EDTN Memo 232

40 ft LO upgrade

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Introduction

Over the life of the 40-foot, the electronics division has supplied synthesizers for the receiver system. These are typically older models with frequency range of a few giga-hertz. The system observes the HI line, frequency 1420.405752 MHz, by lower side LO injection of the first mixer to produce an IF at approximately 100 MHz. A second fixed LO down then converts the IF to a baseband frequency of 10.7 MHz, the center frequency of narrow band crystal filters that follow. The baseband is then square law detected and amplified for display on a chart recorder. With the aging and ultimately failure of synthesizers, a design using the demonstration board for the Texas Instrument chip, LMX2571, is constructed. This board is capable of producing the frequency for the first LO; however, tuning the frequency is awkward and better suited for the fixed second LO. Setting the registers for the proper frequency, requires a software interface over a USB port. All the components are included with the purchase of the demo board. The application TICSPRO-SW for programming the chip is downloaded and installed on the laptop.[1] A screen shot of the setup is shown in Figure 1. Since the chip is capable of synthesizer frequencies up to 1340 MHz, the potential for RFI generation is high; therefore, all the components are housed in an RFI enclosure that includes a USB-2.0 RFI filter.

LO Design

As shown in the block diagram of Figure 2, an external Vectron crystal oscillator of 100 MHz supplies the reference frequency. The LMX2571EVM is modified so that the internal 20 MHz is not used, an option described in the user's guide.[1] The 100 MHz crystal oscillator has much better phase noise characteristics which lowers the phase noise of the 110.7 MHz output and reduces other spurious content. With the crystal as reference, the chip can be programmed to produce the first LO frequency of ~ 1320 MHz, but as shown in Figure 1 there are 7 parameters that are adjusted to set the frequency making step wise tuning awkward. Following the chip output is a filter, amplifier, and two attenuators configured to reduce the harmonic content and set the output level. Currently the output is set a + 6 dBm, but can be either increased or decreased by changing the attenuators if more LO drive is required. The amplifier has a 1 dB compression point at +16 dBm that sets the maximum power output. Increasing the output above + 6 dBm increases the harmonic content. Since this drives a nonlinear device, the mixer, the harmonic content will not degrade the performance of the receiver.

Anechoic Chamber Tests.

With the potential for RFI, the complete device without the laptop, was subjected to anechoic chamber testing to ensure compliance with NRQZ zone 1 requirements. A complete description of the results is available.[2] For the first anechoic measurement the unit had a 3DEI AC RFI filter for the AC input voltage. The device meets the requirement except at two frequencies, 600 MHz by 3 dB, and 1400 MHz by 0.25 dB. By probing the device with a near field antenna, the source of the leakage was confirmed to be through the AC RFI filtered input that was only specified to 30 MHz. This was remedied by replacing the

filter with one with greater attenuation and frequency range. The extended version 3EJTIF has specified attenuation of 40 dB at 600 MHz and 30 dB at 1 GHz, which is sufficient to meet the Zone 1 requirements. The improvements can be seen in Figures 3 and 4.

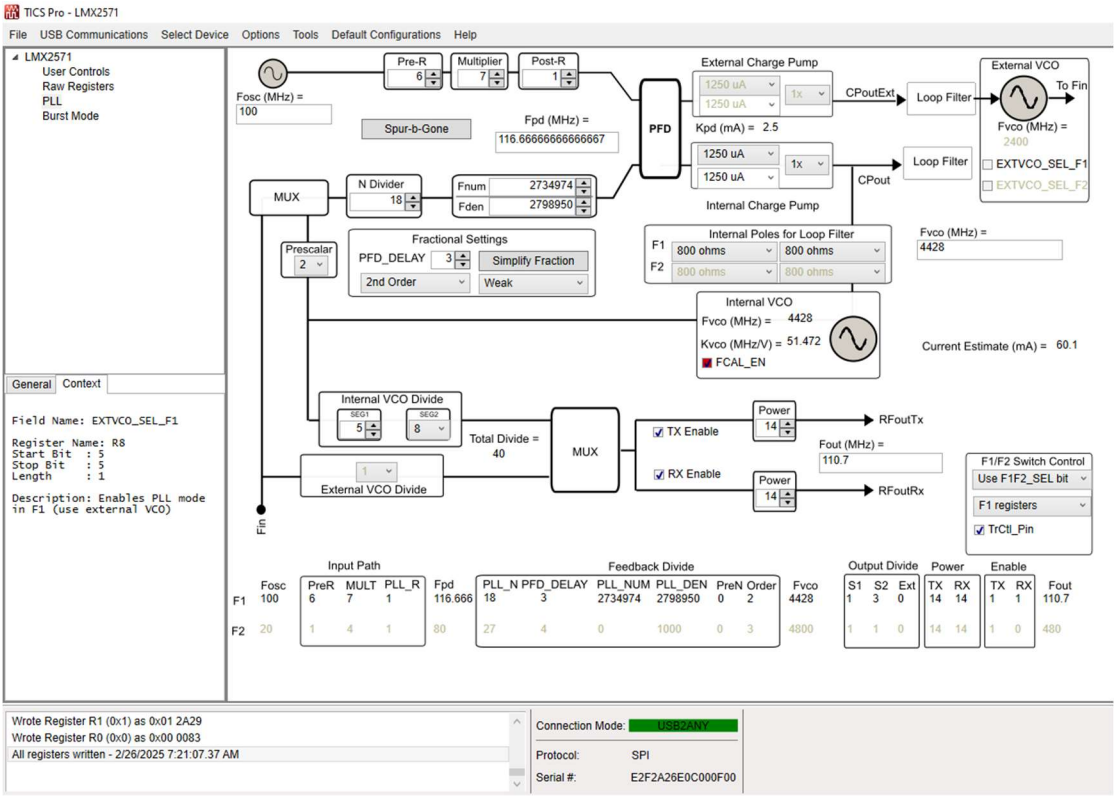

Figure 1 Screen shot of the application software.

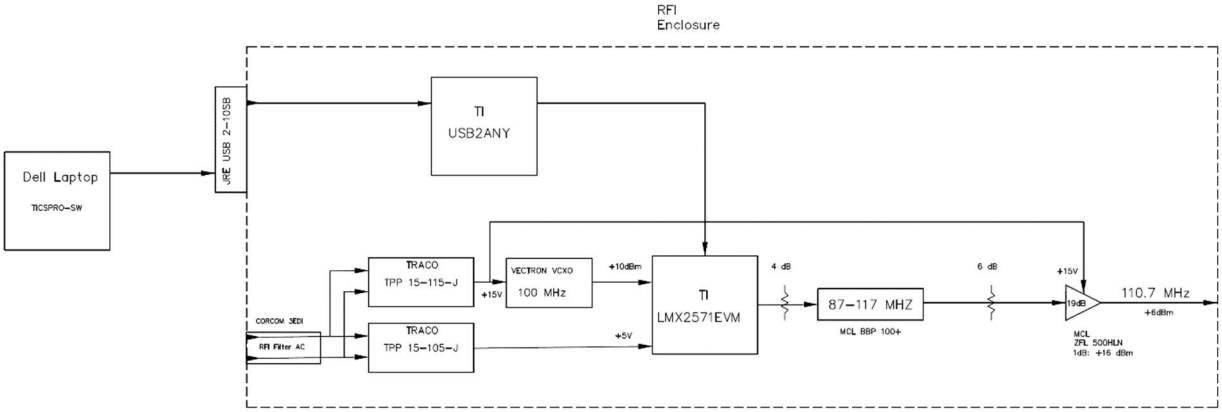

Figure 2 Block Diagram.

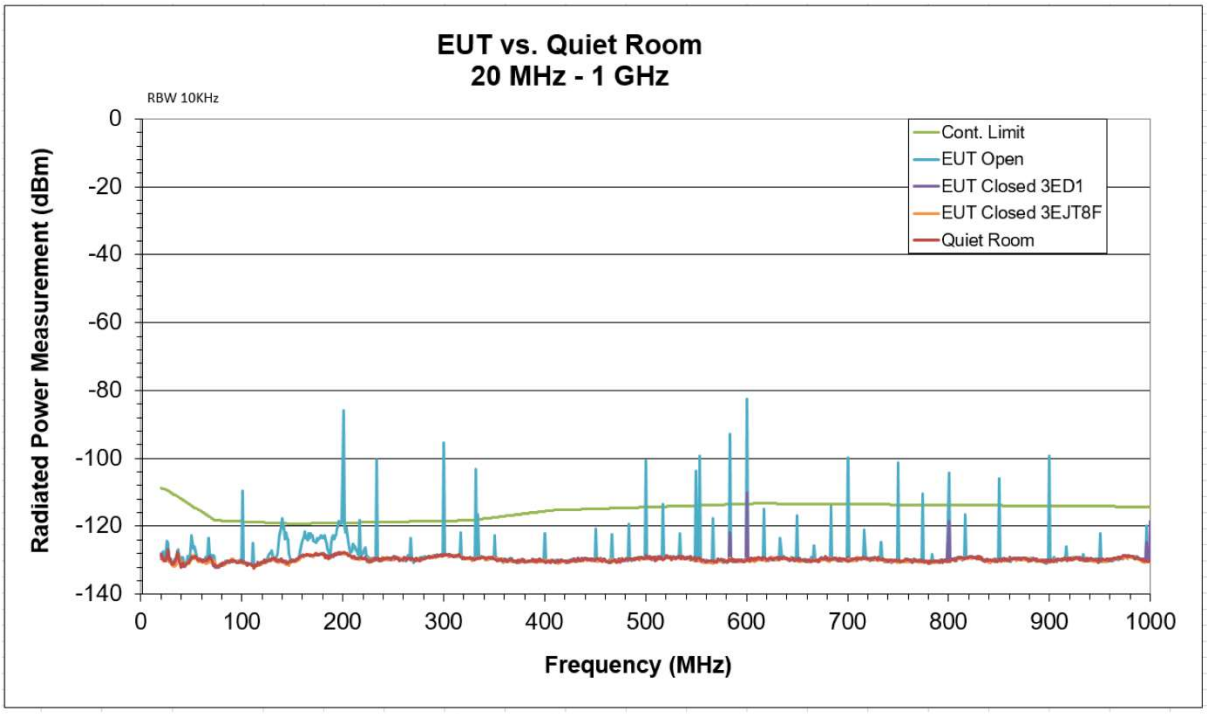

Figure 4: 20 MHz - 1 GHz

Figure 3. RFI Report 0.20-1 GHz EMI Plot.

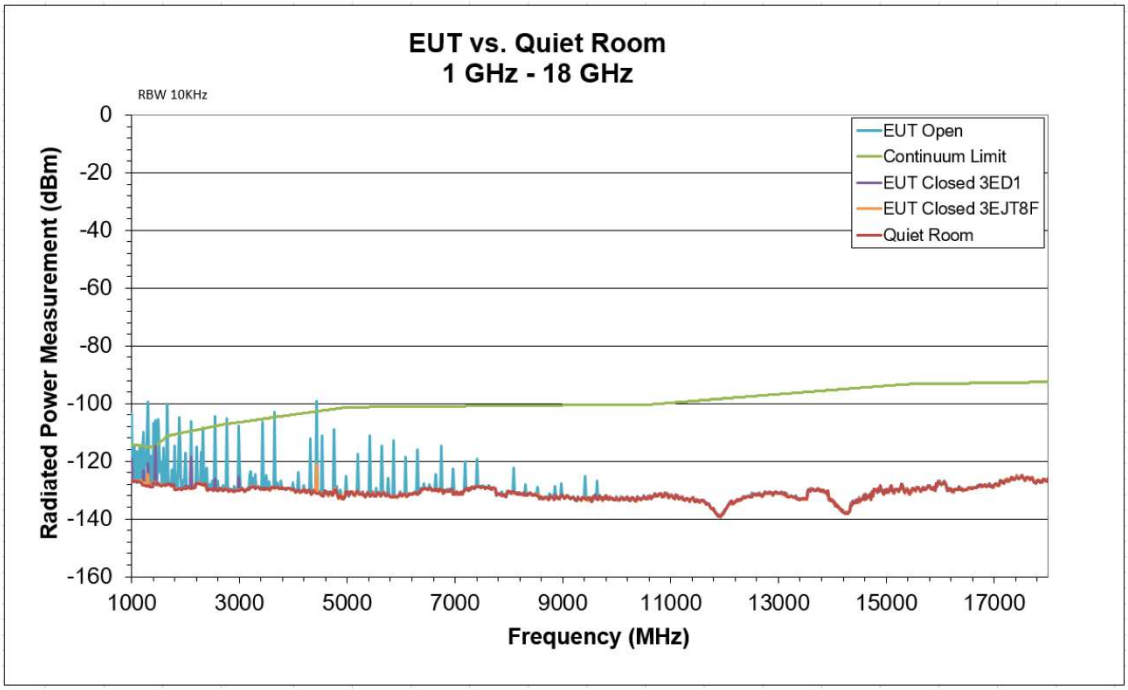

Figure 5: 1 GHz - 18 GHz

Figure 4 RFI Report 1-18 GHz EMI Plot.

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LO Setup Procedure

1. Power up labtop, ‘deimos’, and connect to LO module with USB cable.
2. Start application TICSPRO. The app can be found by executing Microsoft “Start” command to show the “Texas Instrument” folder .
3. If necessary load the file 40_100M_110P7.tcs. The display should be as shown in Figure 1.
4. The Connection Mode: USB2ANY should be green; however, the registers need to be set.
5. Under the tap USB Communications select the write command.
6. The panel to the left should show the values written in Wrote Registers and a time stamp when all registers where written.
7. A green LED on the board lights when the phase loop is locked. The cover has to be removed to inspect.
8. After the parameters are loaded, the laptop does not have to remain connected to the device.

Figure 5. LXM2571EVM locked with green LED on.

Figure 6. Photograph of the LO module with and without cover.[2]

	Vendor	Nomenclature	Part Number	Cost	Qty	Total
1	LMX2571EVM	Synthesizer Eval Board	LMX2571EVM	249.00	1	249
2		USB Interface	USB2ANY	0	1	0
3	Vectron	VCXO	233-9516	Surplus	1	0
4	MCL	BPF	BBP-100+	39.95	1	39.95
5		Amplifier	ZFL 500HLN	109.00	1	109.00
6	JRE	USB 2.0 High Speed Filtered Interface	USB 2-1 USB 2.0	369	1	369.00
7	Traco	+ 5 Volt PS	TPP-15-105-J	46.60	1	46.60
8		+ 15 Volt PS	TPP-15-115-J	46.60	1	46.60
9	Bud	RFI Enclosure	ANS-3811	70.00	1	70.00
10	Corcom	AC RFI Filter	3EJTIF	28.00	1	28.00
11		Attenuators	3 and 6 dB	Surplus	2	0
	Total					864.95

Table 1. Parts List and Costs.

	Reference	Nomenclature	Description
1	LMX2571EVM	TI Website	Website for Evaluation Board and software download
2	Anechoic Document	RFI Results	A detailed report on RFI testing. \\gbfiler\doc\IPG\AnechoicChamberTesting\RF
3	Archived Documents	Network Directory	Folder that contains all the archived drawings \\gbfiler\doc\Archive\GBO Electronics\300009 40ft

Table 2. References.

40 ft Test Observations

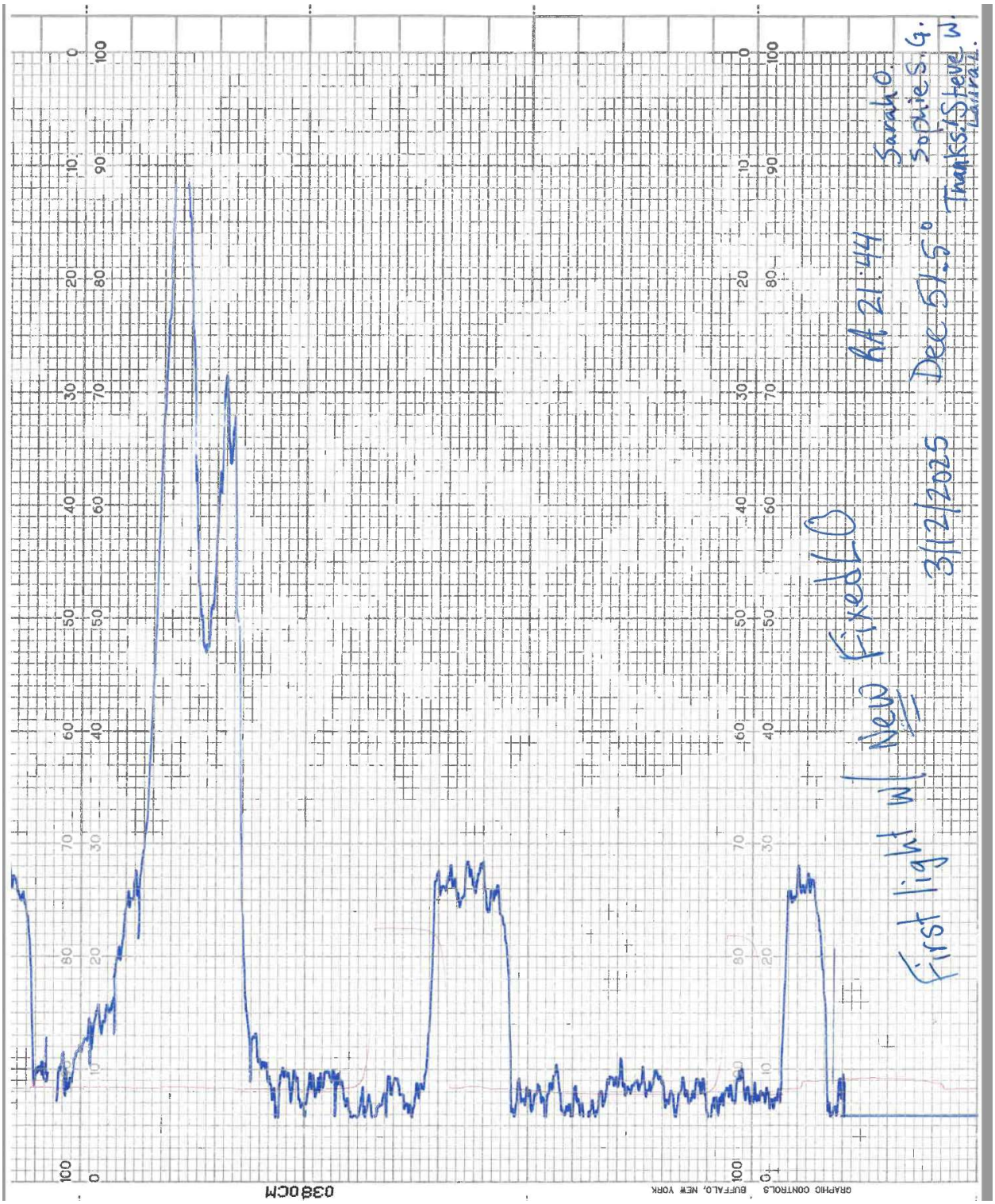

Figure 7. 40 ft chart recorder graph with TI LXM2571EVM as second LO source. Note: This one has higher amplitude resulting from more LO power.

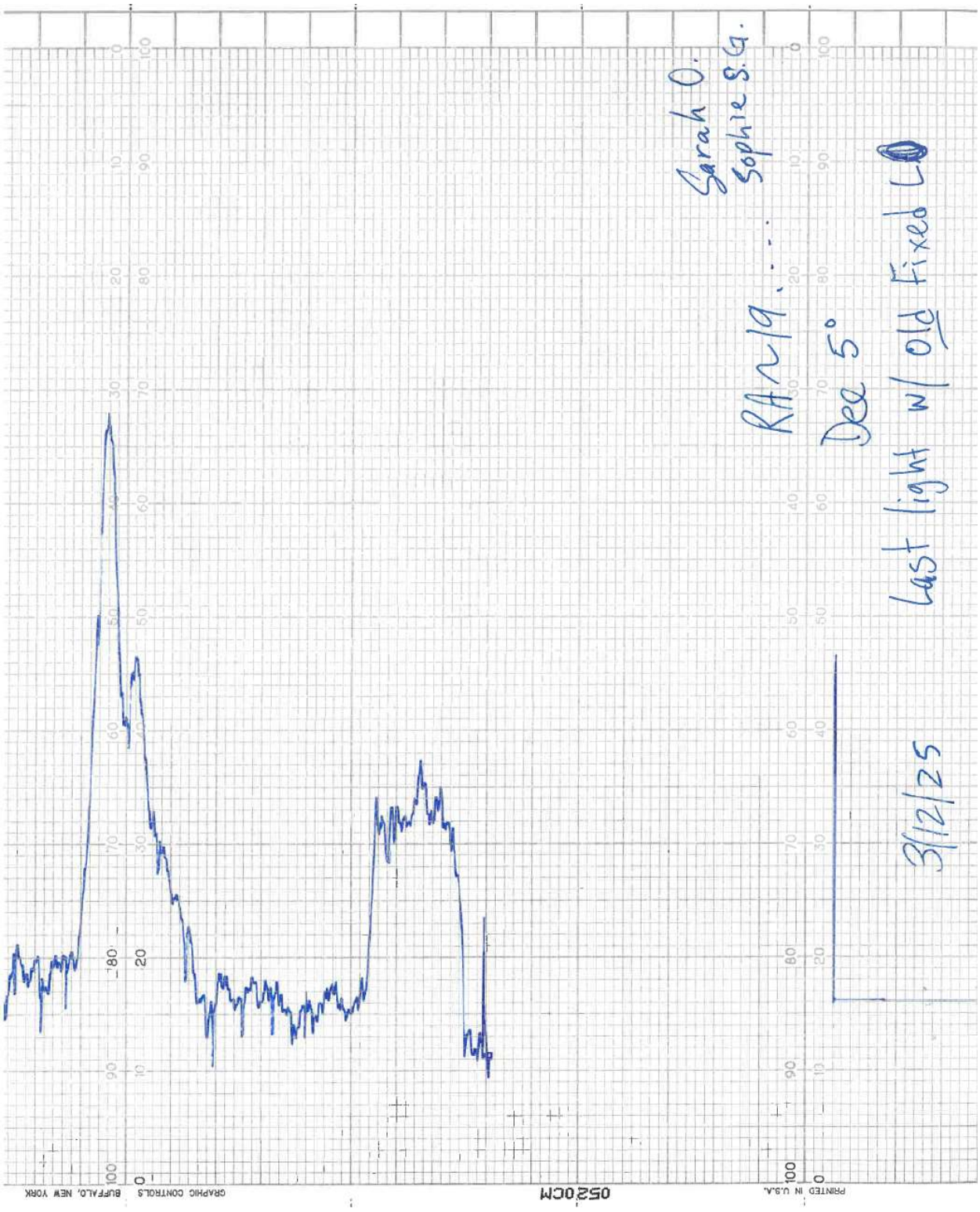

Figure 8. 40 ft chart recorder graph with HP synthesizer(original) as second LO source.