Radiation and Personal Safety Monitoring for a 5G Future

Webinar, June 5th , 2019

Volker Brands, Dipl.-Ing., Regional Sales Manager, Narda STS Germany GmbH

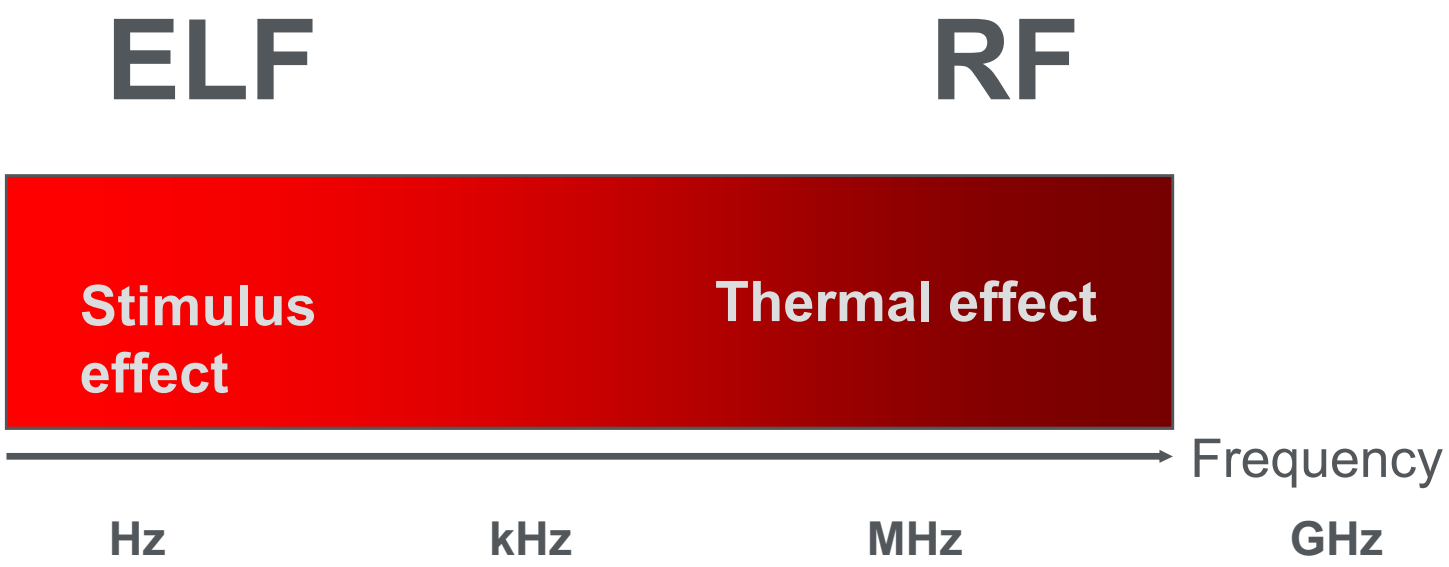
Outline

- Recap : EMF effects on humans
- An introduction to personal radiation monitoring
- An overview of health effects of radiation
- Discussing RadMan 2's functions and features
- An overview of set radiation exposure limits, and how the RadMan 2 is optimised for these standards
- How human body affects radiation readings: RadMan 2's countermeasures to those body effects
- RadMan 2's applications and its capacity to protect workers and public
- Annex Radman 2 and Nadalert S3
- Q & A session

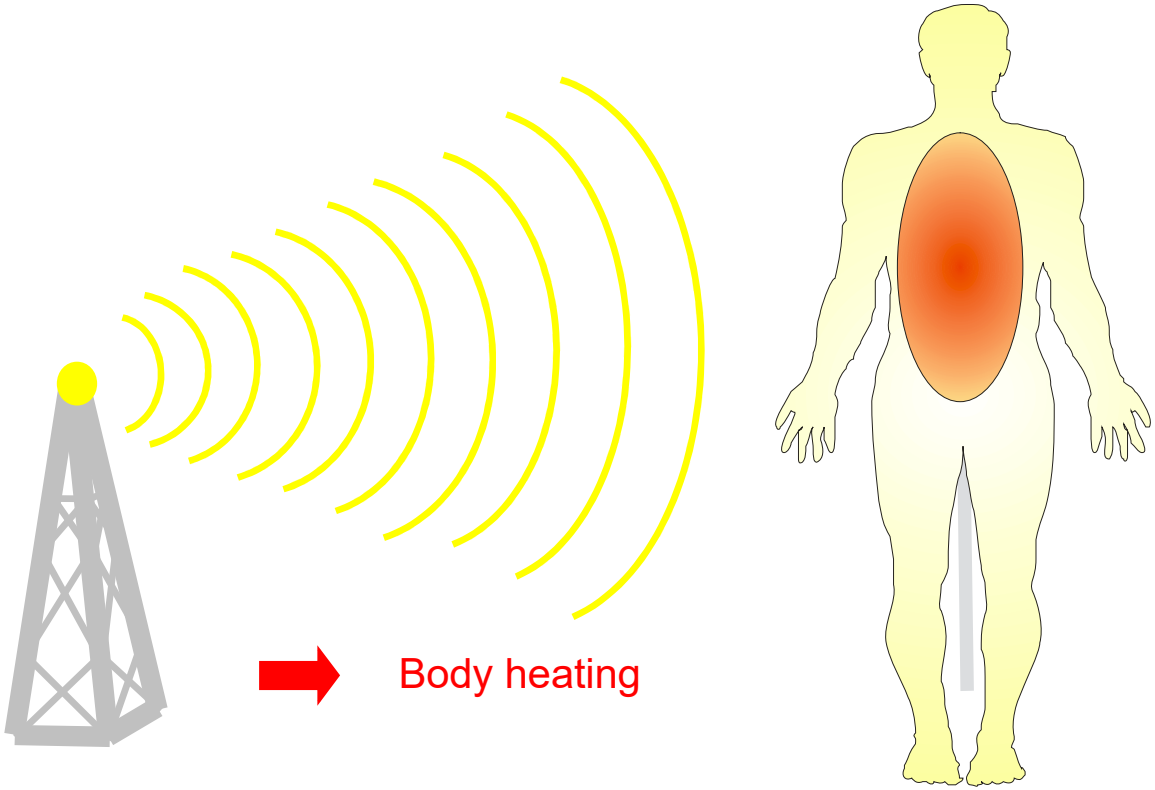
Recap

- EMF effects on humans -

Frequency dependency of biological effect



Absorption of energy from electromagnetic fields



RF - Thermal effect

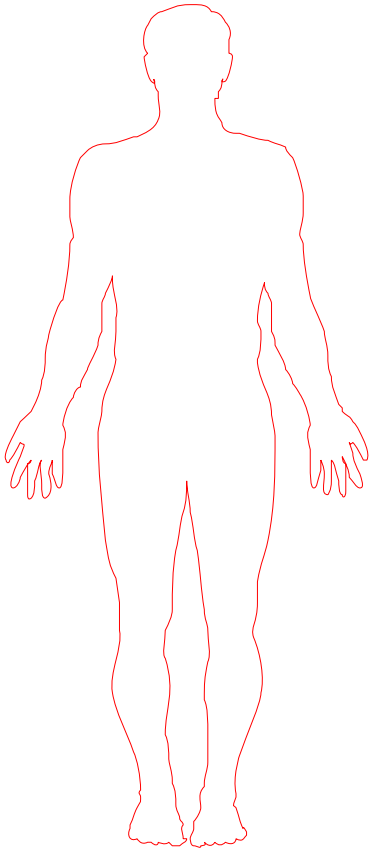
RF radiation heats the body.
Water molecules begin to oscillate.
Heat is produced by the friction losses.

Energy absorbed per unit of time is dependent on **dielectric properties** of the **tissue.**

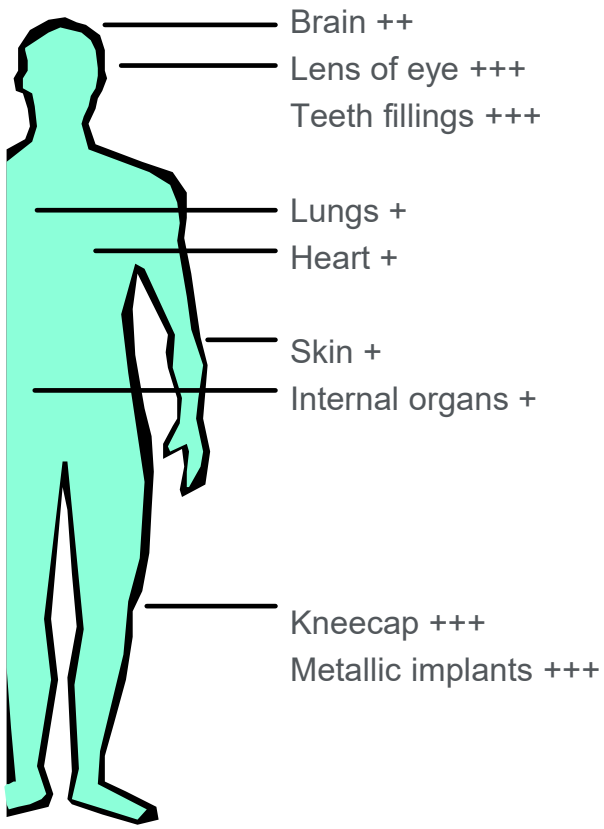
The result is **partial-** or **full-body heating.**

Basic quantity for specifying limits in RF/HF range is the **specific absorption rate** (SAR)

SAR = Absorbed power P in **W / kg** body weight



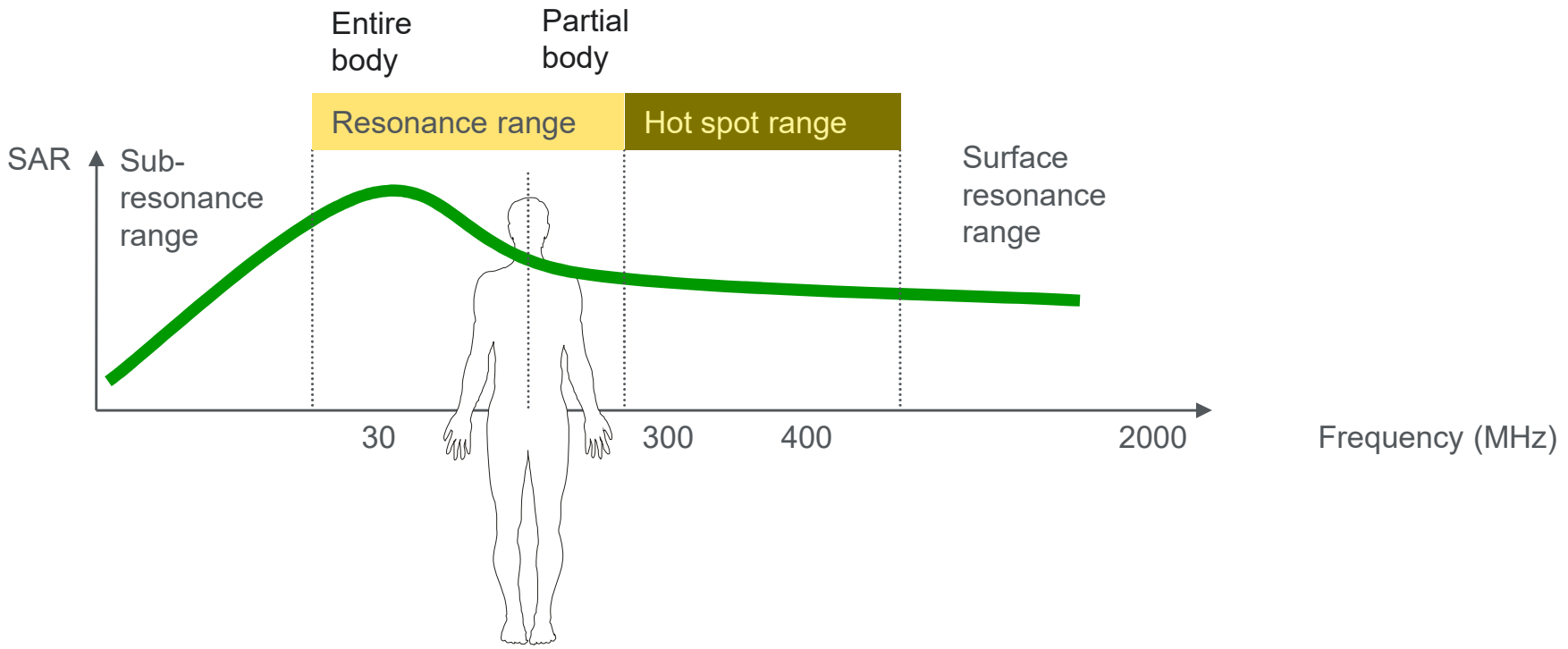
Effects of EMF in RF range



Exposure to homogeneous field, unmodulated signal:

Low absorption	+
Medium absorption	++
High absorption	+++

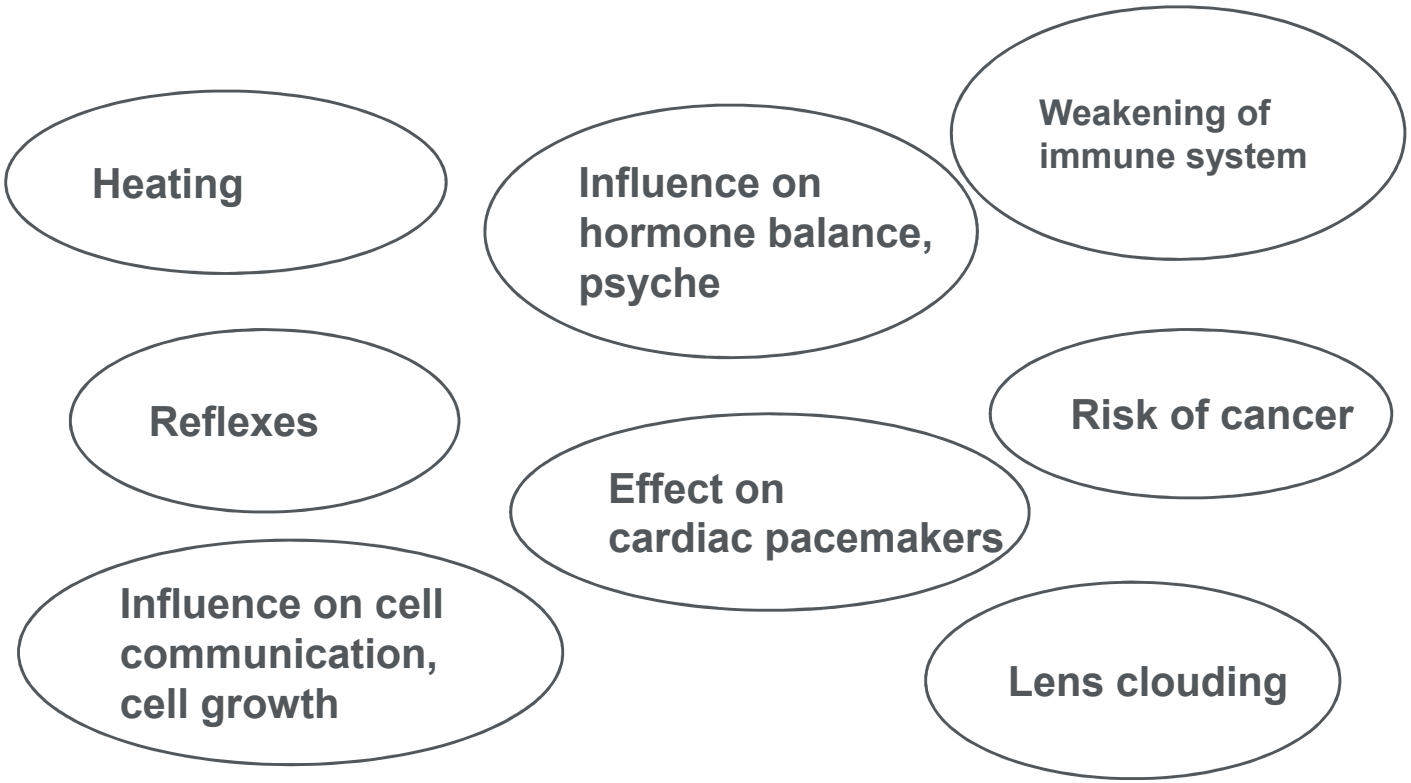
HF/RF: Body's absorption curve as a function of frequency



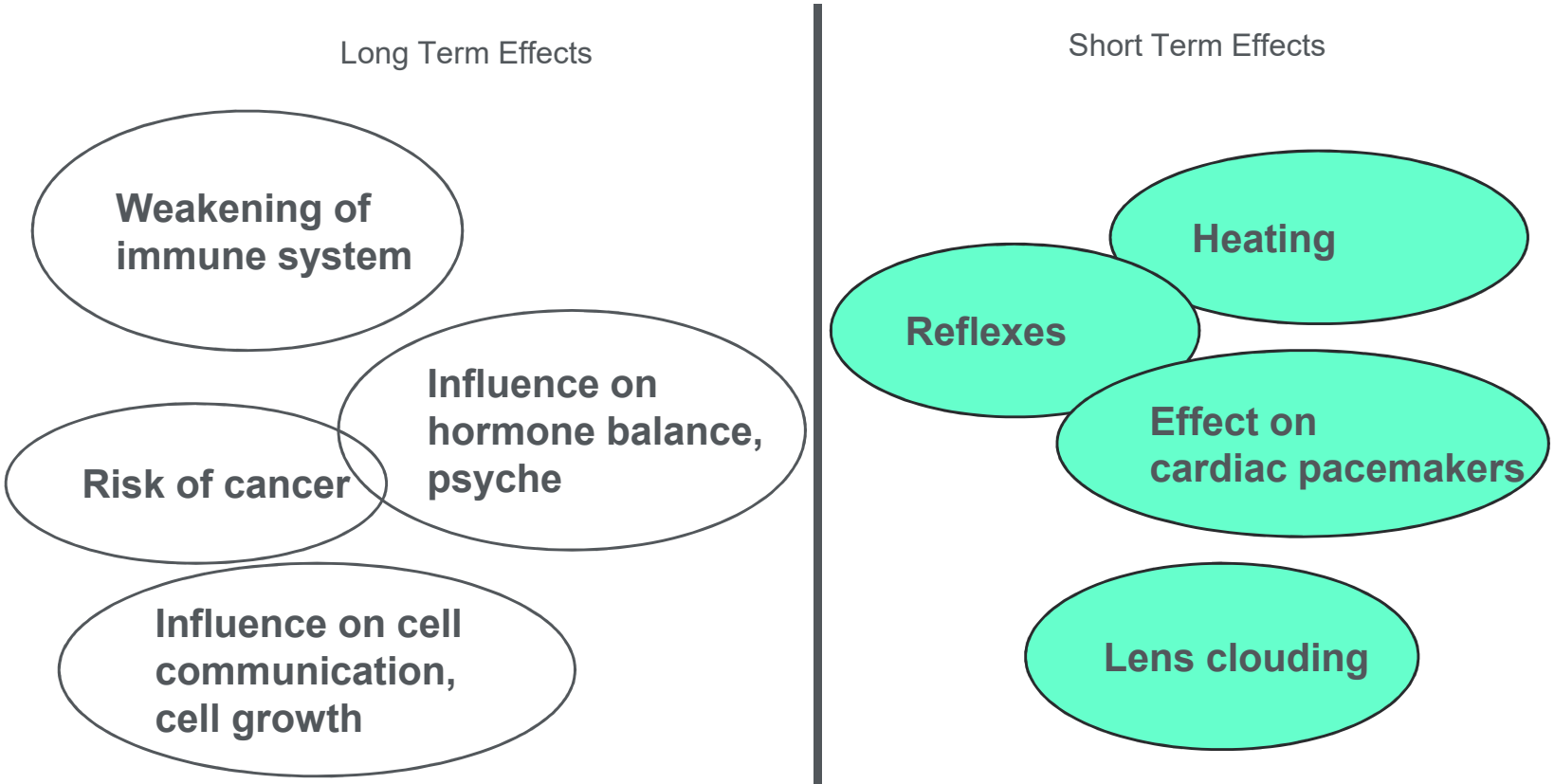
RESONANCE!

In the length range from 0.75 to 2 m, bodies and body parts act as lossy antennas!

To be thought of ...



We will consider ...



Short term effects are the base for many limit values, e.g. ICNIRP

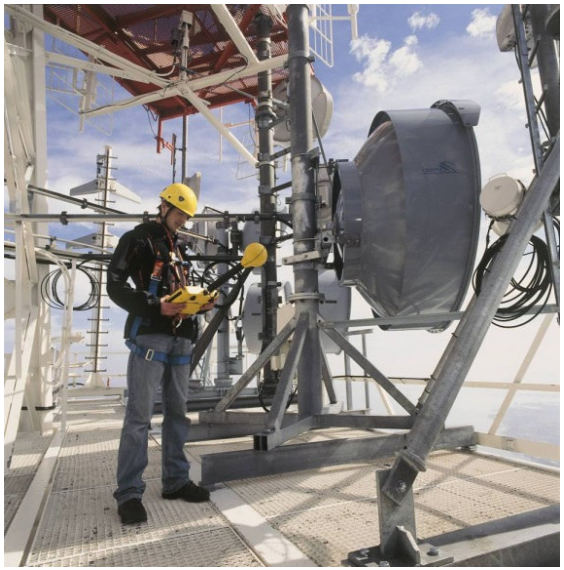
Introduction

Safety in Electro-magnetic fields (EMF)

Infrastructure work in high-EMF environments involves a high level of risk.

Risk for the worker, but also for the employer, who is responsible for health and safety.

Employers are forced to take the necessary precautions. Workers need to be trained.



Introduction

Some important Safety Precautions

- Educate workers about risks from electromagnetic fields
- Educate workers how to detect adverse health effects of exposure and how to report them
- Train safe working practices to minimize risks
- Provide information about the site and about the radiation sources available there
- Use protective clothing in extremely high exposure environment
- Use a personal monitor to warn against high radiation

Introduction

Why should I use a personal monitor?

- It is not always possible to ensure that exposure of workers is below the occupational exposure limit values.
- Electromagnetic radiation can not be heard or tasted. If you feel the consequences, it is usually too late.
- A personal monitor gives us a way to perceive RF radiation,
  which allows us to get out of the danger zone in time.
- Personal monitor with RF detection mode (frequency pitch alters with field strength) allow for quick check if antennas are really turned off - that increases safety.
- A personal monitor also displays the level of exposure. This usually allows the radiation source to be localized and the hazard to be better assessed.
- A personal monitor is easy to use and belongs in every set of personal protective equipment.

Introduction

Are you safe?

Would you use a disc grinder without eye protection?

Would you work with a jack hammer without ear protection?

Would you climb up an antenna mast without EMF warning device?

RadMan 2: New and Improved

NEW

RadMan 2: New and Improved

More than 20 years of field experience goes into the RadMan 2

RadMan 2: New and Improved

Unique Feature

Extended Range
with its frequency range extending up to **60 GHz**, RadMan 2XT covers all services including 5G and millimeter waves

5G ready

Unique Feature

Built-in Sensor Test*

Be sure you are safe. No external test transmitter necessary

* Patent pending

RadMan 2: New and Improved

Simple Display
patented **Shaping** displays the result directly in
"% of limit value"

No conversion,
no settings,
directly according to
ICNIRP, Directive 2013/35/EU,
FCC or Safety Code 6

Never miss an Alarm
unmistakably **loud** alarm and extremely **bright** 270° wide angle light display

To make it complete:
vibrating alert

RadMan 2: New and Improved

Extended Range

with its frequency range extending up to 60 GHz, RadMan 2XT covers all services including 5G and millimeter waves

50 MHz RadMan 2 LT 8 GHz

900 kHz RadMan 2 XT 5G ready 60 GHz




RadMan 2: New and Improved

Two models available

	RadMan 2LT	RadMan 2XT
E-Field	50 MHz to 8 GHz (ICNIRP, FCC, SC6, ICNIRP GP)	900 kHz to 60 GHz (ICNIRP models, Directive 2013/35/EU) 3 MHz to 60 GHz (FCC models) 10 MHz to 60 GHz (SC6 models)
H-Field	50 MHz to 1 GHz (ICNIRP, FCC, SC6, ICNIRP GP)	27 MHz to 1 GHz (ICNIRP, SC6 models) 3 MHz to 1 GHz (FCC models)
Data logger (Ring memory)	2,880 events (48 hours)	100,000 events
Signal detection	RMS	RMS
Integration time	1 s	switchable to 1 s or 30 ms (Pulse Mode)
Additional functions	Functional sensor test	Functional sensor test (patent pending)
		RF detection mode

RadMan 2: New and Improved

Isotropic Sensors for E-Field and H-Field*

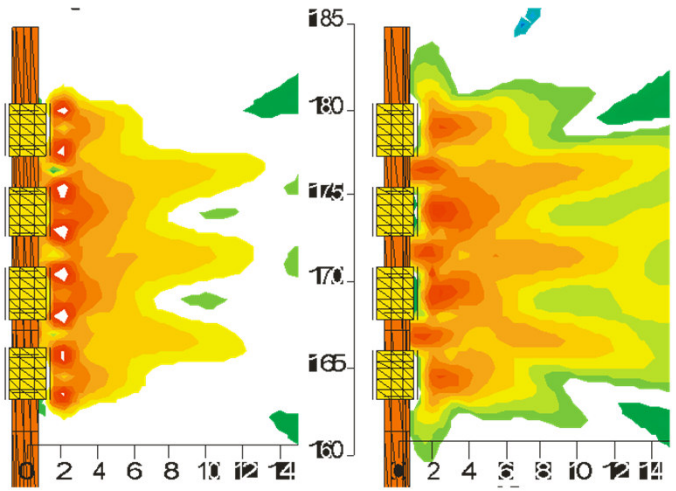
In the near-field of an antenna, E- and H-Field are independent

- **each component can cause an overexposure**
- **both must be controlled not exceeding the limit values**
- **standards (ICNIRP, FCC, SC 6) demanding the control of both components**

That's why RadMan 2 provides both:

- **E- and H-Field sensors**
- **compares both components against their limit values**
- **displays the higher component on the LEDs**
- **triggers alarm if one of the components exceeds their resp. limit value**

*Isotropic off the body/the mounting bracket



H – Field **E – Field**

Simulation of broadcasting antenna

RadMan 2: New and Improved

Detection of short pulsed signals (XT)

Detection Mode “normal”

In telecommunication environment, a response within one second is sufficient

Detection Mode “Pulse”

In e.g. radar surroundings it is essential to have a response within the “time on target” of a rotating radar (down to 30 msec)

Pulse mode is easily started on RadMan 2XT and stays active after off - on

RadMan 2: New and Improved

For protection of untrained workers like craftsmen or visitors

RadMan 2LT according to ICNIRP “general-public” limits

RadMan 2: New and Improved

RadMan 2XT in “Isotropic RF detection mode”

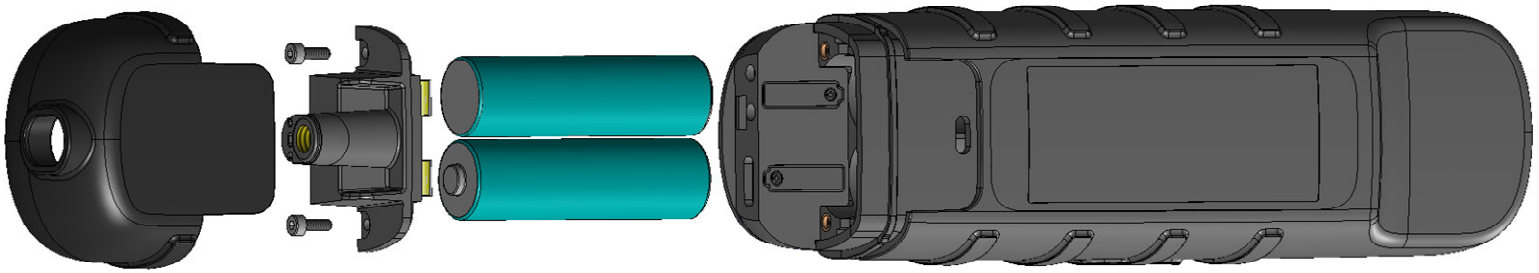
Simple RF survey / assessment instrument

- localization of leaks in waveguides and coaxial screw connectors
- check, if antenna is switched on or off
- tone search to quickly detect leaks or problem areas (varying pitch of tone)

RadMan 2: New and Improved

800 hours of operation on a single charge

- 2 field replaceable, rechargeable NiMH batteries type AA
- rechargeable via USB port, USB-C interface
- charging time < 8 hrs.
- operating time 800 hrs under normal use
  - 800 hours @ 8 h / day → 100 days → 3 * charges per year ☺



RadMan 2: New and Improved

RadMan 2 is rated IP65

First digit: Solid particle protection

Level sized	Effective against
X	—
0	—
1	>50 mm
2	>12.5 mm
3	>2.5 mm
4	>1 mm
5	Dust protected
6	**Dust tight**

Second digit: Liquid ingress protection

Level	Protection against
X	—
0	None
1	Dripping water
2	Dripping water when tilted at 15°
3	Spraying water
4	Splashing of water
5	**Water jets**

RadMan 2 and Nardalert S3

RadMan 2 and Nardalert S3

From front side, the alarm is visible on every product

Looking over shoulder with a camera provides user's perspective

RadMan 2 and Nardalert S3

From front side, the alarm is visible on every product

Looking over the shoulder with a second camera gives the perspective of the user

RadMan 2 and Nardalert S3

Integrated absorber avoids over and underestimations

- the Human body acts like a reflector to electric fields
- any electric field probe worn close to the body (like a personal monitor) is affected by those reflections if no countermeasure has been taken
- these reflections can cause strong over or underestimations
- if the incident field is 180 degrees out of phase of the reflected field the value cancels out
- if the incident field is in phase with the reflected field the values double
- measurements results from units which are worn on-the-body without absorbers material are most likely not accurate

RadMan 2 and Nardalert S3

Absorber avoids over and underestimations

- only Narda Personal Monitors RadMan 2 and Nardalert S3 avoid those effects by inserting absorber material between body and sensor

RadMan 2 and Nardalert S3

RF absorber minimizes the body effect

Worn on the body

The absorber inside the mounting adapter reduces body affects to the measurement results when fixed closed to the body

Taken out of the mounting adapter

When released, absorber stays inside mounting adapter for precise and isotropic measurements according to standards.

RadMan 2 and Nardalert S3

RadMan 2 and Nardalert S3, 50 years of combined history

RadMan 2 and Nardalert S3

	Nardalert S3
E-Field	100 kHz to 50 GHz (FCC models) 3 MHz to 50 GHz (IEEE models) 100 kHz to 50 GHz (ICNIRP models) 100 kHz to 50 GHz (SC6 models) 50 GHz to 100 GHz typical
Data logger (Ring memory)	62,000 events (option)
Signal detection	RMS (> 1 GHz thermocouple array, true RMS)
Additional functions	Field replaceable sensor modules
	Color LCD display

RadMan 2 and Nardalert S3

Keep it simple: display measured values in % of standard

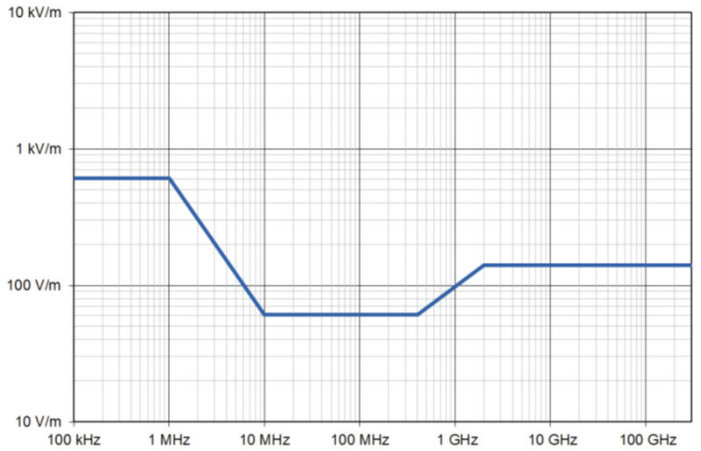
- biological effects depend on frequency
- limit values follow this dependency accordingly

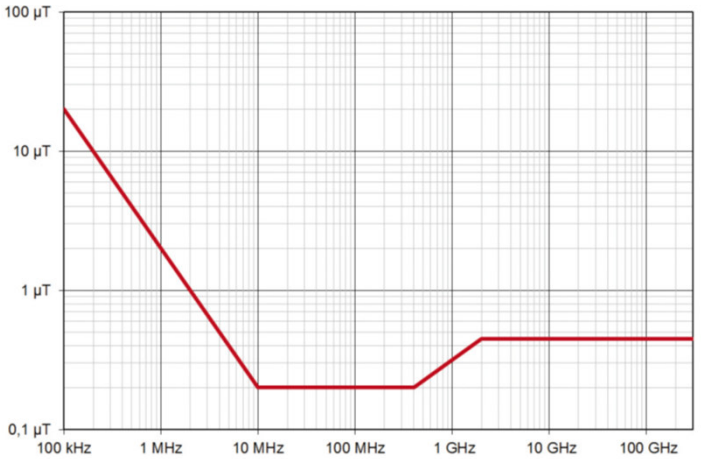
This dependency is taken into account fully automatically

by RadMan 2 and Nardalert S3

- no setting of limit values required
- no reading in mW/cm², V/m …
- direct representation of values in % of standard

→ no misunderstanding, no misreading,
for a maximum of safety





RadMan 2 and Nardalert S3

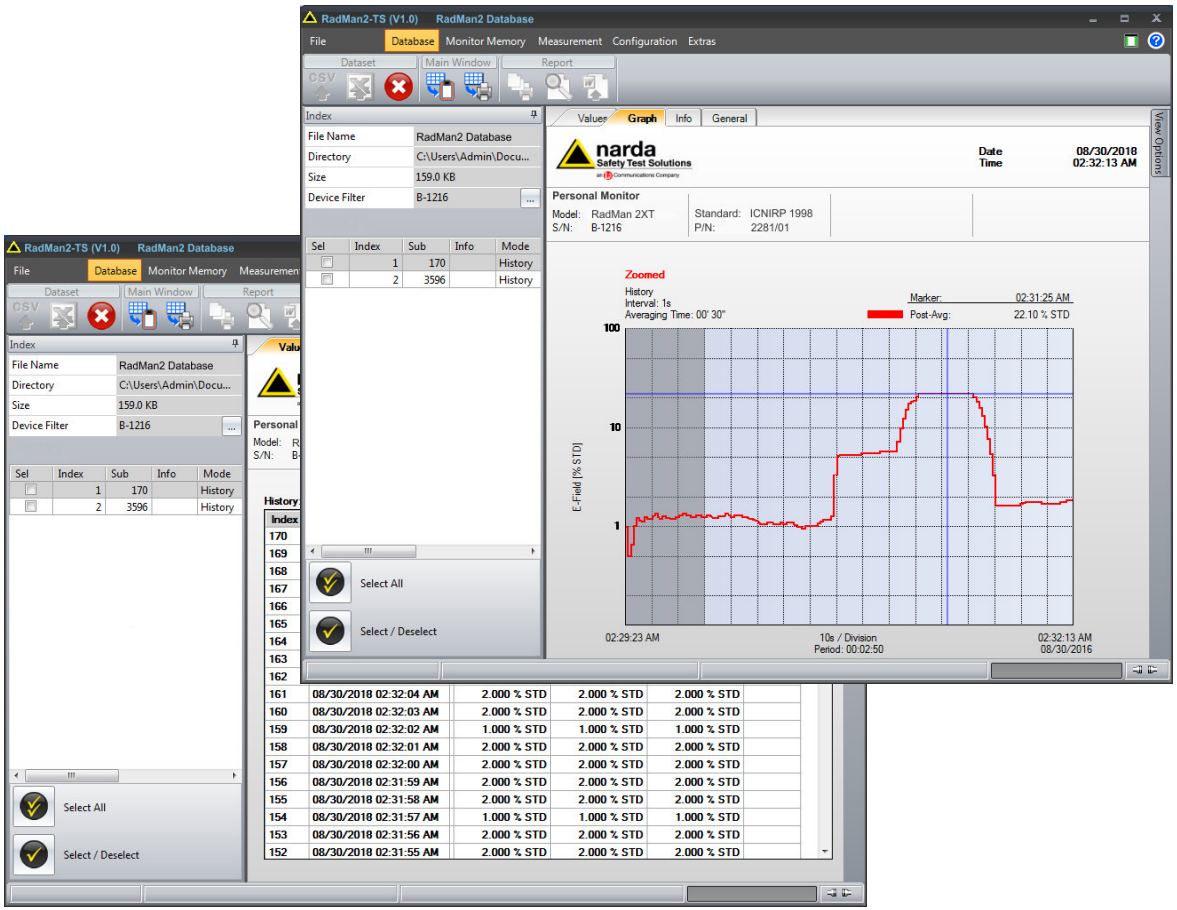
For documentation of your personal safety: representation of recorded values by PC – Software

Data can be:

- transferred to powerful PC Software via USB
- displayed and archived
- do post processing e.g. 6-minutes averaging
- live-view of measurement results possible

USB cable delivered with the product

Software available from Narda website for free download



RadMan 2 and Nardalert S3

For documentation of your personal safety: Data logger is integrated (ring memory)

	RadMan 2LT	RadMan 2XT	Nardalert S3 (Option)
Number of records	2880 events (48 hours)	100,000 events	62,000
Logging interval	1 min	1 s to 6 min (default: 1 min) 100,000 events @ 1 min → 1,666 h → 208 days @ 8 hours	0.25 s to 1 min
Recorded data	E – field: Max. / Average / Min. H – Field: Max. / Average / Min.		E – field: Max. / Average / Min.

RadMan 2 and Nardalert S3

Alarm indication

	RadMan 2LT	RadMan 2XT	Nardalert S3
Optical	✓	✓	✓
Acoustical	✓	✓	✓
Vibration	✓	✓	✓

Other manufacturers claim to have an optical alarm, but is it also visible?

RadMan 2 and Nardalert S3

Differences RadMan 2 and Nardalert S3

	RadMan 2	Nardalert S3
Field type	E- & H-field	E-field
Orientation	3-axes / isotropic	2-axes
Sensor	Dipole / Coil Diode	Dipole Diode / > 1.6 GHz Thermocouple
Detection	RMS	RMS / > 1.6 GHz True RMS
Visualisation	Luminous LED Band, 6 Steps	Graphical Color Display

RadMan 2 and Nardalert S3

RadMan 2: available models

	RadMan 2LT Part number	RadMan 2XT Part number
ICNIRP 1998/ Occupational	2280/101	2281/101
FCC 96-326/ Occupational	2280/102	2281/102
Canada SC 6 (2015)/ Controlled	2280/103	2281/103
ICNIRP 1998/ General Public, E-Field	2280/111	
Accessories included in the Sets:		
RadMan 2 Basic Unit, Mounting Adapter, Fastening Strap, Lanyard, USB Cable, Allen Wrench 1.5 mm, Operating Manual, Carrying Case		
Recommended calibration intervals: 3 years, for the first time 3 years after initial startup		

RadMan XT (former model) is available while stocks last

RadMan 2: optional accessories

	Part number
Tripod, Benchtop, 0.16m, Non-Conductive	2244/90.32
Handle, Non-Conductive Extension, 0.42 m	2250/92.02
Belt Bag for RadMan	2250/92.06
Power Supply (Europe), USB 5V	2259/92.21
Power Supply (USA), USB 5V	2259/92.22
Power Supply (UK), USB 5V	2259/92.23
Car Charger Adapter, USB 5V	2259/92.20

RadMan 2 and Nardalert S3

Nardalert S3: available models

	Nardalert S3
with FCC sensor module	2271/101
with IEEE sensor module	2271/111
with SC6 sensor module	2271/121
With ICNIRP sensor module	2271/131
NS3 Option Key (enables Data Logging, Histogram and Alarm Varying)	2270/90.01
Accessories included in the Sets:	
Nardalert S3 Mainframe, including battery, Carrying case, holds monitor, charger and accessories, Power supply 5 VDC, 100 V-240 VAC, Belt Clip, non-conductive, Lanyard Clip, non-conductive, Cable, USB interface for NS3, 1 m, Software, NS3-TS, PC transfer, Operating manual NS3, Certificate of calibration	
Recommended calibration intervals 4 Years for Mainframe and 2 Years for Sensors	

Nardalert S3: optional accessories

	Part number
Cable, optical fiber, duplex (1000 µm) RP-02, 2 m	2260/91.02
Cable, optical fiber, duplex (1000 µm) RP-02, 20 m	2260/91.03
Cable, optical fiber, duplex (1000 µm) RP-02, 50 m	2260/91.04
Cable, optical fiber, duplex, F-SMA to RP-02, 0.3 m	2260/91.01
Fiber Optic converter RS232, RP-02/DB9	2260/90.06
Fiber Optic converter USB, RP-02/USB	2260/90.07
Cable, adapter, USB 2.0 - RS232, 0.8 m	2260/90.53
Mounting Bracket for Nardalert S3 (Supports Area Monitoring)	11232200

RadMan 2 and Nardalert S3

True RF personal protection for safety in electromagnetic fields

All information available at: https://www.narda-sts.com/en/personal-safety-emf/

Q&A

Thanks

Australian Distributor

Air-Met Scientific Pty Ltd
Sales | Service | Rental

OHS & Environmental Monitoring Equipment Specialists

W: www.airmet.com.au
E: sales@airmet.com.au
P: 1800 000 744
F: 1800 000 774