

S14 Insert Earphones – Use Instructions

The S14 insert earphones are designed for use in research that requires delivery of auditory stimuli to subjects while undergoing fMRI scans. They provide both high-quality acoustic stimulation and substantial attenuation of background noise, while causing very little or no disruption of the scanner image.

I. SETTING UP

The three main components of the S14 earphone system are:

- 1) an audio transformer,
- 2) a long (~9 m) cable, and
- 3) a short (~0.5 m) cable with the insert earphones at one end.

All documentation can be found on the USB flash drive supplied with the S14 system.

The schematic figure below shows these components connected in a typical configuration in which a PC delivers left (blue) and right (red) audio signals. These signals must be amplified by an audio amplifier (not included in the S14 system) before delivery to the transformer. The amplifier must be capable of delivering a few watts.

The preferred setup is to keep the transformer outside of the scanner room with connection to the long cable made via a penetration panel or an intermediate cable. The outer conductor of the BNC connectors may be grounded or floating. Be careful to maintain consistent signal polarity between left and right channels.

NOTE THAT THE BNC CONNECTORS AT THE END OF THE LONG CABLE CONTAIN MAGNETICALLY ATTRACTIVE METAL. THEY SHOULD BE KEPT A SAFE DISTANCE FROM THE SCANNER.

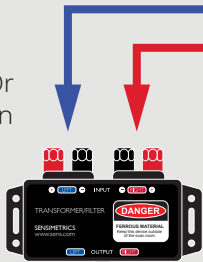
THE TRANSFORMER IS ALSO MAGNETICALLY ATTRACTIVE. IF IT IS TAKEN INTO THE SCANNER ROOM IT SHOULD BE KEPT A SAFE DISTANCE FROM THE SCANNER.

The short cable enables the subject to insert the earphones, and to don an additional hearing-protector muff if desired, prior to entering the scanner room where connection to the long cable can then be made. To insert each earphone, first compress the foam tip by rolling it between thumb and forefinger, narrowing its diameter. While continuing to roll it, screw it onto the post. Then quickly insert it into the ear. Hold it in the ear for about 10 seconds while the foam expands.

MODEL S14 Insert Earphones for fMRI Research Wiring Diagram

Male Banana Plug Or
Bare Wire Connection

Transformer



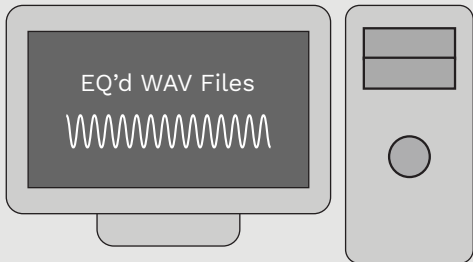
Patch Cables With
Male BNC 50Ω Plugs
On Each End
(Not Included)

Transformer Ground Cable

Audio Amplifier
(Not Included)



PC / Signal Source
(Not Included)



Penetration Panel

Direct Ground Connections
To Faraday Shield Ground

SCANNER ROOM

Shield Cable
(Available Separately)

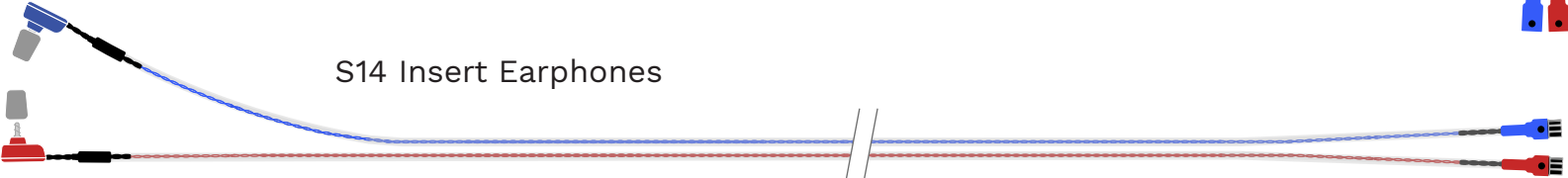
Long Cable Assembly

~9 Meters

Filter



S14 Insert Earphones



~ 1.1 Meters

II. SAFE PRACTICES

Please read the enclosed ***Guidelines for Safest Use of the S14 Earphones.***

In addition to the recommendations listed in the Guidelines, you should adopt the following as routine practices when using the S14 earphones.

- > Inspect all components for damage. If any signs of damage are noticed, please contact Sensimetrics before using the system (contact information given below).
- > Manage cables carefully in the scanner:
 - Route the earphone cables as close as possible to the center axis of the scanner bore
 - Make sure that the earphone cables are kept at least 10cm apart
 - Avoid loops in the cables
 - Advise subjects not to hold the cables in their hands
 - Do not disconnect the earphone cables from the long assembly
- > Be familiar with the sound levels that will be delivered to subjects to ensure that they are comfortable.
- > Establish a procedure by which subjects can indicate if they feel sounds are too loud.

III. ACOUSTIC PERFORMANCE

The acoustic response of the earphones has been measured on a KEMAR manikin equipped with Zwislocki couplers. In order to ensure repeatable measurements, KEMAR's pinnae were removed and the earphones with foam tips were inserted directly into the circular steel ear canals, resulting in a good acoustic seal.

A. Frequency Response and Output Level

The frequency response of the transducer used in these earphones typically has strong resonances. In addition, these responses differ slightly from earphone to earphone, resulting in undesirable phase and amplitude variations between left and right earphones. The frequency responses of the left and right S14 earphones supplied to you are shown in the upper panels of the accompanying documentation (S14_xxxL_xxxR.pdf in folder xxxL_xxxR). The dashed lines show the responses of the transducers to a white noise stimulus. The ordinate values are given in terms of the sound pressure level in the ear canal for a 0 dBV narrowband signal measured at the input to the transformer. The inter-channel phase difference is plotted as the dashed line in the middle panel.

B. Equalization Filters

Digital equalization (EQ) filters have been custom designed to smooth the amplitude responses and to set the inter-channel phase difference to zero. The solid bold lines (red and blue lines in the upper plots and black in the phase plot) show the responses after EQ filtering. These correction filters (EQF_xxxL.bin and EQF_xxxR.bin in folder xxxL_xxxR) can be used for pre-filtering stimuli by the EQ Filtering program provided with the S14 system.

C. Distortion

Measurements of harmonic distortion at three signal frequencies are shown in the bottom panels. Max distortion is defined as the level of the largest of the components at integer multiples of the fundamental stimulus frequency.

IV. CLEANING AND MAINTENANCE

- Use clean foam tips with each subject. Replacement tips can be ordered from <http://shop.sens.com>
- Check that there is no ear wax or other debris blocking the adapter tip of the earphone.
- Establish a quick but repeatable check for gross changes in acoustic performance.

V. CONTACT INFORMATION

Please visit the S14 website (<http://www.sens.com/products/model-s14/>) for updated product information and frequently-asked questions. If your question is not answered there and you need technical support, contact Sensimetrics by:

Email: tech-support@sens.com

or

Phone: (781) 399-0858