

Variable Temperature Unit

**Technical Manual
BVT3300**

Version 003

BRUKER

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Description

1

Introduction

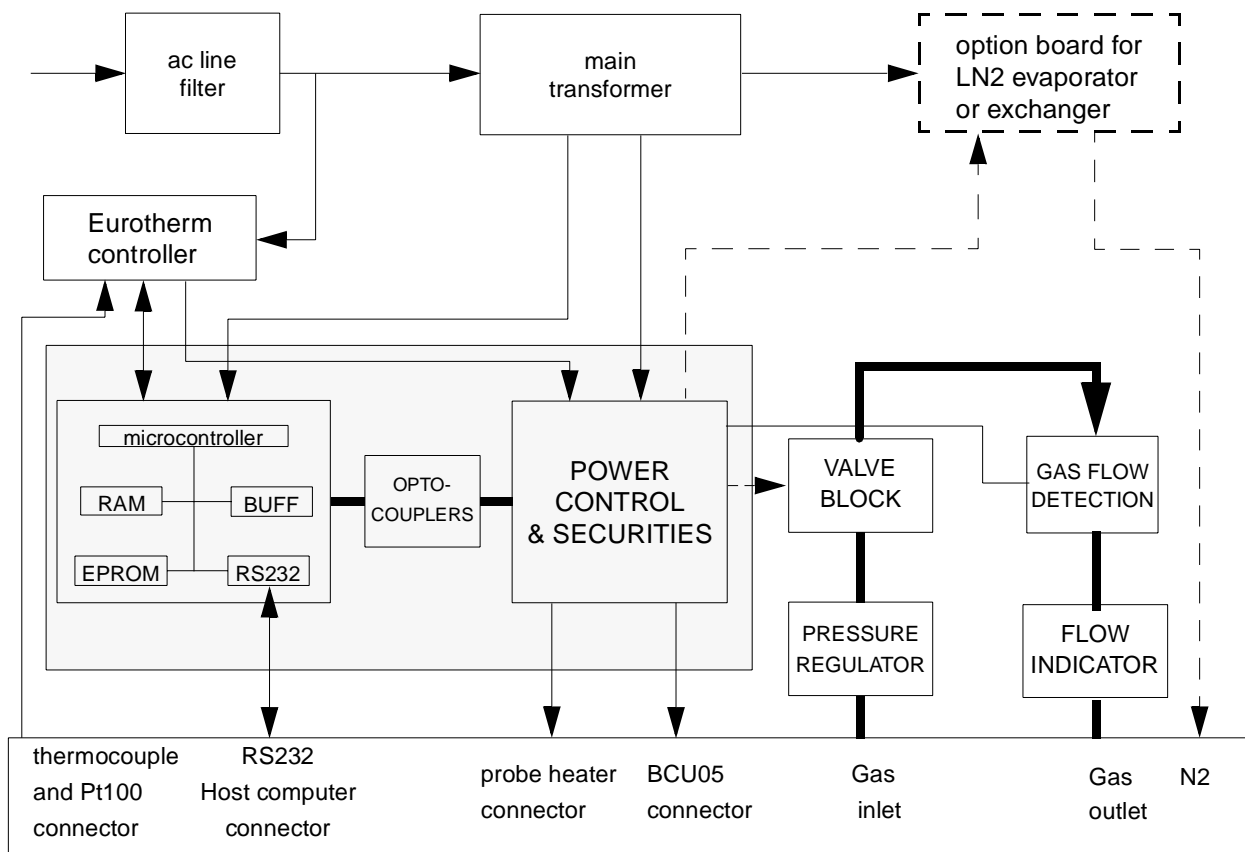
1.1

The new variable temperature unit BVT3300 for sample temperature regulation is equipped with a microcontroller interface for remote control by the host computer. The BVT3300 is manufactured in a separate housing.

The unit includes:

- A main board called interface board with a microcontroller.
- A temperature controller (EUROTHERM model 847).
- A main transformer that supplies the microcontroller and its electronics and the optoisolated power stage of the probe heater.
- The gas flow circuitry (pressure regulator and a block of four valves for gas flow control).
- An option printed circuit for LN2 heater evaporator control or LN2 exchanger.

Figure 1.1. BVT3300 block diagram



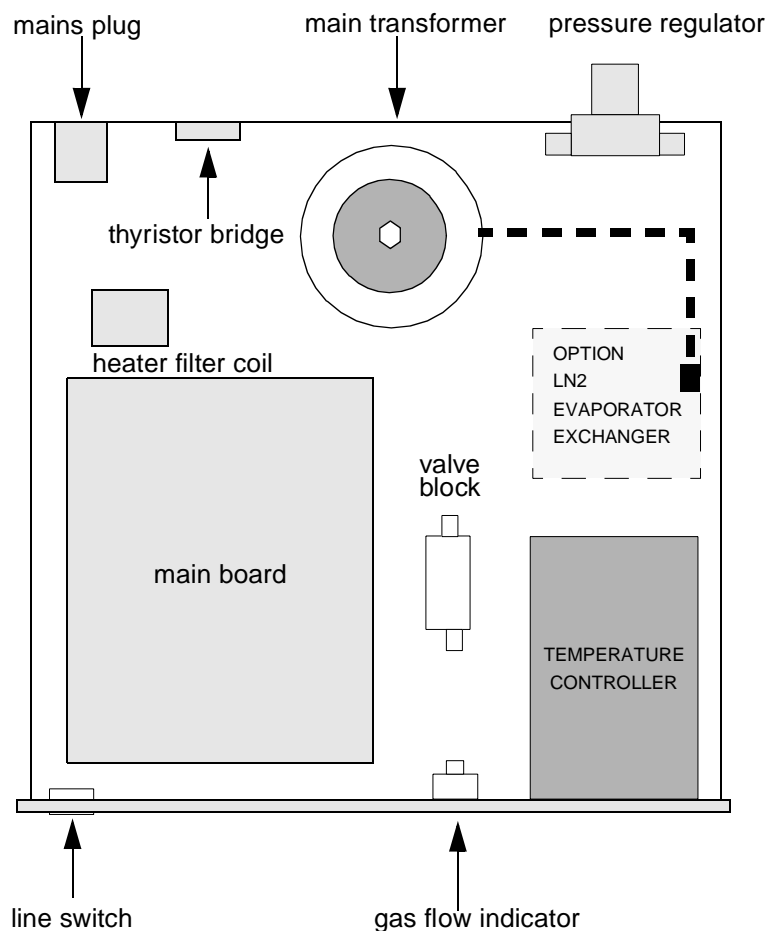
BVT3300 main components

1.2

The interface board has a microcontroller for remote control of the BVT3300. Two RS232 links are available on this printed circuit. One link, on the front panel side, is for the communication with host computer and the other for communication with the Eurotherm 847 temperature controller.

A main toric transformer supplies the different groups. At rear, there is a power supply plug. The thyristor bridge, for heater power control, is placed on the housing at rear side. On the front, a gas flow indicator with a steel ball detects the gas flow. A device, called valve block, is a group of valves which determines the gas flow under software control.

Figure 1.2. Parts location



Principle of operation

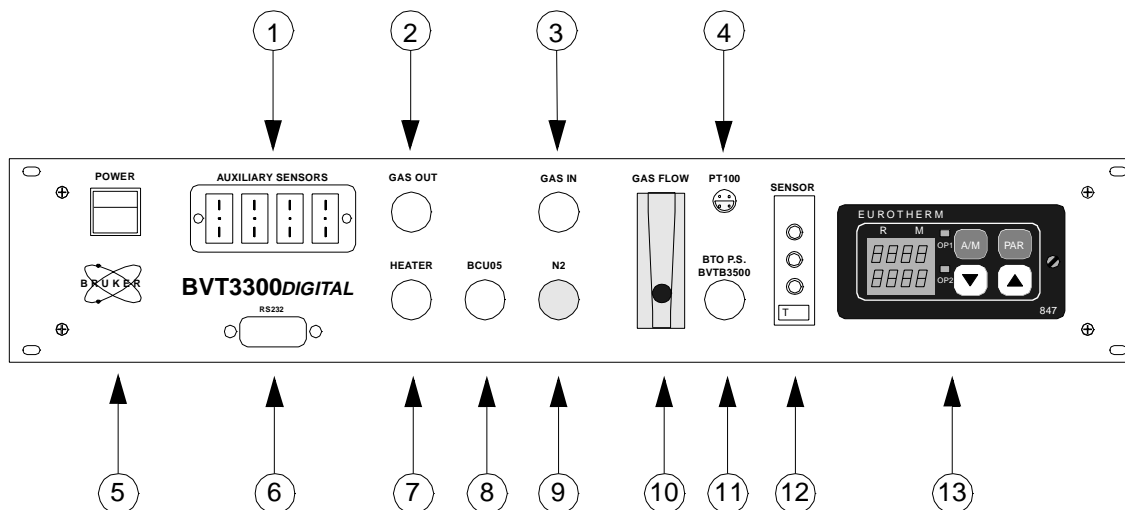
1.4

The sample tube placed in the magnet of the spectrometer is heated by a constant gas flow delivered by the BVT3300. A temperature sensor (e.g. a thermocouple T) located under the sample tube measures the gas temperature. The temperature controller compares the probe 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 detector monitors the gas flow and switch off the heater power if there is no gas flow. A security thermocouple checks also the heater temperature and avoids probe overheating.

On the front panel, there is :

- 1: Auxiliary sensors
- 2: Gas out
- 3: Gas inlet
- 4: Pt100 connector or BTO2000
- 5: Power switch
- 6: RS232 connector
- 7: Heater connector
- 8: BCU05 connector
- 9: N2 connector
- 10: Gas flow indicator
- 11: BTO2000 power supply or BVTB 3500
- 12: Thermocouple connector type T
- 13: Eurotherm controller

Figure 1.3. BVT3300 front panel



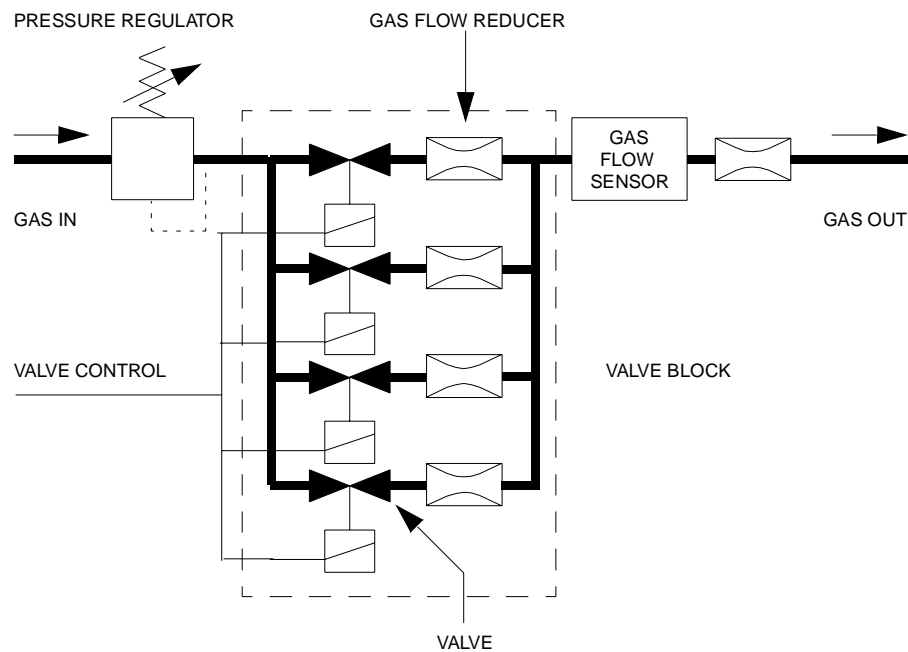
On the rear panel a pressure regulator delivers gas at constant pressure to a group of valves. Each valve, when open, let the gas flow through a calibrated hole. As all valves are in parallel, it is possible to obtain 15 different gas flow rate.

The regulator is factory adjusted to obtain approximately 2000 l/h when all valves are open.

The default value at power on can be changed by hardware jumpers (JP6 to JP9) see figure ***"Valve jumpers settings" on page 45.***

On the front panel a gas flow meter with a steel ball indicates the actual gas flow. An optical barrier at the bottom detects a missing gas flow.

Figure 1.4. Gas flow circuit



Connect the BVT3300 gas input to a dry air or N₂ gas line. The input pressure should be at least 4 bar and must not exceed 8 bar. Power on the BVT3300. The default value of the flow rate is set according to the position of jumper JP6 to JP8. The gas flow rate can also be changed by software in the «EDTE» program on NMR spectrometer.

Table 1.1. Flow rate versus command

DECIMAL COMBINA- TION	COMBI- NATION ABCD	FLOW RATE (L/H)
0	0000	0
1	0001	135
2	0010	270
3	0011	400
4	0100	535
5	0101	670
6	0110	800
7	0111	935
8	1000	1070
9	1001	1200
10	1010	1335
11	1011	1470
12	1100	1600
13	1101	1735
14	1110	1870
15	1111	2000

Front panel connectors

1.7

Heater connector

1.7.1

The heater is plugged in this connector. A safety thermocouple is located close to 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)

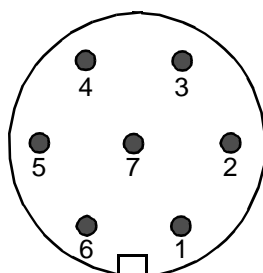


Table 1.2. Heater connector pin assignment

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

Figure 1.6. Pt100 connector (front view)

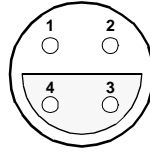


Table 1.3. Pt100 connector pin assignment

PIN	SIGNAL
1	current +
2	measure
3	measure
4	current -

⇒ **Note.** This connector is also used to connect the BTO2000. Pin 2 and 3 are used as signal input pins.

Figure 1.7. Thermocouple connector (Front view)

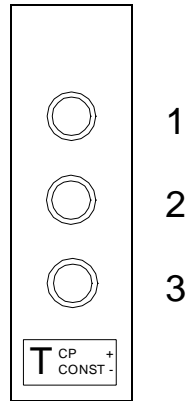


Table 1.4. Thermocouple T pin assignment

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

Figure 1.8. RS232 male connector (Front view)

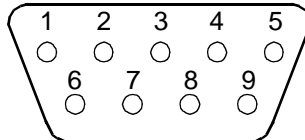


Table 1.5. Rs232 connector pin assignment

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

N2 connector (option)

1.7.5

Figure 1.9. N2 connector (Front view)

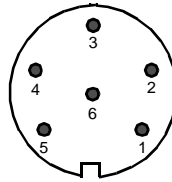


Table 1.6. Evaporator connector pin assignment

PIN NUMBER	SIGNAL NAME	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

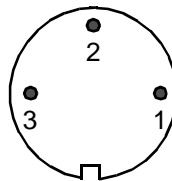


Table 1.7. BCU05 connector pin assignment

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

Description

BVTB 3500 connector

1.7.7

Figure 1.11. BVTB 3500 connector (Front view)

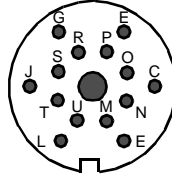


Table 1.8. BVTB 3500 connector pin assignment

PIN	SIGNAL NAME	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 power control output
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 BVT3300.

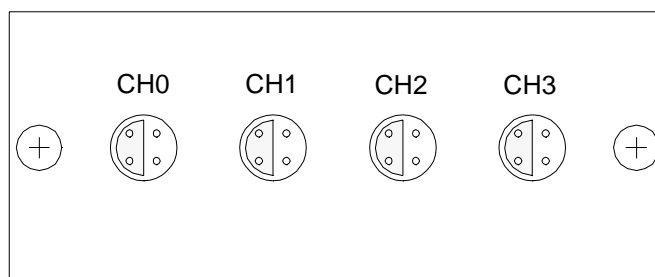
Auxiliary sensor option - BASM

2.1

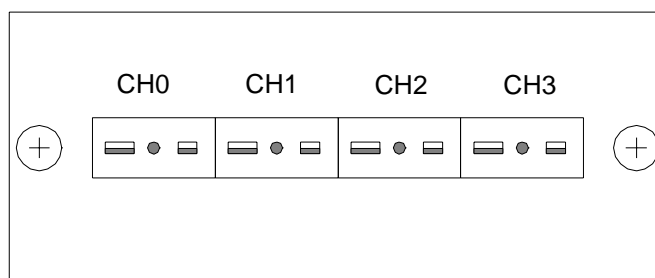
The BVT3300 can be equipped with an electronic module for auxiliary temperature measurement.

This module can receive up to 4 sensors to acquire more temperature in spectrometer environment (ambient temperature, extra temperature in special probe head for exemple).

Figure 2.1. BASM front view



module with 4 Pt100 inputs

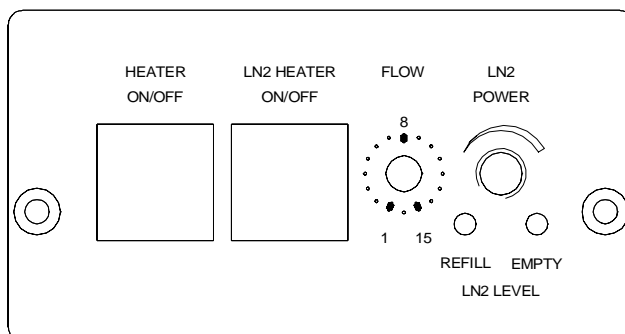


module with 4 thermocouple inputs

The module is inserted in the front of the BVT3300 unit and has a flat cable which must be connected to the interface board.

The BMCM is an electronic module which allows to control manually the main functions of the temperature unit.

Figure 2.2. BMCM Front view



The following functions of the temperature unit can be controlled :

- Probe Heater : the left push button of the module turns on the main probe heater. The heater status is indicated by a green led in the button.
- LN2 Heater : the right push button turns on the LN2 evaporator heater. The LN2 evaporator heater status is indicated by a green led in the button. The status of the LN2 level sensors are indicated by two red leds on the bottom. The LN2 heater power can be set with rightmost potentiometer.
- Gas flow control : a knob permits to select manually stepwise a gas flow between 0 and 2000 l/h.

The module is inserted in the front of the BVT3300 unit and has 4 flat cables which must be connected to the interface board.

Low temperature options

2.3

For sample temperature regulation below room temperature one must use cold gas. The BVT3300 can be equipped with three optional cold gas production devices :

- LN2 exchanger
- LN2 evaporator
- BCU05 gas cooler

The level of the LN2 tank is monitored by software and the power level applied to the LN2 heater is computer controlled. For both first options, an additional printed circuit must be mounted in the enclosure. The LN2 heater cable or the exchanger cable is plugged in the N2 option connector on the front panel.

LN2 exchanger

2.4

This option allows to extend regulation temperature below room temperature. It is necessary to have an nitrogen gas line to use this device. The N2 gas is cooled by circulating in a heat exchanger tube that soaks in liquid nitrogen. The cold gas is transferred to the probe trough a flexible transfer line.

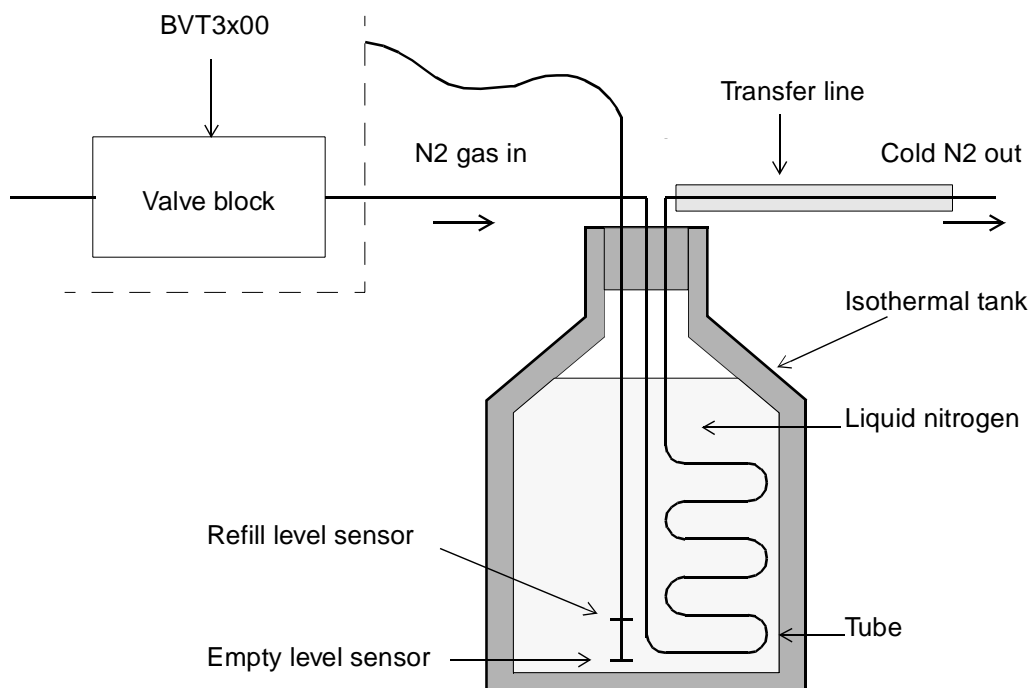
➡ **The gas flow is stopped (it means all four valves are closed) whenever the heater power is off, avoiding sample freezing.**

Regulation accuracy is unchanged.

Exchanger presentation

2.4.1

Figure 2.3. Exchanger principle

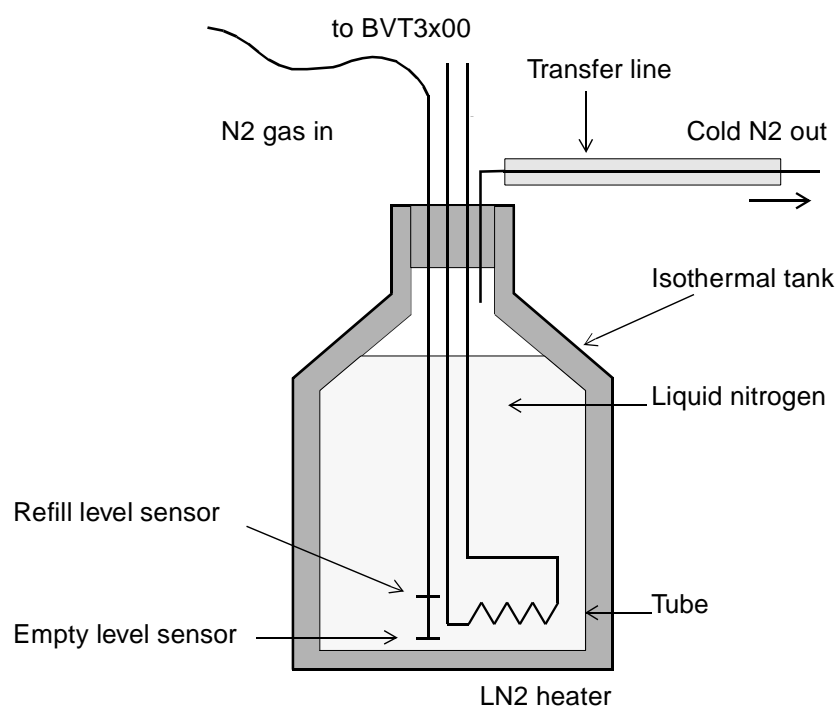


This device is a cold gas generator that allows low temperature sample regulation. The nitrogen gas is produced by evaporating the liquid nitrogen contained in an isothermal tank with an electric heater. The power delivered to the heater, controlled by software, may reach 200 Watts (38V on a 7 ohm heater). The cold gas is transferred to the probe trough a flexible transfer line.

For this option, a printed circuit is installed inside the BVT3300. This electronics controls the power applied to the LN2 heater and monitors the LN2 level in the tank.

Regulation accuracy is unchanged.

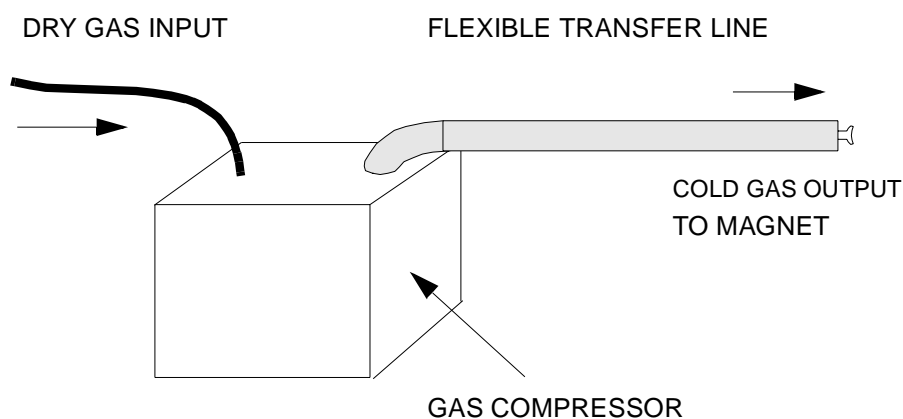
Figure 2.4. Evaporator principle



The BCU05 is a device that cools dry air or nitrogen gas. The device comprises a gas circuit with a gas compressor, an evaporator and a cooler. The nitrogen 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 output of the transfer line the gas temperature may reach - 40 °C.

The BCU05 has a cable that must be connected to the BVT3300 on the connector marked BCU05. When the 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 BVT3300 power is off.

Figure 2.5. BCU05 principle



BCU05

Configuration

3

Sensor selection

3.1

The BVT3300 can be used with three types of sensors:

- Thermocouple T (factory set)
- BTO2000
- PT100 sensor

⇒ **Warning: Never connect two types of sensors at a same time on the BVT3300.**

Eurotherm 847 configuration

3.2

The EUROTHERM 847 controller must be configured to work with the right type of sensor.

To access the configuration mode, a switch located inside the 847 controller must be closed.

⇒ **The switch must be closed only during the configuration mode.**

Proceed as follows:

- Switch off the main power.
- Unscrew the EUROTHERM controller front plate.
- Remove the module out of its cabinet.

The switch **WB1** is located on the left side at the rear of the module.

- Close the switch.
- Insert the controller module and screw the front panel.
- Switch on the main power.
- Press the button until «Sn» appears. («Sn» is the mnemonic for sensor). Then select the sensor type: press the up or down key until the correct sensor appears **"Eurotherm 847 sensor selection" on page 26.**

Table 3.1. Eurotherm 847 sensor selection

sensor type	Sn
T thermocouple internal CJC	t tc
BTO2000	t tc
Pt100	rtd3

If the sensor is a thermocouple or a BTO2000 you must select also the type of (Cold Junction Compensation). Press the par PAR key until CJC appears and select with the up and down key. See table **"CJC selection" on page 26.**

Table 3.2. CJC selection

sensor type	Cjc
T thermocouple	int (internal)
BTO2000	0 °C (external at 0 °C)
Pt100	X (don't care)

- When the configuration is finished, switch off the main power, remove again the controller and **open the switch.**

- finely close the controller and switch on the power supply.

Remote interface control

4

Microcontroller interface

4.1

This interface has several functions:

- Host computer - EUROTHERM transparent communication through a serial port
- Transmission of BVT3300 internal status to host computer.
- Probe heater on/off control
- Gas flow control.
- Installed option control:
 1. Evaporator heating power control.
 2. Exchanger control with nitrogen level detection.
- etc.

Optoisolated inputs receive informations and securities flags:

- Probe heater overheating flag.
- Gas flow detection.
- LN2 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 LN2 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 via the RS232 link.

Sram:

32 Kilobytes

Eeprom:

256 bytes for manufacturing informations storage (BBIS informations).

Interface:

- Serial link to EUROTHERM 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 2500 volt isolation between digital interface and power section.

Power supply:

+5 volt, I < 1 ampère.

Commands and communication protocol

4.3

All commands for the Eurotherm controller cross over the interface. The micro-controller decodes each received command and decides then for whom the command is intended (either for the interface itself or the Eurotherm controller). A command that is not an interface command is automatically transferred to the Eurotherm controller. If the command is processed by the Eurotherm, the 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 BVT3000.

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

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 <-> Eurotherm)
DL	X	X	reads the download transfer status/ initialises a download transfer
DT		X	DAC check (for test 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 LN2 heater power level
NP	X	X	reads / writes LN2 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 BVT3000
XR		X	transmit a hexadecimal record to the host

Rs232 link characteristics

4.6

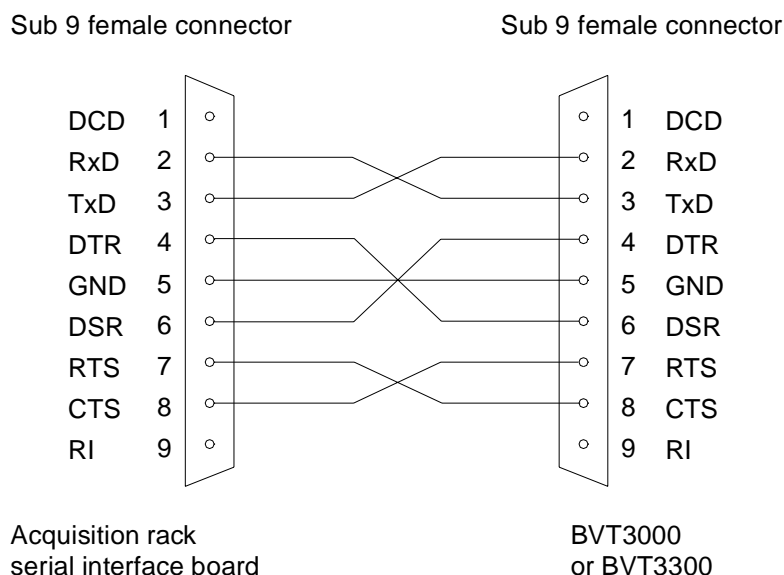
The serial link allows a host computer to communicate with the BVT3000. It is a three wires link with no hardware or software handshake. The communication parameters are 9600 bauds, 1 start bit, even parity, 1 stop bit. RS232 connector pin assignment and names are explained above in table "Rs232 connector pin assignment" on page 16.

Rs232 cable

4.7

A cable with two 9 pins female connectors is required to link the host computer to the BVT3000. The maximum recommended cable length is 10 meters (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 (LN2 evaporator or LN2 exchanger) and the devices connected on the front panel (exchanger or evaporator). The firmware authorises 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 unauthorised 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

COMMANDS	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 "***Flow rate versus command" on page 12*** shows the different gas flow deliveries.

Example: If ABCD is set to «1100» (12 decimal), The delivery corresponds to 1600 litres per hour.

NB: After power on the microcontoller reads 4 jumpers (JP6-JP8) located on the interface printed circuit. Each jumper can be switched between position marked «1» and «0». Each jumper represents a valve; in position «0» the valve will be closed. JP6 represents valve D and JP8 valve A. The initial flow rate is set according to the combination of all jumpers.

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 2.1." Flow rate versus command" on page 12*** shows the different gas flow deliveries.

Read

Syntax: EOT 0 0 0 0 CM ENQ

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

Description: The CM command starts a complete microcontroller ram test.

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

Write

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

Response: ACK

Description: CO command allows to program the Eurotherm - 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 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

NB: _ 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: It allows to read the Interface - Eurotherm communication speed.

Rules: «ABCDE» represent the baud rate. It is a 5 characters string. The string is can have the following values:

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

NB: _ represent the space character.

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 down-load. 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 down-load. If the download is in progress, a new one must be performed completely to make the BVT3X00 run correctly.
- «1» initializes down-load. The «DL1» command must be send twice to start the process (FLASH 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.

Syntax: EOT 0 0 0 0 DT state ETX BCC

Response: ACK

Description: DT starts a LN2 DAC test.

Rules: state can be «0» or «1».

1 means test on.

0 means test off.

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 happened 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, the user must send «ES» requests until response is «ES0».

The returned value «Val» inform about error. The different error codes are given below.

Write

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

Response: Always NACK.

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	erasetfail	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.

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 send 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).

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	LN2 refill	1 = refill LN2 tank
C4	7	LN2 empty	1 = LN2 tank is empty.
B1	8	evaporator status	1 = LN2 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 LN2 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 LN2 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.

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 LN2 heater ON.

«0» switch LN2 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 LN2 heater is ON.

State at «0» means that LN2 heater is OFF.

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

This port represents the main status of the BVT3000 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 = LN2 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.

The power level applied to the Ln2 evaporator is set by an analog control signal coming from a 8 bit DAC (Digital to Analog Converter). Port 2 provides the bits for LN2 control DAC:

Table 4.7. Port2 definition

BIT	NAME	FUNCTION
0	1LN2	DAC bit 0
1	2LN2	DAC bit 1
2	3LN2	DAC bit 2
3	4LN2	DAC bit 3
4	5LN2	DAC bit 4
5	6LN2	DAC bit 5
6	7LN2	DAC bit 6
7	8LN2	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 BVT3000.

It is composed as follows:

Table 4.8. Port3 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	ln2 refill	1 = LN2 tank is almost empty
7	ln2 empty	1 = LN2 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.

Port 4 allows to read the internal status of the BVT3000 and set the valves at power on.

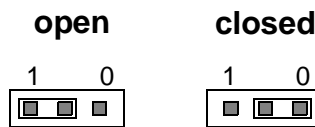
It is composed as follows:

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 JP9
5	V2	jumper JP8
6	V3	jumper JP7
7	V4	jumper JP6

When a jumper is placed in position 1 it means that the valve is open 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 **R B** adr_e2prom A1 A0 ETX BCC

Response: STX **R B** > D0 D1 ETX

NACK if command can't issue.

Description: RB command allows to read a single byte in a BBIS E2PROM

Rules: A1, A0 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: BVT3X00 motherboard address
- 2: BVTB3500 (Booster) address
- 3: Address unused
- 4: Address unused
- 5: Address unused
- 6: Address unused
- 7: Address unused

All other values generates a NACK response

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 : 02H53H56H30H31H32H33H35H02H37H

Ascii : STX'S"V"0"1"2"3"5'ETXBCC

It means: SOFTWARE Version 0.1

HARDWARE Version 2.3

OPTIONS 5

The different options identifications are defined as follows:

- '1' Thermocouple module option.
- '2': Ln2 Evaporator option.
- '3': Ln2 Evaporator option+ thermocouple module.
- '4': LN2 Exchanger option.
- '5': Ln2 Exchanger option+ thermocouple module.
- '6': Problem detected.

Write

Syntax: EOT 0 0 0 0 STX **W B** 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: A1, A0 are values from '0' up to 'F' representing the address in the E2PROM.

D1, D0 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: BVT3X00 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

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: ACK 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 down-load.

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 up-load process.

Val = 1: Initalizes the up-load process.

Val = 2: Autorizes the BVT3X00 to send the next record.

Val = 3: Ask the BVT3X00 to send the same record again.

The up-load process is initialized by receiving «XR1» from the host computer. The BVT3X00 sends the first Intel-hex record. The BVT3X00 waits then for «XR2» to continue. This command autorizes the BVT3X00 to send the next record. This handshake continues until the BVT3X00 sends the last record which is «0 0 0 0 0 0 1 F F». Host computer must detect it. Then, BVT3X00 sends an «XR0» requests to terminate up-load process and return to normal mode.

If BVT3X00 receives an «XR3» command, the previous record is send again.

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

Technical specifications

5

Specifications

5.1

Weight :

- 13 Kg for basic version without any option.

Dimensions :

- 484 (W) x 88 (H) front plate
- 446 (W) x 86 (H) x 500 (D) case

Voltage requirements :

- 220 V + / - 10%, 50/60 Hz

Power consumption :

- 250 VA maximum for standard version.

Inputs:

- Thermocouple type T with standard linearisation.
- Pt100
- BTO2000

Temperature stability :

- temperature controller : Eurotherm 902
- +/- 0.2 °C target temperature = room temperature +5 °C to 200 °C with T thermocouple.(Room temperature must not change by more than +/- 1°C).
- +/- 0.1 °C target temperature = room temperature +5 °C to 50°C with BTO2000.(Room temperature must not change by more than +/- 1°C).

Heater power :

192 W (48 V max. on 12 ohm probe heater with heater cable)

Gas inlet :

- 4 bars mini, 8 bars maxi (dry air or N₂ gas).

Gas flow rate :

- 200 l/h to 2000 l/h with 15 steps

Options

For regulation at low temperature following devices can be used:

- BCU05
- LN2 exchanger
- LN2 evaporator with 200 W heater power.

Security fuses

5.2

Some important electronic functions are fuse protected. To replace a blown fuse, turn off the BVT3000 and disconnect the main power cord. A faulty fuse must always be replaced with the same type.

Table 5.1. Fuses values

Fuses	Value	Protection for
F1	1 AT	+5 V digital
F2	6,3 AT	Heater resistor
F3	0,5 AT	+15 V analog
F4	0,5 AT	-15V analog
F5	0,5 AT	+24V valve block
F6	0,5 AT	+ 15 V BTO2000

Schematics

6

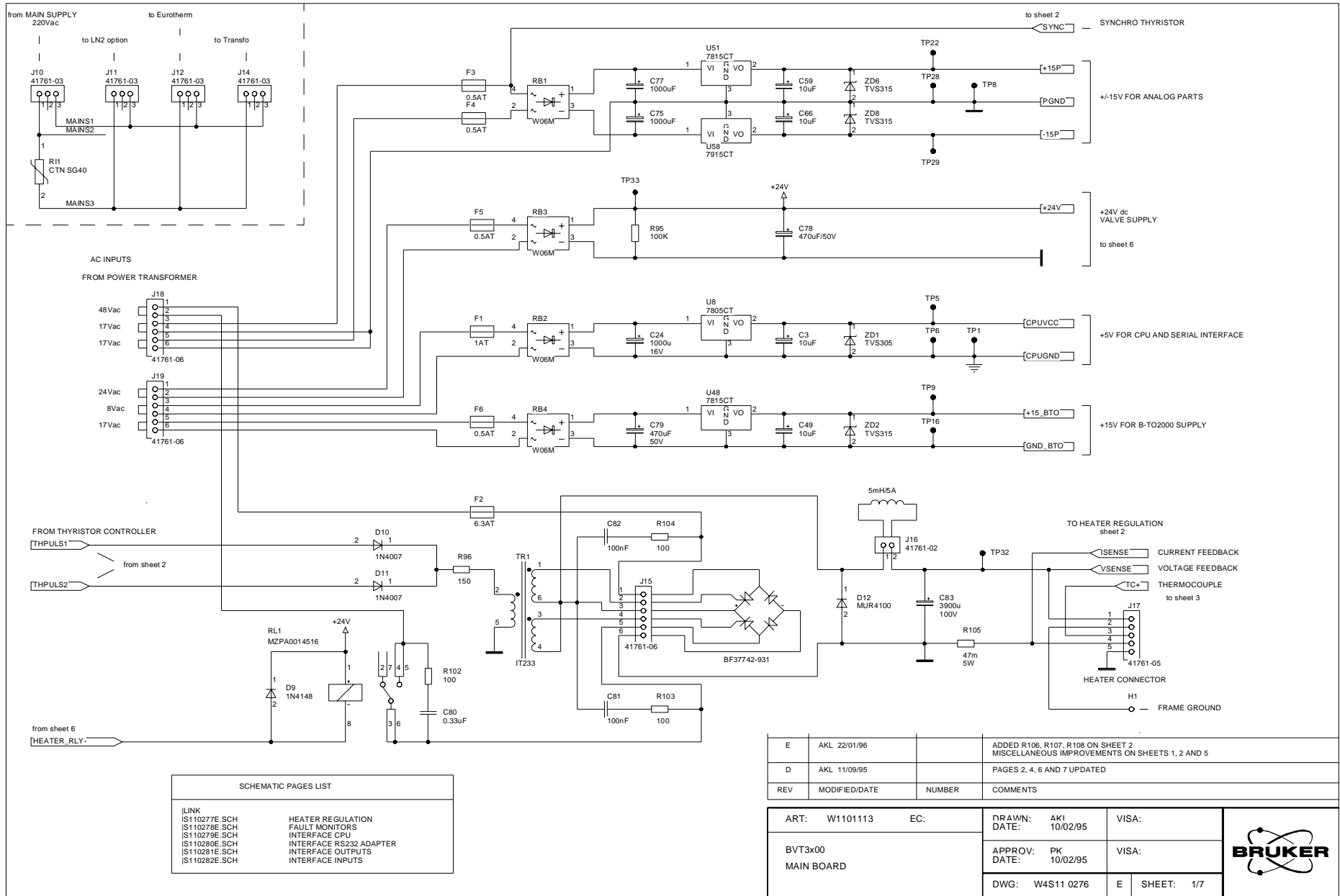
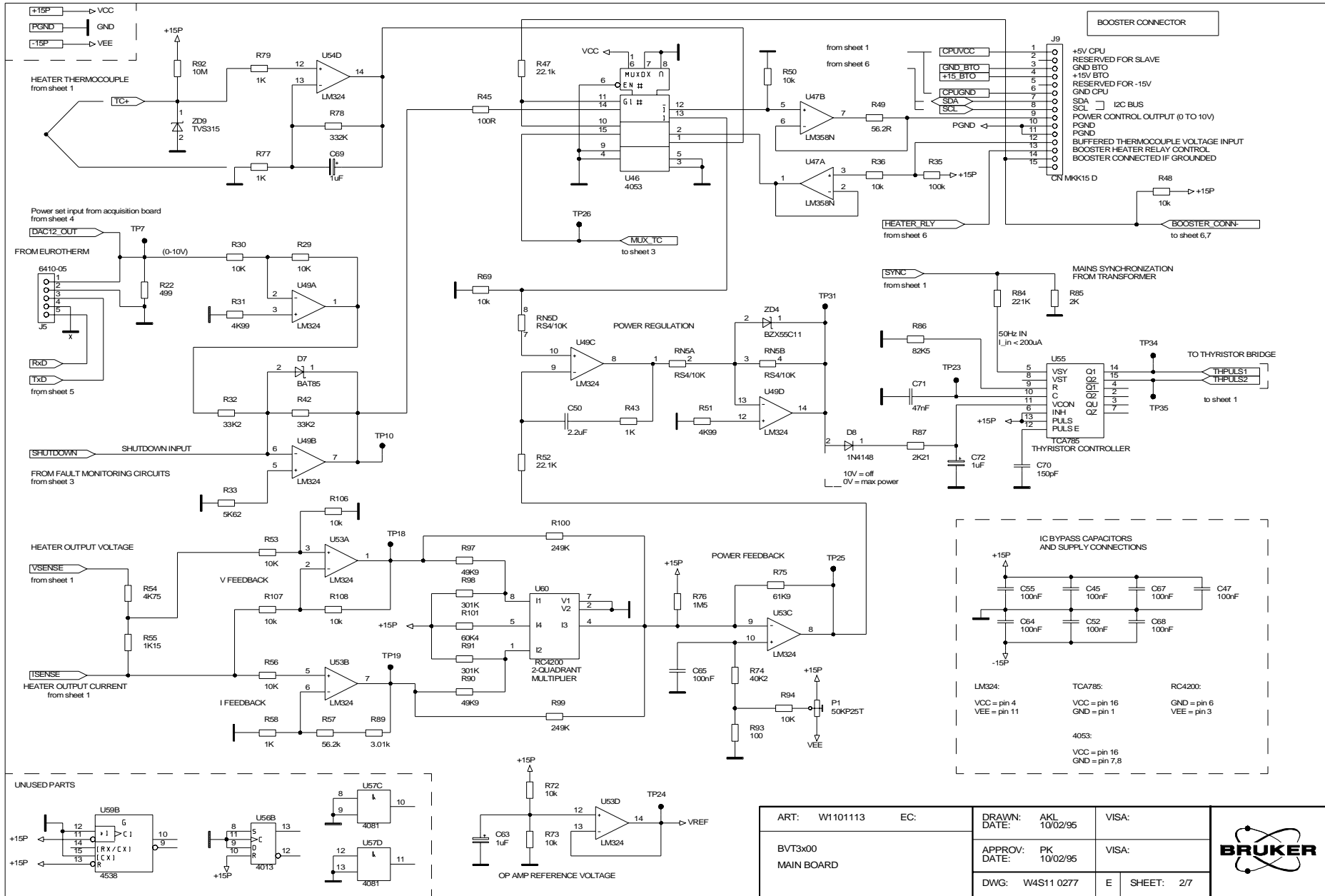


Figure 6.1. Main board sheet 1/7

SCHEMATIC PAGES LIST	
LINK	
IS110277E.SCH	HEATER REGULATION
IS110278E.SCH	FAULT MONITORS
IS110279E.SCH	INTERFACE CPU
IS110280E.SCH	INTERFACE RS232 ADAPTER
IS110281E.SCH	INTERFACE OUTPUTS
IS110282E.SCH	INTERFACE INPUTS

E	AKL 22/01/96		ADDED R106, R107, R108 ON SHEET 2 MISCELLANEOUS IMPROVEMENTS ON SHEETS 1, 2 AND 5
D	AKL 11/09/95		PAGES 2, 4, 6 AND 7 UPDATED
REV	MODIFIED/DATE	NUMBER	COMMENTS
ART:	W1101113	EC:	
BVT3x00 MAIN BOARD		DRAWN: DATE:	AK1 10/02/95
		VISA:	
		APPROV: DATE:	PK 10/02/95
		VISA:	
		DWG:	W4S11 0276
		E SHEET:	1/7





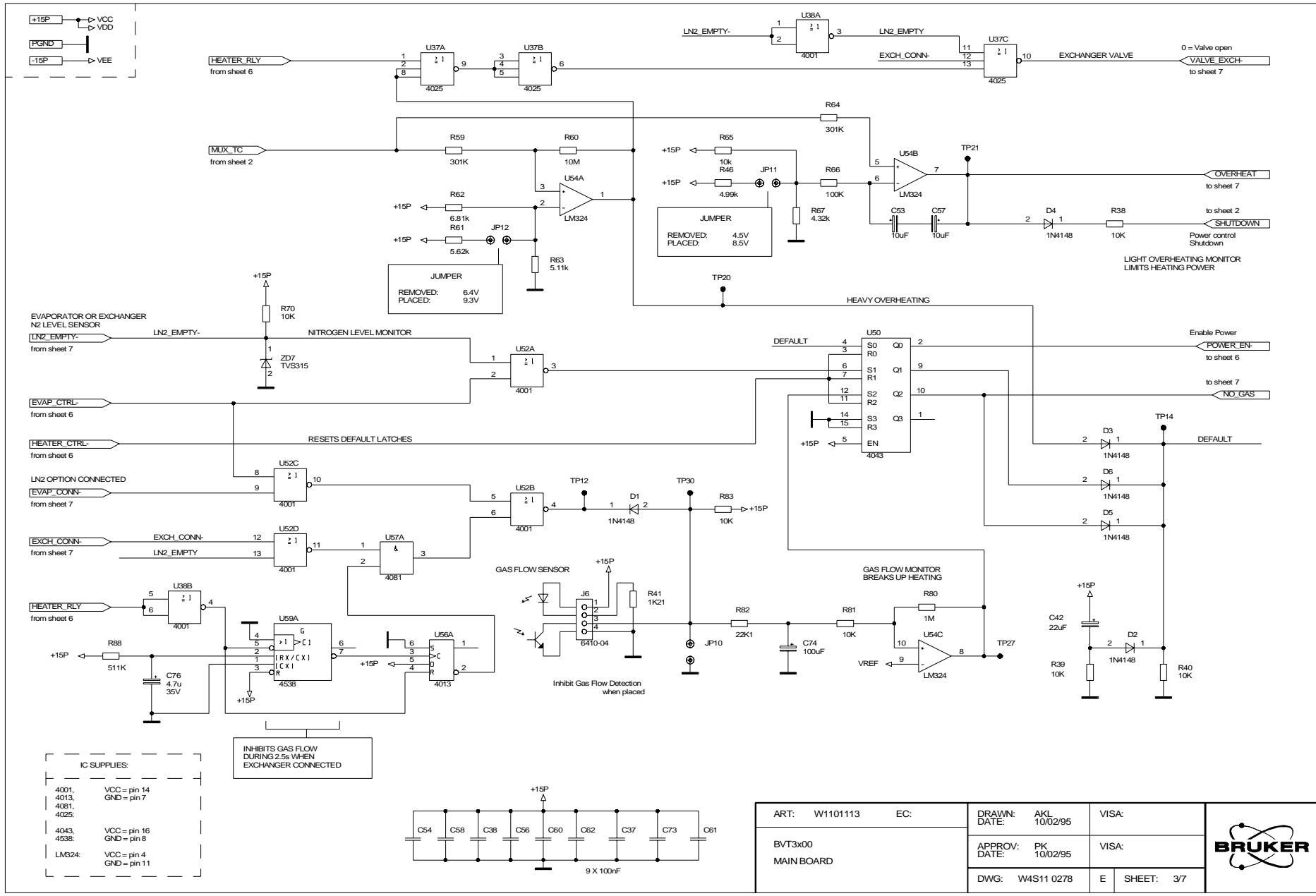


Figure 6.3. Main board sheet 3/7



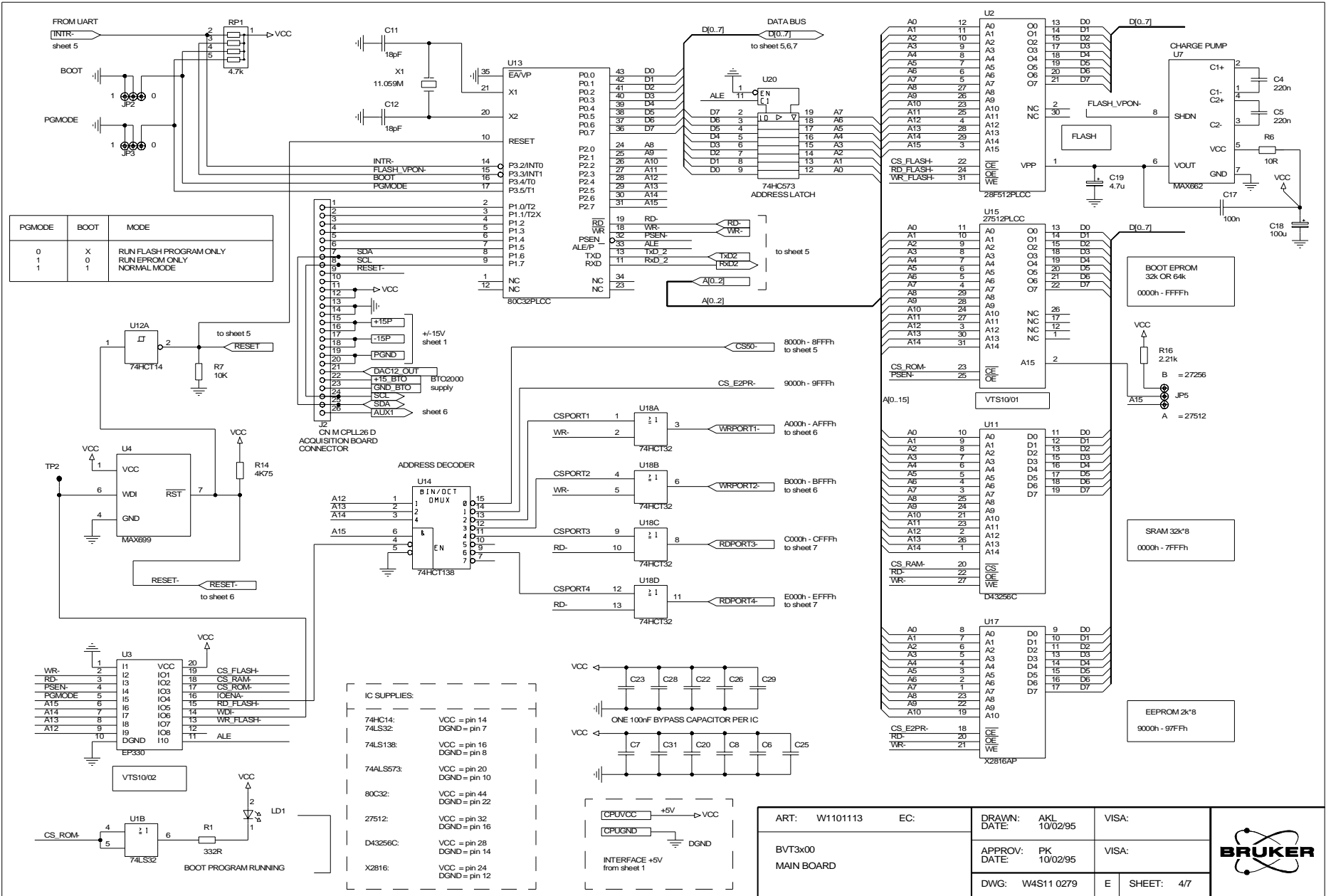


Figure 6.4. Main board sheet 4/7



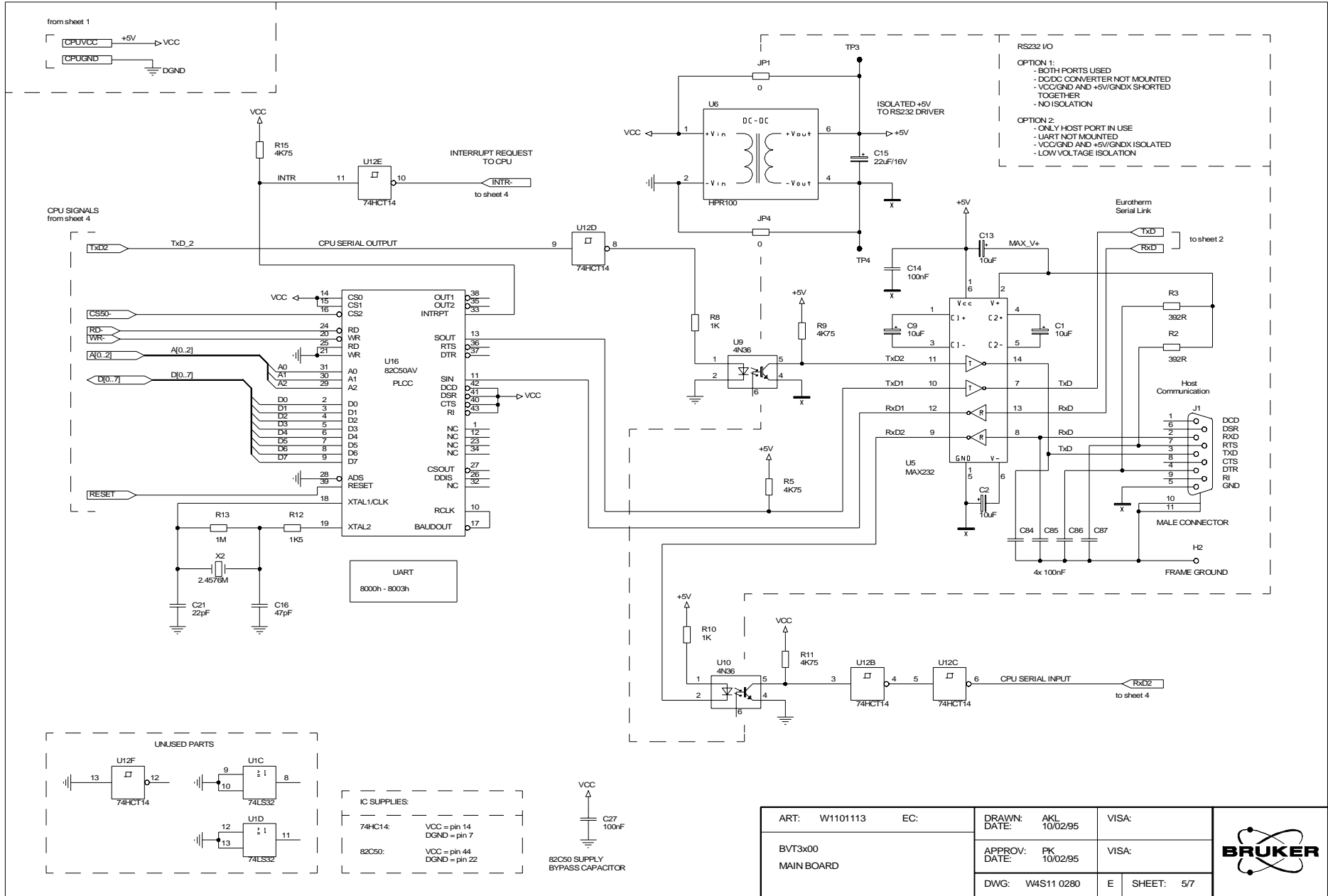


Figure 6.5. Main board sheet 5/7

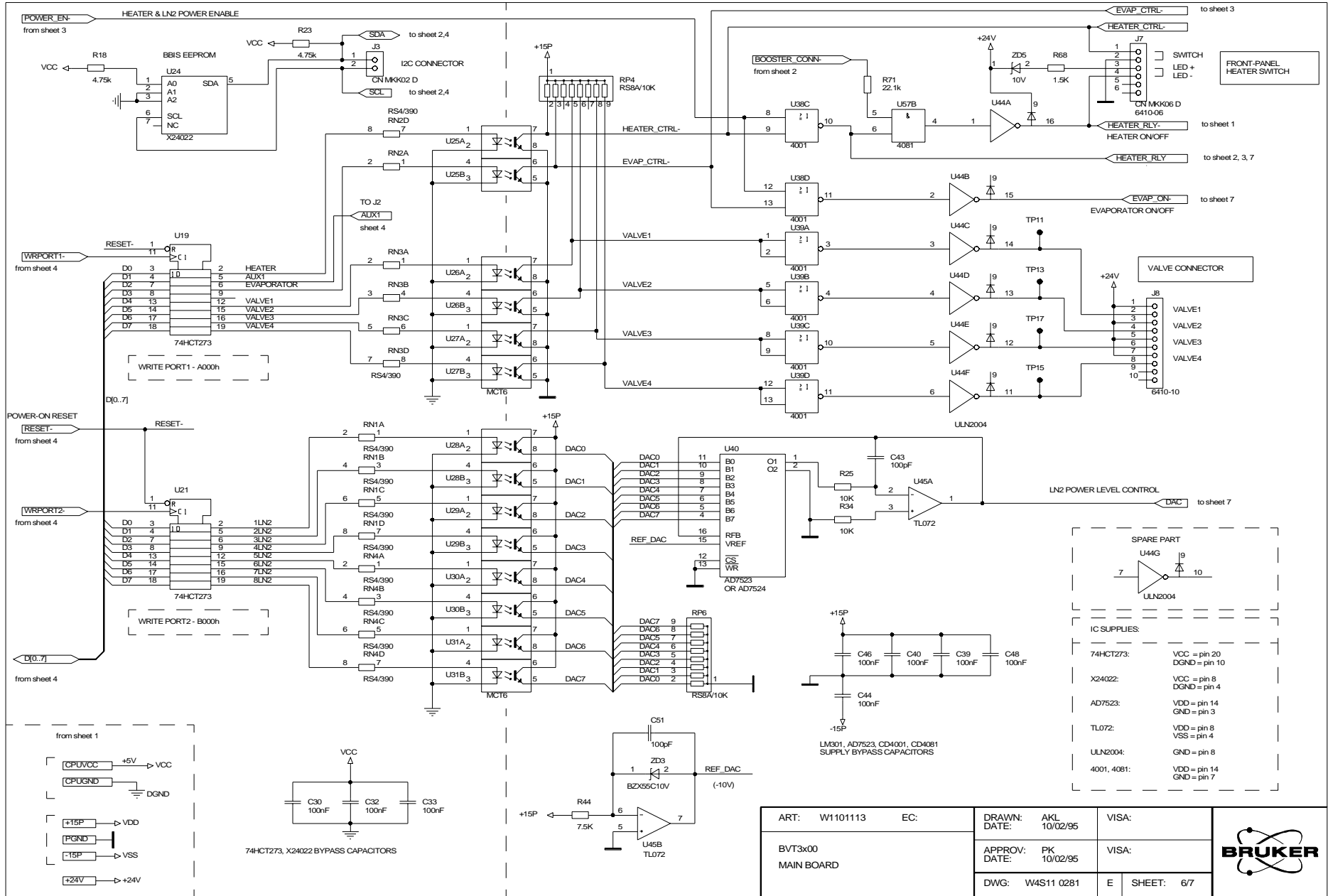


Figure 6.6. Main board sheet 6/7



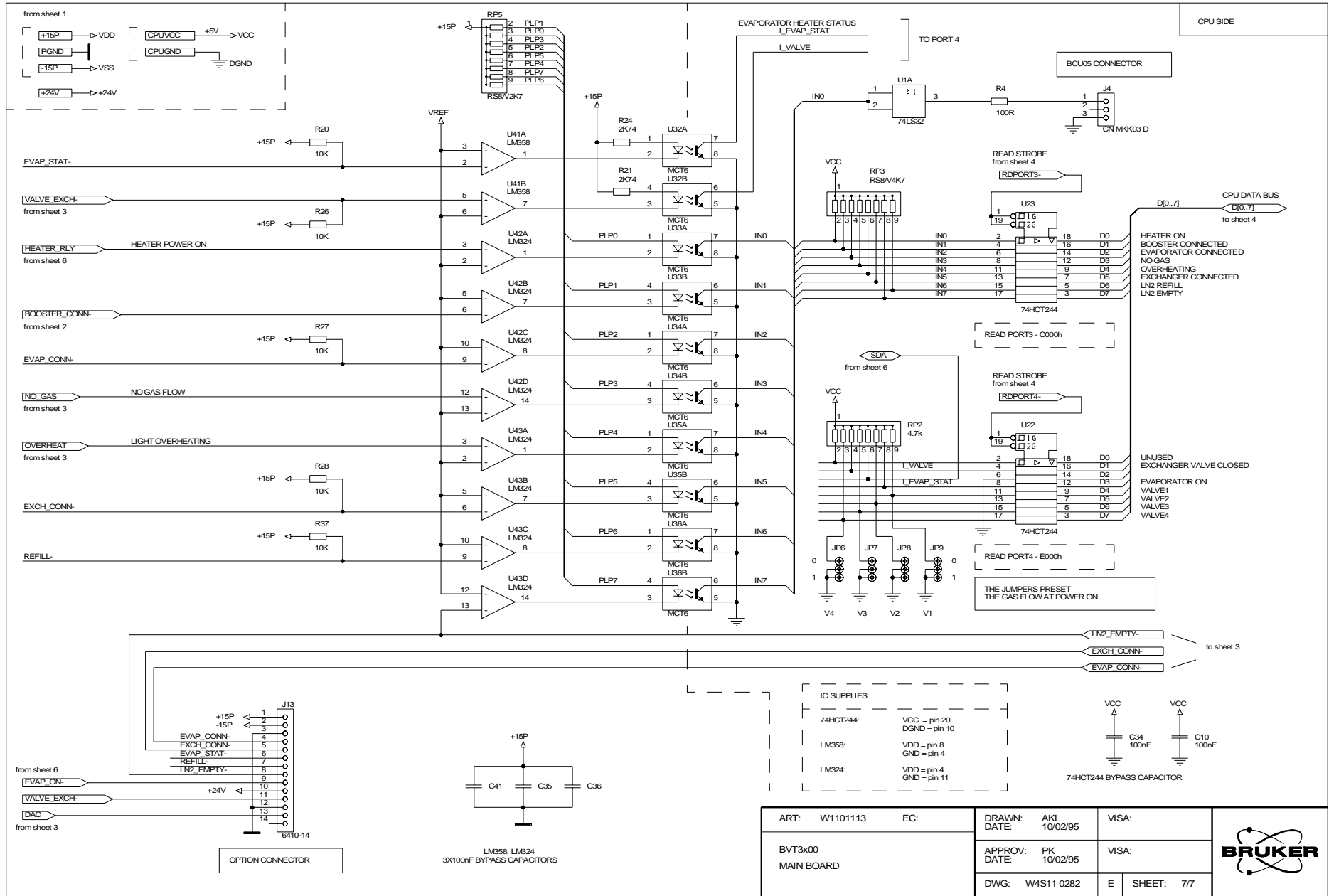


Figure 6.7. Main board sheet 7/7

ART: W1101113	EC:	DRAWN: AKL 10/02/95	VISA:
BVT3x00 MAIN BOARD		DATE: 10/02/95	VISA:
		APPROV: PK 10/02/95	VISA:
		DWG: W4S11 0282	E SHEET: 7/7



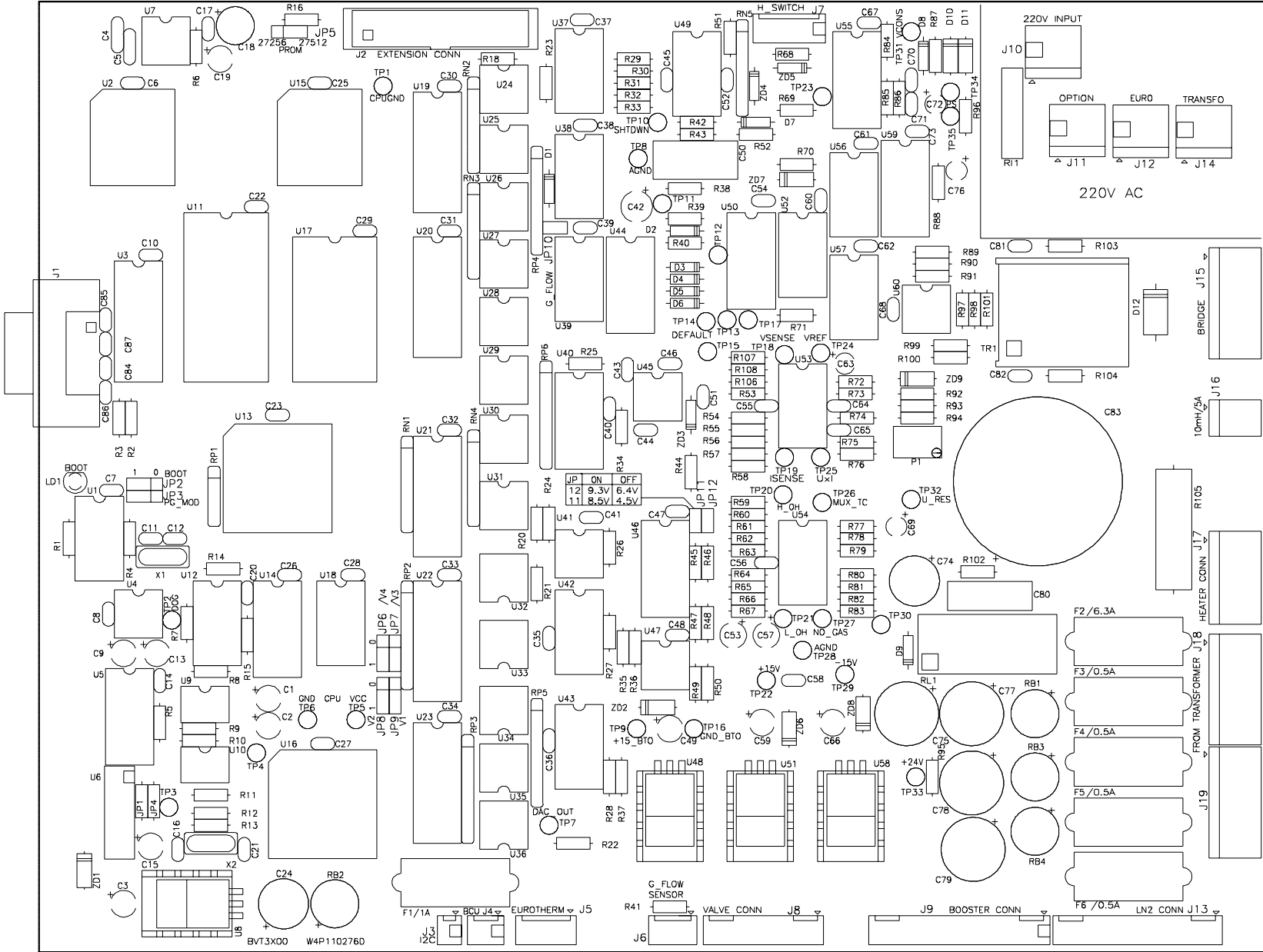



Figure 6.8. Main board layout

ART NR : W1101113	EC :	DRAWN : RC	VISA :
BVT3X00		DATE : 24/01/96	
MAIN BOARD		APPROV : PK	VISA :
CI :W4P110276D		DATE : 24/01/96	
DWG NR :W4L110276 D			SHEET : 1 / 1



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