Raytheon Multi-Program Testbed
GPS Re-Radiator Justification
Ontario California International Airport, Fixed Installation

1. Individual authorization is necessary for each device at a specific location.

Noted. Raytheon is only requesting a single unit at the fixed location specified by 1923 East Avion Street Ontario, CA, Ontario International Airport California, N 34 deg 03' 08", W 117 deg 36' 40"

2. Applications for frequency assignment should be applied for as an XT station with a note indicating the device is to be used as an "Experimental RNSS Test Equipment for the purpose of testing GPS receivers".

Noted.

Raytheon Space & Airborne Systems is requesting permission to install and operate a Global Positioning System (GPS) re-radiator at our new Ontario International Airport California, hangar facility. The GPS re-radiator receives normal free-space GPS RF signals and repeat transmits them into the hangar facility interior.

The GPS re-radiator will be utilized to support the Raytheon Multi-Program Testbed (RMT) aircraft. The RMT aircraft is a testbed developed to support avionics programs.

The RMT aircraft is normally positioned within the hangar during ground operations and pre-flight activities. The GPS re-radiator will provide the normal GPS signals into the hangar interior thus simulating an out-of-hangar GPS RF environment. This will save the RMT program time and effort by eliminating the requirement to position the aircraft out of the hangar during these frequently scheduled program activities.

3. Approved applications for frequency assignment will be entered in the GMF

Noted.

4. The maximum length of the assignment will be two years, with possible renewal.

The RMT program currently anticipates a program need of the STA for 6 months until the move is complete and our government contract is renewed.

5. The operation must be at specified location and mobile operation is not authorized.

Raytheon Space and Airborne Systems is only requesting a single unit at the fixed location specified by:

1923 East Avion Street Ontario, CA, Ontario International Airport California, N 34 deg 03' 08", W 117 deg 36' 40"

6. The area of potential interference to GPS reception (e.g., military or contractor facility) has to be under the control of the user.

The area of potential interference is contained within leased hangar and tarmac space controlled by Raytheon Space and Airborne Systems.

7. The maximum equivalent isotropically radiated power must be such that the emissions are no greater than -140 dBm/24 MHz at a distance of 100 feet (30 meters) from the building where the test is being conducted. The calculations showing compliance with this requirement must be provided with the application for frequency assignment and should be based on free space propagation with no allowance for building attenuation.

Refer to attachments #1 and 2.

8. GPS users in the area of potential interference to GPS reception must be notified that GPS information may be impacted for periods of time.

The only user of GPS information within the area of potential interference is the requesting organization, Raytheon Space and Airborne Systems. All Raytheon Space and Airborne Systems personnel or supporting contractors will be notified of the availability and use of the requested GPS re-radiation system within the area of potential interference.

9. The use is limited to activity for the purpose of testing RNSS equipment/systems.

The application and use of the requested unit is solely for the support of testing RNSS equipment or systems.

Raytheon Space & Airborne Systems is requesting permission to install and operate a Global Positioning System (GPS) re-radiator at the program's Ontario CA International Airport hangar facility. The GPS re-radiator receives normal free-space GPS RF signals and repeat transmits them into the hangar facility interior.

The GPS re-radiator will be utilized to support the RMT aircraft. The RMT aircraft is a testbed developed to support avionics programs.

The RMT aircraft is normally positioned within the hangar during ground operations and pre-flight activities. The GPS re-radiator will provide the normal GPS signals into the hangar interior thus simulating an out-of-hangar GPS RF environment. This will save the RMT program time and effort by eliminating the requirement to position the aircraft out of the hangar during these frequently scheduled program activities.

10. A "Stop Buzzer" point of contact for the authorized device must be identified and available at all times during GPS re-radiation operation of the device under any condition. (Rev. 9/2005)

Mr. Alan Wigdahl 310-417-3706, is the supervisor of the facility where the GPS re-radiator will be located. The backup individual for this purpose is Mr. John Mallet, 310-417-3714.

The input power to the GPS re-radiation unit is controlled by a single power subpanel circuit breaker located adjacent to the Raytheon Space and Airborne Systems maintenance office. The circuit breaker is clearly labeled and under the direct control of Mr. Gerome at all times.

ATTACHMENT #1

GPS Reradiation Signal Strength

Specifications and Evaluation

Below is the computation of the signal level, as transmitted by the reradiation kit, at a fixed distance from the repeater antenna. In particular we are interested in the computed signal level at a distance of 100 ft. from the hangar door.

Calculation:

Signal level of GPS in open space (from the satellites) received at the antenna.	-158.5 dBW (L1 Frequency) -164.5 dBW (L2 Frequency)
LNA amplifier gain in the receive antenna	+ 38 dB
Signal loss through 75 feet of coaxial cable (LMR-400 specified at 6dB of loss per 100 ft.)	- 4.5 dB
Reradiation Amplifier gain	+ 20 dB
Computed L1 Signal Output at the reradiation antenna	- 105.0 dBW
Computed L2 Signal Output at the reradiation antenna	- 111.0 dBW

Signal Loss Through Space:
A sharp attenuation of the GPS signal occurs in the first 10 feet away from the reradiation antenna with a loss of approximately 50dB at that distance. At 50 feet, the expected loss would be 60dB. At 100 feet the signal attenuates by about 65dB from the starting level at the reradiation antenna.

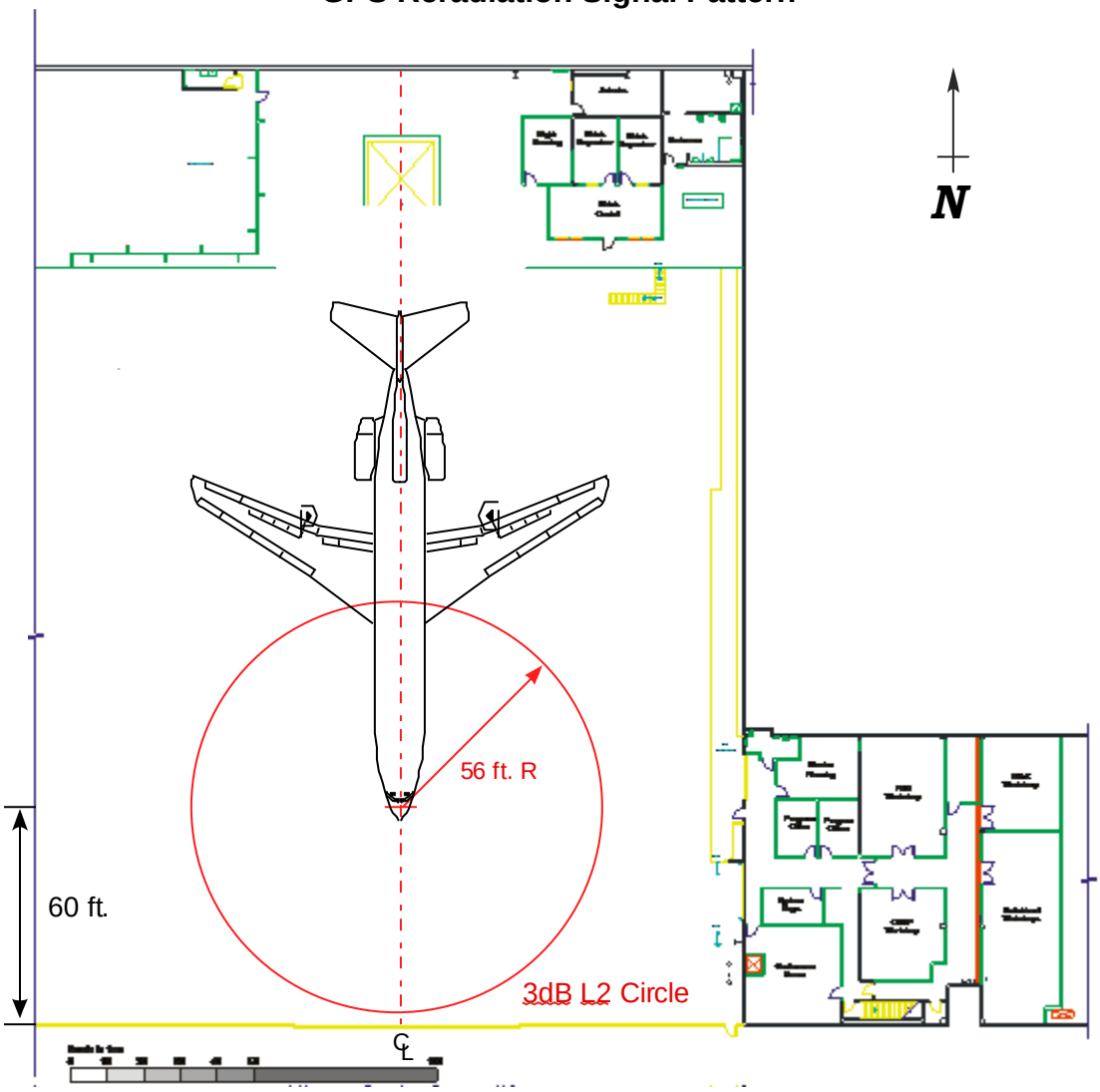
Computed L1 signal level at antenna	- 105.0 dBW
Computed L2 signal level at antenna	- 111.0 dBW
Signal loss through space at 100 feet	- 65dB

Therefore,

Frequency L1 Signal level at 100 feet		-170.0 dBW
	or	-140.0 dBm
Frequency L2 Signal level at 100 feet		-176.0 dBW
	or	-146.0 dBm

ATTACHMENT #2

GPS Reradiation Signal Pattern



Hangar doors shown closed

Note: 3dB L1 Circle is beyond the dimensions of this diagram.

GPS Networking Inc.

LA20RPDC

Technical Product Data

Features

- **Amplifier Gain of 20dB**
  Gain ≥ 20dB

- **Extremely Flat Group Delay**
  Less than 1ns Variation

- **Excellent Gain Flatness**
  Gain | L1 - L2 | < 1.0 dB

Description

The LA20RPDC GPS Line Amplifier is a one input, one output device with a 20dB min. gain block. The frequency response covers the GPS L1 & L2 bands with excellent flatness. In the normal configuration, the RF output (J1) passes DC from the connected GPS receiver through the amplifier to the antenna, allowing the GPS receiver to power both the antenna and the amp.

Electrical Specifications, $T_A = 25^0C$

Parameter	Conditions	Min	Typ	Max	Units
Freq. Range	Ant – J1	1.1		1.7	GHz
In/Out Imped. (1)	Ant, J1		50		Ω
Gain	Ant – J1	20	24.5	26	dB
Input SWR	J1 - 50Ω			1.8:1	-
Output SWR	Ant - 50Ω			1.8:1	-
Noise Figure	Ant – J1		3.3	3.5	dB
Gain Flatness	| L1 - L2 |, Ant – J1		0.5	1	dB
Reverse Isolation	J1 – Ant	35			dB
Group Delay Flatness	$\tau_{d,max} - \tau_{d,min}$: Ant – J1			1	ns
Req. DC Input V.	Non-Network Configuration, DC Input on J1	3.6		15	Vdc
Current (2)	Amplifier Current Draw, All prots - 50Ω			15	mA

(1). Input/Output Impedance = 75Ω for 75Ω connector option.
(2). Current draw on J1 port in the non-networked configuration.

Available Options

Network Power Supply		
Source Voltage Options	VOLTAGE INPUT	STYLE
	110VAC	Transformer (Wall Mount)
	220 VAC	Transformer (Wall Mount)
	240 VAC (United Kingdom)	Transformer (Wall Mount)
	Customer Supplied DC 8-28 VDC	Military Style Connector
Output Voltage Options (1)	DC VOLTAGE OUT	MAX CURRENT OUT FOR CORRESPONDING Vout(2)
	5 V	110mA
	7.5V	130mA
	9V	140mA
	12V	170mA
	15V	210mA
	Custom	TDB
Pass/Block DC Options		
Pass DC(1)	All Ports Pass DC	
DC Blocked (1)	Ant is DC blocked, Pass DC J1	
RF Connector Options		
Connector Options	CONNECTOR STYLE	CHARGE
	Type N	NC
	Type SMA	NC
	Type TNC	NC
	Type N - 75Ω	Contact Sales Agent

(1). With Network Option, any RF port (input or output) can be DC blocked or can pass the network DC voltage.

(2). T_A = +50°C. Assuming Source of 110V, 220 or 240V Wall Mount Transformer. In general, maximum output current can be determined by:

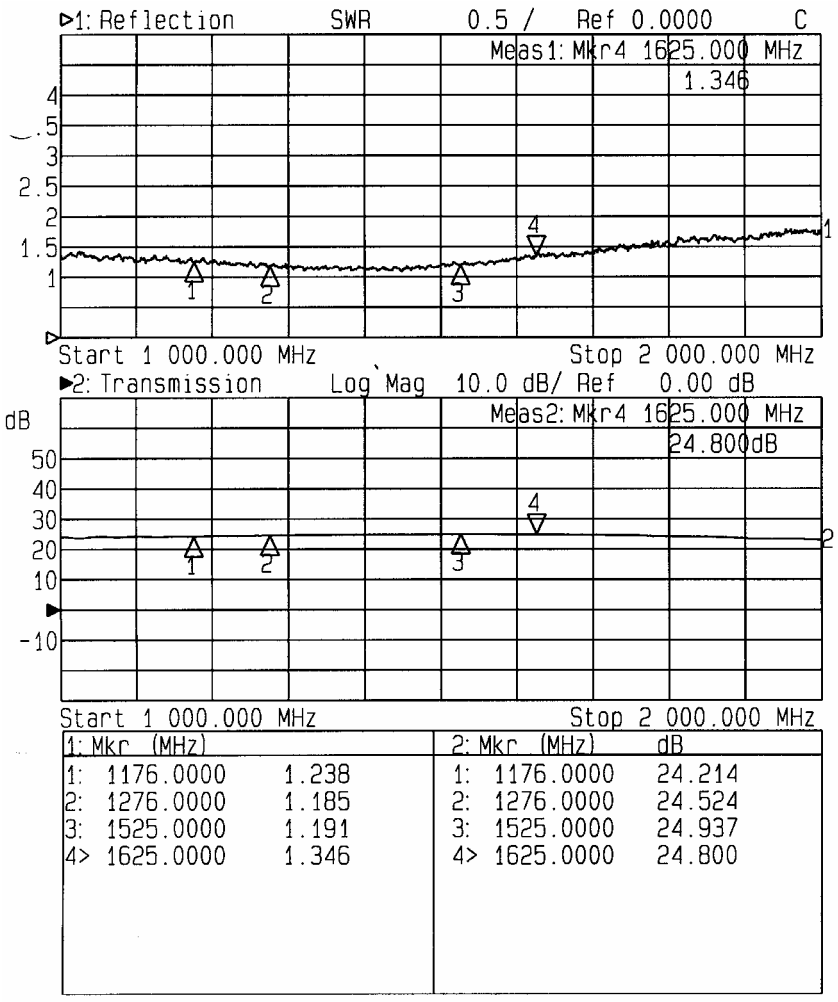
$$Iout \leq 2.9 / (V_{sourceDC} - V_{out})\ A$$

Part Number

N LA20F PDC - S / 5 / 110

Network Option:
N =Network Opt. ; **Blank**: No Network
DC Options:
DCB: Ant. DC Blocked ; **PDC**: Pass DC.
Connector Options:
N: N type; **S**: SMA; **T**: TNC; **N75**: N type -75Ω
DC Output Voltage:
5, **7.5**, **9**, **12**, **15**, **CXX** (Custom:"**XX"** denotes the desired V)
Source Voltage:
110 -Transformer, **220** – Transformer, **240** – Transformer, **MC** – Military Conn. (User supplies DV Voltage)

Performance



Input SWR (Ant. Port) and Frequency Response: Ant. To J1 (Typical, type N conn.):

Mechanical

Dimensions: Height: 1.3”

Length (not including connectors) Body: 2.5”
Base Plate: 3.25”

Width: 2.5”

Weight: 10 oz. (286 grams)

Operating Temp. Range: -40° to + 75°C

L1 Antennas

Part Number: L1ACE

Performance Specifications:

- **Frequency Range: 1575.42+-5MHz**
- **VSWR: 2.5:1 (max.)**
- **Amplifier Gain: 38dB (min.)**
- **Noise Figure: 1.5dB (max.)**
- **Voltage: 4.5 to 5.5 VDC**
- **Polarization: Right-Hand Circular**
- **Impedance: 50 Ohms**
- **Temperature: -40 to +80 C**
- **Connector: TNC, Female**

Part Number: L1ANTC

Performance Specifications:

- **Frequency L1: (1575.42+-10) MHz**
- **VSWR: 1.5:1**
- **DC Grounding: Yes (lightening protection)**
- **LNA Noise Figure: less than 2.4dB**
- **LNA Gain: 33.0+-3.0dB**
- **LNA Current Draw: less than 30mA**
- **LNA Votlage: +3.5 to +24VDC**
- **Rejection: 2 2-Pole Filters**
- **Polarization: Right-Hand Circular**
- **Impedance: 50 Ohms**
- **Temperature: -55 to +85 C**
- **Connector: SMA, Female**

Part Number: L1ARINC

Design Specifications:

- **FAA TSO-C144**
- **DO-160D, D0-228**
- **MIL-C-5541, MIL-E-5400**
- **MIL-I-45208A, MIL-STD-810**

Toll Free: 866-289-4777
Telephone: 719-561-9520
Fax: 719-565-0890

sales@gpssource.com

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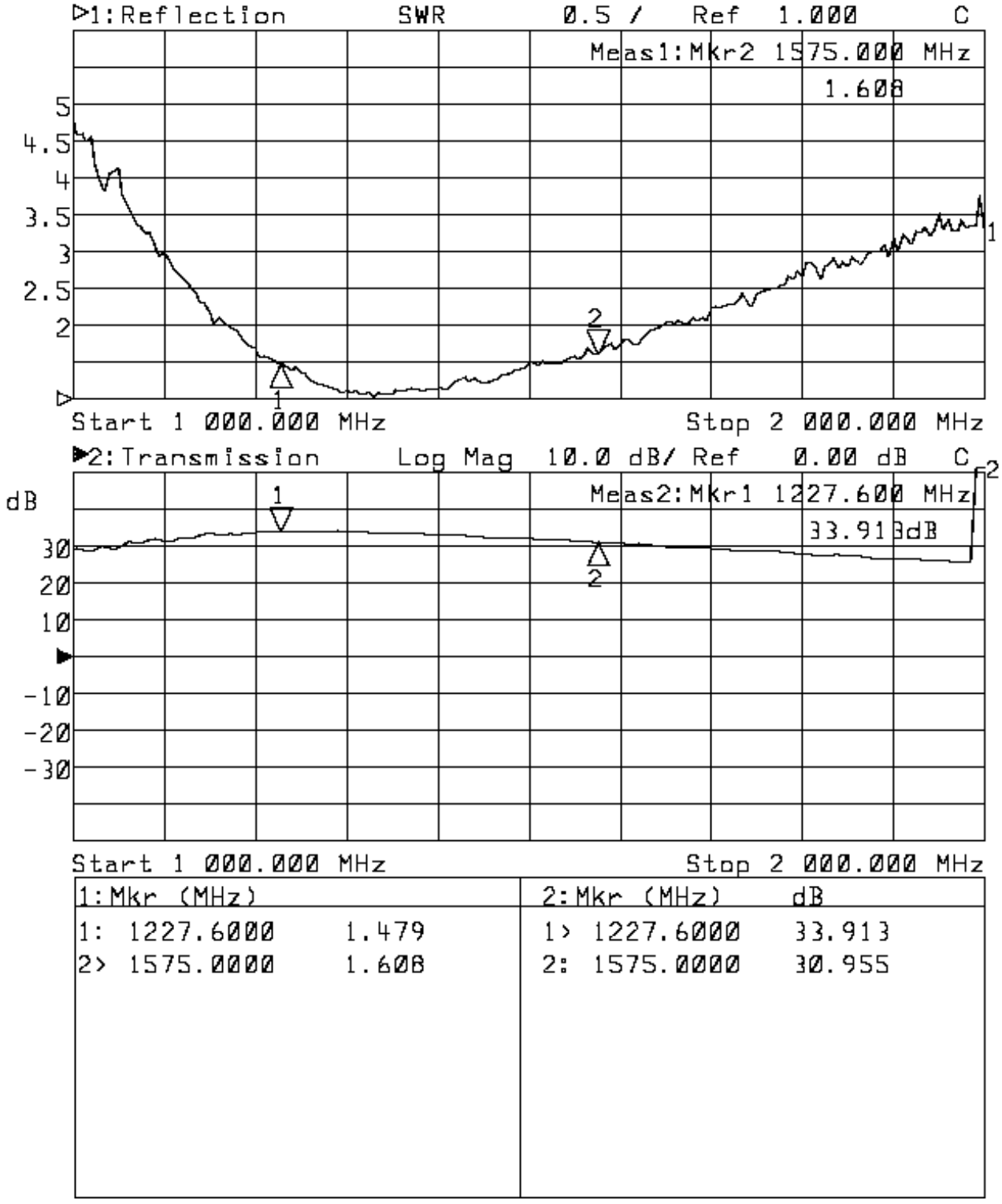
A11 Product Data



PRODUCTS | A11

Electrical Specifications:

- **Frequency response for GPS L1/L2 and GLONASS**
  - **1GHz to 2GHz**
  - **Flatness less than 3.5dB**
  - **Noise figure less than 1.8dB**

- **All ports can either pass DC or block DC voltage**
  - **30dB gain**
  - **50 ohm impedance on both ports**
  - **Input & Output SWR less than 2.0:1**
  - **Reverse Isolation greater than 49dB**
  - **Required DC input 3.1 to 15VDC**
  - **Current draw less than 14mA @ 3V DC input**

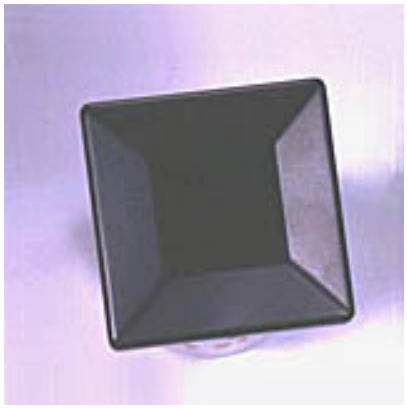
Mechanical Specifications:

- **Dimension**
  - **Length 2.5"**
  - **Width 2.5"**
  - **Height 1.25"**
  - **Base Plate 3.25"x2.5"**

- **Operating Temperature**
  - **-40 to 75 degrees C**

L1 Passive Antennas

Part Number: L1P2



Performance Specifications:

- **Frequency: 1.575 GHz**
- **VSWR: 1.5:1**
- **Bandwidth: 20Mhz (min.)**
- **Peak Gain: 3 dBic (min.)**
- **Polarization: Right-Hand Circular**
- **Impedance: 50 Ohms**
- **Temperature: -40 to +85 C**
- **Connector: SMA, Female**

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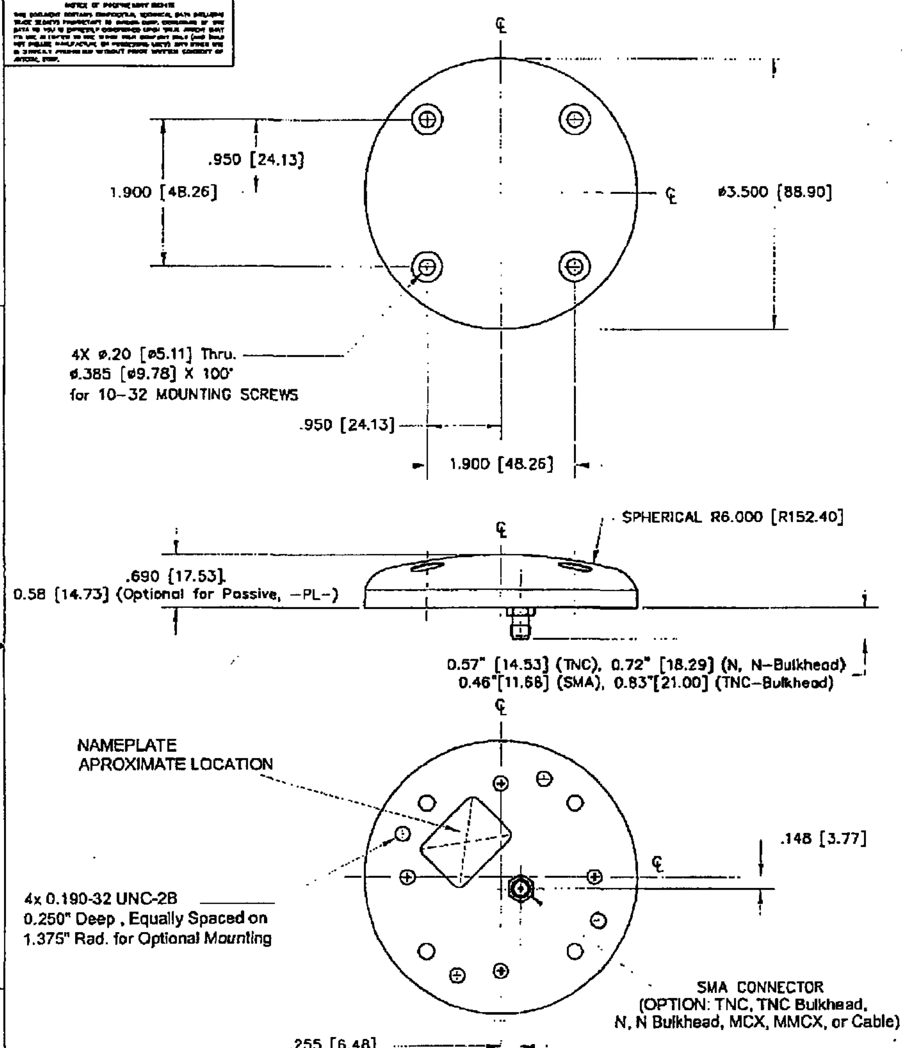


SPECIFICATIONS

ELECTRICAL:

FREQUENCY:	L1: (1575.42 ±12) MHz		L2: (1227.60 ±12) MHz	
RADIATION PATTERN:	HEMISPHERICAL			
POLARIZATION:	RHCP		RHCP	
VSWR:	< 1.5:1		< 1.5:1	
IMPEDANCE:	50 ohms		50 ohms	
ANTENNA GAIN (dBic):	Free Space	4 ft G.P.	Free Space	4 ft G.P.
@ 90 ° (ZENITH):	+ 4.7	+ 3.5	+ 3.3	+ 4.9
@ 10 ° Elevation:	- 1.8	- 2.0	- 3.8	- 3.6
@ 20 ° Elevation:	- 0.3	+ 0.8	- 2.0	- 0.1
@ 30 ° Elevation:	+ 1.4	+ 1.8	- 0.5	- 1.8
@ 60 - 90 ° Elevation:	> 3.9	> 2.8	> 2.7	> 3.0
BEAM WIDTH (3dB):	114 Deg.	139 Deg.	106 Deg.	75 Deg.
AXIAL RATIO:	2 dB		2 dB	
LIGHTNING PROTECTION:	DC GROUNDING			
LNA GAIN:	33 dB		35 dB	
LNA NOISE FIGURE:	3.0 dB		3.0 dB	
LNA P1dB Out:	+13 dBm		+13 dBm	
LNA DC POWER:	2.5V/20mA, 3V/28mA, 3.3V/35mA, (2.5-24)V/<50mA			
REJECTION @ (-50/+50) MHz	-41 dB / -59 dB		-40 dB / -40 dB	
@ (-100/+100) MHz	< -65 dB		< -65 dB	
POWER HANDLING:	1 Watt CW, Optional: 10 Watts 1 Microsec Pulse (-AL-)			

MECHANICAL:

SIZE: DIAMETER: 3.50 in.[88.90 mm]
HEIGHT: 0.690 in. [17.53 mm], 0.58" [14.73] (Optional for Passive)
WEIGHT: 5.15 oz. (.146 Kg)
FINISH: SKYDROL RESISTANT POLYURETHANE ENAMEL
BASE IRIDITE PER MIL-C-5441
MATERIAL: 6061-T6 ALUMINUM ALLOY BASE
COMPOSITE RADOME, IMPACT, ABRASION, UV, SOLVENT, SKYDROL RESISTANCE, AND FIRE RETARDANT
CONNECTOR: SMA FEMALE
(OPTION: TNC, TNC Bulkhead, N, N Bulkhead, MCX, MMCX, or Cable)

ENVIRONMENTAL:

TEMPERATURE: -67 °F TO +185 °F [-55 °C TO +85 °C]
ALTITUDE: 70,000 ft.
VIBRATION: > 30 G's
LEAKAGE: HERMETICALLY SEAL

FEDERAL & MILITARY SPECIFICATIONS:

DESIGN TO: FAA TSO-C144, DO-160D, D0-228, MIL-C-5541, MIL-E-5400, MIL-I-45208A, MIL-STD-810, AND SAE J1455

ACCEPTANCE TEST PROCEDURE: ATP-GPS-L1L2-100

SIZE:	FREQ. BAND:	LNA:
1: 2" SQ.	1215 L1/L2	A: WITH LNA
19. 1.9" SQ.	15. L1 ONLY	AL: WITH LNA/LIMITER
2: 2.6" DIA		P: WITHOUT LNA
3: 3.5" DIA		PL: WITHOUT LNA and THINNER (HEIGHT = 0.58")
4: MINI ARINC		

P/N: 3G1215X-XX-1

CABLE'S LENGTH:	CONNECTOR:	COLOR:
X: NO CABLE	S. SMA, P. PINS	-1: GLOSS WHITE #17925 PER FED-STD 595B
M. MAG , N. NO MAG	M: MCX, MM, MMCX	-2: LUSTERLESS GRAY #36320 PER FED STD 595B
# CABLE LENGTH (IN)	N, NB: N, N-Bulkhead	-3 OLIVE DRAB GREEN #34031 PER FED-STD-595B
R RIGHT ANGLE CON	T, TB: TNC, TNC-Bulkhead	-4. LUSTERLESS BLACK #37038 PER FED-STD-595B

QTY -2	QTY -1	DESCRIPTION	PART NO	FINISH	ITEM NO
4	-	MOUNTING SCREWS: 10-32, 3/4"	MS24693C274	-	5
A/R	-	WASHER, CUSTOM C'SINK	3G15P1001-6	-	3
1	1	ADHESIVE GASKET	12345G-3M-3G	-	1

PARTS LIST

NOTES: UNLESS OTHERWISE SPECIFIED:
1. DIMENSIONS IN BRACKETS ARE IN MILLIMETERS [mm]
2. MOUNTING SCREWS & ADHESIVE GASKET ARE SUPPLIED BY ANTCOM

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± 1/64 ANGLES ± 1°

DO NOT SCALE DRAWING

CHECKED: M. BOAS 01-05-29
APPROVED: S. HUYNH 01-05-29

ANTCOM CORP. TORRANCE CALIFORNIA

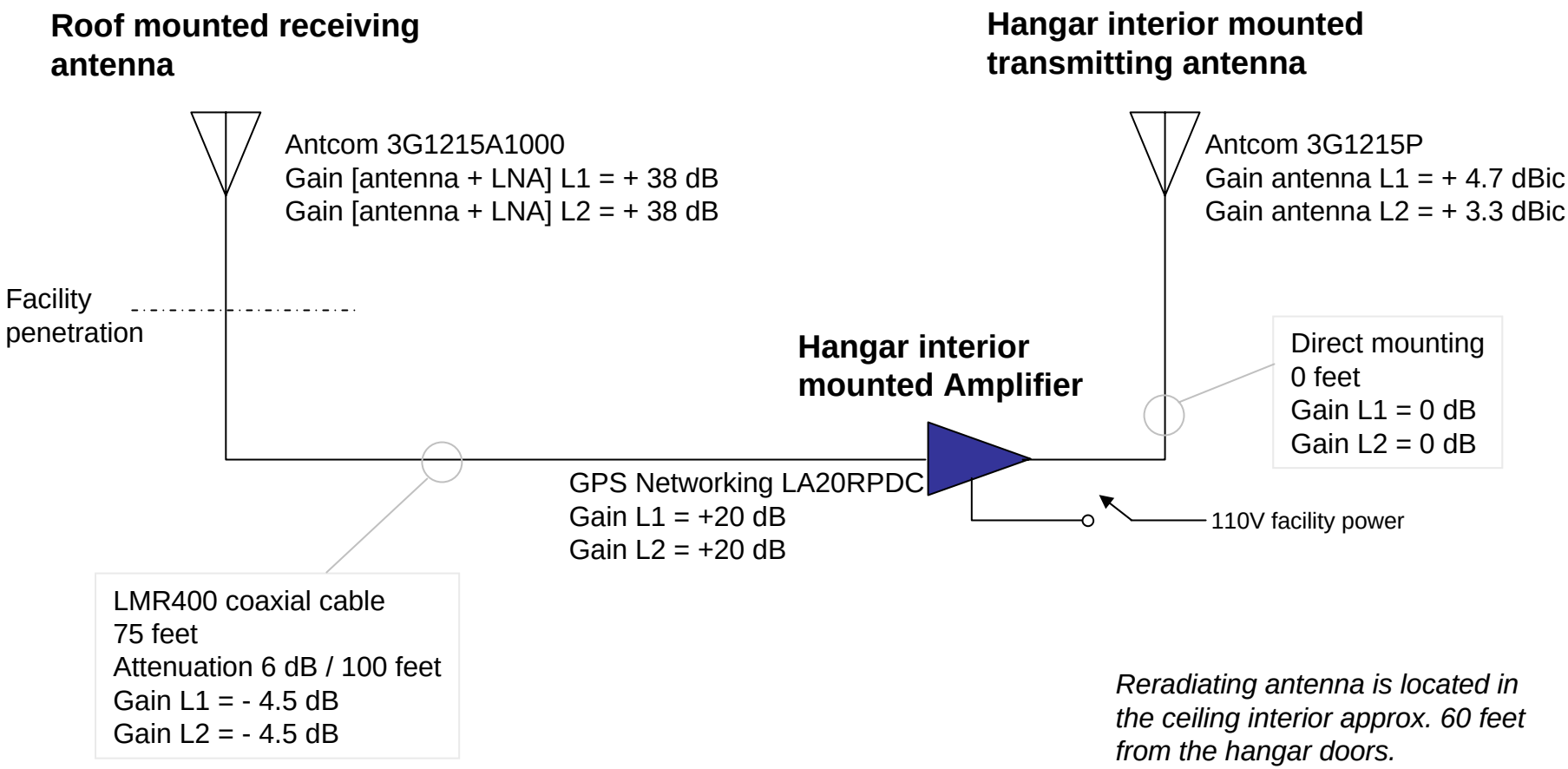
OUTLINE DRAWING
L1/L2 ACTIVE, OR PASSIVE
GPS ANTENNA

D | 3CVE1 | 3G1215X-XX-X | -

SCALE 1/1 SHEET 1 OF 1

XMIT ANTENNA

RSAS LAX Hangar
RMT Program Facility
GPS Reradiator Installation

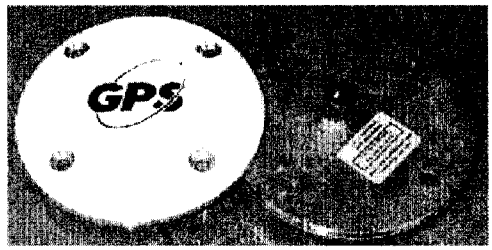


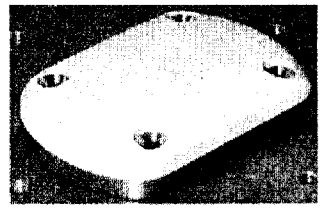
Reradiating antenna is located in the ceiling interior approx. 60 feet from the hangar doors.

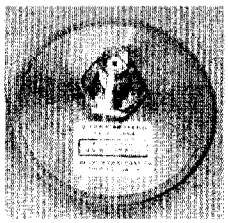
ANTCOM

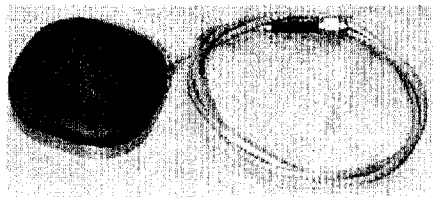
ISO9001/AS9000

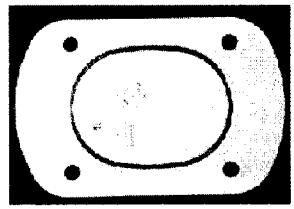
ACTIVE/PASSIVE L1/L2 GPS ANTENNAS











PART No.	1G1215X1000*	2G1215X1000*	3G1215X1000*	4G1215X1000*
SIZE	W = 2.07" SQ (5.3 cm), H = 0.64" (1.6cm)	D = 2.60" (6.6cm), H = 0.64" (1.6cm)	D = 3.50" (8.9cm), H = 0.64" (1.6cm)	W = 2.20" (5.6cm), L = 3.40" (8.6cm), H = 0.72" (1.8cm)
WEIGHT	< 5.0 oz (0.142 Kg)			

*X=A FOR ACTIVE, X=P FOR PASSIVE

SPECIFICATIONS

ELECTRICAL:

FREQUENCY:	L1: (1575.42±10) MHz L2: (1227.00±10) MHz
VSWR:	1.5:1
OUTPUT IMPEDANCE:	50Ω
POLARIZATION:	RIGHT HAND CIRCULARLY POLARIZED (RHCP)
ANTENNA PATTERN:	HEMISPHERICAL
DC GROUNDING:	YES (LIGHTENING PROTECTION)
LNA GAIN:	(33.0+/-3.0) dB
LNA NOISE FIGURE:	< 2.4 dB
LNA DRAWING CURRENT:	< 60 mA
LNA VOLTAGE:	(+3.5 TO +24) Volts DC, DIRECT FROM RF CONNECTOR
REJECTION:	2 2-POLE FILTERS FOR EACH BAND

MECHANICAL:

FINISH:	SKYDROL RESISTANT POLYURETHANE ENAMEL BASE IRIDITE PER MIL-C-5441
COLOR:	GLOSS WHITE #17925 PER FED-STD-595B LUSTERLESS GRAY #36320 PER FED-STD-595B OLIVE DRAB GREEN #34031 PER FED-STD-595B LUSTERLESS BLACK #37038 PER FED-STD-595B
MATERIAL:	6061-T6 ALUMINUM ALLOY BASE THERMOSET PLASTIC RADOME, UV, ABRASION AND SKYDROL RESISTANCE
CONNECTOR:	SMA FEMALE (TNC, OR N TYPE IS OPTIONAL)

ENVIRONMENTAL:

TEMPERATURE:	-67°F TO +185°F [-55°C TO +85°C]
ALTITUDE:	70,000 ft.
VIBRATION:	10 G's
LEAKAGE:	HERMETICALLY SEAL

FEDERAL & MILITARY SPECIFICATIONS:

DESIGN TO:	FAA TSO-C144, DO-160D, D0-228, MIL-C-5541, MIL-E-5400, MIL-I-45208A, AND MIL-STD-810

FEATURES:

- Suitable for manpack, ground, marine, aircraft, and space applications
- Compacts aerodynamic design suitable for harsh environments and long-term operations
- Spherical compounded radius-molded radome made of high grade polymer
- Design prevents ice/snow buildup, protects antenna from UV, rain and lightning strikes
- Chemical, jet fuels, and impact resistance
- Meets or exceeds all military specifications and requirements for standard or custom antenna designs
- Universal single hole mounting, threaded connector, or magnetic mount, or four 10-32 mounting screws

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RFL ~~XMIT~~ ANTENNA