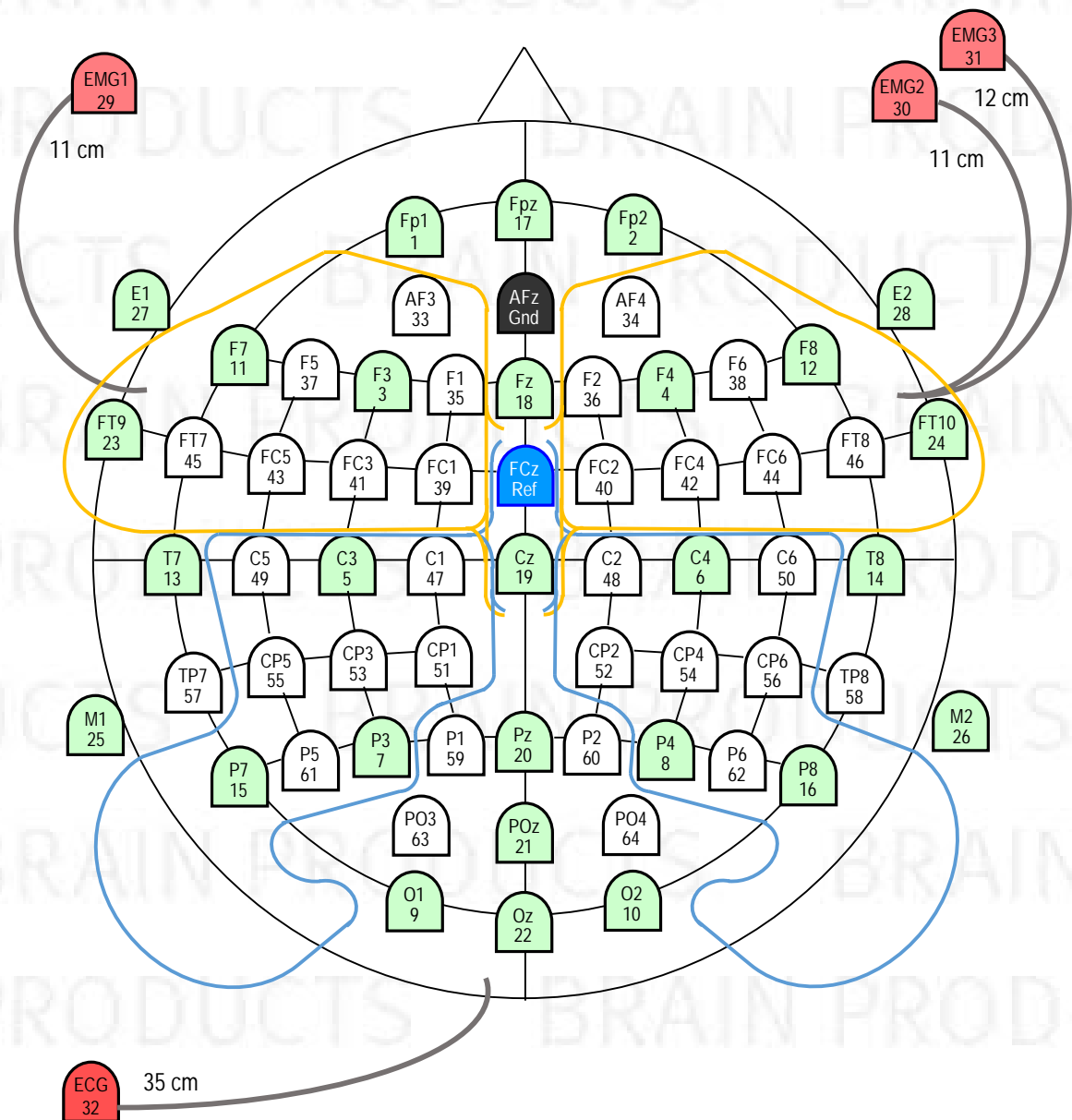




## 64Ch BrainCap MR for 3 Tesla for Sleep Recordings during fMRI

With EOG for reference to FPz. With Carbon Wire Loops.

### 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
- E1/Fpz and E2/Fpz may be used for EOG, they are integrated in the cap for better signal quality

## Details

For ordering please give Article Number, Cap Cut, Exit Point, and Size. With CWL.  
(e.g. *BC-MRS3-64, C-Cut, Exit FFCz, 56, with CWL*):

- Article Number: *BC-MRS3-64, with CWL*
- Cap Cut: *C-Cut or A-Cut*
- 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: *42, 44* (7 month), *46, 48* (2 years)

The catalogue-number comprises the cap as described, serial number, and this document. For further information about accessories or consumables, please visit our website or contact our local distributor.

### Cap

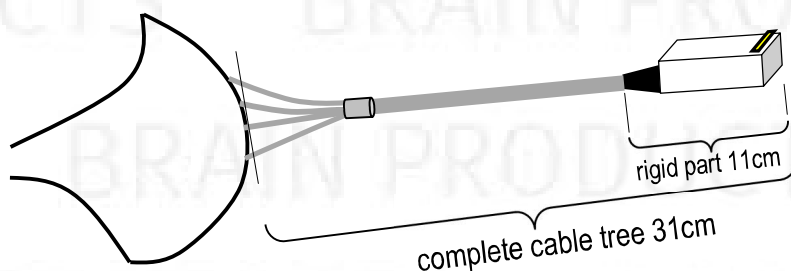
Standard Cap: Sublunion Cap with integrated chin belt, white

Sizes 52 – 64 made from High Precision Fabric, Sizes 50 and smaller made from High Comfort Fabric

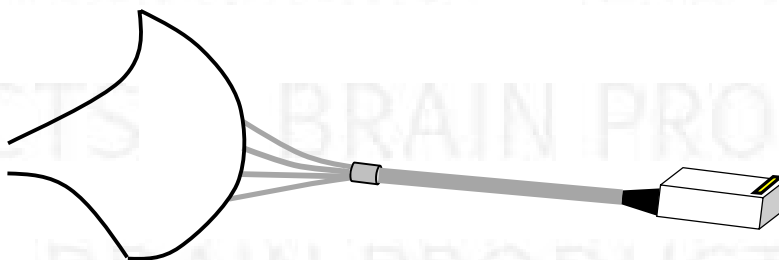
Options: *C-Cut or A-Cut, Exit Point, Size. For further variations, contact us.*

### Exit Point of Cable Tree

In MR caps, depending on the headcoil being used, the optimal exit point of the cable tree can be either fronto-central around FFCz



or centro-parietal around CPz.



Please choose one of these options when ordering, depending on the headcoil being used.

Options: *Exit FFCz, Exit CPz*

## 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:

- EEG Ch1-28, 33-64 10kOhm
- Drop-down Ch 29-32 20 kOhm
- REF, 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 are led 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 leave radially from the area around FFCz or CPz in small branchens, leading straight/tight to a uniting point after approx. 5 cm. After the uniting point, one cable tree continues to each BrainCap-connector-box. The length of the cable trees until the end of the connector box is approx. 31 cm.

## Termination

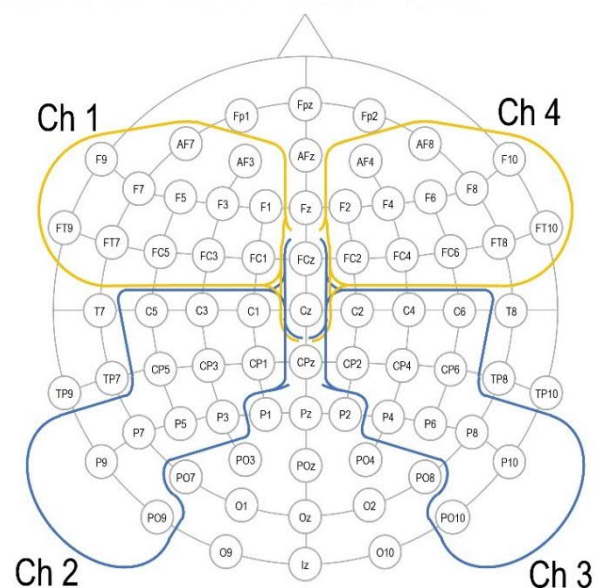
The cable trees each lead to a Connector box. From here the caps are connected to BrainAmp-MR with 10 cm round ribbon-cables. The 10 cm round ribbon-cables can be re-ordered from BrainProducts (Cat-No. BP-345-2000) or from Easycap (Cat.-No. KB-P50F-P50F-R-10).

## Carbon Wire Loops

The BrainCap MR is equipped with carbon wire loops (CWL) for better artefact correction. The loops - bipolar channels 1-4, plus GND - terminate into a connector box for a BrainAmp ExG. In the connector, there is a 5k-resistor both at the (bipolar) plus and minus ending, plus ~150  $\Omega$  per meter loop-cable.

**Note that the connector box for the CWLs must never be left open during simultaneous EEG-fMRI.**

**It must be connected to the BrainAmp ExG MR or be terminated by using a termination socket (available upon request). This CWL add-on is only suitable for a maximum field strength of up to 3T.**

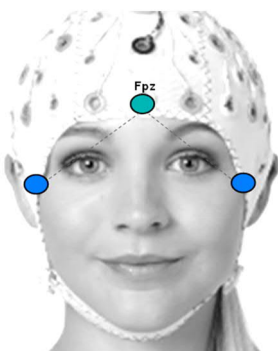


# Theta / Phi Coordinates for BC-MRS3-64

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	-121	18
26	M2	121	-18
27	E1	-121	-30
28	E2	121	30
29	EMG1	-	-
30	EMG2	-	-
31	EMG3	-	-
32	ECG	-	-
REF	(FCz)	23	90

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

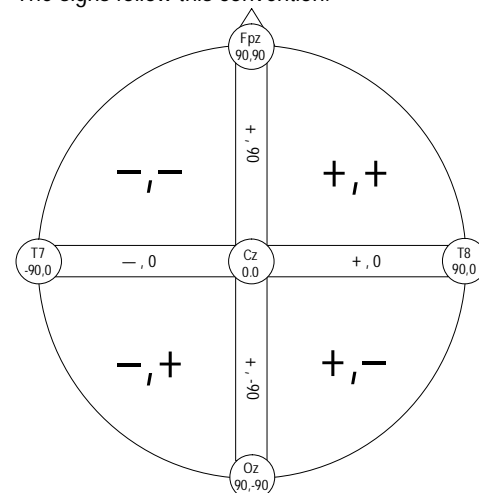
For EOG, please reference the "E1" and "E2" channel offline to Fpz, for EOG left/right:



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JCX

Channel-Number	Name	Theta	Phi
33	AF3	-74	-68
34	AF4	74	68
35	F1	-49	-68
36	F2	49	68
37	F5	-74	-41
38	F6	74	41
39	FC1	-31	-46
40	FC2	31	46
41	FC3	-49	-29
42	FC4	49	29
43	FC5	-69	-21
44	FC6	69	21
45	FT7	-90	-18
46	FT8	90	18
47	C1	-23	0
48	C2	23	0
49	C5	-68	0
50	C6	68	0
51	CP1	-31	46
52	CP2	31	-46
53	CP3	-49	29
54	CP4	49	-29
55	CP5	-69	21
56	CP6	69	-21
57	TP7	-90	18
58	TP8	90	-18
59	P1	-49	68
60	P2	49	-68
61	P5	-74	41
62	P6	74	-41
63	PO3	-74	68
64	PO4	74	-68
GND	(AFZ)	67	90

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 to ASTM 2503-20 and IEC 62570:2014.



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  $\mu$ T. 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 1  $\mu$ T 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.