Bruker BioSpin

BVT3200A

Variable Temperature Unit for BSMS/2
Technical Manual

Version 001

think forward

NMR Spectroscopy

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

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Description 1

Introduction 1.1

The new BVT3200A (P/N: W1101558) is a small size variable temperature unit on single double europe size board.

It has microcontroller interface for remote control by the host computer.

The unit includes:

- A temperature controller (ASCON M5).
- The microcontroller and its electronics and the power electronics for the probe heater.
- A gas flow circuitry (pressure regulator and a block of four valves for gas flow control).

The unit is equiped with an optional board for low temperature - LN_2 evaporator or heat exchanger.

The BVT3200A is supplied by the general power supply of the BSMS/2 crate. The power stage is supplied by an additional 48 V power supply board.

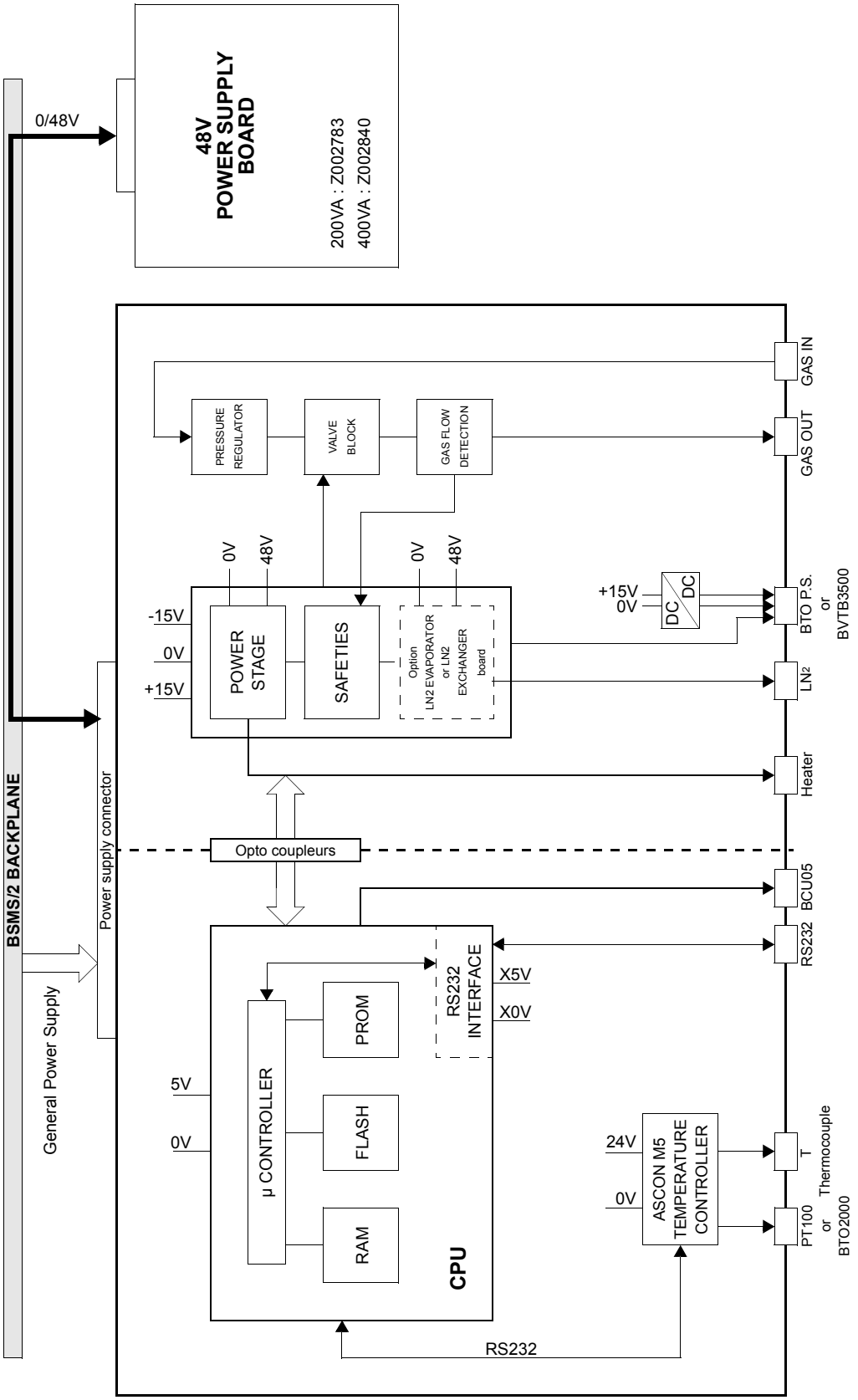

Figure 1.1. BVT3200A block diagram

BVT3200A main components 1.2

The interface board has a microcontroller for remote control of the BVT3200A. Two RS232 ports are available on this printed circuit. One port, on the front panel side, is for the communication with host computer and the other for communication with the ASCON M5 temperature controller.

The power supply connector is at the rear side of the board. On the front, a gas flow indicator with a steel ball detects the gas flow. A device, called valve block, is a group of four valves which control the gas flow rate.

Parts location 1.3

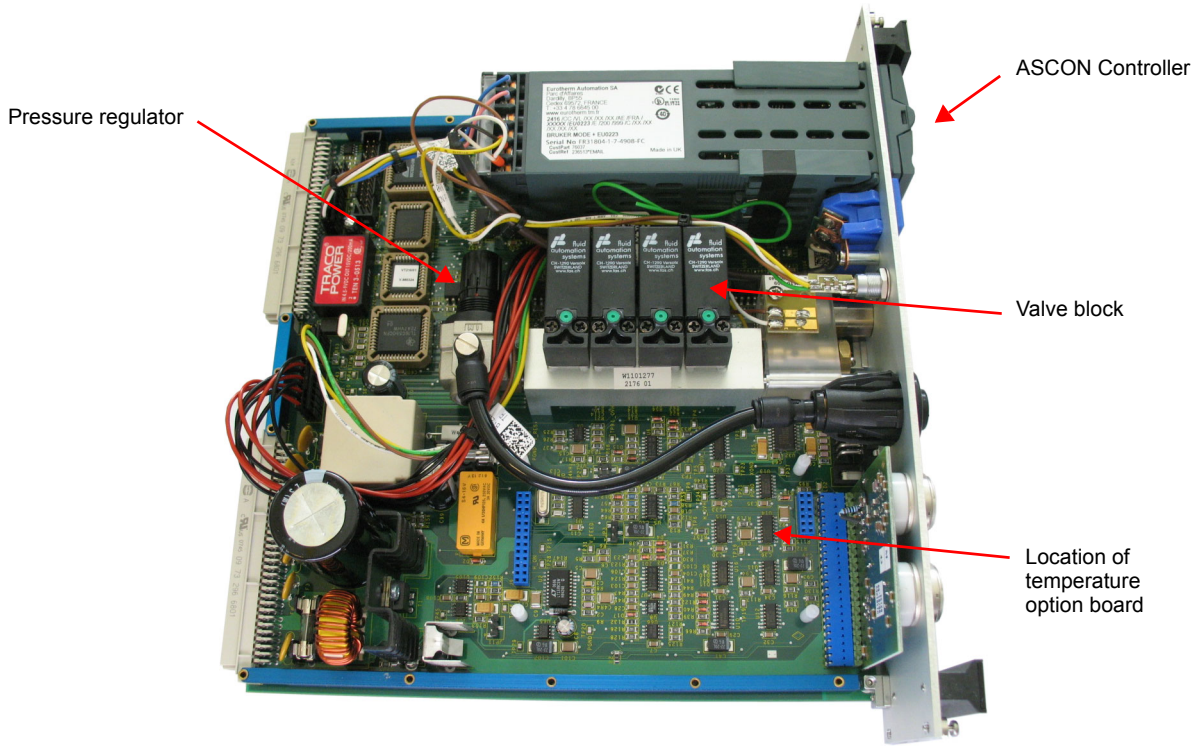

Figure 1.2. Parts location (top view)

Principle of operation 1.4

The sample tube located in the magnet is heated by a constant gas flow delivered by the BVT3200A. A temperature sensor (e.g. a thermocouple T) under the sample tube measures the gas temperature and the temperature controller compares the actual temperature to the target temperature programmed by the operator. It controls the power applied to the heater placed at the base of the magnet in order to stabilise the gas temperature. A special gas flow switch monitors continuously the gas flow in the BVT3200A and switches off the probe heater when the gas flow is missing. A safety thermocouple measures also the heater temperature and avoids probe overheating in case of missing gas flow in the probe.

Front panel description :

1. ASCON M5 controller
2. Thermocouple connector type T
3. PT100 connector or BTO2000
4. Gas IN
5. BT02000 power supply or BVTB3500
6. BCU05 connector
7. Gas OUT
8. RS232 connector
9. N_2 connector
10. Heater connector

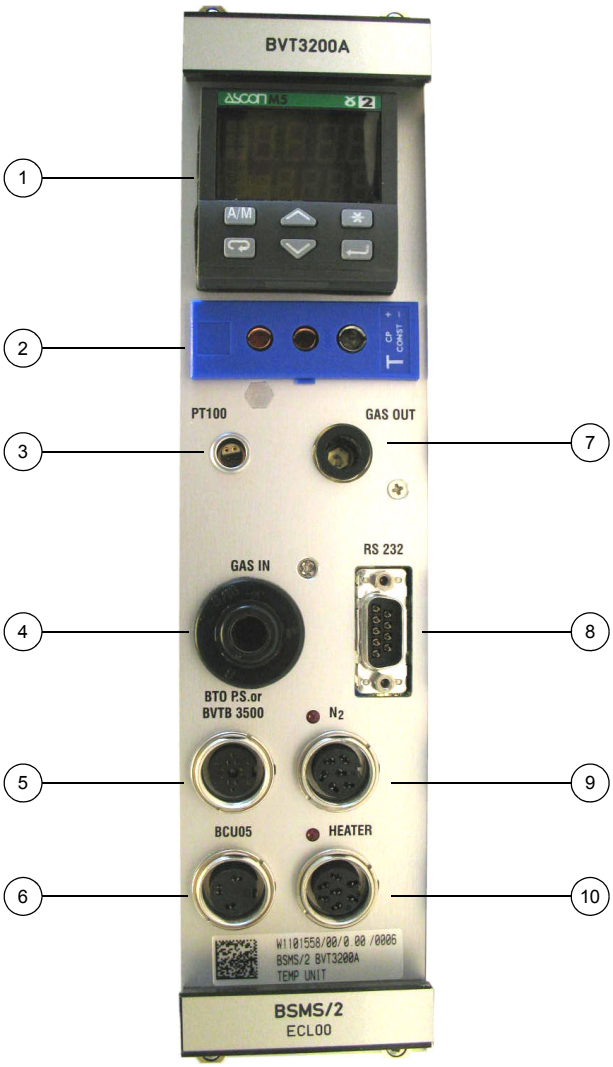

Figure 1.3. BVT3200A front panel

Gas flow circuit 1.6

On the middle of the PC (printed circuit) a pressure regulator delivers gas at constant pressure to a group of valves. Each valve, when open, let the gas flow through a calibrated hole. As all valves are in parallel, it is possible to obtain 15 different gas flow rates.

The regulator is factory adjusted to obtain approximately 2000 l/h when all valves are open and no probe is connected.

The default value at power on can be changed by hardware jumpers (JP12 and JP13) see figure ***"Valve jumpers settings" on page 41***.

An optical gas flow sensor detects the presence of the gaz flow.

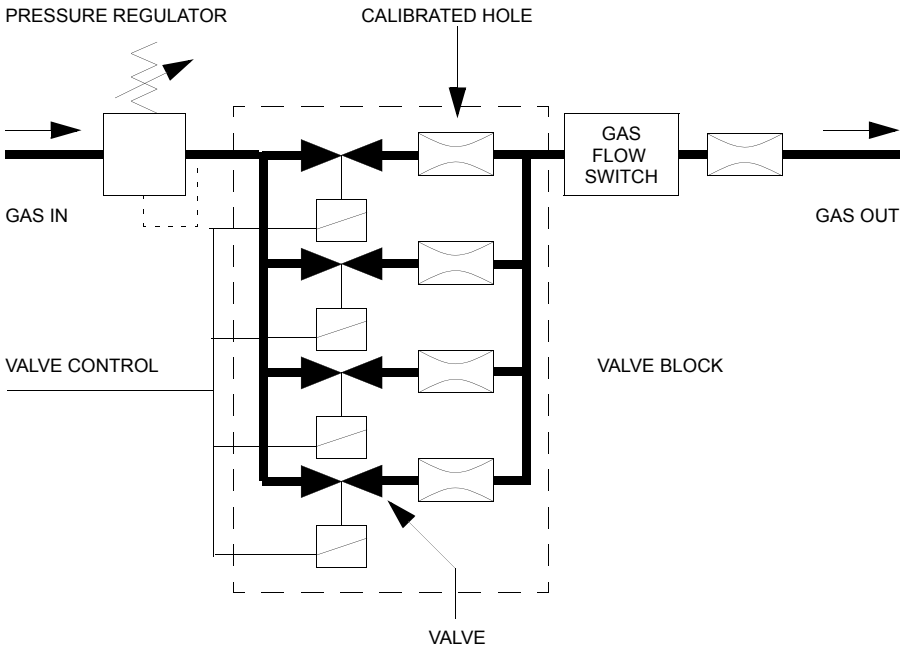

Figure 1.4. Gas flow circuit

Setting up the default gas flow 1.6.1

Connect the BVT3200A gas input to a dry air or a N_2 gas supply line. The inlet pressure must be at least 4 bar and not exceed 7 bar. The default gas flow rate after power on is defined according to the settings of jumpers JP12 and JP13 located between the temperature controller and the valve block.

The gas flow rate may also be changed in the "EDTE" program on the spectrometer.

When a jumper is placed it is read as "0" and the valve is **CLOSED** (no gas flow).

A missing jumper is interpreted as "1" and the valve is **OPEN** (gas flow).

- V4 is the valve with the lowest throughput
- V1 is the valve with the highest throughput
- The factory setting for the default flow is 270 l/h

Table 1.1. Default gas settings

Jumper	Valve	Pins to short	Factory setting (270l/h)
JP12	V4	pin 1(Gnd) - pin 2	Jumper placed
JP12	V3	pin 3(Gnd) - pin 4	No jumper
JP13	V2	pin 1(Gnd) - pin 2	Jumper placed
JP13	V1	pin 3(Gnd) - pin 4	Jumper placed

Table 1.2. Default gas flow versus jumper settings

Combination	V1	V2	V3	V4	Flow rate (l/h)
0	0	0	0	0	0
1	0	0	0	1	135
2	0	0	1	0	270
3	0	0	1	1	400
4	0	1	0	0	535
5	0	1	0	1	670
6	0	1	1	0	800
7	0	1	1	1	935
8	1	0	0	0	1070
9	1	0	0	1	1200
10	1	0	1	0	1335
11	1	0	1	1	1470
12	1	1	0	0	1600
13	1	1	0	1	1735
14	1	1	1	0	1870
15	1	1	1	1	2000

Front panel connectors 1.7

Heater connector 1.7.1

The heater cable is plugged in this connector. A safety thermocouple is attached on the heater resistance in order to detect an overheating in case of a missing gas flow for example.

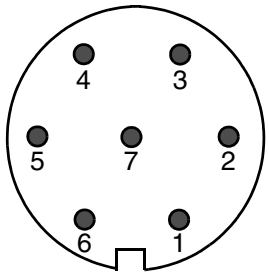

Figure 1.5. Heater connector (Front view)

Table 1.3. Heater connector pin assignment

PIN	SIGNAL
1	heater +
2	heater +
3	safety thermocouple +
4	safety thermocouple -
5	heater -
6	heater -
7	gnd

PT100 connector 1.7.2

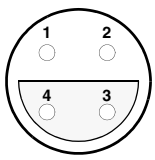

Figure 1.6. PT100 connector (front view)

Table 1.4. PT100 / BTO2000 connector pin assignment

PIN	PT100	BTO2000
1	NC[a]	/
2	I_{PT100}	T-
3	PT100	T+
4	PT100	/

a. NC = not connected

Warning : *The pins assignment of the PT100 plug is different from the BVT3200. When a CRYOPROBE with a PT100 sensor is attached on the BVT3200A, an adapter cable (P/N:W1101619) MUST be used. It is plugged in the PT100 plug. The cable (P/N:W1100644) is attached on the other end of the adapter cable.*

Thermocouple connector *1.7.3*

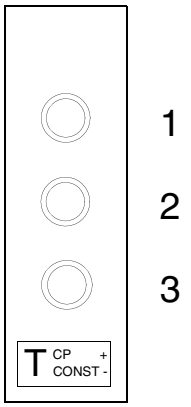

Figure 1.7. Thermocouple connector (Front view)

Table 1.5. Thermocouple T pin assignment

PIN	SIGNAL
1	(Cu) Shield
2	(Cu) Thermocouple +
3	(Co) Thermocouple -

RS232 connector 1.7.4

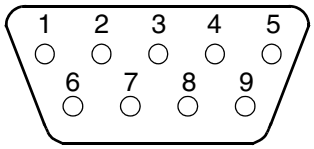

Figure 1.8. RS232 male connector (Front view)

Table 1.6. RS232 connector pin assignment

PIN	SIGNAL	PIN	SIGNAL
1	NC	6	NC
2	RxD	7	RTS
3	TxD	8	DTR
4	NC	9	NC
5	GND		

N_2 connector (option) 1.7.5

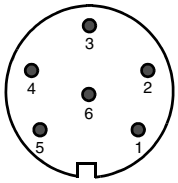

Figure 1.9. N_2 connector (Front view)

Table 1.7. Evaporator connector pin assignment

PIN	SIGNAL	COMMENT
1	heater +	power output (0 - 40 Vac)
2	level sensor +	level detection input (0 - 2,5 V)
3	evaporator detection	evaporator detected if grounded
4	gnd	ground (0 V)
5	heater -	ground power
6	exchanger detection	exchanger detected if grounded

BCU05 connector 1.7.6

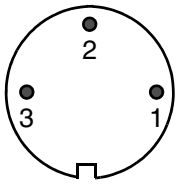

Figure 1.10. BCU05 connector

Table 1.8. BCU05 connector pin assignment

PIN	SIGNAL	COMMENT
1	heater on (output)	turns on the BCU05 when high (> 2,4 V)
2	dgnd	digital ground
3	nc	not connected

BVTB 3500 connector 1.7.7

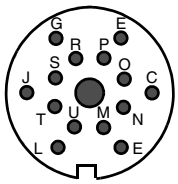

Figure 1.11. BVTB 3500 connector (Front view)

Table 1.9. BVTB 3500 connector pin assignment

PIN	SIGNAL	DIRECTION	COMMENT
A	+5V	O	digital Vcc output
C	NC	---	reserved
E	gnd_BTO	O	BTO2000 has an isolated supply GND
G	+15 v_BTO	O	BTO2000 has an isolated supply output +15V
J	NC	---	reserved
L	dgnd	O	digital ground
M	sda	I/O	I2C bus data line
N	scl	I/O	I2C bus clock line
O	power control	O	0 to 10 volt heater power control output

PIN	SIGNAL	DIRECTION	COMMENT
P	pgnd	O	power ground
R	pgnd	O	power ground
S	thermocouple	I	safety thermocouple input
T	b_relay	O	BVTB 3500 heater relay command
U	b_connected	I	if grounded BVTB 3500 is detected

The BVTB3500 is a power booster for the BVT3200A.

Options 2

Low temperature options 2.1

For sample temperature control below room temperature one must use cold gas. The BVT3200A can drive several devices for cold gas production :

- LN_2 heat exchanger
- LN_2 evaporator
- BCU05 gas cooler

The nitrogen level in the dewar is monitored by the VTU and the power level applied to the LN_2 heater is computer controlled. For both first options, an optional printed circuit must be installed. The LN_2 heater cable or the exchanger cable is plugged in the N_2 connector on the front plate.

LN_2 exchanger 2.2

This device allows to extend sample temperature control below room temperature. A nitrogen gas supply line is required for this device. The N_2 gas is cooled while passing in a heat exchanger tube which soaks in liquid nitrogen. The cold gas is then transferred to the probe by a flexible isolated transfer line.

The gas flow is stopped (it means all four valves are closed in the BVT3200A) whenever the heater power is off, avoiding sample freezing.

A printed circuit (PC) must be installed in the VT unit.

The printed circuit has the part number W1101455. It is plugged on the main printed circuit and fixed by four plastic spacers.

Temperature accuracy is unchanged.

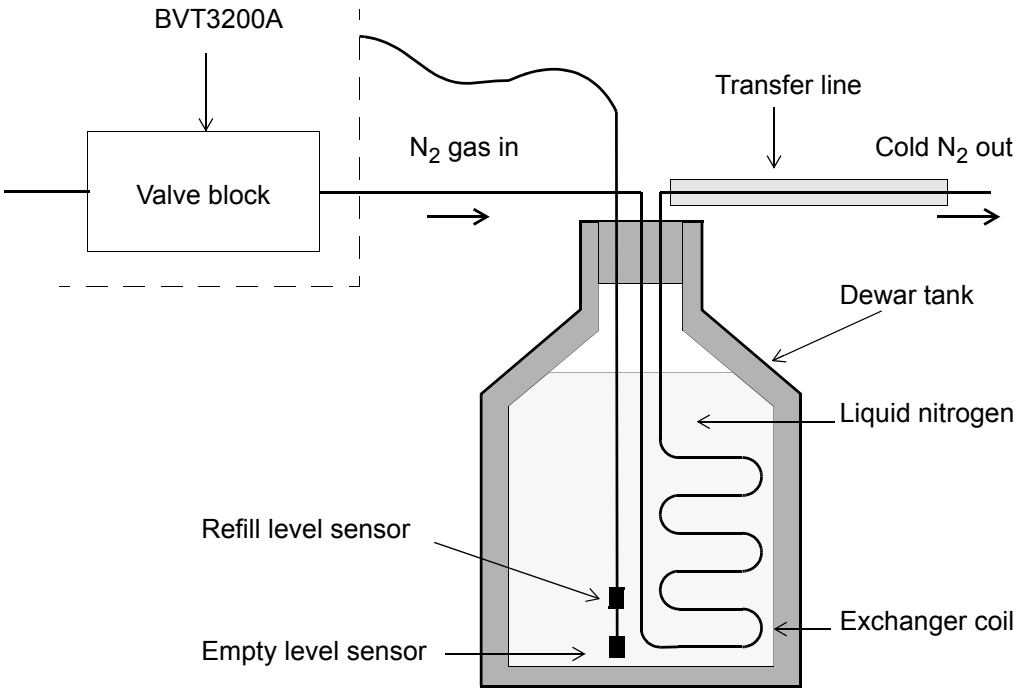

Figure 2.1. Exchanger principle

Exchanger installation 2.2.2

1. Turn off the BSMS/2 power supply
2. Wait 2 minutes to permit the complete discharge of the output capacitor of the heater electronics.
3. Unscrew and remove the BVT3200A from the crate.
4. Disconnect the inlet gas tube (see ***Figure 2.3.*** on ***page 20***).
5. Hold the printer circuit (W1101455) over the main printed circuit, the big male connector on the bottom side of the printed circuit must face the same size female connector of on the top main printed circuit. The 4 plastic spacers must be pushed carefully in the corresponding holes of the main board until they are locked (see ***Figure 2.4.*** on ***page 21***).
6. Plug the gas tube as shown in picture 3 (see ***Figure 2.5.*** on ***page 21***).
7. Insert the BVT3200A in the BSMS/2 crate.
8. Plug the LN_2 exchanger cable in the N_2 connector and insert the exchanger in the LN_2 dewar.
9. Turn on the power supply of the BSMS/2.

LN_2 evaporator 2.3

This device is a cold nitrogen gas generator for low temperature experiments. The nitrogen gas is produced by evaporating the liquid nitrogen contained in a dewar. The power delivered to the heater, controlled by software, may reach 210 Watts (approx. 38 V on a 7 ohm heater). The cold gas is transferred to the probe trough a flexible and isolated transfer line.

For this device, an option printed circuit (PC) must be installed in the BVT3200A. It delivers the power applied on the LN_2 heater. The LN_2 level in the dewar is continuously monitored by the VTU.

This PC has the part number W1101455. It is plugged on the main board of the BVT3200A and is retainded by four plastic spacers.

Temperature accuracy is unchanged.

WARNING : *The BSMS/2 must be equipped with a 48V/400VA power supply (Z002840) to use the LN_2 evaporator option. When a standard 48V/200VA power supply is present in the rack, the rear side must be unscrewed and removed to replace the power supply located beside the BVT3200A.*

Evaporator presentation 2.3.1

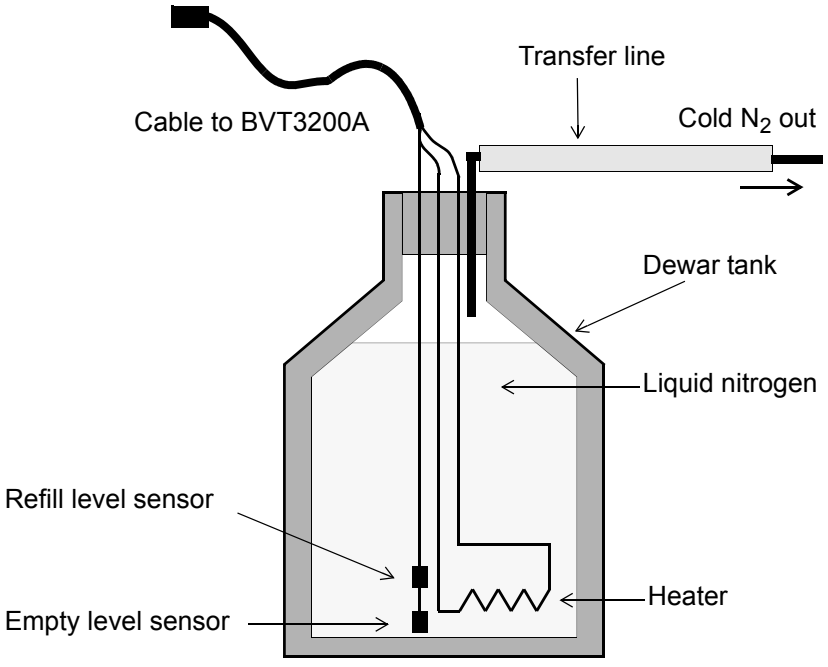

Figure 2.2. Evaporator principle

Evaporator installation *2.3.2*

1. Turn off the BSMS/2 power supply.
2. Wait 2 minutes to permit the complete discharge of the output capacitor of the heater electronics.
3. Unscrew and remove the BVT3200A from the crate.
4. Disconnect the inlet gas tube (see ***Figure 2.3.*** on ***page 20***).
5. Hold the printer circuit (W1101455) over the main printed circuit, the big male connector on the bottom side of the printed circuit must face the corresponding female connector on the component side of the main printed circuit. The 4 plastic spacers must be pushed carefully in the corresponding holes of the main board until they are locked (see ***Figure 2.4.*** on ***page 21***).
6. Plug the gas tube as shown in picture 3 (see ***Figure 2.5.*** on ***page 21***).
7. Insert the BVT3200A in the BSMS/2 crate.
8. Plug the LN_2 evaporator cable in the connector N_2 and insert the evaporator accessory in the LN_2 dewar.
9. Turn on the power supply of the BSMS/2.

Printed circuit installation *2.3.3*

To dismount the gas tube, push forward the gas connector ring and pull back the tube.

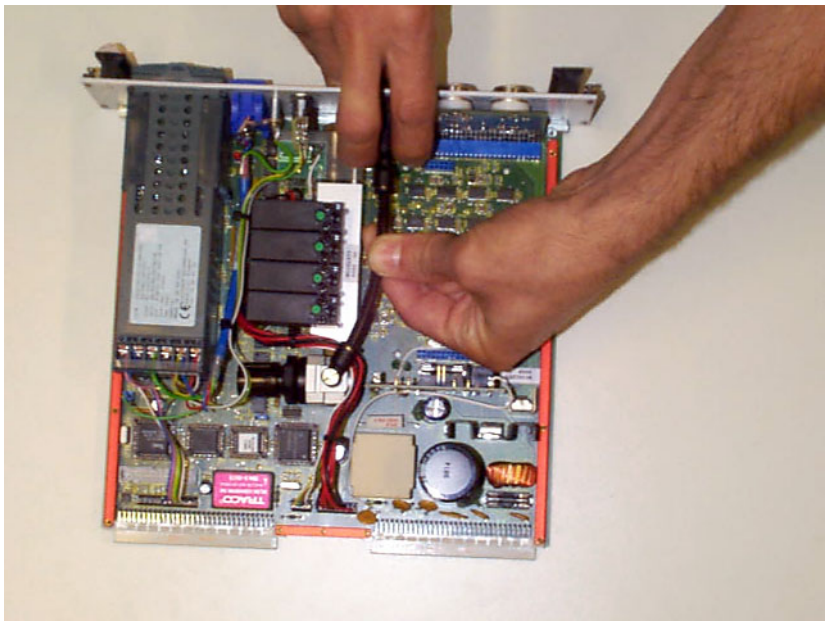

Figure 2.3. Dismount the gas tube

Press on the option board until the 4 plastic spacers are locked.

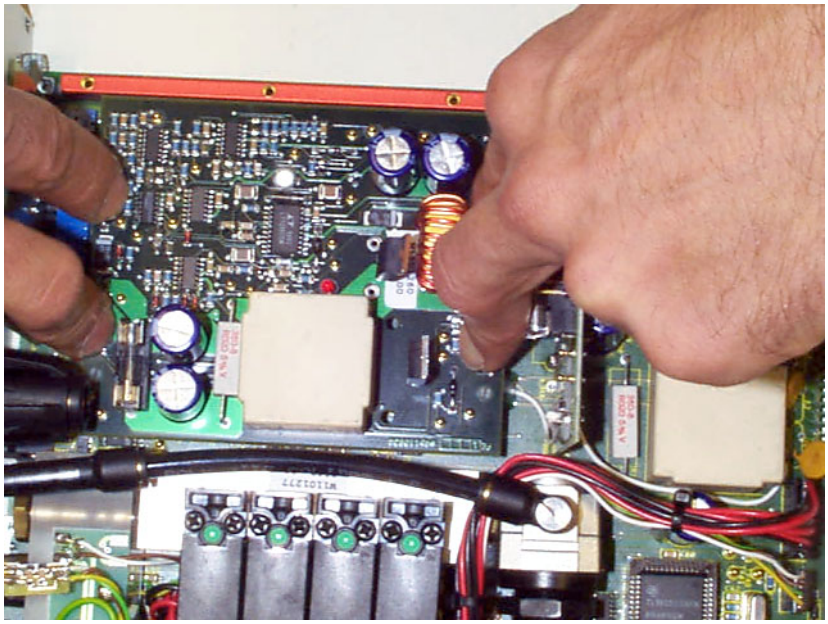

Figure 2.4. Place the option board

Push the male gas connector in the female plug.

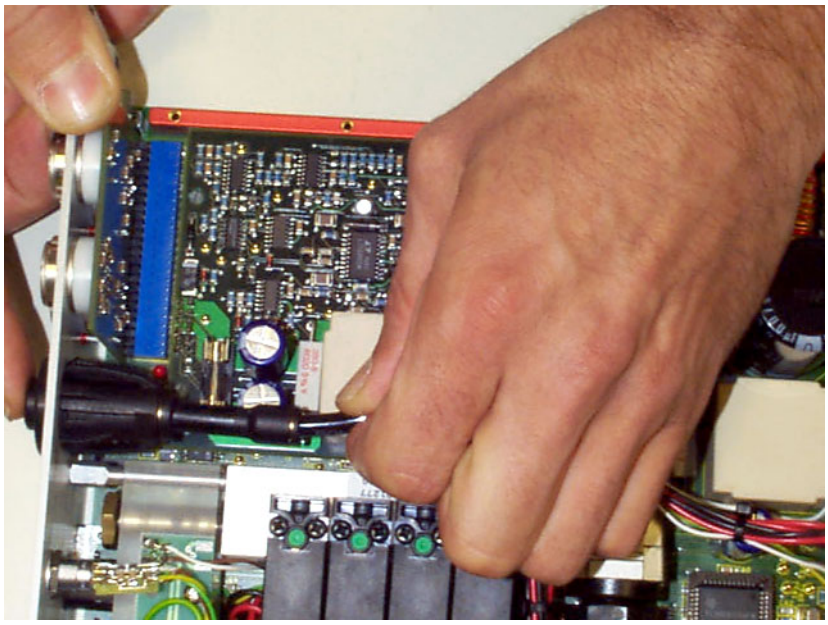

Figure 2.5. Gas connection

The BCU05 is a device that cools dry air or nitrogen gas. The device has a refrigerant gas circuit with a compressor, an evaporator and a cooler. The gas is cooled as it circulates along the evaporator which is located inside the isolated transfer line that connects the BCU05 to the magnet. At the outlet of the transfer line the gas temperature may reach - 40 °C.

The BCU05 has a cable that must be plugged in the connector marked BCU05. When the probe heater is **ON** a signal is delivered to turn on the compressor of the BCU05. This security avoids freezing of the the sample when the BVT3200A power is off.

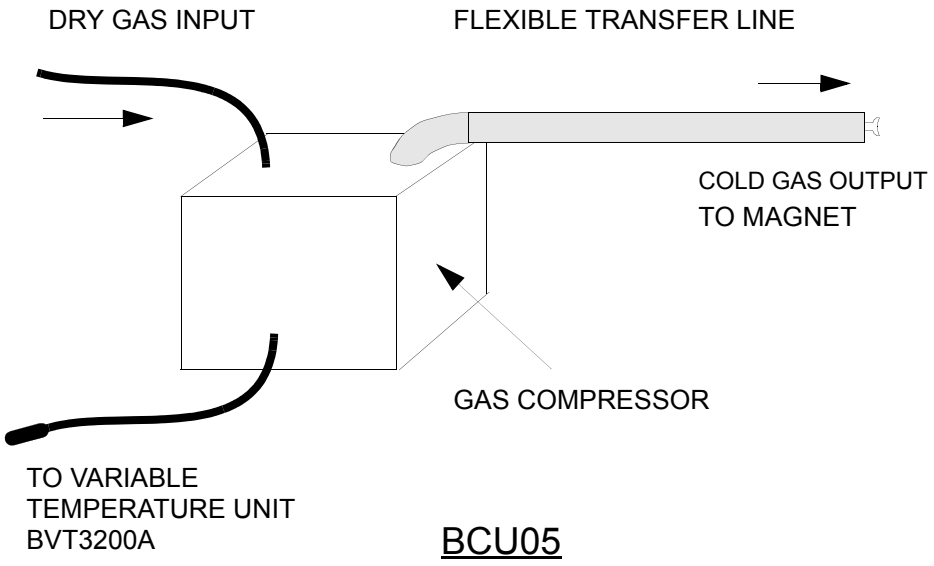

Figure 2.6. BCU05 principle

Configuration 3

Sensor selection 3.1

The BVT3200A can be used with three types of temperature sensors :

- Thermocouple T (factory set)
- BTO2000 for high stability
- PT100 sensor

Warning : *Never connect two sensors at a same time on the BVT3200A.*

ASCON M5 configuration 3.2

The ASCON M5 controller must be configured to work with the right type of sensor.

The sensor can be selected in the EDTE program, it also can be chosen on the keypad of the temperature controller (see the manual of the ASCON M5 controller).

Remote interface control

4

Microcontroller interface 4.1

This interface has several functions :

- Host computer - ASCON M5 transparent communication through a serial port.
- Transmission of BVT3200A internal status to the host computer.
- Probe heater on/off control.
- Gas flow rate settings.
- Installed option control :
    1. Evaporator heating power settings.
    2. Exchanger control with nitrogen level detection.
    3. Etc.

Opto-isolated inputs receive informations and safety flags :

- Probe heater overheating flag.
- Gas flow detection.
- LN_2 level monitoring (when option available).
- Probe heater power status flag (on/off).
- Etc.

Eight optoisolated outputs (**PORT3**) transmit the control byte for the DAC that delivers the LN_2 heater control signal.

Digital interface specifications 4.2

Microcontroller :

8 bits 8032 microcontroller clocked at 11,05 MHz

Program Memory :

Flash EPROM 64 K. A new firmware can be downloaded in this memory through the RS232 link.

Sram :

32 Kilobytes

Eeprom :

256 bytes for manufacturing informations storage (BBIS informations).

Interface :

- Serial link to ASCON M5 controller :

  9600 bauds,1 start bit, even parity, 1 stop bit and three wires link. Baudrate can be changed by software with the «CO» command.

- Serial link to host computer :

  9600 bauds,1 start bit, even parity, 1 stop bit and three wires link.

Isolation :

Optocouplers 2500V isolation between digital interface and power section.

Power supply :

V = +5 Volt, I < 1 Ampere.

Commands and communication protocol *4.3*

All commands for the ASCON M5 controller cross over the interface. The micro-controller looks at each received command and decides then for whom the command is intended (either for the interface itself or the ASCON M5 controller). A command that is not an interface command is automatically transferred to the ASCON M5 controller. If the command is processed by the ASCON M5, the controller answer is returned to the host computer via the interface.

Control characters *4.4*

Six non printing ASCII characters are used to control the messages that are exchanged between host computer and BVT3200A.

Table 4.1. Control characters

NAME	HEX	FUNCTION
STX	02	Start of text
ETX	03	End of text
EOT	04	End of transmission
ENQ	05	Enquiry
ACK	06	Acknowledge
NACK	15	Negative acknowledge

List of commands *4.5*

Table 4.2. List of commands

Commands	R	W	Comment
AF	X	X	reads / writes gas flow delivery
CM	X		starts a ram test of the microcontroller (for test only)
CO	X	X	reads / writes communication speed (Interface <-> ASCON M5)
DL	X	X	reads the download transfer status/ initialises a download transfer
DT		X	DAC check (for test purpose only)
ES	X		reads the error status
HP	X	X	reads / writes heater power state ('1' or '0')
IS	X		reads interface status
NH	X	X	reads / writes LN_2 heater power level
NP	X	X	reads / writes LN_2 heater power state ('1' or '0')
P1	X	X	reads / writes port 1 (for test only)
P2	X	X	reads / writes port 2 (for test only)
P3	X		reads port 3 (for test only)
P4	X		reads port 4 (for test only)
SV	X		reads interface version (software, hardware and installed options)
RB		X	reads BBIS memory content
WB		X	writes to a BBIS memory location
WR		X	writes a record to the BVT3200A
XR		X	transmit a hexadecimal record to the host

RS232 link characteristics 4.6

The serial link allows a host computer to communicate with the BVT3200A. It is a three wires link with no hardware or software handshake. The communication parameters are 9600 bauds, 1 start bit, even parity, 1 stop bit. RS232 connector pin assignment and names are explained above in table ***"RS232 connector pin assignment" on page 13***.

RS232 cable 4.7

A cable with two 9 pins female connectors is required to link the host computer to the BVT3200A. The maximum recommended cable length is 10 m (30 feet). The cable shield is connected to the connector's case.

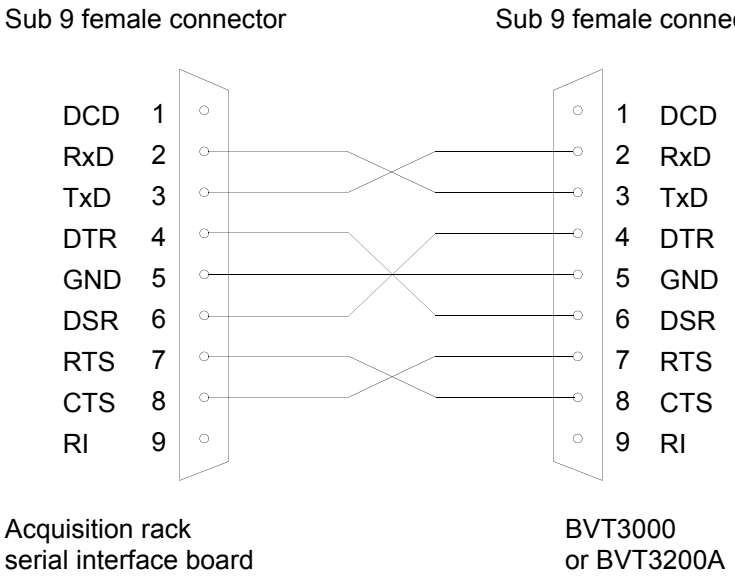

Figure 4.1. RS232 cable

Authorised functions *4.8*

The microcontroller detects automatically the installed optional board (LN_2 evaporator or LN_2 heat exchanger) and the devices connected on the front panel (exchanger or evaporator). The firmware authorizes only the use of the functions relative to the installed options. Let us suppose, for instance, the N2 exchanger is installed : you cannot use the evaporator functions. The answer to an unauthorized function will be a **«NACK»**. The following table gives the different possible options and their authorised functions. In this table, **«X»** means authorised and a empty cell means unauthorised.

Table 4.3. Authorised commands

COMMAND	STANDARD	WITH EVAPORATOR	WITH EXCHANGER	PROBLEM
AF	X	X	X	X
CM	X	X	X	
CO	X	X	X	
DL	X	X	X	
DT	X	X	X	
ES	X	X	X	
HP	X	X	X	
IS	X	X	X	X
NH		X		
NP		X		
P1	X	X	X	X
P2	X	X	X	X
P3	X	X	X	X
P4	X	X	X	X
SV	X	X	X	X
RB	X	X	X	X
WB	X	X	X	X
WR	X	X	X	X
XR	X	X	X	X

Write

Syntax :	EOT 0 0 0 0 STX **AF>**ABCD ETX BCC
Response :	ACK
Description :	This command allows to control the gas flow delivery.
Rules :	The unit has four gas flow valves. ABCD represent the value of the delivery. Each character represent one valve state (a part of the maximum delivery) and can only be «0» or «1». The total delivery is the amount of the four individual deliveries. A **NACK** is send if one of these characters is not «0» or «1». ***Table 1.2." Default gas flow versus jumper settings" on page 10*** shows the different gas flow deliveries.
Example :	If ABCD is set to «1100» (12 decimal), The delivery corresponds to 1600 litres per hour.

NB : At start the microcontroller reads the jumpers (JP7-10) and the gas flow is set as defined by the jumpers settings.

JP7 :	V1 (A)	JUMPER NOT SET	➔	VALVE OPEN
JP8 :	V2 (B)	JUMPER SET	➔	VALVE CLOSED
JP9 :	V3 (C)			
JP10 :	V4 (D)			

These jumpers are located between the valve block and the temperature controller.

WARNING : *Space characters are not allowed.*

Read

Syntax :	EOT 0 0 0 0 **AF** ENQ
Response :	STX **AF** > Value ETX BCC
Description :	This command allows to read the actual gas delivery.
Rules :	Value is a 4 characters string. ***Table 1.2." Default gas flow versus jumper settings" on page 10*** shows the different gas flow deliveries.

CM - Check Memory (for test only) *4.8.2*

Read

Syntax : EOT 0 0 0 0 **CM** ENQ

Response : ACK if the RAM test has complete.
NACK if the test failed.

Description : This command starts a complete microcontroller RAM test.

WARNING : *After the (ACK or NACK) answer the interface is always RESET.*

CO - Communications Speed *4.8.3*

Write

Syntax : EOT 0 0 0 0 STX **CO** ABCDE ETX BCC

Response : ACK

Description : This command allows to program the ASCON M5 interface speed communication. After power on, speed communication is set to 9600 Bauds.

Rules : ABCDE represent the baud rate. It is a five characters string. This string can have one of the following values[a] :
A B C D E
1 9 2 0 0
_ 9 6 0 0
_ 4 8 0 0
_ 2 4 0 0
_ 1 2 0 0

a. _ represent the space character. It can be replaced by '0'.

Read

Syntax : EOT 0 0 0 0 STX **CO** ENQ

Response : STX **CO** ABCDE ETX BCC

Description : This command allows to read the Interface ASCON M5 communication speed.

Rules : «ABCDE» represent the baud rate. It is a 5 characters string. The string can have the following values[a] :
A B C D E
1 9 2 0 0
_ 9 6 0 0
_ 4 8 0 0
_ 2 4 0 0
_ 1 2 0 0

a. _ represent the space character.

DL - Download *4.8.4*

Write

Syntax :	EOT 0 0 0 0 STX **DL** val ETX BCC
Response :	ACK if command issues. NACK in all other cases.
Description :	DL initializes download. This command must be repeated two times successfully to enter in the mode which allows the host to transfer code.
Take care :	Flash Eprom is erased on the second DL command. On second DL1 command, regulation is interrupted. Heater, evaporator and gas flow are switched off. All the software user function are inaccessible.
Rules :	Val can be «0» or «1». • «0» stops download. If the download is in progress, a new one must be performed completely to make the BVT3200A run correctly. • «1» initializes download. The «DL1» command must be send twice to start the process (FLASH memory erased).

Read

Syntax :	EOT 0 0 0 0 **DL** ENQ
Response :	STX **DL** val ETX BCC
Description :	Allows the user to get information about down-load.
Rules :	Val = «0»: No down-load in progress. Val = «1»: Down-load in progress but flash eprom is not erased. Val = «2»: Down-load in progress and flash eprom erased.

DT - DAC Check (for test only) *4.8.5*

Read

Syntax :	EOT 0 0 0 0 **DT** state ETX BCC
Response :	ACK
Description :	This command allows to starts a LN_2 DAC test.
Rules :	State can be «0» or «1». «1» means test on. «0» means test off.

ES - Error Status *4.8.6*

Write

Syntax : EOT 0 0 0 0 STX **ES** val ETX BCC

Response : Always NACK.

Read

Syntax : EOT 0 0 0 0 **ES** ENQ

Response : STX **ES** val ETX BCC

Description : Allows the user to get information about the last six errors.

Explanations : At each «ES» request, the last error code is sent and then reset. If more than six errors are memorised, the oldest error code is replaced by the new one. To erase all errors, one must send «ES» requests until response is «ES0».
The returned value «Val» is the error code. The different error codes are given in the table below.

Table 4.4. Error status description

VAL	SIGNIFICATION	COMMENT
0	NOERROR	no error in command
1	SYNTAX	unknown command/syntax error
2	checksum	checksum error
3	erasefail	flash eprom erase error
4	programmfail	flash eprom program error
5	wrongrecordtype	no intel hex record
6	wrongaddress	program address out of range
7	wrongchecksum	checksum error intel hex
8	wrongtransmissioncheck	wrong eof record
9	wrongdatacount	byte counter error
10	noappsw	no application software
11	nobbis	no BBIS available
12	bbiscs1	BBIS checksum error block 1
13	bbiscs2	BBIS checksum error block 2
14	bbiscs3	BBIS checksum error block 3
15	bbiscs4	BBIS checksum error block 4

Write

Syntax :	EOT 0 0 0 0 STX **HP** state ETX BCC
Response :	ACK If state equals «0» or «1» NACK In all other cases
Description :	This command allows to switch ON or OFF the gas flow heating.
Rules :	State can be «0» or «1». «1» switch the heater ON «0» switch the heater OFF All other values are ignored.

WARNING : *Space characters are not allowed.*

Read

Syntax :	EOT 0 0 0 0 **HP** ENQ
Response :	STX **HP** state ETX BCC
Description :	This command allows to read the heater's state.
Rules :	State can be «0» or «1». «1» means that heater is ON «0» means that heater is OFF

NB : after power on the heater is OFF.

IS - Interface Status *4.8.8*

Read

Syntax : EOT 0 0 0 0 **IS** ENQ

Response : STX **IS** > ABCD ETX BCC

Description : This command allows to read back the interface status.

Rules : The status word is made of sixteen bits, each one represents a particular function of the interface as detailed below.
The 16 bits are sent as four hexadecimal numbers preceded by «>» to warn the computer that the data is hexadecimal.
Digits ABCD are ASCII characters representing a hexadecimal digit (0-9, A-F).

Note : Interface Status (IS) in the format (>ABCD)

Table 4.5. Interface status

DIGIT	BIT	SIGNAL NAME	FUNCTION
D1	0	heater on	1= heater is ON
D2	1	not used	always 0
D3	2	evap conn	1 = evaporator connected
D4	3	missing gas flow	1 = missing gas flow
C1	4	overheating	1 = heater overheating
C2	5	exch conn	1 = exchanger connected
C3	6	LN_2 refill	1 = refill LN_2 tank
C4	7	LN_2 empty	1 = LN_2 tank is empty
B1	8	evaporator status	1 = LN_2 heater is on
B2	9	not used	1 always
B3	10	booster connected	1 = BVTB3500 present
B4	11	reserved	0 always
A1	12	reserved	0 always
A2	13	reserved	0 always
A3	14	reserved	0 always
A4	15	reserved	0 always

Write

Syntax :	EOT 0 0 0 0 STX **NH** Value ETX BCC
Response :	ACK
Description :	This command allows to control the LN_2 heater power (Evaporator).
Rules :	The value from 0 up to 100%, is defined as a string up to 5 characters long. The string can begin with 1 to 5 spaces or «0». After power on, the initial value is set to 0 (the nitrogen heater is OFF).

Read

Syntax :	EOT 0 0 0 0 **NH** ENQ
Response :	STX **NH** Value ETX BCC
Description :	This command allows to read back LN_2 heater power.
Rules :	Value from 0 to 100%, is a string up to 5 characters long. The string can begin with 1 to 5 spaces or «0».

NB : Value is a DECIMAL code.

NP - Nitrogen Heater Power *4.8.10*

Write

Syntax :	EOT 0 0 0 0 STX **NP** state ETX BCC
Response :	ACK
Description :	Allows to switch nitrogen heater power ON or OFF.
Rules :	State can be «0» or «1». «1» switch LN_2 heater ON. «0» switch LN_2 heater OFF.

WARNING : *Space characters are not allowed.*

Read

Syntax :	EOT 0 0 0 0 **NP** ENQ
Response :	STX **NP** State ETX BCC
Description :	Allows to read Nitrogen Power.
Rules :	State can be «0» or «1». State at «1» means that LN_2 heater is ON. State at «0» means that LN_2 heater is OFF.

NB : After power on the nitrogen heater power is at «0».

This port represents the main status of the BVT3200A unit.

Port 1 is described in the following table

Table 4.6. Port 1 definition

BIT	NAME	FUNCTION
0	heater	1 = Probe heater is ON
1	aux1	Unused
2	evaporator	1 = LN_2 heater is ON (with option)
3	aux2	Unused
4	valve1	1 = Valve 1 open
5	valve2	1 = Valve 2 open
6	valve3	1 = Valve 3 open
7	valve4	1 = Valve 4 open

Write

Syntax : EOT 0 0 0 0 STX **P1** AB ETX BCC

Response : ACK

Description : Allows to write directly to port 1.

Rules : The first character represents the state of port 1 bits 4 to 7. The second character represents the state of the bits 0 to 3. The characters are hexadecimal.

Read

Syntax : EOT 0 0 0 0 **P1** ENQ

Response : STX **P1** > ABCD ETX BCC

Description : Allows direct read access to port 1.

Rules : A and B are always «0». The third character represents the state of port 1 bits 4 to 7. The fourth character represents the state of the bits 0 to 3. All the characters are hexadecimal.

P2 - Port 2 (for test only) *4.8.12*

The power level applied to the LN_2 evaporator is set by an analog control signal delivered by a 8 bit DAC (Digital to Analog Converter). Port 2 provides the bits for LN_2 control DAC :

Table 4.7. Port 2 definition

BIT	NAME	FUNCTION
0	$1LN_2$	DAC bit 0
1	$2LN_2$	DAC bit 1
2	$3LN_2$	DAC bit 2
3	$4LN_2$	DAC bit 3
4	$5LN_2$	DAC bit 4
5	$6LN_2$	DAC bit 5
6	$7LN_2$	DAC bit 6
7	$8LN_2$	DAC bit 7

Write

Syntax : EOT 0 0 0 0 STX **P2** AB ETX BCC

Response : ACK

Description : Allows direct write access to port 2.

Rules : The first character represents the state of port 2 bits 4 to 7. The second character represents the state of the bits 0 to 3. The characters are hexadecimal.

Read

Syntax : EOT 0 0 0 0 **P2** ENQ

Response : STX **P2** > ABCD ETX BCC

Description : Allows direct read access to port 2.

Rules : A and B are always «0». The third character represents the state of port 2 bits 4 to 7. The fourth character represents the state of the bits 0 to 3. All the characters are hexadecimal.

Port 3 allows to read the internal status of the BVT3200A.

It is composed as follows:

Table 4.8. Port 3 definition

BIT	NAME	FUNCTION
0	heater on	1 = probe heater is ON
1	booster connected	1 = BVTB3500 present
2	evap conn	1 = evaporator device is connected
3	no gas	1 = missing gas flow
4	overheating	1 = overheating on probe heater
5	exch conn	1 = Exchanger connected
6	LN_2 refill	1 = LN_2 tank is almost empty
7	LN_2 empty	1 = LN_2 tank is empty

Read

Syntax : EOT 0 0 0 0 **P3** ENQ

Response : STX **P3** > ABCD ETX BCC

Description : Allows direct read access to port 3.

Rules : A and B are always «0». The third character represents the state of port 3 bits 4 to 7. The fourth character represents the state of the bits 0 to 3. All the characters are hexadecimal.

P4 - Port 4 (for test only) *4.8.14*

Port 4 allows to read the internal status of the BVT3200A and sets the gas flow rate at power on.

It is composed as follows:

Table 4.9. Port 4 definition

BIT	NAME	FUNCTION
0	unused	
1	unused	
2	unused	
3	evap_on	1 = evaporator heater on
4	V1	jumper JP13
5	V2	jumper JP13
6	V3	jumper JP12
7	V4	jumper JP12

When a jumper is placed, it means that the valve is closed at power on.

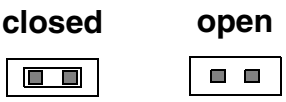

Figure 4.2. Valve jumpers settings

Read

Syntax : EOT 0 0 0 0 **P4** ENQ

Response : STX **P4** > ABCD ETX BCC

Description : Allows direct read access to port 4.

Rules : A and B are always «0». The third character represents the state of port 3 bits 4 to 7. The fourth character represents the state of the bits 0 to 3. All the characters are hexadecimal.

Write

Syntax :	EOT 0 0 0 0 STX **RB** adr_e2prom A1 A0 ETX BCC
Response :	STX **RB** > D0 D1 ETX NACK if command can't issue.
Description :	RB command allows to read a single byte in a BBIS E2PROM.
Rules :	A0, A1 are values from «0» up to «F» representing the byte address in the E2PROM.

adr_E2prom is a value from «0» up to «7» representing the I2C bus address of the E2PROM

«0» : Address unused
«1» : BVT3200A motherboard address
«2» : BVTB3500 (Booster) address
«3» : Address unused
«4» : Address unused
«5» : Address unused
«6» : Address unused
«7» : Address unused

All other values generate a NACK response

SV - Software Version *4.8.16*

Read

Syntax :	EOT 0 0 0 0 **SV** ENQ
Response :	STX **SV** Version ETX BCC
Description :	Version is a 5 characters (SSHHO). This string splits in: - **SS** is the SOFT version - **HH** is the HARDWARE version - **O** indicates the installed OPTIONS
Example :	The string received is :
HEX :	02H 53H 56H 30H 31H 32H 33H 35H 02H 37H
ASCII :	STX 'S' 'V' '0' '1' '2' '3' '5' ETX BCC
It means :	SOFTWARE Version 0.1 HARDWARE Version 2.3 OPTIONS 5

The different options identifications are defined as follows:

«1» : Not used.
«2» : LN_2 Evaporator option.
«3» : Not used.
«4» : LN_2 Exchanger option.
«5» : Not used.
«6» : Problem detected.

Write

Syntax :	EOT 0 0 0 0 STX **WB** adr_e2prom A1 A0 D1 D0 ETX BCC
Response :	ACK if command issues NACK in all other cases
Description :	WB command allows to write a single byte on a BBIS E2PROM.
Rules :	A0, A1 are values from «0» up to «F» representing the address in the E2PROM. D0, D1 are values from «0» up to «F» representing the value to be written.

adr_e2prom is a value from «0» up to «7» representing the I2C bus address of the E2PROM

0 : Address unused
1 : BVT3200A motherboard address
2 : BOOSTER address
3 : Address unused
4 : Address unused
5 : Address unused
6 : Address unused
7 : Address unused

All other values generates a NACK response

WR - Write Record *4.8.18*

Intel-Hex format is used to download the firmware on flash-eprom. The file to transfer is generated with OHS51.EXE. Its file extension is «.HEX». This file is composed by several records. Each record is composed as shown below :

: L L A A A A T T D D D . . . . . .D D C C Cr Lf

Table 4.10. Record format

FIELD	LENGTH	SIGNIFICATION
: (3A)	1	Record start
L	2	Record length
A	4	Record address
T	2	Type (00: Data record, 01: EOF record)
D	LL	Data's
C	2	Checksum

Write

Syntax : EOT 0 0 0 0 STX **TR** Rec ETX BCC

Response : CK if down-load initialized and the record processing issues.
NACK in all other cases

Description : Allows to transfer records extract from a «.hex» file to the BVT3X00.

Rules : Rec value represents an intel-hex record.
The first character «:» (3A), Cr and Lf are not transmitted.

Write

Syntax :	EOT 0 0 0 0 STX **X R** Val ETX BCC
Response :	STX 0 0 0 0 X R Rec BCC
Description :	This command is useful to save a working software before to process a new download.
Take care :	If Val = 1, regulation is interrupted. Heater, evaporator and gas flow are switched off. All the software user function are inaccessible.
Rules :	Val = 0 : Stops the upload process. Val = 1 : Initilizes the upload process. Val = 2 : Autorizes the BVT3200A to send the next record. Val = 3 : Ask the BVT3200A to send the same record again.

The upload process is initialized by receiving «XR1» from the host computer. The BVT3200A sends the first Intel-hex record. The BVT3200A waits then for «XR2» to continue.

This command autorizes the BVT3200A to send the next record. This handshake continues until the BVT3200A sends the last record which is «0 0 0 0 0 0 0 1 F F». Host computer must detect it. Then, BVT3200A sends an «XR0» requests to terminate up-load process and return to normal mode.

If BVT3200A receives an «XR3» command, the previous record is sent again.

An «XR0» Command must be sent to terminate the up-load sequence and return to normal mode.

Technical specifications

5

Specifications 5.1

Table 5.1. BVT3200A Specifications

Temperature controller	ASCON M5 (display units K or °C).
Sensors	T thermocouple with compensated connector. BTO2000 or PT100.
Temperature range	35°C to 200°C without special accessory. • Low temperature limit : - 5° C with BCU05 cooler. -150 °C with LN_2 exchanger or LN_2 evaporator. • High temperature limit : 600 °C with power booster BVTB3500
Temperature stability	0.01 °C/°C for sample temperature between 0 °C and 50 °C, using a BTO2000 and BCU05. 0.1 °C/°C without BTO2000.
Heater power	135 W (48 V max. on 12 Ω probe heater). Output current limitation at 6A max.
Gas inlet	Dry air or nitrogen 4 bar mini and 7.5 bar maxi. Dry air, dew point < 5 °C for operation above room temperature. Dry air, dew point < -50 °C for operation with BCU05 cooler.
Gas flow rate	200 l/h to 2000 l/h. Fifteen values available. Controlled by software.
Control	Computer control via RS232 interface.
Software control	By EDTE / TOPSPIN 2.1 or later.
Options	LN_2 evaporator (210W, with optional printed circuit board and 400 VA power supply). LN_2 exchanger (with optional printed circuit board). BCU05 gas cooler. BVTB3500 External Power Booster. BVT3900 Probe heat exchanger.

Power requirements	5V /1A. 24V / 0.15A for ASCON M5 unit. 24V / 0.5A for pneumatic. -15V / 0.5A. +15V / 0.5A. 48V / 4.1A standard. 48V / 8.3A with LN_2 evaporator option board.
Weight	1.5 kg without option board.
Dimensions	61 mm length. 262 mm height. 246 mm depth.

Safety fuses *5.2*

Some important electronic functions are fuse protected. To replace a blown fuse, turn off the BVT3200A and disconnect the main power cord. A faulty fuse must always be replaced with the same type.

Table 5.2. Fuses values

Fuses	Value	Protection for
F1	5 AT	Probe heater resistor
F3	10 AT	48V power supply

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