Scan-Beam

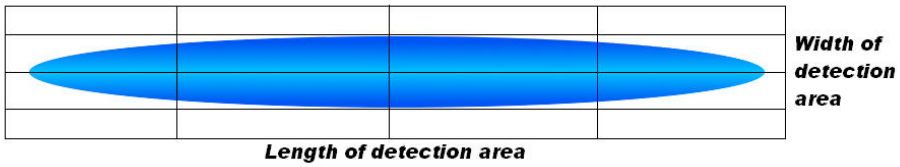
Detector Performance & Site Planning Considerations

This guide briefly describes performance aspects such as creep zones and beam width, and discusses how to best plan a site to optimise these parameters and optimise sensor performance.

The site planning has a direct impact on the effective security level, for example:
In very high security environments it is important to make the detection area as sterile and benign as possible, for example flat poured concrete area with no vegetation, surrounded by fencing to avoid nuisance alarms from animals.

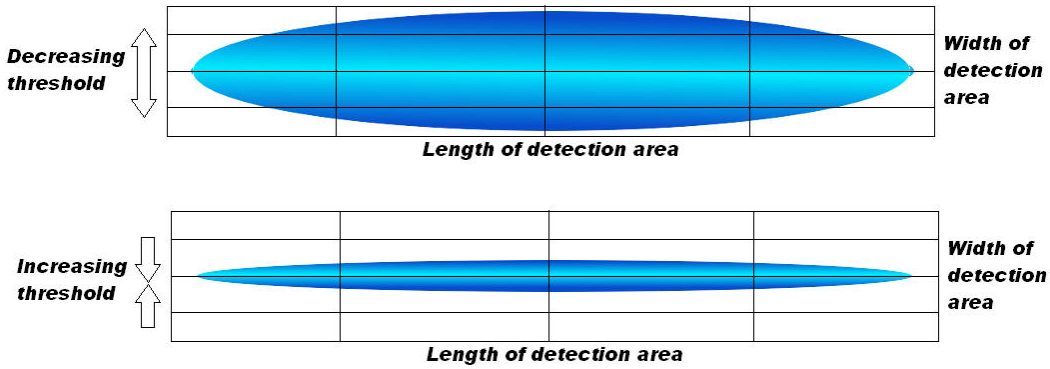
Detection zone width

Performance of the antennas largely defines the ultimate width of the detection zone. Due to the laws of physics the antenna beams diverge from the transmitter and receiver resulting in a narrower detection zone close to either unit and widest detection zone half way between the units, giving a characteristic shape as shown below in the top-down view:



The Scan-Beam has a sensitive ‘movement level’ detector that detects the reflection of microwave energy from moving objects within the detection zone.
Microwave energy is concentrated in the centre of the beam; therefore movements closer to the centre will cause larger reflections than equivalent movements at increased widths.

The effective width over which moving targets cause the alarm to activate can be adjusted by setting the movement level alarm threshold:



The most accurate method to determine the threshold is to walk parallel to the beam and then cross the beam in a few different locations.
Set the threshold based on the measured movement levels so that the parallel movement is under the alarm threshold and the beam breaks are above the threshold.

This ‘walk test’ can be modified to suit the site and security needs, for example driving a car near to the beam or crawling on hands and knees across the beam rather than walking.

Typical performance plots from a 'walk test'

The plots below give an idea of the typical detection performance for a human walking parallel to the beam centre and also crossing the beam (perpendicular movement).

Please Note:

These measurements were taken on a disused runway that was very flat and free from vegetation and obstructions. Units were mounted at height of 1m.

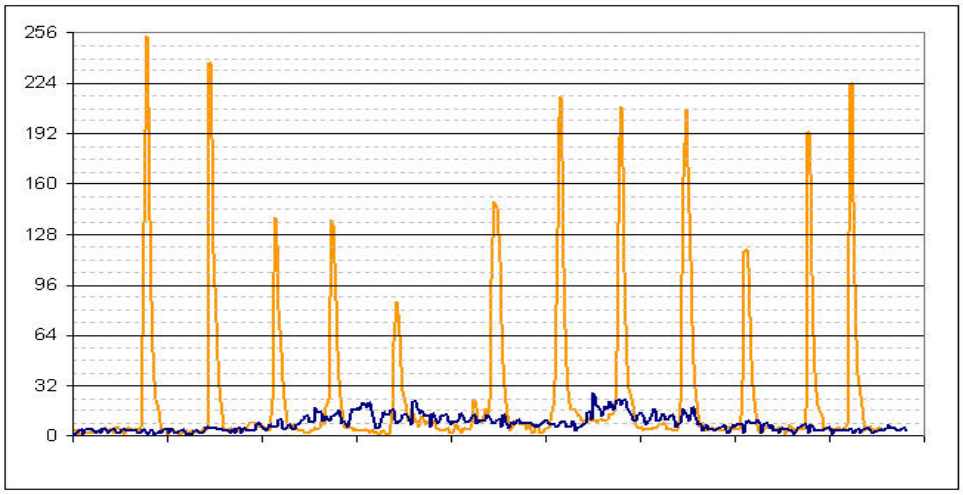
Detection performance may be reduced in other locations due to objects within or near to the detection zone, particularly metallic and/or moving object, such as tall grass, shrubs, bushes, trees and bodies of water.
Where possible prune and cut back vegetation as much as possible to reduce nuisance alarms, especially during wet and windy weather.

Parallel chain link fences may increase the background movement level unless well secured to avoid movement. It is also important to provide adequate separation between the beam centre and objects/fences that could be used to jump over the detection area.

Generally rougher surfaces and lower mounting positions will slightly increase the width. A 'walk test' is always recommended to check the performance when installed.

500m between units

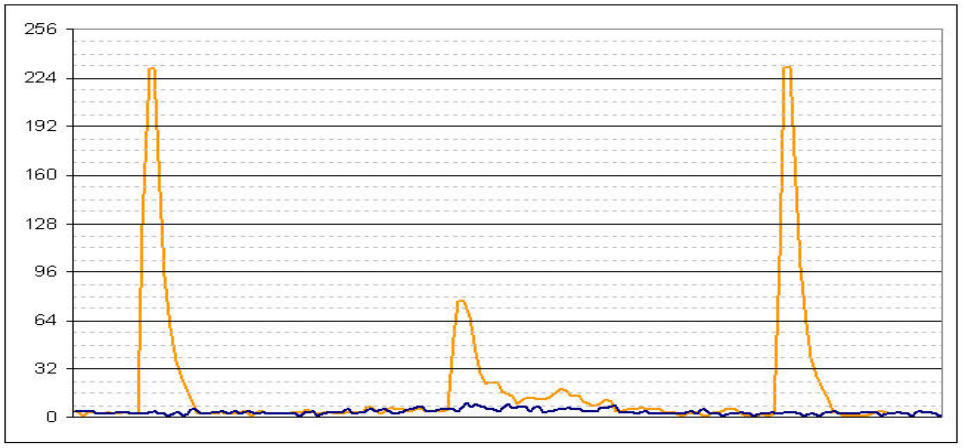
- Orange trace: Target walking across beam at various ranges and speeds.
- Blue trace: Target walking parallel to beam centre, approx 2m from centre.



In this case setting a movement level threshold between 32-64 would be appropriate to detect the crossing target but ignore parallel targets 2m away.

200m between units

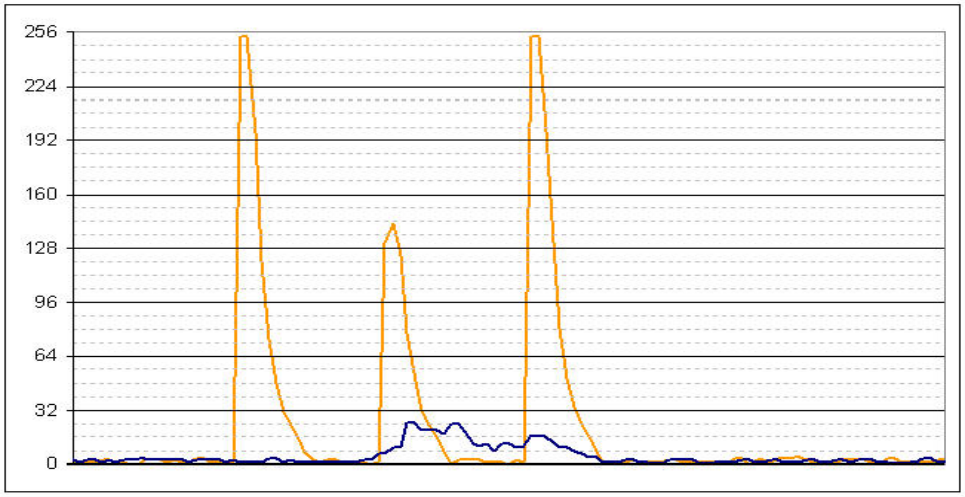
- Orange trace: Target walking across beam at start, middle and end positions.
- Blue trace: Target walking parallel to beam centre, approx 2m from centre.



Human walking 2m away from the beam centreline produces a low movement level. Setting a threshold of 32 would easily detect the wanted beam crossing and reject the parallel movement in this situation

50m between units

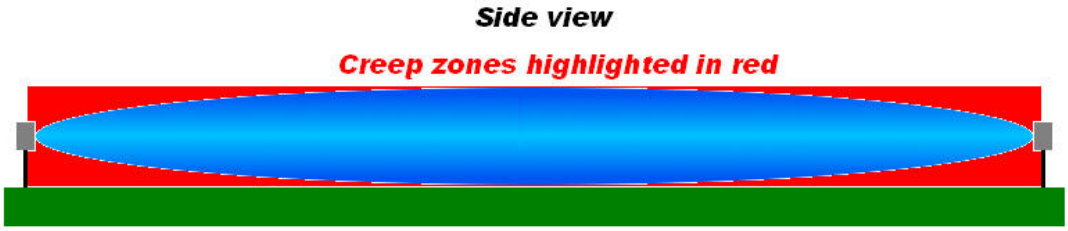
- Orange trace: Target walking across beam in three positions.
- Blue trace: Target walking parallel to beam centre, approx 0.5m from centre.



Since the units are only 50m apart the beam divergence is minimal so parallel walking is only detected when very close to the centreline, within 0.5m in this case.
Movement beyond 1m from centreline was too low to measure.

Detection Creep Zone

The ‘creep zone’ is the area immediately underneath and above the transmitter and receiver where detection performance is reduced because the beam is still spreading.



Intruders may be able to crawl under, or jump over the beam within the creep zone.

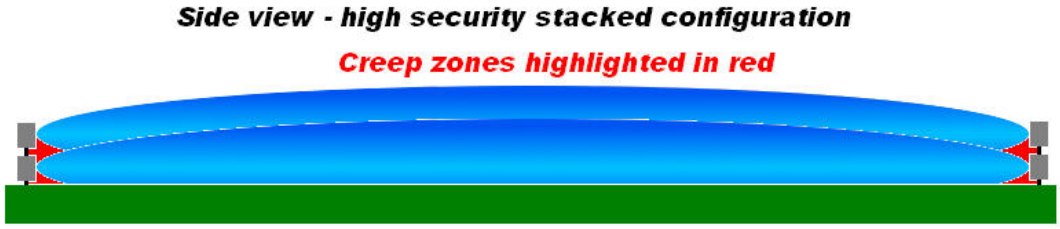
The antennas have been specially designed to ensure the creep zone is as short as possible, although it still exists to some extent.

For absolute maximum security to detect crawling targets:

- Units mounted 1m from ground: allow 10m for creep zone.
- Units mounted 0.5m from ground: allow 5m for creep zone.

Creep zone reduction by stacking equipments

In very high security applications stacking two pairs of equipment on the same mounting pole will make the creep zones significantly smaller and therefore much more difficult to cross without detection:

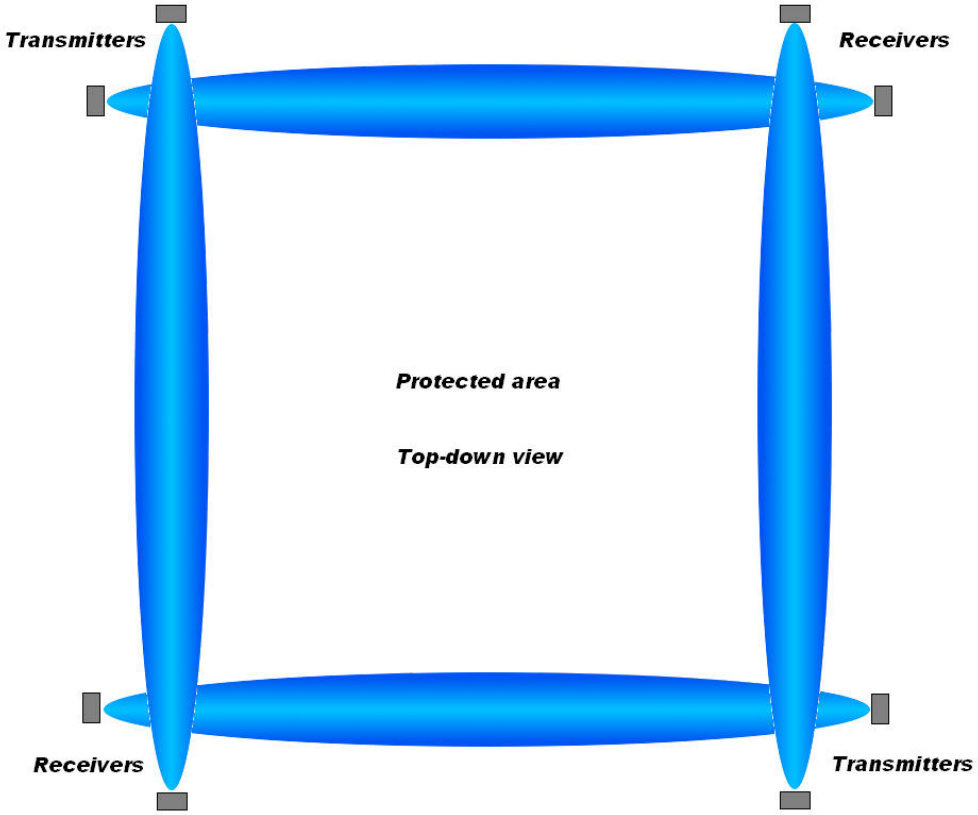


To avoid interference between stacked units always set the top pair to a different operating frequency than the bottom pair.

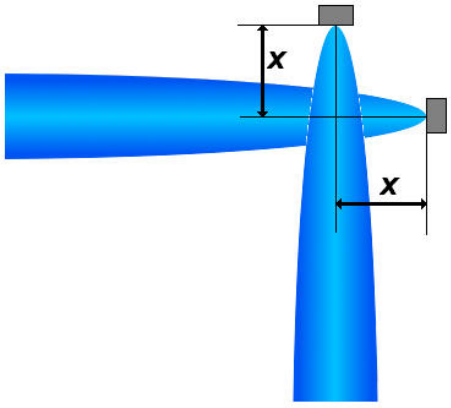
For example to detect a slow crawling intruder:
Position the lower unit between 0.3 – 0.5m height.
Position the upper unit between 0.7 – 1.0m height.

Elimination of creep zone by overlapping sensors

By overlapping equipments the creep zone can be mitigated, providing there is sufficient overlap between adjacent units.



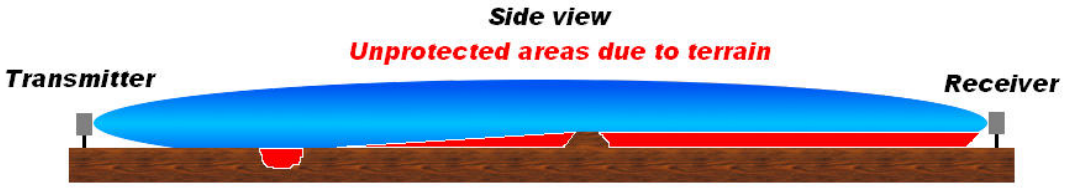
For example when planning for a corner overlap, the distance ‘X’ must be equal to, or greater than the creep zone distance for maximum security.



Ground flatness, obstructions and surface types

Ground flatness & obstructions

Excessive dips or bumps in terrain may produce areas where the microwave beam cannot reach. Try to make the terrain as flat as possible to eliminate any blind spots, gaps or shadows in the coverage between the transmitter and receiver.



For best performance, ensure the ground is level and does not change by more than 0.3m from the lowest to highest point.

Drainage ditches should be avoided as they allow an intruder to sneak past the detection area. Any flowing water can cause nuisance alarms.

Obstructions will degrade the performance to some degree, therefore it is important to eliminate or minimise any such obstructions. Typical obstructions may include posts, fences, lampposts, parked vehicles, piled or stacked materials, etc.

Ground surface types

- **Crushed stone**: Best for highest security.
  Microwaves reflect off small rocks, increasing sensitivity and target detection. Surface tends to disperse rain and prevent puddles from forming.

- **Paving and concrete**: Best for cold climates with risk of snow.
  Intruder may burrow through snow to avoid detection therefore paved area allows easiest removal of accumulated snow to prevent burrowing.

- **Grass**: Acceptable for medium and low security, providing it is kept short, typically <75mm (3”).

- **Packed clay or dirt**: Acceptable for medium and low security.

- Bodies of water: Unacceptable performance as water surface movement causes very high ‘background’ movement level to be detected.