PASAN

FLASH GENERATOR V

OPERATING MANUAL

February 2008
Valid for unit P2300

SUMMARY

1. PURPOSE

This flash generator is designed to provide light to measure photovoltaic solar cells or modules. It is designed to work equally on labs or production sites. The unit works with a Xe flashbulb to provide an illumination essentially with the same spectral response as natural sunlight. The flash duration is short enough to avoid temperature rising giving measurement errors. Typical light duration is 2 ms with +/- 5 % stability and irradiation level is 1 kW/m2 with a source to device distance of 8 m.

Optical design follows rules of punctual sources to reach a good uniformity. A highly reflective and diffusing lamp holder is designed in order to avoid spectral distribution degradation and to approach at best the solar light spectral distribution. In order to meet the different cases of AMO, AM1, AM1,5 and AM 2, a set of suitable filters is provided.

2. EQUIPMENT SURVEY

2.1. Xenon lamp

The light source is an especially designed high intensity Xenon flashbulb with characteristic efficiency of 50 lm/W. Spectral distribution is shown in appendix. This curve was measured at a lamp manufacturer plant.

This discharge lamp is handmade in Switzerland and should only be replaced by an original one supplied by Belval S.A. or its representatives. This will warrant performances and compatability. In case of manipulation, avoid touching glass surface of tube. If dirty, clean it before starting any flash with cotton wool and pure alcohol. Be sure that all alcohol is fully evaporated before starting flash.

Warning. Do not touch bulb surface just after firing, even with a screwdriver point. As it is hot, there is a risk that the bulb will blow out. Wait 2-3 min. with blower working before starting any manipulation.

2.2. BV 25 Flash generator

This equipment consists mainly in a capacitor battery and related loading circuitry. Equivalent capacitance is 15400 µF and max. voltage is 1400 V. This gives a nominal energy of 151092 J at 1400 V. Typically nominal 14000 J are reached at 1348 V.

Charging procedure is drived by Sun Simulator III unit. If independant use is requested, a manual driving pad is available as extra accessory. Voltage setting and flash firing occurs under computer control.

3. INSTALLATION PROCEDURE

3.1. Xenon lamp and testing room

Refer to fig. 7.1. for testing room configuration. For best results the measuring room must be painted completely matt black. First define the suitable position of beam

axis and fix the adjustable module support against wall or in suitable place, eventually with the reference cell support. Then define the panel to flashtube distance according to optical design rules for punctual sources and desired uniformity. A 6 m distance for panels with bigger side not exceeding 1,5 m is usually considered sufficient. Notice that with new tube enclosure and filter support limiting beam divergence, reflectance of walls and floor are much less critical. Avoiding direct reflections with one curtain at half lamp to panel distance is in most cases convenient. Uniformity has to be tested to be sure of the results.

Remember that irradiance vary with the square of distance between source and target. Limit to reach 1 kW/m2 irradiance is usually comprised between 8 and 9 m for a new tube. Regarding to increase of tube lifetime it is better to use closer distances and decreasing operating voltage to reach desired irradiance.

3.2. Flash generator

3.2.1. Voltage setting

At delivery flash is adjusted in conformance with customers requirements. By default it is adjusted for 230 V / 50 Hz. To modify the voltage setting pull out the "Power" card and set the voltage jumpers near back connector according to figures 7.3. and 7.4.

Proper mains fuse into grid connection socket is 10 A slow blow for 230 V and 16 A slow blow for 110 V.

3.2.2. Grid connection

At delivery mains cable is equipped with swiss plug. When not convenient install a plug corresponding to your country. Note that yellow-green wire is protective earth.

3.2.3. Flashtube installation

Dispose flash generator close to its final position. Unscrew completely the two knurled screws at the front of light box. Pivot the filter holder to increase flash tube access. Introduce the flashtube into its socket and push it down to resistance. When done pivot the filter holder in position and screw it again.

CAUTION : Never disconnect or try to change flashtube when flash generator is under voltage. Remember as there is big capacitors inside dangerous voltages may remain for as long as one hour on tube terminals.

3.2.4. Flashlamp connection

First verify that a tube is properly installed in its socket. After that connect the flash plug into corresponding socket and locks it using locking devices. Then connect the ventilator power supply into corresponding socket at the left and lock it.

3.2.5. Starting cable

A convenient plug is furnished with equipment. Refer to fig. 7.5. for wiring. If long cables are needed prefer bifilar screened ones with screen connected to connector case.

3.2.6. First powering-up

CAUTION : Never stay on front of the flashtube when it is under voltage. At close distance to tube light can be sufficient do destroy eyes or cause permanent injury. Also tube may explode resulting in glass parts projected anywhere. At normal working distance light intensity is approximately the same as direct sunlight and no donmage can occur.

Switch the power on. The DVM on front plate indicates the actual voltage of capacitors battery. If maximum loading time is exceeded or if there is any default in the capacitor battery loading is stopped and the "Alarm" red LED comes on. If this occurs try to start a flash using “manual flash button” in the software of Sun Simulator III. If default persists after some trials see section 6 for troubleshooting.

Loading starts immediately after a voltage is programmed through Sun Simulator III and yellow "Charge" LED comes on. When presetted voltage is reached loading is stopped, "Charge" LED goes off and green LED "Ready" comes on. After a few seconds "Charge" comes on again to compensate self-discharge of capacitors but "Ready" stays on until a flash is fired. Minimum adjust voltage is 0 V and maximum is 1400 V. Minimum voltage is really not sufficient and it is necessary to reach 500 to 600 V to start flashing.

If flash generator was not used for a long time (several months), it is a good policy to apply progressive loading on capacitors, in order to form the electrolytic capacitors. Firstly set a voltage of about 25 % on Sun Simulator. When flash regulation works properly at this minimum voltage increase it progressively in order to reach the maximum in about 10 minutes. Then flash is ready to use. The formation process is not needed if flash generator is regularly used. But if it is not used for 3 months or more this process is recommended again.

4. DETAILED DESCRIPTION

4.1. Flash generator

4.1.1. Front plate

See fig. 7.2. for reference.

4.1.2. Block diagramm

See fig. 7.9. for reference.

The flash generator consists mainly in a power transformer associated with limiting

coils, loading a capacitor battery through a rectifier unit and a current supervising transformer.

Especially designed forming coil is disposed in the ouput path to soften the power and light output.

Electronic circuits located inside control unit gives control of loading, setting on or off the triac inside power control unit. It also gives the firing pulse to start the flashlamp.

4.1.3. Capacitors array

See fig. 7.10. for reference.

This unit consists of four groups in serie of 28 capacitors of 21200 µF each in parallel. Each group is fitted with 2 x 33 kohm resistors to equalize voltage. The resulting capacitance is 2200 x 28 / 4 = *15400 µF.*

4.1.4. Power control circuit ref. BV 77/1

Refer to figures 7.11. and 7.12.
Power coming from net goes through fuses, mains switch and input power filter . Then it goes through FS1 and a set of jumpers to the transformer of power supply unit. The loading path goes through TRC1 triac and another set of jumpers to limiting coils and loading transformer.

Auxilliary command circuit using T1, T2 and associated resistors is needed because main triac TR1 circuit is mainly inductive and current flowing through is not in phase with voltage.

Triac firing pulses are coming from control unit through an optocoupler IC1. The power led is powered with ca. 7.5 V from internal transformer XFR1 and associated rectifier and filter.

4.1.5. Flash pilot unit

Refer to figures 7.13. and 7.14.

Frequency coming from mains through power supply card is shaped using op amp IC3b which outputs is a fine positive pulse during zero-crossing of mains voltage. This pulse is used to reset a sawtooth generator formed by C4 and R37. Sawtooth is buffered by K1b and applied to comparator IC3a. On other hand, low slewing loading information comes from C3 through buffer K1a to second comparator input. Transistor T8 is then switched on or off and drives the optocoupler on power card.

Circuit made with R24, C3 and T7 acts as a ramp generator as follows :
Vhen T7 is switched on it fixs the C3 voltage on terminal B at approx. +12V. If switched off, voltage decreases as capacitor is loaded through R24. When -0.7 V point is reached, D1 starts conducting limiting negative excursion. As soon as T7 becomes conductive again, voltage on C3 returns quickly to +12V.

The "Charge" signal coming from Sun Simulator III arrives on R12. It is compared to the +5V internal and blocks T7 through T6 and T11, allowing charging cycle to start.

When predetermined voltage is reached there is responsibility to Sun Simulator to stop loading.

Start flash comes from Sun Simulator through R66 and T9 to starting triac TRC2 and firing condensator C2. C2 was previously loaded to 300 V through R56 to R60. Voltage is limited using zener diodes ZD4 and ZD5.

There are two security features :

- If maximum loading voltage is exceeded, loading is stopped through IC2b and T4. Alarm is led to Sun Simulator III using transistor T3.

- If there is a problem inside a capacitor battery, there is a mismatch into loading currents and result into current transformer, arriving on "Idiff" plugs will be different from zero. This resulting current is rectified, filtered and arrives onto comparator IC5a. It then actions the transistor T5 stopping loading and transistor T13 giving an alarm to Sun Simulator III.

4.1.6. Rectifier unit ref. BV 77/3

Refer to figures 7.15. and 7.16.
Rectifiing is made using four high voltage rectifiers VRI to VR4. Each of them is protected by one fuse FSI to FS4. This configuration used in conjunction with specially wound transformer permits loading the four sections of capacitor array with exactly the same voltage. This ensure that a section will never be overcharged avoiding the risk of destroying capacitors of this section. This configuration also permits survey of current using a current transformer in antiparallel connection.

A firing-aid circuit using capacitors CI to C6 associated with equilibrating resistors RI to R6 is also located on this board. It is connected to flashtube through pins 28 and 30.

4.1.7. Power supply unit ref. BV 77/4
Refer to figures 7.13. and 7.14.
Power coming from mains through BV 77/1 card goes to transformer XFRI. Double secondary windings are connected to a bridge rectifier unit VRI giving + and - bipolar DC voltages stabilized through IC1 and IC3 to +15 V and - 15 V. A single winding is connected to VR2 rectifier giving through IC2 the + 5 V supply. A diode DI is used to isolate the C4 capacitor in order to obtain a mains synchronized signal on pin 8 to be used as starting reference for triac.

The 0 V connections are differentiated on this board in order to avoid addition of dropping voltages due to contacts and wiring resistances.

5. FLASH TROUBLESHOOTING

WARNING : High voltages inside, up to 1'400 V DC. These voltage may stay for several hours on terminals after mains is removed. To avoid personnel injury, make sure that capacitors are completely discharged before opening apparatus. If not, connect a 47 ohm 100 W resistor across capacitors battery terminals an wait a few seconds to full discharge.

5.1. Nothing occurs at Power-up

Verify the following points :
- Power availability on mains.
- Fuse blowed out (See correct values on paragraph 3.2.I.).
- Fuse on electronic card blowed out.
- Power card defective.

5.2. Explosion inside flash generator

Explosion noise means that a capacitor is defective and must be replaced. Be sure that capacitors are full discharged before opening flash generator (see above). First try to locate it visually (Safety-valve open, capacitor body broken, electrolyte projections).
If not possible try as follows : Connect the - of battery capacitors to the neutral of the mains.Connect the + of battery capacitors to the phase of the mains through a 10 µF high voltage capacitor. Take all precautions needed by mains voltage to avoid electrocution !!!. Then by means of a sensitive AC voltmeter measure the voltage across the four capacitor blocks. With 230 V line, voltage on each block must be approx. 35 mV. Then locate the block in which voltage is slighty different from the others, generally 3 % above. Defective capacitor is inside this block. Then disconnect the + jump across capacitors lines in this block and control each line in the same manner. When defective line is discovered disconnect all capacitors in this line and control them individually. When defective capacitor is discovered replace it, clean carefully its environnment if necessary, restore the set of connections, close the apparatus and start again as described on paragraph 3.2.5.

5.3. Voltage doesn't increase on DVM and alarm comes on after 1 min.

Look for :
- Defective triac on power card.
- Defective rectifiers on high-voltage section on defective fuses.
- Broken circuits or defective transformers or coils in high-voltage section.

5.4. Voltage increase doesn't stop at preset value

Stops immediately loading using mains switch and look for :

- Defective triac on power card.
- Defective ICs inside flash pilot unit.

5.5. Flash doesn't start

- Flash cable not connected.
- Flash tube defective or broken.
- Insufficient voltage on tube.
- Ignition coil defective inside tube support.
- Ignition thyristor defective on flash pilot unit.
- ignition capacitor defective on flash pilot unit.

Flash Generator V - ref. BV 77

Final control

Machine number

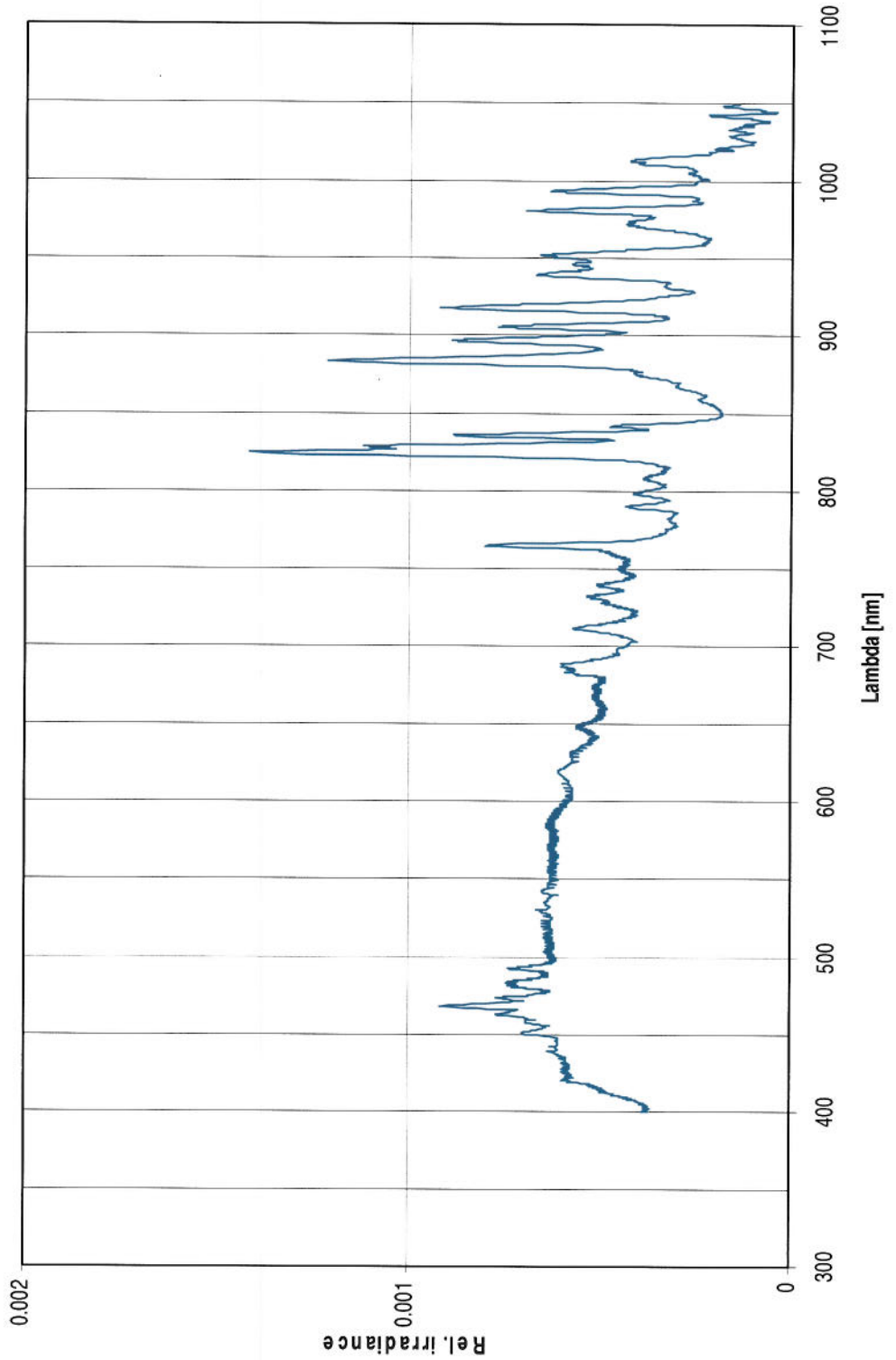
Used RefCell:	Type:	Mono + th	Serial number:	MTP 1738-8	Sensitivity:	103.7 mV
Filter:	Type:	FL 03	Thickness:	4 mm		
Adjustement for 1 kW/m2	60.0	%	or	1'000	Volts	
2 ms stability	Min:	0.987	Max:	1.015	Variation: +/-	1.40%

Cards, descriptions	BV Ref	Serial number
Power circuit	BV 77-1M1	P2118/8
Flash driver	BV 77-2M1	P1960/5
Rectifyer	BV 77-3M1	P1777/8
Power supply	BV 77-4M1	P1998/9

Date: 27.02.2008

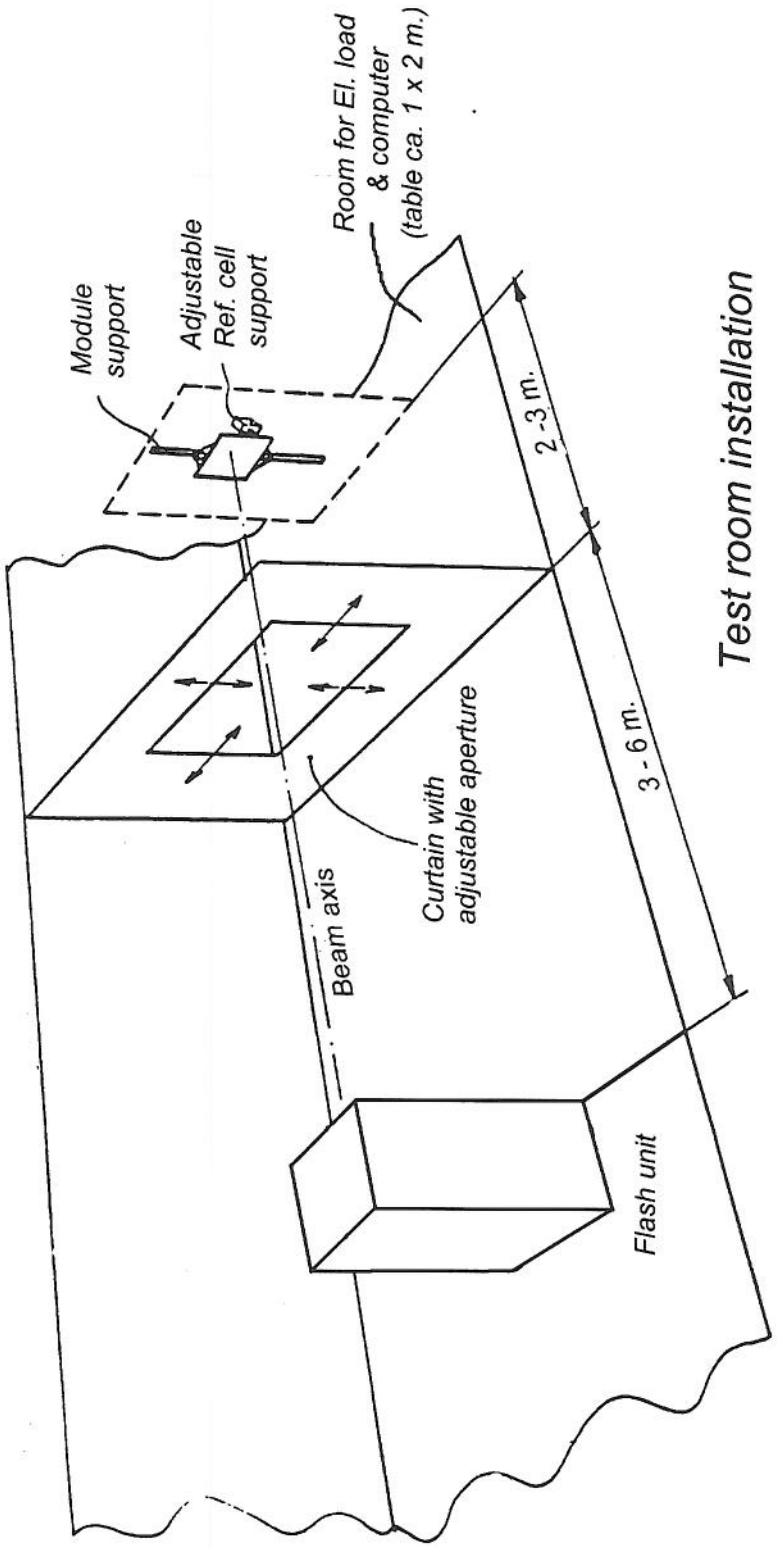
Visa: DK

6.2. Spectrum for P1694 :

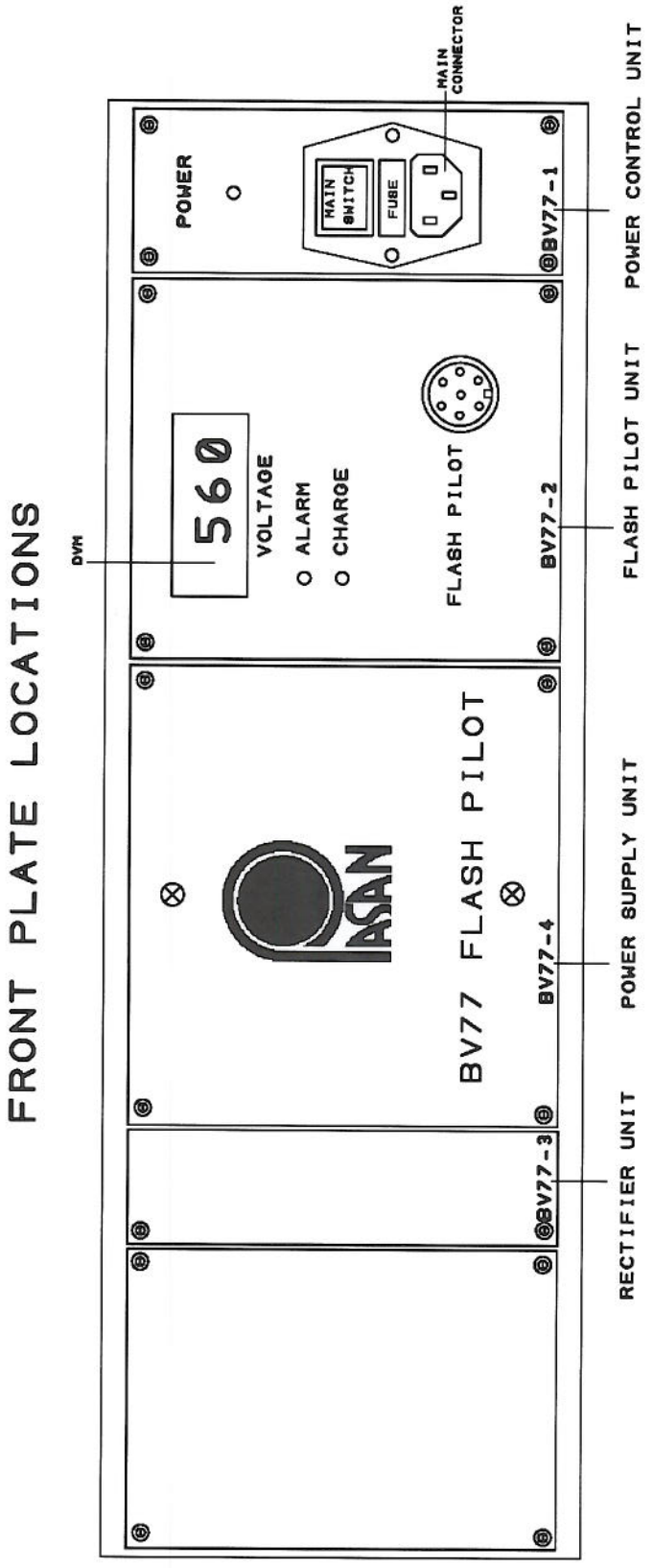


7. LIST OF FIGURES

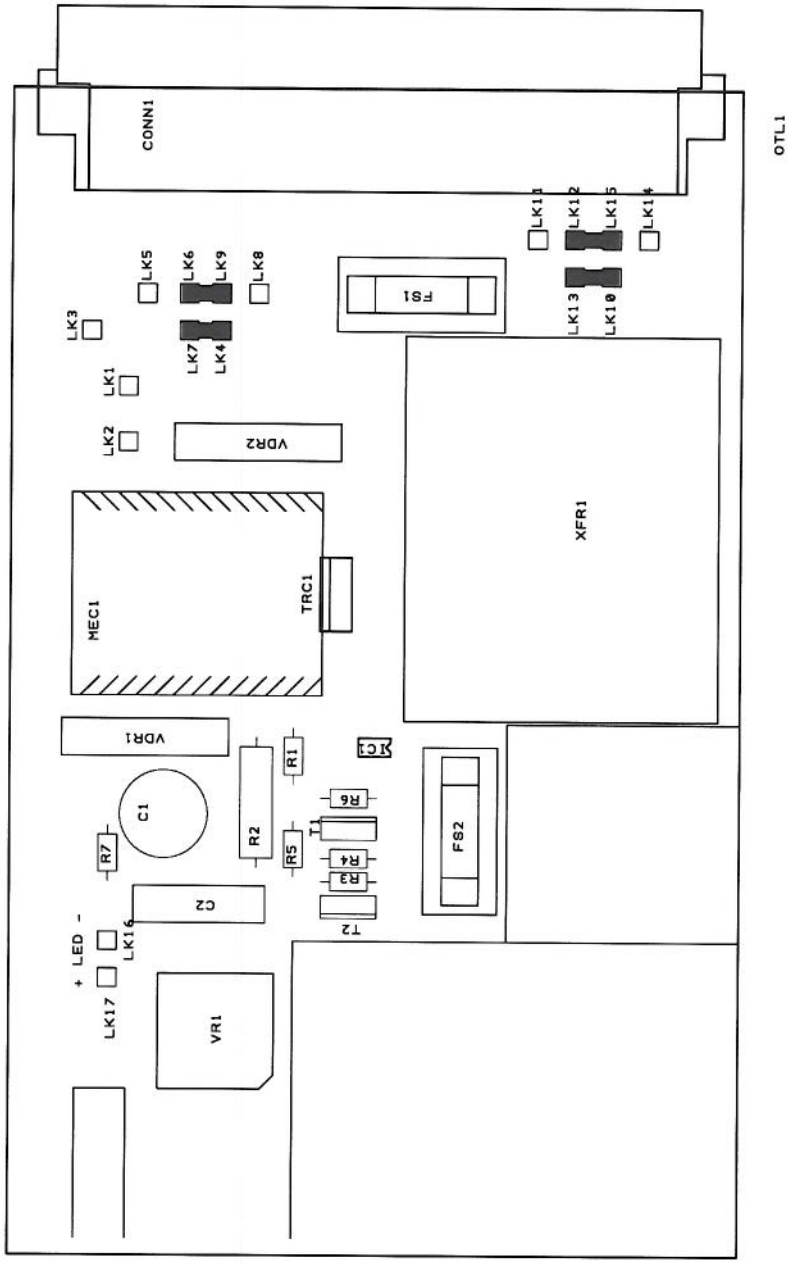
7.1. TEST ROOM CONFIGURATION



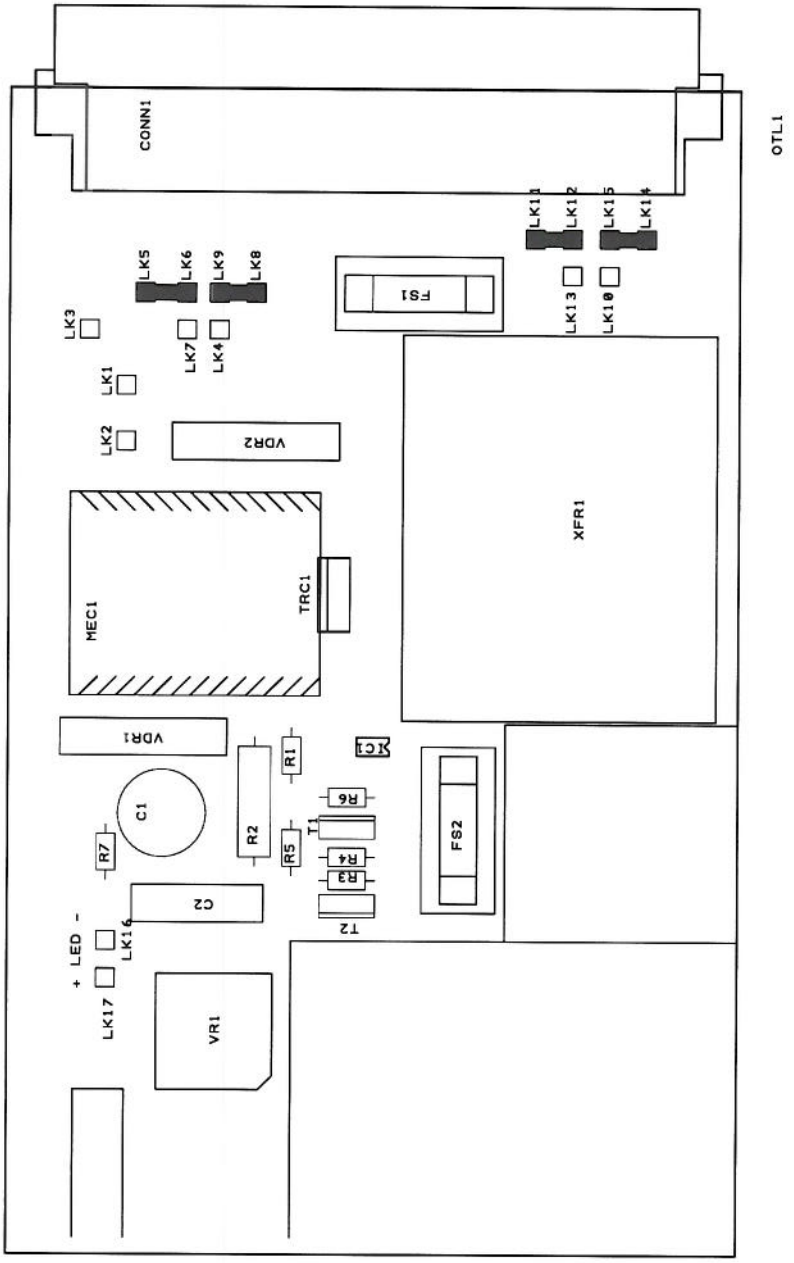
7.2. FRONT PLATE OF FLASH UNIT



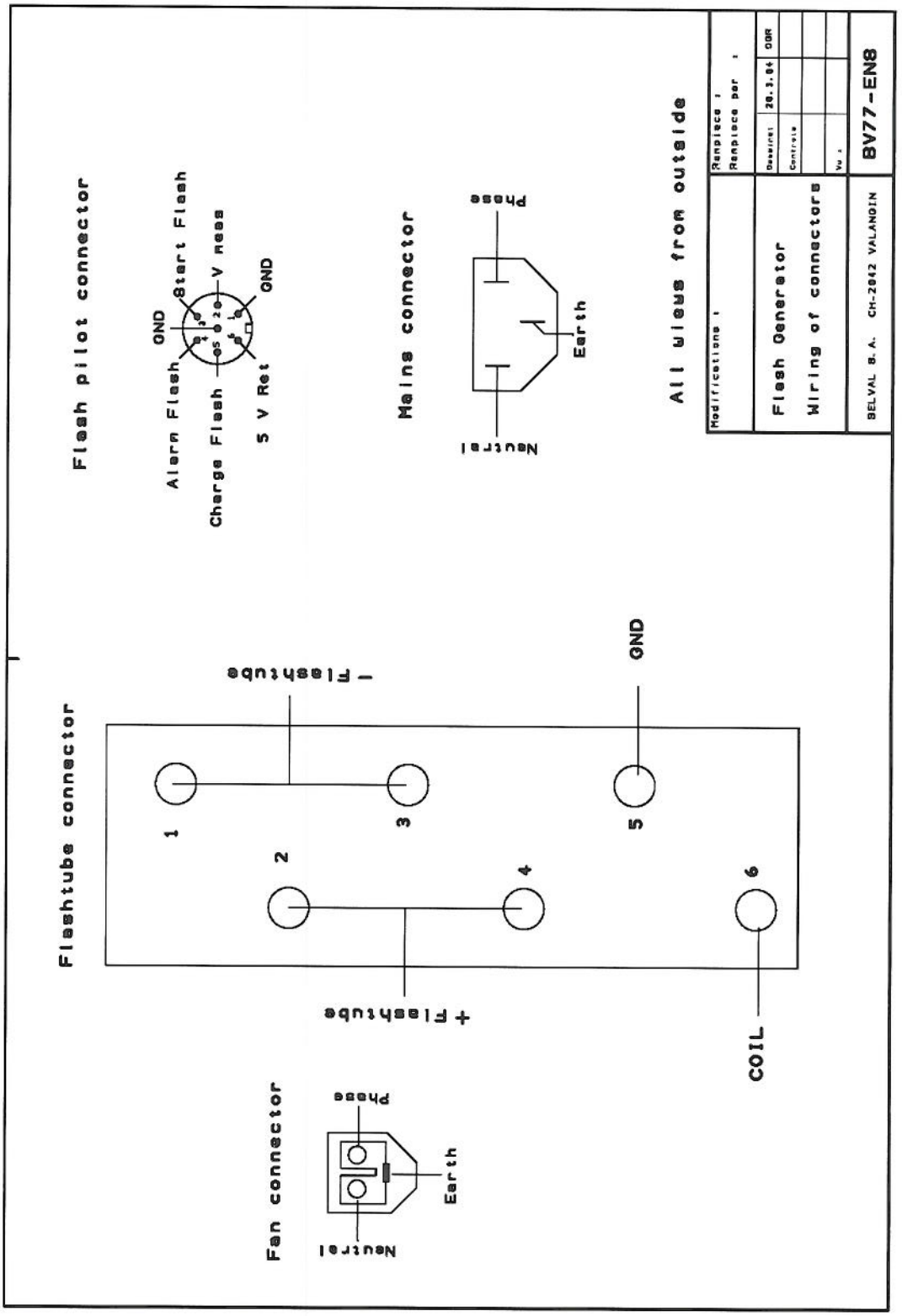
7.3. VOLTAGE SETTING 230 V



7.4. VOLTAGE SETTING 110 V



7.5. WIRING OF PLUGS



7.6. Xe FLASH SPECTRAL DISTRIBUTION (OSRAM)

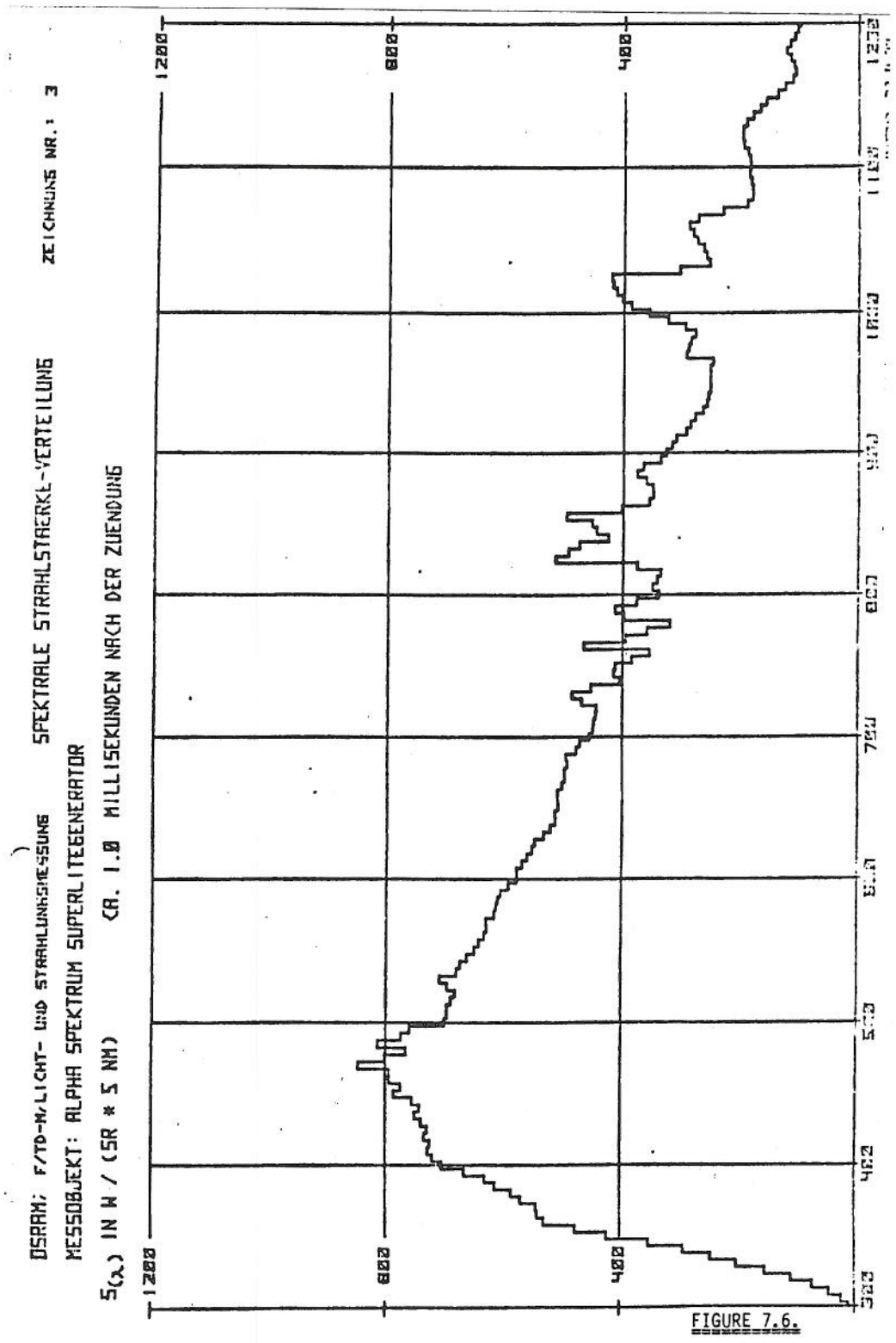
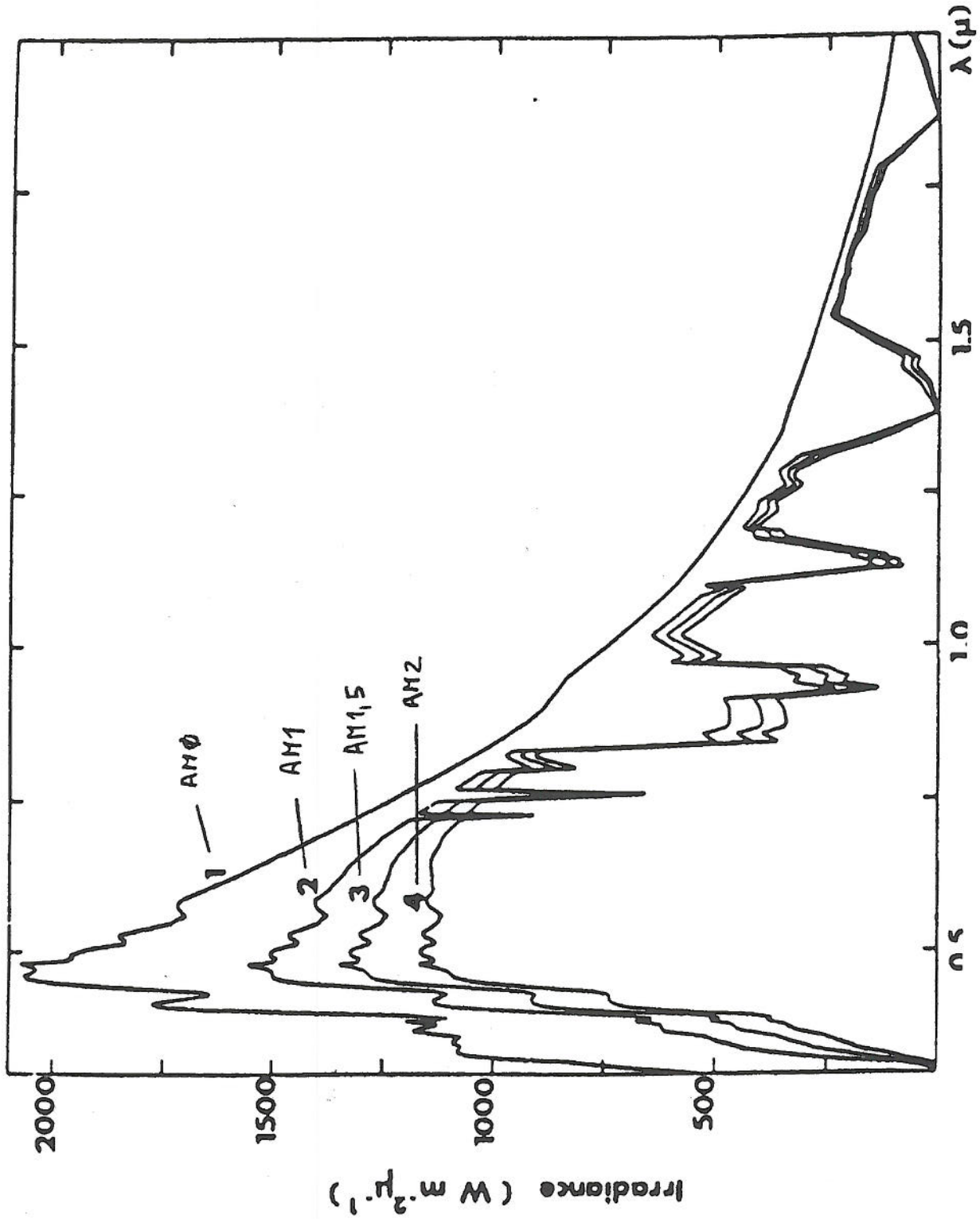
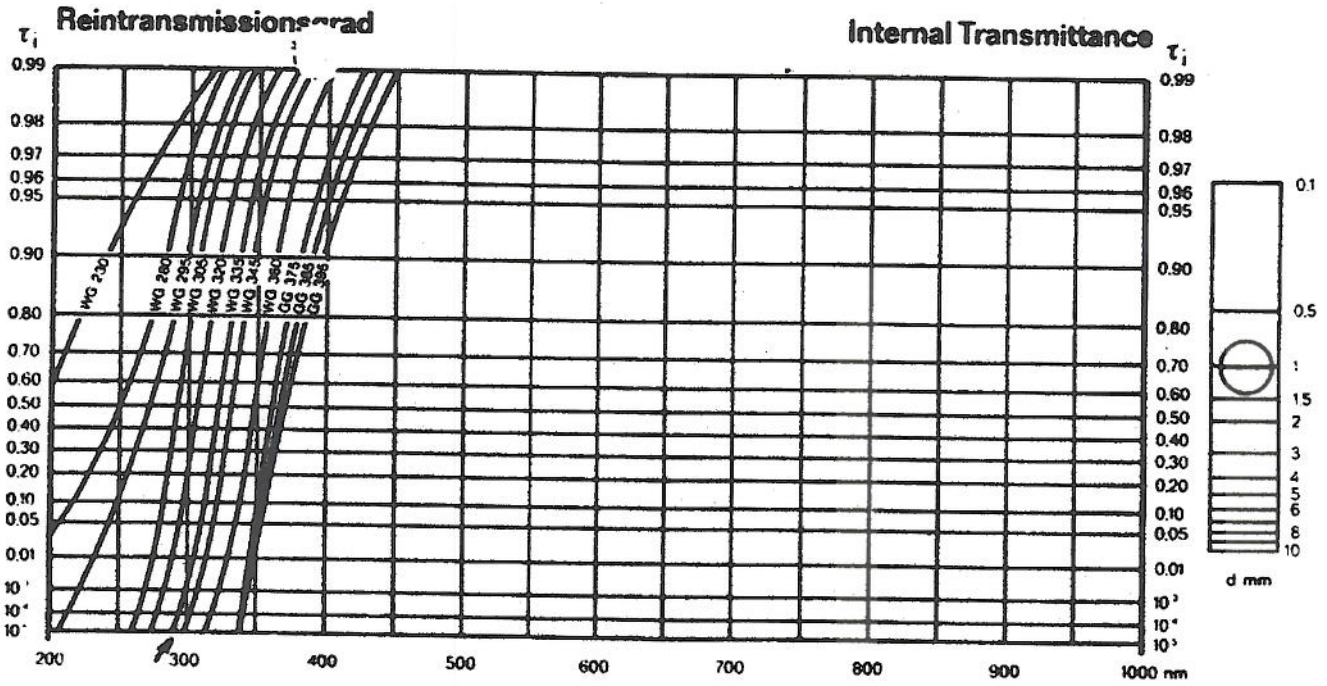


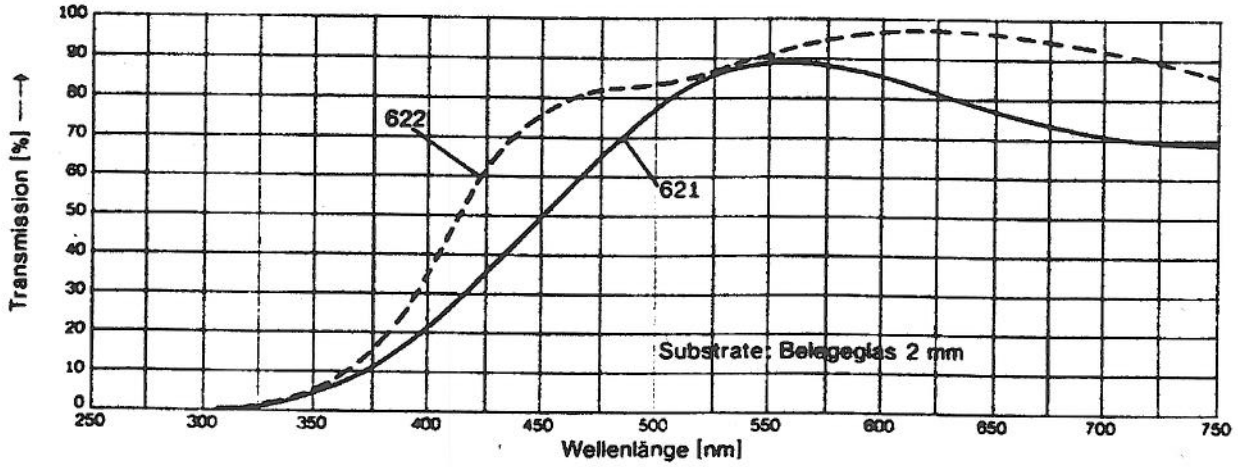
FIGURE 7.6.

7.7. AM0 - AM2 SOLAR SPECTRAL DISTRIBUTION

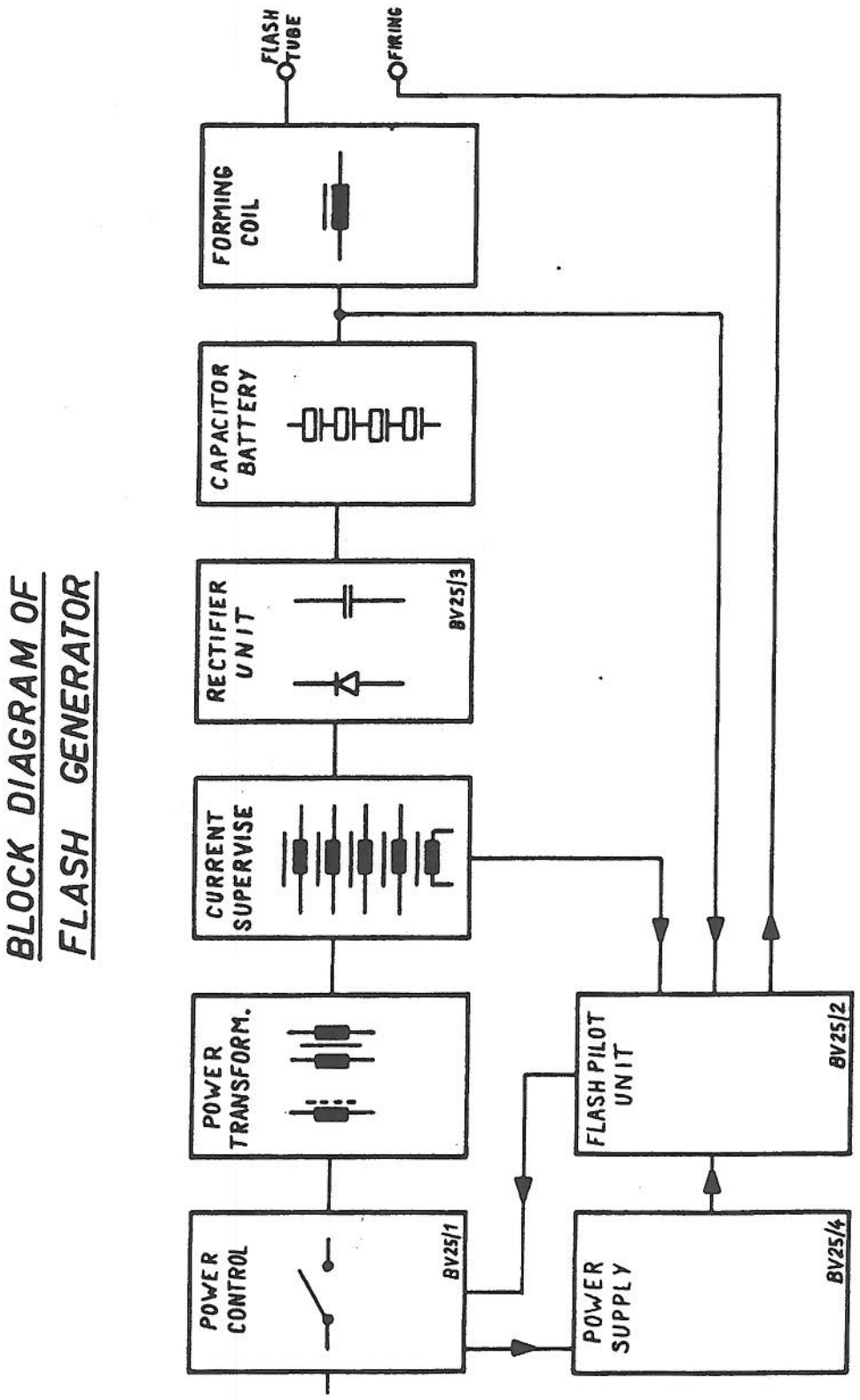


7.8. FILTERS TRANSMITTANCE

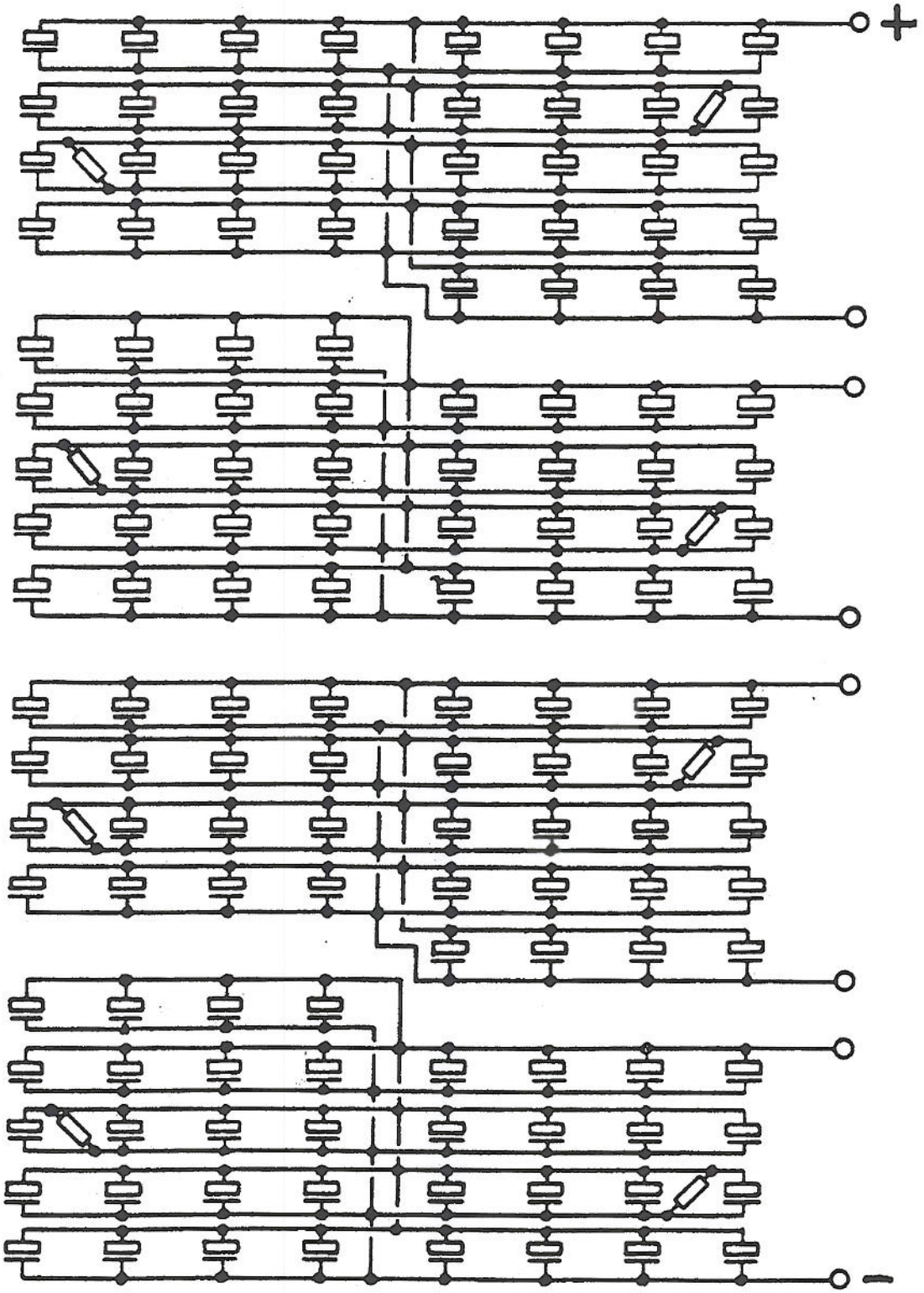




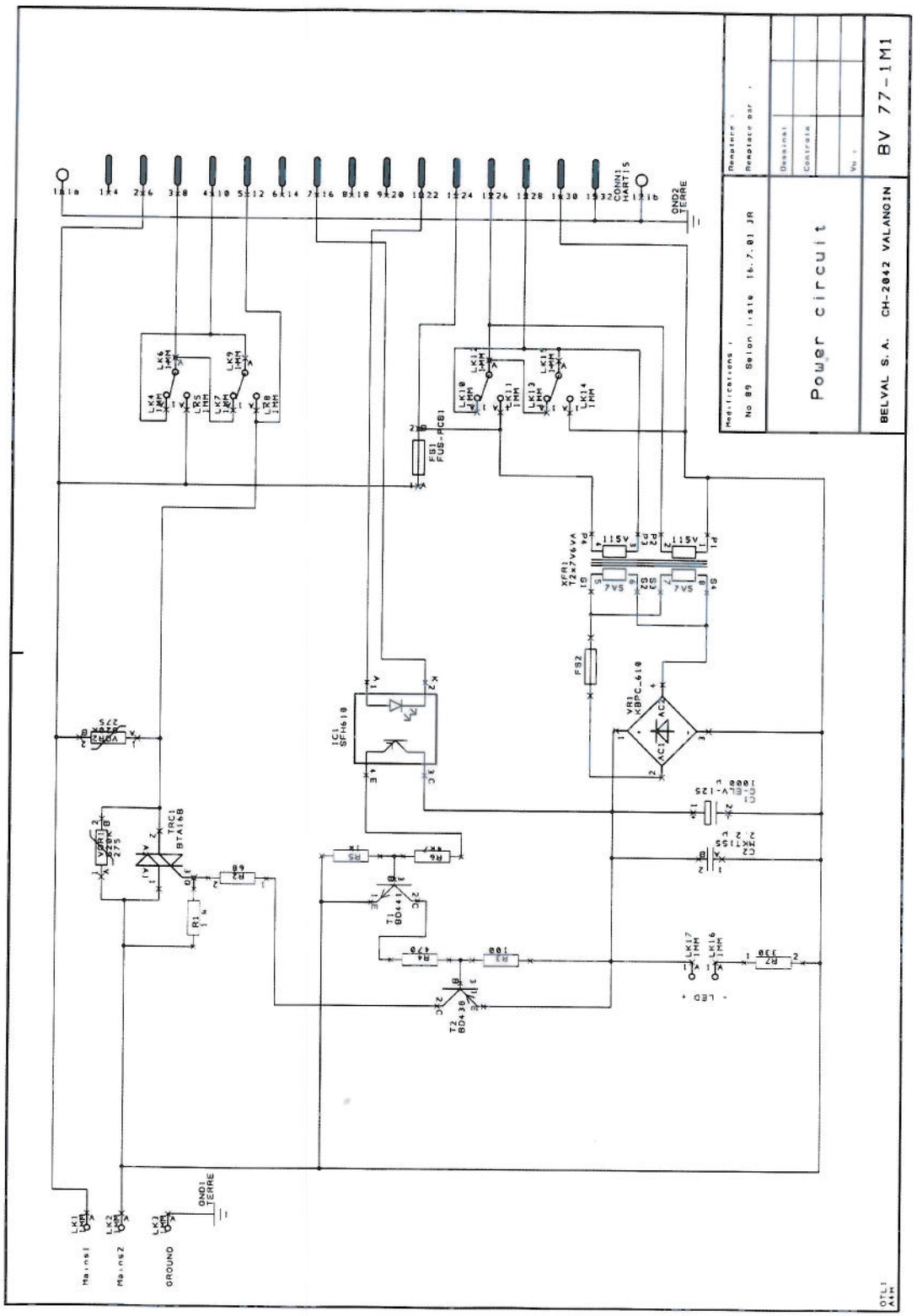
7.9. BLOCK DIAGRAM OF FLASH GENERATOR



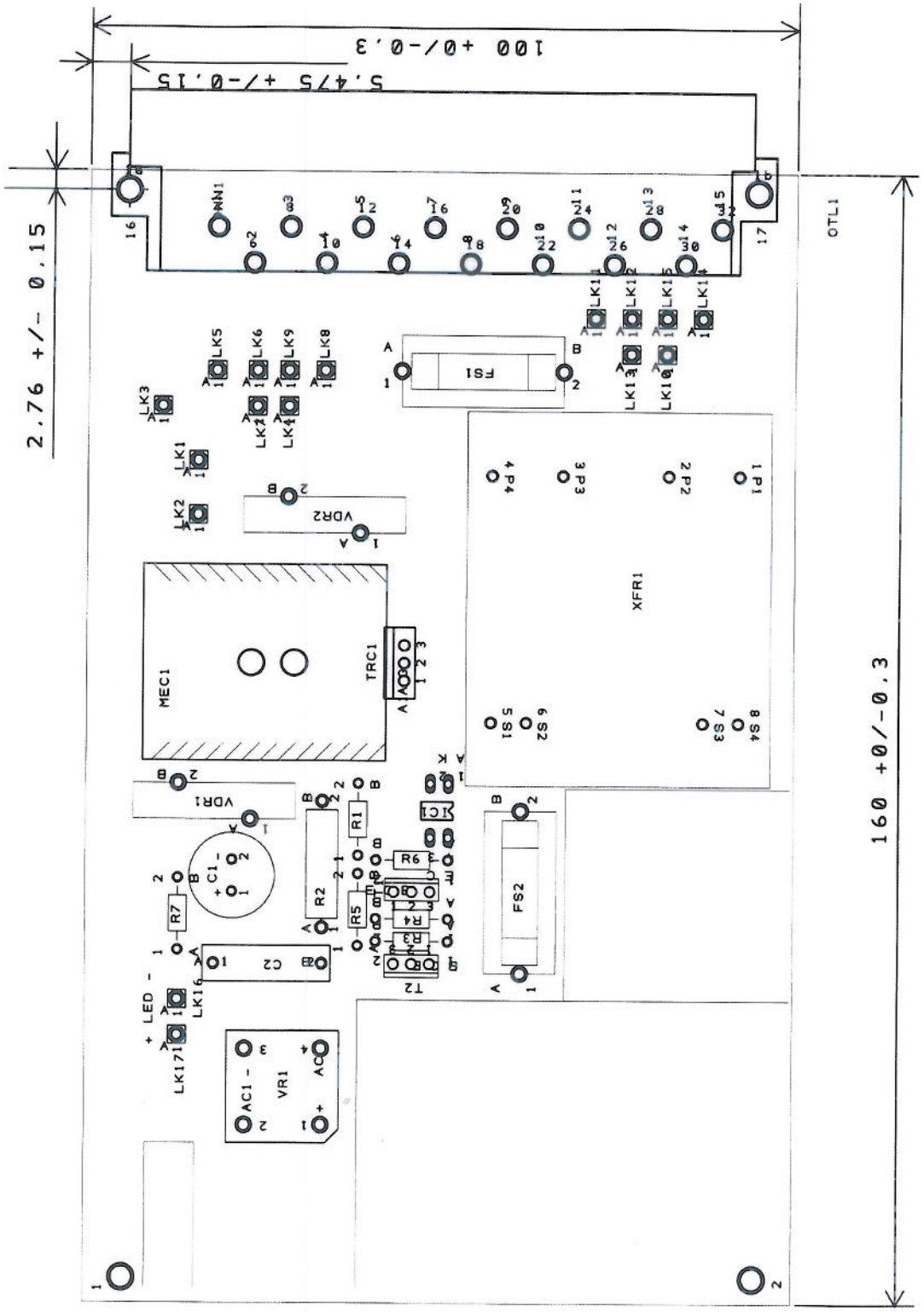
7.10. CAPACITORS ARRAY



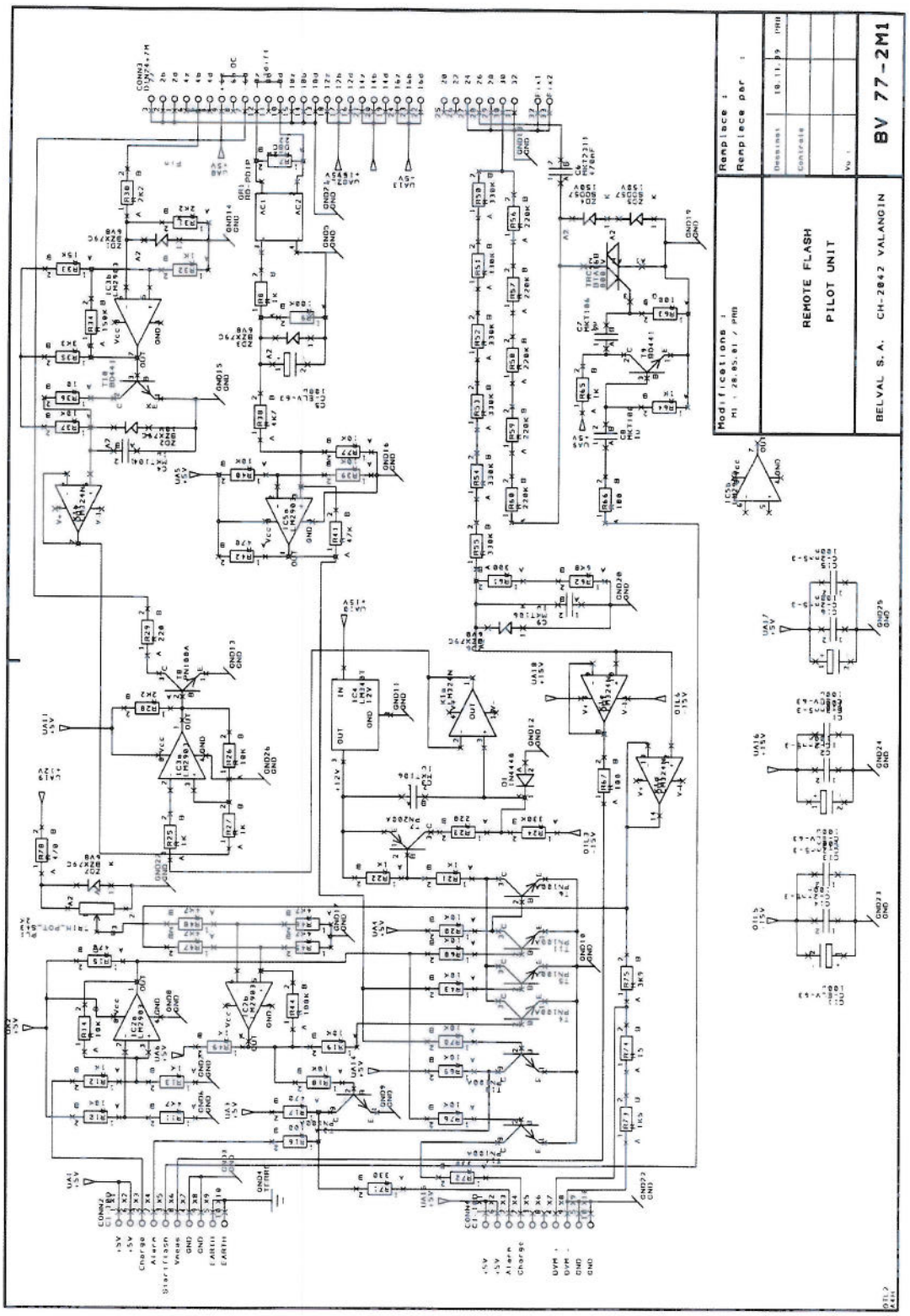
7.11. POWER CIRCUIT BV 77/1. SCHEMATICS



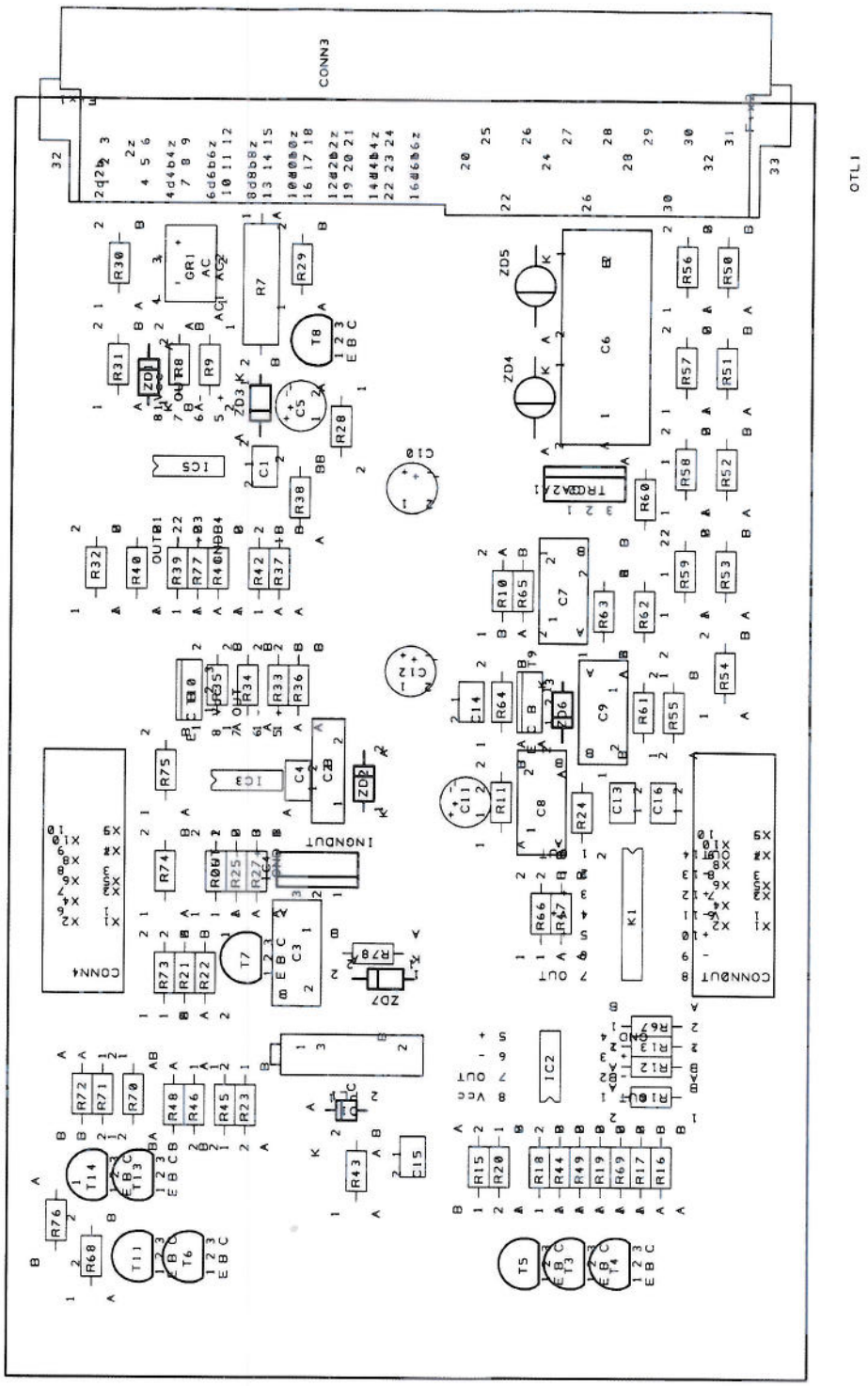
7.12. POWER CIRCUIT BV 77/1. COMPONENTS



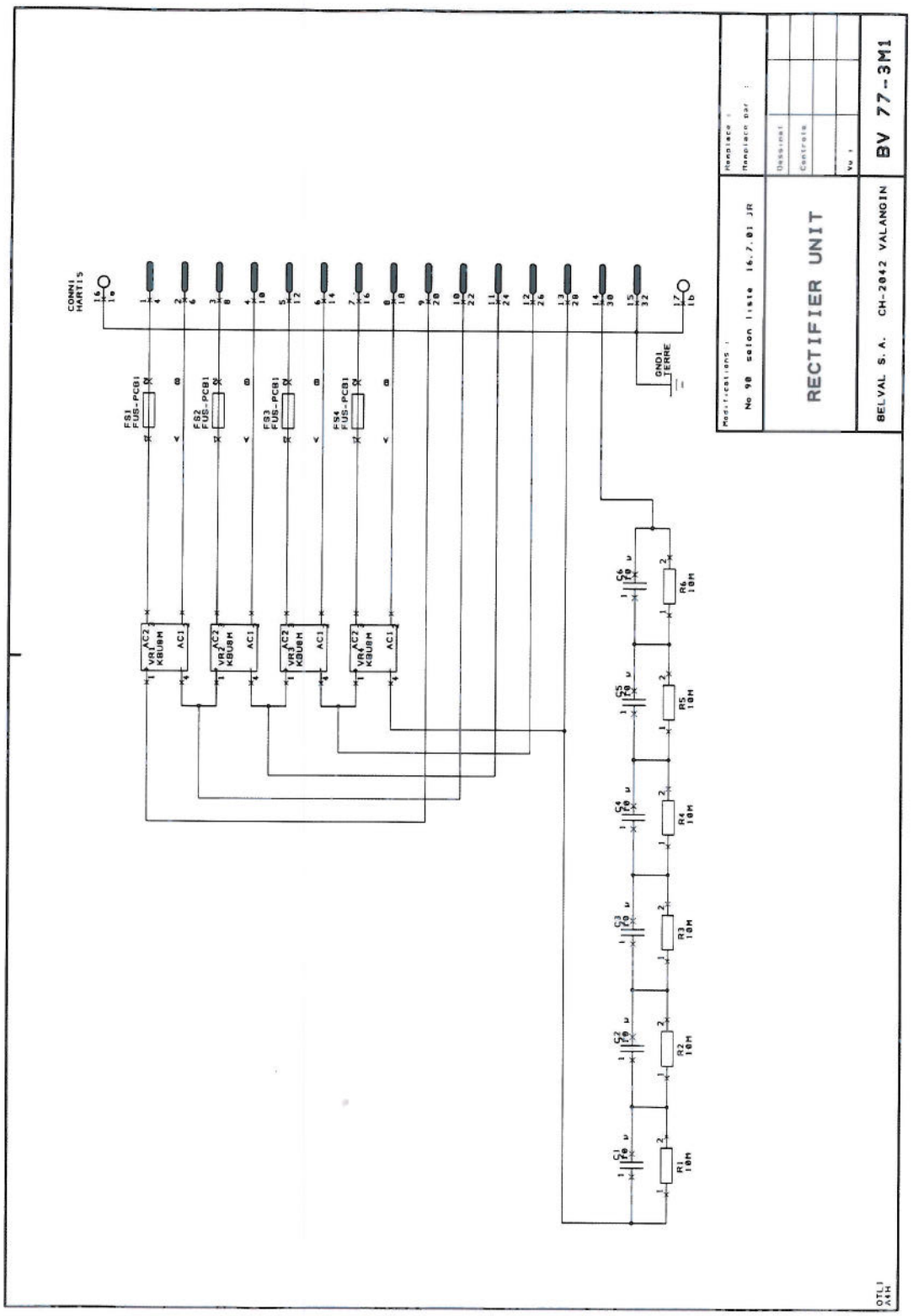
7.13. REMOTE PILOT UNIT BV 77/2. SCHEMATICS



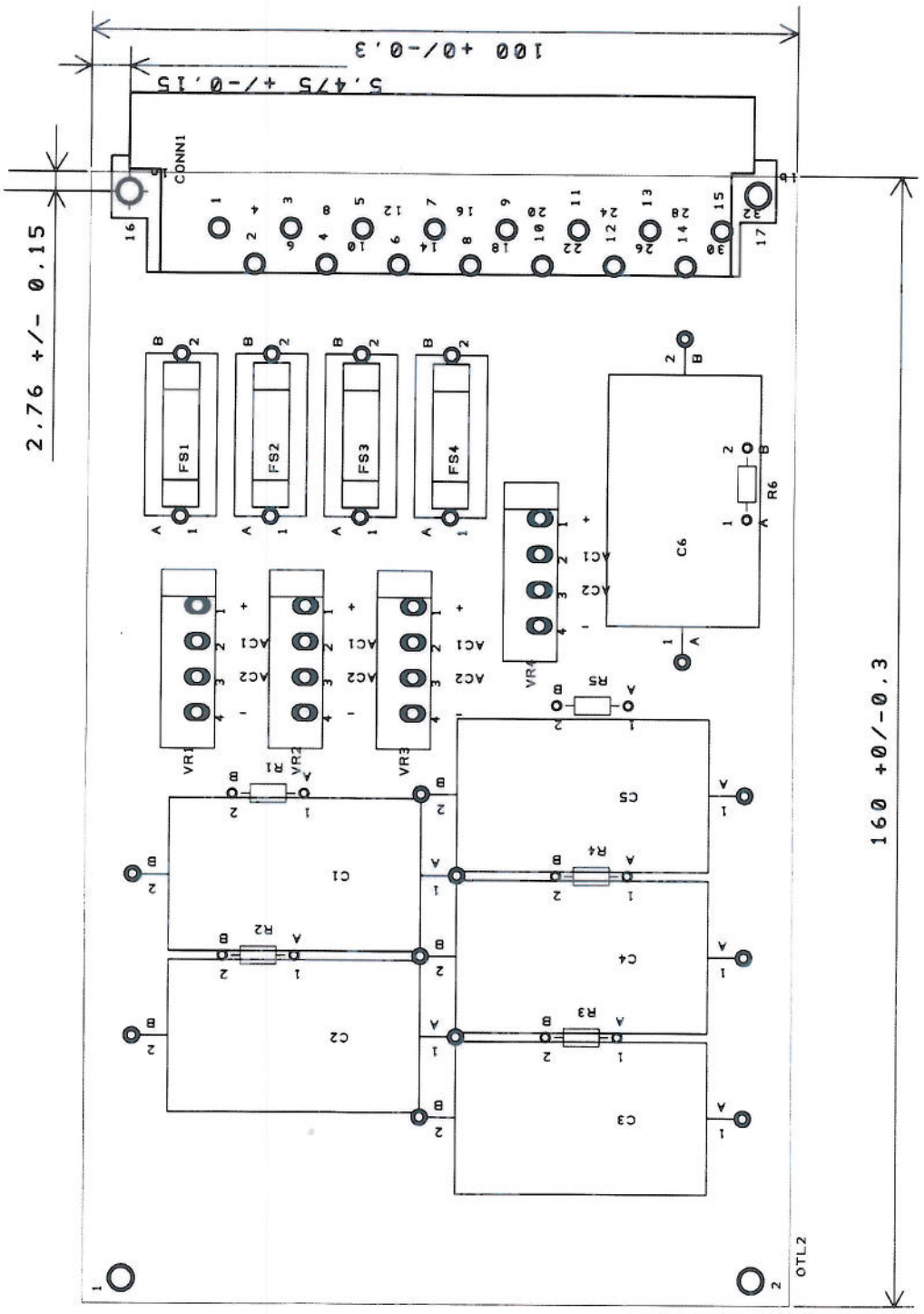
7.14. REMOTE PILOT UNIT BV 77/2. COMPONENTS



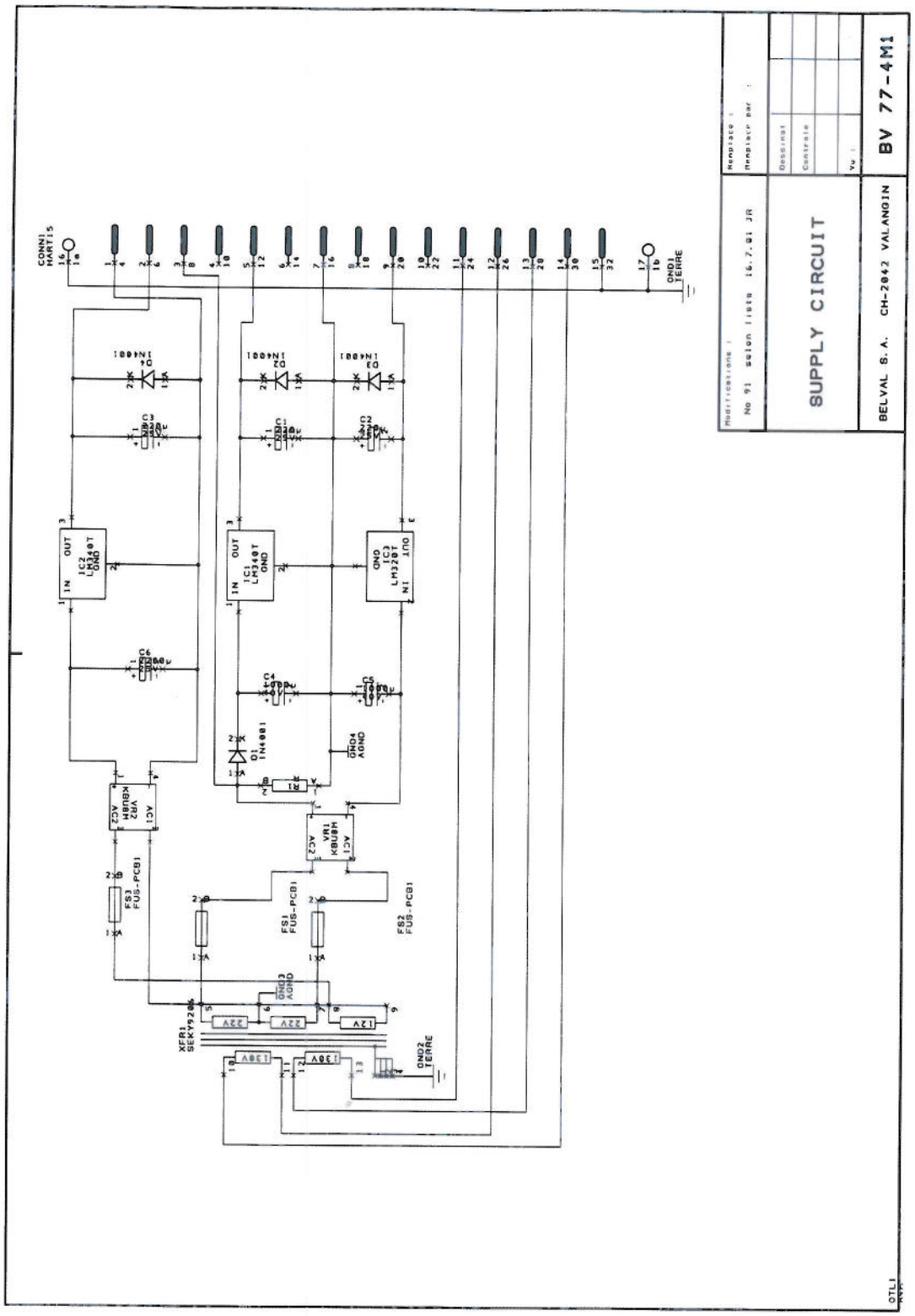
7.15. RECTIFIER UNIT BV 77/3. SCHEMATICS



7.16. RECTIFIER UNIT BV 77/3. COMPONENTS



7.17. SUPPLY CIRCUIT BV 77/4. SCHEMATICS



7.18. SUPPLY CIRCUIT BV 77/4. COMPONENTS.