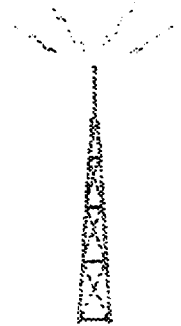
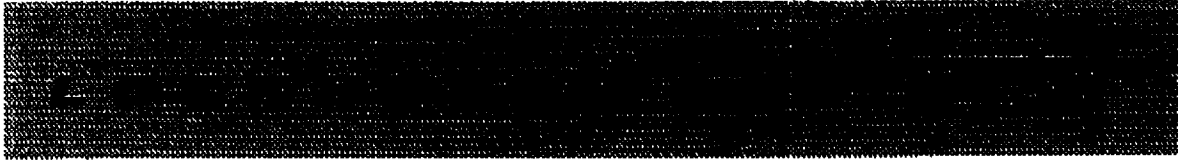


FAX COVER PAGE**Radio Frequency Management Office**

MARCALL 682-2156 FAX 682-0300 (410) 682-2156 FAX (410) 682-0300



To: Franl Wright

From: Claude E. Wells

Subject: GPSIIR program questions.

Pages: 4 (include. Cover Page)

Frank,

you will find attached a copy of the faxed message I received from our personnel in Philadelphia. This is a program being administrated by the same people in CA as the others. John Mergen in Philadelphia is overseeing the project from our side and they have some questions regarding possible liability if interference is caused. The background of this project is, they have been testing in the facilities at Philadelphia for several years, with out incident. They are well aware of the leakage problems they have with their hats for testing, seea tached measurements, but they have not had any complaints of interference or other problems. Typically they do test in the lab or in a large hangar type building using their hats.

The question of liability arose when they sent a unit or units to Florida and the AF was testing them on their test truck, when they were contacted by the FAA to cease operations due to the interference they were causing by at locations by as much as 6 miles away. They also were advised that a Naval ship in the vicinity in the Atlantic reported receiving interference to their GPS system and were receiving a signaal saying they were in the Mediteranian.

I need you to get back to me or contact Ijohn Mergen at the facilities in PA to discuss this problem as he is in need to respond to his management and the AF.

Claude E. Wells

No.
Contract F04701-89-C-0073King of Prussia
Montgomery PA

LOCKHEED MARTIN

Lockheed Martin Missiles & Space
Post Office Box 8555 Philadelphia, PA 19101-8555

To: C. Wells

From: John. W. Mergen

Date: 05-01-97

Subject: GPSIIR RF Hat Leakage in Factory

Loc: VF 100 / M2101
Ext: (610) 354 -2258

Claude;

I was not exactly sure how to fill out form 442, so I am providing some history of what the problem is, and providing information about our Space Vehicle. The Form is set up more for a transmitter application, however our problem is very unique since it is a spacecraft with high leakage emissions under an RF Hat.

Background:

The GPS IIR program is an Air Force managed DoD program. Five years ago, the GPS IIR program elected not to pursue an FCC license to transmit (air link) in the High bay of Building 100. This was due to the fact that when the antenna panel is mated (not hardlined to the test equipment), it would only transmit into an RF Hat that was placed above and approximately over 1/3 of the length of the spacecraft. This was never a problem until we delivered the vehicle to the Air Force and was RF tested by the Government in the DPF facility at Cape Canaveral. During high power Hat testing at the Cape, L- band users complained of interference. Subsequently, permission from the FAA was required prior to air link testing under a Hat or transmitting from building to building. The Air Force performed an experiment to ascertain what the emissions were from the space vehicle. Military L-Band receivers locked up (were jammed) approximately 6 miles away from the DPF facility. I understand now that more testing is taking place at the direction of the Air Force and FAA. LMMS is not responsible for the space vehicle at the CCAS, only at the factory in Valley Forge, PA.

From this incident, we were asked by the Air Force to describe how we are testing the vehicle at the factory, and if we encountered any problems. This was when I contacted you in December of 1996 and initiated a leakage test at a distance of 3 meters from the vehicle to ascertain the level of any and all emissions from the spacecraft transmitters.

We currently perform air link testing in two locations for each space vehicle. The one location is in an anechoic chamber for which we believe no further action is required. The other location is an open highbay underneath an RF Hat. We perform low power and high power testing at various times during the testing of each SV.

The space vehicle has an RF antenna panel with various UHF and L-band antennas connected together to form an array. The following is a brief summary:

GPS IIR antenna panel

L-Band 12 helical antennas to form array
UHF XMIT 1- Volute
S-Band (S1) 1- dipole

One S-band helix on side of SV (S2 / S3)

Frequencies:

	<u>Center F.</u>	<u>Effective Bandwidth</u>	<u>Modulation</u>
L1	1575.42 MHz	1565.19 to 1585.65 MHz	10.23 / 1.023 MHz QPSK
L2	1227.60 MHz	1217.37 to 1237.83 MHz	10.23 / 1.023 MHz , BPSK
L3	1381.05 MHz	1370.82 to 1391.28 MHz	1.023 MHz, BPSK
L4	1379.913 MHz	1379.51 to 1380.31 MHz	200 BPS, BPSK
S1	2227.5 MHz	2217.50 to 2237.50 MHz	1.7 MHz Phase Mod / PRN Mod
S2	2228.524 Mhz *	2226.00 to 2229.00 MHz	85 KBPS, BPSK
S3	2226.476 Mhz *	2226.00 to 2229.0 Mhz	100 KBPS, BPSK

Input into Antenna

EIRP

L1	17.6 dBW	1,440 Watts (Peak)
L2	10.55 dBW	285 Watts (Peak)
L3	12.65 dBW	462 Watts (Peak)
L4	08.5 dBW	2,818 Watts (Peak)
S1	07.0 dBW	11.2 Watts (Peak)
S2	03.8 dBW	30.0 Watts (Peak)
S3	-2.0 dBW	8.3 Watts (Peak)
S2 / S3	08.5 dBW	93.3 Watts (Peak)
UHF	20.71 dBW	332 Watts (Peak)

250 - 300 MHz
* Carrier for S2 and S3 is 2227.5 Mhz.

The UHF transmitter is time division multiplex - frequency hopped spread spectrum. The modulation is 14.815 KHz BPSK. The UHF antenna transmit frequency and bandwidth range is classified. The unclassified bandwidth is 250 MHz to 300 MHz. Power input into the antenna is 108 watts. The peak power output of the antenna (EIRP) is 332 Watts. The UHF transmissions are 1.5 seconds for every 36 second period (duty cycle of 4 %).

The following are leakage measurements taken in our highbay with the Space Vehicle in an Air link configuration transmitting into an RF Hat:

<u>Transmitter</u>	<u>Leakage measurement at 3 meters</u>
L1	1.04 Volts / Meter
L2	1.17 Volts / Meter
L3	1.30 Volts / Meter
L4	Not measured (Will be added to SV #13)
S1	179 Millivolts / Meter
S2	Not measured (Will be added to SV #13)
S3	Not measured (Will be added to SV #13)
250-300 MHz UHF	2.32 Volts / Meter

These measurements were taken to compare and satisfy the requirements that you identified for the following frequency bandwidths:

<u>Frequency BW</u>	<u>Requirement Limit</u>
216 to 960 MHz	≤ 200 microvolts / meter at 3 meters
> 960 MHz	≤ 500 microvolts / meter at 3 meters

As you can see, the leakage is significant as compared to the limit requirement. Please keep in mind that these measurements were made at locations 3 meters from the transmitter (which is inside Building 100). No measurements were taken outside of building 100.

This is all the information I have for now. Can you please review this and get back to me with any question / comments. I don't have the instructions to fill out form 442, but I will make an attempt to fill out the form and fax it tomorrow.

If you have any questions or comments, I can be reached at VF (610) 354 -2258

John W. Mergen
GPS IIR Systems Engineering