

# S15 Insert Earphones

## Instructions

The S15 insert earphones are designed for use in research that requires delivery of auditory stimuli to subjects 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 S15 earphone system are:

- 1) an S15 Transformer/Filter box (note warning on box),
- 2) a long (~9 m) cable assembly with filter termination box at one end (note warning on box)
- 3) a short (~1.4 m) cable with in-line chokes and insert earphones at one end.

The pictorial figure on the next page 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 S15 system) before delivery to the transformer.

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.**

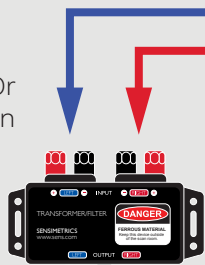
To insert each earphone, first compress a foam tip by rolling it between thumb and forefinger, then screw it on to the earphone and insert it into the ear canal. Hold it in the ear for about 10 sec while the foam expands.

In addition to the signal connections, there are two grounding connectors, one labeled RF ground on the transformer and the other, labeled Shield, on the small Cable/Filter box. These should both be connected to the ground of the scanner room. (A grounded screw attaching the penetration panel to the Faraday cage would be most appropriate).

# MODEL S15 Insert Earphones for fMRI Research Wiring Diagram

Male Banana Plug Or  
Bare Wire Connection

Transformer



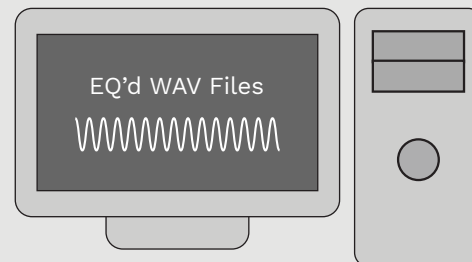
Patch Cables With  
Male BNC 50Ω Plugs  
On Each End  
(Not Included)

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)

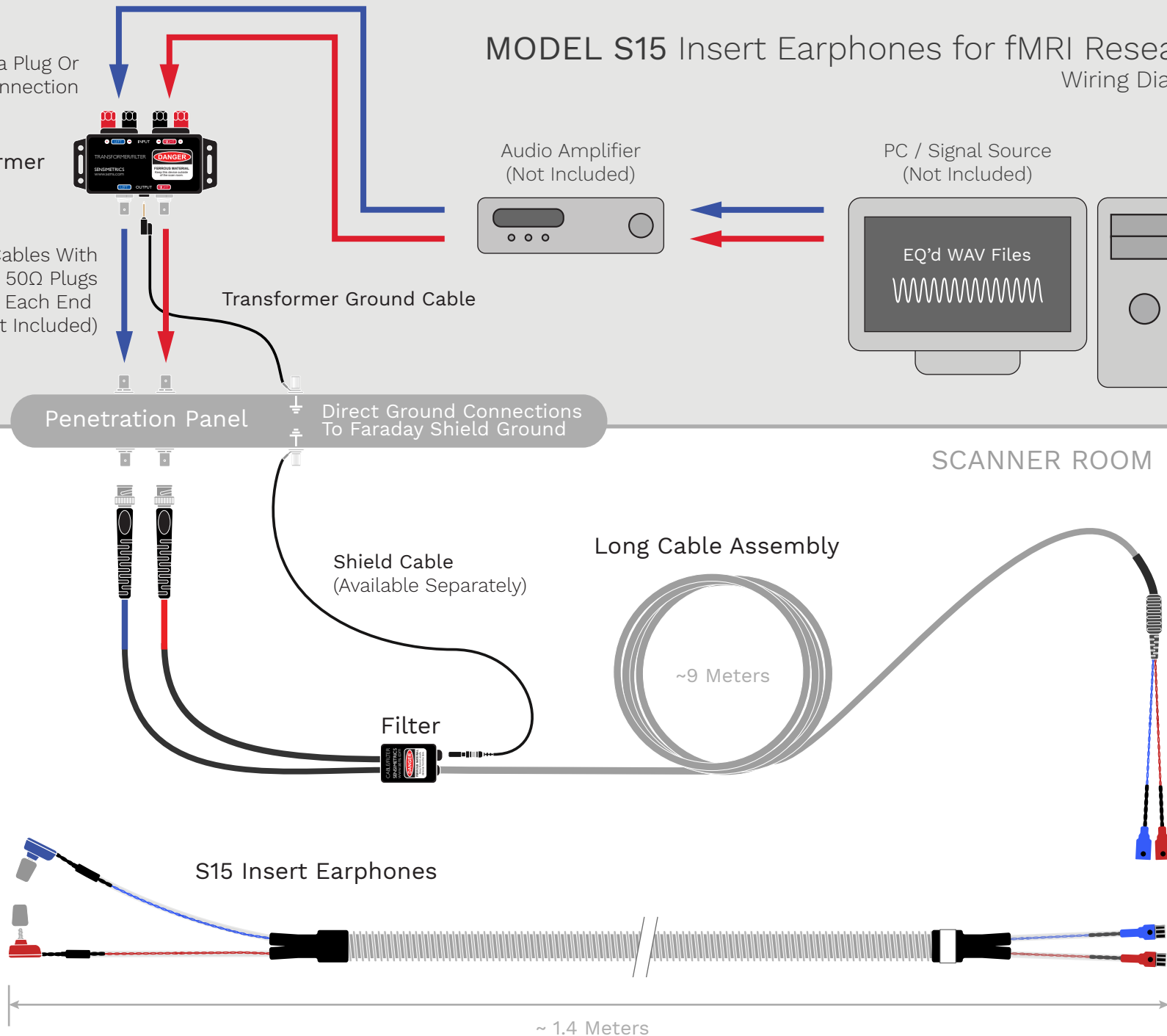
Long Cable Assembly

~9 Meters

Filter

S15 Insert Earphones

~ 1.4 Meters



## II. SAFE PRACTICES

Please read the enclosed *Guidelines for Safest Use of the S15 Earphones*.

In addition to the recommendations listed in the Guidelines, you should adopt the following as routine practices when using the S15 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 the earphone cable carefully in the scanner:
  - Place the corrugated earphone tube as close as possible to the center axis of the scanner bore. Use tape to secure the tube to the middle of the subject's chest.
  - Use the pouch to protect the earphones. The springiness of the tube can cause the earphones to be flung about. Remove the earphones from the pouch as the last step after the tube is secured. When finished testing, insert the phones back into the pouch before removing the tape securing the tube.
  - Advise subjects not to hold the cables in their hands.
  - Do not disconnect the earphone cables from the long cable.
- > 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 S15 earphones supplied to you are shown in the upper panels on the accompanying documentation page (S15\_xxxx\_yyyy.pdf). 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 are found on the USB flash drive supplied with the product and can be used for pre-filtering stimuli by the EQ Filtering program (also on the flash drive).

### **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 second and third harmonics of the fundamental stimulus frequency.

### **IV. CLEANING AND MAINTENANCE**

- Use clean foam tips with each subject. Replacement tips can be ordered from <https://shop.sens.com/products/100-pair-box-replaceable-comply-tm-foam-canal-tips>
- Check the subject's ears for excessive wax before inserting the earphones.
- After removing the earphones, check that there is no ear wax or other debris blocking the adapter tips of the earphones.
- Establish a quick but repeatable check for gross changes in acoustic performance.

### **V. CONTACT INFORMATION**

Please visit the S15 website (<http://www.sens.com/products/model-s15>) 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](mailto:tech-support@sens.com)

or

**Phone:** (781) 399-0858 Ext. 235