LO - TX FREQ ± OFFSET
10KHZ IF
BANDWIDTH

Holography System Specifications

1. Frequency Range
   - 1.1 Primary Frequency: 104.02 GHz
     - 1.1.1 Range: 103.8 to 104.24 GHz (320 steps) −160 → +160
     - 1.1.2 Step: 1.375 MHz
   - 1.2 Secondary Frequency: 78.92 GHz
     - 1.2.1 Range: 78.74 to 79.01 GHz (240 STEPS) −160 → +80
     - 1.2.2 Step: 1.125 MHz

2. Transmitter EIRP: > 10 dBm
   - 2.1 Antenna Gain: ≅ 33 dB
   - 2.2 TX power at antenna input: > 1 μW · 30DBm 2mw EIRP

3. Receiver Dynamic Range[1]
   - 3.1 Signal Channel
     - 3.1.1 Primary Freq. (regardless of Step Atten. Setting): ≅ 55 dB
     - 3.1.1 Secondary Freq. (regardless of Step Atten. Setting): ≅ 55 dB
   - 3.2 Ref. Channel
     - 3.2.1 Primary Freq.
       - 3.2.1.1 Atten. = 0 dB: ≅ 25 dB
       - 3.2.1.2 Atten. = 10 dB: ≅ 35 dB
       - 3.2.1.3 Atten. = 20 dB: ≅ 45 dB
       - 3.2.1.4 Atten. = 30 dB: ≅ 50 dB
       - 3.2.1.5 Atten. = 40 dB: ≅ 53 dB
     - 3.2.2 Secondary Freq.
       - 3.2.2.1 Atten. = 0 dB: ≅ 25 dB
       - 3.2.2.2 Atten. = 10 dB: ≅ 35 dB
       - 3.2.2.3 Atten. = 20 dB: ≅ 44 dB
       - 3.2.2.4 Atten. = 30 dB: ≅ 51 dB
       - 3.2.2.5 Atten. = 40 dB: ≅ 53 dB

4. Signal and Ref. Channels Isolation[2]
   - 4.1 Signal-to-Ref Channel Isolation
     - 4.1.1 Primary Frequency (104.02 GHz)
       - 4.1.1.1 Input power = +11 dBm (at mixer input), Sig. Step Atten = 9 dB
         - 4.1.1.1.1 Ref. Step Atten. = 0 dB: ≅ 44 dB
         - 4.1.1.1.2 Ref. Step Atten. = 10 dB: ≅ 53 dB
         - 4.1.1.1.3 Ref. Step Atten. = 20 dB: ≅ 64 dB
         - 4.1.1.1.4 Ref. Step Atten. = 30 dB: ≅ 72 dB
       - 4.1.1.2 Input power = +11 dBm (at mixer input), Sig. Step Atten = 1 dB
         - 4.1.1.2.1 Ref. Step Atten. = 0 dB: ≅ 50 dB
         - 4.1.1.2.2 Ref. Step Atten. = 10 dB: ≅ 60 dB

4.1.2 Secondary Frequency (78.92 GHz)

4.1.2.1 Input Power = +13 dBm (at mixer input), Sig. Step Atten =8 dB

4.1.2.1.1	Ref. Step Atten. = 0 dB	≅ 37 dB
4.1.2.1.2	Ref. Step Atten. = 10 dB	≅ 47 dB
4.1.2.1.3	Ref. Step Atten. = 20 dB	≅ 57 dB
4.1.2.1.4	Ref. Step Atten. = 30 dB	≅ 67 dB

4.2 Ref-to-Signal Channel Isolation

4.2.1 Primary Frequency > 90 dB

(Test Condition: Input Power = +13 dBm (at mixer input)
Ref. Step Atten. = 25 dB
Sig. Step Atten. = 0 dB)

4.2.2 Secondary Frequency > 90 dB

(Test Condition: Input Power = +13 dBm (at mixer input)
Ref. Step Atten. = 36 dB
Sig. Step Atten. = 0 dB)

5. Noise Temperature

5.1 Primary Frequency (104.02 GHz)

5.1.1	Sig. Channel (step atten. = 10 dB)	≅ 3700 K
5.1.2	Sig. Channel (step atten. = 20 dB)	≅ 5200 K
5.1.3	Ref. Channel (step atten. = 10 dB)	≅ 2300 K
5.1.4	Ref. Channel (step atten. = 20 dB)	≅ 2300 K

5.2 Secondary Frequency (78.92 GHz)

5.2.1	Sig. Channel (step atten. = 10 dB)	≅ 3000 K
5.2.2	Sig. Channel (step atten. = 20 dB)	≅ 4100 K
5.2.3	Ref. Channel (step atten. = 10 dB)	≅ 1800 K
5.2.4	Ref. Channel (step atten. = 20 dB)	≅ 2100 K

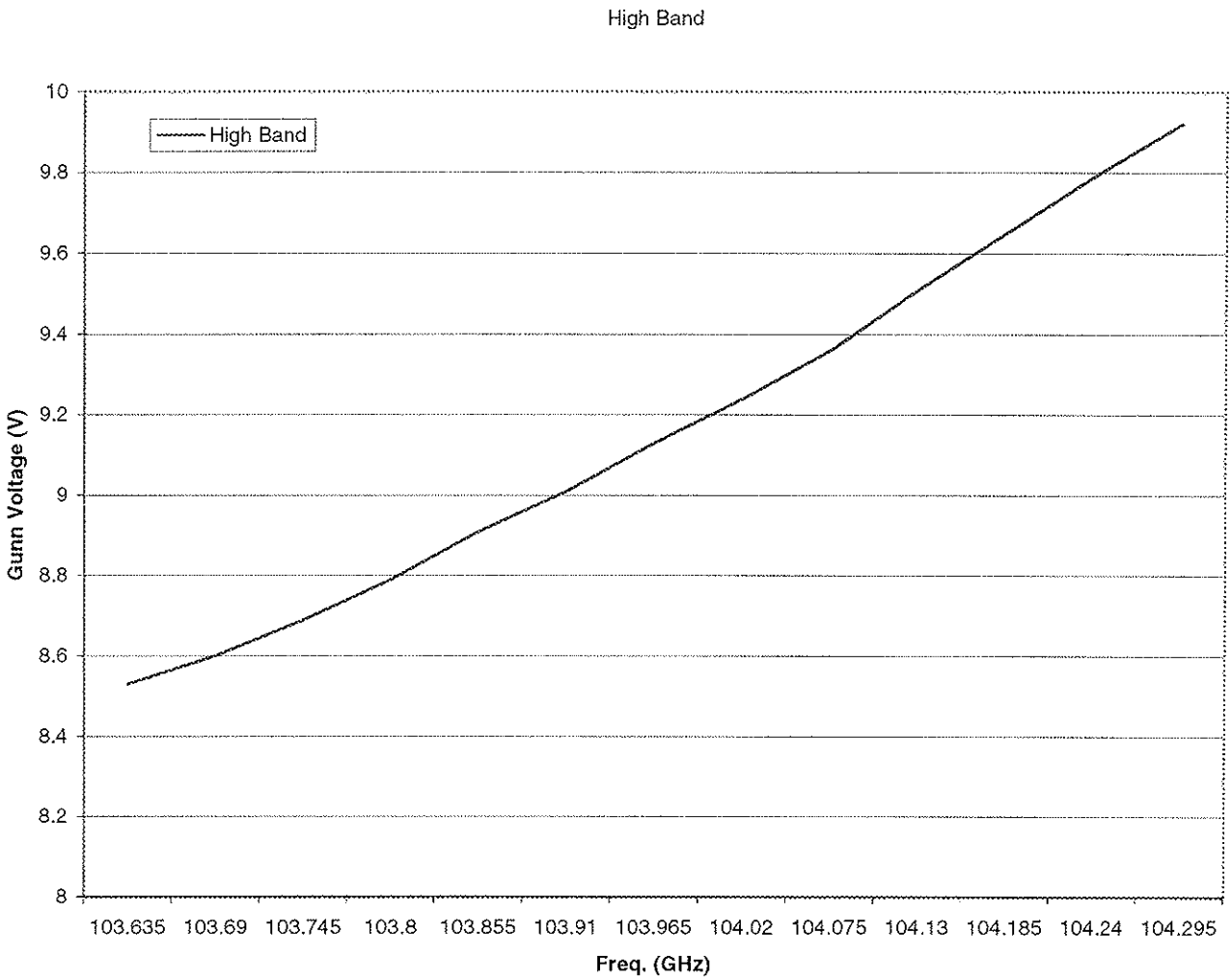


Figure 2. High-Band Gunn oscillator bias voltage vs. freguency.

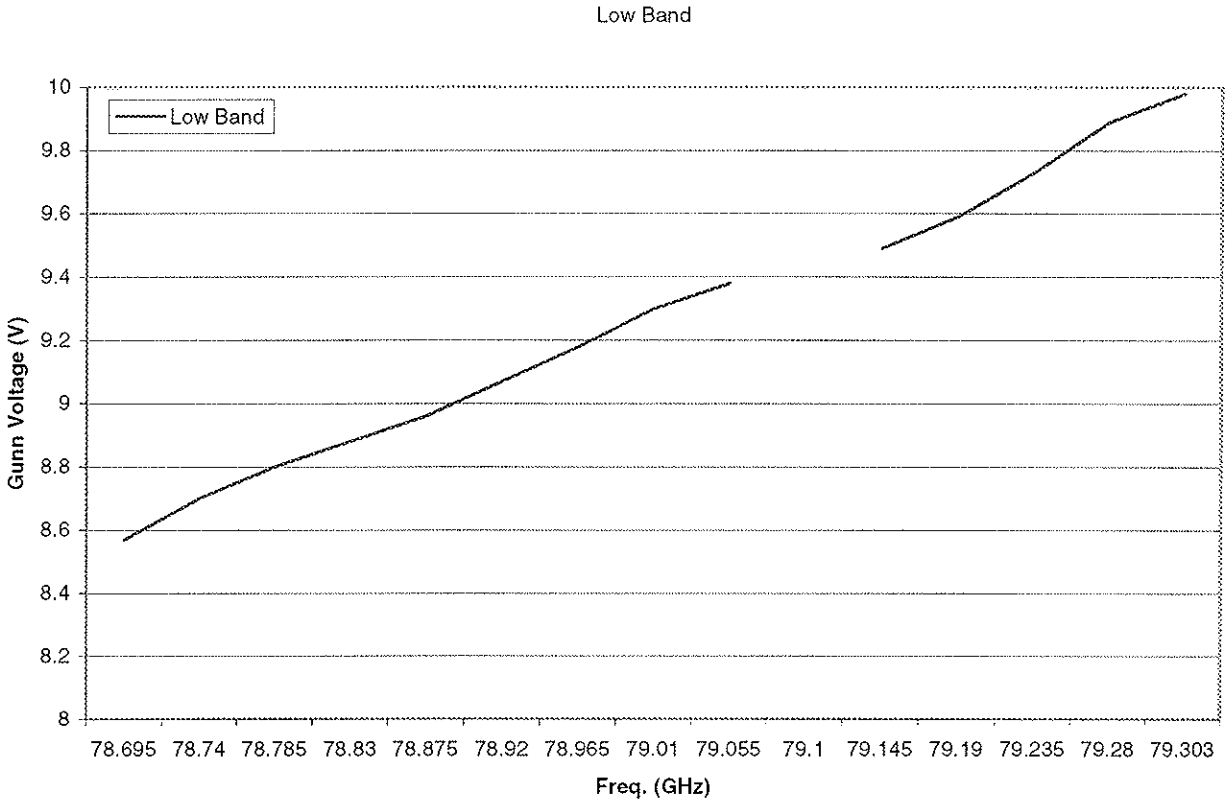
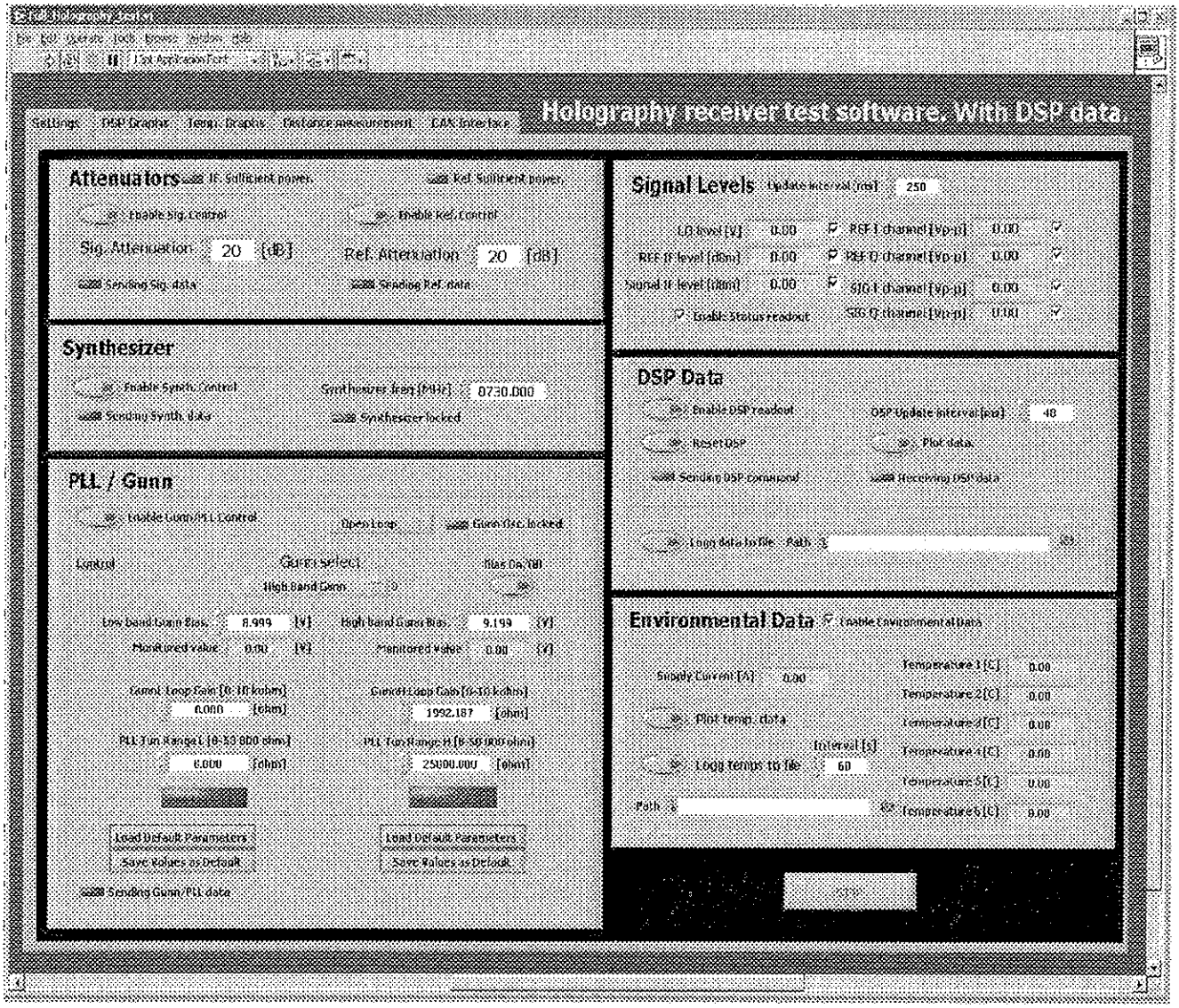


Figure 3. Low-Band Gunn oscillator bias voltage vs. freguency.

Procedure

1. After start-up, change the Sig. Attenuation from 20 dB to 21 dB, then back to 20 dB. Also repeat this step for Ref. Attenuation.
2. Click on the Enable Synth. Control button.
3. Click on the Enable Gunn/PLL Control button.
4. Set Gunn select to High Band Gunn.
5. Click on Load Default Parameters on the high-band side to load the default parameters for the high band Gunn.
6. Set Gunn select to Low Band Gunn.
7. Click on Load Default Parameters on the low-band side to load the default parameters for the low band Gunn.
8. Set the Gunn select back to High Band Gunn.
9. Click on the Bias On/Off button.
10. Click on Open Loop button to select the Close Loop option. The loop should be locked and the green light should be on.
11. Click on Enable DSP readout.
12. Click on Reset DSP.
13. Notice the Vp-p readings on REF I channel [Vp-p], REF Q channel [Vp-p], SIG I channel [Vp-p] and SIG Q channel [Vp-p]. The maximum should be about 20V. For best dynamic range, adjust Sig. and Ref. step attenuators so the voltage readings are about 19V. When the step attenuator value is increased by 6 dB, the I and Q channel voltage should drop by 50%.

Note 1: For the PLL/Gunn to lock, the Monitored Value of the Gunn voltage and the Gunn Bias voltage have to be within 15 mV of each. If the user would change the frequency in big step, the user will need to adjust the Gunn bias for the PLL to lock. The user can refer to the measured Gunn bias voltage charts in the Figures 2 and 3 to set the Gunn Bias voltage.


Holography receiver test software. With DSP data.
Settings
DSP Graphs
Temp. Graphs
Distance measurement
CAN interface
Attenuators
IF: Sufficient power
Ref: Sufficient power
Enable Sig. Control
Enable Ref. Control
Sig. Attenuation: 20 [dB]
Ref. Attenuation: 20 [dB]
Sending Sig. data
Sending Ref. data
Signal Levels
Update interval [ms]: 250
LO level [V]: 0.00
REF I channel [Vp-p]: 0.00
REF IF level [dBm]: 0.00
REF Q channel [Vp-p]: 0.00
Signal IF level [dBm]: 0.00
SIG I channel [Vp-p]: 0.00
Enable status readout
SIG Q channel [Vp-p]: 0.00
Synthesizer
Enable Synth. Control
Synthesizer freq [MHz]: 8730.000
Sending Synth. data
Synthesizer locked
DSP Data
Enable DSP readout
DSP Update interval [ms]: 40
Reset DSP
Plot data
Sending DSP command
Receiving DSP data
Log data to file
Path:
PLL / Gunn
Enable Gunn/PLL control
Open Loop
Gunn osc. locked
Control
Select
Bias On/Off
High Band Gunn
Low band Gunn Bias: 8.999 [V]
High band Gunn Bias: 9.199 [V]
Monitored value: 0.00 [V]
Monitored value: 0.00 [V]
Control Loop Gain [0-10 kohm]
0.000 [ohm]
Control Loop Gain [0-10 kohm]
1992.187 [ohm]
PLL Tun Range L [0-53 800 ohm]
0.000 [ohm]
PLL Tun Range H [0-50 000 ohm]
25000.000 [ohm]
Load Default Parameters
Save Values as Default
Load Default Parameters
Save Values as Default
Sending Gunn/PLL data
Environmental Data
Enable Environmental Data
Supply Current [A]: 0.00
Temperature 1 [C]: 0.00
Temperature 2 [C]: 0.00
Temperature 3 [C]: 0.00
Plot temp. data
Interval [s]
Temperature 4 [C]: 0.00
Logg temps to file: 60
Temperature 5 [C]: 0.00
Path:
Temperature 6 [C]: 0.00
STOP

Default Values of Control Variables

1. Sig. Attenuator:	20 dB
2. Ref. Attenuator:	20 dB
3. Synthesizer Frequency:	
a. High Band	9445 MHz
b. Low Band	8755 MHz
4. Drive_Enable	Low
5. Loop_Enable	Low
6. High band Gunn_Loop_Gain	1992.19 Ohm
7. Low band Gunn_Loop_Gain	1992.19 Ohm
8. High band Gunn_Tune_Range	19921.88 Ohm
9. Low band Gunn_Tune_Range	50000 Ohm
10. High band Nominal_Voltage	9.2 V
11. Low band Nominal_Voltage	9.09 V
12. Gunn_Select	Low

To lock the high band Gunn, do the following:

1. Set_Synth_Frequency to 9445 MHz.
2. Set_Gunn_Select to Gunn_H which is 0.
3. Set_Drive_Enable to high.
4. Set_Nominal_Voltage to 9.365V.
5. Set_Gunn_Loop_Gain to 1992.187 ohm.
6. Set_Gunn_Tune_Range to 19921.875 ohm.
7. Set_loop_enable to high to close the loop.

To lock the Low band Gunn, do the following:

1. Set_Synth_Frequency to 8755 MHz.
2. Set_Gunn_Select to Gunn_L which is 1.
3. Set_Drive_Enable to high.
4. Set_Nominal_Voltage to 9.097V.
5. Set_Gunn_Loop_Gain to 1992.187 ohm.
6. Set_Gunn_Tune_Range to 50000 ohm.
7. Set_loop_enable to high to close the loop.

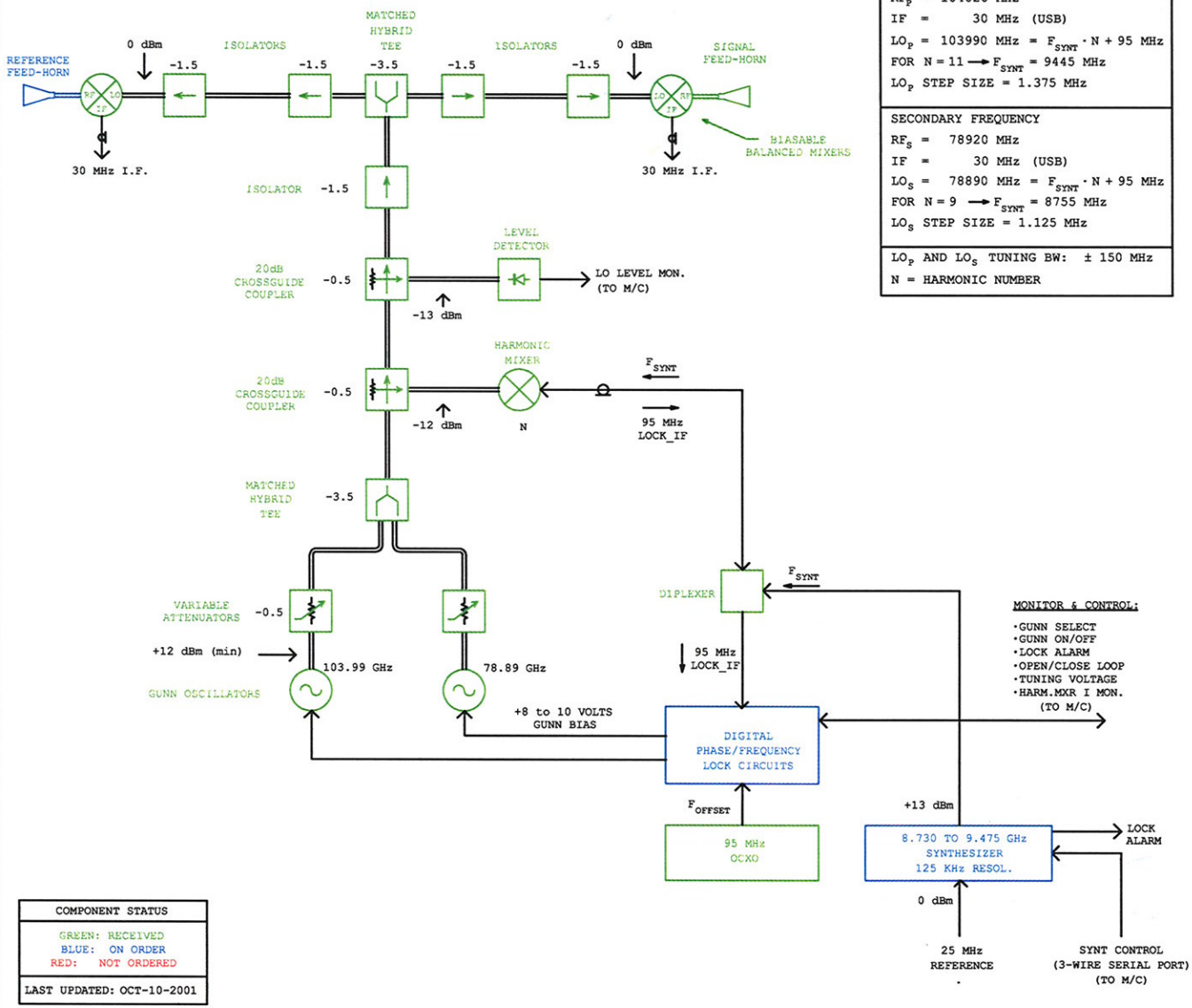
Note 1 Dynamic range is measured with V_{P-P} at the A/D converter set at 20 V as the maximum. With the signal turned off, the noise floor is measured. 100 samples-averaging is used. RR and SS from the DSP are used as the measuring parameters.

Note 2 Signal-to-Ref-Channel isolation is measured by injecting a sinewave at the input of Sig. channel. The isolation is the ratio of the output power of injected sinewave at the Sig_15kHz_I port to that of the sinewave at Ref_15kHz_I. Ref-to-Signal-Channel isolation is measured by injecting a sinewave at the input of Ref. channel. The isolation is the ratio of the output power of injected sinewave at the Ref_15kHz_I port to that of the sinewave at Sig_15kHz_I.

Ref. Channel and Sig. Channel Isolation

The isolation from Ref. to Sig. channel is defined as the ratio of signal power at Ref_30 kHz_I to that of Sig_30kHz_I. Signal is transmitted into to the Ref. channel input. The Ref. step attenuator is adjusted so that the signal is 20V peak-to-peak at the A/D input and the Sig. step attenuator is set at 0 dB.

The isolation from Sig.. to Ref. channel is defined as the ratio of signal power at Sig_30 kHz_I to that of Ref_30kHz_I. Signal is transmitted into to the Sig. channel input. The Sig. step attenuator is adjusted so that the signal is 20V peak-to-peak at the A/D input and the Ref. step attenuator is set at 0 dB.



HOLOGRAPHY FREQUENCIES
PRIMARY FREQUENCY
RF_P = 104020 MHz
IF = 30 MHz (USB)
LO_P = 103990 MHz = $F_{SYNT} \cdot N + 95$ MHz
FOR N = 11 → F_{SYNT} = 9445 MHz
LO_P STEP SIZE = 1.375 MHz
SECONDARY FREQUENCY
RF_S = 78920 MHz
IF = 30 MHz (USB)
LO_S = 78890 MHz = $F_{SYNT} \cdot N + 95$ MHz
FOR N = 9 → F_{SYNT} = 8755 MHz
LO_S STEP SIZE = 1.125 MHz
LO_P AND LO_S TUNING BW: ± 150 MHz
N = HARMONIC NUMBER

COMPONENT STATUS
GREEN: RECEIVED
BLUE: ON ORDER
RED: NOT ORDERED
LAST UPDATED: OCT-10-2001

alma_holorx_lo_rev-c_color.dwg

NATIONAL RADIO ASTRONOMY OBSERVATORY - ALMA/TUCSON		
Title: HOLOGRAPHY RECEIVER LOCAL OSCILLATOR BLOCK DIAGRAM		
Size: B	Document Number: ALMA09003SXXXX	Rev.: C
Date: July 24, 2001	Sheet 1 of 1	Drawn by: A. Perfetto

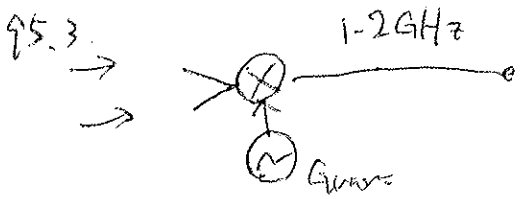
OSC. LOCKED TO SAME REF. ?

FREQ. NOT TUNED
CORRECTIVE FOR
95.3

BANDWIDTH (NARROW)

USB / LSB

Bw
1-2 GHz



10mw

94.18 GHz

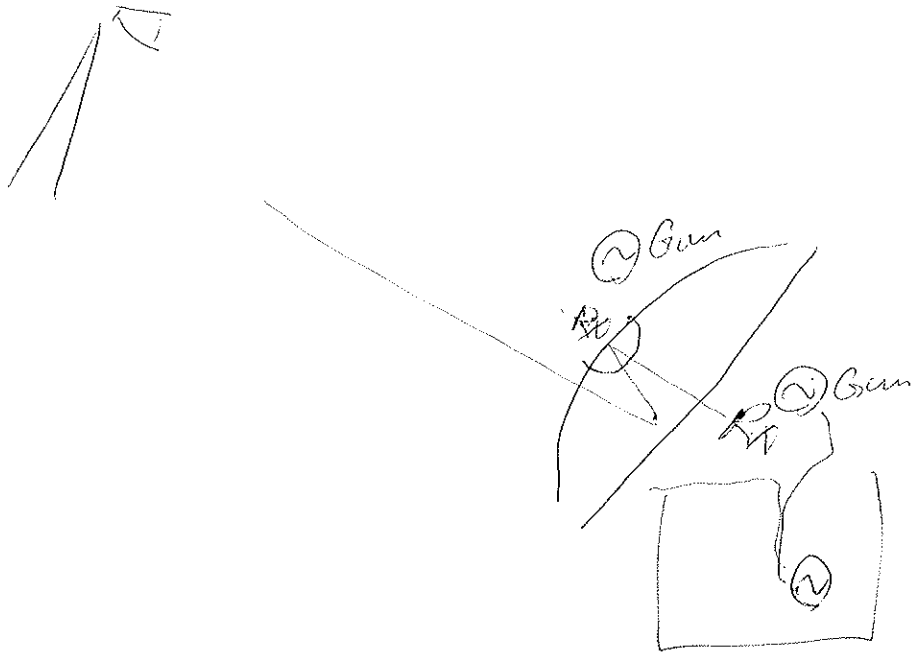
USB
95.3 94.8 - 95.8

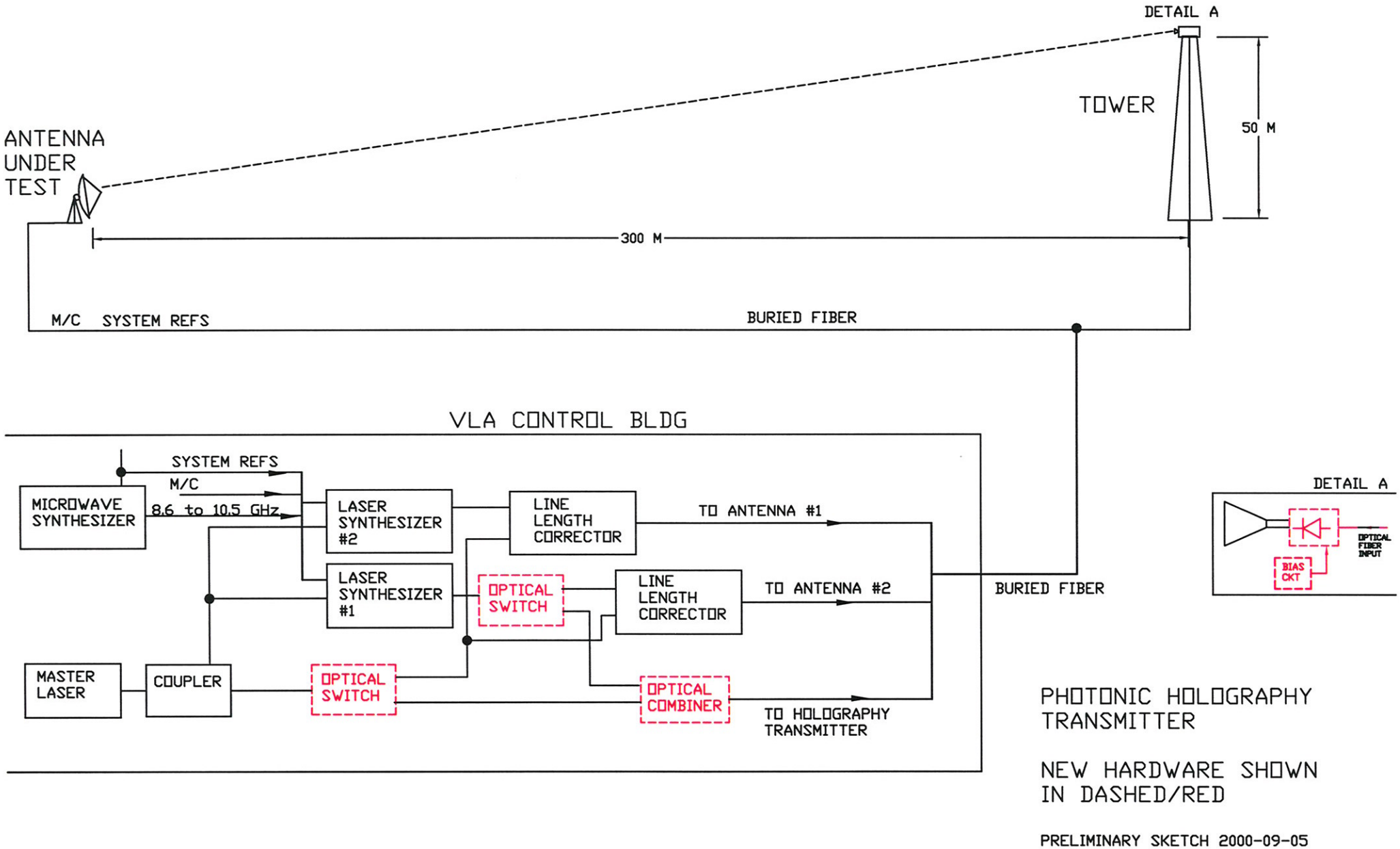
LSB
93

TX Bw

CF < 1HZ

PHASE LOCKED
& NOISE SIDEBANDS





PHOTONIC HOLOGRAPHY TRANSMITTER

NEW HARDWARE SHOWN IN DASHED/RED

PRELIMINARY SKETCH 2000-09-05