Shaped probes: Applications and advantages

When designing probes for measuring electric or magnetic fields, the usual emphasis is on keeping the frequency response as flat as possible over a wide range. Such probes are often referred to as flat probes for this reason. However, probes with a defined non-linear frequency response have also been developed. These probes are designed to mimic the frequency dependency of limit values to enable a direct indication of the measured value as a percentage of the limit value. Such probes are called shaped probes. As well as various flat probes for E and H field measurements, Narda Safety Test Solutions offers a range of shaped probes for the NBM product range. These include probes for the limit values for the ICNIRP, FCC, IEEE or SC6 standards. This is an advantage in many applications.

The main characteristic of these shaped probes is the direct display of the radiation level as a percentage of the applicable limit value. These probes therefore allow convenient measurements in multifrequency environments, for example on a rooftop, where several services such as cellphone, paging, VHF radio and TV signals may be present simultaneously, each of which must be within different exposure limit levels. Even under such complex conditions, measurements using shaped probes deliver unambiguous results quickly and simply. This is made possible by the defined frequency response of the probe, which is shaped to match the limit value curve of a particular standard.

Due to the absorption characteristics of the human body, the limit values for electromagnetic fields vary according to frequency. This frequency dependency is accounted for by the shaped probes. The measurement results are shown directly as a percentage of the limit value. The user does not need to know anything about the frequencies or the corresponding field strength limit values.

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Narda Safety Test Solutions has patented the functional principle of shaped frequency response probes. Such probes are available for most national and international standards.

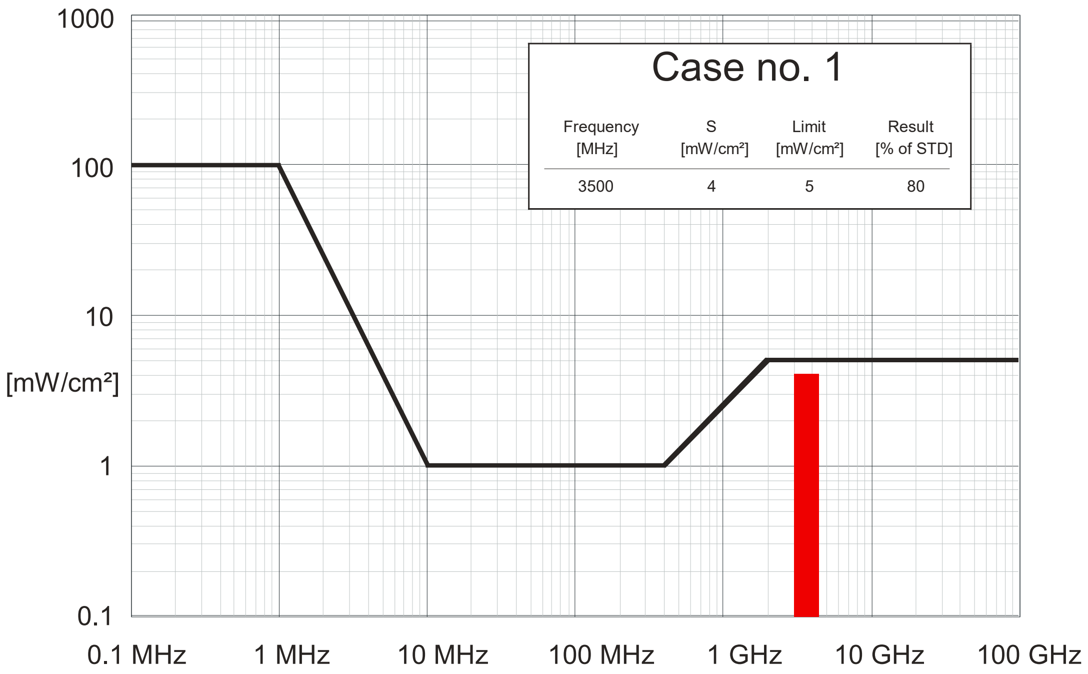
Case no. 1: The image below shows a signal at 3.5 GHz with a power density of 4 mW/cm². The limit value is 5 mW/cm² at 3.5 GHz Let us compare the measurements made with a flat probe with those of a shaped probe:

The flat probe gives a result of 4 mW/cm² (122 V/m). Without an indication of the frequency, we cannot determine whether this value is above or below the standard limit value. We therefore revert to the principle: Use the lowest limit value if the frequency is unknown. This ensures that we are always on the safe side. The lowest limit value of the standard is 1 mW/cm², which is the limit value for the frequency range from 10 MHz to 400 MHz. The result referred to 1 mW/cm² is therefore 400% of the limit value.

Even when the frequency is known,

1. the standard must be known and the limit values must be available, and
2. the measurement results must be evaluated against the standard and the relative percentage value calculated.

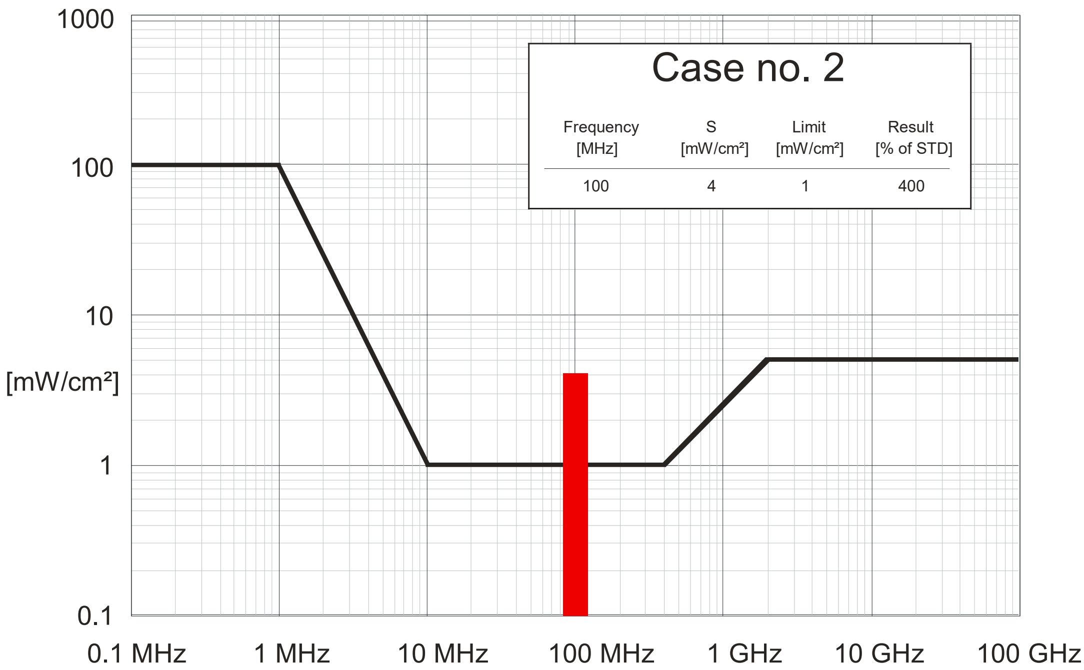
In contrast, the shaped probe immediately indicates an unambiguous result. The signal at 3.5 GHz achieves 80% of the limit value, so it is below the permitted threshold. This result is displayed immediately, without the need for the user to manually carry out any of the steps mentioned above.



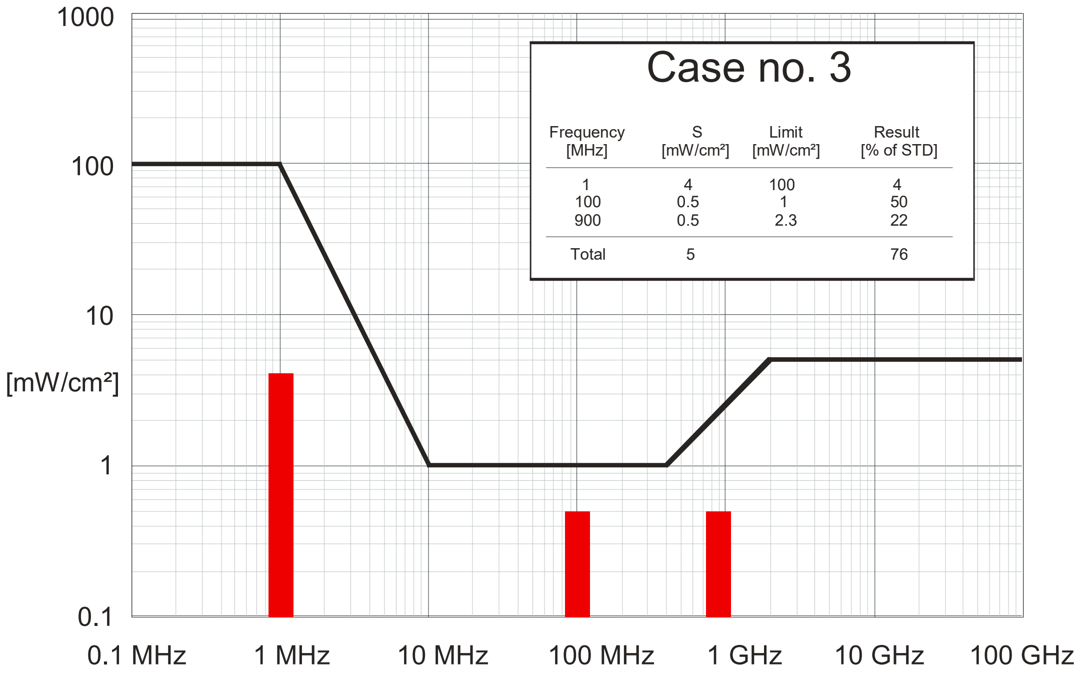
Case no. 2: The signal has the same power density as in case no. 1 but at a frequency of 100 MHz (e.g. a VHF transmitter).

The flat probe will again give the same result of 4 mW/cm², and here, too, we cannot tell whether this value is above or below the limit value because we do not know the frequency.

As the diagram shows, the threshold for 100 MHz is at 1 mW/cm², which is much lower than for 1 MHz. The limit value has in fact been exceeded at 4 mW/cm² by a factor of four. The shaped probe correspondingly gives the result as: 400% of the standard.



Case no.3: This is a typical example of several signals at the same location, i.e. a multifrequency environment. According to the limit value curve, each signal is well below the frequency specific limit value, although the overall radiation level is closer to the limit at 76% of the standard. Once again, the flat probe would only deliver a result of 5 mW/cm². It would not be possible to decide whether this is above or below the standard limit value.



Summary:

- Shaped probes take the frequency dependency of the limit values into account and deliver a result as a percentage of a particular standard.
- You do not therefore need to
  - Know the shape of the relevant standard
  - Refer the results to the particular standard
  - Calculate the relative field exposure level.
- Additionally, shaped probes are a convenient and economical alternative to selective measuring devices in a multifrequency environment.

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