microHAM ARXC.MAG ARCO Smart Antenna Rotator Controller User Manual

ARXC.MAG ARCO Smart Antenna Rotator Controller
User Manual
ARXC.REL/ARXC.MAG/ARXC.LoRa

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Contents

ARXC – GENERAL DESCRIPTION

ARXC modules are ARCO rotator controller accessories for expanded control and extra functionality. Modules are built-in IP65 enclosures designed to operate outside of the shack. ARCO supports up to four chained ARXC modules at the same time. ARX accessories connect the D-SENSOR port on ARCO, using only 4 wires of cheap CAT5 cable. When an extra control cable is not a possible option, ARCO can connect ARXC modules using pair of dedicated ARXC.LoRa modules for wireless connection up to a couple of kilometers distance.
ARXC.REL

ARXC.REL is four (4) external relays module allowing to control of remote antenna switches, polarization switches, mast preamplifiers, or anything that is suitable to be controlled from the ARCO user interface, touch screen, or VNC for Internet remote control. ARCO uses preset buttons for relay control and relays can be optionally set as directional antenna control for 8-circle or 4-square antennae showing direction on the great circle map.

ARXC.MAG

ARXC.MAG is a magnetic azimuth sensor. Mounted-on antenna boom reports true antenna azimuth and can serve as a main azimuth sensor when an original sensor in the rotator has malfunctioned and as a watchdog sensor to alert the user that the antenna is no longer beaming to the calibrated azimuth, that may happen if the antenna slips in bolt during high wind or storm.

ARXC.Lora

ARXC.Lora is a long-range communication transceiver module operating on the ISM band converting bidirectional RS-485 communication used by ARCO and ARXC modules to RF data and back.

ARXC – HARDWARE SETUP

Installation of ARXC consists of hardware and software parts. The mechanical part of the setup is to insert rubber sealing into the slot in the module case lid. Trim its length as necessary. Sealing might be installed by the factory, in this case, skip to next.

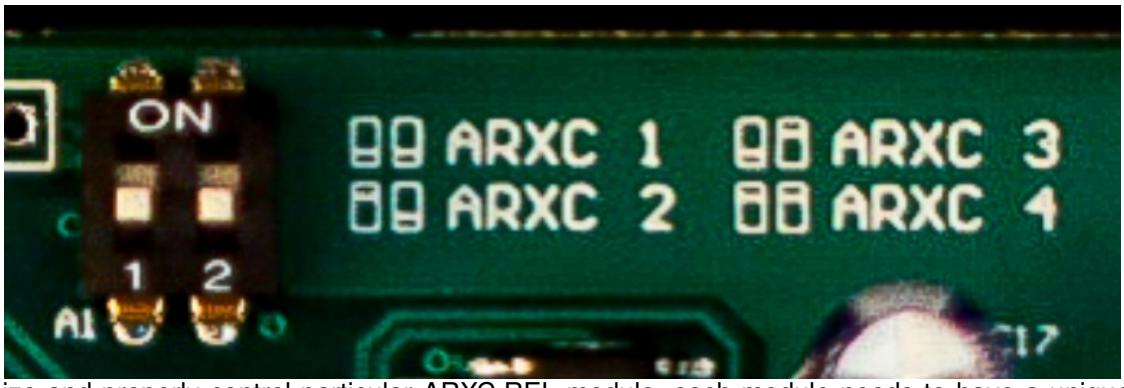
ARXC.REL can be mounted anywhere with cable grommets facing down to avoid water ingress. Although not necessary, it is advisable to mouth box in a place to protect against rain, snow, or direct sunlight.

ARXC.Lora is good to mount in a place where the antenna is not close to metal structures, best when the cable entry grommet is facing down and the module is protected against rain, snow, or direct sunlight.

ARXC.The MAG sensor has to be mounted on the bottom side of the antenna boom and fixed against slipping. For circular booms package includes alligator clamps and zip-tight. Keep clamp screws and nuts in case you are removing them, they are made of nickel-plated brass, steel screws would influence magnetic sensor functionality.

Before proceeding to software setup it is necessary to set the ARXC module address (only on ARXC.REL) and connect it to ARCO.

ARXC.REL addressing



To recognize and properly control particular ARXC.REL module, each module needs to have a unique address. The address is set by a combination of two DIP switches according to the drawing on the PC board next to the DIP switch. It is possible to set up 4 different addresses: 1, 2, 3, and 4. Each ARXC.REL module has then its own setup in the ARCO System menu on respective tabs ARXC 1 – ARXC 4. ARXC.MAG has its address set internally and ARXC. Lora has no address.

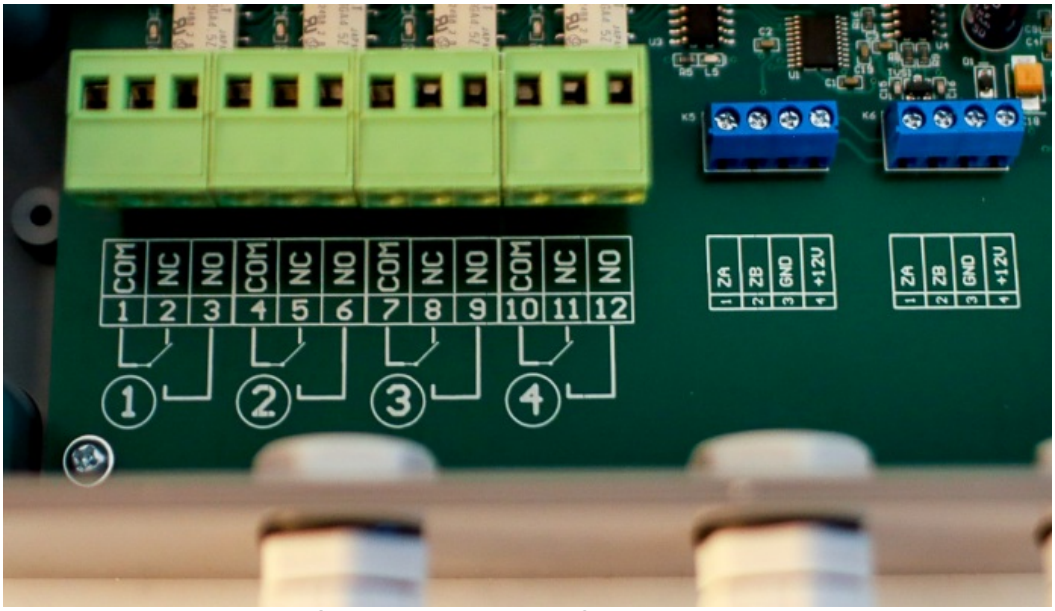
ARXC wiring

In order to control the ARXC module, it must be connected to ARCO first. On ARCO, the connection port is located at the D-SENSOR connector. The communication layer is RS-485 requiring twisted pair of wires connected to port Z (ZA and ZB pins) and two additional wires for module power. 12VDC power is provided by ARCO at the D-SENSOR port on +12V and GND pins.

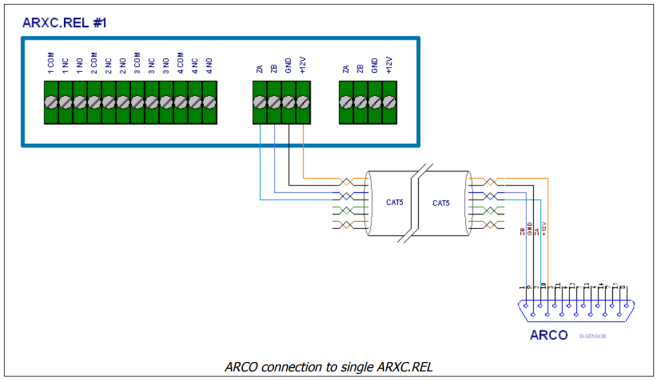
If the control cable between ARCO and ARXC module; or between different ARXC modules for any reason cannot be installed, communication can be established by RF link using ARXC.Lora module. In this case, an external 12V supply must be provided on the ARXC side of the RF link.

Each ARXC module has a 4-pole terminal for connecting wires of the communication cable. ZA and ZB poles serve for communication wires, and +12V and GND poles serve for power. On ARXC.REL there are two sets of terminals for simpler daisy-chain connection to additional modules. Both terminals are connected in parallel, it is not important which one is used if you are connecting a single module.

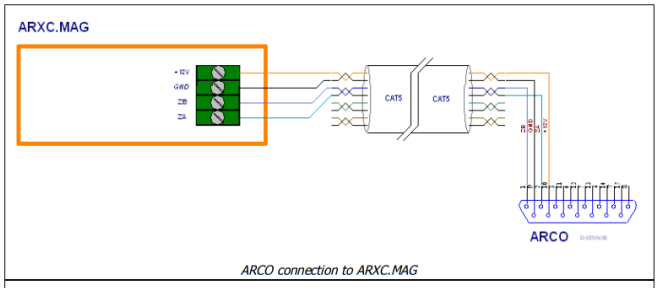
We recommend using cheap CAT5 or CAT6 cable. In case of a longer connection (hundreds of meters), terminate both ends of the communication line with a 150-ohm resistor connected between ZA and ZB poles. Use unused wires in parallel for each power pole connection to minimize power drop, especially if you use power leads also for powering other devices like preamplifiers, antenna switches, or similar devices. For proper ARXC module functionality voltage at its power terminal should be at least 7V. Maximal consumption (including powered device) is 500mA limited internally by ARCO. It is ample power for ARXC devices alone, but if provided power reserve is not enough for powering controlled devices, use D-SENSOR output only for ARXC modules and power controlled devices using a separate power supply.



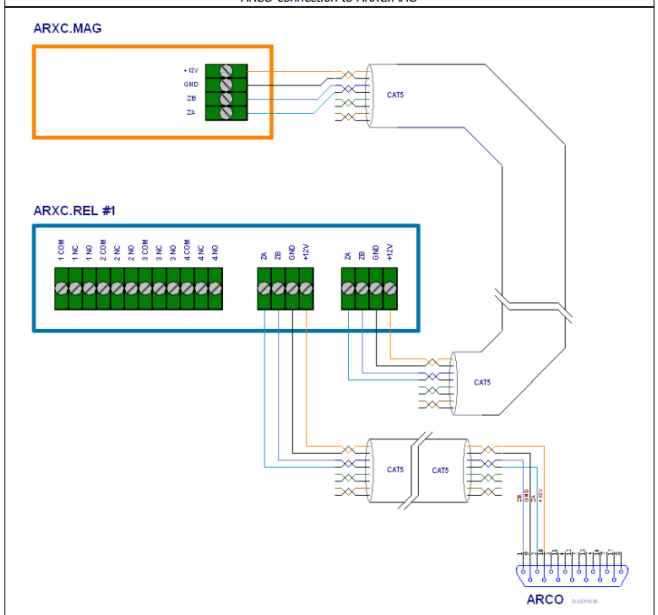
For controlling external devices, ARXC.REL provides one SPDT contact per relay, allowing it to connect and implement any kind of switching requirement. Contacts are located at a pluggable terminal for simpler assembly. Each energized relay is indicated by an LED indicator and each relay can be manually energized by a related pushbutton to help with in-field troubleshooting.



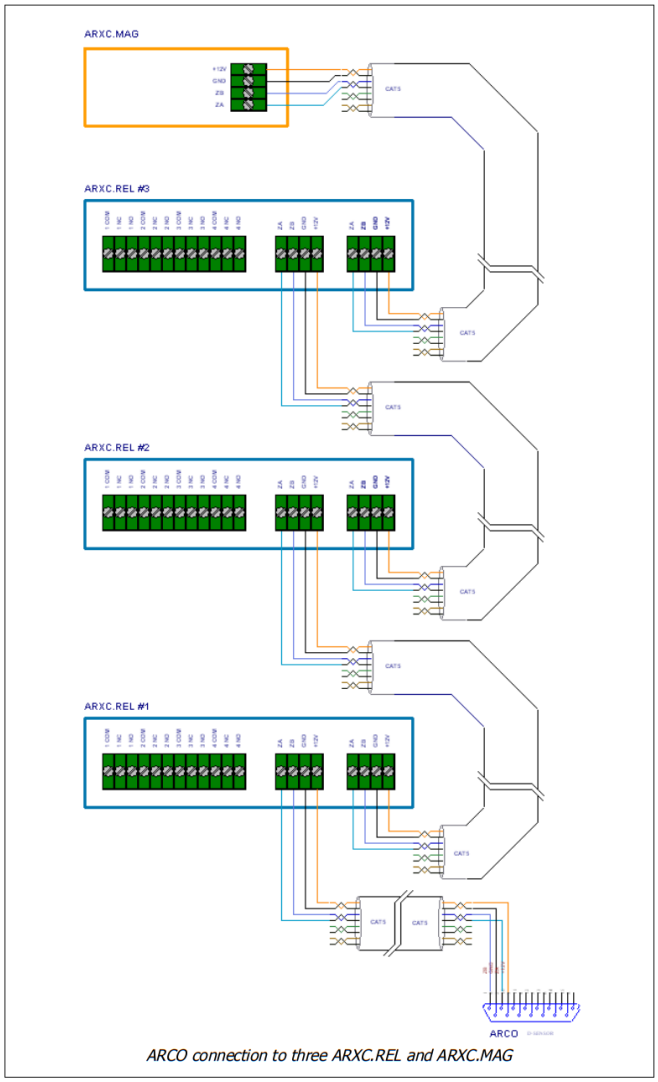
ARCO connection to single ARXC.REL



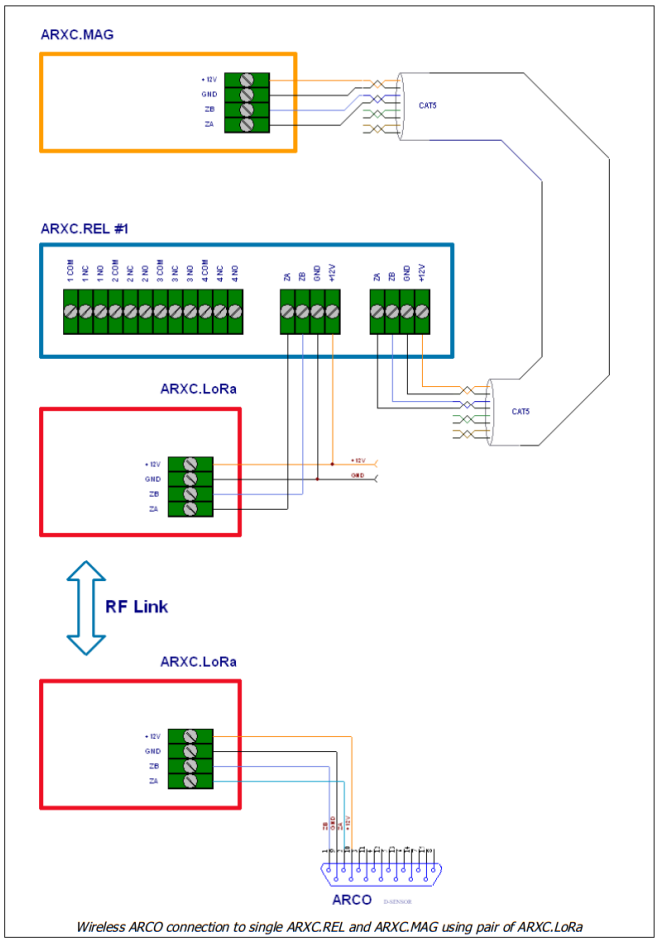
ARCO connection to ARXC.MAG



ARCO connection to single ARXC.REL and ARXC.MAG



ARCO connection to three ARXC.REL and ARXC.MAG



Wireless ARCO connection to single ARXC.REL and ARXC.MAG using pair of ARXC.LoRa

ARXC – SOFTWARE SETUP

After wiring, it is necessary to make a software setup of ARXC modules in the ARCO menu system. ARXC.LoRa modules have no software setup, they are set to operate together in the factory. ARXC.MAG and ARXC.REL requires a specific setup to let ARCO know how to use each module.

ARXC.MAG Settings

Menu->System->ARXC.MAG window serves for magnetic sensor settings.

ENABLE: Enables or disables ARCO communication with ARXC.MAG sensor.

STATUS: This shows the current status of ARXC.MAG sensor

- WAITING SENSOR RESPONSE = Sensor does not communicate to ARCO.
- INIT = Temporary state during initialization and data transfer.
- TURN LIMIT-TO-LIMIT = Sensor is waiting for a full rotator turn.

  Turn the rotator 360˚ using CW/CCW buttons.
- ACTIVE = Sensor uses captured data.
- SENSOR POINTS = Sensor is in user, absolute azimuth calibration state.

RESUME/FINISH LEARNING: When ARXC.MAG is not ARCO's main azimuth sensor, the button switches between "collecting" and "using" magnetic data to determine azimuth. While learning, magnetic data are continuously sampled and ARCO improves the magnetic curve of the sensor.

ARXC.MAG AZI: Shows azimuth determined by ARXC.MAG sensor

SLIP CONTROL: Enables or disables background checking if the azimuth of the main sensor on the rotator matches the azimuth determined by ARXC.MAG sensor within +/- tolerance set next.

ACCEPTED SLIP: Let the user knows the angle of antenna slippage. The angle should be used as "offset" for antenna #2 or #3 for temporary use until antenna slippage is fixed. The angle can be manually reset when slippage is fixed and the antenna is back in its original position.

XYZ: Shows raw magnetic data from the sensor. During rotator movement, ARCO draws graphical magnetic data used for azimuth computing. Deviations from circles visualize strong magnetic interference in a given direction.

TEMPERATURE: Shows temperature of ARXC.MAG sensor.

The Menu->System->ARXC.MAG window behaves similarly as Menu->Heading->Calibration, i.e. when buttons Left or Right are pressed, the rotator motor starts to turn in a given direction with no ramps, using speed set as CALIB SPEED in Menu->Heading->Calibration.

In this window, the ARXC.MAG sensor is continuously polled, unlike during normal operation, when it is polled only when the motor supply is turned on.

Please note, that status transitions described in the following might take some time to be reflected on the Menu->System->ARXC.MAG window. So, after any parameter change/click, please allow a few seconds for the displayed values to refresh.

Using ARXC.MAG Sensor

Initial Setup

Prerequisite:

ARCO is calibrated using the original primary sensor.

- **ENABLE Sensor**

  – Sensor changes STATUS from DISABLED to TURN LIMIT-TO-LIMIT by touching ENABLE box. If the Status did not change to TURN LIMIT-TO-LIMIT, check the prerequisite.

  – Turn the rotator from one limit to the other, not necessarily in this window, you can do it in any other way. This sets the baseline ARXC.MAG calibration and changes Status from TURN LIMIT-TO-LIMIT to LEARNING, and azimuth from ARXC.MAG is displayed as ARXC.MAG AZI.

In the "Learning" state, when the rotator is turning, ARXC.MAG calibration is continuously improved based on the

primary sensor's readings. By clicking FINISH LEARNING, the Status changes to ACTIVE, and SLIP CONTROL can be enabled. It is possible to switch from ACTIVE to LEARNING mode by clicking on the RESUME LEARNING button.
Note, that disabling ARXC.MAG at this point deletes the ARXC.MAG calibration. After transitioning to an ACTIVE state, it is recommended to store ARCO configuration in one of the stored configuration slots in Menu->System->System->Config SAVE.

Slip Control

Prerequisite:
ARXC.MAG is in an ACTIVE state.

- ENABLE Slip Control
- Set tolerance between primary sensor azimuth and ARXC.MAG AZI
- When ARCO detects antenna slippage, the user is warned that the antenna slipped. Until slippage is fixed the main screen shows a "SLIPPED" sign.
- The user has to confirm the new antenna azimuth by a visual check.
- The value of the slipped angle is internally used to automatically compensate software stop limit in the slip direction in order to prevent feedline damage.
- Slipped angle is shown on System → ARXC.MAG tab. If ARXC.MAG sensor is not used as the main azimuth sensor, the user is advised to create antenna #2 or #3 with offset of slipped angle to work with true antenna azimuth.
- Slip Control automatically updates the value of slipped angle if another slippage happens.
- Slip Control is reset automatically after fixing slippage on the antenna and performing new main sensor calibration.
- Slip Control can be reset manually at ARXC.MAG tab after fixing slippage and returning the antenna to its calibrated position.

Switching sensor from rotator's primary sensor to ARXC.MAG

Choice when ARCO was calibrated with the original rotator's sensor but the sensor suddenly failed.
Prerequisite:
ARXC.MAG is in an ACTIVE state.

- In Menu->Rotator->Settings change Sensor from the primary to ARXC.MAG.
  ARXC.MAG calibration is automatically used and ARXC.MAG becomes the primary sensor for all rotator operations.

Note, that at this point, the original primary sensor's calibration is lost, and after restoring the original sensor as the primary sensor in Menu->Rotator->Settings->Sensor, new calibration of this sensor is required. If there is a stored configuration from previous steps, loading it through Menu->System-> System->Config LOAD restores the setup from that point, including the original sensor's calibration, as expected.

ARXC.MAG as the sole azimuth sensor

The choice for rotators without azimuth sensors.
Prerequisite:
ARXC.MAG is selected as the primary sensor in Menu->Rotator->Settings.

- In Menu->System->ARXC.MAG set ENABLE box. Status changes from DISABLED to SENSOR POINTS. It is possible that an interim INIT state is displayed for a few seconds, it is normal. If the Status did not change to SENSOR POINTS, check the prerequisite.
- Now in Menu->Heading->Calibration, turn the rotator to at least 4 evenly spaced points by 90˚ (i.e. North, South, East, West), and enter azimuth for these calibration points using the CUSTOM button. You can add

calibration points more densely than that.

- After all Calibration Points have been entered press the FINISH button. Move to the center of rotator rotation and enter its azimuth, to finalize the calibration.

If the rotator has limit switches and they are enabled in Menu->Rotator->Settings, in Menu->Heading->Calibration an AUTO button is displayed. By pressing an AUTO button, the motor will automatically move first to the CCW limit switch, and then while moving to the CW limit switch it will gather calibration points, assuming that the rotator moves with a constant angular speed during the whole path between the limit switches. Finally, the rotator moves into the estimated mid-position. Here, adjust the position of the rotator to the precise center of rotator rotation and enter its azimuth. This finalizes the calibration assuming that the angular distance between limit switches is exactly the TOTAL ROTATION parameter.
As usual, after calibration it is recommended to store the current ARCO state in one of the Menu->System->System->Config SAVE slots.
Please note, once ARXC.MAG becomes the primary sensor, ARXC.MAG cannot be disabled and slip is checked on power up and wake up from sleep.

Hardware status

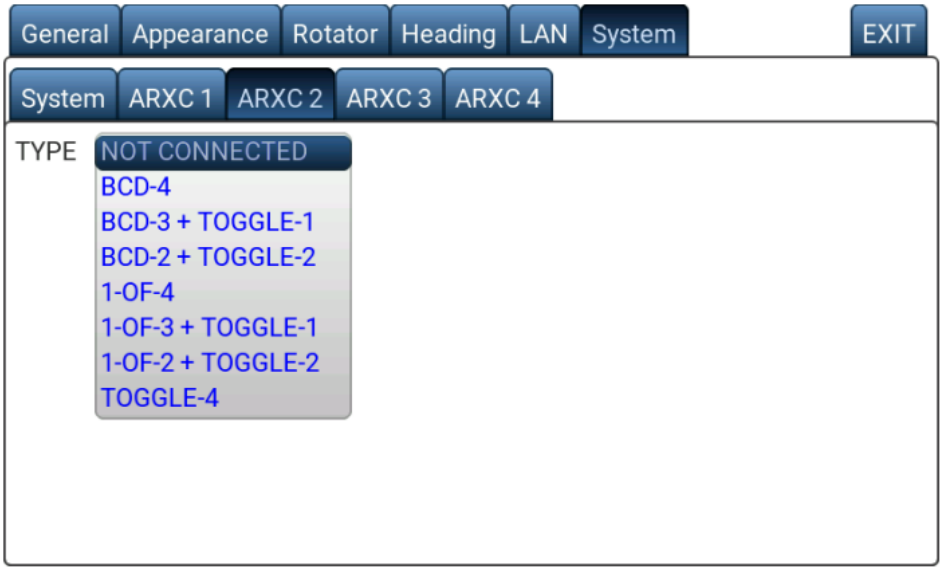
To signal the basic functionality of ARXC.MAG, LED inside module indicates the polarity of the X component of uncalibrated measurement of the magnetic vector. In other words, LED is on, if the general direction of the terminal block of ARXC.MAG is towards the North.
Besides that, LED indicates also the presence or absence of communication from ARCO: if ARCO communicates with ARXC.MAG (i.e. during rotation, or in the Menu->System->ARXC.MAG screen, or in Menu->Heading->Calibration screen if ARXC.MAG is selected as the primary sensor), LED blinks once a second, otherwise, it blinks once in 5 seconds.

ARXC.REL Settings and Use

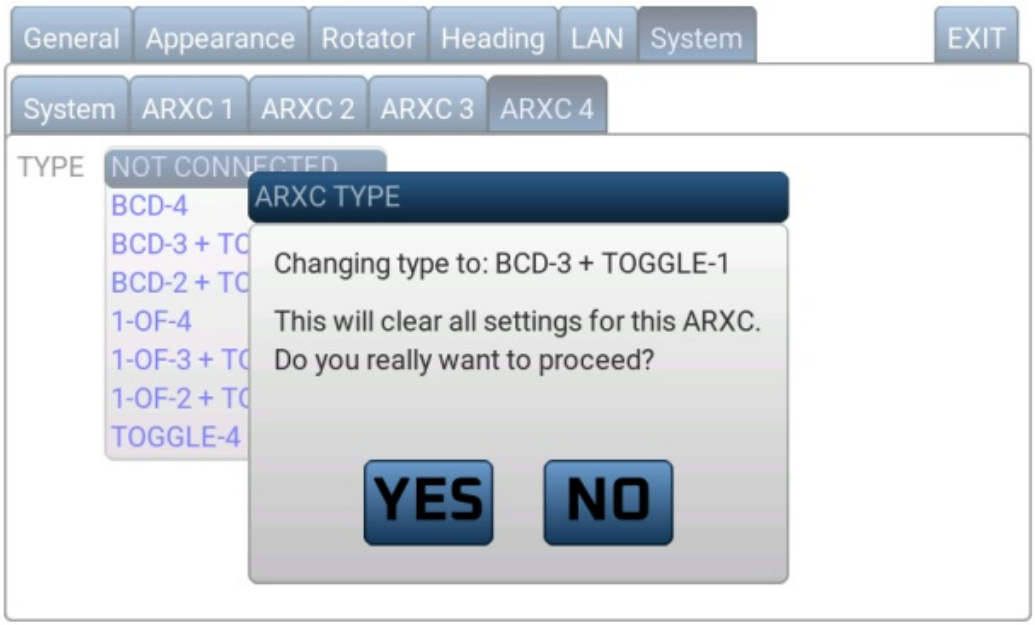
Relay outputs of ARXC.REL can be configured for different behavior (Types) and these types can be combined together.
There are three categories of ARXC Types:

- BCD-N
- 1-of-N
- TOGGLE 1-4

Both BCD-N and 1-of-N consist of a group of the first N relays (where N = 2, 3 or 4), where changing state of relays obeys certain rules; the rest of the relays in given ARXC are free to be set/cleared/toggled individually. Both BCD-N and 1-of-N can also optionally represent azimuths; in that case, they can be used as an Antenna in Menu→Heading, and subsequently be controlled using the same methods (local, remote) that are used to control the physical rotator.
In TOGGLE 1-4 type, all 4 relays are controlled freely.
In **BCD-N**, the state of relays within the group represents a binary number, relay 1 represents the least-significant bit, and relay N is the most-significant bit in that number. Presets targeting the BCD-N group can set the group to a particular number or can increment or decrement the number corresponding to the BCD-N group. However, individual relays can still be controlled freely in the ARXC Control window, as well as in Menu→System→ARXCx.
In **1-of-N**, there is always exactly one relay switched on. This rule is enforced even when controlling relays in the ARXC Control window and in Menu→System→ARXCx. Individual relays can be assigned to Presets, however, when this Preset is clicked, this relay of the group will be switched on and all other relays of the group will be switched off. Presets “moving” the active relay forward and backward within the group, circularly, are available, too.
When one of the Types is selected, the menu window displays multiple items, depending on the particular Type selected.
In the default configuration, all 4 ARXC are set as “NOT CONNECTED”, and ARCO behaves as in older versions without ARXC, namely in Menu→Heading and in Presets setup.

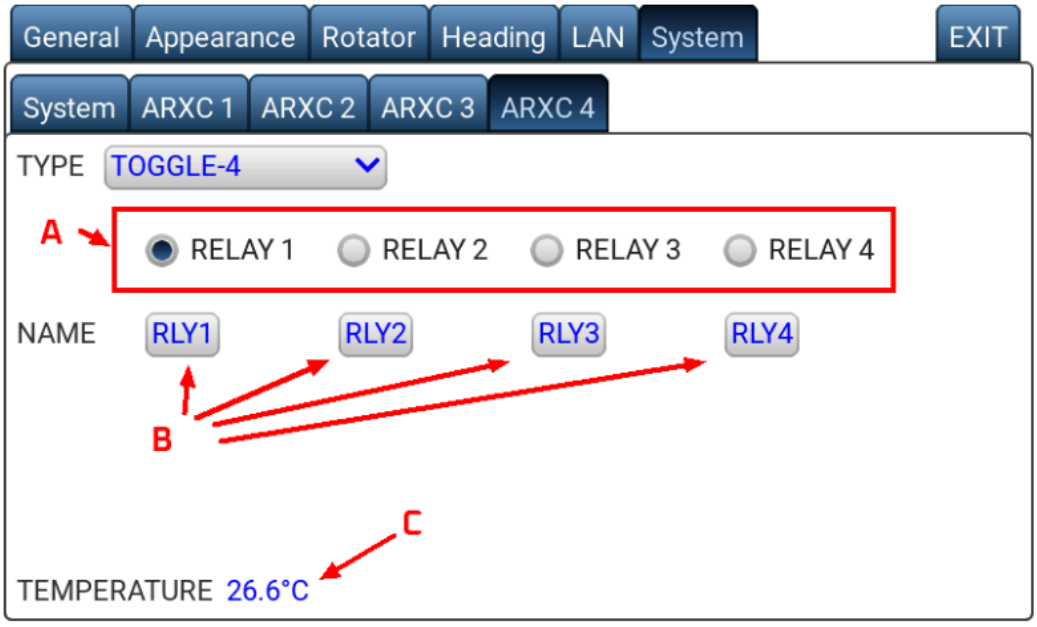


The first step of setting up ARXC, in Menu→System→ARXCx for the given ARXC, is to select Type.
When changing from one Type to a different one, several related configuration parameters are reset to default e.g. individual ARXC relays and group names; if this ARXC's group was selected as Antenna, this selection is reverted to default antenna (i.e. corresponding to the physical rotator with given offset and other attributes, as it was in older versions); and all Presets targeting this ARXC will be changed to plain AZI presets. To avoid inadvertent loss of these parameters, changing ARXC Type is subject to confirmation.



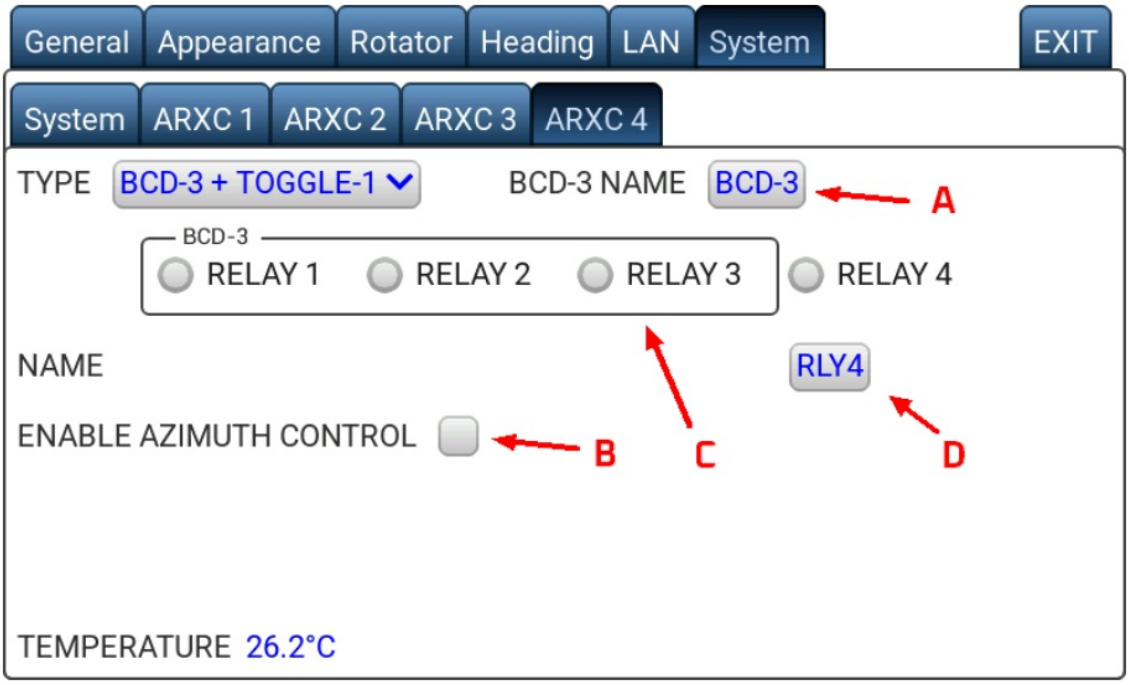
TOGGLE 1-4 Type
TOGGLE 1-4 is the simplest Type, and items in its menu are present also in menus for other Types.

A – this is a "live" visualization of the current state of individual relays; relays' state can be toggled by clicking on the individual "buttons" or their names. If given ARXC is not present on the bus, this field is greyed out, although the relays state can still be toggled and upon connecting the ARXC, relays will be switched accordingly.
B – each relay has an editable name, this is then used as a reference in Presets, etc.
C – this is a live indication of ARXC internal temperature.



BCD-N Type

For the BCD-N type, the menu window is slightly different:



A – the BCD-N group has an editable name, again used as reference to this group.

B – one of applications of BCD-N group is the control of Four Square-type of antenna arrays, so if azimuth control is enabled for BCD-N, the primary direction corresponding to number = 0 is North. The primary direction of subsequent values increases clockwise, by 90º for BCD-2, by 45º for BCD-3, and by 22.5º for BCD-4.

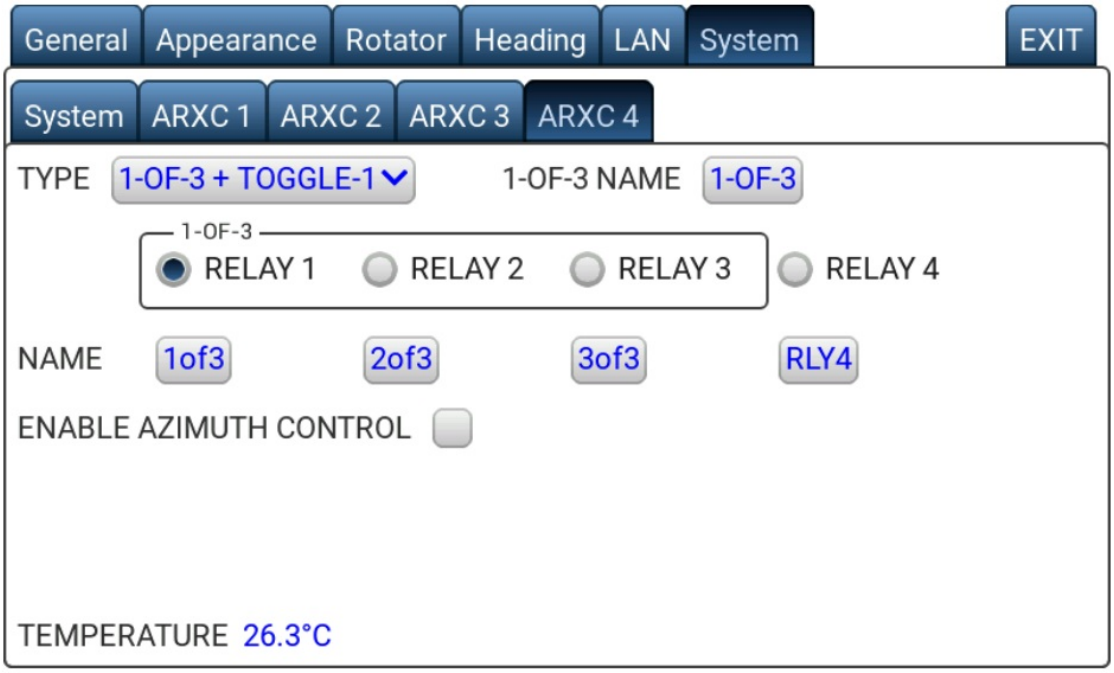
C – the frame around individual relay status “buttons” indicates their grouping.

D – relays within the group don’t have individual names, only the unused free relay has its own name (consequently, if BCD-4 type is selected, there is no NAME row at all).

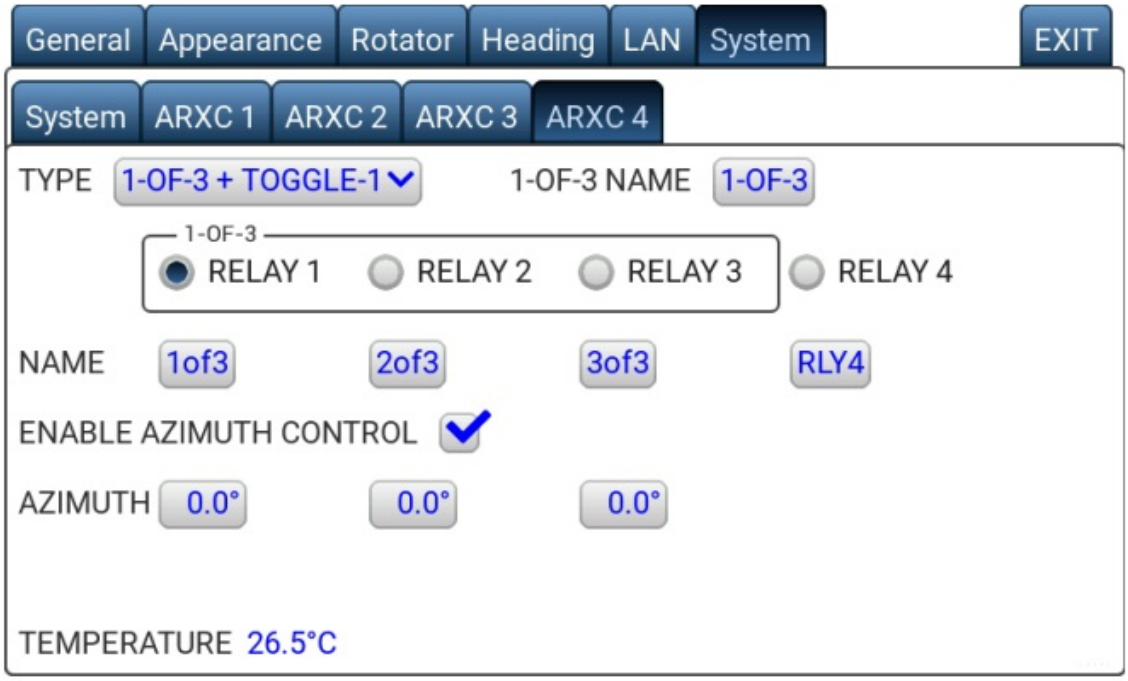
1-of-N Type

The menu window for 1-of-N is similar:

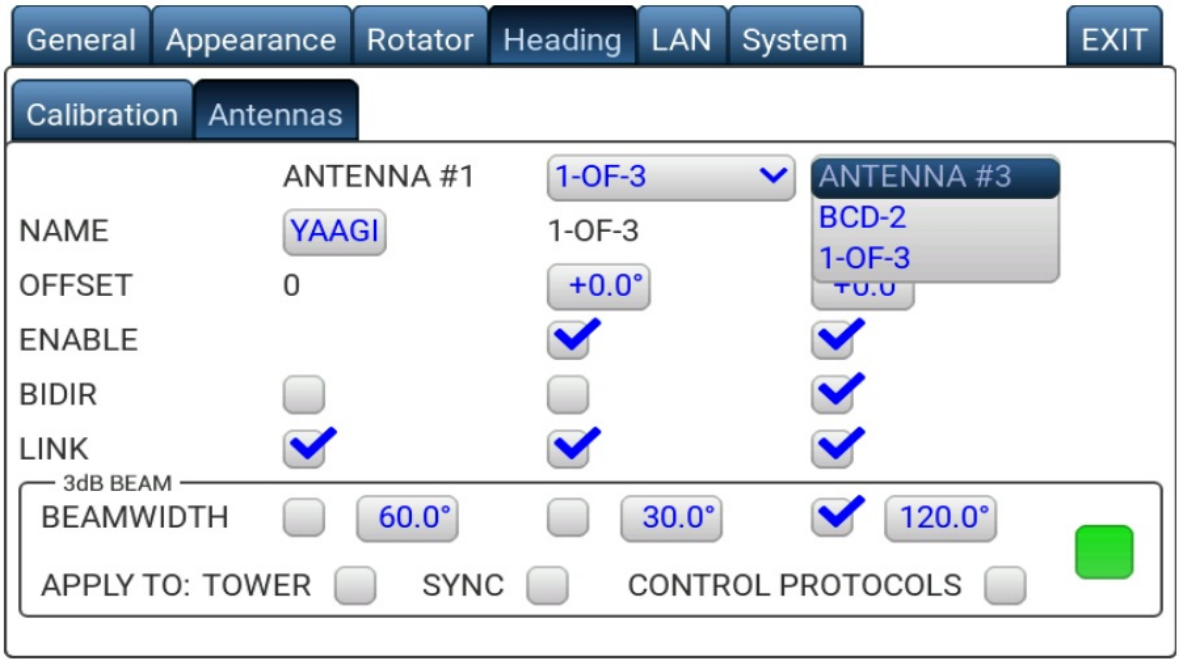
According to the switching rule for the 1-of-N group, when 1-of-N is selected in Menu→System→ARXCx, the first relay is automatically switched on. Contrary to BCD-N, individual relays in the 1-of-N group do have individual names, as they can be used for individual Presets.



When azimuth control is enabled for 1-of-N by ticking the ENABLE AZIMUTH CONTROL tickbox, its menu slightly changes:
Individual relays in the 1-of-N group can be assigned individual azimuths, which represent the primary direction for the state when the corresponding relay is switched on.
There is no requirement on particular values of the azimuth, their order, or span.



In Menu→Heading, if any of ARXC is set to a group with azimuth control enabled, headers to columns corresponding to ANTENNA #2 and ANTENNA #3 are not static labels anymore, but they are pull-down menus. When opened, ANTENNA #x is always the first option, followed by the names of those ARXC groups, which have azimuth control enabled. In the following screenshot, for ANTENNA #2 an ARXC group with the name 1OF3@1 is selected; for ANTENNA #3 the pull-down is opened and displays the list of available options:

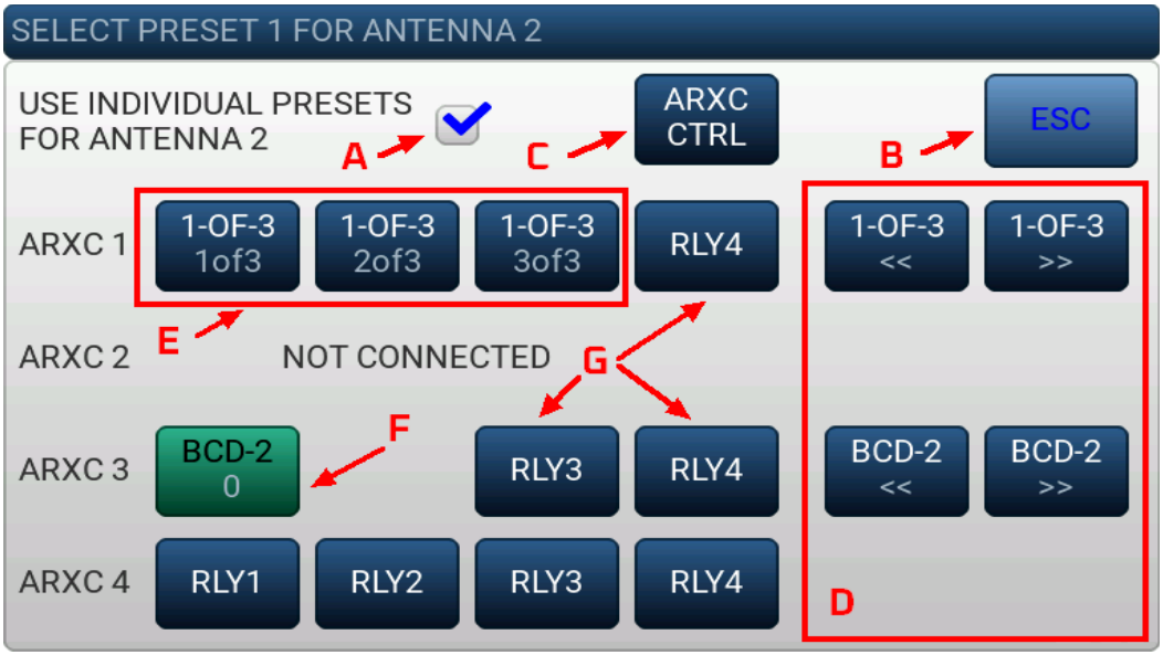


If the ARXC group is selected instead of ANTENNA #x, its name is given by the name of this group set in its respective Menu→System→ARXCx, and it cannot be changed in this menu. All other settings apply in the same way as for normal ANTENNA #x, i.e. ENABLE determines presence in the main screen's selection, OFFSET is added to the primary direction corresponding to state of relays within the group, BIDIR is observed both for display and control, LINK determines presence in the selection within the LINK group (either locally or through LAN).

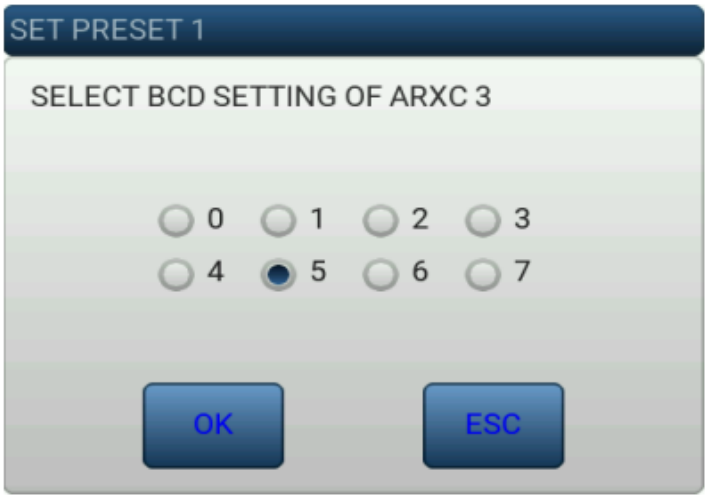
BEAMWIDTH influences only display; azimuth control input is always decoded into the group state which has the closest primary direction, taking into account both OFFSET and BIDIR. ARXC group is azimuth-controlled only if this group is selected as the current Antenna on the main screen.

Non-azimuthal ARXC features can be controlled from the main screen through extended Presets. To preserve the previous behavior, there is a common set of Presets, which is by default assigned to all three Antennas. However, as soon as at least one ARXC is present, each antenna can be optionally assigned its own individual set of presets. When a Preset is held pressed for more than a second, the usual control for setting azimuth appears, but it contains a new "ARXC" button.

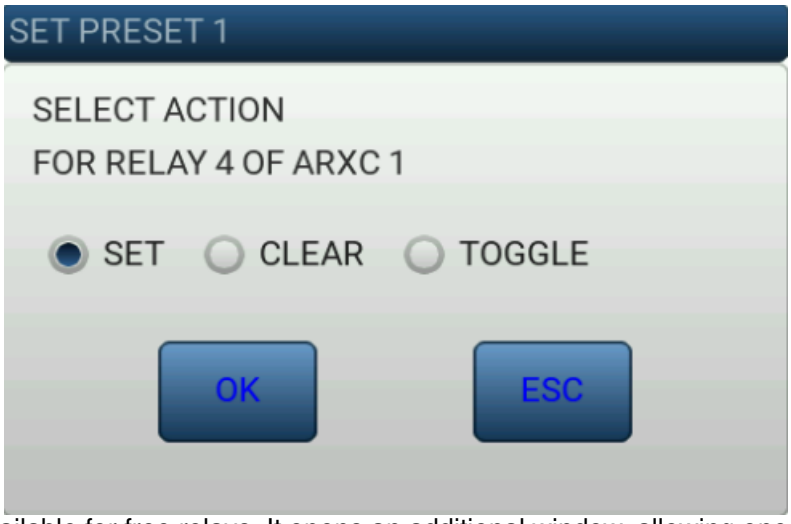
Pressing this button, a new window for setting Preset opens:



A – this tickbox determines, whether a given Antenna has assigned an individual set of Presets, or, if unticked, uses the common set of Presets. Consequently, in this window, the individual or the common set of Presets is edited.
B – exit from this window, without changing the given Preset. All other buttons in this window represent possible options, to which the given Preset can be set. The currently set option is indicated by green background color.
C – this option opens the ARXC CONTROL window, described below.
D – these options are present only for ARXC which are of BCD-N or 1-of-N type and advance forward or backward within the values represented by the group.
E – these options switch individual relays within a 1-of-N group.

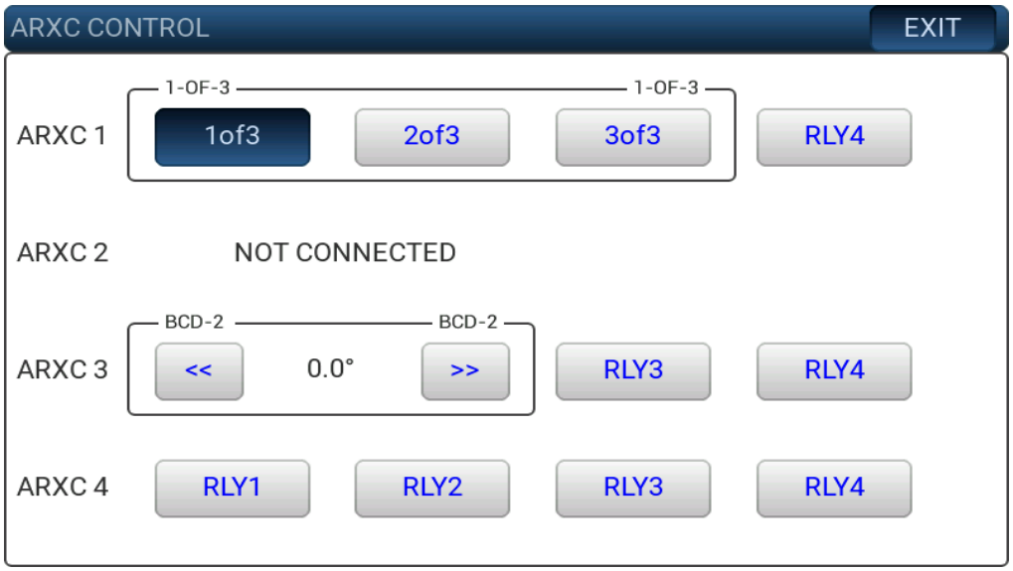


F – this option allows switching to a particular value of the BCD-N group (this option is currently chosen, that's why it's highlighted in by green background). It opens an additional window to choose this value.



G – this is the option available for free relays. It opens an additional window, allowing one to choose the action for the given relay.

One of the options for Preset is the ARXC CONTROL window. In this window, all ARXC outputs can be observed and controlled from one place.



The indication and control are similar to that in Menu→System→ARXCx, except for the visual style (buttons instead of the “radio buttons”), and the different handling of BCD-N groups. The ARXC CONTROL window contains “forward/backward” buttons instead of individual relay control, and in between them, the current value, or, if azimuth control is enabled for a given group, the current primary direction is displayed.

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Documents / Resources

	**microHAM ARXC.MAG ARCO Smart Antenna Rotator Controller** [pdf] User Manual ARXC.REL, ARXC.MAG, ARXC.LoRa, ARXC.MAG ARCO Smart Antenna Rotator Controller, ARXC.MAG, ARCO Smart Antenna Rotator Controller, Antenna Rotator Controller, Rotator Controller, Controller

References

- microHAM - Amateur Radio Accessories
- microHAM - Amateur Radio Accessories