

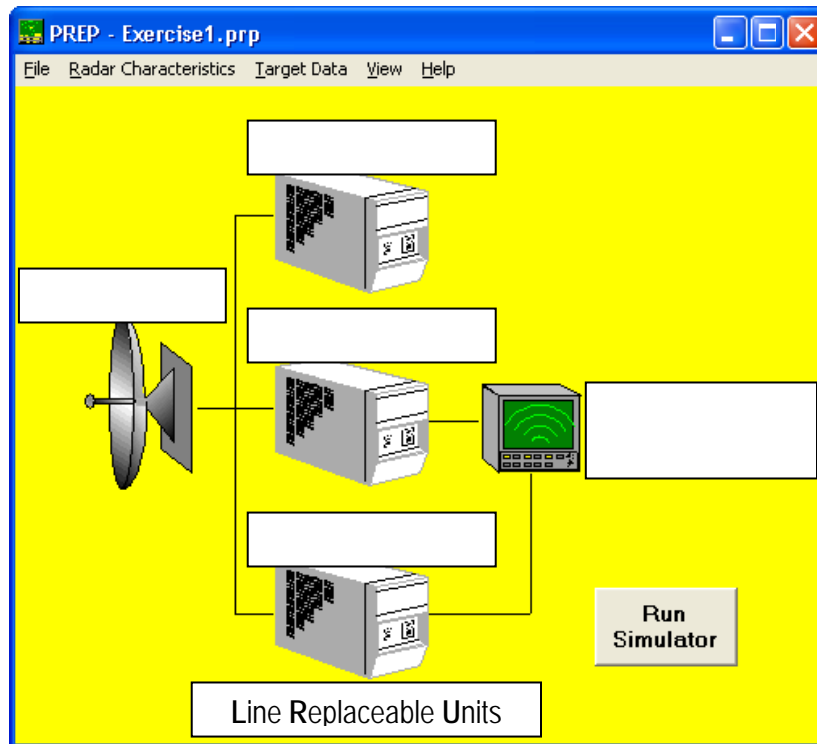


Primary Radar Engineering Program

PREP2

Lab Exercise 1.

Familiarization with PREP2 simulation software.



Procedure-

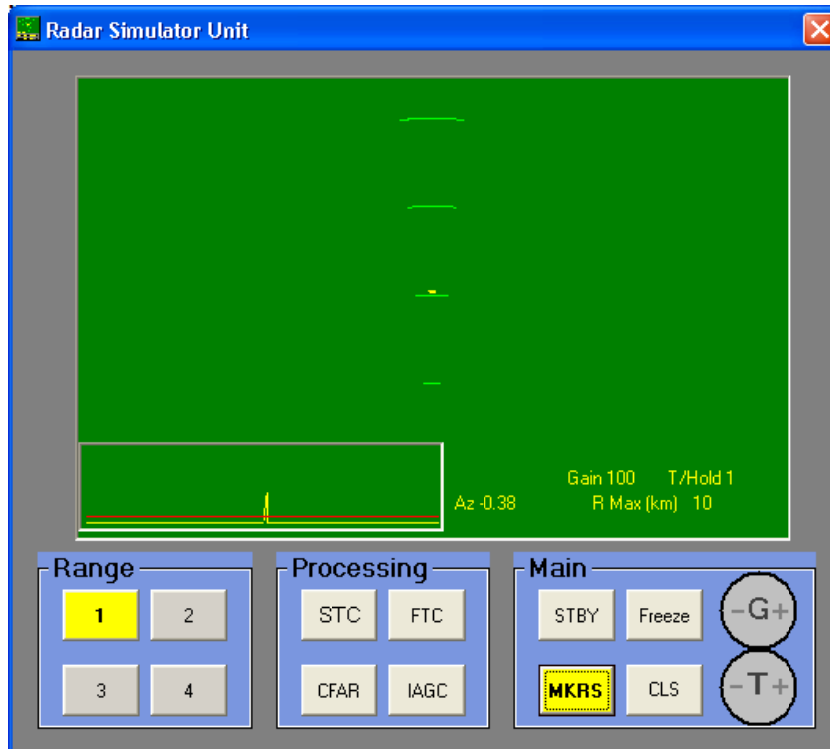
1. Start the PREP simulation software.
2. Move the mouse cursor over each LRU (Line Replaceable Unit) do not click any mouse buttons).
3. Print the name of each LRU in the appropriate box above.
4. Click the mouse button on each LRU starting with the 'Antenna'.
5. Read the contents of each 'Characteristics' Form (do not change any parameters at this time).
6. Note the 'Calculate'* buttons, and the 'Accept Values'* buttons on the various Forms.
 - *These buttons must be clicked after any parameters are changed in the white boxes.
7. Click on the Run Simulator button and observe the PREP radar screens and three control panels.
8. In the Main control panel click the STBY button, and look for a radar target echo on the displays.
9. The Sector Scan PPI (Plan Position Indicator) indicates target Range and Az (azimuth or bearing).
10. The inset display is the 'A-Scope' showing target amplitude and range (time) max range on the right.
11. Observe all parameters and symbols on the PPI and A-Scope displays.
12. In the Main control panel click the MKRS button, and note how the range markers can be activated.
13. What is the approximate range of the target? (note R Max (km) 10)
14. Observe the Scan Width, and click on the Antenna to find the value in Degrees.
15. What is the Scan Width of the antenna? Degrees
16. Click the ON button to go to STBY, exit the PREP program and proceed to Lab Exercise 2.



Primary Radar Engineering Program PREP2

Lab Exercise 2.

Familiarization with PREP2 simulation software.



Procedure-

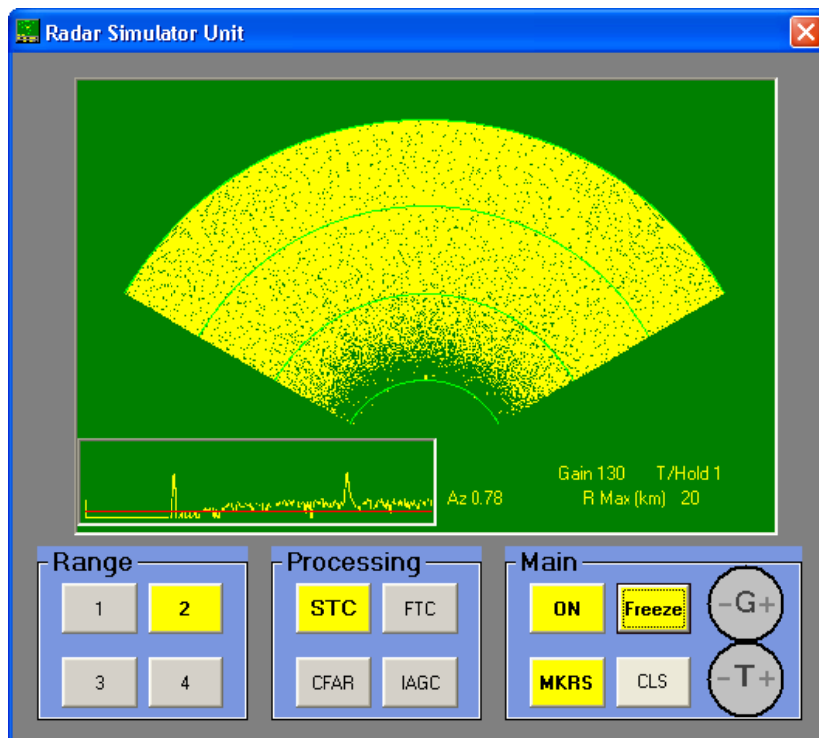
1. Start PREP simulation software.
2. Click on the Run Simulator button and observe the PREP radar screens and control panels.
3. In the Main control panel click the STBY and MKRS buttons.
4. **What is the maximum range (R Max) for Range 1?**
5. Click on Range buttons 2, 3, and 4 and observe the radar displays.
6. **How many targets appear on Ranges 2 and 3?**
7. **What are the approximate ranges of the targets?** (use MKRS!)
8. **Why do we not see two targets on Range 1?**
9. Compare the amplitude (height) of the Range 2 target echoes on the A-Scope display.
10. **Why is the right target smaller than the left target?**
11. Click on the Antenna and change the Scan Width to 100 Degrees (Calculate button!)
12. Note how the Markers extend to 50° either side of zero (North or dead ahead).
13. **What is the approximate Az (bearing) of the targets?** (Freeze then spacebar!)
14. Click on Range 2 button and increase the radar receiver Gain (+) to 110dB.
15. Observe the noise on both displays as it rises above the T/Hold of 1volt (red Threshold on A-Scope)
16. Click the ON button to go to STBY, exit the PREP program and proceed to Lab Exercise 3.



Primary Radar Engineering Program PREP2

Lab Exercise 3.

Familiarization with PREP2 simulation software.



Procedure-

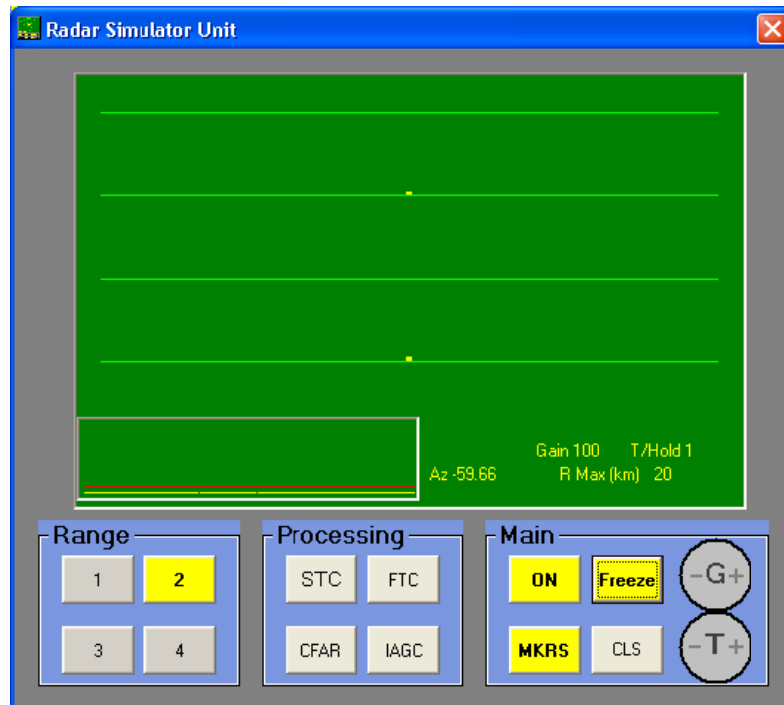
1. Start the PREP simulation software.
2. Click on the Run Simulator button and observe the PREP radar screen and control panels.
3. In the Main control panel click the STBY and MKRS buttons.
4. Click on the Antenna LRU and change the Scan Width to 120 Degrees (Calculate button!)
5. Click on Range 2 button and gradually increase the radar receiver Gain (+) to 120dB.
6. **Is this a good Radar Operator setting?**
7. Click on Range buttons 1, 2, 3, and 4 and observe the radar displays. Try the CLS button.
8. **What happens to the Antenna Scan Speed as the range is increased?**
9. **Which display can still reveal the presence of the targets, A-Scope or PPI?**
10. Click on Range 2 button and gradually increase the radar receiver Gain (+) to 130dB.
11. Click on the STC (Sensitivity Time Control) Processing button
12. Observe **two** targets on the A-Scope but just **one** target on the PPI.
13. **What does the STC process do to the receiver gain?** (see A-Scope!)
14. Switch the STC on and off several times and reduce the receiver Gain to 115dB.
15. **How does the amplitude of the two echoes compare with STC on?**(Freeze spacebar!)
16. Click the ON button to go to STBY, exit the PREP program and proceed to Lab Exercise 4.



Primary Radar Engineering Program PREP2

Lab Exercise 4.

Familiarization with PREP2 simulation software.



Procedure-

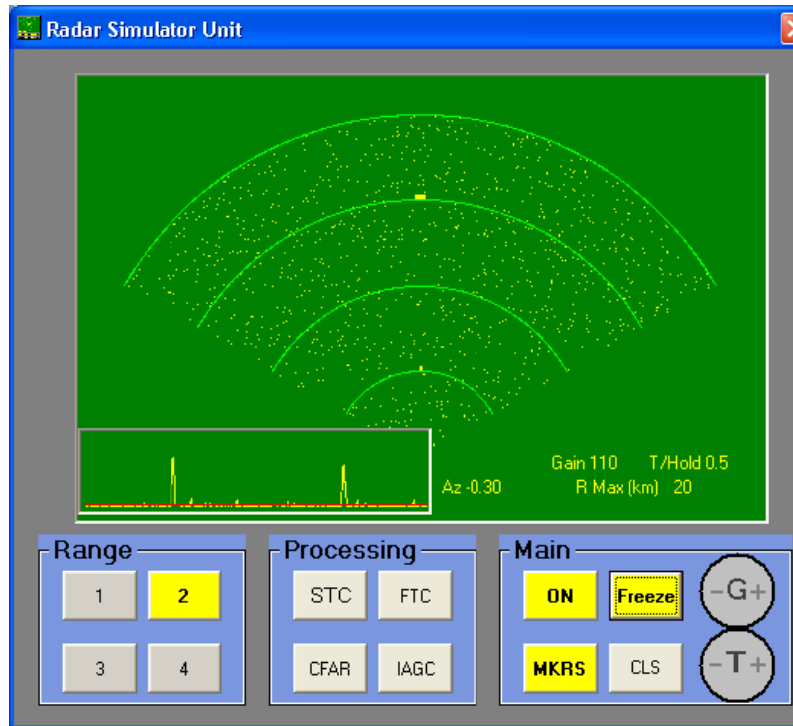
1. Start the PREP simulation software.
2. Click on the **Control & Display Unit** and check the 'B Type' display. (Accept Values!)
3. Click on the **Run Simulator** button and observe the PREP radar screen and control panels.
4. In the **Main** control panel click the **STBY** and **MKRS** buttons.
5. Click on the **Antenna LRU** and change the **Scan Width** to **120 Degrees** (Calculate button!)
6. Describe the scan; is it an 'arc' or 'linear'? (This is a B Type display)
7. Click on **Range 2** button and gradually increase the radar receiver **Gain (+)** to **110dB**.
8. How many targets? (note the horizontal Az scan)
9. Click on **Range** buttons **1, 2, 3, and 4** and observe the radar displays, repeat this action.
10. What happens to the **Antenna Scan Speed** as the range is increased?
11. Which display can still reveal the presence of the targets, **A-Scope** or **PPI**?
12. Click on **Range 2** button and gradually increase the radar receiver **Gain (+)** to **120dB**.
13. Click on the **FTC** (Fast Time Constant) Processing button.
14. Does **FTC** operate the same as **STC**?
15. What does the **FTC** process do to the receiver high frequency noise?
16. Switch **STC** and **FTC** on and observe the effect on the displays.
17. Click the **ON** button to go to **STBY**, exit the PREP program and proceed to **Lab Exercise 5**.



Primary Radar Engineering Program PREP2

Lab Exercise 5.

Familiarization with PREP2 simulation software.



Procedure-

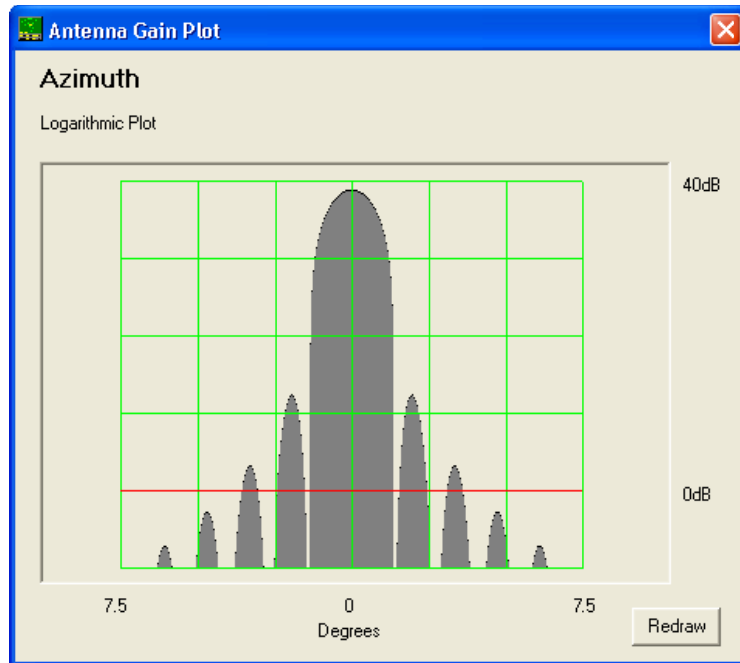
1. Start the PREP simulation software.
2. Click on the Run Simulator button and observe the PREP radar screen and control panels.
3. In the Main control panel click the STBY and MKRS buttons.
4. Click on the Antenna and change the Scan Width to 120 Degrees (Calculate button!)
5. Click on Range 2 button and gradually increase the radar receiver Gain (+) to 110dB.
6. Reduce the T- (T/Hold) setting from 1 volt to 0.5 volt. Observe the red line on the A-Scope.
7. **What happens to the noise on the displays?**
8. Increase the T+ (T/Hold) setting from 0.5 volt to 1 volt. Observe the red line on the A-Scope.
9. **Which display can still reveal the presence of the targets, A-Scope or PPI?**.....
10. Increase the T+ (T/Hold) setting from 1 volt to 5 volts. Observe the red line on the A-Scope.
11. **What happens to the target echoes on the PPI display?**
12. Gradually increase the radar receiver Gain (+) to 140dB
13. **What happens to the target echoes on the PPI display?**
14. Switch FTC on and off and observe the effect on the displays.
15. Click the ON button to go to STBY, exit the PREP program and proceed to Lab Exercise 6.



Primary Radar Engineering Program PREP2

Lab Exercise 6.

Familiarization with PREP2 simulation software.



Procedure-

1. Start the PREP simulation software.
2. Click 'View' on the toolbar, and select 'Ae Azimuth'. This is the azimuth Antenna Gain Plot.
3. Click 'View' on the toolbar, and select 'Ae Elevation'. This is the elevation Antenna Gain Plot.
4. Click 'View' on the toolbar, and select 'Ae 3D Plot'. This is the 3 dimensional antenna plot.
5. Click on the Antenna and change the Antenna Width to 2 meters. (Calculate button!)
6. Click 'View' on the toolbar, and select 'Ae Azimuth'. This is the azimuth Antenna Gain Plot.
7. **What has been the effect of increasing the Antenna Width?**
8. **Has the Ae Elevation plot been changed?**
9. Click 'View' on the toolbar, and select 'Ae 3D Plot'.
10. Click on the Antenna and change the Antenna Height to 2 meters. (Calculate button!)
11. **What has been the effect of increasing the Antenna Height?**(View Ae Elevation)
12. Click 'View' on the toolbar, and select 'Ae 3D Plot'.
13. **Is the antenna beam pattern now symmetrical?**
14. Click on the Antenna and note the '3dB Beamwidth (Az)'.
15. **What is the 3dB Beamwidth when the antenna Width and Height are 1 meter?**
16. Exit the PREP program and proceed to Lab Exercise 7.



Primary Radar Engineering Program PREP2

Lab Exercise 7.

Familiarization with PREP2 simulation software.

Procedure-

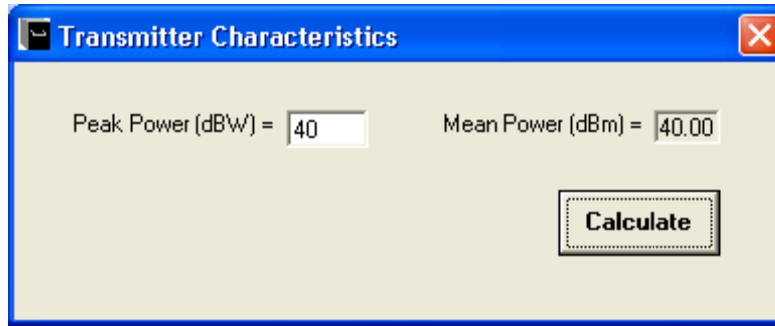
1. Start the PREP simulation software.
2. Click 'Target Data' on the toolbar and study this FORM.
3. **What is the default Range for Target 1? and Target 2?**
4. Change Target 1 Range (km) to 7, and Target 2 Range (km) to 9. (Accept Values!)
5. Click on the Run Simulator button.
6. In the Main control panel click the STBY and MKRS buttons, observe the new target ranges.
7. **Which is the best Range to clearly see the target echoes?**
8. Click 'Target Data' and change Target 1 RCS to 10 and Target 2 RCS to 1. (Accept Values!)
9. Note the amplitude of Target 1 and Target 2 on the A-Scope.
10. Change Target 1 RCS to 1, and Target 2 RCS to 100. (Accept Values!)
11. **What has been the effect on Target 1 and Target 2 amplitudes on the A-Scope?**
12. Change the Bearing (deg) of Target 1 and Target 2 and adjust the antenna Scan Width accordingly.
13. Insert minus values for Target 1 and Target 2 bearings, e.g. -25 and -38 degrees.
14. **Which side of the PPI display represents -25 degrees, Left or Right of zero?**
15. Exit the PREP program and proceed to Lab Exercise 8.



Primary Radar Engineering Program PREP2

Lab Exercise 8.

Familiarization with PREP2 simulation software.



Procedure-

1. Start the PREP simulation software.
2. Click the 'Transmitter' LRU.
3. **What is the default Peak Power (dBW) and Mean Power (dBW)?**
4. Click on the Run Simulator button and click the STBY and MKRS buttons.
5. Click on Range 2 button and change the Peak Power to 20dBW. (Calculate!)
6. **Are both target echoes steady?**
7. Change the Transmitter Peak Power to 25dBW and observe the target echoes on both displays.
8. Increase the Transmitter Peak Power to 90dBW and observe the target echoes on both displays.
9. Reduce the Transmitter Peak Power to 25dBW
10. Click 'Target Data' on the toolbar and for Target 2 change RCS (Radar Cross Section) to 1.
11. **Why has Target 2 disappeared from the displays?**
12. Increase Transmitter Peak Power by 1dBW steps until both echoes are steady on the displays.
13. **At what Transmitter Peak Power are both target echoes steady?**
14. Click 'Target Data' on the toolbar and for Target 2 change RCS (Radar Cross Section) to 0.1.
15. Increase the Transmitter Peak Power to 40dBW.
16. Increase the radar receiver Gain (+) to 110dB.
17. **Are both target echoes steady?**
18. **What are the random blips on the PPI display?**
19. Exit the PREP program and proceed to Lab Exercise 9.



Primary Radar Engineering Program PREP2

Lab Exercise 9.

Familiarization with PREP2 simulation software.

Receiver Characteristics

Rx Noise Factor (dB) = 5

IF Bandwidth (MHz) = 1.4

Rx Temperature = 290

Rx Noise Level (dBm) = -107.52

T/N Ratio (dB) = 17.52

Rx Gain (dB) = 100

Rx Threshold (V) = 1

Probability of False Alarm (Pfa) = 3.076056E-25

Signal Processing

IAGC CFAR

FTC STC

Gain Type

Linear

Logarithmic

Calculate

Procedure-

1. Start the PREP simulation software.
2. Click the 'Receiver' LRU.
3. Study the 'Receiver' FORM and note the Gain Type default is Logarithmic.
4. Click on the Run Simulator button and click the STBY and MKRS buttons.
5. Click on Range 2 button.
6. On the 'Receiver' FORM change Gain Type to Linear.
7. **Are the A-Scope echoes saturated (flat top)?**
8. Note that Rx Gain (dB) and Rx Threshold (V) can also be set in the Receiver' FORM.
9. Remove the check marks from IAGC, CFAR, FTC, STC and observe the Processing panel.
10. Change the IF Bandwidth (MHz) value to 1 and observe the pulse shape on the A-Scope.
11. **Does the reduced IF Bandwidth result in a change in Rx Noise Level (dBm) parameter?**
12. Change the IF Bandwidth (MHz) value to 10 and observe the A-Scope and PPI displays.
13. **Does the increased IF Bandwidth cause an increase or reduction in high frequency noise?**
14. Exit the PREP program and proceed to Lab Exercise 10.



Primary Radar Engineering Program PREP2

Lab Exercise 10.

Familiarization with PREP2 simulation software.

Parameter	1	2	3	4
PRF (kHz)	1	0.5	0.25	0.25
RF Pulse Width (us)	1	20	4	10
Max. Range (km)	10	20	40	100
Pulse Compression			<input type="checkbox"/>	<input type="checkbox"/>

Sector Scan Range Markers
 B Type Freeze Button

Accept Values

Procedure-

1. Start the PREP simulation software.
2. Click the 'Control & Display Unit' LRU.
3. Study the 'Control & Display Unit' FORM and note the Range Setting parameters.
4. Click on the Run Simulator button and click the STBY and MKRS buttons.
5. Click on Range 2 button.
6. On 'Control & Display Unit' change the RF Pulse Width in Range 2 to 10us. (Accept Values!)
7. **What happens to the PPI and A-Scope signals?**
8. Remove the check marks from Range Markers and Freeze Button and observe the Main panel.
9. Click on the Antenna and change the Scan Width to 120 Degrees (Calculate button!)
10. On 'Control & Display Unit' select B Type display. (Accept Values!)
11. On 'Control & Display Unit' change the Max Range for Range 1 to 6km. (Accept Values!)
12. Click on Range 1 button and note the new position of Target 1 on both displays.
13. Click on the Antenna and change the Antenna Width to 0.1m. (Calculate!)
14. **Has the Antenna Beamwidth increased or decreased?**
15. Increase the radar receiver Gain (+) to 110dB and observe the target echo width.
15. Exit the PREP program.