

Table of Contents

Table of Contents	1-1
Overview of Mixed Signal Testing.....	1-1
Objectives	1-1
Digital and Analog Testing with Automatic Test Equipment.....	1-3
Digital Signals.....	1-3
Digital Test Systems	1-7
Functional Testing.....	1-8
Parametric Testing	1-11
Analog Signals	1-14
Analog Test Systems.....	1-18
Mixed Analog and Digital Signals.....	1-22
Mixed Signal Test Systems.....	1-24
Key Points of This Chapter.....	1-30
References.....	1-30
The Mathematics of DSP.....	2-1
Objectives	2-1
Introduction.....	2-3
Logarithms and Exponents	2-3
Decibels	2-7
Time and Frequency.....	2-11
Time and Frequency Domain Signal Representations.....	2-20
Fourier Series.....	2-23
Complex numbers	2-26
Key Points of This Chapter.....	2-31
References.....	2-31
Laboratory I.....	Lab I-1
Chapter 1 Questions.....	Lab I-1
Chapter 2 Questions.....	Lab I-3
Lab Exercise 1.1 - Creating and examining a Fourier series	Lab I-5
Basic Device Specifications	3-1
Objectives	3-1
Digital Device Specifications	3-3
Analog Device Specifications.....	3-4
Key Points of This Chapter.....	3-13
References.....	3-13
Digital to Analog Converter Static Measurements	4-1
Objectives	4-1

Digital-to-Analog Converters	4-3
DAC Static Specifications	4-4
Test System Configuration for DAC Static Parameter Tests	4-13
DAC Architectures	4-16
Current Output DACs	4-23
Averaging to Improve Test Results.....	4-23
Key Points of This Chapter.....	4-24
References.....	4-24
Laboratory II.....	Lab II-1
Chapter 3 Questions	Lab II-1
Chapter 4 Questions.....	Lab II-2
DSP Lab Exercise 2.1 - Examining Noise in the Time Domain.....	Lab II-6
Analog to Digital Converter Static Measurements	5-1
Objectives	5-1
Analog-to-Digital Conversion	5-3
ADC Theory of Operation	5-4
ADC Static Specifications	5-8
Test System Configuration for ADC Static Parameter Tests	5-21
Measuring ADC Transition Points.....	5-24
Key Points of this Chapter	5-38
References.....	5-38
Sampling	6-1
Objectives	6-1
Sampling Theory.....	6-3
Sampling Requirements.....	6-3
Converting a Time Sample Set to Frequency	6-5
Benefits of and Problems Caused by Sampling.....	6-8
Sin(x) / x Amplitude Error.....	6-18
Coherent sampling	6-24
Coherency Formula Relationships.....	6-25
Spectral Parameters.....	6-29
Digitizing samples	6-30
Generating Time Samples.....	6-30
Inverse Fourier Transform	6-32
Key points of this chapter	6-35
References.....	6-35
Laboratory III.....	Lab III-1
Chapter 5 Questions.....	Lab III-1
Chapter 6 Questions.....	Lab III-2

Lab Exercise 3.1 - Sampling.....	Lab III-4
Lab Exercise 3.2 - Creating a Frequency Spectrum from Digitized Samples	Lab III-7
Lab Exercise 3.3 - The Effects of Aliasing in the Frequency Domain	Lab III-13
Lab Exercise 3.4 - Inverse Fourier Transform Time Sample Generation.....	Lab III-15
Digital to Analog Converter Dynamic Parameters.....	7-1
Objectives	7-1
DAC Dynamic Specifications.....	7-3
Intermodulation Distortion (IM).....	7-8
Other Considerations for Dynamic Testing	7-11
Test System Configuration for DAC Dynamic Parameter Tests	7-12
Capturing DAC Output.....	7-23
Synchronization Issues	7-31
Key Points of This Chapter.....	7-33
References.....	7-33
Analog to Digital Converter Dynamic Parameters.....	8-1
Objectives	8-1
ADC Dynamic Specifications.....	8-4
Test System Configuration for ADC Dynamic Parameter Tests	8-10
Creating an ADC Input Signal.....	8-14
Capturing Digital Output Data.....	8-19
Acquiring and Holding the Input Signal.....	8-20
Sampling with the ADC Under Test.....	8-24
Undersampling.....	8-25
Calculating SINAD, THD, SNR and IM	8-27
Key Points of This Chapter.....	8-35
References.....	8-35
Laboratory IV	Lab IV-1
Chapter 7 Questions.....	Lab IV-1
Chapter 8 Questions.....	Lab IV-7
Lab Exercise 4.1 - Creating DAC inputs for a sine wave.....	Lab IV-8
Lab Exercise 4.2 - Digitizing a Sine Wave	Lab IV-13
Lab Exercise 4.3 - Coherently sampling a sine wave	Lab IV-15
Lab Exercise 4.4 - Undersampling with the beat frequency method.....	Lab IV-17
Lab Exercise 4.5 - Undersampling using the Envelope method.....	Lab IV-19
General Test Issues.....	9-1
Objectives	9-1
Does the Measurement Reflect the DUT or the Test System?.....	9-2
Noise in the Test Environment.....	9-3
Ground Issues	9-5

Current Paths.....	9-7
Power Supplies	9-8
Averaging and Repeatability.....	9-11
References.....	9-14
Oversampling to Improve Dynamic Range	A-1
Objectives	A-1
Oversampling.....	A-3
Key Points of This Chapter.....	A-7
Delta-Sigma Conversion.....	B-1
Objectives	B-1
Delta-Sigma Conversion Concepts.....	B-3
Oversampling.....	B-4
Delta Modulator.....	B-7
Delta-Sigma Conversion.....	B-9
Noise Shaping.....	B-12
Digital Filtering.....	B-15
Decimation.....	B-16
Self Tones.....	B-17
Higher Order Converters	B-19
Delta-Sigma Digital-to-Analog Conversion	B-20
Key Points of This Chapter.....	B-21
References.....	B-21
Transmission Lines and Terminations	C-1
Objectives	C-1
Transmission Lines	C-3
Termination Techniques.....	C-7
Key Points of This Chapter.....	C-13
References.....	C-13
Answers to Chapter and Lab Questions.....	Ans-1
Chapter 1 Quiz Answers	Ans-1
Chapter 2 Quiz Answers	Ans-2
Chapter 3 Quiz Answers	Ans-4
Chapter 4 Quiz Answers	Ans-5
Chapter 5 Quiz Answers	Ans-8
Chapter 6 Quiz Answers	Ans-9
Chapter 7 Quiz Answers	Ans-11
Chapter 8 Quiz Answers	Ans-14
Answers to Lab Exercise 1.1- Creating and Examining a Fourier Series.....	Ans-15
Answers to Lab Exercise 2.1 - Examining Noise in the Time Domain	Ans-17

Answers to Lab Exercise 3.1 - Sampling..... Ans-19

Answers to Lab Exercise 3.2 - Creating Frequencies from Digitized Samples..... Ans-20

Answers to Lab Exercise 3.3 - The Effects of Aliasing in the Frequency Domain... Ans-22

Answers to Lab Exercise 3.4 - Using IFFT to Generate Time Samples Ans-22

Answers to Lab Exercise 4.1- Creating DAC Inputs for a Sine Wave Ans-23

Answers to Lab Exercise 4.2 - Digitizing a Sine Wave Ans-26

Answers to Lab Exercise 4.3 - Coherently sampling a sine wave Ans-27

Answers to Lab Exercise 4.4 - Undersampling with the Beat Frequency Method.... Ans-28

Answers to Lab Exercise 4.5 - Undersampling with the Envelope Method..... Ans-28

Glossary G-1

Index.....I-1