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Amendment to application EX-PL-1999

Measurements and Comments
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We have performed the following measurements on our lab equipment as it is currently configured.

Power measurement: We replaced the transmitting antenna with an HP E4413A Power Sensor connected to an HP 4419 Power Meter. The results of the measurements for the two pieces of equipment that we have are:

Time Domain Radio set power: 1.5 dBm

Avtech pulser operated at 1Mpps: -12.1 dBm

The Avtech pulser has a pulse width control voltage. This measurement was made at the width setting that we are using in our current in-lab propagation measurement program. The power could vary a few dB by changing pulse width and of course will vary with PRF. The maximum PRF that this pulser can handle is 2 Mpps.

Pulse shape measurement: We replaced the transmitting antenna with a direct connection to an HP 54750 digitizing oscilloscope and recorded the transmitted pulse shapes accurately and to scale. Those are attached.

Spectral Occupancy: The Fourier transforms of the measured pulses were computed with the built-in FFT feature of the HP 54750 oscilloscope, and are attached (not to absolute scale). Note that the manual for this function indicates that for efficiency, the dc value of the FFT is incorrect.

Avtech pulser usage: In the current lab set-up, the Avtech pulsers are driven at a 1 Mpps pulse rate, and the power in the signal driving the antenna driving the antenna is distributed in a comb of spectral lines 1 MHz apart with power level proportional to the square of the displayed pulse transform magnitude.

Time Domain Radio: In the Time Domain radios, in the absence of data modulation, the power would be distributed in a sequence of spectral lines separated by the inverse of the time-hopping code period (in the 10-100 kHz range). This power would also be distributed in proportion to the square of the pulse transform magnitude. Because of data modulation and time duplexing effects, the energy will be further lowered and smoothed relative to the hypothetical situation described above.

It is possible to capture the detailed structure of these UWB transmitter outputs, but there is a considerable amount of detail in the measured data, and even completely displaying it is difficult. If you need further information or would like transmitter power spectral measurements made at particular video and resolution bandwidths, we will certainly provide them.

Amendment to application EX-PL-1999 (continued)

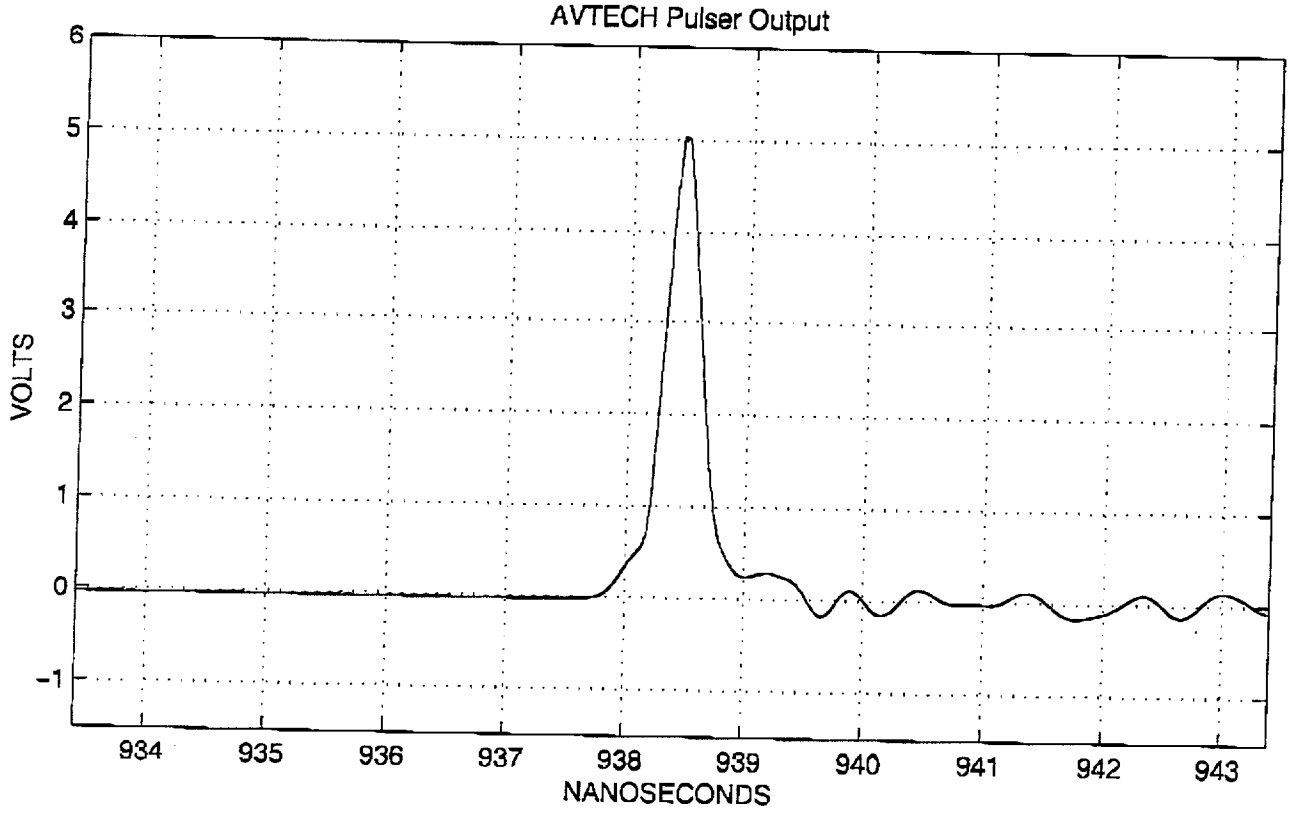
Antenna Measurement: The antenna pairs (each antenna roughly the size of a playing card) that we have were disconnected from the transmitters and receivers and mounted one meter apart with their maximum gain in the direction of their counterparts. Transmitting and receiving antennas are identical. We connected them to an HP 8720 network analyzer and measured the S_{12} parameters of the antenna system. Since we do not have an anechoic chamber available, we repeated the measurement 32 times in different positions in the lab, and plotted the average of the magnitude of the S_{12} parameter measurements. This gives a fairly good picture of the passband of the antenna system. The measurement plots are attached. Their approximate 6 dB passbands are shown below.

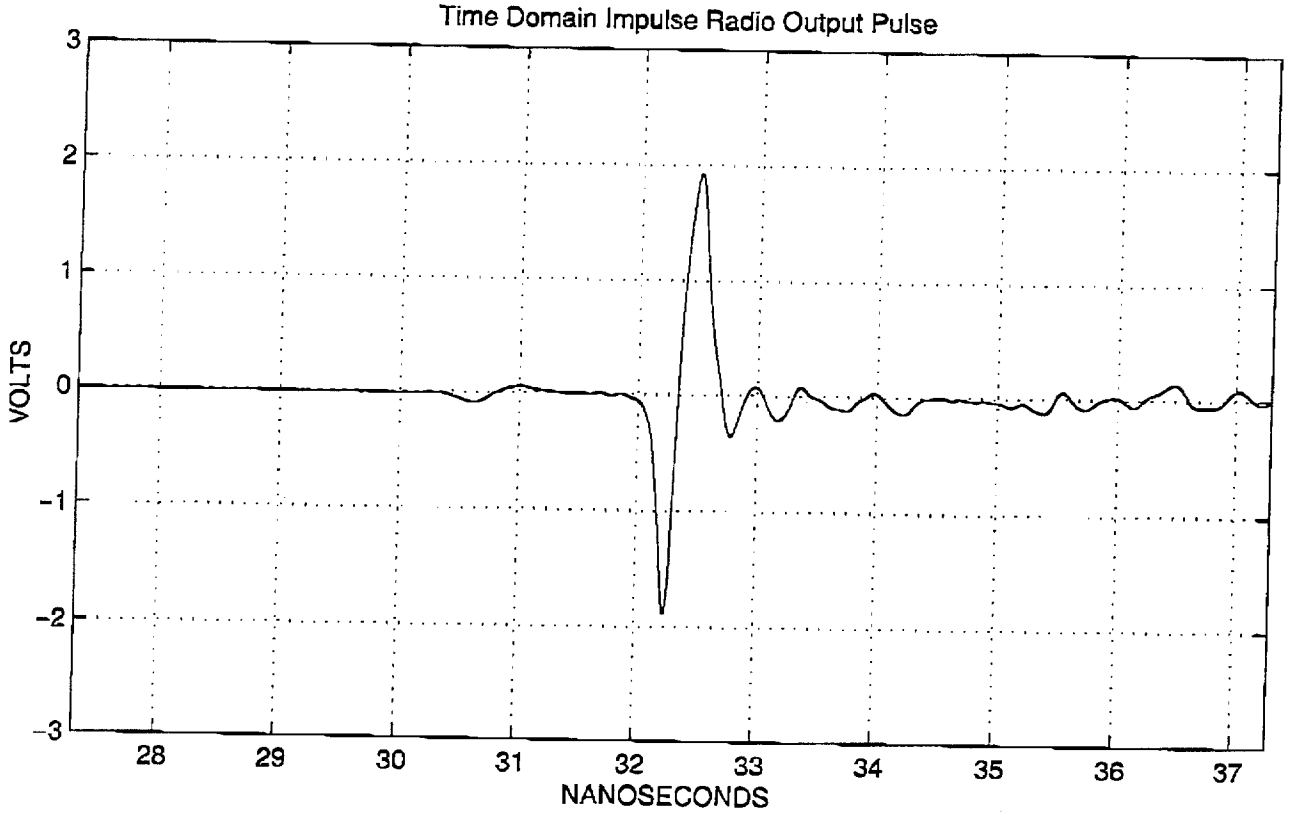
6 dB passband of the Time Domain Radio's antennas: 1.1 GHz to 2.9 GHz

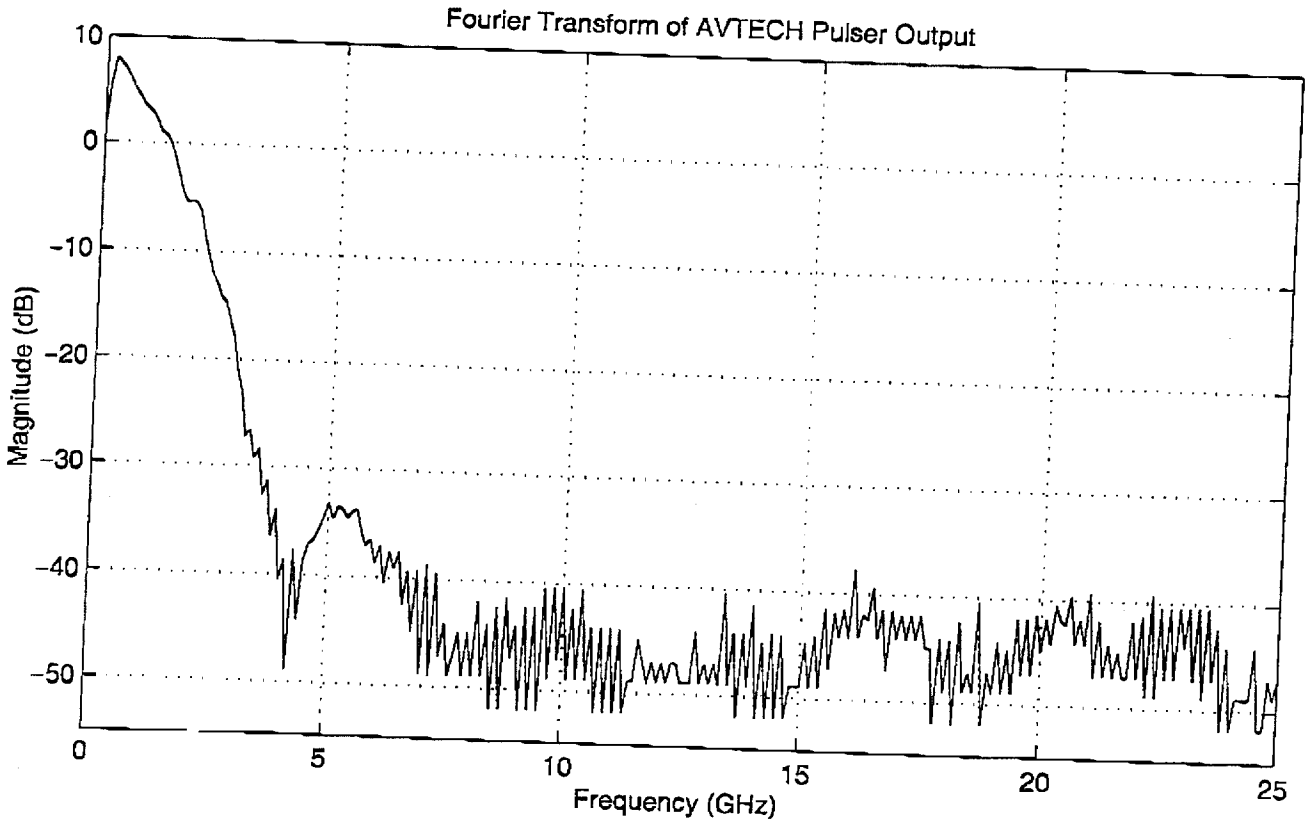
6 dB passband of the lab antennas used with Avtech pulsers: .8 GHz to 1.8 GHz

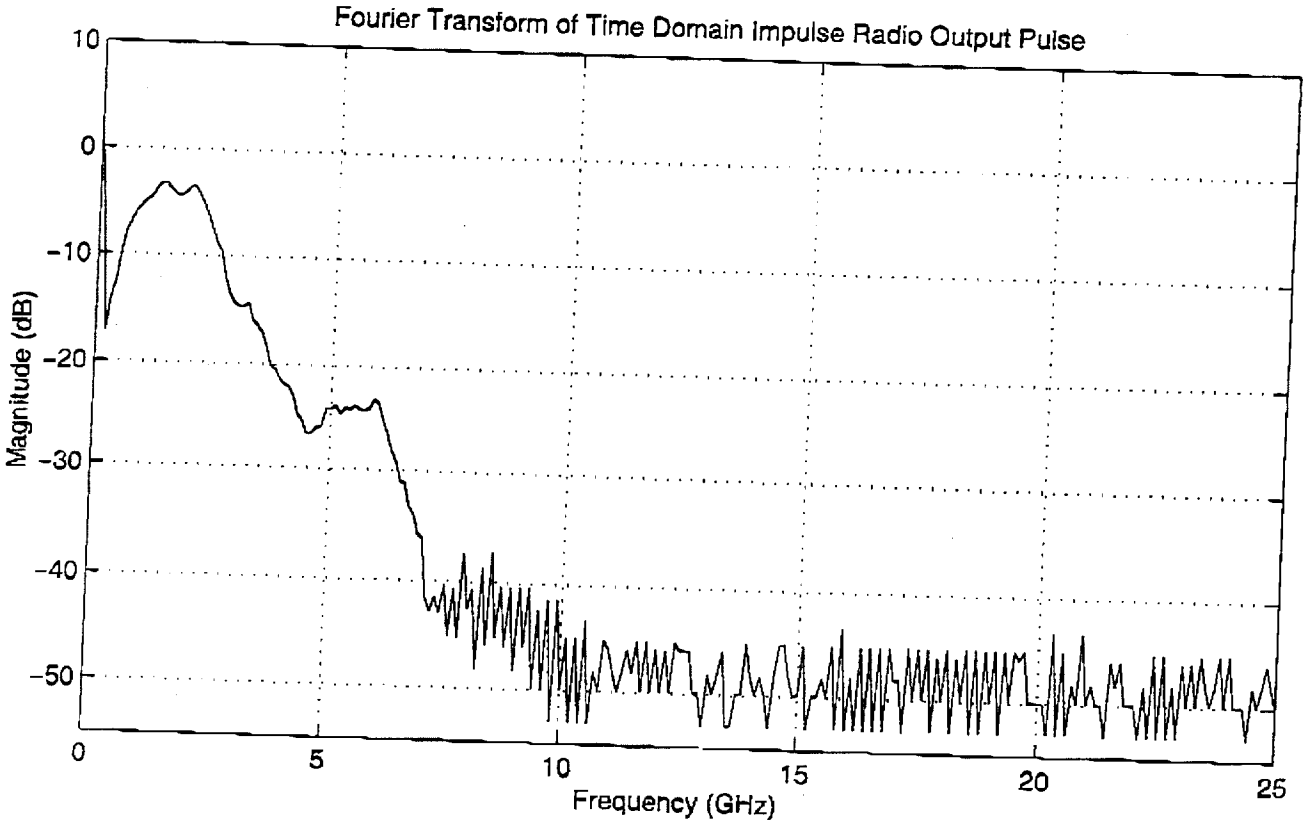
These are not the sharp passbands of highly tuned antennas and they do radiate power at somewhat lower levels over a wider band than stated above (see attachment).

Figure 1 - Amendment to Application EX-PL-1999






Fourier Transform of AVTECH Pulser Output
Magnitude (dB)
Frequency (GHz)
10
0
-10
-20
-30
-40
-50
0
5
10
15
20
25


Fourier Transform of Time Domain Impulse Radio Output Pulse
Magnitude (dB)
Frequency (GHz)
10
0
-10
-20
-30
-40
-50
0
5
10
15
20
25

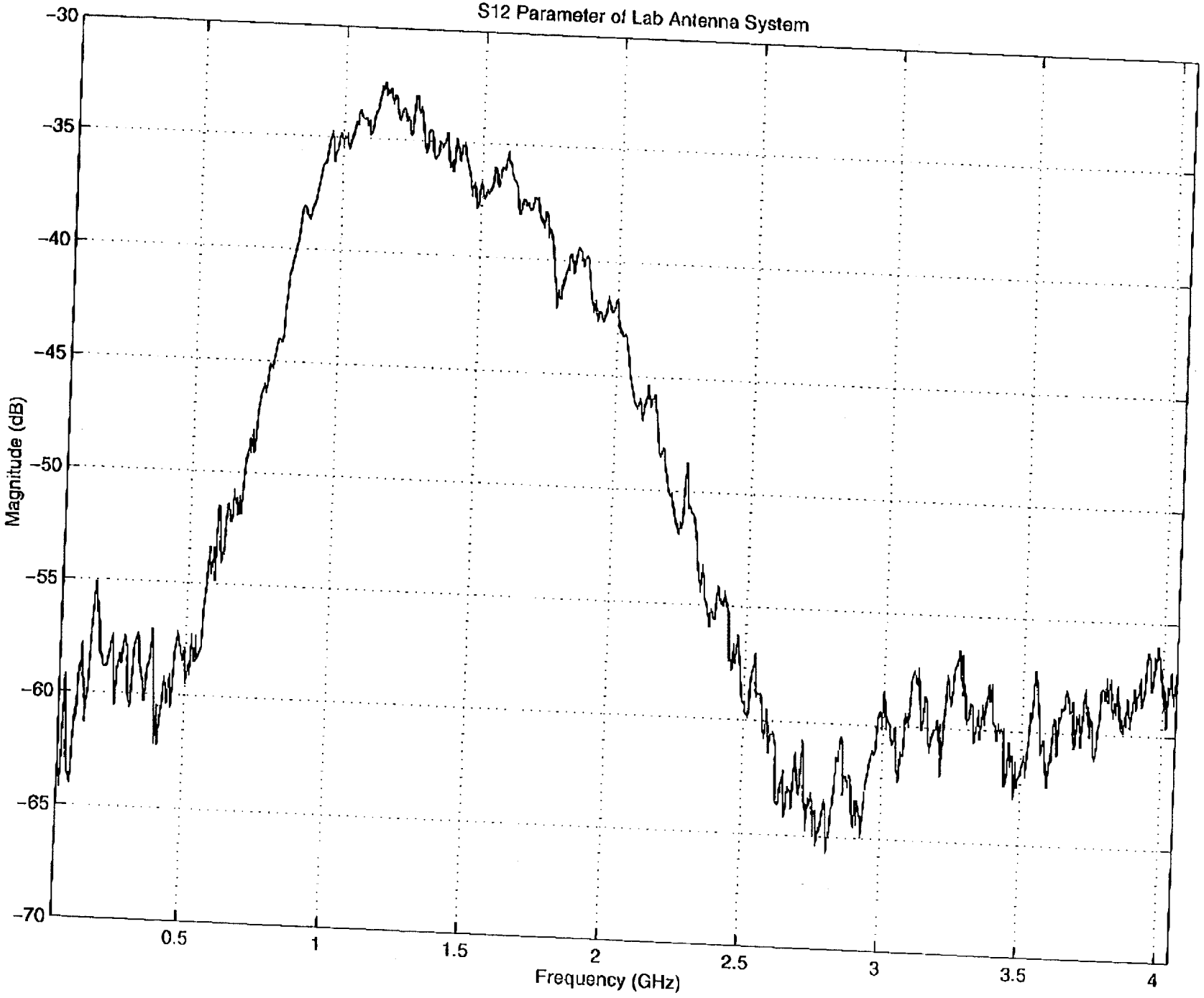


Figure 4 Amendment to Application EX-PL-1999