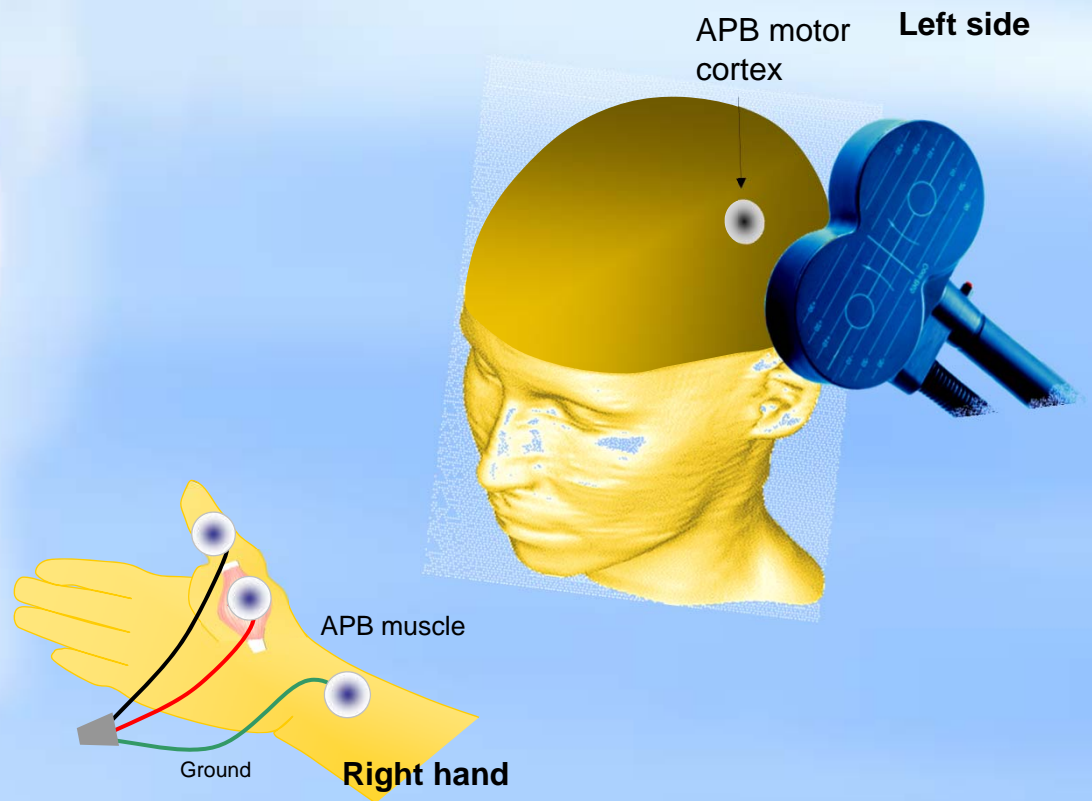


# Motor Threshold

## Introduction to MEP Monitor

### Guideline for performing motor threshold with MagPro and MEP Monitor



# MT Background



When performing Transcranial Magnetic Stimulation (TMS) the relative intensity or strength of stimulation is often referred to as % of Motor Threshold (MT).

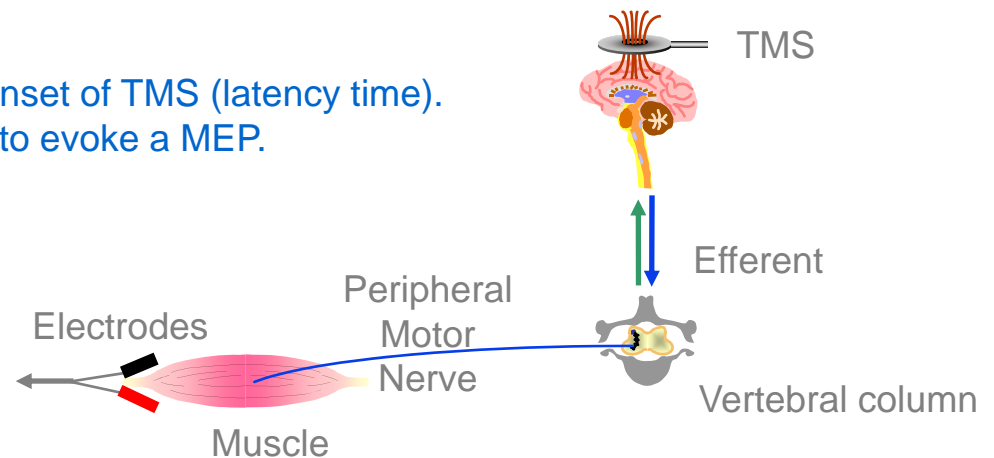
MT is a patient specific value for each subject or patient which is determined before the TMS session. When a magnetic coil is discharged over the motor cortex and the discharge energy is over threshold value neurons are activated and the targeted muscles might twitch.

MT is regarded as an indicator for the subject ability to respond to TMS or an indicator for the relative cortical excitability. Some patients have a high TMS value other a lower value. In the literature MT is the most common reference measure for stimulation intensity.

The visible twitch is associated with an electrical signal from the muscle action or a Motor Evoked Potential (MEP) which can be recorded by surface electrodes connected to an EMG instrument (MEP Monitor).

The signal obtained gives information about:

- Time between the TMS pulse and the onset of TMS (latency time).
- MT the minimum TMS energy required to evoke a MEP.
- The size of MEP.



# MT Background



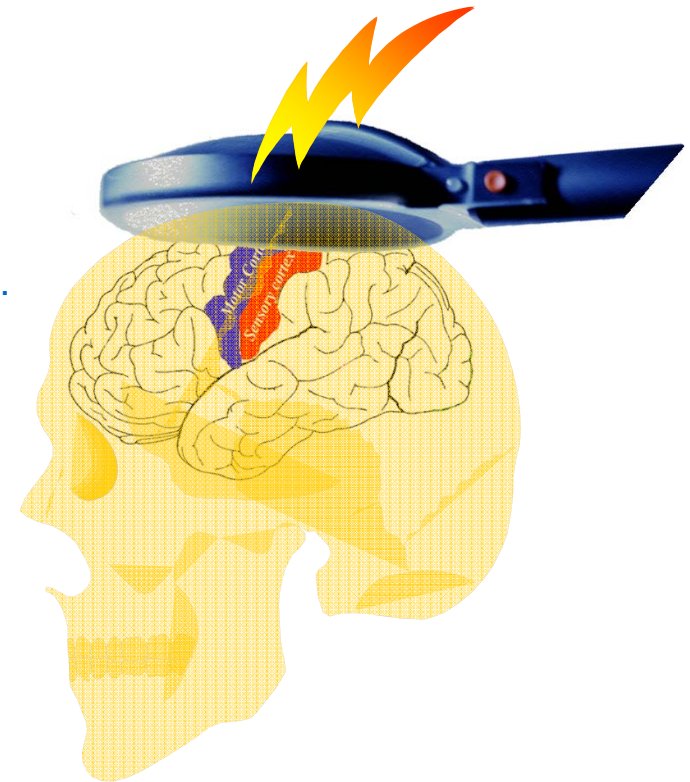
The motor cortex area on the brain is used as the indicator area because it's one of few areas in the brain where TMS is associated with easily observable phenomena.

The MT is defined as: the minimum single pulse TMS energy needed to observe an Abductor Pollicis Brevis contraction (APB or muscle in the hand that functions as an abductor of the thumb).

MT is believed relative stable over time so it's customary to only do a full determination every 1 or 2 weeks.

MT can be determined in two ways:

- visual determination, in which the APB is defined as a minimal twitch of the muscle.
- by MEP recording which this note is about.



*Stimulation of a specific area*

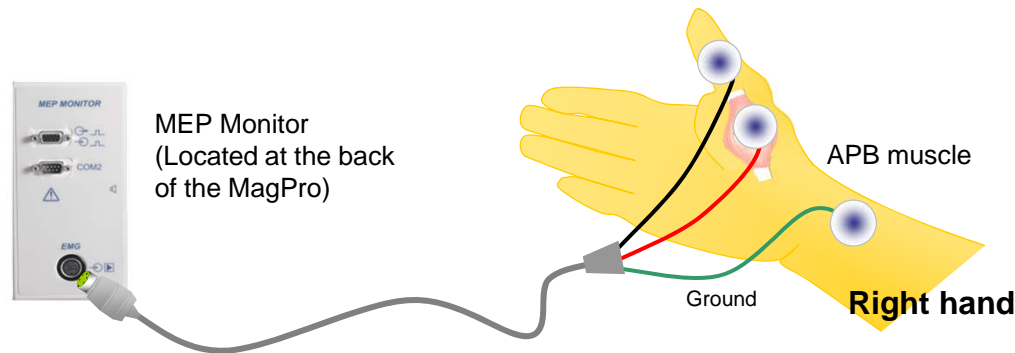
*Upper limb: over the left hemisphere for recording on the right limb.*

*Lower limb: over the vertex*

# MEP Monitor and Electrodes



**Motor threshold is measured on the right APB muscle**



To minimize the noise level grounding of MagPro through mains power cord is required. Make sure wall-outlet includes ground.

Grounding electrode must be placed between the recording electrodes and the stimulation point, eg. on the dorsum of the hand. If surface grounding electrode is not sufficient a wrist grounding electrode type can improve the noise level.

Make sure that all electrodes have good contact with the skin. Clean skin using alcohol swab.  
If using wrist grounding electrode the electrode must be soaked with saline.



Shielded cable, 2meter  
9016C0811



Pre-gelled Surface Electrode  
9016S0201



Velcro wraparound Ground Electrode  
9016S0301

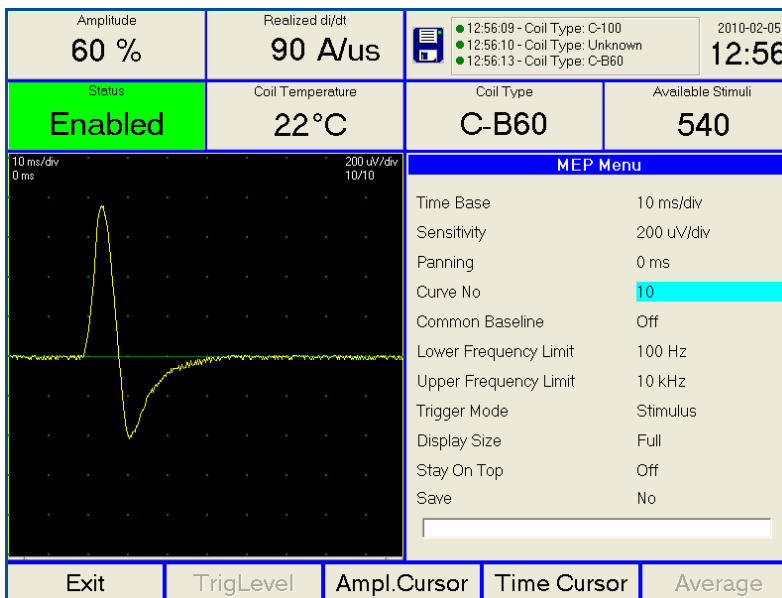
# MEP Monitor



## Introduction to MEP Monitor

The MEP Monitor is a one channel EMG amplifier mounted on the back of MagPro, optimized for Motor Evoked Potentials (MEP) recordings.

The MEP Monitor settings are available via the MEP softkey in the configuration menu.



- Time Base: 1-10ms/div.  
Recording always 100ms !
- Sensitivity: 100uV-10mV/div
- Panning: Panning through all 100ms recordings
- Curve No: Number of displayed curve.  
1-10 shows all curves

Common Baseline: On/off when showing more than one curve

Lower/upper freq.: Filter settings

Trigger Mode: Stimulus or level trig mode

Display Size: Full or reduced

Stay on top: Display on or off

Save: No / Yes to USB stick

# Trigger Facilities



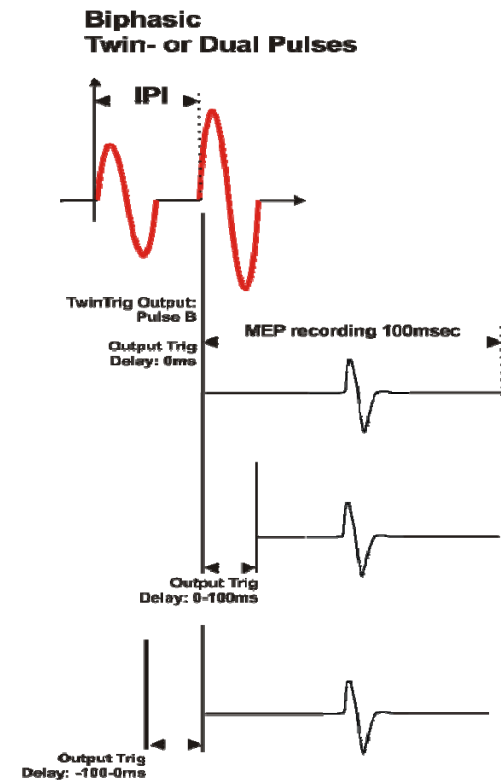
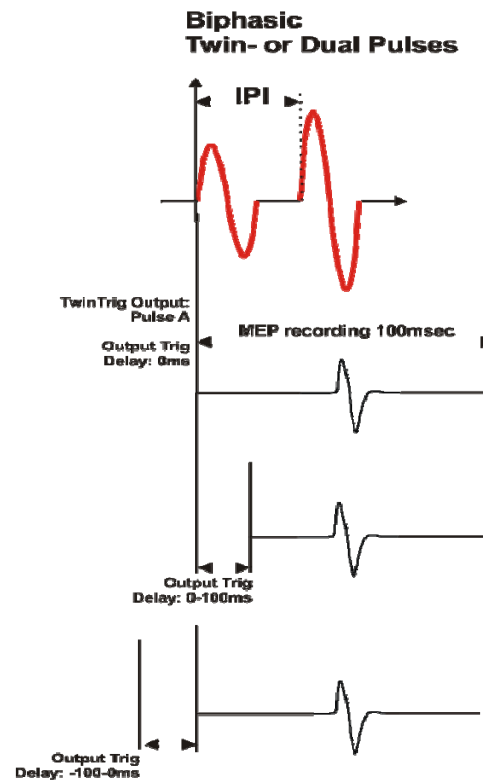
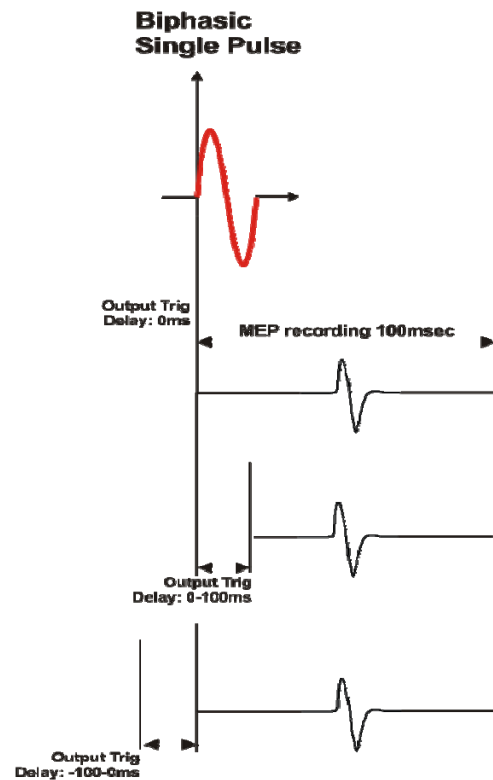
**Recording of the MEP signals are default started by the stimulus trigger signal**

(MEP Trigger Mode: Stimulus)

Output Trig Delay possible from -100ms to +100ms

For Twin- or Dual Pulses Trig Output can be selected for Pulse A, Pulse B or both A+B

Latency time base on MEP curve is calculated from the recording start. If real latency is required, trigger delay and trig pulse values must be included.





# Stimulation Power – Motor Threshold

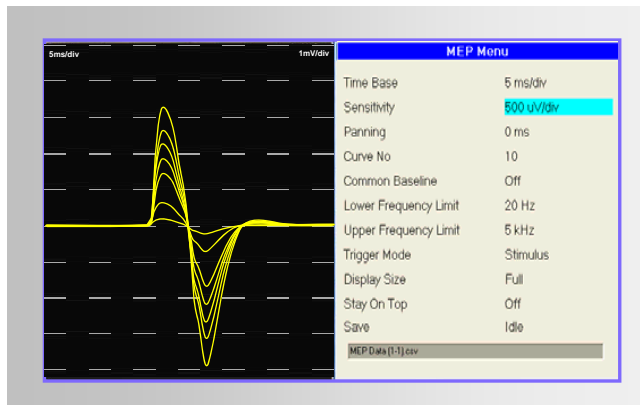


## The motor threshold is determined with the MEP Monitor

Amplitude  
70 %



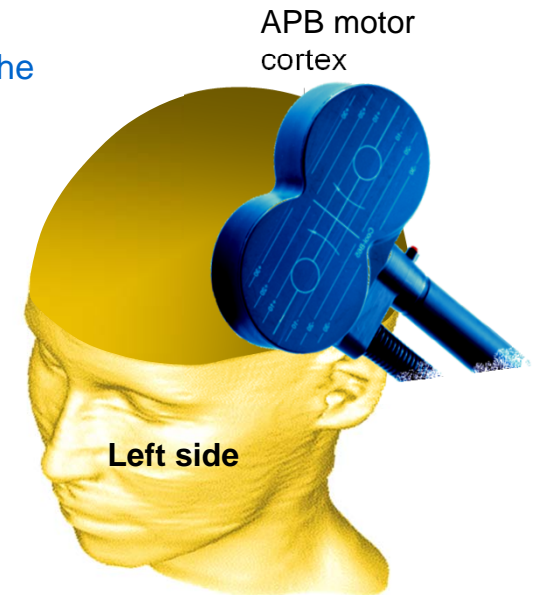
1. Set “Amplitude” at 60-70%
2. Place the coil above the APB motor cortex approximately 5cm below the centerline of the head. For figure of 8 coil: in a 45° angle. Coil must be tangential to the scalp!
3. With successive Biphasic Single Pulse (IPI 3-5 seconds), find the highest response by moving in 3D the coil around the target point.



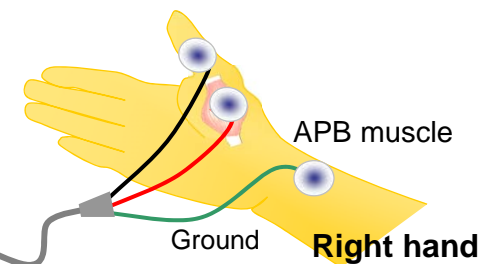
Amplitude  
55 %

Realized di/dt  
105 A/us

4. Keep coil in position and reduce “Amplitude” until the lowest response is reached (50  $\mu$ V peak-peak by 10 consecutive stimuli).
5. Take note of the new “Amplitude” and the “Realized di/dt”, **this is the Motor Threshold (MT).**



MEP Monitor  
(Located at the back of the MagPro)



# MEP settings – Motor Threshold



## MEP Settings

MEP Menu	
Time Base	5 ms/div
Sensitivity	500 uV/div
Panning	0 ms
Curve No	10
Common Baseline	Off
Lower Frequency Limit	100 Hz
Upper Frequency Limit	5 kHz
Trigger Mode	Stimulus
Display Size	Full
Stay On Top	Off
Save	Idle
MEP Data (1-10).csv	

### Important note:

In many cases, you have to increase the sensitivity when you are close to the motor threshold.



# Post processing of MEP curves

**After recording of MEP curves post processing is possible**

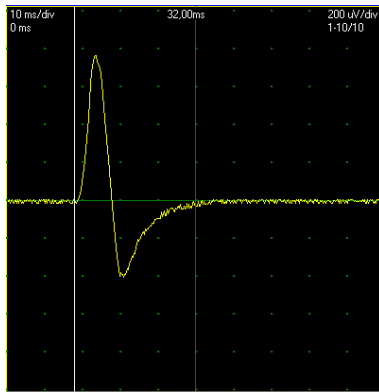
Time Base: Possible to change

Sensitivity: Possible to change

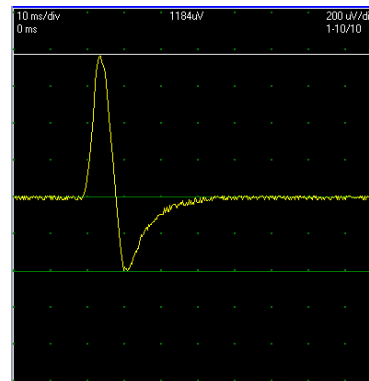
Curve No.: Possible to step through last 10 recorded MEP curves or see all curves at once

Lower/upper freq.: Change of filters is not possible

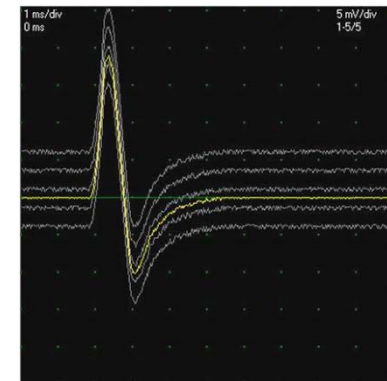
Save: If Yes, the information on the display curve area is exported to USB stick



Time Cursors



Amplitude Cursors



Average Curve

# Export to USB and Excel



## MEP recordings on the display can be exported to a USB stick

- USB stick mounted on the upper USB connector on the MagPro rear panel
- USB stick must be max. 2Gb with FAT16 format
- Select SAVE in the MEP Menu to export display curves to USB in csv-format
- Filename is displayed on the screen

- After export the csv-file can be imported into Microsoft Excel or other spreadsheet program

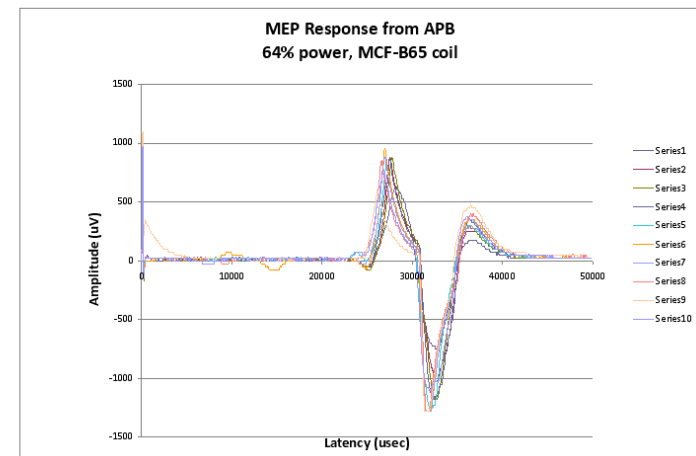
*Note: if the computer is not using the semicolon “;” as separator the Excel will import all curve data into one cell instead of separated cells, to prevent this the csv-file must be renamed to a .txt file.*

*With the .txt file the Excel will ask for separator sign during the open file process and here the semicolon sign is chosen.*

- Select the curve data (red rectangle below)
- Create a chart based on XY scatter type

Curve no	1	2	3	4	5	6	7	8	9	10
Session Id	8	8	8	8	8	8	8	8	8	8
Entry Id	28	29	30	31	32	33	34	35	36	37
Data Code	1	1	1	1	1	1	1	1	1	1
Amplitude (%)	64	64	64	64	64	64	64	64	64	64
di/dt (A/us)	97	97	97	97	97	97	97	97	99	97
(us)	(uV)	f <sub>0</sub> 30	f <sub>0</sub> 30	f <sub>0</sub> 30	f <sub>0</sub> 30	f <sub>0</sub> 30	f <sub>0</sub> 30	f <sub>0</sub> 30	f <sub>0</sub> 30	f <sub>0</sub> 30
0	0	0	0	0	0	0	0	0	0	0
125	850	1000	1000	825	900	725	850	825	1100	975
250	125	-125	-150	-100	-75	-125	-100	-100	225	-125
375	0	25	25	25	25	-25	25	25	350	25
500	0	25	25	25	25	0	25	25	325	25
625	0	50	25	25	25	0	25	25	300	25
750	0	25	25	25	25	0	25	25	300	25
875	0	25	25	25	25	0	25	25	275	25

Model  
Layout Type  
Data Offset  
Date  
Time  
R30+Option  
0  
23  
2010-02-03  
15:57:29  
Time Base  
Sensitivity  
Pan  
Curve no  
Common Baseline  
Lower Frequency Limit  
Upper Frequency Limit  
Trigger Mode  
5 ms/div  
500 uV/div  
0 ms  
1-10  
On  
100 Hz  
20 kHz  
Stimulus



## Printout of MEP settings and MEP curves from Excel

