RF TECHNOLOGY, INC.

INTRODUCTION

The UCL-130T is an all solid-state, line-of-sight, frequency modulated transmitter operating in the 12.7 to 13.25 GHz frequency band under Parts 74, 78 and 101 of the FCC Rules and Regulations with a power output of 2 Watts and a frequency stability of .005%. The emission designator being requested is 25M0F8W.

GENERAL DESCRIPTION

The baseband input signal and internal audio subcarrier signals frequency modulate a voltage controlled oscillator that is phased locked to a crystal reference oscillator. This frequency modulated signal is then fed through two mixing processes where the signal is upconverted to the desired channel frequency. The two local oscillator signals are produced by a phase locked oscillator and a frequency agile synthesizer both of which are phase locked to crystal reference oscillators.

Two audio subcarrier frequencies are generated and are phased locked to a crystal reference oscillator.

If either the synthesizer or the phased locked oscillator were to unlock from the reference oscillator an alarm would be generated and the SHF amplifier would be muted; thus preventing any out-of-channel radiation.

LED's are provided on the front panel to indicate the status of the transmitter.

The input power requirements are 120/240 VAC, 50/60 Hz or 10 TO 20 VDC (floating earth).

TECHNICAL DESCRIPTION

A technical description and photographs of the transmitter are contained in the manual.

MEASUREMENT DATA

In order to demonstrate compliance to the FCC Rules and Regulations, measurement data per paragraphs 2.985, 2.987, 2.989, 2.991, 2.993 and 2.995 were taken. The results of these measurements show that the equipment meets or exceeds all requirements of Parts 74, 78 and 101.

SPURIOUS EMISSION AT ANTENNA TERMINAL (Para. 2.991)
The antenna conducted spurious emission test set-up is shown in Figure 1. The analyzer was first tuned for a reference carrier level at the fundamental operating frequency. The output spectrum was viewed from 50 MHz to 26GHz. Special attention was given to those frequencies which corresponded to possible harmonics and sub-harmonics.

The FCC limit for antenna conducted spurious emission is 43+10LOG P below the main carrier. For the UCL-130T with P = 1.6 W (+32dBm), this corresponds to 45dB below the main carrier, or a level of -13dBm. No signals were detected within 20dB of the FCC limit and therefore, the transmitter meets the requirements set forth in Paragraph 74.637, 78.103 and 101.111.

FIELD STRENGTH OF SPURIOUS RADIATION (Para. 2.993)
Case radiation spurious emission test set-up is shown in Figures 2 and 3. Observations were made at three meters from the transmitter in all planes of polarization. The output spectrum, as received at three meters, was viewed from 50MHz to 26GHz. Special attention was given to those frequencies which corresponded to possible harmonics and sub-harmonics.

The FCC requires case radiated signals to be attenuated by a factor of 43+LOG P or 43+10 LOG 1.6 = 45dB. No case radiated signals were detected within 20dB of the FCC limit and therefore the transmitter meets the requirements set forth in Paragraph 74.637, 78.103 and 101.111.

MODULATION CHARACTERISTICS (Para. 2.987)
To measure the modulation characteristics, a signal generator with an output of 1V P-P was connected to the input of the transmitter, as shown in Figure 4. The frequency of the signal generator was varied and recorded at various bessel nulls. The deviation was then calculated for each frequency using the formula.

$$B = \frac{\Delta F}{fm}$$

ΔF = Peak Frequency Deviation (MHz)
fm = Modulation Frequency (MHz)
B = Modulation Index

Since the FM spectrum is determined by bessel functions of the first kind, as a function of B, it is possible to infer deviation from observed nulls of certain spectral components of the transmitter output. Specifically the central carrier nulls when B = 2.41, 5.51 and 8.65. The first side band components nulls when B = 3.83, 7.02 and 10.17.

fm (MHz)	B	F (MHz)
2.275	2.41	5.48
0.338	3.83	1.29
0.206	5.51	1.13
0.154	7.02	1.08
0.124	8.65	1.07
0.105	10.17	1.07

No modulation limiting is p resent over the frequency range and voltage for which the equipment is specified.

OCCUPIED BANDWIDTH (2.989)
To measure the occupied bandwidth, the transmitter was modulated by a multiburst signal, shown in Figure 5, and the audio subcarrier was modulated by a 1KHz sinewave, which produced the spectrum output shown in Figure 6. Since the spectrum is symmetrical, about Fo, calculations were performed on one-half of the spectrum and then doubled to find the occupied bandwidth. A reference level was set at Fo and amplitude readings were taken every 0.5 MHz from Fo to Fo=12 MHz. The readings were then converted to a linear scale and the total power was calculated using Simpson's Rules of Numerical Integration. The total power was then multiplied by 99.5% to obtain the 0.5% power point. Calculations were then performed to find the frequency that corresponds to the 0.5% power point. From these calculations the occupied bandwidth was determined to be 11.6MHz.

FREQUENCY STABILITY AND RF POWER OUTPUT (Para. 2.995 & 2.985)
Measurements were made to determine the transmitter stability and power output versus the temperature range of -30 deg. to +50 deg. C. The equipment was connected as shown in Figure 7 and the temperature was varied by maximum steps of 10 deg. C. At each temperature setting, the transmitter was allowed to stabilize for a minimum of 30 minuets. The test data as listed in Table 1, shows a maximum frequency change of 0.080MHz (0.00061%).

Measurements were made to determine transmitter frequency stability versus primary supply variation of 85% to 115% of the nominal 120VAC primary power and the DC input voltage range of 12VDC to 20VDC. The equipment was connected as shown in Figure 8. The test data is listed in Table 1 which shows no frequency change.

The transmitter therefore is within the requirements set forth in Paragraph 74.661, 78.111 and 101.107.

NECESSARY BANDWIDTH (Para. 2.202b)
The necessary bandwidth for the video signal and simultaneous transmission of audio was determined by the formula Bn = 2M+2DK.

Where: Bn = Necessary Bandwidth
M = The video bandwidth and the FM subcarrier deviation.
D = Half the difference between the maximum and minimum values of the
instantaneous frequency when modulated by the visual signal.
Plus half
the difference between the maximum and minimum values of the instantaneous frequency.
K = 1

The audio subcarrier is 18dB below the visual signal. It, therefore, causes the instantaneous frequency to vary 0.125 times the visual signal deviation.

TV Microwave Relay System

Aural Program on 7.92 MHz, Aural subcarrier deviation +75 KHz.

D = 4.0MHz (visual) + 0.5MHz (audio subcarrier)
M = 7.92 MHz + 0.75MHz

Bn = 2M + 2DK
Bn = 2(7.995MHz) + 2(4.5MHz)
Bn = 15.99MHz + 9MHz
Bn = 24.99MHz

Therefore, designation of emission is 25M0F8W

RF TECHNOLOGY, INC.

ENGINEERING CERTIFICATION

It is hereby certified that the Type Acceptance Tests on RF Technology's UCL-130T Microwave Transmitter were performed according to acceptable measurement procedures and that all the data submitted in this report is true and correct to the best of my knowledge and belief.

John Timm

Technical Sales Manager

QUALIFICATIONS

Mr. Timm has been employed by RF Technology Inc for 18 years. He received an A. A. S. degree from Norwalk State Technical College in 1971. He has been in the Engineering Department and has worked on the development and testing of equipment that has been submitted to the FCC for approval.

PRODUCTION

RF Technology Inc. is planning a quantity production of the UCL-130T Transmitter.

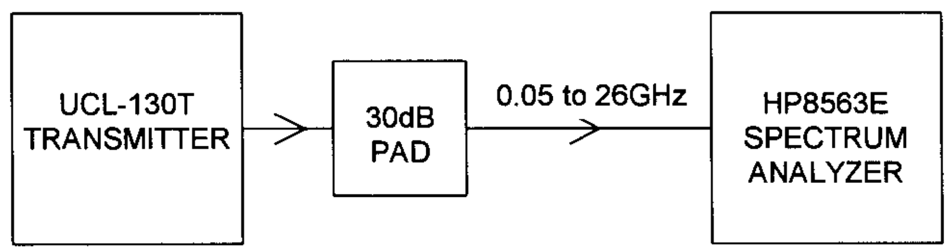

FIGURE 1 - SPURIOUS EMISSION AT ANTENNA TEST SET-UP

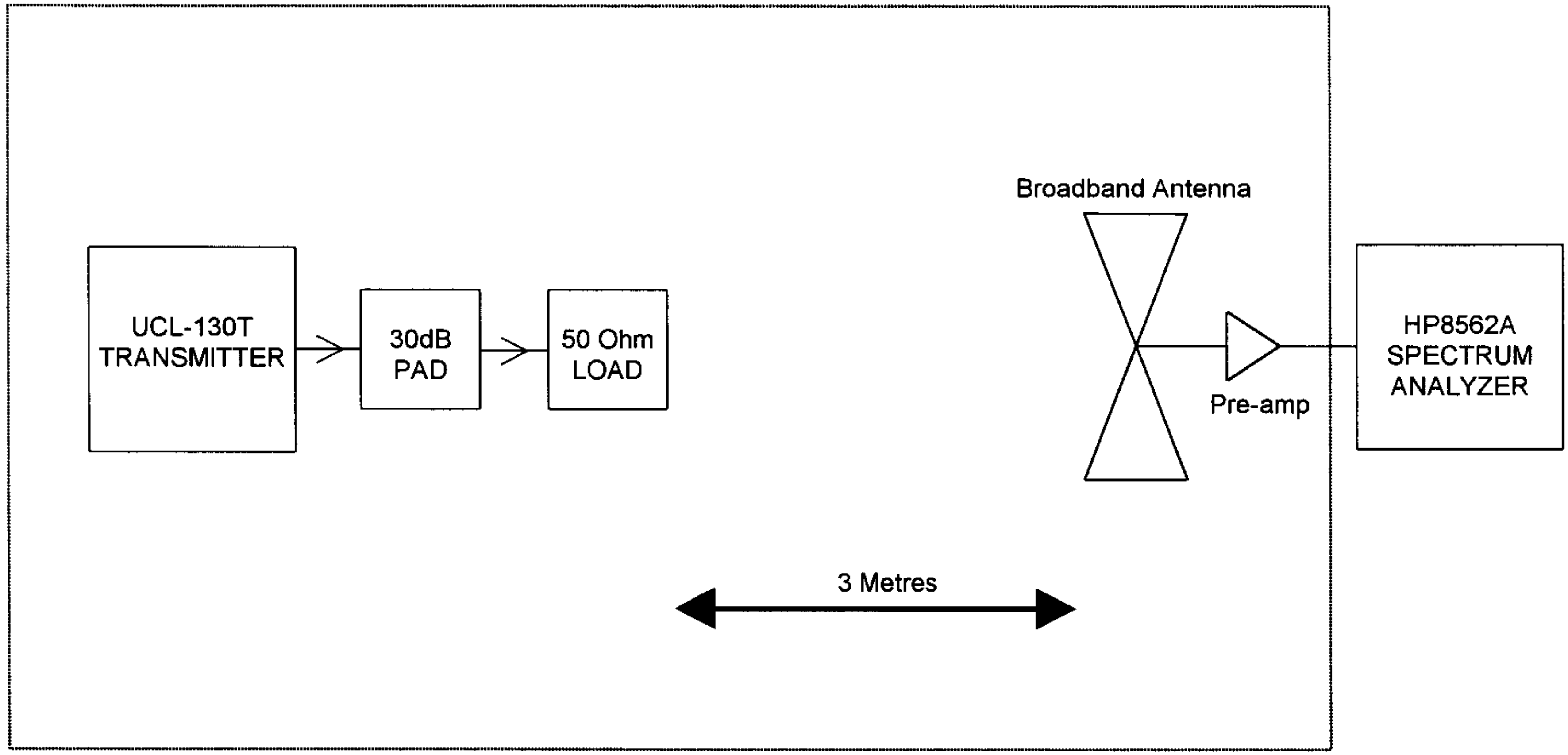

FIGURE 2 - FIELD STRENGTH OF SPURIOUS RADIATION TEST SET-UP 50MHz TO 1GHz

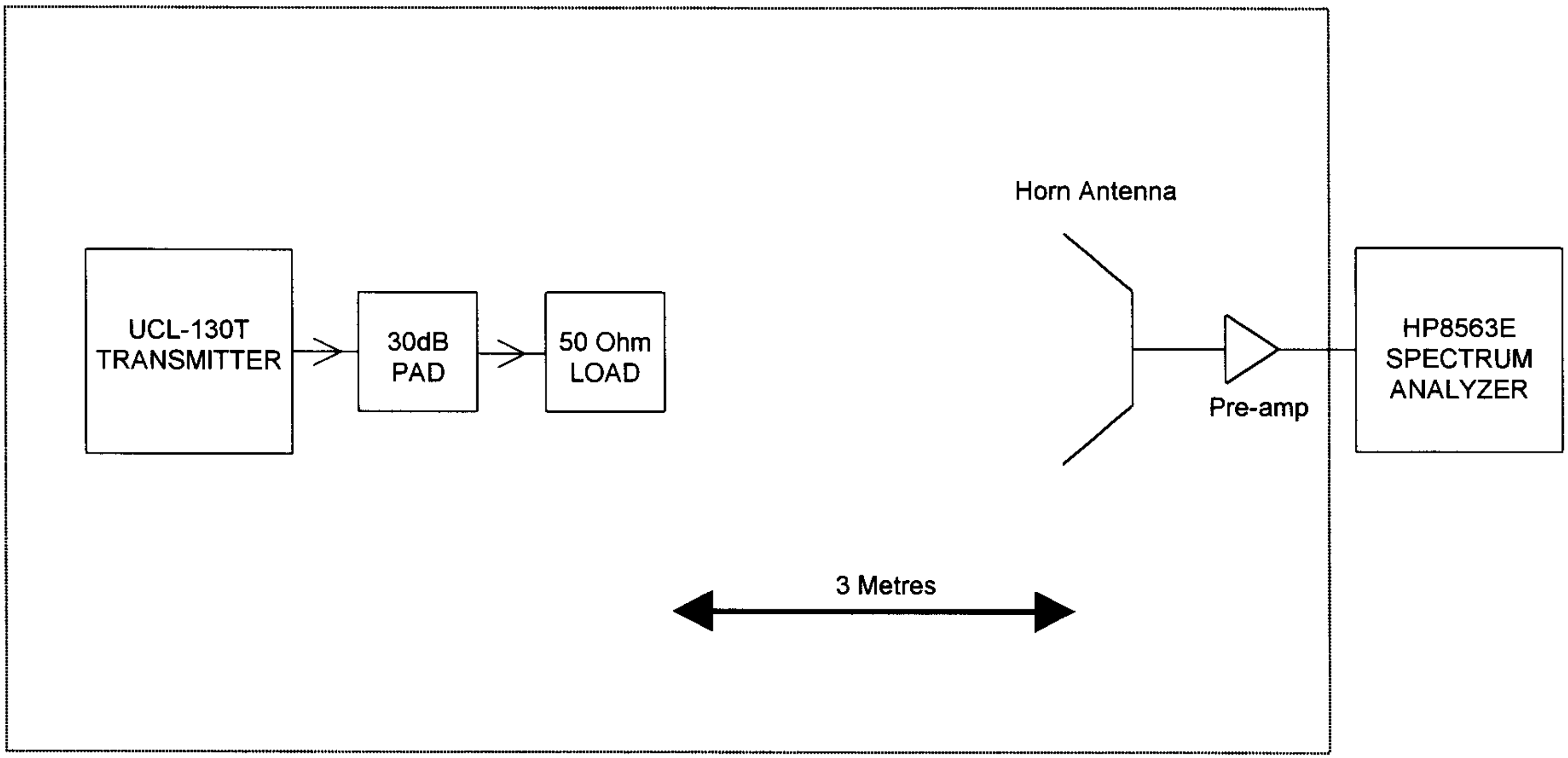

FIGURE 3 - FIELD STRENGTH OF SPURIOUS RADIATION TEST SET-UP 1GHz TO 26GHz

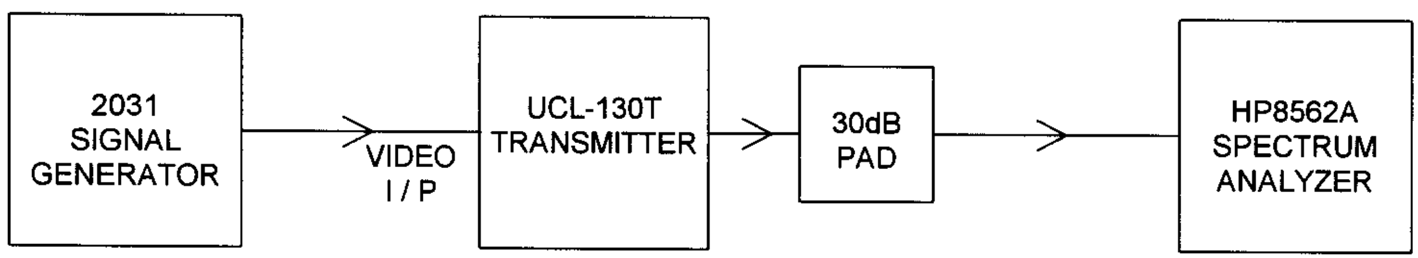

FIGURE 4 - MODULATION CHARACTERISTICS TEST SET-UP

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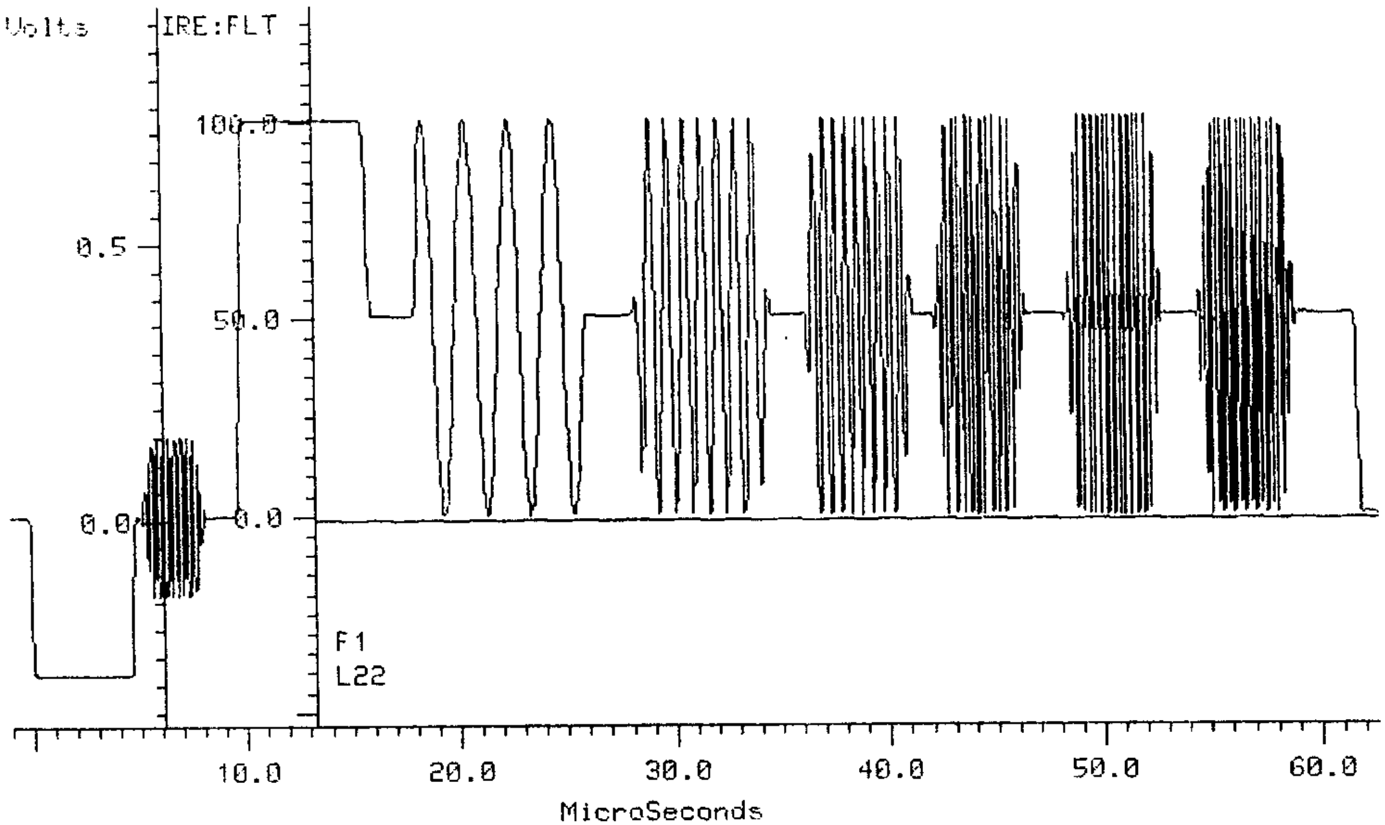
Channel A VIDEO_TEST1 18-Dec-96 10:05:22



APL = 56.1%
525 line NTSC No Filtering
Slow clamp to 0.00 V at 6.63 uS

Precision Mode Off
Synchronous Sync = Source
Frames selected: 1 2

Field Toggle	Field 1 Line 17	Field 1 Line 18	Field 1 Line 19	Field 1 Line 20	Field 1 or 2	Field 3 or 4

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Spectrum output of transmitter when modulated
By multiburst signal and audio subcarrier modulated
By a 1 KHz sinewave

Horizontal Scale: 5 MHz/Div.
Vertical Scale: 10 dB/Div.

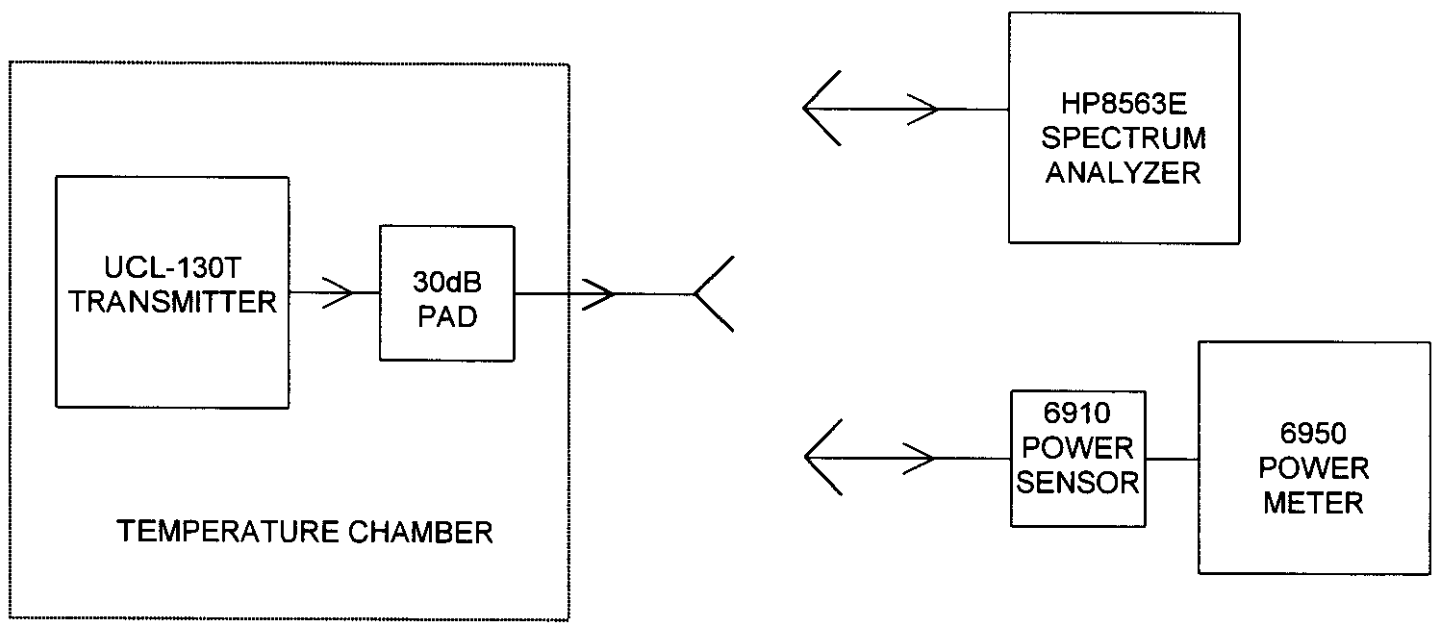

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FIGURE 7 - FREQUENCY STABILITY/ POWER OUTPUT VERSUS TEMPERATURE TEST SET-UP

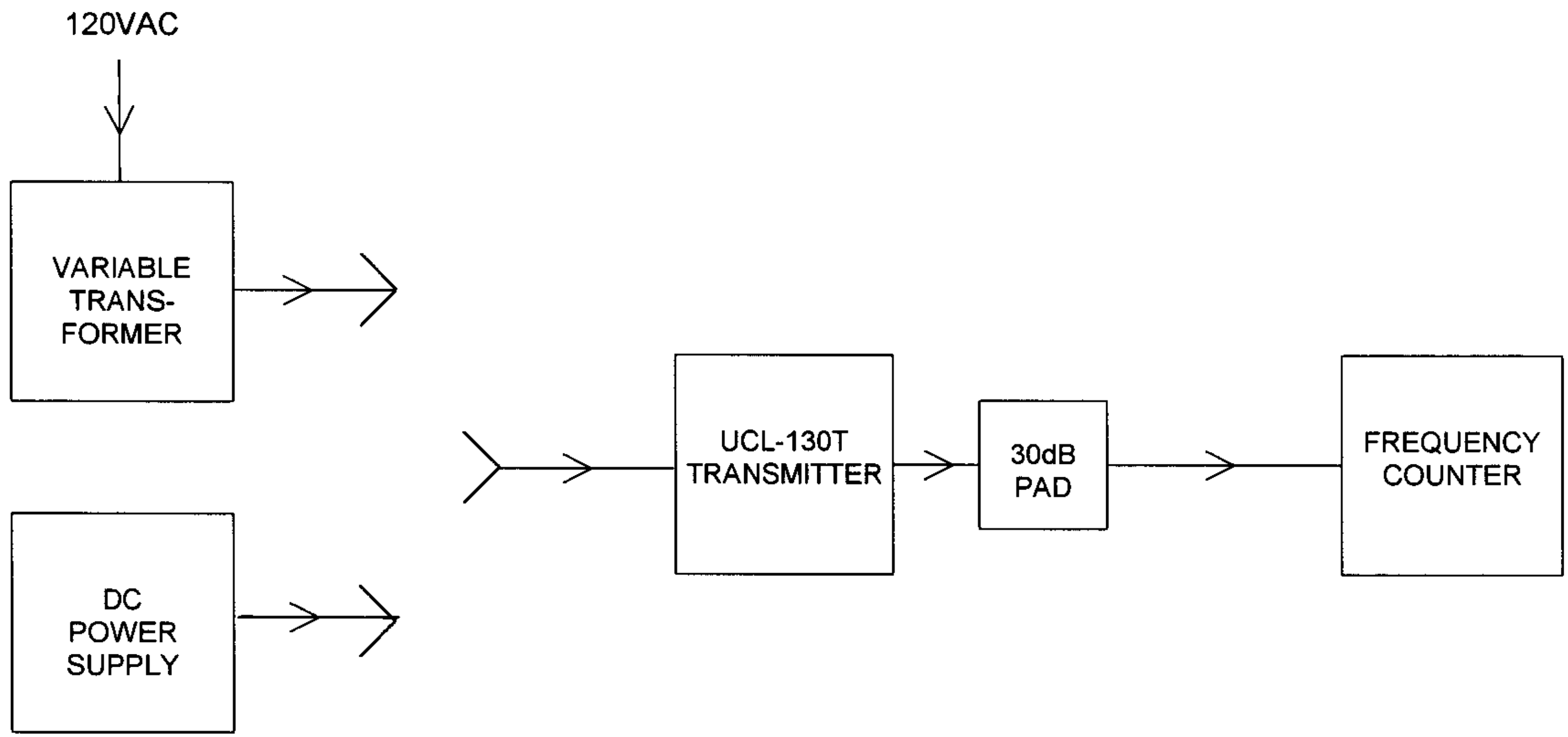

FIGURE 8 - FREQUENCY STABILITY VERSUS PRIMARY POWER TEST SET-UP

TABLE 1

FREQUENCY STABILITY TEST DATA

TEMPERATURE

TEMP °C	TIME	FREQUENCY	ΔFREQUENCY	POWER OUTPUT
+25	8:15am	13012.526MHz	REF	+33.0dBm
+15	8:45	13012.542	+0.016MHz	33.8
+5	9:15	13012.568	+0.042	34.0
-5	9:45	13012.606	+0.080	34.0
-15	10:15	13012.488	-0.038	34.2
-25	10:45	13012.478	-0.048	34.2
-30	11:15	13012.456	-0.070	34.2
+25	8:15am	13012.526MHz	REF	+33.0dBm
+35	8:45	13012.510	-0.016	32.6
+45	9:15	13012.526	-0.000	32.2
+50	9:45	13012.532	+0.006	32.0

PRIMARY POWER

VOLTAGE	VARIATION	FREQUENCY	ΔFREQUENCY
120VAC	REF	13012.544MHz	REF
102VAC	85%	13012.544	0.000
138VAC	115%	13012.544	0.000

VOLTAGE	FREQUENCY	ΔFREQUENCY
12VDC	13012.544MHz	REF
10VDC	13012.544	0.000
20VDC	13012.544	0.000

TABLE 2

TEST EQUIPMENT

The following test equipment was used to perform tests.

DESCRIPTION	MANUFACTURER	MODEL
Spectrum Analyzer	HP	8563E
Spectrum Analyzer	HP	8562A
Power Meter	Marconi	6950
Power Sensor	Marconi	6910
Signal Generator	Marconi	2031
Audio Oscillator	Lindos	LA101
Television Generator	Tektronix	TSG-271
Antenna	Farnell/York	1ESS30280
Antenna	Electro-Magnetic	3115