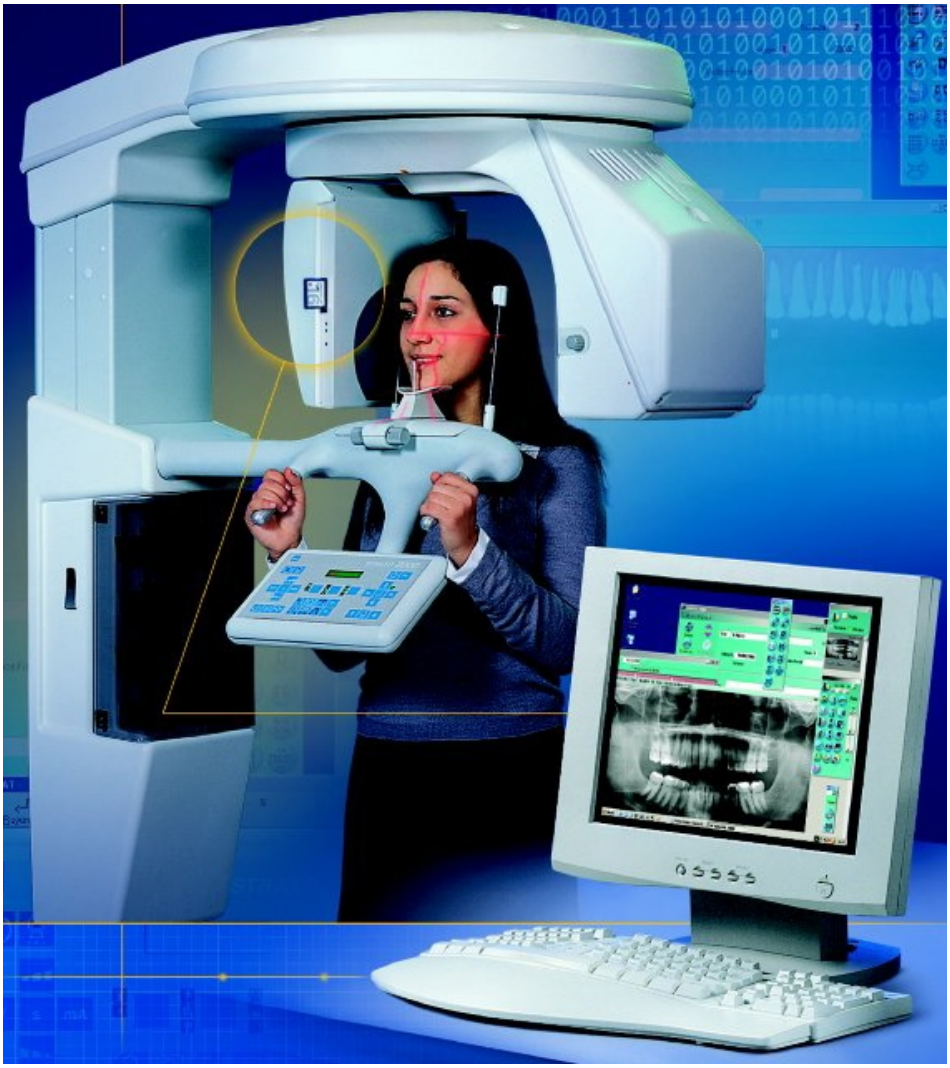
VILLA SISTEMI MEDICALI

STRATO 2000 D CE 0051

(120V Digital Version)



Service Manual

Release 16 March 2005 (Rev. 4)

Revision history

Rev.	Date	Page/s	Modification description
0	03.03.04	-	Document approval.
1	26.03.04	2-6, 3-2, 4-6	Notify body change for CE mark. (Ref. RDM 5781)
2	29.10.04	3-1, 3-2, 6-9, from 9-3 to 9-45, from 9-49 to 6-67, 10-8	New Digital Sensor identification label. Introduction of new ferrite on Digital Sensor USB/2 and power supply cables. Schematics update. Spare Parts update. (Ref. RDM 5775, RDM 5809, RDM 5947)
3	29.11.04	From 9-3 to 9-45, 10-8, 10-10	Schematics update. Spare Parts update. (Ref. RDM 5866, RDM 5925)
4	16.03.05	3-2, 6-5, from 9-49 to 9-75, 10-2, 10-4, 10-6, 10-16, 10-17	ETL certification. Schematics update. Spare Parts update. (Ref. RDM 5891, RDM 5987, RDM 6013, RDM 6046)
5			

THIS PAGE IS INTENTIONALLY LEFT BLANK

Contents

1. INTRODUCTION

NOTE:
The present manual is updated for the product it is sold with in order to grant an adequate reference in performing diagnostics and repair operations normally carried out by the service engineer.
The manual may not reflect changes to the product not impacting service operations.

STRATO 2000 Digital Version, produced by VILLA SISTEMI MEDICALI, is a X-ray device for the radiographic examinations of the maxillo-facial complex.
The device is designed to operate in conjunction with the Direct Digital System, manufactured and certified by Owandy – France.

NOTE:
The Direct Digital System is shipped with STRATO 2000 Digital Version and is matched in the factory for mechanical and electrical alignment, before shipment.
Still the responsibility and certification for the Direct Digital System component stays with the original Manufacturer.

The following models are available:

- PAN version with fixed primary collimator (it cannot implement Cephalometry)
- PAN version with rotating collimator 8"x10" / 24x30cm / 30x24cm
  These models can curry Cephalometry in the specify format.
  Cephalometry is performed on FILMS or on separate digital system not sold by Villa Sistemi Medicali like PSP plates.

The following options are available and must be ordered separately:

- Digital Extended Program (DXP); it allows the execution of the following examinations:
  - **TMJ**: Specific examinations for temporo-mandibular joint
  - **SINUS**: Examination of nasal sinus
  - **A.D.A.**: Advanced Dental Applications including the improved orthogonal projection, frontal dentition and the reduced dose panoramic examination.
- Cephalometry (only for model with rotating primary collimator). Three possible choices to be matched with the collimator type: 18x24cm / 30x24cm / 8"x10".

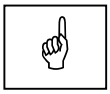
The aim of this publication is to instruct the user on the safe and effective use of the device.
This manual is limited to the description of the X-ray device; instruction on the Digital Acquisition System are given in the relevant Manuals, supplied with the Direct Digital Sensor.

The device must be used complying with the procedures described and never be used for purposes different from those herewith indicated.

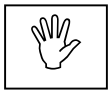
Please read this manual thoroughly before starting using the machine; it is advisable to keep the manual near the device to refer to it while operating.

STRATO 2000 is an electro-medical device and it can be used only under the supervision of a physician or of highly qualified personnel, with the necessary knowledge on X-ray protection.
The user is liable as concerns legal fulfilment related to the installation and the operation of the device.

1.1. Icons appearing in the manual



This icon indicates a NOTE; please read thoroughly the items marked by this picture.



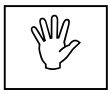
This icon indicates a WARNING message; the items marked by this icon refer to the safety aspects of the patient and/or of the operator.

1.2. How to contact VILLA SISTEMI MEDICALI technical service

For any technical quieries please contact the following:

- Telephone number +39 02 488591
- Fax number +39 02 48859222
- E-mail: service_support@villasm.com

2. SAFETY INFORMATION



WARNING:
Please read this chapter thoroughly.

Villa Sistemi Medicali designs and builds its devices complying with the related safety requirements; furthermore it supplies all information necessary for a correct use and the warnings related to danger associated with X-rays generating units.

Villa Sistemi Medicali, has not to be held responsible for:

- use of STRATO 2000 different than the intended use,
- damages to the unit, to the operator, to the patient, caused both by installation and maintenance procedures different than those described in this manual and in the service manual supplied with the unit, and by wrong operations,
- mechanical and/or electrical modifications performed during and after the installation, different than those described in the service manual.

Installation and any technical intervention must only be performed by qualified technicians authorized by Villa Sistemi Medicali.

Only the authorised personnel can remove the covers and/or have access to the components under tension.

2.1. Warnings

This device has not been designed for use in environments where vapours, anaesthetic mixes flammable with air, or oxygen and nitrous oxide can be detected.

Avoid pouring water, even accidentally, or other liquids into the device, as this could cause short-circuits.

Before cleaning the device, please disconnect the plug from the net-socket.

Wherever necessary, use the fit accessories, such as the leaded aprons, to protect the patient from radiations.

While performing the radiography, no one, apart from the operator and the patient, must remain in the room.

STRATO 2000 has been built to support a continuous operation at intermittent load; therefore please follow the described use cycles to enable the device cooling down.

Though this unit has been designed with a quite acceptable protection level from electromagnetic interference, it is advisable to install it at a certain distance from electric energy transformation chambers, from Uninterruptible Power Supply (UPS) units, from receiving-transmitting units for amateurs use. Cellular telephones are only admitted at a distance of more than 1,5 mt. from any component of the device.

Other medical instruments and devices that must be used in the installation area of the device, must comply the Electromagnetic Compatibility rules in force. Non-complying instruments, of which the poor immunity from electromagnetic fields is well known, must be installed at least 3 mt far from the STRATO 2000 and supplied by a different electrical line.

STRATO 2000 must be off while using devices such as electrical lancets or the like.

Please clean and disinfect, when necessary, all parts that can be in contact with the patient.

Never try to rotate the moving arm manually when the units is switched on, to avoid permanent damage to the unit.

After use, please replace the bite and the ear-centring devices.

The authorised technician must disconnect the unit from the net, before removing the coverings.

Though the X-ray quantity supplied by dental X-ray units is quite low and distributed on a small surface, the operator must adopt the precautions and/or fit protections for the patient and himself, during the execution of radiography. It is advisable to control the X-ray emission from a protected area, by means of a remote control. Should it be necessary to operate near the patient, please stay as far as the cable of the remote control allows it, or at least 1,5 mt far both from the X-ray source and from the patient, as shown in the picture below.

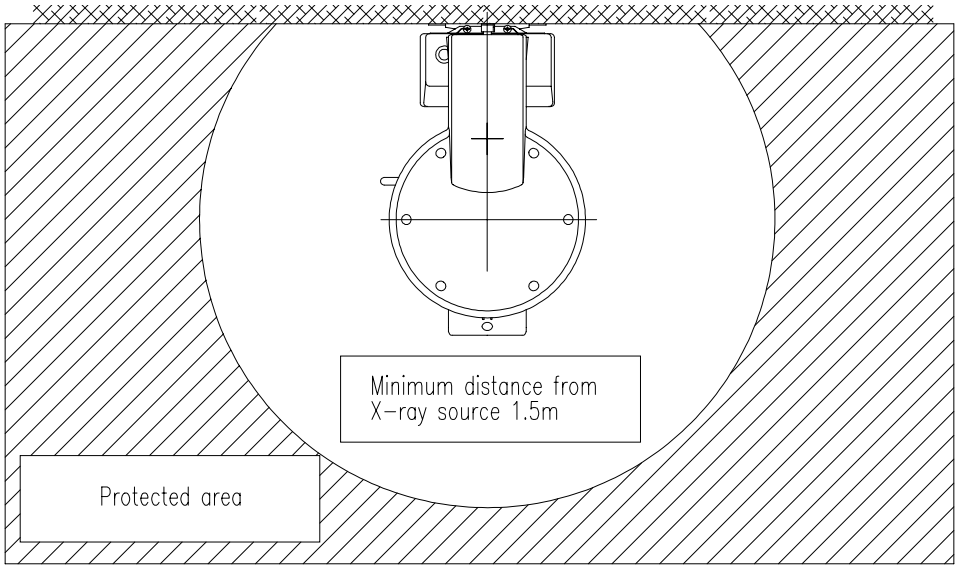


Figure 2-1 - Panoramic version

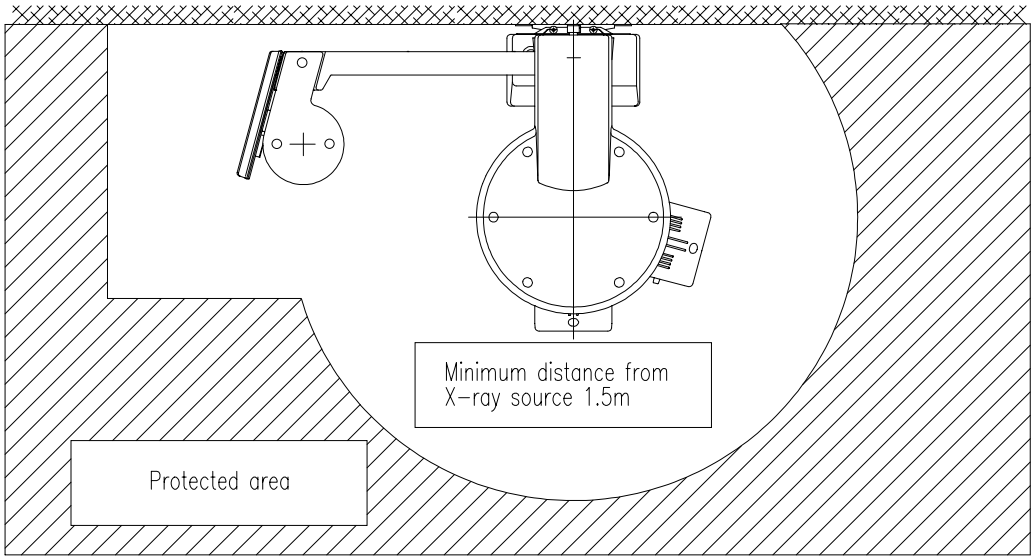
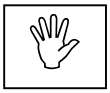
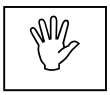


Figure 2-2 - Cephalometric version



WARNING: PRECAUTIONS WHILE USING LASER CENTRING DEVICES

- It is necessary an adequate illumination in the room.
- Do not look into the output windows of laser centring units.
- Do not stare at the reflections of laser pointers.
- Instruct the patient to keep his/her eyes closed as long as the laser pointers are active.
- Before starting an examination, the patient must remove earrings, glasses, necklaces and whatever else could reflect the laser beam or be impressed on the radiographic image.
- Do not clean the openings of laser centring devices with tools that could modify the optics. Necessary cleaning must be performed only by authorised technicians. Operations different than those indicated could cause the ejection of dangerous non-ionising radiations.



WARNING: PRECAUTIONS DURING INSTALLATION AND SERVICE INTERVENTIONS

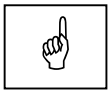
- Please take highest care while mounting the column at the wall and strictly follow the instructions listed in this manual.
- Before removing the coverings of the supply unit set at the base of the column, or before removing the coverings of the HF generating board, disconnect the supply to the device, both switching the main switch and the magneto-thermal differential off, and wait at least 1 minute.
- When the device is supplied without the above mentioned coverings, pay the highest attention since high tension is generated in the supply unit, and the voltage is at about 360 Vdc on the HF generator board. This is indicated by the green LED H1. Should the LED be off and before any other intervention, disconnect the device from the net, wait at least 1 minute, then check the fuses F2 (10A) in the supply unit, or F1 (500mA) on the HF generator board (see circuit diagram code 58094016).
- Each intervention must be performed after having disconnected the device from the supply net and after LED H1 is OFF. It is anyway advisable to wait at least 1 minute from the LED's switching off.

2.2. Environmental risks and displacement

The device contains in some of its parts, materials and liquids that at the end of the units life, must be disposed of at the fit disposal centres.

Particularly the device contains the following materials and/or components.

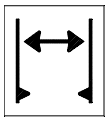
- **Tubehead:** dielectric oil, lead, copper, iron, aluminium, glass, tungsten, beryllium.
- **Control panel and remote control:** iron, copper, aluminium, glass-resin, non-biodegradable plastic material packaging.
- **Column, rotating arm, and extensions:** iron, lead, aluminium, copper, glass-resin, and non-biodegradable plastic material.



NOTE:
VILLA SISTEMI MEDICALI is not responsible for the disposal of the device performed by the user and for the related costs.

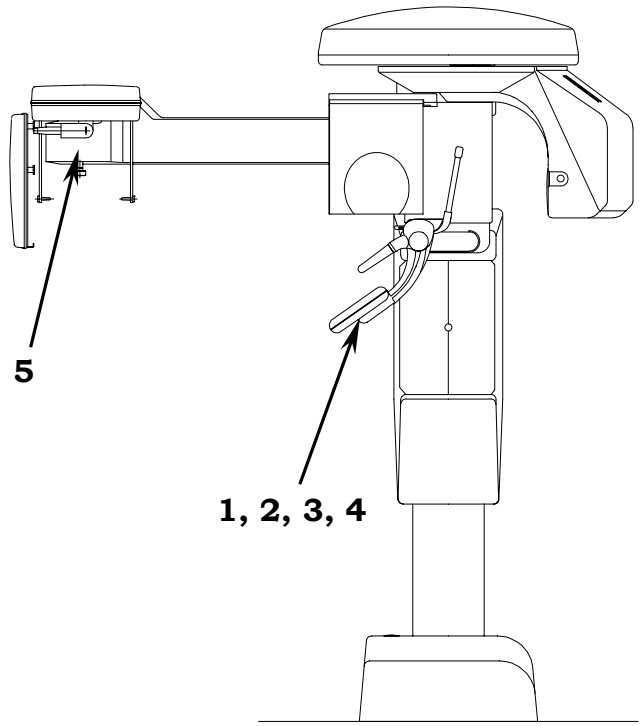
2.3. Symbols used

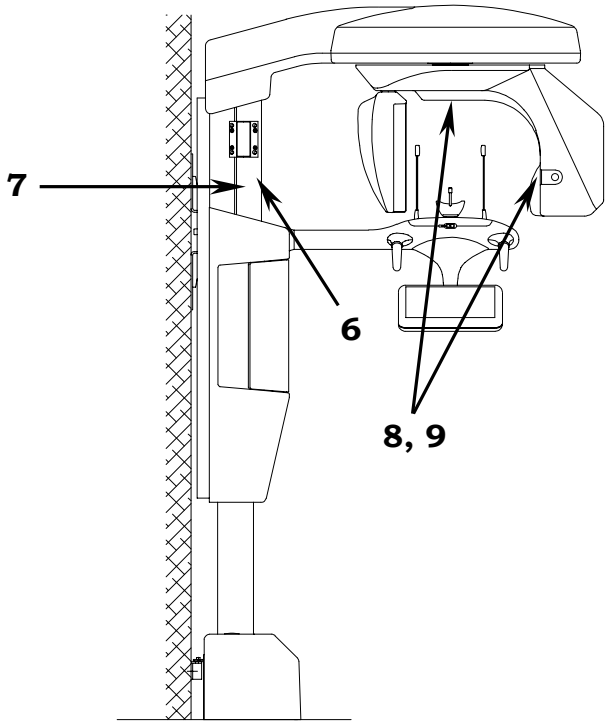
In this manual and on the STRATO 2000 itself, apart from the symbols indicated on the control panel, also the following icons are used:

Symbols	Description
	Device with type B applied parts
~	A.C.
N	Connection point to the neutral conductor
L	Connection point to the line conductor
	Protection grounding
	Operation grounding
	OFF ; device not connected to the net
POWER 	ON ; device connected to the net
	Laser
	Laser source output
	Dangerous voltage
	Actioning of cephalometry ear-set rods
CE 0051	Conformity to the CE 93/42 Directive

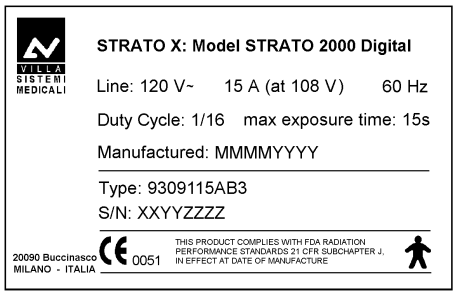
3. DESCRIPTION

3.1. Identification labels and laser labels



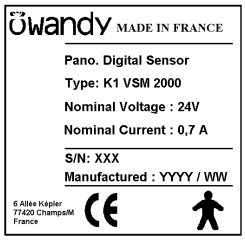


1a
STRATO 2000
identification label

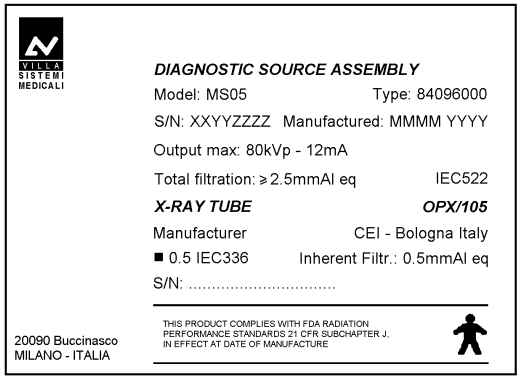


1b
ETL certification label

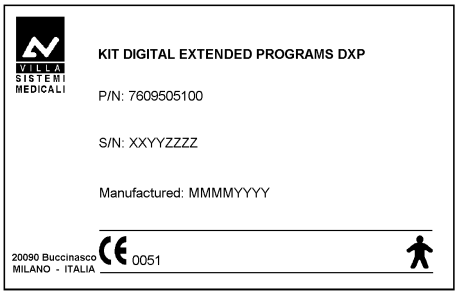
2
Digital Sensor
identification label



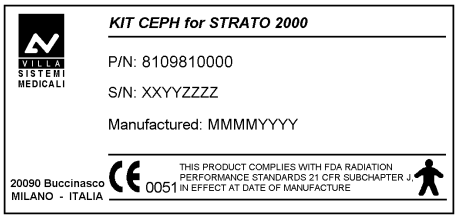
3
Tube-head
identification label



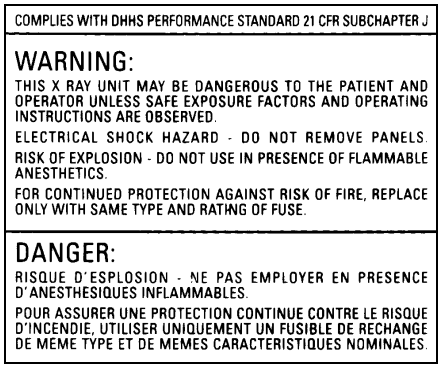
4
DXP (Digital Extension Program)
identification label



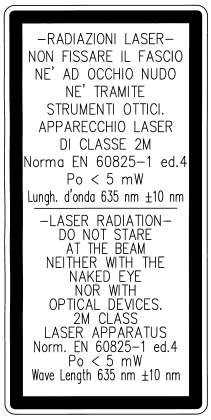
5
CEPHALOMETRIC device
identification label



6
WARNING label



7
Laser
warning
label



8
(N° 2) Spot laser
identification label

9
(N° 2) Laser symbol
label

3.2. Function, Models and Version

3.2.1. Panoramic examination

The Panoramic and DXP tests are carried out using a single slot of the primary collimator. The user can select between Adult and Child and among 3 sizes and 3 dental arch types for a total of 18 combinations in Automatic selection; in manual selection it is possible to select high voltage between 50 kV and 80 kV, in 2 kV steps and anodic current from 4 mA to 10 mA in 1 mA steps.
This function support also the half panoramic for right or left dental arch. All examination are carried out with a "constant magnification" factor of 1 : 1.23.

3.2.2. Versions with Cephalometric device

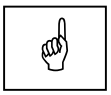
The version with cephalometric device enables to perform the following examinations:

- Panoramic with the same characteristics described for the Panoramic examination (paragraph 3.2.1).
- Cephalometry for Adult and Children with 3 Sizes for up to 6 combinations in automatic selection. The manual mode enables to change the voltage from 60kV to 80kV in 2kV steps, and the anode current from 4mA to 12mA in 1mA steps. The examinations are performed on flat cassettes which size is 8"x10", 18x24cm or 24x30cm depending on the type of primary collimator installed. The positioning of collimators occurs automatically according to the used cassette and to the chosen projection; the Soft Tissues Filter (STF) is motorised and can be adjusted to get the best projection of the face profile.

To get a good image quality, it is advisable to match the intensifying screens and the films, as indicated hereafter:

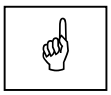
Supplier	Films	Sensibility	Screen
KONIKA	**MG**	**Green**	**KR II**
KONIKA	**MGH**	**Green**	**KR II**
KODAK	**T-MAT G/RA**	**Green**	**Lanex Regular**
AGFA	HTA	Green	Medium
FUJI	HR-G	Green	G8
IMATION	XDA	Green	T 16
KODAK	T-MAT G/RA	Green	Lanex Medium
STERLING	ULTRAVISION	Blue	Ultravision Rapid

Table 1



NOTE:
It is advisable to use always films and screens of the same brand. Combinations of films and screen of different manufacturer are possible so long as the same sensitivity is maintained. Never combine films and screens with different sensibility (green and blue).

The factory set values of the exposure factors listed in paragraph 7.4.4 as default, are indicative and optimised for the combination film/screen supplied with the device (film T-MAT G/RA and screens Lanex Regular or film KONIKA MG and KONIKA screens). For the other combinations listed in the table or for further combinations, the exposure factors have to be modified accordingly.
The real adjustment of these values depends on different conditions such as the preference of the user for much or less exposed images.
The quality of the image, therefore, does not exclusively depend on STRATO 2000 but it is also extremely important to pay attention to the processing procedure of the films and the materials related



NOTE:
Perform the maintenance of the film processor as described in the related instruction manual.
Regularly check the levels of the used chemical substances; replace them regularly as indicated by the manufacturer (or according to the number of processed films).

3.2.3. DXP (Digital Extended Program)

This option adds the following examinations:

- **A.D.A. (Advanced Dental Applications)**
  Allowing to perform improved orthogonality Panoramic examination, reducing the overlapping of teeth in order to improve diagnosis of interproximal caries.
- **Sinus**
  Allowing to get images of the paranasal sinusis in frontal (front/back) or lateral projection for right or left side.
- **TMJ**
  Allowing the following examinations:
  - TMJ closed/open mouth in lateral projection
  - TMJ in biaxial projection.

NOTE:
The code inserted into STRATO 2000 to enable the optional examinations is protected by an Unique Identification Code (UIC); in case the UIC is not present or is faulty, an error **E601** will be shown.

The Enter key "23"  pressure will reset this condition, but at the end of the start-up procedure only standard Panoramic examinations will be enabled.

The UIC can be visualized on the system console by pressing at the same time the Column up "27"  and Column down "29"  arrows.

The UIC is simple an identifier of the single STRATO 2000 unit; in case of error **E601** contact Villa Sistemi Medicali Service department.

3.3. Parts location

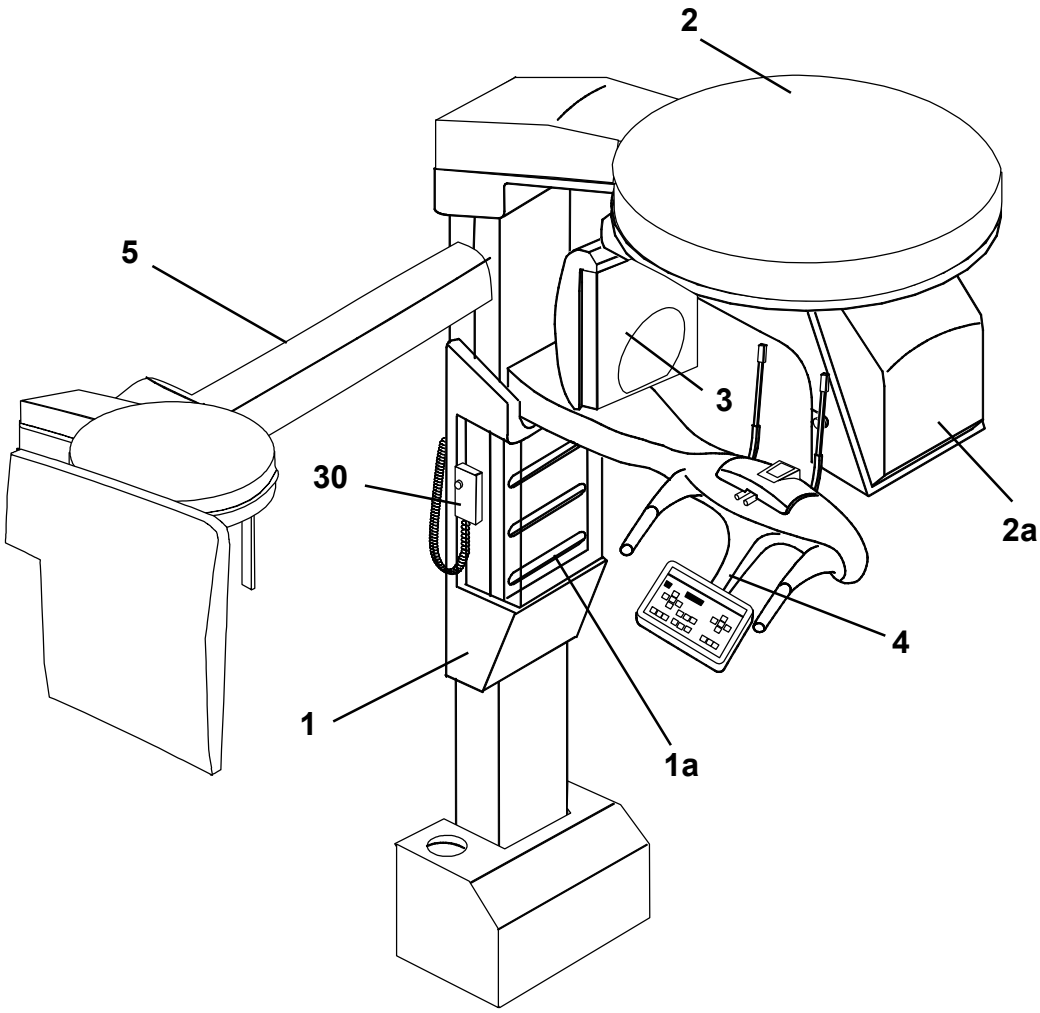


Figure 3-1

1 - Column with base equipped with electrical power part and cursor with motorised vertical movement. The column must be fixed at the wall by 4 dowels, two fixing the upper part and two fixing the lower. The front part of the column is equipped with an housings closed by two covers, within which it is possible to set 4 trays (1a) containing the consumables (bites, rods, etc.) and options (supports, etc.).

2 - X, Y axes movement unit and rotation support, (CPU board) with rotating arm equipped with: HF tubehead with power supply board (2a), primary collimator, Soft Tissues Filter (STF – only on version preset for cephalometry) and laser centring devices.

3 - Digital sensor holder.

4 - Chin support arm equipped with: control keyboard, temple support, chin-rest, centring bite and handles. The control panel is equipped with a soft-key keyboard, indication LED for the selected functions and an alphanumeric two-row display for all technical, operative and warning messages.

5 - Cephalometric arm (optional) including cephalometric device, cassette support (with laser alignment pointer directly from the rotating arm) positioned on the left of the column.

30 - X-ray push button equipped with extendible cable, which allows the user to operate the unit from proper distance as required by the safety rules.

3.4. Location of electronic components

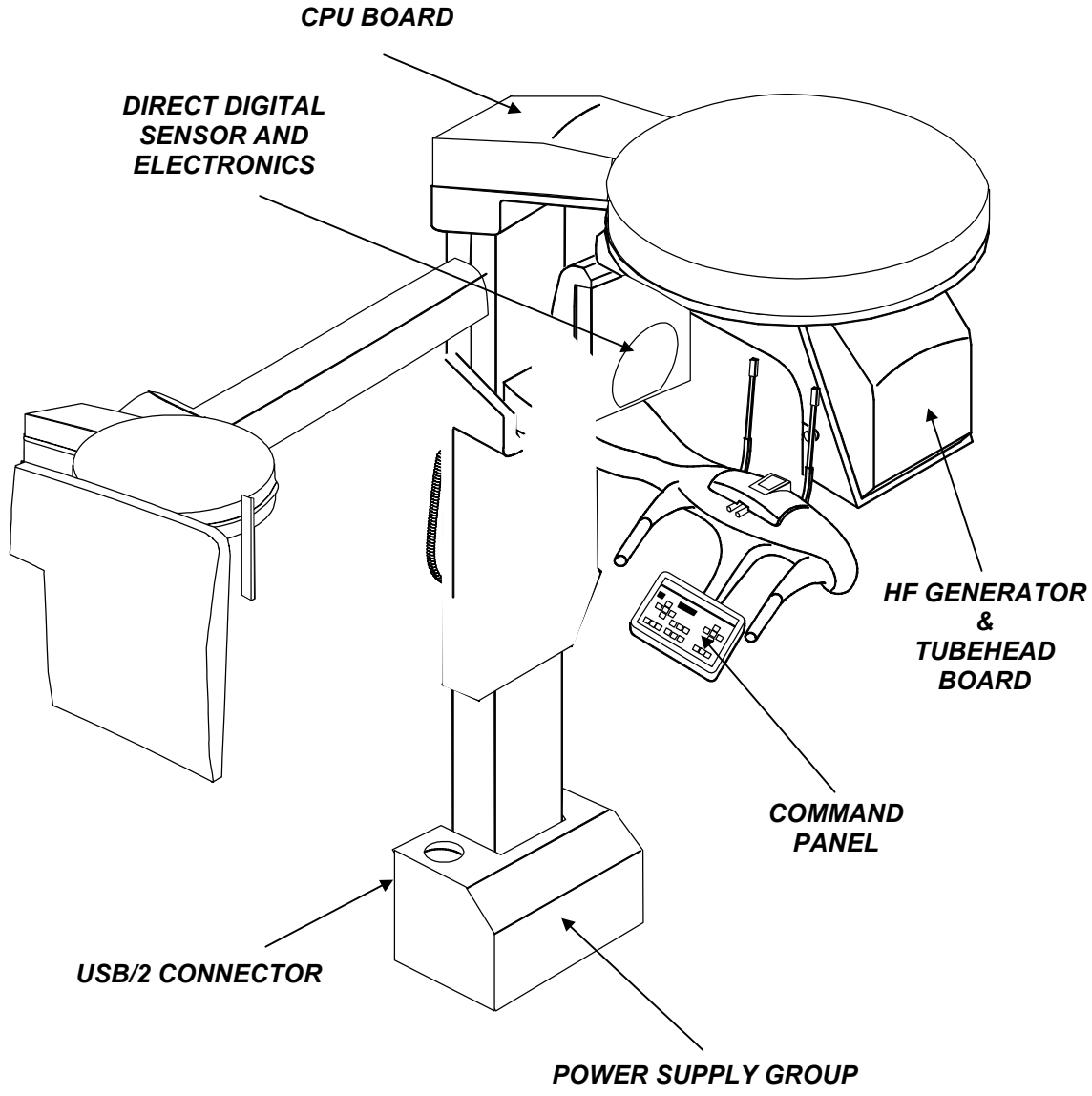


Figure 3-2

3.5. Block diagram

This paragraph provides a brief description, at block diagram level, of the STRATO 2000 Digital Version. Aim of this paragraph is to provide a brief description of the system. More details about the electronic circuits which compose the system can be obtained by analyzing the schematics provided in chapter 9.
During the description of the block diagram, please refer to Figure 3-3.

From the electrical point of view, the system can be divided into 4 main blocks:

- Power supply assembly
- CPU board (A1)
- HF board (A2) and tubehead
- Keyboard

Each of the main blocks above listed is here after described.

For information on the electronics of the Direct Digital Sensor, make reference to the relevant Manual.

3.5.1. Power supply assembly

It is located in the base of the system and is mainly composed by the mains switch (S1), a 24Vdc 7A switching mode power supply which supplies all circuits of the machine excluding the column motor, and a further power supply which supplies the column motor and the enabling circuit for X-ray emission.
A further voltage of 230Vac is directly provided to the HF board and is aimed at suppling the HF group (A2 board and tubehead).
The power supply assembly also acts as interface with a number of external signals and circuits like:

- Input for remote X-ray push button (S31) and output to the CPU of the same signal.
- Outputs for an "X-ray ON" external buzzer and for the "Ready" and "X-ray ON" lamps.
- Driving of the DC column motor (M1): this motor can be activated either through the CPU board, in case the movement is requested by the operator acting on the keyboard, or through the switch S2 located in the rear part of the column base. This switch can be used to raise/lower the column during the installation phase when the CPU has not been yet connected to the system.
- Input for the emergency column motor microswitches (S2 and S3): these microswitches indicates the limit for the movement of the column. If for any reason, the column goes beyond these microswitches, the motor is de-activated by cutting the voltage. Normally, the position of the column is also monitored by other two microswitches (S26 and S27) that, as for all the other positioning sensors, provide their signals to the CPU board.

The unit does not include a voltage selector circuit for the mains voltage. Therefore, the unit is manufactured in different versions, depending on the line voltage of the installation place.

3.5.2. CPU Board (A1)

The STRATO 2000 Digital Version carries a dedicated CPU Board which can be interfaced with the Digital Sensor.
It is located in the arm movement assembly on top of the unit. Main tasks are:

- General controlling of the unit, receiving the signals from the keyboard and from the different microswitches.
- Driving of the 6 motors (5 stepper motors and 1 DC motor) which compose the system.
- Monitoring the functioning of the motors through the analysis of the signals coming from the positioning sensors.
- Driving of the HF group (HF board and tubehead) in order to provide the X-ray doses set by the operator on the keyboard (kV and mA set point) and in the meantime, check the functioning of this group through the managing of the relevant alarm signals.
- Activation of the 3 luminous centering devices.
- Managing of the alarms that can be generated by anomalous conditions present in the unit and caused by the operator or by a fault.

The CPU board is based on a 32 bit Motorola Microprocessor MC68332, mounted on a piggy-back PCB, which also includes:

- 512 Kbytes of Flash EPROM, containing the software and the system configuration data (2 EPROM's for ODD and EVEN data)
- 512 Kbytes of RAM, (2 chips, ODD and EVEN)
- 12 bit, 8 channel serial A to D converter
- 2 channel, 8 bit serial D to A converter
- three bus transceivers
- a 32 kHz quartz
- other logic and passive components.

The CPU board also includes a number of input/output channels necessary for the functioning of the system and 5 stepper motor driving stages based on integrated motor drivers. Each of these motors is associated to positioning sensors that monitor their functioning. The signals of these sensors is fed back to the CPU board, except the signals of microswitches S2 and S3 (column motor) that, as already described are fed back to the power supply assembly.
The number and the type of sensors depend on the function of each motor. In general, microswitches are used, except for the Primary collimator motor which uses a microswitches for the "zero position" detection and 3 optocouplers (mounted on board A9) to decode the position of the collimator disk which carries the 7 apertures.

Depending on the physical location of the motors on the machine, their signals and the ones of the relevant positioning sensors are routed directly to the CPU through dedicated cables, or passing through interconnection boards located nearby.

The transmission of the motion from the motor to the relevant movement assemblies is achieved through toothed belts (rotation motor, X axis motor, Y axis motor and primary collimator motor) or through actuators (column motor and Soft Tissue Filter motor)

The functioning of the different motors and relevant positioning sensors can be tested through the use of the Service Programs (Passwords). For more details, please refer to paragraph 8.3.

A serial output of the CPU board (TTL level) is fed to a small TTL/RS232 conversion board (A12).
This RS232 line is used to connect to the Direct Digital Sensor board. From this board, the USB/2 line is connecting the Digital Sensor to the external PC.

The circuits of the CPU board are supplied starting from the +24Vdc provided by the Power supply assembly and generating on board the requested voltages (+5V, +5VS and +12VS). Three LED's on the board indicate the presence of these 3 voltages (+5V=LED H2, +12VS=LED H3, +5VS=LED H4).

3.5.3. HF Board (A2) and Tubehead

The HF board and the tubehead are located on the rotating arm, very close to each other. The power supply voltage (230Vac) is directly provided by the Power supply assembly, passing through a filtering box having the function to rectify the input voltage to generate a 360Vdc voltage.

Dedicated switching circuits, directly located on the board, generate the voltage used on the board itself (+12V/-12V).

Managing of the HF board is done by the main CPU board of the unit.

The high frequency (HF) circuit is based on an inverter circuit working at the frequency about 30Khz, which drives the tubehead through an output stage based on IGBT components.

The HF board receives the signals concerning the X-ray dose to provide (kV and mA), directly from the CPU board. The HF board provides to the tubehead the voltages that drive the high voltage transformers that then drive anode and filament of the X-ray tube, also giving the relevant timing.

The tubehead is composed by the radiogenic tube (CEI OPX/105) inserted in a sealed container, together with the high voltage transformers, filled with dielectric oil.

Checking of proper functioning of the X-ray emitting system is achieved through the analysis of feed back signals generated inside the tubehead and transmitted to the HF board. Possible anomalous conditions are then communicated to the CPU board which in turn generates error codes to alert the operator.

3.5.4. Keyboard

The keyboard is the interface with the operator, and is composed by the following items:

- Matrix of keys, constituted by microswitches with short stroke, necessary to activate the different available functions
- Signalling LED integrated in the touch panel
- LCD display equipped with back-light, composed by a matrix of 16 characters and 2 rows
- Keyboard PCB.

The keyboard PCB is directly connected to the CPU board which controls it. The language of the messages shown on the display can be selected among 5 different options (English, Italian, French, German and Spanish). The language selection is only available for the messages dedicated to the user. The messages relative to the service programs (Password) are always in English.

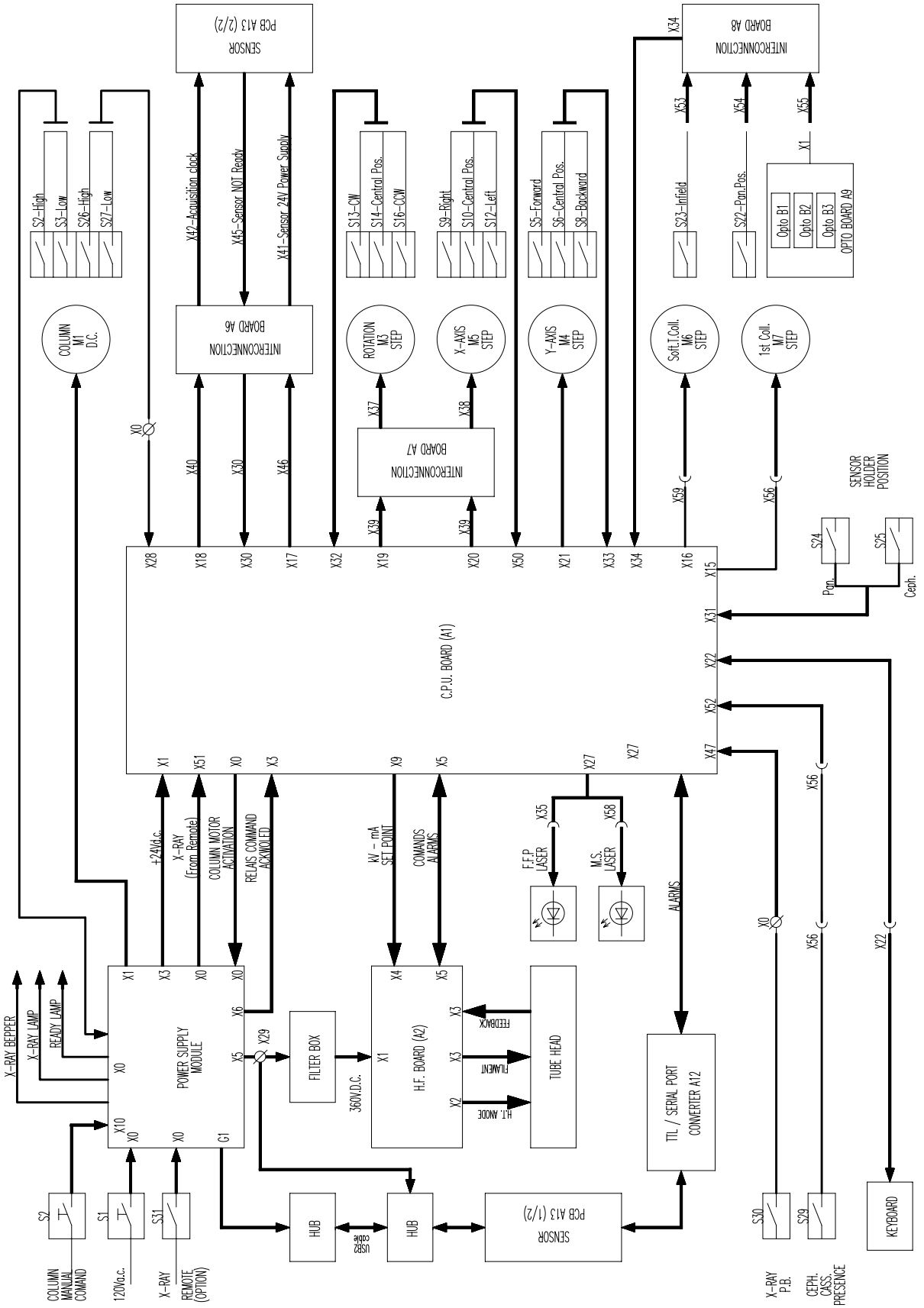


Figure 3-3 – Block diagram

3.6. Control panel - Descriptions and functions

STRATO 2000 keyboard is divided into 8 functions areas, and a display to view the messages and the error codes.
Next figure shows a general view of the keyboard, while details an each functional area are provided in the following pages.

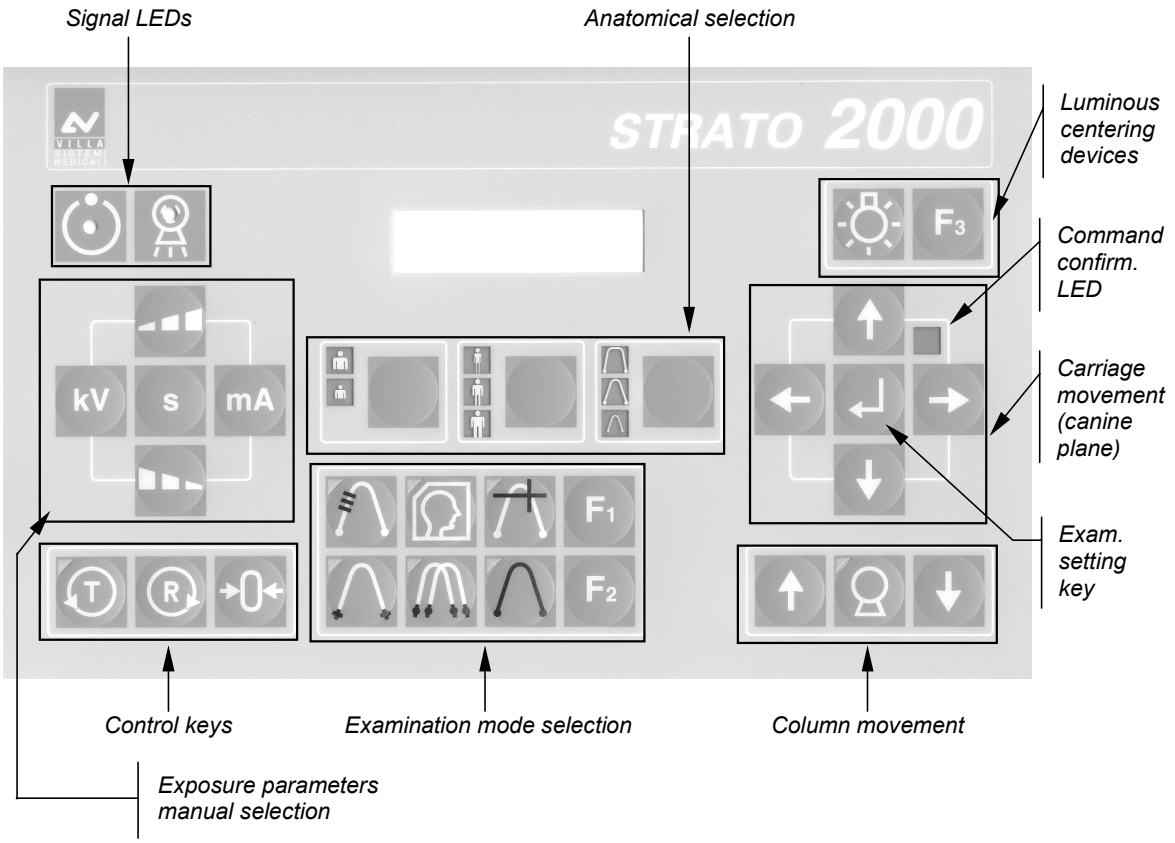
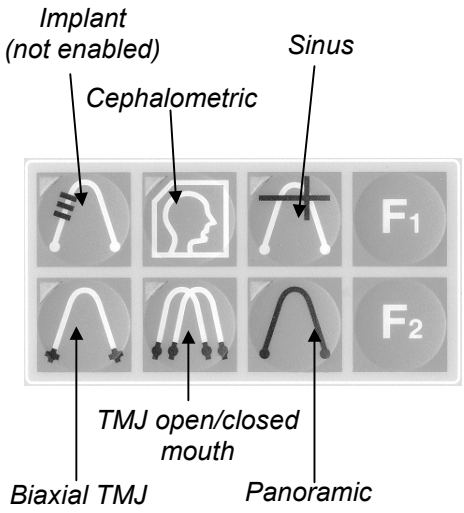
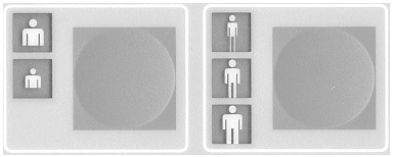


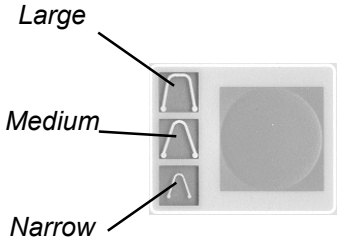
Figure 3-4



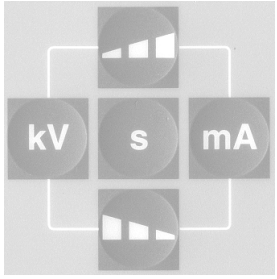
Each key enables the selection of a specific examination. The pre-set examinations are:
Panoramic – TMJ open/closed mouth, TMJ biaxial, Implant (not enabled), Sinus, Cephalometry.



It is possible to select the examinations automatically (anatomic selection) using pre-fixed exposure values. This kind of selection enables to choose between Adult/Child, each with three different sizes (small, medium, large); for Panoramic and TMJ open/closed mouth there is the possibility to chose among three different dental arches.

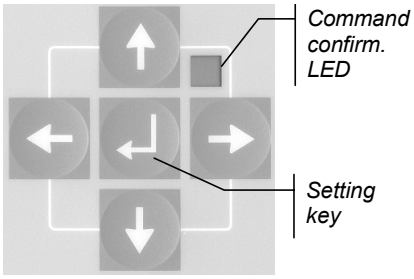


In panoramic and TMJ examination mode, the system allows the selection of the type of the dental arch.
The arch key allows the selection among 3 different mouth conformations: narrow - medium - large.
The selection made is confirmed by the activation of the corresponding LED.
The arch selection does not influence the values of kV and mA but acts on the position of the focus layer.



Furthermore there is the possibility to select manually the exposure parameters; in this case select at first the parameter to be changed and secondly, using the increasing and reducing keys, set the required value.
The parameters available are: kV, mA and time. The latter just for cephalometry.

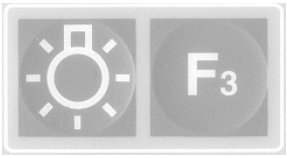
This area contains the keys which control the tubehead arm movements (canin plane) during the patient positioning, and the relevant confermation key. When the "Command confirmation LED" is lit, it means that the key  , must be pressed to confirm the selected command.



There are two light indicators; the first one on the left indicates the condition "Machine Ready", indicating the user that by pressing the X-ray button key once more, X-rays emission will start; the second led indicates the emission of X-rays.

The movement of the column is controlled by the related keys; for safety's sake, this control is performed pressing two keys at the same time, the central one and one of the two lateral.

The left button is dedicated to the center of sagittal, canine and Frankfurt planes, thus adapting the STRATO 2000 to the patient anatomy.
The right button is reserved for future use.



Apart from the keys dedicated to the selection of the examination functions, part of the STRATO 2000 keyboard is dedicated to the services. From left to right, we have: the "Test" key (which disables the X-ray emission during arm rotation), the "Reset" key (to be pressed after the unwanted release of the X-ray push button "30" during exposure) and the "Arm return" (to prepare the system for the next examination).

3.6.1. Key functions description

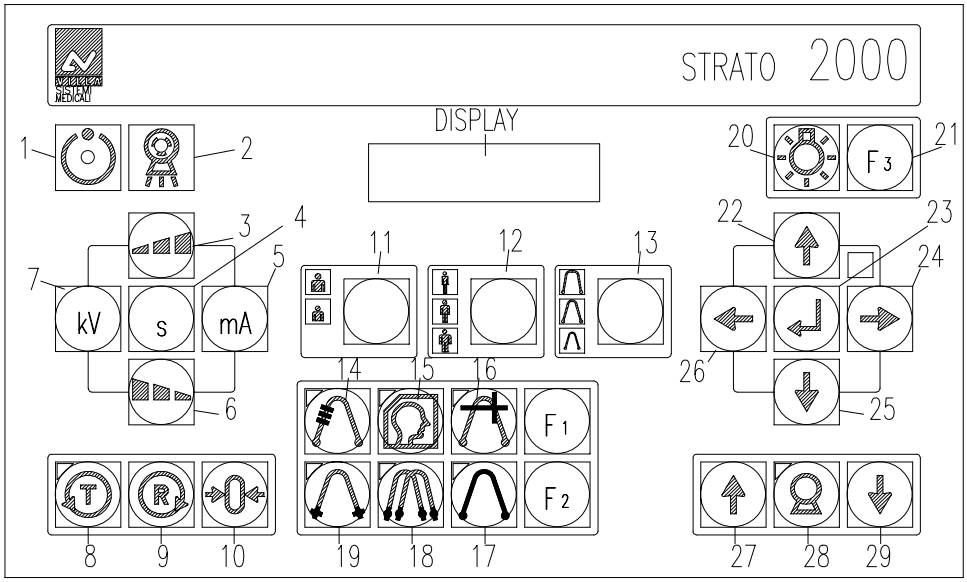


Figure 3-5 - Control panel

LEGEND:

Messages
Display: indicates operative messages, warnings and exposure parameters.

Signal lights
1 - Led indicating the machine is ready for X-ray emission (green LED)
2 - Yellow LED indicating X-rays emission

Manual setting of exposure parameters
3 - kV, s or mA increasing
4 - Seconds
5 - milliAmpere
6 - Reduction of kV, s or mA
7 - KVolt

Preparation functions
8 - Key to set Test function
9 - Reset, axes alignment and enabling to modify exam modes
10 - Positioning of the rotation unit to start the selected examination or return of the unit for a new setting

Anatomic selection
11 - Adult or Child (green LED)
12 - Small, medium or large size (green LED)
13 - Wide, normal or narrow arch (for Panoramic and TMJ exposure) (green LED)

Examination mode
14 - Implant (not enabled)
15 - Cephalometry (Optional)
16 - Sinus examination (Optional)
17 - Panoramic
18 - TMJ closed mouth – open mouth
19 - TMJ biaxial / TMJ P/A (Optional)

Centring devices
20 - Saggital, Frankfurt and Canine Plane centring unit
21 - Button not active

Patient centring
22 - Moving canine plane
23 - Enter key
24 - Button choice cassette (Ceph)
25 - Moving canine plane
26 - Button choice cassette (Ceph)

Height adjustment
27 + 28 - Column up
29 + 28 - Column down

3.7. Service programs description

STRATO 2000 allows the authorised technicians to access to the different functional parameters of the unit through a dedicated software composed by the following service programs. Each service program can be accessed through a dedicated password.

The service programs available are the following:

- ***Password 94:*** test of a number of HW components in the system
- ***Password 102:*** allows reading of the parameters stored into the non-volatile memory of the unit (e.g. motor offset)
- ***Password 118:*** test on motors/positioning sensors, setting of the zero offsets of the axes and the collimators
- ***Password 124:*** definition of the parameters for the cephalometric examination
- ***Password 130:*** language setting for the displayed messages (the Service messages are always in English)
- ***Password 143:*** display and reset of the counters for the various examinations. Display of total time of the system's exposure.

The above mentioned programs are described at paragraph 8.3 of this manual.

3.7.1. Special Password

Two special passwords are used to configure the proper hardware for the Digital Version.
These configuration is accessed in a different way with respect to the above listed service program passwords:

- ***Password 89:*** selection of primary collimator type
- ***Password 90:*** selection of digital version.

The above mentioned programs are described at paragraph 8.3 of this manual.

3.8. Service tools

The unit is supplied equipped by the following tools:

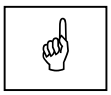
Code	Description	Function
39099004	Upper template	Template for the upper fixing of the column

Furthermore, the following service kit is available:

Code	Description	Function
54099005	Fluorescent screen	To verify the centring of the X-ray beams
54089021	Round centering tool	Used for centring purposes
54099002	Flat centring tool	PAN function centring template to be used in case a wrong alignment af the laser beam has been detected while using the round centring tool (54089021)

4. TECHNICAL DATA

General features	
Type	STRATO 2000
Manufacturer	VILLA SISTEMI MEDICALI Buccinasco (MI) Italia
Class	Class II according to 21 CFR-Subchapter J. Class II B for European Directive for Medical Devices 93/42. Class I with type B applied parts according to IEC 601-1. 
Protection degree	IP20
Rated line voltage	120V~ ±10%
Line frequency	60Hz
Maximum line current	15 A (at 108V, 80kV, 12mA – see Note 1)
Power consumption	2 kVA
Protection fuse (F2)	15 A F
Transformer protection fuse T1 (F1)	0.8 A T
Controls supply protection fuse (F5)	0.5 A T
Column motor protection fuse (F3, F4)	7 A T
Line voltage regulation	< 3% at 108V~ (see Note 1)
Rated output voltage (kVp)	50 ÷ 80 kVp in 2 kVp steps
Anodic current	4 ÷ 10 mA in 1 mA steps for PAN/TMJ 4 ÷ 12 mA in 1 mA steps for Ceph



NOTE 1:
Due to the technology used to compensate line voltage fluctuations, the max line current drawn from the line is at lowest voltage (108 V).

Exposure time	
Panoramic (PAN)	15 s PAN Adult / 13.5 s PAN Child
Emi Panoramic	8 s Adult / 8 s Child
TMJ open/closed mouth	5.3 s per image for left and right joint in open and closed condition
TMJ biaxial	10.7 s (total time)
Sinus P/A projection	10.5 s
Sinus lateral projection	5.2 s each side
Cephalometry (Ceph)	0.2 ÷ 3 s
Exposure time accuracy	± 10 %
Examination programs	
Examination selection	• Automatic selection for Adult and Child, 3 sizes, 3 arches (in Panoramic and TMJ) • Automatic selection for Adult and Child, 3 sizes (in biaxial TMJ) • Manual selection • Collimator with automatic positioning
Panoramic	• Standard Panoramic • Emi Panoramic
TMJ (Temporal Mandibular Joint)	• TMJ open and closed mouth • TMJ biaxial
Cephalometry	• Cassette 8" x 10" • Cassette 18 x 24 cm • Cassette 30 x 24 cm (24 x 30 cm optional; in this case the size 24 x 18 symmetric is not available). • Soft Tissues filter adjustable by motorized movement.
Image magnification	
PAN and TMJ open/closed mouth	1 : 1.23
TMJ biaxial	1 : 1.20 (average)
Ceph	1 : 1.1 (average)
No. of images in TMJ (open/closed mouth/biaxial)	4

X-ray tube characteristics	
Manufacturer	CEI Bologna (Italia)
Type	OPX 105
Nominal focus size	0.5 IEC 336
Inherent filtration	0.5 mm Al eq.
Anode tilt	5°
Anode material	Tungsten
Nominal maximum voltage	105 kV_p
Filament max current	4 A
Filament max voltage	8 V
Anode thermal capacity	30 kJ
Tubehead characteristics	
Model	MS 05
Manufacturer	Villa Sistemi Medicali S.p.A. 20090 Buccinasco (MI) Italia
Maximum tube voltage	80 kV_p
kV_p accuracy	± 8 %
Max. anodic current	12 mA
Anodic current accuracy	± 10 %
Duty cycle	1 : 16
Nominal power	0.96 kW (80 kV_p - 12 mA)
Total filtration	2.5 mm Al eq. @ 70 kV_p
HVL (Half value layer)	> 2.5 mm Al eq. @ 80 kV_p
Transformer insulation	Oil bath
Cooling	By convection
Leakage radiation at 1 m	< 0.5 mGy/h @ 80 kV_p - 12 mA - 3 s duty cycle 1/16
Reference time product current	1.2 mAs (6mA for 200msec)

Laser centering devices	
3 laser beams are used for the patient positioning; beams align mid Sagittal, Frankfurt and Canine Planes (please refer to relevant paragraphs for detailed explanation).	
Wave length	635 nm
Optical power of laser diode	5 mW
Optical power of the collimed beam	4.5 nW
Divergence	6.67 mRad
Optical power on the working surface	< 3 mW
Laser class	2 M
DNRO in 30 s application period	0.05 m
Mechanical characteristics	
Focus-receptor distance (PAN, TMJ)	51 cm (20")
Focus film distance (CEPH)	165 cm (65")
Film size (CEPH)	8" x 10", 18 x 24 cm and 24 x 30 cm
Telescopic motorized column run	67 cm (26.4")
Total height max.	232 cm (91.3")
Width x Length	• 100 x 125 cm (39.4" x 49.2") without CEPH • 177 x 125 cm (69.7" x 49.2") with CEPH
Weight	• 130 kg without CEPH • 145 kg with CEPH
Column weight	72 kg
Weight of arm support, rotating arm and tubehead	48 kg
Weight of the chin rest arm	8 kg

Environmental features	
Working area (please refer to paragraph 5.3)	• 130x130 cm (51.2"x51.2") without CEPH • 130x190 cm (74.8"x51.2") with CEPH
Minimum height ceiling (please refer to paragraph 5.3)	250 cm (98.5")
Temperature in working condition	+ 10° ÷ + 40°
RH (related humidity) in working condition	30% ÷ 75%
Temperature for transport and storing	- 20° ÷ + 70°
Humidity for transport and storing	< 95% without condense
Min. atmospheric pressure for transport and storing	630 hPa

4.1. Applied safety regulations

STRATO 2000 complies with the following standards:

- 21 CFR subchapter J
- General safety:
  IEC 601-1
  IEC 601-1-1
  IEC 601-2-7
  IEC 601-2-28
- Electromagnetic compliance:
  IEC 601-1-2
- Protection against radiation:
  IEC 601-1-3
  IEC 825-1

CE 0051 The symbol CE grants that STRATO 2000 complies with directives 93/42 for medical devices issued by the European Community.

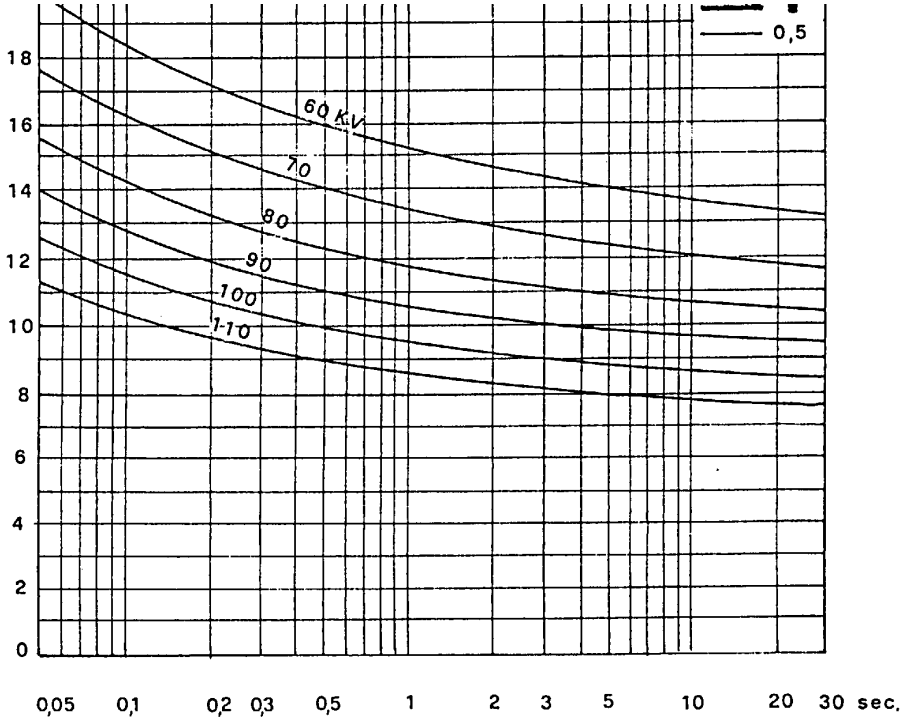
Classification

STRATO 2000 is an electro-medical X-ray device belonging to Class 1 and Type B as per classification IEC 601-1, foreseen for a continuous working at intermittent load.
According to CE 93/42 directive for medical devices, the equipment belongs to class II B.
According to FDA 21 CFR, the equipment belongs to class II.

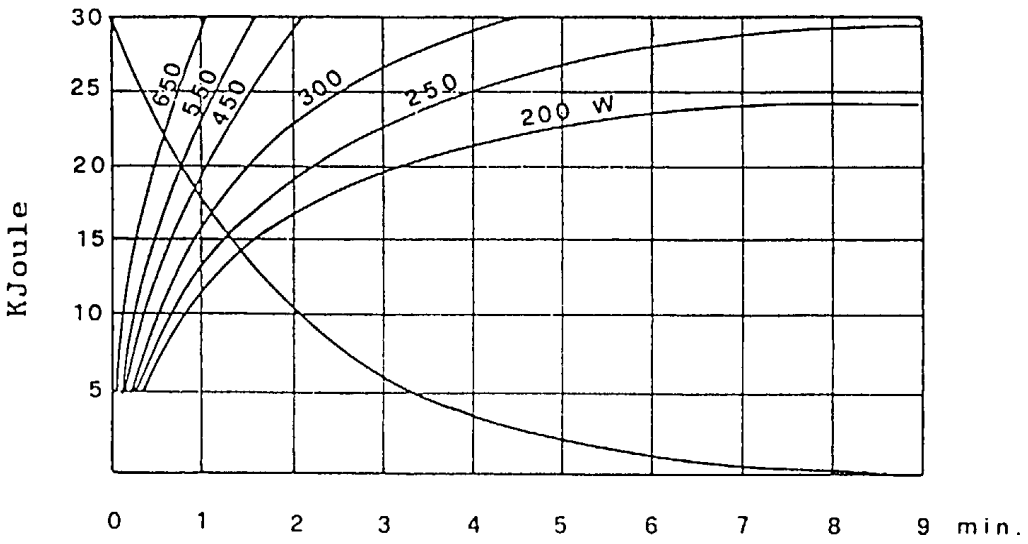
4.2. Loading curve of the tube and cooling curve of the anode

Tube "CEI - OPX / 105" (0.5 IEC 336)

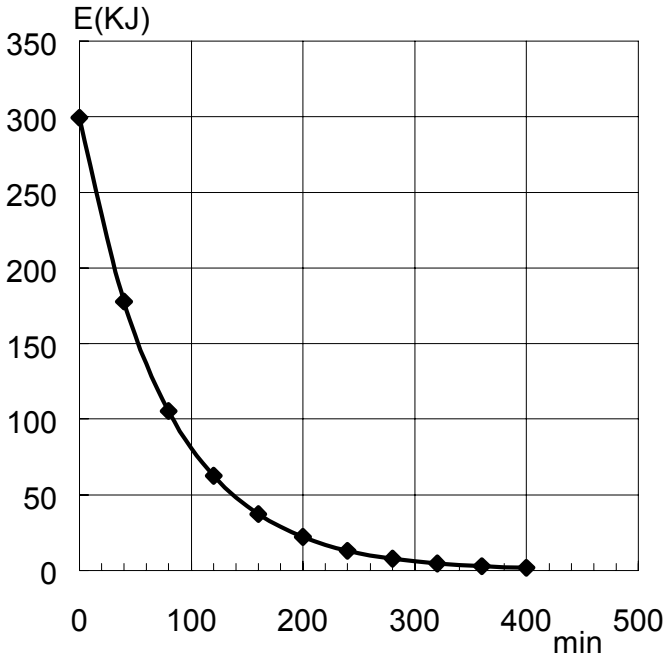
Load



Anode cooling curve



Cooling curve of Tubehead

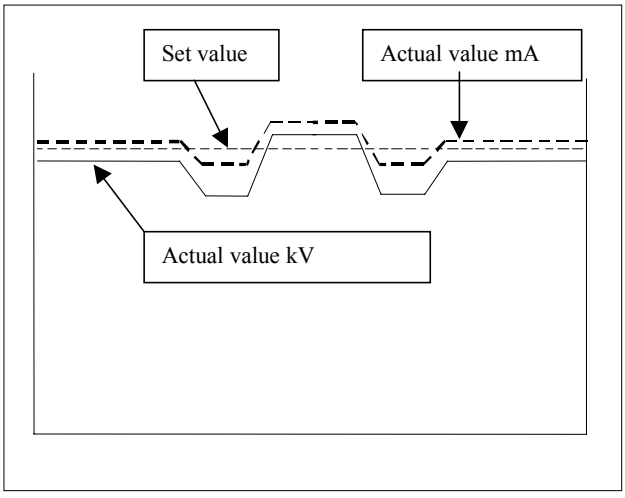


4.3. Measurement method of technical factors

WARNING:
These measurements require the removal of the HF group covers; this means to gain access to internal parts where high voltage are normally present.

For the measurement of the exposure parameters with the invasive method, please follow the procedure described in paragraphs 7.2 and 7.3 of this manual.

WARNING:
During the panoramic examination, the set value of kV and tube current varies according to a pre-determined curve in order to compensate the different absorption of X-ray beam due to different anatomical structures. In this way, it is possible to obtain a good uniformity of the image's contrast. Particularly, the chosen value is lowered on the initial phase of the panoramic and increased on the scissors/canine zone, in order to compensate the effect of the cervical spine.
The value displayed during the panoramic examination corresponds to the to chosen one, while the istantaneusly value can be different; these effects must be considered in case of measure of the exposure factors using standard diagnostic mode. As an example, the variation follows the curve hereafter:

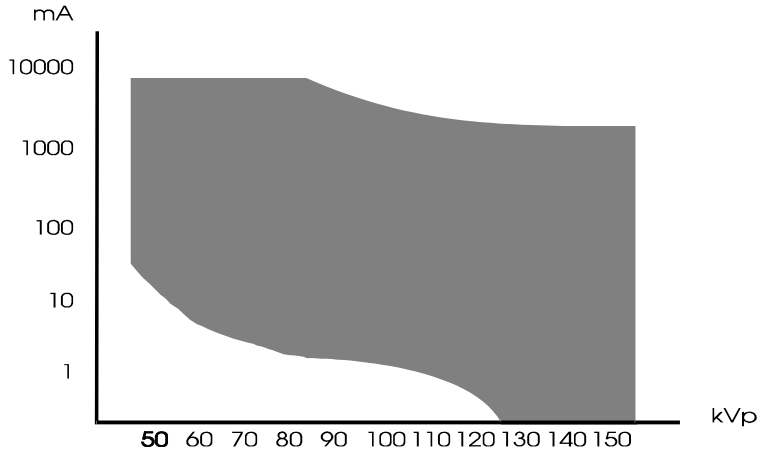


Accuracy declared on the section "Technical data" is referred to the actual value of kV and/or mA. In any case, manufacturer guarantees that the accuracy of loading factors is always compliance with the international standard for safety of medical devices IEC 601-1. Particularly, in accordance with IEC 601-2-7, the maximum deviation (including the correction and instrument's accuracy) is less than or equal to ±10 for kV, while for tube current is less than or equal to ± 15%.

4.4. Verify method of exposure parameters

The exposure parameters can also be verified using the so called "non-invasive method".

NOTE:
The instruments normally used for the measurement of the exposure parameters (kVp) with the non-invasive method, have an intrinsic measurement non-linearity when used to measure low dose radiations. This non-linearity can lead to measuring errors clearly not due to the STRATO 2000.
As example, please see the next diagram where the sensitivity curve of a normal measuring instrument is shown. Working outside the dark area, the instrument is not linear.



The exposure parameters can be checked with a non-invasive instrument.

WARNING:
In case of a unit with fixed collimator the X-ray beam is very narrow and the system does not have the possibility to use a Ceph slot to get a wider beam.
Measurement by a non invasive kV meter an a very narrow beam can be difficult and/or unreliable and special probes with reduced sensitive area must be used.
It may result helpful to use a fluorescent screen to locate the X-ray beam and consequently position the probe of the kV meter.

The procedure to measure kVp by a non-invasive kV meter is the following:

1. With the unit on, select the Panoramic examination mode by pressing key "17"  .

2. Press keys "10"  , "28"  and "24"  at the same time. LED's of "patient type", "patient size" and "Arch" switch off and the display shows the following two messages alternatively

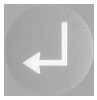
				R	**E**	**M**	**O**	**V**	**E**						
			C	**H**	**I**	**N**		**R**	**E**	**S**	**T**				

and

					C	**L**	**O**	**S**	**E**						
	T	**E**	**M**	**P**	**L**	**E**		**S**	**U**	**P**	**P**	**O**	**R**	**T**	

NOTE:
The following operations is a confirmation that the above points have been performed.

NOTE:
This program allows you to carry out the measuring of the exposure parameters having the tubehead-arm in a fixed position (not rotating).

3. Carry out the actions mentioned above; press key "23"  ; the unit will carry out a movement to reach the "zero" position. During this phase, the display shows:

P	**L**	**E**	**A**	**S**	**E**		**W**	**A**	**I**	**T**	**.**	**.**	**.**		

Once the "zero" position is reached, if the unit carries a fixed collimator go to step 5.
If the unit carries a rotating collimator the following message will be displayed:

					O	**P**	**E**	**N**							
	C	**A**	**S**	**S**	**E**	**T**	**T**	**E**		**U**	**N**	**I**	**T**		

4. After opening the sensor holder to Ceph position (this action is sensed by the unit which monitors the status of microswitches S25), the display shows:

P	L	E	A	S	E		W	A	I	T	.	.	.		

In the mean time, the unit sets the primary collimator to position 18x24 symmetric (Slot #5) and the Soft Tissue Filter in position "not in field"; at the end of the positioning phase.

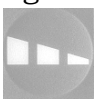
5. The display shows:

	R	X		P	A	R	A	M	E	T	E	R	S		
	7	0	k	V		0	8	m	A		1	.	0	0	S

6. Place the measuring instrument over the chin support.

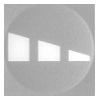
7. Acting on keys "4" 

and "7" 

and on keys "3"  or "6"  set the exposure parameters to carry out the desidered checks.
The variation range of the parameters is shown in the following table (see also NOTE at page 4-10):

Parameter	Minimum value	Maximum value
kV	50	80
s	0,2	15

NOTE:
Acting on key "5" 

and then on keys "3"  or "6"  the mA value can be changed.
The mA value ranges from 4 to 12 (1 mA step).

WARNING:
X-ray will be emitted during the performance of the following operations. Authorised technicians are therefore recommended to use the greatest caution and to comply with the safety regulations and laws of their country.

8. Perform an exposure; the emitted parameters (kV and Time) can be read on the measuring instrument.

NOTE:
The performances are guaranteed if the measurement of kV and mA is done with the invasive method (see paragraph 7.2 and 7.3).

9. To quit this routine, press key "9"  ; if the unit carries a rotating collimator and the sensor holder is open, the display will show:.

	C	L	O	S	E		C	A	S	S	E	T	T	E	
		T	O		P	A	N	O	R	A	M	I	C		

In case of fixed collimator jump to step 10.
After closing the sensor holder to Panoramic position (the position is sensed by the unit through microswitch S24), the display will show the following message:

P	R	E	S	S		E	N	T	E	R					

Press key "23"  ; the unit will carry out the zeroing and will set itself in the patient entry position; the display will first show:

P	L	E	A	S	E		W	A	I	T	.	.	.		

10. The display will show:

S	T	D	.		P	A	N	O	R	A	M	I	C		
	x	x	k	V		x	x	m	A		1	5	.	0	s

and the unit returned at a standard mode.

4.5. Dimensions

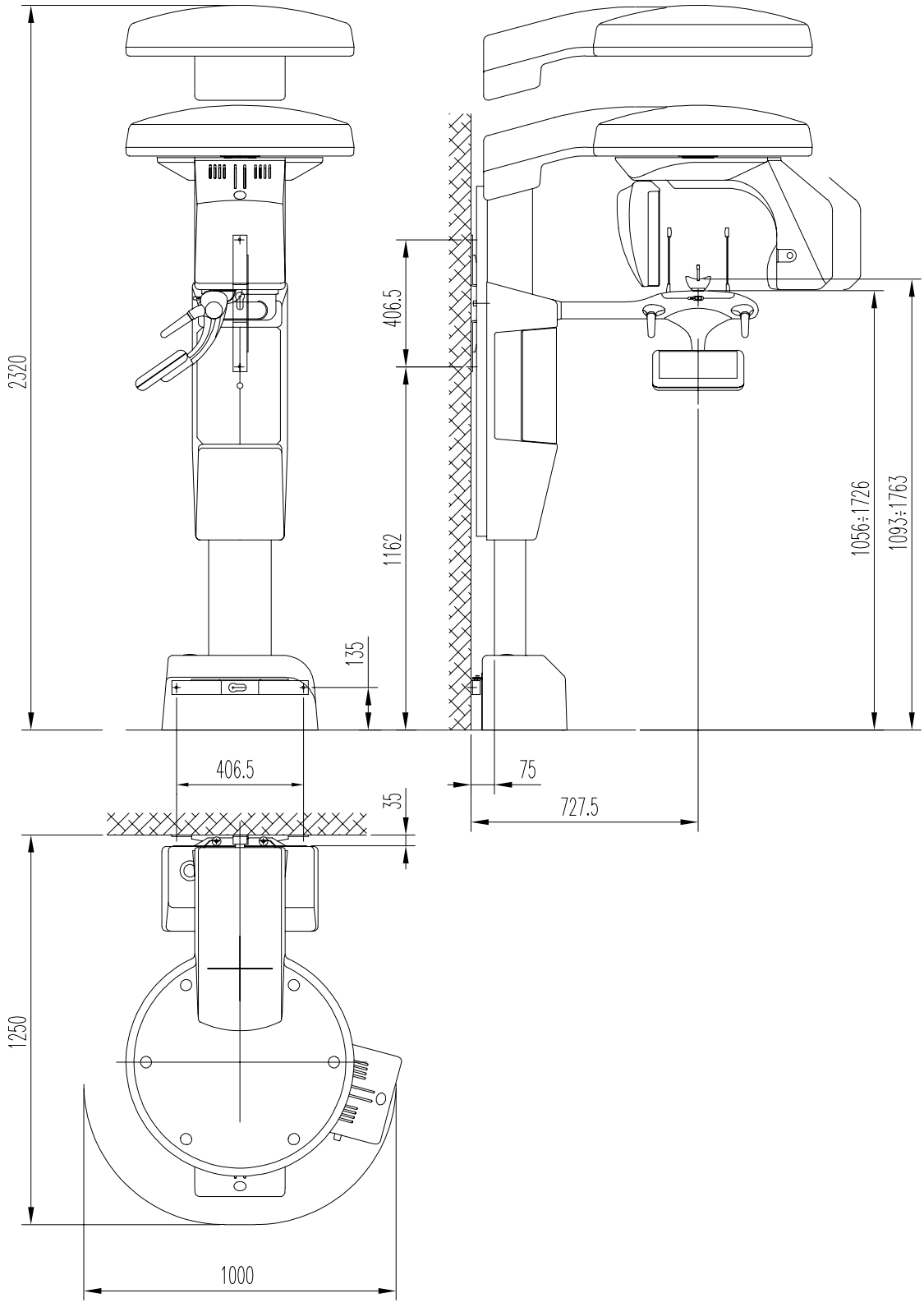


Figure 4-1 - Base version

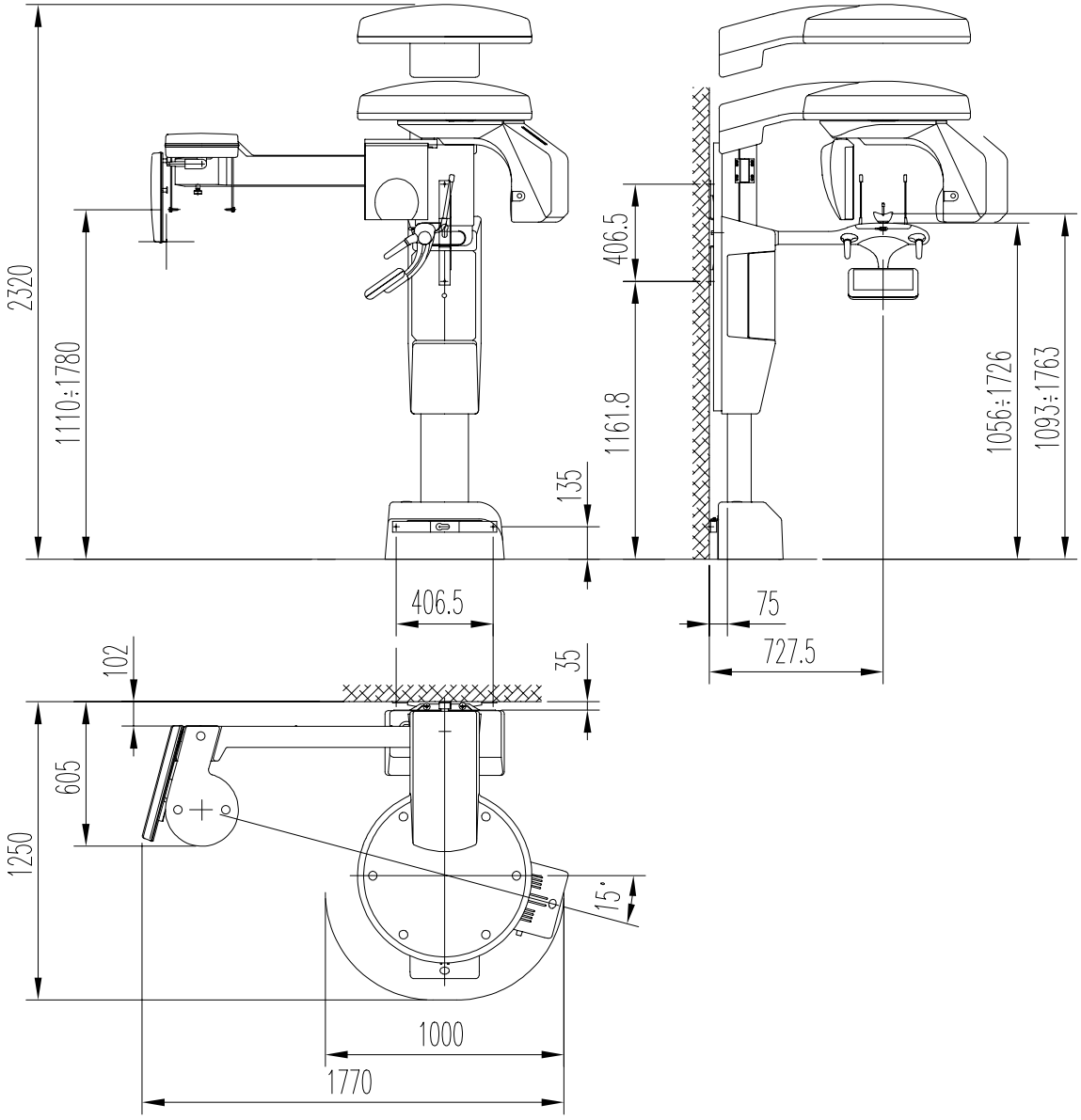


Figure 4-2 - Version with cephalometric unit

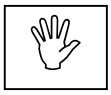
THIS PAGE IS INTENTIONALLY LEFT BLANK

5. PRE-INSTALLATION

The instructions indicated in this and in the following chapter enable to perform a correct installation in order to grant a regular operation of STRATO 2000 Digital Version.
The supplier can supply the assistance and the necessary technical advice for pre-installation, all masonry works and the pre-installation phase are at the customer's charge and must be performed complying with the indications given below.

The requirements for a correct installation of STRATO 2000 are:

- minimum height of the room: 2.5 mt. and a surface variable according to the configuration of STRATO 2000 to be installed, as indicated in the picture at paragraph 5.3
- a certain distance from heating devices
- the entries in the room, for the transport of the unit, must have a minimum width of 80 cm.



WARNING:
In all its versions, STRATO 2000 must be fixed at the wall by the two brackets supplied, which have to be fixed by the dowels enclosed. Each dowel must support a max. extraction force of 120 kg.
The fixing dowels to be employed, for any kind of wall, are the following:

- **full bricks:** supplied dowels (cast-iron dowels for the upper bracket and plastic dowels for the lower one)
- **wood mountings:** self tapping screws
- **hollow bricks:** optional chemical dowels (code VSM 6660132000).

5.1. Electrical setting up

- Single-phase grounding supply 120V ~
- Frequency 60Hz
- Power consumption 2kVA
- Current consumption (max.) 15A
- Line voltage regulation < 3% @ 108V

NOTE:
The device is supplied as unit to be installed permanently.
Please DO NOT connect the unit to the line using a normal socket, to avoid compromising the electrical safety.

The unit must be connected to a differential magneto-thermal switch, to divide the unit from the supply. This switch must comply the electrical regulations in force in the country of installation.
The supply conductors must have a 1,5 mm^2 (16 AWG) section.
The general grounding must comply with the rules in force; a wrong quality of the grounding could be dangerous for the operator's safety and cause a bad function of the electrical devices.

NOTE:
STRATO 2000, complying with rule **IEC 601-2-7**, IS SET TO connection, at the entrance of the X-ray room, the following control and warning devices:

- **REMOTE X-RAYS BUTTON:** "Dead-man" remote control, enables to perform the exam at a distance, the operator can stand outside the X-ray emission area. Terminal board X0 pin 8 and 9.
- **READY light:** Green light (24V 40W max.), it signals that the machine is ready to perform the exam. Terminal board X0 pin 10 and 11 (contact N.O.).
- **X-RAYS light:** Yellow light (24V 40 W max.) it signals the entry in the X-ray room is forbidden, since an exposure is on the run. Terminal board X0 pin 12 and 13 (contact N.O.).
- **BEEPER:** Outer acoustical signal (24V max.), it indicates entrance in the X-ray room is forbidden since an exposure is on the run. Terminal board X0 pin 14 and 15 (contact N.O.).

NOTE:
The connections of the above described accessories is carried out throug terminal block X0 located in the power supply module, at the base of the column (see chapter 9, drawing #1, sheet 11 for contact identification). The power supply module is normally shielded by a metal cover. Remove the cover to gain access to terminal block X0.

NOTE:
The electrical connection must be done on the terminal board X0 (see operation circuit diagram – chapter 9).

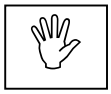
NOTE:
The unit only provides the closing contacts relative to the above mentioned functions. Power voltages for the relevant devices have to be provide from outside, making sure not to exceed the indicated ratings.

To connect all control and warning devices it is advisable to set 8 wires with 0.5 mm^2 section.

5.2. Packaging

STRATO 2000 in base version is delivered in two carton-board boxes; the device equipped with Cephalometric unit will be delivered in three boxes. Net weight, gross weight and the contents of the packaging are indicated in the following table:

Contents	Weight	
	Net	**Gross**
- Axis movement device, complete with tubehead - Digital sensor holder - Accessories	55 kg	90 kg
- Column complete with base - Chin-rest arm and keyboard - Various coverings	105 kg	130 kg
- Cephalometric device - Accessories for Cephalometric device	25 kg	42 kg



WARNING:
Before unpacking the different components of the equipment, read carefully paragraph 6.3 of this manual.
Villa Sistemi Medicali will not bear any responsibility for damages caused to the equipment due to improper unpackaging procedure, and for the relevant costs.

5.3. Space requirements

5.3.1. Version without CEPH

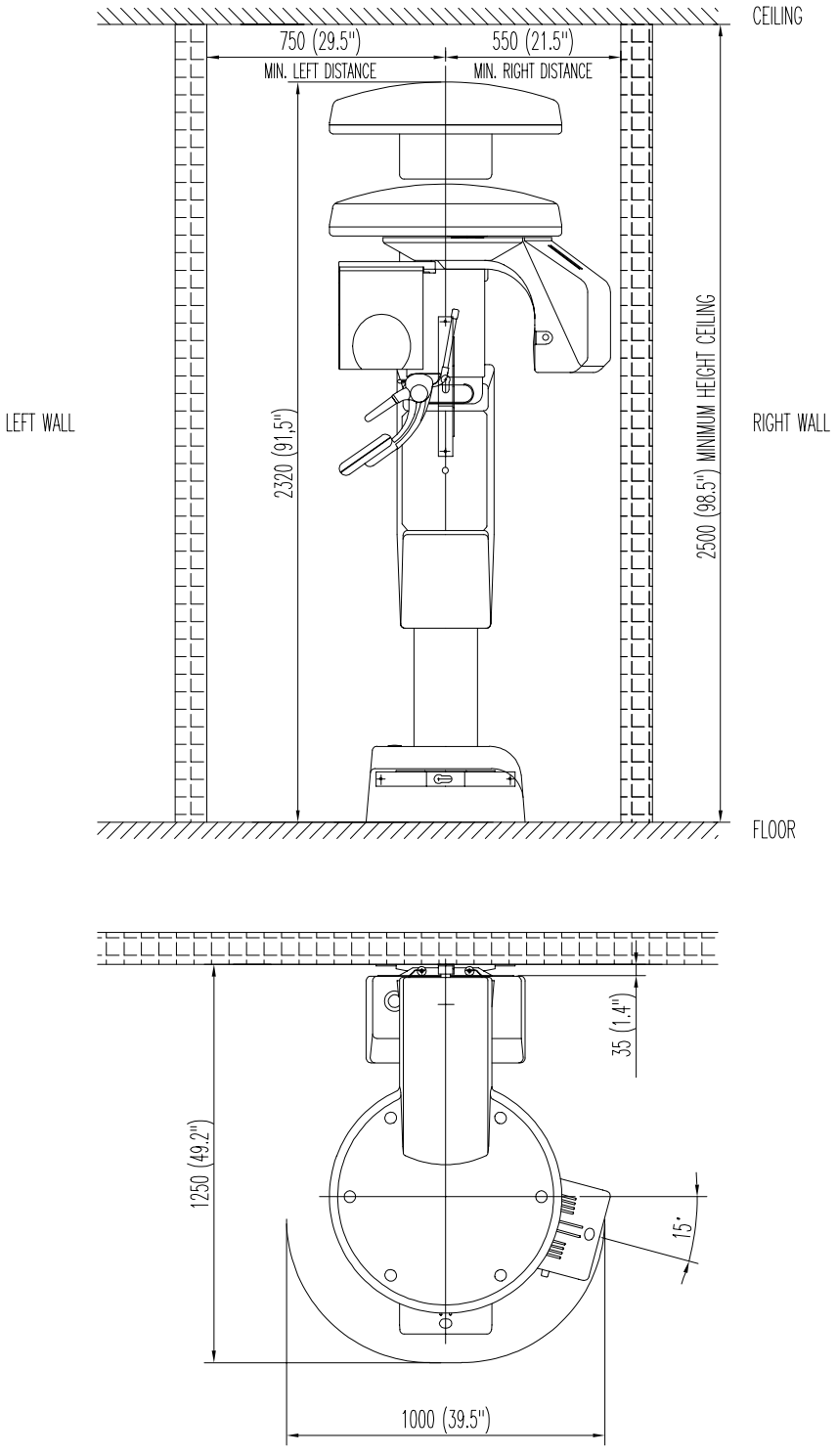


Figure 5-1

5.3.2. Version with CEPH

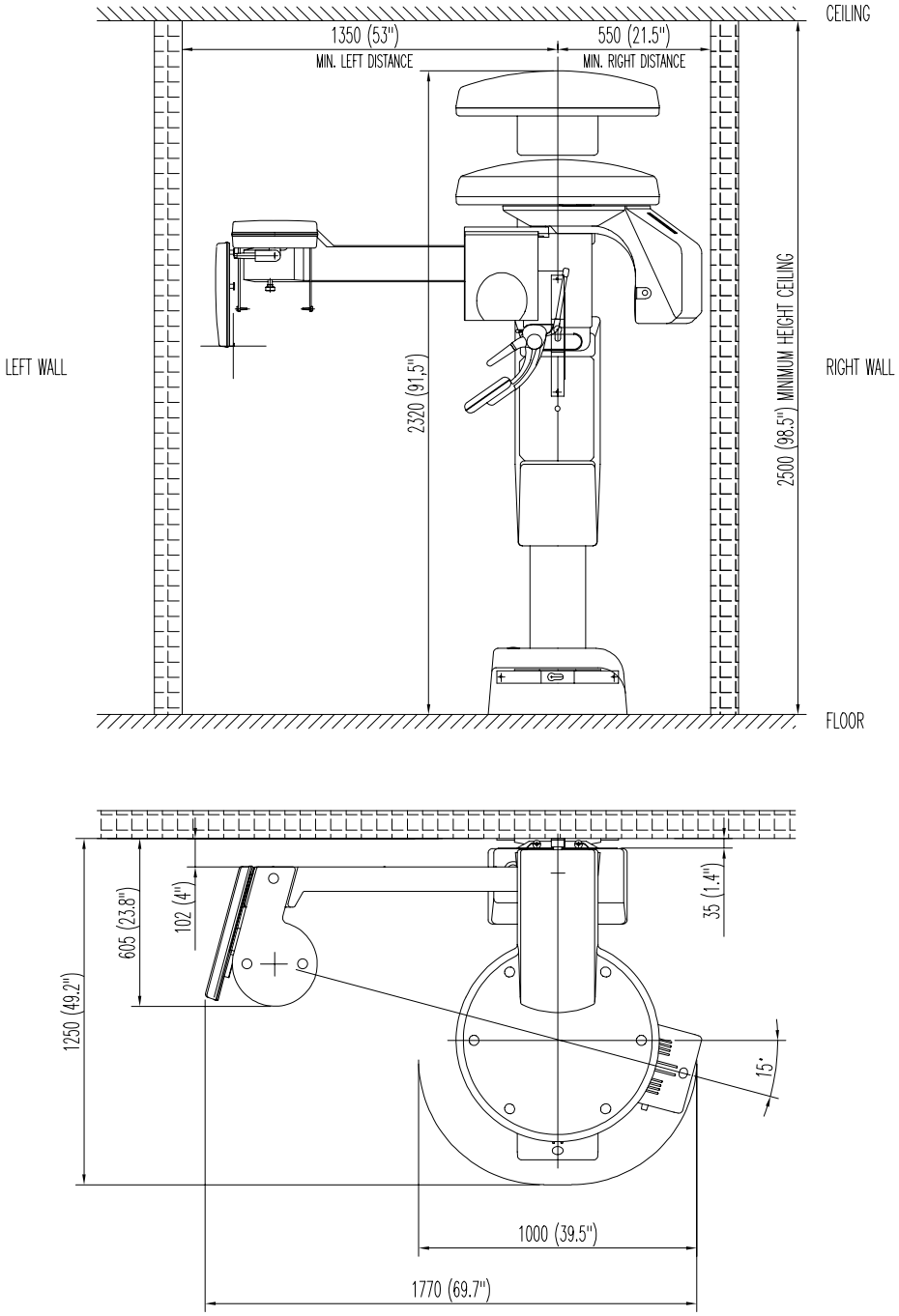


Figure 5-2

6. INSTALLATION

NOTE:
STRATO 2000 is delivered pre-mounted in groups.
The mechanical mounting consists exclusively in assembling the above mentioned groups. Bearings adjustment and the adjustment of possible fixing couplings are therefore carried out in factory; each intervention on these particulars is useless and could damage the device.
Two technicians will be necessary to perform some procedures; the phases requiring the intervention of two men are identified in the related chapters.

6.1. Setting of the wall

NOTE:
STRATO 2000 has been designed for a wall fixing by two brackets, each of which requires to be fixed by two dowels. This initial setting foresees the fixing of the upper bracket; the lower one will be set just after having fitted the column in the upper.

1. Position the paper template "A" enclosed to the manual (Code 39099004) on wall, and mark the position of the holes to drilled. The template must be set on the wall setting the dotted line at 1365 mm from the floor as indicated on the same template.
2. Then mark the wall by a centre punch, at the level of the fixing holes, use drill "B" to hole the wall according to the type of dowels (see chapter 5).
3. Mount wall bracket "C".

NOTE:
The bracket is to be mounted positioning the wider part of the eye upwards, as shown in the picture.

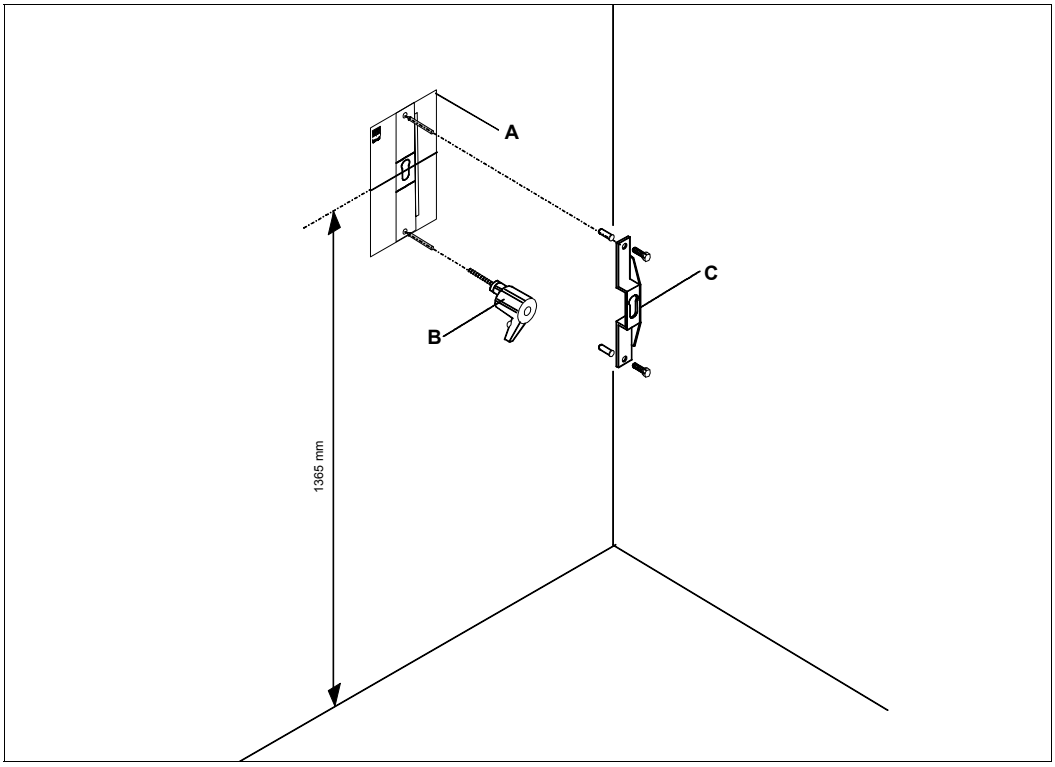


Figure 6-1

6.2. Column mounting

NOTE:
Check that bracket "C" is fixed correctly.

1. Fix on the base of the column the trapezoidal square "D" by the two side screws.
2. Fix the four handles "F" equipped with the unit, on the sides of column "E".
3. Grasp the handles (operation to be done by two persons) and make the rear pin "G" get into the eye on the wall bracket "C".

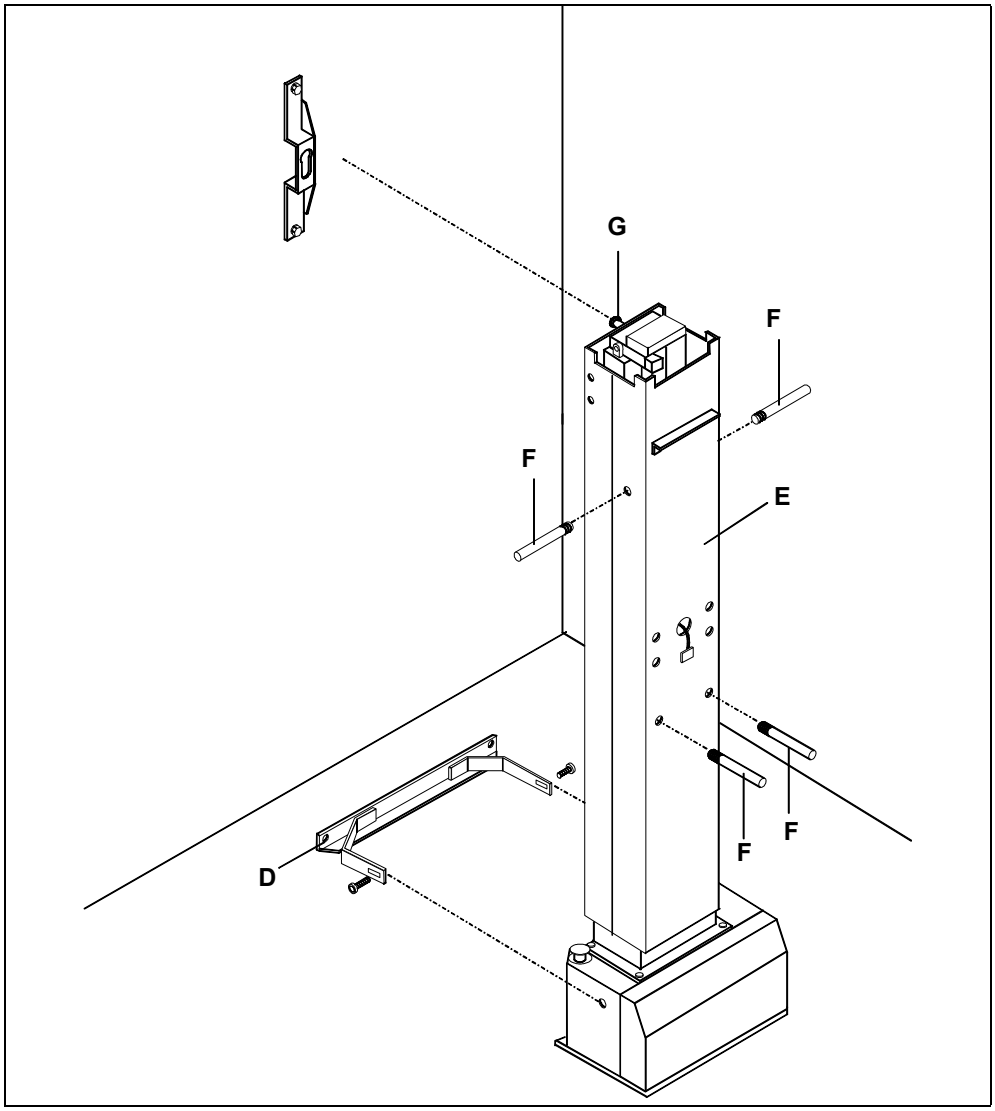


Figure 6-2

4. Remove the four side handles "F" from the column.

5. Use the level "H" to position the column vertical.

6. Mark the lower fixing points on the wall and then drill the wall, with drill "B" according to the kind of dowels to use (see chapter 5).
To perform the drilling three different methods are available:

- **a.** Remove the column and drill the wall. At the end of the operation, position the column again.
- **b.** Move the column rightwards and drill the left hole, then slant it leftwards and drill the right hole.
- **c.** Keep the column in its position and with a long point drill, drill the wall.

7. Tighten the column to the wall making sure that the level bubble "H" is aligned; sign the checklist in Appendix B.

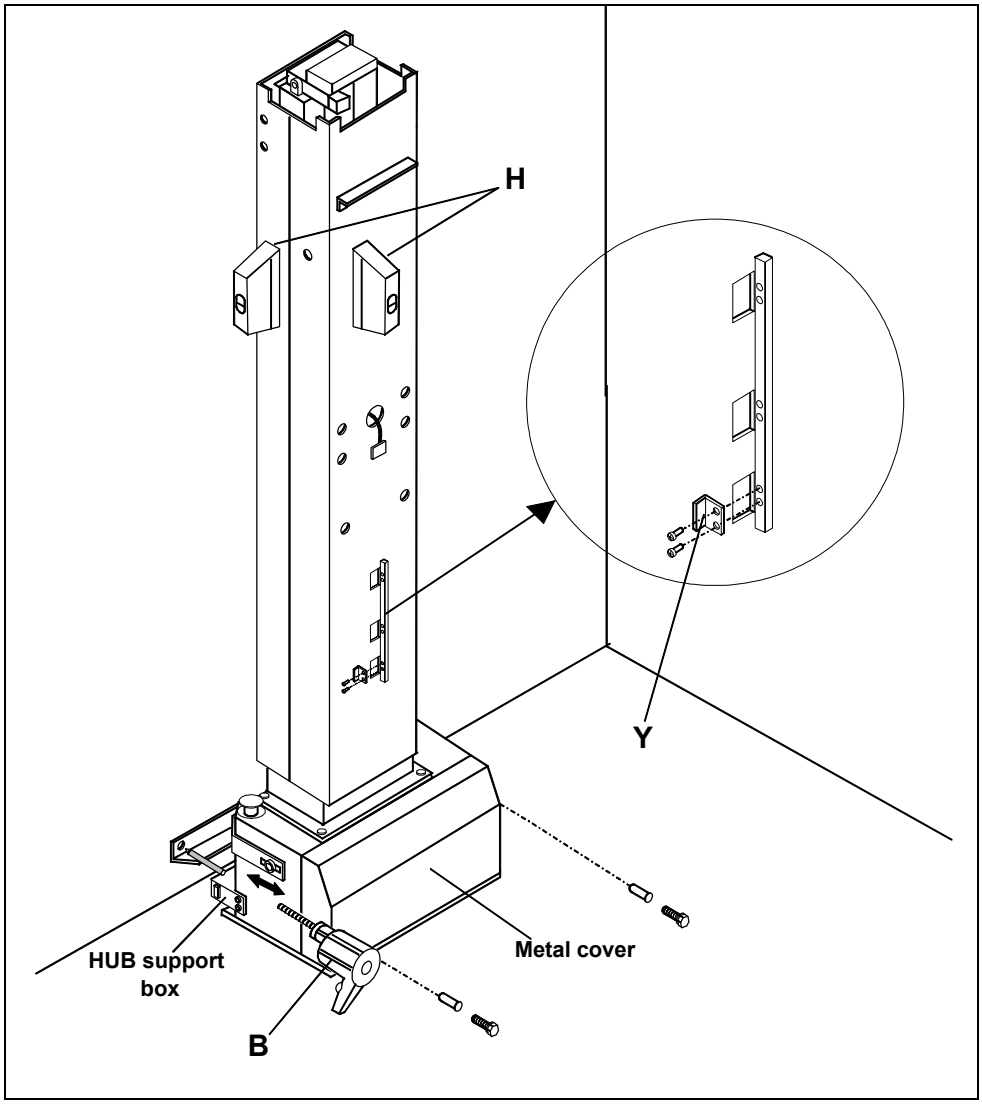


Figure 6-3

8. Install the HUB support box (normally resting on the side of the mains switch during shipment) in its location just under the exit of the mains cable (see previous Figure 6-3) and fix it with the two relevant fixing screws.

9. Power the HUB using a normal line outlet.

10. Connect the USB/2 cable coming down along the column and the output USB/2 cable (L=5mt) that will go to the PC (the connection to the PC must be done only when requested by the Digital Panoramic software installation procedure).

NOTE:
Normally, the unit is shipped pre-set for the maximum stroke of 670mm. This stroke will bring the unit to the maximum height of 2320mm from the floor.
Whenever the stroke has to be reduced (e.g. in case of lower ceiling), act on plate "Y" (Figure 6-3), located on the front side of the column.
Normally, plate "Y" is fixed in the lower position (thus activating later the end travel microswitches and allowing the longer stroke). It can be fixed in the intermediate position, thus limiting the stroke of 130mm (maximum height of the unit 2190mm) or in the highest position, thus limiting the stroke of 230mm (maximum height of the unit 2090mm).

11. When the column is fixed to the wall, remove the metal cover located at the base of the column (see previous Figure 6-3).
Such item normally covers the power supply module. Removal of the cover is achieved by removing the two relevant fixing screws.
Removing the cover allows to gain access to terminal block X0.

6.3. Mounting of the rotating arm assembly

1. Unscrew the 4 fixing screws "Z" of the caton box "K" from the lower pallet. Raise the carton box to gain access to the wooden frame "J" that holds the rotating arm.
2. Remove the fixing device (6 screws and wooden piece) of the wooden frame " J" to the pallet.

WARNING:
Do not remove from the rotating arm assembly "I" the wooden structure "J" since together with the related carton box "K" it will be used to fix the moving unit on the column.
Damages to the unit (e.g. uncentering of some positioning sensors) with possible failures can occur if the rotating arm assembly rests on the floor without the presence of the protective wooden frame. Therefore do not remove the latter from the rotating arm assemly until is clearly requested by the installation procedure.

3. Fix the four handles "F" equipped with the unit and used before to set up the column, on the side of the unit "I".
4. Position the carton box "K" near the column, set the rotating arm "I" complete with the wooden structure "J" over the box, using handles "F" to hold it all (this operation requires the intervention of two persons).
5. Remove the metal plate support located behind the tubehead by loosening the relevant fixing screw.
6. Set the rear part of the movement unit at the level of support "L" set on the column.
7. While a person will keep the unit in position, the other one will fix it to the column by 6 M6 screws.
8. Check the correct positioning of the rotation arm assy placing a level bubble on the carriage guides; the assy must be horizontal along both directions. Tighten first screws "M1" and later screws "M2"; when alignement has been achieved, sign the checklist in Appendix B.
9. Remove handles "F", the wooden structure "J" (first remove the wooden piece "W"), the safety blocking screw "N" and the three safety blocks (against translation) "O".

WARNING:
If safety device "N" and "O" are not properly removed, damages to the unit can occur.

10. Connect the cables from the column to the related connectors set on the movement unit. The signal cables and the supply cable X29 exit the column. X29 has to be connected to the related connector set on the left of the movement unit, after having removed the protection caps.

NOTE:
The STRATO 2000 is equipped with a service microswitch (S2) which allows to move the column vertically even when the signal cables are not connected to the Chin support arm.
To do this, just connect the mains voltage to terminal block X0 and act on the mentioned microswitch, located on the rear right part of the base of the unit.
During the "manual" activation of the column motor, make sure not to exceed the limits given by the limit microswitches, as these are not connected and therefore cannot stop the movement of the column itself.

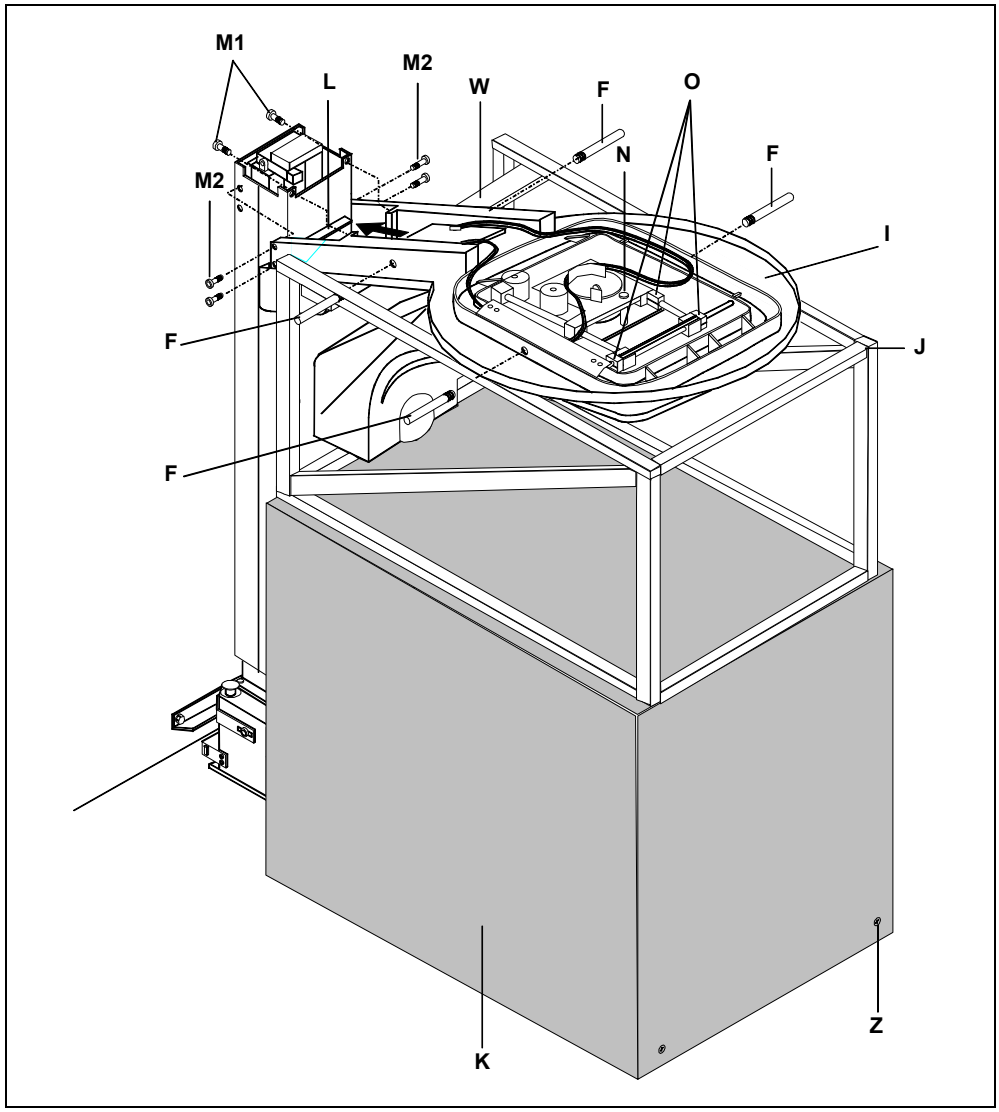


Figure 6-4

6.4. Mounting of the chin-rest arm

1. Remove the four screws "P" set on the front of the column.
2. Position the chin-rest arm "Q" complete with control panel "R" near the column, connect the connector from the column to the one from the arm and then insert the cable into the arm.
3. Fix the chin-rest arm with the four previously removed screws. Check that the chin support is horizontal using a level bubble; sign the checklist in Appendix B.

NOTE:
Only if the horizontal alignment cannot be achieved, act on grab screws M5 (which carry the read painting seal) on the mounting plate of the console arm to the column.

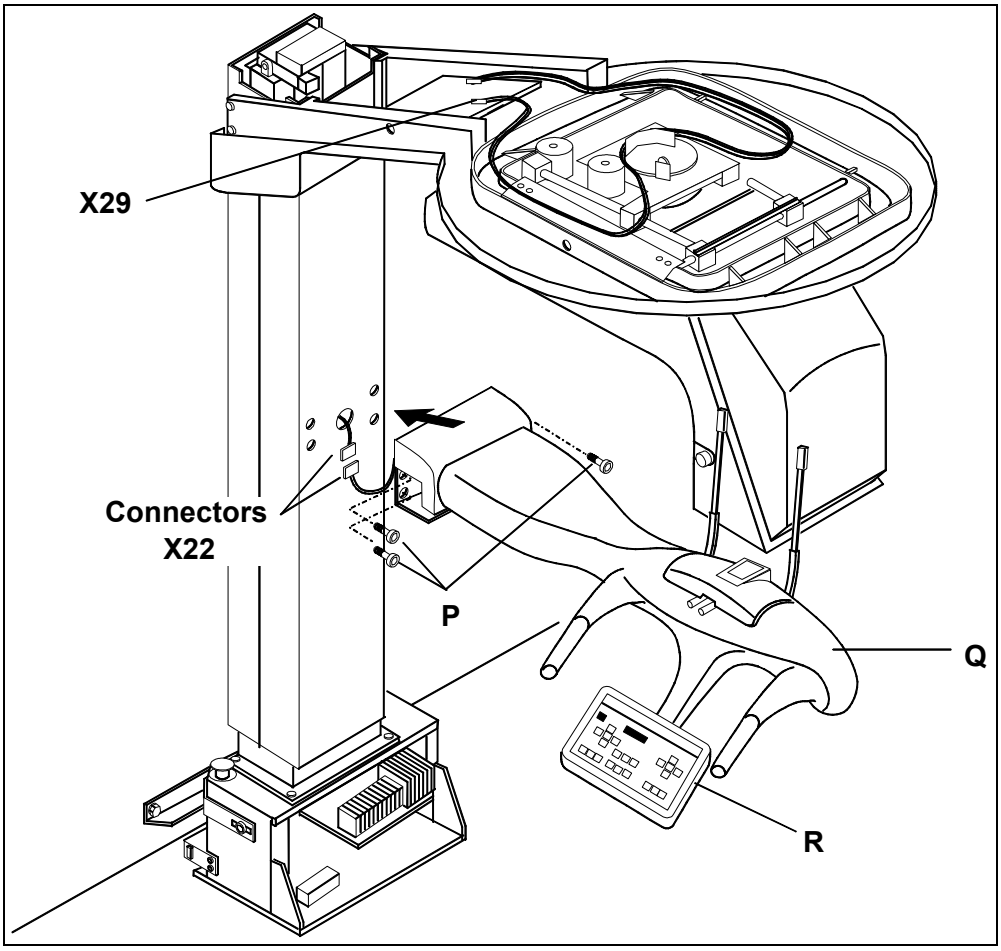


Figure 6-5

6.5. Digital sensor holder mounting

1. Remove the fixing square "T" from the sensor holder.
2. Insert the cables from the rotating unit into the pin of the sensor holder "S".
3. Insert the pin of the sensor holder into the hole of the rotating unit making the tab on the pin match with the groove on the hole.
4. Mount the fixing square "T".
5. Connect the cables X30, X40 and X46 to the related connectors set in the sensor holder A6 board (code 58094162).

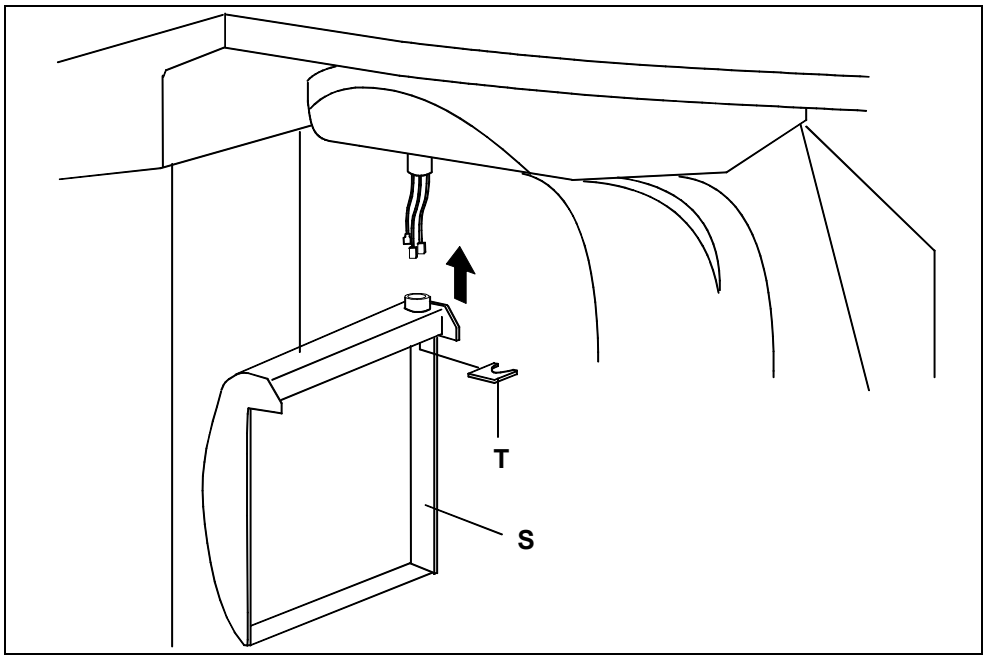


Figure 6-6

6. Connect J6 to its connector on the sensor board; connect grounding wire of the same cable to the ground node on the metal support.
7. Connect USB/2 cable on the sensor board after having coiled it once around the ferrite tied to cable J11.
8. Connect the grounding cable to the ground node on the metal support.

Once the system mounting has been completed turn on the system and enter Password 102 (paragraph 8.3) and check that data in memory are correct and matching those listed in Appendix A; sign the checklist in Appendix B.

NOTE:
If the date in the table do not match those in the memory it is posisible that the system has a serious damage on CPU board; contact your Technical Service provider.

NOTE:
Before mounting the coverings it is necessary to perform the controls indicated at paragraphs 7.1.1 and 7.1.2.

NOTE:
Before installing the plastic cover on the base of the column, mount the metal cover over the power supply module (see Figure 6-7, item "*Metal cover*").

6.6. How to mount the coverings

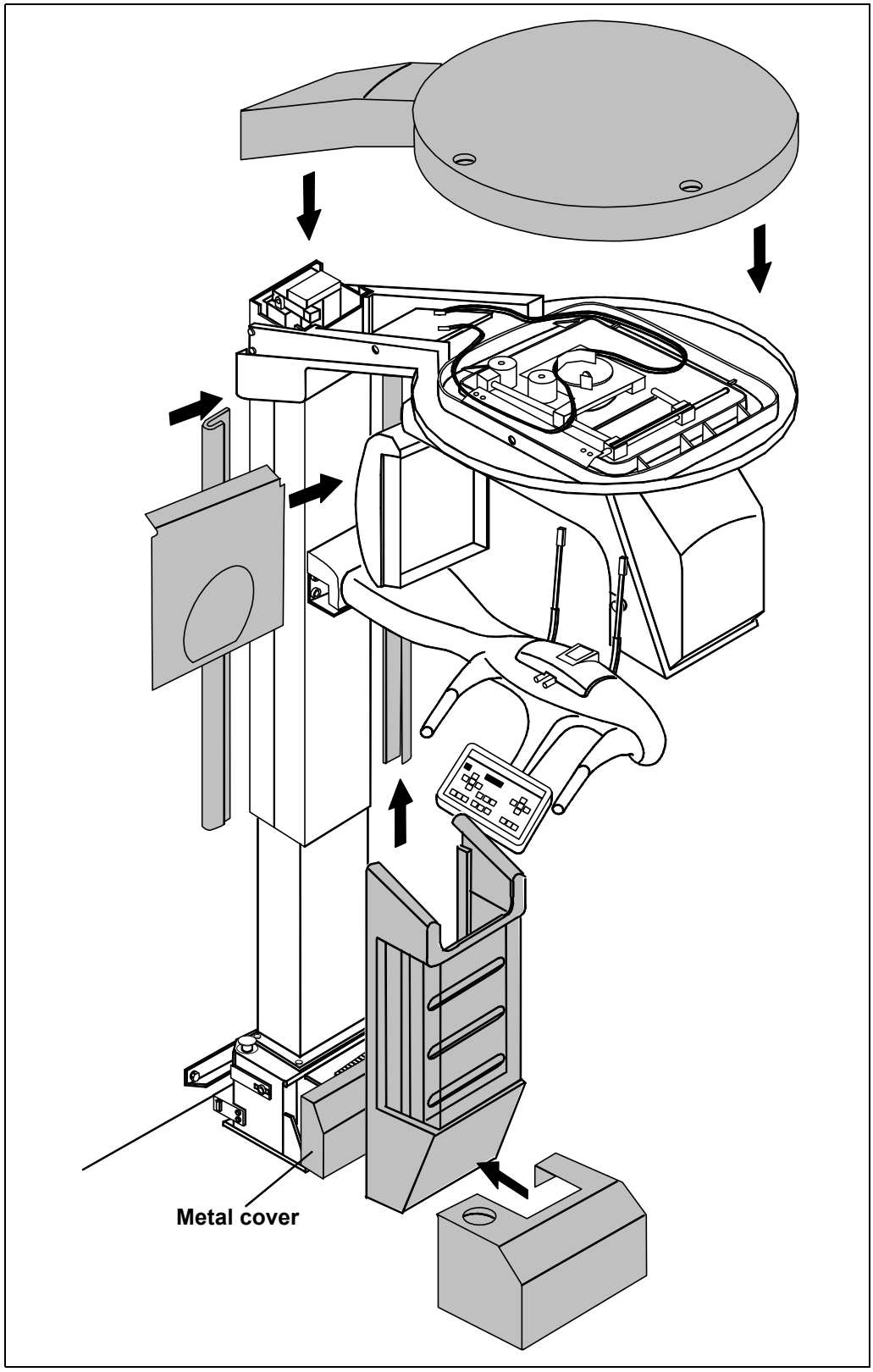


Figure 6-7

6.7. Mounting of ceph-arm (Optional)

The CEPH kit can be installed on the machine both during the first installation and later as updating of the device. In case the STRATO 2000 is sold already equipped with the Ceph arm, centering between the X-ray beam and the cassette will be very quick as the arm is already adjusted and pinned in the factory. In case the arm is provided later (unit upgrade), the unit is already pre-set to accept it, but the centering between the X-ray beam and the cassette must be performed in the field, including the pinning of the arm.

The Ceph device is shipped in a dedicated packaging and is already pre-assembled in a single piece composed by the following parts (plus the arm cover):

- Ceph arm
- Skull clamp and ear centering device
- Cassette holder.

1. Bring CEPH arm "U" close to the column; connect "X52" output from the column to "X52" coming from the arm; then fit the cable inside the arm.

2. Screw in the CEPH arm with the four screw "V". Using a bubble level check that the panoramic sensor holder and the CEPH cassette tray have the same inclination. If this is not the case act on the four fixing screws of the CEPH arm to the column; when alingment is achived sign the checklist in Appendix B.

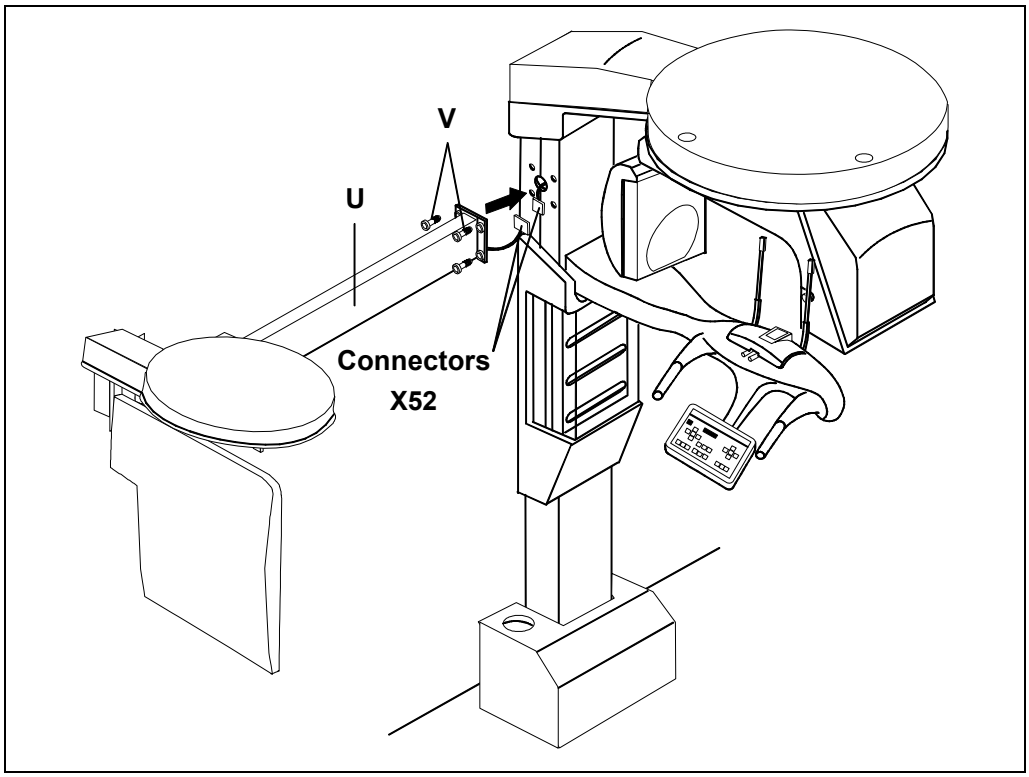


Figure 6-8

NOTE:
Before mounting the covering, please perform the check indicated at paragraph 7.1.3; the cassette/projection default setting can also be set as described in paragraph 8.3.6.

6.8. Coverings mounting for ceph-arm

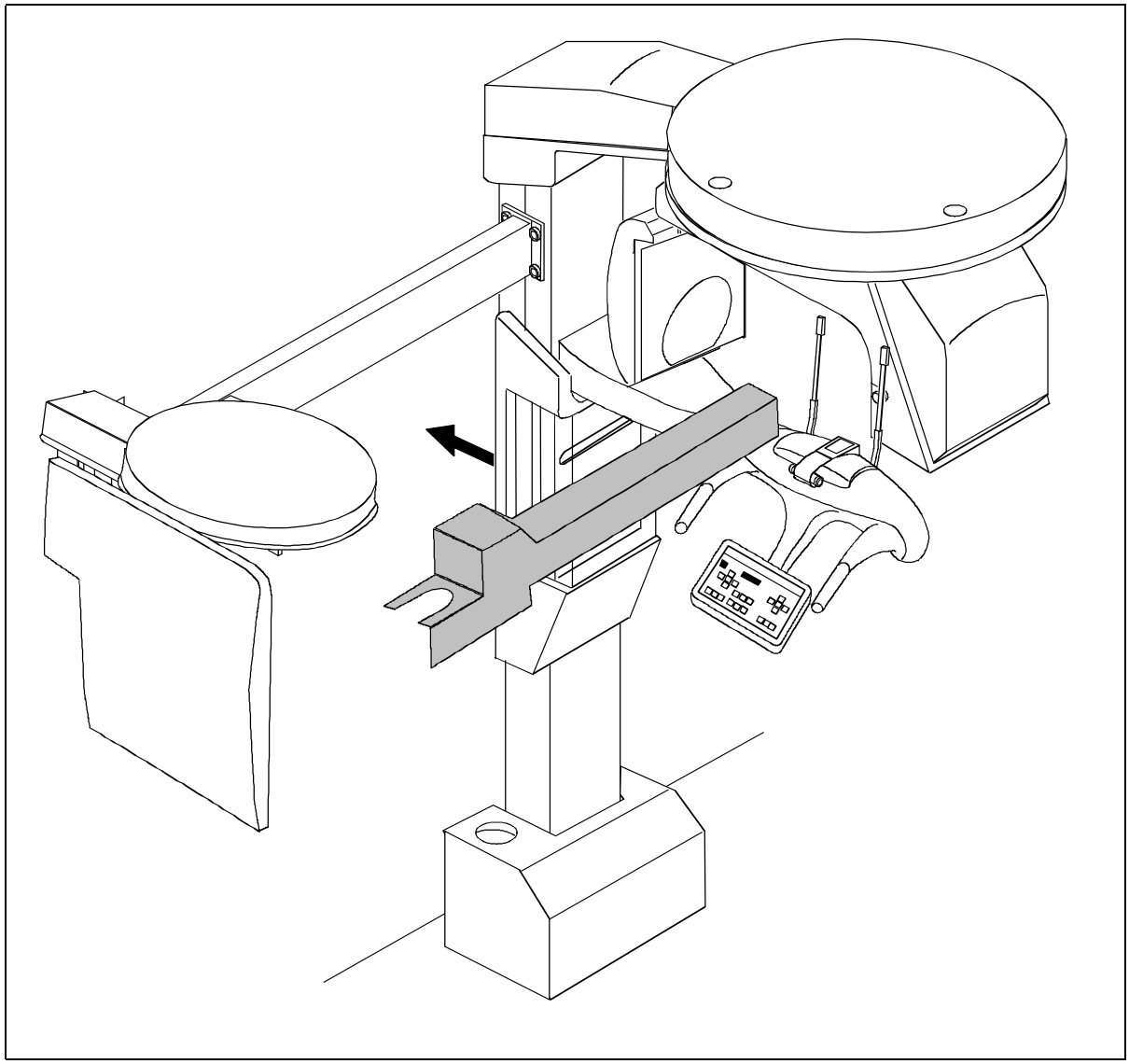


Figure 6-9

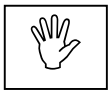
7. MAINTENANCE AND SERVICING

As with all electrical appliances, this unit must be used correctly and maintenance and inspections must be effected at regular intervals. Such precautions shall guarantee the safe and efficient function of the appliance.

Periodic maintenance consists in inspections made directly by the operator and/or Technical Service Department.

The inspections made directly by the operator are the following:

- ensure that the rating labels are intact and correctly fastened
- check whether there are any traces of oil on the tubehead
- check to ensure that the X-rays push-button switch cable is not split or damaged
- check to ensure that there is no external damage to the appliance which could jeopardise protection from radiation.

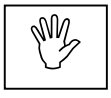


WARNING:
The operator is recommended to perform these inspections before each session of operations.
If the operator detects irregularities or damage, he should immediately inform the Technical Service Department.

The appliance's performance is checked and, where necessary corrected, during the maintenance activities performed by the Technical Service Department, in accordance with the indications provided in the following chapters. Such interventions are recorded in the "Maintenance Logbook" in the User's Manual.

The periodic maintenance performed by the Technical Service Department comprises the performance of the following additional inspection activities to made yearly:

- General visual inspection
- Grounding of all the accessible conductive parts
- Condition of the internal and external cables: wear and tear and fastenings
- The tightening of the primary bolts and screws such as the wall fastening systems, the moving mechanisms and the chin rest arm
- The status of cleanness of the console
- The correct functioning of the luminous indicators of the console
- Verification of the exposure parameters: kV, mA, time
- Verification of the correct function and status of cleanness of the laser centering devices.



WARNING:
Components may only be replaced by original spare parts.

7.1. Verification and centering adjustment

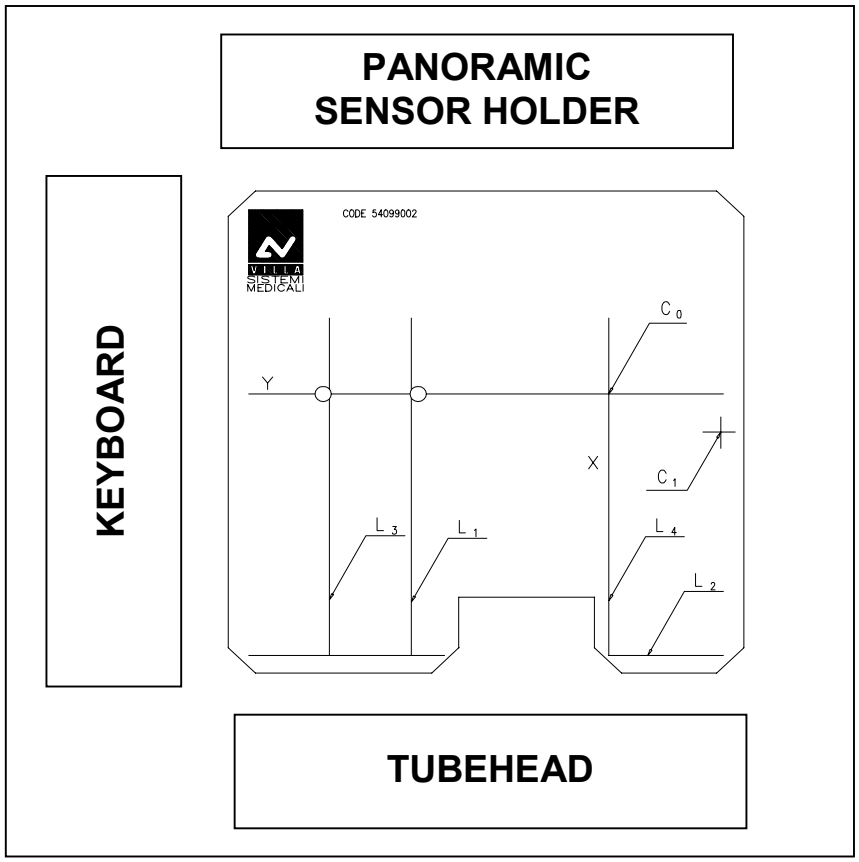
The STRATO 2000 does not require any adjustment to be made to the laser beam but, should any problem of centering be encountered, the verifications described in the following paragraphs may be made.

7.1.1. Axes alignment for the PANORAMIC function

To verify the panoramic function centering proceed as follows:

1. Switch on the machine and go to "Exam Selection". Press key "17" to select the Panoramic function.

2. Open the temple support, position the centering template (code 54099002) with fastening pins on the chin rest arm. If there are no fastening pins, place the centering tool under the chin rest. Close the temple support which will hit against the centering tool.



3. Press key 20  , the laser centering devices light up.

4. Verify that the sagittal median laser projection corresponds with the Y line (X axis) and the canine laser projection corresponds with the L1 line (Y axis) of the centering device; sign the checklist in Appendix B. If even one of these conditions does not correspond, switch off the unit and follow the procedures described in the following chapters.

The following chapters require access to the service password programs of the STRATO 2000 system. Following is described the sequence of operations for accessing these programs.

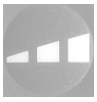
The following procedure must be followed to access the service program:

1. Switch on the unit. The following message will be displayed:

R	**E**	**L**	**E**	**A**	**S**	**E**			*****	**.**	*****	*****	*****		

After 3 seconds, the following message will be displayed:

					>	**T**	**E**	**S**	**T**	**<**					

2. When this message appears, press the increase key "3"  and decrease key "6"  simultaneously. After 3 seconds, the following message will be displayed

				S	**E**	**T**		**U**	**P**						
P	**A**	**S**	**S**	**W**	**O**	**R**	**D**	**?**			**1**	**0**	**0**		

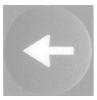
3. Using keys "22"  and "25"  select the password number for the desired Service Program and press key "23"  to confirm this selection.

7.1.1.1. Centering the RO(tation), AX (X-axis) and AY (Y-axis) axes via the laser

NOTE:
All changes made and stored result in the loss of the original calibration data. The user is therefore recommended to make and store only those changes that are deemed necessary.
If changes are made and stored but the user quits password 118 by switching the system off and not going through the normal quitting procedure, the stored data will be lost and the system will be reset to the previous data.

1. Access the Service Program as described in the previous page. With keys "22"  and "25"  go to Password 118 and confirm the selection by pressing key "23"  . After a few seconds the following message will be displayed

S	E	R	V	I	C	E		M	E	N	U				
X		Z	E	R	O										

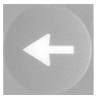
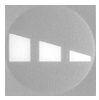
2. Press keys "26"  or "24"  until the following message is displayed:

S	E	R	V	I	C	E		M	E	N	U				
R	O	T	A	T	I	O	N		Z	E	R	O			

3. Press key "23"  and the following message will be displayed:

T		Z	E	R	O		[	f	f	]		a	b	c	d
Z	E	R	O		O	F	F	S			±	e	e	e	e

4. Press key "20"  . The laser centering device will be activated and will project two laser beams at right angles to each other onto the centering tool.

5. Using key "26"  or "24"  position the laser beam parallel to the L2 line. When keys "26" and "24" are pressed the arm will rotate. Press increase key "3"  or decrease key "6"  to change the rotation speed. The speed variation is represented on the display in the [ff] position.
This figure can vary between 0 (single-step, slow speed - best for micro-adjustments) and 16 (high speed - ideal for large adjustments/movements). When the laser beam is parallel to the L2 line press key "9"  to store the position . The following message will be displayed:

U	**P**	**D**	**A**	**T**	**E**		**C**	**H**	**A**	**N**	**G**	**E**	**S**	**?**	
E	**N**	**T**	**E**	**R**	**=**	**Y**			**R**	**E**	**S**	**E**	**T**	**=**	**N**

Press key "23"  to store the changes or press key "9"  if these changes are not to be stored. The rotation group will return to its previous position and the following message will be displayed:

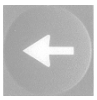
R	**E**	**S**	**T**	**O**	**R**	**I**	**N**	**G**							
A	**X**	**I**	**S**		**P**	**O**	**S**	**I**	**T**	**I**	**O**	**N**	**.**	**.**	**.**

6. Once the ROtation axis has been adjusted, press key "26"  or "24"  until the following is displayed:

S	**E**	**R**	**V**	**I**	**C**	**E**		**M**	**E**	**N**	**U**				
X		**Z**	**E**	**R**	**O**										

7. With the Panoramic sensor holder open and the laser centering device on, press key "23"  : the following will be displayed

X		**Z**	**E**	**R**	**O**		**[**	**f**	**f**	**]**		**a**	**b**	**c**	**d**
Z	**E**	**R**	**O**		**O**	**F**	**F**	**S**			**±**	**e**	**e**	**e**	**e**

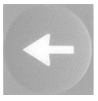
8. Press key "26"  or "24"  to superimpose the laser beam on line L2. When keys "26" and "24" are pressed, the arm will translate. Change the translation speed using the increase key "3"  or decrease key "6"  . The speed variation is represented on the display in the [ff] position.
This figure can vary between 0 (single-step, slow speed - best for micro-adjustments) and 16 (high speed - ideal for large adjustments/movements). When the laser beam is parallel to the L2 line press key "9"  to store the position. The following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to store the changes or key "9"  if these changes are not to be stored. The rotation group will return to its previous position and the following message will be displayed:

R	E	S	T	O	R	I	N	G							
A	X	I	S		P	O	S	I	T	I	O	N	.	.	.

<u>Sign the chekclist in Appendix B; remind to write down the new value in the relavant box in Appendix A.</u>

9. Once the X-axis had been regulated, close sensor holder too panoramic and press key "26"  or "24"  until the following message is displayed:

S	E	R	V	I	C	E		M	E	N	U				
Y		Z	E	R	O										

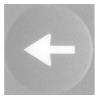
10. Press key "23"  . The machine will rotate once and the following message will be displayed:

S	E	R	V	I	C	E		M	E	N	U				
P	L	E	A	S	E		W	A	I	T	.	.	.	.	.

11. When the unit stops rotating the following message will be displayed:

Y		Z	E	R	O		[	f	f	]		a	b	c	d
Z	E	R	O		O	F	F	S			±	e	e	e	e

12. Press key "25"  or "22"  to superimpose the laser beam on line L3. Using keys "25" and "22" the arm will translate. Change the translation speed using the increase key "3"  or decrease key "6"  . The speed variation is represented on the display in the [ff] position.
This figure can vary between 0 (single-step, slow speed - best for micro-adjustments) and 16 (high speed - ideal for large adjustments/movements).

13. Before going on to store the Y position, it is necessary to ensure that the sagittal Median laser beam is superimposed on the Y line (X-axis) of the centering tool. If the laser beam is not superimposed on the Y line, adjust it with key "26"  or "24"  . When the beam is superimposed press key "9"  and the following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to store the changes or key "9"  if these changes are not to be stored. The rotation group will return to its previous position and the following message will be displayed:

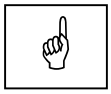
R	E	S	T	O	R	I	N	G							
A	X	I	S		P	O	S	I	T	I	O	N	.	.	.

<u>Sign the chekclist in Appendix B; remind to write down the new value in the relavant box in Appendix A.</u>

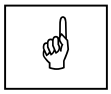
14. Press key "9"  to quit Password. The following message will be displayed:

C	O	N	F	I	R	M		E	X	I	T	?		
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to quit Password and access the program's Start-Up function or press key "9"  to remain in password 118 mode.



NOTE:
All changes made and stored result in the loss of the original calibration data. The user is therefore recommended to make and store only those changes that are deemed necessary.
If changes are made and stored but the user quits password 118 by switching the system off and not going through the normal quitting procedure, the stored data will be lost and the system will be reset to the previous data.



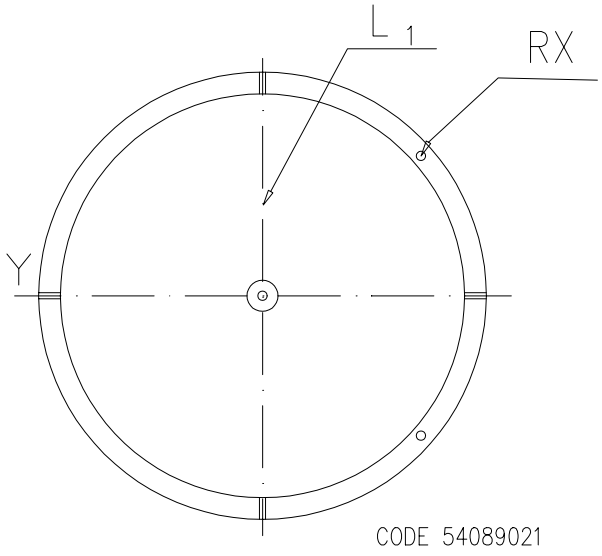
NOTE:
If the system has been correctly aligned, the rotation center will be at point C_0.

7.1.2. Centering the X-ray beam for the PANORAMIC function

WARNING:
X-rays will be emitted during the performance of the following operations. Authorised Technicians are therefore recommended to use the greatest caution and to comply with the safety regulations and laws of their country.

Upon completion of the laser beam centering for the Panoramic function, the X-ray beam must also be centered as follows:

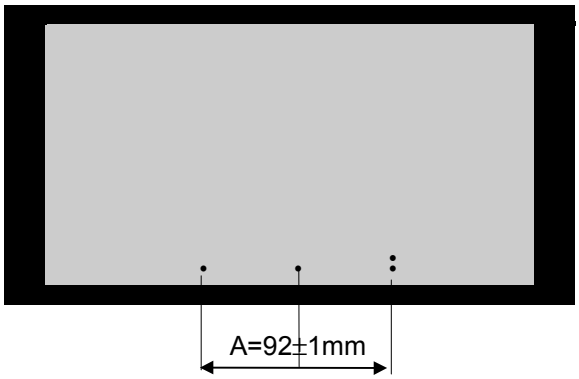
1. Switch on the machine and go to Exam Selection.
2. Press key "17"  to select the Panoramic function.
3. Position the centering tool (code 54089021) on the chin rest.



4. Make an exposure at 50kV and 4mA.

NOTE:
If, with the above parameters (kV and mA), the image obtained is not like the one represented in the following figure, i.e. the dots cannot be distinguished, place several millimeters of aluminium between the tubehead and the sensor.

5. Using the measuring rule of the Digital Acquisition Software determine the relative positions of the three balls images. It must be like in the following picture.



NOTE:
The four white dots that appear on the image refer to the metallic spheres on the centering device (code 54089021).

6. If distance A is outside the tolerance range, check the alignment of the Canine axis (line L3 of the centering tool).

7. If the distance between the projection of the side spheres with that of central sphere is not symmetrical (and not within the tolerance range of ± 1 mm.), check the centering of the sagittal Median axis (Line Y or Line L2 of the centering tool).

Once completed sign the checklist in Appendix B.

7.1.3. Axes alignment for the CEPH function

NOTE:
When these operations are performed during Maintenance it will be necessary to remove some of the covers.

To verify the centering of the Cephalometric function it is necessary to:

1. Switch on the machine and access Password 124 following the operations sequence described in paragraph 7.1.1. Once Password 124 is reached, close the Panoramic sensor holder, if open, and press key "23"  .The following message will be displayed:

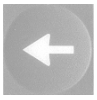
M	**A**	**C**	**H**	**I**	**N**	**E**		**S**	**E**	**T**	**T**	**I**	**N**	**G**	

2. Press key "23"  . The machine will move and the following message will be displayed:

			W	**A**	**I**	**T**		**F**	**O**	**R**					
M	**A**	**C**	**H**	**I**	**N**	**E**		**S**	**E**	**T**	**T**	**I**	**N**	**G**	

When the machine stops moving, the following message will be displayed:

C	**E**	**P**	**H**		**S**	**E**	**T**	**U**	**P**						
C	**E**	**P**	**H**		**a**	**a**	**a**								

3. Press key "26"  or "24"  until the following is displayed:

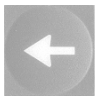
C	**E**	**P**	**H**		**S**	**E**	**T**	**U**	**P**						
C	**E**	**P**	**H**		**O**	**N**									

4. Press key "23"  to confirm this setting. The machine will move and the following message will be displayed:

C	E	P	H		P	O	S	I	T	I	O	N	I	N	G
P	L	E	A	S	E		W	A	I	T		.	.	.	.

When the machine stops rotating the following message will be displayed:

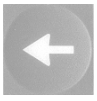
C	E	P	H		S	E	T	U	P					a	b
X		O	F	F	S	E	T								

5. Press key "26"  or "24"  until the following is displayed:

C	E	P	H		S	E	T	U	P					a	b
D	E	F	A	U	L	T		F	O	R	M	A	T		

6. Press key "23"  .The following message will be displayed:

D	E	F	A	U	L	T		F	O	R	M	A	T		
a	a	a	a	a	a										

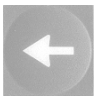
7. Press key "26"  or "24"  . The following message will be displayed:

D	E	F	A	U	L	T		F	O	R	M	A	T		
1	8	x	2	4	S										

8. Press key "9"  . The following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

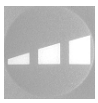
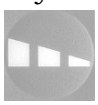
9. Press key "23"  to store the changes.

10. Press key "26"  or "24"  until the following is displayed:

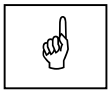
C	E	P	H		S	E	T	U	P					a	b
R	O	T	.		O	F	F	S	E	T					

11. Press key "23"  .The following message will be displayed:

C	E	P	H		T		|	f	f	|		a	b	c	d
Z	E	R	O		O	F	F	S		±	e	e	e	e	e

12. Press keys "5"  , "4"  and "7"  and key "3"  or "6"  . Set the following exposure parameters: 50kV, 6mA, 0.30s.

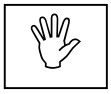
13. Set the skull unit in Latero-Lateral projection with the ear bars completely open and the skull unit height regulation device completely down.



NOTE:
If the skull unit height regulation device is not completely lowered, this will generate a projection error of the ear centering devices as these will not be aligned with the X-rays beam.

14. Insert the cassette provided into the cassette holder in the symmetrical projection. Position a strip of adhesive paper horizontally on the Cephalometer cassette holder.

15. Switch on laser centering device "20"  which will project two light beam at right angles to each other onto the Cephalometer cassette holder. Make a mark on the paper strip in correspondence with the vertical projection of the laser beam.



WARNING:
X-rays will be emitted during the performance of the following operations. Authorised Technicians are therefore recommended to use the greatest caution and to comply with the safety regulations and laws of their country.

16. Press the X-ray button. The primary collimator will position itself on relevant slot diaphragm. Press the X-ray button again. An exposure will be made. Develop the film.

17. With the film developed, to establish whether the CEPH device is perfectly aligned, the following must be verified:

a. The presence of a white border on the edge of the film as required by international laws and regulations for radiation protection. The following tables show the ideal values.

b. Two concentric circles with a tolerance range of 1 mm with respect to the relative centers. These circles refer to the ear centering rings.

	INCHES COLLIMATOR			
Diaphragm formats	8"x10" symm	8"x10" asymm	10"x8" asymm	12"x10" symm
Film formats	8"x10"			10"x12"
Film nominal size	201x252 mm			252x302 mm
Height of X-ray beam	225÷250 mm		180÷200 mm	225÷250 mm
Width of X-ray beam	180÷200 mm		225÷250 mm	270÷295 mm

	18x24 cm COLLIMATOR			
Diaphragm formats	18x24 symm	18x24 asymm	24x18 asymm	30x24 symm
Film formats	18x24			24x30
Film nominal size	178x238			238x298
Width of X-ray beam	160÷175		215÷235	270÷295
Height of X-ray beam	215÷235		160÷175	215÷235

	24x30 cm COLLIMATOR			
Diaphragm formats	18x24 asymm	24x30 symm	24x30 symm	30x24 symm
Film formats	18x24	24x30		
Film nominal size	178x238	238x298		
Width of X-ray beam	160÷175	215÷235		270÷295
Height of X-ray beam	215÷235	270÷295		215÷235

18. If one of the two above conditions do not occur, follow the instructions in the following paragraphs (7.1.3.1÷7.1.3.5).

7.1.3.1. Horizontal White Border Missing

If the horizontal white border is missing (top or bottom), remain in Password 124 mode and proceed as follows:

1. Press key "20"  to switch on the laser centering device.

Position a strip of paper in correspondence to the horizontal laser projection and draw a line on the strip so that the millimeters and the direction of the movement (above or below) can be seen.

2. Change the height of the CEPH arm using the upper or lower screws "A", moving them symmetrically in pairs (above or below) after having previously loosened nuts "B". If the white border is missing from the top, turn the lower pair after having slightly loosened (portion of a turn) the two lower arm fastening screws "C". (Ref. "V", chapter 6). Perform this procedure in reverse if the white border is missing from the bottom.

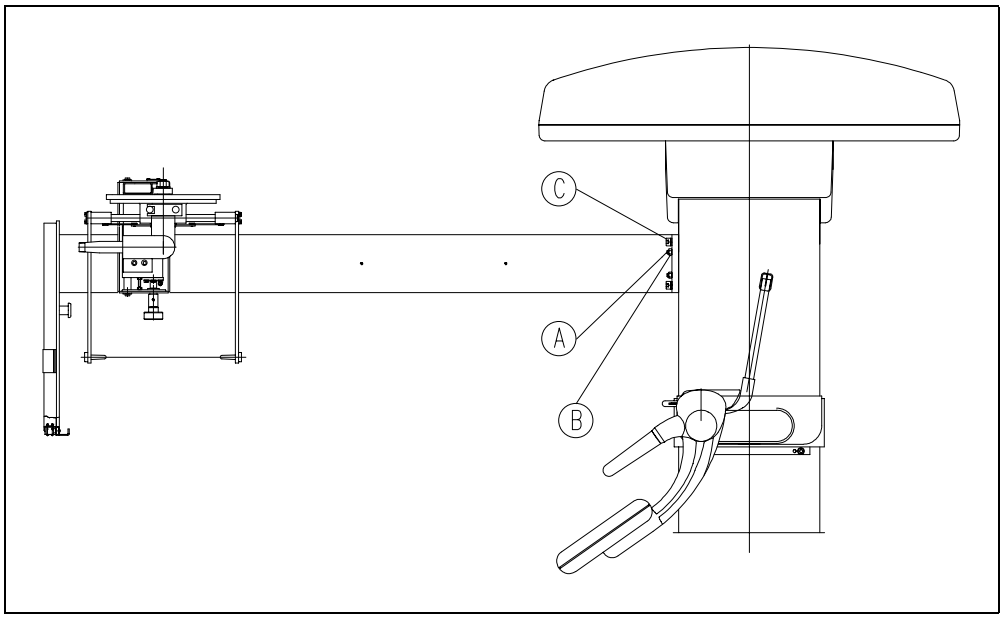
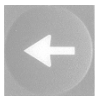


Figure 7-1

3. Once horizontal alignment has been completed, tighten the loosened screws "C" and block adjustment screws "A" with the relative nuts "B".

7.1.3.2. Vertical White Border Missing

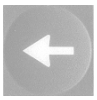
If the white border is outside the tolerance range on one of the vertical sides (right or left), remain in Password 124 mode and proceed as follows:

1. Using a ruler, measure the white border that is present on the film or the one that is larger.
2. According to the measurement obtained and using the above table, calculate the quantity (mm.) of movement that the X-rays beam (tubehead) must make.
3. Press key "26"  or "24"  until the following is displayed:

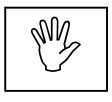
C	E	P	H		S	E	T	U	P					a	b
X		O	F	F	S	E	T								

4. Press key "23"  .The following message will be displayed:

C	E	P	H		X		[	f	f	]		a	b	c	d
Z	E	R	O		O	F	F	S		±	e	e	e	e	e

5. Press key "20"  to switch on the laser centering device. The laser beam will be projected onto the Cephalometry cassette holder.
6. Press key "26"  or "24"  to superimpose the laser projection onto the vertical reference line traced during exposure.
7. Press key "26"  or "24"  to move the laser projection by the quantity obtained from the following formula:

Measurement detected (mm) – 3.5 mm



WARNING:
X-rays will be emitted during the performance of the following operations. Authorised Technicians are therefore recommended to use the greatest caution and to comply with the safety regulations and laws of their country.

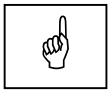
8. Press the X-ray button to make an exposure using the same parameters as before (50kV, 6mA, 0.30s).

9. Repeat this operation until a radiography picture within the tolerance ranges given in the above tables is obtained.

10. When alignment is made press key "9"  . The following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to store the changes made.



NOTE:
All changes made and stored result in the loss of the original calibration data. The user is therefore recommended to make and store only those changes that are deemed necessary.
If changes are made and stored but the user quits password 124 by switching the system off and not going through the normal quitting procedure, the stored data will be lost and the system will be reset to the previous data.

7.1.3.3. Symmetrical Image either too Large or too Small

If the radiographed projection is too small or too large with respect to the data provided in the previous table, remain in Password 124 mode and proceed as follows:

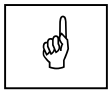
1. Press key "26"  or "24"  . The following message will be displayed:

C	E	P	H		S	E	T	U	P				a	b
Y		O	F	F	S	E	T							

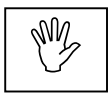
2. Press key "23"  . The following message will be displayed:

C	E	P	H		Y		[	f	f	]		a	b	c	d
Z	E	R	O		O	F	F	S		±	e	e	e	e	e

3. If the radiography picture is too small, i.e. the white border exceeds the tolerance range on all sides, press key "22"  to increase the distance between the tubehead and the cassette holder. If the picture is too large, i.e. the white border is too small or missing on all sides, press key "25"  to decrease the distance between the tubehead and the cassette holder.



NOTE:
If during the movement of the Y-axis the carriage beyond the limit stops the E501 error will occur during the examination phase.



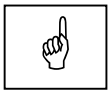
WARNING:
X-rays will be emitted during the performance of the following operations. Authorised Technicians are therefore recommended to use the greatest caution and to comply with the safety regulations and laws of their country.

4. Make an exposure using the same parameters as before (50kV, 6mA exposure of 0.30sec.) using the X-ray button and develop the film. Repeat this operation until the size values of the exposed area of the film lie within the parameters indicated in the previous tables.

5. Once the correct sizes are obtained, press key "9"  . The following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to store the change.



NOTE:
All changes made and stored result in the loss of the original calibration data. The user is therefore recommended to make and store only those changes that are deemed necessary.
If changes are made and stored but the user quits password 124 by switching the system off and not going through the normal quitting procedure, the stored data will be lost and the system will be reset to the previous data.

7.1.3.4. Projection of Non-Concentric Ear Centering Circles

Loosen the fixing screws of positioning sphere "A" (max. 1 turn) and using adjustment screw "C" adjust (rotate) skull-stand unit "B".
If the greater diameter (ear set farthest from the cassette) is shifted more towards the nose-rest with respect to the smaller diameter (ear-rest nearer to the cassette), unscrew adjustment screw "C" and manually turn sphere holder "E" anticlockwise. In the opposite case, turn adjustment screw "C" and the sphere holder will shift automatically. Once the correct centering is obtained (a test exposure is required), fix screw "A" and block adjustment screw "C" using security nut "D".

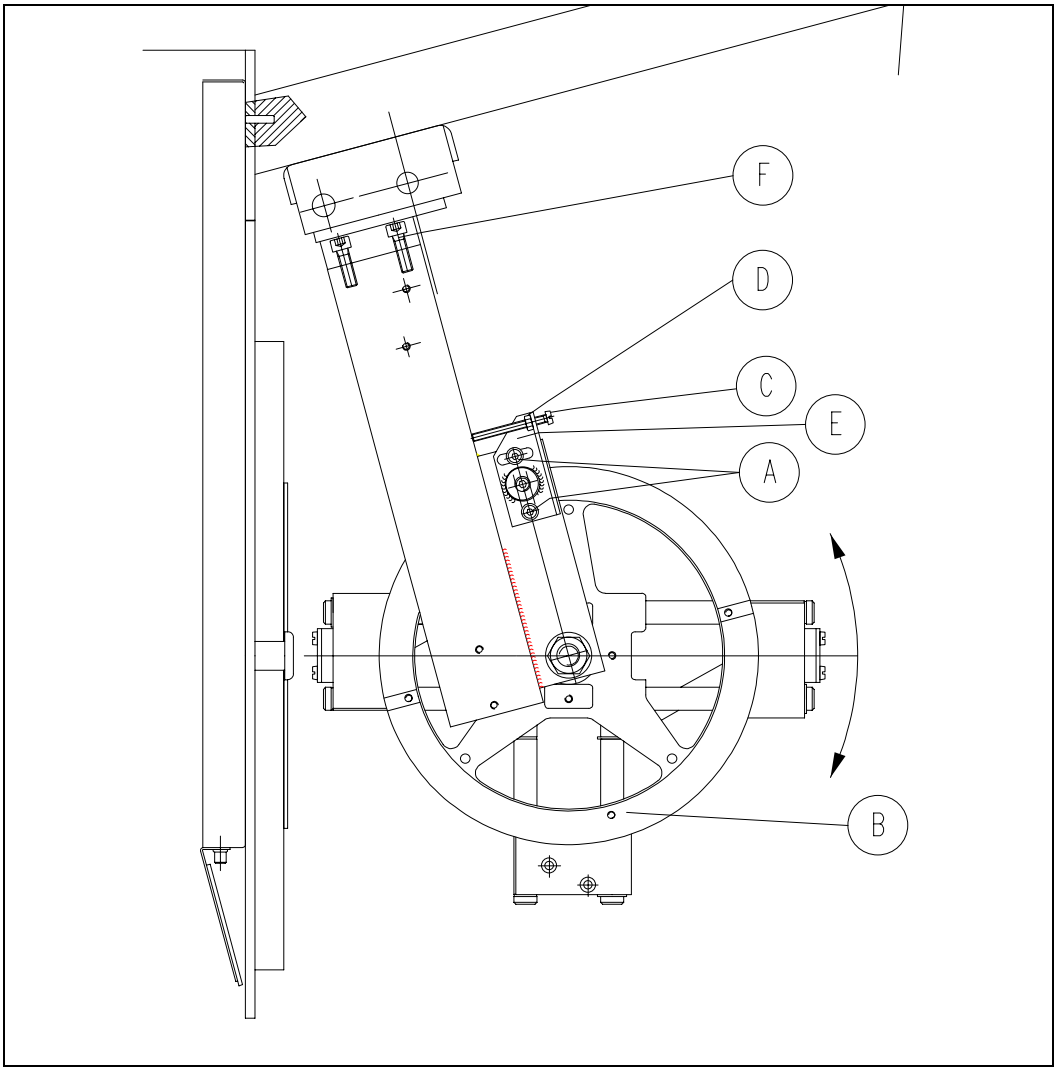


Figure 7-2a (Top view)

7.1.3.5. Projection of Vertically Non-Concentric Ear Centering Circles

Loosen screws "F" (Figure 7-2a). Adjust position of the arm acting on screw "G" (Figure 7-2b) on the side. Once the aligned position has been reached tighten bolt "H" (Figure 7-2b). Upon completion of the adjustment a test exposure is required, to verify it. Tighten screws "F" (Figure 7-2a).

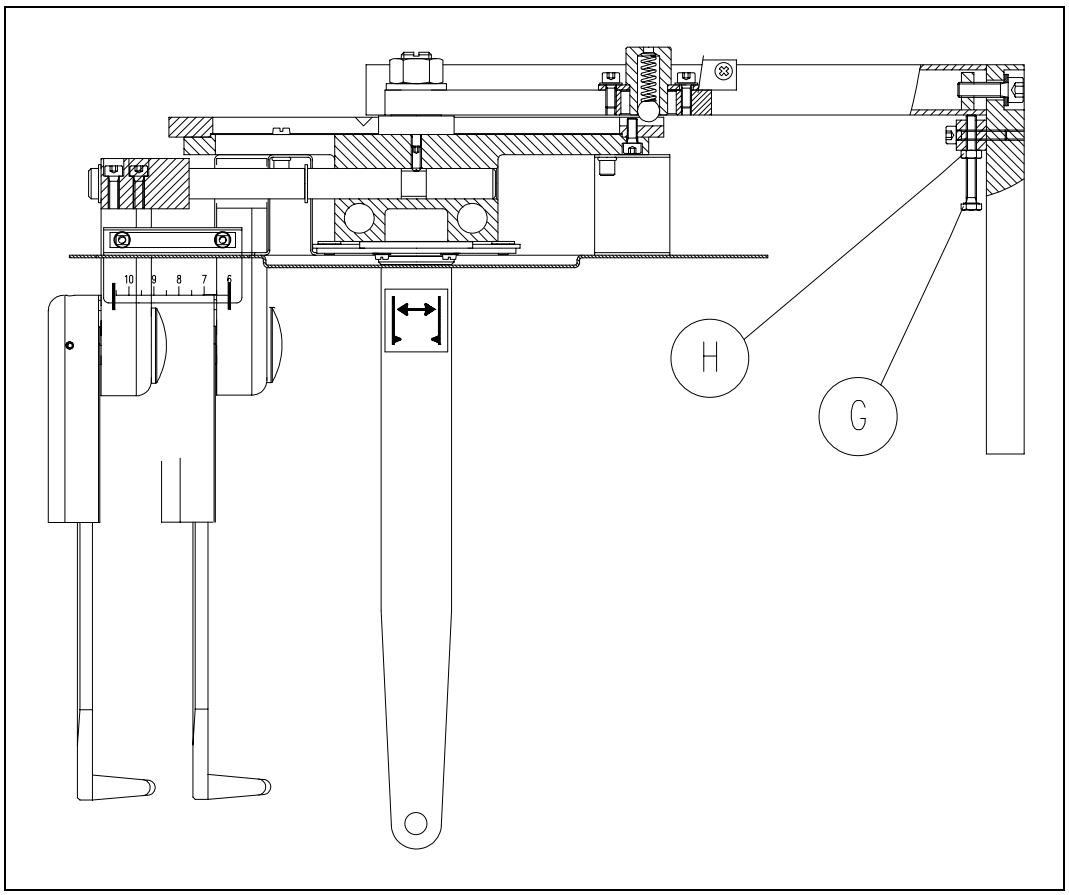


Figure 7-2b (Side view)

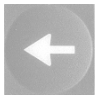
7.1.3.6. Soft Tissue Filter (STF) adjustment

This adjustment is accessed in by activating password 124 as described at paragraph 8.3.6.

NOTE:
Before proceeding with the adjustment of the Soft Tissue Filter (STF), check that the default format of the cassette is asymmetric as described in paragraph 8.3.6.7.
If non, set it for an asymmetric format.

1. When next display is shown:

C	E	P	H		S	E	T	U	P			a	b	c
X		O	F	F	S	E	T							

Press key "26"  or "24"  until reaching the following display:

C	E	P	H		S	E	T	U	P			a	b	c
S	T	F		O	F	F	S	E	T					

2. Press key "23"  . The following message will be displayed:

S	T	F		Z	E	R	O		O	F	F	S		a
O	F	F	S	E	T		x	x	x					

3. Fit a cassette into the cephalometric device in the selected asymmetric position at set the NASION to 6 cm.

4. Acting on keys "5" 

, "4" 

and "7" 

and on key "3"  or "6"  set the desired exposure parameters.

WARNING:
X-ray will be emitted during the performance of the following operations. Authorised technicians are therefore recommended to use the greatest caution and to comply with the safety regulations and laws of their country.

5. Press the X-ray push button and keep it depressed until the end of the exposure.

6. Develop the film and check the distance "**A**" (Figure 7-3) between the Soft Tissue Filter (STF) edge and the center of the rings is 60 mm. If not, calculate the algebric difference between 60 and the measured value and divide the calculate value by 1.3 in order to find the number of correction steps (motor offset) to be stored into the unit.

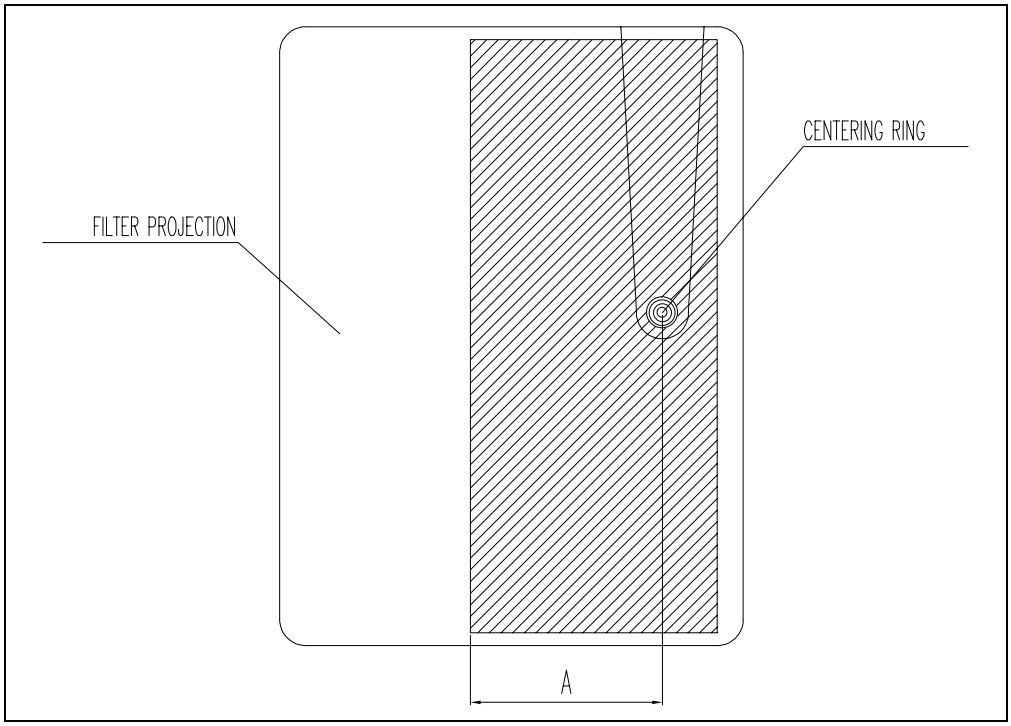


Figure 7-3

Example A:

*Current offset = 010, measured distance "**A**" = 50 mm*

60 mm – 50 mm = 10 mm

10 mm : 1.3 ≅ 8

New offset value to store: 010 (current offset) + 8 = 018

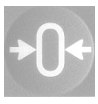
Example B:

*Current offset = 020, measured distance "**A**" = 75 mm*

60 mm – 75 mm = -15 mm

- 15mm :1.3 ≅ - 11

New offset value to store: 020 (current offset) – 11 = 009

7. Press key "10"  to bring the Soft Tissue Filter (STF) to the zeroing position. The display will show:

S	**T**	**F**		**Z**	**E**	**R**	**O**		**O**	**F**	**F**	**S**			**0**
O	**F**	**F**	**S**	**E**	**T**		**x**	**x**	**x**						

8. Press key "24"  up to reach the new calculate offset to be stored.

9. Check proper alignment of the Soft Tissue Filter by performing a new exposure and developping the film.
If the alignment is now correct, store it into the non-volatile memory of the unit by pressing key "9"  . The display will show:

U	P	D	A	T	E		C	H	A	N	G	E	S	?
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the change.

If the measure is not yet correct, please repeat above points from 5 to 9.

7.2. Verify of kV and exposure time

kVp and time can be measured directly (invasive method) on the HF generator board, more precisely the following procedure must be performed.

NOTE:
If the following actions are performed during maintenance some covers have to be removed:

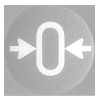
a. Remove the outer covering of the tubehead.

b. Remove the protection grid of the HF generator board.

WARNING:
The HF board has a working voltage of about 360V.

The exposure parameters can be checked with the following procedure:

1. With the unit on, select the Panoramic examination mode by pressing key "17"  .

2. Press contemporaneously keys "10"  , "28"  and "24"  ; LED's of "patient type", "patient size" and "Arch" switch off and the display shows the following two messages alternatively:

				R	E	M	O	V	E						
			C	H	I	N		R	E	S	T				

and

					C	L	O	S	E						
	T	E	M	P	L	E		S	U	P	P	O	R	T	

NOTE:
This program allows you to carry out the measuring of the exposure parameters having the tubehead-arm in a fixed position (not rotating).

3. Carry out the actions mentioned above; press key "23"  ; the unit will carry out a movement to reach the "zero" position. During this phase, the display shows:

P	L	E	A	S	E		W	A	I	T	.	.	.		

4. Once the "zero" position is reached, if the unit carries a fixed collimator go to step 6.
If the unit carries a rotating collimator the following message will be displayed:

					O	P	E	N						
	C	A	S	S	E	T	T	E		U	N	I	T	

5. After opening the sensor holder to Ceph position (this action is sensed by the unit which monitors the status of microswitches S25), the display shows:

P	L	E	A	S	E		W	A	I	T	.	.	.	

In the mean time, the unit sets the primary collimator to position 18x24 symmetric (Slot #5) and the Soft Tissue Flter in position "not in field".

6. The display shows:

	R	X		P	A	R	A	M	E	T	E	R	S	
	7	0	k	V		0	8	m	A		1	.	0	0	S

7. Set the exposure parameters to carry out the desidered checks. The variation range of the parameters is shown in the following table:

Parameter	Minimum value	Maximum value
kV	50	80
s	0,2	15
mA	4	12

WARNING:
X-ray will be emitted during the performance of the following operations. Authorised technicians are therefore recommended to use the greatest caution and to comply with the safety regulations and laws of their country.

For the execution of measurement follow instruction at paragraphs 7.2.1, 7.2.2 and 7.3.

8. To quit this routine, press key "9"  ; if the unit carries a rotating collimator and the sensor holder is open, the display will show:

	C	L	O	S	E		C	A	S	S	E	T	T	E	
		T	O		P	A	N	O	R	A	M	I	C		

In case of fixed collimator jump to step 10.
After closing the sensor holder to Panoramic position (the position is sensed by the unit through microswitch S24), the display will show the following message:

P	R	E	S	S		E	N	T	E	R					

Press key "23"  ; the unit will carry out the zeroing and will set itself in the patient entry position; the display will first show:

P	L	E	A	S	E		W	A	I	T	.	.	.		

9. The display will show:

S	T	D	.		P	A	N	O	R	A	M	I	C		
	x	x	k	V		x	x	m	A		1	5	.	0	s

and the unit returned at a standard mode.

7.2.1. kVp

Use a multimeter (R input >= 10MΩ) in working conditions VDC and end of scale 20V, position the cold pole on TP4 (GND) and the hot pole on TP3 (kV) on the HF generator board. Set the following parameters in CEPH mode: 60kV-6mA-3s.
Perform an exposure and considering that the ratio between the value on the voltmeter and high voltage is 1V= 10kV, verify that the value indicated by the multimeter ranges from 5.7÷6.3V (6V±5%).
In case the read value is outside the specified range, shift the hot pole of the voltmeter on TP5 (set kV). Once a new exposure is done, the voltage on TP5 must range from 5.76÷6.24V (6V±4%).
Should this last value be outside the specified limit, detect the "set kV" voltage supplied by CPU, connecting the voltmeter between GND test points and kV (set nearby X10). The tension on these points must range from 5.82 and 6.18 V (6V±3%). If it is out of tolerance replace the CPU, otherwise replace the HF generator board.
If all measures are within the specified range, and there is an evidence of a performance loss, measure the high tension of the tubehead, and the exposure time using a non-invasive kilovoltmeter with ≤ ±3kVp tolerance.

WARNING:
In case of a unit with fixed collimator the X-ray beam is very narrow and the system does not have the possibility to use a Ceph slot to get a wider beam.
Measurement by a non invasive kV meter an a very narrow beam can be difficult and/or unreliable and special probes with reduced sensitive area must be used.
It may result helpful to use a fluorescent screen to locate the X-ray beam and consequently position the probe of the kV meter.

The high voltage value must be within 8% of the set value, while the time value must be within 10% of the set value. If the voltage is not within the expected range, replace the tubehead; otherwise replace CPU board.

7.2.2. Time

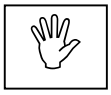
Verify the accuracy of the exposure time using an oscilloscope connected at the same test points used to measure kV (TP4 and TP5) of the HF generator board. The exposure time calculated at about 75% of the maximum kV value, must correspond to the set one ±10%. In case the time is outside the prescribed values, replace the CPU.

7.3. mA Check

mA can be measured directly (invasive method) on the tubehead by the test points on the HF generator board after having performed the following procedures:

a. Remove the outer covering of the tubehead.

b. Remove the metal protection grid of the generator board.



WARNING:
The board has a working voltage of about 360V.

Use a multimeter (R input >= 10MΩ) in working conditions VDC and end of scale 20V, position the cold pole on TP4 (GND) and the hot pole on TP1 (mA). Set the following parameters in CEPH mode: 60kV-4mA-3s. Perform an exposure and considering that a ratio 1V DC = 2 mA, verify that the value indicated by the multimeter ranges from 1.84÷2.16V (4mA±8%).
Set 80kV - 12mA - 3s. The value read must range from 5.52 to 6.48V (12mA±8%).

In case the detected values are outside these ranges, check that the voltage on TP2 is -4V ± 0.02V. Otherwise, adjust trimmer R165 to obtain this value. After having adjusted the trimmer, check again the current during the emission.

7.4. Storing of automatical exposure parameters

At the end of mechanical installation and functional check the stored exposure parameters can be modified depending on the operator needs.

7.4.1. Exposure parameter

To modify the automatic exposure parameters, please follow the indicated procedure:

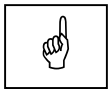
1. Select the exam, the type of patient and the size to be modified.

2. According to the parameter to be modified press "7" 

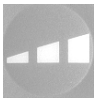
and/or "5" 

and/or "6" 

(the latter just for Cephalometric function). On display, on the left of the selected parameter value, a reference character will be displayed.



NOTE:
The pressure of one of the three parameters setting keys will cause the de-activation of the patient size LED and the blinking of the patient type and function/examination LED's. This LED's will be reactivated only when storing parameters (paragraph 7.4.3).

3. Press "3"  or "6"  to set the value to store.

7.4.2. Soft Tissue Filter

It is possible set the default value of the Soft Tissue Filter in function of patient type (Adult/Child) and the patient size (small, medium, large).

NOTE:
The value of Soft Tissue Filter is stored for all Asymmetric projections. For the symmetrical projections instead, the default position of the STF is out (the display shows OUT).

7.4.3. Storing parameters

To store the set value, press the key "28"  e "23"  , at the same time, the display will show the following message:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

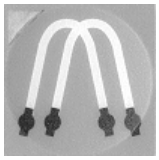
press key "23"  to confirm, the LED's will lit again, or the key "9"  to cancel the setting; in this case the LED's blink and the display still shows the same value.

7.4.4. Table of pre-set anatomic parameters

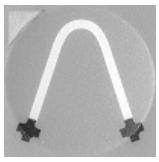
PANORAMIC

	Adult 	Child 
Thin 	70 kV 10 mA	66 kV 8 mA
Normal 	74 kV 10 mA	68 kV 8 mA
Robust 	76 kV 10 mA	70 kV 9 mA

TMJ open/close mouth

	Adult 	Child 
Thin 	70 kV 10 mA	60 kV 10 mA
Normal 	74 kV 10 mA	66 kV 10 mA
Robust 	78 kV 10 mA	70 kV 10 mA

TMJ BIAXIAL

	Adult 	Child 
Thin 	70 kV 10 mA	60 kV 10 mA
Normal 	74 kV 10 mA	66 kV 10 mA
Robust 	78 kV 10 mA	72 kV 10 mA

CEPHALOMETRY (L.L)

	Adult 	Child 
Thin 	74 kV 12 mA 0.8 s 83 FPM	72 kV 11 mA 0.9 s 83 FPM
Normal 	76 KV 12 mA 0.8 s 83 FPM	74 kV 11 mA 0.9 s 83 FPM
Robust 	78 KV 12 mA 0.8 s 83 FPM	76 kV 12 mA 0.7 s 83 FPM

7.5. STRATO 2000 Software Utilities

The STRATO 2000 Software utilities is a special software program that allows the user to perform special functions like the U.C.A. upgrade. This software also allows viewing the calibration data of STRATO 2000; there is a special pop-up menu, named "Service", to perform this operation.

Power on the STRATO 2000 and let it reach the Patient's entering position.
To install the software on the PC, insert the CD named "Strato 2000D Software Utilities" (P/N 4492710500) shipped among with the STRATO 2000 on the CD reader of the PC; the software installation procedure will start automatically; if not, start it using the "Start", "Run" procedure and selecting the "Autorun" program on the CD.

Figure 7-4

Select the language to be used during the installation and also on the program itself by clicking on the corresponding flag.
The Software will try to determine if the STRATO 2000 is connected to the PC; click on "Test Connection" tab.

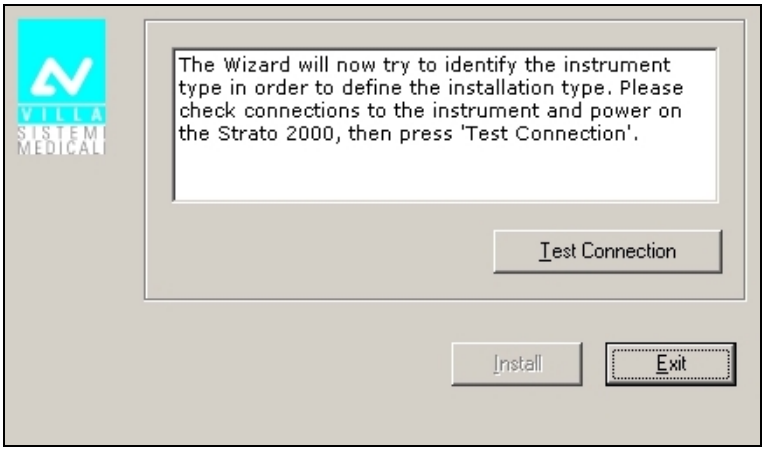


Figure 7-5

Once the connection procedure has been terminate, the following windows will appear.

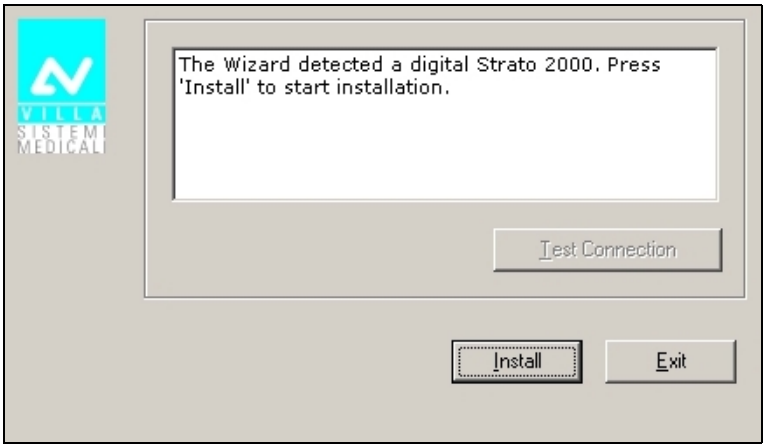


Figure 7-6

Clicking on "Install", the software will be installed on the PC; please follows the steps of the installation.

At the end of installation process, the STRATO 2000 Software Utilities package will be installed; the normal folder is:
"C:\Programs\VSM\Strato2000D\

Execute the package using the standard Windows process. The following windows will open.

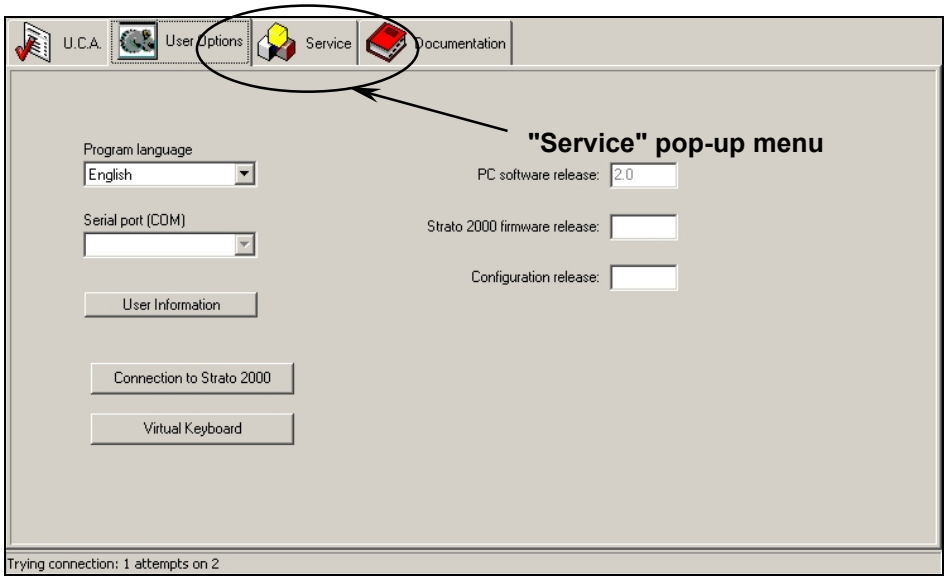


Figure 7-7

Pushing a "Service" tag; a new window will be displayed, asking for a password (Figure 7-8). This password is used to protect from unwanted access to this area that can be dangerous for the system.
The final customer must not know the password.

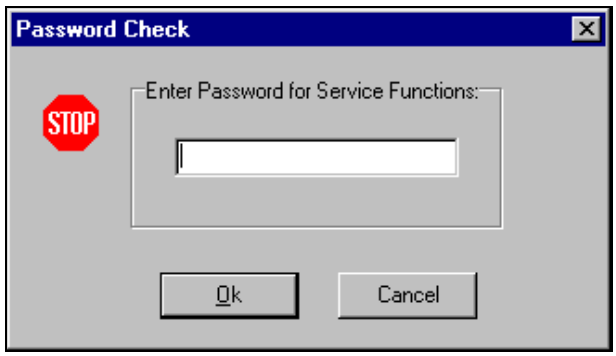


Figure 7-8

Input the name "PLUTO" (capital characters) and confirm by selecting OK or pressing the "Enter" key on the keyboard to enter into the services menu; the DMS software will take some seconds to receive the configuration data from the STRATO 2000.
At the end of the communication, the following windows will appear.

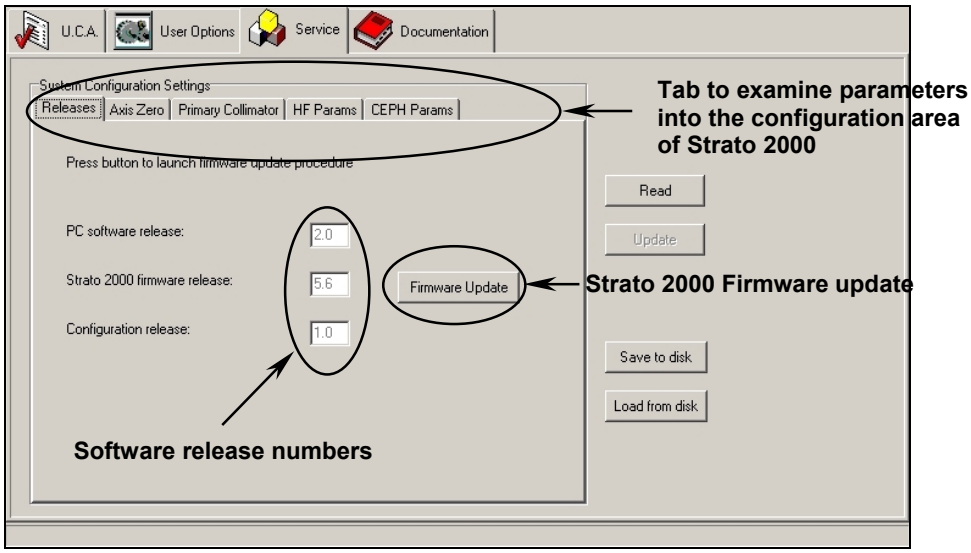


Figure 7-9

By selecting one of the Tab to examine the configuration parameters, one of the following figures will be displayed.

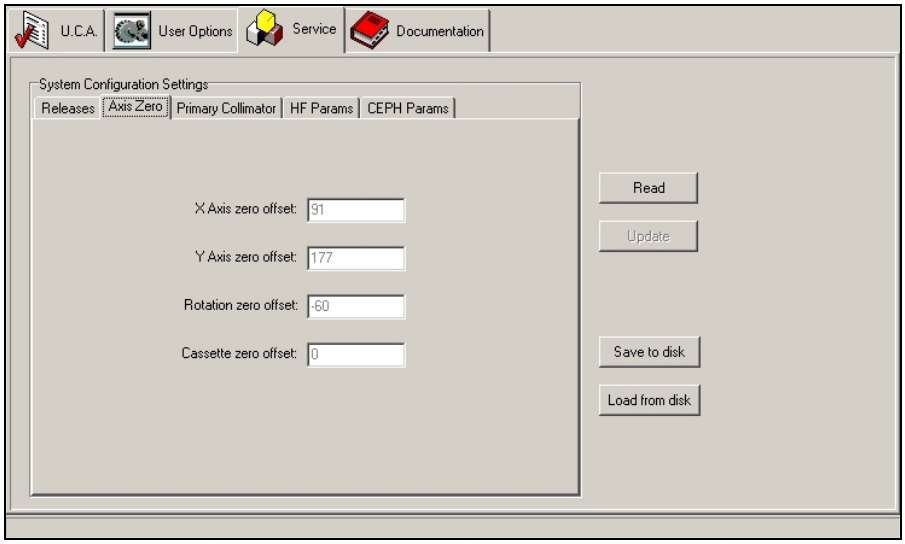


Figure 7-10: Axis Zero

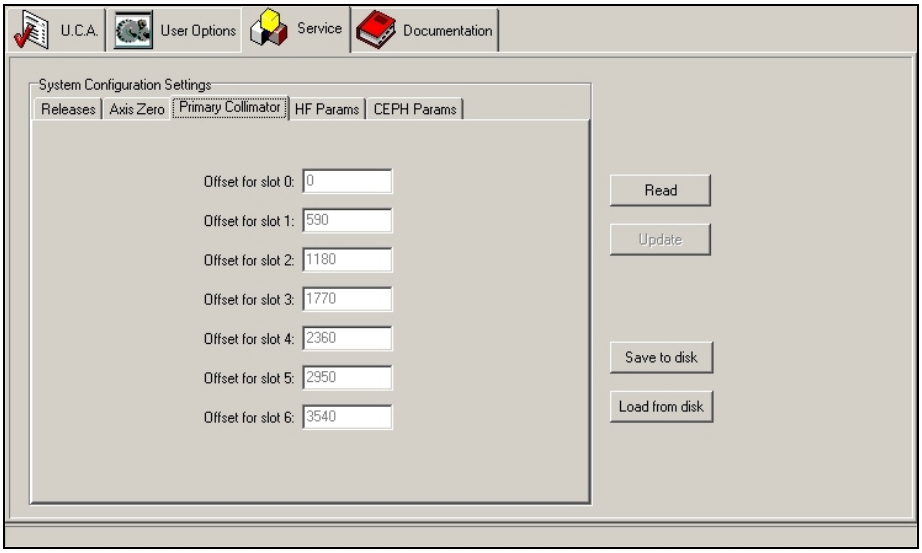


Figure 7-11: Primary collimator

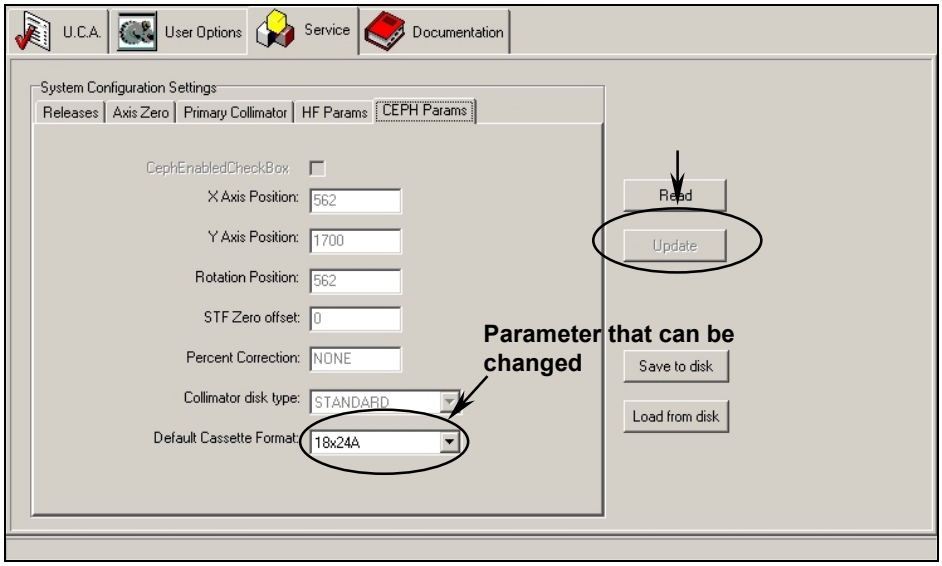


Figure 7-12: CEPH Params

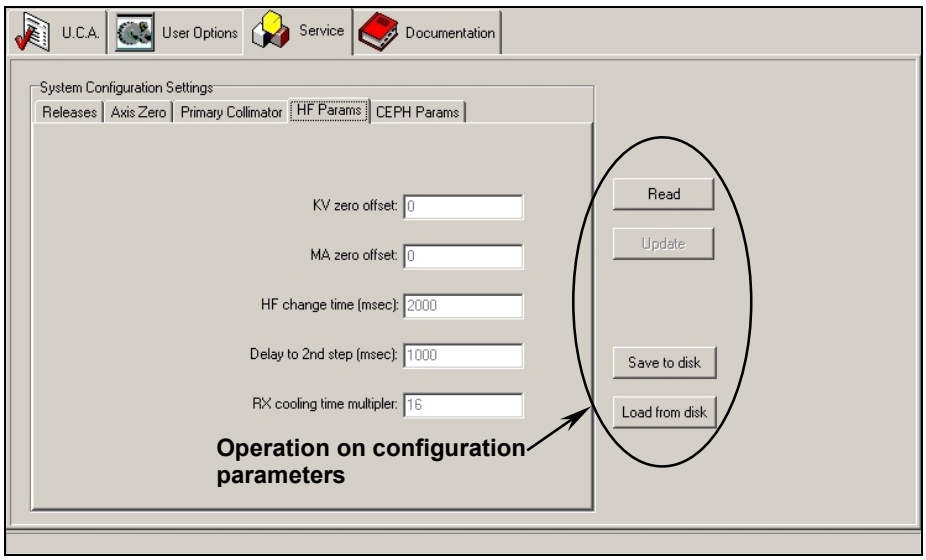


Figure 7-13: HF Params

NOTE:
On this software release of the STRATO 2000 Software Utilities there is no possibility to modify parameters with the exception of default cassette format for CEPH (Figure 7-12); the change can be transferred to the STRATO 2000 by pressing the "Update" button. This button is enabled once that software detects a change in the data.

The four buttons on the right side of the screens are useful to manage configuration files:

- "**Read**" button performs a new reading of the parameters from the STRATO 2000; it can be used to verify the functionality of the Upload function
- "**Save to disk**" is used to store on a file, on the hard disk or in a floppy or different media, the configuration data.
  Pressing this button, the following window appears:

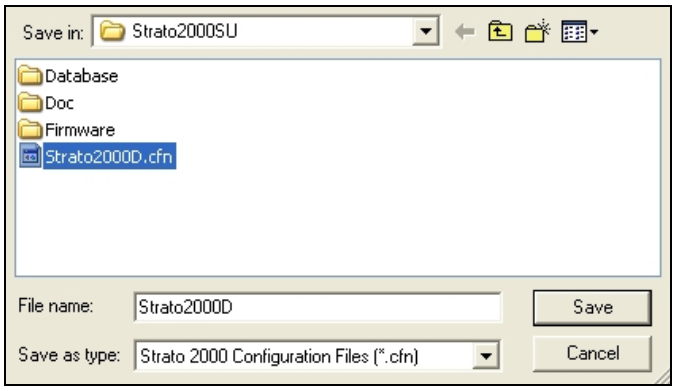


Figure 7-14

Using the stardard Windows commands, store the file with ".cfn" extension on the disk/directory selected.
As a suggestion, the doctor's name can be used to specify the file.

- "**Read from disk**" is the function that allows reading the configuration file from the disk (*.cfn).

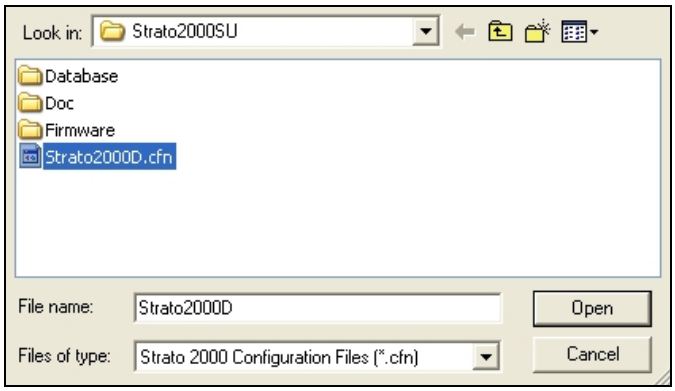


Figure 7-15

In the above picture, the file *"Strato2000proto.cfn"* data will be loaded from the root directory of hard disk.

- The "**Update**" button is automatically enabled every time the SW detects a change in the data; pressing it data displayed in the various windows will be uploaded into the STRATO 2000.

The last function is the Firmware updolad; this can be used in case there the need to load a new firmware release on the STRATO 2000. Selecting the button "**Firmware Update**" (Figure 7-9), the following picture will be displayed:

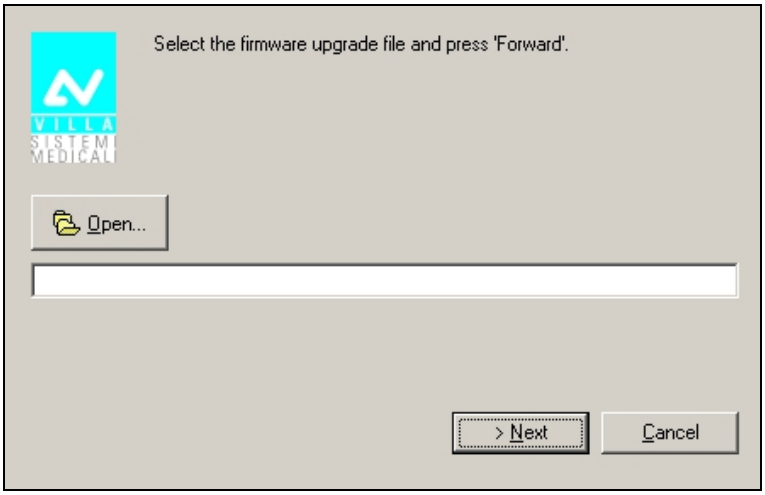


Figure 7-16

Clicking on the "Open" tab, it is possible to select the firmware fire using standard window commands; the software locates automatically a folder named "Firmware" where may be contained the file, but it is possible to select it in other folders; choose the correct one. This files have the ".txt" extension.

As an example, following the file *"v5_06.txt"* is selected.

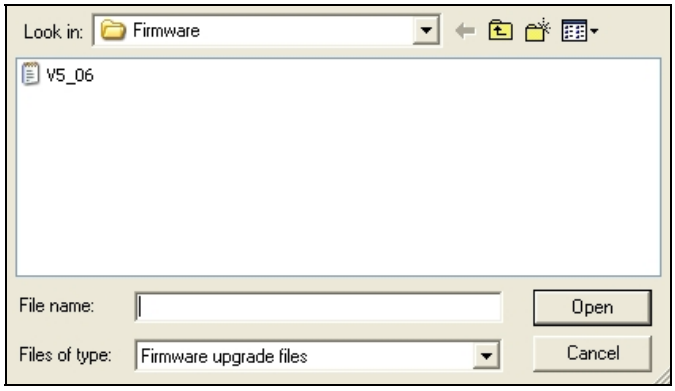


Figure 7-17

By confirming, the Firmware update procedure will start. The following windows is displayed, showing that the USB port is in use.

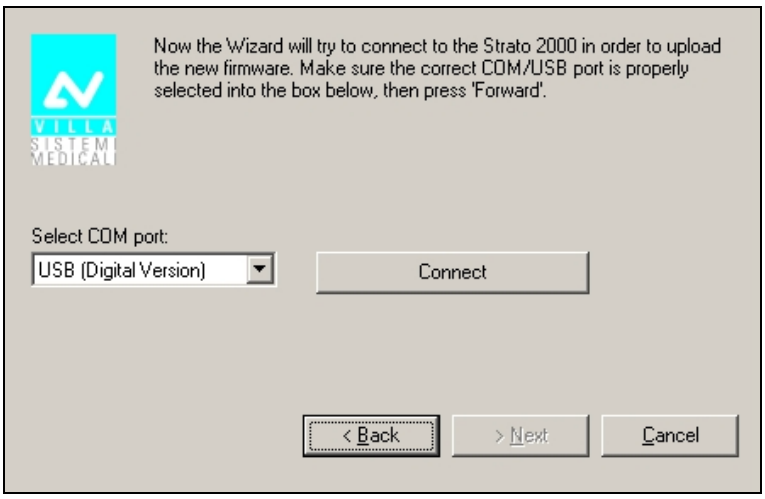


Figure 7-18

Clicking "Back" is possible to return to file update selection; click on "Connect" to start the communication with the firmware upgrade procedure on the STRATO 2000.

NOTE:

- The STRATO 2000 keyboard is locked during Firmware update procedure.
- The update procedure will last for at least 25 minutes; during this time no other operations can be performed on the PC and/or the STRATO 2000.
- During the operation, a scrolling bar and a numerical indication of elapsed and remaining time is displayed.
- If the following message is displayed, please switch off the STRATO 2000, power on it again and let it reach the patient's centering position; click on "OK" and "Connect" again.

If the communication is well established, the appropriate message is showed.

Click on "OK" and a new windows will appear.

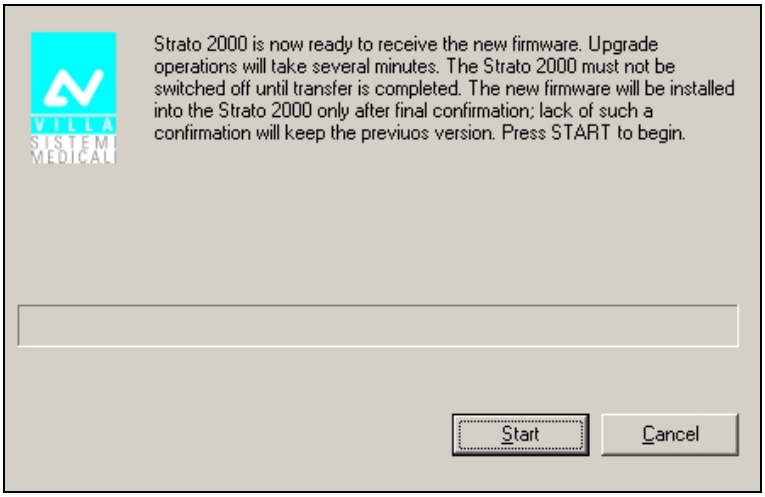


Figure 7-19

Click on "Start" to begin the software transfer procedure.
During the operation, a window showing the progress of the transfer is displayed.

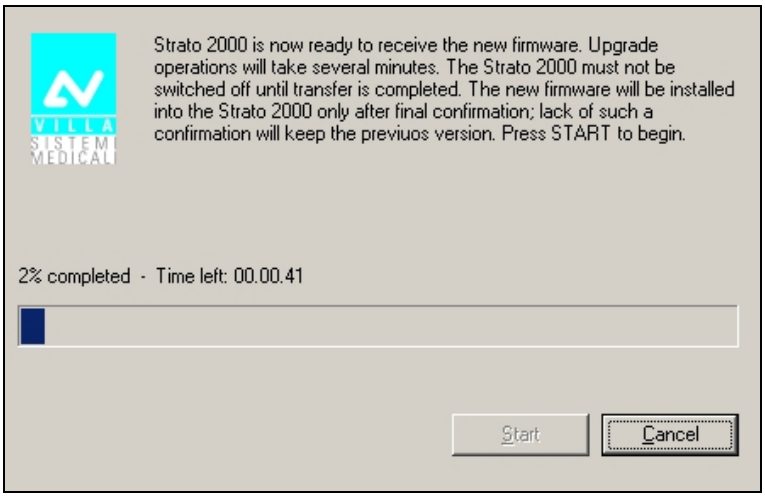


Figure 7-20

At the end, windows will appear asking to confirm the upload process.

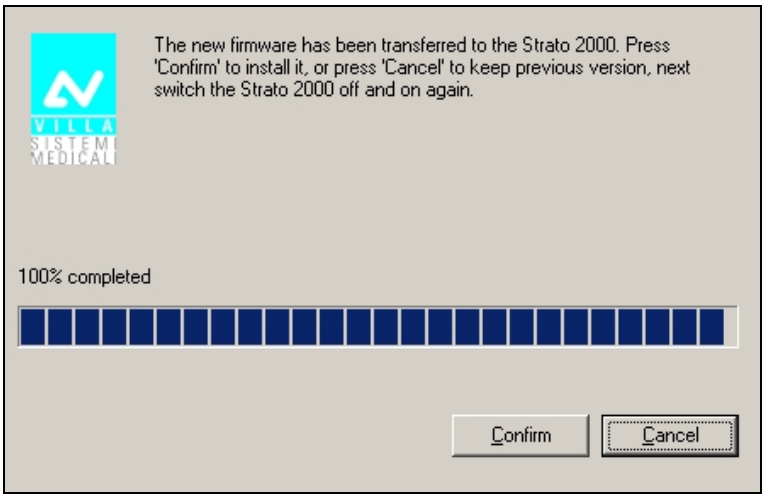


Figure 7-21

Confirming by pressing on "Confirm" or pressing the "Enter" key on the keyboard will complete the upload operation.

Now the STRATO 2000 has to be reset from the main keyboard; it will boot again; the display should visualise the new software release. There is no need to adjust the calibration of the STRATO 2000, because the previous data are maintained.
The Software Utilities program was automatically terminated so if you need to verify other data, it must be restarted again.

8. TROUBLESHOOTING

8.1. Displayed messages

STRATO 2000 is fully driven by a microprocessor which controls the programming of the emission parameters and indicates via displayed messages the different conditions of the unit and any defects and errors that occur.

The messages are divided into two groups:

- **Operational messages**: messages that guide the operator in setting up the unit for performing an examination (see User Manual).
- **Error messages**: messages that are displayed when an error occurs. There are three types of error messages:

1 - Messages that could have been caused by the operator when releasing the X-ray button or pressing key "9"  when a movement is in progress.
This message will be displayed as follows:

E		x	x	x											
P	R	E	S	S		R	E	S	E	T					

xxx code number of the error message

Operating conditions are reset by pressing key "9"  .

2 - Messages arising from a system defect. In this case, the Technical Service must be called.
The messages that require the intervention of the Technical Service are displayed as follows:

E		x	x	x											
C	A	L	L		T	E	C	H		A	S	S	.		

xxx code number of the error message

3 - Messages related to problems regarding the HF board. In this case, the unit must be switched off. Wait a few seconds for the circuit capacitors to discharge and then switch the unit on again. If the problem persists, call the Technical Service.

E		x	x	x											
S	W	I	T	C	H		O	F	F		S	Y	S	T	.

xxx code number of the error message

The following table illustrates the various messages that require the intervention of the Technical Service and the reference chapters where the diagnostic procedure and the corrective actions are given.

Motors movement		
Code	**Error description**	**Reference chapter**
500	Unexpected limit switch activation X-axis	**8.3.5.1.1**
501	Unexpected limit switch activation Y-axis	**8.3.5.2.1**
502	Unexpected limit switch activation Rotation	**8.3.5.3.1**
504	X-Y-Rotating time-out motors zeroing	**8.3.5.4.1**
505	Time-out motor Y zeroing	**Action as per E501**
506	Time-out motor R zeroing	**Action as per E502**
508	Time-out motor X zeroing	**Action as per E500**
542	Collision of rotation arm with patient	**8.3.5.3.2**
Collimator 1		
Code	**Error description**	**Reference chapter**
510 (*)	Primary collimator Position 0 not found	**8.3.5.5.1**
511 (*)	Decoding error of primary collimator position (optical switches)	**8.3.5.5.2**
513 (*)	Motor "timeout" during the movement of the primary collimator	**8.3.5.5.3**
514 (*)	Limit switch not found during reset of primary collimator	**8.3.5.5.4**
515 (*)	The zero microswitch is always closed	**8.3.5.5.4**
Soft Tissues Filter		
Code	**Error description**	**Reference chapter**
520 (*)	Soft tissues filter timeout	**8.3.5.6.1**
521 (*)	The movement of the soft tissues filter stops at the limit switch	**8.3.5.6.1**
522 (*)	Limit switch not found during reset of soft tissues filter	**8.3.5.6.1**

***(*)** Not present on PAN version with fixed primary collimator.*

H.F. Board & Tubehead		
Code	**Error description**	**Reference chapter**
550	"No power supply" alarm H.F. generator board	**8.3.3.3.1**
551	H.F. generator board "overvoltage" alarm	**8.3.3.3.2**
552	H.F. generator board "overload" alarm	**8.3.3.3.3**
553	H.F. generator board "broken filament" alarm	**8.3.3.3.4**
554	H.F. generator board "no X-ray emission" alarm	**8.3.3.3.5**
555	"X-ray emission too long" alarm	**8.3.3.3.6**
Buttons		
Code	**Error description**	**Reference chapter**
560	One or more keys are reported as pressed during the switching-on phase (see following table)	**8.3.3.2.1**
561	RX key released during X-rays examination	**8.3.3.2.2**
562	RX key short-circuited during start-up and/or during examination programming	**8.3.3.2.3**
563	Remote RX key pressed during start-up and/or during examination programming	**8.3.3.2.4**
Memory checksum		
Code	**Error description**	**Reference chapter**
570	Checksum error on Flash EPROM	**8.4.1**
571	Writing error on Flash EPROM	**8.4.2**
572	Error during erase of Flash EPROM	**8.4.2**
573	Error during the verification phase of Flash EPROM	**8.4.2**
574	Unspecified error of Flash EPROM	**8.4.2**
575	Configuration data corrupted on Flash EPROM	**8.4.2**
Code	**Error description**	**Reference chapter**
600	Reset key pressed during movement	**8.3.5.3.3**
601	U.I.C. not found and/or faulty	**8.4.3**

NOTE:
The CPU board contains a non-volatile memory where all the calibration data of the unit (e.g. motor offset) and all the preference settings performed by the user (e.g. exposure parameters different from the default ones) are stored. This non-volatile memory is mounted on a small piggy-back board fitted on the CPU board through a socket. In case of replacement of the CPU board, the piggy-back board containing the non-volatile memory must be removed from the defective CPU board and installed on the new CPU board in place of the existing one which contains a blank non-volatile memory. In this way, the calibration data will be automatically loaded in the new board (otherwise these data will be lost). When removing/fitting the piggy-back board, pay attention not to damage it or the CPU board.
If the failure of the CPU is due to the non-volatile memory or to the piggy-back board, and therefore stored data are lost, see Appendix A of this manual where calibration data are listed. This information can be manually entered into the new CPU board through the service programs of the machine (passwords).

WARNING:
If the original flash Eproms cannot be reused the first operation after having replaced the full CPU is to set-up the hardware configuration using Password 89 and Password 90 (see paragraph 8.3.1 and 8.3.2).
If this configuration is not correct the CPU board will result not operative.

If error E560 occurs, the keys pressed during start-up will also be displayed as follows:

E		**5**	**6**	**0**		**(**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**)**
C	**A**	**L**	**L**		**T**	**E**	**C**	**H**		**A**	**S**	**S**	**.**		

xxxxxxxx code number of error message 560

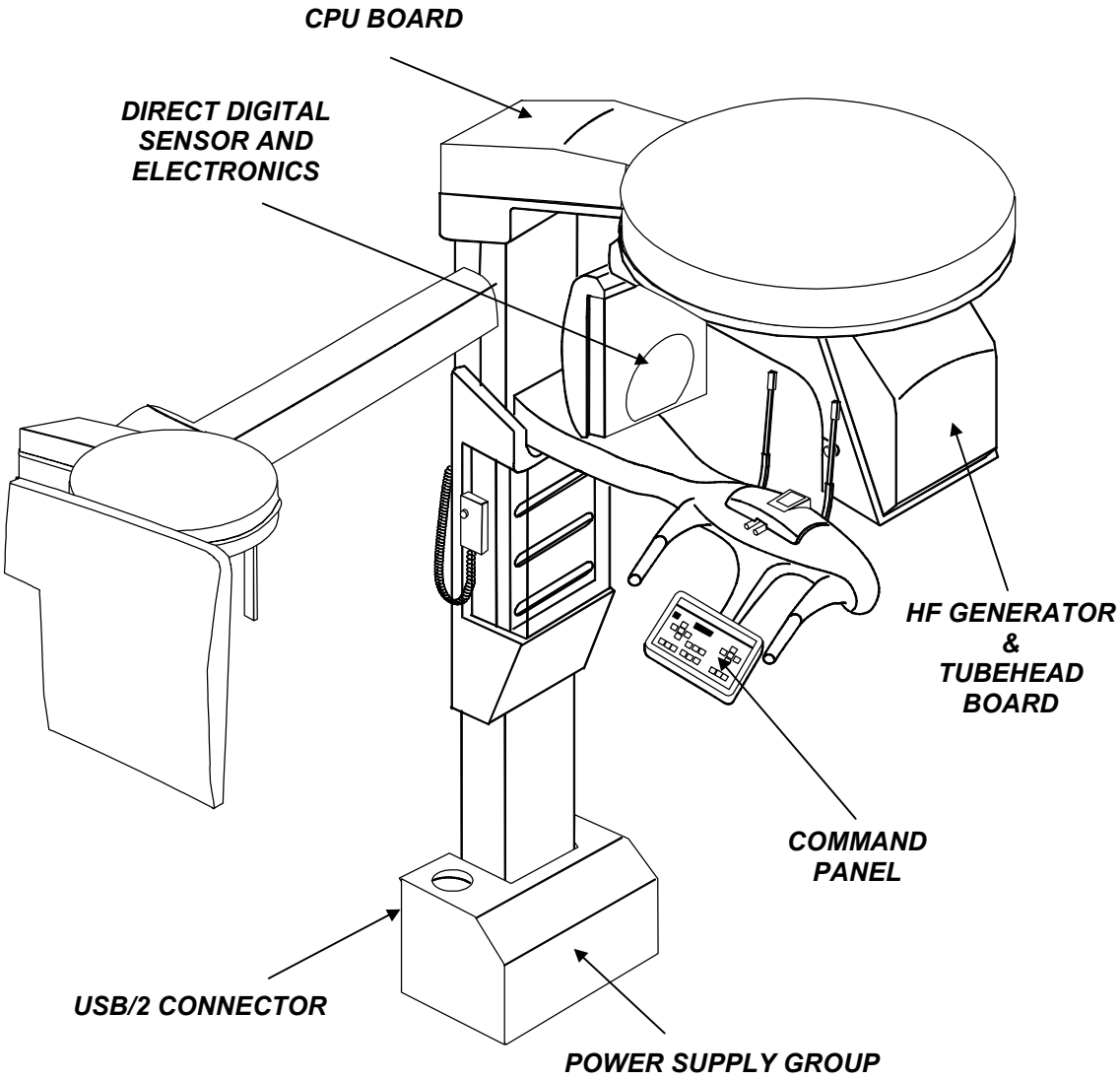
Code	Key description	Key no. (Figure 3-5)
0000000**1**	Not used	21
0000000**2**	PANORAMIC centering device	20
0000000**4**	Arrow up	22
0000000**8**	Arrow right	24
00000**10**	ENTER	23
00000**20**	Arrow left	26
00000**40**	Arrow down	25
00000**100**	Selection of arch type (wide, normal, narrow)	13
00000**200**	Column key	28
00000**800**	TMJ translateral examination selection	16
0000**1000**	Size selection (small, standard, large)	12
0000**2000**	Adult/Child selection	11
0000**4000**	CEPHALOMETRY selection	15
0000**8000**	IMPLANT selection	14
000**10000**	Column down	29
000**80000**	PANORAMIC selection	17
00**100000**	TMJ open/closed mouth selection	18
00**200000**	TMJ BIAXIAL selection	19
00**400000**	Patient input	10
00**800000**	Reset	9
0**2000000**	Increase by steps	3
0**4000000**	Column up	27
0**8000000**	kV selection	7
10000000	Exposure time selection	4
20000000	mA selection	5
40000000	Reduction by steps	6
80000000	Test	8

8.2. LEDs

This paragraph describes the diagnostic significance of the LEDs on the STRATO 2000 boards.
The chapter includes the following paragraphs:

- 8.2.1 CPU board LED
- 8.2.2 HF board LED
- 8.2.3 Power supply group LED

The location of the boards is as follows:



NOTE:
The LED on the keyboard are not described in this chapter. These are described in paragraph 3.6.1. These LEDs are tested by activating password 94 (see paragraph 8.3.3.2).
The LEDs of the Direct Digital Sensor board are described on the relevant Manual.

8.2.1. CPU board LED

The following table shows the LED that are present on the CPU board, their colors, their significance and the recommended corrective actions in case of defects. To locate the LEDs, refer to the CPU A1 board illustrated in chapter 9, drawing #3, of this manual:

LED	Colour	Function	Status of the LED under normal condition	Corrective actions in case of defect
H1	Green	"+24V" presence from power supply group	ON	- Verifies +24V output from the power supply group and relative wiring system.
H2	Green	"+5V" presence generated inside the CPU	ON	- Verifies +24V presence. - Verifies +5V stabilizer circuit on the CPU (IC N2).
H3	Green	"+12V" presence generated inside the CPU	ON	- Verifies +24V presence. - Verifies +12V stabilizer circuit on the CPU (IC N3).
H4	Green	"+5VS" presence generated inside the CPU	ON	- Verifies +24V presence. - Verifies +5VS stabilizer circuit on the CPU (IC N1).
H6	Yellow	Microprocessor Watchdog circuit	ON	- The microprocessor does not work. Change the CPU board.

In case no LEDs are turned ON no activity can be observed on the keyboard check the wiring X3 (Power Supply group) –X1 (CPU board) and the green LED on the base of the device

8.2.2. H.F. board LED

The following table shows the LED that are present on the H.F. board, their colours, their significance and the recommended corrective actions in case of defects. To locate the LEDs, refer to the layout of the HF board (A2) illustrated in chapter 9, drawing #7, of this manual:

LED	Colour	Function	Status of the LED under normal conditions	Corrective actions in case of defect
H1	Green	"Power"; correct function of the switching power supply oscillator (IC U1)	ON	- Check fuse F1 on the power supply group. - Check fuses F1 and F2 on the HF board.
H2	Green	"Filament OK"	ON	X-ray tube filament broken. Change tubehead.
H3	Red	"Overvolt"	OFF	Tubehead power supply tube overvoltage. Switch off the unit, then switch on again. If the error persist, change the H.F. board.
H4	Yellow	"X-ray ON"	ON with X-rays emission	Check the X-ray button and cable.
H5	Red	"Overload"	OFF	Tubehead power supply circuit overload. Switch off the unit, then switch on again. If the error persists, change the H.F. board.

8.2.3. Power supply LED group

The led shown in the following table is on the +24V switching power supply located at the base of the column (the layout of the +24V switching power supply module is shown in chapter 9, drawing #17, of this manual).

LED	Colour	Function	Status of the LED under normal conditions	Corrective actions in case of defect
LED	Green	Correct functioning of the +24V switching power supply.	ON	Check the presence of +24V output from the +24V switching power supply module. Disconnect the CPU (X3) board. If the defect persists, change the switching power supply module.

8.3. Service programs descriptions

This paragraph provides a brief description of the service programs (password) of the unit.
There are two levels of password; one level is used for the hardware configuration and should be used only when the entire CPU board has been replaced.
The second level enables the service engeneer to perform a series of tests of the machine's functions, for example, providing the possibility of activating the various motors and verifying the correct working of the relative positioning sensors.

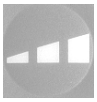
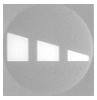
Access to the hardware configuration and service programs is as follows:

1. Switch on the unit. The following message will be displayed:

R	E	L	E	A	S	E			*	.	*	*	*		

After 3 seconds, the following will be displayed:

					>	T	E	S	T	<					

2. When this message is displayed, increase key "3"  and decrease "6"  must be pressed simultaneously. After 3 seconds, the following will be displayed:

				S	E	T		U	P						
P	A	S	S	W	O	R	D	?			1	0	0		

3. - Using key "22"  or "25"  , set the number of the Password relative to the desired Service Program.
For the service programs confirm the selection by pressing key "23"  .

- For hardware configuration password confirm the selection by pressing **at the same time** keys "7"  and "5"  .
For the service programs confirm the selection by pressing key "23"  .

The hardware configuration password are the following:

- **Password 89:** collimator type
- **Password 90:** selection of digital version.

The service programs available are the following:

- **Password 94:** test of a number of HW components in the system
- **Password 102:** allows reading of the parameters stored into the non-volatile memory of the unit (e.g. motor offset)
- **Password 118:** test on motors/positioning sensors, setting of the zero offsets of the axes and the collimators
- **Password 124:** definition of the parameters for the cephalometric examination
- **Password 130:** language setting for the displayed messages (the Service messages are always in English)
- **Password 143:** display and reset of the counters for the various examinations. Display of total time of the system's exposure.

The activation of the various functions provided by the service programs is made using the keyboard. The function of each key is described in the following sub-sections dedicated to the various passwords. In this phase, the console display will present data regarding the password/selected function. The relative description is given in the following paragraphs.

In this chapter, inside the specific service program description, it is possible to find a more detailed description of the different error messages listed in the table of paragraph 8.1 and suggestions for troubleshooting of the problem and correct it

8.3.1. Password 89

The display will show alternatively:

P	**R**	**.**		**C**	**O**	**L**	**L**	**.**		**M**	**O**	**D**	**E**		
S	**T**	**A**	**N**	**D**	**A**	**R**	**D**		**M**	**O**	**D**	**E**			

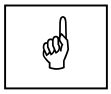
P	**R**	**.**		**C**	**O**	**L**	**L**	**.**		**M**	**O**	**D**	**E**		
C	**H**	**I**	**L**	**D**		**A**	**S**		**A**	**D**	**U**	**L**	**T**		

P	**R**	**.**		**C**	**O**	**L**	**L**	**.**		**M**	**O**	**D**	**E**		
N	**O**	**T**		**P**	**R**	**E**	**S**	**E**	**N**	**T**					

To move from one selection to another use keys  and  .

To confirm selection press key "23"  .

Select "**STANDARD MODE**" for devices with rotating collimator if the Direct Digital Sensor can operate with Child slot when executing a Panoramic examination in Child mode.



NOTE:
The functionality of the Digital Sensor with the reduced slot size of the primary collimator for Child is not granted on all versions of the Direct Sensor.

Select "**CHILD AS ADULT**" for devices carrying the rotating collimator. This choise will use the same slot for Child and Adult in Panoramic examination.

Select "**NOT PRESENT**" for fixed collimator PAN only unit.

8.3.2. Password 90

The display will show:

D	**I**	**G**	**I**	**T**	**A**	**L**		**S**	**E**	**T**		**U**	**P**		
D	**I**	**G**	**I**	**T**	**A**	**L**		**M**	**O**	**D**	**E**		**O**	**F**	**F**

or

D	**I**	**G**	**I**	**T**	**A**	**L**		**S**	**E**	**T**		**U**	**P**		
D	**I**	**G**	**I**	**T**	**A**	**L**		**M**	**O**	**D**	**E**		**O**	**N**	

To move between possible selection, use key  as a toggle; select "**DIGITAL MODE ON**" and press enter  .

8.3.3. Password 94

This password is used for testing a number of system components. Upon access to this function, the following menu is displayed:

T	**E**	**S**	**T**		**M**	**E**	**N**	**U**						
<	**m**	**e**	**n**	**u**		**o**	**p**	**t**	**i**	**o**	**n**	**>**		

where <menu option> indicates one of the following selectable functions:

- <Test Input Ports>: Input ports test
- <Test Keyboard>: Keyboard test
- <Test kV circuit>: XR tube piloting voltage generation circuit test
- <Test mA circuit>: XR tube filament current generation circuit test

Scrolling through the various functions is made using the keys:  (forward scroll) and  (backward scroll). Scrolling is made in rotation. To enter a function press key "23"  .

8.3.3.1. Input ports test

This function is used to carry out diagnostics at low level of the various input signals of the CPU board. It may be used, for example, to verify the limit switches without necessarily moving the axes but manually activating the microswitches.

The display will be updated as follows:

T	E	S	T		I	N	P	U	T		P	O	R	T	S
D	y	y						8	7	6	5	4	3	2	1

NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly:

- **yy**= selected port code (D9, D10, D11, D12, D17)
- **87654321**= logic status of the port inputs.

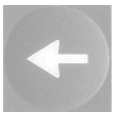
The port code correspond to the chip initials as per the wiring diagram, while the status of the bits describes the logic level of the inputs on the selected port.

NOTE:
The following table describes the correspondence between the displayed figures and the corresponding input signal. The digits are numbered from 8 to 1. The eighth digit corresponds to the character furthest to the left on the display, while digit 1 corresponds to the character furthest to the right.

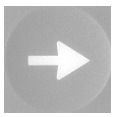
Port	Bit	Association	µSwitch/sensor initials	Logic status at rest
D9	8	Limit switch forward /Y-axis right	S5	0
	7	Limit switch backwards/Y-axis left	S8	0
	6	Y back with respect to zero	S6	see Note
	5	Y-axis forward with respect to zero	S6	see Note
	4	X-axis left limit switch	S9	0
	3	X-axis right limit switch	S12	0
	2	X-axis to right of zero	S10	see Note
	1	X-axis to left of zero	S10	see Note
D10	8	Right rotation limit switch (clockwise)	S13	0
	7	Left rotation limit switch (anti-clockwise)	S16	0
	6	Rotation to right of zero	S14	see Note
	5	Rotation to left of zero	S14	see Note
	4	Left cassette limit switch	S18	NOT USED
	3	Right cassette limit switch	S17	NOT USED
	2	Left secondary collimator - IMPLANT position	S20	NOT USED
	1	Right secondary collimator - PANORAMIC position	S21	NOT USED
D11	8	Primary collimator in zero position	S22	0
	7	Soft tissue filter all in field	S23	0
	6	Limit switch column all down	S27	0
	5	Limit switch column all up	S26	0
	4	Sensor holder in CEPHALOMETRIC position	S25	1
	3	Sensor holder in PANORAMIC position	S24	1
	2	X-rays button on column		1
	1	Sensor ready	S19	0
D12	8	not used		
	7	not used		
	6	not used		
	5	not used		
	4	not used		
	3	CEPHALOMETRIC cassette present	S29	1
	2	not used		
	1	Remote control X-rays button		0
D17	8	X-rays presence sensor		1
	7	X-ray tube filament broken alarm		0
	6	H.F. board overload alarm		1
	5	H.F. board overvoltage alarm overvoltage		1
	4	H.F. board - no power supply		0
	3	Primary collimator B3 photodiode (top bit)	B3	1
	2	Primary collimator B2 photodiode	B2	1
	1	Primary collimator B1 photodiode (bottom bit)	B1	1

NOTE:
The logic status of these signals depends on the physical position of the relevant microswitch with respect to the "0" position. Check the functioning of the microswitch by moving the relevant axis (motor/movement) and checking that the logic status changes.

The keys active for this test are:



Displays the preceding port in the list of ports present (key "26")



Displays the next port in the list of ports present (key "24")

Returns to the main menu (key "9")

8.3.3.2. Keyboard test

This function is used to verify the functions of the keys and the relative light indicators.
Upon access, only the title of the function is displayed:

K	E	Y	B	O	A	R	D		T	E	S	T			

After which the system awaits the pressing of a key. Each time a key is pressed the description of the key (character string) and the code (hexadecimal numeric value) is displayed and for those keys associated with a LED, the corresponding LED lights up. In order to be able to verify the light indicators "1"  and "2"  that are not associated to keys, the system lights up the two LEDs upon entering the function.

For example, when key "23"  is pressed, the display shows the following message:

K	_	E	N	T	E	R									
C	O	D	E	:		0	x	0	0	0	0	0	0	1	0

The function is exited by pressing key "9"  . Before quitting, the following message is displayed:

K	_	R	E	S	E	T									
C	O	D	E	:		0	x	0	0	8	0	0	0	0	0

To enable the reading of the "RESET" key code. After two seconds, the display returns to the main menu.

There are a set or errors, grouped in the range E560 to E563 for the diagnostics of the functionality of the keyboard; E560 is specifically for a problem related only to the keyboard functionality, while the others are related to emission buttons (local and remote).

8.3.3.2.1. ERROR 560: One or more buttons pressed at start-up

If error E560 occurs, the keys pressed during start-up will also be displayed as follows:

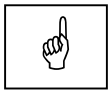
E		**5**	**6**	**0**		**(**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**)**
C	**A**	**L**	**L**		**T**	**E**	**C**	**H**		**A**	**S**	**S**	**.**		

xxxxxxxx code number of error message 560

The xxxxxxxx characters are used to identify the pressed button, according to the following table:

Code	Key description
0000000**1**	IMPLANT centering device
0000000**2**	PANORAMIC centering device
0000000**4**	Arrow up
0000000**8**	Arrow right
00000**10**	ENTER
00000**20**	Arrow left
00000**40**	Arrow down
00000**100**	Selection of arch type (wide, normal, narrow)
00000**200**	Column key
00000**800**	TMJ translateral examination selection
0000**1000**	Size selection (small, standard, large)
0000**2000**	Adult/Child selection
0000**4000**	CEPHALOMETRY selection
0000**8000**	IMPLANT selection
000**10000**	Column down
000**80000**	PANORAMIC selection
00**100000**	TMJ1-TMJ2 selection
00**200000**	TMJ BIAXIAL selection
00**400000**	Patient input
00**800000**	Return
0**1000000**	Not used
0**2000000**	Increase by steps
0**4000000**	Column up
0**8000000**	kV selection
10000000	Exposure time selection
20000000	mA selection
40000000	Reduction by steps
80000000	Test

1. Try to unlock the pressed buttons.
2. Check the cable from keyboard to CPU, looking especially to the connector between chin rest and column.



NOTE:
The usual fault of the cable is a poor contact on this connector and the result can be an unreadable message but the machine looks functional, or the column does not move, etc..

3. Check also the cable up to the CPU X22 connector.
4. If the cabling is OK, replace the keyboard.

8.3.3.2.2. ERROR 561: X-ray button released during emission

This message appears only if, during an examination with or without emission, the X-ray button has been released.
Press the reset button and restart the operation as suggested by the control system.

8.3.3.2.3. ERROR 562: X-ray button pressed during start-up or during exam preparation

This message is displayed if the X-ray button is sensed pressed during the power on or during the preparation of the exam, that is during the movements of the rotating arm to reach the initial position.

1. If the button was not intentionally pressed, power off the machine, disconnect the connector X47 on the CPU and power on the machine again. If the message continues to be displayed, replace the CPU.
2. Check the cable from X51 up to the local button and replace it if faulty.
3. In case the X-ray button is faulty because always closed , replace it.

8.3.3.2.4. ERROR 563: Remote X-ray button pressed during start-up or during exam preparation

This message is the equivalent of the above message but applies to the remote one.

1. Repeat the above steps, but disconnect the cable from connector X51.
2. Check the cable from X51 up to the X0 connector on the main base.
3. Disconnect the remote X-ray button from X0 connector on the main base plate and verify that the error disappear; if remains, check the cable from power board to CPU.
4. In case the X-ray button is faulty because always closed, replace it.

8.3.3.3. kV / mA Piloting Circuits Test

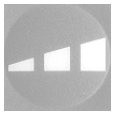
The two functions are described together as they behave in exactly the same way. This test is aimed at verifying the functionality of the CPU and the connection between the CPU board and the HF board.

The H.F. board piloting signals (anode voltage and filament current) is generated by an 8-bit D/A converter (i.e. at 256 levels). The two functions described change the output level and therefore piloting voltage of the H.F. board within the range: 0 - 255 that corresponds to a variation of between 0 to 10 Volts at the converter output.

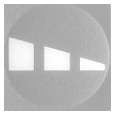
Upon access to this function, the current setting of the output level and the corresponding voltage value is displayed:

T	**E**	**S**	**T**		**m**	**A**		**C**	**I**	**R**	**C**	**U**	**I**	**T**	
L	**E**	**V**	**E**	**L**	**=**	**6**	**4**				**2**	**.**	**5**	**V**	

The active keys for this test are the following:



Decreases the output level by one unit to a minimum of zero (key "3")



Increases the output level by one unit to a maximum of 255 (key "6")

Returns to the main menu (key "9")

The voltage values set via this test can be measured with a DVM on the following test points on the CPU board X35 (see chapter 9, drawing #3):

- TP1 = GND
- TP2 = kV
- TP3 = mA

The voltages set with this test must be measured on the above test points with a tolerance of ± 10%. Each increment bit causes a variation of 39mV.
Check different settings to see the correspondence between the level set and the Volt value displayed and measured; in case there is no correspondence or no variation changing the settings, replace the CPU board.
Making reference to the HF board layout and schematics, connect the DVM probes to test points TP4 (ground) and TP5 (kV) , repeat setting variations and check the correspondence of values ; if there is no correspondence or no variations it is likely that the cabling between the CPU and the HF board is broken, so replace it.

NOTE:
When this function is quit the voltage value present at the moment of access to the function is reset. Therefore, this function cannot be used to permanently change the piloting voltages. Furthermore, it is possible that when the piloting voltages are changed, this could activated the HF board protection system (e.g. OVERVOLTAGE), with the consequent block of the X-rays emission. It is therefore recommended that the unit be reset upon completion of the diagnostic procedure of the piloting voltages.

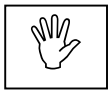
There is a set of errors which help diagnose the functionality of the HF power supply section of the STRATO 2000. The HF board is located on the rotating arm, just above the tubehead/collimator assy. To access it, remove the upper plastic cover of the rotating arm and remove also the metal cover; in this way it will be possible to look at the various LEDs mounted on the board.

WARNING:
In the HF power board a voltage of 400 V is present; this voltage is also applied during a discharging period of the high voltage capacitor filter that feed the board, so caution has to be taken also if mains has been cut off in advance.

8.3.3.3.1. ERROR 550: No voltage present on HF board

This message means that there is no voltage feeding the board; this can be checked looking at the LED H1 that must be ON.
If ON, check the cable X5 from the board to CPU and replace it if interrupted.

1. If the LED H1 is off, check fuse F1 on the power supply group located on the base; check also fuses F1 and F2 on the board itself and replace the blown one.



WARNING:
If one of the above fuses blown, may be that a short circuit on the board/tubehead occur, so carefully power on the system after the replacement, because the failure can replicate.

2. Check resistor R9 (470Ω 1W) of the HF power board; if broken, replace it with another one of the same value and power dissipation.
3. If the LED H1 is ON and the error message is still present, check the status of bit 4 of port D17, using the password 94. The normal condition is 0; if 1, check the cable X5 from the HF power board to CPU. If the cable is OK and the signal is still 1, a possible fault of the CPU is the cause.
4. If fuse F1 on the base is blown, check the cable X5 from the base to X29 on the filter box located on the rotating arm; disconnect carefully X 29 and verify that the fuse does not blow. If yes, means that the cable itself is short circuited.
5. Power off the system; reconnect X29 and disconnect X1 on the HF board. Power on the system and verify that the fuse do not blow; if it blows, a short circuit on the filter box occur, so replace the filter and/or the cable.
6. Power off the machine and reconnect X1, disconnecting the cables feeding the tubehead, X2 and X3 of the HF board; repeat the power on procedure. A blown fuse means a short circuit on the HF power board, so replace it. **A fault in this board can also be caused by a discharge on the tubehead. Please notice that the HF board has always to be replaced together with the tubehead because there are adjustments needed to match the two components.**

8.3.3.3.2. ERROR 551: Overvoltage

This message can occur during a power on state if the system was switched off and on with a rapid sequence; switch off the system and wait for half a minute before powering it on again.

1. If the error remains; look at LED H3 that should be ON; if it is OFF, check the cable X5 from the HF board to the CPU.
2. If ON, possible cause can be a fault on the cable X4 (HF) to X9 of the CPU; check all contacts looking for loosen wires.
3. Verify the status of bit 5 of D17 using the password 94; it must be 1 in normal status (no error present) and 0 when there is an error. If there is a difference between the status bit and the LED, check the cable X5 from HF power board to CPU; eventually replace the cable or CPU.
4. If all test failed (that is, all cables are OK), check the values of kV set on the output of the CPU board, using a digital meter set to VDC and following the steps described on paragraph 7.2 and 7.3.

8.3.3.3.3. ERROR 552: Overload

1. Check the LED H5, that should be ON; in case it is OFF, check cable X5.
2. If ON, performs the steps from 2 to 4 described for error E551, looking at the status of bit 6 (normal status 1) of the port D17.

8.3.3.3.4. ERROR 553: Broken filament

This message means that the system detects a fault on the circuit feeding the X-ray tube filament; a small current is always circulating in the filament to reduce the pre heating time and reduce temperature stress; if the circuit is interrupted, the above message is displayed.

1. Power off the machine; using a digital meter check the ohm value between X3.5 and X3.6 of the connector X3 of the HF power board. A low value has to be measured. If an open circuit is sensed, disconnect the connector X3 and check the continuity of the wires from X3.5 and X3.6 to the tubehead.
2. If a broken cable is sensed, replace it, otherwise the tubehead has to be replaced.
3. Check that LED H2 is ON; if off, check the cable X5.
4. If the Led is ON, check the cable X3 from the HF power board to the tubehead.
5. Look at the status of bit 7 of port D17, using the password 94. Normal status of the bit is 0 (with no error condition) and 1 if there is an error. If there is a difference between the bit the LED status, and the cable X5 from HF power to CPU.
6. Replace the tubehead. **Please notice that the HF board and the tubehead have always to be replaced together because there are adjustments needed to match the two components.**

8.3.3.3.5. ERROR 554: No X-ray output

This message is visualised if, during examination, the system does not sense the X-ray ON signal at the preset time.

1. Check the fuse F2 on the HF power board; eventually replace it. If the fuse continues to blow out, try to perform an exposure with the connector X3 disconnected. If the fuse continues to blow, means that there is a short circuit on the HF power board, so it must be replaced. Otherwise, there is a possible short circuit on the tubehead. Note that also in case of faulty HF power board, the tubehead can be defective.
2. Performs an exposure, looking at LED H4, the yellow one. It must light up during the emission. If the LED is lit and the message is displayed, check the cable X5 up to the CPU.
3. If the LED does not light up and the fuse F2 is OK, the problem can be caused by a loose contact on the cable X5; check the cable X5, looking carefully to signal coming from the CPU to the HF generator.
4. If the cable X5 is OK, verify the input bit 8 of port D17 using password 94; if it is always 1, means that the input port or the cable is broken. If input the input port is broken, replace CPU.
5. If the LED is off and the error message is still present, repeat the above test on port D17.

8.3.3.3.6. ERROR 555: X-ray output too long

This message means that the control system senses the signal of "X-ray on" also after the allowed time for that signal to go off. **This is a dangerous situation because an unwanted emission can be present up to the intervention of safety backup timer, that disconnect the HF power.**

1. Check the yellow LED H4 of the HF power board; if it is still ON, power off the STRATO 2000 immediately.
2. Check cable X3 and X4 from the HF power board to the CPU; if incorrect replace the faulty cable, otherwise replace the HF power board. **Please notice that the HF board and the tubehead have always to be replaced together because there are adjustments needed to match the two components.**

8.3.4. Password 102

This password allows the service engineer to read all parameters stored into the non-volatile memory of the system.

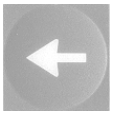
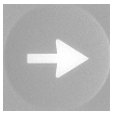
Parameters that can be read are the following:

- Motor offset
- Status of optional examination (OFF=disable, ON=enabled)
- Type of CEPH cassette
- Language selection

When accessing password 102 the following message appears on display:

X		**A**	**X**	**I**	**S**		**O**	**F**	**F**	**S**	**E**	**T**			
n	**n**	**n**	**n**												

The active keys for this test are the following:

 or  Selection of the different parameters (key "26" or "24")

 Quits password (key "9")

To quit Password 102, press "9"  . The unit returns to normal working condition.

8.3.5. Password 118

WARNING:
All movements of the STRATO 2000 controlled by stepper motors are based on counting the number of steps starting from a reference position defined by a microswitch transition.
The mechanical centering of the different movements is achieved determining the number of steps between the microscwitch transition position and the centering position. This reference steps number is called OFFSET and is a calibration parameter of each motor.

This password activates the various motors present in the unit, verifies the functions of the relative positioning sensors (microswitches or optoisolators) and performs a series of operations necessary for the calibration phase.

The following functions are verified with password 118:

- X-axis motor and relative sensors (identified with X Zero)
- Y-axis motor and relative sensors (identified with Y Zero)
- Rotation motor and relative sensors (identified with Rotation Zero)
- Primary collimator motor and relative sensors (identified with Pr. Coll. Setup)
- Soft tissues filter motor and relative sensors (identified with Test STF)
- Column movement motor and relative sensors (identified with Test Column).

Each of the above motor is described in detail here below.

The following message is displayed upon access to this password:

M	A	C	H	I	N	E		S	E	T	T	I	N	G	

Press key "23"  , the machine will move and the following message will be displayed:

		W	A	I	T		F	O	R						
M	A	C	H	I	N	E		S	E	T	T	I	N	G	

When the machine stops, the following message will be displayed:

S	E	R	V	I	C	E		M	E	N	U				
X		Z	E	R	O										

When quitting each function (press key "9" ), and data has been changed, the following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

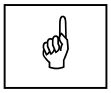
Press key "23"  to store the changes made or press key "9"  not to store them. The rotation group will return to its previous position and the following message will be displayed:

R	E	S	T	O	R	I	N	G							
A	X	I	S		P	O	S	I	T	I	O	N	.	.	.

Press key "9"  to quit Password 118. The following message will be displayed:

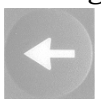
C	O	N	F	I	R	M		E	X	I	T	?			
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to quit the password or key "9"  to remain in password 118.



NOTE:
All changes made and stored result in the loss of the original calibration data. The user is therefore recommended to make and store only those changes that are deemed necessary.
If changes are made and stored but the user quits password 118 by switching the system off and not going through the normal quitting procedure, the stored data will be lost and the system will be reset to the previous data.

8.3.5.1. X-Axis Zero (M5 Motor)

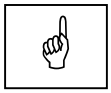
The movement of the X-axis is perpendicular to the column. It therefore moves to the right () when it moves away from the column, and to the left () when it moves towards the column. The concept of right and left is given in relation to the operator who is positioned in front of the keyboard/patient.

This test is accessed by activating password 118. The following configuration is displayed:

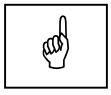
S	**E**	**R**	**V**	**I**	**C**	**E**		**M**	**E**	**N**	**U**				
X		**Z**	**E**	**R**	**O**										

Press key "23"  . The following message will be displayed:

X		**Z**	**E**	**R**	**O**		**[**	**f**	**f**	**]**		**a**	**b**	**c**	**d**
Z	**E**	**R**	**O**		**O**	**F**	**F**	**S**			**±**	**e**	**e**	**e**	**e**



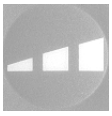
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.



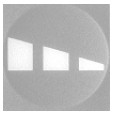
NOTE:
The components described here below (microswitches) can be seen on the block diagram in paragraph 3.5 and in Figure 8-1.

- **a** = S9 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **b** = S10 microswitch-switch status (N.O.: 0= contact open; 1=contact closed)
- **c** = S10 microswitch-switch status (N.C.: 0= contact open; 1=contact closed)
- **d** = S12 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **eeeee** = number of correction steps (of the motor) (offset)
- **ff** = speed of motor shift
- **X ZERO** = indicates the selected motor. In this case the X-axis motor.

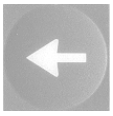
The active keys for this test are the following:



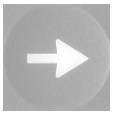
Increases the speed of the motor (key "3")



Decreases the speed of the motor (key "6")



Shifts the carriage to the left (key "26")



Shifts the carriage to the right (key "24")

Switches on/off the panoramic centering device/TMJ (key "20")

Quits the motor function, does not save the changes made and returns to the "Service Menu" display (key "9")

Upon quitting saves the changes made (key "23")

8.3.5.1.1. ERROR 500

This error is displayed when there is an unexpected transition of limit switches S9 or S12 of X-axis

Entering in the X-axis service program it is possible to check the cause of the error.

In normal conditions the display the display must visualise "0XX0" instead of characters "abcd"; that is, status of "b" and "c" depend on the current position. These values are linked to opposite side of the same microswitch, so the possible status can be "0100" or "0010"; the situation "0110" is possible only for a short time.

- If a, b, c, and d are all 1, check the cable harness X50 up to the connector on the CPU board
- if a and/or d are set to 1 at the same time; verify that switches S9 and/or S12 can be activated/deactivated; this test can be performed using a DVM set to measure Ω. If glued, replace the microswitch, otherwise check cable X50
- if the cable is OK, check input port D9, bits 4 and 3; eventually activate/deactivate manually the switch looking at the corresponding bit, that must change its status
- if switch and cable are OK but bit doesn't change, the CPU port is broken; replace the CPU.

1. Using key  , set speed (ff) equal to 5.

2. Pressing the  key, the arm must move to right, so away from the column; continue to press it until the arm stops; the display must show 0011; if not check the switch S12 and/or the cable X50, as described before.

3. Pressing the  key, the arm must move toward the column; continue until the arm stops the end and the display must show 1100; if not, check the switch S9 and/or the cable X50, as described before.

4. Check that, during the movement the bits b and c change the status; as these are linked to a single switch, S10, so they must change at the same time. If they do not change, check S10.
   - check the functionality of S10.
   - if glued, replace it.
   - if not, verify the port D9, bits 1 and 2. If the displayed value do not change also if the switch is activated and the cable has been tested OK, the CPU port is broken; replace it.

   If the switch S10 does not change its status, the control system will not be able to determine the zero position of X axis, so the message error E508 will be displayed.

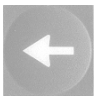
5. If there is no variations of above signals, if arm does not move or moves with difficulty or jumps:
   - check the belt and verify that it is not broken; if the belt is loose, adjust its tension
   - check cables X39 and X38; there can be a short circuit or a broken wire; check also for a loosen contact. In case of short circuit, replace the cable, verifying also that no damage has been caused to the motor driver (D25) on the CPU.

6. If there is no variation of the above signals and the arm moves, verify the cable X50 up to the CPU board. If still there is no variation of the signals when there is an activation of the switches, change the CPU board.

In case of no motion, it is possible that the problem is related to the motor: in order to check this connect the driver of the X-axis motor to the rotation motor putting X20 on X19 on the CPU board.
Try to move the motor and look at the rotation arm: if it rotates the problem is either on the motor (or in its mechanism) or in the interconnecting board A7; if the arm does not rotate the problem is in the electronics, but it should have already been detected in steps 1-6.
Take care to restore the correct connections.

8.3.5.2. Y-Axis Zero (M4 Motor)

The movement of the Y-axis is parallel to the column. It therefore moves forward () when it goes nearer to the patient or backwards () when it goes nearer to the operator. The concept of back and forth is given in relation to the movement along the operator/patient direction.

This test is accessed in password 118 by pressing key "26"  or key "24"  until the following message is displayed:

S	**E**	**R**	**V**	**I**	**C**	**E**		**M**	**E**	**N**	**U**				
Y		**Z**	**E**	**R**	**O**										

Press key "23"  . The following message will be displayed:

Y		**Z**	**E**	**R**	**O**		**[**	**f**	**f**	**]**		**a**	**b**	**c**	**d**
Z	**E**	**R**	**O**		**O**	**F**	**F**	**S**			**±**	**e**	**e**	**e**	**e**

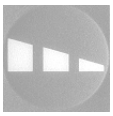
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

NOTE:
The components described herebelow (microswitches) can be seen on the block diagram in paragraph 3.5 and in Figure 8-1.

- **a** = S8 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **b** = S6 microswitch-switch status (N.O.: 0= contact open; 1=contact closed)
- **c** = S6 microswitch-switch status (N.C.: 0= contact open; 1=contact closed)
- **d** = S5 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **eeeee** = number of correction steps (of the motor) (offset)
- **ff** = speed of motor shift
- **Y ZERO** = indicates the selected motor. In this case the Y-axis motor.

The active keys for this test are the following:

Increases the speed of the motor (key "3")



Decreases the speed of the motor (key "6")

Shifts the carriage towards the patient (key "22")

Shifts the carriage towards the operator (key "25")

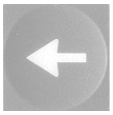
Switches on/off the panoramic centering device/TMJ (key "20")

Allows to carry out a 180° rotation, to check the proper alignment of the "Y" axis with respect to the "0" position. This can be verified by measuring the distance between the sensor holder and the "Y" line on the centering tool (code 54099002). The two distances measured in position 0° and after the 180° rotation must be the same (± 1mm) (key "8")

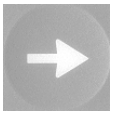
Quits the motor function, does not save the changes made and returns to the "Service Menu" display (key "9")

Upon quitting saves the changes made (key "23")

The X-axis motor function can be accessed directly from the Y-axis function using the following keys:



Access X-axis motor test and shift the carriage towards the column (key "26")



Access the X-axis motor and shift the carriage away from the column (key "24")

When one of the two above keys are pressed, the following will be displayed:

X		Z	E	R	O		|	f	f	|		a	b	c	d
Z	E	R	O		O	F	F	S			±	e	e	e	e

After a few seconds after key "26 or 24" has been released, the display will return to the following message:

Y		**Z**	**E**	**R**	**O**		**[**	**f**	**f**	**]**		**a**	**b**	**c**	**d**
Z	**E**	**R**	**O**		**O**	**F**	**F**	**S**			**±**	**e**	**e**	**e**	**e**

NOTE:
When this function is quit and the settings are stored, the system will store any variations made both to the offset of the Y-axis motor and that of the X-axis motor.

8.3.5.2.1. ERROR 501

This error is displayed when there is an unexpected transition of limit switches S5 or S8

Entering in the Y-axis service program it is possible to check the cause of the error.

In normal conditions the display the display must visualise "0XX0" instead of characters "abcd"; that is, status of "b" and "c" depend on the current position. These values are linked to opposite side of the same microswitch, so the possible status can be "0100" or "0010"; the situation "0110" is possible only for a short time.

- If a, b, c, and d are all 1, check the cable harness X33 up to the connector on the CPU board
- if a and/or d are set to 1 at the same time; verify that switches S5 and/or S8 can be activated/deactivated; this test can be performed using a multimeter set to measure Ω. If glued, replace it, otherwise check cable X33
- if the cable is OK, check input port D9, bits 7 and 8; eventually activate/deactivate manually the switch looking at the corresponding bit, that must change its status
- if switch and cable are OK but bit doesn't change, the CPU port is broken; replace the CPU.

1. Using key  , set speed (ff) equal to 5.

2. Pressing the  key, the arm must move away from operator;

continue to press it until the arm stops; the display must show 0011; if not check the switch S5 and/or the cable X33, as described before.

3. Pressing the  key, the arm must move toward the column;

continue until the arm stops the end and the display must show 1100; if not, check the switch S8 and/or the cable X33, as described before.

4. Check that, during the movement the bits b and c change the status; as these are linked to a single switch, S6, so they must change at the same time. If they do not change, check S6.

- check the functionality of S6
- if glued, replace it
- if not, verify the port D9, bits 6 and 5. If the displayed value do not change also if the switch is activated and the cable has been tested OK, the CPU port is broken; replace it.

If the switch S6 does not change its status, the control system will not be able to determine the zero position of Y axis, so the message error E505 will be displayed.

5. If there is no variations of above signals, if arm does not move or moves with difficulty or jumps:

- check the belt and verify that it is not broken; if the belt is loose, adjust its tension
- check cables X21; there can be a short circuit or a broken wire; check also for a loosen contact. In case of short circuit, replace the cable, verifying also that no damage has been caused to the motor driver (D27) on the CPU.

6. If there is no variation of the above signals and the arm moves, verify the cable X33 up to the CPU board. If still there is no variation of the signals when there is an activation of the switches, change the CPU board.

In case of no motion, it is possible that the problem is related to the motor: in order to check this connect the driver of the Y-axis motor to the rotation motor putting X21 on X19 on the CPU board.
Try to move the motor and look at the rotation arm: if it rotates the problem is either on the motor (or in its mechanism) or in the interconnecting board A7; if the arm does not rotate the problem is in the electronics, but it should have already been detected in steps 1-6
Take care to restore the correct connections.

8.3.5.3. Rotation Axis Zero (M3 Motor)

The movement of the rotation axis is towards the right () when the tubehead rotates towards the right of the operator, and towards the left () when it rotates towards the left of the operator. The same concept can be expressed by saying that the rotation is towards the right when it is made clockwise in relation to an operator who is looking at the arm from above (from above the unit).
This test is accessed in password 118 by pressing key "26"  or key "24"  until the following message is displayed:

S	E	R	V	I	C	E		M	E	N	U				
R	O	T	A	T	I	O	N		Z	E	R	O			

Press key "23"  . The following message will be displayed:

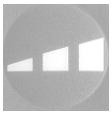
T		Z	E	R	O		[	f	f	]		a	b	c	d
Z	E	R	O		O	F	F	S			±	e	e	e	e

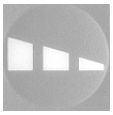
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

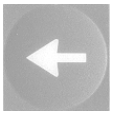
NOTE:
The components described herebelow (microswitches) can be seen on the block diagram in paragraph 3.5 and in Figure 8-1.

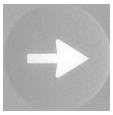
- **a** = S16 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **b** = S14 microswitch-switch status (N.O.: 0= contact open; 1=contact closed)
- **c** = S14 microswitch-switch status (N.C.: 0= contact open; 1=contact closed)
- **d** = S13 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **eeeee** = number of correction steps (of the motor) (offset)
- **ff** = speed of motor rotation
- **T ZERO** = indicates the selected motor. In this case the rotation motor.

The active keys for this test are the following:


Increases the speed of the motor (key "3")


Decreases the speed of the motor (key "6")


Rotates the arm anti-clockwise (key "26")


Rotates the arm clockwise (key "24")


Quits the motor function, does not save the changes made and returns to the "Service Menu" display (key "9")


Upon quitting saves the changes made (key "23")


Switches on/off the panoramic centering device/TMJ (key "20")

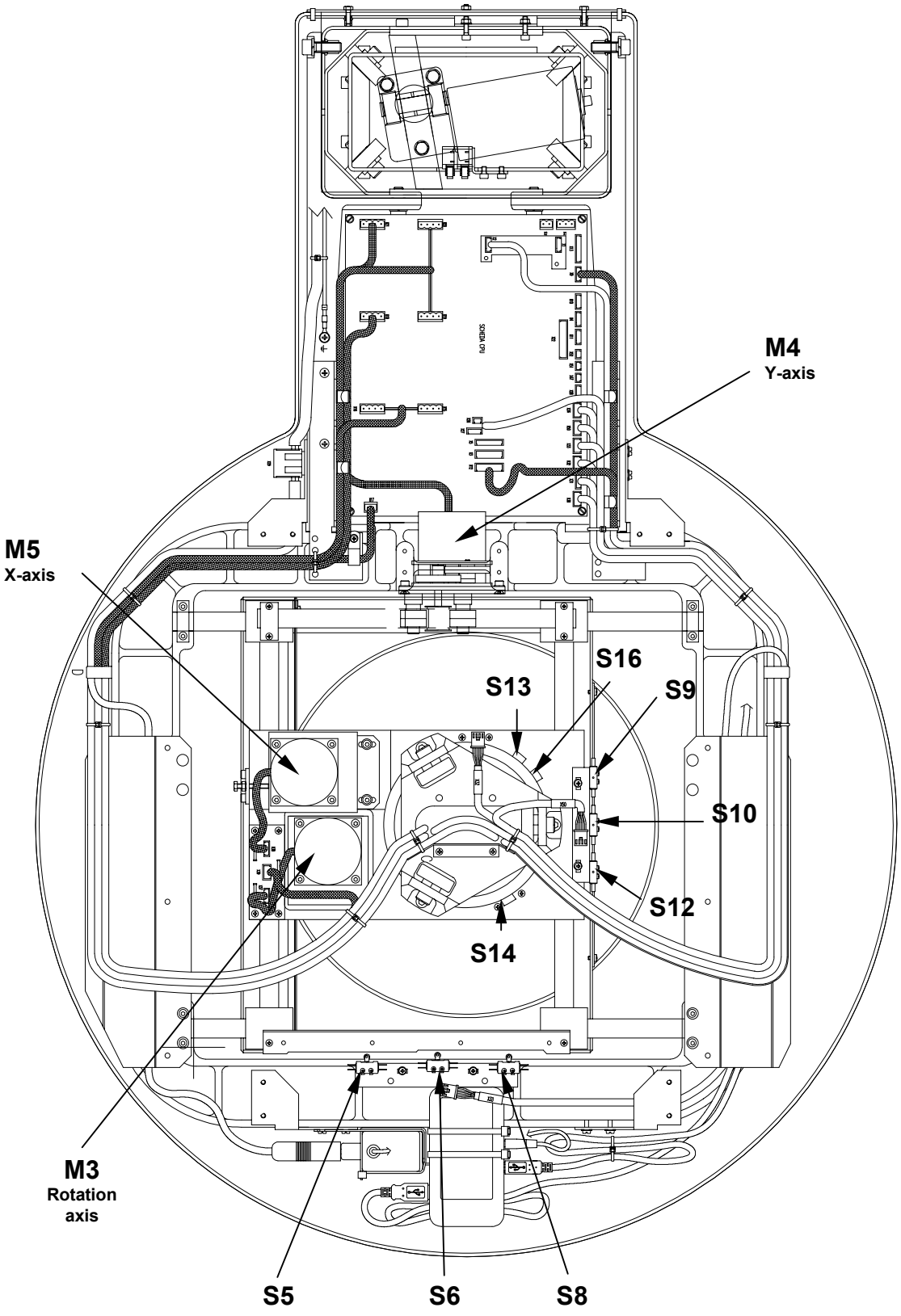

M4
Y-axis
M5
X-axis
S16
S13
S9
S10
S12
S14
M3
Rotation
axis
S5
S6
S8

Figure 8-1

8.3.5.3.1. ERROR 502

This message means that, during the rotation, there is an unexpected activation of switch S13 and/or S16.
The movement of the rotation axis is defined as right when the tubehead rotates towards the right of the operator, and defined as left when it rotates towards the left of the operator. The same concept can be expressed by saying that the rotation is towards the right when it is clockwise with respect to an operator who is looking at the arm from above the unit).

Entering the rotation motor service program it is possible to check the casue of the error.

In normal conditions the display must visualise "0XX0" in place of characters "abcd"; that is, status of b and c depend on the current position. These values are linked to the current position on the opposite side of the same microswitch, so the possible status can be "0100" or "0010"; the situation "0110" is possible only for a short time.

- If a, b, c, and d are all 1, check the cable X32 up to the connector on the CPU board
- if a and/or b are set to 1 at the same time; verify that switches S13 and S14 can be activated/deactivated; if glued, replace it, otherwise check cable X32
- if the cable is OK, check input port D10, bits 7 and 8; eventually activates/deactivates manually the switch looking at the corresponding bit, that must change
- if the cable is OK and the bit doesn't change, the CPU port is broken; replace the CPU.

1. Using key  , set speed (ff) equal to 5.

2. Pressing the  key, the arm must rotate in clockwise direction;

continue to press it until the arm stops; the display must show 0011; if not check the switch S16 and/or the cable X32, as described before.

3. Pressing the  key, the arm must rotate in the anticlockwise

direction; continue until the arm stops the end and the display must show 1100; if not, check the switch S13 and/or the cable X32, as described before.

4. Check that, during the movement the bit b and c changes the status; as these are linked to a single switch, S14, so they must change quite at the same time. The change of a and b must occur quite in the front of the operator. If they do not change in a few steps, check S14.

- check the functionality of S14
- if glued, replace it
- if not, verify the port D10, bits 6 and 5. If the displayed values do not change also if the switch is activated and the cable has been tested OK, the CPU port is broken; replace it.

If the switch S14 do no change its status, the control system will not be able to determine the zero position of the rotation axis, so the message error E506 will be displayed.

5. If there is no variations of above signals, if arm does not move or moves with difficulty or jumps:

- check the belt and verify that it is not broken; if the belt is loose, adjust its tension
- check cable X21; there can be a short circuit or a broken wire; check also for a loosen contact. In case of short circuit, replace the cable, verifying also that no damage has been caused to the motor driver (D23) on the CPU.

6. If the arm moves, verify the cable X32 up to the CPU board. If still continue to haven't a variation of the signals when there is an activation of the switches, change the CPU board.

In case of no motion, it is possible that the problem is related to the motor: in order to check this connect the driver of the rotation motor to the X-axis motor putting X19 on X20 on the CPU board.
Try to move the motor and look at the X arm: if it moves the problem is either on the rotation motor (or in its mechanism) or in the interconnecting board A7; if the arm does not move the problem is in the electronics, but it should have already been detected in steps 1-6.
Take care to restore the correct connections.

8.3.5.3.2. ERROR 542: Collision of the rotating arm

During the panoramic examination the system checks that the rotating arm is functioning checking that the transition of the zero switche for that movement occurs at the correct position; if this does not happens, it indicates a possible collision between the rotating arm and, for instance, the shoulder of the patient. Reset the machine pressing the appropriate button,  ; the rotating arm will position at the normal status and the exam can be repeated.
If the system does not reset correctly, the error message E502 will be displayed, so performs the test already described under ERR 502.

8.3.5.3.3. ERROR 600: Reset button pressed during movement or exam preparation

This message is displayed during a motion of the rotating arm or during the exam preparation; in this case, the button is used as a safety button to interrupt the motion or to avoid collision between the system and the patient. Another pressure of the button will instruct the machine to perform a standard power up sequence and restart the functionality.

8.3.5.4. X-Y-Rotation time-out motor zeroing

8.3.5.4.1. ERROR 504

During the power on procedure, or after a request of "press Reset" message, the control system performs a check of the "zero" position; this check is needed to correctly position the equipment. During this phase, the control system moves, at the same time, the motors for X, Y and Rotation and looks to find the transition of zero position switches; this sensing must occur during a certain time and the control system is waiting for it. If at least one of the transition is not sensed, a timeout error is displayed and the system stops.

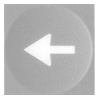
Possible causes can be from the following:

- zero sensors for a movement not functioning
- a motor is not running
- transmission belt loose or broken.

Power off the machine and on again, observing that all motors move; if one of the motor is not moving, perform the appropriate service program already described under the error 500, 501, 502.

8.3.5.5. Primary Collimator Motor (PC)

NOTE:
This program can be accessed only in models carrying the rotating collimator; trying to enter this program on a fixed collimator Pan only unit, no action will be performed.

This test is accessed in password 118 by pressing key "26"  or key "24"  until the following message is displayed:

S	E	R	V	I	C	E		M	E	N	U				
P	R	.		C	O	L	L	.		S	E	T	U	P	

Press key "23"  . The following message will be displayed:

P	C		P	O	S	=	g		S	P	D	=	f		d
a	b	c				S	T	E	P	=	e	e	e	e	e

NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

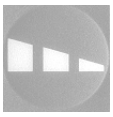
NOTE:
The components described herebelow (microswitches and optoisolators) can be seen on the block diagram in paragraph 3.5 and in Figure 8-3.

- **a** = B3 optoisolator status (0= optoisolator lit; 1=optoisolator darkened)
- **b** = B2 optoisolator status (0= optoisolator lit; 1= optoisolator darkened)
- **c** = B1 optoisolator status (0= optoisolator lit; 1= optoisolator darkened)
- **d** = S22 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **eeeee** = number of correction steps (of the motor for the specific position - offset)
- **f** = speed during manual rotation
- **g** = number of the diaphragm of the primary collimator
- **PC** = indicates the selected motor. In this case the primary collimator motor.

NOTE:
Error 513 is generated if the number of steps stored for Adult panoramic slot is higher than 50 steps.

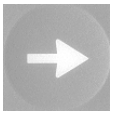
The active keys for this test are the following:

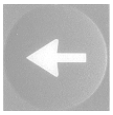

Increases the speed of the motor (key "3")

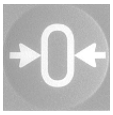

Decreases the speed of the motor (key "6")


Selects the next diaphragm of the primary collimator (key "22")


Selects the previous diaphragm of the primary collimator (key "25")


Rotates the collimator disk clockwise (key "24")


Rotates the collimator disk anti-clockwise (key "26")


Stored the set parameter (key "10")

Returns to the "Service Menu" display (key "9")


Upon quitting saves the changes made (key "23")

(5), 

(4) and 

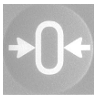
(7) Change the exposure parameters since X-rays can be emitted during this phase

Tests the positioning of the set collimator (key "8")

X-RAY BUTTON Emit X-rays in order to center the diaphragms of the principal collimator (key "30")

The logical status of optoisolators B1, B2, B3 in function of the selected collimator is as follows:

#	Collimator	Opto B3 status	Opto B2 status	Opto B1 status
0	Panoramic - adult	0	0	0
1	Panoramic - child	0	0	1
2	Implant	0	1	0
3	18x24 asymmetric	0	1	1
4	18x24 symmetric	1	0	0
5	24x18 asymmetric	1	0	1
6	30x24 symmetric	1	1	0

NOTE:
When quitting the primary collimator function (key "9" ) confirmation is requested for the update of the offset value if memorisation has been requested with key "10"  . The following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the changes made or press key "9"  not to store them.

All functional slits used during the examinations are mounted on a circular leaded disk; this disk also has seven groups of holes used to decode the slit being used, by means of three optical switches, labeled B1, B2 and B3 on Figure 8-2.
A switch (S22) is used to sense the zero reference position; this switch is activated by the relevant cam on the rotating disk; this zero positioning is used as a reference for all subsequent positions, but it is sensed only during the power on sequence or reset; all further changes of slit is performed only on the basis of differential number of steps.
Each position (or slit) of the collimator has its own 'offset' setting.

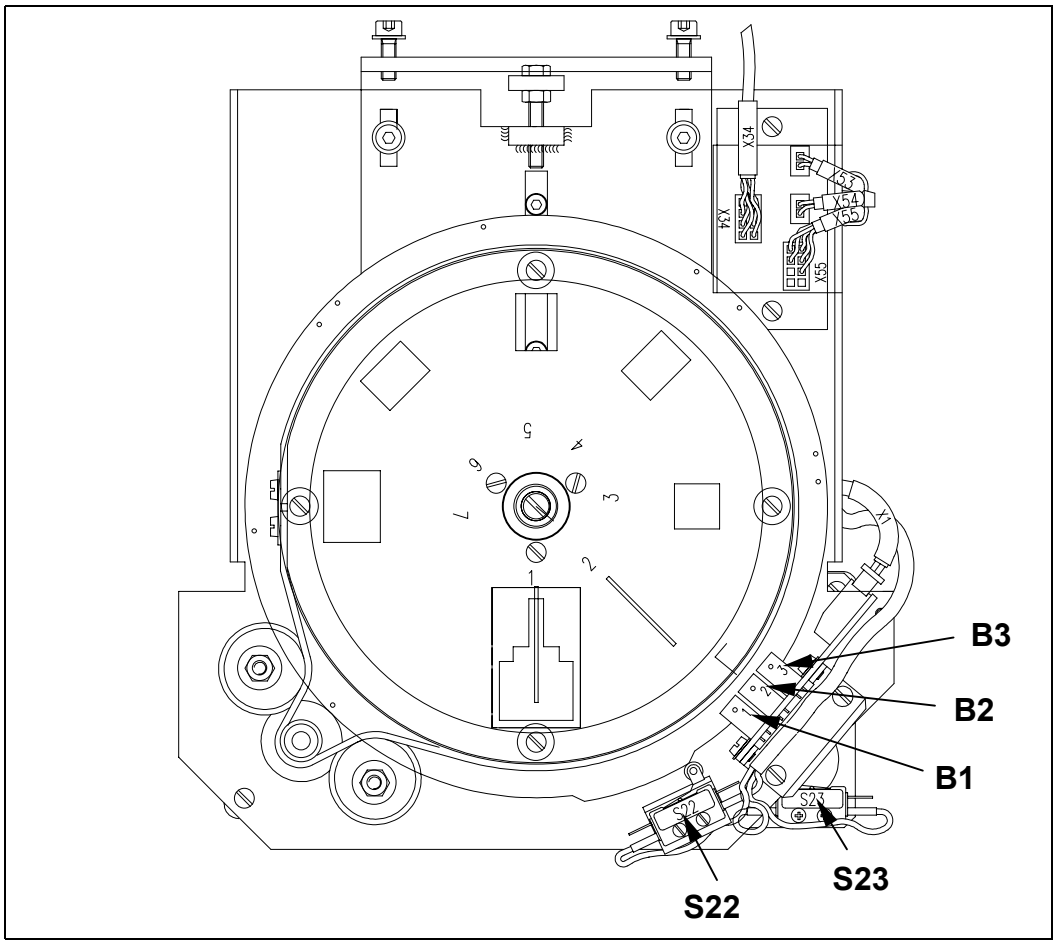


Figure 8-2

To access these sensor, the plastic cover of the tubehead/collimator disk has to be removed; to do that operation, the sensor holder unit has to be removed prior to remove the cover itself.

8.3.5.5.1. ERROR 510: Primary collimator zero position not found

The message , present in older SW version is no more displayed and has been replaced by ERR 514.

8.3.5.5.2. ERROR 511: Decoding error of primary collimator position

This message means that the control system does not find the selected slit using all possible seek retry attempts; in fact, the system moves the collimator from one slit to the other and, if does not find it, repeats the retry looking at first to the zero position. If all these retry are unsuccessfully, the above message is displayed.
Possible cause of the error can be: optical switches B1, B2 and B3), the cable and/or the motor M7 driving the collimator disk.

Optical switches B1, B2 and B3 are mounted on the opto board A9, attached to collimator support; the system senses the collimator position by sensing the binary code made by three holes of the disk.
The logical status of optoisolators B1, B2, B3 in function of the selected collimator is as follows:

#	Collimator	Opto B3 status	Opto B2 status	Opto B1 status
0	Panoramic - adult	0	0	0
1	Panoramic - child	0	0	1
2	Implant	0	1	0
3	Ceph 1, asymmetric	0	1	1
4	Ceph 2, symmetric	1	0	0
5	Ceph 3, asymmetric	1	0	1
6	Ceph 4, symmetric	1	1	0

For the diagnosis of the problem please follow the sequence outlined here below:

1. First step consists in determining the functionality of the three optical sensors: in order to do so move the collimator step by step and check that each sensor has a transition 0-1; If one or more sensors never see the light, it may still mean that the sensors are not aligned with the slots in the disk so it may be necessary to remove the board carrying the sensor and check the signal when light transmission is secure. If one or more sensors are failed replace the sensor board and proceed to step 3.
2. The sensors have been proved good in step 1; then move the collimator step by step close to the first slit where all sensors are supposed to be in light, and check that all sensors have the transition dark-light and light-ark within a couple of steps and that the light window is larger than 18 steps. If this is the case position the collimator in the center of the light window and check that the slit is vertical; selecting 65kV, 10mA and placing the fluorescent filter on the secondary collimator, verify that the beam is vertical and well centered. If this is the case store the new offset value and exit the program; if the beam is not vertical and centered proceed to step 3.

3. Disregarding the reading of the optical sensor, move the collimator to have the slit vertical and check by an exposure at 65kV, 10mA , positioning the fluorescent screen on the sensor slot, that the beam is vertical and well centered. If necessary make multiple expsures, seeking the perfect centering of the beam, moving each time the wheel in the appropriate direction.
4. The number of steps identified in step 3 as the position where the beam is perfectly vertical and centered on the secondary collimator is the number of steps to store as the offset of the primary collimator position in the first slot.
5. Position the sensor board so that all three sensors are in light: "abc" on the display must show "000".
6. Move the collimator in both direction with respect to the center position and check that there are at least 7 steps with 'abc' =000 on both sides; if this cannot be granted move lightly the sensor board and try again always starting from the centering position.
7. When the electrical centering has been achieved (i.e. the window of 'abc' =000 extends for at least 7 steps on both sides of the collimator centering position in first slit, go back to the center step and memorize the new offset setting by pressing the key  .
8. Using key  , change the selected slit.
9. Press key  to position the collimator on the selected slit (the next one).
10. The disk will rotate to the new position using the 'offset' of that position currently stored: this value may not be correct; check that the decoding of the sensors is as detailed in the table shown at the beginning of this section; move the collimator step by step in both directions determining the wideness of the window with the correct sensor decoding. The centering step (to be used as the 'OFFSET' of that slot position) should be selected in a way to replicate the relative position of the centering step with respect to the window borders as in the first slot previoulsy calibrated.

    Example:
    Suppose that the centering position of the first slot has an offset of 40 steps and the window within which all optical sensor are in light extend from step 32 to step 54. The centering position is acceptable because there are at least 7 steps of light in both direction with respect to the centering position: in this case the centering offset of all the other positions should be selected in such a way that the centering position reflects the lack of simmetry in the sensor decoding window; this means that the distance of the centering position with respect to the

first border of the sensor window should be around 8 steps and the distance from center to the opposite side of the sensor window should be around 14 steps. So if the borders of the window are at 250 and 272 steps, the centering position should be selected to be 258.

11. Once the centering position for that slit has been determined store the offset value for that specific position by pressing the key  .

Proceed to the next slot and repeat the procedure as in steps 9-11.

12. For the cephalometric slots it is appropriate to check the centering position selected as described in step 9-11 by performing a radiography and checking the film; if the image is not satisfactory the centering position offset can be changed taking care to always verify the width of the sensor decoding window.

NOTE:
It is important to carefully check the data before storing it; if a wrong data is stored in a position it will alter the functionality of the system. Moreover, in case of a high number of offset steps stored for position 0 can cause an E513 error message.

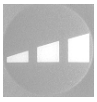
8.3.5.5.3. ERROR 513: Motor timeout during primary collimator movement

Time out of primary collimator motor, has a very low probability to occur; in fact, it designates an internal error of the system. After the sense of transition of S22, the control system expects to find the first slit position in a few steps and has a fixed time to perform this operation; if for same reason this time elapses without the execution of the offset passes, this message is displayed. Normally this message means that a severe error occur on the control unit, so it will be needed to replace the SMART CPU card.
Another possibility can be of an error on the memorisation of the offset position for the first slit; if , for example, it was recorded a very high offset value for first slit (this can be done, for instance, positioning the collimator on position 6 and memorising its offset without physically moving the collimator). If this is the case, there are two possibilities:

- for software release 3.04 and higher, it is possible to enter anyway the set up procedure, pressing the "Reset" button; in this way, it will be possible to correct the positioning errors repeating the primary set up procedure for the collimator.
- for earlier software releases, the replace of SMART CARD CPU is needed.

8.3.5.5.4. ERROR 514: Zero position of primary collimator has not been found / ERROR 515: Zero switch sensor always closed

Error messages E514 and E515 are related to the status of S22; they identify this switch as always open (E514) or always closed (E515); if one of the above messages are displayed, enter the service program related to primary Collimator and performs the following steps:

1. Using key  , set speed (ff) equal to 6.
2. Press key "24"  and looks at the collimator; it must rotate in the clockwise direction.
3. Look at S22 and visually check that its status changes.

If the displayed status of S22 never change also if there is a visual indication of changing, check also the transition by measuring the resistance using a digital meter set to Ω with leads connected to the legs of the switch itself. If the switch is functioning, but the displayed status dose not change:

- check the cable harness X54 up to the exchange board A7 and from there to the CPU the connector X34. In case there is a broken wire or a short circuit, replace S22 with X54 cable or X34
- if the switch is never activated or it is always activated during collimator's rotation, adjust its position using the screws that fix S22 to the support plate

NOTE:
To perform this operation, switch off the unit and, with the power off, gently rotate the collimator disk in order to have S22 not activated.

- loose the two screws holding S22 and move it in such a way that it can be activated by the relevant cam on the disk
- gently move the collimator disk, checking that the cam activates S22
- fix the two screws, taking care do not fix it very hard; a strong fixing can "glue" the switch itself
- power on the machine, checking that the switch is functioning; after the above adjustment, may be that error message E511 will be displayed; in fact, a complete set up procedure of primary collimator is needed.

In any case, perform the complete set up procedure for the collimator, in order to verify that all slits are correctly found by the system (see Error 511).

If the disk never moves, the fault can be due to the stepper motor M7 or to the power belt; if that is loose, adjust it using the appropriate tool. If the belt is broken, it must be replaced.
In both cases, a new complete set up procedure for the collimator must be performed (see Error 511).

8.3.5.6. Soft Tissue Filter Motor (C3)

NOTE:
This program can be accessed only in models carrying the rotating collimator; trying to enter this program on a fixed collimator PAN only unit no action will be performed.

NOTE:
This function is used only to test the functionality of the Soft Tissue Filter, not to adjust/check the alignment.

This test is accessed in password 118 by pressing key "26"  or key "24"  until the following message is displayed:

S	E	R	V	I	C	E		M	E	N	U				
T	E	S	T		S	T	F								

Press key "23"  . The following message will be displayed:

S	T	F													a
O	F	F	S	E	T		e	e	e						

NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

NOTE:
The components described herebelow (microswitches and optoisolators) can be seen on the block diagram in paragraph 3.5 and in Figure 8-3.

- **a** = S23 microswitch status (0= contact open; 1=contact closed)
- **eeeee** = number of correction steps (of the motor) (offset).

The active keys for this test are the following:

Shifts the filter in the field in steps (key "24")

Shifts the filter out of field in steps (key "26")

Quits the motor function, does not save the changes made and returns to the "Service Menu" display (key "9")

Upon quitting saves the changes made (key "23")

mA (5), s (4) and kV (7) Change the exposure parameters since X-rays can be emitted during this phase

X-RAY BUTTON Emits X-rays in order to center the soft tissues filter (key "30")

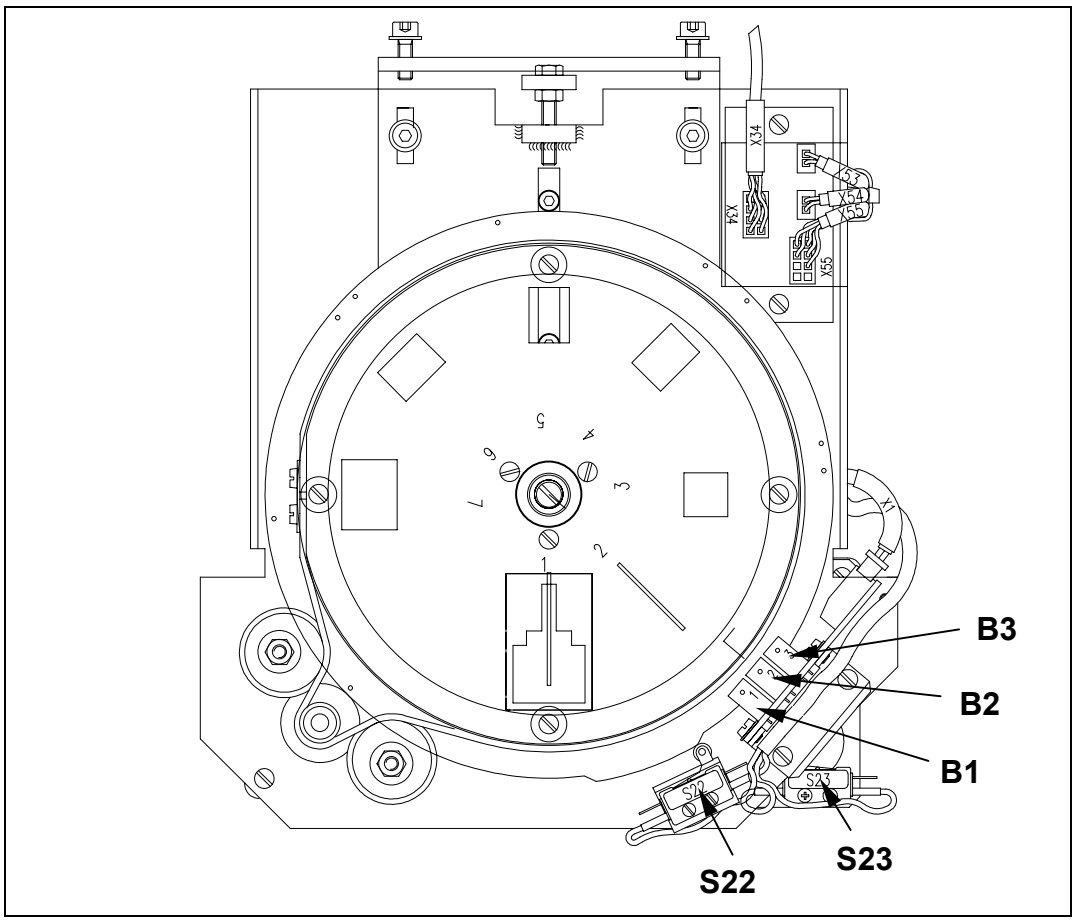


Figure 8-3

8.3.5.6.1. ERROR 520: Motor time out during STF movement / ERROR 521: STF stopped an end run switch / ERROR 522: Zero switch not found

STRATO 2000 contains a motorised Soft Tissue Filter used during the execution of cephalometric exam; this filter has the function to avoid the overexposure of the soft part of the patient during a latero-lateral cephalometric exam.
The normal position of the soft tissue filter is "ON", that is inserted; the condition is sensed at the power on, when the control system checks the zero position switch S23 and after that moves the filter out.

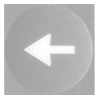
ERROR 522 means that, having the control system made all calculated steps to bring the filter at the zero position, the switch never activated.

- Check that the motor is running
- check that the gear is engaged and there is no mechanical obstacle to prevent the movement
- broken switch and/or wires: check that the switch is functioning, measuring the value of resistance at the contacts using a multimeter set for Ω measure; the meter has to measure a value from very high to very low activating the switch. If the switch is functioning, check the wire up to connector X53 of board A8 and from X34 of the same board up to X34 of the CPU. The switch can also be tested using password 94, input port D11 bit 7. If a wire is broken, replace it, otherwise if it is correct up to X34 and the switch is sensed always closed, CPU is broken. Replace it.

ERROR 521 means that the switch S23 is sensed always closed, so the actions already described for E522 are valid.

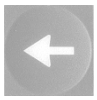
ERROR 520

To test this motor/sensor, the Soft Tissue Filter program has to be used;

1. Using key  , set speed (ff) equal to 4.
2. Press key "24"  and/or "26"  and looks at the soft tissue filter; it must move in or out; the motion continues until the switch S23 reaches the closed position.
3. Check that the motor is moving.
4. Look at the digit "a" and check that it changes status.

In case it is necessary to modify the position of the filter use the service programs described under password 124.

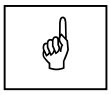
8.3.5.7. Column Motor (Column Test)

This test is accessed in password 118 by pressing key "26"  or key "24"  until the following message is displayed:

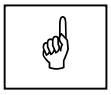
S	E	R	V	I	C	E		M	E	N	U				
T	E	S	T		C	O	L	U	M	N					

Press key "23"  . The following will be displayed:

C	O	L	U	M	N		T	E	S	T				a	b



NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

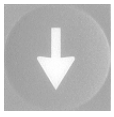


NOTE:
The components described herebelow (microswitches and optoisolators) can be seen on the block diagram in paragraph 3.5 and in Figure 8-4.

- **a** = S27 microswitch status (0= contact open; 1=contact closed)
- **b** = S26 microswitch status (0= contact open; 1=contact closed)

The active keys for this test are the following:

Raises the column (key "27")



Lowers the column (key "29")

Enables the shift of the column (press together with one of the two previous keys (key "28")

Quits the motor function and returns to the "Service Menu" display (key "9")

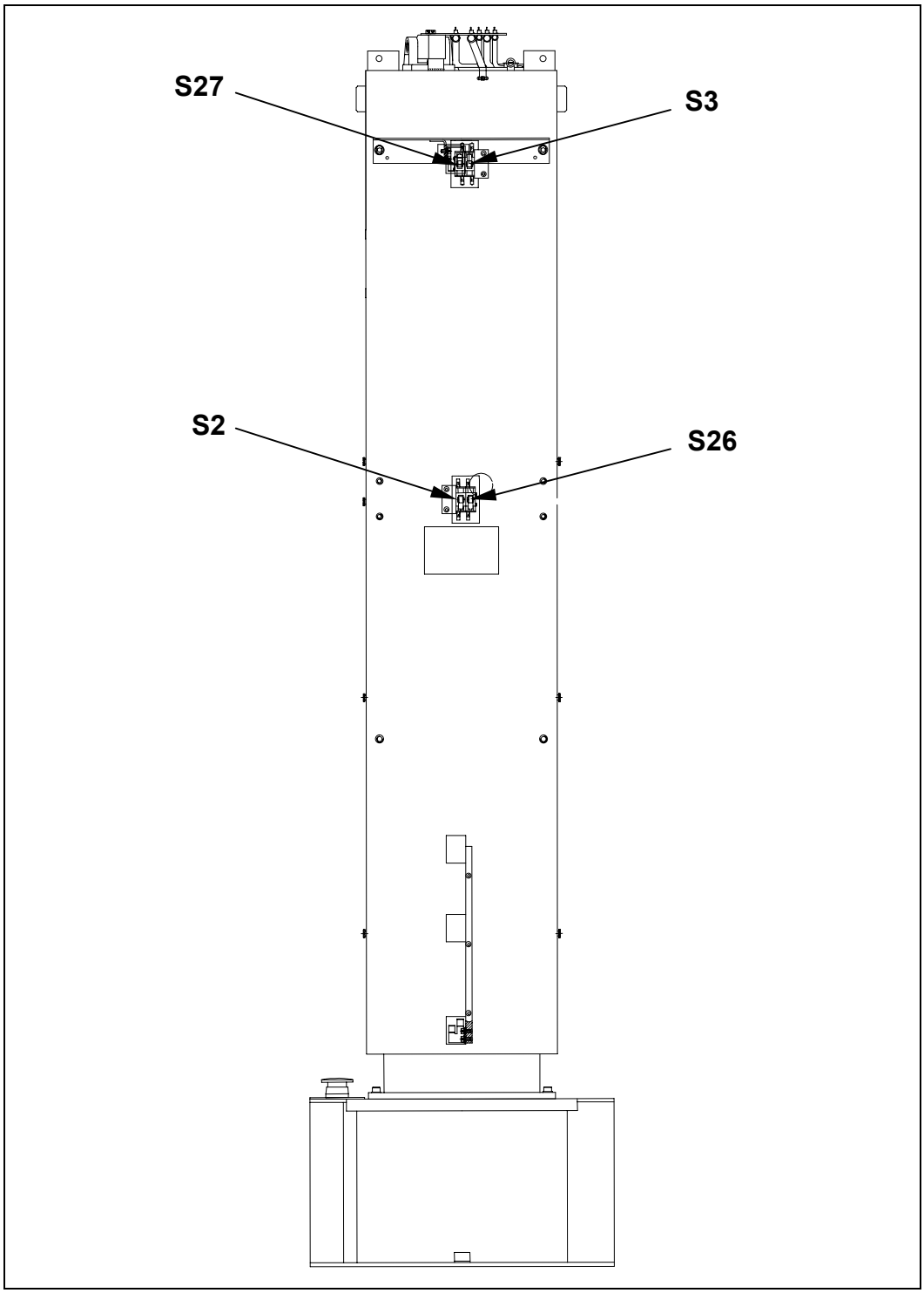


Figure 8-4

NOTE:
To quit Password 118 press key "9"  . The following message will be displayed:

C	O	N	F	I	R	M		E	X	I	T	?			
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to quit the password or press key "9"  to remain in password 118.

8.3.6. Password 124

NOTE:
This program can be accessed only in models carrying the rotating collimator; trying to enter this program on a fixed collimator Pan only unit, no action will be performed.

This password allows to enable/disable and optimise the Cephalometric examination mode. It allows to perform:

- positioning of the X axis
- positioning of the Y axis
- positioning of the rotation axis
- offset adjustment of the Soft Tissue Filter (STF)
- adjustment of the % of the Soft Tissue Filter (STF) in-field depth
- selection of the primary collimator format
- selection of the ceph cassette default configuration (4 slots available).

Whenever any data has been modified, exiting from each single function (by pressing the key "9" ) the display will show the following message:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to store the modifications introduced, or press key "9"  to cancel the changes; the rotating arm will return to the previous position and the display will show:

R	E	S	T	O	R	I	N	G							
A	X	I	S		P	O	S	I	T	I	O	N	.	.	.

Optimisation of the Cephalometric examination consists of the proper positioning of the tubehead arm with respect to the cassette holder, by acting on the different motors associated to the positioning of the tubehead arm itself.

Accessing password 124, the following message appears on the display for few seconds:

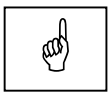
M	A	C	H	I	N	E		S	E	T	T	I	N	G	

Then press key "23"  ; the unit will carry out some movements and the display will show:

			W	A	I	T		F	O	R				
M	A	C	H	I	N	E		S	E	T	T	I	N	G

When the unit stops moving the following message will be displayed:

C	E	P	H		S	E	T	U	P					
C	E	P	H		x	x	x							



NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

xxx = Corresponds to the possibility of activating=ON or deactivating=OFF the Cephalometric examination.

Press key "26"  or key "24"  to move from one option to the other.

If OFF is set (CEPH device not present or activated) and confirmed with key "9"  the following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the changes or press key "9"  not to store them. The system will quit password 124 in both cases.

If ON is set (CEPH device present and activated) and confirmed with key "23"  the machine will move and the following message will be displayed:

C	E	P	H		P	O	S	I	T	I	O	N	I	N	G
P	L	E	A	S	E		W	A	I	T		.	.	.	.

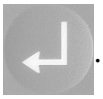
When the machine has stopped rotating the following message will be displayed:

C	E	P	H		S	E	T	U	P				a	b	c
X		O	F	F	S	E	T								

NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

NOTE:
The components here after indicated (microswitches) can be identified on the block diagram of paragraph 3.5 and in Figure 8-5 and Figure 8-6.

- **a** = S24 microswitch status (N.O.:0=contact open; 1=contact closed – sensor holder in panoramic position)
- **b** = S25 microswitch status (N.O.:0=contact open; 1=contact closed - sensor holder in Ceph position)
- **c** = S29 microswitch status (N.O.:0=contact open - cassette not in place; 1=contact closed - cassette in place)

If access to the next function of this password is required, press key "23"  . Then proceed with next paragraph 8.3.6.1.

Press instead key "9"  to quit Password 124. The following message will be displayed:

C	O	N	F	I	R	M		E	X	I	T	?			
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to quit the password or key "9"  to remain in password 124.

Upon quitting password 124 the rotation group will abandon the cephalometry position and the following message will be displayed:

R	E	S	T	O	R	I	N	G							
A	X	I	S		P	O	S	I	T	I	O	N	.	.	.

NOTE:
All changes made and stored result in the loss of the original calibration data. The user is therefore recommended to make and store only those changes that are deemed necessary.
If changes are made and stored but the user quits password 124 by switching the system off and not going through the normal quitting procedure, the stored data will be lost and the system will be reset to the previous data.

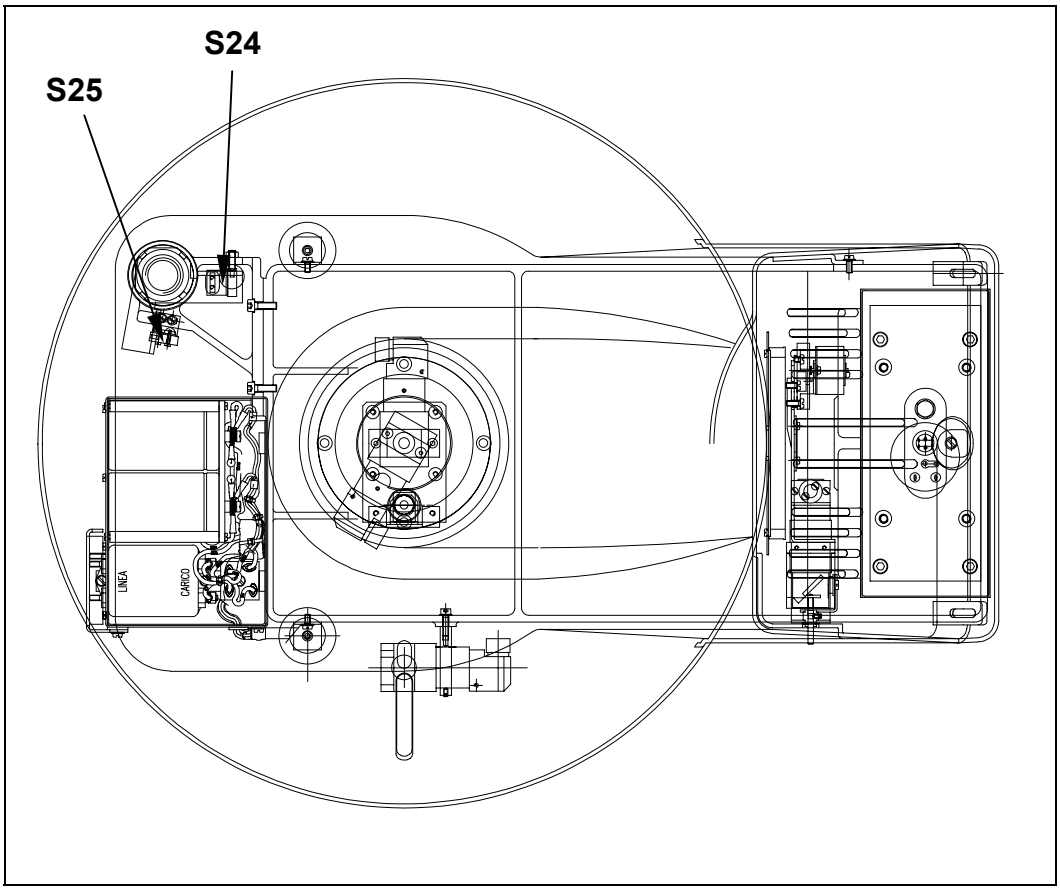


Figure 8-5

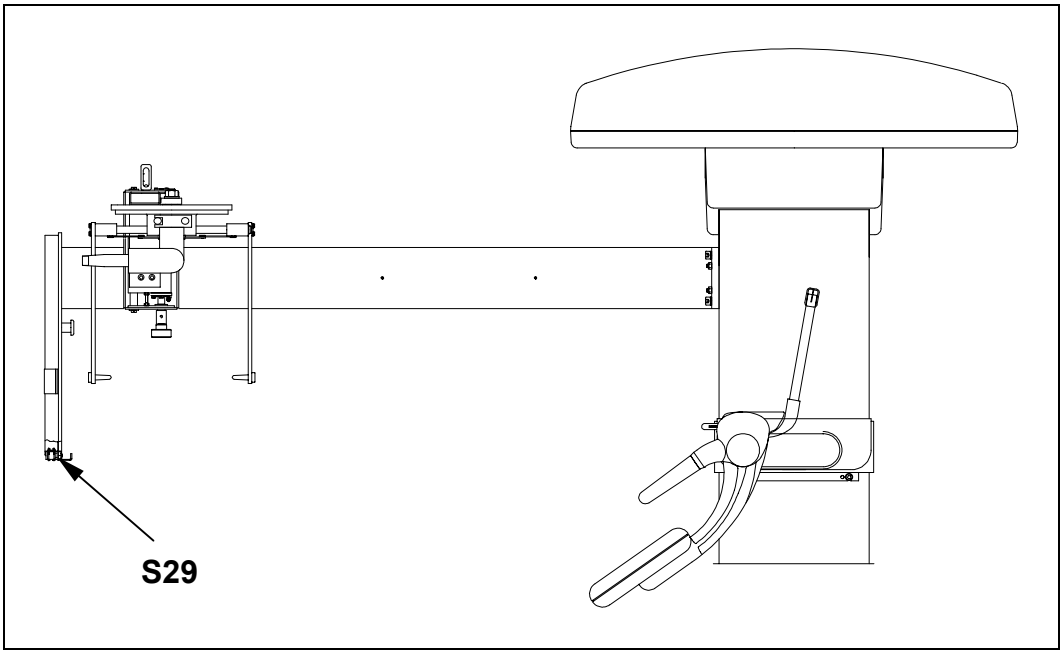


Figure 8-6

8.3.6.1. X-Axis position

This test is accessed in by activating password 124 as described in previous paragraph 8.3.6. When next display is shown:

C	**E**	**P**	**H**		**S**	**E**	**T**	**U**	**P**				**a**	**b**	**c**
X		**O**	**F**	**F**	**S**	**E**	**T**								

Press key "23"  . The following message will be displayed:

C	**E**	**P**	**H**		**X**		**[**	**f**	**f**	**]**		**a**	**b**	**c**	**d**
Z	**E**	**R**	**O**		**O**	**F**	**F**	**S**		**±**	**e**	**e**	**e**	**e**	**e**

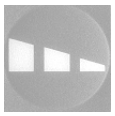
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

NOTE:
The components here after indicated (microswitches) can be identified on the block diagram of paragraph 3.5 and in Figure 8-1.

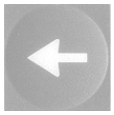
- **a** = S9 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **b** = S10 microswitch-switch status (N.O.: 0= contact open; 1=contact closed)
- **c** = S10 microswitch-switch status (N.C.: 0= contact open; 1=contact closed)
- **d** = S12 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **eeeee** = number of correction steps (of the motor) (offset)
- **ff** = speed of motor shift.

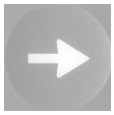
The active keys for this test are the following:

Increases the speed of the motor and the exposure factors (key "3")



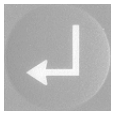
Decreases the speed of the motor and the exposure factors (key "6")


Shifts the carriage to the left (key "26")


Shifts the carriage to the right (key "24")


Switches on/off the panoramic centering device/TMJ (key "20")


Quits the setup program, does not save the changes made and returns to the "Service Menu" display (key "9")


Upon quitting saves the changes made (key "23")


(5),

(4) and

(7) Change the exposure parameters since X-rays can be emitted during this phase

X-RAY BUTTON Emit X-rays in order to center the diaphragms of the principal collimator (key "30")

If any change has been introduced, after pressing key "9"  the display shows:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the changes or press key "9"  not to store them. The system will exit from this routine in both cases and the display returns to:

C	E	P	H		S	E	T	U	P				a	b	c
X		O	F	F	S	E	T								

Press key "24"  to select next routine (Y Axis position, see paragraph 8.3.6.2).

8.3.6.2. Y-Axis position

This test is accessed in by activating password 124 as described at previous paragraph 8.3.6. When next display is shown:

C	**E**	**P**	**H**		**S**	**E**	**T**	**U**	**P**				**a**	**b**	**c**
X		**O**	**F**	**F**	**S**	**E**	**T**								

Press key "24"  until reaching the following display:

C	**E**	**P**	**H**		**S**	**E**	**T**	**U**	**P**				**a**	**b**	**c**
Y		**O**	**F**	**F**	**S**	**E**	**T**								

Press key "23"  . The following message will be displayed:

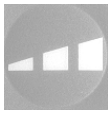
C	**E**	**P**	**H**		**Y**		**[**	**f**	**f**	**]**		**a**	**b**	**c**	**d**
Z	**E**	**R**	**O**		**O**	**F**	**F**	**S**		**±**	**e**	**e**	**e**	**e**	**e**

NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

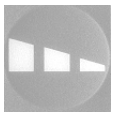
NOTE:
The components here after indicated (microswitches) can be identified on the block diagram of paragraph 3.5 and in Figure 8-1.

- **a** = S8 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **b** = S6 microswitch-switch status (N.O.: 0= contact open; 1=contact closed)
- **c** = S6 microswitch-switch status (N.C.: 0= contact open; 1=contact closed)
- **d** = S5 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **eeeee** = number of correction steps (of the motor) (offset)
- **ff** = speed of motor shift.

The active keys for this test are the following:



Increases the speed of the motor and the exposure factors (key "3")



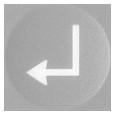
Decreases the speed of the motor and the exposure factors (key "6")

Shifts the carriage towards the patient (key "22")

Shifts the carriage towards the operator (key "25")

Switches on/off the panoramic centering device/TMJ (key "20")

Quits the setup program, does not save the changes made and returns to the "Service Menu" display (key "9")



Upon quitting saves the changes made (key "23")

(5),


(4) and


(7)

Change the exposure parameters since X-rays can be emitted during this phase

X-RAY BUTTON

Emit X-rays in order to center the diaphragms of the principal collimator (key "30")

If any change has been introduced, after pressing key "9"  the display shows:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the changes or press key "9"  not to store them. The system will exit from this routine in both cases and the display returns to:

C	**E**	**P**	**H**		**S**	**E**	**T**	**U**	**P**				**a**	**b**	**c**
Y		**O**	**F**	**F**	**S**	**E**	**T**								

Press key "24"  to select next routine (Rotation position, see paragraph 8.3.6.3).

8.3.6.3. Rotation axis position

This test is accessed in by activating password 124 as described at previous paragraph 8.3.6. When next display is shown:

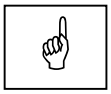
C	E	P	H		S	E	T	U	P				a	b	c
X		O	F	F	S	E	T								

Press key "24"  until reaching the following display:

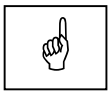
C	E	P	H		S	E	T	U	P				a	b	c
R	O	T	.		O	F	F	S	E	T					

Press key "23"  . The following message will be displayed:

C	E	P	H		T		|	f	f	|		a	b	c	d
Z	E	R	O		O	F	F	S		±	e	e	e	e	e



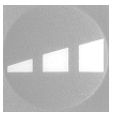
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.



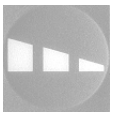
NOTE:
The components here after indicated (microswitches) can be identified on the block diagram of paragraph 3.5 and in Figure 8-1.

- **a** = S16 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **b** = S14 microswitch-switch status (N.O.: 0= contact open; 1=contact closed)
- **c** = S14 microswitch-switch status (N.C.: 0= contact open; 1=contact closed)
- **d** = S13 microswitch status (N.O.: 0= contact open; 1=contact closed)
- **eeeee** = number of correction steps (of the motor) (offset)
- **ff** = speed of motor shift.

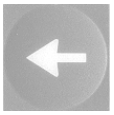
The active keys for this test are the following:



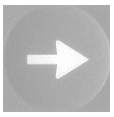
Increases the speed of the motor and the exposure factors (key "3")



Decreases the speed of the motor and the exposure factors (key "6")



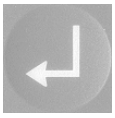
Rotates the carriage anti-clockwise (key "26")



Rotates the carriage clockwise (key "24")

Switches on/off the panoramic centering device/TMJ (key "20")

Quits the setup program, does not save the changes made and returns to the "Service Menu" display (key "9")



Upon quitting saves the changes made (key "23")

(5),


(4) and


(7)

Change the exposure parameters since X-rays can be emitted during this phase

X-RAY BUTTON

Emit X-rays in order to center the diaphragms of the principal collimator (key "30")

If any change has been introduced, after pressing key "9"  the display shows:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the changes or press key "9"  not to store them. The system will exit from this routine in both cases and the display returns to:

C	**E**	**P**	**H**		**S**	**E**	**T**	**U**	**P**				**a**	**b**	**c**
R	**O**	**T**	**.**		**O**	**F**	**F**	**S**	**E**	**T**					

Press key "24"  to select next routine (Soft Tissue Filter – STF) offset, see paragraph 8.3.6.4).

8.3.6.4. Soft Tissue Filter (STF) offset

This test is accessed in by activating password 124 as described at previous paragraph 8.3.6. When next display is shown:

C	E	P	H		S	E	T	U	P				a	b	c
X		O	F	F	S	E	T								

Press key "24"  until reaching the following display:

C	E	P	H		S	E	T	U	P				a	b	c
S	T	F		O	F	F	S	E	T						

Press key "23"  . The following message will be displayed:

S	T	F		Z	E	R	O		O	F	F	S			a
O	F	F	S	E	T		0	0	0						

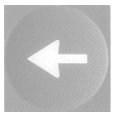
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

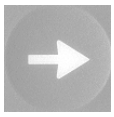
NOTE:
The components here after indicated (mocroswitches) can be identified on the block diagram of paragraph 3.5 and in Figure 8-3.

a = S23 microswitch status (N.O.: 0= contact open; 1=contact closed)

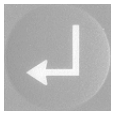
NOTE:
The procedure to set the correct value of the Soft Tissue Filter offset is described on paragraph 7.1.3.6. Please refer to that if adjstment is needed.

The active keys for this test are the following:


Move the STF to the left (key "26") [inside]


Move the STF to the right (key "24") [outside]


Quits the setup program, does not save the changes made and returns to the "Service Menu" display (key "9")


Upon quitting saves the changes made (key "23")


(5), 
(4) and 
(7) Change the exposure parameters since X-rays can be emitted during this phase

X-RAY BUTTON Emit X-rays in order to center the diaphragms of the principal collimator (key "30")

If any change has been introduced, after pressing key "9"  the display shows:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the changes or press key "9"  not to store them. The system will exit from this routine in both cases and the display returns to:

C	E	P	H		S	E	T	U	P				a	b	c
S	T	F		O	F	F	S	E	T						

Press key "24"  to select next routine (Soft Tissue Filter % of correction, see paragraph 8.3.6.5).

8.3.6.5. Soft Tissue Filter (STF) % of correction

This data is used to increase/decrease the functionality of the Soft Tissue Filter. A value of 100% means no action on the set value for STF, while a value higher than 100% will reduce the insertion of STF so reducing the area interested by the filter. Otherwise a lower than 100% will introduce more the filter.

This test is accessed in by activating password 124 as described at previous paragraph 8.3.6. When next display is shown:

C	E	P	H		S	E	T	U	P				a	b	c
X		O	F	F	S	E	T								

Press key "24"  until reaching the following display:

C	E	P	H		S	E	T	U	P				a	b	c
S	T	F		%		C	O	R	R	E	C	T	I	O	N

Press key "23"  . The following message will be displayed:

S	T	F		%		C	O	R	R	E	C	T	I	O	N
V	A	L	U	E	=		a	a	a	%					

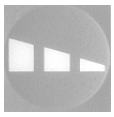
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

NOTE:
The components here after indicated (mocroswitches) can be identified on the block diagram of paragraph 3.5 and in Figure 8-3.

aaa= percentage of correction of in-field depth of Soft Tissue Filter (dafault value = 100%)

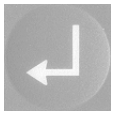
The active keys for this test are the following:

Increases percentage of correction (key "3")



Decreases percentage of correction (key "6")

Quits the setup program, does not save the changes made and returns previous display (key "9")



Upon quitting saves the changes made (key "23")

If any change has been introduced, after pressing key "9"  the display shows:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the changes or press key "9"  not to store them. The system will exit from this routine in both cases and the display returns to:

C	E	P	H		S	E	T	U	P				a	b	c
S	T	F		%		C	O	R	R	E	C	T	I	O	N

Press key "24"  to select next routine (Setting the Collimator format, see paragraph 8.3.6.6).

8.3.6.6. Set of the Collimator format

NOTE:
This value must be set accordingly to the format specified at the order. **Changing it will introduce differences between the X-ray beam and the chosen cassette.**

This test is accessed in by activating password 124 as described at previous paragraph 8.3.6. When next display is shown:

C	E	P	H		S	E	T	U	P				a	b	c
X		O	F	F	S	E	T								

Press key "24"  until reaching the following display:

C	E	P	H		S	E	T	U	P					a	b
P	R	.		C	O	L	L	.		T	Y	P	E		

Press key "23"  ; the display will show:

P	R	.		C	O	L	L	.		T	Y	P	E		
a	a	a	a	a											

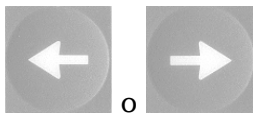
aaaaa= can be set among the following formats:

- **STD:** collimator based on 18x24 cm format
- **24x30:** collimator based on 24x30 cm format
- **INCH:** collimator in inches, based on 8"x10" format

Available formats, according to the selection are:

Standard	24x30	Inches
18x24 A	18x24 A	8"x10" A
18x24 S	24x30 S	8"x10" S
24x18 A	24x30 A	10"x8" A
30x24 S	30x24 S	12"x10" S

The active keys for this test are the following:


o

Changes the existing setting (key "26" or "24")

Quits the function, does not save the changes made and returns to the "Service Menu" display (key "9")

Upon quitting saves the changes made (key "23")

If any change has been introduced, after pressing key "9"  the display shows:

U	**P**	**D**	**A**	**T**	**E**		**C**	**H**	**A**	**N**	**G**	**E**	**S**	**?**	
E	**N**	**T**	**E**	**R**	**=**	**Y**			**R**	**E**	**S**	**E**	**T**	**=**	**N**

Press key "23"  to permanently store the changes or press key "9"  not to store them. The system will exit from this routine in cases and the display returns to:

C	**E**	**P**	**H**		**S**	**E**	**T**	**U**	**P**				**a**	**b**	**c**
P	**R**	**.**		**C**	**O**	**L**	**L**	**.**		**T**	**Y**	**P**	**E**		

Press key "24"  to select next routine (Defining the default format of the CEPH cassette, see paragraph 8.3.6.7).

8.3.6.7. Definition of the default format of the cephalometric cassette (selected from the four cephalometric slots available)

This parameter is used to set the default format of the cephalometric cassette, i.e. the first one displayed at the selection of Ceph examination.

This test is accessed in by activating password 124 as described at previous paragraph 8.3.6. When next display is shown:

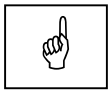
C	E	P	H		S	E	T	U	P				a	b	c
X		O	F	F	S	E	T								

Press key "24"  until reaching the following display:

C	E	P	H		S	E	T	U	P					a	b
D	E	F	A	U	L	T		F	O	R	M	A	T		

Press key "23"  . The following message will be displayed:

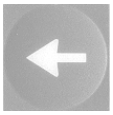
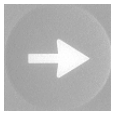
D	E	F	A	U	L	T		F	O	R	M	A	T		
c	c	c	c	c	c										



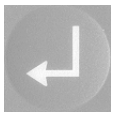
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

ccccc = corresponds to the possible cassette format/projections that can be selected and set as default values for the cephalometric examinations, i.e. the type of cassette format/projections that appears each time the cephalometric examination is accessed.

The active keys for this test are the following:

 or  Changes the existing setting (key "26" or "24"), and select the cassette format/projections among the four choices

 Quits the function, does not save the changes made and returns to the "Service Menu" display (key "9")

 Upon quitting saves the changes made (key "23")

The formats available are the following:

Standard	24x30	Inches
18x24 A	18x24 A	8"x10" A
18x24 S	24x30 S	8"x10" S
24x18 A	24x30 A	10"x8" A
30x24 S	30x24 S	12"x10" S

If any change has been introduced, after pressing key "9"  the display shows:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

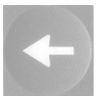
Press key "23"  to permanently store the changes or press key "9"  not to store them. The system will exit from this routine in both cases and the display returns to:

C	E	P	H		S	E	T	U	P					a	b
D	E	F	A	U	L	T		F	O	R	M	A	T		

Press key "24"  to select next routine (X-Axis position, see paragraph 8.3.6.1).

8.3.7. Password 130

This password enables the operator to change the language in which the messages are displayed during normal working use. The Technical Services messages are always in English.

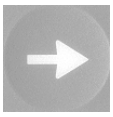
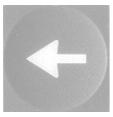
To change this setting press key "24"  or key "26"  .

The languages that may be selected are: ENGLISH, ITALIANO, FRANCAIS, DEUTSCH, ESPANOL.

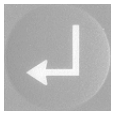
A typical message displayed is:

S	E	L	E	C	T		L	A	N	G	U	A	G	E	
I	T	A	L	I	A	N	O								

The active keys in this password are the following:

 o  Sets the desired language for the display of the operational messages (key "24" or "26")

 Quits the function (key "9")

 Upon quitting saves the changes made (key "23")

Press key "9"  to quit Password 130. If no changes have been made, the system will quit the password mode, otherwise the following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently store the changes made or press key "9"  not to store them (maintain previous language).

The system will quit password 130 in both cases.

8.3.8. Password 143

With this password, the operator can keep a centralised control of the readings and resetting of the counters for the various examinations and of the overall exposure of the system.

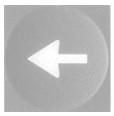
The following message is displayed upon access to this function:

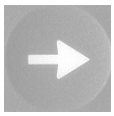
P	**A**	**N**		**T**	**E**	**S**	**T**								
V	**A**	**L**	**U**	**E**	**=**	**n**	**n**	**n**							

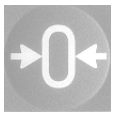
NOTE:
The characters presented on the display have been substituted with letters in this figure, so that the significance/function of each one can be described more clearly.

- **PAN** = indicates the type of examination to which the counter refers
- **nnn** = indicates the current number of exposures made for the type of examination indicated in the first line.

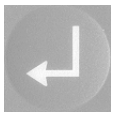
The active keys for this password are the following:


Selects the counter relative to the previous examination (key "26")


Selects the counter relative to the next examination (key "24")


Resets the selected counter (excluding the overall time of activation of the tubehead. **This parameter cannot be reset**)


Quits the counter function, quits the password, does not save the changes made and returns to the "Service Menu" display (key "9")

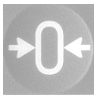

Upon quitting saves the changes made (key "23")

The reading of the overall exposure time of the system is indicated on the display as follows:

R	X		T	U	B	E		U	S	A	G	E			
h	h	:	m	m	:	s	s								

where:

- **hh** = hours of use
- **mm =** minutes of use
- **ss=** seconds of use.

After each reset request (key "10" ) the following message will be displayed:

U	P	D	A	T	E		C	H	A	N	G	E	S	?	
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to permanently change the settings made or press key "9"  not to store them.

Press key "9"  to quit Password 143. The following message will be displayed:

C	O	N	F	I	R	M		E	X	I	T	?			
E	N	T	E	R	=	Y			R	E	S	E	T	=	N

Press key "23"  to quit the password or press key "9"  to remain in password 143 mode.

8.4. Memory errors

The group of error messages with code range E570 to E574 is related to errors occurring on the Flash Eprom; this memory stores both program and data. Of these group of error messages, only the first one (E570) can be reset, while all others are related to a severe error on the chip, so they require to replace of the Smart Card CPU or at least of the Flash Eprom chips. The memory chips have to be replaced with programmed ones.

NOTE:
In all cases, when the original flash Eproms of the system have failed, the data stored in the memory are lost or replaced with default values, so a complete calibration of the machine has to be performed.

8.4.1. ERROR 570: Checksum error on flash eprom

This error message is dispalyed if the control system, at power up, verifies that the memory contains no valid data; the system can try to correct the error related to the memory section used to store current functional data; in this case the message "Press Reset button" to restore data will be visualised. At the button'pressure, the default values for data will be stored in the memory, so a complete calibration of the machine will be needed. The calibration has to be performed using service programs.

If after the storing of the new values the error message persists, it means that a severe error occurred on the chips, so replace the Memory chips or the Smart Card complete.

8.4.2. ERROR 571-572-873-574-575

All these errors suggest an anomaly in the CPU or in the Flash Eprom: replace the CPU board.

8.4.3. ERROR 601

This error is shown when the firmware of the STRATO 2000 does not sense the presence of the U.I.C.; the U.I.C. is an hardware components, mounted on the CPU card A11 (Smart CPU) on connector/jumper X6. This components holds a unique code that is read, with its check byte, from the control system at the start-up; if the check byte is incorrect, the system displays the above error number.

In case this error is displayed, a pressure of the key "23"  allows

the system to continue its functioning, but only standard base examination will be possible.

Verify that the U.I.C. component is well inserted.

Verify that the U.I.C. is correctly inserted on the connector X6: the component shows a flat side on the upper part; the U.I.C. must be inserted having this flat side on the inner part of the CPU board. The reset of the situation is performed switching off and on the system.

In case there is a fault on the U.I.C. components itself, the U.I.C. must be replaced. **In this case, all the optional features must be re-enabled with proper codes linked to the new U.I.C.** Before requesting a new U.I.C. device, the S/N of the equipment and/or the U.I.C. itself must be recorded and reported to Villa Sistemi Medicali.

8.5. Search and correction of possible defects in dental radiographies

8.5.1. Defects due to incorrect position of the patient

Problem	Description	Solution
Incisors too large and blurred.	The patient is not positioned correctly. He is too far back from the optimal focal plane.	Position the patient correctly, and verify that he is holding the bite with his incisors on the fit notch and that the bite holder rod is vertical.
Incisors too small and blurred.	The patient is not positioned correctly. He is too far forward of the optimal focal plane.	Position the patient correctly, and verify that he is holding the bite with his incisors on the fit notch and that the bite holder rod is vertical.
Radiography with blank central area.	The patient's spine inhibits the passage of the X-rays because it is too compressed.	Check the alignment of the Frankfurt plane. Try to stretch out the cervical tract of the spine correcting the height of the cursor and moving the patient's feet forward (see 6.4.3.3/4/6/7 of the User Manual).
Dental arch not symmetrical.	The median sagittal line does not correspond to the laser centering beam.	Realign the patient (see 6.4.3.6 of the User Manual).
Upper apical area too dark.	The patient does not keep his lips closed and his tongue is not against the palate.	See paragraph 6.4.3.8 of the User Manual.
Upper central apical area out of focus.	The patient's head is turned backwards (Frankfurt plane not aligned).	Position the patient correcting the Frankfurt plane.
The image is slanted with respect to the longitudinal axis of the image frame and some of the anatomical structures are not symmetrical.	The patient's head is slanted (not vertical).	Position the patient correcting the sagittal plane.
The teeth are bigger on one side than the other.	The patient's head is turned with respect to the axis of the bite.	Position the patient correcting the sagittal plane and checking that the test is not turned.
(In CEPH examination) white area on the lower part of the film.	Panoramic chin-rest mounted.	Repeat the examination removing the PAN chin-rest.

8.5.2. Defects due to incorrect radiological data input and darkroom (Ceph examination)

Problem	Description	Solution
Under or overexposed plate.	The set kV values are not suitable for the size of the patient. Possible error during development.	Check the development system or repeat the examination changing the kV values. See paragraph 6.4.4 of the User Manual.
Completely black plate.	The film was exposed to light or to involuntary radiation.	Check that the darkroom is properly closed and do not store new films near X-ray sources.
Veiled plate.	The edges of the films not impressed by the dental arch are not perfectly transparent with consequent faulty definition on the entire film.	Check that the film has not expired and that the film manufacturer's storage indications have been complied with. Check the working non-actinic lamp in the darkroom.
Plate with stripes.	The film has rubbed against its box and accumulated electrostatic charges or the screens have not treated with anti-static liquid.	Clean the screens with the anti-static liquid.
Plate with blurred details and good contrast.	The screen is not correctly pressed between the screens.	Change the cassette.
Plate completely white.	Was not exposed to X-rays or the development process was incorrect.	Check the passage of the X-rays via acoustic and light signals (led **2**). If the error persists, check the development procedure. Position the fluorescent screen near the cassette (option) and check the passage of the X-rays.
Soft Tissues not or poorly visible in L-L projection.	The STF value is not correct.	Refer to paragraph 6.9.3 of the User's Manual to adjust the position of the "STF".
	A symmetric cassette size was selected.	Select an asymmetrical cassette size (which will enable the STF filter).

8.5.3. Defects due to the unit

The experience from field problem observed on the STRATO 2000 has allowed to list under this chapter some possible typical problems that can affect the radiological quality.

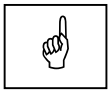
8.5.3.1. Panoramic image too light

The PAN image results in a light one also if the exposure parameters are correctly selected for the patient size.

Possible causes:

- **Sensor holder not in panoramic position (only for units set to accept Ceph arm)**

  Check that the sensor holder is in panoramic position and that the sensing switch S24 is correctly functioning. The switch has to sense the correct position when the sensor holder is closed; possibly adjust the position of the switch.



NOTE:
Take care that the position of switch S24 determines also the perpendicularly of the beam to the receptor. The adjustment of S24 has to be performed carefully.

- **X-ray beam not aligned to digital sensor**
  - Check that the X-ray beam lay completely on the slot of the sensor aperture; this check has to be performed removing the cover on the sensor holder and using a scintillator screen. Perform an exposure, using the procedure described in paragraph 7.2.
  - The scintillator screen has to be positioned in front of the sensor slot.
  - If the beam does not position on the slit, the adjustment of the primary collimator has to be performed. For model carrying the rotating collimator make reference to Error E511 (paragraph 8.3.5.5.2). For models with the fixed collimator, it is possible to move slightly the tubehead to align the X-ray beam.

- **Exposure parameters not correct**
  - Check the correctness of the exposure parameters using the procedure described on paragraph 7.2 and 7.3.
  - If the measured value of the feedback signals coming from the tubehead are correct, a possible fault of the tubehead itself has occurred, so replace the tubehead. Please notice that the tubehead replacement implies also the replacment of the HF board because there a matching of the two components.
  - If the feedback measured values are not in the specified range, check the correctness of the set value, using a digital meter having at least 10 MΩ input resistance and set it for VDC measure with a 20V full scale reading.
    1. Power off the machine and connect the ground cable to Test Point TPGNGD and the sensing pod to test point kVset.
    2. Power on the machine and, using password 118, primary collimator menu, perform an exposure using 60 kV and a time of 1s.
    3. Check that the set value during exposure is 3 V ± 0.2V.
    4. Repeat the test selecting 70 and 80 kV; the reading should be 3.5 and 4 V ± 0.2V, respectively.
    5. If test fails, repeat the test connecting the meter to the CPU test points; see description below.
    6. If all tests pass, check tube current, connecting the sensing pod to mAset.
    7. Set mA to 4 mA and perform an exposure and read the value that must be 2V ± 0.2V.
    8. Repeat the test for 6, 8 and 10 mA; the measured value should be 3, 4 and 5 V, always with the same accuracy.
    9. If the test pass, repeat the tests attaching the meter to the CPU.
    10. If the test fails, check the cable X4 (HF) – X9 (CPU); if broken, replace the cable.
    11. Check of set point at the CPU side; disconnect the meter from HF power board and connect it to CPU board; ground to TPGROUND sense pod to KVSET. Repeat the exposure above, checking both kV and mA.
    12. If the measured values for set points at the CPU are not correct, replace the CPU; otherwise replace the tubehead.

8.5.3.2. Image with not irradiated areas

Possible interruption of exposure due to malfunction of the generator: check kV and HF board.
Possible failure of Direct Digital Acquisition System.

8.5.3.3. Image with missing highlight of the Soft Tissues

In the case of cephalometry, in a latero-lateral, with missing highlight of the soft tissues , check the set FPM values following the procedure given in password 124.

8.6. Analysis of the problems on the panoramic examinations

This chapter is aimed at giving a more detailed and in depth description of defects affecting panoramic images; basically this chapter deals with the same type of problems described in paragraph 8.5 adding a more detailed explanation of the cause and corrective actions to take.

The panoramic radiography is the examination of the maxillo-facial region normally used to view the dental region inside the complete head and sinuses-orbital complex. A good panoramic examination allows distinguishing the main anatomical structures that are shown in the next drawing:

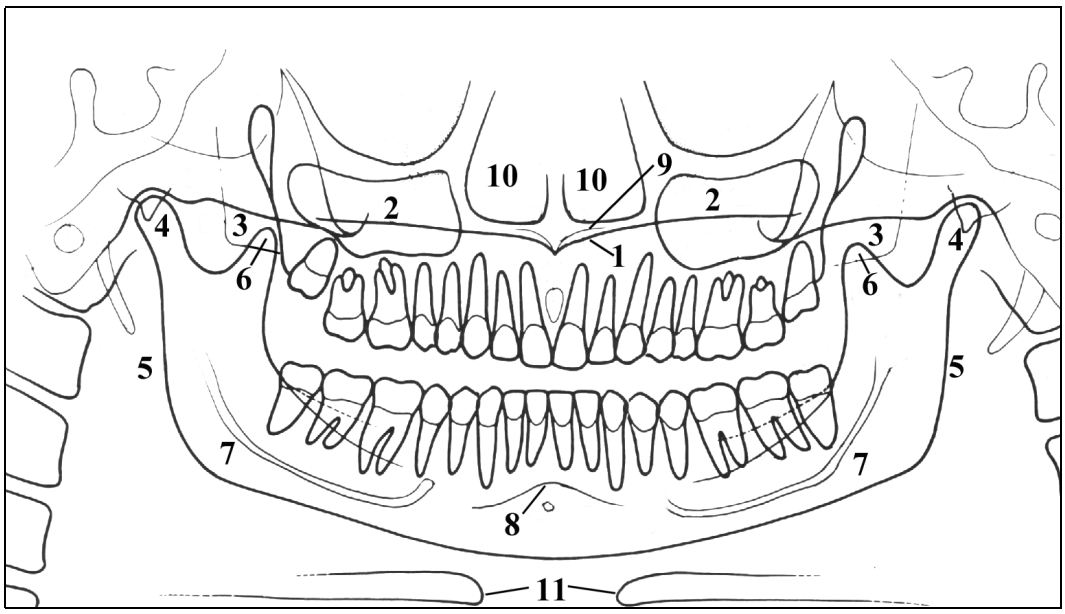


Figure 8-7

Ref.	***Anatomic structure***
1	*Hard palat plane*
2	*Maxillary sinus*
3	*Mandible*
4	*Temporo mandibular condyle*
5	*Ascending ramus of the TMJ*
6	*Coronoid process*
7	*Mandibular canal*
8	*Foramen*
9	*Nasal anterior spine*
10	*Nose*
11	*Ioid bone (normally duplicated)*

8.6.1. Proper positioning of the patient

The proper positioning of the patient during the panoramic examination is very important in order to get good quality radiography. This is due to the fact that the shape of the focussed area, e.g. of the layer clearly shown on the image, tends to follow the dental arch and has a non-constant deepness.
The objects outside this focussed area will therefore appear blurred on the resulting radiography.

1. The patient should not dress clothes that may interfere with the X-ray beam, also to leave more space between the patient's shoulders and the rotating arm of the machine. Care must be taken in order to avoid interference between the X-ray beam and the protective apron worn by the patient.
2. Metal objects (neck chain, ear-ring) must be avoided; this objects not only create radio-opaque images in their own position but also false images projected in other parts of the radiography, so disturbing the correct view of the anatomy.
3. The patient's head must be lightly tilted downward in order to have the Frankfurt plane horizontal. In this way, the hard palatal ceiling will be projected slightly over the superior apex of anterior teeth. If the patient has a low palatal ceiling, slightly increase the tilting downward.
4. Align the middle sagittal plane with centre of the chin support, normally indicated by the relevant light beam.
5. Check that the vertical light beam falls on the canine and lays between the third and fourth teeth. This will insure that the apex of the anterior teeth are positioned within the focussed area and therefore will be properly reproduced on the radiography. Normally, the panoramic equipment has a narrower focussed layer in the front area, and therefore a proper positioning of the anterior teeth is of the utmost importance.

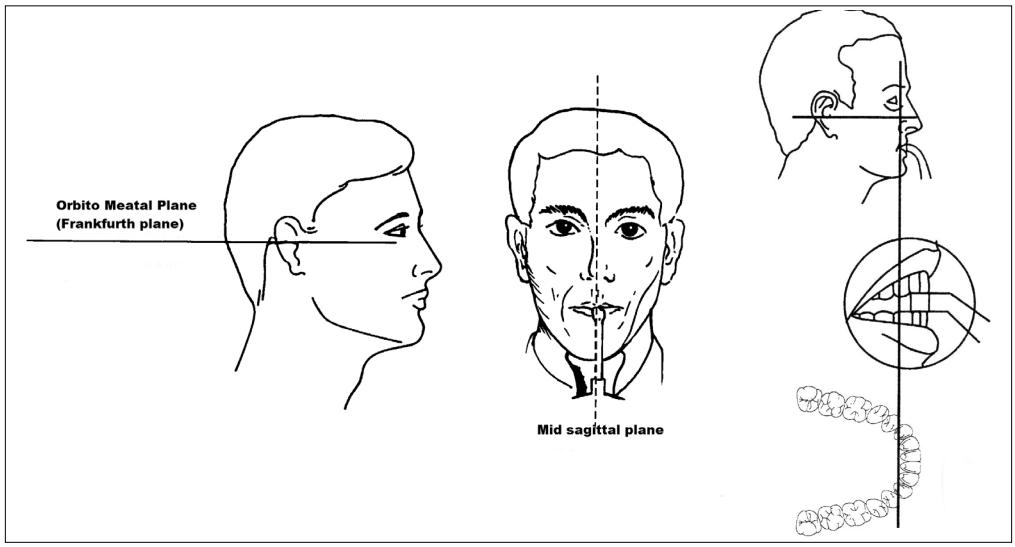


Figure 8-8

6. The patient must extend the spine; this is normally obtained by asking the patient to step forward, making sure that all other conditions are unchanged. If not properly extended, the spine will cause the appearing of a lower exposed area (clearer) in the front part of the image.

7. The patient's tongue must be positioned against the palate, otherwise the air between the tongue and the palate will create a lower absorbance area which will result on the image as a darker area which in turn will hide the apex of the superior incisor teeth.

The result of all the above listed actions will be radiography where all the parts are properly exposed are well identifiable as in the schema of Figure 8-9.

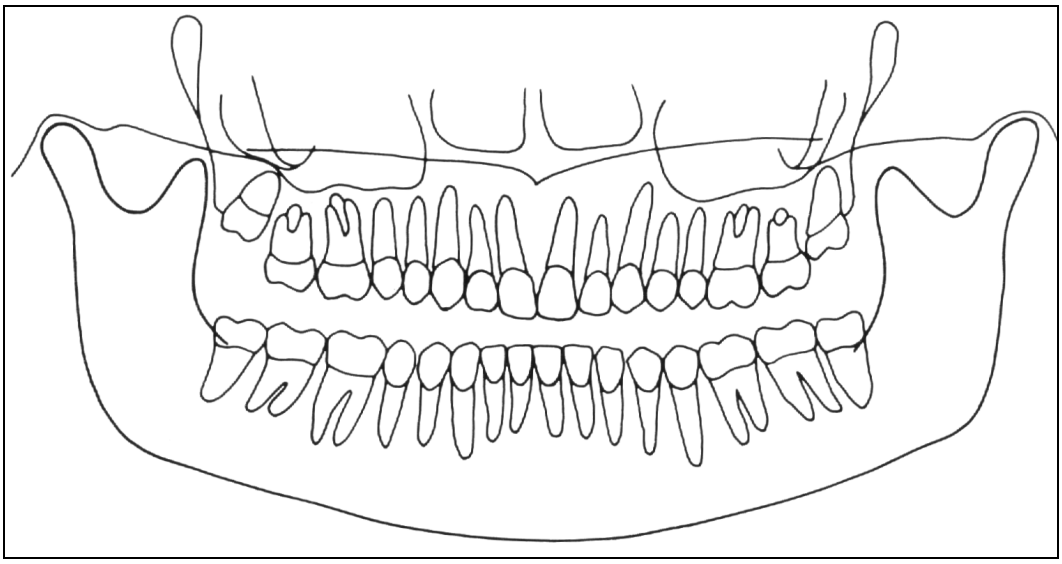


Figure 8-9

It must be noted that radiography is quite symmetrical, with the ascending rami of temporo mandibular joints almost parallel. The occlusal plane is shown slightly tilted upward, the palatal plane does not overlap the apex of the upper arch and therefore allows a good sight of the same.

8.6.2. Error due to a bad patient's positioning

- **The image shows the anterior teeth with reduced megnification and not well defined. The cervical spine is shown an evident white shadow.**

  In addition, on the molar zone there are too much shadows, disturbing the view.

  The resulting image is similar to the schema shown on Figure 8-10.

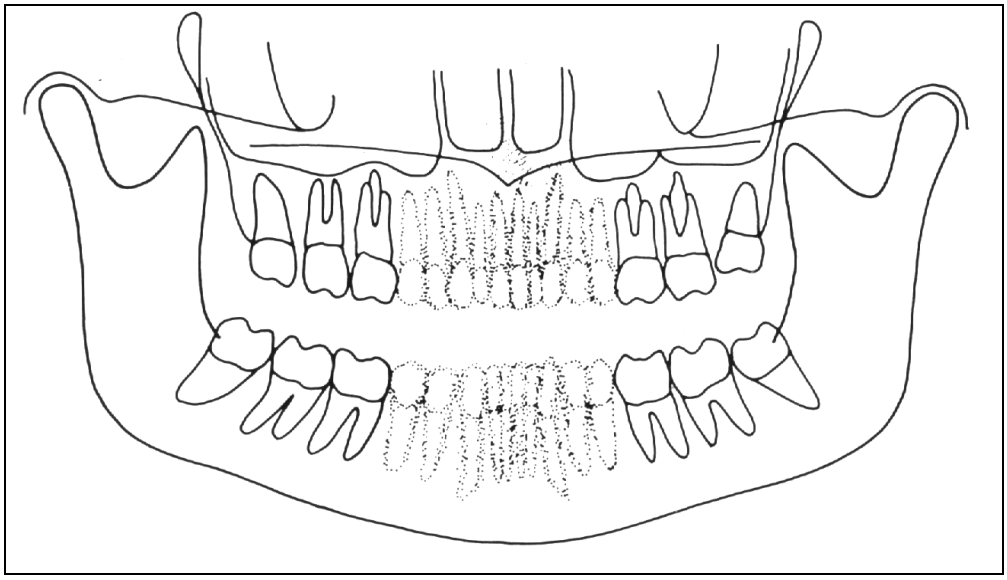


Figure 8-10

Possible cause:

The patient is positioned too forward, e.g. the centring light beam falls at the back as shown in the drawing, the anterior teeth will result unfocussed and reduced.

Remedy:

Check the patient positioning by using the light beams and the adjustment knob of the canine light beam.

If, after the correct patient's positioning, the problem still remain, check the alignment of the centering laser lights, as described on paragraph 7.1.2.

A fast check can be performed lighting on the beams and verifying its positioning. The mid sagittal line must lay on the center of chin rest while the canine one has to lay on the terminal part of the bite block.

A more accurate check can be performed using the rounded service tool and verifying that the distance between the two lateral metal parts.

- **Anterior teeth are enlarged and blurred**

  The Figure 8-11 depicts the resulting image.

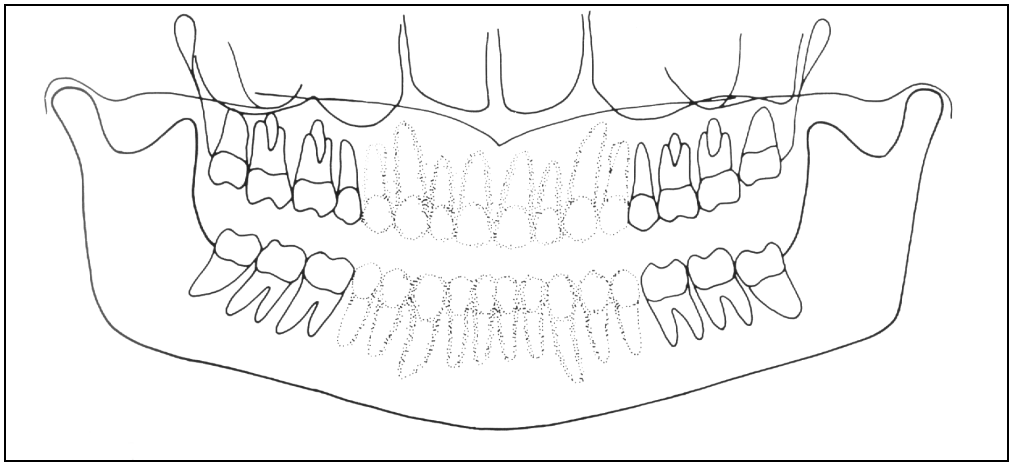
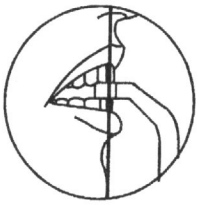


Figure 8-11



Possible cause:

In the case the patient is positioned too backward, e.g. the centring light beam falls at the beginning of the anterior teeth, as shown in the drawing.

Remedy:

Check the patient positioning by using the light beams and the adjustment knob of the canine light beam as above described.

- **Part of the image is enlarged while the other one is reduced**

The schema described on Figure 8-12 the image obtained; it is possible to observe that one part of the radiography is blurred and enlarged, while the other one is reduced and seems to be on focus; the two condiles are at the same height on the image.

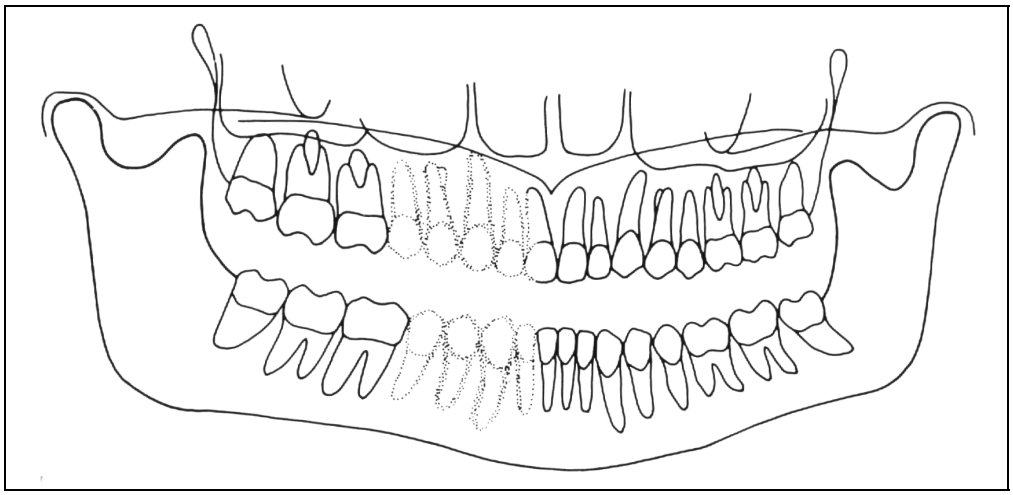
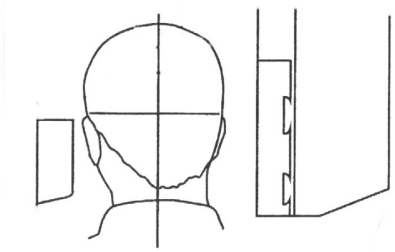


Figure 8-12

Possible cause:



This effect can be due to two different causes.
In the first one, the median-sagittal plane is not aligned with the relevant centring light beam, which falls at the centre of the chin support.
In the second case instead, the centre of the median-sagittal plane matched the centre of the chin support, but the patient's head is rotated.

In both cases, one side is closer to the image plane than the other, thus resulting in a different magnification of the two sides; the part more distant from the image will be more magnified while the part closer to the image plane will result smaller. This error in positioning the patient will result in a radiography as shown in the next drawing: the right-most area of the image shows a bigger magnification that can be noticed either on the teeth and on the ascending rami of the TMJ.

Remedy:

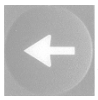
Check the positioning of the median-sagittal plane by using the relevant centring light beam.
Check also the position of the middle sagittal beam; lighted, it must fall down on the center of the chin rest and also on the center of the byte.

A more accurate check is performed using the special rounded tool and making a image; the dimensiuons measured on the obtained image must match those reported on the service manual, with a ± 1 mm tolerance.

In case these dimensions are not respected, perform a calibration of the X and Rotation axis; particularly X axis has to be checked if the mid sagittal beam is off center, while the rotation must be checked if the two measures (center to right against center to left) are different.

In case of rotation adjustment, the X axis position must be always cheched; this can be accomplished using the program for Y axis and measuring the distance between , with the beam lighted , pressing the Test button  to perform a rotation of 180°, looking at the intersection of the laser beam with the reference line of the flat template. The intersection point must not drift more than 2 mm, measure this drift.

If this does not happens, means that the sigittal laser is not aligned with the rotation center, so it must be adjusted; to perform it, remove the upper cover of the STRATO 2000.

Still in the Y axis position, using the  and/or  , moves the X axis half of the above measure and on the opposite direction of the drift; save the new position of the X-axis. At this point, the mid sagittal laser will not be in the correct position and it must be aligned using the four screws of the laser support; this operation must be performed in such a way that all the laser beam falls on the reference line.

- **The image shows TMJ at different height**

This fact is described in Figure 8-13.

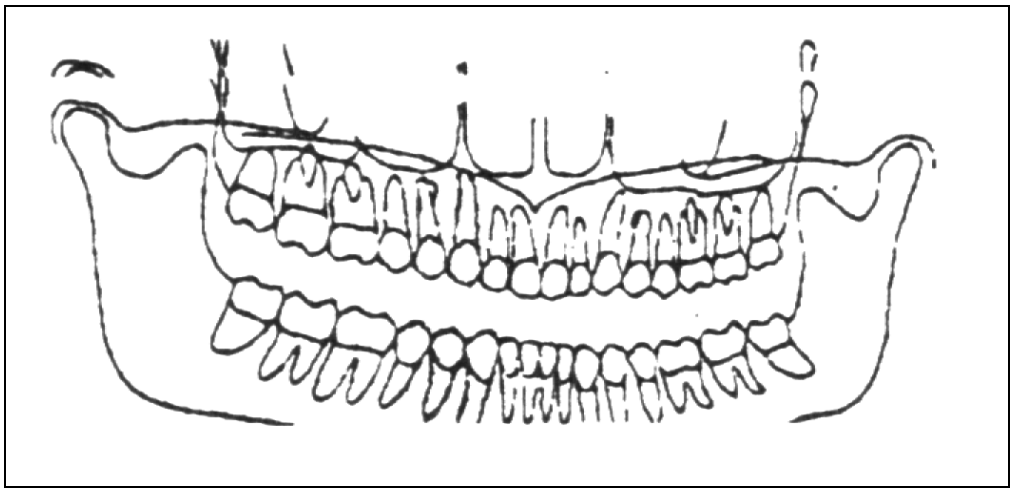


Figure 8-13

Possible cause:

The mid sagittal plane is not vertical. This can be a patient's problem, but if the defect is always present, check the laser beam.

Remedy:

Verify that the laser beam is vertical; this check can be performed very quicly using the laser beam and verifying that falls on the center of the chin support; remove the chin support itself and check that the beam falls on the center of the holes used to fix the chin itself.

If not, a possible cause can be due to a non perfect horizontally of the chin arm, that must be adjusted using the relevant screws.

- **The image shows undulated teeth rows**

As can be seen on Figure 8-14, the upper teeth are magnified and unfocussed, with the shadow of the hard palate positioned over the superior apex. The temporo-mandibular joints are exposed outward, with lines divergent upward. In some cases, the condile vertex might not appear on the image.

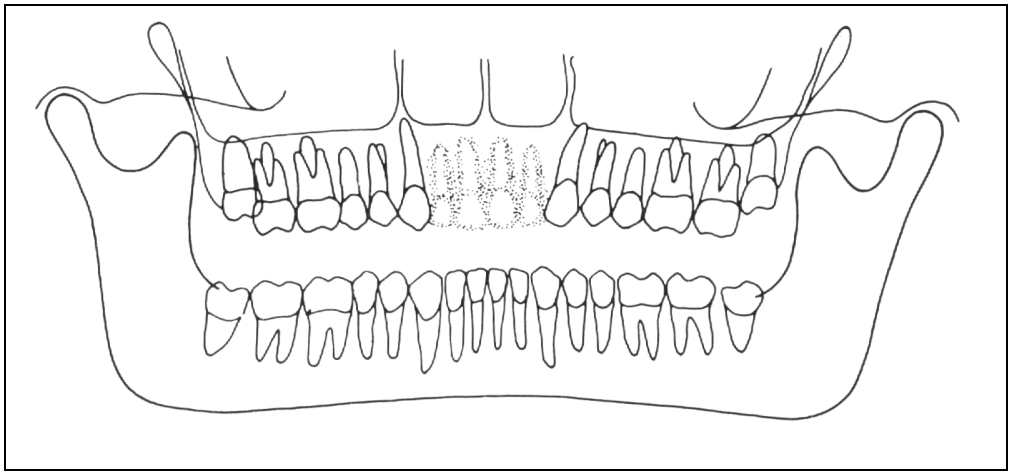


Figure 8-14

Possible cause:

Patient's head tilted upward.

A Frankfurt plane too tilted upward produces different anomalies that may also appear contemporaneously. A chin support plane too high during the patient positioning or when extending the spine may generate this mistake. In this condition, the rear side of the patient's head may also interfere with rotating arm of the panoramic equipment.

- **The radiographic image shows the teeth row too curved upward with the lower incisor non-focussed**

  Additional defects shown on Figure 8-15, the temporo-mandibular joints will be positioned too high with lines converging upward. In some cases the upper condile might not be visible in the image.

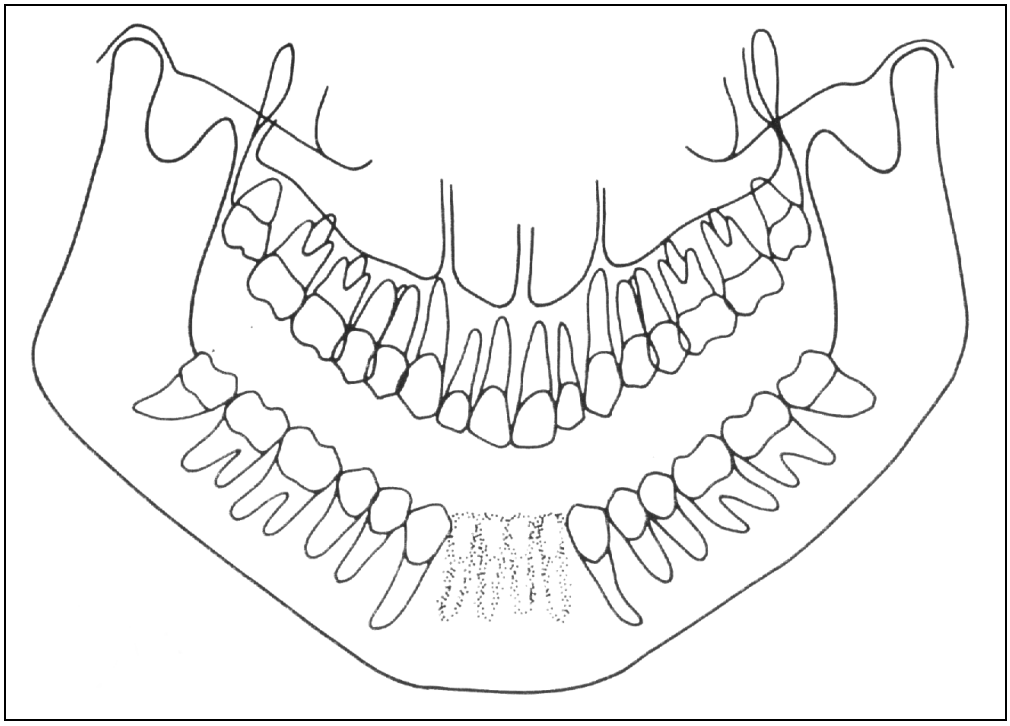


Figure 8-15

Possible cause:

Patient's head tilted downward, as on the aside schema.

Remedy:

Check the positioning of the patient by aligning it with the help of the corresponding light beam.

NOTE:
In some cases the positioning of the Frankfurt plane too tilted downward produces a correct image of the lower incisors, but the projection of the palate falls on the lower teeth apex, as shown on Figure 8-16.

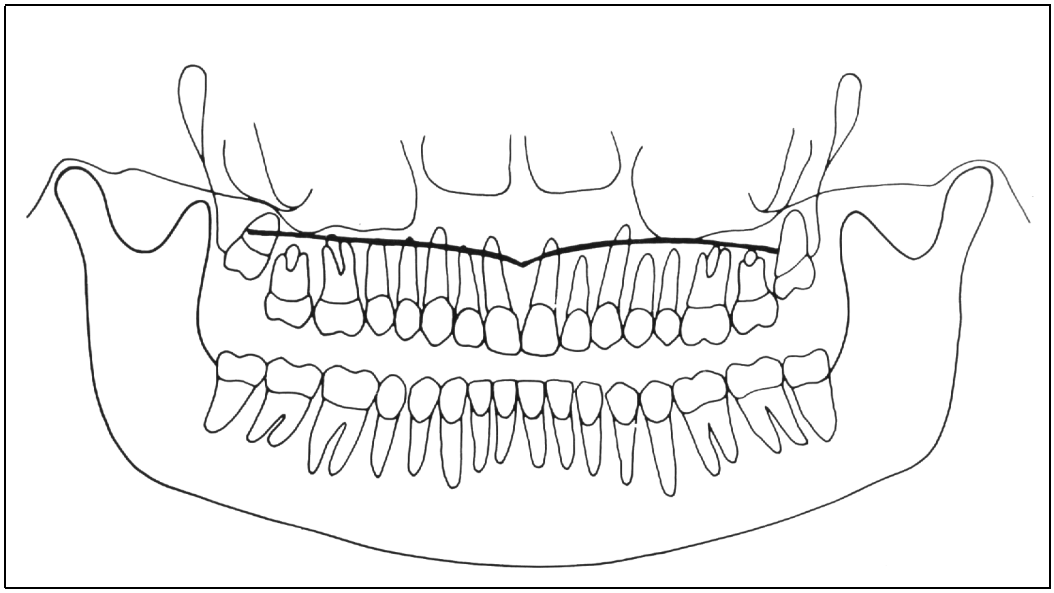


Figure 8-16

In this case, a light tilting downward of the Frankfurt plane causes the palate to be projected over and too far from the root of the teeth of the maxilla arch, without distortion of the incisor teeth, as on Figure 8-17.

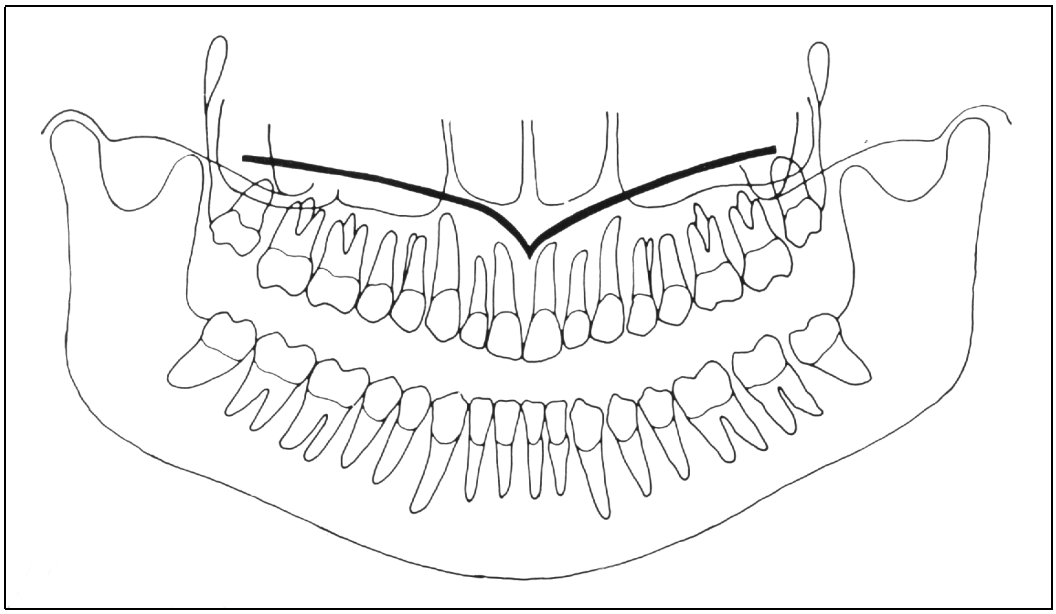


Figure 8-17

8.6.3. Images with artefacts

- **Radiographs that show images with soft tissues or artefacts**

The radiographs may show anatomical parts of the soft tissues or show radiographic artefacts.
Normally the soft tissues might be more or less present depending on the patient positioning, while the presence of artefacts is strictly dependent on the presence of foreign objects on the trajectory of the X-ray beam.
Next figure shows these cases; please consider that all structures have a bilateral duplicate.

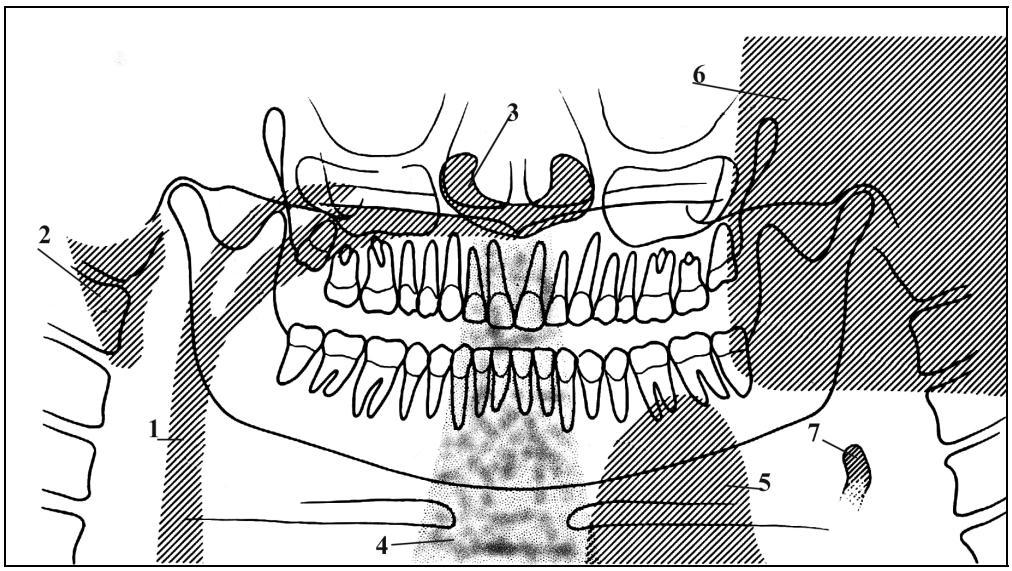


Figure 8-18

Where different references are described among with the cause/remedy, if any.

Soft tissue	Description	Artifacts	Description
2	Hear soft tissue	1	Dark shadows due to the air gap between tongue and palat
3	Nose soft tissue	4	Spine column
7	Epiglottis	5	Leaded apron too high

The part identified with "6" in Figure 8-18 represents the image of the controlateral mandible (the other side of the mandible). That therefore results as a clearer area overlapped to the real image. Very often the resulting darker area in the bottom corner is noticed and is considered as an artefact of the radiological image.

This is not true, because it is derived from the projection geometry used to obtain the panoramic image. The effect can be more evident if the image in underexposed due to wrong radiological parameters.

With reference to the previous Figure 8-18, let's analyse the cause and remedy.

- **Wrong positioning of the spine**

  In the case the image shows a too clear and unfocussed area in the central portion (see point "4" - Figure 8-18), this is probably caused by the wrong position of the spine that has not been properly extended by the patient. In this case, the spine absorbs a too big quantity of radiation that therefore causes the image to be too clear. This lightness can be noticed especially in the lower part of the image, while it's normally less visible on the upper part of the image.

  Remedy:

  Ask the patient to step forward thus extending the spine, in order to reduce X-ray absorption.

- **Shadows or bright artefacts**

  The most common cause for the presence of these artefacts is the presence of metal objects worn by the patient (ear-rings, necklace). The necklace worn on the neck of the patient can normally result in a radio-opaque arch positioned in the chin area. This arch normally overlaps the chin itself and the shadow of the spine, disturbing the diagnosis of possible problems in the chin area and in the area of the superior apex.

  The ear-rings instead creates real images in the proper position and shadow images projected in the contro-lateral area, thus hiding possible problems or generating bright areas within the paranasal sinuses.

  In some cases, that may depend either on the trajectory of the panoramic machine or on the position of the metal objects, they can generate up to three images (one real ad two shadows), thus further disturbing the correct diagnosis.
  This situation may occur especially if the patient has large prothesis or metal cures and if it is associated to a positioning error, that projects the shadow of the metal part on wide area of the image.

- **Non-exposed area in the lower-central part of the image**

  If the problem appears as shown in point "5" of the previous Figure 8-18, it indicates that there has been interference between the leaded apron worn by the patient and the X-ray beam.

  Remedy:

  Properly position the leaded apron (it must be worn well tight to the shoulder and neck of the patient) then carry out a new examination.

- **The teeth rows are overexposed**

  As already described, if the tongue is not positioned against the palate during the exposure, it will create an air chamber between the tongue and the palate; this air gap creates a less absorbing area that overlaps the teeth, often in the apex area. This area is identified with reference "1" in Figure 8-18.

  Remedy:

  Ask the patient to position the tongue against the palate during the exposure.

THIS PAGE IS INTENTIONALLY LEFT BLANK

9. SCHEMATICS AND DRAWINGS

1. Functional layout PAN version

2. Functional layout PAN/CEPH version

3. Lay-out CPU assy PCB (A1+A11)

4. Lay-out CPU PCB A1

5. Circuit diagram CPU PCB A1

6. Lay-out Microprocessor PCB A11

7. Circuit diagram Microprocessor PCB A11

8. Lay-out HF board A2

9. Circuit diagram HF board A2

10. Lay-out power supply PCB A3

11. Circuit diagram power supply PCB A3

12. Lay-out keyboard PCB A4

13. Circuit diagram keyboard A4

14. Lay-out and circuit diagram sensor interconnection A6

15. Lay-out and circuit diagram motor and X-axis interconnection A7

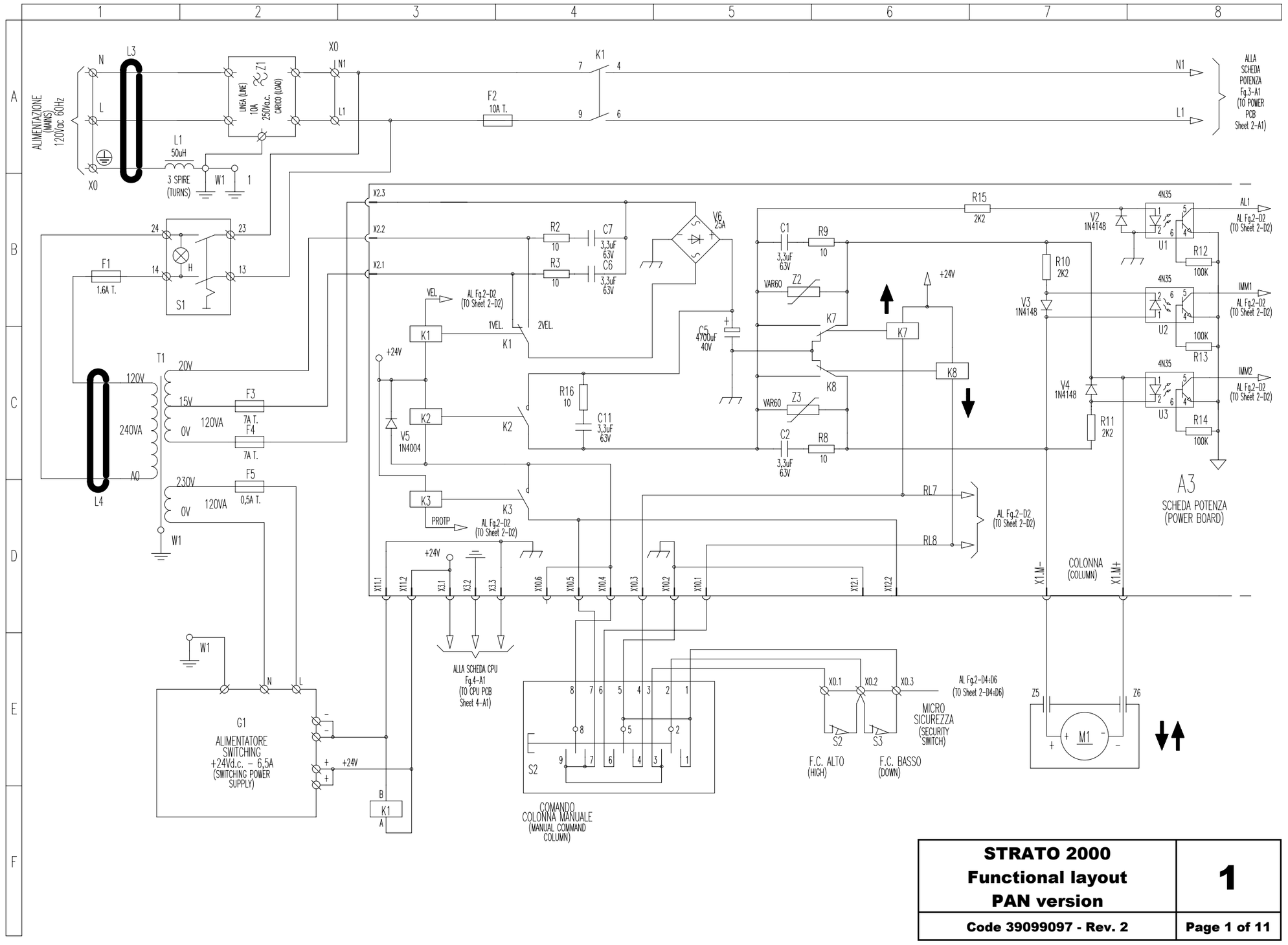
16. Lay-out and circuit diagram primary collimator interconnection A8

17. Lay-out and circuit diagram optical switches primary collimator A9

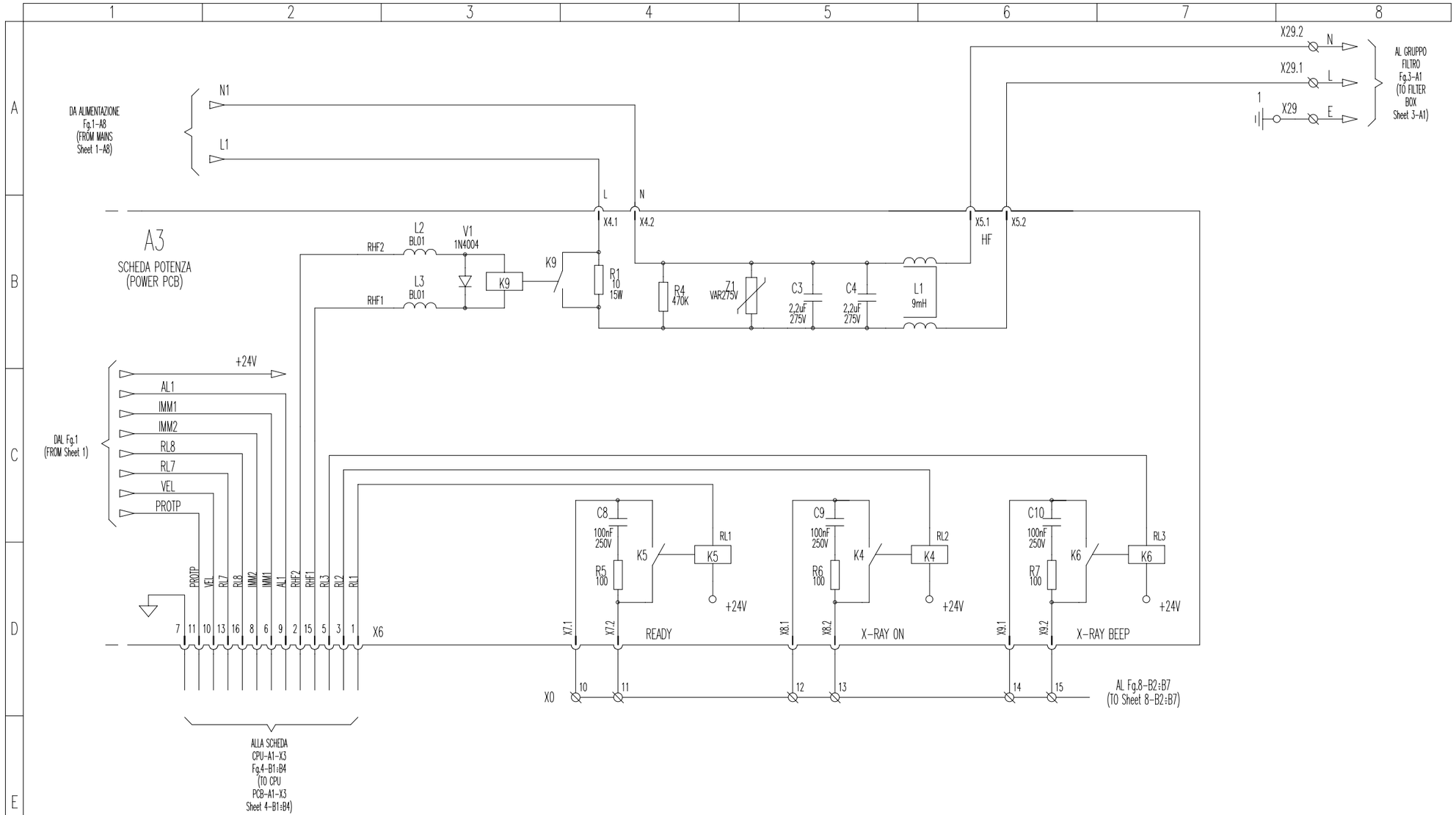
18. Lay-out and circuit diagram TTL / Serial converter PCB A12

19. Switching power supply S-150W-24Vdc-6.5A

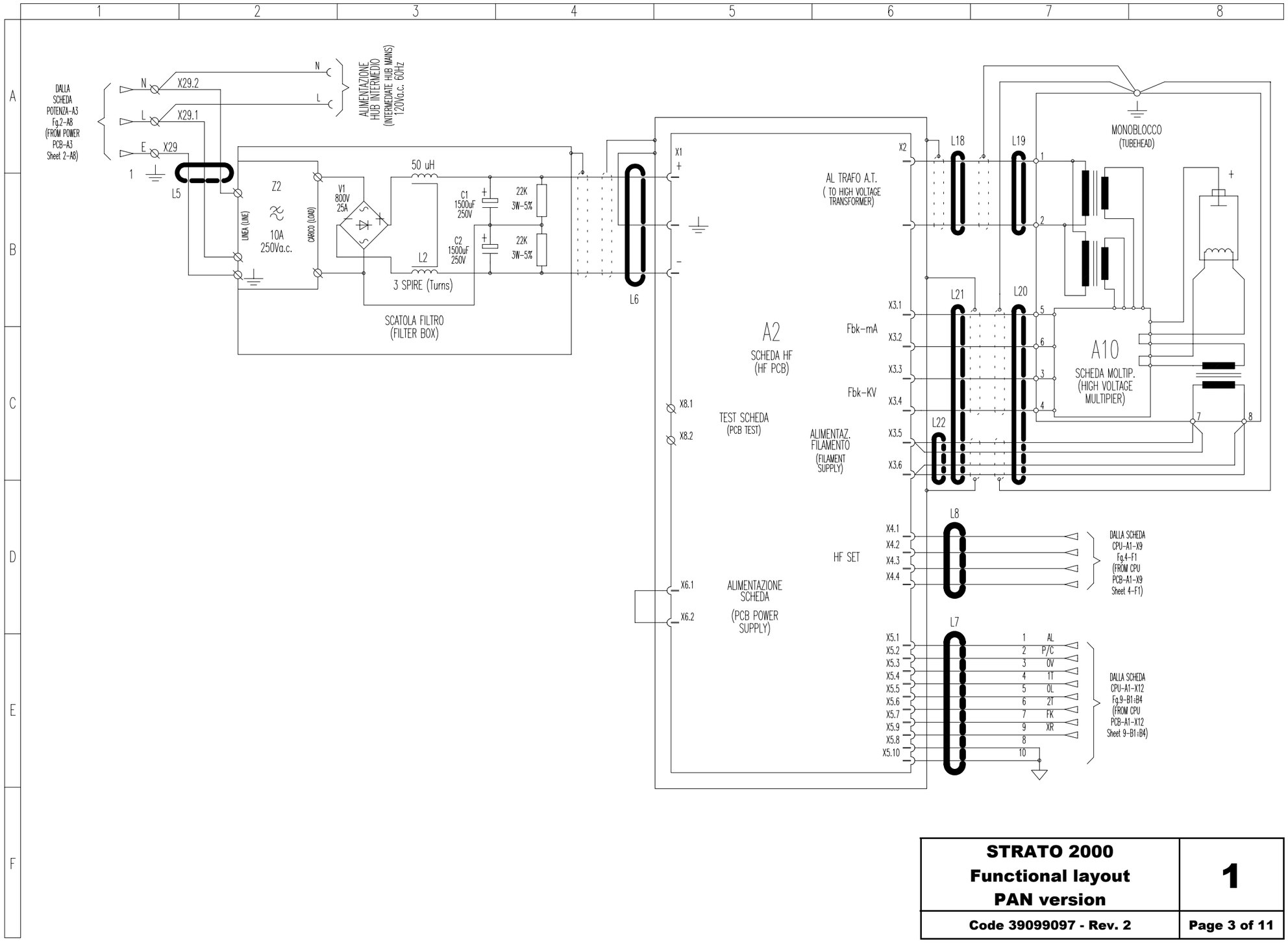
THIS PAGE IS INTENTIONALLY LEFT BLANK



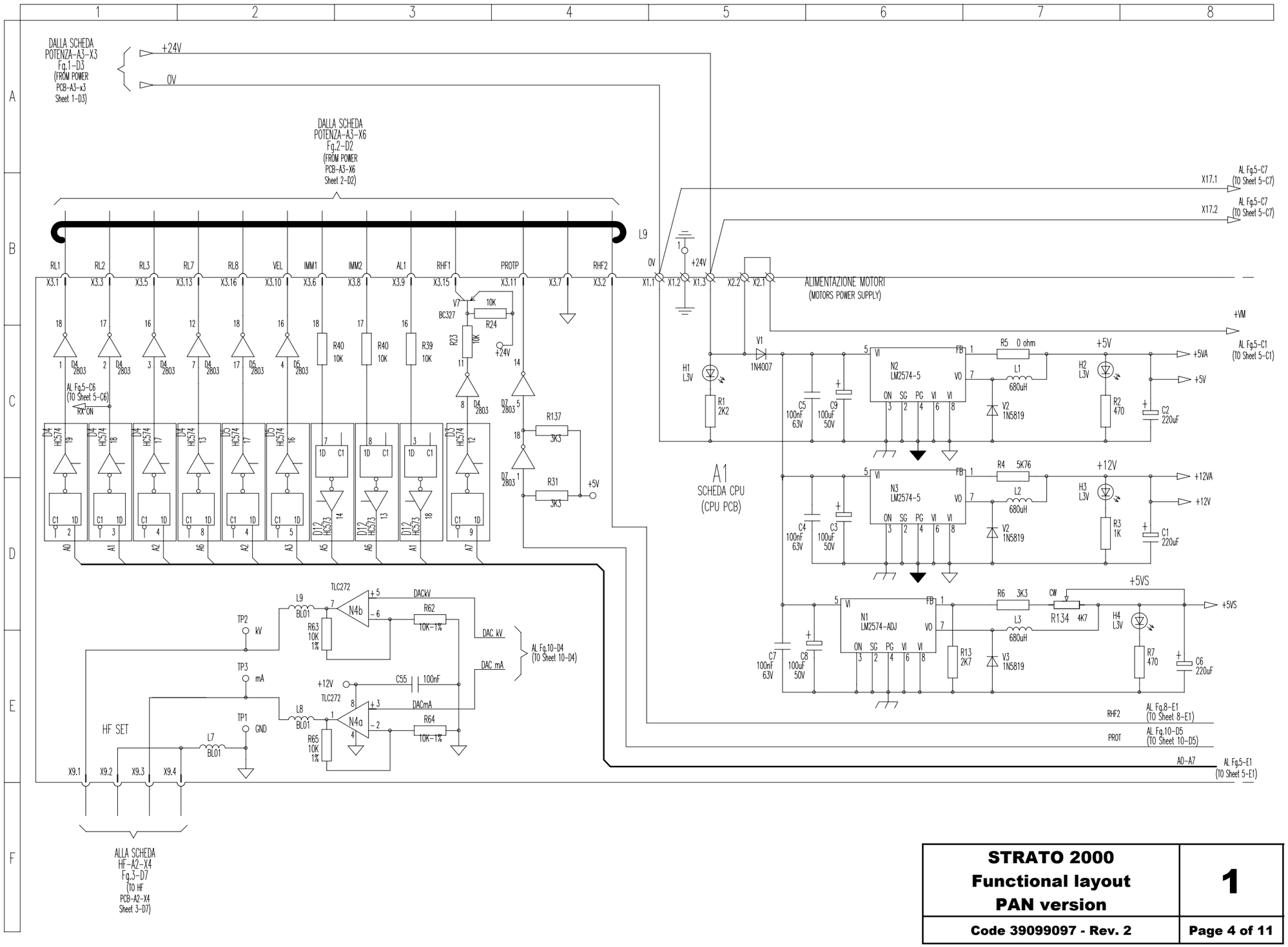
STRATO 2000 Functional layout PAN version	**1**
Code 39099097 - Rev. 2	**Page 1 of 11**



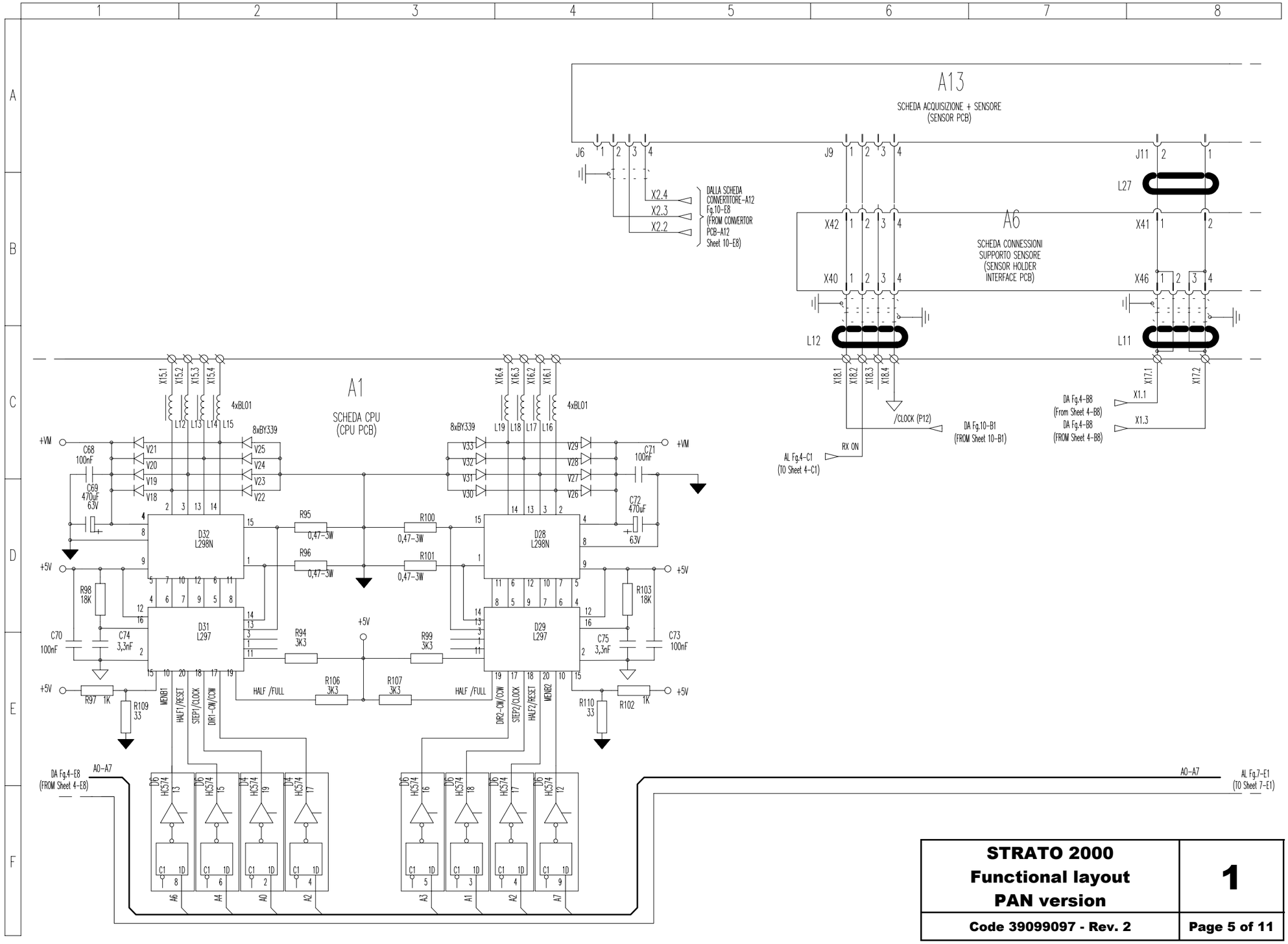
STRATO 2000 **Functional layout** **PAN version**	**1**
Code 39099097 - Rev. 2	**Page 2 of 11**



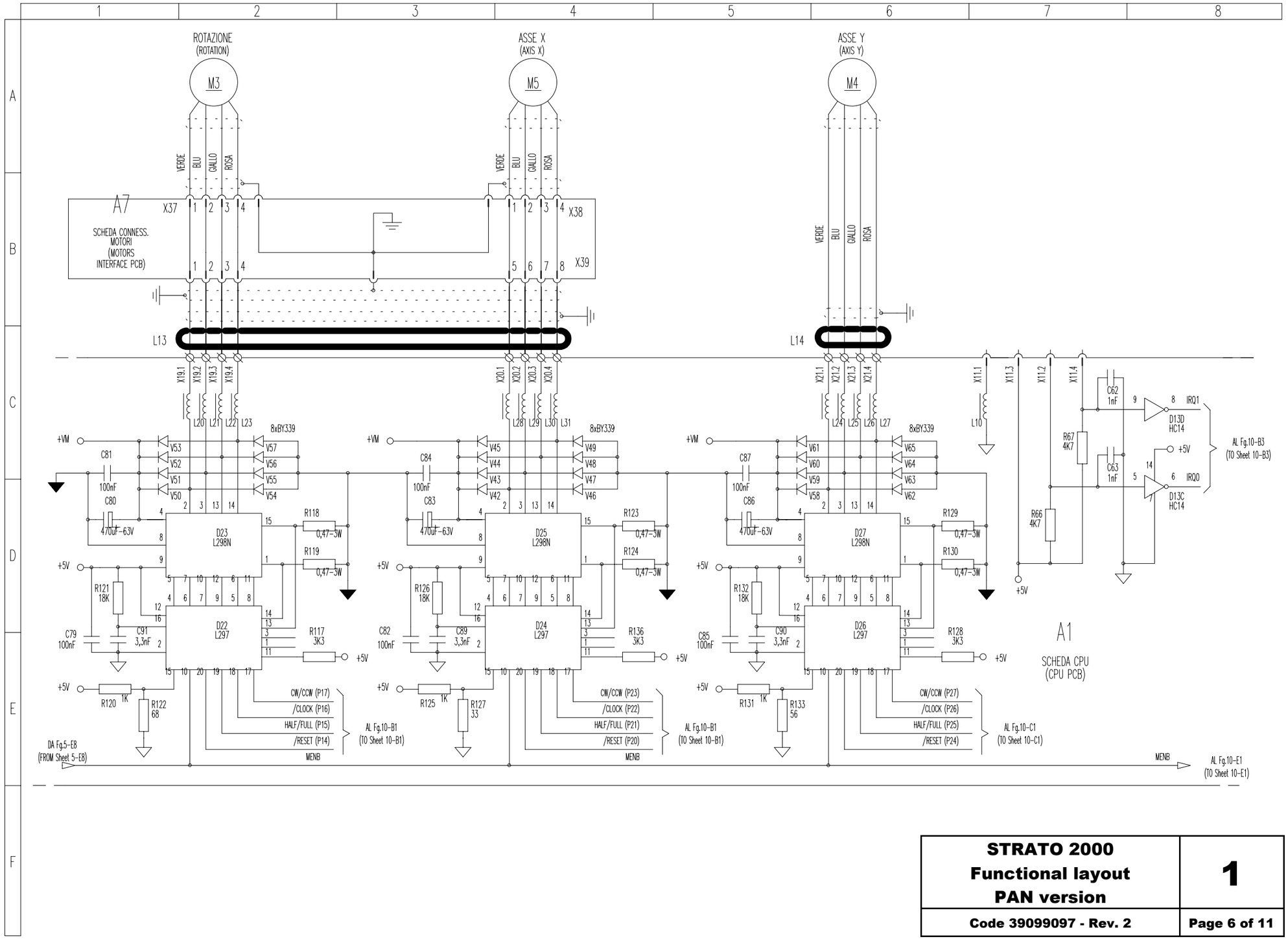
STRATO 2000 Functional layout PAN version	**1**
Code 39099097 - Rev. 2	**Page 3 of 11**



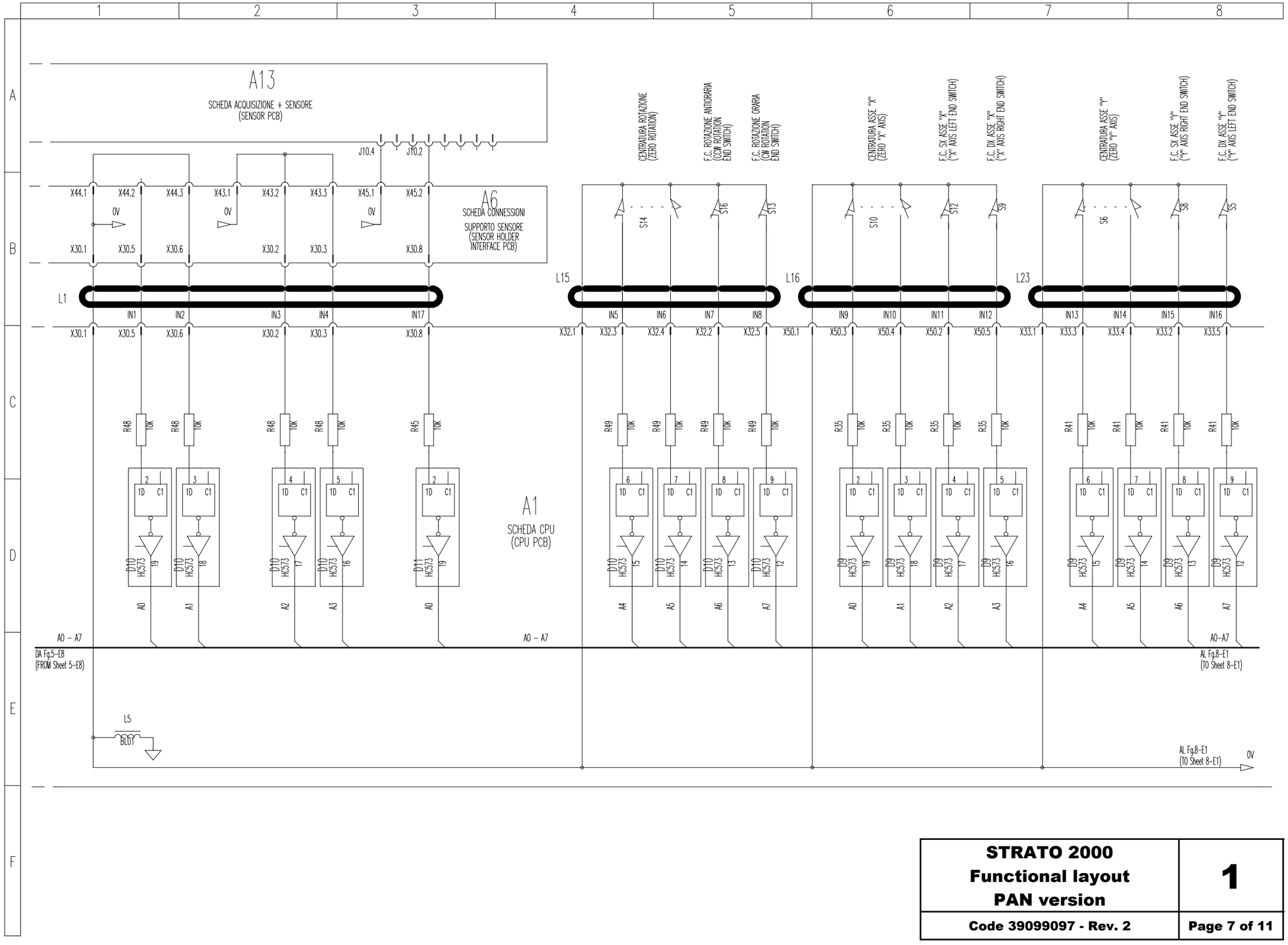
STRATO 2000 **Functional layout** **PAN version**	**1**
Code 39099097 - Rev. 2	**Page 4 of 11**



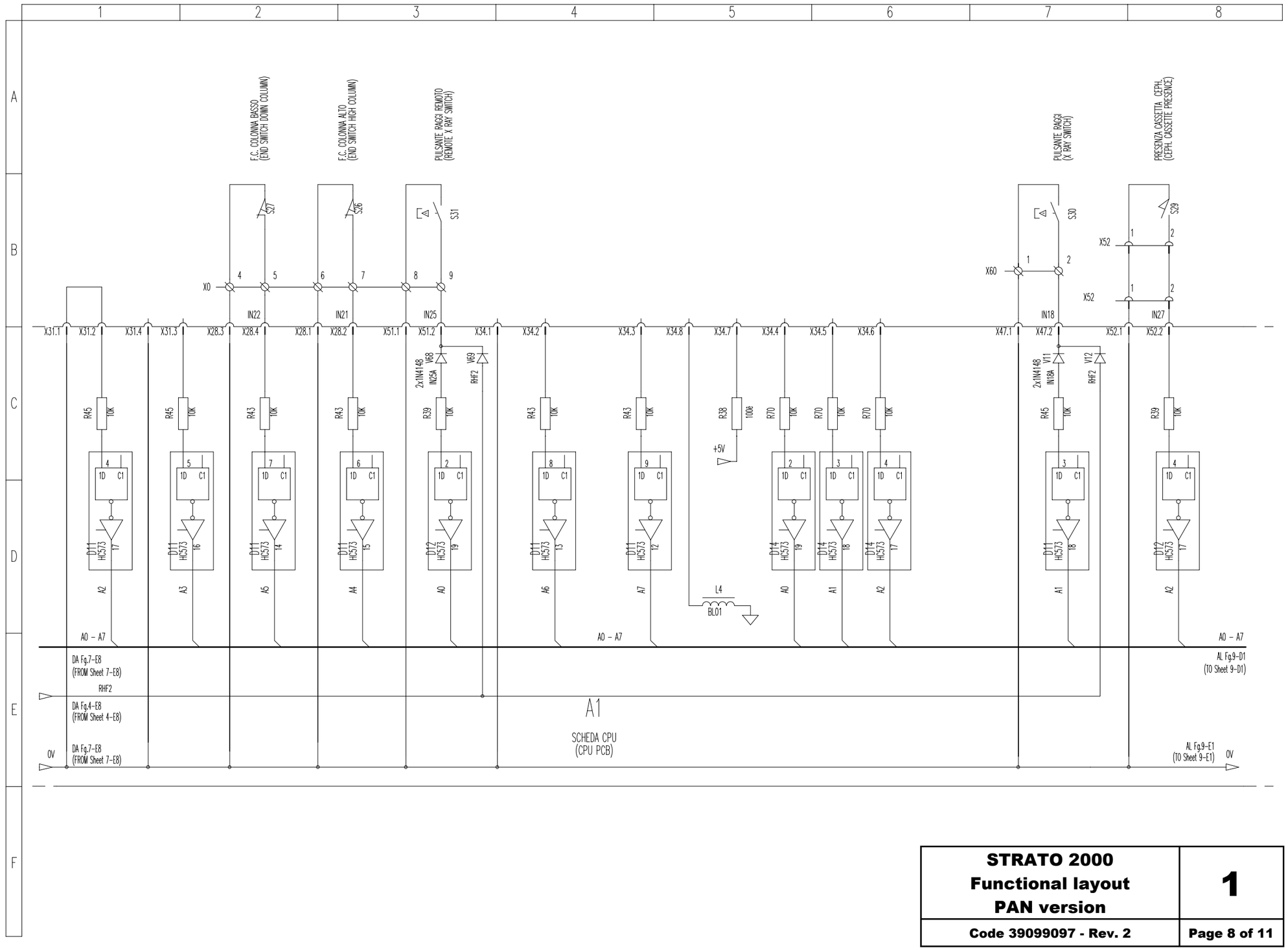
STRATO 2000 **Functional layout** **PAN version**	**1**
Code 39099097 - Rev. 2	**Page 5 of 11**



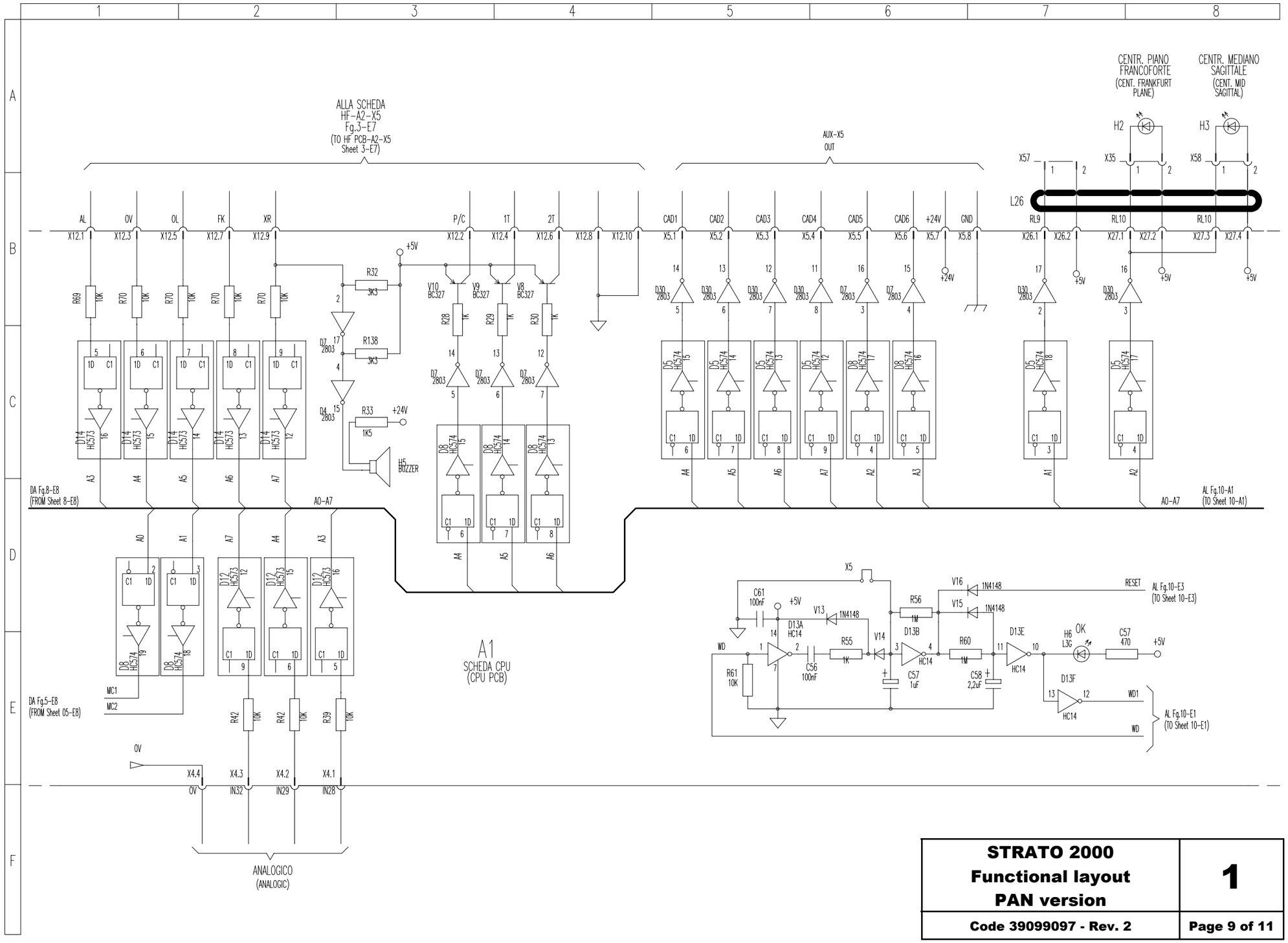
STRATO 2000 **Functional layout** **PAN version**	**1**
Code 39099097 - Rev. 2	**Page 6 of 11**



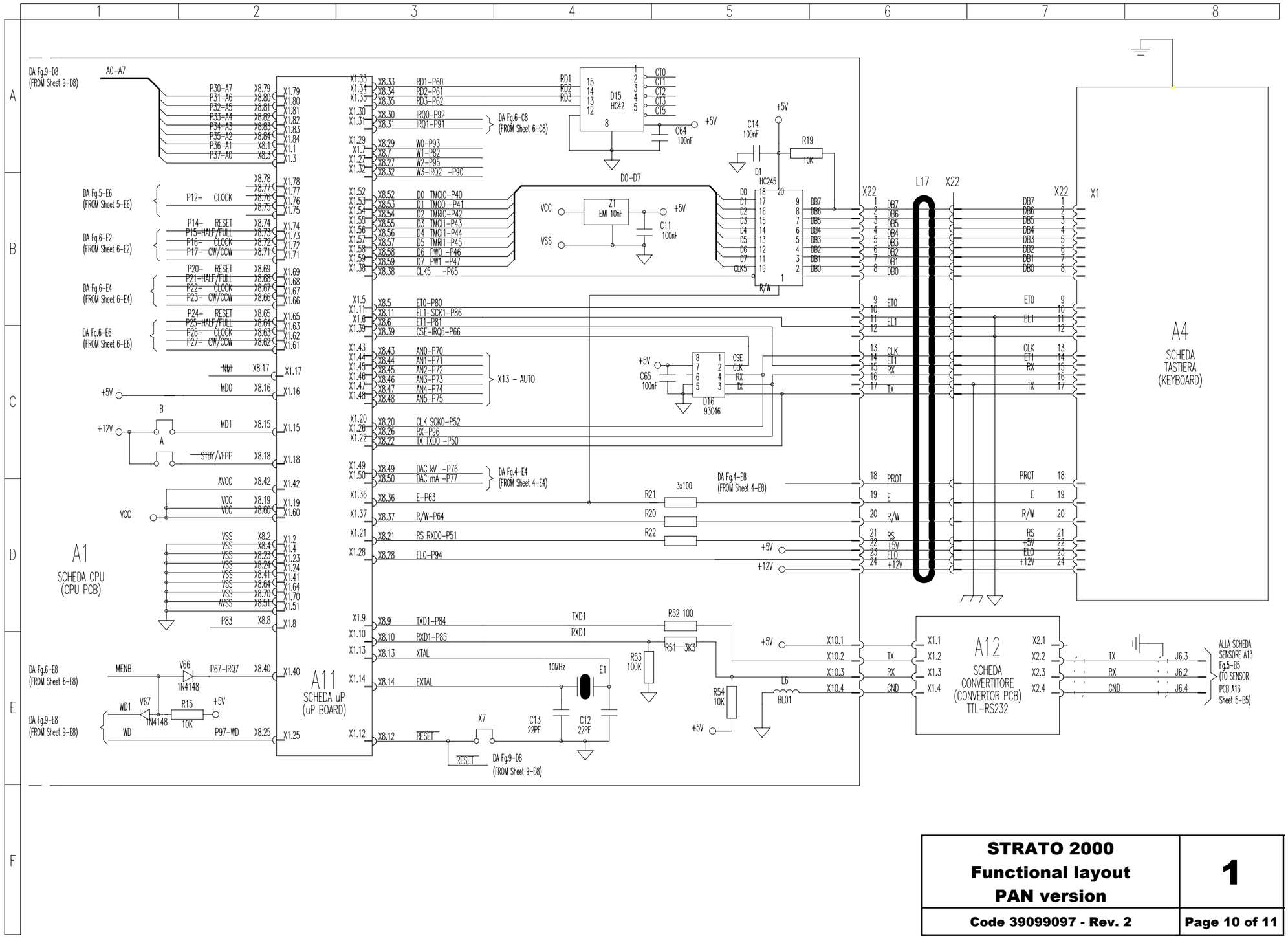
STRATO 2000 **Functional layout** **PAN version**	**1**
Code 39099097 - Rev. 2	**Page 7 of 11**



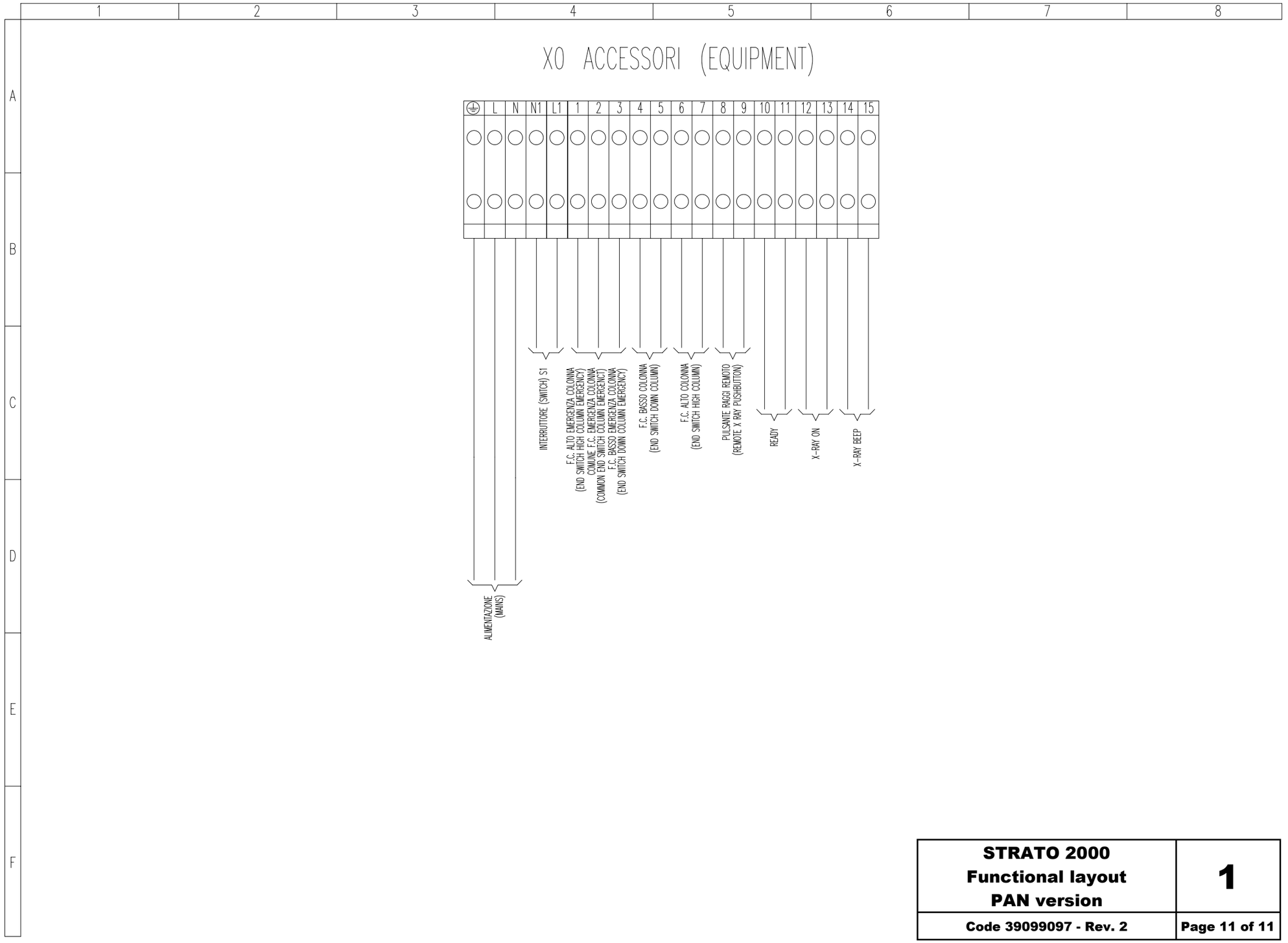
STRATO 2000 **Functional layout** **PAN version**	**1**
Code 39099097 - Rev. 2	**Page 8 of 11**



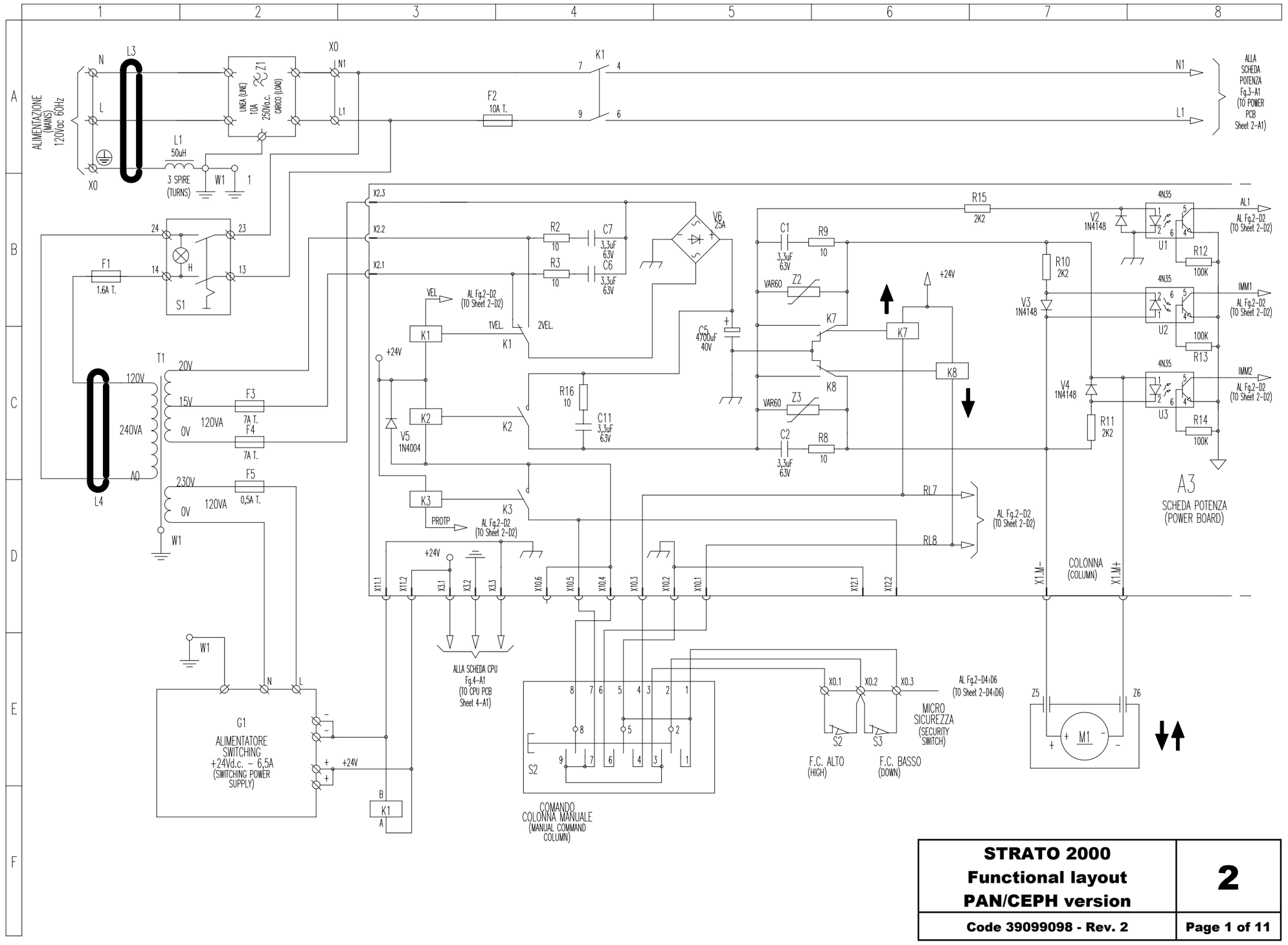
STRATO 2000 **Functional layout** **PAN version**	**1**
Code 39099097 - Rev. 2	**Page 9 of 11**



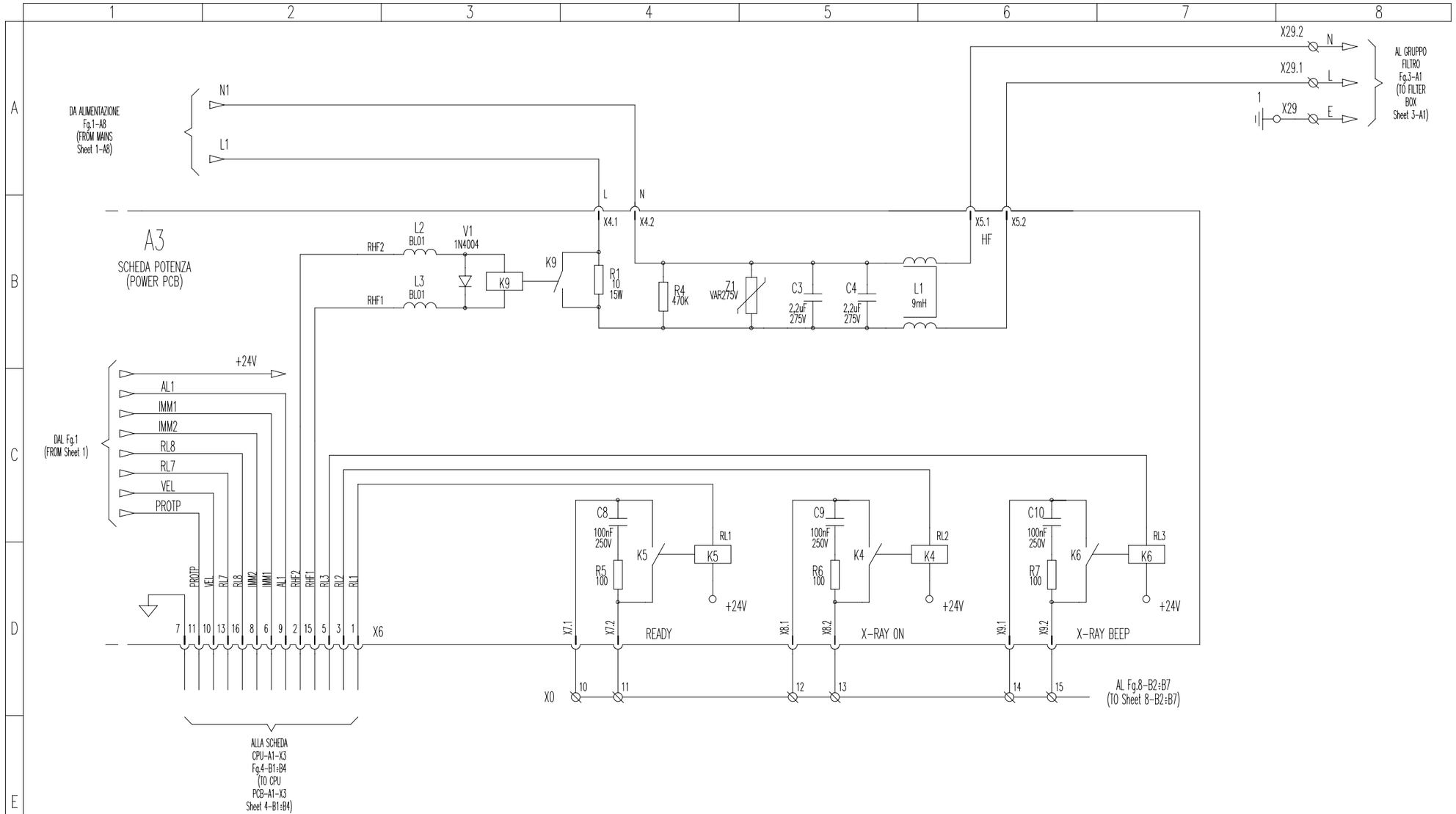
STRATO 2000 **Functional layout** **PAN version**	**1**
Code 39099097 - Rev. 2	**Page 10 of 11**



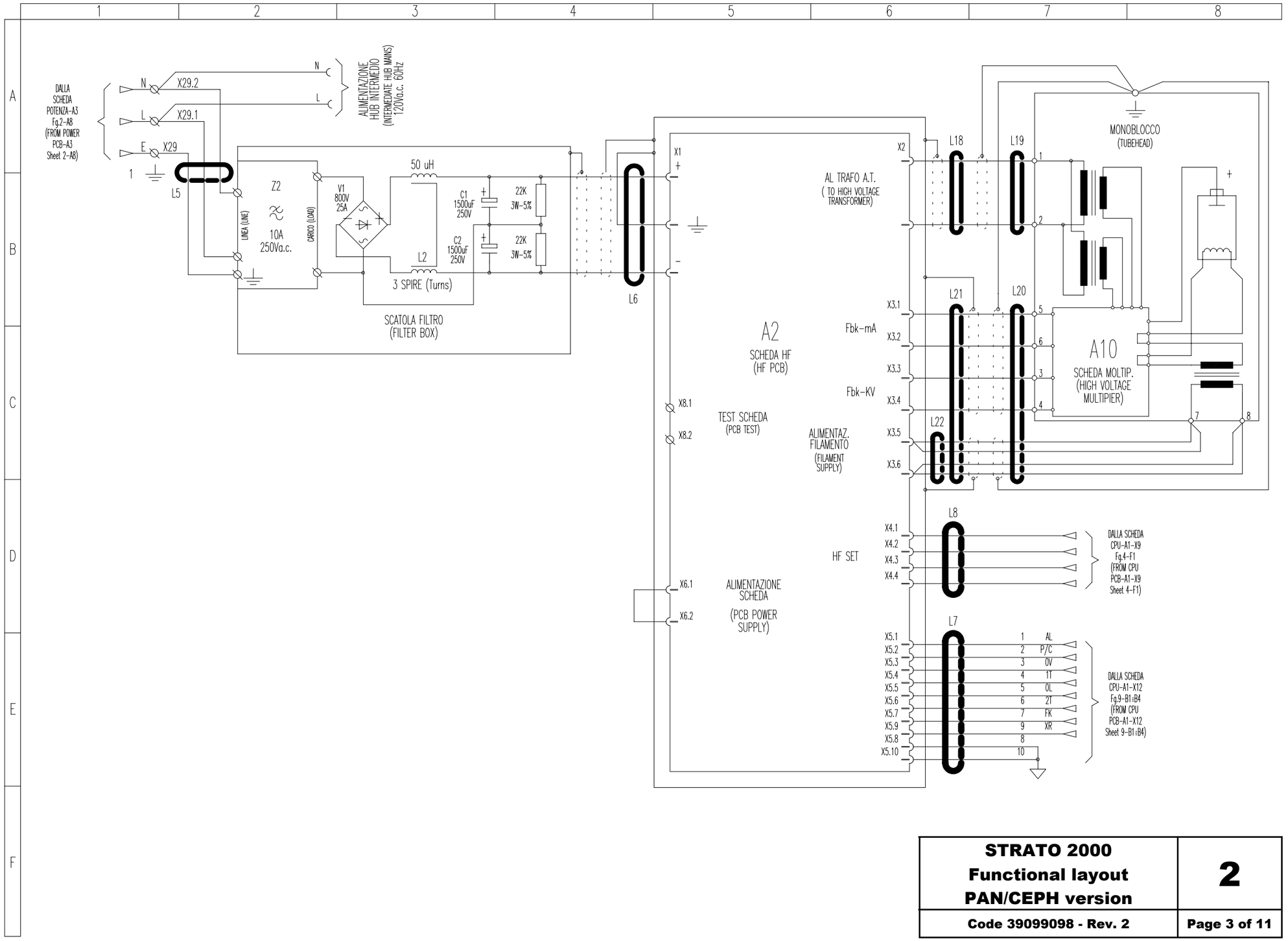
STRATO 2000 Functional layout PAN version	1
Code 39099097 - Rev. 2	Page 11 of 11



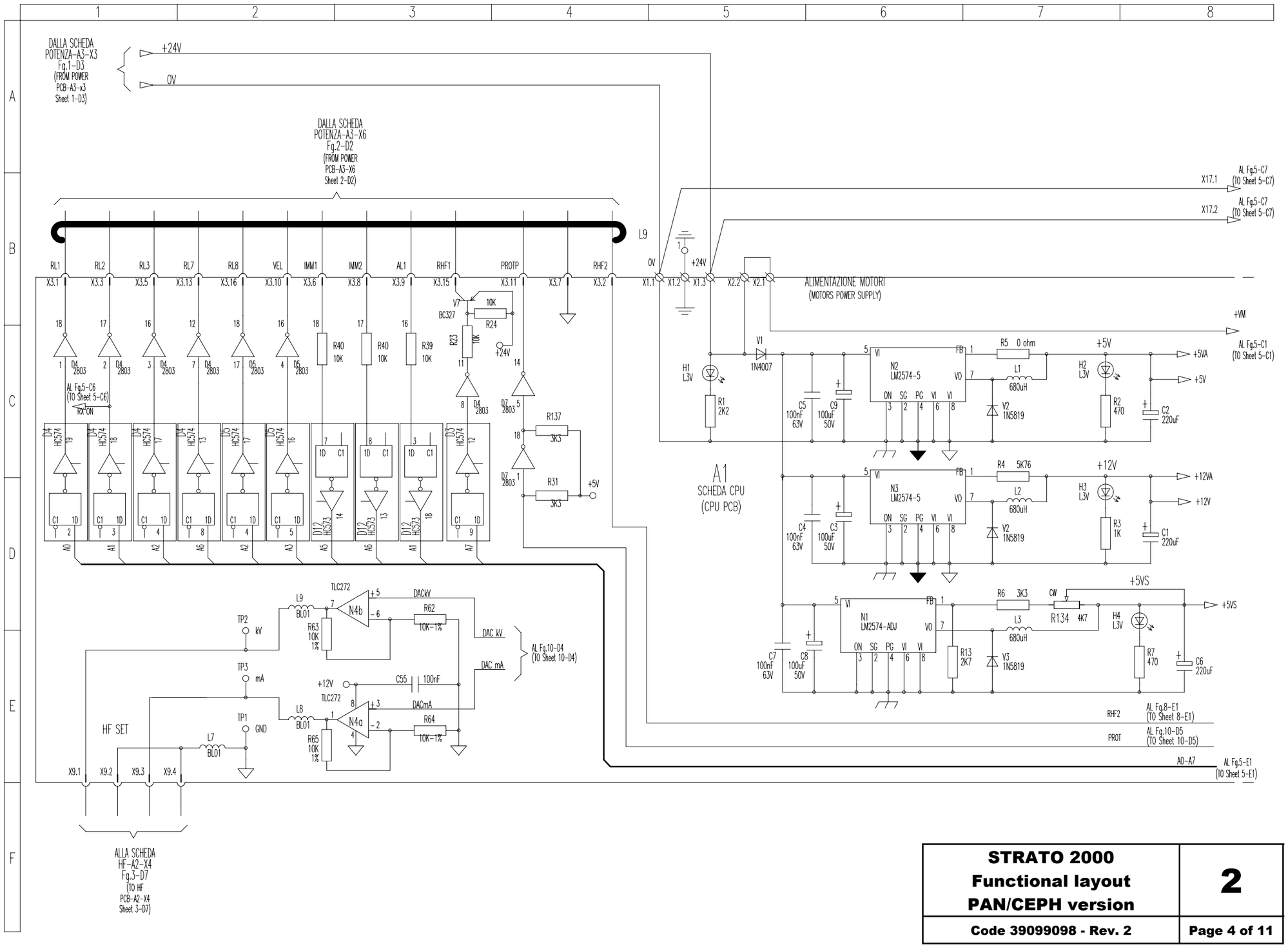
STRATO 2000 **Functional layout** **PAN/CEPH version**	**2**
Code 39099098 - Rev. 2	**Page 1 of 11**



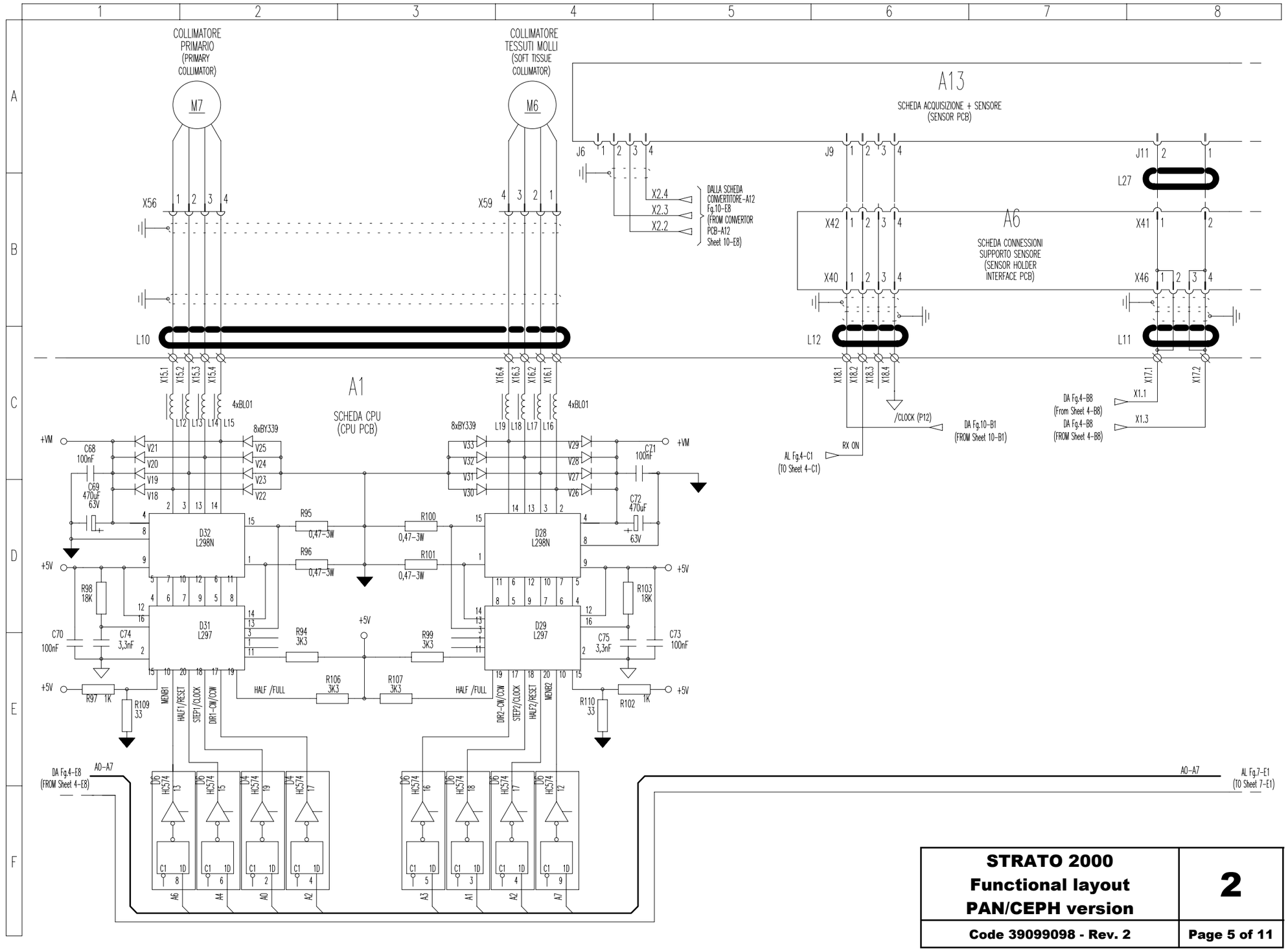
STRATO 2000 **Functional layout** **PAN/CEPH version**	**2**
Code 39099098 - Rev. 2	**Page 2 of 11**



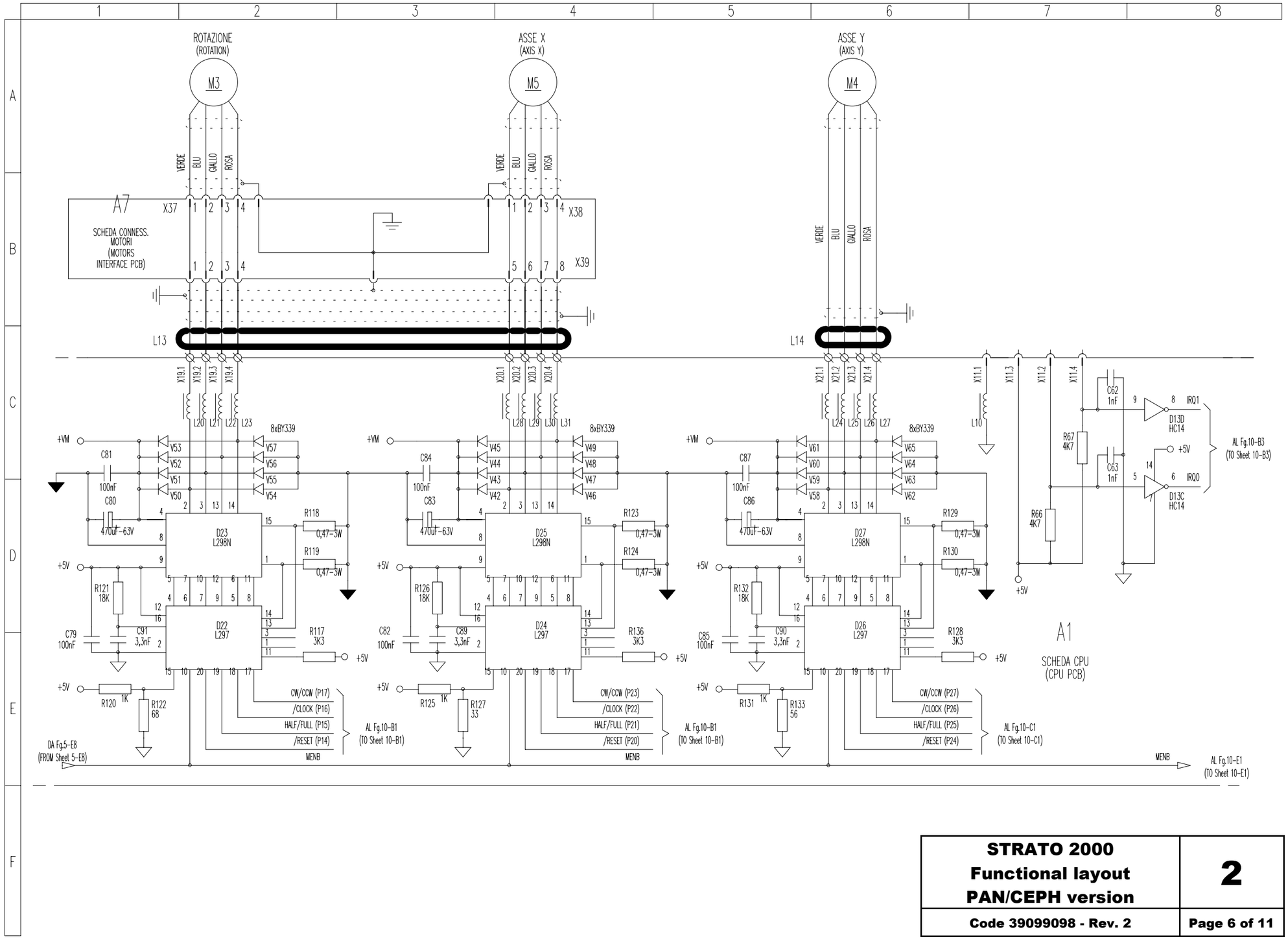
STRATO 2000 **Functional layout** **PAN/CEPH version**	**2**
Code 39099098 - Rev. 2	**Page 3 of 11**



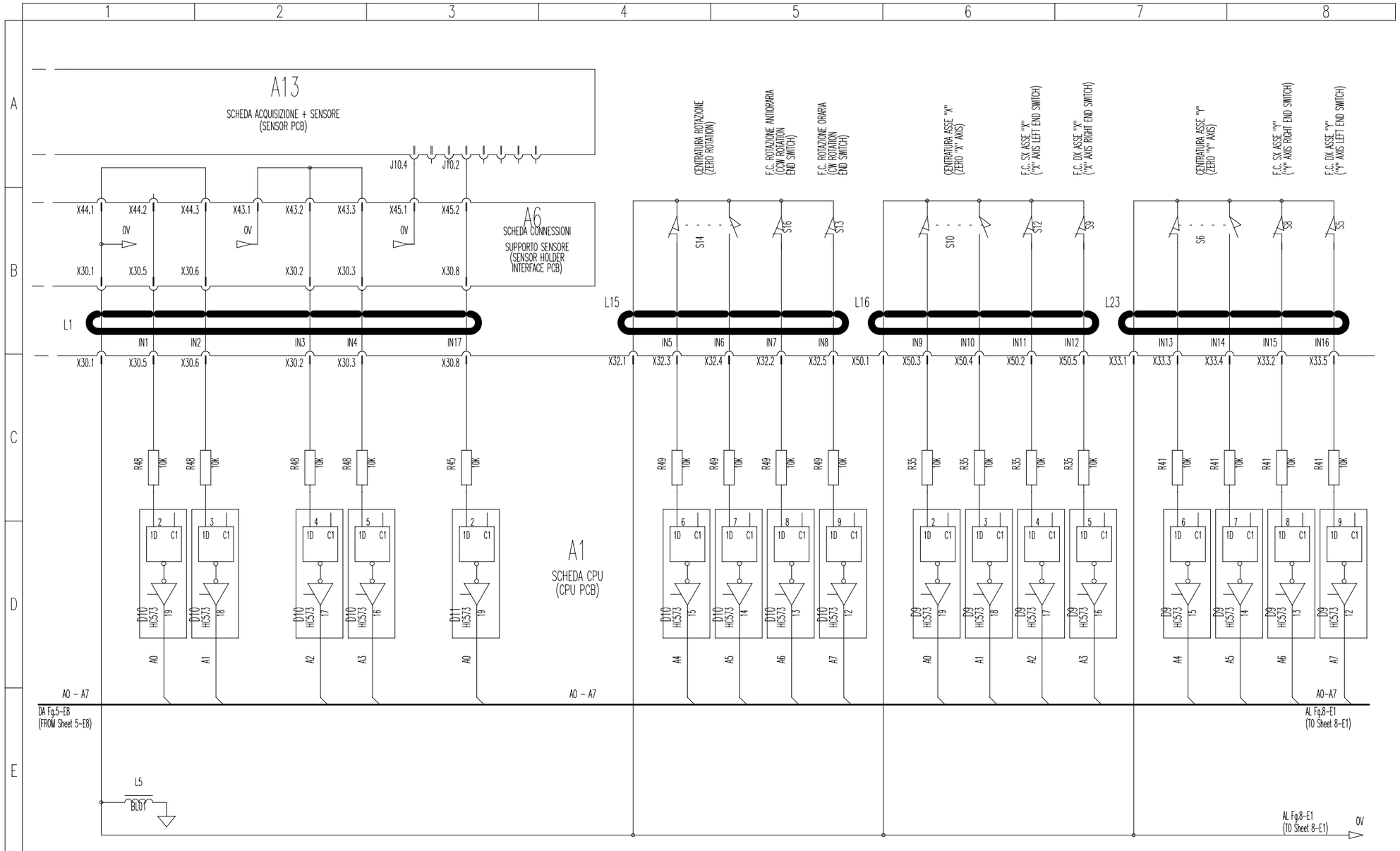
STRATO 2000 Functional layout PAN/CEPH version	**2**
Code 39099098 - Rev. 2	**Page 4 of 11**



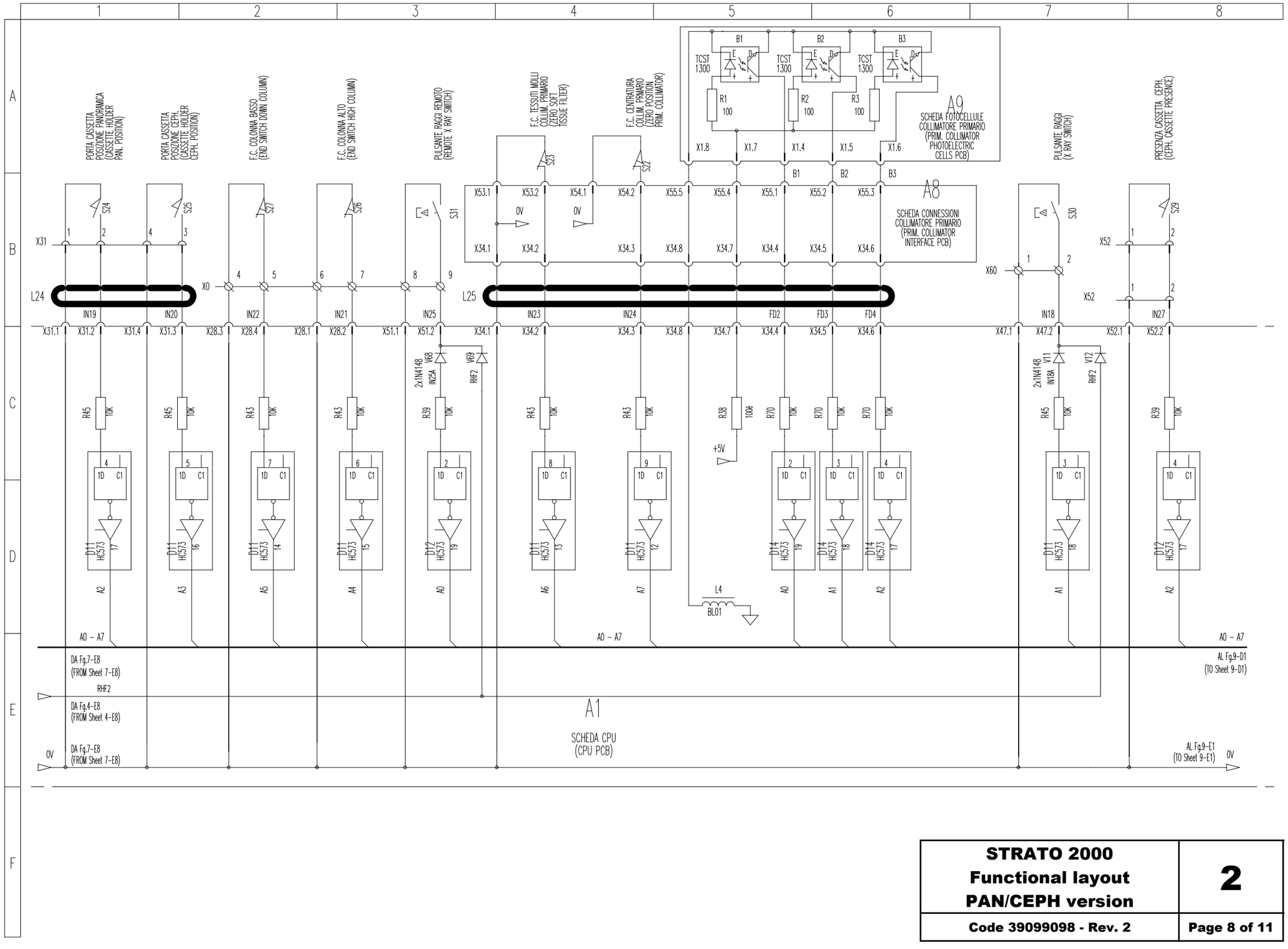
STRATO 2000 Functional layout PAN/CEPH version	**2**
Code 39099098 - Rev. 2	**Page 5 of 11**



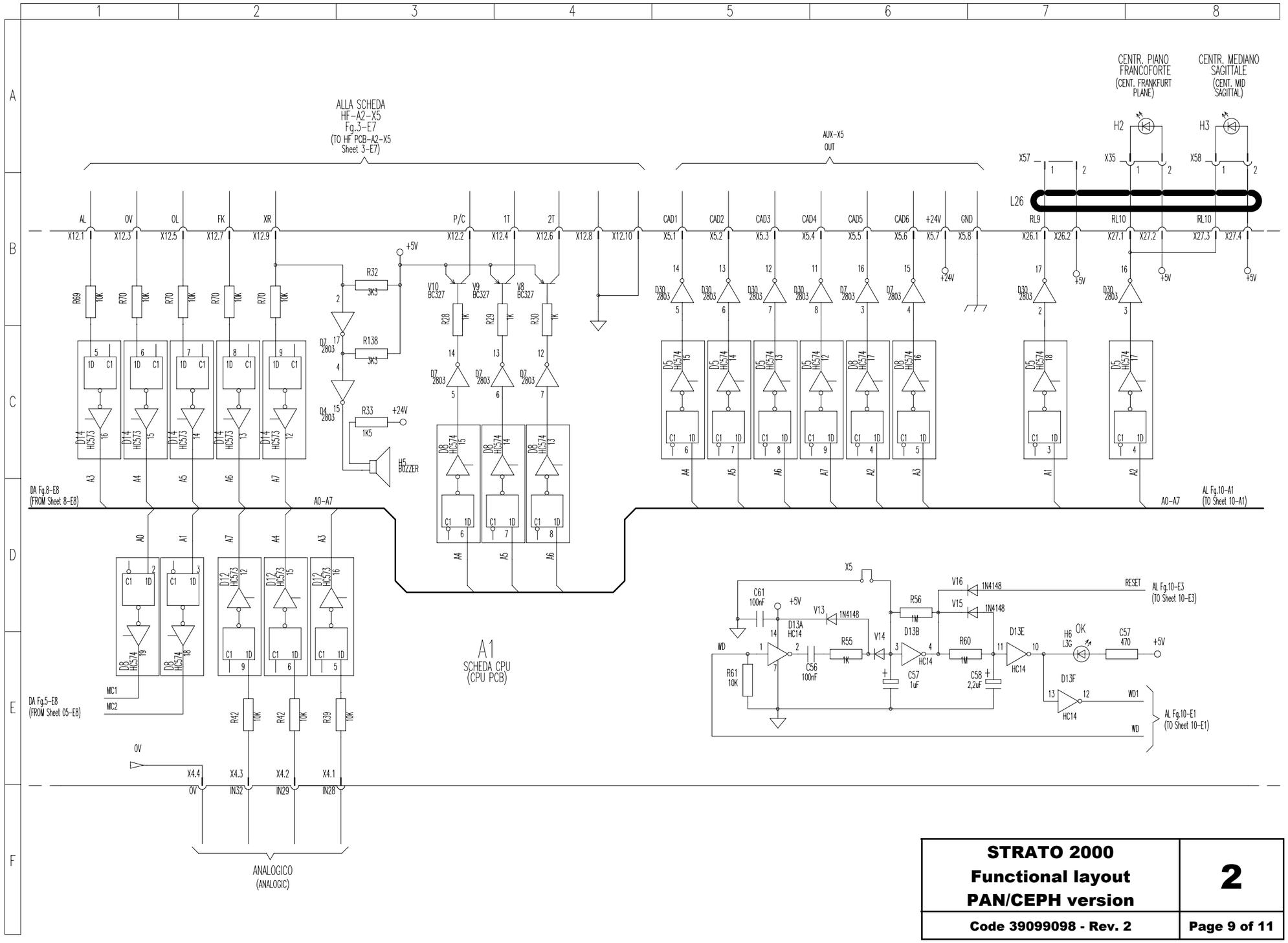
STRATO 2000 Functional layout PAN/CEPH version	**2**
Code 39099098 - Rev. 2	**Page 6 of 11**



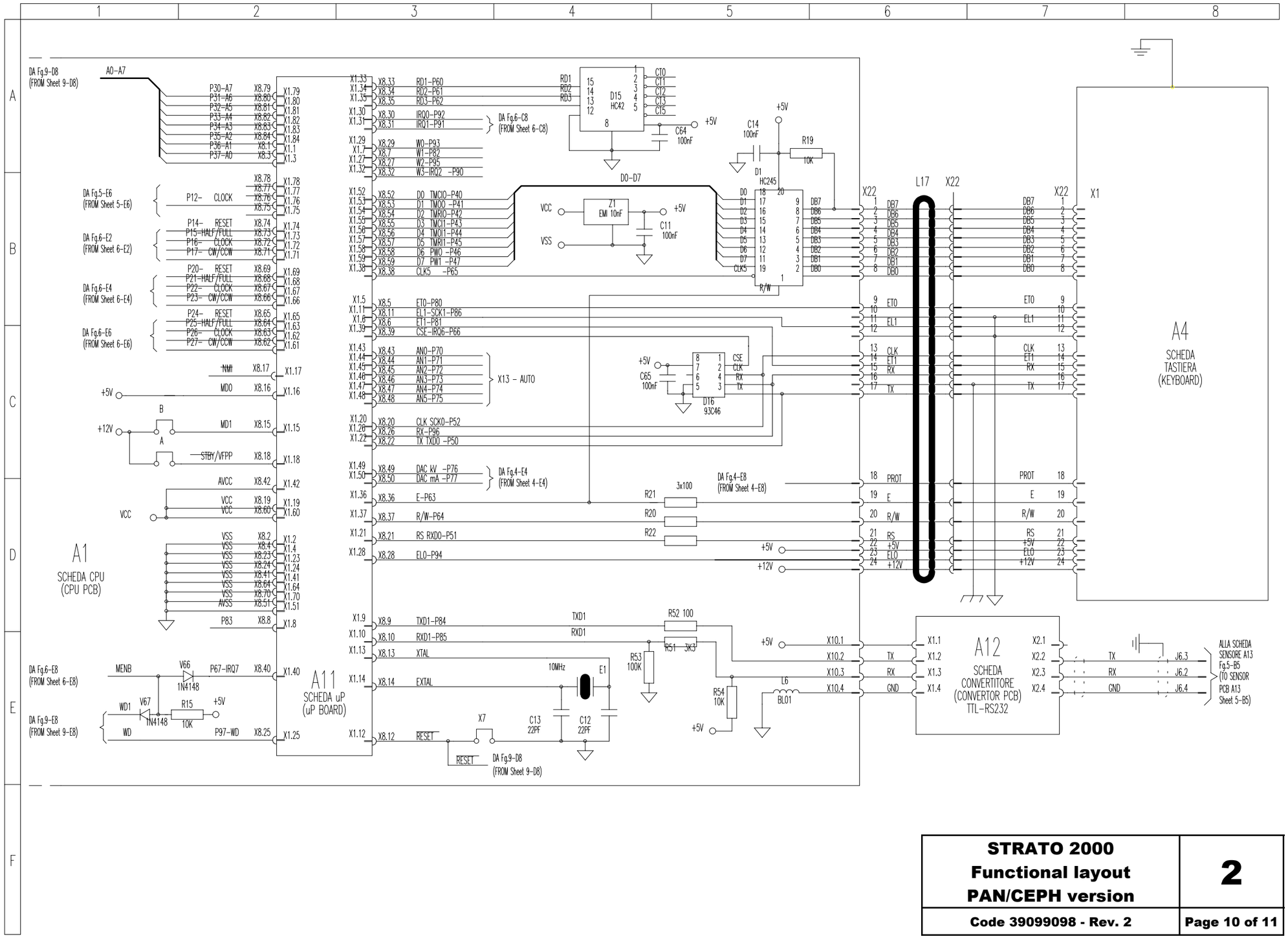
STRATO 2000 **Functional layout** **PAN/CEPH version**	**2**
Code 39099098 - Rev. 2	**Page 7 of 11**



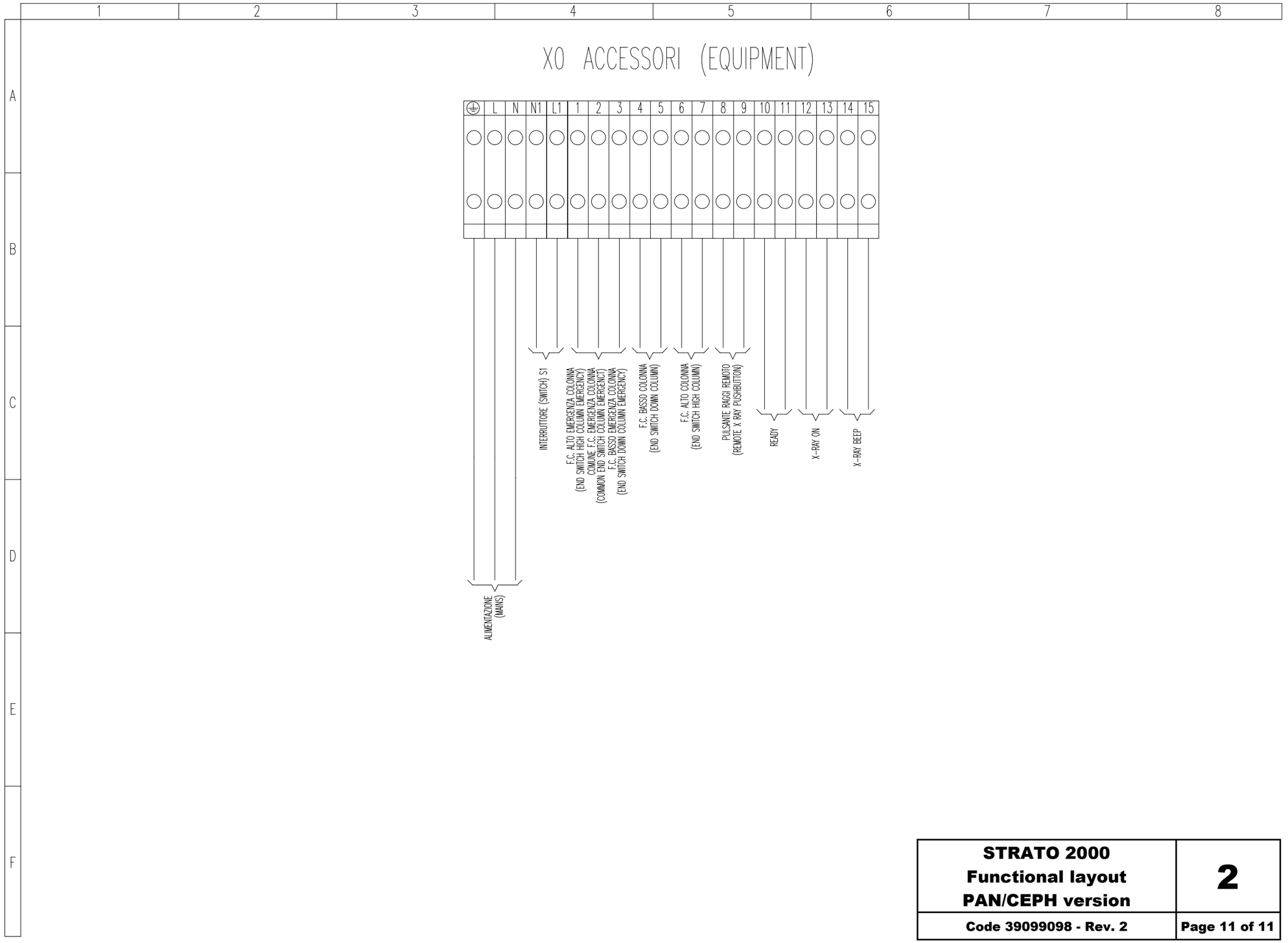
STRATO 2000 Functional layout PAN/CEPH version	**2**
Code 39099098 - Rev. 2	**Page 8 of 11**



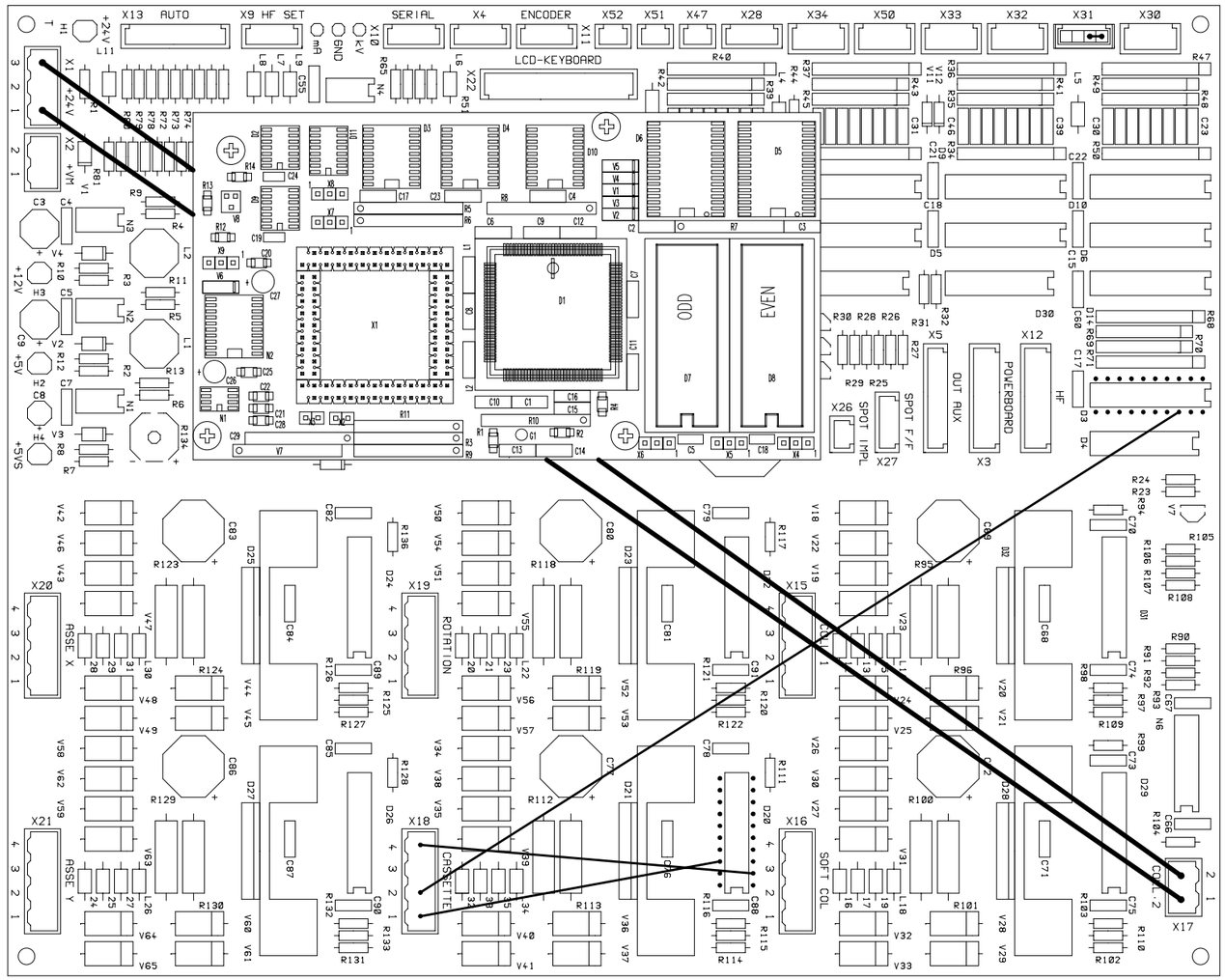
STRATO 2000 **Functional layout** **PAN/CEPH version**	**2**
Code 39099098 - Rev. 2	**Page 9 of 11**



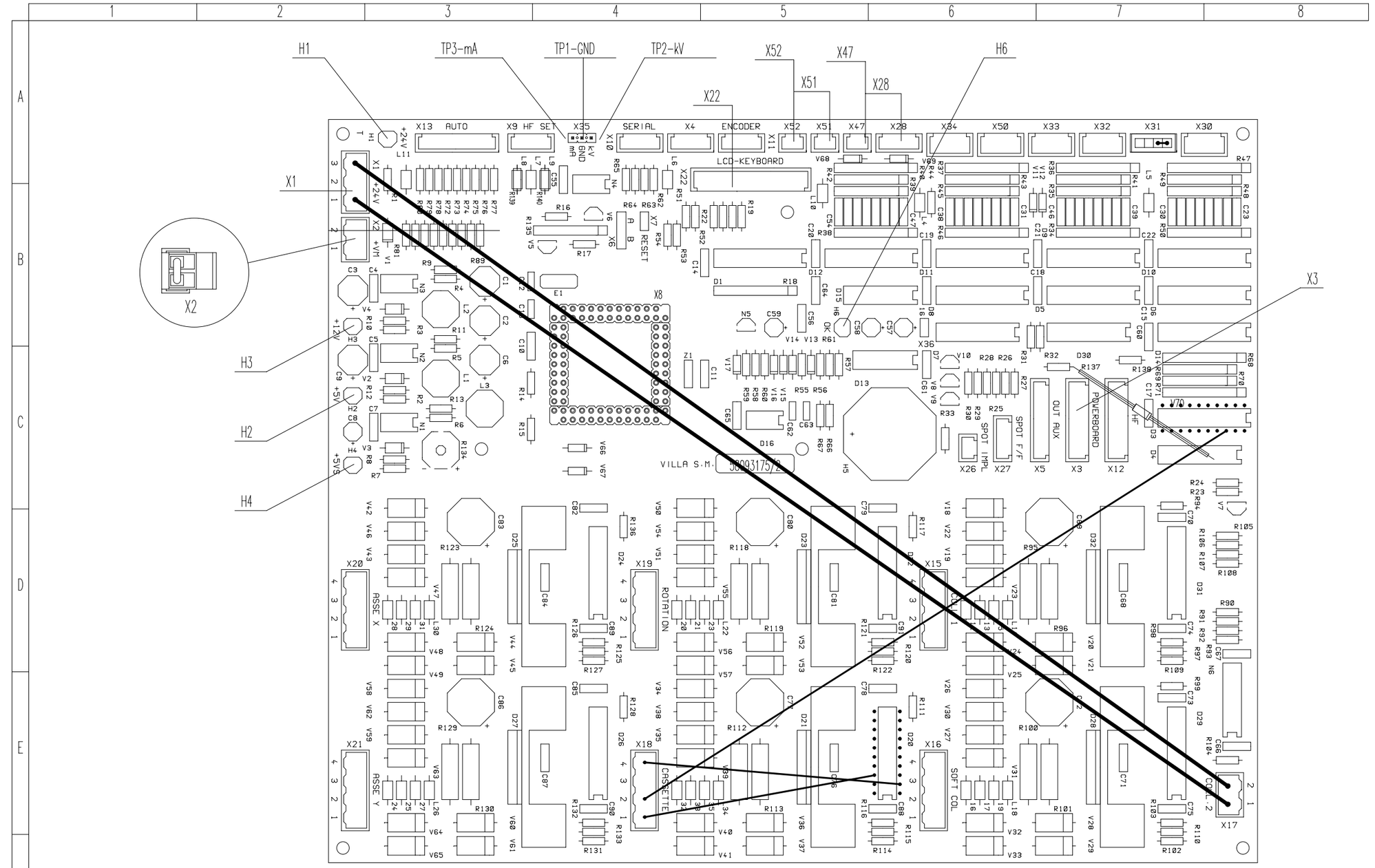
STRATO 2000 **Functional layout** **PAN/CEPH version**	**2**
Code 39099098 - Rev. 2	**Page 10 of 11**



STRATO 2000 Functional layout PAN/CEPH version	2
Code 39099098 - Rev. 2	Page 11 of 11



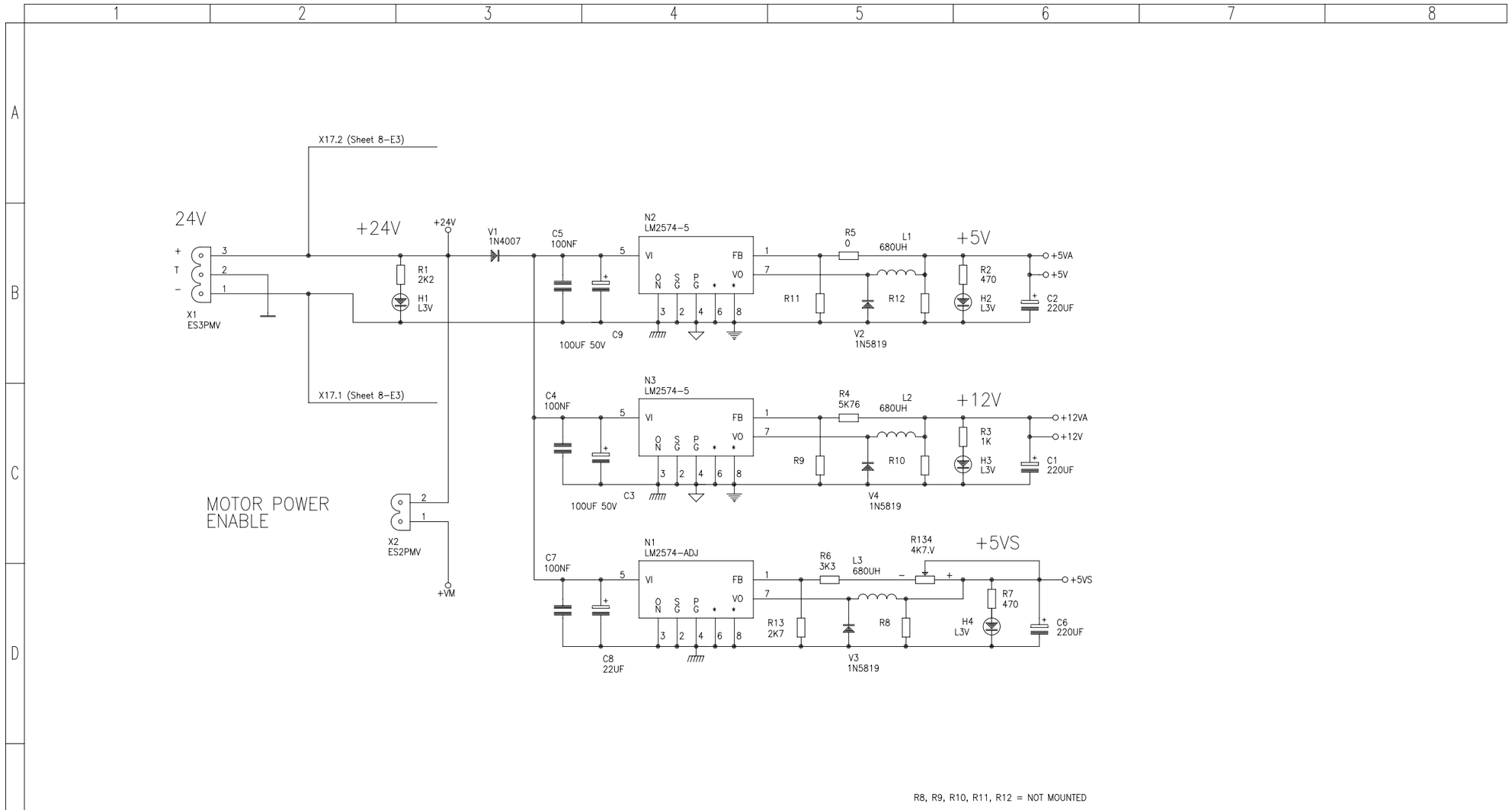
STRATO 2000 **Lay-out CPU assy PCB** **(A1+A11)**	**3**
Code 58093179 - Rev. 0	**Page 1 of 1**



NOT MOUNTED:

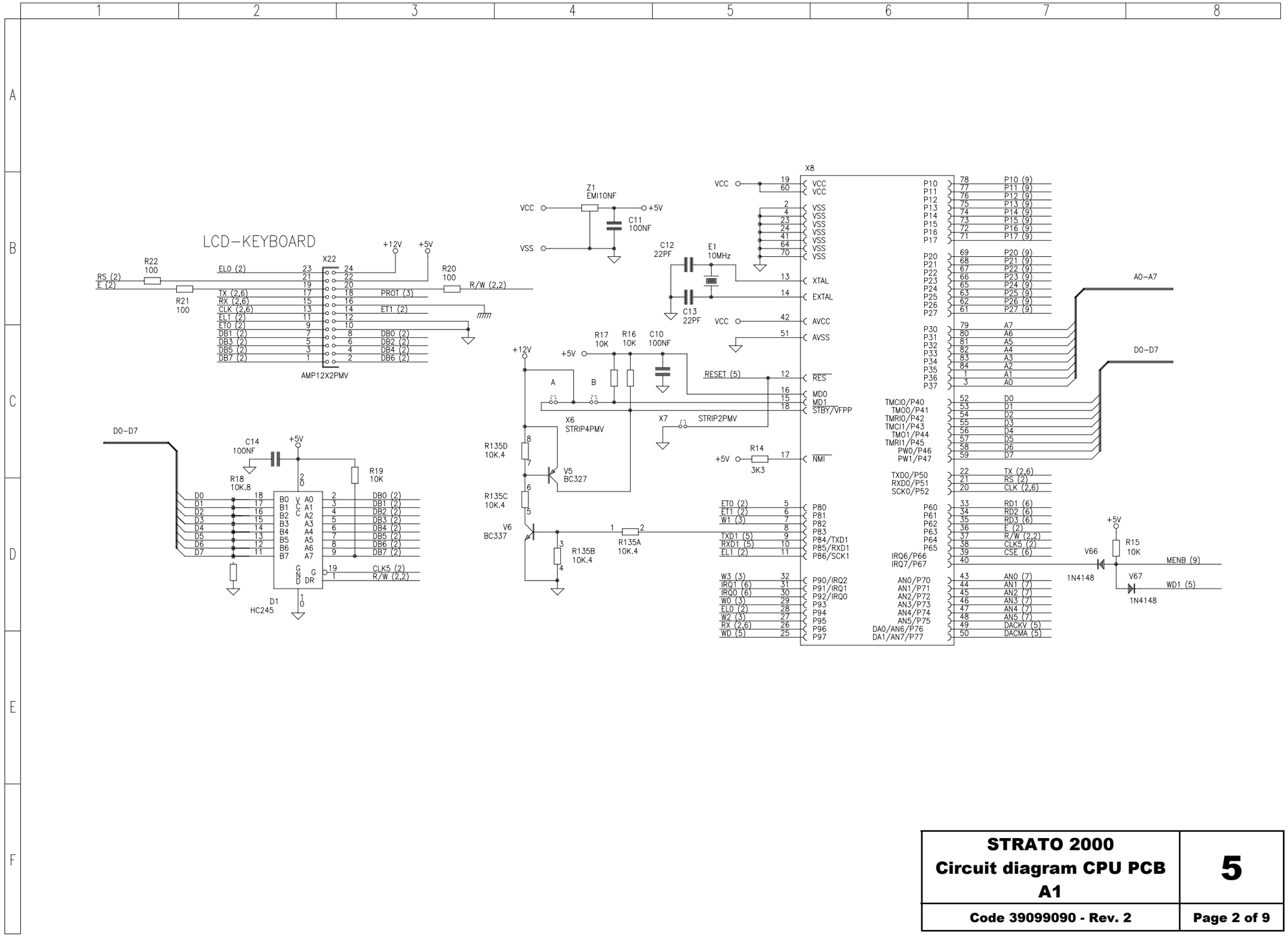
R8-R9-R10-R11-R12-R72-R73-R74-R75-R76-R77-R78-R79-R80-R81-R82-R83-R90-R91-R92-R93
R104-R105-R108-R111-R112-R113-R114-R115-R116-C66-C67-C76-C77-C78-C88-C92-L8-L9-L11
L32-L33-L34-L35-V34-V35-V36-V37-V38-V39-V40-V41-D20-D21-N6-X13

STRATO 2000 **Lay-out CPU PCB** **A1**	**4**
Code 58093175 - Rev. 2	**Page 1 of 1**

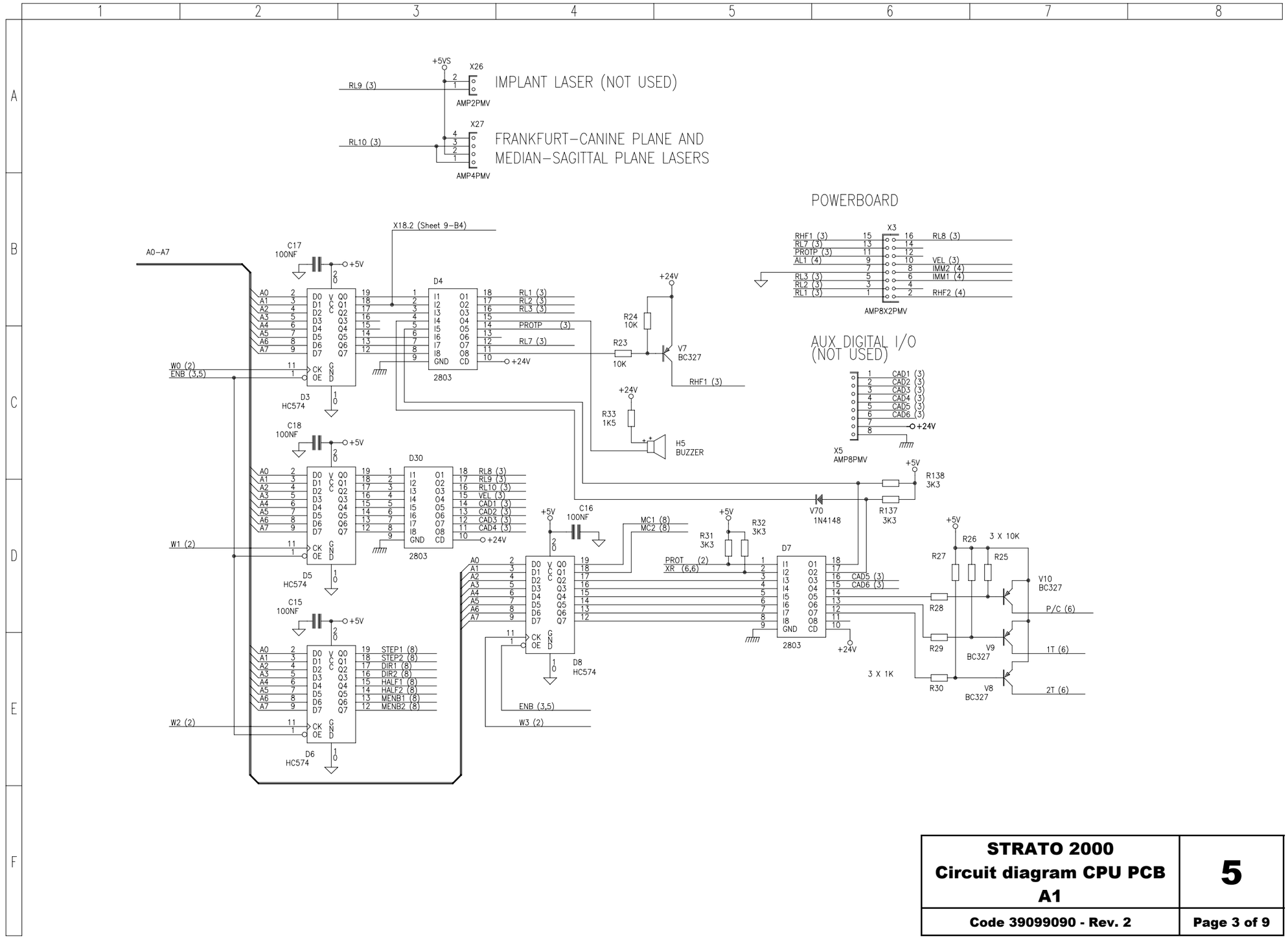


R8, R9, R10, R11, R12 = NOT MOUNTED

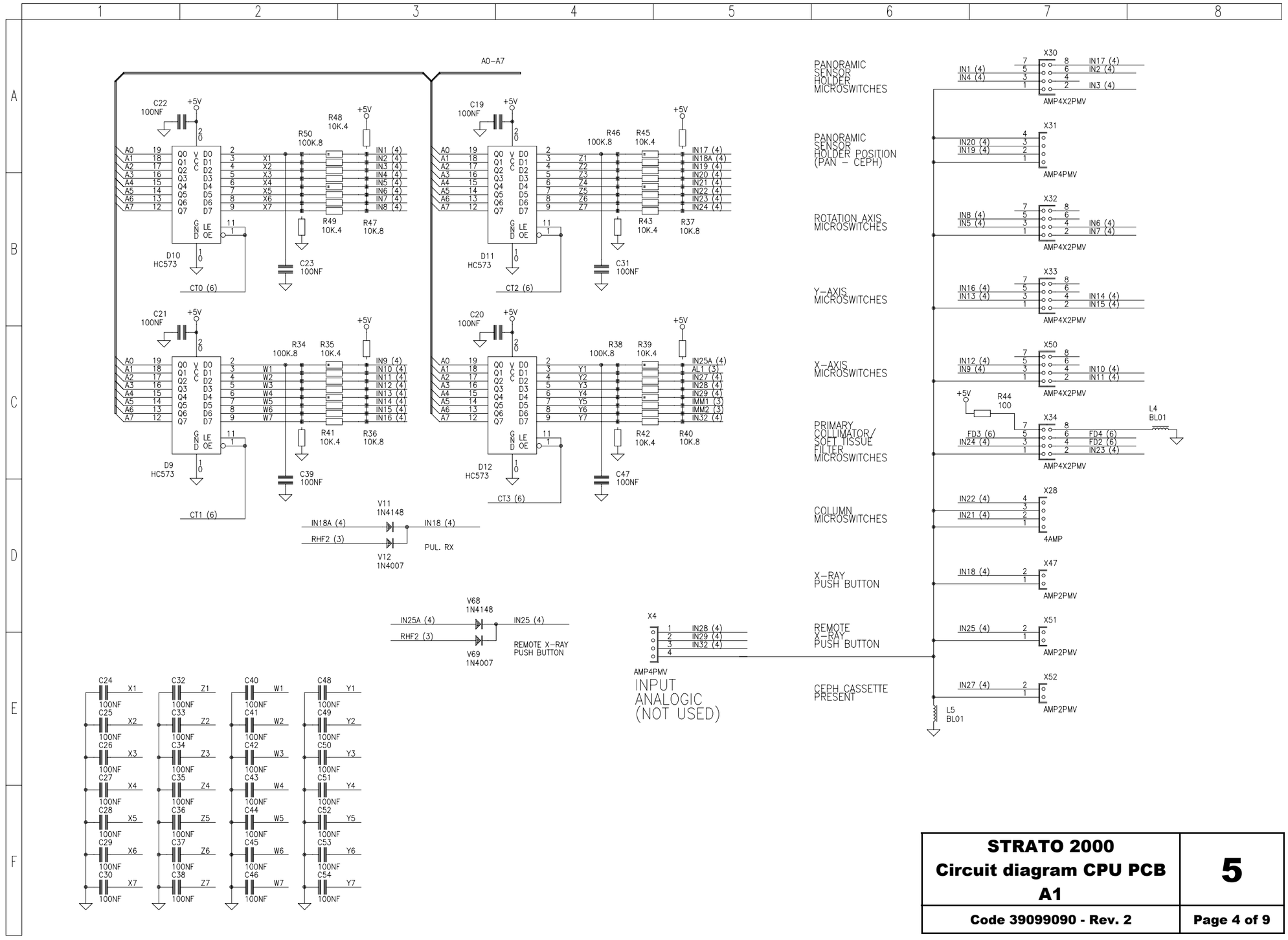
STRATO 2000 **Circuit diagram CPU PCB A1**	**5**
Code 39099090 - Rev. 2	**Page 1 of 9**



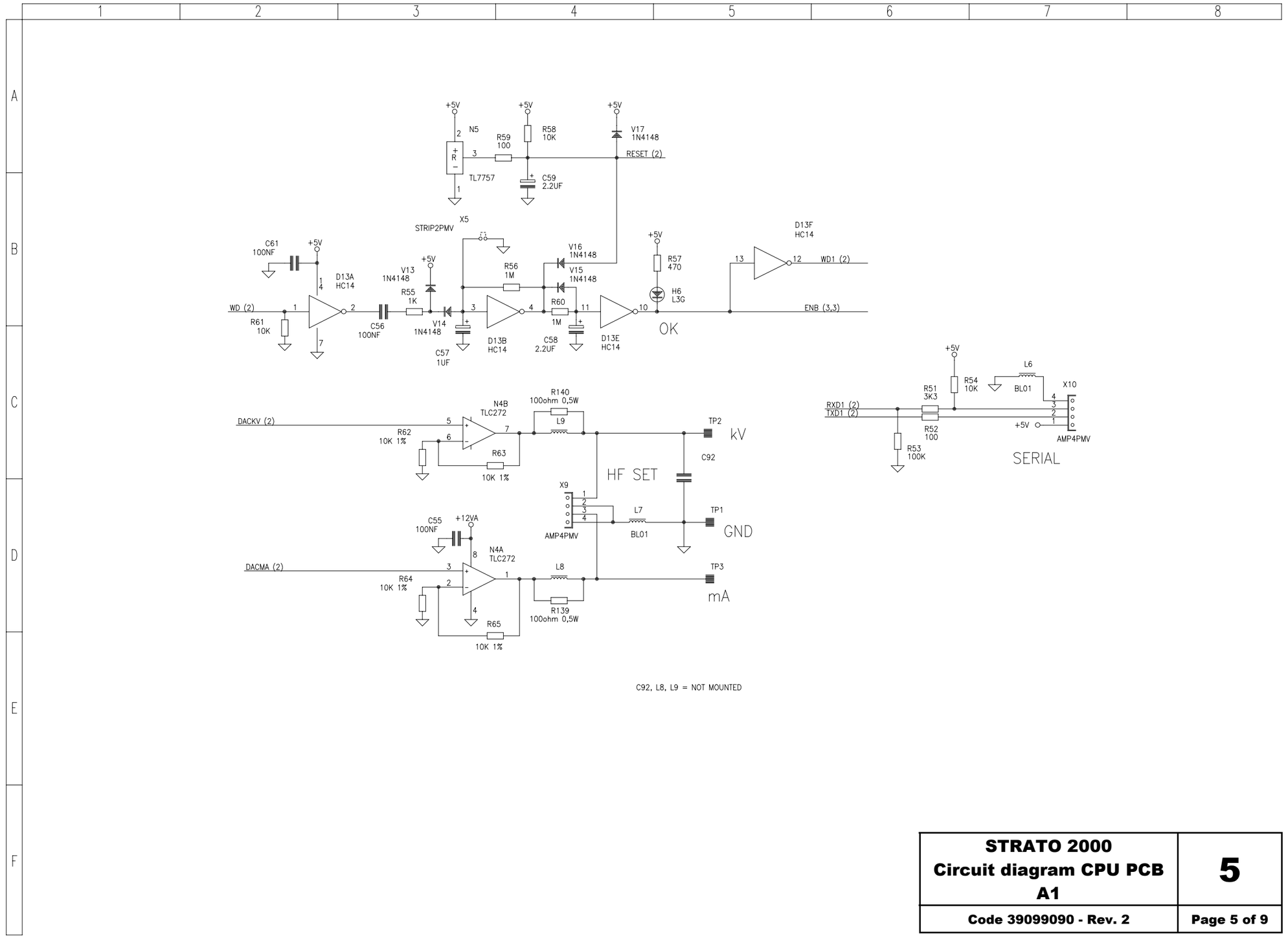
STRATO 2000 **Circuit diagram CPU PCB A1**	**5**
Code 39099090 - Rev. 2	**Page 2 of 9**



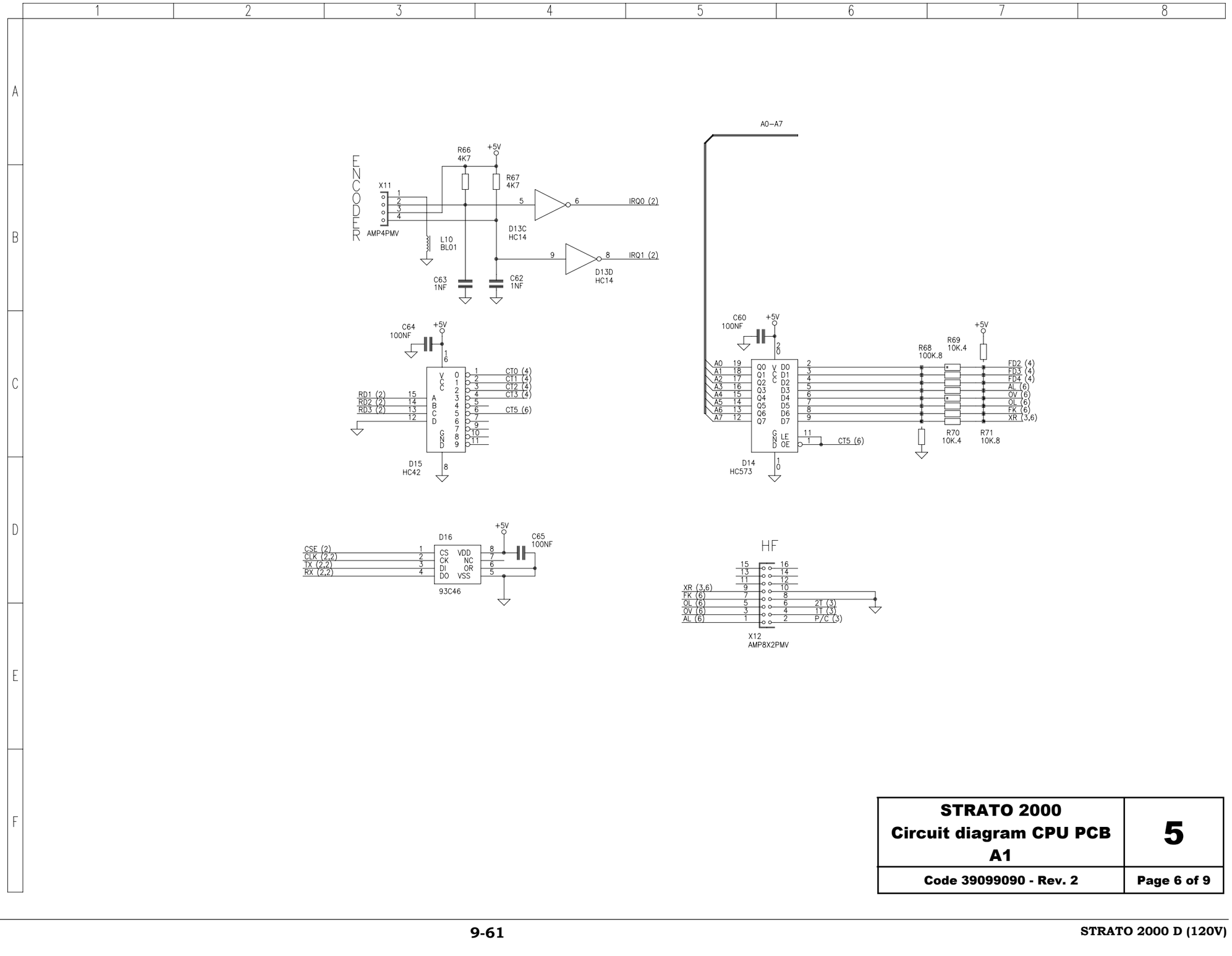
STRATO 2000 Circuit diagram CPU PCB A1	5
Code 39099090 - Rev. 2	Page 3 of 9



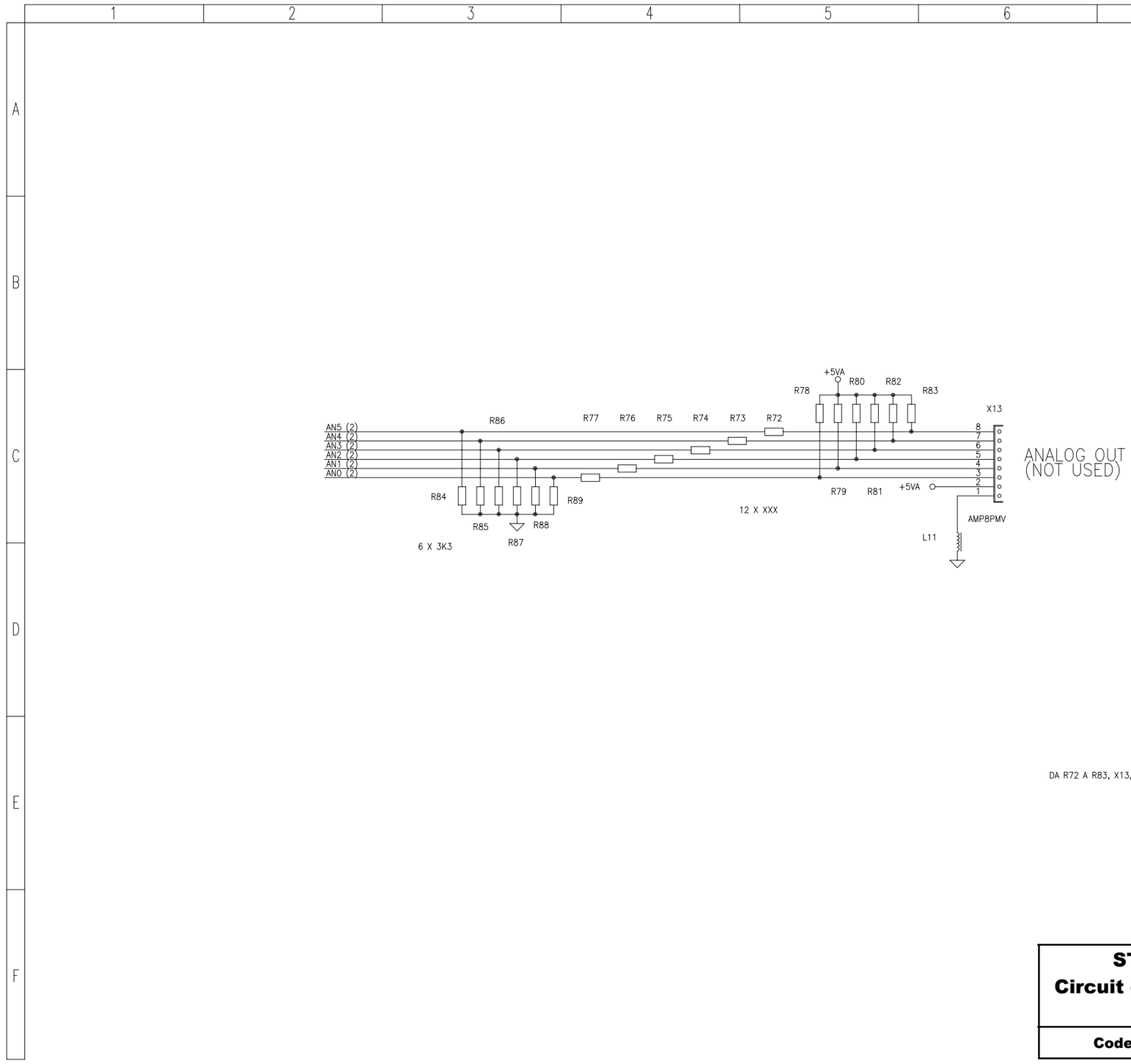
STRATO 2000 **Circuit diagram CPU PCB A1**	**5**
Code 39099090 - Rev. 2	**Page 4 of 9**



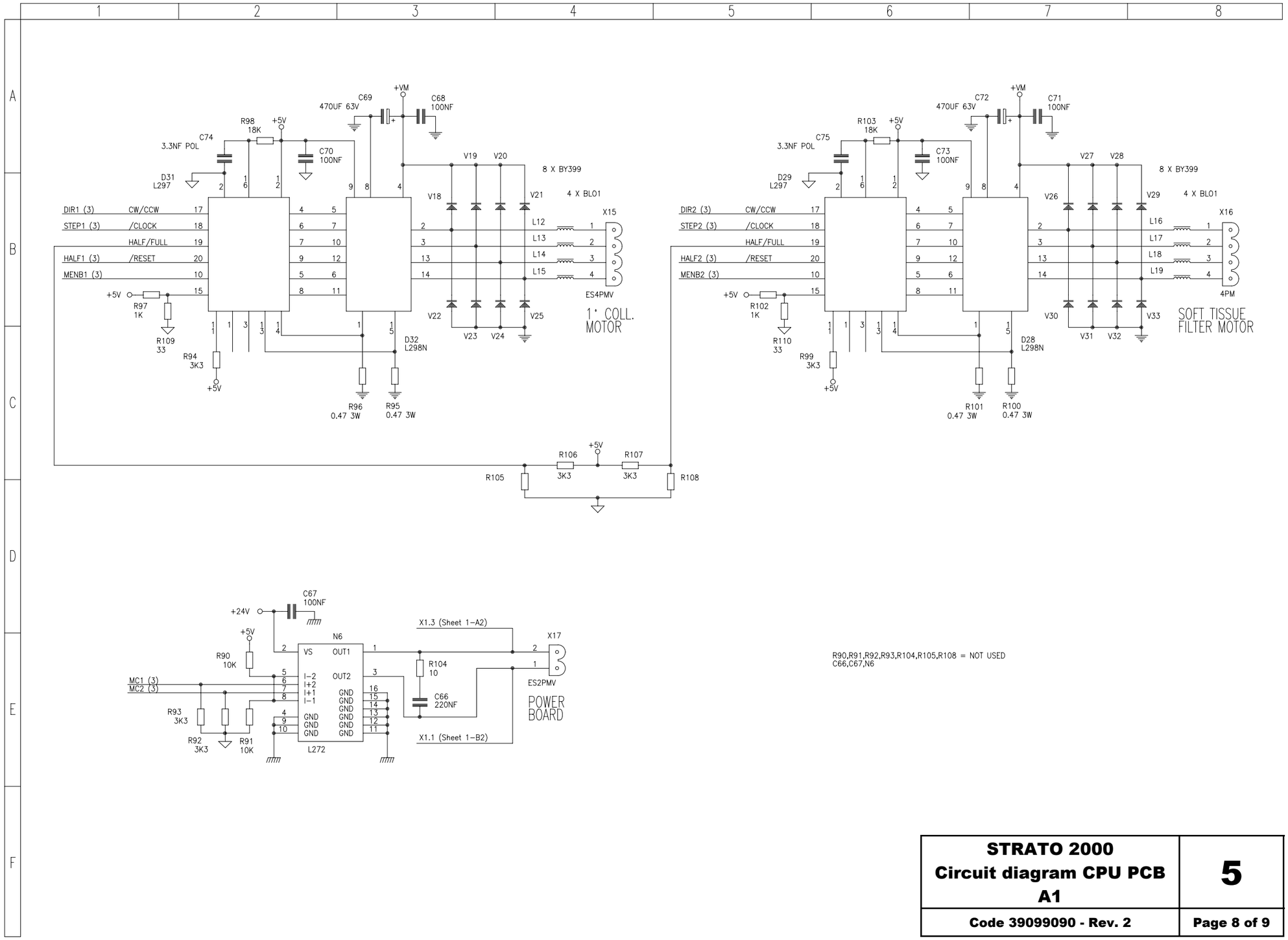
STRATO 2000 Circuit diagram CPU PCB A1	**5**
Code 39099090 - Rev. 2	**Page 5 of 9**



STRATO 2000 Circuit diagram CPU PCB A1	5
Code 39099090 - Rev. 2	Page 6 of 9

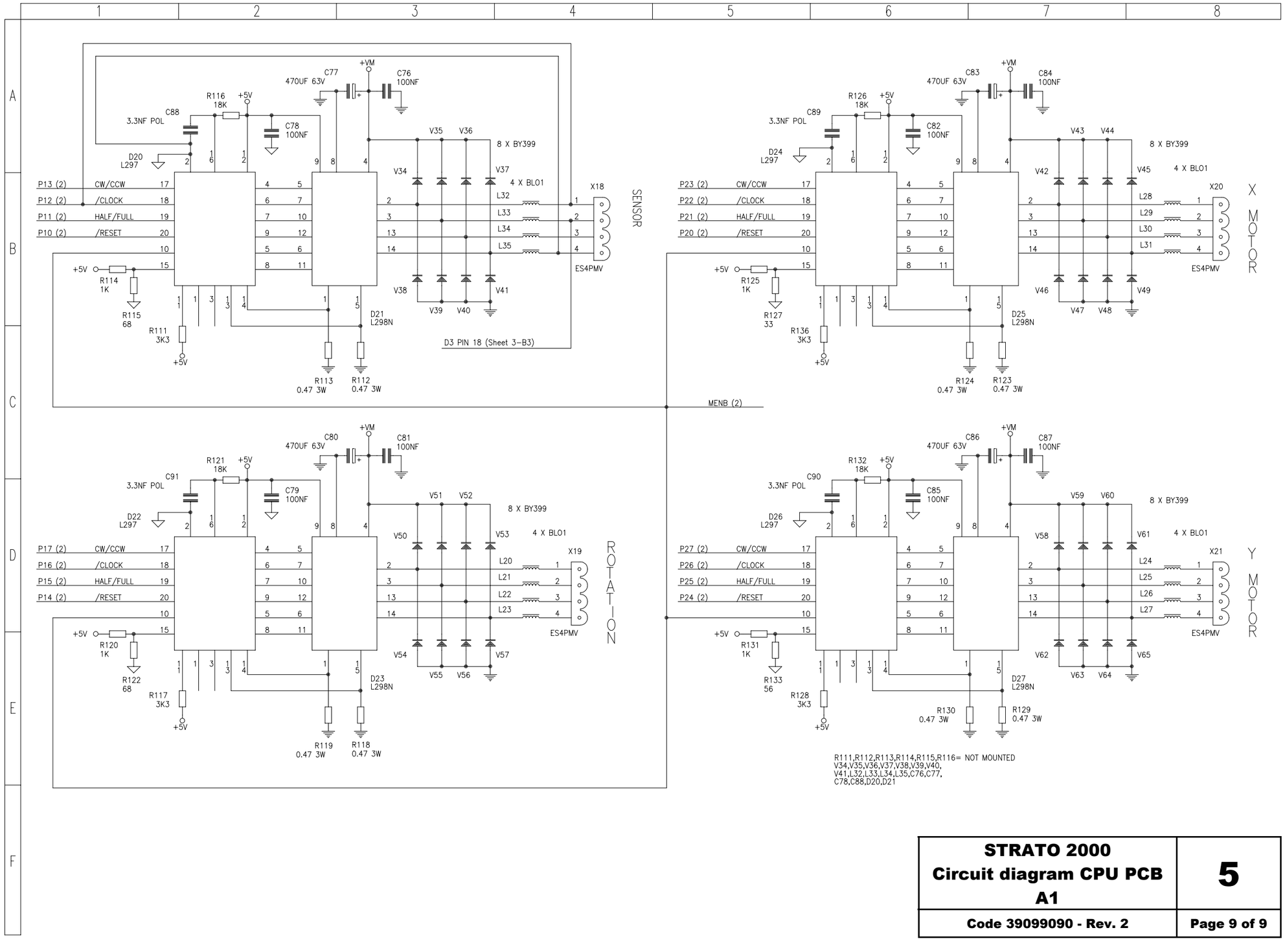


STRATO 2000 Circuit diagram CPU PCB A1	5
Code 39099090 - Rev. 2	Page 7 of 9

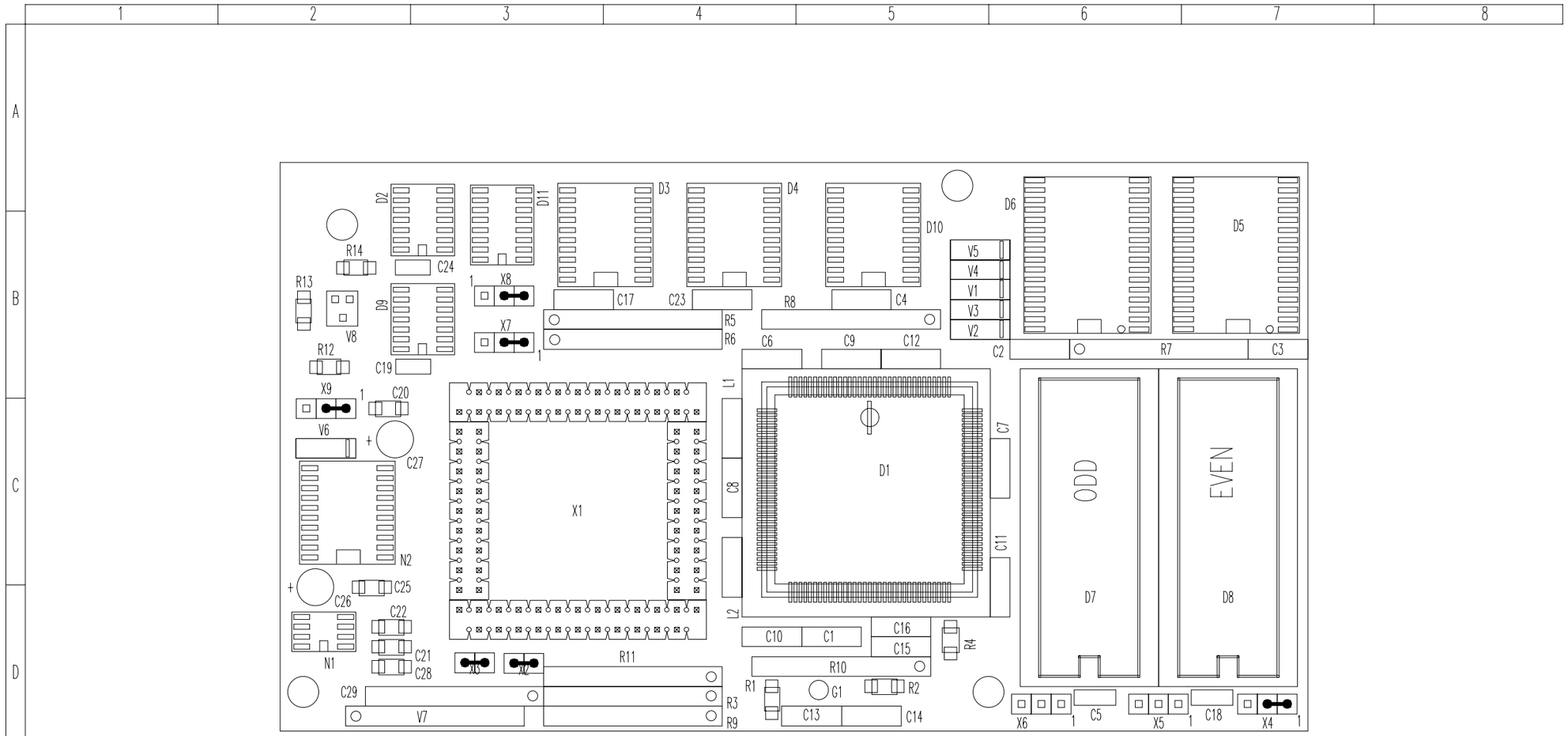


R90,R91,R92,R93,R104,R105,R108 = NOT USED
C66,C67,N6

STRATO 2000 **Circuit diagram CPU PCB A1**	**5**
Code 39099090 - Rev. 2	**Page 8 of 9**

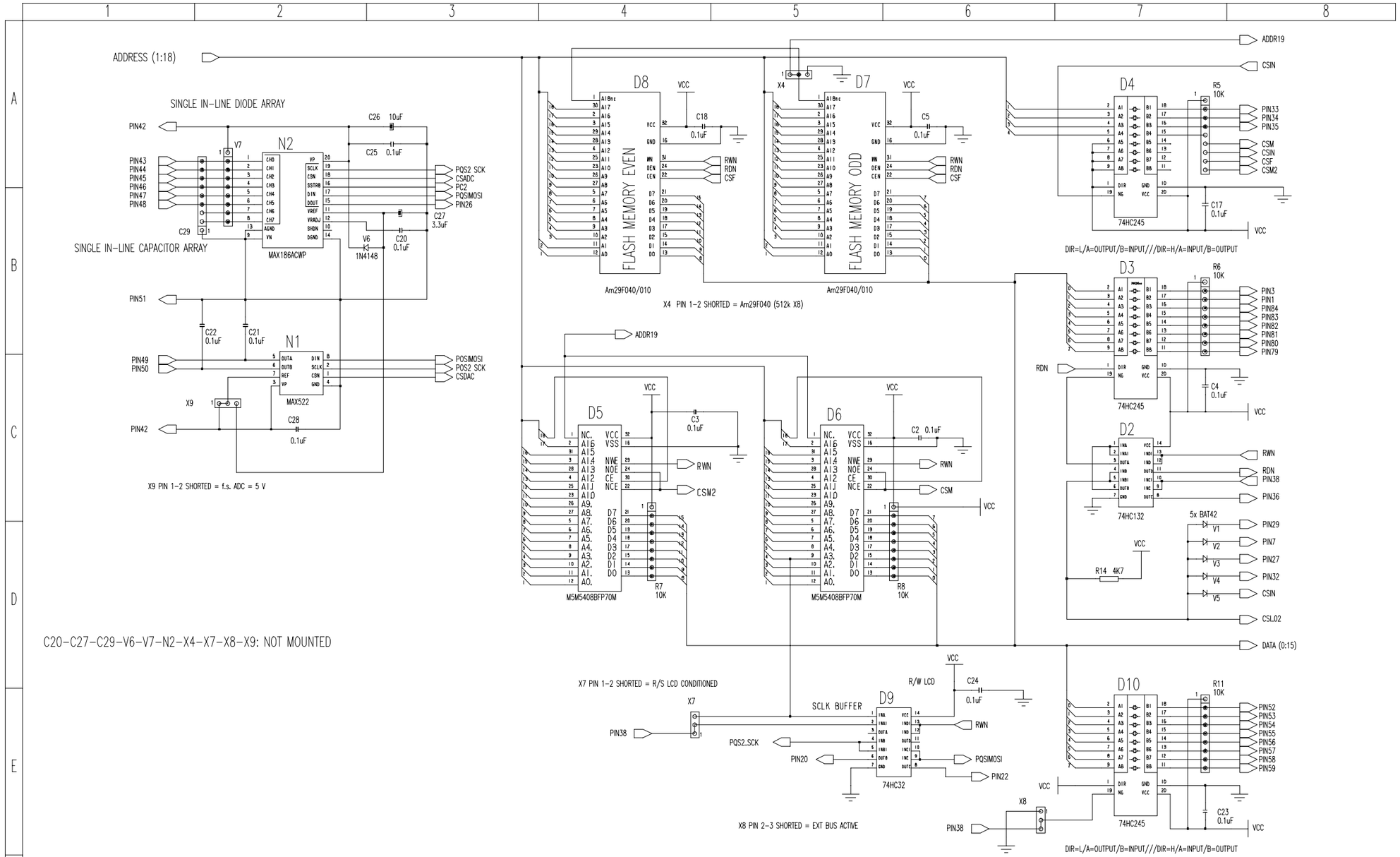


STRATO 2000 Circuit diagram CPU PCB A1	5
Code 39099090 - Rev. 2	Page 9 of 9

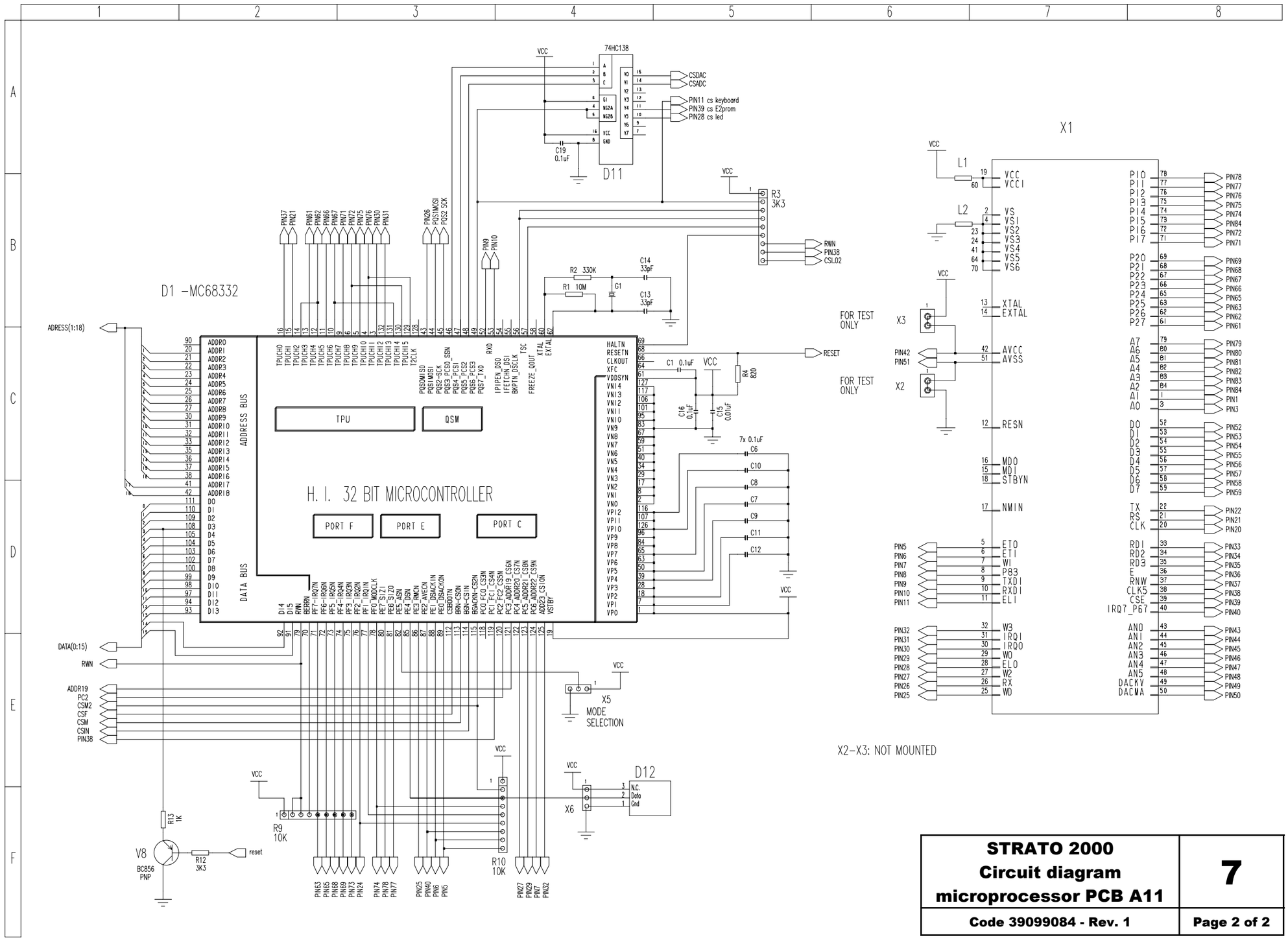


C20-C27-C29-V6-V7-N2-X2-X3-X4-X7-X8-X9: NOT MOUNTED
CONNECTOR X1 MOUNTED ON SOLDERING SIDE

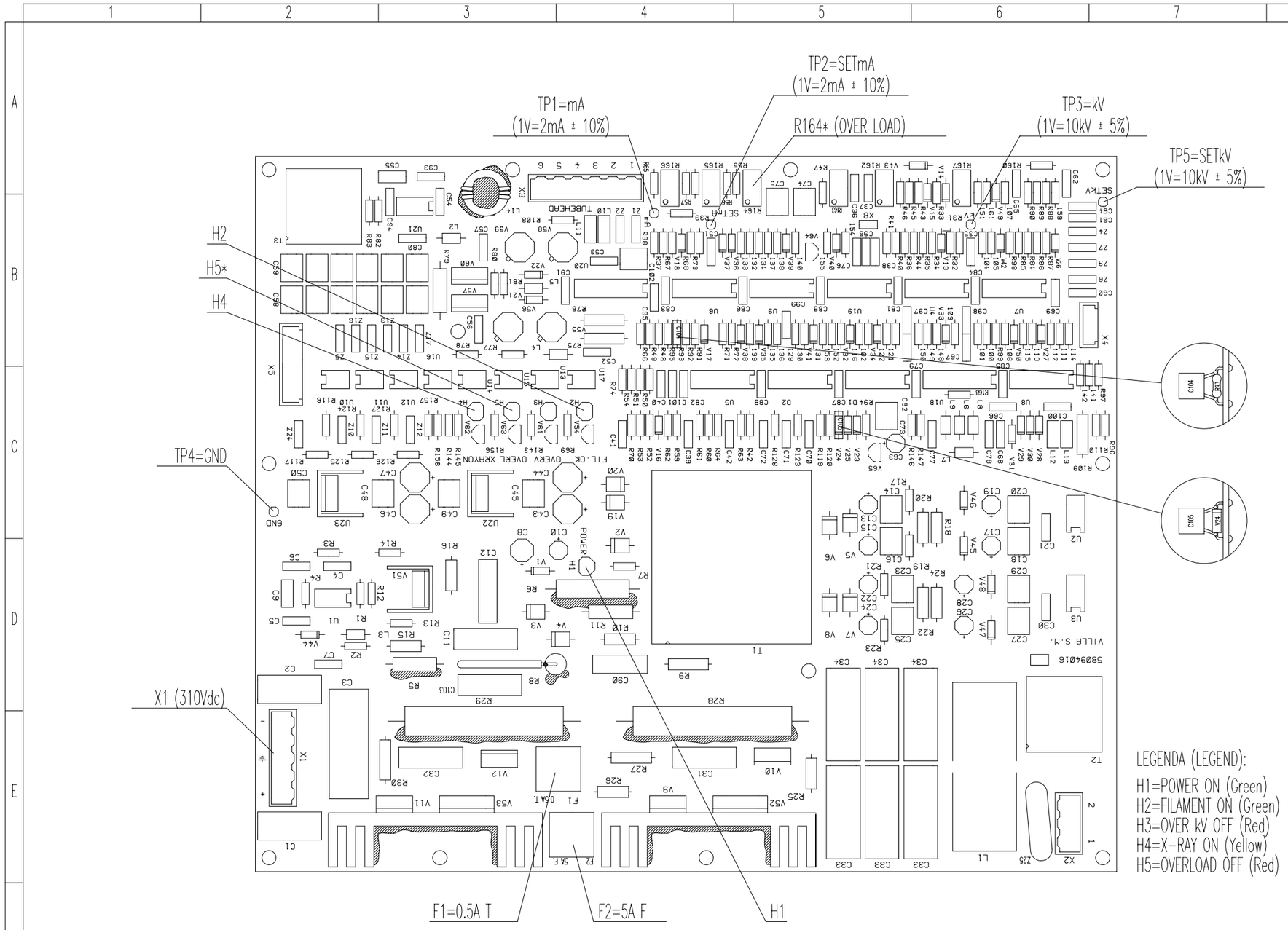
STRATO 2000 **Lay-out microprocessor** **PCB A11**	**6**
Code 58093161 - Rev. 8	**Page 1 of 1**



STRATO 2000 Circuit diagram microprocessor PCB A11	7
Code 39099084 - Rev. 1	Page 1 of 2

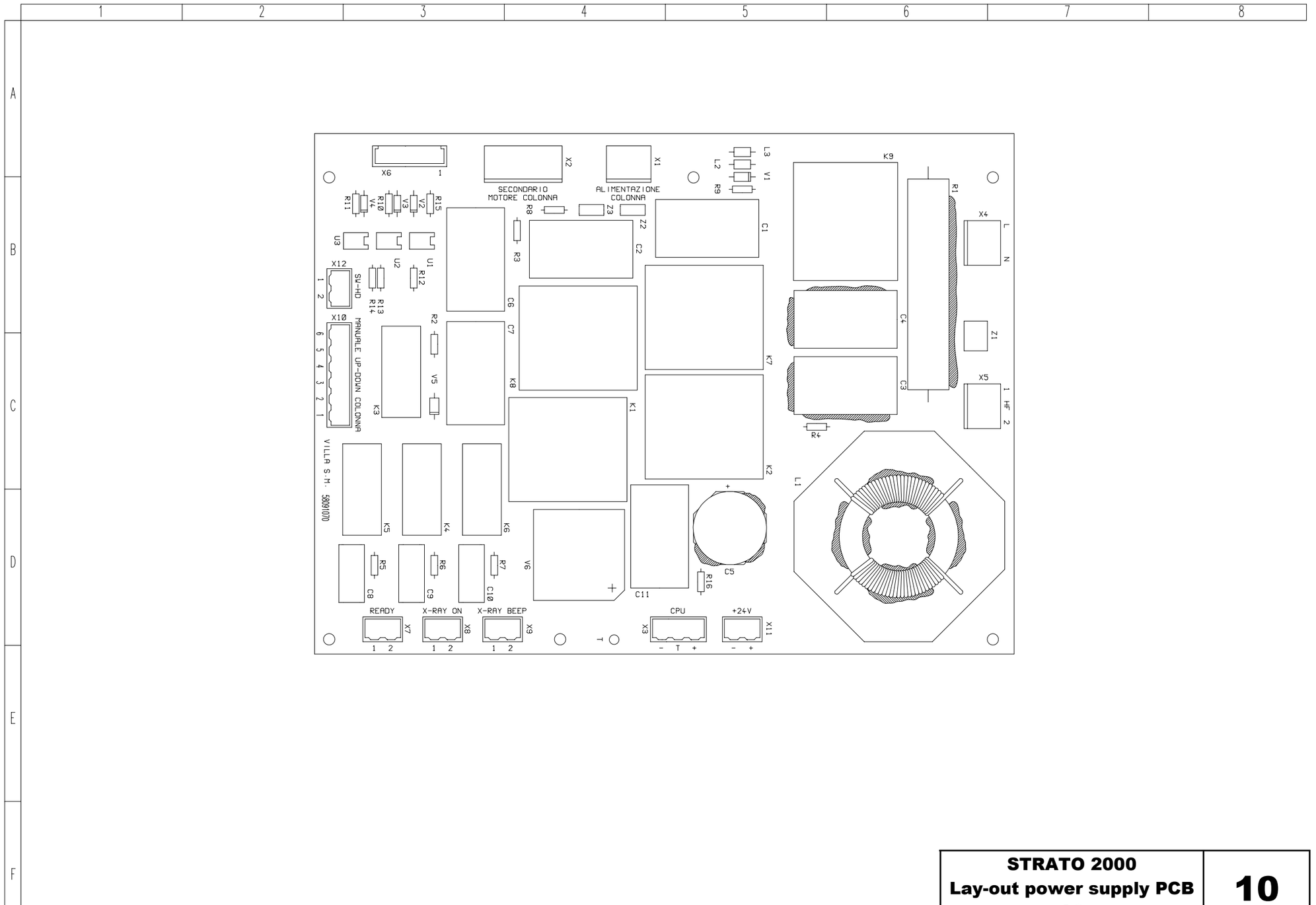


STRATO 2000 Circuit diagram microprocessor PCB A11	7
Code 39099084 - Rev. 1	Page 2 of 2

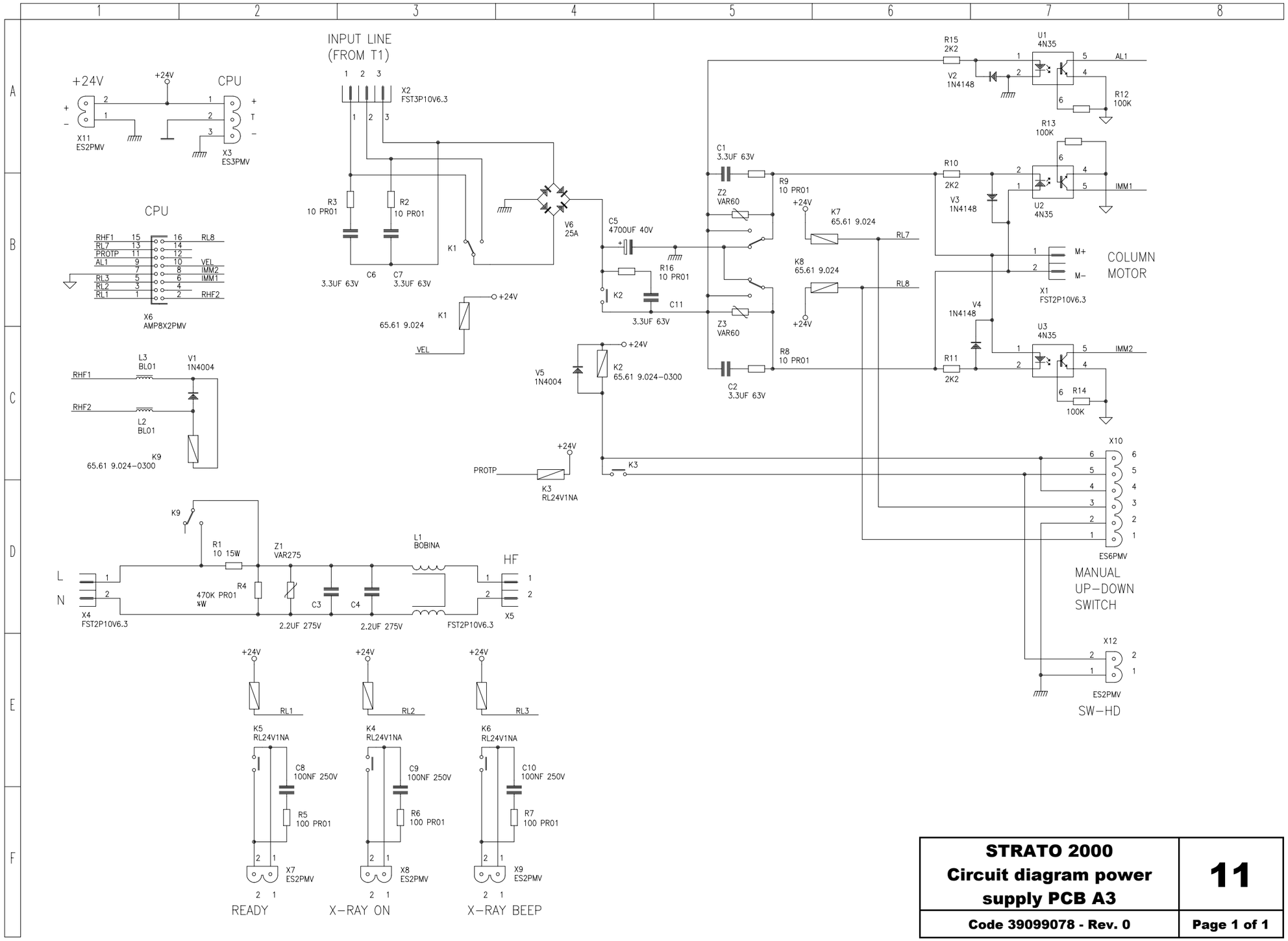


STRATO 2000 **Lay-out HF board** **A2**	**8**
Code 58094016 - Rev. 8	**Page 1 of 1**

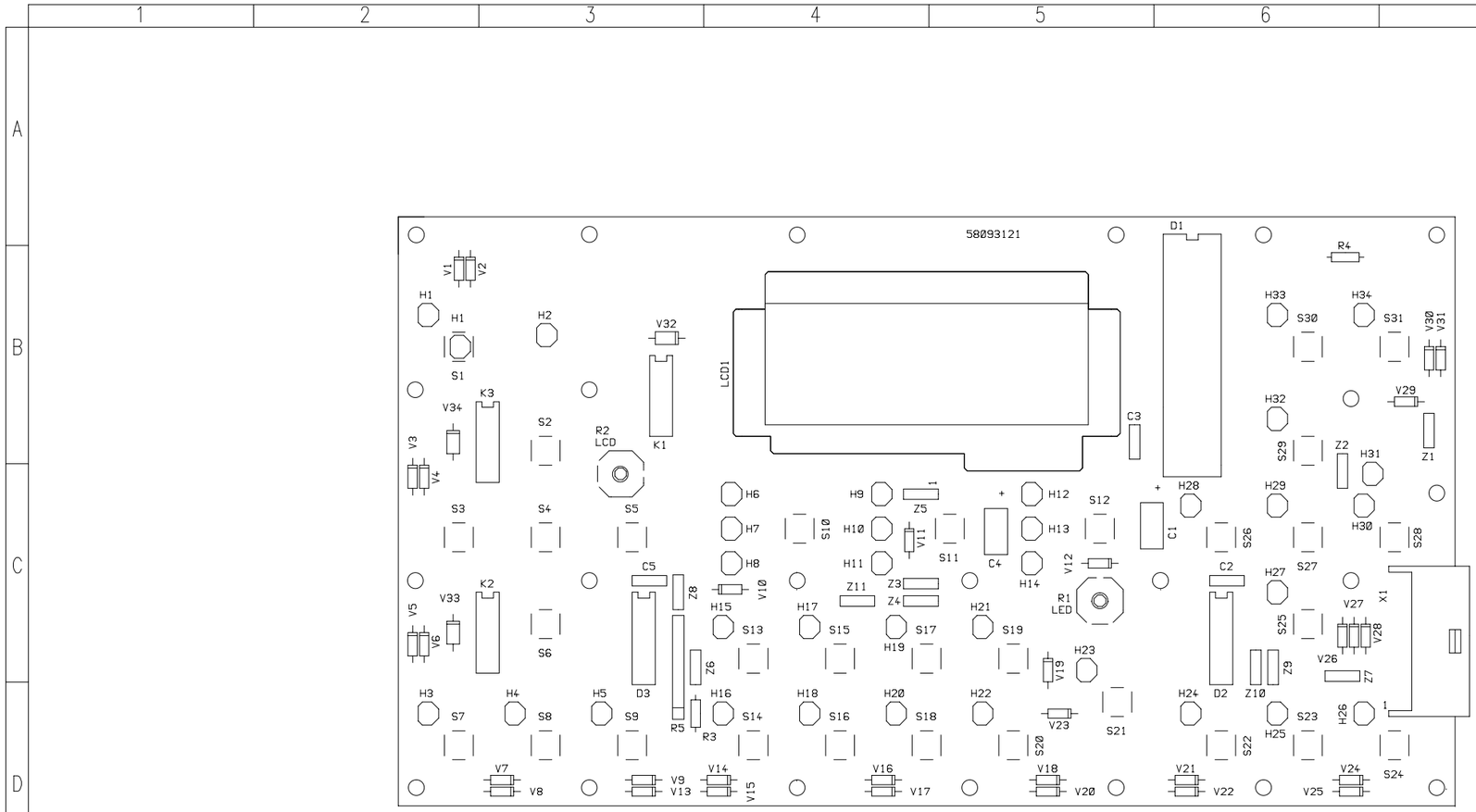
STRATO 2000 Circuit diagram HF board A2	9
Code 39099050 - Rev. 7	Page 1 of 1



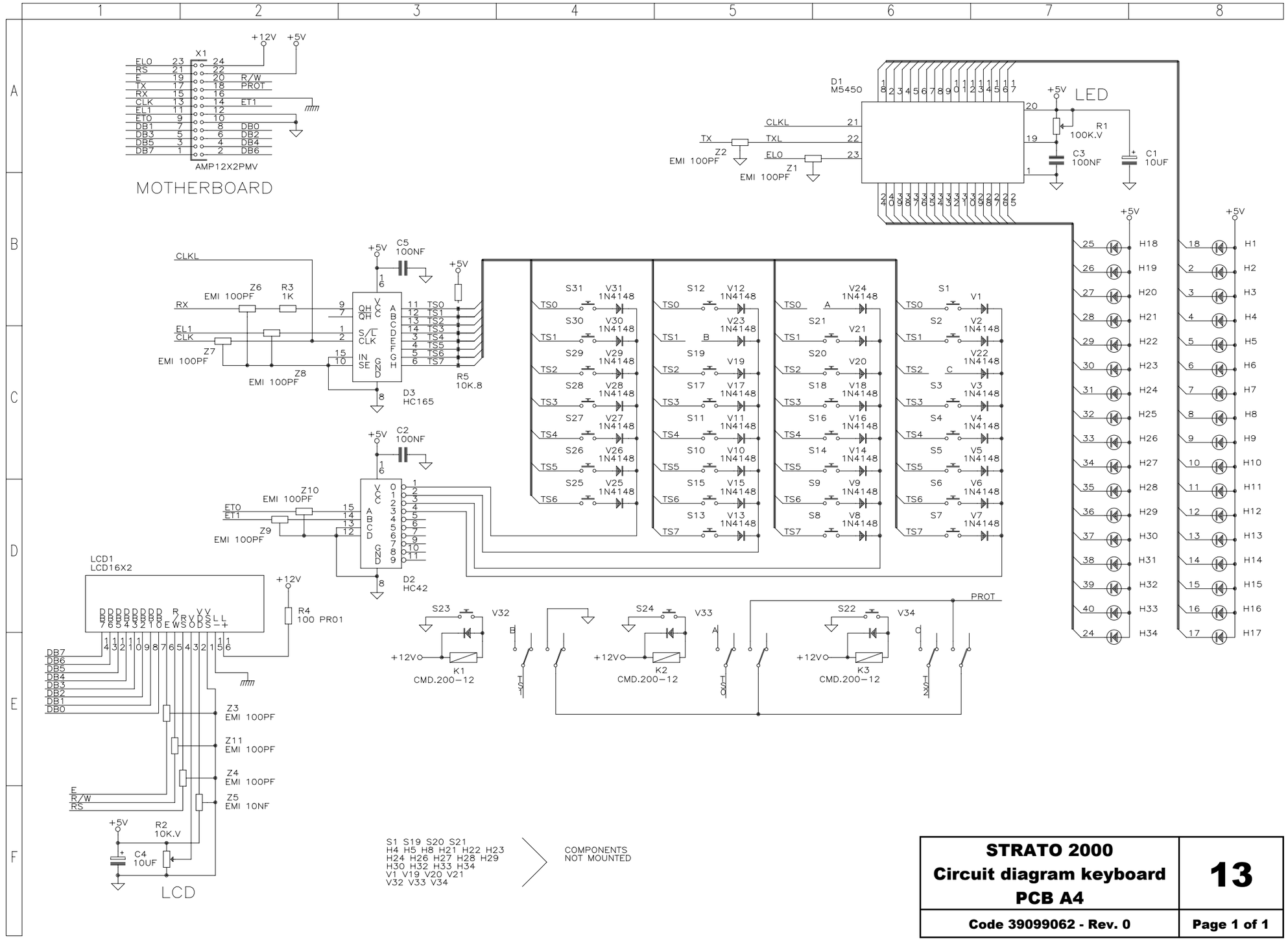
STRATO 2000 Lay-out power supply PCB A3	10
Code 58091070 - Rev. 1	Page 1 of 1



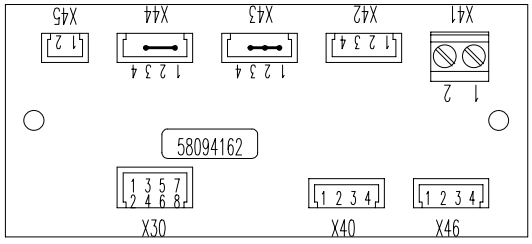
STRATO 2000 **Circuit diagram power supply PCB A3**	**11**
Code 39099078 - Rev. 0	**Page 1 of 1**

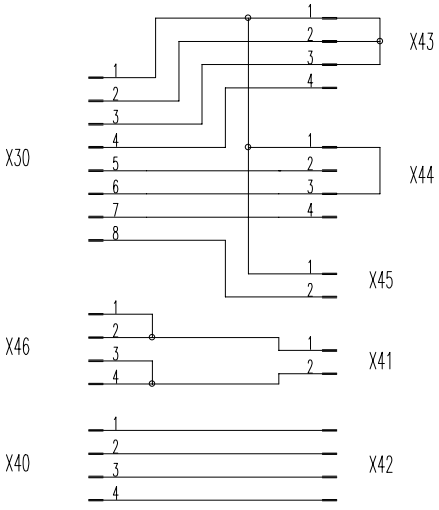


STRATO 2000 **Lay-out keyboard PCB** **A4**	**12**
Code 58093121 - Rev. 0	**Page 1 of 1**

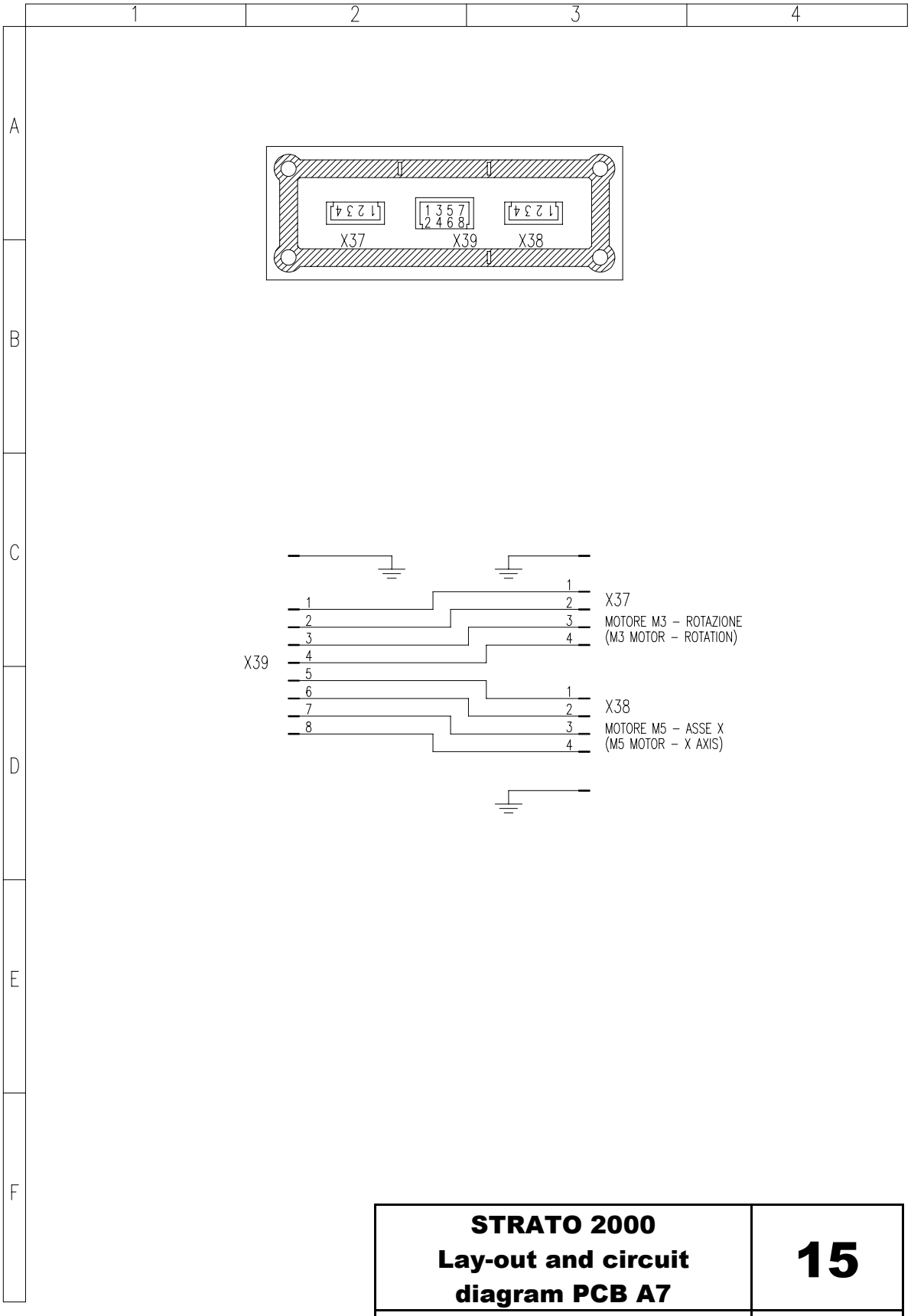


STRATO 2000 **Circuit diagram keyboard** **PCB A4**	**13**
Code 39099062 - Rev. 0	**Page 1 of 1**

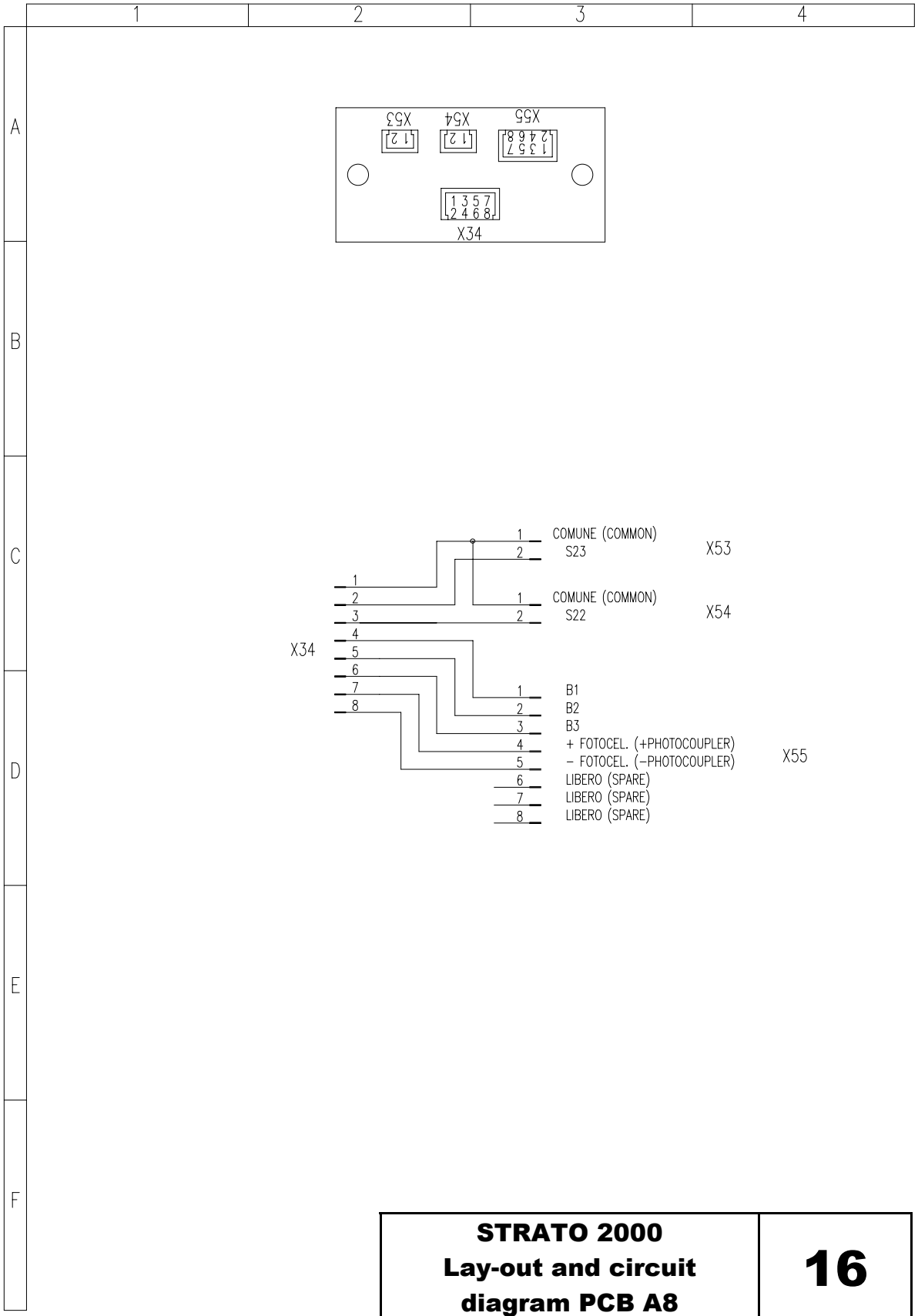




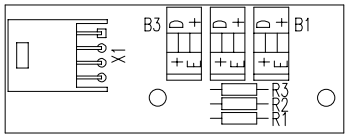
STRATO 2000 Lay-out and circuit diagram PCB A6	14
Code 58094162 - Rev. 0	Page 1 of 1

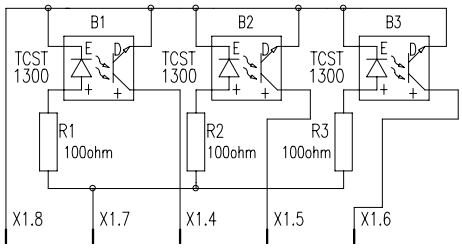


STRATO 2000 Lay-out and circuit diagram PCB A7	15
Code 58093074 - Rev. 0	Page 1 of 1

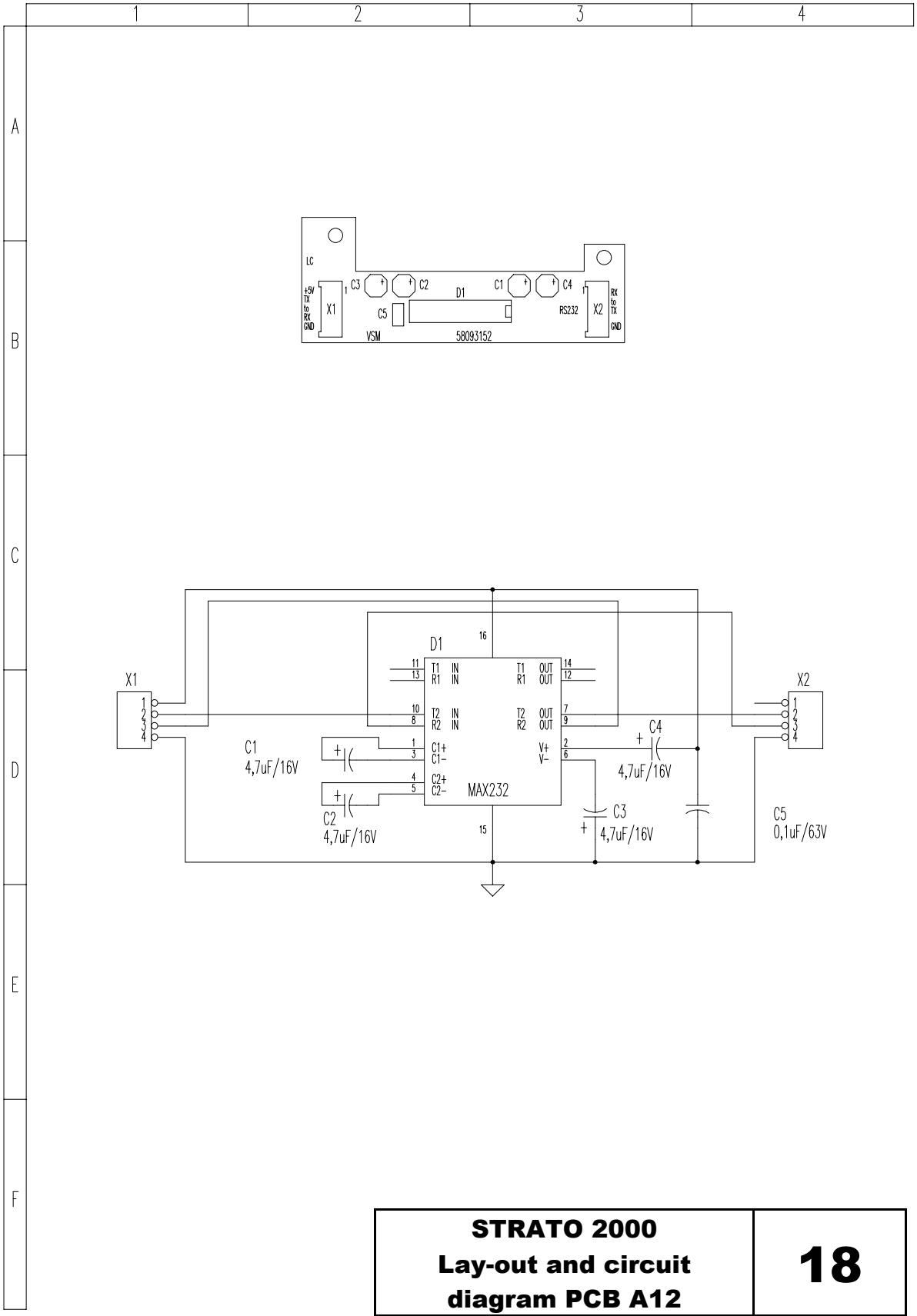


STRATO 2000 Lay-out and circuit diagram PCB A8	16
Code 58096073 - Rev. 0	Page 1 of 1

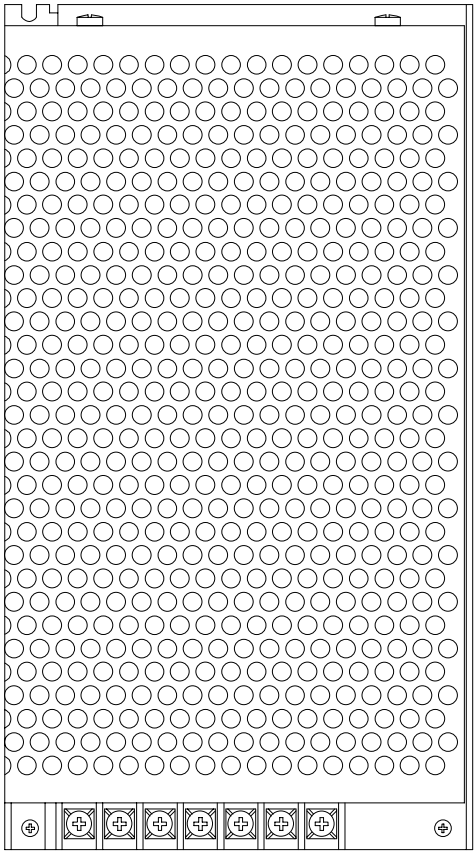


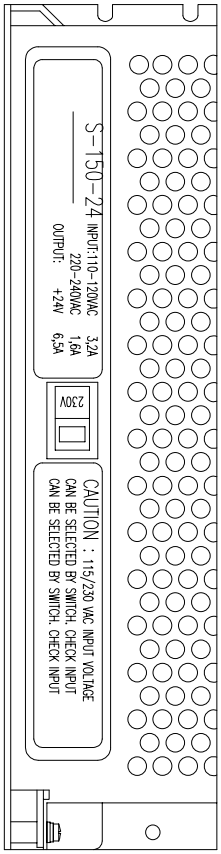


STRATO 2000 Lay-out and circuit diagram PCB A9	17
Code 58096094 - Rev. 1	Page 1 of 1



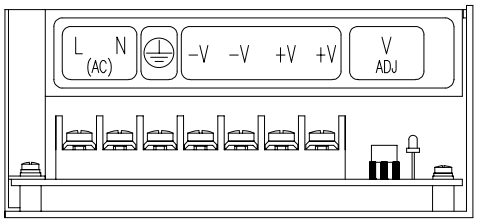
STRATO 2000 Lay-out and circuit diagram PCB A12	18
Code 58093152 - Rev. 0	Page 1 of 1





CARATTERISTICHE ALIMENTATORE TIPO S-150-24
(POWER SUPPLY S-150-24 TYPE SPECIFICATION)

INPUT:110-120VAC		3,2A
220-240VAC		1,6A
OUTPUT:	+24V	6,5A

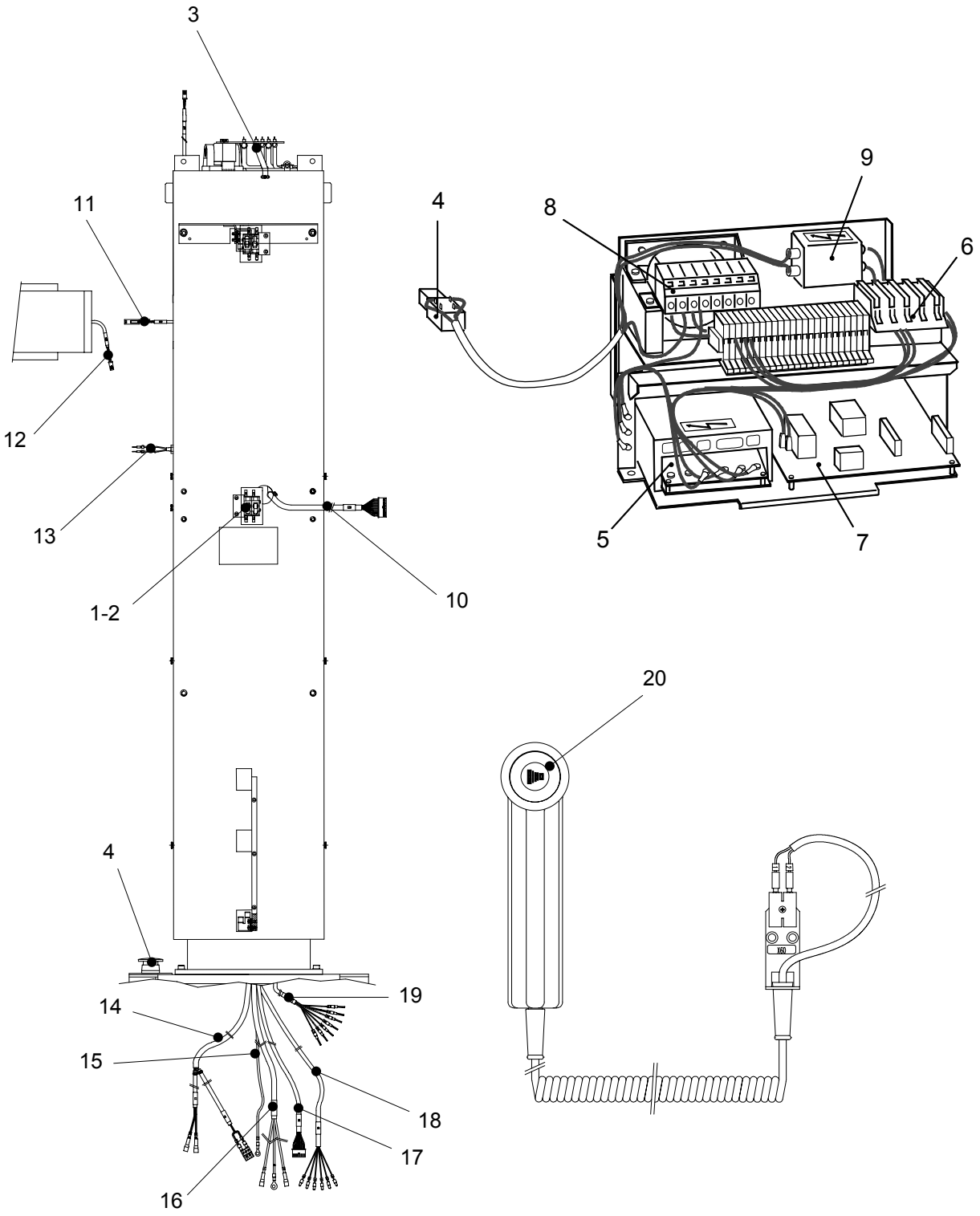


STRATO 2000 **Switching power supply** **S-150W-24Vdc-6.5A**	**19**
Code 44928177 - Rev. 0	**Page 1 of 1**

10. SPARE PARTS

1 - COLUMN AND BASE

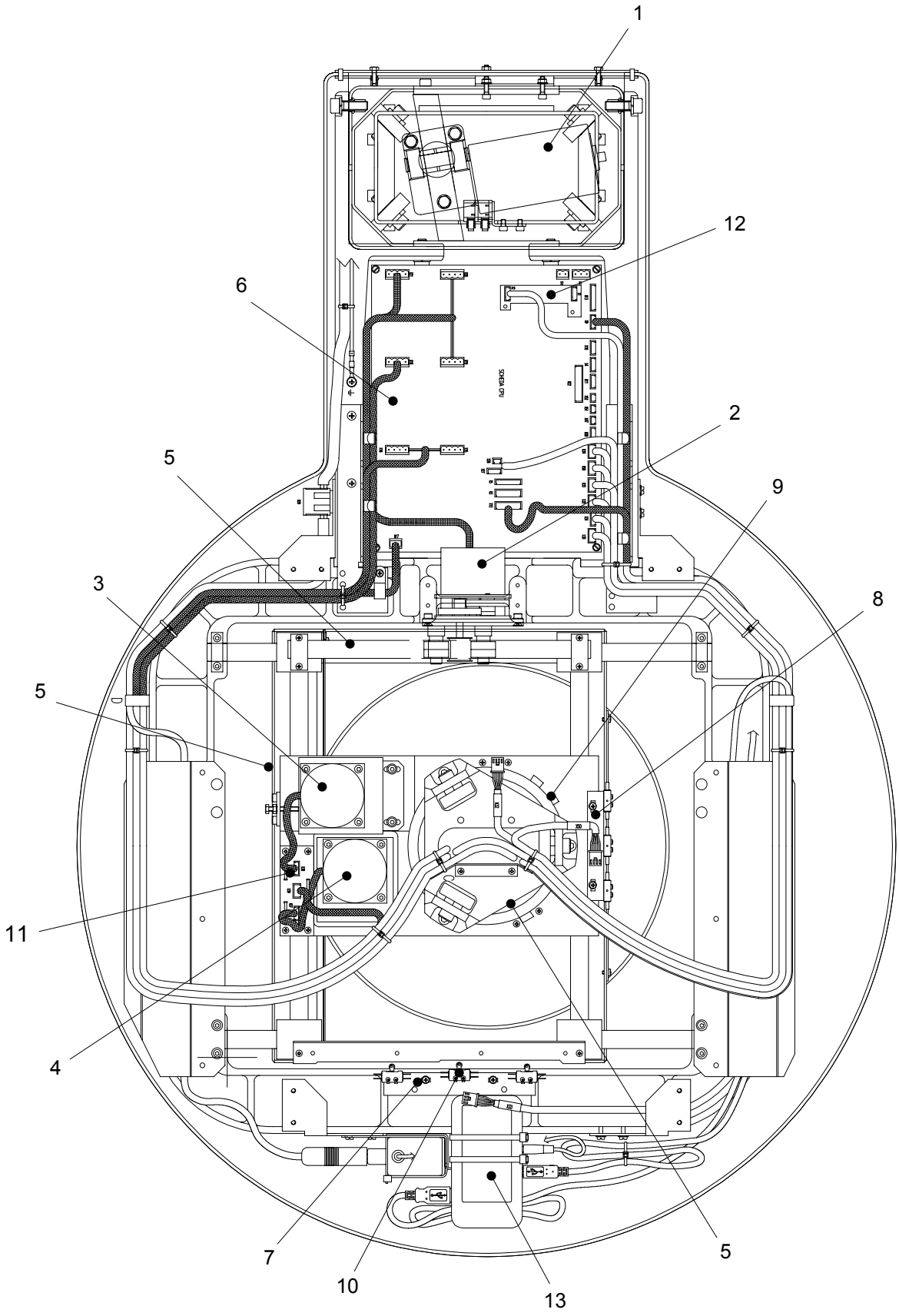
Rif.	Order code	Description	Note
1	4208404000	Column and travel microswitch (S2/S3)	
2	6609108300	Column microswitch (S2/S3) plus cable	
3	6609101800	Column actuator M1	
4	4291418900	Mains switch	
5	4492817700	+24V switch mode power supply	
6	6609107700	Fuses kit	
7	5809107000	Power supply board (A3)	
8	4492819900	Transformer	
9	8027001021	Line filter	
10	6209317100	Cable X22 (console connection)	
11	6209807100	Cable X52 (connection between CEPH arm and CPU board)	
12	6209807300	Cable X52 (CEPH arm cable)	
13	6209103600	Cable X47/X60 (X-ray push button cable)	
14	6209103700	General supply cable	
15	6209109900	Ground cable #1	
16	6209103200	Cable X5/X29 (filter box connection)	
17	6209103500	Cable X3/X6 (CPU board connection cable)	
18	6209105100	Cable X28/X51	
19	6609108300	Column end-travel microswitch assy	
20	6209110000	X-ray push button	
-	4492706700	HUB USB2	
-	4492821900	HUB USB2 power supply	
-	5009318300	USB2 cable L=5mt.	


3
11
12
13
1-2
10
4
8
9
6
5
7
20
4
19
14
15
18
17
16

2 - UPPER MOVEMENT ASSY

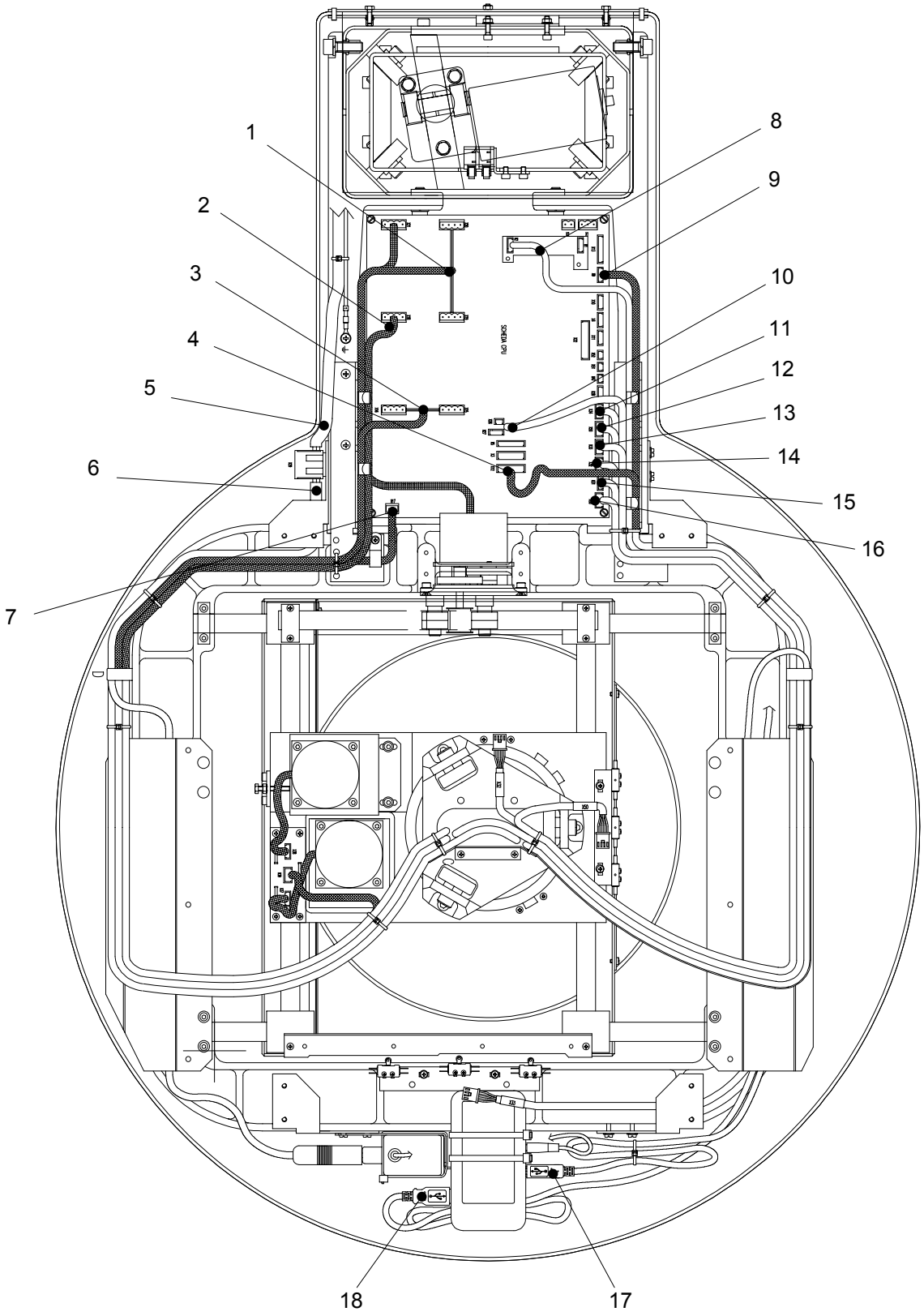
Electrical and mechanical parts

Ref.	Order code	Description	Note
1	6609101800	Column actuator	
2	6609311500	M4 Y-Axis stepper motor assy	
3	6609314500	M5 X-Axis stepper motor assy	
4	6609314500	M3 rotation stepper motor assy	
5	4990805200	Carriage belt	
6	6609317900	CPU PCB A1	
7	6109311000	Y-Axis microswitches assy	
8	6109305000	X-Axis microswitches assy	
9	6209314300	RO Axis microswitches assy	
10	4291308500	Microswitch	
11	5809307400	Interconnection PCB RO-Y	
12	5809315200	TTL / Serial converter PCB A12	
13	4492706700	HUB USB2	
	4492821900	HUB USB2 power supply	


1
12
6
2
5
9
3
8
5
11
4
7
10
13
5

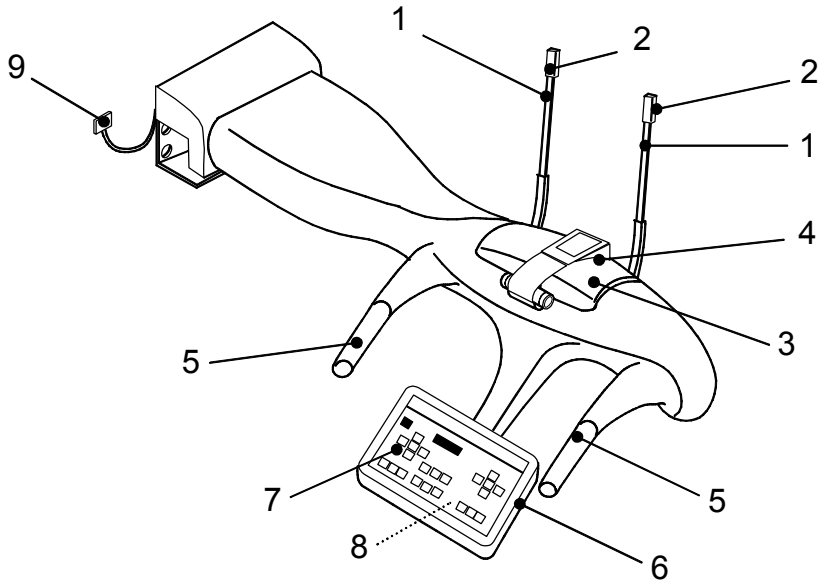
Cables

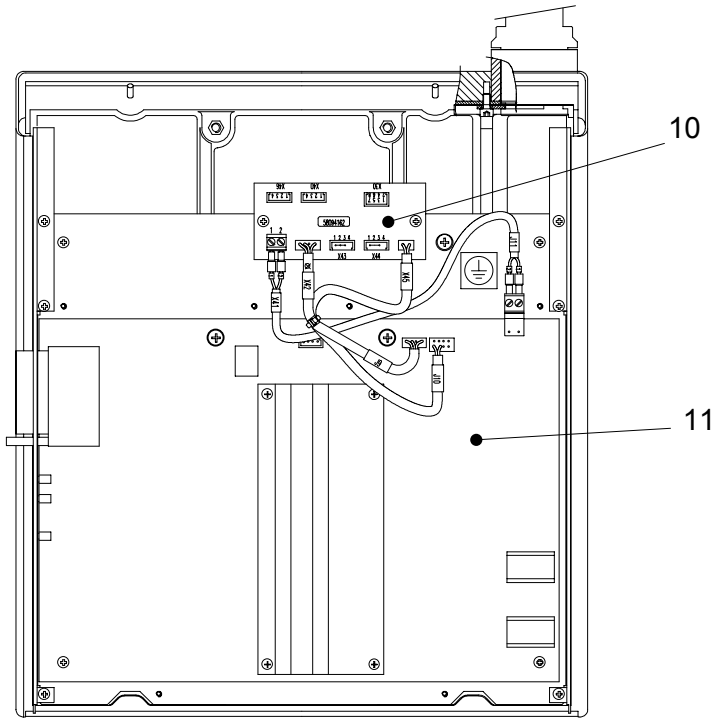
Ref.	Order code	Description	Note
1	6209309900	Cable X19-X20/X39 (rotation and X axis motor supply)	
2	6209410000	Cable X18/X40 (sensor PCB input signals)	
3	6209606100	Cable X15-X16/X56-X59 (collimator motor supply)	
4	6209310400	Cable X5/X12 (HF board signals)	
5	6209103200	Cable X5/X29 (filter box connection)	
6	6209319100	Cable X29-(filter box & HUB power connection)	
7	6209403300	Cable X17/X46 (+24V sensor supply)	
8	6209415700	RS232 cable	
9	6209306300	Cable X9/X4 (kV/mA signals)	
10	6209305200	Cable X26-X27/X35-X57-X58 (laser spot connections)	
11	6209605300	Cable X34 (primary collimator/STF miocroswitches connection)	
12	6209301400	Cable X50 (X axis microswitches connection)	
13	6209305300	Cable X33 (Y axis microswitches connection)	
14	6209304700	Cable X32 (rotation microswitches connection)	
15	6209402400	Cable X31 (panoramic sensor holder position microswitches connection)	
16	6209406400	Cable X30 (panoramic sensor holder microswitches connection)	
17	5009318300	HUB USB2 cable	
18	5009318200	HUB – Sensor connection cable	


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

3 - CHIN REST ARM / SENSOR HOLDER

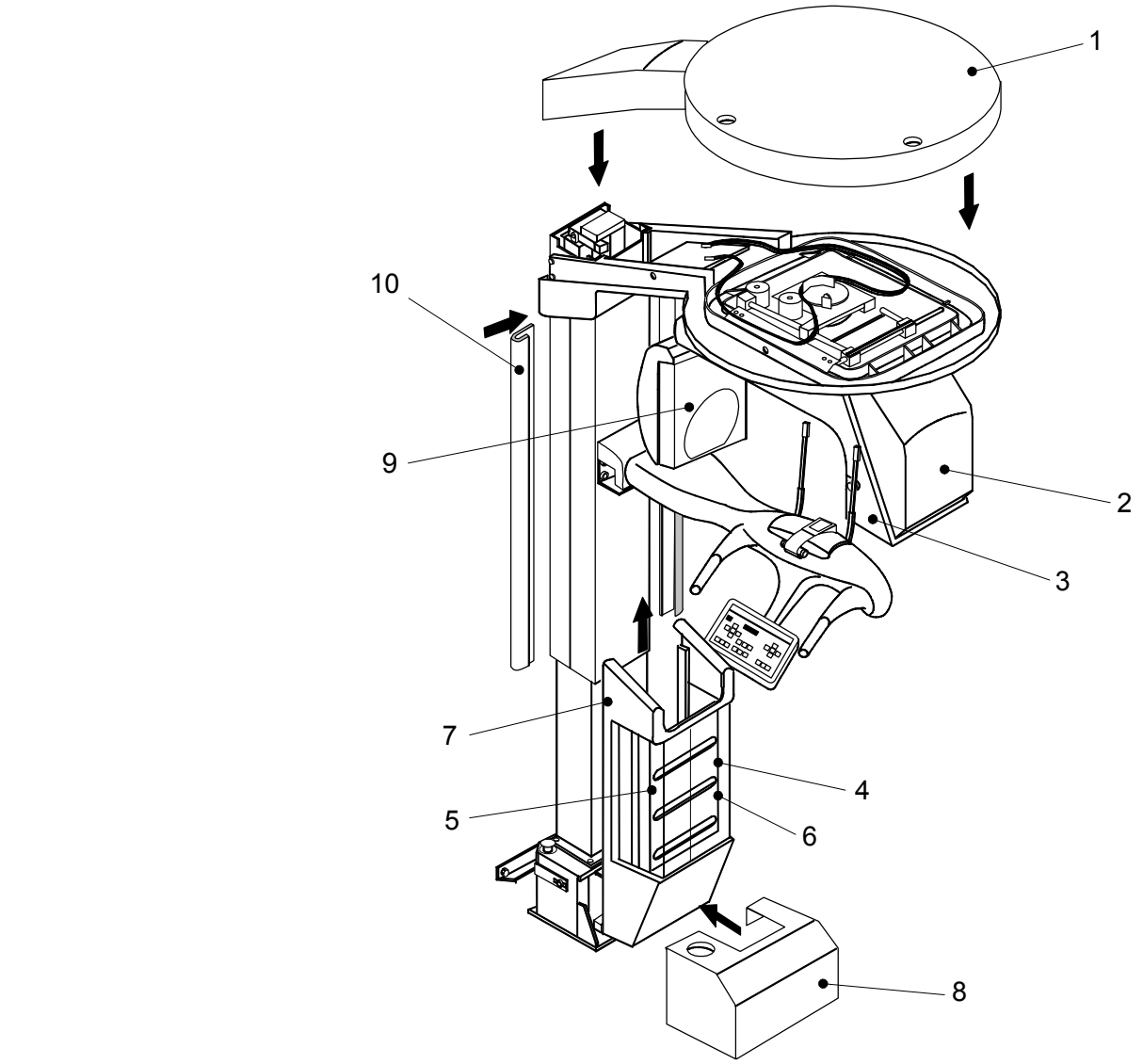
Ref.	Order code	Description	Note
1	5909513100	Temple support rod	
2	5409513200	Skull clamp plastic cup (1 pc.)	
3	6609515006	Skull clamp assy	
4	6309514906	Skull clamp cover	
5	5209502000	Handle for patient (1 pc.)	
6	6609507000	Keyboard assy	
7	5409506100	Keyboard panel	
8	6609312100	Keyboard PCB (A4)	
9	6209317200	Cable X1/X22 (console connection)	
10	5809416200	Sensor interconnection PCB	
11	6609903300	Acquisition PCB + CCD sensor	

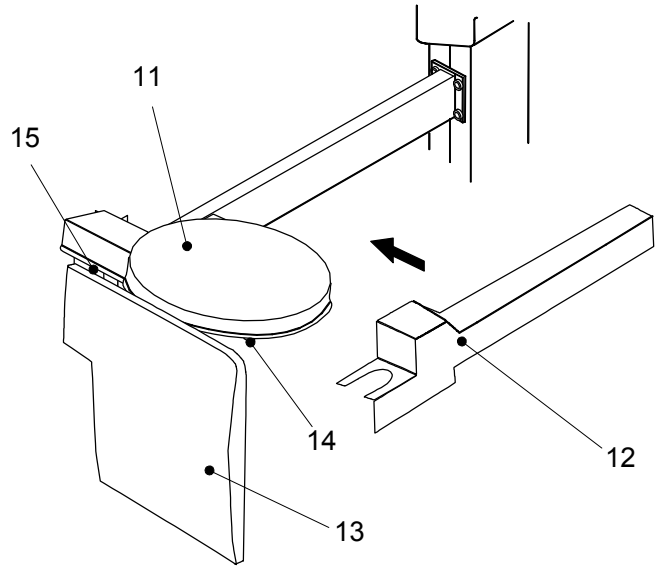

1
2
9
2
1
4
3
5
5
7
8
6


10
11

4 - COVERS

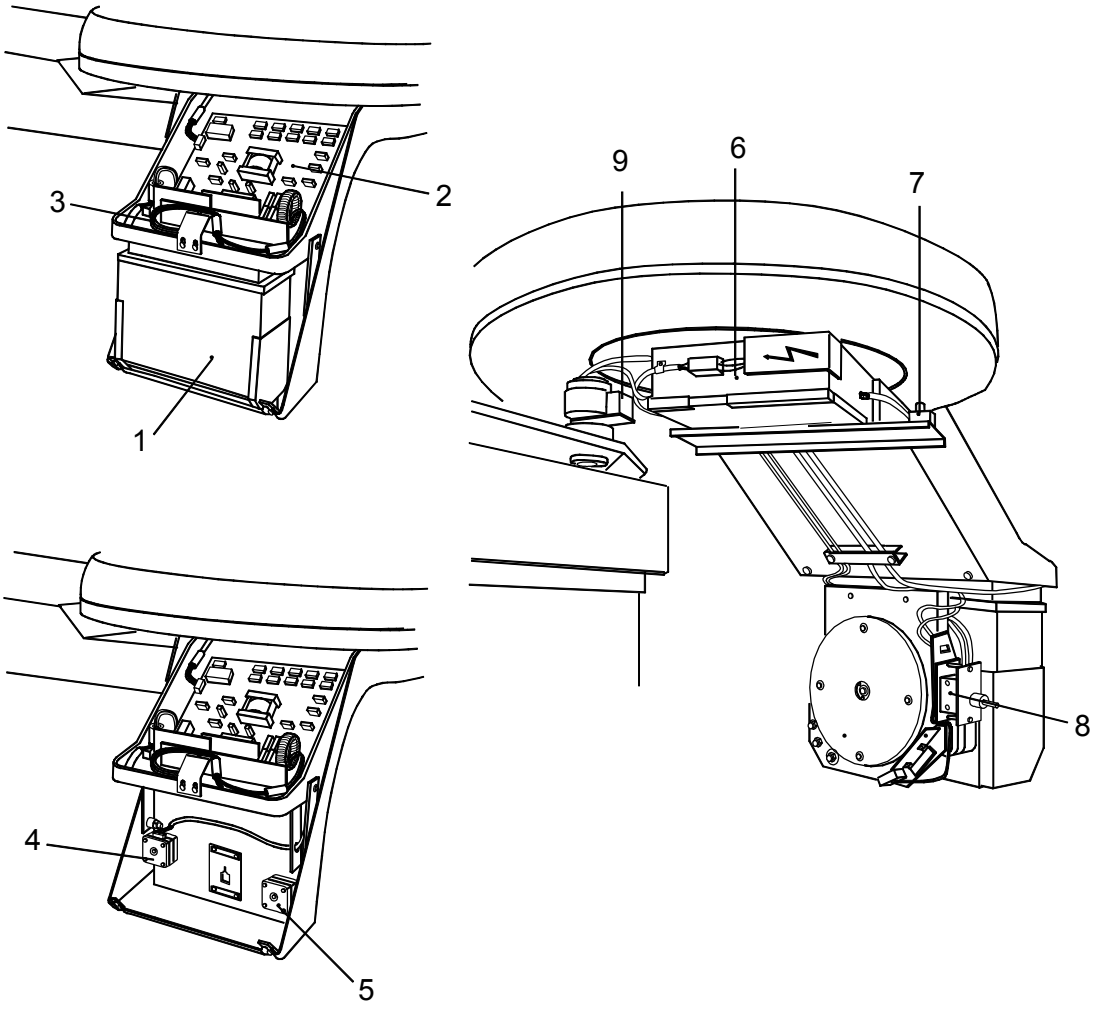
Ref.	Order code	Description	Note
1	5409300705	Upper cover	
2	5409400505	Tubehead back cover	
3	5409400405	Arm cover	
4	6609200900	Left door assy	
5	6609200800	Right door assy	
6	5409200700	Tray for consumable	
7	6109201505	Column cover assy	
8	5409100505	Base cover	
9	6109406205	Sensor cover	
10	5609105503	Protection cover for rear cable	
11	5409801005	Ceph device upper cover	
12	5409802505	Ceph arm cover	
13	5409805005	Ceph cassette rear cover	
14	5409801505	Ceph device lower cover	
15	5409801605	Ceph device lower-rear cover	
-	6609839400	Covers rubber profile (Length=8mt.)	

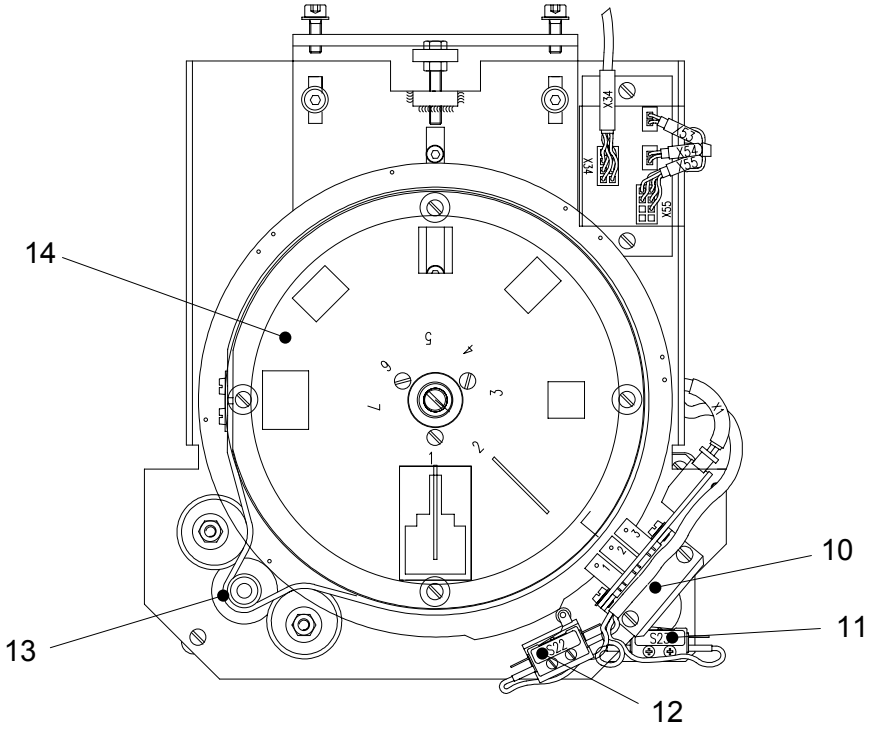

1
10
9
2
3
7
4
5
6
8


11
15
14
12
13

5 - ROTATION ARM

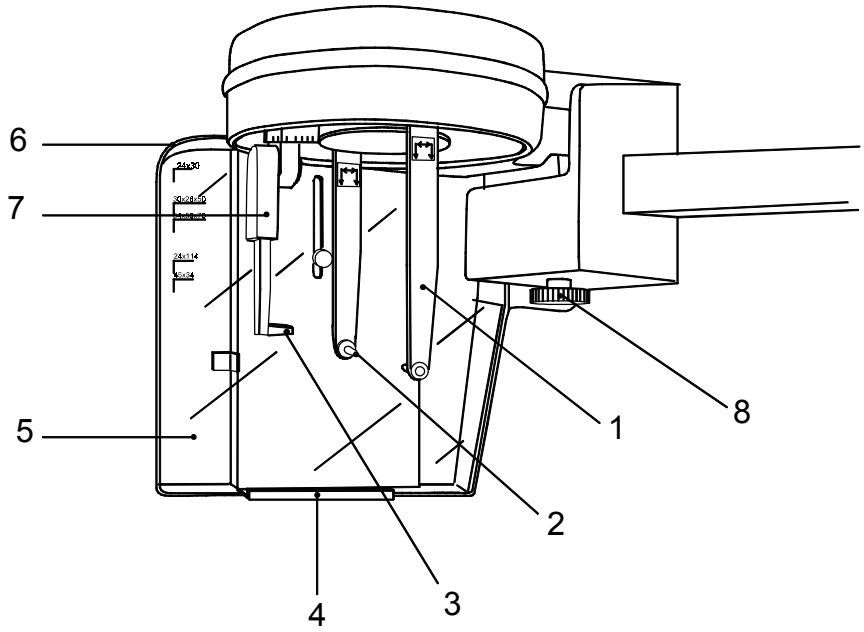
Ref.	Order code	Description	Note
1	6609600000	HF Tubehead	
2	6609401600	HF PCBoard (A2)	
3	6609603200	Tubehead cable	
4	6609606000	STF stepper motor (M6)	
5	6609611200	Primary collimator stepper motor (M7)	
6	6209415000	Filter box	
7	6609311200	Sagittal laser centering device	
8	6609608700	Frankfurt laser centering device	
9	4208422900	Microswitch S24 (sensor holder in PAN position) S25 (sensor holder in CEPH position)	
10	5809609400	Photocoupler PCBoard (A9)	
11	4291308600	Microswitch S23 (Soft Tissue Filter)	
12	4291308600	Microswitch S22 (Primary collimator zeroing)	
13	4990804800	Toothed belt	
14	6609613000	8"x10" collimator assy	
	6609605000	18x24 cm collimator assy	
	6609614500	24x30 cm collimator assy	


1
2
3
4
5
6
7
8
9


10
11
12
13
14
X34
X35
S1
S2

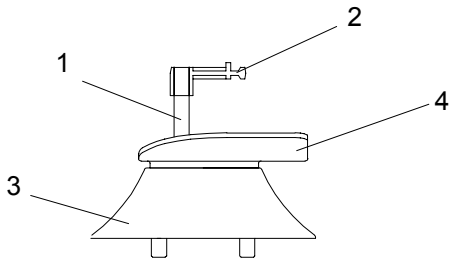
6 - CEPH device

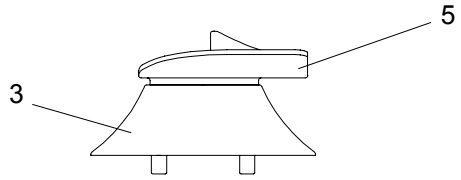
Ref.	Order code	Description	Note
1	6609802900	Rod for Ceph centering device	
2	6608906100	Ceph ear pivot (10 pcs)	
3	5909803800	Nose-rest rod	
4	6209808000	Ceph cassette microswitch	
5	5909806800	Ceph mirror	
6	6609806002	Ceph cassette holder assy	
7	6609803500	Nose-rest rod assy	
8	5409805400	Skull clamp vertical movement knob	

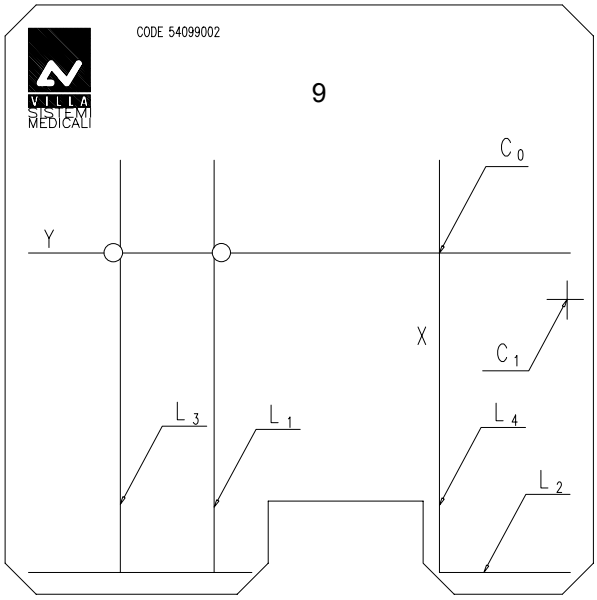

6
7
5
1
8
2
4
3

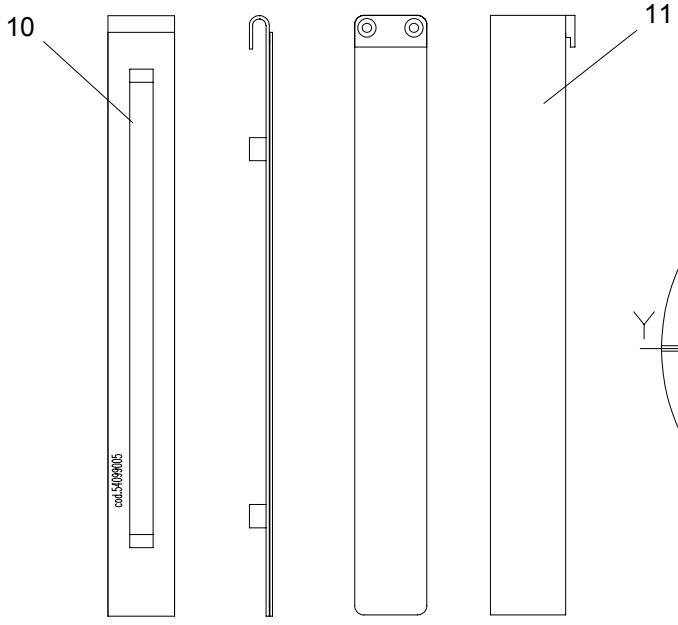
7 - ACCESSORIES AND SERVICE TOOLS

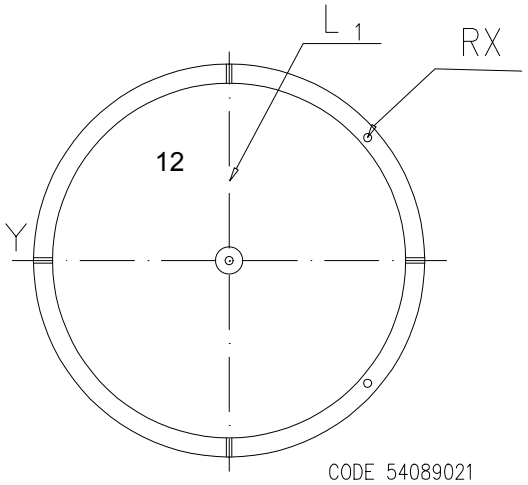
Ref.	Order code	Description	Note
1	6608906000	Kit for 50 centering bite rods	
2	4099927000	Kit for 500 centering bites	
3	5409501400	Base for chin rest	
4	5409501500	Panoramic chin rest	
5	5409501600	Edentulous chin rest	
6	6608906900	CEPH cassette 8"x10"	
7	6608907000	CEPH cassette 24x30cm	
8	6608907100	CEPH cassette 18x24cm	
9	5409900200	Flat centering tool	
10	5409900500	Fluorescent screen for X-ray beam centering	
11	5109900800	Sensor calibration tool	
12	5408902100	Round centering tool	
-	6609903400	Centering tools kit	


1
2
3
4


3
5


CODE 54099002
9
C 0
Y
X
C 1
L 3
L 1
L 4
L 2


10
11
cod.54099005


L 1
RX
12
Y
CODE 54089021

THIS PAGE IS INTENTIONALLY LEFT BLANK

11. FIXING TEMPLATE

This system is equipped with a set of templates, composed of the following elements:

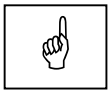
Code	**Description**
39099004	Upper template

THIS PAGE IS INTENTIONALLY LEFT BLANK

12. APPENDIX

12.1. Appendix A: Setup parameters table

The following table lists those adjustment parameters stored in the unit during factory testing and that must be re-entered into the non-volatile memory in case of replacement of the CPU board. This is due to the fact that the new CPU board, provided as a spare part, has been factory tested from the functional point of view, but contains only default parameters which are not related to the unit where it will be installed. Entering of the listed parameters can be performed through the service programs (passwords).



NOTE:
The information listed in the table are the technical parameters set during factory testing. Preferences set by the user (e.g. exposure parameters different than the default ones) are not listed.

The table also has columns with blank cells. These cells must be filled in when, during installation or during the life on the unit, any of the listed parameters will be modified (e.g. after replacing a motor or a positioning sensor).

STRATO 2000

Unit code: _____

Unit S/N: _____

U.I.C.: _____

Parameter	**Factory setting**	**New setting**	**New setting**	**New setting**	**New setting**
Date					
X axis motor offset					
Y axis motor offset					
Rotation axis motor offset					
Cassette motor offset					
Primary collimator motor offset (slot 0=position Panoramic adult)					
Primary collimator motor offset (slot 1=position Panoramic child)					
Primary collimator motor offset (slot 2=position Implant)					
Primary collimator motor offset (slot 3=1st CEPH cassette)					
Primary collimator motor offset (slot 4=2nd CEPH cassette)					
Primary collimator motor offset (slot 5=3rd CEPH cassette)					

Parameter	**Factory setting**	**New setting**	**New setting**	**New setting**	**New setting**
Primary collimator motor offset (slot 6=4th CEPH cassette)					
Soft Tissue Filter (STF) motor offset					
Soft Tissue Filter (STF) % correction					
Cephalometric status (OFF = disabled, ON = enabled)					
Cephalometric X axis motor offset					
Cephalometric Y axis motor offset					
Cephalometric rotation axis motor offset					
Collimator format (STD, 24x30, inch)					
Implant status (OFF = disabled, ON = enabled)					
Language (English, Italian, French, German, Spanish)					

THIS PAGE IS INTENTIONALLY LEFT BLANK

12.2. Appendix B: Installation checklist

- Vertical alignment of COLUMN (par. 6.2) ..... ☐
- Horizontal alignment of ROTATION ARM ASSY (par. 6.3) ..... ☐
- Horizontal alignment of CHIN SUPPORT (par. 6.4) ..... ☐
- Check of CONFIGURATION PARAMETERS (par. 6.5) ..... ☐
- Alignement of PANORAMIC AXIS (par. 7.1.1) ..... ☐
  - X AXIS (par. 7.1.1.1) ..... ☐
  - Y AXIS (par. 7.1.1.1) ..... ☐
- X-RAY BEAM centering (par. 7.1.2)..... ☐
- RECEPTORS ALIGNMENT PAN vs. CEPH (par. 6.7)..... ☐

Date and sign

THIS PAGE IS INTENTIONALLY LEFT BLANK

VILLA
SISTEMI
MEDICALI

Cod. 6909906303_Rev.4

CE 0051

VILLA SISTEMI MEDICALI S.p.a.
Via Delle Azalee, 3
20090 Buccinasco (MI) - ITALY
Tel. (+39) 02 48859.1
Fax (+39) 02 4881844

DEL Medical Systems Group