Bruker BioSpin

BCU-Xtreme

Cooling Unit
Technical Manual

Version 001

think forward

NMR Spectroscopy

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This manual describes the units as they are at the date of printing. On request, the manufacturer shall supply circuit diagrams, lists of components, descriptions, calibrating instructions and any other information for use by qualified personnel of the user, in charge of repairing the parts of the unit which have been stated by the manufacturer to be "repairable". Such supply shall in no event constitute permission to modify or repair the units or approval of the same.

This unit is not designed for any type of use which is not specifically described in this manual. Such use may be hazardous.

This manual was written by

KRENCKER Patrick

Wissembourg, France

P/N: Z31757
DWG-Nr: 1459.001

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Introduction

1

Please read the manual before installing the unit

The BCU-Xtreme (P/N:W1212749) is a cooling unit that delivers very cold gas, either nitrogen or dry air, through a flexible isolated non-magnetic transfer line.

It is possible to control the sample temperature down to -60°C inside the probe for solid or liquid NMR applications.

The sample temperature is controlled by a BVT3X00 series variable temperature unit and with the TOPSPIN EDTE software.

Safety interlocks prevent damage to the probe and sample in case of line power or air supply failure.

Figure 1.1. BCU-Xtreme Cooling Unit

Introduction

Bill of Material

2

The following items are delivered with the BCU-Xtreme Cooling Unit.

Table 2.1. BCU-Xtreme cooling unit

Part Number	Quantity	Designation
W1212749	1	BCU-Xtreme Cooling Unit

The accessories (P/N:W1213081) are included with the BCU-Xtreme Cooling Unit.

Table 2.2. BCU-Xtreme accessories

Part Number	Quantity	Designation
2166	1	BVT clip for ball joint
W1100510	1	Ball joint fitting for hose d = 6,5mm
W1211318	2	Plastic hose 8/6mm HDPE black L = 7m
W1213467	1	Plastic hose 6/4mm PUR black L = 6m
92145	1	Pneumatic elbow w/plastic tail 8mm
34941	10	Cable clamp 4,8 x 279mm
33003	1	Power line cord 3 x 1mm² GR 7m
35006	1	Fuse TR5 8 x 7mm 0,125A T 250V (Flow sensor fuse)
2260	2	Fuse mini 5 x 20mm 10A T 250V (Line fuses)
W1100117	2	Cable heater MAS-DAB
86830	1	Pneumatic plastic reducer adapter 6/4mm
W1212078	1	BCU remote control cable

A large tripod stand (P/N:W1208509) is included with the BCU-Xtreme Cooling Unit.

Table 2.3. BCU-Xtreme large tripod stand

Part Number	Quantity	Designation
W3202026	1	Stand pole slider assembly L = 340mm
W1208508	1	Stand column L = 345mm
W3200336	1	Stand base plate D = 450mm
W3202318	1	Stand pole lengthen
11113	3	Screws HSHC M4 x 6 Stainless Steel
32498	2	Screws flap M6 x 30 brass nickel plated

A stand (P/N:W1208415) is also included with the BCU-Xtreme Cooling Unit.

Table 2.4. BCU-Xtreme stand assembly

Part Number	Quantity	Designation
52039	1	Clamp ring D = 50mm
W1208506	1	Stand assembly
W1208416	1	Stand pole L = 400mm
30465	1	Screw M4 x 8 brass

System Requirements 3

Dry gas 3.1

The BCU-Xtreme requires very dry gas, either nitrogen or dry air, because ice blockage may occur with gas containing to much moisture.
The dew point of the inlet gas should be ideally under -85°C.

BRUKER BIOSPIN recommands a special gas dryer unit (AD-XT gas dryer P/N:**W1213728** for 230V AC or P/N:**W1213729** for 110V AC) that was designed to work together with the BCU-Xtreme. This dryer delivers extremely dry air.

This dryer allows to work continiously with the BCU-Xtreme for a period longer than a week. Dry gas contains always a very small amount of moisture that will trapped and freezed inside the very cold heat exchanger located near the end of the transfer line.

It may therefore be necessary to de-ice the BCU-Xtreme from time to time if the gas flow rate decreases.

De-icing procedure 3.2

Hence it may be possible that after a long period of continuous operation that the gas flow decreases due to the progressive clogging of the heat exchanger. This will reduce the cooling power of the unit.
The unit may stop completely if the gas output is insufficient.

We recommand to de-ice the unit periodicaly before a complete clogging occurs.

Follow the steps of the de-icing procedure:

1. Stop the unit operation for several hours (at least 12 hours) to allow the internal parts of the exchanger to warm-up. The ice that was built up inside the exchanger will melt slowly and be transformed in water.
2. Disconnect the BCU-Xtreme transfer line from the probe only if the coupling to the probe is no longer frozen.
3. Start up normally the BCU-Xtreme unit to blow off the exchanger with dry air for 5 minutes (probe heater must be "ON"). The small amount of water collected in the heat exchanger will be ejected by the gas flow.
4. Stop then the unit and connect the transfer line on the probe again.

Variable Temperature unit 3.3

The unit is designed to be controlled by a Bruker Variable Temperature unit (BVT) like models BVT3000, BVT3300 or BVT3200.

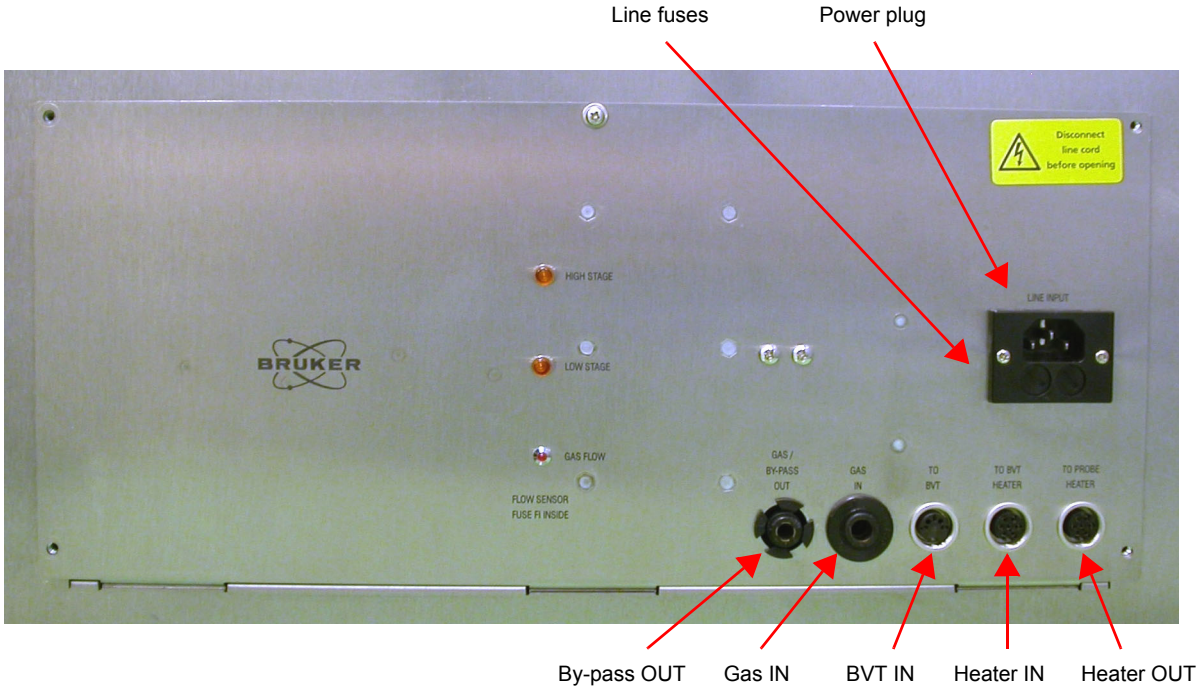
The BVT unit delivers an enable signal on its BCU05 connector when the heater is ON.

The unit is cooling only if the probe heater is ''ON''. The BVT unit allows to set the gas flow rate.

Connectors 3.4

All connectors and fittings are located on the rear panel of the unit.

Figure 3.1. BCU-Xtreme rear panel



HEATER IN connector 3.4.1

It receives the heater cable from the BVT unit.

Figure 3.2. HEATER IN connector (Front view)

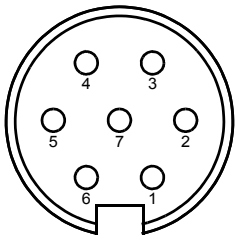


Table 3.1. HEATER IN connector pin assignment

Pin	Signal
1	heater +
2	heater +
3	safety thermocouple +
4	safety thermocouple -
5	heater -
6	heater -
7	GND

HEATER OUT connector *3.4.2*

Delivers the heater current to the probe heater.

Figure 3.3. HEATER OUT connector (Front view)

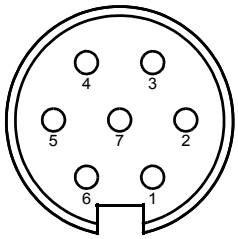


Table 3.2. HEATER OUT connector pin assignment

Pin	Signal
1	heater +
2	heater +
3	safety thermocouple +
4	safety thermocouple -
5	heater -
6	heater -
7	GND

BVT IN connector 3.4.3

This connector receives the remote enable signal from the BVT.

Figure 3.4. BVT IN connector (Front view)

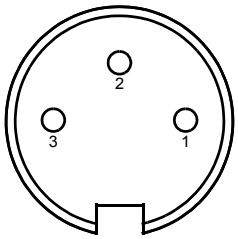


Table 3.3. BCU IN connector pin assignment

Pin	Signal	Comment
1	Heater ON	Input : Turns on BCU-Xtreme when > 4V DC
2	DGND	Digital ground
3	NC	Not used

Technical Specifications

4

Table 4.1. General specifications

Outlet temperature	-80°C min
Gas type	Dry nitrogen or dry air
Gas dew point	< -85°C @ 3 barg and 35°C
Gas flow rate	0,5 up to 50 liter/min
Maximum inlet pressure	4 bar
Cooling power	110W @ -80°C outlet temperature
Flexible heat exchanger length	4m / standard length
Flexible external diameter	6cm
Adapter termination	For coupling to a probe dewar with ball seal
Adapter	Threaded adapter for Bruker HR MAS probe
Stands for flexible heat exchanger	3 telescopic stands are included

Table 4.2. Gas supply

Gas port inlet	8mm quick coupling
Gas by-pass outlet port	8/6mm quick coupling

Table 4.3. External electrical interfaces

«BVT IN» connector	Remote ON/OFF control from BVT, female 3 pins
«HEATER IN» connector	From BVT, female 7 pins
«HEATER OUT» connector	To probe heater, female 7 pins

Table 4.4. Power

Voltage range / frequency	230V AC ±10% 50/60Hz
Input current	10A max (steady operation). During the start-up phase, up to 20A
Power consumption	2300VA max.

Table 4.5. Safeties

Gas flow detection	Optical gas flow sensor
By-pass function	Heat exchanger is by-passed when external enable signal is not present (i.e. probe heater is off)
Remote ON-OFF control	Enable signal provided by the Variable Temperature unit (ON if V > 3V DC)
Pressure sensitive switch with hysteresis	The pressure switch is closed if gas pressure > 140 ±20mbar The switch is open if gas pressure < 60 ±20mbar

Table 4.6. Physical characteristics

Net unit weight	74kg
Dimensions in mm (Height x Depth x Width)	740 x 586 x 547mm

Table 4.7. Environmental

Operating temperature	10 to 32°C
Non operating temperature	-20 to 60°C
Humidity	20 to 80% relative humidity @ 29°C room temperature

Installation 5

BCU-Xtreme installation 5.1

- Install the BCU-Xtreme a few meter away from magnet.
- Unroll the transfer line.
- Install the three stands to hold the transfer line.
- Connect the adapter on the probe dewar ball joint and attach it with the clip.
- Do not cover the ventilation grids located on the front and rear side of the unit to allow correct ventilation of the unit.
- A minimal clearance of 10 cm from unit to a wall is requested.

Gas hoses connections 5.2

- Connect the 8mm gas hose (P/N:W1211318) from the VTU "GAS OUT" to the BCU-Xtreme "GAS IN" inlet.

Figure 5.1. Gas by-pass with adapter

- Connect the supplied black plastic 6mm tube between "GAS BY-PASS OUT" on the adapter at the end of the exchanger on the clear plastic 4mm tube, if necessary use the diameter reductor (P/N:21813).

Electrical wiring *5.3*

WARNING: The power supply voltage is 230V AC 50Hz or 60 Hz

- Connect the remote control cable (P/N:W1212078) from VTU plug "BCU05" to the plug "TO BVT".
- Connect a heater cable (P/N:W1100117) from BVT unit "PROBE HEATER" plug to plug "BVT HEATER" on BCU-Xtreme.
- Connect the second heater cable (P/N:W1100117) from BCU-Xtreme connector "TO PROBE HEATER" to heater on probe.

Note: The heater circuit between "BVT heater" and "Probe heater" is interrupted if the inlet pressure is too low.
This safety feature is mainly intended for all solid probes other than DVT.
For standard HR probes, the heater cable can be connected directly on the probe heater.

- Check the line voltage and connect the line power cord on the BCU-Xtreme.

Operation 6

Set the desired gas flow rate in the EDTE program. The new gas flow is really applied when the probe heater is switched to "ON".

Gas flow sensor 6.1

An optical sensor detects the gas flow passing through the unit.
A minimal gas flow rate (0,5 liter/min) is necessary to operate the unit and to lift the ball in the flow sensor.

The gas flow presence is indicated by a red led on the rear panel.

If the gas flow is not detected, all compressors are "OFF" and no cooling is possible. In case off exchanger clogging, for example, the compressors are automatically stopped.

Pressure sensitive switch 6.2

A pressure sensitive switch measures the gas inlet pressure. Above 140 mbar (±20 mbar) it closes the electrical probe heater circuit. The heater is connected to the BVT.

The pressure switch has a small hysteresis and the low pressure switching point is close to 60mbar.

When the switch is open, the heater circuit is open and the probe heater is disconnected, but no information is displayed in the EDTE program.

This minimal pressure threshold value is set to work with either HR or MAS probes.

Gas by-pass function 6.3

An internal solenoid valve by-passes the BCU-Xtreme heat exchanger when the probe heater is "OFF" or when the unit is not powered.
When the probe heater is "OFF", the gas, at room temperature, delivered by the BVT is directed towards the by-pass port by the two way valve and enters directly in the probe through its adapter.

This safety feature will avoid accidental freezing of the NMR sample when the probe heater is "OFF" and the heat exchanger is still cold.

Starting Cooling 7

The BCU-Xtreme cooling unit includes two cascaded compressors, a high temperature (high stage) and a low temperature called low stage.

The high stage compressor starts immediately when the probe heater is switched "**ON**" in the EDTE program. When the heater is "**ON**", the BVT switches the "**ENABLE**" signal to high and starts the BCU-Xtreme.

As soon as the high stage compressor is on, a timer starts and after a 3 to 5 minutes delay the second low stage compressor is powered on.

The status of the compressors is indicated by leds on the rear panel.

The BCU-Xtreme cooling unit needs about 10 minutes to reach the full cooling power and a steady low output temperature.

The heat exchanger cools the gas to a temperature below -80°C.

Starting cooling

Fuses

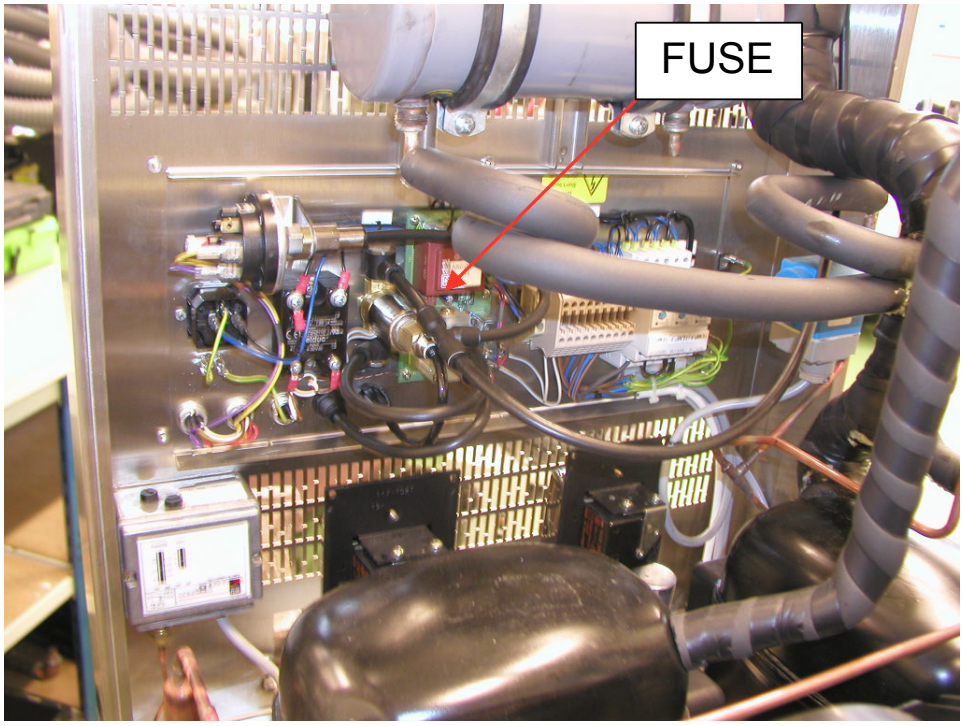
8

Warning: Before replacing fuses, always disconnect the power supply cord from the unit.

A small round fuse (P/N:35006 for Fuse TR5 8 x 7mm 0,125A T 250V), see the picture below, located on a small printed circuit attached on the back panel, protects the gas flow sensor electronics. If the fuse is broken, the sensor does not detect the gas flow and the compressors cannot start.

It is necessary to unscrew the steel plate on the rear side and flip it outside to replace this fuse.

Figure 8.1. Fuse replacement



Two line fuses (P/N:2260 for Fuse mini 5 x 20mm 10A T 250V) are located in the power line plug on the rear panel.

Fuses

Troubleshooting 9

The following table shows several problems and their possible origins.

Table 9.1. Troubleshooting listing

Symptoms	Origin
Unit does not cool	- Gas is not connected - Inlet gas pressure too low - Heater is OFF in EDTE program - BCU cable is not installed - Line fuses are blown - Heat exchanger is clogged - Leak in compressor refrigerant gas circuit - Condenser fan failure
Fuses blown	- Heat exchanger is almost clogged by internal icing, the gas flow is very low and the compressors cycle between ON and OFF
Probe heater does not work	- Inlet gas pressure too low - Heater cables not connected

Troubleshooting

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info@bruker-biospin.com
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