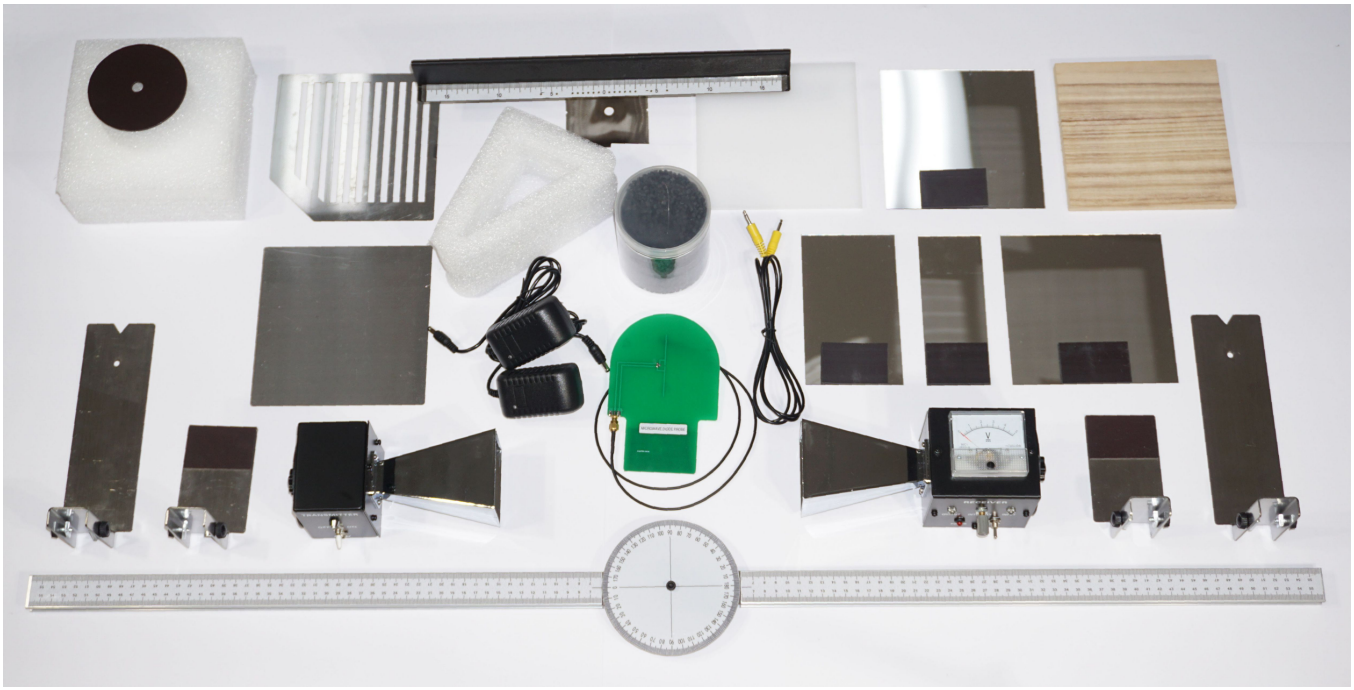
Microwave Apparatus

EM1405-01

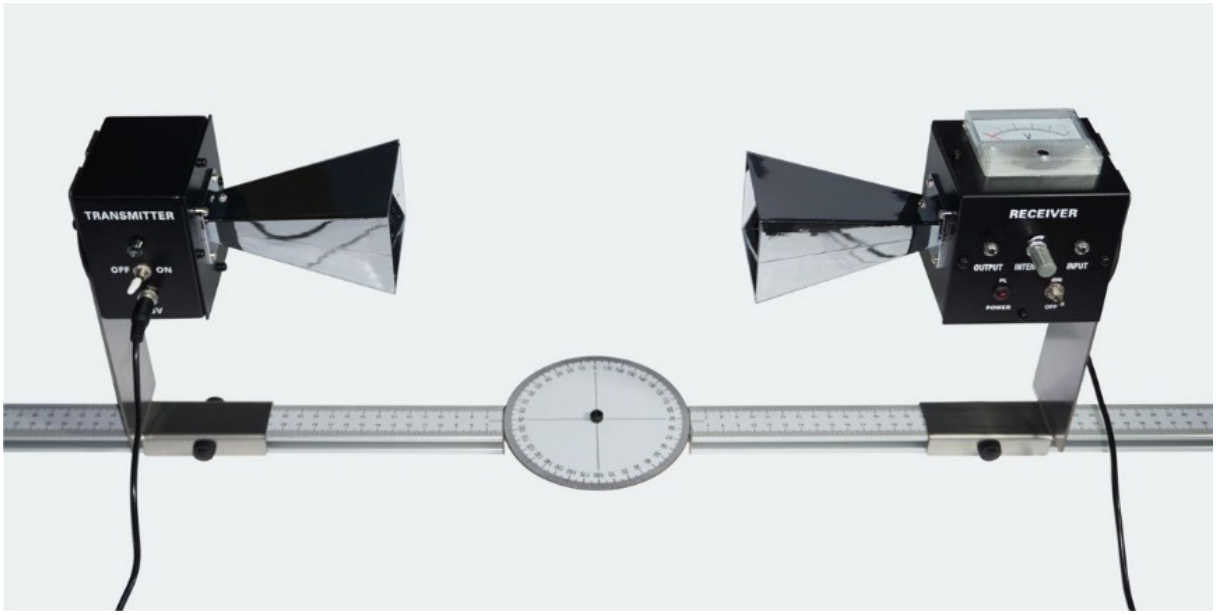


Kit Contents:

1. 10.525GHz Microwave Transmitter, can rotate 360 degrees to change transmitting angle.
2. Microwave Receiver, can rotate 360 degrees to change receiving angle.
3. Microwave Diode Probe.
4. Two guide rails with metric scales, connected together with a centre pivot fitted with angular scale.
5. Two high brackets, can be moved and fixed along the guide rail.
6. Two low brackets, can be moved and fixed along the guide rail.
7. Centre bracket to be fitted to centre pivot disc.
8. Stainless steel reflector.
9. Stainless steel polariser, can be magnetically attached.
10. Microwave absorbers, one plastic and one made of wood.
11. Interference experiment stainless steel horizontal support
12. Set of three screens for Interference experiment.
13. EPE (Expanded Polyethylene) triangular container to be filled with plastic particles to create a 30, 60, 90 degree prism.
14. EPE (Expanded Polyethylene) rotating table, to be located on centre pivot disc.
15. Container of plastic particles.
16. Two 240V.AC. to 12V.DC Plug Packs to power microwave transmitter and receiver.
17. 3.5mm mono plug to 3.5mm mono plug lead.

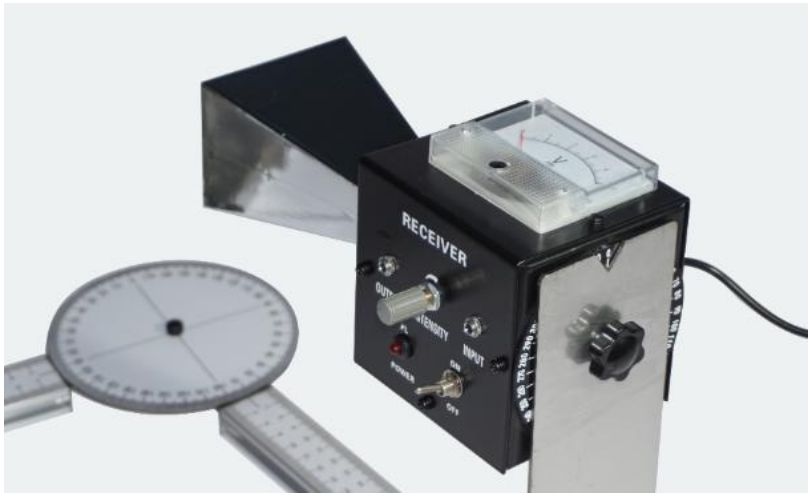
Basic Setup:

1. Place the tow aluminium graduated guide rails below the centre screw of the graduated disc and lock them in place with the nut.
2. Insert the two stainless steel tall brackets onto the left and right guide rails respectively, and secure them with screws.
3. Mount the microwave receiver on the left tall bracket with the horn facing right, and mount the microwave receiver on the right tall bracket with the horn facing left.
4. The completed basic setup is shown in the image below.



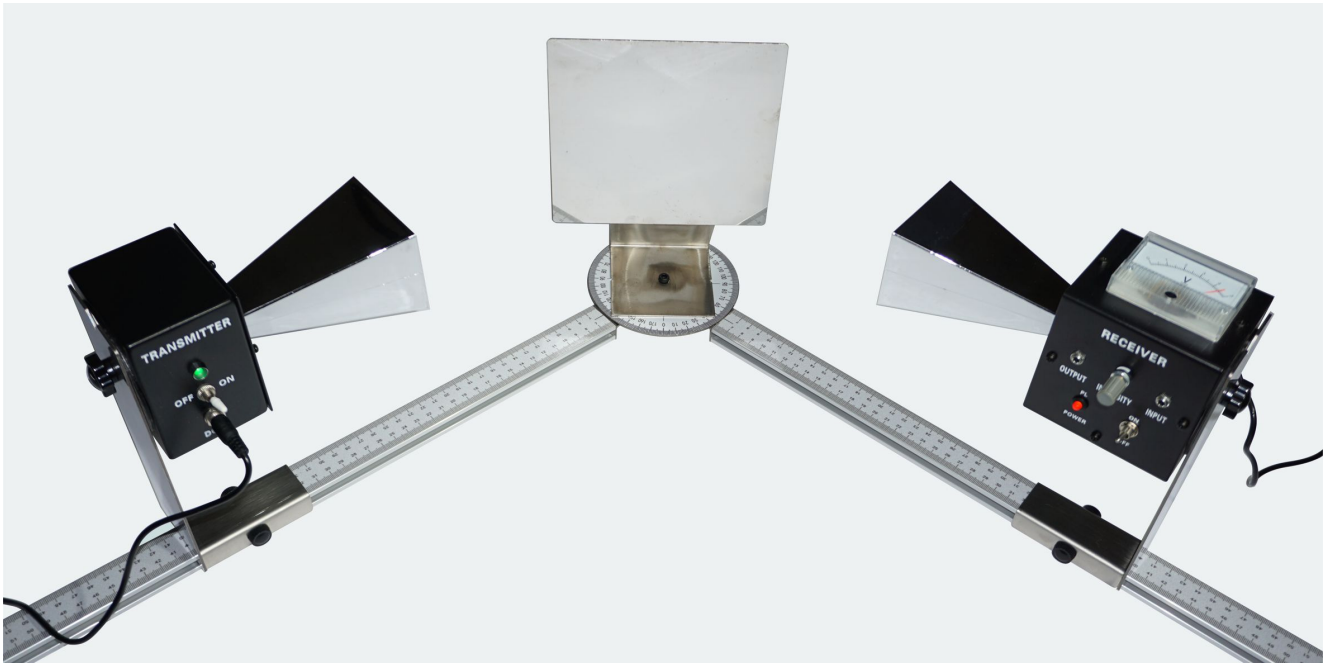
Function Description:

1. The guide rail's included angle can be adjusted around its centre point. Rotate the graduated dial until 0 degrees point to the left guide rail, the included angle can be directly read from the right guide rail.
2. Both the transmitter and the receiver can be rotated, the angle can be read through the triangular notch above the support bracket. See the image below.



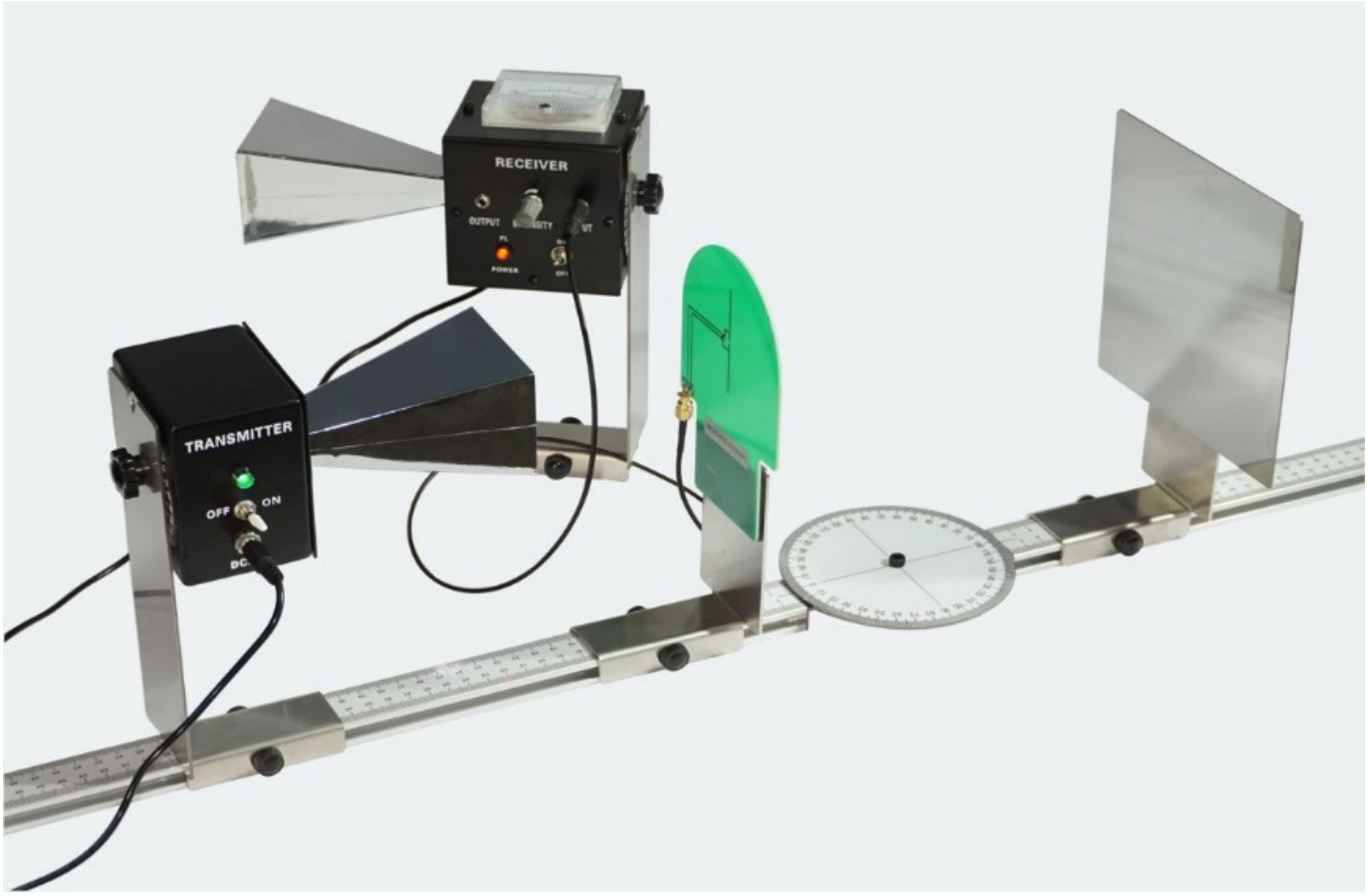
Experiment 1: Reflection

1. Install the transmitter on the left guide rail, with the horn facing the centre of the disk. Connect the power supply and turn on the switch. The green indicator light will illuminate,
2. Indicating that it is working condition and has generated microwaves that are emitted from the horn.
3. With the horns facing each other, adjust the receiver's sensitivity at a certain distance. When the transmitter is on, the voltmeter should read at or near its maximum value.
4. As shown in the image below. Note: the larger the difference in the voltage indicated by the receiver when the transmitter is powered on and off, the better. This indicates that the sensitivity has been adjusted to the optimal point at his fixed distance.
5. Attach the centre support of the disc to the graduated disc, and then attach the stainless steel reflector to the support.
6. Align the zero line of the disc with the left guide rail of the transmitter. Select the angle of incidence, the angle of incidence can be read from the small notch on the support.
7. Rotate the right guide rail of the receiver to change the reflection angle. Observe the change in voltage value. When it displays its maximum value, it indicates the theoretically correct position of the reflection angle.
8. The angle of reflection can be obtained by subtracting the angle of incidence from the angle between the two guide rails.
9. The experimental setup is shown below.

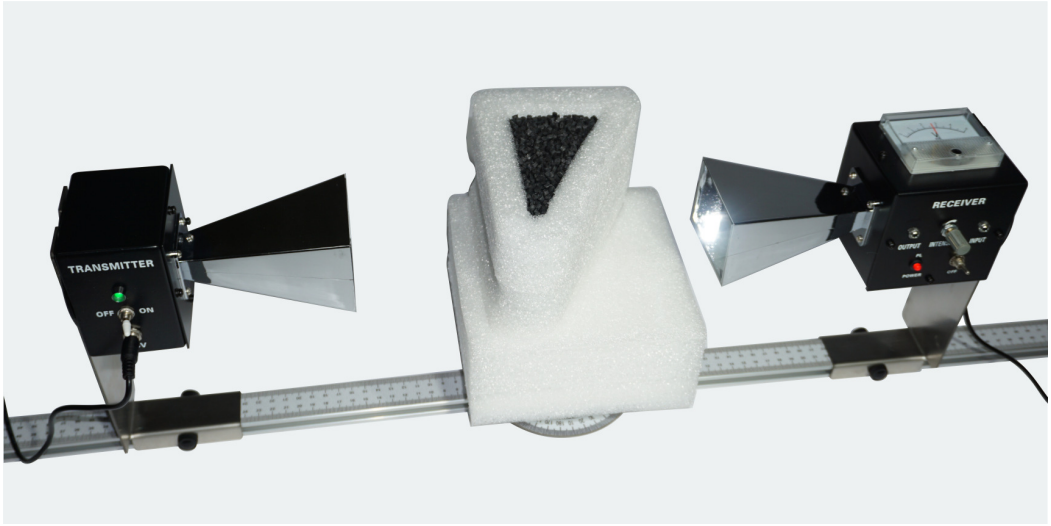


Experiment 2: Standing Waves

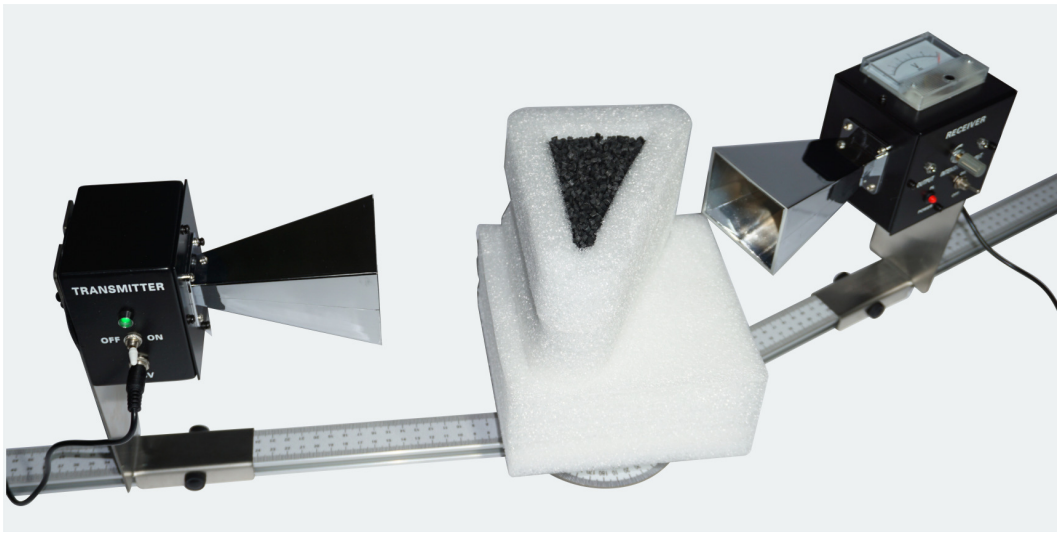
1. On the left rail, first insert a short support, then a tall support. Attach a microwave diode probe to the short support, and mount the microwave transmitter on the tall support.
2. On the right rail, insert a short support and attach a steel reflector to it.
3. Insert the plug of the microwave receiver into the input socket on the receiver, which is located outside the rail. This allows observation of voltage changes during the experiment via the receiver's internal amplifier. Note: The receiver's horn should not receive signals from the transmitter.
4. Turn on the power to both the transmitter and the receiver.
5. Place the right reflector near the central disc, closer to the microwave diode probe.
6. Within a small distance of approximately 2-3 cm, move the reflector back and forth while simultaneously adjusting the receiver's sensitivity knob to create a wide range of difference in the voltmeter reading.
7. Slowly move the reflector further away from the microwave diode probe. During this movement, the voltmeter pointer will show significant changes in voltage, rotating back and forth.
8. Record the position of the reflector on the guide rail each time the voltage reading reaches a high point.
9. During this repeated process, the low voltage reading represents a node, and the high voltage reading represents an antinode.
10. By calculating the number of nodes or antinodes over a relatively long distance, a more accurate wavelength value can be obtained.
11. The experimental setup is shown in the image below.



Experiment 3: Refraction Law



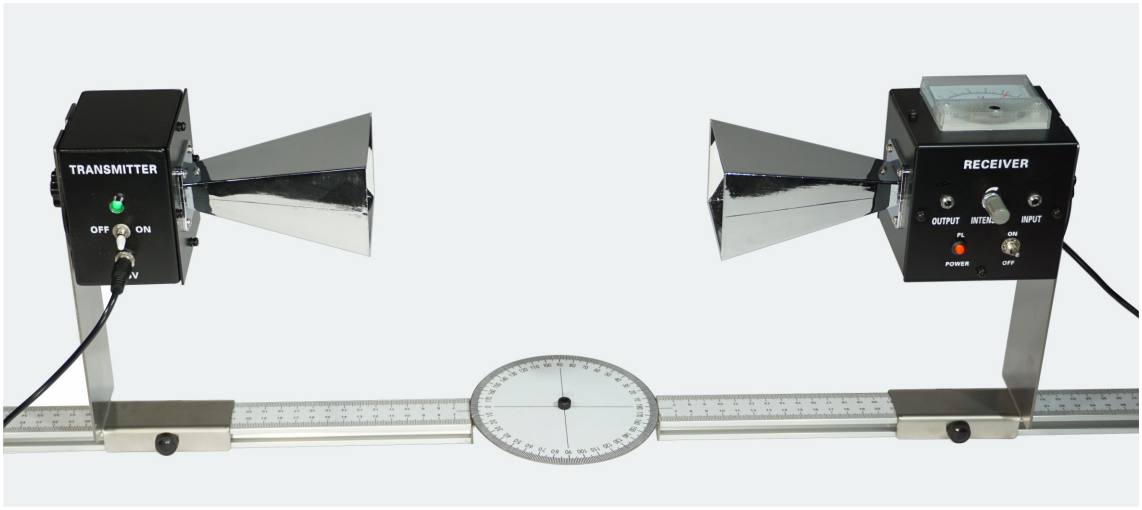
1. Set up the apparatus as shown in the image above.
2. The transmitter is on the left side of the guide rail. The receiver is on the right side of the guide rail. First attach the EPE rotating stage to the graduated disc in the middle, then place the EPE triangular container on top.
3. With the left and right guide rails in a straight line, position the container at a 90 degree angle to the upper left, 60 degree angle to the upper right and the 30 degree angle to the lower left.
4. Adjust the rotating stage so that the left side of the container is perpendicular to the left guide rail. In this position, the emitted wave can directly enter the container without bending on this surface.
5. First remove the container. Turn on The power switches of the transmitter and the receiver, and adjust the receiver's sensitivity. The Receiver's voltmeter should show a larger voltage value when the transmitter is on and a smaller value when the transmitter is off. The larger the difference between the larger and smaller values the better the sensitivity.
6. During the experiment, after aligning the left guide rail with the 0 mark on the central disc, the left guide rail and the central disc must remain fixed, i.e. the incident angle must remain unchanged. Only the right rail needs to be rotated.
7. First place the empty container box on top, rotate the right guide rail up and down, and observe and record the angular position at the maximum voltage value.
8. After filling the container with the plastic granules and compacting them, rotate the right guide rail again, observe and record the angular position at the maximum voltage value, as shown in the image below.
9. Based on the experimental results, draw a graph and calculate the refractive index of the plastic granules.



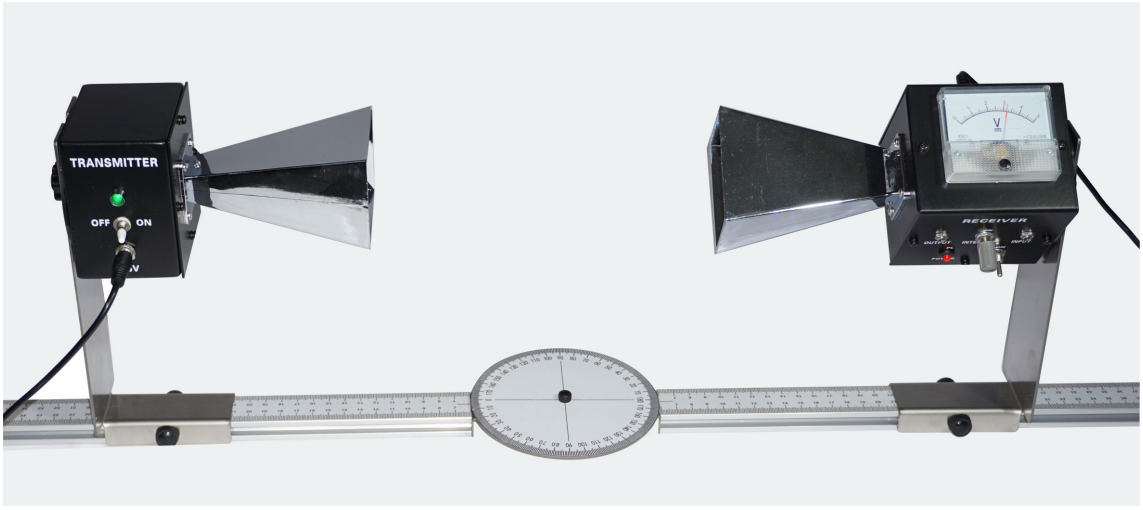
Experiment 4: Polarisation (I)

1. Instrument configuration is shown in the image above.
2. Ensure the left and right guide rails are in a straight line.
3. Attach the microwave transmitter to the tall support on the left guide rail.
4. Attach the microwave receiver to the tall bracket on the right guide rail.
5. Attach the dedicated centre disc support to the centre disc of the guide rail.
6. Turn on the power switches of the transmitter and receiver. Before the polarising plate is attached to the centre disc support, adjust the receiver's sensitivity to ensure it is in the experimental state, producing a more easily observable and obvious effect.
7. When the transmitter is on, the receiver's voltage reading should be high, but not necessarily the higher the better. If it's excessively high, the voltmeter reading will also be high when the transmitter is off, potentially even higher, thus decreasing sensitivity instead of increasing it. Higher sensitivity means that the difference between the receiver's voltage reading and the transmitters off state should be as large as possible.
8. Attach the stainless steel polarising plate, keeping the lines horizontal to the central disc support. Observe and record the voltage reading. See image above.
9. Attach the polarising plate with the notched corner to the central disc support in a horizontal position. The slots should now form a 45 degree angle with the horizontal. Observe and record the voltage reading. See image below.
10. Change the angle again, so that the polarising plate slots are vertical, and attach it to the central disc support. Observe and record the voltage reading.

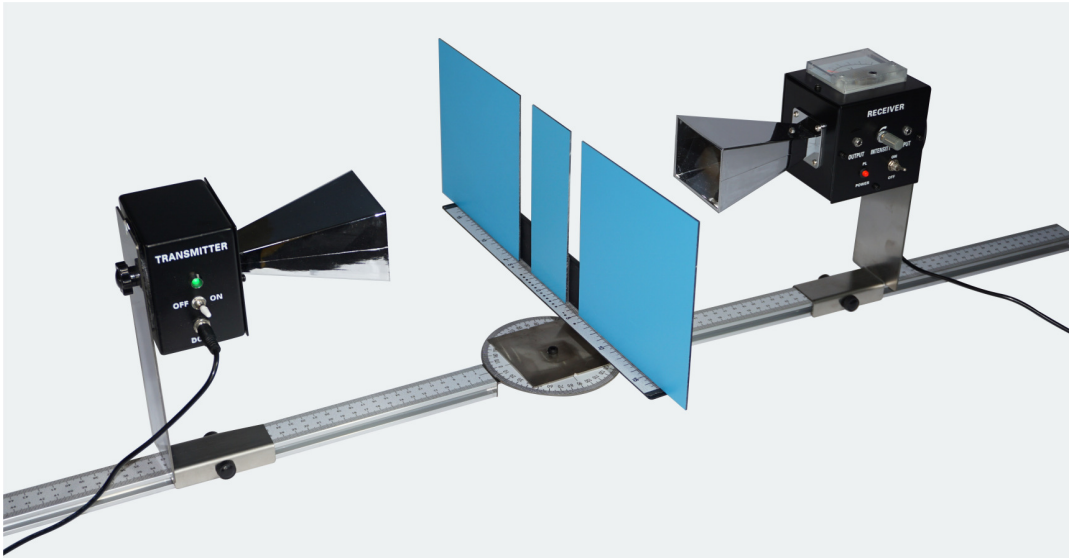
Experiment 5: Polarisation (II)



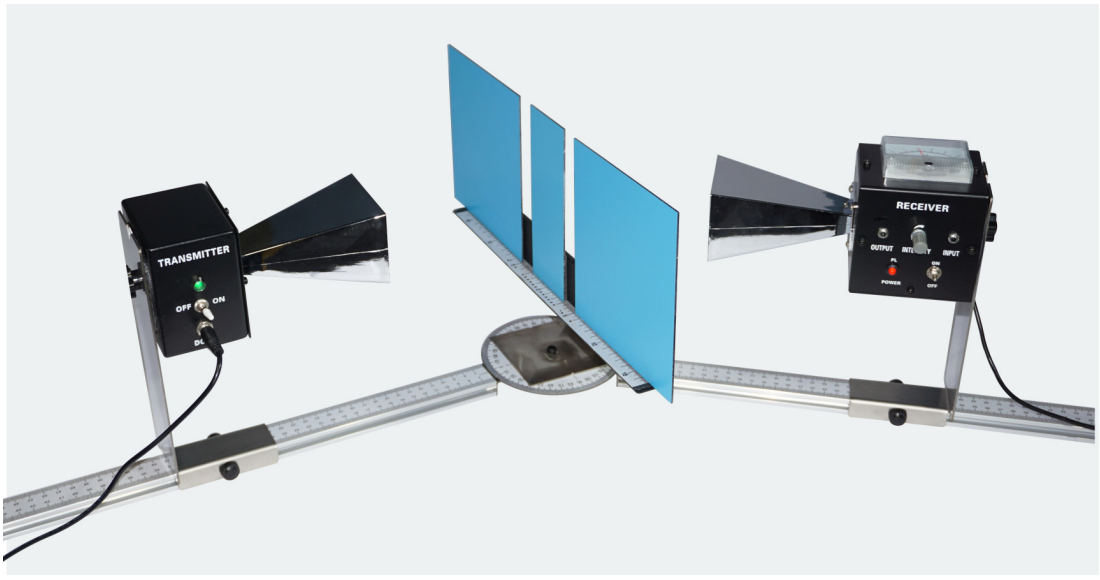
1. The instrument configuration is shown in the image above.
2. Keep both left and right guide rails in a straight line.
3. Insert the left guide rail into the stainless steel tall bracket and install the microwave transmitter. Align the central notch at the top of the bracket with the 0 mark on the transmitter.
4. Insert the right guide rail into the stainless steel tall bracket and install the microwave receiver. Align the central notch at the top of the bracket with the 0 mark on the receiver.
5. Turn on the power switches of the transmitter and the receiver, and adjust the receiver sensitivity to the optimal state. That is, when there is a signal, the voltage value should be as high as possible. And when there is no signal, the voltage should be as low as possible. The larger the difference between the high and low points, the better.
6. Under the same conditions, that is, without changing any other conditions, only rotate and fix the angle of the receiver. Observe and record the voltage values of the receiver at 0 degrees, 10 degrees, 20 degrees, 30 degrees, 40 degrees, 50 degrees, 60 degrees, 70 degrees, 80 degrees and 90 degrees.



Experiment 6: Double Slit Interference



1. The instrument configuration is shown in the image above.
2. Insert a stainless steel tall bracket into the left guide rail and fix it at a position far from the centre. Install the microwave transmitter on the bracket.
3. Insert a stainless steel tall bracket onto the right guide rail and fix it at a position far from the centre. Install the microwave receiver on the bracket.
4. Turn on the power switches of the microwave transmitter and receiver. Adjust the sensitivity of the microwave receiver so that the voltage readings show a significant difference between when there is a signal (transmitter on) and when there is no signal (transmitter off).
5. Vertically attach the centre support to the graduated disc at the centre of both guide rails, and then attach and hang the horizontal support rod for the interference experiment.
6. Attach two wide and one narrow wave-damping plates to the horizontal support rod. Place the narrow plate at the centre, and place the two wide plates on either side of the narrow plate, leaving a gap of about 2cm between them.
7. Keeping the left guide rail and the central disc fixed, slowly rotate the right guide rail to change its angle. Observe and record the angle positions where the voltage is extremely high or extremely low as the voltmeter reciprocates.
8. The angle changes are shown in the image below.



Experiment 7: Transmittance

1. Different materials have different transmittances for microwaves. For the same material, unless it is totally internal reflective of microwaves, its thickness will affect the transmittance.
2. The instrument setup is shown in the mage below.
3. Mount the microwave transmitter on the left rail and the microwave receiver on the right rail.
4. Ensure both rails are straight.
5. Turn on the power switches for both transmitter and receiver, adjust the receiver's sensitivity.
6. Observe and record the voltmeter reading when there is no blocking material between the transmitter and receiver.
7. Place microwave absorbing plates of different materials, such as acrylic, wood or stainless steel, between the transmitter and receiver. Observe the voltmeter readings for each plate.