Array Solutions RA-S1 Rotator Controller

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Contents

1   Front Panel

The RA-S1 has four buttons that are used for configuration and to manually turn the rotator. It has two potentiometers POS and SPEED. POS is used to choose an angle to point-and-shoot and also choosing between options when the RA-S1 is on the setup mode.

Figure 1: *Front panel*

SETUP
Button used to access and navigate through menus and sub-menus

GO
Button used to access sub-menus, define parameters and execute the point-and-shoot.

CCW
Button used to turn the rotator counter-clockwise.

CW
Button used to turn the rotator clockwise.

POS
Used to choose options on the menus also it is used to choose the azimuth for the point-and-shoot.

SPEED
Potentiometer that defines the speed that the rotator will turn. When turned the display 1 shows a value from 1 to 9.

ON/OFF
Power switch

2   Displays
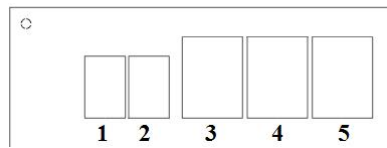
Figure 2: *Display*

The RA-S1 has two possible states that can change the function of the displays. The usual one called operating mode and the setup mode. They will be explained referring to the numbers showed on the Figure 2.

The displays on operating mode:

Display 1: The display 1 on the operating mode has two main functions. It is used to show the speed when the SPEED potentiometer is turned going from 1-9 and, when the controller is configured to rotators that has a braking system (Ex: HAM4, T2X) the display 1 indicates that the brake is released by showing "b".

Display 2: Show the direction the rotator is turning.

Displays 3, 4, 5: Shows the actual azimuth the rotator is. If the POS potentiometer is turned the display 1 and 2 will display "to" while the displays 3-4-5 shows an angle between 0 and 359 for four seconds. If you press GO the controller will go to the chosen angle.

The displays on setup mode (details on configuration mode is on section 13):

Display 1 and 2: The display 1 on the setup mode is used to display the menu number going from 1 to 4. By pressing GO you will enter on the selected menu. By entering a menu, the display 1 and 2 will show the menu and the sub-menu like "1.1 TYP", "1.2 POS", etc.

Displays 3, 4, 5: When turned it is possible to see the available options of each sub-menu.

3   Rear panel

Figure 3: *Rear panel*

1: Grounding Connection (Connected to the AC neutral)
2: Fuse (2A)
3: Power Supply
4: 110 V / 220 V Switch
5: Molex Mini-fit Jr (12 pin) Connector
6: DB-9F Connector – Serial RS-232
7: USB "B" Connector – Used for virtual serial COM and Firmware update.

4   Configuration Explained

This section explains the details and meanings of the controller configuration. If you want a detailed step-by-step configuration of the controller for your rotator go to its respective section.

To configure the RA-S1 for your rotator it is necessary to configure three internal jumpers and connect the correct wires from the transformer depending on the voltage your rotator require.

4.1   Jumpers and Connections

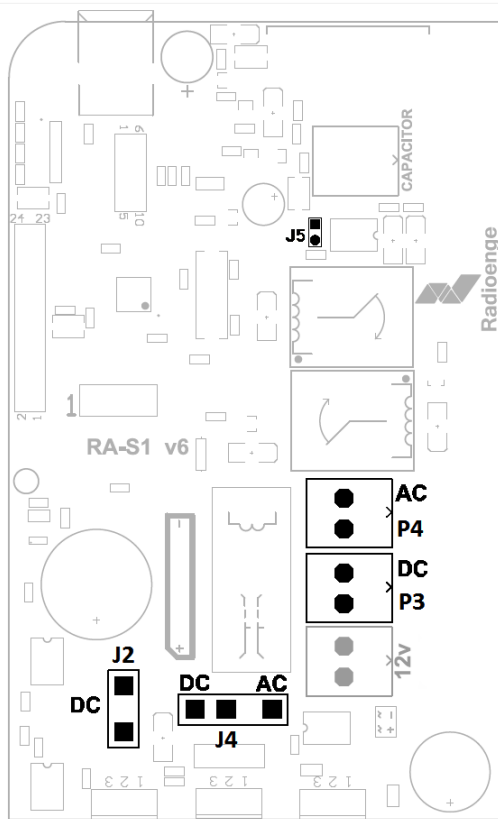- The **J5** jumper is inserted depending if the potentiometer of the rotator has the wiper grounded (Ex: HyGain HAM-IV or T2X) or not (Ex: Yaesu G-1000). If the wiper is grounded then the controller will read only one side of it (variable resistance). If the wiper is grounded then the **J5** must be jumped.

- The bornes **P4** and **P3** marked as **AC** and **DC** are used to connect the wires from the transformer. If the rotator is AC connect the transformer wires on **P4**, if it is DC connect the wires on **P3**.

  It is possible to choose between 24V and 36V. For 24V rotators, it is connected the 0V wire (the one with the aerial fuse) and the 24V wire (yellow). For 36V rotators it is connected the 0V and the 36V wire (red).

- **J4** and **J2** are connected depending if your rotator is AC or DC. For AC rotators remove the jumper from **J2** and connect it on **J4** between the pin 2-3. If the rotator is DC **J2** and **J4** must be jumped.

Figure 4: *Jumpers and cable connectors used for configuration*

4.2   Connecting the controller to the rotator

When connecting the rotator to the controller, there are three main factors that will define the connections: the rotator power input (AC or DC), if it has a brake solenoid, and the positioning feedback (usually by pulses or a potentiometer). How to make those connections will be explained in the following tables referring to the RA-S1 Connector shown on the image below.
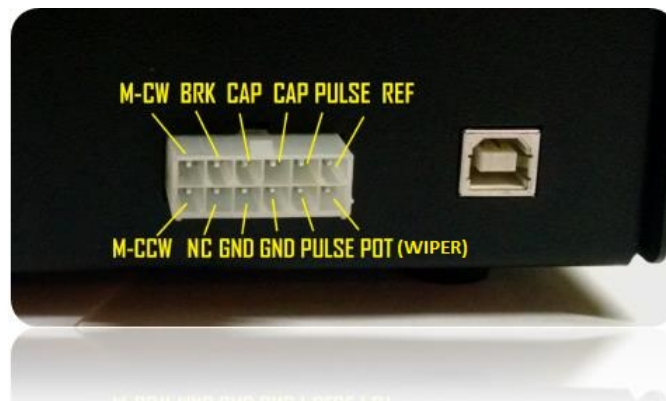

Figure 5: *RA-S1 Connector*

The Image 5 indicates the function of each pin of the RA-S1 connector.

Table 1: Connection DC Rotator / RA-S1

DC Rotator	RA-S1 Controller
Motor	M-CW
Motor	M-CCW

Table 2: Connection AC Rotator / RA-S1

AC Rotator	RA-S1 Controller
Winding 1	M-CW
Winding 2	M-CCW
Motor Ground	GND

For rotators with brake solenoid (Ex: Ham-IV) connect it to BRK on the RA-S1 Controller.

If the rotator is rotating to opposite directions that the one desired, for DC rotators invert the motor wires for AC rotators invert the winding wires.

Table 3: Rotator With Pulse Feedback / RA-S1

Rotator Pulses	RA-S1 Controller
Pulse Wire	PULSE
Pulse Wire	PULSE

Table 4: Rotator With Potentiometer Feedback / RA-S1

Rotator Potentiometer	RA-S1 Controller
Right End of Potentiometer	REF
Wiper	POT(WIPER)
Left End of Potentiometer	GND

4.3   Firmware configuration and calibration

After the Jumpers and Connections we need to do some setup on the controller program. To navigate on the menu, the **SETUP** button is used. To enter a menu or save a value at a sub-menu, the **GO** button is used and, for choosing an option, the **POS** potentiometer is used. To configure and calibrate the controller for the connected rotator, follow these steps.

(This is a general explanation, for more detailed information on connecting and configuring a specific rotator check the following chapters regarding common rotators configurations or contact Array Solutions)

1. Hold the **SETUP** button until the controller displays **"1 CAL"**

2. Press the button **GO** to enter this menu. It should display **"1.1 TYP"**. This menu 1.1 is to define if the rotator is AC or DC powered, if you turn the **POS** potentiometer you can see the options: **AC**, **DC2**, and **DC1**. **AC** is meant for AC rotators, **DC2** is for 24 V DC or 36 V DC rotators, **DC1** is meant for 12 V DC rotators.)

3. If your rotator is 24 V DC or 36 V DC, turn the potentiometer **POS** until it appears on the screen **"1.1 DC2"**.

   If your rotator is 12 V DC, turn the potentiometer **POS** until it appears on the screen **"1.1 DC1"**.

   If your rotator is AC powered, turn the potentiometer **POS** until it appears on the screen **"1.1 AC"**.

   Hold the button GO until the screen blinks to save the selected option.

4. Press **SETUP** to go to the next sub-menu. It should appear **"1.2 POS"**.
   This sub-menu serves for defining what position feedback the rotator uses.

   Turn the potentiometer **POS** to see the options. The options are:
   "HYG" used for the potentiometer of Hy-Gain rotators or variable resistances,
   "NO" used when for some reason the rotator don't have a feedback position,
   "POT" used when rotator have a potentiometer as a feedback like Yaesu that varies from 0 to 100% of its value,
   "PST" used for Pro.Sis.Tel rotators or potentiometers that are used only partially (Ex: 1 turn of a 10 turn potentiometer), and
   "PUL" when the rotator have pulses as position feedback.

   Turn the potentiometer **POS** until the display shows the desired option.

   Hold the button **GO** until the screen blinks to save this option.

5. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.3 BRA"**. This sub-menu serves to tell the controller if the rotator has a brake. The possible options are yes or no.

   Turn the potentiometer **POS** to select the desired option.

   Hold the button **GO** until the screen blinks to save this option.

(This is the calibration part, if your rotator has a <u>potentiometer</u> as position feedback go to the next item, if it has <u>pulses</u> go to Item 10)

6. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 L"**. *(On this sub-menu, the "L" on the screen means Left or Counter Clockwise.)*

   In order to calibrate the controller, press the **CCW** button and turn the rotator to a counter-clockwise position the closer to the end-of-track the better. Notice that the display will show a number, this number is the value of the voltage on the potentiometer's wiper and goes from 0 to 999 (0 to 100% of the potentiometer value) it's not the real azimuth. When moving counter-clockwise this number should descend.

   After you turned to a point near the rotator's **CCW** end-of-track, stop the rotation and check the REAL azimuth of the antenna at this point, and put this **REAL** azimuth on the controller screen using the **POS** potentiometer to set this azimuth.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save it.

7. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 R"**. *(On this sub-menu, the "R" on the screen means Right or Clockwise.)*

   Now press the **CW** button and turn the rotator to a clockwise point, the closer to the clockwise end-of-track the better. Notice that the number shown on the screen should now be ascending.

   After you turned to a point near the **CW** rotator's end-of-track, stop the rotation and check the **REAL** azimuth of the antenna at this point and put this **REAL** azimuth on the controller screen using the **POS** potentiometer to insert this azimuth.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save the CW azimuth you inserted.

8. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.6 OL"**. In this sub-menu you need to tell if there was an overlap on the rotation you just made. *(If when you moved the rotator to the right (CW) you turned the rotator <u>more than 360º</u> from the CCW point, there has been an overlap.)*

   If an overlap happened as described above, use the potentiometer **POS** to select the option **YES**.

   If an overlap did not happen, select the option **NO**.

   Hold the button **GO** until the screen blinks to save this option.

9. The configuration and calibration is now complete. Press setup multiple times to exit the configuration mode.
   (Now the next Items refer to pulsed feedback rotators, when the positioning selected on the menu 1.2 is PUL, it changes what the menus 1.4, 1.5 and 1.6 refers to.)

10. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 ANG"**. *(On this sub-menu, ANG means Azimuth)*

    In order to calibrate the controller, verify the REAL AZIMUTH that the rotator (or the antenna) is pointing at. Set this azimuth by turning the potentiometer **POS**.

    With the real azimuth on the screen, hold **GO** until the screen blinks to save the azimuth you inserted.

11. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 PHI"**. *(On this sub-menu, PHI means Pulse-High)*

    Here you need to insert the how many pulses (divided by 100) your rotator generates on a full 360º rotation (usually it is on the rotator manual.).

    Example 1: Your rotator generates **3960** pulses on a **full 360º** rotation; in this sub-menu **(1.5 PHI)** you should insert **39** with the POS potentiometer.

    Example 2: Your rotator generates **10850** pulses on a **full 360º** rotation; in this sub-menu (1.5 PHI) you should insert **108** with the POS potentiometer.

    Example 3: Your rotator generates **365** pulses on a full **360º** rotation; in this sub-menu (1.5 PHI) you should insert **3** with the POS potentiometer.

    Hold **GO** until the screen blinks to save the number you inserted.

12. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.6 PLO"**. *(On this sub-menu, PLO means Pulse-Low)*

    Here you need to insert the how many pulses (tens and units) your rotator generates on a full 360º rotation (usually it is on the rotator manual).

Example 1: Your rotator gives **3960** pulses on a **full 360º** rotation; in this sub-menu (**1.6 PLO**) you should insert **60** with the POS potentiometer.

Example 2: Your rotator gives **10850** pulses on a **full 360º** rotation; in this sub-menu (**1.6 PLO**) you should insert **50** with the POS potentiometer.

Example 3: Your rotator gives **365** pulses on a **full 360º** rotation; in this sub-menu (**1.6 PLO**) you should insert **65** with the POS potentiometer.

Hold **GO** until the screen blinks to save the number you inserted.

13. The configuration and calibration is now complete. Press setup multiple times to leave the menu.

4.3.1   Observation for Rotators With Potentiometer Feedback

For the Pro.Sis.Tel configuration (menu "1.2 PST"), after the calibration the RA-S1 will only point-and-shoot to positions between the calibration points (azimuths inserted on menu 1.4 and 1.5). In order to reach further azimuths with the point-and-shoot, you must manually reach them using the CCW and CW buttons so the RA-S1 knows it's possible to go on further.

(It is extremely recommended to set Soft Limits when using the Pro.Sis.Tel rotator as it don't have mechanical end-courses, for that go to the page 25.)

With the Soft Limits ON the controller will only point-and-shoot to azimuths between the Soft Limits.

4.3.2   Observation for Rotators With Pulse Feedback

After calibrating you will notice that the point-and-shoot isn't working. This happens because the **RA-S1** will only point-and-shoot to positions where you manually turned once with CW or CCW button.

This is made that way so the controller won't overturn or run onto the end-course.

5   Configuration for PRO.SIS.TEL "D" Rotators (PST 61D, 71D, 2051D, 641D)

5.1   Jumpers and connections
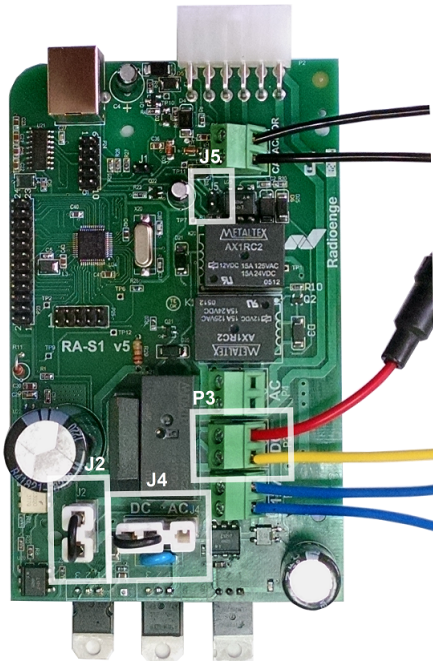
Figure 6: *Board scheme for PRO.SIS.TEL("D") rotators*

- Remove the jumper from **J5**.

- Place the yellow wire and the red wire with the in-line fuse holder on the **P3** borne marked as DC.

- Insert the Jumpers on **J2** and **J4** as indicated in the figure.

5.2   Connecting the controller to the rotator

Connect the controller to the rotator following the table below.
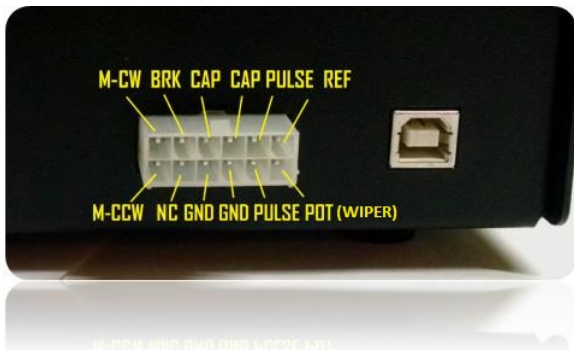
Figure 7: *RA-S1 Connector*
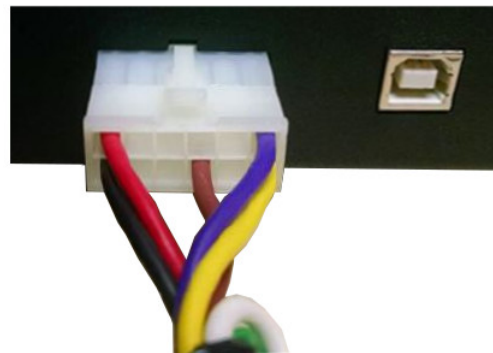
Figure 8: *RA-S1 Connector for Pro.Sis.Tel. Rotators*

Table 5: Wire by wire - PRO.SIS.TEL to RA-S1

Rotator PST "D"	RA-S1 Controller
1	M-CCW (Black)
2	M-CW (Red)
3	POT (Yellow)
4	REF (Purple)
5	GND (Brown)

Table 6: PRO.SIS.TEL Rotator Truth Table

Pins	10kΩ Pot.	500Ω Pot.
1 and 2 (Motor)	4 ~19Ω	4 ~19Ω
1 and 2 to GND	open	open
1-2 to 3-4-5	open	open
4 and 5	~10kΩ	~500Ω
3 to 4 or 3 to 5	$<$10kΩ	$<$500Ω

5.3   Firmware configuration and calibration

For navigating on the menu, the **SETUP** button is used. For entering a menu or saving a value at a sub-menu, the **GO** button is used and, for choosing an option, the **POS** potentiometer is used.

1. Hold the **SETUP** button until the controller displays **"1 CAL"**

2. Press the button **GO** to enter this menu. It should display **"1.1 TYP"**.

3. If your rotator is the **PST 61D, 2051D or 641D**, turn the potentiometer **POS** until it appears on the screen **"1.1 DC1"**.

   If your rotator is the **PST 71D**, turn the potentiometer **POS** until it appears on the screen **"1.1 DC2"**.

   Hold the button GO until the screen blinks to save this option.

4. Press **SETUP** to go to the next sub-menu. It should appear **"1.2 POS"**.

5. Turn the potentiometer **POS** until it appears on the screen **"1.2 PST"**.

   Hold the button **GO** until the screen blinks to save this option.

6. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.3 BRA"**.

7. Turn the potentiometer **POS** until it appears on the screen **"1.3 NO"**.

   Hold the button **GO** until the screen blinks to save this option.

8. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 L"**.

   In order to calibrate the controller, press the **CCW** button to turn the rotator to a counter-clockwise point (recommended to turn the rotator visually to north if the system is adjusted for north-stop or south if south-stop).

   You may notice as you turn the rotator **CCW** that the display shows a number that is descending, this number is **not** the azimuth. This number is the variation of the potentiometer and it ranges from **0 to 1000** approximately. As the Pro.Sis.Tel comes with a 10 turn potentiometer each lap of it will be a physical lap of the PST Rotator and will result in a variation of 100 on the RA-S1 "1.4 and 1.5" sub-menu.

   After you turned the rotator to your desired end-of-track (north or south), stop the rotation and check the REAL azimuth of the antenna at this point, and put this **REAL** azimuth on the controller screen using the **POS** potentiometer.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save it.

9. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 R"**.

   Press the **CW** button to turn the rotator to a clockwise point (recommended to turn the rotator 360º from the chosen point on the previous menu).

   After you turned the rotator to the clockwise point stop the rotation and check the **REAL** azimuth of the antenna at this point and put this **REAL** azimuth on the controller screen using the **POS** potentiometer.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save the CW azimuth you inserted.

10. Press **SETUP** to go to the next sub menu It should be appearing **"1.6 OL"**. In this sub menu you need to tell if there was an overlap on the rotation you just made. *(If when you moved the rotator to the right (CW) you turned the rotator <u>more</u> than 360º from the CCW point, there has been an overlap.)*

    If an overlap happened as described above, use the potentiometer **POS** to select the option **YES**.

    If an overlap did not happen, select the option **NO**.

    Hold the button **GO** until the screen blinks to save this option.

11. The configuration and calibration is now complete. Press setup multiple times to exit the configuration mode.

5.3.1   Observation for PRO.SIS.TEL

For the Pro.Sis.Tel configuration (menu "1.2 PST"), after the calibration the RA-S1 will only point-and-shoot to positions between the calibration points (azimuths inserted on menu 1.4 and 1.5). In order to reach further azimuths with the point-and-shoot, you must manually reach them using the **CCW** and **CW** buttons so the RA-S1 knows it's possible to go there.

   (It is extremely recommended to set Soft Limits when using the Pro.Sis.Tel rotator as it don't have mechanical end-courses, for that go to the page 25.)

   With the Soft Limits ON the controller will only point-and-shoot to azimuths between the Soft Limits.

6   Configuration YAESU G-800, G1000, G2800

6.1   Jumpers and Connections
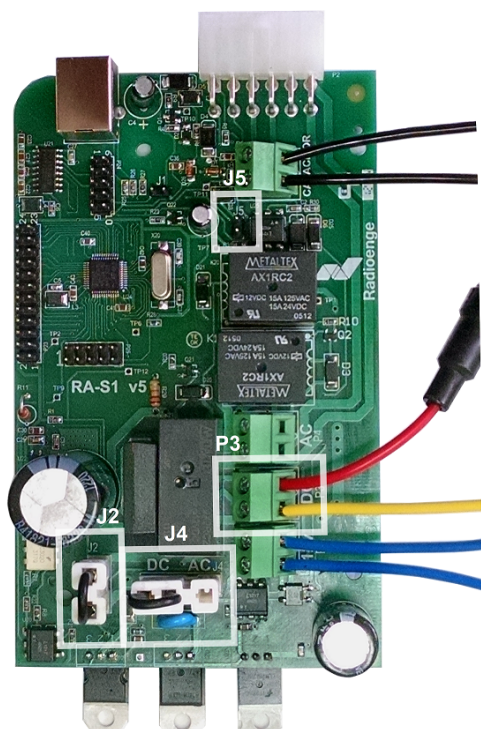
- Remove the jumper from **J5**.

- Place the yellow wire and the red wire with the in-line fuse holder on the **P3** borne marked as DC.

- Insert the Jumpers on **J2** and **J4** as indicated in the figure.

Figure 9: *Board scheme for YAESU G-800, G1000, G2800 rotators.*

6.2   Connecting the controller to the rotator

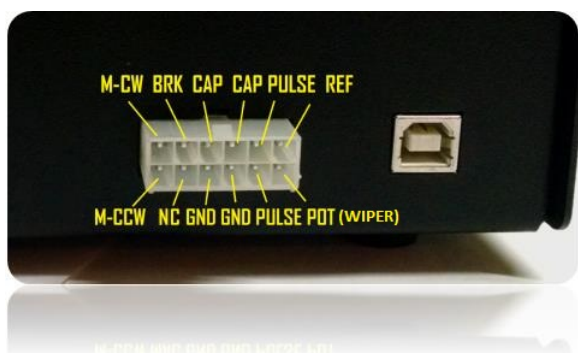Connect the controller to the rotator following the table below.

Figure 10: *RA-S1 Connector*

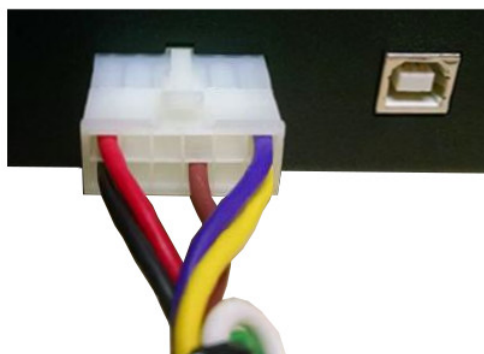Figure 11: *RA-S1 Connector for Yaesu DC Rotators*

Table 7: Wire by wire - YAESU / RA-S1

YAESU G-800/G-1000/G-2800	RA-S1 Controller
1	REF - Purple
2	POT - Yellow
3	GND - Brown
4	M-CW - Red
5	M-CCW - Black

6.3   Firmware configuration and calibration

For navigating on the menu, the **SETUP** button is used. For entering a menu or saving a value at a sub-menu, the **GO** button is used and, for choosing an option, the **POS** potentiometer is used.

1. Hold the **SETUP** button until the controller displays **"1 CAL"**

2. Press the button **GO** to enter this menu. It should display **"1.1 TYP"**.

3. Turn the potentiometer **POS** until it appears on the screen **"1.1 DC2"**.

   Hold the button **GO** until the screen blinks to save this option.

4. Press **SETUP** to go to the next sub-menu. It should appear **"1.2 POS"**.

5. Turn the potentiometer **POS** until it appears on the screen **"1.2 POT"**.

   Hold the button **GO** until the screen blinks to save this option.

6. Press **SETUP** to go to the next sub-menu It should be appearing **"1.3 BRA"**.

7. Turn the potentiometer **POS** until it appears on the screen **"1.3 NO"**.

   Hold the button **GO** until the screen blinks to save this option.

8. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 L"**.

   In order to calibrate the controller, press the **CCW** button and turn the rotator to a counter-clockwise point (the closer to the end-of-track– the closer to 0 on the display -, the better).

   You may notice as you turn the rotator **CCW** that the display shows a number that is descending, this number is **not** the azimuth. This number is the variation of the potentiometer and it ranges from **0 to 1000** approximately, meaning ~**0** is the **CCW** rotator's end-of-track and ~**1000** is the **CW** rotator's end-of-track. These values can be higher for the CCW end of track or lower for the CW end-of-track depending on the wire resistance.

   After you turned to a point near the rotator's **CCW** end-of-track, stop the rotation and check the REAL azimuth of the antenna at this point, and put this **REAL** azimuth on the controller screen using the **POS** potentiometer.

   With the real azimuth on the screen, hold GO until the screen blinks to save it.

9. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 R"**.

   In order to calibrate the controller, press the **CW** button and turn the rotator to a point to the right (the closer to the end-of-track – the closer to 1000 on the display -, the better).

   After you turned to a point near the **CW** rotator's end-of-track, stop the rotation and check the **REAL** azimuth of the antenna at this point and put this **REAL** azimuth on the controller screen using the **POS** potentiometer.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save the CW azimuth you inserted.

10. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.6 OL"**. In this sub-menu you need to tell if there was an overlap on the rotation you just made. *(If when you moved the rotator to the right (CW) you turned the rotator <u>more</u> than 360º from the CCW point, there has been an overlap.)*

    If an overlap happened as described above, use the potentiometer **POS** to select the option **YES**.

    If an overlap did not happen, select the option **NO**.

    Obs: If you calibrated from the CCW end-of-track until the CW end-of-track, select the option **"YES"** because those Yaesu rotators have 90º overlap.

    Hold the button **GO** until the screen blinks to save this option.

11. The configuration and calibration is now complete. Press setup multiple times to exit the configuration mode.

6.3.1   Observation for Yaesu

If you calibrated from the CCW end-of-track to the CW end-of-track, you may notice when you exited the menu that there is a point on the display on the right side of the angle, this point means that the rotator is on the overlap.

7 Configuration for YAESU G450/G650

7.1 Jumpers and connections
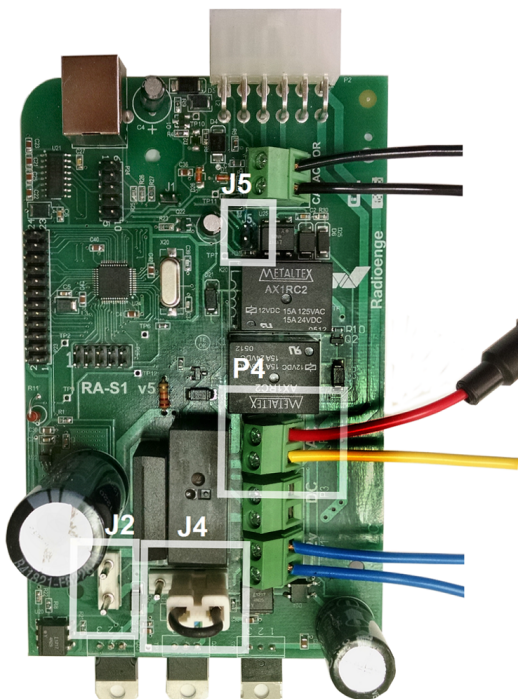
- Remove the jumper **J5**.

- Place the yellow wire and the red wire with the aerial fuse on the borne **P4** marked as AC as shown on the picture.

- Remove the jumper from **J2** and insert it on **J4** as shown on the picture.

Figure 12: *Board scheme for YAESU G450/G650*

7.2 Connecting the controller to the rotator

Connect the controller to the rotator following the table below.

Figure 13: *Board scheme for YAESU G450/G650*

Table 8: Wire by wire - YAESU

| Rotator YAESU G450/G650	RA-S1 Controller
1	REF
2	POT
3	GND
4	M-CW
5	M-CCW
6	GND

7.3   Firmware configuration and calibration

1. Hold the **SETUP** button until the controller displays **"1 CAL"**

2. Press the button **GO** to enter this menu. It should be displaying **"1.1 TYP"**.

3. Turn the potentiometer **POS** until it appears on the screen **"1.1 AC"**. Hold the button **GO** until the screen blinks to save this option.

4. Press **SETUP** to go to the next sub-menu. It should appear **"1.2 POS"**.

5. Turn the potentiometer **POS** until it appears on the screen **"1.2 POT"**.

   Hold the button **GO** until the screen blinks to save this option.

6. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.3 BRA"**.

   Turn the potentiometer **POS** until it appears on the screen **"1.3 NO"**.

   Hold the button **GO** until the screen blinks to save this option.

7. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 L"**.

   In order to calibrate the controller, press the **CCW** button to turn the rotator to a counter-clockwise point (the closer to the end-of-track– the closer to 0 on the display -, the better).

   You may notice as you turn the rotator **CCW** that the display shows a number that is descending, this number is **not** the azimuth. This number is the variation of the potentiometer and it ranges from **0 to 1000** approximately, meaning ~**0** is the **CCW** rotator's end-of-track and ~**1000** is the **CW** rotator's end-of-track. These values can be higher for the CCW end of track or lower for the CW end-of-track depending on the wire resistance.

   After you turned to a point near the rotator's **CCW** end-of-track, stop the rotation and check the REAL azimuth of the antenna at this point, and put this **REAL** azimuth on the controller screen using the **POS** potentiometer.

   With the real azimuth on the screen, hold GO until the screen blinks to save it.

8. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 R"**.

   In order to calibrate the controller, press the **CW** button to turn the rotator to a point to the right (the closer to the end-of-track – the closer to 1000 on the display -, the better).

   After you turned to a point near the **CW** rotator's end-of-track, stop the rotation and check the **REAL** azimuth of the antenna at this point and put this **REAL** azimuth on the controller screen using the **POS** potentiometer.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save the CW azimuth you inserted.

9. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.6 OL"**. In this sub-menu you need to tell if there was an overlap on the rotation you just made. *(If when you moved the rotator to the right (CW) you turned the rotator <u>more</u> than 360º from the CCW point, there has been an overlap.)*

   If an overlap happened as described above, use the potentiometer **POS** to select the option **YES**.

   If an overlap did not happen, select the option **NO**.

   Obs: If you calibrated from the CCW end-of-track until the CW end-of-track, select the option **"YES"** because those Yaesu rotators have 90º overlap.

   Hold the button **GO** until the screen blinks to save this option.

10. The configuration and calibration is now complete. Press setup multiple times to exit the configuration mode.

7.3.1   Observation for Yaesu

If you calibrated from the CCW end-of-track to the CW end-of-track, you may notice when you exited the menu that there is a point on the display on the right side of the angle, this point means that the rotator is on the overlap.

8   Configuration for Hy-Gain HAM-X, T2X, CD-45

8.1   Jumpers and connections
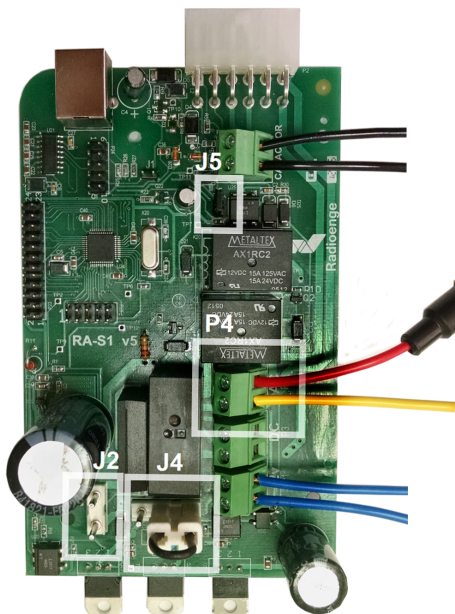
- Insert the jumper on **J5**.

- Place the yellow wire and the red wire with the aerial fuse on the borne **P4** marked as **AC**.

- Remove the jumper from **J2** and insert it on **J4** as shown on the picture.

Figure 14: *Board scheme for HAM-X, T2X, CD-45 rotators*

8.2   Connecting the controller to the rotator

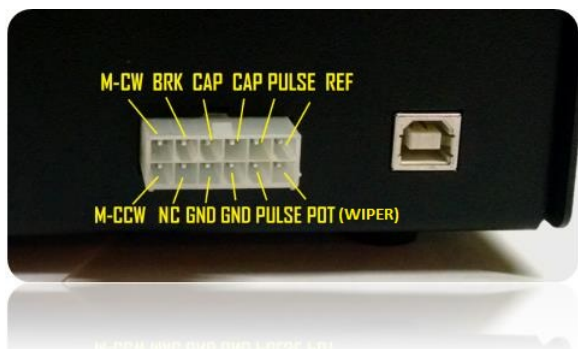Connect the controller to the rotator following the table below.

Figure 15: *RA-S1 Connector*
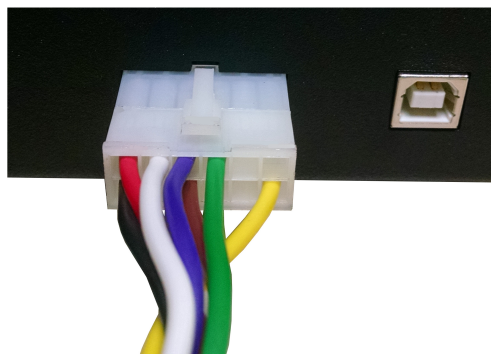
Figure 16: *RA-S1 Connector for HAM-X, T2X, CD-45* Rotators*

Table 9: Wire by Wire

HyGain Rotator	RA-S1 Controller
1	GND (Brown)
2	BRK (White) / ***N/C for CD-45**
3	POT (Yellow)
4	CAP (Purple)
5	M-CCW (Black)
6	M-CW (Red)
7	N/C
8	CAP (Green)

8.3   Firmware configuration and calibration for Hy-Gain HAM-X, T2X, CD-45

1. Hold the **SETUP** button until the controller displays **"1 CAL"**

2. Press the button **GO** to enter this menu. It should be displaying **"1.1 TYP"**.

3. Turn the potentiometer **POS** until it appears on the screen **"1.1 AC"**.

   Hold the button **GO** until the screen blinks to save this option.

4. Press **SETUP** to go to the next sub-menu. It should appear **"1.2 POS"**.

5. Turn the potentiometer **POS** until it appears on the screen **"1.2 HYG"**.

   Hold the button **GO** until the screen blinks to save this option.

6. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.3 BRA"**.

7. If your Rotator is the Hy Gain **HAM-X** or **T2X** turn the potentiometer **POS** until it appears on the screen **"1.3 YES"**.

8. If your Rotator is the Hy-Gain **CD-45** turn the potentiometer **POS** until it appears on the screen **"1.3 NO"**.

   Hold the button **GO** until the screen blinks to save this option.

9. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 L"**.

   In order to calibrate the controller, press the **CCW** button to turn the rotator to a *counter-clockwise point* (the closer to the rotator's end-of-track – the closer to 0-, the better).

   You may notice as you turn the rotator **CCW** that the display shows a number that is descending, this number is **not** the azimuth. This number is the variation of the potentiometer and it ranges from **0 to 500** approximately, meaning ~**0** is the **CCW** rotator's end-of-track and ~**500** is the **CW** rotator's end-of-track. These values can be higher for the CCW end of track or lower for the CW end-of-track depending on the wire resistance.

   After you turned to a point near the **CCW** rotator's end-of-track, stop the rotation and check the REAL azimuth of the antenna at this point, and put this REAL azimuth on the controller screen using the **POS** potentiometer to set this azimuth.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save it.

10. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 R"**.

    Press the **CW** button to turn the rotator to a clockwise point (the closer to the rotator's end-of-track – the closer to 500 -, the better).

    After you turned to a point near the **CW** rotator's end-of-track (~500), stop the rotation, check the **REAL** azimuth of the antenna at this point, and put this **REAL** azimuth on the controller screen using the **POS** potentiometer to insert this azimuth.

    With the real azimuth on the screen, hold **GO** until the screen blinks to save it.

11. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.6 OL"**. In this sub-menu. you need to tell if there was an overlap on the rotation you just made.

    If when you moved the rotator to the right (CW) and you turned the rotator more than 360º from the CCW point, there has been an Overlap.

    If an overlap happened as described above, use the potentiometer **POS** to select the option **YES**. If an overlap did not happen, select the option **NO**.

    For Hy-Gain rotators, this option is usually selected **"NO"** as they don't overlap.

    Hold the button **GO** until the screen blinks to save the selected option.

12. The configuration and calibration is now complete. Press setup multiple times to leave the menu.

9   Configuration for HyGain HDR-300

9.1   Jumpers and connections

- Remove the jumper **J5**.

- Place the yellow wire and the red wire with the aerial fuse on the borne **P4** marked as AC as shown on the picture.

- Remove the jumper from **J2** and insert it on **J4** as shown on the picture.

Figure 17: *Board scheme for Hy-Gain HDR-300*

9.2   Connecting the controller to the rotator

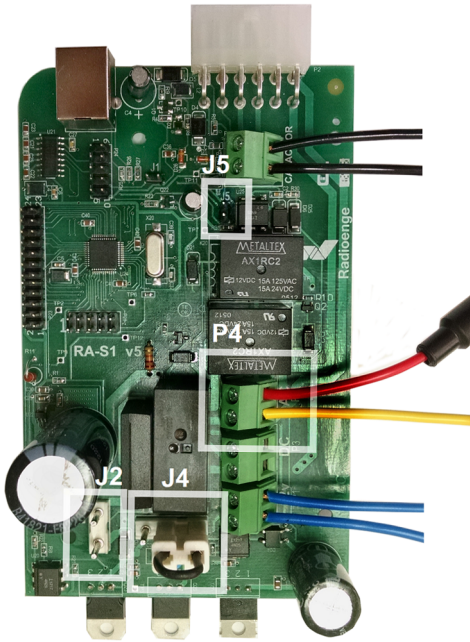Connect the controller to the rotator following the table below.
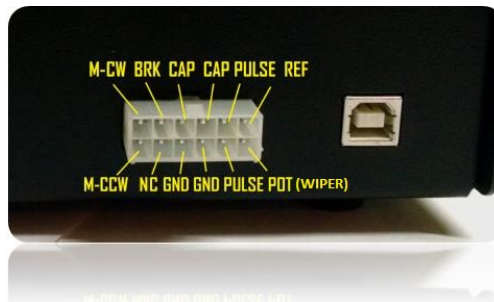

Figure 18: *RA-S1 Connector*

Table 10: Wire by wire - HyGain HDR 300A

Rotator HyGain HDR 300A	RA-S1 Controller
1	M-CCW
2	M-CW
3	GND
4	BRK
5	GND
6	POT
7	REF

9.3   Firmware configuration and calibration

After configuring the jumpers and setting up the connection between controller and rotator we will now configure its program. For that, turn on the controller and follow the detailed steps bellow.

1. Hold the **SETUP** button until the controller displays **"1 CAL"**

2. Press the button **GO** to enter this menu. It should be displaying **"1.1 TYP"**.

3. Turn the potentiometer **POS** until it appears on the screen **"1.1 AC"**. Hold the button **GO** until the screen blinks to save this option.

4. Press **SETUP** to go to the next sub-menu. It should appear **"1.2 POS"**.

5. Turn the potentiometer **POS** until it appears on the screen **"1.2 POT"**.

   Hold the button **GO** until the screen blinks to save this option.

6. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.3 BRA"**.

   Turn the potentiometer **POS** until it appears on the screen **"1.3 YES"**.

   Hold the button **GO** until the screen blinks to save this option.

7. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 L"**.

   In order to calibrate the controller, press the **CCW** button to turn the rotator to a *point to the left* (the closer to the rotator's end-of-track – the closer to 0 shown on the screen-, the better).

   You may notice as you turn the rotator **CCW** that the display shows a number that is descending, this number is **not** the azimuth. This number is the variation of the potentiometer and it ranges from **0 to 1000** approximately, meaning ~**0** is the **CCW** rotator's end-of-track and ~**1000** is the **CW** rotator's end-of-track. These values can be higher for the CCW end of track or lower for the CW end-of-track depending on the wire resistance.

   After you turned to a point near the **CCW** rotator's end-of-track, stop the rotation and check the REAL azimuth of the antenna at this point, and put this **REAL azimuth** on the controller screen using the **POS** potentiometer.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save it.

8. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 R"**.

   In order to calibrate the controller, press the **CW** button to turn the rotator to a point to the right (the closer to the rotator's end-of-track – the closer to the 1000 -, the better).

   After you turned to a point near the **CW** rotator's end-of-track, stop the rotation, check the **REAL** azimuth of the antenna at this point, and put this **REAL** azimuth on the controller screen using the **POS** potentiometer.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save it.

9. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.6 OL"**. In this sub-menu you need to tell if there was an overlap on the rotation you just made.*(If when you moved the rotator to the right (CW) and you turned the rotator more than 360º from the CCW point, there has been an Overlap.)*

   If an overlap occurred as described above, use the potentiometer **POS** to select the option **YES**.
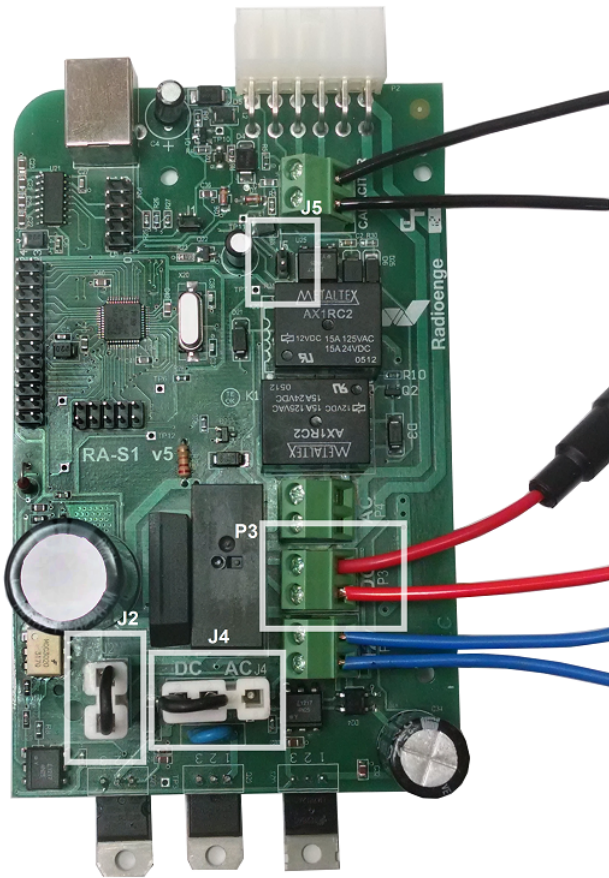
   If an overlap did not happen, select the option **NO**.

   Hold the button **GO** until the screen blinks to save this option.

10. The configuration and calibration is now complete. Press setup multiple times to leave the menu.

10   Configuration for M2 Orion 2800 (DC)

10.1   Jumpers and connections

- Remove the jumper on **J5**.

- Place the red wire (36 V DC) and the red wire with the aerial fuse (0 V) on the borne **P3** marked as DC as shown on the picture.

- Insert the Jumpers on **J2** and **J4** as indicated in the figure.

Figure 19: *Board scheme for M2 Orion 2800*

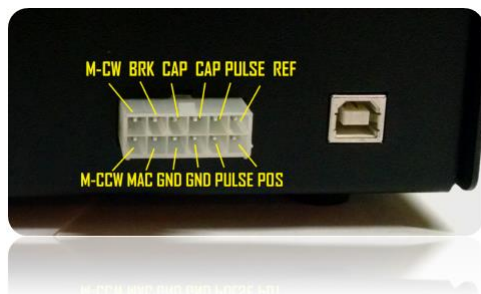### 10.2   Connecting the Controller to the Rotator
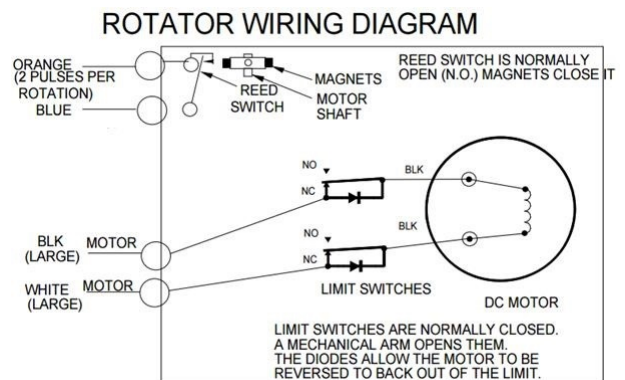

Figure 20: *RA-S1 Connector*

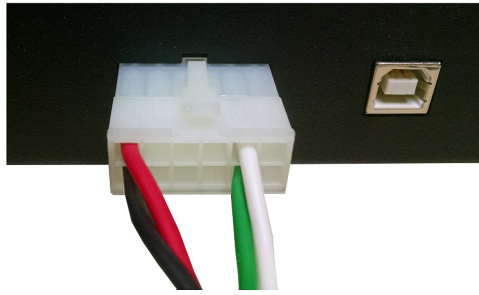Figure 21: *M2 Orion 2800 wiring diagram*

Figure 22: *RA-S1 Connector for M2 Orion 2800 (DC)*

Following the Orion 2800 wiring diagram connect the controller to the rotator as indicated on the table below.

Table 11: Wire by wire - M2 Orion 2800 / RA-S1

Orion 2800 Rotator	RA-S1 Controller
ORANGE	PULSE (WHITE)
BLUE	PULSE (GREEN)
BLK	M-CW (RED)
WHITE	M-CCW (BLACK)

If the rotator moves in the opposite direction when pressing CW or CCW, switch the BLK and the WHITE wire.

10.3   Firmware configuration and calibration

1. Hold the **SETUP** button until the controller displays **"1 CAL"**

2. Press the button **GO** to enter this menu. It should be displaying **"1.1 TYP"**.

3. Turn the potentiometer **POS** until it appears on the screen **"1.1 DC2"**.

4. Press **SETUP** to go to the next sub-menu. It should appear "**1.2 POS**".

   5) Turn the potentiometer **POS** until it appears on the screen "**1.2 PUL**".

   Hold the button **GO** until the screen blinks to save this option.

5. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.3 BRA"**.

   Turn the potentiometer **POS** until it appears on the screen **"1.3 NO"**.

   Hold the button **GO** until the screen blinks to save this option.

6. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 ANG"**.

   In order to calibrate the controller, verify the REAL AZIMUTH that the rotator is pointing at. Set this azimuth by turning the potentiometer **POS**.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save the azimuth you inserted.

7. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 PHI"**.

   Here you need to insert the how many pulses (divided by 100) your rotator generates on a full 360º rotation (usually it is on the rotator manual). For the M2 Orion it is 3960 pulses / 360º.

   Turn the POS potentiometer until the display shows 39. With the number 39 on the screen, hold **GO** until the screen blinks to save the number you inserted.

8. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.6 PLO"**.

   Here you need to insert the how many pulses (tens and units) your rotator generates on a full 360º rotation (usually it is on the rotator manual).

   Turn the POS potentiometer until the display shows 60. With the number 60 on the screen, hold **GO** until the screen blinks to save the number you inserted.

9. The configuration and calibration is now complete. Press setup multiple times to leave the menu.

10.3.1   Observation for rotators with pulsed feedback

After calibrating you will notice that the point-and-shoot isn't working. This happens because the **RA-S1** will only point-and-shoot to positions where you manually turned once with CW or CCW button. So it's recommended after the calibration to manually do a full turn on your rotator using the CW or CCW button.

This is made that way so the controller won't overturn or run onto the end-course.

11   Configuration for AlfaSpid RAK Rotator

11.1   Jumpers and connections
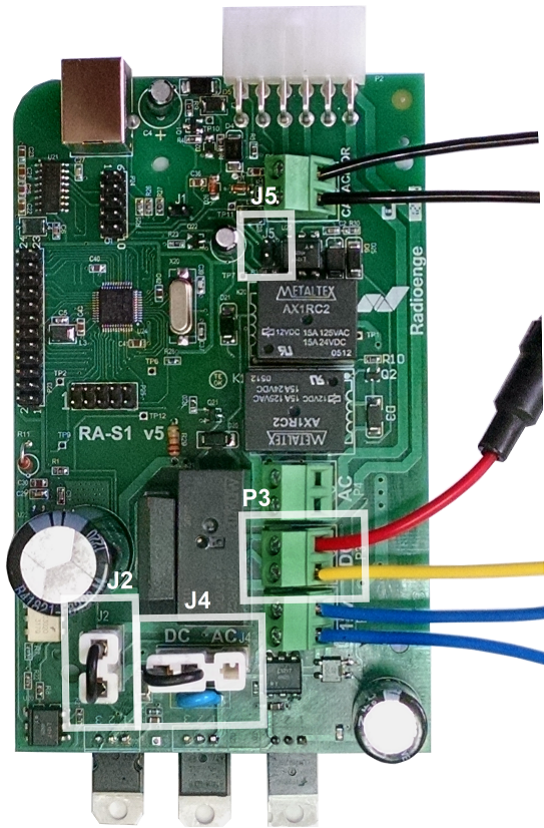
- Remove the jumper from **J5**.

- Place the yellow wire and the red wire with the in-line fuse holder on the **P3** borne marked as DC.

- Insert the Jumpers on **J2** and **J4** as indicated in the figure.

Figure 23: *Board scheme for AlfaSpid Rotators*

11.2   Connecting the Controller to the Rotator
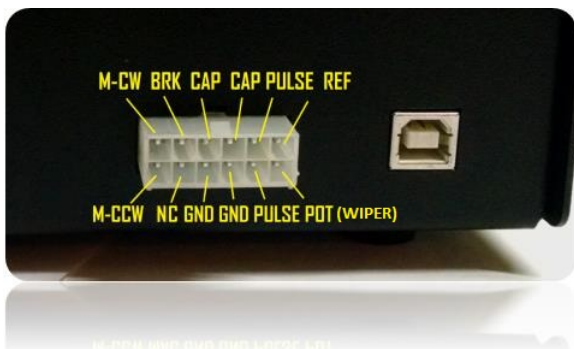

Figure 24: *RA-S1 Connector*

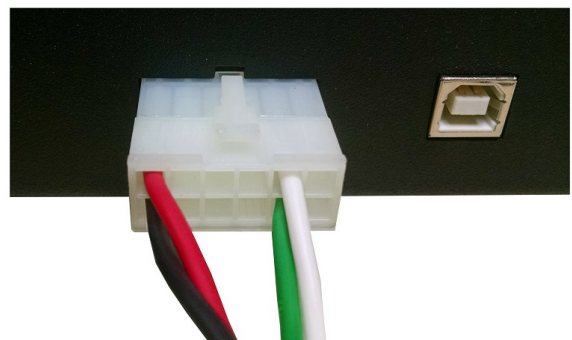Figure 25: *RA-S1 Connector for Alfa Spid RAK Rotators*

Table 12: Wire by Wire - Alfa Spid RAK

Alfa Spid RAK Rotator	RA-S1 Controller
1	M-CW (Red)
2	M-CCW (Black)
3	PULSE (White)
4	PULSE-(other) (Green)

11.3   Firmware configuration and calibration

1. Hold the **SETUP** button until the controller displays **"1 CAL"**

2. Press the button **GO** to enter this menu. It should be displaying **"1.1 TYP"**.

3. Turn the potentiometer **POS** until it appears on the screen **"1.1 DC2"**.

4. Press **SETUP** to go to the next sub-menu. It should appear "**1.2 POS**".

   5) Turn the potentiometer **POS** until it appears on the screen "**1.2 PUL**".

   Hold the button **GO** until the screen blinks to save this option.

5. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.3 BRA"**.

   Turn the potentiometer **POS** until it appears on the screen **"1.3 NO"**.

   Hold the button **GO** until the screen blinks to save this option.

6. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.4 ANG"**.

   In order to calibrate the controller, verify the REAL AZIMUTH that the rotator is pointing at. Set this azimuth by turning the potentiometer **POS**.

   With the real azimuth on the screen, hold **GO** until the screen blinks to save the azimuth you inserted.

7. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.5 PHI"**.

   Here you need to insert the how many pulses (divided by 100) your rotator generates on a full 360º rotation (usually it is on the rotator manual). For the AlfaSpid RAK it is usually 360 or 720 pulses / 360º.

   In this example we will assume that it is 360 pulses / 360º if in your case it is 720 pulses / 360º insert the values accordingly.

   Turn the POS potentiometer until the display shows 3. With the number 3 on the screen, hold **GO** until the screen blinks to save the number you inserted.

8. Press **SETUP** to go to the next sub-menu. It should be appearing **"1.6 PLO"**.

   Here you need to insert the how many pulses (tens and units) your rotator generates on a full 360º rotation (usually it is on the rotator manual).

   Turn the POS potentiometer until the display shows 60. With the number 60 on the screen, hold **GO** until the screen blinks to save the number you inserted.

9. The configuration and calibration is now complete. Press setup multiple times to leave the menu.

11.3.1   Observation for rotators with pulsed feedback

If the rotator moves in the opposite direction when pressing CW or CCW, swap the M-CW and the M-CCW wires. After calibrating you will notice that the point-and-shoot isn't working. This happens because the **RA-S1** will only point-and-shoot to positions where you manually turned once with CW or CCW button. So it's recommended after the calibration to manually do a full turn on your rotator using the CW or CCW button.
   This is made that way so the controller won't overturn or run onto the end-course.

12 Point-and-shoot

To point-and-shoot your rotator to an azimuth, turn the **POS** potentiometer until this azimuth appears on the screen. With the desired azimuth on the screen press the **GO** button. Notice that the desired azimuth will disappear from the screen after 4 seconds so, in order to point-and-shoot, you must press the **GO** button before that. if the rotator has overlap, the RA-S1 will always chose the shortest route to the desired angle.

12.1 Observation for rotators with pulsed feedback (ex: Orion G2800)

After calibrating the rotator you will notice that the point-and-shoot isn't working. This happens because the **RA-S1** will only point-and-shoot to positions where you manually turned once with CW or CCW button. So it's recommended after the calibration to manually do a full turn on your rotator using the CW or CCW button.

This is made that way so the controller won't overturn or run onto the end-course.

12.2 Observation for PRO.SIS.TEL

For the Pro.Sis.Tel configuration (menu "1.2 PST"), after the calibration the RA-S1 will only point-and-shoot to positions between the calibration points (azimuths inserted on menu 1.4 and 1.5). In order to reach further azimuths with the point-and-shoot, you must manually reach them using the CCW and CW buttons so the RA-S1 knows it's possible to go there.

(It is recommended to set Soft Limits when using the Pro.Sis.Tel rotator as it do not have mechanical end-courses, for that go to the page 25.)

With the Soft Limits ON the controller will only point-and-shoot to azimuths between the Soft Limits.

13   Setup menu

When pressing the **SETUP** button for 2 seconds, the controller will enter on menu mode. To navigate through the menus press **SETUP**.

The display 1 will show the menu number going from 1 to 4. To enter a menu, press **GO**.

Table 13 describes the function of each menu.

To navigate through the sub-menus press **SETUP**. To see the available options turn **POS**, to save a value hold **GO** until the screen blinks.

On the sub-menus, the controller will show the <u>saved value</u> after a few seconds represented with a point on the right similar to the image below

Figure 26: *Menu 1 with sub-menu 4 displaying a saved value*

The table below shows the available menus and its main functions, each menu has its own sub-menus that will be explained in details. Obs: The menu 1 is detailed in the section 4 - Configuration Explained, and for each rotator specifically on the configuration for common rotators sections.

Menu	Display	Function
1	CAL	Calibration
2	SFT	Software-defined limits
3	OFS	Offset azimuth
4	CFG	General configuration

Table 13: Available menus

13.1   Soft Limits

The soft-limits are software-defined limits configured by the user. Define it <u>after</u> the calibration process, if needed.

Its purpose is to define the **CCW** and **CW** azimuth limits for the rotator run.

In this menu it is important to do it sequentially. If for some reason you accidentally jump one of the menus, you have to do it again from the **"2.1 r"** menu. The steps are explained in details on the **table 14**, but summarizing: define the **CCW** limit, then the **CW** limit then turn **ON** the Soft Limits.

Menu/Sub-menu	Display	Explanation
2.1	L	Using the **CCW** button, turn the rotator to the azimuth that you want to set the **CCW** limit. When you are at the desired azimuth, press **GO** until the screen blinks. Press **SETUP** to proceed to the menu 2.2.
2.2	R	Using the **CW** button, turn the rotator to the azimuth that you want to set the **CW** limit. When you are at the desired azimuth, press **GO** until the screen blinks. Press **SETUP** to proceed to the menu 2.3.
2.3	ON/OFF	After defining the limits, turn **ON** the Soft limits by turning the **POS** potentiometer until it shows **"ON"** on screen, hold the **GO** button until the screen blinks to save the selected option. If you want to turn **OFF** the Soft limits, do the same but with the **OFF** option.

Table 14: Soft limits menu

After the Soft-Limits are defined, the RA-S1 Controller will automatically ramp down the rotator speed to 1 when approaching the soft-limits. When reaching a soft-limit it will stop turning the rotator and will display "LL" when reaching the CCW soft-limit or "rL" when reaching the CW soft-limit.

13.2   Azimuth offset

If your antenna mast has slipped, you can correct the angle the RA-S1 is showing by setting an offset. To do that go to the menu **"3 Ofs"**.

Menu/Sub-menu	Display	Explanation
3.1	Ang	With the **POS** potentiometer, insert the correct azimuth the ro-tator is pointing to. Hold the **GO** button until the screen blinks to save the selected azimuth. **The controller will calculate the necessary offset.**
3.2	ON/OFF	Turn **ON** the offset azimuth by turning the **POS** potentiometer until it shows **"ON"** on screen, hold the **GO** button until the screen blinks to save the selected option. If you want to turn **OFF** the offset compensation, do the same but with the **OFF** option.

Table 15: Azimuth offset menu

13.3   Configuration menu

Menu	Display	Explanation
4.1	DT	Define the dead-time (reverse delay)
4.2	SP1	Define the minimum speed (Speed when the SPEED potentiometer is 1)
4.3	SP2	Define the maximum speed (Speed when the SPEED potentiometer is 9)
4.4	DBG	Debug mode
4.5	BTL	Bootloader mode

Table 16: Configuration menu

13.3.1   Defining the Dead-Time (menu "4.1 DT")

Dead-Time or reverse-delay is the time that the controller waits to allow the rotator to turn again after it has stopped. It is defined on the menu **"4.1 dt"**.

On the menu 4.1 turn the **POS** potentiometer to select the desired Dead-Time, the values are in seconds. Hold **GO** until the screen blinks to save the desired value.

13.3.2   Setting the minimum speed (SP1)

The minimum speed is the lowest speed (lowest voltage) on which your rotator will turn before it stops. It is also the speed that it will turn when the **SPEED** potentiometer is 1. To define it:

1. Check if the rotator is turning when the **SPEED** potentiometer is on 1.

2. If the rotator is turning too slowly (it should be slow, but not too slow) or not turning at all, go to the menu "4.2 SP1" and increment the value of SP1 with the **POS** potentiometer. Hold GO until the screen blinks to save the desired value.

3. If it is turning too fast, decrease the value of SP1.

It is important to define the minimum speed (SP1) because it is the speed that the controller uses to turn the rotator 15º before the target azimuth when point-and-shooting.

13.3.3   Setting the maximum speed (SP2)

It is also possible to define the speed when the potentiometer **SPEED** is 9. To define it go to the menu "4.3 SP2". The possible values are from 5 to 9. The recommended value is 7, if you think that the rotator is turning slowly with this setting, increase it, if you think it is turning to fast, decrease it. **Don't forget to hold the button GO to save the selected value.**

For 24 V DC rotators, when SP2 is higher than 7 the voltage output is higher than 24 V DC.
For 36 V DC rotators, when SP2 is higher than 7 the voltage output is higher than 36 V DC.

14   USB Virtual Com Port and Serial Setup

As seen on the section 3, the RA-S1 controller has a USB port and a DB-9F. Both can be used to control the RA-S1 via RS-232.

14.1   Connecting via DB-9F

To control the RA-S1 using the DB-9F port, connect it to the computer serial port or to a USB-to-serial converter. The baud rate must be 9600bps.

14.2   Connecting via USB

It's also possible to control the RA-S1 via USB via the Virtual COM Port it will open. To connect the RA-S1 to the computer it is used a USB-B - USB-A cable (same as used on printers). When the controller is connected to the computer it will automatically find the driver. It is possible to manually install the driver.

14.3   Using the RA-S1 with softwares

The RA-S1 uses the Yaesu GS232 protocol, so you can connect to the RA-S1 and configure the software as if it was a Yaesu controller. The following topics will detail how to use the RA-S1 with the most commonly used programs.

14.3.1   Setup with N1MM

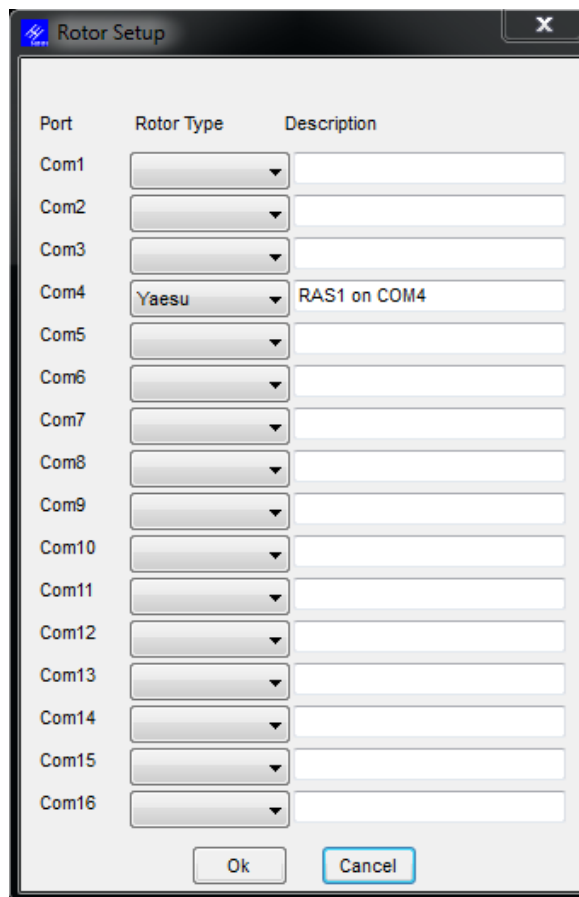Open N1MM Rotor, then click on Tools>Setup Rotor.

Figure 27: *N1MM with RA-S1 Controller Setup*

After selecting "Yaesu" on the COM Port that the RA-S1 is connected press OK.

14.3.2   Setup with PSTRotator

Open PSTRotator and connect it to the RA-S1 COM port by selecting Communication>RS232/TCP Server. Then Azimuth COM Port>Select the COM port in which the RA-S1 is connected.
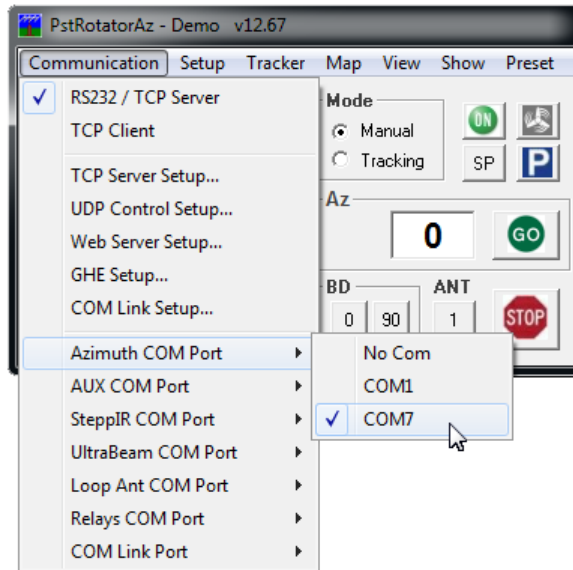
Figure 28: *PSTRotator COM Port configuration*

Then click on Setup>Controller>GS232 Yaesu 360 deg.

Obs: Even though your rotator has 450 degree capability select the 360 deg option. The RA-S1 will always choose the closer route if the rotator has overlap.
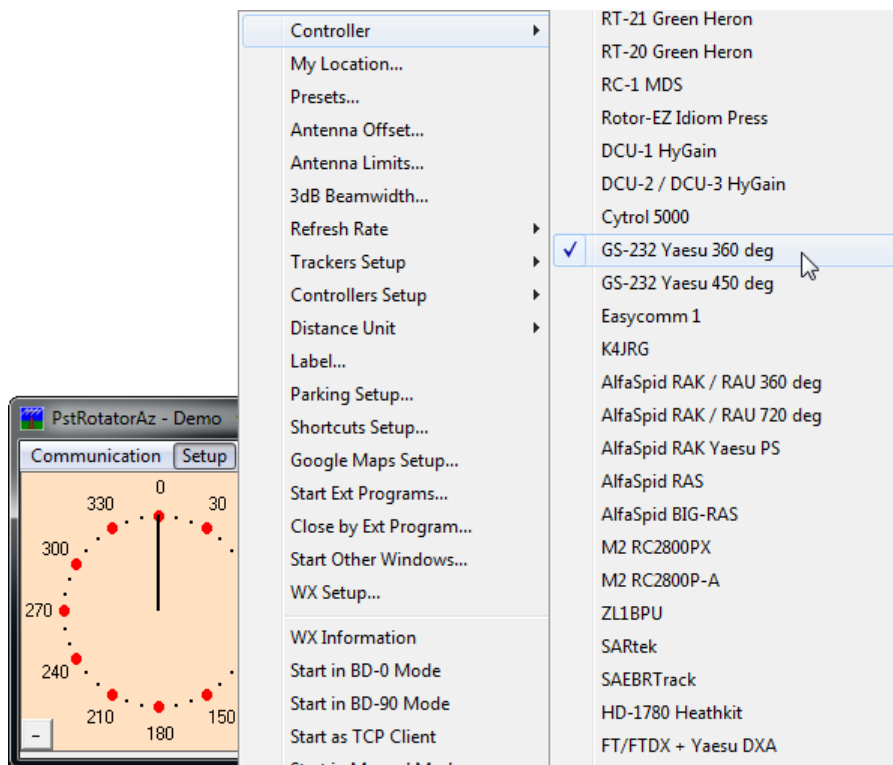
Figure 29: *PSTRotator with RA-S1 Controller Setup*

14.3.3   Setup with DX4Win

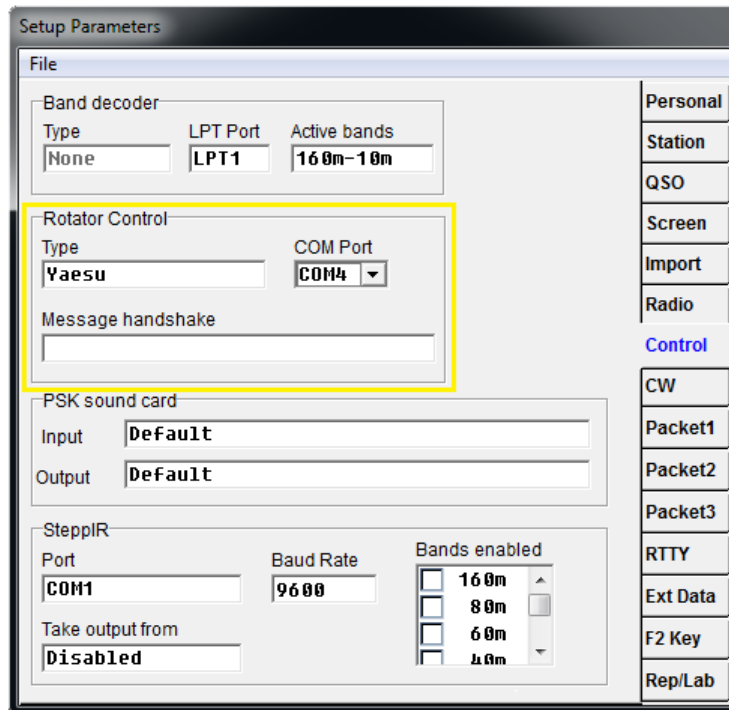Open DX4Win, then click on Files>Preferences>Control.

Figure 30: *DX4Win with RA-S1 Controller Setup*

After selecting "Yaesu" on Type and selecting the COM Port in which the RA-S1 is connected press File>Save Changes and Exit.

14.3.4   Setup with Ham Radio Deluxe

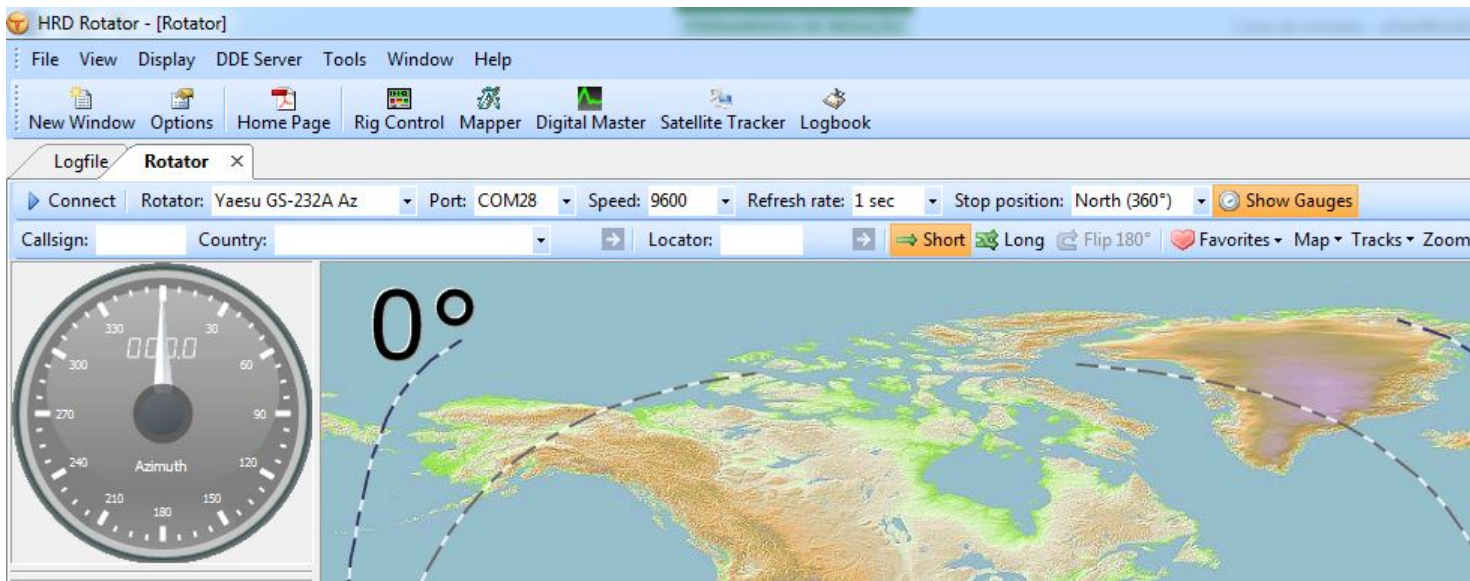Open HRD Rotator, then configure it following the image below.

Figure 31: *DX4Win with RA-S1 Controller Setup*

Then press *Connect*.

15   Errors

The RA-S1 has the capability of detecting two situations that are considered Errors. Those are: when the rotator is not turning to the correct direction and if the rotator is not moving when it should.

15.1   Error E0

Figure 32: *Display - Error E0*

When E0 shows on the screen, it means that the controller detected that the rotator is not turning to the right direction. When this error shows up, the controller stops turning the rotator. It never stops suddenly. When the error appears, it ramps down the speed until it stops.

15.1.1   E0 Troubleshooting

Check if the rotator is turning clockwise when you press **CW** and counter-clockwise when pressing **CCW**. If it's not, invert the **M-CW** and **M-CCW** wires that are connected from the controller to the rotator. If the error persists even when the rotator is turning to the right direction, invert the wires **REF** and **GND** from the potentiometer.

15.2   Error E1

Figure 33: *Display - Error E1*

When E1 shows on the screen it means the controller detected that the rotator is not moving when it should.
   This error can occur because of four reasons:

1. The **M-CW** and **M-CCW** wires might be not connected.

2. The feedback wires (**POT, REF, GND** or **PULSE-1**, **PULSE-2**) might be not connected.

3. Rotator is at the end of its race.

4. Problem with the rotator motor or potentiometer.

15.2.1   E1 Troubleshooting

1. Verify the connection of the **M-CW**, **M-CCW** wires from the controller to the rotator. If the error persists check the feedback wires: **REF, POT** and **GND** or **PULSE-1** and **PULSE-2**.

2. If the error persists and the rotator doesn't turn, verify the rotator motor. If the rotator turns but the error still appear, verify the rotator position feedback.

16   Reset

To reset the controller saved options and reset to factory settings, turn the **SPEED** potentiometer to 1 (fully to the left) and hold **SETUP** and **GO** for approximately ten seconds until "RES" is shown on the display.

The reset cannot be undone. After resetting, it is necessary to recalibrate the rotator using the menu "1 CAL"

17   Setup lock

To avoid the calibration or options of your controller being changed, it is possible to lock the menu. For that you need to click **GO** five times. It will appear L on the left display meaning "Locked" if you press **GO** five times again, it will display "O" meaning "Open", or the controller menu is unlocked.