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Operating and Maintenance Handbook

RESISTIVE HEATER CONTROLLER RHC



REVISION	DATE	COMMENTS	INITIALS
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WARRANTY

1. Subject to fair wear and tear and the due, observance of any installation user, storage, operating or maintenance instructions the Seller undertakes to replace or, at its option repair free of charge to the purchaser, any goods which the purchaser can establish are defective by reason of defective workmanship or materials which are returned to the Seller, carriage paid, within 12 months of the date of dispatch by the Seller. In the event, however, that the Seller supplies spare parts either direct, or that are fitted or installed or replaced by the Sellers' service center such spare parts will be subject to a warranty period of six months only.
2. The Purchaser cannot return any product for warranty repair without the prior approval of VACGEN and the issue of a Goods Return Number (GRN). This shall be obtained by contacting the service center at VACGEN. All returned products must be accompanied by a completed Declaration of Contamination form. Customers must, in the first instance, contact the local selling agent.
3. We reserve the right to decline to service equipment, we consider is in any way hazardous until a clearance or safety certificate, in a form satisfactory to VACGEN, has been completed and returned by the customer.

REPAIR

The following additional terms and conditions apply in the event that the customer elects to use the services of VACGEN workshop on a chargeable basis.

1. At its own cost the customer shall dispatch the equipment to the workshop, carriage paid, suitably packaged, protected and insured, bearing, a Goods Return Number (GRN) and a completed Declaration of Contamination certificate obtained from VACGEN in advance of shipment.
2. During the period that the equipment is on VACGEN premises, VACGEN will insure the equipment against all risks.
3. Vacuum Generator will provide an acknowledgement of the receipt together with an estimate of the repair charges. Such estimates are carried out on a visual basis and are therefore intended as a guide only. Formal fixed price repair quotations are available and involve the disassembly of the equipment to determine the full extent of the work necessary to restore the equipment to an acceptable standard. In the event that the customer chooses not to proceed with the repair VACGEN will make a charge to cover this examination effort.

Note:

The above are extracts from VACGEN Conditions of sale. Complete copies can be obtained from: VACGEN, Maunsell Road, Castleham Industrial Estate St. Leonards on Sea, East Sussex, TN38 9NN, United Kingdom.

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1. INTRODUCTION

HEALTH AND SAFETY INFORMATION

This equipment is a component for use with vacuum systems. Whilst every effort has been made to eliminate hazards, its safe use is also dependent on the system to which it will be connected.

The owner of the equipment must ensure that all users are aware of the Health and Safety information contained in this handbook. If the equipment is sold or passed to another owner, this handbook must be included with the equipment. If in doubt contact VACGEN.

Warning: This equipment must be installed by qualified personnel.

Warning: Never operate the RHC with any of the covers removed.

Warning: Servicing must only be carried out by qualified personnel who are aware of the potential risks of working with live equipment.

Warning: The front panel mains switch should not be relied upon to provide adequate isolation from the mains supply for servicing or maintenance purposes.

Warning: Safe disposal of the equipment is the responsibility of the user.

Warning: It is the responsibility of the user to fit emergency stops to automated equipment.

Warning: Equipment must be fully earthed to prevent dangerous electrostatic charge build-up.

1.1 INTRODUCTION

The RHC is an accurate and simple to use heater temperature controller with user definable facilities. It is constructed to be robust and has an optional communications facility. The RHC has been developed primarily for use with in-vacuum heating elements such as the HST or XL heaters produced by VACGEN. The unit is 3U high, full rack width, and is compliant with relevant EU directives.

The RHC can be used for a range of heating elements which include but is not limited to: HST, EBH, XL09, XL25, and CTPO POD. See section 3.0 for individual settings.

1.2 FEATURES

1.2.1 Cables

The RHC is supplied as standard with a mains cable assembly, suitable for local use, requested at the time of ordering the unit.

Caution: The fuse in the supplied mains cable assembly is designed to protect the cord set only. You must ensure that the mains input fuse to the RHC is of the correct type and value for your territory.

Output cable and thermocouple compensating cable assemblies are included to connect the RHC to VACGEN vacuum feedthroughs. A connector kit is provided for the process trip facility. See Section 2.2 for the appropriate cable type.

The RHC must also be earthed via the rear panel stud provided, use 2.5mm² cable or braid connected to your system 'star-point' earth.

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1.2.2 Output

The maximum output voltage may be selected as 15, 30 or 60Vac up to a maximum current of 5A. This covers standard VACGEN heater types and temperature ranges, and any other heater assembly with requirements that match the power (VA) limits. The maximum output current can be set to protect heater filaments from excess current, or used directly as an output level control.

1.2.3 VACGENcouple

Most thermocouple types can be accommodated with automatic cold-junction compensation. The RHC will usually be configured for 'K' or 'N' thermocouple types; other types are available as an option. The thermocouple type and range is software selected, all that needs to be added is the correct type of compensation cable and connectors. Your EBHC will have been configured to the thermocouple type requested at the time of ordering.

1.2.4 Temperature Controller

In normal operation the temperature controller will display actual and target temperatures (whether or not set point ramp-rate or self-tune is involved) or indicate if the temperature sensor has failed. In the full configuration mode, all parameters and values can be viewed and edited.

Control can be PID, PI, PD, P only or ON/OFF, with values automatically set or manually entered. A front panel control allows the operator to switch between two pre-programmed set points. The output power level is programmable if the sensor fails.

For processes where the maximum temperature must not be exceeded, the ramp-rate facility allows the user to define the temperature rise in programmed units (per second, minute or hour). A self-tuning algorithm automatically sets the PID and the under and overshoot values.

An RS485 communications package can be added at time of purchase or retro-fitted. This package (part code ZEUCOMMS) also includes software, making external control extremely powerful and simple to use.

1.2.5 Process Trip

A process trip facility has been added to protect the heater assembly; for example, to maintain the overall system pressure within limits, or referenced to some other process. If the trip facility is not required, then leave the supplied trip connector unwired. Implement the trip facility by wiring the supplied connector (See Installation section 2.2) and fitting to the RHC 'Process Trip' connector. External control should be a N/O (normally open) contact that on closure will suspend RHC output until the process parameter is within the operating limits. The external process should set any required trip hysteresis.

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1.3 SPECIFICATIONS

Mains Voltage	230Vac, +/- 10%, 50/-60Hz or 110Vac. 50/60Hz
Power Consumption	350VA
Output maximum	15, 30 or 60Vac @ 5Amps
Temperature Controller:-	
Type	Eurotherm 2408
Sensor Types	K or N as standard, others as options
Sensor Ranges	K -200°C to + 1372°C N -250°C to + 1300°C For others, consult Eurotherm handbook
Cold Junction	Automatic compensation, typically >30 to 1 compensation rejection of ambient temperature change
Sample Rate	9Hz
Accuracy	0.25% of reading +/- LSD or +/- 1°C or °F
Control Mode	PID, PI, PD, P ONLY or ON/ OFF
Ramp Rate	0.01 to 99.99 degrees/second, minute or hour
Tuning	One-shot self-tune algorithm
Sensor Fail	Output programmable between 0-100%
Communications	RS232 or RS485. 1200, 2400, 4800, 9600 or 19200 baud Modbus, Bisyncor SPI
Display	Dual 4-digit x 7 high intensity LED
Front Panel Controls	Illuminated mains ON/OFF, OFF/SPI/SP2 switch, process current limit, temperature controller
Rear Panel Input	Overall output current limit, heater output, thermocouple input and communication, process trip,
Indicators	Output current analogue meter, process trip active LED, output voltage settings LEDs
Temperature Controller	
Fusing - Rear Panel-	
Mains Input	FS3, 230Vac,2.5A (delay) 20mm, HRC 110Vac, 5.0A (delay) 20mm, HRC
Temp Controller	FS4, 1.0A (delay) 20min. HRC
Process trip	FS1, 100mA, (fast), 20mm glass
Output	FS2, 6.3A FF(very fast), 20mm HRC
Environmental-	
Operating Temp	+5°C to +40°C
Storage	-10°C to +70°C
Relative Humidity	5% to 85% RH

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General Non-explosive atmosphere. Electrically conductive pollution to be excluded from the cabinet

Dimensions-

Height 3U, 134mm
Width 19 inch, full rack mounting
Depth 370mm, excluding mating connectors
Weight 10kg

EMC and Safety Standards - Compliant with relevant EU directives

2.0 INSTALLATION

2.1 GENERAL

Warning: This equipment must be installed by qualified personnel

Warning: This equipment must be earthed

For optimum performance the RHC should be operated in a clean, dust-free environment and not be exposed to elevated ambient temperatures, toxic, corrosive, explosive, biological, or radioactive contamination, or any other harmful substances. The integrity of the unit case, operating controls and cables should be maintained in a good condition as degradation may jeopardize compliance with EU directives - as may any end-user modifications.

Connect the mains supply to the unit with the supplied molded mains cable assembly (IEC connector to local plug

The EBHC is supplied set to the mains input voltage requested at the time of ordering. If this is incorrect, please contact VACGEN Sales Department. We do not recommend that users change the mains input voltage setting.

Caution: the fuse in the supplied mains cable assembly is designed to protect the cord set only. You must ensure that the mains input fuse to the RHC is of the correct type and value for your territory.

A separate earth stud is provided on the rear of the unit. This should be connected to the system 'star-point' earth, using 2.5mm² cable or braid.

Connect the heater output from the RHC to your vacuum system with the supplied cable assembly.

Connect the VACGENcouple input from the RHC to your vacuum system with the supplied cable assembly.

2.2 PROCESS TRIP CONNECTION

Connection for the Process Trip are as below.

Pin(1) 24Vac protected by FS1

Pin(2) 0V relay coil

Use 0.5mm² screened, and overall sheathed cable. The screen connections should be made at the vacuum feedthrough

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2.3 COMMUNICATIONS CONNECTIONS AND CABLE

Communications are via the rear panel 25-way 'D' connector. Use a twisted pair cable, overall screened, with bleed wire and connect as below.

2.3.1 RS232: 25-Way Connector terminal

Pin	Eurotherm Terminal	Function
1		RHC 'starpoint' earth
2	HF	Tx
3	HE	Rx
7	HD	Common

2.3.2 RS485: 25-Way Connector

Pin	Eurotherm Terminal	Function
1		RHC 'starpoint' earth
2	HF	B(-)
3	HE	A(+)
7	HD	Common

2.4 TEMPERATURE CONTROLLER SETTINGS

(for software level V3.06 or greater)

Refer to the Eurotherm handbook and to figure 1, in coalition with the following sections-

2.4.1 Controls and Displays

Button/Indicator	Function
Output 1	Illuminates when output is active. Power will be supplied to the heater if the front panel output switch is on SP1 or SP2 and the Process Trip is not active.
Output 2	Output 2 is not used on the RHC.
Setpoint 2	Illuminated when SP2 selected
Remote Setpoint	Not used on the RHC.
Auto/Manual	Toggles between auto and manual mode. Disabled in standard RHC configuration.
Run/Hold	For use with programmer version controller, Not used in the RHC.
Page	Press to select a new list of parameters.
Scroll	Press to select new parameter in list.
Down	Press to decrease parameter value in lower readout.
Up	Press to increase parameter value in lower readout.

Display	Displayed Parameter
Upper Readout	Measured temperature, process value, list header or parameter name.
Lower Readout	Setpoint or parameter value.

2.4.2 Home Screen

This is the temperature controller screen that you will normally see. This will indicate whether or not the controller output is ON, its measured temperature, the setpoint temperature, the ramp rate target temperature (if selected), and any other parameter lists and promoted parameters which can viewed and adjusted using the Page, Scroll and Up/Down buttons. If desired parameter is not available in the lists, refer to the following sections on access levels and editing.

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Note. If no key is pressed for 45 seconds when in Operator, Full or Edit modes, the display returns to the Home screen.

2.4.3 Access Levels

The Eurotherm temperature controller has four access levels as described below:-

Level	Display	Description	Password
Operator	OPEr	User can view and adjust parameters defined in Edit level	No
Full	FuLL	All parameters relevant to the configuration. are visible. All alterable parameters can be adjusted.	Yes
Edit	Edit	All parameters can be hidden or revealed, made alterable or read-only, these are then available in Operator level.	Yes
Configure	conF	Sets up the fundamental characteristics of the controller.	Yes

The RHC will be supplied in Operator level, with all parameters relevant to the requested specification readable and alterable. Refer to the section below for Configuration and Edit levels set-up. Only change to Full level if you are completely conversant with the function of each parameter, and where there is no risk of tampering.

The procedure for entering passwords to gain entry to the different access levels is as follows:-

With the RHC powered-up, press the Page button until the display shows-

ACCS
LiST

then press the Scroll button. The display now shows:-

code
0

Enter the main access password (which is factory set to 1), using the Up-arrow button. After a short interval, the display blinks and shows:-

codE
PASS

Now press Scroll button; the display shows:-

Goto
OPEr (or last access level used)

Use the Up or Down buttons to change lower display to access the level required. This can be OP Er (Operator), FuLL (Full), Edit (Edit) or Conf (Configuration). The selection has been accepted when the display blinks.

If Conf is selected, press the Scroll button. The display now shows:-

ConF
0

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Now enter the Configuration password (which is factory set to 2), using the Up arrow button. After a short interval display blinks and shows: -

ConF
PASS

Use the Page button to select the parameter list required, the Scroll button to access the particular parameter within a list, and the Up/Down buttons to set required value. When in Conf, use the Page button until screen shows: -

Exit
no

and use either arrow button to set YES. After a short delay the controller returns to the Home screen and the new configuration is saved.

2.4.4 Factory Configuration Setup

Below are the factory configuration settings for the Eurotherm temperature controller, which determine the fundamental characteristics of the RHC. Refer to Section 2.4.3 for instructions on how to access this Configuration level. The list is mainly for information as a reference back-up, and will not normally need to be changed. The configuration settings are set via the 'ConF' access level (see access level selection above). Some of the parameters are not used, or are not active, in the RHC specification, but are all listed.

Caution: Great care should be exercised when changing configurations. Consult the Eurotherm manual.

List	Parameter	Setting	Description
inST	CTRL	Pid	PID Control
	Act	rEV	Control action, reverse acting
	COOL	Lin	Linear cooling type
	ti.td	SEC	Integral and derivative units, seconds
	dtyP	PV	Derivative type, process variable
	m-A	diSA	Manual button disabled
	r-h	diSA	Run/hold button disabled
	pwrF	OFF	Power feedback off
	Fwd.t	nonE	Feed forward type, none
	Pd.tr	no	Bumpless auto/manual transfer, no
	Sbr.t	Sb.OP	Sensor break, go to pre-set level
	FOP	no	Forced manual output, no
	Bcd	nonE	BCD input function none
	GSch	no	Gain schedule enable, no
PV	unit	oC	Instrument display units
	dEc.P	nnnn	No decimal points in display
	rnG.L	-200(k) OR -250(n)	Low setpoint limit
	rnG.H	1200	High setpoint limit
	OFS.H	0.0) Do not assign values

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	OFS.L	0.0)
iP	inPt CJC	k.tc OR n.tc Auto	VACGEN couple input Automatic cold junction compensation
	imP	Auto	Sensor break impedance (factory set)
SP	nSP	2	Select number of setpoints
	rm.tr	OFF	Remote tracking
	m.tr	OFF	Manual track
	rmP.U	Pmin	Setpoint rate limit units, per minute
	rmt	nonE	Remote setpoint, disabled
AL	AL 1	OFF	No alarm, 1
	Ltch	no	No latch, 1
	bLoc	no	No blocking, 1
	AL 2)	
	AL 3)	As above. No alarms fitted to EBHC as standard
	AL 4)	

List	Parameter	Setting	Description
PROG	PtYP	nonE	Programmer disabled
LA	id Func	LoG.i SP.2	Logic input Setpoint 2
LB	id Func	Log.i nonE	Logic input No logic input function
HA	(when fitted with a comms. Module)		
	id	cmS	EIA-232 or EIA-485
	Func	EI.bi	Eurotherm Bisync protocol
	bAud	9600	Baud rate
	deLy	no	No delay
HA	(no module fitted)		
	id	none	No module fitted
	Func	none	No function
JA	(As HA)		
IA	id	dC.OP	Module 1, DC output
	Func	HEAt	Heating output
	VAL.H	100	Output high %
	VAL.L	0	Output low %
	unit	voLt	Voltage output
	Out.H	5.0	Output voltage high

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2A	Out.L id Func	0.0 nonE nonE	Output voltage low No module fitted No function
3A	As 2A above		
CAL	cAL	nonE	No comms fitted
PASS	ACC.P cnF.P	1 2	Access password Configuration password
Exit	YES/NO		Exit configuration

2.4.5 Factory Edit Setup

The edit access level is a factory set up as shown below. Refer to section 2.4.3 on how to access the Edit level. In the following, ALtr = Alterable, HIde = Hidden and PrO = Promoted (to operator level).

List	Parameter	Settings
AL (Alarms)		HIde
Atun (Autotune)		ALtr
	Atun	ALtr
	drA	HIde
	drA.t	HIde
	Adc	HIde
Pid (PID)		ALtr
	SEt	ALtr
	Pb	ALtr
	ti	ALtr
	rES	HIde
	td	ALtr
	Hcb	ALtr
	Lcb	ALtr
	Pb2	ALtr
	ti2	ALtr
	td2	ALtr
	rES.2	HIde
	Hcb2	ALtr
	Lcb2	ALtr
SP (Setpoint)		ALtr
	SSEL	HIde
	SP 1	ALtr
	SP 2	ALtr
	SP H	ALtr
	SP L	ALtr



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SP2.H ALtr
 SP2.L ALtr
 SPrr PrO
 Hb.tY HidE

IP (Input)

rEAD
 FiLt ALtr
 CAL HidE
 CAL.S HidE
 ADJ HidE
 OFS.1 HidE
 mV.1 HidE
 CJC.1 HidE
 Li.1 HidE
 PV.SL HidE

oP(output)

rEAD
 OP.Hi ALt
 OP.Lo ALtr
 Opr ALtr
 CYC.H HidE
 Ont.H HidE
 Sb.OP ALtr

CmS (communications)

rEAD (only if fitted)
 Addr ALtr

inFo(Information)

rEAD
 diSP ALtr
 LoG.L HidE
 LoG.H HidE
 LoG.A HidE
 LoG.t HidE
 LoG.v HidE
 RES.L HidE
 MCT HidE
 w.OP HidE
 POP HidE
 IOP HidE
 dOP HidE

ACCS(Access) LIST

codE PASS
 Goto Use arrow buttons to go to new access level

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2.4.6 Factory Operator Setup

Having configured the fundamental characteristics and edited parameters to those that are necessary, the RHC will have the following value/conditions factory set. From the Home display, press the Page and Scroll buttons in turn to display the following list, and the values and conditions that have been assigned. These values and conditions are alterable using the Up/Down buttons in the ranges shown. Refer to section 2.4.4 for range units, where applicable.

List	Parameter	Setting (Range)
Atun (Autotune)	tunE	OFF (ON/OFF)
Pid(PID)		
Select PID ½	SEt	Pid.1
Proportional Band 1	Pb	xx values set by factory
Integral Time 1 ti		xx test auto-tune
Derivative Time 1	td	x
Cutback High 1 Hcb		Auto
Cutback Low 1 Lcb		Auto
Proportional Band 2	Pb2	85
Integral Time 2 ti 2		30
Derivative Time 2	td2	5.0
Cutback High 2 Hcb2		Auto
Cutback Low 2 Lcb2		Auto

SP(Setpoint)

Setpoint 1	SP1	20
Setpoint 2	SP2	20
Setpoint Maximum 1	SPH	1200
Setpoint Minimum 1	SPL	-200 (-250)
Setpoint Maximum 2	SP2.H	1200
Setpoint Minimum 2	SP2.L	-200 (-250)
Setpoint Ramp rate	SPrr	OFF

iP (input)

Input Filter T/C	FILT	1.6
------------------	------	-----

oP (Output)

High Power Limit	OP.Hi	100.0
Low Power Limit	OP.Lo	0.0
Output rate Limit	OPrr	OFF
Sensor Break Output	SB.OP	0.0

ACCS(Access) As previously described

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3. OPERATION

When switched on, the Eurotherm temperature controller will perform a self-test prior to displaying the Home screen. Use the supplied output and thermocouple cable assemblies to connect the RHC to the vacuum feedthrough. Ensure that the in-vacuum thermocouple is of the same type as the supplied cable, as gross errors will result from a mismatch. Observe the instructions for the heater being used. In particular, ensure that the thermocouple is positioned correctly to avoid temperature overshoots that may permanently damage the heater.

Warning: The thermocouple junction can rise to a high potential if isolated from ground. Avoid contact with the thermocouple vacuum feedthroughs if the junction is not at ground potential.

Warning: Never operate the RHC with any of the covers removed.

3.1 STANDARD RHC MODELS

3.1.1 Setting Maximum Output Voltage and Voltage Indication

Remove all power to the RHC by disconnecting the main input lead. Set the front panel current limit potentiometer fully counterclockwise and the setpoint switch to OFF. Remove the unit top cover. The available options are 15, 30 and 60 Vac. Connect the links as described below for the required output voltage setting and front panel voltage indication.

Terminal Block Numbers

From	To	Voltage
10	9	15Vac output
10	13	Indicator
10	8	30Vac output
10	12	Indicator
10	7	60Vac output
10	11	Indicator

For each voltage setting there are two connections, as shown above. Both of these must be made to ensure correct operation of the RHC. After setting the correct voltage, replace the top cover ensuring that the earth connection is secure.

3.1.2 Setting a Maximum Output Current

This procedure sets the maximum current that can be applied to the heater filament. The heater temperature will rise during the setting of the current limit and it is therefore best to set the current limit starting from a low (or ambient) temperature.

Note: The RHC will have been factory set for a maximum current of 3A. If this is suitable for your process, do not adjust the rear panel current potentiometer setting.

Initially set both the front and the rear panel current limit potentiometers fully counterclockwise. Switch to the Setpoint 1 position and slowly rotate the front panel potentiometer fully clockwise. In this position the maximum output current will be approximately 1A, this being the lowest overall output current that can be set. If this is adequate for your process, then leave the rear panel potentiometer at this setting. If more current is required, rotate the rear panel potentiometer (clockwise) until the desired output current is indicated on the front

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panel meter. Leave the rear panel potentiometer at this setting and lock the knob; then rotate the front panel potentiometer fully counterclockwise (minimum setting).

1.1.1

1.1.2 HST

3 amps maximum, 2.75 amps continuous.

90 watts maximum, 80 watts continuous.

Voltage 30 volts.

Temperatures above 900°C should only be run for short periods, i.e. 1 minute.

Filament, 0.9 to 1.5 ohms.

Insulation, >20 meg ohms @ 500 volts.

1.1.3 EBH

2.75 amps maximum, 1.9 normal running.

Voltage 30 volts.

Temperatures above 900°C should only be run for short periods, i.e. 1 minute.

Filament, 0.9 to 1.5 ohms.

Insulation, >20 meg ohms @ 500 volts.

1.1.4 XL09

3 amps maximum.

Voltage 30 volts.

Filament wire, 0.3 estimated.

PBN Heater, 17 ohms.

Insulation, >20 meg ohms @ 500 volts.

1.1.5 XL25

3 amps maximum.

Voltage 30 volts.

PBN Heater, 17 to 22.5 ohms.

Insulation, >20 meg ohms @ 500 volts.

1.1.6 CTPO POD

3 amps maximum.

Voltage 30 volts.

3.1.3 Entering and Using Set Points

Setpoint 1 can be directly entered from the Home display, as can Setpoint 2, when this is selected using the front panel setpoint switch. Use the UP/Down buttons to enter the required setpoint. Alternatively, press the Page button until the SP list header is reached, the Scroll button to select a parameter within the list, and the Up/Down buttons to set the value.

From the SP list you can set values for SPI, SP2, SP H, SP L, SP2.H, SP2.L and SPrr. See Section 2.4.6 for a brief description and the range of these parameters.

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Two separate setpoints can be set with upper and lower limits. In operation, the front panel setpoint switch can be used to change the process control from SPI to SP2, giving a step change facility. If a value has been assigned to the SPrr, (Setpoint ramp rate) parameter then the process will try to achieve or control to this rate. In this case the output current limit must be set high enough for the controller to achieve the required rate. Pressing the Scroll button when in ramp rate control will display the final target temperature. After a few seconds the lower display will show the ongoing target temperature, with the actual measured temperature on the upper display.

3.1.4 Positive Temperatures (above 0°C)

For positive temperatures it is simply a matter of entering a setpoint, starting the high voltage supply, and increasing the output current limit to a level that will achieve that setpoint. However, the PID values may not be correctly matched to your process, and reference should be made to section 3.1.8 on how to auto-tune or section 3.1.7 on how to set PID values manually.

Different temperatures may have differing optimum PID and cutback values, and some over or undershoot may be seen. Where different target temperatures are required, it is advisable to autotune for each level, then fine tune if necessary by manually altering values, record the final values so that they can be manually entered each time the process is repeated. Where the process is critical and no overshoot is permissible, use the setpoint ramp rate facility (see Section 3.1.6).

3.1.5 Negative Temperatures (below 0°C)

For temperatures between that of liquid nitrogen (-197°C) and the system ambient, adjust the setpoint to its minimum (-200 or -250°C) and the setpoint switch to OFF. If, for example, a temperature of -100°C is required, cool the system using a flow of liquid nitrogen to a steady temperature below that which is required (i.e. -200 to -150°C). Adjust the setpoint switch to SP 1 or SP2 (whichever has been set for the process) and increase the current limit potentiometer if this is fully counterclockwise. The RHC will now heat the system to the required temperature.

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3.1.6 Running a Ramp Rate

The ramp rate parameter has already been 'promoted' to the home list. To set this facility, press the Scroll button until the SPrr parameter is displayed. The factory set range for this parameter is OFF to 9999 degrees/minute; set the desired rate and scroll back to the home screen. Press the Scroll button to show the on-going target temperature on the lower display and actual temperature on the upper display. Ensure the current limit is set at a level to achieve the rate required. When the ramp rate facility is no longer required, repeat the above sequence and set the parameter OFF.

3.1.7 Selecting PID and Cutback Sets

There are two sets of PID and cutback values that can be assigned to SP 1 and SP2. This can be selected using the S_{Et} parameter in the PID list of the Operator access level. See section 2.4.3 for details of how to gain entry to the different access levels. Note that if you are in the Home screen, Operator level is available by using the Page button to select PID list, the Scroll button to select the S_{Et} parameter, and the Up/Down keys to select either Pid.1 or Pid.2 as required.

3.1.8 Setting Control Type

In most processes, full PID control is suitable for stable control. Control can also be set for PI; PD, P only or. ON/OFF, This is further described below:-

i) **ON/OFF Control** (proceed to ii) if you do not wish to use ON/OFF control)

Select the CT_{RL} parameter in the in_{ST} list of the Configuration access level. See section 2.4.3 for details of how to gain entry to the different access levels, Use the UP/Down keys to select ON.OF.

In the Edit and Operator access levels PID and OP lists have now been replaced by an ON.OF list. All displayed parameters should be made alterable in the Edit access level, A brief description of the available parameters is given below:-

List	Parameter	Description
On-OFF	hYS.H	Sets the level of hysteresis in display units
	ont.H	Minimum output time in seconds
	SB.OP	Sets the output level in % if the sensor fails

ii) **PI, PD or P only Control**

Select the PID list of the Operator access level. Use the Scroll button to select ti, td, ti2 or td2, and use the Down button to switch the parameter(s) OFF, or to select PI, PD or P only control.

Warning: The control typesetting will have a fundamental effect on the stability of the process control loop.

3.1.9 Setting PID Values Manually

Use this facility to manually enter PID values either to fine-tune a process control, or to enter known values for a particular process. Press the Page button until Pid List is displayed. Use the Scroll button to access the parameters and the Up/Down buttons to alter values. From the Pid list you can set values for Pb, ti, td, Hcb, Lcb, Pb2, ti 2, td2, Hcb2 and Lcb2. Either of the two sets of PID values and cutback values can operate on SP1 or SP2 - see section 3.1.7 on how to access the two PID and cutback sets. The function of the PID parameters is briefly described below:

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Pb	Proportional band	The bandwidth in display units over which the output power is proportioned between maximum and minimum.
ti	Integral time	Determines the time taken by the temperature controller to remove steady-state error signals.
td	Derivative time	Determines how strongly the temperature controller will react to the rate-of-change of the measured value.
Lcb	Low cutback	The number of display units below setpoint at which the temperature controller will cutback the output power in order to prevent overshoot on heat up.
Hcb	High cutback	The number of display units above the setpoint at which the temperature controller will increase the output power in order to prevent undershoot on cool down.

3.1.10 Autotuning

PID and cutback values can be automatically set using this facility. Press the page button until Atun List is displayed. Press the Scroll button to display tunE/OFF, and use either the Up or Down buttons to set the parameter ON, Select the setpoint from the front panel switch and set a current limit. See Section 3.1.7 above for brief description of parameters set by autotune.

Warning: The autotune procedure sets the temperature controller output to 100% and 0% in sequence as it calculates temperature rise and decay. The current limit must be set so as not to damage your process. The setpoint can also be exceeded during this process, Enter a lower setpoint if any overshoot is unacceptable. After an autotune this parameter will automatically set itself OFF. Note that you cannot autotune if the SPrr (setpoint ramp rate) parameter is not set to OFF.

3.1.11 Using the Process Control Trip

In the spares kit you will find a connector kit to mate with the Process Trip socket. This should be wired to a normally open contact, i.e a relay or contactor. See section 2.2 for individual connections and wire type.

Note: Connections are at a potential of nominally 24Vac.

If this contact is made or closed, the RHC output will be inhibited until it is opened again. This facility could form part of a pressure control or other process control system. The front panel LED will illuminate when the trip is active. If the Process Trip is not required then don not wire or fit the supplied connector. The external process should set the trip hysteresis.

3.1.12 Sensor Break

If, during a process, the in-vacuum thermocouple becomes open circuit, or the out-of-vacuum connection becomes broken, the RHC output will assume the percentage output as set by the parameter SB.OP. This is factory set to 0.0, but is alterable, in order to match the requirements of different processes. Refer to section 2.4.6 for instructions on how to access this parameter and how to view or adjust the value.

The Eurotherm temperature controller upper display will flash S.br, indicating an open sensor circuit. The lower display continues to show setpoint temperature which can be adjusted in the normal manner.

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3.2 MODELS WITH EXTERNAL COMMUNICATIONS

If your RHC has been supplied with the communications option, please refer to the Eurotherm Controls handbook, IPS HA 027549. This explains the software and its operation in detail. In order get the communications link up and running quickly, some details are briefly outlined below. Remember, your cabling from the RHC to your PC must be as described in section 2.3. The interface is either RS232 or RS485.

3.2.1 Installing the Software

You must have an IBM AT compatible PC with one free Serial Port, and the following-

Free Memory	At least 640kbyte
Operating System	Dos 3.1 or later. Will operate from 'Windows'
Display	CGA, EGA, VGA or Hercules

A mouse or other pointing device such as a tracker ball is recommended.

Ensure that your DOS configuration file CONFIG.SYS contains the following lines.-

Files= 70

Buffers= 10

Values greater than those above are also acceptable; consult your DOS handbook on how to do this. If using 'Windows', run SYSEDIT to check values or to make changes.

Always keep a back-up copy of your configuration files!

At the DOS prompt type-

A..INSTALL (or any other appropriate drive letter) or use the RUN command in Windows

3.2.2 Getting Started with the Software

Refer to section 2.3 for information on how to connect the communications function to the RHC. Set up the communications link and start up your computer. If starting from Windows, double click on the Eurotherm icon, if starting from the DOS prompt type IPS (return). An error message will be displayed if insufficient free memory is available to run the software.

The computer will display the main IPS screen and scan the communications link for any connected temperature controllers. The RHC will be factory set for an address of 1 (displayed as 0. 1). When this has been detected, assuming the communications link is functioning correctly, the '2408' controller icon will be displayed. The temperature controller has now been recognized and the REM indicator on the front of the temperature controller will flash on/off until the communications link is disconnected.

Double click on the '2408' controller icon to display the Operating List screen. All relevant parameters can now be selected by the mouse, and values amended by means of keyboard input.

Warning: Before changing parameter value/type the user must be aware of any, effects that this may have on the functioning of the control loop.

Reference should now be made to the supplied temperature controller handbook for information on how to set preferences, on how to use the different screens, and for recording trends etc.

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4.0 MAINTENANCE AND SERVICE

Warning: In order to maintain compliance with relevant EU directives, only use recommended spares when servicing; these must have the same specifications and ratings as the original components. Spares can be purchased from VACGEN. Beware that end user modifications can jeopardize compliance. Do not add to or modify cable forms, or alter cableform routing.

Warning: Servicing must only be carried out by qualified personnel who are aware of the potential risks of working on live equipment.

Warning: The front panel mains switch should not be relied upon to provide adequate isolation from the mains supply for servicing or maintenance purposes.

The EBHC is designed as a reliable and robust unit and should not require any regular maintenance. Basic preventative maintenance should be carried out every six months. The unit should be inspected for visible signs of overheating, corrosion, loose or broken electrical connections or accumulation of contamination (oil, dust or dirt). Repair any obvious defects or return the unit to VACGEN for repair. Clean the unit as necessary.

Only use fuses of the correct rating and type; see section 1.4. All unit cabling must be maintained in good condition; replace if damaged, especially if the outer sheathing is cut, cracked or burnt.

5.0 SPARES AND ACCESSORIES

Cable to connect the Heater output from the RHC to your vacuum system:

part code ZRHCAB3

Cable to connect the VACGENcouple input from the RHC to your vacuum system:

K type VACGENcouple part code ZTCCA03:

N type VACGENcouple part code ZTCCAN03

For other parts please contact VACGEN with your model type and serial number, stating requirements clearly.6.0 Schematic Diagrams

6.0 SCHEMATIC DIAGRAMS

Refer to the appended circuit diagrams. These show arrangements for the low and high mains input voltage versions. All wiring inside the RHC is numbered where applicable, and indicated on the schematics. Do not remove the wiring identifications when servicing.



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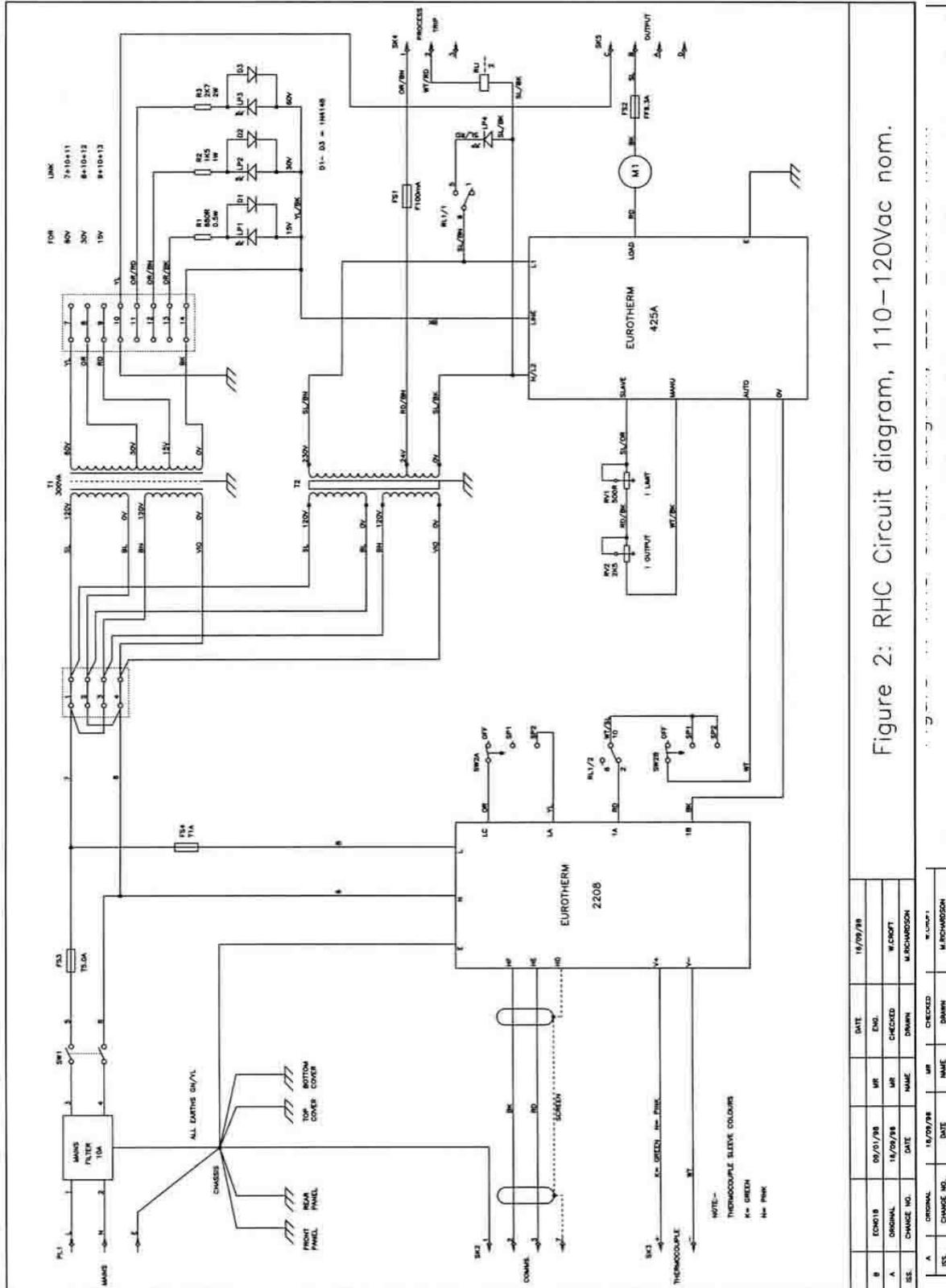


Figure 2: RHC Circuit diagram, 110-120Vac nom.

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B	EDN018	09/01/98	MR	MR	16/09/98	M. RICHARDSON
A	ORIGINAL	16/09/98	MR	MR	16/09/98	M. RICHARDSON



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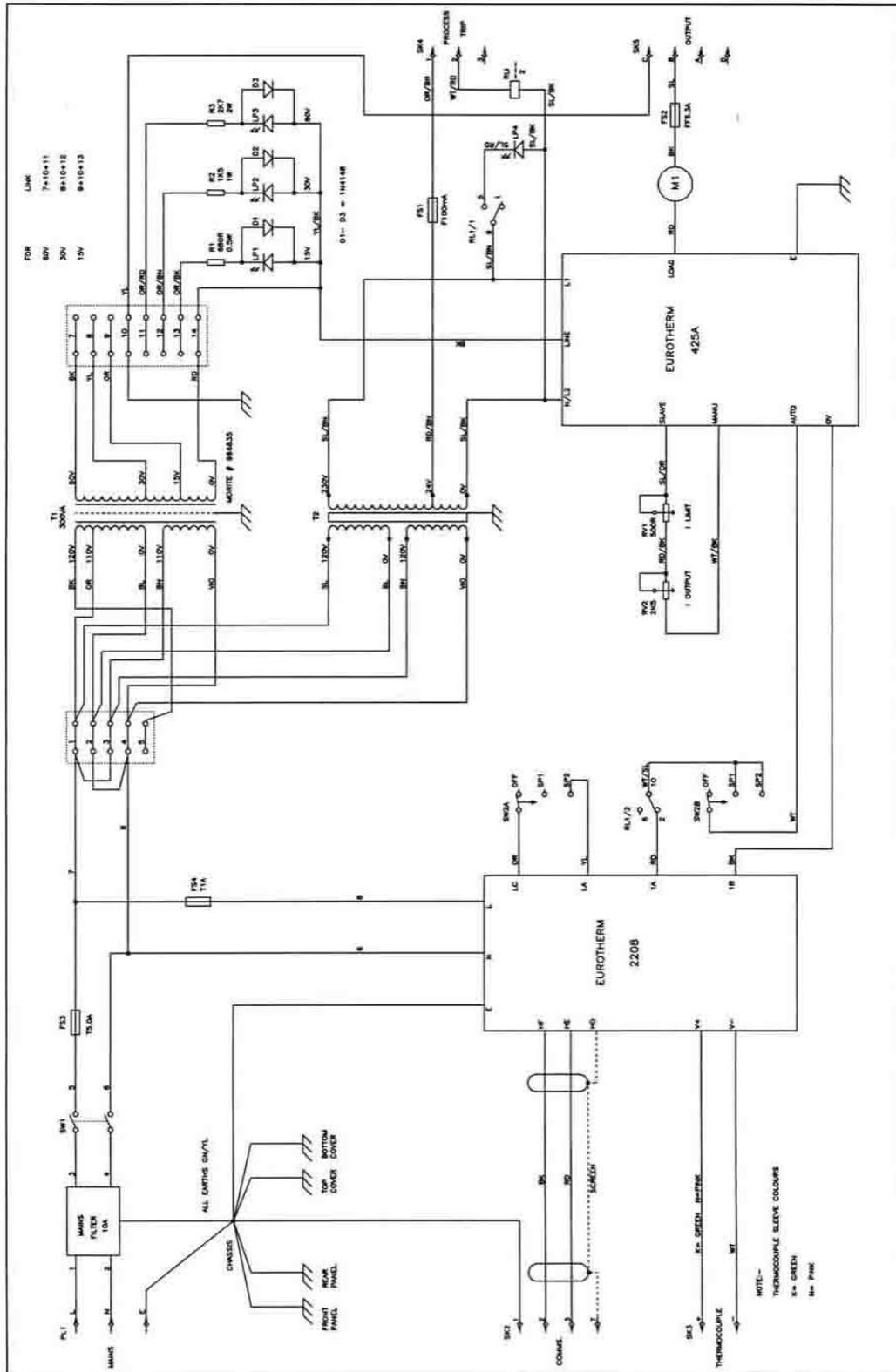


Figure 3: RHC Circuit diagram, 110V Morite trans.



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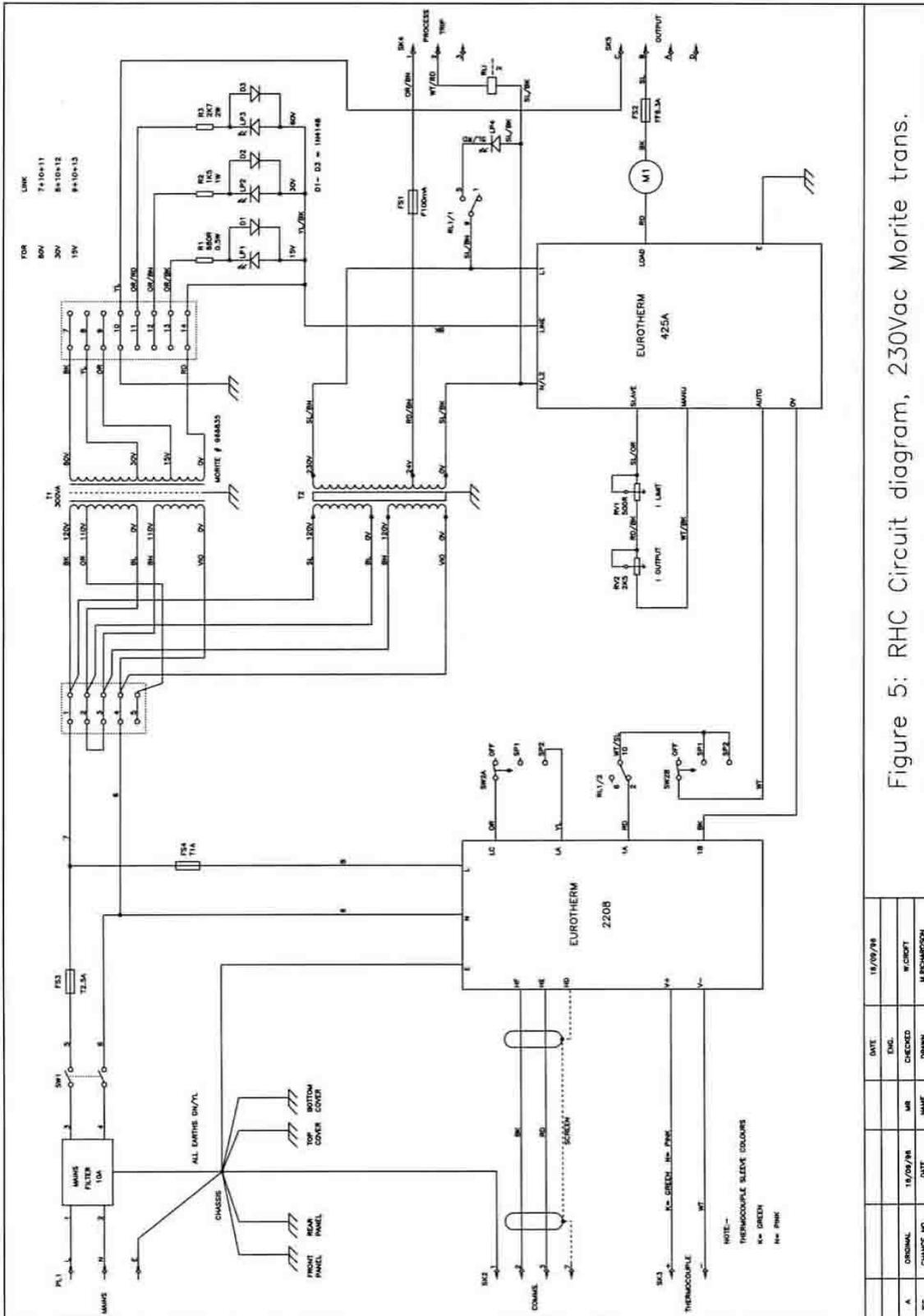


Figure 5: RHC Circuit diagram, 230Vac Morite trans.

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DRAWN	M. RICHARDSON
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VACGEN
Diamond Drive,
Hailsham,
BN27 4EL, UK, Phone 0044 1323379335

We hereby declare that the following product range:

Part Codes:

RHC, RHCN, RHCL, RHCNL.

Serial numbers: from RC9603001

are, suitable for incorporation or assembly into a vacuum system or other machinery. These products may only be put into service if it has been verified that the system or machinery into which it is incorporated conforms to the provisions of the appropriate EU directives and with the limitations of the equipment specifications.

Applicable regulations:

Low voltage directive: 72/23/EEC Version.92/31/EEC

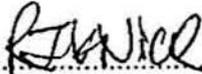
Electromagnetic compatibility directive: 89/336/EEC Version. 93/68/EEC

Appropriate harmonised or national standards.

BS EN61010-1: Safety requirements for electrical equipment of measurement Control and Laboratory use.

BS EN50081-2: Generic emissions standard, industrial equipment

BS EN50082-2: Generic immunity standard, industrial equipment

(Signed).....

Dr R J K Nicholson
Director of Development

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Service and Repair Form

Declaration of Contamination of Equipment and Components	
<p>Servicing and repairs will only be carried out if the conditions for Servicing and Repair are complied with in full, according to the VACGEN Ltd. Conditions of Sale. A summary of these requirements are included on the inside front cover of the Operating Instructions. The manufacturer will refuse to accept any equipment without a signed declaration attached to the OUTSIDE of the packaging. This declaration can only be completed and signed by authorized and qualified staff.</p>	
1 Description of Equipment and Components	
Equipment Type.....Model Number..... Serial Number..... Your Reference Number.....	
2 Reasons for return	
.....	
.....	
3 Condition of Equipment	
YES () NO () Toxic?	YES () NO () Corrosive?
YES () NO () Explosive?	YES () NO () Biological Hazard?
YES () NO () Radioactive?	YES () NO () Other Harmful Substances?
Equipment and Components that have been contaminated WILL NOT be accepted without written evidence of decontamination.	
5 Contamination Materials	
List all the substances, gases and by-products that may have come in contact with the equipment, giving trade name, manufacture, chemicals names or symbols. Please note that any of these listed, must be completely removed, so it is safe to handle and weld, without giving off health threatening gases. Please enter details below and/or attach data sheets	
6 Legally Binding Declaration	
I hereby declare that the information supplied on this form is complete and accurate. There by stating that the goods offer no risk to health or safety Organisation..... Name..... Country..... Job Title..... Post/ZIP code..... Telephone..... Email..... Signature..... Date.....	
Return goods to: Diamond Drive, Hailsham, BN27 4EL, UK, Phone 0044 1323 379335 (Form VGF33)	