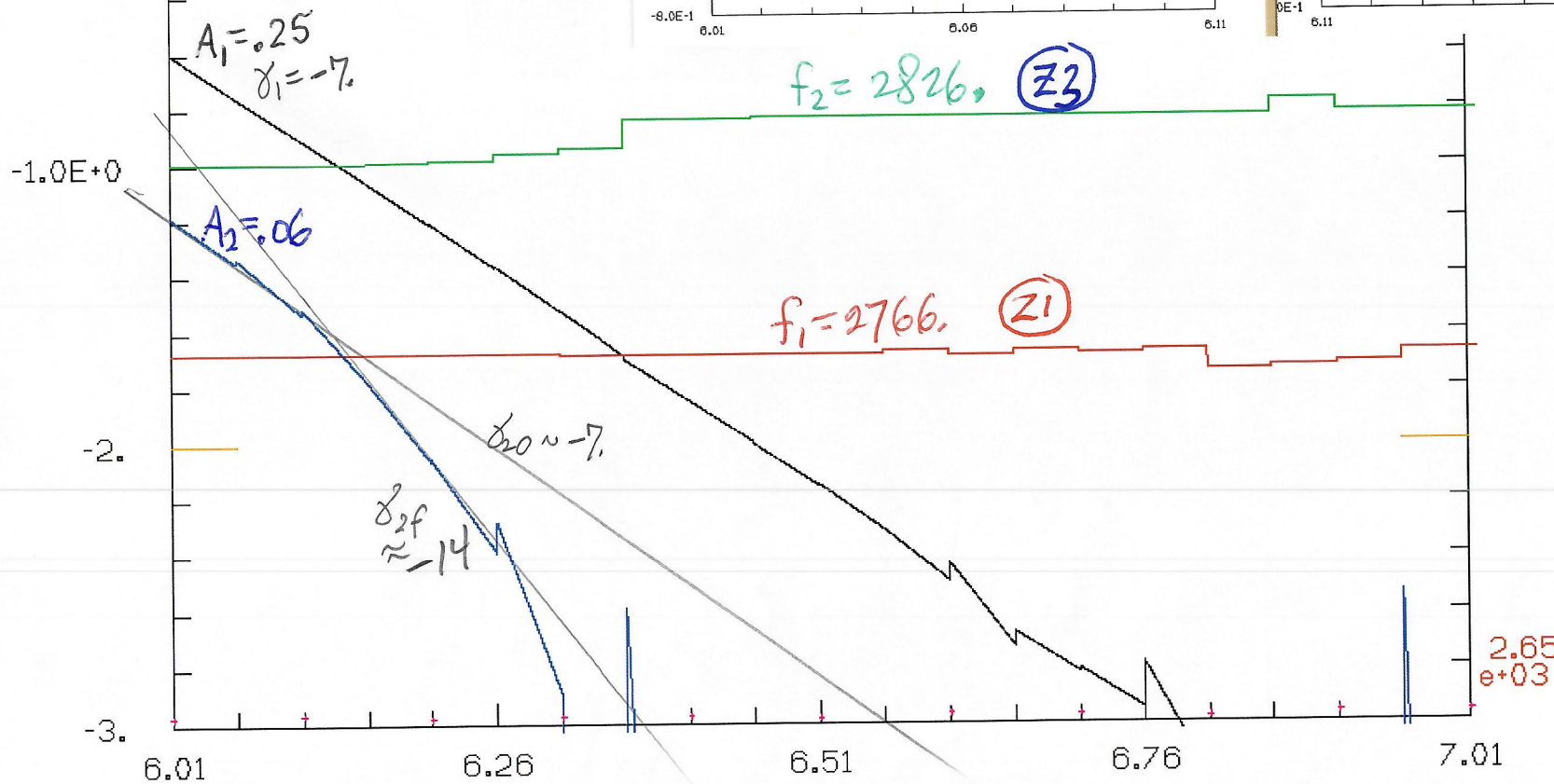
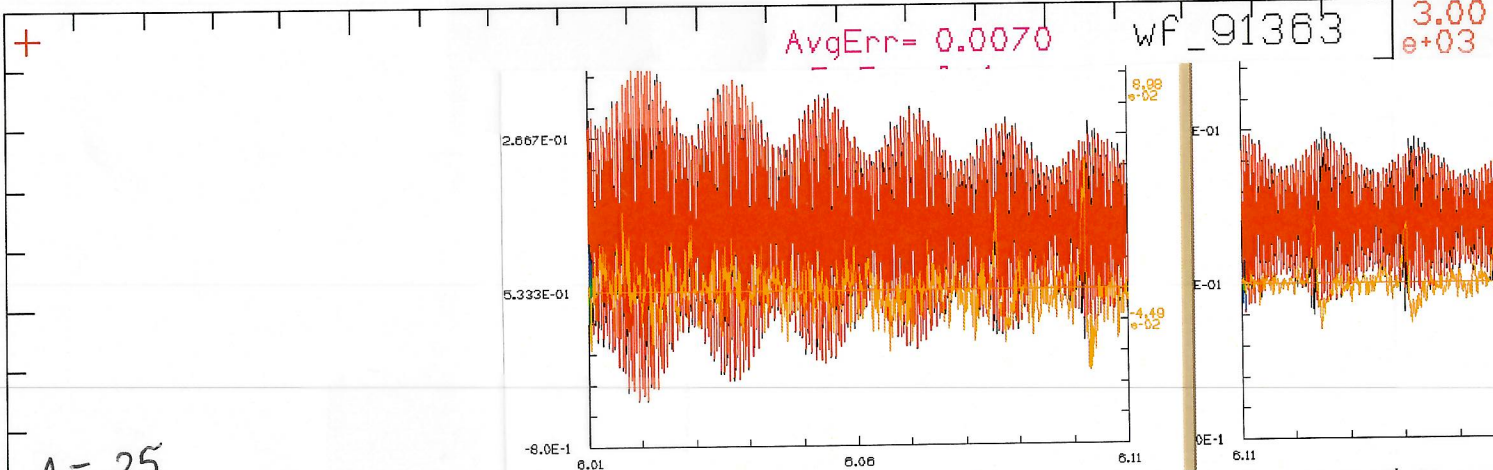
B2w8

AmpLg1 Frq1 AmpLg2 Frq2



AmpLg1 Frq1 AmpLg2 Frq2

1.

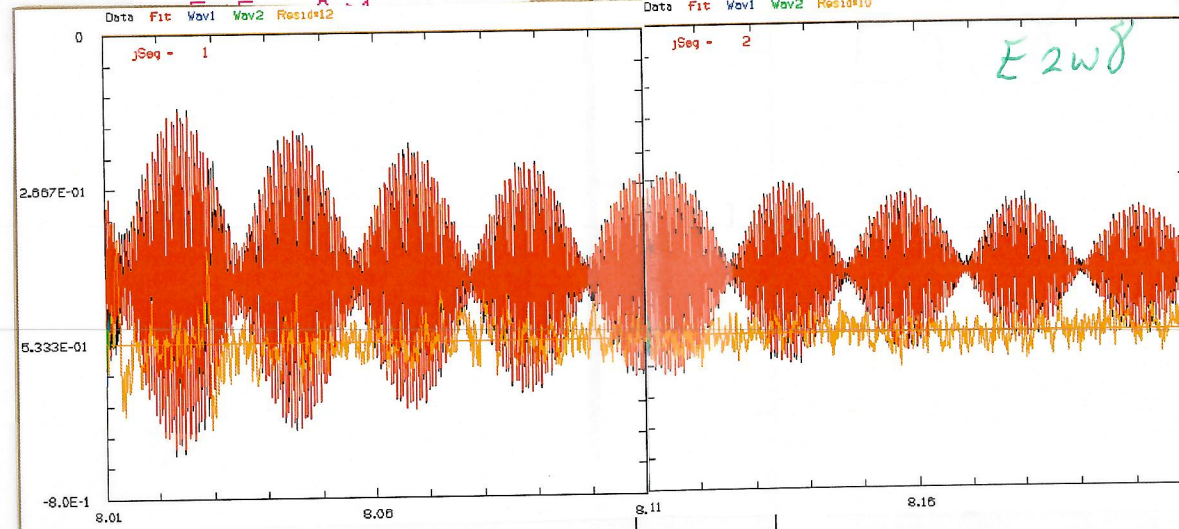




AmpLg1 Frq1 AmpLg2 Frq2

1.

AvgErr= 0.0070 wf\_91363 3.00 e+03



E2w8

$\gamma_1 = -7$   
 $A_1 = 20$   
 $A_2 = -12$   
 $\gamma_2 = -5$

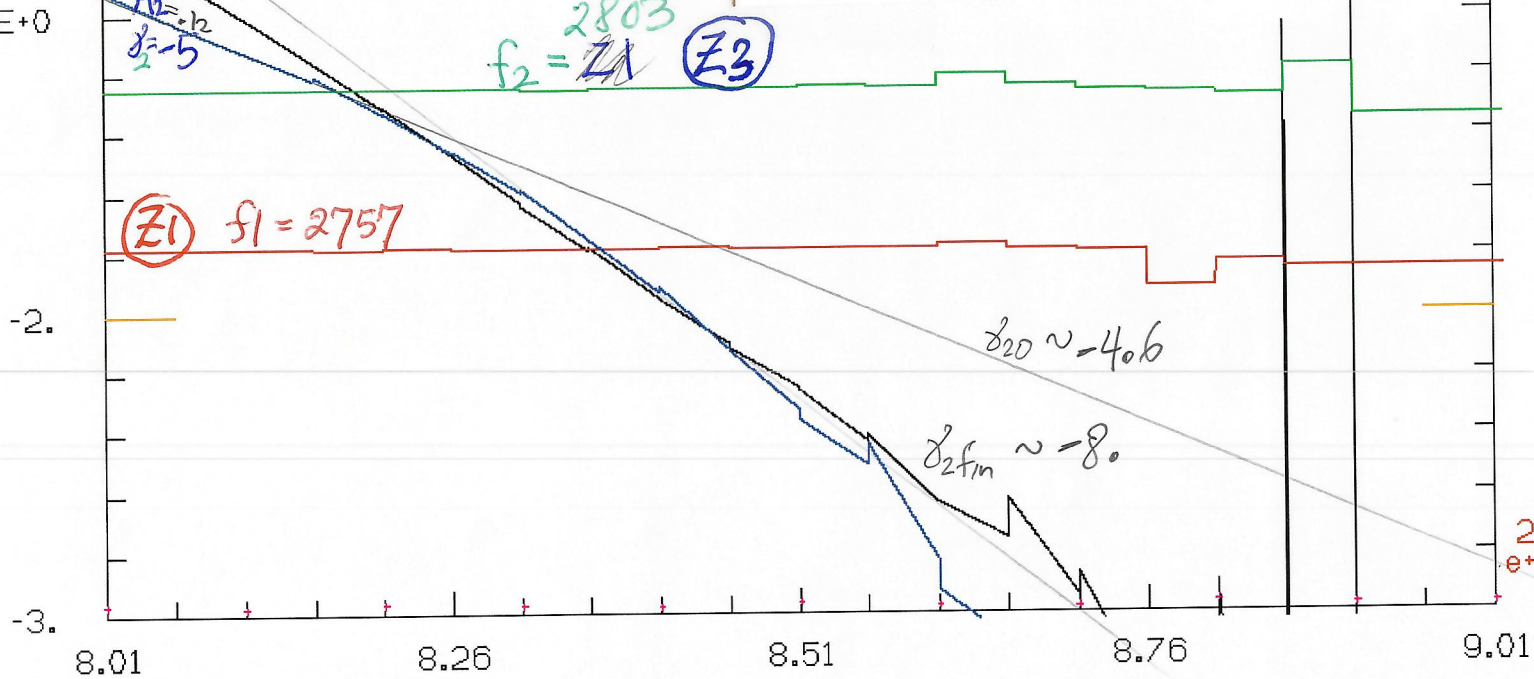
$f_2 = 2803$   
 $Z_3$

$Z_1$   $f_1 = 2757$

$\delta_{20} \sim -4.06$

$\delta_{2f_m} \sim -8.0$

2.65 e+03





AmpLg1 Frq1 AmpLg2 Frq2

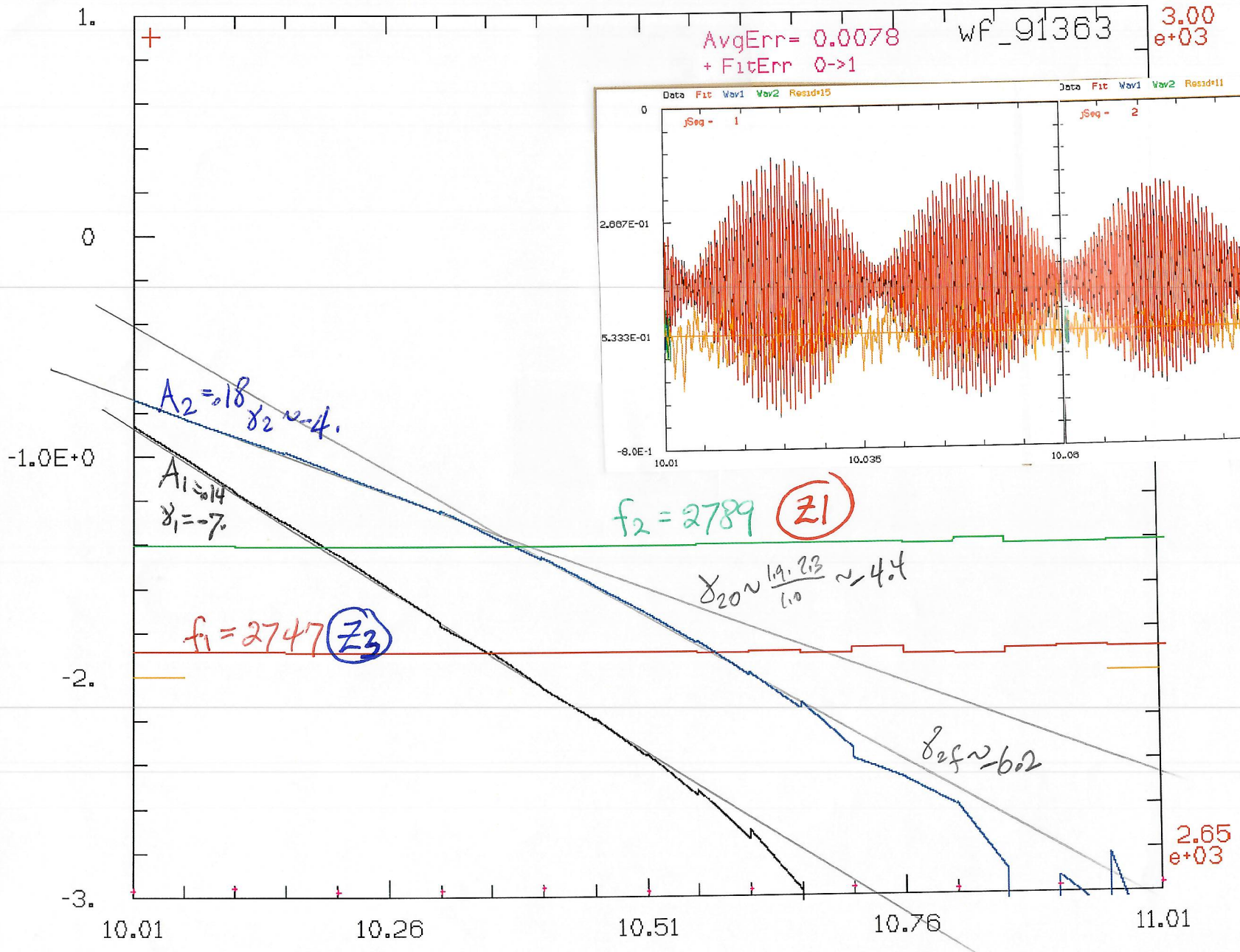
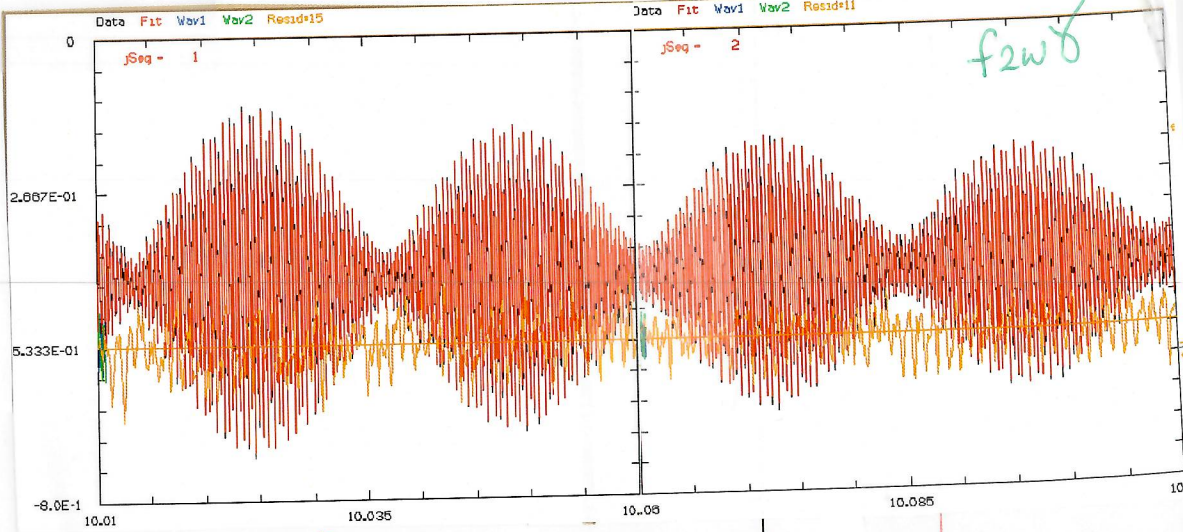
AvgErr= 0.0078  
+ FitErr 0->1

wf\_91363

3.00  
e+03

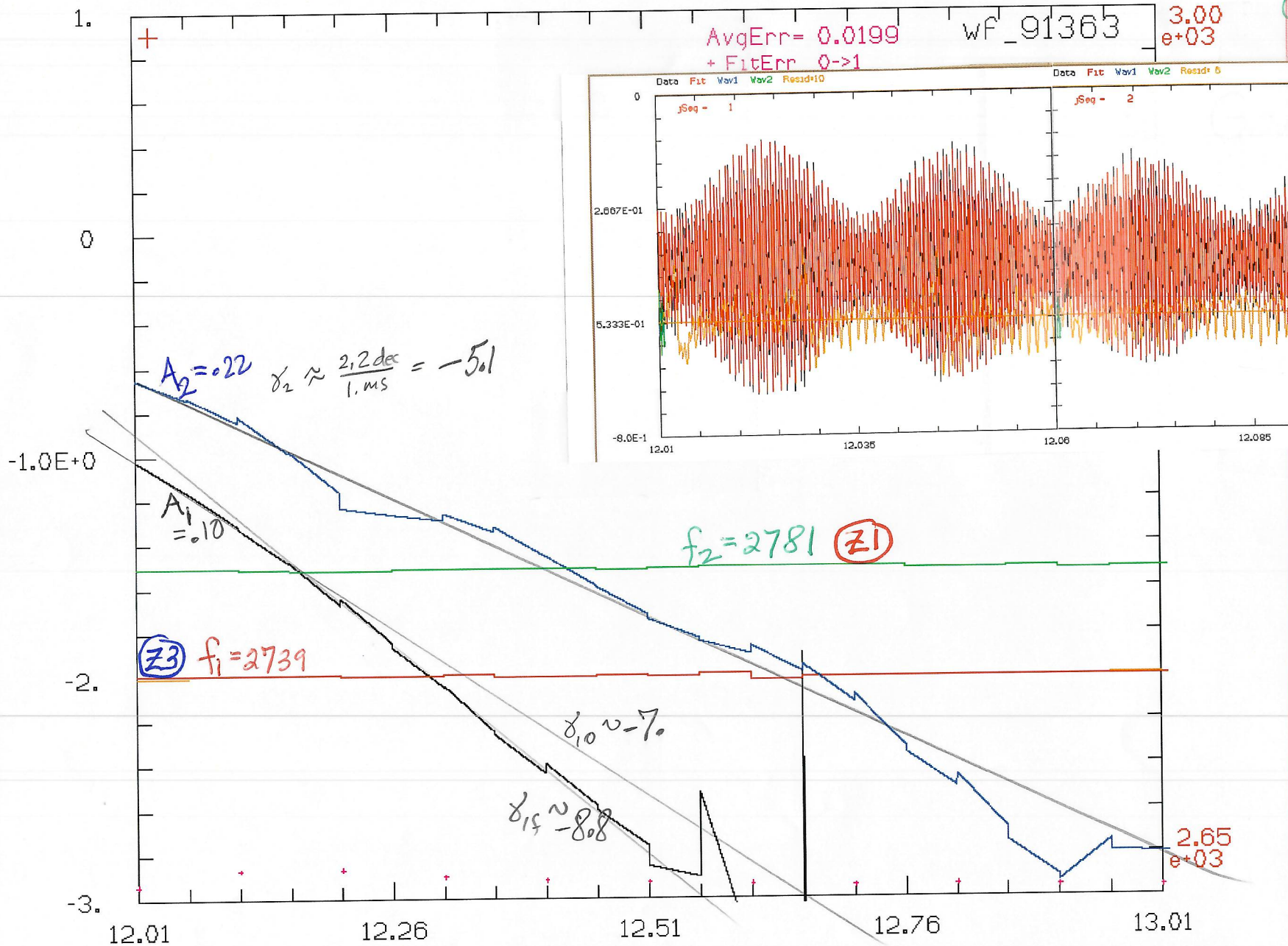
F2w8

f2w8



AmpLg1 Frq1 AmpLg2 Frq2

G2WJ



G2WJ



wfAF

AmpLg1 Frq1 AmpLg2 Frq2

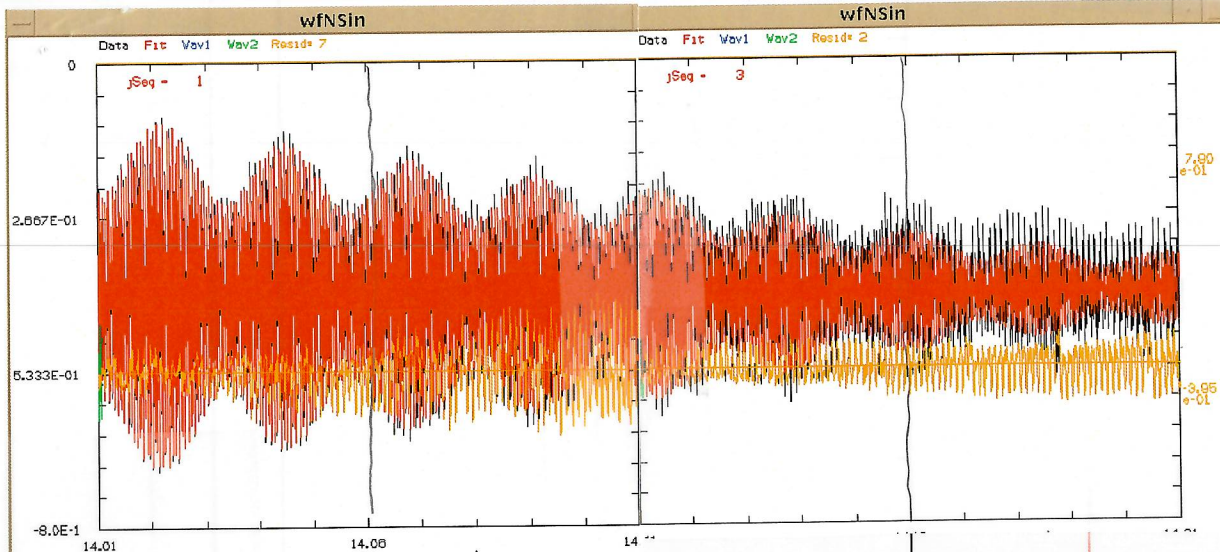
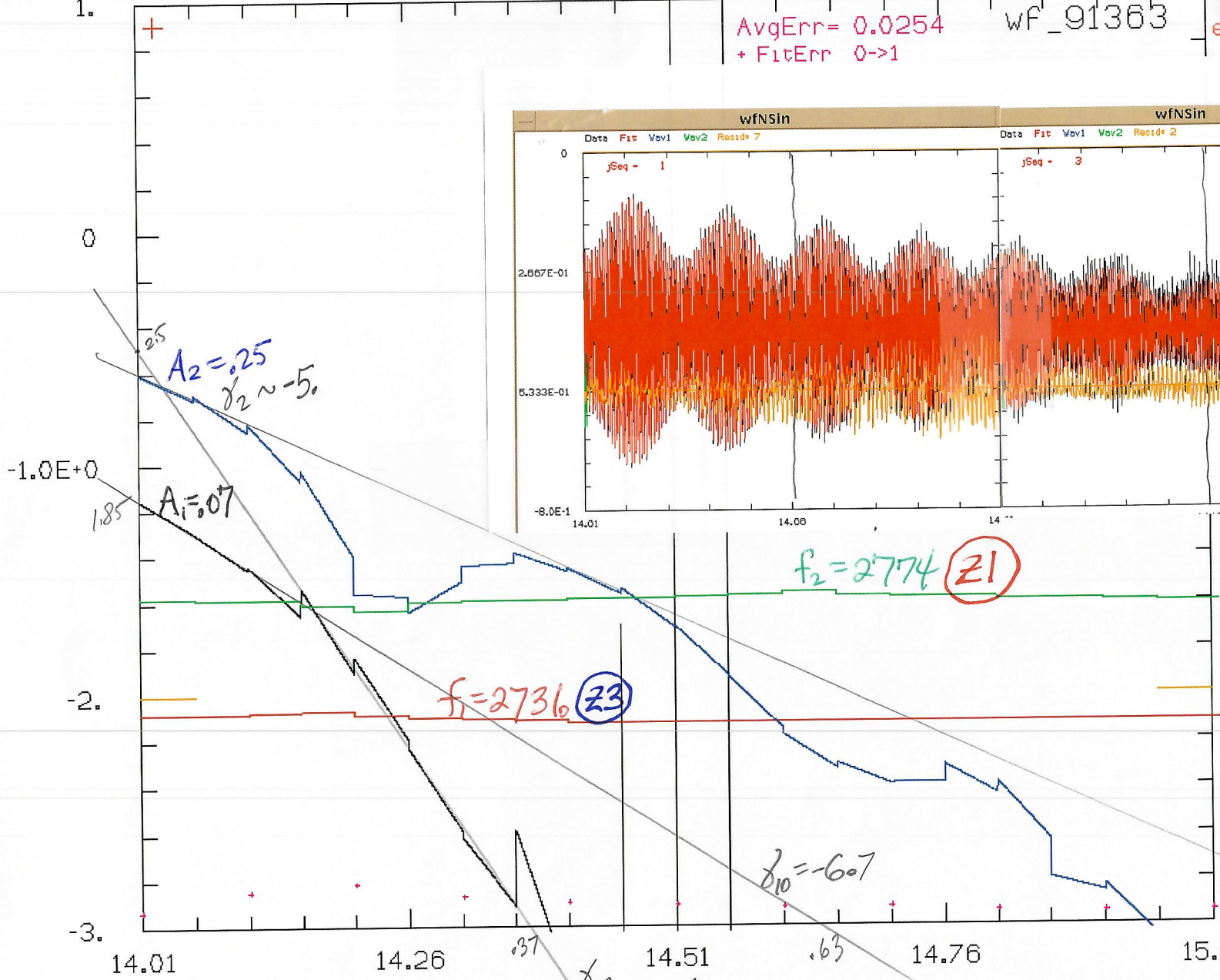
1.

AvgErr= 0.0254  
+ FitErr 0->1

wf\_91363

3.00  
e+03

H<sub>2</sub>X  
HawX



CFD10

ZZI0TEMR:[000000]wf3\_FitSW\_91363.txt;13

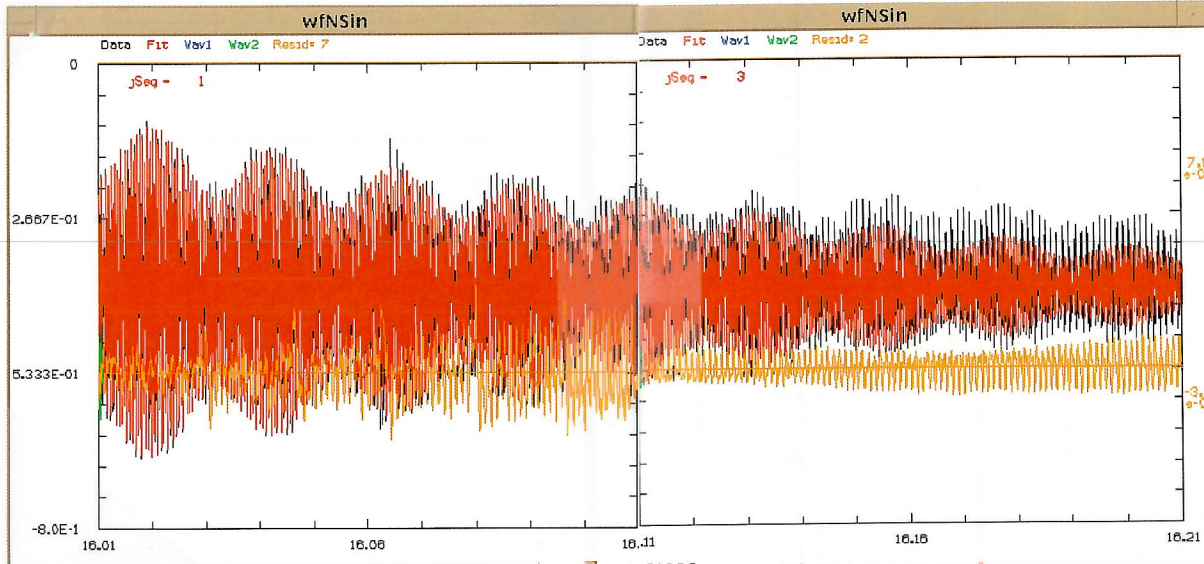
16-JAN-2022 10:22:55  
\_3\_ 15-JAN-2022 15:38:44

wFAF

AmpLg1 Frq1 AmpLg2 Frq2

I2w8  
I2w8

1. + AvgErr= 0.0223 wf\_91363 3.00  
+ FitErr 0->1 e+03



$A_2 = 0.25$   
 $\delta_2 = -5.01$

$A_1 = 0.056$   
 $\delta_1 = -1.8$

-1.0E+0

-2.

-3.

(Z1)  $f_2 = 2769$

(Z3)  $f_1 = 2724$

2.65  
e+03

16.01 16.26 16.51 16.76 17.01



AmplG1 Frq1 AmplG2 Frq2

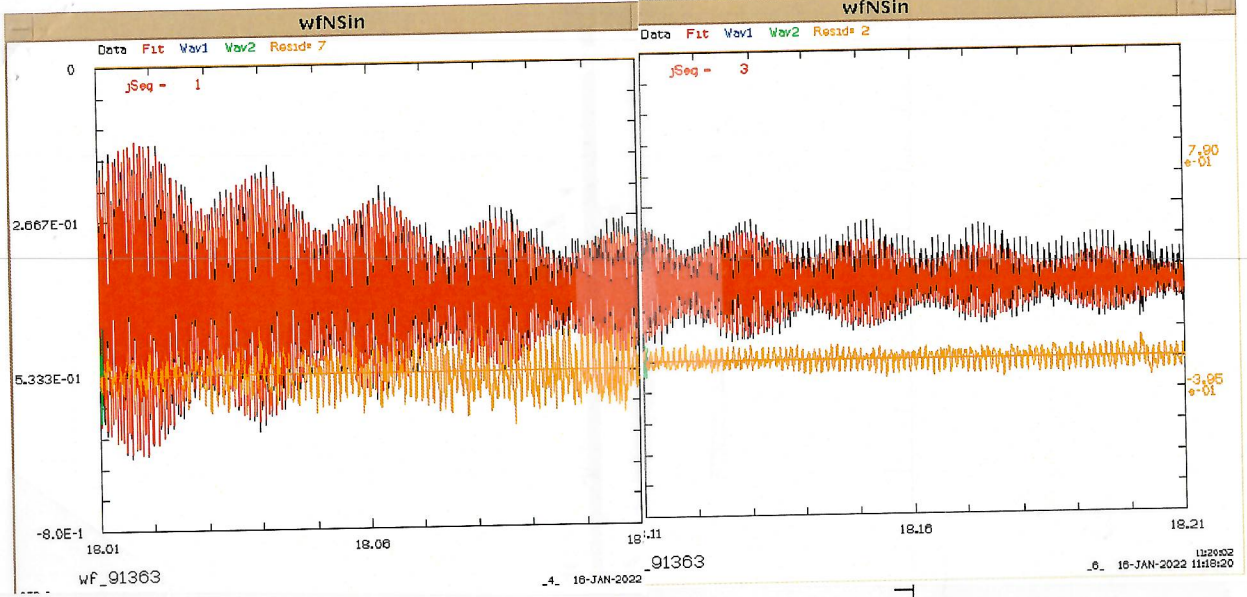
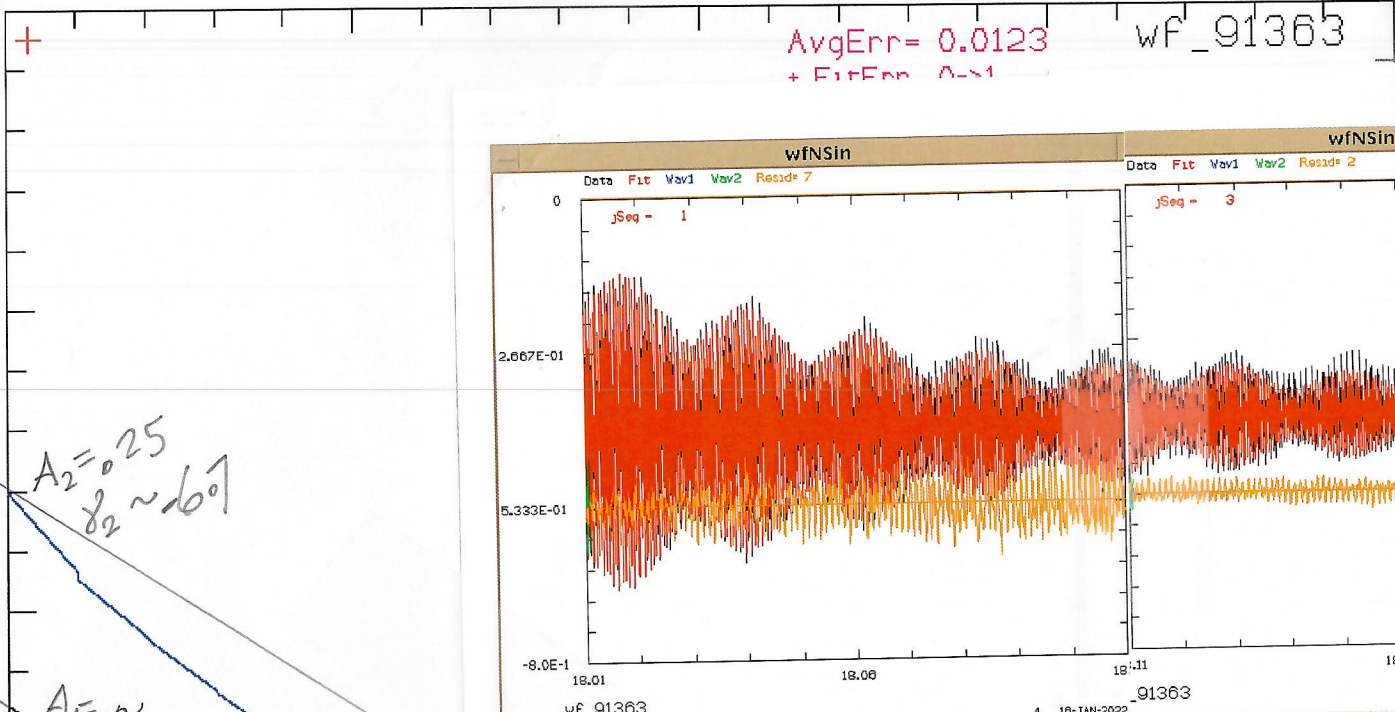
wf\_91363

3.00  
e+03

Jaw δ  
Jaw δ

AvgErr= 0.0123  
+ FitErr Δ=1

1.



(Z1)  $f_2 = 2765$

(Z3)  $f_1 = 2720$

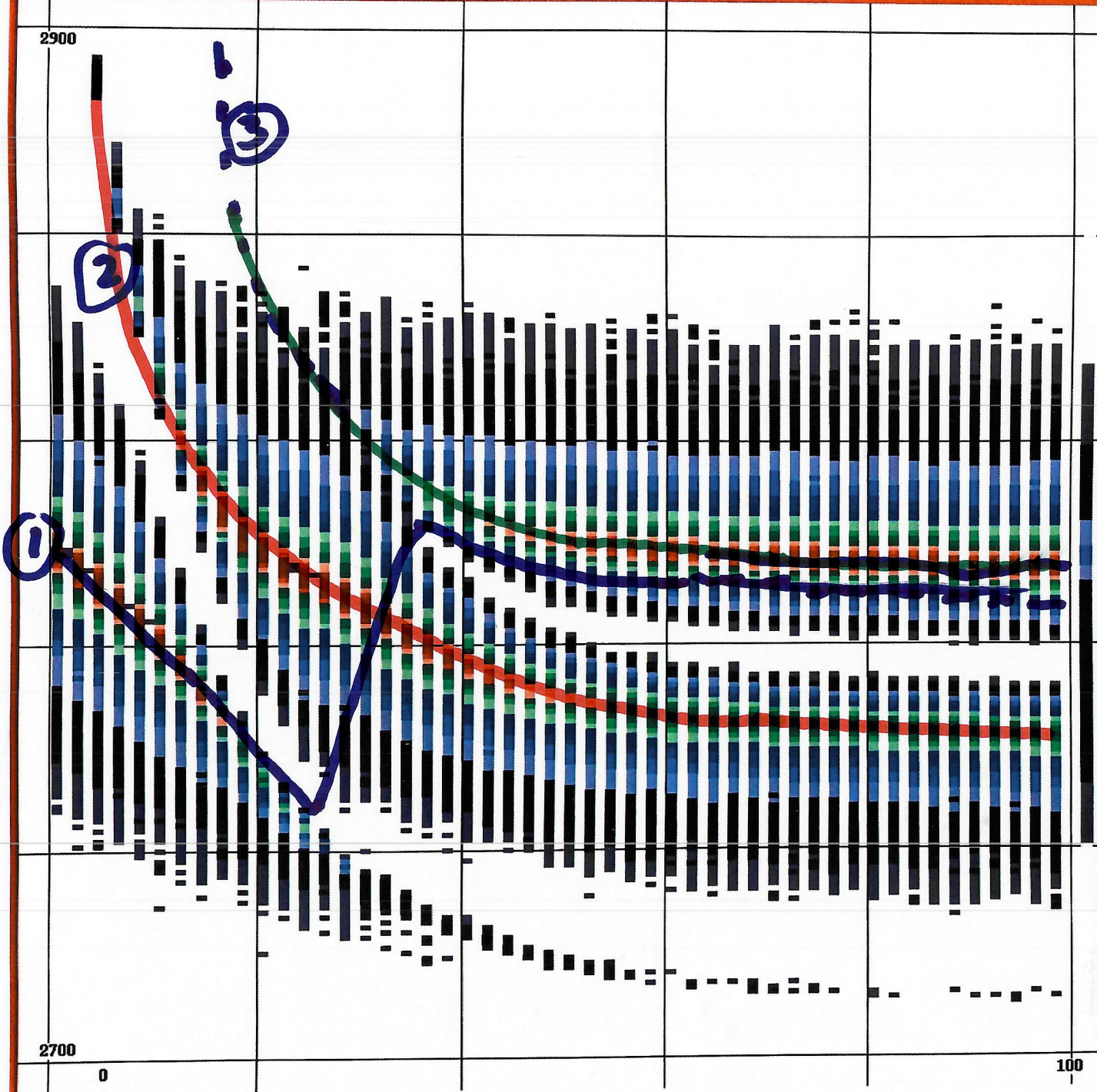
2.65  
e+03

-3.

18.01 18.26 18.51 18.76 19.01



AAK:  
3-Mode (2" Doa Crossing")  
wf-91275



2900

2700

0

100