

MRI SAFETY—CONNECTION GUIDE

Connections for Physiological Signals in an MRI *MRI Chamber Room to MRI Control Room*

This connection guide describes how to connect BIOPAC MECMRI filtered cable sets to the control room patch panel. Connection diagrams are included but please contact BIOPAC with any questions to ensure proper setup.

WARNING! Correct installation of MRIRFIF is required to maintain MRI imaging performance, preserve physiological recording quality, and create a safe operating environment.

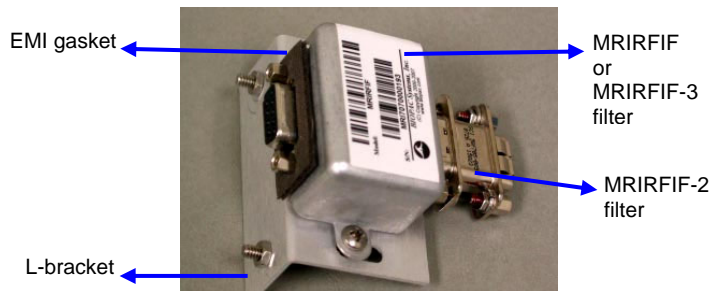
BIOPAC Systems, Inc. offers a series of MRI isolated and RF filtered interfacing cables that can be employed successfully to safely collect physiological data in the MRI environment. In particular, these products are as follows:

Filtered/cable Set	Components	Description
<u>MECMRI-BIOP</u>	<u>MEC for MRI Biopotential Amplifiers</u>	
	MRIRFIF	MRI RFI Filter, including gasket, L-bracket and mounting hardware
	MRIRFIF-2	MRI RFI Filter Secondary
	MECMRI-1	8 meter extension cable for MRI Chamber Room
	MECMRI-2	MRI extension cable for Biopotential Amplifiers
<u>MECMRI-TRANS</u>	<u>MEC for MRI Transducer Amplifiers</u>	
	MRIRFIF	MRI RFI Filter, including gasket, L-bracket and mounting hardware
	MECMRI-1	8 meter extension cable for MRI Chamber Room
	MECMRI-3	MRI extension cable for Transducer Amplifiers
<u>MECMRI-STMISO</u>	<u>MRI Cbl/Filter Set to STMISO series</u>	
	MRIRFIF	MRI RFI Filter, including gasket, L-bracket and mounting hardware
	MECMRI-1	8 meter extension cable for MRI Chamber Room
	MECMRI-4	MRI extension cable for Stimulator
<u>MECMRI-DA</u>	<u>MRI Cbl/Filter Set to DA100C</u>	
	MRIRFIF	MRI RFI Filter, including gasket, L-bracket and mounting hardware
	MECMRI-5	MRI Cbl/Filter Sys. to DA100C
<u>MECMRI-HLT</u>	<u>MRI Cbl/Filter Set to HLT100C</u>	
	MRIRFIF	MRI RFI Filter, including gasket, L-bracket and mounting hardware
	MECMRI-6	MRI Cable for HLT
<u>MECMRI-OXY</u>	<u>MRI Cbl/Filter Set to OXY100C</u>	
	MECMRI-OXY	Interface Adapter includes MRIRFIF-2 filter (discontinued)
<u>MECMRI-NICO</u>	<u>MRI Cbl/Filter Set to NICO100C</u>	
	MRIRFIF-3	MRI RFI Filter Primary, including gasket, L-bracket and mounting hardware
	MRIRFIF-2	MRI RFI Filter Secondary
	MECMRI-1	8 meter extension cable for MRI Chamber Room
	MECMRI-2	MRI extension cable for Biopotential Amplifiers

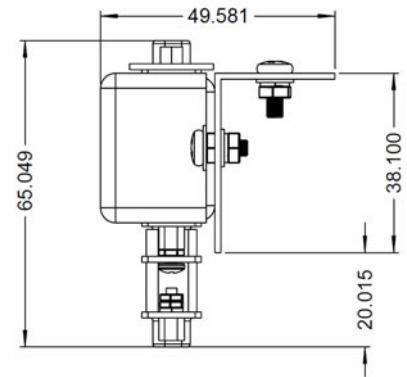
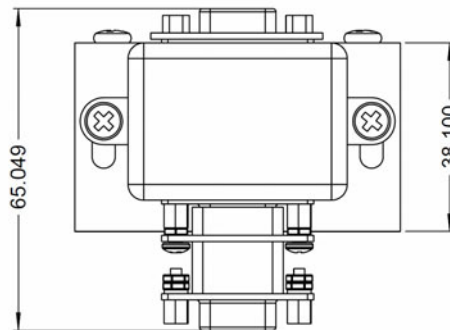
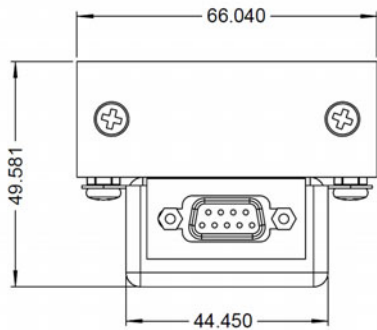
Definitions:

1) **MRIRFIF Filter Set:** The MRIRFIF Filter Set includes the following components and is shipped assembled.

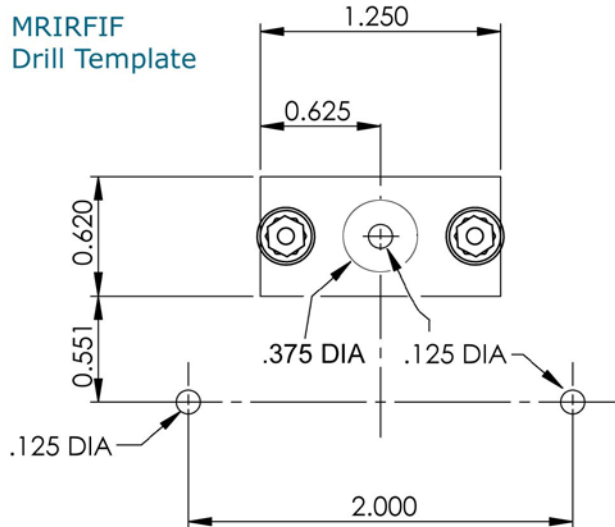
- MRIRFIF or MRIRFIF-3 filter
- MRIRFIF-2 filter
- EMI gasket
- L-bracket
- Nibbling cutter



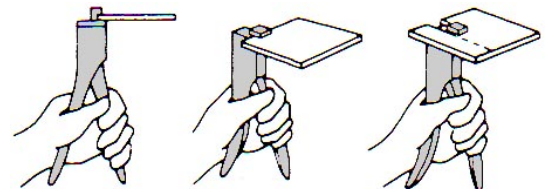
NOTE: The three dimension drawings below are in mm.



If necessary, use the drill template and nibbling cutter to mount the MRIRFIF assembly to the room-dividing panel:



- a) Drill three .125" dia. holes as indicated on the drill template.
- b) Drill a 3/8" (9.5 mm) dia. pilot hole as indicated on the drill template.
- c) Use the nibbling cutter to create a .625" x 1.250" square hole, as indicated on the drill template.
Cuts 18 gauge (.046") steel, 1.5 mm (1/16") copper, aluminum, or other unhardened metals.
 - i. Place the nibbling cutter in the 3/8" pilot hole so that the metal is in the gap between the punch and the blade channel.



- ii. Squeeze the handles together (the punch will move into the channel and cut a slug of metal).
- iii. Repeat as necessary.
- d) Mark panel with drill template.
- e) Affix bracketed filter assembly to panel with screws provided.

- 2) **MRI Chamber Room:** This is the room that contains the MRI equipment that images the subject. This room is EMI shielded and requires special precautions to enter in that no ferrous or similar magnetically influenced materials are allowed inside.
- 3) **MRI Control Room:** This room is adjacent to the MRI Chamber Room and houses the associated computers and equipment that are used to examine image data and otherwise support operation of the MRI equipment.
- 4) **Patch Panel:** This metal panel, typically made out of aluminum, establishes a boundary suitable for passing signals between the MRI Chamber Room and MRI Control Room. Typically, connectors are placed into the patch panel for routing electrical signals. Typically, the patch panel incorporates a combination of 9 pin DSUB connectors and BNC connectors. Also, the patch panel will usually incorporate waveguides (metal tubes) for routing cabling, including non-conductive cabling such as required for pressure-based signals.
- 5) **Wave guide:** Tubular pass through from Control room to Chamber room for routing non-electrical cabling/tubing.

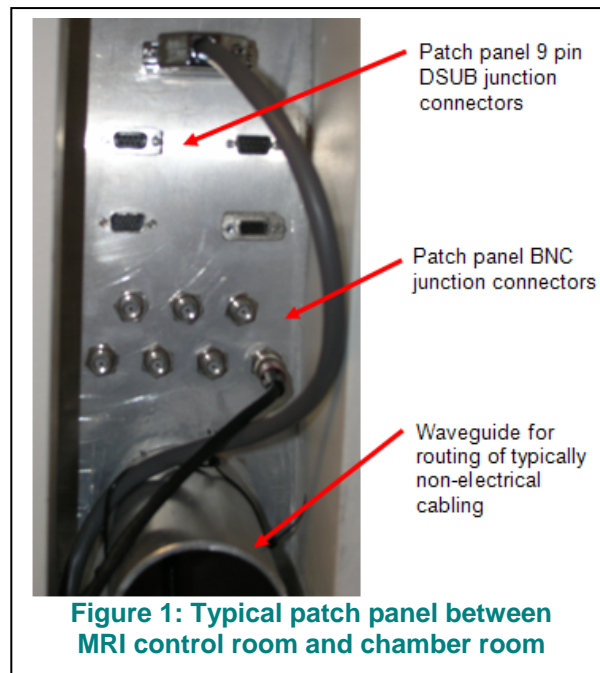


Figure 1: Typical patch panel between MRI control room and chamber room



It is important to note that the MRI Chamber Room is robustly EMI shielded. This shielding is very important to maintain signal integrity in the NMR image data. This EMI shielding will be compromised if unfiltered electrical cabling is routed between the MRI Control Room and the MRI Chamber Room. Accordingly, considerable attention should be directed to patch panel connector configurations and associated signal routing and filtering.

Patch Panel Connector Configurations:

- 1) If no patch panel connector exists in the patch panel, then it is recommended that the MECRFIF or MRIRFIF-3 be installed directly into the patch panel. The MRIRFIF/MRIRFIF-3 is symmetrical so orientation direction is not important, however it is very important that the MRIRFIF/MRIRFIF-3 be installed on the CONTROL room side of the patch panel. This is critical because the MRIRFIF/MRIRFIF-3 incorporates ferromagnetic elements. The MRIRFIF/MRIRFIF-3 performs an internal pin swap of pins 1 thru 5; pins 6 thru 9 are unused by the MRIRFIF/MRIRFIF-3. The MRIRFIF/MRIRFIF-3 mounts to the patch panel via the included L-bracket support. Prior to mounting the support bracket and MRIRFIF/MRIRFIF-3, a cutout in the panel is required to expose one female connector of the MRIRFIF/MRIRFIF-3 to the MRI Chamber Room. The panel cutout should only be large enough to expose the female connector in order to maintain a uniform EMI seal between the MRIRFIF/MRIRFIF-3 EMI gasket and the patch panel. Also required are two mounting holes to bolt the L-bracket to the patch panel.
 - See Figures 2, 4, 5 (Installation method A) for details.
- 2) If a patch panel connector exists which may or may not incorporate RF filtering, then the MRIRFIF/MRIRFIF-3 should be connected to the CONTROL room side of the patch panel connector. In this case, the chamber room side of the patch panel connector must be a 9 pin female DSUB and the control room side of the patch panel connector must be a 9 pin male DSUB. In this situation verify that pins 1 thru 5 are mapped straight-thru on the M/F patch panel connector. The MRIRFIF/MRIRFIF-3 plugs directly into the existing patch panel connector (Male 9 pin DSUB) and is supported via the included L-bracket. Two mounting holes are also required in the patch panel to bolt the L-bracket to the panel. Also, it's important to perform a dielectric test to make certain that sufficient electrical isolation (typically 1500VDC or greater) is present between the existing patch connector pins and mains ground as established on the patch panel itself.
 - See Figures 3, 4, 5 (Installation method B) for details.

MRIRFIF Connectors and Patch Panel Connector Notes

It's important to note that the MRIRFIF's/MRIRFIF-3's symmetrical construction, with dual 9 pin female connectors, results in a pin swap for pins 1, 2, 3, 4, 5, regarding signal flow as illustrated here:

	DSUB 9 female				
Control Room side	1	2	3	4	5
Chamber Room side	5	4	3	2	1

Accordingly, if the MRIRFIF/MRIRFIF-3 and associated cable assemblies (such as MECMRI-1, 2, 3) are used with any existing patch panel connectors, the existing connector must be a Male/Female 9 pin straight-thru DSUB patch connector. The Male side of the existing connector must be on the Control room side to successfully connect the MRIRFIF/MRIRFIF-3 to this connector.

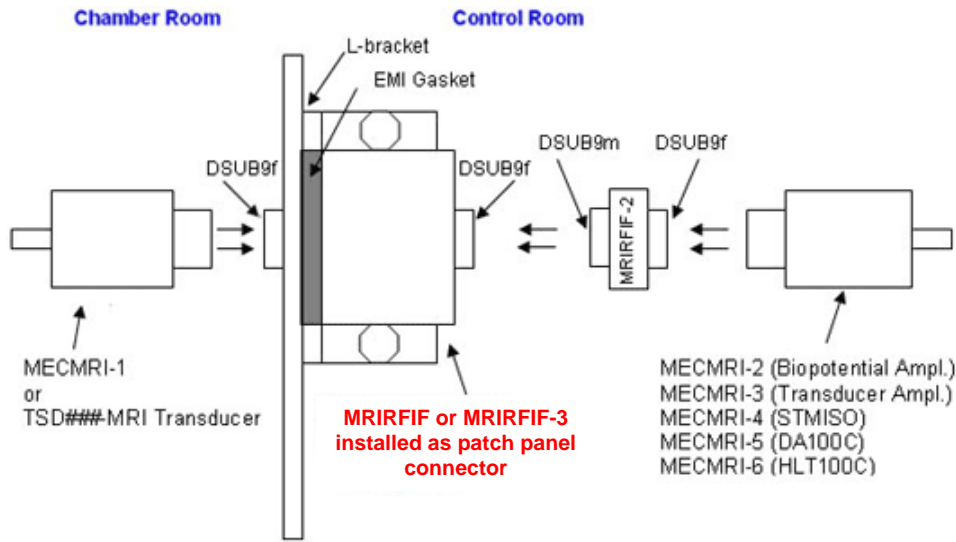


Figure 2: Cabling sequence for patch panels with no existing connectors

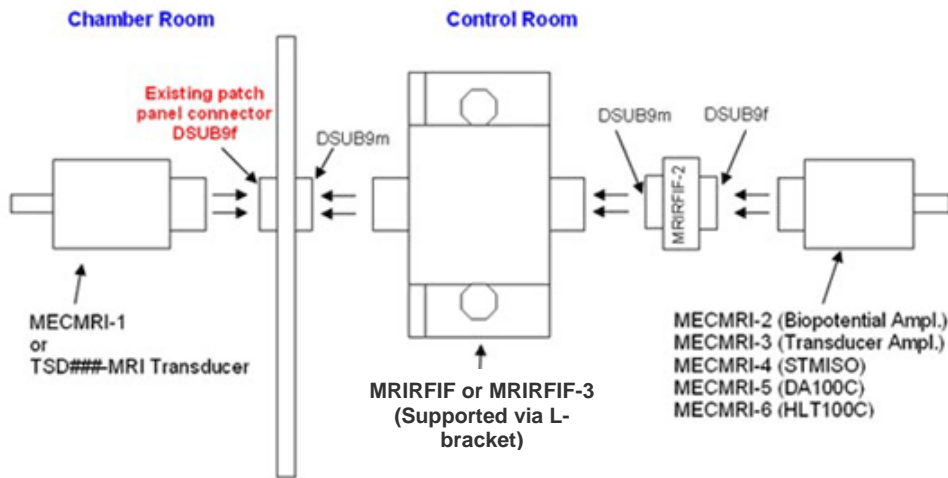


Figure 3: Cabling sequence using existing patch panel connector

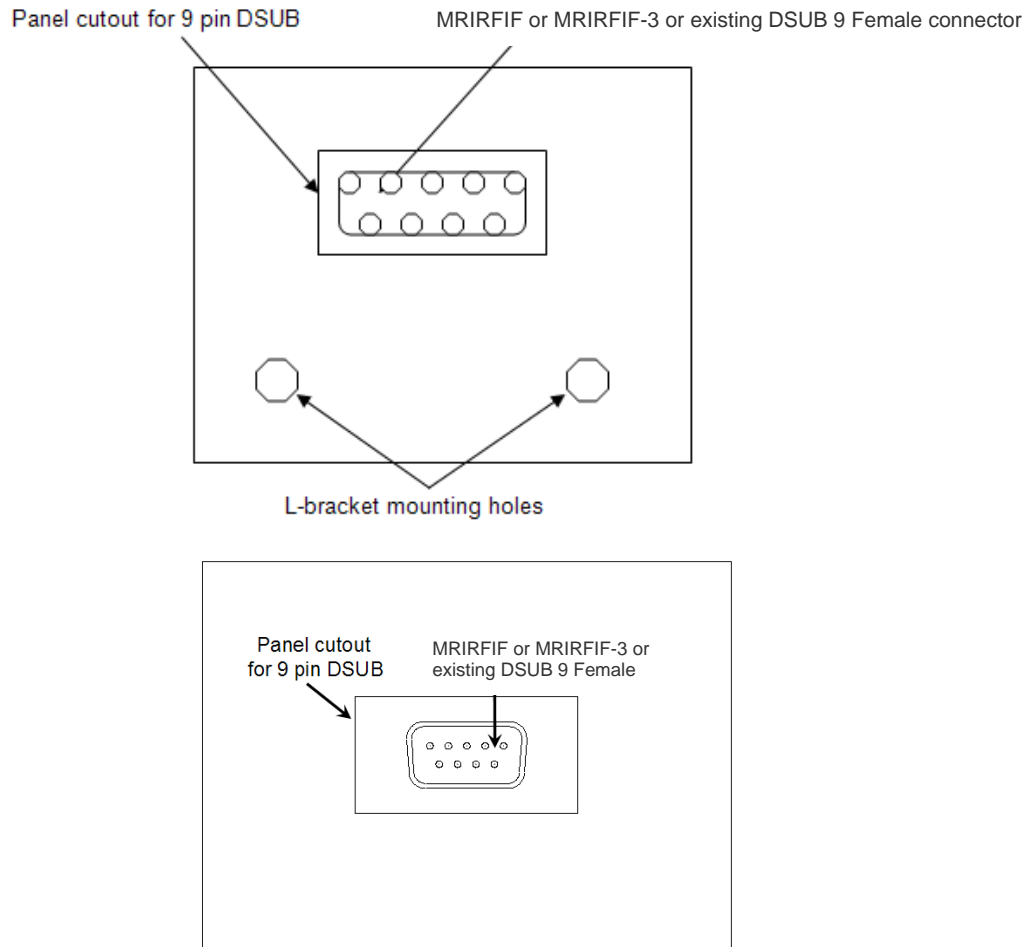


Figure 4: Chamber room view of cutout to support MRIRFIF mounting

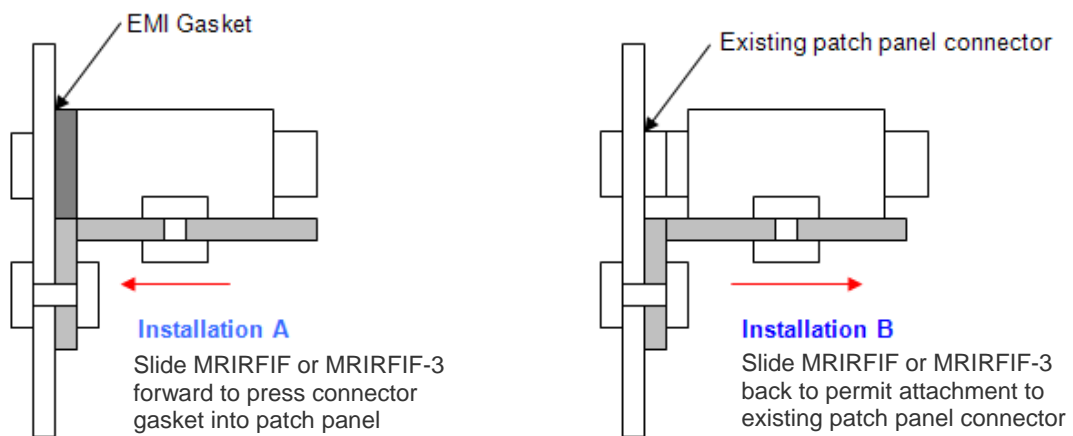


Figure 5: Side view of MRIRFIF installation methods to patch panel

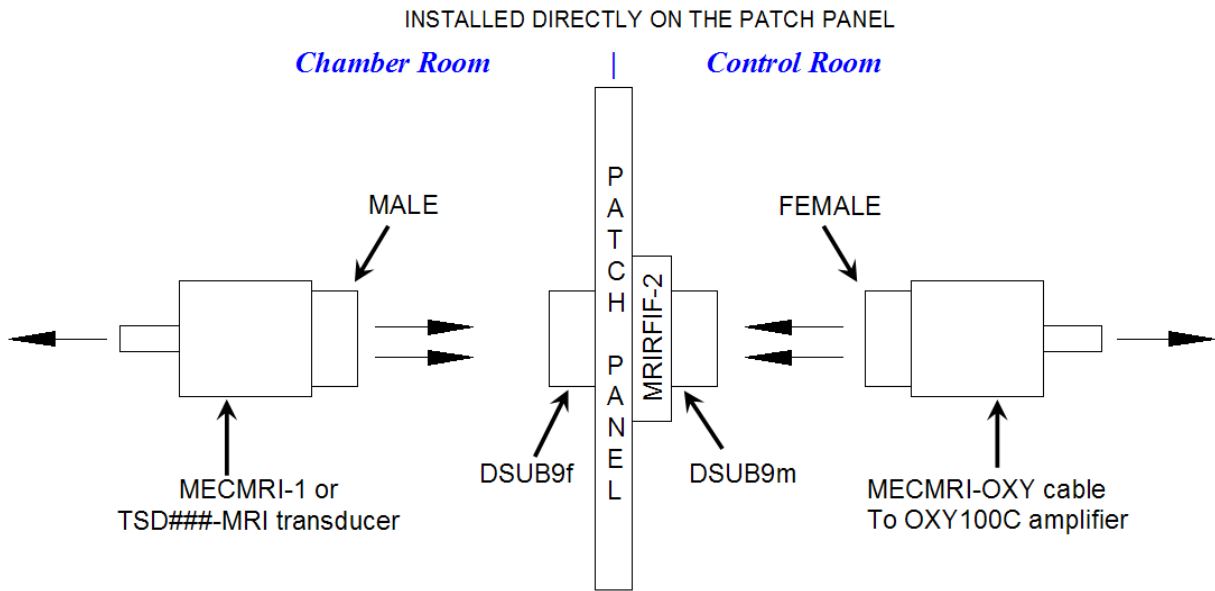


Fig. 6 Special Case "Installation A" for MECMRI-OXY (Obsolete)

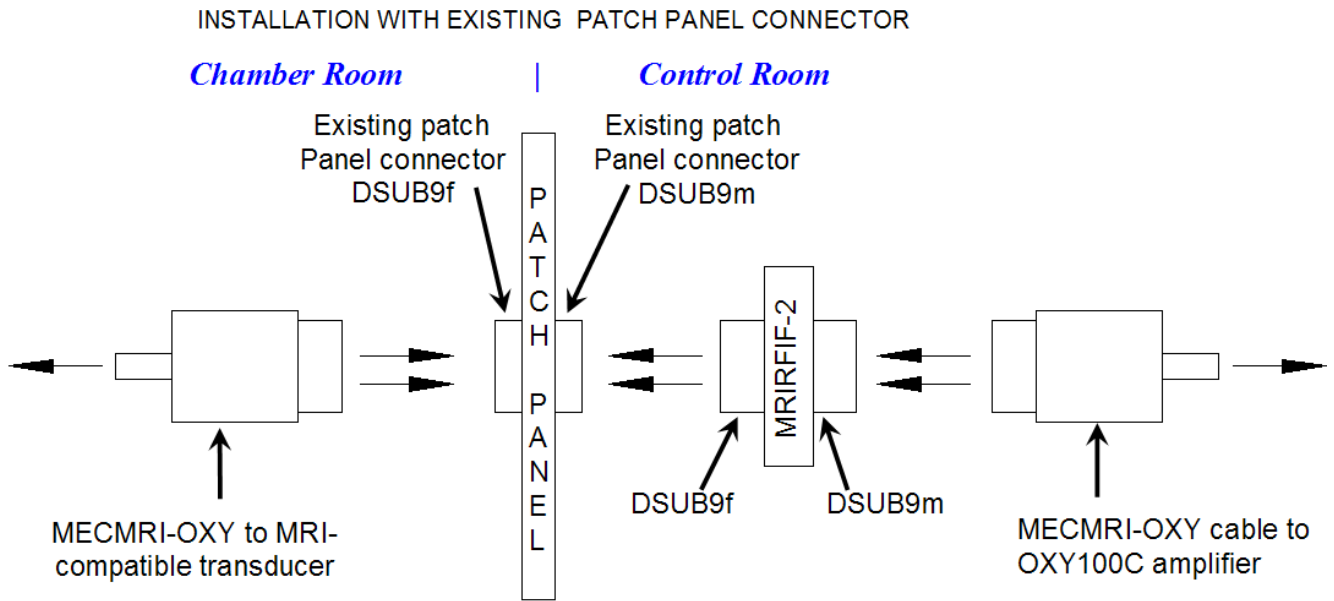


Fig. 7: Special Case "Installation B" for MECMRI-OXY (Obsolete)

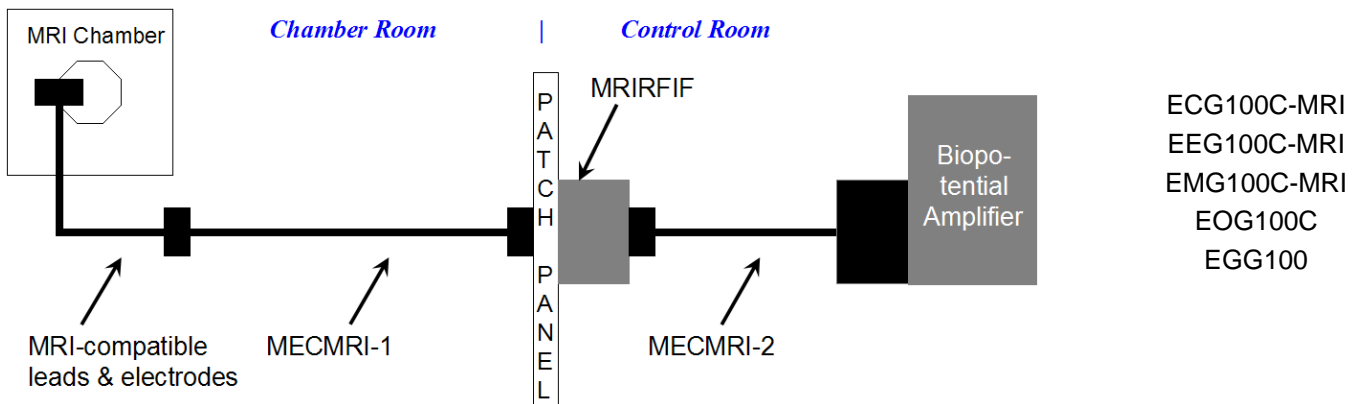
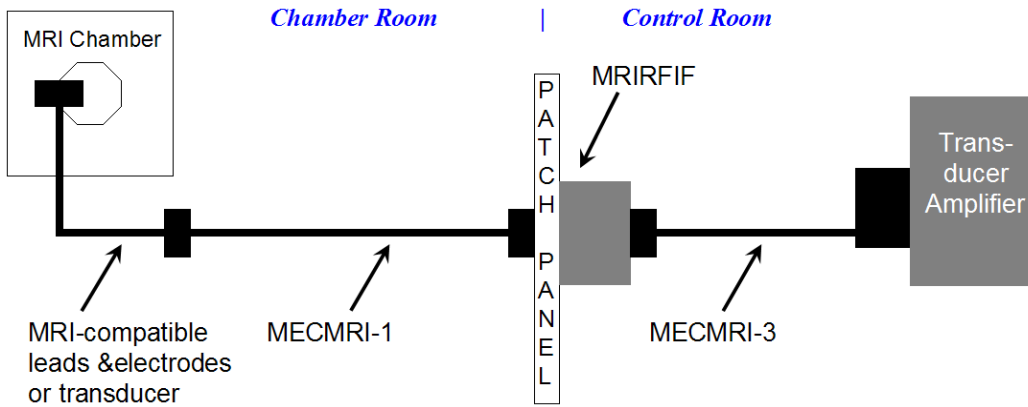
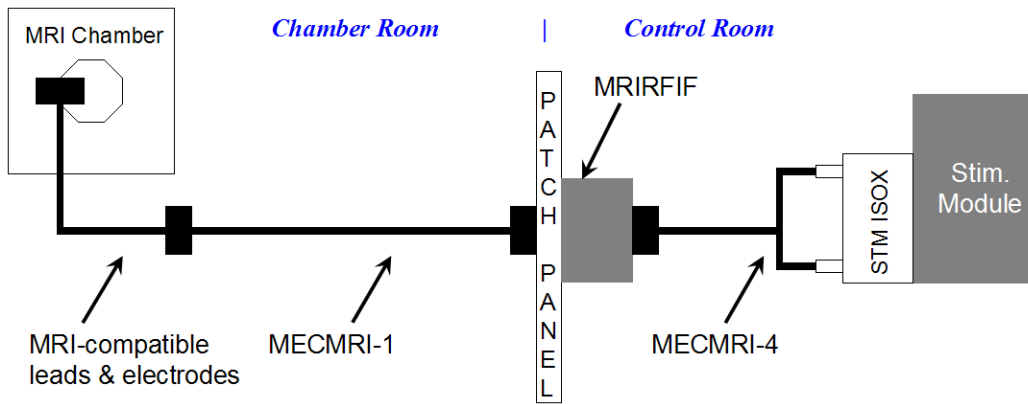


Figure 8: MECMRI-BIOP



PPG100C-MRI
 EDA100C-MRI
 RSP100C
 SKT100C

Figure 9: MECMRI-TRANS



STMISOC
 STMISOD
 STMISOE

 with CBL207:
 STM200

Figure 10: MECMRI-STMISO

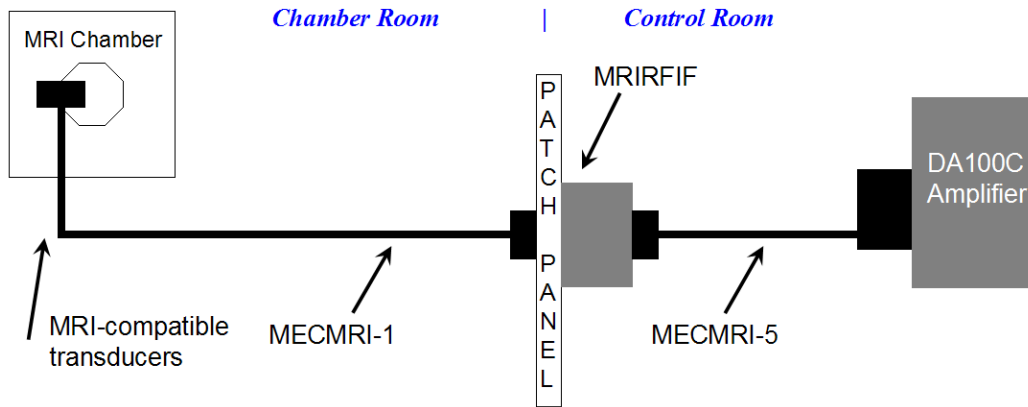


Figure 11: MECMRI-DA

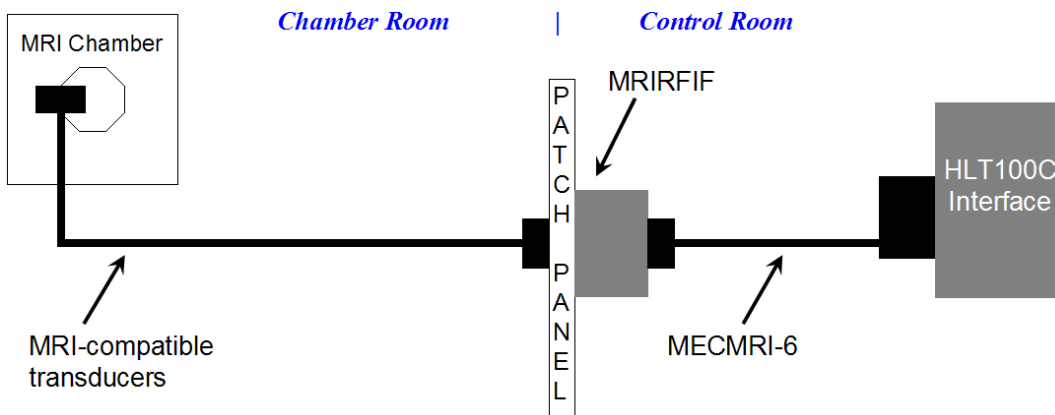


Figure 12: MECMRI-HLT

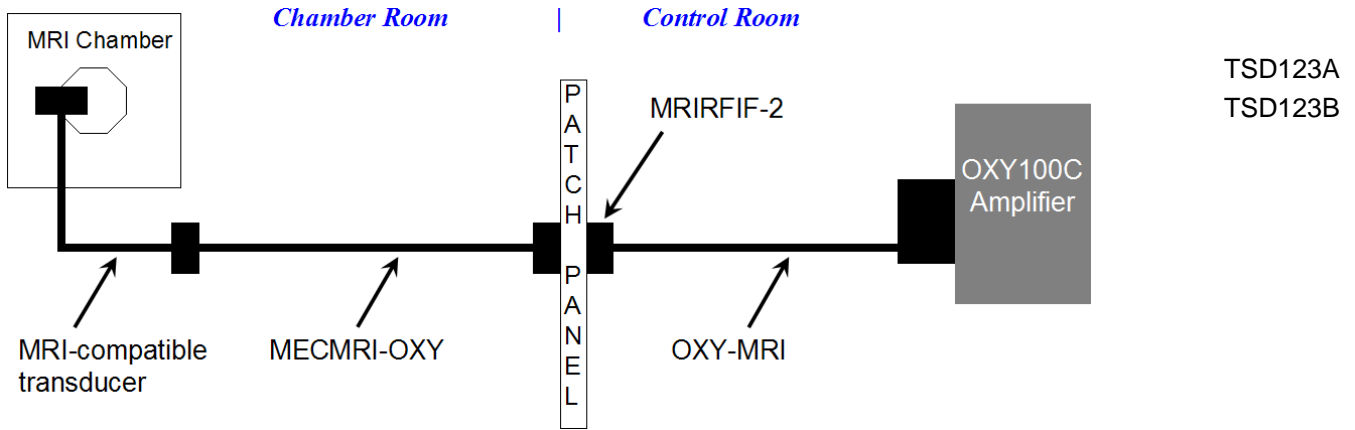
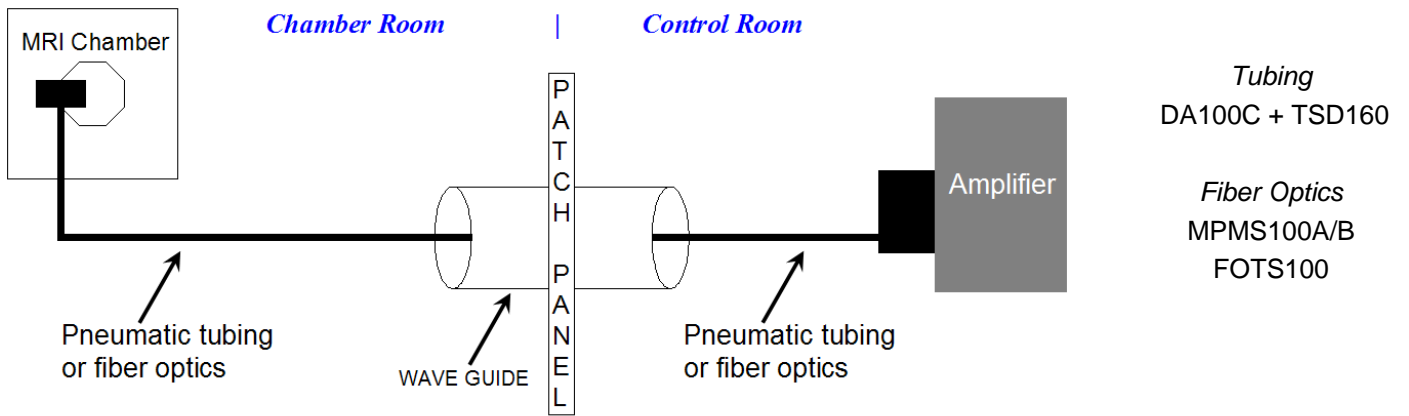


Figure 13: MECMRI-OXY (Obsolete)



⚠ DO NOT pass any electrical cabling through the wave guide. Wave guide is for pneumatic tubing or fiber optics ONLY.

Figure 14: Pneumatic Tubing or Fiber Optics

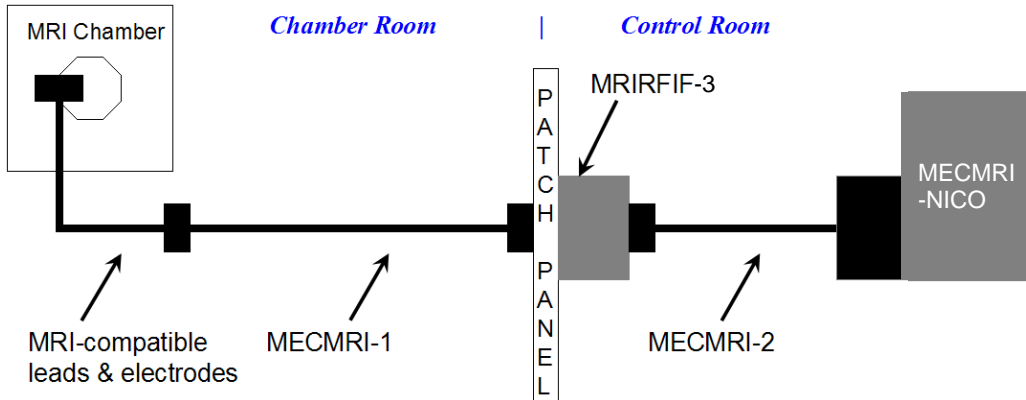


Figure 15: MECMRI-NICO

Female—not usable with MRIRFIF; must be reversed in panel to be compatible with MRIRFIF

Male—usable with MRIRFIF

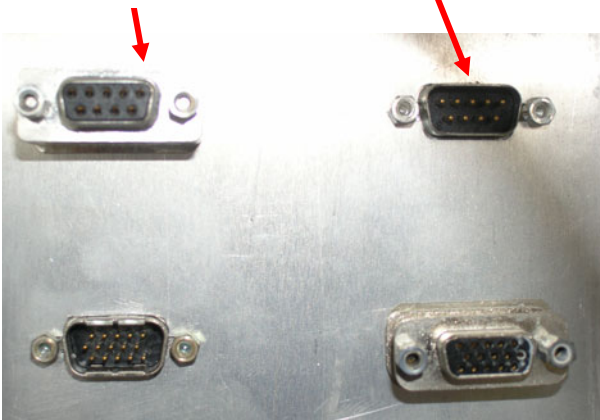


Figure 16: Patch panel 9 pin DSUB connector types

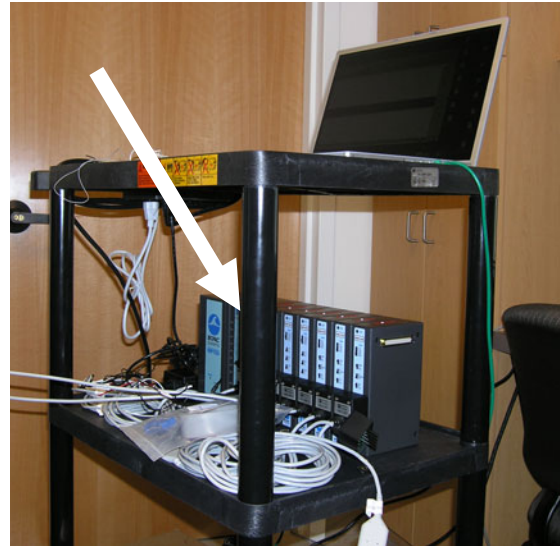


Figure 17: BIOPAC MP150 system setup in MRI control room