CHL NETHERLANDS B.V.
Christiaan Huygens Laboratorium

Concept

Adjusting the phase shifter

This Engineering Note describes the procedure for adjusting the phase shifter in the Artemis MK5 Antenna Unit type A5AU. Adjustment of the phase shifter may be necessary after replacement of the original antenna of the Antenna Unit (AU) by another antenna.

The function of the phase shifter is to maintain the phase relationship of the received SUM and DIF signal up to the servo detector on the Antenna Unit Processing (AUP) board, i.e., to compensate for the unequal signal path of the SUM and DIF signal from the antenna ports to the input of the servo detector.

Note: An Artemis Beacon has no phase shifter.

Equipment and tools required

- Two-channel oscilloscope, 100MHz.
- Artemis counter station (Mobile or Fixed station or a Beacon).
- Metric spanner no. 5.
- Phase shifter tuning screw M4 (preferably screw 70 mm long with knurled knob).

For the adjustment of the phase shifter it is necessary to make a link with an Artemis counter station. If only a Beacon is available as a counter station, then the Antenna Unit of which the phase shifter needs to be adjusted must be configured as a Mobile station. The counter station must be set enabled for remote control. The distance between the two stations should preferably be a few hundred metres and a clear line of sight between the two stations should exist.

Procedure

1. Switch off the 230 VAC supply to the AU.

2. Remove the Bottom Cover of the unit of which the phase shifter has to be adjusted. To do so, loosen the three snap-locks at the side of the AU and lower the Bottom Cover until it hangs on the two straps provided for.

3. Connect the probe of oscilloscope channel 1 to test point TP5 (SUM) on the AUP board (see photo 1 on page 2). [The probe can be connected from the side of the AUP board, without the necessity to remove the lid of the board].

4. Connect the probe of oscilloscope channel 2 to test point TP6 (DIFF) on the AUP board.

5. Connect the ground lead of the two probes to one of the semi-rigid coaxes in the vicinity.

6. Switch on the 230 VAC supply to the AU.

7. Set the frequency pair to the same frequency pair the counter station is set for.

Distribution

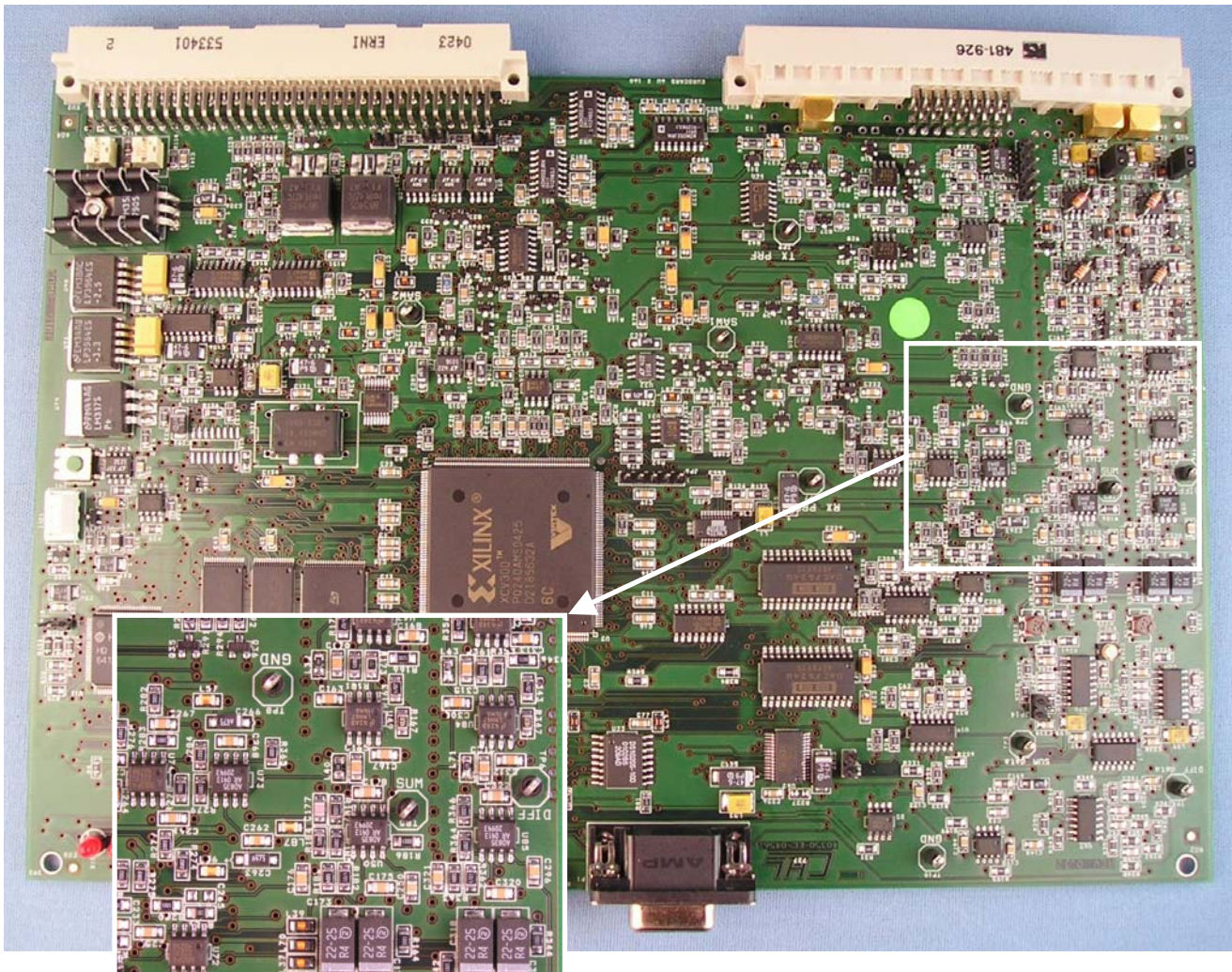|	
CHL NETHERLANDS B.V.	: AKI, AKO, HEB, JMH, SHH
Reson B.V.	: A. van Valkenhoef, S. Gillebaard, T. Mulyono, B. Bos, N. van Woerkom
Other	:

Continued from page 1

Photo 1

8. Set the ground level of channels 1 and 2 on the horizontal centre line of the oscilloscope screen.

9. Turn the antenna towards the antenna of the counter station. When the antenna is properly locked to the counter station, the amplitude of the DIF signal on the oscilloscope is minimal.

10. Trigger the oscilloscope on channel 1 (SUM signal) and set its sensitivity to a value that gives an amplitude of at least three divisions. Set the sensitivity of channel 2 (DIF signal) to the same value.

11. Set the time base of the oscilloscope to 10 ns/div (the 30 MHz signal period shows then as 3.3 divisions).

12. Shift the time base of the oscilloscope until one zero crossing of the SUM signal falls over a vertical grid line. See photo 2.

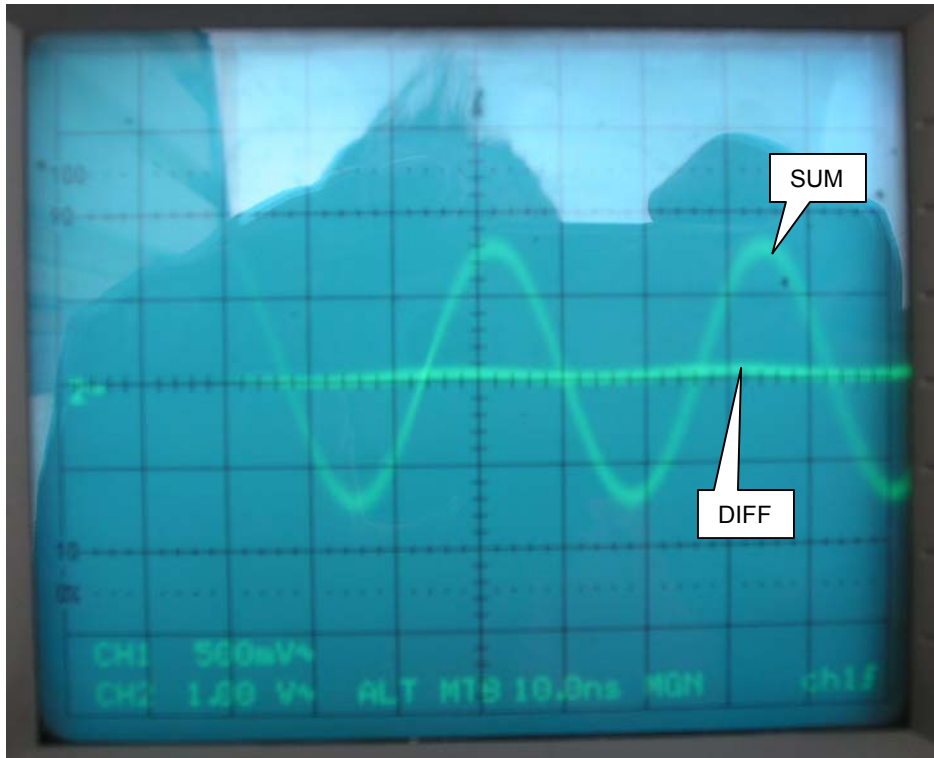13. Set the operating mode of the station to open loop.

Photo 2
(to be replaced by a better photo)

14. Manually turn the antenna slightly away from the counter station until the DIF signal has about the same amplitude as the SUM signal.

    Note: Do not turn the antenna away by more than two degrees, otherwise the amplitude of the SUM signal starts to decrease.

    Note: If the DIF signal seems to be in anti-phase with the SUM signal, turn the antenna in the other direction.

15. Observe the phase difference between the SUM and the DIF signal by reading the ΔT at the zero line crossing as a positive value (DIF signal right from the SUM signal) or as a negative value (DIF signal left from the SUM signal). Note this value in a table as shown on page 6.

16. Note the value of the servo signal (read from the Service Page of the Reson Artemis MK5 control software or, more convenient, from the external operating panel (requires menu software version 2.0)).

17. Remotely set the counter station for the next frequency pair.

18. Set the station for the next frequency pair.

19. Note the phase difference (ΔT) between the SUM and DIF signal and the servo signal.

20. Repeat steps 17 - 19 until the phase difference and the servo signal for all frequency pairs has been noted.

21. Evaluate the measurement results. A phase difference of up to 4 ns (this equals about 45 degrees) is acceptable. Also, the greater the servo signal, the better, be it that the servo signal should be approximately the same for all four frequency pairs.

    If there are large phase differences and/or large differences in servo signal, continue with step 22. Otherwise perform steps 26, 28 and 29.

22. Screw the phase shifter tuning screw in the phase shifter until it can go no further. See photo 3 below.

23. Loosen the lock screw on top of the phase shifter, using a metric number 5 spanner.
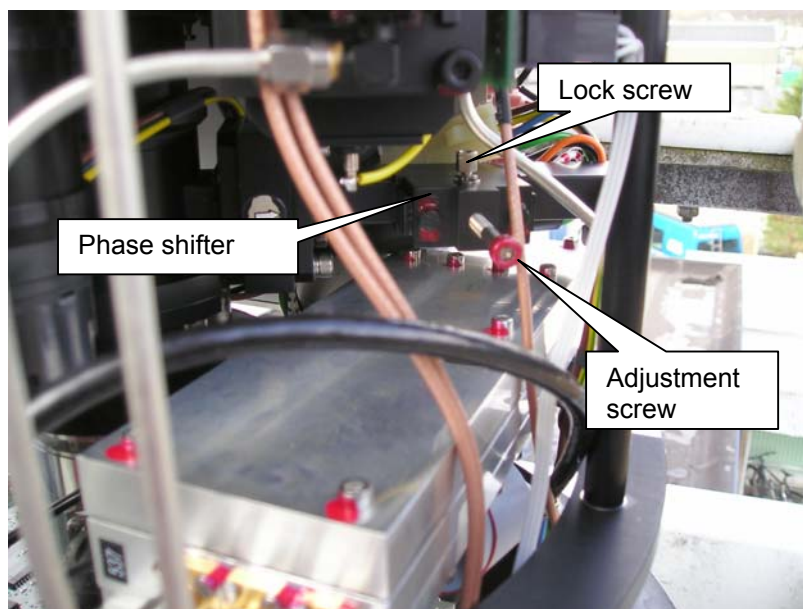

Photo 3

24. Adjust the phase shifter by screwing the tuning screw in or out; when screwing the screw out, slide the phase shifter in by hand. Adjust until the phase difference between the SUM and the DIF signal is minimal and the servo signal is reasonably equal for all four frequency pairs.

Note: If the range of the phase shifter is not sufficient, adjust it for anti-phase of the SUM and DIF signal and slightly turn the antenna in the other direction to make the SUM and DIF signal being in phase again.

Note: If the phase shifter has to be adjusted for anti-phase, the value of the parameter azimuth error polarity parameter (azep) must be inverted to achieve lock. See step 26.

25. Carefully tighten the lock screw of the phase shifter (make sure that its setting does not change while tightening the lock screw).

26. Check that the system locks well for all four frequency pairs.

Note: If the antenna turns away from the counter station's antenna, invert the value of the AUP parameter "azimuth error polarity" (azep)" (see also Engineering Note EN5-1A) and verify that the antenna now locks.

27. Remove the tuning screw from the phase shifter.

28. Switch off the 230 VAC supply to the AU and disconnect the oscilloscope probes.

29. Put the Bottom Cover back in place and lock it by closing the three snap locks.

Tables for entering phase shifter adjustment results

Frequency Pair (FP)	Frequency Mobile (MHz)	Frequency Fixed (MHz)	ΔT (ns)	Servo signal
0	9200	9230		
1	9300	9270		
2	9230	9200		
3	9270	9300		

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