

MRI CABLES

Use MECMRI Cables for [biopotential & transducer amplifiers](#) as specified when recording in MR environments.

MECMRI-1

This is a Biopotential or Transducer cable for use inside the MRI chamber room. It supports one to five subject or transducer electrical connections and is 8 meters long. The cable incorporates a plastic housed DSUB9 Male connector to panel mount with the chamber room exposed DSUB9 female connector of the MRIRFIF.



MRI Use: MR Conditional to 7T

Note: To collect physiological data, the MECMRI-1 cable DSUB-9 connector must be connected to the MRIRFIF filter on the patch panel. Electrode leads/electrodes employed should be carbon composition BIOPAC LEAD108/EL508 series. Transducers employed should be BIOPAC certified MR Conditional or MR Safe.

MECMRI-2

This is a Biopotential cable for use inside the MRI control room. It supports one to five subject electrical connections and is 2 meters long. The cable incorporates a plastic housed DSUB9 Male connector to panel mount with the control room exposed DSUB9 female connector of the MRIRFIF. This cable connects directly to any of the following biopotential amplifiers: ECG100C-MRI, EGG100C, EMG100C-MRI, EOG100C, EEG100C-MRI.



MECMRI-3

Transducer cable for use inside the MRI control room. It supports one to three-subject transducer connections and is 2 meters long. The cable incorporates a plastic housed DSUB9 Male connector to panel mount with the control room exposed DSUB9 female connector of the MRIRFIF. This cable connects directly to any of the following transducer amplifiers: PPG100C-MRI, RSP100C, SKT100C, EDA100C-MRI.

MECMRI-4 **Note-** One MECMRI-4 comes with the MECMRI-STIMISO setup kit.

This cable is used inside the MRI control room. It supports one channel of subject stimulator connection and is 2 meters long. The cable incorporates a plastic housed DSUB9 Male connector to panel mount with the control room exposed DSUB9 female connector of the MRIRFIF interference filter. This cable connects directly to any of the following stim isolation adapters: STMISOC, STMISOD, or STMISOE.

MECMRI-5 **Note-** One MECMRI-5 is included with the MECMRI-DA setup kit.

This 2-meter cable is used inside the MRI control room. It supports one channel of general-purpose transducer output and connects directly to the DA100C high-level transducer module and the MRIRFIF interference filter. Cable incorporates a plastic housed DSUB9 male connector to panel mount with the control room exposed DSUB9 female connector of the MRIRFIF interference filter.

MECMRI-8 **Note-** One MECMRI-8 is included with the MECMRI-AMI setup kit.

This cable is used inside the MRI control room. It supports one channel of high-level transducer output and is 2 meters long. The cable incorporates a plastic housed DSUB9 Male connector to panel mount with the control room exposed DSUB9 female connector of the MRIRFIF interference filter. This cable connects directly to the HLT100C or AMI100D high level transducer module.

MECMRI-9

The primary purpose of this cable is to permit use of three axis MRI accelerometers in the MRI.

This is an MRI compatible cable assembly : This cable connects between MRI-RFIF and HLT100C. This is three channel interface cable - 2 meters long. This part is a three channel version of MECMRI-8, which is a one channel cable between MRIRFIF and HLT100C or AMI100D. This cable will be used with the TSD109C2-MRI accelerometer.

NOTE: The MECMRI-6 and MECMRI-7 cables were discontinued in February of 2019. For current offerings, see MECMRI-8 (replaces 6) and MECMRI-9 (replaces 7), which support both HLT100C and AMI100D modules.

OXY-MRI

The OXY-MRI SpO2 amplifier is placed inside the MRI control room, the associated 9 meter fiber-optic sensor cable is passed through a waveguide (connecting control room to chamber room), and the finger sensor is attached to the subject in the MRI chamber room. No patch panel MRIRFIF connections are required because of the fiber-optic construction of the sensor cable.

MECMRI-OXY Discontinued product- Available by request for existing OXY100C users.

MRI Cable/Filter set for discontinued OXY100C Pulse Oximeter (see OXY100E or OXY-MRI).

MRIRFIF (COMBINATION FILTER)

MRIRFIF is a five-line Pi filter set, designed for interfacing between the MECMRI-1 chamber room cable and any of the MRI control room cables (MECMRI-2 to MECMRI-8).

See also: App Note 223 Physiological Measurements in Magnetic Resonance Imaging Systems Using BIOPAC Equipment.



1. **MRIRFIF:** -3 dB point = 100 kHz
2. **MRIRFIF-2:** -3 dB point = 1 MHz
3. **MRIRFIF-3:** -3 dB point = 500 kHz
4. **MRIRFIF + MRIRFIF-2** = -3 dB point = 70 kHz
 - attenuation is -60 db from 7 MHz to 1000 MHz
 - attenuation slope from 70 kHz to 7 Mhz is 30 dB per decade
5. **MRIRFIF-3 + MRIRFIF-2** = -3 dB point = 400 kHz
 - attenuation is -60 db from 7 MHz to 1000 MHz
 - attenuation slope from 400 kHz to 7 Mhz is 30 dB per decade

This Pi filter set has a dielectric withstand voltage of 1500 VDC and conforms to IEC 60601-1 requirements. The Pi filter set is designed to shunt RF energy from the MRI control or chamber room to EARTH GROUND without sacrificing CMRR performance for the recording of small valued biopotential or transducer signals.

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

The MRIRFIF'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 above right:

Accordingly, if the MRIRFIF and associated cable assemblies (such as MECMRI-#) are used with any existing patch panel connectors, the existing connector must be a male/female 9-pin straight-through DSUB patch or filter connector. The male side of the existing connector must be on the Control room side to successfully connect the MRIRFIF to this connector.

Best performance is obtained by robustly attaching the GROUND of the MRIRFIF (metal enclosure) to EARTH GROUND at the junction panel. Mounting the MRIRFIF to the junction panel via the included L-bracket establishes an excellent ground to the panel. EARTH GROUND must be robust and held to the same potential as MAINS GROUND.

LEAKAGE CURRENTS

1. **MRIRFIF:** The IEC 60601-1 standard specifies a leakage current of 5 ma assuming double fault conditions. 265 VAC at 60 Hz will source 5ma into a reactance of 53 K. This reactance is equivalent to an effective subject capacitance to equipment ground of 0.05uF. The BIOPAC MP unit establishes a subject to ground capacitance of 0.005 uF. The Pi filter (MRIRFIF) incorporates a 0.002uF subject capacitance to ground (2 of 0.001 uF caps). Accordingly, even with 16 MECMRI cables (with 16 MRIRFIFs) this results in a capacitance of .037 uF, which is 74% of the IEC 60601-1 limit, assuming mains is 265 VAC at 60 Hz.

2. **MRIRFIF-2:** This filter has a dielectric withstand voltage of 1500 VDC and is compatible with IEC 60601-1 requirements. The filter is designed to shunt RF energy from the MRI or control room chambers to EARTH GROUND without sacrificing CMRR performance for the recording of small valued signals.

- o MRIRFIF-2: -3 dB point = 1 MHz

The MRIRFIF-2 (nine-line Pi filter) is normally attached to the MRIRFIF to create a cascaded Pi filter for superior EMI rejection. The MRIRFIF-2 is also designed for interfacing between MRI chamber room specialty cable (such as with NICO100C-MRI) and the MRI control room cable.

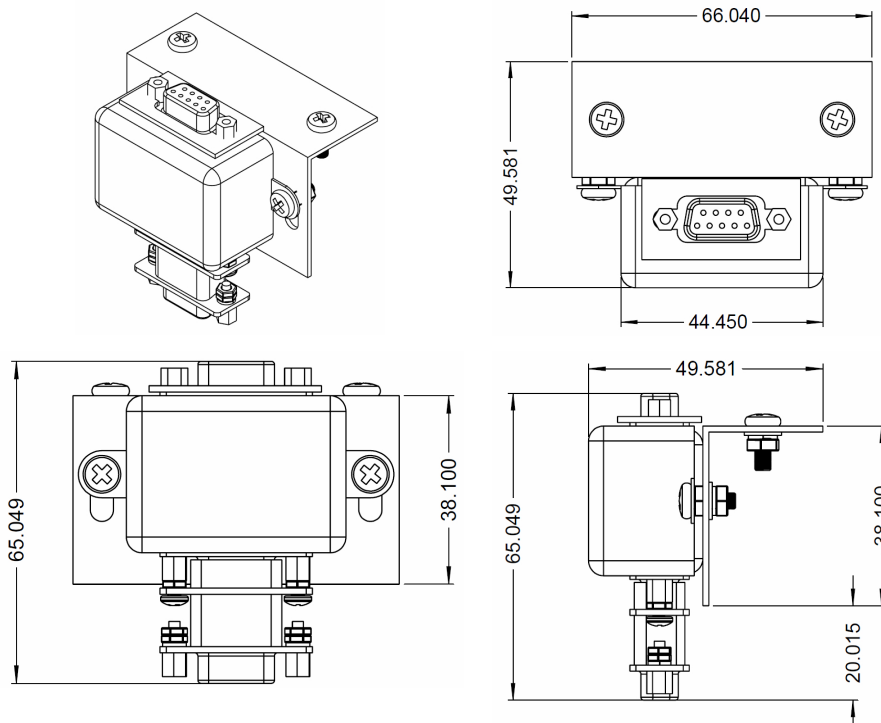
If the specialty cable set is used with an existing patch panel connector, the MRIRFIF-2 should be plugged into the Control Room side of the patch panel connector, which must be a male/female 9-pin straight-through DSUB patch or filter connector. The male side of the existing connector must be on the Control room side to successfully connect to the MRIRFIF-2 and specialty cable.

Best performance is obtained by robustly attaching the GROUND of the MRIRFIF-2 (metal enclosure) to EARTH GROUND at the junction panel. Mounting the MRIRFIF-2 to the junction panel establishes an excellent ground to the panel. EARTH GROUND must be robust and held to the same potential as MAINS GROUND.

The IEC 60601-1 standard specifies a leakage current of 5 ma assuming double fault conditions. 265 VAC at 60 Hz will source 5 ma into a reactance of 53 K. This reactance is equivalent to an effective subject capacitance to equipment ground of 0.05 uF. The BIOPAC MP unit establishes a subject to ground capacitance of 0.005 uF, and the Pi filter (MRIRFIF-2) incorporates a 0.001 uF subject capacitance to ground. Accordingly, even with 16 MECMRI cables with 16 MRIRFIFs, this results in a capacitance of 0.021 uF, which is 42% of the IEC 60601-1 limit, assuming mains is 265 VAC at 60 Hz.

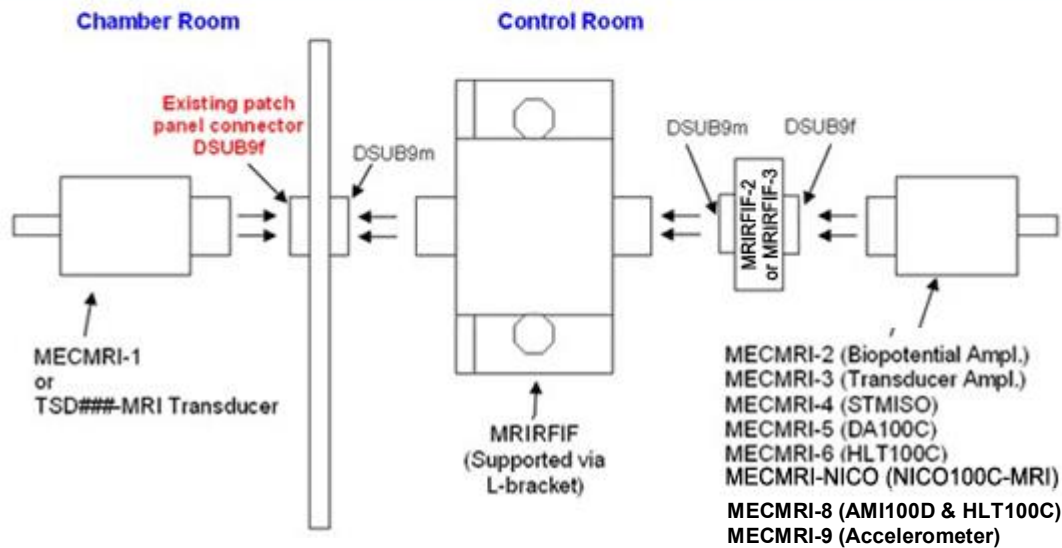
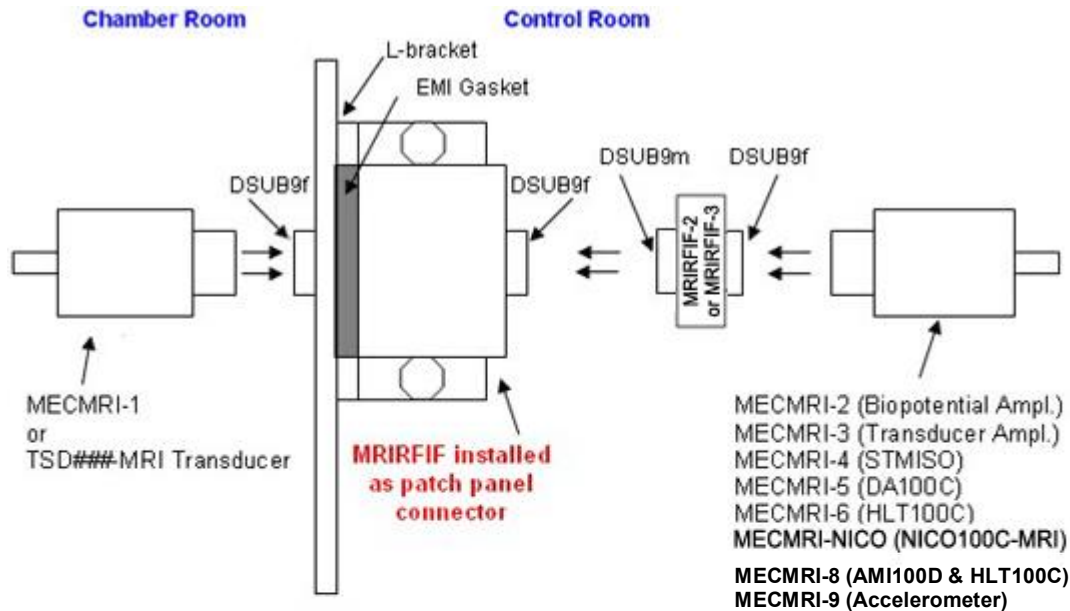
3. **MRIRFIF + MRIRFIF-2 & MRIRFIF-3 + MRIRFIF-2:** The IEC 60601-1 standard specifies a leakage current of 5 ma assuming double fault conditions. 265 VAC at 60 Hz will source 5 ma into a reactance of 53 K. This reactance is equivalent to an effective subject capacitance to equipment ground of 0.05 uF. The BIOPAC MP unit establishes a subject to ground capacitance of 0.005 uF. The Pi filter set (MRIRFIF + MRIRFIF-2) incorporates a 0.003 uF subject capacitance to ground. Accordingly, even with 15 MECMRI cables with 15 MRIRFIFs this results in a capacitance of .05 uF, which is 100% of the IEC 60601-1 limit, assuming mains is 265 VAC at 60 Hz.

MRIRFIF DIMENSIONS (ALL DIMENSIONS IN MM)



MRI CABLE SETS

MECMRI-xxxx cable systems for MRI applications. Cables must be attached to the MRI patch panel according to BIOPAC's instructions; see web for diagrams. These cable sets include a five line Pi filter set, designed for interfacing between the MECMRI-1 chamber room cable and any of the MRI Control room cables (MECMRI-2 to MECMRI-6).



MRI Use: **MR Conditional to 7T**

Note: The MRIRFIF + MRIRFIF-2 Pi filter must be on the control room side of the patch panel. Conductive parts of cable are electrically and thermally isolated from subject.

MECMRI-xxx components—MRI chamber room cable only:

Tinned copper wire (99.99% pure copper), Polyvinyl chloride (PVC) plastic, Acrylonitrile Butadiene Styrene (ABS) Thermo-molded, Plastic, Solder (non-magnetically susceptible RoHs compliant), Copper clad fiberglass lamination (PCB material), Tinned copper connectors

MRI CABLE/FILTER SETS TABLE

The following table illustrates the components of each cable/filter set. See table for full descriptions of each included cable and filter.

CABLE/FILTER SETS	MRIRFIF	MRIRFIF-2	MRIRFIF-3	MECMRI-1	MECMRI-2	MECMRI-3	MECMRI-4	MECMRI-5	MECMRI-8	MECMRI-9
MECMRI-DA — For recordings with a transducer in the MRI chamber room and the DA100C in the MRI control room. Use to connect directly to the following transducers: Medium Flow Pneumotach (TSD117-MRI,) Hand clench dynamometer (TSD121B-MRI,) or arterial pressure TSD104A-MRI.	X							X		
MECMRI-AMI — For recordings in the MRI with the AMI100D or HLT100C. Use to connect directly to the following transducers: TSD115-MRI, TSD131-MRI, or TSD109C2-MRI accelerometer.	X								X	X
MECMRI-OXY — Use to connect to the OXY100C Pulse Oximeter and TSD123A/B Oximetry transducers for MRI applications. (Discontinued)		X								
MECMRI-STMISO — Use to connect directly to the following stim isolation adapters: STMISOC, STMISOD, or STMISOE.	X			X			X			
MECMRI-TRANS — For Transducer recordings in the MRI. Use to connect directly to the following transducer amplifiers: PPG100C-MRI, RSP100C*, SKT100C*, or EDA100C-MRI. Connection Sequence: Subject to transducer to MECMRI-1 to MRIRFIF to MECMRI-3 to transducer module. <i>*These amplifiers can be used for MRI measurements.</i>	X			X		X				
MECMRI-BIOP δ Component set for Biopotential recordings in the MRI. Use to connect directly to any of the following biopotential amplifiers: ECG100C-MRI, EEG100C-MRI, EGG100C*, EMG-100C-MRI or EOG100C*. Connection Sequence: Subject to electrodes to leads to MECMRI-1 to MRIRFIF to MECMRI-2 to Biopotential Module. <i>*BIOPAC can customize these amplifiers for use in MRI.</i>	X			X	X					
MECMRI-NICO — Component (Cable/Filter) set for noninvasive cardiac output recordings in the fMRI and MRI. Use to connect directly to the NICO100C-MRI amplifier. Connection Sequence: Subject to electrodes to leads to MECMRI-NICO to NICO100C-MRI.		X	X	X	X					
PNEUMATIC LINES δ No electrical MRI Cable/Filter required ó use DA100C. TSD110-MRI, TSD114-MRI, TSD137 series, TSD221-MRI, TSD237 series (for animal.)										