John Kennedy

From: Wye, David [david.wye@lmco.com]
Sent: Tuesday, January 09, 2007 10:38 AM
To: John Kennedy
Cc: Wye, David
Subject: RE: FCC File # 0654-EX-PL-2006

John—Yes and No. The first one (Exhibit 1) is part of our formal application. The second file (Palmdale Application…) should not have been filed with you. It was meant only as an aid to Claude Wells so he could fill out the on-line application. It does have a handy table of the antenna ERP values for each antenna if you need it, however. Do we need to formally withdraw that document or how should we proceed?

Just to clarify, for our application, you should have received three exhibits. Exhibit 1 is the system description (which you just sent me so you obviously got that). Exhibit 2 was the powerpoint file I sent you earlier today. Exhibit 3 was simply a collection of spec sheets so you all could see exactly what equipment we plan to use.

Did you get all three of these files originally or would you like me to resend?

Thanks very much,

David Wye

From: John Kennedy [mailto:John.Kennedy@fcc.gov]
Sent: Tuesday, January 09, 2007 10:19 AM
To: Wye, David
Subject: FCC File # 0654-EX-PL-2006

Mr. Wye,

Are the two attached MS Word documents being submitted in addition to the Power Point document?

John W. Kennedy
Federal Communications Commission
Office of Engineering and Technology
Experimental Licensing Branch
(202) 418-2484

Exhibit 1
Description of Experimental Program

Lockheed Martin Corporation requires the use of GPS Re-Radiation (Re-Rad) systems inside our aircraft production/flight test facilities at Palmdale Airfield, California.[1] This equipment will be used as an "Experimental RNSS Test Device" for the purpose of testing and verifying GPS receiver functionality of various aircraft systems. Currently, in order to obtain a GPS signal, the aircraft and all supporting test equipment must be towed outside of the production/flight test facility. During this time, aircraft and personnel are exposed to adverse weather conditions and prevented from accessing certain tools and equipment. In addition, additional power and cooling is required for the aircraft. At certain times, due to safety and efficiency considerations, Lockheed Martin must have the ability to perform pre-flight GPS receiver functionality tests indoors. The GPS Re-Rad systems are designed to re-transmit the GPS signal at approximately the same signal level as received outside the hangars. This Exhibit describes the various implementations required at Palmdale.

1. PROGRAM DESCRIPTIONS

F-117. The program title is: F-117 "Blackhawk" Total System Support Partnership (TSSP). The contract number for this program is: F33657-98-D-0117.

General Description.

GPS re-rad capability is needed in a total of six buildings at USAF Plant 42, Site 7 to support the F-117 program. These facilities are used to test the avionics, the weapons systems, the navigation system and the test data system of the F-117 aircraft. The F-117 Combined Test Force (CTF) must correlate data between these various systems based upon GPS-derived time signals. Prior to a test mission, it is critical to perform a functional check of these systems to determine their operational readiness. Without this correlation the test data could become useless.

Technical information.

Locations:

- Three fixed antennas inside hangar facility at USAF Plant 42, Site 7, Building 730.

730T1
Latitude: W 118 05.735
Longitude: N 34 37.128

730T2
Latitude: W 118 05.755
Longitude: N 34 37.115

730T3
Latitude: W 118 05.791
Longitude: N 34 37.110

[1] The overall Palmdale Airfield is mostly USAF property. The AF designated their Palmdale facility "Plant 42" and segregated the facility into several physical "sites" or buildings that are used for specific purposes or programs, many of which are operated by contractors such as Lockheed Martin. Lockheed Martin also privately owns property associated with the Palmdale Airfield, which has been named "Plant 10" (not to be confused with Site 10 of USAF Plant 42).

- One fixed antenna inside hangar facility at USAF Plant 42, Site 7, Building 740.

  740T1
  Latitude: W 118 05.710
  Longitude: N 34 37.204

- One fixed antenna inside hangar facility at USAF Plant 42, Site 7, Building 762.

  762T1
  Latitude: W 118 05.709
  Longitude: N 34 37.259

- One fixed antenna inside hangar facility at USAF Plant 42, Site 7, Building 763.

  763T1
- Latitude: W 118 05.520
  Longitude: N 34 37.326

- One fixed antenna inside hangar facility at USAF Plant 42, Site 7, Building 751.

  751T1
- Latitude: W 118 05.565
  Longitude: N 34 37.384

- One fixed antenna inside hangar facility at USAF Plant 42, Site 7, Building 750.

  750T1
- Latitude: W 118 05.565
  Longitude: N 34 37.359

Advanced Development Programs. The program title is: Advanced Development Programs (ADP). The primary classified contract number for this program is: F33657-01-C-4198.

General Description.

ADP encompasses many programs, several of which are supported in this one large hangar facility, in building 602. Most of the programs are classified by the US government. However, some unclassified programs are also supported in portions of this building. One such program is the DARPA WALRUS development and evaluation program, contract number HR0011-05-C-0139. Where possible, a single GPS re-rad system will be used to support an area of a facility that may house multiple programs.

GPS re-rad capability is needed in a total of three buildings at Lockheed Martin Aeronautics Company Plant 10 to support classified, proof-of-concept and developmental systems programs. These facilities are used to test the electronics, weapons systems, navigation, test and communications systems of conceptual, experimental and developmental systems. These programs require GPS position and timing information for accurate navigation and time correlation between various sub-systems and support elements. Verification of proper systems/sub-systems performance is critical to the development and safe operation of these programs. Outdoor test and evaluation is often impossible or impractical due to the experimental and/or classified nature of the systems under test/development.

Technical Information.

Locations:

- Three fixed antennas inside hangar and laboratory facilities at Lockheed Martin Aeronautics Co. Plant 10, Building 602, North Hangar.

  602T2
  Latitude: W 118 07.092
  Longitude: N 34 37.110

  602T3
  Latitude: W 118 07.126
  Longitude: N 34 37.111

  ADP Avionics Laboratory, Room 309:
  602T1
  Latitude: W 118 07.100
  Longitude: N 34 37.097

- Two fixed antennas inside hangar facility at Lockheed Martin Aeronautics Co. Plant 10, Building 602, South Hangar.

  602T4
  Latitude: W 118 07.126
  Longitude: N 34 37.064

  602T5
  Latitude: W 118 07.092
  Longitude: N 34 37.064

- Four fixed antennas inside hangar and laboratory facilities at Lockheed Martin Aeronautics Co. Plant 10, Building 601, East Hangar.

  601T3
  Latitude: W 118 07.125
  Longitude: N 34 36.833

  601T4
  Latitude: W 118 07.052
  Longitude: N 34 36.835

  601T6
  ADP Avionics Laboratory, Room 111:
  Latitude: W 118 07.038
  Longitude: N 34 36.860

  601T7
  EMI/EMC Development Laboratory, Room 135:
  Latitude: W 118 07.130
  Longitude: N 34 36.862

- One fixed antenna inside hangar facility at USAF Plant 42, Site 2, Building 214.

  214T1
  Latitude: W 118 05.129
  Longitude: N 34 38.232

- One fixed antenna inside hangar facility at Lockheed Martin Aeronautics Co. Plant 10, Building 681A (Flight Line stall 1).

  681T1
  Latitude: W 118 06.925
  Longitude: N 34 37.180

F-22. The program title is: F-22 "Raptor" Modification Line. The contract number for this program is: F33657-99-C-0036.

General Description.

GPS re-rad capability is needed in one building at Lockheed Martin Aeronautics Company Plant 10 to support the F-22 "Raptor" modification line. GPS signals are necessary for the checkout, alignment and maintenance of the F-22 avionics and test instrumentation systems. GPS signal coverage indoors is needed to allow GPS enabled systems to be operated while the aircraft is physically unable to be moved outdoors.

Technical Information.

Locations:

- Two fixed antennas inside hangar facility at Lockheed Martin Aeronautics Co. Plant 10, Building 601, West Hangar.

  601T1
  Latitude: W 118 07.175
  Longitude: N 34 36.791

  601T2
  Latitude: W 118 07.177
  Longitude: N 34 36.835

- One fixed antenna inside hangar facility at Lockheed Martin Aeronautics Co. Plant 10, Building 601, Room 307, Flight Test Instrumentation Development Laboratory.

  601T5
  Latitude: W 118 07.170
  Longitude: N 34 36.861

U-2. The program title is: U-2 "Dragon Lady" Depot Maintenance, Modifications and Flight Test. The contract number for this program is: FA8528-05-D-0015-DO0012.

General Description.

GPS re-rad capability is needed in one building at USAF Plant 42, Site 2 to support the U-2 "Dragon Lady" program. This facility is used for periodic and depot maintenance, modifications, flight testing and sensor systems development/integration on the U-2 high altitude surveillance aircraft. GPS re-rad is needed for testing and verification of the flight platform, flight test instrumentation, avionics and missions equipment when moving the aircraft outdoors is unreasonable for mechanical, logistics, weather or security classification reasons.

Technical Information.

Locations:

- Four fixed antennas inside hangar facility at USAF Plant 42, Site 2, Building 210.

  210T1
  Latitude: W 118 05.383
  Longitude: N 34 38.270

  210T2
  Latitude: W 118 05.366
  Longitude: N 34 38.251

  210T3
  Latitude: W 118 05.428
  Longitude: N 34 38.250

  210T4
  Latitude: W 118 05.422
  Longitude: N 34 38.270

2. EQUIPMENT

All of the above sites will use the following equipment:

Antenna Orientation:	180 degrees vertical, 360 degrees horizontal. All antennas are directional facing down towards the ground.
Antenna Polarization:	Left hand circular polarization (LHCP)
Frequencies:	1227.6 MHz, 1575.42 MHz (GPS L2/L1)
Emissions:	20M4W7D

Power at antenna:

TABLE 1	L1				L2		
Reradiator Identifier	Maximum RF Power at the Transmitter Output Terminals	Maximum ERP from the Antenna			Maximum RF Power at the Transmitter Output Terminals	Maximum ERP from the Antenna	
	Watts	dBm	Watts		Watts	dBm	Watts
730T3	30.0E-12	-70.32	92.8E-12		36.3E-12	-70.90	81.3E-12
730T1	26.0E-12	-70.96	80.2E-12		37.5E-12	-70.75	84.0E-12
730T2	24.8E-12	-71.16	76.6E-12		29.8E-12	-71.76	66.7E-12
740T1	34.9E-12	-69.67	108.0E-12		39.4E-12	-70.54	88.3E-12
762T1	9.3E-12	-75.44	28.6E-12		9.6E-12	-76.69	21.4E-12
763T1	9.3E-12	-75.44	28.6E-12		9.6E-12	-76.69	21.4E-12
751T1	13.6E-12	-73.77	42.0E-12		14.9E-12	-74.76	33.4E-12
750T1	13.6E-12	-73.77	42.0E-12		14.9E-12	-74.76	33.4E-12
602T3	28.9E-12	-70.49	89.3E-12		41.3E-12	-70.34	92.4E-12
602T2	28.9E-12	-70.49	89.3E-12		41.3E-12	-70.34	92.4E-12
602T1	29.2E-12	-70.44	90.3E-12		31.8E-12	-71.47	71.2E-12
602T5	28.9E-12	-70.49	89.3E-12		41.3E-12	-70.34	92.4E-12
602T4	28.9E-12	-70.49	89.3E-12		41.3E-12	-70.34	92.4E-12
601T4	32.4E-12	-69.99	100.1E-12		45.7E-12	-69.91	102.2E-12
601T3	32.4E-12	-69.99	100.1E-12		45.7E-12	-69.91	102.2E-12
601T6	4.6E-12	-78.49	14.2E-12		5.4E-12	-79.16	12.1E-12
601T7	4.6E-12	-78.49	14.2E-12		5.4E-12	-79.16	12.1E-12
601T1	32.4E-12	-69.99	100.1E-12		45.7E-12	-69.91	102.2E-12
601T2	32.4E-12	-69.99	100.1E-12		45.7E-12	-69.91	102.2E-12
601T5	7.7E-12	-76.21	23.9E-12		8.6E-12	-77.15	19.3E-12
681T1	20.4E-12	-71.99	63.2E-12		22.0E-12	-73.08	49.2E-12
210T2	45.4E-12	-68.53	140.2E-12		63.1E-12	-68.50	141.3E-12
210T3	41.1E-12	-68.96	127.1E-12		61.1E-12	-68.64	136.8E-12
210T1	12.6E-12	-74.10	38.9E-12		17.3E-12	-74.12	38.7E-12
210T4	9.1E-12	-75.51	28.1E-12		14.9E-12	-74.78	33.3E-12
214T1	17.4E-12	-72.70	53.7E-12		18.6E-12	-73.81	41.6E-12

3. CONDITIONS OF LICENSE

For all the foregoing programs, the following conditions will apply.

The experimental period will last for two years or 24 months.

In order to ensure no GPS re-radiated signal adversely affects safety-of-life applications, Lockheed Martin will only transmit:

- Indoors;
- Such that no GPS re-radiated signal level greater than or equal to –140 dBm, measured 100 feet from the building perimeter will occur; and
- When testing an airplane indoors is considered necessary by flight-test personnel.

In addition:

- The “Stop Buzzer” emergency point of contact (POC) will be Mr. Wayne Maynard (661) 572-3516, pager (888) 449-5479. The secondary POC will be Rich Elersich (661) 572-3019, pager (888) 336-5619.
  If the POC changes, Lockheed Martin Aeronautics Company will immediately notify the FCC, FAA, DoD and any other interested agency.
- The location of the GPS transmitters will be fixed and located in such a way that the entire area of potential interference from the GPS transmitters is under the control of Lockheed Martin personnel - the facility where the transmitters will be located is a “secure” facility where security personnel control ingress and egress.

If you have any questions, please contact David Wye at 703-413-5603 or david.wye@lmco.com.

LOCKHEED MARTIN

EXHIBIT 2
GPS SIGNAL LEVEL CALCULATIONS

LOCKHEED MARTIN AERONAUTICS COMPANY

Palmdale, CA.

LOCKHEED MARTIN

SYSTEM 1
USAF PLANT 42 SITE 7
BUILDING 730
F-117 MAINTENANCE
IDENTIFIERS: 730T1/T2/T3

The following calculations are for System 1 transmit identifiers 730T1, 730T2 and 730T3. All transmitter locations are equal distance from the nearest exterior wall. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet)
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(182.5) + 20*LOG(1575.42) = 71.3 dB

2. For L2: FSL = -37.87 + 20*LOG(182.5) + 20*LOG(1227.6) = 69.1dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 19.9 picowatts EIRP = -77.0 dBm/24 MHz
At 100 feet = -77.0 - 71.3 = **-148.3 dBm/24 MHz**

2. L2 Transmitted Power = 16.9 picowatts EIRP = -77.7 dBm/24 MHz
At 100 feet = -77.7 - 69.1 = **-146.8 dBm/24 MHz**

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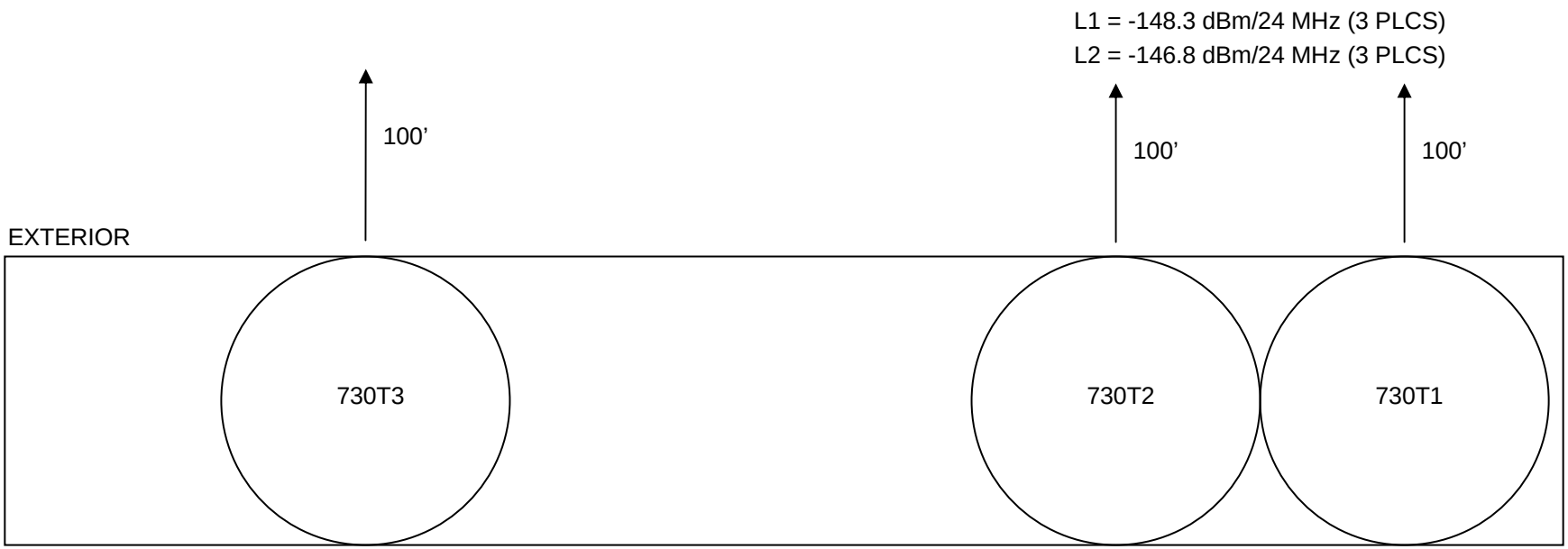
SYSTEM 1
USAF PLANT 42 SITE 7
BUILDING 730
F-117 MAINTENANCE
IDENTIFIERS: 730T1/T2/T3
BUILDING DIMENSION: 161' X 712'



LOCKHEED MARTIN

SYSTEM 2
USAF PLANT 42 SITE 7
BUILDING 740
F-117 MAINTENANCE
IDENTIFIERS: 740T1

The following calculations are for System 2 transmit identifier 740T1. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(180.3) + 20*LOG(1575.42) = 71.2 dB

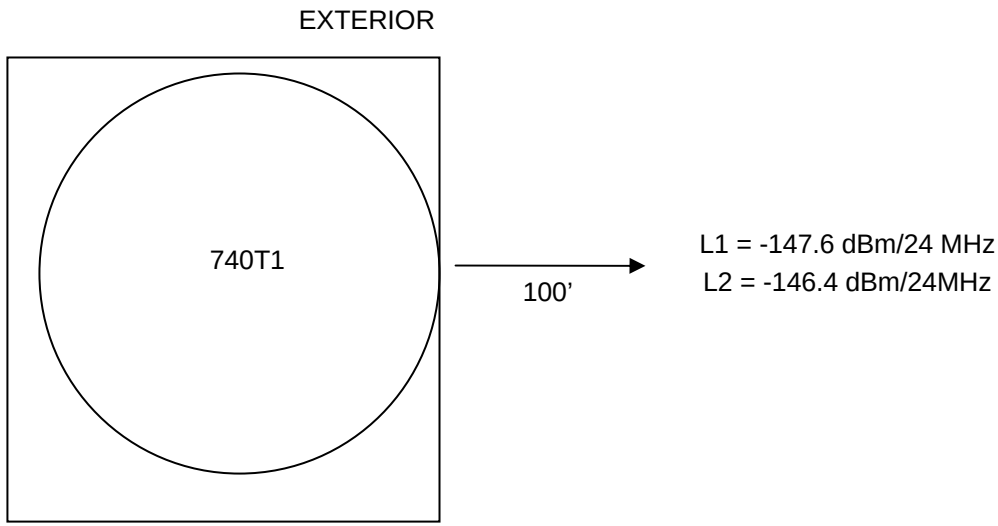
2. For L2: FSL = -37.87 + 20*LOG(180.3) + 20*LOG(1227.6) = 69.0 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 23.1 picowatts EIRP = -76.4 dBm/24 MHz
At 100 feet = -76.4 - 71.2 = **-147.6 dBm/24 MHz**

2. L2 Transmitted Power = 18.4 picowatts EIRP = -77.4 dBm/24 MHz
At 100 feet = -77.4 - 69.0 = **-146.4 dBm/24 MHz**

SYSTEM 2
USAF PLANT 42 SITE 7
BUILDING 740
F-117 MAINTENANCE
IDENTIFIERS: 740T1
BUILDING DIMENSION: 163’ X 183’



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SYSTEM 3
USAF PLANT 42 SITE 7
BUILDING 762
F-117 MAINTENANCE
IDENTIFIERS: 762T1

The following calculations are for System 3 transmit identifier 762T1. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(123.8) + 20*LOG(1575.42) = 67.9 dB

2. For L2: FSL = -37.87 + 20*LOG(123.8) + 20*LOG(1227.6) = 65.8 dB

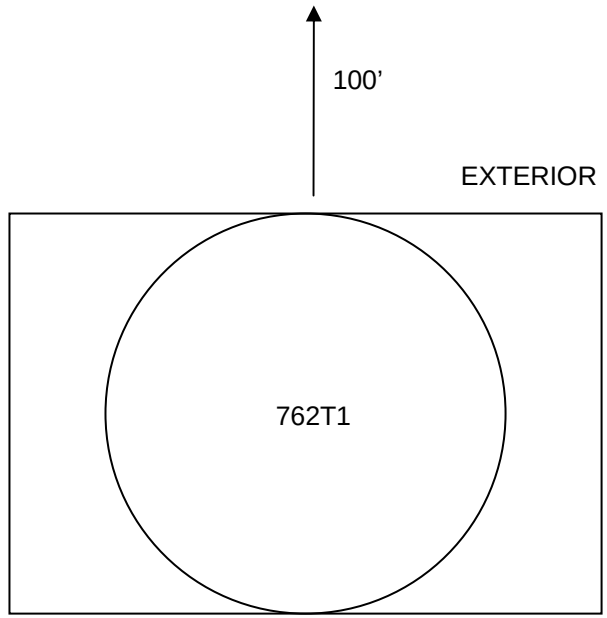
The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 6.1 picowatts EIRP = -82.1 dBm/24 MHz
At 100 feet = -82.1 - 67.9 = **-150.0 dBm/24 MHz**

2. L2 Transmitted Power = 4.5 picowatts EIRP = -83.5 dBm/24 MHz
At 100 feet = -83.5 - 65.8 = **-149.3 dBm/24 MHz**

SYSTEM 3
USAF PLANT 42 SITE 7
BUILDING 762
F-117 MAINTENANCE
IDENTIFIERS: 762T1
BUILDING DIMENSION: 42’ X 69’

L1 = -150.0 dBm/24 MHz
L2 = -149.3 dBm/24MHz



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SYSTEM 4
USAF PLANT 42 SITE 7
BUILDING 763
F-117 FLIGHT TEST
IDENTIFIERS: 763T1

The following calculations are for System 4 transmit identifier 763T1. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(123.8) + 20*LOG(1575.42) = 67.9 dB

2. For L2: FSL = -37.87 + 20*LOG(123.8) + 20*LOG(1227.6) = 65.8 dB

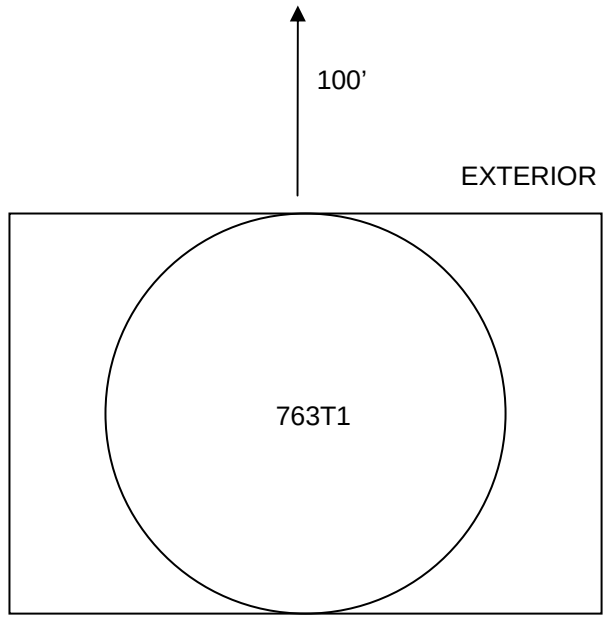
The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 6.1 picowatts EIRP = -82.1 dBm/24 MHz
At 100 feet = -82.1 - 67.9 = **-150.0 dBm/24 MHz**

2. L2 Transmitted Power = 4.5 picowatts EIRP = -83.5 dBm/24 MHz
At 100 feet = -83.5 - 65.8 = **-149.3 dBm/24 MHz**

SYSTEM 4
USAF PLANT 42 SITE 7
BUILDING 763
F-117 FLIGHT TEST
IDENTIFIERS: 763T1
BUILDING DIMENSION: 42’ X 69’

L1 = -150.0 dBm/24 MHz
L2 = -149.3 dBm/24MHz



LOCKHEED MARTIN

SYSTEM 5
USAF PLANT 42 SITE 7
BUILDING 751
F-117 FLIGHT TEST
IDENTIFIERS: 751T1

The following calculations are for System 5 transmit identifier 751T1. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(135.1) + 20*LOG(1575.42) = 68.7 dB

2. For L2: FSL = -37.87 + 20*LOG(135.1) + 20*LOG(1227.6) = 66.5 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

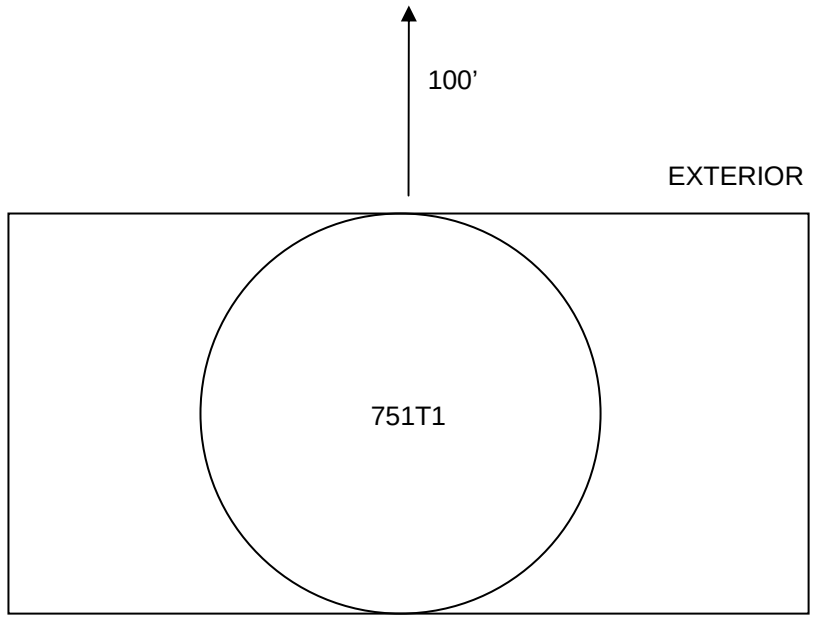
1. L1 Transmitted Power = 9.0 picowatts EIRP = -80.5 dBm/24 MHz
At 100 feet = -80.5 - 68.7 = **-149.2 dBm/24 MHz**

2. L2 Transmitted Power = 7.0 picowatts EIRP = -81.6 dBm/24 MHz
At 100 feet = -81.6 - 66.5 = **-148.1 dBm/24 MHz**

LOCKHEED MARTIN

SYSTEM 5
USAF PLANT 42 SITE 7
BUILDING 751
F-117 FLIGHT TEST
IDENTIFIERS: 751T1
BUILDING DIMENSION: 71’ X 147’

L1 = -149.2 dBm/24 MHz
L2 = -148.1 dBm/24MHz



LOCKHEED MARTIN

SYSTEM 6
USAF PLANT 42 SITE 7
BUILDING 750
F-117 FLIGHT TEST
IDENTIFIERS: 750T1

The following calculations are for System 6 transmit identifier 750T1. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(135.1) + 20*LOG(1575.42) = 68.7 dB

2. For L2: FSL = -37.87 + 20*LOG(135.1) + 20*LOG(1227.6) = 66.5 dB

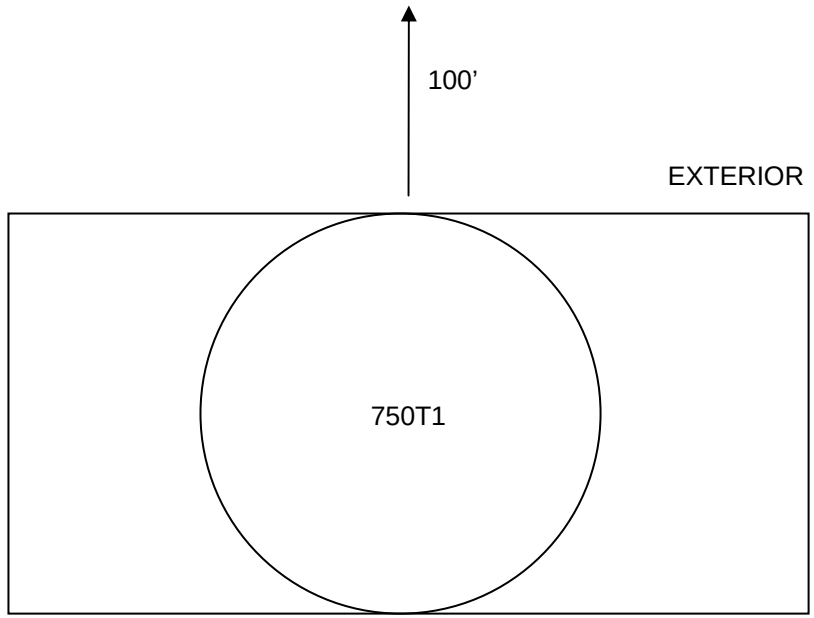
The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 9.0 picowatts EIRP = -80.5 dBm/24 MHz
At 100 feet = -80.5 - 68.7 = **-149.2 dBm/24 MHz**

2. L2 Transmitted Power = 7.0 picowatts EIRP = -81.6 dBm/24 MHz
At 100 feet = -81.6 - 66.5 = **-148.1 dBm/24 MHz**

SYSTEM 6
USAF PLANT 42 SITE 7
BUILDING 750
F-117 FLIGHT TEST
IDENTIFIERS: 750T1
BUILDING DIMENSION: 71’ X 147’

L1 = -149.2 dBm/24 MHz
L2 = -148.1 dBm/24MHz



LOCKHEED MARTIN

SYSTEM 7
USAF PLANT 42 SITE 2
BUILDING 210 EYEBROWS
U-2 PROGRAM
IDENTIFIERS: 210T1/T4

The following calculations are for System 7 transmit identifiers 210T1 and 210T4. All transmitter locations are equal distance from the nearest exterior wall. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(152.1) + 20*LOG(1575.42) = 69.7 dB

2. For L2: FSL = -37.87 + 20*LOG(152.1) + 20*LOG(1227.6) = 67.6 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 10.5 picowatts EIRP = -79.8 dBm/24 MHz
At 100 feet = -79.8 - 69.7 = **-149.5 dBm/24 MHz**

2. L2 Transmitted Power = 10.0 picowatts EIRP = -80.0 dBm/24 MHz
At 100 feet = -80.0 - 67.6 = **-147.6 dBm/24 MHz**

LOCKHEED MARTIN

SYSTEM 7
USAF PLANT 42 SITE 2
BUILDING 210 HANGAR
U-2 PROGRAM
IDENTIFIERS: 210T2/T3

The following calculations are for System 7 transmit identifiers 210T2 and 210T3. All transmitter locations are equal distance from the nearest exterior wall. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(209.8) + 20*LOG(1575.42) = 72.5 dB

2. For L2: FSL = -37.87 + 20*LOG(209.8) + 20*LOG(1227.6) = 70.4 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 30.0 picowatts EIRP = -75.2 dBm/24 MHz
At 100 feet = -75.2 - 72.5 = **-147.7 dBm/24 MHz**

2. L2 Transmitted Power = 29.4 picowatts EIRP = -75.3 dBm/24 MHz
At 100 feet = -75.3 - 70.4 = **-145.7 dBm/24 MHz**

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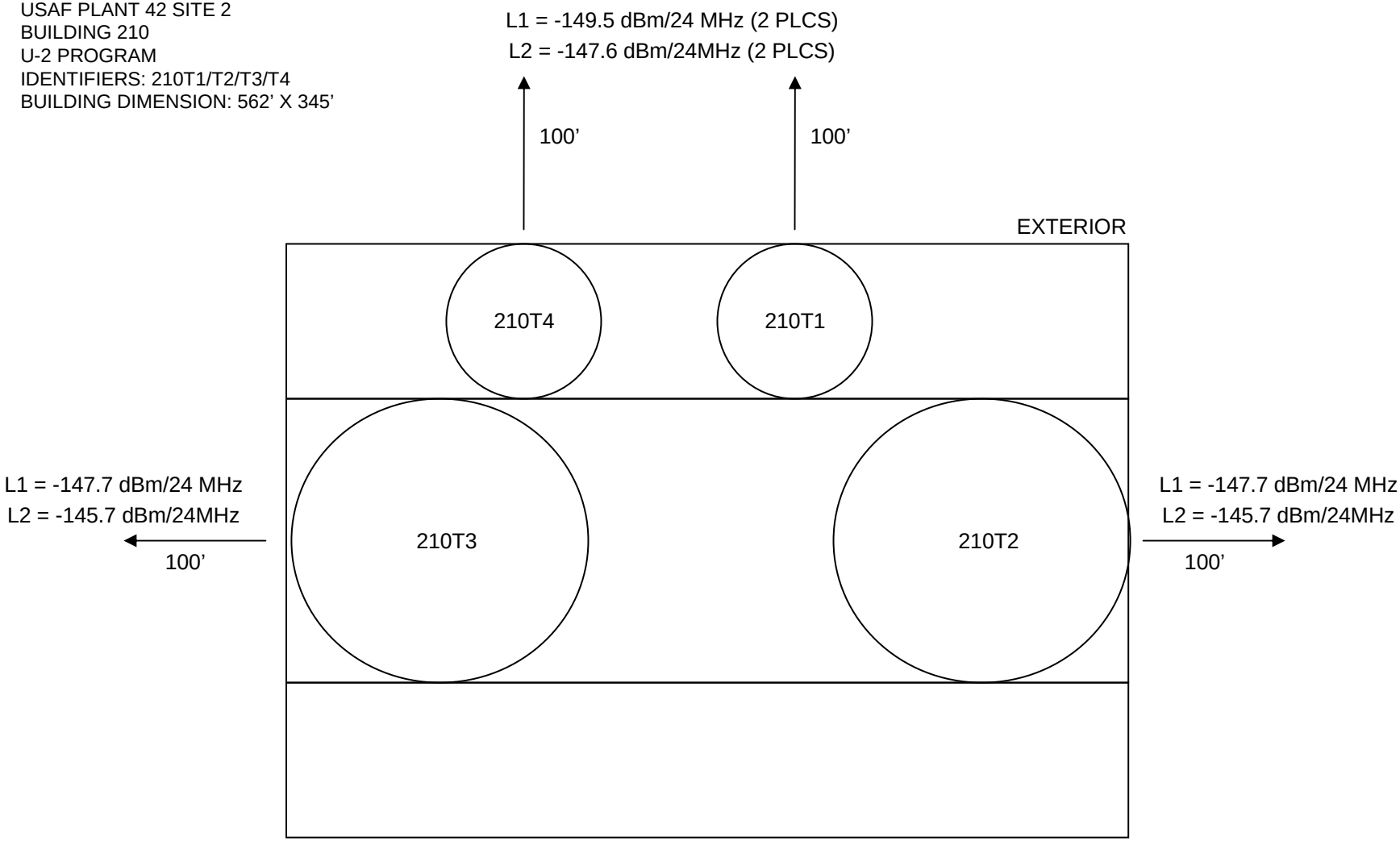
SYSTEM 7
USAF PLANT 42 SITE 2
BUILDING 210
U-2 PROGRAM
IDENTIFIERS: 210T1/T2/T3/T4
BUILDING DIMENSION: 562' X 345'



2 NOV 06

LOCKHEED MARTIN

SYSTEM 8
USAF PLANT 42 SITE 2
BUILDING 214
U-2 FUEL BARN
IDENTIFIERS: 214T1

The following calculations are for System 8 transmit identifier 214T1. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(146.2) + 20*LOG(1575.42) = 69.4 dB

2. For L2: FSL = -37.87 + 20*LOG(146.2) + 20*LOG(1227.6) = 67.2 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 14.5 picowatts EIRP = -78.4 dBm/24 MHz
At 100 feet = -78.4 - 69.4 = **-147.8 dBm/24 MHz**

2. L2 Transmitted Power = 10.7 picowatts EIRP = -79.7 dBm/24 MHz
At 100 feet = -79.7 - 67.2 = **-146.9 dBm/24 MHz**

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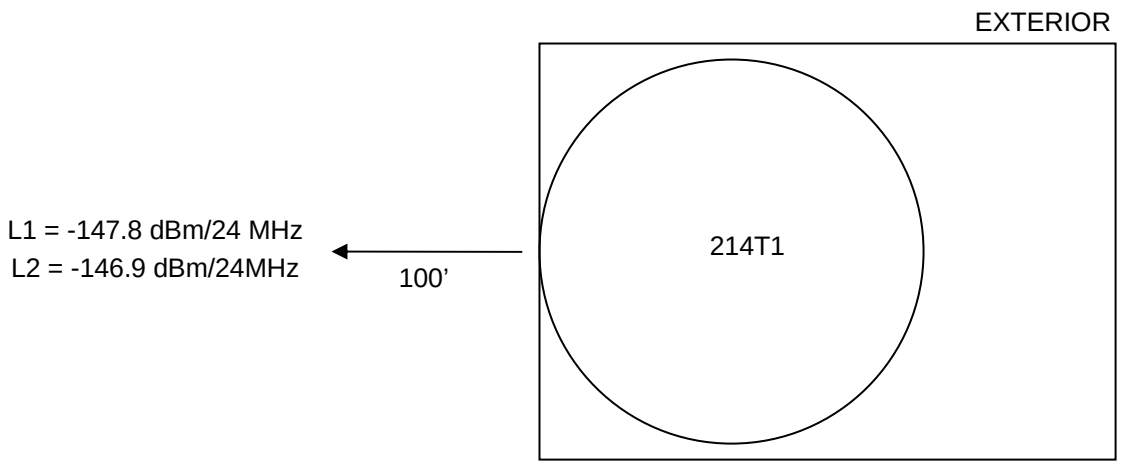
SYSTEM 8
USAF PLANT 42 SITE 2
BUILDING 214
U-2 “FUEL BARN”
IDENTIFIERS: 214T1
BUILDING DIMENSION: 123’ X 80’



2 NOV 06

LOCKHEED MARTIN

SYSTEM 9
LMAC PLANT 10
BUILDING 602
ADP AVIONICS LAB
IDENTIFIERS: 602T1

The following calculations are for System 9 transmit identifier 602T1. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(185.2) + 20*LOG(1575.42) = 71.4 dB

2. For L2: FSL = -37.87 + 20*LOG(185.2) + 20*LOG(1227.6) = 69.3 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 13.2 picowatts EIRP = -78.8 dBm/24 MHz
At 100 feet = -78.8 - 71.4 = **-150.2 dBm/24 MHz**

2. L2 Transmitted Power = 10.1 picowatts EIRP = -80.0 dBm/24 MHz
At 100 feet = -80.0 - 69.3 = **-149.3 dBm/24 MHz**

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SYSTEM 9 & 10
LMAC PLANT 10
BUILDING 602 NORTH & SOUTH
ADP HANGAR AREAS
IDENTIFIERS: 602T2/T3/T4/T5

The following calculations are for System 9 & 10 transmit identifiers 602T2, 602T3, 602T4 and 602T5. All transmitter locations are equal distance from the nearest exterior wall. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(198.3) + 20*LOG(1575.42) = 72.0 dB

2. For L2: FSL = -37.87 + 20*LOG(198.3) + 20*LOG(1227.6) = 69.9 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 29.8 picowatts EIRP = -75.3 dBm/24 MHz
At 100 feet = -75.3 - 72.0 = **-147.3 dBm/24 MHz**

2. L2 Transmitted Power = 28.9 picowatts EIRP = -75.4 dBm/24 MHz
At 100 feet = -75.4 - 69.9 = **-145.3 dBm/24 MHz**

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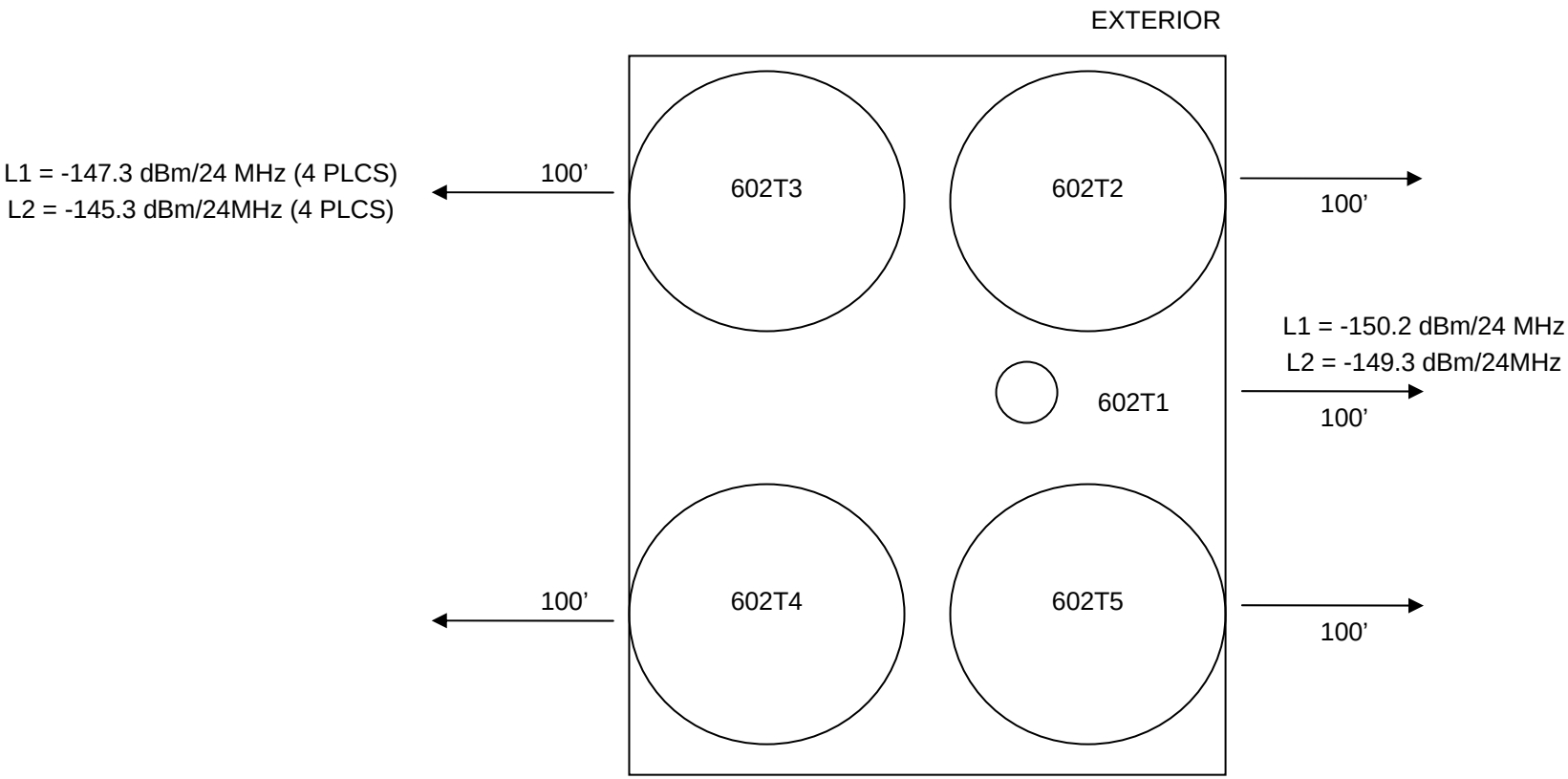
SYSTEM 9 & 10
LMAC PLANT 10
BUILDING 602 NORTH & SOUTH
ADP HANGAR AREAS & LAB
IDENTIFIERS: 602T1/T2/T3/T4/T5
BUILDING DIMENSION: 475' X 354'



2 NOV 06

LOCKHEED MARTIN

SYSTEM 11
LMAC PLANT 10
BUILDING 601
ADVANCED DEVELOPMENT LABS
IDENTIFIERS: 601T6/T7

The following calculations are for System 11 transmit identifiers 601T6 and 601T7. All transmitter locations are equal distance from the nearest exterior wall. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(120.9) + 20*LOG(1575.42) = 67.7 dB

2. For L2: FSL = -37.87 + 20*LOG(120.9) + 20*LOG(1227.6) = 65.6 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 3.0 picowatts EIRP = -85.2 dBm/24 MHz
At 100 feet = -85.2 - 67.7 = **-152.9 dBm/24 MHz**

2. L2 Transmitted Power = 2.5 picowatts EIRP = -86.0 dBm/24 MHz
At 100 feet = -86.0 - 65.6 = **-151.6 dBm/24 MHz**

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SYSTEM 11
LMAC PLANT 10
BUILDING 601 EAST
ADVANCED DEVELOPMENT HANGAR
IDENTIFIERS: 601T3

The following calculations are for System 11 transmit identifier 601T3. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(273.5) + 20*LOG(1575.42) = 74.8 dB

2. For L2: FSL = -37.87 + 20*LOG(273.5) + 20*LOG(1227.6) = 72.6 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 33.5 picowatts EIRP = -74.8 dBm/24 MHz
At 100 feet = -74.8 – 74.8 = **-149.6 dBm/24 MHz**

2. L2 Transmitted Power =32.0 picowatts EIRP = -75.0 dBm/24 MHz
At 100 feet = -75.0 – 72.6 = **-147.6 dBm/24 MHz**

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SYSTEM 11 & 12
LMAC PLANT 10
BUILDING 601 EAST & WEST
ADVANCED DEVELOPMENT & F-22 MOD LINE HANGARS
IDENTIFIERS: 601T1/T2/T4

The following calculations are for System 11 & 12 transmit identifiers 601T1, 601T2 and 601T4. All transmitter locations are equal distance from the nearest exterior wall. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(235.8) + 20*LOG(1575.42) = 73.5 dB

2. For L2: FSL = -37.87 + 20*LOG(235.8) + 20*LOG(1227.6) = 71.4 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 33.5 picowatts EIRP = -74.8 dBm/24 MHz
At 100 feet = -74.8 - 73.5 = **-148.3 dBm/24 MHz**

2. L2 Transmitted Power = 32.0 picowatts EIRP = -75.0 dBm/24 MHz
At 100 feet = -75.0 - 71.4 = **-146.4 dBm/24 MHz**

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SYSTEM 13
LMAC PLANT 10
BUILDING 601 NW
FLIGHT TEST LAB
IDENTIFIERS: 601T5

The following calculations are for System 13 transmit identifier 601T5. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(120.9) + 20*LOG(1575.42) = 67.7 dB

2. For L2: FSL = -37.87 + 20*LOG(120.9) + 20*LOG(1227.6) = 65.6 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 3.0 picowatts EIRP = -85.2 dBm/24 MHz
At 100 feet = -85.2 - 67.7 = **-152.9 dBm/24 MHz**

2. L2 Transmitted Power = 2.5 picowatts EIRP = -86.0 dBm/24 MHz
At 100 feet = -86.0 - 65.6 = **-151.6 dBm/24 MHz**

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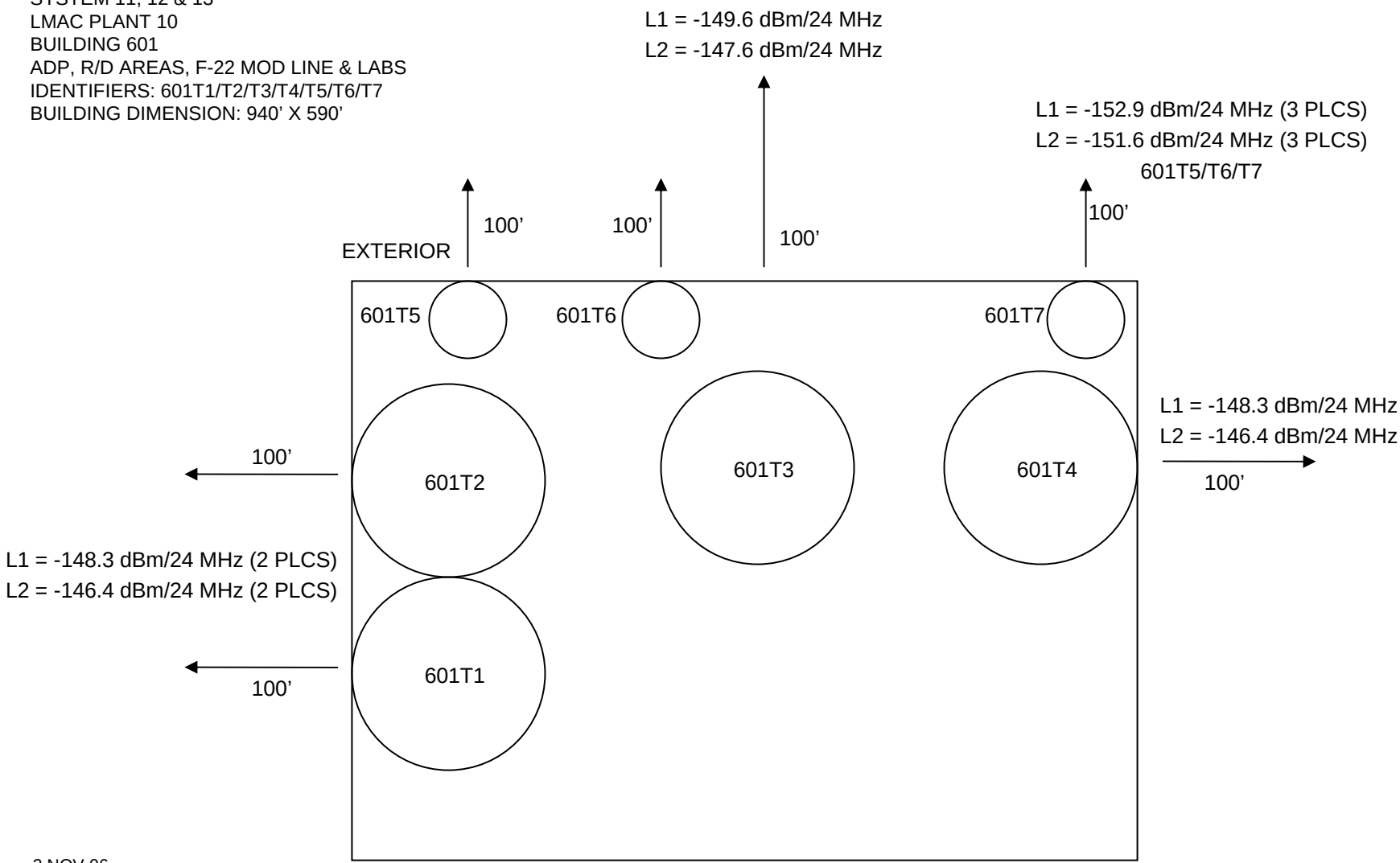
SYSTEM 11, 12 & 13
LMAC PLANT 10
BUILDING 601
ADP, R/D AREAS, F-22 MOD LINE & LABS
IDENTIFIERS: 601T1/T2/T3/T4/T5/T6/T7
BUILDING DIMENSION: 940' X 590'



2 NOV 06

LOCKHEED MARTIN

SYSTEM 14
LMAC PLANT 10
BUILDING 681A
FLIGHT LINE – STALL 1
IDENTIFIERS: 681T1

The following calculations are for System 14 transmit identifier 681T1. Calculations are based upon an average receive power for L1 and L2 of -130 dBm.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

FSL = K1 + 20*LOG (D) + 20*LOG (F)
Where:
K1 = the constant factor (-37.87) for the desired units (feet),
F = the frequency in MHz; and
D = the slant range distance from the transmitter antenna to 100 feet beyond the nearest exterior wall in feet.

The GPS Re-radiation device transmits at two frequencies: 1575.42 MHz for L1 and 1227.6 MHz for L2.

Therefore, the Free Space Path Loss (FSL) equals:

1. For L1: FSL = -37.87 + 20*LOG(152.2) + 20*LOG(1575.42) = 69.7 dB

2. For L2: FSL = -37.87 + 20*LOG(152.2) + 20*LOG(1227.6) = 67.6 dB

The calculated signal at 100 feet beyond the nearest exterior wall from the transmit antenna is as follows:

1. L1 Transmitted Power = 13.5 picowatts EIRP = -78.7 dBm/24 MHz
At 100 feet = -78.7 - 69.7 = **-148.4 dBm/24 MHz**

2. L2 Transmitted Power = 10.2 picowatts EIRP = -79.9 dBm/24 MHz
At 100 feet = -79.9 - 67.6 = **-147.5 dBm/24 MHz**

SYSTEM 14
LMAC PLANT 10
BUILDING 681A
FLIGHT LINE STALL 1
IDENTIFIERS: 681T1
BUILDING DIMENSION: 150’ X 100’

L1 = -148.4 dBm/24 MHz
L2 = -147.5 dBm/24MHz

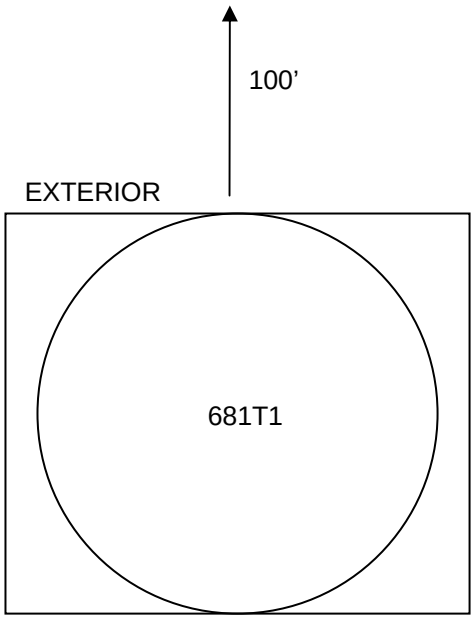


Exhibit 3

Equipment Specification Sheets

A11XLV-L-F1-P110/5-NF

Technical Product Data

Features

- **Features that Facilitate FCC Site Authorization for GPS Repeaters**
- **Calibrated & Controlled ERP Levels**
- **Filtered L1\L2**
- **Oscillation Detection & Prevention**
- **Antenna Monitor & Alarm Indication**
- **Wireless Remote Control via Bluetooth Option**

Description

The A11XLV represents a significant advancement in GPS Repeater technology, including features that facilitate FCC site authorization. Featuring an integrated GPS receiver, the A11XLV provides a calibrated and controlled ERP at the user defined or FCC authorized level, regardless of the uncertain loss or gain in the receive antenna cable network. Additionally, the A11XLV provides a tracking indication when the device is tracking satellites and controlling the re-radiated signal levels, and enables the operator to observe the list of satellites that are being re-radiated. The product also includes optional features for oscillation detection and prevention, receive antenna monitoring, and filtering for the GPS L1 & L2 bands. The A11XLV features digital display with a user friendly menu enabling easy operation and configuration of the device. With an optional Bluetooth wireless interface also available, the A11XLV may be configured remotely when access to the system is not convenient.

The A11XLV is only available for certain eligible customers in the United States or for customers outside the United States. This is the product you need to facilitate FCC authorization of your site for GPS Repeaters. Call, email (sales@gpssource.com), or visit our website (www.gpssource.com) for further information on product options, specifications, or to receive an easy to use order sheet.

Repeater Amplifier:

Electrical Specifications, Operating Temperature -40 to 85°C

Parameter	Conditions	Min	Typ	Max	Units
Freq. Range: 1575.4MHz 1227.6MHz	IN – OUT, IN/OUT-50Ω	 1565 1217		 1585 1237	MHz
Rejection: 1575MHz +/- 50MHz +/- 75MHz +/- 300MHz 1227MHz +/- 50MHz +/- 75MHz +/- 300MHz	IN – OUT, IN/OUT-50Ω;	 5 12 33 5 12 33			dB
Gain -Min. Gain Setting -Max. Gain Setting	IN – OUT (Tx Ant.)	 -21.8 37.2	 -19 40	 -16.2 42.8	dB
Controlled Sig. Lvl. ERP: -Min. RF Out(1)(2) -Max. RF Out(1)(3)	IN – OUT (Tx Ant.)	 -84.5 -63.5	 -86 -65	 -87.5 -66.5	dBm
Input/Output Imped.	IN, OUT Port		50		Ω
Input/Output SWR	Input, Output Port 50Ω			2.0:1	-
Noise Figure	IN Port – Tx Ant; Max. Signal Setting			2.5	dB
DC IN	DC Input from wall mount transformer, or quick disconnects Optional DC input on IN Port:	8 6	9	16 16	VDC VDC
Current	Amplifier Current Draw, DC Input			180	mA
Current (Iout)	Antenna Current Draw, DC output to Ant VDC In = 16V,			35	mA

Notes:

1. Min. and Max. calibrated/controlled GPS repeater output signal levels in ERP.
2. Equates to a range of approximately 30ft., assuming ERP signal level of -142.1dBm (EIRP of -140dBm) and typical value of -86dBm.
3. Equates to a range of approximately 350ft., assuming ERP signal level of -142.1dBm (EIRP of -140dBm) and typical value of -65dBm.

Electrical Specifications, Operating Temperature -40 to 85^{0}C

Parameter	Conditions	Min	Typ	Max	Units
Freq. Range: 1575.4MHz 1227.6MHz	Ant – Output, Output = 50Ω	 1565 1217		 1585 1237	 MHz
Imped.			50		Ω
Gain	Output =50Ω	2.5	3.0	3.5	dBi
Output SWR	Output = 50Ω			2.5:1	-
Polarization	Right Hand Circular				

Antenna GPS L1& L1/L2

PRODUCT DATA SHEET

Part Number: L12GP – Passive GPS L1 Antenna

Part Number: L1L22GP – Passive GPS L1/L2 Antenna

Performance Specifications

Frequency response covers GPS L1 & L2
- **1575.42 +- 10MHz**
- **1227.00 +- 10MHz**
- **VSWR < 1.5:1**
- **Antenna Gain: +3.5dBic**
- **DC Grounding: Yes (lightening protection)**

Specifications
- **Rejection: (2) 2-pole Filters for each band**
- **Polarization: Right Hand Circular**
- **Impedance: 50 Ohms**

Environmental

- **Temperature: -55°C to +85°C**
- **Altitude: 70,000ft**
- **Vibration: 10G's**
- **Leakage: Hermetically Sealed**

Federal & Military

- **FAA TSO C-144, DO-160D, DO-228**
- **MIL-C-5541, MIL-E-5400**
- **MIL-I-45208A, MIL-STD-810**

Mechanical Specifications

Dimensions
- **Size: 2.6"D x 0.64"H**
- **Weight: 3.9oz**

Connector

- SMA(f)