



ROGERTM

GPS repeater

How to use ROGER GPS Repeater and accessories.



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Product description


ROGER GPS repeater operates by receiving GPS satellite signals with an antenna located outside the building and re-radiating the signals to the indoor area or covered space.

Use of re-radiated signals means that GPS receiver is tracking the current GPS status meaning that when a GPS receiver is moved from covered area to outdoors, the receiver is instantly tracking the location instead of time consuming acquisition of GPS data.

Please note that ROGER GPS repeater cannot be used for indoor navigation since the receiver will always give the position of the outdoor antenna instead of the real position.

Operating license note

Note: GPS repeaters may require a license or they may not be used in your country. Check license conditions with the local (radio)authorities before operating the GPS repeater product. In some countries the ROGER™ package contains instructions and the necessary forms to obtain an operating license from the local authorities.

DECLARATION OF CONFORMITY	
We hereby declare that the electrical device manufactured by Sparklike Ltd. complies with essential requirements of R&TTE Directive (1999/5/EC).	
Manufacturer:	Sparklike, Ltd.
Contact information:	Särkiniementie 5 C 6, FI-00210, Helsinki, Finland tel. +358 10 387 7701, fax +358 10 387 7707 email: sparklike@sparklike.com
Product:	Radio frequency signal repeater for retransmitting received GPS navigation signals to indoor spaces. Available accessories include outdoor receiving antenna, RF cabling and CE certified power supply.
Commercial name of the device:	Roger GPS Repeater
Type number:	GPSR-1
The structure of this device complies with the following universal standards:	
ROGER™ GPS repeater complies with the essential requirements of R&TTE Directive (1999/5/EC) Following standards and requirements have been used for the assesment: Art. 3.2, Radio spectrum: Requirements set by Notified Body #0523 according to Annex III+IV route. (Partly based on EN 300 440-1&2) Art. 3.1 b, EMC: EN 301 489-1 Art. 3.1 a, electrical safety: EN 60950-1	
The technical construction file has been approved and the device has been inspected by accredited testing and certification company Intertek Oy in its reports T08-600A-EMC and T08-600A-ELSA.	
The device has been CE certified in 2008. 	
Helsinki, on the 3rd of June, 2008, Sparklike Oy, Ermo Launo, Managing Director	

Company

Owned by Sparklike Ltd., Roger-GPS Ltd. is a company specialized in GPS technology. Its customers include a wide range of users who need GPS signal reception indoors. Users include rescue services, police, defence, airlines and companies manufacturing, selling and servicing GPS terminals. Roger-GPS Ltd.'s business concept permits the use of GPS devices and services in places where it was previously impossible.

The company was established in 2009 to carry on the development, manufacture and marketing of GPS products started by Sparklike Ltd. In September 2008 Sparklike Ltd. launched the first CE-certified GPS repeater and product family approved by the communications authorities in Finland and Sweden for use as radio-licensed devices. So far it is the only product of its type to meet the applicable standards.

The first GPS repeater users in Finland and Sweden are the fire-fighting and rescue services. Additionally, devices have been installed in the premises of local police departments and airlines and in testing and servicing companies.

The increasing popularity of GPS terminals has generated new applications and given rise to expectations that these devices would be able to operate indoors as well.

Contact information:

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Products

ROGER GPS Repeater Package (GPSR-BP)

A single ROGER GPS Repeater Package is enough to provide a GPS indoor coverage area of 30 metres in diameter from the repeater. Mount the external antenna on the roof of the building and connect the cable (RG58), 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 GPS coverage is immediately available. The kit includes clear installation instructions and a pre-completed application for a radio license.

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

- 1. GPS Repeater**
- 2. Outdoor antenna for receiving the GPS signals**
- 3. Power supply**
- 4. RF-cabling, 19,5m**

1. GPS Repeater

The GPS repeater works by receiving GPS signals from satellites with an outdoor antenna. The signals are then transmitted to indoors via cable and re-radiated by the GPS repeater. The GPS Repeater is powered from mains by the power supply.

In addition, it is possible to use custom length cables and line amplifiers to extend the cable length and signal splitters with additional transmitters to extend the coverage area.

Since the GPS signals are very low level, the repeater incorporates special circuitry to limit the output level to a maximum value within the requirements to conform with the CE requirements.

2. Outside antenna

The outside antenna is used to receive GPS satellite signals. The antenna has a female TNC connector and requires +5VDC power through the center pin. The power is usually supplied by the repeater, but if there is a DC block in the cable used, the power must be supplied from an another source.

Please note that a good quality antenna and a good location are essential for effective operation of the GPS repeater system. The standard antenna supplied in the kit has +35dB gain and <3dB noise figure.

In some cases a small patch antenna may be used. Typically this kind of solution is used in research labs where the receive antenna can be easily located outside by the window. The indoor coverage is typically greatly reduced in this case and feedback may present a problem (indicated by RED led indication), but is typically sufficient to bench test handheld GPS equipment.

Hint: the location of the outside antenna can be easily located by using a GPS receiver to read the coordinates through the repeater.

3. Power supply

The GPS Repeater system is powered by a DC wall adapter supplied in the installation kit.

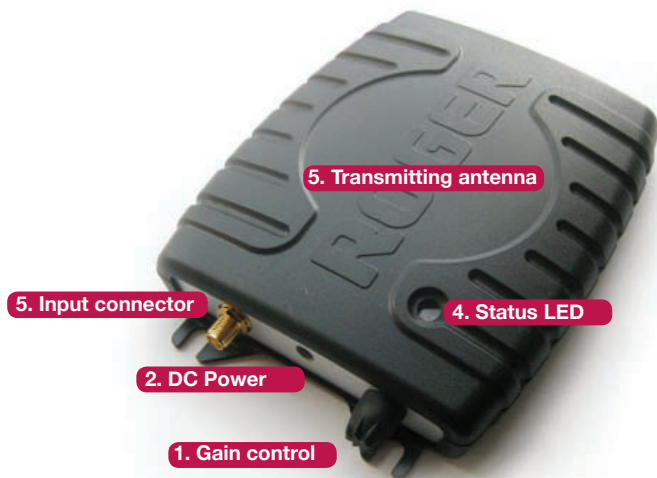
4. Cable

The standard cable supplied with the repeater is of RG58 type, which can be used for cable runs of up to 20 meters. Cable runs up to 40 meters can be realized with RG214. Longer cable runs may require a separate line amplifier to compensate the power loss in the cable .

ROGER GPS Repeater, transmitter unit

The transmitter unit is the main component of the system. The GPS Repeater transmitter contains filtering, amplifiers and power control circuits. The GPS Repeater also supplies power (+5VDC, max 100mA) to the outdoor antenna through the antenna cable.

ROGER GPS Repeater, controls and connectors



Description of GPS Repeater controls and connectors :

- 1. Gain control knob**
The gain control knob is used to control the output power of the GPS repeater.
- 2. DC power connector**
The repeater power is supplied through the DC input connector. The connection is reverse polarity protected. (+12VDC 300mA in)
- 3. Receiving antenna connector**
Receiving antenna should be connected to the SMA input connector with the cable supplied. Alternatively, a custom cable can be used. (SMA female, +5VDC 100mA output for active antenna)
- 4. Status LED**
The LED of the repeater should flash a few times at startup and then turn constant red or green.
- 5. Integrated antenna inside the case**

Technical information

Size	110*143*28 mm
Weight	165 g
Overall Gain	> 40dB
Noise Figure	< 2dB
Variable attenuation	0-40dB
Impedance	50Ω
Input connector	SMA-female
Operating temperature	-35 - +60°C
Power supply	+12VDC, 300mA Power supply included
Indoor coverage radius	5-10m
Antenna power output	+5VDC, 100mA
TX antenna gain	max +4dBd, RHCP polarization

Other features

Automatic gain control	Output power limit -60dBm
Feedback oscillation suppression	Status/power LED
Manual gain control	Internal transmit antenna

CE-certified

Installation

When installing the GPS repeater, you should have:

- a suitable tools to tighten the SMA connector
- handheld GPS receiver (*)
- Suitable fixing tools and accessories

(*The GPS receiver must be able to show the satellite signal levels.)



Fast instructions

1. Open the ROGER GPS Repeater Pack.
2. Use the black mount to connect cable with TNC male connector.
3. Mount the external antenna on the roof of the building and connect the cable (RG58), supplied with the kit, to the antenna and to the repeater installed indoors.
4. Install the GPS repeater transmitter by fixing it to ceiling, wall or a suitable mount.
5. After having installed the outside antenna, cable and repeater, plug in the wall adapter cable and plug the adapter to a power outlet.
6. The LED of the repeater should flash a few times at startup and then turn constant red or green. Adjust the repeater's transmission power according to the local conditions, to prevent a signal loopback, and indoor GPS coverage is immediately available.



About installation

Receiving antenna installation

The receiving antenna should be placed in a place where it can 'see' as much of the sky as possible. It should be also located as far as possible from any RF interference sources, like any transmitting antennas. Before fixing the antenna, check that the cable is long enough and it can be run from the antenna to the required indoor location.

It is also recommended that the system is first tested by running the cable through a convenient route to the indoor installation place and checking that the indoor GPS coverage is suited to the use.

GPS repeater installation

Install the GPS repeater transmitter by fixing it to ceiling, wall or a suitable mount. The repeater has an integrated antenna, which is located next to the status LED. The transmitter radiates mostly towards to the same direction as the LED. Ideally the transmitter should be located so that any desired GPS receiving location (like an antenna on top of a van in a garage) has a direct line-of-sight to the repeater antenna.

Also note the length of the wall adapter cable when planning the installation location.

After having installed the outside antenna, cable and repeater, plug in the wall adapter cable and plug the adapter to a power outlet. The LED of the repeater should flash a few times at startup and then turn constant red or green.

The indications of the status LED are:

- **GREEN:** Transmitter is operating normally
- **Constant RED/GREEN:** Transmitter is operating normally, output power has been limited to maximum allowed value.
- **RED:** Transmitter has detected an error or interfering signal. Typical reason is that the input antenna is located so that it can pick up the signal from the transmitter and a feedback oscillation occurs. Other common reason is that there is an interference source close to the receiving antenna.

Troubleshooting

GPS receiver cannot receive signals next to the repeater.

- Check that +5VDC is present in the antenna end of the cable and in at the antenna connector of the repeater. Broken or short-circuited cable?
- Check that repeater power is on and LED is on.

No LED indication on GPS Repeater

- Check that +12VDC is present in the wall power adapter connector
- Check that power is available in the wall connector where power adapter is connected

LED turns RED and GPS coverage is lost.

- Check that outdoor receiving antenna is in a location where it cannot receive signals from the repeater
- Try turning down the gain setting
- Check that there are no interference signals close to the receiving antenna. The system is very sensitive to interference at the GPS L1 frequencies (1575.42+/-20 MHz)

Small indoor coverage radius

- Check that outside antenna is correctly positioned
- Check that there are no interference sources close to the receiving antenna
- Check gain setting
- Check the repeater positioning
- Are there obstacles that could limit signal coverage?
- Shorter cable run or a line amplifier can improve signal level slightly
- Signal splitter and additional repeater units may be required to cover a larger or obstructed areas

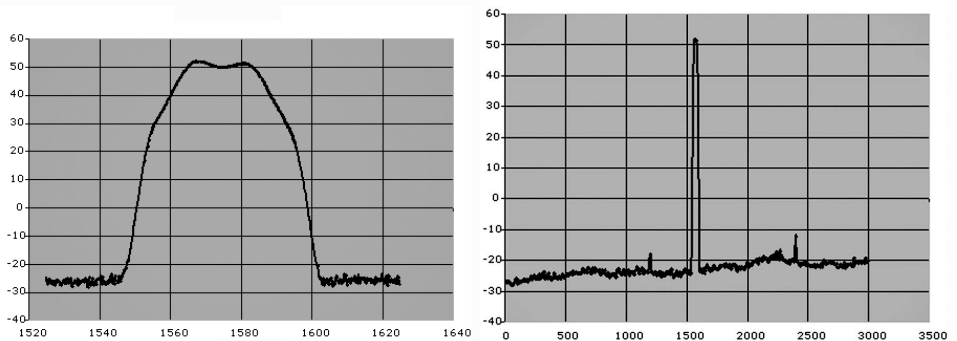


Figure 2: Wideband gain. NOTE: Attenuation outside the 1.575GHz passband is typically better than -60dB. Graph indicates lower attenuation due to measurement setup (spectrum analyzer noise floor).

Splitter and Amplifier Installation instructions

ROGER™ GPS Signal Splitter and Line Amplifier provide longer cable runs and signal splitting to several ROGER™ GPS Repeaters.



ROGER GPS Amplifier (GPSR-A)

ROGER™ GPS Line Amplifier is an amplifier that is used to allow for longer cable runs and/or signal splitting to several GPS Repeaters. It has a gain of +18dB at the GPS L1 frequency band and it includes a filter to remove unwanted signals that may have entered the cable at somepoint.

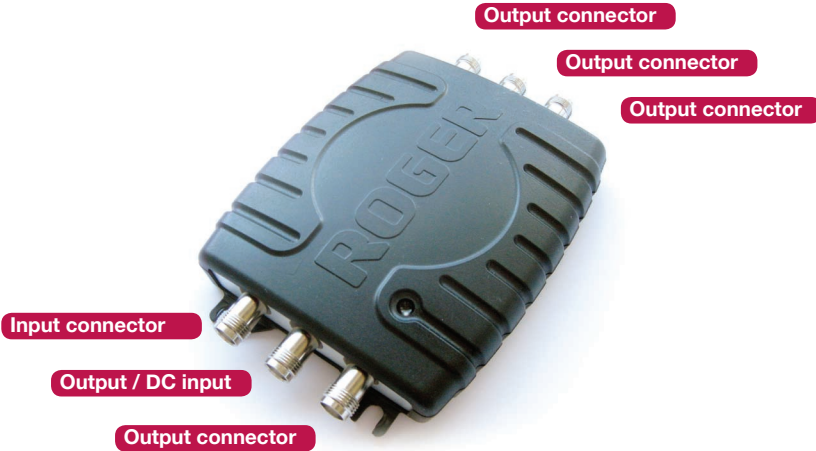
The amplifier is powered though the output signal cable by the ROGER GPS Repeater and also passes on DC power for the GPS receiving antenna or an another GPS line amplifier.

TECHNICAL SPECIFICATIONS

Size	110*143*28mm
Weight	135 g
Operating temperature	-35 - +85°C
Connectors	TNC female input TNC female output
Frequency range	1575.42 +/-15MHz filtered
Noise figure	<5dB
Impedance	50Ω
Power supply cable	The amplifier is powered though the output signal by the ROGER GPS Repeater
Gain	+15dB

ROGER GPS Splitter (GPSR-S)

ROGER GPS Signal Splitter is used to distribute GPS signal to several GPS Repeaters. Splitter works with both GPS L1 and L2 frequency bands. It has one chaining output and four repeater outputs. DC power is passed from the chaining output to the input connector for GPS line amplifier and GPS receiving antenna. If the signal is to be transmitted to fewer than five repeaters, the unused ports should be terminated.

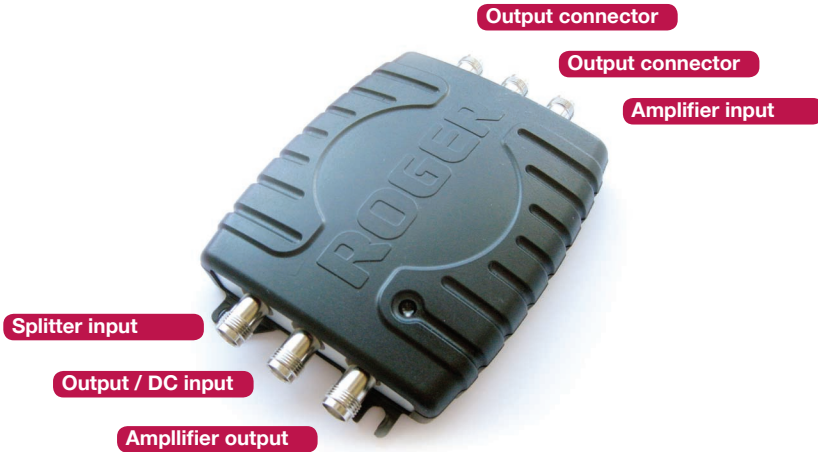


TECHNICAL SPECIFICATIONS

Size	110*143*28mm
Weight	185 g
Operating temperature	-35 - +85°C
Connectors	TNC female input, 5 x TNC female output: 1 x -4dB with DC pass 4 x -12dB
Frequency range:	1200-1700MHz
Impedance:	50Ω
Power	The splitter is powered though the output / DC input connector by the ROGER GPS Repeater

ROGER GPS Amplifier&Splitter (GPSR-AS)

ROGER GPS Signal Splitter & Amplifier is a combined signal splitter and line amplifier with an output of +18db that can transmit to up to three separate repeater units. The splitter & amplifier is easy to use and permits a wide range of system configurations.



TECHNICAL SPECIFICATIONS

Amplifier section

Size	110*143*28mm	
Weight	195 g	
Operating temperature	-35 - +85°C	
Connectors	TNC female input	TNC female output
Frequency range	1575.42 +/-15MHz	filtered
Noise figure	<3.8dB	
Impedance	50Ω	
Gain	+18dB	

Splitter section

Connectors	TNC female input, 3xTNC female output
	1 x -4dB output with DC input
	2 x -12dB output, DC blocked, for repeaters
Power supply:	The amplifier&splitter is powered though the output / DC input connector by the ROGER GPS Repeater
Frequency range:	1200-1700MHz

What to consider when planning a ROGER GPS Repeater installation

1. Distance between the outdoor antenna and the repeater.

The Roger GPS repeater system needs ~ 15 dB RF gain from the antenna including cable losses for best performance. The antenna supplied with the basic repeater package has an RF gain of 35 dB, which results in a cable loss budget of approximately -20 dB. Using an RG-58/RG-223 cable to connect the antenna therefore limits the distance between the antenna and the repeater to ~ 30 m as the typical loss of a RG-58 cable is ~ 0,65 dB/m @ 1575 MHz. If the distance between the outdoor antenna and the repeater requires longer cable runs different methods can be used.

a) Use a lower loss cable.

Using RG214/RG213 cable will allow a cable run of 65 - 70 meters, as the typical attenuation for this cable is ~ 0,3 dB/m @ 1575 MHz

b) Use a Line Amplifier to compensate cable losses.

Connecting the ROGER Line Amplifier between the antenna and the repeater provides an additional +18dB gain, which increases the allowed cable length to 58 m with RG-58/RG-223 cable and 125 m with RG214/RG213 cable. The ROGER Line Amplifier should be placed as close as possible to the outdoor antenna and as it is powered by the ROGER GPSR-1 repeater through the coaxial cable, no separate power line connection is required. Two ROGER Line Amplifiers can be connected in series, increasing the maximum cable length to ~ 180 m using RG-214/RG-213 and ~ 85 m using RG-58/RG-223 cable.

2. Area to be covered by the repeater.

The area covered by the repeater typically has a radius of 10 - 15 m. This means that for some installations, like in parking houses or garages, multiple repeaters will be needed to provide the desired coverage.

In this example five repeaters and a 1:5 Signal Splitter are used to cover the area of a garage. The ROGER Signal Splitter allows up to 5 repeaters to be connected to one receive antenna. One splitter output is DC-coupled, has -4 dB coupling loss and must always be connected to a repeater to allow DC to be fed to the receive antenna and / or line amplifier. The four remaining outputs are DC-blocked, have -12 dB coupling loss and should be terminated if not used. To cover bigger areas, additional signal splitters can be connected in a chain configuration using the DC-coupled output.

Important!

In applications using multiple repeaters, the loss budget for each repeater must be calculated to make sure - 20 dB of link loss is not exceeded.

Example of link loss budget

Antenna to Line Amplifier loss, 1.5 m of RG-58 cable:	- 2 dB
Line Amplifier gain:	+18 dB
Line amplifier to Splitter loss, 40 m RG-213:	- 13 dB
Splitter coupling loss:	- 12 dB
Splitter to repeater loss, 10 m RG-58:	- 7 dB
TOTAL Link (antenna to repeater) loss:	- 16 dB

Even if the low loss RG-214/RG-213 cable is higher cost than RG-58/RG-223, if it's only a question of increasing the distance between the outdoor antenna and a single repeater, using a low loss RG-214 cable will be more economical than adding a Line Amplifier. However, if a Signal Splitter is used to allow more than one repeater sharing the same outdoor antenna, most applications will require a Line Amplifier to be used.

