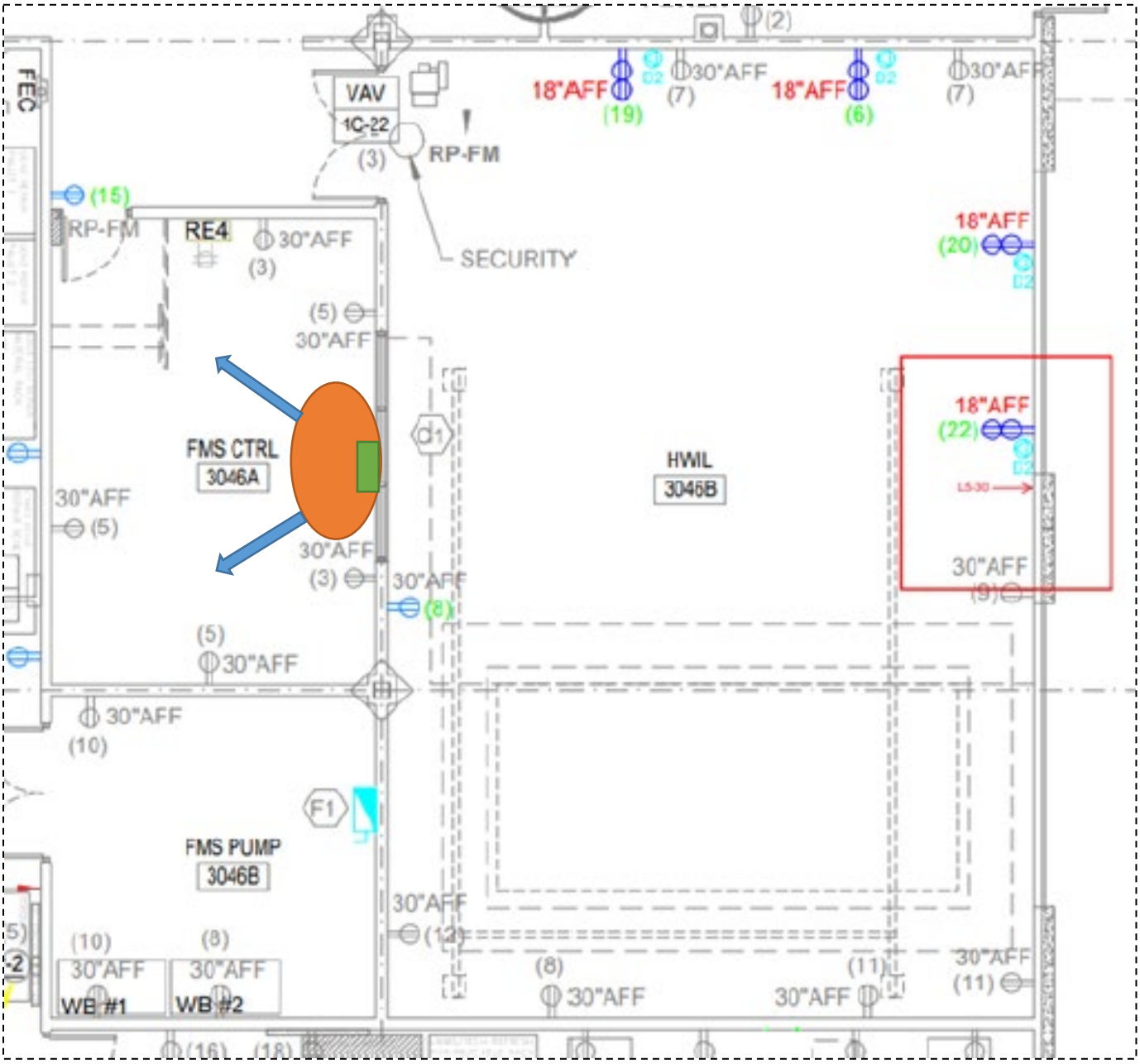
BAE Systems RNSS REPEATER Documentation

Installation for 400 Jan Davis Drive NW, Huntsville Alabama
Including NTIA Manual
Section 8.3.28 Items a. through f.

Outside Antenna Location
Roof mounted GPS Received Antenna
GNSS-TW-3872-ANT

BAE Systems, 400 Jan Davis Drive NW, Huntsville Alabama 35806 Coordinate DMS: Lat 34°42’52”N / Long 86°41’24”W
Precision Guidance Kit Lab within Room 3046A

BAE Systems RNSS System Repeater, Receive Antenna and Transmit Antennas Location and Wiring



Roger GPS Repeater mounted at 8 feet above floor, angled 135° towards floor – Facing 270° relative to North

NTIA Manual Section 8.3.28

a. Individual Authorization/Indoor only use/site specific: BAE Systems seeks individual authorization for indoor use only of a RNSS Repeater and Systems fully understands that the RNSS signal is not to extend beyond the property. The BAE Systems RNSS system has one low power, short range repeater. The signals will cover only one small area at the repeater within a lab at BAE Systems, 400 Jan Davis Drive NW, Huntsville Alabama 35806. A photo of the building, and the lab area floor plan with the locations of the repeater are provided on sheets 2 and 3.
b. BAE Systems RNSS Use: BAE Systems manufactures precision guidance kits for defense which incorporate an embedded RNSS system to determine the units' location and therefore feed navigation guidance to the kit. The RNSS experimental equipment will provide low level short range 1.2276 GHz, and 1.57542 GHz RNSS signals indoors at our facility to allow testing of embedded RNSS receivers. The Experimental RNSS Test Equipment will be installed inside our building at 400 Jan Davis Drive NW, Huntsville Alabama in order to develop, integrate and test these units and insure they function properly prior to sale.
c. Entry in GMF: Yes, please enter any frequency assignment in the GMF
d. License Period and Renewal: BAE Systems fully understands that the repeater license will require renewal every two years. BAE Systems is a manufacturer of electronic instruments for commercial and defense use. BAE Systems will comply and renew its RNSS repeater license as required.
e. RNSS Signal Control: The area of potential interference from the BAE Systems RNSS repeater is under complete control and BAE Systems will take responsibility for maintaining that control, and of the affected areas. The walls of the lab where the repeater will

be installed are foil lined for tempest protection and the roof is metal. The repeater is gain limited and with losses, the signal will not be a source of interference.

f. Maximum EIRP: The following calculations indicate the distance of 30 meters from exterior walls of free space will attenuate the BAE Systems RNSS repeater signal to below the maximum allowed level. Note that '*d*', the distance in meters from an outside wall to the repeater is set to 0 meters and 12 meters for reference.

   The calculation for maximum EIRP shall be based on free space propagation with no allowance for additional attenuation (e.g., building attenuation) as shown below.

Formula:

$P_{T\max} = P_R + 20\log_{10} f + 20\log_{10}(30+d) - 27.55$

Where:

$P_{T\max}$ is the maximum permissible EIRP in dBm

P_R is the power received at 30 meters from the building (i.e. -140 dBm/24 MHz)

f is frequency in MHz

d is the distance between the radiator and the closest exterior wall of the building in meters.

Conversion to pW:

$P_{T\max}$ converted to picowatts by using the formula:

$P_{T\max}$ (pW)=10^(($P_{T\max}$ / 10) + 9)

BAE Systems Installation Calculations:

The $P_{T\max}$ for:

GPS L2 (1.22760 GHz) is 19.3pW, < limit 23.8pW.

GPS L1 (1.57542 GHz) is 31.6pW, < limit 39.3pW.

GPS L1 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. NTIA regulations require that the repeated signal be weaker than -140 dBm

Receive Ant Gain	Ant Cable Insertion Loss	Repeater Amp Gain	Repeater Ant Gain Best Case	Building Length (Feet)	Signal Power @ End of Building	Signal Power @ 100' Outside of Building In dBm
38	-15.6	20	4	30	-139.24	-151.9717998

GPS Carrier Frequency MHz L1
1575
Avg Receive Power L1 dBm North America
-130
Free Space loss with Isotropic Antennas
-55.64

Total System Gain	Range in Miles	Total Signal Power @ Range in Watts
46.4	0.01	11.9E-18

Range in Meters	Radiated Power dBm
9.14	-83.6

Range in Kilometers	Transmitted Power (W)
0.01	2.2E-12

Effective Radiated Power (W)
4.4E-12

Effective Radiated Power (dBW)
-113.6

GPS L2 Networking Link Budget Calculator

System Receive Antenna

Part Number	Gain/Loss (dB)
L1GPSA-N	38

Passive Components (Cause Loss)

Part Number	Gain/Loss (dB)

Amplified Components (Cause Gain)

Part Number	Gain/Loss (dB)
Built Into Roger GPS	20

Repeating Antennas

Part Number	Gain/Loss (dB)
Built into Roger GPS	4

Cable Runs

Cable Type	Loss Per 100 Feet	Feet of Cable	Cable Losses
RF-195	-14	131	-18.34
			0
			0
			0
			0
			0
			0
			0
			0
			0
			0

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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. NTIA regulations require that the repeated signal be weaker than -140 dBm

Receive Ant Gain	Ant Cable Insertion Loss	Repeater Amp Gain	Repeater Ant Gain Best Case	Building Length (Feet)	Signal Power @ End of Building	Signal Power @ 100' Outside of Building In dBm
38	-15.6	20	4	30	-137.07	-149.8073262

GPS Carrier Frequency MHz L2
1227.6
Avg Receive Power L1 dBm North America
-130
Free Space loss with Isotropic Antennas
-53.47

Total System Gain	Range in Miles	Total Signal Power @ Range in Watts
46.4	0.01	19.6E-18

Range in Meters	Radiated Power dBm
9.14	-83.6

Range in Kilometers	Transmitted Power (W)
0.01	2.2E-12

Effective Radiated Power (W)
4.4E-12

Effective Radiated Power (dBW)
-113.6

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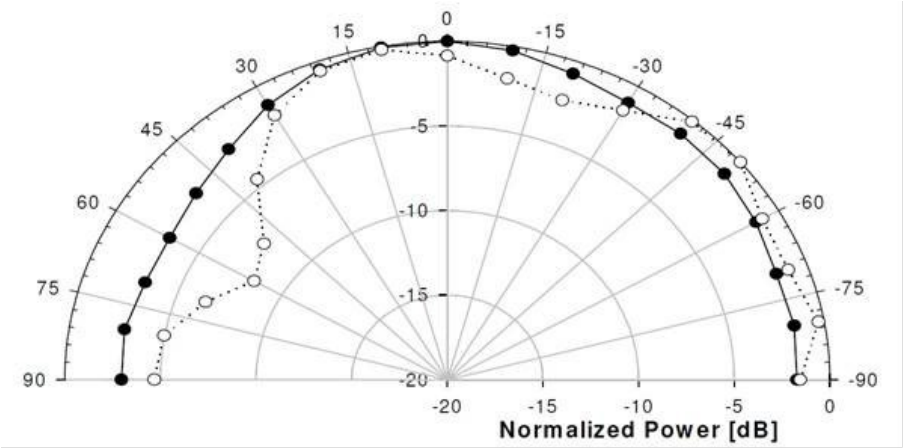
Built into Roger GPS	4

Cable Runs

Cable Type	Loss Per 100 Feet (RF-195)	Feet of Cable	Cable Losses
RF-195	-12	131	-15.72
			0
			0
			0
			0
			0
			0
			0
			0
			0

ROGER GPS Antenna beam is ~ 180 degrees.



g. All GPS users in the area of potential influence will be limited to BAE Systems employees aware of the RNSS repeater and interference.
h. Yes, BAE Systems use of its RNSS repeater will be limited to its test of RNSS receivers.
i. I, Michael Hodnett am the point of contact for this RNSS repeater system. My number at BAE Systems is 256-210-2621. BAE Systems will make all pertinent staff aware of the location of the power source controlling the repeater. Instructions for powering the repeater off will be posted near the repeater.

RNSS ELECTRONICS

Steffe's & Company, LLC.

ROGER-GPS Repeater Package (GNSS-L1L2G1GA-67-BP40-US)

ROGER
GNSS repeater

A single ROGER-GPS (GNSS-L1L2G1GA-67-BP-US) Repeater Package is enough to provide a GPS L1 (1.57542 GHz), GPS L2 (1.2276 GHz) indoor signal coverage area of ~ 10,700 ft2 and a distance of up to 164 ft. from the repeater center. Mount the external antenna on the roof of the building and connect the cable supplied with the kit to the antenna and to the repeater installed indoors. Connect the power supply unit to the repeater, adjust the repeater's transmission power according to the local conditions, to prevent a signal loopback, and indoor GNSS coverage is immediately available. With a ROGER-GPS repeater you can avoid time consuming signal acquisition when moving from indoors to outdoors and vice versa.
Several ROGER-GPS Repeater Packages can be installed in the same building. Alternatively, the signal coverage provided by a single package can be extended with ROGER-GPS Accessories, such as line amplifiers and signal splitters.

WHAT'S IN THE BOX

- Outdoor antenna for receiving the GNSS signals
- Adjustable antenna mount and cable spacer
- ROGER-GPS Repeater unit (GNSS-L1L2G1GA-67)
- Power supply (IP51)
- RF-cabling, 130 ft. (40 m) including connectors
- Manual

TECHNICAL SPECIFICATIONS		
Frequency	1.2276 GHz, 1.57542 GHz, 1. 561 GHz, 1.602 GHz	GPS L2 (1.2276 GHz), GPS L1 and Galileo E1 (1.57542 GHz)
Size	9.6 x 6.49 x 2.5 inches (244 x 165 x 64mm)	
Weight	21.5 ounce (610 g)	
Overall Gain	> 40 dB	
Noise Figure	< 2 dB	
Adjustable attenuation	0 - 40 dB	Two separate Gain Adjustment knobs
Impedance	50 Ω	
Input connector	TNC-female	
Operating temperature	-40 to 167 °F (- 40 to +75 °C)	
Gain internally	+12 dB	
Attenuation out port	+ 4 dB	
Power supply	+12VDC, 1,5 A	IP51 rated power supply with US plug included (optional IP67 PSU available)
Antenna power output	+5VDC, 100mA	
TX antenna gain	+4 dBd, RHCP polarization	
Type Approval	CE 1986 (!) R&TTE Directive (Directive 199/5/EC)	
Antenna Gain	+38 dB	
Coaxial Cable Length	131 ft. (40 m)	Kit with 131 ft. (40 m) cable available (GNSS-L1L2G1GA-67-BP40-US)

High Tech Products – Outstanding Service

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