

ARCO Junior

Smart Azimuth Rotator Controller

microHAM

www.microham.com






microHAM s.r.o.
Maticna 28
92401 Galanta
Slovakia

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IMPORTANT PRECAUTIONS

-  **AVOID** opening the device before you have disconnected it from power supplies. Any internal repairs have to be done only by an authorized person according to Appendix D.
-  **DO NOT** allow any objects to enter inside the device.
-  **DO NOT** cover the cooling ribs at rear side of the device.
-  **DO NOT** expose the device to the high humidity environments.
-  **AVOID** permitting children to play with the device.

TRADEMARKS

Yaesu is a trademark of Yaesu/Vertex Standard USA,
Hy-Gain is a trademark of Hy-Gain Corporation,
Orion is a trademark of M2 Antenna Systems,
TIC RingRotor is a registered trademark of TIC General

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1 - DEVICE DESCRIPTION

The ARCO Junior (ARCO Jr.) is a modern rotator (motor + position sensor) controller designed for reliable operation with virtually any azimuth rotator ever made as well as with the home brew rotators. It is smaller brother of regular ARCO, providing cost effective solution for controlling additional rotator, or rotators in unattended remote setups.

ARCO Jr. has same internal circuits and capabilities as ARCO less internal power supplies and instead touch screen uses simplified user interface. Includes VNC server providing same screen on connected computer or mobile device as regular ARCO. While it can work completely alone, benefits from deep integration with the ARCO. When linked together, ARCO is providing for operator same great touch panel UI also for virtually unlimited number of ARCO Juniors.

Azimuth is controlled by Point and Shot knob or by CW and CCW buttons, heading is always displayed on front panel LCD display. Along with the manual control, ARCO Jr. offers rich connectivity for the computer using standard RS-232 port, USB serial port not requiring any driver installation on Windows 10, 11, macOS, and Linux, and Ethernet port to enable control over Internet.

For rotator position feedback, ARCO Jr. supports wide range of the absolute and relative sensors including rheostat, potentiometer, reed contact, Hall sensor, PWM sensor and microHAM proprietary magnetic sensor – ARXC.MAG. Additional digital sensor port provides three differential lines supporting RS-485 communication as well as single ended push-pull and open collector connection for various quadrature encoders. With high resolution sensors positioning accuracy is 0.1°.

For the motor control, ARCO Jr. uses high current, 4-channel PWM driver with overload, short circuit and overheat protections, combined with current monitoring preventing driver damage caused by operation failures. This combination is capable to safely drive any DC motor up to 48V, any AC motor up to 24V, or any bipolar stepper motor up to 48VDC. Motor start and stop uses configurable, ultra-fine gradual speeds ramps, significantly reducing inertial forces stress to the rotator, tower and antennas, prolonging their lifetime. Gradual speed control uses auto-adapting, self-learning procedure considering variable, dynamically changing resistance caused by wind or ice.

ARCO Jr. uses external, user provided 48VDC power supply for motor PWM driver, and external 13.8VDC supply for logic. For high voltage or high power motors ARCO provides common control outputs for inverters as well as industry standard MODBUS RTU control. All rotator settings including compensation for power loss in the motor cables are menu driven, comfortably without requiring to open cover and change some internal wiring.

Networking is another strong point of ARCO Jr. ARCO Jr. supports not only LAN networking but allows to build a simple but powerful, isolated two-wire local LINK bus, coupling multiple ARCO Jr. controllers together with regular ARCO for automated stacks tracking, multi-directional beaming, and counter rotation for rotating towers. In this case, regular ARCO provides user interface for all linked ARCO Juniors. To expand this feature even further, regular ARCO located at operator place provides user interface and control for stream of ARCO Jr. controllers located at unattended remote place over Internet.

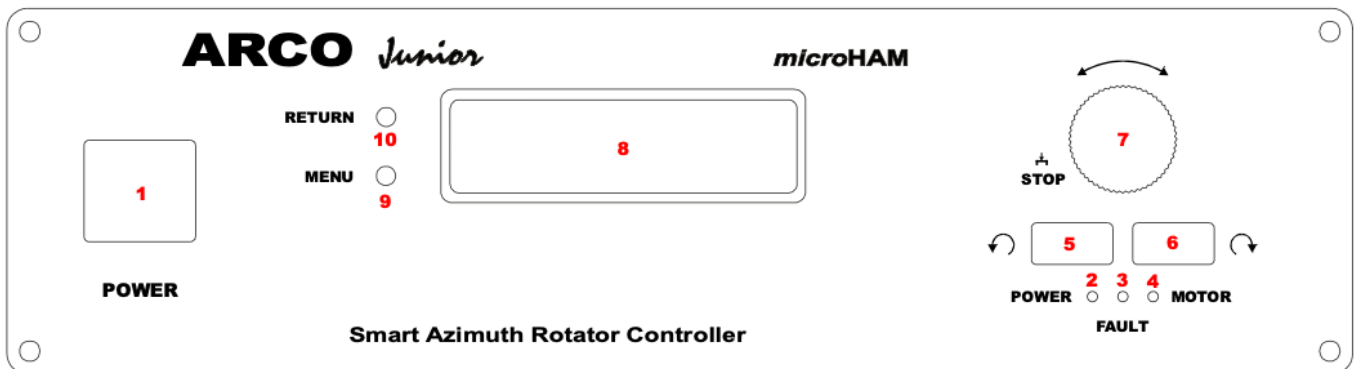
For unattended remote operation, ARCO Jr. offers autonomous parking function and physically disconnects all wires coming to the rotator port from the rotator hardware when connection is

over, breaks, or if ARCO Jr. goes to the power down mode, in order to minimize possible damage by high static or nearby lightning during storms.

Firmware provides wide range of additional protections and self explaining error messages for quick troubleshooting if any failure happens. All of this packed in a full aluminum, compact enclosure with always free firmware updates.

2 - PANEL DESCRIPTION

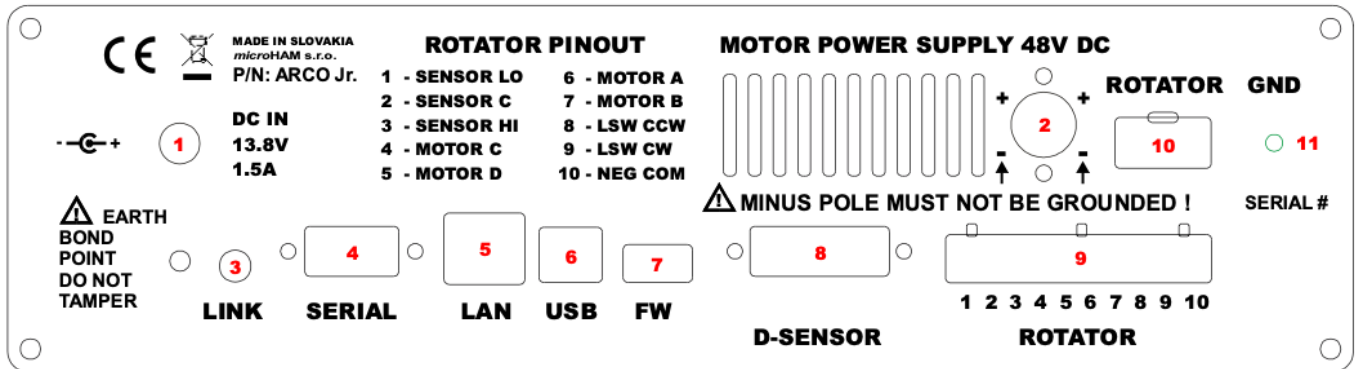
Front Panel



- | | |
|---|--|
| <p>1. POWER
Mains power switch</p> <p>2. POWER LED
LED is on when controller is on.
Flashes when controller is in Stand By mode.</p> <p>3. FAULT LED
LED indicates operation fault.</p> <p>4. MOTOR LED
LED is on when power is applied to the motor.</p> <p>5. ← CCW BUTTON
Turns motor in counterclockwise direction.</p> <p>6. → CW BUTTON
Turns motor in clockwise direction.</p> | <p>7. HEADING KNOB
Sets rotator position. Power is applied to the motor when knob stops. Depressing knob will stop rotator movement.

In Menu is knob used for changing menu items and parameter values.</p> <p>8. DISPLAY</p> <div data-bbox="954 1451 1463 1630" data-label="Image"> </div> <p>9. MENU
Enters and navigate menu.</p> <p>10. RETURN
Leaves and navigate menu.</p> |
|---|--|

Rear Panel



- 1. DC IN**
Power input for controller – 13.8VDC. 5.5/2.1mm socket, positive pole on center pin.
- 2. MOTOR SUPPLY**
Power input for motor – 48VDC. KPJX-4S socket, matting plug KPPX-4P.
When used KPPX-4P ↔ 5.5/2.1mm adapter, positive pole is on center pin.
Minus pole **MUST** be floating, isolated from the chassis or GND!
- 3. LINK**
Bus port for linking multiple controllers together. 3.5mm (1/8”) stereo jack.
- 4. SERIAL**
RS-232 serial port for legacy computer control. DB9 female socket.
- 5. LAN**
Ethernet port, for control over internet. RJ45 socket.
- 6. USB**
USB B port for computer control.
- 7. FW**
USB A port for keypad connection or local firmware update.
- 8. D-SENSOR**
Digital position sensor port, DB15 female socket.
- 9. ROTATOR**
Rotator connection port, 10 position removable terminal, 5.08mm pitch.
- 10. ROTATOR**
Rotator connection port connected in parallel with (9), directly connects YAESU rotators.
- 11. GND**
Rotator cable shield connection, M4 stud. Bonded to chassis.

3 - SETUP

Installation of ARCO consists of hardware and software parts. First, it is necessary to connect ARCO Jr. to power supplies and rotator.

Connecting ARCO Jr. to power supplies

For operation, ARCO Jr. must be connected to both, motor and controller power supplies.

Controller power supply requires **13.8VDC** power connected to the coaxial 5.5/2.1mm jack [1]. See Rear Panel description, positive pole is on center pin. Internally is 13.8VDC power input protected by 3.15A 5x20mm fuse in the green holder on PCB.

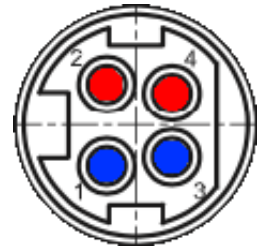


ARCO draws around 0.5A. From this supply connection are fed also optional AXRC modules limited to another 0.5A. It is recommended to use 13.8V capable to provide 1.5A current in peaks. Using parallel connection to your transceiver power supply, or using supply with grounded negative pole is possible.



Double check polarity of connected supply before you turn it on.

Motor power supply requires connection to external **48VDC** +/-5%. Do not use power supplies with higher or lower voltage. Internally is 48VDC power input protected by 16A 6.3x32mm fuse located in cable fuse holder. Motor supply is connected to ARCO Jr. thru 4 pole jack KPJX-4S [2]. See rear Panel description. Positive (plus) pole to pin 2 and pin 4 in parallel, negative (minus) pole to pin 1 and pin 3 in parallel.



If you are using supplied KPPX-4P ↔ 5.5/2.1mm adapter, positive pole is on center pin.



If you are going to make own motor supply cable using KPPX-4P plug, we recommend to follow assembly instructions to letter. Connector assembly is one attempt procedure, there is no much room to correct mistakes. <https://youtu.be/4KoLS5mJQUQ?si=XmPxdbHpyhC0urot>

You can use virtually any 48VDC power supply which has negative pole floating, isolated from the ground. Many POE 48VDC adapters providing around 2A can be well used as motor supply for vast majority of rotators including all Yaesu, Kenpro, Create, Prosistel (up to PST-61), or Hy-Gain. If you prefer verified branded power supply with universal input, we recommend MeanWell model: GSM220B48-R7B (220W). This model is also well suitable for powerful rotators like PST-71/110D, RT4500HD or Orion.



Negative pole of motor supply must NOT be connected to the ground (PEN), ARCO Jr. chassis or negative pole of controller 13.8VDC supply. Double check polarity of connected supply before you turn it on.



When you are connecting power supply cables to ARCO Jr., make sure they are turned OFF before you are going to plug them in. Never connect or disconnect powered leads.

Now you can proceed to rotator connection.

Understanding Rotator

Rotator is a device contains AC or DC motor, gear box and coupled sensor for position feedback. ARCO supports both types of motors. In addition it may have electromagnetic brake to lock in on position and turning range limit switches to avoid travel beyond preset limits. ARCO Jr. supports both brake control as well as limit switches.

Rotator can be equipped with one of two types of the sensors; **absolute sensor** as potentiometer, rheostat, PWM sensor, absolute encoder, geomagnetic sensor OR **relative sensor** like reed contact, Hall sensor or incremental encoder in any form. Absolute sensor is always hard coupled to gearbox and always provide absolute value of rotator orientation. Relative sensor is not hard coupled and provides value of the orientation change. ARCO supports both sensor types and internally converts relative sensor values to an absolute by counting pulses and constant storing last position value since calibration. It is important to realize, that rotator position is not antenna position. Relationship between rotator position and antenna position is set by precess called calibration, and is mandatory for every new rotator setup.

Rotator Connection



Always turn off main power switch and unplug external power supplies from mains sockets when are connecting or disconnecting power plugs or rotator cable to the ARCO Jr. controller. Safety first!

For connection to the rotator hardware serve two connectors, removable 10-pins screw terminal connector (9) and snap-in 6-pins rectangular connector (10), compatible with connectors used on current YAESU rotators. Corresponding pins on both connectors are internally wired in parallel. We recommend to wind rotator cable end through ferrite toroid core, you can make 6-8 turns using FT-240 mix #31 core, what will significantly attenuate unwanted interferences.

If you are connecting recent Yaesu rotator, connect cable end with the 6-pins (2x3) rectangular plug to the rectangular jack (10) on your ARCO. Since Yaesu rotator may use AC or DC motor and connection cable may have different number of wires, please refer to APPENDIX B for more information, **especially if you are connecting G-450 or G-650** series rotator. Once done, turn the controller ON and proceed to next step.

If you are connecting rotator, having different connector cable end, you need to build an adapter between mating cable jack and 10-pins ROTATOR terminal on ARCO, or cut it and connect wires to the terminal directly. Terminal is industry standard 5.08mm (0.2") pitch pluggable screw terminal block. We understand, that some users may be hesitant to cut connections to the old controller. As a solution, use the male version of the screw terminal block.

As you cut wires of the cable, one by one, and connect their rotator end to the female terminal block for ARCO, simply connect the other end of the cut wire of original connector to the respective, same terminal pin of the male terminal block. In this way, whenever desired, the original connection can be simply restored by plugging in the cable into the stub on the original controller, ending with the newly installed male terminal block. Take your time, make nice, clean and solid connections. We recommend to use isolated wire ferrules crimped to the cable wire ends. Wiring diagrams for various rotators included in the MODEL menu, can be found at the end of this manual, Appendix B. If you are connecting unlisted or custom rotator, please make connections according to the charts in Appendix C, with respect to the motor and sensor type.

Prepare for Calibration

Having rotator connected to ARCO, it is necessary to perform verification steps that connection is correct, rotator is moving in correct direction and sensor provides proper feedback. You are safe, all protections are already running and if something isn't right ARCO stops turning and shows error message of the problem. However, observing antenna if is turning is required. DO NOT perform first tests blindly during night or if you cannot see rotator or rotating antenna, ask your friend for help.

There are three choices how to calibrate ARCO Jr. to your rotator.

- A.** You already have regular ARCO connected to rotator, and you want to transfer rotator control to ARCO Jr., clone settings and calibration from regular ARCO to ARCO Jr.
- B.** You want to get rotator control without connecting to computer and have rotator which can be auto-calibrated, calibrate directly on ARCO Jr. using menu.
- C.** Setup VNC Viewer and calibrate ARCO Jr. using VNC viewer on computer or mobile device.

A. Clone Settings and Calibration from ARCO

Setup and calibration can be transferred from regular ARCO to ARCO Jr. through their LINK (CAN) connection. ARCO have to be connected according to "Rotator - Link" chapter in ARCO manual. In Setup | Menu | Rotator | Link, make sure, that LINK ENABLE is ticked and that ARCO and ARCO Jr. are set to different ROTATOR ID. ROTATOR ID on ARCO Jr. is menu item M02, LINK ENABLE is menu item M01.

On the ARCO Jr. navigate to menu M82:RECEIVE CFG, set to YES and confirm by pushing MENU button. On display you should see "**RECEIVE CONFIG, WAITING...**"

On the regular ARCO, which is the source of setup/calibration data ("SENDER"), in Setup | System | System, touch on CONFIG SAVE, and in the CONFIG SAVE window, touch on **SEND CONFIG**. A new window opens, touch YES to continue.

The window in ARCO then displays "SENDING", and in ARCO Jr. it displays "RECEIVING". Transferring data is relatively fast, and on both ARCOs the window displays DONE within approximately one second. At that moment, on ARCO, LINK is switched off to prevent bus collision, as ARCO Jr. now has the same ROTATOR ID for LINK. Also note, that if ARCO's LAN setting does not use DHCP, i.e. it uses a fixed IP ADDR, this is copied also to ARCO Jr., and may cause conflicts on LAN, so if both ARCOs are continued to be used simultaneously on the same LAN, it is necessary to change this setting on one of them.

After successful configuration transfer, we strongly recommend to check antenna heading if you are using rotator with potentiometer or rheostat sensor. Due to small piece-to-piece variations in analog section and reference output, heading may need to recalibrate.

B. AUTO Calibration from ARCO Jr. menu

Rotators with absolute sensor and limit switches can be AUTO calibrated using their preset parameters. These rotators are available to chose in menu M20, their preset parameters can be found in Appendix B of this manual. Parameters are fixed and cannot be changed on ARCO Jr. only by connecting ARCO Jr. to VNC Viewer. If default parameters suits your needs, you can proceed with built-in calibration.

- Select your rotator model in menu M20 and confirm by MENU button.
- Navigate to menu M22. Using CW and CCW front panel buttons observe if rotator is rotating antenna and if percentage value of sensor position on display is changing. Value must be increasing in CW direction. On rotators with relative sensor, animation must be moving.

If you encounter any issue, proceed by connecting ARCO Jr. to VNC and verify connection described in next chapter.

- If all is OK, push MENU to get to bottom line, change to YES by knob and confirm by MENU button. Depends on calibrated rotator next step divides to procedure A or B.
- A. If you are calibrating rotator with absolute sensor like Yaesu or Create rotators, ARCO Jr. first turns rotator to the CCW limit, then to the CW limit, and then stops at rotation center. Whole process is automatic and takes time, just wait until you see CENTER AZIMUTH on display. Please note, percentage position of the sensor is rarely right on 50%, rather low because sensor in rotator is installed with certain mechanical margin, that's normal. Rotator is now exactly at the center of its rotation, now go outside and check azimuth where antenna is beaming and dial this azimuth to ARCO Jr. using knob. Confirm by MENU button.
- B. If you are calibrating rotator with relative sensor like our S75, SPID or DXE rotators, turn rotator to the desired center of rotation using CW/CCW front panel buttons and observe antenna azimuth. Dial this azimuth using knob and confirm by MENU.
- Calibration is done. Verify calibration status at menu M21 and press RETURN.
- Freshly calibrated rotator has to learn ramps duration related to the motor, gearbox, and inertia of rotating antenna. ARCO prompts you to PREPARE RAMPS which can be confirmed by MENU button or cancelled by RETURN button. Learned duration of ramps can be reset anytime by menu M30 without impact to calibration.

Unless CALIBRATION STATUS is CALIBRATED, only place where you should turn rotator is MENU M22 or CALIBRATION tab. Stay there until ROTATOR STATUS shown on screen or menu M21 is CALIBRATED!

C. VNC Setup

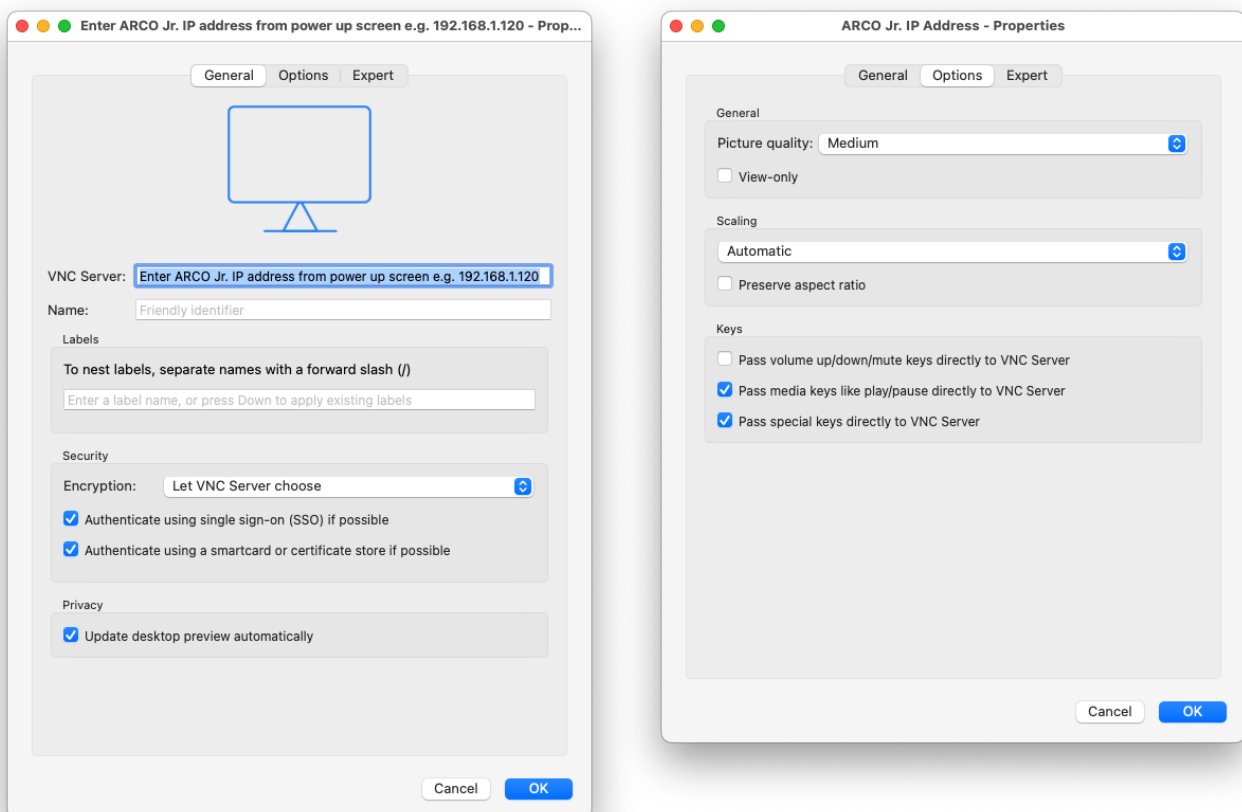
Connecting ARCO Jr. by VNC expands its full potential and changes ARCO Jr. to full featured ARCO on computer. VNC server in ARCO Jr. is compatible with wide variety of VNC viewers, we recommend free RealVNC Viewer supporting all major operating systems. It is available for download at link below:

<https://www.realvnc.com/en/connect/download/viewer/>

Recommended option is to set Picture quality to Automatic, Scaling to Automatic, and uncheck preserve aspect ratio. This will provide the best appearance and optimal scaling to available area on your computer desktop.

VNC connection requires ARCO Jr. being connected to your local LAN network. ARCO Jr. has by default enabled DHCP for IP address assignment. IP address required for VNC connection is shown on front panel display after power up. It can be also found in menu, item M10.

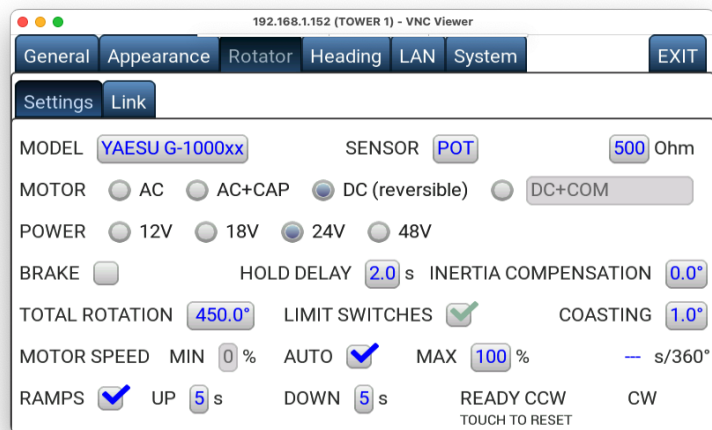
VNC Server can be enabled or disabled in menu, item M11. By default is enabled. Default password is ARCO.



After a short while you'll see main screen on display. Touch settings icon in the left bottom corner to enter SETTINGS MENU. On top you'll see several tabs which will be described later, now touch **General** tab, touch **ROTATOR LOCATION** button and enter QRA locator or GPS coordinates of the place where rotator is installed in WGS 84 format. If you don't know, please find your location on satellite map <https://www.gps-coordinates.net/> or check GPS coordinates in your mobile phone. As a result ARCO will show you your QRA locator and vice versa. Then set current UTC **TIME** in HH:MM:SS format and current UTC **DATE** in DD:MM:YYYY format.



Now touch **Rotator** tab. At Rotator tab select your rotator **MODEL** from drop down menu. If you do not see your model listed, select **CUSTOM** and configure your rotator parameters. Please refer to SETTINGS MENU | Rotator chapter for parameters description. If you are not sure, contact us for help.



Settings proper parameters on **Rotator** tab, namely **SENSOR**, p/360° (if applicable), **ROTATION**

RANGE, **BRAKE** and **LIMIT SWITCHES** presence are absolutely necessary for proper calibration. They are set automatically when you chose particular rotator model, but if you are going to calibrate custom rotator, make sure all above mentioned parameters are set correctly.

When you are done touch **EXIT** tab. ARCO will generate maps centered to rotator location and register your settings. It takes about 15 seconds per map, please be patient. When job is finished turn off main power switch and turn it back on. If any error message pop-ups just confirm and ignore it, it is normal as some protections always run in real time but you haven't rotator calibrated yet.

FIRST CONNECTION INSTRUCTIONS and TROUBLESHOOTING

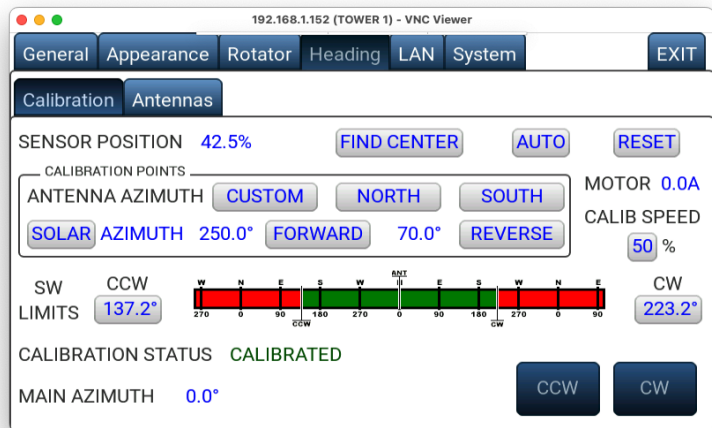
- Touch the settings icon at the left bottom corner of the main screen to enter menu.
- Touch Heading | **Calibration** tab.
- Touch **RESET** to clear calibration memory.



To turn antenna use exclusively ← CCW and → CW buttons on the controller front panel or Calibration tab. For setting up accurate position, CW and CCW buttons do not use ramps (only on this tab) and speed is automatically limited to **CALIB SPEED** in % of power.

- Press front panel CW button and observe if rotator is turning in CW direction. If is turning in opposite CCW direction, turn ARCO off, swap CW/CCW motor leads connected to ARCO and return back.

Please note, if connected rotator has absolute sensor and SENSOR POSITION shows 0% or 100%, turning in CCW (if shows 0%) or CW (if shows 100%) direction is intentionally prohibited to avoid sensor damage. Get out of 0% or 100% region by turning rotator in opposite direction. If you cannot, verify sensor settings and connection.



If you are not sure you have correctly identified motor leads use ohm meter. Motor winding has typically few ohms to few tens of ohms, not more and are usually thicker than sensor leads. AC motor has two winding with identical resistance, sharing one common (COM) lead. Resistance between CW and CCW leads has to be twice the resistance between COM and CW or COM and CCW leads. If motor does not turn and you are getting NO MOVEMENT error message, increase CALIB SPEED. Above CALIB SPEED is shown real time motor current monitor. If you see zero Amps motor is not connected correctly. If you see very high value and motor is steady or humming, there is a short circuit in wiring or motor type is not set correctly.

- When motor is turning correctly, check sensor feedback. Number next to SENSOR POSITION must be increasing in CW direction. If is decreasing and your rotator has potentiometer sensor (POT or M-TURN POT), turn ARCO off, swap SENSOR HI and SENSOR LO leads connected to ARCO and return back. Please note, M-TURN POT sensor may generate very small changes (in order of 0.1%) but they must be there. If your rotator has relative, pulse sensor (any), you should see the simple moving animation with -- characters instead % number indicating pulses presence.
- Once rotator turns correctly and sensor provides proper feedback, you can proceed further. **DO NOT proceed until motor and sensor responds properly.**

Unless CALIBRATION STATUS is CALIBRATED, only place where you should turn rotator is MENU M22 or CALIBRATION tab. Stay there until ROTATOR STATUS shown on screen or menu M21 is CALIBRATED!

Rotator Centering

If you are just swapping controller and going to calibrate already installed rotator with antenna, you can skip this chapter and continue on **Calibration** chapter, you **do not need** to center rotator.

Rotators with relative sensor without limit switches has free rotation center and does not need any preset or centering, even on new installations. You can proceed to Calibration chapter.

If you are going to do new rotator installation, equipped with absolute sensor or rotators with hardware limit switches it is desirable to preset rotator close to its **rotator rotation center**. Reason is that you can then adjust **antenna rotation center** mechanically by rotating antenna around the mast (or mast in rotator clamps) during installation and get then equal antenna travel in both CW and CCW directions. AUTO or FIND CENTER procedures on Heading tab allows to safely find and set rotator to its center and then calibrate antenna position individually, unrelated to the actual mounting orientation of the rotator.

The most comfortable way to center rotator is to do this prior installation on the tower while is down, using temporary connection cable. It is also possible to center rotator when is already installed on the tower together with an antenna, in this case we recommend to carefully watch the antenna feedline, release it, or entirely disconnect during the process, to avoid its damage.

ROTATOR CENTERING INSTRUCTIONS

- Touch RESET to clear calibration memory, touch AUTO or FIND CENTER button.

AUTO automatically and accurately sets rotator to its center. Procedure takes longer time as automatically finds and register position of both CW and CCW limits. AUTO function is provided only for rotators with hardware limit switches and automatically registers usable travel of absolute sensor.

FIND CENTER automatically sets rotator with absolute sensor to its center, assuming the sensor center is also a rotator rotation center, by shortest possible path without searching and registering limit positions. This function may not set rotator to its rotation center if absolute sensor does not use full 100% of sensor travel.

If automatic finding of the rotator center is not appropriate for whatever reason, you can turn rotator to its center manually using CW and CCW front panel buttons until SENSOR POSITION reading shows 50%.

Once rotator is centered setup is done, rotator can be installed on the tower. After rotator and antenna installation, release antenna or mast clamp a bit to be able to rotate antenna manually (mechanically, DO NOT TURN ROTATOR BY THE ARCO) to the North or to the South or to any other desired **antenna rotation center**, and firmly tight all clamps. Antenna positioning does not need to be super accurate as caused error will only influence position of CW and CCW limits, accurate calibration will be done in next step.

From now, antenna can be turned by ARCO controller equally in both CW and CCW directions by CW and CCW buttons because you've nulled mounting shift and aligned requested antenna rotation center to the rotator rotation center mechanically. Turn rotator to both limits and check for possible feedline problems. Next step is registering position (calibration) of rotation limits and accurate calibration of the antenna position.

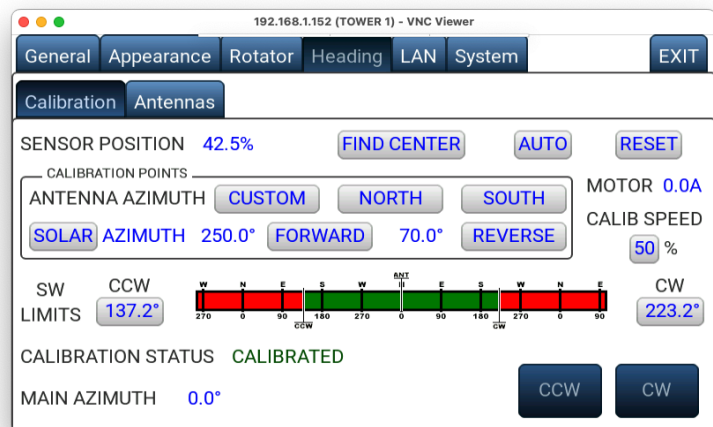
Calibration

Unless CALIBRATION STATUS is CALIBRATED, only place where you can turn rotator is CALIBRATION tab, stay on CALIBRATION tab!

CW/CCW LIMITS CALIBRATION INSTRUCTIONS

- If available (only rotators with hardware limit switches) touch AUTO button. ARCO will automatically find position of both CW and CCW limits and set rotator to its center. When done, proceed to HEADING CALIBRATION.

- If AUTO button is not available and your rotator uses absolute sensor, calibrate CW and CCW limits manually. You **must turn** antenna to desired CCW limit using CCW button on ARCO front panel, touch CUSTOM, enter antenna azimuth and confirm you are calibrating CCW limit on calibration pop-up window. Then turn antenna to desired CW limit using CW button on ARCO front panel, touch CUSTOM, enter antenna azimuth and confirm you are



calibrating CW limit on calibration pop-up window. Watch and select correct point on strip! Distance between CCW and CW limit positions has to be ROTATION RANGE range degrees. When done, proceed to HEADING CALIBRATION.

Please note, for rotators with M-TURN POT sensor (multi-turn potentiometer), calibration of both CW and CCW limits is mandatory (typically Prosistel and TIC rotators). Such rotators use only part of potentiometer travel for position feedback and potentiometer value does not represent ROTATION RANGE range as typically on POT or RHEO sensors. Do not skip or fake limits calibration!

- If your rotator has relative position sensor without limit switches, touch SET CENTER button and enter desired center of antenna rotation, usually 0° for North center or 180° for South centered rotations, but center can be anywhere from 0° - 359.9°. This azimuth is used to preset software limit switches according to the ROTATION RANGE parameter, symmetrically divided in CW and CCW directions. Once center is set, proceed to HEADING CALIBRATION.

HEADING CALIBRATION INSTRUCTIONS

- **DO NOT** touch FIND CENTER, SET CENTER, AUTO or RESET buttons on the first line unless you want to clear all calibration data and start calibration from the scratch. If yes, first touch RESET and calibrate CW/CCW limits as described above.

ARCO needs at least one calibration point to show antenna heading and it can be entered by accurate aiming antenna to the known specific direction and then register this direction as a calibration point by touching appropriate calibration button. ARCO provides several ways of entering a calibration point. All buttons inside CALIBRATION POINTS area serve to same purpose to register a calibration data but provide different choices for calibration, choose most suitable method for you, it doesn't matter which one.

CUSTOM button allows to enter actual antenna heading. If you have rotator with overlapping segments (ROTATION RANGE > 360°), make sure the antenna is **NOT** in any of these segments. Actual heading can be found by using compass. Please realize that all compass devices are influenced by magnetic declination. https://en.wikipedia.org/wiki/Magnetic_declination Make sure to check value of the magnetic declination for your QTH: <https://www.magnetic-declination.com/> and add/subtract found value to the compass reading. **NORTH / SOUTH** calibration buttons. If you know accurate North or South position, turn antenna that direction using CW/CCW buttons on ARCO front panel as accurately as possible and touch appropriate NORTH or SOUTH button to register calibration point.

Most accurate method of registering calibration point is if you can accurately aim antenna to a visible distant place which can be found on satellite maps. Find GPS coordinates of this distant point <https://www.gps-coordinates.net/>, aim antenna to that place and enter coordinates to the ARCO. Controller consequently compute heading value and register it as an calibration point. Please note, if you are calibrating antenna heading to GPS coordinates, use GPS coordinates for ROTATOR LOCATION first as QRA locator method is too coarse for accurate calibration.

SOLAR / LUNAR AZIMUTH. Since ARCO known your rotator location coordinates, time and date, controller can compute exact sun/moon position, and knows azimuth of the shadow projected by the tower on the ground. To use it, you need to precisely align antenna boom shadow in parallel to the mast shadow with director beaming to sun/moon and touch FORWARD button. Or turn antenna to opposite direction, align antenna boom shadow in parallel to the mast shadow with reflector pointing to sun and touch REVERSE button.

Once position is calibrated it is confirmed by message showing:

CALIBRATION STATUS: CALIBRATED and MAIN AZIMUTH will display antenna azimuth.

ARCO allows to alter software (SW) rotation limits. By default they are worked out from the rotation center position and ROTATION RANGE parameter, and are set 2° inwards rotation range. Within rotation range can be set by touching CW and CCW SW LIMITS buttons.

Watch proper azimuth point on calibration strip when adjusting!

POST CALIBRATION INSTRUCTIONS

Freshly calibrated rotator has to learn ramps duration related to the motor, gearbox, and inertia of rotating antenna. To let ARCO learn duration of ramps, go to main screen and turn rotator in each direction by CW/CCW buttons or any other method. Whenever status of rotator is CALIBRATED but ramps are not learned yet, ARCO will prompt you to perform “learning” providing built-in automatic procedure. Learned duration of ramps can be anytime reset by touching RESET CCW area on Rotators tab without impact to calibration.

Key of “learning” procedure is to reach MAX speed indicated by full bargraph and leave stop it to him. Do this for each CW and CCW direction separately.

If you are moving to a specific direction by Touch'n turn, rotator may overshoot targets. That's normal, ARCO will use overshoot value for next more accurate stop on target.

Status of “learning” process is indicated by OK sign next to READY CCW and CW marks on Rotator tab. You can reset learned values by touching READY CCW position, it will not influence calibration, just smoothness and accuracy of stopping rotator at desired heading.

Please note, changing parameters with direct impact to precise target positioning (POWER, SPEED and RAMP) causes self learning procedure to restart.

CALIBRATION IMPROVEMENTS (optional)

- If you have rotator with POT or RHEO absolute sensor, for a better accuracy near rotation ends we recommend to calibrate also CW and CCW limits, even if they are already registered by AUTO button. Reason is that single turn potentiometer sensors are typically used for its full travel but ends might not be linear. In addition, if such rotator has no hardware limits, travel over these limits will damage sensor, it is more safe to let ARCO sample at least exact position of both limits in addition to calibrated heading.
- Turn rotator to desired CW limit position but watch SENSOR POSITION number to not exceed 99%. Touch CUSTOM button and enter antenna azimuth. On next window confirm CW limit position.
- Turn rotator to desired CCW limit position but watch SENSOR POSITION number to not run under 1%. Touch CUSTOM button and enter antenna azimuth. On next window confirm CCW limit position.
- You can increase accuracy and improve heading linearity by adding more calibration points. ARCO can register up to 72 calibration points if new point is more apart from the old one than $(ROTATION\ RANGE / 72)$ degrees, what is 5° for rotators with 360° rotation range. If new calibration point is within $\pm 5^\circ$ from old, ARCO will delete old, and use new point instead. Position of calibration points are shown on calibration strip as small yellow vertical lines.

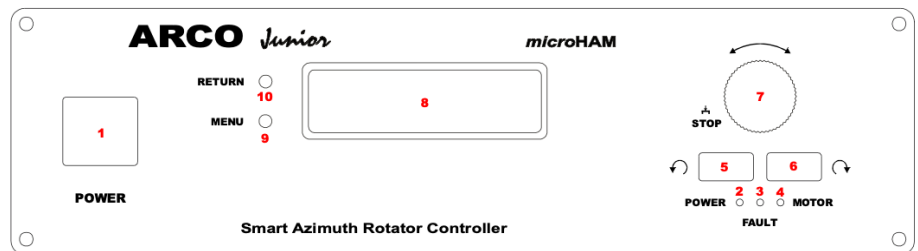
If you want to reset all calibration data, touch RESET button and restart calibration.

4.A – FRONT PANEL USER INTERFACE

ARCO Junior can be operated from the front panel, from VNC Viewer on the computer or mobile device or by linked regular ARCO. This chapter describes operation from the front panel.

Main power switch [1] connects ARCO Jr. to attached 13.8VDC and 48VDC power supplies. Power on state is indicated by POWER [2] led. In sleep mode POWER led is slowly changing its intensity.

Flipping power switch to O position disconnects ARCO Jr. from both power supply inputs - positive poles. Negative poles remain connected to ARCO Jr. internal circuits.



After power up, ARCO Jr. shows on display [8] status of power up sequence, connection to LAN, assignment of IP address, status of VNC and runs selftest. If during power up procedure is found any problem, error message is shown on the display. When everything is OK, display shows UTC, rotator name and antenna azimuth.

Azimuth can be changed by point-and-shot knob [7] or by CCW [5] and CW [6] buttons. Applying power to the motor in the rotator is indicated by MOTOR led [4]. Any error arisen during rotation is indicated by FAULT [3] led, and error message is shown on the display.

Buttons MENU [9] and RETURN [10] serve exclusively for navigation in the menu system. Pushing MENU once enters menu. Required menu number is dialed by knob [7]. Next MENU button push moves cursor to second line. In second line knob changes menu parameter value. Third MENU button push confirms parameter for selected menu, stores its value to the memory, and leaves menu. To leave MENU without storing use RETURN button.

Menu system in ARCO Jr. is minimalistic, including only absolute necessary parameters to get most common rotators calibrated and running. For access to extra settings, it is necessary to use VNC Viewer on the computer or mobile device described in the next chapter.

List of MENU Items:

M01: LINK ENABLE	YES/NO. Enables local remote control of the ARCO Jr. controller from another ARCO controller present on the LINK bus. Each ARCO and ARCO Jr. <u>MUST HAVE</u> unique ROTATOR ID number.
M02: ROTATOR ID	1-30. Specifies unique rotator identification number for addressing on the LINK bus network.
M10: LAN STATUS	Shows LAN connection events. Once connected, shows ARCO Jr. IP address.
M11: VNC ENABLE	YES/NO. Enables internal VNC server.

M20: ROTATOR TYPE	Specifies rotator model for direct calibration from ARCO Jr. menu. microHAM S75A, S57AE (AZ), Yaesu G-800xx, G-1000xx, G-2700xx, G-2800xx, G-5500DC (AZ), G-450DC(ADC/CDC), G-400, G-650A, G-650C, G-5500 (AZ), G-600, HyGain HAMxx, T2xx, CD-44, HDR-300A, Create RC5x, Spid RAU, RAK, RAS (AZ), BIG-RAK, BIG-RAS (AZ), RAK/HR, BIG-RAK/HR, RAS/HR (AZ), BIG-RAS/HR (AZ), PropPitch , Prosistel PST71D, PST100D, Ultrabeam UB-ONE, DXEngineering RT4500HD
M21: CALIBRATED?	UNCALIBRATED/CALIBRATED. Shows calibration status.
M22: CALIBRATE	YES/NO. Starts calibration procedure. Calibration procedure is available only for rotators selected in menu M20. All other rotators require calibration from VNC.
M30: VOID LEARNED	YES/NO. Resets learned timing for ramps.
M80: RESET CONFIG	YES/NO. Resets all settings and calibration.
M81: LOAD CONFIG	
M82: RECEIVE CFG	YES/NO
M99: NEW FIRMWARE	YES/NO

4.B – VNC USER INTERFACE

When ARCO Jr. is access by VNC viewer, user interface and features are identical to regular ARCO, hence from now till the end is for simplicity ARCO Jr. called ARCO.

The main display of ARCO provides real time information about antenna heading, antenna selection, rotator state and six memories for quick antenna heading change. Heading is provided by orientation needle on great circle and by large heading number which can be set to show either real time heading or target rotation heading. Under the heading number is located **graphical rotator status** displaying actual rotator speed, turning direction and brake state. Under graphical status is shown self explaining detailed status of each operation step executed by the rotator controller.

Antenna heading can be set in many ways, by **Touch'n Turn** - touching great circle map at desired direction, by **Heading Dial Screen** - entering specific heading by touching large heading number area, by memory preset buttons on display, by **Point and Shot** knob dialing in required heading, instantly by CCW ← and CW → buttons on front panel, by numeric keypad attached to the USB A (FW) port on ARCO, and by computer, either thru the RS-232, USB or Ethernet port. **Touch'n Turn** is the fastest heading setting ever bought to the rotator controller. You simply touch the great circle where you want to turn your antenna and that's all. If you keep finger on display, by moving it in all directions you can fine tune desired target heading. Rotator will start movement when you remove finger from the screen.

Heading Dial Screen allows you to enter desired heading not only by large on screen keypad but it also allows to set heading to QRA locator getting azimuth and QRB response, specific DXCC country or prefix, or particular WAZ or ITU zone. Screen shows current and new azimuth, to confirm choice touch the GO. By touching NEW AZIMUTH button, you can switch new heading to short path (SP) or long path (LP). If you want to return back to the main screen without heading change touch RETURN.

If you need to stop rotator movement for any reason, press knob or press one of CW/CCW buttons. If rotator is stopped by the knob, heading can be optionally restored to the stop position if RETRUN UPON MANUAL STOP in Setup | General is enabled.

ANTENNA button allows to choose one of three antennas if these antennas have different offset to the main antenna or any available rotator/antenna present on local LINK network or chosen ARCO controller over Internet.

BACK button serves to return antenna heading to the previous heading. What should be considered “returnable” heading is defined in the SETTINGS MENU | General.

Next to BACK button is located SYNC switch and ALIGN button. These controls are available only if SYNC is enabled in the setup Link tab and if you have your controller linked over LINK bus to the another ARCO controller(s).

SYNC switch enables or disables heading synchronization, basically sends or receive “follow me” command on the bus on every direction change while keeping heading difference. If is switched off, rotator works independently, does not send or receive synchronization commands.

ALIGN button sends command to bus for instant alignment of position to match sending controller's heading. Menu settings specifies which antennas will be aligned.

At the bottom right are located six memory buttons for quick recall or store most used headings. To recall heading just touch desired button. Touch and hold the button if you want to change heading or label. Memory buttons supports absolute headings as well as incremental or decremental heading changes by using +/- sign key.

At the top left corner is shown UTC time of the sunrise or sunset. It is switching automatically, depends which event is closer. By touching on sun it can be switched to the countdown mode showing how much time remains to the event by using minus sign or expired from the event by plus sign.

Antenna position at software or hardware limits and overlap, if position exceeds 180° from the antenna rotation center is indicated by easy to read traffic signs at the middle top of the screen.



Overlaps by a roundabout sign

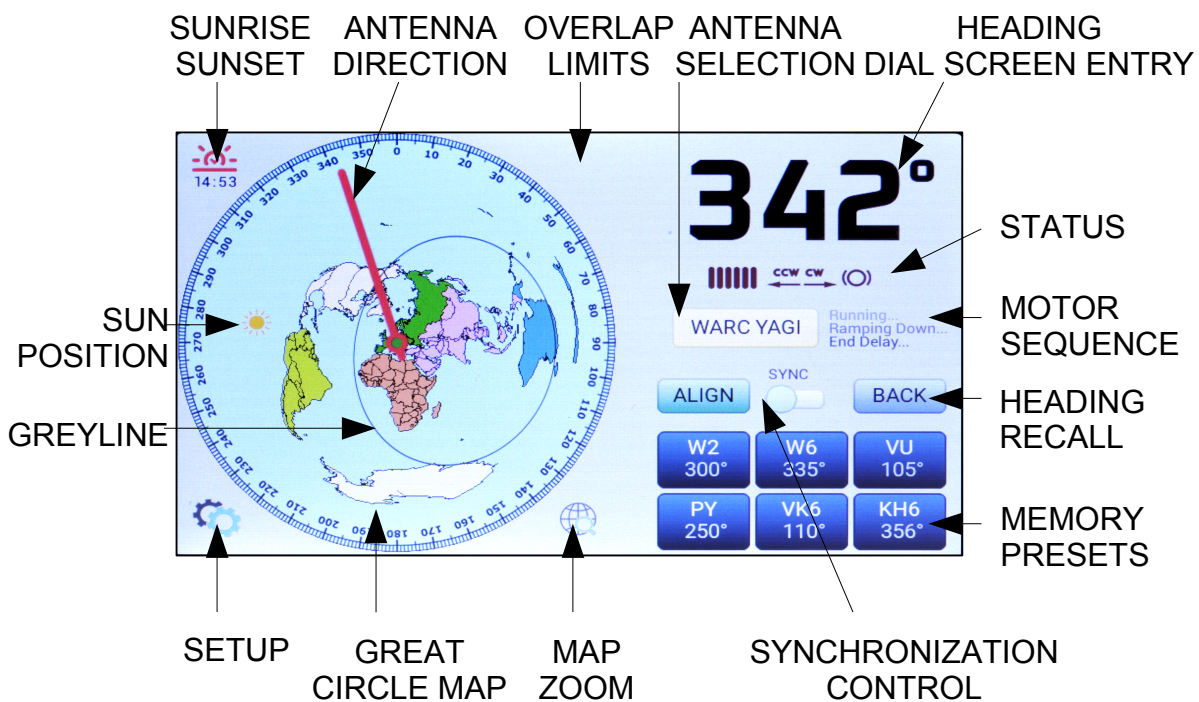


Software limit by no left turn or no right turn sign



Hardware limit by the stop sign.

If position of the antenna is in the overlapped section, touching overlap sign will re-position antenna to the same heading in the non-overlapped section.



At the middle bottom of the screen is an appearance switch, globe with a loupe, providing quick selection for one of four map “zoom” presets for different great circle map radius, colors, greyline projection etc ... Each zoom can be customized in the Appearance menu.

At the bottom left corner is located typical settings button for entering the SETTINGS MENU.

Keyboard operation

ARCO can be conveniently operated also from a connected USB keyboard or keypad.

In the Main Screen, the following keys are active:

- digits (0..9) - direct entry of target azimuth
- Backspace, minus - while entering azimuth, deletes last entered digit; if there are no more digits, cancels direct azimuth entry
- Escape - while entering azimuth, cancels direct azimuth entry, otherwise stops rotator movement
- asterisk (*) - stops rotator movement
- Enter - while entering azimuth, starts movement to this target azimuth immediately
- slash (/), Tab - switch to the Heading Dial Screen

In the Heading Dial Screen:

- digits (0..9) and letters (A..Z) - entry of target
- Backspace, minus - deletes last entered digit/letter
- Del - clear the entry field
- Enter - start movement to azimuth displayed in NEW window and return to Main Screen
- Escape, slash (/), Tab - return to Main Screen with no change in azimuth
- asterisk (*) - swap LP/SP
- decimal (.), space - LOC, calculate heading towards entered Maidenhead Locator
- Home - WAZ, calculate heading towards entered WAZ zone
- End - ITU, calculate heading towards entered ITU zone
- Insert - DXCC, calculate heading towards entered country/prefix

Keyboard works also in most places in Menu, where numeric or alphanumeric value is entered.

Most functions of a local keyboard/keypad can also be used through VNC connection. Note, that VNC clients and/or operating systems can influence operation of the keyboard according to locale and other settings.

Please note, if you plan to use USB keypad to control directions, be aware that some complex keypads, especially those embedding other functions such as an embedded display or touchpad, may in fact be a complex USB device, e.g. embedding an USB HUB, and these may not work with ARCO. Simple and cheap USB keypads work well.

5 - SETTINGS MENU

SETTINGS MENU of ARCO controller allows to set individual parameters of complete controller behavior. There are no internal switches, jumpers or trimmers, all settings can be set here.

General

ROTATOR NAME: Sets rotator name for identification and is also shown on the screensaver.

ROTATOR LOCATION: Sets GPS coordinates of rotator installation place in WGS 84 format (decimal degrees, World Geodetic System 84). Controller shows computed QRA locator. Settings proper location is important for various calculation, greyline and sun position.

DISTANCE UNITS: Sets ARCO to use kilometers (km) or miles (mi) as a distance units.

TIME: UTC Time in the HH:MM:SS format

DATE: UTC Date in the DD:MM:YYYY format. Accurate time and date is necessary for various calculations, same as rotator location. Time and date can be automatically synchronized using NTP server, see LAN settings tab.

SCREENSAVER: Specifies time for activating screensaver. Screensaver activates automatically if there is no manipulation with ARCO or no heading change for a specified time. During screen saving is ARCO fully operational and cancels screensaver automatically by manipulating the front panel controls and optionally by touching screen - **CANCEL BY TOUCH** or **BY REMOTE** command on any interface port. **LOCAL AZI** forces screen saver to show locally connected rotator azimuth in even if ARCO controls antenna on other ARCO.

STAND BY: Specifies time when controller enter Stand by mode. In stand by mode, display, touch screen and rotator control CPU is off. Rotator hardware is physically disconnected from the controller. Controller can be waken up by pressing hardware buttons, touching knob, by receiving poll from RS-232, USB or by valid packet received over LAN.

PARK BEFORE STAND BY: Allows to turn rotator to a specific heading defined in next field before controller enters Stand By mode.

KNOB STEP: Defines *Point and Shot* knob steps. It also automatically sets heading number resolution on the main screen to tenths of degrees (0.1°). **COARSE:** Doubles knob sensitivity.

BUTTONS USE RAMPS: Applies RAMP UP and RAMP DOWN timing to CW / CCW buttons on front panel. When disabled, CW / CCW buttons turns rotator instantly without ramps at speed defined by CALIB SPEED parameter on Heading tab.

RETURN UPON MANUAL STOP: Enables back rotation to azimuth at which rotator was stopped but overshoot due to ramp duration.

BACK RETURNS LAST HEADING SET BY: Defines what heading changes are remembered for returning last heading by BACK button on the main screen.

TOUCH'n TURN: Enables heading settings by touching the great circle map.

Appearance

Appearance tab serves to define look of the main screen for four different presets – Zooms.

Appearance - Global

DISPLAY BRIGHTNESS (DAY): Sets display brightness level used during the day time.

DISPLAY BRIGHTNESS (NIGHT): Sets display brightness level used during the night.
Please note: Day and Night time is derived from the sunrise/sunset events at the rotator location.

LIGHT BACKGROUND: Sets background and heading color for the LIGHT schemes.

DARK BACKGROUND: Sets background and heading color for the DARK schemes.
Please note: Levels 3 and 4 have the same background but inverse heading color.

HEADING: Sets the main heading number meaning to show the TARGET heading or real time CURRENT heading.

DISTANCE TO TARGET: Shows remaining angle to the target while rotator is turning.

ALWAYS SHOW MAIN HEADING: When checked, main screen contains small indicator of main heading direction for antennas with heading offset.

SHOW HEADING OF SYNC GROUP: When checked, main screen contains shorter heading needles of other ARCO controllers belonging to same SYNC group.

SHOW OVERLAP ZONES: When checked and rotator position is more than +/- 180° apart from its center of rotation (rotator is in overlap), main screen shows overlap zone as darker segment on great circle, providing visual feedback of further possible rotation without counter-rotation.

CUSTOM MAP: Allows to load two separate images A and B for great circle background. Image needs to be pre-processed on computer. Instructions are shown by touching LOAD button.
Please note, image has to be 450x480 pixels (HxV) but corners and about 20px margins are not visible due to projection into the great circle with azimuth scale around.

Appearance - Zoom 1..4

RADIUS: Sets great circle map radius centered at the rotator location.

BACKGROUND: Sets background scheme defined at the Global tab. AUTO selection will use LIGHT scheme during the day time, DARK during the night.

GREAT CIRCLE: Sets great circle color, light blue or dark blue. AUTO selection will use light blue color during the day time and dark blue color during the night.

SHOW SUN: Displays sun position on the great circle.

GREYLINE AREA: Enables greyline projection to the great circle map.

BORDER LINE: Enables projection of a fine line corresponding to the time when the center of the sun is located right on the horizon.

SHOW MOON: Displays moon position on the great circle.

MOONLIT AREA: Enables moon visibility area projection to the great circle map.

SAME EL. LINE: Shows line on the great circle where moon is visible at same elevation angle.

SHOW MAP: Enables azimuthal equidistant map projection to the great circle area.

CUSTOM MAP: Enables display of custom image loaded to ARCO instead built-in vector map.

MAP COLOR: Defines style of map coloring. Colors were chosen with no intention implied.

DISTANCE CIRCLES: Enables distance circles to be drawn on the great circle. Step is chosen automatically according to the defined RADIUS parameter.

All above settings are set individually for each presets at Zoom tabs 2, 3 and 4.

Rotator - Settings

MODEL: Sets connected hardware rotator model. Choosing any model other than CUSTOM automatically fills all remaining parameters. CUSTOM model always uses settings from previously selected model. If there is a need to change some locked parameter, selecting base model and then CUSTOM will copy and unlock all parameters.

SENSOR: Selects type of the sensor installed in the rotator.

- **POT:** 3 leads potentiometer, next field allows to enter pot resistance, 50 Ω - 10 k Ω .
- **M-TURN POT:** 3 leads multi-turn potentiometer, 50 Ω - 10 k Ω . Setting requires individual CW and CCW limits calibration if rotator has no hardware limit switches.
- **RHEO:** 2 leads rheostat or potentiometer. Next field defines its resistance 50 Ω - 10 k Ω .
- **PWM:** PWM sensor with 0-100% pulse duty per 360° travel.
- **HALL:** Hall sensor or single channel incremental encoder. Counts one edge.
- **ENCODER:** Same as HALL but counts both, rising and falling edges. Doubles resolution on sensors with 50% pulse duty.
- **D-HAL:** Same as HALL but sensor is connected to D-SENSOR port.
- **D-ENCODER:** Same as ENCODER but sensor is connected to D-SENSOR port.
- **D-QUAD:** Dual channel quadrature encoder. Counts both, rising and falling edges. Quadruples resolution on sensors with 50% pulse duty and 90° shift between channels.
- **REED:** Magnetic reed contact sensor. Counts closures, software debounced.
- **SEI:** Absolute encoder using SEI bus protocol.
- **ARXC.MAG:** microHAM's absolute digital compass sensor – ARXC.MAG.

p/360°: Sets number of pulses generated by the pulse sensor (magnetic reed contact, Hall sensor, any encoder) per 360° travel, 360 – 65535 pulses.

MOTOR: Sets type of motor used in the connected rotator.

- **AC:** 3 leads (1 phase) AC motor with an external start/run capacitor (capacitor is not used with ARCO). These motors are used in old Yaesu, Hy-Gain and Alliance rotators.
- **AC+CAP:** 3 leads (1 phase) AC motor with internal start/run capacitor build in the rotator. These motors had been used in Yaesu (450A, 650A), Create, and Daiwa rotators.
- **DC (reversible):** 2 lead reversible DC motor. By swapping leads motor turns in opposite direction. These motors are used in newer Yeasu rotators (450DC, 800, 1000, 2700, 2800), Prosisel, Spid, Orion, and TicRing rotators.
- **OTHER:** Selects other type of motor:
 - **DC+COM:** Special 3 leads DC motor (CW/CCW + COM) used by PropPitch rotators.
 - **INVERTER:** Motor outputs generate positive CW, CCW, RUN, ENABLE signals for external inverter. POWER settings sets control voltage output level. Use and set according to your inverter requirements. RAMP output generates industry standard 0-10V output for inverters requiring external ramp control.
 - **MODBUSx:** External digital inverter controlled by MODBUS RTU protocol. See Appendix-C for details.
 - **STEPPER:** Bipolar stepper motor, used in microHAM rotator.

POWER: Sets motor nominal voltage. If motor is AC or AC+CAP, setting is limited to 24V.

BRAKE: Enables brake solenoid control. Brake is used on Hy-Gain rotators.

EXT: enables 16VAC external brake control. It must be checked for external brake booster, and MUST NOT be checked if brake is driven directly from the ARCO.

HOLD DELAY: Sets delay used to delay further rotation after rotator stops, letting rotating structure time to damp. This delay is also used for synchronization timing and BRAKE control, which is held under power after rotator fully stops, and brakes when oscillations damp.

ROTATION RANGE: Sets total rotation (rotation range from CCW to CW limit) of the rotator specified by the manufacturer. Parameter is used to set software end limits for rotation and is used as an initial measure for absolute sensors.

Please note, rotators with absolute sensor typically turn 360°, Yaesu rotators 450°, TicRing and Prosisstel over 450°. Always set according to the rotator manufacturer specifications and feedline connection clearance to not risk sensor or feedline damage.

LIMIT SWITCHES: Defines if rotator has hardware limit switches. If yes and hardware limit switches uses separate leads from rotator (as on Hy-Gain rotators), connect them to rotator port LSW CW (9) and LSW CCW (8) pins. Other poles of limit switches are expected to be connected to the motor. Operation range of limit switch (LSW) input is 20-60V AC/DC. Rotators with DC motors typically have limit switches connected in series with motor leads and do not need separate connection.

INERTIA COMPENSATION: Sets angle remaining to the target when motor stops. When motor stops, some rotators still move, even the motor is already without a power. It is caused by inertial forces of rotating structure and gearbox which is non self-locking (planetary or single worm). If you notice that the target is constantly overshoot, set it as is typical overshoot angle.

COASTING: Sets advance angle shift used for final coasting to the target at MIN speed. Decrease value if coasting to the target takes too long. Increase if target is overshoot or if rotator stops prior reaching target. Optimal value depends on MAX speed and RAMPS timing.

MOTOR SPEED: MIN, AUTO and MAX parameter defines minimal and maximal power level for RAMPS - gradually increasing or decreasing speed.

- **AUTO** automatically finds guaranteed minimal speed for the motor when it just starts turning during RAMP UP cycle and changes MIN SPEED value automatically. Procedure repeats on every RAMP UP and dynamically adjusts MIN SPEED to consider variable motor load during winds or icing. It is most safe choice, guarantees maximal smoothes of rotation under any conditions. AUTO is not available for AC motors.
- **MIN** manually specifies minimal voltage/frequency to control speed of the rotator. Must be set high enough for guaranteed motor movement. 50% is a good value to start with. MIN value is fixed to 65% for AC motors.
- **MAX** sets maximal voltage/frequency applied to the motor to control maximal rotator speed. It is possible to set it up to 150% of nominal POWER for a power drop compensation in the long run motor cables. Observe rotation speed and set MAX according the manufacturer specification to not overload motor rating. Rotator speed is updated when it turns at MAX speed for more than 5% of ROTATION RANGE travel.

RAMP OUTPUT: Available only if motor is set to INVERTER. Allows to define custom MIN and MAX voltage on 0-10V output, supporting non standard inverters like Minarik 90/180VDC.

RAMPS: Defines time to build a ramped output.

- **UP** defines time for motor start from MIN SPEED to MAX SPEED.
- **DOWN** defines time for motor stop from MAX SPEED to MIN SPEED. Ramp down can

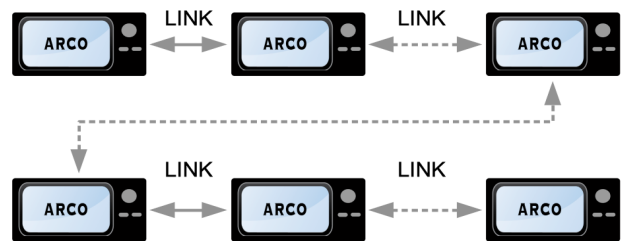
be automatically terminated if required heading is reached, but actual speed must be in lower half between MIN and MAX and must be lower than CALIB SPEED.

Rotator - Link

Rotator - Link tab serves to setup ARCO for multi-controller environment by specifying various ID numbers setting up identification, assignment to the towers and synchronization groups. If you have only one ARCO controller or not going to link them, you can skip this chapter.

LINK is a unique ARCO feature using two wire CAN bus allowing ARCO to digitally communicate to another ARCOs present on a bus and exchange data. Thanks to Link feature ARCO can control rotator connected to the other ARCO, control synchronization and direction tracking on several ARCOs in parallel or using two ARCOs make a combo rotator controller for rotators installed on rotary towers or AZ/EL rotators.

LINK bus connector is located at the rear panel LINK jack, 3.5mm stereo receptacle. Maximal distance for the bus wiring is 1km but for a such distance is necessary to use shielded, twisted pair cable. For connections under 10m, standard, shielded stereo audio cable works just fine. If there is necessary to connect more than two controllers to the bus, connect them in parallel using stereo Y adapters.



LINK ENABLE: Enables local remote control of the ARCO controller from another ARCO controller present on the LINK bus. Each ARCO MUST HAVE unique ROTATOR ID number.

ROTATOR ID: Specifies unique rotator identification number for addressing on the LINK bus network.

SYNC GROUP: Assigns membership to the synchronization group for ARCO controllers required synchronized positioning, in general to stacks or antennas for multidirectional beaming within same band.

Rule is: Only rotators in the same SYNC GROUP can be synchronized together. Position change can be initiated by any, same SYNC GROUP member.

TOWER ID: Specifies rotators installed on the same tower (usually rings) where simultaneous turning is not permitted in order to avoid tower structural overload. All these rotators should have the same TOWER ID number.

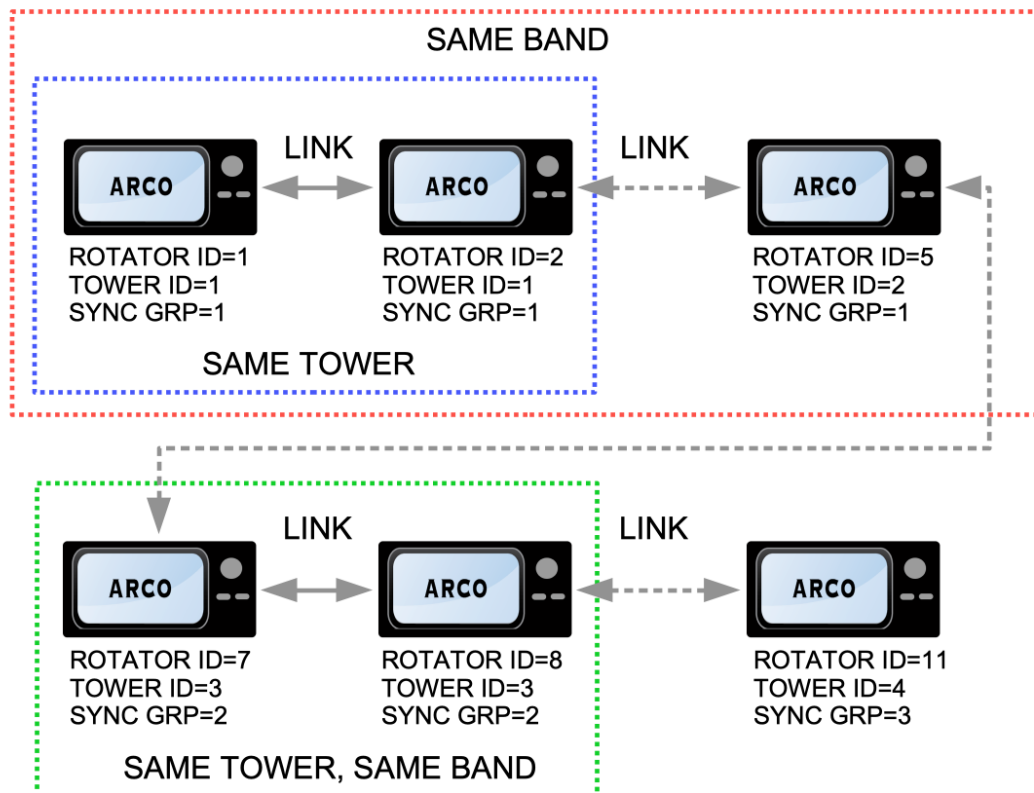
Rule is: Rotators with the same TOWER ID never turn simultaneously, always waiting first to finish its rotation including the HOLD DELAY. Then follows in ascending order by the ROTATOR ID.

SYNC ENABLE: Enables heading synchronization for other ARCO controllers present on the LINK bus for either parallel heading tracking for antenna stacks or counter-rotation. Each controller is recognized by its ID number and can be individually and dynamically enabled or aligned by SYNC switch and ALIGN button on the main screen.

SENSITIVITY: Specifies “dead zone” where new heading azimuth is ignored.

ALIGN SAME ... : Switch which sets behavior of the main screen ALIGN button.

- **GROUP:** Aligns antennas which belongs to the same SYNC GROUP regardless of the tower assignment. Such setting is suitable for aligning stacks or antennas on different towers.
- **GROUP & TOWER:** Aligns antennas which belongs to the same SYNC GROUP **and** have the same TOWER ID. Such setting is suitable for aligning antenna stack while keeping other antennas on different towers in their directions for multidirectional beaming.



COUNTER TO ROTATOR ID: Enables counter rotation to the specified ARCO controller present on the LINK bus. This is a special setting for the ARCO controlled rotator which is installed over another rotator or on a rotating tower also controlled by own ARCO controller. COUNTER TO ID number specifies ROTATOR ID number of that controller. This function works always in pairs and requires SYNC ENABLE option to be enabled in menu and turned ON on the main screen.

REMEMBER SUPERIOR POSITION: For counter rotation ARCO always checks for presence and position of the superior rotator to show correct position of the subordinated rotator. If superior rotator is not available (controller for rotating tower is turned off), ARCO normally not allow to change position of the antenna on subordinated rotator. If this function is enabled, ARCO can use “last known” superior position from the memory when it was on. Use carefully! If you move superior rotator while subordinate is off, than turn superior off and subordinate on, memorized position of the superior rotator in the subordinate controller memory is no longer valid. Turning superior controller on will automatically fix data mismatch.

Heading - Calibration

SENSOR POSITION: Indicates position of absolute sensor in percents [%] of its value. If rotator sensor is relative, it shows rotation center position in degrees [°]. Touching it toggles between raw value as seen by the microcontroller or user.

FIND CENTER: Automatically sets rotator to its center, assuming the sensor center is also a rotation center by shortest possible path. Procedure uses slower motor speed defined by CALIB SPEED without ramps and takes time, be patient. Movement can be anytime stopped by pressing Point and shot knob or by touching CW+CCW buttons. Please note, FIND CENTER buttons is available only for rotators with absolute position sensor (POT, RHEO, PWM, SEI).

SET CENTER: Sets azimuth of desired antenna rotation center and consequently computes position of CW and CCW SW Limits according to the ROTATION RANGE parameter, symmetrically in both directions. Please note, SET CENTER button is available only for rotators with relative position sensor (REED, (D-)HALL, (D-)ENCODER, D-QUAD).

AUTO: Automatically sets rotator to its center, assuming the sensor center is also rotator rotation center and automatically finds and register position of both CW and CCW limits relative to the sensor position. Please note, AUTO button is available only for rotators with hardware limit switches and is mutually exclusive to SET CENTER for rotators with relative sensor.

RESET: Resets calibration data.

ANTENNA AZIMUTH: Sets calibration point.

- **NORTH:** Sets the 0° (North) calibration point. Antenna must be accurately beaming to the north at a time of registering calibration point.
- **SOUTH:** Sets the 180° (South) calibration point. Antenna must be accurately beaming to the south at a time of registering calibration point.
- **CUSTOM:** Allows to enter and register custom azimuth as a calibration point. It is possible to work out azimuth by entering GPS coordinates of a visible distant reference point. Antenna must be accurately beaming to the custom heading or to the distant reference point at a time of registering calibration point.
- **SOLAR / LUNAR AZIMUTH:** Sets calibration point with help of sun shadow.
 - **FORWARD:** Sets the forward beaming calibration point. Antenna boom shadow must be precisely aligned (in parallel) to the mast shadow with director beaming to sun/moon at a time of registering calibration point.
 - **REVERSE:** Sets reverse (backward) beaming calibration point. Antenna boom shadow must be precisely aligned (in parallel) to the mast shadow with reflector beaming to sun/moon at a time of registering calibration point.

CALIB SPEED: Sets fixed speed for motor based on POWER setting for automatic and manual positioning using CW/CCW buttons. Please note, on Heading tab are ramps intentionally disabled to allow precise set and detect position without any damping. Heading tab is only place on ARCO where ramps are disabled even if they are enabled on Rotator tab. To avoid stress on the rotator and tower, use only necessary power to turn the rotator, default setting is set to 50%.

SW LIMITS: Sets CW and CCW software rotation limits.

CALIBRATION STATUS: Shows status of the rotator calibration. Once rotator is calibrated, MAIN AZIMUTH shows calibrated heading direction.

Heading - Antennas

ANTENNA #1/2/3: Allows to define three individual antennas installed on same rotator. Antenna #1 is considered MAIN antenna having same heading as rotator.

ANTENNA #2 or ANTENNA #3 can be enabled to show real azimuth of intentionally offset antenna installation, usually installed perpendicularly to main antenna to minimize performance and patten influences, or as a temporary selection for antenna slipped in mast bolt during wind. If ARCO uses external ARXC.MAG sensor, antenna slippage angle is detected automatically.

ANTENNA #2 or ANTENNA #3 can be optionally set to show direction of antenna controlled by ARXC Relay module (ARXC.REL), if module has enabled AZIMUTH CONTROL. ARCO than simultaneously works also as touch screen controller for vertical arrays as 4 squares, 8 circles or beverages displaying antenna direction on great circle map. See ARXC [manual](#) for details.

- **NAME:** Sets the name of an antenna.
- **OFFSET:** Sets mounting offset of an additional antenna to the main antenna. Please note, ANT #1 is main antenna setting up base direction.
- **ENABLE:** Enables support for an additional antenna installed with the direction offset on the same rotator. Additional antenna can be selected by touching Antenna button on the main screen.
- **BIDIR:** Enables bidirectional support for dipoles or beams with bidirectional feature like SteppIR or UltraBeam. Great circle shows shortened bidirectional needle and rotator turns by shortest way to the target.
- **LINK:** Enables antenna to be controlled over the local LINK network or by the Internet remote control using Client – Server connection.
- **3dB BEAM:** Sets horizontal angle of the antenna. When box is checked, main screen directional needle is replaced by circular slice of defined angle.

Special functionality of 3dB BEAM function is that antenna will NOT turn to new direction if target is within 3dB beamwidth. This functionality can be individually applied to:

TOWER – subordinated ARCO controller controlling rotator on rotary tower

SYNC – ARCO controller enabled for synchronized operation

CONTROL PROTOCOL – computer controlled direction

Please note, new target entered manually on ARCO is intentionally always accepted.

LAN

LAN ENABLED: Connects ARCO to the local Ethernet LAN network.

Please note. To avoid network conflicts while parameters are edited LAN connection is automatically disabled if any LAN parameter is changed. Connection needs to be manually re-enabled before you leave this menu. ARCO will pop-up warning if LAN tab is left with interface disabled.

USE DHCP: Enables automatic IP configuration from an external DHCP server (usually router). Do not use DHCP if you plan to control ARCO over the Internet without IP address reservation in your home Internet router.

IP ADDR: Manually assigns ARCO IP address.

MASK: Manually assigns network mask.

GW: Manually assigns Gateway IP address.

DNS: Manually assigns DNS server IP address.

USE NETWORK TIME (NTP): Enables time synchronization with the Internet time server.

NTP SERVER: Defines time server address.

CONTROL PROTOCOL: Enables and defines type of the control protocol and TCP port number used for ARCO control over the LAN. Controller supports max. four (4) parallel LAN connections, active connection is indicated by number 1-4. ARCO can be controlled by Yaesu GS-232A, DCU-1/Rotor EZ, SPID HR 0.1° control protocols and native protocol*.

For Internet remote control from the computer we recommend to use DXLab by AA6YQ or PstRotatorAz program by YO3DMU. They can connect ARCO box directly providing necessary interface between logger on your computer and remotely located rotator controlled by ARCO. No computer is required on rotator side.

VNC: Enables internal VNC server for screen sharing on connected computer over local network or the Internet. VNC server is compatible with wide variety of VNC viewers, we recommend free RealVNC Viewer available for all major operating systems. It is available for download at link below:

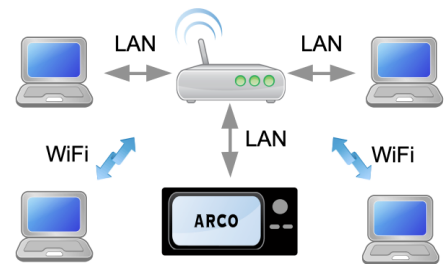
<https://www.realvnc.com/en/connect/download/viewer/>

Recommended option is to set Picture quality to Medium, Scaling to Automatic, and uncheck preserve aspect ratio. This will provide the best appearance and optimal scaling to available area on your computer desktop.

VNC server allows only one viewer connection at a time. Data transfer is unencrypted but establishing connection is password protected.

PORT: Sets port number of the VNC server. Port number must be unique, default is 5900.

PASSWORD: Sets password for VNC viewer - server connection. Default is ARCO.



Internet Remote Control

Along with direct TCP control described above using one of supported rotator control protocols (over the local LAN or over the Internet), ARCO allows also special CLIENT-SERVER connection between two controllers. This feature is designed solely for smart control over the Internet, when one ARCO plays a SERVER role, (remotely located controller connected to the rotator) and second plays a CLIENT role (at operator place), connecting ARCO which is set as a SERVER.

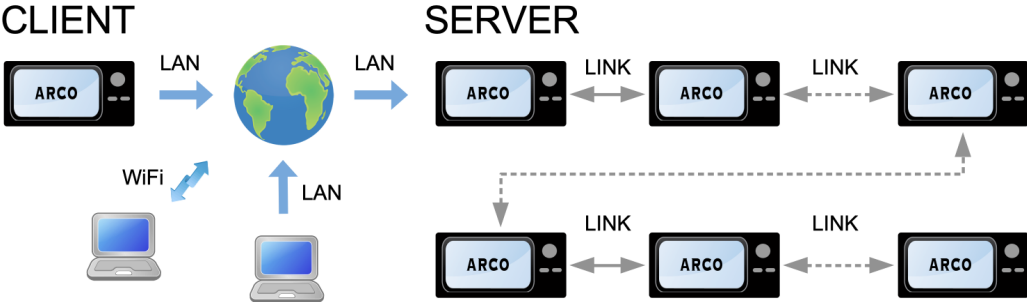


Typical example is a home setup with the ARCO on the desk controlling home rotator.

This ARCO is also set as a CLIENT for the another ARCO located at a remote QTH controlling its own rotator.

This remotely located ARCO is set as a SERVER. Than ARCO at home can control both home and remote rotator in a same way, switching between them is done by main screen ANTENNA button. If ARCO on remote QTH is also LINKed to more ARCO controllers controlling more rotators on remote QTH, ARCO at home will have access to all linked and enabled rotators on remote location. Without any computer on either side, right from the ARCO box.

Computers located at remote QTH can connect to local ARCOs by LAN, USB or RS232 at the same time as ARCOs or computers located anywhere in the world thru the Internet.



ROLE: Defines role of the ARCO controller for ARCO to ARCO Internet remote connection. NONE, CLIENT, SERVER

CONNECT TO / PASSWORD: Defines IP address or domain name and sets password for client server connection. Password set on client must match password set on server.

PORT: Sets TCP port number of the ARCO server for the CLINT-SERVER (ARCO-ARCO) connection. Port number must be different to CONTROL PROTOCOL port above.

Please note, an antenna you want to share its rotation on server must have LINK box checked on Heading | Antennas tab.

Status of Client – Server operation

- **IDLE:** After setup/reset, before attempt to select antenna. Attempt initiates connect.
- **DNS LOOKUP:** If connection is initiated, LAN is set to DNS, and there's no IP address yet.
- **DNS FAILED:** Remote antennas won't be offered in the selection.
- **CONNECTING:** If there's IP address, connect is initiated but there is no connection yet.
- **COULD NOT CONNECT:** Remote antennas won't be offered in the selection.
- **CONNECTED:** If there's a connection and remote antenna was selected from the offer.
- **TIMEOUT:** If the remote antenna is selected but the remote ARCO stopped responding. Local antenna is automatically selected as consequence.
- **ERROR:** TCP/IP error while remote antenna selected.
- **REMOTE DISCONNECT:** If remote antenna was deselected by user (i.e. user selected local antenna).

For operation over Internet you need Internet connection with static IP address or running dynamic DNS service on server side. ARCO must have static IP address outside of DHCP range of your router or reserved IP address, and you must have enabled forwarding feature for ports used by ARCO to its local IP address in your home Internet router. If it is something you cannot manage yourself, please ask your Internet service provider and/or router vendor for help.

System

Please note, ARXC configuration is described in separate ARXC [manual](#).

ARCO hardware is build on two 32-bit micro-controllers. One is dedicated to the motor control, second for user interface and communication. First line shows installed firmware version for both micro-controllers. Firmware update updates both micro-controllers at once.

FIRMWARE UPDATE: Primary method of updating firmware in the ARCO is to do this directly from the box. Update requires ARCO connected to the local LAN network connected to the Internet.

By touching LOAD button ARCO connects to microHAM's private server where checks for available files. Provided are at least two firmware versions, last stable version marked CURRENT and PREVIOUS stable version if for some reason you want to step one stable version back. There can be more versions shown like beta version if you want to have inside view of future update or specific test version to check some new feature requirements. Any other version than CURRENT and PREVIOUS have no functionality guaranteed.

After touching on particular firmware version text or LOAD button, next process is automatic. ARCO first downloads update to its internal flash memory and if download passes without any integrity check errors, update procedure starts automatically. During update display is blank, various leds blink or lit, just wait until update finishes and ARCO boots to its main screen, it takes a while, up to one minute.

Do not turn ARCO power off or disconnect LAN cable during the update. No damage will occur but you'll have to repeat update procedure again or perform update from the USB flash drive.

After update ARCO automatically applies your last config. If for any reason last configuration is not retained, use your backup or AUTOSAVED config backup by touching CONFIG LOAD.

CONFIG SAVE: Saves current configuration to the internal memory.

CONFIG SAVE / SEND CONFIG: Sends current configuration to another ARCO.
See Transferring setup and calibration chapter.

CONFIG LOAD: Loads saved configuration to the ARCO.

CONFIG LOAD / RESET: Resets configuration to the factory defaults and clears NV memory.

CONFIG LOAD / RECEIVE CONFIG: Receives configuration from another ARCO.
Transferring setup and calibration chapter.

RS232 CONTROL PROTOCOL: Specifies control protocol used for control over RS232 port.

BAUD RATE: Specifies communication speed for RS232 port. Control application on computer has to use this speed, 8bit data length, no parity, one or two stop bits, 8/N/1 or 8/N/2 settings.

USB CONTROL PROTOCOL: Specifies control protocol used for control over USB port. Baud rate setting for USB port is not important, control software on computer can use any speed, important is to keep 8bit data length and no parity, 8/N/1 or 8/N/2 settings.

Same as over LAN, also over USB and RS232, ARCO supports Yaesu GS-232A, DCU-1/Rotor EZ, SPID HR 0.1° control protocols and native ARCO protocol.

MINIMUM DISPLAY BACKLIGHT: Sets display backlight intensity used for screen saver, enabling optimal visibility under hamshack specific lighting condition.

TOUCH RESPONSIVITY: Sets different responsiveness for different operating experience.

TOUCH MIN DURATION: Sets minimal time of touch presence to be considered valid in order to suppress false touches caused by nearby electrical noise or RFI.

SUPPLY: During rotation shows power [W] delivered by the internal motor supply to the rotator.

MOTOR: During rotation shows calculated current [A] taken by the rotator's motor.

TEMPERATURE: Shows motor driver heatsink temperature [°C]. Internal fan automatically starts cooling if temperature exceeds 57 °C until drops down below 47 °C.

USE SPREAD SPECTRUM: Sets motor driver clock generation to use spread spectrum techniques instead of fixed frequency.

Transferring setup and calibration from one ARCO to other ARCO

Setup and calibration can be transferred between two ARCOs through their LINK (CAN) connection. Both ARCOs have to be connected according to "Rotator - Link" chapter in ARCO manual. In Menu-Rotator-Link, make sure, that both have LINK ENABLE ticked and that they are set to different ROTATOR ID.

On the ARCO, which is the recipient of setup/calibration ("RECEIVER"), in Menu-System-System, click on CONFIG LOAD, and in the CONFIG LOAD window, click on **RECEIVE CONFIG**. A new window opens, which displays "WAITING..."

On the ARCO, which is the source of setup/calibration ("SENDER"), in Menu-System-System, click on CONFIG SAVE, and in the CONFIG SAVE window, click on **SEND CONFIG**. A new window opens (with description of the procedure to be done for RECEIVER); click YES to continue.

The window in SENDER then displays "SENDING", and in RECEIVER it displays "RECEIVING". Transferring data is relatively fast, and on both ARCOs the window displays DONE within approximately one second. At that moment, on SENDER, LINK is switched off to prevent bus collision, as RECEIVER now has the same ROTATOR ID for LINK. Also note, that if SENDER's LAN setting does not use DHCP, i.e. it uses a fixed IP ADDR, this is copied also to RECEIVER, and may cause conflicts on LAN, so if both ARCOs are continued to be used simultaneously on the same LAN, it is necessary to change this setting on one of them.

On RECEIVER, the received configuration is stored into the 8th position with "RECEIVED" as name (it's the same position, where "AUTOSAVED" configuration is stored, when firmware is updated via LAN).

After successful configuration transfer, we strongly recommend to check antenna heading if you are using rotator with potentiometer or rheostat sensor. Due to small piece-to-piece variations in analog section and reference output, heading may need to recalibrate.

USB Firmware Update

If ARCO firmware cannot be updated over the internet under SYSTEM menu, alternative method is to use USB FLASH (“thumb”) drive:

1. Copy the update file **arco.upd** available at our webpage Downloads section to the root directory of a USB FLASH drive. Don't place the update file to any subdirectory. Don't rename the file.
2. Turn off main power switch, push and hold the LEFT ← button, then turn main power switch on. The red FAULT led starts to flash. The display will remain blank.
3. Insert the USB FLASH drive to the **FW** connector on the rear panel. POWER and MOTOR leds will briefly flash and the MOTOR led than blink while the update file is getting recognized and loaded into ARCO. This process should not take more than a minute. The new firmware will be started automatically.
4. Remove the USB FLASH drive from ARCO and continue operating.

If the update process fails the POWER, FAULT and MOTOR leds will indicate the possible cause of failure:

- MOTOR and POWER leds flash – **arco.upd** file not found in the root directory of USB FLASH drive.
- POWER led lit, FAULT led flashes – connected device is not recognized as standard Mass Storage Class USB FLASH drive. This might be a nonstandard device, a complex device, e.g. embedding an USB HUB (such as the older U3 “smart drives”, or the FLASH/fingerprint combinations, etc.), or simply a different device such as a keyboard, connected by mistake.
- MOTOR led lit, POWER led flashes – USB FLASH disk's format is unknown. This may happen, when the FLASH disk is partitioned or formatted in an unusual way. Use simple and low capacity USB FLASH disks, which usually come with traditional simple partition table and FAT file system.

Please note, that current supplied through the USB-A connector is limited to approximately 100mA, and does not allow using traditional rotary USB disks.

USB Serial Port

USB port of ARCO automatically installs serial port on host computer for connection to your favorite logging or rotator tracking program. Installation process on Windows 10, macOS and Linux is automatic, serial port uses USB CDC class compatible driver built-in to the operating system.

Windows 10, 11, macOS: No action required, port installs automatically. On Windows the port is labeled “COM(x)”, on macOS “usbmodem(xxxxx)” where x stands for the port number.

If is desired to use different COM port number for ARCO than was automatically assigned by Windows, it can be changed it in the Device Manager by double-click on ARCO COM port under Ports folder, Port Settings, Advanced button.

Windows XP, Windows 7, Windows 8: Windows versions prior Windows 10 did not support USB CDC serial ports automatically. After connecting ARCO, “New Hardware Detected” dialogue pops up, asking for a driver (in our case definition file). This definition file **ARCO.inf** can be downloaded from our website Downloads section (right click “Save Link as ...”) or directly:

<http://www.microham.com/Downloads/ARCO.inf>

When ARCO is plugged in for the first time and the “New Hardware” window appears, select Manual installation, than Browse ... than Next and than click on Have Disk button and direct the operating system to the path with the downloaded ARCO.inf file. If Windows pop-ups security warning window choose Install Anyway option.

Alternatively, if New Hardware window won't pop-up, you can open Device Manager, find ARCO in Other Devices folder, right click on it and choose Install or Update Driver. Than follow above mentioned procedure.

Please note, Windows XP must have Service Pack 3 installed, older Service Packs have a bug in the USB CDC driver. Versions older than Windows XP SP3 are not supported.

Linux: No driver installation is required on Linux operating system; the new port assigned to the ARCO is labeled “ttyACMxx” where x stands for the port number. However, to make the port accessible for applications and operate correctly, an initial setup step is required. By default, most Linux distributions run a core application called “ModemManager.” The problem is that Modem Manager sees the creation of any /dev/ttyACM* device as modem and claims exclusive access to it by opening it right away. If you want to avoid sending useless modem data to your controller (as you certainly do), you can do that for specific “modem” (your ARCO) through udev. The procedure is described here:

<http://linux-tips.org/t/prevent-modem-manager-to-capture-usb-serial-devices/284/2>

ARCO identification numbers are: VID=0483 PID=a2f7

Alternatively, if you don't need Modem Manager (usually you don't), you can uninstall Modem Manager in terminal. Then, to make new ports accessible to your applications you have to set permissions:

```
sudo apt-get remove modemmanager  
sudo chmod a+rw /dev/ttyACM*
```

6 - HARDWARE SPECIFICATIONS

POWER INPUT	
CONTROLLER SUPPLY POWER	13.8VDC, max. 1.5A, 5.5/2.1mm positive center socket
MOTOR SUPPLY POWER	48VDC, typ. 3A, max. 8A, KPJX-4P socket
FUSE	5x20 mm, T, 3.15 A for 13.8VDC INPUT, 6x32mm, T, 16A for 48VDC INPUT
ROTATOR	
MOTOR OUTPUT	4x isolated PWM output, max. 48 V, max. 7 A
SENSOR INPUT	0-9 V, max. 16 kHz
REFERENCE OUTPUT	9 V, max. 18 mA (shorted)
SENSOR ADC RESOLUTION	2x 12 bit, 64x oversampling, 10 bit DAC for offset control
D-SENSOR	4x RS-485, 1x 0-10 V analog output, 1x 12 VDC, 0.5 A auxiliary output
LINK	CAN bus
COMPUTER	
USB B	USB 2.0, full speed, CDC compliance
USB A	USB 2.0, full speed, mass storage, keyboard HID support
Ethernet	IEEE 802.3, 100BaseTX, auto MDI/MDIX
SERIAL	RS-232
GENERAL	
DIMENSIONS	W: 265 mm D: 150 mm H 82 mm
WEIGHT	1.8 kg net

7 - PACKAGE CONTENTS

The product includes ARCO controller 1pc, 10pin terminal 1pc.

If the shipment is incomplete, please contact your supplier or us at the following address:

E-mail: support@microham.com

phone: +421 910 716 140

by Post: **microHAM s.r.o.**
Maticna 28
92401 Galanta
SLOVAKIA

8 - WARRANTY

microHAM warrants this product for two (2) years. The product must not be modified in any way or the warranty is voided.

What is covered: During the warranty, *microHAM*, s.r.o., will repair or replace defective product at their sole discretion. You must send the unit postpaid with a copy of the original invoice to the distributor from whom you purchased the product. *microHAM* will pay return shipping.

What is not covered: This Limited Warranty does not cover (1) correction of installation or software errors in the user's computer(s), (2) damage caused by misuse, negligence, user modifications or failure to follow the user manual, (3) connection to improper or excessive voltage or voltage surges, (4) the incorrect installation of any cables connected to the device by the user or (5) weather related storm, lightning or electrostatic discharge damage.

microHAM assumes no liability or responsibility for damage to other devices or injuries to persons as a consequence of using our products.

If the terms of the above warranty are not acceptable, return the unit, all associated documents and accessories in the original package, prepaid, to *microHAM* or to your supplier for refund less shipping and a restocking fee.

DECLARATION OF CONFORMITY

European Union Declaration of Conformity



We, microHAM s.r.o., Matičná 28, 92401 Galanta, Slovakia, declare under our sole responsibility for the equipment name ARCO Junior, model ARCO Jr., serial number 0001 and higher that the equipment is in conformity with the following relevant Union harmonization legislation directives:

2014/35/EU relating to electrical equipment safety designed for use within certain voltage limits
2014/30/EU relating to electromagnetic compatibility

and that the equipment is in conformity with the following harmonised standards and/or other normative documents or technical specifications:

EMC 2014/30/EU:	RoHS 2015/863/EU:
EN 55032:2015+A11:2020	EN 63000:2018
EN 55035:2016	
EN 61000-4-2:2009	
EN 61000-4-3:2006+A2:2010	
EN 61000-4-4:2012	
EN 61000-4-5:2014+A1:2017	
EN 61000-4-6:2013	
EN 61000-4-8:2010	
EN 61000-4-11:2019	

On behalf of microHAM s.r.o.
Ing. Jozef Urban, CEO
28th February 2024

Federal Communications Commission Statement (USA)



This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna. Increase the separation between the equipment and receiver. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. Consult the dealer or an experienced radio/TV technician for help.

Information for Users on Collection and Disposal of Old Equipment and used Batteries.



These symbols on the products, packaging, and/or accompanying documents mean that used electrical and electronic products and batteries should not be mixed with general household waste. For proper treatment, recovery and recycling of old products and used batteries, please take them to applicable collection points, in accordance with your national and local legislation.

APPENDIX A – ARCO CONNECTORS

ROTATOR: green 10 pin terminal block / white 6 pin (2x3) receptacle

NAME	TYPE	10 PIN	6 PIN	DESCRIPTION
SENSOR LO	GND	1	3	ANALOG GND
SENSOR C	INPUT	2	2	ANALOG/DIGITAL SENSE INPUT, max. 9 V
SENSOR HI	INPUT/OUTPUT	3	1	REFERENCE 9 V + 500 Ω in series
MOTOR C	PWM OUTPUT	4	5	Isolated DRIVER OUTPUT, max. 48 V, max. 7 A
MOTOR D	PWM OUTPUT	5	6	Isolated DRIVER OUTPUT, max. 48 V, max. 7 A
MOTOR A	PWM OUTPUT	6	4	Isolated DRIVER OUTPUT, max. 48 V, max. 7 A
MOTOR B	PWM OUTPUT	7		Isolated DRIVER OUTPUT, max. 48 V, max. 7 A
LSW CCW	INPUT	8		CCW LIMIT SWITCH DETECTOR, isolated
LSW CW	INPUT	9		CW LIMIT SWITCH DETECTOR, isolated
NEG COM	NEGATIVE COMMON	10		PWM driver supply negative common

IMPORTANT! DO NOT connect NEG COM pin 10 to any circuit or ground unless it is explicitly required for a particular rotator connection.

D-SENSOR

NAME	TYPE	PIN	DESCRIPTION
XA	INPUT/OUTPUT	4	RS-485 A
XB	INPUT/OUTPUT	3	RS-485 B
YA	INPUT/OUTPUT	6	RS-485 A
YB	INPUT/OUTPUT	5	RS-485 B
ZA	INPUT/OUTPUT	2	RS-485 A
ZB	INPUT/OUTPUT	1	RS-485 B
+12V OUT	OUTPUT	10	POWER OUTPUT +12 V, max. 500 mA
LINE REF	OUTPUT	12	LINE BIAS REFERENCE +5 V, max. 4 mA
GND	GND	9, 11, 13, 14	GND
MOD +	INPUT/OUTPUT	8	RS-485 A
MOD -	INPUT/OUTPUT	7	RS-485 B
RAMP	OUTPUT	15	ANALOG 0-10 V, max. 10 mA

SERIAL

NAME	TYPE	PIN	DESCRIPTION
TXD	OUTPUT	2	RS-232 TX DATA
RXD	INPUT	3	RS-232 RX DATA
GND	GND	5	GND

LINK

NAME	TYPE	PIN	DESCRIPTION
LINK HI	INPUT/OUTPUT	RING	CAN HI DATA
LINK LO	INPUT/OUTPUT	TIP	CAN LO DATA
GND	GND	SHELL	GND

APPENDIX B – ROTATOR SETTINGS & CONNECTIONS

YAESU (G) and KENPRO (KR)

TYPE: **G-800**(any), **G-1000**(any), **G-2700**(any), **G-2800**(any), **G-5500DC** (AZ part), connected to WHITE rectangular ROTATOR (10) connector. If rotator cable has no pin. 1 connected, change sensor type to RHEO and **short pins 2 + 3 together** on green ARCO rotator terminal.

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 500 Ω
MOTOR	DC (reversible)
POWER	24 V
BRAKE	NO
ROTATION RANGE	450
LIMIT SWITCHES	YES

Rotator connection to green ROTATOR terminal:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
POT HI	1	SENSOR HI	3
WIPER	2	SENSOR C	2
POT LO	3	SENSOR LO	1
CW	4	MOTOR A	6
CCW	5	MOTOR C	4

TYPE: G-400

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 500 Ω
MOTOR	AC
POWER	24 V
BRAKE	NO
ROTATION RANGE	370
LIMIT SWITCHES	YES

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
POT HI	1	SENSOR HI	3
WIPER	2	SENSOR C	2
POT LO	3	SENSOR LO	1
CCW	4	MOTOR C	4
CW	5	MOTOR A	6
COM	6	MOTOR D	5

TYPE: G-400RC

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 500 Ω
MOTOR	AC
POWER	24 V
BRAKE	NO
ROTATION RANGE	370
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
WIPER	2	SENSOR HI	3
POT LO	3	SENSOR LO	1
CCW	4	MOTOR C	4
CW	5	MOTOR A	6
COM	6	MOTOR D	5

TYPE: **G-450A**, normally connected to WHITE rectangular ROTATOR (10) connector. If rotator cable has only 5 wires without connection to pin 1, **short pins 2 + 3 together** on green ARCO rotator terminal and change sensor type to RHEO.

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 500 Ω
MOTOR	AC+CAP
POWER	24 V
BRAKE	NO
ROTATION RANGE	450
LIMIT SWITCHES	NO

Rotator connection to green ROTATOR terminal:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
POT HI	1	SENSOR HI	3
WIPER	2	SENSOR C	2
POT LO	3	SENSOR LO	1
CCW	4	MOTOR A	6
CW	5	MOTOR C	4
COM	6	MOTOR D	5

TYPE: **G-450C** **IMPORTANT!** G-450C name is used by Yeasu for old version with AC motor as well as for new with DC motor. Check controller rear panel label for proper model identification. Plain G-450C name on label is AC motor version. G-450ADC or G-450CDC is DC motor version, use G-450DC settings. When rotator is connected to WHITE rectangular ROTATOR (10) connector, **short pins 2 + 3 together** on green ARCO rotator terminal. If rotator cable has all 6 wires connected, do not short these pins and change sensor type to POT for better linearity.

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 500 Ω
MOTOR	AC+CAP
POWER	24 V
BRAKE	NO
ROTATION RANGE	450
LIMIT SWITCHES	NO

Rotator connection to green ROTATOR terminal:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
WIPER	2	SENSOR HI	3
POT LO	3	SENSOR LO	1
CCW	4	MOTOR A	6
CW	5	MOTOR C	4
COM	6	MOTOR D	5

TYPE: **G-450DC (ADC, CDC**, check label on controller). When connected to WHITE rectangular ROTATOR (10) connector, **short pins 2 + 3 together** on green ARCO rotator terminal. If rotator cable has all 3 wires connected on top row of the white connector, do not short these pins and change sensor type to POT instead for better linearity.

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 500 Ω
MOTOR	DC (reversible)
POWER	24 V
BRAKE	NO
ROTATION RANGE	450
LIMIT SWITCHES	YES

Rotator connection to green ROTATOR terminal:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
WIPER	2	SENSOR HI	3
POT LO	3	SENSOR LO	1
CW	4	MOTOR A	6
CCW	5	MOTOR C	4

TYPE: G-450XL

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 500 Ω
MOTOR	AC+CAP
POWER	24 V
BRAKE	NO
ROTATION RANGE	450
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
WIPER	2	SENSOR HI	3
POT LO	3	SENSOR LO	1
CCW	4	MOTOR C	4
CW	5	MOTOR A	6
COM	6	MOTOR D	5

TYPE: G-600

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 500 Ω
MOTOR	AC
POWER	24 V
BRAKE	NO
ROTATION RANGE	360
LIMIT SWITCHES	YES

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
POT HI	1	SENSOR HI	3
WIPER	2	SENSOR C	2
LS CCW/POT LO	3	MOTOR D + SENSOR LO	5 + 1
CCW	4	MOTOR C	4
CW	5	MOTOR A	6
LS CW	6	MOTOR B	7

- pins 1 and 5 connected together in parallel

TYPE: G-600RC

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 500 Ω
MOTOR	AC
POWER	24 V
BRAKE	NO
ROTATION RANGE	360
LIMIT SWITCHES	YES

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
WIPER	2	SENSOR HI	3
POT LO	3	SENSOR LO	1
CCW	4	MOTOR C	4
CW	5	MOTOR A	6
LS CW	6	MOTOR B	7
LS CCW	7	MOTOR D	5

TYPE: **G-650A**, normally connected to WHITE rectangular ROTATOR (10) connector. If rotator cable has only 5 wires without connection to pin 1, **short pins 2 + 3 together** on green ARCO rotator terminal and change sensor type to RHEO.

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 500 Ω
MOTOR	AC+CAP
POWER	24 V
BRAKE	NO
ROTATION RANGE	450
LIMIT SWITCHES	YES

Rotator connection to green ROTATOR terminal:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
POT HI	1	SENSOR HI	3
WIPER	2	SENSOR C	2
POT LO	3	SENSOR LO	1
CCW	4	MOTOR A	6
CW	5	MOTOR C	4
COM	6	MOTOR D	5

TYPE: **G-650C**. When connected to WHITE rectangular ROTATOR (10) connector, **short pins 2 + 3 together** on green ARCO rotator terminal. If rotator cable has all 6 wires connected, do not short these pins and change sensor type to POT for better linearity.

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 500 Ω
MOTOR	AC+CAP
POWER	24 V
BRAKE	NO
ROTATION RANGE	450
LIMIT SWITCHES	YES

Rotator connection to green ROTATOR terminal:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
WIPER	2	SENSOR HI	3
POT LO	3	SENSOR LO	1
CCW	4	MOTOR A	6
CW	5	MOTOR C	4
COM	6	MOTOR D	5

TYPE: **G-2000RC**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 500 Ω
MOTOR	AC
POWER	24 V
BRAKE	YES
ROTATION RANGE	370
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
WIPER	1	SENSOR HI	3
POT LO	2	SENSOR LO	1
CCW	3	MOTOR C	4
CW	4	MOTOR A	6
LS CCW	5	MOTOR D	5
LS CW	6	MOTOR D	5
BRAKE	7	MOTOR B	7
BRAKE COM	8	MOTOR D	5

Due to rotator internal wiring, limit switches must be bypassed.

TYPE: G-5500 (AZ part)

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 500 Ω
MOTOR	AC+CAP
POWER	24 V
BRAKE	NO
ROTATION RANGE	450
LIMIT SWITCHES	YES

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
POT HI	1	SENSOR HI	3
WIPER	2	SENSOR C	2
POT LO	3	SENSOR LO	1
CCW	4	MOTOR C	4
CW	5	MOTOR A	6
COM	6	MOTOR D	5

PROSISTEL

TYPE: **D** series **PST-641, PST-2051, PST-61**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	M-TURN POT 10 kΩ
MOTOR	DC (reversible)
POWER	18 V
BRAKE	NO
ROTATION RANGE	500
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR C + D	4 + 5
CCW	2	MOTOR A + B	6 + 7
WIPER	3	SENSOR C	2
POT HI	4	SENSOR HI	3
POT LO	5	SENSOR LO	1

- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

TYPE: **D** series **PST-71, PST-110**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	M-TURN POT 10 kΩ
MOTOR	DC (reversible)
POWER	24 V (old 71D 48 V)
BRAKE	NO
ROTATION RANGE	500
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR C + D	4 + 5
CCW	2	MOTOR A + B	6 + 7
WIPER	3	SENSOR C	2
POT HI	4	SENSOR HI	3
POT LO	5	SENSOR LO	1

- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

TYPE: **PRO** series, **PST-71, PST-110, PST-110HP**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	D-HALL
P/360°	PST-71 = 23400 PST-110 = 30420
MOTOR	DC (reversible)
POWER	24 V (48 V 110HP)
BRAKE	NO
ROTATION RANGE	360
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR MOTOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR C + D	4 + 5
CCW	2	MOTOR A + B	6 + 7

ROTATOR SENSOR		ARCO D-SENSOR	
WIRE	PIN	NAME	PIN
+5VDC	3	+12V OUT	10
GND	4	GND	13
ENC A	5	XA	4
ENC B	6	YA	6
		XB, YB, LINE REF	3 + 5 + 12

Pins 3, 5 and 12 connected together in parallel

SPID

TYPE: **RAU, RAK, RAS, BIG-RAK, BIG-RAS (AZ part)**, Reed contact sensor

Rotator tab settings:

PARAMETER	VALUE
SENSOR	REED
P/360°	360, BIG 720
MOTOR	DC (reversible)
POWER	12 V
BRAKE	NO
ROTATION RANGE	720
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR A + B	6 + 7
CCW	2	MOTOR C + D	4 + 5
REED B	3	SENSOR LO	1
REED A	4	SENSOR C + HI	2 + 3

- pins 2 and 3 connected together in parallel
- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

TYPE: **RAK/HR, BIG-RAK/HR, RAS/HR, BIG RAS/HR (AZ part)**, Hall quadrature encoder

Rotator tab settings: AZ

PARAMETER	VALUE
SENSOR	D-QUAD
P/360°	2880
MOTOR	DC (reversible)
POWER	12 V
BRAKE	NO
ROTATION RANGE	360
LIMIT SWITCHES	NO

Rotator tab settings: EL part of RAS

PARAMETER	VALUE
SENSOR	D-QUAD
P/360°	2880
MOTOR	DC (reversible)
POWER	12 V
BRAKE	NO
ROTATION RANGE	205
LIMIT SWITCHES	YES

Rotator connection: Hall v.1, open collector output

ROTATOR MOTOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR A + B	6 + 7
CCW	2	MOTOR C + D	4 + 5

Rotator connection: Hall v.2, push-pull output

ROTATOR MOTOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR A + B	6 + 7
CCW	2	MOTOR C + D	4 + 5

- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

ROTATOR SENSOR		ARCO D-SENSOR	
WIRE	PIN	NAME	PIN
SENSOR -	4	GND	13
SENSOR +	5	+12V OUT	10
IMP1	6	XA	4
IMP2	3	YA	6
		XB, YB, LINE REF	3 + 5 + 12

ROTATOR SENSOR		ARCO D-SENSOR	
WIRE	PIN	NAME	PIN
SENSOR -	4	GND	13
SENSOR +	5	+12V OUT	10
IMP1	6	XB	3
IMP2	3	YB	5

Pins 3, 5 and 12 connected in parallel

HY-GAIN

Hy-Gain (CDE): **CD-44, HAM xx, T2xx**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 830 Ω
MOTOR	AC
POWER	24 V
BRAKE	YES / (NO for CD-44)
ROTATION RANGE	360
LIMIT SWITCHES	YES

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
COM/WIPER	1	MOTOR D + SENSOR LO	5 + 1
BRAKE	2	MOTOR B	7
POT HI	3	SENSOR HI	3*
CCW	4	MOTOR C	4
LS CW	5	LSW CW	9
LS CCW	6	LSW CCW	8
CW	8	MOTOR A	6

* Add supplied 330Ω resistor in series for improved accuracy in first CCW quarter segment. Our optional Hy-Gain adapter has 330Ω resistor built-in.
 - connect pins 1 and 5 together in parallel

Hy-Gain (CDE): **AR-40(X)**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	RHEO 1 kΩ
MOTOR	AC
POWER	24 V
BRAKE	NO
ROTATION RANGE	360
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
POT LO	1	SENSOR LO	1
WIPER	2	SENSOR HI	3
COM	3	MOTOR D	5
CCW	4	MOTOR C	4
CW	5	MOTOR A	6

Hy-Gain: **HDR-300A**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 1 kΩ
MOTOR	AC+CAP
POWER	24 V
BRAKE	YES
ROTATION RANGE	400
LIMIT SWITCHES	YES

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR A	6
CCW	2	MOTOR C	4
COM	3	MOTOR D	5
BRAKE	4	MOTOR B	7
POT HI	5 (8)	SENSOR HI	3
WIPER	6 (9)	SENSOR C	2
POT LO	7 (10)	SENSOR LO	1

OTHER

Create: **RC5x**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 1 kΩ or 5 kΩ
MOTOR	AC+CAP
POWER	24 V
BRAKE	NO
ROTATION RANGE	370
LIMIT SWITCHES	YES

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
COM	1	MOTOR D + LSW CCW	5 + 8
CW	2	MOTOR A	6
CCW	3	MOTOR C	4
POT HI	4	SENSOR HI	3
WIPER	5	SENSOR C	2
POT LO	6	SENSOR LO	1
LS	7	LSW CW	9

- pins 5 and 8 connected together in parallel.

Create reversed potentiometer connection along production cycle. If you get “NO MOVEMENT” error, swap POT ends going to pins 1 and 3.

TIC General: **1022, 1032, 1048**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 500 Ω
MOTOR	DC (reversible)
POWER	24 V
BRAKE	NO
ROTATION RANGE	400
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
CW	2	MOTOR A + B	6 + 7
CCW	3	MOTOR C + D	4 + 5
POT HI	4	SENSOR HI	3
WIPER	5	SENSOR C	2
POT LO	6	SENSOR LO	1

- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

M2 Antenna Systems: **OR2800G2**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	REED
P/360°	3960
MOTOR	DC (reversible)
POWER	48 V
BRAKE	NO
ROTATION RANGE	388
LIMIT SWITCHES	YES

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR A + B	6 + 7
CCW	2	MOTOR C + D	4 + 5
REED B	3	SENSOR LO	1
REED A	4	SENSOR C + HI	2 + 3

- pins 2 and 3 connected together in parallel
- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

Daiwa: **MR-300E, 750E/PE**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 500 Ω
MOTOR	AC+CAP
POWER	24 V
BRAKE	YES*
ROTATION RANGE	365
LIMIT SWITCHES	NO

* Internal auto-brake

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
POT HI	1	SENSOR HI	3
WIPER	2	SENSOR C	2
POT LO	3	SENSOR LO	1
CCW	5	MOTOR C	4
CW	6	MOTOR A	6
COM	7	MOTOR D	5

DX Engineering: **RT4500HD**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	REED
P/360°	4814
MOTOR	DC (reversible)
POWER	24 V
BRAKE	NO
ROTATION RANGE	365
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1 (White)	MOTOR C + D	4 + 5
CCW	2 (Black)	MOTOR A + B	6 + 7
REED A	3 (Red)	SENSOR C + HI	2 + 3
REED B	4 (Green)	SENSOR LO	1

- pins 2 and 3 connected together in parallel
- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

UltraBeam: **UB-One**

Rotator tab settings:

PARAMETER	VALUE
SENSOR	D-HALL
P/360°	8400
MOTOR	DC (reversible)
POWER	24 V
BRAKE	NO
ROTATION RANGE	540
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR MOTOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR C + D	4 + 5
CCW	2	MOTOR A + B	6 + 7

- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

ROTATOR SENSOR		ARCO D-SENSOR	
WIRE	PIN	NAME	PIN
GND	3	GND	13
POS	4	XA	4
REF	5	+12V OUT	10
		XB, LINE REF	3 + 12

- pins 3 and 12 connected together in parallel

K7NV: Prop Pitch S, M, L, XL

Rotator tab settings:

PARAMETER	VALUE
SENSOR	REED
P/360°	*
MOTOR	DC+COM
POWER	24 V
BRAKE	NO
ROTATION RANGE	360
LIMIT SWITCHES	NO

* S=9576, M=7063, L=7056
XL=7497/5920

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
REED B	1	SENSOR LO	1
REED A	2	SENSOR C + HI	2 + 3
CW	3	MOTOR A + B	6 + 7
CCW	4	MOTOR C + D	4 + 5
COM	5	NEG COM	10

- pins 2 and 3 connected together in parallel
- pins 4 and 5 connected together in parallel
- pins 6 and 7 connected together in parallel

RCA: VH226E or Hy-Gain: AR-500/X

Rotator tab settings:

PARAMETER	VALUE
SENSOR	ARXC.MAG
MOTOR	AC+CAP
POWER	24 V
BRAKE	NO
ROTATION RANGE	360
LIMIT SWITCHES	YES

- rotator control requires optional ARXC.MAG sensor

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
COM	1 (Silver)	MOTOR D	5
CCW	2 (Black)	MOTOR C	4
CW	3 (Green)	MOTOR A	6

ROTATOR SENSOR		ARCO D-SENSOR	
WIRE	PIN	NAME	PIN
ZA	1	ZA	2
ZB	2	ZB	1
GND	3	GND	9
+12V	4	+12V	10

Alliance: HD-73

Rotator tab settings:

PARAMETER	VALUE
SENSOR	POT 75 Ω
MOTOR	AC
POWER	24 V
BRAKE	NO
ROTATION RANGE	360
LIMIT SWITCHES	NO

Rotator connection:

ROTATOR		ARCO	
WIRE	PIN	NAME	PIN
CW	1	MOTOR A	6
WIPER	2	SENSOR C	2
COM	3	MOTOR D	5
POT LO	4	SENSOR LO	1
POT HI	5	SENSOR HI	3
CCW	6	MOTOR C	4

APPENDIX C – CUSTOM ROTATOR SETTINGS & CONNECTIONS

MOTOR and SENSOR CONNECTIONS

MOTOR: AC or AC+CAP

Wiring for all 3 leads (2 phase) AC motors. If rotator has no brake solenoid, keep MOTOR B pin unconnected

MOTOR LEAD	ROTATOR PORT NAME	PIN NUMBER
CW	MOTOR A	6
CCW	MOTOR C	4
COMMON	MOTOR D	5
BRAKE	MOTOR B	7

MOTOR: DC (reversible)

Wiring for most common, all 2 leads DC motors. Polarity assignment assumes the rotator is turning clockwise when positive power is applied to the positive motor lead.

For better power handling we recommend to connect MOTOR A pin in parallel to MOTOR B pin as well as MOTOR C pin in parallel to MOTOR D pin.

MOTOR LEAD	ROTATOR PORT NAME	PIN NUMBER
POSITIVE	MOTOR A + B	6 + 7
NEGATIVE	MOTOR C + D	4 + 5

MOTOR: DC+COM

Wiring for special DC motor with 3 leads, having separate CW and CCW leads, closing circuit against common (PropPitch alike).

MOTOR LEAD	ROTATOR PORT NAME	PIN NUMBER
CW	MOTOR A + B	6 + 7
CCW	MOTOR C + D	4 + 5
COMMON	NEG COM	10

MOTOR: MODBUS

Wiring for MODBUS RTU controlled inverter, connects D-SENSOR connector

INVERTER PORT	D-SENSOR PORT NAME	PIN NUMBER
MODBUS (RS485) +	MOD +	8
MODBUS (RS485) -	MOD -	7
COM	GND	9

ARCO Modbus support expects proper drive configuration to be done in the inverter accordingly to requirements of connected motor and final rotator. Please understand that MODBUS RTU is a description of protocol between host device (ARCO) and driver (inverter) but there is no common standard in content and mapping of communication registers and almost each brand implements them own way. Contact us if you have problem connecting your driver. Always follow manufacturer instructions for driver setup and set these communication parameters in the driver menu:

MODBUS1: Invertek Optidrive E3

- Required parameters:
 - P-12 = 3 Modbus enable
 - P-36:1 = 1 Address
 - P-36:2 = 9600 Speed
 - P-03 Ramp Up
 - P-04 Ramp Down

MODBUS2: Omron Q2V, Yaskawa J1000

- Required parameters:
 - b1-02 = 2 Run commanded by Modbus
 - b1-03 = 0 Stopping Method = Ramp->Stop
 - H5-01 = 01 Address
 - H5-02 = 4 Speed = 9600 Baud
 - H5-03 = 3 Parity = None
 - H5-05 = 0 (*) Modbus Fault Detection = Disabled
 - C1-01 Ramp Up [s], set same for Ramp Up on ARCO Rotator tab
 - C1-02 Ramp Down [s], set same for Ramp Down on ARCO Rotator tab
- turn driver OFF/ON after parameters change, set RE mote mode with LO/RE button

(*) This setting results in inverter ignoring Modbus communication errors, e.g. when cable is inadvertently disconnected. ARCO firmware does support also the following combination:

- H5-05 = 1 Modbus Fault Detection = Enabled
- H5-04 = 0 Modbus Error Stop = Ramp->Stop

With this combination, if Modbus is inadvertently disconnected during rotation, inverter detects this after timeout given by H5-09 (2.0s by default) and automatically performs ramp down. However, to avoid useless electromagnetic interference while the rotator is stationary, ARCO communicates through Modbus only when rotator is turning. As a consequence, with this setting, the inverter will enter "CALL" alarm after power up or reset, and "CE" error state after rotation ends. Regardless of this, before each rotation start, ARCO clears these states, so rotation proceeds normally.

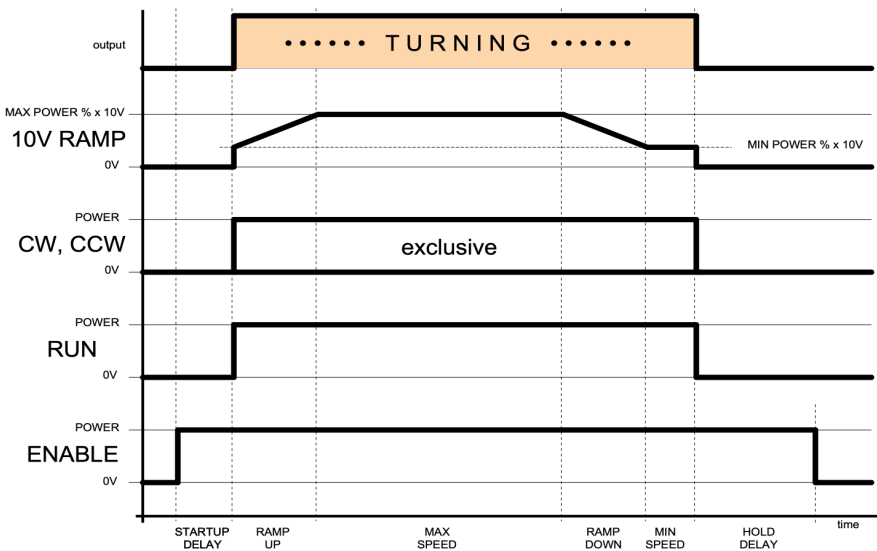
MOTOR: INVERTER

Wiring for standard inverter with direct movement control. Motor POWER selects output control level, typically 24VDC.

INVERTER INPUT	ROTATOR PORT NAME	PIN NUMBER
CW	MOTOR A	6
CCW	MOTOR C	4
ENABLE	MOTOR B	7
RUN	MOTOR D	5
COM	NEG COM	10

If inverter has no build in ramps, ARCO can provide industry standard 0-10V output at D-SENSOR connector. Voltage range is fully configurable, supporting also 0-5V inverters.

INVERTER INPUT	D-SENSOR PORT NAME	PIN NUMBER
RAMP	RAMP OUT	15
COM	GND	9



MOTOR: STEPPER

Wiring for rotators with bipolar Stepper motor. Output voltage and nominal speed is set internally to 48V and 150 rpm. Current shouldn't exceed 7A driver limit.

MOTOR	ROTATOR PORT NAME	PIN NUMBER
A +	MOTOR A	6
B +	MOTOR C	4
A -	MOTOR B	7
B -	MOTOR D	5

SENSOR: POT

Wiring for three wires pot with CENTER, LOW (left) and HIGH (right) leads. Resistance between LOW and CENTER leads should decrease towards CCW limit.

POTENTIOMETER	ROTATOR PORT NAME	PIN NUMBER
LOW side	SENSOR LO	1
CENTER	SENSOR C	2
HIGH side	SENSOR HI	3

SENSOR: RHEO

Wiring for two wire rheostat with LOW and HIGH leads. Resistance between LOW and HIGH leads should decrease towards CCW limit.

RHEOSTAT	ROTATOR PORT NAME	PIN NUMBER
LOW side	SENSOR LO	1
HIGH side	SENSOR HI	3

SENSOR: REED CONTACT

Wiring for simple magnetic reed contact, leads have no polarity and can be reversed without any adverse effect.

RHEOSTAT	ROTATOR PORT NAME	PIN NUMBER
A	SENSOR LO	1
B	SENSOR C + HI	2 + 3

SENSOR: HALL or PWM

Wiring for three wires (1 output) Hall sensor. If sensor has no internal source driver or has low side (open collector) output with no internal pull up resistor, connect any small 4.7Kohm – 10Kohm resistor between its output and positive power lead. You can connect it directly between terminal ports 2 - 3.

HALL SENSOR	ROTATOR PORT NAME	PIN NUMBER
GND	SENSOR LO	1
OUTPUT	SENSOR C	2
POWER +	SENSOR HI	3

SENSOR: DIGITAL ENCODER, D-HALL, D-ENCODER, D-QUAD

Wiring for differential quadrature encoder. Connects D-SENSOR port.

DIGITAL ENCODER	D-SENSOR PORT NAME	PIN NUMBER
X+ or A+ or A	XA (for D-HALL or D-ENCODER or D-QUAD)	4
X- or A- or A'	XB (for D-HALL or D-ENCODER or D-QUAD)	3
Y+ or B+ or B	YA (only for D-QUAD)	6
Y- or B- or B'	YB (only for D-QUAD)	5
POWER+ or VCC	+12 V OUT	10
GND or 0V	GND	9
	LINE REF	12

- If encoder has differential outputs, connect both wires of each channel to corresponding input on D-SENSOR port. Preserve polarity.
- If encoder has single ended push-pull outputs, connect them to XB, YB ports keeping XA, YA unconnected.
- If encoder has single ended open collector outputs, connect them to XA, YA ports, and separately connect XB, YB and LINE REF together (3+5+12 in parallel).

SENSOR: SEI BUS ENCODER

Wiring for absolute US Digital encoder with SEI bus. Connects D-SENSOR port.

ENCODER	D-SENSOR PORT NAME	PIN NUMBER
SEI -	YA	6
SEI +	YB	5
BUSY -	XA	4
BUSY +	XB	3
POWER +	+12 V OUT	10
GND	GND	9

SENSOR: ARXC MAGNETIC SENSOR

Wiring for our ARXC.MAG, absolute magnetic compass sensor. Connects D-SENSOR port.

ARXC.MAG	D-SENSOR PORT NAME	PIN NUMBER
ZA	ZA	2
ZB	ZB	1
+12V	+12 V OUT	10
GND	GND	9

APPENDIX D – FUSES REPLACEMENT



Following instructions are only for mechanically and electronically experienced persons with skill working on electronic devices.

ARCO Jr. includes two internal fuses, one on controller power supply input, second on motor supply input. Both these fuses are not intended to fail under regular failures. They are present for protection against catastrophic failures caused by lightning or hard overvoltage failures to avoid abnormal current flow from external power supplies which may cause fire.

Controller supply input is protected by 5x20 mm, T, 3.15 A 250 V fuse, located in green fuse holder on PCB next to fan. Motor supply input is protected by 6x32 mm, T, 16 A 250 V fuse, located in cable fuse holder connected to motor supply input connector.

For real time clock backup ARCO Jr. uses an internal CR2032 battery. Battery is not charged, and is connected only to the micro-controller dedicated battery pin. Battery capacity should last for very long time and normally doesn't need to be replaced. If there is a requirement for replacement for any reason, use only 3 V CR2032 battery. Battery is located above fan.

In order to replace fuses or battery follow these instructions:

- Disconnect power cords from the ARCO, turn front panel power switch OFF.
- Remove front panel encoder knob.
- Remove encoder shaft nut completely.
- Release four (4) screws located at the front panel corners. Pull front panel.
- Slide front panel to bottom and left, do not disconnect any cables.
- Pull top cover fully out to make motor fuse in cable holder and controller fuse in PCB holder accessible.
- If fuse needs replacement, pull top cover of the fuse holder upward, replace fuse in the cover and push it back to its socket on the PCB. Use only above specified fuse.
- If there is a need for battery replacement, observe battery polarity, according to the marking on the battery socket. Use only above specified battery.
- Return top cover back to place, make sure the gaskets are inserted in the panel slots.
- Install back front panel. Watch leds to be aligned to holes and 2x20 connector to front panel display assembly female part. All four screws can be tightened only when front panel perfectly sits on rest of enclosure with no gaps in the corners. Both side panels, bottom panel, and top panel must enter into front panel slots.
It requires patience, aligning panel by tightening screws will cause its damage or bend.
- Reinstall encoder shaft washer, nut and the knob.