

**6.002 Demo# 03 ( Load set up demo#03.set )**  
**Salt water**  
**Lecture 3**

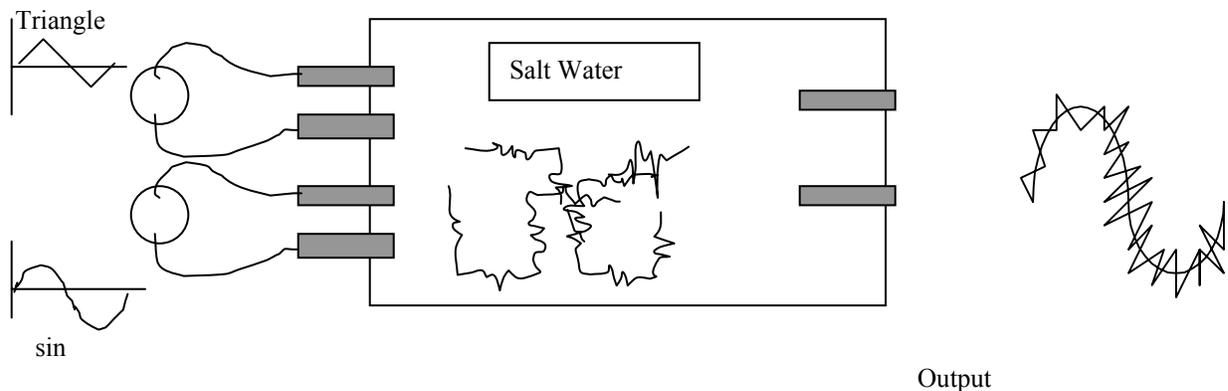
**Agarwal Fall 00**

Purpose:

This demo uses a tray of salt water to demonstrate concepts such as linearity, superposition and Thevenin equivalent circuits. The salt water is modeled as a complicated network of resistors, but its properties can be summarized using simple equivalent circuits. Two sets of input terminals and one set of output terminals are connected to the tray, and the salt water is treated as a “black box”. Two different signals (DC and a sinusoid) are placed across the inputs, and the resulting output is measured. The output is shown to be the sum of the responses to the individual drives.

Steps:

1. (optional?) In describing the demo to the students (modeled by a complex linear resistor network), mention that regular water (or distilled water) has a high resistance compared with salt water. Show this using the scope by showing the output waveform growing when salt is added to the water. (Notes: the demo can behave erratically if stirred up too much. Also, there is an opportunity here for a joke regarding the high conductivity of Cambridge water!)
2. Show the inputs (constant, sinusoid) on the scope along with the total output. Turn off the sinusoidal source by removing the cable. Now show the triangle source on the scope
3. Turn on the sinusoidal source and the triangle source and observe the output with little triangle waveform ridding over the sine waveform.



When Prof. Agarwal ( Fall 00) asked question about the water if they knew where we got it ?

Some students suggested water from Charles River!!!!!!

**Description: Linearity, superposition, Thevenin equivalences**

**CONNECT EXT1 (Blue) to INPUT, EXT2 (Red) to OUTPUT \*\***

**Scope look @ CH1 and CH4**

**FG1 set freq @ 1 Khz Amp 1 v p-p Offset zero Sine Wave**

**FG2 set freq @ 10 Khz Amp 1 v p-p Offset zero Triangle Wave**

**Note: see the pictorial diagram next page for more detail**

**\*\* We use direct connection because the jumper board was picking up signal without water!  
We use the above connection instead the one on the last page. They both work.**

### Oscilloscope Setup

| CH          | V/DIV | OFFSET | MODE              | FUNC | MATH | VERTICAL | HORIZONTAL |
|-------------|-------|--------|-------------------|------|------|----------|------------|
| 1           | on    | 1      | 0                 | DC   | off  |          |            |
| 2           | off   |        |                   |      | off  |          |            |
| 3           | off   |        |                   |      | on   |          |            |
| 4           | on    | 200 mV | 0                 | DC   | off  |          |            |
| Horizontal: |       | 500 us | Acquisition: AUTO |      | AUTO | 4        | Trigger:   |

### Waveform Generator Setup

### Power Supply Setup

| UNIT | WAVE     | AMP | OFFSET | FREQ   | +6  | +25 | -25 | OUTPUT       |
|------|----------|-----|--------|--------|-----|-----|-----|--------------|
| FG1  | SIN      | 2 * | 0      | 1 Khz  | off | off | off |              |
| FG2  | Triangle | 1   | 0      | 10 Khz |     |     |     | Trigger: INT |

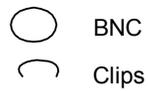
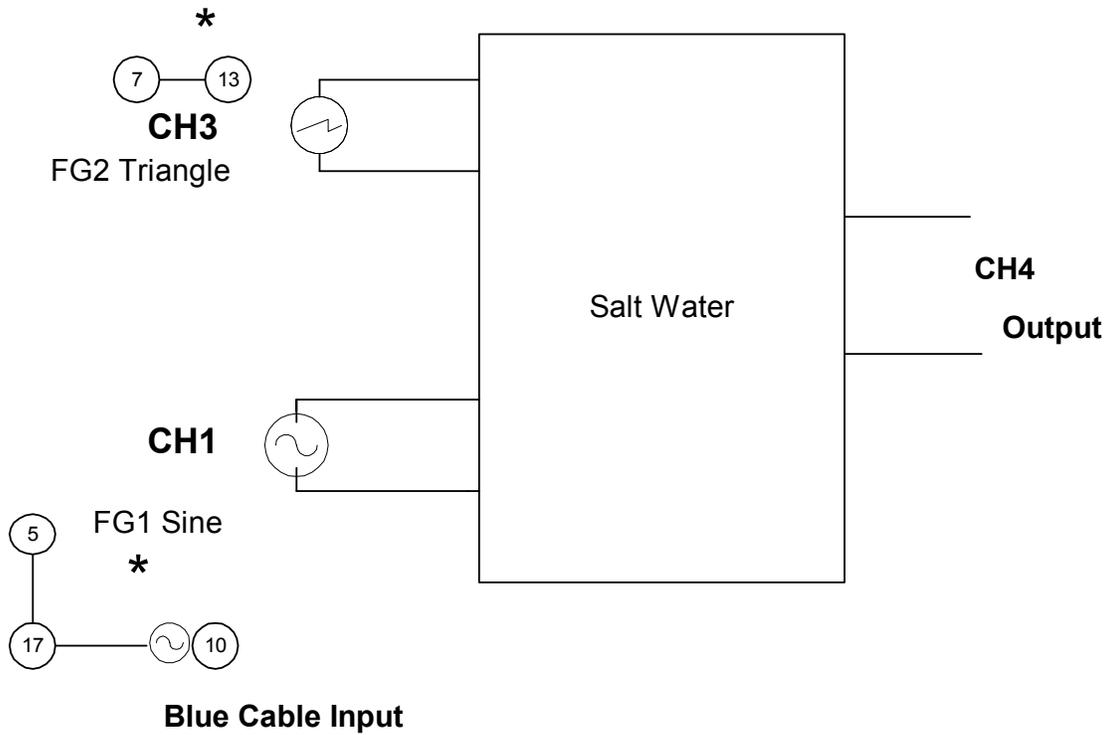
Note

- 1) Note: Prof Gary Removed cable completely from FG2 and did not show CH3. Add distilled water and show the output CH4, later add cambridge water and the output should be shown.
- 2) Remove FG1 cable and connected FG2 cable and do not show CH1, later connect FG1 and show CH1+CH3 and CH4 output, combination of two inputs on CH4.

\* Prof Lang wants 2 V instead 1 V.

# Salt Water

Red Cable input



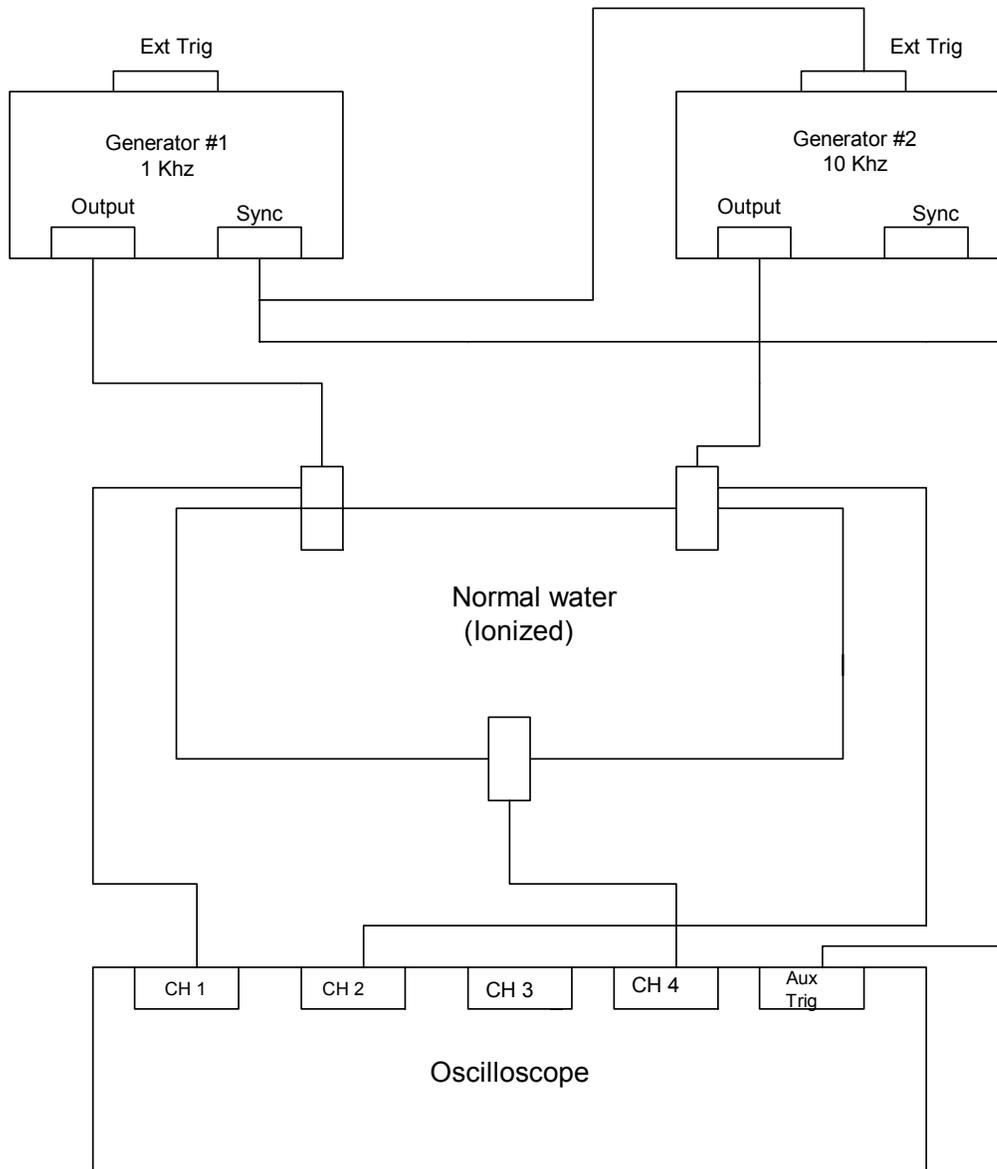
\* Make these connections with the Tee BNC externally because the wire has been removed from board due to noise

# Salt Water Demo#03GS.set

Prof Sussman  
Fall 01

Waveform generator setup: same as prof Gray  
Oscilloscope setup: Demo#03GS.set

Cable setup: see below



**All Grounds Tied together**

To set sources to zero remove BNC from output of signal generator and attach 50 ohm load (terminator) Put input signals FG1&FG2 on the side facing the edge of cart and input facing the opposite side side works better with a camera looking at them.