

ADVANCED TMS

Research with PowerMAG
Products and Application Booklet

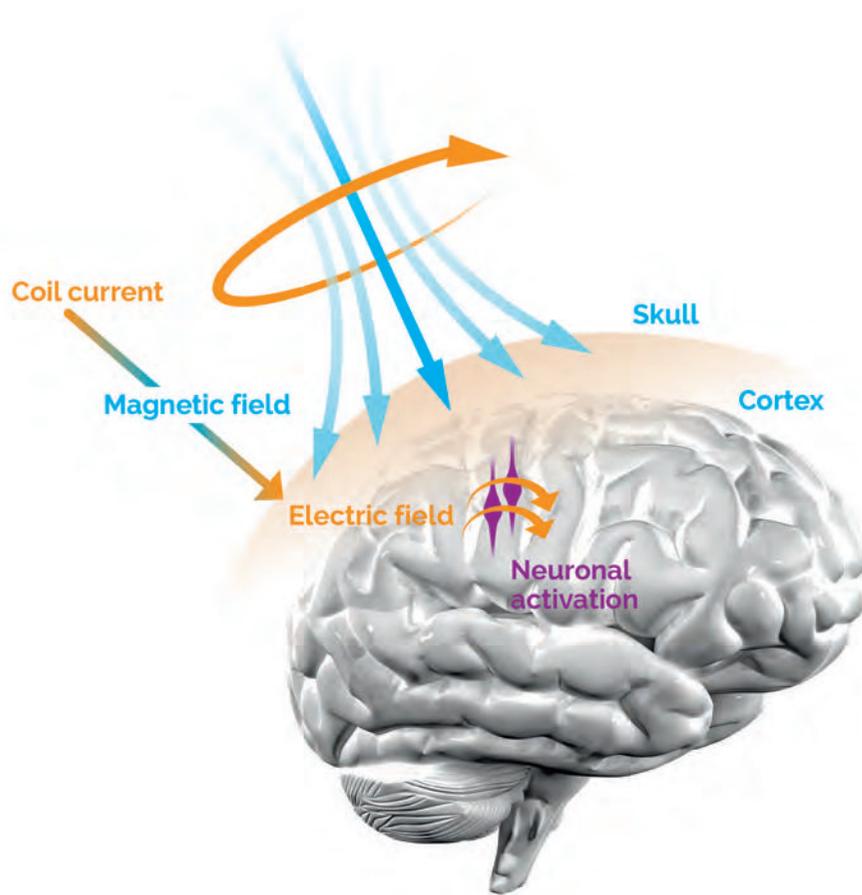


mAG & more



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TMS IN GENERAL

TMS (Transcranial Magnetic Stimulation) is a technique where neuronal activity can be influenced by non-invasively stimulating the cortex through the intact skull bone. The stimulation is caused by short magnetic pulses that induce a current flow in cortical brain areas. Thus brain activity may be triggered or modulated without surgery or externally applied electrodes. TMS is a non-invasive method with several benefits:

- > No skin preparation is needed
- > The magnetic field is able to penetrate high resistance structures, such as the skull, without attenuation
- > TMS is almost completely pain free as currents do not have to pass through the skin

Depending on the stimulation protocol, neuronal functionalities can be inhibited or facilitated for a defined period of time. In addition, repetitive TMS, also known as rTMS, may produce longer-lasting effects.

Overactive or underactive areas of the brain can be observed and then focally modulated with TMS e.g. using functional imaging, such as fMRI and PET. This makes TMS an excellent therapeutic treatment option for psychiatric and neurological disorders.

Furthermore, TMS also contributes to research in neuroscience by demonstrating the involvement of brain regions in various cognitive tasks or mental processes.

WHY MAG & MORE:



Full external controllability



Decentral mini coils



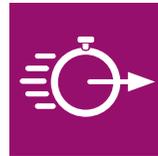
Reproducibility



Stable output power



Optimized coil design



Precise timing



Usability



Various protocols



Optimized pulse length



Various Coils



Safety Borders



Integration



Electrical shielding



High frequency TMS



Half- and full wave



Integrated navigation points



Accuracy



Customization



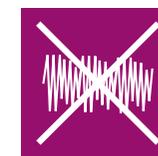
Online EEG feasible



High speed stimulation



Current direction invertible



No mains noise

OVERVIEW:

The use of TMS in research requires an individual and precise positioning of the TMS coil at the selected brain region. MR-based neuro-navigation systems can visualize the electromagnetic hot-spot of the coil in real-time at an individual, anatomical MR-data record. This enables the user to stimulate the target with great precision and makes reproducibility of the TMS set-up much easier. Additionally navigated TMS allows the researcher to protocol and map his or her work for studies and papers. Color coded fMRI data showing active regions of the brain is another helpful tool to find the right target areas.

MAJOR CONSIDERATIONS AND SOLUTIONS:

Precise coil navigation

Wireless IR-tracking system with great accuracy and high resolution.
 Integrated navigation points on the stimulation coils.
 Ability to integrate (future) coil geometries.

Intuitive operability

Implementation of intelligent algorithms (fully automated brain segmentation, surface reconstruction, „brain peeling“).

Handling of data formats for 3D reconstruction

DICOM capable.
 Proprietary data formats for most of the current MR scanner manufacturers.

Reproducibility and data export for statistical analysis

Store and recall stimulation points and coil positions in 6D.
 Record EEG electrode positions.

Data import and interfaces

Interfaces to BrainVoyager for importing and overlaying functional data onto the anatomical reconstruction of the brain.
 Import of structural and functional MRT analysis (fMRI, DTI, EEG/MEG).

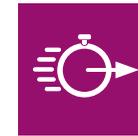
WHY MAG & MORE:



Full external controllability



Accuracy



Precise timing



Reproducibility



Usability



Integrated navigation points



Integration



Various protocols

RELATED PRODUCTS FOR NAVIGATED TMS:

Stimulators:

- » PowerMAG EEG
- » PowerMAG QPS

Coils:

- » PMD70
- » PMD45-EEG
- » PMD45-fMRI
- » PMD25-decentral

Accessories:

- » control splitter box
- » TMS-field probe
- » Neuronavigation

Service:

- » Training
- » Integration

OVERVIEW:

Clinical TMS research is conducted to evaluate the safety and effectiveness of TMS by investigating its effects on human beings.

Transcranial Magnetic Stimulation is a great way to selectively modulate targeted areas of the brain (facilitating or inhibiting) in order to treat neurological and psychiatric diseases.

In contrast to pharmaceuticals, TMS is a non-systemic way of treatment which means that TMS does not circulate in the blood stream throughout the body and does not have body wide systemic side effects.

By delivering its therapeutic effects directly to the brain this non-invasive and almost side-effect free technique appears to have a great future in treatment of various neurological and psychiatric indications.

MAJOR CONSIDERATIONS AND SOLUTIONS:**Individually set all stimulation parameters**

Customize the TMS equipment to fit your needs.

Free configurable stimulation protocols.

Capable of advanced TMS protocols such as Theta-Burst or Quattro-Burst.

Future proof equipment

Upgradable technology in order to follow future TMS developments.

Precise coil navigation

Wireless IR-tracking system with great accuracy and high resolution.

Integrated navigation points on the stimulation coils.

Ability to integrate (future) coil geometries.

Reproducibility and data export for statistical analysis

Store and recall stimulation points and coil positions in 6D.

Record EEG electrode positions.

WHY MAG & MORE:

Full external controllability



Safety borders



Precise timing



Reproducibility



Usability



Integrated navigation points



Integration



Various protocols

RELATED PRODUCTS FOR STIMULATION IN CLINICAL RESEARCH:**Stimulators:**

- » PowerMAG LAB
- » PowerMAG QPS

Coils:

- » PMD70-pCool
- » PMD70-pCool SHAM

Accessories:

- » PC Interface
- » TMS-field probe
- » Neuronavigation

Service:

- » Training
- » Integration

OVERVIEW:

Using TMS in conjunction with other techniques allows for a more complete understanding of the human brain. TMS can be combined with various neuroimaging and neurophysiological technologies as EEG, MEG, EMG, PET, fMRI, NIRS or DTI. The combination of TMS with other techniques can show neuronal interactions and connectivity between different brain areas.

Because TMS cannot directly reach subcortical structures, combining TMS with neuroimaging methods can bring additional insights into the modulation of deeper brain structures which are indirectly induced by TMS

MAJOR CONSIDERATIONS AND SOLUTIONS:**Safe operation of the stimulator in various combinations**

Patented safety concept with safety restrictions on stimulation intensities and frequencies.

Integrated, independent safety channels and pneumatic safety switches.

Easy integration with existing laboratory equipment

Free control of stimulation parameters (USB, analogue & digital interface, triggers in/out).

Reliable results and reliable timing

Emitting TMS pulses with high pulse precision and stable timing.

Reproducible results with different protocols

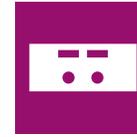
Stable output power through all stimulation patterns (single-pulse, rTMS, Trains, Theta-burst, QPS).

Avoid electrical disturbances and electrical induction

Extremely high standards in the design and production with our quality seal "Made in Germany".

Advanced recharging technology to avoid disturbing e.g. the EEG signal and allow high frequency TMS.

Special signal shielding.

WHY MAG & MORE:

Full external controllability



Safety borders



Precise timing



Reproducibility



Electrical shielding



Integrated navigation points



Integration



Various protocols

RELATED PRODUCTS FOR MULTI-MODAL STIMULATION:**Stimulators:**

- » PowerMAG EEG
- » PowerMAG QPS

Coils:

- » PMD70
- » PMD45-EEG
- » PMD45-fMRI
- » PMD25-decentral

Accessories:

- » Control splitter box
- » TMS-field probe
- » Neuronavigation

Service:

- » Integration

OVERVIEW:

Multi-side TMS describes the use of multiple independently controlled stimulation coils which all are stimulating one subject.

It is used for the investigation of functional connectivity within complex interconnected networks. By varying the timing and location of each coil, the temporal and spatial relationships between brain regions can be investigated. The operator can e.g. stimulate multiple locations with or without time delay between the stimulation pulses .

It is for instance possible to suppress one hemisphere while activating the other stimulation side.

Another approach is to combine a "virtual lesion" which is evoked by applying rTMS on one or more brain area(s) and using single-pulse stimulation on another area. Up to 4 selected brain regions can be stimulated with different patterns and intensities at the same time while using highly focal coils.

MAJOR CONSIDERATIONS AND SOLUTIONS:**Safe and flexible operation of up to 4 stimulators**

Patented safety concept with safety restrictions on stimulation intensities and frequencies.

Set and control the stimulation parameters freely through different options (USB, analogue & digital interface, triggers in/out, front panel).

Coil sizes and abilities

Variety of stimulation coils – different sizes and housings.

Application-oriented coil geometries for specific applications.

Precision of stimulation coils

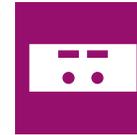
Extraordinary temporal and spatial resolution through continuous development.

Reproducible results with different protocols

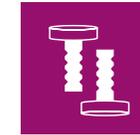
Stable output power through all stimulation patterns (single-pulse, rTMS, Trains, Theta-burst, QPS).

Stimulation of two spatially close brain areas at the same time

Decentral mini-coils enable the stimulation of areas that are only 2-3cm apart.

WHY MAG & MORE:

Full external controllability



Decentral mini-coils



Precise timing



Integrated navigation points



Online EEG feasible



Half- and full wave



Current direction invertible



Various protocols

RELATED PRODUCTS FOR MULTI-SIDE STIMULATION:**Stimulators:**

- » PowerMAG LAB
- » PowerMAG EEG

Coils:

- » PMD70
- » PMD25-decentral

Accessories:

- » PC Interface
- » Control splitter box

Service:

- » Coil tooling
- » Rapid prototyping

OVERVIEW:

Event-related TMS depicts the combination of TMS together with a specific, cognitive task. Examples are stimulating the visual cortex while the subject is shown pictures, or stimulating Broca's area while asking the subject to talk. As TMS is very focal and hence only influences very specific brain regions it is a very instrumental technique towards studying the brain's inter-connections and functionalities while performing cognitive tasks.

For event-related TMS, the temporal relationship between a task with a reliable timing of the stimulation is crucial. The spatial resolution which is determined by the coil geometry is a second important factor which has to be considered.

The selection of the right stimulator and coil for event-related studies is essential for reliable results.

MAJOR CONSIDERATIONS AND SOLUTIONS:**Precise and reliable timing**

Trigger in/out must be without jitter to ensure a proper, reproducible experiments.

Stimulation coils

Different geometries and sizes must be available.
Customized coil development for innovative ideas.

Connection to existing lab equipment

Various interfaces to easily connect to devices which record VEP, AEP, MEP and other electrophysiological parameters.
Different possibilities to control the stimulator with existing equipment.

Induction of mains noise into recording equipment and electrodes

Advanced shielding avoid interferences by mains noise and the stimulation pulse.

Reproducible stimulation

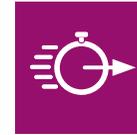
Integration into MR-based neuronavigation systems.

WHY MAG & MORE:

Full external controllability



Various Coils



Precise timing



Integrated navigation points



Electrical Shielding



Integration



Half- and full wave



High speed stimulation

RELATED PRODUCTS FOR EVENT-RELATED FAST TMS:**Stimulators:**

- » PowerMAG LAB
- » PowerMAG EEG

Coils:

- » PMD70
- » PMD45-EEG
- » PMD25-decentral

Accessories:

- » Control splitter box
- » TMS-field probe
- » Neuronavigation

Service:

- » Coil tooling

OVERVIEW:

Experimental brain research can benefit enormously from pain-free and non-invasive stimulation options. As such, TMS can induce a temporary functional disturbance in a focal area of the cortex. This lesional effect can be characterized by psychophysical measurements and lead to important conclusions about the functional relevance of the stimulated area of the cortex.

The high temporal resolution of electroencephalography (EEG) permits the direct derivation of brain activity triggered by TMS. In addition to the performance of TMS and EEG at separate times (offline method), the simultaneous use of TMS and EEG (online method) can provide an especially unique opportunity to investigate corticocortical connections.

- » Interactive method: Analysis of TMS effects on functional networks during cognitive tasks.
- » Inductive method: Evaluation of cortical reactivity and connectivity by measuring transcallosal evoked potentials (TEP).
- » Rhythmic method: Monitoring of the influence of TMS stimulation on oscillatory brain activity to understand the causal relationships between cortical rhythm and perceptual, cognitive or motor processes.

MAJOR CONSIDERATIONS AND SOLUTIONS:**Induction of mains noise into electrodes and leads**

Advanced shielding of stimulator to avoid interferences.

Precise and reliable timing

Trigger in/out must be without jitter.

Integration into existing EEG-labs

Various possibilities to control the stimulation with existing equipment.

Future proof equipment

Possibility to upgrade stimulation hard- and software in order to follow future TMS developments.

WHY MAG & MORE:

Full external controllability



Integrated navigation points



Precise timing



No mains noise



Short pulse length



Half- and full wave



Current direction invertible



High frequency TMS

RELATED PRODUCTS FOR EEG-TMS:**Stimulators:**

- » PowerMAG EEG
- » PowerMAG QPS

Coils:

- » PMD70
- » PMD45-EEG
- » PMD25-decentral

Accessories:

- » Control splitter box
- » TMS-field probe
- » Neuronavigation

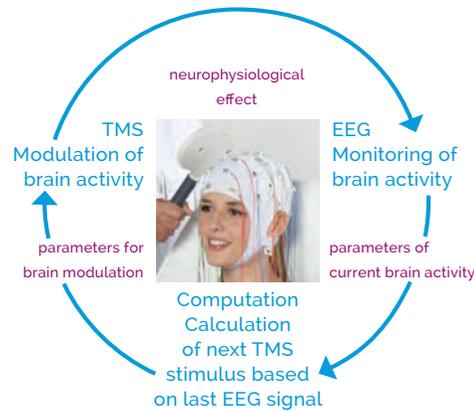
Service:

- » Training
- » Coil tooling

OVERVIEW:

A hot topic in today's brain research is state-depending modulation of brain networks in real time by applying personalized TMS patterns. This real-time application allows you to investigate cortical excitability and induction of long lasting plasticity in network pathways with respect to the „right“ timing with the „right“ TMS stimuli.

Synchronizing the timing of the individual stimulation patters with the actual state parameters is technically challenging. For following the dynamics in different brain states an online streaming EEG data acquisition equipment and a real-time capable TMS device is essential.



MAJOR CONSIDERATIONS AND SOLUTIONS:

Real-time capable equipment with reliable timing

- Jitter free stimulation equipment.
- Online streaming EEG data acquisition equipment.

No interference of mains noise

Shielded stimulator technology to avoid disturbances by mains noise.

Integration into existing lab setups

Free control of stimulator with existing equipment

Future proof equipment

Upgradable technology in order to follow future TMS developments

WHY MAG & MORE:



Full external controllability



Various coils



Precise timing



Electrical Shielding



Integrated navigation points



Integration



Half- and full wave



High speed TMS

RELATED PRODUCTS FOR REAL TIME EEG TRIGGERED TMS:

Stimulators:

- » PowerMAG EEG
- » PowerMAG QPS

Coils:

- » PMD70
- » PMD45-EEG
- » PMD25-decentral

Accessories:

- » Control splitter box
- » TMS-field probe
- » Neuronavigation

Service:

- » Training
- » Integration

OVERVIEW:

This innovative, new patterned repetitive transcranial magnetic stimulation protocol called quadri-pulse stimulation (QPS) can generate a broad range of motor cortical plasticity ranging from MEP suppression to MEP facilitation. In addition to evoking lasting cortical plasticity changes,

QPS can also be used to evaluate priming effects: when used as a priming stimulation, which does not induce an LTP- or LTD-like phenomena itself, it can nevertheless change the threshold for LTP- or LTD-like plasticity caused by consecutive stimulations. Said effects enable the examination of metaplasticity theories in more details in humans. Other more clinical applications of QPS are being researched towards inducing symptomatic relief in patients with neurological or psychiatric disorders, such as Parkinson's disease, depression, or intractable pain.

Our new technology platform enables for the first the combination of ultra-fast QPS and online TMS-EEG in one single device.

MAJOR CONSIDERATIONS AND SOLUTIONS:

Safe operation of the stimulator

Safety channel to immediately stop of the stimulation if necessary.
Patented safety concept for setting safety borders of stimulation intensity and frequency.

Combination of QPS stimulation with EEG

Biphasic QPS pulses for minimization of stimulation artifact.
Advanced shielding of stimulator and to avoid interferences by mains noise.

Comparison of various stimulation protocols

All-in-one stimulation equipment enables QPS, TBS and rTMS in one device.

Integration into existing research labs

Various possibilities to control the stimulation with existing equipment.

WHY MAG & MORE:



Safety Boardes



Optimized coil design



Precise timing



Customization



No mains noise



Integration



High frequency TMS

RELATED PRODUCTS FOR QPS STIMULATION:

Stimulators:

- » PowerMAG QPS

Coils:

- » PMD70
- » PMD45-EEG

Accessories:

- » Control splitter box
- » TMS-field probe
- » Neuronavigation

Service:

- » Integration

OVERVIEW:

Translational and basic research are the major areas of TMS applications in animals. The use of animals has advantages in terms of subject homogeneity, disease models and available histology.

Focuses such as TMS safety, neuronal connectivity, synaptic plasticity and cortical organization all have strong translational relevance.

Rats, mice, dogs, cats, rabbits and horses are the most commonly used animals for research with TMS. Stimulating small animals with TMS, sometimes even in conjunction with EEG, is challenging because of the animal's size. This requires specific equipment, such as small dedicated TMS-coils with very focused magnetic fields.

MAJOR CONSIDERATIONS AND SOLUTIONS:**Size of the animals:**

Decentral mini-coils enable a very focal stimulation in rodents.
Large range of stimulation coils – different sizes and housings.
Application-oriented coil geometries for specific animals.

No standardized experimental setup:

Customization of the setup – from cable length to coil mountings.
Free control of the stimulator.
Different stimulation parameters (pulse direction, pulse shape, protocols).

Simultaneous use with other equipment

Avoiding electrical disturbances and induction with special shielding.
Integrated safety concepts for safe operation in various combinations.
High frequency multimodal-TMS enabled with advanced recharging technology.

Precise coil positioning:

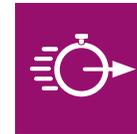
Integration into MR-based neuronavigation systems.

WHY MAG & MORE:

Full external controllability



Various coils



Precise timing



Customization



Online EEG feasible



Half- and full wave



Current direction invertible



Various protocols

RELATED PRODUCTS FOR ANIMAL STIMULATION:**Stimulators:**

- » PowerMAG LAB
- » PowerMAG EEG

Coils:

- » PMD70
- » PMD45-EEG
- » PMD25-decentral

Accessories:

- » Control splitter box
- » TMS-field probe

Service:

- » Integration of custom-made coils
- » Coil simulations

OVERVIEW:

In-vitro cell stimulation is utilized to research the physiological events in cortex cells on neuro-chip-systems.

Findings in the field of in-vitro cell stimulation help improve current applications in neurodiagnostics and -rehabilitation.

The main advantage of neuro-chip-systems is that, due to their inter-neuronal connections, they represent nerve tissue much more comprehensively than single nerve fibers or preparations. These systems also highly suited towards analyzing defined chemical impacts on nerve cells (e.g. neuro-toxic impacts). Reproducible measurements can be conducted over extended periods of time while excluding many interference factors.

MAJOR CONSIDERATIONS AND SOLUTIONS:**Ability to modulate the stimulus activity of neurons:**

Exact stimulation dosage and reproducibility.

Definition of the geometric field parameters for the induced magnetic field:

Selection of different coil forms and types.

Research different pulse forms:

Optimizing stimulus time and sequence (with or without switching the polarity).

Improved stimulus effect for induced stimulation:

Application of different pulse forms and patterns.

WHY MAG & MORE:

Full external controllability



Various coils



Stable output power



Customization



Optimized pulse length



Half- and full wave



Current direction invertible



Various protocols

RELATED PRODUCTS FOR IN-VITRO CELL STIMULATION:**Stimulators:**

- » PowerMAG LAB
- » PowerMAG QPS

Coils:

- » PMD70
- » PMD25-decentral

Accessories:

- » Control splitter box
- » TMS-field probe

Service:

- » Integration of custom-made coils
- » Coil simulations

OVERVIEW:

Robotic TMS is a highly advanced technique and a unique tool to assure stimulation quality in terms of precision.

The combination of a robot, MR-based neuronavigation and focal stimulation makes it possible to reproduce multiple sessions or ensure identical setups in e.g. multi-center studies.

Modern TMS robots are able to safely readjust to the subject's head movement and ensure contact between the TMS coil and the subject's head. Image guided TMS sessions can be planned in advance for fully automatic executions.

In addition to holding the stimulation coil reliably and accurately for target points, TMS robots are also capable of moving along pre-defined paths on the subjects head. With this functionality it is possible to stimulate larger target areas with a focal stimulation coil.

MAJOR CONSIDERATIONS AND SOLUTIONS:**Safety:**

Real time force control of the robotic arm.

TMS safety concept with safety restrictions on stimulation intensities and frequencies.

Dedicated workspace and limitation of the robotic arm's movement range.

Accuracy and reproducibility:

Computer controlled coil positioning with multiple sensors

Store and recall individually set target points.

Performing complex TMS protocols

Integration of wireless real-time tracking systems.

TMS stimulator capable of running advanced protocols.

Compatible TMS equipment

Dedicated lightweight robotic coils with long and highly flexible cables

WHY MAG & MORE:

Full external
controllability



Various coils



Precise
Timing



Customization



Integration



Half- and
full wave



Safety
borders



High
frequency
TMS

RELATED PRODUCTS FOR ROBOTIC TMS:**Stimulators:**

» PowerMAG LAB

Coils:

» PMD70-pCool-robotic

Accessories:

» Control splitter box

» PC Interface

Service:

» Integration

WE ARE THE TMS EXPERTS

MAG & more



WORLDWIDE

PowerMAG Research is available to over 1 billion people in more than 30 countries of the world.



QUALITY

Designed, engineered and manufactured in Germany.



EXPERIENCE

MAG & More has almost 20 years' experience in development and manufacturing of high-end TMS devices.



FLEXIBLE

Rapid response to customer needs. MAG & More is privately owned and proud to listen to our customers.



SAFETY

Our medical products are developed and manufactured according to strict medical guidelines for therapy and research use.



CERTIFIED TRAINING PROGRAM

Become a certified TMS professional with our international TMS-Academy training program.

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