USAF ACADEMY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
LESSON 17 LAB - Introduction to Phased Array Hardware
Lab Packet
Fall 2026

Name: _____ **Section:** _____ **Date:** _____

Learning Objective 3.3: I can identify the hardware architecture of the ADALM-PHASER and control it via SDR software.

This packet is the L17 Lab, in three parts, and you turn it in once, complete, before Lesson 18. Do **Part 1** on your own before the lab period: a few questions about the hardware you will bring up. **Part 2** is your own record from your kit, in class: did it come up, and does it see the source. Do **Part 3** on your own after the lab: a block diagram of the kit, two bench diagnoses, and two short written answers.

Grading. One submission, counted toward your engagement grade and graded as a genuine, documented attempt.

Part 1: Pre-Lab (individual, before the lab period)

1. **The receive chain.** A wave from the HB100 reaches the PHASER's patches and ends up as numbers in the Raspberry Pi.

   (a) Put these six blocks in the order the signal meets them, from one patch to the Pi, and say in a few words what each one does: ADALM-Pluto, ADAR1000, frequency converter, LNA, patch, Raspberry Pi.

Order	Block	What it does
1		
2		
3		
4		
5		
6		

   (b) The ADAR1000 sets each element's phase with a 7-bit phase shifter. How many phase settings does it have, and how far apart are neighboring settings in degrees?

settings = _____

step = _____

(c) How many elements feed one ADAR1000? How many signals leave the pair of ADAR1000s after their sums, and so how many channels does the Pluto digitize?

elements per chip = ____

signals out = ____

channels = ____

2. The kit's name. I assign each kit a two-digit number NN, and Part A of the procedure on the L17 Lab page gives the kit the name `phaser-NN` when it is provisioned. The laptop reaches the kit by that name over the Ethernet cable. Fill in the row for kit 07, and your own row once you know your number.

Kit	Kit name	ssh command	GUI address
07			

Part 2: Measurements (your kit, in class)

Follow the procedure on the L17 Lab page in read mode, and record each value as the kit or the GUI reports it.

3. **The bring-up record.** Part A of the procedure: did the kit come up?

Item	**Value**
Kit number NN	
Date the Pi printed after Step 15	
Result of `ping -c 4 github.com`	
Last line `provision.sh` printed	
What `hostname` prints	
What the connection pill reads	
Frequency **Find HB100** reported	
IF **Characterize IF** chose	
Calibrate Phaser ran to completion (yes or no)	

4. **The kit check.** Part B of the procedure: does the kit see the source, and does it follow the source when it moves? Open the **Lab Presets** section, load **1 Steering Angle**, and press **Start**, with the HB100 about 1 m out at boresight, then set **Rx Gain (dB)** so the FFT peak reads -10 ± 3 dBFS. The level is the reference, not the gain: the gain that reaches it depends on your source and your distance.

Rx Gain used = _____ distance = _____

(a) The FFT tab.

Peak position (MHz)	**Peak (dBFS)**	**Floor (dBFS)**	**Separation (dB)**

(b) The Rectangular tab, with **Show Peak Angle Marker** on. For the second row, carry the HB100 to about 30° on one side, at the same distance from the array and aimed at it, and write the end of the array it moved toward, E1 or E8. Facing the patches, E1 is the element on your right.

Source	**Angle**	**Peak Gain (dB)**
At boresight		
About 30° toward		
Back at boresight		

Part 3: Writeup (individual, after the lab)

5. **The labeled block diagram.** Sketch the receive chain from the patches to the Raspberry Pi. Label every block with its name and with the frequency of the signal at that point, mark where the analog sum happens, and mark where the two digital channels begin.

6. **Bench diagnosis.** Two classmates ask for help with Part B.

   (a) The first presses **Start** and sees no peak anywhere on the FFT tab. Give the first two checks you would make, in order, and say what each one rules out.

   (b) The second classmate's FFT tab shows a peak 25 dB above the floor, but on the Rectangular tab its sweep stands only 8 dB above the sweep's floor, against about 23 dB on a working kit, and Angle reads 11° with the source at boresight. What would you check next, and why?

7. **Written answers.** Answer each in three or four sentences.

   (a) Why does the control software have to measure the HB100's frequency instead of assuming 10.525 GHz?

   (b) The array has eight elements, but software sees only two digital channels. Explain where the other six went, and name one thing this rules out.

Documentation: _____