



SR-Series

User Manual



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1. INTRODUCTION

1.1 ABOUT MAGOS SYSTEMS

Magos was established in 2007 to realize its co-founders' vision of bringing advanced radar technology to the security and perimeter protection and detection market. We are Experts in Low cost, Low power consumption, High performance radars that can be easily integrated with existing VMS, PSIM and other control software and automatic PTZ slew-to-cue for an end-to-end cost effective and easily maintained solution of the customer's security requirements.

1.1.1 CONTACTING MAGOS SYSTEMS

Please contact us through the following channels:

Medium	Details
Email	info@magosys.com
Mail	Gad Feinstein 13 Office 225, Rehovot Israel 7638517
Website	www.magosys.com

1.1.2 CONTACTING MAGOS SUPPORT

Support is available to customers who have a trial version of a Magos product or who have purchased a Magos product and have a valid maintenance contract.

To contact Magos support, send an email to support@magosys.com.

2. SCOPE

This document aims to provide a user manual for the setup and installation of the SR sensor by Magos Systems. The manual provides information on mechanical structure and interface, installation procedure and guidelines, interface to managing system. Please read the entire document prior to the installation and or use of the product.

2.1 PROFESSIONAL INSTALLATION INSTRUCTIONS

2.1.1 INSTALLATION PERSONNEL

The SR Radar is designated for installation by technicians/system integrators who have received training by Magos Ltd. Only. It is not designated for the casual consumer or installation by “lay-men”. If you have not received proper training please contact Magos Ltd or visit our website (www.magosys.com) for a list of authorized installation personnel.

2.1.2 INSTALLATION LOCATION

The product shall be installed at a location where the radiating antenna can be kept at least 2m from a nearby person in normal operation conditions

2.1.3 INSTALLATION PROCEDURE

Please refer to the rest of this manual for further details

2.2 IDENTIFICATION

System name: SR Radar

2.3 SYSTEM OVERVIEW

SR outdoor perimeter defense sensors are designated for outdoor installation and use only. It provides high accuracy, real-time location and speed data on detected targets.

The SR series is a radar technology based sensor. This means that it transmits low power (less than 100mW) RF signal in the C-Band frequency and inspects the returned signal. Radars detect movement within the transmitted beam coverage area, based on modification in the returned signal and Doppler induced frequency detection. The SR series contains no moving parts and relies on a multi-channel antenna array and digital beam forming technology to determine target azimuth. This fact increases scan rate capabilities and thus enhances detection probability and s detection performance in general. In addition it contributes to MTBF increase making the entire system more reliable. Finally as an RF based sensor the SR exhibits superb immunity to lighting, visibility (FOG, Smog), weather (rain, snow) and other environmental conditions.

The SR implements all data processing, detection and target tracking algorithm intrinsically, and reports the tracking results via Ethernet UDP protocol to the host computer approximately twice per second.

Unlike most radars, the SR Series support "zero Doppler" detection – meaning that it can detect very slow moving targets (crawlers etc) and tangent moving targets. Static objects are not reported as targets since each target must travel a certain minimum target to be considered as a target, however a moving target that was tracked and stop moving will still be detected.

Radar coverage area is nominally 120° in azimuth (horizontal plane) and 30° in elevation. A more accurate description of the radar coverage area can be found in Figure 9. Note that in similar to all transmitting/receiving antennas and devices, the SR also exhibits low gain to areas outside the stated coverage area (above 60° to the left or to the right of the face of the radar and even to the back of the radar). This results in some wanted and unwanted phenomena for example:

- **Zero range detection:** even when installed on very high (>10m) poles with zero tilt angle – the radar might still detect targets moving on the ground directly below it (allegedly increasing coverage in elevation to 90 degrees below the horizon).
- **Near range disturbances:** large moving targets (or metallic objects acting as reflectors) in the near vicinity of the radar (up to 10 meters away from it for human up to car sized targets) outside the area of coverage and even directly behind the radar might be detected by the radar and falsely interpreted as targets moving within the coverage area.

3. SYSTEM DESCRIPTION

SR Radar Series are autonomous, low energy, high probability of detection sensors for security applications.

Specifications:

- Sensor type: High resolution MIMO digital beam-forming radar
- Detection range: Up to 400m Human & 600m for Vehicle/Boat
- No moving parts. MTBF of 100,000 hours.
- Azimuth coverage: 120°
- Elevation coverage: 30°
- Azimuth accuracy: 1°
- Frequency: 5.8GHz
- Range resolution: 0.4m
- Scan rate: 2 scans per second
- Detected target speed: 0.3 – 30m/sec.
- False alarm rate: <1 per day
- Power: For POE supported models 48V
- Built in tracker – low data bandwidth (<1kbps)
- Interface: Ethernet with POE according to IEEE 802.3at Type 1 (802.3af) and Type 2
- Dimensions 9.8"(w) x 5.8"(h) x 2.3"(d)
- Weight: 3.3 Pounds
- IP67
- 5.8/2.4FCC & CE compliant.



Figure 1: SR sensor general view

4. MECHANICAL INSTALLATION

4.1 INSTALLATION RESTRICTIONS AND LIMITATIONS

In order to properly install the SR radars and integrate it into an active, efficiency protection system, it is imperative that the user will first understand some basic rules regarding radars in general and specifically regarding the SR radars. Prior to sensor installation it is imperative that the user reads the following list of limitations and restrictions and ensures that the intended installation site is suitable for installation. When in doubt please consult with Magos representatives.

The following limitation and restriction should be considered prior to installation:

- Environment: Radars are based on line-of-sight detection. Any obstacles hiding or partially hiding areas from the radar will not be properly protected. This include obvious obstacles such as walls, buildings, hills etc, but also includes less obvious obstacles such as light foliage, low bushes etc., where target is only partially obscured from the radar. In such case detection performance is reduced.
- While the SR radar features "zero-doppler" detection, maximum detection ranges for tangent moving targets (moving targets that remain at a constant or near constant distance from the radar) or for crawlers are typically reduced compared to radial moving targets. This occurs in areas that are not clear of obstacles such as bushes, trees and other vegetation.
- The SR radar does not implement target classification – which means that cars, human walker large animals and sometimes small animals are all declared as targets.
- The SR's instrumental resolution in azimuth is $\sim 5^\circ$, and in range it is $\sim 0.4\text{m}$. Therefore target separation capabilities are $\sim 1\text{m}$ in range and 7° in azimuth. This means that two or more targets moving within less than 1m difference in range from each other **and** less than 7° will be declared as single target, and the reported location will be near the center of the group. **Note** that for single target location accuracy is much better than resolution, and reach less than 1° in azimuth and approximately 0.1m in range.
- As mentioned earlier the SR series might exhibit disturbances and "ghost" targets as a result of large returned signals. This occurs when a very large target (car/ truck etc.) moves in the vicinity of the radar (30m away or less, and 5m away or less for human targets) even outside the stated coverage area. Therefore it is recommended to install the sensor in unpopulated, isolated spots (or alternatively use high poles to distance the radar from ground movement).
- The SR in similar to all radar based technologies relies on returned signal to interpret target location. If the coverage area contains metallic objects (cars, large pipes, fences etc) or non-metal surface (straight walls, buildings) this might result in multiple reflections (in similar to looking at a mirror) from a signal target, arriving at the radar from multiple angles. This means, for example, that if the

radar is set to protect an area containing a metallic fence, a target moving at one side of the fence might be detected by the radar as 2 targets moving from both sides of the fence.

- In general water is non-transparent to RF signals. A consequence of this fact is that when the SR radar is positioned to cover an area containing large bodies of water, large waves and other disturbances in the surface of the water might be interpreted by the radar as moving targets.

4.2 GENERAL INSTALLATION GUIDELINES

The SR radar sensor is very simple to handle and install.

Using the four holes on the back, the unit may be assembled either using one of Magos' solutions or any other means of securing the unit in the desired location.

General guidelines for assembly:

Figure 2 outlines the mechanical dimensions of the unit and mounting holes, and the electronic connector location. Holes are compatible to 1/4"-20X1/2 screws. Screws and mounting brackets can be purchased separately from Magos. The brackets and their use are depicted in:

- **Figure 2** and **Figure 3** for installation on a tripod, or Figures 5-7 for wall/mast/pole mounted installation.
- When using Magos' brackets or any other bracket ensure all 4 screws are used. During installation make sure all screws are properly fastened, and are installed with spring washers and washers. Otherwise Magos is not responsible to damage caused to the unit or people that might result from the detachment of the sensor unit under harsh wind conditions.

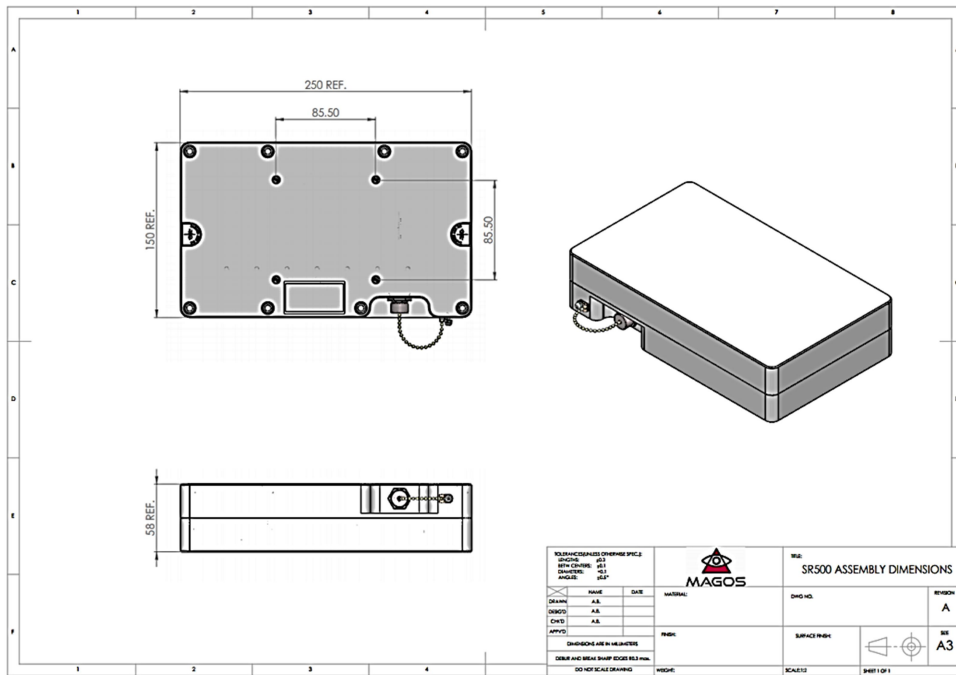


Figure 1: SR sensor outline and dimensions

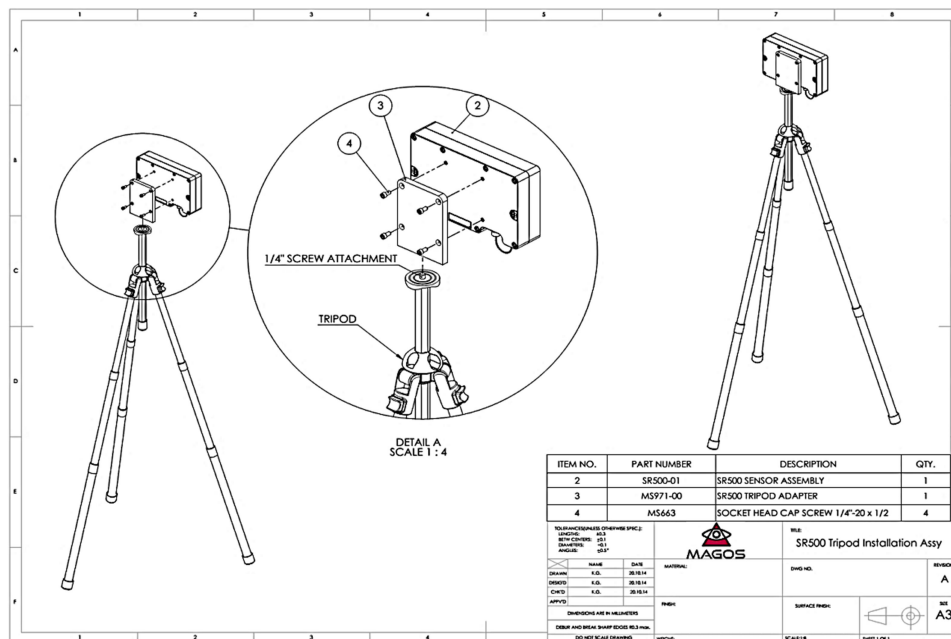


Figure 2: SR Tripod Installation

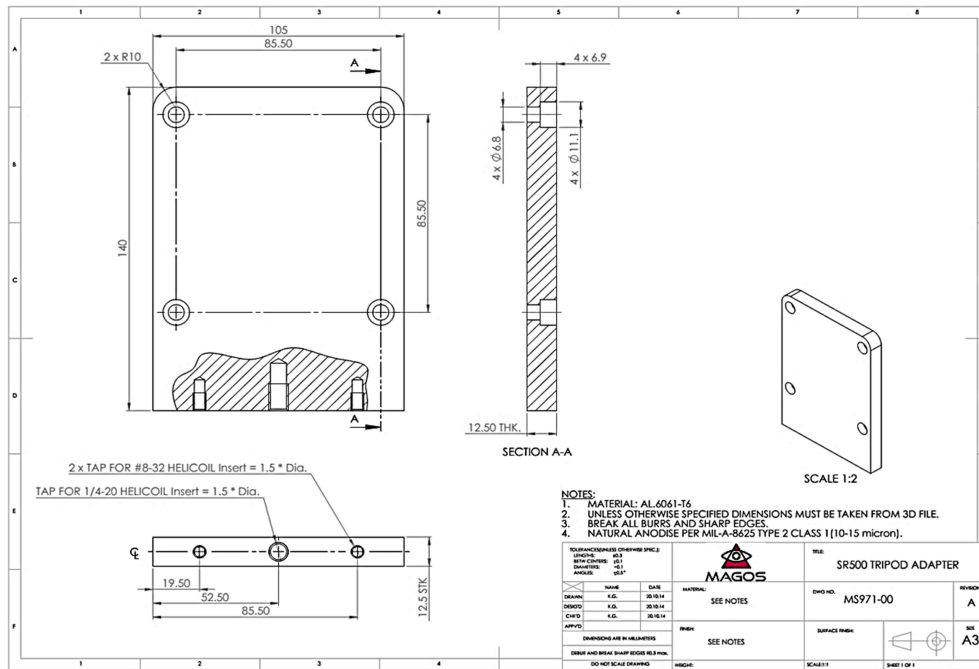


Figure 3: SR Tripod adapter

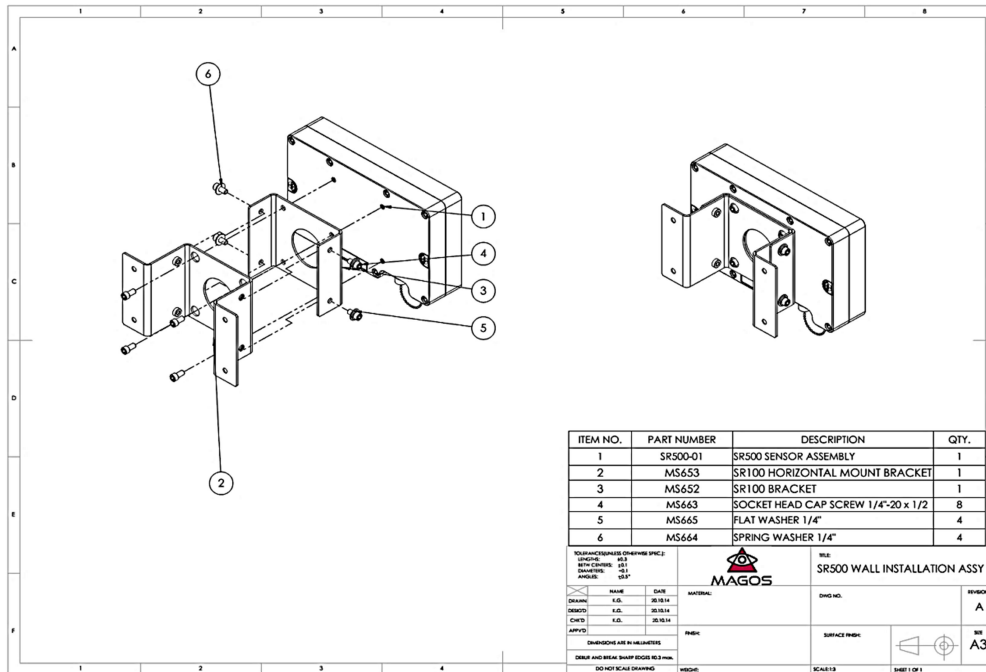


Figure 4: SR Wall Installation

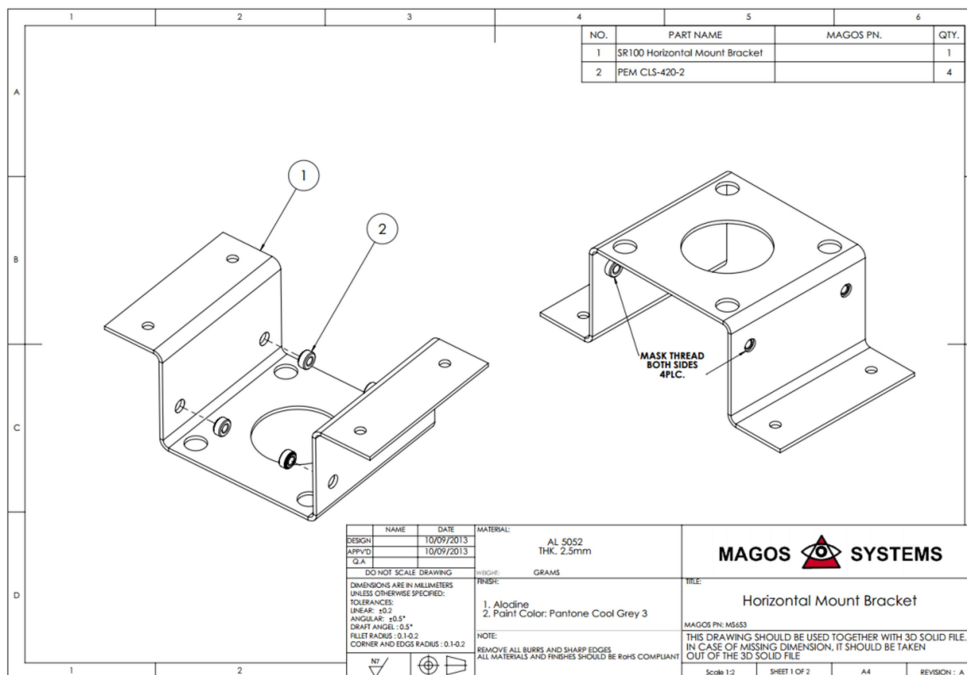


Figure 5: Wall mount Bracket

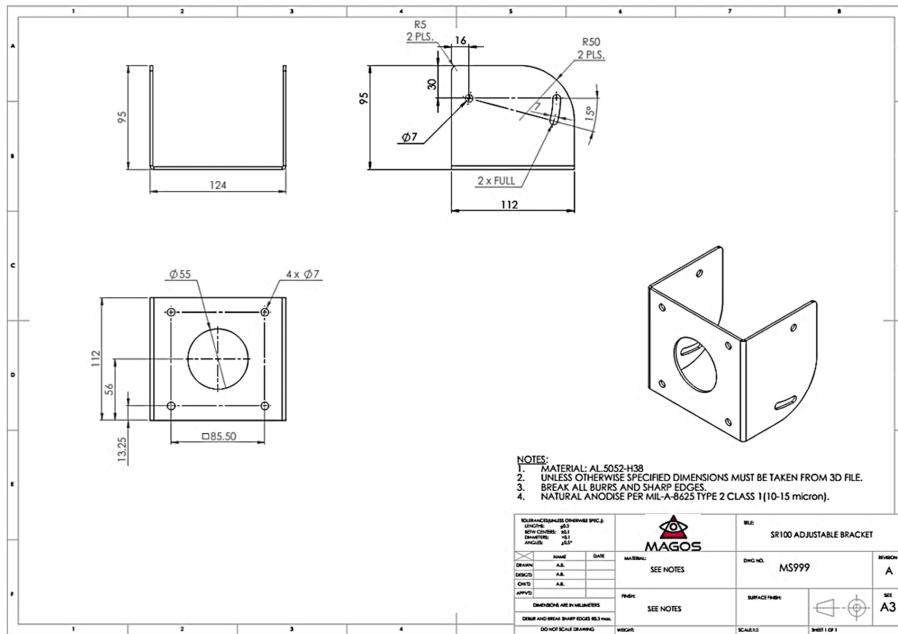
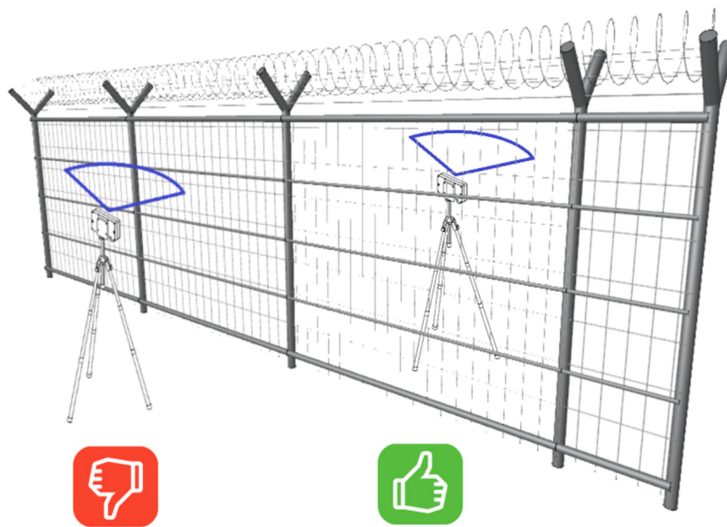


Figure 6: Elevation angle Adjustable Bracket (Replaces MS652 from figure 3)

Carefully choose the area of installation: make sure that the coverage area of the unit is a sparsely populated area with minimum human traffic. In addition avoid positioning the unit in the vicinity of large metal (or other) reflectors that might block line of sight to the entire coverage area or otherwise hamper sensor performance. Figure 7 and Figure depict general rules of thumb for unit placement. It is strongly recommended that customers new to radar technology in general and the SR specifically would perform a preliminary site survey in cooperation with Maogs' sales & support representatives to



ensure that the protected area is suitable for coverage using the SR.

Figure 7: Proper Installation on tripod

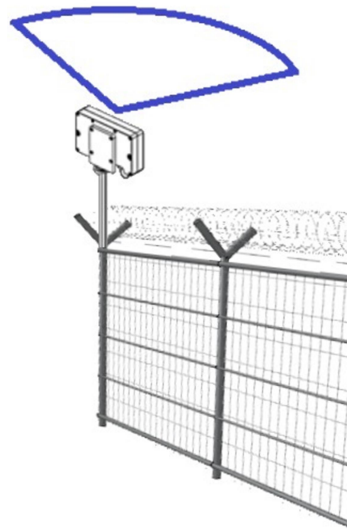


Figure 9: Proper Installation on fence

Aim the center of the sensor towards the center of the area of interest. Refer to Figure 8 for elevation and azimuth angle coverage relative to the unit. Figure 9 demonstrates typical detection performance – maximum range as a function of angle of approach from the birds-eye view. Ensure that sensor is level with the ground, otherwise sensor coverage area might be reduced depending on the sensor's elevation angle coverage and the degree of tilt relative to the ground.

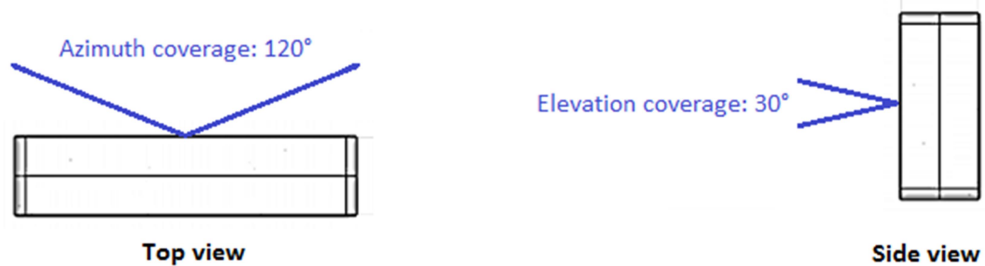


Figure 8: Angle Coverage

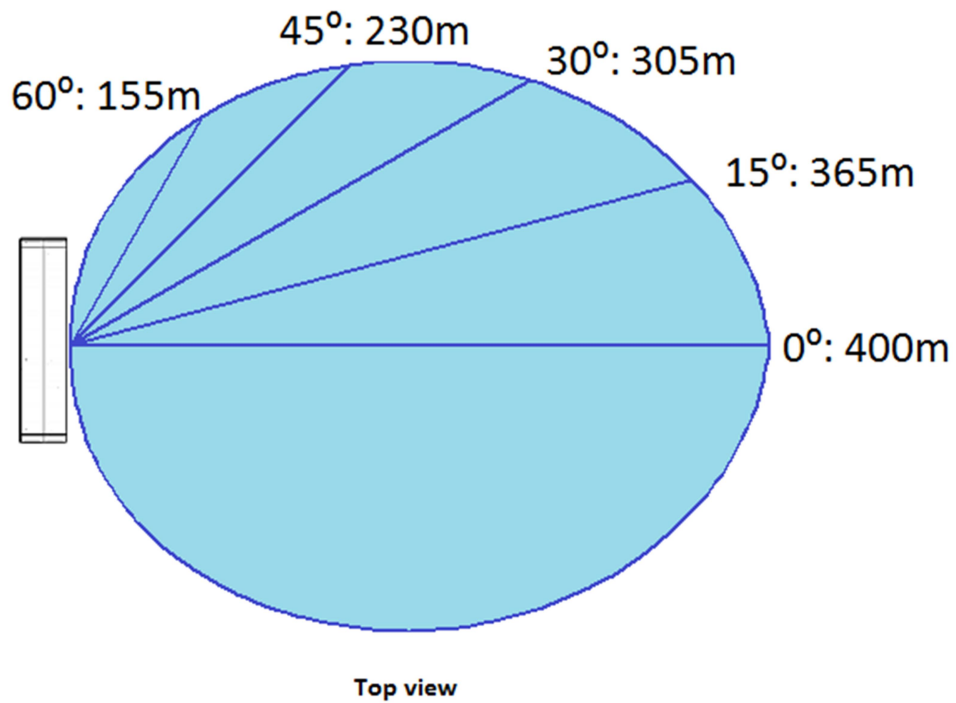


Figure 9: Nominal detection ranges as a function of angle of approach

Recommended installation height is 3-9m. Below 3m user might experience degradation in sensor performance. Above 9m there might be a “dead-zone” in the vicinity of the sensor in accordance with the sensor’s elevation angle coverage. In order to achieve best performance refer to Table 1 and Figure 10 for recommended tilt angle.

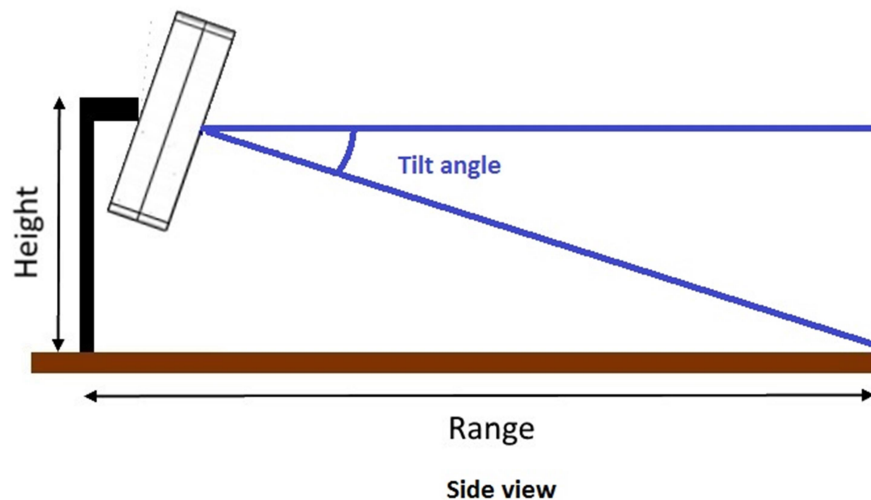


Figure 10: Tilt Angle

Height [meters]	Range [meters]	Tilt angle [degrees]
3	50	-3
3	100	-2
3	200	-1
3	300	0
3	400	0
5	50	-6
5	100	-3
5	200	-2
5	300	-1
5	400	0
10	50	-11
10	100	-6
10	200	-3
10	300	-2
10	400	0
15	50	-15
15	100	-8
15	200	-4
15	300	-3
15	400	-2
20	100	-11
20	200	-6
20	300	-4
20	400	-3

Table 13: Tilt Angle

Make sure the sensor is stable and secure. The mounting solution should be stiff and stationary under harsh wind conditions. As a general guideline, oscillations of more than 3cm should not be allowed, or the unit's performance might be compromised.

If several sensors need to be installed next to each other, we recommend a distance of at least 1m between the sensors when not aimed at each other (back to back installation). Avoid aiming the sensors at each other when they are installed with less than 150 meters distance between them.

Failure to observe the above restrictions might result in sensor performance degradation and in extreme cases might lead to irreversible damage to the sensor units.

Connecting to the sensor: use outdoor weather immune cables. When cable is not plugged in use the connector cap to maintain weather immunity. Magos is not responsible to weather damage (corrosion etc.) caused by using improper cables/failure to the use the cap when not installed. In such cases product warranty is void. See chapter 5 for details on sensor electronic connection. Ensure that the electronic connecting cable is firmly secured to the pole/wall or any other contraption upon which the radar is installed in such a fashion that would not allow it to dangle within the coverage area of the sensor. In addition make sure that the cable securing method renders it resistible to strong winds and that it does not apply excessive force on the connector.

5. ELECTRICAL INSTALLATION GUIDELINES

Electrical installation of the sensor consists of a simple cable connection on the radar side. Depending on the interface required and the available on-site infrastructure the user can choose to prepare custom made cables or use Magos cables that are supplied separately. For your convenience in case of the custom cable option, cable and connector pin-outs infrastructure are depicted in Figure 11.

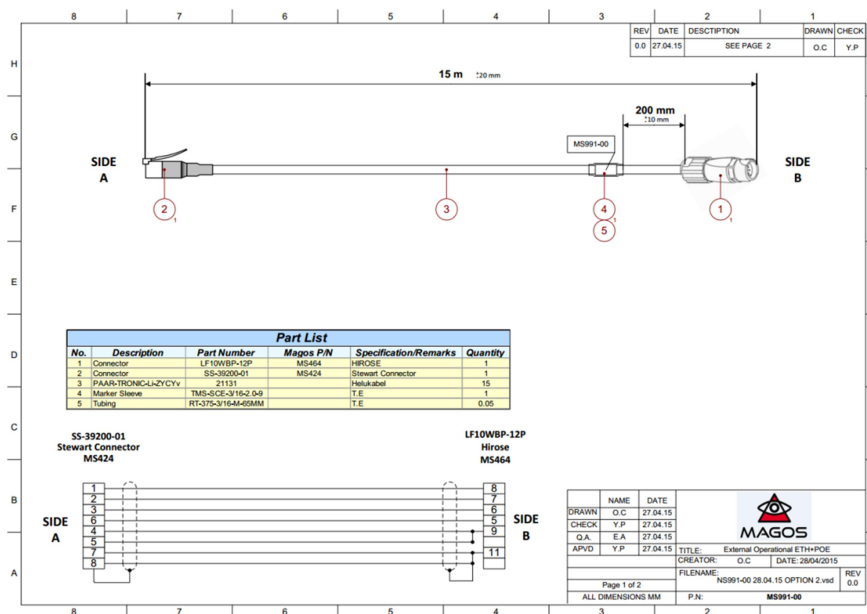


Figure 11: SR500 External operation cable

5.1 POWER SUPPLY INTERFACE

Ensure that the SR Radar is powered only from an IEEE 802.3at Type 1 (802.3af) and Type 2 certified POE injector/switch which is in conformance with all safety and EMC standards that are relevant and applicable in your country. If you are unfamiliar with such standards it is recommended that you contact Magos and enquire as to the compatibility of the suggested power supply.

Electrical requirements of the power supply are 48V and 15W, according to IEEE 802.3at Type 1 (802.3af) and Type 2. Using power supplies that do not meet these requirements and/or are not properly authorized for public use in your country is under the sole responsibility of the user, and might result in unexpected sensor behavior or even irreversible damage to the unit.

An example for such a POE supply can be found here: POE injector . **Note** that this is an indoor unit that can be useful for initial sensor configuration only and cannot be used in outdoor fixed installations.

6. COMMUNICATION INTERFACE

The SR sensor supports standard ethernet interface (standard 100Mbps). The product label contains its unique MAC address. When interfacing Magos proprietary MASS C&C software consult with the MASS user manual for more details on sensor interface and ICD.

Otherwise please contact Magos at support@magosys.com for information on supported C&C software, sensor setup etc.

6.1 RADAR MANAGER

The "Radar Manager" software tool is a simple configuration tool for swift and easy network configuration of the SR Radar. This tool doesn't require installation and can be downloaded from (www.magossystems.com/download/). If you encounter problems during download you may contact Magos support team (support@magosys.com) for assistance.

This section contains instructions on how to use the "Radar Manager" tool to detect radars connected to your local network and to assign them with user defined IP addresses. This initial step is crucial for proper communications with the radars via C&C/PSIM software (either Magos MASS or any other software based on Magos SDK).

Figure 12 depicts the Radar Manager main screen as it is shown when first running the tool.

The play/stop buttons on the top left of the screen can start/stop the tool from scanning network messages.

While running the tool scans for specific broadcast messages periodically sent by each of the operational SR radars that are connected to the same local network as the PC running the Radar Manager.

As seen in Figure 12 the main screen lists the radars it detected in a table. Each device occupies one row in the table with the following columns:

- MAC – device specific and unique MAC address
- IP – current IP address assigned to the SR50
- Model – Device model and firmware version
- Last Update – the time and data of the last message broadcast by the device.

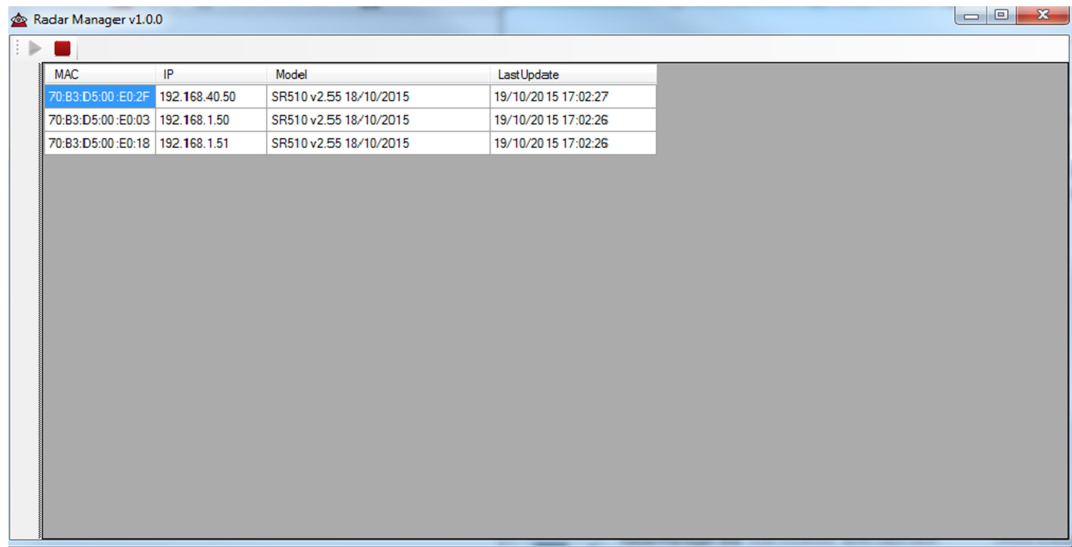


Figure 12: Radar Manager Main Screen

In order to assign a different IP to a radar, right click on the row containing the device details, and choose "Assign IP".

An "Update IP" window will be opened as shown in Figure 13. The window shows the MAC of the selected device and the current IP assign to it. The user is prompted to type in the new IP address. When done click set.

The new IP will be updated in the device table of the main screen within a few seconds, when the next broadcast message arrives from the device. It is recommended to wait and check that IP was indeed updated successfully.

This IP will be retained in flash memory on the radar and will not be erased upon reset. It can be re-configured using the radar manager tool whenever needed.

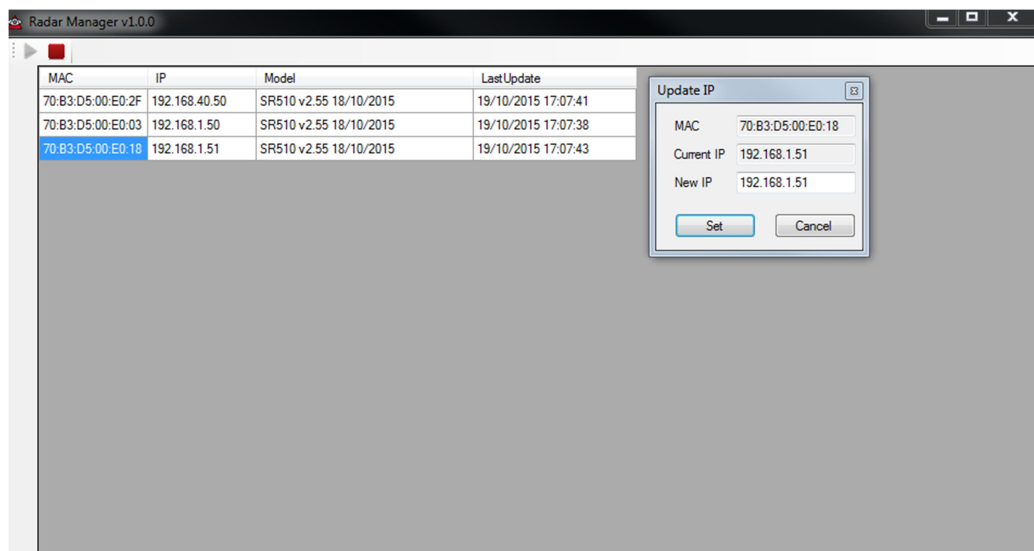


Figure 13: Radar Manager - Choosing a fixed IP

7. BIT

The SR sensor includes a built-in test feature. This feature is designed to allow operators to identify HW or other faults that might result in reduced sensor performance or even prevent operation of the sensor.

Note – The BIT feature is not support in all FW versions. In order to find out whether your sensor support BIT please contact Magos support team.

7.1 BIT MECHANISM

The built-in test contains 2 types of tests – continuous and periodic. Continuous tests are run continuously. If the test fails BIT status is immediately reported. Periodic tests run periodically (approx. once per minute).

In any event, regardless of test results, a BIT status report is sent periodically upon completion of all periodic tests.

While all tests have a "Boolean" "Pass/Fail" result, most tests also report a numeric test result if relevant.

To find out how to access the BIT status report, and depending on the control software you use, please see:

- MASS user guide – "BIT Status Report" chapter
- Technician software user guide
- SDK/ICD documentation

7.2 BIT DESCRIPTION

The following built-in tests are included in the SR Radar:

- **Jamming** – Radar SW suspects a jamming attempt / an external interference. This test is run continuously and any suspected jamming/interference is immediately reported. Jamming test also returns the estimated direction of the jamming source, and measurement standard deviation.
- **Current** – Radar current consumption is too high/low. Test result includes current measurement in mA. This test is periodic.
- **Vmain** – The internal 5V DC supply output voltage exceeds limits. Test result includes voltage measurement in mV. This test is periodic.
- **VextPOE** – The main DC voltage supply input level exceeds limits. Test result includes voltage measurement in mV. This test is periodic.
- **Temp.** – The temperature exceeds operating limits. Test result includes temperature measurement in ° Celsius. This test is periodic.
- **Vneg, Vhighh, Vpll, Vrf1, Vrf2, VpdPre, VpdCh0** - Various internal DC converter voltages levels. These tests include voltage measurement in mV. This test is periodic.
- **TxRfP** – RF power detector places on the Tx output detects a power level that exceeds limits. This test includes estimated power measurement in dBm. This test is periodic.
- **PIILck** – The PII (in charge of generating the Tx RF signal) fails. This test does not include additional results. This test is continuous.
- **TamperSw** – Internal tamper switch has been activated. This means that the radar's front cover (Radome) has been physically removed. This test is continuous.

Note I – This test is only support in specific HW models that include the Tamper Switch. Contact Magos support to find out whether your unit includes this feature.

Note II – Once tamper switch is set it can only be cleared by an authorized Magos technician.

7.3 HANDLING FAILED BIT REPORTS

In case of Jamming report – try to find out if there are any radio emitting devices in the vicinity of the radar (wireless communication equipment, nearby radars, etc.). Use the angle measurement report to narrow down the emitting source possible locations.

In case of temperature – the radar is designed to operate in extreme temperature conditions from -40° up to +85° Celsius. If installed in a harsh environment that exceeds these limits try to control temperature by shading/adding circulation (in case of over-heating) or adding an external heat source (even a lamp) in case of extremely low temperatures.

In case of tamper SW – this indicates that radar has been physically tampered. Even if tamper occurred due to an innocent mistake, once the Radome has been opened the unit must be inspected by Magos personnel or an authorized technician to ensure that no lasting damage has occurred.

In case of failure in all other tests the unit must be inspected by Magos personnel or an authorized technician in order to locate the HW fault and repair it.

8. WARNINGS AND DISCLAIMERS

8.1 GENERAL

1. The SR Radar is an electronic radiating product. As such it is not recommended for installation with densely populated areas, or in the vicinity of such areas. Magos recommends installation at remote, un-populated, outdoor sites only. In addition avoid prolonged unnecessary human contact with the radar and as a rule it is recommended that the installation with maintain a 3m radius safety distance from the sensor.
2. The SR Radar is not intended for direct connection to the AC power network. When using power supplies/converters with the radar that are connected to a local or national AC power network make sure they are properly isolated and are in full compliance with your local regulations. In any event Magos will not liable to any damage caused to the product or any interference caused to the power network resulting from a faulty/in-appropriate power supply.
3. Mechanical installation of the SR500 is not within the scope of responsibility of Magos. Magos is not liable to any damage incurred to the customer and/or to a third party due to faulty installation (loose bolting/weak brackets etc).
4. The SR Radar should be serviced only by a person qualified by Magos.

8.2 FCC COMPLIANCE STATEMENT

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio and television reception.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause such interference, which can be verified by turning the device off and on, the user is encouraged to eliminate the interference by one or more of the following measures:

- Re-orient or re-locate the receiving antenna.
- Increase the distance between the device and the receiver.
- Connect the device to an outlet on a circuit different from the one that supplies power to the receiver.
- Consult the dealer or an experienced radio/TV technician.

WARNING! Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To comply with FCC Section 1.1310 for human exposure to radio frequency electromagnetic fields, implement the following instruction:

A distance of at least 20 cm. between the equipment and all persons should be maintained during the operation of the equipment.

8.3 INDUSTRY CANADA COMPLIANCE

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may be received or that may cause undesired operation.

A distance of at least 20 cm. between the equipment and all persons should be maintained during the operation of the equipment.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Une distance d'au moins 20 cm. entre l'équipement et toutes les personnes devraient être maintenues pendant le fonctionnement de l'équipement

8.4 WARRANTY

Unless otherwise agreed upon Magos supplies 1 year warranty from date of purchase.

The product warranty extends to the original purchaser only and is not transferable.

The product warranty does not apply to software programs, power supplies, cables, brackets or other accessories supplied with the product.

Transport in case of a malfunction that requires maintenance at Magos premises is under the responsibility of the customer.

Magos Ltd does not have any liability or responsibility under the Product Warranty where any cost, loss, injury or damage of any kind, whether direct, indirect, consequential, incidental or otherwise arises out of events beyond Magos's reasonable control. This includes but is not limited to: acts of God, war, riot, embargoes, acts of civil or military authorities, fire, floods, electricity outages, lightning, power surges, or shortages of materials or labor.

The product warranty is automatically voided if:

- You or anyone else use the product or attempt to use it other than as specified by Magos;
- The fault/defect in your product is the result of a voltage surge subjected to the product either by the way of power supply or communication line, whether caused by thunderstorm activity or any other cause;
- The fault is the result of accidental damage in transit, including but not limited to liquid spillage;
- Your product has been used for any purposes other than that for which it is sold, or in any way other than in strict accordance with the user manual supplied;
- Your product has been repaired or modified or attempted to be repaired or modified or tampered with by anyone other than a person qualified to do so by Magos. Specifically opening the product cover or any of the cover fastening screws will be considered as tampering described in this section;
- The serial number label has been defaced or altered in any way or removed.

8.5 LIMITATION OF LIABILITY

Magos accepts no liability or responsibility, for consequences arising from the use of this product.

Specifically, although this is a security device, under no circumstances is Magos responsible or liable to direct/indirect damages and or costs caused/inflicted to the customer or a third party as a result of false alarms, missed detections, or inaccurate sensor readings. Though the SR Radars are in top of the line technology and in most scenarios the best security sensor in terms of detection performance it is not 100% fault proof and must not be treated as such.

Magos reserves the right to change the specifications and operating details of this product without notice.

If any law implies a guarantee, condition or warranty in respect of goods or services supplied, and Magos' liability for breach of that condition or warranty may not be excluded but may be limited, then subject to your rights and remedies under any applicable Consumer Protection Laws which cannot be excluded, Magos' liability for any breach of that guarantee, condition or warranty is limited to: (i) in the case of a supply of goods. Magos doing any one or more of the following: replacing the goods or supplying equivalent goods; repairing the goods paying the cost of replacing the goods or of acquiring equivalent goods; or paying the cost of having the goods repaired; or (ii) in the case of a supply of services, Magos doing either or both of the following: supplying the services again; or paying the cost of having the services supplied again.

To the extent Magos is unable to limit its liability as set out above, Magos limits its liability to the extent such liability is lawfully able to be limited.