

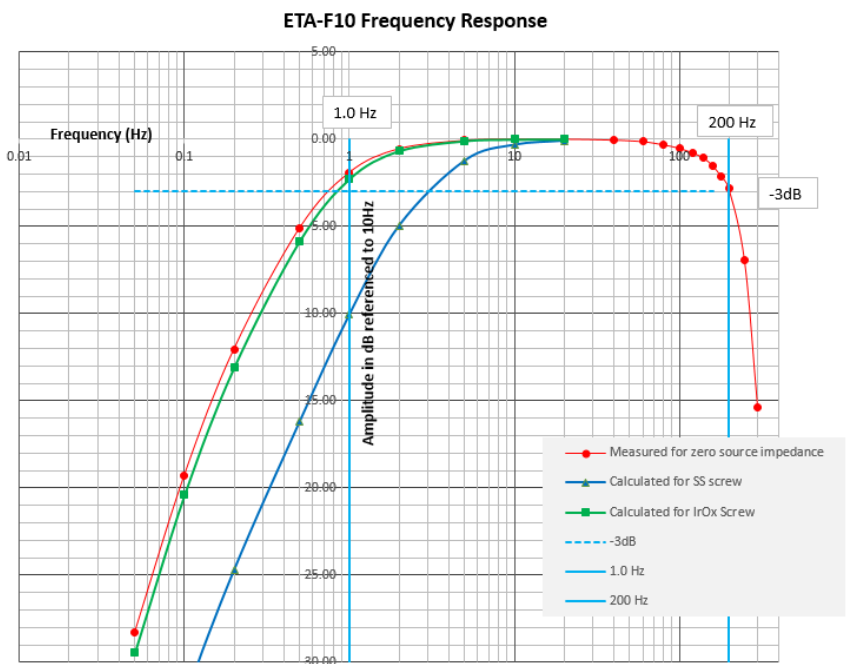
Guidelines for the use of EEG Screws with Telemetry

Applications involving sampling of electrical signals such as EEG require telemetry implants with adequate technical specifications to accurately acquire and analyze data. This document provides guidance for what applications will benefit from DSI’s Iridium Oxide (IROX) coated EEG stainless steel screws, listed in the below table.

Part Number	Model	Description
012011-001	EEG IROX Screws, Mouse	00-96 X 1/16, EEG, IROX screw, MOUSE, Pack of 50
012012-001	EEG IROX Screws, Rat	00-80 X1/16, EEG, IROX screw, RAT, Pack of 50
012013-001	EEG IROX Screws, LA-1	00-80 X 3/16, EEG, IROX screw, Large Animal-1, Pack of 50

Best Practices – EEG recording:

- Impedance is the measure of the opposition which a circuit presents to a current when a voltage is applied.
 - Impedance is important to consider for EEG recordings because the source impedance of EEG electrodes is inversely proportional to the electrode contact between the target tissue and electrode material; a high source impedance may attenuate the lower EEG frequencies
 - EEG electrodes have a higher source impedance than ECG electrodes because the contact area between electrode and target tissue tends to be smaller than ECG electrodes
 - Source input impedance is most consistent across multiple cortical recordings by anchoring the biopotential electrodes to screws and contacting the dura
- DSI’s recommends IROX EEG screws if using a single biopotential channel telemetry implant such as ETA-F10
 - These implants were designed to work best with ECG where the electrode source impedance is low.
 - For EEG recordings, the lowest attainable frequency is 3 Hz when using uncoated stainless-steel screws and 1Hz if using IROX coated screws, since IROX screws have lower impedance (Figure 1)
 - Frequencies below 3 Hz are a component of the EEG’s Delta band, important for identifying and classifying slow wave sleep



- Input Voltage Range
 - Rodents: recommended input voltage range of ± 1.25 mV or ± 2.5 mV to keep noise levels low
 - Large Animals: recommended input voltage range of ± 2.5 mV to keep noise levels low
- Note, the following implants may be paired with either IROX or stainless-steel screws and have no effect on DSI's specified EEG bandwidth: HD-X02, HD-S02, F50-EEE, 4ET, L04, L04, and D70-EEE
 - See implant specifications table below for complete details

Additional Resources

- For more information about best practices for measuring bioelectric signals with DSI telemetry, visit DSI's Knowledgebase (datasci.com) and search, "Guidelines for Biopotential Applications"
- Implant bandwidth specifications determined by benchtop testing; testing data is on file at DSI
- Selection of biocompatibility publications:
 - <https://www.sciencedirect.com/science/article/pii/S0142961209011168>
 - <https://www.sciencedirect.com/science/article/abs/pii/S0925838816327980>
 - <https://ieeexplore.ieee.org/document/1002326>
 - <https://www.scientific.net/AMR.1027.191>
 - <http://agris.fao.org/agris-search/search.do?recordID=US201500030564>
 - <http://waset.org/pdf/books/?id=100114&pageNumber=43>
 - <http://jes.ecsdl.org/content/164/5/B3029.full>

Implant Specifications

Implant Family	Implant Model	# of Biopotential Channels	Input Voltage Range	Biopotential Channel Bandwidth (Hz)	Biopotential Channel Nominal Sampling Rate (Hz)	Signal Type
PhysioTel	ETA-F10, ETA-F20	1	± 2.5 mV	1-200	1000	ECG, EMG, EEG ¹
	CTA-F40	1	± 10 mV	1-200	1000	ECG, EMG, EEG ¹
	F50-W-F2	1	± 0.5 mV	50-1000	5000	Nerve activity
	F50-EEE, D70-EEE	3	± 2.5 mV	1-100	500	ECG ² , EEG, EMG
	4ET	4	± 2.5 mV	1-100	400	ECG ² , EEG, EMG
PhysioTel HD	HD-X02	2	± 1.25 mV	0.5-80	300	EEG, EMG (ECG ²)
	HD-S02	2	± 1.25 mV	0.5-100	375	EEG, EMG (ECG ²)
	HD-X11	1	± 2.5 mV	0.1-200	600	ECG, EMG, EEG ¹
	HD-S11	1	± 5 mV	0.1-145	600	ECG, EMG, EEG ¹
	HD-S21	1	± 5 mV	0.1-145	450	ECG, EMG, EEG ¹
PhysioTel Digital	L11, L21	1	Programmable $\pm 2.5, 5, 10, 20^{\wedge}$ mV	0.1-100	448	ECG, EMG, EEG ¹
	L03	3	Programmable (Ch. 1-2)	0.5-100	500	EEG, EMG, ECG

			±2.5, 5, 10, 20 [^] mV			
	L04	4	Programmable (Ch. 1-2) ±2.5, 5, 10, 20 [^] mV	Ch. 1-3: 0.5- 100 Ch. 4: 0.5-50	Ch. 1-3: 375 Ch. 4: 185	EEG, EMG, ECG
	M11, M01	1	±10 mV	0.1-100	448	ECG, EMG, EEG ¹

¹ Specialized IROX screw electrodes are required to ensure waveforms below 3 Hz are measured, critical for measuring slow wave sleep.

² If there is a need to record ECG, EMG, or EOG with these devices, channel 1 should not be used; (Note that signal railing in the ECG may occur in mice and rats at high R wave amplitudes using implants with input voltages that equal ±1.25 mV)

Dependent on electrode input impedance

[^] 20 mV input voltage may be selected when solid tip lead placement results in ECG amplitude exceeding 10 mV