

SM 1150

SM1150 D for line 3 x 208V

SM1150 T for line 3 x 400V

**SWITCHING POWER GENERATOR
WITH EMBEDDED MICROCONTROLLER
FOR 3 KW MAGNETRON**

TECHNICAL NOTE

(issue February 2007)



CE Declaration of Conformity *Dichiarazione di Conformità CE*

Manufacturer's Name: ALTER s.r.l
Nome del Costruttore:

Manufacturer's Address: Via Curie, 8 - 42100 Reggio Emilia - Italy
Indirizzo del Costruttore:

Declare that the microwave generator:
Dichiara che il Prodotto:

product name: SM1150 (power supply) and TM0 30 (microwave generator head)
nome del prodotto SM1150 (alimentatore elettrico) e TM030 (generatore a distanza)

model: SM1150D.xxx, SM1150T.xxx - SM1150D.xxxC, SM1150T.xxxC - TM030.xxx0,
modello TM030.xxx1

Complies with the following norms:
Soddisfa le seguenti norme:

EN 61010-1: 1994 + A2: 1996 (EN 61010: 1993 + A2: 1995)
EN55011: 1991

The "D" version complies also the following EMC (Electromagnetic Compatibility) norms:
IEC 61000-4-11 (voltage dips, short interruptions and voltage variations)*
IEC 61000-4-4 (burst); IEC 61000-4-5 (surge)

The products listed above comply with the requirements of the Low Voltage Directive 73/23/EEC.
I Prodotti sopraindicati sono conformi con la Direttiva di Bassa Tensione 73/23/EEC

Reggio Emilia, February 2007.

Marco Garuti



Presidente C.d.A.

* **Note:** the conformity to this norm makes it also compliant with the american SEMI F47-0200 (voltage sag) related to equipments for the semiconductor technology.

Rev.	Revision note	Date	File
0	First emission	September 2000	SM1150_r0
1	Upgraded Software ver. 2.02	June 2002	SM1150_r1
2	Upgraded Software from 2.02 ver. to 2.05 ver.	February 2005	SM1150_r2
3	No thermocouple input, sw ver. 2.06	April 2005	SM1150_r3
4	IEC 61000 conformity ver. "D" & RoHS conformity	June 2006	SM1150_r4
5	Upgraded fuses dimensions	February 2007	SM1150_r5

Alter' policy about Reduction on Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE)

Law Reference

- Directive 2002/96/EC of European Parliament (WEEE)
- Directive 2002/95/EC of European Parliament (RoHS)
- Decreto Legislativo D.L. n. 151 – 25/07/2005 (WEEE and RoHS)

Starting from September 2005 Alter has set the rule to accept only RoHS compliant components from its Suppliers. At the present date of 15 May 2006, 90% of components in our stock is RoHS compliant.

The components still not compliant were hold in stock and still used for two reasons:

- there is not the same or equivalent product RoHS compliant, or
- the product is a spare part for equipment produced and put on market before 1st July 2006.

Alter Risk Assessment on RoHS

Of the six substances forbidden from electronic equipment (Lead (Pb), Mercury (Hg), Cadmium (Cd), Hexavalent Chromium (Cr-VI), Polybrominated biphenyls (PBB), Polybrominated diphenyl ethers (PBDE)) only two are used in Alter's current manufacturing process, Pb and Cr-VI, of whose lead is the more important.

Mercury: not present, never used

Cadmium: was present as part of alloy on relay contact. We are using relay RoHS compliant now.
Never used as anti-corrosion coating on metal parts.

Pbb & Pbde: may be present in some cables and insulating material in the past.
We are using only RoHS compliant suppliers and products now.

Cr-VI: is used as anticorrosion layer on aluminium part. We are evaluating alternative coating. It is still present within the limit of 0,1% in weight as set by Directive.

Lead: it is largely used as an alloy for welding of electronic parts. We are already using alternative alloys lead-free, but as we still have components that cannot be soldered without lead, we have to use some lead-alloy for welding. At present there are still general concerns about reliability over the time of a soldered electronic joint done without traditional Sn/Pb alloy. We are putting any effort on reducing lead weight within 0,1% of products as set by Directive.

Important information to User about disposal, recycling, reuse of this electronic equipment at the end of its useful life (WEEE Directive).

According to Annex IA and IB of EC Directive 200/96/EC this equipment is not included on the list of categories/products covered by the Directive (as a matter of fact it does not perform a function alone, must be included into a larger process equipment and it's for stationary use).

Nevertheless we invite the User to respect the following Directive rules:

- this WEEE is not a municipal waste and should be collected separately according to rules of your country
- the symbol  means that this WEEE cannot be disposal in the same place and in the same way like municipal waste
- this WEEE may present risk for environment as well as for person in case of disposal in unauthorized place, due to content of hazardous substances
- for disposal of this WEEE in unauthorized area the User may be charged with a fine or prosecuted by law.

Contents

A	
Alarm codes table	27, 28
B	
Buttons meaning	10
C	
CE Declaration	1
Cleaning	7
Components List	19
Control menu configuration	12, 13
E	
Environmental conditions	6
Equipment installation	7
Equipment Ratings	5
F	
Fuses replacement	7
Fuses specifications	6
G	
General Description	4
General Information	3
H	
Handling instructions	7
Handling Warnings	4
How to order	29
I	
Internal Wiring Schematic	24, 25, 26
M	
Meaning of external command	9
Monitor signals	16
P	
Physical characteristics	6
Pin out of CONN. #1	20
Pin out of CONN. #2, 3, 4	21
Pin out of CONN. #5	22
Pin out of serial lines connectors	23
Power-up procedure	8
R	
RoHS conformity	2
S	
Software Specifications	11
Software upgrading	17
T	
Technical Assistance	29
U	
User Interface	10
W	
Warnings	3
Wiring instructions	7
Working modes	9

General Informations

This equipment satisfy the European Standard EN 61010-1 (=CEI 66-5) (=IEC 1010-1) approved by CENELEC on 9/3/1993.

With reference to EN 61010-1 standard, note:
this appliance must be installed and serviced only by qualified personnel.
The appliance must only be used by persons acquainted with the regulations covering the application.

Note about EMC regulation: the generic emission standard EN50081-2 (title: Electromagnetic compatibility - Generic emission standard - Part 2: Industrial environment) sets that "Where a relevant dedicated product or product-family EMC emission standard exists, it shall take precedence over all aspects of this generic standard".
The equipments described in this manual have been classified as industrial, scientific and medical (ISM) radio-frequency equipments and the related standard for the emission is the EN55011 (title: Limits and methods of measurement of radio disturbance characteristics of ISM equipment.)

With reference to EN55011 standard, this equipment is included into Group 2 (Microwave generators, Thyristor command equipment, Welding equipment, Induction heating equipment or machine, Microwave industrial oven, etc.), Class A (industrial environment): for this reason this equipment shall not be used in the residential, commercial and light-industrial environment.

The SM1150x and TM030, when properly installed, complies with the limits of radio disturbance characteristic of a Group2, Class A equipments as stated by EN55011.

Copy of the tests performed may be sent on request. Be aware those tests cannot be used as a conformity certificate of the user's final equipment.

WARNINGS

The SM1150D/T are powered by industrial main line and has high voltage output (close 5 kV): read carefully this manual before using. Be sure of correct connections and use.

Failure to comply with the instructions enclosed in this manual may involve considerable risks for the staff responsible for checking and using the equipment, as well as the risk of general malfunctions of the equipment itself.

Handling Warnings

The SM1150x has two handles on the front panel to help unpacking and handling operations: never use only the handles to lift the equipment but support the weight with an appropriate base on bottom!
The handles do not withstand the off-center weight of the equipment (17.3 kg=38 lbs).

General Description

The SM1150x is able to supply the power required by a magnetron type NL10230 or equivalent, with nominal power of approx. 3,000 W @ 2.45 GHz.

The power output can be adjusted continuously, from 10 up to 100%, using an external analog signal or by means of the panel controls.

The unit, in addition to power the magnetron, has several features and commands to control and power the magnetron's accessories.

The power supply is built in a self-ventilated 19" wide rack, 3 HE high, with a front panel comprising (see drw):

- a main switch [1];
- LED status lamps [2];
- a 4 digits display showing a working parameter, i.e. the output power, or the alarms codes, also performing the function of parameters viewing and setting, as well as status mode displaying [3];
- 3 push-buttons for parameters settings having the meaning of "scroll down", "escape", "enter" [4];
- a rotating knob to adjust the chosen value [5];
- pull off handles.

The power supply is designed to guarantee stable, correct and safe operation, and offers the following special features:

- a) it has a powerful CPU which controls the parameters and the working mode; the CPU has also 2 serial communication ports, one RS 232 to allow the upgrade of the software, the second for future implementation of a field-bus.
- b) it is equipped with a circuit capable of detecting the overvoltage on the magnetron ("moding", detecting operation at frequencies other than the normal operating frequency or damage or end of the magnetron life). The circuit also ensures that the power supply is switched off if the high voltage cable is disconnected, or if the heating filament fails.
- c) it has a circuit capable of detecting an earth current on the anode circuit, superimposing the normal current circulating in the magnetron (which returns to earth). This feature allows to cut out the output in less than 1 ms.

The **SM1150x** has been developed to power and monitor our removable microwave head type TM030.

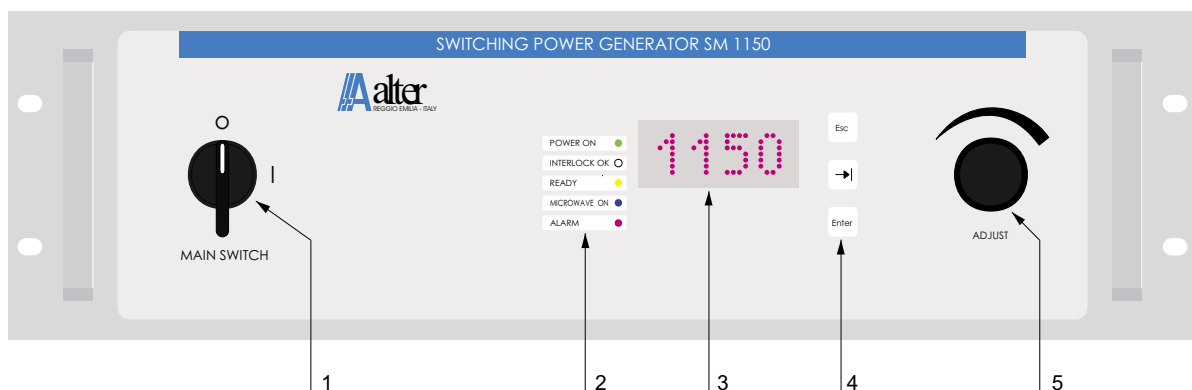
The **SM1150x** unit may be used also to power microwave generators (heads) developed by others manufacturers under condition that they are electrically compatible. See the electrical specifications of the unit on the next pages.

The SM1150D has been designed for US main line 3x208V, while the SM1150T is for European system 3x400V: both models accept wide line fluctuations.

The reduced height of the rack (only 3 HE, corresponding to 133 mm) allows to use small cabinet, even in big plant: i.e. in a standard cabinet with an height of 2 meters, arranged to receive 19" racks, up to 12 SM1150x units may be easily installed.

The user must provide a proper cooling flow: the cooling air enter into the unit from the right side, it passes through the internal circuits and components, then it goes out from the back. The intake air flow is approx. 120 mc/h.

FRONT PANEL



The rear panel comprises the following:

- a 7 pins socket for main supply (CONN. #1) [1]
- a 14 pins socket for the signals coming from the remote microwave head (CONN. #2) [2]
- a socket for the high voltage output (CONN. #3)[3]
- a 7 pins socket to power the remote microwave head (CONN. #4) [4]
- a 25 pins "D" type socket for the signals (CONN. #5) [5]
- a 9 pins "D" type socket for the RS 485/Field bus port (CONN. 6) [6]
- a 9 pins "D" type socket for the RS 232 port [7]
- the fuses holders (F1, F2) [8]
- the filter mesh of the inlet cooling air, having also the function of reducing EMI noise irradiation [9]
- the equipment label [10]

Equipment Ratings

SM1150D: Main supply (nominal) 3 x 208 V 50/60 Hz

Minimum main voltage: 3 x 190 V

Maximum main voltage: 3 x 240 V

SM1150T: Main supply (nominal) 3 x 400 V 50/60 Hz

Minimum main voltage: 3 x 360 V

Maximum main voltage: 3 x 450 V

Transient overvoltage: overvoltage cat. II
according IEC 664

Intake current @ 208 V: 3 x 17 Arms

Intake current @ 400 V: 3 x 10 Arms

Form factor: 1.33

Efficiency: 95%

Max Output power: 4,800 W

Max anodic mean current (CW): 1000 mA
(at the max ambient
temperature of 35°C)

Output ripple: +/- 4,5% @ 300 Hz (current)

+/- 3% @ 40 KHz (current)

Suitable magnetrons: NL10230/2M252/2M265

Filament trafo type: FIL100F

Filament control: with presetted hardware curve

Filament preheating: automatic at power-on
or by 24Vdc command

Enabling microwave command: 24 Vdc (range 8÷30Vdc)
optoinsulated

Monitor output signal*: 0÷10 V @ 50 mA max,
where:

1V= 200 mA for anode
current

1V= 500 W for electrical
output power

1V= 1.000V for anode
voltage

* **Note:** monitor output signals must be filtered as close as
possible to the sampling point.

Load of the status contacts: max 130V-0,5 A

Working mode of Alarm contact:

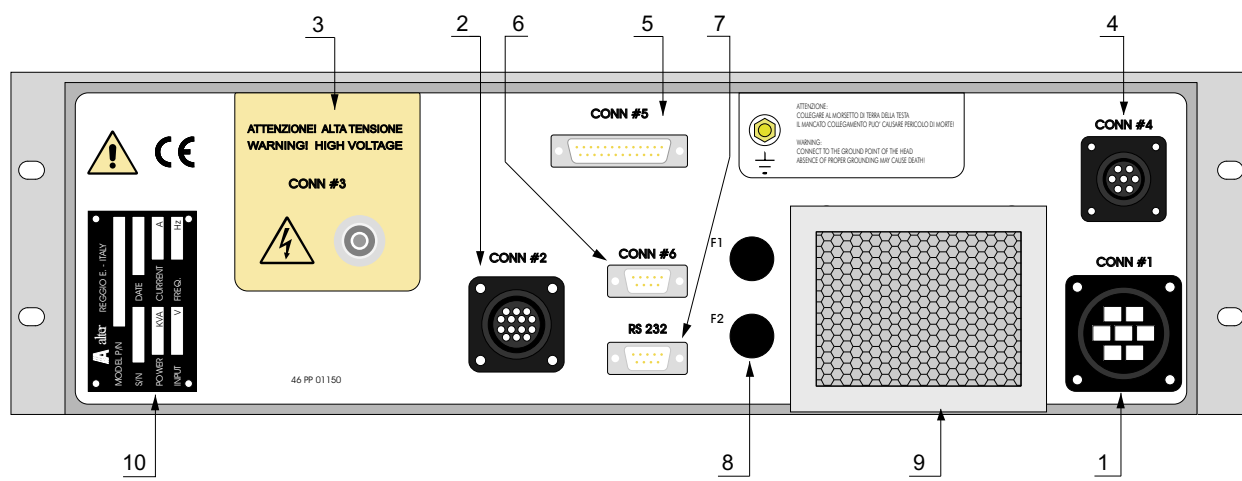
- a) unit in power OFF: contact open
- b) unit in power ON, no alarms: contact closed
- c) unit in power ON, alarm status: contact open

Working mode of Ready contact:

- a) unit in power OFF: contact open
- b) unit in power-ON, no alarms,
filament ready (preheating completed): contact closed
- c) unit in power ON, alarm status
or filament preheating not completed : contact open

Output stability: within 1% with input
fluctuations within +/-10%

REAR PANEL



Reference signal to adjust power: a) 0-10 Vdc
(Z=10 Kohm)
(standard)
b) 0-5 Vdc (Z=20 Kohm)
c) 0-20 mA(Z=250 ohm)

Management of alarm situations: a) by internal
alarm relay, contact
load: max 130 V 0.5A.
b) by showing of
the alarm on display
(see the alarm table on
next pages).
c) emission of the 4-bits
code on the signals con-
nector)

Fuses specifications

The SM1150x has 2 fuses installed on the rear panel (look at the drawing on page 4, position 8): both fuses, labelled F1 and F2, protect the output line powering the remote head.

Fuse F1 and F2 specs:

- Size, type: 10x38 mm, ceramic cartridge
- Speed action: quick (F)
- Rated current: 6 A
- Rated voltage: 500 V

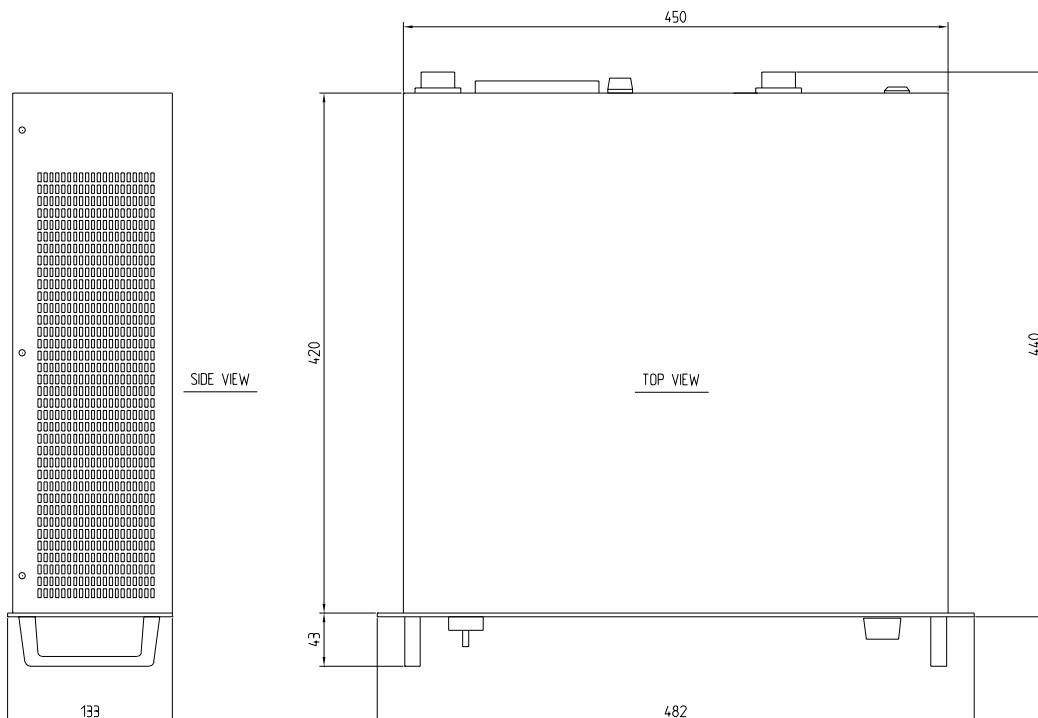
For instructions about fuse replacement pls refer to related paragraph at next page.

Environmental conditions

Use: Indoor use only
Altitude: tested up to 2,000 m
Temperature: 5°C to 40°C
(41°F÷104°F)
Relative Humidity: 80% RH up to 31°C
(88°F), decreasing
linearly to 50% RH at
40°C (104°F)
Pollution degree: 2, complies with the
norm IEC664

Physical characteristics

Front panel dimensions: 19" x 3HE (482 x 133 mm)
Rack total width: 450 mm
Rack total height: 130 mm
Rack depth (without handles): 420 mm
Housing board depth (minimum): 600 mm
Total weight: 17.3 kg (38 lbs)
Intake air flow: approx 120 m³/h



Equipment maintenance

Cleaning

Cleaning of air filter: verify once a month. In case you need to remove dust then proceed as follow:

- remove main line from the unit
- remove the cover
- use pressurized air from inside to outside for short time: do not exceed or you may damage the fan
- install the cover and then power-on again.

Fuses replacement

To replace the fuses on rear panel proceed as follow:

- switch-off the main breaker on front panel or whatever device is provided to remove main line from the equipment;
- unscrew fuseholder cap;
- replace the fuse with a new one with the same electrical characteristics;
- inspect also the fuseholder: if it's oxidated or it has burned point then replace it;
- install the fuseholder cap and screw tight.

For the fuse value look at chapter "Fuses spec", pg 5.

Equipment installation

The SM1150x cannot operate on a bench: it must be installed into a proper cabinet like a commercial 19" standard enclosure.

The equipment is intended for industrial use only, not for laboratory use, and user must respect the wiring norms and prescriptions as described into next paragraph ("Wiring instruction").

The equipment cannot operate cantilevered, it must be safely fixed inside a cabinet by means of screws on the front panel (which is provided with 4 holes) and supported by means of a proper frame on the bottom for, at least, 3/4 of the total depth. Usually two "L" shaped supports on each side of the equipment, having a dimension of mm 10(h) x 30(l) x 2 (thick) are suitable for that purpose.

The rear side of the equipment must be protected by a fixed panel which can be removed only by means of tools or by a door with security micro-switch: when the door is opened the micro-switch must shut-off the main line. This safety precautions must be taken to avoid operations on rear fuses or on connectors while the unit is still powered.

Special attention must be taken on designing the cooling air flow in case of stacking several units into the same cabinet. Note that each equipment has its own fan which intake approx 120 m³/h: the outlet of the exhaust air is on rear panel, the inlets on the right side (looking at front).

When designing a board to house several units we recommend to adopt the following design criteria:

1. use a standard 19" wide enclosure with a depth of 800 mm (32");
2. allow free intake of the cooling air from the side of the cabinet and exhaust air from back panel throu the top of the cabinet or the back side;
3. in case of ambient air with high degree of dust and moisture, install a proper air conditioner; if you cannot do this, then you have to use suitable air filters and instruct the user about their cleaning;
4. provide a separation between the air intake duct and the air outlets, in order to avoid air-recirculating;

Handling instructions

The equipment weight is 17.3 kg (38 lbs). Always lift from the bottom and use an adequate rugged support to avoid personal injury and damage to equipment itself.

In case of shipping, package with the original package or use a wooden case and a proper filler: movement of the equipment inside the package must be avoided.

Warning for handling: use handles only for help during installation. **Never use handles to lift the rack: the handles don't withstand the off-center weight of the rack!**
To lift always lean the rack over a proper supporting base.

Wiring instructions

The SM1150 must be installed and serviced only by qualified personnel acquainted with the regulations covering the application. For safety operations the following rules must be adopted:

- I) The equipment must be grounded through the connector #1 using pin 4 (see the wiring diagram at page 20).
- II) Connect the ground screw on panel rear (indicated by "ground" symbol) directly to the remote microwave generator head by a separate yellow/green wire gauge 2.5 mm².

III) The main supply, 3 x 208V or 3 x 400V must be provided through connector #1: connect phases according to schematic at page 20, the connector's pins can house wires with gauge up to 4 mm².

IV) The connector #2, with 14 pins, brings the head's signals to the equipment. Use wires with max gauge of 1.5 mm², refer to wiring diagram at page 21.

V) The connector #3 is the **high voltage output** and must be connected to magnetron's cathode, usually marked with the symbol "FA" on the magnetron's terminal. The voltage value is near 5 kV. Use a proper insulated cable with working voltage >8 kVdc and minimum gauge of 0.25 mm²; protect the wire with sheathing (armoured if appropriate).

Assemble the wire into plug according to professional rules. The reliability of the equipment starts from the h.v. connections.

ALTER may supply the HV cable with length on request.

VI) The connector #4 provides the power supply for the filament transformer (usually located near the magnetron), the magnetron fan and a warning lamp. Use wires with max gauge 1.5 mm². Refer to wiring diagram at page 21;

VII) The "D" type female connector #5 has 25 pins and brings the I/O signals to the equipment. We suggest to use a shielded ribbon cable. Refer to wiring diagram at page 22.

VIII) The "D" type male connector # 6 has 9 pins and is the RS485 serial port on the standard version of the equipment. It will be used for future implementation of a field-bus (like the CANbus).

IX) The "D" type female connector RS232 has 9 pins and it's a standard serial port, useful to allow upgrade of the software from a PC. Look the pin-out at pg 23.

X) The user must provide external cut-off device, to protect the SM1150 from short-circuit and thermal runaway; this external protection device must allow to switch-off the main line for maintenance operations.

XI) The external circuit breaker must be a 3-poles breaker and must comply the norm EN61010-1.

XII) The external circuit breaker must be in close proximity of the equipment and within easy reach of the operator.

XIII) The external circuit breaker must be marked as the disconnecting device for the SM1150.

XIV) The connector #1 must never be used as a switch-off device.

Failure to comply with these instructions may involve considerable risks for the staff responsible for checking and using the equipment, as well as the risk of general malfunctions of the equipment itself.

Equipment operation

Power-up procedure

Before power-up the equipment you must be sure to have properly connected (look at the chapter "Wiring Instruction" for any doubt), then set the front panel breaker in "ON" position, marked with "I"; to switch-OFF set it to "0".

Once set to OFF (position "zero") wait at least five seconds before setting it ON again.

This rule must be valid even in case the power is given by an external contactor (and the panel breaker has always left in ON state): the OFF state, between two consecutive ON state, must last five seconds minimum.

At power on the unit enters into "POWER-ON" state for few seconds to perform some controls, then goes immediately into "STAND-BY" and here stays until the "filament heating" command is switched ON.

It's also possible to enable permanently the "filament heating" command: in this case the SM1150 performs the filament heating immediately after the "POWER-ON" state, but only in absence of alarms.

At the end of the heating cycle the unit enters in "READY" mode: the power supply may power the magnetron, which generates microwave, only when it will receive the enabling command.

Any types of alarms force the unit to exit from "READY" state and enters in "ALARM" state.

In absence of alarms the power supply may be left in "Ready" continuously: when it receives the enabling command (ON) it enters into "RF-ON" state and generates output power, when the enabling command is removed (OFF) the unit comes back to "READY" state.

Working Modes

The working capability of the SM1150x depends from its "working status": it has several statuses with different meaning and functionality. The logic flow of these statuses is showed on the bottom drawing.

These statuses (or modes) are:

POWER-ON: it goes in this mode at power-on, when the main breaker is set to 1: the CPU performs some controls, displays the name of the unit ("1150") then the software version (i.e. "V2.01"), and after few seconds, the unit enters in Stand-By mode.

STAND-BY it's a waiting state, the unit is powered but not ready as the magnetron filament is not powered; the display shows "STBY", all the working parameters can be setted from Operator Panel; the unit enters in Stand-By from the previous Power-On state or from a Reset state.

The unit exits from Stand-by and goes to Preheating only if there aren't alarms, the Interlock chain is closed and the HIBERNATE command is OFF.

PREHEATING it's a temporary state, driven by a timer, to allow the filament to be heated. The display shows "PREH". Entrance in this mode is done by an external command or self-starting after the end of Power-On state. When the timer is elapsed the unit goes in Ready mode.

READY it's a waiting state, the display shows "RDY". The unit waits the enabling command to generate power to the magne-

tron. The magnetron filament has been heated.

The unit may last in this state as long as needed: it exits automatically in case of alarms or when the "filament heating" command is removed. It goes to next "MW-ON" when the enabling command is set ON.

MW-ON starts microwave emission at the presetted power level. The display shows alternatively the name of the choosen unit ("CURRENT" or "%POWER" or "POWER" or..) and its value, while the led "MW ON" is lighted up.

The unit exits from this mode in case of:

- * the enabling command is set OFF: enters into Ready state, or
- * ALARM presence: the unit goes to Stand-by, or
- * the INTERLOCK chain is open: it goes to Stand-by again.

ALARM in this mode the output power is immediately shut-off as well as the filament.

The alarm type is showed on the display, alternatively with the word "ALAR".

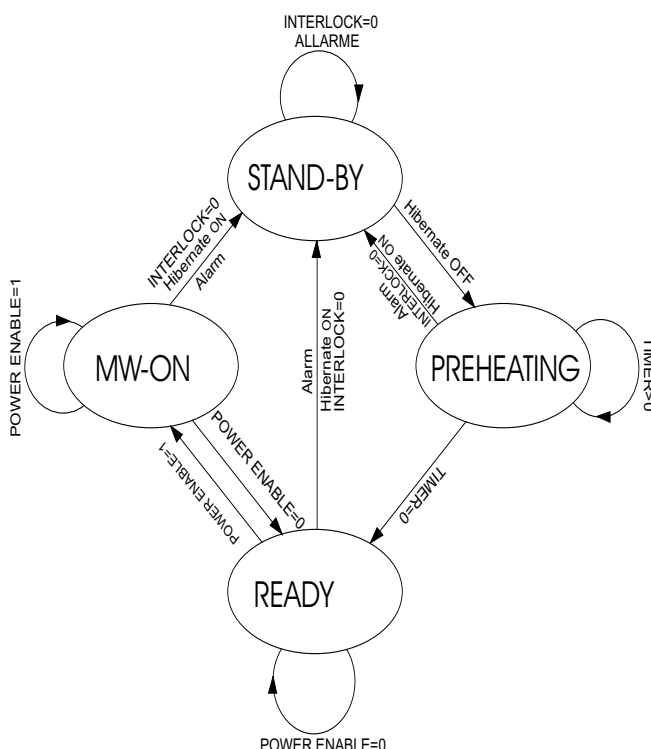
The unit may exits from the Alarm mode, to enter into the Reset Waiting mode, only when the alarm cause is removed.

RESET WAITING: the unit enters in this mode when the alarm cause is cancelled and the enabling command is still present (ON).

The unit exits from this condition, and enter in Reset mode, only when the enabling command is switched OFF.

RESET: It's a temporary state, driven by a two seconds timer. When the timer is elapsed the Reset state end, and the SM1150 enters automatically in Stand-By mode.

The working condition is indicated on the display. Look at the diagram for the working mode logic.



Meaning of external command.

HIBERNATE: has value ON/OFF. If ON the magnetron's filament is not powered and the SM1150 goes into Stand-by mode.

In OFF the unit makes filament heating and, when the related timer is elapsed, enters in Ready mode.

If a user don't like to use the Hibernate function, he may not connect it: the system then detect it as in OFF condition.

POWER ENABLE: has value ON/OFF, but its effect is related also with the Hibernate command as follow:

- a) in OFF state -and HIBERNATE is OFF- the unit performs filament preheating and goes in Ready mode but does not generate output power, even if the reference signal is >0;

- b) in OFF state -and HIBERNATE is ON- the unit is in Stand-by mode but does not generate output power, even if the reference signal is >0;
- c) in ON state -and HIBERNATE is OFF- the unit waits the end of preheating timer, if not yet elapsed, then starts to generate output power;
- d) in ON state -and HIBERNATE is ON- the unit is in Stand-by mode but does not generate output power, even if the reference signal is >0.

POWER SET: it's an analog input value and has the meaning of "percent" of the output power.

When this value is lower than 9% of full value the unit does not generate any output power, when >9% the unit generate power proportional to signal value.

The signal can be 0-10V, 0-5V, 0-20mA depending on hardware setting of internal jumpers located on the CPU board (look at the related drawing to find them).

The output power can also be considered:

- a) linear to the anodic current generated, or
- b) linear to electrical output power ($V * I$), or
- c) linear to forward r.f. power when the related feedback signal is available from the process cavity.

INTERLOCK: has value ON/OFF. When in ON state the serie of the hardware safety contacts is closed and the CPU light-up the related Interlock OK led; in OFF state the led is Off and the unit goes in Stand-by.

User Interface

At power on the 4 characters display shows the name of the unit ("1150") then the software version (i.e. "V100"), and after few seconds, the unit may enter in the working mode the unit had at Power-Off only if the related parameter is set in this way, otherwise the unit enters in Stand-By mode.

The unit, throu the display, informs the user of its working mode displaying the abbreviations SBY or RDY or PREH. At the end of the temporary filament preheating cycle (PREH), the unit enters into the mode set by user and gives the following informations:

Control Mode: the parameter to be displayed (Power or Current or Voltage or...) and the parameter's name.

The parameter can be set throu the parameters table, position zero.

Alarm Mode: type of alarm, alternating its name (look at the alarms list) and the word "ALAR".

Programming Mode: depending on the selected level (look at the next par.) may be displayed the Parameters Name or the

Parameter: in the latter case it may be possible to modify the value using the digital potentiometer.

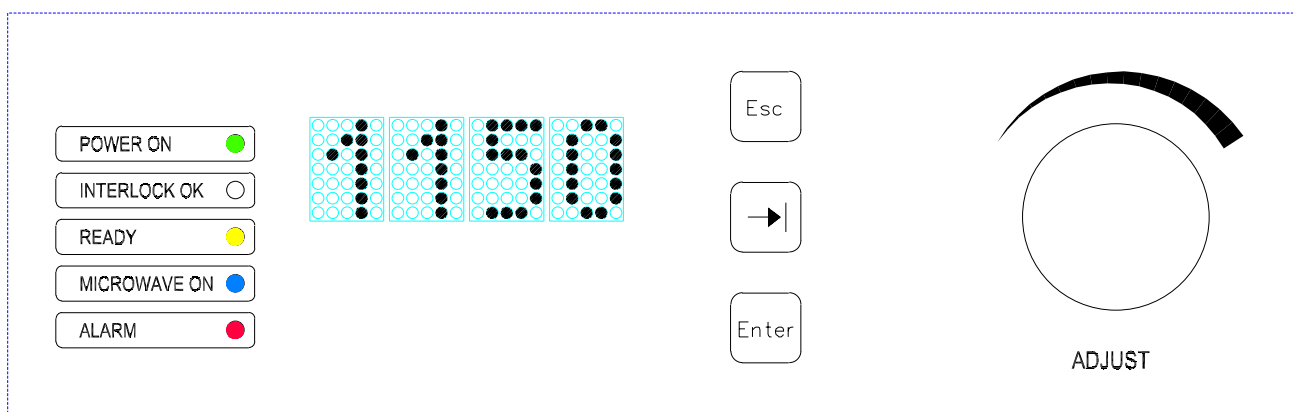
Buttons meaning

To enter on Programming mode press **ESC** button, then with **TAB** button (the button with the **arrow**) it is possible to run over all the parameters and with the ESC button, or after a period of 10 seconds idle, you may exit from Programming. When you are set on a Parameter with the **ENTER** button you go to second level and view its value (numeric or alfanumeric).

This value can be modified by the **potentiometer** (which is a digital encoder), but the new value is stored only pressing the ENTER button once again.

When positioned at second level, pressing the ESC button will bring you to upper level without saving any variation.

Look at the next drawing about the "Control menu configuration".



Software specifications

At present the following versions of software have been distributed:

- **ver. 1.04** (V104) see the menu config. at page 12
- **ver 2.01** (V201) to **ver 2.05** (V205) see the menu config. at page 11.

Main Characteristics of ver. 1.04:

The version 1.04 has a complex menu organization, with all the functions than can be reached and selected by means of the front panel commands only. In addition the Ver. 1.xx allows to choose between 5 different control modes of the output:

1- Open Loop control: the reference signal sets the anodic current and the control loop is performed only by hardware, the CPU does not execute any control. *I.e.: $1V = 90\text{ mA}$, $5V = 450\text{ mA}$, $10V = 900\text{ mA}$. This mode is equal to the control mode of any unit without CPU (like the SMx45, SM1050, SM1180): if the anode voltage does not vary then the power is constant. The precision of the control is driven only by precision/tolerance of the hardware.*

2- Current Loop control: the reference signal sets the anodic current and the control loop is performed also by the CPU. *I.e.: $1V = 90\text{ mA}$, $5V = 450\text{ mA}$, $10V = 900\text{ mA}$. If the anode voltage does not vary then the power is constant. The precision of the control is improved by the CPU which reduces hardware drift for temperature modification.*

3- Forward Power control: the reference signal sets the r.f. forward power and the feedback signal should come from a power sensor installed on the load cavity or waveguide. *I.e.: $1V = 300\text{ Wrf}$, $5V = 1500\text{ Wrf}$, $10V = 3000\text{ Wrf}$. It is useful only if the feedback signal from the power sensor is true and quite stable.*

4- Power control: the reference signal sets the electrical output of the power supply unit: the CPU reads continuously the anodic voltage and adjusts the anodic current to keep the output power constant. *I.e.: $1V = 500\text{ Wdc}$, $5V = 2500\text{ Wdc}$, $10V = 5000\text{ Wdc}$. The precision and repeatability of the output is within 1% of full scale.*

5- Table control: the reference signal sets the electrical power needed by the magnetron to get a presetted r.f. power. It is useful to linearize the r.f. power with reference to the signal. The “Table” is a set of 20 values of electrical output power that has the effect to produce the 20 corresponding r.f. power by the magnetron: intermediate values are calculated by the CPU with linear interpolation. The 20 r.f. values start from 300 (Wrf) up to 3000 W, with steps of 150 W (300, 450, 600, 750....): at each of these steps corresponds a DC power that the unit has to produce.

The SM1150 has a “default” Table (20 prestored values) that can be used at any time and is not erasable by the user: in addition the software allows to load customized values that may be used instead of those of the default Table.

To customize the Table it’s required to have a power meter connected to the microwave cavity and then to select a table step, adjust the power with the panel knob till the power meter’s reading is the same. See more details on the Menu Descriptions.

Main Characteristics of ver. 2.01:

The version 2.01 has a simplified menu organization and the default control mode is the Table mode. The other two control modes available, Open Loop and Forward Power, can be selected only by means of the remote control with a PC, connected thru the serial port RS232, and the specific program “FrontPanel” distributed together with the unit. See the relevant paragraph “The FrontPanel program”.

For the basic explanation of the control modes see the previous paragraph about characteristics of the ver 1.xx

With reference to the “Control Menu Configuration” at page 11 there are the further explanations of the symbols and names; the numbers enclosed in bracket [] into description refer to the small numbers associated to names or functions on the drawing. The description apply to drawing of the version 1.04 too.

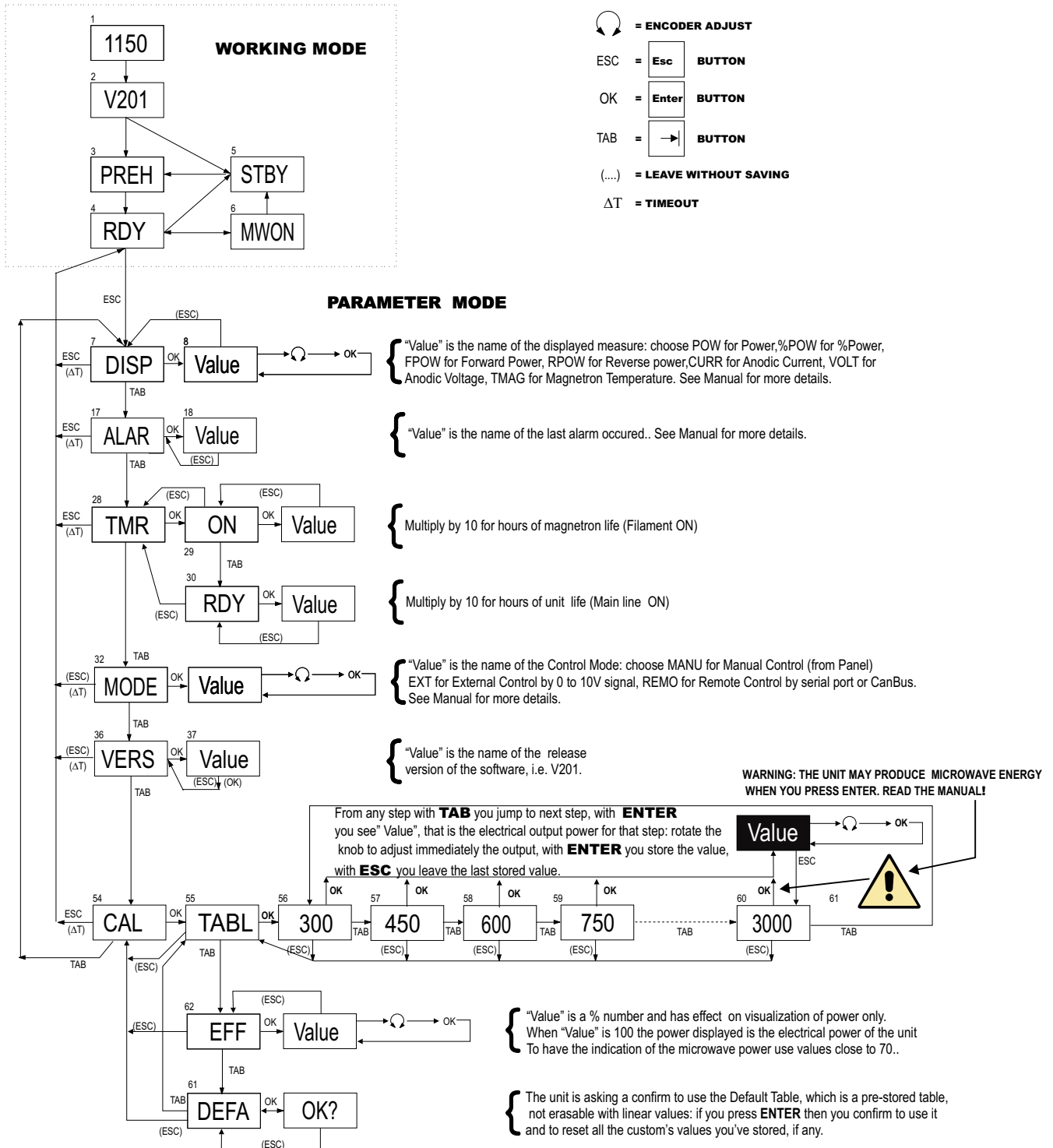
[1, 2, 3, 4, 5, 6] WORKING MODE: see “Working Mode” paragraph at page 8.

[7] DISP: entering this menu you select what value the unit DISPLAYS between the following **[8]:**

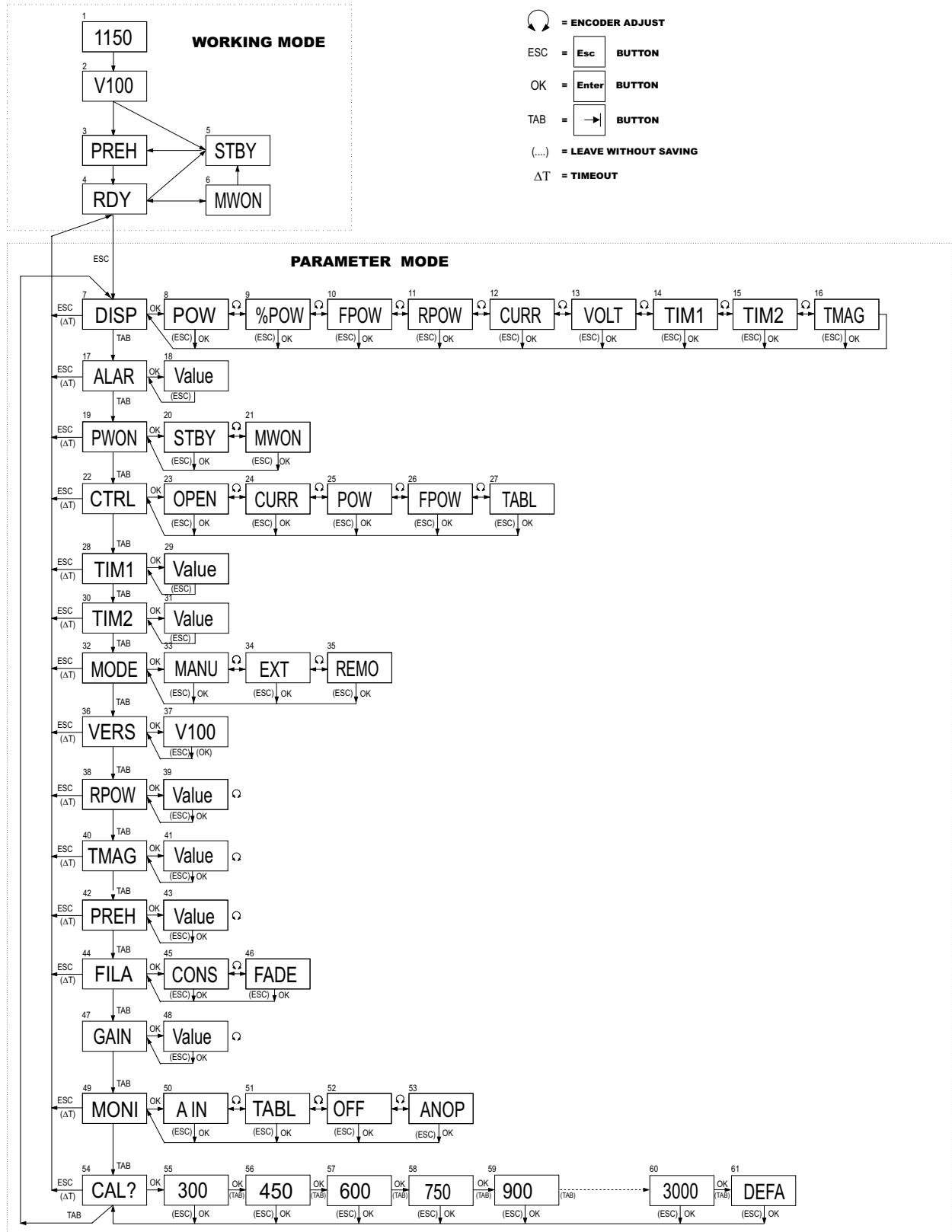
POW	DC power (Watt)
%POW	Percent of output power
FPOW	Forward Power (Watt)
RPOW	Reverse Power (Watt)
CURR	Anodic Current (mA)
VOLT	Anodic Voltage (Volt)

Once selected the measured value is displayed only when the unit is in MW-ON state.

SM1150: CONTROL MENU CONFIGURATION from version 2.01 (V201)



SM1150: CONTROL MENU CONFIGURATION for release up to version 1.04 (V104)



[17] **ALARM**: entering this menu you get the name of the last alarm occurred [18]:

MAGN	Magnetron Overtemp. <i>Code 01</i>
TEMP	Rack Overtemperature <i>Code 02</i>
ARC	Arc Detector <i>Code 03</i>
CURR	Overcurrent <i>Code 04</i>
VOLT	Overvoltage <i>Code 05</i>
AIR	Air Pressure Low <i>Code 06</i>
H2O	Water Flow <i>Code 07</i>

LOCK	Open Interlock <i>Code 08</i>
LEAK	Current Leakage <i>Code 09</i>
RACK	Rack Error <i>Code 10</i>
MREV	Max Reverse Power <i>Code 11</i>
POWD	Power Down <i>Code 12</i>

The *Code number* is the number present on the 4 bits alarm contacts (binary form).

BIT ALARM TABLE

Allarme	Codice	Descrizione	BIT 3	BIT 2	BIT 1	BIT 0
-----	0	No alarm	0	0	0	0
MAGN	01	Magnetron Overtemperature	0	0	0	1
TEMP	02	Rack Overtemperature	0	0	1	0
ARC	03	Arc Detection (on head)	0	0	1	1
CURR	04	Overcurrent	0	1	0	0
VOLT	05	Overvoltage	0	1	0	1
AIR	06	Air Pressure Low (on head)	0	1	1	0
H2O	07	Water Flow Low (on head)	0	1	1	1
LOCK	08	Interlock	1	0	0	0
LEAK	09	Current Leakage on Ground	1	0	0	1
RACK	10	Rack Alarm	1	0	1	0
MREV	11	Max Reverse Power	1	0	1	1
POWD	12	Main Line Drop	1	1	0	0
RAM	13	RAM Memory Error	1	1	0	1
COM	14	Communication Interrupted	1	1	1	0

[28] TMR: entering this menu you access to internal timers
 [29]: ON timer: it's enabled only when the filament is hot (Ready mode): the value can be resetted by user but the system holds information of the reset.
 The CPU makes a round value to tens of hours, but the time count has the accuracy of the minute. Max value displayed is 99.99 (=99,990 hours)

[30]: RDY timer: it's enabled by presence of main line and cannot be resetted by user.
 The CPU makes a round value to tens of hours, but the time count has the accuracy of the minute. Max value displayed is 99.99 (=99,990 hours).

[32] MODE: entering this menu you access the Control Mode, enabling the type of control
 MANU (Manual): the unit is controlled by the panel commands, i.e. if you want to adjust the power by panel knob
 EXT (External) the unit is controlled by external command, i.e. if you are supplying commands from a PLC
 REMO (Remote) the unit is driven by serial port or CanBus

[36] VERS: entering this menu you get the release number [37], i.e. V201 (for version 2.01)

[54] CAL: entering the Calibration menu you access to customize /verify the Table [55] or modify the Efficiency value [62] or select the Default Table [61]

[55] TABL: entering this menu you may modify the Table. The Table consists of 20 values of linearized output power the unit will reach to match the reference signal.

The unit has a default Table that is stored during final tests at Alter: from vers. 2.01 the unit uses, as standard at Power-ON, this default Table.

Customizing of the Table: you need a power meter measuring the forward r.f. power on your system.

The measure is needed to linearize the whole system as, in principle, twice the dc power supplied to magnetron does not mean twice the microwave power delivered to the load.

Once entered into TABL menu, the software shows you fixed numbers, starting from 300 - with increment of 150 - up to 3000: these are the 20 steps you may customize. These numbers represent the desired microwave power (i.e. 300 = 300 Wrf).

At every step is associated and memorized a corresponding d.c. power that the SM1150 will ignite to the magnetron to produce the desired microwave energy.

You may skip forward and backward, leaving them as they are or modifying all or just few.

To modify confirm with ENTER button but be careful: this procedure requires the SM1150 to produce power and the microwave generator will produce, consequently, microwave energy.

Warning: if the power supply is in MW - ON state but does not produce microwave energy because the reference signal is zero, once you push the ENTER button, from TABL menu, then the SM1150 will produce output power and you may adjust at any level of power, once you are entered into a step, simply rotating the encoder knob on the panel

I.e.: suppose the first step 300, which is 1/10 of the full range and also corresponding to 1V of reference signal, has stored a default value of 500 Wdc, and the third step 600, corresponding to 2 V of signal, has stored a default value of 1000 Wdc: if you'd like to verify and, in case, to modify them, you have:

- a) to enter into TABL menu (press ENTER from CAL menu)
- b) to enter into the 300 step (press ENTER again)
- c) to see the stored dc power value press ENTER and the unit will produce energy: the display shows you 500 (Wdc, the stored value)
- d) read from your power meter the microwave energy: suppose it's close 300 W, then you decide to leave the step as it is: press ESC
- e) you are back, the display shows you the number 300 (point b)
- f) reach the third step (600) with the TAB and then press ENTER
- g) repeat point c): the display shows you 1000
- h) read the power meter: it shows close to 550 Wrf and then you decide to correct it

- i) rotate the encoder knob on panel till the power meter shows you the value of 600 Wrf and confirm with ENTER. The display will show you the new dc power needed to obtain that rf value: suppose 1100.
- l) use ESC to leave the procedure.

You have customized the Table: when you'll apply a reference signal of

- 1 V you'll get a microwave power of 300 W: the SM1150 ignite 500 Wdc into the magnetron,
- 2 V you'll get a microwave power of 600 W: the SM1150 ignite 1100 Wdc into the magnetron.
- 1.5 V = 450 Wrf = 800 Wdc.

[62] EFF: entering the Efficiency menu you may modify the visualization of the power: it represents the percentage factor to display the power. It has effect on visualization only. If you set 100 the power displayed is the electrical power of the unit; if you select a value close to 70 it gives you the indication of the microwave power produced by the whole system.

[61] DEFA: entering the Default Table menu, if you confirm the OK? question pressing ENTER you reset the Customized Table, if any, and load the Default Table.

Main Characteristics of ver. 2.02:

- a) Improved display data visualization
- b) Added RAM alarm and Com time-out alarm
- c) Modified user interface

Main Characteristics of ver. 2.03:

- a) Modified scale of reverse power signal (10 V = 1000).
- b) Introduced the possibility to disable the reverse power alarm threshold when is settled = 0.

Main Characteristics of ver. 2.04:

- a) Corrected logic of alarm contact.
- b) Modified scale of forward power signal (10 V = 1000)

Main Characteristics of ver. 2.05:

- a) Modified scale of voltage and current monitor signals (10 V = 10 kV and 10 V = 2 A)
- b) The reference signal is forced to 0 when the enabling command is OFF.

Main Characteristics of ver. 2.06:

- a) Improved control loop
- b) Disabled reading input thermocouple
- c) Improved analog channels precision.

MONITOR SIGNALS

On the "D" type female connector #5, installed on the rear panel of the PSU, there are two monitor signals, in the range 0 - 10 Vdc (pin 2 and pin 3, ground on pin 15 and 16 respectively)

You must have the "Frontpanel" software interface to select four different meanings of the output signals and a firmware version from rel. 2.04 (and upper) on the SM1150 (the release number is showed on PSU unit at switch-on):

Reverse and Forward power	Output Power (electrical current)	Off	Anodic voltage and current	PIN
Reverse Power $1 V_{mon} = 1 V_{in}$	Output Power $1 V_{mon} = 500 W_{el}$	$V_{mon} = 0$	Anodic Voltage V_a $1 V_{mon} = 1000 V$	Pin #2 (and #15)
Forward Power $1 V_{mon} = 1 V_{in}$	Output Power $1 V_{mon} = 500 W_{el}$	$V_{mon} = 0$	Anodic Current I_a $1 V_{mon} = 200 mA$	Pin #3 (and #16)

- 1) **Reverse and Forward power:** the two signals shows the Forward and Reverse power supplied to the SM1150, coming from external measurement circuits generally located on the MW generator (head).
- 2) **Output Power:** both signals represent the electrical output current ($V \times I$)
- 3) **Off:** the monitor signals are switched-off
- 4) **Anodic voltage and current:** on pin 2 the signal represents the Anodic Voltage; on pin 3 it represents the Anodic Current.

The monitor signals are filtered through the internal CPU and can't follow fast variation.

Software upgrading

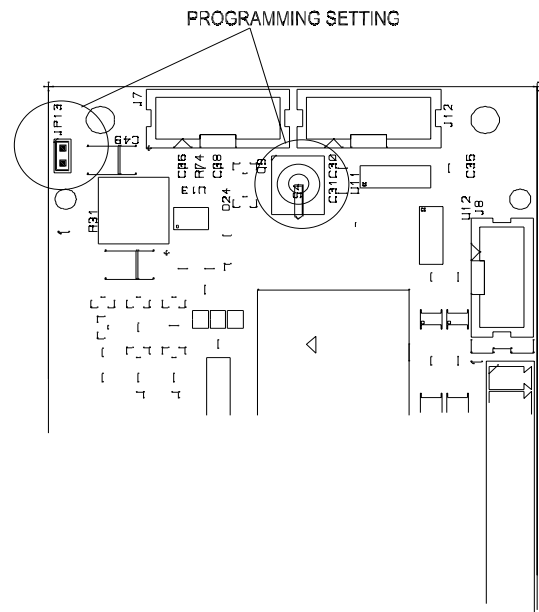
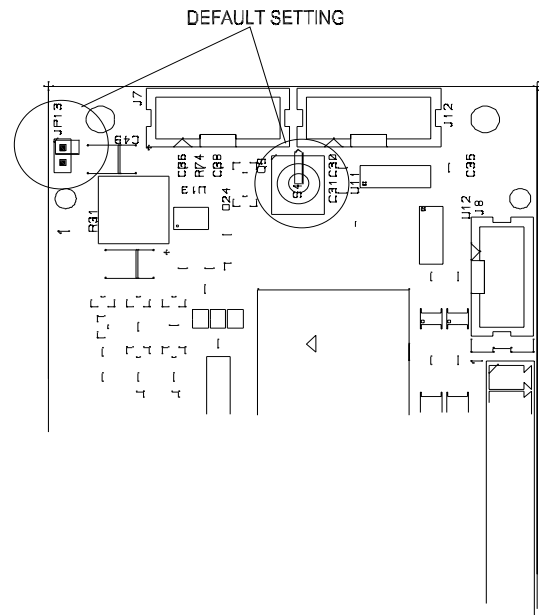
The software stored on the CPU can be upgraded to a newer version thru the RS232 serial port provided on the unit, with simple operation and an external PC.

To upgrade you need:

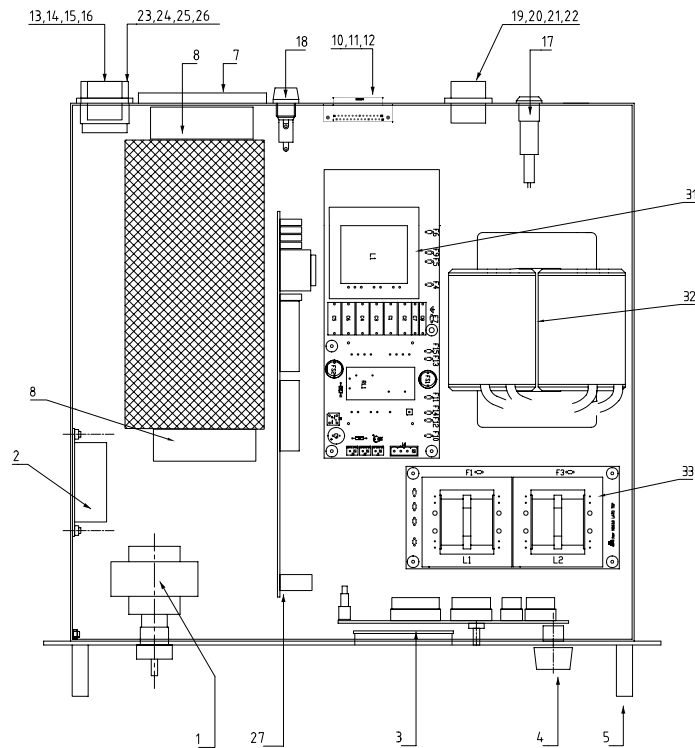
- a serial cable with 9 pin D type connectors, one male on the equipment side, the female for the PC side. Wiring of connectors must be 1:1 (pin 1 to pin 1, pin 2 to pin 2, etc.);
- the program "FlashPro32" to run under your PC: ask a copy to Alter or download the latest version from the web site at www.altersystem.com
- the new version of software you want to upload into the SM1150 (a file with extension .hex: usually the latest version is available also from our site but you have to ask whether you may have advantage or not)

Upgrading procedure:

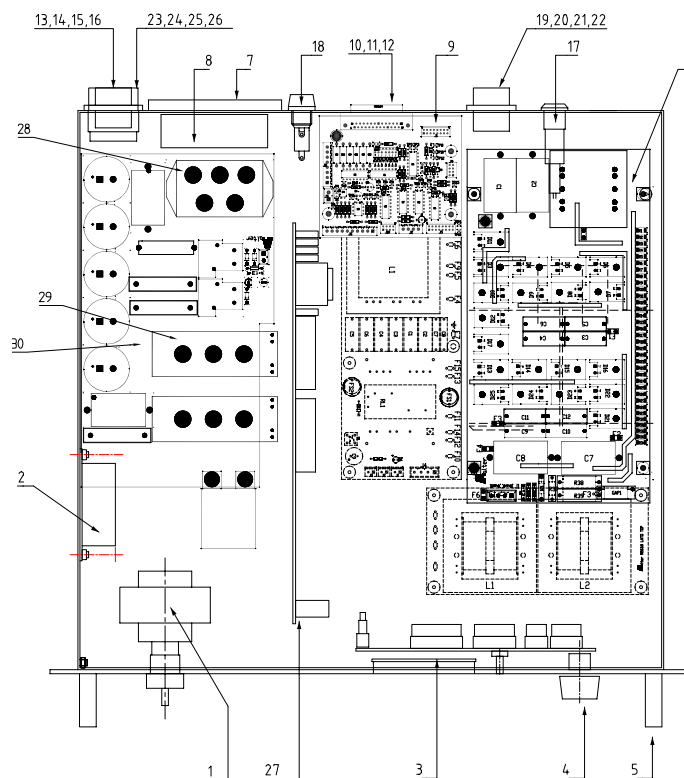
- I) switch OFF the SM1150 - (Enable signal must be OFF)
- II) connect the serial cable to PC serial port and to RS232 serial port on the SM1150
- III) remove the cover
- IV) find the CPU board installed on the front panel and localize the programming switch and the jumper as indicated. Switch ON the SM1150
- V) insert the jumper into the 2 pins and move the arm switch as indicated: The CPU is ready to upload the new program into its "flash" memory: this will cancel the existing program
- VI) run the FlashPro and download from the PC the new software: it will takes few minutes and FlashPro will advise once completed.
- VII) The CPU's display may show random pattern: don't care
- VIII) when the procedure has been completed, remove the jumper and place it into the original position and move back the switch arm
- IX) close the cover
- X) switch ON the SM1150: one of the first messages should be the new version number.



COMPONENTS LAYOUT, bottom layer



COMPONENTS LAYOUT, top layer

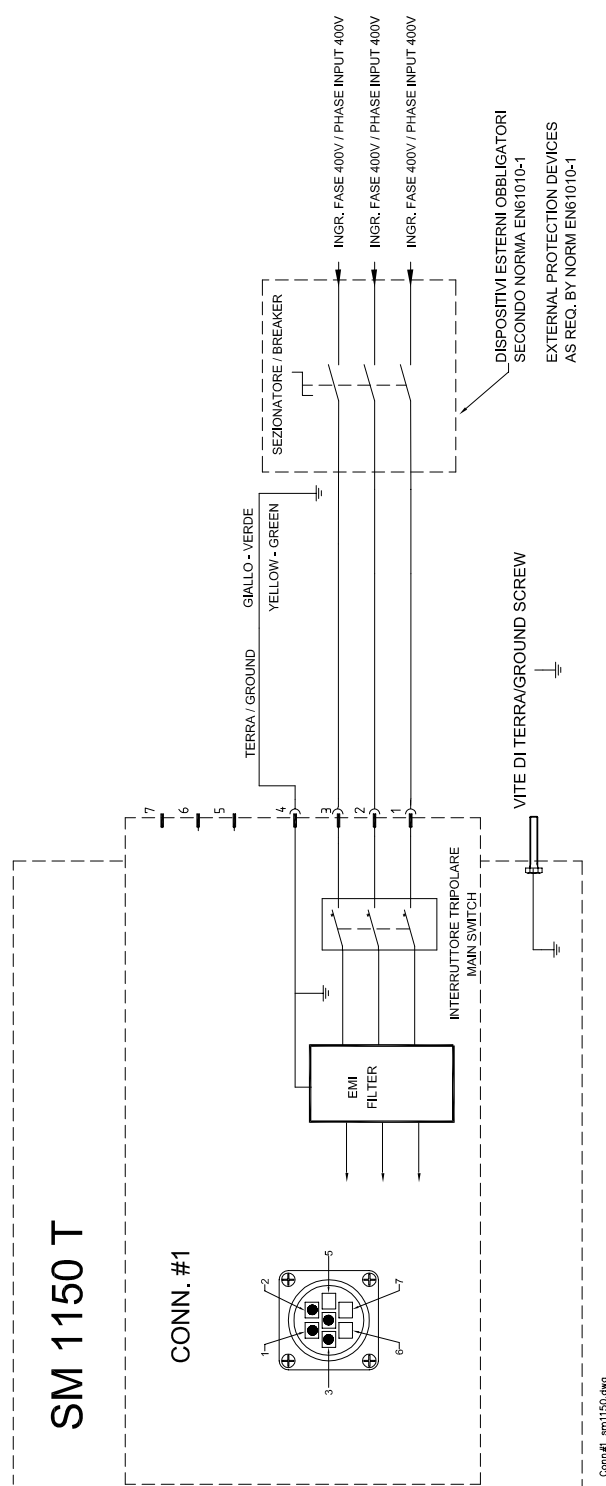
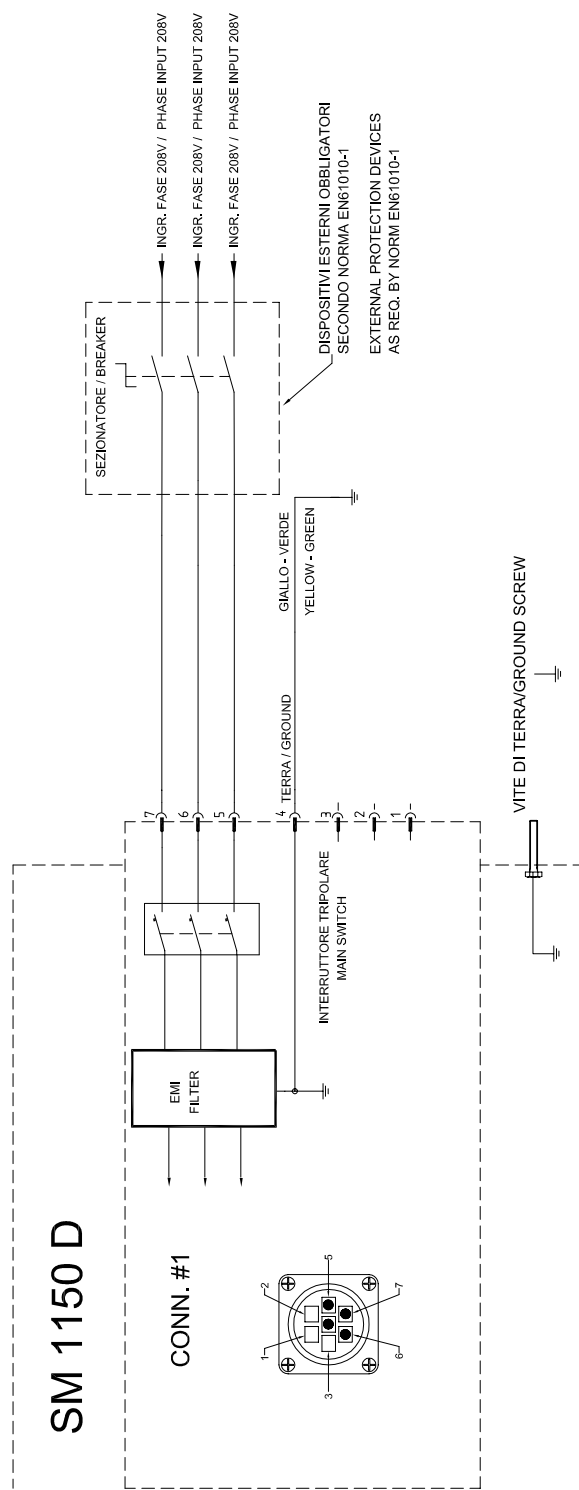


Component list (See drawing pag.18)

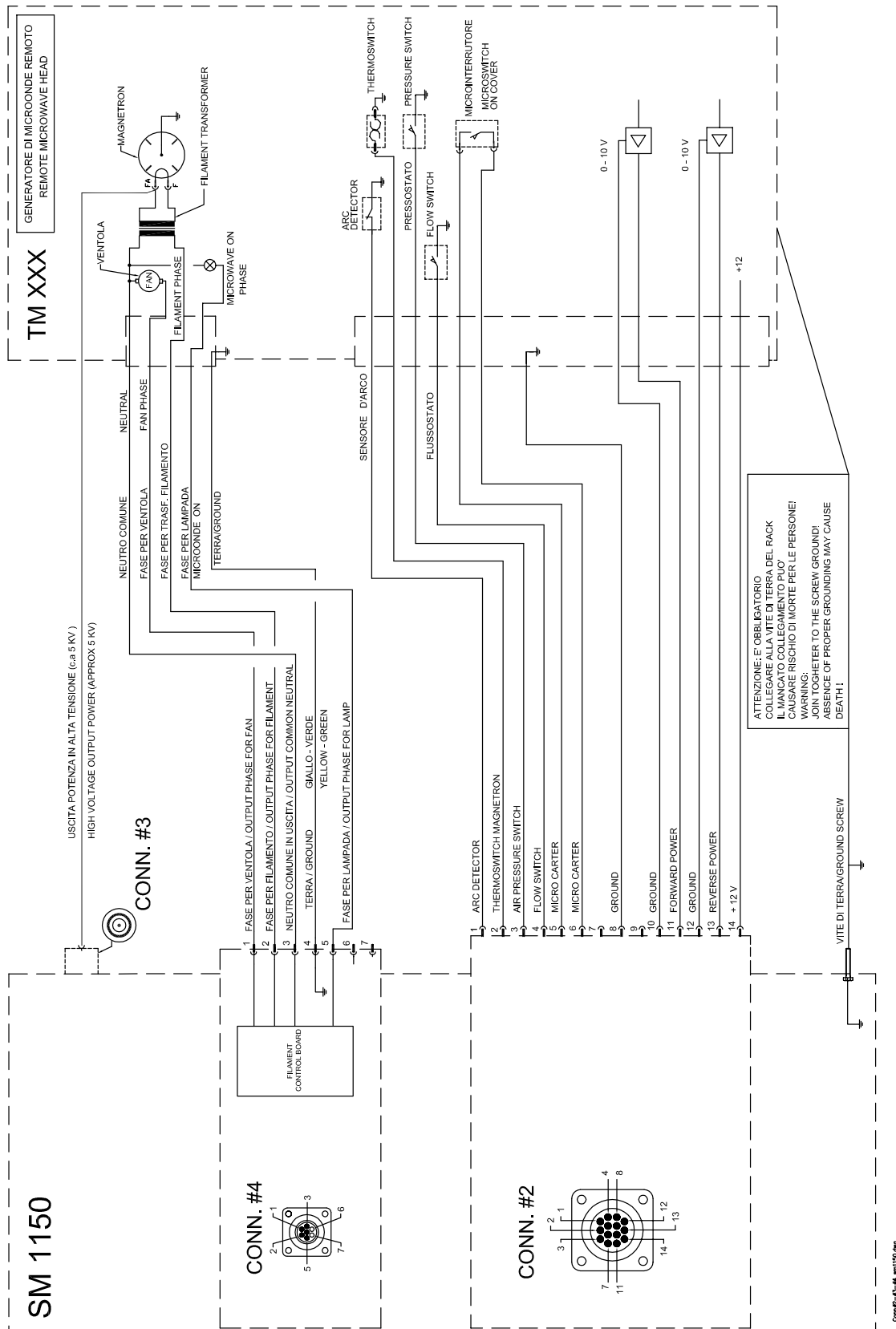
Pos.	Q.ty	Description	P/N	Note
1	1	Main switch	IG590XA323R	
2	1	Main filter	FL20AY01	
3	1	CPU board M226	800000226	
4	1	Digital Potentiometer (HP)	RSHRPG/AD3259R	
5	1	Handles	AR79363H	
6	1	H.V. board M262	800000262	
7	1	Air filter	461862015	
8	2	Fan, dim. 80x80x25 mm	VE8412NGH	
9	1	Interface board M253	800000253	
10	1	Connector, 25 pins,	MODCS25FL	Conn.#5
11	1	Connector, 9 pins,	MODFL09F	
12	1	Connector, 9 pins,	MODFL09M	
13	1	7 pins Socket, AMP/CPC	MOCPC07/2113981	Conn.#4
14	1	7 pins Plug, AMP/CPC (*)	MOCPC07/2114001(*)	
15	5	Female pin, size III	MOCPCX/1630881	
16	5	Male pin, size III	MOCPCX/1630861	
17	1	H.V. Socket, Lemo	MOERAY/410	Conn.#3
	1	H.V. Plug, Lemo (*)	MOFFA1Y/410 (*)	
18	2	Fuseholder for fuse 10X38 mm	FUP1891	
	2	Fuse 10X38 mm, 6A 500 V, cer. quick act.	FU10X38/6A	
19	1	14 pin Socket. AMP/CPC	MOCPC14/1826411	Conn.#2
20	1	14 pin Plug. AMP/CPC	MOCPC14/1826491 (*)	
21	14	Male pin, size III	MOCPCX/1630861	
22	14	Female pin, size III	MOCPCX/1630881	
23	1	7 pins Socket, AMP/CPC	MOCPC07/2061371	Conn.#1
24	1	7 pins Plug, AMP/CPC	MOCPC07/2061361	
25	4	Male pin, size III	MOCPCX/0662614	
26	4	Female pin, size III	MOCPCX/0667402	
27	1	Control board	800000216	
28	1	Power bridge	DDSKD6212	
29	2	IGBT Module	SKM100GB123D	SM1150 T/D
30	1	Power board (version 3x208V)	800000260	SM1150 D
	1	Power board (version 3x400V)	800000259	SM1150 T
31	1	Filter board	800000261	
32	1	H.V. Transformer (version 3x208V)	42FT1150DA	SM1150 D
	1	H.V. Transformer (version 3x400V)	42FT1150TA	SM1150 T
33	1	Snubber board	800000263	

Note: Components marked with (*) are included on the connector set p/n 44SET1150 to be ordered separately

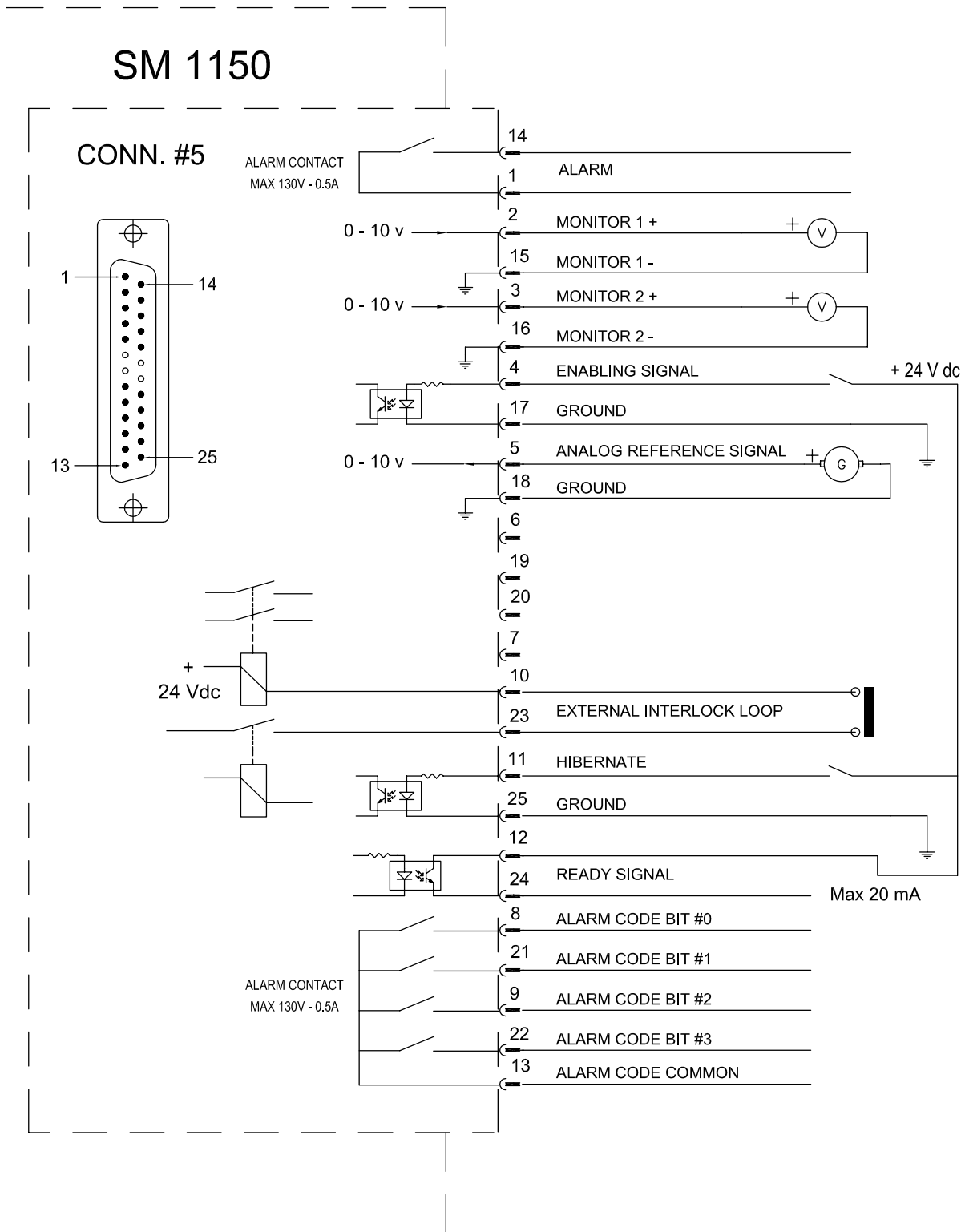
Pin out of conn. #1



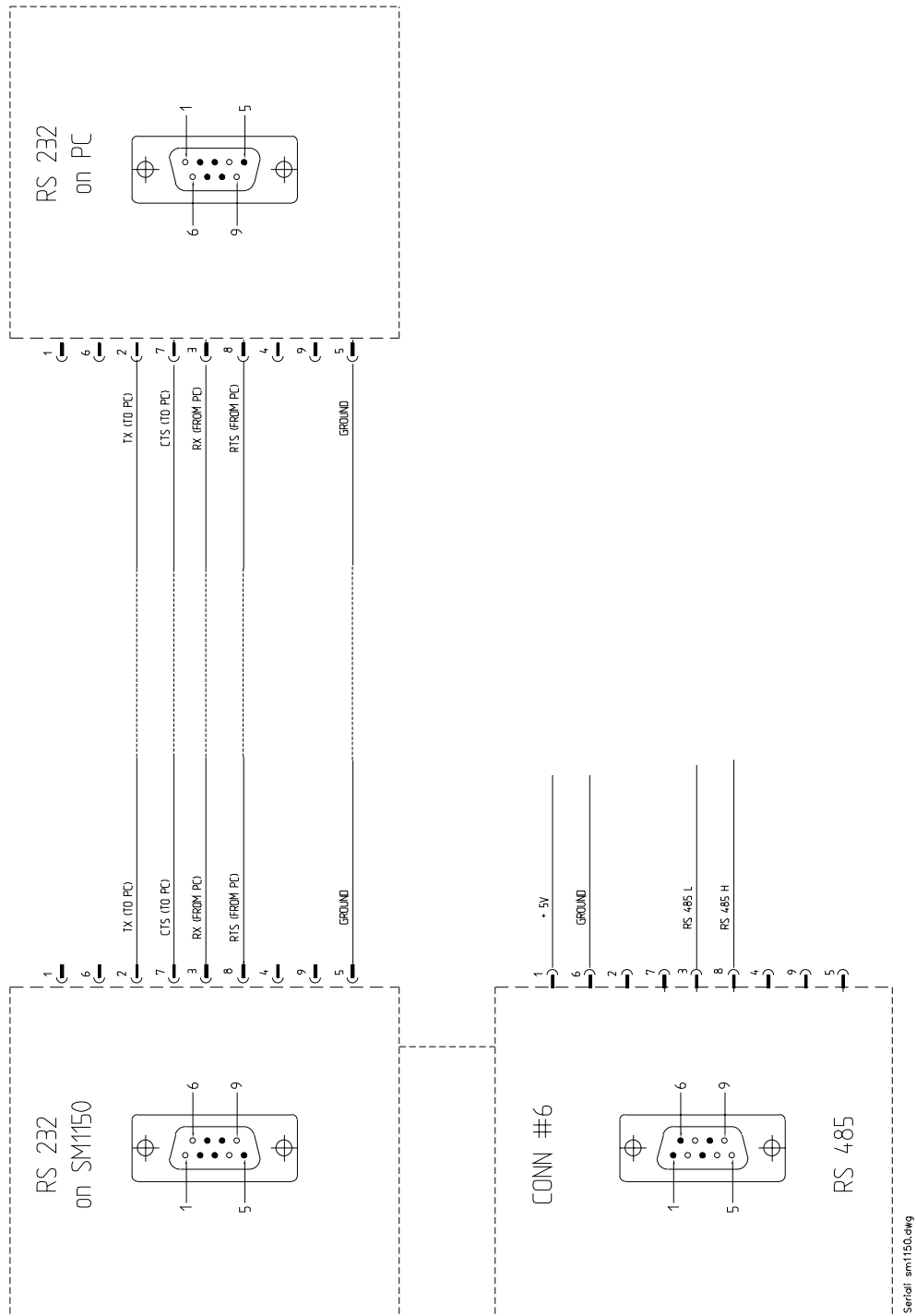
Pin out of conn. # 2,3,4



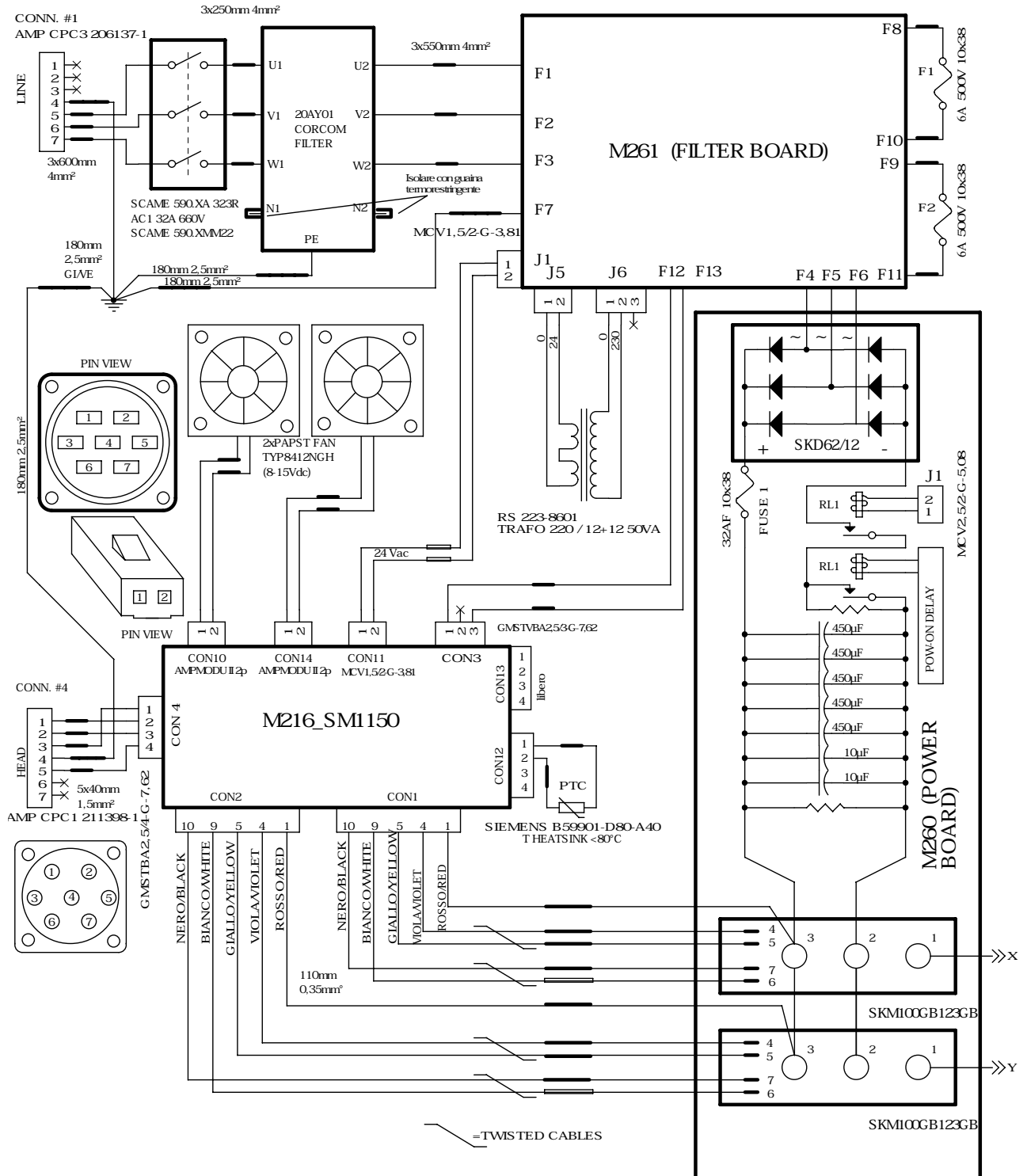
Pin out of conn. # 5



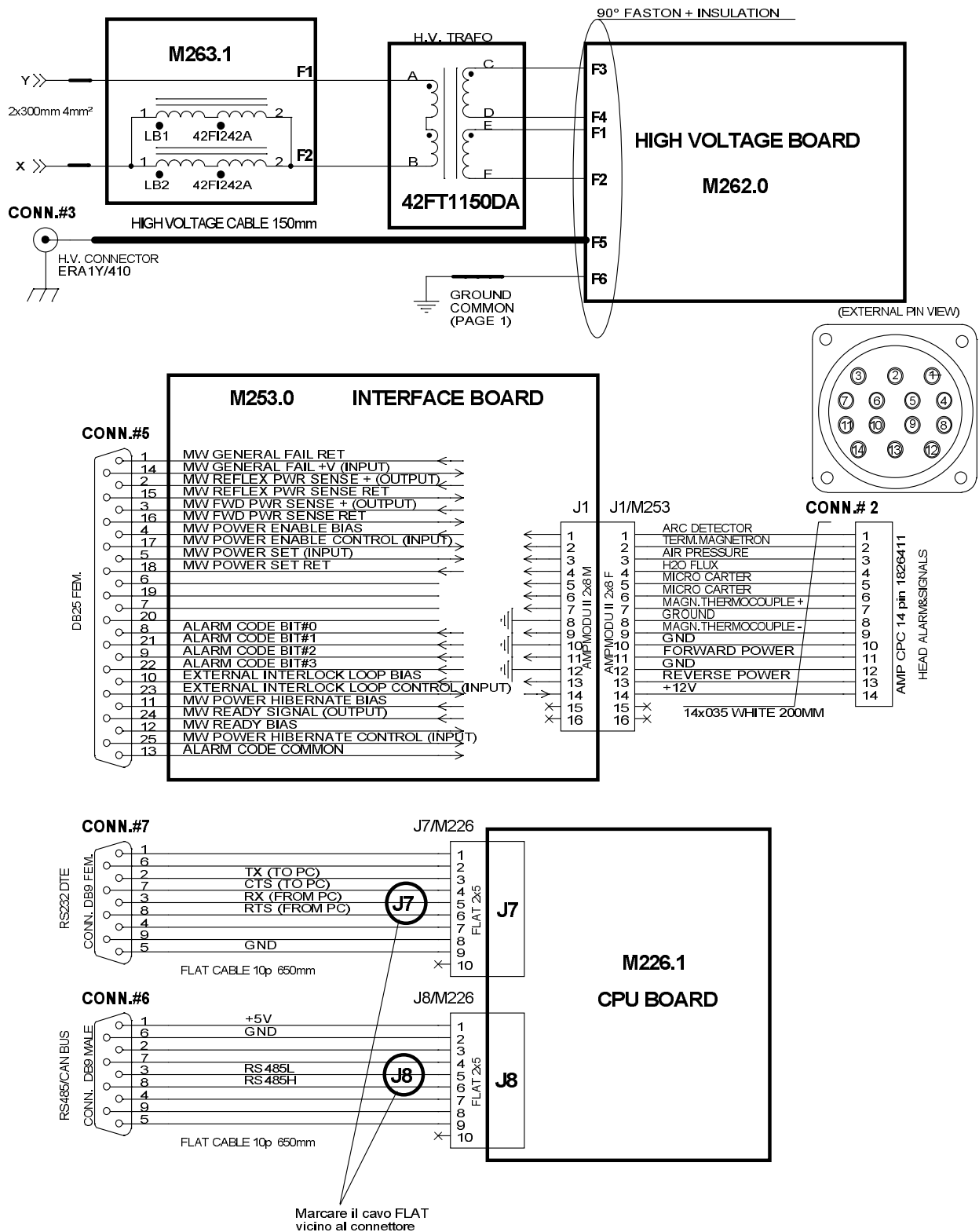
Pin out of serials



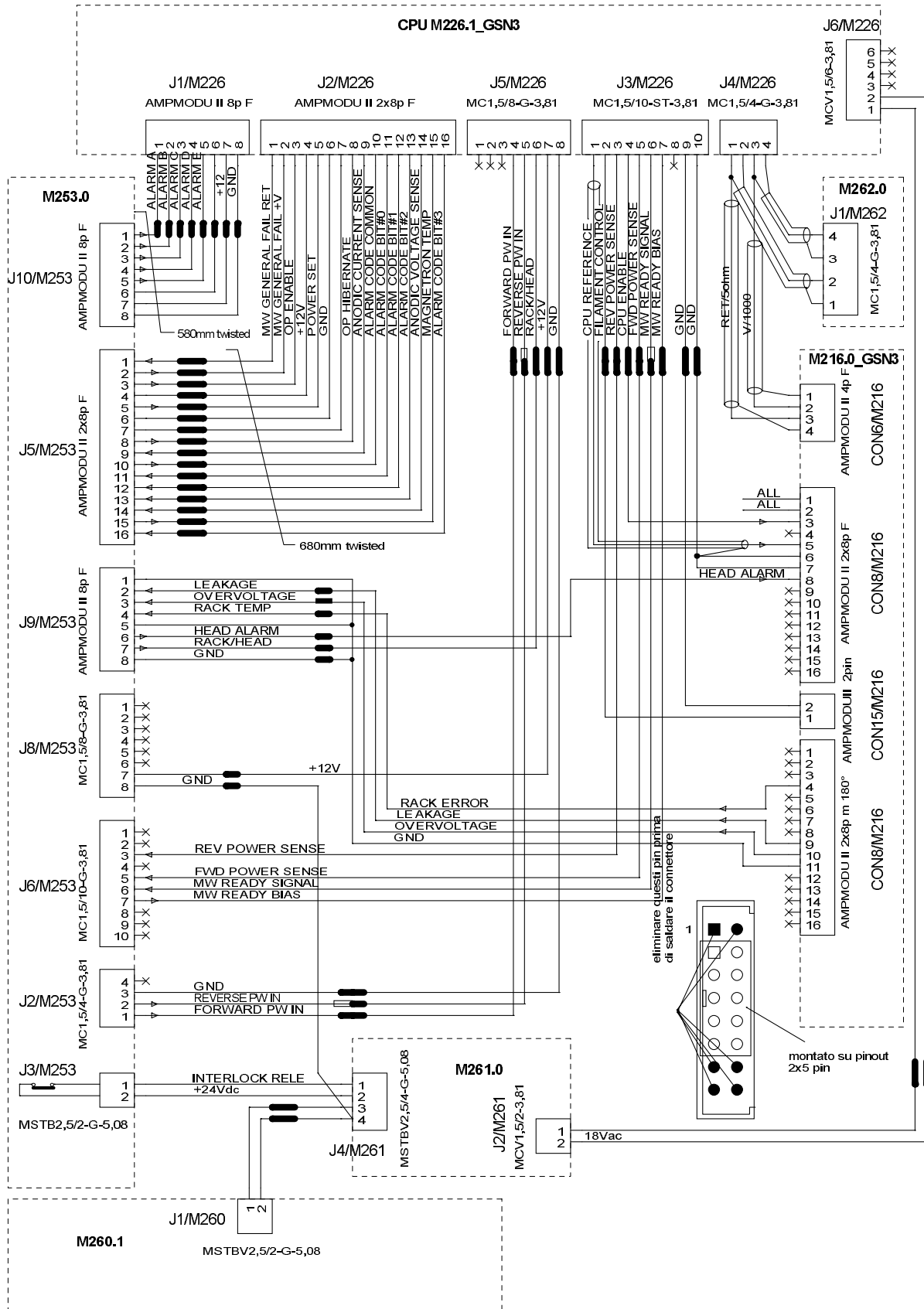
Internal Wiring Schematic - Schema dei collegamenti interni SM 1150 D



Internal Wiring Schematic - Schema dei collegamenti interni



Internal Wiring Schematic - Schema dei collegamenti interni



ALARM CODES TABLE

Alarm	Code	Description	Cause/Solution
MAGN	01	Magnetron Over Temperature	a) Check water flow and incoming water temperature b) Check magnetron thermoswitch (contact grounded=OK, open=alarm) c) Check setting of magnetron thermocouple: if latter isn't present the alarm threshold must be set = 0 d) Check air flow. e) Excess of reverse power. Reduce power,
TEMP	02	Rack Over Temperature	a) Check for restrictions to the air flow b) Eliminate air recirculating between outlet on the sides and the rear inlet c) If you are using the "current control mode" limit the output at 750 mA
ARC	03	Arc Detected	Electric arc in waveguide. If arc detector isn't used, the related input must be grounded. If used, contact grounded=OK, open=alarm On alarm, check waveguide and magnetron antenna status. Check Arc detector wiring.
CURR	04	Over Current	An excessive current has been detected, or a dangerous temperature is present into the unit. a) Check air flow blocks. b) Eliminate air reflow between side entry and rear output. c) In "Current control" mode, limit output current to 950mA maximum. d) A short circuit is present on H.V. cable: check wiring.
VOLT	05	Over Voltage	a) The high voltage connection is open b) Magnetron may be moding c) The high voltage connectors are not fully inserted: if true check for h.v. spot discharge inside socket/plug: in case replace them. d) The filament is cold: check filament current with high voltage OFF (=enable signal OFF, h.v. connector #3 disconnected) Check filament transformer wiring and compliance. e) Verify preheating timer checking how many seconds require the "READY" led to become ON stable: if you feel too short try to enable the unit (= enable MW ON) only 10 seconds after enabling the filament (if the command is available) or after general power ON (when the filament command is always ON) f) check the filament timer (with the FrontPanel program from the PC): set >10 seconds.

ALARM CODES TABLE

Alarm	Code	Description	Cause/Solution
AIR	06	Low Air Pressure from head	If it isn't used the related input must be grounded. If used, contact grounded=OK, open=alarm Check head air filter.
H2O	07	Low Water Flow from head	If it isn't used the related input must be grounded. If used, contact grounded=OK, open=alarm Check head water flow.
LOCK	08	Open Interlock	Check interlocks on magnetron head assembly including waveguide. Check 25 pin D-Sub interlock
LEAK	09	Current Leakage	Check Connector # 3 for signs of arcing: in case replace both socket & plug with new one. Check arcing on the magnetron head. in case replace the magnetron
RACK	10	Rack Error	The unit has detected an output current 10% lower than expected, usually due by a sudden drop of the main line voltage: check the main line
MREV	11	Maximum Reverse Power Exceeded	The reverse power threshold has been exceeded. Check the threshold limit setting.
POWD	12	Power Down	a) The alarm "Power Down" is enabled and the line voltage has been suddenly removed while the unit was in MW-ON. Check main line for faults b) Disable "Power Down" alarm: the only disadvantage is the unit will not inform you of unexpected main voltage removal when in MW-ON state
RAM	13	Ram Error	Internal RAM memory data corrupted: check for Ram Battery presence (it's a "click on" battery installed over the CPU Ram) or charge. Replace the battery. Switch OFF the unit and restart.
COM	14	Communication interrupted	The unit was running in "remote control mode" and the communication failed. Check: a) cable and connectors insertion b) remove any "suspend or low power mode" from yr PC (the OS may stops to drive the PC serial port) c) disable any screen saver from the PC d) do not move the FrontPanel window on yr desktop: some early version of operating system may stop driving the serial port. e) Raise communication timeout setting in FrontPanel.

How to order

<u>Power supplies:</u>	SM1150x.yyyjb , where:
x:	T = input 3 x 400V D = input 3 x 208V
yyy:	don't care, it's the code we use for customized unit;
j (version code):	0 or nul = standard version 1 = version 1
b (interface bus code):	0 or nul = standard version C = CANBUS interface

I.e: SM1150D = standard version, without bus interface .
SM1150DC= version with Canbus interface

Pls specify at order the value of the reference signal you have:
0-10 V (standard)
or 0-5 V

Connector/plug set: p/n **44SET1150**

Remotable Microwave generator: **TM030.xxx0**
Includes the NL10230
magnetron or an equivalent
(but not the 3 ports isolator)
See manual TM0-TMA

3 port isolator with dummy load: several models
available: ask for quote and type.

Cable set:
for SM1150D:
p/n **44 1384 115** (double side
plugs SM<.....>TM)
p/n **44 1384 117** (single side
plug SM<.....>TM)
for SM1150T:
p/n **44 1384 116** (double side
plugs SM<.....>TM)
p/n **44 1384 118** (single side
plug SM<.....>TM)

Includes high voltage cable,
main line cables, head
cables, signals cable.
Standard lenght is 3 mt;
other lenghts on request.

Filament transformer: p/n **FIL100F**

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