

MagLink RT Electrode Caps

Specifically designed electrode caps for
acquiring data from within the MR bore



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1 MagLink RT Electrode Caps

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User Manual

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1.1 Contact Information

For Technical Support...

If you have any questions or problems, please contact Technical Support through any of the following routes.

If you live outside the USA or Canada, and purchased your system through one of our international distributors, please contact the **distributor** first, especially if your system is under warranty.

In all other cases, please use **techsup@neuroscan.com**, or see the other Support options on our web site (<http://www.neuroscan.com>).

Or, if you live in the USA or Canada, please call **1-800 474-7875**. International callers should use **877-717-3975**.

For Sales related questions, please contact your local distributor, or contact us at **sales@neuroscan.com**.

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8583A MagLink RT Electrode Caps

2 General Information

Compumedics Neuroscan MagLink RT Cap™ - Intended Use

The MagLink RT Cap is a passive cabling and cap system intended for use in recording routine research and clinical EEG data in the MR Conditional environment.

Your cap has been designed with a highly elastic fabric that provides a uniform fit over a wide range of head sizes and shape variability. Sintered silver chloride electrodes minimize DC offset potentials and ensure stable EEG recordings (and need no rechloriding). The electrodes are attached to an external wiring harness for easy cap placement, particularly in thick hair. The wiring harness includes all EEG, as well as Reference, Ground, and Vertical and Horizontal EOG leads. The harness is positioned for maximum comfort, while maintaining the lead wires away from the electrodes for easy access during electrolyte application.

MagLink caps come in small, medium, and large sizes, with 32, 64, or 128 electrodes.

MagLink RT Electrode Cap

The MagLink RT cap is designed with sintered silver-silver chloride electrodes. The sintered electrodes contain the same materials (i.e., silver and chloride) as the silver-silver chloride disks, but are constructed as a compressed disk pellet containing a mixed silver-silver chloride compound. The reported disadvantage of the sintered electrode is marginally higher impedances. We have found the differences in impedances between conventional and sintered electrodes to be negligible and the quality of the recorded EEG to be very comparable. The major advantage of the sintered electrode is the absence of an easily damageable electrode surface. While we recommend that due care always be taken in cleaning (see description of cleaning electrodes below) and handling all electrodes, sintered electrodes cannot lose a chlorided surface since the chloride is embedded in the structure of the electrode itself. Even with careful handling, silver-silver chloride electrodes will eventually require re-chloriding of the surface. This process is not necessary with the compressed structure of the sintered electrode.



The MagLink RT caps are designed specifically for use in the MRI (yours may appear different from the one in the picture - your wiring may be black - as we are occasionally making further modifications). Unlike normal electrodes and electrode cap assemblies, a 7.5kOhm resistor is placed in series with each electrode in the MagLink RT cap. This resistor serves to minimize any loop currents induced into the carbon-fiber electrode leads by the large magnetic field of the MR magnet, thus ensuring patient/subject safety. The use of non-ferrous fiber electrode leads is also an important aspect of the safety of the MagLink RT cap and cabling system. All cables on the electrode cap are braided to minimize the creation of current loops, which further ensures the safety of the subject.

WARNING: Because of the special design of the MagLink RT electrode cap, DO NOT USE QUIK-CAPS OR ANY OTHER CAPS IN PLACE OF MAGLINK RT CAPS. USE OF ANY OTHER ELECTRODE CAP, OR INDIVIDUAL MRI ELECTRODES NOT SUPPLIED BY COMPUMEDICS, POSES A POTENTIAL SAFETY RISK TO THE SUBJECT AND INVALIDATES ANY SERVICE AGREEMENTS / WARRANTIES WITH COMPUMEDICS/ NEUROSCAN. For the same reason, do not attempt to service the cap yourself; DAMAGED CAPS MUST BE RETURNED TO COMPUMEDICS/NEUROSCAN FOR REPAIRS.



3 Preparation and Application

Like all other electrode caps, a successful recording of EEG depends on a good conductive path between the recording electrode and the scalp of the subject. There are several steps that can be taken to ensure a good contact between the electrode and the scalp. These steps are listed below.

Subject Scalp Preparation and Electrode Cap Application

(1) The night/day before scheduled testing, contact the subject and make sure that they wash their hair the morning of testing. They should wash their hair with a normal shampoo that does not contain any conditioner. Conditioner coats the scalp and makes it much more difficult to obtain low impedance connections. After shampooing, the subject should not use any conditioners or styling gels that would also coat the scalp and hair.

(2) Once arriving at the laboratory for testing, have the subject vigorously brush their hair and scalp with an old-fashioned bristle hairbrush for 3-5 minutes. This will help to exfoliate the scalp surface and will dramatically reduce (any in some cases eliminate) the need to abrade the scalp surface after loading the electrodes with gel. It is recommended that the lab be equipped with hairbrushes that can be used once and

given to the subject at the end of the test session. We have found the inexpensive brushes (\$1-\$2 per brush) purchased from neighborhood department stores are of sufficient quality for this purpose.

(3) Prepare the skin areas where drop electrodes will be located. It is usually sufficient to clean these areas with an alcohol or acetone swab. It is important that these areas are clear of makeup and foundation to ensure low impedances.

(4) Position the cap on the head of the subject. This is typically a two-person process, one of which may be the subject. While standing behind the subject, have a second assistant (or the subject) place their thumbs under the front edge of the electrode cap. Then pull the cap onto the head, slowly, carefully ensuring that midline row of electrodes is properly aligned on the head. Then secure the chin strap. The strap should be tight enough to hold the cap in place, but does not need to be snug. A snug chin strap is a primary cause of discomfort for the subject. The subject should be able to feel minimal tension on their jaw, but it should not be so loose that the cap is not held snug onto the head.

(5) Attach all drop electrodes. If necessary, use two butterfly tapes to make sure the electrodes are in secure contact with the skin.

OPTIONAL - This is a good point at which to digitize the electrode positions on the scalp. Optionally, locations may be digitized at the end of the experimental session.

At this point it depends on which conductant method you are using - gel or QuikCell. The QuikCell method uses a micropipette to insert a small, pre-measured amount of a saline solution onto a sponge pad contained within the plastic wall of the electrode. Please refer to the QuikCell User Guide for more information. The directions for the gel method are described next.

(6) Load all electrodes with electrode gel beginning with the ground and reference electrodes. *Remember*, the electrode gel is used to build a column of conductive medium between the scalp and the surface of the electrode. If too little gel is loaded, this conductive column will contain gaps. Consequently, contact between the scalp and the electrode will be intermittent. If too much gel is loaded, it will spread beyond the proximity of the electrode reservoir and (with high density electrode arrays) could result in a salt bridge with other electrode locations.

(7) If all electrodes are reading high impedances, this usually reflects high impedance at either the ground or reference electrode location. After loading the ground and reference electrodes, load all remaining cap and drop electrodes. It is a good idea to let the gel soak in before testing the impedances; the gel will lower the impedances significantly on its own without abrading.

(8) Perform the first impedance test. If the subject has clean hair and a well prepared scalp, many of the electrodes will have impedances that are sufficiently low (<10kOhm) so that no further preparation is required. (With the inline resistors, an impedance of 10kOhms is usually sufficient).

(9) When abrading is necessary, always begin with the ground and reference electrodes. Do not direct force down on the needle toward the scalp. It is usually sufficient to make sure that the needle has contact with the scalp, and then simply rotate the needle in a circular manner (rotate the needle in an arc). Place light

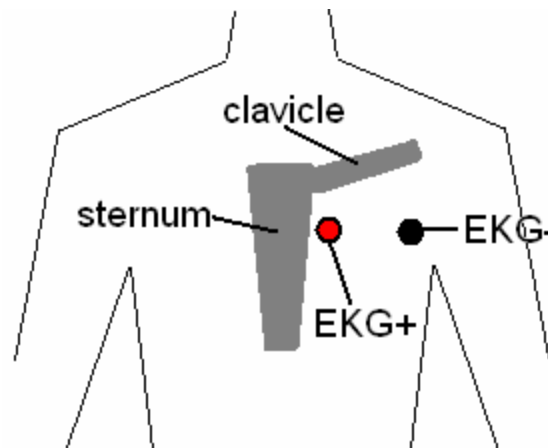
pressure down the electrode holder with one hand while abrading with the other hand. This will ensure that the electrode gel remains confined to the reservoir of the electrode holder. Run the ACQUIRE module of the SCAN software while preparing the subject. Watch the impedances while abrading. As soon as the impedance for an electrode begins to decrease, stop abrading and remove the preparation needle from the electrode. Usually the impedance will continue to fall. An immediate increase in electrode impedance after removing the preparation needle usually indicates that the column of gel in the electrode reservoir is intermittent - the preparation needle is thus the conductor between the scalp and the electrode. In this situation, inject a little more gel into the electrode holder. Slightly withdraw the needle while injecting the gel. This will help to construct a column of conductor that is uniform and will last throughout the recording sessions. Use the extra gel that flows out of the top of the electrode reservoir to seal the opening - this will keep air out of the electrode and prevent the gel in the reservoir from drying out.

Take your time and try to get all impedances <10-15kOhm, and balanced across electrodes. This is especially critical for obtaining clean recordings in the MR.

IMPORTANT - Always use a clean blunt-end needle when abrading. Never reuse syringes and blunt needles for more than one subject. Use a "sharps" dispenser to dispose of blunt needles, if available.

(10) Heads vary greatly in both size and shape. While we endeavor to make electrode caps that snugly conform to the surface of the head, some electrodes may not always be in good contact with the scalp. In these cases, we recommend using the wound gauze mesh over the top of the electrode cap. The mesh can be cut into lengths of 10-15 cm in length and then pulled over the top of the electrode cap. Under most conditions it is not necessary to place the gauze mesh over the frontal pole electrodes as the cap is typically quite snug at these locations. Subjects/patients are likely to experience excessive pressure and some discomfort if the gauze is placed over these electrodes.

(11) Of special importance for EEG recordings in the MR is the placement of electrodes to record the electrocardiogram (EKG). This is critically important as this data will be used as a trigger for extracting the ballistocardiogram. The EKG+ electrode should be positioned along the sternum, about 1-2" down from the sternoclavicular joint and 1" to the left of the sternum. The EKG- electrode should be placed near the shoulder joint, so a straight line could be drawn connecting the two leads and crossing the heart. Because of the location of these electrodes, it is important to clearly explain the need for these electrodes, particularly to female subjects. If you are using a pulse oximeter, you may not need the additional EKG channels.



3.1 Critical Tips for Subject Comfort

Critical Tips for Subject Comfort

(1) **Prepare in advance.** Magnet time is expensive and subject time is also extremely valuable. Optimize your testing procedures by preparing all electrode application materials in advance. Prior to the arrival of the subject, load the necessary number of needles with gel to complete the entire cap (32-40 channels, 2 syringes; 64 channels, 3-4 syringes, etc.). Have the gauze mesh cut to the necessary length (10-12 cm). Have all butterfly tapes available and ready for placement. Have the SCAN software open and ready for testing electrode impedances.

(2) **Do not** place the mesh over the frontal pole electrodes Fp1 and Fp2 (or other frontal pole electrodes) - pull the mesh back off these electrodes. Usually, these electrodes do not require any additional force to be firmly in contact with the scalp. Placing the mesh over these electrodes may result in considerable discomfort to your subject.

(3) **Do not** place a drop electrode under the edge of the electrode cap. This will result in considerable discomfort for your subject. At frontal electrode locations, this discomfort can rapidly advance to nausea and/or headache.

(4) **Check for special medical conditions.** The electrode cap is secured to the head using a fairly snug chin strap, which can cause discomfort. This discomfort can be particularly acute for individuals with temporal-mandibular joint disease (TMJ - disease). Ask your subject in advance if they are affected by TMJ. If such individuals are to be tested, perform a recording sequence outside the MR environment to determine their tolerance (including time of comfort). Prolonged testing of TMJ subjects with the electrode cap can result in acute discomfort.

(5) **Subject Comfort is a Priority.** Provide a bathroom break before starting. Have bottled water available for your subject. Routinely inquire about your subject's comfort during preparation and during testing. EEG recordings in MR environments are qualitatively different from those performed in the relative comfort of a testing lab. Subjects are more likely to return for repeat testing if you have made obvious efforts to ensure their physical and emotional comfort.

3.2 Time Estimates

Time Estimates for Electrode Cap Application/Preparation

With experience, and with the subject's cooperation (by following the above preparations) it is possible to complete the electrode cap application and preparation process for a 32-40 electrode cap in 15-20 minutes, even if there is only one individual involved in the application process. It is recommended that with higher electrode applications (64-128 channels) two lab technicians prep the subject. We have routinely prepped the 128 channel cap for use in the MR in 30-40 minutes.

3.3 Cleaning the Caps

Cleaning the MagLink RT Electrode Cap

Your MagLink RT cap represents a considerable investment. To maximize the life of the cap and the quality of data obtained from the cap, thorough cleaning is critical.

After each use remove all tape, markers, and electrode pads from the cap and unhook any wire harness shoulder restraint. Unplug the wire harness from the amplifier equipment and remove the cap from the wearer. Take the cap to a sink and rinse off any electrolyte on the outside of the cap and electrodes. Next, turn the cap inside out to expose the electrodes that are down inside the rubber holders. Run a tight stream of very warm or hot water from the faucet to remove the electrolyte from the holder cavity. This should remove the electrolyte completely if you are using Quik-Gel. If not, and the electrolyte has oils in it (like ECI-Gel), you will need to use cotton swabs to help remove the electrolyte residue from the electrode surface while the water is running. Do this carefully to avoid scratching or pitting the surface of the electrodes.

To clean the electrodes, we strongly recommend the use of a WaterPik[®]-like device. This is a device consisting of a small water reservoir that projects a high-pressure stream of water through a nozzle that is designed for cleaning teeth. The jet-stream of water produced by these devices does an excellent job of cleaning the surface of the electrode and the electrode reservoir without using any object that comes in contact with and potentially damages an electrode's surface. When cleaning the cap using such a device, fill a sink (or basin) with moderately hot water. Hold the cap under the water so that the nozzle of the WaterPik[®] is also under the surface of the water. Direct the jet-stream of water from the nozzle into the electrode holder. It is important to keep the nozzle of the WaterPik[®] directed at the electrode and under water to prevent any back-spray onto the person cleaning the cap. Clean both the under surface and top surface of each electrode holder. If you are using QuickCells, there is little residual conductant and you may not need the WaterPik[®].

When you are satisfied that nearly all electrolyte has been removed, place the cap and wire harness into a warm water and soap bath being careful not to get the connector at the end of the harness wet. The bath should contain 4 quarts of water with 1 or 2 ounces of mild dish soap (IvoryTM, DoveTM, etc.). Let the cap sit in the bath for approximately 1/2 hour. Remove and rinse the cap with warm water and place it into a disinfecting solution (such as Envirocide, Metricide, or Betadine) in a concentration of 1 part disinfectant to 4 parts water. If this disinfectant method is selected, leave the cap in the solution for 15 to 30 minutes. If full strength

disinfectant is desired, the cap should not be left in solution for more than 10 minutes. After disinfectant, rinse the cap thoroughly and hang it up to dry.

Be sure to clean the chin strap as well as the cap (e.g., makeup from one person may be transmitted to a hyper-allergenic subject).

It is recommended that the cap be left to dry at room temperature. It can also be dried more quickly with a hand-held hair dryer. *However*, never use high temperature settings when drying the cap as it will rapidly degrade the elastic material. **USE ONLY LOW TEMPERATURE OR ROOM TEMPERATURE SETTINGS** on a portable hair dryer to dry the electrode cap.



Note: *Compressed air can be used to blow moisture from the electrodes and wire entry points and is very useful for extending the life of your QuikCap.*



Note: *Electrodes should be cleaned and disinfected, but sterilization is generally not necessary as they are used externally.*

We recommend that you inspect electrodes for extensive wear or damage prior to use. If the electrode wire, termination, or surface area is worn so as to impair performance, the electrode should be discarded. Compumedics/Neuroscan is not responsible for injury, infection, or other damage resulting from improper electrode preparation or use.

4 Warranty

LIMITED WARRANTY

Electrode Caps

Compumedics Neuroscan, a division of Compumedics USA, Inc. (Neuroscan) warrants the electrode caps it manufactures will be free from defects in materials and workmanship through the warranty period. For MagLink Electrode Caps, the warranty term is one-year beginning upon the date of installation by Compumedics Neuroscan.

Damage to Compumedics Neuroscan's products during shipping to you is covered under this warranty. Otherwise, this warranty does not cover damage due to external causes, including accident, servicing not authorized by Compumedics Neuroscan, usage not in accordance with product instructions, failure to perform required preventative maintenance, or any other abuse or misuse.

Compumedics Neuroscan, at its own discretion, reserves the right to repair or replace caps returned to Compumedics Neuroscan's facility. To request warranty service, you must contact Compumedics Neuroscan within the warranty period. If warranty service is required, Compumedics Neuroscan will issue a Return Merchandise Authorization Number (RMA). Cap owner is required to ship the products back to Compumedics Neuroscan in its original packaging or appropriate equivalent at their own expense. Compumedics Neuroscan recommends the owner insure the shipment or otherwise accept all the risk of loss or damage during shipment. Compumedics Neuroscan will ship the repaired or replacement products to you, freight prepaid. Compumedics Neuroscan owns all parts removed from repaired products. Compumedics Neuroscan reserves the right to use new and/or equivalent-to-new parts made by various manufacturers in performing warranty

repairs and in-building replacement products. If Compumedics Neuroscan repairs a product, the original warranty term is not extended; if Compumedics Neuroscan replaces a product, the replacement is warranted for the remainder of the original term or 60 days, whichever is greater. Repair or replacement as provided under this warranty is the exclusive remedy to the purchaser. This warranty is in lieu of all other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular use or purpose, and Compumedics Neuroscan shall in no event be liable to purchaser for indirect or consequential damages of any kind or character. This warranty does not cover defects arising from modifications or misuse of the electrode caps or documentation after purchase or receipt.

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