VACGEN

Operating and Maintenance Handbook
SPC8 Pump Controller
Document Number UI6200

Change Control

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A	01/97	-------
B	10/07	3514

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Contents

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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 despatch 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 centre 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 despatch 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. VACGEN 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, Diamond Drive, Lower Dicker, BN27 4EL

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1.0 Introduction

1.1 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 dependant on the system/equipment 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. Failure to observe the instructions contained in this handbook may result in a safety hazard.
Warning. The unit must not be operated with any of the covers removed.
Warning. It is the responsibility of the user to observe the environmental conditions stated in "Specifications" on page 2.
Warning. Equipment must be fully earthed. Refer to "Installation" Section.
Warning. End user modifications, including cable form modifications/re-routing or the use of non-approved spare parts may jeopardize compliance with the relevant EU directives.
Warning. Safe disposal of the equipment is the responsibility of the user.

1.2 Important Notes

Caution. The SPCB is set for the mains voltage requested at the time of ordering. This should be checked before connection to the electrical supply. If a different voltage is required, contact VACGEN.
Caution. A separate Earth connection must be made between the vacuum system and the rear panel Earth stud, on the SPCS controller.

1.3 The SPC8

The SPC8 has been designed as a reliable, easy-to-use titanium sublimation pump controller. The SPC8 can control up to four filaments sequentially, with manual switch selection of the operating filament. Sublimation (ON) and interval (OFF) times are set on the front panel asymmetric front panel digital timer. The Start and Reset functions of the timer can be remotely controlled (for example by a relay interface card in a PC), and an output on/off indication is provided, via a connector on the rear panel.

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1.4 Specifications

Mains Voltage Input	Supplied set for range	110-120VAC or 220-240VAC, 50-60HZ
Power Consumption Output	Normal load conditions Phase angle controlled Soft Start	400V A Maximum 360V A Maximum, 60A at 6V ~3 seconds from 0% to 100%
Front Panel Controls	Supply Switch Cycle ON/OFF Process Timer Output Current Filament Select	Mains (ON/OFF) Push-button control to enable the output in local control Digital asymmetric timer with 8 ranges Timer counts up or down Accuracy +/-0.005%, +/-50ms 2-Colour LCD display of T1, T2 See 3.2.2 for ranges and default settings Continuously variable, zero and span adjustable Selects Filament 1, 2, 3 or 4
Indicators	Cycle ON/OFF Output Current Process Timer	Button illuminated during ON period Directly reading moving iron meter, 0-60A T1, T2 and status indicators
Rear Panel	Supply Earth Output Remote Fuses	IEC inlet Additional earth stud Access for cable assemblies 9-way 'D' connector FS1, F52 and FS2
Protection	FS1 (Main) FS2 (Phase control) FS3 (Timer) Transformer	3.15A (delay), 220/240Vac, or 6.3A (delay), 110/120vac 100mA F200mA Internal thermal cut-out and reset
Remote	Via 9-way 'D' connector	Start, Reset, T1 and T2 remote LED indicator supplies
Environmental	Operating temperature Storage temperature Installation Relative Humidity	5 to 45°C -10 to 70°C Non-explosive atmospheres. Electrically conductive pollution must be excluded from the cabinet 5 to 85%, non-condensing
Dimensions	19 inch rack mounting excluding output cabling (or Height 3U, Width 483mm, Depth 370mm free-standing)	
Weight	Excluding output cables 10kg	

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2.0 Installation

2.1 Unpacking

The packaging should be inspected for visual signs of damage. If the packaging appears to be damaged you should contact either your local, sales office, or VACGEN, immediately.

2.2 Rack Mounting

The SPC8 is supplied as a free-standing unit. If the unit is to be fitted into an instrument rack, then the feet will need to be removed. This is done as follows--
Turn the unit upside down and remove the two cap head screws which fix the bottom cover to the case of the unit.
a. Lift and remove the cover and disconnect the earth wire.
b. Push out the centre pins of the four feet; these can then be removed.
c. Reconnect the case earth wire, replace the cover and fix in place with the cap head screws.

2.3 Connections

The sublimation pump should be connected to the SPC8 using cables of the appropriate rating. VACGEN supply standard interconnecting cables (See "Accessories"). Cables of at least $10mm^2$ cross-section are recommended for connection to sublimation pump filaments and the common connection: subject to any local regulations. The cross-sectional area of the cable should be increased if cable lengths in excess of 10m are required.

Connections for the pump leads are located on the terminal block inside the unit. The cables should pass through the access hole provided on the rear of the unit. The four filament connections are labelled F1 - F4, and the filament common connection is labelled COM. The mains plug must be removed from the supply when working inside the unit.

If possible, the mains supply should be interlocked to the vacuum chamber pressure to prevent the pump operating when the vacuum chamber is at atmosphere or poor vacuum. A separate Earth connection must be made between the SPC8 rear panel Earth stud and the vacuum system 'star point' Earth.

The power requirement for the unit is detailed in Specifications on page 5.
Your SPC8 will have been supplied set to the mains input voltage requested at the time of ordering. If this is incorrect, contact VACGEN either directly or via an approved VACGEN agent. Do not attempt to alter the mains input voltage configuration.
Fit the 9-way D-connector/hood supplied to the rear panel Remote socket. This must be fitted for local control and has a link between pins 3+4. See Remote Operation section for external control.

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3.0 Controls, Setup and Operation

3.1 Front Panel Controls

3.1.1 Supply

This rocker switch switches the mains supply to the unit. The SPCS is active when the switch is in the '1' position. In this position the switch will be illuminated.

3.1.2 Process Timer

The LT4H-W timer controls the sublimation On/Off times.
The front panel layout of the controls and display for the timer are shown in Figure 1.

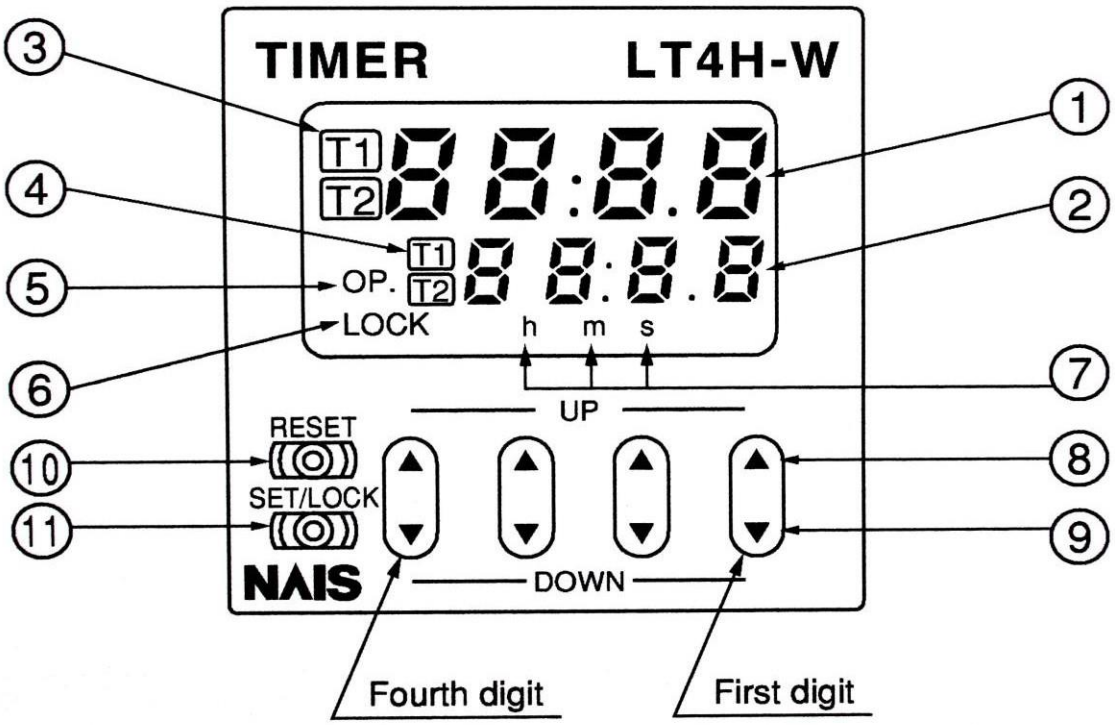

Figure 1. Display and controls for the Digital Timer

1. Elapsed Time Indicator (T1/T2)
2. Preset Value (T1/T2)
3. Operation Indicator (T1 or T2)
4. T1/T2 setting indicator
5. Control Output Indicator
6. Lock Indicator
7. Time Range
8. Up Keys
9. Down Keys
10. Reset Button
11. Set/Lock Button

The LT4H-W is supplied with the following default conditions.

T1 (On time): 60:00 Seconds
T2 (Off time): 02:00 hours
Down Count
Signal width: 20mS
Operation Mode: Pu-c (Pulse On-Start Cycle)
Keys Locked

3.1.3 Changing the Factory Preset T1 (On) or T2 (Off) times

This section describes how to change time period for T1 or T2 within a pre-selected range. See Section 3.2 for more details of changing time ranges and timer setup.
Unlock keys by pressing the 4th Up key while pressing the Set/Lock key. Use the Up/Down keys to set a new value and the Set/Lock key to select either T1 or T2 to change. When setting a new value each key changes the one digit. To prevent unwanted changes, repeat unlock key pressing procedure above to re-enable the key lock.

3.1.4 Cycle On/Off

This button enables the output from the unit when in 'local' control. In the factory-supplied configuration of the timer, pushing this button in will start the sublimation cycle. When the output is on, the lamp in this push-button is illuminated. The cycle can be started at any time by releasing and then pressing this button again, or by pressing the RESET button on the timer, with the Cycle On/Off button in the On position (keys need to be unlocked).

3.1.5 Set Zero and Span Filament Current

This single turn knob provides control of the output current between the Zero and Span settings of the phase angle controller. These are factory set to give Zero = 0 Amps and Span = 60 Amps at the fully counter clockwise and fully clockwise positions respectively. If it is necessary to adjust these settings, the work must be carried out by a suitably qualified engineer who is aware of the potential risks of working on live equipment. The output current is displayed on the directly reading analogue meter.

3.1.6 Output Soft Start

This is determined by the soft-start setting of the phase-angle controller, and is factory set to approximately 3 seconds for a 0 to 60 Amp span. If the soft start facility is not required, rotate the control fully counter-clockwise. Rotate clockwise for longer periods.

3.1.7 Filament Select

This four-position switch selects which of the four output connections is to be energised. Filament selection should only be changed when the filament current output is at zero (i.e. when the filament control knob is in the fully counter clockwise position).

3.2 The Digital Timer Setup

3.2.1 Overview

The LT4H-W digital timer has been factory set to provide the user with the optimum parameters for controlling the SPC8 under normal conditions. This section describes the factory preset operating parameters that should be appropriate for most user requirements. The timer has two independent time ranges for T1 (ON) and T2 (OFF); can be set to count up or down and an input signal width minimum. The later should be left as factory set in order to minimise spurious triggering of time periods or resets. These parameters can only be set via the DIP switches on the side of the timer. Access these by removing timer from the front panel. Always ensure power is disconnected from the SPC8 before changing DIP switch settings. See figure 2 below for DIP switch configuration.

3.2.2 DIP Switches

Factory settings are:

T1 range:	0.1 s to 999.9 s (OFF OFF OFF)
Min Reset, etc:	20mS
Time direction:	Subtract
T2 range:	0 h 01 min to 99 h 59 min (OFF OFF ON)
Operating Mode:	Pu-c (Pulse input ON-Start, repeating operation)

To set the Operating Mode press the Set/Lock key with the Up/Down key of the first digit. Release the Set/Lock key and use the Up/Down key of the first digit to change the Operating Mode from the following sequence: Pu-A, Pu-b, Pu-c, In-A, In-b, In-c. Pu= pulse input, In= Integrating input, A= Off start one operation, b= Off start repeat operation and c= On start repeat operation.
Caution: Great care should be taken when using an Operating Mode not recommended above.

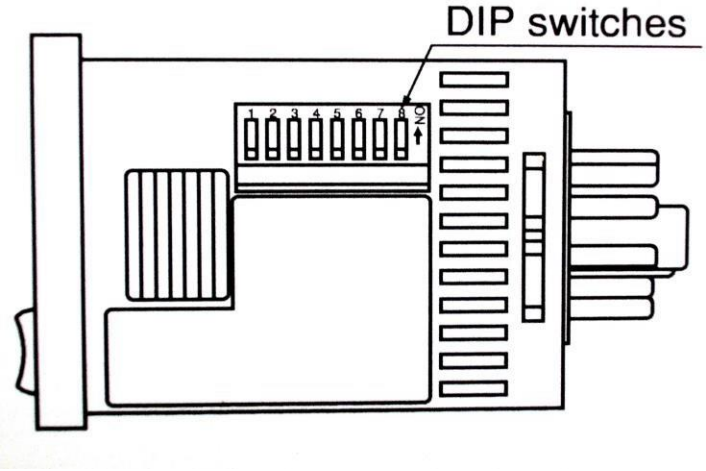

Figure 2. Location of DIP Switches

The Operation Mode and Time Ranges can be set using the DIP switches as listed below.

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	Item	DIP Switch	
		OFF	ON
1	Time range (Timer T1)	Refer to Table 1	
2			
3			
4	Minimum input reset, signal, and stop signal width	20mS	1mS
5	Time delay direction	Addition	Subtraction
6	Time range (Timer T2)	Refer to Table 2	
7			
8			

Table 1: Setting the timer range (Timer T1)

DIP Switch No.			Timer range
1	2	3	
ON	ON	ON	0.01 s to 99.99 s
OFF	OFF	OFF	0.1 s to 999.9 s
ON	OFF	OFF	1 s to 9999 s
OFF	ON	OFF	0 min 01 s to 99 min 59 s
ON	ON	OFF	0.1 min to 999.69 min
OFF	OFF	ON	0 h 01 min to 99 h 59 min
ON	OFF	ON	0.1 h to 999.9 h
OFF	ON	ON	1 h to 9999 h

Table 2: Setting the timer range (Timer T2)

DIP Switch No.			Timer range
6	7	8	
ON	ON	ON	0.01 s to 99.99 s
OFF	OFF	OFF	0.1 s to 999.9 s
ON	OFF	OFF	1 s to 9999 s
OFF	ON	OFF	0 min 01 s to 99 min 59 s
ON	ON	OFF	0.1 min to 999.69 min
OFF	OFF	ON	0 h 01 min to 99 h 59 min
ON	OFF	ON	0.1 h to 999.9 h
OFF	ON	ON	1 h to 9999 h

3.3 Rear Panel

3.3.1 Mains Inlet and Fuses

A standard IEC three-pin mains inlet is provided together with a separate earthing terminal. All three fuses are accessible from the rear panel. FS I is the main input fuse, FS2 protects the phase angle controller, and FS3 protects the timer. The fuse ratings are given in the Specifications Section. Never use fuses with values other than those stated in these operating instructions.

3.3.2 Remote 9-way 'D' Connector

The SPC8 may be placed under "external" control by means of the Remote connector. The On cycle may be started or reset thus allowing, for example, control by a computer or remote switch panel. The remote connector also provides output signals that indicate that the unit is in either the output On or Reset state. When in Local control the rear panel 9-way connector must be fitted to the unit rear panel with a link between pins 3+4 (as supplied). The Cycle On/Off button should be in the Off position (out) during Remote operation. The lamp in this button will still light when the output is On. See Section on Remote Operation.

3.3.3 Output Cable Access

Cables should be protected from damage where they pass through the framework into the SPC8. Use VACGEN cable assembly ZSPCCAB, or a suitable cable gland.

3.4 OPERATION

3.4.1 Overview

Important.
This information is intended for guidance only; the operator must determine the appropriate operating conditions (filament current and cycle times) that best match the requirements of the sublimation pump and vacuum system.

The front panel controls of the SPC8 allow the operator to select the filament to be used, to control the output current, to set the On and Off cycle times and to manually or automatically control the firing of the filament. In most cases it is likely that the operating conditions will not need to be changed very frequently once the optimal conditions have been determined. The sections below briefly discuss some of the factors that should be considered when using the SPC8.

3.4.2 Filament Degassing

New filaments need to be carefully degassed, particularly if they are intended to be used in the generation of UHV pressures. All the filaments must be degassed in sequence before the pump will operate successfully. When a new filament is fired for the first time a substantial amount of outgassing can take place. The filament current should be increased slowly from a low value whilst monitoring the chamber pressure. The operator should refer to the instruction manual of the sublimation pump in order to determine the recommended degassing currents.

3.4.3 Operating Current

Once all the filaments in the pump cartridge have been degassed, one should be selected as the operating filament. The operating sublimation current should then be set on the current meter, and the On and Off-cycle times set in the timer. The output current may be seen to vary slightly from the initial setting during the On-cycle due to changes in resistance of the filament and supply cables as they warm up. If this occurs the supply current should be increased until the required value is reached, and this value should be left as the "true" operating current (the starting current will initially be higher).

3.4.4 Filament Outgassing During Operation

When operating at UHV pressures, it is likely that some pressure rise will be observed when the TSP filament fires. The amount of pressure rise will depend on how well the filaments in the pump cartridge have been outgassed, chamber design and the nature of any process taking place within the system. The SPC8 output should be disabled, or the process time adjusted to ensure that the pump does not fire at a critical time during any process or measurement.

3.4.5 TSP Cycle Times

At pressures greater than 1 x 10^{-6}mbar it can be assumed that any newly deposited titanium layer will become saturated almost as soon as it forms by reaction with the "active" gases within the vacuum system (inert gases are not pumped by titanium sublimation pumps). Thus, for pressures above 1 x 10^{-6}mbar it is necessary to run the filament continuously in order to pump gas with the sublimation pump. At pressures below 1 x 10^{-6} mbar it is possible to deposit titanium faster than it can be consumed. Table 3 below indicates typical Off-cycle times for different pressures. The On-cycle time is assumed to be 1 minute.

Table 3. Suggested Off cycle times at different pressures.

Pressure	Off Cycle Time
10^{-6} mbar	On Continuously
10^{-7} mbar	6 to 1 0 minutes
10^{-8} mbar	20 to 30 minutes
10^{-9} mbar	60 to 90 minutes
10^{-10}rnbar	5 to 10 hours
10^{-11} mbar	10 to 20 hours

The above times may need to be varied to meet the requirements of a particular vacuum system.

3.4.6 Remote Operation

The SPC8 may be placed under "external" control by means of the Remote connecter. The On cycle may be started or reset thus allowing, for example, control by a computer, vacuum gauge controller or remote switch panel or relay. The remote connector also provides output

signals that indicate if unit is in either the output On or OFF. Simple contacts (relay or switch) are required to operate the start and reset functions; minimum contact closure time is 20 ms.

Remote connector Pin-outs and functions are as below.

Pin 1	Start
Pin 2	Switch Common
Pin 3	Reset (link to 4 when in local control)
Pin 4	Link to 3 when in local control
Pin 5	Not used
Pin 6	OFF lamp (20mA max for LED Anode)
Pin 7	ON lamp (20mA max for LED Anode)
Pin 8	Not Used
Pin 9	0V (for LED Cathodes)

Remove the link between pins 3+4 (local control link, which must be restored if external control is no longer required). Connect a Change-Over (C/O) relay (or switch arrangement) where the Common is connected to Pin 2; Normally Closed (N/C) to pin 3; and Normally Open (N/O) to Pin 1. Connect two standard 5mm LED's to Pins 6, 7 and 9 as above to indicate Cycle ON/OFF. Lamp supply is limited to 20mA each.
When external relay is energized the output will be ON.

4.0 Maintenance

The SPC8 is a simple and robust unit and should not require any regular maintenance. Simple 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 - clean the unit if necessary). Repair any obvious defects or return the unit to VACGEN for repair. Clean the unit if necessary.
In order to maintain compliance with EU directives, only use approved spare parts.

5.0 Accessories

Order	Code Description
ZSPCCAB	5m non-bakeable pump lead, 4 filaments plus Common
ZSPCIB	Bakeout Interface Box with 1.5m bakeable Cables ZST22
	ST22 Sublimation Pump Cartridge
ZST22F	Replacement Filaments for ST22
ZST22FC	Replacement Filament Clamps for ST22
ZST22IB	Replacement Insulator Bushes for ST22
ZST22CS	Replacement Screws for ST22 Filament Clamps

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Declaration of Contamination of Equipment and Components

Serving 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 is 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.

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.

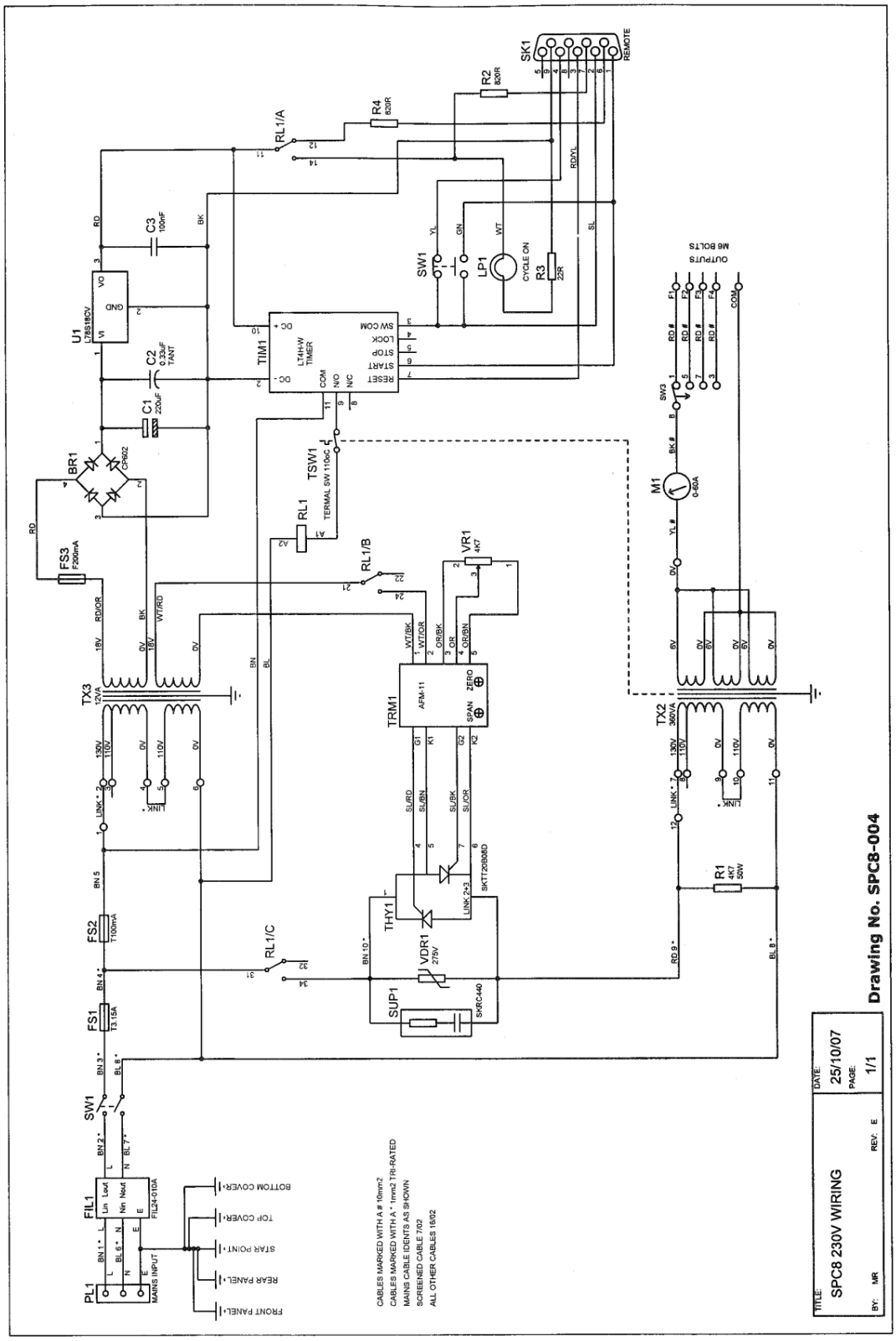
5 Contamination Materials

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
Organization…….. Name…….
Country…….. Job Title…….
Post/ZIP code……..Telephone……..
FAX……..
Signature……..Date……..

Return goods to: VACGEN, Diamond Drive, Lower Dicker, BN27 4EL - 01323379335
(Form VGF33)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R2
820R
R4
820R
RL1/A
C3
100nF
SW1
LP1
CYCLE ON
R3
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LTB518CV
C2
0.33uF
TANT
C1
220uF
TIM1
LTHH+W
TIMER
BR1
GP602
TSW1
TERMAL SW 110oC
RL1
RL1/B
VR1
4K7
FS3
250mA
TX3
12VA
TRM1
AFM-11
ZERO
SPAN
THY1
SKT20/08D
VDR1
275V
SUP1
SKRC440
RL1/C
FS2
T100mA
FS1
T3.15A
SW1
FIL1
FIL24-010A
PL1
MAINS INPUT
BOTTOM COVER
TOP COVER
STAR POINT
REAR PANEL
FRONT PANEL
M1
0-60A
SW3
TX2
380VA
R1
47R
50W
OUTPUTS
M6 BOLTS
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CABLES MARKED WITH A * 1mm2 TRI-RATED
MAINS CABLE IDENTS AS SHOWN
SCREENED CABLE 7/02
ALL OTHER CABLES 16/02
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DATE:
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1/1
BY: MR
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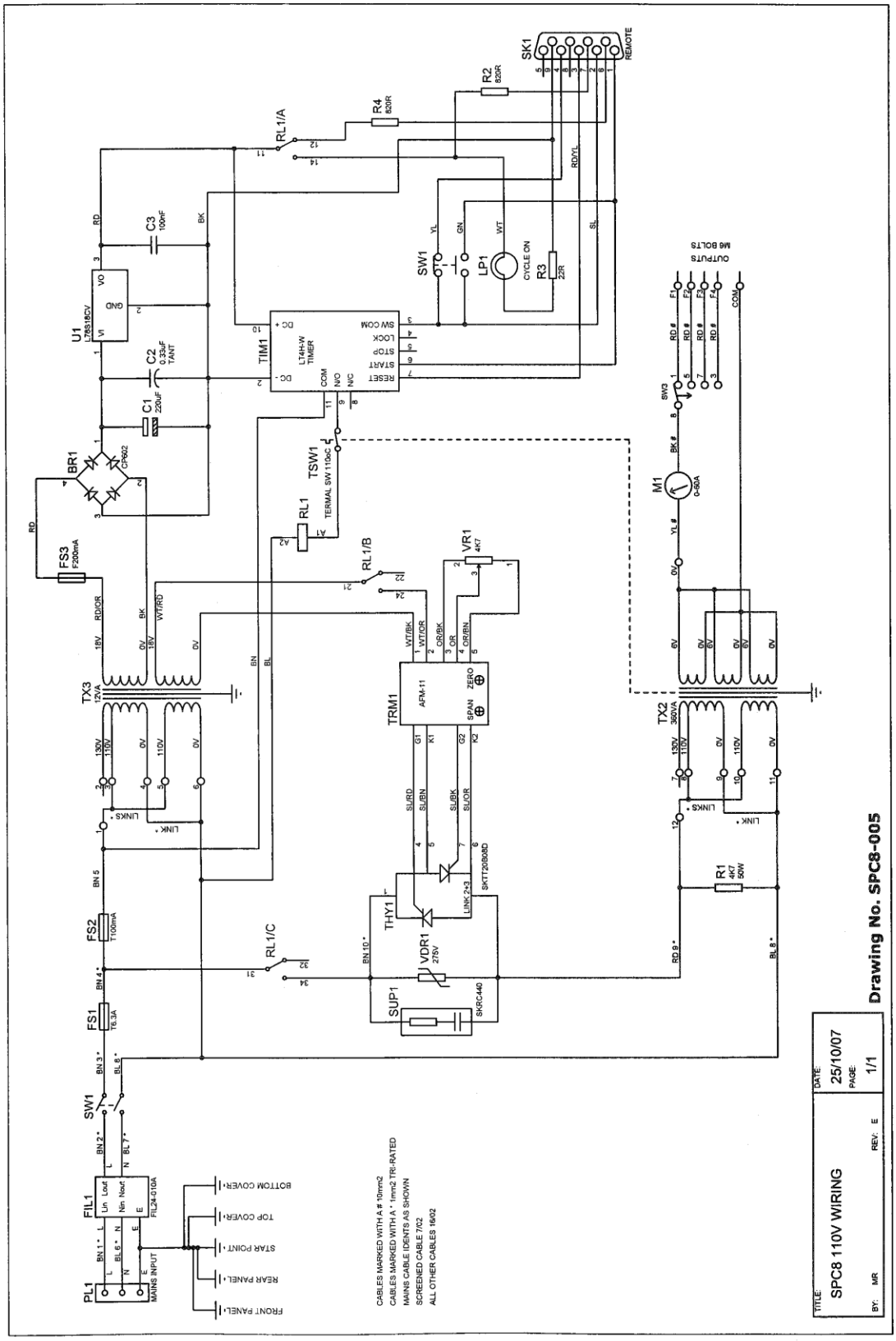
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MAINS CABLE IDENTS AS SHOWN
SCREENED CABLE 7/02
ALL OTHER CABLES 16/02
REMOTE
OUTPUTS
M6 BOLTS
MAINS INPUT
FRONT PANEL
REAR PANEL
STAR POINT
TOP COVER
BOTTOM COVER
LINKS
CYCLE ON
TERMAL SW 110oC