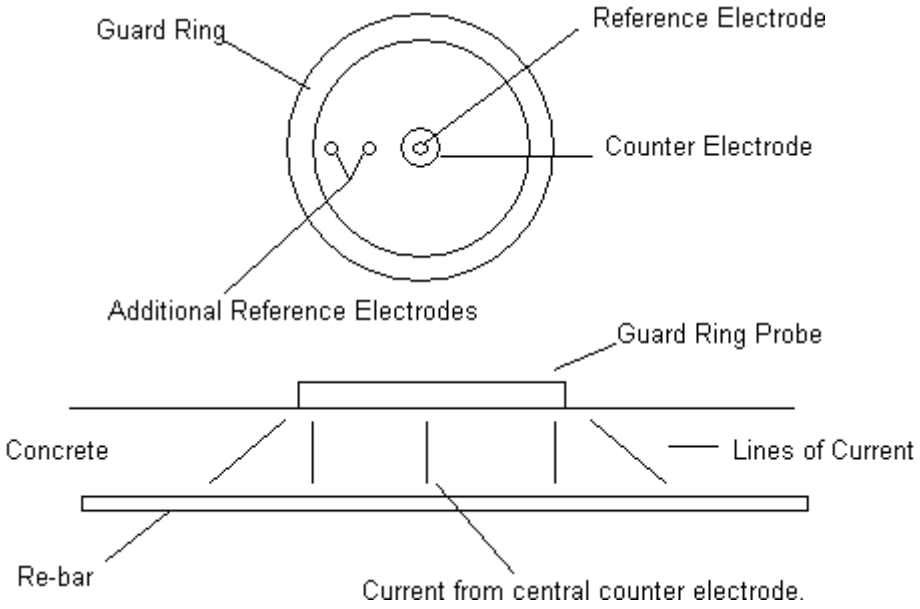
ACM Instruments

Guard Ring, Segmented Guard ring and Guard Chrysanthemums

Guard Ring devices are typically used for monitoring a specific area of re-bar beneath a layer of concrete. The idea of the Guard Ring is to concentrate the current from the central counter electrode straight down to the re-bar directly beneath. Any additional current needed to polarise the surrounding re-bar is believed to be supplied by the Guard Ring. A typical Guard Ring arrangement is shown below.



The Guard Ring potential is controlled by the two additional reference electrodes. The Potential difference between these two electrodes is measured when the system is un-polarised. This potential difference is maintained during polarisation of the re bar by controlling the potential of the outer Guard Ring. For the Potential to remain the same between the two additional reference electrodes, we can assume that no additional horizontal component of current is being applied to the system. From this assumption, it follows that if there is no horizontal component of current, then all the current from the monitored central counter electrode, flows straight down to the re-bar. If this theory is valid, then it follows that we have an idea of the area of re-bar polarised underneath the guard ring and we can have an idea of corrosion rates.

Guard Rings have their faults however. Reinforcing bar beneath the surface of concrete is not like a perfect flat metal sheet under a set distance of uniform concrete. There are all sorts of reasons why the current will not flow directly down to the re-bar perpendicular to the concrete surface. These include Re-bar not situated underneath the probe, localised corrosion hot spots, non uniform concrete with localised conductive paths. This problem can be highlighted by the different readings obtained at different rotations of the Guard Ring Probe. The Guard Ring potential is controlled by two additional Reference Electrodes. If these are pointing towards a corrosion hot spot, they will control the Potential of the Guard Ring in a different way than if they were pointing away from a corrosion hot spot.

To counteract the problem of Guard Ring rotation, the Guard Ring is segmented into separately controlled segments such as quarters. Each Guard Ring segment is then controlled by its own additional two Reference Electrodes radiating from the centre.

Although a segmented Guard Ring helps to give a better focus to the monitoring signal from the central counter electrode, it still only gives a single measurement. In order to get a picture of the corrosion data, and even crude images of the Corroding Re-bar beneath the concrete's surface, it is necessary to either take lots of measurements, which has its own problems associated with repeated polarisation of the re-bar, or use a Guard Ring Chrysanthemum. Guard Ring Chrysanthemums start off looking like a segmented Guard Ring. Except additional segmented rings can be added with twice the number of segments than the previous ring. Each additional Segment is controlled by its own pair of Reference Electrodes radiating from the central counter electrode and situated between the previous ring layer and the next. With this system, both the Potential and Current for each segment is monitored in an attempt to obtain the corrosion rate beneath each segment. Such a system can be provided by ACM Instruments. It is suggested that this is done under a special Task Master product rather than an option for a Field Machine. A five layer Guard Ring with a central counter electrode and 64 monitored guard ring segments is quite acceptable for an instrument of this type. ACM Instruments can also supply a suitable probe complete with inbuilt reference electrodes.

Guard ring Chrysanthemums are not without problems of their own. Although current flow is controlled in the direction of the additional reference electrodes, it is not controlled flowing at an angle that is perpendicular to this. Thus some current from each of the Guard Ring Segments will polarise neighbours on the same segmented ring. This will lead to errors. The problem of this effect can be minimised by increasing the gap between segments on each ring and even considering the use of dot type Guard Ring segments in order to maximise the distance between segments on each ring.