D. Installing a Spare RCP02

D.1 Standard Spares Kit Contents

An RCP02 standard spares kit contains the following items:

- Qty. 1 RCP02 mother-board and daughter-board (as single integrated unit).
- Qty. 1 Front panel display.
- Qty. 2 Power supplies (1 of each type).
- Qty. 1 Fan

In addition, the daughter board will be configured with the plug-in IP modules that were ordered with your original system and in most cases, any custom wire-wrap jumpers that were installed at SIGMET will be on the spare board.

D.2 Successful Preparation for Failure

The RCP02 is a very flexible hardware and software product. This means that before a spare can be "popped-in" it must be properly configured.

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i **The time to configure the spare board is before the primary system fails since you will need information from the primary system to configure the spare.**

When your spares kit arrives, the RCP02 mother and daughter boards must be checked and configured to match your primary system. **THIS SHOULD BE DONE BEFORE A FAILURE OCCURS**. With proper configuration of the spare board, it can be "popped-in" your system in a matter of minutes. The sections below describe this procedure.

D.3 Documenting the Primary System Hardware

The primary system hardware should be documented for your own internal use. The original factory hardware configuration is documented at SIGMET, but it is quite common to make field modifications to the RCP02. This means that you should maintain your own internal documentation.

- Record the IP module part numbers and the IP position on the daughter board.
- Record the jumper settings on the daughter board.
- Record the jumper settings on the mother board (the larger board).
- Record any wire-wrap jumpers that have been installed on the mother board. These are installed to/from the wire-wrap headers. You can make a from/to list of the wire-wrap jumpers.

D.4 Documenting the Primary System D/A and A/D Spans

The only other hardware settings that need to be documented are the D/A convertor spans for the AZ/EL drive outputs, and the A/D convertor spans for the AZ/EL tachometer inputs.

There are test points for monitoring these on the front of the board (behind the fold-down cover). You will need a digital voltmeter and the primary system board installed. Follow the procedure below:

⚠ **The following procedure involves disabling various safety features of the RCP02. This should only be done by an experienced technician since damage to the RCP02 or the radar system could result if proper caution is not used.**

⚠ **Do not invoke SAVE at any time during this measurement procedure so that you do not over–write your safety settings.**

- Position the antenna to approximately 30 degrees elevation.
- If you have a shipboard system, temporarily disable stabilization by responding NO to the first question of the INU setups.
- Disable the drive on your system by shutting-off the servo power switches and/or circuit breakers. **THIS IS AN IMPORTANT SAFETY STEP SINCE SAFETY CHECKS MUST BE DISABLED FOR THIS PROCEDURE.**
- Enter the TTY setups (e.g., antcheck –chat in IRIS or with a terminal).
- In **site host**, set **Process incoming servo control packets: NO** so that the host computer does not interfere with any commands that you issue.

Now, disable the safety features that would interfere with the measurements:

- In the **axis** command (for both AZ and EL) disable all of the safety checks, i.e., soft limits, inconsistent tach/position, unresponsive antenna and acceleration limit. BE SURE THAT YOUR SERVO POWER IS SWITCHED OFF OR THE BREAKER DISABLED SINCE THESE TESTS WILL NO LONGER BE AVAILABLE TO PROTECT YOUR ANTENNA.

Measuring the azimuth and elevation drive D/A spans is done as follows:

- In the monitor mode, type "alt" (as a l t rather than the <alt> key) until you see headings for AZ and EL position, tach and drive.
- Set an azimuth drive output of 50% by typing **ad 50**. The antenna should not move since the drive is disabled. Record the voltage on the azimuth drive test point. Use the ground test point that is provided for the common connection.

- Repeat the above procedure for the elevation drive.

If you do not measure any output drive voltage for EL, check to see that you are on the correct test point and that there is no limit switch indication on the front panel or in the terminal status monitor (mon status). Limit switch indication might occur if connector J11 is disconnected and this will cause the hardware limit switch protection circuitry to inhibit the drive signal.

Measuring the azimuth and elevation tach A/D spans is done by inputting a known DC voltage into the tach input on connector J11 on the RCP02 back panel. You will need a reliable DC voltage source that is approximately 50% of the range of your tachometer voltage span. The exact value is not critical.

The voltage span of your tachometer should be known from the tachometer specification. If you are uncertain of the voltage span that you need, you can check to see how the RCP02 tachometer jumpers are set (i.e., the voltage span range). This should give you a general idea of what kind of voltage source you will need. Refer to section 2.1.3 of this manual. In addition, you can re–install the primary system board and then monitor the AZ and EL tach voltages on the test points during system operation to get an idea of the approximate voltage range.

The best voltage source is a variable DC voltage source. You can also use a battery if the voltage range is appropriate.

- Remove the cable on J11 (DRV/TACH).

Since the limit switches are also on this connector, you may run into the problem that the antenna will shutdown when J11 is removed. If this happens, temporarily disable the limit switch shutdown in site misc.

- For the azimuth, connect the positive voltage into J11 (DRV/TACH) Pin 5 of the female connector on the RCP02 back panel and GND to Pin 7 (refer to table A–6). You should observe on the TTY monitor that the AZ tach is responding to the voltage. Adjust the voltage so that the AZ TACH displays somewhere between 20 and 90 tach units. The exact value is not critical. Measure the voltage with a digital voltmeter in parallel and record both the tach reading (e.g. +50 tach units) and the voltage (e.g., +15.6 volts). Record the signs properly. BE SURE TO RECORD THE TACH UNITS (+–100) NOT THE VELOCITY IN DEGREES/SEC.

During this phase of the test, you might input a voltage that would correspond to a very large velocity. In this case the antenna may shutdown because of the over–velocity protection. Reduce the input voltage and type "reset" to reset from the shutdown.

- Repeat the procedure for elevation, this time with positive voltage into J11 pin 9 and GND into pin 11.

When you are done, cycle power on the RCP02 to restore all settings. This assumes that you have not invoked SAVE while all the safety checks were disabled.

Now you have a record of the span of the A/D and D/A convertors for the AZ and EL tach and drive. Your record should appear as shown below (be sure to record all signs correctly):

AZ Tachometer Span	_____ Volts	_____Tach Units	
EL Tachometer Span	_____ Volts	_____Tach Units	
AZ Drive Span	_____ Volts	+50	Drive Units
EL Drive Span	_____ Volts	+50	Drive Units

D.5 Documenting the Primary System TTY Setups

Even if you do not have a spare, it is a good idea to document the software settings on your primary system. The "help listall" command will make a listing of these settings that you can write down by hand. However, if you are using a PC as a terminal emulator, we recommend that you capture the text and paste it into a file. For IRIS users we recommend the following procedure which makes use of the UNIX "script" command:

- In a UNIX terminal window login as operator.
- **$ cd /usr/sigmet/config** (assuming your system is rooted at /usr/sigmet) or other directory writable by operator where you would like to keep backup information.
- **$ script rcp02_1.bak1** will start a script file which records all terminal I/O. The information will be stored as text in the file rcp02_1.bak1. You should increment the numbers (e.g., rcp02_1.bak2) as you make new backups to reflect the changes you might make to the TTY setups. It's a good idea to keep a few previous versions in case there is a problem with a change and you want to revert to a previous configuration. The notation rcp02_2.bak1 would be used to indicate the configuration of a spare unit if it were different.

- **$ antcheck –chat** will enter the chat mode. Type <Enter> to get a prompt that you are in the RCP02 TTY setup menus.
- **RCP> help listall** will list all of the setups.
- **RCP> <Ctrl>C** will exit the menus back to the **$** prompt in your UNIX terminal window.
- **$ exit** will close the script file.
- **$ cat rcp02_1.bak1** will verify that the file is there and list the contents.
- **$ lp rcp02_1.bak1** will print the file to your default printer.

SIGMET recommends that IRIS managers make backup listings according to the above procedure whenever changes are made to the RCP02 TTY setups. Hardcopy should be placed with your system documentation.

D.6 Configuring the Spare Board Hardware

With proper documentation as described in the preceding sections, it is straightforward to configure the spare mother and daughter boards. First check the hardware configuration of the spare board against the primary board:

- Verify that the model number and version of the spare mother board matches the primary system (e.g. on the mother board "SIGMET RCP02 Rev B"). If they are different, contact **support@sigmet.com** to check for compatibility.
- Verify that the spare daughter board has the same IP modules as the primary system and that these are installed in the same slots. If in doubt, contact **support@sigmet.com**.
- Verify that the jumper settings on both the mother and daughter boards match the primary system.
- Verify that any wire-wrap jumpers match those of the primary system mother board. If needed, add or remove jumpers on the spare board to match the primary system board.

D.7 Configuring the Spare Board TTY Setups

Next, set the TTY setups in the spare board to match the primary board.

If the primary system board is not currently functioning and you have no documentation of the TTY setups, you will need to configure all of the TTY setups from scratch. DOCUMENT YOUR SETTINGS BEFORE A FAILURE OCCURS SO THIS DOES NOT HAPPEN.

- Verify that you have a current backup listing of the TTY setups for the primary system. Make one if necessary.

⚠ **When the spare board is first installed, the TTY settings will not be correct for your radar. To avoid possible damage to your system, it is recommended that you disable the radar and antenna and disconnect the cables from the RCP02.**

- Disable the radar and the antenna by use of manual power switches or circuit breakers.
- It is also recommended that you disconnect all I/O cables on the back panel as an additional safety step. If you will be using antcheck –chat to configure the TTY setups, leave the Comp Serial (J5) cable connected.
- Turn power off to the RCP02, install the spare board and turn power back on.
- Using either a hardcopy backup of the system settings as a check list, go through the TTY setups and set the backup system values to match the primary system values. It is helpful to have another person to assist you and check your work. Type SAVE after you have set each section to store your progress.
- When this is completed for all sections of the TTY setups SAVE your results.
- Finally, do a **help listall** and double–check all of the settings against the primary system TTY setup documentation. It is preferable that another person do this check since you are likely to make the same error twice.

⚠ **Do not reconnect the back panel cables, especially J11 until you have completed the configuration of the Drive/Tach spans as described below. The antenna will not be stable so you should not attempt to operate it or serious damage might occur.**

D.8 Configuring the D/A and A/D Convertor Spans

⚠ **The following procedure involves disabling various safety features of the RCP02. This should only be done by an experienced technician since damage to the RCP02 or the radar system could result if proper caution is not used.**

⚠ **Do not invoke SAVE at any time during this measurement procedure so that you do not over–write your safety settings.**

The hardware and software configurations are now the same for the primary and backup systems. The last step is to configure the tach and drive spans to match the values of the primary system board. The primary system board values are obtained according to the procedure in Section D.4. The procedure for setting the spans on the spare board is nearly identical except that you will adjust the gain pots to match the values that were measured for the primary board. These are next to the test points on the front of the mother board (behind the fold-down front panel). There is also a ground point (GND).

First adjust the drive output span:

- Disable the radar and antenna by means of manual switches or circuit breakers.
- If you have a shipboard system, temporarily disable stabilization by responding NO to the first question of the INU setups.
- In **site host**, set **Process incoming servo control packets: NO** so that the host computer does not interfere with any commands that you issue.

Now, disable the safety features that would interfere with the adjustment:

- In the **axis** command (for both AZ and EL) disable all of the safety checks, i.e., soft limits, inconsistent tach/position, unresponsive antenna and acceleration limit. BE SURE THAT YOUR SERVO POWER IS SWITCHED OFF OR THE BREAKER DISABLED SINCE THESE TESTS WILL NO LONGER BE AVAILABLE TO PROTECT YOUR ANTENNA.
- Carefully re–connect cable J11 (DRV/TACH). The antenna should not move when this is done, else quickly disconnect it and make sure that the servo drive is disabled by manual switch or breaker.
- In the monitor mode, type "alt" (as a l t rather than the <alt> key) until you see headings for AZ and EL position, tach and drive.
- Set an azimuth drive output of 50% by typing **ad 50**. The antenna should not move since the drive is disabled.
- Monitor the AZ DRIVE voltage on the test point and adjust the pot until the voltage matches the corresponding ad 50 voltage that was recorded for the primary system board.
- Repeat the above procedure for the elevation drive.

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i **If you do not measure any output drive voltage for EL, check to see that you are on the correct test point and that there is no limit switch indication on the front panel or in the status monitor. Limit switch indication might occur if connector J11 is disconnected and this will cause the hardware limit switch protection circuitry to inhibit the drive signal.**

Now set the tach voltage span. You will need to a digital voltmeter and a DC voltage source as described in Section D.4.

- Remove the cable on J11 (DRV/TACH).

Since the limit switches are also on this connector, you may run into the problem that the antenna will shutdown when J11 is removed. If this happens, temporarily disable the limit switch shutdown in site misc.

- For the azimuth, connect the positive voltage into J11 (DRV/TACH) Pin 5 of the female connector on the RCP02 back panel and GND to Pin 7 (refer to table A–6). You should observe on the TTY monitor that the AZ tach is responding to the voltage.
- Monitor the voltage in parallel with a digital voltmeter. Adjust it so that it corresponds to voltage that was used to benchmark the primary board.
- Adjust the AZ TACH pot until the AZ TACH values in the monitor display match those that you recorded for the primary board for the same input voltage.

During this phase of the test, you might input a voltage that would correspond to a very large velocity. In this case the antenna may shutdown because of the over–velocity protection. To work–around this, you can temporarily adjust the gain pot based on a lower voltage (e.g., half the voltage and half the desired tach reading). Once this is done, readjust based on the actual voltage that was used to benchmark the primary unit.

- Repeat the procedure for elevation, this time with positive voltage into J11 pin 9 and GND into pin 11.

When you are done, cycle power on the RCP02 to restore all settings. This assumes that you have not invoked SAVE while all the safety checks were disabled. DO NOT RECONNECT THE CABLES AT THIS POINT UNTIL YOU HAVE GONE THROUGH THE TEST PROCEDURE DESCRIBED BELOW.

D.9 Re–Connect all Cables and Test

Testing should be done by an experienced technician familiar with the RCP02 to avoid possible damage to the antenna system.

All configurations are now complete and the hardware and software in the primary and the spare units now match. It is time to re–connect all of the cables and make a first test of the spare unit according to the procedure below:

- Set the elevation angle to approximately 30 degrees by means of manual control, physically moving the antenna or by re–installing the primary unit and using it to set the elevation. If you use the latter approach, you will need to re-connect the cables at this point.
- Disable the radar and antenna by means of manual switches or circuit breakers.
- If you have a shipboard system, temporarily disable stabilization by responding NO to the first question of the INU setups.
- In **site host**, set **Process incoming servo control packets: NO** so that the host computer does not interfere with any commands that you issue.
- Temporarily set the elevation shutdown limits in axis elevation to +25 to +35 degrees (antenna set to 30 degrees). In the event of an unpredicted motion of the elevation, this will provide an added degree of protection.
- Temporarily set the elevation soft limits in axis elevation to +26 to +34 degrees (antenna set to 30 degrees).
- Reconnect all of the cables to the back of the RCP02. When you connect J11 (DRV/TACH) verify that the antenna does not move, else quickly remove J11 and verify that the servo drive is properly disabled.

First test the azimuth stabilization:

- If possible, enable only the azimuth drive by means of manual switch or breaker. If this is not possible on your system, verify that when the drive is enabled, that the elevation does not move.
- When the antenna is stationary, check in the monitor mode and note if there is any azimuth tach offset (T–units). If there is, then remove it be typing the offset into the axis azimuth command (last question). You should be able to adjust this so that there is zero tach indication when the antenna is stationary (except perhaps for some noise jitter). Write down the value, since you do not want to type SAVE at this point.
- Use the monitor command to check the velocity servo in azimuth (at commands) starting with small velocities. Be sure to check both CW and CCW motion.
- Use the monitor command to check the position servo (ap commands) starting with small displacements (e.g., 1 degree) and gradually progressing up to 180 degree displacements.

The azimuth performance should be nearly identical to the performance of the primary board system. If the performance is not the same, check the settings of the vservo and axis commands to make sure they match the primary system. Also

recheck the drive and tach spans. Experience shows that if the primary and spare units are properly adjusted to match, they will perform identically. Only as a last resort should you change the stabilization settings in the spare board.

Now check the elevation servos. This requires caution since the elevation is untested to this point. Unlike azimuth, the elevation axis can impact physical stops. Have a person standing by the elevation servo drive breaker during the early part of the test in case the antenna is unstable. In addition, the shutdown limits set as indicated above, will prevent the elevation from driving into the stops.

- Carefully turn–on the elevation servo drive switch/breaker and be prepared to turn it off immediately if the elevation axis starts to move.
- When the antenna is stationary, check in the monitor mode and note if there is any elevation tach offset (T–units). If there is, then remove it be typing the offset into the axis elevation command (last question). You should be able to adjust this so that there is zero tach indication when the antenna is stationary (except perhaps for some noise jitter). Write down the value, since you do not want to type SAVE at this point.
- Enter the monitor command and issue ep commands for 1 degree displacements. If there is any sign of unpredictable motion you can hit the ESC key to remove any drive output from the RCP02.
- If these small displacements are acceptable gradually increase to 5 degree displacements. Be aware that your soft limits should be set for 25 to 35 degrees, so you must stay within these with your ep commands.
- If these first experiments are acceptable, go to the axis elevation setups and widen the shutdown limits and soft limits to approximately 10 degrees of their desired values and retest the position servo. Also test some velocity servo and verify that the soft limits properly stop the antenna. Finally set the soft limits to their final values and test.

If the elevation performance does not match that of the primary system, then 1.) Verify the TTY setups for the axis, vservo and pservo commands for EL match the primary system. 2.) Verify that the TACH and DRIVE spans match the primary system. This may require re–installing the primary system. 3.) Verify that the tach offset is properly set in the axis elevation command so that the monitor command shows 0 T–units for a stationary antenna (except for noise jitter). Remember that if the performance of the backup should be identical to the spare unit without tuning the servo. Do this only as a last resort after you have verified the configurations are properly matched.

D.10 Operational Test

Once you are satisfied with the antenna tests, restore the saved values (restore command) and enter the AZ and EL tach offsets permanently via the axis command and SAVE. Now continua to test the other features of the RCP02 such as BITE (if

available) and the standard status and control features. Finally perform a full operational test. At this point you can now swap either the spare or the primary and they will function identically.