

# A724 Series 4 addSWITCH

User Guide





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# Chapter 1. Introduction

This manual explains the hardware aspects of Adcon's A724 Series 4 addSWITCH remote telemetry units, including installation issues and certain parameter configurations. The manual has the following chapters:

- *Introduction*, which gives some general information and document conventions.
- *Using the addSWITCH*, which details the installation and use of the remote telemetry unit.
- *Performing Advanced Functions*, which discusses connectors and controllers and provides other information for advanced users.
- *Specifications*, which describes operating parameters for the devices.

## About the A724 Series 4 addSWITCH

The A724 Series 4 addSWITCH™ remote telemetry unit (RTU) is a low-power, short-range telemetry device that can sample four pulse counter inputs and one analog input, and control two irrigation valves of the latching solenoid type.

The frequency of operation is in the 432 to 470 MHz range, making it adaptable to most radio communication regulations in the world. The output power is 10 mW, while the modulation is narrow-band FM (12.5 or 25 kHz channel spacing).



Due to its construction as well as to the software controlling it, the power consumption is extremely low. The unit operates off an internal

6.2 Volt rechargeable battery, which is charged either by a solar panel or an external power adapter. A special configuration can be implemented where no internal battery is used, rather the power is obtained exclusively over an external connector.

The A724 is a ruggedized unit, complying to the IP65 environmental protection class (NEMA 4). You can easily install and integrate the unit into an Adcon A733 network. Depending on the topography, you can get a reliable wireless connection to an A733 series device to distances up to 1000 meters. Under favorable conditions, the distance can be even farther.

## Conventions

Certain conventions apply in this document.

<i>Italics</i>	Indicate that the text is variable and must be substituted for something specific, as indicated in the explanation. Italics can also be used to emphasize words as words or letters as letters.
<b>Bold</b>	Indicates special emphasis of the text. Also indicates menu names and items in a window.
<code>fixed font</code>	Indicates characters you must type or system messages.
<b>File ▶ Save</b>	Indicates menu selection. For example, select the <b>File</b> menu, then the <b>Save</b> option.
Note	Indicates information of interest. Notes appear <b>after</b> the information they apply to.
 CAUTION	Indicates that you may get unexpected results if you don't follow the instructions. Cautions appear <b>before</b> the information they apply to.
 WARNING	Indicates danger to yourself or damage to the device if you don't follow the instructions. Warnings appear <b>before</b> the information they apply to.

## Chapter 2. Using the addSWITCH

The A724 Series 4 addSWITCH remote telemetry unit (RTU) is part of the A7xx series. For testing purposes, you should have an A840 or A850 Telemetry Gateway including the A440 Wireless Modem installed before you install the A724 Series 4 RTU. For information about installing the A840 or A850, refer to the device's user's guide.

### Opening the packages

The addSWITCH RTU package contains the A724 Series 4 RTU, a valve connector cable, and a ring clamp. If ordered, the following items come in separate packaging:

- A solar panel with ring clamp
- A set of aluminum poles
- An LED tool
- Sensors and cables, one box per sensor, and one or several cable ties in each sensor box

Make sure you have received all the equipment and read through the instructions that follow. When you are sure you understand them, you are ready to install your RTU.

Figure 1 shows the front view of an addSWITCH RTU.



**Figure 1. addSWITCH RTU**

**Note:** *If you turn or manipulate the Gore Prevent element, the unit's IP65 environmental protection could be affected.*

## Installing the RTU

The following restrictions apply:

- In general, the typical "line-of sight" distance the RTU can communicate is 1 km (0.6 miles). This is valid if both the RTU and its partner device are mounted on a 3 m mast (9 ft.). The results can vary under different conditions and you could achieve higher or lower distances.
- As with all wireless communication devices, the higher the transmitter is installed, the better the communication will be.



## Field Installation

It is relatively easy to install RTUs in the field. You can perform a connectivity check with an LED tool, an example of which is shown in Figure 2.



**Figure 2. LED Tool**

**Note:** *The LED tool is a blind plug to be connected to the POWER connector.*

Follow these steps to install Adcon's RTU in the field:

1. Review the installation area and choose the best site.
2. Perform a connectivity check using the LED tool:
  - a. Insert the LED tool into the POWER connector and wait up to 10 seconds. If the unit connects to at least one station (or a base station), it will light up the LED for about four seconds.
  - b. Keep observing the LED tool and, after another several seconds, the LED will blink one or more times (the number of blinks indicates the number of stations it has contacted).
3. Unpack the pole set.
4. Using a sledge hammer, drive the base pole (pointed tip) into the ground until it is securely and tightly seated. To prevent damage to the top of this pole make sure to put a protective cap on top of it prior to pounding it in. Such a pole pounder can be ordered from your Adcon distributor (item number 900.000.014).
5. Using a ring clamp, fasten the solar panel onto the aluminum pole. Make sure that the panel is facing south (north if you are located in the southern hemisphere) and out of the way of the RTU.

**Note:** *The solar panel can be mounted under or behind the RTU, but be sure that the RTU does not shadow the panel.*

6. Fasten the RTU to the top of the pole using another ring clamp. Adcon recommends that you perform another connectivity test, if you can, to check the positioning of the device.



### **WARNING**

*If you turn the fastening screws too tightly, you might damage the plugs.*

7. Attach the sensors to the INPUT connectors and the solar panel to the POWER connector by turning the plugs' fastening screws clockwise until secure.
8. Secure the extra length of the sensor cables to the pole with UV resistant cable ties.

This completes the installation of your addSWITCH RTU. If one of the I/O connectors is left unused, use the cap provided to protect it against moisture and dust. Be sure to make a note of the following information because you'll need it when you configure the device in the software:

- Serial number of each RTU and location
- Type of sensors connected to which port of each RTU

## More about the LED tool

The LED tool allows you to rapidly check the status of an RTU. After you insert the LED tool into the POWER connector, the unit waits up to two seconds and then sends a broadcast frame. If a nearby listening station or receiver decodes the frame, it will answer—this may take up to 10 seconds. When an answer is received, the LED tool lights up for about four seconds. After another few seconds, the LED lights up one or more times, depending on the number of stations/receivers that answered to its broadcast frame.

In addition, the LED always blinks briefly at half-second intervals to indicate that the unit is alive and the internal battery has enough energy to operate. If the blinking interval lengthens to two seconds, the battery has become undercharged (that is, under 5.6 volts but over 5.2 volts)—this is called the *misery* state. In this state, an RTU reduces its activities to a minimum. The radio unit is switched off, the sensor sampling ceases, and no data is stored in the internal memory. Only the internal real-time clock is maintained and the power management functions are performed.

If the battery level drops below 5.2 volts, the system switches completely off, effectively decoupling itself from the battery in order to protect it. In this case the LED tool stays permanently off. An RTU in such a situation will restart only after connecting it to an external power supply (even a solar panel under low light conditions).

**Note:** *New addSWITCH RTUs are delivered with their internal batteries unformatted, meaning they have never been charged before. You should install them only on sunny days. The battery will be fully charged after two consecutive sunny days, but you should get an LED light-up after several minutes of charging in the sunlight. You can also charge the unit with Adcon's RTU charger (item number 200.733.550).*

## The addTIMER extension for addVANTAGE Pro 5.3 and newer

In order to fully exploit the capabilities of the A724 addSWITCH, we have developed the addTIMER extension for addVANTAGE Pro. This extension lets you define several irrigation shifts by determining their start time and their run time in minutes. By assigning a valve to a predefined shift, addTIMER will automatically open and close each addSWITCH without further intervention by the user. This routine will continue until you modify or halt the sequence.

To configure the addSWITCH RTU in your A840 or A850 Telemetry Gateway and addVANTAGE Pro, please check the respective user guide.

## Maintaining and servicing the RTU

A Series 4 RTU needs virtually no maintenance. It is waterproof and designed to withstand harsh environmental conditions (-30 to +70 °C, or -22 to 158 °F), high RH values, water, and other non-corrosive liquids. It conforms to the European protection class IP65. This applies also to the connectors, as long as they are mated. Don't let unmated connectors on either the RTU or the sensors be exposed to the environment for extended periods of time as this might seriously affect their functionality.

### The RTU battery

The internal battery supplies 6.2 volts and consists of a NiMH pack. The internal electronics manage the battery's charging/discharging process, ensuring it a long life time. This approach, coupled with a remarkably low average power consumption, allows an RTU to operate at least two weeks on a fully charged battery, under the following conditions:

- The radio channel used has moderate radio activity, with requests every 15 minutes.
- The analog and the counter values are stored in the internal memory every 15 minutes.
- No more than 40 valve activations per day (12V Type).

Table 1 shows the addSWITCH device's expected operation time on a fully charged battery under various conditions.

**Table 1. addSWITCH Device Operation Time**

Radio Activity	Valve Actions	Average Consumption (mA)	Estimated Operation (days)
No	none	0.667	100
Yes	none	0.833	80
Yes	40	1.8	37

**Note:** "Radio activity" means that one base station and one to three RTUs are active on the same operating frequency and within the transmission distance of the addSWITCH.

However, if for some reason (wearout or accident) the battery loses its capacity (noted in the software with repeated "Battery low"

messages), it must be replaced. Make sure though, that the problem is really due to the battery and not to a defective or dirty solar panel.

Adcon highly recommends that you frequently check and clean your solar panels. Rain and dust can cover the solar panel's surface with a thin layer of dirt, effectively reducing its power output. Surrounding vegetation can also lower panel efficiency.

## Replacing the battery

If you have verified that the battery needs to be replaced, follow these steps to do so:

1. Open the lid by unscrewing the four screws in the corners of the RTU, then remove the lid as shown in Figure 3. Make sure to use a 3mm Allen key to prevent damage to the screw heads.



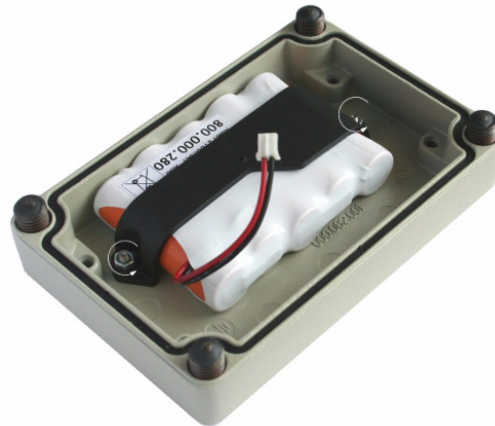
**Figure 3. Removing the addSWITCH Lid**

2. The battery pack is connected to the electronics board by means of a PCB connector. Remove the battery pack's plug from the PCB connector, as shown in Figure 4.



**Figure 4. Unplugging the PCB Connector**

3. Unscrew the two nuts of the plastic cover that holds the battery pack in place, then remove the cover. Figure 5 shows the battery pack inside the RTU.



**Figure 5. Battery Pack**

4. Remove the battery pack and replace it with a new one (obtainable from Adcon).
5. Replace the plastic cover and fasten the two nuts.
6. Insert the battery plug into the PCB connector.



**WARNING**

*Be sure to mount the rubber gasket properly, so that the unit's IP65 environmental protection is not affected. You must also be sure to not squeeze the battery cable.*

7. Mount the lid back, taking care that the rubber gasket sealing the box is correctly in place and free of dirt and soil.

8. Screw the four cover screws back in, applying a moderate force.

# Chapter 3. Performing Advanced Functions

With the appropriate knowledge, you can configure addSWITCH devices in the field by using a hyperterminal window. To configure the RTU, you will need a special serial cable adapter (not supplied, but available from your Adcon distributor).



## CAUTION

*Do not try to configure your RTUs if you are not sure what to do—the unit might not communicate with the remote measuring station or function with the addVANTAGE software.*



## WARNING

*Tampering with parameters for the RTUs may void your warranty or damage the device. In general, the commands described in this chapter are intended for technical support staff and users with a great deal of highly technical hardware and software experience.*

In the system architecture, the base station and RTU are both considered to be nodes. The base station is called the master node, or *master*, while the RTU is called the slave node, or *slave*.

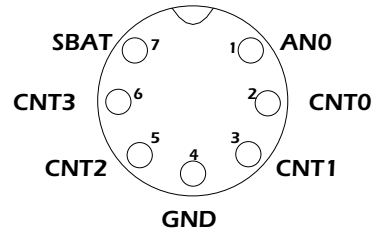
## Understanding connectors

The addSWITCH devices have cable attachments called *connectors*. The connector type determines how the device communicates with the sensors or the computer.

### The RTU connector

The A724 Series 4 addSWITCH RTU uses a non-standard 7-pin sensor I/O connector (model Binder 702 and 712 series or equivalent). The

connector contains four pulse counter inputs, one analog input, and a sensor supply voltage output. Figure 6 illustrates the individual pins of an I/O connector.



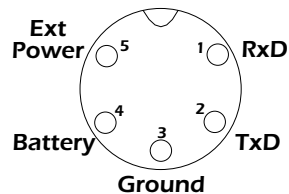
**Figure 6. Pins on the I/O Connector (Top View)**

## The POWER Connector

The RTU also has a POWER connector, which allows for:

- External supply (battery or any DC source from 5.6 to 10 volts)
- External charge supply (either a solar panel or an AC adapter) if an internal rechargeable battery is used
- Communication over serial lines, at 19200 baud

Figure 7 illustrates the connections available at the POWER connector.



**Figure 7. A724 POWER Connector (Top View)**

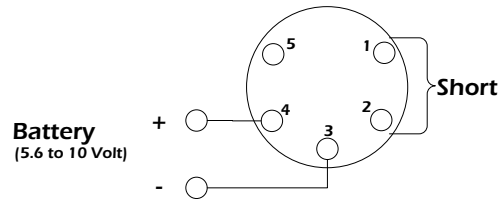


### **WARNING**

*The serial line is 3-volt CMOS compatible; therefore, a special adapter cable must be used to reach the RS-232 levels. Also, if an external battery is used, the internal battery must be disconnected.*

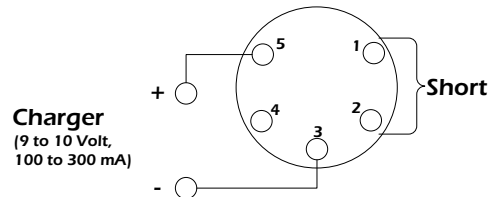
You might want to use the POWER connector with something other than the standard configuration. For example, if you want to connect an external battery to the RTU, disconnect the internal battery and use the configuration shown in Figure 8.





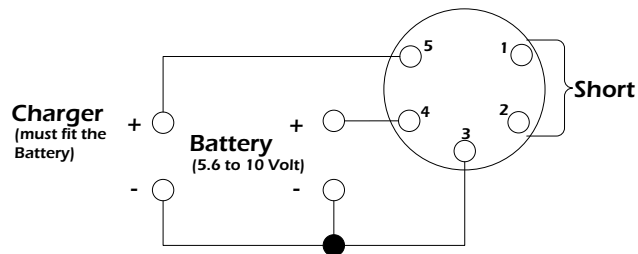
**Figure 8. A724 Connection with External Battery**

If you want to use the internal battery with a different power supply (charger) than the provided solar panel, disconnect the solar panel and use the configuration shown in Figure 9.



**Figure 9. A724 Connection with External Power Supply**

And if you want to use an external battery with a different power supply (charger) than the provided solar panel, disconnect the internal battery and solar panel and use the configuration shown in Figure 10.

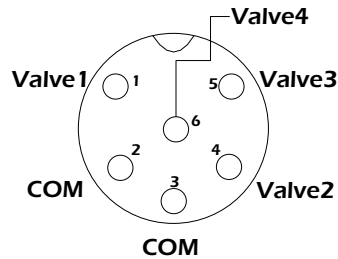


**Figure 10. A724 Connection with External Battery and Power Supply**

## The VALVE Connector

The VALVE connector (Figure 11) is used to connect up to four latching solenoids. The connector is a 6-pin SWITCHCRAFT connector (EN3P6F, counterpart is the EN3C6M).

The A724 comes with a 0.5m cable with flying ends. A standard insulating screw joint can be used to connect the solenoid. It is up to you to protect this insulating screw joint for outdoor usage.



**Figure 11. The Valve Connector**



**WARNING**

*Do not use only one COM wire for all valves.*

Connect the positive terminals (commonly red) of the valve to the corresponding Valve1-4 pins and the negative terminals (commonly black) to the COM pins.



**WARNING**

*Be sure to check the cabling, otherwise one or more valves will switch to ON state when the RTU enters misery mode or upon a reset of the RTU.*

**Table 2. Valve Connector Signals and Cable Colors**

Signal	Switchcraft pin	Color
Valve1	1	white
COM	2	brown, green
Valve2	4	yellow
Valve3	5	gray
COM	3	pink, blue
Valve4	6	red

**Note:** *COM wires brown and green should be used for valve1 and valve2, pink and blue for valve3 and valve4.*

The cable colors of your valve may differ from this scheme. Please consult the manufacturer of your valves.

**Note:** *When the polarity is reversed, the valve operation is also reversed. The user can check the correct cabling with the power up sequence of the A724.*



**WARNING**

*Be sure to check the cabling for shortcuts because the RTU can be damaged when it is operated with improper connections.*

When the A724 starts up (e.g. the battery is connected), it immediately sends OFF commands to all valves (sequential).

## Communicating with the RTU

You can use a Windows Hyperterminal window to connect to the addSWITCH RTU. After you have installed the system, follow these steps to configure the device and set the default parameters:

**Note:** *To configure the A724 Series 4 RTU, you must have a special adapter cable (item number 200.720.540 from your Adcon distributor) and plug it into the POWER connector.*

1. Open a Hyperterminal window.
2. Select the appropriate serial port and click **OK**.
3. Configure your terminal as follows:
  - 19200 baud
  - 1 stop bit
  - 8 data bits
  - No parity
  - No protocol (neither hardware nor software)
4. Select **OK** to open the terminal window.
5. Press **Enter** to generate a response in the window.

**Note:** *Beginning with the A724 Series 4, RTUs operate in two modes, **bootloader** and **firmware**.*

## Booting the RTU

**Note:** *This section is included for informational purposes. You will rarely need to boot the RTU. However, when you do need to do so, you will work within a Windows Hyperterminal window on your computer.*

When the Series 4 RTU starts from a power-up reset (such as when you connect the battery to the RTU), it enters the bootloader mode. If you press no keys in the interim, the RTU enters the firmware mode in five seconds.

If you want to work with commands in the bootloader rather than continuing to the firmware mode, press ESC within five seconds after seeing the following sign-on message:

```
A724_S4 Bootloader V1.7
Copyright (C) Adcon Telemetry GmbH 2009
Press <ESC> within 5 seconds to start the commandline
interface...
```

You are in the command line interface. The command line interface enables you to perform certain commands such as rebooting the RTU and upgrading to a new firmware.

**Note:** *If you press no keys within 60 seconds, the command line interface will start firmware mode automatically.*

In bootloader mode, the command line interface's prompt is the character `>`. Therefore, to reboot the RTU just type the following after you see the `>` prompt:

```
reboot
```

An alternative way to boot the RTU is to disconnect the battery and after a few seconds reconnect it.

For a list of the available commands, type `Help` at the `>` prompt.

```
Available commands:
```

```
upgrade [baudrate] ... upgrade from Y-modem download
version ... show the version of the bootloader
state ... show the board state
reboot [id] ... reboot the RTU
firmware ... start the firmware
help ... display this help text
```

*Note:* For some commands, such as the `reboot` command, you can supply the ID of the RTU.

## Firmware Mode

When you enter firmware mode, the following message is displayed in the Hyperterminal window:

```
Checking firmware ... firmware found!
41239 0
#
```

The bootloader scans the program memory for a valid firmware by testing the checksum, which takes a moment. If everything is correct, the "firmware found!" message appears.

A moment after the firmware is found, the RTU's identification number (for example, 41239) and error code (in this example, 0) are displayed. After another moment, the firmware mode's command line interface prompt is displayed (`#`).

If you need to return to bootloader mode when you're in firmware mode, enter the `Reboot <ID>` command at the prompt.

See "Using terminal commands" on page 24 for commands available in firmware mode.

## Upgrading the Firmware

*Note:* This section is included for informational purposes. You will rarely need to upgrade the firmware. However, when you do need to do so,

*you will work within a Windows HyperTerminal window on your computer.*

Before upgrading the firmware, you must reboot the RTU to access the bootloader mode's command line interface. Follow the procedure described under *Booting the RTU* to get into the bootloader.

**Before you start the upgrade, it is very important that you copy the firmware image to the hard drive of the computer you use in the field.**

You also need to know which version of the bootloader you are running. You can determine the version any of the following ways:

- Look at the bootloader's signon message when you start it.
- At the bootloader mode's > prompt, enter the `Version` command.
- In firmware mode, enter the `Reboot <ID>` command and look at the signon message.
- In firmware mode, enter `ver` at the # prompt.

Now you're ready for the upgrade.

1. At the '>' prompt, enter the following command:  
`upgrade 115200`

The upgrade process starts.

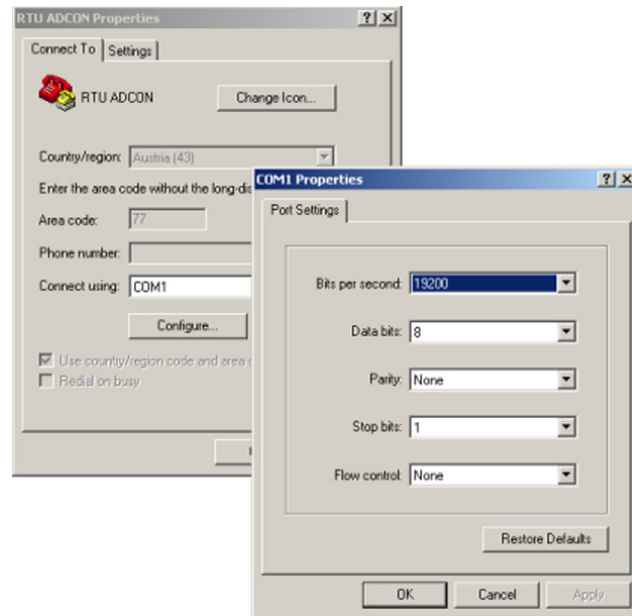
**Note:** *For pre-1.7 versions of the bootloader, omit the speed parameter (115200 used to be the default). For 1.7 and later versions, include the 115200 baudrate parameter. If you do not specify a baudrate, the upload runs at the default 19200 baudrate.*

`Change the baudrate of your terminal to '115200' and hit <Return> to start flashing.`

2. Select **File** **»** **Properties** to open the hyperterminal's Properties dialog.
3. Select a com port for the **Connect using** field.

**Note:** *If your bootloader is version 1.7 or later and you used the > update command rather than the > update 115200 command, you can skip Step 4 through Step 6. The bootloader will use a baud rate of 19200.*

4. Click the **Configure** button to display the com port's Properties dialog (Figure 12 shows a COM1 com port).



**Figure 12. Hyperterminal and Com Port Properties Dialogs**

5. In the **Bits per second** field, select **115200**.
6. Select **OK** in the com port's Properties dialog to close it.
7. Select **OK** in the hyperterminal's Properties dialog to close it.
8. Back in the hyperterminal window, press **Enter** to continue the upgrade.

-----  
**The current firmware image must be erased for the upload.**

**If you continue now, you \*MUST\* upload a valid firmware image for an A724\_S4!**

Continue? [y/n]:



**WARNING**

*When you continue with the upgrade process, any existing firmware image in the RTU's flash memory will be erased! You must supply a valid image for upload or the RTU will have only bootloader capabilities (that is, it will have no radio capabilities).*

9. Enter **Y** to continue the upgrade.

The bootloader starts sending the letter C (for connect)

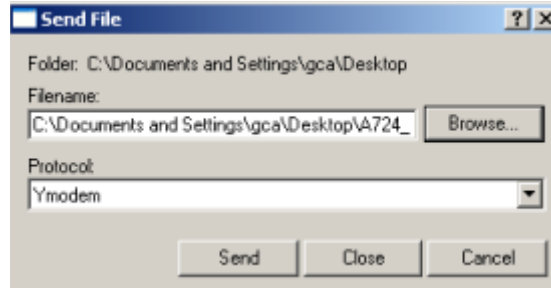
**Starting flash blankcheck and erase process. . . done**

-----  
**Start the Y-modem upload now!**

**Starting CCCC**

- From the hyperterminal window's menu bar, select **Transfer ► Send File** to display the dialog shown in Figure 13.

**Note:** You must start the image upload within 60 seconds or a timeout will occur.



**Figure 13.** Dialog to Upload Firmware Image

- Browse to and select the firmware image.
- Select the `Ymodem` **Protocol** and click **Send**.
- To start the new firmware, enter the following command:

```
firmware
```

## Serial communication protocol

This protocol is based on a master sending commands and a node answering. The whole communication is conducted in plain ASCII, as strings, and numbers are represented in decimal format. All commands are terminated with a CR/LF combination. All responses (answers) are terminated with the `#` character.

### General format of a command

The commands have the following format:

*ID Command Param1 Param2 ... ParamN*

- `ID` is the destination device. If you include an ID as part of a command, the node checks whether `ID=ownID`. If it does, the node executes the command on itself. If the ID is not the node's ID, the node executes the command on a remote device, if such an ID exists. If the ID is missing, this implies that the command is addressed locally.

**Note:** Not all the commands can be relayed remotely.

- `Command` is the command proper, which can be composed of a variable string of characters (for example, `SLOT`). Each node can implement a set of commands depending on the functionality of the node itself. However, as a minimum requirement, a node recognizes the `CMDS` command, which returns a list with the commands accepted by the node.

- `Param1 Param2 ... ParamN` represent the parameters, which are command dependent. If you type no parameters when you issue a command, it is the equivalent of querying for information (the **GET** version of a command). If you type parameters, you are issuing the **SET** version of a command and are setting the command to the parameters you typed.

## General format of an answer

The answers have the following format:

*ID Command Result1 Result2 ... ResultN ErrResult #*

- `ID` is the answering device. If a command was further routed, it is the ID of the end device. The answer must always contain the ID on return.
- `Command` is the string representing the original command. It is supplied so that a master can distinguish between the answers it is waiting for, and out-of-band notifications (which may come, for example, over the radio port of a node). As with the ID, the command name must always be supplied.
- `Result1 Result2 ... ResultN` are the result values returned by the remote node. If the `ErrResult` is not zero, all other possible characters and/or strings until the end of the line might be ignored.
- `ErrResult` shows whether the command was successfully executed. If this value is 0, the command was successfully executed. If this value is other than 0, the command failed. The number may further indicate the error type. (See also “Returned errors list” on page 42.)

The answer string may contain any number of spaces or CR/LF characters between its components. However, after the terminator (`#`), no other characters are allowed.

## Using terminal commands

The addSWITCH A724 firmware is basically the same as the addIT A723 Series 4, except for the following items:

- new device type: `A724_S4`
- digital ports are used internally for valve control (bit 4-7)

Following is a list of available commands and an explanation of their use.

*Note:* You can type uppercase or lowercase characters because the commands are not case sensitive.

### **ANLG**

#### DESCRIPTION

Sets/returns the various parameters for the analog subsystem (for example, the sampling/averaging method).



PARAMETERS	A control byte specifying the command and the analog input channel number the command is acting on. Please look into the <i>A733 User Guide</i> for a complete command description.
RETURNS	The current ANLG setting.
REMARKS	For the A724 Series4, only one analog channel is available.
REMOTE	Yes.
EXAMPLE	<pre># ANLG 64 41239 ANLG 0 # ANLG 0 41239 ANLG 0 4 0 0 0 0 0 0 0 0 0 0 0 0 #</pre>

**ANRT**

DESCRIPTION	Sets/returns the analog signal routing configuration for RTUs earlier than Series 4.
PARAMETERS	See the manual for the appropriate pre Series 4 RTU.
RETURNS	The current setting.
REMARKS	Remote only. Support for pre Series 4 RTUs.
REMOTE	Yes.
EXAMPLE	<pre>14446 ANRT 14446 ANRT 0 1 2 3 4 5 6 7 8 9 10 11 0 #</pre>

**B**

DESCRIPTION	Sends a broadcast frame.
PARAMETERS	None.
RETURNS	A data block.
REMARKS	After the device has sent the broadcast frame, it will listen for answers. All valid answers will be listed with their IDs.
REMOTE	Yes. A device getting this frame would have to wait for a random time (2 to 10 seconds) before performing the actual broadcast; if no terminal is active, no results will be listed. A list of stations heard, with their RF levels, will be updated in the memory and will be available whenever the <b>BLST</b> command is issued.
EXAMPLE	<pre>B 41239 B 0 #42340 BA 0 #34781 BA 0</pre>

**BLST**

DESCRIPTION	Lists the stations heard after the last broadcast command was issued.
PARAMETERS	None.
RETURNS	The date and time the broadcast was performed, the number of stations heard, and a list with the heard stations' IDs and their respective RF levels.
REMARKS	<b>GET</b> only.
REMOTE	Yes. The remote version will list only the first nine stations heard.
EXAMPLE	<pre> BLST 41239 BLST 08/05/2009 15:56:04 4 42340 235 255 34781 255 255 # </pre>

**CALC**

DESCRIPTION	Sets/returns the settings for optional minimum and maximum values for the analog input.
PARAMETERS	Two 1-bit bitmasks. The first mask is used to enable minimum and the second for maximum values.
RETURNS	The current CALC setting.
REMARKS	The masks are binary masks.
REMOTE	No.
EXAMPLE	<pre> # CALC 1 1 41239 CALC 0 # CALC 41239 CALC 1 1 0 # </pre>

**CMDS**

DESCRIPTION	Returns a list of supported commands.
PARAMETERS	None.
RETURNS	A list of strings separated by spaces.
REMARKS	<b>GET</b> only.
REMOTE	No.
EXAMPLE	<b>CMDS</b>

```
41239 cmds ANLG ANRT B BLST CALC DATA DATASDI DPE DYNSLOT
FDEV FREQ ID INFO MSTR PMP PORT ROUTE RSSI SBAT SLOT SST
TIME TYPE VER VERB XCONF XDATA XIMME 0
#
```

**DATA**

**DESCRIPTION** Retrieves data frames from RTUs earlier than Series 4.

**PARAMETERS** See the manual for the appropriate pre Series 4 RTU.

**RETURNS** A pre Series 4 data frame.

**REMARKS** Remote only. Support for pre Series 4 RTUs.

**REMOTE** Yes.

**EXAMPLE**

```
14446 DATA 14446 24/12/2008 16:00:00
14446 DATA 24/12/2008 16:00:00 21 37 235 255 15
0 0 0 89 2 0 350 0 0 0 0 0 2 504 1312 0 0
#
```

**DATASDI**

**DESCRIPTION** Retrieves SDI-12 data frames from RTUs earlier than Series 4.

**PARAMETERS** See the manual for the appropriate pre Series 4 RTUs.

**RETURNS** A pre Series 4 SDI-12 data frame.

**REMARKS** Remote only. Support for pre Series 4 RTUs.

**REMOTE** Yes.

**EXAMPLE**

```
14446 DATASDI 14446 24/12/2008 16:00:00
14446 DATA 24/12/2008 16:00:00 FIXME
#
```

**DPE**

**DESCRIPTION** Sets/returns the digital port event settings of a device.

**PARAMETERS** The first parameter is the 12-bit bitmask to specify the port bits that will trigger a digital port event.  
The second parameter is the timeout in seconds (1-65536). When the timeout occurs without a port change on a configured port, a digital port event will be enforced. This is useful for having regular port state updates and additionally updates when the port state changes. Use 0 for the second parameter to turn off the timeout.

**Note:** *A low timeout value will produce a lot of dataframes, which might overload the radio channel transmission capacity!*

RETURNS	The current settings.
REMARKS	GET/SET.
REMOTE	Yes, via XCONF.
EXAMPLE	<p>This example shows a setup where a status change of one of the valve ports will throw a digital port event. Additionally, the state of the valves will be recorded every 3600 seconds with a digital port event.</p> <pre># dpe 240 3600 41239 dpe 0 # dpe 41239 dpe 240 3600 0 #</pre>

## ***DYNSLOT***

DESCRIPTION	<p>Sets/returns the dynamic slot switching function of the device. The dynamic slot switching function checks whether the measurement value of a given sensor matches the given condition, then switches between two operating modes:</p> <ul style="list-style-type: none"> <li>1—normal mode (when the condition is false and the lock timer is zero)</li> <li>2—execution mode (when the condition is true and the lock timer is non-zero)</li> </ul> <p>The rules for the mode switching are:</p> <ul style="list-style-type: none"> <li>• When the condition becomes true the first time, exception mode is entered and the lock timer is set.</li> <li>• While the condition is true, the lock timer is set at every sample; thus it does not reach zero.</li> <li>• While the condition is false, the lock timer is decremented if not already zero.</li> <li>• When the lock timer reaches zero, normal mode is entered.</li> <li>• The SLOT settings are changed only when the mode changes.</li> </ul> <p>Thus, the RTU enters exception mode whenever a sample value matches the condition, and stays there until the sample value does not match the condition for at least the given lock time (this prevents excessive wear of the EEPROM due to jitter in the measurement value).</p>
PARAMETERS	<p>1—sensor type (0=none, 1=internal battery, 2=anlg, 3=port, 4=counter).</p> <p>2—sensor address (channel number as in the ANLG and PORT command).</p> <p>3—limit type (0=above, 1=below, 2=out of range, 3=within range).</p>

4—the limits (depending on limit type):  
 For type=0 /1—one limit.  
 For type=2/3—two limits.

**Note:** *The limit values are raw adc values (0-2.5V=0-65535).*

5—a bitmask specifying for which connector the SLOT value must be changed (0=internal, 1..4=I/O-A..I/O-D, 5=Valves, 6=SDI-12).

6—lock time for the active state.



### WARNING

*Timeout values lower than 3600 seconds can lead to an excessive use of the data storage. This can reduce dramatically the lifetime of the device.*

7—SLOT value for exception state.

8—SAMPLE value for exception state.

9—SLOT value for normal state.

10—SAMPLE value for normal state.

### RETURNS

The actual setting, the lock timer value (0=inactive, 1-43200=active) and the number of dynamic slot switches since power-on of the RTU.

### REMARKS

GET/SET.

### REMOTE

Yes.

### EXAMPLE

This example describes a DYN SLOT setup for:

- I/O-A (Input connector) cabling 1 (Analog channel 0)
- When value is greater than 1.25V (1.25V=32768)
- SLOT/SAMPLE will be altered on I/O-A (Input connector)
- Timeout will be 3600 seconds
- The exception SLOT/SAMPLE settings will be 900 15
- The normal SLOT/SAMPLE settings will be 900 15

```
# DYN SLOT 2 0 0 32768 0x02 3600 60 1 900 15
41239 DYN SLOT 0
# DYN SLOT
41239 DYN SLOT 2 0 0 32768 0x02 3600 60 1 900 15 0 0 0
#
```

### FDEV

#### DESCRIPTION

Formats the internal memory (might destroy all the data).



### WARNING

*The chip configuration setting (first parameter of the command) depends on the current hardware version and must not be altered.*

*Please contact our support team for further information.*

#### PARAMETERS

If the parameters are missing, the command will show the current settings. To format the internal memory (all data will be lost) with the current settings, use 0 as the first parameter. The storage

organization (only index size), can be optimized for your specific application.

The first parameter for this command is the chip configuration and second parameter is the index size.

The following EEPROM types are currently available:

- 3– 32Kbytes (e.g. model 25256, 1 device)
- 7– 64Kbytes (e.g. model 25256, 2 devices)

RETURNS

Current setting.

REMARKS

**GET/SET.**

REMOTE

Yes, **SET** only.

EXAMPLE

```
FDEV
41239 fdev 7 32+32 256..4096 1280/0 51200/0 0
# FDEV 7 1280
41239 fdev 0
#
```

## **FREQ**



### **CAUTION**

*Do not change the frequency of your device without reason: apart from the fact that it might not communicate in the network anymore, you might also violate the applicable radiocommunications laws in your country. Depending on the destination country, some models may also return an error message.*

DESCRIPTION

Sets/returns the operating frequency.

PARAMETERS

The operating frequency and step (Hz), or none in the **GET** version.

RETURNS

The actual frequency and step, in Hz.

REMARKS

**GET/SET.**

REMOTE

Yes, **SET** only.

EXAMPLE

```
FREQ 433925000 25000
41239 FREQ 0
#

FREQ
41239 FREQ 433925000 25000 0
#
```

## **ID**

DESCRIPTION

Sets/returns the node's ID.

PARAMETERS

The node ID.

RETURNS

The node ID.

REMARKS           **GET/SET.**

REMOTE            Yes, **SET** only.

EXAMPLE           **ID 4557**  
**41239 ID 0**  
**#**

**ID**  
**4557 ID 4557 0**  
**#**

## **INFO**

DESCRIPTION       Returns various status information.

PARAMETERS       None.

RETURNS           A list of a device's internal variables:  
*ID INFO rf\_in rf\_out date time ver clk stack cop batt temp  
days\_uptime hr:min\_uptime rssi pmp\_low pmp\_high type slot  
samples po err\_level*  
**#**

The formats for the above parameters are as follows:

- *rf\_in* and *rf\_out* as a decimal
- *date* as dd/mm/yyyy
- *time* as hh:mm:ss
- *ver* as x.x
- *clk*, *stack*, and *cop* as decimal; they represent internal housekeeping parameters: the A724 uses *cop* to number watchdog occurrences, but *clk* and *stack* are currently undefined
- *batt* as battery level using the standard voltage conversion equation (0 is 0 volts, 255 is 20 volts)
- *temp* as internal temperature in the the A724 housing, which is device dependent. The precision of the sensing element is low ( $\pm 2^{\circ}\text{C}$ ), but it is sufficient for battery power management (charge/discharge). To compute the actual value (in  $^{\circ}\text{C}$ ), the following equation must be used:

$$Temp [^{\circ}\text{C}] = \frac{\text{internalTemp} \cdot 400}{255} - 68$$

- *days\_uptime* in days; together with *hr:min\_uptime*, it represents the amount of time the device is up without a reset or watchdog
- *hr:min\_uptime* in hours:minutes format
- *rssi* as decimal; it is the value programmed with the **RSSI** command

- *pmp\_low* and *pmp\_high* are the programmed values with the **PMP** command)
- *type* is used to represent the device type; the following types are currently assigned:
  - 0 for A730MD
  - 1 for A720
  - 2 for A730SD
  - 3 for A720B
  - 4 for A733
  - 5 for A723
  - 6 for A440
  - 7 for A733GSM
  - 8 for A731
  - 9 for A732
  - 10 for A740
  - 11 for A740GSM
  - 12 for A724
  - 13 for A725
  - 14 for A726
  - 15 for A723\_S4
  - 16 for A724\_S4
  - 21 for A733GSM\_S4
- *slot* and *samples* are the actual values programmed by means of the **SLOT** command
- *po* is the power output of the device during the last frame sent
- *err\_level* is the error value; 0 means no error

REMARKS

**GET** only.

REMOTE

Yes, **GET** only. The the A724 can issue the command both remotely and locally.

EXAMPLE

```

INFO
41239 INFO 0 80 08/05/2009 15:05:55 1.3 0 0 0 77 61 7 1:46
100 65 72 16 60 0 21 0
#

```

**MSTR**

DESCRIPTION

Sets/returns the master receiver setting, which is used for delivery of notifications.

PARAMETERS

The ID of the master receiver.

RETURNS

The current master setting.

REMARKS

MSTR is used for notifications delivery only, not for time synchronization.

REMOTE

No.



EXAMPLE           # MSTR 43  
                   41239 MSTR 0  
                   # MSTR  
                   41239 MSTR 43 0  
                   #

### **PMP**

DESCRIPTION       Sets/returns the node's Power Management Parameters (switches the battery charge on/off).

PARAMETERS        The lower (switch on) and the higher limit (switch off), both in volts x 10. Standard Values are 65 (for 6.5 Volts) for switch on and 72 (for 7.2 Volts) for switch off, for a standard 6.2 Volt NiMH battery. From these values, other thresholds are internally computed.

RETURNS           The lower (switch on) and the higher limit (switch off), both in volts x 10.

REMARKS           **GET/SET.**

REMOTE            Yes, **SET** only.

EXAMPLE           **PMP 65 72**  
                   41239 **PMP 0**  
                   #  
                   **PMP**  
                   41239 **PMP 65 72 0**  
                   #

### **PORT**

DESCRIPTION       A complex command acting upon the I/O ports of a device.

PARAMETERS        A control byte specifying the command the bit of the port to command is acting on, and two 16-bit parameters, depending on the control byte. For some commands, the control byte or the parameters (or both) might be missing. Refer to the *A733 User Guide* for a complete command description.

RETURNS           The result depends on the control byte.

REMARKS           For the A724 Series4, only one analog channel is available.

REMOTE            Yes.

EXAMPLE           **For MFS:**  
                   # **PORT 212 1 20**  
                   41239 **PORT 212 0**  
                   #

**ROUTE**

DESCRIPTION	Sets/returns the routing information of a device.
PARAMETERS	None, or a route (with destination) containing up to eight intermediaries. When just the destination ID is given, the route for this device is deleted.
RETURNS	The commands success or error code and the route table.
REMARKS	GET/SET.
REMOTE	No.
EXAMPLE	<pre>For MFS: # ROUTE 41240 43 41239 ROUTE 0 # ROUTE 41239 ROUTE 41240 43 0 #</pre>

**RSSI**

DESCRIPTION	Sets/returns the Relative Signal Strength Indicator threshold at which the RF receiver must wake up.
PARAMETERS	The threshold value. For the A724 Series 4, it can take values from 0 to 255; it is typically factory set to 100.
RETURNS	The instant RSSI value and the programmed threshold.
REMARKS	<b>GET/SET.</b>
REMOTE	No.
EXAMPLE	<pre>RSSI 50 41239 RSSI 0 #  RSSI 41239 RSSI 34 50 0 #</pre>

*Note:* The values of the RSSI threshold have no units, they are arbitrary.

**RX**

DESCRIPTION	Switches the unit to permanent receive mode (for tuning purposes).
PARAMETERS	None.
RETURNS	Nothing.

REMARKS The system stops, and exits the command only when a key is pressed. This command returns no message.

REMOTE No.

EXAMPLE **RX**  
41239 RX 0  
#

### **SBAT**

DESCRIPTION Sets/returns the operating voltage for the valves .

PARAMETERS The operating voltage of the valves in tenths of volt.

RETURNS The current setting.

REMARKS See also: *Setting the valve voltage* on page 42.

REMOTE No.

EXAMPLE **SBAT**  
41239 SBAT 0 0 120 0  
#

### **SLOT**



#### **CAUTION**

*Changing these parameters may adversely affect the ability of the device to operate for extended periods under low sunlight conditions.*

DESCRIPTION Sets/returns the node's sampling interval and rate.

PARAMETERS The interval (10 - 43200) and rate (0 - 255). The interval represents the time (in seconds) elapsed between two slots stored in the internal memory, while the rate represents the numbers of samples used to build the average that will be stored. No average will be calculated for the interval and the SDI-12 sensors. A third parameter can be used to set the SLOT/SAMPLE settings for a specific connector.

*Note: Not all combinations of SLOT/SAMPLE are accepted due to the time alignment feature of A724 Series 4 RTU.*

RETURNS The interval and rate.

REMARKS **GET/SET.** The default interval is 900 (15 minutes) and rate is 3 (5 samples per 15 minutes).

REMOTE Yes, **SET** only.

EXAMPLE **SLOT** 900 15  
41239 SLOT 0  
#

```

SLOT
41239 SLOT 900 1 900 15 900 15 900 15 900 15 900 1 0 0 0
# slot 600 10
41239 slot 0
# slot
41239 slot 600 1 600 10 600 10 600 10 600 10 600 1 0 0 0
# slot 300 30
41239 slot 0
# slot
41239 slot 300 1 300 30 300 30 300 30 300 30 300 1 0 0 0
# slot 3600 200
41239 slot 0
# slot
41239 slot 3600 1 3600 200 3600 200 3600 200 3600 200 3600 1
0 0 0
#slot 900 3
41239 slot 0
# slot
41239 slot 900 1 900 3 900 3 900 3 900 3 900 1 0 0 0
# slot 60 2 2
41239 slot 0
# slot
41239 slot 900 1 900 3 60 2 900 3 900 3 900 1 0 0 0
#

```

## SST

### DESCRIPTION

Sets/returns the sensor supply time of a device.

### PARAMETERS

The first parameter is the sensor supply time in seconds.  
 The second parameter specifies 0=parallel or 1=sequential measurement. This parameter is not used for the A724 Series 4.  
 The third parameter addresses the channel (connector):

- 0— internal (can't be modified)
- 1— I/O-A (INPUT)
- 2— I/O-B
- 3— I/O-C
- 4— I/O-D
- 5— Valves
- 6— SDI-12

**Note:** *The A724 Series 4 supports only connector I/O-A, which is identical to the INPUT connector. The other connector SST settings should be 0.*

### RETURNS

Current configuration.

### REMARKS

GET/SET.

### REMOTE

Yes, SET only. For full control use XCONF.

### EXAMPLE

```

# SST 0
41239 SST 0

```

```
# SST
41239 SST 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
# SST 5 0 1
41239 SST 0
# SST
41239 SST 0 0 5 0 0 0 0 0 0 0 0 0 0 0 0
#
```

**TIME**

**DESCRIPTION** Sets/returns the real time clock.

**PARAMETERS** The actual time, or none in the **GET** version.

**RETURNS** The actual time as dd/mm/yyyy hh:mm:ss.

**REMARKS** **GET/SET.**

**REMOTE** No.

**EXAMPLE**

```
TIME 10/10/2010 22:10:10
41239 TIME 0
#
TIME
41239 TIME 10/10/2010 22:10:10 0
#
```

**TX**

**DESCRIPTION** Switches the unit to transmit mode (for tuning purposes).

**PARAMETERS** None (sends an unmodulated carrier), **1** (sends a 1 kHz modulated carrier), **0** (sends a 2 kHz modulated carrier) or **5** (sends a mixed 1 + 2 kHz modulated carrier).

**RETURNS** Nothing.

**REMARKS** The system stops, and exits the command only when a key is pressed. This command returns no message.

**REMOTE** No.

**EXAMPLE**

```
TX
41239 TX 0
#
TX 1
41239 TX 0
#
TX 5
41239 TX 0
#
```

**TYPE**

DESCRIPTION Requests the hardware type information of the device.

PARAMETERS None.

RETURNS The hardware type.

REMARKS **GET** only.

REMOTE No.

EXAMPLE **TYPE**  
41239 **TYPE** A724\_S4  
#

**VER**

DESCRIPTION Requests the firmware version of the device.

PARAMETERS None.

RETURNS The current version.

REMARKS **GET** only.

REMOTE No.

EXAMPLE **VER**  
15535 **VER** 1.3.0 0  
#

**VERB**

DESCRIPTION Sets the verbosity level of the RTU. This command is used for debugging only.

**WARNING**

*The RTU will consume a lot more power when the verbosity level is greater than 0. This could discharge your battery and/or prevent from proper operation.*

PARAMETERS A verbosity level (0...255).

RETURNS Error code.

REMARKS SET only.

REMOTE No.

EXAMPLE # **VERB** 1  
41239 **VERB** 0  
**VERB** 1 # src=43 dest=9002 type=?  
src=43 dest=9002 type=?  
verb 0

```
41239 verb 0
#
```

### **XCONF**

DESCRIPTION	This command transmits command strings for commands (those that are suited for this mode of operation) to the targeted RTUs. Allowed commands are: CALC, DPE, DYN SLOT, MSTR, SBAT, SLOT, SST and SDI.
PARAMETERS	A command string.
RETURNS	The replying string and error code.
REMOTE	Yes.
EXAMPLE	<pre># 41240 XCONF SBAT 41240 XCONF SBAT 0 0 120 0 # 41240 XCONF CALC 41240 XCONF CALC 0 0 0 #</pre>

### **XDATA**

DESCRIPTION	Returns data stored for a certain device.
PARAMETERS	XDATA requires a lot of parameters for specifying what to retrieve. Please consult the <i>A740 User Manual</i> for detailed explanation of this command. The output of the command is not intended to be human readable.
RETURNS	A data block.
REMOTE	Yes, for a <b>GET</b> , but only one frame at a time.
EXAMPLE	<pre>XDATA 0 8 0 255 1 0 41239 xdata 0 196 0x18 0x4A042CD0 1 0 0xF6 :0F0262645B3D 0x4A042CD0 1 1 0xF6 :0700000262640B40 0x4A042DFC 1 2 0xF6 :030000003C64 0x4A042CD0 1 3 0xF6 :030000026264 0x4A042CD0 1 4 0xF6 :030000026264 0x4A042CD0 1 5 0xF6 :F3026264 0 #</pre>

### **XIMME**

DESCRIPTION	Samples all inputs and immediately returns the sampled data.
PARAMETERS	First parameter specifies the sample mode, which has to be 2 for raw data. The second parameter sets the maximum packet size. If you specify the third parameter, you can select a certain input connector.

**Note:** Only sample mode 2 is supported on the A724 Series 4 RTU.

**RETURNS** A data block of io-port, raw adc and counter values.

**REMARKS** **GET** only. The command needs a certain delay to execute (for example, for the standard SST setting this delay amounts to two seconds). The delay is necessary to allow for the sensors to settle after applying power to them.

**REMOTE** No.

**EXAMPLE**

```
# ximme 2
41239 ximme
0 0 91 61 0 0
1 240 64 0 0 9
2 240 0 0 0 12
3 240 0 0 0 1890
4 240 0 0 0 19
5 240
0
#
```

The first column is the channel number. Channel 0 uses the internal sensors such as temperature and battery voltage. Channels 1-4 are the virtual connectors IO-A through IO-D. The four counter inputs of the A724 Series 4 are mapped to virtual connectors IO-A through IO-D, although the A724 Series 4 has only one sensor connector (INPUT). Column 6 of channel 1-4 are the counter values. The analog input is mapped to column 3 of channel 1. In the above example, the analog value is 64 and counters 1-4 have a count of 9, 12, 1890, and 19 respectively. The actual valve state is displayed in column 2. The decimal value 240 shows that all four valves are inactive (high=inactive).

**Note:** The number 240 displayed in binary form is 11110000, which means bits 7 to 4 are high.

## Commands for controlling the valves

This section describes various commands you can use to control the valves.

### Switching the valves

The valves can be controlled by the following commands shown in Table 3.



**Table 3. addSWITCH Commands**

Requested action	addSWITCH A724 command
Open Valve 1 for $n$ seconds	PORT 212 d n
Open Valve 2 for $n$ seconds	PORT 213 d n
Open Valve 3 for $n$ seconds	PORT 214 d n
Open Valve 4 for $n$ seconds	PORT 215 d n
Close Valve 1 (before time $n$ has elapsed)	PORT 164
Close Valve 2 (before time $n$ has elapsed)	PORT 165
Close Valve 2 (before time $n$ has elapsed)	PORT 166
Close Valve 2 (before time $n$ has elapsed)	PORT 167

$n$  is the desired run-time in seconds (max. 65535, approximately 18h) and  $d$  is the startup delay in seconds (max. 65535, approximately 18h, the recommended minimum is 1s).

**WARNING**

*Do not use any other commands described here to control the valves.*

## Reading status information

Using the PORT 0 command, the actual status can be read back. For details on the returned value see Table 4.

**Table 4. addSWITCH Status Information**

Return value (decimal)	Return value (binary)	Status
240	1111 xxxx	idle
224	1110 xxxx	VALVE 1 active
208	1101 xxxx	VALVE 2 active

**Table 4. addSWITCH Status Information**

Return value (decimal)	Return value (binary)	Status
176	1011 xxxx	VALVE 3 active
112	0111 xxxx	VALVE 4active

## Setting the valve voltage

Please note that all valves need to operate on the same voltage because voltage cannot be set individually. The valve voltage can be programmed via the command SBAT.

The parameter for the command SBAT is the valve operating voltage (pulse). It is specified in tenths of volt.

If the operating voltage of your valves is 12V, issue the command:

```
SBAT 120
```

If you want to inspect the current setting, use the command SBAT without a parameter:

```
SBAT
```

```
41239 SBAT 0 0 120 0
```

*Note:* The sensor supply voltage can't be programmed—only the valve voltage.

## Returned errors list

Following are error messages you might get.

### Command line interpreter

- 1 — nonexistent command
- 2 — command line buffer overflow (input line too long)
- 3 — internal error
- 4 — reserved
- 5 — missing or false parameters in command
- 6 — operation not implemented
- 7 — remote operation not allowed
- 8 — Invalid IMEI checksum number
- 9 — command not supported in this configuration

### Device descriptors and storage handler

- 10 — device not found (attempt to perform a command on a nonexistent device)
- 11 — device already exists

- 12 — reserved
- 13 — no more space for descriptors (too many devices)
- 14 — no more records for the specified device
- 15 — temporary communication break, no more data (the last request was not successful)
- 16 — timeout (the handler blocked or is busy)
- 17 — internal error
- 18 — attempt to insert a reserved device ID number (0 or 65535)

## Real time clock

- 20 — incorrect time supplied (conversion to `time_t` was not possible)

## Radio interface

- 30 — error at receive (CRC, etc.)
- 31 — unexpected frame received
- 32 — wrong length
- 33 — reserved
- 34 — reserved
- 35 — timeout (remote device not responding)
- 36 — receiver busy (for example, just executing a polling series)
- 37 — time stamp of a frame is too far in the future
- 38 — general modem error
- 39 — “unknown modem” error

## Notifications

- 40 — request to read notification when no notification is pending

## Appendix. Specifications

The addSWITCH A724 Series 4 was intended to fulfill the specification of the ETSI 300 220, Class I, Subclasses a and b, but other national norms are similar to this (for example, the CFR 47, Part 90, Subpart J).

Table 5 shows the main operational parameters of the A724.

**Table 5. Operational Parameters**

Parameter		Min	Typical	Max	Unit
Common					
	Supply	5.0	6.2	10.0	V
	Operating Temperature	-30		+70	°C
	Relative Humidity	10		99	%
	Class Protection		IP65		
	Data Rate (using the onboard software modem)	1000	1500 <sup>a</sup>	2000	bps
	Operating Frequency <sup>b</sup>	432		470	MHz
	Frequency Stability (-20 to +60 °C)			±1.5	kHz
	Frequency Stability (-30 to +70 °C)			±2.0	kHz

**Table 5. Operational Parameters (Continued)**

Parameter		Min	Typical	Max	Unit
Receiver					
	Sensitivity (10 db S/N)		-105		dBm
	Image Frequency Attenuation (IF = 200kHz)	35			dB
	Local Oscillator Leakage			2	nW
	Adjacent Channel Attenuation	55			dB
	RSSI Dynamic	90			dB
	Operating Current (incl. onboard microcontroller) <sup>c</sup>			65	mA
Transmitter (all measurements made on a 50 Ohm resistive load)					
	Output Power ERP		10		dBm
	Spurious Radiation (0 to 862 MHz)			2	nW
	Spurious Radiation (862 MHz to 3.5 GHz)			200	nW
	Adjacent Channel Power (12.5 kHz version)			-32	dBm
	Adjacent Channel Power (25 kHz version)			-44	dBm
	Occupied Bandwidth (12.5 kHz version)			8.5	kHz
	Occupied Bandwidth (25 kHz version)			15	kHz
	Operating Current (incl. onboard microcontroller)			50	mA
	Counter Inputs $V_{il}$	0		0.5	V
	Counter Inputs $V_{ih}$	2.5		3.3	V
	Pulse Counter Input Frequency			50	Hz
	Pulse Counter Resolution		16		bits
	Valve Output Voltage <sup>d, e</sup>	5		15	V
	Valve Output Pulse		100		ms

a. Data rate is content dependent.

b. This parameter represents the tuning range; the switching range may be limited in the software to a narrower space (even to the extent of a single channel).

c. Continuous duty.

d. The energy stored in a 4700uF capacitor is fired to the valve.

- e. A latching solenoid is compatible with the addSWITCH A724 output signals, when following requirements are fulfilled: 5-15V operating voltage (programmable), 2 wire polarity reversal type, and activation energy equivalent to the charge of a 4700 $\mu$ F capacitor.

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