

35. Ensure that the Buffer module's *Gain* control is turned fully anti-clockwise.
36. Without wearing the headphones, plug them into the Buffer module's headphone socket.
37. Put the headphones on.
38. Turn the Buffer module's *Gain* control clockwise and listen to signal.
39. Disconnect the plugs from the Master Signals module's *2kHz SINE* output and connect them to the Speech module's output.
40. Speak into the microphone and listen to the signal.
41. Disconnect the plugs from the Speech module's output and connect them to the Master Signals module's *100kHz SINE* output.
42. Carefully turn the Buffer module's *Gain* control clockwise and listen to the signal.

Question 6

Why is the Master Signals module's *100kHz SINE* output inaudible?

43. Turn the Buffer module's *Gain* control fully anti-clockwise again.



Ask the instructor to check
your work before finishing.

2.2 - The Adder and Phase Shifter modules

The Adder module

Several communications and telecommunications systems require that signals be added together. The Adder module has been designed for this purpose.

Procedure

1. If you're starting the experiment from here, gather the equipment listed on page 2-2 (but not the headphones).
2. Set up the scope per the instructions in Experiment 1. Ensure that:
 - the *Trigger Source* control is set to the *CH1* (or *INT*) position.
 - the *Mode* control is set to the *CH1* position.
3. Locate the Adder module and turn its *g* control (for *Input B*) fully anti-clockwise.
4. Set the Adder module's *G* control for (*Input A*) to about the middle of its travel.
5. Connect the set-up shown in Figure 1 below.

Note: Although not shown, insert the black plugs of the oscilloscope leads into a ground (*GND*) socket.

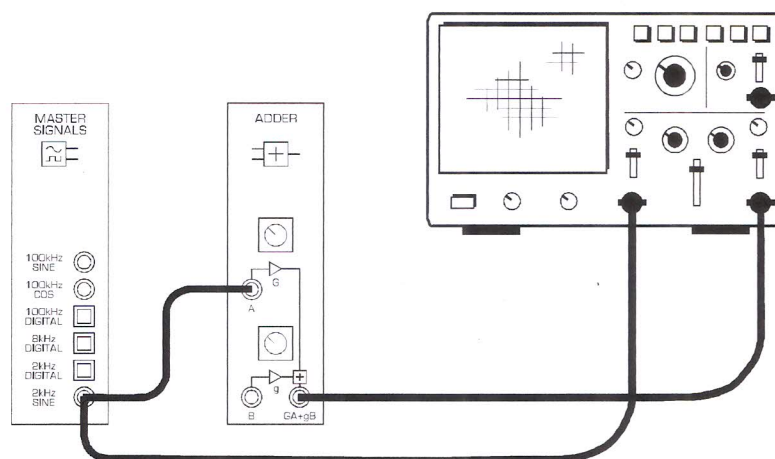


Figure 1

The set-up in Figure 1 on the previous page can be represented by the block diagram in Figure 2 below.

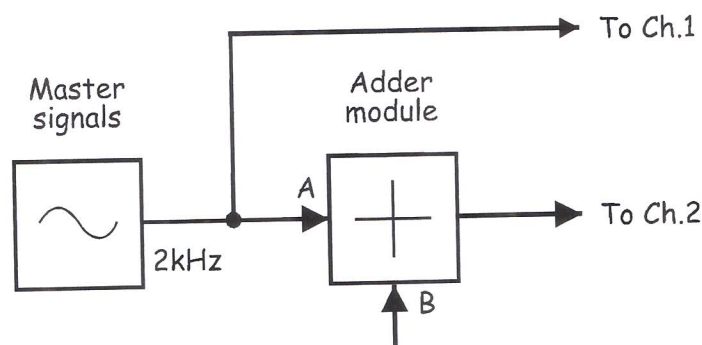


Figure 2

6. Adjust the scope's *Timebase* control to view two or so cycles of the Master Signals module's 2kHz SINE output.
7. Set the scope's *Mode* control to the DUAL position to view the Adder module's output as well as the Master Signals module's 2kHz SINE output.
8. Set both of the scope's *Vertical Attenuation* controls to the 1V/div position.
9. Vary the Adder module's *G* control left and right and observe the effect.

Question 1

What aspect of the Adder module's performance does the *G* control vary?

10. Measure the voltage on the Adder module's *Input A*. Record your measurement in Table 1 on the next page.
11. Turn the Adder module's *G* control fully clockwise.
12. Measure and record the Adder module's output voltage.
13. Calculate and record the voltage gain of the Adder module's *Input A*.
14. Turn the Adder module's *G* control fully anti-clockwise.
15. Repeat steps 12 and 13.

Table 1		Input voltage	Output voltage	Gain
Input A	Maximum			
	Minimum			

Question 2

What is the range of gains for the A input?



Ask the instructor to check your work before continuing.

16. Turn the Adder module's *G* control fully anti-clockwise.
17. Disconnect the Master Signals module's *2kHz SINE* output from the Adder module's *Input A* and connect it to the Adder's *Input B*.
18. Turn the Adder module's *g* control fully clockwise.
19. Measure the Adder module's output voltage. Record your measurement in Table 2 below.
20. Calculate and record the voltage gain of the Adder module's *Input B*.
21. Turn the Adder module's *g* control fully anti-clockwise.
22. Repeat steps 19 and 20.

Table 2		Input voltage	Output voltage	Gain
Input B	Maximum	See Table 1		
	Minimum			

Question 3

Compare the results in Tables 1 and 2. What can you say about the Adder module's two inputs in terms of their gain?



Ask the instructor to check your work before continuing.

23. Turn both of the Adder module's gain controls fully clockwise.
24. Connect the Master Signals module's *2kHz SINE* output to both of the Adder module's inputs.
25. Measure the Adder module's new output voltage. Record your measurement in Table 3 below.

Table 3

Adder's output voltage	
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Question 4

What is the relationship between the amplitude of the signals on the Adder module's inputs and output?



Ask the instructor to check your work before continuing.

The Phase Shifter module

Several communications and telecommunications systems require that the signal to be transmitted (speech, music and/or video) is phase shifted. Crucial to being able to implement these systems in later experiments is the ability to phase shift any signal by almost any amount. The Phase Shifter module has been designed for this purpose.

26. Locate the Phase Shifter module and set its *Phase Change* control to the 0° position.
27. Set the Phase Shifter module's *Phase Adjust* control to about the middle of its travel.
28. Connect the set-up shown in Figure 3 below.

Note 1: Insert the black plugs of the oscilloscope leads into a ground (*GND*) socket.

Note 2: The LED on the Phase Shifter module will turn on but don't be concerned by this. The LED is used to indicate that the module has automatically adjusted itself for your low frequency input.

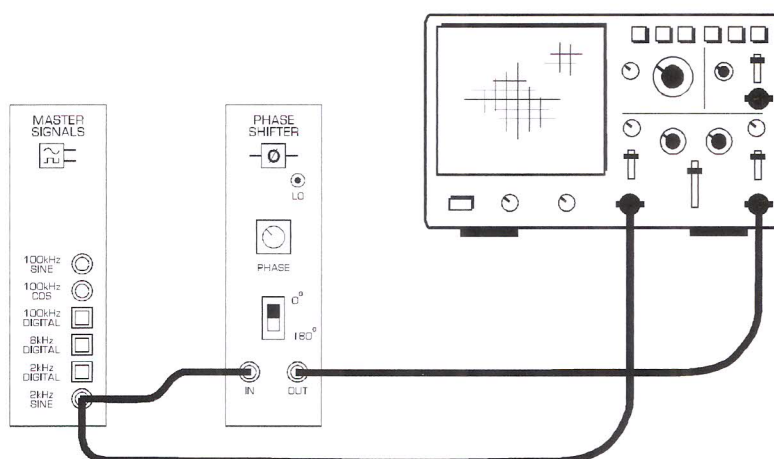


Figure 3

The set-up in Figure 3 on the previous page can be represented by the block diagram in Figure 4 below.

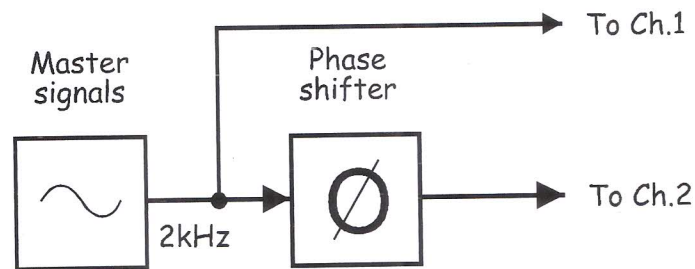


Figure 4

29. Adjust the scope's *Timebase* control to view two or so cycles of the Master Signals module's *2kHz SINE* output.
30. Set the scope's *Mode* control to the *DUAL* position to view the Phase Shifter's output as well as the Master Signals module's output.
31. Vary the Phase Shifter module's *Phase Adjust* control left and right and observe the effect on the two signals.
32. Set the Phase Shifter module's *Phase Change* control to the *180°* position.
33. Vary the Phase Shifter module's *Phase Adjust* control left and right and observe the effect on the two signals.

Question 5

This module's output signal can be phase shifted by different amounts

- ☐ but it always leads the input signal.
- ☐ but it always lags the input signal.
- ☐ and can either lead or lag the input signal.

Question 6

Is the Phase Shifter module capable of shifting a signal by *360°*? **Tip:** If you're not sure, repeat steps 31 to 33.