

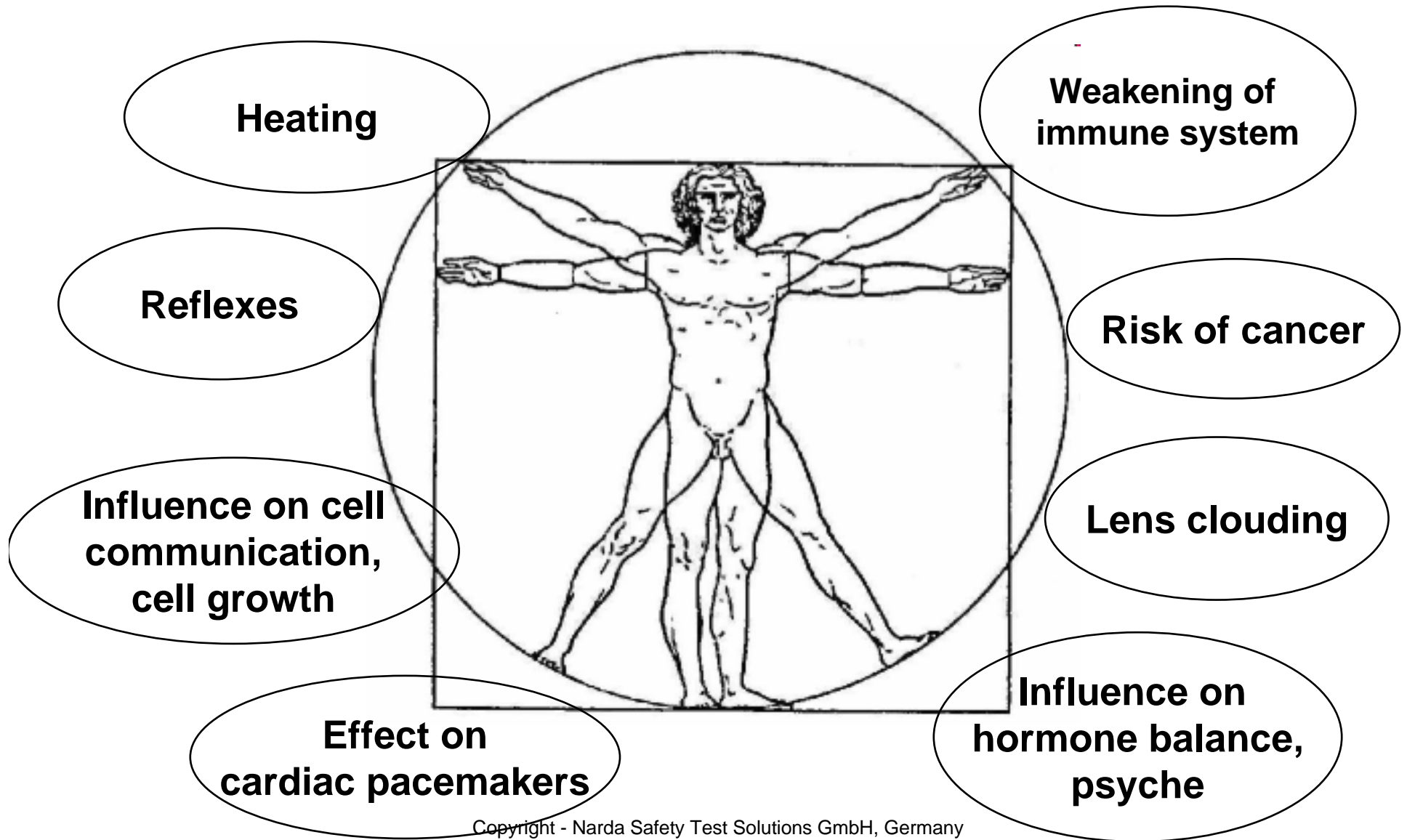
# Influence on human body of and measurement solutions for high frequency EMF fields

*swissT.net*

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## What are the effects on human body which require an EMF safety approach ...



## Long Term Effects

Weakening of  
immune system

Risk of cancer

Influence on cell  
communication,  
cell growth

Influence on  
hormone balance,  
psyche

## Short Term Effects

Body  
reflexes

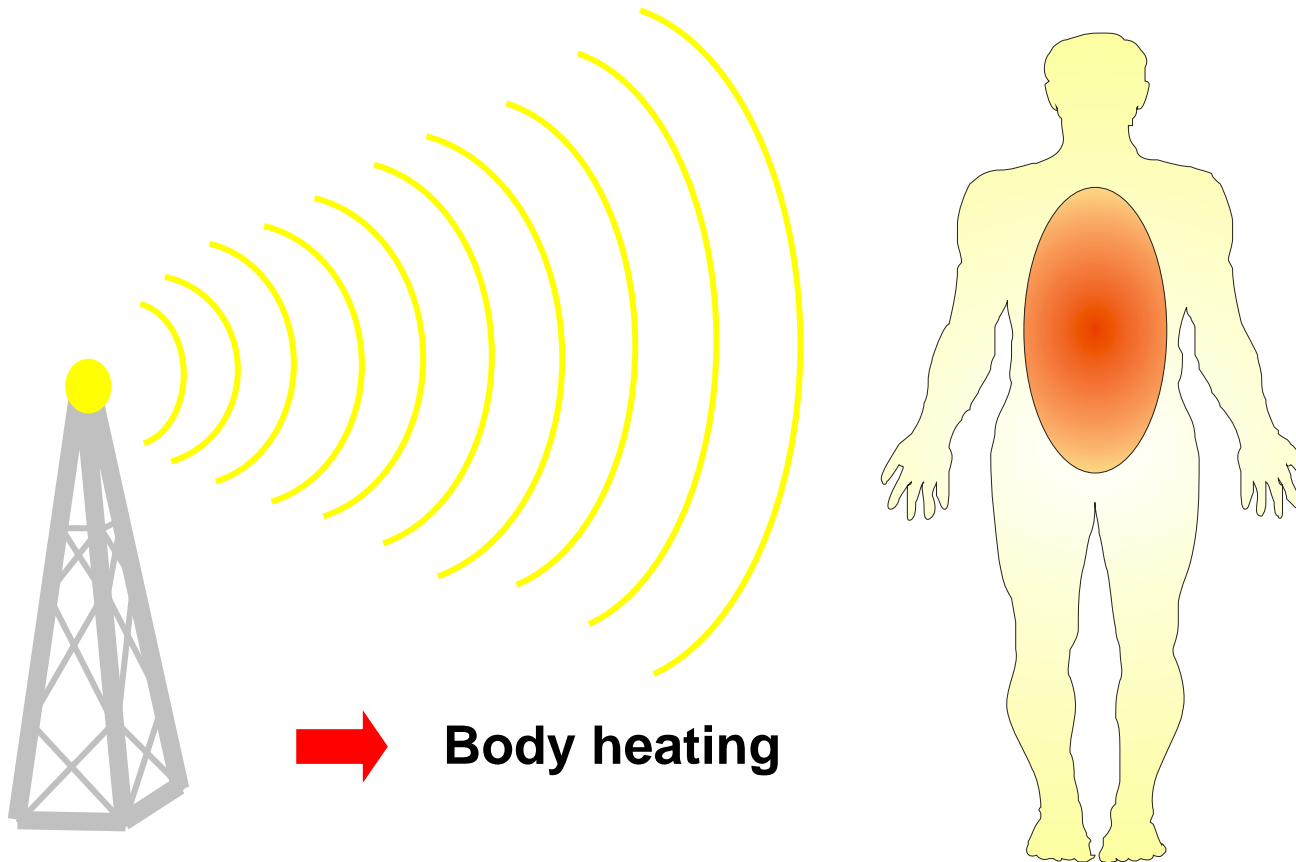
Body  
Heating

Effect on  
cardiac pacemakers

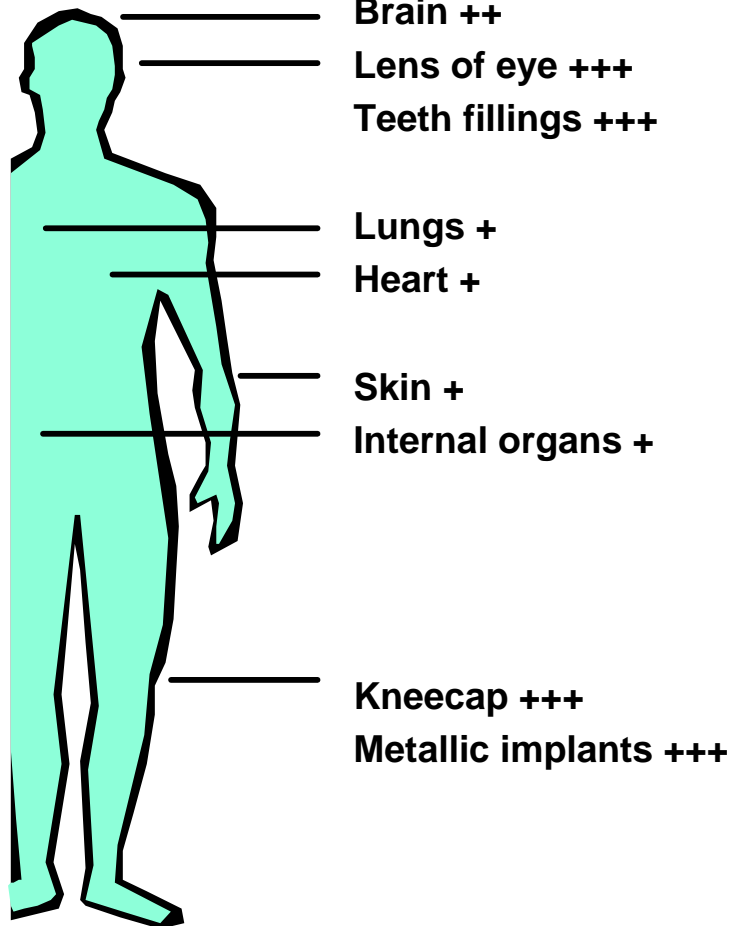
Lens clouding

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

# Absorption of energy created by Exposition to high-frequency EMF

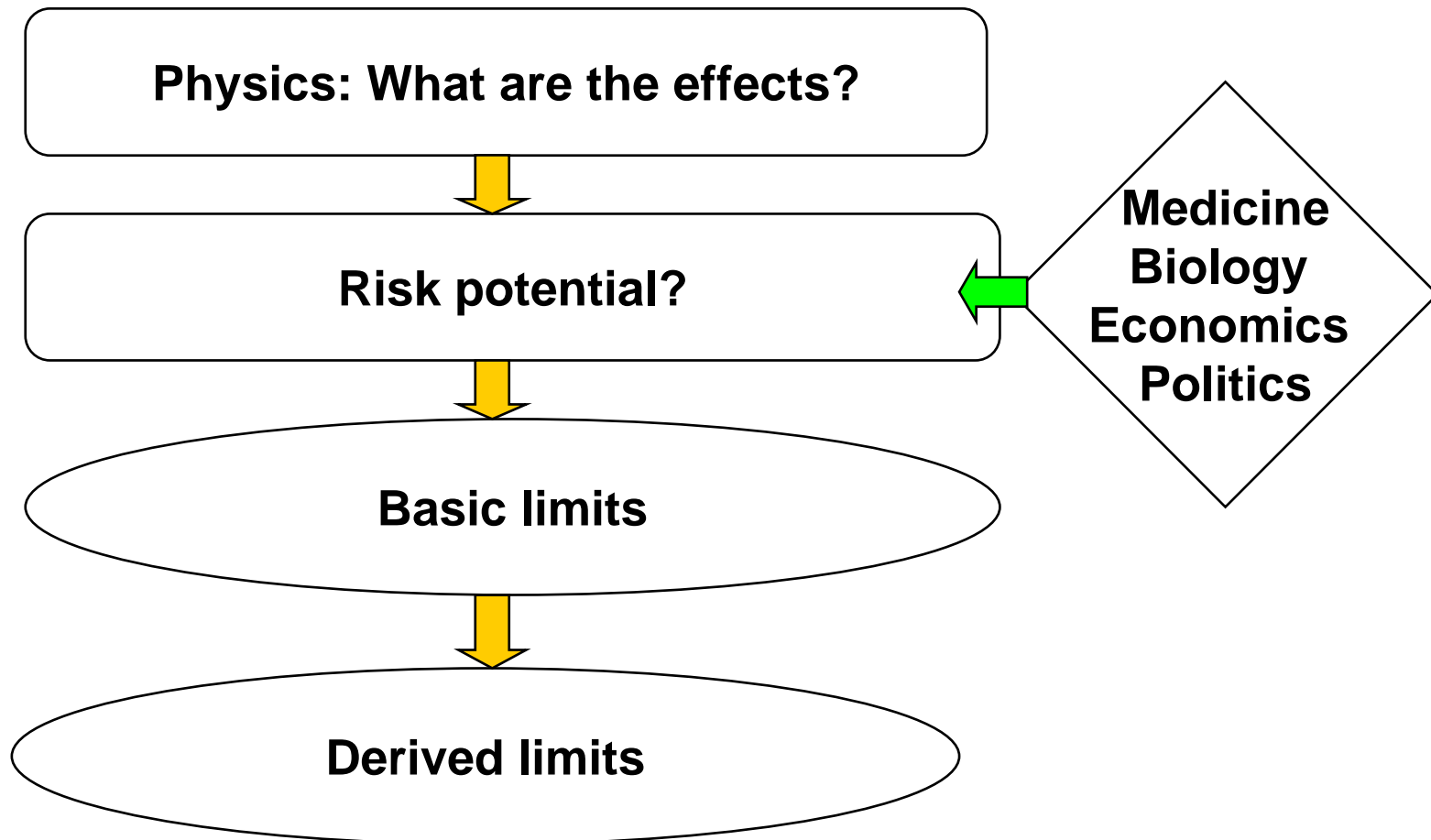


## Effects of High Frequency fields



**Exposure to homogeneous field, unmodulated signal:**

<b>Low absorption</b>	<b>+</b>
<b>Medium absorption</b>	<b>++</b>
<b>High absorption</b>	<b>+++</b>



## Basic Limits

ELF: Current density  $J$  [ $\text{mA}/\text{m}^2$ ]  
RF: Specific absorption rate - SAR [ $\text{W}/\text{kg}$ ]

Model computations,  experiments & worst-case studies

## Derived Limits / Action Values

E field [ $\text{V}/\text{m}$ ]  
H field [ $\text{A}/\text{m}$ ] or Flux density  $B$  [ $\text{T}$ ]  
Power flux density  $S$  [ $\text{mW}/\text{cm}^2$ ]

Tesla (T)  
Milliwatt ( $\text{mW}/\text{m}$ )  
Milliampere ( $\text{mA}/\text{m}$ )

## RF - Typical SAR Values

Base value (body at rest)	1 W/kg
Light activity	3 - 5 W/kg
RF therapy	10 - 50 W/kg
1 °C body heating	4 W/kg



Safety factor 10

Basic limit from ICNIRP (worker) **0.4 W/kg**

Safety factor 5

Basic limit from ICNIRP (GP) **0.08 W/kg**



### Reference level:

- ▲ The reference levels are derived from the basic limits (biological, difficult to measure) of exposure to electromagnetic fields by computations, experiments and worst-case studies.
- ▲ Measurements below the reference level guarantee that basic limits of exposure are not exceeded.

### Decision level:

- ▲ The decision levels are thresholds set by the administration to allow for measurement uncertainties. They are x dB below the reference level.

**Reference and decision levels refer to either ICNIRP or national limits!**

- ▲ Differentiation:
  - Low Frequency
  - High frequency
- ▲ Precautionary approach - Decision level or precautionary levels
  - For Working safety
  - For General public
  - e.g. Switzerland or Italy regarding General public
- ▲ Direct approach – using “directly” the suggested derived levels by e.g. ICNIRP or IEEE
  
- ▲ In all cases more and more low levels are required to be evaluated
- ▲ Beside the need for Broadband measurement equipment more and more the need for **Frequency Selective measurements up to 6 GHz occurs**
  
- ▲ Narda Safety Test Solutions has in its portfolio suitable equipment for all cases:
  - Measurement equipment
  - Simulation Software

▲ Visit Narda Safety Test Solutions @ <http://www.narda-sts.com>

▲ Find many more useful links

▲ Find applications notes and technical articles about:

- Biological effects on human body
- measurement techniques
- Recommendations for RF safety trainings
- Compliant measurement equipment to international standards
- etc. ...




**SAFETY IN ELECTROMAGNETIC FIELDS**  
Basics - Formulas - Biological effects

**Biological effects in the LF range**  
\* Absorption of energy from the electric field is proportional to the conductivity of the tissue.  
\* Absorption of energy from the magnetic field is a function of the body.

**The electromagnetic spectrum**

**Biological effects in the HFRF range**  
\* SAR (Specific Absorption Rate) is the main parameter for the body's response to the frequency of the field.  
\* SAR is a function of the frequency of the field.  
\* SAR is a function of the body's response to the frequency of the field.

**HEMFI: The body's absorption curve as a function of frequency (f) (Qualitative)**

**Application Note**  
**Radar measurements with the Selective Radiation Meter SRM-3000**  
using air traffic control radar as an example

Measuring the field emissions of radar equipment sets particular challenges for both the test equipment and the technician performing the measurement. On the one hand, radar signals are usually pulsed, highly directional and spatially stable, with the main lobe only illuminating the target as well as the measuring antenna for a brief moment. On the other hand, frequency selective test equipment does not measure all frequencies simultaneously or does not measure continuously in the same domain, so not every radar impulse will be detected. This Application Note uses air traffic control radar as an example to describe the use of the SRM-3000 for measurement and evaluation of field emissions with regard to human safety issues.

**Contents**

1. Background
2. Norms and regulations
3. Preparing for measurement
4. Checklist measurement
5. Measuring with SRM-3000
6. Measuring with SRM-3000
7. Evaluating results
8. Annex 1: Special features
9. Annex 2: Calculating abbreviations, values

**Basic insights**  
Safety in electric, magnetic and electromagnetic fields

- Fundamental principles
- Biological effects
- Regulations and standards
- Protective measures

**ELECTROMAGNETIC FIELDS**

MEASURE: WHY?  
MEASURE: HOW?  
MEASURE RIGHT!  
MONITOR OR METER?  
NARDA SAFETY TEST SOLUTIONS

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Safety Test Solutions  
an ICS Communications Company

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# Thanks for your attention !