1. **I would like to measure output impedance using the J2111A Current Injector, but the 25mA offset is way above my typical operating current. Why is this offset needed, and is there a way around it?**

   The J2111A includes bias positions of -25mA, 0 and +25mA. This bias is provided as a convenience for the user. Since the J2111A can only sink current it is necessary to provide a bias in order to put the device into class A operation. If we did not do this, only one half of the analyzer signal would be provided, resulting in a severely distorted signal and poor accuracy.

   In cases where the 25mA is too much, it is possible to provide an external bias. The modulation input is 50 Ohms and the transconductance of the J2111A is 10mS. We routinely use the bias injector along with the J2111A for measuring references. This combination results in 50uA/V and at the 50V limit of the bias injector the J2111A can produce up to 2.5mA. The typical offset in the J2111A is 150uA, and it can be as high as 400uA. It is also possible to use the J2110A in conjunction with the J2111A.

2. **I see that with the J2111A can perform the "non-invasive stability" measurement. I don't understand what we can take away about stability from this measurement, and how is this different from a Bode plot?**

   The J2111A along with the Bode-100 can provide the phase margin of a control loop without access to the control loop. This is convenient in that it allows a stability assessment without lifting any wires or breaking any connections. It also works with fixed voltage regulators where there is no access to the control loop, as well as assessing the stability of a negative resistance switching regulator with an input filter. The result is a singular solution, providing only the phase margin. The method is quite accurate, but requires real and imaginary roots for the solution, so the results can only be determined for values below 70 Degrees. Above this the result is displayed as >70 Degrees.

   It is not possible to get a Bode plot using this method, only the phase margin; however, it is an accurate method for assessing the performance where other methods are not possible.

3. **How do I get a Bode plot with the J2111A?**

   It is not possible to get a Bode plot using this method, only the phase margin; however it is an accurate method for assessing the performance where other methods are not possible.

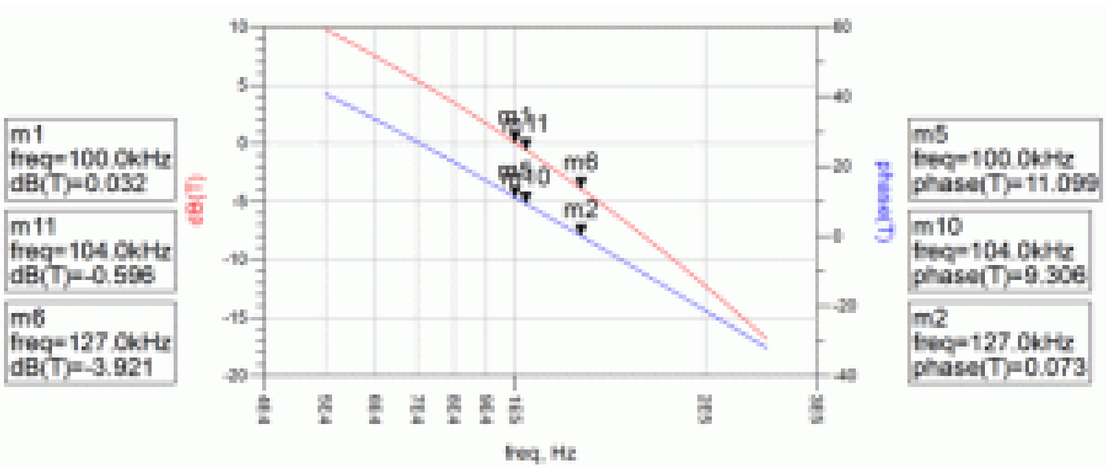
   The J2111A along with the Bode-100 can provide the phase margin of a control loop without access to the control loop. This is convenient in that it allows a stability assessment without lifting any wires or breaking any connections. It also works with fixed voltage regulators where there is no access to the control loop, as well as assessing the stability of a negative resistance switching regulator with an input filter. The result is a singular solution, providing only the phase margin. The method is quite accurate, but requires real and imaginary roots for the solution, so the results can only be determined for values below 70 Degrees. Above this the result is displayed as >70 Degrees.

4. **What are the main differences between J2100A injection transformer, J2110A solid state injector and the J2111A current injector?**

   The J2110A is a solid state voltage injector, offering lower noise and wider bandwidth (DC-50+mhz) than a transformer. The J2110A has a 25 ohm output impedance and is limited to +/- 10v input and output levels. Picotest offers two transformers, the J2100A and the J2101A. The difference between the two transformers is the bandwidth. The J2100A offers a low end bandwidth of 1Hz satisfying low frequency measurements such as PFCs, while the J2101A is designed for a higher frequency range starting at 10Hz. The J2101A is most beneficial for linear regulators, LDOs and switching regulators. The J2111A is a current injector with a transconductance of 10ms. The J2111A is a current sink (two actually, one for positive voltages and one for negative voltages. Both are contained inside the J2111A; steering electronics automatically choose the correct path. The device has a precision current port allowing a current to be injected to create a small signal step load and also for output impedance, PSRR and reverse transfer measurements. The device can sink current from voltages above 0.7V and below -0.7V. It will not operate between -0.7V and +0.7V and cannot source current, only sink it. The J2111A is our most popular injector and is the basis for the non-invasive phase margin measurement, which is derived from output impedance.

5. **So how does this non-invasive measurement relate to phase margin and gain margin?**

   The measured Q from the output impedance is 5.77 and we can equate that with 1/(1-T). It doesn't, at least not directly. Since stability is an assessment of the proximity of the gain vector to the singular unstable point, (1,0) on the complex plane, we can assess it, via Q, as 1/(1-T) (or 1+T depending on where we account for the negative feedback). This means that there is no such thing as "gain margin" or "phase margin", but stability margin as a measure of the proximity of the vector gain, T to (1,0).



   We can equate the stability to an equivalent phase margin by assuming the magnitude of the gain vector to be 1 and solving for the Q.

   In our simple example below, the measured Q from the output impedance is 5.77 and we can equate that with 1/(1-T).