Measuring Optocouplers with the J2130 DC Bias Injector and the Agilent E5061B Network Analyzer

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 Agilent E5061B 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 Agilent E5061B 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.

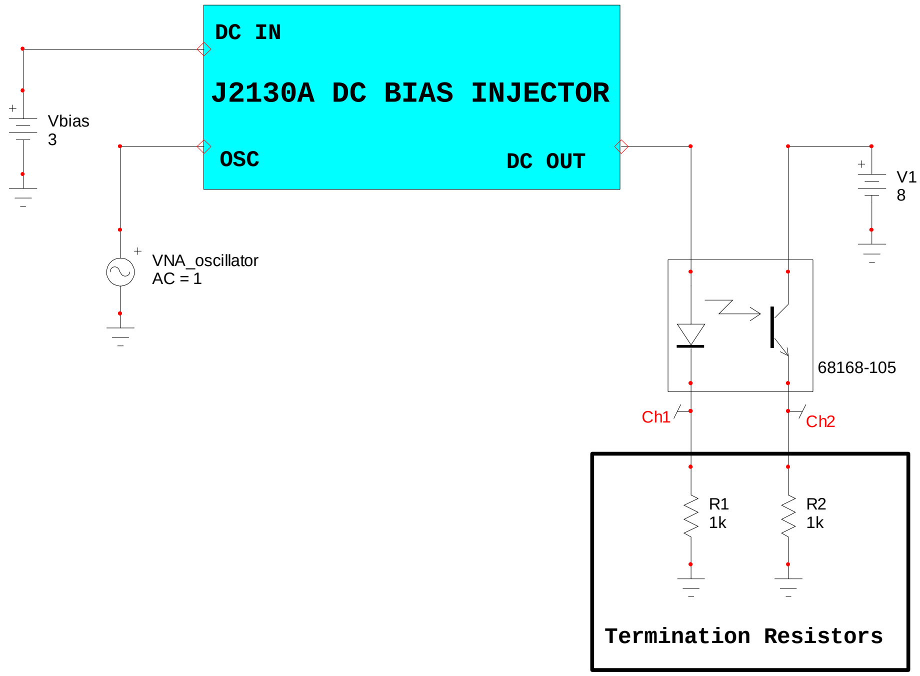

Figure 1 – Schematic diagram for the DC Bias Injector, E5061B and optocoupler.

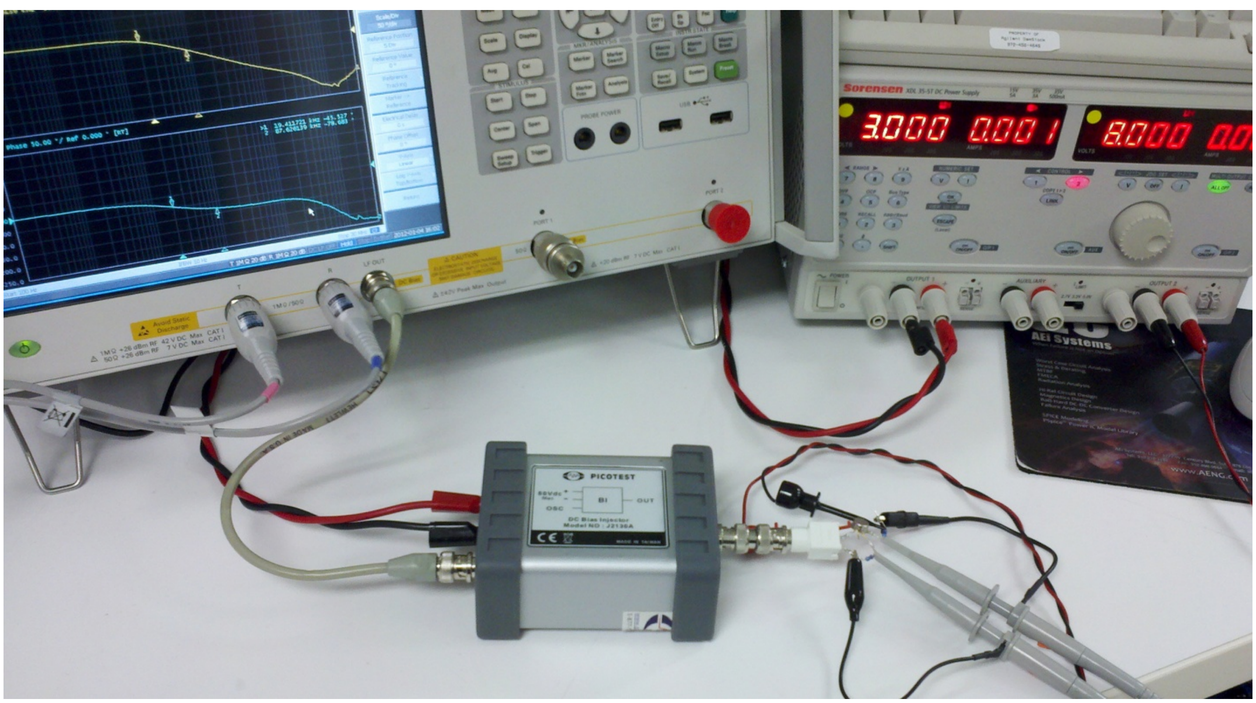

Figure 2 – Photo showing the optocoupler mounted at the output of the J2130A Bias Injector for the measurement.

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 E5061B source signal and a thru calibration is executed. The detailed instructions for the calibration are described in the E5061B software help menu.

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

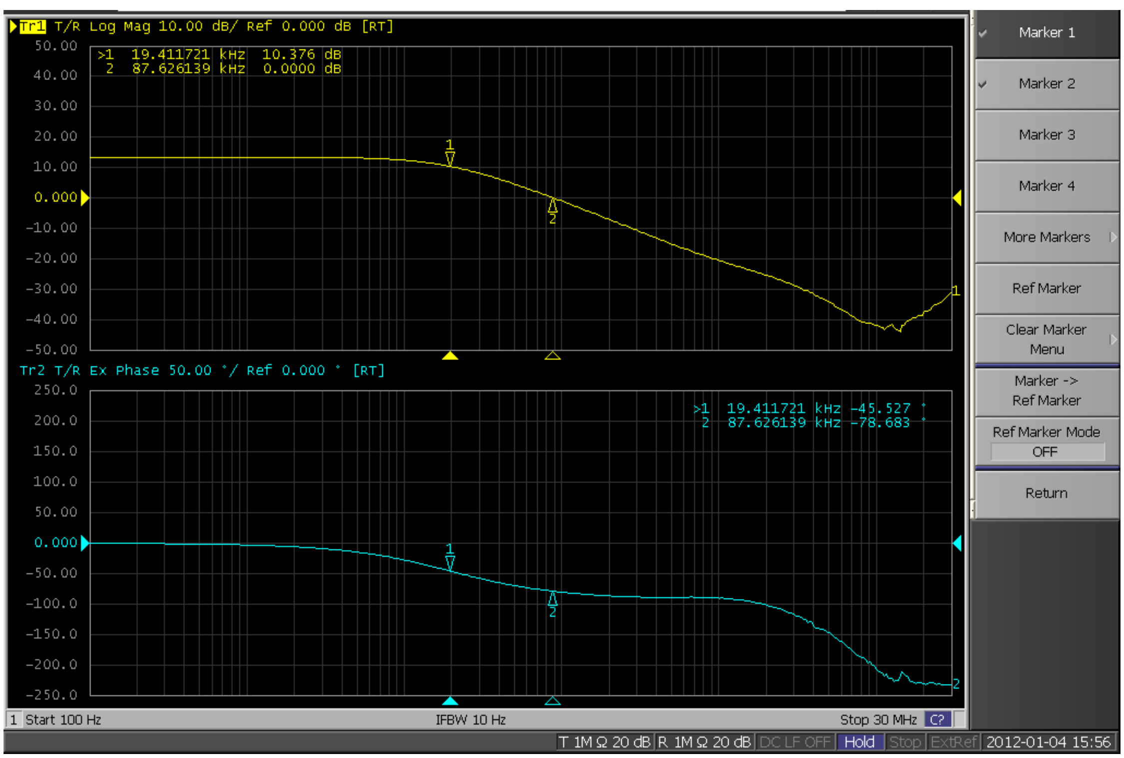

Figure 3 – Measured CTR of MICROPAC 66068-105

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

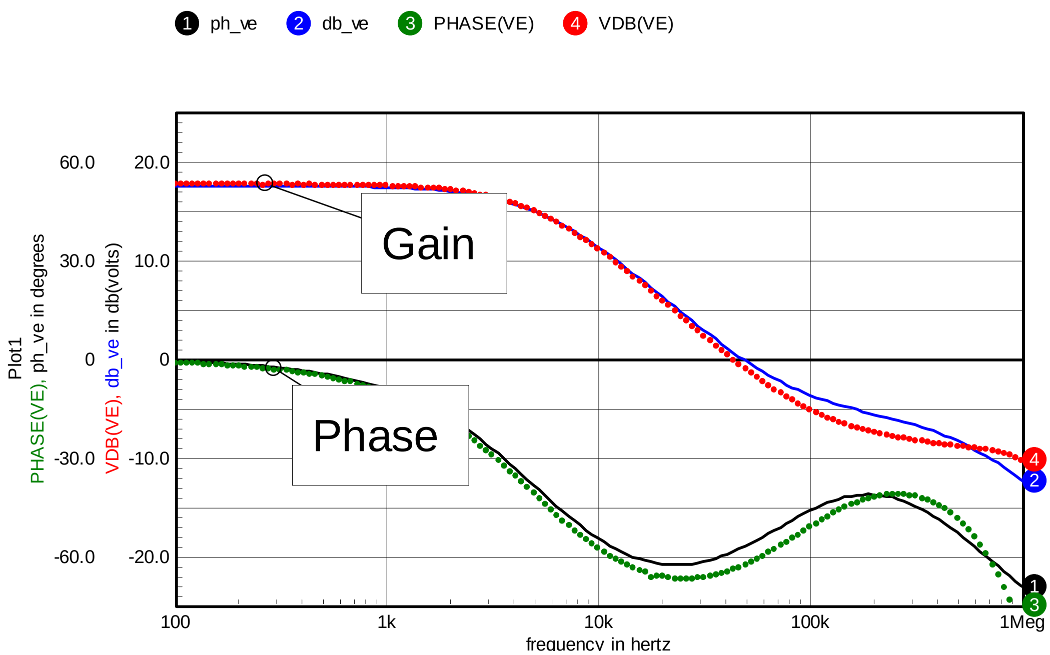

Figure 4 – Comparison between measured performance and simulated performance (gain and phase). Courtesy AEi Systems.

It is preferable to use the J2130A DC Bias Injector for this measurement; however the analyzer output can be placed directly at the anode of the diode in the optocoupler and biased using the internal DC bias of the analyzer. DC Bias sweeps can then be performed at low frequency (10-100Hz) to generate CTR vs. IF curves provided the current is monitored during each point in the sweep to extract IF from the applied DC bias. This is not recommend, however, as the internal 50 Ohm resistor will not limit the IF current of the optocoupler to the same low level (4mA) as the J2130A and could result in damaging the device.

Conclusion

The Agilent E5061B 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.