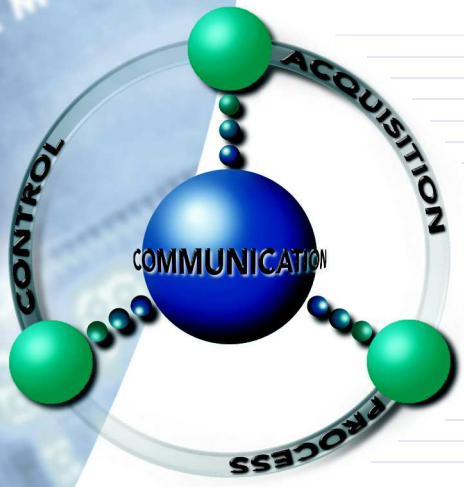
ADCON TELEMETRY

A724 addSWITCH

User Manual



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Document Release 0.1, October 2006

Chapter 1. Introduction

This manual explains the hardware aspects of Adcon's A724 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 RTU," which details the installation and use of the remote telemetry unit.
- "Specifications," which describes operating parameters for the devices.

About the A724 addSWITCH

The A724 Remote Telemetry Unit—RTU (commercial trademark *addSWITCH™*) is a low power, short range telemetry device, capable of sampling two pulse counter inputs; in addition, it can control two irrigation valves.

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 under 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 from a built in 6.2 Volt rechargeable battery, which is charged either using a solar panel or an external power supply 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 with the IP65 environmental protection class (NEMA 4). It can easily be installed and it integrates perfectly into an Adcon A733 network. Depending on the terrain, it assures a reliable wireless connection to an A733 series device to distances up to 1000 meters, under favorable conditions even more.

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 addSWITCH remote telemetry unit (RTU) is part of the A7xx series. For testing purposes, you should have an A840 Telemetry Gateway installed before you install the A724 RTU. For information about installing the A840, refer to the *Base Station, Telemetry Gateway A840 and Wireless Modem A440 User Guide*.

Opening the packages

The addSWITCH RTU package contains the A724 RTU, an antenna, and a ring clamp. If ordered, the following items come in separate packaging:

- A solar panel and ring clamp
- A set of aluminum poles
- A LED tool
- Sensors and cables, one box for each sensor, and a fastening tie 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, and you can sometimes achieve greater distances.

- 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. Assemble the rod from the set of poles.
4. Using a hammer, drive the aluminum rod into the ground. How far you drive the rod into the ground depends on your application. Put a plastic cap on top of the rod to protect it.
5. Using a ring clamp, fasten the solar panel onto the aluminum rod. Ensure 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 rod 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 could 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 rod with 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 for each RTU
- 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 are completely discharged, and 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.

Configuring an addSWITCH RTU in the addVANTAGE software

To configure the addSWITCH RTU with an A840 Telemetry Gateway and the addVANTAGE Pro software, check the *Base Station, Telemetry Gateway A840 and Wireless Modem A440 User Guide*.

Maintaining and servicing the RTU

The A724 unit 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 noncorrosive 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.

The RTU battery

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

- The channel has moderate radio activity, with requests every 15 minutes.
- The counters 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 between one and three RTUs are active on the same operating frequency as the addSWITCH remote station under test.

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 check the solar panels' state and clean them often. The rain droplets can splash thin layers of soil on the panels, thus reducing their power output. The surrounding vegetation can also lower the panels' efficiency.

Changing 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.

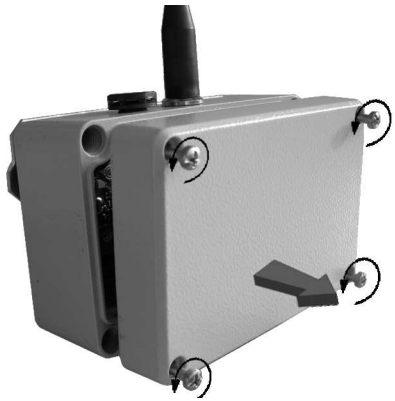

Figure 3. Removing the addSWITCH Lid

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 screws of the metal 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 metal cover and screw the two screws back in.
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.

WARNING Be sure to mount the rubber gasket properly, so that the unit's IP65 environmental protection is not affected.

Screw the two 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 two pulse counter inputs (. Figure 6 illustrates the individual pins of an I/O connector.)

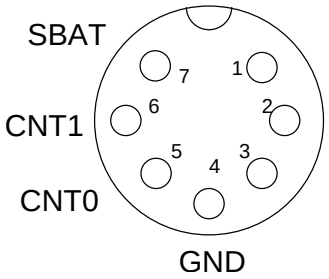

Figure 6. Pins on the I/O Connector (Top View)

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.

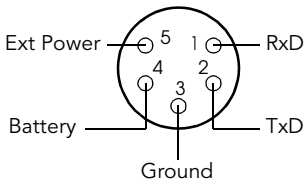

Figure 7. A724 POWER Connector (Top View)

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.

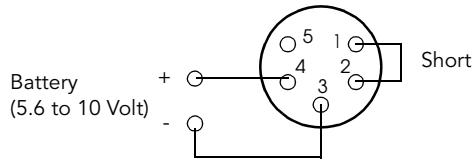

Figure 8. A724 Connection with External Battery

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.

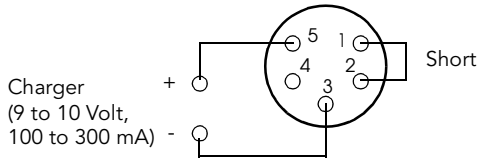

Figure 9. A724 Connection with External Power Supply

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.

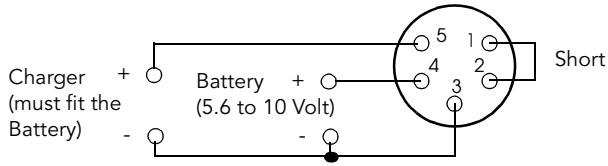

Figure 10. A724 Connection with External Battery and Power Supply

The Valve Connector

The VALVE connector is used to connect up to 2 latching solenoids. The connector is a 4 pin SWITCHCRAFT connector (EN3P4F, counterpart is the EN3C4M).

The A724 comes with a 1m 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.

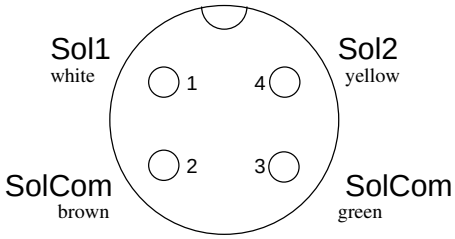

Figure 11. The Valve Connector

Connect the positive terminal (commonly red) of the first valve to the Sol1 pin and the negative (commonly black) terminal to the SolCom pin (1-2). The second valve must be connected to Sol2 and the second SolCom pin.

WARNING Do not use only one SolCom wire for both 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 both 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 RTU, you must have a special adapter cable (available 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.

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 33.)

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 in the addIT A723, except for the following items:

- new device type: A724
- digital ports are used internally
- additionally digital port: PORT BIT 15

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
15535 CMDS CMDS ID PMP RSSI TIME FREQ SLOT DATA
INFO RX TX FDEV 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 12/12/1999 22:10:10
15535 TIME 0
#

TIME
15535 TIME 12/12/1998 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 radiocommunica-tions 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
15535 FREQ 0
#

FREQ
15535 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, it can take values from 0 to 255; it is typically factory set to 42.

RETURNS The instant RSSI value and the programmed threshold.

REMARKS **GET/SET**.

REMOTE No.

EXAMPLE
```
RSSI 50
15535 RSSI 0
#

RSSI
15535 RSSI 34 50 0
#
```

*Note: The values of the RSSI threshold have no units, they are arbitrary. However, a value of **160** corresponds approximately to the maximum value allowed in the addVANTAGE software (that is, 8 µV).*

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
15535 ID 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 (60 - 65535) 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. The second parameter is neglected by the A724 RTU.

RETURNS The interval and rate.

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

REMOTE Yes, **SET** only.

EXAMPLE

```
SLOT 900 15
15535 SLOT 0
#

SLOT
15535 SLOT 900 15 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 NiCd or 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
15535 PMP 0
#

PMP
15535 PMP 65 72 0
#
```

DATA

DESCRIPTION — Returns data stored for a certain device.

PARAMETER — The ID of the device for which the data is requested and the date/time (in the standard format) the data was stored. If missing, then it refers to the data of the local device.

RETURNS — A data block.

REMARKS — **GET** only. If the date/time parameter is not included, the latest data is returned. If the date/time parameter is included, the data closest to, but later than, the given date/time is returned.

REMOTE — Yes, for a **GET**, but only one frame at a time. The A724 can issue the command only for itself, locally.

EXAMPLE

```
DATA 15535 1/3/2000 12:12:12
15535 DATA b1 b2 b3 ... bn 0
#
```

The data block returned will typically contain a number of data frames (telegrams). The structure of a block is as follows:

dd mm yyyy hh mm ss si ft d1 d2 ... dn dd mm yyyy ... dn cs

where:

- *dd mm yyyy* is the date
- *hh mm ss* is the time
- *si* is the size of the frame
- *ft* is the frame type (39 for the A724)
- *d1 d2 ... dn* are the data values (the frame content)
- *cs* is a 16-bit checksum obtained by summing the bytes and discarding the carries over `0xFFFF`

The A724 devices always respond with a type 39 data frame. The composition of the data block of such a frame (the values marked as d1, d2... dn) is depicted in Figure 12, while the digibyte is depicted in Figure 13.

RF incoming
RF outgoing
Digibyte
Pulse Counter CNT0
Pulse Counter CNT1
Battery
I/O A Cabling 1, always 0
I/O A Cabling 2, always 0
I/O A Cabling 3, always 0
I/O B Cabling 1, always 0
I/O B Cabling 2, aways 0
I/O B Cabling 3, always 0

Figure 12. Frame 39 description

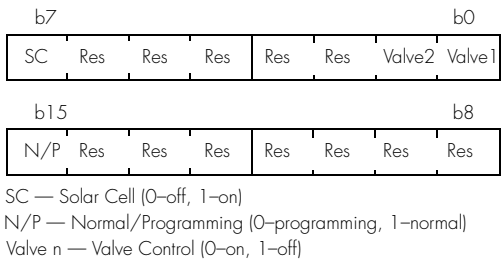

Figure 13. The Digibyte

The remote version is limited to a single frame. An example of such a command is given below:

```
9999 DATA 9999 30/9/1999 14:50:00
9999 DATA
30 9 1999 14 54 55 21 37 255 255 77 0 0 0 0 89 156
126 20 0 0 0 0 0 0 0 0 3197 0
#
```

Notice that if you need to get data that is not the last (newest) slot remotely from a device, the ID must be supplied twice. If you need to get the last slot stored, you can ignore the ID and the date/time parameters:

```
9999 DATA
9999 DATA
13 9 1999 19 26 36 21 37 255 255 79 0 0 0 0 87 148
149 15 0 0 0 0 0 0 0 0 3148 0
#
```

IMME

DESCRIPTION — Samples all inputs and immediately returns the sampled data.

PARAMETER — The ID of the requested subsystem; default is the standard A/D subsystem of the A724 (ID=0).

Note: Currently only the default subsystem is implemented on the A724.

RETURNS — A data block (see also "DATA" on page 24).

REMARKS — **GET** only. The command needs a certain delay to execute (for example, for the standard subsystem 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

```
IMME
15535 imme 26 5 2003 17 18 28 21 37 0 0 127
0 554 0 0 84
0 0 0    1016 2048 3072       0 0 0       0 0 0
9056 0
#
```

FDEV

DESCRIPTION — Formats the internal memory (destroys all the data).

PARAMETER — If the parameters are missing, the command will destroy all the data in the EEPROM file. If a parameter is given, the EEPROM type is defined (data won't be destroyed). The following EEPROM types are currently defined:

- 0 – 16 Kbytes (e.g. model 25128)
- 1 – 32 Kbytes (e.g. model 25256)

RETURNS Nothing.

REMARKS **SET** only.

REMOTE Yes, **SET** only.

EXAMPLE
```
FDEV 1
15535 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
  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
15535 INFO 255 0 18/4/1999 21:5:11 1.3 0 0 0 91 72
40 1:46 58 65 72 3 900 15 175 0
#
```

- The **Command Code** specifies the operation that will be applied to the selected port. They are explained in Table 2.

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
15535 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
15535 TX 0
#

TX 1
15535 TX 0
#
```

```
TX 5
15535 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
15535 B 0
#234 BA 0
#7851 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
15535 BLST 10/12/1999 12:15:04 4
2008 150
2003 177
6883 168
4027 220
#
```

VER

DESCRIPTION	Requests the firmware version of the device.
PARAMETERS	None.
RETURNS	The current version.
REMARKS	**GET** only.
REMOTE	No.
EXAMPLE	**VER** **15535 VER 2.14.0 0** #

Commands for controlling the valves

Switching the valves

The valves can be controlled by the following commands:

Table 2. addSWITCH Commands

Requested action	addSWITCH A724 command
Open Valve 1 for n seconds	PORT 208 d n
Open Valve 2 for n seconds	PORT 209 d n
Close Valve 1 (before time "n" is elapsed)	PORT 160
Close Valve 2 (before time "n" is elapsed)	PORT 161

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 asdescribed 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 3. addSWITCH Status Information

Return value (decimal)	Return value (binary)	Status
32771	1000 0000 0000 0011	idle, no command pendig
32770	1000 0000 0000 0010	VALVE 1 active
32769	1000 0000 0000 0001	VALVE 2 active
32768	1000 0000 0000 0000	VALVE 1+2 active
3	0000 0000 0000 0011	Programming mode, no command pending
32899	1000 0000 1000 0011	idle, no command pending, solar cell connected
32897	1000 0000 1000 0001	VALVE 2 active, solar cell connected
32896	1000 0000 1000 0000	VALVE 1+2 active, solar cell connected
131	0000 0000 1000 0011	Programming mode, no command pending, solar cell connected

Programming the valve voltage

The valve voltage can be programmed via the following signal sequence:

Table 4. addSWITCH Programming Commands

Step	addSWITCH command
Setting up the programming mode	PORT 159
Setting up UValve programming mode	PORT 161
Setting up a monoflop function (MFS) to program the desired valve voltage	PORT 208 1 n
WAIT at least the time: n+1s, until the MFS operation is completed!	-
Switch back to normal operating mode	PORT 175

n is the desired valve voltage according to the following formula:

n = (UValve-5)*2

Note: The 1s ON time is always required for the MFS command. n must be in the range of 1-20.

An example:

A valve voltage of 12 volt is required. The value for n therefore is calculated as follows:

```
(12-5)*2 = 14
```

The port command is: PORT 208 1 14

Due to the use of MFS (Mono Flop Function), the programming commands can be sent via the radio link, too. However, remote programming is not recommended.

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

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

Appendix. Specifications

The addSWITCH A724 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)			±2.5	kHz
Receiver				

Table 5. Operational Parameters (Continued)

Parameter	Min	Typ	Max	Unit
Sensitivity (10 db S/N)		-105		dBm
Image Frequency Attenuation (1st IF = 45 MHz)	35			dB
Local Oscillator Leakage			2	nW
Adjacent Channel Attenuation	55			dB
RSSI Dynamic	90			dB
Operating Current (incl. onboard microcontroller)[c]			15	mA
Transmitter (all measurements made on a 50 Ohm resistive load)				
Output Power	7	9	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, FPC = 0			1.5	Hz
Pulse Counter Input Frequency, FPC = 1			30	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.