

4. TEST REPORT

4.1 RF Power Measurements

Figure 4-1 shows the test equipment setup for the RF power measurements.

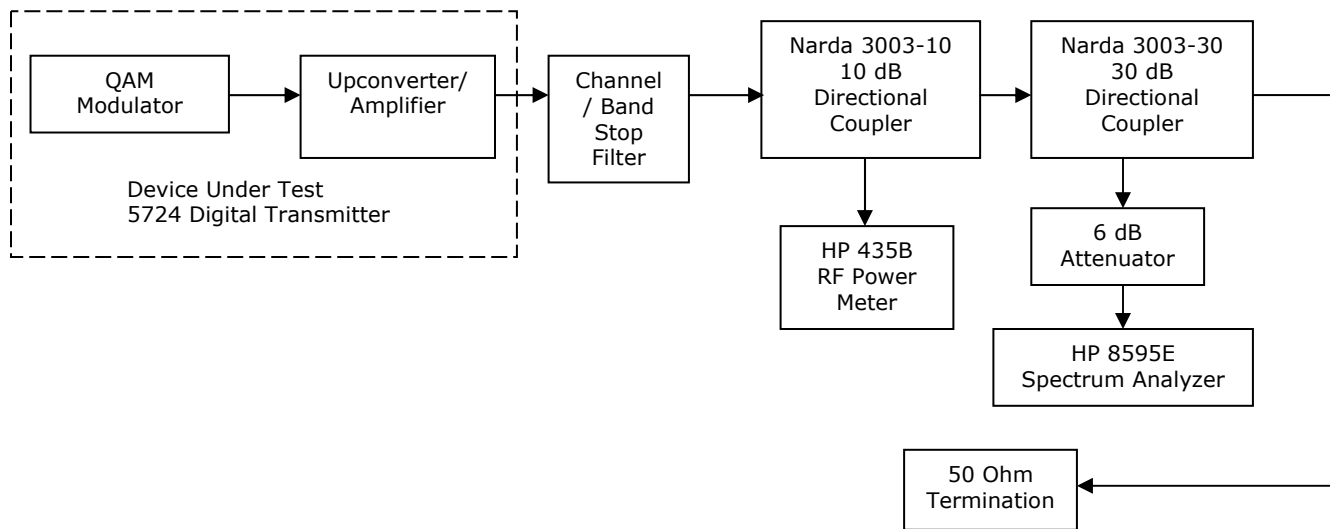


Figure 4-1. Test Equipment Setup for RF Power Measurements

The output power of the 5724 was adjusted to obtain 12 watts average RF output as observed on the power meter.

With the power level properly set to 12 watts average, all required tests were performed and recorded in the following sections.

4.2 Modulation Characteristics

The modulator tray incorporates a modulation technique known as QAM, Quadrature Amplitude Modulation, which uses two carriers, each of the same frequency, but 90° apart in phase. This means that one carrier trails the other by one fourth of a cycle. Each is then phase and amplitude modulated by a portion of the digital input signal. The two modulated signals are then combined and transmitted as a single waveform. The spectrum of a QAM signal is noise-like in appearance and has a relatively stable average power and a widely varying peak-envelope-power (PEP). The power is normally referred to in average power. QAM, used in conjunction with digital compression, provides a high bandwidth efficiency allowing a data rate of 30 MBPS in a 6 MHz channel bandwidth.

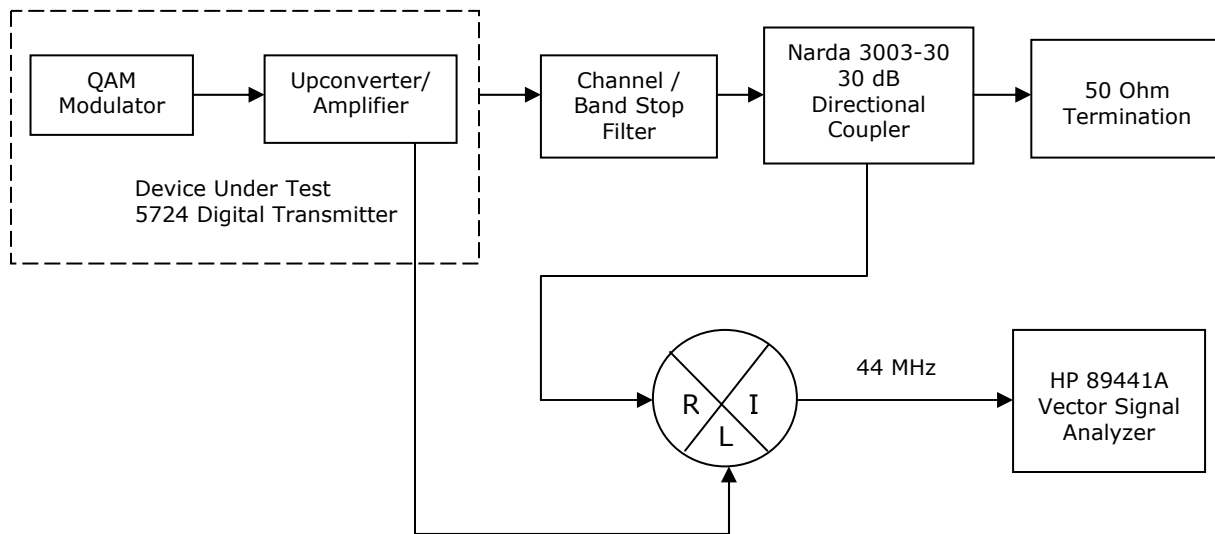


Figure 4-2. Typical QAM Demodulation Test Setup

4.3 Occupied Bandwidth

Using the test setup in Figure 4-4, with the transmitter operating at maximum power, photographs of the transmitter occupied bandwidth spectrum were taken and are shown in Figure 4-5.

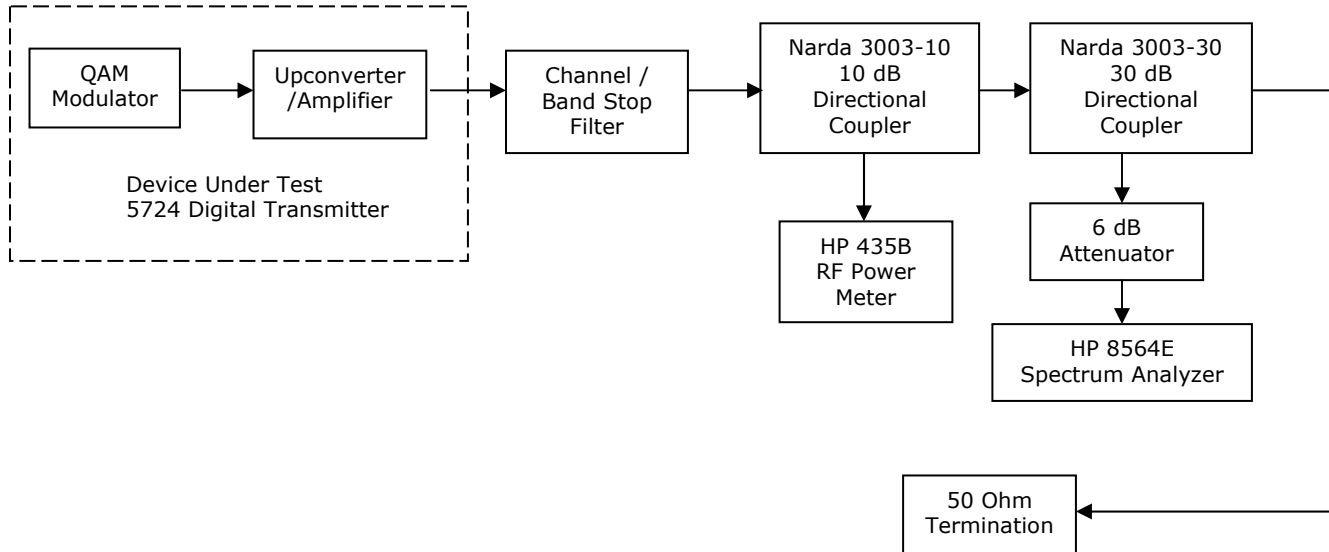


Figure 4-4. Test Setup for Occupied Bandwidth Spectrum Analysis

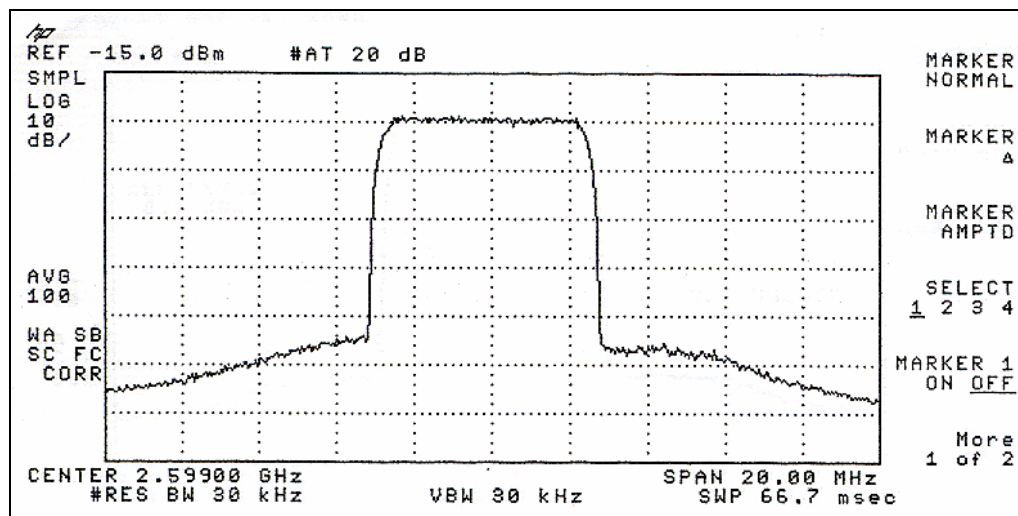


Figure 4-5. Channel Occupied Bandwidth

4.4 Conducted Spurious Emissions

Using the test setup shown in section 4.1, the spectrum outside of the specified channel was observed and the data was taken on all products above the -63 dB noise floor of the spectrum analyzer.

Spurious Emissions were observed on the analyzer at a 1.330 GHz span (see spectrum plots on the following page). With the average in band signal set as the reference, the spurious emissions were observed. The measured data is shown in the table below for 12 watts (average) output power.

This data is shown in Table 4-1 and is presented as graphs in Figure 4-9.

Table 4-1. Products Above the -63 dB Noise Floor of the Spectrum Analyzer

Frequency (MHz)	Source	Peak Level Observed (dB)
2599.00	Center of Channel	0 dB (Reference)
44.00	IF Frequency	None Observed
2643.00	Local Oscillator	None Observed
5198.00	2 nd Harmonic	None Observed
7797.00	3 rd Harmonic	None Observed
10396.00	4 th Harmonic	None Observed
12995.00	5 th Harmonic	None Observed
15594.00	6 th Harmonic	None Observed
18193.00	7 th Harmonic	None Observed
20792.00	8 th Harmonic	None Observed
23391.00	9 th Harmonic	None Observed
25990.00	10 th Harmonic	None Observed

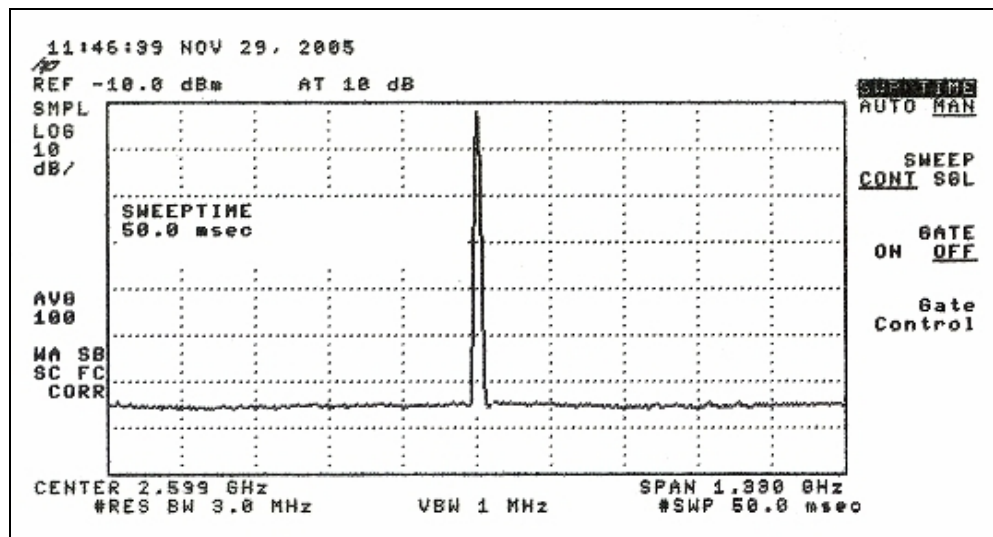


Figure 4-7. Products Above the -63 dB Noise Floor of the Spectrum Analyzer (1.330 GHz Span)

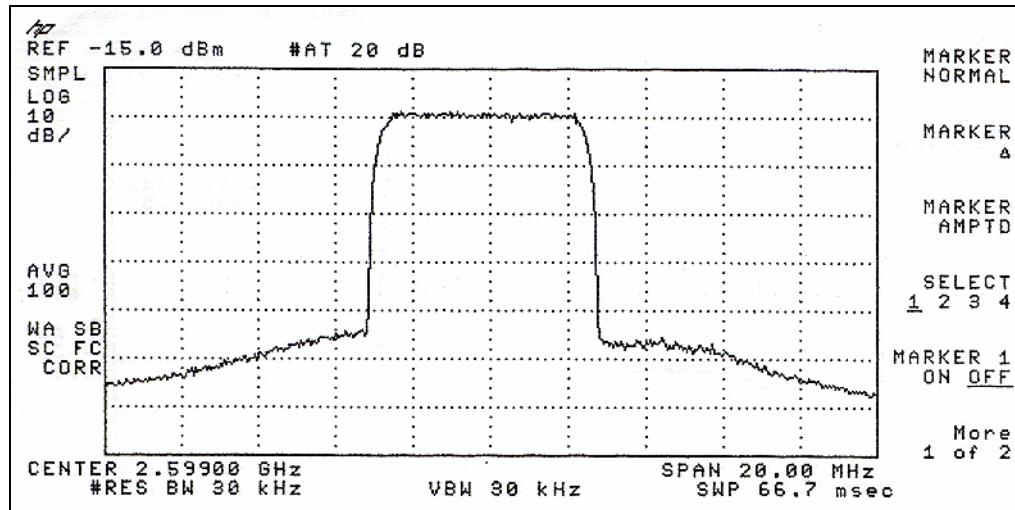


Figure 4-8. Conducted Spurious Emissions (before channel/band stop filter)

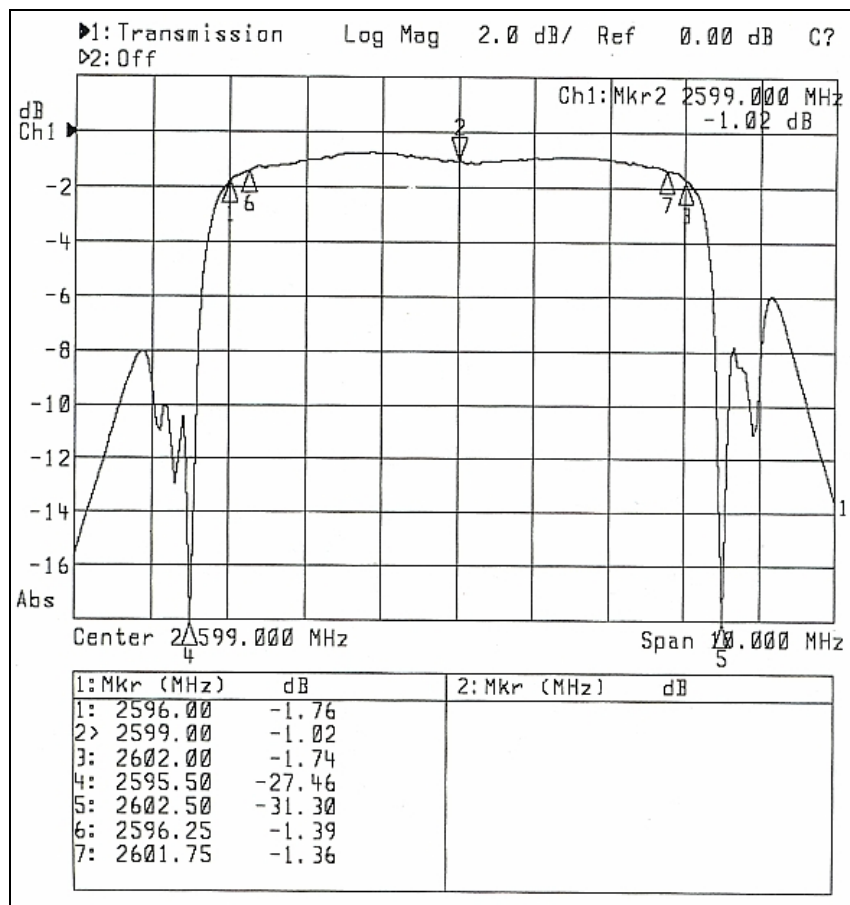


Figure 4-9. Conducted Spurious Emissions (Filter response of channel/band-stop filter)

Part 27.53 of the Rules states:

- 27.53 (l)(2) (l) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts.
(2) For fixed and temporary fixed digital stations, the attenuation shall be not less than $43 + 10 \log (P)$ dB.
- 27.53 (l)(6) (6) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. With respect to television operations, measurements must be made of the separate visual and aural operating powers at sufficiently frequent intervals to ensure compliance with the rules.

Applying the formula above, the maximum amount of out-of-band power in a 1MHz bandwidth relative to the transmitter power can be calculated:

12W Transmitter:
 $43 + 10 \cdot \log(12) = 53.79$ dB.

The performance of the Mask Filter was measured, and data was generated for its attenuation vs. frequency.

This attenuation was added to the Power Spectral Density of the transmitter's IMD products, and the resulting energy integrated across a 1MHz bandwidth. The energy in the channel was integrated across the channel and the ratio between the in band and out of band energy calculated. The following tables present the data.

The first column is the measurement frequency. The second column shows the measured attenuation of the filter. The third column adds the amplifier's IMD reduced by the filter attenuation. The final column converts the ratio in the third column to power. The energy in the fourth column was then added up across the entire 1 MHz bandwidth adjacent to the channel and compared to the integrated power in the channel. The ratio of the two powers was taken and converted back to decibels. The Out of Band power for the adjacent 1 MHz Spectrum was:

Lower Adjacent 1MHz: 57.20 dB
 Upper Adjacent 1 MHz: 56.74 dB

Table 4-2. Lower Adjacent 1MHz

	Lower Side		
Frequency (MHz)	Filter S21 (dB)	Filter+ Regrowth (dB)	Energy
2595	-9.23	-54.23	3.77572E-06
2595.005	-9.36	-54.36	3.66438E-06
2595.01	-9.49	-54.49	3.55631E-06

2595.015	-9.63	-54.63	3.4435E-06
2595.02	-9.77	-54.77	3.33426E-06
2595.025	-9.92	-54.92	3.22107E-06
2595.03	-10.08	-55.08	3.10456E-06
2595.035	-10.23	-55.23	2.99916E-06
2595.04	-10.39	-55.39	2.89068E-06
2595.045	-10.53	-55.53	2.79898E-06
2595.05	-10.69	-55.69	2.69774E-06
2595.055	-10.83	-55.83	2.61216E-06
2595.06	-10.94	-55.94	2.54683E-06
2595.065	-11.05	-56.05	2.48313E-06
2595.07	-11.15	-56.15	2.42661E-06
2595.075	-11.2	-56.2	2.39883E-06
2595.08	-11.24	-56.24	2.37684E-06
2595.085	-11.26	-56.26	2.36592E-06
2595.09	-11.24	-56.24	2.37684E-06
2595.095	-11.21	-56.21	2.39332E-06
2595.1	-11.13	-56.13	2.43781E-06
2595.105	-11.06	-56.06	2.47742E-06
2595.11	-10.97	-55.97	2.5293E-06
2595.115	-10.86	-55.86	2.59418E-06
2595.12	-10.76	-55.76	2.65461E-06
2595.125	-10.63	-55.63	2.73527E-06
2595.13	-10.52	-55.52	2.80543E-06
2595.135	-10.4	-55.4	2.88403E-06
2595.14	-10.3	-55.3	2.95121E-06
2595.145	-10.21	-55.21	3.01301E-06
2595.15	-10.13	-55.13	3.06902E-06
2595.155	-10.07	-55.07	3.11172E-06
2595.16	-10	-55	3.16228E-06
2595.165	-9.96	-54.96	3.19154E-06
2595.17	-9.93	-54.93	3.21366E-06
2595.175	-9.91	-54.91	3.22849E-06
2595.18	-9.91	-54.91	3.22849E-06
2595.185	-9.93	-54.93	3.21366E-06
2595.19	-9.96	-54.96	3.19154E-06
2595.195	-10.02	-55.02	3.14775E-06
2595.2	-10.09	-55.09	3.09742E-06
2595.205	-10.16	-55.16	3.04789E-06
2595.21	-10.26	-55.26	2.97852E-06
2595.215	-10.36	-55.36	2.91072E-06
2595.22	-10.48	-55.48	2.83139E-06
2595.225	-10.63	-55.63	2.73527E-06
2595.23	-10.76	-55.76	2.65461E-06
2595.235	-10.93	-55.93	2.5527E-06
2595.24	-11.11	-56.11	2.44906E-06

2595.245	-11.27	-56.27	2.36048E-06
2595.25	-11.46	-56.46	2.25944E-06
2595.255	-11.67	-56.67	2.15278E-06
2595.26	-11.85	-56.85	2.06538E-06
2595.265	-12.04	-57.04	1.97697E-06
2595.27	-12.22	-57.22	1.89671E-06
2595.275	-12.41	-57.41	1.81552E-06
2595.28	-12.57	-57.57	1.74985E-06
2595.285	-12.71	-57.71	1.69434E-06
2595.29	-12.84	-57.84	1.64437E-06
2595.295	-12.94	-57.94	1.60694E-06
2595.3	-13.02	-58.02	1.57761E-06
2595.305	-13.05	-58.05	1.56675E-06
2595.31	-13.06	-58.06	1.56315E-06
2595.315	-13.02	-58.02	1.57761E-06
2595.32	-12.96	-57.96	1.59956E-06
2595.325	-12.87	-57.87	1.63305E-06
2595.33	-12.74	-57.74	1.68267E-06
2595.335	-12.59	-57.59	1.74181E-06
2595.34	-12.43	-57.43	1.80717E-06
2595.345	-12.26	-57.26	1.87932E-06
2595.35	-12.08	-57.08	1.95884E-06
2595.355	-11.89	-56.89	2.04644E-06
2595.36	-11.7	-56.7	2.13796E-06
2595.365	-11.55	-56.55	2.21309E-06
2595.37	-11.38	-56.38	2.30144E-06
2595.375	-11.24	-56.24	2.37684E-06
2595.38	-11.11	-56.11	2.44906E-06
2595.385	-11.01	-56.01	2.50611E-06
2595.39	-10.93	-55.93	2.5527E-06
2595.395	-10.89	-55.89	2.57632E-06
2595.4	-10.87	-55.87	2.58821E-06
2595.405	-10.87	-55.87	2.58821E-06
2595.41	-10.94	-55.94	2.54683E-06
2595.415	-11.04	-56.04	2.48886E-06
2595.42	-11.18	-56.18	2.40991E-06
2595.425	-11.35	-56.35	2.31739E-06
2595.43	-11.6	-56.6	2.18776E-06
2595.435	-11.85	-56.85	2.06538E-06
2595.44	-12.23	-57.23	1.89234E-06
2595.445	-12.63	-57.63	1.72584E-06
2595.45	-13.12	-58.12	1.5417E-06
2595.455	-13.7	-58.7	1.34896E-06
2595.46	-14.41	-59.41	1.14551E-06
2595.465	-15.23	-60.23	9.48418E-07
2595.47	-16.28	-61.28	7.44732E-07

2595.475	-17.47	-62.47	5.66239E-07
2595.48	-19	-64	3.98107E-07
2595.485	-20.91	-65.91	2.56448E-07
2595.49	-23.49	-68.49	1.41579E-07
2595.495	-27.47	-72.47	5.66239E-08
2595.5	-34.89	-79.89	1.02565E-08
2595.505	-39.21	-84.21	3.79315E-09
2595.51	-28.7	-73.7	4.2658E-08
2595.515	-24.19	-69.19	1.20504E-07
2595.52	-20.92	-65.92	2.55859E-07
2595.525	-18.67	-63.67	4.29536E-07
2595.53	-16.92	-61.92	6.42688E-07
2595.535	-15.48	-60.48	8.95365E-07
2595.54	-14.24	-59.24	1.19124E-06
2595.545	-13.24	-58.24	1.49968E-06
2595.55	-12.34	-57.34	1.84502E-06
2595.555	-11.55	-56.55	2.21309E-06
2595.56	-10.85	-55.85	2.60016E-06
2595.565	-10.25	-55.25	2.98538E-06
2595.57	-9.72	-54.72	3.37287E-06
2595.575	-9.23	-54.23	3.77572E-06
2595.58	-8.78	-53.78	4.18794E-06
2595.585	-8.4	-53.4	4.57088E-06
2595.59	-8.03	-53.03	4.97737E-06
2595.595	-7.69	-52.69	5.3827E-06
2595.6	-7.39	-52.39	5.76766E-06
2595.605	-7.1	-52.1	6.16595E-06
2595.61	-6.85	-51.85	6.53131E-06
2595.615	-6.6	-51.6	6.91831E-06
2595.62	-6.39	-51.39	7.26106E-06
2595.625	-6.15	-51.15	7.67361E-06
2595.63	-5.96	-50.96	8.01678E-06
2595.635	-5.78	-50.78	8.35603E-06
2595.64	-5.59	-50.59	8.72971E-06
2595.645	-5.44	-50.44	9.03649E-06
2595.65	-5.27	-50.27	9.39723E-06
2595.655	-5.13	-50.13	9.7051E-06
2595.66	-4.98	-49.98	1.00462E-05
2595.665	-4.85	-49.85	1.03514E-05
2595.67	-4.73	-49.73	1.06414E-05
2595.675	-4.61	-49.61	1.09396E-05
2595.68	-4.49	-49.49	1.1246E-05
2595.685	-4.38	-49.38	1.15345E-05
2595.69	-4.27	-49.27	1.18304E-05
2595.695	-4.18	-49.18	1.20781E-05
2595.7	-4.08	-49.08	1.23595E-05

2595.705	-3.98	-48.98	1.26474E-05
2595.71	-3.9	-48.9	1.28825E-05
2595.715	-3.85	-48.85	1.30317E-05
2595.72	-3.73	-48.73	1.33968E-05
2595.725	-3.7	-48.7	1.34896E-05
2595.73	-3.58	-48.58	1.38676E-05
2595.735	-3.54	-48.54	1.39959E-05
2595.74	-3.42	-48.42	1.4388E-05
2595.745	-3.4	-48.4	1.44544E-05
2595.75	-3.34	-48.34	1.46555E-05
2595.755	-3.27	-48.27	1.48936E-05
2595.76	-3.21	-48.21	1.51008E-05
2595.765	-3.11	-48.11	1.54525E-05
2595.77	-3.07	-48.07	1.55955E-05
2595.775	-3.07	-48.07	1.55955E-05
2595.78	-3	-48	1.58489E-05
2595.785	-2.95	-47.95	1.60325E-05
2595.79	-2.86	-47.86	1.63682E-05
2595.795	-2.84	-47.84	1.64437E-05
2595.8	-2.8	-47.8	1.65959E-05
2595.805	-2.74	-47.74	1.68267E-05
2595.81	-2.75	-47.75	1.6788E-05
2595.815	-2.66	-47.66	1.71396E-05
2595.82	-2.63	-47.63	1.72584E-05
2595.825	-2.57	-47.57	1.74985E-05
2595.83	-2.53	-47.53	1.76604E-05
2595.835	-2.54	-47.54	1.76198E-05
2595.84	-2.48	-47.48	1.78649E-05
2595.845	-2.47	-47.47	1.79061E-05
2595.85	-2.4	-47.4	1.8197E-05
2595.855	-2.41	-47.41	1.81552E-05
2595.86	-2.37	-47.37	1.83231E-05
2595.865	-2.33	-47.33	1.84927E-05
2595.87	-2.3	-47.3	1.86209E-05
2595.875	-2.22	-47.22	1.89671E-05
2595.88	-2.2	-47.2	1.90546E-05
2595.885	-2.16	-47.16	1.92309E-05
2595.89	-2.17	-47.17	1.91867E-05
2595.895	-2.16	-47.16	1.92309E-05
2595.9	-2.12	-47.12	1.94089E-05
2595.905	-2.1	-47.1	1.94984E-05
2595.91	-2.1	-47.1	1.94984E-05
2595.915	-2.1	-47.1	1.94984E-05
2595.92	-2.04	-47.04	1.97697E-05
2595.925	-2.05	-47.05	1.97242E-05
2595.93	-2	-47	1.99526E-05

2595.935	-1.99	-46.99	1.99986E-05
2595.94	-2.01	-47.01	1.99067E-05
2595.945	-1.94	-46.94	2.02302E-05
2595.95	-1.91	-46.91	2.03704E-05
2595.955	-1.9	-46.9	2.04174E-05
2595.96	-1.9	-46.9	2.04174E-05
2595.965	-1.91	-46.91	2.03704E-05
2595.97	-1.85	-46.85	2.06538E-05
2595.975	-1.85	-46.85	2.06538E-05
2595.98	-1.84	-46.84	2.07014E-05
2595.985	-1.82	-46.82	2.0797E-05
2595.99	-1.84	-46.84	2.07014E-05
2595.995	-1.77	-46.77	2.10378E-05
2596	-1.79	-46.79	2.09411E-05
		Total Energy in 1MHz	0.001531389
Insertion Loss		Filter Loss	0.788860118
-1.0 dB		Total Energy in 5.1 MHz	805.4261801
		Ratio	525944.7833
		Ratio (dB)	57.20940152
Transmitter Power (W)			
15			
Power at Waveguide Output (W)		Required Ratio	53.79181246
12			

Table 4-3. Upper Adjacent 1MHz

	Upper Side		
Frequency (MHz)	Filter S21 (dB)	Filter+ Regrowth (dB)	Energy
2602	-1.7	-46.7	2.13796E-05
2602.005	-1.69	-46.69	2.14289E-05
2602.01	-1.71	-46.71	2.13304E-05
2602.015	-1.74	-46.74	2.11836E-05
2602.02	-1.78	-46.78	2.09894E-05
2602.025	-1.75	-46.75	2.11349E-05
2602.03	-1.78	-46.78	2.09894E-05
2602.035	-1.82	-46.82	2.0797E-05
2602.04	-1.78	-46.78	2.09894E-05
2602.045	-1.78	-46.78	2.09894E-05
2602.05	-1.82	-46.82	2.0797E-05
2602.055	-1.87	-46.87	2.05589E-05
2602.06	-1.88	-46.88	2.05116E-05
2602.065	-1.84	-46.84	2.07014E-05
2602.07	-1.88	-46.88	2.05116E-05
2602.075	-1.87	-46.87	2.05589E-05
2602.08	-1.91	-46.91	2.03704E-05

2602.085	-1.94	-46.94	2.02302E-05
2602.09	-1.93	-46.93	2.02768E-05
2602.095	-1.96	-46.96	2.01372E-05
2602.1	-1.99	-46.99	1.99986E-05
2602.105	-2.02	-47.02	1.98609E-05
2602.11	-2.01	-47.01	1.99067E-05
2602.115	-2.05	-47.05	1.97242E-05
2602.12	-2.04	-47.04	1.97697E-05
2602.125	-2.06	-47.06	1.96789E-05
2602.13	-2.11	-47.11	1.94536E-05
2602.135	-2.11	-47.11	1.94536E-05
2602.14	-2.19	-47.19	1.90985E-05
2602.145	-2.16	-47.16	1.92309E-05
2602.15	-2.17	-47.17	1.91867E-05
2602.155	-2.27	-47.27	1.87499E-05
2602.16	-2.25	-47.25	1.88365E-05
2602.165	-2.31	-47.31	1.8578E-05
2602.17	-2.34	-47.34	1.84502E-05
2602.175	-2.32	-47.32	1.85353E-05
2602.18	-2.39	-47.39	1.8239E-05
2602.185	-2.36	-47.36	1.83654E-05
2602.19	-2.45	-47.45	1.79887E-05
2602.195	-2.49	-47.49	1.78238E-05
2602.2	-2.51	-47.51	1.77419E-05
2602.205	-2.55	-47.55	1.75792E-05
2602.21	-2.65	-47.65	1.71791E-05
2602.215	-2.66	-47.66	1.71396E-05
2602.22	-2.71	-47.71	1.69434E-05
2602.225	-2.77	-47.77	1.67109E-05
2602.23	-2.81	-47.81	1.65577E-05
2602.235	-2.87	-47.87	1.63305E-05
2602.24	-2.92	-47.92	1.61436E-05
2602.245	-2.99	-47.99	1.58855E-05
2602.25	-3.06	-48.06	1.56315E-05
2602.255	-3.11	-48.11	1.54525E-05
2602.26	-3.18	-48.18	1.52055E-05
2602.265	-3.26	-48.26	1.49279E-05
2602.27	-3.33	-48.33	1.46893E-05
2602.275	-3.41	-48.41	1.44212E-05
2602.28	-3.5	-48.5	1.41254E-05
2602.285	-3.58	-48.58	1.38676E-05
2602.29	-3.67	-48.67	1.35831E-05
2602.295	-3.77	-48.77	1.32739E-05
2602.3	-3.87	-48.87	1.29718E-05
2602.305	-3.98	-48.98	1.26474E-05
2602.31	-4.07	-49.07	1.2388E-05

2602.315	-4.19	-49.19	1.20504E-05
2602.32	-4.32	-49.32	1.1695E-05
2602.325	-4.45	-49.45	1.13501E-05
2602.33	-4.58	-49.58	1.10154E-05
2602.335	-4.73	-49.73	1.06414E-05
2602.34	-4.88	-49.88	1.02802E-05
2602.345	-5.06	-50.06	9.86279E-06
2602.35	-5.23	-50.23	9.48418E-06
2602.355	-5.41	-50.41	9.09913E-06
2602.36	-5.62	-50.62	8.66962E-06
2602.365	-5.83	-50.83	8.26038E-06
2602.37	-6.06	-51.06	7.8343E-06
2602.375	-6.3	-51.3	7.4131E-06
2602.38	-6.56	-51.56	6.98232E-06
2602.385	-6.84	-51.84	6.54636E-06
2602.39	-7.13	-52.13	6.1235E-06
2602.395	-7.44	-52.44	5.70164E-06
2602.4	-7.79	-52.79	5.26017E-06
2602.405	-8.14	-53.14	4.85289E-06
2602.41	-8.56	-53.56	4.40555E-06
2602.415	-8.99	-53.99	3.99025E-06
2602.42	-9.42	-54.42	3.6141E-06
2602.425	-9.92	-54.92	3.22107E-06
2602.43	-10.46	-55.46	2.84446E-06
2602.435	-11.03	-56.03	2.49459E-06
2602.44	-11.65	-56.65	2.16272E-06
2602.445	-12.36	-57.36	1.83654E-06
2602.45	-13.08	-58.08	1.55597E-06
2602.455	-13.95	-58.95	1.2735E-06
2602.46	-14.91	-59.91	1.02094E-06
2602.465	-16	-61	7.94328E-07
2602.47	-17.26	-62.26	5.94292E-07
2602.475	-18.8	-63.8	4.16869E-07
2602.48	-20.67	-65.67	2.71019E-07
2602.485	-22.92	-67.92	1.61436E-07
2602.49	-25.82	-70.82	8.27942E-08
2602.495	-30.14	-75.14	3.06196E-08
2602.5	-32.63	-77.63	1.72584E-08
2602.505	-28.7	-73.7	4.2658E-08
2602.51	-24.52	-69.52	1.11686E-07
2602.515	-21.55	-66.55	2.21309E-07
2602.52	-19.28	-64.28	3.7325E-07
2602.525	-17.52	-62.52	5.59758E-07
2602.53	-16.03	-61.03	7.8886E-07
2602.535	-14.76	-59.76	1.05682E-06
2602.54	-13.68	-58.68	1.35519E-06

2602.545	-12.81	-57.81	1.65577E-06
2602.55	-11.98	-56.98	2.00447E-06
2602.555	-11.29	-56.29	2.34963E-06
2602.56	-10.69	-55.69	2.69774E-06
2602.565	-10.17	-55.17	3.04089E-06
2602.57	-9.74	-54.74	3.35738E-06
2602.575	-9.36	-54.36	3.66438E-06
2602.58	-9.04	-54.04	3.94457E-06
2602.585	-8.75	-53.75	4.21697E-06
2602.59	-8.52	-53.52	4.44631E-06
2602.595	-8.31	-53.31	4.66659E-06
2602.6	-8.16	-53.16	4.83059E-06
2602.605	-8	-53	5.01187E-06
2602.61	-7.91	-52.91	5.11682E-06
2602.615	-7.82	-52.82	5.22396E-06
2602.62	-7.76	-52.76	5.29663E-06
2602.625	-7.73	-52.73	5.33335E-06
2602.63	-7.72	-52.72	5.34564E-06
2602.635	-7.72	-52.72	5.34564E-06
2602.64	-7.73	-52.73	5.33335E-06
2602.645	-7.77	-52.77	5.28445E-06
2602.65	-7.81	-52.81	5.236E-06
2602.655	-7.87	-52.87	5.16416E-06
2602.66	-7.94	-52.94	5.08159E-06
2602.665	-8.02	-53.02	4.98884E-06
2602.67	-8.09	-53.09	4.90908E-06
2602.675	-8.18	-53.18	4.80839E-06
2602.68	-8.26	-53.26	4.72063E-06
2602.685	-8.34	-53.34	4.63447E-06
2602.69	-8.42	-53.42	4.54988E-06
2602.695	-8.49	-53.49	4.47713E-06
2602.7	-8.55	-53.55	4.4157E-06
2602.705	-8.6	-53.6	4.36516E-06
2602.71	-8.63	-53.63	4.33511E-06
2602.715	-8.65	-53.65	4.31519E-06
2602.72	-8.66	-53.66	4.30527E-06
2602.725	-8.66	-53.66	4.30527E-06
2602.73	-8.65	-53.65	4.31519E-06
2602.735	-8.63	-53.63	4.33511E-06
2602.74	-8.61	-53.61	4.35512E-06
2602.745	-8.58	-53.58	4.38531E-06
2602.75	-8.56	-53.56	4.40555E-06
2602.755	-8.53	-53.53	4.43609E-06
2602.76	-8.52	-53.52	4.44631E-06
2602.765	-8.51	-53.51	4.45656E-06
2602.77	-8.52	-53.52	4.44631E-06

2602.775	-8.52	-53.52	4.44631E-06
2602.78	-8.55	-53.55	4.4157E-06
2602.785	-8.58	-53.58	4.38531E-06
2602.79	-8.61	-53.61	4.35512E-06
2602.795	-8.65	-53.65	4.31519E-06
2602.8	-8.71	-53.71	4.25598E-06
2602.805	-8.78	-53.78	4.18794E-06
2602.81	-8.85	-53.85	4.12098E-06
2602.815	-8.94	-53.94	4.03645E-06
2602.82	-9.03	-54.03	3.95367E-06
2602.825	-9.12	-54.12	3.87258E-06
2602.83	-9.23	-54.23	3.77572E-06
2602.835	-9.35	-54.35	3.67282E-06
2602.84	-9.47	-54.47	3.57273E-06
2602.845	-9.6	-54.6	3.46737E-06
2602.85	-9.73	-54.73	3.36512E-06
2602.855	-9.87	-54.87	3.25837E-06
2602.86	-10.02	-55.02	3.14775E-06
2602.865	-10.17	-55.17	3.04089E-06
2602.87	-10.31	-55.31	2.94442E-06
2602.875	-10.47	-55.47	2.83792E-06
2602.88	-10.61	-55.61	2.74789E-06
2602.885	-10.75	-55.75	2.66073E-06
2602.89	-10.89	-55.89	2.57632E-06
2602.895	-10.99	-55.99	2.51768E-06
2602.9	-11.1	-56.1	2.45471E-06
2602.905	-11.18	-56.18	2.40991E-06
2602.91	-11.24	-56.24	2.37684E-06
2602.915	-11.29	-56.29	2.34963E-06
2602.92	-11.28	-56.28	2.35505E-06
2602.925	-11.26	-56.26	2.36592E-06
2602.93	-11.2	-56.2	2.39883E-06
2602.935	-11.1	-56.1	2.45471E-06
2602.94	-10.99	-55.99	2.51768E-06
2602.945	-10.85	-55.85	2.60016E-06
2602.95	-10.68	-55.68	2.70396E-06
2602.955	-10.48	-55.48	2.83139E-06
2602.96	-10.27	-55.27	2.97167E-06
2602.965	-10.03	-55.03	3.14051E-06
2602.97	-9.8	-54.8	3.31131E-06
2602.975	-9.57	-54.57	3.4914E-06
2602.98	-9.32	-54.32	3.69828E-06
2602.985	-9.08	-54.08	3.90841E-06
2602.99	-8.84	-53.84	4.13048E-06
2602.995	-8.61	-53.61	4.35512E-06
2603	-8.38	-53.38	4.59198E-06

		Total Energy in 1MHz	0.001702322
Insertion Loss		Filter Loss	0.788860118
-1.0 dB		Total Energy in 5.1 MHz	805.4261801
		Ratio	473133.941
		Ratio (dB)	56.74984104
Transmitter Power (W)			
15			
Power at Waveguide Output (W)		Required Ratio	53.79181246
12			

4.5 Radiated Emissions

Using the test setup shown in Figure 4-10, with the transmitter operating at full power, the spectrum analyzer was moved 20 meters from the transmitter and connected to a dipole antenna cut to the IF frequency (44 MHz). This antenna was oriented to maximize the received level and the data was recorded. The antenna was then cut to the carrier frequency, local oscillator frequency and the second through tenth harmonic frequencies of the transmitter, and all of the signals received, were maximized by antenna orientation and their absolute levels were recorded.

The spectrum analyzer had a maximum sensitivity of -110 dBm during these tests.

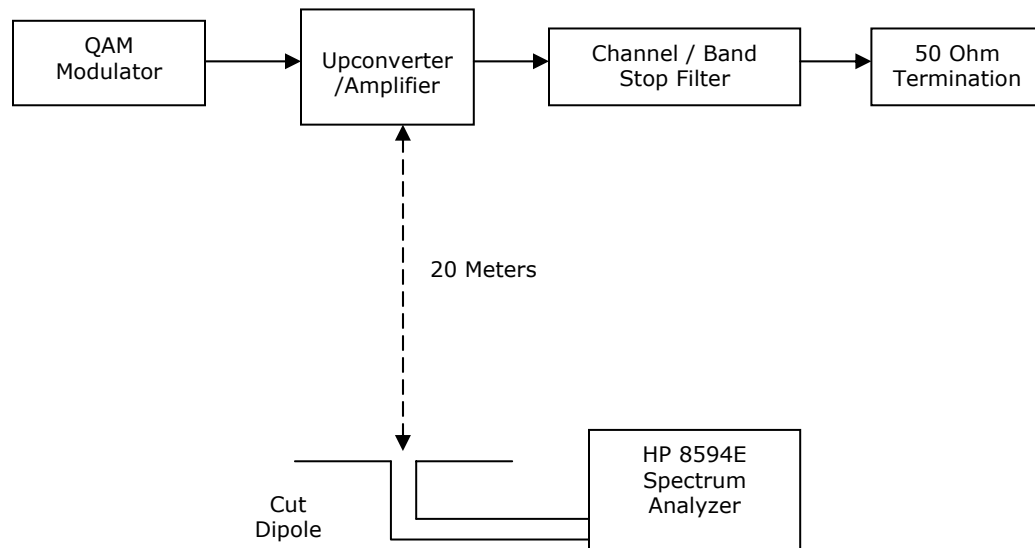


Figure 4-10. Test Setup for Measuring Radiated Emissions

FREQUENCY (MHz)	SOURCE	PEAK LEVEL OBSERVED (dB)
44.00	IF Frequency	None Observed
2599.00	Center of Channel	None Observed
2643.00	Local Oscillator	None Observed
5198.00	2 nd Harmonic	None Observed
7797.00	3 rd Harmonic	None Observed
10396.00	4 th Harmonic	None Observed
12995.00	5 th Harmonic	None Observed
15594.00	6 th Harmonic	None Observed
18193.00	7 th Harmonic	None Observed
20792.00	8 th Harmonic	None Observed
23391.00	9 th Harmonic	None Observed
25990.00	10 th Harmonic	None Observed

Table 4-4. Radiated Emissions Data

With these various antennas, and with an adjustable length dipole for 44 to 2599 MHz, the frequency spectrum from 44 MHz to 2599 MHz was observed. No measurable levels were observed.

The cabinet radiation was also checked with the receive dipole antenna cut to 2599 MHz, within very close proximity to the trays of the transmitters, and the received level that was recorded at no time exceeded a power density in excess of +0.0 dBm.

This level is far less than the current or proposed standard for safe radiation levels.

4.6 Frequency Stability

The ITS-5724 is designed to operate using an external 10 MHz precise reference oscillator. The frequency stability of this external reference determines the frequency stability of the transmitter.

The frequency determining variables of the transmitter may be defined as follows:

F_{LO} = Desired local oscillator frequency
 F_{IF} = Desired IF oscillator frequency
 F_R = Desired external reference oscillator frequency
 F_{RF} = Desired RF output frequency
 E_{LO} = Local oscillator frequency offset error
 E_{IF} = IF oscillator frequency offset error
 E_R = External reference oscillator frequency offset error
 E_{RF} = RF output frequency error

The PLL circuitry maintains a constant ratio between the external reference frequency and the output frequency of the oscillator. This ratio is defined below for both the LO and IF oscillators.

$$G_{LO} = F_{LO}/F_R$$

$$G_{IF} = F_{IF}/F_R$$

Any change in the external 10 MHz reference will effect a corresponding change in the output frequency such that the above ratios are maintained.

$$G_{LO} = (F_{LO} + E_{LO})/(F_R + E_R) = F_{LO}/F_R$$

$$G_{IF} = (F_{IF} + E_{IF})/(F_R + E_R) = F_{IF}/F_R$$

Solving for the change in output frequency yields:

$$E_{LO} = E_R * (F_{LO}/F_R) = E_R * G_{LO}$$

$$E_{IF} = E_R * (F_{IF}/F_R) = E_R * G_{IF}$$

The desired RF carrier frequency is equal to the LO frequency minus the IF frequency:

$$F_{RF} = F_{LO} - F_{IF}$$

The actual RF frequency, including any error introduced by the external reference, may be defined as follows:

$$F_{RF} + E_{RF} = (F_{LO} + E_{LO}) - (F_{IF} + E_{IF})$$

$$F_{RF} + E_{RF} = (F_{LO} + F_{IF}) - (E_{LO} - E_{IF})$$

$$F_{RF} + E_{RF} = F_{RF} + (E_{LO} - E_{IF})$$

Calculating for the error of the RF carrier yields:

$$\begin{aligned} E_{RF} &= (E_{LO} - E_{IF}) \\ E_{RF} &= E_R * G_{LO} - E_R * G_{IF} \\ E_{RF} &= E_R (G_{LO} - G_{IF}) \\ E_{RF} &= E_R / F_R * (F_{LO} - F_{IF}) \\ E_{RF} &= E_R / F_R * F_{RF} \end{aligned}$$

Therefore, the error of the RF carrier is a function of the external 10 MHz reference error.

The maximum RF frequency error for this service is ± 1.0 KHz. The highest channel frequency for this service ($E_4 = 2611$ MHz) represents the worst-case condition. With these values the maximum allowable reference error ($E_{R(max)}$) can be calculated.

$$E_{R(max)} = 1.815 \text{ Hz}$$

The required reference oscillator stability may be calculated as follows:

$$\begin{aligned} \text{Stability} &= E_{R(max)} / F_R \\ \text{Stability} &= 1.815 \text{ Hz} / 10 \times 10^6 \text{ Hz} = 0.1815 \times 10^{-6} \end{aligned}$$

Therefore, the RF frequency error of the ITS-5724 will not exceed ± 500 Hz when operated with a precise reference oscillator with a stability equal to or better than 0.1815×10^{-6} .

Commercially available GPS precise reference oscillators, such as the TRAK Systems 8821 which has a frequency stability of 1×10^{-9} over a temperature range of 0 to 50 °C, and a line voltage/frequency range from 85 to 265 VRMS/48 to 440 Hz (see TRAK Systems 8821 specifications at the end of this report), insure a frequency stability within the tolerance specified in the Rules and Regulations for this service.

4.7 Test Equipment

The test equipment that was used to analyze the Axcera 5724 system is listed in Table 4-6.

Table 4-6. Test Equipment

MODEL	MANUFACTURER	DESCRIPTION	SERIAL #
8564E	Hewlett-Packard	Spect. Analyzer 9 KHz-40 GHz	Rental
8595E	Hewlett-Packard	Spect. Analyzer 9 KHz-6.5 GHz	3543A01613
3003-30	Narda	Directional Coupler	41991
3003-10	Narda	Directional Coupler	09049
435B	Hewlett-Packard	30 Watt Power Head	2732009080
2349A	Hewlett-Packard	30 dB Directional Coupler	3318A05525
2230	Tektronix	Oscilloscope	2230B025251
1992	Racal-Dana	Frequency Counter	950304
8135	Bird	50 Ohm Termination	8520
79	Fluke	Digital Multi-meter	56660032
89441A	Hewlett-Packard	Vector Sig. Analyzer (IF Section)	3416A01020
89441A	Hewlett-Packard	Vector Sig. Analyzer (RF Section)	3415A00333
2022D	Marconi Instruments	Signal Generator	119216/045