TECHNICAL ARTICLE

SMP2

Unparalleled combination of low frequency spectrum analysis and high frequency broadband measurements

wavecontrol
www.wavecontrol.com | info@wavecontrol.com

The SMP2 offers **Spectrum Analysis (FFT) and Weighted Peak Method (WPM) mode** from 1 Hz to 400 kHz for the low frequency electric and magnetic fields, and **Broadband Measurements** for the high frequency electromagnetic fields in a single unit, taking RF safety assessment to the next level.

The new version of the popular SMP has been developed to meet demanding customer requirements in the RF safety measurements domain. Its versatility makes it the perfect measurement tool for many different industries: **Railway, Power, Manufacturing, Chemical, Medical, Defence, RFID and EAS, Telecommunications, etc.**

- Selective measurements of the different spectral components of the fields are possible by means of a FFT (Fast Fourier Transform) procedure. Together with the WPM (Weighted Peak Method) technique it is possible to directly compare the selective results with the limit values by shaping (weighting) the obtained data to the specific industry standard, providing simple and reliable RF safety assessment.

- Broadband measurements are possible at low and high frequencies. The measurement bandwidth will depend on the used field probe. A set of different field probes are available from 10 Hz to microwave frequencies. Field probes are interchangeable and automatically recognized.

- Offering straightforward and intuitive operation, the SMP2 makes RF safety measurements reliable, fast and easy.

- SMP2 versatility redefines RF safety equipment giving you the power to test according to many national and international standards with a single tool in your hands.

- The SMP2 has been specifically designed for the assessment of the safety and health protection of workers concerning the exposure to the electromagnetic fields.

- Among many other international legislation, SMP2 meets exacting demands in accordance with the new European Directive 2013/35/EU “on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)”.

Main Features

- Unparalleled combination of spectrum analysis and broadband measurements
  - Fast Fourier Transform (FFT)
  - Weighted Peak Method (WPM)
  - Broadband measurements
- X, Y, Z and Total field values
- Min, Max, Max hold and average measurements
- Field probe automatic recognition
- Straightforward result display (with graph plotting) designed for convenience.
- New generation of integrated GPS
- Fiber optics and USB connection for data downloading and device control
- Extended storage capacity
- Screen shot function for easy reporting
- High-resolution 4.3" TFT screen
- Warning alarm with adjustable threshold
- Internal rechargeable Li-ion battery with more than 14 hours of autonomy
- Light and user-friendly

Main Applications

The SMP2 is an ideal EMF measurement system for analysing magnetic and electric fields in public spaces and workplaces. The variety of probes which can be used with the SMP2 make this system unique as it performs, in a simple and precise way, measurements covering both the low and high frequency ranges.

The SMP2 can be used to perform measurements according to many international exposure standards applicable to different industry sectors.

Basic standards may apply to different sectors. EN 50499 is the general procedure for the assessment of the exposure of workers, EN 50413 provides general procedures only for those products and workplace categories for which there do not exist any relevant assessment procedures in any existing European EMF basic standard, while IEC 61786-1 applies to any instrument used for exposure measurements in the low frequency range (1 Hz to 100 kHz):

EN 50499	Procedure for the assessment of **the exposure of workers** to electromagnetic fields
EN 50413	Basic standard on measurement and calculation procedures for **human exposure** to electric, magnetic and electromagnetic fields (0 Hz - 300 GHz)
IEC 61786-1	Measurement of DC magnetic, AC magnetic and AC electric fields from 1 Hz to 100 kHz with regard to **exposure of human beings** - Part 1: Requirements for measuring instruments

Figure 1: Worker on a Telecom mast

Manufacturing

The SMP2 permits checking the safety of workers concerning EMF exposure caused by several manufacturing machines and areas such as **industrial ovens, welding systems, RF heating, tempering and drying equipment**.

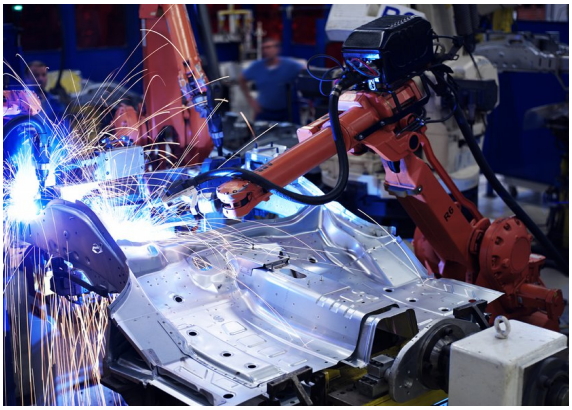

Figure 2: Industrial welding machine

Figure 3: Industrial smelting

Typical industrial frequencies:

Industry	Frequency range	Wavecontrol Solution
Smelting	50Hz; 2kHz; 10kHz	SMP2 + WP400
Induction heating	50Hz-8MHz	SMP2 + WP400 + WPF3
Electrochemical process	50Hz; 300Hz; 600Hz and 900Hz	SMP2 + WP400
Arc and resistance Welding	Arc welding: 50Hz Resistance welding: 100-500kHz	SMP2 + WP400
Plastic Welding	Plastic welding: 27.12MHz	SMP2 + WPF3
Microwave drying	27MHz and 2450 MHz	SMP2 + WPF3

Related standards:

EN 50519	Assessment of workers' exposure to electric and magnetic fields of **industrial induction heating** equipment
EN 50505	Basic standard for the evaluation of human exposure to electromagnetic fields from equipment for **resistance welding and allied processes**
EN 50444	Basic standard for the evaluation of human exposure to electromagnetic fields from equipment for **arc welding and allied processes**
EN 50445	Product family standard to demonstrate compliance of equipment for **resistance welding, arc welding and allied processes** with the basic restrictions related to human exposure to electromagnetic fields (0 Hz – 300 GHz)

Some company examples:

Smelting and heating:

ASARCO GRUPO MEXICO, ALCOA, Rio Tinto Alcan

Electrochemical process: energy storage systems

GAMRY INSTRUMENTS, Electrosynthesis, VARTA

Resistance and arc welding:

PEUGEOT, CAT, SIEMENS, ALSTOM

Plastic Welding:

BPF British Plastics Federation, LEISTER

Microwave drying:

PÜSCHNER MikrowellenEnergietechnik, EnWave Corporation, IMS

Detection of articles and people

Electronic articles, RFID systems and detectors in general are very common in public spaces. This big variety of systems generate complex fields. Most of this systems operates within low frequency range which make using the SMP2 the adequate solution.

Figure 4: RFID sandwich machine

Figure 5: Electronic article surveillance machines

Typical SRD frequencies:

Short range devices	Frequency range	Wavecontrol solution
Electronic Article Surveillance	1. non linear magnetic: 10Hz – 20kHz 2. resonant inductive: 20-235kHz 3. resonant radio frequency: 1-20MHz 4. non linear microwaves: 0.8-2.5 GHz	SMP2 + WP400 + WPF3
Metal Detectors	1. gate detectors: 630 Hz – 7.3 kHz 2. hand detectors: 13kHz-1.9MHz	SMP2 + WP400 + WPF3
RFID	1.low: 1Hz-500kHz 2.intermediate: 2-30MHz 3.high: 850-950MHz; 2.45GHz; 5.8GHz	SMP2 + WP400 + WPF8

Some company examples:

Companies using electronic article surveillance:

Carrefour

IKEA

Companies using metal detectors:

EN 50364	Limitation of human exposure to electromagnetic fields from devices operating in the frequency range 0Hz to 300GHz, used in **Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID)** and similar applications
IEC/EN 62369-1	Evaluation of human exposure to electromagnetic fields from **short range devices (SRDs)** in various applications over the frequency range 0 GHz to 300 GHz – Part1: Fields produced by devices used for **electronic article surveillance, radio frequency identification** and similar systems
EN 50357	Evaluation of human exposure to electromagnetic fields from devices used in **Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID)** and similar applications

Power (Railway, power distribution and chemical) industry:

Power stations, generators, transformers, rectifiers, conductors and electrolysis includes a wide variety of equipment that operates at very low frequency 50/60 Hz generating Important electromagnetic fields.

Figure 6: Electric power station

Figure 7: Rail-road power lines

Typical frequencies:

Electricity production and distribution	Frequency range	Wavecontrol solution
Power supply equipment	50 Hz; 60 Hz	SMP2 + WP400
Power supply equipment for railroads	50 Hz; 60 Hz; 400 Hz	SMP2 + WP400
Transmitters HT	30 MHz - 5 GHz	SMP2 + WPF8

Some company examples:

Energy:

RTE Réseau de transport d'électricité nationalgrid RED ELÉCTRICA DE ESPAÑA

Railway:

List of European railway companies:

http://en.wikipedia.org/wiki/List_of_railway_companies#Europe

Related standards:

IEC/EN 62110	Magnetic field levels generated by **AC power systems** – Measurement procedures with regard to public exposure
EN 50500	Measurement procedures of magnetic field levels generated by electronic and electrical apparatus in the **railway environment** with respect to human exposure

Telecommunications:

Mobile telephony, radio and television transmission is now commonplace around the world. These technologies rely upon an extensive network of fixed antennas, or base stations, transmitting information with radiofrequency (RF) signals. Millions of base stations exist worldwide and the number is increasing significantly with the introduction of new generation wireless technologies. The SMP2 is an ideal equipment to measure and survey the population exposure to electromagnetic emissions in public and private environments.

Figure 8: Radio TV base station

Figure 9: Telecom tower

Related standards:

EN 50400	Basic standard to demonstrate the compliance of **fixed equipment for radio transmission** (110 MHz - 40 GHz) intended for use in wireless telecommunication networks with the basic restrictions or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service
EN 50401	Product standard to demonstrate the compliance of **fixed equipment for radio transmission** (110 MHz - 40 GHz) intended for use in **wireless telecommunication** networks with the basic restrictions or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service
EN 50492	Basic standard for the in-situ measurement of electromagnetic field strength related to human exposure in **the vicinity of base stations**
IEC 62232	Determination of RF field strength and SAR in the vicinity of **radiocommunication base stations** for the purpose of evaluating human exposure
EN 50496	Determination of workers' exposure to electromagnetic fields and assessment of risk at a **broadcast site**
EN 50554	Basic standard for the in-situ assessment of a **broadcast site** related to general public exposure to radio frequency electromagnetic fields

Wavecontrol Solution: SMP2 + WPF3/WPF8/WPF18/WPT

Medical:

In medicine, both the medical staff and patients are exposed to EMF fields generated by equipment related to **Diathermy**, **RF generating medical devices** and **MRI machines**. SMP2 is the adequate solution to make measurements of the EMFs generated by these machines.

Figure 10 :Medical diathermy machine

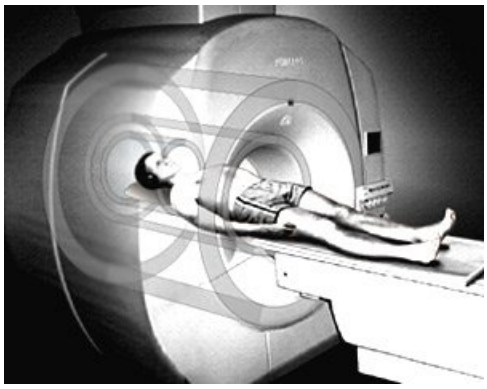

Figure 11: Medical MRI machine

Typical medical devices frequencies:

Medical application	Frequency range	Wavecontrol Solution
Magnetic Resonance Imaging	0 Hz; 0.024-65kHz; 10-400MHz	THM 1176, SMP2 + WP400 + WPF3
Diathermy	27MHz; 2.45GHz	SMP2 + WPF3
Hyperthermia	434MHz; 70 MHz	SMP2 + WPF3
Electrosurgery	300-600kHz; 13.5MHz; 27MHz	SMP2 + WP400 + WPF3

Some company examples:

Medicine equipment manufacturer:

SIEMENS medical

Hospitals and Clinics en general

Related standards:

IEC 60601	Medical electrical equipment

Household appliances:

Figure 12: Household machines

Many people are surprised when they become aware of the variety of magnetic field levels found near various household appliances. The field strength does not depend on how large, complex, powerful or noisy the device is. Furthermore, even between apparently similar devices, the strength of the magnetic field may vary a lot. Typical household appliances generating EMF are: **Stereo receiver, iron, Refrigerator, microwave ovens, mixer, television sets and computer screens,...**

Related standards:

IEC/EN 62233	Measurement methods for electromagnetic fields of **household appliances** and similar apparatus with regard to human exposure
EN 50366	Household and similar electrical appliances – Electromagnetic fields – Methods for evaluation and measurement

Main Applications, standards and frequency ranges

Principal Applications	Standard	Frequency range	Probe
Dielectric heating	EN 50519	High frequency	Broadband field probe
Induction heating	EN 50519	Low/High frequency	Selective / broadband
Welding	EN 50444 EN 50445 EN 50505	Low frequency	Selective (FFT+WPM)
Detection of articles and people	EN 50364 EN 62369-1 EN 50357	Low/High frequency	Selective / broadband
Electricity production and distribution	EN 62110	Low frequency	Selective (FFT+WPM)
Transport and traction systems	EN 50500	Low frequency	Selective (FFT+WPM)
Transmitters and Telecom Base Stations	IEC 62232 EN 50400 EN 50401 EN 50492	High frequency	Broadband field probe
Radio / TV base stations	EN 50496 EN 50554	Low/High frequency	Selective / broadband
Medical applications	IEC 60601	Low/High frequency	Selective / broadband
Household appliances	IEC 62233 EN 50366	Low frequency	Selective (FFT+WPM)

Selective Probe WP400: Technical Specifications

SMP2		
Field	Electric	Magnetic
Sensor Type	Patented Electrode (Isotropic, RMS)*	Coil (Isotropic, RMS)*
Field Strength Mode		
Frequency range	**1 Hz – 400 kHz**	
RMS averaging time	**1 sec**	
Peak Value	**Digital Real-time**	
Measurement Range	**1 V/m to 100 kV/m**	**500 nT -40 mT**
Noise level	**< 1 V/m (1 Hz – 400 kHz)**	**< 500 nT (1 Hz – 400 kHz)**
Linearity	**± 1% (typ.)** **± 2% (max.)**	
Isotropic response	**± 5% (typ.)**	
Graphical display	**RMS, AXIS VALUES, AVG, MAX, MIN, PEAK, Time graphic**	
WPM Mode		
Frequency range	**1 Hz – 400 kHz**	
Standards	**ICNIRP 2010 and DIRECTIVE 2013/35/EU**	
Measurement overload limit	**0,5 – 200 %**	**0,5 – 200 %**
uncertainty		
Graphical display	**%, AXIS VALUES (%), AVG (%), MAX (%), MIN (%), Time graphic**	
FFT Mode		

* Accredited ISO 17025 calibration
* Accredited ISO 17025 calibration

Frequency range	1 Hz – 400 kHz			
SPAN	1 Hz – 400 Hz	1 Hz – 4 kHz	1 Hz – 40 kHz	1Hz – 400 kHz
Resolution by SPAN	1 Hz	10 Hz	100 Hz	1 kHz
Detection	RMS, PEAK, AXIS (X, Y, Z)			
Measurement range	4 mV/m – 100 kV/m		0,5 nT – 40 m	
Sampling resolution	1024 points			
Graphical display	Frequency analysis			
High Pass Filters				
HPF @ 1 Hz	Response 0.1 dB @ 9.3 Hz – Filter Attenuation @ 50Hz 99.96 % (0.0034 dB)			
HPF @ 10 Hz	Response 0,1 dB @ 79 Hz – Filter Attenuation @ 50Hz 96.8 % (0.28 dB)			
HPF @ 25 Hz	Response 0,1 dB @ 170 Hz – Filter Attenuation @ 50Hz 88.3 % (1.08 dB)			
HPF @ 100 Hz	Response 0,1 dB @ 657 Hz – Filter Attenuation @ 50Hz 44.2 % (7.09 dB)			
Memory				
Maximum measurements	> 1000000			
Maximum FFT	>2000			
General Specifications				
Operating temperature	-15ºC to 40ºC			
Battery Broadband measurement	> 14 hours			
Battery Selective measurement	> 4 hours			
Dimensions	270 mm x 115 mm Ø			

European Directive 2013/35/EU

Electromagnetic fields (EMFs) arise whenever electrical energy is used. It has been known for a long time that exposure of people to high levels of EMFs can give rise to acute effects. The effects that can occur depend on the frequency of the radiation. At low frequencies the effects will be on the central nervous system of the body whilst at high frequencies, heating effects can occur leading to a rise in body temperature. In this sense, a new directive 2013/35/EU on workers exposure to electromagnetic fields has been adopted by the European Union. The Directive deals with health and safety at work and applies to work activities where workers are exposed to risks from electromagnetic fields.

This directive places a number of duties on the employers. They have to conduct a risk assessment and calculate EMF strengths and they shall eliminate or reduce to a minimum the risks that arise from electromagnetic fields at the workplace in line with the principles of the new directive. This new directive has been presented to cover all known direct biophysical effects and other indirect effects caused by electromagnetic fields. It covers the risks assessment of electromagnetic fields at the workplace and should be carried out in line with the standards.