

# Antenna Rotator System USB



## ARS-USB Reference Manual

**May/2015**

**Rev 1.5h**

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## Introduction

Thank you for purchasing the ARS-USB Product.

Presently, the ARS provides the most powerful highest performance and lowest cost *universal rotor interface* available anywhere in the world. It can be connected into any rotor providing 10 bits ADC resolution ( $2^{10} = 1024$  states).

It can work with any “azimuth rotor” or “azimuth & elevation rotor” and a large list of control and tracking programs are also supported.

Moreover it will convert your rotor into the latest technology automated rotor tracking system available.

◆ ***It's very important*** that you read this manual carefully. Failure to understand the contents of the manual could lead to damaging the rotor or the RCI-USB circuit board through incorrect wiring. Remember that the time you spend reading the manual and understanding how the system works and how the RCI-USB board will interface with your rotor could save you time and money by avoiding an incorrect installation. If any questions occur when reading the manual, please contact us. Our goal is to provide you will a state of the art antenna tracking system.

The ARS System has been developed to operate with most rotators available at the market. If you don't find your rotor mentioned in the Quick Start Guide, again you should contact us. We will provide assistance to help you successfully connect your rotor to the RCI-USB circuit board. It is certain that no changes will be required in the RCI-USB circuit design.

This board is the product of design evolution of previous RCI-SE circuits beginning in 2002. A major enhancement with the current ARS System is the use of a USB port instead a traditional LPT port.

📖 The board is not powered by the USB port from your computer. It requires a 12-14Vdc from a power supply.

When connected to the computer and a 12-14 VDC regulated power supply, and the proper driver installed, a virtual COM Port will be added to your computer. The RCI-USB firmware will emulate a Yaesu GS232A interface. Any 3<sup>rd</sup> party program that supports a Yaesu rotator will be able to control the board.

Additionally, you may use a supplied program called **ARSVCOM** that will control the board and allow adjustment and configuration of the RCI-USB product in an attractive package.

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## About this manual

The manual is divided into several parts.

It covers the installation and configuration of the ARS System hardware and software on your computer. Another manual, the "Quick Installation Guide" is also supplied. It provides information on connecting your RCI-USB board to many popular rotors.

Please be sure to properly install and configure the hardware and software as described in this manual. Once this is completed, you may continue with the "Quick Installation Guide."

After reading the manual, if you have questions or concerns, please contact Interlanco Communications. You may check our website or reach us by email. We are committed to helping you achieve a successful implementation of the ARS System.

**Address:**

Interlanco Comunicaciones  
Attn.: Pablo García - EA4TX  
Albasanz 48-50 4º Derecha  
28037 Madrid - SPAIN

**E-mail:**

[jpgarcia@interlanco.com](mailto:jpgarcia@interlanco.com)

**Web:**

<http://www.ea4tx.com>

## Driver Installation for the RCI-USB

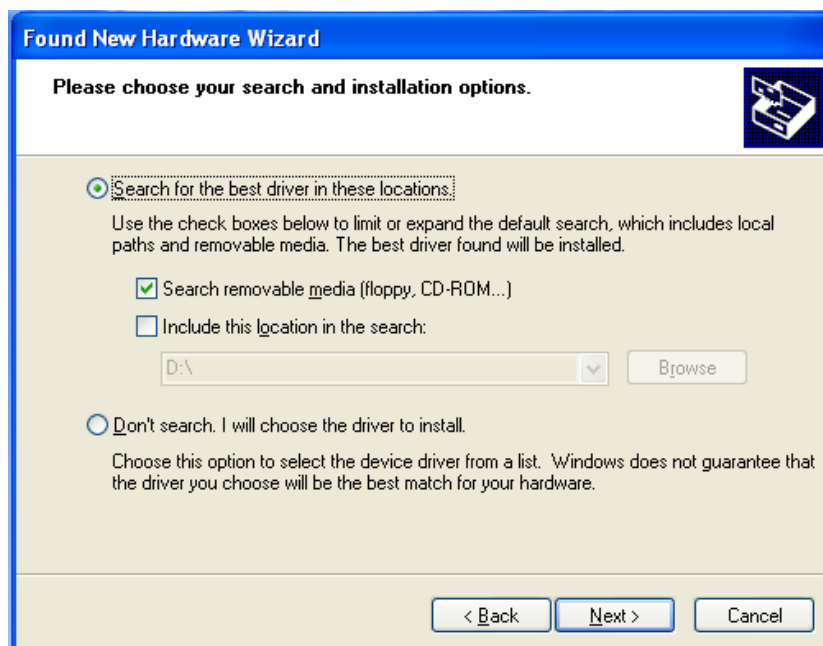
Plug your board into a USB Port and wait for Windows to begin. It will guide you through the driver installation process.

When asked **Can Windows connect to Windows Update to search for Windows?** Select, **No, not this time**.

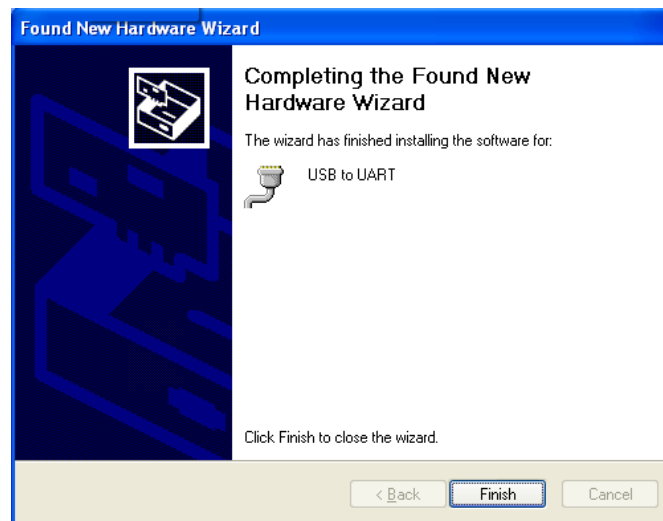
Click next to continue.



Select **Install from Removable Media (Supplied)**. Click next.



The driver is included in the CD-Rom. Once you finish the installation process, a COM Port will be added



Now determine if the port was added correctly and verify the COM Port number assigned by the system:

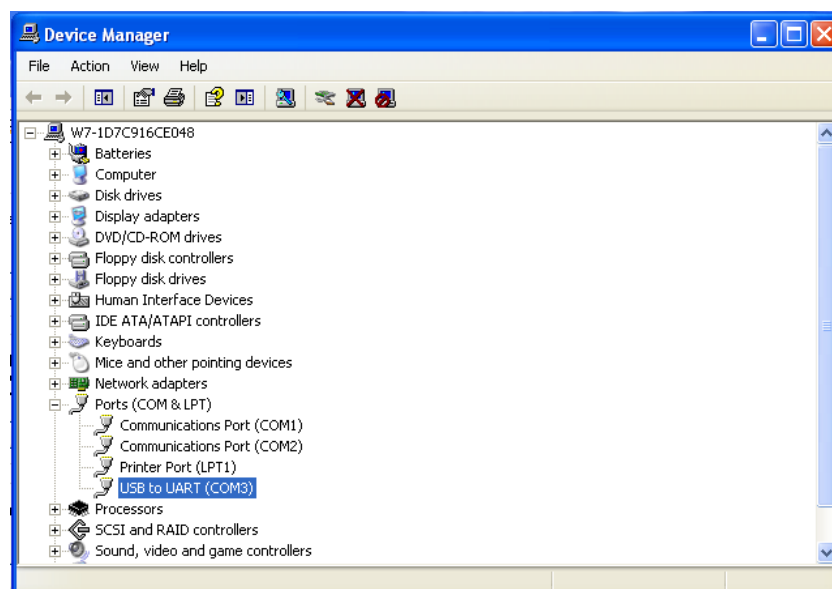
1) Go to the Device Manager:

Windows XP/Vista/Win7 -> Start -> Control Panel -> System -> Hardware -> Device Manager

Windows 2000/2003 -> Start -> Settings -> Control Panel -> System -> Hardware -> Device Manager

2) Click plus (+) next to "Ports"

3) If the device is installed properly, you will see "USB to UART (COMx). Note that x is the number of the COM Port. Any program that needs to communicate with the RCI-USB Board (logger, satellite tracking, etc) needs to use the new this COMx port.



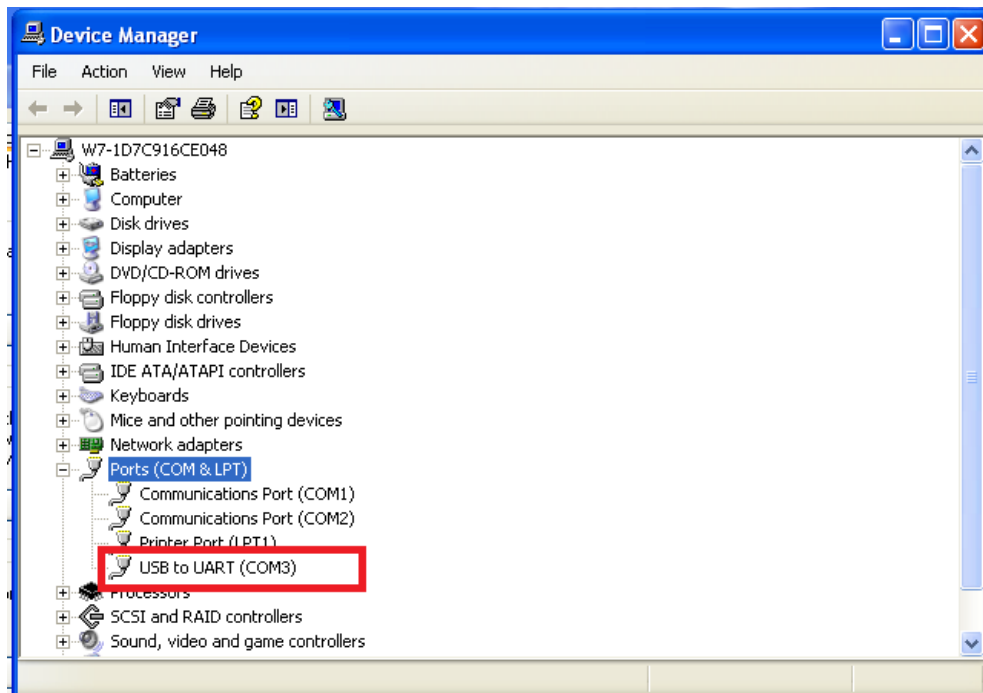
## 1.1 Port reassignment

If you need to change the port assigned:

1) Go to Device Manager:

Windows XP/Vista/Win7 -> Start -> Control Panel -> System -> Hardware -> Device Manager

Windows 2000/2003 -> Start -> Settings -> Control Panel -> System -> Hardware -> Device Manager



2) Right click on the "USB to UART." Click properties.

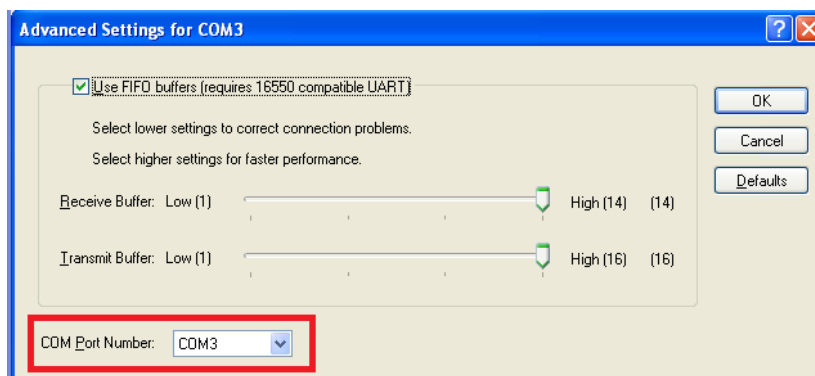
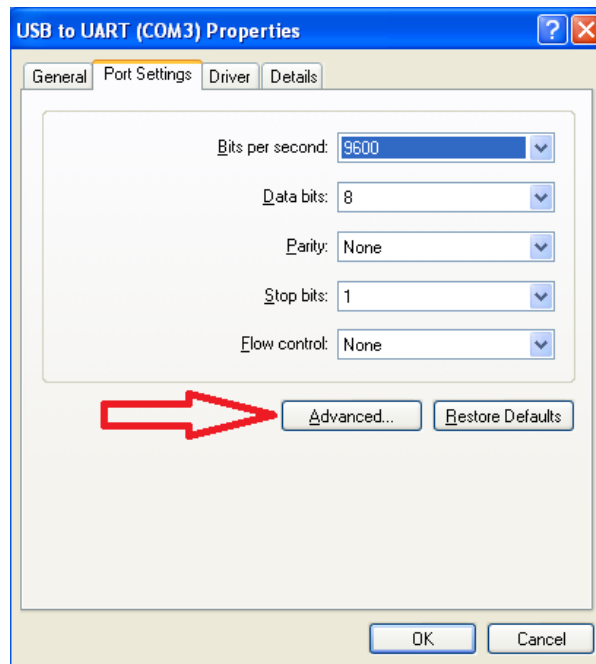
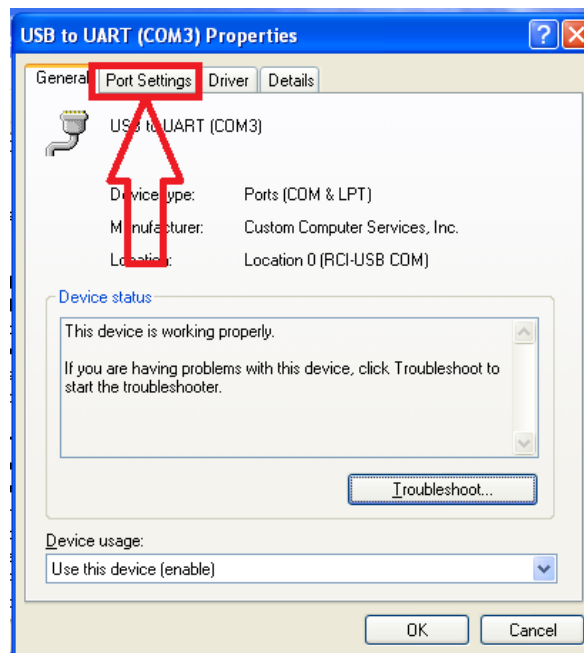
3) Click on the "Port Settings" tab and then click the "Advanced" button.

4) Pull down the scrollbar on the bottom left side. You will see several COM ports listed. Select one that doesn't say "in use" next to it. Then click "OK".

5) Click "OK" again. Notice that the device will now appear on the previously unassigned port you just selected. Verify this by closing Device Manager and selecting it again.

6) Close device manager.

7) This process is illustrated on the following page.



## RCI-USB circuit Setup

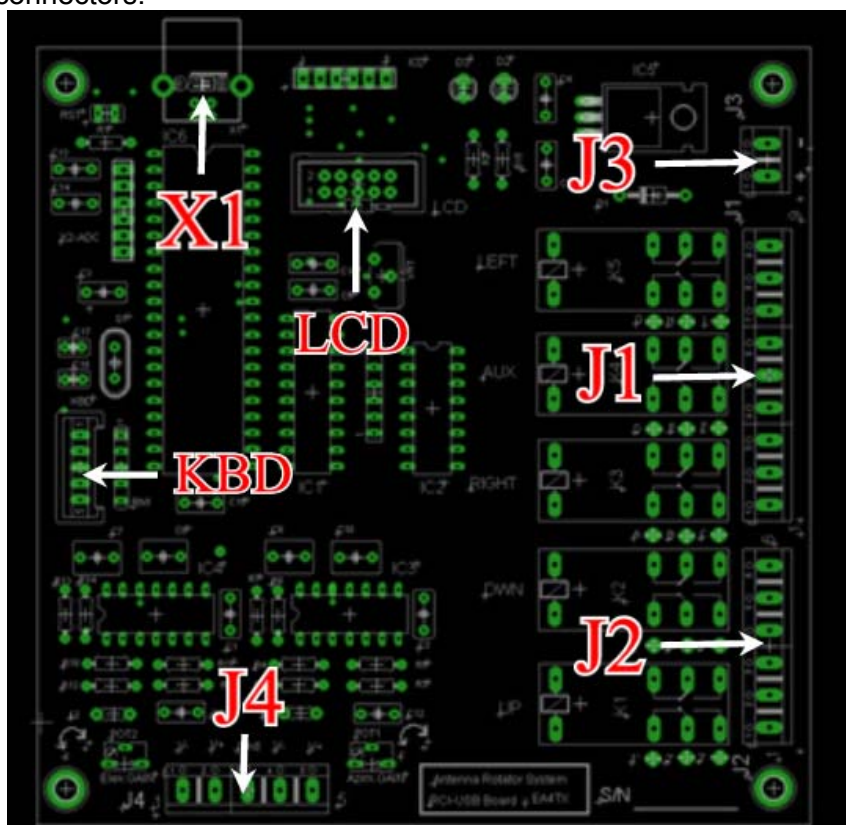
The RCI-USB circuit fulfils the two following objectives:

- ▶ It reads the current antenna position by means of an incorporated A/D converter.
- ▶ It controls the movement of the rotor. For an azimuth rotor, this would be right or CW and left or CCW. This is accomplished through relays using the data obtained from the A/D converter.

The RCI-USB has the following connectors:

- **J1:** The azimuth antenna rotation is controlled by means of this connector. It is attached to 3 relays on the RCI-USB Board. One of the relays provided (AUX) is able to control a brake.
- **J2:** Similar than J1, J2 is used for elevation control.
- **J3:** Power input. Connection point for the required 12 - 14 Vdc regulated power supply. Correct polarity is required.
- **J4:** Input to the A/D converters for the azimuth & elevation rotators. This input is used to read the antenna position. This point will be connected in parallel with the wires attached to the rotor's potentiometer enabling the readout of the antenna position.
- **X1:** USB Port.
- **LCD:** IDC connector used to attach the LCD.
- **KBD:** IDC connector used by the Keyboard.

The following image is the RCI-USB circuit schematic allowing easy location of the different connectors:



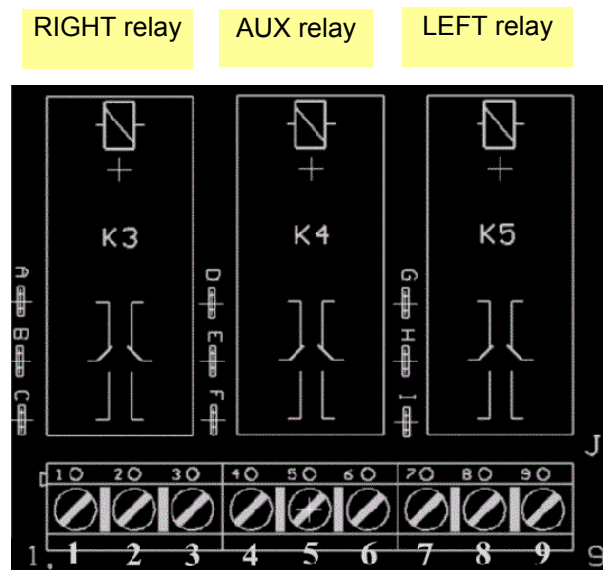


## 2.1 Connector J1: Azimuth Relay connections

The RCI-USB has two relays to control the Azimuth movement: right (CW) or left (CCW). An additional relay (AUX), located between them may be used to control a brake in rotators requiring a braking function.

These relays are 2 position with 2 circuit switches. Each circuit supports 5A at 220V.

One of the two circuits of each relay is already wired and attached to its connector as it appears in the following image.



In this manual, the 9 terminals of this connector will be called J1-1, J1-2, J1-3, J1-4, J1-5, J1-6, J1-7, J1-8 and J1-9.

In de-energised position, J1-2 is switched to J1-1. When it's activated, J1-2 is switched to J1-3.

In de-energised position, J1-5 is switched to J1-4. When it's activated, J1-5 is switched to J1-6.

In de-energised position, J1-8 is switched to J1-7. When it's activated, J1-8 is switched to J1-9.

	Relay OFF	Relay ON
Right/CW	J1-2 to J1-1	J1-2 to J1-3
AUX	J1-5 to J1-4	J1-5 to J1-6
Left/CCW	J1-8 to J1-7	J1-8 to J1-9

This first circuit (available at J1) will be used to control movement to the right or left. If necessary, the second circuit can be used to make a second electric circuit active on the rotor. It is silk-screen printed on the circuit board. It is next to the relays and identified with the following references:

**A B C   D E F   G H I**

Switching is similar to J1. The de-energised positions are:

- B to A
- E to D
- H to G

And the energised positions remain switched:

- B to C
- E to F
- H to I

	Relay OFF	Relay ON
Right/CW	B - A	B - C
AUX	E - D	E - F
Left/CCW	H - G	H - I

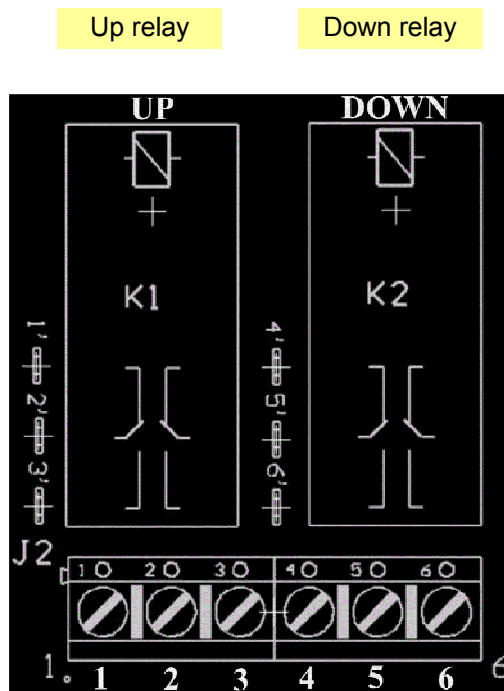
## 2.2 Connector J2: Elevation Relay connections

In addition to the 3 azimuth relays, the RCI-USB Board includes 2 relays for elevation control if an elevation rotor is present.

	Relay OFF	Relay ON
UP	J2-2 to J2-1	J2-2 to J2-3
Down	J2-5 to J1-4	J2-5 to J2-6

The extra second circuit is also available:

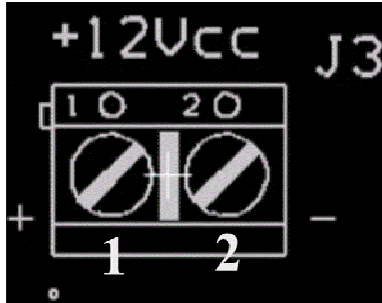
	Relay OFF	Relay ON
UP	2' - 1'	2' - 3'
DOWN	5' - 4'	5' - 6'



### 2.3 Connector J3: Power input

The RCI-USB Board must be powered at 12-14 Vdc.

- Note the polarity. Incorrect polarity can damage the board.



**J3-1** is the positive terminal.

**J3-2** is the negative terminal.

**Note:** Although the CPU and some parts of the RCI-USB could be powered from the USB, it requires an external power supply. Some components as the relays requires a 12Vdc. Remember to connect this J3 terminal into a 12-14Vdc power supply.

### 2.4 Leds: Red and Green

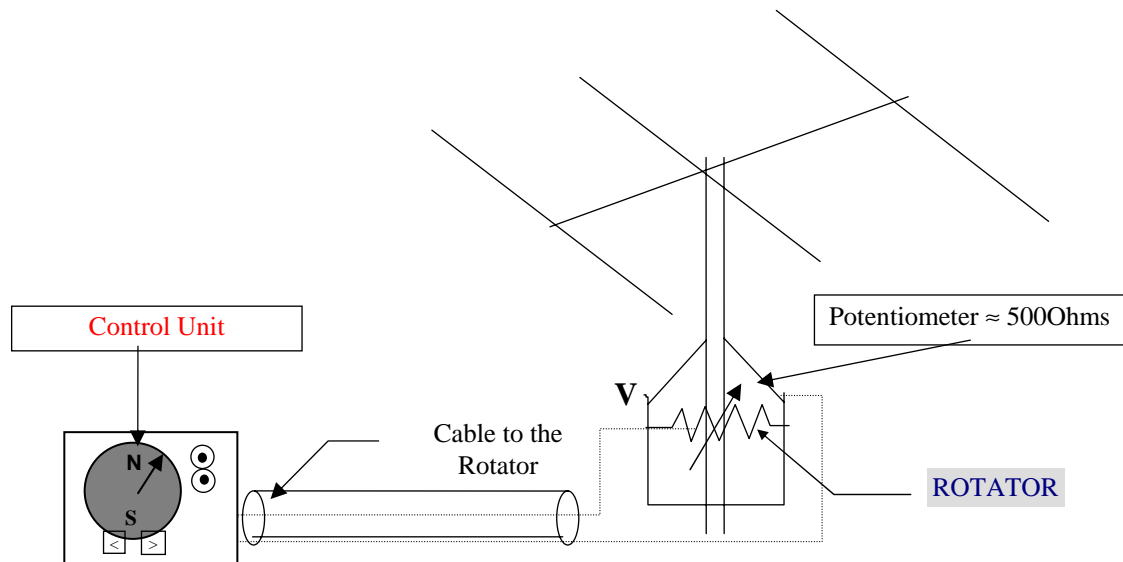
The RCI-USB includes 2 Leds:

- Red Led is ON when the unit is powered.
- Green Led should be blink quickly. It means it's working properly.

## 2.4 Connectors J4: Operation of the ADC

The Analog-to-Digital converter (ADC) allows the computer to determine the direction the rotor and antenna are pointing. To enable, connect the two wires attached to the azimuth (or elev.) rotator's potentiometer to J4.

Most rotors use a similar system to read the position in the control unit. The illustration below offers an overview of this operation:



Inside the rotator there is a potentiometer engaged with the antenna mast axis. The voltage feedback changes when the antenna is turned. The existent voltage will change at both ends of the rotation cycle. Normally this will be 0 V at one end (CCW). The other end will show the maximum value in the rotation cycle. It will be called "**V**". This value depends on each model of rotator optimized for a specific rotor by the manufacturer. A 500 Ohms linear potentiometer is normally used.

As examples, voltage "**V**" in a HAM-IV rotor is 12V, in the Kenpro KR-600RC or YAESU G-2000 it is -3.6V. In some rotors the value is 5V. Again this depends on the individual rotor.

► It is very important to know the voltage "**V**" provided by your rotator. This voltage **V** may not be specified in the manufacturer's documentation so it must be checked with a voltmeter for correct operation of the ARS System. If the Pot is Grounded, you can connect the "V-" Input at J4 (J4-4 for Azimuth and J4-1 for Elevation) to Ground at J4-3.

As the RCI-USB board must obtain the voltage feedback from the external Pot, the two wires that join the control unit with the rotator (the one from the cursor of the potentiometer and the other from the ground or reference) must be connected in **parallel** with the J4 terminals (J4-4 & J4-5). Remember that J4-1 & J4-2 are only used in elevation rotators.

By this method, the RCI-USB board can read the voltage present at the rotator potentiometer and thus calculate the beam direction.

The A/D converter has 10 bits resolution. This equates to 1024 possible values. For example, if the maximum rotation is 360 degrees, a positional resolution of 0.35 degrees is possible. This capability will be more than adequate for most applications.

Unfortunately as previously discussed, not all rotors have a standard voltage value for **V**. The A/D converter accepts 5V as maximum voltage. To obtain the maximum digital output level, the signal from the rotor will have to either be attenuated or amplified. Again this will depend on the individual rotor.

In the previous example we found that a HAM-IV or T2X rotator gives 12V when it is fully turned clockwise (CW limit). Therefore voltage from the rotor will have to be attenuated to 5 V by adjusting Pot1.

In other examples mentioned, rotators like the Kenpro KR-600RC or YAESU G-2000 may show a maximum voltage that is negative (-3.6V). Therefore the signal to the RCI-USB board will have to be amplified to avoid losing resolution in the converter. Polarity will also change from negative to positive. This is also accomplished by adjusting the gain at Pot1.

The RCI-USB has a potentiometer for each input providing all of these adjustments:

***Azimuth input:***

- ▶ Pot1 adjusts the Gain/Attenuation between 3-24V.

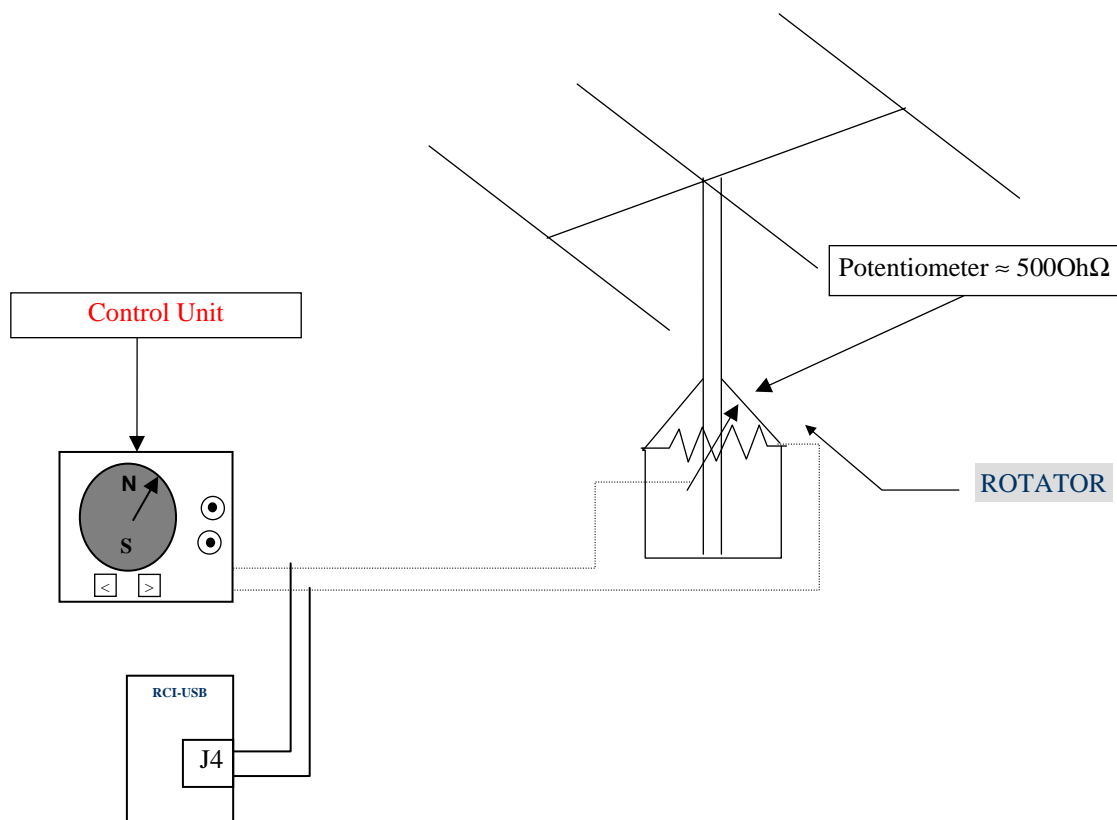
***Elevation input:***

- ▶ Pot2 adjusts the Gain/Attenuation between 3-24V.

Even though your rotator may appear in Part 3 in this manual, it is highly recommended that you check the data with your own rotor by means of a voltmeter.

- ▶ The insertion of the RCI-USB in parallel between the **Rotor** and the **Control Unit** should not cause any error or modification in the readout of the original instrument. The RCI-USB circuit presents high impedance at the J4 input.

The following illustration shows the correct Rotator + Control Unit + RCI-USB wiring :



You can find the two wires by looking at the circuit diagram included with the rotator.

**Be very careful with the polarity!** J4-4 is the negative input or reference connection and J4-5 is the cursor of the potentiometer. It is important that you check the actual voltage at these points with a voltmeter. This can be achieved by turning the antenna from one end to the other and writing down all the voltage readings at both ends. You should also observe that the voltage increases or decreases between its ends while the rotator and antenna are turning. Remember that one end will correspond to 0V and the other to the maximum voltage “V”.

**Note:** If you Potentiometer rotor is grounded it's **highly recommended** to connect the V- input (J4-4) to the RCI-USB ground (J4-3).

#### Azimuth Calibration:

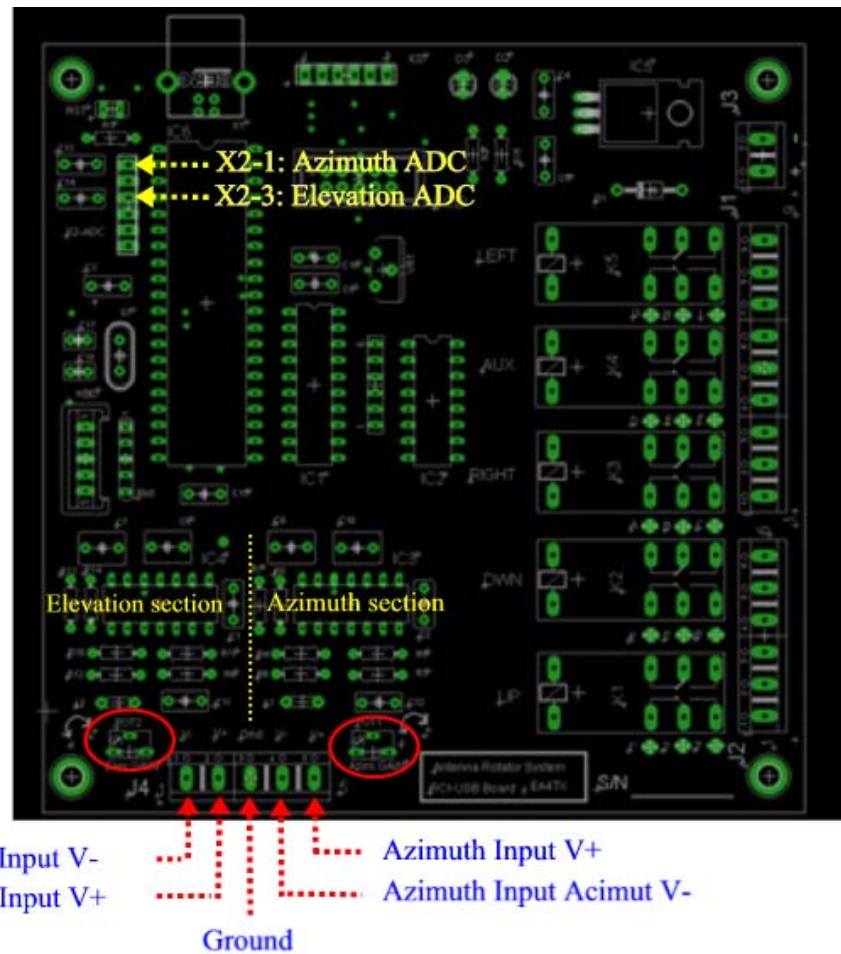
Move the Azimuth rotor to the CW limit (right limit). Check the voltage at **X2 pin #1**. The X2-ADC pin #1 is located close to the 40 pin IC close to C13. It is the ADC analog Azimuth Input of the  $\mu$ Controller. Adjust Pot1 until you obtain a reading of 5.0V. When Pot1 is moved CW, the signal input will be attenuated. When it's moved CCW, it will be amplified.

#### Elevation Calibration:

Similar to the azimuth calibration, elevation calibration is accomplished by a similar process at **X2 pin #3** (close to C14).

**Note:** Instead of using a voltmeter connected at X2 pin #1 and pin #3, you can use the calibration function in the software for making the Pot1 or Pot2 adjustments.

## 2.4.1 PCB Description



J4 is the Voltage feedback Input. In most cases, this Input is referenced to ground, so "V-" should be connected to GND.

From left to right the inputs are:

- J4-1: Elevation V-
- J4-2: Elevation V+
- J4-3: Ground Reference
- J4-4: Azimuth V-
- J4-5: Azimuth V+

**Note:** Most rotors are referenced to ground, so J4-1 (V-) and J4-4 (V-) must be wired to J4-3.



When positive the Voltage feedback that the external rotor provides will be connected to the V+ input. The reference voltage that normally is Ground will be connected to the V- input. Remember that most rotors are referenced to a real ground and it is highly recommended to connect the V- input to the Ground reference.

Example for Azimuth rotors referenced to Ground:

Positive Potentiometer Feedback —————▶ J4-5

Negative Potentiometer Feedback —————▶ J4-4

If the Negative is referenced to Ground, connect J4-4 to J4-3.

Once connected, there is a Pot that can be adjusted for correct input to the RCI-USB ADC input:

#### **Azimuth Input Adjustment:**

- **POT1:** will adjust the Gain of the Amplifier. CCW movement will attenuate the input voltage while CW movement will increase the input voltage. You can additionally use the ARSVCOM software calibration procedure to read the maximum ADC value. While doing this, use a screwdriver to adjust POT1. Of course you can place a voltmeter at point X2-1, and adjust the POT1 in the same manner until the voltmeter displays 5V. This adjustment must be done when the rotor is placed at the CW (Right limit).

#### **Elevation Input Adjustment:**

- **POT2:** The procedure to calibrate the Elevation Gain at POT2 is the same as the Azimuth calibration with POT1.

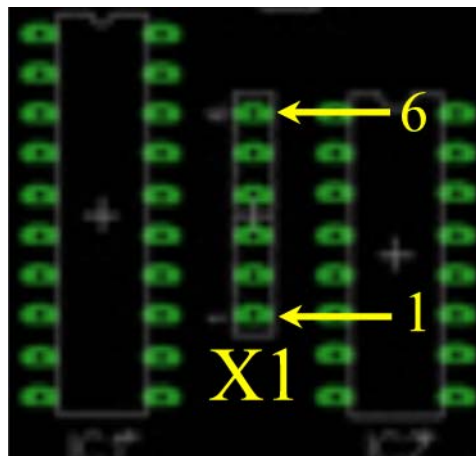
## 2.5 X1 Point, Led point

The RCI-USB includes at the X1 connector, a check point for each relay:

- Left, Aux and Right
- Down and Up

The pins available at the X1 socket can be connected with 5 Led's. However a 470 Ohms resistor must be added in serie. Those points will supply 0V when not activated and 5V when each pin is activated.

The common point for each Led is wired with the ground at the RCI-USB PCB.



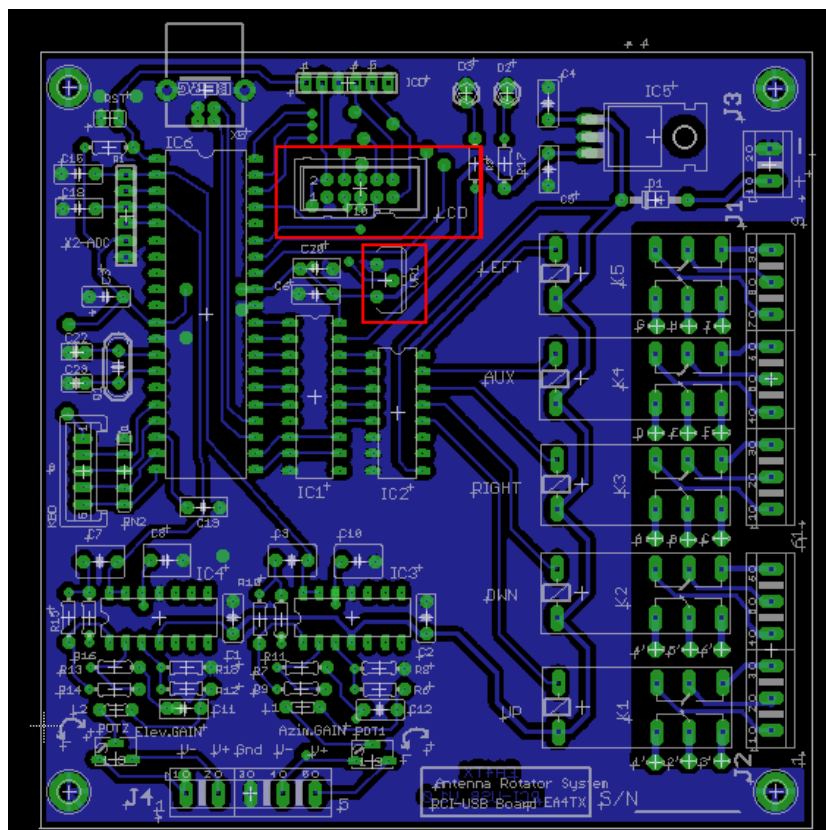
### X1 Pin assignment:

- X1-1: GND
- X1-2: Up relay
- X1-3: Down relay
- X1-4: CW/Right relay
- X1-5: Aux relay
- X1-6: CW/Left relay

## 2.6 LCD Socket and contrast adjustment

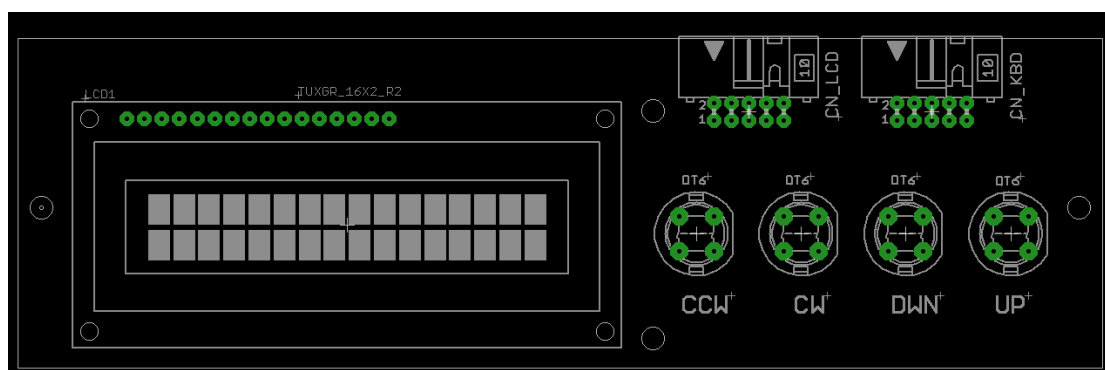
The RCI-USB can handle a 16x2 LCD display.

This connector is used to attach the LCD module to the RCI-USB.



VR1 can be used to adjust the LCD contrast.

This RCI-USB-LCD supports a 16x2 LCD and 4 bush buttons.



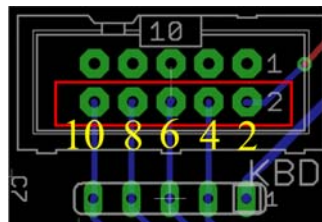
RCI-USB-LCD board

## 2.7 KBD Socket

The RCI-USB includes a connector labeled KBD. This allows 4 buttons to be used for manual control of the RCI-USB. There are 4 inputs plus common signal available at the KBD socket. The 5 pins used this IDC (10 pins) are:

- KBD-2: +5Vdc (common)
- KBD-4: Manual Left/CCW control.
- KBD-6: Manual Right/CW control.
- KBD-8: Manual Down control.
- KBD-10: Manual Up control.

**Note:** Pins 1, 3, 5, 7 and 9 are unassigned.



If you connect:

- KBD-4 to KBD-2, the Left/CCW movement will be activated.
- KBD-6 to KBD-2, the Right/CW movement will be activated.
- KBD-8 to KBD-2, the Down movement will be activated.
- KBD-10 to KBD-2, the Up movement will be activated.

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## **Working with the RCI-USB**

Once you have wired the RCI-USB board with your rotor and the driver is installed, you can begin to control the interface.

There are 2 ways you can interact with the product:

- COM Port: this port is automatically created each time the PC detect the RCI-USB
- 4 Keypad: F1, F2, F3 & F4

### **3.1 COM Port:**

Via the COM port the user or a 3<sup>rd</sup> part program can send and receive commands to/from the RCI-USB.

The manual: "RCI-USB Commands" describe all commands that are supported. Some of them are commands for configuring and calibrate the interface. Some others are used for controlling the appointing. Basically a satellite tracking program or a logging program will use only those commands for control the appointing.

#### **IMPORTANT NOTE:**

The RCI-USB emulates a Yaesu GS232A interface, so any program that supports this tracker interface will work with it.

### **3.2 Keypad: F1, F2, F3 & F4**

If you have ordered the RCI-USB LCD optional PCB, you have an additional board with a 16x2 LCD and 4 buttons, which are labeled as:

- F1: Which control the Left/CCW movement
- F2: Which control the Right/CW movement
- F3: Which control the Up movement
- F4: Which control the Down movement

So pressing those buttons you can control manually the motors.

If you own an "Azimuth" model, the Up/Down buttons are not required, so in this case, those buttons are assigned as "PRESET" or "Point and Shoot" control.

So pressing F3/F4 you can change the preset and after an idle period, the RCI-USB will start the appointing into that preset value.

Remember that you can cancel an appointing at any time, just press F1 or F2.

### 3.3 Special Keypad options

If some buttons (individual or combined) are pressed meanwhile the RCI-USB is powered on, we can get some extra functions.

#### A.- Bootloader – F1

Some time ago, the only option for upgrade a microcontroller with a new firmware (code) was to request a new chip from the manufacturer. As you can imagine this is a slow and expensive method. A bootloader is an option for loading a new firmware into the microcontroller and the RCI-USB includes it.

You can enable the bootloader code, by pressing F1 button during the power on.

**Note:** When the bootloader is enable, the LCD will not work (no information is displayed) and the green led of the back panel will blink (4 peer second).

Now you need a program that helps you to send the new firmware (hex file) into the microcontroller. You can use HyperTerminal (send the firmware as a text file) or use the RCI\_Load program, included on the CD-ROM. So locate inside the CD-ROM the directory Teleloader, and run the setup.exe, and the RCI\_Load will be installed on your computer.

#### B.- Absolute Mode – F2

The **Absolute mode** is enabled if F2 button is pressed during the power on of the RCI-USB.

The absolute mode allows to:

- Disabled the watchdog limits
- Display on the LCD the ADC value (0-1022)

By default, the RCI-USB includes a watchdog and if it detects that the rotator has reach one of their limits (CCW/Left or CW/Right on Azimuth; Up or Down on Elevation) the relay which control the movement in that direction is disabled. Imagine that the RCI-USB reads ADC = 0, so it suppose that the motor is at the CCW/Left limit. So the CCW Relay will be disabled.

The Absolute mode disables this feature, so you can move any relay.

This option is useful when you have done a wrong calibration and you don't want a factory default configuration.

#### C.- Factory default configuration – F3 + F4

If you want to load the default configuration, you must press F3 and F4 (both buttons at the same time) and power on the unit.

Immediately the default configuration will be restore.

### 3.4 Error Messages

The ARS-USB Unit can show in the LCD, 3 possible errors.

**Error 1:** Az\_WD\_ALARM

Caused when the ARS-USB try to move the Azimuth rotor and after a while, the feedback position is the same (no feedback voltage changed).

It could be because the Azimuth rotor is jammed.

**Error 2:** EI\_WD\_ALARM

Caused when the ARS-USB try to move the Elevation rotor and after a while, the feedback position is the same (no feedback voltage changed).

It could be because the Elevation rotor is jammed.

**Error 3:** Az\_WD\_INV\_ALARM

Caused when it's detected that the rotor moves in opposite direction. For instance, the rotor tries moves to Left/CCW and the position feedback increases (as a CW movement).

It could be caused because the rotor is wired inverted (CCW and CW upside down).

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## Specifications

### **J1: AZIMUTH RELAY CONNECTOR**

3 x Relay: 2 circuits, 5A at 220V.

### **J2: ELEVATION RELAY CONNECTOR**

2 x Relay: 2 circuits, 5A at 220V.

### **J3: POWER CONNECTOR**

Input voltage:	12-14V
Power consumption (Standby):	<200mA with LCD or < 110mA w/o LCD
Power consumption with relays switched on :	<250mA with LCD or < 160mA w/o LCD

### **J4 INPUTS**

J4-5 & J4-4 are the azimuth rotor feedback input. It is adjusted by means of Pot1 (Gain control).

J4-2 & J4-1 are the elevation rotor feedback input. It is adjusted by means of Pot2 (Gain control) .

Input signals between +/-3 to +/-24V can be regulated by means of Pot1 or Pot2.

### **CONNECTOR X1:**

USB socket.

The USB Port is detected by the computer as a COM or Serial port.

The ARS-USB emulates a Yaesu GS232S interface, so it's compatible with any program that supports it.

### **CIRCUIT DIMENSIONS**

12cm x 12cm x 3,5cm	(Deep, Wide, High)
4.7inch x 4.7inch x .8inch	(Deep, Wide, High)



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## Notes

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