ARXC

ARCO External Control Accessories

ARXC.REL
ARXC.MAG
ARXC.LoRa

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TRADEMARKS

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1 - 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. ARXC accessories connect D-SENSOR port on ARCO, using only 4 wires of cheap CAT5 cable. When 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 couple of kilometers distance.

ARXC.REL

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

ARXC.MAG

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

ARXC.LoRa

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

2 - ARXC - HARDWARE SETUP

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

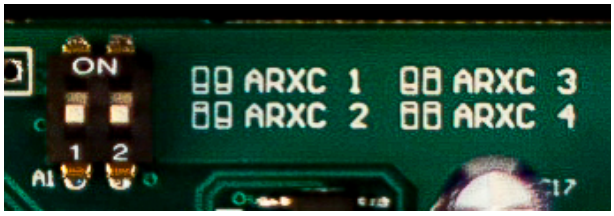
ARXC.REL can be mounted anywhere with cable grommets facing down to avoid water ingress. Although not necessary, it is advisable to mouth box on place protected against rain, snow or direct sunlight.

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

ARXC.MAG sensor has to be mounted on bottom side of 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 it, they made of nickel plated brass, steel screws would influence magnetic sensor functionality.

Before proceeding to software setup it is necessary to set 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. Address is set by combination of two DIP switches according to drawing on PC board next to DIP switch. It is possible to set up to 4 different addresses: 1, 2, 3, and 4. Each ARXC.REL module has then its own setup in 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

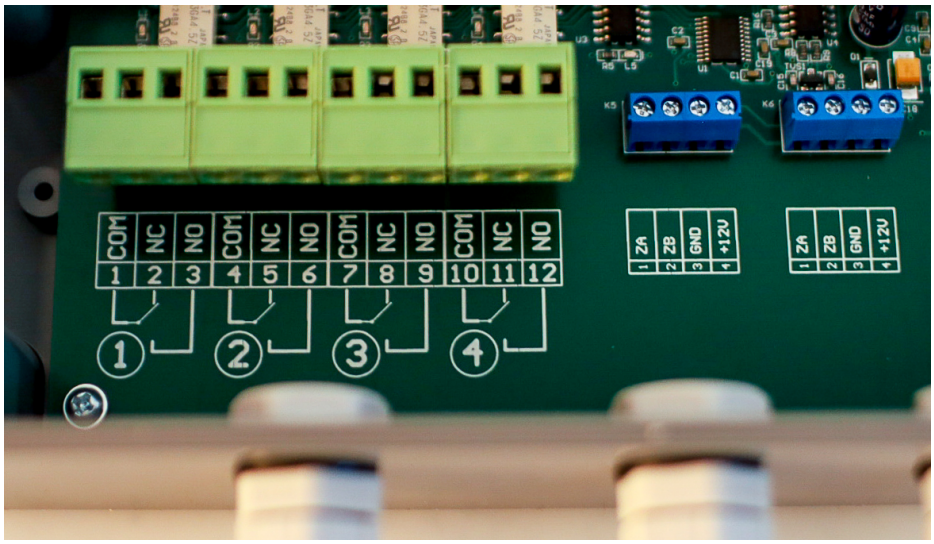
In order to control ARXC module, it must be connected to ARCO first. On ARCO, the connection port is located at D-SENSOR connector. Communication layer is RS-485 requiring twisted pair of wires connected to port Z (ZA and ZB pins) and two additional wires for module power. 12VDC power is provided by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

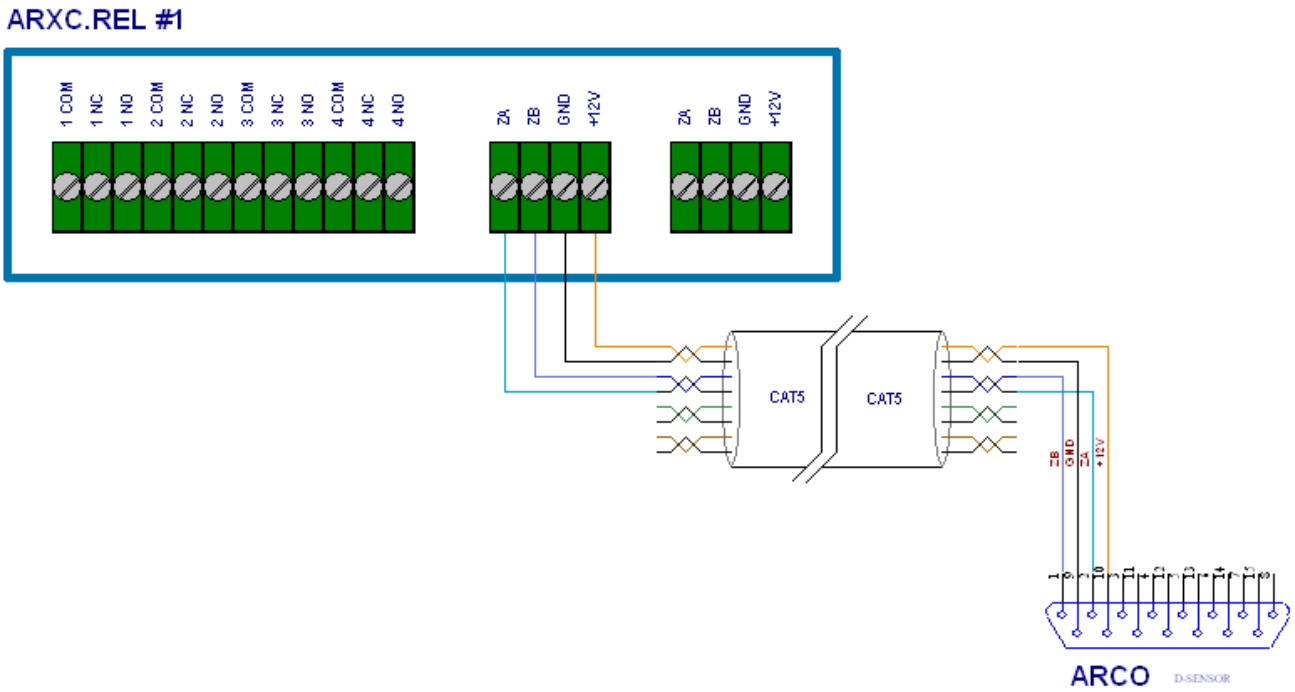
If control cable between ARCO and ARXC module; or between different ARXC modules for any reason cannot be installed, communication can be established by RF link using ARXC.LoRa module. In this case, external 12V supply must be provided on ARXC side of RF link.

Each ARXC module has a 4 pole terminal for connecting wires of the communication cable. ZA and ZB poles serve for communication wires, +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.

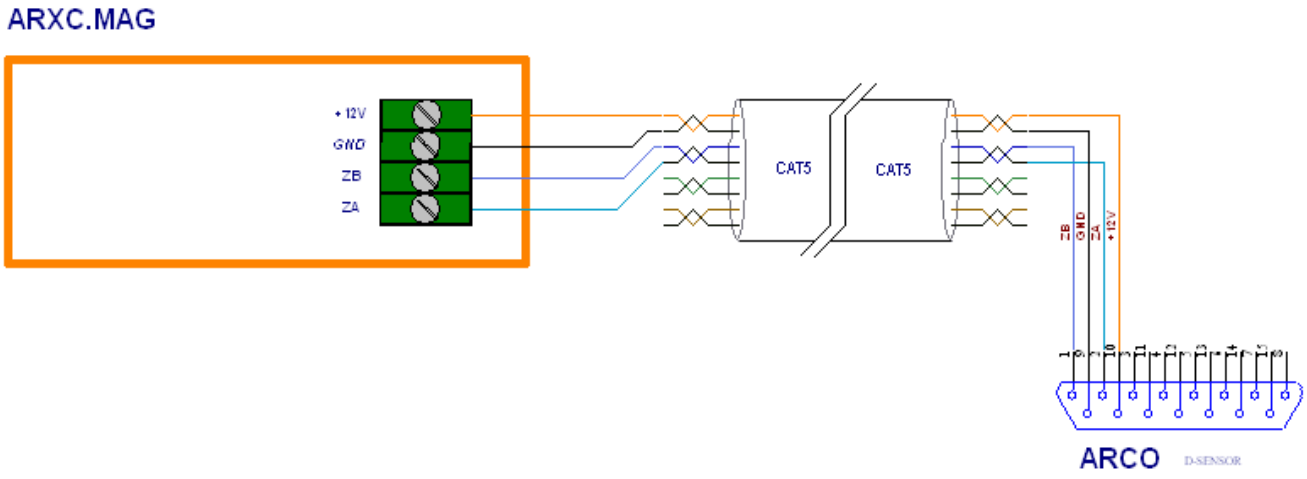
We recommend to use cheap CAT5 or CAT6 cable. In case of longer connection (hundreds of meters), terminate both ends of communication line by 150 ohm resistor connected between ZA and ZB poles. Use unused wires in parallel for each power pole connection to minimize power drop, especially if you use power leads also for powering other device like preamplifier, antenna switch or similar device. 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 separate power supply.

For controlling external devices, ARXC.REL provides one SPDT contact per relay, allowing 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 LED indicator and each relay can be manually energized by related pushbutton to help in-field troubleshooting .

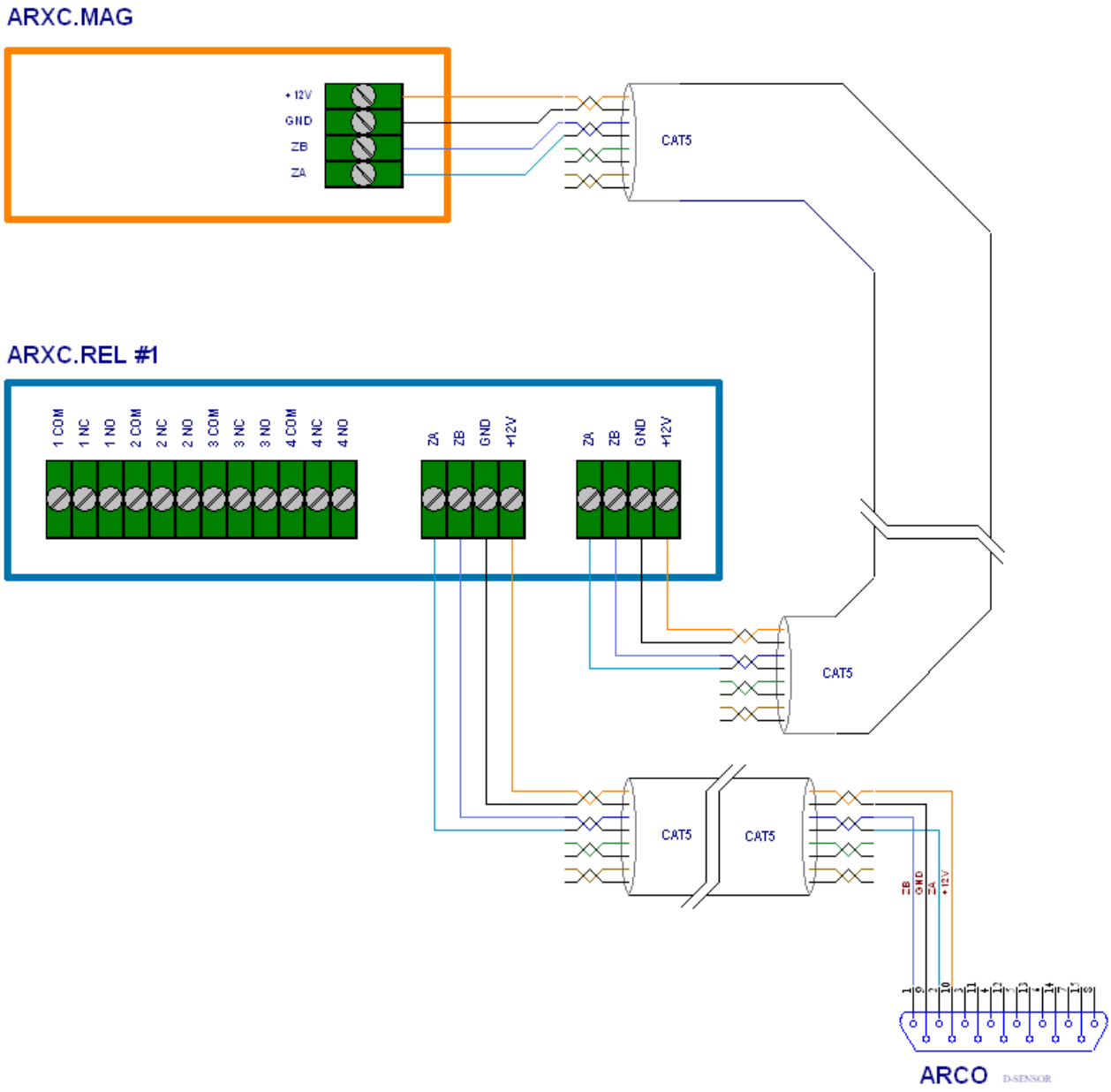




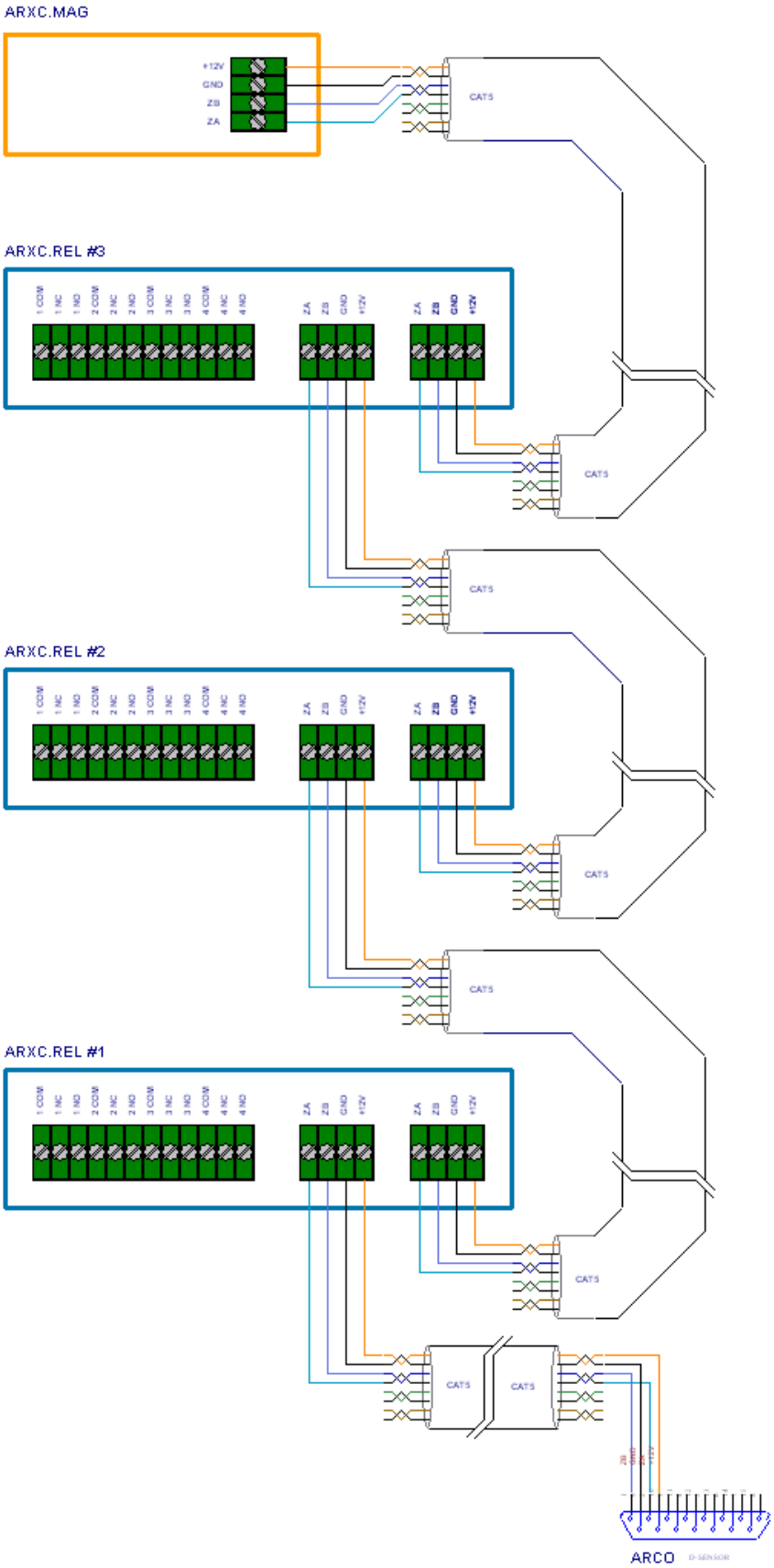
ARCO connection to single ARXC.REL



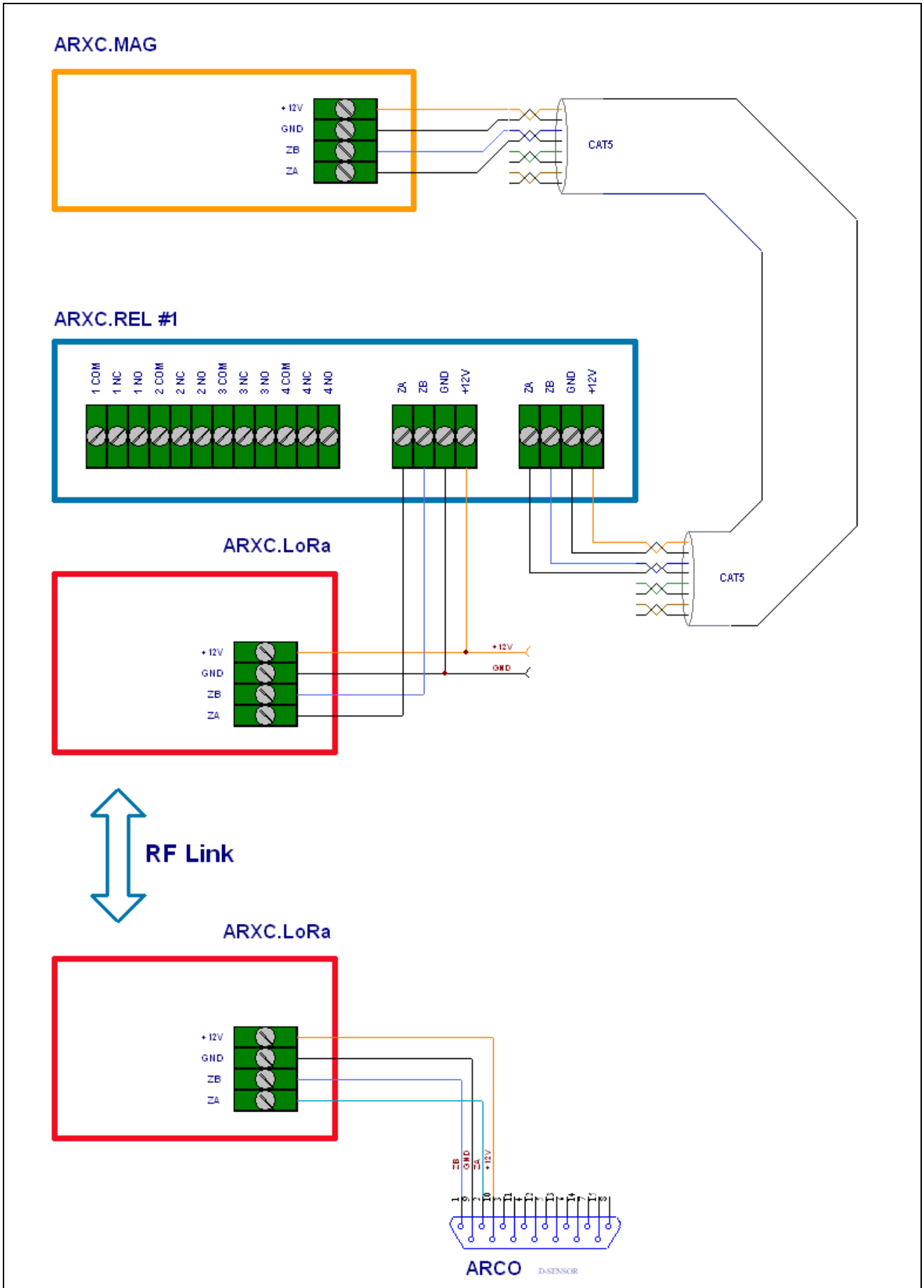
ARCO connection to ARXC.MAG



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

3 - ARXC - SOFTWARE SETUP

After wiring it is necessary to make software setup of ARXC modules in the ARCO menu system. ARXC.LoRa modules have no software setup, they are set to operate together in factory. ARXC.MAG and ARXC.REL requires 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: Shows 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 full rotator turn.
  Turn 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 main azimuth sensor, button switches between “collecting” and “using” magnetic data to determine azimuth. While learning, magnetic data are continuously sampled and ARCO improves magnetic curve of the sensor.

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

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

ACCEPTED SLIP: Lets user know angle of antenna slippage. Angle should be used as “offset” for antenna #2 or #3 for temporary use until antenna slippage is fixed. Angle can be manually reset **when slippage is fixed** and antenna is back in its original position.

XYZ: Shows raw magnetic data from sensor. During rotator movement ARCO draws graphical magnetic data used for azimuth computing. Deviations from circle visualizes strong magnetic interference in 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 is pressed, the rotator motor starts to turn in 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 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 original primary sensor.

- ENABLE Sensor
  - Sensor changes STATUS from DISABLED to TURN LIMIT-TO-LIMIT by touching ENABLE box. If Status did not change to TURN LIMIT-TO-LIMIT, check prerequisite.
  - Turn rotator from one limit to the other, not necessarily in this window, you can do it in any other way. This sets 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 "Learning" state, when the rotator is turning, ARXC.MAG calibration is continuously improved based on the primary sensor's readings. By clicking FINISH LEARNING, Status changes to ACTIVE, and SLIP CONTROL can be enabled. It is possible to switch from ACTIVE to LEARNING mode by clicking on RESUME LEARNING button.

Note, that disabling ARXC.MAG at this point deletes the ARXC.MAG calibration. After transition to ACTIVE state, it is recommended to store ARCO configuration to one of the stored configuration slots in Menu->System->System->Config SAVE.

Slip Control

Prerequisite:
ARXC.MAG is in ACTIVE state.

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

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

Choice when ARCO was calibrated with original rotator's sensor but sensor suddenly failed.

Prerequisite:
ARXC.MAG is in 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 operation.

Note, that at this point, the original primary sensor's calibration is lost, and after restoring the original sensor as 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 original sensor's calibration, as expected.

ARXC.MAG as the sole azimuth sensor

Choice for rotators without azimuth sensor.

Prerequisite:
ARXC.MAG is selected as 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 Status did not change to SENSOR POINTS, check 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 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 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 rotator to precise center of rotator rotation and enter its azimuth. This finalizes the calibration assuming that angular distance between limit switches is exactly TOTAL ROTATION parameter.

As usually, after calibration it is recommended to store the current ARCO state into 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 basic functionality of ARXC.MAG, LED inside module indicates polarity of the X component of uncalibrated measurement of magnetic vector. In other words, LED is on, if the general direction of terminal block of ARXC.MAG is towards North.
Besides that, LED indicates also 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 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 behaviour (Type) and these types can be combined together.

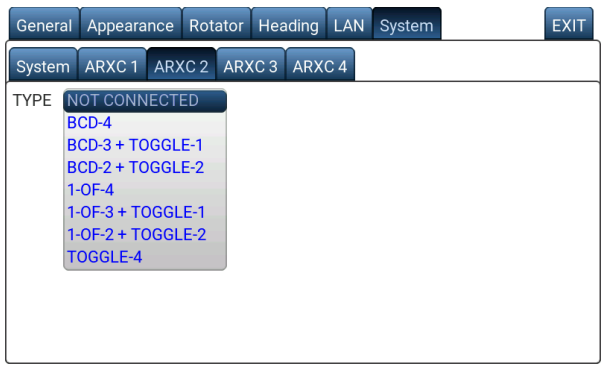
There are three cathegories of ARXC *Types*:
- BCD-N
- 1-of-N
- TOGGLE 1-4

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; 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 *free*ly.

In ***BCD-N***, state of relays within the group represents a binary *number*, relay 1 representing the least-significant bit, relay N the most-significant bit in that number. Presets targeting *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.

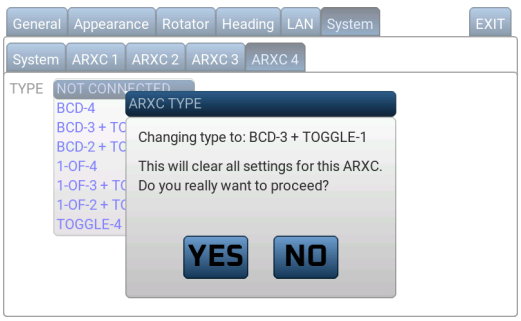
In ***1-of-N***, there is always exactly one relay switched on. This rule is enforced even when controlling relays in the *ARXC Control* window and in Menu→System→ARXCx. Individual relays can be assigned to Presets, however, when this Preset is clicked, this relay of the group will be switched on and 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 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.

As the first step of setting up ARXC, in Menu→System→ARXCx for the given ARXC, is to select *Type.*

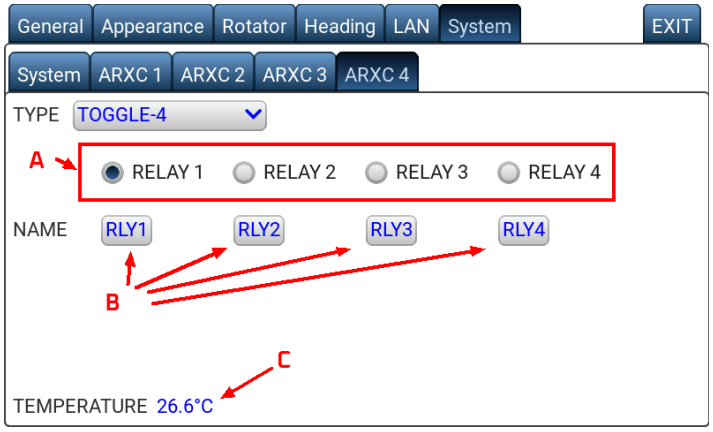
When changing from one *Type* to a different one, several related configuration parameters are reset to default e.g. individual ARXC relays and group names; if this ARXC's group was selected as *Antenna*, this selection is reverted to default antenna (i.e. corresponding to the physical rotator with given 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*.

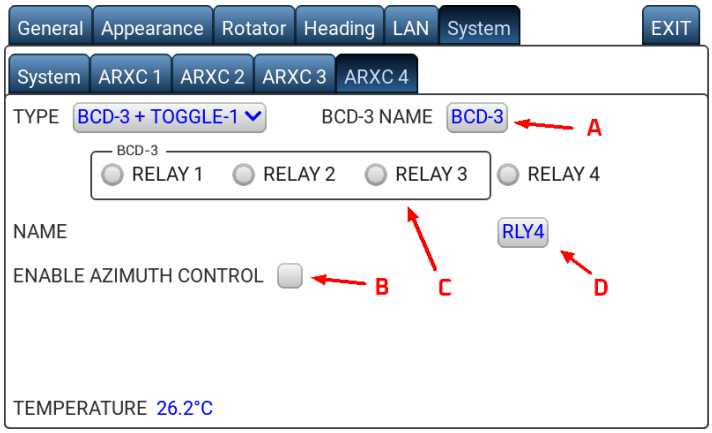
A - this is a "live" visualization of current state of individual relays; relays' state can be toggled by clicking on the individual "buttons" or their names. If given ARXC is not present on the bus, this field is greyed out, although relays state can still be toggled and upon connecting the ARXC, relays 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 *BCD-N* type, the menu window is slightly different:

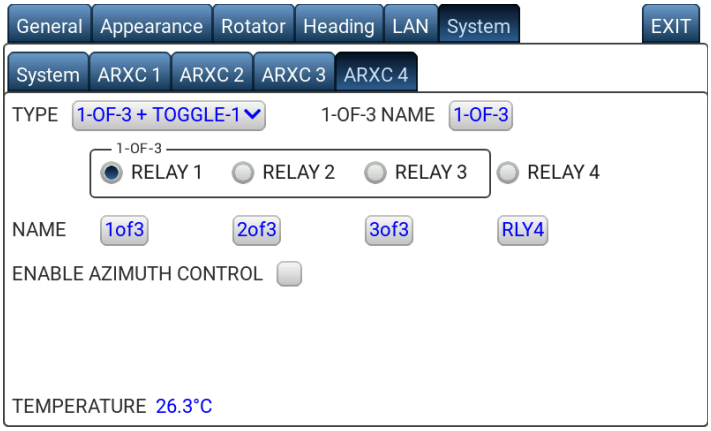
A - the *BCD-N* group has an editable name, again used as reference to this group.
B - one of applications of *BCD-N* group is control of Four Square-type of antenna arrays, so if azimuth control is enabled for *BCD-N*, the primary direction corresponding to *number* = 0 is North. Primary direction of subsequent values increases clockwise, by 90º for *BCD-2,* by 45º for *BCD-3,* 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).



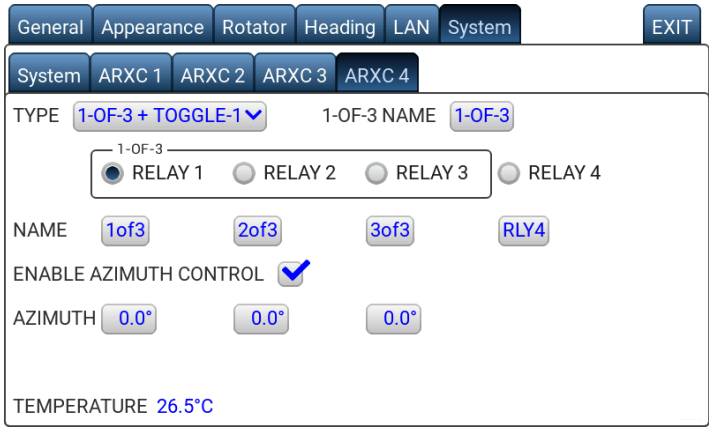
1-of-N Type

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

According to the switching rule for *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 *1-of-N* group do have individual names, as they can be used for individual Presets.

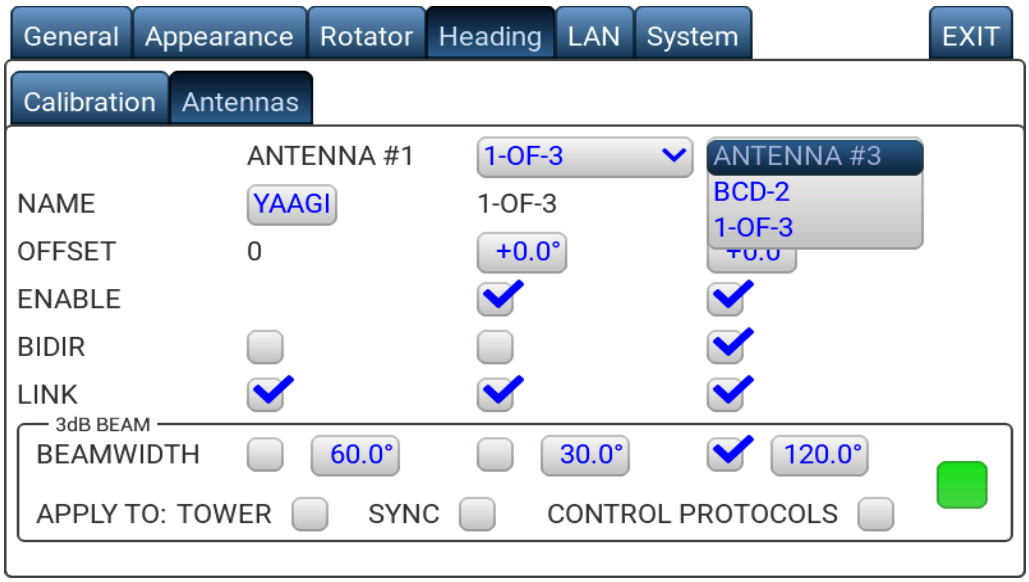


When azimuth control is enabled for *1-of-N* by ticking the ENABLE AZIMUTH CONTROL tickbox, its menu slightly changes:



Individual relays in the *1-of-N* group can be assigned individual azimuths, which represent the primary direction for the state, when corresponding relay is switched on. There is no requirement on particular values of the azimuth, their order nor 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 a 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 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* in the main screen.

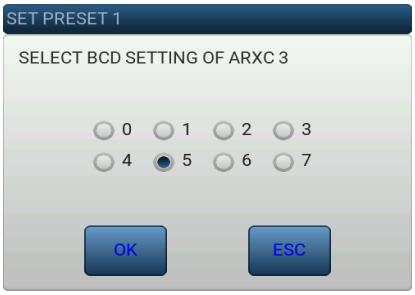
Non-azimutal ARXC features can be controlled from the main screen through extended Presets. To preserve the previous behaviour, there is a common set of Presets, which is by default assigned to all three Antennas. However, as soon as at least one ARXC is present, each Antenna can be optionally assigned 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 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 given Preset can be set. The currently set option is indicated by green background color.

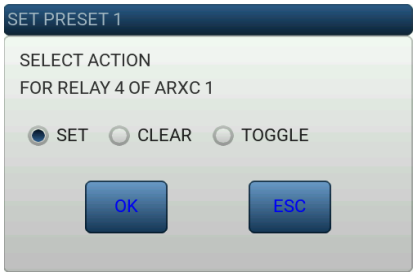
C - this option opens the ARXC CONTROL window, described below.



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.

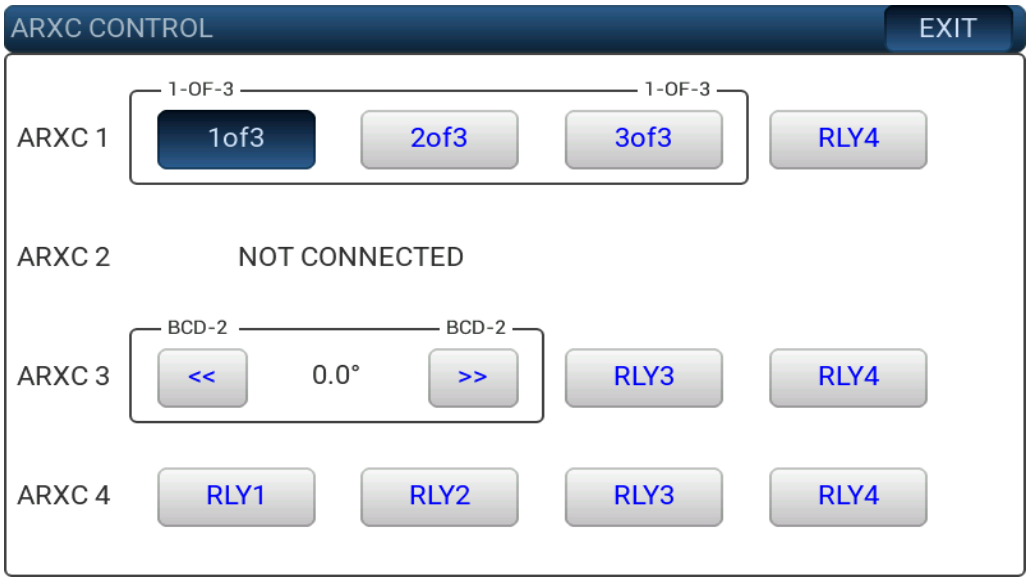
E - these options switch individual relays within a *1-of-N* group.

F - this option allows to switch to a particular value of *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 to choose the action for 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 is similar to that in Menu→System→ARXCx, except for the visual style (buttons instead of the "radiobuttons"), and the different handling of *BCD-N* groups. In ARXC CONTROL window they contain "forward/backward" buttons instead of individual relays control, and in between them, the current value, or, if azimuth control is enabled for given group, the current primary direction, is displayed.

DECLARATION OF CONFORMITY

European Union Declaration of Conformity

CE

We, microHAM s.r.o., Matičná 28, 92401 Galanta, Slovakia, declare under our sole responsibility for the equipment name ARXC, model ARXC.MAG, ARXC.REL and ARXC.LoRa that the equipment is in conformity with the relevant Union harmonization legislation directives.

On behalf of microHAM s.r.o.
Ing. Jozef Urban, CEO
30th September 2022