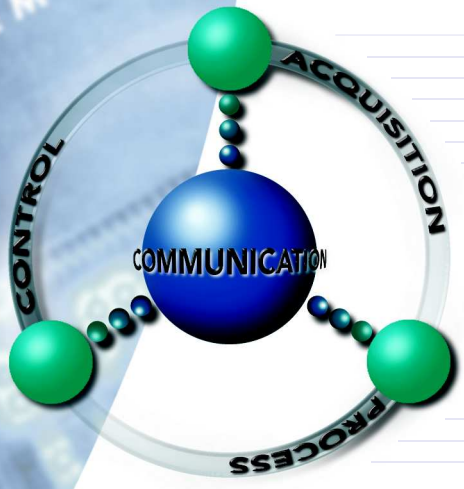
ADCON TELEMETRY

A724 Series 4 addSWITCH

User Manual



SMART WIRELESS SOLUTIONS

ADCON TELEMETRY GMBH
INKUSTRASSE 24
A-3400 KLOSTERNEUBURG
AUSTRIA
TEL: +43|2243|38280-0
FAX: +43|2243|38280-6
http://www.adcon.at

ADCON INTERNATIONAL INC
2050 LYNDELL TERRACE
SUITE 120
CA-95616 DAVIS,USA
TEL: +1|530|7531458
FAX: +1|530|7531054
http://www.adcon.at

Document Release 1.0, May 2009

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 is divided as follows:

- "Introduction," which gives some general information and document conventions.
- "Using the A724 Series 4 RTU," which details the installation and use of the remote telemetry unit.
- "Specifications," which describes operating parameters for the devices.

About the A724 Series 4 addSWITCH

The A724 Sereies 4 *addSWITCH™* Remote Telemetry Unit (RTU) is a low power, short range telemetry device, capable of sampling two pulse counter inputs and controlling two irrigation valves of 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 may 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). It can easily be installed and integrates perfectly into an Adcon A733 network. Depending on the topography it assures a reliable wireless connection to an A733 series device to distances up to 1000 meters, under favorable conditions even more.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by Adcon Telemetry for compliance could void the user's authority to operate the equipment.

Conventions

Certain conventions apply in this document.

Italics	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.
Bold	Indicates special emphasis of the text. Also indicates menu names and items in a window.
`fixed font`	Indicates characters you must type or system messages.
File ›› Save	Indicates menu selection. For example, select the **File** menu, then the **Save** option.
Note	Indicates information of interest. Notes appear **after** the information they apply to.
CAUTION	Indicates that you may get unexpected results if you don't follow the instructions. Cautions appear **before** the information they apply to.
WARNING	Indicates danger to yourself or damage to the device if you don't follow the instructions. Warnings appear **before** 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 incl. the A440 Wireless Modem installed before you install the A724 Series 4 RTU. For information about installing the A840 or A850, refer to the *respective devices 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
- A 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: Do not turn or manipulate the Gore Prevent element! The unit's IP65 environmental protection may be affected.

Installing the RTU

The following restrictions apply:

- In general, the typical "line-of sight" distance the RTU can communicate is 1 km (.6 miles). This is valid if both the RTU and its partner device are mounted on a 3 m mast (9 ft.); the results may vary under different conditions. Sometimes higher, sometimes lower distances can be achieved.

- As with all wireless communication devices, the higher the transmitter is installed, the better the communication will be.

Field Installation

Installing addSWITCH RTUs in the field is a fairly simple process. You can perform a connectivity check with a LED tool. The LED tool 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 an addSWITCH 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 4 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. Prepare 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. Refer to item No. 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 addSWITCH RTU.

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

6. Fasten the addSWITCH 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 counter connector to the INPUT connector 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 specially 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 each RTU

More about the LED tool

The LED tool allows you to rapidly check the status of an addSWITCH 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 back—this may take up to 10 seconds. When an answer is received, the LED tool lights up for about 4 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 0.5 second intervals to indicate that the unit is alive and the internal battery has enough energy to operate. If the blinking interval lengthens to 2 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 addSWITCH 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 addSWITCH 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. Alternatively charge the unit up with Adcon's RTU charger, item Nr. 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 5.3. 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 then 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 5.3, please check the respective User Manuals.

Maintaining and servicing the RTU

An A724 Series 4 addSWITCH 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 addSWITCH 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 addSWITCH 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 then 40 valve activations per day (12V Type).

Table 1 shows the addSWITCH devices' 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 (wear-out 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 the panels' 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 addSWITCH RTU, then remove the lid as shown in Figure 3. Make sure to use a Philips 2 screw driver 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 A724 battery pack inside the RTU.

Figure 5. A724 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.
7. Mount the lid back, taking care that the rubber gasket sealing the box is not out of place and free of dirt and soil.

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

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

Chapter 3. Performing Advanced Functions

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

CAUTION Do not try to configure your addSWITCH devices if you are not sure what to do—the unit may not communicate with the remote measuring station or function with the addVANTAGE software.

WARNING Tampering with parameters for the addSWITCH devices 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 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 (. Figure 6 illustrates the individual pins of an I/O connector.)

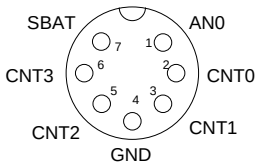


Figure 6. Pins on the I/O Connector (Top View)

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.

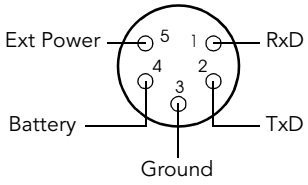


Figure 7. A724 POWER Connector (Top View)

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.

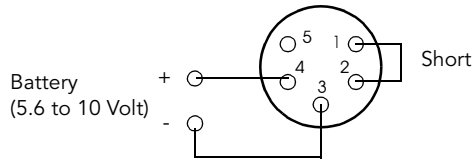


Figure 8. A724 Connection with External Battery

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.

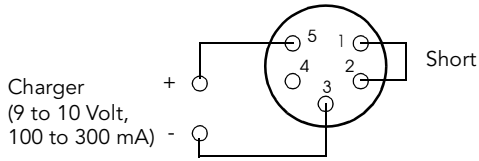


Figure 9. A724 Connection with External Power Supply

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.

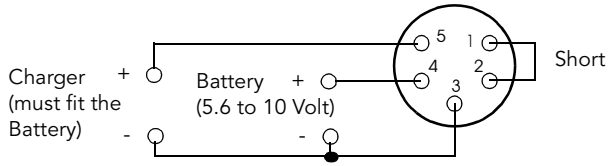


Figure 10. A724 Connection with External Battery and Power Supply

The Valve Connector

The VALVE connector is used to connect up to 4 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 cable clamp can be used to connect the solenoid. It is up to the user to protect this cable clamp for outdoor usage.

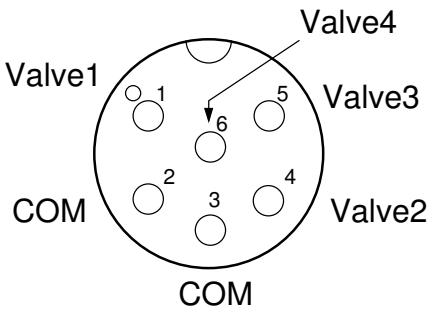


Figure 11. The Valve Connector

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

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 valve5.

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

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.

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

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

WARNING Please check cabling for shortcuts, the RTU may be damaged when operated with improper connections.

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 (available from your Adcon distributor, item No. 200.720.540) 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.

Booting the RTU

When the RTU starts up from a power-up reset, the Series 4 BOOT LOADER is executed. This will happen, when you connect the battery to the RTU.

The RTU will stay in the BOOT LOADER for 5 seconds if no key is pressed. After this 5 seconds the RTU FIRMWARE will be started.

To stop the boot process, press the ESC button on your keyboard when the following sign-on message is displayed.

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

If you have pressed the ESC key within 5 seconds , then you are in the command line mode. The command line mode enables you to perform certain commands like upgrading to a new firmware.

To get a list of the available commands, try the help command

```
Available commands:


upgrade [baudrate] ... upgrade from Y-modem down-
load
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: If you don't press any key within 60 seconds, the command line interface will start the FIRMWARE automatically.

Upgrading the Firmware

To upgrade the FIRMWARE, the RTU must be (re)booted to get into the command line interface of the BOOT LOADER.

If the RTU is already executing the FIRMWARE and you want to reboot the device, simply type

```
reboot 41239
```

where 41239 is the ID, which you have to replace with your actual RTU ID.

For some commands, as for the reboot command, you have to supply the ID of the RTU.

An alternative way to boot the RTU is to disconnect the battery and after a few seconds reconnect it. Follow the procedure decribed under Booting the RTU to get into the bootloader.

Note: The BOOT LOADER prompt is the '>' character. If the FIRMWARE is executed, it will change to '#'.

At the '>' prompt, you can enter the command

```
upgrade 115200
```

to start the upgrade process.

Note: For early version of the BOOT LOADER, you have to omit the speed parameter (115200, which was bydefault).

Newer version will accept the baudrate parameter (115200 only). If no baudrate is specified, the upload will start with 19200 (which is the default baudrate).

WARNING If you continue with the upgrade process, an existing firmware image will be erased! If you do not supply a valid image for upload, the RTU will have only the bootloader capabilities.

Follow the instructions on the screen to proceed with the upgrade process.

Note: Please have the right firmware image in a handy place. The image upload must be started within 60 seconds. Otherwise a timeout will occure.

As prompted, start the Ymodem upload fuction of your terminal program. For the Windows Hyper Terminal program, choose on the menu bar

```
Transfer
Send File...
```

select the desired image, choose Ymodem Protocol and press the Send button.

After successful upload of the image, the RTU will flash the new image.

To start the new firmware, you can enter the following command:

```
firmware
```

This step completes the upgrade process.

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. When exchanging numbers, they 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 may 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 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.

CMDS

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

```
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

#
```

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
#
```

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
#
```

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 — **GET/SET**.

REMOTE — No.

EXAMPLE

```
RSSI 50
41239 RSSI 0
#
```

```
RSSI
41239 RSSI 34 50 0
#
```

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

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
41239ID 0
#
```

```
ID
4557 ID 4557 0
#
```

SLOT

CAUTION Changing these parameters may adversely affect the ability of the device to operate for extended periods under low sun shine 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 internal and the SDI-12 sensors. A third parameter can be used to set the SLOT/SAMPLE settings for a specific connector.

Note: Please keep in mind, that 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
#
```

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
#
```

XDATA

DESCRIPTION — Returns data stored for a certain device.

PARAMETER — XDATA requires a lot of parameters for specifying what to retrieve. Please consult the A740 User Manual 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 **GET**, but only one frame at a time.

EXAMPLE
```
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
#
```

XIMME

DESCRIPTION Samples all inputs and immediately returns the sampled data.

PARAMETER First parameter specifies the samplemode which has to be 2 for raw data. The second parameter sets the maximum packet size. If you specify the 3rd 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 are the internal sensors like temperature and battery voltage. Channel 1-4 are the virtual connectors IO-A through IO-D. The 4 counter inputs of the A724 Series 4 are mapped to this vitual 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, we have an analog value of 64, counter 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 bit 7 to 4 are high.

FDEV

DESCRIPTION

Formats the internal memory (may destroys all the data).

PARAMETER

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)

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 for further information.

RETURNS

Current setting.

REMARKS

SET only.

REMOTE — Yes, **SET** only.

EXAMPLE

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

INFO

DESCRIPTION — Returns various status information.

PARAMETER — 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 A724 housing, which is device dependent. The precision of the sensing element is low (±2°C), but it is sufficient for battery power management (charge/discharge). To compute the actual value (in °C), the following equation must be used:

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

- *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
  — 16 for A724_S4
  — 21for 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 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
#
```

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
#
```

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
#
```

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, then no results will be listed. A list of heard stations with their RF levels will be updated in the memory and will be available whenever the **BLST** command is issued.

EXAMPLE

```
B
41239 B 0
#42340 BA 0
#34781 BA 0
```

BLST

DESCRIPTION Lists the stations heard after the last broadcast command was issued.

PARAMETERS None.

RETURNS The date and time when the broadcast was performed, the number of stations heard, and a list with the heard stations' ID and their respective RF levels.

REMARKS **GET** only.

REMOTE Yes. The remote version will list only the first 9 stations heard.

EXAMPLE

```
BLST
41239 BLST 08/05/2009 15:56:04 4
42340 235 255
34781 255 255
#
```

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** **#**

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** **#**

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 41.
REMOTE	No.
EXAMPLE	**SBAT** **41239 SBAT 0 0 120 0** **#**

ANRT

DESCRIPTION	Sets/returns the analog signal routing configuration of pre Series 4 RTUs
PARAMETERS	See Manual of pre Series 4 RTUs.
RETURNS	The current setting.
REMARKS	Remote only. Support for pre Series 4 RTUs.
REMOTE	Yes.

EXAMPLE

```
14446 ANRT
14446 ANRT 0 1 2 3 4 5 6 7 8 9 10 11 0
#
```

DATA

DESCRIPTION — Retrievs data frames from pre Series 4 RTUs

PARAMETERS — See Manual of pre Series 4 RTUs.

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 0 89 2 0 350 0 0 0 0 0 0 2 504 1312 0 0
#
```

DATASDI

DESCRIPTION — Retrievs SDI12 data frames from pre Series 4 RTUs

PARAMETERS — See Manual of pre Series 4 RTUs.

RETURNS — A pre Series 4 SDI12 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
#
```

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 synchonisation.

REMOTE — No.

EXAMPLE

```
# MSTR 43
41239 MSTR 0
# MSTR
41239 MSTR 43 0
#
```

CALC

DESCRIPTION — Sets/returns the settings for optional minimum and maximum values for the analog input.

PARAMETERS — Two 1-bit bitmasks. 1st mask is used to enable minimum and 2nd mask for maximum values.

RETURNS — The current CLALC setting.

REMARKS — The masks are binary masks.

REMOTE — No.

EXAMPLE

```
# CALC 1 1
41239 CALC 0
# CALC
41239 CALC 1 1 0
#
```

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 A733 User Guide for a complete command description.

RETURNS — The current ANLG setting.

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

REMOTE — Yes.

EXAMPLE

```
# ANLG 64
41239 ANLG 0
# ANLG 0
41239 ANLG 0 4 0 0 0 0 0 0 0 0 0 0 0 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 acton on, and two 16-bit parameters, depending on the control byte; for some commands, one or both of them may be missing. Please look into the A733 User Guide for a complete command description.

RETURNS — The result depends on the control byte

REMARKS — For the A724 Series4, only the valve control ports are 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 destiination) containing up to eight intermediaries. When just the destination id is given, then the route for this device is deleted.

RETURNS — The commands success or error code and the route table.

REMARKS — GET/SET.

REMOTE — No.

EXAMPLE — For **MFS:**

```
# ROUTE 41240 43
41239 ROUTE 0
# ROUTE
41239 ROUTE
41240 43
0
#
```

XCONF

DESCRIPTION — This command transmits command strings for commands , which are suited for this mode of operation, to the targeted RTUs. Allowed commads are: CALC, DPE, DYNSLOT, MSTR, SBAT, SLOT, SST and SDI

PARAMETERS — A command string.

RETURNS — The replying string and error code.

REMOTE — Yes.

EXAMPLE

```
# 41240 XCONF SBAT
41240 XCONF SBAT 0 0 120 0
# 41240 XCONF CALC
41240 XCONF CALC 0 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 > 0. This may 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
#
```

DPE

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

PARAMETERS

1st parameter is the 12-bit bitmask to specify the port bits which will trigger an digital port event.
2nd parameter is the 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

```
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.

# dpe 240 3600
41239 dpe 0
# dpe
41239 dpe 240 3600 0
#
```

SST

DESCRIPTION

Sets/returns the sensor supply time of a device.

PARAMETERS

1st parameter ist the sensor supply time in seconds.
2nd parameter specifies 0=parallel or 1=sequential measurement. This parameter is not used for the A724 Series 4.
3rd 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. All other connector's SST setting 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
#
```

DYNSLOT

DESCRIPTION Sets/returns the dynamic slot switching function of the device. The dynamic slot switching function checks wether the measurement value of a given sensor matches the given condition, then swiches between two operating modes:

1—normal mode (when the condition is false and the lock timer is zero)

2—exection mode (when the condition is true and the lock timer is non-zero)

The rules for the mode switching are:
1—when the condition becomes true the first time, exception mode is entered and the lock timer is set.
2—while the condition is true, the lock timer is set at every sample, thus does not reach zero.
3—while the condition is false, the lock timer is decremented if not already zero.
4—when the lock timer reaches zero, normal mode is entered.
5—the SLOT settings are only changed when the mode changes.

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 locktime (this pre-

vents excessive wear of the EEPROM due to jitter in the measurement value).

PARAMETERS

1—sensor type (0=none, 1=internal battery, 2=anlg, 3=port, 4=counter).

2—sensor address (channel number as in the ANLG and PORT command).

3—limit type (0=above, 1=below, 2=out of range, 3=within range).

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 stting, 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 DYNSLOT 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

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

Commands for controlling the valves

Switching the valves

The valves can be controlled by the following commands:

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 3for n seconds	PORT 214 d n
Open Valve 4for n seconds	PORT 215 d n
Close Valve 1 (before time "n" is elapsed)	PORT 164
Close Valve 2 (before time "n" is elapsed)	PORT 165
Close Valve 2 (before time "n" is elapsed)	PORT 166
Close Valve 2 (before time "n" is elapsed)	PORT 167

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

WARNING Do not use any other commands as 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 the following table:

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
176	1011 xxxx	VALVE 3 active
112	0111 xxxx	VALVE 4active

Setting the valve voltage

Please note that both valves need to operate on the same voltage as it 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 volatge of your valves is 12V, then issue the command:

```
SBAT 120
```

If you want to inspect the current setting, then 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 sopported in this connfiguration

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 — time-out (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 — time-out (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 — "unknow 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	Typ	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[a]	2000	bps
Operating Frequency [b]	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	Typ	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)[c]			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[d,e]	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 is equivalent to the charge of a 4700µF capacitor.