Measuring Optocouplers with the J2130 DC Bias Injector and the OMICRON Lab Bode 100 VNA

Many power supplies use optocouplers in the feedback loop. The stability and overall performance of the power supply are often dependent on the CTR and the location of the poles (and zeros) of the optocoupler. It is also common for optocouplers to have a minimum specified CTR, but not a maximum. CTR curves vs. LED current are also not always provided. Therefore, measurements are required to determine the expected performance range. These measurements also support the creation of a SPICE model. The OMICRON Lab Bode 100 Vector Network Analyzer can be used in conjunction with Picotest injectors to measure the CTR and frequency response of optocouplers. The DC Bias injector can be used over a reasonable frequency range of 10Hz -40MHz, and limits the IF current up to approximately 4mA. The objective is to provide a DC+AC bias to the optocoupler while the Bode 100 controls the AC bias, as well as measures the CTR over frequency.

In this measurement the J2130A provides a DC bias to the Optocoupler LED, which returns to ground through a termination resistor. The optocoupler transistor collector is powered from a separate power supply and the emitter is terminated through a termination resistor to ground, we use equal valued termination resistors in order to normalize the CTR to 100%. The resistor value is not as critical as it is for the resistors to be the same value and type.

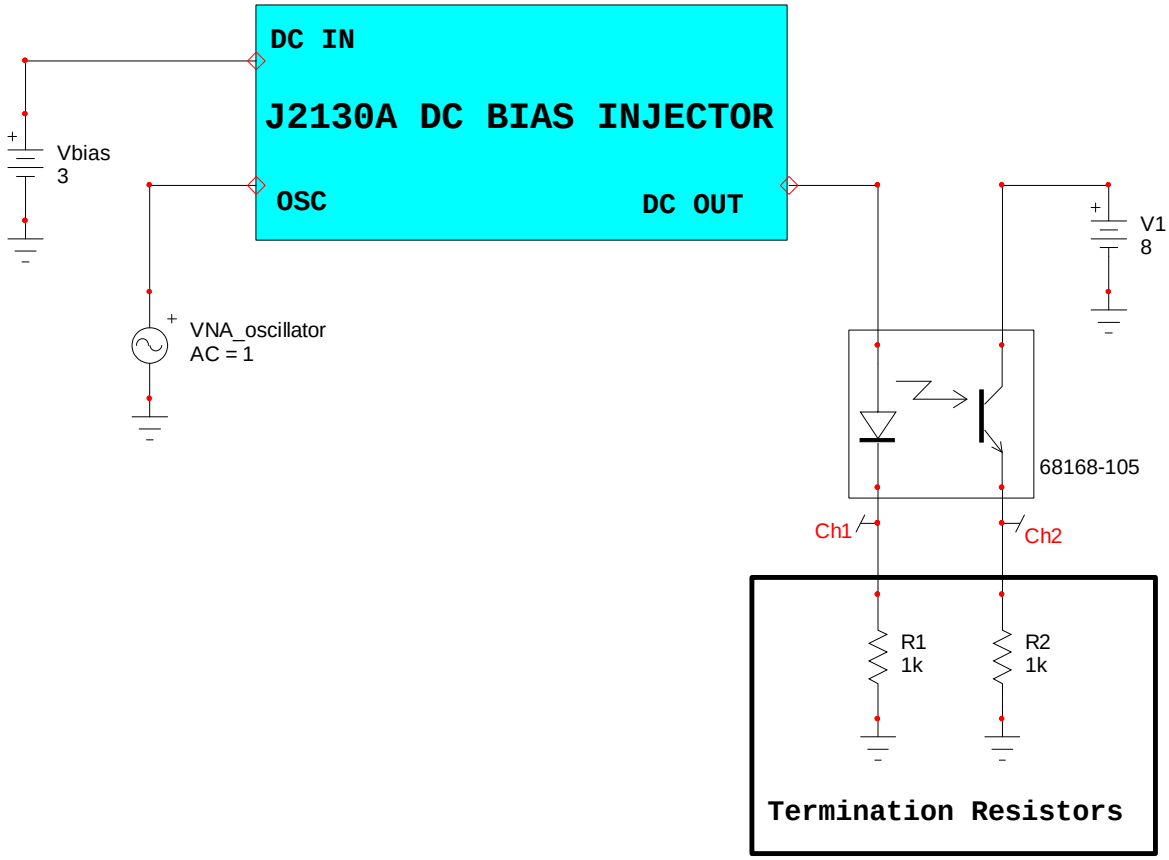

Figure 1 – Schematic diagram for the DC Bias Injector, Bode 100 and optocoupler.

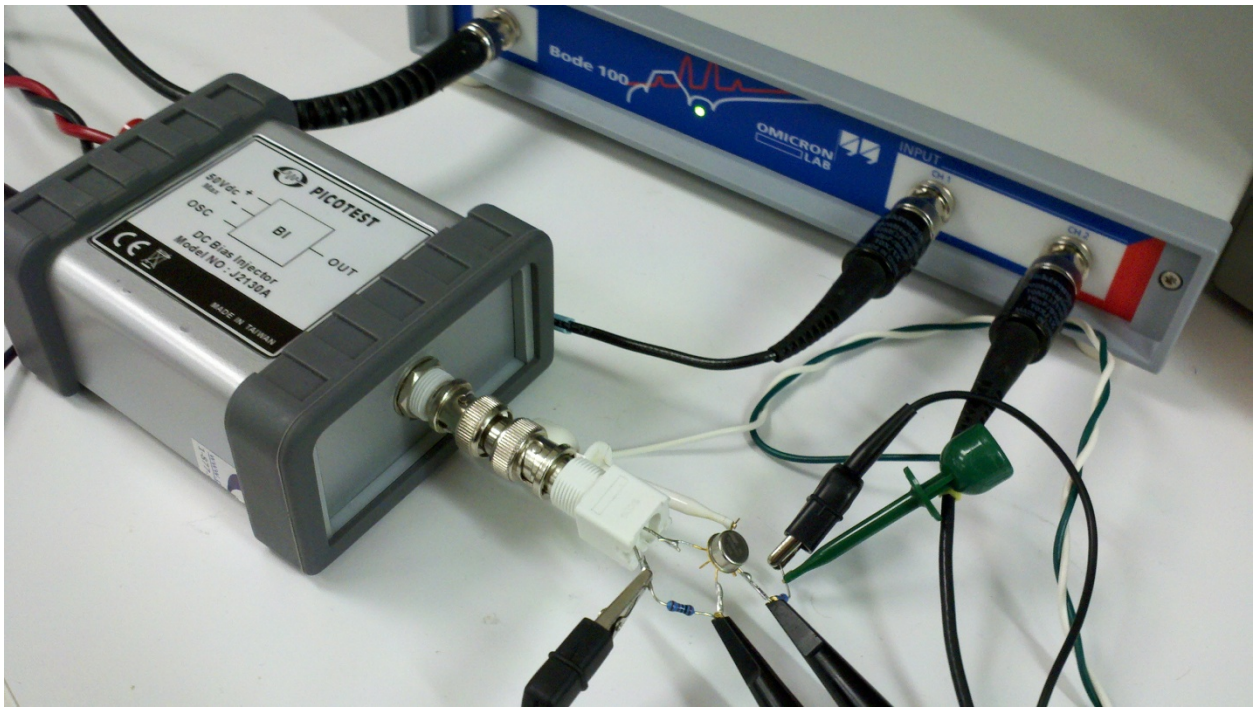

Figure 2 – Photo showing the optocoupler (center) mounted for the measurement.

Calibrating the Measurement

This measurement uses two oscilloscope probes which, for optimum results require a “thru” calibration with the analyzer in order to eliminate any differences between the two probes. During the thru calibration both probes are connected to the Bode 100 source signal and a thru calibration is executed. The detailed instructions for the calibration are described in the Bode 100 user manual.

While you may use a DMM to monitor the LED and collector currents of the optocoupler, you should NOT leave the meter connected for the measurements. The meters can add capacitance that will distort the results.

The performance of the optocoupler can be dependent on the IF current and also the V_{CE} voltage, therefore you must make sure to measure the DUT over a variety of operating points the operating point close to the intended application.

Making the Measurement

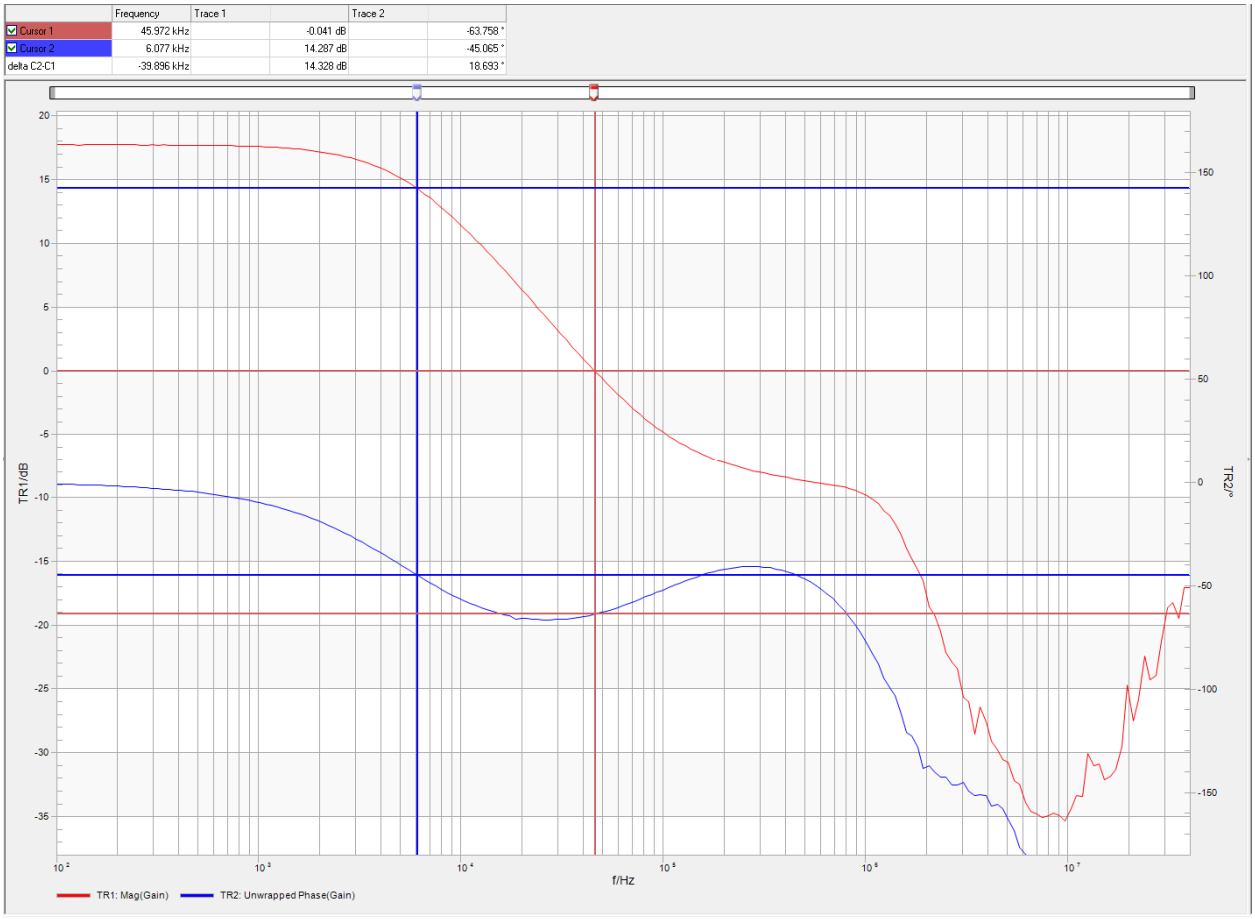

Figure 3 – Measured CTR of MICROPAC 66068-105

The results of this measurement were used to create a SPICE model of the the 68168-105 optocoupler. Figure 4 shows a comparison of the measured result and the simulation of the model.

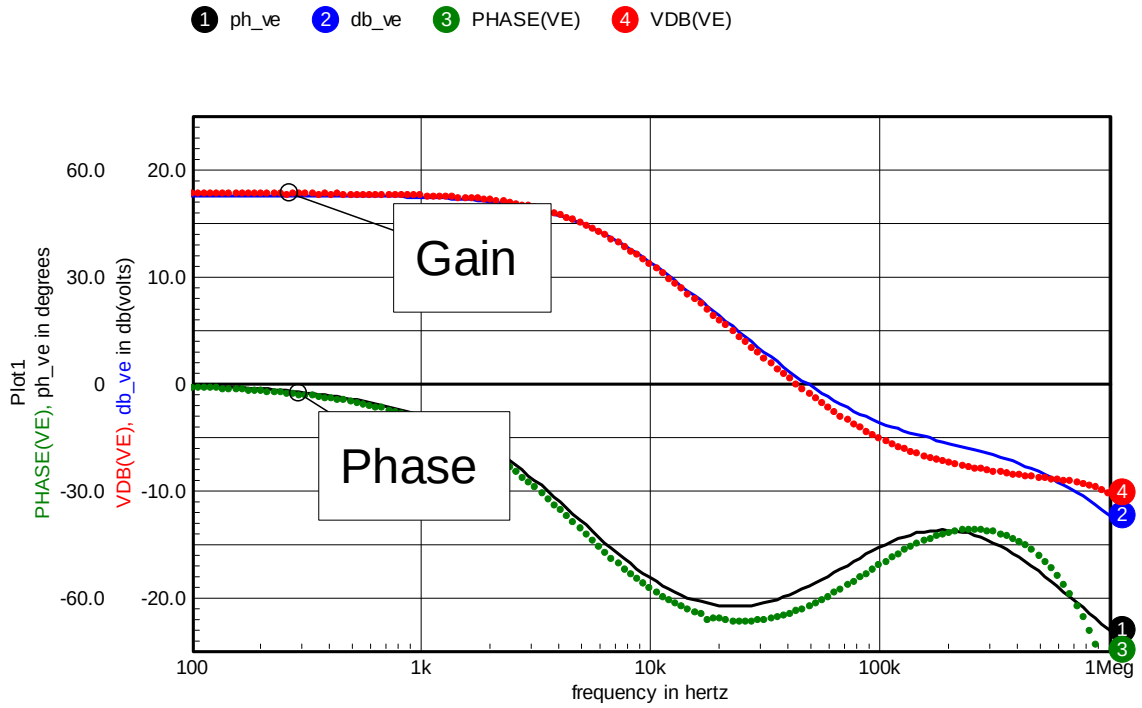

Figure 4 – Comparison between measured performance and simulated performance (gain and phase). Courtesy AEi Systems.

Conclusion

The OMICRON Lab Bode100 Vector Network Analyzer, combined with the Picotest J2130A DC Bias Injector makes measuring optocoupler performance a quick and simple effort. Since the tolerances of optocouplers tend to be quite large, it is generally best to measure a statistical sample of at least 5 or 6 devices.