T 10000

BROADCAST EQUIPMENT

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SUMMARY

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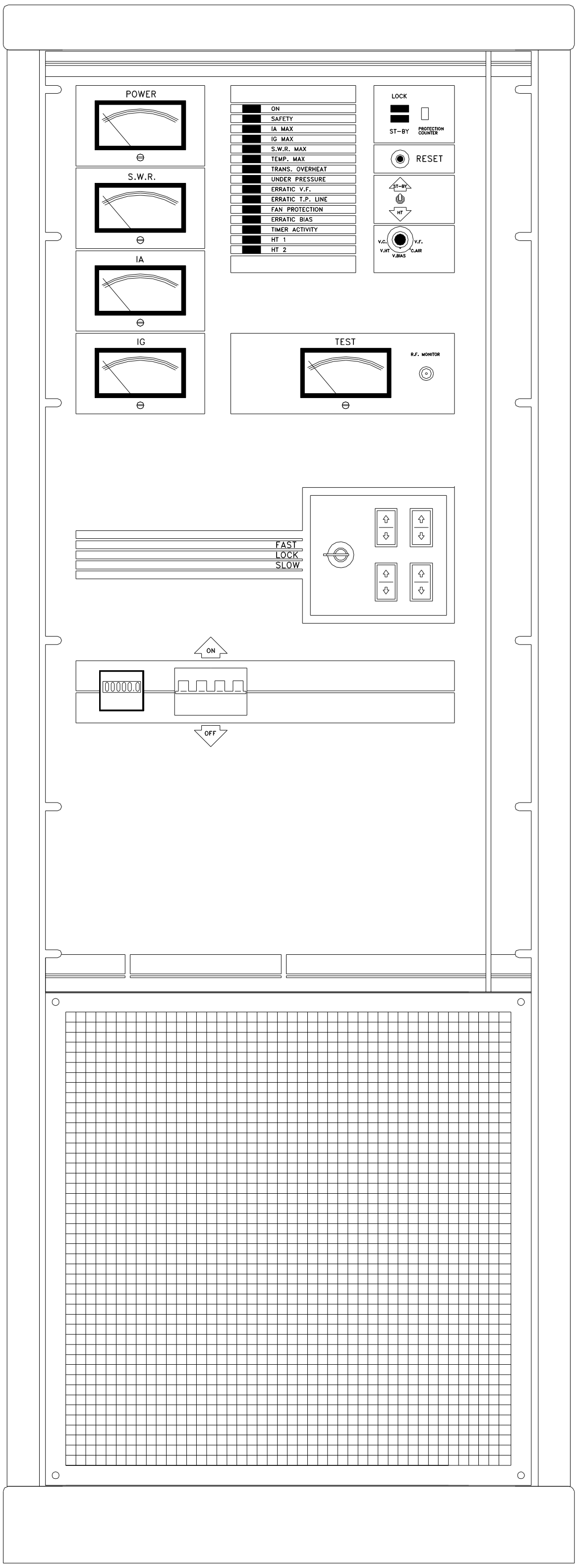
OVERVIEW



The T10000 is a power triode amplifier conceived for the FM band 88 - 108 MHz, with input and output frequency tuning.

Conceived as the final stage in a transmission system, it requires a modulator and other intermediate stages of amplification, housed in the same or separate mechanical structure.

The amplifier is housed in a 19" rack cabinet, 32U high.

TECHNICAL FEATURES

DESCRIPTION		5000W OUT	10000W OUT
THERMOIONICS TUBE TYPE		TRIODE EIMAC 3CX15000A7	
POWER OUTPUT	MAX	10000 WATT	
EXCITATION POWER	TYP	200W	400W
REFLECTED POWER	MAX	750W	500W
POWER GAIN	TYP	ca. 13,6 dB	
R.F. HARMONIC COMPONENT	MIN	1mW	
HIGH TENSION	TYP	V.HT.=7400V	
ANODE EFFICENCY	TYP	63%	67%
ANODE CURRENT {IA}	TYP MAX REST	1.0A	1.7A 2.6A 100 - 200 mA
GRID CURRENT {IG}	TYP MAX	200 Ma	300 mA 1A
BIAS VOLTAGE	TYP	V.BIAS=30-35V	
FILAMENT VOLTAGE	range	V.FIL.=6.1 ÷ 6.4V	
OUTPUT AIR TEMPERATURE	MAX	85 °C	
INSTALLATION ALTITUDE	MAX	3000 mt. on sea level	
AMBIENT HUMIDITY	MAX	95 %	
OPERATING TEMPERATURE	range	-5°C to -45°C	
INPUT CONNECTIONS		50 OHM N-LC-3/16-7/8" TYPE CONNECTOR	
OUTPUT CONNECTIONS		50 OHM 3+1/8" TYPE CONNECTOR	
STAR TYPE SUPPLY		3x380V + N 26A, 26A, 30,5A, 4.5A	
TRIANGLE TYPE SUPPLY		3x220V - 3x240V 50-60 Hz 46A, 51A, 51A	
GENERAL POWER SUPPLY		10.5 KVA	18.4 KVA
POWER FACTOR		COS § = 0.9	
WEIGHT		430 Kg.	

OPERATIONAL CONTROLS

All operational controls and parameters display are situated on the front panel. Any suspension of operation, whether temporary or indefinite, results in the thermionic tube's HT anode supply being shut down and the disabling of the modulator's supply. The shutting down of the equipment as a result of a fault condition will be refer hereafter as the protection state. The most frequent causes of each anomaly indicated are also displayed, assuming the unit is not faulty.

Four of the five meters simultaneously display the following operational parameters:

1. The **POWER** meter displays RF power output, 25KW f.s.d.
2. The **S.W.R.** meter displays the reflected r.f. power present at the radiating system connector, 2,5KW f.s.d.
3. The **IA** meter displays the thermionic tube's anode current 5A f.s.d.
4. The **IG** meter displays the thermionic tube's grid control current 2A f.s.d.

The fifth meter (**TEST**) can be switched to five different functions via a rotary **selector** switch situated above it:

1) (**V.C**.) calibration of all meters. With the selector in this position, all the meters will display full scale deflection (f.s.d.) to allow the operator to calibrate the scales and identify a faulty meter. Adjustment of the meters is via 5 pre-set potentiometers located on the card E20131 behind the front panel (see circuit diagrams).

2) (**V.HT**) selects the reading of the anode supply voltage, 10KV f.s.d. DC.

3) (**V.BIAS**) selects the reading of the cathode/grid bias voltage of the thermionic tube, 200Vdc f.s.d.

4) (**C.AIR**) selects the reading of the temperature of the amplifying cavity's hot air exit, 100°C f.s.d.

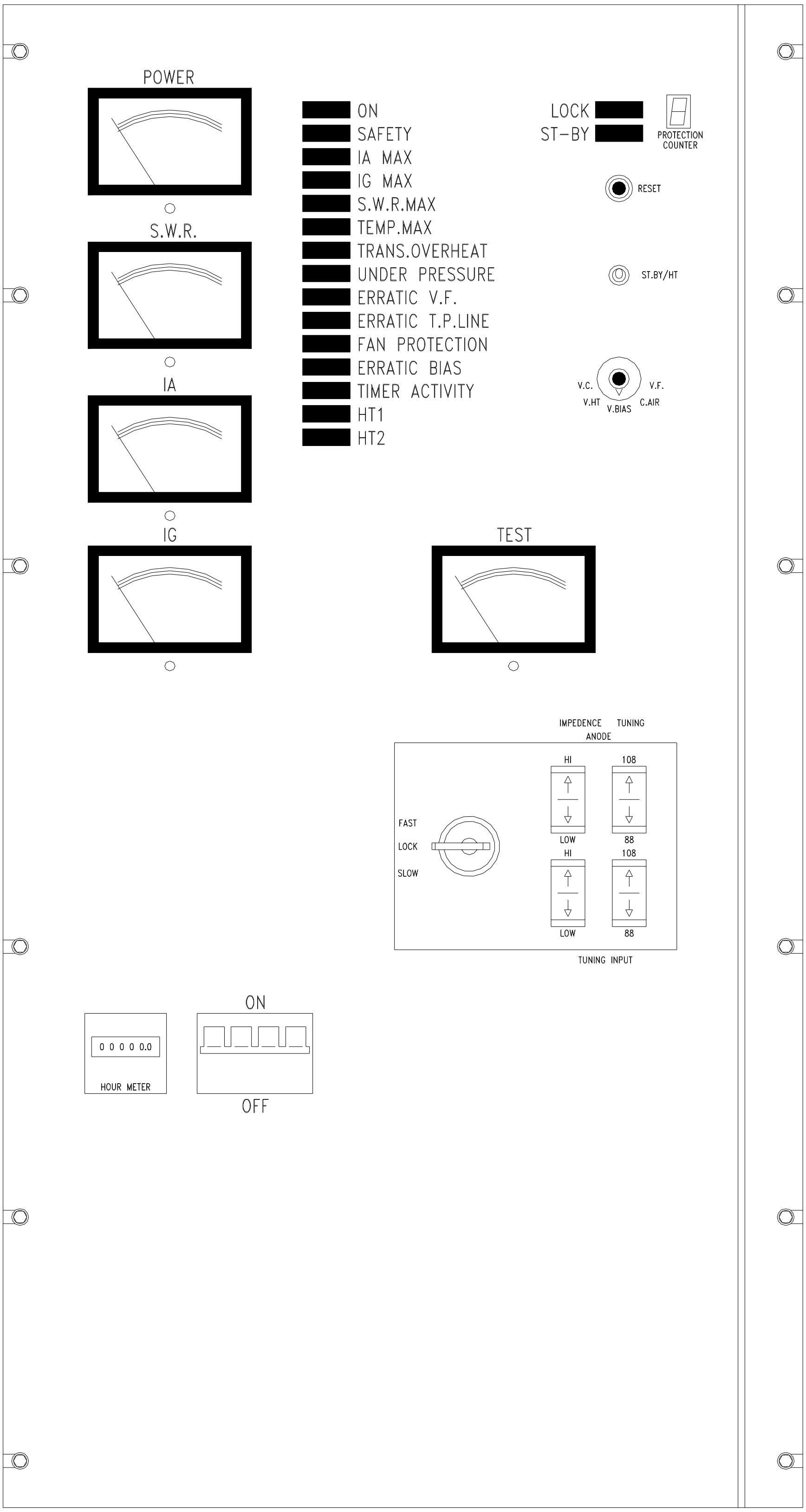
5) (**V.F.**) selects the reading of filament voltage, 10V f.s.d. AC

The lever switch located above the rotary selector, described above, allows operation to be suspended by the operator (**ST.BY**) or restored (**H.T**.). In the ST.BY position, the thermionic tube's anode voltage is removed and the modulators supply is cut as in a "protection state".

The **ST.BY indicator** light identifies the position of the switch described above.

The **ON** indicator light indicates that the T10000 is powered by the line supply.

Front panel view



The **RESET** switch allows the operator to disable the automatic shutdown of the transmitter which follows when the maximum number of automatic resets has been reached (8) for various parameters being monitored: reflected power, anode current, grid control current and amplifier cavity cooling air exit temperature. The number of resets that have taken place is displayed on the front panel alphanumeric display (**PROTECTION COUNTER**). When the electronic logic has reached the limit of automatic resets permitted, the unit will shutdown indefinitely and the front panel **LOCK** indicator will light. The attempts at automatic reset are cumulative and will increment the counter even if they result from different causes.

The flashing **SAFETY** light indicates that the equipment is not in a safe condition to operate at high voltage and is thus in a protection state. This happens when a panel is open or an important electrical connector is not inserted correctly.

The **IA MAX** indicator indicates that the maximum permitted anode current has been exceeded. The amplifier is in the protection state. The protection logic attempts a reset after about 3 seconds and increments the counter. The most probable causes of this anomaly are an excessive demand of RF power from the output, or incorrect tuning (the impedance seen by the anode circuits is too low). If the impedance of the radiating system is incorrect or unstable it is possible that large fluctuations of anode current will be experienced with likely intervention of the protection mechanism. Variations of line voltage will have a significant influence on anode current if the preceding RF stages maintain stable power levels; in particular if the line voltage reduces but the excitation power remains unchanged, anode current will increase appreciably. When the thermionic tube is at the end of its life, it is possible for this fault to occur often.

The flashing **IG MAX** light indicates that the maximum permitted grid current has been exceeded. The amplifier is in the protection state. The protection logic attempts a reset after about 3 seconds and increments the counter. The most probable causes of this anomaly are an excessive RF power input, or incorrect tuning (the impedance seen by the anode circuits is too high). If the impedance of the radiating system is incorrect or unstable it is possible that large fluctuations of grid current will be experienced with likely intervention of the protection mechanism. Variations of line voltage will have an significant influence on grid current if the preceding RF stages maintain stable power levels; in particular if the line voltage reduces but the excitation power remains unchanged, grid current will increase appreciably. When the thermionic tube is at the end of its life, it is possible for this fault to occur often, with problems of matching RF impedance with preceding stages.

The flashing **SWR MAX** light indicates that the maximum permitted reflected power at the power output connector has been exceeded. The amplifier is in the protection state. The protection logic attempts a reset after about 3 seconds and increments the counter. The most probable cause of this anomaly is an incorrect value of impedance of the radiating system connected to the output of the transmitter. Very often the cause of the protection state can seem inexplicable;

this can occur when there is a temporary collapse of the radiating system without permanent damage.

The flashing **TEMP MAX** light indicates that the maximum permitted temperature (85°C) of the hot air output from the amplifying cavity has been exceeded. The amplifier is in the protection state. The protection logic attempts a reset when normal temperatures have been restored and increments the counter. The most probable causes of this anomaly are excessive ambient temperatures, inefficient air filters or incorrect tuning (the impedance seen by the anode circuits is too high).

The flashing **TRANS. OVERHEAT** light indicates that the anode power supply transformer is overheating. The amplifier is in the protection state. The protection logic attempts a reset when the transformer sensor detects that normal temperatures have been restored. The most probable causes of this anomaly are excessive ambient temperatures, or inefficient air filters.

The flashing **UNDER PRESSURE** light indicates that the pressure of cooling air within the amplifying cavity is insufficient. The amplifier is in the protection state. The protection logic attempts a reset when the pressure sensor detects that normal pressures have been restored. In this protection state, the power amplifier will disable the filament supply as indicated by the ERRATIC VF light. The principle cause of this fault is the inefficient condition of the cooling air filters or an insufficient circulation of air in the room where the equipment is located. When the cooling fan is damaged or not incorrectly powered, this protection state can arise sporadically.

The flashing **ERRATIC VF** light indicates that the filament voltage at the thermionic tube's socket is incorrect. The amplifier is in the protection state. The protection logic resets operation when the value returns to within a 5% tolerance. In the first phase of switching on, it is normal for this indication to remain lit for up to ten seconds; this is due to the time taken for the filament power supply to reach its operating value. This indication remains active if the UNDER PRESSURE indicator is lit at the same time. When the filament voltage is at normal levels, the timer is activated to ensure a period of 300-400 seconds elapses before the anode supply and the RF EXCITER supply are restored. In the event of a loss of power lasting more than 1.5 seconds, the protection logic puts the transmitter into the ERRATIC VF protection state and repeats the preheating cycle (TIMER ACTIVITY) before restoring normal operation. The principle causes of anomalies can be related to problems of air pressure within the amplifying cavity (see relevant paragraph) or caused by brief losses of power from the line supply.

The flashing **ERRATIC T.P. LINE** light indicates that the protection mechanism connected to the anode power supply has intervened. The amplifier is in the protection state. The protection logic will not automatically reset the unit; operator intervention is necessary. The principal causes of this anomaly are short circuits, temporary or permanent, to any part of the anode supply circuit or chassis. In many cases, it is a sign that the thermionic tube is at the end of its life or defective. Another cause of this fault is high line voltage or an unbalanced three phase supply.

The flashing **FAN PROTECTION** light indicates that the protection mechanism connected to the main amplifying cavity cooling fan has intervened. The amplifier is in the protection state. The protection logic will not automatically reset the unit; operator intervention is necessary. The principal cause of this fault is high line voltage or an unbalanced three phase supply.

The flashing **ERRATIC BIAS** light indicates that the cathode/grid bias voltage is incorrect. The amplifier is in the protection state. The protection logic will not automatically reset the unit; operator intervention is necessary: the only way to clear this fault and its effect is to remove electrical power from the unit for at least ten seconds. The principal causes of this anomaly are short circuits, temporary or permanent, to any part of the anode or cathode supply circuit or chassis. In many cases, it is a sign that the thermionic tube is at the end of its life or defective.

The **TIMER ACTIVITY** light indicates that the timer is counting down during the pre-heating phase required by the filament before the anode supply is enabled and RF excitation is applied to the input. The amplifier is in the protection state even if no malfunction is present. When the timer has finished its count, the indicator light goes out. Consult the paragraphs regarding ERRATIC VF, HT1 and HT2.

The HT1 light indicates when the TIMER ACTIVITY cycle has ended, but only if the unit is not in the protection state due to any fault. This light indicates the first step of activating the anode power supply at which point the transformer is connected to the line supply via a series resistance to limit overcurrent. This phase is always followed, after about a second, by a second and final phase when the **HT2** indicator is lit. HT1 remains lit even when HT2 is lit. In this final phase, the unit is fully activated: the anode transformer is connected directly to the line supply and the interlock enables the modulator. The modulator is enabled if both indicators, HT1 and HT2 are lit; furthermore, both these must be permanently lit when the transmission system is ready to go on-air. They will be extinguished when the T10000 power stage is faulty or has been shutdown by the operator.

An **hour counter** is located on the front panel which registers the number of hours that the unit has been connected to the line supply. This provides useful information for the purpose of periodic maintenance.

A **switch** on the front panel controls the supply of power to all the internal circuits of the amplifier. WARNING! The entire transmission system MUST BE DISCONNECTED from the line supply before any internal work is carried out.

Actuators located on the front panel allow adjustment of tuning of the amplifying cavity (see chapter on tuning adjustments). The three position key: FAST, LOCK and SLOW allows selection of the most suitable motor speed for tuning. In the **LOCK** position all motors are inactive. Moving the key to the **FAST** position selects a fast adjustment speed. **SLOW** provides a fine adjustment speed. The four 2-position switches activate the motors for tuning the amplifying cavity and have the following functions:

1) **ANODE IMPEDANCE** (top left). Adjusts the matching impedance between the thermionic tube's anode and the radiating system. When pushed up, the anode impedance is increased and vice versa.

2) **ANODE TUNING** (top right). Adjusts the tuned frequency of the anode output circuit. When pushed up the tuned frequency increases and vice versa.

3) **INPUT IMPEDANCE** (bottom left). Adjusts the matching impedance between the thermionic tube's cathode and the exciter stage. When pushed up the impedance is increased and vice versa.

4) **INPUT TUNING** (bottom right) Adjusts the tuned frequency of the cathode input circuit. When pushed up the tuned frequency increases and vice versa.

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TECHNICAL DESCRIPTION

The T10000 unit is composed of various functional elements: power amplifying cavity which houses the thermionic tube, (this is a triode with direct cathode heating, configured in common grid mode with input signal to the cathode and output from the anode); low-pass output filter for the suppression of harmonic components of the carrier frequency; analogue filter connected to the input circuit; three phase high voltage power supply for the thermionic tube's anode; cathode bias circuit; AC stabilised power supply circuit for the filament/cathode; safety circuits for the protection of the unit and service personnel; power supply for the motors which control the amplifying cavity's tuning. The unit is designed to function with the thermionic tube at full power in class C mode, at lower powers in class B and very low powers in class AB. The cathode bias circuit (see card E20123) is automatic and senses cathode current. The cathode/grid voltage is obtained via a chain of power diodes connected in series with each other. The very high voltage gain of the thermionic tube allows the class of amplification to be changed with small changes in bias voltage. The tube filament AC supply is kept constant by a phase-angle switching power supply with stability of better than 1.5% (see cards E20127 and E20128). Activation of the filament power supply is conditional upon the pressure of cooling air within the amplifying cavity; if regular, the filament supply is enabled. The working voltage is reached progressively to avoid overcurrent to the tube's socket. A regulator circuit is available on card E20127 which allows the filament voltage/power to be varied in order to extend the life of the thermionic tube if the RF power required is less than the nominal value (see technical notes on the filament). The high voltage anode power supply (7500 volts DC) is generated by a six phase rectifier (see card E20144) with an inductive filter followed by a capacitive filter. A high power, insulated resistor is connected in series with the tube's anode supply output in order to limit the energy dissipated in the event of accidental electric arc within the amplifying cavity or the thermionic tube. The high power transformer is inserted electrically in 2 steps, the first connects a series resistor to limit overcurrent, the second connects the transformer directly to the line supply. This avoids inadvertent power loss due to the action of the local supply's safety cut-outs. The principal electronic circuit card (E20127) contains all the user interface circuits (see also card E20131) and the circuits which monitor all the important variables of the amplifier. Control of the unit includes the facility to disable operation in the event of variables exceeding their safety limits, with various automatic reset modes. For a detailed description of the unit's protection logic, consult the chapter entitled "user interface". The low-pass output filter is housed within the unit, above the amplifying cavity. It is essential that this filter is both connected and functioning perfectly; in case of malfunction it is not possible to guarantee the suppression of spurious, out-of-band RF frequencies and, furthermore, dangerous internal overheating of the equipment may be caused. The control of the RF tuning of the cavity is performed by 2-speed electric motors. This technique , besides being convenient, ensures the safety of personnel responsible for tuning the equipment. There are two amplifier cavity adjustment controls for the input and two for the output; one of the two matches impedance, the other tunes the frequency.

INSTALLATION

Before describing the operational phases of the installation procedure, an indication of the ambient requirements of the location where the equipment is to be installed will be given.
In the In the room designated for installation, a means of removing the hot air generated by all the equipment should be fitted. If the T10000 is the largest source of heat of the entire system, and if the ambient temperature is 25°C, at least 1400m³ per hour should be removed. If the temperature is 45°C then at least 2000m³ per hour should be evacuated. Clearly, it is necessary to provide an equal amount of fresh air from outside which must be filtered appropriately to avoid ingress of insects, dust, smoke and organic material. The equipment can function normally at ambient temperatures between -5 and 45°C with a relative humidity of 95%, non-condensing at 45°C.
The line supply should be three phase with a voltage of 208/240 volts for delta connection (without neutral) and 380/415 volts for star connection (with neutral). Alternatively the supply can be single phase (for single phase equipment) with line voltage 208/240 volts. The power required to supply the T10000 is at least 20 KVA, taking account of the power factor produced by the powerful anode rectifier.
An efficient earth system must be provided to cater for loss of current that can involve the chassis of the unit and other equipment in contact. Particular attention should be paid to the connection with the radiating system which is especially prone to electrical atmospheric phenomena. Before the antenna cable is fed to any enclosed space, an electrical conductor with a section of at least 150mm² must be connected from the external conductor of the antenna cable to a low impedance earth point dedicated to the antenna structure. Given the very low values of parasitic inductance of the connections to the T10000, the amount of electrical energy of atmospheric origin can only be partially controlled, in terms of personal safety, by earth connections.
To maximise safety of personnel, it is very important that the equipment is installed in a room which is only entered by personnel on a temporary basis for \reasons of maintenance, repairs or short checks. If the installation room is entered frequently by personnel for reasons other than occasional service operations on the transmitter, it is imperative that a metal grid, connected to an efficient earth, is used to enclose the equipment in order to isolate it from the personnel.
Having taken account of the precautions previously detailed, the installation phase may now proceed. Remove all packing pieces from the equipment used for transport and take care not to mislay any items included. Open all the equipment's panels and check the integrity of electrical connections and the mechanical components of the RF connections; if any damage has been incurred in transit, contact ELENOS for information regarding the guarantee.
Remove the fixing bracket of the anode power supply inductor which is no longer required for transport and is now dangerous!

POWER TRANSFORMER INSTALLATION

Locate the rectangular plastic PVC tablet, supplied with the equipment, within the unit and place the anode transformer on top, in the place clearly intended. The transformer is not fixed with bolts inside the unit to avoid extra currents flowing between its external parts and the base of the equipment in which it is located. Should the installation be made in seismic zones, the transformer should be lashed to the internal structure of the unit using cord made of insulating material.

The external body of the transformer MUST be connected to the electrical earth of the unit, AT ONE POINT ONLY of its body. Make absolutely certain that this earth conductor is connected to the earth terminal of the whole T10000 unit. Do not connect the central node of the star of the transformer primary to the neutral of the line supply.

Connect the anode transformer primary to the intended, heavy-section cables with the terminals best suited for high voltage operation (see the diagram for three-phase connection).

Connect the anode transformer secondary to the intended, heavily insulated cable (see identification labels).

Connect the two wires from the front, right-hand spar (see identification labels) to the thermal probe socket of the anode transformer.

WARNING! Malfunctions occurring during the first few hours of operation are frequently caused by the passage of connection cables, using ordinary insulation, close to parts of the anode transformer which present a risk. Take care to prevent loose cables from making contact with the high voltage terminals of the anode transformer.

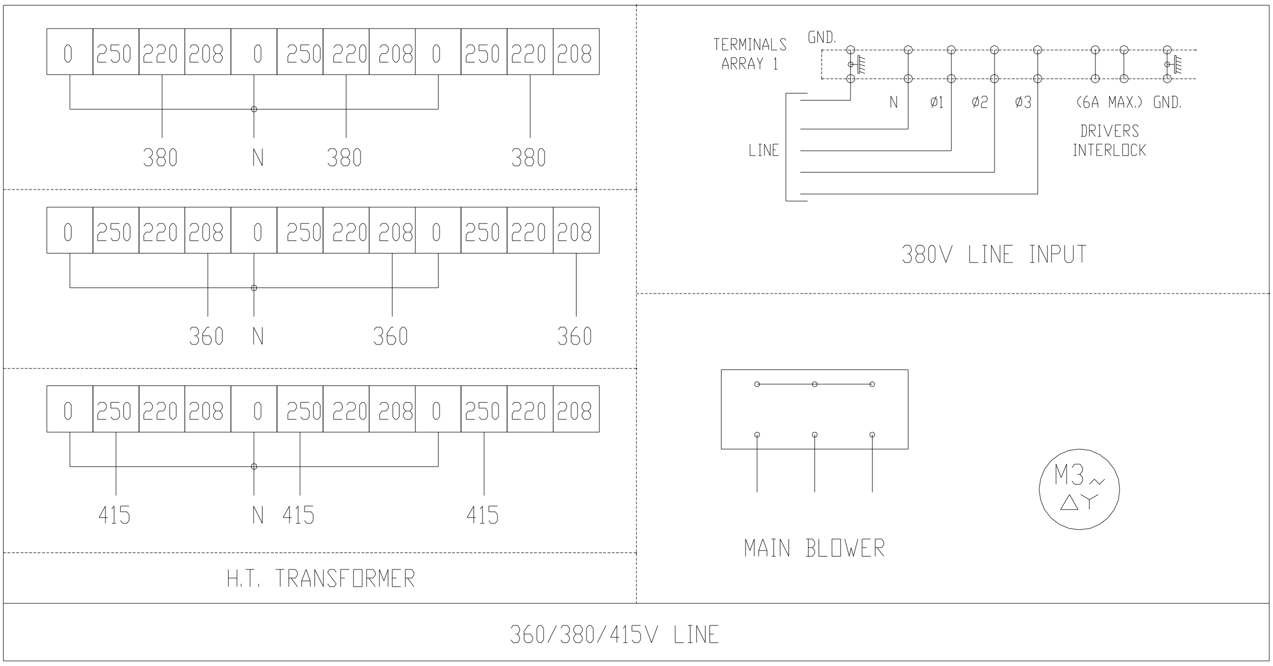
CONNECTION TO THE ELECTRICAL SUPPLY

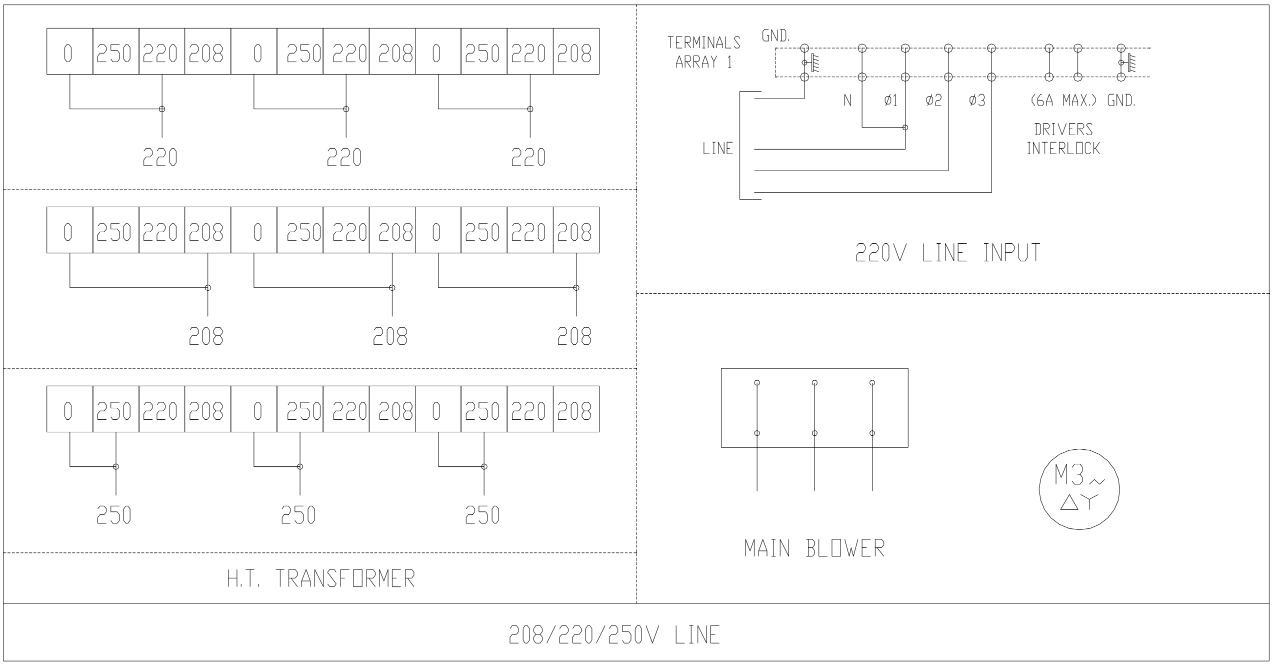
The method of connection to the line supply depend on the supply type :

- STAR connection for line voltages of 380/415V, with neutral connection (4 wire + earth)
- DELTA connection for line voltages of 208/240V, without neutral connection (3wire + earth)

The entry for the main electrical supply cables is located on the rear of the unit where a series of holes are available. Inside the unit, near the two high-power contactors, a terminal block is provided for the connection of the electrical supply cables.

Electrical supply connections diagram





The section of the cables depend on the type of connection and can be determined from the technical table defining values of current absorption of the line supply. Each country has its regulations concerning the section of cable connected to the line supply which MUST be respected. In the absence of precise indications the section of cable should allow for a current density of not greater than 4A per square millimetre of conductor. (for example: a 50A current will require a cable of section of 50/4 = 12.5mm²).

WARNING ! For star connection, do not swap the neutral line for any of the phases; this will do permanent damage to the equipment.
The neutral terminal can be readily identified by its label inside the unit.
WARNING ! For delta connection do not connect neutral to the terminal inside the unit; this has been intentionally short-circuited to one of the three phases.
IT IS ESSENTIAL THAT THE EQUIPMENT IS CONNECTED TO THE EARTHING POINT of the system on site. Inside the unit is a terminal which can be identified by its yellow/green colours; its dimension is the same as those of the three phases. The earth connection is essential to ensure the safety of personnel who have occasion to make physical contact with the apparatus or any mechanical structure or electrical conductor which are in electrical contact with the apparatus. The earth connection is useful for minimising damage to the equipment or other nearby equipment, in the event of high voltage discharges of an atmospheric nature, or caused by the equipment itself.
In the case of the three phase version, with a three phase cooling fan, the three phase connection determines the direction of rotation of the fan, which clearly must be correct. Testing for correct rotation of the cooling fan must only be performed once the unit is fully closed to ensure operator safety.
The electrical supply system which supplies the unit and all other equipment with power, MUST be fitted with a CIRCUIT BREAKER with a current calibration not greater than 30% of the current drawn by the whole transmitter. When the equipment is connected to the electrical supply, it exposes personnel to the risk of coming into contact with high voltage lines; for this reason it is ABSOLUTELY ESSENTIAL THAT THE CIRCUIT BREAKER IS IN THE OFF POSITION, while any equipment panel remains open. Maintaining the unit's on/off switch in the off position IS NOT SUFFICIENT! DO NOT SUPPLY ELECTRICAL POWER TO THE EQUIPMENT UNTIL ALL PANELS ARE SHUT AND IT IS CONNECTED TO AN EARTHING POINT.
An isolating transformer between the equipment and the line supply significantly reduces the incidence of damage incurred by atmospheric causes, greatly increases reliability and reduces the costs of faults caused by overvoltage of the line supply.
It is useful to construct a winding of about 25 turns, diameter 25-35 cm (about 1 foot) with the line supply cables of the 3 phases and neutral before they enter the equipment. UNDER NO CIRCUMSTANCES CONSTRUCT A WINDING WITH THE EARTH CABLE WHICH MUST BE OF HEAVY SECTION AND MUST CONNECT THE EQUIPMENT TO EARTH DIRECTLY AND WITH THE SHORTEST POSSIBLE LENGTH.

CONNECTION TO EXCITER EQUIPMENT

The T10000 is always connected to other excitation equipment which, in the majority of cases, comprises one intermediate amplifier stage (driver) and an FM modulator (exciter). The connections to the preceding amplification stages and the modulator are of two types: radio frequency connections and electrical line supply connections with a safety interlock system.

The RF connection is straightforward : the RF output of the modulator is connected to the RF input of the intermediate stage; the RF output of the intermediate stage is connected to the RF input of the final amplifier T10000. Connection to the radiating system will determine the final positioning of the equipment which, for convenience, ought to be left free until the final phase of installation.

The connection of the electrical supply is more complex and can vary according to the configuration of the transmission system components. The crucial constraint that must be satisfy is the following : if either the final power stage or the driver fall into the protection state, the exciter must shutdown the RF output .The T10000 does not supply electrical power to the driver or exciter but is able to disconnect it via an interlock switch with a 10A capacity. One of the wires for the supply of the exciter must be cut and connected trough the two EXCITER (or DRIVER) INTERLOCK terminals situated in the rear of the T10000, near the electrical supply terminals.

INSTALLATION OF THE THERMIONIC TUBE

The electrical circuit breaker supplying the whole transmission system must be open before performing this operation so that the system is ISOLATED from electrical power. The T10000 must also be ISOLATED from the radiating system.

WARNING! During the installation of the thermionic tube, the hands of the operator will be in physical contact with parts normally functioning at HIGH VOLTAGE. Even if the equipment has been inactive for some time, it is ESSENTIAL that a conductor be used to electrically connect the high voltage supply to the chassis of the unit..

WARNING! In order to discharge the high voltage capacitor, connect the solid conductor to the unit's chassis at the point INTENDED for this operation: the electrical junction connecting the overcurrent-limiting series power resistor with the anode of the thermionic tube. If the high voltage capacitor is discharged at a point other than that previously described, it is possible to cause permanent damage to the equipment.

Remove the top panel of the unit. Remove the hot air exit flue above the amplifying cavity after having disconnected the thermal probe tied to the flue. Take the thermionic tube out of its packing and check that it is whole and fit for operation. The thermionic tube should not show any signs of smearing with pollutants on any part; if this is not the case, contact the supplier. Introduce the thermionic tube into the amplifying cavity keeping the tube VERTICAL and CENTRAL and rotated so that its "handles" are turned towards the side walls of the amplifying cavity.

WARNING! It is possible to damage the socket during installation of the thermionic tube, in particular the spring "finger" contacts of the control grid electrode. Proceed with care and caution, do not force and, in particular, AVOID ROTATION and TORSION to the vertical axis of the thermionic tube. To ensure that the thermionic tube is correctly positioned in its socket use a small mirror and torch to verify that the circular control grid contact is well inserted into the "fingers".

WARNING! Exciting the unit with RF when the tube is not correctly inserted will probably cause damage to both the tube and the equipment. The installation of the thermionic tube is concluded when the hot air exit flue is refitted, the thermal probe reconnected and the top panel closed.
WARNING! Do not forget to remove the safety shorting cable between the high voltage contact and the unit's chassis before re-fitting the panels.

COMPLETION OF INSTALLATION

When all the phases of electrical connection are complete and checked, it is possible to close all the panels of the equipment. Arrange all the other transmission system apparatus in their final positions.
Included with the T10000 unit is a kit of sleeves made from material which are used to close the three wide access points which correspond to the entrance and exits of the RF cables and the hot air exit. The application of the three sleeves is clear, their function is to prevent the ingress of insects or organic vegetable material into the equipment.
WARNING! Particular care should be taken with the connection to the radiating system as the principal cause of functional problems within the first few hours of operation is caused by an inefficient RF load. The connection phase of the radiating system is particularly hazardous for the operator since he is not aided by an earth connection; the efficiency of the earth connection can never be relied upon at radio frequency. The above information is very important if the transmitter being installed is connected to a multiport radiating system (duplexer, triplexer, etc...). In this case IT IS NECESSARY TO DISACTIVATE ALL THE TRANSMITTERS CONNECTED TO THE SAME RADIATING SYSTEM.

START - UP

Power to the transmitter should only be applied once all safety and connection checks have been carried out : check in particular that the earthing strap connecting the H.T. to the chassis has been removed ; check the antenna connection. Before supplying electrical power to the transmission system, check that all equipment components have there on/off switches switched OFF. Check that the frequency of the modulator has been correctly programmed and that it has been adjusted for zero RF power.
Activate the circuit breaker which supplies power to the transmission system. Move the small switch on the panel of the T10000 to the ST-BY position (advised).
Switch on only the T10000 to check for correct rotation of the three phase cooling fan ; if correct the UNDER PRESSURE indicator, located on the front panel, will go out 3 seconds after switch-on. If the rotation is not correct, carry out the following procedure: SWITCH OFF the main circuit breaker of the electrical installation so as to remove electrical power from the whole transmission system. Remove the rear panel of the T10000 to access the terminal connector block. Invert two of the main supply phases. Close the rear panel of the T10000 and switch on the installation's main circuit breaker.

Switch on the power on/off switches of all the components of the transmitter system. At this point the T10000 is operative, and the front panel indicators will light: ON, TIMER ACTIVITY, ST BY (if selected), UNDER PRESSURE (for about 3 seconds) and ERRATIC V.F. (for about 10 seconds). Each apparatus of the system has a start-up sequence and only when concluded will that stage operate at radio frequency. The modulator will remain inactive until the start-up phase of the other system sent is concluded. After about 300/400 seconds the TIMER ACTIVITY indicator, located on the front panel of the T10000 "final" amplifier will go out. This signifies that the pre-heating cycle of the thermionic tube's filament has ended.

It is essential that the modulator, in the first phase, is adjusted for zero power output when it concludes its preparatory cycle (for other equipment, consult the technical manual supplied). Move the switch on the T10000 front panel to the H.T. position; the ST-BY indicator will now go out, the H.T.1 indicator will light and, after about a second, the H.T.2 indicator will also light. When all the components of the transmission system have concluded their respective initial phases, the modulator is also enabled and has its own preliminary phase. When this has terminated, the whole transmission system is ready for the frequency tuning operations.

All other components of the transmission system, both active and passive must be tuned before the T10000 amplifier is ready for frequency tuning.

TUNING INSTRUCTIONS

NOTE: The T10000 unit is factory-adjusted (if no other request has been made) to operate at 98MHz. The tuning adjustments are motorised and controlled by 4 controls (UP/DOWN) on a switchboard located on the front panel. Two choices are available: FAST adjustment and SLOW adjustment, depending on the position of the selector key on the front panel. The four switches vary the following parameters: ANODE IMPEDANCE, top left; ANODE TUNING, top right; INPUT TUNING, bottom right; INPUT IMPEDANCE, bottom left. If one of the four switches is lifted up, the parameter is increased and vice versa. Adjust the modulator power for an anode current consumption of about 500-600mA on the T10000. Move the selector key to the FAST position and simultaneously move the ANODE TUNING switch (top right) in one of the two positions: up, to tune to a frequency greater than 98MHz; down, to tune to a frequency of less than 98MHz. Continue with this adjustment to obtain a maximum reading on the P.W.R. meter located on the front panel. Increment the excitation power of the modulator, keeping under control the reflected power reading of the preceding driver stage; this should be less than the threshold at which the protection mechanism intervenes to allow other adjustments to be made. With the key in the SLOW position, adjust alternately the two input tuning adjustments of the final stage; first INPUT TUNING (bottom right), then INPUT IMPEDANCE (bottom left) in order to minimise the reflected power reading of the preceding driver stage. Increment again the modulator power, keeping under control the I.A. and I.G. values of the final stage and the driver's reflected power value. Make adjustments to obtain the maximum relative power output of the final stage using the ANODE TUNING control (top right) and, if necessary, adjust the two controls INPUT TUNING and INPUT IMPEDANCE to optimise matching with the driver stage. If neither the I.A. or I.G readings of the final stage approach the threshold of protection intervention, proceed with the same sequence of operations until a final power output greater than 50% of the maximum is obtained. At this point evaluate the tendency of the tuning characteristics which can be of two types: the I.A. value tends to be too high with low values of I.G.; or the value of I.G. tends to be too high with I.A. relatively low and low power output. The two tendencies can be normalised with the ANODE IMPEDANCE control (top left). This adjustment is important to obtain equilibrium between the I.A. and I.G. parameters but must be adjusted in small steps IMMEDIATELY FOLLOWED by a compensating adjustment of the ANODE TUNING control to maximise the relative output power reading of the T10000 P.W.R. meter. The rule is as follows: if incrementing exciter power results in excessive anode current (I.A.), increase ANODE IMPEDANCE by lifting the corresponding switch (top left) (simultaneously compensating ANODE TUNING). In this way the output power will increase, reducing I.A. and compensating I.G. Otherwise, if increasing exciter power results in excessive levels of grid current (I.G.), reduce ANODE IMPEDANCE (top left) by pushing the dedicated switch down (simultaneously compensate ANODE TUNING). This last adjustment, for the same exciter power, will not increase output power (it may decrease it) but the saturation effect will disappear and the final stage will accept the higher level of input power to achieve maximum performance. WARNING! It is worth repeating that each adjustment of ANODE IMPEDANCE must be made in small steps and immediately followed by compensatory adjustments of ANODE TUNING (top right) to maximise the relative power output and thus the electrical efficiency of the T10000. These instructions refer to output tuning, however it will be necessary, during this procedure, to also optimise the input tuning in order to minimise the reflected power reading of the driver stage.

OPERATIONAL LIMITS

The T10000 power amplifier can function at full power if the ambient conditions fall within the limits defined in the chapter entitled "First Phase of Installation". The maximum altitude of the installation must not exceed 2000m above sea level to guarantee maximum RF power output. If the altitude of the installation does exceed 2000m, the specified RF power output must be reduced, also in correlation with the ambient temperature. The limits of the working output power in this case have to be found experimentally, the performance of the unit is not readily definable under these conditions. It is not however possible for the equipment to conform to conditions of safety and the guarantee if the site has an atmospheric pressure equivalent to an altitude in excess of 3500 m above sea level. The ambient humidity is very important in relation to the high voltage circuits; a value of up to 95% can be tolerated at a temperature of 45°C, but only if variations in atmospheric pressure do not provoke condensation. The equipment cannot function under any condition if the ambient humidity is condensing. If fluctuations in line voltage are very large, the whole system should be adjusted taking account that the RF power output can exceed the safety limits of the equipment or the radiating system. If the only unit dependant on line voltage is the T10000, the voltage/power characteristics are as follows:

A 2% variation of line voltage implies a 5% variation of RF power output

A 5% variation of line voltage implies a 15% variation of RF power output

A 10% variation of line voltage implies a 25% variation of RF power output

The equipment will not operate however if line voltage exceeds 15% of nominal or is 20% less than nominal. The thermionic tube is subject to wear through use. After a year of operation, the performance of the T10000 will most certainly have been degraded, but not necessarily terminated. The thermionic tube must be changed when the gain of the amplifier falls below 9dB. The radiating system must present an electrical impedance of 50Ω. The T10000 amplifier can function normally if the standing wave ratio (S.W.R. or R.O.S) is less than 1.6. When the radiating system exceeds this figure permanently, it is possible for the protection mechanism to trigger due to standing waves. Operation at reduced power levels is useful to avoid loss of service but does not guarantee that, due to variations of electrical or ambient conditions, loss of service will be avoided.

PERIODIC MAINTENANCE

Each time a new thermionic tube is installed, certain safety precautions should be observed in order to maintain the rights of the guarantee of the equipment or the tube itself. For the first 200 hours of operation, power output should be limited to 70% of the nominal maximum level. After the thermionic tube has been operating for 200 hours, full RF power may be developed. At this point certain adjustments should be performed to the stabilised filament power supply in order to prolong the life of the thermionic tube (see chapter regarding filament voltage adjustment). Every three months, periodic alignment of the amplifier tuning is necessary to compensate for consumption of the thermionic tube. This is essential mainly if the radiating system is suffering adversely from the external ambient conditions. Several parts of the T10000 are employed in the filtering of the cooling air; depending on the relative ambient conditions, the anti-dust filters will need replacing at intervals dependant on the quality of air in the area. The thermionic tube is subject to wear and has an operating life of about 10,000 hours under normal conditions. If the performance demanded of the equipment is less than nominal, and if the filament voltage is regularly adjusted, an operating life of 15,000 hours or more can be obtained.

ADJUSTMENT OF THE FILAMENT VOLTAGE

The filament of the thermionic tube installed in the T10000 is powered by an AC stabilised circuit with a precision of better than 1.5%. The filament voltage has a very important influence on the operational life of the thermionic tube, that is, the lower the voltage, the longer the life of the tube. However, if the thermionic tube is working with the filament underheated (voltage too low for the working cathode voltage) the tube life will be reduced by cathode pollution. There therefore exists an ideal filament voltage for the power at which the thermionic tube is operating. Adjustments of the filament voltage should be performed with the equipment operating at the desired RF power level; for this reason personnel making these adjustments must be fully prepared technically in order to carry out this task with the equipment open.

The sequence of operations to follow is:

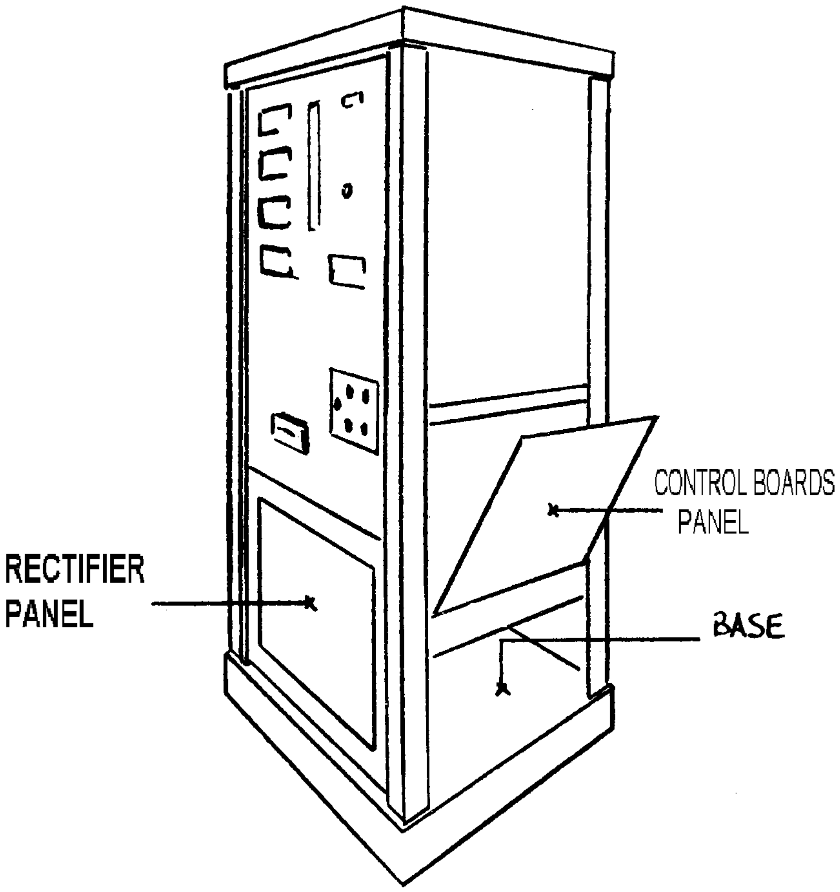
1) Prepare the unit so that it is operating at the desired power level with the front panel open to allow adjustment of the low-power trimmer potentiometer located on card E20127 (reference P6).

2) Rotate the trimmer clockwise for 3 or 4 turns (this will reduce the voltage) keeping the front panel voltage reading under observation. Continue with small steps until it is possible to detect the smallest variation of anode current (I.A.) or RF power output (P.W.R.).

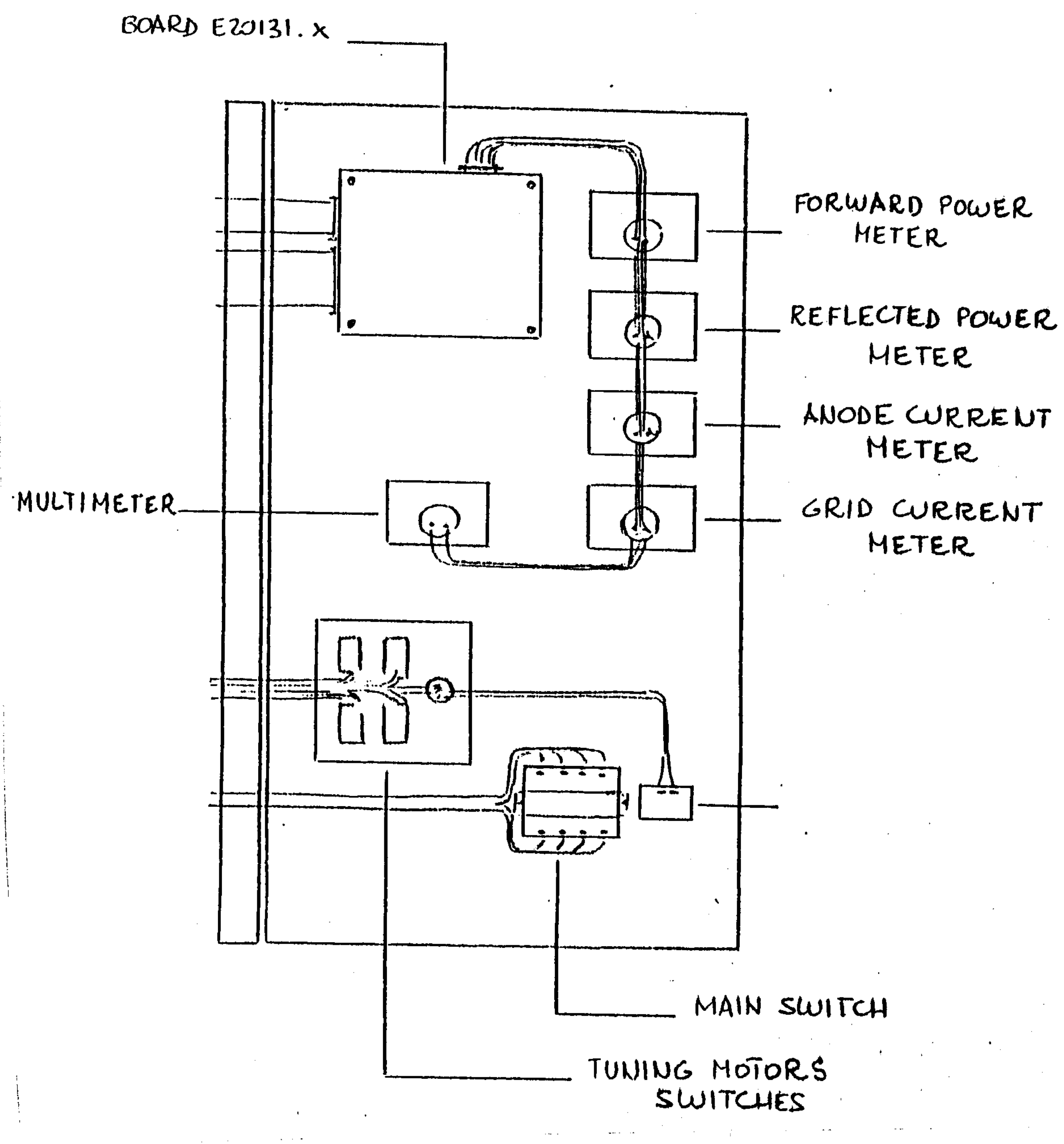
3) Rotate the trimmer very carefully in the opposite direction until the filament voltage is just beyond the point at which the variations of the performance of the tube begin.

The final value of filament voltage obtained will be unique and will vary from tube to tube. The voltage should not be reduced within the first 200 hours of operation of the thermionic tube; adjustments after 4000 hours are of no use. It is necessary to correct the filament voltage with a slight increase every three months, in order to compensate for consumption of the thermionic tube's cathode. For this operation it is necessary to first return to the nominal value and then repeat the three steps described above. WARNING! Ensure that the safety precautions described at the beginning of the chapter are complied whenever maintenance is carried out on the equipment.

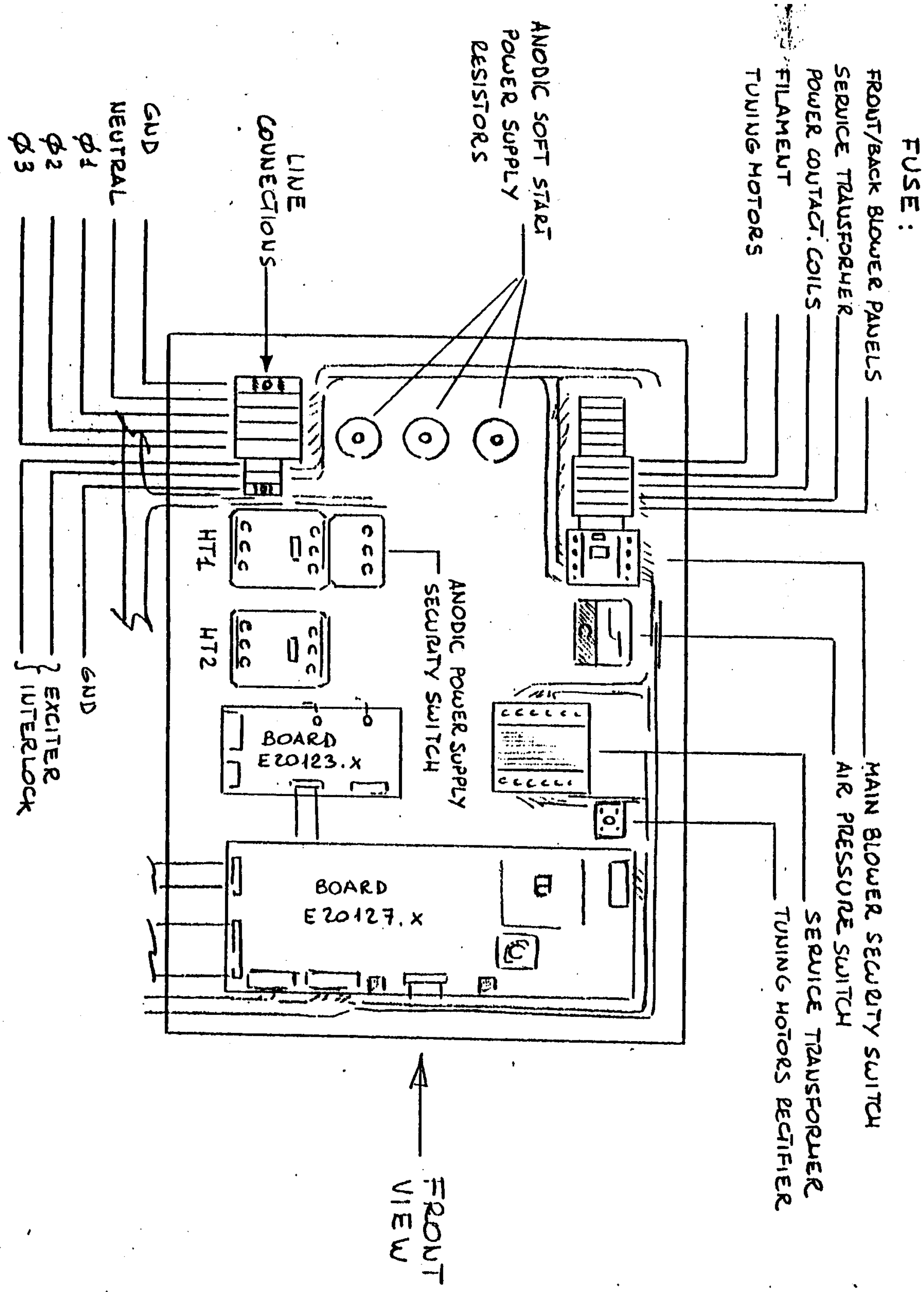
Electrical parts panels disposal plan



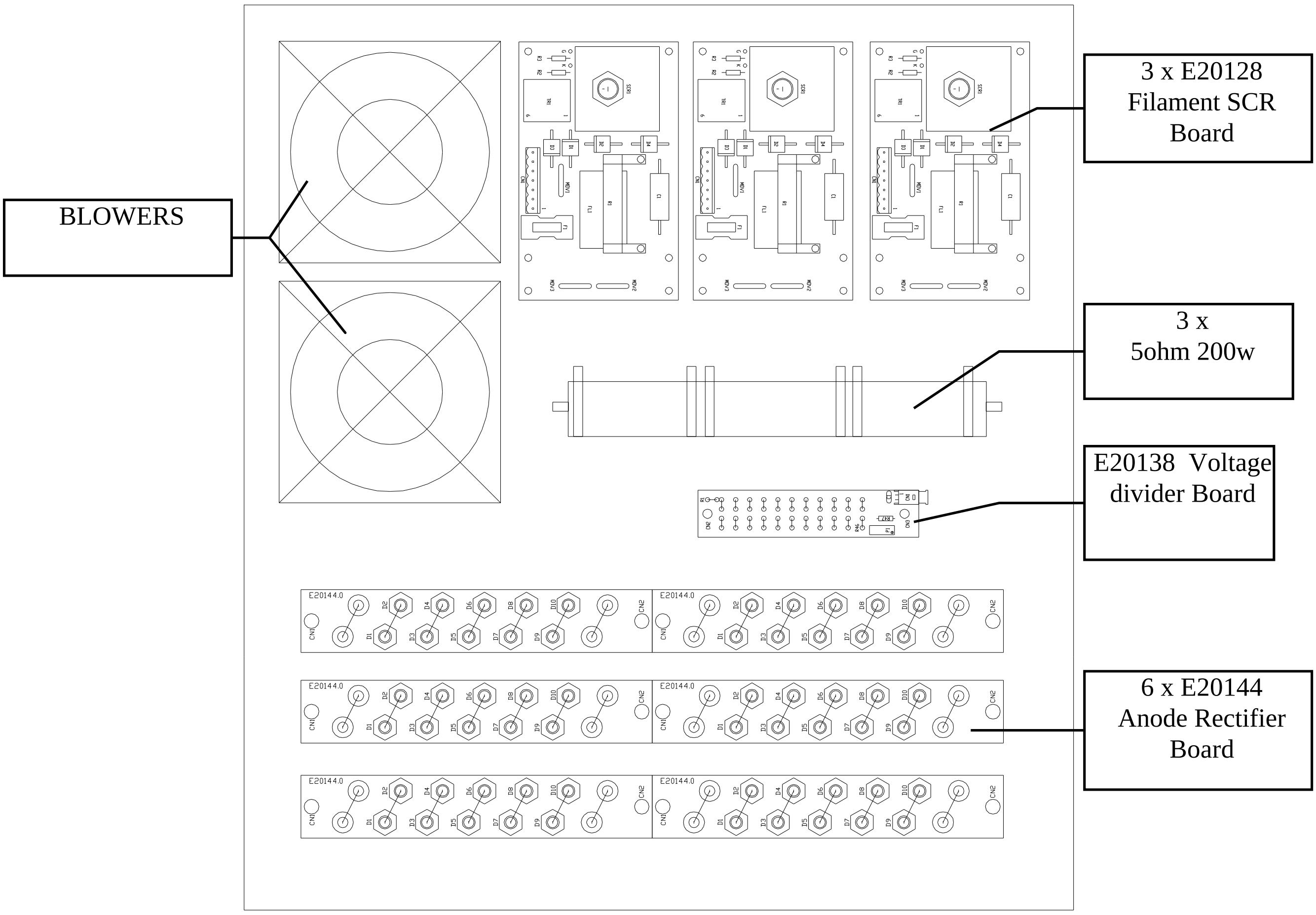
Front panel layout



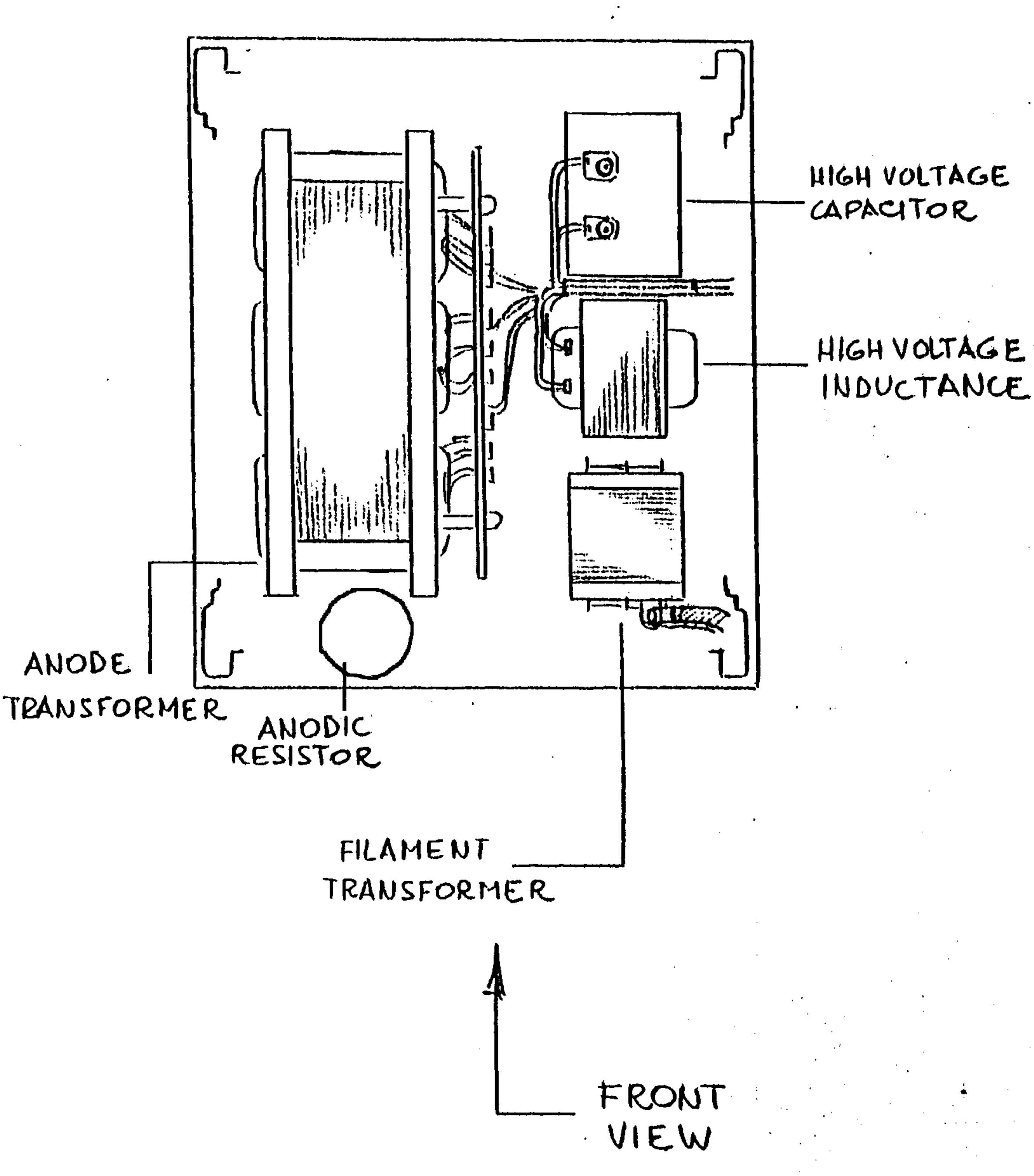
Control boards panel



Rectifier boards panel



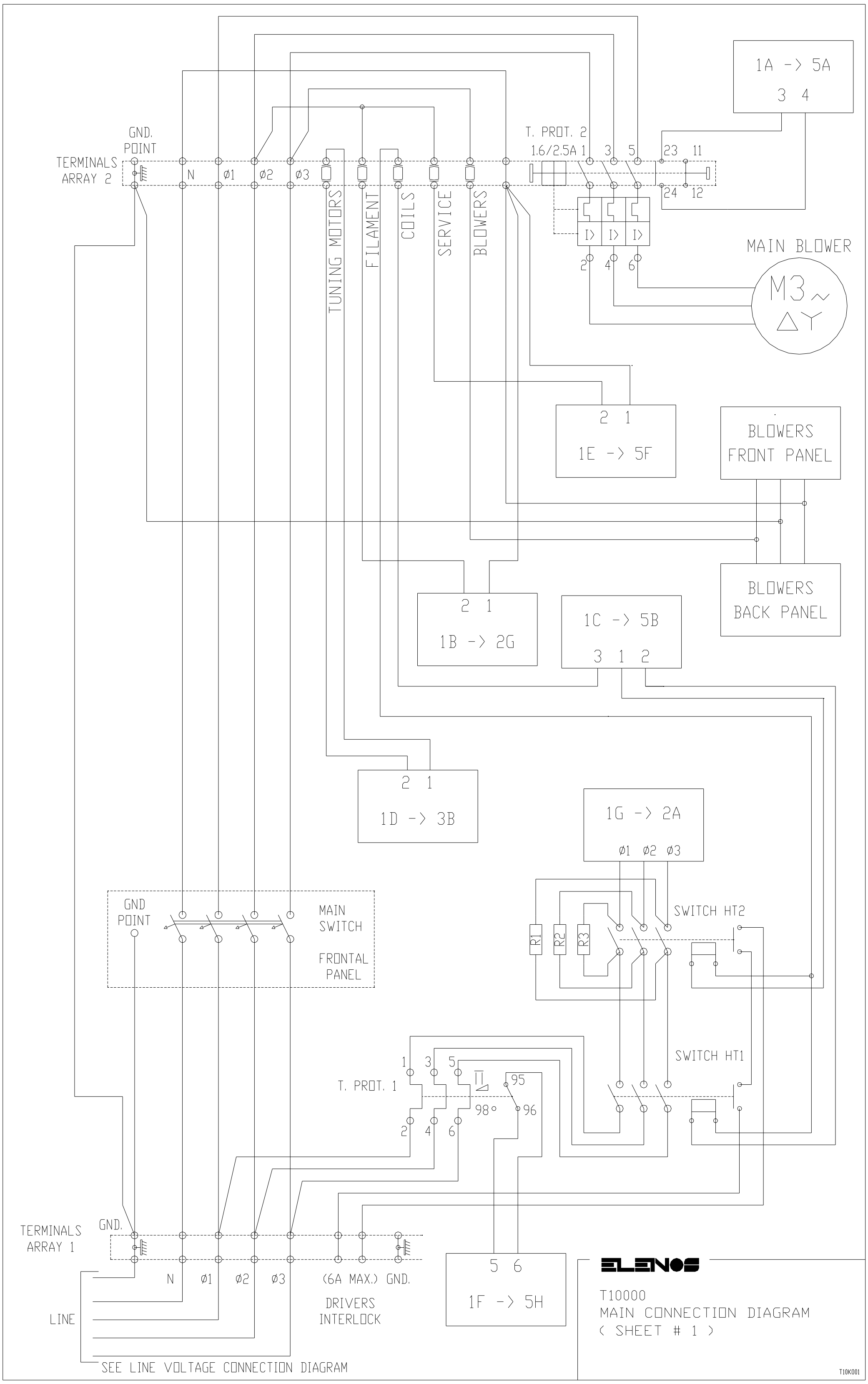
Base layout


HIGH VOLTAGE
CAPACITOR
HIGH VOLTAGE
INDUCTANCE
ANODE
TRANSFORMER
ANODIC
RESISTOR
FILAMENT
TRANSFORMER
FRONT
VIEW

Remarks on electrical diagrams

We in these notes explain how interpret the electrical schemes that follows this page. All electronic components are installed on various mechanical panels, a drawing shows their positions with a reference label. A special drawing represents the frontal panel and helps to find the various warning indications and status conditions of the machinery. This draft is useful also in order to trace the position of the driving in order to activate / disarm the machinery and in order to tune the radio frequency amplifier cavity. The electrical schemes have split up in two categories: connection schemes between different unity and relative schemes of electronic boards. The connection schemes between different electrical unity have distributed in more sheets with needed cross references between draft and draft, it that's why is present a symbology a little bit special but effective. Inside of a box it is present a text-row that like this: 1A-> 3C, this means that lines connections inside the box with its respective identification numeration depart from the draft #1 label A to arrive to draft #3 label C. Each draft collects a distinctive functional theme in order to facilitate the breakdowns research.

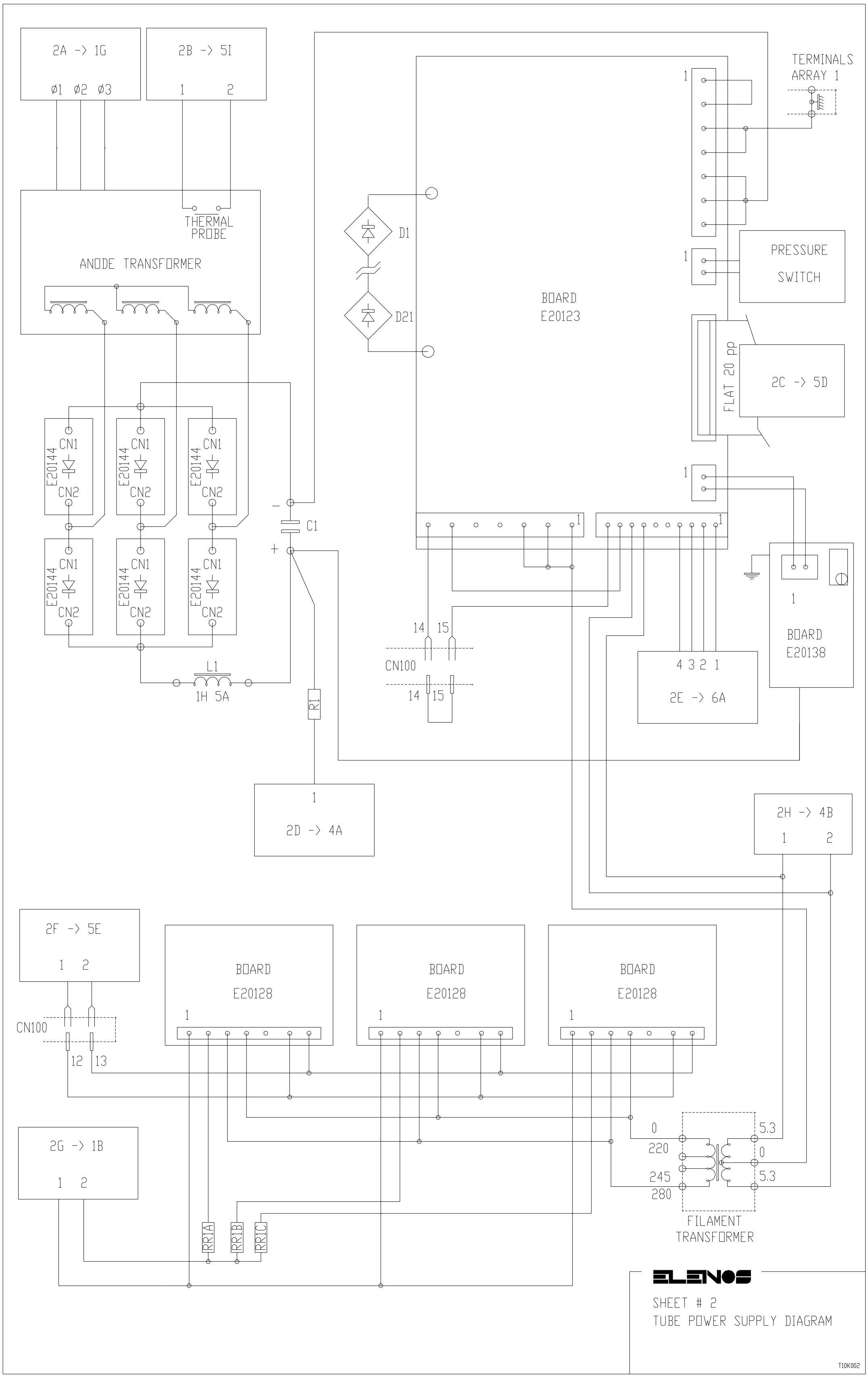
Sheet # 1 - Main connection diagram



Part List of Sheet #1

Rif.	Description	Value	Remarks
Terminals array 1	6 contact + 5 with fuse		
Terminals array 1	8 contact		
Tuning motors fuse	4A		
Filament fuse	10A		
Coils fuse	6,3A		
Service fuse	10A		
Blowers fuse	10A		
Main Switch	380 V 25 A		
R1, R2, R3	Wire Wound Resistor 35 x 100	20 ohm	
Switch HT 1, HT2 T10000	400V 3-Phase	 18,5KW	
T. PROT. 1 T 10000 T 10000 220V	Thermal Protection	 29A 50A	
T. PROT. 2	Thermal Protection	1.5-2.6A	
Main Blower	0.75HP 380V 1.6A		

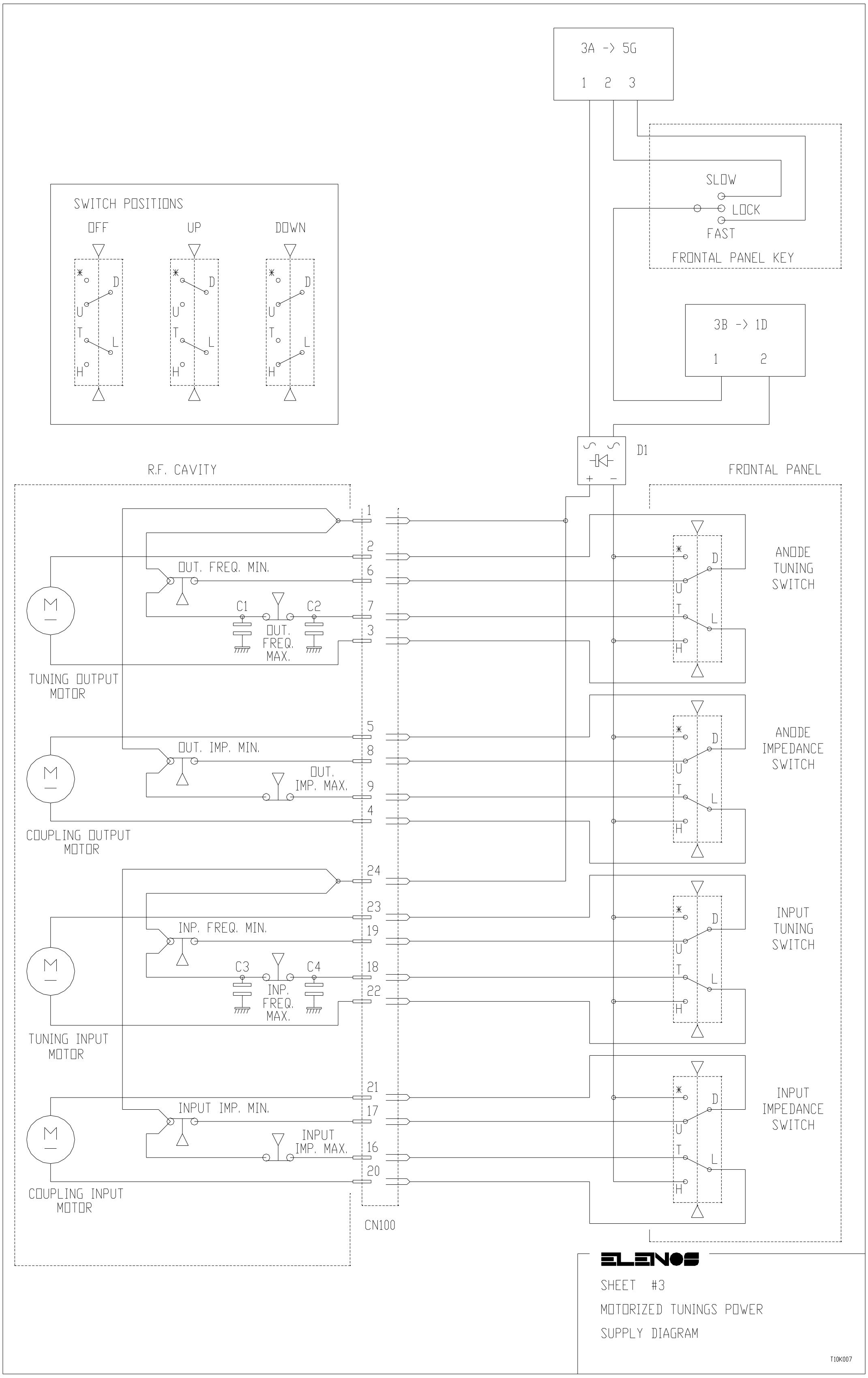
Sheet # 2 - Tube power supply diagram



Part List of Tube Power Supply Diagram

Rif.	Description	Value	Remarks
R1	Wire Resistor // 2 x (50 x 400, 60 ohm, 400W) (T10000 32u, wire Resistor 60 x 600, 30ohm, 1200W)		
RR1	Wire Resistor 3 x (30 x 220, 5 ohm, 200W)		
L1	Inductor	1H	5A
C1	Capacitor	3 uF	7500V
D1 - D21	Bridge type KBPC250G		
E20123	Cathode Bias and signals conveyor board		
E20128	Choking phase board		
E20138	Voltage Divider Board		
E20144	Rectifier unit board		
Anode Transformer	20 KVA		
Filament Transformer	2 KVA		
Pressure switch	ELBI 0.3- 5 mbar		
Terminals Array 1	1 Contact		
CN100	AMP cylinder connector 24 pin		

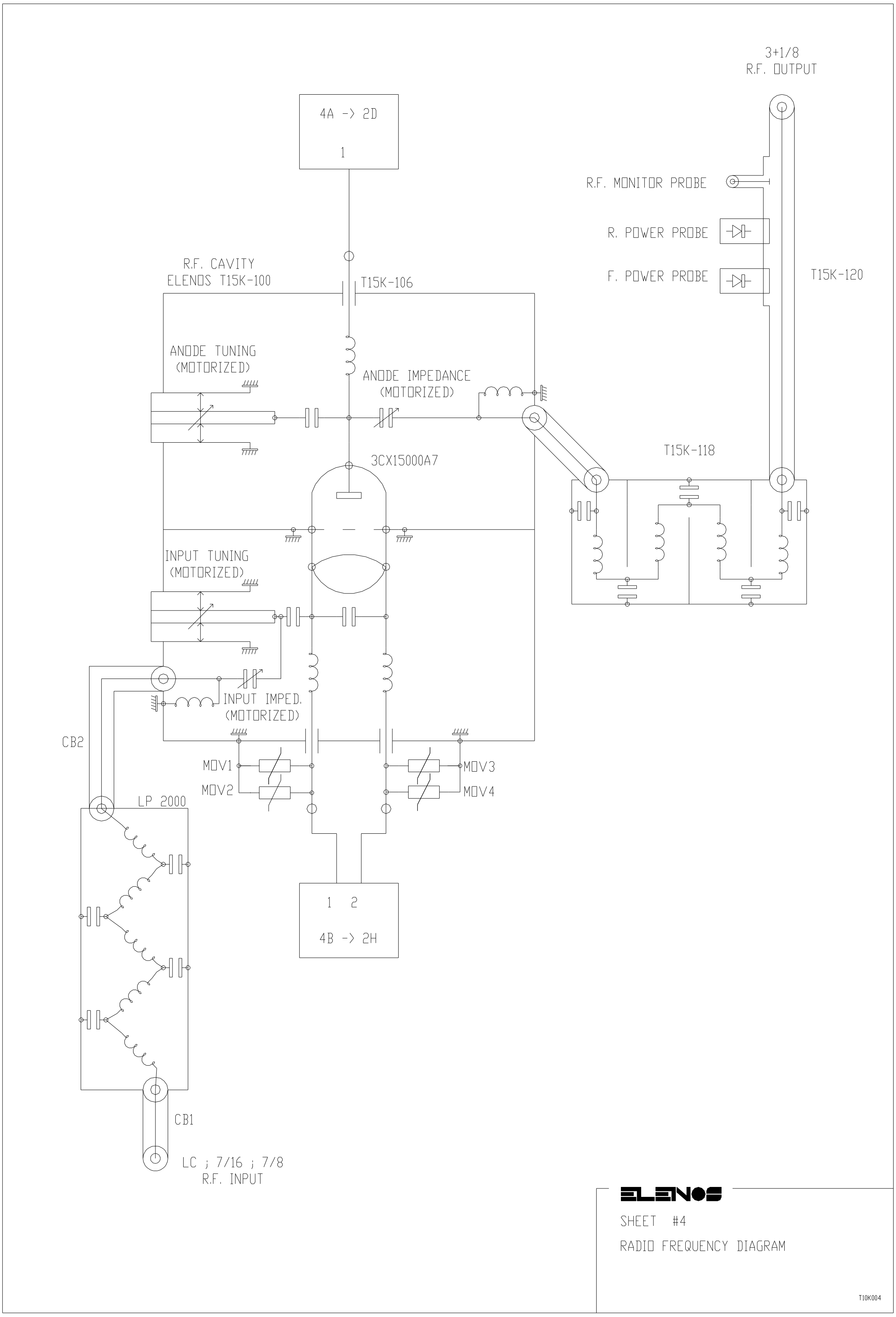
Sheet # 3 - Motorised tuning diagram



Part List of Motorised Tuning Diagram

Rif.	Description	
C1 - C4	Ceramic capacitor 4n7 2KV	
D1	Bridge type KBPC250G	
Input Tuning Switch Input Impedance Switch Output Tuning Switch Output Impedance Switch	Switch Toggle 2-Way 3-Pos. 131FL	
Input coupling Motor	Motor type 1.61.013.325	1MOT0005
Output Tuning Motor Output Impedance Motor Input tuning Motor	Motor type 36.10.5 12V	1MOT0003
Input Freq. Min Input Freq. Max. Input Imp. Min. Input Imp. Max. Output Freq. Min Output Freq. Max. Output Imp. Min. Output Imp. Max.	Microswitch AH3222 or Microswitch MS10	2SW00008 2SW00001
F. P. Key	Selector 3-pos with Key	
CN100	AMP Cylinder connector 24 pin	

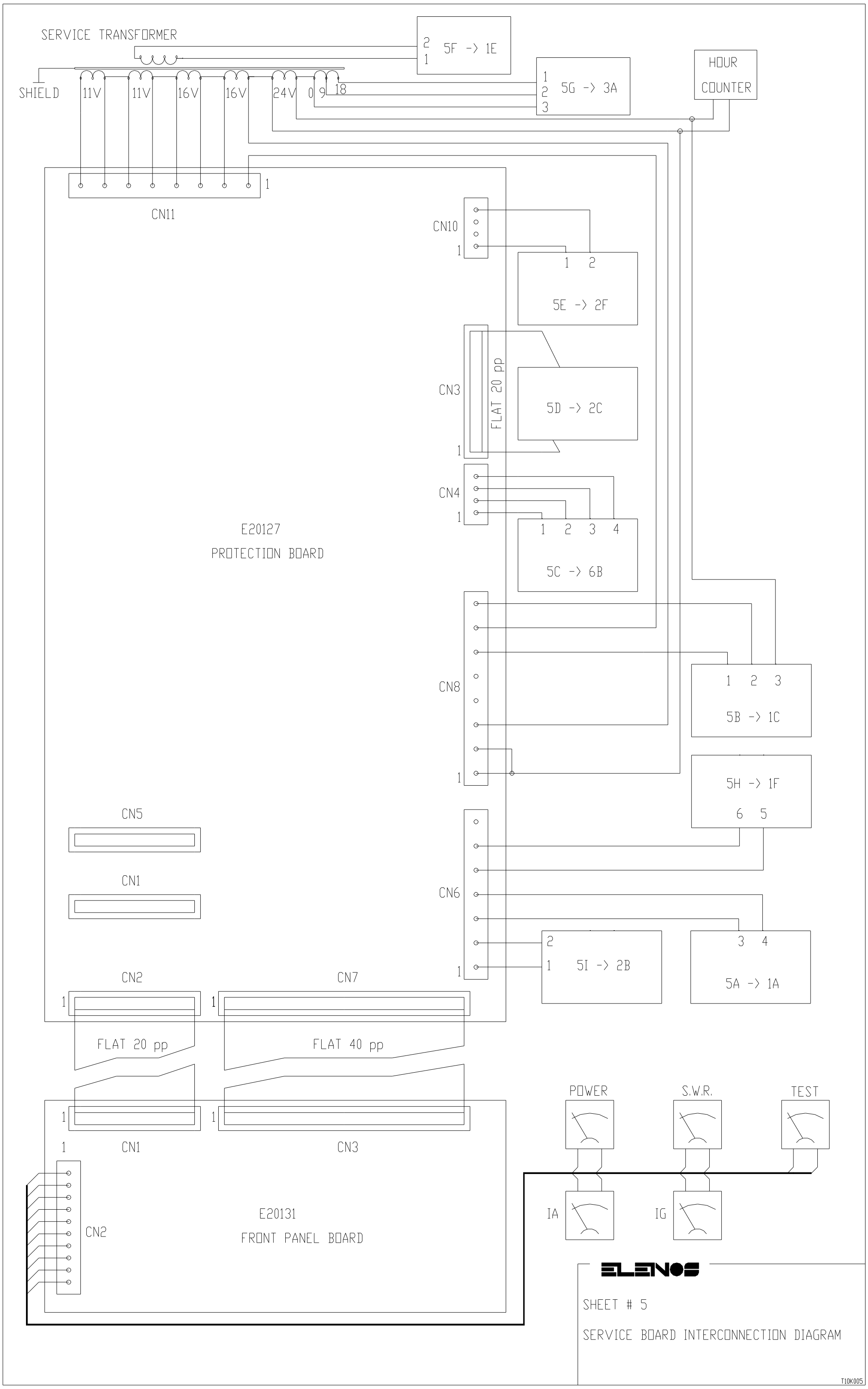
Sheet # 4 - R.F. Cavity Amplifier Diagram



Part List of R.F. Power Amplifier Cavity

RIF.	DESCRIPTION
MOV1 - MOV4	MOV type S20K-275
R.F. CAVITY	ELENOS CODE 15K-100 + 15K-106
LP 2000	INPUT FILTER
T15K-118	OUTPUT FILTER
T15K-120	OUTPUT LINE
CB1	LD CABLE 1/2" 50 OHM
CB2	LD CABLE 1/2" 50 OHM

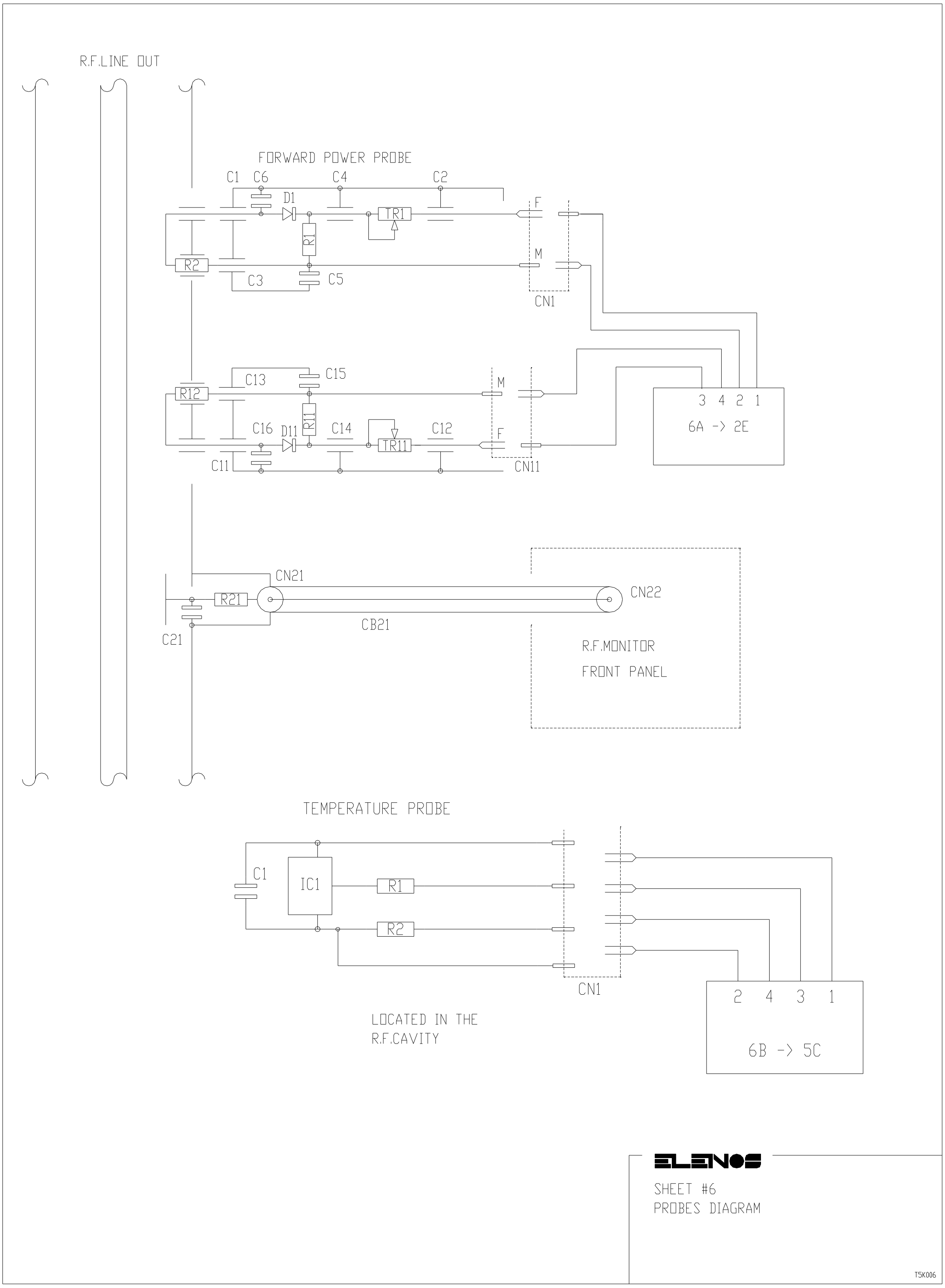
Sheet # 5 - Service board interconnection diagram



Part List of Service Board Interconnection Diagram

Rif.	Description
E20127	General Control Board
E20131	Front Panel Display Board
POWER S.W.R. TEST IA IG	Meter 100uA f.s. M3D
Service Transformer	220V - 11/11/16/16/24/9/18 V

Sheet # 6 - Probes diagram



Part List of Forward Power Probe

Rif.	Description	Value	Remarks
C1	Ceramic F.P. Capacitor	3,3 pF	
C2, C3, C4	Ceramic F.P. Capacitor	1000pF	
C5	Ceramic Capacitor	4700 pF	
C6	Ceramic Capacitor	22 pF	
D1	Diode type AA118		
R1	Resistor	2,7 KΩ	0.25W 1%
R2	Resistor	180 Ω	0.25W 1%
TR1	Trimmer type 89P	200 KΩ	
CN1	Twin/BNC connector 31-223		

Part List of Reflected Power Probe

Rif.	Description	Value	Remarks
C11	Ceramic F.P. Capacitor	3,3 pF	
C12, C13, C14	Ceramic F.P. Capacitor	1000pF	
C15	Ceramic Capacitor	4700 pF	
C16	Ceramic Capacitor	22 pF	
D11	Diode type AA118		
R11	Resistor	18 KΩ	0.25W 1%
R12	Resistor	180 Ω	0.25W 1%
TR11	Trimmer type 89P	20 KΩ	
CN11	Twin/BNC connector 31-223		

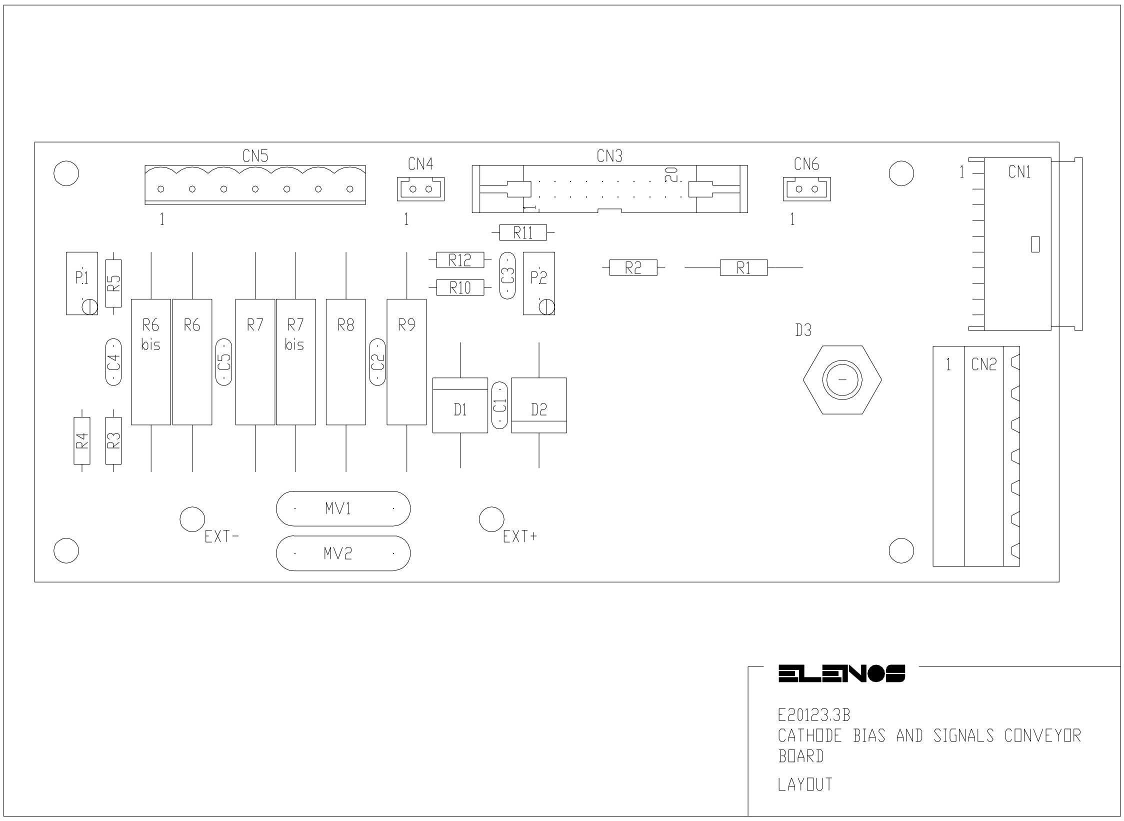
Part List of R.F. Monitor Probe

Rif.	Description	Value	Remarks
C21	Ceramic Capacitor	22 pF	
R21	Resistor	49.9 Ω	0.25W 1%
CB21	Coax. Cable type RG58	2,15 mt.	
CN21, CN22	Coax. Connector type BNC		

Part List of Temperature Probe Board

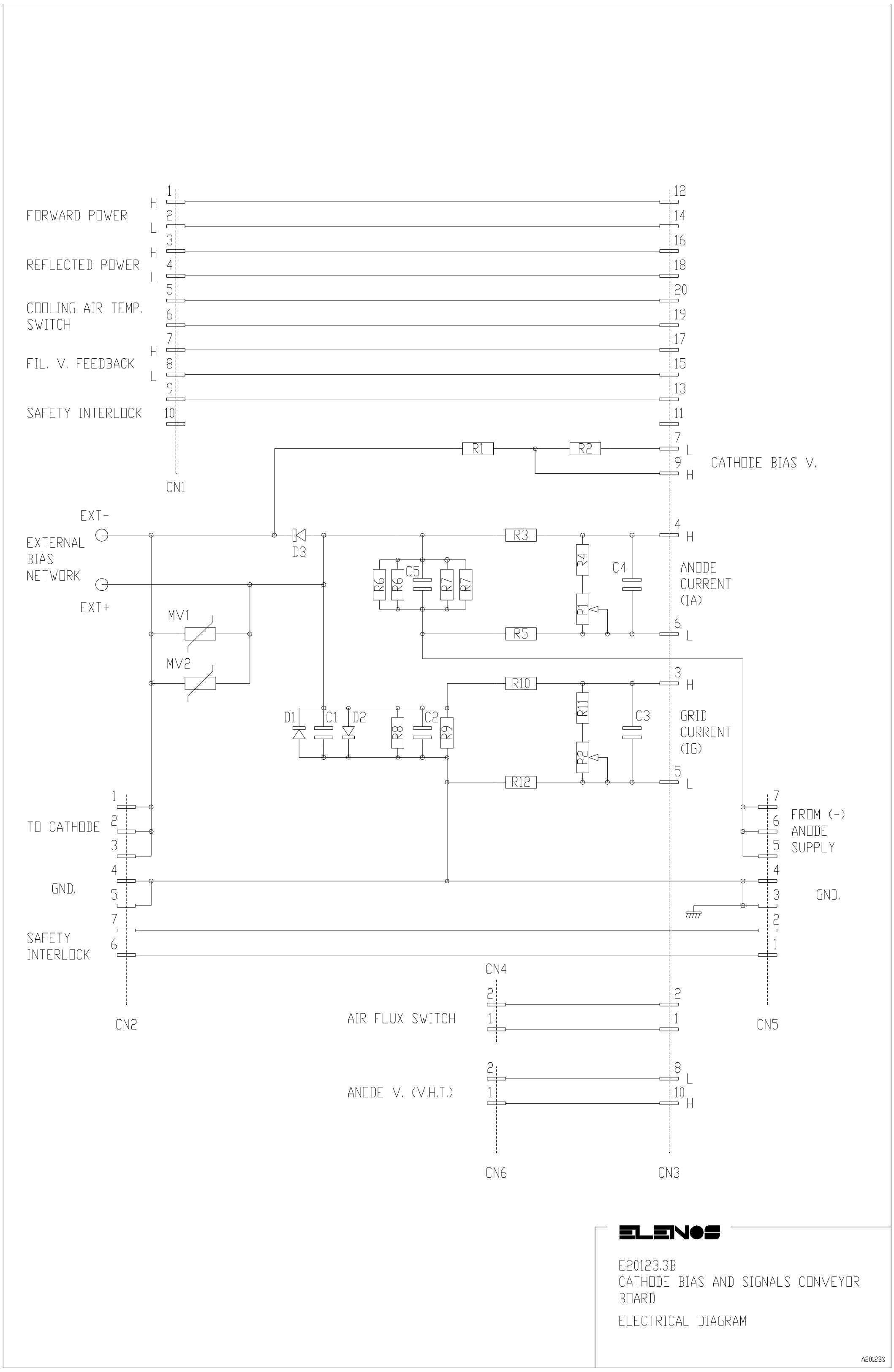
Rif.	Description	Value	Remarks
R1, R2	Resistor	6980	0.25W 1%
C1	Ceramic Capacitor	4700 pF	
IC1	Sensor type LM35DH		
CN1	AMP MODU connector 280.371-1		

E20123 - Cathode Bias and Signal Conveyor Board

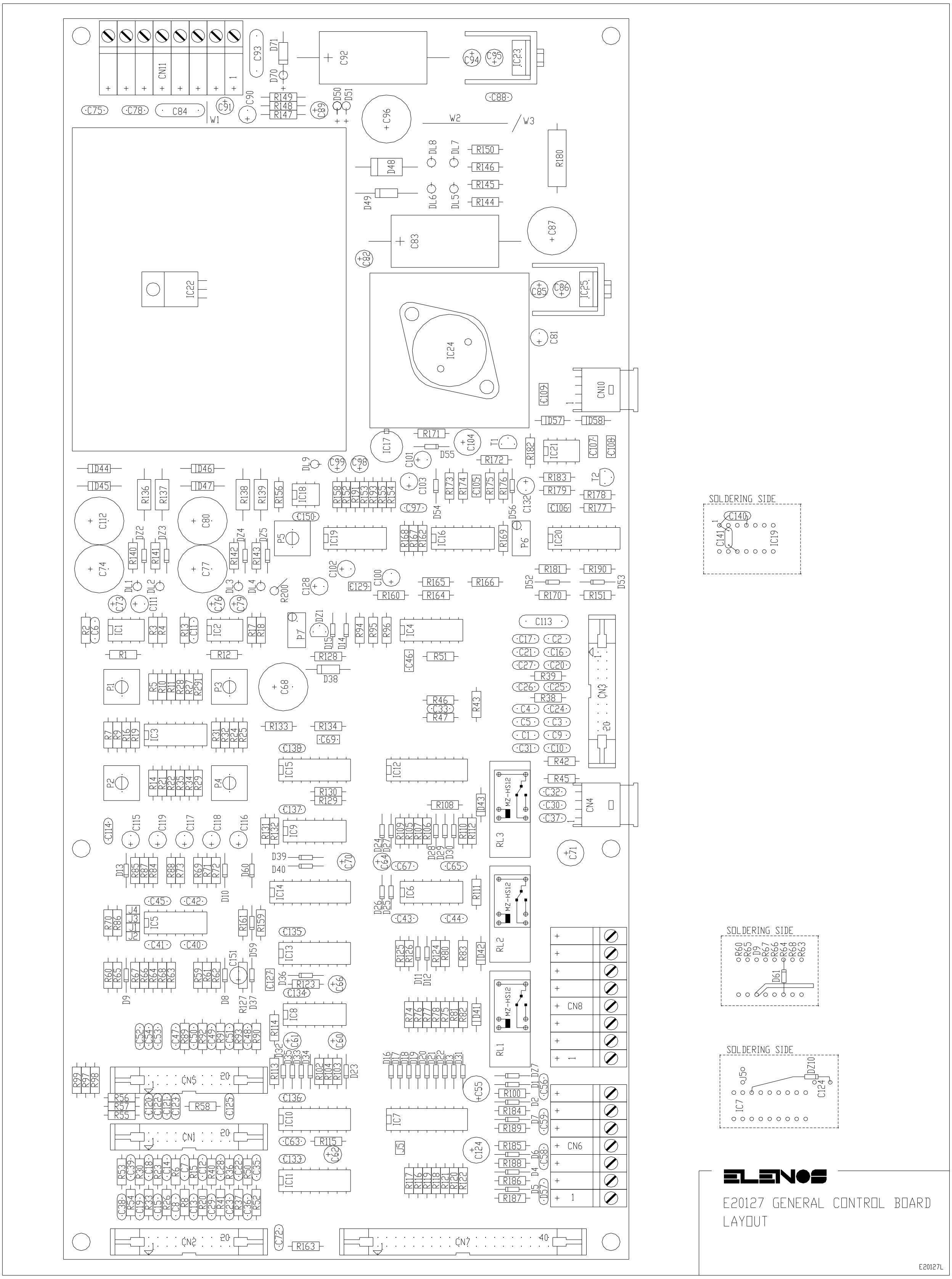


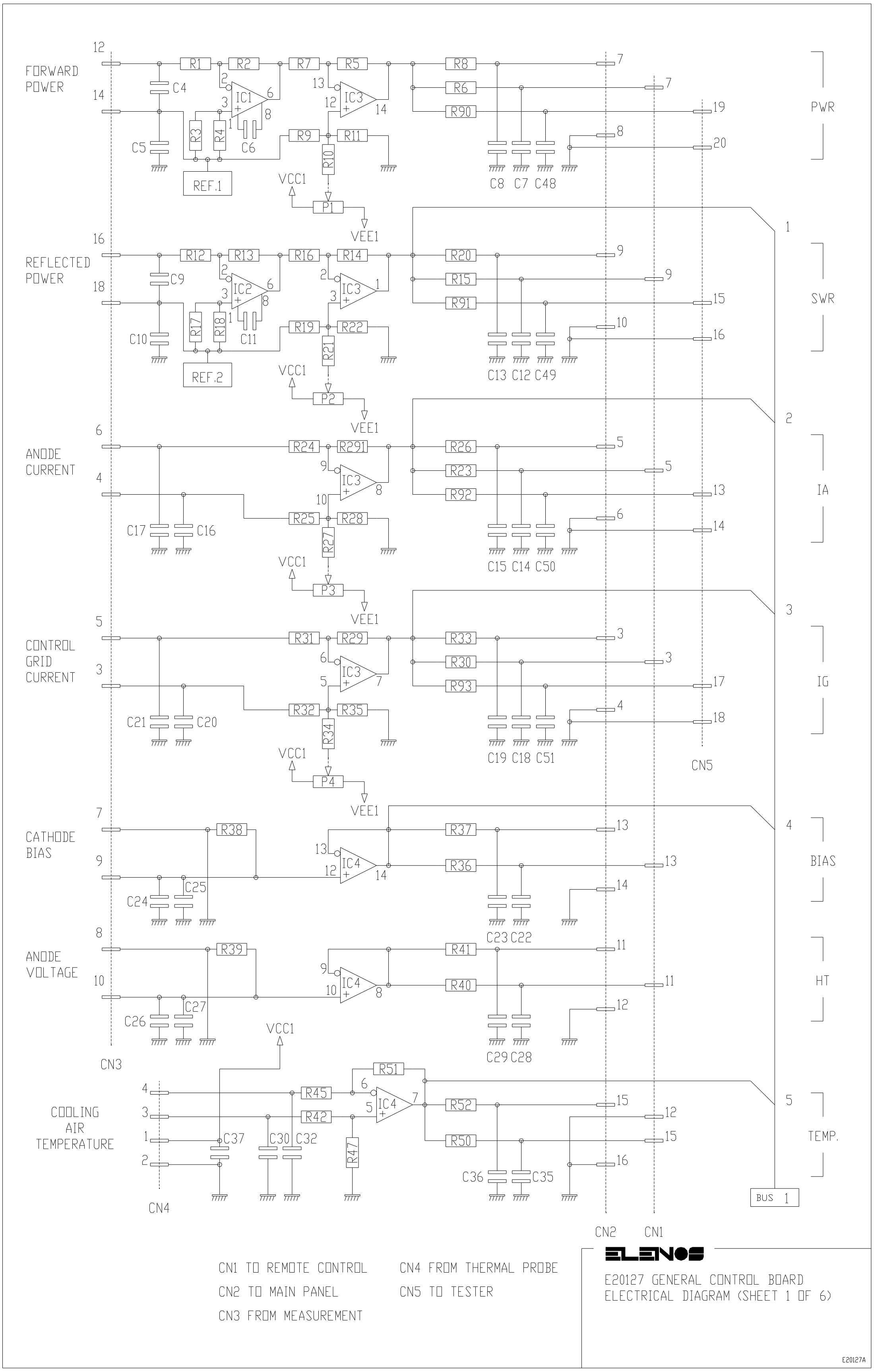
Part List of 20123.3B Board

Rif.	Description	Value	Remarks
PCB	Board code 2PCB0167		
R1	Resistor	47Kohm	0.25 W 5%
R2	Resistor	1Kohm	0.25 W 1%
R3, R4, R5	Resistor	49.9 ohm	0.25 W 1%
R6, R6bis, R7, R7bis	Resistor	0.12 ohm	5 W
R8	Resistor	0.12 ohm	5 W
R9	Resistor	0.12 ohm	5 W 1%
R10, R11, R12	Resistor	49.9 ohm	0.25 W 1%
P1, P2	Trimmer type 67W	100 ohm	
C1, C2,C3, C4, C5	Ceramic Capacitor	100 nF	50 V
D1, D2	Diode type P600K		6A 800V
D3	Diode type 16F120		
CN1	AMP connector MODU male 10 pin Angled		
CN2	Phoenix connector male 7 pin Angled		
CN3	ANSLEY connector 10+10 pin Straight		
CN4	AMP connector MODU male 2 pin Straight		
CN5	Phoenix Connector male 7 pin Straight		
CN6	AMP connector MODU male 2 pin Straight		
MV1, MV2	MOV type S20K-60		
EXT+, EXT-	Fixing Stud F/M		

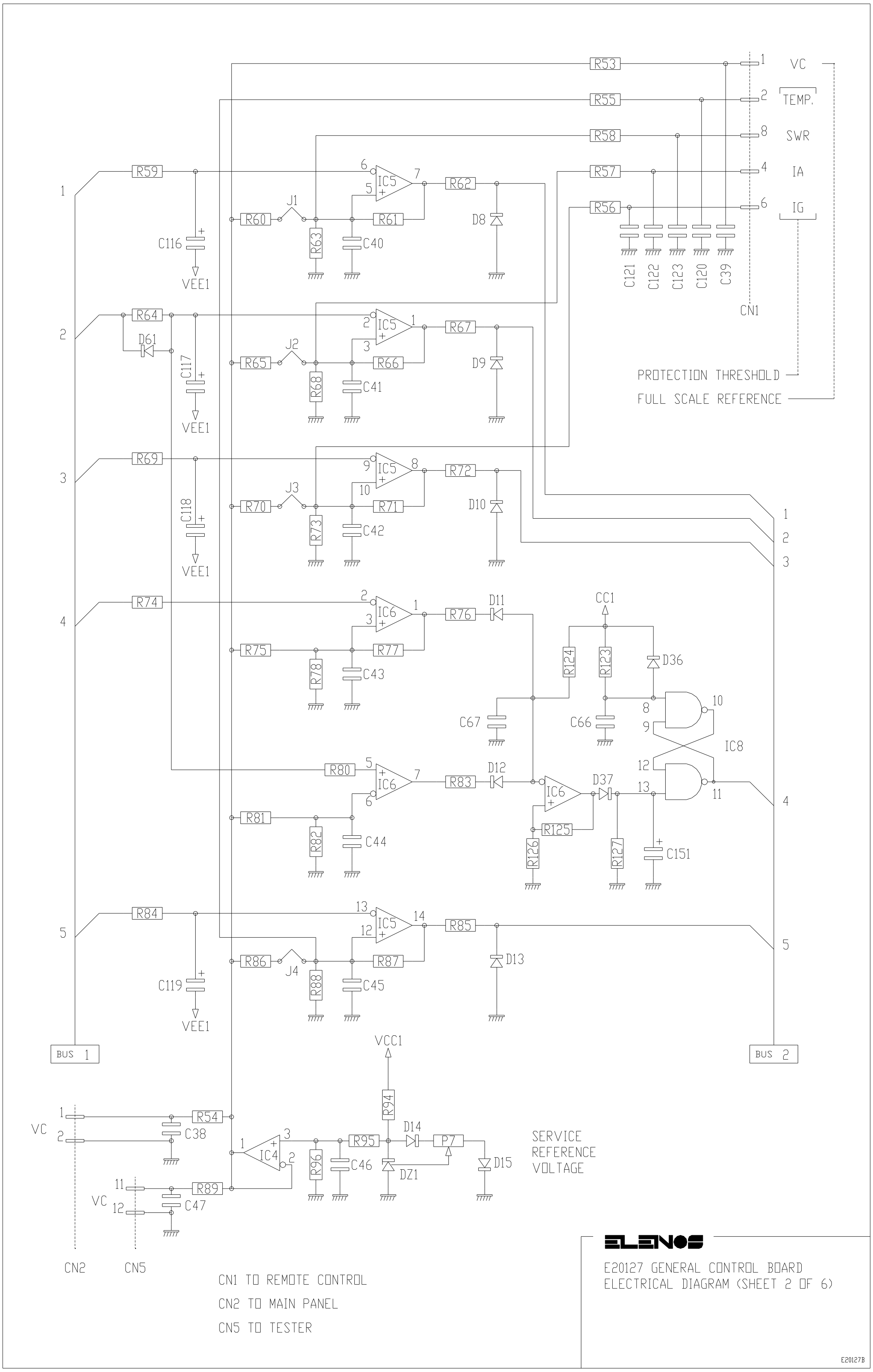

FORWARD POWER
REFLECTED POWER
COOLING AIR TEMP. SWITCH
FIL. V. FEEDBACK
SAFETY INTERLOCK
CN1
CATHODE BIAS V.
EXT-
EXTERNAL BIAS NETWORK
EXT+
MV1
MV2
D3
R1
R2
R3
R4
R5
R6
R7
C5
C4
P1
ANODE CURRENT (IA)
R10
R11
R12
R8
R9
C1
C2
C3
D1
D2
P2
GRID CURRENT (IG)
TO CATHODE
GND.
SAFETY INTERLOCK
FROM (-) ANODE SUPPLY
CN4
CN2
AIR FLUX SWITCH
CN5
ANODE V. (V.H.T.)
CN6
CN3
ELENOS
E20123.3B
CATHODE BIAS AND SIGNALS CONVEYOR BOARD
ELECTRICAL DIAGRAM
A20123S

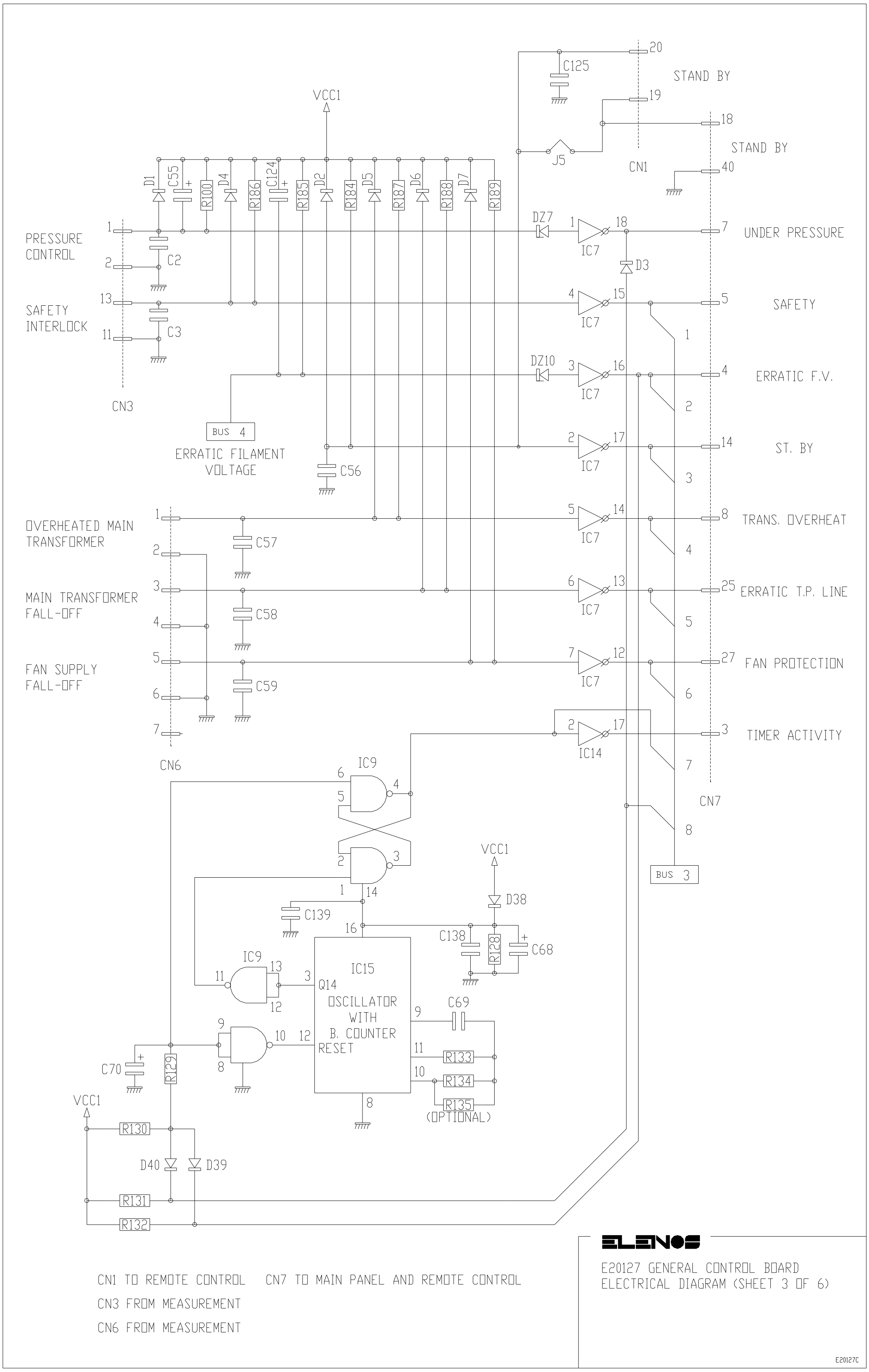
E20127 - General Control Board

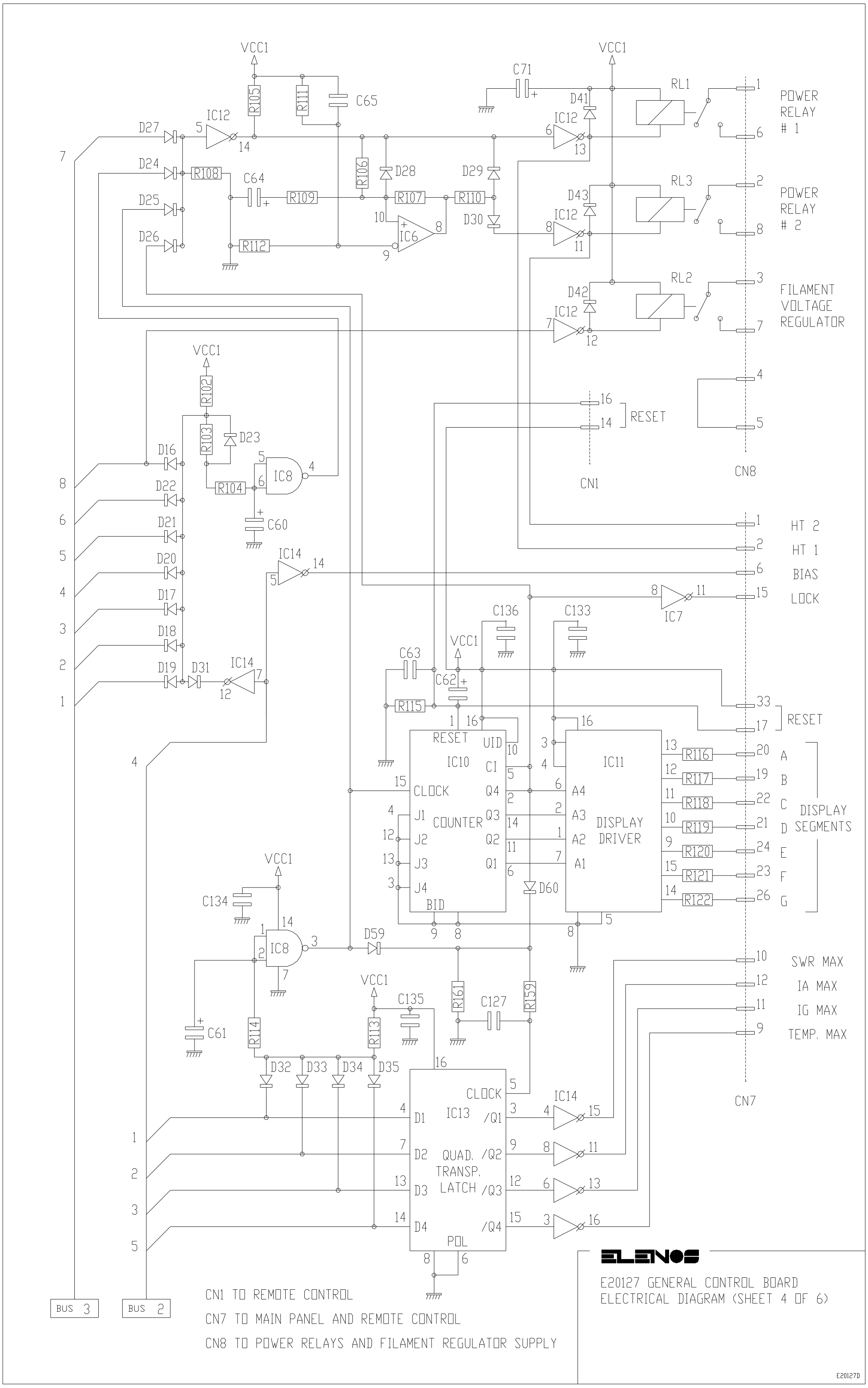


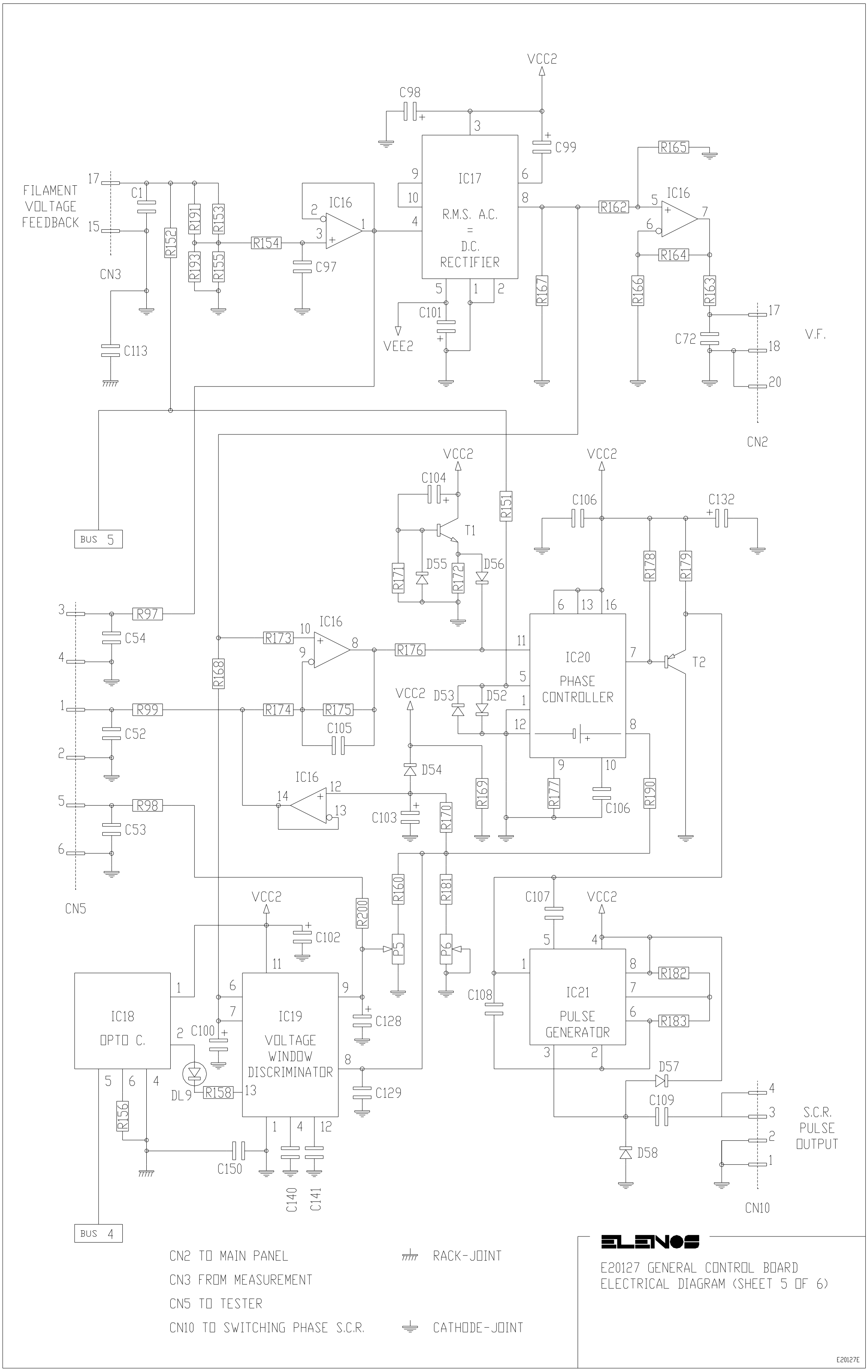


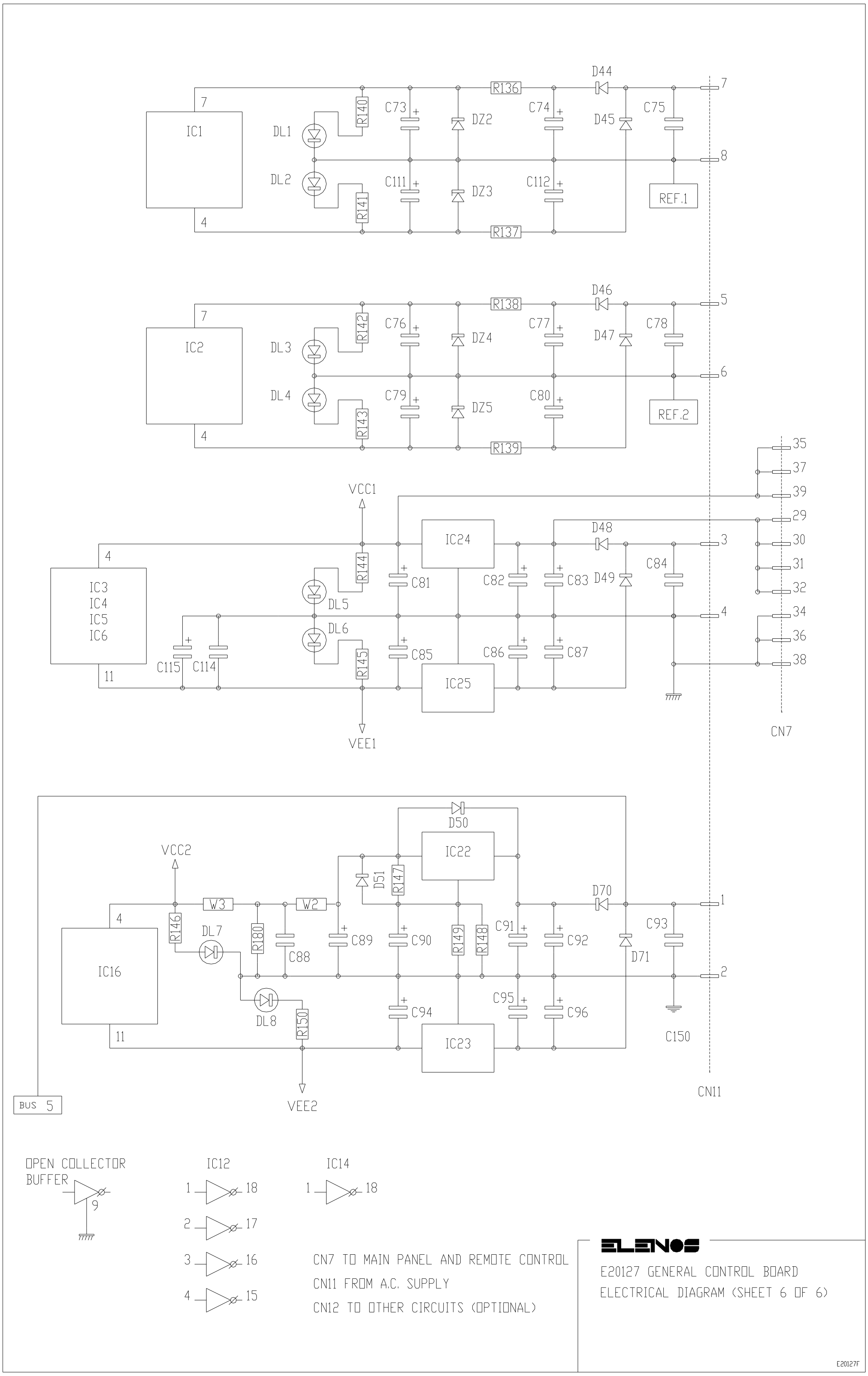
FORWARD POWER
REFLECTED POWER
ANODE CURRENT
CONTROL GRID CURRENT
CATHODE BIAS
ANODE VOLTAGE
COOLING AIR TEMPERATURE
PWR
SWR
IA
IG
BIAS
HT
TEMP.
REF.1
REF.2
VCC1
VEE1
CN1
CN2
CN3
CN4
CN5
BUS 1
CN1 TO REMOTE CONTROL
CN2 TO MAIN PANEL
CN3 FROM MEASUREMENT
CN4 FROM THERMAL PROBE
CN5 TO TESTER
ELENOS
E20127 GENERAL CONTROL BOARD
ELECTRICAL DIAGRAM (SHEET 1 OF 6)
E20127A


VC
TEMP.
SWR
IA
IG
CN1
PROTECTION THRESHOLD
FULL SCALE REFERENCE
BUS 1
BUS 2
VCC1
SERVICE
REFERENCE
VOLTAGE
CN2
CN5
CN1 TO REMOTE CONTROL
CN2 TO MAIN PANEL
CN5 TO TESTER
E20127 GENERAL CONTROL BOARD
ELECTRICAL DIAGRAM (SHEET 2 OF 6)
E20127B


VCC1
C125
STAND BY
J5
CN1
STAND BY
PRESSURE CONTROL
SAFETY INTERLOCK
CN3
UNDER PRESSURE
SAFETY
ERRATIC F.V.
ST. BY
TRANS. OVERHEAT
ERRATIC T.P. LINE
FAN PROTECTION
TIMER ACTIVITY
CN7
BUS 4
ERRATIC FILAMENT VOLTAGE
OVERHEATED MAIN TRANSFORMER
MAIN TRANSFORMER FALL-OFF
FAN SUPPLY FALL-OFF
CN6
IC7
IC14
IC9
IC15
OSCILLATOR WITH B. COUNTER
RESET
BUS 3
(OPTIONAL)
CN1 TO REMOTE CONTROL
CN7 TO MAIN PANEL AND REMOTE CONTROL
CN3 FROM MEASUREMENT
CN6 FROM MEASUREMENT
ELENOS
E20127 GENERAL CONTROL BOARD
ELECTRICAL DIAGRAM (SHEET 3 OF 6)
E20127C


VCC1
POWER RELAY # 1
POWER RELAY # 2
FILAMENT VOLTAGE REGULATOR
RL1
RL3
RL2
RESET
CN1
CN8
HT 2
HT 1
BIAS
LOCK
RESET
DISPLAY SEGMENTS
IC10
COUNTER
IC11
DISPLAY DRIVER
SWR MAX
IA MAX
IG MAX
TEMP. MAX
CN7
IC13
QUAD. TRANSP. LATCH
BUS 3
BUS 2
CN1 TO REMOTE CONTROL
CN7 TO MAIN PANEL AND REMOTE CONTROL
CN8 TO POWER RELAYS AND FILAMENT REGULATOR SUPPLY
E20127 GENERAL CONTROL BOARD
ELECTRICAL DIAGRAM (SHEET 4 OF 6)
E20127D


FILAMENT VOLTAGE FEEDBACK
IC17
R.M.S. A.C. = D.C. RECTIFIER
VCC2
VEE2
V.F.
CN2
CN3
BUS 5
IC20
PHASE CONTROLLER
CN5
IC18
OPTO C.
IC19
VOLTAGE WINDOW DISCRIMINATOR
IC21
PULSE GENERATOR
S.C.R. PULSE OUTPUT
CN10
BUS 4
CN2 TO MAIN PANEL
CN3 FROM MEASUREMENT
CN5 TO TESTER
CN10 TO SWITCHING PHASE S.C.R.
RACK-JOINT
CATHODE-JOINT
E20127 GENERAL CONTROL BOARD
ELECTRICAL DIAGRAM (SHEET 5 OF 6)


IC1
DL1
DL2
R140
R141
C73
C111
DZ2
DZ3
R136
R137
C74
C112
D44
D45
C75
REF.1
IC2
DL3
DL4
R142
R143
C76
C79
DZ4
DZ5
R138
R139
C77
C80
D46
D47
C78
REF.2
VCC1
IC3
IC4
IC5
IC6
C115
C114
DL5
DL6
R144
R145
C81
C85
IC24
IC25
C82
C86
C83
C87
D48
D49
C84
VEE1
CN7
35
37
39
29
30
31
32
34
36
38
D50
VCC2
IC22
D51
R147
W3
W2
IC16
R146
DL7
R180
C88
C89
C90
R149
R148
C91
C92
D70
D71
C93
DL8
R150
C94
C95
C96
IC23
C150
VEE2
CN11
BUS 5
OPEN COLLECTOR
BUFFER
IC12
IC14
CN7 TO MAIN PANEL AND REMOTE CONTROL
CN11 FROM A.C. SUPPLY
CN12 TO OTHER CIRCUITS (OPTIONAL)
E20127 GENERAL CONTROL BOARD
ELECTRICAL DIAGRAM (SHEET 6 OF 6)
E20127F

Part List of 20127 Board

Rif.	Description	Value	Remarks
R1	Resistor	1,3K	0.25 W 1%
R2	Resistor	2K	0.25 W 1%
R3	Resistor	1,3K	0.25 W 1%
R4	Resistor	2K	0.25 W 1%
R5	Resistor	34 K	0.25 W 1%
R6	Resistor	100	0.25 W 1%
R7	Resistor	1,02K	0.25 W 1%
R8	Resistor	100	0.25 W 1%
R9	Resistor	1,02K	0.25 W 1%
R10	Resistor	1 M	0.25 W 1%
R11	Resistor	34 K	0.25 W 1%
R12	Resistor	1,3K	0.25 W 1%
R13	Resistor	2K	0.25 W 1%
R14	Resistor	34 K	0.25 W 1%
R15	Resistor	100	0.25 W 1%
R16	Resistor	1,02K	0.25 W 1%
R17	Resistor	1,3K	0.25 W 1%
R18	Resistor	2K	0.25 W 1%
R19	Resistor	1,02K	0.25 W 1%
R20	Resistor	100	0.25 W 1%
R21	Resistor	1 M	0.25 W 1%
R22	Resistor	34 K	0.25 W 1%
R23	Resistor	100	0.25 W 1%
R24, R25	Resistor	1,02K	0.25 W 1%
R26	Resistor	100	0.25 W 1%
R27	Resistor	1 M	0.25 W 1%
R28, R29	Resistor	34 K	0.25 W 1%
R30	Resistor	100	0.25 W 1%
R31, R32	Resistor	1,02K	0.25 W 1%
R33	Resistor	100	0.25 W 1%
R34	Resistor	1 M	0.25 W 1%
R35	Resistor	34 K	0.25 W 1%
R36,R37	Resistor	100	0.25 W 1%
R38, R39	Resistor	34 K	0.25 W 1%
R40, R41	Resistor	100	0.25 W 1%
R42	Resistor	10K	0.25 W 1%
R43		none	
R45	Resistor	10K	0.25 W 1%
R46		none	
R47	Resistor	34K	0.25 W 1%
R50	Resistor	100	0.25 W 1%
R51	Resistor	34 K	0.25 W 1%
R52, R53	Resistor	100	0.25 W 1%
R54	Resistor	27	0.25 W 1%
R55, R56, R57, R58	Resistor	100	0.25 W 1%
R59	Resistor	10K	0.25 W 1%
R60	Resistor	15K	0.25 W 1%
R61	Resistor	10 M	0.25 W 1%
R62, R63	Resistor	10K	0.25 W 1%
R65	Resistor	3,3K	0.25 W 1%
R66	Resistor	10 M	0.25 W 1%
R67	Resistor	10K	0.25 W 1%
R68	Resistor	1 K	0.25 W 1%
R69	Resistor	100 K	0.25 W 1%
R70	Resistor	10K	0.25 W 1%
R71	Resistor	10 M	0.25 W 1%
R72, R73, R74	Resistor	10K	0.25 W 1%
R75	Resistor	100K	0.25 W 1%
R76	Resistor	10 K	0.25 W 1%

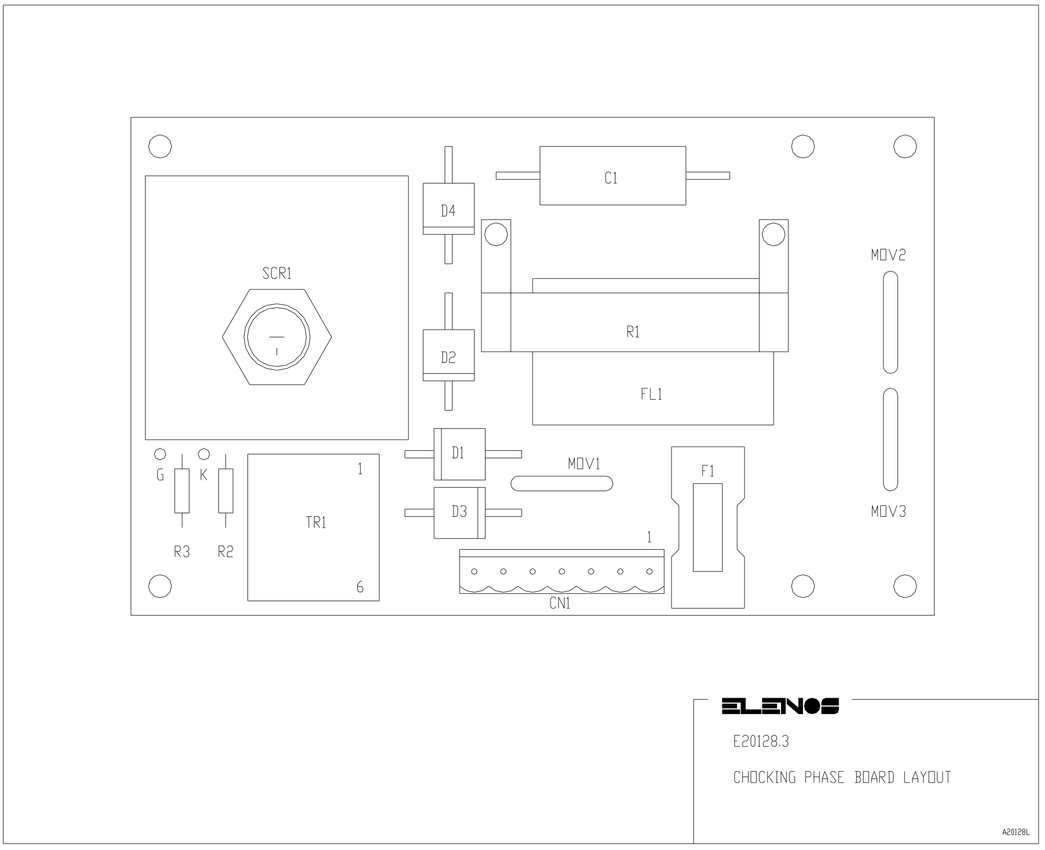
R77	Resistor	10 M	0.25 W 1%
R78	Resistor	10 K	0.25 W 1%
R80	Resistor	1 K	0.25 W 1%
R81	Resistor	4,75K	0.25 W 1%
R82, R83,R84,R85	Resistor	10 K	0.25 W 1%
R86	Resistor	1.8 K	0.25 W 5%
R87	Resistor	10 M	0.25 W 1%
R88	Resistor	10 K	0.25 W 1%
R89, R90	Resistor	100	0.25 W 1%
R91, R92, R93	Resistor	100	0.25 W 1%
R94	Resistor	6810	0.25 W 1%
R95	Resistor	34 K	0.25 W 1%
R96	Resistor	137 K	0.25 W 1%
R97, R98, R99	Resistor	100	0.25 W 1%
R100	Resistor	10 K	0.25 W 1%
R102	Resistor	1K	0.25 W 1%
R103	Resistor	100 K	0.25 W 1%
R104, R105	Resistor	10 K	0.25 W 1%
R106	Resistor	100 K	0.25 W 1%
R107	Resistor	10 M	0.25 W 1%
R108	Resistor	10 K	0.25 W 1%
R109	Resistor	100	0.25 W 1%
R110, R111, R112	Resistor	10 K	0.25 W 1%
R113	Resistor	100 K	0.25 W 1%
R114	Resistor	100	0.25 W 1%
R115	Resistor	10 K	0.25 W 1%
R116, R117,R118, R119, R120, R121, R122	Resistor	1K	0.25 W 1%
R123, R124	Resistor	100 K	0.25 W 1%
R125	Resistor	10 M	0.25 W 1%
R126	Resistor	10 K	0.25 W 1%
R127	Resistor	4750	0.25 W 1%
R128	Resistor	1 K	0.25 W 1%
R129	Resistor	100 K	0.25 W 1%
R130, R131, R132	Resistor	10 K	0.25 W 1%
R133	Resistor	475 K	0.25 W 1%
R134	Resistor	150 K	0.25 W 1%
R136 - R139	Resistor	150	0.5 W 5%
R140 - R143	Resistor	100	0.25 W 1%
R144 -R147	Resistor	1 K	0.25 W 1%
R148	Resistor	15 K	0.25 W 1%
R149	Resistor	22 K	0.25 W 1%
R150	Resistor	1 K	0.25 W 1%
R151	Resistor	15 K	0.25 W 1%
R152	Resistor	2,2K	0.25 W 1%
R153	Resistor	2,87K	0.25 W 1%
R154	Resistor	10 K	0.25 W 1%
R155	Resistor	1 K	0.25 W 1%
R156	Resistor	150 K	0.25 W 1%
R158	Resistor	1 K	0.25 W 1%
R159, R160, R161	Resistor	100 K	0.25 W 1%
R162	Resistor	10 K	0.25 W 1%
R163	Resistor	100	0.25 W 1%
R164, R165	Resistor	15 K	0.25 W 1%
R166 - R169	Resistor	10 K	0.25 W 1%
R170, R171, R172	Resistor	475 K	0.25 W 1%
R173	Resistor	6810	0.25 W 1%
R174	Resistor	1 K	0.25 W 1%
R175	Resistor	475 K	0.25 W 1%
R176	Resistor	2.2 K	0.25 W 5%
R177	Resistor	82 K	0.25 W 5%
R178, R179	Resistor	10 K	0.25 W 1%

R180	Resistor	270	2 W 5%
R181	Resistor	10 K	0.25 W 1%
R182, R183	Resistor	6810	0.25 W 1%
R184 - R189	Resistor	10 K	0.25 W 1%
R190	Resistor	6,81K	0.25 W 1%
R191	Resistor	10K	0.25 W 1%
R193		none	
R200	Resistor	1 K	0.25 W 1%
R291	Resistor	34 K	0.25 W 1%
P1 - P4	Trimmer type 72P	100K	
P5	Trimmer type 72P	10K	
P6, P7	Trimmer type 67W	10K	
C1 - C5	Ceramic Capacitor	4.7 nF	50V
C6	Ceramic Capacitor	33 pF	50V
C7 - C10	Ceramic Capacitor	4.7 nF	50V
C11	Ceramic Capacitor	33 pF	50V
C12 -C25	Ceramic Capacitor	4.7 nF	50V
C26	Mylar Capacitor	220 nF	63V
C27	Mylar Capacitor	100 nF	63V
C28, C29	Ceramic Capacitor	4.7 nF	50V
C30	Ceramic Capacitor	4.7 nF	50V
C31		none	
C32	Ceramic Capacitor	4.7 nF	50V
C33		none	
C35, C36	Ceramic Capacitor	4.7 nF	50V
C37	Ceramic Capacitor	4.7 nF	50V
C38, C39	Ceramic Capacitor	4.7 nF	50V
C40 - C46	Ceramic Capacitor	100 nF	63V
C47 - C54	Ceramic Capacitor	4.7 nF	50V
C55	Electrolytic Vert. Capacitor	100 uF	35V
C56 - C59	Ceramic Capacitor	4.7 nF	50V
C60 - C62	Electrolytic. Vert. Capacitor	10 uF	35V
C63	Ceramic Capacitor	4.7 nF	50V
C64	Electrolytic. Vert. Capacitor	10 uF	35V
C65	Ceramic Capacitor	100 nF	63V
C66	Electrolytic. Vert. Capacitor	10 uF	35V
C67	Ceramic Capacitor	100 nF	63V
C68	Electrolytic. Vert. Capacitor	1000 uF	40V
C69	Mylar Capacitor	100 nF	63V
C70	Electrolytic. Vert. Capacitor	10 uF	35V
C71	Electrolytic. Vert. Capacitor	100 uF	35V
C72	Ceramic Capacitor	4.7 nF	50V
C73	Electrolytic. Vert. Capacitor	10 uF	35V
C74	Electrolytic. Vert. Capacitor	470 uF	40V
C75	Ceramic Capacitor	4.7 nF	50V
C76	Electrolytic. Vert. Capacitor	10 uF	35V
C77	Electrolytic. Vert. Capacitor	470 uF	40V
C78	Ceramic Capacitor	4.7 nF	50V
C79	Electrolytic. Vert. Capacitor	10 uF	35V
C80	Electrolytic. Vert. Capacitor	470 uF	40V
C81, C82	Electrolytic. Vert. Capacitor	10 uF	35V
C83	Electrolytic. Axial Capacitor	2200 uF	63V
C84	Ceramic Capacitor	4.7 nF	2KV
C85, C86	Electrolytic. Vert. Capacitor	10 uF	35V
C87	Electrolytic. Vert. Capacitor	1000 uF	40V
C88	Ceramic Capacitor	4.7 nF	50V
C89, C90, C91	Electrolytic. Vert. Capacitor	10 uF	35V
C92	Electrolytic. Axial Capacitor	2200 uF	63V
C93	Ceramic Capacitor	4.7 nF	2KV
C94, C95	Electrolytic. Vert. Capacitor	10 uF	35V
C96	Electrolytic. Vert. Capacitor	1000 uF	40V
C97	Ceramic Capacitor	4.7 nF	50V
C98 - C102	Electrolytic Vert. Capacitor	10 uF	35V

C103	Tantalum Capacitor	10 uF	35V
C104	Electrolytic. Vert. Capacitor	47 uF	35V
C105	Mylar Capacitor	470 nF	63V
C106	Mylar Capacitor	47 nF	63V
C107	Mylar Capacitor	10 nF	63V
C108	Mylar Capacitor	4.7 nF	63V
C109	Mylar Capacitor	470 nF	63V
C111	Electrolytic. Vert. Capacitor	10 uF	35V
C112	Electrolytic. Vert. Capacitor	470 uF	40V
C113	Ceramic Capacitor	4.7 nF	2KV
C114	Ceramic Capacitor	100 nF	63V
C115 - C119	Electrolytic. Vert. Capacitor	10 uF	35V
C120 - C123	Ceramic Capacitor	4.7 nF	50V
C124	Electrolytic. Vert. Capacitor	100 uF	35V
C125	Ceramic Capacitor	4.7 nF	50V
C127	Mylar Capacitor	100 nF	63V
C128	Electrolytic. Vert. Capacitor	10 uF	35V
C129	Mylar Capacitor	470 nF	63V
C132	Electrolytic. Vert. Capacitor	10 uF	35V
C133 - C138	Ceramic Capacitor	100 nF	63V
C140, C141	Ceramic Capacitor	100 nF	63V
C150	Ceramic Capacitor	4.7 nF	2KV
C151	Electrolytic. Vert. Capacitor	10 uF	35V
D1 - D37	Diode type 1N4148		
D38	Diode type 1N4007		
D39, D40	Diode type 1N4148		
D41 - D47	Diode type 1N4007		
D48	Diode type BY255		
D49, D50, D51	Diode type 1N4007		
D52 - D56	Diode type 1N4148		
D57, D58	Diode type 1N4007		
D59, D60, D61	Diode type 1N4148		
D70, D71	Diode type 1N4007		
DL1 - DL9	Led red 3 mm.		
DZ1	I.C. type LM336	2.5 V	
DZ2 - DZ5	Zener Diode	9.1 V	0.5 W
DZ7, DZ10	Zener Diode	5.1 V	0.5 W
T1	Transistor type BC337		
T2	Transistor type 2N2905		
IC1, IC2	I.C. type LM308 + Socket 8 pin		
IC3, IC4, IC5, IC6	I.C. type TL074 + Socket 14 pin		
IC7	I.C. type ULN2804 + Socket 18 pin		
IC8, IC9	I.C. type CD4093 + Socket 14 pin		
IC10	I.C. type CD4029 + Socket 16 pin		
IC11	I.C. type CD4511 + Socket 16 pin		
IC12	I.C. type ULN2804 + Socket 18 pin		
IC13	I.C. type CD4042 + Socket 16 pin		
IC14	I.C. type ULN2804 + Socket 18 pin		
IC15	I.C. type CD4060 + Socket 16 pin		
IC16	I.C. type TL074 + Socket 14 pin		
IC17	I.C. type AD536		
IC18	Opto I.C. type 4N35		

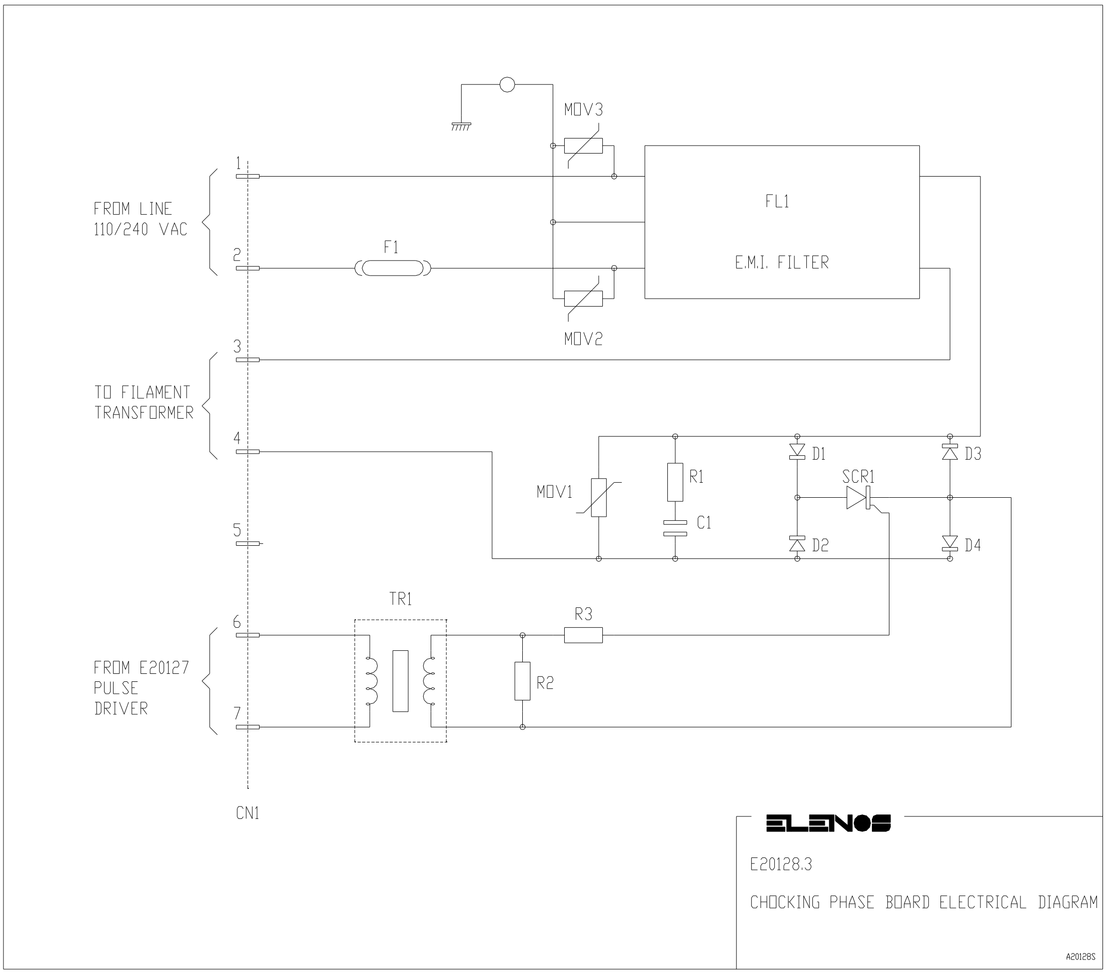
	+ Socket 6 pin		
IC19	I.C. type TCA965 + Socket 14 pin		
IC20	I.C. type TCA785 + Socket 16 pin		
IC21	I.C. type NE555 + Socket 8 pin		
IC22	I.C. type LM317		
IC23	I.C. type LM7912 case TO220 + Heat-sink 21C / W		
IC24	I.C. type LM7812 case TO3 + Heat-sink 7.7 C / W		
IC25	I.C. type LM7912 case TO220 + Heat-sink 21C / W		
J1 -J5	Jumper 2 pin		
W1, W2, W3	Wire		
RL1, RL2, RL3	Relay		
CN1, CN2, CN3	ANSLEY connector 2x10 pin		
CN4	AMP connector 4 pin 90 deg.		
CN5	ANSLEY connector 2x10 pin		
CN6	PHOENIX connector 7 pin 90 deg.		
CN7	ANSLEY connector 2x20 pin		
CN8	PHOENIX connector 8 pin 90 deg.		
CN10	AMP connector 4 pin 90 deg.		
CN11	PHOENIX connector 8 pin 90 deg.		

E20128 - Choking phase board

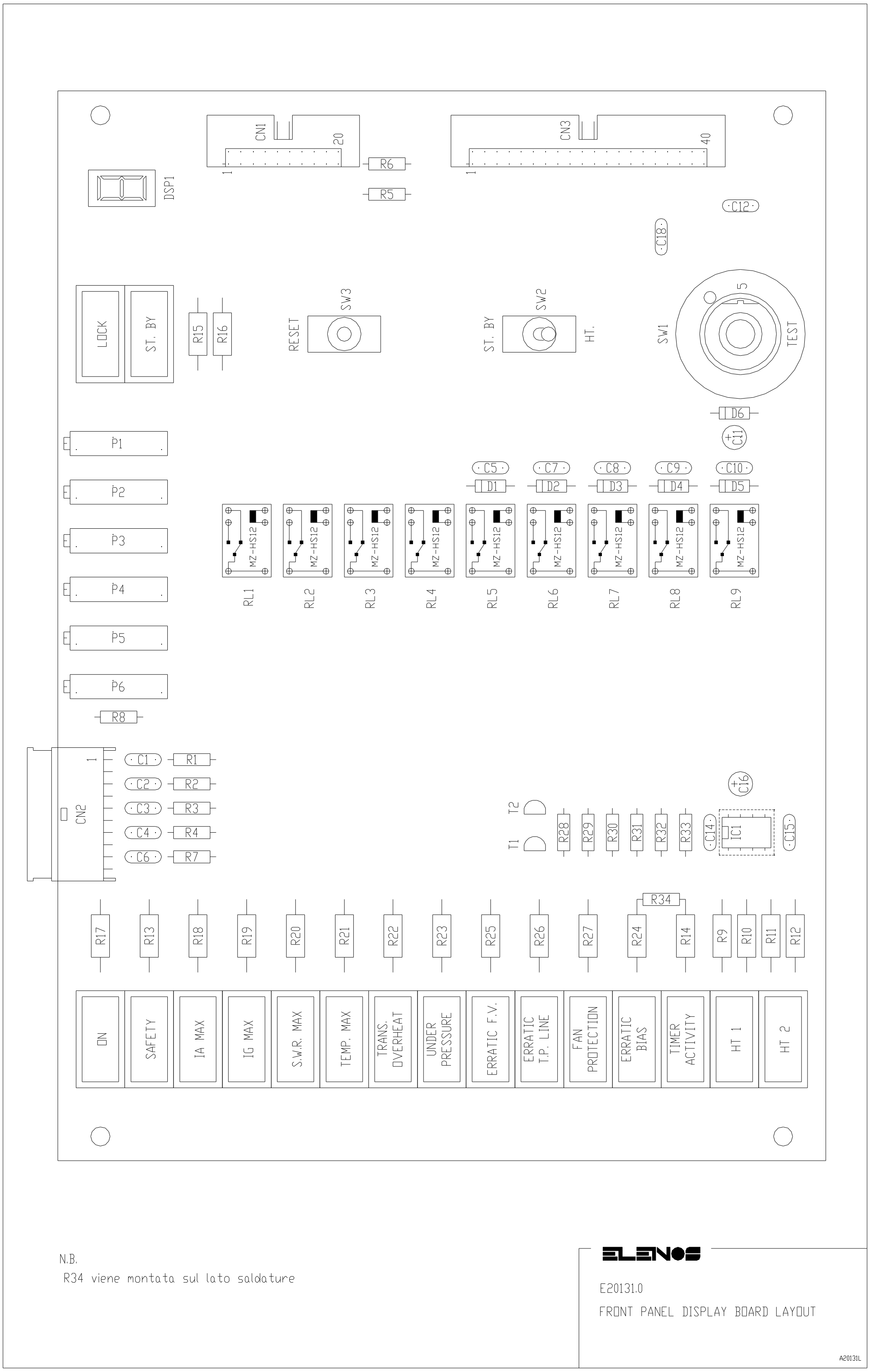


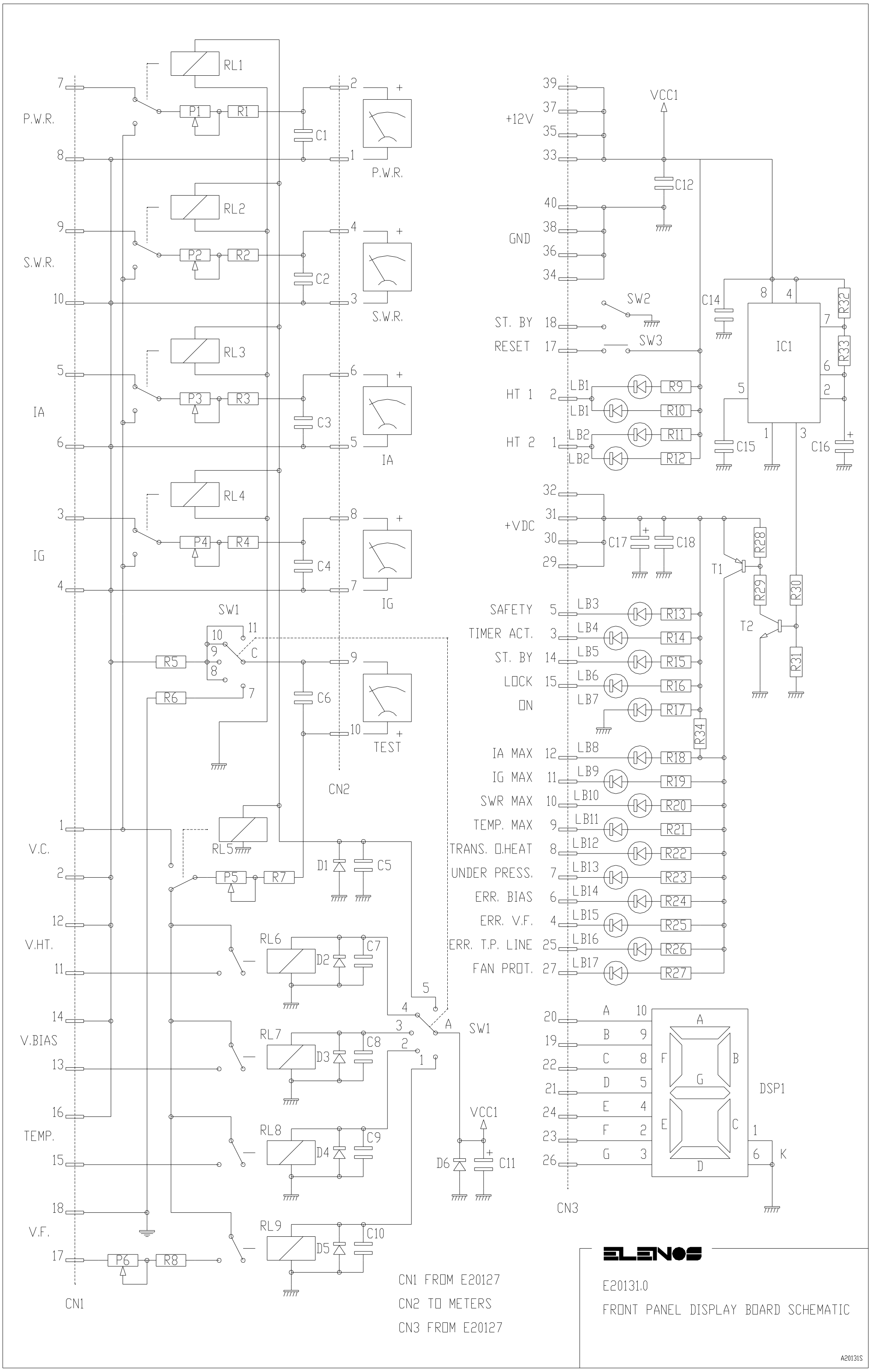
Part List of E20128.3 Board

Rif.	Description	Value	Remarks
PCB	Board code 2PCB0162		
R1	Resistor 10 x 64	50	5%
R2	Resistor	1 K	0.25 W 1%
R3	Resistor	49.9	0.25 W 1%
C1	Axial Electr. Capacitor	0.1 uF	1 KV 5%
MOV1 - MOV3	MOV type S20K-275		
D1 - D4	Diode type P600G		
SCR1	SCR type R16RIA120 + Heat-sink 7.7 C / W		
TR1	Transformer type TI 153		
F1	Fuse + fuse holder	10 A	250V
FL1	Arcotronics filter type FAH. AV.3100.ZF		
CN1	PHOENIX connector 7 pin		


MOV3
1
FROM LINE
110/240 VAC
2
F1
FL1
E.M.I. FILTER
MOV2
3
TO FILAMENT
TRANSFORMER
4
D1
D3
R1
SCR1
MOV1
C1
5
D2
D4
TR1
6
R3
FROM E20127
PULSE
DRIVER
R2
7
CN1
E20128.3
CHOCKING PHASE BOARD ELECTRICAL DIAGRAM

E20131 - Front Panel Display Board

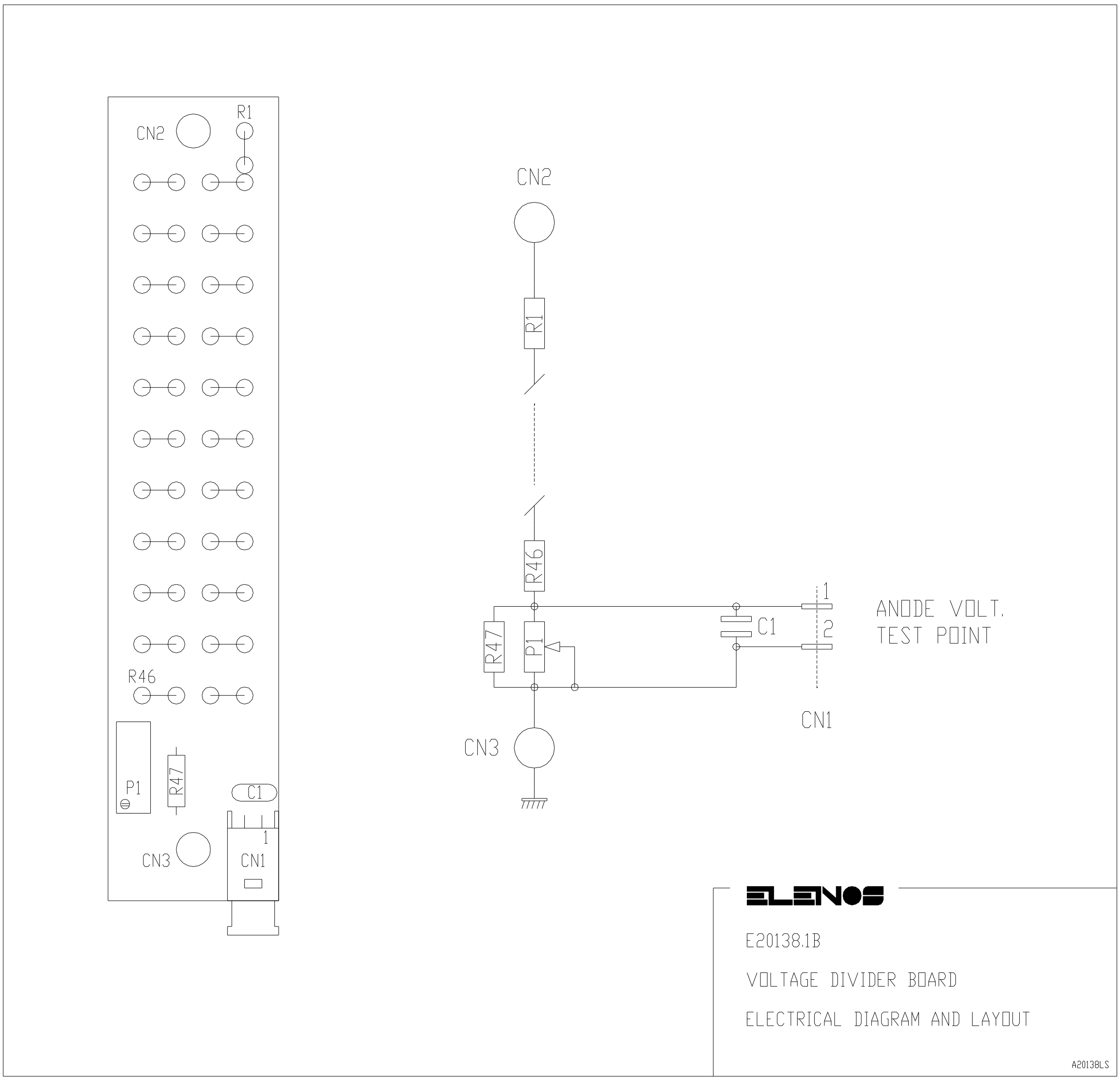



P.W.R.
S.W.R.
IA
IG
V.C.
V.HT.
V.BIAS
TEMP.
V.F.
CN1
CN2
CN3
TEST
+12V
GND
ST. BY
RESET
HT 1
HT 2
+VDC
SAFETY
TIMER ACT.
ST. BY
LOCK
ON
IA MAX
IG MAX
SWR MAX
TEMP. MAX
TRANS. O.HEAT
UNDER PRESS.
ERR. BIAS
ERR. V.F.
ERR. T.P. LINE
FAN PROT.
VCC1
DSP1
IC1
CN1 FROM E20127
CN2 TO METERS
CN3 FROM E20127
E20131.0
FRONT PANEL DISPLAY BOARD SCHEMATIC
A20131S

Part List of E20131 Board

Rif.	Description	Value	Remarks
PCB	Print Board code 2PCB0168		
R1 - R4	Resistor	15K	0.25W 1%
R5, R6	Resistor	10K	0.25W 1%
R7	Resistor	6,8K	0.25W 1%
R8	Resistor	10K	0.25W 1%
R9 -R12	Resistor	150	0.5W 5%
R13 - R27	Resistor	330	0.5W 5%
R28 - R31	Resistor	10K	0.25W 1%
R32	Resistor	2,2K	0.25W 5%
R33, R34	Resistor	47K	0.25W 5%
P1 - P6	Trimmer type 89P	10K	
C1 - C4	Ceramic Capacitor	4,7nF	63V
C5	Ceramic Capacitor	100nF	63V
C6	Ceramic Capacitor	4,7nF	63V
C7 - C10	Ceramic Capacitor	100nF	63V
C11	Vert. Electr. Capacitor	10uF	63V
C12	Ceramic Capacitor	4,7nF	63V
C14 - C15	Ceramic Capacitor	100nF	63V
C16	Vert. Electr. Capacitor	10uF	63V
C18	Ceramic Capacitor	4,7nF	63V
D1 -D6	Diode type 1N4007		
DSP1	Display type HDSP-7303		
LB1 - LB17	Led type HLMP-2685		
RL1 - RL9	Relay Siemens V23101-D0106-B201		
SW1	2-way 6-pos. rotate switch		
SW2	2-pos switch 25A-250 VAC		
SW3	Push-button		
T1	Transistor type BC327		
T2	Transistor type BC337		
IC1	I.C. type ST91D540		
CN1	ANSLEY connector 2x10 pin		
CN2	AMP connector MODU male 10 pin angled		
CN3	ANSLEY connector 2x20 pin		

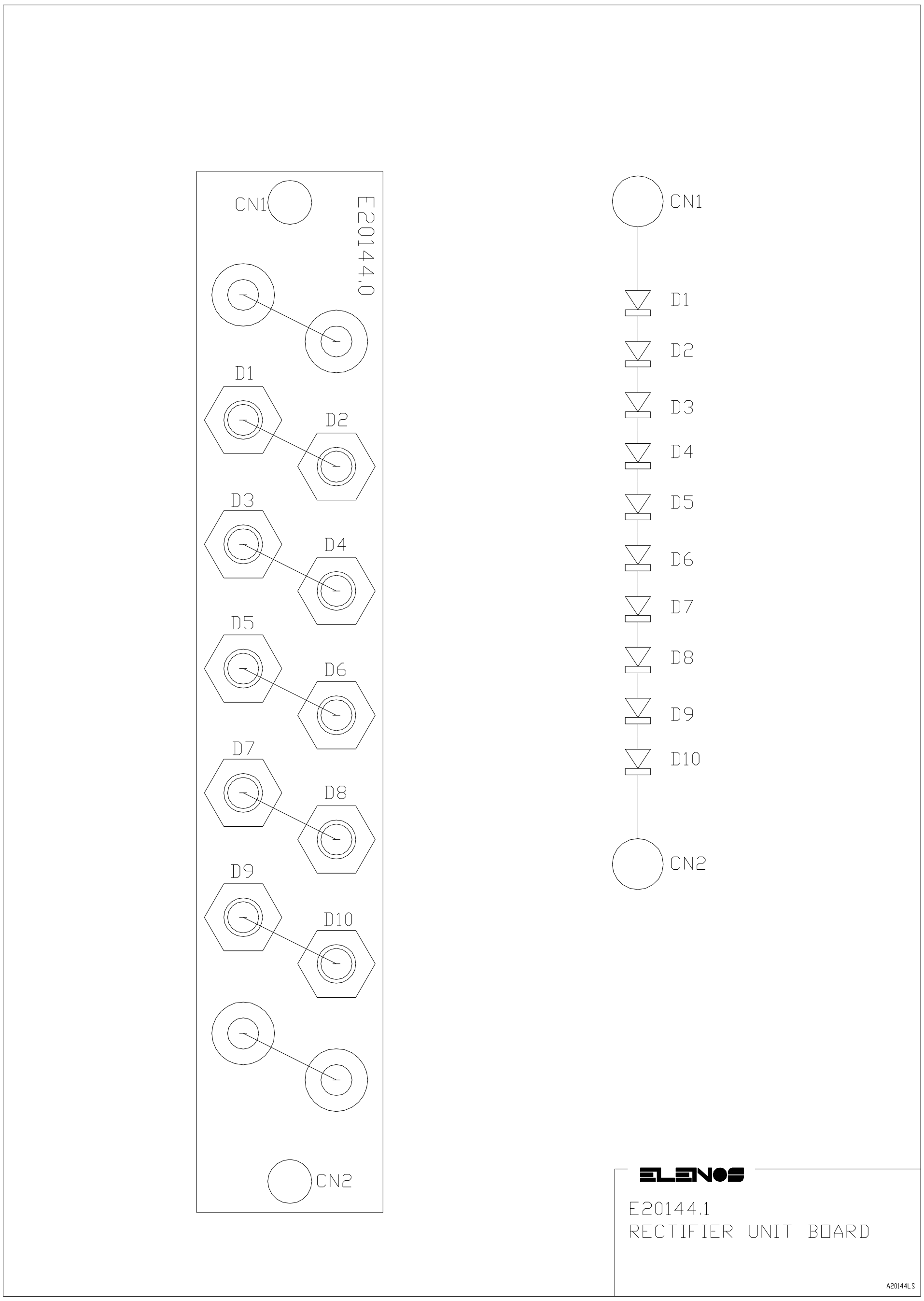
E20138 - Voltage Divider Board



Part List of E20138.1B Board

Rif.	Description	Value	Remarks
PCB	Board Code 2PCB0176		
R1 - R46	Resistor	1 M	0.25 W 5%
R47	Resistor	100 K	0.25 W 1%
P1	Trimmer type 67W	200K	
C1	Ceramic Capacitor	100 nF	63V
CN1	AMP connector 2 pin 90 deg.		
CN2, CN3	Fixing Stud		

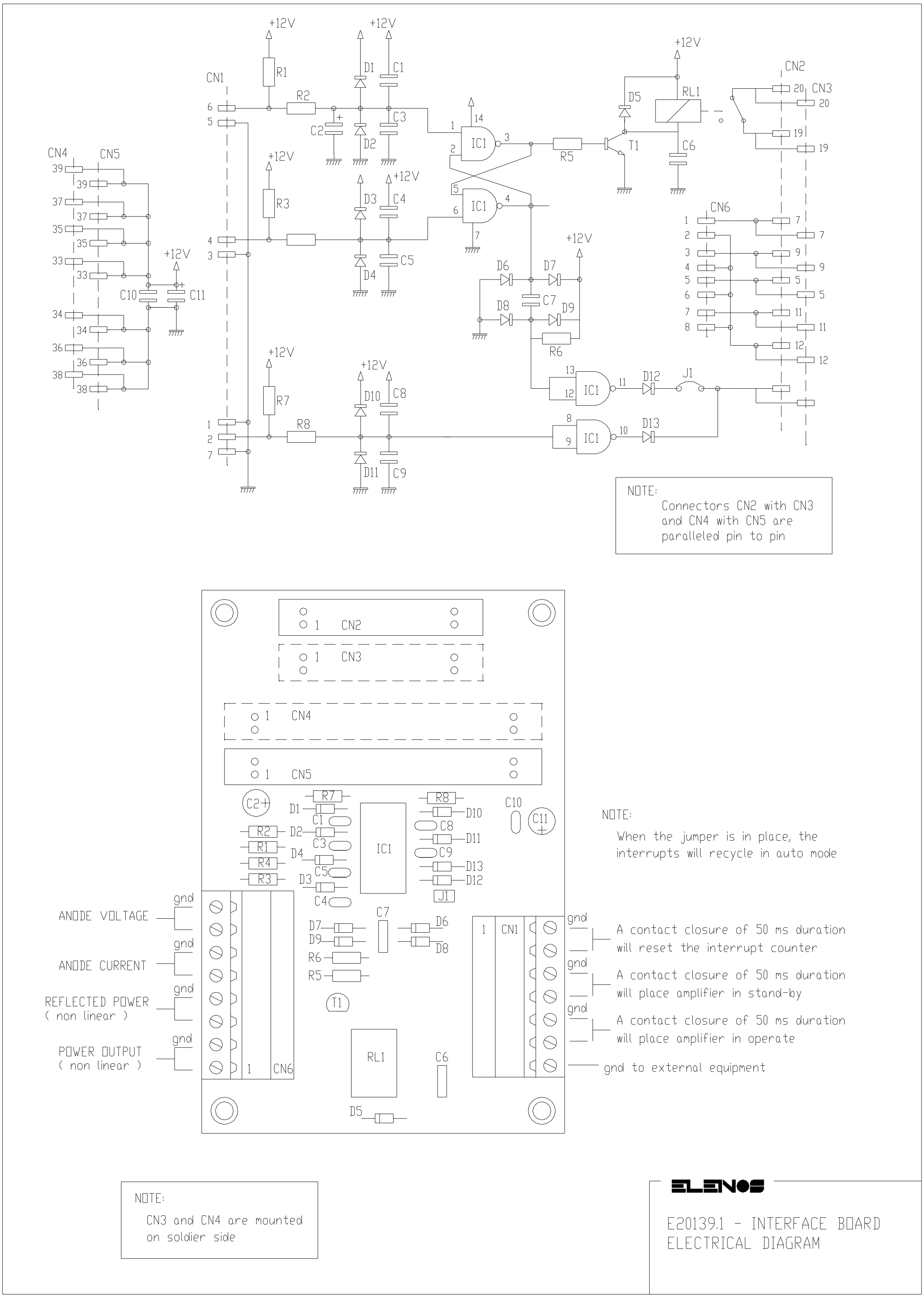
E20144 - Rectifier Unit Board



Part List of E20144 Board

Rif.	Description	Value	Remarks
PCB	Board code 2PCB0182		
D1, D3, D5, D7, D9	Diode Type A12F120		
D2, D4, D6, D8, D10	Diode Type A12FR120		

E20139 - Interface board (optional)



Part List of E20139.1 Board

Rif.	Description	Value	Remarks
PCB	Board Code 2PCB0177		
R1 - R8	Resistor	10K	0.25 W 1%
C1	Ceramic Capacitor 5mm	4.7 nF	50V
C2	Electrolytic vert. Capacitor	10 uF	35V
C3,C4,C5	Ceramic Capacitor 5mm	4.7 nF	50V
C6, C7	Mylar capacitor 5mm	100 nF	63V
C8,C9,C10	Ceramic Capacitor 5mm	4.7 nF	50V
C11	Electrolytic vert. capacitor	10 uF	35V
D1 - D4	Diode type 1N4148		
D5	Diode type 1N4007		
D6 - D13	Diode type 1N4148		
T1	Transistor type BC547		
IC1	IC type 4093 + socket 14 pin		
RL1	Relay SIEMENS V23101 D0106 B201		
J1	Jumper		
CN1	PHOENIX conn. 7 pin angled		
CN2, CN3	ANSLEY conn. 10+10 pin male with extractors		
CN4, CN5	ANSLEY conn. 20+20 pin male with extractors		
CN6	PHOENIX conn. 8 pin male with extractors		

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