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"INRAD Microphones and Transmission of the Human Voice"

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Allow us to provide a brief primer on the human voice, and how it projects from us and at what frequency response. This is important to understand how different microphones will project the voice depending on their individual characteristics.

For the sake of clarity, assume in this document that you have your HF transceiver properly set up for SSB transmission. The use of mic gain, compression and other settings on the radio have a wide set of variants. Their use, or non-use, or abuse is outside the scope of this document.

Vocal output changes with output level, and frequency spectrum of voice. Pitch of voice changes with increased vocal output. Talking in a soft voice sounds different from shouting. Where do you find the right balance between the level of your voice, the audio response of your voice, and a microphone to reproduce it for transmitting intelligible SSB audio? Add in that not everyone wants the same response from their voice when transmitted via radio. Some of us want a clear natural sound. Others want plenty of high-end audio punch, or audio energy.

The fundamental frequency response of the adult male human voice is approximately 85 to 180 Hz with much of complex speech tone being in the 100-120 Hz range.
The fundamental frequency of the human voice also carries significant harmonic transmission. Consonant sounds like k, p, s, and t are heard at higher harmonics, in the 2 to 4 kHz range. The usable voice frequency band for typical SSB transmission can typically be between 100 Hz and somewhere above 3 kHz.

Speech consists of vowel and consonant sounds. At normal vocal output, vowel sounds diminish rapidly above 1 kHz and consonants appear as low as 500 Hz and continue to as high as 4 kHz.

The important frequencies in Western languages peak in the 2 kHz range for perceived intelligibility. Most consonants appear in this frequency range.

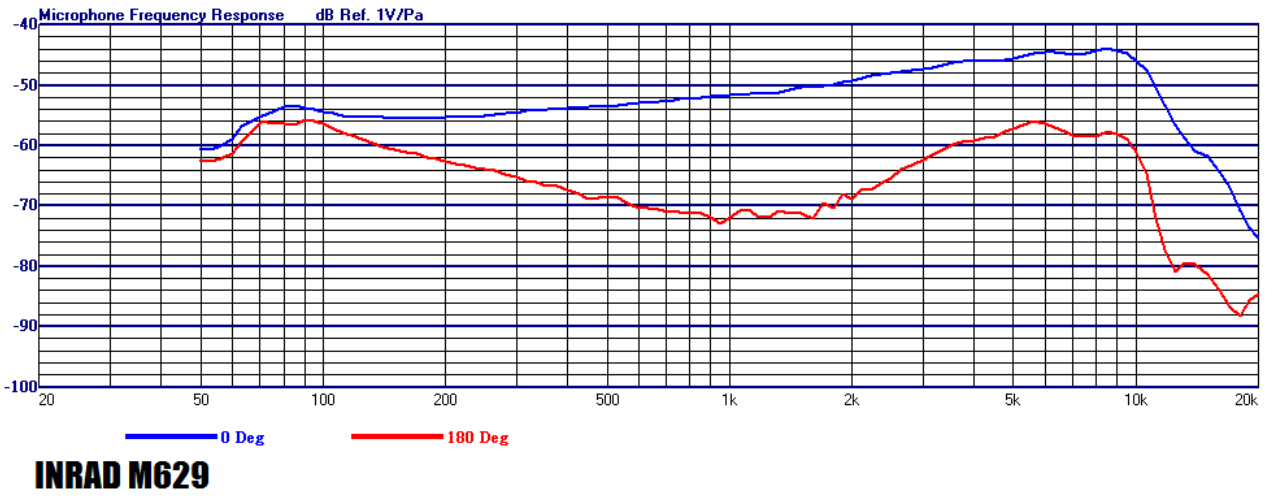
Speaking spectrum can be low pass or high pass filtered. Using a high pass filter at a comparatively low frequency (50 Hz, which also happens to be a typical high pass cutoff for microphone response) leaves speech 100% intelligible. A high pass filter, even at a comparatively high frequency of 500 Hz still leaves something like 95% of speech

understandable even though speech energy is diminished overall. On the other hand, a low pass filter cuts intelligibility down dramatically. A cut at 1 kHz decreases intelligibility by as much as 40%. 1 kHz to 4 kHz is very important!

We've established a baseline of somewhere slightly below 100 Hz to approximately 4 kHz, with a peak at 2 kHz, is prime for maximum intelligibility for spoken voice.

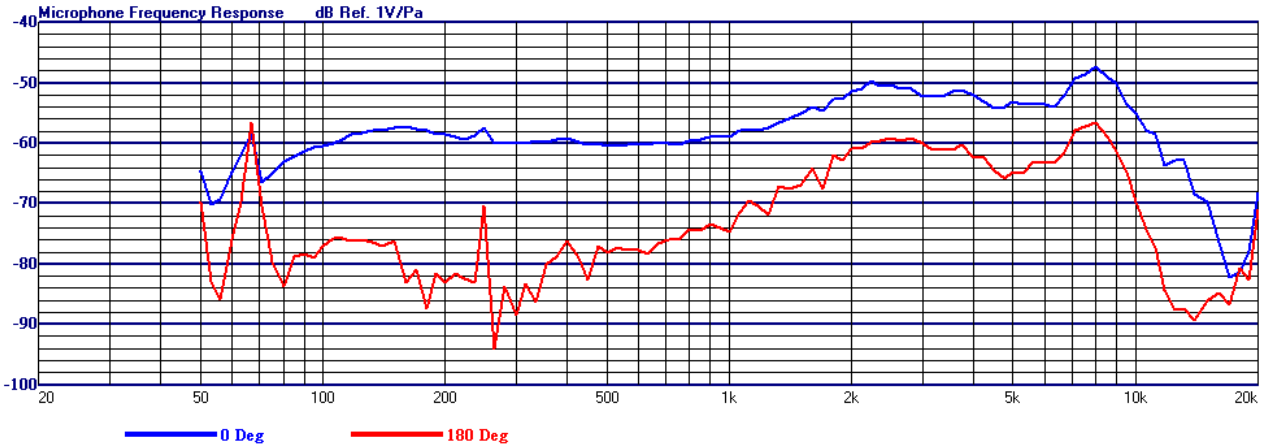
Unsurprisingly if microphone frequency response articulates this frequency range well with exaggerated response at the peak of intelligibility of the human voice and is not inhibited by set up of the transceiver itself, what do you think the predictable result will be? Nice sounding, well articulated speech via SSB transmission.

Consider the frequency response pattern of the INRAD M629 microphone, shown here:



Output has been tailored to rise from 500 Hz, crossing 1 kHz up to 4 kHz, exaggerating the microphone output frequency response of these vocal frequencies – the result is clear, well-articulated audio reproduction of your voice. Your on-air contacts will say … "You sound great – it sounds just like you!" This is no accident!

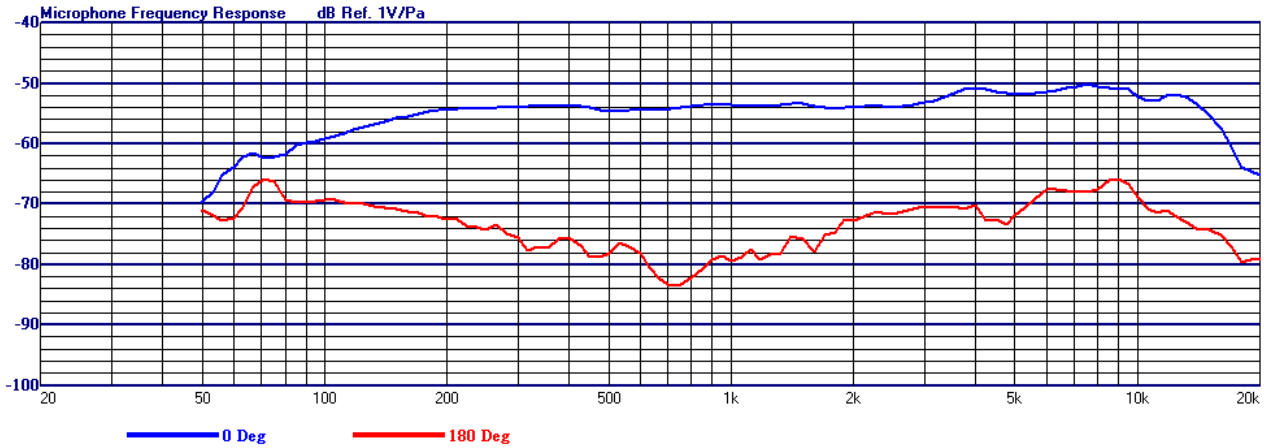
Now, let us consider the other top of the line INRAD microphone, the M650. Here is the frequency response chart:



INRAD M650

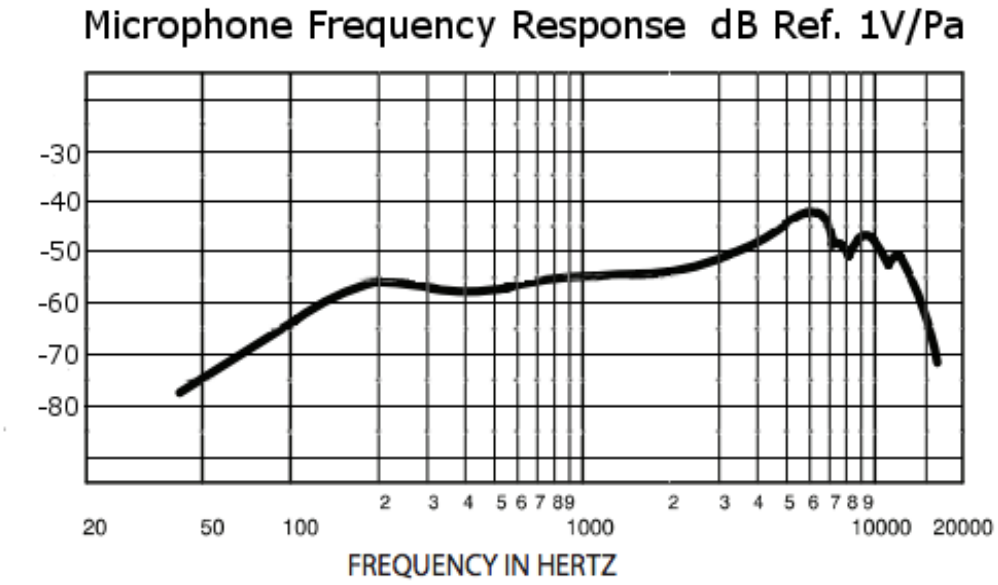
Witness the difference in the response for the M650. Instead of a slow gradual rise, there is an abrupt response change after flat response from 100 Hz to 1 kHz upward to 2 kHz and then flat from there over to 4 kHz. Is this better or worse? It's neither. Recall the low pass versus high pass – as the lower frequencies in this case are diminished in relative output to the higher ones, this microphone will have punchier highs and lower output lows. Did you guess "more DX sounding transmit audio response than the M629"? That's correct. While still having a well-rounded overall response, the M650 is more suitable for audio punch. Turning the speech processor on to beat the pileup? Good microphone for that!

Generally speaking, an overall flat microphone response curve will result in no vocal frequencies being exaggerated or diminished and hence, no transmitted response being exaggerated or diminished either. A good, all-purpose microphone will exhibit a more uniform flat response from somewhere below 100 Hz to above the range of concern for vocal articulation or transmit energy (10 kHz or more). Here's the curve for the INRAD M628 microphone:

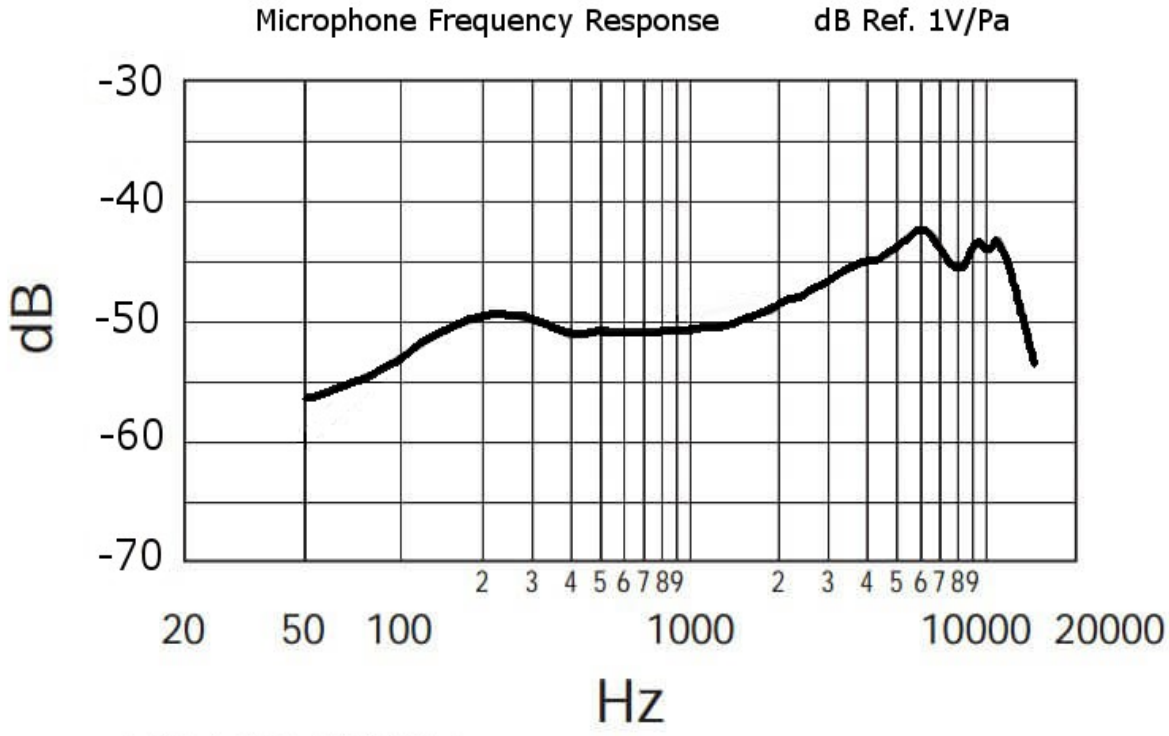


INRAD M628

Flat response equals good audio response across all vocal frequencies, without a boost or kick at specific spots to increase articulation or to cut the lows or highs down. This is an excellent all-purpose microphone that can be used with just about any HF transceiver.



INRAD M686



INRAD M665

Note the M665 response curve is similar to the M650, except the abrupt rise from 1 to 2 kHz with the M650 does not occur with the M665 until 2 kHz. In layman terms, this microphone has a little bit less higher end punch and a little bit more overall flat response from 100 Hz to 2 kHz than the M650. Still has high-end punch, but not as much as the M650 is going to give you, with overall well-rounded audio.

The M686 also has a similar mostly flat response like the M665 on the low end, and the rise from flat is less sharp, beginning after 2 kHz up through 4 kHz. This microphone for audio response is more like the M629, with lower highs and a gradual rise from 2 kHz to 4 kHz. This is a slightly more full, well-rounded sounding microphone than the M665 at the expense of higher-end audio punch. The M665 has slightly elevated higher end output over the M686.

Summary:

M629
Overall well-articulated audio response tailored to match intelligibility of human voice

M650
Well-articulated overall audio with plenty of high end punch for DX operation and/or using the speech processor on the radio to drive output.

M665
Similar to M650, but with less high-end punch and slightly better overall frequency response.

M686
Junior version of the M629. Similar high end rise in the 2 kHz to 4 kHz range, with lower highs than the M629 but more well-rounded audio than either of the M665 or M650.

M628
Flat audio response for accurate reproduction of voice spoken into the microphone. Peaks less pronounced than other microphones. Good all-purpose microphone for any Amateur Radio application.