

GPS Source Repeater System Link Budget Calculator

Provided by GPS Source, Inc.

The following is a link budget calculator that may be used to design a GPS Repeater system for your specific environment and to calculate the signal levels available from that system. Simply follow the steps below, referring to the Comments and Directions as necessary in order to design your system and calculate the signal levels.

		Input/Result:			
Process:		Green=User Input	Red=Result	Units	
				Comments & Directions	
GPS Repeater System Definition	Step 1: Select Max Operating Range (ft.)	100		ft.	Select the maximum slant range distance, in feet, that a GPS receiver must be able operate from the repeater's transmit antenna.
	Step 1a: Select the Min Operating Range (ft.)	15		ft.	Select the minimum slant range distance, in feet, that a GPS receiver must be able operate from the repeater's transmit antenna.
	Step 2: Select Desired Signal Level at the Max Op. Range (ERP, in dBm)	-135		dBm	Select the desired signal level available to a GPS Receiver operating at the maximum range. Note: Most GPS Receivers have a limited signal level range over which they will operate. You should design for no less than -135dBm at the maximum range, but for no more that -110dBm at the minimum range.
	Result 1: Required ERP for Selected Sign Lvl & Range: (in picowatts)	-68.90706729	128.6154884		dBm pW

Exhibit 4: Hyundai Motor Manufacturing Alabama, LLC

GPS Repeater System Design	Step 3: Select GPS Repeater Sys. Receive Antenna Gain:	35	dB	Select the GPS Repeater System's Receive Antenna Gain. This is the antenna that will be placed outside with an unobstructed view of the signals from the GPS Satellites. This gain includes the sum of the antenna element gain and the LNA gain. The following are the typical values for antennas available from GPS Source: a). L1A : 35dB b). L12GA: 33dB c). L13GA: 33dB d). L1L22GA: 33dB e). L1L23GA: 33dB
	Step 4: Select Coaxial Cable Type1:	LMR240	--	Select the type of Coaxial Cable that will be used to bring the GPS signals from the receive antenna outside into the facility that you wish to re-radiate. LMR240 is best for runs less than 100ft. For runs greater than 100ft, LMR400 or RG8 is a better choice. RG316 and RG58 should only be used for runs less than 25ft. Select RG8 if plenum rated cable is required (be sure to specify plenum cable on the order form). Note: LMR400 is equivalent to CommScope® WBC-400, Times Microwave Systems® LMR-400, Belden® 9914 / 9913 / 7810 and Andrew® CNT-400 coax cable
	Step 5: Select Coaxial Cable length	50	ft.	Select the length, in feet, of the Coaxial Cable that will be used to bring the GPS signals from the receive antenna outside into the facility that you wish to re-radiate.
	Result 2: Cable Loss for the cable and length you have selected	5.0	dB	This result is the total signal loss that will be encountered in the coaxial cable for the cable type and length you have selected.
	Step 6: Enter Additional System Gains/Losses	0	dB	Some GPS Repeaters systems may include additional signal distribution elements, such as a line amplifier for a very long cable run or GPS signal splitters that split the received signal to multiple GPS repeater units. Enter in this field the sum of the gains for all additional elements that are included between the receive antenna and the GPS repeater unit (do not include the gain of the GPSRK amplifier itself). Some typical gain vaules of other GPS Source elements that may be used in the system are as follows: a). A11 Line Amp: 30dB b). S12 Splitter: Passive: -4dB; Active: 24dB c). S14 Splitter: Passive: -8dB; Active: 21dB d). S18 Splitter: 18dB <i>If there are no additional signal distribution elements, set this field to 0dB.</i>
	Step 6a: Additional Cable Type	LMR240	--	If additional signal distribution elements are included in Step 6, there are most likely additional coaxial cables included in the GPS repeater system as well. Select the additional cable type included in the system between the additional elements and repeater unit. <i>Ignore this field if there are no additional cable runs.</i>

Exhibit 4: Hyundai Motor Manufacturing Alabama, LLC

Step 6b: Additional Cable Length	0	ft.	Enter the total length of the additional cable runs that are included in the GPS repeater system between the the additional elements and repeater unit. Leave this field set to zero (0) if there are no additional cable runs.
Result 3: Cable Loss for the cable and length you have selected	0.0	dB	This result is the total signal loss that will be encountered in the coaxial cable for the cable type and length you have selected.
Result 4: Calculated GPSRK Gain:	28	dB	This result is the necessary GPSRK amplifier gain that is required to achieve the System ERP in Result 1 above. If this gain value is negative, the system already has too much gain prior to the GPSRK - adjust the system design by removing excessive gain in step 6. The maximum gain of the GPSRK amplifier is 30dB (40dB if you select the GPSRKXL). If this gain value is greater than 30dB (or 40dB for the GPSRKXL), you will need to add additional gain in step 6. Be sure to specify this gain on your purchase order.

System Verification	ERP At Maximum Selected Range: 100	-135.04	dBm	Verify that the signal level available to the GPS Receiver operating at the maximum range is approximately the level you specified above and that the level is greater than -135dBm.
	ERP At Minimum Selected Range: 15	-118.56	dBm	Verify that the signal level available to the GPS Receiver operating at the minimum range is not greater than -110dBm.

FCC/NTA A	Criteria Distance to Nearest Outer Wall:	150	ft.	Enter the distance from the transmit antenna to the nearest outer wall of the building in any direction that is within the transmission pattern of the antenna (i.e. +/- 90degrees from the boresite of the antenna)
	EIRP at 100ft from the building:	-140.8537329		Verify that the EIRP at 100ft. From the building is less than -140dBm. If not, reduce the "Desired Signal Level at the Max Op. Range" (step 2) until the EIRP at 100ft is less than or equal to -140dBm.