B-ACS 60/120

Troubleshooting
Service Guide

Version 003

The information in this manual may be altered without notice.

BRUKER BIOSPIN accepts no responsibility for actions taken as a result of use of this manual. BRUKER BIOSPIN accepts no liability for any mistakes contained in the manual, leading to coincidental damage, whether during installation or operation of the instrument. Unauthorized reproduction of manual contents, without written permission from the publishers, or translation into another language, either in full or in part, is forbidden.

This manual was written by

Volker Reiss

Rheinstetten, Germany

P/N: Z31723
DWG-Nr.: 1431003

Contents

Introduction 1

Introduction 1.1

This manual contains information about troubleshooting and debugging B-ACS errors.

Disclaimer 1.2

This manual is written for Bruker service staff only, it is not intended for customer use.

Service or maintenance work on the unit must be carried out by qualified personnel.

Only those persons schooled in the operation of the B-ACS Sample Changer should operate the unit.

Read this manual before operating the unit. Pay particular attention to any safety related information.

Warnings and Notes 1.3

There are two types of information notices used in this manual. These notices highlight important information or warn the user of a potentially dangerous situation. The following notices will have the same level of importance throughout this manual.

Note: Indicates important information or helpful hints

WARNING: Indicates the possibility of severe personal injury, loss of life or equipment damage if the instructions are not followed.

Contact for Additional Technical Assistance *1.4*

For further technical assistance on the B-ACS unit, please do not hesitate to contact your nearest BRUKER dealer or contact us directly at:

BRUKER BioSpin GMBH
am Silberstreifen
D-76287 Rheinstetten
Germany

Phone:	+ 49 721 5161 0
FAX:	+ 49 721 5171 01
E-mail:	service@bruker.de
Internet:	www.bruker.de

Before contacting the Bruker Help desk first annotate the following information:

- Spectrometer type and order number, e.g. AV400 HH123456
- Magnet Type, e.g. 600 MHz US+
- B-ACS part number and serial number, e.g. H1080, ECL05, #1234
- XWIN / ICONNMR version, e.g. 3.5 Patch Level 6
- Whether the sample changer has the new electronics.
- Whether the sample down detection box is installed.
- Error number and error text.

Having this information on hand will expedite handling when contacting Bruker Service!

Troubleshooting Overview 2

Introduction 2.1

For service use only - not intended for customer use!

The contents of this manual will assist Bruker service personnel in finding and correcting problems with the B-ACS sample changer.

Electronics & Housing Overview 2.2

There are several B-ACS electronics and housing configurations that are currently in use:

- Old B-ACS Housing
- New B-ACS Housing
- Old Electronics in Old B-ACS Housing
- New Electronics in Old B-ACS Housing
- New Electronics in New B-ACS Housing

References to these various configurations will be used throughout this manual. The various troubleshooting steps outlined in the manual will vary based on these configurations. Please familiarize yourself with these configuration which are outlined in the following sections before using this manual.

Old B-ACS Housing *2.2.1*

The old B-ACS housing can be identified with it's gray anodized aluminium cabinet.

Figure 2.1. Old B-ACS Housing

New B-ACS Housing *2.2.2*

The new B-ACS housing consists of a beige colored cabinet.

Figure 2.2. New B-ACS Housing

Old Electronics in Old B-ACS Housing *2.2.3*

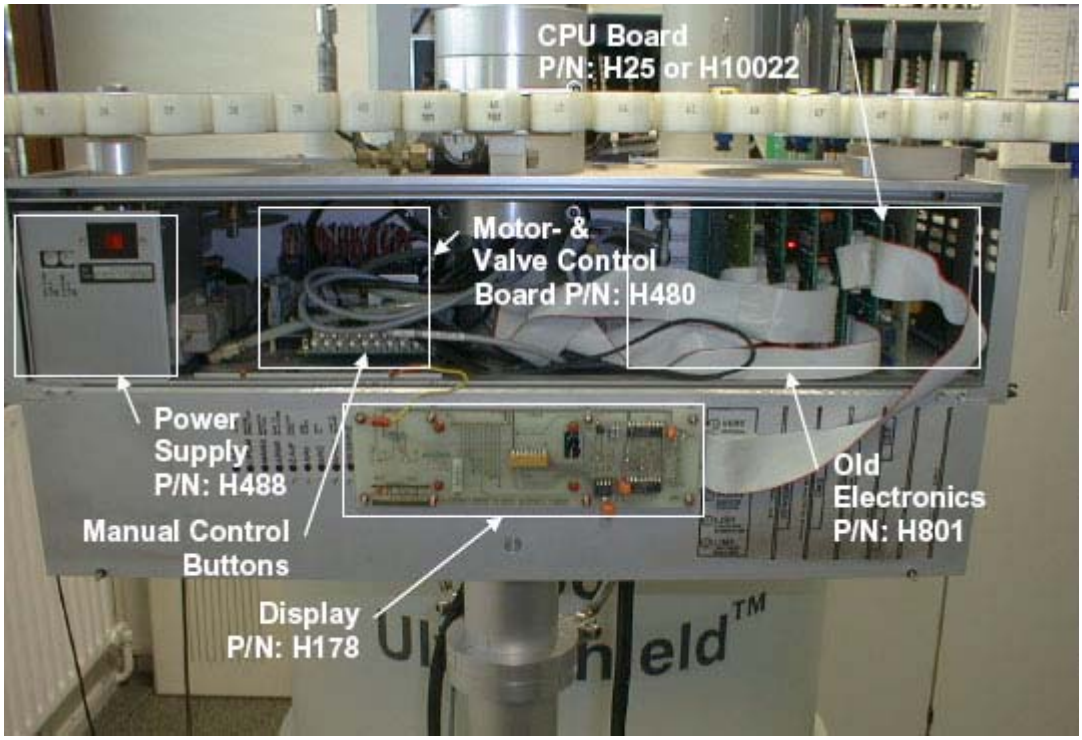


Figure 2.3. Old Electronics in Old B-ACS Housing

New Electronics in Old B-ACS Housing *2.2.4*

This configuration can occur with or without the Motor & Valve Control Board.

- If the B-ACS was delivered with the new electronics directly from production to the customer, the Motor & Valve Control Board will not be present. The the 15-pin D-sub valve control connect and the 5-pin mini connector for the lift control valve and under pressure sensor are connected to the connector panel.
- If the B-ACS electronics was upgraded to the new electronics using the upgrade kit P/N HU071, the Motor & Valve Control Board is still populated and daisy-chained between the power supply unit and the new electronics. The 15pin DSUB valve connector is connected to the back of the Motor & Valve Control Board; the 5-pin mini-connector (connector #7), which contains the signals for lift valve and the under pressure sensor, is also connected to the Motor & Valve Control Board.

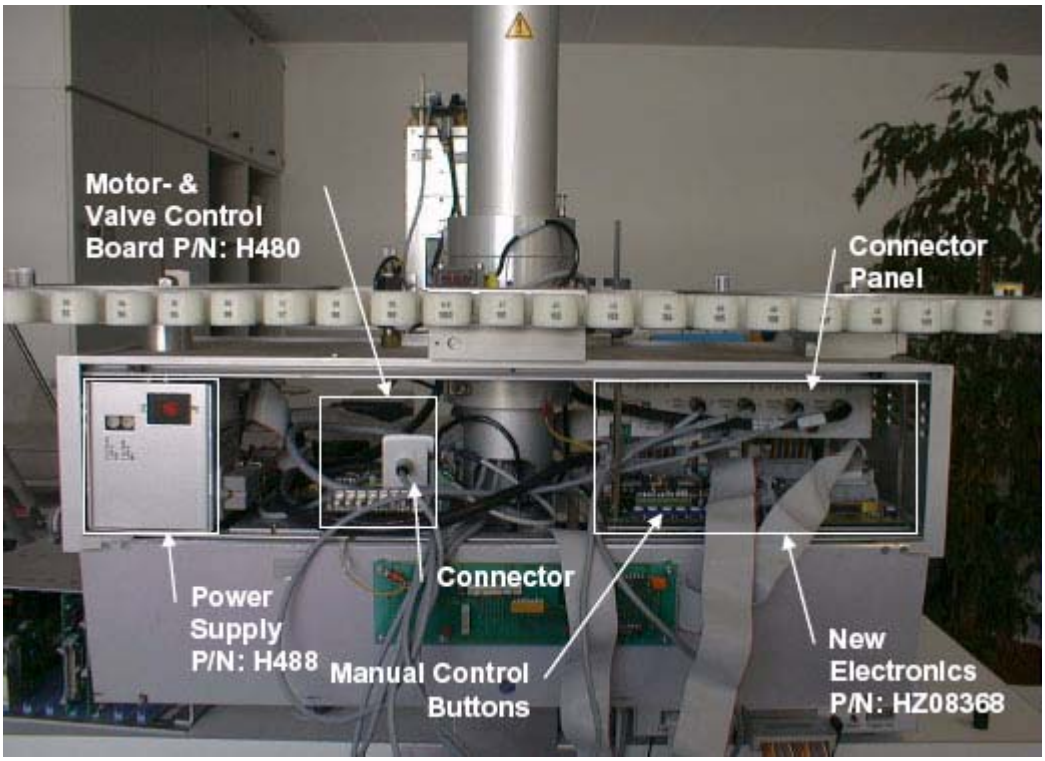


Figure 2.4. New Electronics in Old B-ACS Housing with Motor & Valve Control Board populated.

New Electronics in New B-ACS Housing *2.2.5*

The new electronics in a new B-ACS housing no longer utilize the Motor and Valve Control Board.

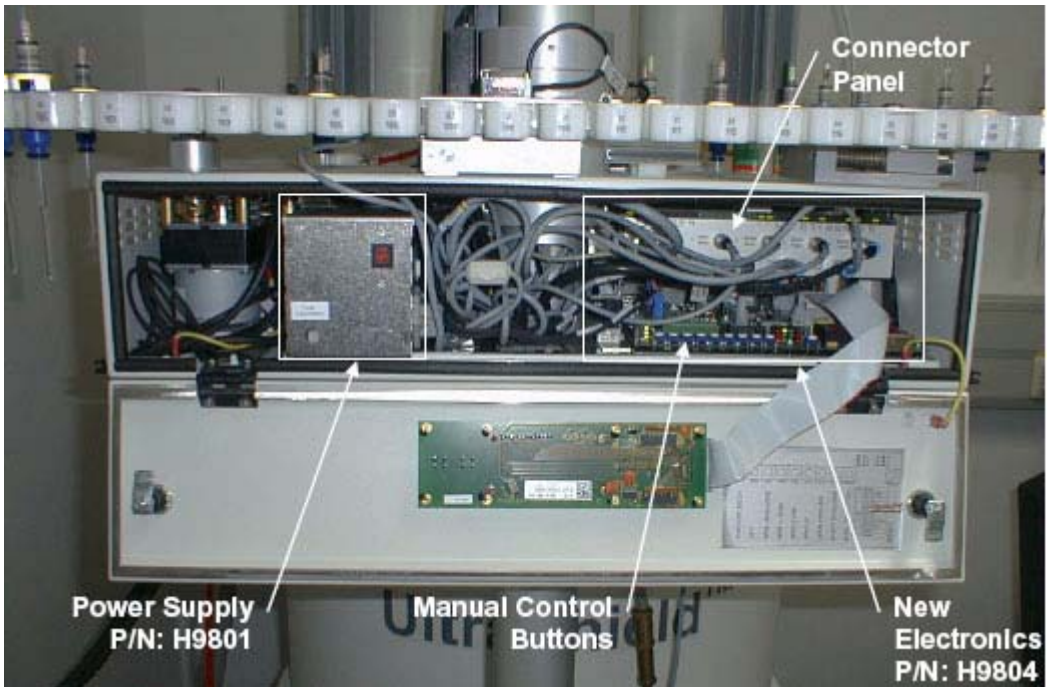


Figure 2.5. New Electronics in New B-ACS Housing

Troubleshooting Overview

Manual Adjustments & Motion Control 3

Introduction 3.1

With the B-ACS 60/120 it is possible to control each motion manually. The method used to control the motion and make adjustments manually depends on the hardware configuration that you have. These hardware configurations include:

- Manual motion control when using the old electronics (see ***Figure 2.3.***).
- Manual motion control when using new electronics in combination with the Motor & Valve Control Board. Here either the valves are on the Motor & Valve Control board, or the 15-pin D-subconnector to the valve block is connected to this board (see ***Figure 2.4.***).
- Manual motion control when using new electronics without a Motor & Valve Control board. In this case the 15-pin D-Sub connector to the valve block is connected to the connector panel (see ***Figure 2.5.***).

Attention: There are no safety measures available that will prevent unauthorized motions (e.g. magazine motion when the closed pincer is down)! Thus it is possible to break glass tubes when a manual motion is carried out! Remove all sample tubes from B-ACS before using the manual motion control. When it is absolutely necessary to use a tube, then use empty glass tubes or dummy samples!

Manual Motion Control with Old Electronics 3.2

To use the manual motion control when you have the old electronics (see ***Figure 2.3.***), please complete the following steps:

1. Turn the B-ACS power off.
2. Remove the CPU Board. This is very important, as otherwise the CPU may start unexpectedly, or hold the valves on continuously, which will prevent you from executing manual motions.
3. Turn the B-ACS power on again.
4. The manual control buttons can now be used to initiate motion by pressing the corresponding button on the Motor & Valve Control Board.

Manual Motion Control with the New Electronics and Motor & Valve Control Board *3.3*

This step is for systems which contain the new electronics, in combination with the Motor & Valve Control Board (see ***Figure 2.4.***), whereas either:

- the valves are on the Motor & Valve Control Board, or
- the 15pin D-sub connector to the valve block is connected to the Motor & Valve Control Board.

1. Turn the B-ACS power off.
2. Disconnect the 26-pin flat ribbon cable from the Motor & Valve Control Board (which leads to the main control board).
3. Turn the B-ACS power on again.
4. Now the manual control buttons on the Motor- & Valve Control Board can be used to initiate motions by pressing the corresponding button.

Manual Motion Control without Motor & Valve Control Board *3.4*

This step is for systems which contain the new electronics, without a Motor & Valve Control Board (see ***Figure 2.5.***). The 15pin D-subconnector to the valve block is connected to the connector panel. It is possible to manually operate the motion either with the front panel open or closed.

With the front panel open:

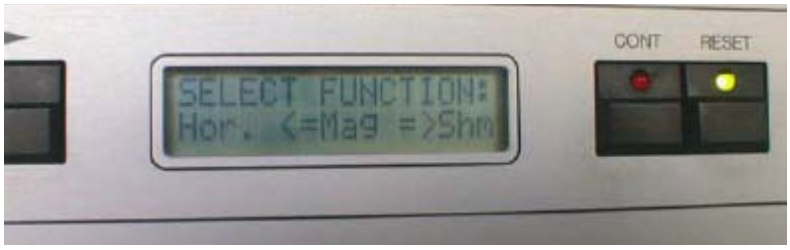
1. Press one of the manual control buttons, e.g. “Barc Valve” and hold it down.
2. Press the reset button for a short time, while holding the other button (here “Barc Valve“) still pressed (about 5 seconds), until the green LED “buttons enabled” is illuminated (see ***Figure 10.1.*** and ***Figure 10.2.***).
3. Now you can release the “Barc Valve” button and press the button corresponding to the action you would like to start.
4. To leave the manual mode, press reset and wait until the end of the initialization.

With the front panel closed:

1. Press and hold the continue (CONT) button.
2. While still holding the CONT button, press the RESET button (and release).

3. Wait until “BACS Man. Motor/Cylinders Adjust” is displayed, then release the continue (CONT) button. Using the arrow selection buttons (◄ ►) find the function that you wish to adjust:

Hor	=	Horizontal motion
Vert	=	Vertical motion
Pin	=	Pincer open
Lift	=	Lift on
Mag	=	Magazine
Barc	=	Barcode functions (operates only when the standard bar-code detection board, P/N H10028, is present).



4. Select the function by pressing the continue (CONT) button. The red LED will light signaling that the function has been selected.
5. Use the arrow selection buttons (◄ ►) to conduct the manual adjustment that you have selected.

6. To exit the manual adjustment function press the continue (CONT) button, whereas the display will return to the main menu and the red LED will turn off.
7. When you are finished with the adjustment, press the RESET button.

Valve Control & Sensor Signals

4

Introduction 4.1

The new B-ACS electronics utilize LED's for the visualization of all valve control and sensor signals. The LED's are located on the top of the connector panel. If a LED is illuminated, the corresponding valve or sensor must be active.

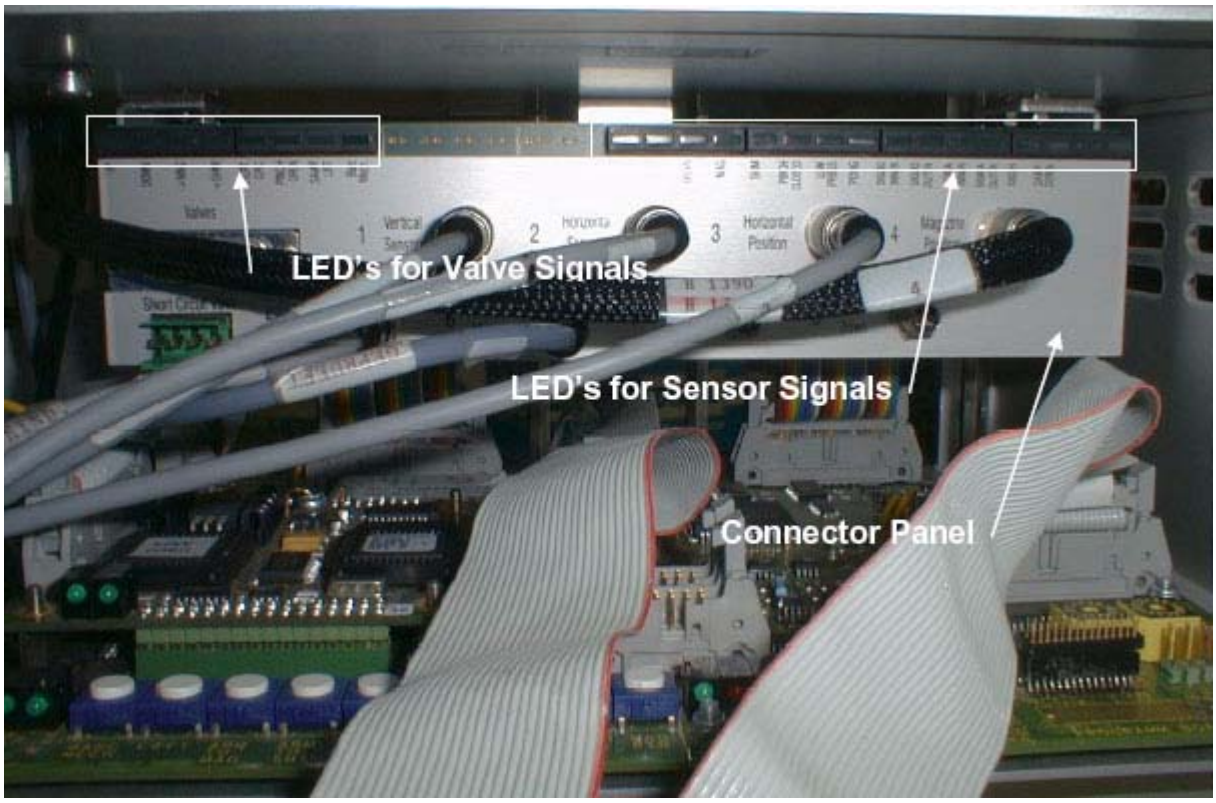


Figure 4.1. Location of Control and Signal LED's

Table 4.1. Valve Control LED's

LED	Meaning
Up	When on, the valve for moving the vertical cylinder upwards is turned on.
Down	When on, the valve for moving the vertical cylinder down is turned on.
-> Mag	When on, the valve for moving the horizontal cylinder to the magazine is turned on.
-> Shim	When on, the valve for moving the horizontal cylinder to the magnet is turned on.
Short Circ	When on, the valve for stopping the horizontal cylinder in the current position (Pos A2) is turned on.
Pinch Open	When on, the valve for opening the pincer is turned on.
Samp. Lift	When on, the valve for ejecting a sample with the sample lift valve is turned on.
Barc. Mech	When on, the valve for fixing the barcode collars for rotation is turned on.

Refer to Chapter 3 ***"Manual Adjustments & Motion Control"*** for information on manual motion control.

Table 4.2. Sensor Signal LED's

LED	Meaning
+5V	When on, the 5V power supply is available at the connector panel.
Up	When on, the vertical cylinder is detected in its "up" end position.
Down	When on, the vertical cylinder is detected in its "down" end position.
Mag	When on, the horizontal cylinder is detected above the magazine.
Shim	When on, the horizontal cylinder is detected above the magnet (shim system).
Pinch Closed	When on, the pincer is closed.
Low Press	When on, the pressure value is below it's lower limit.
POSIG	When on, the magazine is detected in a locked position, whereas the pincer is able to take a sample out of, or insert a sample into, a magazine holder.
SIGHO INNER	When on, the horizontal cylinder is detected near the outer magazine ring in direction of the inner magazine ring (B-ACS 120 only). With the B-ACS 60 this LED must always be off!
SIGHO OUTER	When on, the horizontal cylinder is detected near the outer magazine ring in direction of the magnet (B-ACS 120 only). If both the SIGHO INNER and SIGHO OUTER LED's are on, the horizontal cylinder is directly above the outer magazine ring (A2 position), whereas the pincer is able to take a sample out of, or insert a sample into, a magazine holder. With the B-ACS 60 this LED must always be off!
SIGMA INNER	When on, the holder on the inner magazine ring (holder positions 1-60) is EMPTY.
SIGMA OUTER	When on, the holder on the outer magazine ring (holder positions 61-120) is EMPTY (B-ACS120 only). With the B-ACS 60 this LED must always be off!
SIGSH	When on, the BST upper light barrier beam has been interrupted, e.g. there is a sample hovering on the air stream.
SAMP DOWN	When on, there is a sample detected down in the magnet. This LED can only be on when the Sample Down Detection Unit is connected to the B-ACS. Otherwise the LED is always off.

Serial Communication 5

Introduction 5.1

The B-ACS is connected to the spectrometer using a RS232 communication port. This port can be used to send diagnostic commands to the B-ACS, e.g. to start test loops or single motions, to receive sensor signals, or for downloading a new application program firmware from the spectrometer host computer.

Refer to ***"Main Control Board Hex Switches" on page 67*** for the baud rate settings.

Communication Path from the Spectrometer Host Computer 5.2

There are two possible tools that can be used for diagnostics/download:

RS Test 5.2.1

This tool can be opened from the ICONNMR test tools directory (e.g. c:\Bruker\topspin\prog\bin\utilities\testtools\rstest.cmd). Open the tool and select “B-ACS” to have access to the serial communication path to B-ACS.

This tool is only able to send commands (see the chapter ***"List of Commands"***) to the B-ACS. Download of new application firmware is not possible with this tool.

The Unitool Service Tool 5.2.2

This tool is only available when you have the new electronics and XWINNMR 3.5 or higher. Start Unitool from the Service Tools directory (e.g. c:\Bruker\topspin\prog\bin\utilities\servtool\unitool\unitool.cmd) of ICONNMR-PC and enter the device name „bacs“. If this device is not known by UniTool, then enter the SBS address 1 and identifier B when queried from Unitool.

A menu will be displayed where you can select what you want to do, e.g. send a command to the sample changer.

This tool should be used if you want to receive the debug buffer (refer to the chapter ***"The Debug Buffer" on page 27***).

Communication Path from a Windows Notebook Computer 5.3

The sample changer is normally connected directly to the spectrometer CCU extension via the serial interface Null modem cable. To connect it to your notebook computer, first make a note of the TTY location where B-ACS is connected to (standard TTY08). Disconnect the serial cable from the CCU extension and connect it to the notebook computer serial interface.

If it is necessary to extend the length of the interface connection, either use a one to one serial interface cable (TXD & RXD lines are not crossed over) together with the Null modem cable or use a longer Null modem cable.

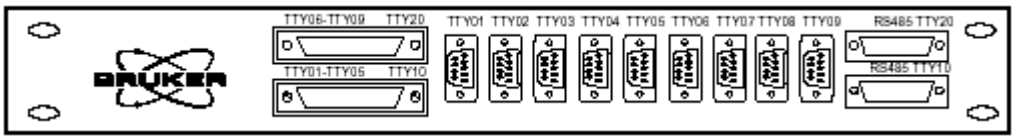


Figure 5.1. The CCU Extension

There are two possible tools that can be used for diagnostics / download. You can use either of these tools if you want to receive the debug buffer (refer to the section ***"The Debug Buffer" on page 27***).

Hyperterminal 5.3.1

You can start the Hyperterminal, which is normally located in Start – Programs – Accessories – Hyperterminal. Set up the communication parameters as follows:

9600 baud, 7 data bit, Parity “marked”, 1 Stop bit; or,

9600 baud, 7 data bit, no parity, 2 stop bit (which is the same).

This tool is only able to send commands to the B-ACS (see the chapter ***"List of Commands" on page 69***). Download of new application firmware is not possible with this tool.

Unitool 5.3.2

Start Unitool from the Unitool directory of your notebook computer and enter the SBS address 1 and identifier B when queried from Unitool.

A menu will be displayed where you can select what you want to do, e.g. send a command to the sample changer, or download new firmware etc.

Reconnecting the Serial Link Cable 5.3.3

After you have finished your work with the notebook computer (diagnostics, firmware download, etc.), quit the communication tool first, then disconnect the PC serial interface Null modem cable from your notebook computer and reconnect it to the spectrometer CCU Extension (standard TTY08).

Switching to Diagnostic Mode *5.4*

In Diagnostic Mode, B-ACS enables low level debugging commands via an RS232 connection port. These commands are explained in the section ***"Additional Commands Enabled in Diagnostic Mode" on page 88***.

1. Using Hyperterminal (see section 5.3.1) or RSTool (see section 5.21):

   Enter the command <**Esc**>, then <**enter**>,
   Press <**Esc**> & release the key,
   Press dot (**.**) and release the key,
   Press <**enter**>.

2. Using Unitool (see section ***5.2.2*** or ***5.3.2***)

   Select the corresponding menu item from the B-ACS main menu in Unitool.

In both cases B-ACS responds by changing to Sample Changer Diagnostic Mode.

Switching to Operation Mode *5.5*

After you have completed diagnostics you should switch back to operation mode as follows:

1. Using Hyperterminal or RSTool:

   Enter the command sequence <**Esc**> **?** <**enter**>

2. Using Unitool

   Select the corresponding menu item from the B-ACS main menu in Unitool.

In both cases B-ACS responds by changing to Sample Changer Operation Mode.

The Debug Buffer 6

Fetching the Debug Buffer 6.1

This feature is only available if you have new sample changer electronics. The Debug Buffer contains a log file with information about commands received, actions started, parameter timing etc.

Before you can fetch the debug buffer you must first establish a serial communication path to your notebook computer or to another PC using a terminal program or Unitool (see the chapter ***"Serial Communication" on page 23***).

Establishing a Serial Communication with a Terminal Program

For example with Hyperterminal (see section ***"Hyperterminal" on page 24****).*

If B-ACS is already in error mode (red LED on the front panel is blinking), the command to receive the debug buffer is automatically enabled. If B-ACS is not in error mode, you must switch B-ACS to the diagnostic mode as described in ***"Switching to Diagnostic Mode" on page 25***.

Enter the command “DR” (for **D**ebug **R**ead) and press enter. The entire content of the debug buffer will be downloaded to your computer. Save this log file to a local log file on your computer. The information is very helpful if you must contact Bruker Service for additional help.

Establishing a Serial Communication with Unitool

*(*see section ***"The Unitool Service Tool" on page 23*** or ***5.3.2***)

1. Create a subdirectory in the Unitool directory **\files\bacs** if it does not already exist (use only lower case letters).

   For example:

   c:\bruker\topspin\conf\instr\servtool\unitool\files\bacs (when you are running Unitool from the spectrometer host computer)

   or

   c:\unitool\files\bacs (when you are running Unitool from your notebook computer)

2. Start Unitool and select the menu item „**Write Debug.txt file**“.
3. Quit Unitool using the menu item „Exit“.
4. Examine the contents of the „Debug.txt“ file or send it to Bruker if requested.

The BSMS Debug File 7

Transferring the Communication Log File to B-ACS 7.1

The BSMS Debug Log File is an automation debug file that logs the communication between ICON-NMR and the B-ACS.

The information in the log file is very helpful if you must contact Bruker Service for additional help.

When Using XWIN-NMR Prior to Version 3.5 7.1.1

To generate an automation debug file, the XWIN-NMR program **debugmod** is required.

Start the **debugmod** program and set the DEBUG_BSMS entry to db.bsms. Make a note of the directory location shown on the bottom of the window and click on „**Apply**“.

When the ICON-NMR Automation starts you'll find that ICON-NMR places an additional window on the screen.

The file db.bsms will be created in the directory shown at the bottom of the window when you started the debugmod program. This directory is usually in the login user's home path.

Note that this flag should not be set indefinitely. The **db.bsms** file will continue to grow larger and larger, so this should be deactivated once the debugging has been completed. To deactivate the debug modus:

- Start the **debugmod** program again and clear the **db.bsms** entry from DEBUG_BSMS, then click on „**Apply**“.
- Restarting XWIN-NMR will also deactivate the debug mode.

When Using XWIN-NMR Version 3.5 or Higher 7.1.2

In the directory XWINNMRHOME/prog/curdir/<USERNAME>, whereas USERNAME is the name under which you login, you will find debug files showing the communication between XWIN-NMR/ICON-NMR and the B-ACS. These files are generated automatically without any configuration being necessary. The files have the name BacsDebug, followed by an extension which represents the process ID of the process governing the run (the ICON-NMR driver).

Only the last 5 runs are documented in the debug file.

When Using Topspin 1.3 or Higher *7.1.3*

In addition to the B-ACS debug file described above, you will also find an Icon driver debug file detailing the actions of the ICON-NMR automation driver script. This file is also useful for any debugging processes. As with the B-ACS debug file, only the last 5 runs are documented in the file. These files have an extension corresponding to the B-ACS debug files.

Downloading Firmware

8

Introduction 8.1

This feature is only available if you have the new B-ACS electronics (see ***Figure 2.4.*** and ***Figure 2.5.***).

You can find the newest firmware version on the Bruker FTP server at the following location:

ftp.bruker.de/pub/nmr/AUTOMATION/BACS/firmware/

In this directory you will find all the current firmware versions and a description file named “VersionInfo.txt” with information about firmware improvements. Typically you will find 2 firmware files and respectively directories with the same Build.

For example:

BACS_VS20030910_B12.HEX and BACS_VS19991201_B12.HEX.

Both files in the example pertain to Build 12 of the firmware version, whereas the first file in the example has a version date of September 10, 2003 and the second file has a version date of December 1, 1999, otherwise both of the firmware files are identical!

XWINNMR 3.2 or earlier have year 2000 problems, therefore the old-trimmed firmware (e.g. BACS_VS19991201_B12.HEX) should be downloaded. By factory default, the firmware version >2000 is downloaded to the electronics.

You can download any firmware version from this directory to the new B-ACS electronics unless otherwise noted in the “VersionInfo.txt” file. It is recommended that you always use the newest firmware version.

It is highly recommended that you check the B-ACS firmware version using the command **VS**, **VM**, and **VB**, and if necessary, upgrade the B-ACS to the latest firmware version!

In the firmware file directories, e.g. „BACS_VS20040805“ on the FTP server you will find two files. In this example BACS_VS20040805.HEX, which is necessary when using the SBS Download Tool (see section ***8.2***) or SBS Terminal (see section ***8.3***), and the file „bacsao01.bin“ which is necessary when using Unitool (see section ***8.4***). Both firmware source files result in the same application program at the B-ACS after download.

Technical Background

***.BIN files** contain a memory image of the microcontroller memory. For each byte in the memory, only 1 byte in the file is needed.

***.HEX files** encode the information for download in lines containing length, address, data and checksum. For each byte in microcontroller program memory, 2 bytes in the file are needed, plus the additional overhead for address, etc.

Therefore downloading *.bin files with Unitool is much faster because the firmware files are smaller than the *.hex files.

The necessary download tools will be provided on the image CD (beginning with TopSpin version 1.3) used to install the spectrometer operating system on the customers spectrometer host computer. This eliminates the need for you to downloading huge files at the customer’s site!

On the CD you will find a similar directory structure as the FTP server:

\servtool\bacs\firmware	Contains the firmware files.
\servtool\SBS Download Tool	Contains the SBS Download Tool.
\servtool\SBS Terminal	Contains the SBS Terminal program.
\servtool\Unitool	Contains the Unitool program.
\servtool\Unitool\files\bacs\bacsxx01.bin	The latest firmware file available when the CD was created.

Downloading Firmware Using the SBS Download Tool 8.2

This is an easy method of downloading new firmware to the new B-ACS electronics.

This tool requires a Windows-based PC (Window NT 4.0 or newer) and the *.HEX firmware file.

You can find the download instruction file on the Bruker Germany FTP server at:

ftp://ftp.bruker.de/pub/nmr/AUTOMATION/BACS/FIRMWARE/Firmware_Download_SBSDownloadTool.pdf

You will also need a tool named „Download.exe“ which is also available on the Bruker Germany FTP site at:

ftp://ftp.bruker.de/pub/nmr/AUTOMATION/DownloadTool

Downloading Firmware Using the SBS Terminal Program 8.3

This method not only allows you to download firmware, but also provides the possibility of sending commands to the B-ACS after a download, e.g. for diagnostics.

You will need the *.HEX firmware file and a download tool named „SBS Terminal“ which is available from the Bruker Germany FTP server in the directory:

ftp://ftp.bruker.de/pub/nmr/AUTOMATION/SBSTERMINAL

Note: SBS Terminal only works with Window’s based PC’s.

To download the newest firmware version from the Bruker Germany FTP server to the sample changer electronics, follow the instructions written in the document ’Firmware_Download_SBSTerminal.pdf’, which can be found at:

ftp://ftp.bruker.de/pub/nmr/AUTOMATION/BACS/FIRMWARE/

Downloading Firmware Using the Unitool *8.4*

1. Copy the file **bacsxx01.bin** from the FTP server directory (e.g. BACS-VS20040805_B18) into the **\files\bacs** subdirectory of the spectrometer control PC's service tools directory.

   This will make the file available for Unitool, for example:

   C:\bruker\topspin\conf\instr\servtool\unitool\files\bacs\bacsao01.bin

   When you have a serial connection from your notebook computer then copy the file to the subdirectory:

   C:\unitool\files\bacs\bacsao01.bin

2. Start Unitool (see ***"Unitool" on page 24***).
3. Select the Unitool item '**Download new Application Program**' and press '**Enter**' to start the download. B-ACS electronics will search the Unitool \files\bacs directory for files named bacsxx01.*, where x = 'a' .. 'z' and * = 'hex' or 'bin'.

The file name with the highest numeric value will be selected, for example:, bacsao01.* is newer than bacsan01.*

Please do not rename any filename because this will effect the automatic search filter!

Technical Background - How does a firmware download work? *8.5*

When downloading a new application firmware to the B-ACS, a separate program (called a boot program), which runs on the microcontroller, is necessary.

This program first erases the application memory, then receives the firmware file information from the download tool (SBS Download Tool, SBS Terminal or Unitool) and stores it in the correct place in the microcontrollers application memory.

The boot program cannot be deleted or modified at the customer site (which is really not necessary), you can only download a new application program.

The boot program is first active after a reset or power up. The program checks if a valid ***and*** complete application program for the B-ACS is available in the memory. You can watch this by observing the „BOOT RUNNING“ LED (see ***Figure 10.1.*** and ***Figure 10.2.***) which will be activated directly after reset.

This check takes about 1-5 seconds, whereas the INFOLED1 LED will blink. When the application program is completely and correctly available, the boot program switches over to the application program, which will then initialize the B-ACS hardware (horizontal & vertical motion, carroussel, etc.) You should then observe that the „BOOT RUNNING“ LED turns off and the „APPL. RUNNING“ LED activates.

Firmware Download Problem Handling *8.6*

When a firmware download is initiated, but is not completed successfully (e.g. communication error, etc), the application program in the microcontroller memory is not complete. In this case the boot program will not switch over to the application program, but will remain active (refer to section ***8.5***) in order to receive a complete new application program.

Unfortunately, the first boot program version (20011211) had a bug. When the download was unsuccessful, the program did not enable the download of a new application program using the SBS Download Tool or SBS Terminal. Both tools stopped download and displayed the error message 'Order Error'. Only download attempts with Unitool would complete the download.

The reason for this problem was that a variable in the boot program was set incorrectly. This bug has been solved in the boot program version 20020716.

You can only check the boot program version using Unitool:

1. Start Unitool as described in the sections ***"The Unitool Service Tool" on page 23*** or ***"Unitool" on page 24*** and access the boot program main menu.
2. If you cannot establish a communication between Unitool and B-ACS you must send the new B-ACS electronics (P/N HZ08368 or H9804) back to Bruker Germany for repair.
3. Select the menu item "Show versions" in the Unitool menu of B-ACS and note the boot version.
4. You can now start to download a new application program using Unitool (see section ***"Downloading Firmware Using the Unitool" on page 34***) or, you can quit Unitool using the "exit" menu item. When you quit Unitool, the initially incorrect set variable will be set to valid, which will enable downloads using the SBS Download Tool or SBS Terminal.

Notebook Computers *8.7*

With some notebook computers the download will not start sucessfully because the voltage for the RS232 is too low when in battery mode. Always connect the external power supply to the notebook computer when communicating with the sample changer!

List of Errors 9

Introduction 9.1

Before troubleshooting the explicit error messages described below, you should be familiar with the debug possibilities described in the previous chapters! Nearly all the error messages make references to these basic skills or procedures.

General Checks before Detailed Troubleshooting 9.2

General checks to be performed BEFORE detailed troubleshooting:

- Is there enough main air pressure?
- Is the power supply working (fuses blown)?
- Is the sample changer initializing after reset (or is it doing nothing)?
- Is there an error message displayed at the B-ACS display? When yes, then note the error number and complete error message text before contacting Bruker Service for further help!

Before contacting the Bruker Help desk first annotate the following information:

- Spectrometer type and order number, e.g. AV400 HH123456
- Magnet Type, e.g. 600 MHz US+
- B-ACS part number and serial number, e.g. H1080, ECL05, #1234
- XWIN / ICONNMR version, e.g. 3.5 Patch Level 6
- Whether the sample changer has the new electronics.
- Whether the sample down detection box is installed.
- Error number and error text.

Having this information on hand will expedite handling when contacting Bruker Service!

Simple Errors with Error Number and Message *9.3*

Error 01: INSUFFICIENT AIR PRESSURE

Meaning: There is not enough main pressure for the pneumatic parts to work properly.

Possible reasons:
- Main pressure supply is not sufficient. The sample changer has detected that the pressure left has reached the lower limit of 3 bar.
- Under pressure – Switch is disconnected or not working. If you have new electronics you can monitor the pressure switch output to the electronics with the sensor LED “Low Press” (see chapter ***"Valve Control & Sensor Signals" on page 19***).

Check the following: Start the pressure test loop using the diagnostic command “**PT**” (see section ***11.3***) and open / close the pressure regulator in the B-ACS column. Watch the B-ACS display!

Technical background: The sensor signal LOW_PRESS is wired using connector #7 at the connector panel.

Error 02: DOWNWARDS MOTION FAILED and Error 03: UPWARDS MOTION FAILED

Meaning: The vertical cylinder motion was not detected as being in its “down” / “up” position.

Possible reasons:
- Cable to the vertical cylinder is damaged.
- End position switches in the vertical cylinder are damaged.
- Valve is not working.

Check the following:
- Does the vertical arm move using the manual control buttons (see chapter ***"Manual Adjustments & Motion Control" on page 15***)?
- Do the sensors work (only easy to check if you have the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- Use the diagnostic commands **AU**, **AD** and **VL** to find the error (see section ***11.3***).

Technical background: The sensor signals UP and DOWN are wired using connector #1 at the connector panel.

The valve control signals run through the cable with the 15pin D-subconnector at the connector panel.

Error 04: OUTWARDS MOTION FAILED and Error 05: INWARDS MOTION FAILED

Meaning: The horizontal cylinder motion was not detected as being in its end position above the shim system or the magazine.

Possible reasons:
- The end position switches at the horizontal cylinder are damaged.
- Valve is not working.

Check the following:
- Does the horizontal arm move using the manual control buttons (see chapter ***"Manual Adjustments & Motion Control" on page 15***)?
- Do the sensors work (only easy to check if you have the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- Use the diagnostic commands **A1**, **AS**, and **HL** to find the error (see section ***11.3***).

Technical background: The sensor signals MAG and SHIM are wired using connector #2 at the connector panel.

The valve control signals run through the cable with the 15pin D-subconnector at the connector panel.

Error 06: PINCER OPENING FAILED and Error 07: PINCER CLOSING FAILED

Meaning: The pincer did not open / close within a specified time.

Possible reasons:
- Cable to the vertical cylinder is damaged.
- Micro-switch inside the vertical cylinder is damaged.
- Valve is not working.

Check the following:
- Does the pincer open with the manual control button (see chapter ***"Manual Adjustments & Motion Control" on page 15***)?
- Does the sensor work (only easy to check if you have the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- Use the diagnostic commands **PO**, **PC** and **PL** to find the error (see section ***11.3***).

Technical background: The sensor signal PINCER_OPEN is wired using connector #1 at the connector panel.

The valve control signals run through the cable with the 15pin D-subconnector at the connector panel.

Error 08: CARROUSEL MOTION FAILED

Meaning: The magazine did not move even when it was started by the controller.

Possible reasons: Motor or Driver-IC damaged.

Check the following:

- Does the magazine move using the manual control button (see chapter ***"Manual Adjustments & Motion Control" on page 15***)?
- Does the motion direction change when pressing the MAG DIR button (see chapter ***"Manual Adjustments & Motion Control" on page 15***)?
- Does the positioning sensor (POSIG) work (only easy to check if you have the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- Use the diagnostic commands **MB**, **MF**, **MP**, **LB** and **LF** to find the error (see section ***11.3***).

Technical background: The sensor signal POSIG is wired using connector #4 at the connector panel.

The signals to start the motor and to set the direction are in the 26pin flat ribbon cable to the power supply box.

Error 09: CARROUSEL POSITION UNDEFINED

Meaning: B-ACS tried three times to lock the magazine at the current position, but the magazine moved too far.

Possible reasons:

- Magazine Positioning Switch is damaged / mis-adjusted.
- If this error occurs during initialization without any movement of the cylinders, the power supply may by damaged. Check the fuses!
- If the magazine does not stop, the magazine positioning switch is damaged.

Error 09: CARROUSEL POSITION UNDEFINED

Check the following:

- Does the magazine move with the manual control button (see chapter ***"Manual Adjustments & Motion Control" on page 15***)?
- Does the magazine lock at the next position after releasing the button?
- Does the positioning sensor (POSIG) work (only easy to check if you have the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- Use the diagnostic commands **MB**, **MF**, **MP**, **LB** and **LF** to find the error (see section ***11.3***).

Technical background: The sensor signal POSIG is wired using connector #4 at the connector panel.

The signals used to start the motor and to set up the direction are in the 26pin flat ribbon cable to the power supply box.

Error 10: SAMPLE HOLDER NOT EMPTY

Meaning: B-ACS ejected a sample from the magnet and tried to place it in the magazine in an occupied position.

Possible reasons:

- Someone has inserted a sample manually in the corresponding holder.
- The reflex lights detect a sample at the magazine even when the position is empty.

Check the following:

- Does the sensor work (use the LED indicators at the housing and at the connector panel of the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- What is the range from where a sample is detected?
- Use the diagnostic command **OM** to find the error (see section ***11.3***).

Technical background: The sensor signals SIGMA_INNER and SIGMA_OUTER are wired using connector #6 at the connector panel.

Error 11: SAMPLE DETECT AT MAGNET FAILED

Meaning:

B-ACS took a sample out of the magazine and tried to insert it into the magnet. The sample could not be seen at the shim top light barrier or it could not be detected down in the magnet (if you have the new electronics with a sample down detection box installed).

Possible reasons:

- Misaligned cylinders (the sample is inserted too far into the BST, or not far enough to interrupt the light barrier beam).
- Upper shim light barrier damaged.
- Sample down detection box not working properly.

Check the following:

- Insert / Eject samples using the manual lift button - see chapter ***"Manual Adjustments & Motion Control" on page 15*** (or the diagnostic commands **LU** and **LD** - see section ***11.3***).
- Observe the sensor LED's "SIGSH" (if you have the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***) and "Samp Down" (only if the sample down detection box is installed).
- Query B-ACS for the state of the upper shim light barrier using the command **ST** and the diagnostic command **OS** (see chapter ***"List of Commands" on page 69***).

If the sample down detection box is installed:

- Observe the indicator at the box. The indicator will only be lit if a sample is down in the magnet. Refer to the corresponding installation manual.
- Query B-ACS for the state of the sample down sensor using the command **PD** (see section ***"Normal Operation Mode" on page 69***).

Technical background:

The sensor signal SIGSH is wired using connector #5 at the connector panel.

The sensor signal SAMPLE DOWN is wired using connector #8 at the connector panel.

Error 12: SAMPLE DETECT AT CARROUSEL FAILED

Meaning:	B-ACS took a sample out of the magnet and tried to insert it into the magazine. The sample could not be detected in the magazine ring where it was inserted.
Possible reasons:	• Someone has taken the sample out of the magazine before the sample changer completed it's motion. • The reflex light fails to detect a sample at the magazine even if the position is occupied.
Check the following:	• Does the sensor work (use the LED indicator at the sensor housing and at the connector panel of the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)? • What is the range from where a sample is detected? • Use the diagnostic command **OM** to find the error (see section ***11.3***).
Technical background:	The sensor signals SIGMA_INNER and SIGMA_OUTER are wired using connector #6 at the connector panel.

Error 13: SAMPLE DETECT AT MAGNET FAILED

Meaning: B-ACS tried to take a sample out of the magnet. The sample could not be detected inside the magnet (if you have the new electronics with a sample down detection box installed) or could not be seen at the shim top light barrier even if the lift is on.

Possible reasons:

- Lift is weak, maybe main pressure supply is not constant.
- Upper shim light barrier is damaged.
- Sample down detection box not working properly.

Check the following:

- Insert / Eject samples using the manual lift button - see chapter ***"Manual Adjustments & Motion Control" on page 15*** (or the diagnostic commands **LU** and **LD** - see section ***11.3***).
- Watch the sensor LED's "SIGSH" (if you have the new electronics) and "Samp Down" (only if the sample down detection box is installed).
- Query B-ACS for the state of the upper shim light barrier using command **ST** and the diagnostic command **OS** (see chapter ***"List of Commands" on page 69***).

If the sample down detection box is installed:

- Watch the indicator at the box. The indicator will only be lit if a sample is down in the magnet.
- Ask B-ACS for the state of the sample down sensor using the command **PD** (see section ***"Normal Operation Mode" on page 69***).

Technical background: The sensor signal SIGSH is wired using connector #5 at the connector panel.

The sensor signal SAMPLE DOWN is wired using connector #8 at the connector panel.

Error 14: SAMPLE GRASPING FAILED

Meaning: B-ACS tried to take a sample out of the magazine or magnet, but the sample is still detected at the lower sensor (at the magazine, at the shim top) after the vertical cylinder has reached its upper end position.

Possible reasons:

- Mis-adjusted / damaged sensor.
- Sample is stuck in the magazine or in the BST.
- Pincer did not close enough to create enough friction to grasp the sample.

Check the following:

- If the sample could not be taken from the magazine:

  Possible reasons:
  a) Someone has inserted a new sample into the magazine before the sample changer has completed its motion.
  b) The reflex lights detect a sample at the magazine even if the position is empty.

  Check the following issues:
  a) Does the sensor work (use the LED indicator at the housing and at the connector panel of the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
  b) What is the range from where a sample is detected?
  c) Use the diagnostic command **OM** to find the error (see section ***11.3***).

- If the sample could not be taken from the BST (magnet):

  Possible reason:
  The BST upper light barrier or the sample down detection box is damaged.

  Check the following:
  a) Insert / Eject samples using the manual lift button - see chapter ***"Manual Adjustments & Motion Control" on page 15*** (or the diagnostic commands **LU** and **LD** - see section ***11.3***).
  b) Observe the “SIGSH” (if you have a new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***) and “Samp Down” (only if the sample down detection box is installed) sensor LED’s.
  c) Query B-ACS for the state of the upper shim light barrier using the commands **ST** and **OS** (see chapter ***"List of Commands" on page 69***), and for the state of the sample down detection sensor using the command **PD** (see section ***11.1***).

Use the diagnostic commands **IJ** and **EJ** to repeat the motions which caused the error (see chapter ***"List of Commands" on page 69***)!

Technical background: The sensor signal SIGSH is wired using connector #5 at the connector panel.

The sensor signals SIGMA_INNER and SIGMA_OUTER are wired using connector #6 at the connector panel.

The sensor signal SAMPLE DOWN is wired using connector #8 at the connector panel.

Error 15: SHIM SYSTEM NOT EMPTY

Meaning:

- During initialization, B-ACS tried to move down to the BST to check if there is a sample hanging at the pincer, but the BST upper light barrier beam is already interrupted, or
- B-ACS tried to insert a sample into the magnet and there is already a sample inside the BST (BST upper light barrier is closed) or, if the sample down detection box is installed, it is detected down inside the magnet.

Possible reasons:

- There is really a sample down in the magnet.
- There is really a sample at the top of the BST interrupting the upper light barrier beam (e.g. lift was turned on manually using the BSMS keyboard and a sample was in the magnet and is now hovering in the air stream).
- The sample down detection box is not working correctly (if installed).
- The BST upper light barrier is damaged.

Check the following:

- Insert / Eject samples using the manual lift button - see chapter ***"Manual Adjustments & Motion Control" on page 15*** (or the diagnostic commands **LU** and **LD** - see section ***11.3***).
- Observe the sensor LED's "SIGSH" (if you have a new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***) and "Samp Down" (only if the sample down detection box is installed).
- Query B-ACS for the state of the upper shim light barrier using the diagnostic commands **ST** and **OS** (see chapter ***"List of Commands" on page 69***), and for the state of the sample down detection sensor using the command **PD** (see section ***11.1***).
- If the sample down detection unit is installed, check if the jumper inside the unit is really set to B-ACS (it may be set to BSR).

Technical background:

The sensor signal SIGSH is wired using connector #5 at the connector panel.

The sensor signal SAMPLE DOWN is wired using connector #8 at the connector panel.

Error 16: CODE WHEEL DETECTION FAILED! CODE: xxx

Meaning: B-ACS read the code wheel and the value received was outside the range of 1 to 60. The value read will be displayed behind “CODE”.

Possible reasons:

- Dust / dirt is on the code wheel.
- The code wheel unit is not synchronized with the magazine locked position.
- The code wheel detection lights are damaged.
- Is the magazine positioning switch working correctly (check POSIG LED at connector panel if you have new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- The 16-pin flat ribbon cable to the code wheel unit is not connected or is connected incorrectly.

Check the following:

- Is the code wheel clean?
- Is the 16-pin flat ribbon cable connected to the code wheel unit? If the error occurred for the first time after a B-ACS modification, it can be assumed that the cable was inserted the wrong way. Reverse the cable (nothing will be damaged if the cable is reversed).
- Use the diagnostic command **CA** (see section ***11.3*** to find out if the code wheel unit is synchronized with the magazine lock (the position displayed should change in the middle between 2 locked magazine positions) and not located near the locked position. When the codewheel is not adjusted properly, please adjust it using the instructions provided below.
- Does the magazine move to all positions using the arrow keys at the front panel left to the display (try forward and backward motions!)? Does it lock properly?

Technical background: If you have new sample changer electronics and the firmware version is before 20021112 Built 05, download (see chapter ***"Downloading Firmware" on page 31***) the newest firmware version from the Bruker FTP server.

The sensor signal POSIG is wired using connector #4 at the connector panel.

Hint: Code wheel units are only exchanged as a complete package (electronics, belt & and code wheel itself). Never exchange the light emitting and light sensing board separately! They are precisely aligned with another!

Error 16: CODE WHEEL DETECTION FAILED! CODE: xxx

Adjusting the code-wheel:

1. Establish a serial communication to the sample changer, e.g. using RSTEST from the spectrometer computer.

2. Switch B-ACS to Diagnostic Mode.

3. Enter the command "**CA**" for codewheel adjust. On the B-ACS display you can now see the currently read position, e.g. "CODEWHEEL TEST CODE NUMBER: 25".

4. Open the rear panel of the B-ACS.

5. Looking from behind into the B-ACS housing, you can see on the right hand side a disc with a black pattern on it. This is the codewheel detection unit.

6. On the CDW-Unit are 3 small screws: 1 at the motor shaft with a small cogwheel, 1 at the shaft with the CDW disc at the big cogwheel, and 1 at the shaft with the CDW disc directly at the CDW disc holder.

7. Check if the screws at the motor shaft and the screw at the big cogwheel on the shaft with the CDW disc are tightened (both screws refer to the cogwheels of the belt). Do not tighten them too much! Open the screw which fixes the CDW-disc at the CDW shaft with the big cogwheel. The CDW disc must be vertically in the middle between the two opto boards, which are above and below the CDW disc.

8. Rotate the codewheel detection disc until the correct position number is displayed on the samle changer LCD

9. When the carousel is locked correctly (look at the micro-switch below the carousel at the position where samples are taken from/placed in the carousel, it must be released!), then the codewheel disc should be fixed in a way where:

   a) If you move the carousel manually (with new sample changer types you need to apply some force to move the belt) to the LEFT, the position displayed at the LCD should change earliest after a movement of about 3-4 mm.

AND

   b) If you move the carousel manually (using force) to the RIGHT, the position displayed at the LCD should change earliest after a movement of about 3-4 mm.

10. Fix the small screw you just opened. Now check step 9 again!

11. Press the "RESET" button at the sample changer front panel and wait until the end of the initialization.

12. Press the "**<-**" button shortly until the carousel motion starts, then release it immediately. Wait until the magazine stops. Compare the position displayed in the LCD with the real position of the carousel. Redo this with all 60 positions.

13. Redo step 12. with the "**->**" button.

14. Close the rear panel of the sample changer.

Error 21: CODEWHEEL MISADJUSTED FOR POSITION NO: xxx

Meaning:	B-ACS read the code wheel and the value received was not the expected value, e.g., if B-ACS moves forward from position 18, the value read at the next locked magazine position must be 19. If it is not 19, this error is raised.
Possible reasons:	The same as at error 16 “CODEWHEEL DETECTION FAILED! CODE: xxx”
Check the following:	The same as at error 16 “CODEWHEEL DETECTION FAILED! CODE: xxx”
Technical background:	The same as at error 16 “CODEWHEEL DETECTION FAILED! CODE: xxx”

Error 22: NO FREE MAGAZINE POSITION

Meaning: The B-ACS was asked to eject a sample from the magnet and to place it back into the magazine, but all the positions are occupied.

Possible reasons:

- Someone has manually filled all the magazine holder positions.
- The reflex lights detect a sample at the magazine even if the position is empty.

Check the following:

- Does the sensor work (use the LED indicator at the sensor housing and at the connector panel of the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- What is the range from where a sample is detected?
- Use the diagnostic command **OM** (see section ***11.3***) to find the error.

Technical background: The sensor signals SIGMA_INNER and SIGMA_OUTER are wired using connector #6 at the connector panel.

Error 23: SAMPLE MISSING

Meaning: The B-ACS was asked to take a sample from the magazine and to insert it into the magnet, but no sample is present at the specified position.

Possible reasons:
- Someone has taken the sample out of the magazine before the sample changer has completed a motion sequence.
- The reflex light is not detecting a sample at the magazine even when the position is occupied.

Check the following:
- Does the sensor work (use the LED indicator at the housing and at the connector panel of the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)?
- What is the range from where a sample is detected?
- Use the diagnostic command **OM** to find the error (see section ***11.3***).

Technical background: The sensor signals SIGMA_INNER and SIGMA_OUTER are wired using connector #6 at the connector panel.

Error 25: FAILURE OF SPINNING DEVICE

Meaning: B-ACS tried to fix the position of the barcode collar using the small white wheels, but the corresponding pneumatic cylinder was not be detected in it's "fixed" position.

Possible reasons:
- The 26 pin flat ribbon cable from the electronics barcode detection piggyback board to the barcode reading device is not connected.
- The detection micro-switches do not work (there is currently no indicator for this sensor).
- The cylinder or valve does not work.
- The pressure reduction throttle is misadjusted.

Check the following:
- Does the barcode collar fixing cylinder work with the manual control button (see chapter ***"Manual Adjustments & Motion Control" on page 15***)?
- Does the sensor work (can you hear it clicking)?
- Use the diagnostic command **BT** (see section ***11.3***) to find the error.

Error 26: ARM POSITIONING FAILED

Meaning: B-ACS tried to move the vertical cylinder over the outer magazine ring but could not lock at this position after 3 attempts. This error will only occur if you have a B-ACS with 120 holder positions.

Possible reasons:

- The speed of the horizontal cylinder is too fast.
- The reflex light barrier above the outer magazine ring is misadjusted / damaged / dirty.

Check the following:

- Switch the B-ACS to manual operation mode (see chapter ***"Manual Adjustments & Motion Control" on page 15***).

  Move the horizontal cylinder by hand slowly from the inner magazine ring to the magnet and check if the signals follow those in the ***"Sensor Signal Table"*** below. Refer to chapter ***"Valve Control & Sensor Signals" on page 19*** for the meaning of the LED's.
- Check movement to the A2 position using the diagnostic command **A2** - see section ***11.3*** (the A2 position is above the outer magazine ring with holders 61-120).

  Check if the short circuit valve (see chapter ***"Valve Control & Sensor Signals" on page 19***) is being activated when the horizontal arm is above the outer magazine ring.

  Start the motion from the inner ring and from the shim system to see if both directions work. Use the diagnostic commands (see section ***11.3***) **A1** to move to the inner magazine ring and **AS** to move to the shim system.

Technical background: The signals MAG and SHIM are wired using connector #2 at the connector panel.
The signal SIGHO_INNER and SIGHO_OUTER are wired using connector #3 at the connector panel.

Table 9.1. ***Sensor Signal Table***

MAG	SIGHO INNER	SIGHO OUTER	SHIM	Meaning
On	On	Off	Off	The horizontal arm is above the inner magazine ring.
Off	On	Off	Off	The horizontal arm is near the outer magazine ring, but closer to the inner magazine ring. Sample cannot be gripped from the outer magazine ring.
Off	On	On	Off	The horizontal arm is directly above the outer magazine ring and is able to grip samples from there.
Off	Off	On	Off	The horizontal arm is near the outer magazine ring, but not above it. It is a little too far outside in the direction of the magnet

Off	Off	Off	Off	The horizontal arm is somewhere between the outer magazine ring and the magnet.
Off	Off	Off	On	The horizontal arm is directly above the magnet.

Error 50: BARCODE READER NOT PRESENT

Meaning: B-ACS was asked to read a barcode or to transmit some barcode information for a specified position, but there is no barcode reader installed.

Possible reasons:

- There is no barcode reader installed.
- The barcode reader was not detected by the B-ACS main control board.
- There is no Board Information System (BIS) present on the barcode board.

Check the following:

- Check if you have mounted the barcode reader piggyback board correctly in the main control board socket.
- Reset B-ACS and wait until the initialization is complete. Fetch the B-ACS debug buffer (see chapter ***"The Debug Buffer" on page 27***) and read the information in the area “Initializing Barcode Reader” carefully to find out if BIS is correctly available on the board. If BIS is missing or destroyed please send the barcode reader piggyback board back to Bruker Electronic for repair. Writing BIS (e.g. a dummy BIS) is possible in the field, but not desirable.

Error 51: INVALID COMMAND

Meaning: The command sent to B-ACS is unknown or invalid.

Possible Reasons and What to Check:

- The command is not valid. Check if the command is available in the ***"List of Commands" on page 69***.
- Unknown command for your software version. During the development progress new commands are continuously being added to the B-ACS firmware. With an older firmware version, not all of the commands may be present.
- When you have the old electronics use only capital letters when entering commands. Only the new B-ACS electronics can utilize commands regardless of case sensitivity.
- When you have the old electronics use exactly 1 space between a command and a parameter (if required). The new electronics (only) will except 0, 1, or 2 spaces between the command and the parameter.
- There were already some characters in the command receive buffer before the current command was received. The command you sent was added to the end of these characters and was interpreted as an invalid command. Reenter the command.

If you have new electronics, also check the following:

If the error occurred during automation and the command send was a valid command, check the following: If the B-ACS firmware version is before 20040526 Built 16, please download the newest firmware version from Bruker FTP server (see chapter ***"Downloading Firmware" on page 31***).

Technical background: Old B-ACS firmware versions monitored the main air pressure continuously, even if there was no motion executed which needed the air pressure. If the air pressure fell below 3 bar, the error 01: INSUFFICIENT AIR PRESSURE was created and transmitted to ICONNMR. ICONNMR did not clear (and not recognize!) this error message before it sent the next command. The next command was a normal operation command and not allowed in B-ACS error mode, thus the error message was not cleared and was still visible on the B-ACS display.

Error 52: INVALID PARAMETER

Meaning: The parameter transmitted after the command was outside the expected range.

Possible Reasons and What to Check:

- The parameter is outside the range (e.g. you want to insert a sample from position 65, but you only have a B-ACS 60). Check the range using the ***"List of Commands" on page 69***.
- When you have older electronics use exactly 1 space (blank) between a command and a parameter. The new electronics can work with 0, 1, or 2 spaces between the command and the parameter, too.
- Do not enter any spaces (blanks) between the parameter and the ENTER key.

Error 54: HORIZONTAL OPTIC NOT PRESENT

Meaning: The horizontal optic which detects the horizontal position above the outer magazine ring is not present.

Possible reasons: You have entered the diagnostic command "**OH**" (see section ***11.3***) to adjust the horizontal optic, but B-ACS assumes that it has only 60 holders, and that the optic does not exist.

Check the following:

- Does the B-ACS really have 120 holder positions (2 magazine rings)? Is the horizontal optic physically installed?
- Is the sensor cable from the horizontal optic connected to connector #3 at the connector panel?
- Do the sensor signals follow those in the ***"Sensor Signal Table" on page 51***?

Error 55: AUTOPREP HARDWARE NOT PRESENT

Meaning: B-ACS is not connected to an ASP (Automated Sample Preparation) station, so some commands are not enabled.

Possible reasons: You have tried to send the command **XL** (see chapter ***"List of Commands" on page 69***) to mark a sample as "measured". This command is disabled without the ASP station.

Check the following:

- Do you really have an ASP station connected to B-ACS?
- Does B-ACS recognize the ASP station (the corresponding LED is active - see ***Figure 10.2.***)?

Error 57: xx COMMAND IS NOT AVAILABLE IN DIAGNOSTICS!

DIRECT LIFT CONTROL IS SWITCHED OFF! Where xx is I2, IJ, E1, EJ, SE, TL, LD, or LU.

Meaning: The diagnostic command (see section ***11.3***) you have entered cannot be executed because the BST sample lift is required for the execution. The BSMS is currently controlling the sample lift, rather than B-ACS.

Solution: Change the sample lift control back to B-ACS using the command **NL** (see chapter ***"List of Commands" on page 69***) and retry the command which caused the error.

Error 59: BUSY

Meaning: B-ACS is currently unable to execute the command.

Possible reasons:

- A command that was previously entered is not completed -> B-ACS is still executing this command.
- B-ACS is in error mode. Only a few commands are enabled in error mode (see section ***11.2***).
- B-ACS is blocked by the ASP station and is not allowed to move and to change the magazine position.

Errors Greater than 80 *9.3.1*

All the errors with error number 80 and higher are sensor errors and were implemented in the new B-ACS electronics firmware version 20031020 Built 13. These errors indicate that a physically impossible combination of sensor signals has been detected by the B-ACS electronics.

Error 80.x

Meaning: This error regards sensor errors at the horizontal cylinder. An illegal combination of the signals MAG, SHIM, SIGHO_INNER and SIGHO_OUTER has been detected.

Check the following: Please check if the sensor signals follow those in the ***"Sensor Signal Table" on page 51*** (B-ACS 120 only).

For B-ACS 60, only the MAG and SHIM signals must correspond to the sensor signal table. The SIGHO_INNER and SIGHO_OUTER must be off.

Technical background: The signals MAG and SHIM are wired using connector #2 at the connector panel.

The signal SIGHO_INNER and SIGHO_OUTER are wired using connector #3 at the connector panel.

Error 80.1: SENSOR ERROR: HORIZONTAL CYLINDER. MAGAZINE & SHIM!

Meaning: The horizontal end position switch above the magnet (SHIM) and above the inner magazine ring (MAG) are both active.

Error 80.2: SENSOR ERROR: HORIZONTAL CYLINDER. MAGAZINE & NOT A2 INNER!

Meaning: You have a B-ACS with 120 holder positions and the horizontal arm is detected above the inner magazine ring (MAG sensor is active), but the horizontal sensor SIGHO_INNER is not active (but should be).

Error 80.3: SENSOR ERROR: HORIZONTAL CYLINDER. MAGAZINE & A2 OUTER!

Meaning: You have a B-ACS with 120 holder positions and the horizontal arm is detected above the inner magazine ring (MAG sensor is active), but the horizontal sensor SIGHO_OUTER is active (but should be inactive).

Error 80.4: SENSOR ERROR: HORIZONTAL CYLINDER. SHIM & A2 INNER!

Meaning: You have a B-ACS with 120 holder positions and the horizontal arm is detected above the shim system (SHIM sensor is active), but the horizontal sensor SIGHO_INNER is active (but should be inactive).

Error 80.5: SENSOR ERROR: HORIZONTAL CYLINDER. SHIM & A2 OUTER!

Meaning: You have a B-ACS with 120 holder positions and the horizontal arm is detected above the shim system (SHIM sensor is active), but the horizontal sensor SIGHO_OUTER is active (but should be inactive).

Error 81: SENSOR ERROR: VERTICAL CYLINDER. UP & DOWN!

Meaning: The vertical cylinder end position detection mechanism detects the vertical cylinder at both end positions simultaniuosly.

Check the following: Check the sensor signals UP & DOWN by using manual motion of the vertical cylinder. The signals UP and DOWN are wired using connector #1 at the connector panel.

Error 82.x:

Meaning: This error pertains to sensor errors inside the BST. Either an illegal combination of the signals SIGSH and SAMPLE DOWN has been detected, or the BST shim top light barrier (SIGSH) is closed, even when the lift (controlled by B-ACS) is not turned on.

Check the following:

- Insert / Eject samples using the manual lift button - see chapter ***"Manual Adjustments & Motion Control" on page 15*** (or the diagnostic commands **LU** and **LD** - see section ***11.3***).
- Observe the sensor LED's "SIGSH" (if you have new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***) and "Samp Down" (only if the sample down detection box is installed).
- Query B-ACS for the state of the upper shim light barrier using the diagnostic commands **ST** and **OS** (see section ***11.3***).

If the sample down detection box is installed:

- Observe the indicator at the box. It will only be lit if a sample is in the magnet.
- Query B-ACS for the state of the sample down sensor using the command **PD** (see section ***11.1***).

Technical background: The sensor signal SIGSH is wired using connector #5 at the connector panel.

The sensor signal SAMPLE DOWN is wired using connector #8 at the connector panel.

Error 82.1: SENSOR ERROR: SAMPLE AT MAGNET. LISH & SAMPLE DOWN!

Meaning: The sensor signal SIGSH (at the BST shim top) and SAMPLE DOWN (in the sample inside the BST) are simultaneously active.

Error 82.2: SENSOR ERROR: SAMPLE AT MAGNET. LISH IS CLOSED!

Meaning: The sensor signal SIGSH (at the BST shim top) detects a sample, although the lift (controlled by B-ACS) is not turned on.

Possible reasons:

- The lift does not stop even though B-ACS closes the lift valve (e.g. the BSMS unintentionally controls the lift).
- The sample does not drop down into the BST and is stuck at the shim top light barrier.
- The BST shim top light barrier is damaged.

Error 82.3: SENSOR ERROR: SAMPLE AT MAGNET. SAMPLE IS DOWN!

Meaning: A sample is still detected down in the magnet after a sample was supposed to be removed from the magnet by the B-ACS pincer (normal eject-procedure), and the lift was turned off.

Possible reasons:

- The pincer did not grasp the sample correctly, but rather pushed it down into the BST so that the BST upper light barrier is open (the sensor no longer sees a sample). After turning off the lift, this sample will fall back into the BST.
- The sample down detection box does not work.

Error 83: SENSOR ERROR: SAMPLE AT MAGAZINE!

Meaning: This error pertains to sensor errors at the magazine light barrier. This error can only occur if you have a B-ACS with 120 holder positions. When inserting/ removing a sample from the magazine ring with the B-ACS pincer (normal insert or eject procedure), the magazine light barrier signal from the magazine's other ring (where no sample is inserted or ejected) also changes.

Possible reasons:

- Someone has taken the sample out of the magazine before the sample changer has completed its motion sequence.
- Someone has inserted or removed a sample manually from the magazine ring (regardless of the position) while B-ACS is inserting or removing a sample from the magazine ring.
- The reflex light did not detect a sample at the magazine even when the position was occupied.
- The reflex light detects a sample even when the position is empty.

Check the following:

- Does the sensor work (use the LED indicator at the connector panel housing of the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***) ?
- What is the range from where a sample is detected?
- Use the diagnostic command **OM** to find the error (see section ***11.3***).

Technical background: The sensor signals SIGMA_INNER and SIGMA_OUTER are wired using connector #6 at the connector panel.

Complex Errors without Error Message *9.4*

No or Very Slow Initialization Process
(starts a few minutes after reset)

Meaning:	B-ACS does not do anything after a reset, whereas after a few minutes the text “SAMPLECHANGER INITIALIZATION” is displayed and B-ACS starts to initialize with very long interrupts between the individual motions.
Possible reasons:	The Debug Baud rate hex switch at the board is set to the wrong value. Check them. See ***Figure 10.3.***.

After a Short Mounting Time at the NMR Magnet, B-ACS no Longer Works
(no motion visible, seems to be dead).

Possible reasons:	The earlier new generation B-ACS electronic main control boards (ECL00 & ECL01) contained DC/DC converters which sometimes do not work in strong magnetic stray fields (magnets >= 400MHz without UltraShield). If customers complain about this problem, the B-ACS electronics must be upgraded to at least ECL02 at no cost.

There is a Spike in the Spectrum Which Cannot be Seen When B-ACS is Turned Off.

Meaning:	With the new electronics some customers have complained about a spike being present in the NMR spectrum.
Check the following:	Check if the electronics have firmware version before 20030422 Built 08.
Solution:	Download (see chapter ***"Downloading Firmware" on page 31***) the latest firmware version from the Bruker FTP server. Firmware versions greater or equal to 20030422B08 allow the microcontroller sleep until it is required.

Magazine starts motion, but does not stop.

Possible reasons:

- The magazine positioning switch (POSIG) is damaged.
- The start motor signal is always active

Check the following:

- Does the positioning sensor (POSIG) work? (can you hear it clicking?) with new electronics only: look at the POSIG sensor LED (see chapter ***"Valve Control & Sensor Signals" on page 19***).
- Is the sensor physically pushed and released during magazine motion? Check the adjustment.

Technical background: The sensor signal POSIG is wired using connector #4 at the connector panel. The signals to start the motor and to set up the direction are in the 26pin flat ribbon cable to the power supply box.

Barcode Reader needs a lot of attempts to read the code (standard barcode reader AND new vertical barcode reader) ***/ does not read the barcode or the new vertical barcode reader often moves magazine during barcode reading).***

Meaning: The barcode reader is not aligned correctly.

Possible Reasons and Solutions:

- If you have a standard barcode reader (with rotating barcode collar) try to adjust detecting distance and height.
- Does the motor rotate the barcode collar?

  Check if the barcode collars are not held with too much pressure. The collars must revolve continuously without any skipping.

- If you have a new vertical barcode reader, be sure that it does not look straight to the middle of the collar. Rotate it a little bit inside of the mounting holes.

  Be sure that the collar detecting reflex light barriers are adjusted correctly. If there is a barcode collar at the sample, the orange LED must be lit. If there is no barcode collar at the sample (only naked glass tube or no glass tube), the orange LED at the sensor must be off! The green LED (good operation mode) must be lit in both states, otherwise the threshold is set wrong. Try to readjust the threshold by teaching both situations to the sensor. Refer to the corresponding installation manual.

Both barcode reader types:

- Look at the barcode collar. Is it damaged? Is the tape (only at standard rotating barcode collars) still tight? Are the lines and white areas of the barcode ok? Are lines / white areas missing / dirty?

After taking a sample out of the magnet or magazine, the vertical arm moves up, the pincer opens (and lets the sample fall down) ***and then it moves down to grasp it again.***

Possible Reasons and Solutions:	The light barrier at the magazine (resp. at the magnet) does still detect a sample, so B-ACS assumes that it could not grasp the sample out of the magazine (the magnet) and retries.
Check the following:	• Does the sensor work (use LED indicator at the housing and at the connector panel of the new electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***)? • How far is the range where a sample is detected? • Use the diagnostic command **OM** (see section ***11.3***) to find the error.
Technical background:	The sensor signals SIGMA_INNER and SIGMA_OUTER are wired using connector #6 at the connector panel. The sensor signal SIGSH is wired using connector #5.

List of Errors

Background Information 10

How does B-ACS detect if it has 60 or 120 holder positions?

B-ACS recognizes the number of holder positions during the initialization process after a reset. Normally, the horizontal arm moves back to the magazine holders before it moves outwards above the magnet. At the end of the backwards motion cycle, when the vertical arm is above the inner magazine ring (with the positions 1-60), the signal SIGHO INNER should light up if the B-ACS has 120 holder positions (you can observe this at the small LED display at the top of new B-ACS electronics - see chapter ***"Valve Control & Sensor Signals" on page 19***). If this signal is not available, B-ACS assumes that it has only 60 holders.

What about the Motor & Valve Control Board (P/N H480) when you upgrade the electronics from the old to the new?

If you are performing an upgrade from the old B-ACS electronics to the new electronics, you can leave the Motor & Valve Control Board daisy chained between the power supply box and the new electronics. If the valves are mounted on the Motor & Valve Control Board, you MUST leave the board daisy chained inside the B-ACS.

If you leave the Motor & Valve Control Board inside the B-ACS, you should also leave the 15pin D-subconnector for the valve control connected to this board, as well as the lift control and pressure sensor connector (connector #7).

The new B-ACS electronics automatically detects if the board is populated and creates the corresponding valve signals for this board.

What is the purpose of the LED's and manual control buttons on the main control board?

Main control boards with ECL 00 and 01 have the purpose of the LED's and buttons clearly marked on the board. For boards with ECL 02 or higher, there was not enough space for the text on the board, so you need the following drawing to know their purpose:

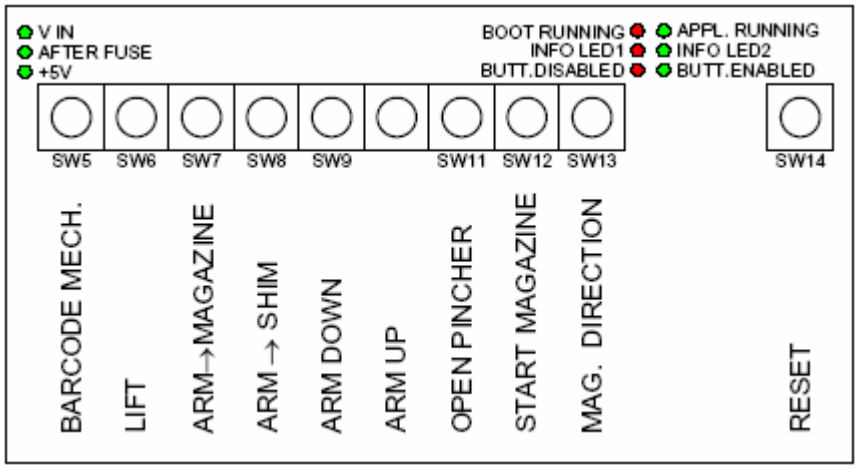


Figure 10.1. Board ECL02 without ASP

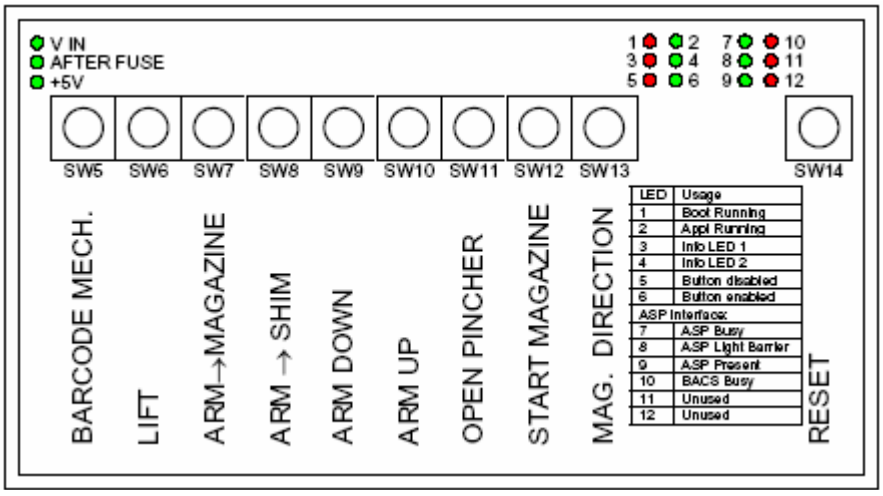


Figure 10.2. Board ECL02 with ASP

„**V IN**" refers to the supply voltage coming from the main power supply unit, typically 24-35V.

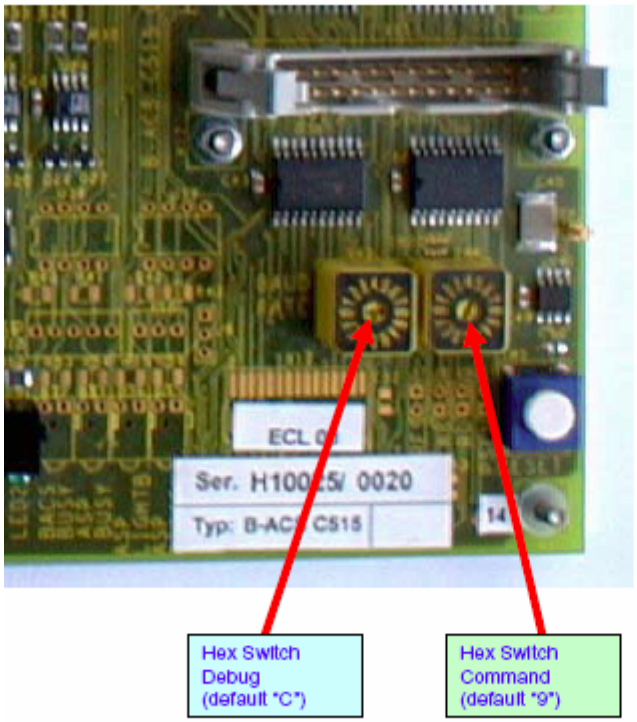
„**After Fuse**": There is a multifuse inside which limits the current to the B-ACS Main Control Board to a maximum value. If too much current is drawn, this fuse reaches the high-impedance-state and the „After Fuse" LED will turn off.

„**+5V**" is the voltage output from the DC/DC converter, which converts the incoming 24-35V from the After Fuse to the the +5V voltage required for the micro-controller.

What what is the purpose of the Hex switches on the main control board?

The Hex switches at the main control board are used to set the baud rates for the serial communication to the CCU (host computer) and to the debug RS232 port.

The Hex switch settings are shown in the figure below:



Hex Switches

Debug Switch		Command Switch	
Baud Rate	Position	Baud Rate	Position
50	0	50	0
75	1	75	1
110	2	110	2
150	3	150	3
300	4	300	4
600	5	600	5
1200	6	1200	6
2400	7	2400	7
4800	8	4800	8
9600	9	9600	9 (default)
19200	A	19200	A
38400	B		
57600	C (default)		

Figure 10.3. Main Control Board Hex Switches

Do the new B-ACS electronics work with the old AC instruments?

Yes, the new B-ACS electronics still works with old AC instruments without any problems.

Is the Level Sense Interface still supported?

The first version of B-ACS (about 1984) was controlled by a level sense interface which instructed B-ACS to insert the next sample into the magnet. This interface is **no longer supported** by the new electronics.

List of Commands 11

Normal Operation Mode 11.1

Instruction:	**AP**
Format:	AP<CR>
Description:	**A**SP **P**resent Asks if the ASP hardware is connected and the firmware is available.
Reply:	BDXX<CR><LF> with XX= 0 means: No ASP is present. XX= 4 to 12. This is the number of barcode digits currently selected.

Instruction:	**BD** (**B**arcode **D**igits)
Format:	BD XX<CR>
Description:	Sets the barcode length to 4, 6 or 12 digits.
Reply:	<CR><LF>

Instruction:	**BS**
Format:	BS<CR>
Description:	**B**arcode **S**tatus Report of the selected barcode digit length and the associated code type.
Reply:	BD 4<CR><LF> 4 digits, code 2 of 5 interleaved. BD 6<CR><LF> 6 digits, code 2 of 5 interleaved. BD 12<CR><LF> 12 digits, code EAN 13.

Instruction:	**CL** (**C**lear **L**abel)
Format:	CL XXX<CR>
Description:	Clear the stored label of the sample in position XXX.
Reply:	<CR><LF>

Instruction:	**CP**
Format:	CP<CR>
Description:	**C**urrent **P**osition Replies with the current magazine position.
Reply:	PXX<CR><LF> Position XX is always in the range of 1 to 60.

Instruction:	**CX**
Format:	CX<CR>
Description:	Clears the „sample is measured“ flag for all magazine positions.
Reply:	<CR><LF>

Instruction:	**DC**
Format:	DC X<CR>
Description:	**D**ebug **C**ontrol Enable or disable the debug report function via an additional debug SIO board (old electronics) or respectively the debug RS232 (new electronics). DC 1 Enables debug RS232 (this is the default after a reset). DC 0 Disables debug RS232.
Reply:	<CR><LF>

Instruction:	**DS**
Format:	DS<CR>
Description:	**D**ebug **S**tatus Report the status of the debug report function.
Reply:	DC1<CR><LF> Debug RS232 enabled. DC0<CR><LF> Debug RS232 disabled.

Instruction:	**EC**
Format:	EC X<CR>
Description:	**E**cho **C**ontrol Replies with the received character back to the console. X=0 Echo is set to inactive (default after a power on or reset). X=1 Echo is to active. Available in Operation and Diagnostic Mode.
Reply:	<CR><LF>

Instruction:	**E1**
Format:	E1<CR>
Description:	**E**ject **S**ample part one. Takes the sample out of the shim system and moves it to directly above the shim system.
Reply:	<CR><LF>

Instruction:	**E2**
Format:	E2<CR>
Description:	**E**ject **S**ample part two. Moves the sample from over the shim system to the sample changer's magazine and inserts it into the associated holder. Corresponds with the restore mode X that is selected (see the command RC). The restore behavior of the EJ command is as follows: X= 0 Standard restore mode. Automation stops when the sample source magazine position is occupied. X= 1 Moves to position 60/120 and starts the search from there for a new position. No report of the insert position is given. X= 2 Moves to position 60/120 and starts the search from there for a new position. Reports the insert position when the command is finished. X= 3 If the position is occupied it searches for a new free position in reverse order. No report of the insert position is given. X= 4 If the position is occupied it searches for a new free position in reverse order. Reports the insert position when the command is finished.
Reply:	Depends on the restore mode that is selected (see command RC). The reply is as follows: Restore mode 0, 1 and 3 Reply: <CR><LF> Restore mode 2 and 4 Reply: PXXX<CR><LF> Whereas XXX represents the insert magazine position of the sample.

Instruction:	**EJ**
Format:	EJ<CR>
Description:	**EJ**ect Sample from Magnet to Magazine Moves the sample from over the shim system to the sample changer's magazine and inserts it into the associated holder. Corresponds with the restore mode X that is selected (see the command RC). The restore behavior of the EJ command is as follows: X= 0 Standard restore mode. Automation stops when the sample source magazine position is occupied. X= 1 Moves to position 60/120 and starts the search from there for a new position. No report of the insert position is given. X= 2 Moves to position 60/120 and starts the search from there for a new position. Reports the insert position when the command is finished. X= 3 If the position is occupied it searches for a new free position in reverse order. No report of the insert position is given. X= 4 If the position is occupied it searches for a new free position in reverse order. Reports the insert position when the command is finished.
Reply:	Depends on the restore mode that is selected (see command RC). The reply is as follows: Restore mode 0, 1 and 3 Reply: <CR><LF> Restore mode 2 and 4 Reply: PXXX<CR><LF> Whereas XXX represents the insert magazine position of the sample.

Instruction:	**ES**
Format:	ES<CR>
Description:	Report **E**cho **S**tatus Shows the current setting of the echo state.
Reply:	**EC0**<CR><LF> Echo is inactive (default after Power On or Reset). **EC1**<CR><LF> Echo is active.

Instruction:	**EX** (Experiment)
Format:	EX XXX<CR>
Description:	Reads the barcode at position XXX. If it is an EAN 13 code, the first two digits which identify the experiment number are extracted.
Reply:	EXX<CR><LF> Whereas XX is the experiment number. E0 means that there is no EAN 13 label available.

Instruction:	**HO** (**HO**me)
Format:	HO<CR>
Description:	The sample changer moves to it’s "HOME" position over the magazine. If a sample is in the pincher it will be placed in an empty magazine position.
Reply:	<CR><LF>

Instruction:	**HP** (**H**eater and Mixer **P**resent)
Format:	HP<CR>
Description:	Checks if the Heater & Mixer Unit is present. This is a dummy instruction, because the Heater and Mixer Unit was never released.
Reply:	H0<CR><LF>

Instruction:	**I1**
Format:	I1 XXX<CR>
Description:	**I**nject Sample part **1**. Takes the sample of magazine position XXX and moves it to directly above the shim system.
Reply:	<CR><LF>

Instruction:	**I2**
Format:	I2 XXX<CR>
Description:	**I**nject Sample part **2**. Inserts the sample from directly above the shim system into the magnet.
Reply:	<CR><LF>

Instruction:	**IJ**
Format:	IJ XXX<CR>
Description:	**I**n**J**ect Sample. Takes the sample in magazine position XXX and inserts it into the magnet.
Reply:	<CR><LF>

Instruction:	**LL**
Format:	LL<CR>
Description:	Reads the barcode labels at the current magazine position in the inner and in outer magazine ring.
Reply:	<CR><LF>

Instruction:	**LS**
Format:	LS<CR>
Description:	Report **L**ift **S**tatus Shows the current status of the lift control.
Reply:	**NL0**<CR><LF> The lift is controlled through the sample changer (default after power on or reset). **NL1**<CR><LF> The lift is controlled through the spectrometer's BSMS.

Instruction:	**MS**
Format:	MS<CR>
Description:	**M**easured **S**amples
	Reports the number of the measured samples in the sample changer magazine.
Reply:	MSXX<CR><LF>
	Whereas XX is the number of measured samples present. As this instruction was only implemented for the NMR AutoPrep coupling, only the sample holder range from Nr. 1 to Nr. 60 is considered. This is also relevant for a B-ACS 120 sample changer (i.e. Nr. 1 to Nr. 120).

Instruction:	**NL**
Format:	NL X<CR>
Description:	**N**o **L**ift
	Control of the lift pressure. Whereas:
	X=0 The lift is controlled by the sample changer (default after a power on or reset).
	X=1 The lift is controlled by the spectrometer's BSMS.
Reply:	<CR><LF>

Instruction:	**NM** (**N**umber of available **M**agazine positions)
Format:	NM <CR>
Description:	Reports the number of available magazine positions.
Reply:	NXXX<CR><LF>
	Whereas XXX is the number of magazine positions that are available.

Instruction:	**PD (P**robe **D**own in magnet)
Format:	PD <CR>
Description:	Reports if a sample is down inside the magnet.
Reply:	P0<CR><LF> There is no sample in the magnet. P1<CR><LF> There is a sample in the magnet. P? <CR><LF> The sample down detection sensor is not populated.

Instruction:	**RC**
Format:	RC X<CR>
Description:	**R**estore **C**ontrol Sets the specific restore mode. Where X corresponds to the restore mode list as followed: X= 0 Standard restore mode. Automation stops when the sample source magazine position is occupied. X= 1 Moves to position 60/120 and starts the search from there for a new position. No report of the insert position is given. X= 2 Moves to position 60/120 and starts the search from there for a new position. Reports the insert position when the command is finished. X= 3 If the position is occupied it searches for a new free position in reverse order. No report of the insert position is given. X= 4 If the position is occupied it searches for a new free position in reverse order. Reports the insert position when the command is finished.
Reply:	<CR><LF>

Instruction:	**RS**
Format:	RS<CR>
Description:	**R**estore **S**tatus Reports the status of the specific restore mode.
Reply:	RCX<CR><LF> Whereas the parameter X corresponds to the restore mode list of the command RC.

Instruction:	**RP** (**R**eport measurement **P**osition)
Format:	RP<CR>
Description:	Reports the current measurement position.
Reply:	P<number><CR><LF> or P0<CR><LF> There is no sample in the magnet.

Instruction:	**RL** (**R**eport **L**abel)
Format:	RL XXX<CR>
Description:	Reports the label of the sample to be measured (XXX indicates the magazine position).
Reply:	L<number><CR><LF> or L0 There is no label available.

Instruction:	**RT** (**R**eport **T**ube ID)
Format:	RT<CR>
Description:	Reports the Tube-ID of the sample in the magnet. This information is saved in a memory buffer when a sample is inserted into the magnet and deleted when the sample is withdrawn and ejected.
Reply:	LXXXX<CR><LF> Whereas X= 0 No entry or an error. X > 1 The Tube-ID of the sample. Important !!!! XXXX can contain leading zeros !!!

Instruction:	**SB**
Format:	SB XXX<CR>
Description:	**S**ample check at **B**arcode reader. Checks if a sample is present in the barcode reader at magazine position XXX.
Reply:	S1<CR><LF> Sample is present. S0<CR><LF> No sample was found at position XXX.

Instruction:	**SC**
Format:	SC X<CR>
Description:	**S**creen **C**ontrol. Sets the specific display mode, where X refers to the display mode list as follows: X= 0 Standard display. X= 1 Displays in addition the Tube-ID of the actual measured sample in the magnet. X= 2 Displays in addition the source magazine position of the actual measured sample in the magnet. With new electronics firmware greater than or equal to 20040526B16, X=1 and X=2 are the same. Both display the current position(s), the Tube ID and the source position of the actual measured sample in the magnet.
Reply:	<CR><LF>

Instruction:	**SE** (**SE**curity test)
Format:	SE<CR>
Description:	Tests if a sample was left in the magnet. This starts the sample lift for 30 seconds to check if there is no sample in the magnet. When a sample is found, the sample lift is kept on and the message **S1** is returned. When no sample is found within 30 seconds, the lift is turned off and the message **S0** is returned.
Reply:	S0<CR><LF> There is no sample in the magnet. S1<CR><LF> There is a sample in the magnet.

Instruction:	**SO** (**SO**lvent)
Format:	SO XXX<CR>
Description:	Reads the barcode at position XXX. If it is an EAN 13 code, it extracts digits 3 and 4 of the barcode which identify the solvent number.
Reply:	VXX<CR><LF> Whereas XX is the solvent number. V0 means that there is no EAN 13 label available.

Instruction:	**SP** (**S**ample **P**resent in position)
Format:	SP XXX<CR>
Description:	Checks if a sample is present in magazine position XXX.
Reply:	S0<CR><LF> There is no sample present. S1<CR><LF> There is a sample present.

Instruction:	**SS**
Format:	SS<CR>
Description:	Screen Status Reports the specific display mode.
Reply:	SCX<CR><LF> Whereas parameter X refers to the display mode list of the command SC.

Instruction:	**ST**
Format:	ST<CR>
Description:	Checks whether a sample is present in the BST upper light barrier.
Reply:	SX<CR><LF> Where X= 0 No sample is present. X= 1 A sample is present.

Instruction:	**TD**
Format:	TD<CR>
Description:	Locks the magazine motion keys on the front panel of the sample changer.
Reply:	<CR><LF>

Instruction:	**TE**
Format:	TE<CR>
Description:	Unlocks the magazine motion keys on the front panel of the sample changer.
Reply:	<CR><LF>

Instruction:	**UR** (**U**se**R**)
Format:	UR XXX<CR>
Description:	Reads the barcode at position XXX. If it is an EAN 13 code, it extracts digits 5 to 7 of the barcode which identify the user number.
Reply:	UXXX<CR><LF> Whereas XXX is the user number. U0 means that there is no EAN 13 label available.

Instruction:	**VB** (**V**ersion **B**uild)
Format:	VB<CR>
Description:	Reports the actual firmware version.
Reply:	Built XX<CR><LF> Where XX is the firmware build version.

Instruction:	**VM** (**V**ersion **M**illennium)
Format:	VM<CR>
Description:	Reports the firmware version in the format JJJJMMDD. JJJJ 4 digit year MM 2 digit month DD 2 digit day
Reply:	JJJJMMDD<CR><LF>

Instruction:	**VS** (**V**er**S**ion)
Format:	VS<CR>
Description:	Reports the actual firmware version.
Reply:	yymmdd<CR><LF>

Instruction:	**XL**
Format:	XL XXX<CR>
Description:	Releases position XXX for removal through NMR *AutoPrep*.
Reply:	<CR><LF>

Instruction:	**ZY** (**Z**ero **Y**ell)
Format:	ZY<CR>
Description:	Repeats the last reply sent.
Reply:	Last reply<CR><LF>

Instruction:	**ESC.** (**ESC**ape key + "**.**")
Format:	ESC.<CR>
Description:	Switches to diagnostic mode.
Reply:	SAMPLE CHANGER DIAGNOSTIC MODE!

Instruction:	**ESC?** (**ESC**ape key + "**?**")
Format:	ESC?<CR>
Description:	Switches to operation mode.
Reply:	SAMPLE CHANGER OPERATION MODE!<CR><LF>

Error Mode *11.2*

Instruction:	**CO** (**CO**ntinue)
Format:	CO<CR>
Description:	Continues the program at the point where it was interrupted when an error occurred. Normally retries the function which created the error.
Reply:	<CR><LF>

Instruction:	**HO** (**HO**me)
Format:	HO<CR>
Description:	The sample changer moves to it’s "HOME" position.
Reply:	<CR><LF>

Instruction:	**DE** (**D**ebug Buffer **E**rase)
Format:	DE<CR>
Description:	Erases the internal debug buffer. This command is also available in diagnostic mode.
Reply:	<CR><LF>

Instruction:	**DR** (**D**ebug Buffer **R**ead)
Format:	DR X<CR>
Description:	Transmits the internal debug buffer via the command RS 232, where X represents the number of lines to be transmitted before a key action is expected. Without a parameter, the entire debug buffer will be transmitted at once. This command is also available in diagnostic mode.
Reply:	Content of the debug buffer.

Additional Commands Enabled in Diagnostic Mode *11.3*

Note: Running test loops can be terminated with the CONT button if the red LED is on.

Instruction:	**A1**
Format:	A1<CR>
Description:	Moves the horizontal cylinder over the inner ring position. When the vertical arm is down, it will move up before horizontal motion begins.
Reply:	EXECUTED<CR><LF>

Instruction:	**A2**
Format:	A2<CR>
Description:	Moves the horizontal cylinder over the outer ring position. This command is only available if the sample changer type is 120. When the vertical arm is down, it will move up before horizontal motion begins.
Reply:	EXECUTED<CR><LF>

Instruction:	**AD** (**A**rm **D**own)
Format:	AD<CR>
Description:	Moves the vertical cylinder downwards.
Reply:	EXECUTED<CR><LF>

Instruction:	**AU** (**A**rm **U**p)
Format:	AU<CR>
Description:	Moves the vertical cylinder upwards.
Reply:	EXECUTED<CR><LF>

Instruction:	**AS** (**A**rm to **S**him)
Format:	AS<CR>
Description:	Moves the horizontal cylinder over the magnet shim system. When the vertical arm is down, it will move up before horizontal motion begins.
Reply:	EXECUTED<CR><LF>

Instruction:	**BT** (**B**arcode **T**est)
Format:	BT<CR>
Description:	Tests the barcode reader unit. The barcode will be read and shown continuously at the LC display. If you have a B-ACS 120 use the arrow keys at the front panel to switch between the inner ring (channel A, positions 1-60) and the outer ring (channel B, positions 61-120).
Reply:	EXECUTED<CR><LF>

Instruction:	**CA** (**C**ode wheel **A**djust)
Format:	CA<CR>
Description:	Tests the adjustment of the code wheel for magazine position detection. The code-wheel position will be read and shown at the LC display.
Reply:	EXECUTED<CR><LF>

Instruction:	**DT** (**D**isplay **T**est)
Format:	DT<CR>
Description:	Calls the display test program with the character pattern check routine. Press the CONT button to stop the test.
Reply:	EXECUTED<CR><LF>

Instruction:	**HL** (**H**orizontal **L**oop)
Format:	HL<CR>
Description:	Moves the horizontal cylinder from position A1 to AS and back in an endless loop.
Reply:	EXECUTED<CR><LF>

Instruction:	**LD** (**L**ift **D**own)
Format:	LD<CR>
Description:	Switches the sample lift off.
Reply:	EXECUTED<CR><LF>

Instruction:	**LB** (**L**oop **B**ack)
Format:	LB<CR>
Description:	Moves the magazine backwards. Stops after each position is reached.
Reply:	EXECUTED<CR><LF>

Instruction:	**LF** (**L**oop **F**orward)
Format:	LF<CR>
Description:	Moves the magazine forwards. Stops after each position is reached.
Reply:	EXECUTED<CR><LF>

Instruction:	**LU** (**L**ift **U**p)
Format:	LU<CR>
Description:	Switches the sample lift on.
Reply:	EXECUTED<CR><LF>

Instruction:	**MB** (**M**agazine **B**ack)
Format:	MB<CR>
Description:	Moves the magazine one position backwards.
Reply:	EXECUTED<CR><LF>

Instruction:	**MF** (**M**agazine **F**orward)
Format:	MF<CR>
Description:	Moves the magazine one position forwards.
Reply:	EXECUTED<CR><LF>

Instruction:	**MP** (**M**agazine **P**osition)
Format:	MP XXX<CR>
Description:	Moves the magazine to position XXX.
Reply:	EXECUTED<CR><LF>

Instruction:	**OH** (**O**ptic **H**orizontal)
Format:	OH<CR>
Description:	Test the horizontal positioning optic (necessary to reach position A2).
Reply:	EXECUTED<CR><LF>

Instruction:	**OM** (**O**ptic **M**agazine)
Format:	OM<CR>
Description:	Tests the optic at the magazine which detects the samples in the magazine rings.
Reply:	EXECUTED<CR><LF>

Instruction:	**OS** (**O**ptic **S**him)
Format:	OS<CR>
Description:	Tests the optic at the magnet shim upper part.
Reply:	EXECUTED<CR><LF>

Instruction:	**PC** (**P**incer **C**lose)
Format:	PC<CR>
Description:	Closes the pincer.
Reply:	EXECUTED<CR><LF>

Instruction:	**PL** (**P**incer **L**oop)
Format:	PL<CR>
Description:	Opens and closes the pincer in an endless loop.
Reply:	EXECUTED<CR><LF>

Instruction:	**PO** (**P**incer **O**pen)
Format:	PO<CR>
Description:	Opens the pincer.
Reply:	EXECUTED<CR><LF>

Instruction:	**PP** (**P**robe down sensor **P**opulated)
Format:	PP<CR>
Description:	Obtains the analog value from the sensor population detection.
Reply:	PXXX<CR><LF> Where XXX is the analog value from 0 (= 0 Volt) to 255 (= 5V). Values between 100 and 200 represent a populated sample down sensor.

Instruction:	**PT** (**P**ressure **T**est)
Format:	PT<CR>
Description:	Displays the current pressure sensor signal.
Reply:	EXECUTED<CR><LF>

Instruction:	**TL** (**T**est **L**oop)
Format:	TL<CR>
Description:	Used to implement a complete sample changing test loop. The magazine moves on until a sample has been found. This sample is inserted into the magnet, ejected, and then placed back into the magazine. This cycle will be repeated until the CONT button at the front panel is pressed when the red LED is lit.
Reply:	EXECUTED<CR><LF>

Instruction:	**VL** (**V**ertical **L**oop)
Format:	VL<CR>
Description:	Moves the vertical cylinder up and down in an endless loop.
Reply:	EXECUTED<CR><LF>

Instruction:	**ESC?** (**ESC**ape key + "**?**")
Format:	<ESC>?<CR>
Description:	Switches to operation mode.
Reply:	SAMPLE CHANGER OPERATION MODE! <CR><LF>

Frequently Used Part Numbers 12

Introduction 12.1

Here is a list of frequently used part numbers related to B-ACS. This list was prepared in August 2004 and is subject to change at any time.

When replacing a damaged part, always check the part number written on the damaged part before ordering a part from the list below. It is possible that a newer part number is written on the damaged part which is currently not written is this manual.

Always order the part using the part number which is written on the damaged part, unless the Bruker Production Department provides you with a new replacement part number.

Main Control Electronics & Peripherals 12.2

There are 2 different types of electronics available.

Old Electronics, P/N H801 12.2.1

These electronics (see ***Figure 2.3.***) are no longer produced due to discontinued parts. The electronics contain the boards listed in the following table:

Table 12.1. Old Electronics P/N H801

P/N	Description
H25	Processor Board. This board needs 2 EPROMS for the firmware and 1 Address Decoder Logic (P/N H5907 - programmed IC's). These programmed IC's are the lower address firmware EPROM (P/N H957) for address range 0-2000h, the higher address firmware EPROM (P/N H958) for address range 2000-4000h and the address decoding PLD (P/N H5056).
H10022	Processor Board (alternate for item P/N H25). This board needs only 1 EPROM for the firmware and 1 Address Decoder Logic (P/N H10021 - programmed IC's). These programmed IC's are the firmware EPROM (P/N H10020) and the address decoding PLD (P/N H10019).
H3	Sensor Interface Board. Most sensor signals are transferred to the processor via this board. It also contains logic to start the magazine motion, to read the code wheel position and to provide signals to the front panel display.

Table 12.1. Old Electronics P/N H801

H650	Serial I/O Interface Board. This board is responsible for the serial link between the spectrometer and the B-ACS.
H769	Terminator Board. This is the data bus terminator board and also transfers the sensor signals from the light barrier at the magazine and the horizontal optic to the processor.
H1993	Barcode Detection Board. This board is only populated if a B-ACS barcode reader mechanics is installed.

New Electronics *12.2.2*

These electronics are a replacement for the old electronics P/N H801. The electronics are available in 2 versions:

Table 12.2. New Electronics

P/N	Description
HZ08368	This is the electronic housing for the new electronics which is necessary when mounted in the old, gray anodized aluminium B-ACS cabinet (see ***Figure 2.1.***).
H9804	This is the electronic housing for the new electronics which is necessary when mounted in the new, beige colored B-ACS cabinet (see ***Figure 2.2.***).

Both electronics contain the same 2 boards shown in the following table:

Table 12.3. Boards Common to Both Electronics

P/N	Description
H10025	B-ACS C515 Main Control Board. This is the big horizontally mounted board in the electronics housing.
H10049	B-ACS Connector Panel. This is the vertically mounted board with the connectors.

Please do not exchange single boards in these electronics. Always exchange the entire electronics housing, P/N HZ08368 or H9804.

Upgrade Kit *12.2.3*

There is an upgrade kit available to upgrade the old electronics to the new electronics.

Table 12.4. Upgrade Kit: Upgrade from Old to New Electronics

P/N	Description
HU071 Var 0	Upgrade Kit from the old electronics to the new electronics for old B-ACS housings (see ***Figure 2.1.***). It contains P/N HZ08368.
HU071 Var 1	This kit additionally contains the barcode detection board (P/N H10028) for Bruker Standard barcode collars e.g. P/N HZ4026 (which must rotate during barcode reading) see ***Table 12.11.***.

ASP Interface on new Electronics *12.2.4*

The ASP interface is only populated on the Main Control Board, P/N H10025 Variant 1. Please ask Bruker production to create this board explicitly for you, as there are only a few ASP working worldwide.

Other Part Numbers *12.2.5*

Table 12.5. Other Part Numbers

P/N	Description
H178	Display board.
H488	Power supply box for the old, gray anodized aluminium B-ACS cabinet (see ***Figure 2.1.***).
H9801	Power supply box for the new, beige colored B-ACS cabinet (see ***Figure 2.2.***).
H469	Code wheel unit. Please do not replace individual boards, rather replace the entire code wheel unit.
H480	Motor & Valve Control Board. This board is located between the power supply unit and the electronics housing, and transfers the processor's valve control signals to power signals for the valves. It also contains manual control buttons to test each valve.
2255	Fuse 2.5A SB. One of these fuses is needed for the B-ACS Power Supply Box.
2247	Fuse 0.4A SB. Two of these fuses are needed for the mains power filter at the B-ACS square foot piston.

Special Part Numbers for B-ACS 120 — 12.2.6

Table 12.6. Special for B-ACS 120

P/N	Description
H579	Horizontal Optic Board. Used for detecting the horizontal cylinder to be above the outer magazine ring.
H794	Reflex area to be mounted at the vertical cylinder.
H795	Metal pin for mounting & aligning the reflex area P/N H794 at the vertical cylinder.

Sample Down Detection Units — 12.2.7

The sample down detection units only work with the new electronics! Old electronics do not support this sensor!

Table 12.7. Sample Down Detection Unit

P/N	Description
HZ07506	BSR Sample Down. This was the first sample down detection developed for SampleRail (BSR). It is in a black plastic housing mounted at the top of the magnet. The black housing has 3 connectors named 1, 2, and 3. This unit sometimes did not detect a sample down in the magnet because the fixed light intensity threshold does not always correspond to the light intensities shown in the BST at a customer's site. If this unit is mounted on a B-ACS, please exchange it (without any costs for the customer) with HZ12416 (or H10162 if you also need the installation manual). 
HZ12416	B-ACS Sample Down. This is the improved version of the old sample down unit (P/N HZ07506) and is only valid for the B-ACS. It has an adjustable threshold which must be adjusted during installation. 
H10162	B-ACS Sample Down Kit. This kit contains the sample down unit (P/N HZ12416), some necessary cables and the installation manual. This is the part number the customer should order when they want to have a sample down detection unit installed with their magnet.

Mechanics and Pneumatics 12.3

Table 12.8. Mechanics & Pneumatics

P/N	Description
H9538	Pneumatic Valve Control Block. Mounted at the top of the horizontal cylinder.
H532	Magazine Holder Chain Assembly for B-ACS 60. P/N for each of the 60 holders: H531; metal pin: 10495.
H1590	Magazine Holder Chain Assembly for B-ACS 120. P/N for each of the 60 double holders: H1060; metal pin: 10495.
10362	Pressure regulator for the main pressure supply.
14803	Low main air pressure detection switch.
H1132	Pincher finger - five are required.
69331	Tension spring used in combination with the HZ0322 pulley. Always replace older model pulleys with the new HZ0322 pulley when upgrading from the old rubber O-ring (P/N 10347) to the the tension spring (P/N 69331).
HZ0322	B-ACS Pulley

Barcode Reader Option 12.4

Old Electronics 12.4.1

There are 2 types of barcode mechanics available depending on the type of B-ACS you have:

Table 12.9. Old Barcode Electronics

P/N	Description
H1233 Var 0	Barcode Mechanic & Barcode Board (P/N H1993) for B-ACS 60 for standard barcode collars (which must rotate during barcode reading).
H1097 Var 0	Barcode Mechanic & Barcode Board (P/N H1993) for B-ACS 120 for standard bar-code collars (which must rotate during barcode reading).

New Electronics *12.4.2*

There are 4 types of barcode mechanics available, depending on the type of barcode you want to use and the type of B-ACS you have:

Table 12.10. New Barcode Mechanics

P/N	Description
H1233 Var 1	Barcode Mechanic & Barcode Board (P/N H10028) for B-ACS 60 with standard barcode collars (which must rotate during barcode reading).
H1097 Var 1	Barcode Mechanic & Barcode Board (P/N H10028) for B-ACS 120 with standard barcode collars (which must rotate during barcode reading).
H9781	Barcode Mechanics for vertical barcodes with barcode board (P/N H10016) for a B-ACS 60 with vertical barcode collars which do not need to be rotated to be read.
H10112	Barcode Mechanics for vertical barcodes with barcode board (P/N H10016) for a B-ACS 120 with vertical barcode collars which do not need to be rotated to be read.

The Barcode Collar *12.4.3*

The barcode collar must correspond to the barcode reading mechanics that you have.

Table 12.11. Barcode Collars

P/N	Description
HZ4026	One (1) standard barcode collar (which must rotate during barcode reading) for 5mm sample tubes for the use in combination with barcode mechanics H1233 variants 0 and 1 as well as H1097 variants 0 and 1. 
H10113	Set of 100 vertical barcode collars which need not to be rotated during barcode reading for the use in combination with the barcode mechanics H9781 and H10112. 

Table 12.12. Other Parts for Standard Barcode Reader Options, H1097 and H1233

P/N	Description
HZ0458	Barcode reader with connector.
H1194	Motor & cable.
H1994	Reflex board. Detects if a spinner is in front of the barcode reader.
18413	Pressure regulator for collar fixing clamps.
18415	Pressure gauge.

Table 12.13. Other Parts for Vertical Barcode Reader Options, H9781 and H10112

P/N	Description
HZ12041	Barcode reader with connector.
HZ10338	Reflex Light Barrier. Detects if a barcode collar is in front of the barcode reader.

Sensors *12.4.4*

Table 12.14. Sensors

P/N	Description
H1402	Light barrier block at the magazine of B-ACS 60. Contains the Reflex Light Barrier P/N HZ0415 for detecting if there is a sample available in the inner magazine ring and the magazine position switch (P/N H1390).
H1403	Light barrier block at the magazine of B-ACS 120. Contains - the Reflex Light Barrier P/N HZ0415 for detecting if there is a sample available in the inner magazine ring (position 1-60), - the Reflex Light Barrier P/N H1388 for detecting if there is a sample available in the outer magazine ring (positions 61-120), and - the magazine position switch (P/N H1390).
H1390	POSIG Switch. This micro-switch detects if the magazine has reached a valid position where the pincer can grasp a sample out of the magazine.

Cables *12.4.5*

Table 12.15. Cables

P/N	Description
H461	Cable with the sensor signals vertical arm is up/down and pincer is open. Connected from the top of the vertical cylinder to the connector panel connector #1.
HZ10024	Serial link cable, 8 meters long. For connection between 9 pin male connector at CCU and 25 pin female connector at B-ACS.
HZ10019	Serial link cable, 9.5 meters long. For connection between the 9 pin male connector at the CCU and the 9 pin male connector at the B-ACS.

Figures

Figures

Tables

Tables

Notes: