



# PREP2 STUDENT

## Familiarization Lab Exercises

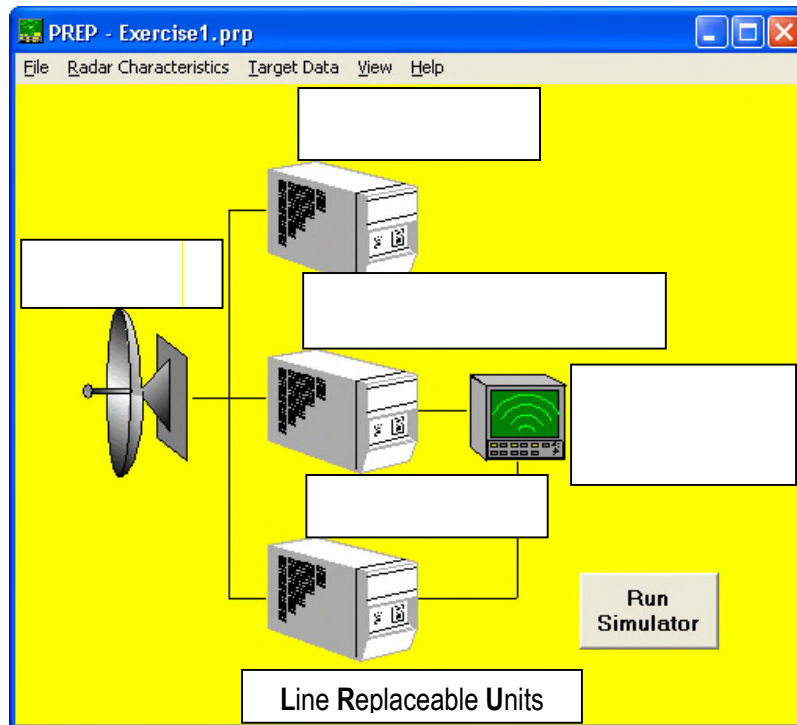
After you have completed these very basic exercises, you should be familiar with the functions and procedures in **PREP2** enabling you to experiment with advanced radar scenarios of your own creation.



# Primary Radar Engineering Program PREP2



## Lab Exercise 1



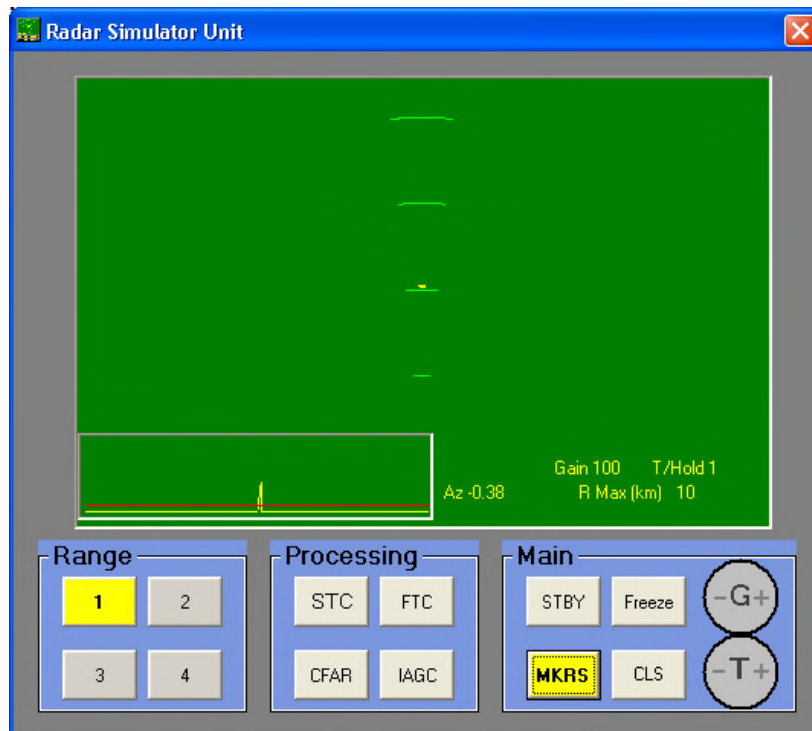
### Procedure -

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 white box.
4. Now 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**'\* button, or the '**Accept Values**'\* button on the various forms.
7. Click **Run Simulator** - observe the **PPI Sector Scan**, **A-Scope** displays, and **three control panels**.
8. On the **Main** control panel click the **STBY** button, and look for a radar target echo on both displays.
9. The **Sector Scan PPI (Plan Position Indicator)** indicates target **Range** and **Az** (azimuth or bearing).
10. The '**A-Scope**' timebase displays target **amplitude** and **range** (time), max range on the right.
11. Observe all **parameters** on the **PPI** display.
12. On the **Main** control panel click the **MKRS** button. **How many range markers are activated?** .....
13. **What is the approximate range of the target?** ..... (Note **R Max** (km) 10)
14. Observe the **Scan Width (MKRS)**click on the **Antenna** to find the value in **Degrees**.
15. **What is the default 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**.

\*These buttons must be clicked after any parameters are changed in the forms boxes.



## Lab Exercise 2

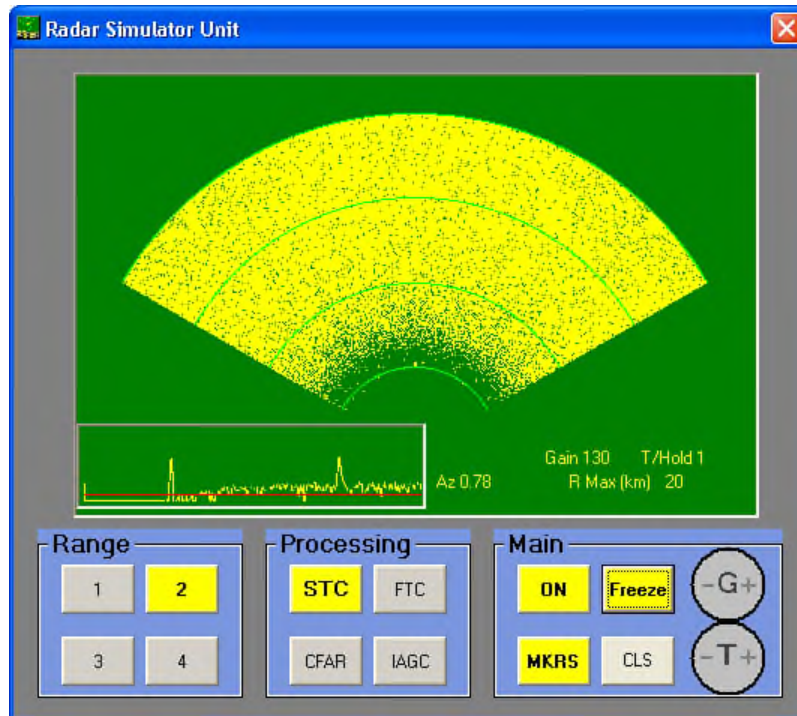


### Procedure -

1. Start **PREP** simulation software.
2. Click the **Run Simulator** button and observe the **PREP** radar displays and control panels.
3. On the **Main** control panel click the **STBY** and **MKRS** buttons.
4. **What is the maximum range (R Max) for Range 1?** .....
5. Click the **Range** buttons **2, 3, and 4** and observe the change in **R Max (km)**.
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** of the **Range 2** target echoes on the **A-Scope** display.
10. **Why is the right target (Target 2) smaller than the left target?** .....
11. Click 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?** ..... (use **Freeze** then spacebar!)
14. Cancel **Freeze**, click the **Range 2** button and increase the radar receiver **Gain (+)** to **110dB**.
15. The noise on both displays now exceeds the default threshold (**T/Hold**) of **1volt** (**red** line on **A-Scope**)
16. Click the **ON** button to go to **STBY**, exit the **PREP** program and proceed to **Lab Exercise 3**.



### Lab Exercise 3

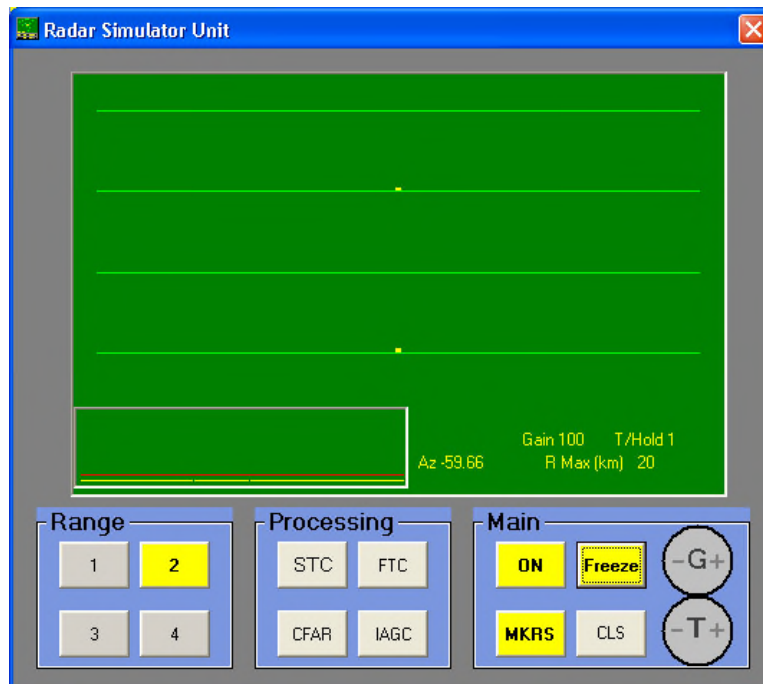


#### Procedure -

1. Start the **PREP** simulation software.
2. Click the **Run Simulator** button and observe the **PREP** radar screen and control panels.
3. On the **Main** control panel click the **STBY** and **MKRS** buttons.
4. Click the **Antenna** LRU and change the **Scan Width** to **120 Degrees** (**Calculate** button!)
5. Click the **Range 2** button and gradually increase the radar receiver **Gain (+)** to **120dB**.
6. **Is this a good Radar Operator display setting?** .....
7. Click the **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 clearly show the targets, A-Scope or PPI?**.....
10. On **Range 2** button, gradually decrease the radar receiver **Gain (-)** to **115dB**.
11. Click the **STC** (**Sensitivity Time Control**) signal processing button.
12. Observe **two** targets but note how the noise increase with range.
13. **What does the STC process do to the receiver gain?** ..... (see **A-Scope!**)
14. Increase the receiver **Gain** to **130dB**.
15. Switch the **STC** on and off several times and note the shape of the **A-Scope** timebase.
16. **How does the amplitude of the two echoes compare with STC on?**.....(**Freeze/** spacebar!)
17. Click the **ON** button to go to **STBY**, exit the **PREP** program and proceed to **Lab Exercise 4**.



### Lab Exercise 4

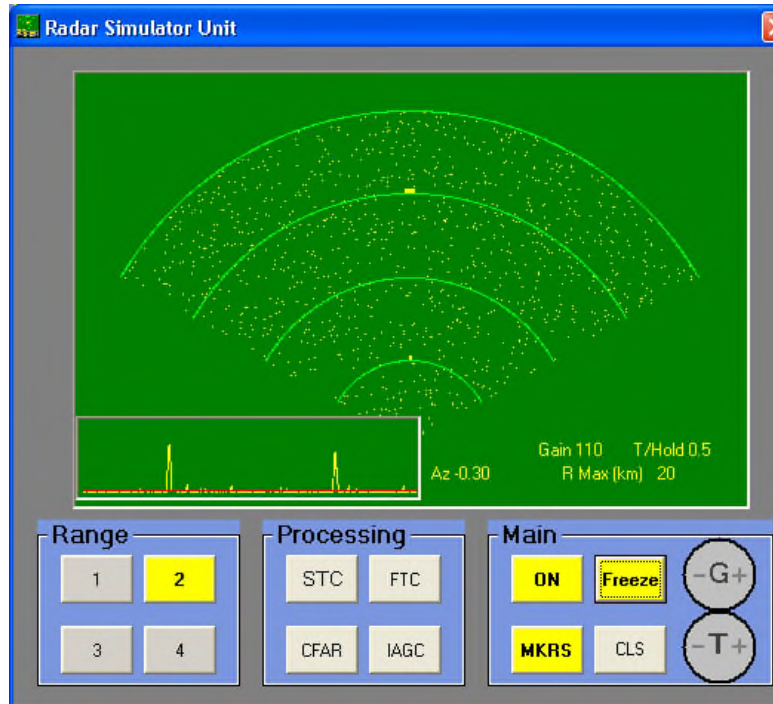


#### Procedure -

1. Start the PREP simulation software.
2. Click the **Control & Display Unit** and check the 'B Type' display. (Accept Values!)
3. Click the **Run Simulator** button and observe the PREP radar screen and control panels.
4. On the **Main** control panel click the **STBY** and **MKRS** buttons.
5. Click 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 the **Range 2** button and gradually increase the radar receiver **Gain (+)** to **115dB**.
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. Click the **Range 2** button and gradually increase the radar receiver **Gain (+)** to **120dB**.
12. **Which display can still reveal the presence of both targets, A-Scope or PPI?**.....
13. Click the **FTC** (Fast Time Constant) signal Processing button.
14. **Does FTC operate the same as STC?** .....
15. **What does the FTC process do to the receiver clutter noise?** .....
16. **Is it possible to use STC, FTC, CFAR and IAGC signal processing all at the same time?** .....
17. Click the **ON** button to go to **STBY**, exit the PREP program and proceed to **Lab Exercise 5**.



## Lab Exercise 5

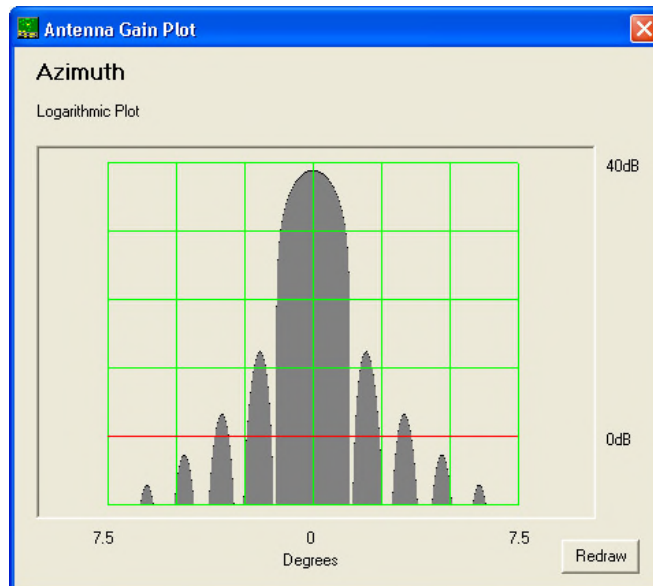


### Procedure -

1. Start the **PREP** simulation software.
2. Click the **Run Simulator** button and observe the **PREP** radar screen and control panels.
3. On the **Main** control panel click the **STBY** and **MKRS** buttons.
4. Click the **Antenna** and change the **Scan Width** to **120 Degrees** (**Calculate** button!)
5. Click the **Range 2** button and gradually increase the radar receiver **Gain (+)** to **110dB**.
6. Reduce the threshold **-T** setting from **1 volt** to **0.5 volt** and observe the **red** line on the **A-Scope**.
7. **What happens to the noise on the displays?** .....
8. Increase **T+** setting to **7 volts** again observe the **red** line on the **A-Scope**.
9. **What happens to the target echoes on the PPI display?** .....
10. **Which display can still reveal the presence of the targets, A-Scope or PPI?**.....
11. Gradually increase the radar receiver **Gain (+)** to **150dB**
12. **What happens to the target echoes on the PPI display?** .....
13. Try combinations of **STC** and **FTC** and observe the effects on the displays.
14. Click the **ON** button to go to **STBY**, exit the **PREP** program and proceed to **Lab Exercise 6**.



## Lab Exercise 6



### 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 3Dimensional Antenna Gain 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 new azimuth Antenna Gain Plot.
7. **What has been the effect on beamwidth by increasing the Antenna Width?** .....
8. **Has the Ae Elevation plot been changed?** .....
9. Click 'View' on the toolbar, and select 'Ae 3D Plot'. **Is the plot symmetrical?** .....
10. Click 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 'Ae 3D Plot' beam plot now symmetrical?** .....
14. **Click the Antenna and note the '3dB Beamwidth (Az)'** .....
15. **What is the 3dB Beamwidth when the antenna Width and Height are 1 meter?** .....
16. **What is the 3dB Beamwidth when the antenna Width and Height are 2.5 meters?** .....
17. Exit the PREP program and proceed to Lab Exercise 7.



## Lab Exercise 7

**Target Data**

Target 1	Target 1 Repeater	Target 2	Chaff Cloud
RCS (m <sup>2</sup> )	Gain (dB)	RCS (m <sup>2</sup> )	Weight (g)
Bearing (deg)	Delay (us)	Bearing (deg)	Bearing (deg)
Range (km)	Number of Repeats	Range (km)	Width (m)
	1 2 3		Range (km)
	Tgt 1 Repeater On		Depth (m)
ERP (dBW)		ERP (dBW)	Height (m)
B/W (MHz)		B/W (MHz)	Volume (m <sup>3</sup> )
Bearing (deg)		Bearing (deg)	RCS per m <sup>3</sup>
Range (km)		Range (km)	Chaff On
Mount on Tgt 1		Mount on Tgt 2	
Noise 1 On		Noise 2 On	

Accept Displayed Values

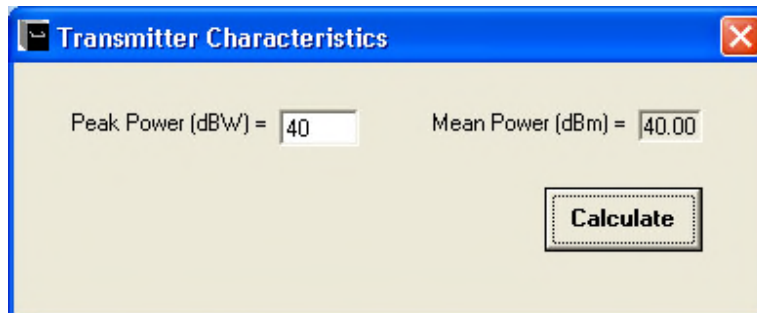
### Procedure -

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 Displayed Values!)
5. Click the Run Simulator button.
6. On the Main control panel click the STBY and MKRS buttons, observe the new target ranges.
7. **Which are the best Ranges 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/Target 2 on the A-Scope, which is larger? .....**
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 then adjust the antenna Scan Width accordingly.
13. Insert new 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.





## Lab Exercise 8

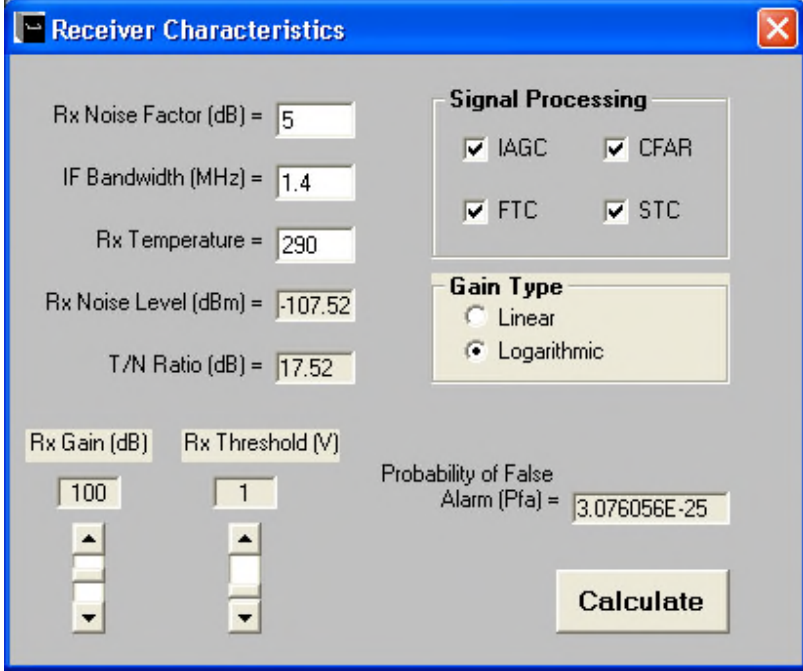


### Procedure -

1. Start the **PREP** simulation software.
2. Click the 'Transmitter' LRU.
3. **What is the default transmitter Peak Power (dBW) & Mean Power (dBm)?** .....
4. Click the **Run Simulator** then click the **STBY** and **MKRS** buttons.
5. Click the **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 approximately what minimum Peak Power are both target echoes steady?** .....
14. Click 'Target Data' and change **Target 2 RCS** (Radar Cross Section) to **0.1**.
15. Increase the **Transmitter Peak Power** to **45dBW**.
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**.



## Lab Exercise 9



The image shows a software dialog box titled "Receiver Characteristics". It contains several input fields and checkboxes. The fields include: 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, and Probability of False Alarm (Pfa) = 3.076056E-25. There are two sections of checkboxes: "Signal Processing" with IAGC, CFAR, FTC, and STC all checked; and "Gain Type" with Linear unselected and Logarithmic selected. A "Calculate" button is at the bottom right.

### 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**, and **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 increase or decrease the noise?** .....
14. Exit the **PREP** program and proceed to **Lab Exercise 10**.



## Lab Exercise 10

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

Now that you have completed these very basic exercises, you should be familiar with the functions and procedures in **PREP2** enabling you to experiment with advanced radar scenarios of your own creation.



# Primary Radar Engineering Program PREP2



**Your Notes & Sketches.**