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OMICRON

INSTRUMENTS FOR SURFACE SCIENCE

SPECTALEED Control Unit

NG LEED / NG LEED S

Technical Reference Manual

including LIAC and MUL

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M3152

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> **Please note:** This documentation is available in English only.

> **Attention:** Please read the safety information on pages 9 and 10 before using the instrument.

Related Manuals
SPECTALEED Optics
SPECTALEED Channelplate
SPA-LEED
AES using SPECTALEED

Table 1 Related manuals.

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Conditions of CE Compliance

OMICRON instruments are designed for use in an indoor laboratory environment. For further specification of environmental requirements and proper use please refer to your quotation and the product related documentation (i.e. **all** manuals, see individual packing list).

The **NG LEED SPECTALEED Control Unit** complies with CE directives as stated in your individual delivery documentation if used unaltered and according to the guidelines in the relevant manuals.

Limits of CE Compliance

This compliance stays valid if repair work is performed according to the guidelines in the relevant manual and using original OMICRON spare parts and replacements.

This compliance also stays valid if original OMICRON upgrades or extensions are installed to original OMICRON systems following the attached installation guidelines.

Exceptions

Omicron **cannot** guarantee compliance with CE directives for **components** in case of

- changes to the instrument **not authorised by OMICRON**, e.g. modifications, add-on's, or the addition of circuit boards or interfaces to computers supplied by OMICRON.

The customer is responsible for CE compliance of entire **experimental setups** according to the relevant CE directives in case of

- installation of OMICRON components to an on-site system or device (e.g. vacuum vessel),
- installation of OMICRON supplied circuit boards to an on-site computer,
- alterations and additions to the experimental setup not explicitly approved by OMICRON

even if performed by an OMICRON service representative.

Spare Parts

Omicron spare parts, accessories and replacements are not CE labelled individually since they can only be used in conjunction with other pieces of equipment.

1. Introduction

General Description

The SPECTALEED control unit provides all necessary electrical supplies to operate various OMICRON rear-view LEED optics in LEED mode. It supplies the high voltage for the screen, the suppressor grid voltage and the heating current for the cathode of the integral electron gun. Voltages are generated to drive the electron-optical elements of the gun at kinetic energies up to 1000 eV.

In addition the control unit can run the SPECTALEED optics in Auger mode. It provides all necessary voltages for the internal electron gun (up to 3.5 kV) for a focused beam, and the retard voltage which has to be set by an external programming voltage.

An optional electronics package upgrades the SPECTALEED together with the NG LEED to a retarding field analyser with fully computer controlled data acquisition. The electronics package NG LEED S comprises

NG LEED

- lock-in amplifier integrated into the NG LEED,
- combined interface / precision-oscillator board integrated into the PC,

matching unit MUL consisting of a preamplifier and a modulator,

- and all necessary control software for lock-in amplifier, retarding voltage and data acquisition.

The NG LEED is equipped with an emission current regulation in order to provide a stable beam current. The beam current can be measured and monitored without biasing the sample.

Normal Use

The **NG LEED SPECTALEED Control Unit** supplies the SPECTALEED optics with the filament heating current and the voltages for the lens elements of the electron gun, for the grid and for the LEED screen.

The **NG LEED SPECTALEED Control Unit** shall always be used in combination with

either a flange mounted gun SL 1000 / SL 1000 SPA

or a Channelplate optics and NG CPL control unit

or a SPECTALEED optics

or a SPECTALEED Auger package consisting of

1. SPECTALEED optics
2. NG LEED S: LEED/Auger electronics package
3. PC PEN LEED including DAT 100 data acquisition software and LIAC control software

or a SPA-LEED package consisting of

1. spa-leed optics
2. NG LEED: SPECTALEED control unit
3. NGSPA: SPA-LEED control unit
4. MUS: matching unit SPA-LEED
5. VOR: preamplifier
6. PC PEN SPA including SPASO SPA-LEED software

Please note: CE compliance for a combination of certified products can only be guaranteed with respect to the lowest level of certification. Example: when combining a CE-compliant instrument with a CE 96-compliant set of electronics, the combination can only be guaranteed CE 96 compliance.

The **NG LEED SPECTALEED Control Unit** shall always be used

with original cable sets which are explicitly specified for this purpose

- with all cabling connected and secured, if applicable
- with all electronics equipment switched on

in an indoor research laboratory environment

by personnel qualified for operation of delicate scientific equipment

in accordance with all related manuals.

Warning: Lethal Voltages!!

Adjustments and fault finding measurements as well as **installation procedures and repair work** may only be carried out by authorised personnel qualified to handle lethal voltages.

Attention: Please read the safety information in all relevant manuals before using the instrument.

All connectors which were originally supplied with fixing screws must always be used with their fixing screws attached and tightly secured.

Technical Specification

Mains Input	90-264 V, 50/60 Hz (150 VA)
Beam Energy / Cathode Potential	0 to -3.5 kV, 100 µA with respect to ground/earth
Filament Heating Current	0 to 2.7 A, 0-10 V, floating, centre tapped to cathode potential
Wehnelt	0 to -100 V, 2 mA with respect to cathode potential
Anode	+400 V, 2 mA, fixed, with respect to cathode potential
Lens 1 and Lens 3	-20 V to +2.5 kV, 50 µA with respect to cathode potential
Lens 2	-20 V to +1.1 kV, 50 µA with respect to cathode potential
Screen	0 to +7 kV, 500 µA with respect to earth (in steps of 1 kV)
Suppressor	0 V or 80% to 110% of beam energy
Retard	0 to -2.0 kV, 50 µA with respect to ground/earth
Preamp Power	±15 V, 100 mA with respect to ground/earth ±300 V, 50 µA with respect to ground/earth

DISPLAY

Gun Parameters Current Monitor	**4 1/2 digit panel meter**

MONITOR OUTPUTS

Beam Energy E_0 Monitor	0 to +10 V equiv. 0 to -1000 V in LEED mode or 0 to +10 V equiv. 0 to -3.5 kV in Auger mode
Beam Current I_0 Monitor	1 V per µA

REMOTE CONTROL (switch on/off)

Beam Energy	0 to +10 V equiv. 0 to -1000 V in LEED mode or 0 to +10 V equiv. 0 to -3.5 kV in Auger mode (+10 V reference output is provided)

MECHANICAL

19 inch rackmount case	width 448.5 mm (84 U), height 132.5 mm (3 U), depth 400 mm
weight	9 kg incl. LIAC

Cables for connecting the screen HV, grids and electron gun are supplied together with the SPECTALEED optics. Standard length is 5 m.

2. Safety Information

☑ Important:

- **Please read this manual and the safety information in all related manuals before installing or using the electronics equipment.**
- The safety notes and regulations given in this and related documentation have to be observed at all times.
- Check for correct mains voltage before connecting any equipment.
- Do not cover any ventilation slits/holes so as to avoid overheating.
- The **NG LEED** may only be handled by authorised personnel.

⚠ Warning: Lethal Voltages!!

Adjustments and fault finding measurements may only be carried out by authorised personnel qualified to handle lethal voltages.

- Lethal voltages may present at the SCREEN and BEAM SHV sockets and at the GUN 13-pin socket during operation.
- Lethal voltages are present inside the NG LEED / NG LEED S.

⚠ Always

- **All connectors which were originally supplied with fixing screws must always be used with their fixing screws attached and tightly secured.**
- **Always disconnect the mains supplies of all electrically connected units before**
  - opening the vacuum chamber or a control unit case,
  - before touching any cable cores or open connectors,
  - before touching any part of the in-vacuum components (except for tip and sample exchange as described in this manual).
- Leave for a few minutes after switching off for any stored energy to discharge.

⚠ This product is only to be used:

- indoors, in laboratories meeting the following requirements:
  altitude up to 2000 m,
  temperatures between 5°C / 41°F and 40°C / 104°F (specifications guaranteed between 20°C / 68°F and 25°C / 77°F)
  relative humidity less than 80% for temperatures up to 31°C / 88°F (decreasing linearly to 50% relative humidity at 40°C / 104°F)
  pollution degree 1 or better (according to IEC 664),
  overvoltage category II or better (according to IEC 664)
  mains supply voltage fluctuations not to exceed ±10% of the nominal voltage

3. Installation and Functional Test of Power Supply

> ⚠ **Attention: Installation procedures** may only be carried out by authorised personnel qualified to handle lethal voltages.
>
> Switch off all units and wait for a few minutes (for discharge of the power supplies) before connecting or disconnecting any cables.
>
> Make sure all high voltage plugs are secured before switching any one of the electronics units on.

Before switching on the SPECTALEED control unit check on rear panel if:

- mains input voltage is correct (see panel)
- 3-wire power cable is properly connected
- switch INTERN/EXTERN is set to INTERN

Without connecting the SPECTALEED optics you may check proper operation of the power supply by pushing the MAINS ON switch (LEED cable or MUL modulator connected to power supply). The operation light in the mains switch and the digital panel meter should now come on. It is possible to check the correct operation of the digital panel meter and the voltage supplies e.g. by selecting the range position E and turning the ENERGY potentiometer. The corresponding beam energy is then displayed on the meter.

If any problems should occur, refer to chapter 10 in this manual.

Before connecting the SPECTALEED optics, make sure that

- ENERGY and FILAMENT potentiometers are turned fully counter clockwise,
- SCREEN is set to 0 (zero),
- Mains is switched off.

> ⚠ **IMPORTANT!** Switch off all supplies and leave for at least 2 minutes for any stored energy to discharge before connecting the SPECTALEED optics!

Now connect your SPECTALEED optics to the control unit using the provided cables.

> ⚠ **All connectors which were originally supplied with fixing screws must always be used with their fixing screws attached and tightly secured.**

All FT 12 connections have fixing screws which prevent accidental disconnection. The plugs must always be used with their fixing screw(s) tightened, i.e. plug secured. These screws, see figure 1, also prevent connecting a plug to the wrong FT 12 feedthrough and hence should not be removed when disconnecting the plug.

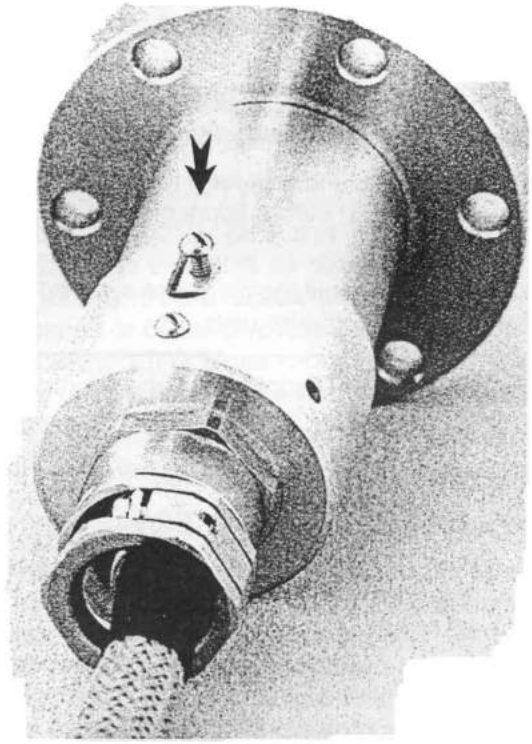


Figure 1 FT 12 connectors: always tighten the fixing screw.

Default Setting

After switching on the power supply, the button LEED is lit and the digital panel meter shows the beam energy voltage, which should read "0".

4. Functions and Controls

Front Panel

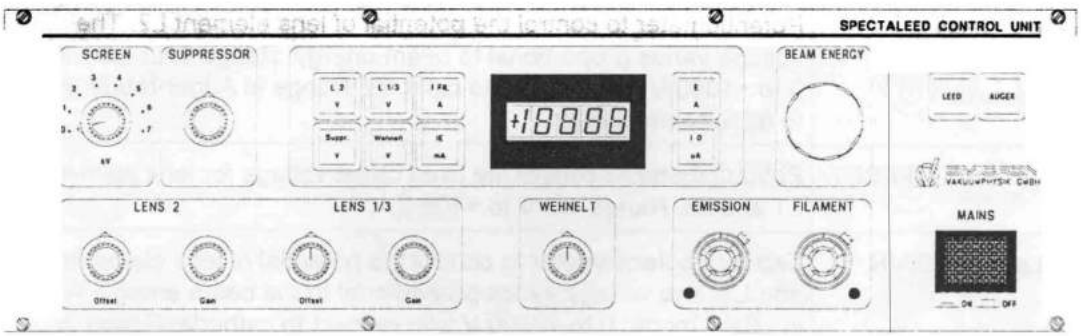


Figure 2. Front panel layout, schematic diagram.

MAINS ON	Push-button to switch on the control unit. The light indicates that the unit is on. Press again to switch unit off.
LEED / Auger	Push-buttons to select LEED or Auger mode. LEED mode: all functions are active except for retard voltage. Ranges of L 1/3 and L 2 voltages are selected for LEED mode. The beam energy is limited to 1 kV. Auger mode: Screen and suppressor are not active. Ranges of L 1/3 and L 2 voltages are selected for Auger mode. The beam energy is limited to 3.5 kV.
SCREEN	Rotary switch to control the high voltage for the screen in 7 steps. Range limited to +7 kV. (Only active in LEED mode.)
SUPPRESSOR	Potentiometer to control the voltage of the suppressor grid, varies proportional to the beam energy. Range 80% to 110% of beam energy. When fully counter clockwise the switch will click and there will be no suppressor potential. (Only active in LEED mode.)
BEAM ENERGY	Ten turn potentiometer to control the beam energy. Range 0 to -1000 V in LEED mode and 0 to -3.5 kV in Auger mode.
FILAMENT	Ten turn potentiometer to control the filament heating current. Range 0 to 2.7 A. Green LED is lit when the filament current is limited to the preset value, see also page 27.
EMISSION	Ten-turn potentiometer to control the emission current, range 0 to 50 µA. Green LED is lit when the emission current is kept constant by the emission regulator. If the potentiometer is turned fully clockwise the emission current is not limited. Note: the regulation circuit works differently for different filament types. If changing the filament typ (LaB_6 or WTh) please refer to section Adjustments on page 27.

WEHNELT	Potentiometer to control the potential of the Wehnelt cylinder of the electron gun. Range 0 to -100 V with respect to cathode potential.
L 2 OFFSET	Potentiometer to control the fixed offset voltage for lens element L2. Range 0 to +100 V.
L 2 GAIN	Potentiometer to control the potential of lens element L2. The voltage varies proportional to beam energy. Range in LEED mode: 0 to +1000 V with respect to cathode. Range in Auger mode: 75% to 85% beam energy.
Lens 1/3 OFFSET	Potentiometer to control the fixed offset voltage for lens elements L1 and L3. Range -20 V to +100 V.
Lens 1/3 GAIN	Ten turn potentiometer to control the potential of lens elements L1 and L3. The voltage varies proportional to the beam energy. Range in LEED mode: 0 to +2500 V with respect to cathode. Range in Auger mode: 40% to 65% beam energy.
Digital panel meter and push buttons	Potential of the elements in volts: L 2 Lens L 2 with respect to cathode L 1/3 Lenses L 1 and L 3 with respect to cathode SUPPR. Suppressor grid with respect to cathode W Wehnelt cylinder with respect to cathode I_{Fil} Filament heating current in A I_E Emission current in mA, measured at the anode E Beam energy in eV I_0 Beam current, range 0.00 to 100 µA

Back Panel

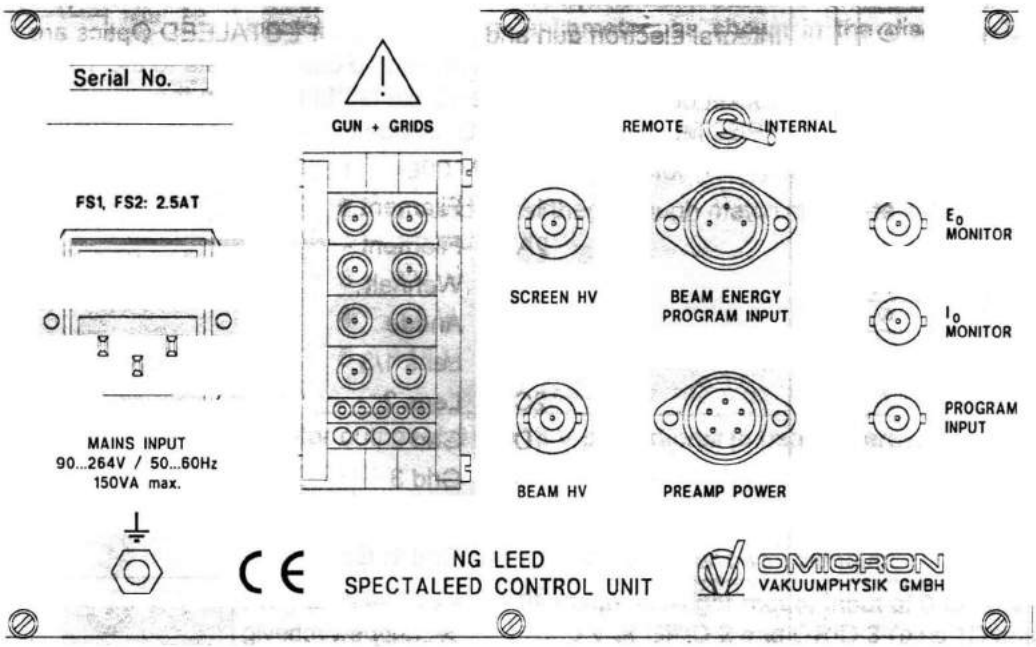
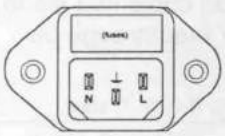


Figure 3. Back panel layout, schematic diagram.



This unit is supplied with a 3-pin standard European mains socket for ac input of 90 to 264 volts, 150 VA and 50 to 60 Hz. The wire insulations of the standard 3-lead mains cable are coloured in accordance with the following code:

Brown:	Live
Green/Yellow:	Earth
Blue:	Neutral

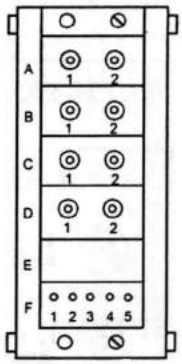
Mains fuse(s): 5mm ∅, 20mm long

use 2 × 2.5 A (T) for 90-264 V ac

To change the fuse

- disconnect mains
- lift the flap using a screw driver for leverage
- replace the fuse as indicated above
- re-fit the fuse holder.

GUN + GRIDS



13-pin socket, connection to electron gun and elements of the SPECTALEED optics.

Integral electron gun and grids of the SPECTALEED Optics are connected with a supplied multi-lead cable that fits to the 13-pin socket on the rear and the 12-pin feedthrough on the SPECTALEED Optics.

1A	Filament +
2A	Filament -
1B	Wehnelt
2B	Anode
1C	Lens 1/3
2C	Lens 2
1D	Grid 2
2D	Grid 3
1F	0 V (Lens 4)
2F	Grid 1; Grid 4
3F	Earth/Ground
4F	security switch
5F	security switch



SCREEN HV

BNC-SHV high voltage socket. Screen supply output.

High voltage is fed to the screen with a single lead cable that fits to the SHV socket on the control unit and to the HV feedthrough on SPECTALEED Optics.

Attention: cover this socket with a protective cap if not in use.



BEAM HV

BNC-SHV high voltage socket. Beam energy output (0 to 3.5 kV).

Attention: cover this socket with a protective cap if not in use.

Remote  Internal

Switches program voltage between external input and internal control of the beam energy.

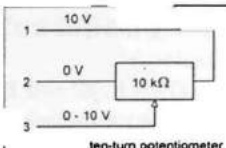


Beam Energy
Program input

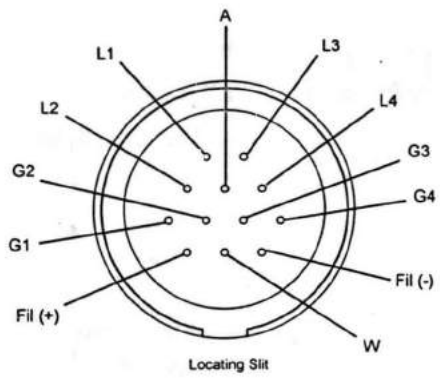
3-pin DIN socket for external control of energy.
Input 0 to +10 V for 0 to -1000 V in LEED mode.
Input 0 to +10 V for 0 to -3500 V in Auger mode.
Reference output +10 V

For connection to the 3-pin DIN socket a mating plug is provided. External wiring is left to the customer.

1	+10 V Reference Output
2	Earth/Ground
3	Programming Voltage Input (with respect to pin 2)

 ten-turn potentiometer	The "program beam energy" input can be used to control the beam energy via a remote control unit. Connect the +10V supply of the input to a 10 turn potentiometer, as shown in the diagram. Use screened cables to avoid introducing disturbances to the programming input.
Preamp power	5-pin DIN socket. Supply output for amplifier of matching unit. 1 +300 V electron collector 2 grounded/earthed through matching unit to system ground/earth. 3 0 V 4 -15 V 5 +15 V
Eo Monitor	Monitor output of 0 to +10 V proportional to beam energy.
Io Monitor	Monitor output of 1 V per µA of beam current This output can be used to connect your own voltmeter.
Program Input	Program input for retard voltage in Auger mode. Input of 0 to 10 V gives an output of 0 to -2000 V at GRID 2 and GRID 3 (pins 1D and 2D of 13-pin socket). Active in Auger mode only.

Connectors and Pin Assignments



atmospheric side

12-pin feedthrough, as seen from atmospheric side.

A	Anode
L	Lens
G	Grid
Fil	Filament
W	Wehnelt

Default Settings

After switching on the power supply is in LEED mode, the meter reading shows the beam energy in volts.

5. LIAC Lock-In Amplifier Cassette

Interface/Precision Oscillator Board

The board contains a precision oscillator for frequencies between 0 and 20 kHz and amplitudes between 0.1 V_{pp} to 10 V_{pp}. Three different output signals are available simultaneously at BNC sockets on the panel:

- **Sine Out** gives the sine wave with the preset frequency and amplitude.
- **TTL Sync.** yields a TTL signal with the preset frequency.
- **2f OUT** gives a TTL signal with double the preset frequency.

The jumpers JP2, JP3 and JP4 select an output attenuation of the sine wave amplitude by -40 dB, -20 dB and 0 dB, respectively. For small amplitudes it may be sensible to set an attenuation >0; for normal Auger electron spectroscopy, however, we recommend selecting 0 dB (JP4).

The parallel I/O provides the signal for running the lock-in amplifier.

Four different addresses can be selected for the board using jumpers JP5 and JP6, see table

Address	JP5	JP6
$300	in	in
$30C	out	in
$308	in	out
$314	out	out

Table 2. Address settings using JP5 and JP6.

If you find your board conflicting with other boards in your PC try one of the other addresses. Note that the correct address has to be set in the software as well.

Installation

If the NG LEED is upgraded with an Auger package (NG LEED S) the back panel will have an additional lock-in amplifier module (LIA).

> **Please note: For full CE compliance the LIAC package must be installed in factory.** The customer is responsible for CE compliance according to the relevant CE directives in case of installation of OMICRON supplied circuit boards to an on-site computer or electronics unit.

> **Attention:** The lock-in can be set and run manually. For computer control all dip switches have to be set to ON. All rotary switches have to be set to 0.

Inserting the lock-in amplifier cassette into the NG LEED power supply (LEED/Auger):

- Make sure the three dip switches S1, S2 and S3 have been set to ON.
- Make sure the rotary switches for phase control (coarse and fine), sensitivity and time constant are set to zero.
- Slacken the four screws and remove the blank panel at the rear of the NG LEED.
- Insert the lock-in amplifier cassette and plug in the power cable of the lock-in.
- Attach the cassette by tightening the four screws.

To install the interface/oscillator board:

- Remove the cover from your PC.
- Note the board address, see table 2. Preferably write it down as you need to enter this address when you configure the software.
- Insert the board into a free slot and fix the screws.
- Replace the PC cover.

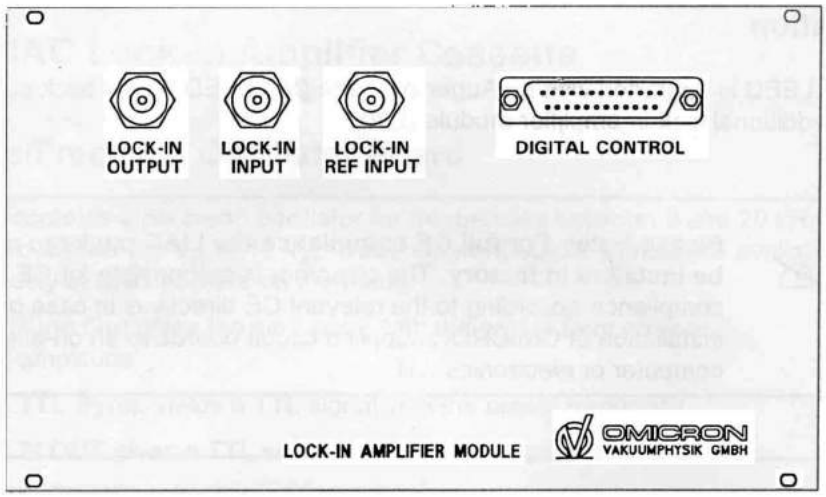


Figure 4. The lock-in amplifier module LIA. Back panel schematic diagram.

LOCK-IN OUTPUT	BNC socket for signal output of lock-in amplifier. Range ±10 V.
LOCK-IN INPUT	BNC socket for signal input to lock-in amplifier. Voltage sensitive input for full scale 100 µV up to 1 mV.
LOCK-IN REF INPUT	BNC socket for oscillator reference input.
DIGITAL CONTROL	25-way sub-D socket for digital control of the lock-in amplifier.

Pin	Signal
1	overload
2-4	not connected
5,6	sensitivity
7,8	time constant
9-12	phase setting
13	digital ground
14	unlocked
15-17	not connected
18	sensitivity
19	low drift/high dynamic
20	time constant
21	slope
22-25	phase settings

Technical Details

General

Power input	±15 V, 100 mA, 3 VA
Frequency range	voltage sensitive input: 1 kHz to 20 kHz current sensitive input: 10 Hz to 15 kHz
Reference input	TTL pulse (switchable to signal between ±100 mV and ±15 V)
Phase	0 to 360° with 8-bit resolution, drift < 0.01°/K;
Phase accuracy	±1 bit for frequencies between 10 Hz and 10 kHz ±3 bit for frequencies between 10 kHz and 20 kHz

Voltage Sensitive Input

Sensitivity (full scale)	30 μV_{eff} to 1 V_{eff}, in 1 - 3 - 10 sequence
DC	differential or non-symmetric
AC	non-symmetric
Impedance	1 MΩ non-symmetric, 2 MΩ differential
Noise	typically 12 nV / $\sqrt{Hz}$ at 1 kHz
Common mode rejection	typically 110 dB at 1 kHz 100 dB at 10 kHz
Gain stability	< 100 ppm/K
Input dynamics	50 dB

Output

Output voltage	±10 V full scale at 2 kHz
Impedance	50 Ω
Stability	< 50 ppm/K
Accuracy	2%

Low Pass

time constant	3 ms to 10 s, variable in 1-3-10 sequence; choice of 6 dB/octave or 12 dB/octave

6. Matching Unit LEED (MUL)

The matching unit for LEED operation (MUL) consists of a preamplifier and a modulator. The oscillator voltage is added to the retard voltage from the NG LEED within the modulator box which also connects the grids and the electron gun to the appropriate voltages. The electron current onto the SPECTALEED screen is amplified within the amplifier box and transferred to a voltage output.

Crosstalk between the modulated voltage at the grids and the screen can be suppressed by adjusting phase and sensitivity at the amplifier.

7. Operation

Filament Operation

The internal electron gun of SPECTALEED optics is supplied with a WTh (thoriated tungsten) filament.

A LaB_6 (lanthanum-hexaboride) filament is available on application. The LaB_6 filament is a directly heated thermal electron emitter which combines a high achievable emission current with low operating temperatures (approx. 1700 K and less) and a low work function.

The NG LEED provides a high current supply for filament heating. Its output current is regulated by the 10-turn potentiometer FILAMENT on the front panel.

Filament degassing and run-up as well as the forming procedure for exchange filaments are described in detail in the instruction manual for SPECTALEED optics. Please refer to the respective manual for operation.

Emission Current Regulation

The NG LEED is equipped with an emission current regulation. The filament emission is measured as the current flow to the anode. It hence not only depends on the filament current but also on the Wehnelt setting. NOTE: the emission current regulation only works for 0 - 50 µA, at higher values it may be unstable.

For switching on the electron gun

- set the emission potentiometer fully clockwise and check that the green Filament LED is lit.
- Adjust all lens settings for best signal (in either Auger or LEED mode).
- Bring down the filament current until the emission is a little over 50 µA.
- To keep the beam current stable now turn the emission current potentiometer counter clockwise until the Filament LED turns off and the Emission LED lights up (about half way).

The emission current regulation is now active, indicated by the green Emission LED. If the Emission LED turns off and the Filament LED lights up, the preset filament current limit is too low to achieve the preset emission current.

In this case raise the filament current by turning the potentiometer clockwise. Always take care not to exceed the maximum allowable filament current.

For jumper locations and values please refer to page 27.



Please note: changing the Wehnelt voltage also changes the measured emission current drastically. This can easily result in an increase of the filament current up to its limit. Always set the Wehnelt voltage before activating the emission current regulation.

The emission regulation circuit is sensitive to the filament type. In case of changing the filament type (LaB_6 or WTh), the circuit must be adjusted by setting the correct jumper, see page 27.

Beam Current Measurement

All electron gun potentials are related to a near-earth potential "0". This is connected to the system ground via an operational amplifier to allow direct beam current measurements. Since all return currents to elements of the gun are connected to this potential, they do not contribute to the measured beam current, see figure 6. **The measured beam current is hence equal to the total current emitted by the gun.**

Hints of Operation

It is recommended to switch off the screen supply during sample preparation in order to avoid any harmful influence to the screen.

Lens voltages are optimized by modifying OFFSET at low energies, GAIN at high energies. Optimum can be found when this procedure is cyclically repeated for all lens elements until LEED spots remain sharp over the energy range of interest.



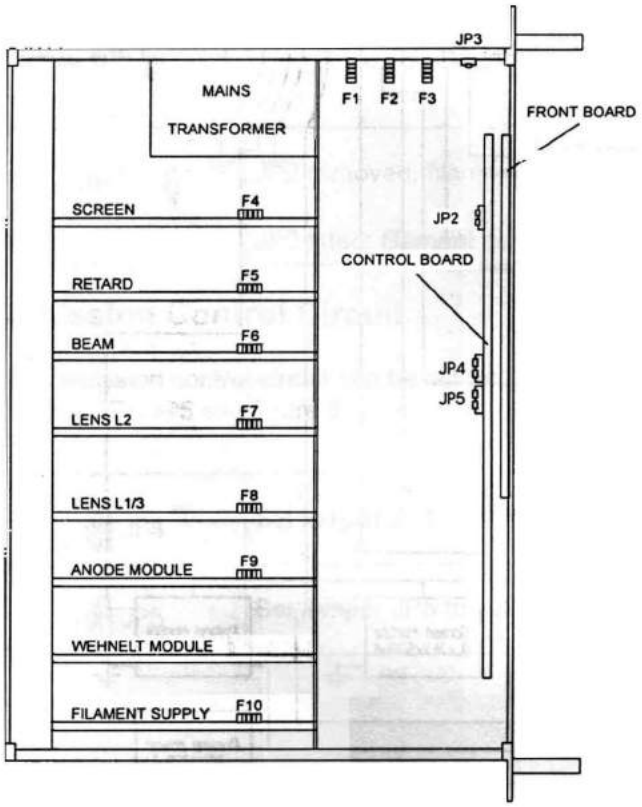
Please note: WEHNELT allows fine focusing. Do not use the Wehnelt for adjusting the beam current.

SUPPRESSOR changes the retard grid potential in order to suppress the secondary (inelastic scattered) electrons. Start optimising for best spot to background intensity ratio with potentiometer turned counter clockwise. For low energy work it may be useful to turn the suppressor off.

For remote control of the energy and lower beam current measurements see page 16.

8. Technical Information

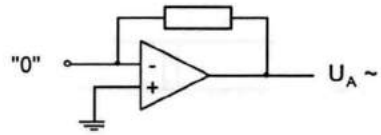
Layout of Unit



Fuse	Valu
F1	1 A (T
F2	1.6 A (T
F3	1 A (T)
F4	630 mA (T
F5	630 mA (T
F6	630 mA (T
F7	630 mA (T
F8	630 mA (T
F9	630 mA (T
F10	630 mA (T

Figure 5. Location of boards, jumpers and fuses within the unit as seen from the top.

Reference Potentials '0' and 'K'



"0" Near earth potential, which is connected to system earth via an operational amplifier to allow direct beam current measurement. Since all return currents to the elements of the gun are connected to this potential they do not contribute to the measured current which therefore is equal to the total current emitted by the gun.

'K' Cathode potential at centre of filament, equal to the kinetic energy of the emitted electrons. Potential is set by beam energy with respect to '0'-potential.

Principle of Operation

The principle of operation of the SPECTALEED control unit is shown in the following diagram :

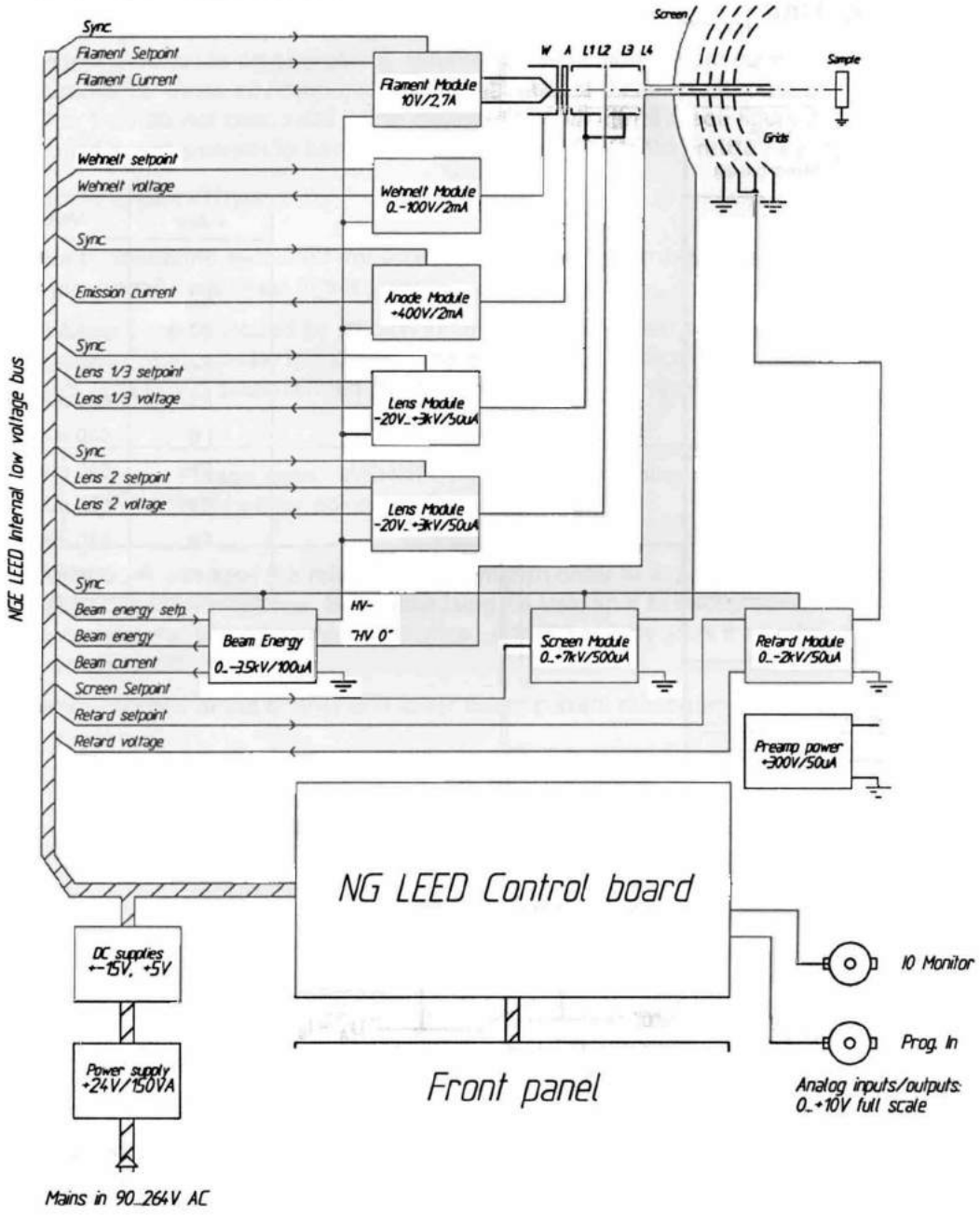


Figure 6. Principle of operation, schematic diagram.

9. Adjustments

Filament Current Limit

The filament current limit can be set to be 1.7 A or 2.7 A using jumper JP2 on the control board, see figure 5.

JP2 	JP2 removed: filament current limit is 1.7 A. JP2 fitted: filament current limit is 2.7 A.

Emission Control Circuit

The emission control circuit can be set for LaB_6 filaments or for WTh filaments using jumper JP4/JP5 see figure 5.

 JP4	Set jumper JP4 to select WTh filament.
 JP5	Set jumper JP5 to select LaB_6 filament.

10. Maintenance

> **Warning: Lethal Voltages!!**
>
> Adjustments and fault finding measurements as well as **installation procedures and repair work** may only be carried out by authorised personnel qualified to handle lethal voltages.

> **ATTENTION!** Use an isolated DVM for measurement, range max. 1000 V dc, R_i 10 MΩ

Faultfinding Guide

Problem:	Check:
After switching on, all front panel push-buttons are lit except for the Auger button	The security switch is open. Check that the LEED cable is properly connected.

11. LIAC Operation in Digital Mode

All settings relevant for Auger electron spectroscopy using a CMA or a 4-grid SPECTALEED optics are controlled by the LIA 100 software together with the I/O interface board.

The lock-in is run using the 16 TTL-compatible digital inputs. The level at these inputs must be constant during a measurement. A group of 8 inputs set the phase from 0° to 360° in 256 steps.

The following tables show all functions and logical values which can be set digitally. The pin numbering is for the 25 'D' connector on the rear panel, the pin numbering on the lock-in module is different.

TIME CONSTANT	PIN 8	PIN 20	PIN 7
3 ms	low	low	low
10 ms	low	low	high
30 ms	low	high	low
100 ms	low	high	high
300 ms	high	low	low
1 s	high	low	high
3 s	high	high	low
10 s	high	high	high

Table 3. Time constant logical levels.

SLOPE	PIN 21	INPUT	
		(switch)	(S3)
6 dB/octave	low	voltage input	on
12 dB/octave	high	current input	off

Table 4. Slope and input logical levels.

SENSITIVITY	LOW DRIFT				HIGH DYN. RESERVE			
	Pin 19	Pin 6	Pin 18	Pin 5	Pin 19	Pin 6	Pin 18	Pin 5
1V	low	low	low	low	-	-	-	-
300mV	low	low	low	high	-	-	-	-
100mV	low	low	high	low	high	low	low	low
30mV	low	low	high	high	high	low	low	high
10mV	low	high	low	low	high	low	high	low
3mV	low	high	low	high	high	low	high	high
1mV	low	high	high	low	high	high	low	low
300µV	low	high	high	high	high	high	low	high
100µV	-	-	-	-	high	high	high	low
30µV	-	-	-	-	high	high	high	high

Table 5. Sensitivity logical levels.

PHASE	BIT	PIN
LSB	Phi 0	9
	Phi 1	22
	Phi 2	10
	Phi 3	23
	Phi 4	11
	Phi 5	24
	Phi 6	12
MSB	Phi 7	25

Table 6. Phase settings of the lock-in.

Switch S1 is set to ON to set the reference input level to 2.0 V. Switch S2 is set to ON to ensure a stable phase.

12. Circuit Diagrams

Schematics of the boards and wiring diagrams can be found on following pages.

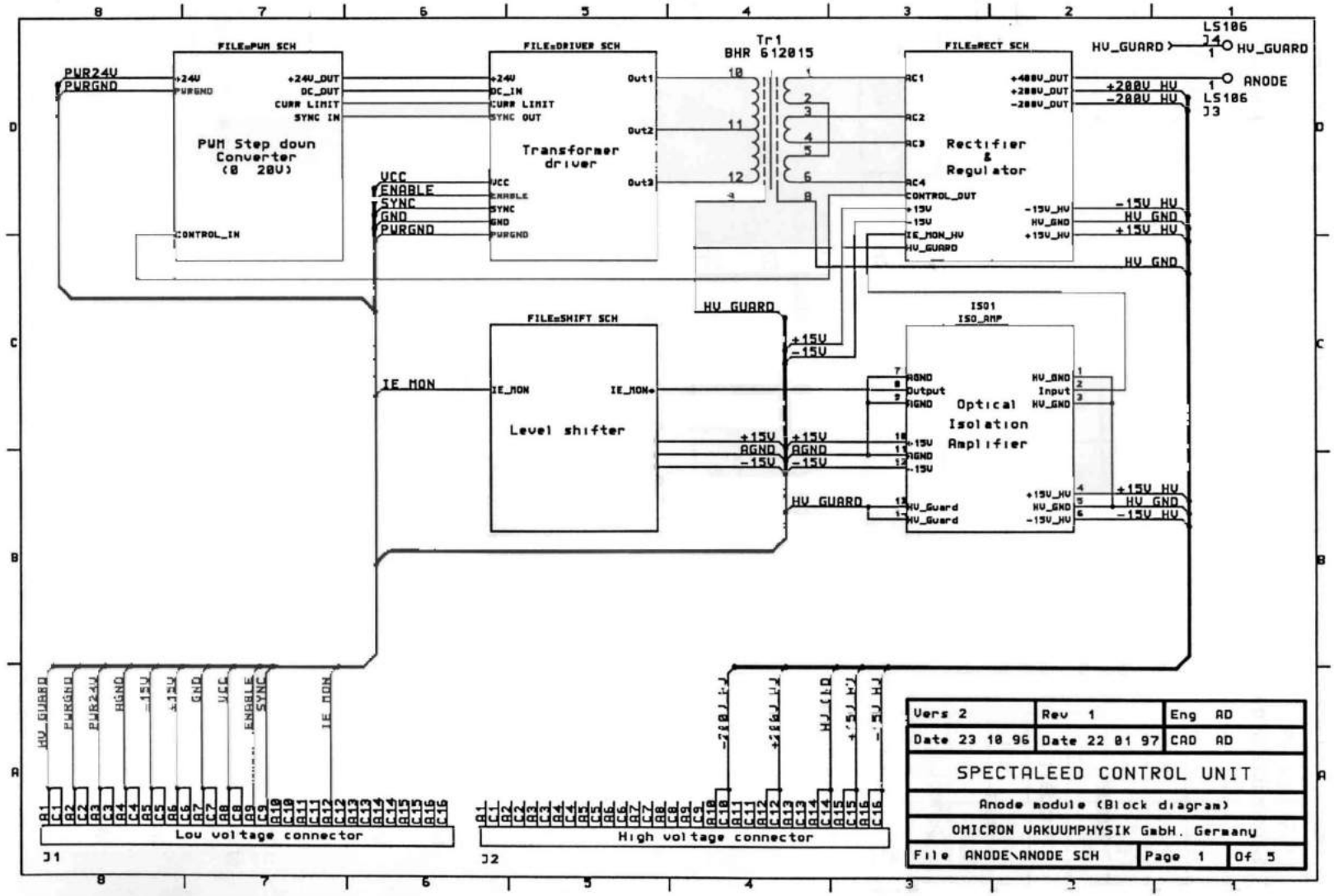
NG LEED

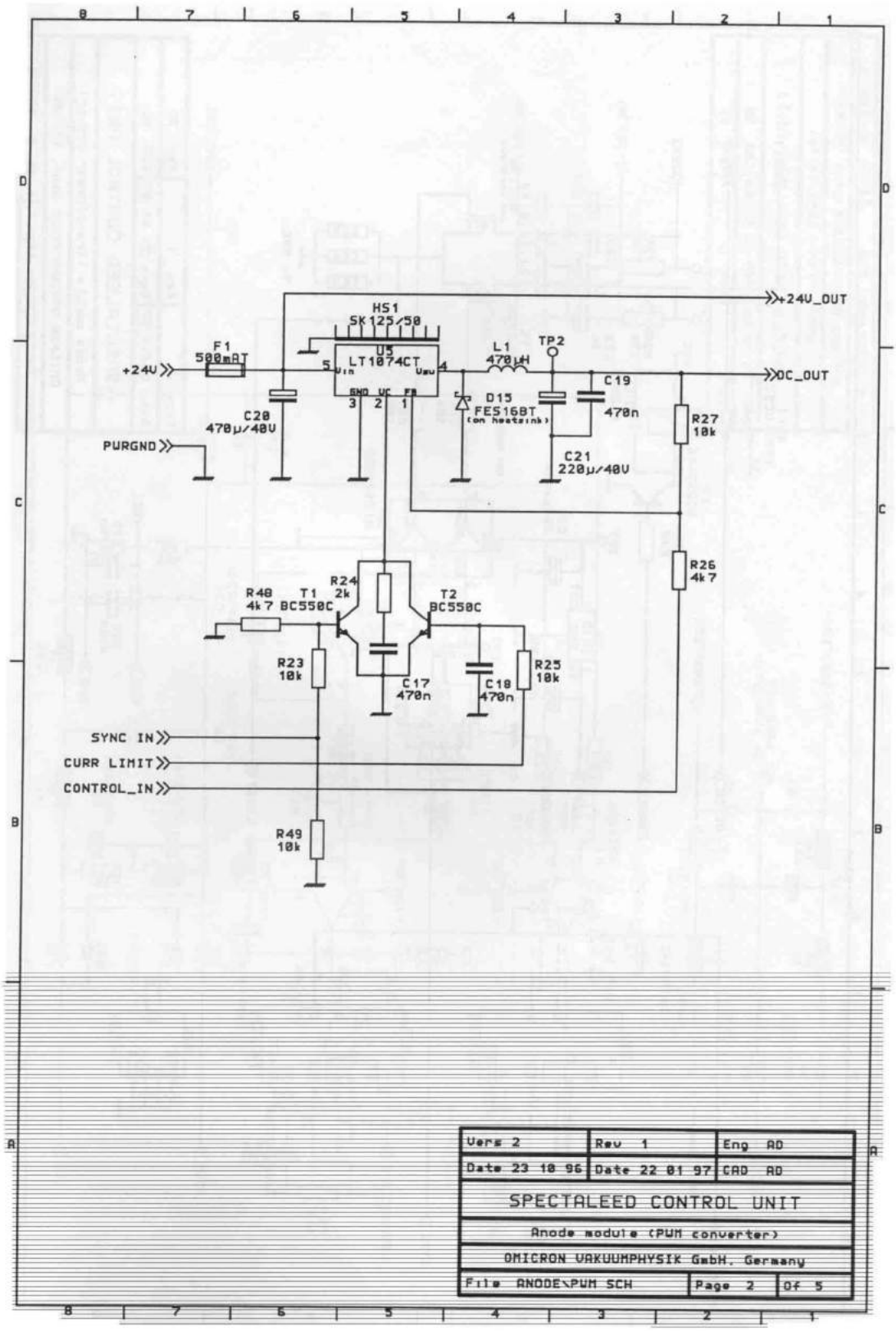
Module	page
Anode	32
Beam	37
Control	42
Filament	46
Floating Supply	51
Front Panel	52
Lens	53
Motherboard	58
Opto-Iso	60
Retard	61
Screen	66
Wehnelt	71
Wiring	74

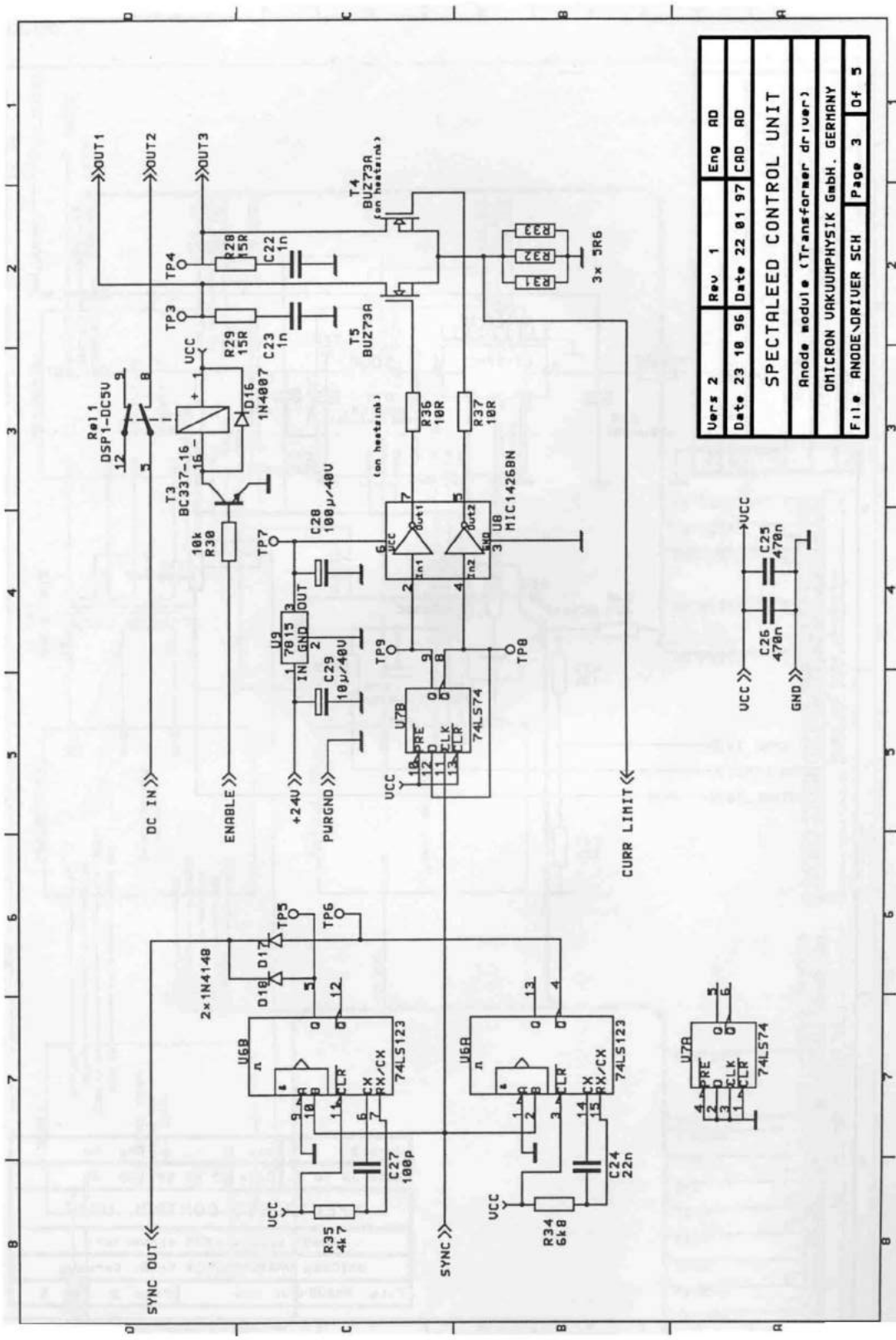
Additional

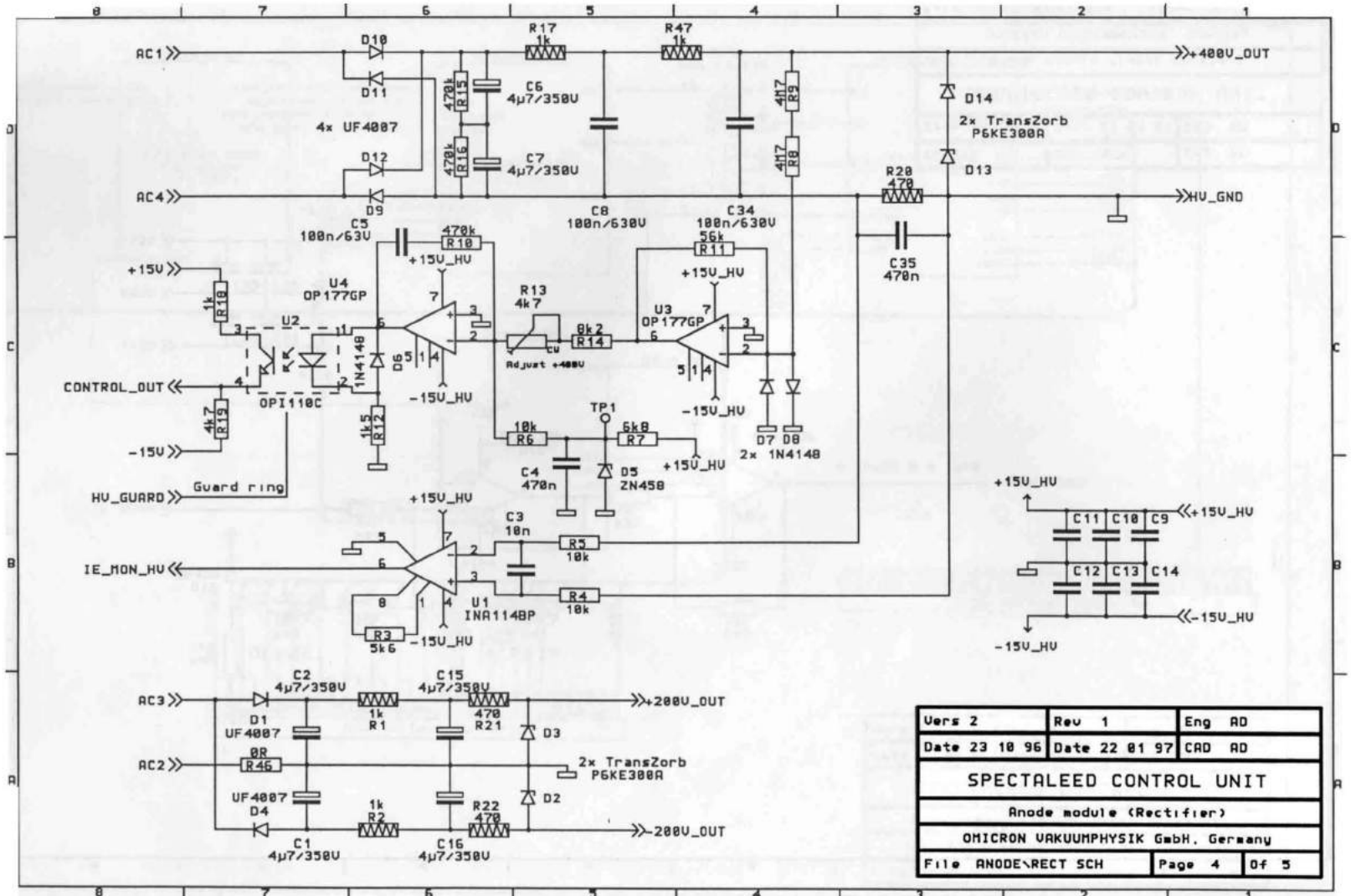
Module	page
Lock-In Amplifier	77
Interface / Precision Oscillator	78
Matching Unit LEED (MUL)	80

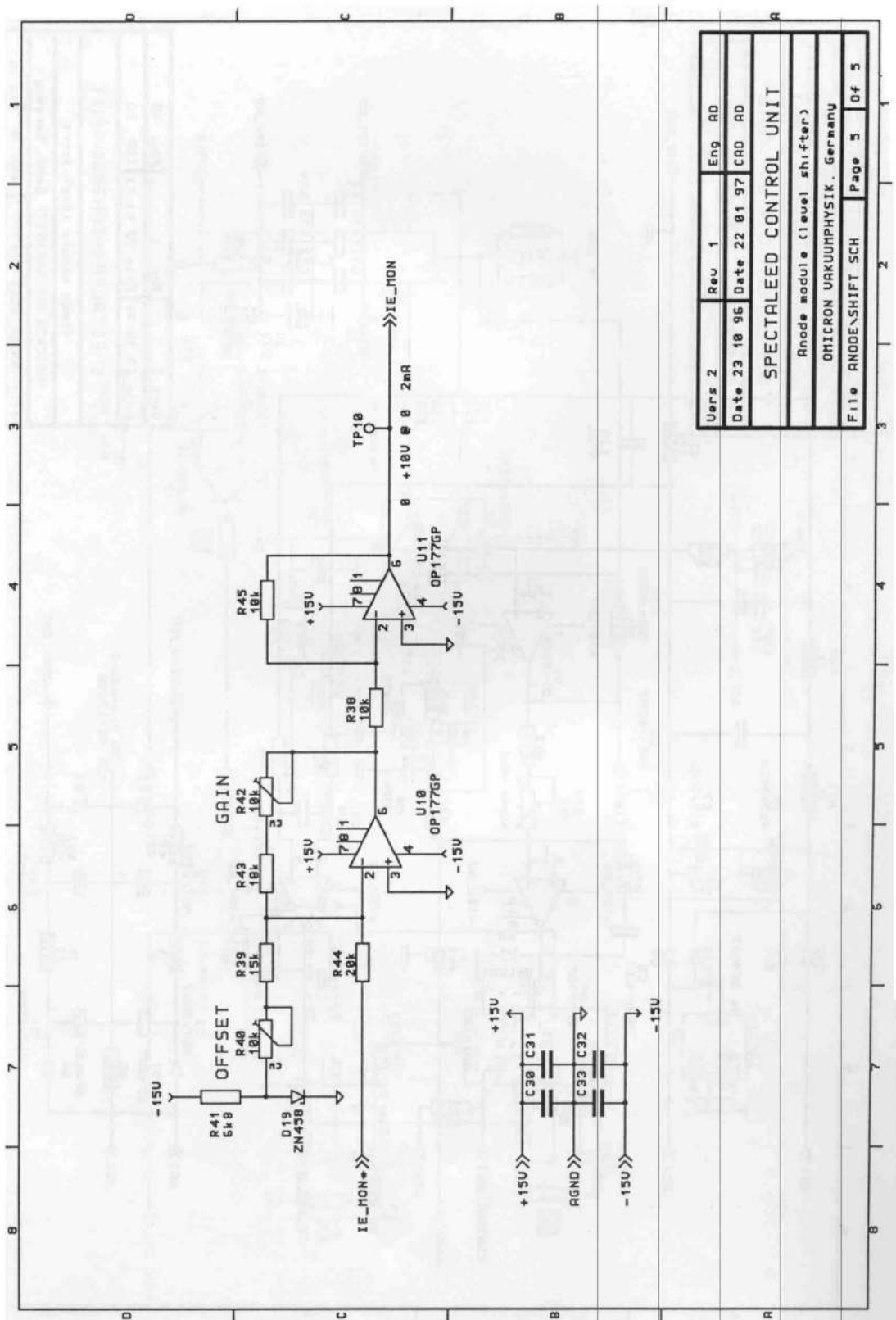
Anode


FILE=PWM.SCH
PWR24V
PWRGND
+24V
PWRGND
+24V_OUT
DC_OUT
CURR LIMIT
SYNC IN
CONTROL_IN
PWM Step doun Converter (0 28V)
FILE=DRIVER.SCH
+24V
DC_IN
CURR LIMIT
SYNC OUT
Out1
Out2
Out3
Transformer driver
VCC
ENABLE
SYNC
GND
PWRGND
Tr1
BHR 612015
FILE=RECT.SCH
AC1
AC2
AC3
AC4
CONTROL_OUT
+15V
-15V
IE_MON_HV
HV_GUARD
+400V_OUT
+200V_OUT
-200V_OUT
Rectifier & Regulator
-15V_HV
HV_GND
+15V_HV
HV_GUARD
LS106
J4
HV_GUARD
+200V HV
-200V HV
ANODE
LS106
J3
-15V HV
HV GND
+15V HV
HV GND
FILE=SHIFT.SCH
IE_MON
IE_MON
IE_MON
Level shifter
+15V
-15V
AGND
-15V
ISO1
ISO_AMP
AGND
Output
AGND
HV_GND
Input
HV_GND
Optical Isolation Amplifier
+15V
AGND
-15V
HV_Guard
HV_Guard
+15V_HV
HV_GND
-15V_HV
+15V HV
HV GND
-15V HV
HV_GUARD
PWRGND
PWR24V
AGND
-15V
+15V
GND
VCC
ENABLE
SYNC
IE_MON
Low voltage connector
J1
-PWR24V
+PWR24V
HV_GUARD
-15V_HV
+15V_HV
High voltage connector
J2
Vers 2
Rev 1
Eng AD
Date 23 10 96
Date 22 01 97
CAD AD
SPECTALEED CONTROL UNIT
Anode module (Block diagram)
OMICRON VAKUUMPHYSIK GmbH. Germany
File ANODE\ANODE.SCH
Page 1
Of 5

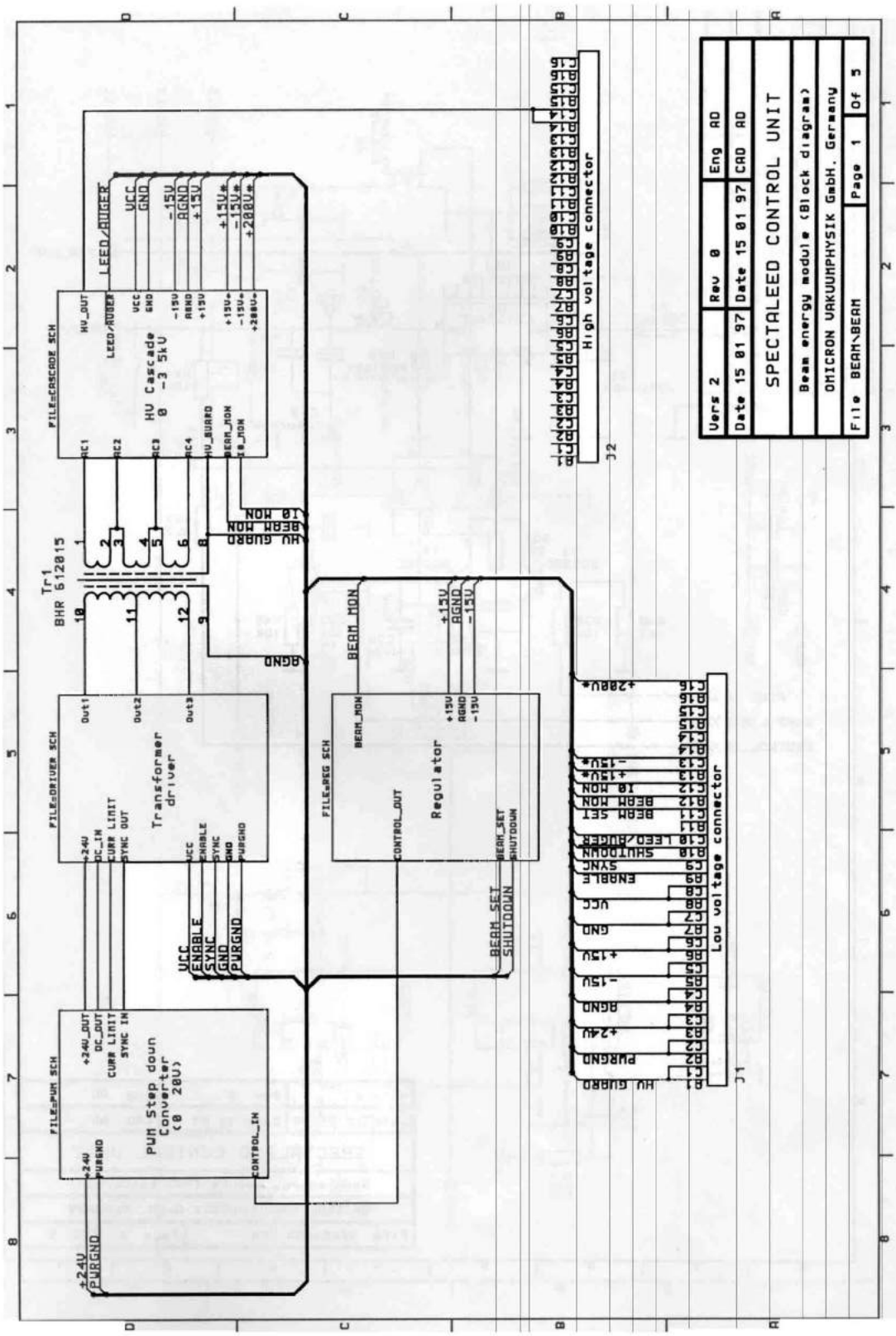

HS1
SK125/50
U5
LT1074CT
F1
500mAT
+24V
+24V_OUT
L1
470µH
TP2
DC_OUT
C19
470n
C20
470µ/40V
D15
FES16BT
(on heatsink)
C21
220µ/40V
R27
10k
PURGND
R26
4k7
R48
4k7
T1
BC550C
R24
2k
T2
BC550C
R23
10k
C17
470n
C18
470n
R25
10k
SYNC IN
CURR LIMIT
CONTROL_IN
R49
10k
Vers 2
Rev 1
Eng AD
Date 23 10 96
Date 22 01 97
CAD AD
SPECTALEED CONTROL UNIT
Anode module (PWM converter)
OMICRON VAKUUMPHYSIK GmbH, Germany
File ANODE\PWM SCH
Page 2
Of 5

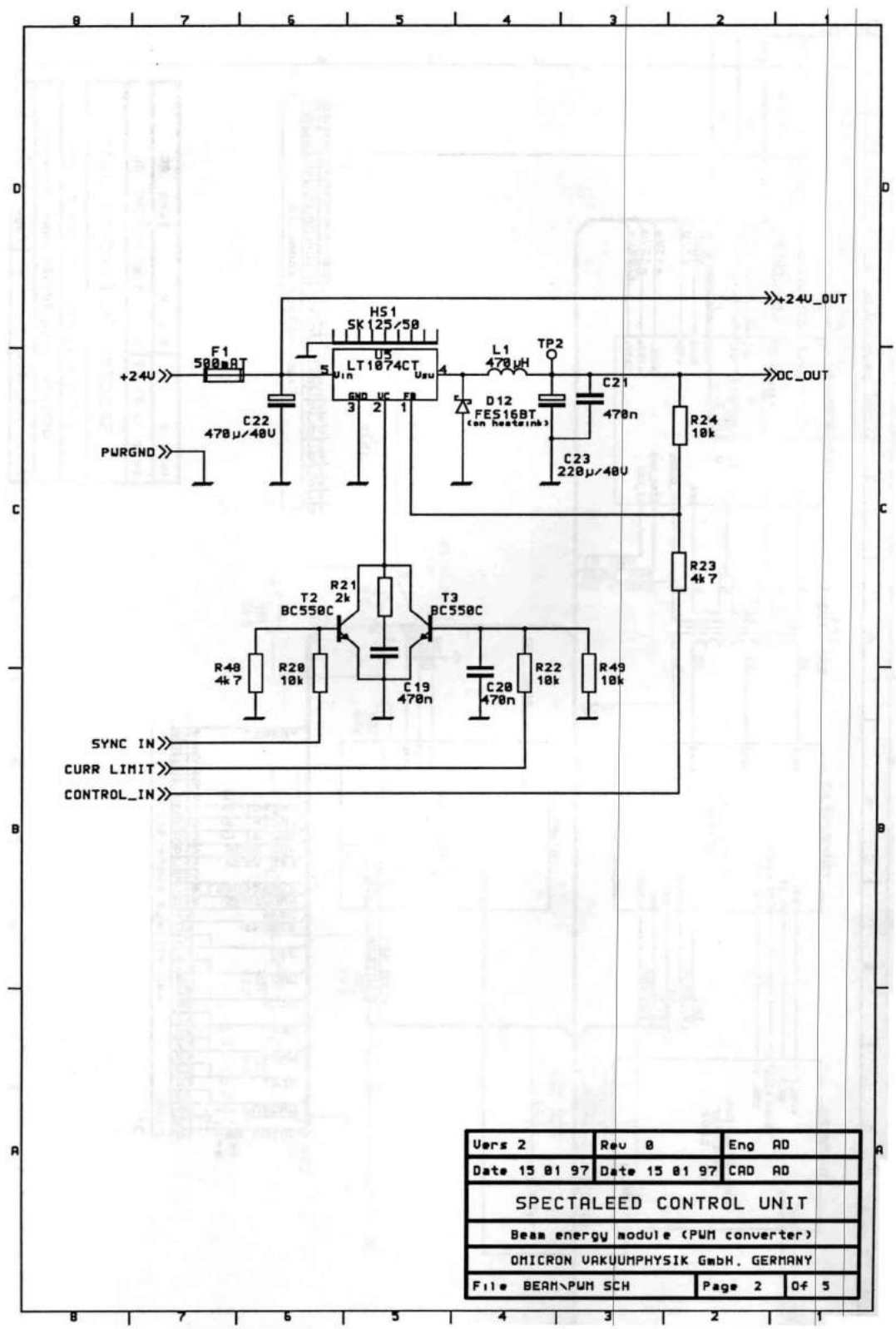

SPECTALEED CONTROL UNIT
Anode module (Transformer driver)
OMICRON VAKUUMPHYSIK GmbH., GERMANY
Vers 2
Rev 1
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Date 23 10 96
Date 22 01 97
CAD AD
File ANODEDRIVER SCH
Page 3
Of 5
OUT1
OUT2
OUT3
DC IN
ENABLE
+24V
PURGND
CURR LIMIT
SYNC OUT
SYNC
VCC
GND
Rel1 DSP1-DC5V
T3 BC337-16
T4 BUZ73A (on heatsink)
T5 BUZ73A (on heatsink)
D16 1N4007
D17 D18 2×1N4148
U8 MIC1426BN
U9 7815
U7B U7A 74LS74
U6B U6A 74LS123
R28 15R
R29 15R
R30 10k
R31 R32 R33 3× 5R6
R34 6k8
R35 4k7
R36 10R
R37 10R
C20 100µ/40V
C22 1n
C23 1n
C24 22n
C25 470n
C26 470n
C27 100p
C29 10µ/40V
TP3 TP4 TP5 TP6 TP7 TP8 TP9

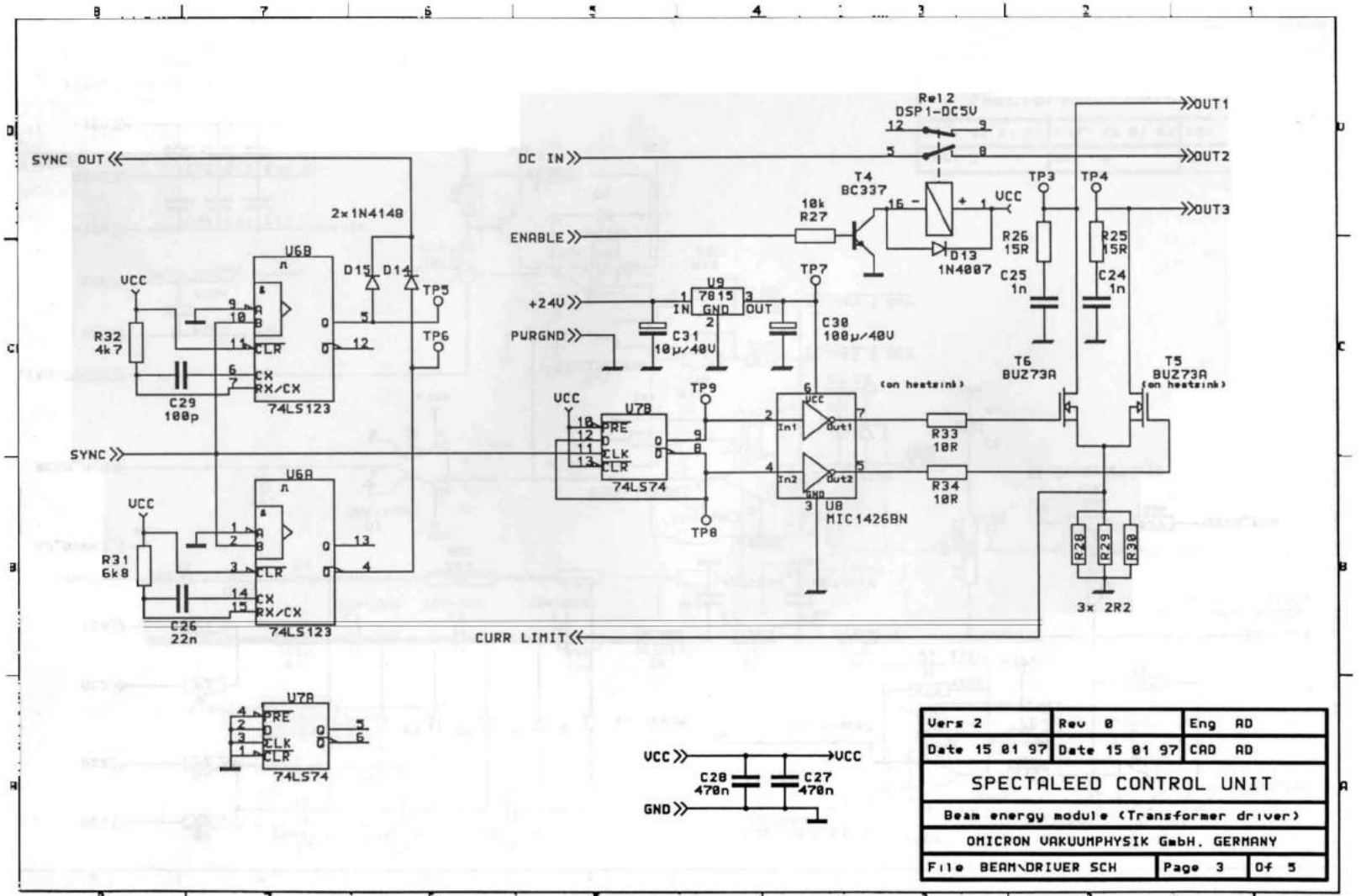

AC1
AC4
AC3
AC2
D10
D11
D12
D9
4x UF4007
R17 1k
R47 1k
C6 4µ7/350V
C7 4µ7/350V
C8 100n/630V
C34 100n/630V
C5 100n/63V
R15 470k
R16 470k
R10 470k
R11 56k
R5 4k7
R8 4k7
D14
2x TransZorb P6KE300A
D13
R20 470
C35 470n
+400V_OUT
HV_GND
+15V
-15V
CONTROL_OUT
HV_GUARD
Guard ring
U2
OPI110C
1N4148
D6
R18 1k
R19 4k7
R12 1k5
U4 OP177GP
U3 OP177GP
R13 4k7
Adjust +400V
R14 8k2
R6 10k
R7 5k6
TP1
C4 470n
D5 ZN458
D7 D8
2x 1N4148
+15V_HV
-15V_HV
IE_MON_HV
C3 10n
R5 10k
R4 10k
R3 5k6
U1 INA114BP
C11 C10 C9
C12 C13 C14
C2 4µ7/350V
C15 4µ7/350V
D1 UF4007
D4 UF4007
R1 1k
R2 1k
R21 470
R22 470
R46 0R
D3
D2
2x TransZorb P6KE300A
C1 4µ7/350V
C16 4µ7/350V
+200V_OUT
-200V_OUT
Vers 2
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Date 23 10 96
Date 22 01 97
CAD AD
SPECTALEED CONTROL UNIT
Anode module (Rectifier)
OMICRON VAKUUMPHYSIK GmbH, Germany
File ANODE\RECT SCH
Page 4
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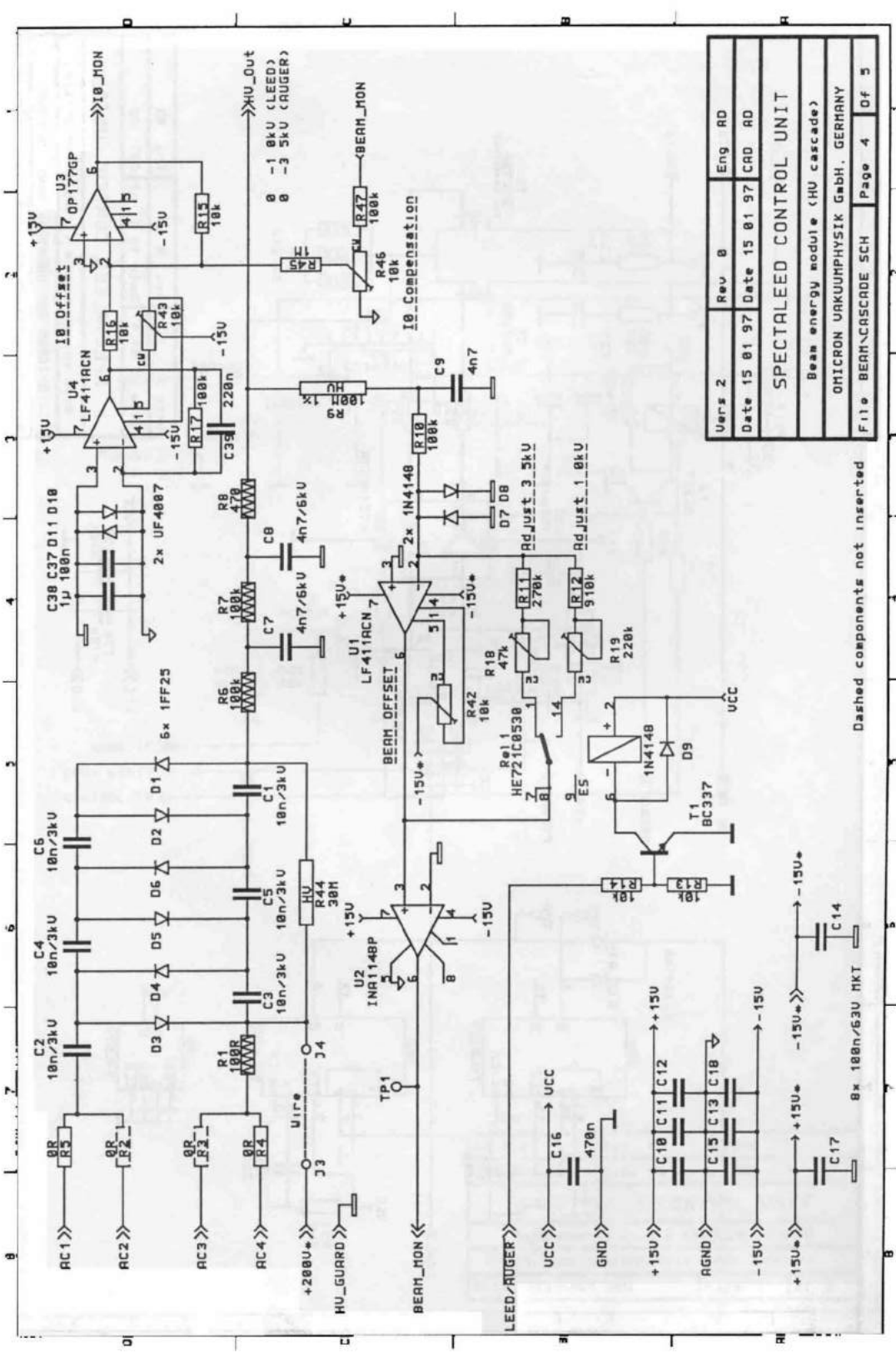

Vers 2
Rev 1
Eng AD
Date 23 10 96
Date 22 01 97
CAD AD
SPECTALEED CONTROL UNIT
Anode module (level shifter)
OMICRON VAKUUMPHYSIK, Germany
File ANODE\SHIFT SCH
Page 5
Of 5
IE_MON
TP10
0 +10V @ 0 2mA
U11
OP177GP
U10
OP177GP
R45 10k
R38 10k
R42 10k
R43 10k
R39 15k
R44 20k
R40 10k
R41 6k8
D19 ZN458
GAIN
OFFSET
+15V
-15V
C30
C31
C32
C33
AGND

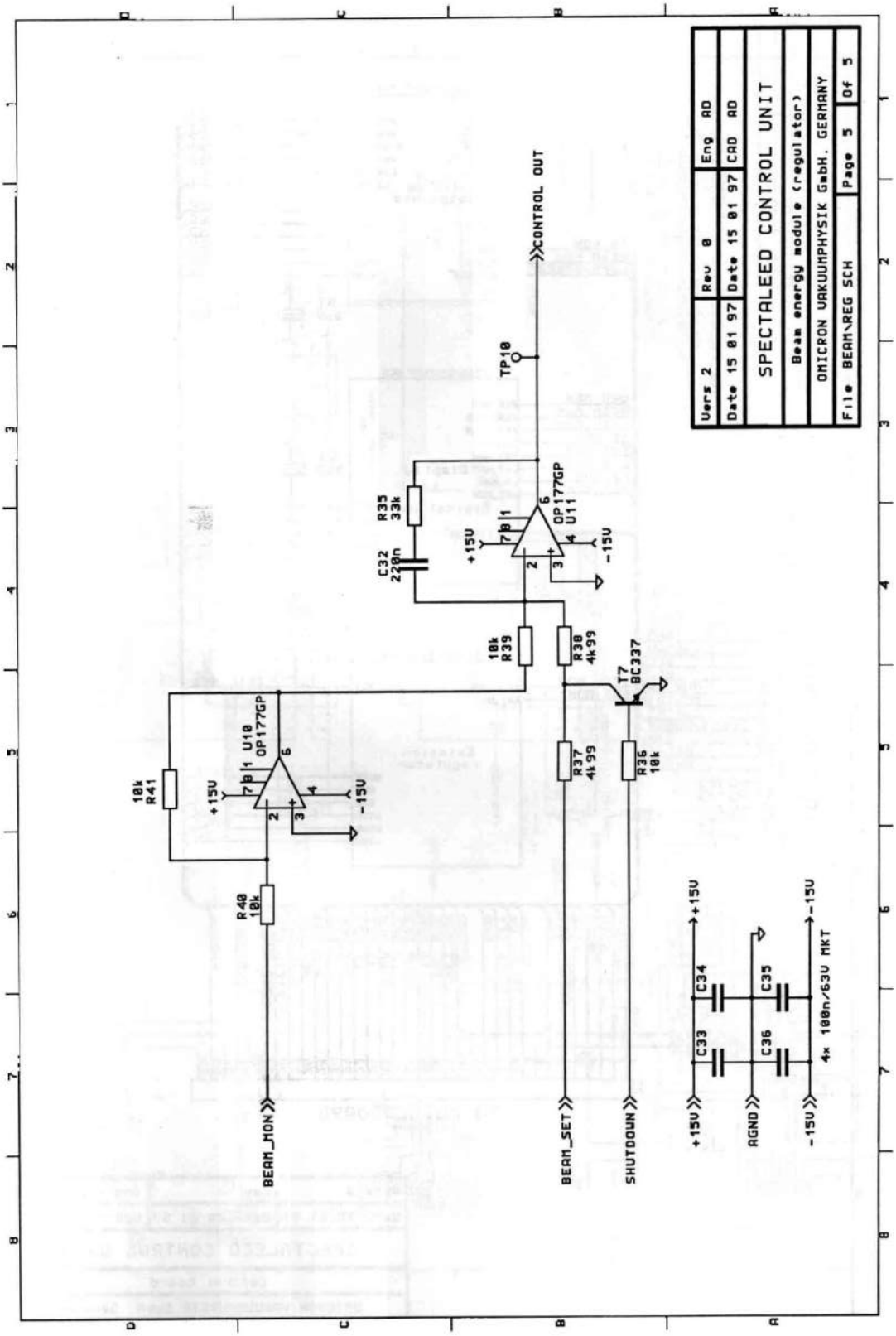
Beam


SPECTALEED CONTROL UNIT
Beam energy module (Block diagram)
OMICRON VAKUUMPHYSIK GmbH, Germany
Vers 2
Rev 0
Eng AD
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Date 15 01 97
CAD AD
File BEAM\BEAM
Page 1
Of 5
High voltage connector
Low voltage connector
HV Cascade
0 -3 5kU
Transformer driver
Regulator
PWM Step down Converter (0 28V)
BEAM_MON
BEAM_SET
SHUTDOWN
ENABLE
SYNC
VCC
GND
PURGND
AGND
+15V
-15V
+24V
+280V*
HV_GUARD
10 MON

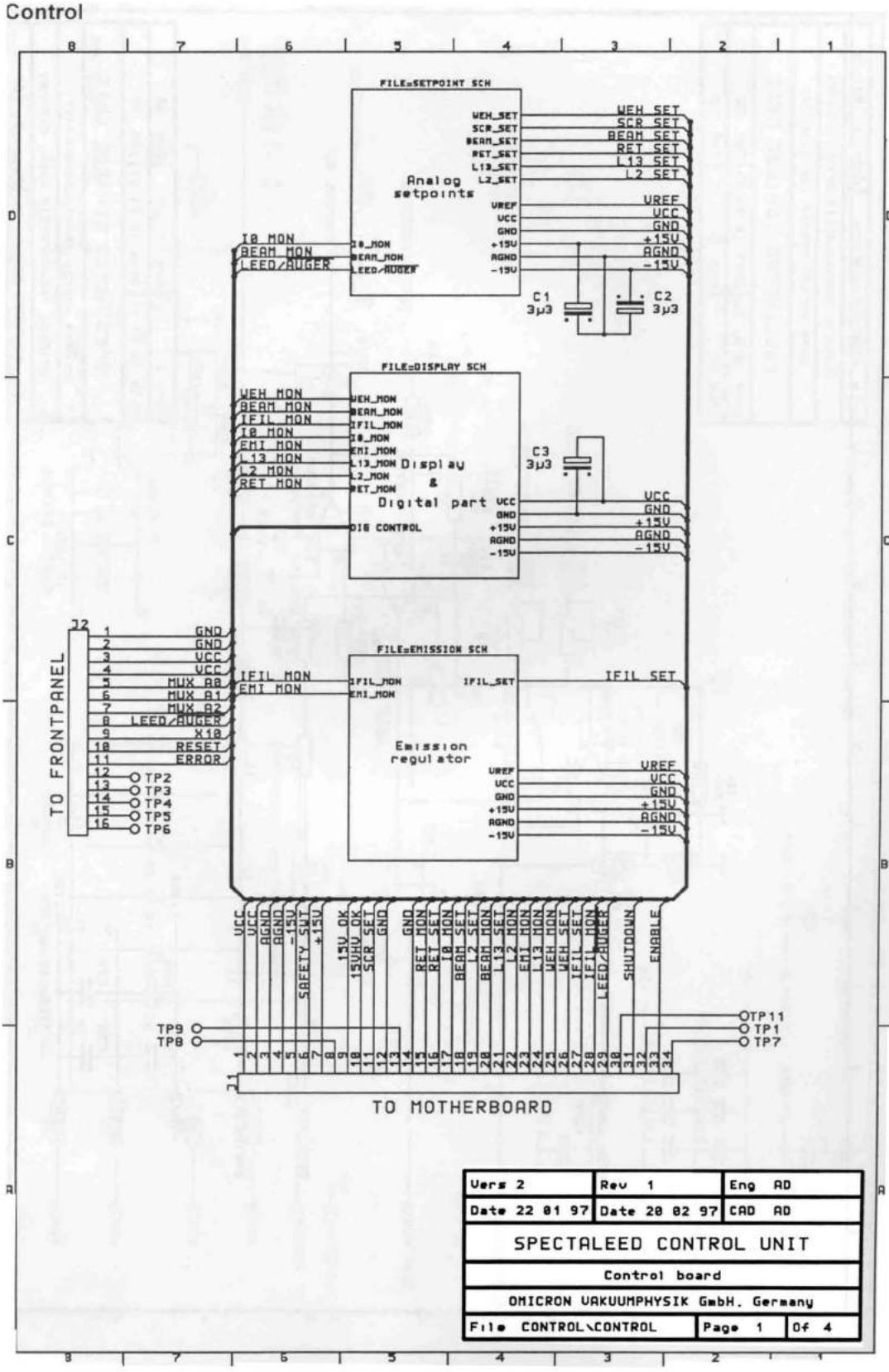

HS1
SK 125/50
F1
500mAT
+24V
U5
LT1074CT
L1
470µH
TP2
+24V_OUT
OC_OUT
C21
470n
D12
FES16BT
(on heatsink)
C22
470µ/40V
C23
220µ/40V
R24
10k
PURGND
R23
4k7
R21
2k
T2
BC550C
T3
BC550C
R48
4k7
R20
10k
C19
470n
C20
470n
R22
10k
R49
10k
SYNC IN
CURR LIMIT
CONTROL_IN
Vers 2
Rev 0
Eng AD
Date 15 01 97
Date 15 01 97
CAD AD
SPECTALEED CONTROL UNIT
Beam energy module (PWM converter)
OMICRON VAKUUMPHYSIK GmbH. GERMANY
File BEAM\PWM SCH
Page 2
Of 5

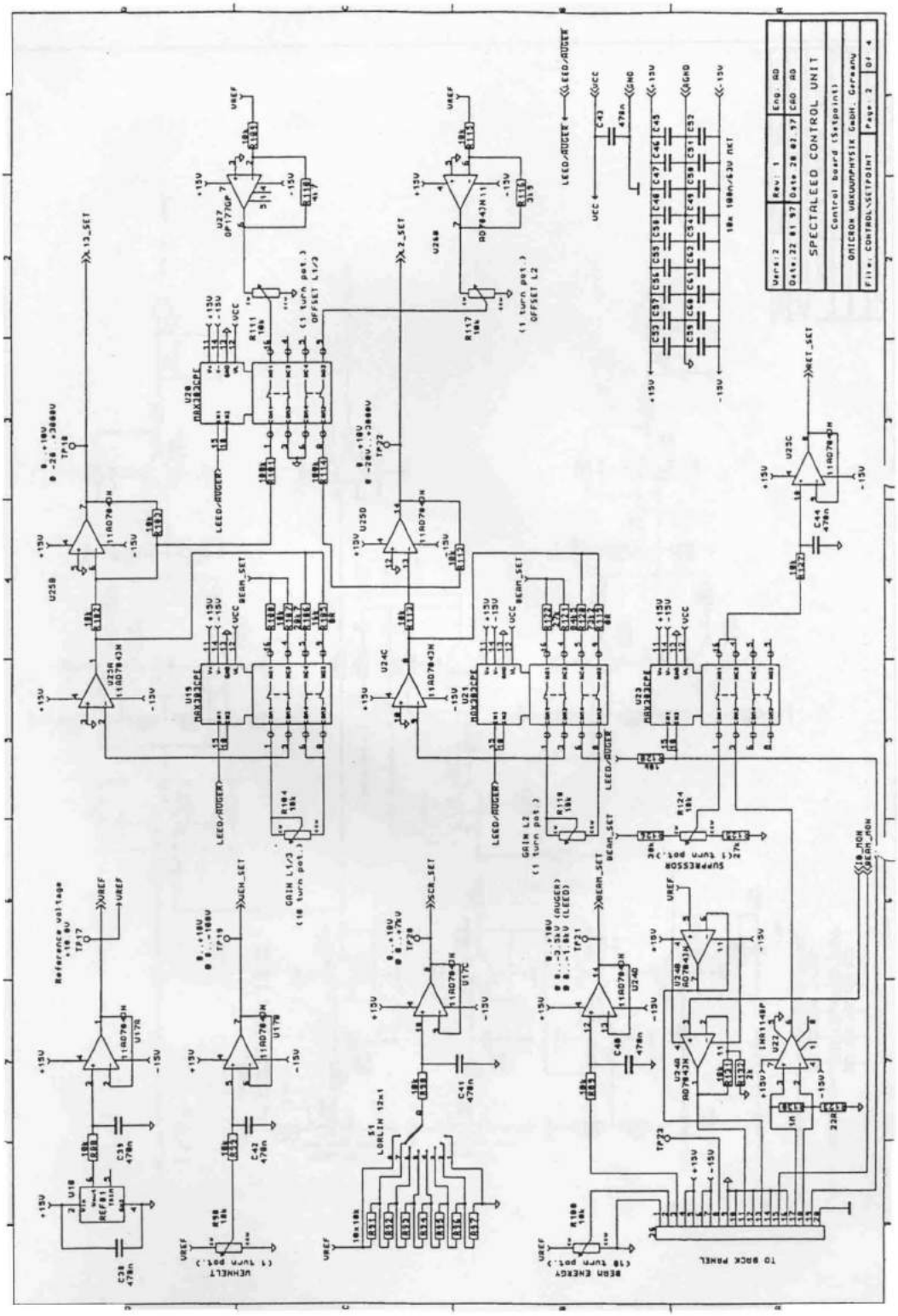

SYNC OUT
DC IN
ENABLE
+24V
PURGND
SYNC
CURR LIMIT
2x1N4148
D15
D14
TP5
TP6
U6B
U6A
74LS123
R32 4k7
R31 6k8
C29 100p
C26 22n
VCC
U7B
74LS74
TP9
TP8
U8 MIC1426BN
R33 10R
R34 10R
Rel2 DSP1-DC5V
OUT1
OUT2
OUT3
T4 BC337
10k R27
D13 1N4007
TP3
TP4
TP7
R26 15R
R25 15R
C25 1n
C24 1n
U9 7815 IN GND OUT
C31 10µ/40V
C30 100µ/40V
T6 BUZ73A
T5 BUZ73A
(on heatsink)
R28
R29
R30
3x 2R2
U7A
C28 470n
C27 470n
Vers 2
Rev 0
Eng AD
Date 15 01 97
Date 15 01 97
CAD AD
SPECTALEED CONTROL UNIT
Beam energy module (Transformer driver)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
File BEAM\DRIVER SCH
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SPECTALEED CONTROL UNIT
Beam energy module (HV cascade)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
Vers 2
Rev 0
Eng AD
Date 15 01 97
Date 15 01 97
CAD AD
File BEAM-CASCADE SCH
Page 4
Of 5
Dashed components not inserted
I0_MON
HV_Out
0 -1 0kV (LEED)
0 -3 5kV (AUGER)
BEAM_MON
I0_Offset
I0_Compensation
Adjust_3_5kV
Adjust_1_0kV
BEAM_OFFSET
2x UF4007
2x 1N4148
6x 1FF25
1N4148
BC337
HE721C0530
AC1
AC2
AC3
AC4
+200V*
HV_GUARD
BEAM_MON
LEED/AUGER
VCC
GND
+15V
AGND
-15V
+15V*
-15V*
8x 100n/63V MKT

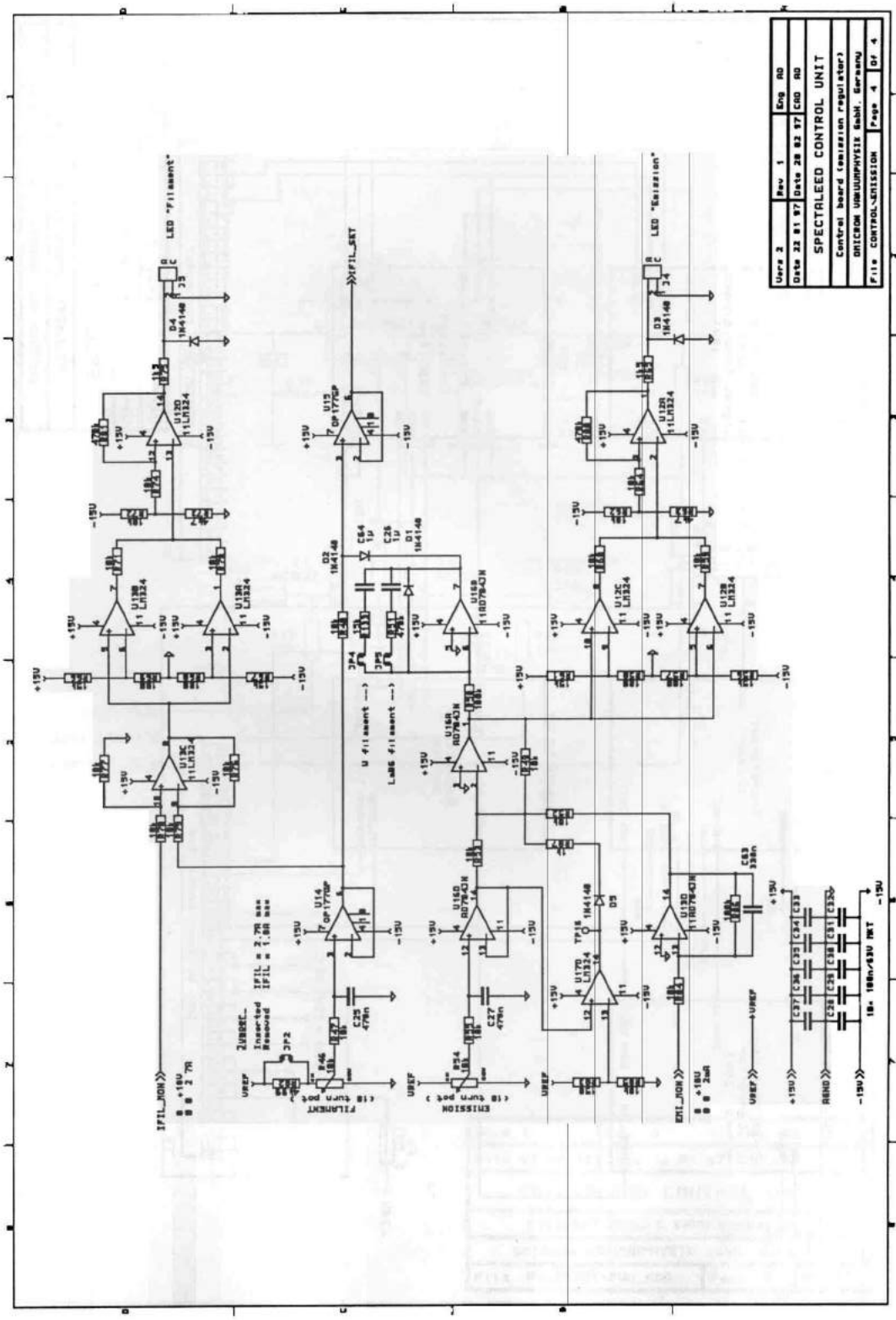

Vers 2
Rev 0
Eng AD
Date 15 01 97
Date 15 01 97
CAD AD
SPECTALEED CONTROL UNIT
Beam energy module (regulator)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
File BEAMREG SCH
Page 5
Of 5
CONTROL OUT
TP10
R35 33k
C32 220n
U11 OP177GP
+15V
-15V
10k R39
R38 4k99
T7 BC337
R37 4k99
R36 10k
10k R41
U10 OP177GP
R40 10k
BEAM_MON
BEAM_SET
SHUTDOWN
C34
C35
C33
C36
4x 100n/63V MKT
+15V
AGND
-15V

Control

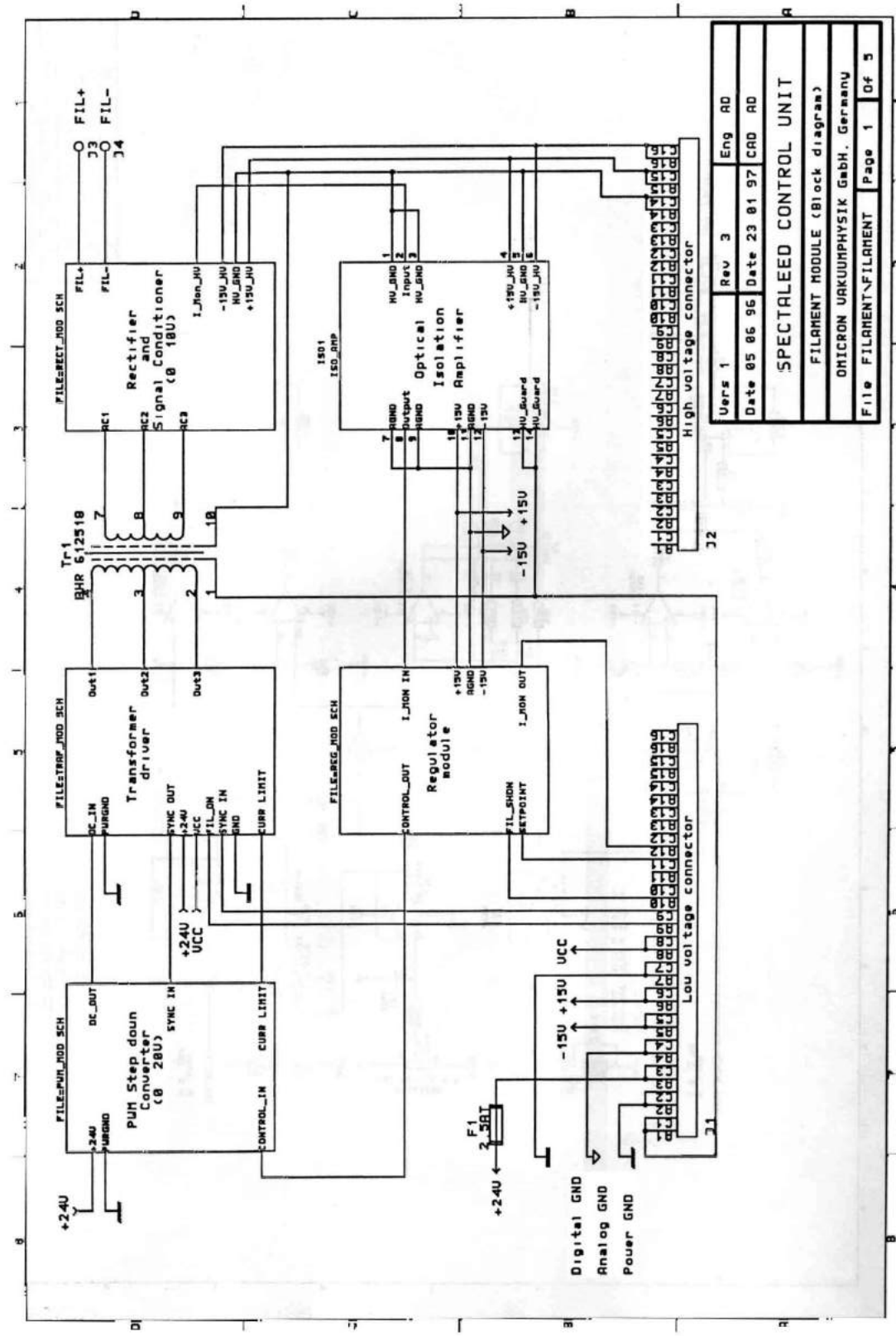

FILE=SETPOINT SCH
Analog setpoints
WEH_SET
SCR_SET
BEAM_SET
RET_SET
L13_SET
L2_SET
VREF
VCC
GND
+15V
AGND
-15V
I0 MON
BEAM MON
LEED/AUGER
C1 3µ3
C2 3µ3
FILE=DISPLAY SCH
WEH MON
BEAM MON
IFIL MON
I0 MON
EMI MON
L13 MON
L2 MON
RET MON
Display & Digital part
DIS CONTROL
C3 3µ3
FILE=EMISSION SCH
IFIL MON
EMI MON
IFIL_SET
Emission regulator
J2
TO FRONTPANEL
GND
VCC
MUX A0
MUX A1
MUX A2
X10
RESET
ERROR
TP2
TP3
TP4
TP5
TP6
TP9
TP8
TP11
TP1
TP7
J1
TO MOTHERBOARD
SAFETY SHT
15V OK
15VHV OK
SCR SET
RET MON
RET SET
I0 MON
BEAM SET
L2 SET
BEAM MON
L13 SET
L2 MON
EMI MON
L13 MON
WEH MON
WEH SET
IFIL SET
IFIL MON
LEED/AUGER
SHUTDOWN
ENABLE
Vers 2
Rev 1
Eng AD
Date 22 01 97
Date 20 02 97
CAD AD
SPECTALEED CONTROL UNIT
Control board
OMICRON VAKUUMPHYSIK GmbH, Germany
File CONTROL\CONTROL
Page 1
Of 4

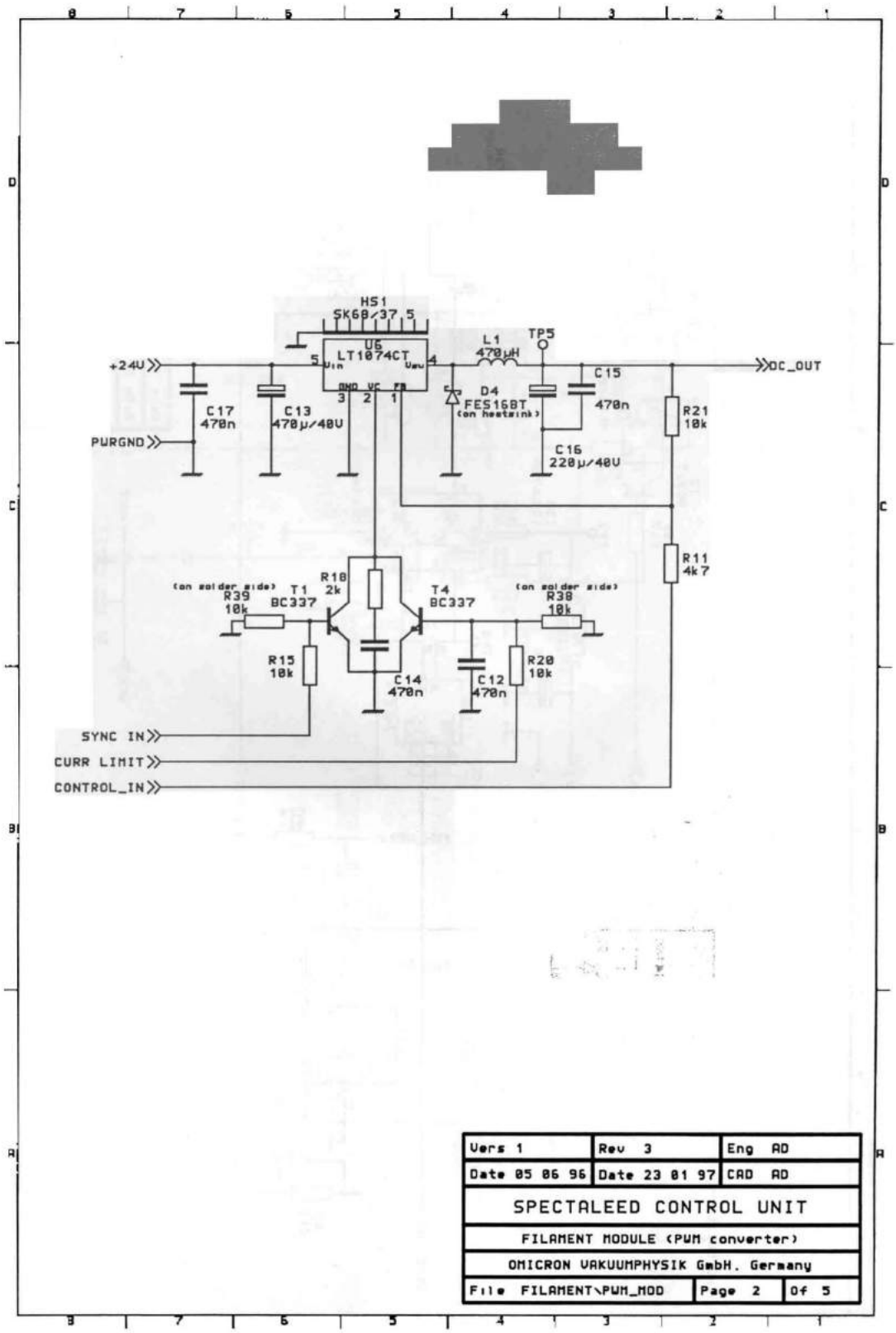


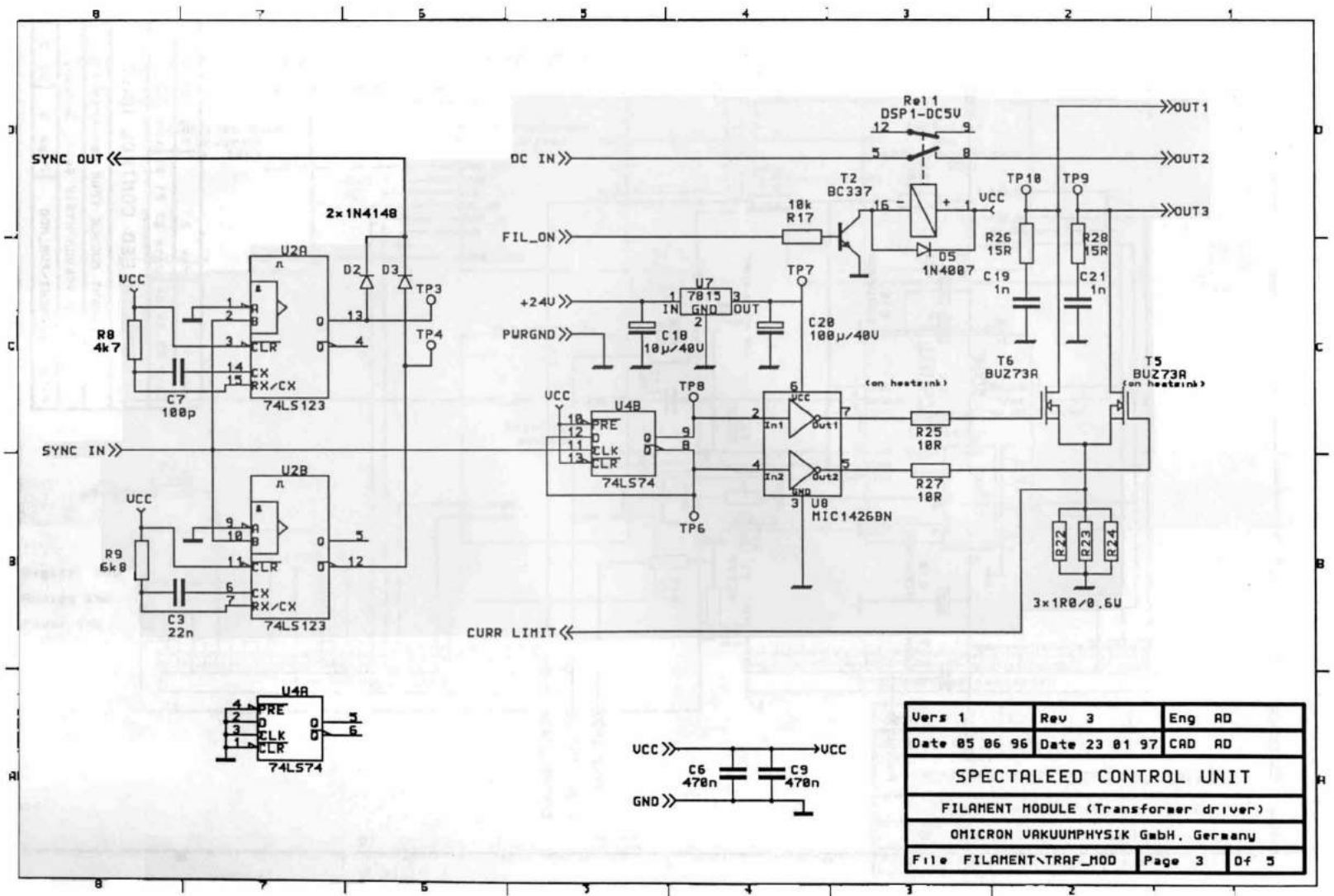
OMICRON INSTRUMENTS FOR SURFACE SCIENCE

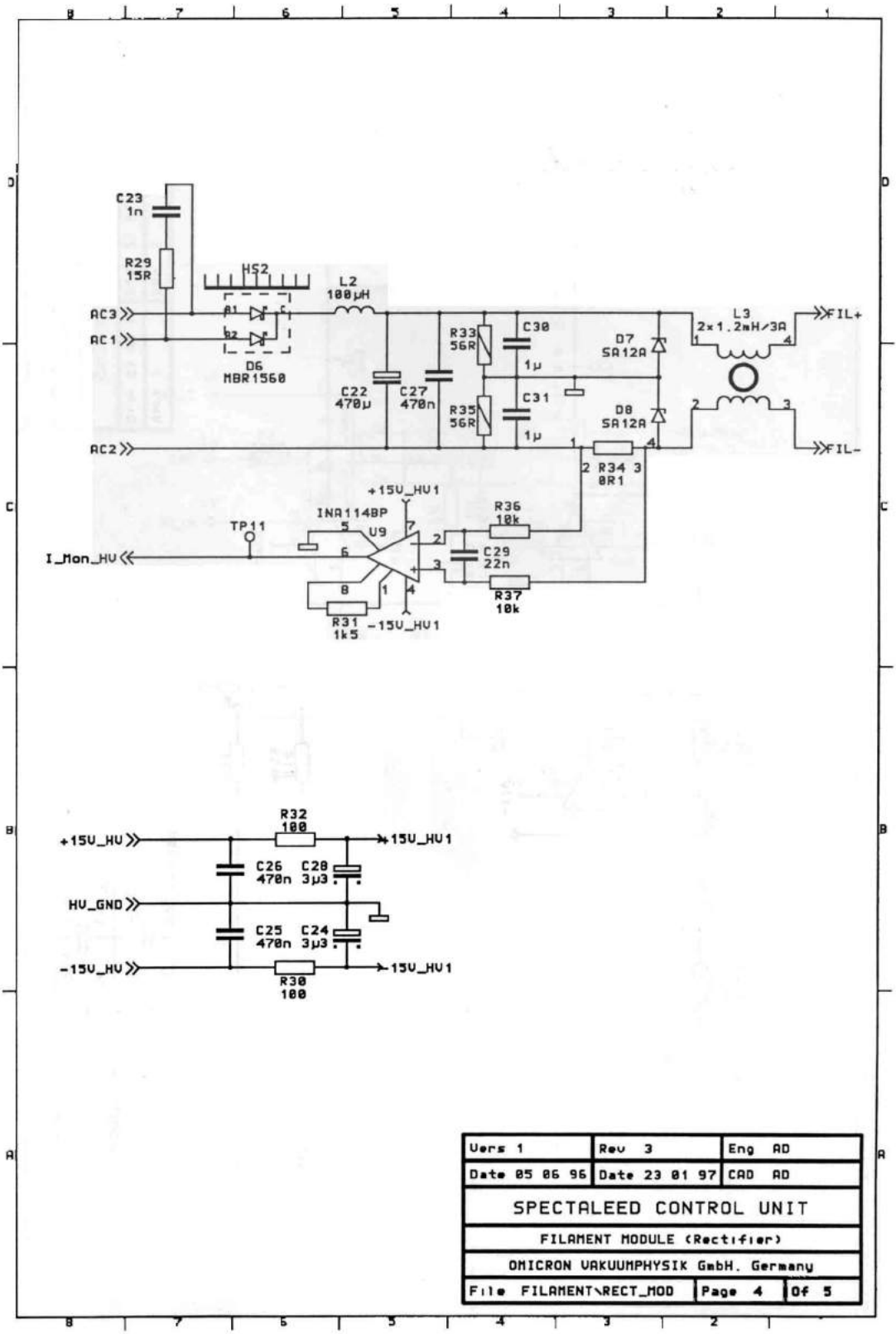

SPECTALEED CONTROL UNIT
Control board Emission regulator
OMICRON VAKUUMPHYSIK GmbH, Germany
LED "Filament"
LED "Emission"
IFIL_SET
IFIL_MON
EMI_MON
VREF
+15U
-15U
FILAMENT
EMISSION
U filament --->
Lamb filament --->
IFIL = 2.7A max
IFIL = 1.8A max
Zunder_
Inserted
Removed

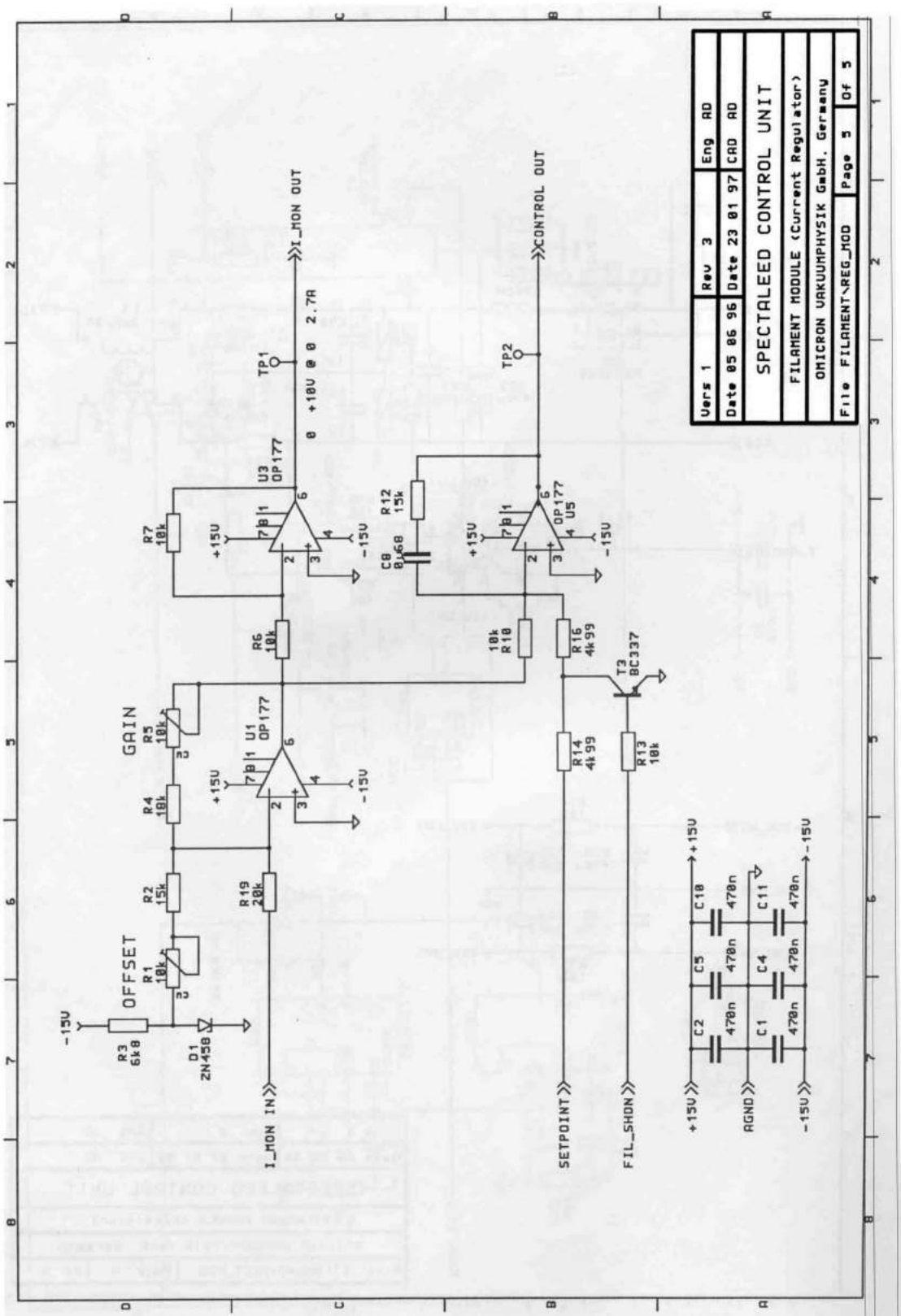
Filament


FIL+
FIL-
J3
J4
Rectifier and Signal Conditioner (0 18V)
Optical Isolation Amplifier
Tr1
BHR 612518
Transformer driver
Regulator module
PWM Step doun Converter (0 28V)
High voltage connector
Low voltage connector
J2
J1
F1
2.5AT
+24V
VCC
-15V +15V
Digital GND
Analog GND
Power GND
SPECTALEED CONTROL UNIT
FILAMENT MODULE (Block diagram)
OMICRON VAKUUMPHYSIK GmbH. Germany
Vers 1
Rev 3
Eng AD
Date 05 06 96
Date 23 01 97
CAD AD
File FILAMENT-FILAMENT
Page 1
Of 5

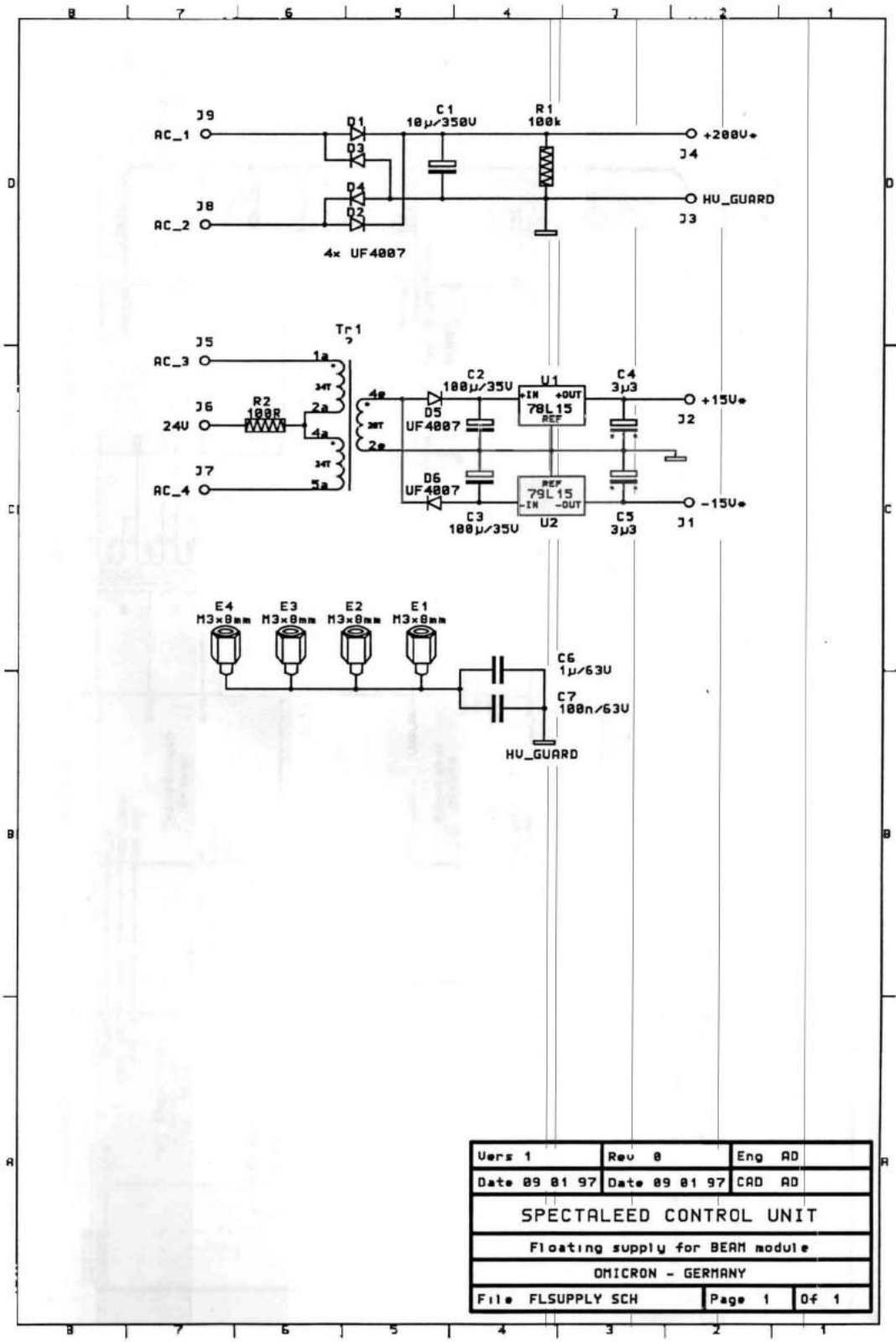

HS1
SK68/37.5
U6
LT1074CT
L1
470µH
TP5
+24U
DC_OUT
C17
470n
C13
470µ/40V
D4
FES16BT
(on heatsink)
C15
470n
C16
220µ/40V
R21
10k
PURGND
R11
4k7
R18
2k
(on solder side)
R39
10k
T1
BC337
T4
BC337
(on solder side)
R38
10k
R15
10k
C14
470n
C12
470n
R20
10k
SYNC IN
CURR LIMIT
CONTROL_IN
Vers 1
Rev 3
Eng AD
Date 05 06 96
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
FILAMENT MODULE (PWM converter)
OMICRON VAKUUMPHYSIK GmbH. Germany
File FILAMENT\PWM_MOD
Page 2
Of 5


SYNC OUT
SYNC IN
DC IN
FIL_ON
+24U
PWRGND
CURR LIMIT
OUT1
OUT2
OUT3
Rel1
DSP1-DC5V
2x1N4148
D2
D3
D5
1N4007
T2
BC337
18k
R17
VCC
TP3
TP4
TP6
TP7
TP8
TP9
TP10
U2A
U2B
U4A
U4B
U7
U8
7815
IN
GND
OUT
74LS123
74LS74
MIC1426BN
R8
4k7
C7
100p
R9
6k8
C3
22n
C18
10µ/40V
C20
100µ/40V
C19
1n
C21
1n
R25
10R
R27
10R
R26
15R
R28
15R
R22
R23
R24
3x1R0/0.6W
T6
BUZ73A
T5
BUZ73A
(on heatsink)
C6
470n
C9
470n
Vers 1
Rev 3
Eng AD
Date 05 06 96
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
FILAMENT MODULE (Transformer driver)
OMICRON VAKUUMPHYSIK GmbH, Germany
File FILAMENT\TRAF_MOD
Page 3
Of 5


C23
1n
R29
15R
HS2
L2
100µH
AC3
AC1
AC2
D6
MBR1560
C22
470µ
C27
470n
R33
56R
C30
1µ
R35
56R
C31
1µ
D7
SA12A
D8
SA12A
L3
2x1.2mH/3A
FIL+
FIL-
R34
0R1
+15V_HV1
INA114BP
U9
TP11
I_Mon_HV
R36
10k
C29
22n
R37
10k
R31
1k5
-15V_HV1
R32
100
+15V_HV
15V_HV1
C26
470n
C28
3µ3
HV_GND
C25
470n
C24
3µ3
-15V_HV
R30
100
Vers 1
Rev 3
Eng AD
Date 05 06 96
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
FILAMENT MODULE (Rectifier)
OMICRON VAKUUMPHYSIK GmbH, Germany
File FILAMENT\RECT_MOD
Page 4
Of 5

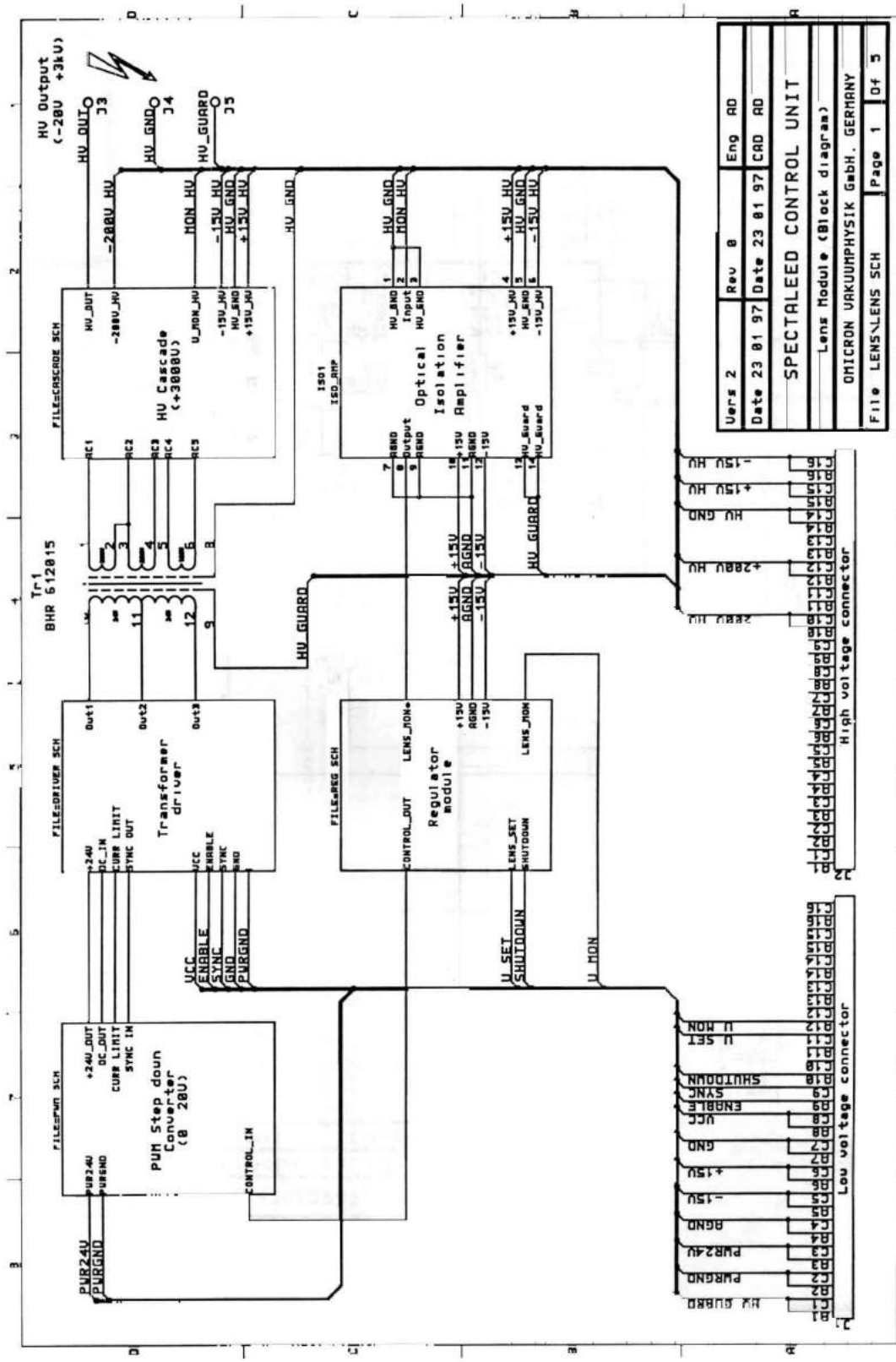

Vers 1
Rev 3
Eng AD
Date 05 06 96
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
FILAMENT MODULE (Current Regulator)
OMICRON VAKUUMPHYSIK GmbH, Germany
File FILAMENT\REG_MOD
Page 5
Of 5
I_MON OUT
CONTROL OUT
TP1
TP2
0 +10V @ 0 2.7A
U3 OP177
U5 OP177
U1 OP177
GAIN
OFFSET
R1 10k
R2 15k
R3 6k8
R4 10k
R5 10k
R6 10k
R7 10k
R10 10k
R12 15k
R13 10k
R14 4k99
R16 4k99
R19 20k
C8 0,68
T3 BC337
D1 ZN458
+15V
-15V
C1 470n
C2 470n
C4 470n
C5 470n
C10 470n
C11 470n
I_MON IN
SETPOINT
FIL_SHDN
AGND

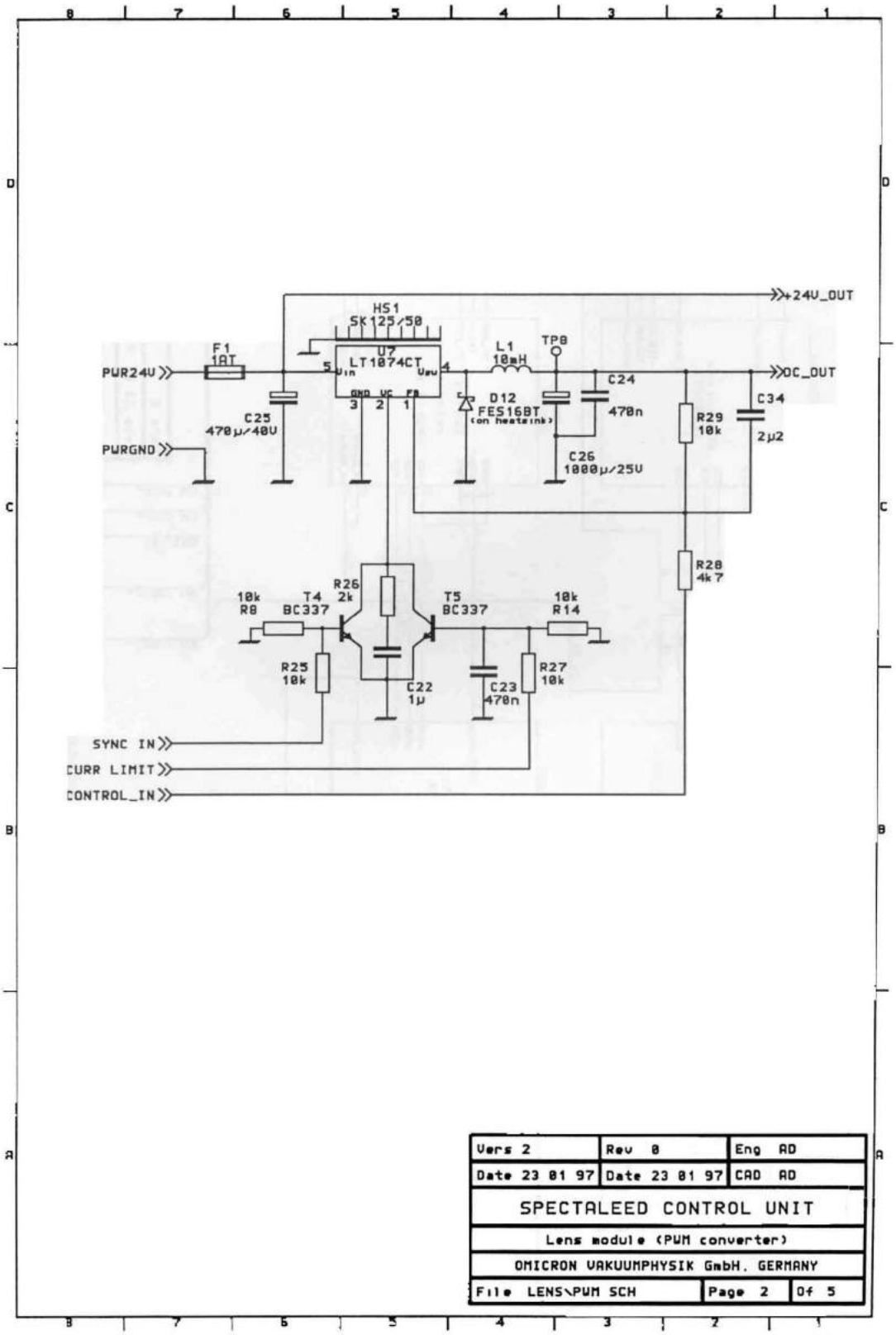
Floating Supply

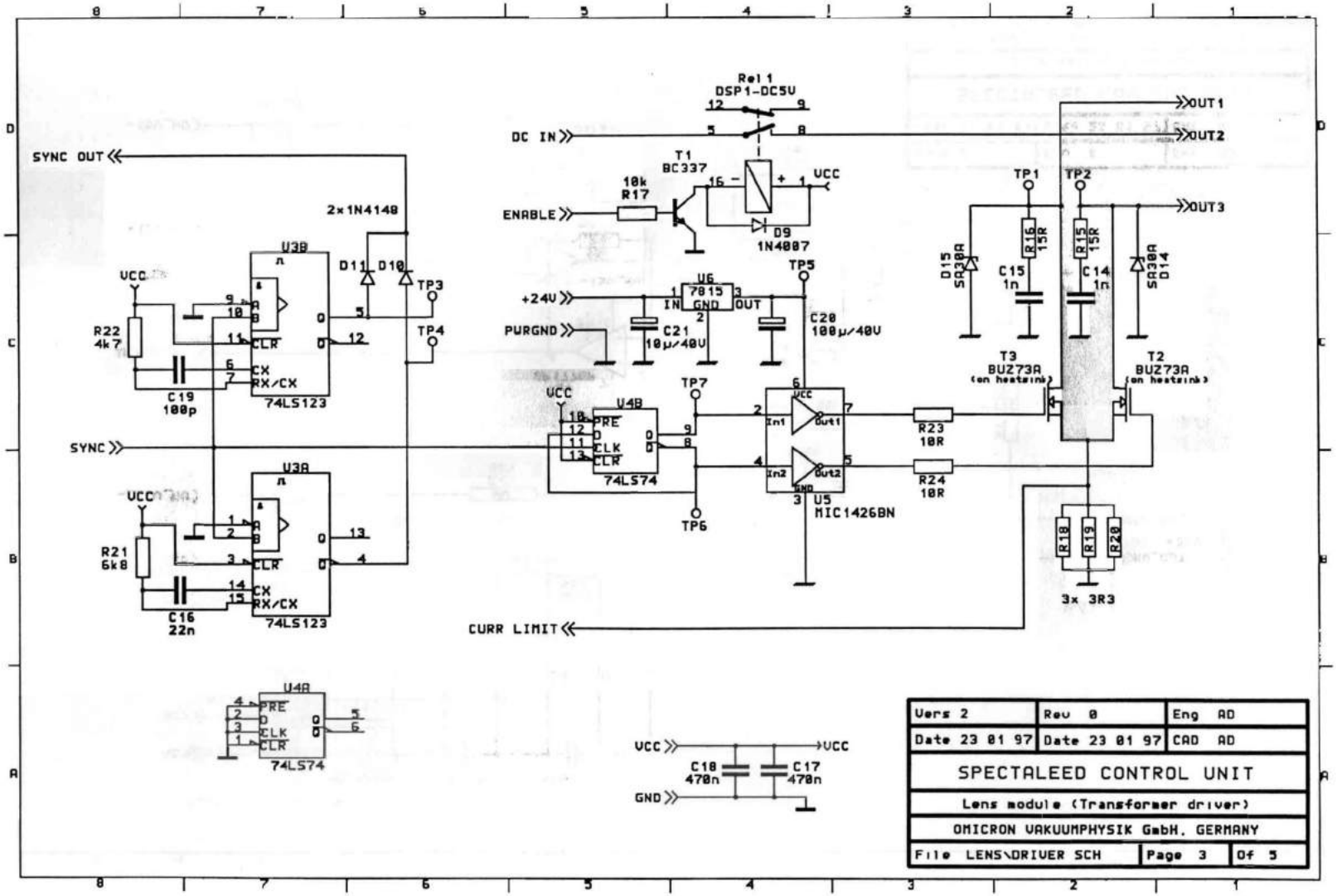


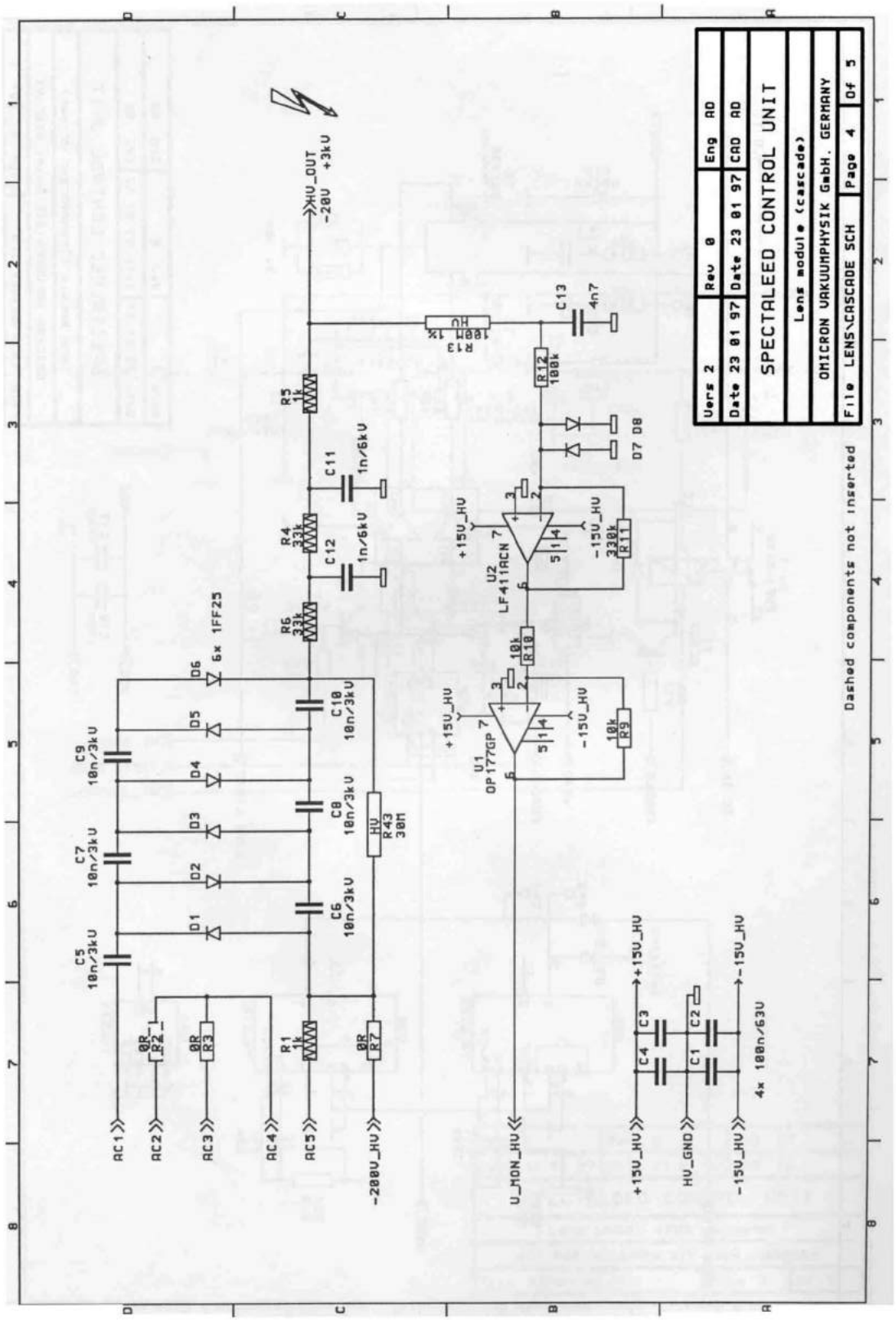
Front Panel

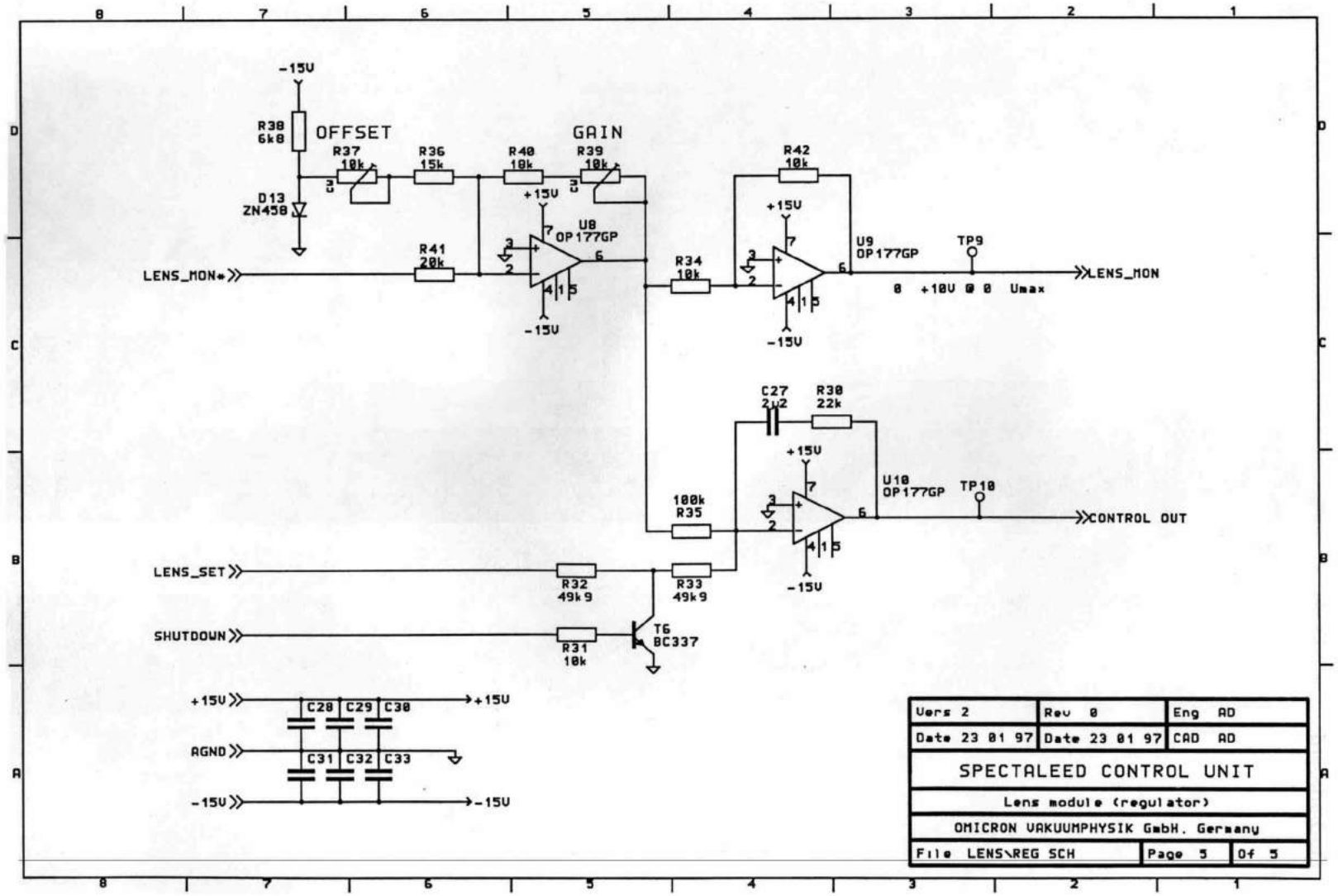
Lens


HV Output
(-20U +3kU)
HV OUT
HV GND
HV_GUARD
-200V HV
MON HV
-15V HV
+15V HV
HV GND
HV Cascade
(+3000U)
Optical
Isolation
Amplifier
Tr1
BHR 612015
Transformer
driver
Regulator
module
PWM Step down
Converter
(8 20U)
PWR24V
PWRGND
VCC
ENABLE
SYNC
GND
U SET
SHUTDOWN
U MON
SPECTALEED CONTROL UNIT
Lens Module (Block diagram)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
File LENS\LENS SCH
Page 1
Of 5
High voltage connector
Lou voltage connector


HS1
SK 125/50
U7
LT1074CT
F1
1AT
L1
10mH
TP8
+24V_OUT
PWR24V
DC_OUT
C25
470µ/40V
D12
FES16BT
(on heatsink)
C24
470n
C34
2µ2
R29
10k
C26
1000µ/25V
PWRGND
R28
4k7
10k
R8
T4
BC337
R26
2k
T5
BC337
10k
R14
R25
10k
C22
1µ
C23
470n
R27
10k
SYNC IN
CURR LIMIT
CONTROL_IN
Vers 2
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Lens module (PUM converter)
OMICRON VAKUUMPHYSIK GmbH. GERMANY
File LENS\PUM SCH
Page 2
Of 5

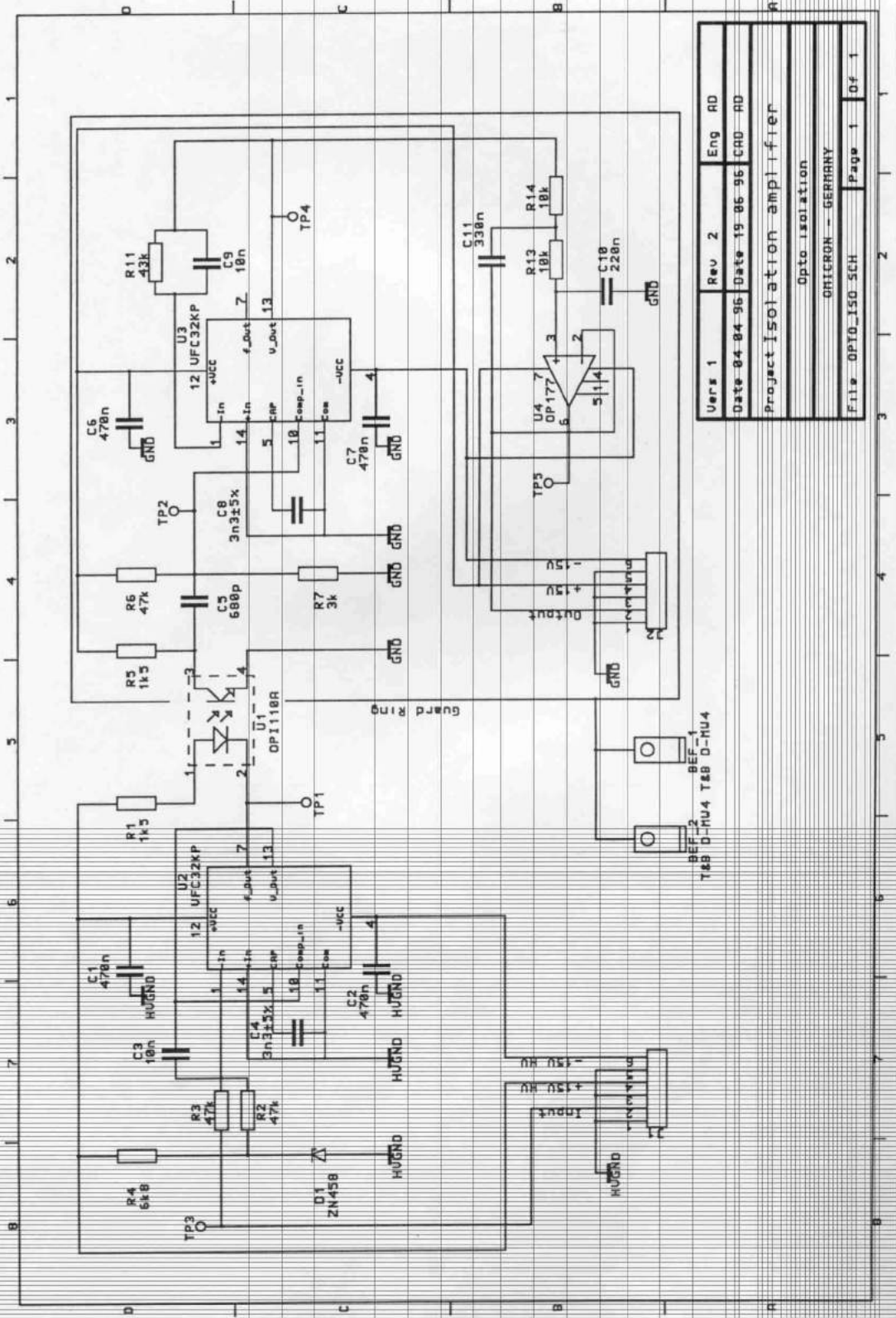

Rel1
DSP1-DC5V
DC IN
SYNC OUT
ENABLE
T1
BC337
10k
R17
D9
1N4007
VCC
OUT1
OUT2
OUT3
TP1
TP2
TP3
TP4
TP5
TP6
TP7
2x1N4148
D11
D10
U3B
U3A
U4B
R22
4k7
C19
100p
74LS123
R21
6k8
C16
22n
74LS74
SYNC
+24V
PURGND
U6
7815
IN
GND
OUT
C21
10µ/40V
C20
100µ/40V
D15
SA30A
D14
SA30A
R16
15R
R15
15R
C15
1n
C14
1n
T3
BUZ73A
(on heatsink)
T2
BUZ73A
(on heatsink)
R23
10R
R24
10R
U5
MIC1426BN
R18
R19
R20
3x 3R3
CURR LIMIT
C18
470n
C17
470n
Vers 2
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Lens module (Transformer driver)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
File LENS\DRIVER SCH
Page 3
Of 5


SPECTALEED CONTROL UNIT
Lens modul e (cascade)
OMICRON VAKUUMPHYSIK GmbH. GERMANY
Vers 2
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
File LENSCASCADE SCH
Page 4
Of 5
Dashed components not inserted
HV_OUT -20V +3kV
R13 100M 1% HV
C13 4n7
R12 100k
D7 D8
R5 1k
C11 1n/6kV
R4 33k
C12 1n/6kV
R6 33k
D6 6x 1FF25
D5
D4
D3
D2
D1
C10 10n/3kV
C9 10n/3kV
C8 10n/3kV
C7 10n/3kV
C6 10n/3kV
C5 10n/3kV
R43 30M HV
R2 0R
R3 0R
R1 1k
R7 0R
AC1
AC2
AC3
AC4
AC5
-200V_HV
U2 LF411ACN
+15V_HV
-15V_HV
330k R11
10k R10
U1 OP177GP
10k R9
U_MON_HV
C3
C4
C2
C1
HV_GND
4x 100n/63V

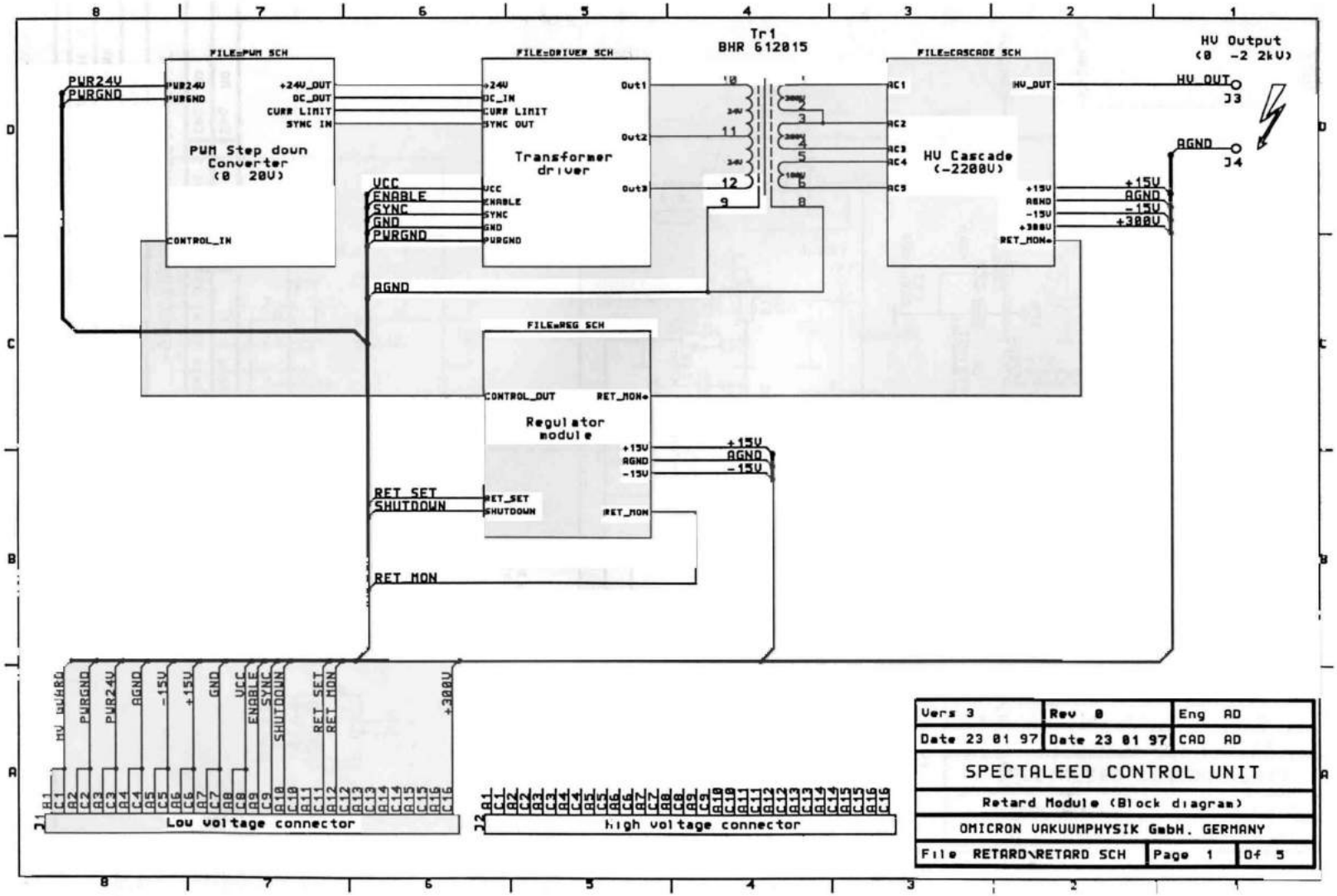

-15V
R38 6k8
OFFSET
R37 10k
R36 15k
R40 10k
GAIN
R39 10k
R42 10k
D13 ZN458
+15V
U8 OP177GP
R41 20k
LENS_MON*
R34 10k
U9 OP177GP
TP9
LENS_MON
0 +10V @ 0 Umax
C27 2u2
R30 22k
U10 OP177GP
TP10
100k R35
CONTROL OUT
LENS_SET
R32 49k9
R33 49k9
SHUTDOWN
R31 10k
T6 BC337
C28 C29 C30
C31 C32 C33
AGND
Vers 2
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Lens module (regulator)
OMICRON VAKUUMPHYSIK GmbH. Germany
File LENS\REG SCH
Page 5
Of 5

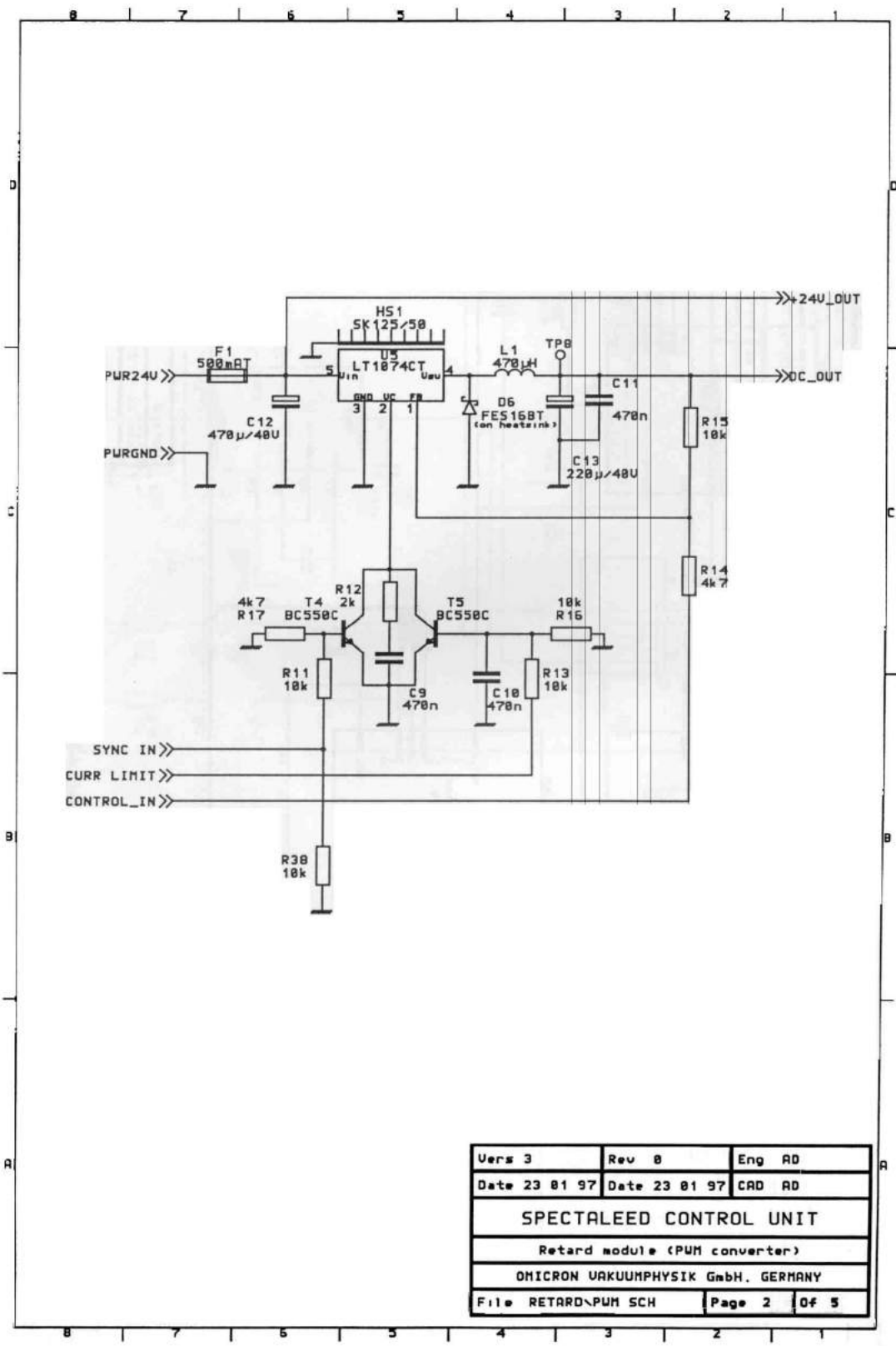
Motherboard

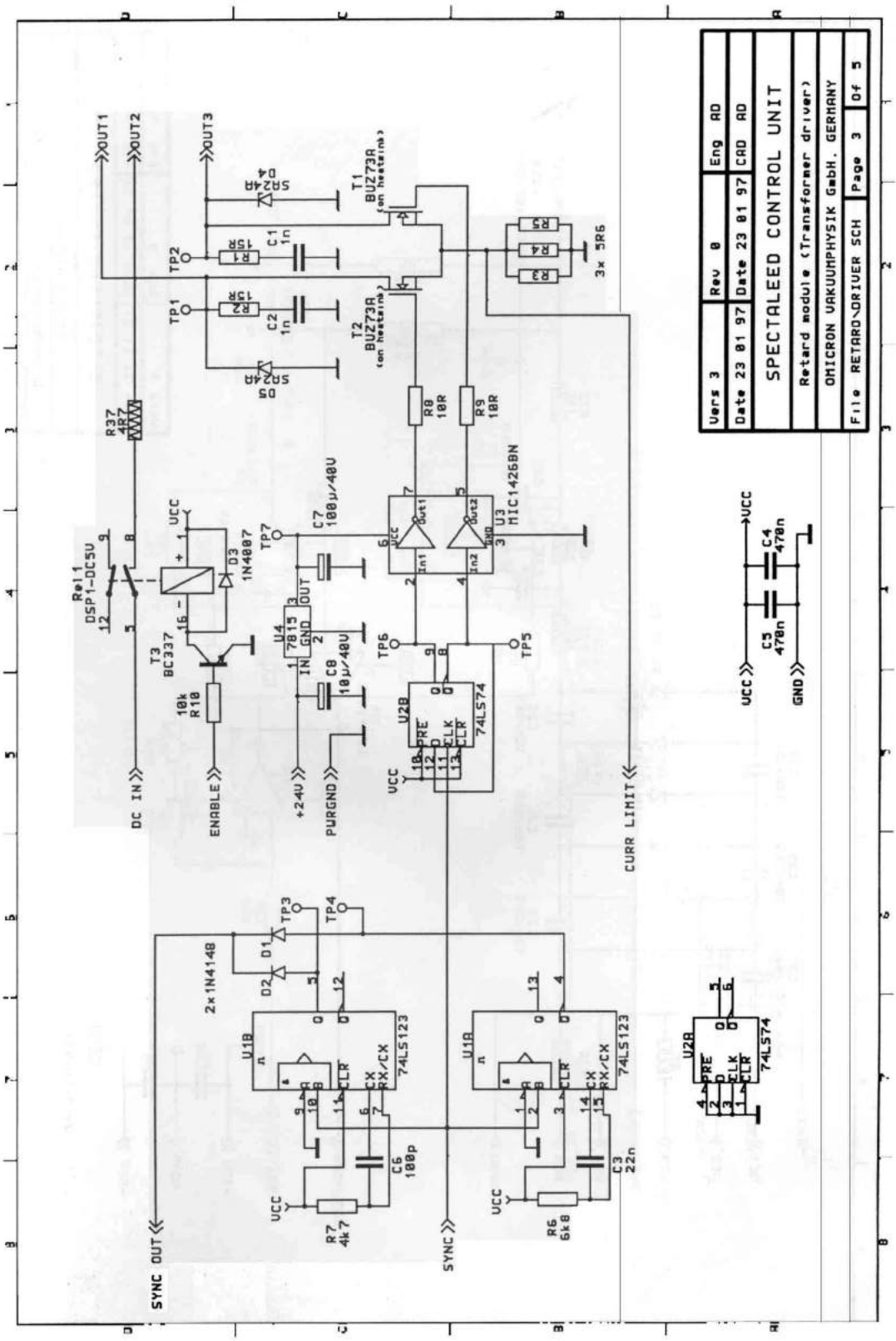
Opto-Iso

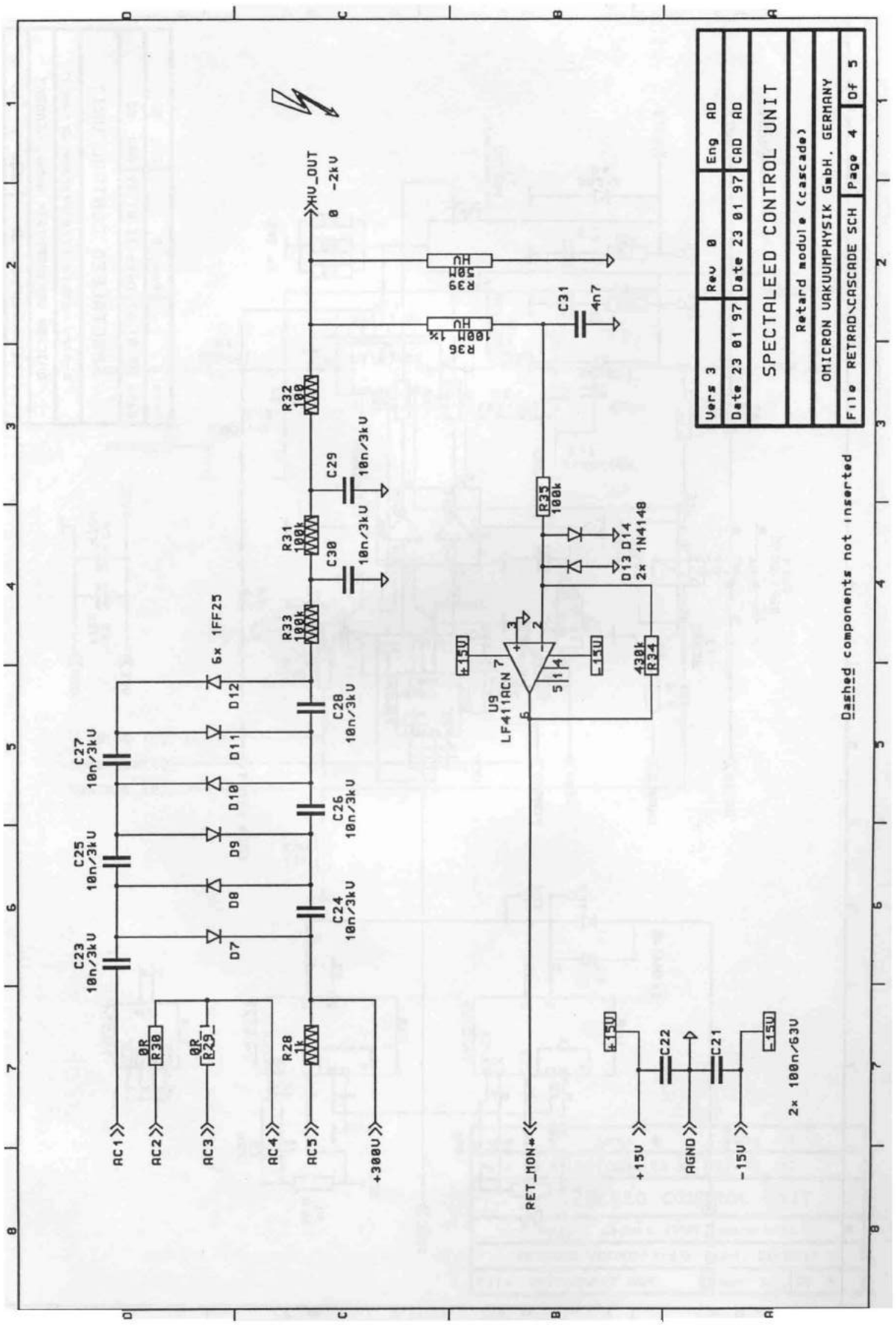

Vers 1
Rev 2
Eng AD
Date 04-04-96
Date 19-06-96
CAD AD
Project Isolation amplifier
Opto isolation
OMICRON - GERMANY
File OPTO_ISO.SCH
Page 1
Of 1
Guard ring
U1 OPI110A
U2 UFC32KP
U3 UFC32KP
U4 OP177
R1 1k5
R2 47k
R3 47k
R4 6k8
R5 1k5
R6 47k
R7 3k
R11 43k
R13 10k
R14 10k
C1 470n
C2 470n
C3 10n
C5 680p
C6 470n
C7 470n
C8 3n3±5%
C9 10n
C10 220n
C11 338n
D1 ZN458
TP1
TP2
TP3
TP4
TP5
GND
HUGND
BEF-1 T&B D-HU4
BEF-2 T&B D-HU4

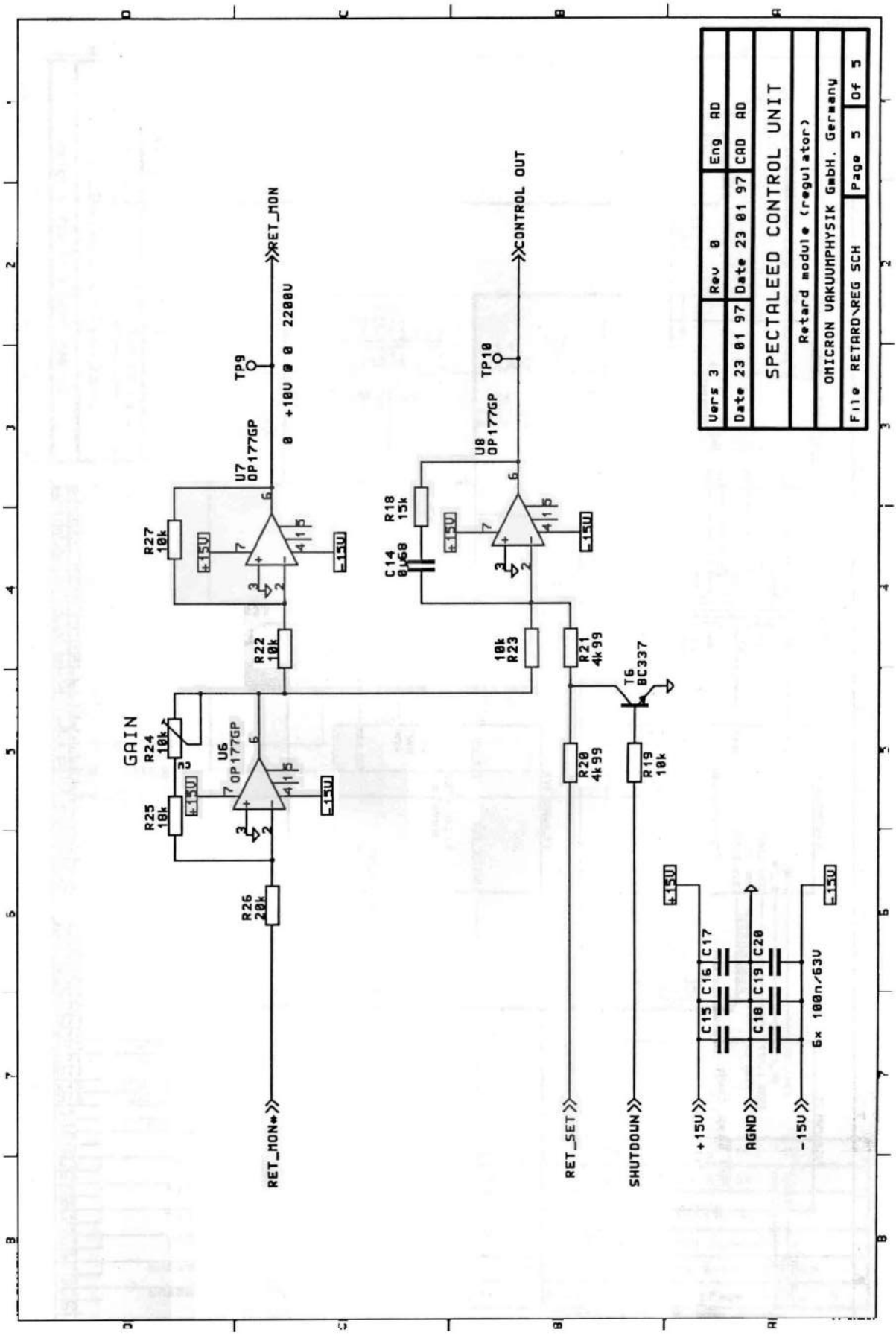
Retard


FILE=PWM SCH
PWR24V
PWRGND
+24V_OUT
DC_OUT
CURR LIMIT
SYNC IN
PWM Step down Converter (0 20V)
CONTROL_IN
FILE=DRIVER SCH
+24V
DC_IN
CURR LIMIT
SYNC OUT
Out1
Out2
Out3
Transformer driver
VCC
ENABLE
SYNC
GND
PWRGND
Tr1
BHR 612015
FILE=CASCADE SCH
AC1
AC2
AC3
AC4
AC5
HV_OUT
HV Cascade (-2200V)
+15V
AGND
-15V
+300V
RET_MON
HV Output (0 -2 2kV)
HV OUT
J3
AGND
J4
FILE=REG SCH
CONTROL_OUT
RET_MON
Regulator module
+15V
AGND
-15V
RET_SET
SHUTDOWN
RET_MON
HV ON/OFF
PWRGND
PWR24V
AGND
-15V
+15V
GND
VCC
ENABLE
SYNC
SHUTDOWN
RET_SET
RET_MON
+300V
Low voltage connector
high voltage connector
Vers 3
Rev B
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Retard Module (Block diagram)
OMICRON VAKUUMPHYSIK GmbH. GERMANY
File RETARD\RETARD SCH
Page 1
Of 5

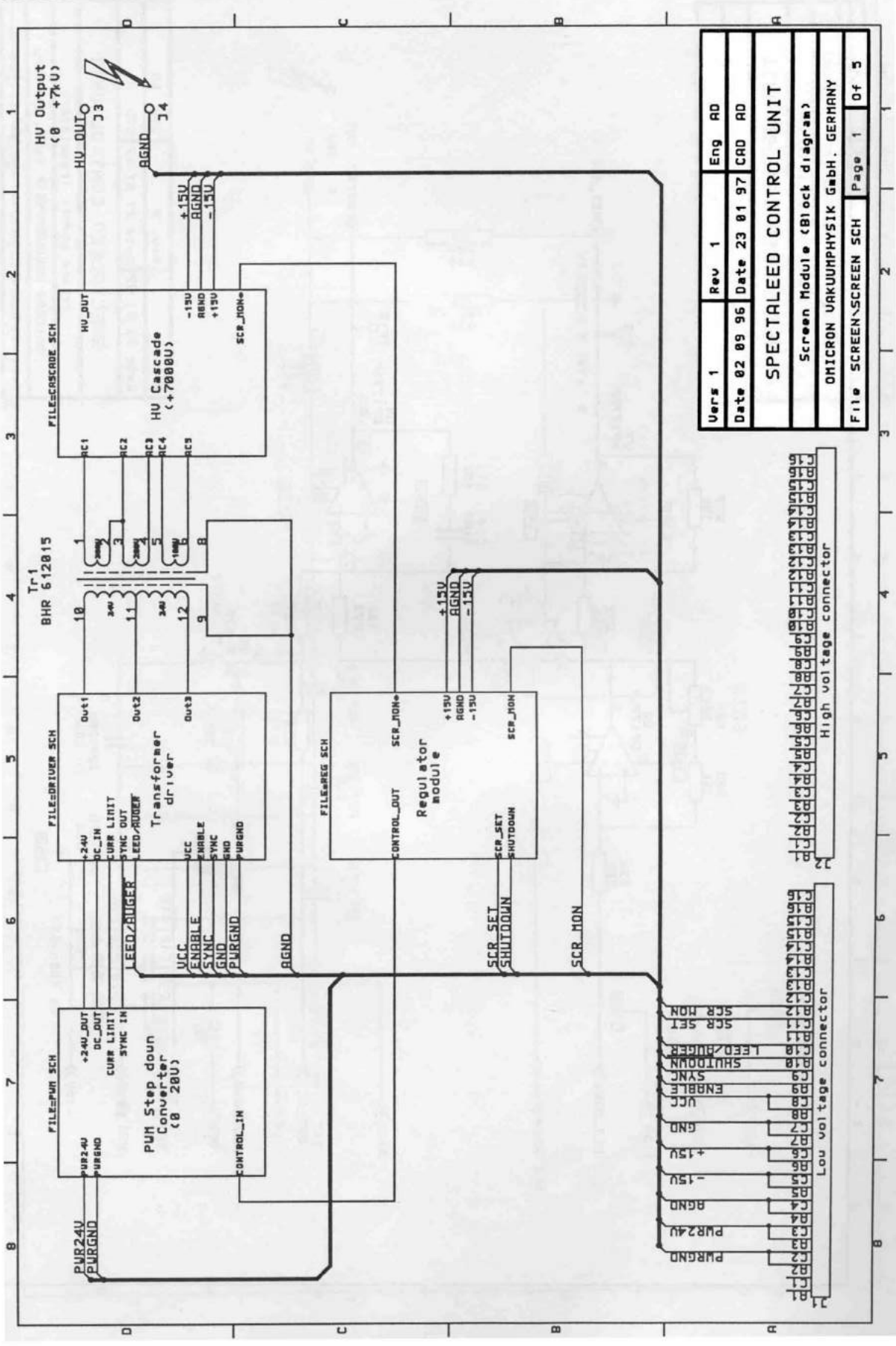

HS1
SK125/50
U3
LT1074CT
F1
500mAT
PWR24V
PWRGND
C12
470µ/40V
L1
470µH
TP8
D6
FES16BT
(on heatsink)
C11
470n
C13
220µ/40V
+24V_OUT
DC_OUT
R15
10k
R14
4k7
4k7
R17
T4
BC550C
R12
2k
T5
BC550C
10k
R16
R11
10k
C9
470n
C10
470n
R13
10k
SYNC IN
CURR LIMIT
CONTROL_IN
R38
10k
Vers 3
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Retard module (PWM converter)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
File RETARD\PWM SCH
Page 2
Of 5

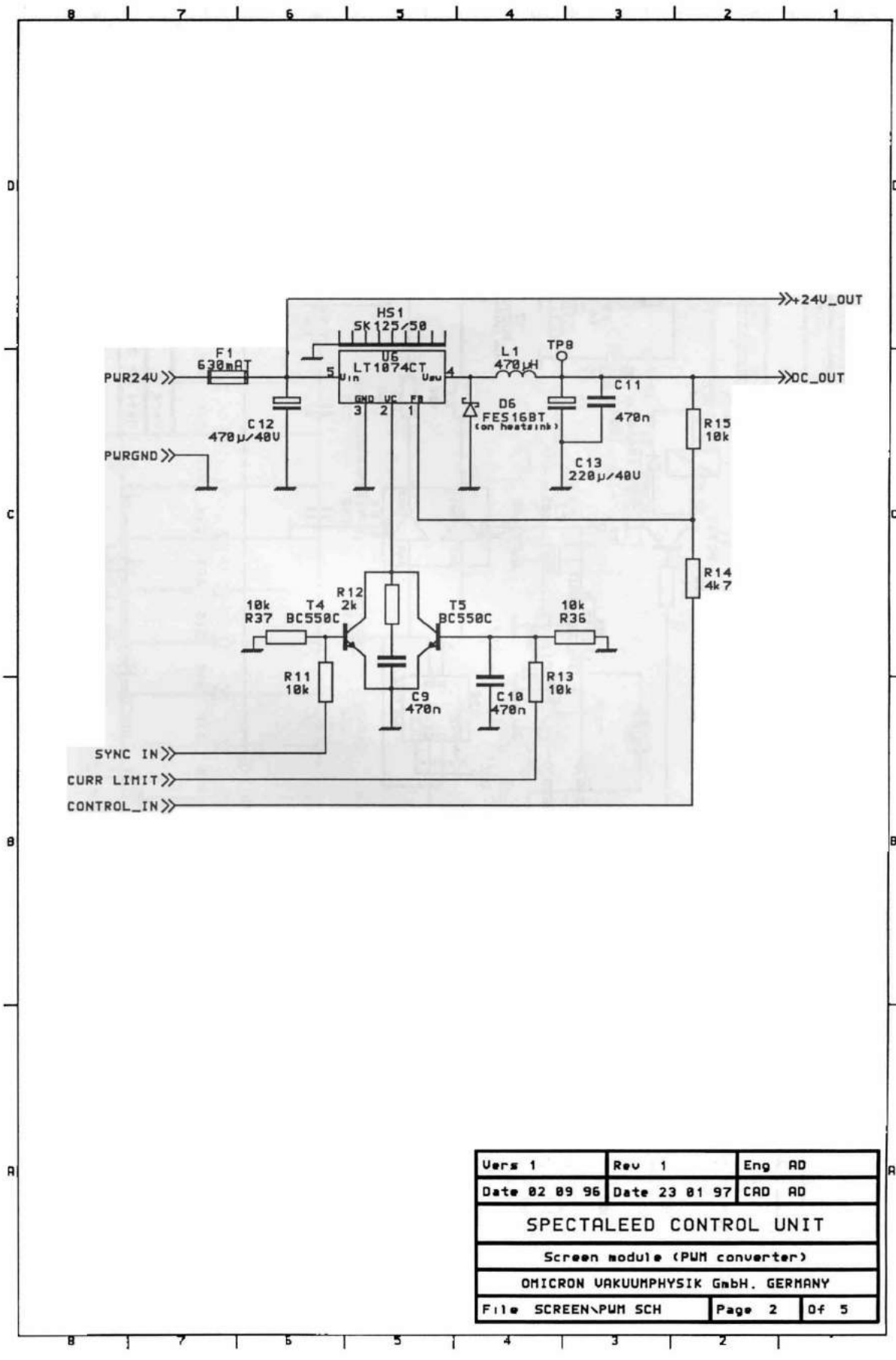

SPECTALEED CONTROL UNIT
Vers 3
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
Retard module (Transformer driver)
OMICRON VAKUUMPHYSIK GmbH. GERMANY
File RETARD-DRIVER SCH
Page 3
Of 5
OUT1
OUT2
OUT3
T1 BUZ73A (on heatsink)
T2 BUZ73A (on heatsink)
SR24D
D4
D5
R1 1SR
R2 1SR
C1 1n
C2 1n
TP1
TP2
R3
R4
R5
3x 5R6
R37 4R7
R8 10R
R9 10R
U3 MIC1426BN
C7 100µ/40V
TP7
Rel1 DSP1-DC5V
D3 1N4007
T3 BC337
10k R10
U4 7815
C8 10µ/40V
TP6
TP5
U2B 74LS74
DC IN
ENABLE
+24V
PURGND
VCC
GND
C4 470n
C5 470n
CURR LIMIT
2x1N4148
D1
D2
TP3
TP4
U1B 74LS123
R7 4k7
C6 100p
R6 6k8
C3 22n
SYNC OUT
SYNC

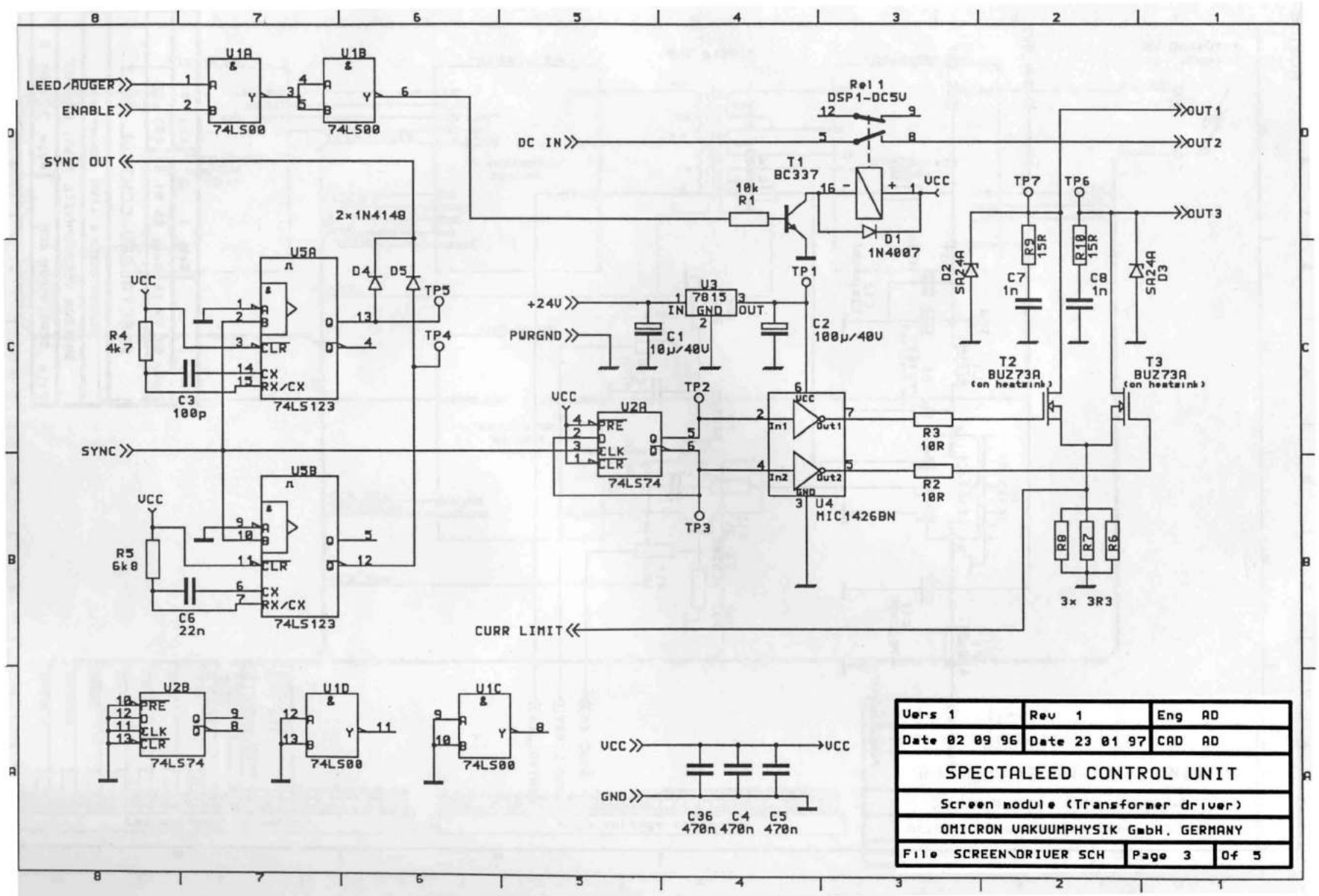

SPECTALEED CONTROL UNIT
Retard module (cascade)
OMICRON VAKUUMPHYSIK GmbH. GERMANY
Vers 3
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
File RETRAD\CASCADE SCH
Page 4
Of 5
Dashed components not inserted
HV_OUT
0 -2kV
R39 100M HV
R36 100M 1% HV
C31 4n7
R32 100
C29 10n/3kV
C30 10n/3kV
R31 100k
R33 100k
R35 100k
D13 D14 2x 1N4148
6x 1FF25
D12
D11
D10
D9
D8
D7
C28 10n/3kV
C27 10n/3kV
C26 10n/3kV
C25 10n/3kV
C24 10n/3kV
C23 10n/3kV
U9 LF411ACN
+15V
-15V
430k R34
0R R30
0R R29
R28 1k
AC1
AC2
AC3
AC4
AC5
+300V
RET_MON
+15V
AGND
-15V
C22
C21
2x 100n/63V

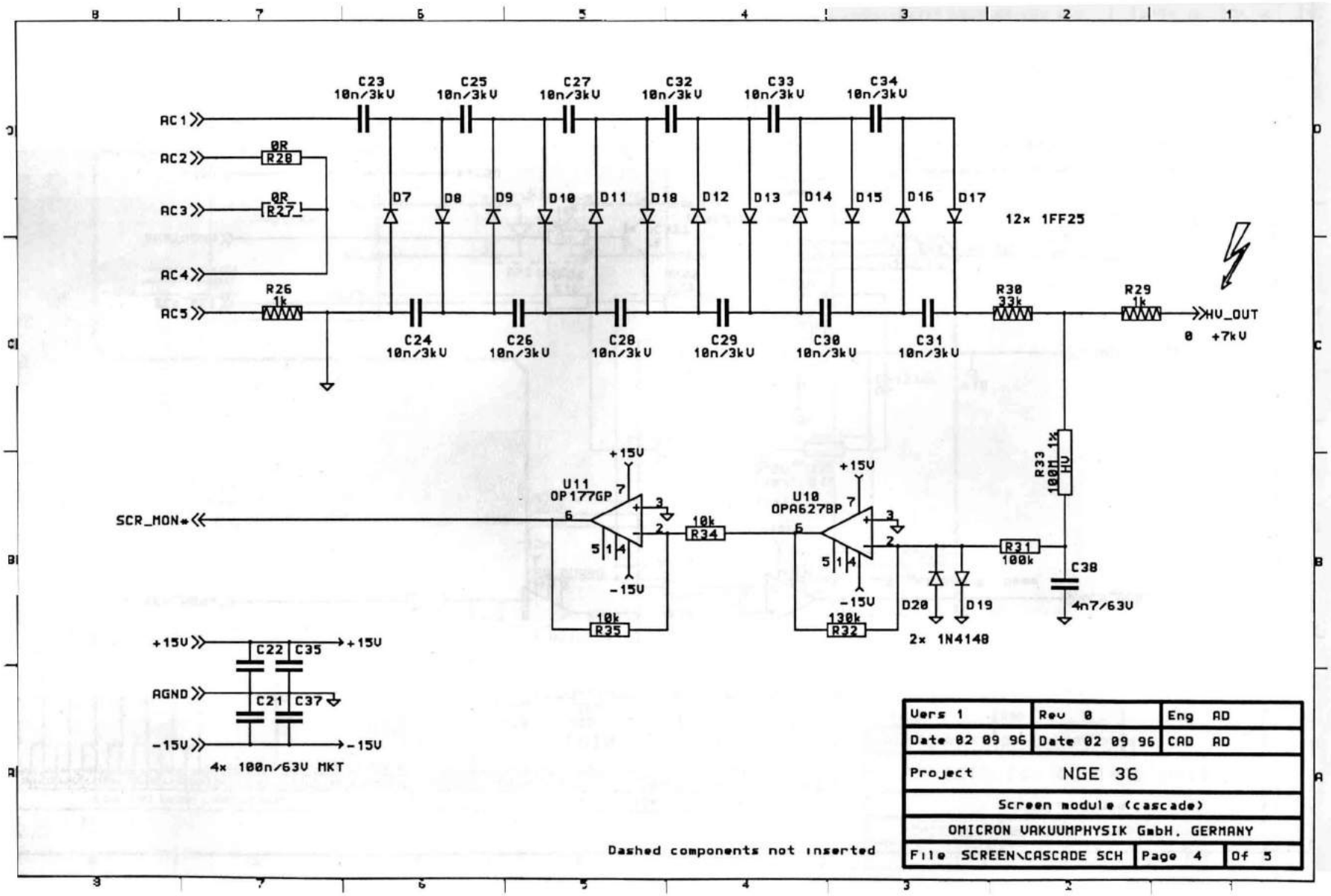

SPECTALEED CONTROL UNIT
Retard module (regulator)
OMICRON VAKUUMPHYSIK GmbH, Germany
Vers 3
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
File RETARDREG SCH
Page 5
Of 5
RET_MON
CONTROL OUT
TP9
TP10
0 +10U @ 0 2200U
U7 OP177GP
U8 OP177GP
U6 OP177GP
R27 10k
R18 15k
C14 0u68
R22 10k
10k R23
R21 4k99
T6 BC337
GAIN
R24 10k
R25 10k
R26 20k
R20 4k99
R19 10k
+15U
-15U
C15 C16 C17
C18 C19 C20
6x 100n/63V
RET_MON*
RET_SET
SHUTDOWN
+15V
AGND
-15V

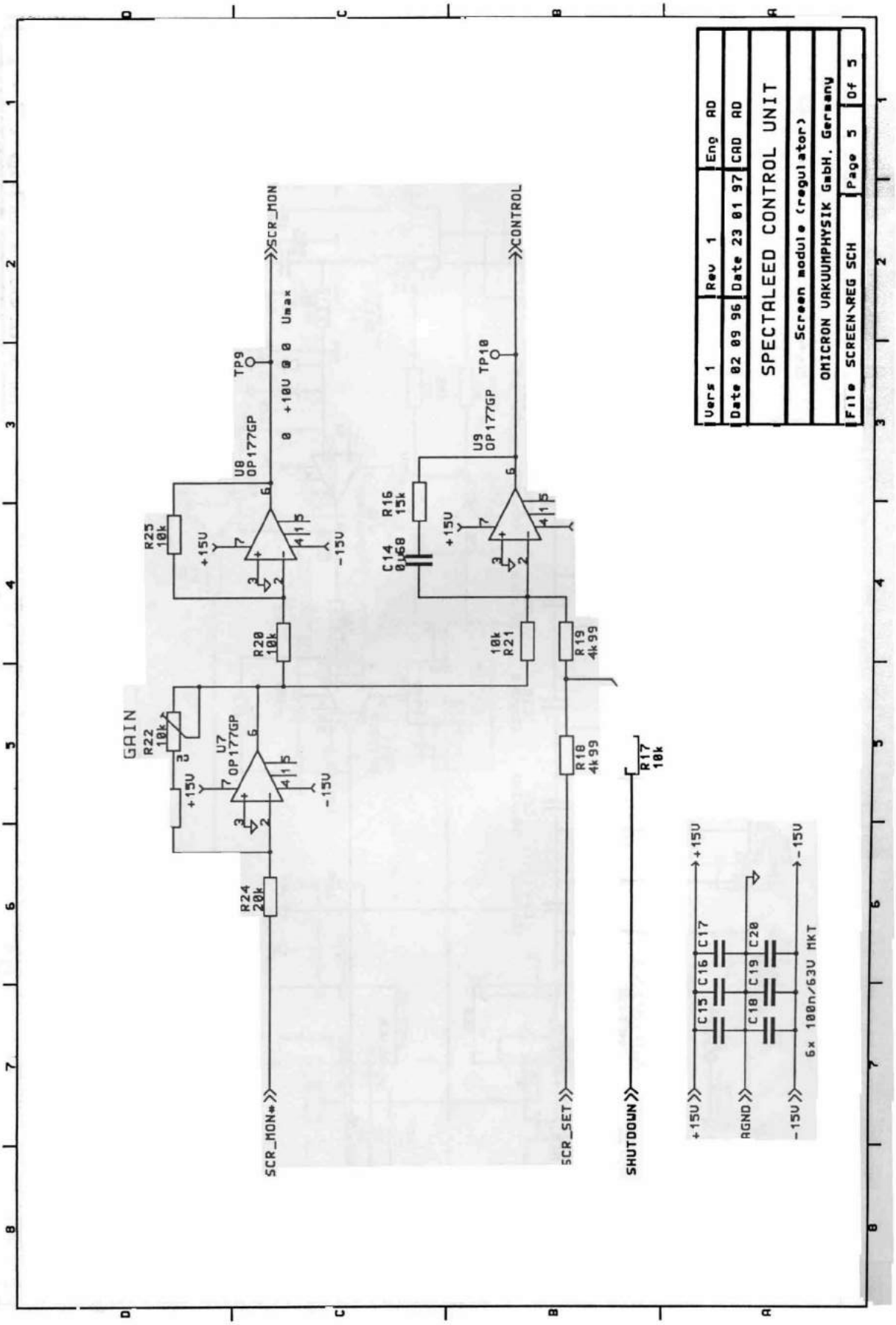
Screen


SPECTALEED CONTROL UNIT
Screen Module (Block diagram)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
Vers 1
Rev 1
Eng AD
Date 02 09 96
Date 23 01 97
CAD AD
File SCREEN\SCREEN SCH
Page 1
Of 5
HV Output (0 +7kV)
HV OUT
J3
AGND
J4
FILE=CASCADE SCH
HV Cascade (+7000V)
Tr1
BHR 612015
FILE=DRIVER SCH
Transformer driver
FILE=REG SCH
Regulator module
FILE=PWR SCH
PWM Step down Converter (0 28V)
LEED/AUGER
VCC
ENABLE
SYNC
GND
PWRGND
AGND
SCR SET
SHUTDOWN
SCR MON
+15V
-15V
PWR24V
High voltage connector
Low voltage connector

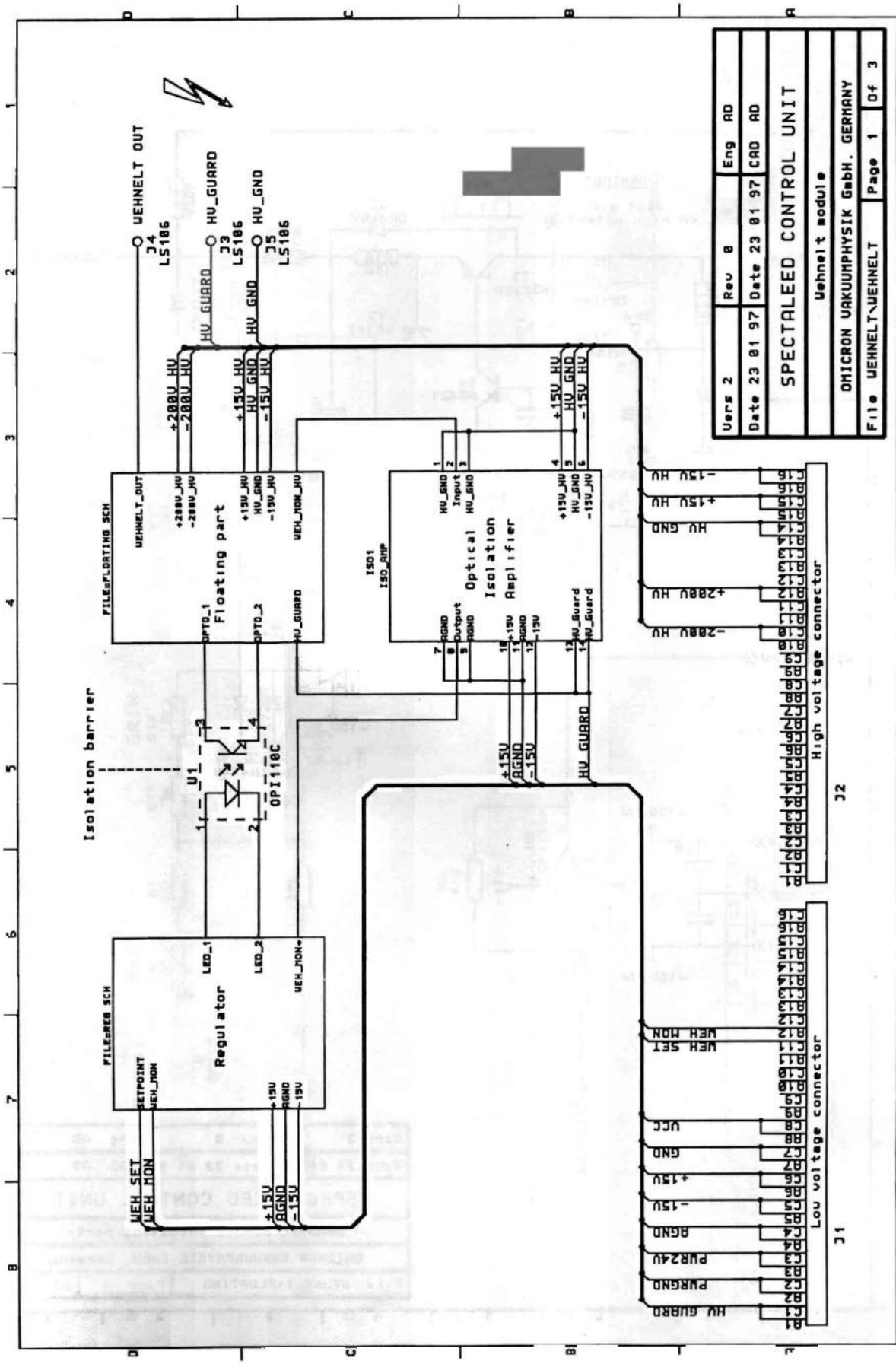

HS1
SK 125/50
F1
630mAT
U6
LT1074CT
L1
470µH
TP8
+24V_OUT
PWR24V
DC_OUT
C11
470n
D6
FES16BT
(on heatsink)
C12
470µ/40V
R15
10k
PWRGND
C13
220µ/40V
R14
4k7
R12
2k
10k
R37
T4
BC550C
T5
BC550C
10k
R36
R11
10k
C9
470n
C10
470n
R13
10k
SYNC IN
CURR LIMIT
CONTROL_IN
Vers 1
Rev 1
Eng AD
Date 02 09 96
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Screen module (PWM converter)
OMICRON VAKUUMPHYSIK GmbH. GERMANY
File SCREEN\PWM SCH
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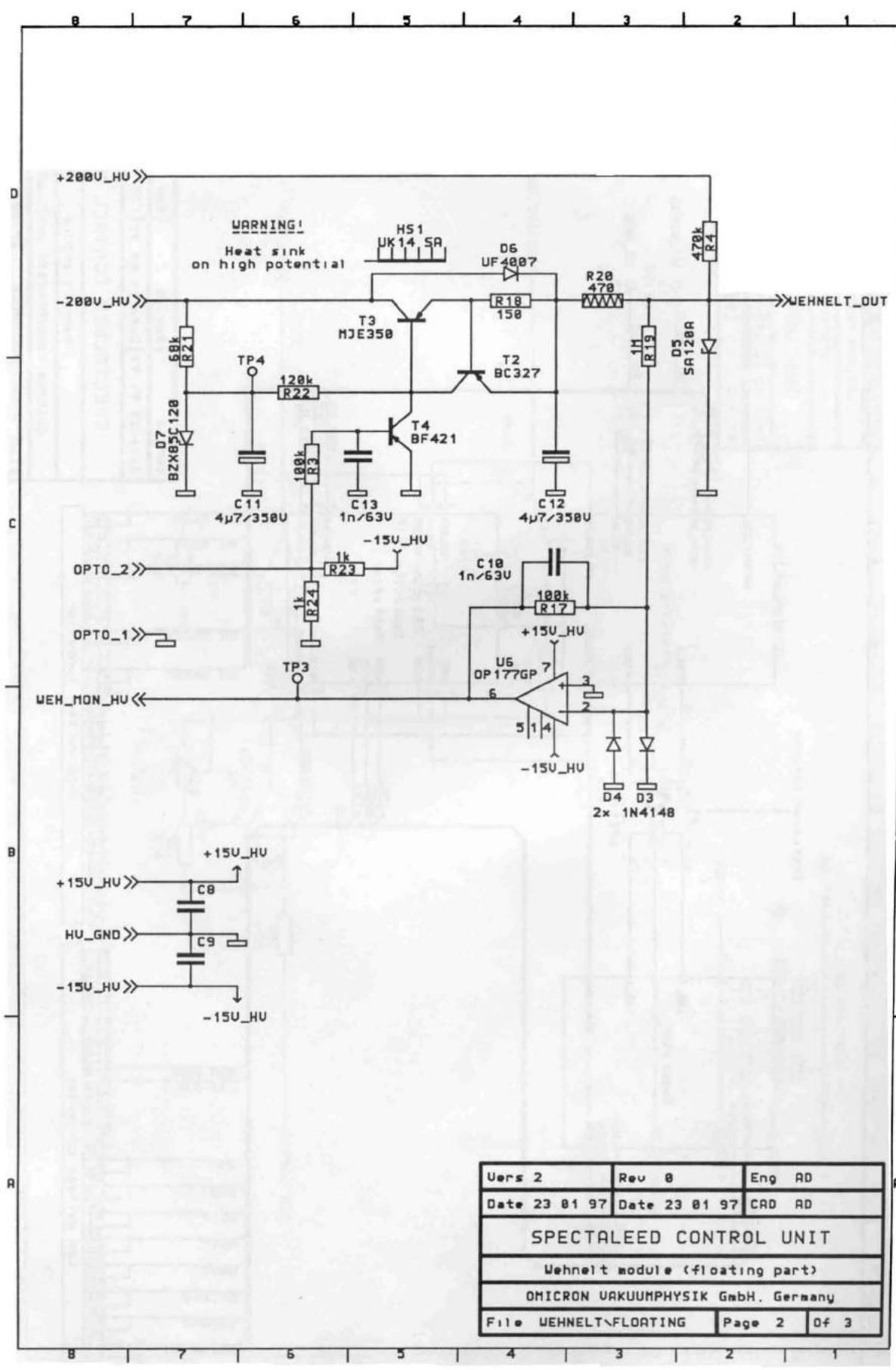

LEED/AUGER
ENABLE
74LS00
SYNC OUT
DC IN
Rel 1
DSP1-DC5V
OUT1
OUT2
OUT3
T1
BC337
10k
R1
VCC
D1
1N4007
2x1N4148
U5A
U5B
74LS123
R4
4k7
C3
100p
R5
6k8
C6
22n
D4
D5
TP5
TP4
TP1
TP2
TP3
+24V
PURGND
U3
7815
IN
GND
OUT
C1
10µ/40V
C2
100µ/40V
U2A
74LS74
SYNC
U4
MIC1426BN
R3
10R
R2
10R
T2
BUZ73A
(on heatsink)
T3
BUZ73A
(on heatsink)
TP7
TP6
R9
15R
R10
15R
C7
1n
C8
1n
D2
SA24A
D3
SA24A
R8
R7
R6
3x 3R3
CURR LIMIT
U2B
U1D
U1C
GND
C36
470n
C4
470n
C5
470n
Vers 1
Rev 1
Eng AD
Date 02 09 96
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Screen module (Transformer driver)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
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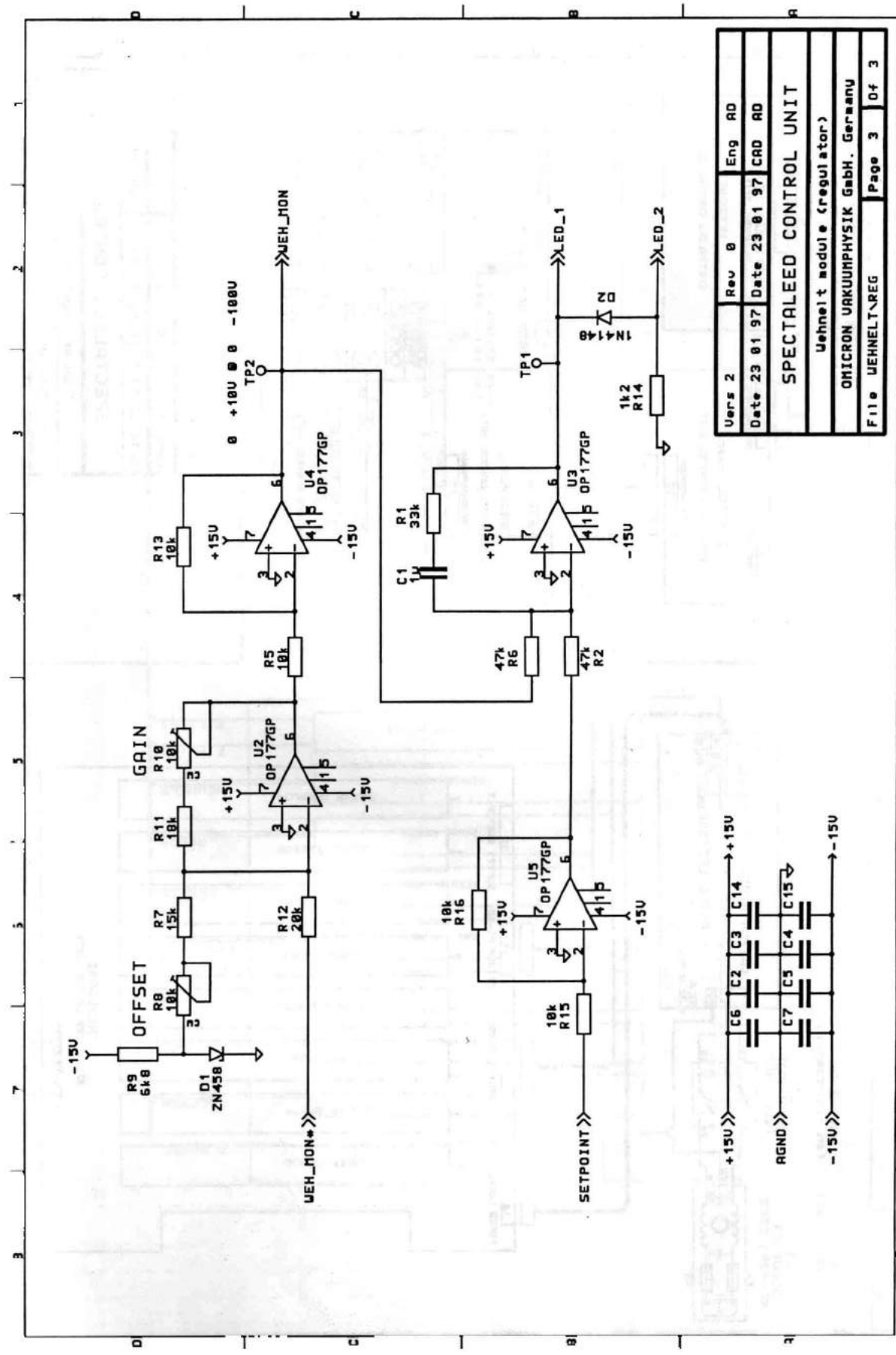

C23 10n/3kV
C25 10n/3kV
C27 10n/3kV
C32 10n/3kV
C33 10n/3kV
C34 10n/3kV
AC1
AC2
AC3
AC4
AC5
0R R28
0R R27
D7 D8 D9 D10 D11 D18 D12 D13 D14 D15 D16 D17
12x 1FF25
R26 1k
C24 10n/3kV
C26 10n/3kV
C28 10n/3kV
C29 10n/3kV
C30 10n/3kV
C31 10n/3kV
R30 33k
R29 1k
HV_OUT
0 +7kV
+15V
U11 OP177GP
SCR_MON*
10k R34
-15V
10k R35
U10 OPA627BP
130k R32
R33 100M 1% HV
R31 100k
C38 4n7/63V
D20 D19
2x 1N4148
+15V C22 C35 +15V
AGND C21 C37
-15V -15V
4x 100n/63V MKT
Dashed components not inserted
Vers 1 | Rev 0 | Eng AD
Date 02 09 96 | Date 02 09 96 | CAD AD
Project NGE 36
Screen module (cascade)
OMICRON VAKUUMPHYSIK GmbH, GERMANY
File SCREEN\CASCADE SCH | Page 4 | Of 5


SPECTALEED CONTROL UNIT
Screen module (regulator)
OMICRON VAKUUMPHYSIK GmbH, Germany
Vers 1
Rev 1
Eng AD
Date 02 09 96
Date 23 01 97
CAD AD
File SCREEN-REG SCH
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SCR_MON
CONTROL
TP9
TP10
U8 OP177GP
U9 OP177GP
U7 OP177GP
R25 10k
R16 15k
C14 0,68
R20 10k
10k R21
R19 4k99
R18 4k99
R17 10k
R22 10k
R24 20k
GAIN
+15U
-15U
SCR_MON*
SCR_SET
SHUTDOWN
C15 C16 C17
C18 C19 C20
6x 100n/63V MKT
AGND

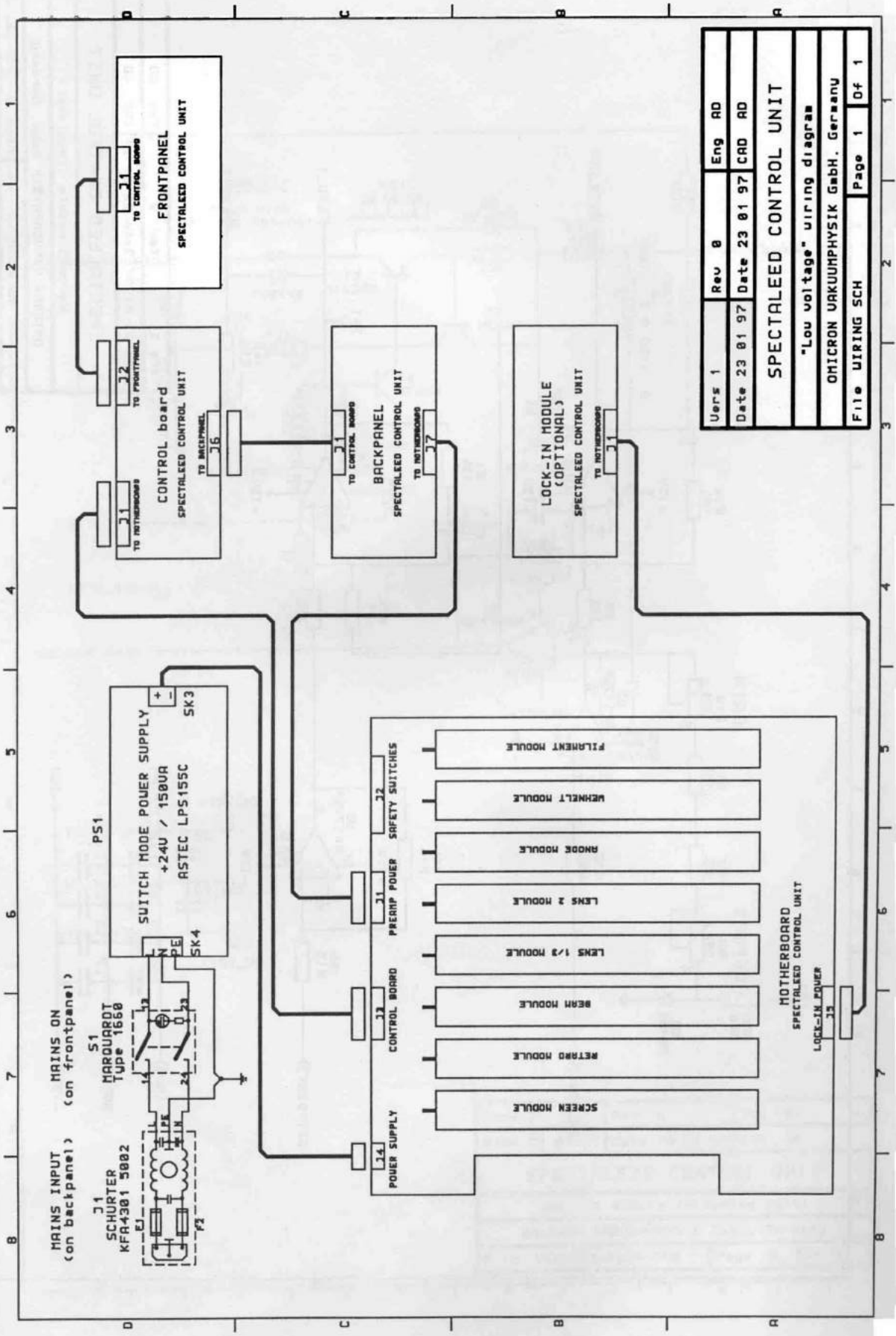
Wehnelt

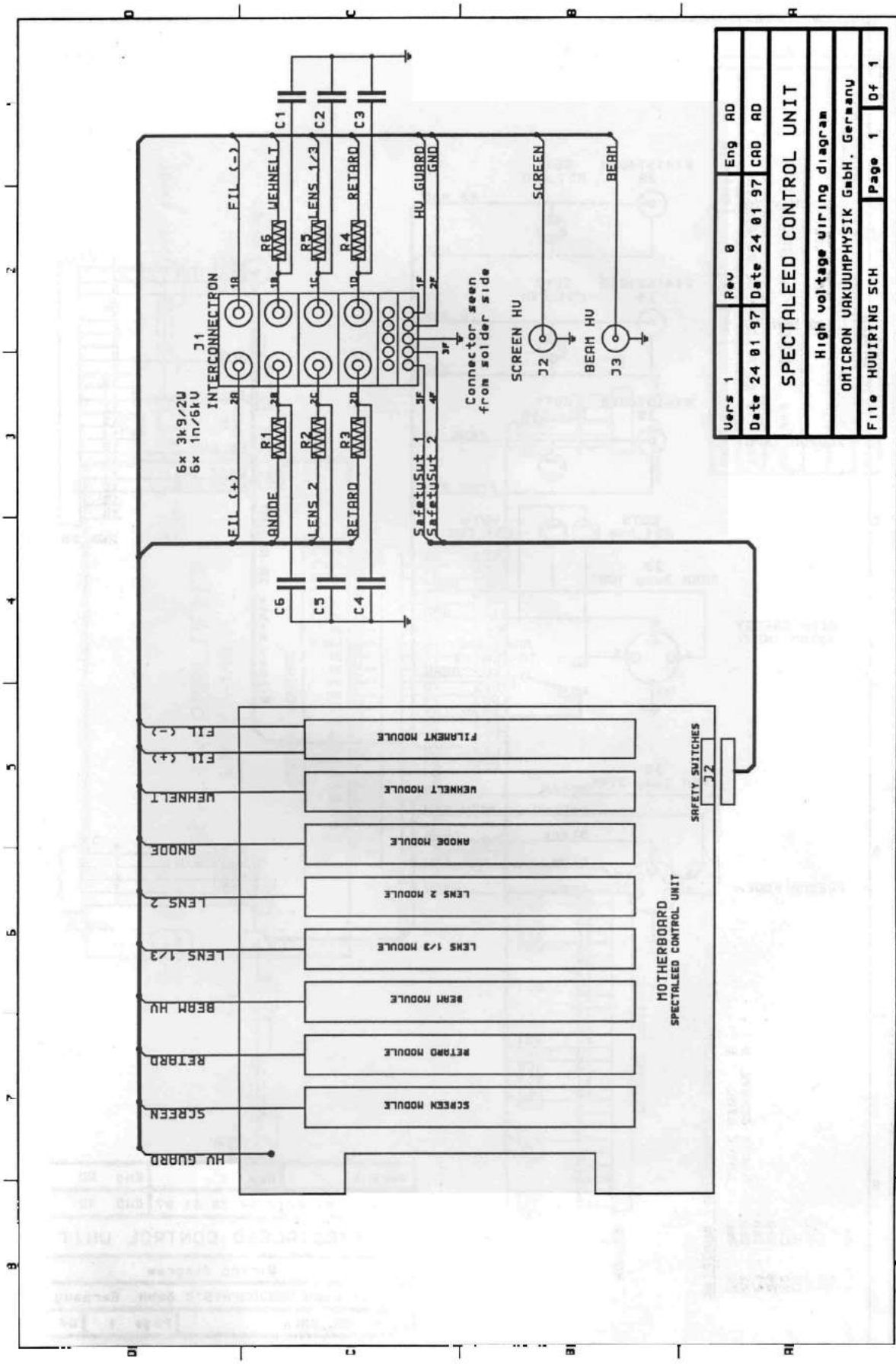

WEHNELT OUT
J4
LS106
HV_GUARD
J3
LS106
HV_GND
J5
LS106
HV GUARD
HV GND
+200V HV
-200V HV
+15V HV
HV GND
-15V HV
FILE=FLOATING SCH
WEHNELT_OUT
+200V_HV
-200V_HV
+15V_HV
HV_GND
-15V_HV
WEH_MON_HV
Floating part
OPTO_1
OPTO_2
HV_GUARD
ISO1
ISO_AMP
HV_GND
Input
HV_GND
Optical
Isolation
Amplifier
+15V_HV
HV_GND
-15V_HV
RGND
Output
RGND
+15V
RGND
-15V
HV_Guard
HV_Guard
Isolation barrier
U1
OPI1110C
+15V
AGND
-15V
HV GUARD
-15V HV
+15V HV
HV GND
+200V HV
-200V HV
High voltage connector
J2
FILE=REG SCH
SETPOINT
WEH_MON
LED_1
LED_2
WEH_MON
Regulator
+15V
AGND
-15V
WEH SET
WEH MON
WEH MON
WEH SET
VCC
GND
+15V
-15V
AGND
PWR24V
PWRGND
HV GUARD
Low voltage connector
J1
Vers 2
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Wehnelt module
OMICRON VAKUUMPHYSIK GmbH. GERMANY
File WEHNELT\WEHNELT
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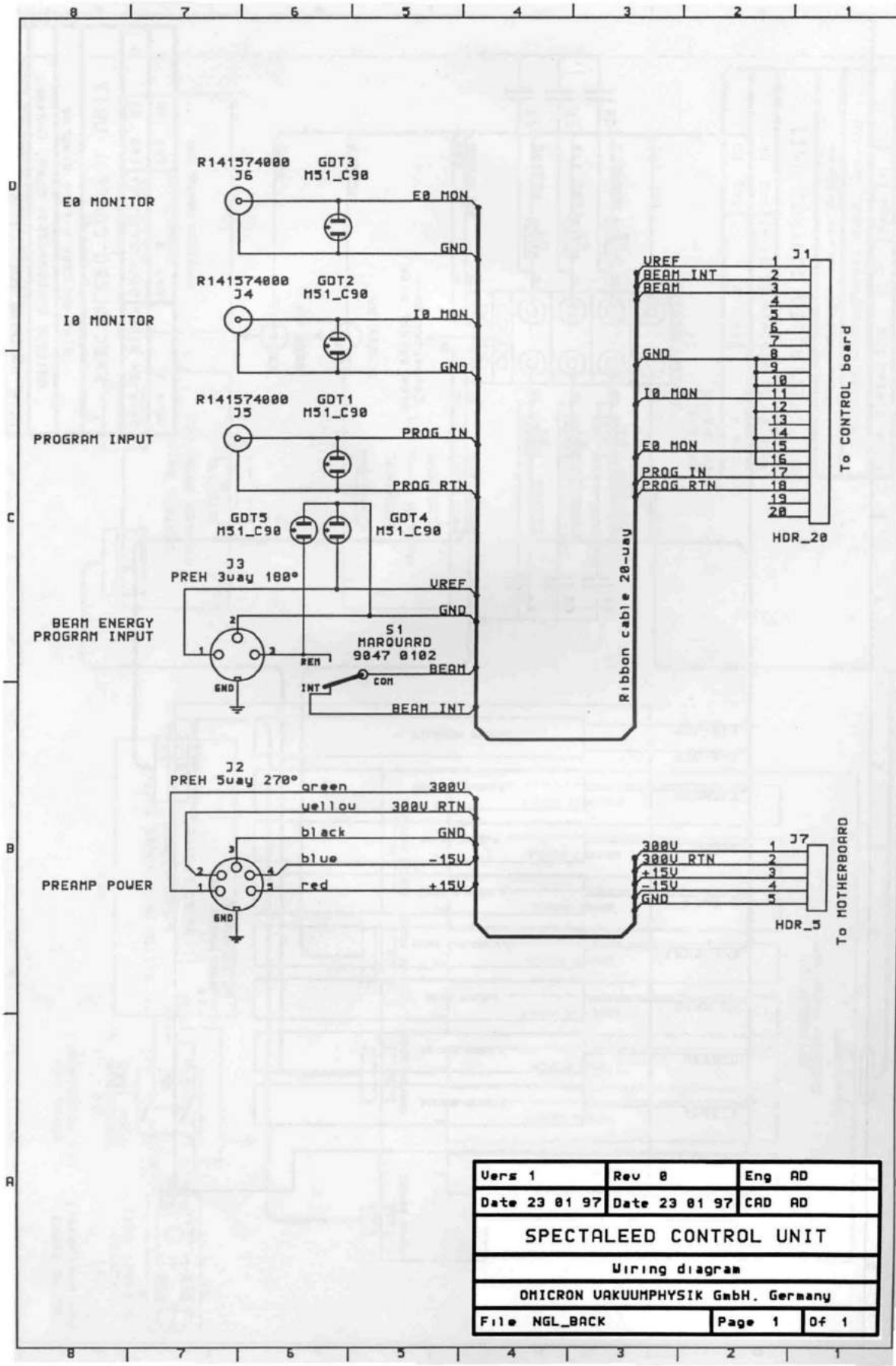

+200V_HV
WARNING!
Heat sink
on high potential
HS1
UK14 SA
D6
UF4007
470k
R4
R20
470
-200V_HV
R18
150
WEHNELT_OUT
T3
MJE350
68k
R21
TP4
120k
R22
T2
BC327
1M
R19
D5
SA120A
D7
BZX85C120
T4
BF421
180k
R3
C11
4µ7/350V
C13
1n/63V
C12
4µ7/350V
-15V_HV
OPTO_2
1k
R23
C10
1n/63V
100k
R17
1k
R24
+15V_HV
OPTO_1
U6
OP177GP
TP3
WEH_MON_HV
-15V_HV
D4
D3
2x 1N4148
+15V_HV
+15V_HV
C8
HV_GND
C9
-15V_HV
-15V_HV
Vers 2
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Wehnelt module (floating part)
OMICRON VAKUUMPHYSIK GmbH. Germany
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SPECTALEED CONTROL UNIT
Wehnelt modul e (regulator)
OMICRON VAKUUMPHYSIK GmbH. Germany
Vers 2
Rev 0
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Date 23 01 97
Date 23 01 97
CAD AD
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WEH_MON
LED_1
LED_2
TP1
TP2
0 +10U @ 0 -100U
U2 OP177GP
U3 OP177GP
U4 OP177GP
U5 OP177GP
GAIN
OFFSET
R1 33k
R2 47k
R5 10k
R6 47k
R7 15k
R8 10k
R9 6k8
R10 10k
R11 10k
R12 20k
R13 10k
R14 1k2
R15 10k
R16 10k
C1 1µ
D1 ZN458
D2 1N4148
+15U
-15U
WEH_MON*
SETPOINT
AGND

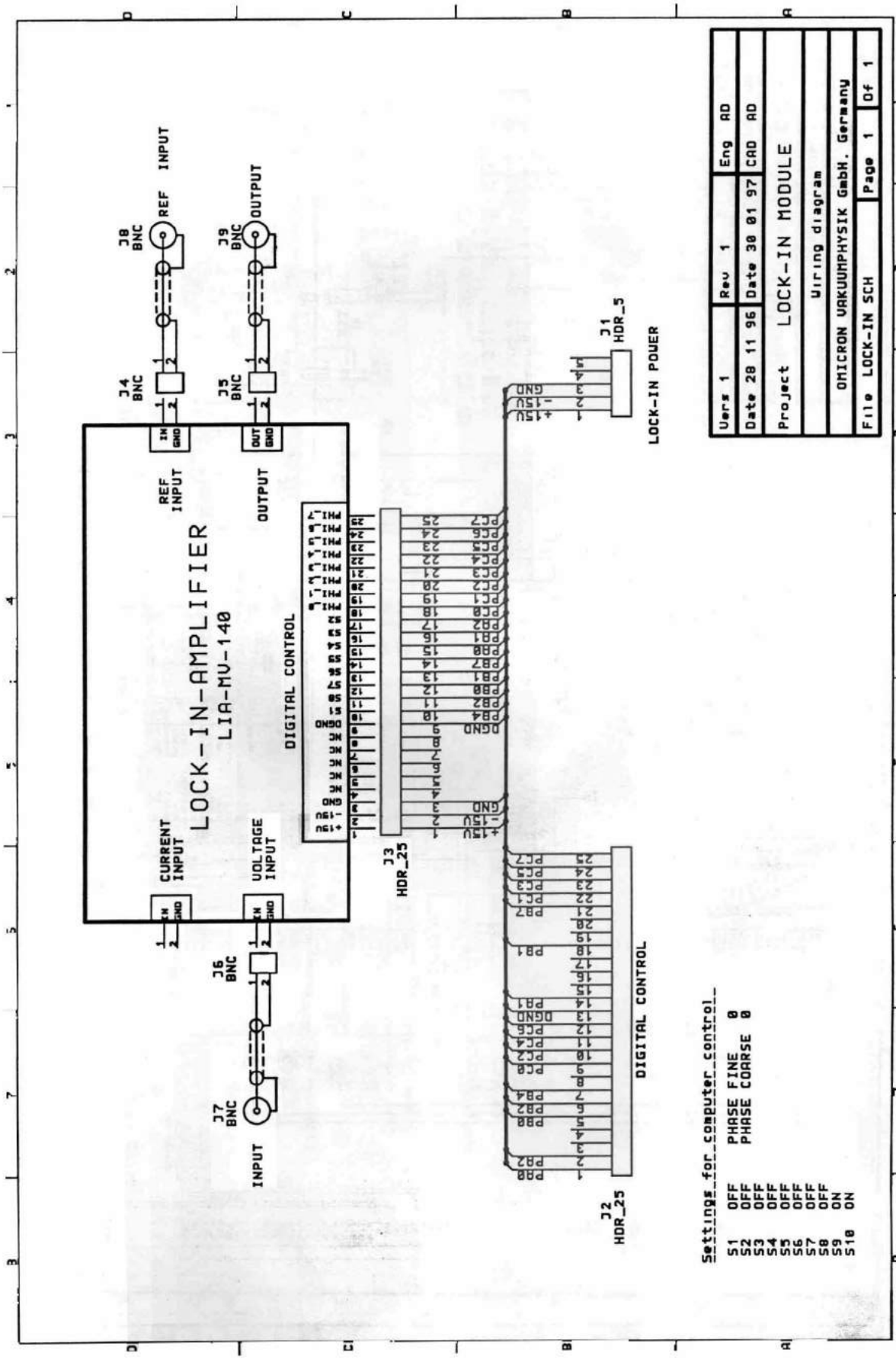
Wiring


FRONTPANEL
SPECTALEED CONTROL UNIT
TO CONTROL BOARD
CONTROL board
SPECTALEED CONTROL UNIT
TO FRONTPANEL
TO BACKPANEL
TO MOTHERBOARD
BACKPANEL
SPECTALEED CONTROL UNIT
TO CONTROL BOARD
TO MOTHERBOARD
LOCK-IN MODULE
(OPTIONAL)
SPECTALEED CONTROL UNIT
TO MOTHERBOARD
SPECTALEED CONTROL UNIT
"Low voltage" wiring diagram
OMICRON VAKUUMPHYSIK GmbH. Germany
Vers 1
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
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SWITCH MODE POWER SUPPLY
+24V / 150VA
ASTEC LPS155C
PS1
SK3
SK4
MAINS ON
(on frontpanel)
S1
MARQUARDT
Type 1660
MAINS INPUT
(on backpanel)
J1
SCHURTER
KFA4301 5002
F1
F2
POWER SUPPLY
CONTROL BOARD
PREAMP POWER
SAFETY SWITCHES
SCREEN MODULE
RETARD MODULE
BEAM MODULE
LENS 1/3 MODULE
LENS 2 MODULE
ANODE MODULE
WEHNELT MODULE
FILAMENT MODULE
MOTHERBOARD
SPECTALEED CONTROL UNIT
LOCK-IN POWER

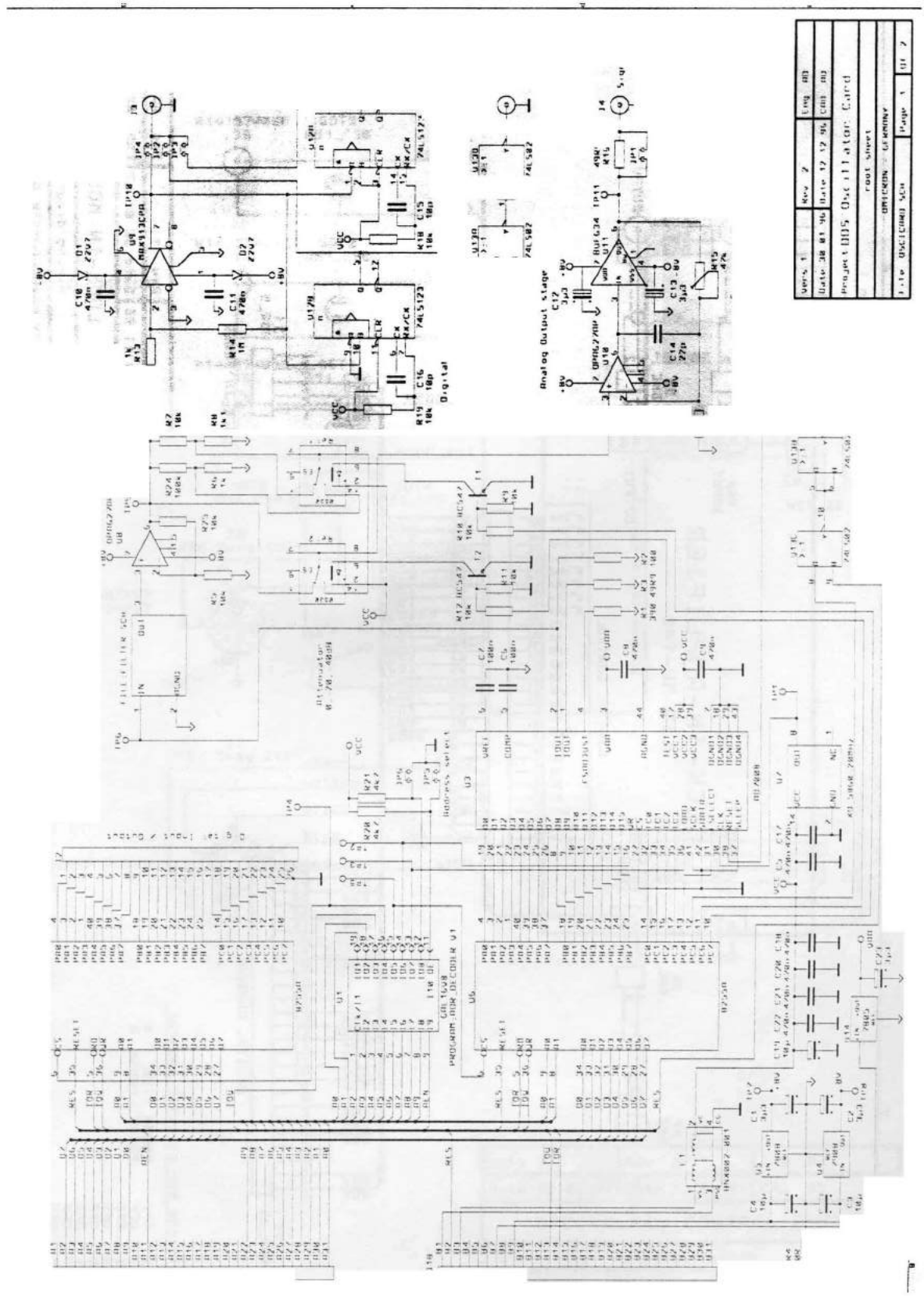

SPECTALEED CONTROL UNIT
High voltage wiring diagram
OMICRON VAKUUMPHYSIK GmbH. Germany
Vers 1
Rev 0
Eng AD
Date 24 01 97
Date 24 01 97
CAD AD
File HVWIRING SCH
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J1 INTERCONNECTRON
6x 3k9/2W
6x 1M/6kV
FIL (-)
WEHNELT
LENS 1/3
RETARD
HV GUARD
GND
SCREEN
BEAM
FIL (+)
ANODE
LENS 2
RETARD
SafetySwt 1
SafetySwt 2
Connector seen from solder side
SCREEN HV
BEAM HV
J2
J3
R1
R2
R3
R4
R5
R6
C1
C2
C3
C4
C5
C6
FILAMENT MODULE
WEHNELT MODULE
ANODE MODULE
LENS 2 MODULE
LENS 1/3 MODULE
BEAM MODULE
RETARD MODULE
SCREEN MODULE
MOTHERBOARD
SPECTALEED CONTROL UNIT
SAFETY SWITCHES
J2

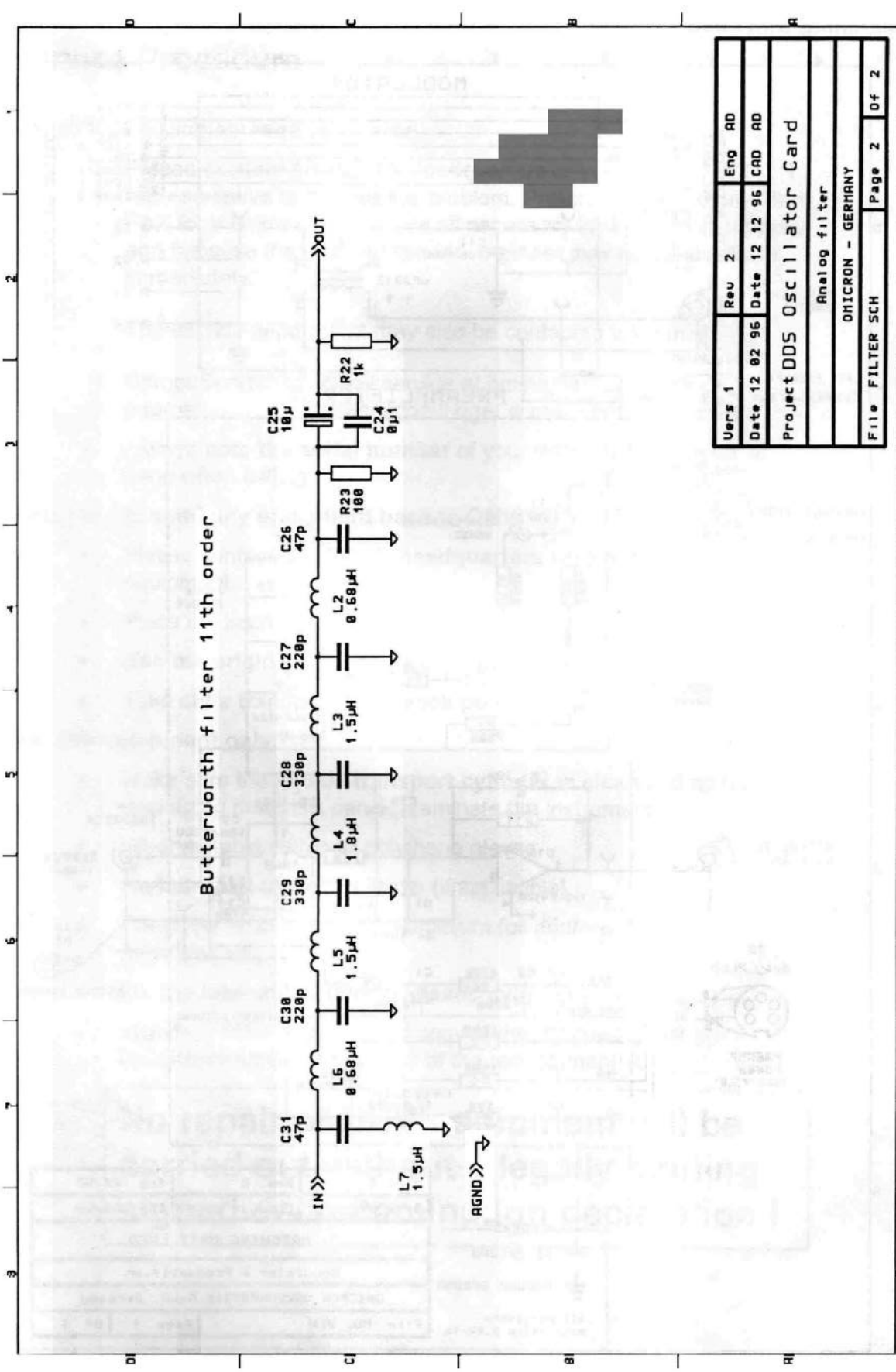

R141574000 GDT3
J6 M51_C90
E0 MONITOR
E0 MON
GND
R141574000 GDT2
J4 M51_C90
I0 MONITOR
I0 MON
GND
R141574000 GDT1
J5 M51_C90
PROGRAM INPUT
PROG IN
PROG RTN
GDT5 M51_C90
GDT4 M51_C90
J3
PREH 3way 180°
VREF
GND
BEAM ENERGY
PROGRAM INPUT
S1
MARQUARD
9847 0102
REM
GND
INT
COM
BEAM
BEAM INT
Ribbon cable 20-way
J1
VREF
BEAM INT
BEAM
GND
I0 MON
E0 MON
PROG IN
PROG RTN
To CONTROL board
HDR_20
J2
PREH 5way 270°
green
yellow
black
blue
red
300V
300V RTN
GND
-15V
+15V
PREAMP POWER
GND
J7
300V
300V RTN
+15V
-15V
GND
HDR_5
To MOTHERBOARD
Vers 1
Rev 0
Eng AD
Date 23 01 97
Date 23 01 97
CAD AD
SPECTALEED CONTROL UNIT
Wiring diagram
OMICRON VAKUUMPHYSIK GmbH. Germany
File NGL_BACK
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Lock-In Amplifier

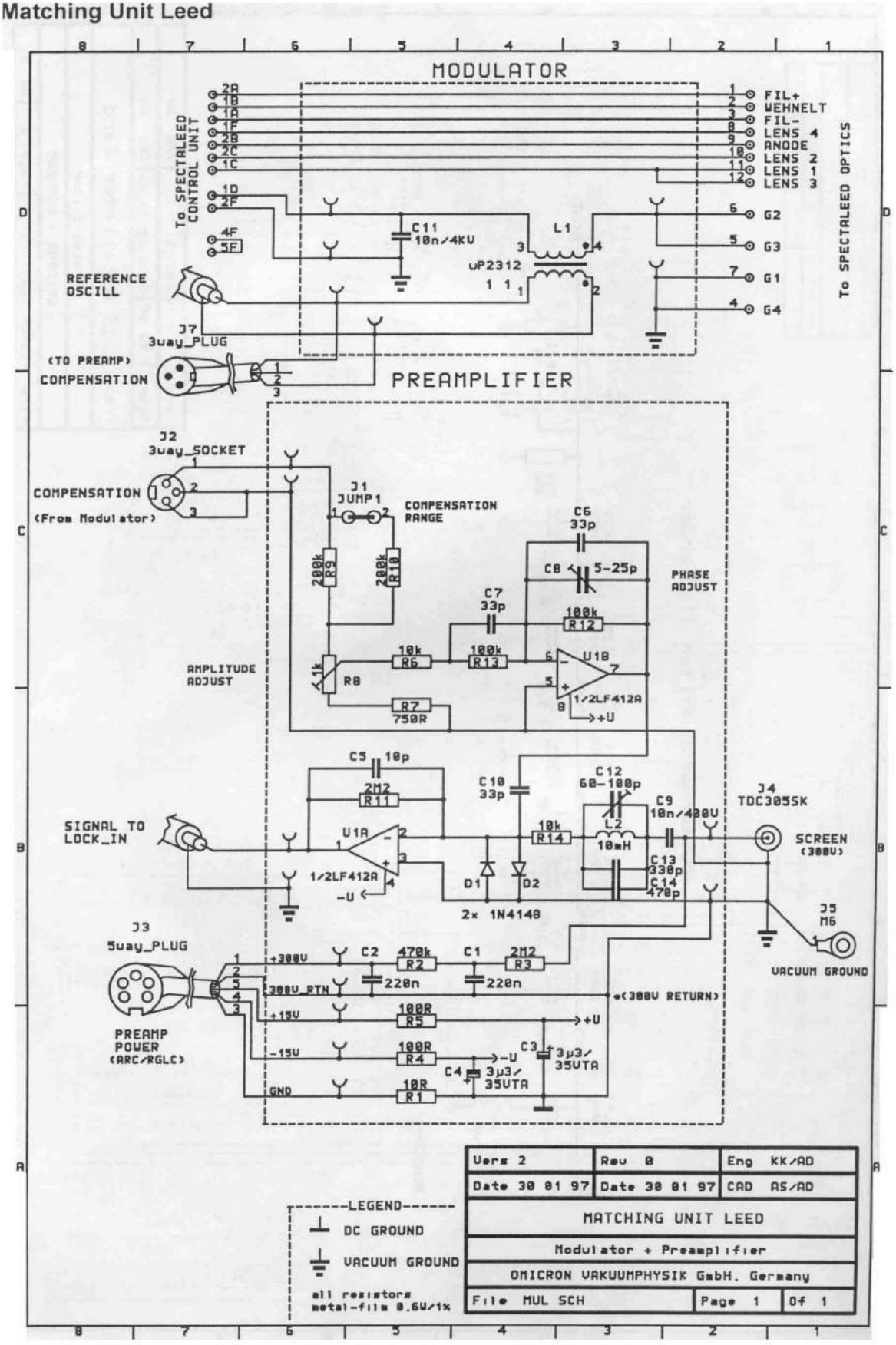


Interface/Precision Oscillator Board




Butterworth filter 11th order
IN
OUT
AGND
C31 47p
L6 0.68µH
C30 220p
L5 1.5µH
C29 330p
L4 1.8µH
C28 330p
L3 1.5µH
C27 220p
L2 0.68µH
C26 47p
R23 100
C25 10µ
C24 0µ1
R22 1k
L7 1.5µH
Vers 1
Rev 2
Eng AD
Date 12 02 96
Date 12 12 96
CAD AD
Project DDS Oscillator Card
Analog filter
OMICRON - GERMANY
File FILTER SCH
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Of 2

Matching Unit Leed



Service Procedure

Should your equipment **require service**

- Please **contact OMICRON** headquarters or your local OMICRON representative to discuss the problem. Preferably use the provided FAX form below to make sure all necessary information is supplied and because the required service engineer may not be available immediately.

  The service department may also be contacted via e-mail.

  CompuServe: "ccmail:service at omihqger"
  Internet: "service@omihqger.ccmail.compuserve.com"

- Always **note the serial number** of your instrument or have it at hand when calling.

If you have to **send any equipment back to OMICRON**

- Please contact **OMICRON headquarters** before shipping any equipment.
- Place the instrument it in a polythene bag.
- **Use the original packaging and transport locks.**
- Take out a **transport insurance policy.**

For UHV equipment only:

- Make sure the **plastic transport cylinder is clean** and no dust or packaging materials can contaminate the instrument.
- Wear suitable cotton or polythene gloves.
- **Re-insert all transport locks** (if applicable).
- Cover the instrument with aluminium foil and/or place it in a polythene bag.
- **Fix the instrument into its plastic cylinder** (if applicable).
- Include a filled-in and signed copy of the "Declaration of Decontamination" at the back of the related manual.

No repair of UHV equipment will be carried out without a legally binding signed decontamination declaration !

FAX

To
OMICRON Vakuumphysik GmbH

Test and Service Department
Idsteiner Straße 78
D - 65232 Taunusstein
Germany

Tel: +49 - 61 28 - 987-0
FAX: +49 - 61 28 - 987 193

From
.....
.....
.....
.....
.....
.....
Tel: .....
FAX: .....

Type of Instrument .....
Serial Number .....
Purchasing Date .....
(Last Service Date ..... **)**

Problem:

Date: **Signature:**

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