Electric and Magnetic Field Instrument Selection Guide

Design Features that Impact Application

SURVEY SYSTEM CONFIGURATION
Every survey system requires a minimum of one probe (the sensor) and one meter (that displays the measurement data). Systems may include a cable to connect the meter to the probe. In many applications, it is desirable to mount the probe directly on the meter. Similarly, a fiber optic link is sometimes used to provide remote information to a computer, or another meter.

A direct connection between the probe and the meter is useful:
- For one-handed measurements, such as when climbing.
- For making more accurate measurements below 10 MHz (see page 116).

A fiber optic output is useful:
- For making more accurate measurements without human perturbation.
- For making measurements with the system separated from the surveyor by up to 20 meters, or to remote the meter/probe from a computer.

METERS
Meter features to consider:

CALIBRATION
There are two basic design options:
1. The meter and probe are calibrated as a system with meter. This is a less expensive design because there is less calibration work and an amplifier is not needed inside the probe. The advantage of this approach is that the system can be calibrated as a set, but this may require a larger exposure area to fully simulate field conditions.
2. The probe and meter are calibrated as independent modules. This design approach normally uses a microprocessor to provide calibration information directly to any meter it is connected to. Any meter in the series can be used with any probe in the series without impacting calibration accuracy.
PROBE DESIGN
Most probes are isotropic, or omni-directional, to measure the energy from all directions. Anisotropic, or directional probes, are used primarily for leakage measurements such as with microwave ovens (see page 99). Isotropic probes, such as Narda’s NIM and NBM Series products, employ three mutually perpendicular sensors to provide isotropic response. This configuration results in accurate field measurements independent of the position of the probe or polarization of the incident field.

DETECTION AND UNITS OF MEASURE
All electric field probes detect either the vector electric field, measured in V/m or the mean square of the electric field measured in V²/m². All magnetic field probes in the RF/microwave frequency range detect either the vector magnetic field, measured in A/m, or the mean square of the magnetic field, measured in A²/m². The unit that is displayed is often different from what is actually detected. For example, although no probe actually measures power density, standards may use equivalent power density. The equivalent power density units of mW/cm² and W/m² are entirely valid in the far field. These units are also useful in the near field for quickly comparing the relative strength of the electric field to the magnetic field since the same unit is used for both fields, even though a far field relationship is assumed. Narda NIM and NBM Series probes detect the square of the electric field or the square of the magnetic field.

SENSOR TYPE
Electric field probes normally use dipoles with either a diode or thermocouple as a detector. Magnetic field probes normally use current loops with either a diode or a thermocouple as a detector. Isotropic, or omni-directional probes use three sets of dipoles or loops and detectors. One exception is the low frequency EHP-50F that uses an active plate antenna design – in essence a small, almost static field sensor that allows the use of a small antenna despite a long wavelength.

Diodes have the advantage of being rugged and their high output results in little thermal or zero drift. The major disadvantage is that they tend to peak detect pulsed signals and overestimate field levels whenever the signals are amplitude modulated and especially if there are multiple signals. A typical communications site now often contains radio and especially if there are multiple signals. Overestimate field levels whenever the signals are amplified and especially if there are multiple signals.

Narda’s diode probes are designed with larger square-law regions to remain accurate in most field strength situations that are below human limits. They are recommended for all applications except for pulsed systems, where RMS average levels are sought, but can be employed if the surveyor knows the signal characteristics.

Thermocouples are always true RMS (root mean squared) detectors and yield accurate readings for all signal conditions. Narda’s patented designs operate in the traveling wave mode at higher frequencies. The Models EF 5091 and EF 5092 for example, have been proven accurate up to at least 100 GHz. The major disadvantage of thermocouple probes is the zero drift which occurs for several minutes during warmup and can occur if the ambient temperature changes significantly.

Product Recommendations for Common Applications
Select a meter based on the features that you expect to use and the skills of the surveyor. For example, if you plan on simply checking a piece of industrial equipment for leaks, advanced features such as data logging are not needed. Probe selection depends on several factors. Refer to page 65 for details. The following are suggested hardware configurations for some of the most common applications.

WIRELESS AND BROADCAST COMMUNICATIONS
The combination of complex multi-signal environments, frequency dependent exposure standards and regulations for emitters that generate more than 5% of exposure limits, makes the SRM-3006 the ideal choice for the wireless and broadcast industries. The ability to identify important emitters below 6 GHz at these sites, by frequency and level makes it an ideal solution for a better understanding of the site. The broadband NBM meters and probes are also good choices for quick measurements where only the total field strength is needed.

MILITARY SYSTEMS
The NBM Series system is ideal because of the broad range of frequencies used by the military. Flat response probes are normally selected because the users have control of the emitters and a shaped response is not required. However, shaped probes are very useful for multiple-emitter flightiness and classified areas. Users performing complex surveys will appreciate the advanced features of the Model NBM-550 Meter. Basic surveys can easily be handled by the very user-friendly NBM-520 Meter.

RADARS
Radar systems normally use microwave frequencies and waveguide. The NBM series, with either the NBM-550 or
NBM-520 meter, are appropriate. The probe should employ thermocouple detectors if RMS average results are required (see page 114). The unique averaging and history display available from the NBM-550 is very useful for Radar measurements, while the NBM-520 Meter is ideal for simple waveguide leakage measurements.

**WAVEGUIDE SYSTEMS**
The NBM-520 and one of four microwave probes with small heads and diode or thermocouple detectors are the most practical choices. The EF1891 and EF 6092 probes use high dynamic range diodes. They are useful for measuring the smallest of leaks from communication waveguides. For Radar (pulsed) waveguides, the EF 5091 or EF5092 are useful because of their thermocouple sensors. Earlier versions of these probes (8721, 8723) have been used by military and air traffic control organizations for years. These four probes are used for leakage detection in densely packaged systems where it is important to distinguish between closely spaced junctions.

**SEMICONDUCTOR PROCESS EQUIPMENT**
The NIM Series Industrial Compliance Meters are ideal for checking leaks on semiconductor fabrication equipment. The NIM-513 is used by many organizations that operate only at 13.56 MHz. The NIM-511 is a similar unit with a much broader frequency range that also accommodates the 300-500 kHz sources used in some of the newest fabrication equipment.

**HEAT SEALERS**
The vast majority of heat sealers or vinyl welders operate at the 27.12 MHz ISM band which makes the NIM-513 the perfect solution.

**OTHER INDUSTRIAL APPLICATIONS**
Industrial heating systems utilizing 915 and 2450 MHz are best covered by the NBM-520 meter and the EF 0391 Electric field probe. This economical and robust design provides exceptional accuracy and ease of use.