

MEASUREMENT NOTE: IP3 SPECMANSHIP GAMES

Third Order Intercept Point (TOI or IP3) is a measure of how well an RF component or system can maintain linearity and performance under strong signal conditions. While it is an important parameter in almost any receiver, it becomes crucial in those designed to handle the weakest signals in the presence of the strongest interferers, such as the high end systems that Epiq designs for. This measurement therefore becomes a parameter that systems such as software defined radios (SDRs) live or die by when suppliers are being selected for military programs. Because the temptations to game the system are so strong, we wanted to put a stake in the ground on how we measure IP3, and why we try to make measurements that will be faithful to real-world use. Note that we're assuming you, as the reader, are already familiar with how IP3 measurements are made - if not, one of many good tutorials can be found on YouTube here.¹

¹ <https://www.youtube.com/watch?v=m-2H8ddSwTI>

This note focuses on the placement and separation of the two test signals used in most IP3 measurements. Many high performance SDRs are composed of a chain of filters, often starting off with a pre-selector, then various IF filters through the block diagram. Signals outside the pass-bands of these filters are attenuated by design. However, strong signals inside these pass-bands are the ones most likely to induce non-linear behavior and spurs.

Figure 1 illustrates several approaches to the measurement using different tone spacings. We believe that a worst case where two test signals are close enough together such that they pass through the whole system is the most representative, and is the right way to assess receiver performance (A). However, we find that others can sometimes find ways to make their numbers better, and this is not always obvious. For example, illustrated in (B) where the tones are pushing into the pre-selector filter, and (C) where they are pushing one into the IF

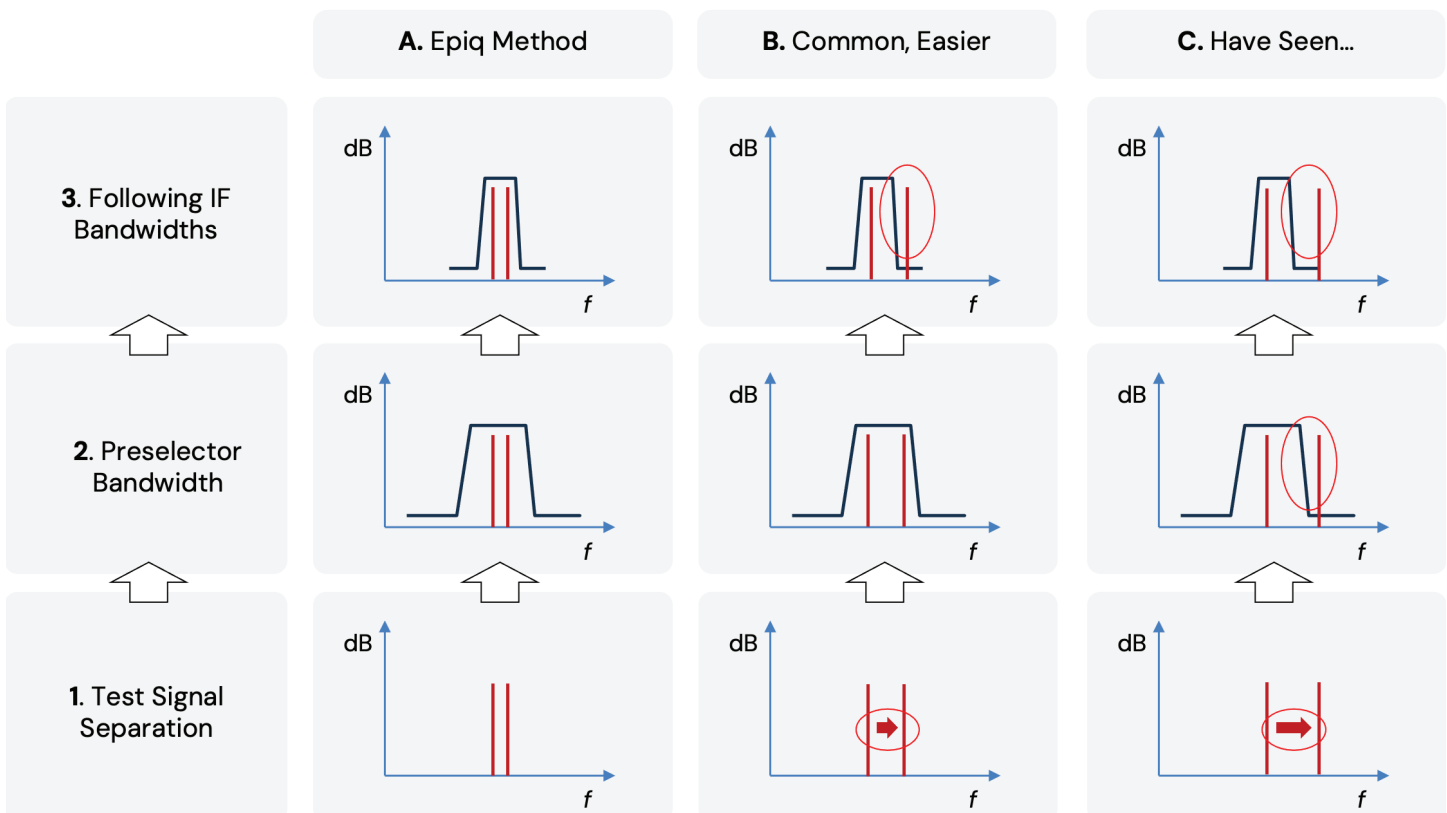


Figure 1: Possible methods of setting test signals up for IP3 measurements.

filter. With this in mind, here is how Epiq spec's IP3 measurements.

IP3 Measurement Method

(Method A in Figure 1)

1. RF input referred
2. Maximum gain setting
3. 2 test tones that are:
 - Inside the pre-selector filter,
 - Inside the 1st IF filter,
 - Inside the 2nd IF filter and
 - Inside all digital filters in the DSP signal chain.
4. Measurement taken from RF input to Digital IF Output

As may be obvious by now, such a rigorous test method ensures that the resulting number will be less favorable than other methods, and this should be borne in mind when making comparisons. It is important make sure that equivalent methods and bandwidths were used before making a judgment.

To learn more about how SDRs are applied in different applications or to learn more about specific products that might be employed, [contact us](#) or visit [our website](#).

ABOUT EPIQ

Epiq Solutions develops cutting edge tools for engineering teams and government-focused organizations requiring situational awareness and detailed insight into their RF environments in order to identify and act against wireless threats.