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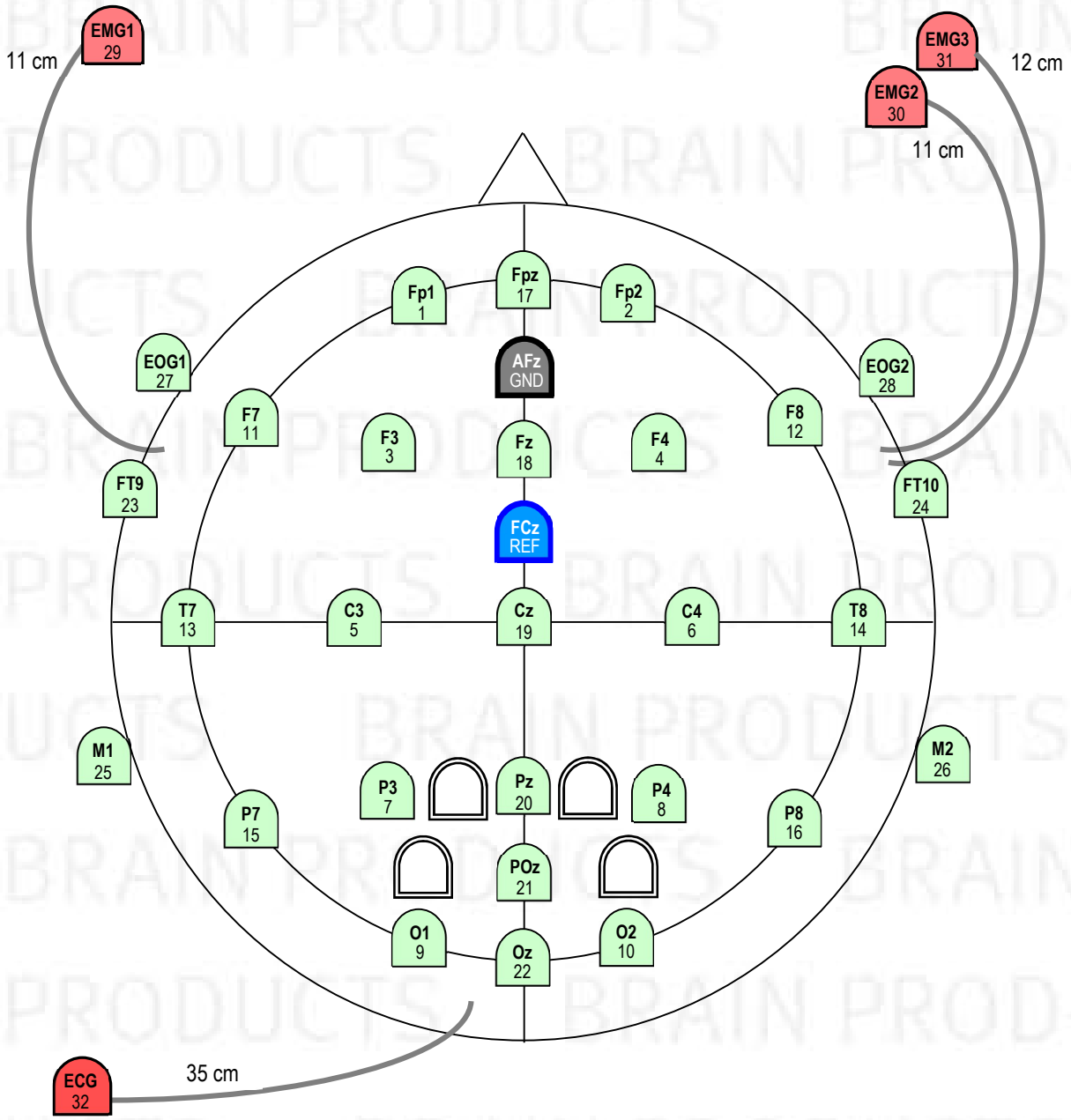
32Ch BrainCap MR for 3 Tesla for Sleep Recordings during fMRI

With EOG for reference to FPz

Electrode Layout and Channel Assignment

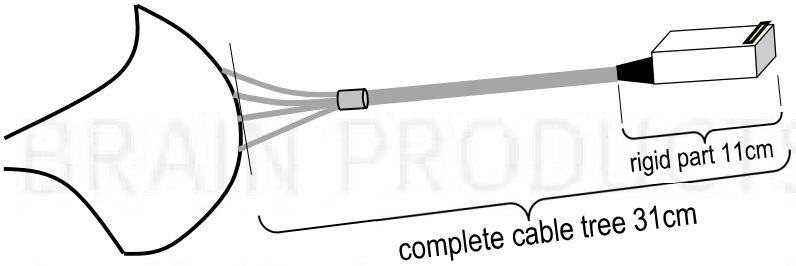


- M1 / M2 are approximately at mastoid positions (TP9' / TP10')
- FCz offers a reliable online recording reference; please reference offline to mastoid position e.g. M2
- EOG1/Fpz and EOG2/Fpz may be used for EOG, they are integrated in the cap for better signal quality
- Additional rings in occipital area offer higher comfort

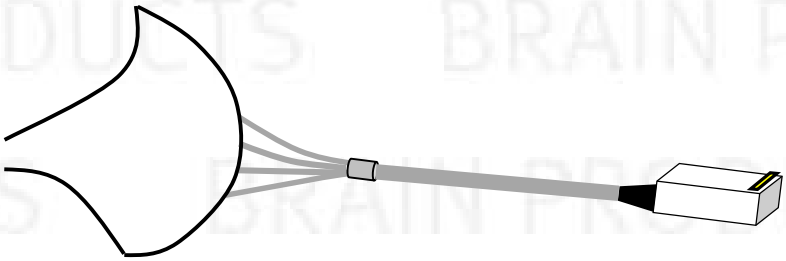
Details for Users

Exit Point of Cable Tree

In BrainCap-MRS the exit point of the cable tree can be either fronto-central:



or centro-parietal:



The decision depends on the headcoil used. Upon ordering one of these options needs to be chosen.

Ordering Information

For ordering please give **Article Number, Cap Cut, Exit Point, and Size**
(e.g. BC-MRS3-32, Caucasian, Exit FFCz, 56):

- Article Number: ***BC-MRS3-32***
- Cap Cut: ***Caucasian*** or ***Asian***
- Exit Point: ***Cable Tree Exit Frontal (at FFCz)*** or ***CentroParietal (at CPz)***
- Size (given in cm head circumference):
  Adult caps: ***54***, ***56***, ***58***, ***60***, ***62***, ***64*** (average male: 58, average female: 56)
  Children caps: ***50*** (3-4 years), ***52*** (5-10 years), ***54*** (11-14 years)
  Infant caps: ***34***, ***36*** *(newborn)*, ***38***, ***40*** *(3 months)*, ***42***, ***44*** (7 month), ***46***, ***48*** (2 years)

The catalogue-number comprises the cap as described, serial number, and this document; all packed in a labelled cardboard box. For further information about accessories or consumables, please visit our website or contact our local distributor.

Cap

Standard: SubInion Cap with integrated chin belt, white
Sizes 52 – 64 made from High Precision Fabric, Sizes 50 and smaller made from High Comfort Fabric
Options: Caucasian or Asian, Exit Point, Size

Electrodes

All electrodes are Multitrodes for MR with sintered Ag/AgCl sensors. They are buttoned directly into the cap (total height less than 3,5 mm) or can be attached to the skin with washers (= double-sided adhesive rings). In the parieto-occipital area, empty electrode housings (double border lines in the layout) provide more comfort.

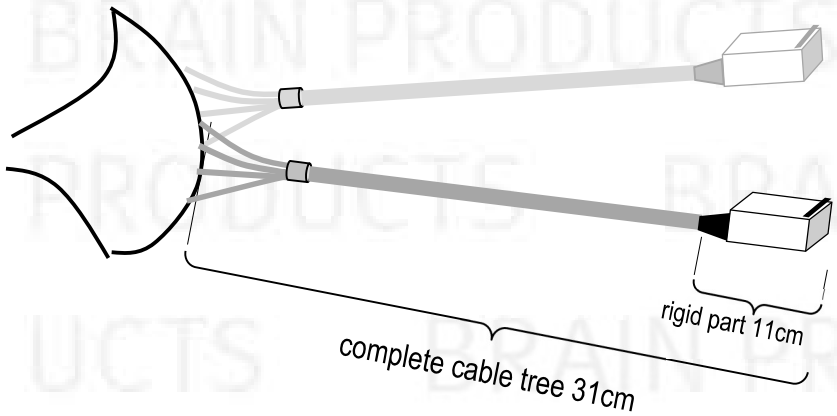
All electrodes come with current-limiting resistors on both ends, sensor and connector. Drop-down electrodes are made from resistive carbon leadwire.This results in these overall resistor values for each electrode:

- Ch1-28 10kOhm
- Ch 29-32 (drop-down) 20 kOhm
- REF 15kOhm
- GND 15kOhm

Electrode housing colours are according to the above figure. All cables are white, except Ch 29-32 red sensor and carbon leadwire, REF = blue cable, GND = black cable. All electrodes are name-labelled (Fp1, Fp2, …) near sensor.

The drop-down electrode cable parts outside the cap are covered in spiral tube - to avoid direct contact to skin.

All cables go on the outside of the cap directly to the leaving point of the cable tree. Cables are fixed with double-T-nylon threads. The cables part from the cap in branches of approx. 8 cables. These branches leave radially from the area around FFCz or CPz and straight/tight to a uniting point after approx. 5 cm. After the uniting point, one cable tree continues to the BrainCap-connector-box.
The length of the cable tree until the end of the connector box is approx. 31 cm.



Termination

The cable tree leads into a Connector box. From here the caps are connected to BrainAmp-MR with 10 cm round ribbon-cables. These round ribbon cables are delivered with the BrainAmp MR system (from April 2020 onwards; prior to April 2020 30 cm flat ribbon cables were delivered). The 10 cm round ribbon-cables can be re-ordered from BrainProducts (Cat-No. BP-345-2000) or from Easycap (Cat.-No. KB-P50F-P50F-R-10).

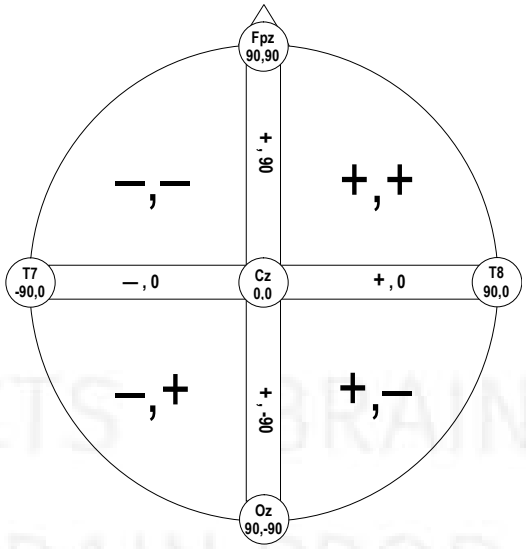
Inside the connector box there is another 5 kOhm-resistor on each channel, REF, GND.

The top side of the connector box is labelled “BrainCap-MR”. The bottom side label states

- 10kΩ in cap electrodes
- 20kΩ at drop-down
- 15kΩ at REF, GND

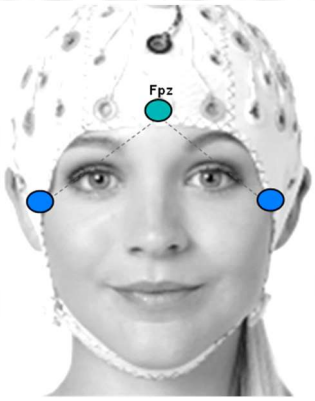
Theta / Phi Coordinates for BC-MRS-32

Channel-Number	Name	Theta	Phi
1	Fp1	-90	-72
2	Fp2	90	72
3	F3	-60	-51
4	F4	60	51
5	C3	-45	0
6	C4	45	0
7	P3	-60	51
8	P4	60	-51
9	O1	-90	72
10	O2	90	-72
11	F7	-90	-36
12	F8	90	36
13	T7	-90	0
14	T8	90	0
15	P7	-90	36
16	P8	90	-36
17	Fpz	90	90
18	Fz	45	90
19	Cz	0	0
20	Pz	45	-90
21	POz	67	-90
22	Oz	90	-90
23	FT9	-113	-18
24	FT10	113	18
25	M1 (TP9‘)	-121	18
26	M2 (TP10‘)	121	-18
27	EOG1 (F9‘)	-121	-30
28	EOG2 (F10‘)	121	30
29	EMG1	-	-
30	EMG2	-	-
31	EMG3	-	-
32	ECG	-	-
Ref	FCz	23	90
Gnd	AFz	67	90



EEG data can be referenced offline to mastoid position, e.g. M2, as recommended in AASM manual.

For EOG, please reference the "E1" and "E2" channel offline to Fpz, for EOG left/right:



These values are standardized to a Theta of 90° for the plane through Fpz, T7, T8, Oz.

The signs follow this convention:

Summary of Safety Rules for BrainCap-MR3

Together, the BrainCap MR and the BrainAmp MR / MR plus form a MR-conditional system according ASTM 2503-05.

In this context, the term MR-conditional means that restrictions from the manufacturer regarding field strength and imaging sequences apply to the product. A detailed explanation of the conditions for use can be found in the document *'Performing simultaneous EEG-fMRI measurements - Conditions for the safe use of BrainAmp MR amplifiers and accessories in the MR environment'*. A hard copy can be ordered from Brain Products (BP-265-4000) or it can be downloaded from the Brain Products website.

A summary of the main safety related points can be found below.

Any safety rules stipulated by the manufacturer of the MRI-Scanner and the local scanning facility must also be followed.

Scanner field strength and MR-sequences:

The BrainCap MR is designed and approved for field strengths up to 3T.

For MRI sequences used with the BrainCap MR there is a maximum allowed RF power; at 3 T B1+rms must not exceed 1.5 µT. Note that a 10 cm round ribbon-cable must be used to attach the BrainCap MR to the BrainAmp MR / MR plus. If a longer cable is used a B1+rms limit of 1µT applies.

All other conditions specified in the BrainAmp MR user manual must also be met.

Cable Routing:

No loops in connection cables or electrode leads are allowed. When recording in the MR environment all cables between the BrainCap MR and the BrainAmp MR / MR plus must be routed as straight as possible and must never form loops or similar (e.g. meander).

Amplifier protection:

To protect amplifiers from RF overload it is important that all connected electrodes have low impedance values during measurements in the MR scanner. Impedance values can be verified by means of the impedance mode in BrainVision Recorder.

This also applies if the BrainCap MR is used for measurements on imaging phantoms; all electrodes must be connected and have a low impedance. This can be achieved by covering the entire phantom surface with electrode gel and filling all electrodes with gel. Never perform phantom measurements with the BrainCap MR connected to the amplifier with unterminated electrodes.

Repair:

The cap may not be altered by the customer. For any repair the cap must be sent to Brain Products via the local Brain Products distributor.