ECE 558 - Mixed-Signal Test and Product Engineering

Course Outline

A. Simple Mixed-Signal Comparator (review of Analog TPE material with comparator)

   i. Datasheet (production vs. characterization, key production tests, turning a datasheet into a testplan) (Notes)

   ii. production testing methodology for comparators (Chapter 3.10)

   iii. data analysis (repeatability, reproducibility, process variation, turning measurement variability into guardband limits, impact of multiple measurements) (Chapter 4 & 15)

B. DAC Testing (Chapter 11)

   i. Overview of different DAC structures

   ii. Datasheets for different DAC structures showing common tests among structures, structure specific tests, application specific tests

   iii. DC tests (full-scale, DC gain, gain error, offset, LSB step size, DC PSS)

   iv. Transfer curve tests (absolute effort, monotonicity, differential nonlinearity, integral nonlinearity)

   v. Dynamic tests (conversion time, overshoot and undershoot, rise time and fall time, DAC-to-DAC skew, glitch energy)

   vi. Voltage references and resistor trimming.

C. ADC Testing (Chapter 12)

   i. Overview of different ADC structures

   ii. Datasheets for different ADC structures showing common tests among structures, structure specific tests, application specific tests

   iii. Edge code measurement techniques iv. DC tests (DC gain, offset)

   v. Transfer curve tests (INL, DNL, monotonicity, missing codes)

   vi. Dynamic tests (conversion time, recovery time, sampling frequency, aperture jitter, sparkling)

D. Switched Capacitor Filter Testing (if there is time)

   i. Overview of switched-capacitor circuits

   ii. Datasheets for switched-capacitor circuits

   iii. Common tests (fclock, fmax, fcorner, fclock/fcorner, VOH, VOL, clock and data feedthrough)

Lab Topics

Lab 1: ATE demonstration: device-interface-board example and schematic, creating a program in the ETS system, analog resources, UserInit

Lab 2: Continuity: Purpose of the continuity function, how to create a function, use of analog resources, datalogging, running test on ATE and receiving results

Lab 3: Comparator V_{OS}: Let the students develop a new function on their own to obtain practice using the resources, datalogging, and using the ATE.

Lab 4: Slew Rate Test: Perform a slew-rate test on a comparator to understand the clocking scheme, AWG function, and time-measurement unit.

Lab 5: DAC Continuity: Using the digital pin units to perform continuity. Learn how to use the digital resources. This will help in future labs knowing that the chip is loaded correctly.

Lab 6: DAC Gain Error and Offset Voltage: Learning the digital vector editor and applying the clocking system to measure gain error and offset voltage. Have students perform a repeatability study on this test and calculate GRR and guardband limits.

Lab 7: DAC INL and DNL: Students write the test using the vector editor to find VO for a subset of digital input codes. From this data, INL and DNL calculations are performed. Have students perform a repeatability study on this test and calculate GRR and guardband limits.

Lab 8-10: ADC Transfer Function Histogram: Write the test function to create the DC transfer curve of the ADC using the histogram method.