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MFG IDENT CODE **4HVG5**	PROJECT CODE	SIERRA NEVADA CORPORATION INTEGRATED MISSION SYSTEMS **4000 Market Street** **Huntsville, Alabama 35808**

REVISIONS					
Issues	**Descriptions**	**Date**	**Author**	**TW/Checker**	**Engineering**
A	Initial Release				

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1.0 INTRODUCTION

1.1 GENERAL

Sierra Nevada Corporation (SNC), located at 4000 Market Street Huntsville, AL. 35808 wishes to install a GPS re-radiation kit that would allow GPS reception inside our Systems Integration Lab (SIL). It is important to have an accurate GPS location to allow testing of Unmanned Aerial Vehicles and other subsystems.

1.2 CURRENT NEEDS

SNC is presently perusing several UAV contracts and having an accurate source of GPS information indoors will allow test and integration of sensors on those air vehicles. SNC has selected GPS Networking Inc. L1/L2GHNRRKIT off the shelf solution to provide receipt, amplification and rebroadcast of a GPS signal within our SIL. The specifications for that system are detailed below:

1.2.1 Receive Antenna (Roof)

An active GPS antenna will be positioned on the room of the building above the SIL. Specifications for the antenna are located in Table 1:

Roof Antenna Electrical Specifications, TA=25°C

Parameter	Notes	Min	Typ	Max	Unit
Frequency	Receives and amplifies all major GNSS constellations.	1500 1150		1615 1290	MHz
Axial Ratio	Ratio between the major and minor axes of the polarization ellipse.			2.5	dB
Gain	The relative increase in signal power provided by the internal LNA.	35	40	45	dB
GPS L1 Bandwidth	Passband centered at GPS L1 frequency.		115		MHz
GPS L2/L5 Bandwidth	Passband centered at GPS L2/L5 frequency.		140		MHz
Filtering	Out of band rejection +/-50MHz from band-edge	-30	-45	>80	dB
Noise Figure	The increase in noise power relative to an ideal amplifier.		3.0		dB
Output SWR	Output Standing Wave Ratio: S22 over the passband.		2.0:1		-
Characteristic Impedance	Output port matched to 50Ω.		50		Ω
Req. DC Input V.	Operating Voltage Range.	2.5		12.0	VDC
Current Draw	Typical current consumption.		37	50	mA
Polarization					
Right Hand Circular Polarization					
Connector Options	Connector Style	Charge			
	Type TNC-female	No Charge			

Table 1: Roof Antenna

1.2.2 Amplifier (Internal to Building)

Internal to the building SIL a re-radiating amplifier will be installed to receive the GPS signal from the roof antenna and rebroadcast it in real time. The Amplifier specifications are detailed in Table 2:

Re-Radiating Amplifier Electrical Specifications, TA=25°C

General Specification

Parameter	Notes	Min	Typ	Max	Unit
Frequency Range	Covers all major GNSS constellations.	1.1		1.7	GHz
Characteristic Impedance	Input and output ports matched to 50Ω.		50		Ω
Req. DC Input V.	Operating Voltage Range.	3.3		15	VDC
Current Draw	Typical current consumption.		36	40	mA

GPS L1 & L2 RF Specification (1)

Parameter	Notes	Min	Typ	Max	Unit
Gain	The relative increase in signal power provided by the amplifier.	29	30	31	dB
Input SWR	Input Standing Wave Ratio: S11			2.0:1	-
Output SWR	Output Standing Wave Ratio: S22			2.0:1	-
Noise Figure	The increase in noise power relative to an ideal amplifier.		L1:2.00 L2:4.25		dB
Band Gain Flatness	The difference in loss or gain between the L1 and L2 frequencies.		0.5	1.0	dB
Group Delay	The transmit time for the signal passing through the device.		L1:1.5 L2:2.1		ns
Reverse Isolation	Attenuation applied signals traveling backwards through the amplifier: S12.		L1: -55 L2: -60		dB
Input P1dB	The 1dB compression point.		L1: -21.5 L2: -23.0		dBm
3rd Order Intercept	Third-order intercept point at L1.		-14		dBm

(1): Performance is slightly reduced around GPS L5. If working on sensitive L5 applications, please request performance data.

Table 2: Re-radiating Amplifier

1.2.3 Re-Radiating Antenna

Finally a re-radiating antenna is used to broadcast the GPS signal internal to the SIL. The specifications for the re-radiating antenna are detailed in Table 3:

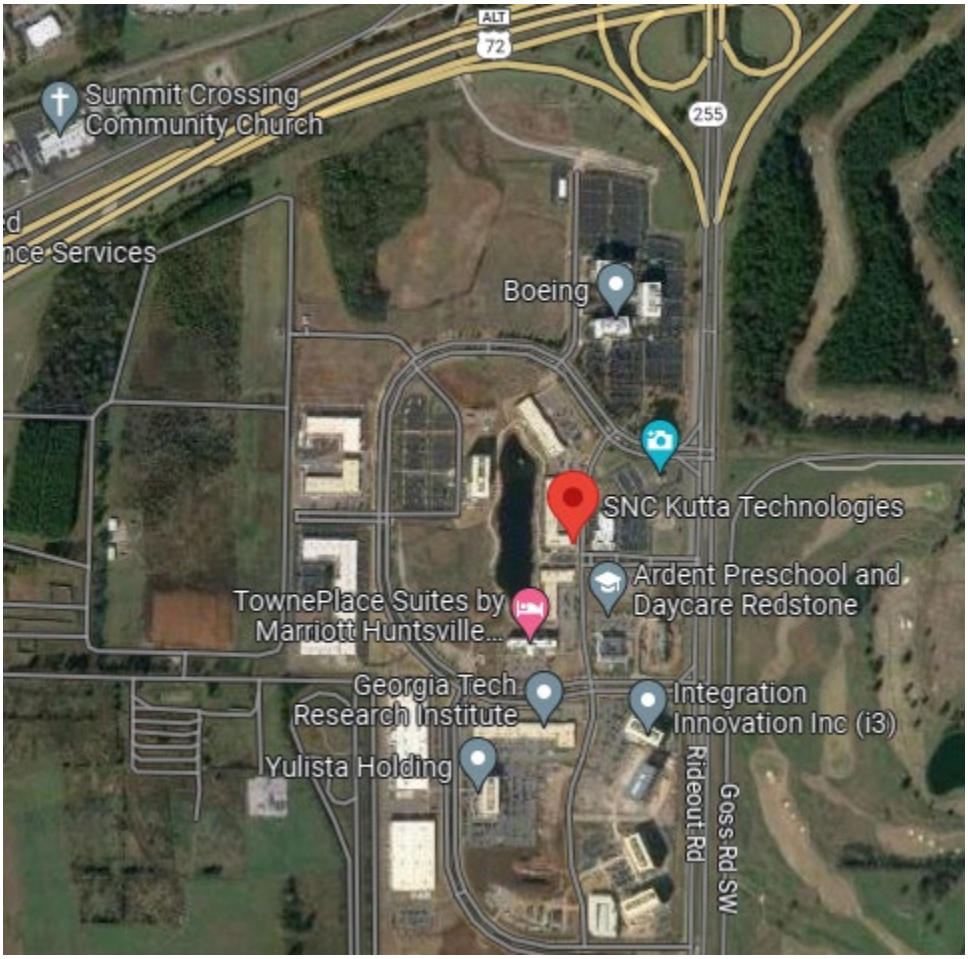
Re-Radiating Antenna Electrical Specifications, TA=25°C

Parameter	Notes	Min	Typ	Max	Unit
Frequency	Re-Radiates all major GNSS frequencies.	1500 1150		1615 1290	MHz
Axial Ratio	Ratio between the major and minor axes of the polarization ellipse.			2.5	dB
Peak Gain	The Increase in signal power relative to an isotropic antenna source.	3			dBic
GPS L1 Bandwidth	Passband centered at GPS L1 frequency.		115		MHz
GPS L2/L5 Bandwidth	Passband centered at GPS L2/L5 frequency.		140		MHz
Input SWR	Input Standing Wave Ratio: S11 over the passband.		2.0:1		-
Characteristic Impedance	Input port matched to 50Ω.		50		Ω
Polarization					
Right Hand Circular Polarization					
Connector Options	Connector Style	Charge			
	Type TNC-female	No Charge			

Table 3: Re-radiating Antenna

2.0 TEST SITE

The proposed test site will include a fixed location internal to the SNC facility at 4000 Market St. Huntsville, Alabama 35808.



3.0 ANALYSIS

The following spreadsheet was used to calculate the effective radiated power for a GPS Networking reradiating system as well as the effective signal power at given range in dBm. The components for the strongest repeating path in our system equated to -141.2 dBm. NTIA regulations require that the repeated signal be weaker than -140 dBm when measured 100 FT outside of the reradiated structure.

GPS Networking Link Budget Calculator

The following spreadsheet calculates the effective radiated power for a GPS Networking reradiating system as well as the effective signal power at given range in dBm. Enter the components for the strongest repeating path in your system into the section with the red border. NTIA regulations require that the repeated signal be weaker than -140 dBm when measured 100 FT outside of the reradiated structure. Please feel free to reach out to GPS Networking if you need assistance.

Receiving Antenna Gain	*Antenna Cable Insertion Loss*	*System Gain*	*Nominal Antenna Gain Best Case*	*Distance to Nearest External Wall (FT)*	*Signal Power at Nearest External Wall Building*	*Signal Power at 100' Outside of Nearest External Wall In dBm*
38	**-12.00**	**30**	**4**	**80**	**-134.15**	-141.20

GPS Carrier Frequency MHz	Total System Gain	Range in Miles	Total Signal Power @ Range in Watts
1575	60	0.02	38.4E-18
Avg Receive Power L1 dBm North America		Range in Meters	Radiated Power dBm
-130		24.38	-70
Free Space loss with Isotropic Antennas		Range in Kilometers	Power (pW)
-64.15		0.02	50.12
Helpful Links:			Effective Radiated Power (pW)
Get an FCC Registration Number:	https://apps.fcc.gov/coresWeb/publicHome.do		100.00
FCC Experimental Broadcast Form 442:	https://apps.fcc.gov/oetcf/els/forms/442Entry.cfm		
Cable Loss Calculator	https://www.timesmicrowave.com/Calculator		Effective Radiated Power (dBW)
GPS Networking Store	https://www.gpsnetworking.com/store		
Tim's Email Address (if you need help)	mailto:tim@gpsnetworking.com		-100

4.0 ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Description
FCC	Federal Communication Commission
GPS	Global Positioning System
RF	Radio Frequency
SNC	Sierra Nevada Corporation
STA	Special Temporary Authority