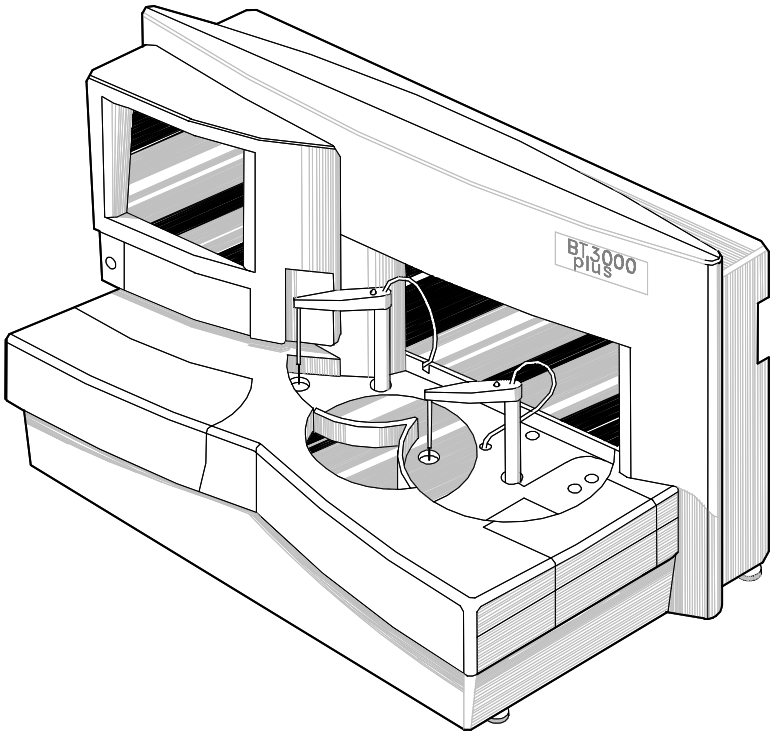
BT3000 PLUS

Technology Advanced Random Generation Analyzer System

SERVICE MANUAL

P/N: MS-04444-05-ING



Software Version 8
Rev. 0, September 9, 2004

CE

This product conforms to the safety requirements of the Council Directives 98/79/EEC of 27 October 1998 (European Parliament) regarding the In-Vitro Diagnostic Medical Devices. This directive is in accordance with the Article 2, Paragraph 2 of the Directive 89/336/EEC, which ceases to apply to the products complying with the present directive. Refer to Paragraph 7, Article No.1 of the IEC Official Gazette No. L331 of Dec. 1998.
It also conforms to Italian Regulations CEI EN 61010-01 and CEI EN 61326-1 (EMC).

The conformity is attested when the equipment is installed in accordance with the conditions outlined in the manual

MANUAL REVISION RECORD

This record page is for recording revisions to your BT3000 PLUS manual that has been published by Biotecnica Instruments S.p.A. We recommend that only the management or facility representative authorized to process changes and revisions to publications observe as follows:

- Make the pen changes or insert the revised pages.
- Ensure that obsolete pages are withdrawn and either disposed of immediately, or marked as superseded and placed in a superseded document file.
- Enter the information below reflecting that the revisions have been entered.

Rev. No.	Date	Description	Approved By

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BT 3000 PLUS - TABLE OF CONTENTS

SECTION A

SECTION I
INTRODUCTION - BT3000 PLUS SYSTEM

SECTION II
TECHNICAL SPECIFICATIONS

BT3000 PLUS - TABLE OF CONTENTS

SECTION III
ELECTRONICS

SECTION IV
SOFTWARE

BT3000 PLUS - TABLE OF CONTENTS

SECTION V
REPAIR OR REPLACEMENTOF VARIOUS PARTS

BT3000 PLUS - TABLE OF CONTENTS

SECTION VI
READING STATION SYSTEM

BT3000 PLUS - TABLE OF CONTENTS

SECTION VII
REAGENTS MODULE

SECTION VIII
SAMPLING STATION

BT3000 PLUS - TABLE OF CONTENTS

SECTION IX
ISE MODULE

SECTION X
COMPUTER MODULE

BT3000 PLUS - TABLE OF CONTENTS

SECTION XI
POWER SUPPLY

SECTION XII
VACUUM PUMP SYSTEM P/N 06-05161-01

VACUUM PUMP SYSTEM, P/N 662.0788 & BY-PRODUCTS PREVIOUS VERSION (OBSOLETE)

BT3000 PLUS - TABLE OF CONTENTS

SECTION XIII
MEASUREMENTS AND CALIBRATIONS

BT3000 PLUS - TABLE OF CONTENTS

SECTION XIV
TROUBLE-SHOOTING

BT3000 PLUS - TABLE OF CONTENTS

SECTION XV
SPARE PARTS FOR REPAIR AND MAINTENANCE

BT3000 PLUS - TABLE OF CONTENTS

SCHEMATICS AND DIAGRAMS
ELECTRONICS SYSTEM

BLOCK DIAGRAMS

<<Vacuum Pump System on the next page>>

BT 3000 PLUS - TABLE OF CONTENTS

VACUUM PUMP SYSTEM P/N 06-05161-01/02/03

VACUUM PUMP SYSTEM P/N 662.0788/C/D/E/F - OBSOLETE

SECTION A

WARRANTY CONDITIONS

- Biotecnica Instruments S.p.A., after having accurately tested this analyzer, guarantees the instrument for 1 (one) year starting from invoice.
- The warranty includes the repairing and the replacement for free of the faulty parts due to wrong manufacturing. Warranty is not extended to the normally consumable parts of the system.
- The warranty is not valid in case of improper use, negligence, improper or lack of maintenance and cleaning, tampering or repairing by third parties not authorized by Biotecnica Instruments S.p.A. and in any case when the cause cannot be stated as original manufacturing fault.
- The costs of shipment and transport to Biotecnica Instruments S.p.A. for repair or substitution, and the risks deriving from this is the responsibility of the buyer, including all the costs of onsite technical service at client's location (transport, board and lodging) as well.
- If the stated defects will result to be out of warranty limits, the buyer will pay repair or replacement costs.
- Biotecnica Instruments S.p.A. is not responsible for any unforeseen technical problem that might occur. If the requested technical assistance is outside the terms of warranty a charge will me made to the customer as per current rates in force.
- Biotecnica Instruments S.p.A. is an internationally known for its high quality standards in production. Biotecnica Instruments S.p.A. is thus responsible for providing to the customer clear and effective information for use of it's products, including all the precautions and warnings for a secure and risk-free use.
- Service personnel must also refer to the warnings and cautions notices in this manual. It is the duty of the service engineer of Biotecnica to instruct his service personnel to take all necessary precautions during repair and handling of products.
- Biotecnica Instruments S.p.A. is not responsible for any damage that may be caused directly or indirectly to persons or things due to a lack of observance of all the warnings and cautions outlined in the user's manual, and concerning the warnings and cautions during the different working phases of the instrument (see chap. M). Direct, indirect, incidental, special, moral damages as well as other damages of any type (including, with no limitation, those deriving from profit's loss, business interruption or information loss) cannot be ascribed to Biotecnica Instruments S.p.A. even in the case in which the possibility of the event had been explicitly stated.

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biotecnica instruments

Mod.05-35a-ing Rev. 0

Parts / Instruments Return Authorization

DATE: _____/_____/____

From:			
To: Technical Assistance – Export Manager			
Client information			
Instrument model:		Serial number:	
Defective part			
Part description:			
Code:		Serial number:	
Bar-code number:		Quantity:	
Under warranty: Yes ❑ No ❑	Order number:		Date:
Description of the problem:			
Request for:			
Repair ❑	**Exchange ❑**	**Quotation ❑**	**Urgent ❑**
Name:		Signature:	
Biotecnica Instruments response			
Return authorization number: **/ 2004**		Date:	
Approved: Yes ❑ No ❑			
Repair ❑	Exchange ❑	Destroy ❑	Quotation:
Note:			
Approved by: Technical Assistance Dept.		Signature:	
Quality Control Manager Supervising		Signature:	

Note: No parts or instruments will be accepted for repair or replacement without a Return Authorization number, which can be obtained from Biotecnica Instruments S.p.A. Fax this Return Authorization form to +39 06 410 3079 to the attention of Technical Assistance/Export Manager, who will then evaluate and issue a Return Authorization number.

WARRANTY EXCTRACT: Biotecnica Instruments S.p.A. warrants its instruments to be free from defective parts and workmanship for a period of one (1) year from the date of purchase. Liability under this warranty is expressly limited to repair or replacement of defective parts at the option of Biotecnica Instruments S.p.A. This warranty does not cover the results of misuse, accident or abuse of any parts of its instruments which have been repaired, tampered with or altered by anyone other than personnel authorized by Biotecnica Instruments S.p.A. This warranty does not apply to fluid handling devices, consumables or reagents.
Products returned to Biotecnica Instruments S.p.A. for repair or replacement shall be sent with transportation prepaid.
If found not to be defective under the terms of warranty, a charge will be made for repair or replacement and freight costs will be at customer's expense.

POTENTIAL RISKS DURING OPERATION AND MAINTENANCE

- **USE**

  Although the BT3000 PLUS analyzer system uses high performance components, which provide a high degree of safety, it is essential that the user takes the usual precautions to safeguard himself and to ensure a safe working environment.

  Biotecnica Instruments S.p.A. only guarantees the workmanship and materials of its products. It is the duty of the user to take care of safe operation and no amount of warnings can take place of such care.

  As regards the moving parts in the analyzer, these have been appropriately protected to avoid any potential risks to the user, and for proper instrument operation and safety. However, it is highly recommended to exercise extreme care during analyzer operation and especially when working close to the devices.

  To avoid accidental contamination, use suitable guards and/or personal protection, such as overall and gloves. When handling reagents, it is advisable to observe good laboratory practice (GLP) rules.

  Chemicals, serum samples and reagents must be handled with extreme caution. Patient samples may be biologically hazardous. The reagents or any other substances that may enter in contact with samples should be treated in the same way as samples themselves.

  The materials of human origin, such as control sera, are tested for the detection of HbsAg, anti-HCV anti-HIV-1 anti-HIV–2 antibodies. Even if the result is negative, as no known analytical method can exclude any infection's risk with certainty therefore these materials must be considered as potentially infective and thus must be handled with extreme caution. The reagents and any other substance entering in contact with samples must be treated in the same way. The reagents must be manipulated (before, during and after the use) by qualified personnel familiar with their characteristics in order to safeguard the user as well as the quality of the reagent itself.

- **MAINTENANCE**
  - It is of extreme importance that the instrument is fully turned off and the power cord unplugged from the wall outlet to safely perform any maintenance or service procedure.
  - During maintenance procedures (see **"Chapter N**, **"Maintenance"**), the safety and warning precautions must be observed as outlined in the preceding paragraph.
  - The exterior of the analyzer casing may be cleaned periodically to remove dust grease and other contamination. It is not necessary to clean the inside. Use soft cloth dampened with a mild solution of detergent with water.
  - The owner shall be responsible for maintenance of the analyzer. Wear or damage caused by lack of normal maintenance or by misuse of the analyzer shall not be considered as defective workmanship and material.

WARNINGS

ALTHOUGH THE BT3000 PLUS ANALYZER SYSTEM USES HIGH PERFORMANCE COMPONENTS WHICH PROVIDE A HIGH DEGREE OF SAFETY, IT IS ESSENTIAL THAT THE SERVICE ENGINEER TAKES THE USUAL PRECAUTIONS TO SAFEGUARD HIS SERVICE PERSONNEL. WE ONLY GUARANTEE THE WORKMANSHIP AND MATERIALS OF OUR PRODUCTS. IT IS THE DUTY OF THE SERVICE ENGINEER TO TAKE CARE FOR SAFE OPERATION AND NO AMOUNT OF WARNINGS CAN TAKE THIS PLACE OF SUCH CARE. THE FOLLOWING WARNINGS WILL AID THE SERVICE PERSONNEL TO PROVIDE ADEQUATE SAFEGUARDS TO ASSURE SAFE TROUBLE-FREE PERFORMANCE:

1. BEFORE SERVICING THIS SYSTEM, BE SURE TO READ THE SERVICE MANUAL THOURALLY AND CAREFULLY. AFTERWARDS, KEEP IT HANDY FOR FUTURE REFERENCE.
2. TAKE SPECIAL CARE TO FOLLOW THE WARNINGS AND CAUTIONS INDICATED ON THE SYSTEM REAR PANEL AS WELL AS IN THE SERVICE MANUAL.
3. SERVICING OF THIS SYSTEM SHOULD BE RESTRICTED TO QUALIFIED/APPROVED SERVICE PERSONNEL.
4. SLOTS AND OPENINGS IN THE CASE, BACK PANEL, AND BOTTOM ARE PROVIDED FOR VENTILATION. THIS ENSURE RELIABLE OPERATION OF THE SYSTEM AND TO PROTECT IT FROM OVERHEATING. DO NOT BLOCK OR COVER THESE OPENINGS.
5. BEFORE SERVICING, CHECK THAT THE VOLTAGE ON THE REAR PANEL LABEL MATCHES THE LOCAL LINE VOLTAGE.
6. TO GUARANTEE SAFETY THE SYSTEM MUST BE GROUNDED. THE WIRES IN THE MAINS POWER CORDSET ARE COLORED IN ACCORDANCE WITH THE FOLLOWING CODES:

GREEN AND YELLOW:	EARTH
BLUE:	NEUTRAL
BROWN:	LIVE

   THE WIRE COLORED BLUE IS INTERCHANGEABLE WITH WIRE COLORED BROWN.
7. REPLACE FUSE AS MARKED. PRIOR TO THE REMOVAL OF ANY FUSE, TURN POWER OFF AND UNPLUG THE CORDSET FROM THE WALL.
8. TO REDUCE THE RISK OF ELECTRIC SHOCK. DO NOT REMOVE ANY PANEL OR COVER UNDER POWER "ON" CONDITION. BEFORE REMOVING ANY PANEL OR COVER, TURN POWER "OFF" AND UNPLUG THE POWER CORDSET FROM THE WALL
9. FOR OPERATING SAFETY, DO NOT INSTALL THE SYSTEM IN A LOCATION WHERE IT WILL BE EXPOSED TO HEATING EQUIPMENT OR RADIATORS, DIRECT SUN LIGHT, OR ANY OTHER SOURCE OF EXTREMELY HIGH TEMPERATURES.
10. DO NOT OPERATE THE SYSTEM IN THE PRESENCE OF FLAMMABLE FLUIDS OR GASEOUS ATMOSPHERE, DISINFECTING AGENTS, CLEANING AGENTS, ETC., DUE TO POSSIBLE FIRE OR EXPLOSION.
11. DO NOT KINK, BEND, LAY OBJECT ON, OR OTHERWISE DAMAGE OR RESTRICT CABLES.
12. BE SURE THAT THE POWER SWITCH ON THE BACK PANEL OF SYSTEM IS OFF WHEN PLUGGING IN, OR REMOVING THE POWER CORDSET FROM A WALL OUTLET.
13. TURN OFF THE MAINS POWER SWITCH WHENEVER THE SYSTEM IS NOT IN USE; THE SYSTEM IS SWITCHED OFF BUT NOT ENTIRELY. TO TURN OFF POWER TO WHOLE SYSTEM, UNPLUG POWER CORD FROM WALL OUTLET.
14. DO NOT ATTEMPT TO ALTER THE SHAPE OF ANY PART OF THE SYSTEM.

15. IF THE SYSTEM IS NOT OPERATING PROPERLY AND THE TROUBLE-SHOOTING SECTION DOES NOT PROVIDE A SATISFACTORY SOLUTION TO THE PROBLEM, THEN DO NOT USE THE SYSTEM UNTIL THE DEFECTS ARE REMEDIED.
16. INSPECT ALL ACCESSORIES AND SYSTEM CORDS. DO NOT USE IF DAMAGE CAN BE SEEN SUCH AS CUT INSULATION OR OUTER COVERING, FRAYED OR BROKEN WIRES, CORRODED OR BROKEN CONNECTORS ETC.
17. TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT ALLOW FLUIDS OR ANY FOREIGN OBJECT TO ENTER THE SYSTEM. WIPE OFF SPILLS IMMEDIATELY.
18. DO NOT USE BENZENE, THINNER, ANY KIND OF SOLVENTS, OR ABRASIVE DETERGENTS TO CLEAN THE CASE. CLEAN WITH SOFT DUSTING CLOTH DAMPENED WITH DISTILLED WATER. IF NECESSARY USE ONLY NEUTRAL DETERGENT.
19. DO NOT STICK OBJECTS OF ANY KIND INTO THE SYSTEM THROUGH BACK PANEL OR CASE SLOTS AS THEY MAY TOUCH DANGEROUS VOLTAGE POINTS OR SHORT OUT PARTS THAT COULD RESULT IN FIRE OR ELECTRIC SHOCK.
20. INSTALL THE SYSTEM IN SUCH A WAY THAT ADEQUATE VENTILATION IS PROVIDED ALL AROUND TO PROPERLY DISSIPATE THE HEAT.
21. MAKE SURE ALL FLUID LINES ARE FREE OF KINKS, NICKS, SHARP BENDS, PUNCTURES, OR OCCLUSIONS BEFORE INSTALLING ON SYSTEM.
22. DO NOT TWIST THE PERISTALTIC PUMP TUBING WHEN PLACING IN THE RACEWAY OF THE PUMP ROLLER.
23. RELEASE THE PERISTALTIC PUMP TUBING WHENEVER THE SYSTEM IS UNUSED FOR LONG PERIODS OF TIME.
24. IF IT IS NOT BE USED FOR SOME TIME, THE PINCH-VALVES TUBING SHOULD BE RELEASED.

    CAUTION

    THE HYDRAULIC CIRCUIT SHOULD BE FULLY DISCHARGED AND THE WATER RESERVOIR DISCONNECTED FROM THE CIRCUIT PRIOR TO RELEASING THE TUBES FROM THE PINCH VALVES. IF THESE STEPS ARE NOT TAKEN, SERIOUS DAMAGE MAY BE CAUSED TO THE ANALYZER.
25. THE HALOGEN LAMP MUST BE REPLACED SOME MINUTES AFTER THE INSTRUMENT HAS BEEN TURNED OFF AND POWER CORD UNPLUGGED.
26. ALWAYS ALLOW THE BURNT OUT LAMP TO COOL DOWN BEFORE HANDLING OR ATTEMPTING REPLACEMENT.
27. NEVER TOUCH THE LAMP OR THE REFLECTOR WITH BARE FINGERS. USE A RAG WHEN CHANGING.
28. IF THE LAMP IS TOUCHED INADVERTENTLY DURING INSTALLATION, CLEAN THE LAMP OR REFLECTOR WITH ALCOHOL AND DRY WITH A CLEAN, SOFT CLOTH BEFORE BURNING. CONTAMINATION OF THE LAMP OR REFLECTOR MAY REDUCE LAMP PERFORMANCE.
29. THIS LAMP EMITS UV (ULTRAVIOLET) RADIATION. PROLONGED EXPOSURE TO THIS LAMP MAY CAUSE SKIN AND EYE IRRITATION
30. USE ONLY ORIGINAL TUBING REPLACEMENTS-"MONTHLY AND QUARTERLY REPLACEMENT KITS". DO NOT USE CONVENTIONAL TUBING. THIS WILL CAUSE MALFUNCTION OF THE SYSTEM.
31. THE ANALYZER SYSTEM MUST NOT BE DISMANTLED OR REPAIRED BY ANYONE WHO HAS NOT BEEN QUALIFIED BY THE MANUFACTURER. INCORRECT WORK MAY CAUSE FIRE OR IRREPARABLE DAMAGE TO THE SYSTEM.
32. DO NOT OVERLOAD ACCESSORIES POWER OUTLETS AND EXTENSION CORDS AS THIS CAN RESULT IN FIRE OR ELECTRIC SHOCK.

33. DO NOT PLACE THE SYSTEM ON AN UNSTABLE CART, STAND, OR TABLE; THE SYSTEM MAY FALL, CAUSING SERIOUS INJURY TO USER, AND SERIOUS DAMAGE TO THE APPLIANCE. PLACE THE SYSTEM ON A STABLE, VIBRATION-FREE, LEVEL TABLE OR CART.
34. USE ONLY SECURE POWER SOURCE TO PROTECT THE ANALYZER SYSTEM AGAINST POWER SURGES. DISCONNECT TEMPORARILY THE ANALYZER POWER CORD FROM THE WALL OUTLET IN CASE OF BAD ATMOSPHERIC CONDITIONS.
35. DO NOT USE VACUUM PUMP UNTIL THE TWO TRANSIT SCREWS (COLORED RED) AT THE BOTTOM OF CABINET HAVE BEEN REMOVED **(VALID FOR OLD VACUUM PUMP SYSTEM P/N 662.0788 AND BY-PRODUCTS)**.
36. DO NOT OIL ANY PART OF THE SYSTEM.
37. EMPTY WASTE CONTAINERS WHENEVER THEY ARE FULL. ENSURE THAT THE CONTAINER LIDS ARE SCREWED ON TIGHTLY TO PREVENT LEAKAGE OR DISPERSION INTO THE ENVIRONMENT.
38. THE SAFE DISPOSAL OF THE ANALYZER WASTE MATERIAL WITH MINIMAL ENVIRONMENTAL IMPACT IS THE RESPONSIBILITY OF THE USER.
39. DO NOT ATTEMPT TO REMOVE ANY PANELS OR COVERINGS OF THE ANALYZER OR THE VACUUM PUMP SYSTEM WHILE THE SYSTEM IS IN OPERATION.
40. DO NOT USE SOFTWARE DISKS OF UNKNOWN ORIGIN IN THE ANALYZER COMPUTER AS THEY MAY INTRODUCE VIRUSES.
41. DO NOT USE THE COMPUTER OF THE ANALYZER FOR ANY OTHER PURPOSE THAN THE ONE FOR WHICH IT IS DESIGNED FOR.
42. AFTER OPERATION/SERVICING, COVER THE SYSTEM WITH A PROTECTIVE PLASTIC OR CLOTH SHEET.
43. BE PARTICULARLY CAUTIOUS THAT NO PARTS OF YOUR BODY (e.g. FINGERS HAIR, ETC.) OR LOOSE OBJECTS (e.g. CABLES, TUBING, ETC.) CAN BE TRAPPED BY ANY MOVING OR ROTATING PARTS (e.g. SAMPLING ARM, PLATES, WASHER MODULE, PUMP ROLLERS ETC.) OF THE ANALYZER SYSTEM.

NOTE:

a) THE CAREFUL OBSERVATION OF THE PROCEEDING WARNINGS SHOULD RESULT IN A LONG AND SATISFACTORY PERFORMANCE.

b) THIS INFORMATION IS BELIEVED TO BE CURRENT AT THE TIME OF PUBLICATION, BUT IT IS PROVIDED WITHOUT WARRANTY OF ANY KIND AND WE ASSUME NO RESPONSIBILITY WITH RESPECT THERETO.

WASTE DISPOSAL

- To ensure environment health and safety, it is recommended not to discard the used consumables, waste liquids or disposable maintenance kits into the environment.
- Insure that the disposal of waste material is done according to all applicable laws and regulations.

SAFE DISPOSAL OF THE UNUSABLE INSTRUMENT

For the proper disposal of instrument that is obsolete, outdated, beyond repair, or unusable, follow these steps carefully:

1) Remove all consumables from the instrument (test tubes, cups, bottles, containers, fluidic tubing etc.), and thoroughly clean the instrument with an approved disinfectant for decontamination.
2) Contact a firm specialized in "hazardous waste disposal" for safe instrument disposal.

NOTE:

a. ***The manufacturer of the instrument assumes no responsibility for any breaches resulting from the delivery of the analyzer to a third party for disposal.***

b. ***The manufacturer of the instrument is not responsible for collection and safe disposal of the instrument. The safe disposal of the instrument and its contents is the responsibility of the user.***

DANGER

a) TO AVOID ACCIDENTAL CONTAMINATION WITH CHEMICALS, PATHOLAGICALS, AND MICROBIAL CONTAMINANTS, USE SUITABLE GUARDS AND/OR PERSONAL PROTECTION-WHEN HANDLING CHEMICALS, SERUMS, REAGENTS, ETC.

b) THE SAFE DISPOSAL OF THE WASTE MATERIAL IS THE RESPONSIBILITY OF THE USER.

c) INSURE THAT THE DISPOSAL OF RINSE WATER IS DONE ACCORDING TO ALL APPLICABLE LAWS AND REGULATIONS.

d) ACCIDENTAL INJECTION OR PRICKING OF THE SKIN WITH ANY SHARP OBJECT (NEEDLES, ETC.) MAY CAUSE A PROLONGED AND VERY PAINFUL LOCAL ANTIMICROBACTERIAL INFLAMMATORY REACTION. EVERY PRECAUTION SHOULD BE TAKEN TO AVOID SUCH ACCIDENTS.

IMPORTANT NOTICE

THE "WARNINGS" INFORMATION ITSELF IMPLIES MANY NATURAL AND ACCEPTED PRECAUTIONS. THE "WARNINGS" INFORMATION, THEREFORE, IS NORMALLY USED TO CALL ATTENTION ONLY TO THE MOST IMPORTANT PRECAUTIONS, OR TO THOSE THAT ARE NOT NECESSARILY LISTED WITH THE INSTRUMENT COMPONENTS.
THE RESPONSIBILITY FOR THE SAFE USE OF THE INSTRUMENT OF "BIOTECNICA INSTRUMENTS S.p.A." RESTS WITH THE CUSTOMER. THE INSTRUMENT SHOULD BE OPERATED OR SERVICED BY THE QUALIFIED PERSONNEL FAMILIAR WITH LABORATORY PROCEDURES. THEY SHOULD ALSO BE FAMILIAR WITH THE NATURE OF THE SUBSTANCES USED IN COMBINATION WITH THE INSTRUMENT AND ANY NECESSARY PRECAUTIONS WHICH SHOULD BE TAKEN IN THE HANDLING, USE AND STORAGE OF THE PRODUCTS IN NORMAL USE. THE CUSTOMER SHALL BE RESPONSIBLE FOR THE CONTROL AND USE OF THIS INSTRUMENT WHETHER ALONE OR IN COMBINATION WITH OTHER ARTICLES OR SUBSTANCES OR IN ANY OTHER MANNER WHATSOEVER.

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- ® *Pharmed is a registered trademark of Norton Performance Plastics Corporation.*
- ® *Baydur is a registered trademark of Bayer Polymers, LLC.*

CONFORMANCE

IMPORTANT NOTICE - EMC CERTIFICATE

The analyzer BT3000 PLUS has passed all the tests relevant to Electromagnetic Compatibility (EMC) and electrical safety. This product received the certificate of compliance with international standards EN 66110-1 and EN 61326-1 from OCE (Organismo di Certificazione Europea) of Rome (Italy), accredited and certified (certificate number 051 of 21 Oct.1998) by Ministero delle Comunicazione of Italy. The test reports 46/E and 47/E are available upon request.

CE

This product conforms to the safety requirements of the Council Directives 98/79/EEC of 27 October 1998 (European Parliament) regarding the In-Vitro Diagnostic Medical Devices. This directive is in accordance with the Article 2, Paragraph 2 of the Directive 89/336/EEC, which ceases to apply to the products complying with the present directive. Refer to Paragraph 7, Article No.1 of the IEC Official Gazette No. L331 of Dec. 1998.
It also conforms to Italian Regulations CEI EN 61010-01 and CEI EN 61326-1 (EMC).

The conformity is attested when the equipment is installed
in accordance with the conditions outlined in the manual

THE COMPANY PROFILE

Biotecnica was founded in 1972, with years of technical expertise and manufacturing knowledge in the field of design, production, sales and technical support behind its staff. The Company develops and manufactures clinical chemistry equipment and relevant reagent products, to be sold directly and through OEM agreements. The market consists of private and state clinical laboratories, hospitals, clinics, day hospitals, and universities, etc. Since that time the company has developed and produced instruments of uncompromising performance characteristics, which has enabled Biotecnica to become one of Europe's leading manufacturers of clinical chemistry instruments. Biotecnica is headquartered in Rome (Italy) and markets products both domestically and internationally through a network of distributors.

Our actual range of instruments is composed of:

- Photometers for clinical chemistry
- Automatic analyzers for clinical chemistry
- Electrophoresis densitometers & accessories
- Flame photometers & associated reagents
- Ion selective analyzer
- Clinical chemistry reagents

Biotecnica has over 3,000 square meters of manufacturing facility, which houses the latest in engineering, manufacturing, testing, and quality control equipment. It is staffed with highly experienced personnel with a dedication to quality.

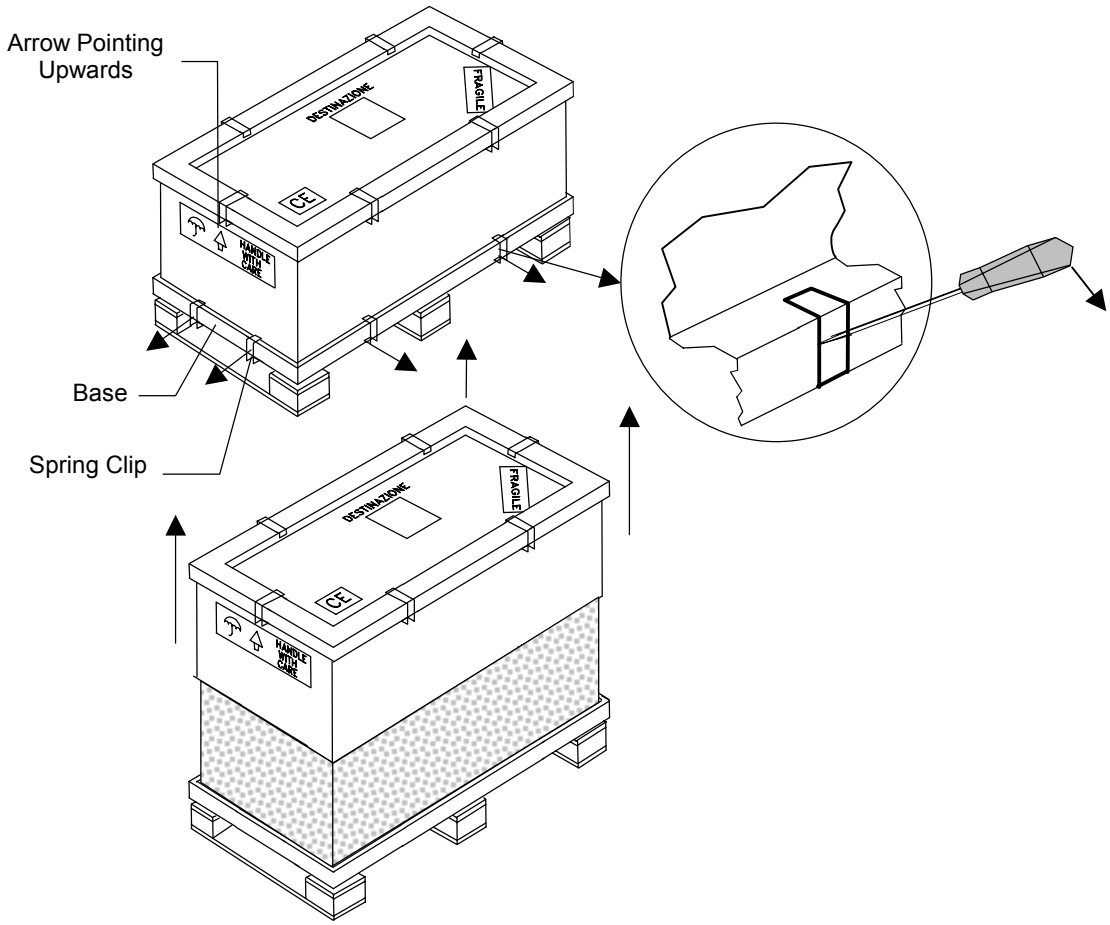
The company supplies more than just products, it provides highly efficient technical and manufacturing support based on the requirements of its customers with ongoing training programs to keep them current on advancements in technology. A global network of distributors and sales engineers, assure the most comprehensive customer support across the world.

For more information about Biotecnica, visit the Biotecnica web site at www.biotecnica.it Please do not hesitate to contact us. We will be pleased to assist with any inquiries you may have.

PACKING / UNPACKING THE ANALYZER

UNPACKING THE ANALYZER & ACCESSORIES

Two wooden crates contain the analyzer and the accessories. The crates can be easily opened by applying a lever action, with a large screwdriver, to remove all the spring clips on the base of the crate as shown in the figure below. Carefully remove the upper covering from the base. Remove the analyzer and place it on a stable, vibration-free-surface, level table or cart. Carefully unpack all the accessories and place them in a protected place. Store the empty wooden crate assy in a safe place for future use.



Verify upon receipt of the BT3000 PLUS analyzer system that all parts are present and intact when opening the wooden crates and packaging. If there is a damage or missing items then please fill out the form found in the Operator's Manual. Refer to Section 2, Chapter 2, and entitled "Warranty". Return it to your nearest sales/service office or directly to Biotecnica Instruments S.p.A. After appropriate evaluation, Biotecnica or its branch office will provide the best solution to the problem.

VERIFICATION OF THE CONTENTS OF THE WOODEN CRATES

In the Basic Package, the BT3000 PLUS analyzer system is provided with the following items:

Contents of Large Wooden Crate		
Qty	**Description**	**OK**
1	ANALYZER	
1	USER'S MANUAL	
1	INSTALLATION DISK	
1	IMAGE DISK (HARD DISK)	
1	WINDOWS 2000 PROFESSIONAL SOFTWARE DISK WITH LICENSE	
1	DRIVERS AND UTILITY DISK	
1	UPS DRIVER	
1	PRINTER DRIVER	
1	VGA DRIVER DISK	

Contents of Small Wooden Crate		
Qty	**Description**	**OK**
1	SURFACTANT WASH CONC. 2x50 ml (P/N 392)	
1	WASHING SOLUTION FOR CUVETTE 1 liter (P/N 393)	
1	ISE STARTER KIT (P/N 947)	
1	Cl ELECTRODE CLEANING TOOL (P/N 03254)	
1	VACUUM PUMP SYSTEM, (P/N 06-05161-01)	
1	BIMONTHLY MAINTENANCE KIT (P/N 662.1016)	
1	SIX-MONTHLY MAINTENANCE KIT (P/N 11-05219-01)	
1	ANNUAL MAINTENANCE KIT (P/N 11-05220-01)	
1	FUNNEL CAP OPENER, TOOL (90-05201-01)	
1	TRANSPARENT OVERFLOW TUBE 50cm LONG	
1	CORDLESS KEYBOARD & MOUSE (P/N 662.2057)	
1	UPS UNIT 1100VA (P/N 330.2132)	
1	PRINTER (P/N 330.2172)	
2	FUSE 250 VOLT, 0.5A RVT (P/N 330.6338)	
2	POWER CORDSET F/M VDE (P/N 330.6400) FOR PERIPHERAL DEVICES.	
2	FUSES 250 VOLT, 8A RVT (P/N 330.6342B)	
1	POWER CORDSET (P/N 330.6391).	
1	QUARTZ HALOGEN LAMP 12V, 35W, 9° (P/N 330.9321)	
1	CLEANING TOOL FOR SAMPLING NEEDLE (P/N 662.0629A)	
3	CUBITAINER 10 LITERS WITH BOX (P/N 662.1010)	
1	WASHING PISTON GRIP SLEEVE, TOOL (P/N 662.1025)	
1,000	TRANSP. SAMPLE CAPSULE 2ml #STD & CTRL (P/N 667.1040)	
50	REAGENT CONTAINER 80 ml WITH CAP (P/N 667.1072)	
50	REAGENT CONTAINER 50 ml WITH CAP (P/N 667.1073)	
25	REAGENT CONTAINER 20 ml WITH CAP (P/N 667.1074)	
25	REAGENT CONTAINER 10 ml WITH CAP (P/N 667.1076)	
1	50 ml BOTTLE WITH SCREW CAP (P/N 667.1080)	

♦ VERIFYING EVENTUAL DAMAGES OCCURRED DURING SHIPMENT

It is highly recommended to accurately verify the instrument and its accessories for any damages that could have occurred during shipment. In case there is a damage or missing items then please fill out all the sections of the Form 05-35a in this section. Send it to your nearest sales/service office or directly to Biotecnica Instruments S.p.A. Rome, Italy. After appropriate evaluation, Biotecnica or its branch office will provide the best solution to the problem.

NOTES FROM THE MANUFACTURER

- **The Biotecnica Instruments S.p.A. reserves the right to revise this manual without notice, for any reason. This includes but is not limited to, utilization of advance in the state-of-the-art and changes thereof. Product enhancement resulting from our continuing quality improvement effort may necessitate changes in specifications without notice. This fact doesn't oblige the company to inform its actual customers because the information included in the present manual refers to state of the product when shipped, thus no warranty about notification of future changes is given.**
- **The information contained in this manual is proprietary with "Biotecnica Instruments S.p.A.". Reproduction of any part or whole may only be performed with written permission from "Biotecnica Instruments S.p.A.".**

SECTION - I
INTRODUCTION - BT3000 PLUS

The BT3000 PLUS is an automated analyzer for the determination of clinical chemistry and electrolyte results. The combined performance of this analyzer is from 300 to 500 tests per hour.

The technical material in this manual is for approved technical personnel with reasonable familiarity with similar instruments only. A diligent effort has been made to provide engineering illustrations, schematics, and other helpful information regarding the analyzer on the following pages to facilitate the task of service personnel.

The BT3000 PLUS is a fully automatic analyzer that can perform high volume of analysis on serum or urine samples. The test sample is followed continuously, upon insertion, so the analysis can be performed quickly and with maximum reliability. The automated instrument consists of the following three distinct subsystems:

a) The Mechanical System: Utilized for the transfer of the solutions, samples, and reagents
b) The Electronic System: Based on microprocessors for activating drive motors, alarm devices, and temperature control, etc.
c) The Information Management System: IBM® compatible for patient inputs, processing of the results, and communication with the host computer etc.

1-1. Examples of The Basic Operations of Clinical Chemistry

1-2. PHASE 1: Creation of the Worklist.

1-3. PHASE 2: Placement of Samples and Reagents

1-4. PHASE 3: Start-up.

1-5. PHASE 4: Process Initiation

The mechanical arm is equipped with a sampling needle that can perform both swiveling and up/down motions to accomplish complete mixing during the sampling cycle along with the diluter pump. The cycle sequence starts with the aspiration of the reagent and the serum, followed by the dispensing and mixing in the reading cuvette.

The sampling cycle is performed using the following devices: a sampling arm, a diluter pump, and a peristaltic pump. The sequence of the sampling cycle is as follows:

a) Washing and drying of cuvettes
b) Reagent aspiration
c) Needle washing
d) Sample aspiration
e) Dispensing and mixing the solution in the pre-washed and dried cuvette
f) Washing the needle and the hydraulic circuit

The diluter provides the aspiration of the solution. A built-in liquid sensor, attached directly to the needle mechanism, controls the descent of the needle into the reagent or sample. This controlled immersion of the needle avoids any excessive contamination. The first part of the hydraulic circuit (located inside the sampling arm) is pre-heated to about 40°C in order to compensate for the low temperature of the reagent. The peristaltic pump provides approximately 2.0ml of H_2O into the waste bowl to wash the needle and the attached hydraulic circuit.

1-6. PHASE 5 - Reading Cycle

In this phase, the sample remains in its cuvette for the necessary incubation time, after which, the reading phase will begin. The reading cycle takes place every 10 seconds and lasts about 2 seconds. The photometer, located under the reading station, converts the luminous intensity of the cuvettes into digital signals and transfers them to the microcontroller. After the initial reading, the acquired data is stored as concentration and absorbance values for generating the test results.

1-7. Examples of Basic Electrolytes Operation

The process described above regards the complete dynamics for the testing of clinical chemistry samples. The operation for running electrolytes is similar and can be performed simultaneously with the preceding clinical chemistry samples. The final solution to be analyzed is not dispensed into a cuvette, but into the ISE (Ion Selective Electrode) funnel located on top of the ISE module. Obviously the phases 1, 2, and 3 are basically the same.

1-8. ISE Sampling

The right sampling arm aspirates the reagents positioned near the ISE Module on the right of the analyzer. The sampling is performed in two phases. The first phase is dedicated to the aspiration and dispensation of the reference solution into the ISE funnel. The second phase is assigned to the sampling of serum aspirated together with diluent reagent and buffer. The solutions are dispensed and mixed in the ISE funnel followed by the use of a peristaltic pump to draw the solution into the ISE electrodes for measurements. The signal produced by the electrodes is then processed, as per the NERNST formula, and is translated into values of concentration. The ISE module has its own diluter pump that is similar to that of the sampling (located on the reading station) for clinical chemistry.

SECTION - II
TECHNICAL SPECIFICATIONS

NOTE: Specifications are subject to change without notice.

2-1. PHYSICAL DIMENSIONS OF THE BT3000 PLUS

Packed analyzer without accessories:	Approximately 135 Kg. (298 lb)
Packed analyzer with accessories:	Approximately 225 Kg. (496 lb)
Packed accessories:	Approximately 90 Kg. (199 lb)
Analyzer dimensions:	W = 100cm (40"), D = 58cm (23"), H = 68cm (27")
Crate dimensions:	W = 120cm (48"), D = 80cm (32"), H = 80cm (32")
Accessories package dimensions:	W = 120cm (48"), D = 72cm (29"), H = 70cm (28")

NOTE: Weight and dimensions shown are approximate.

2-2. POWER SUPPLY REQUIREMENTS

BT3000 PLUS analyzer:

Input Voltage Range:	Universal input, 90 - 240 V~
Input Frequency:	50-60 Hz
Power Consumption:	590 Watts max

New "Vacuum Pump System" P/N 06-05161-01:

Input:	90/240 V~, 50-60 Hz
Power:	60 Watts

Previous "Vacuum Pump System" P/N 662.0788 - (OBSOLETE)

Input:	220 V~, 50-60 Hz (110 V~ on request)
Power Consumption:	80 Watt

Printer (accessory): Approx. 50 Watts, 100/240V~ (depending upon model)

UPS (optional): Input 210V~, 50-60 Hz (110 V~ on request)
Output 210V~, 50-60 Hz (110 V~ on request)

The detailed information regarding the specifications of the instrument power supply is outlined in Section XI entitled "Power Supply" The internal power supply of the analyzer is stabilized and incorporates the Power Factor Correction device (PFC), thereby require no additional external electronics accessory. The use of an optional UPS device (uninterrupted power supply) is recommended to avoid undesired power interruptions and to ensure software integrity in case of sudden power failure.

2-3. EMC AND ELECTRICAL SAFETY

The BT3000 PLUS chemistry analyzer conforms to following EMC directives (Electro Magnetic Compatibility):

EMC:	EN61326
EMC:	EN55011
Electrical Safety:	EN61010-1

The EMC performance characteristics and electrical safety reports are available upon request.

2-4. PERFORMANCE & TECHNICAL SPECS

Operating Mode:	Random access
Methods:	Tests for Clinical Chemistry and Immune-Chemistry
ISE Module:	Na, K, Cl (CO_2 optional)
Test Mode:	Routine, Batch, Emergencies (STAT), and profiles
Tests on line:	80 refrigerated reagents + Relation Tests
Tests in memory:	500 single or double- reagent + unlimited Relation Tests
Test Re-runs:	Automatic or on demand
Calibrations and Controls:	Automatic or on demand
Automatic Profiles:	Automatic execution of related profiles or on demand
Measurement:	Direct reading of 34 cuvettes in non-disposable optical glass
Quality Control:	3 known levels and 3 unknown levels
Remote Diagnostic:	Via modem (optional)
Maintenance:	Automatic program
Sample Tray Capacity:	52 positions for Samples & STAT, 26 for Standard and Controls
Sampling Arm:	2, for serum and reagents
Bar code scanner:	2 distinct readers for positive identification of samples and reagents

TIME REQUIRED TO REACH STEADY STATE

Ambient conditions:	21 °C R.T., 33% RH
Time required for the analyzer to reach steady state:	20 minutes
Ambient conditions:	21°C T. A., 33% RH
Time required for refrigerated bottles to reach steady state:	Approximately 2 hours

CLINICAL CHEMISTRY

Sampling Cycle:	11 seconds
Analytical throughput:	330 tests/hour single reagent
Test processing time	max 360 seconds

ISE PROCEDURE

ISE Test processing time:	70 seconds
Executive throughput:	51 Samples/hour
Analytical throughput:	204 Results/h (K^+, Na^+, Cl^- and CO_2)

2-4.1. OPERATING AMBIENT CONDITIONS

The instrument will perform optimally in the following ambient conditions:

CUVETTE OPERATING TEMPERATURE

Programmable Temperatures: Room Temperature, 32 °C, and 37 °C

Precision ± 0,2°C - Accuracy ± 0,2°C

Temperature Monitoring Device based on Peltier Effect

REAGENT CHAMBER TEMPERATURE

Nominal Temperature: 11°C Approx.

Temperature Monitoring Device based on Peltier Effect

OPERATING AMBIENT TEMPERATURE

18 °C to 32 °C, 10% to 90% RH, Non condensating

2-4.2. VOLUMES

WORKING SOLUTIONS

Clinical Chemistry

Reaction Volume:	280 µl minimum - 700 µl max (for double reagent)
Sample Volume:	From 1 to 100 µl

ISE

Concentrated Buffer Solution:	50 µl + 400 µl (H_2O)
Concentrated Reference Solution:	50 µl + 400 µl (H_2O)
Sample Volume:	30 µl
Concentrated Buffer 10 ml:	200 tests
Concentrated Reference Solution 10 ml:	200 tests

RESIDUAL VOLUMES OF REAGENT BOTTLES

80 ml BOTTLES:	1 ml
50 ml BOTTLES:	1 ml
20 ml BOTTLES:	0.5 ml
10 ml BOTTLES:	0.5 ml

2-4.3. ISE MODULE

The ISE Module is designed to utilize solid state Ion Selective Electrodes:

Number of electrodes:	4 plus Reference Electrode	
Analytes:	K^+, Na^+, Cl^- e CO_2 (optional)	
Test processing Time for the ISE:	70 seconds	
Executive throughput:	51 Samples/h	
Analytical throughput:	204 Results/h (K^+, Na^+, Cl^- and CO_2)	
Number of Reagents for the test:	2, Buffer and Reference Solution (concentrated)	
Sample Type:	Serum, Urine (Whole)	
Minimum Sample Volume:	30 µl	
Concentrated Reagents Dilution:	1/10 with H_2O (automatically)	
Dilution of Serum/ Buffer:	1/14 (automatically)	
Precision on Serum test:	± 1% for K^+, Na^+	
	+/- 2% Cl^-	
	+/- 3% CO_2	
Precision on Urine test:	+/- 2%	K^+, Na^+, Cl^-
Linearity for Serum test:	Na^+ 50 - 200 mEq/l	K^+ 1 - 20 mEq/l
	Cl^- 50 - 400 mEq/l	CO_2 10 - 45 mEq/l
Linearity for Urine test:	Na^+ 20 - 400 mEq/l	K^+ 2 - 200 mEq/l
	Cl^- 40 - 400 mEq/l	
Accuracy for Serum test:		
Intra Run Serum (20 samples):	Na^+ K^+	C. V. < 1%
	Cl^-	C. V. < 2%
	CO_2	C. V. < 5%
Infra Run Serum (N°20 samples):	Na^+ e K^+	C. V. < 2%
	Cl^-	C. V. < 2.5%
	CO_2	C. V. < 5%
Accuracy for Urine test:		
Intra Run Urine (20 samples):	Na^+, K^+ e Cl^-	C. V. < 2%
	CO_2	C. V. < 5%
Infra Run Urine (20 samples):	Na^+, K^+ e Cl^-	C. V. < 2.5%
Average Life of Electrodes:	Na^+ and Reference Electrode	12 months
	K^+	3 months
	Cl^- & CO_2	3 months

2-4.4. "UTILITY" EXECUTION TIMES

Wash & Fill Up:	270 sec. (approximately)
Wash H_2O:	180 sec. (approximately)
Zeroing:	420 sec. (approximately)
F.C.C.:	900 sec. (approximately)
Extra Wash ISE:	800 sec. (approximately)
Extra Wash Cuvette:	540 sec. (approximately)
Wash Shut Down:	12 min. (approximately)

WASH VOLUMES

Clinical Chemistry Washes:

H_2O Single Wash of Cuvette:	5 ml (approximately)
H_2O Single Wash of Needle:	2 ml (approximately)
Consumption per test:	7 ml (approximately)
H_2O for Zeroing:	250 ml (approximately)
H_2O Total Wash of Cuvette:	170 ml (approximately)
Extra Wash of Cuvettes:	approx. 170ml H_2O + 13ml Cuvettes Washing Solution

I.S.E. Washes:

H_2O per test:	2 ml (approximately)
I.S.E. Extra Wash:	0.5 ml I.S.E. Washing Solution 0.5 ml Enzyme Solution

2-5. FUNCTIONAL LIMITS

The instrument will not perform correctly in the following situations:

1) Out of range (defined) ambient conditions.
2) Use of unapproved chemical products such as Washing Solution, Distilled Water, and ISE reagents etc.
3) Non-observance of care and maintenance procedures.
4) Use of unapproved spare parts and consumables.

The manufacturer does not guarantee the correct instrument performance if new methods are implemented unexpectedly. Consult the manufacturer regarding application of different methods.

2-6. CUVETTE TEMPERATURE CONTROL

The cuvette plate is thermally controlled in a very precise way. The solution dispensed in the cuvette reaches the working temperature in minimal time possible. However, it is possible to observe a notable time difference due to the potential difference of the temperature of reagents. Therefore, the heated sampling tube aids in preheating the reagent before dispensing.
The stabilization times of the solution in cuvette range from 80 seconds to 60 seconds with reagent temperatures at 11°C and 22°C, respectively. The time was measured after the solution had reached 36.7°C:

Accuracy measured after 2 minutes:	+/- 0.25°C.
Adjustment measured after 2 minutes:	+/- 0.20°C.

2-7. REAGENT REFRIGERATION

The purpose of reagent refrigeration is for optimal conservation and reagent performance. The temperature inside the reagent chamber is variable, based on the external ambience and the time inside the refrigerated chamber. A reagent bottle inside the chamber gradually reaches the minimum temperature within 2 hours. The temperature range may go from 10°C to 22°C with outside temperature of 20°C and 32°C, respectively.

2-8. DILUTER LINEARITY AND ACCURACY

A unique diluter system is used for the processing of chemistries and ISE testing. Technical Specifications for the Biotecnica dilutor are as follows:

Diluter:-

Volume F.S.:	470 µl
Linearity F.S.:	+/- 0.1% F.S.
Accuracy at 3 µl:	+/- 3%
Accuracy from 10 to 470µl:	+/- 1%
Reproducibility:	+/- 0.7% at 3µl; +/- 0.6% > 3µl
Life Expectancy:	3 million operating cycles
Maintenance:	Every 300,000 operating cycles (O-ring seal replacement)

Peristaltic Pump:-

Dispensation Volume:	Approximately 1ml per sec.
Average Life	>1 million cycles
Maintenance:	Every 50,000 cycles (Cartridge replacement)

Pinch-Valve:-

Average Life:	Approximately 1 million cycles
Maintenance:	Monthly replacement of valve tube

NOTE:
All declared values are approximate and are dependent upon work load of the components, inactivity, and observance of routine maintenance.

2-9. PHOTOMETER LINEARITY AND ACCURACY

Optical System	Solid state photometry, (patented by Biotecnica Instruments)
Detectors	10 UV/VIS photodiodes + reference channel

PRECISION AND ACCURACY

Spectral Response:	340, 380, 405, 436, 480, 510, 546 578, 630, 700 nm
Bandwidth:	+/- 5nm max
Linearity O.D.:	+/- 1% from 0 to 2,000; +/- 2.5% from 2,000 to 2.400
Resolution:	+/- 0.0005 Abs.
Drift:	+0.005 Abs. per hour (after warm-up)
Optical path length	7 mm

NOTE: The specification regarding drift applies exclusively to the photometer, excluding the drift related to the halogen lamp of the photometer.

2-10. PHOTOMETER TUNGSTEN HALOGEN LAMP

This lamp is custom made for Biotecnica Instruments S.p.A. It is a halogen lamp with dichroic reflector and a special coating for maximum UV (ultra violet) emission.

Beam Angle:	9°
Watts:	35W
Volts:	12
Avg Rated Life:	Approximately 2000 hours

***NOTE:* For optimal result the lamp can be used for about 1500 hours. The long-term use will result in the gradual deterioration of the UV emission.**

2-11. DATA MANAGEMENT

Computer	≥ Pentium IV ≥ 2400 MHz or more, IBM compatible
DVD/CD Rom Player	≥ 16X
Hard disk	>20 Gb
Floppy Disk Drive	1,44 Mb
Monitor	LCD Display Module TFT 12" with integrated touchscreen
Interface	2 Serial Ports RS232C + 2 USB PORTS
Printer	Ink-jet Color IBM compatible or other
Mouse & keyboard	Cordless
External Modem	Optional
Error Messages	Visible (Vocal optional)

2-12. FLUID DYNAMICS

Mixing, Prime, Water H_2O Supply, Liquid Sensor Sensitivity, Contamination, Sample Viscosity, Carry-Over, and Sample Evaporation.

2-13. WASHING SOLUTION SUPPLY

The analyzer BT 3000 PLUS, utilizes distilled water mixed with a surface - active agent (surfactant) for all the washing and sampling operations. The operator can use any container of desired dimensions for the washing solution. The container can be positioned at a considerable distance from the analyzer as a powerful peristaltic pump is used for constant supply of washing solution to the additional reservoir of the analyzer.
The maximum permissible connecting tube distance between the analyzer and the water container is 25 meters horizontally and 6 meters vertically. This data is valid for a flexible plastic tube with inside diameter of 6 mm max.

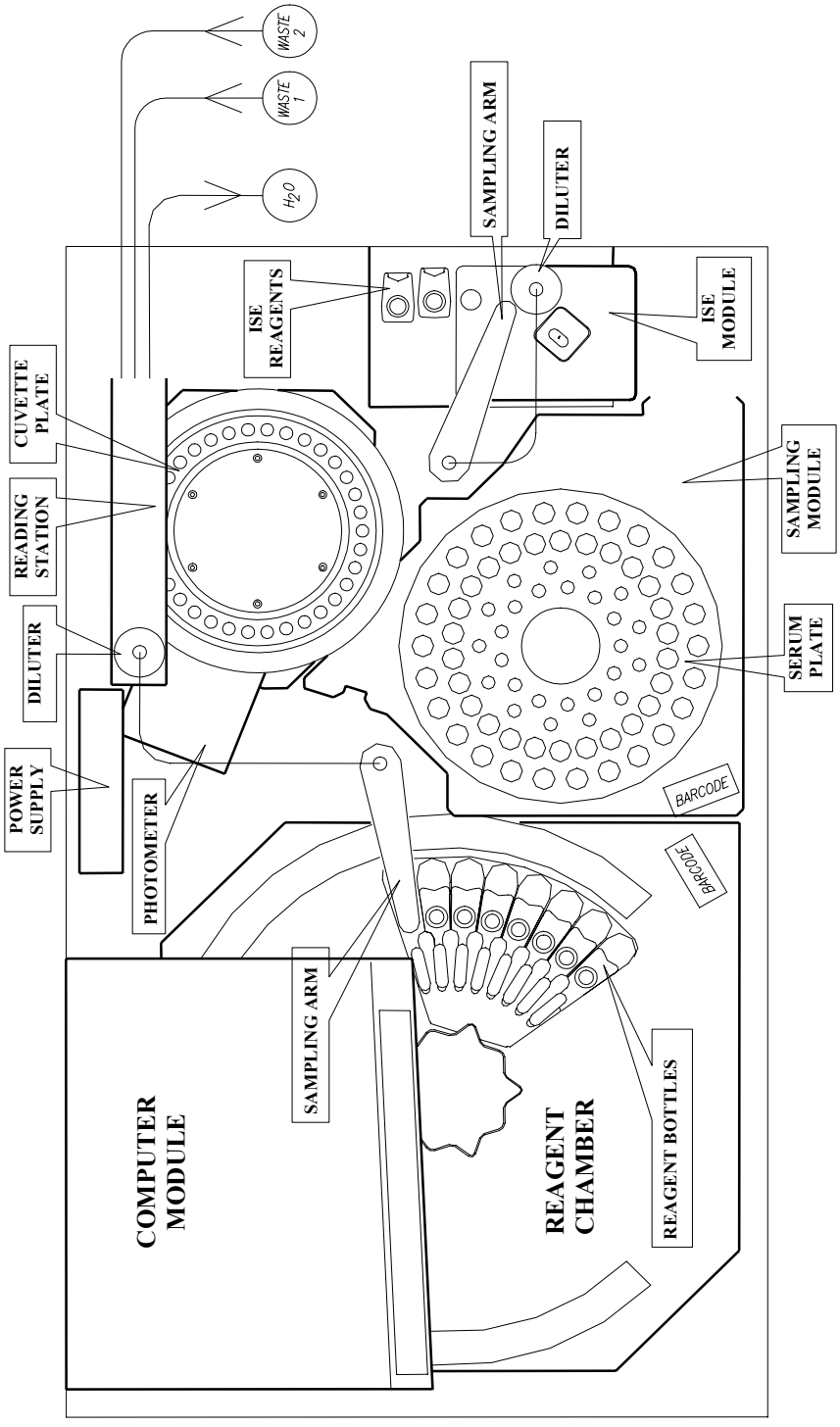
2-14. LIQUID SENSOR

The liquid sensor incorporates a high frequency electronic circuit with functions of capacitive discriminator.
For this characteristic, the sensor can detect any type of liquid including distilled water with the same sensitivity. In the normal operating conditions the minimum detectable volume is 100 µl.
The limiting factor necessitates that the container is surrounded by a metallic surface. The distance of the isolating material from the metal should not be more than 4 mm. However in different conditions and without the surrounding metallic material around, the analyzer is sensitive to minimum volumes of 150 µl.
Recently carbon filled plastic adapters (black) have been introduced, which have identical characteristics to the ones in metal.

SECTION - III

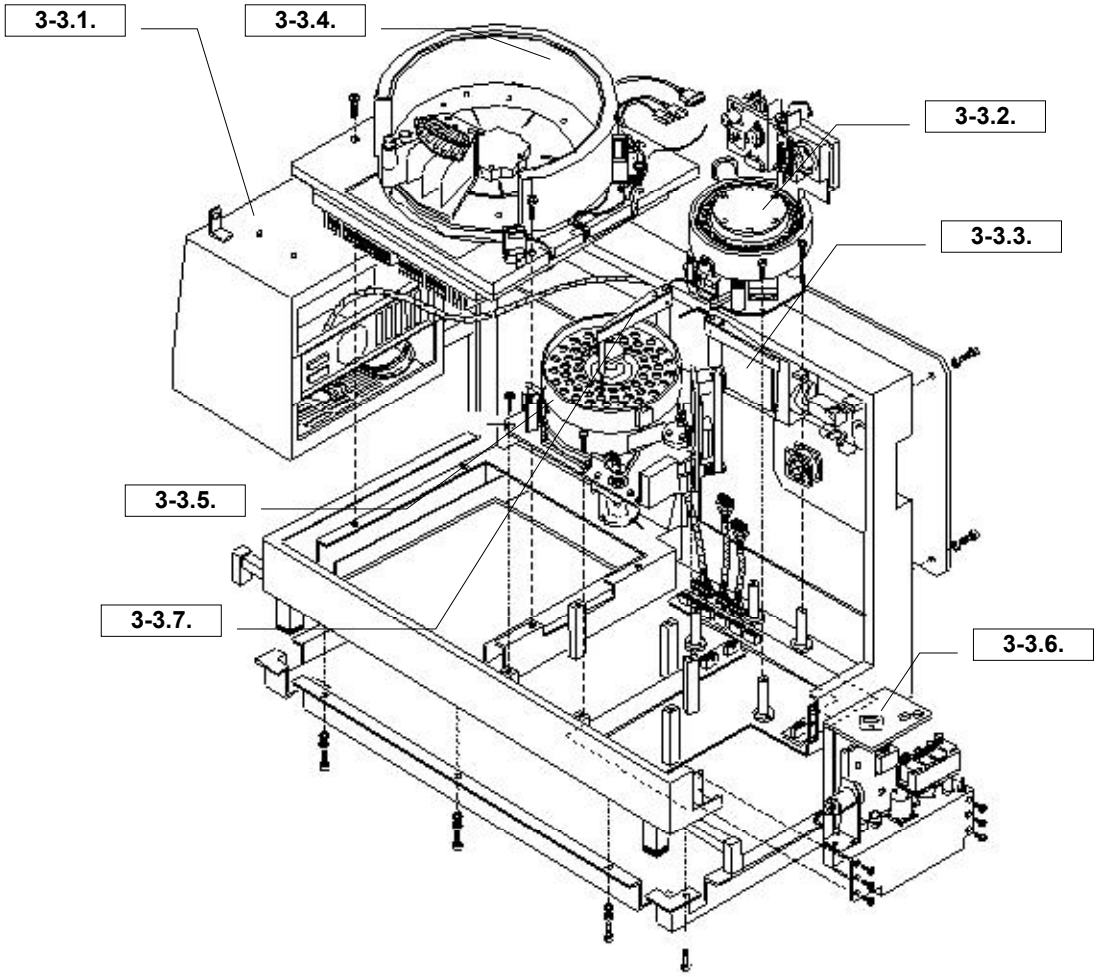
ELECTRONICS

3-1. Top View of the BT3000 PLUS



3-2. Analyzer Structure

The analyzer structure is composed of a heavy-duty sheet metal. The outer casing and covers are molded in a highly resistant Baydur® material. The preceding figure illustrates the location of various modules on the analyzer. Each module has a specific function for the analyzer operation.



3-3. Description of Analyzer Modules

3-3.1. Computer Module

The computer module consists of a LCD monitor, a touch-screen, main-board, power supply, and peripheral devices.

3-3.2. Reading Station

The reading station is comprised of a cuvette plate, photometer, diluter, washing station, water reservoir, and the associated electronics.

3-3.3. Power Supply Module

The power supply module is the general power source of the analyzer.

3-3.4. Reagents System

The reagent system consists of the rotating reagent plate, refrigeration system, barcode, and electronics.

3-3.5. Sampling Module

The sampling system consists of the rotating serum plate, barcode, Vacutainer® sensors, washing bowls, and electronics.

3-3.6. ISE Module

The ISE module consists of the electrodes panel, diluter, ISE reagents, and electronics.

3-3.7. Dual Sample Arm Modules

The dual sample arm modules consists of 2 sampling arms, incorporating electronics with appropriate Servomotors, and sampling needles.

Note: *For detailed description of the preceding modules, refer to Sections VI to XII of this manual.*

3-4. System Electronics

The electronics of the analyzer, with the exception of the IBM compatible computer, is composed of 80C51 micro-controllers. All the modules are defined as intelligent peripherals.

Micro-controller 87LPC764 is programmed to perform process control functions assigned to it as a slave driver. The master functions are performed by a 552 microprocessor, which communicates with the main-board of the IBM through RS 232 serial port. The modules communicate between them through the I^2CBUS protocol, established by only two conductors, SCL and SDATA. The wiring of the instrument is extremely simplified, with the cable connecting various modules has only two wires for communication and additional wires for power supplies.

The power supply of the instrument is composed of two power supplies of high quality. One power supply is located inside the computer module and is used for powering the IBM module with its various peripheral devices. The 5 Volt power supply, in addition to supplying the main-board, is used for energizing the series of micro-controller modules.

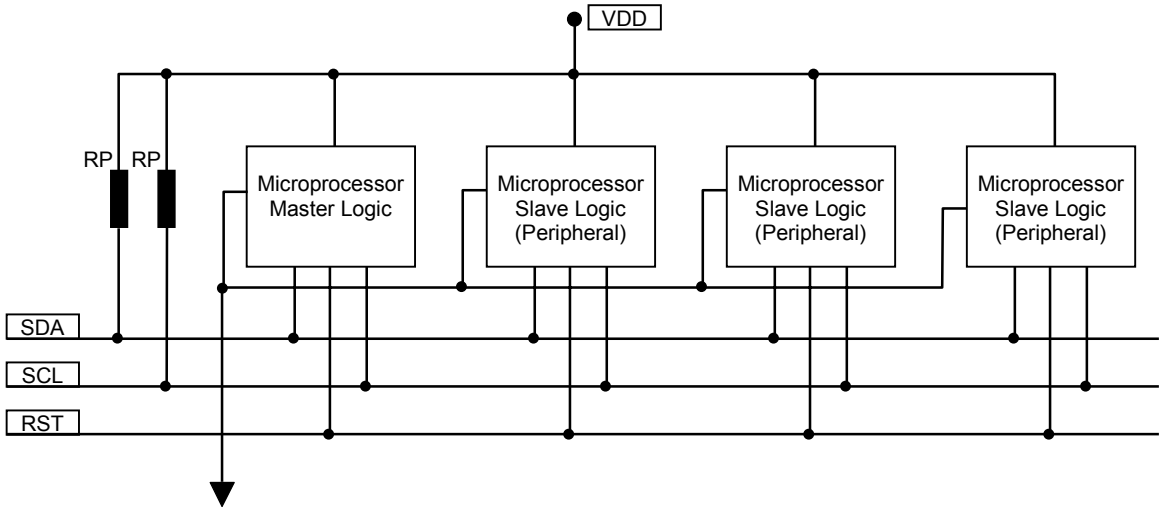
The second power supply, located outside the computer module, is for the supply of voltage to the power circuits. The three voltage outputs power the following systems:

1. 24V, 8A; variable from 18 to 26 Volts, for refrigerated Peltier groups.
2. 24V, 8A; stabilized the servomotors, solenoid valves, pumps, temperature controls, and fans
3. 12V, 8A; stabilized, for Halogen lamp of photometer

All of the supplies are isolated to enhance digital communication through the opto-electronic devices, thus greatly reducing the interference, which is typical of direct digital-power circuits communication. Both of the power supplies incorporate PFC and have a universal input, which ranges from 100 to 240 Volts.

3-5. Example of the I²C-BUS Configuration

The I²C-BUS uses several microprocessors as shown below:



SECTION - IV
SOFTWARE

Important Notice:

Any modification to the Variable Serial Protocol is restricted to qualified personnel only. The Biotecnica Instruments S.p.A. guaranties the correct performance of the internal serial protocol. The responsibility for any malfunction arising out of any modifications to the scripts of the Variable Serial Protocol rests with the customer.

WARNING

This information regards the setting up of the barcode for sample tubes identification. The reading of the sample barcode label has the same progression as patient code.
For example: Once a patient code of 15 characters has been entered, then a code of 8 characters followed by 7 empty spaces to reach the 15 characters is sent.
The code read on the barcode label must have the same sequence 8 + 7 for correct detection.

SERIAL COMMUNICATION OF THE BT3000 PLUS TO A HOST COMPUTER

4-1. GENERAL

The analyzer BT 3000 PLUS allows bidirectional communication through RS 232C serial connection with any host computer.
The particular feature of the dialog is that it is always the host computer, which initiates the communication for either transmitting patient list or for receiving the results.
To initiate any communication the host computer will have to send to analyzer the character STX (0x02) and expect the character ACK (0x06) as a response. At this point the host computer will send data to the analyzer and terminate the communication by sending the character EOT (0x04).
It is important to remember that any communication is followed by a response from the analyzer.
It must be noted that if the parameter to be transmitted is shorter in length than the length requirement of the communication protocol than a space must be added before or after. For example the analysis have length 4, therefore to send a code GLI one must add a space before or after to reach the length of 4 characters.

4-2. PATIENT TRANSMISSION

- ► Start communication with sequence STX<->ACK
- ► Send patient code..... (15 characters)
- ► Send list type for patient insertion..... ("T" for Routine or "R" for STAT)

- ► Send type of serum..... ("S" for Serum or "U" for Urine)
- ► Send if the patient is a clone..... ("Y" for Yes or "N" for No)
- ► Transmit position of capsule..... ("00" unknown)
- ► Send number of tests to be executed..... (from "01" to "99")
- ► Send codes of tests to be performed..... (4 characters)
- ► Send Check-Sum..... (3 characters)
- ► Send end transmission character EOT
- ► Wait for response from the analyzer..... (2 characters)

If the communication is successful then the analyzer responds with character "Y" followed by a byte, which identifies the position where patient has been inserted. In case the communication was unsuccessful, then the analyzer responds with "N" followed by a byte identifying the type of error. The possible errors generated by the analyzer in response to the invalid insertion of patient are as follows:

0x01..... Check-Sum Error
0x02..... Unknown Command
0x03..... Routine/STAT field Error
0x04..... Serum/Urine field Error
0x05..... Clone Yes/No field Error
0x06..... Capsule position Error
0x07..... Number of Analysis field Error
0x08..... Wrong Number of Test
0x09..... Position already in execution
0x0A..... Cloning impossible
0x0B..... Code duplicated
0x0C..... One or more analysis not present in the analyzer
0x0D..... One or more analysis not present in the current plate
0x0E..... Too many analysis for the patient

For example to send a patient with code 000000000000001, serum type and with analysis GLI, BUN and COL onto the STATS list, then one must send the following sequence of characters (excluding initial sequence STX<->ACK):

000000000000001RSN0003GLI BUN COL 134<EOT>

Where:

000000000000001..... Patient code
R..... Identifies STATS list
S..... Identifies the type of patient (in this case: Serum)
N..... Identifies that the patient is not a clone
00..... Unknown position (the analyzer will insert the patient in a convenient position)
03..... identifies the number of test to be executed.
GLI, BUN, COL..... Test codes (observe the space after each code to reach the 4 characters limit)
134..... Identifies the Check-Sum
<EOT>..... This character ends communication

4-3. RESULTS RECEPTION

There are three commands for receiving reports from the analyzer:

R..... Reception of next available report
L..... Reception of the last report sent (in case of reception problems)
A..... Reception of the first available report (in case one desires to receive again all the reports)

The commands R, L, and A require standard communication or the procedure STX<->ACK and the character EOT to end communication.
As a response to one of these three commands the analyzer sends the requested report (if available) or the character NAK (0x15) if there is no report to be sent.
It must be borne in mind that after a run test the reports are not immediately available for transmission, as these need validation. To do this go to Utility menu, RS232 and enable the option "Accept result to be sent". This operation must always be performed after each run test or groups of run test.
There is also an additional option for performing validation operation automatically. Go to Setup of the analyzer (Menu Utility, Setup Analyzer), go to the Serial (fourth from the left) and enable the option "All results must be sent automatically (without validate)" at the bottom of the page.
In case of positive response to the request for a report the analyzer transmits:

Patient code..... 15 characters
List type..... "T" for Routine or "R" for STATS
Sample type..... "S" for Serum or "U" for Urine
Number of reports..... 3 characters

For each report:
Analysis code..... 4 characters
Result..... 7 characters
Check-Sum..... 3 characters
<EOT>

The following is an example of eventual response to the data sent in "Sending a patient to BT 3000 PLUS":

000000000000001RS003GLI 000.000BUN 0010.10COL 00100.0107<EOT>

Where:
000000000000001.. Patient code
R..... Identifies STATS list
S..... Identifies the type of patient (in this case: Serum)
003..... Identifies numbers of reports
GLI..... First test code
000.000..... GLI test result
BUN..... Second test code
0010.10..... BUN test result
COL..... Third test code
00100.0..... COL test result
107..... Identifies the Check-Sum
<EOT>..... This character ends communication

4-4. CALCULATION OF CHECK-SUM:

This procedure calculates a Control code in accordance with the transmitted or received data.

An algebraic sum of ASCII values of all the sent characters is executed. For example the character "A" has ASCII value 65 - 0x41.

Consequently the module 256 of the found value is executed (balance of dividing the value by 256). This is the Check-Sum to be sent.

4-4.1. ADDITIONAL NOTES ON THE SERIAL PROTOCOL

The patients reception has been improved in the following manner:

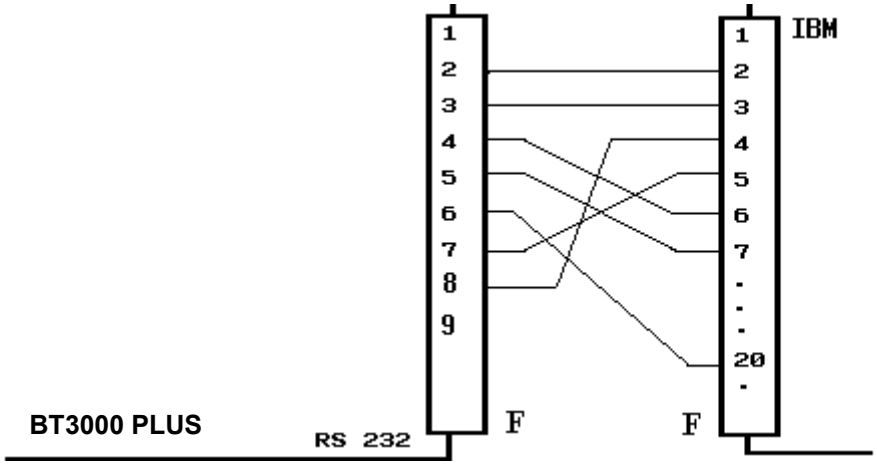
1) If a patient is already in the list and is sent again, then the same will be overwritten.

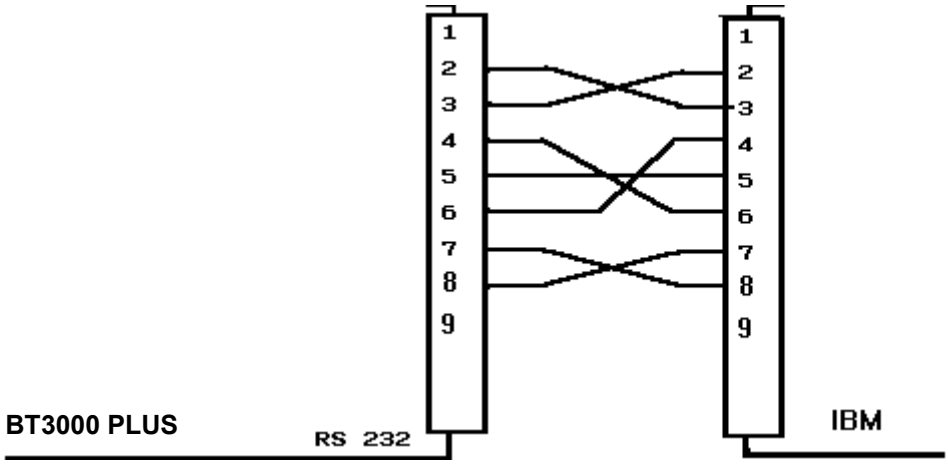
2) If more patients above the real capacity of the list were sent then these were sent to the supplementary list of controls. This error has been corrected.

3) The following errors have been added to the existing list:

Code	Description
22	A patient has been sent after assigning him a specific position, which is already occupied.
23	The patient is already in the list (or has been executed), the Clone field has not been enabled, but the list of assignment is different in comparison to that of the patient stored in the analyzer.
24	The transmitted code belongs to an executed patient but neither the Repetition field nor the Clone field has been activated.

4-5. WIRING DIAGRAM OF INTERFACE CABLE





4-6. VARIABLE SERIAL PROTOCOL

Introduction

The variable serial protocol has been designed to provide the user with possibility to personalize the transmitted and received data from the analyzer.
The user can transmit or receive in addition to preset data (patient code, analysis code, results etc.), also the simple text strings and/or characters in order to meet the personal requirements.
Not only the user can decide to send or receive numerical information (for example number of tests) not as single byte but as a preset numerical string or vice versa.
For example the user can decide to receive something like:

"Initiate analysis data"
<Analysis data true and typical>
"End analysis data"

Where the phrases "Initiate analysis data" and "End analysis data" do not refer to any preset data by the analyzer but serve only for monitoring communication process (can be useful for inserting specific markers on those programs which obtain information from text files).
It is obvious that the protocol of initiation and end of communication, the commands for the request of report, and the analyzer responses in case of error or success remain identical to the usual preset serial communication.

NOTE:

a) **If a check-sum is omitted in a communication then the analyzer will not control it.**
b) **The following numbers have been used to represent the error codes relevant to sending a patient to the analyzer as regards the parameters not part of the standard serial communication:**

Error Code	Description
1	Number of invalid analysis
2	Invalid Data (not through variables)
3	Invalid Data (through variables)
4	An analysis variable is outside the **SET BEGIN/END** relative to the analysis

Error Code	Description
18	The patient is not to be repeated
19	The field corresponding to the Serum/Urine is different from the patient in memory
20	Patients list full
21	Transmitted list different from the original
22	A patient has been sent after assigning him a specific position, which is already occupied.
23	The patient is already in the list (or has been executed), the Clone field has not been enabled, but the list of assignment is different in comparison to that of the patient stored in the analyzer.
24	The transmitted code belongs to an executed patient but neither the Repetition field nor the Clone field has been activated.

Notes regarding Scripts

A script is a text document. Each one of the single commands must each reside in a different line and be complete. In other words a single command cannot be divided into more lines.

Stringn 'Name'|$10 -> *Valid line*
Stringn 'Name'|$10 **char** 'A' -> *Invalid line*
Stringn 'Name' -> *Invalid Command*
|$10

An editor for writing, modifications, saving and compiling of one or more scripts is accessible inside the program (setup function). In any case it is possible to write a script with any text editor (DOS or Windows) like Notepad of Windows or the EDITOR of the DOS. It is not possible to import documents written with UNIX as the characters used for going to the next line are different from the ones used by the DOS or Windows.

CAUTION!
If one wants to use the script stored in a removable disk (for example floppy disk) then it will be necessary to copy it on the hard disk.

TYPE OF DATA

Character: Identifies a single character, can pass as printable character (enclosed between single apostrophes), as decimal ASCII value (followed by symbol **$**) or else hexadecimal ASCII value (followed by **0x**).
If for example we want to identify the character **A** (decimal value **65** or hexadecimal value **41**) then we can write **'A', $65** or **0x41**.

String: Identifies a sequence of printable characters enclosed in single apostrophes, for example: **'this is a string'**.

Comment: Identifies a portion of test (preceded by a character **;** which will not be compiled but will serve as note only for the programmer.

Variables: These are particular sequence of characters preceded by the symbol **#**, which will be used by the program for storing internal informations (patient code, analysis name and etc.), refer to "TABLE 1 - TRANSMISSION/RECEPTION".

There are also variables for direct uses, which allow for identification of any character below ASCII 32 (space) to facilitate the writing of the script (for example, one can use the variable **#EOT** to identify the character **$4**), see "TABLE 2 - INTERNAL VARIABLES".

SCRIPT FUNCTIONS

String: Identifies a string of variable length ending with a particular character.

Syntax:
String <string>**|**<Terminator>

Where
<String> Transmit/receive string
<Terminator> End character

Note:
It is not possible to use the variables like parameter <Terminator>

Example:
String 'Hello Word'**|**$0
String 'My String'**|**'@'
String #Variable1**|**0x10

Stringn: Identifies a string of fixed length

Syntax:
Stringn <*String*>**|**<*Length*>

Where
<String> Transmit/receive string
<Length> String length

Note:
If the length of the text strings is less than the data length then a series of spaces will be added on the right to reach the data preset length. In case the text string is longer than the data length then the string end will be cut off to match the data length.
If the length of the numerical values is less than the data length then a series of characters '0' will be added to the left to reach the preset data dimension. In case the length of the numerical values string is longer than the data length then the string will be truncated to match the data length.
It is not possible to use variables as parameter <Length>.

Example:
Stringn 'Hello Word'**|**$40
Stringn #Variable1**|**0x10

Char: Identifies a single character (or single byte)

Syntax:
Char <*Character*>

Example:
Char 'H'
Char $20
Char 0x10
Char #STX

Set: Identifies the beginning and the end of the group of repetitive commands

Syntax

Set Begin<*Name of group*>
Begin repetitive group

Set End<*Name of group*>
End repetitive group

NOTE:
Actually the ANALYSESDATA is the unique SET present, which identifies the analysis in transmission/reception.
Only one command SET BEGIN and one command SET END can be present in a script.
A script must always contain the command SET.
The variable PATIENTNUMBERTEST must be present before the command SET.

COMPILATION ERROR

One or more errors due to incorrect script writing or the system error may show up during compilation of a script. The compiler shows the error code, the description of error, and the line where it has been detected.
The following table shows the error codes, description, and the possible causes:

Error Code	Description	Possible Causes
1	Unknown command	An invalid command has been inserted in the commands of script.
2	A string request	A string as first parameter for String or Stringn command has not been inserted.
3	A number request	A string like parameter <lunghezza> of command Stringn has been inserted.
04	Invalid number format	Inserted invalid decimal or hexadecimal number.
5	Excessive data	a) Inserted more than two parameters for command String or Stringn. b) Inserted more than one parameter for the command Char or Set.
6	Invalid data	A string for command Char has been inserted.
7	String Terminator Request	The end (') character of a string not found.
8	Too little data	a) Inserted less than two parameters for command String or Stringn. b) No parameter inserted for command Char or Set.
9	Invalid String Length	The string length for Stringn command is less than 0 or more than 128.
10	Empty string	a) An empty string inserted for the command String or Stringn. b) Inserted a character identified as "
11	Unknown variable	a) Tried to transfer an invalid variable in the list of internal variables. b) Tried to use a transmission variable in the script of reception or vice versa.
12	Damaged file	Hard disk error. Contact Sales/Service.
13	Unknown file	Internal error. Probably damaged program. Reinstall the program. If the problem persists contact sales/service.

14	Incorrect identifier in the SET command.	a) The text SET BEGIN or SET END not written. b) A different value from ANALYSEDATA transferred as <Group name> for the SET command.
15	Damaged exit file	Hard disk error. Contact sales/service.
16	SET command not closed	The SET END not inserted in the script.
17	Too many SET commands	More than one SET BEGIN command inserted.
18	SET command not found	The SET BEGIN command not found in the script.
19	Incorrect variable for SET command	A different value from ANALYSEDATA transferred as <Group name> for the SET command.
20	Variable not found before the SET command	The highlighted variable required in the script before the SET BEGIN command.
21	The variable must be String type	The highlighted variable must be String type, not Char

TABEL 1 – TRANSMISSION

The following variables are used for the transmission of a report from analyzer to the host computer:

Variable	Usage	Type of valid data
PATIENTCODE	Patient Code	String
PATIENTNAME	Patient Name	String
PATIENTSURNAME	Patient Surname	String
PATIENTGROUP	Group (1)	String Character
PATIENTLISTTYPE	List (2)	String Character
PATIENTTYPE	Method Type (3)	String Character
PATIENTNOTE	Descriptive Note	String
PATIENTNUMBERTEST	Number of Results	String Character
CHECKSUM	Check-Sum	String Character
ANALYSESCODE	Analysis Code	String
ANALYSENAME	Analysis name	String
ANALYSESTYPE	Analysis Type (4)	String Character
ANALYSESCONCENTRATION1	1st Concentration	String
ANALYSESCONCENTRATION2	2nd Concentration	String
ANALYSESFLAGS1	Flag 1st Result	String
ANALYSESFLAGS2	Flag 2nd Result	String
ANALYSESMINVALUE	Minimum Value	String
ANALYSESMAXVALUE	Maximum Value	String
ANALYSESUM1	1st Unit of Measurement	String
ANALYSESUM2	2nd unit of measurement	String
ANALYSESUMFACTOR	Unit Factor	String
ANALYSES2RESULT	Does the 2nd result exists? (5)	String Character
ANALYSESSERUMTYPE	Method Type (3)	String Character
ANALYSESURINE24H	Urine in 24/h	String

(1) Identifies Male, Female or Child (Select one of these):
'M' : Male
'F' : Female
'C' : Child

(2) Identifies Routine or STAT (Select one of these):
'R' : Routine
'S' : STAT

Transmitting patient from archive will always have identifier of Routine.

(3) Identifies Serum or Urine (Select one of these):
'S' : Serum
'U' : Urine

(4) Identifies Clinical Chemistry, ISE Module or Relation Analysis (Select one of these):
'C' : Clinical Chemistry
'I' : ISE Module
'R' : Relation Analysis

(5) Identifies if the 2nd result exists or not (Select one of these):
'Y' : 2nd result exists
'N' : 2nd result does not exists

- If only the final result is desired then always refer to variables pertaining to 2nd result.
- In case of the absence of 2nd result then its variables will have the same values of the 1st result.

TABLE 1 – RECEPTION

The following variables are used for reception of a patient by the analyzer:

Variable	Usage	Type of valid data
PATIENTCODE	Patient Code	String
PATIENTNAME	Patient Name	String
PATIENTSURNAME	Patient Surname	String
PATIENTLISTTYPE	List (1)	String Character
PATIENTGROUP	Group (2)	String Character
PATIENTTYPE	Method Type (3)	String Character
PATIENTURINE24H	Urine in 24/h	String
PATIENTNOTE	Descriptive Note	String
PATIENTISCONTROL	If the patient is a control (4)	String Character
PATIENTCONTROLKNOK	If it is a known control (5)	String Character
PATIENTCONTROLLEVEL	Control Level (6)	String Character
PATIENTCLONE	If it is a clone (7)	String Character
PATIENTCUPPOSITION	Vial (Cup) position	String Character
PATIENTNUMBERTEST	Number of test	String Character
#PATIENTTOREPEAT	Patient repetition	String Character
CHECKSUM	Check-Sum	String Character
ANALYSESCODE	Analysis Code	String

(1) Identifies Routine or STAT (Select only one of these):
$0 : Routine
$1 : STAT
'0' : Routine
'1' : STAT
'R' : Routine
'S' : STAT
'ROUTINE' : Routine
'STAT : STAT

(2) Identifies Male, Female or Child (Select only one of these):
$0 : Male
$1 : Female
$2 : Child
'0' : Male
'1' : Female
'2' : Child
'M' : Male
'F' : Female
'C' : Child
'MAN' : Male
'FEMALE' : Female
'CHILD ' : Child

(3) Identifies Serum or Urine (Select only one of these):

$0	: SERUM
$1	: URINE
'0'	: SERUM
'1'	: URINE
'S'	: SERUM
'U'	: URINE
'SERUM '	: SERUM
'URINE'	: URINE

(4) Identifies a Control or a Sample (Select only one of these):

$0	: Sample
$1	: Control
'0'	: Sample
'1'	: Control
'N'	: Sample
'Y'	: Control
'S'	: Sample
'C'	: Control
'NO'	: Sample
'YES'	: Control
'SAMPLE'	: Sample
'CONTROL'	: Control

(5) Identifies a Known or Unknown Control (Select only one of these):

$0	: Unknown
$1	: Known
'0'	: Unknown
'1'	: Known
'N'	: Unknown
'Y'	: Known
'U'	: Unknown
'K'	: Known
'NO'	: Unknown
'YES'	: Known
'UNKNOW'	: Unknown
'KNOW'	: Known

(6) Identifies Control Level (Select only one of these):

$1	: Level 1
$2	: Level 2
$3	: Level 3
'1'	: Level 1
'2'	: Level 2
'3'	: Level 3
'L'	: Level 1
'N'	: Level 2
'A'	: Level 3
'LOW'	: Level 1
'NORMAL'	: Level 2
'ABNORMAL'	: Level 3

(7) Identifies if it is a Clone (Select only one of these):

$0	: Normal
$1	: Clone
'0'	: Normal
'1'	: Clone
'N'	: Normal

‘Y’ : Clone
‘NOCLONE’ : Normal
‘CLONE’ : Clone

(8) Identifies if the patient is a repetition or not
#00 : Normal patient
#01 : To be repeated
'0' : Normal patient
'1' : To be repeated
'N' : Normal patient
'Y' : To be repeated

Note:
It is possible to repeat the patient if:

1. **It is not present among the executed patients**
2. **No free position exists on the plate**
3. **The patient has already been inserted in the current list**
4. **The lists of execution are different**
5. **The Serum/Urine field is different**
6. **It is also selected as clone**

TABEL 2 – INTERNAL VARIABLES

Variables	Decimal	Hexadecimal
NUL	$00	0x01
SOH	$01	0x02
STX	$02	0x03
ETX	$03	0x04
EOT	$04	0x05
ENQ	$05	0x06
ACK	$06	0x07
BEL	$07	0x08
BS	$08	0x09
TAB	$09	0x0A
LF	$10	0x0B
VF	$11	0x0C
FF	$12	0x0D
CR	$13	0x0E
SO	$14	0x0F
SI	$15	0x10
DLE	$16	0x12
DC1	$17	0x13
DC2	$18	0x14
DC3	$19	0x15
DC4	$20	0x16
NAK	$21	0x17
SYN	$22	0x18
ETB	$23	0x19
CAN	$24	0x1A
EM	$25	0x1B
SUB	$26	0x1C
ESC	$27	0x1D
FS	$28	0x1E
GS	$29	0x1F
RS	$30	0x20
US	$31	0x21

SCRIPT EXAMPLES

The examples outlined here are the transformation in script of the standard routine of the patient reception by the analyzer.

Stringn #PatientCode|$15
Char #PatientListType
Char #PatientType
Char #PatientClone
Stringn #PatientCupPosition|$2
Stringn #PatientNumberTest|$2

Set #BeginAnalysesData
Stringn #AnalysesCode|$4
Set #EndAnalysesData

Stringn #CheckSum|$3

The following are the details of the above Scripts:

Stringn #PatientCode|$15
Patient Code of fixed length equal to 15 characters

Char #PatientListType
Type of list (Routine/STAT) as single character

Char #PatientType
Serum type (Serum/Urine) as single character

Char #PatientClone
Identifies if the patient is or is not a clone (single character)

Stringn #PatientCupPosition|$2
Position of serum cup (string of fixed length equal to 2 characters)

Stringn #PatientNumberTest|$2
Number of tests to be executed (string of fixed length equal to 2 characters)

Set #BeginAnalysesData
Beginning of analysis codes

Stringn #AnalysesCode|$4
An analysis code of fixed length equal to 4 characters. It must be entered for each type of test as per qty indicated in the #PatientNumberTest.

Set #EndAnalysesData
End of analysis codes

Stringn #CheckSum|$3
Check-Sum (transferred as a string of fixed length equal to 3 characters)

The following examples are the transformation in script of the standard routine for the transmission of a report by the analyzer to the host computer:

Stringn #PatientCode|$15
Char #PatientType
stringn #PatientNumberTest|$3
Set #BeginAnalysesData
Stringn #AnalysesCode|$04
Stringn #AnalysesConcentration2|$7
Set #EndAnalysesData
Stringn #CheckSum|$3

The details of the above scripts are as follows:

Stringn #PatientCode|$15
Patient Code of fixed length equal to 15 characters

Char #PatientType
Serum type (Serum/Urine) as single character

Stringn #PatientNumberTest|$3
Number of results to be sent (a string of fixed length equal to 3 characters)

Set #BeginAnalysesData
Beginning of zone repeated for the number of results to be sent (see #PatientNumberTest)

Stringn #AnalysesCode|$04
An analysis code of fixed length equal to 4 characters

Stringn #AnalysesConcentration2|$7
Concentration referred to the analysis code as per #AnalysesCode (a string of fixed length equal to 7 characters)

Set #EndAnalysesData
End of zone repeated for the number of results to be sent

Stringn #CheckSum|$3
Check-Sum (transferred as a string of fixed length equal to 3 characters)

4-7. SERIAL COMMUNICATION TEST PROGRAMS

4-8. PROGRAM COMUNICA.EXE:

A simple communication program for sending command characters to the analyzer and receive any response.
At the start the only input to the program is the number of the communication port (from 1 to 4).
A blue screen divided into two sections is displayed. In the upper section the characters coming from the analyzer are displayed, while the lower section displays the characters sent to the analyzer.
The only special keys used are F1 to clear the screen and F10 for exiting the program.
The special characters (with values less than 32) are displayed in ASCII notations along with their values.

For example the Character EOT - value 4 - will be shown as EOT (4).
To send a special character (with values less than 32 or higher than 124) it is necessary to keep pressed the ALT key and simultaneously write the value of the character to be sent using numerical keys. For example to send EOT it is necessary to keep the ALT key pressed and simultaneously enter the value 4 through the numerical key and then release the ALT key.

4-9. PROGRAM BTPLUS.EXE:

A simple communication program that simulates the host computer. At the start it is necessary to identify the number of communication port (from 1 to 4) and the desired procedure (Transmission or Reception).
In case the Transmission is selected the program will ask for patient code (from 1 to 15 characters), the test number (from 1 to 9) and the relevant analysis code for each test (for example: BUN).
It is a good practice to use the same analysis codes, which the analyzer has memorized in the plate actually in use, if otherwise then an error will result in the transmission phase.
Now the program will execute an initialization procedure of communication with the analyzer, will send patient data and wait for the outcome of transmission.
At the end the screen will display the outcome of the operation or show the position number of the plate where the patient has been inserted or explanation of error code sent by the instrument (for example: Patient Code Duplicated).
If the Reception procedure is selected, then the program will begin initialization of communication with analyzer, will ask for data of the next report ready for serial dispatch and show data of relevant downloaded report.
If there are no reports to be received, then a relevant message will be displayed.
Every time the program waits for a response from the analyzer, in case of problem it is possible to abort the current operation by simply pressing the Esc (Escape) key.

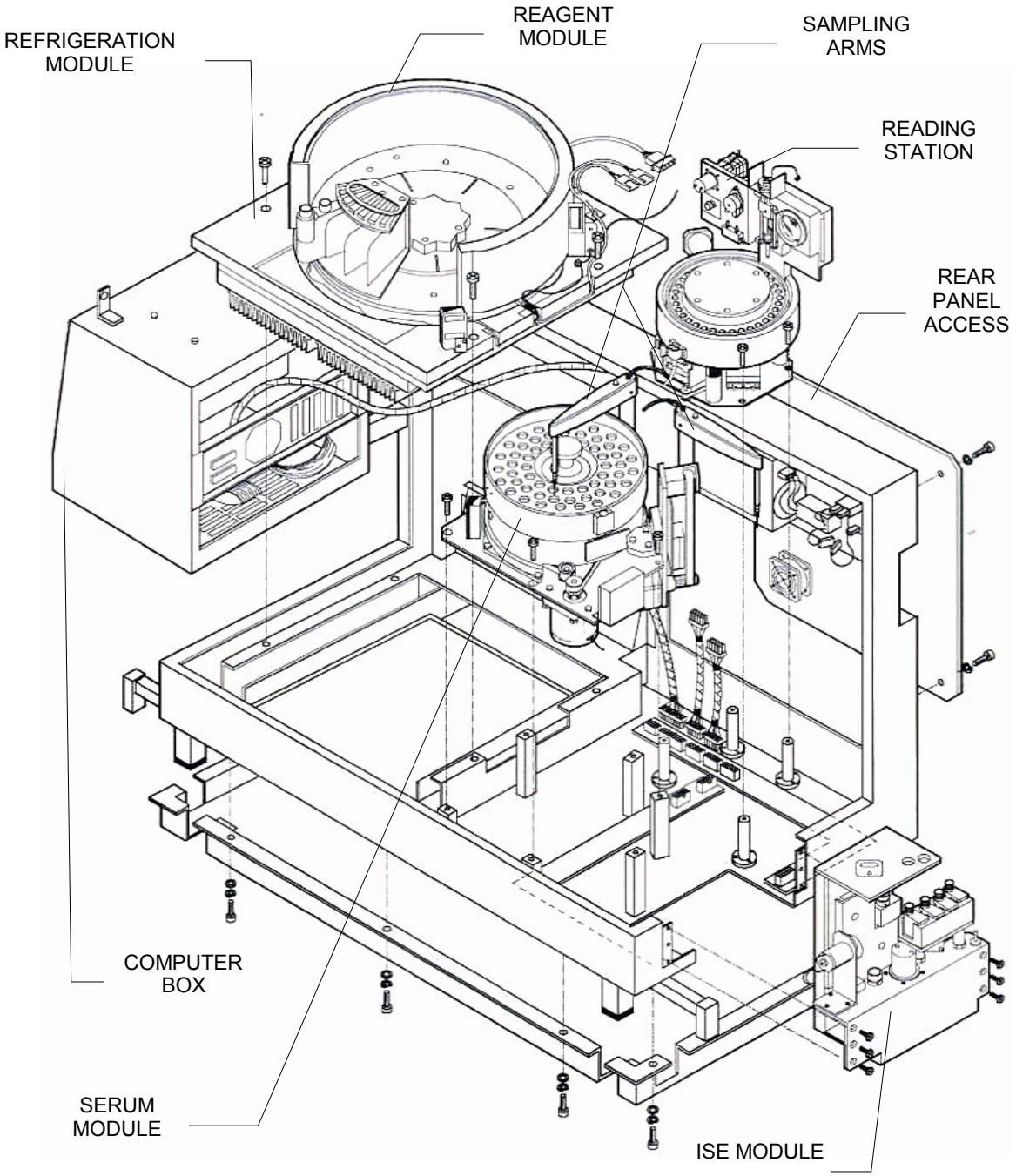
Note:
Both the programs must reside in the computer connected serially to the analyzer through appropriate cable indicated in the Operators Manual.
The computer must be an IBM compatible equipped with DOS operative system: Windows 95, Windows 98, or Windows 2000. The operating systems such as MAC, UNIX, Windows ME or XP are not supported.
Since the programs operate in DOS ambience, therefore in case the Windows operating system is used then it will be necessary to open a DOS shell (the command Prompts of MS-DOS is found in the menu Programs, Accessories - accessed through the Start button on the bottom left of the screen).
Both the programs use serial port with the following setups:

Baude-Rate.....	9600
Stop-Bits.....	1
Parity.....	None
Hand-shake.....	Hardware

Important Notice:
These two programs are in the installation disk under Utility folder.

SECTION - V

REPAIR OR REPLACEMENT OF VARIOUS PARTS



BT3000 PLUS - EXPLODED VIEW
Figure 5-1

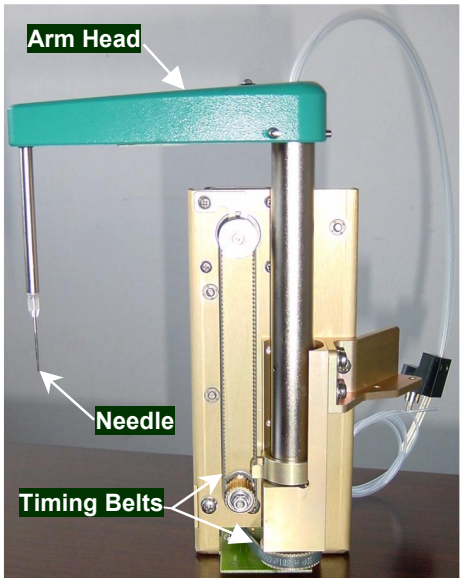
5-1. ACCESS TO VARIOUS MODULES - INTRODUCTION

The BT3000 PLUS chemistry analyzer requires a series of mechanical adjustments during the production and assembly process to assure optimal performance. The same mechanical adjustment procedures that were followed in the production are outlined here for field maintenance and repair.

The analyzer is based on a modular construction. Each module must be correctly inserted into its proper location. Any positioning adjustments are facilitated by the large tolerances on the mounting holes. It is important to check that the sampling arm movement precisely coincides with all the operating positions. A fine adjustment of positions can be made through the software. During the production phase of the analyzer, a special reference mask (jig) is used to correctly position the various modules in their locations. However, during maintenance and repair, one must take care to operate, step by step, so as not to alter the original assembly. Therefore, it is strongly recommended not to disassemble multiple modules at one time. Instead, the modules should be serviced and calibrated one at a time

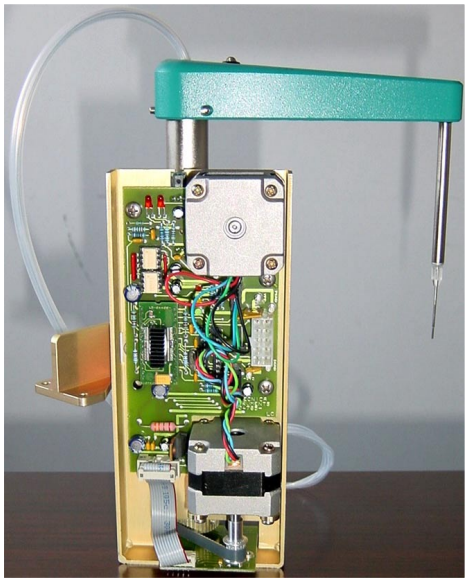
5-2. REPAIR OR REPLACEMENT OF THE SERUM/ISE SAMPLING ARM

Turn off all power to the instrument before replacing or repairing the sample arm. Remove the casing and all of the parts necessary to access the arm subassembly (see Figures 5-2 & 5-3). Disconnect the electrical cable and the liquid heater cable. Unscrew the liquid line connector from the appropriate diluter. Unscrew the sampling arm assembly 3 mounting screws. Gently lift the sampling arm module and place it on a safe location. This operation may not seem simple but the figure here facilitates the removal. Replace the repaired or substitute sampling arm module in its appropriate location observing the preceding steps in reverse order.



SAMPLING ARM (FRONT)

Figure 5-2



SAMPLING ARM (REAR)

Figure 5-3

Do not tighten the new sampling arm mounting screws to allow for position calibration. Manually swivel the sampling arm to verify coverage from reagent plate to the cuvette plate. Also verify if the sampling needle centers the washing funnel and the reading cuvette correctly by observing the following procedure:

1) Turn off power to the analyzer and unplug the power cord from the wall outlet to avoid electrical shock.
2) Manually lower the sampling needle all the way into the washing funnel to verify that it centers correctly. Gently lift out needle from washing funnel and move it CCW (counterclockwise) to the cuvette plate.
3) Align any cuvette on the cuvette-plate with the washing piston, and then carefully slide downwards the washer body until the piston bottoms into the cuvette.
4) Locate and mark the position of 12th cuvette by counting anticlockwise starting from the cuvette adjacent to the cuvette with washing piston. The latest production instruments have an index mark corresponding to the 12th cuvette position on the rim of the cuvette system housing for facilitating mechanical calibrations.

5) Move CCW (counterclockwise) and lower sampling needle into the 12th cuvette and verify that it centers correctly. If the needle centers properly on the washing funnel and the cuvette then finally tighten the three setscrews on the arm head and the three mounting screws on the arm bracket. If otherwise, repeat preceding steps until the sampling needle is centered correctly, and then securely fasten the screws and continue with the procedure below.

NOTE:

When the sampling arm is substituted or simply removed for service and then remounted, it is highly important to verify the zero position and afterwards check all the other positions observing the procedure as follows:

a) Start up the analyzer and let the program bootstrap begin.
b) During bootsrap press the keys <Alt>, <Ctrl> and <Shift> simultaneously.
c) Let the bootstrap end (a message "ONLY FOR SPECIALIST" appears on the screen).
d) Align any cuvette on the cuvette-plate with the washing piston, and then carefully slide downwards the washer body until the piston bottoms into the cuvette.
e) Lower the sampling arm needle into the washing funnel and press enter key. Do not touch the sampling arm; leave it in whatever position it is in.
f) Enter the mechanical calibration program (icon with gear symbol).
g) Carefully perform mechanical calibration of all the positions. Do not overlook any position.
h) Perform a general reset (F5). The arm needle should position itself on the center of the washing bowl. Verify the correct position.

In case the sampling needle is not positioned correctly then recalibrate by entering the mechanical calibration program (icon with gears symbol). It is not necessary to turn off the instrument and perform the bootstrap process. Perform a reset by clicking on the icon ® and press the keys ALT, CTRL, and SHIFT simultaneously and then repeat preceding steps d) to h).

IMPORTANT NOTICE:

Mechanical calibration procedure for the ISE Arm is the same as above except that the ISE Arm needle is first centered on the ISE washing funnel (metallic funnel located on the right of the serum plate) and then moved CCW to any cuvette on the cuvette plate where it centers correctly.

5-2.1. ARM HEAD RETROFIT KIT P/N 07-04438-02 INSTALLATION INSTRUCTIONS

This retrofit kit replaces and upgrades the previous sampling arm head (P/N 07-04438-01). It simplifies the routine maintenance procedure. The new arm head installation is permanent, and only the tube heater assy must be replaced when necessary.

To install the arm head observe the following step-by-step procedure:

1) Turn off power to the analyzer and unplug the power cord from the wall outlet to avoid electric shock.
2) Gently disconnect the previous arm head tubing and cable connectors.
3) Loosen the 3 setscrews on the rear near the (shaft) and remove the arm head.
4) Unscrew the 2 lateral screws from the new arm head cover and remove cover (Figure 5-6) from the body.
5) Carefully place the new arm head body over vertical shaft (Figure 5-4) ensuring that the locking screw is parallel to the reference slot on top edge of the shaft. Gently push down the arm head body until level with the top edge of shaft and securely tighten the locking screw.
6) Insert the metallic fin into the aperture on the rear of arm head and tighten the screw (Figure 5-5).

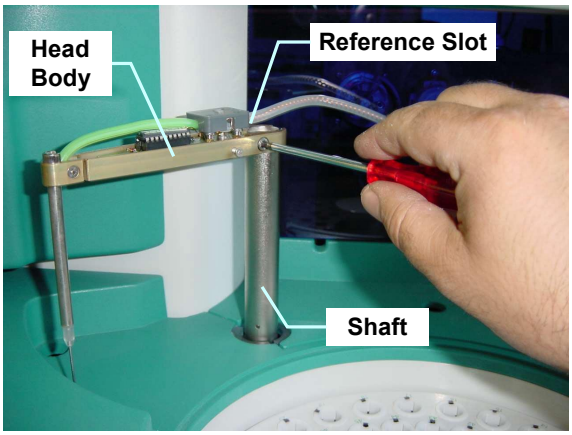


Figure 5-4

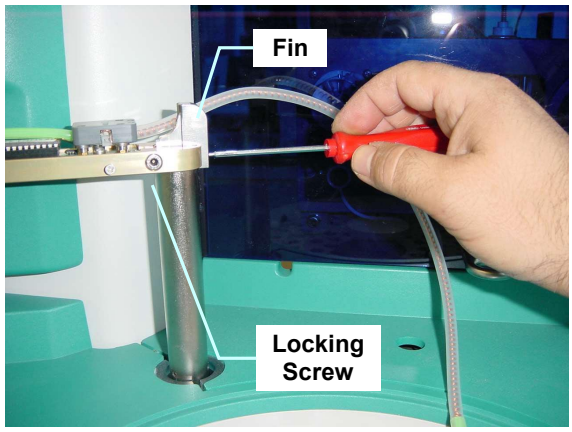


Figure 5-5

7) Place the cover on the arm head and gently push down to stop. Ensure that the sample tube is correctly positioned between the metallic fin and the appropriate slot on the rear of cover. Securely fasten the two screws on the sides of the cover (Figure 5-6).
8) Securely connect sample tube and cable to correct connectors.

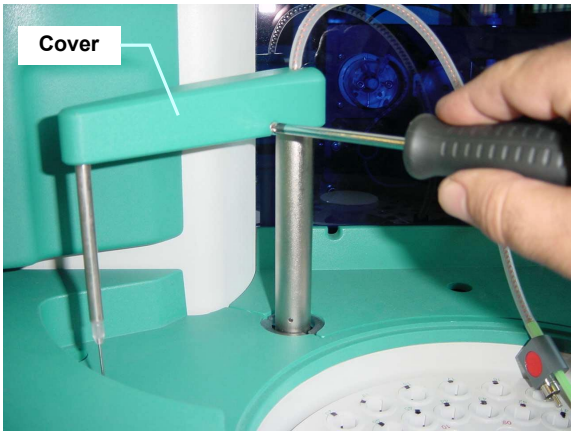
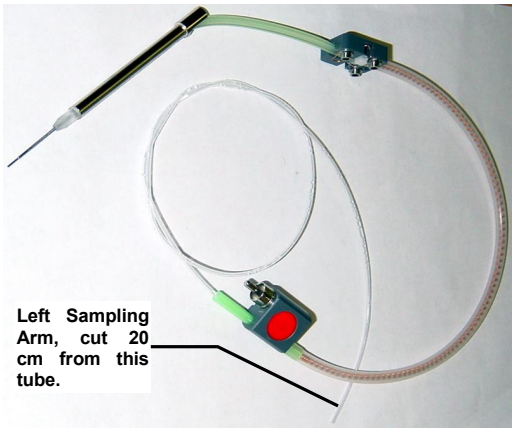


Figure 5-6



Sampling Tube with Needle Holder P/N 08-05029-01

Figure 5-7

NOTE:

The preceding installation procedure is identical for both the sampling and ISE arms (left arm and right arm in BT 3000 PLUS). To facilitate production the length of sample tube (single plastic tube adjacent to the electrical connector - Figure 5-7) is identical in both the arms. It is necessary to reduce the length of the plastic tube of left arm head (for clinical chemistry sampling) by about 20 centimeters prior to connecting it to the diluter. The length of tube of right arm head (ISE sampling arm) remains unaltered. In the analyzers BT 1000 and BT 2000 PLUS (without ISE sampling arm) the tube length of sampling arm head must be reduced by 20 centimeters (Figure 5-7) as already outlined

9) It is mandatory to perform calibration of positions with the standard service procedures. This operation is necessary because of possible variations during installation.
10) It is mandatory to perform the calibration of volumes using appropriate procedure. This procedure is necessary because the vertical position of needle may result to be slightly displaced with respect to the previous version of sampling arm.

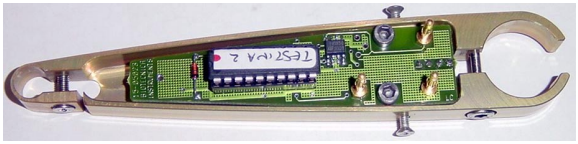
Final testing:

After terminating the installation procedure, test the system as follows:

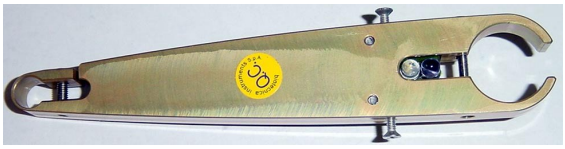
a) Verify that the new arm head is firmly secured to the shaft (Fig. 5-4, 5-5 and 5-6). Try to rotate the head after holding the shaft stationary. Head should not move, if otherwise then firmly tighten the locking screw.
b) Touch with finger the sampling needle, instantly the red LED at the bottom of arm head lights and projects a beam downwards.
c) Let few minutes pass and then touch the needle holder, it should feel warm (heated).
d) In the program of calibration services repeat the verification of positions and eventually correct them.

Now the new arm head has been correctly installed. Any future maintenance will be much easier as the only part subject to wear and periodic replacement is the "Sampling Tube with Needle Holder" P/N 08-05029-01 (Figures 5-7 & 5-11), which also incorporates the supply voltage leads for powering the arm head system. The "Sampling Tube with Needle Holder" kit integrates sampling needle, needle holder, sampling tube with heating circuit and appropriate connectors.

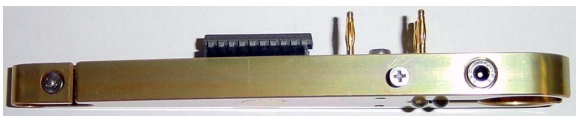
Additional Informative Photographs:



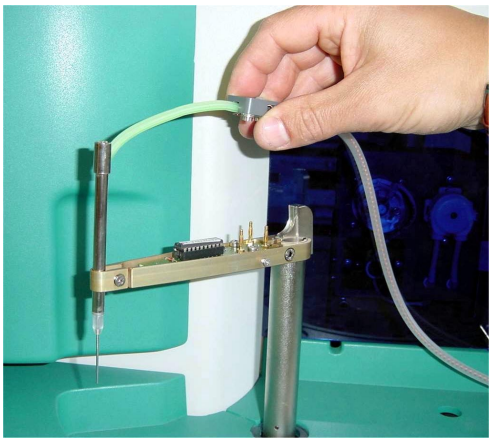
Arm Head (Top View)
Figure 5-8



Arm Head (Bottom View)
Figure 5-9



Arm Head (Side View)
Figure 5-10



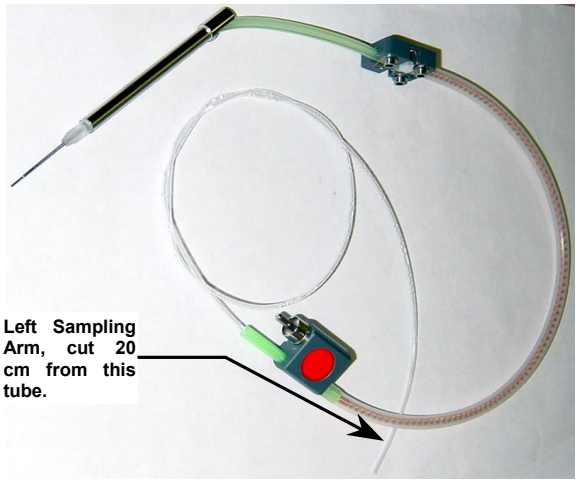
Sampling Tube with Needle Holder
P/N 08-05029-01
Figure 5-11

5-2.2. SAMPLING TUBE WITH NEEDLE HOLDER P/N 08-05029-01 INSTALLATION INSTRUCTIONS

In the arm head the only part subject to wear and periodic replacement is the "Sampling Tube with Needle Holder" P/N 08-05029-01 (Figure 5-12), which also incorporates the supply voltage leads for powering the arm head system. The "Sampling Tube with Needle Holder" kit integrates sampling needle, needle holder, sampling tube with heating circuit and appropriate connectors.

To install the arm Sampling Tube with Needle Holder observe the following step-by-step procedure:

1) Turn off power to the analyzer and unplug the power cord from the wall outlet to avoid electric shock.
2) Loosen (do not remove) the 2 lateral screws from the arm head cover and carefully remove cover by sliding upwards from the arm head (Fig.5-13).
3) Gently disconnect the previous "Sampling Tube with Needle Holder" tubing and cable connectors (Figure 5-14). Note that the ISE ARM (on the right side) cable and tubing connectors have different locations.
4) Loosen (do not remove) the screw (Figure 5-15) on the needle clamp.
5) Carefully disconnect tube (Figure 5-16) from the arm head and remove the defective "Sampling Tube with Needle Holder" (Figure 5-17).



Sampling Tube with Needle Holder
P/N 08-05029-01

Figure 5-12

Figure 5-13

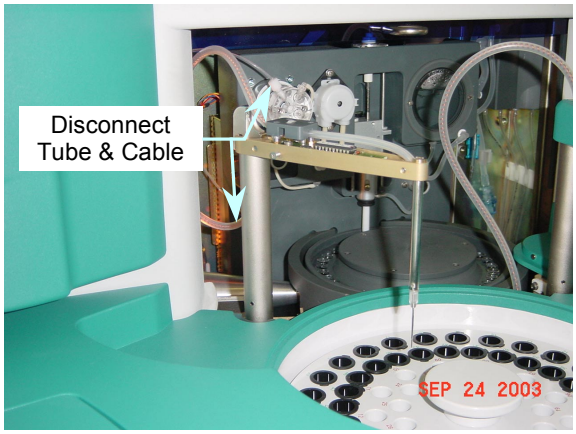


Figure 5-14

6) Correctly install the new "Sampling Tube with Needle Holder" on the arm head and firmly secure the needle holder by tightening the clamp screw (Figure 5-15).
7) Place the cover on the arm head and gently push down to stop. Ensure that the sample tube is correctly positioned between the metallic fin and the appropriate slot on the rear of cover. Securely fasten the two screws on the sides of the cover (Figure 5-13).

Figure 5-15

Figure 5-16

NOTE:

The preceding installation procedure is identical for both the sampling and ISE arms (left arm and right arm in BT 3000 PLUS). To facilitate production the length of sample tube (single plastic tube adjacent to the electrical connector - Figure 5-12) is identical in both the arms. It is necessary to reduce the length of the plastic tube of left arm head (for clinical chemistry sampling) by about 20 centimeters prior to connecting it to the diluter. The length of tube of right arm head (ISE sampling arm) remains unaltered. In the analyzers BT 1000 and BT 2000 PLUS (without ISE sampling arm) the tube length of sampling arm head must be reduced by 20 centimeters (Figure 5-12) as already outlined

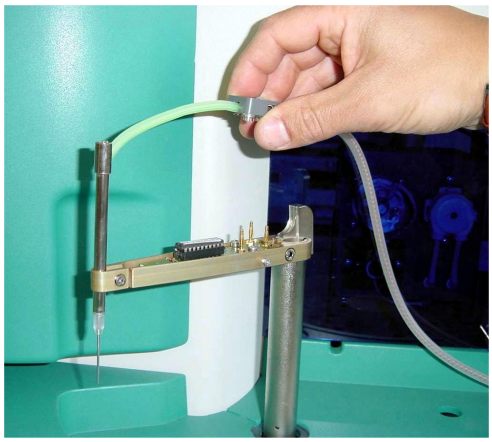


Figure 5-17

5-3. REPAIR OR REPLACEMENT OF THE REAGENT MODULE

The repair or replacement of the reagent module is relatively complex because of the necessity to remove many parts before the extraction of whole module. It is important to turn off power to the analyzer before any repair or replacement. After the repair or replacement, no mechanical re-calibration is necessary. However, there is the possibility that the sample arm may require an angular position adjustment through software program.

The following situations may require service personnel intervention:

1) Replacement of one or more Peltiers
2) Replacement of the transmission belt
3) Replacement of the drive motor
4) Replacement of the temperature or Hall sensors

For these operations, refer to disassembly procedure and associated photos.

5-3.1. REPLACEMENT OF REAGENT PELTIER MODULES

This operation requires the removal of the front body, computer box, and the front cover. Refer to the photo sequence in the disassembly procedure. Disconnect all of the connecting cables, unscrew the 4 mounting screws securing the Peltier module and remove the module. Turn it upside down and carefully place it on a surface. Unscrew and remove the two heat sinks. Now, observe the exposed group of Peltiers and the electrical connections soldered to a PCB. Check for the defective or interrupted Peltier using the Ohmmeter.

Bear in mind the difficulty of instrumental measurement because of the emission of residual energy produced from the Peltier. The use of a digital tester may provide a faulty measurement. It is recommended to verify the inconsistency of an average measurement rather than the absolute value that is, in theory, approximately 2 Ohm per Peltier.

Generally, a defective Peltier presents a partial interruption with values of some 10 Ohms, which are sufficient to drastically reduce the current flow in the series of Peltiers, therefore generating a diminished performance of the refrigeration group.

Unsolder the leads of the defective Peltier, unscrew the 2 screws on the metallic disc securing the Peltier element and remove it. Substitute the damaged Peltier with a new Peltier module using thermal grease for dissipation. Make sure to take into account the proper polarity (see Figure 7-1 in Section VII). An incorrect assembly may affect the system performance. Carefully tighten the screws ensuring that these are not over-tightened so as to avoid damage to the ceramic elements of the Peltier. After assembling all of the devices, it is important to recalibrate the temperature control.

5-3.2. REPLACEMENT OF THE REAGENT PLATE TRANSMISSION BELT

For this operation, it is necessary to remove the case, computer box, and the front cover. Remove the round refrigeration chamber (in aluminum) by unscrewing the 16 mounting screws. Observe the photo sequence for disassembly details. Loosen the screws of drive motor assembly plate, located on the top left corner, and slide it slightly inward to loosen the belt. Remove the damaged belt and replace it with a new belt.

To reassemble, follow the preceding steps in reverse order. Carefully slide the motor plate outwards to the left to provide the correct tension and tightness to the belt, and then tighten the mounting screws.

5-3.3. REPLACEMENT OF REAGENT PLATE DRIVE MOTOR

The removal operations are similar to the above "Replacement of the Reagent Plate Transmission Belt". The motor is secured to the plate through 4 screws.

5-3.4. REPLACEMENT OF THE REAGENT TEMPERATURE AND HALL SENSORS

The removal operations are similar to the "Replacement of the Reagent Plate Transmission Belt". Two fixing screws on one side secure the rectangular PVC housing of Hall sensor. The sensor requires precise positioning to correctly couple with the magnet on the drive pulley. The Hall sensor assembly must come close to the transmission belt, which interposes between the magnet and the Hall sensor at a maximum distance of 1mm almost grazing the same belt.

The temperature sensor is housed in a rectangular metallic container, which is closely secured to the bottom of the circular aluminum reagent chamber with a single screw accessible from the top of the chamber. The Replacement of the temperature sensor does not require any particular care, except that the two parts must be joined perfectly by properly tightening the screw. No temperature verification or calibration is necessary.

5-4. REPAIR/REPLACEMENT - READING STATION MODULE

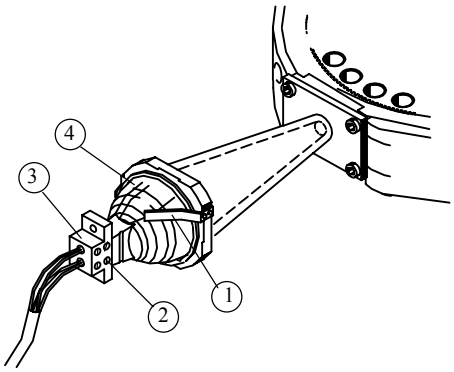
It is possible to access nearly all the parts of the reading station module for the maintenance and the repair. The analyzer must be turned off prior to repair or Replacement. Only in the case of the Replacement of Peltiers (located at the bottom of module). It will be necessary to remove this module. The following components are easily accessed without removal of the module:

1) Replacement of the Peltier
2) Replacement of Halogen lamp
3) Replacement of all the tubes of the hydraulic circuit
4) Replacement or maintenance of diluter
5) Replacement of washing piston
6) Replacement and inspection of reading cuvettes
7) Replacement of photometer

5-4.1. REPLACEMENT OF THE CUVETTE PELTIER

For the Replacement of the Peltiers it is necessary to remove the 3 mounting screws (see Figure 3-1 entitled "Top View of the BT3000 PLUS".) To facilitate the removal of a screw located inside, it is necessary to remove the front cabinet. It is important to disconnect all of the cables and tubing before removing the station.

Each Peltier group contains a fan and heat sink and is securely attached with 4 screws to the base of the station. Coat the new Peltier surface with a thin layer of thermal grease and secure it to the base of the reading station with 4 screws. Tighten the mounting screws until they are snug, ensuring that the pressure is applied uniformly. Do not over-tighten otherwise the Peltier may get damaged. Ensure leads' polarity is matched correctly. The incorrect assembly of the Peltier can cause serious malfunction of the thermostatic system.



Replacing the Halogen Lamp
Figure 5-18

5-4.2. REPLACEMENT OF THE HALOGEN LAMP

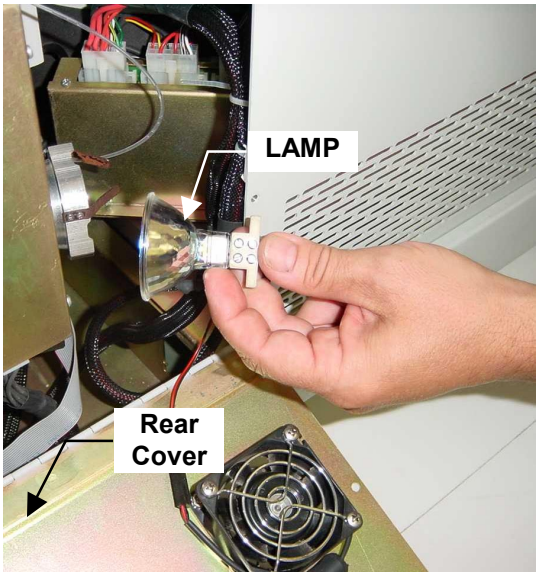
Precautions for handling the halogen lamp:

a) *Always allow the burnt out lamp to cool down.*

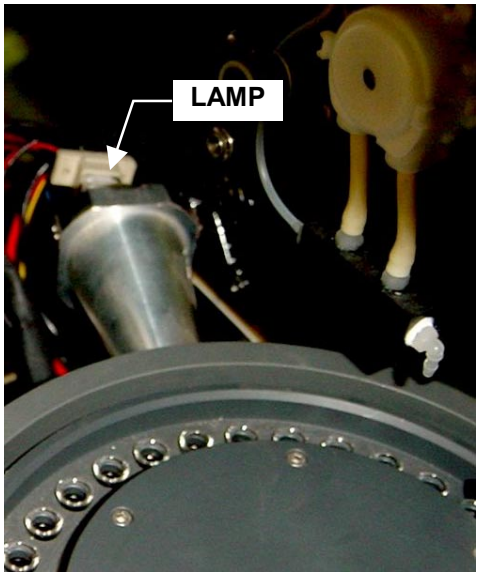
b) *Never touch the reflector or the lamp with bare fingers. Use a rag when changing.*

c) *If the lamp is touched inadvertently during installation, clean the lamp or reflector with alcohol and dry with a clean, soft cloth before burning. Contamination of the lamp or reflector may reduce lamp performance.*

d) *It is recommended to initially burn the new lamp for about 30 minutes before analyzer operation.*



LAMP REMOVAL (Rear Cover)
Figure 5-19



LAMP REMOVAL (Front Shutter)
Figure 5-20

Disconnect the input power before servicing. The replacement of the Halogen lamp can be done by the removal of the rear panel, or by sliding the transparent shutter front panel and then removing the access cover from the deck (Figures 5-19 & 5-20).

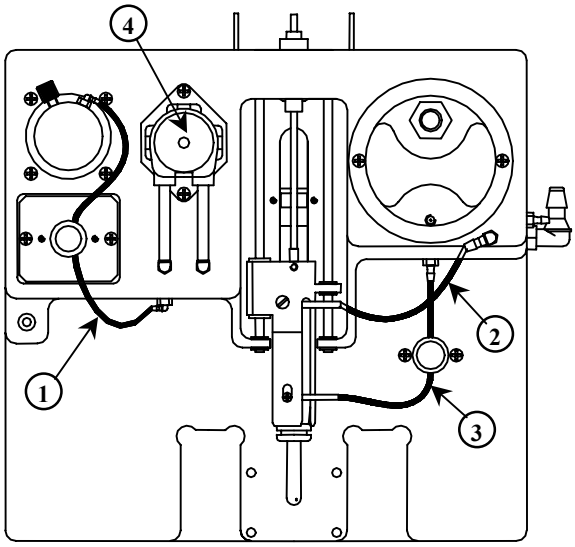
Release the lamp assembly by gently sliding downwards. Loosen the front screws ❷ in the socket ❸ and remove the burnt out lamp ❹.

Insert a new halogen lamp fully into the socket and firmly tighten the screws to secure the lamp. It is recommended to slightly press both of the lamps retaining spring clips ❶ before fitting the lamp. Slide the lamp assembly onto the light cone and orient the lamp socket in the vertical position as shown in the Figure 5-20.

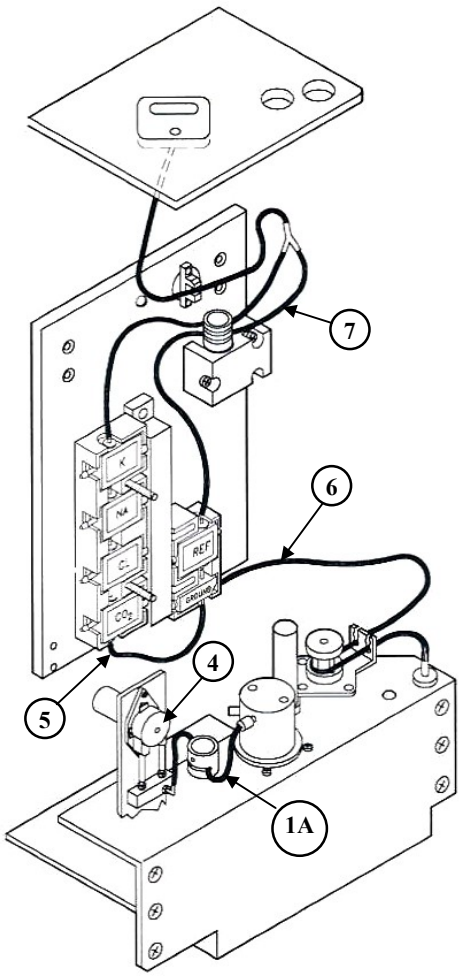
5-4.3. REPLACEMENT OF HYDRAULIC TUBES

There are three tubing and accessory kits for maintenance. A Bimonthly Maintenance Kit for ISE tubing, Six Month Kit for special tubes exposed to wear and tear, including pump cartridges, etc., and an annual maintenance kit for general tubing for interconnections and liquid transfers.

When installing any tubing kit, it is important that the hydraulic circuit is empty. To avoid any undesired liquid spills, disconnect the external water input before applying any maintenance kit. Turn on the instrument and perform a washing cycle to evacuate all liquid in the hydraulic circuit. When changing tubes, follow the illustrative diagrams (Figure 5-21) on the next page.



Washer/Diluter - BT 3000 PLUS
(Reading Station)



ISE Module

HYDRAULIC TUBES AND ACCESSORIES
Figure 5-21

BIMONTHLY MAINTENANCE KIT (P/N. 662.1016)		
ITEM	**QTY**	**DESCRIPTION**
1A	2	Diluter/Pinch Valve Tube ISE
5	1	Interconnection Tube for GND/Bypass OR CO2 Electrode
6	1	ISE Pump Tube
7	1	REF - K Tube Manifold

SIX MONTH MAINTENANCE KIT (P/N. 11-05219-01)		
ITEM	**QTY**	**DESCRIPTION**
1	2	Diluter/Pinch Valve Tube
1A	2	Diluter/Pinch Valve Tube ISE
2	1	Aspiration Tube for Washing Module
3	1	H_2O Tube for Washing Module
4	2	Peristaltic Pump Cartridge
5	1	Interconnection Tube for GND/Bypass OR CO2 Electrode
6	1	ISE Pump Tube
7	1	REF - K Tube Manifold

ANNUAL MAINTENANCE KIT (P/N. 11-05220-01)		
ITEM	**QTY**	**DESCRIPTION**
1	2	Diluter/Pinch Valve Tube
1A	2	Diluter/Pinch Valve Tube ISE
2	1	Aspiration Tube for Washing Module
3	1	H_2O Tube for Washing Module
4	2	Peristaltic Pump Cartridge
5	1	Interconnection Tube for GND/Bypass OR CO2 Electrode
6	1	ISE Pump Tube
7	1	REF - K Tube Manifold
8	1	Tubular Filter for Water Container
9	2	Sampling Needle

5-4.4. REPLACEMENT OR MAINTENANCE OF DILUTER

Even though it is unlikely that the diluter will require Replacement, its removal for service is quite simple. Turn off all power to the instrument before servicing. The diluter is secured through 4 screws on its flange and one cable connector for electrical circuitry.

The maintenance involves yearly cleaning of the piston and the transparent Plexiglas chamber. To perform maintenance disconnect the fluid tubing. Unscrew the 2 screws located on the front of the diluter Plexiglas chamber and carefully remove the Plexiglas chamber exposing the piston. Clean the piston with a soft lint-free cloth. Wash the Plexiglas chamber and the inside of the O-ring with distilled water. After cleaning, gently replace the chamber onto the diluter drive. Firmly secure with the 2 screws.

The O-ring (P/N 330.5703) must be substituted every 300,000 cycles. Prior to O-ring installation, make sure that all surfaces are free of dust, dirt and the like.

5-4.5. REPLACEMENT OF THE WASHING PISTON

Turn off the analyzer prior to replacing the washing piston. Push the washing piston carriage fully upward to facilitate the piston removal. Remove all of the silicone tubes. Gently unscrew the piston from the plunger stem by turning clockwise (Fig.22). In case of difficulty (slippery piston, etc.), use the Piston Grip (Fig. 25) or lint-free cloth to improve the grip. Fit the new piston and finger-tighten firmly by turning counterclockwise until it is properly seated against the thread shoulder. Reposition the carriage into its original position. Attach all tubing to the appropriate connectors.

Washer Module
Figure 5-22

5-4.6. REPLACEMENT OF READING CUVETTE

It may become necessary to remove the cuvette wheel in order to inspect or replace damaged cuvettes. Generally this operation is necessary when the following malfunctions occur:

a) Water is present on the cuvette wheel
b) Accidental dropping of foreign matter into the cuvettes
c) Accidental damage of one or more cuvettes

Turn off the analyzer. Push the washing piston carriage fully upward to aid in the cuvette wheel removal. Unscrew the 6 screws from the cuvette wheel and carefully lift out. Use a gentle oscillating movement, if necessary, while exercising extreme care to prevent any damage to the cuvettes. Inspect the cuvette wheel, rotor, and housing for the presence of any liquid. Clean and dry if necessary. Afterwards, diagnose the cause of the problem. Avoid removing the cuvette wheel to wash the cuvettes as this operation will result to be complex because of the use of only distilled water to avoid calcareous build-up. Perform the washing after the cuvette drying or substitution by using appropriate analyzer functions. The foreign objects or physical debris inside the cuvettes can also be removed by turning the cuvette wheel upside-down.

Another solution for cleaning cuvette (analyzer must be turned on) is to use the aspiration tube of the washing piston (on top of the washing plunger) by inserting it all the way into the cuvette for few seconds and then manually rotate the cuvette wheel to move to the next cuvette for cleaning.

When replacing the cuvette wheel, position the small guide hole in the cuvette wheel that coincides with the locating pin on the cuvette rotor.
Gently push the cuvette wheel downward onto the rotor. Fasten the cuvette wheel securely by screwing the 6 socket head screws back onto the cuvette rotor. To ensure that pressure is applied uniformly, first tighten all of the screws finger-tight and then tighten them in a crosswise pattern. Do not use excessive force. Gently push downward each cuvette until it bottoms against the depth of the rotor. Attach any disconnected tubing to the appropriate ports. A thorough washing procedure should be performed through the analyzer program before any testing is performed on the analyzer.

NOTE: Another efficient method for cleaning the cuvettes may be used without removing the cuvettes plate from its original position. Disconnect the aspiration tube located on top of the washing piston carriage and insert it into the bottom of the cuvette for few seconds to aspirate any dirt or contaminants. Repeat this procedure after manually rotating the cuvette wheel to clean off the desired cuvettes. The high power suction produced by the vacuum pump will quickly eliminate any dirt or contamination.

CAUTION: It is required that a complete FCC procedure be performed after replacement of one or more cuvettes. If the removal and replacement of cuvette wheel required no replacement of cuvettes, only the "zeroing" procedure is required.

5-4.7. PHOTOMETER REPLACEMENT

The box containing the photometer module is mounted on the underside of the base plate of the light source. Turn off the power to the analyzer before replacing the photometer. The photometer module can be easily removed by unscrewing the 4 mounting screws on the base plate. The new generation photometers (since July 2004) are equipped with an additional connecting cable (having a pare of male/female connectors) for the Reference Channel (Figure 5-23).

Caution: It is required that a complete FCC procedure be performed after replacement of the photometer.

5-5 INTRODUCTION TO THE COMPUTER BOX

The LCD Display module, with fully integrated touch-screen, is on the front of the computer box. An on/off switch for the analyzer is located on the bottom left of the display. The peripherals, CD-ROM player and the floppy disk drive are accessed through a cover just below the display.

All of the connections to the external peripheral devices are located on the rear of the box as follows:

1 USB Port for the Printer
1 Serial-Port for Host Computer
1 Serial-Port for Modem
1 USB Port for UPS
2 PS/2 ports for Keyboard & Mouse

The ASUS main-board with a 2.4 GHz Intel Pentium® IV processor, 128 Mb RAM, CD-ROM player, 20 Gb hard disk, floppy disk drive, and the power supply are all located inside the computer box. Product enhancement resulting from new innovations in technology and from our continuing quality improvement effort may necessitate changes in this configuration in the future. However, any eventual changes will be fully compatible with the previous version. A connecting cable composed of lead conductors of the serial port and the 5-Volt supply interconnects the computer box and the process electronics.

5-5.1. REPAIR AND REPLACEMENT OF THE COMPUTER BOX

First, remove the 2 mounting screws on the rear to access the internal parts of the module. Now, it is possible to open the box from right to left so that the rear of the box is exposed to the service engineer. One can observe the DVD player, floppy disk drive, and the hard disk inside the lower opening on the rear of the box.

The following different operations are required for the removal and Replacement of each particular device:

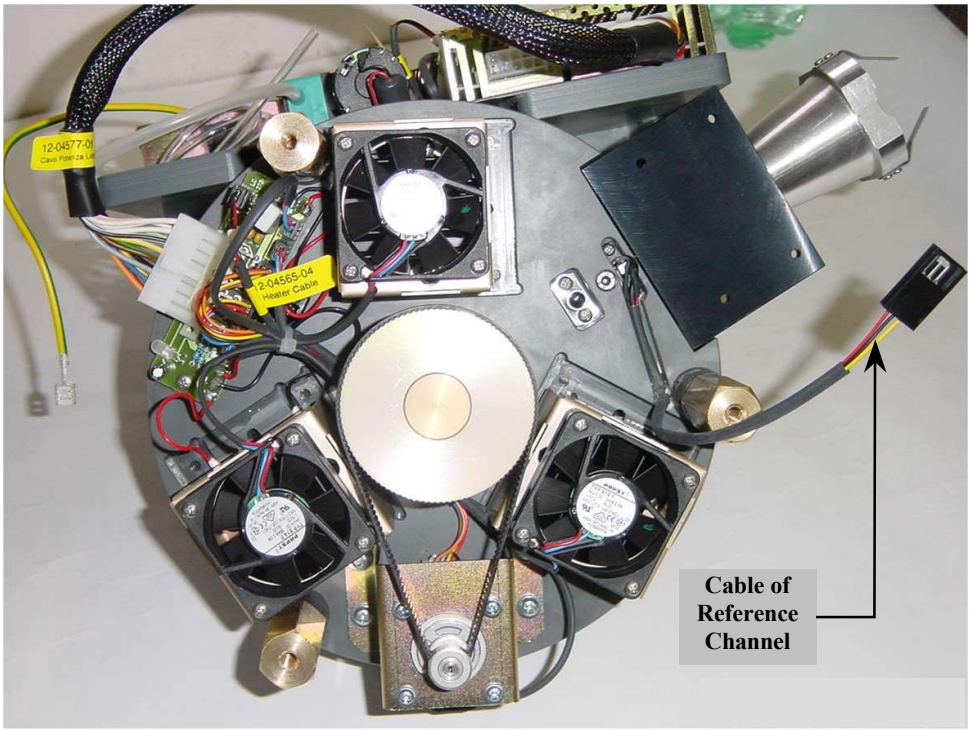
1) Hard Disk: Remove the mounting screws on the supporting bracket and dislodge the hard disk driver.
2) DVD & Floppy Disk: Unscrew the appropriate screws on the underside of the box and remove the DVD or floppy-disk drivers. It is also necessary to remove the plastic front panel of the LCD display module.
3) Main-board and Peripheral Devices: The main-board (motherboard) is secured to an "L" shaped metallic bracket. Remove the 4 mounting screws on the rear and extract the slide. With this operation, it is possible to access the main-board and all the peripheral devices.
4) TFT-LCD Display Panel: Remove the plastic front panel. Unscrew the 4 screws on the corners, securing the display, and remove the LCD display panel.
5) Power Supply: The power supply of the computer is located in the upper section of the box. To remove the power supply, it is necessary to extract the supporting bracket of the main-board and then remove the 4 screws securing the omega shaped metallic bracket.

5-5.2. 8-WIRE ANALOGUE RESISTIVE TOUCH-SCREEN

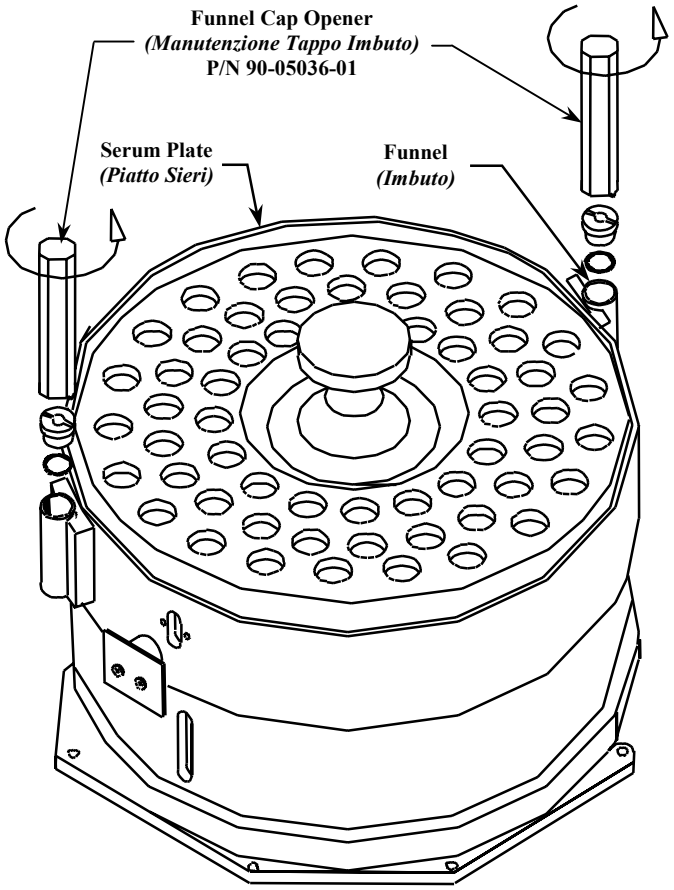
To remove the touch-screen, it is necessary to use a fine blade for lifting away the glass-backing panel from the display. The touch-screen is secured to the LCD panel with a very fine double-sided adhesive tape.

It is important that the glass-backing panel is precisely centered. Ensure that the active area of the touch-screen matches the active area of the display. When mounting the touch-screen, carefully observe the four angles marked on the perimeter as a point of reference for facilitating the application. The new touch-screen is already equipped with double-sided adhesive tape.

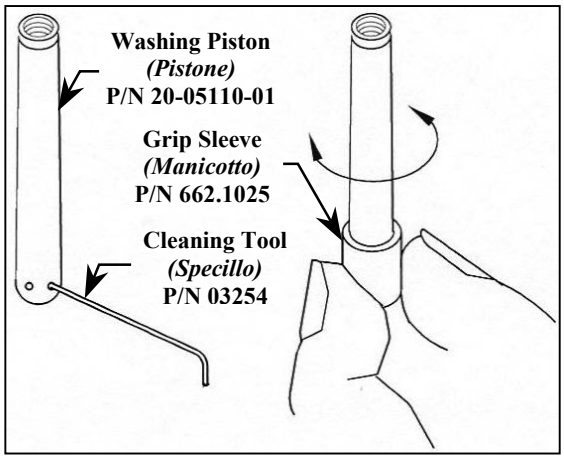
If necessary, replace the touch-screen driver. It is important to install the driver found on the CD provided with the new touch-screen monitor. For application, refer to Section XIV, Paragraph 14-2. Entitled "Computer Module Trouble-Shooting".



Reading Station - Bottom View
Figure 5-23



FUNNEL CAP OPENER
Figure 5-24

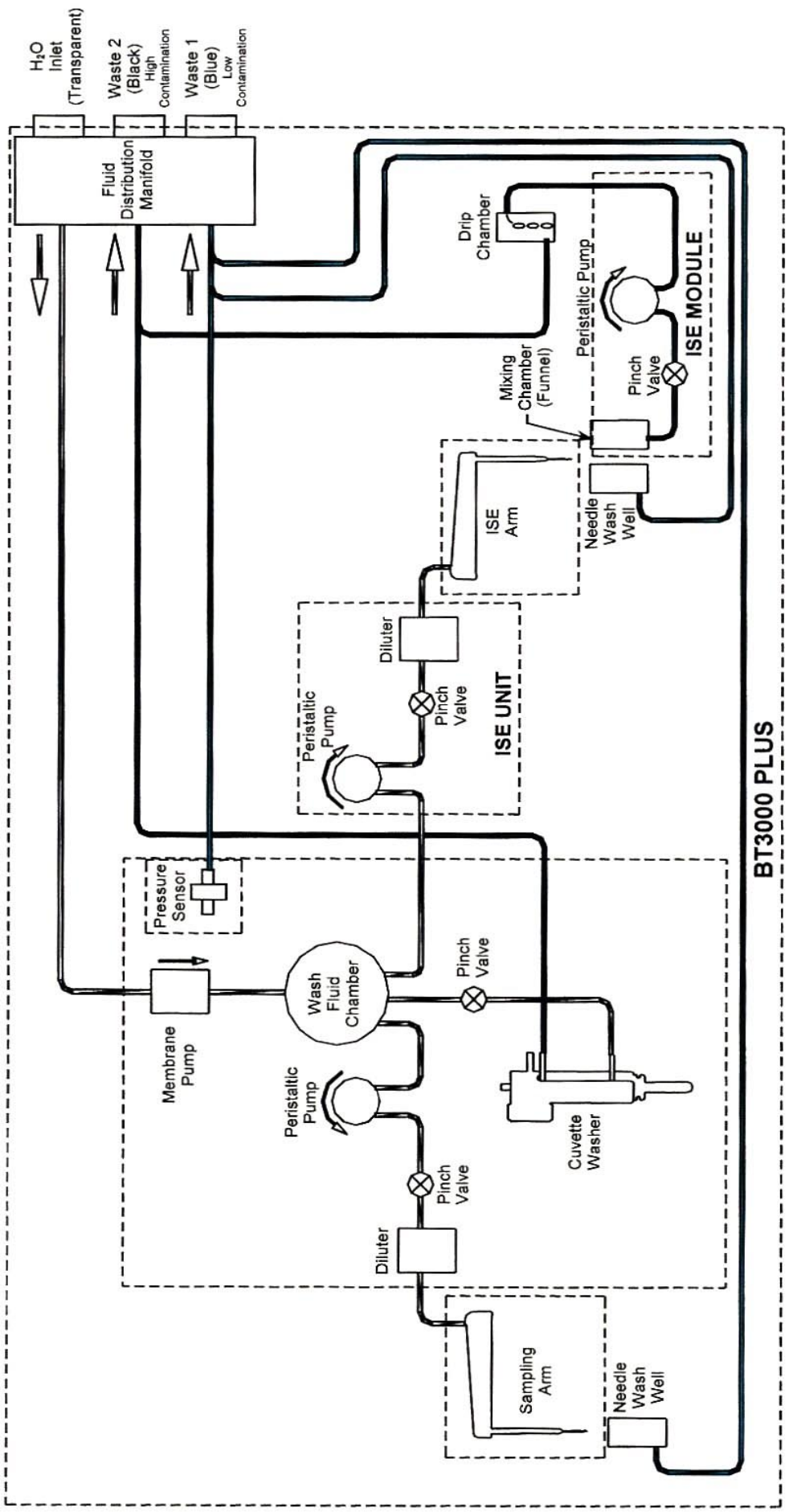


Washing Piston Removal & Cleaning
Washing Piston Kit P/N 662.0610

The washing piston (in Teflon) may have occluded holes. Turn off the analyzer prior to changing the piston as follows:

1) Push the washing piston carriage fully upwards with the thumbs
2) Gently unscrew the washing piston from the plunger stem by inserting the supplied "Grip Sleeve" or abrasive paper of fine mesh (to avoid slipping) and using light finger pressure clockwise.
3) Clean small holes on the side of the piston using the supplied "Cleaning Tool".
4) Fit the cleaned piston and finger tighten firmly by turning counterclockwise until properly seated against thread shoulder of the plunger stem. Use "Grip Sleeve" to tighten

Figure 5-25



Hydraulic Circuit
Figure 5-26

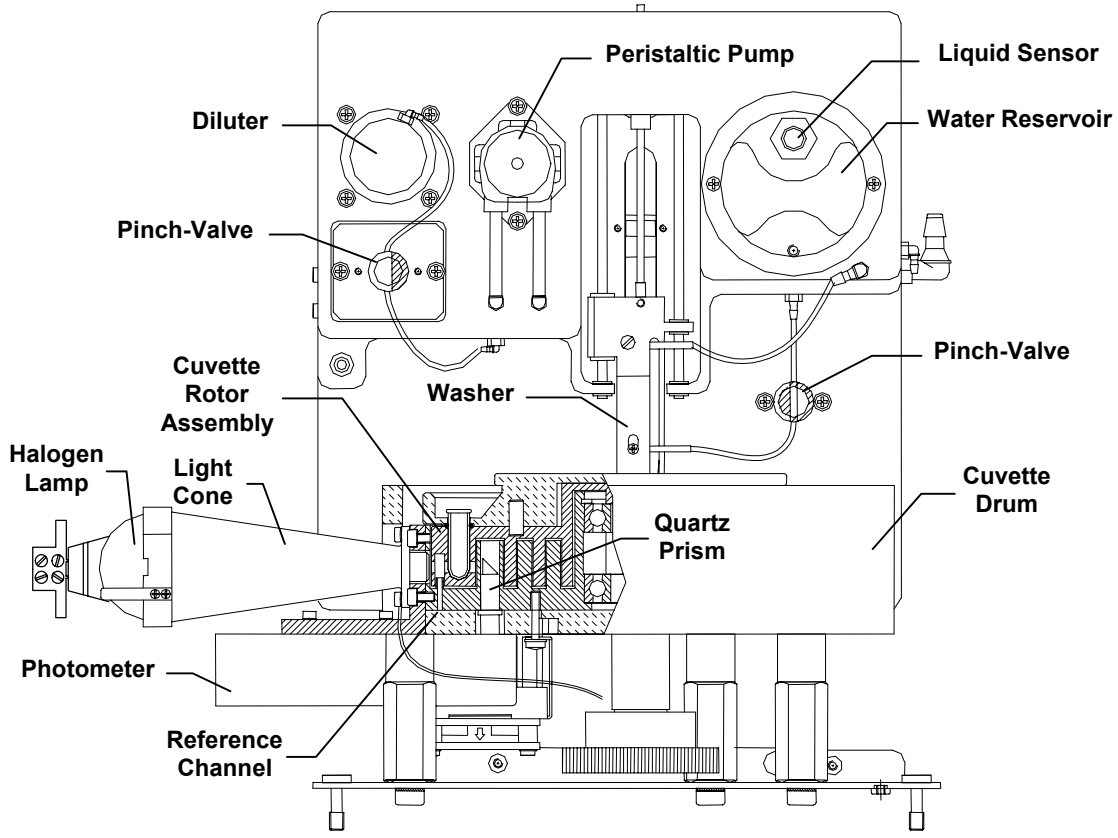
SECTION - VI
READING STATION

6-1. GENERAL

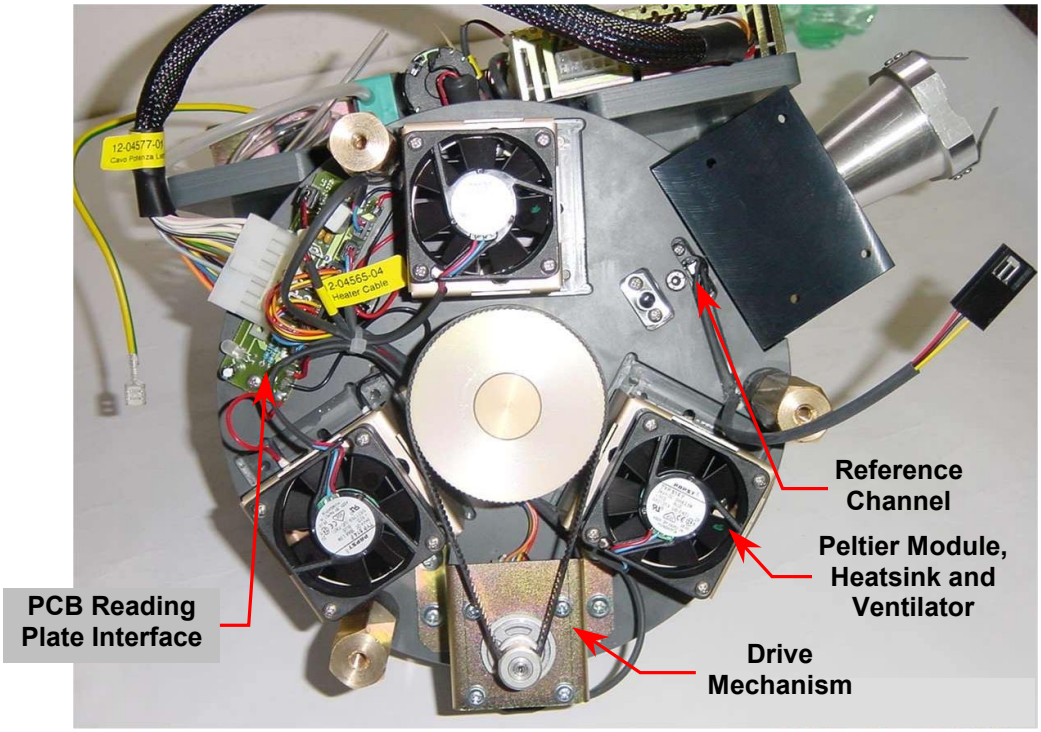
The Reading Station is a composite system comprehending the following devices:

1) Heated rotor assembly for reading cuvette.
2) 10-channel stationary Photometer module with additional reference channel
3) Halogen lamp with dichroic reflector for photometer
4) Stationary cuvette drum with integrated Peltier-based (heating/cooling element) thermostatic control.
5) Fluidic system consisting of Water (H_2O) reservoir, diluter, and washer.
6) Electronic circuits located on the rear of Reading Station

The above-mentioned devices are illustrated in the **Figure 6-1** below.



READING STATION
Figure 6-1



READING STATION - BOTTOM VIEW
Figure 6-2

6-2. PHOTOMETER MODULE

The Biotecnica photometer (**Figure 6-1**) is a patented product and it consists of a small metallic enclosure containing 10 photometric channels. Each channel has its own interferential filter, photo diode, and amplifier. Each amplifier has a dedicated trimmer for gain adjustment as illustrated in the schematic **15-04649-01**. The channels amplification is factory calibrated to adapt the signal levels to the manufacturing tolerances of various optical components (photodiodes, interference filters etc.). The light beam enters through the unique port in the photometer enclosure, and after passing through a series of beam splitters, it reaches all the ten channels simultaneously. The reason for this approach is the instantaneous processing of numerous signals.

Reference Channel

The reference channel is not inside the photometer box but it is located nearby externally. It is an amplified photodiode embedded in the cuvette drum (see **Figure 6-1** and **Figure 6-2**) with its cable connected to the photometer for processing by the multiplexer circuit and A/D converter.

The reference channel provides stability to the transmission signal when the photometric system is used in the monochromatic mode. When the photometer is selected in the bichromatic mode e.g. 340/700nm, the reference channel is not utilized as the same function is accomplished by the 700nm channel.

The Light path

The photometer lamp transmits light beam, which converges on the center of reading cuvette, and then through the cuvette it is reflected into the photometer module by the 90º quartz prism located inside the cuvette drum (see **Figure 6-1**). A small quantity (approximately 2%) of light flux is captured by the reference photodiode prior to the light passes through the cuvette.

6-2.1. REACTION CUVETTE OPERATING PRINCIPLE

The light is transmitted through the light cone, into the reaction cuvette, and then reflected into the photometer module by the quartz prism located inside the cuvette system housing. The UV specific optical glass transparent cuvettes allow transmission of wavelengths down to 340nm. The function of the photometer module is to monitor and measure the color variations or absorbance values, between different reaction mixtures over a wavelength range from 340nm-700nm. After a reaction cuvette has passed a photometer measuring position and the reaction mixture has been analyzed, the cuvette moves on towards the washer module where the single piston drains, rinses, and dries the reaction cuvette for re-use.

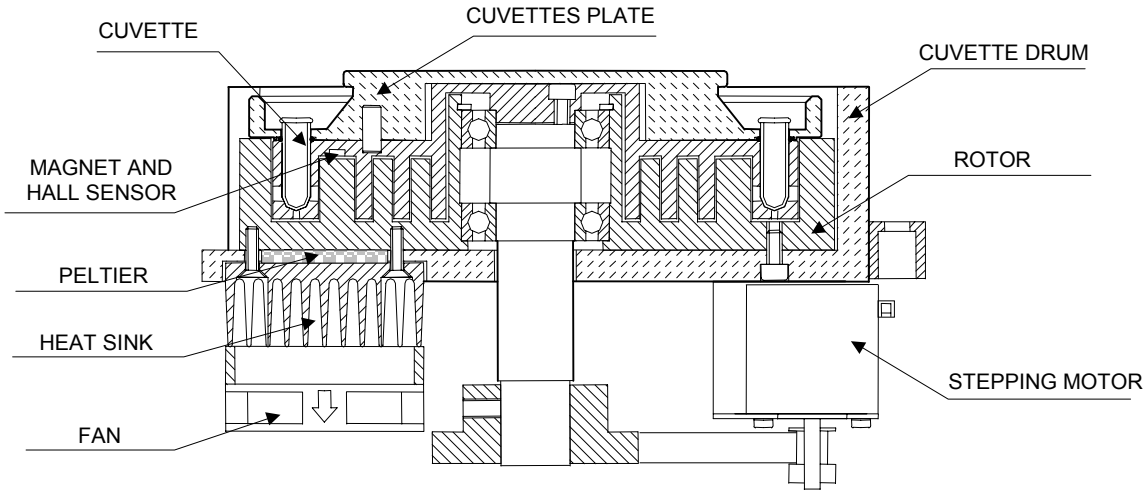
6-2.2. LIGHT SOURCE

The photometer light source consists of a 12 Volt, 35 Watt tungsten halogen lamp with integral dichroic reflector for the dissipation of infrareds. The lamp is secured through the lamp retaining spring clips on the light cone for easy removal or substitution (see **Figure 6-1**). This custom made, UV enhanced, halogen lamp provides a high radiation output in the 340nm UV range throughout its operating life of approximately 2000 hours.

The lamp efficiency is controlled by the analyzer, which detects the radiation insufficiency at 405nm when the optical transmission goes below the 50% of original emission level. Bear in mind that the acquisition of 100 % is memorized when the "SETLAMP" procedure is performed after replacing with new lamp.

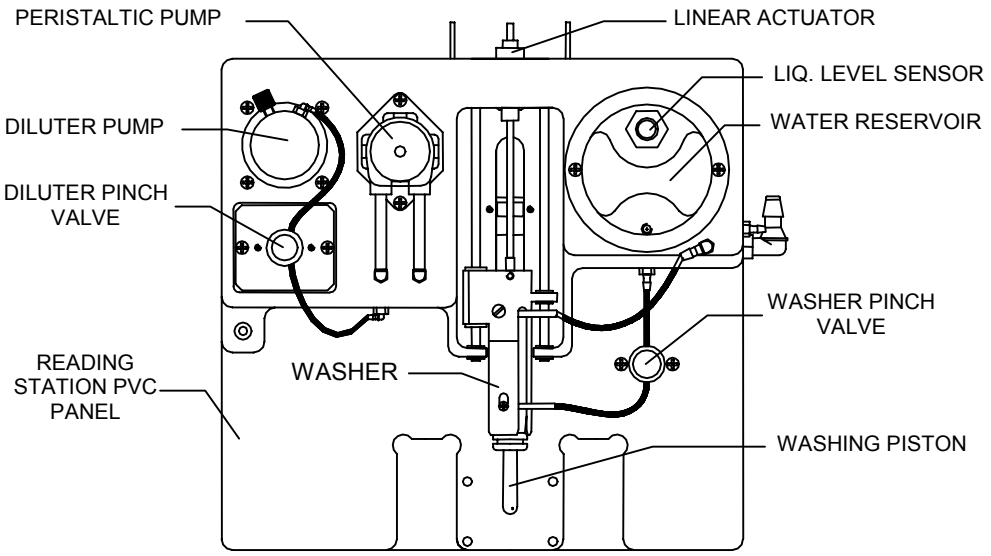
6-3. READING CUVETTE SYSTEM

The consistent mass of the aluminum cuvette rotor allows for maintenance of temperature uniformity throughout the 34 cuvette wells (**Figure 6-3**). The stationary cuvette drum in aluminum encompassing the cuvette rotor integrates Peltier modules, which thermostatically maintain the selected temperature. The Peltier modules, relative heat sinks, and the cooling fans are affixed on the underside of the cuvette drum as shown in the **Figure 6-2**.



CUVETTES SYSTEM
Figure 6-3

The selected temperature is maintained to within ± 0.1ºC at the base and ± 0.2ºC in the cuvette wells. The stationary part and the moving part are tightly matched with 0.2mm spacing in-between. However there is a thermal gradient between the two parts, which makes it necessary to perform accurate temperature calibrations. The regulation of cuvette temperature is highly simplified through the software. However it requires an appropriate thermometer for calibration adjustments. The calibration procedure is outlined in the **Section XIII**, paragraphs **13-2.** and **13-2.1.**



DILUTER/WASHER MODULE
Figure 6-4

6-4. DILUTER AND WASHER MODULE

The upper part of the reading station consists of a PVC panel (**Figure 6-4.**), which accommodates the following devices:

1) **DILUTER:** A 470 µl (Full Scale) diluter pump providing the analyzer with high precision, reproducibility, and reliability. The stepper motor and the photo-sensor cable is connected to the Master Power Board (15-04209-01) on the rear of the PVC panel.
2) **PINCH VALVE:** A pinch valve, peristaltic pump and sample needle, which complete the sampling system as described in detail in Section VIII entitled, "Sampling Station". The cuvette washer module positioned in a similar manner to the previous version used on BT 2000/3000.
3) **WASHER MODULE:** The washer module utilizes a bi-directional, linear actuator-based stepper drive mechanism to provide the washing piston carriage rapid linear movement in up/down directions. The piston has a central bore, three equal openings on the external hemisphere, and a tapered body for improved cleaning, emptying, and drying of the cuvettes. A photo-switch is provided for reset and standby position. The actuator stepper motor and the photo-switch cable connects to the Master Power Board (15-04209-01) located to the rear of the PVC panel. These are all managed by the microcontroller µC764.

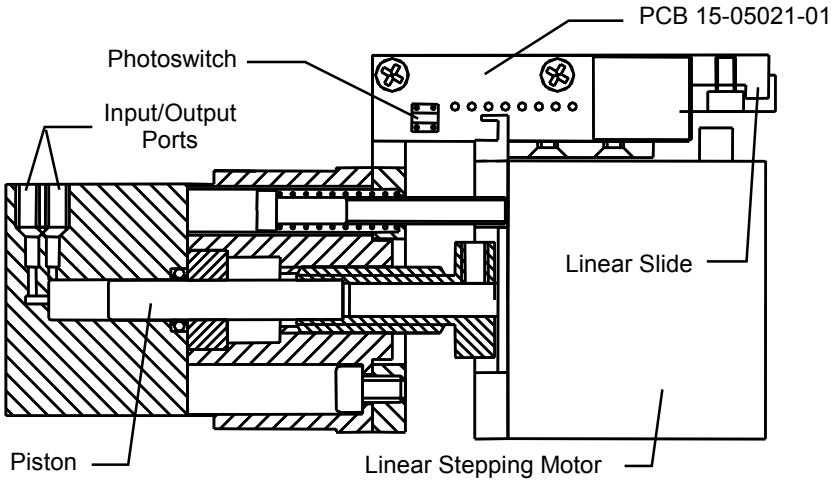
4) **TUBING & CONNECTORS:** Most of the in/out fluid tubing has "quick-connect" connectors that incorporate shut-off valves to facilitate the removal of the reading station without liquid spills.

5) **WATER RESERVOIR:** A water reservoir of 55ml capacity has a transparent porthole and an internal liquid level sensor, which emits yellow light when the fluid reaches the maximum level. The membrane pump located on the rear of the reading station PVC panel refills the reservoir. The washing water from the external water supply tank is aspirated through a transparent tube connected to the rear right side of the analyzer.

   A filter attached to the transparent tube in the water supply tank and an additional filter on the intake of membrane pump removes undesired corpuscles. In case of liquid level sensor malfunction an emergency overflow tube connected on top of the water reservoir discharges liquid into appropriate container outside the analyzer. The liquid level sensor cable is connected to the Master Power Board (15-04209-01), where the microcontroller (µC 552) monitors the pump through the feedback control with the sensor.

6) **PERISTALTIC PUMP:** The peristaltic pump is dedicated to supplying the washing water from the water reservoir to the fluidic circuit, which consists of diluter, pinch-valves, sampling tube and the sampling needle. During the washing cycle, the pump dispenses a necessary quantity of water, which flows through diluter, sample tube, sampling needle, and then finally ends up in the funnel for discharging.

6-4.1. DILUTER OPERATING PRINCIPLE

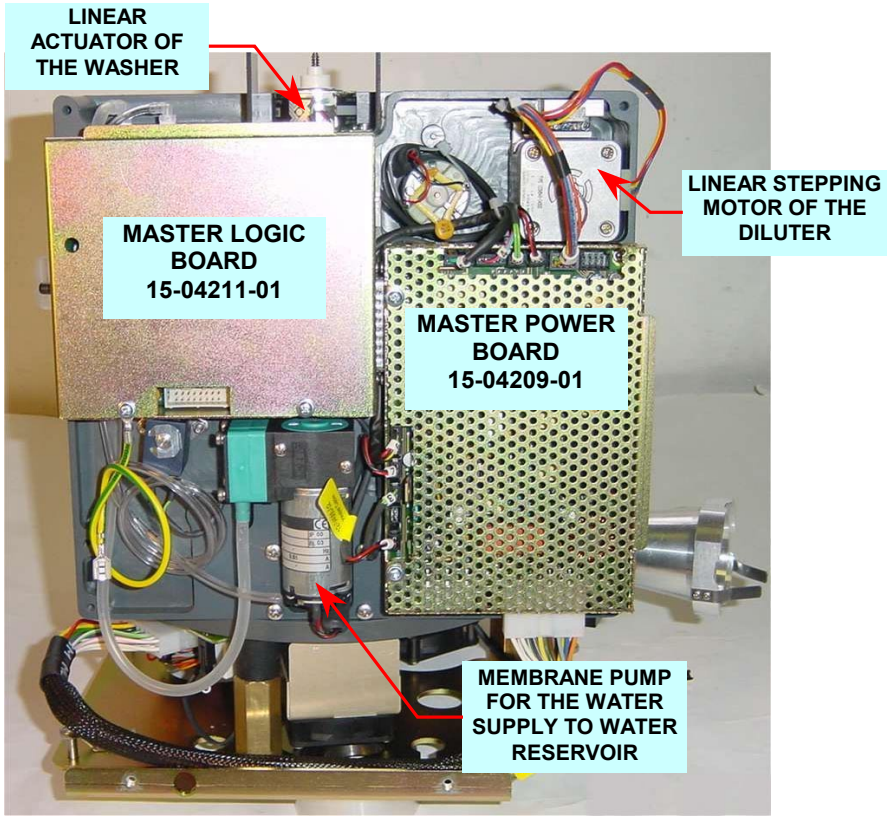


DILUTOR
Figure 6-5

It consists of a ceramic piston driven by a linear stepping motor inside a transparent thermoplastic chamber. It is high-resolution device, which allows fluid displacement of 1/10th of microliter per step. A driver circuit operating in micro steps actuates the stepping motor. The zeroing of the piston is realized through photoswitch and a miniature metallic shield. The electro-mechanical system moves to and fro on a linear bearing slide.

The diluter module is connected to the control electronics on the "Master Power Board" P/N 15-04209-01 (located on the rear of the reading station) through a 8-pin connector cable.

The diluter aspirates and dispenses fluid when the pinch-valve is in the closed position. The washing of the proper fluidic circuit is performed with the pinch-valve in the open position. In the latter case the peristaltic pump on the right of the diluter is activated to supply the washing water from the water reservoir to wash the diluter chamber, tubing, and the sampling needle. The washing water finally ends up in the funnel located on the analyzer deck for discharging.



READING STATION - REAR VIEW
Figure 6-6

6-5. ELECTRONICS FOR THE READING STATION SYSTEM

The entire electronics of the reading station, excluding the photometer, is integrated in two boards located on the rear of its PVC panel: the Master Power Board (**15-04209-01**) and the Master Logic Board (**15-04211-01**). See **Figure 6-6**.

6-6. MASTER LOGIC BOARD (15-04211-01).

This board (**Figure 6-6**) can be considered the heart of the electronic system. This board accommodates the master microprocessor with a high capacity RAM and EPROM. The bootstrap of the process program for all of the satellite microcontrollers is executed in this RAM. This software is resident in the hard disk and can be modified if needed. Another µC764 is resident on this board and, together with µP552, processes an analog digital signal. Observing the schematic carefully, the µC552 utilizes the UART for communicating with the IBM through the MAX232 (U7) via the RS232.

The same µP552 utilizes two analog inputs for reading the temperature of the cuvette plate and the vacuum level of the vacuum pump system. The U8A temperature chip and U8B pressure chip amplify the analog signals of the sensors. The µC764 is dedicated to the control of cuvette plate motor and the linear actuator of the washer module. The U2 chip is a Programmable Array Logic (PAL) device programmed for generating the complex quantity of logic gates used for interfacing the photometer preamplifier with the µP552. The µC764 also uses this gate for connecting to the Master Power Board (**15-04209-01**) described below.

The U3 chip is an isolated DC/DC converter, which powers the photometer preamplifier. It regulates +5 Volt DC input voltage into a ±12 Volt DC output voltage.

6-7. MASTER POWER BOARD (15-04209-01)

The Main Power Board (**Figure 6-6**) is the densest board of the analyzer. It accommodates all the devices required to control the stepping motors, valves, etc. for the reading station. However, for practical reasons, another µC764 has been inserted to provide temperature control and regulation for the cuvette plate.

The circuit consists of a comparator connected to the temperature sensor, which is inserted into the bottom of the cuvette housing. The U8 comparator output, along with the U5 chip, regulates the switching which generates a variable voltage in the terminals of the Peltier modules. One section of the comparator controls a relay for inverting the polarity when the ambient temperature requires momentary cooling of the cuvettes system.

The process just outlined produces a relatively coarse temperature regulation of approximately ±1°C. The fine regulation of ±0.1°C is performed by the software implemented in the µP552. When monitoring the temperature of the sensor, the above-mentioned regulator allows a continuous adjustment of the selected temperature.

6-8. INTERFACE BOARD (15-04270-01)

The ISE sampling arm heater, the cuvette motor, Peltier modules of the reading station system and their cooling fans, the Hall sensor, and the temperature sensor are all connected to the Interface Board (**Figure 6-2**). A bi-color LED indicator is also located on this board to visualize the hot/cold status.

NOTE:

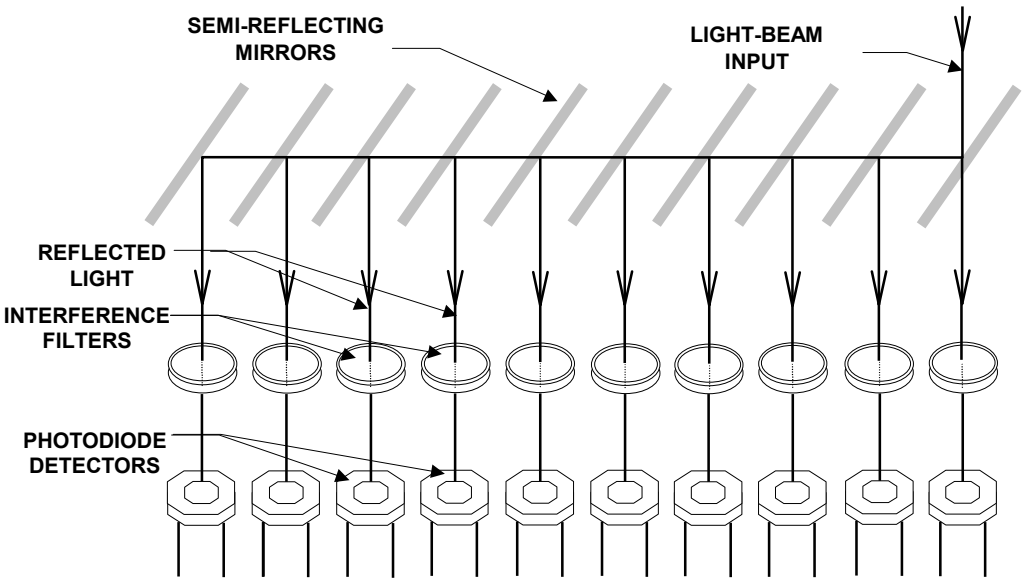
The Master Logic Board, Master Power Board, Photometer, Halogen Photometric Lamp, Diluter Pump, Peristaltic Pump or any other device on the reading station can be simply accessed through an appropriate cover on the rear panel. This access cover has been designed into the system for facilitating the inspection and maintenance operations. After receiving the information from the central processing unit (IBM), the integrated electronics make the module an independent intelligent peripheral.

6-9. THE 10-CHANNEL PHOTOMETER

The Biotecnica 10-channel photometer (**Figure 6-1** and **Figure 6-7**) is a discrete device and has ten channels with interference filters. Each channel has an independent filter, photodiode, and amplifier. The unique optical system provides for simultaneous illumination of all of the channels. The electronics circuit is capable of communicating and acquiring signals from 2 channels for bi-chromatic reading.

The 10 amplifiers and as many diodes are visible on the schematic (**Figure 6-7**). Each amplifier is equipped with a trimmer for gain regulation. The gain adjustment is necessary for adapting the signal level to the manufacturing tolerances of optical components. The two multiplexers, U6 and U7, and their outputs that are connected to the inputs of two A/D converters, U8 and U9, establish the simultaneous selection of two channels. The conversion is serial type. The digital impulses pass through the U10 Gate (74LS132) with Smith trigger function. The two multiplexers are addressed by the µC764 (master logic board) with 4-bit per multiplexer. The electronic circuit of the photometer is powered by ±12 Volts for the analog circuits and +5 Volts for the digital circuits. A 16-conductor flat cable is used for connecting the photometer to the master logic board.

The calibration of each channel is performed in reference conditions (usually at the factory). The following requirements must be observed for the calibration procedures: clean and transparent cuvette filled with distilled water, new halogen lamp, and sufficient warm up time. The diagnostic program can be used for verification and any correction, if necessary. Each channel must generate an output signal between 4 Volts and 10 Volts (theoretical). The voltage values are not visible in the diagnostic program, but the integration values are equivalent if the conversion factors are assumed as reference. In practice, the integration values should be between 14,000 and 28,000 points for all of the channels. This range takes into account the tolerances necessary for different lots of lamps and their related exhaustion. In addition an external photodiode acting as Reference Channel (**Figure 6-2**) has a range (unadjustable) of 3000 to 16000 points.
Refer to the diagram of "10-Channel Photodiode Array Photometer" below.



10-Channel Photodiode Array Photometer
Figure 6-7

6-9.1.TECHNICAL SPECIFICATIONS OF THE PHOTOMETER

Optics:	Ten (10) static channels with semireflective mirrors (beam splitters), with a light input angle of 90°.
Interference Filters:	340, 380, 405, 436, 478, 510, 546, 578, 630nm at a 8nm hbw and 700nm long wavepass.
Photodetectors:	Silicon photodiodes for UV and visible detection 310nm-700nm. In addition a photodiode for reference channel (**Figure 6-2**).
Electronics:	Ten (10) multiplexed amplifiers and A/D conversion with 22-bit resolution. The photodiode of reference channel is embedded in the cuvette drum (**Figure 6-1** and **Figure 6-2.**

6-10. FCC PROCEDURE

The FCC (Cuvette Correction Factor) function is essential for correcting the optical path of the cuvette, which in any case does not exceed the tolerance of ± 3%. After introducing the potassium bichromate solution in each cuvette and reading the relevant absorbance, the software creates a correction factor for each cuvette based upon average absorbances. As final result one obtains an equivalent response in absorbance better than 99%.

The FCC procedure is necessary every time one or more cuvettes are substituted. **After the termination of FCC cycle, the analyzer system sets the transmission of all the cuvettes at 100%.**

Prior to activating the FCC function, prepare reference solution with 4.3 grams of potassium bichromate powder in 1000 ml of H_2SO_4 0.1 N. Afterwards dilute this solution 1/100 with H_2SO_4 0.1 N. The absorbance measurement for this product is 400 units at 340nm. The interference filters 340/700nm are used for the test. During the FCC process the system performs: washing, zeroing, introduction of bichromate solution, absorbance readings, and the creation of correction factors.

Once the FCC is completed, the system presents simultaneously the absorbance values of all the cuvettes before correction and the percentages of corrections. The program generates a FCC error if one or more cuvettes require a correction of more than 3%. In this case, it is recommended to repeat the FCC procedure to exclude any possibility of other causes. If necessary, substitute the cuvette.

SECTION VII

REAGENT SYSTEM

7-1. GENERAL

The reagent module system incorporates an appropriately insulated reagent chamber (in aluminum) for reagents refrigeration. The reagent chamber accommodates the rotating reagent plate (divided into sectors) where trays with wedge-shaped reagent bottles are inserted. Each reagent tray (removable) can accommodate 5 large wedge-shaped reagent bottles (50ml or 80ml) snap-fitted with 5 smaller reagent bottles (10ml or 20ml), for a total of 80 reagent bottles.
Two large heatsinks with eight (8) Peltier assemblies are affixed to the underside of the reagent module. A cross-flow blower located near the heatsinks, removes the air towards outside. An electronic circuit in feedback with temperature sensor regulates the electronic current of Peltiers and ventilator, thus realizing the temperature monitoring system. A stepping motor driven belt-drive/pulley mechanism provides rotary motion to the reagent plate.
The temperature uniformity throughout the reagent chamber is maintained at approximately 12ºC. The temperature inside the reagent chamber is maintained constant up to 26ºC of ambient temperature. Any increase beyond this ambient temperature value will consequently increase the reagent chamber temperature considerably.

7-2. REAGENT PLATE CONTROLLER - 15-05211-01 (Valid from July 2004 onwards)

The board **15-05211-01** is mainly dedicated to the barcode scanner, stepping motor, temperature monitoring, and the reset sensor for the reagent plate.
It consists primarily of a **µC U3 87LPC767**, which controls the actuation of stepper motor connected to the connector **J3**.
The stepping motor provides rotary motion to the reagent plate accommodating reagent trays with reagent bottles. The isolation between the driver **A1** (power constituent) and the **µC U3** (digital element) is obtained through the optoisolators **U4** and **U5** (**TLP2630**).
The **µC U3** (with gates **P1.0** and **P1.1**) and the integrated circuit **U6** control the signals from the barcode module connected to J5.
The **Hall** sensor is connected to the board through **J4**. The reagent plate resetting occurs when the **Hall** sensor is face to face with its magnet located in the reagent pulley.
The refrigerator temperature control is accomplished through the comparator U7A (MAX492). The voltage present at pin 1 of the comparator reaches the gate P0.4 of U3 and its value corresponding to the reagent plate temperature determines the amount of voltage to be supplied to the Peltier and as well as turning on or off the cross blower fan.
The U7B part of the comparator is dedicated to the control of the safety interlock sensor connected to J6. This sensor stops the plate movement when the reagent access cover is opened.

The gate P0.7 of µC U3 sends the command bit of optoisolator U8 (TLP521-1). A low logic level of P0.7 determines the simultaneous opening of the MOSFETs Q1 and Q2 (BUZ111S) and the consequent inhibition of the peltier modules of the refrigeration system.
The gate P1.6 of U3 controls the high velocity optoisolator U9 (6N136). This optoisolator drives the digital potentiometers PD1 and PD2. The potentiometers through their ohmic variation determine the Peltier supply voltage value. An approximate voltage of 26VDC corresponds to the higher cooling capacity and the approximate voltage of 16VDC corresponds to the lower cooling capacity. The power supply is interfaced through the connector J2. The NTC1 sensor protects the reagent controller module against overheating. The high temperature inside the module (>70ºC) produces a voltage variation on the gate P0.6 of U3. The intervention threshold is fixed at 4.5V. During the alarm condition the Peltier modules are disabled and an alarm message is displayed on the analyzer screen.
The gate P0.0 of U3 drives the optoisolator U11 (TLP521-1). The low level logic of P0.0 determines the opening of the transistor Q3 and the power off to the cross blower ventilator. The operating logic turns the cross blower fan ON or OFF when the reagent plate reaches the preset temperature (±0.5º) in the analyzer setup to avoid ice formation in the reagent plate with ambient temperature up to +12ºC (values beyond the operating range).
The glowing LED (DL5) indicates the activation of cross blower fan.

This board, compared to the previous board, has the advantage of functioning also when the analyzer is in the standby mode, without any supply voltage from the IBM.
The supply voltage for the µC 767 is realized on board through a DC/DC converter, which is powered by the same source that energizes Peltiers. The temperature sensor is connected to the gate A/D of the 764 for reading the value in ºC. The temperature monitoring system is controlled digitally by regulating nominal 24V in the range of 16V to 28 Volts.
Below a certain temperature (approximately 5ºC), it is not possible to further reduce the current of the Peltiers. Therefore to control the temperature, the operation of cross-blower fan is interrupted for the time necessary to reset the selected temperature. The temperature is selected in the instrument setup and the temperature can be set between 5ºC and 15ºC. The set temperature is maintained reagent chamber base to a tolerance of +/-2°C as long as the ambient temperature does not exceed the 26ºC. Beyond 26ºC it is possible to have a considerable increase in the set temperature. If the µC reads a temperature higher than approximately 40ºC, then it interrupts the current to the regulation circuit assuming that there is a problem in the system. For example a defective or damaged fan or an exceptionally high ambient temperature (40ºC) may generate an excessive temperature in the reagent chamber. One can observe in the electrical schematic the NTC near the power connectors. It has the function of heat sensor, which may be produced by false contacts in the connections or some other problems in the printed circuit board. In this case the MOSFET Qx interrupts the Peltier current, when the temperature in the interested zone is approximately 70ºC.

7-3. REAGENT PLATE CONTROLLER - 15-04313-03 *(OBSOLETE - used on Analyzers up to June 2004)*

This module designed for reagent plate management is housed in an easily removable metallic container. The electronic devices on this board have the following functions:

a) Reagent plate drive motor control.
b) Zero position sensor control.
c) Reagent plate temperature control.
d) Barcode reading and interface.

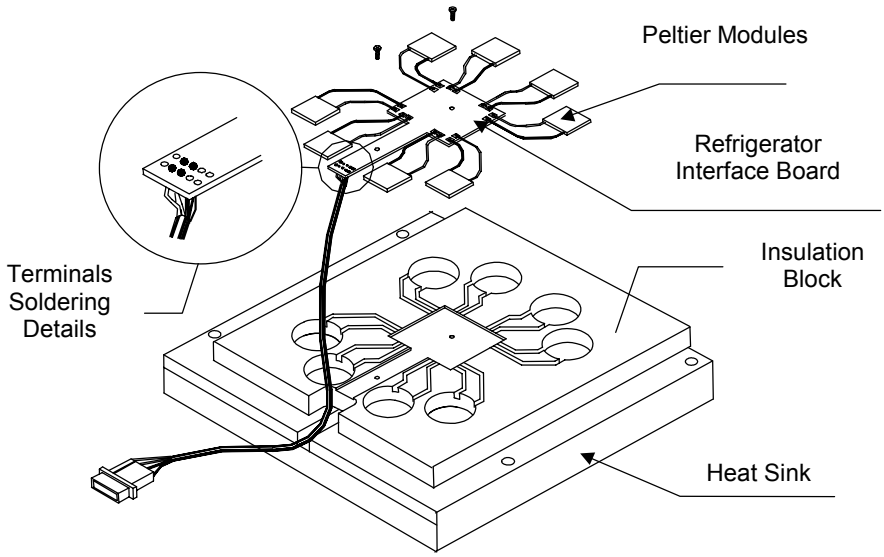
This module is located on the rear of the reagent chamber and is easily accessible for service or repair through the small panel on the rear of the analyzer.

The Reagents Plate Controller Module (15-04313-03) is controlled by µC87LPC764. This micro-controller manages the stepper motor through two opto-couplers, U3 & U4, which isolates the power driver A1 from the digital circuit.

The µC764 receives signals from the barcode module through the U5 chip (Max 232). The reagents chamber temperature is controlled through a U6A comparator and the Q1 transistor. The control temperature is fixed at about 5°C by using the remote control of the power supply (Lambda Alpha 400W). The J2 connector connects the power supply to the controller circuit of the reagent plate. The Q2 transistor functions as a switch to interrupt power supply to the Peltiers through the µC764 (pin 14) whenever requested by the software. The circuit for the control of the Peltier voltages has an additional function of interrupting power to the refrigeration system in case the temperature inside the reagents chamber exceeds 40°C. The circuit, which generates this function, consists of a U6B comparator and an U7 opto-coupler. The Hall sensor (zero position), temperature sensor, and the Peltier modules are all located under the reagent chamber.

7-4. REAGENT REFRIGERATION SYSTEM

The reagents refrigeration system comprises reagents chamber, refrigeration module with the Peltier modules, conductive spacers, and heat sink, along with the reagent pulley drive assembly.



Reagent Refrigeration Module
Figure 7-1

7-5. REAGENT & SERUM BARCODES

The available codes for sampling procedure are in the memory in blocks of 5 codes. To insert a new block (5 codes) it is important to import data using a floppy disk. The following blocks are available at the present:

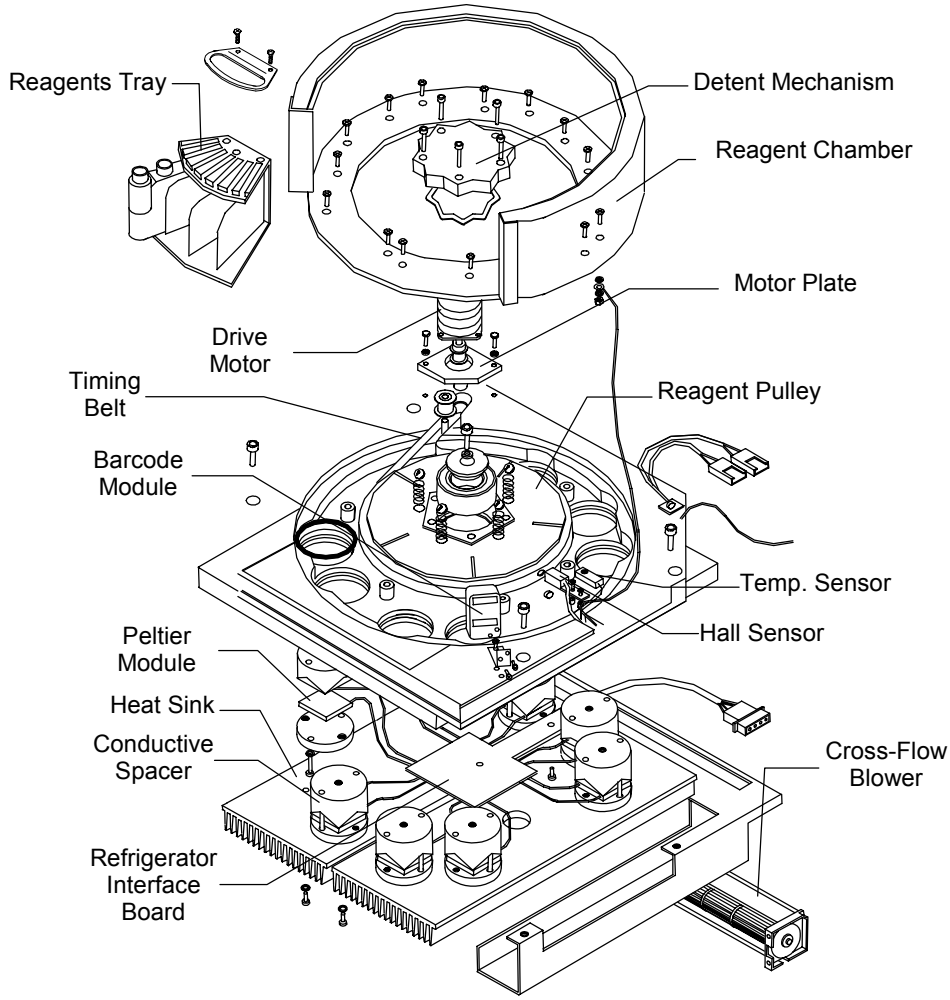
CODE39, CODE39, FULL ASCHII, CODABAR, CODE128
EAN128, CODE93, PLESSEY, PHARMACODE, EAN13
UPCA, UPCE, EAN13 AddON2, EAN8 AddOn2, UPCA AddOn2
UPCE AddOn2, EAN13 AddOn5, EAN8 AddOn5, UPCA AddOn5, UPCE AddOn5

Reagents Barcodes

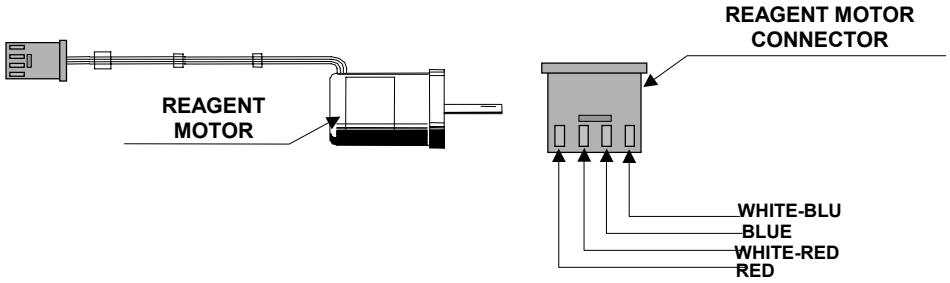
For the reagent system the code used is type EAN13.

1°, 2°, 3°:	Numeric analysis code, for example: 128 (GLU)
4°:	Type of tube (for example: 80ml)
5°:	Reagent 1° or Reagent 2°
6°, 7°, 8°:	Expiry date, year, and month (for example: August 2004 = 408)
9°, 10°, 11°, 12°:	Progressive number of 4 digits from 0 to 9999

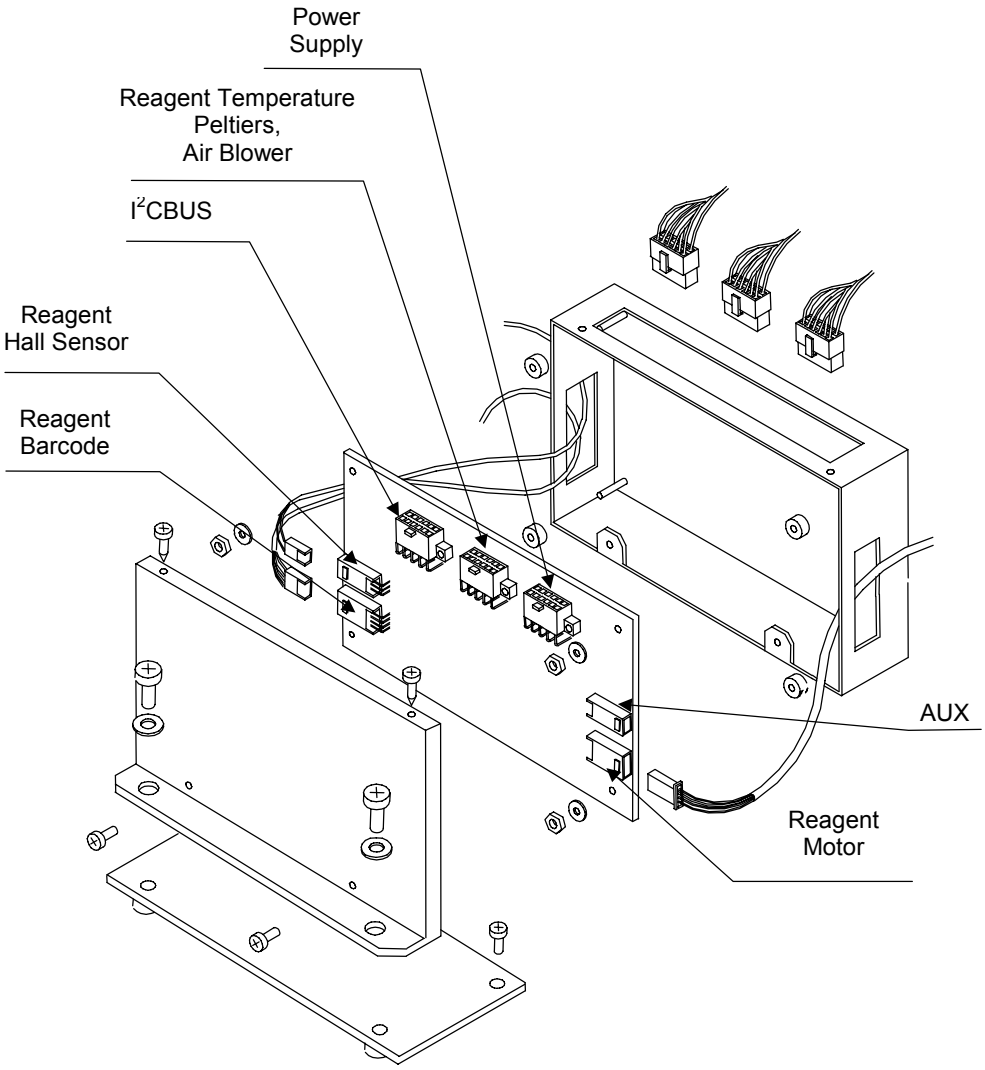
The algorithm, which manages the control of utilization of the tube, is as follows:
A password establishes if one desires to operate the analyzer as a system: "OPEN" or "CLOSED"
In the last case (CLOSED), when the tube is empty it cannot be reused if refilled with another reagent. There are other control parameters to avoid the reuse of the same sample tube, as for example the number of possible tests, the decrement of the consumed liquid, the expiry date etc.
Obviously it is possible to use the instrument by reading only the analysis code for positive detection through use of another password.



REAGENT REFRIGERATION SYSTEM - EXPLODED VIEW
Figure 7-2



REAGENTS DRIVE MOTOR
Figure 7-3



REAGENT CONTROLLER MODULE
Figure 7-4

SECTION - VIII
SAMPLING STATION

8-1. GENERAL

The removable sample plate is protected by a transparent dust cover with various apertures for the sampling needle entry during operation. The sample plate can be placed in any position because the home position will automatically be recognized once the reset has been activated.

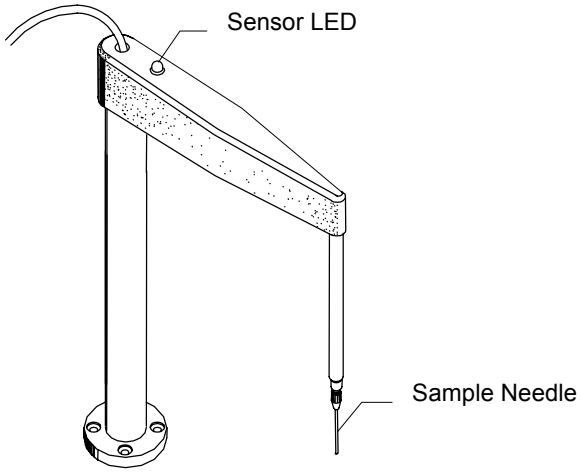
The primary tubes can be inserted without removing the plate. Place the tube in the position indicated by the flashing red LED. An optical sensor will differentiate the primary tubes from the cups used for the samples. A barcode reader automatically identifies the position and the data concerning the sample.

The two sampling arms are located on the right side of the analyzer deck. On each sampling arm the stepper motor belt driven mechanism causes the needle to move in up and down linear motion. Another stepper motor drive a belt driven pulley mechanism which swivels the sampling arm to the right or left positions across the deck to position the sampling needle for the aspiration and dispensing procedures.

The left sampling arm can position the sampling needle for aspiration, dispensing, and mixing on the reagent chamber, serum plate, reaction cuvettes, the wash funnel, and the "home" position. The right sampling arm can position the sampling needle on the sample tubes of serum plate, ISE reagent bottles, ISE funnel, and the wash funnel and the "home". It also positions the sample needle over reaction cuvettes for aspiration, dispensing, or mixing.

Both arms have a built-in facility for the pre-heating reagents through special heating tube. They also have the capability to measurement of the remaining reagent volume in the bottles through a built-in liquid level sensor through an Arm Liquid Sensor Emitter (15-05023-01). All other devices, including, the diluter, peristaltic pumps, pinch valves, serum plate drive motor, sample arm drive motors, liquid temperature control circuits, and the electronics, are housed inside the analyzer.

The stepper motor for the angular motion of the arm, can generate high frequency oscillations for mixing. The rapid angular movements providing efficient high frequency oscillations of the sampling needle, which when immersed in the cuvette can mix the dispensed fluids. The entire module is an intelligent peripheral slave, which autonomously performs the sampling procedures after receiving information from the Master Logic Board.



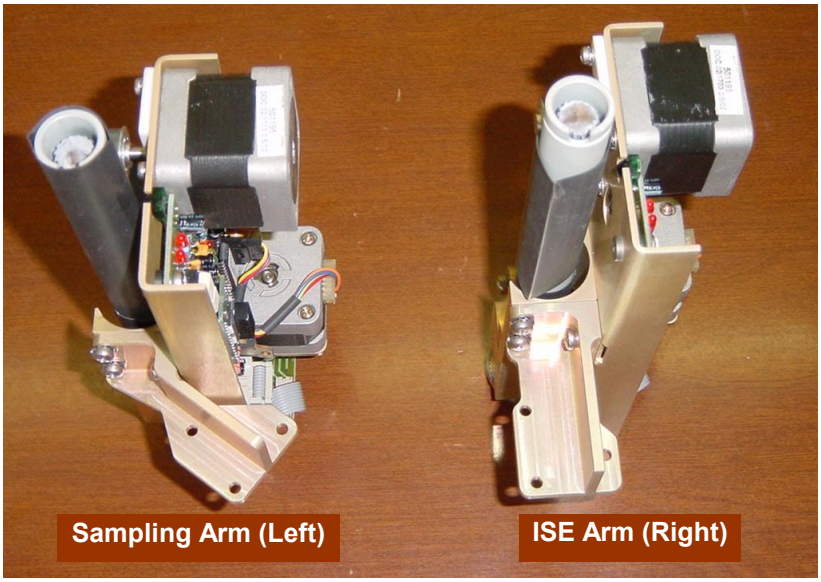
SAMPLING ARM WITH HEATER
Figure 8-1

8-2. SAMPLING ARM MODULE

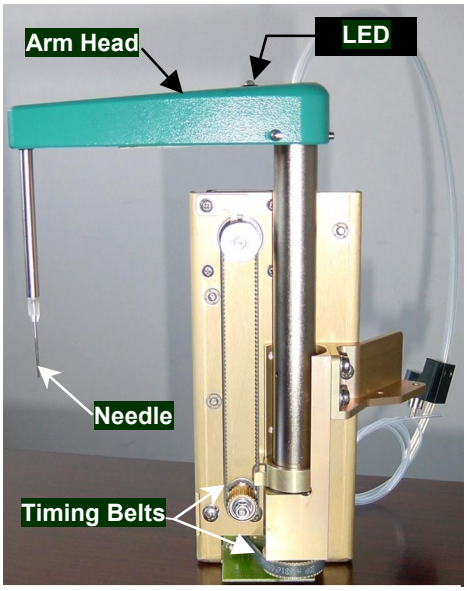
The sampling arm module is an electro-mechanical system for provides the sampling needle with vertical (up/down) and angular (swiveling) motion. The Arm Controller Board (15-04765-01) containing a micro-controller for actuating the stepper motor and is located on the lower section of this module, near the vertical drive mechanism. The liquid sensor circuit is located inside the needle head.

8-2.1. ARM CONTROLLER BOARD (15-04765-01)

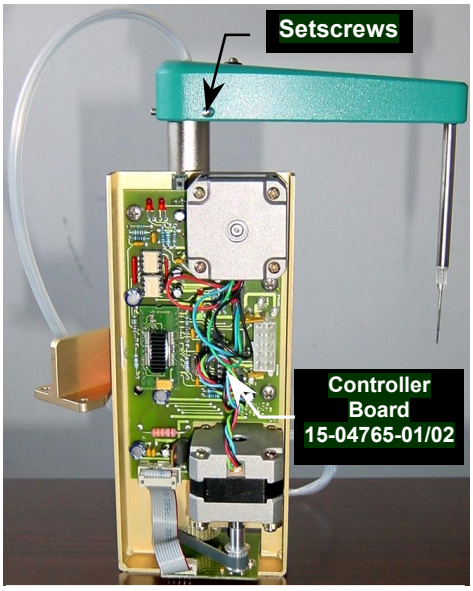
The arm controller board is the basic circuit for controlling arm movement. The µC764 controls the power to the A & B dual-driver for the sampling arm up/down & swivel motions through the opto-coupled gates. The "home" or zero position of the sampling arm is realized through a photo-switch and shutter on the base of the motorized shaft mechanism. An additional sensor module is located at the upper section of the drive mechanism.



SAMPLING ARM MODULE
Figure 8-2



SAMPLING ARM (FRONT)
Figure 8-3



SAMPLING ARM (REAR)
Figure 8-4

8-2.2. ARM LIQUID SENSOR & EMITTER BOARD (15-05023-01)

It is a microcontroller 764 based small electronic circuit board located inside the arm head. The 8Mhz oscillator of µC764 is used for realizing amplitude modulation of signal transmitted from needle.

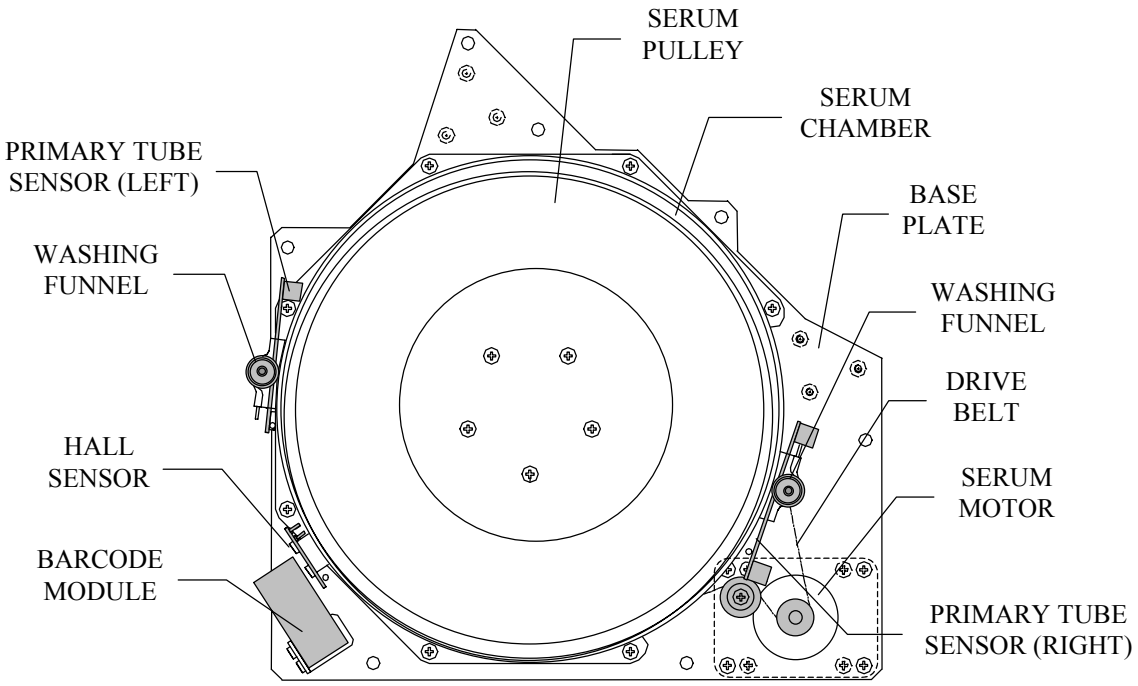
The variation of amplitude generated by the needle contacting liquid is controlled and converted by the µC764 in a chain of 40Khz impulses through infrared LED and simultaneously the red Led indicator at the underside of the arm head provides visual repetition of the infrared LED. The circuit is powered by the 5 Volt generated by a low-dropout linear regulator, which obtains the voltage from the downstream of supply line coming from the reading station. No calibration is required for this circuit.

8-2.3. ISE SAMPLING ARM MODULE

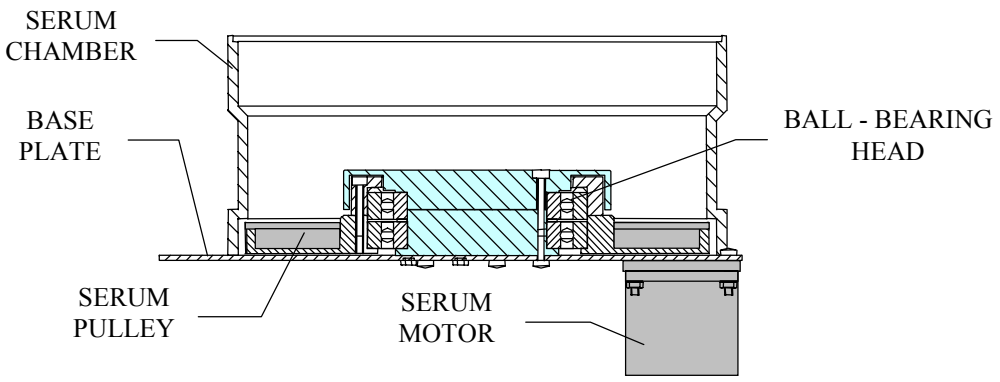
The ISE sampling arm module is identical to the preceding sampling arm description. It consists of a drive mechanism, stepper motors for the angular and up/down motions, the Arm Liquid Sensor & Emitter Board (15-05023-01), ISE electronics, and arm controller board. Refer to Figure 8-2 entitled "Sampling Arm Module", for the technical information.

8-3. THE SERUM MODULE

The serum module is made up of the stepper motor drive mechanisms for serum plate movement, electronics, primary tube sensor with electronics, ISE sensor and electronics, and the Serum Plate Controller Board (15-04422-01).



SERUM MODULE - TOP VIEW



SERUM MODULE - FRONT VIEW

SERUM MODULE
Figure 8-5

The new design of the sampling module integrates the entire sampling system into a single module with the following features:

a) Autonomous testing of the module before incorporating into the analyzer
b) Compact hydraulic circuit providing stabilized flow efficiency
c) Hydraulic circuit hidden from view for safety
d) Technical assistance facilitated by the ability to substitute components with other tested sampling modules

8-3.1. SERUM PLATE CONTROLLERS

The serum plate controllers are a group of various electronic circuits applied to the removable sampling module. The main controller circuit is housed in a metallic container located near the serum chamber. The additional circuits are firmly secured to the rim of the serum chamber. These electronic circuits perform the following functions:

a) Control of the serum plate stepper motor
b) Acquisition and management of the barcode data of the serum plate
c) Control of the Hall sensor for "home" or zero position
d) Control of sensors detecting primary tube sensor presence

8-3.2. SERUM PLATE CONTROLLER BOARD (15-04422-01)

This board housed in a metallic container accommodates the µC764, which controls the serum stepper motor through the U4 and U5 opto-couplers, and the A1 driver. The barcode data is acquired and processed through the U3 MAX232 chip. The module receives the data from the Hall sensor at the zero position, connected to J2, as well as the signals from primary tube sensors incorporated in their independent circuits located on the left and right of the serum chamber.

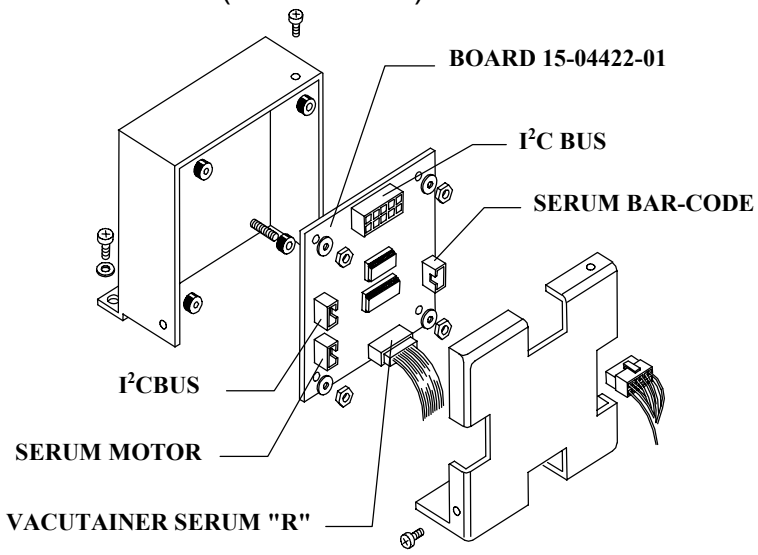
8-3.3. LEFT SERUM PRIMARY TUBE SENSOR BOARD (15-04280-01)

This supplementary circuit is located on the left of the serum chamber. It accommodates a noninvasive infrared detector housed in a PVC body, for the detection of the primary tube. This circuit board is connected to the Serum Plate Controller Board (15-04422-01) through the J1 connector, passing through the another supplementary circuit board on the right. Close by, there is a Hall sensor module connected to the Serum Hall Sensor Board (15-04282-01) on the serum plate, which is connected by the J2 connector, to the Serum Primary Tube Sensor Board (15-04280-01).

The Hall sensor uses the Smith trigger, while the primary tube sensor uses the U2A-B amplifier in the A.C mode. The emitter LED EM1 is impulse-driven through the U1C oscillator.

8-3.4. RIGHT SERUM PRIMARY TUBE SENSOR BOARD (15-04278-01)

This supplementary circuit is located on the right of the serum chamber. This circuit is identical to the one outlined in the preceding paragraph, but without the control for the Hall sensor. For operating characteristics, refer to the preceding paragraph. The J2 connector attaches to the identical board on the left. The J1 connector interconnects these two identical boards through a flat cable to the Serum Plate Controller Board (15-04422-01).



SERUM PLATE CONTROLLER MODULE
Figure 8-6

8-4. BARCODE SCANNER

This is a high quality laser scanning & CCD module (Figures 8-5, & 8-7). It is connected to the "Serum Plate Controller Module" through the serial port. It can automatically read 6 different types of codes. It is also possible to reprogram the scanning modules with additional codes during installation. Bt 3000 PLUS has barcode scanning modules for the reagent module and the serum module.

Important Notice:

Any modification to the Variable Serial Protocol (refer to paragraph 4-6. "Variable Serial Protocol" in Section IV) is restricted to qualified personnel only. The Biotecnica Instruments S.p.A. guaranties the correct performance of the internal serial protocol. The responsibility for any malfunction arising out of any modifications to the scripts of the Variable Serial Protocol rests with the customer.

WARNING

This information regards the setting up of the barcode for sample tubes identification. The reading of the sample barcode label has the same progression as patient code.

For example: Once a patient code of 15 characters has been entered, then a code of 8 characters followed by 7 empty spaces to reach the 15 characters is sent.

The code read on the barcode label must have the same sequence 8 + 7 for correct detection.

8-5. SERUM & REAGENT BARCODES

The available codes for sampling procedure are in the memory in blocks of 5 codes. To insert a new block (5 codes) it is important to import data using a floppy disk. The following blocks are available at the present:

CODE39, CODE39, FULL ASCHII, CODABAR, CODE128

EAN128, CODE93, PLESSEY, PHARMACODE, EAN13

UPCA, UPCE, EAN13 AddON2, EAN8 AddOn2, UPCA AddOn2

UPCE AddOn2, EAN13 AddOn5, EAN8 AddOn5, UPCA AddOn5, UPCE AddOn5

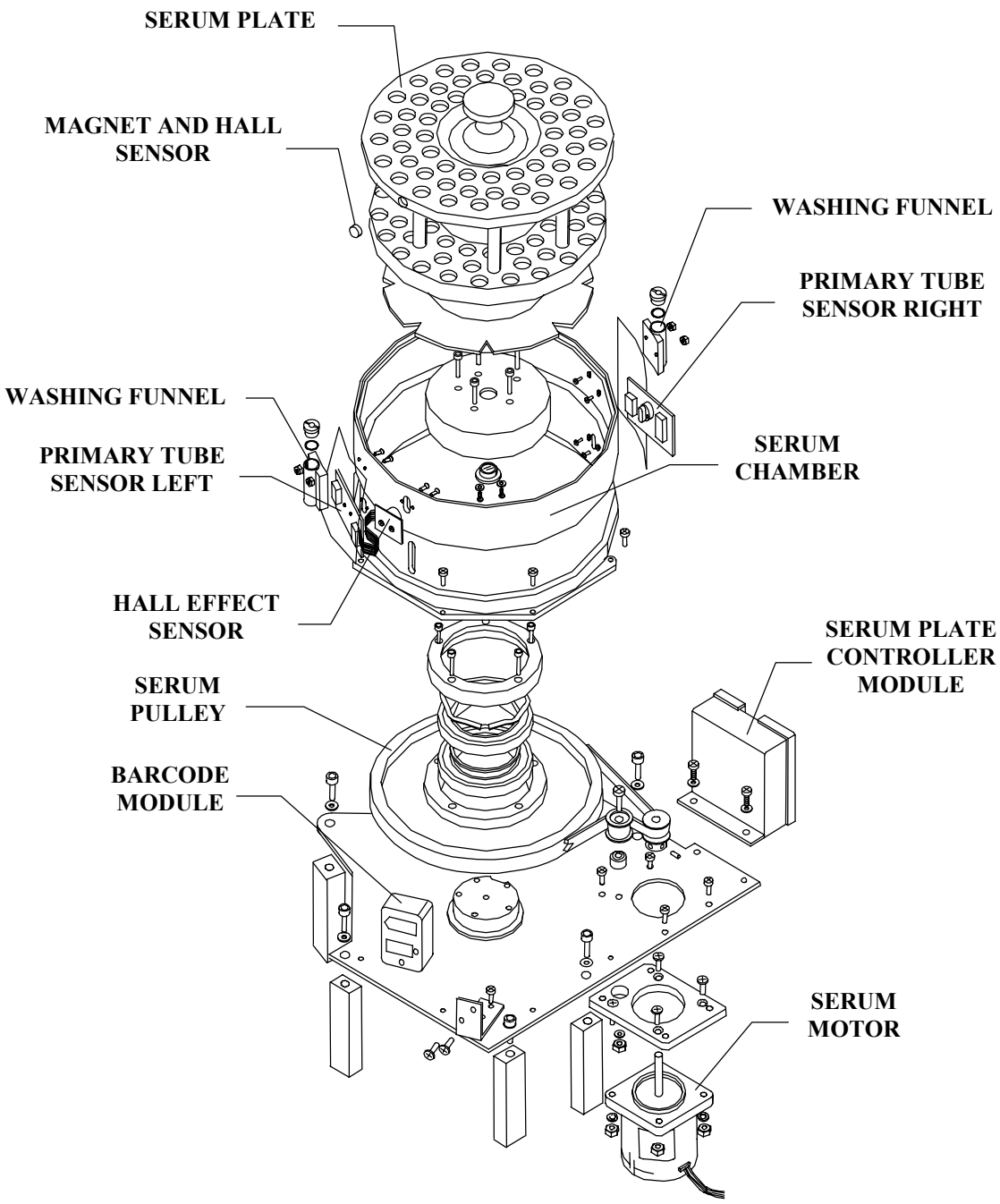
Reagents Barcodes

For the reagent system the code used is type EAN13.

1°, 2°, 3°:	Numeric analysis code, for example: 128 (GLU)
4°:	Type of tube (for example: 80ml)
5°:	Reagent 1° or Reagent 2°
6°, 7°, 8°:	Expiry date, year, and month (for example: August 2004 = 408)
9°, 10°, 11°, 12°:	Progressive number of 4 digits from 0 to 9999

The algorithm, which manages the control of utilization of the tube is as follows:
A password establishes if one desires to operate the analyzer as a system:
"OPEN" or "CLOSED"

In the last case (CLOSED), when the tube is empty it cannot be reused if refilled with an another reagent. There are other control parameters to avoid the reuse of the same sample tube, as for example the number of possible tests, the decrement of the consumed liquid, the expiry date etc.
Obviously it is possible to use the instrument by reading only the analysis code for positive detection through use of another password.



SERUM MODULE - EXPLODED VIEW
Figure 8-7

SECTION - IX

ION SELECTIVE ELECTRODES (ISE) MODULE

9-1. GENERAL

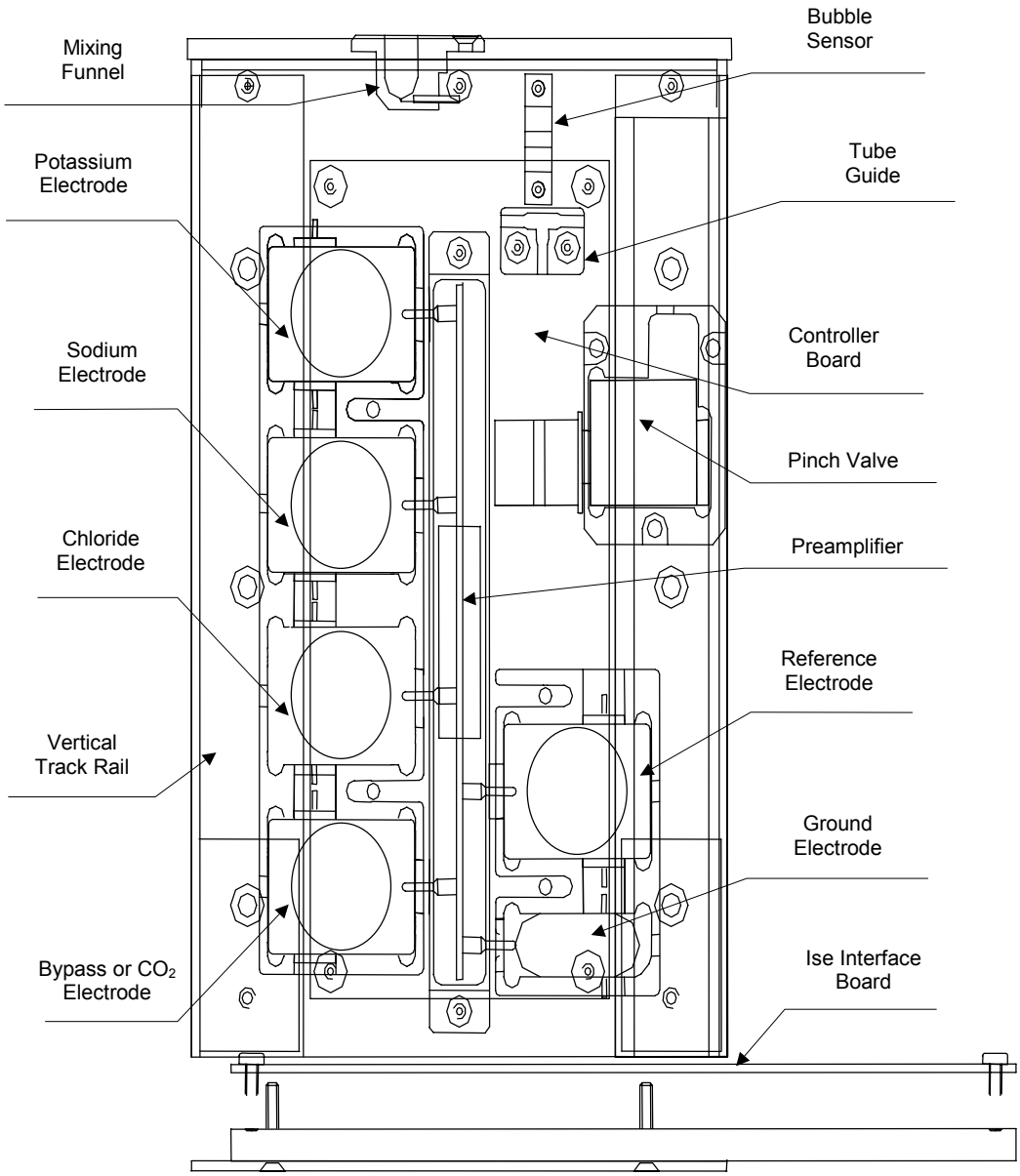
The ISE module, located on the right side of the analyzer, is used for the determination of electrolytes, in human serum and urine. The analysis method is based on the Ion Selective Electrodes (ISE) technology as the electrodes respond to the ions of the molecules respectively in conformance with the following equation of NERNST:

$$E = E0 + RT/Nf \log aM+$$

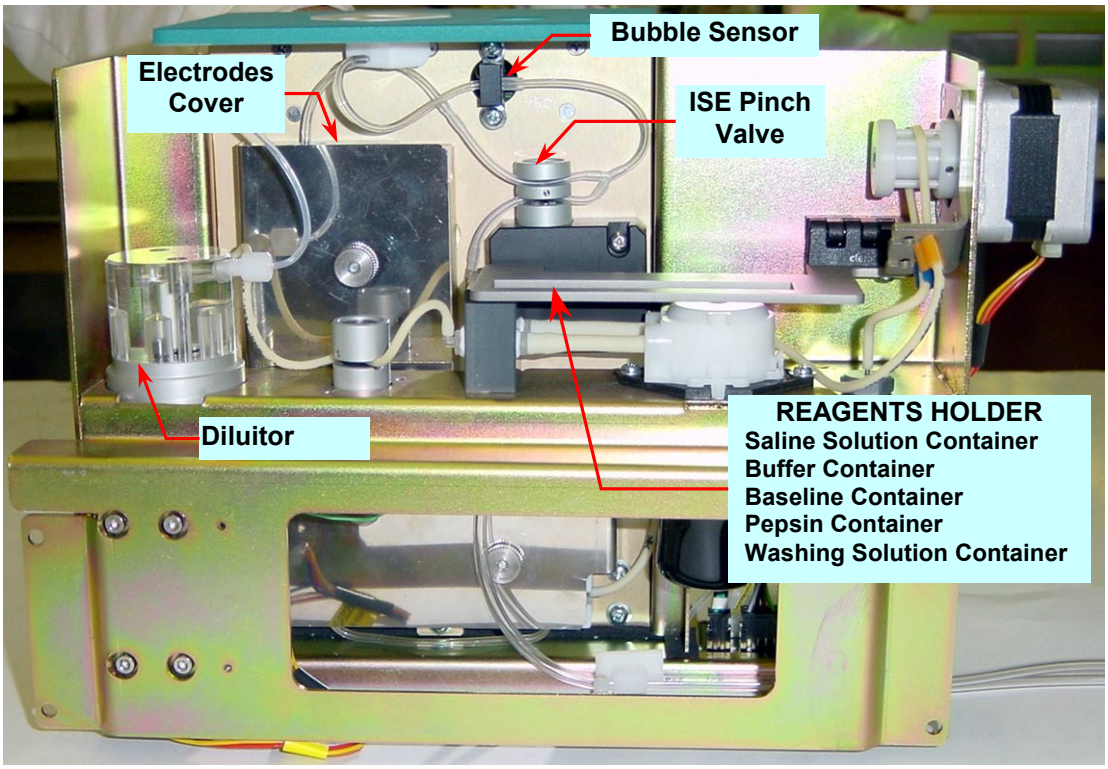
The BT3000 PLUS processes the electrolytes independently from the clinical chemistry. In fact, the module has dedicated devices like a sampling arm, diluter, and a hydraulic circuit. The specific operation method is outlined below.

A sample of serum or urine is aspirated and diluted with buffer solution in the ratio of 1/14 and then dispensed in the mixing funnel. A peristaltic pump, positioned downstream of the electrodes, aspirates the solution until the bubble sensor detects an air segment, which indicates the final part of the solution. The diluted sample remains in the electrodes for a short period of incubation and is read for four seconds. Afterwards the reference solution is dispensed into the mixing bowl and follows the preceding routine. The values of baseline potentials are subtracted from the sample values for zeroing any eventual drift. The system is calibrated using two standards of known values to obtain a slope. The reference (REF) and buffer solutions (BUF) are concentrated and are diluted automatically with distilled water in a 1/10 ratio during the sampling phase.

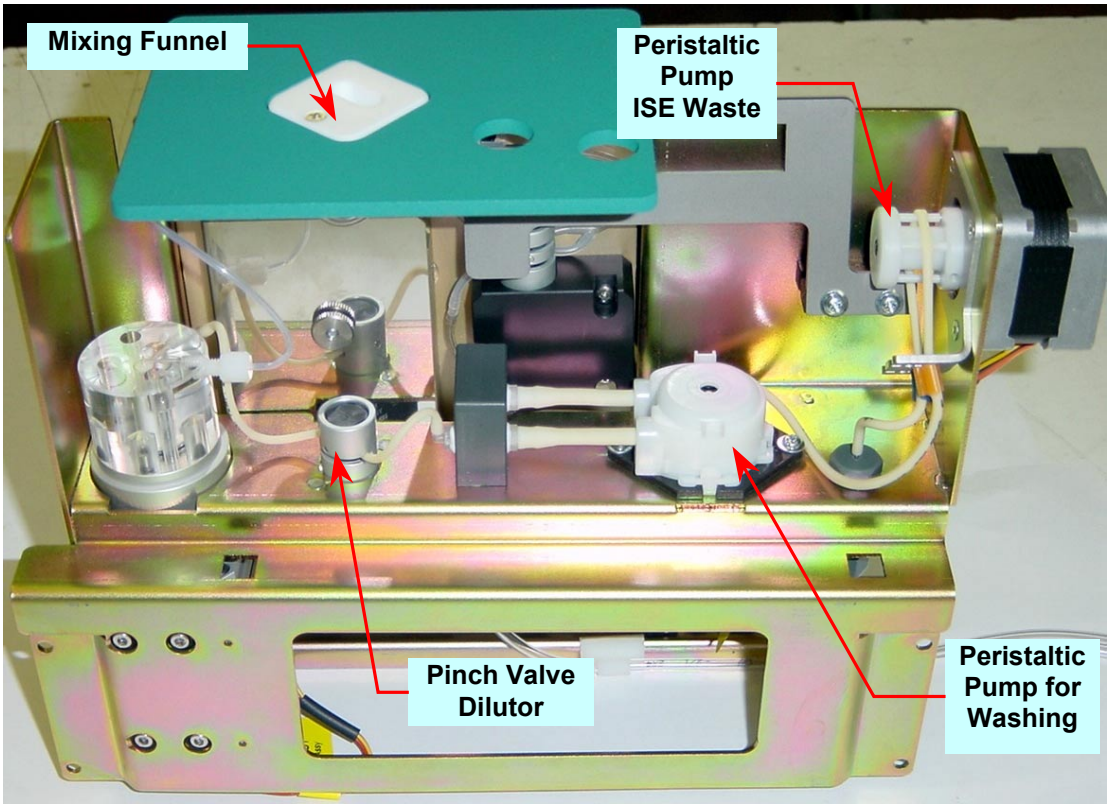
A second arm identical to that utilized on the Sampling Module, is used for the sampling of the electrolytes (refer to paragraph 2-4.2.). The elaboration of the data can also be performed in an independent way. The ISE Sampling Arm is located to the right of the Serum Module so that the aspiration needle can easily draw the Sera, the Standards & the Controls in the serum plate. The needle also aspirates the cleaning solution, the Pepsin, Buffer, and the Baseline from the appropriate bottles and funnels of the ISE Module.



ISE MODULE ARRANGEMENT - FRONT VIEW
Figure 9-1.



ISE Module - View "A"
Figure 9-2



ISE Module - View "B"
Figure 9-3

FRONT VIEW
ISE Module
Electrodes location
Figure 9-4

The ISE module accommodates the ISE electrodes, electronics, hydraulic circuit, ISE mixing funnel, bubble sensor, and the pinch valve. The highly integrated single module solution provides a very compact physical design. The remaining hydraulic circuit is located nearby on the right side and includes two pinch valves, diluter pump, and two peristaltic pumps driven by a DC motor and a stepping motor.

During instrument operations, the ISE module is out of the view under the cover of the analyzer. However, it can be raised upward and removed by disconnecting the peristaltic pump tube, for inspection or maintenance by the operator or service personnel. This module can be easily be accessed by lifting the little cover on the right side of the analyzer. The location of the ISE funnel directly over the electrodes minimizes carryover and residual bubble interference. The ISE controller board is an intelligent peripheral device. It receives information from the master processor, and using the program resident in its slave processor all the operations relevant to the ISE module are performed.

9-2. SUBASSEMBLIES OF THE ISE MODULE

For the following subassemblies, refer to Figure 9-1, 9-2, 9-3 & 9-4 on the preceding pages.

1) ISE controller board 15-04320-01
2) ISE preamplifier board 15-04440-01
3) ISE interface board 15--04503-01
4) Diluter pump module
5) Peristaltic water pump
6) Waste peristaltic pump
7) ISE pinch valve
8) Diluter pinch valve
9) Bubble sensor
10) ISE mixing funnel
11) Saline solution container (BSS)
12) Buffer solution container (BUF)
13) Reference solution container (RES)
14) Enzyme (Pepsin) solution container (ENZ)
15) Washing Solution container (WAS)

The ISE controller module is a group of electronic devices for the operation of ISE module. The controller module consists of a metallic container divided in two parts (fixed supporting bracket integral with analyzer base having two rail tracks and the mobile part with electrodes and electronics). The mobile part is removable for routine maintenance and servicing by technical personnel.

The electronic circuit of the ISE module consists mainly of a high impedance preamplifier for the electrodes, an analog-to-digital converter, and a µC767 for data processing. A µC764 is also mounted on the same circuit and is dedicated to the control of diluter pump, photo-switch, and the diluter pinch valve. The separate control of the diluter pump group allows the same diluter pump to be used as required for serum sampling and diluting.

9-2.1. ISE PREAMPLIFIER BOARD (15-04440-01)

This ISE preamplifier board is inside a module affixed to the right side of the electrodes and is connected to the ISE Controller Board through a connector. Three dual-chips (two chips in a single housing) are mounted on this board. Each chip of the dual-chip is an electrometer and is connected to the appropriate electrode through a unity-gain as shown on the schematic. On the same schematic, besides the terminals for the ISE electrodes, there is a terminal for connecting the ground electrode at reference voltage of 2.5 Volts called the virtual ground. The preamplifier is powered by a DC/DC ±5 Volt mini-converter located on the controller board.

9-2.2. ISE CONTROLLER BOARD (15-04320-01)

The controller board is connected to the ISE Interface Board (15-04503-01) at the bottom through an Euro Connector. When the ISE module is raised for maintenance or service, it is disconnected electrically from the ISE Interface Board. However, it is possible to use an extension cable to activate the module for any functional test that is required.

A 7714 chip Analog/Digital converter is located on the controller board. This is a special A/D converter with filter and amplification functions that are programmable through the micro-controller. This chip filters and amplifies the analog signals after acquiring them from the preamplifier. It has 24-bit of resolution and can convert weak signals into highly stabile and precision signals. The A/D converter is controlled by µC767 (U11).

The µC767 (U11), utilizing opto-electronic gates (section B of the Motors Driver 15-04408-01), drives the stepper motor of the ISE peristaltic pump. Other devices controlled by the micro-controller are the J4 bubble sensor, the U12 temperature sensor, and the ISE pinch valve. The temperature sensor is used for monitoring the ambient temperature near the electrodes. If there is an excessive variation of temperature during the test run, a prompt is generated to repeat calibration.

The second µC764 (U2) controls as follows: the diluter system using the section A of the driver A1, the reset photo-switch, and the pinch valve of the diluter. The opto-isolated gates that separate the digital section from the power section are also visible on the schematic.

The following external devices are connected to the ISE module through the ISE interface board located underneath the module: diluter pump, peristaltic pump, and the pinch valve.

The bubble sensor uses an opto-isolated device as a sensing element. The translucent plastic tube from the ISE mixing funnel passes through the appropriate channel in the bubble-sensor. The variations of signals produced by presence or absence of liquid is detected by the µC 767, which through an appropriate software algorithm signals the presence of bubble.

9-3. COMMONLY ASKED ISE QUESTIONS

The question and answer list below can assist regarding routine system operation, maintenance and the appropriate answers with relevant technical procedures. Exercise extreme care to ensure that the system is regularly provided with properly maintained and care should be taken to avoid any problems and malfunctions.

COMMONLY ASKED ISE QUESTIONS	
Questions	**Answers**
Should the samples be manually diluted?	No. The analyzer performs the dilution automatically.
Can I test urine samples automatically and together with serum?	Yes. It is not necessary to pre dilute the urine sample, use the same calibration procedure as for serum.
Which parameters should be set on the analyzer?	Initially set the date, hour, and the desired measurement units. Only the concentration values of standards when the lot has changed.
Should I calibrate the analyzer everyday?	Yes. The calibration is valid for approximately 4 hours and the analyzer will prompt the to recalibrate as required.
Can the analyzer operate unattended?	Yes. The analyzer can operate incessantly without problems.
Do the reagents deteriorate easily?	No. Care should only be given to the Buffer when using the CO_2 electrode. It is recommended to close the buffer container at the end of use to prolong the life. Overexposure to air by the Buffer will diminish the CO_2 slope.
Can I substitute similar reagents?	No. The ISE reagents are very specific and substituting may affect the precision of the analyzer, as well as the integrity of electrodes.
How do I maintain the standards?	Close them immediately after the use. Do not contaminate them! The accuracy of the samples is dependent upon the quality of the standards. Do not expose them to the sources of strong light and the heat.

COMMONLY ASKED ISE QUESTIONS (contd.)	
Can the analyzer suddenly not produce an ISE result?	Yes, when the reagents are finished.
What has happened if all test values are high?	Samples may have exposed to air for more than half an hour on the sample plate or a calibration was performed with a contaminated standard.
Why is the Cl and CO_2 electrode slopes represented in negative numbers?	The potentials of the Cl and CO_2 electrodes are inversely proportional to the concentration.
What happened if the Na & K slopes are negative and the Cl & CO2 slopes are positive?	The two standards were placed in the inverted positions on the sample (serum) plate.
Is it normal for the analyzer to alert the user with messages like: Reagent Empty, Blocked Pump, Air in Sample, etc.?	Occasionally It is acceptable. If the system detects a transiting air bubble in the hydraulic circuit. Certainly a momentary stop is preferable than an erroneous result. It is important to perform a prime after replacing exhausted reagent so that the hydraulic circuit is completely filled up with fluid. This reduces the possibility of a bubble formation to minimum.
Can the hydraulic circuit occlude completely?	If maintained properly, the hydraulic system will flow continuously. If an obstruction should occur, clean the chloride electrode, with the appropriate tool, first before attempting to clean any other electrode. In case the problem persists then replace all the fluidic tubes with a new tubing kit.
Can the Ground Electrode influence the quality of results?	Yes. Even a partial occlusion in the ground electrode hydraulics may affect all the channels.
Which actions are necessary prior to turning off the analyzer?	If the analyzer is not to be used for a long period, it is essential to disconnect all the tubes and leave the electrodes disengaged in their lodgings. The tubes of peristaltic pumps should be released from their supporting brackets and manually manipulated externally to restore roundness and to avoid sticking. When the analyzer is going to be used again then reconnect all the disconnected tubes and recalibrate the analyzer at least twice. Use new Buffer solution.
What are the consequences of incorrect maintenance?	Apart from generating erroneous results, it may cause irreparable damage to the electrodes. Use of incorrect fluids for cleaning the system may also cause serious damage to the analyzer. For general cleaning in extreme circumstances of the ISE funnel, electrodes, ground electrode, fluidic tubes, etc. use distilled water and a syringe.

9-4. ISE TROUBLE-SHOOTING BT3000 PLUS

(Quick Reference Guide to resolve main problems in ISE Module)

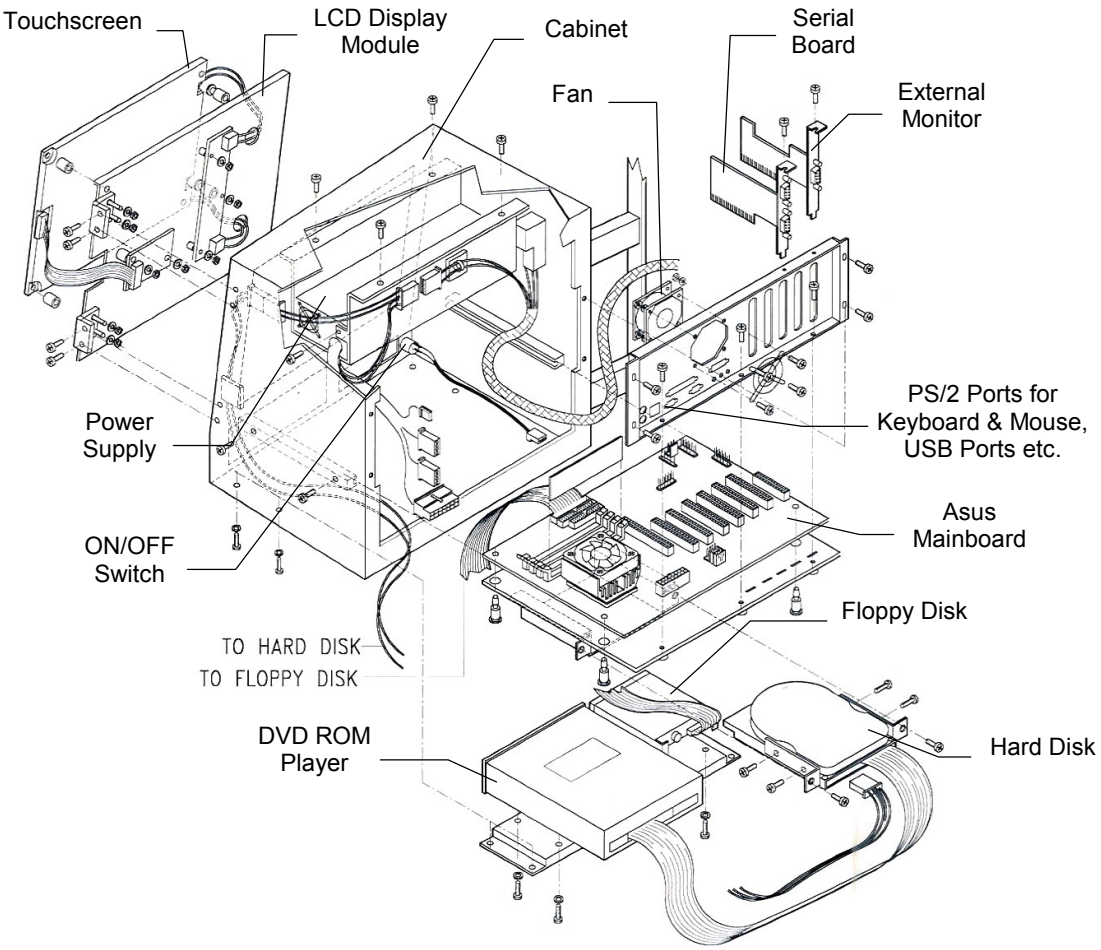
SYMPTOMS	CAUSE AND CORRECTIVE ACTION
Bubbles in ISE Module	1) No prime performed after maintenance/service of the module. Perform prime. 2) The solution is not aspirated, consequently it remains in the funnel. Obstruction in the Cl and CO_2 electrodes column. Remove obstruction by observing appropriate cleaning procedure. 3) Worn peristaltic pump cartridge. Replace with new cartridge. 4) Funnel obstructed. Clean funnel. 5) Tubing sticking together in pinch-valve. Repair or replace.
Calibration Error. **High values of slope** **K > 60, Na > 68 and unstable values.**	1) Partially occluded Cl electrode. Clean electrode with appropriate tool. 2) A small obstruction in the Ground electrode. Clean electrode.
Calibration Error **Slope values at the limit of acceptance.**	1) Reagent solutions not homogenized during refill. Use homogenized solution for refilling. 2) Dirty funnel. Clean the funnel. 3) New electrodes still in the conditioning phase.
Inexact values in samples and slopes.	1) Erroneous STD solutions. Use correct solutions. 2) Inversion of Baseline with Buffer. Position correctly Baseline and Buffer. 3) Empty Reference electrode. Pinch-valve tube problem. Repair or replace. 4) Use of contaminated distilled water of the analyzer. Use non-contaminated distilled water.
Drift of values	1) Module just reconditioned. Repeat calibration 3 or 4 times. 2) Deteriorated Reference Electrode. Verify and replace. 3) The deproteinization of the electrode column has not been performed. Lack of washing at end of work. Observe appropriate washing procedure.

NOTE:

If the problem is still not resolved after all the preceding steps, then substitute the preamplifier or the entire ISE Module to resolve the problem.

SECTION - X

COMPUTER BOX ASSEMBLY



Computer Module

Figure 10-1.

10-1. ELECTRONICS MODULE

10-1.1. COMPUTER BOX

The LCD Display module, with fully integrated touch-screen, is on the front of the computer box. An on/off switch for the analyzer is located on the bottom left of the display. The peripherals, DVD-ROM player and the floppy disk drive are accessed through a cover just below the display.

All of the connections to the external peripheral devices are located on the rear of the box as follows:

1 USB Port for the Printer
1 Serial-Port for Host Computer
1 Serial-Port for Modem
1 USB Port for UPS
2 PS/2 ports for Keyboard & Mouse

The ASUS main-board with a 860 MHz Intel Pentium® III processor, 128 Mb RAM, DVD/CD-ROM player, 20 Gb hard disk, floppy disk drive, and the power supply are all located inside the computer box. Product enhancement resulting from new innovations in technology and from our continuing quality improvement effort may necessitate changes in this configuration in the future. However, any eventual changes will be fully compatible with the previous version. A connecting cable composed of lead conductors of the serial port and the 5 Volt supply interconnects the computer box and the process electronics.

10-1.2. MOTHERBOARD CONNECTORS

1 PS/2 mouse connector (green) 6-pin.
1 PS/2 keyboard connector (purple) 6-pin.
Universal Serial Bus (USB) for Data Bus 1 & 2 (black) 2X4 pins.
2 Serial Ports Connector (turquoise green) com1 = 9-pins & com2 = 9-pins.
Parallel Port Connector (purple red) 25-pins Printer.

Automatic turning off of the fan: during this process, the power supply to the fan will automatically switch to a standby mode. This function reduces both the energy consumption and disturbances in the system, and this is an important feature in implementing a silent system.

10-1.3. LCD MODULE 8-WIRE ANALOGUE RESISTANCE TOUCH-SCREEN

The touch-screen interface enables functional operation of the program without the use of an external keyboard or mouse. The LCD module has a protective surface to prevent damage during data input or other operations.

10-1.4. POWER SUPPLY MODULE

Input Voltage Range - Electrical Specifications

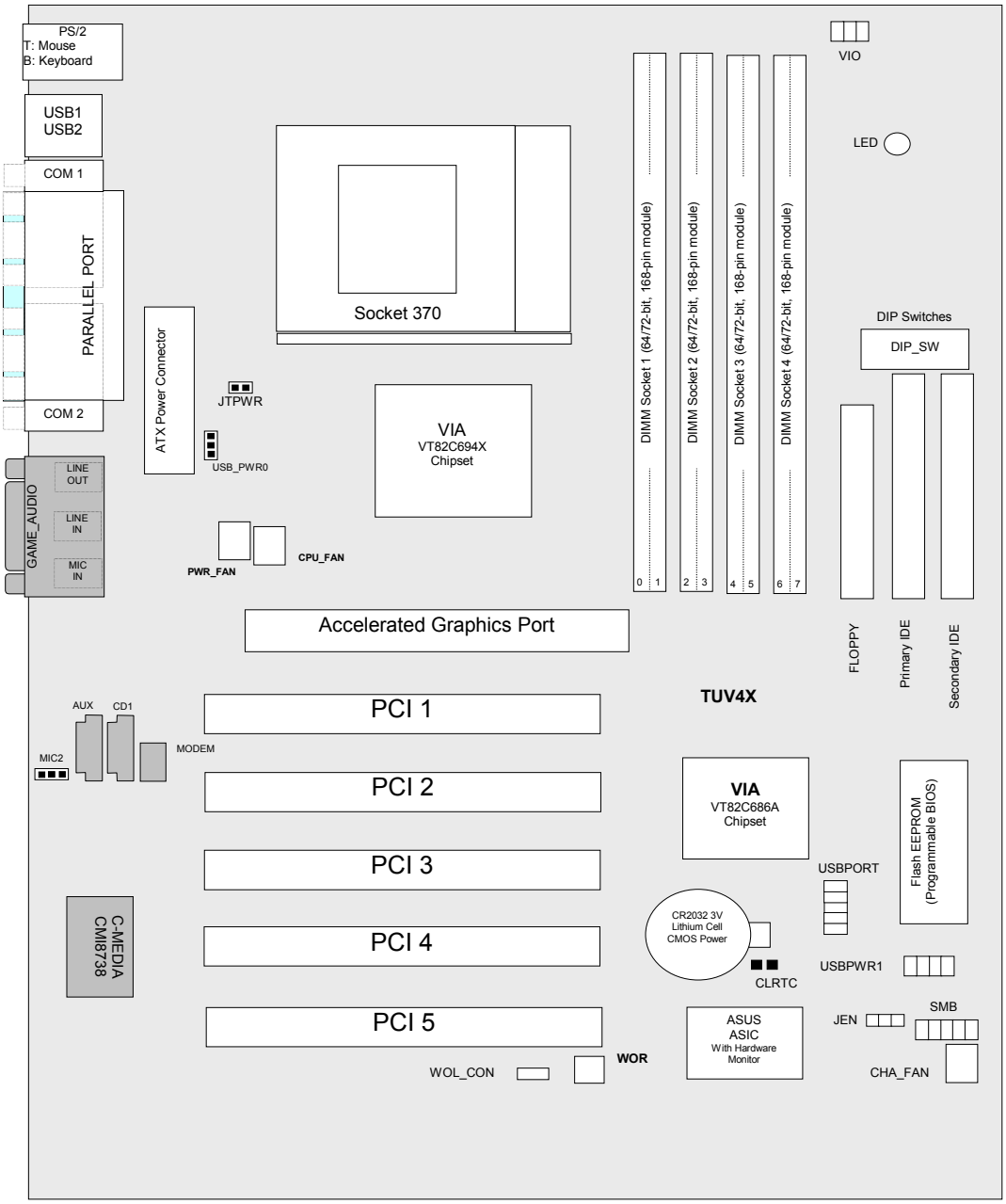
PARAMETER	**MIN**	**NOM.**	**MAX**	**Unit**
V-input Range	90	115/230	264	V-rms

Output Voltage Range - Electrical Specifications

Output Voltage	**Nominal Value**	**Regulation**	**Ripple & Noise**	**Output Current**		**Peak**
				Min	Max.	
1	+3.3V	± 5%	50mV	0.3A	16A	
2	+5V	± 5%	50mV	2A	25A	
3	+12V	± 5%	120mV	0.2A	13A	16A
4	-5V	± 5%	100mV	0 A	0.3A	
5	-12V	± 5%	120mV	0 A	0.8A	
6	+5VSB	± 5%	100mV	0 A	2A	

Note: The Connector meets AT standard specifications.

10-1.5. MOTHERBOARD LAYOUT CONTENTS



External Connectors		
1	PS2KBMS	PS/2 Mouse Port Connector (6-pin female)
2	PS2KBMS	PS/2 Keyboard Port Connector (6-pin female)
3	USB	Universal Serial Bus Connectors 1&2 (two 4-pin female)
4	PRINTER	Parallel Port Connector (25-pin female)
5	COM1/COM2	Serial Port Connectors (two 9-pin/10-1 pin male)
6	GAME/AUDIO	Game/MIDI Connector (15-pin female)
7	AUDIO	Audio Connectors (three 1/8" jacks)

Internal Connectors		
1	IDELED	IDE Activity LED (2-pin)
2	FLOPPY	Floppy Disk Drive Port Connector (34-1 pin)
3	PRIMARY IDE SECONDARY IDE	DE Connectors (Two 40-1 pin)
4	WOL/CON	Wake-On-LAN Connector (3-pin)
5	WOR	Wake-ON-Ring Connector (2-pin)
6	CPU/PWR/CHA/FAN	Chassis and CPU Fan Connectors (3-pin)
7	CHASSIS	Chassis Intrusion Lead (4-1 pin)
8	SMB	SM Bus Connector (5-1 pin)
9	IR	Infrared Module Connector (5-pin)
10	USBPORT	USB Header (10-1 pin)
11	ATXPWR	ATX Power Supply Connector (20-pin)
12	AFPANEL	ASUS Panel Connector (12-1 pin)
13	MIC2	Internal Microphone Connector (3-pin)
14	CD/AUX/MODEM	Internal Audio Connectors (three 3-pin)
15	PWR. LED (PANEL)	System Power LED Lead (3-pin)
16	SPEAKER (PANEL)	System Warning Speaker Connector (4-pin)
17	MSG. LED (PANEL)	System Message LED (2-pin)
18	SMI (PANEL)	System Management Interrupt Lead (2-pin)
19	PWR. SW (PANEL)	ATX/Soft-Off Switch Lead (2-pin)
20	RESET (PANEL)	Reset Switch Lead (2 pins)

SECTION - XI

POWER SUPPLY AC/DC MODULE

11-1. POWER SUPPLY

Lambda CA400 Series

Alpha power supply AC/DC: 12MIN, 24D, 24DRP

Universal Input voltage range: 85 to 264 ~

Frequency: 47 Hz to 63 Hz

Modular configurable single and multiple outputs:

CONFIGURED OUTPUT VOLTAGES		
Output Voltages (preset)	Adjustment Range	Output Current
12 Volts	12 Volts	8A
24 Volts	24 Volts	8A
24 Volts	18-29 Volts	8A adjustable

11-1.1. EMC DIRECTIVE APPLICATION TO THE POWER SUPPLIES

The EMC directive does not apply to power supplies component. It is impossible for the manufacturer of the power supply unit to guarantee conformity of the final product to this EMC directive. The EMC behavior of the power supply can be considerably affected by the way it is installed in the users system. However, since the power supply is a major component in the performance of the final product, in regards to this Directive, it is indispensable that the power supply manufacturer ensures that the power supply enables the end user to conform to the EMC Directive in the most effective manner.

11-1.2. POWER FACTOR CORRECTION (PFC)

Certain applications have a legal requirement for harmonic reduction, as found with in-vitro diagnostic devices. Power Factor Correction provides the advantage of wide range input, and maximizes the load that can be taken from the main power sources.

11-1.3. INHIBIT OPTION (INH)

The inhibit option is provided as a board inside the module that can reduce the output voltage of 12 Volts to less than 0.5 Volts by application of a TTL compatible control signal. This circuit is inhibited through the reset signal. In this way the voltage supply to the analyzer lamp is cut off, while interrupting power to the solid state relay located on the Control Board (15-04431-01), thus interrupting the mains voltage supply to the peripherals (printer and vacuum pump).

SECTION XII
VACUUM PUMP SYSTEM P/N 06-05161-01
OPERATING INSTRUCTIONS

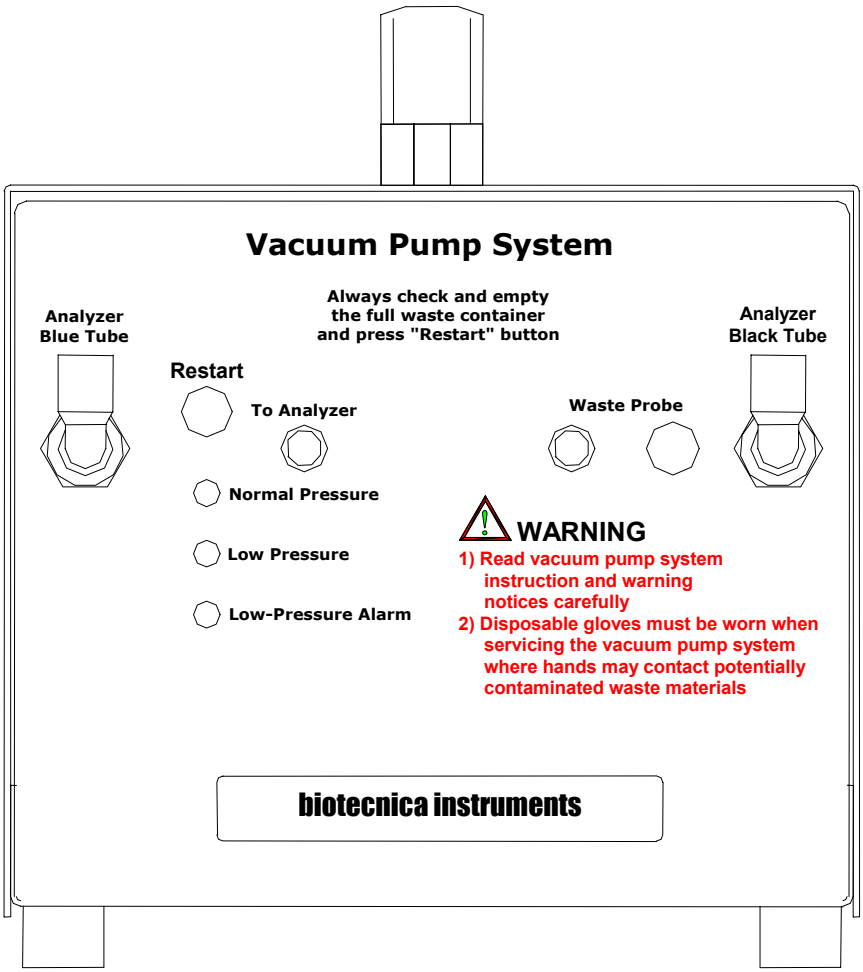


Figure 12.1
Vacuum Pump System P/N 06-05161-01
for BT3000 PLUS

12-1. FUNCTIONAL CHARACTERISTICS

This silent and compact vacuum pump system has been specifically designed for use with BT3000 PLUS type analyzers. It provides for an automatic and safe collection of waste liquids from analyzer's reaction cuvettes and sampling needle washing into the external waste disposal container in lab environment. The system consists of a metallic cabinet containing two membrane pumps controlled by a microprocessor, electronics, and the electrical and fluidic connections to the analyzer. The microprocessor manages 3 main functions: pressure measurement, waste container full check, and pump shutdown. The waste discharge has the following pathway (course):

The liquids aspirated by the pumps from the needle washing funnels (bowls) and the cuvettes washing through the two tubes (Blue and Black tubes) respectively are transferred to an internal waste chamber (made of transparent Pyrex). From here the waste fluid is ejected to the external waste container through the waste probe equipped with liquid level sensor.

Whenever the external waist container is full the waste-probe liquid level sensor activated audio/visual alarm alerts the operator and instantly shuts down the pumps.

12-1.1. SYSTEM CONTROL FUNCTIONS

Pressure: Three LEDs on the front panel indicate the system vacuum level.

Green LED: Normal operating vacuum level (approximately –60 millibar).

Yellow LED: Low vacuum level (below 40 millibar).

Red LED: Vacuum level lower than –15 millibar

Alternating Green, Yellow, and Red LEDs: Indicate high vacuum level (higher than –300 millibar).

All LEDs turned off: Pumps disabled.

The green LED indicates that the system is functioning properly.

The yellow LED may indicate an operating limit condition, still satisfactory but signalling the beginning of vacuum level deterioration. The **red LED** indicates vacuum level failure due to various reasons.

The alternate lighting of Green, Yellow, and Red LEDs indicate excessive vacuum level probably caused by an occluded waste probe tube (from the vacuum pump system to the external waste container.

All LEDs turned off condition is reached when the standby time (2 minutes) terminates without resetting the system (pumps disabled). In this case the **green LED** of the **Restart** button flashes in quick successions.

The green LED also confirms the power on condition of the vacuum pump system. If the **green LED** is not lit then this may be due to either the power cordset of the vacuum pump system is disconnected from the analyzer or the vacuum pump system malfunction.

12-1.2. DESCRIPTION OF THE BOARD 15-05085-01 (VACUUM PUMP SYSTEM)

The Board 15-05085-01 controls the vaccum pump system operation.

The microcontroller (µC) U2 (87LPC767) in OTP version monitors all the functions of the system. It controls the signals from level sensor of the waste probe, two pumps in DC, 3-way solenoid valve, pressure sensor SP1, and generates acoustic alarms at two distinct frequencies.

The connector J1 allows connection to the power supply, which supplies 24Vdc.

The voltage of 5Vdc is obtained from the 24Vdc through the low dropout regulator U1 (L4931 CV50).

The connectors J2 and J3 connect the circuit to the two 24Vdc membrane pumps dedicated to the aspiration of the waste liquids.

The connector J4 allows connection for the signals from the LEDs, and the maximum level limit of the waste probe level sensor.

The connector J5 is utilized for transmitting alarm signals to the analyzer (for TARGA BT3000 and by-products only).

The connector J6 connects the circuit to the 3-way solenoid valve, which deviates waste liquids to the internal waste bottle in the vacuum pump system when the external waste container is full.

The connector J7 is provided for an eventual pressure measurement device.

The bit P1.7 of the U2 controls the Buzzer BZ1. Depending upon the alarm function, it generates two distinct audible alarms as follows:

1) Frequency of 1 beep per second.
2) Frequency of 2.5 beeps per second.

The green LED diode DL1 is lit in normal operating conditions (pressure > 30 millibar) and is monitored by the gate P1.4 of the U2.

The yellow LED DL2 lights up when the pressure is in the range of 20 - 30 millibar. This range indicates pre-alarm condition. The gate dedicated to this is P0.2 of U2.

The red LED diode DL3 lights up to indicate low-pressure alarm condition < 16 millibar. The command gate is P0.6 of U2.

The MOSFET Q1 is used for supplying or switching off voltage to the two membrane pumps connected in parallel. The command bit arrives from the gate P1.0 of U2.

The pushbutton SW1 is dedicated to the Restart function of the system. When the green LED inside the pushbutton is lit, it indicates that the vacuum pump system is turned on. The blinking green LED in the pushbutton indicates that the system requires restarting.

The gate P0.4 of the U2 controls the Darlington transistor Q2. It activates or inactivates the 3-way solenoid valve for waste liquids management of external waste container or the internal waste bottle in the vacuum pump system.

The pressure sensor SP1 supplies a voltage proportional to the operating pressure of the vacuum pump system. An appropriately amplified signal from the integrated circuit U4 is transmitted to the gate P0.3 of U2.

12-1.3. VACUUM PUMP SYSTEM P/N 06-05161-01 COMPONENT FUNCTIONS

System Overview

This paragraph provides a description of the functions of the main components of the Vacuum Pump System P/N 06-05161-01.

The Vacuum Pump System consists of four main components inside the cabinet: an AC/DC power supply with universal input 95-240 VAC and 24VDC output, the Controller Board 15-05085-01, two membrane pumps, and a 3-way solenoid valve.

CIRCUIT FUNCTIONS:

Pressure monitoring

Only the green LED (DL1) should be lit (indicating nominal operating pressure) during the normal operation of the vacuum pump system.

The lighting up of yellow LED (DL2) indicates that the operating pressure has gone below 30 millibar (it can be acceptable if this occurred now and then).

If the red LED (DL3) lights up then this indicates that the operating pressure has gone below 16 millibar (inadequate for normal analyzer operation). An audible alarm of 1 beep per second frequency is generated after 6 seconds.
In particular cases (e.g. when large amount of liquid is aspirated) it is possible that all three LEDs (on the front panel of the pump cabinet) are lit intermittently. This indicates the presence of high pressure (more than 200 millibar) in the waste bottle located inside the pump cabinet. If this persists for more than 10 seconds then the **"Restart"** pushbutton LED illuminates generating an audible alarm at the frequency of 2.5 beeps every 10 seconds.

Waste Container control

The waste probe is placed into the external waste container to transfer liquid ejected from the waste pumps into the container. For safety reasons the waste probe is equipped with a liquid level sensor, which is activated, when the external waste container is full. In this condition the liquid level sensor transmits the signal to the microprocessor, thus putting the system in standby mode. In addition the vacuum pump system generates an intermittent audible alarm of low frequency (1 beep per second), and simultaneously the red LED on top of the waste probe and the LED in the **"Restart"** button start flashing. In the mean time the system continues to function for about 100 seconds as the waste liquids are deviated to the internal waste bottle through the 3-way solenoid valve, thus continuing the waste aspiration function transitorily but the waste flow to external waste container is stopped. The purpose of this momentary deviation is to avoid any spillage during the transfer of the waste probe from one waste container to another empty container. After emptying or substituting the external waste container press momentarily the **"Restart"** button on the vacuum pump system front panel to continue the operating procedure and reset the alarm. If the preceding step is not taken, after approximately 100 seconds the aspiration pumps stop running, the three LEDs on the cabinet front panel are switched off and an audible alarm of 2.5 beeps per second frequency is generated. After additional 10 seconds the 3-way solenoid valve is de-energized.

NOTE: *The liquid level sensor is magnetically actuated reed switch make and break type.*

Vacuum Pump System reset

If due to the above-mentioned reasons the vacuum pump system enters the alarm condition the **"Restart"** button LED starts flashing, simultaneously the analyzer enters the standby mode and a corresponding warning message **"LOW PRESSURE"** appears on the screen. Empty or substitute the external waste container and momentarily press the **"Restart"** pushbutton to reset the vacuum pump system. The vacuum pump system starts functioning and the internal waste bottle is emptied. After reaching the correct operating pressure all the normal operating controls and alarms are restored.

12-1.4. INSTALLATION & OPERATION

1) Connect the Blue and Black waste tubes from the right side of the analyzer to the appropriate quick connect on the vacuum pump cabinet front panel.

3) Connect the Waste Probe electric cable (liquid level detector) and the drain tube of to the vacuum pump cabinet front panel.

4) Insert the Waste Probes in authorized external waste container.

5) Plug the power cordset to power inlet on the rear of vacuum pump cabinet and then into one of the accessory power connectors on the analyzer rear panel.

6) Now the system is fully installed and ready for operation.

7) Switch on the analyzer. The vacuum pump will start running

NOTE:

The vacuum pump system power inlet on the rear has no ON/OFF switch. The system turns ON and OFF simultaneously with the analyzer. The vacuum Pump System is equipped with a universal power supply of 90 to 240 Volt AC, 50/60 Hz similar the power supply of BT3000 PLUS.

12-1.5. MAINTENANCE AND CARE

This compact pump system is virtually maintenance-free and offers continuous duty collection of waste liquids outside the analyzer. Does not require inconvenient peristaltic pump cartridge and filter changes. The theoretical operating life of the pumps is between 4000 to 5000 hours, after that the service technician should substitute the pumps.

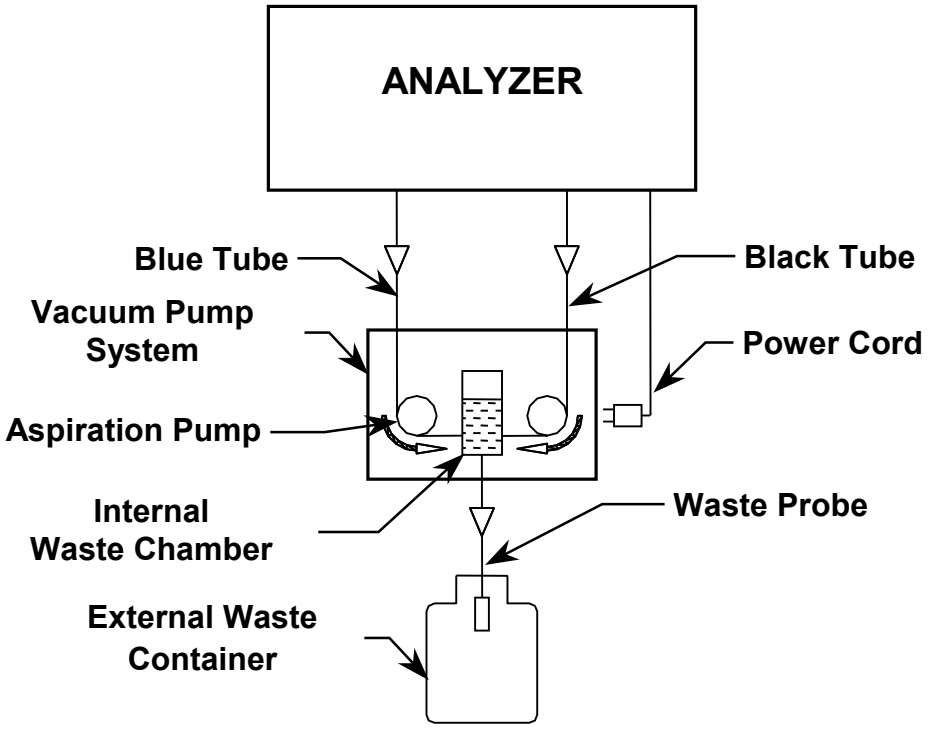
WARNING

a) *DISPOSABLE GLOVES MUST BE WORN WHEN SERVICING THE VACUUM PUMP SYSTEM WHERE HANDS MAY CONTACT POTENTIALLY CONTAMINATED WASTE MATERIALS.*

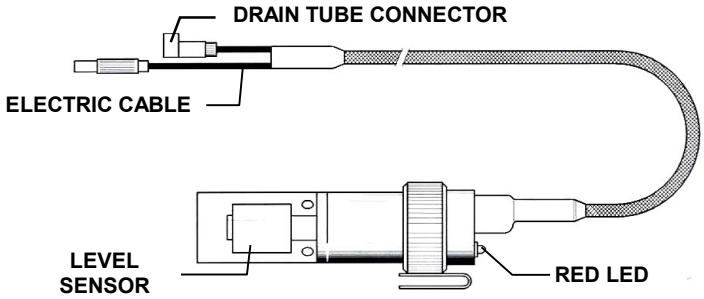
b) *THE SAFE DISPOSAL OF THE WASTE MATERIALS IS THE RESPONSIBILITY OF THE USER. INSURE THAT THE DISPOSAL OF WASTE CONTAINER FLUIDS IS DONE ACCORDING TO ALL APPLICABLE LAWS AND REGULATIONS.*

12-1.6. TROUBLE-SHOOTING

TROUBLE-SHOOTING GUIDE	
SYMPTOMS	**CORRECTIVE ACTIONS**
The vacuum pump is silent and "Restart" green LED not lit.	a) No power to the system. Power cord disconnected. Connect the power cord. b) Blown fuse/s. Replace with appropriate fuses as marked.
Audible alarm of intermittent frequency, some flashing LEDs and the instrument in standby mode.	Indicates vacuum level variation due to leakage in the hydraulic circuit connection/s. Ensure that the waste tubes (blue and black tubes connecting vacuum pump to the analyzer) are firmly connected. During the analyzer operation this phenomenon may be considered normal, as there may be sudden variations in the vacuum level during emptying of the reading cuvettes.
Audible Alarm of intermittent frequency with the LED on the waste probe lit.	External waste container full. Empty the external waste container and press “RESTART” button on the vacuum pump cabinet to continue the operating procedure and to reset the alarm.
Damaged Unit	The unit has suffered severe shock such as being dropped. Do not use the unit. Consult your nearest sales/service office regarding repair.
Smoke, strange odor or noise	Stop using the unit immediately and disconnect the power supply. Consult your dealer regarding repair.



Fluidic Pathway
Figure 12.2



Waste Probe (P/N. 07-05165-01)
Figure 12-3

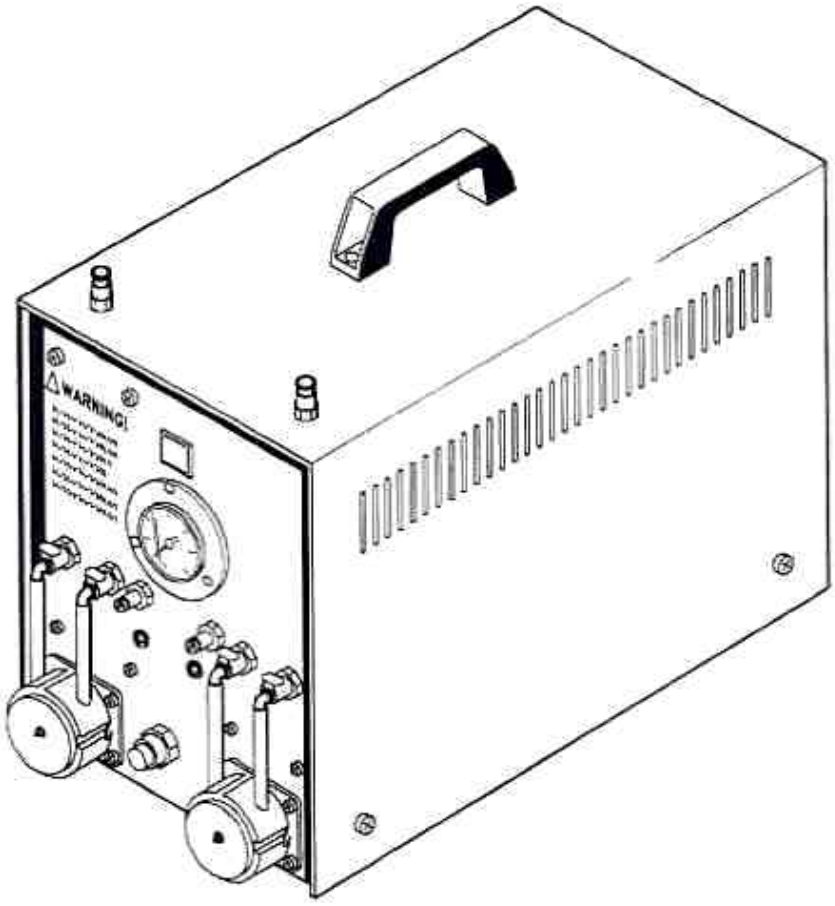
12-1.7. SPARE PARTS FOR REPAIR AND MAINTENANCE

The following is listing of subassemblies and individual parts, which are available for field replacement:

PART NO.	DESCRIPTION
06-05161-01	VACUUM PUMP SYSTEM (COMPLETE) FOR BT3000 PLUS
07-05165-01	WASTE PROBE
08-05162-01	VACUUM PUMP ASSY
15-05085-01	VACUUM PUMP SYSTEM CONTROLLER BOARD
20-05145-01	INTERNAL WASTE CHAMBER (TRANSPARENT GLASS)
330.6312	POWER ENTRY MODULE
330.6338	FUSE 250 VOLT, 0.5 AT
330.6400	MAIN POWER SUPPLY CORDSET
330.7175	POWER SUPPLY
330.9099	3-WAY SOLENOID VALVE

VACUUM PUMP SYSTEM P/N 662.0788/C/D/E/F (OBSOLETE)

No longer in production



12-2. INTRODUCTION

This compact and silent waste suction unit has been specifically designed for use with the BT3000 PLUS chemistry analyzer where continuous elimination of liquid is required to be automatic removal of waste. The gauge-controlled suction can reach a maximum vacuum of -400 mbar. It produces low-noise level while maintaining strong suction capabilities. It provides for an automatic and safe collection of waste liquids from to the external waste disposal containers in laboratory. Whenever the external waist container is full the waste-probe liquid level sensor activates a low frequency audio/visual alarm and instantly shuts down the peristaltic pump. The vacuum pump stops running, if any of the internal waste collection chamber is full and remains in the standby mode until the waste containers are emptied and the alarm reset.

The suction unit cabinet accommodates two inner waste collection chambers of approximately 300ml capacity each. The vacuum to the waste chambers is aspiration of waste liquids from analyzer is provided by the vacuum pump. The waste liquid, aspirated from the analyzer is collected in these waste chambers. Simultaneously, two high throughput peristaltic pumps are used to transfer the waste liquid to the external waste containers through external waste probes, thus preventing secondary contaminant exposure. The peristaltic pump features a removable and disposable cartridge that is pre-loaded with special Pharmed tube.

12-2.1. VACUUM GAUGE

The vacuum status is clearly indicated on the front panel vacuum gauge.

12-2.2. VACUUM LEVEL REGULATOR

The pump circuit incorporates an automatic vacuum level regulator, which is factory set at -400 mbar (-40 kPa, -300 mm Hg, -11.8 in Hg). The vacuum regulator monitors the vacuum level and automatically adjusts it when the vacuum level rises above the desired point, in the event of clogged filter or any other system occlusion. By using the vacuum regulator the risk of a pump failure due to excessive is eliminated, extending the pump life and ensuring high performance.

12-2.3. HYDROPHOBIC FILTER

A disposable hydrophobic filter protects the vacuum pump from contamination If the filter becomes clogged it may be replaced any time. The hydrophobic filter captures superfine particles, bacteria, condensate, and any liquid that may contaminate or damage the pump.

12-2.4. CAUTION! SHIPPING RETAINER FOR THE VACUUM PUMP SYSTEM

To protect the vacuum pump from vibration and impact during shipment, it comes installed with a clamping device. When you unpack your vacuum pump system, make sure to remove two transit screws (colored red) at the bottom of cabinet to release the vacuum pump. Running the pump with the transit screws installed will cause an increased noise level during operation and may damage internal mechanisms.

12-2.5. INSTALLATION PROTOCOL

Refer to Figure 1 entitled "Vacuum Pump System Installation" before attempting to install the analyzer. Install all electrical cables and tubes as follows:

1) Remove the transit screws at the bottom of the pump cabinet.
2) Connect waste tubing from the right side of the analyzer to the appropriate quick connect connectors on top of the vacuum pump cabinet.
3) Connect the liquid level detector cables and the drain tubes of Waste Probes to the front panel of the vacuum pump.
4) Insert the waste probes in the appropriate external waste containers.
5) Plug one end of the power cord to the power inlet on the vacuum pump cabinet and the other end to the accessory power connectors on the analyzer rear panel.

12-2.6. QUICK START-UP

1) Switch on the analyzer. The vacuum pump will start running.
2) Maximum operating vacuum is preset at –400 mbar ± 10%.
3) The vacuum level during unit's normal standby/operating mode may vary between –100 mbar (-75 mmHg) to -300 mbar (-225 mmHg). In case the vacuum level drops below –100 mbar then refer to Paragraph 12-1.14. entitled "Trouble-Shooting Guide".

   Note: The waste probe LED and audible alarms keep you aware of the unit's status as follows:

a) 1st alarm (Beep of 1-second frequency):
   The LED on the waste probe will be lit. The external waste container is full. Empty it. In the mean time vacuum pump continues to function without blocking the analyzer for about 4 minutes as the waste chamber inside vacuum pump system is being used. It is important to press the "RESTART" button on the vacuum pump cabinet to continue the operating procedure and to reset the alarm.

b) 2nd alarm (Beep of 0.5 second frequency):
   The LED on the waste probe will be lit: This alarm is activated when the external waste container is not emptied and the waste chamber inside the vacuum pump system is full. A signal is sent to the analyzer to interrupt the operating functions with a "Waste Bottle Full" message.

c) The "Waste Bottle Full" message will stop analyzer function. Once the cause of the message is remedied, the command "Start Another Tray" can be selected to carry on the operating procedure with the analyzer.

12-2.7. CARE AND MAINTENANCE

For this care and maintenance section, refer to Figures 12-2, 12-3, and 12-4. It is highly recommended to replace the Peristaltic Pump Cartridge P/N 330.9088 and the Hydrophobic Filter P/N 662.0807 every 6 months.

CAUTION

a) HIGH VOLTAGE INSIDE! HAZARD OF ELECTRICAL SHOCK. PUMP WIRING IS LIVE. DISCONNECT INPUT POWER (POWER CORD) BEFORE SERVICING. NEVER OPERATE WITHOUT SECURE GROUND CONNECTION. FAILURE TO DO THIS MAY CAUSE ELECTRIC SHOCK OR INJURY.

b) THE VACUUM PUMP SYSTEM MUST NOT BE DISMANTLED OR REPAIRED BY ANYONE WHO HAS NOT BEEN QUALIFIED TO DO SO BY THE MANUFACTURER. INCORRECT WORK MAY CAUSE FIRE OR IRREPARABLE DAMAGE TO THE VACUUM PUMP SYSTEM.

12-2.8. FUSE REPLACEMENT FOR MAIN POWER INLET MODULE

The mains power inlet module has a built-in fuse holder and two fuses of 250 Volt, 2AT (P/N 330.6340) for 230 VAC pump or 250 Volt, 4 AT (P/N 330.6342) for 115 VAC pump. Fuses protect the system against power surges or overload by interrupting power. Replace fuse/s as marked on the rear panel. To replace a fuse proceed as follows:

1) Disconnect the power cord. Remove the fuses by gently extracting the fuse-holder with a tool. The fuse-holder has two grooves on the sides for tool accessibility only.
2) Discard the old fuses and replaces with new fuses that matches the selected voltage rating indicated on the back panel label. Insert the fuse-holder into the compartment and push until the latch snaps back into position.

12-2.9. FILTER REPLACEMENT

1) Disconnect the power cable.
2) Loosen the cover screws and remove cover.
3) Remove the filter tubing (blue) from the waste chamber and the vacuum pump quick connects. Discard the filter.
4) Install a new filter by connecting longer tubing (filter outlet) to the quick connect on the vacuum pump. It is important that the arrow indicator (→) on the filter point towards the air intake of the pump.
5) Connect the shorter feed tubing to the quick connect on the waste chamber. Install the cover and tighten screws.

NOTE: ***The hydraulic circuit, inside the pump cabinet, accommodates quick-connect fittings for the reliable connection and the prevention of accidental release. The approved tubing for quick-connect must always be cut clearly at 90° angle. To connect or disconnect observe the following simple steps:***

a) To connect simply push tubing into the collar past the O-ring to the internal tube stops.
b) To disconnect press collar against the fitting body and slide out tubing.

12-2.10. PERISTALTIC PUMP CARTRIDGE REPLACEMENT

The peristaltic pump features removable cartridge pre-loaded with special Pharmed® tube. To replace cartridge proceed as follows:

1) Remove both ends of the peristaltic tubing with elbow inserts from the quick-connect couplings. Remove elbow inserts.
2) Squeeze the locking catches and remove the defective cartridge and discard it.
3) Introduce elbow inserts into the pump tubing. Place the new cartridge on the drive shaft and gently press to snap fit.
4) Carefully connect the pump tubing to both quick-connect on the front panel. The pump is now ready for operation.

NOTE: ***The disposable cartridge is based on snap-fit principle. As the cartridge is put in place and locked, the three rollers within the cartridge engage the unit's drive shaft. To connect coupling simply plug insert into body. The fitting halves lock in place instantly with an audible "click", which assures a reliable and leak-free connection. To disconnect the fitting halves, simply press the thumb latch (lever) on the coupling body and the coupling halves separate.***

12-2.11. VACUUM REGULATION PROCEDURE

The vacuum limit valve is located on the internal right waste chamber. This modulating valve protects the pump from “maximum vacuum” (the highest vacuum the pump can attain when the pump inlet is closed). In the event of clogged filter or any system occlusion, the vacuum regulator eliminate possible trouble or burnout caused by tentative overload. The valve maintains a constant predetermined vacuum level and will automatically respond to any rise of vacuum level above the valve setting. The following procedure should be observed when calibrating the vacuum limit valve:

1) Disconnect the power cable. Disconnect the waste tubes with elbow inserts (Blue and Black) from the quick-connect couplings on the right side of analyzer.
2) Loosen the cover screws and remove cover. Turn on vacuum pump system.
3) Loosen the lock nut securing the vacuum regulating cap (this is the vacuum regulator located on the right chamber).
4) Carefully turn the vacuum regulator cap clockwise or counterclockwise until the vacuum gauge needle points to the recommended set point –400 mbar (-40 kPa, -300 mm Hg, 11.8 inch Hg, -5.8 PSI) The preset vacuum level clearly reflects the vacuum level existing in the suction line.

NOTE: ***To reduce the vacuum level, turn the regulator cap counterclockwise. To increase the vacuum level, turn the regulator cap clockwise. When adjusting valve, make no more than one turn of the cap at a time and observe the vacuum level closely to prevent over-shooting the specified setting. As much as 1 minute may be required for the new balance to take place after the adjustment is made.***
Tighten the lock nut against regulating cap while firmly holding the cap in position. Connect waste tube to the rear of analyzer. Start the Vacuum Pump System and verify proper operation.

12-2.12. PRINCIPLES OF OPERATION

The fluids aspirated from the analyzer are separated according to degree of contamination into 2 separate channels. Basically the blue tube evacuates minimally contaminated fluids while the black tube evacuates highly contaminated fluids. The internal waste chamber receives the fluid and is not emptied by the peristaltic pump until the rising liquid level (few centimeters) actuates the bottom liquid level sensor.

The liquid level sensor controls the peristaltic pump until the liquid level returns to the minimum position. The liquid level sensor is used for operating the peristaltic pump when necessary.

The liquid level sensor located on the top of waste chamber is for signaling any system error. If the peristaltic pump were to malfunction, the waste chamber would continue to fill up until the liquid overflows into the vacuum pump. To prevent this from happening, the upper liquid level sensor is actuated. This disables the system by turning off the vacuum pump. Instantly an audible alarm is activated, with intermittent acoustic signals of high frequency.

The waste probe transfer the liquid ejected from the peristaltic pumps into the external waste containers. For safety reasons each waste probe is equipped with a liquid level sensor which is activated when the external waste container is full. In this situation, the vacuum pump system generates an intermittent audible alarm and a visual red LED would be lit on top of the waste probe is lit.

12-2.13. TECHNICAL DESCRIPTION BOARD (15-04541-01)

The board 15-04541-01 controls and monitors the whole vacuum pump system. The μC764, in the OTP version, controls all the functions of the system. In addition this micro-controller controls the signals of the liquid level switches, activates the peristaltic pumps and generates acoustic alarms.

The J1 connector is used to connect the power supply to obtain 24 VDC. The reduction to 5 VDC voltage is derived from 24 VDC supplied through the U1 voltage regulator (LM7805). The J2 connector is used to connect the circuit to the liquid level sensors inside the two waste chambers. The rising level float switch is connected in OR. When the liquid level inside the waste chambers reaches the high actuation level (upper liquid level switches), the associated liquid level switches from closed to open. In case the liquid level in the waste chamber is below the low actuation level, the bottom float switches from open to closed contacts.

The Q1 and Q2 transistors are the power drivers of the peristaltic pumps. The J3 connector permits connection to the main AC power. The vacuum pump is connected to the J4 connector. The J5 connector is used to connect the circuit to the peristaltic pumps, waste probes, and the "Restart" push button.

The various gates of the integrated U3 circuit (ULN2803) control the following functions:

- The U3A gate activates the red LED (visual alarm) on the Waste Probe-2.
- The U3B gate activates the red LED (visual alarm) on the Waste Probe-1.
- The U3C gate activates acoustic alarm through BZ1 buzzer.
- Gates U3D, U3F, and U3H control the relay K1 to turn off power to the vacuum pump in case of error in the system.

The jumpers 1, 2, and 3 allow the utilization of the electronic circuit in the following mode:

a) Jump 1 shorted for BT3000 PLUS; open for BT3000 and by-products.
b) Jump 2 shorted for BT3000 PLUS; open for BT3000 and by-products.
c) Jump 3 shorted for BT3000 PLUS; open for BT3000 and by-products.

12-2.14. Trouble-Shooting Guide

SYMPTOMS	CORRECTIVE ACTIONS
A 1-second audible with the LED on the waste probe lit. Waste Bottle Full message.	1. External waste container full. Empty the external waste container and press "RESTART" button to reset. 2. Remedy the causes of alarm and then enter the command "Start Another Tray" to carry on the operating procedure with the analyzer. ***NOTE:*** *The vacuum pump continues to function without blocking the analyzer for about 4 minutes as the waste chamber inside vacuum pump system is being used. It is important to press the "RESTART" button on the vacuum pump cabinet to continue the operating procedure and to reset the alarm.*
A 0.5-second audible with the LED on the waste probe lit.	The external waste container is not emptied and the waste chamber inside the vacuum pump system is full. In this case a signal is sent to the analyzer to interrupt its functions. Empty the external waste container. Press the "RESTART" button to reset the alarm.
The vacuum level below –100 mbar (-75 mmHg)	1. In the normal operating conditions the vacuum range may vary between -100 mbar (-75 mmHg) to -300 mbar (-225 mmHg). The vacuum level below -100 mbar (-75 mmHg) indicates leakage in the hydraulic circuit. Ensure that the waste tubes (the blue & black tubes connecting vacuum pump to the analyzer) and the exhaust tubes in the analyzer are firmly connected. 2. Partially occluded hydrophobic filter located inside vacuum pump system. Replace with Part No. 662.0807. ***Caution:*** *Always install filter with the flow (flow directional arrow pointing towards the pump) entering the vacuum pump from the waste chamber side.*
Damaged Unit	The unit has suffered severe shock such as being dropped. Do not use the unit. Consult your dealer regarding repair.
Liquid such as water has been sucked into the vacuum pump	Stop using the unit immediately and disconnect the power supply. Consult your dealer regarding repair.
Smoke, strange odor or noise	Stop using the unit immediately and disconnect the power supply. Consult your dealer regarding repair.

12-2.15. SPARE PARTS FOR REPAIR AND MAINTENANCE

The following is listing of subassemblies and individual parts, which are available for field replacement:

PART NO.	DESCRIPTION
15-04541-01	VAC.PUMP SYSTEM CONTROLLER BOARD (FIG. 12-2., 12-4.)
330.6312	POWER ENTRY MODULE WITH FUSES (FIG. 12-2., 12-4.)
330.6340	FUSE 250 VOLT, 2 AT (230 VAC VACUUM PUMP SYSTEM)
330.6342	FUSE 250 VOLT, 4 AT (115 VAC VACUUM PUMP SYSTEM)
330.6400	MAIN POWER SUPPLY CORDSET
330.7175	POWER SUPPLY (FIG. 12-2., 12-4.)
330.9088	CARTRIDGE # PERISTALTIC PUMP (FIG. 12-2., 12-4.)
330.9622	COUPLING BODY WITH SHUTOFF VALVE - FRONT PANEL (FIG. 12-2.)
330.9623	ELBOW FITTING FOR PERISTALTIC PUMP CARTRIDGE(FIG. 12-4.)
330.9624	COUPLING BODY STRAIGHT THROUGH FRONT PANEL (FIG. 12-2.)
330.9625	SINTERED BRONZE SILENCER (FIG. 12-2.)
330.9649	COUPLING INSERT FOR WASTE PROBE - FRONT PANEL (FIG. 12-2.)
330.9659B	VACUUM REGULATOR (FIG. 12-2.)
662.0777B	VACUUM PUMP 115 VAC WITH FITTINGS (FIG. 12-2., 12-4.)
662.0777C	VACUUM PUMP 230 VAC WITH FITTINGS (FIG. 12-2., 12-4.)
662.0788	VACUUM PUMP SYSTEM (COMPLETE SYSTEM WITH 2 WASTE PROBES– 230 VAC
662.0788A	WASTE PROBE-1 (FIG. 12-5.)
662.0788B	WASTE PROBE-2 (FIG. 12-5.)
662.0788E	VACUUM PUMP SYSTEM (COMPLETE SYSTEM WITH 2 WASTE PROBES– 110 VAC
662.0806	"RESTART" PUSH BUTTON (NOT WIRED)
662.0807	HYDROPHOBIC FILTER ASSEMBLY WITH VAC PUMP (FIG. 12-2.)
662.0808	PERISTALTIC PUMP - LEFT (FIG. 12-2., 12-4.)
662.0808A	PERISTALTIC PUMP - RIGHT (FIG. 12-2., 12-4.)
662.0810	VACUUM GAUGE ASSY (FIG. 12-2., 12-4.)
662.0831	CABLE FOR POWER SUPPLY/BOARD 15-04541 (FIG. 12-6.)
662.0831A	CABLE FOR POWER SUPPLIES (FIG. 12-6.)
662.0831C	FEMALE FISCHER CONNECTOR KIT (FIG. 12-6.)
662.0831D	"RESTART" PUSH BUTTON KIT (FIG. 12-6.)
662.0831E	GROUNDING CABLE FOR VAC PUMP (FIG. 12-6.)
662.0831F	GROUNDING CABLE FOR POWER INLET (FIG. 12-6.)
662.0831G	GROUNDING CABLE FOR POWER SUPPLY (FIG. 12-6.)
662.0831H	GROUNDING CABLE FOR PUMP COVER (FIG. 12-6.)
662.0832	THE INTERNAL WASTE CHAMBER-LEFT (FIG. 12-2., 12-3.)
662.0832A	THE INTERNAL WASTE CHAMBER-RIGHT (FIG. 12-2., 12-3.)

IMPORTANT NOTICE: ***Prior to any internal repairs or transportation, continue pressing the "RESTART" button until the waste chamber inside the cabinet is completely emptied (approximately 30 seconds) and the pump beeps continuously.***

12-2.16. TECHNICAL SPECIFICATIONS

Technical Specifications	
Main Voltage.....	230 VAC, 50 Hz or 117 VAC, 60 Hz (As per Clients disposition)
AC-DC Power Supply	
Input Voltage Range:.....	100-240 VAC, Switched Mode
Input Frequency:.....	(AC) 47-63 Hz
Output Voltage Range:.....	24VDC ± 10%
Operating Temperature	0 to +50°C
Vacuum Pump	
Pump Type:.....	Linear-motor driven free piston, oil-less
Rated Voltage:.....	230VAC 50 Hz or 115VAC 60 Hz (As per Clients disposition)
Operating Vacuum ± 10%:.....	Varies between -100 mbar (-75 mmHg) to -300 mbar (-225 mmHg).
Vacuum Level:.....	Automatically regulated by Vacuum Limit Valve factory set at -400 mbar (-300 mmHg). The valve is located downstream of the Hydrophobic Filter.
Attainable Vacuum (Max):.....	-800 mbar, -80 kPa, -600 mmHg, -23.6 in. Hg
Peristaltic Pump	
Drive:.....	Direct Current Motor 24 VDC
Motor Speed:.....	3000 RPM
Flow Rate:.....	110 ml/min
Tube Material and Bore:.....	Pharmed; Bore: Ø3.2 mm
Transmission:.....	Friction transfer at minimal speed directly onto the rollers.
Media:.....	Analyzer waste
Life Expectancy:.....	***NOTE:*** *It is recommended that the Pump Cartridge be changed every 6 months.*
Hi-Lo Level Sensor:.....	Liquid Level Float Switch with hermetically sealed magnetic Reed Switch and permanent magnet.
Filter:.....	Disposable hydrophobic/bacteria filter
Life expectancy:.....	***NOTE:*** *It is recommended that the filter be changed every 6 months.*
Dimensions (Approx.)	
Height:.....	310 mm (12.2 inches)
Width:.....	230 mm (9.1 inches)
Depth:.....	420 mm (16.54 inches)
Weight:.....	15 kg (33.1 lbs)
EMC:.....	Meets EN 55011, EN 50082-1 For conducted and radiated emission.
Electrical Standards:.....	Conforms to Council Directives 98/79/EEC of 27 October 1998.
Warranty:.....	1 year including parts and labor, excluding Consumables

The Biotecnica Instruments S.p.A. reserves the right to alter technical specifications without prior notice.

12-2.17. CLEANING OF THE HYDROPHOBIC FILTER

(Vacuum Pump System #BT3000 PLUS & BT2000/3000 TARGA)

Normally during the routine maintenance, the hydrophobic filter, located inside the vacuum pump system, is replaced approximately every 12 months.
Sometimes the filter may become occluded after a short period of time or suddenly. These occlusions are generally caused by the presence of excessive foam formed in the waste liquid by agitation. This can happen if an excessive amount of surfactant detergent is used in the washing liquid or reagents containing too much surfactant. Even if there is a waste chamber in the vacuum pump system to attenuate the problem, the foam may overflow from the waste chamber into the hydrophobic filter, before the liquid level detector turns off the vacuum pump.

Observe the following procedure to resolve this problem:

1) When the external waste container is full, the system generates an audio-visual alarm. The operator must intervene soon to avoid overfilling of internal waste chamber causing foam to overflow into the filter.
2) Regeneration of the filter through cleaning. This operation is possible if the filter is occluded recently and has not exceeded its current operating life. In practice an old filter with membrane occluded by dried up residues, must be substituted.
3) Disconnect the power cable. Remove the cover from the vacuum pump system. Remove the filter tubing from the internal waste chamber and the vacuum pump quick connects (metallic). Turn the filter upside down with the flow arrow indicator (⌦) on the filter (Fig. A) must point upwards. Remove the vent cap (Fig. A) at the bottom of the filter and drain any liquid inside the filter. Use a plastic pipette on the top (opposite to flow arrow indicator) to blow out any liquid or wet residues from the clogged filter membrane. Now about 90% of the filter efficiency must have been restored. Best results can be obtained by using compressed air in place of the pipette.
4) Replace vent cap (Fig. A) and tighten it. Install the filter and the vacuum pump system cover and tighten screws.

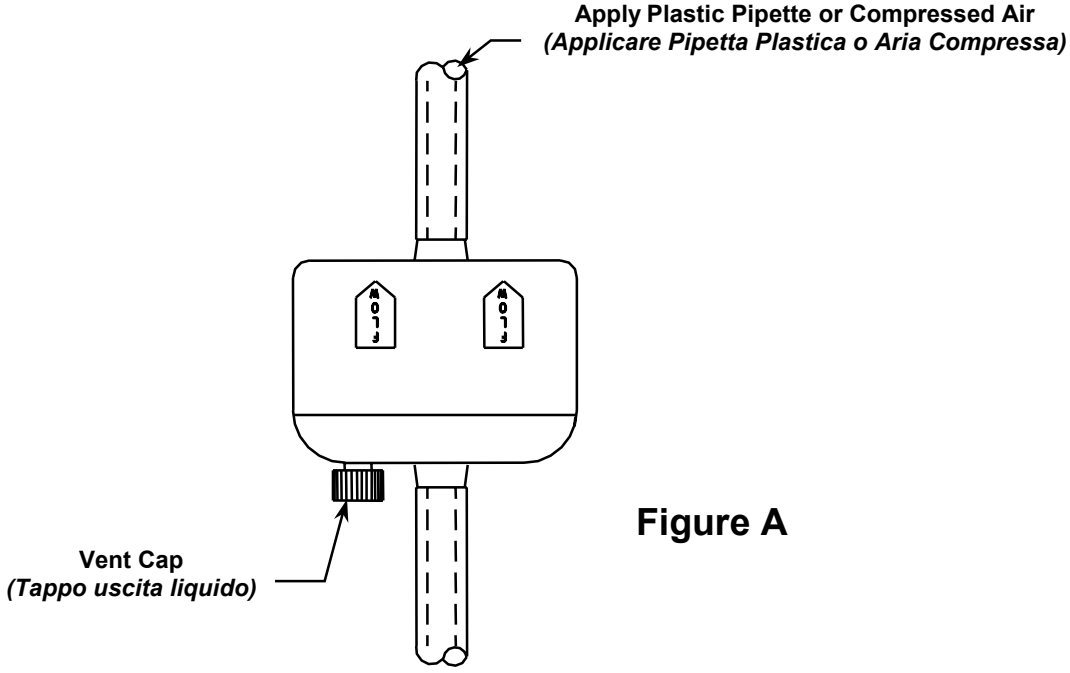
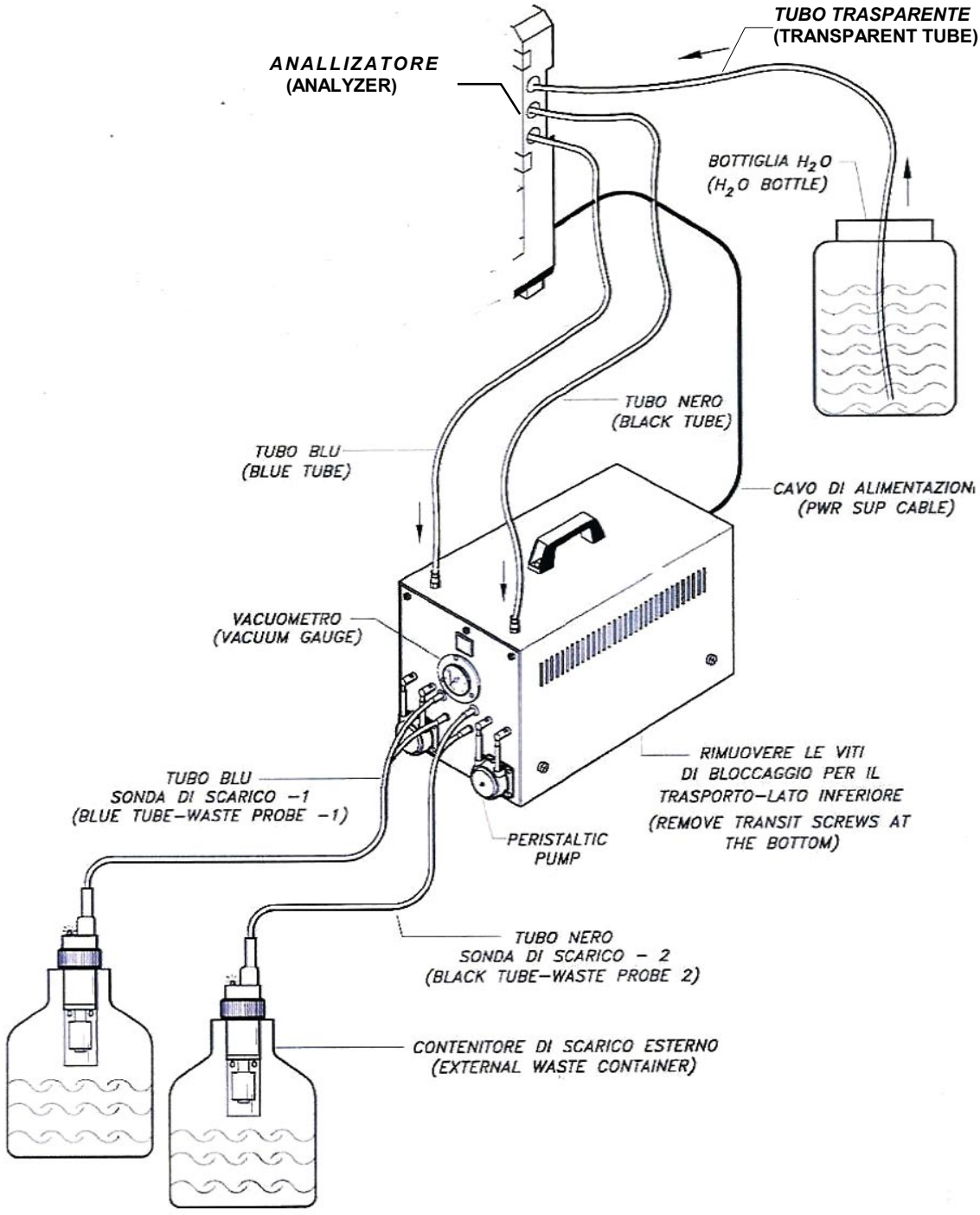
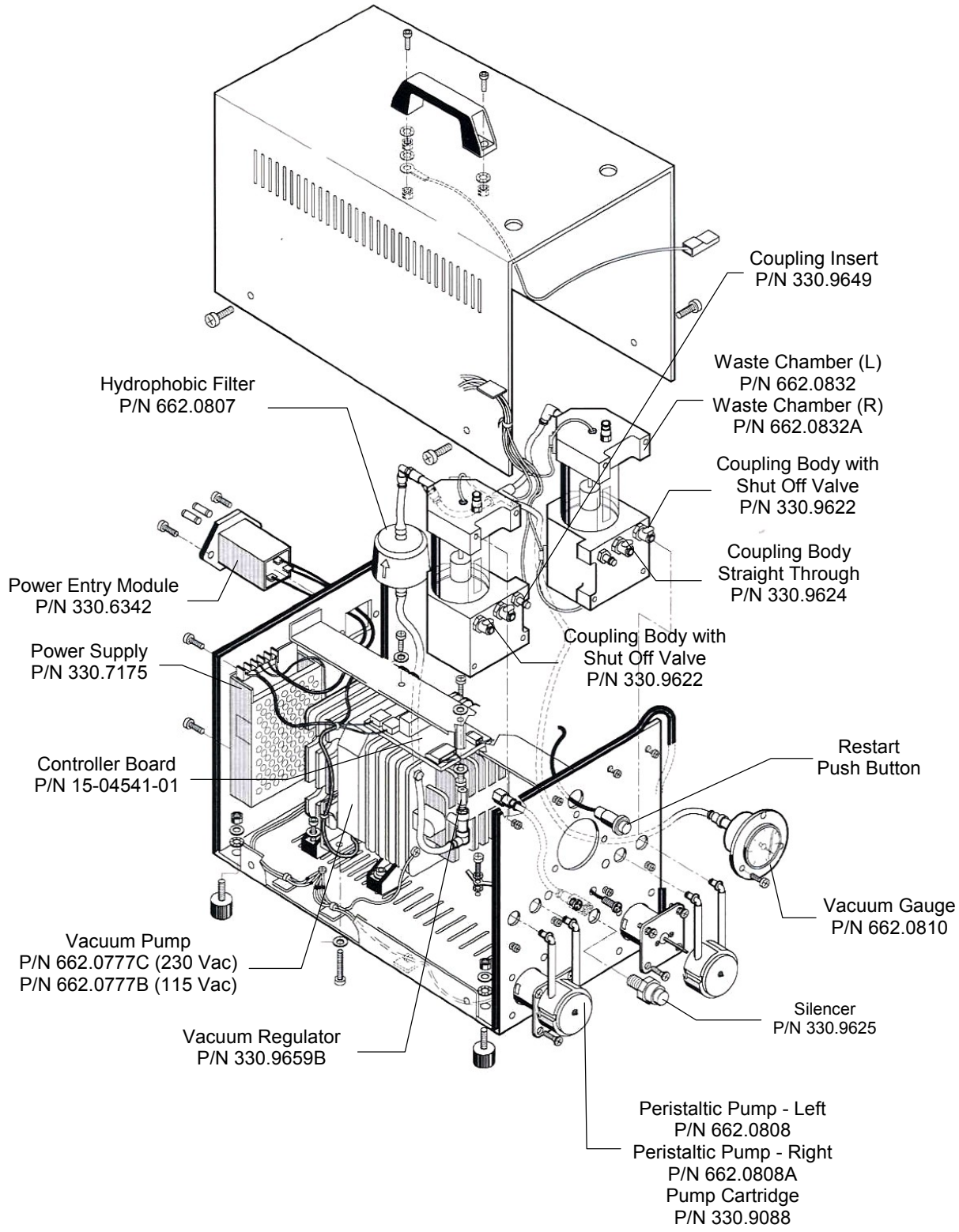


Figure A

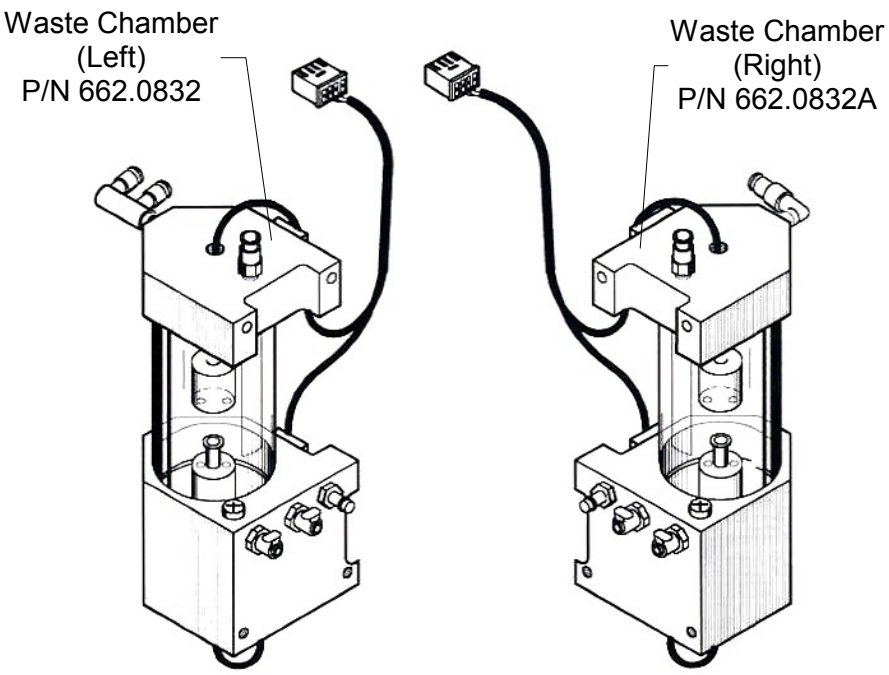


Vacuum Pump System Installation

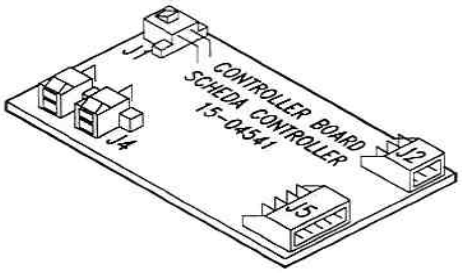
Figure 12-4



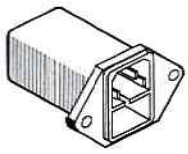
SPARE PARTS FOR MAINTENANCE & REPAIR
Figure 12-5



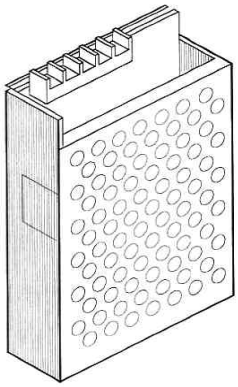
WASTE CHAMBERS LEFT & RIGHT
Figure 12-6



CONTROLLER BOARD
P/N 15-04541-01

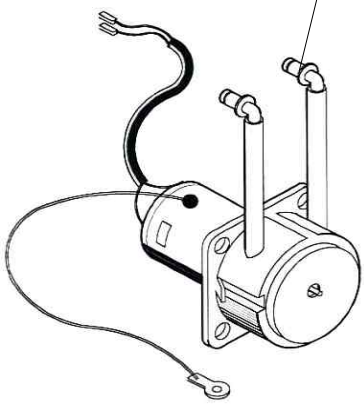


POWER ENTRY
MODULE WITH
FUSES

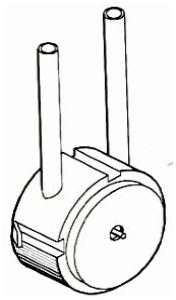


POWER SUPPLY
P/N 330.7175

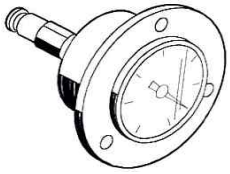
ELBOW FITTING
P/N 330.9623



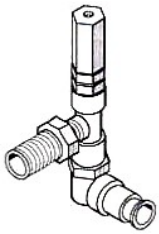
PERISTALTIC PUMP - LEFT
P/N 662.0808
PERISTALTIC PUMP - RIGHT
P/N 662.0808A



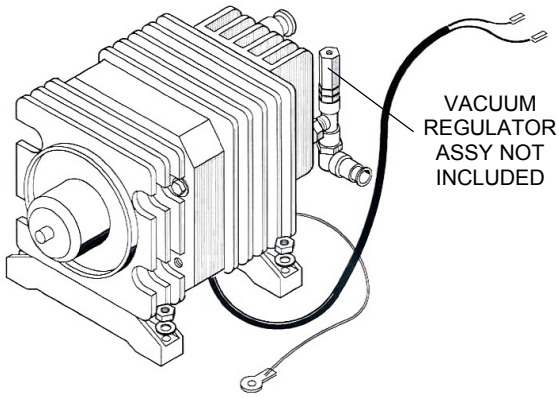
PUMP CARTRIDGE
P/N 330.9088



VACUUM GAUGE
P/N 662.0810

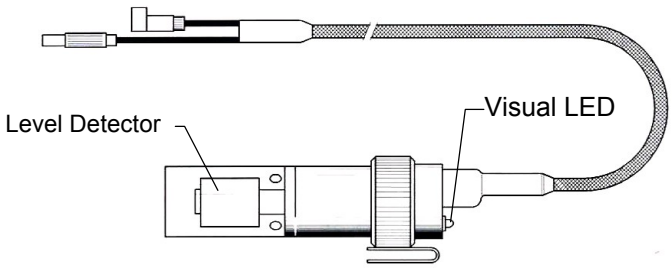


VACCUM
REGULATOR ASSY
P/N 662.1015



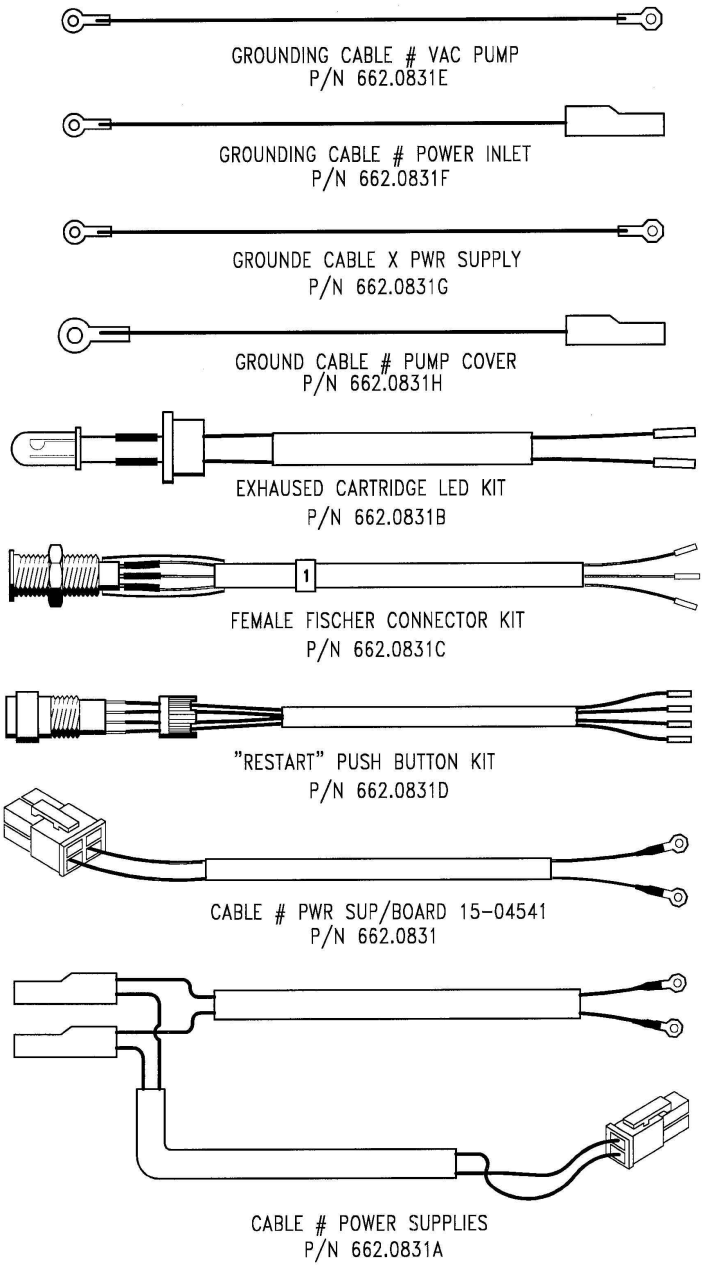
VACUUM PUMP 115 VAC
P/N 662.0777B
VACUUM PUMP 220 VAC
P/N 662.0777C

DETAILS OF SOME SPARE PARTS
Figure 12-7



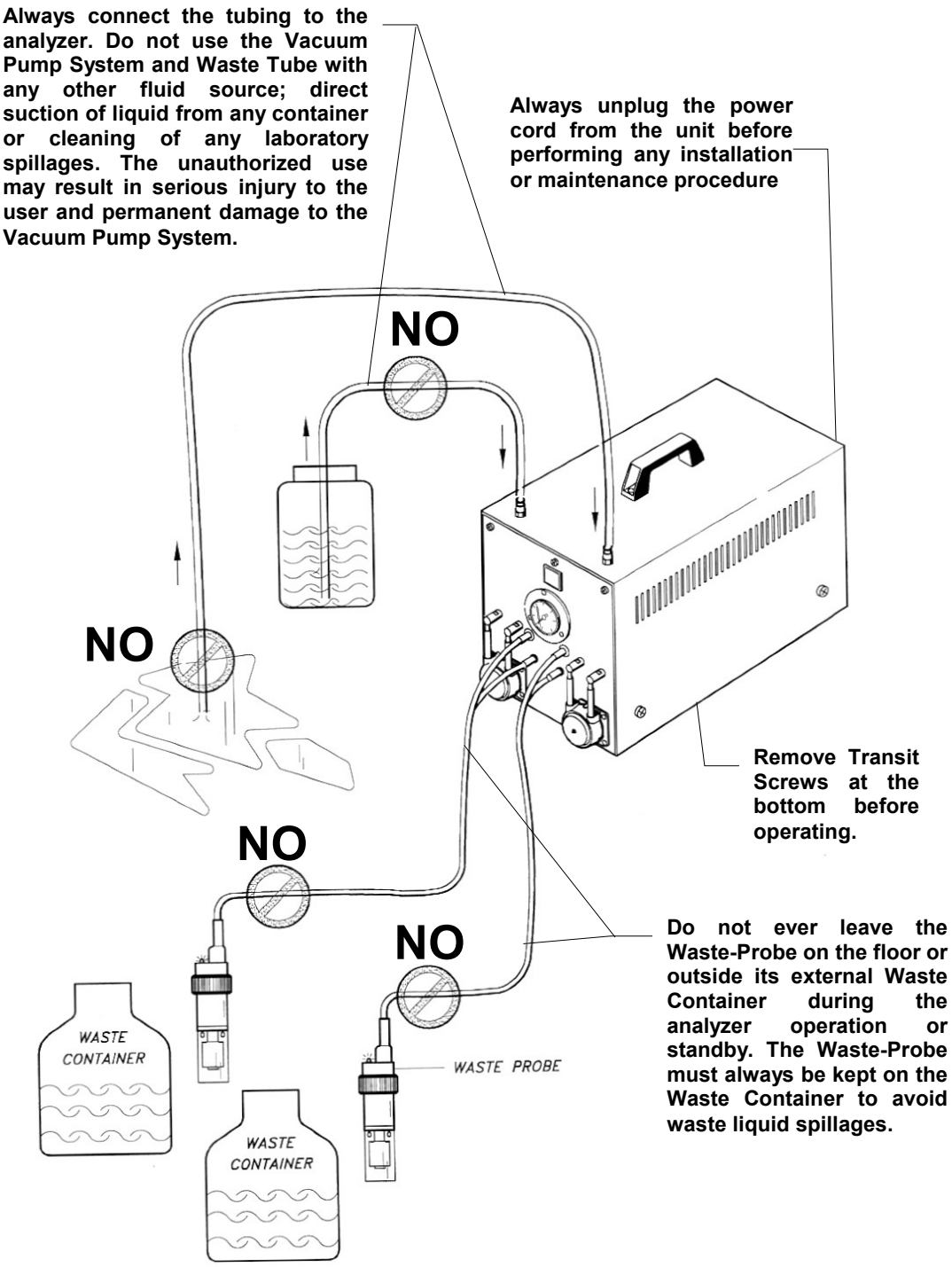
WASTE PROBE (P/N 662.0788A & B)

Figure 12-8



SPARE CABLES FOR VACUUM PUMP

Figure 12-9



VACUUM PUMP SYSTEM WARNINGS!

Figure 12-10

SECTION - XIII

MEASUREMENTS & CALIBRATIONS

13-1. INTRODUCTION

The BT3000 PLUS chemistry analyzer has a general diagnostic program exclusively for the technical assistance personnel. The access to this program is protected by a password and it requires absolute familiarity with the analyzer as a prerequisite.
The following functions can be performed in this program:

1) Verification of operation and stability of the photometer.
2) Testing hydraulic functions including sampling, washing, and emptying of cuvette.
3) Verification of ISE module operation.
4) Verification and programming of the barcode.
5) Program of stress.
6) Cuvette temperature calibration (manual & automatic).
7) Reagent chamber temperature calibration (fixed or variable).

To access the diagnostic program, click on the “Analyzer” button, and then click on the “General Diagnostic” button for displaying the “General Diagnostic” page. Now click on the desired functions.

13-1.1. PHOTOMETER CALIBRATION AND SPECIFICATIONS

The calibration consists of amplification adjustments of each channel so that these are appropriate to variables present in the photometer. The interference filters and the semi-reflecting mirrors may have tolerances of ±30%, which must be compensated to avoid saturation of the amplifiers.
The calibration procedure for amplifications remains the same whether it is performed with the photometer test box or directly on the analyzer. A photometer supplied by the QC with attached test report, may show different amplification values on the analyzer where it will be installed. This is due to the sum tolerances of the entire optical system: halogen lamp and quartz prism light guide. However, any slight deviation is tolerated if the values are within the specified limits. Optical conditions for calibrations and reading of values are as follows:

1) Reading station fully tested and electro-mechanically functional
2) Cuvettes calibrated and properly cleaned as per specifications
3) Distilled water, in all the 34 cuvettes (300 to 600µl)
4) Lamps tested as laid down in the specifications (see specification label)
5) Warm up period of at least 5 minutes to allow the system to reach steady state

Specifications are valid for the BT3000 PLUS with a reading cycle of 1.5 seconds and 34-cuvette plate. The average value of signal for all the channels is 24,000 points (recommended value for calibration). Limit values of signals for all the channels are from 14,000 to 30,000 points.
The reference channel has a wide excursion range of correct value from 3500 points to the 16000 points without any adjustment controls.

NOTE:

An average value of 24,000 points is recommended as the halogen lamp progressively burns out (exhausts). After about 1,500 hours of burning the lamp may reach a minimum acceptable value limit of 14,000 points.

The acceptable minimum and maximum values have the following implications:

- ***Below 14,000 points the photometric resolution tends to reduce progressively to about 2,200 points of optical density.***
- ***Beyond 30,000, towards 35,000 points, the amplifiers tend to saturate and disturb the linearity of photometer also at lower values of optical density.***

13-1.2. PHOTOMETER CALIBRATION PROCEDURE

Select a pair of sequential filters (i.e. 340nm/380nm) using diagnostic program. Execute a reading of the 34-cuvette plate and observe the values of integration. If necessary, adjust the trimmer corresponding to each channel, clockwise to increase and counterclockwise to decrease the measured values. At each adjustment perform reading of the 34-cuvette plate for verification. Select the next pair of interference filters, (i.e. 405/436nm) and repeat the preceding operations. Continue this until terminating with the last pair of 630nm/700nm filters. The calibrations can also be performed in the random mode.

13-1.3. VERIFICATION OF EVENTUAL PROBLEMS DURING THE READINGS

The verification of the photometer requires the following; selection of filters 1 and 2, the filling of one or more cuvettes, the gain reading of the amplifier of desired channel, the reading of offsets of all the channels, the reading of the absorbance in mono and bi-chromatic modes, zeroing the absorbance of all the cuvettes, sample one cuvette using the reagent number 1 and serums number 1 and then read its absorbance value.

1) Click on the “Select Filter” and select the 2 filters.
2) Click on the "Read zero filter" to have the transmission values in the dark of channel 1 & channel 2 amplifiers. The values should be between 0 and 390. Values higher than that may cause problems in the photometer electronics or produce an incorrect mechanical calibration of cuvette tray (i.e.: light passage in the cuvette during reading in the dark).
3) Fill all the cuvettes with water by first clicking the "Cuvette" button and then the "Wash and fill up" button. It is possible to perform additional controls after the cuvettes have been filled.
4) It is possible to read the absorbance and the relevant values of the amplifiers on all the cuvettes by simply clicking the "Read" button. The sequence of the values has the following meaning:

Cuvette # cuv.	1st Chan. rel. gain	2nd chan. rel. gain	mAbs x 1 abs (filter 1)	mAbs x 2 abs (F1-F2)
Es.1	18,000	18,900	300	100

Selected Filters: 340nm/630nm

The above example shows that the cuvette #1 (with H_2O) has an absorbance of 300 mABS at 340nm and an absorbance of 100 mABS in bi-chromatic reading at (340-630nm). The relative gains of the channels #1 and #2 should have the values between 14,000 and 28,000 when all the cuvettes are filled up with distilled water.
If the zeroing of the absorbance is desired then click on "Zeroing" button, if necessary click a couple of times. When performing the a sample and read process using reagent in position #1 and sample in position #1, click on the "Sampling" button and select the appropriate method "Normal Sample" or "Sample Starter".
In the "Normal Sample" mode a sequential sampling is carried out with the same needle, first reagent and then serum. The volume of the reagent is fixed at 300µl, while the volume of the sample is selectable from 0 to 27ml. Take into consideration that the instrument restores the stoicometric ratio when the volume of the sample has been selected. If 3µl of serum is chosen, then the reagent volume becomes 297µl. After the sampling, it is possible to read the absorbance values of the sample directly in the mono or bi-chromatic mode using previously mentioned commands. The "Sample Starter" mode is similar to the preceding method except the sample, which is dispensed subsequently by the second sampling arm. The sampling test is always carried out in cuvette #1.

13-2. CUVETTES CALIBRATION AND TEMP. CONTROL SPECS

The calibration involves adjustment of the temperature sensor to manufactures specifications. A LM35 chip, with tolerance of ±1°C, is used as the sensing element and is located inside a metallic housing.
Operative conditions for correct temperature calibration inside the cuvettes are as follows:

- Ambient Temperature: 18°C to 32°C
- Analyzer turned on for at least 20 minutes to reach steady state
- All 34 cuvettes filled with 300µl to 600µl volume of distilled water
- A certified electronic thermometer with micro-probe with at least 0.1°C resolution

Keep in mind that a thermometer probe of 2 to 3 mm diameters, equipped with a K type thermocouple, when immersed in the cuvette, produces an instantaneous temperature drop of about 0.2°C.
We advise against the use of thermometers of medium to large dimensions to avoid incorrect measurements because of difficulty of inserting the probe and for the necessity of performing measurements quickly. Do not perform measurements or calibrations if the cuvettes have been filled with distilled water without waiting for necessaryl 20 minutes warm-up period

13-2.1. CUVETTE TEMP. CALIBRATION PROCEDURE

Prior to proceeding with calibrations, set the cuvette temperature at 37ºC in "ANALYZER SETUP" page.

Manual temperature calibration

The manual temperature calibration adjustments are made through trimmer located on the "MASTER LOGIC BOARD" (on the rear lower part of the reading station).
Automatic temperature calibration is possible in the software version 7.2 onwards, refer to instructions.
Enter the service page and select the icon "Check Temperature". The cuvettes plate stops temporarily. Immerse the temperature measurement probe in an easily accessible cuvette. Gently shake the probe with rotational movement (for mixing) at the bottom of the cuvette to quicken the measurement.
After measuring and noting the correct and stable value, stop the operation. Do not exceed 45 seconds of measurement time to avoid that irregular heating underneath affect the temperature of the rotating plate. The temperature monitoring system functions correctly, only when the metallic mass of the cuvettes rotor makes cyclical motion. After making a correct measurement, note down the measurement value, remove probe from the cuvette and click on the button, which appeared previously "Push Button...". The plate starts rotating clockwise and counterclockwise in the alternative manner, instantly the temperature is displayed in real time just below the commands line. The displayed temperature value should be identical with previous value measured with the probe.
If necessary, adjust the TR1 trimmer on the Master Logic Board (15-04211-01) to match the value measured by the thermometer probe. Make this adjustment in the shortest time possible. The value of temperature measurement should not be necessarily 37°C as it is automatically corrected when exiting the service page. For example, the measurement of cuvette temperature by thermometer in a motionless plate is equal to 35.9°C. The measurement displayed on the monitor in the "Check Temp" function with plate rotating alternatively between clockwise and counter clockwise directions is 36.5°C. Adjust the trimmer TR1 until the temperature of 35.9°C is displayed on the monitor. Exit service page of "Check Temp".
After the settling time of a few minutes, the monitor should display the correct temperature with fluctuation of ±0.2°C.

Automatic temperature calibration, only with software 7.2 onwards.

An appropriate thermometer is necessary (as indicated previously) to perform a valid calibration. With the instrument in steady state condition and the cuvettes filled with water, enter the diagnostic page (Analyzer > Diagnostic > General Diagnostic > Mechanics). Select "Mechanics" and click "SET TEMPERATURE".

Select "Temperature Calibration" in the next window. This is a step by step guided procedure. Insert the certified thermometer probe tip into the cuvette and after 45 seconds read the measurement value. Write the exact temperature measurement value (including decimals) by using mouse and the keyboard. After this operation is terminated the instrument will assume the set value after couple of minutes.
It is possible to view on the display the measurement value of temperature in the cuvette. Some times one can observe the temperature fluctuations of +/-0,2°C, caused by the automatic corrections of feedback circuit. However the real variations in the cuvette are much less because of the considerable mass of the cuvette system components.

NOTE:

Verify the following parameters for an accurate calibration:

1) **The water must be poured into the cuvette at least 10 minutes before the calibration.**
2) **The ideal ambient temperature should be between 20ºC and 26ºC.**
3) **The precision thermometer probe must be of miniature size. The instruments for measuring temperature such as thermometer having glass tube with mercury or alcohol are not suitable for this purpose.**
4) **The trimmer used in manual calibration adjustments is not required in the automatic calibrations. Therefore this trimmer must not be adjusted during or after the automatic calibration.**

13-3. REFRIGERATION SYSTEM CALIBRATION AND SPECS

The thermostatic control system of the reagent chamber consists of a refrigeration system based upon Peltier modules, which are affixed underneath the circular aluminum chamber. This system maintains reagents at low temperature. The system has refrigeration limits when the ambient temperature exceeds 28ºC, consequently the reagent chamber temperature increases beyond the preset temperature. The electronics of the temperature regulation is inside the "**REAGENT CONTROLLER**" board.
A reagent controller board was produced up to July 2004, which had fixed regulation of temperature. The controller used an approximate value of 5ºC as reference. After 15th July 2004, a new controller board was introduced in the production, giving the user a facility to select temperature between 5ºC and 15ºC.

13-3.1. REAGENT CONTROLLER P/N.15-04313-03 (OBSOLETE)

Unadjustable temperature at 5°C (installed prior to July 2004).

The control is realized by varying the Peltier supply voltage from 16 to 28 volt approximately through a feedback system between the temperature sensor LM35 (located under the aluminum chamber) and the 400 Watt power supply. The comparator (chip U6B) changes the state, when by system fault a temperature exceeding 43ºC is read. In this case the switch (MOSFET Q2) interrupts voltage to the Peltier modules. If one desires to interrupt the refrigeration through Setup Analyzer then the same MOSFET disconnects the system through software.
When the ambient conditions exceed the extreme operating conditions (18ºC and 32ºC) the system limits are evident. Particularly, the ice formation in the reagent chamber is possible below 18ºC and beyond 28ºC the preset temperature value of 5ºC starts rising.

13-3.2. REAGENT CONTROLLER BOARD P/N 15-05211-01

Temp. adjustable from 5°C to 15°C. (installed from July 2004 onwards).

This electronic circuit as compared to the previous circuit allows the refrigeration chamber to reach lower temperatures (below 10ºC). In addition the user can select the desired operating temperature in the setup. The real value of the selected temperature will be displayed on the analyzer display.

The temperature sensor is read by the **µC U3 767**, which in turn proportionally regulates the voltage of the 400W power supply. Because of the limited excursion of the regulation under a certain temperature value, the **µC 767** interrupts the operation of the cross blower fan to avoid excessive decrease in temperature. The final regulation is optimized between 8°C to 28°C (+/- 1,5°C) of ambient. When the room temperature exceeds the 40ºC, this circuit also interrupts the system for defect. A supplementary safety circuit consisting of a NTC (**NTC1**), located near the power connector **J2**, completely cuts off voltage to the Peltiers. The purpose of the circuit is to detect temperatures higher than 75ºC on the printed circuit, possibly caused by the false contacts in the connections. This circuit also functions with the analyzer in the sleep mode, thus assuring the selected temperature.

13-4. BARCODE CALIBRATION AND SPECIFICATIONS

The calibration involves the aligning of the barcode scanner beam in the precise direction corresponding to the reagent bottle and the sample tube in the serum plate. The mechanical adjustment should be performed with the aid of the diagnostic program. The barcode module should also be programmed for the special reading of up to five types of barcode labels.

13-4.1. PROGRAMMING OF SERUM/REAGENT BARCODE

Click on "Mechanics" button to access the barcode diagnostics program. The available functions allow the user to verify and optically align the scanner beam on the reagent and sample barcode labels. It is also possible to read the information of the barcode label if it is present.

The mechanical alignment can be carried out by repeatedly clicking on the desired sample or reagent barcode button. It is possible to precisely align the scanner beam on the barcode label after loosening the mounting screws. The barcode controller can also be programmed in the diagnostics program by using a specific floppy disk available upon request.

13-4.2. BARCODE - MECHANICAL CALIBRATION

In the same "Mechanics" page, select the desired barcode scanner to be calibrated mechanically. Click on the command button "Laser Scan". Verify that the scanner beam is precisely centered on the barcode label of the reagent bottle or the sample tube in the serum plate. It is possible to correctly align the barcode modules by loosening the mounting screws. After the alignment, fasten the screws. Refer to Paragraph 13-6. entitled "Primary Tube Sensor Calibration and Specifications" for the final verification of the correct operation of the barcode module.

13-5. ISE MODULE CALIBRATION AND SPECIFICATIONS

The calibration involves the adjustment of sensibility threshold of bubble sensor and the verification of correct operation of the hydraulic circuit and electronics.
The bubble sensor calibration should be performed by measuring the voltage of the electronic photo-switch with an empty and a full fluid tube inside. The difference between the two measurement values must be of at least 0.5 Volts.
The diagnostic program for the I.S.E module, allows verification of the drift of the electrodes, the efficiency of the hydraulic circuit and the bubble sensor. It does not allow the calculation of slope and therefore the real efficiency of the electrodes.
The commands are as follows: "ISE Module Prime", "Read ISE", "Fill Up ISE", "Empty Out ISE", and "Read Sensors".
The first command "ISE Module Prime" is essential for setting bubble sensor sensitivity threshold, when accessing the diagnostic program for the first time. The command, “Read ISE” reads potentials of all the electrodes in mV. The potential of the REF electrode is displayed separately in the upper section of the screen. The clicking of the “Fill up ISE” button performs a baseline sampling followed by a reading. Reading repeatedly with “Read ISE” it is possible to observe the potential and therefore the drift.
The expected values should be between +500mV and -500mV. The REF should have a value between 2.2 Volt to 2.9 Volt. The values other than the expected values may indicate an improper flow in the electrodes or in the worst case a defective electronic circuit. A typical example of electrodes malfunction is encountered when handling the electrodes during the maintenance. One can inadvertently touch the gold-coated contact pin of the electrode, causing an electrostatic charge in the electrode. In this case, it is possible to observe the continuously changing values of the potential.
To verify the efficiency of the bubble sensor, click on "Read Sensors" button to display the fluid tube "Full Value" and "Empty Value" in volts. The difference between the two values should be higher than 0.5 Volts for the correct operation of the sensor. A difference of less than 0.5 Volt indicates that the optical sensor has not detected sufficient variation between air and liquid. This may be due to fluid being stationary in the segment of tube across bubble sensor or the tube has lost its original transparency.
Finally, the command "Empty ISE" is a useful option for emptying the ISE mixing funnel.

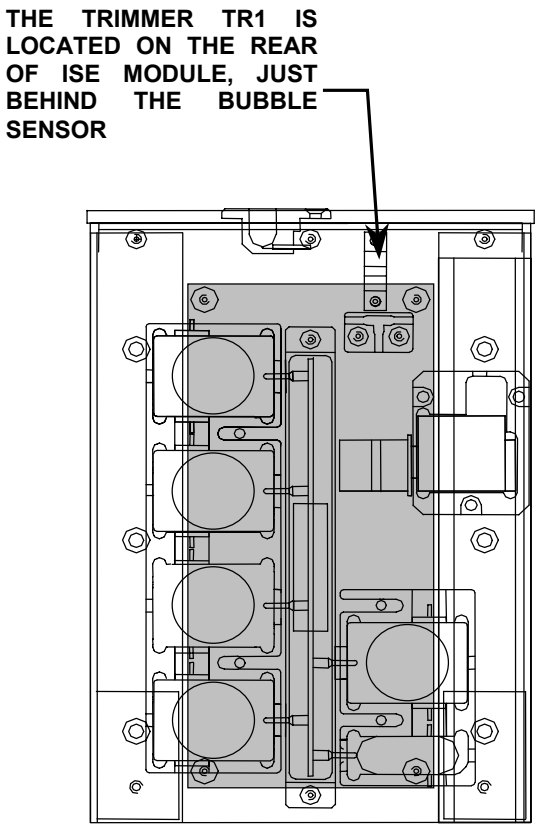
13-5.1. ISE BUBBLE SENSOR CALIBRATION PROCEDURE

To calibrate the ISE bubble sensor, proceed with the following:

a) Click "Analyzer".
b) Click "Diagnostic".
c) Click "General Diagnostic"
d) Click "ISE MODULE". Place a bottle containing Baseline on the small tray in the ISE module and click "ISE Module Prime" and wait for the termination of prime cycle.
e) Click "Read Sensor", and wait for the values (Full Value and Empty Value) to appear automatically on the screen. The difference between the two values should be more than 0.5 Volt.

NOTE:

The measurement value generated by sensor for tube filled with Baseline (Full Value), must be between 3 Volts (minimum) and 4.2 Volts maximum. If otherwise, then lift out the ISE module from its track rail (even with the analyzer turned on) and turn the TR1 trimmer adjustment screw clockwise to increase or counter clockwise to decrease the voltage. See Figure 1.



ISE MODULE
Figure 1

f) Put back the module in its place and press the key F5 to perform a general reset.
g) Repeat the preceding steps (for tube filled with liquid) until the desired values are obtained.

NOTE:
In case the delta results are below the threshold of 0.5 Volts, this may be due to incorrect observation of calibration procedure, or malfunction of hydraulic circuit or photo-switch.

13-5.2. ISE HYDRAULIC CIRCUIT VERIFICATION

It is very important to control the flow of liquids in the hydraulic circuit. During the prime function, the Baseline must completely fill up the Reference electrode, thus keeping the hydraulic circuit full and without air bubbles - starting from the "Y"-connector to the ground electrode.

CAUTION!

Any interruption in the flow of liquid causes air bubbles and affects measurement of potentials of all the electrodes.

Enter the "Utility" page and click on the icon "Prime ISE". After the prime function terminates, gently lift out the ISE module and observe if the hydraulic circuit is full. Put back in place the ISE module and press F5 to reset.

13-5.3. ISE ELECTRODES POTENTIAL VERIFICATION

It is possible to make a precise measurement of the electrodes potential through Diagnostic program.

IMPORTANT NOTICE: Prior to verification, the ISE system must be primed.

After entering the diagnostic page concerning the ISE, click "Fill Up". In this operation the Reference Solution fills up all the electrodes including the reference electrode. After the sampling read the potentials by clicking on the "Read ISE". After some seconds the monitor displays the mV measurement values of 4 selected electrodes. The electrode potential is expressed in Volts and is displayed on the upper part of the screen.

The expected values for Ref, Na, K, Cl and CO_2 electrodes should be within the range -400mV to +400mV. If the values do not correspond then there is a probability that a hydraulic circuit problem did not let the solution correctly fill up the electrodes. Note that, if the electrodes are empty, they can assume any potential value. It is also possible that only the REF electrode is empty. In this case, it will affect the level of the other electrodes. Verify the correct operation of peristaltic pump for emptying and the pinch-valve tubing.

Other situations that may cause a malfunction of ISE module are as follows:

1) One or more electrodes out of range because they were subjected to electrostatic discharge during handling
2) Defective preamplifier
3) Incorrect reference solution

NOTE: The reading of potential does not indicate any exhaustion or expiration of an electrode. The electrode's efficiency is verified only through the SLOPE performed by a calibration and the performance characteristics listed in the package insert.
For additional details refer to ISE troubleshooting.

13-6. PRIMARY TUBE SENSOR CALIBRATION AND SPECS

The calibration consists of sensitivity threshold adjustment of electro-optical system (LED and photodiode). The optical element exploits the principle of reflection. The infrared light beam emitted by LED is reflected back from the primary tube and received by the photodiode sensor element. One can proceed with calibration after placing three 10mm diameter primary tubes with appropriate adapter in a triangular configuration (i.e.: in positions 02, 03, 29 on the serum plate.)

There are two primary tube sensors. The one on the left of serum chamber detects the presence or absence of primary tubes appropriate to the left sampling arm. The one located on the right of serum chamber detects the presence or absence of tubes pertaining to the right sampling arm used for aspiration of serum for ISE, starter and dilution. The sensitivity threshold should be adjusted in such a way that the primary tube sensor detects only the primary tube and not the interference from the adjacent tubes.
A green LED located on top of the detecting circuit provide the user with a visual indication of the sensitivity threshold monitoring for distinguishing the primary tube. The removal of front casing is necessary for making any adjustment or service.
As a first step use unlabelled 10mm tubes for calibrating in worst conditions. Manually rotate the serum plate with slow motion so that the three primary tubes #02, 03, and 29 sequentially move past the primary tube sensor. Bear in mind that the waste funnel is the reference point of the sensor located on the same axis. Observe that with each primary tube moving past the primary tube sensor turns on and off the green LED.
A sensor with an excessive sensibility does not distinguish the spacing between the primary tubes and on the contrary it may not detect the presence of a tube particularly the one located on the inner circle further away.
The sensitivity is adjusted through trimmers TR1 located on the boards 15-04280-01 and 15-04278-01. Turning the trimmer adjusting screw clockwise increases the sensitivity and turning it counterclockwise decreases the sensitivity. Keep in mind that the analyzer must always function with labeled tubes therefore it is preferable to adjust calibration to lower sensitivity rather than to higher sensitivity.
The final test is performed by fully scanning the serum plate and by inserting at least six tubes with barcode labels. Placing three tubes in triangle formation in positions #02, 03, and 29. Now place three tubes in positions #15, 16, and 42. Once completed, go to the "Patient Entry" page and enter "Options" to start "Scan Tray-All". At the end of scanning, if the primary tube sensor has correctly tracked the presence of all the six tubes, then their barcode numbers should be visible in the patient page. This means that the primary tube sensor and the barcode scanner have functioned properly.
If scanning problems occur, the following two types of error messages may appear:

a) "Label Not Found in Pos.28": all primary tubes have been detected. The barcode scanner has not read the barcode label correctly because it is defective.
b) Barcode numbers of 5 primary tubes displayed, instead of 6 tubes. The primary sensor has not detected the remaining one primary tube. Verify the mechanical calibration of the serum plate and ultimately the sensitivity of the optical detection circuit.

13-7. STRESS ANALYZER

This program performs a limitless cycle of mechanical stress on the analyzer. Generally this program is used for verifying the efficiency of replaced mechanical devices after service and repair.

SECTION - XIV
TROUBLE - SHOOTING

14-1. INTRODUCTION

Any investigation of malfunction, which might occur, must begin with verification of power supply and the ambient conditions. During troubleshooting the following parameters for correct analyzer operation must be verified:

Power Supply:	100 – 240~, 50/60 Hz
Ambient Temperature:	18°-32°C
Relative Humidity:	10 - 85% non-condensed

In case the parameters do not correspond to the indicated range of values, then observe the following procedures and the appropriate corrective actions. Prior to servicing the BT3000 PLUS chemistry analyzer, switch off the instrument and disconnect the power cordset.

14-1.1. TROUBLE-SHOOTING CUVETTE TEMPERATURE

CUVETTE TEMPERATURE	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
Cuvettes do not reach operating temperature of 30°, 32° and 37°C or unstable temperature.	1) Ambient temperature out of limits. Reenter ambient temperature limits 18°- 32°C. 2) Defective electronic circuit causing unstable temperature or for temperature to exceed maximum limits. Replace the temperature sensor or the master power board or the chip µC764. Refer to "Measurement and Calibration" procedures for the reading station outlined in the Section XIII to find out the defective device. After replacing the temperature sensor, there may be temperature fluctuation of ± 0.5°C. In this case make adjustments as per calibration procedure. 3) A defective Peltier module will cause temperatures to be lower or near ambient temperature. Check if there are one or more defective Peltiers. Even one defective Peltier can stop the temperature monitoring system.

14-1.2. TROUBLE-SHOOTING REAGENT CHAMBER TEMP.

REAGENTS CHAMBER TEMPERATURE	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
The base of the reagent chamber does not reach the set lower temperatures (5°-20°C) or some times seems to be heating. In some cases excessive cooling with ice formation.	1) Defective Cross-flow blower causing high temperature. Verify and replace if necessary. 2) Interrupted Peltier causing refrigeration failure. Verify and replace defective Peltier. 3) Defective temperature sensor or reagent control board causing overheat or ice formation. Verify and replace the defective part.

14-1.3. TROUBLE-SHOOTING POWER SUPPLY

POWER SUPPLY PROBLEMS	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
1) The analyzer turns off suddenly without any apparent reason. The vacuum pump system makes unusual noises. 2) UPS (if installed) generates continuous alarms. 3) The analyzer generates random resets of mechanical devices or the software.	1) Power supply problems: defective main power, power cord not properly connected, UPS connected incorrectly. Get your main power line checked and repaired by a competent electrician. Connect power cord correctly. 2) Main power line generating high surge voltage due to lack of ground connection. Request your electric company to verify and repair the line if necessary. 3) Defective UPS or discharged batteries. Disconnect UPS temporarily to verify if it is causing the problem If necessary substitute with new UPS. Try to recharge the batteries or substitute them. Bear in mind that the UPS supplied with the instrument is universal type and it cannot be used in extremely critical situations where the electrical lines are subject to large surges. In such cases it is recommended to use a more sophisticated UPS (i.e. NOBREAK, etc.)

14-1.4. TROUBLE-SHOOTING POWER UP PROBLEMS

POWER UP PROBLEMS	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
After turning on the analyzer, nothing happens.	1) No power due to various causes. The monitor is off; only the refrigerator fan can be heard. Verify all the connections and the correct operation of the UPS. 2) The computer has not been turned on through its push button. Press push button to turn on the computer. 3) Hardware problem: defective motherboard or power supply. After verifying, repair or replace.
After turning on, the program loading (bootstrap) by the computer is interrupted and the computer blocks. Turning off the computer with the push button becomes necessary.	1) The analyzer has been turned off incorrectly through main switch or sudden main power line interruption with consequent damaging of some files. Wait for the disks verification to be performed automatically by the system. Verify any errors in the hard disk. Contact the service engineer for any problems. 2) Hardware conflict between the system peripheral devices or damaged peripheral device. The peripheral device must be reconfigured or substituted in case of damage. Contact service engineer.

14-1.5. TROUBLE-SHOOTING THE MOUSE AND KEYBOARD

THE MOUSE & KEYBOARD	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
The system performs the boot correctly, the analyzer logo appears and seems to be ready, but the cordless keyboard and mouse do not work.	1) The RF Receiver cable disconnected from the rear panel. Check and correctly connect the cable. 2) Exhausted batteries in the keyboard or the mouse. Substitute the batteries with the analyzer power on; press the devices button to put them in communication (setup). The sequence is: RF Receiver, keyboard and the mouse.

14-1.6. TROUBLE-SHOOTING RESET ERRORS

Reset Errors: Serum Plate/Reagent Tray/Diluter/Arm	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
The analyzer after routine boot displays an error message about one of the following modules: • Reset error of serum plate • Reset error of reagent tray • Reset error of diluter • Reset error sampling arm etc.	1) Inadvertent accidental blockage by operator of one or more modules. For correct operation perform a general reset (F5 or Reset Icon). 2) If the problem persists the problem may lie in the mechanics or electronics of one of the modules. The defective module seems to be operating but an error message appears. ***NOTE:*** *To diagnose a mechanical or electronic problem is quite simple. Generally speaking a mechanical defect produces a partial movement in the device and careful observation of the mechanism during operation one can easily identify the problem. The electronic problems are related to motor drivers and the position sensors. In case the device is functional but does not stop in correct position, the problem in the reset sensor. Depending upon the module it may be a photo-switch or Hall sensor. These specified problems might associate to diluter, reagent tray, serum plate, cuvettes plate, and the washing piston. If the device makes no movement then there is a defective circuit of the power driver or a defective motor. Consideration should be given to the fact that all modules have the same basic structure: motor, driver, position sensor and the micro-controller. The service operations for resolving the problem are deliberately confined to the substitution of the defective devices already mentioned. In case the service engineer is unable to resolve the problem, the whole electronic circuit of the module can be substituted. It is important to verify that the devices are properly connected and that the cables and connectors are free of defects.* *It is also important to try to distinguish the hydraulic problems from those of electronics as regards analyzer malfunctions. Any improper evaluation of problems may lead to inadmissible loss of time. Outlined below are some procedures for quickly locating the problems.*

Reset Errors: Serum Plate/Reagent Tray/Diluter/Arm	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
	DILUTER
Diluter blocked:	Defective motor, driver, micro-controller, connecting cable, or PCB. Repair or replace.
Diluter functions but does not reset:	Defective photo-switch, micro-controller, connecting cables, or PCB. Repair or replace. In case the Diluter is damaged or defective then it should be completely substituted.
	SAMPLING ARM
Sampling arm moves vertically without resetting:	Defective Hall sensor or positioned incorrectly. Repair or Replace
Sampling Arm blocked:	Defective driver or interrupted motor. Bear in mind that the arm does not make angular (swivel) motion until after the vertical reset. To verify the correct functioning of the three arm sensors (Hall sensor for UP/DOWN motion, Liquid Sensor, Photo-switch for angular motion) observe the three corresponding LEDs located on a small PVC bracket near the arm shaft. If the arm is moved up/down manually, the upper LED lights to indicate the correct functioning of the Hall sensor. The touching with a finger of the arm needle will light the middle LED. Swiveling the arm to the left or right will light and switch off the lower LED. Repair or replace defective motor or driver.
Zero position calibration of the sampling arm not maintained in successive resets:	The upper part of the arm (needle head) has loose screws and is not secured to shaft properly. Dirt in the Zero position photo-switch or the photo-switch shutter. Tighten the screws. Clean with a brush the photo-switch or the shutter.

Reset Errors: Serum Plate/Reagent Tray/Diluter/Arm	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
The arm needle holder does not heat up:	Interrupted heater circuit inside the sampling arm, in this case the liquid sensor functions as the LED lights up just by the bare touch of the finger. On the other hand if the LED does not light up then the electrical circuit is interrupted at the source. Verify the power supply starting from the source, the Master Power Board 15-04209-01. If the arm is damaged or defective then it is recommended to substitute it completely.
The serum plate rotates during reset and stops at an incorrect position with a screen message "Reset Error...":	**SERUM PLATE** Most likely the Hall sensor malfunction. The magnet on the upper rim of the serum plate is not properly aligned with the Hall sensor. Defective Hall sensor or connecting circuit interrupted. No rubber mat over the rotating serum base. In the absence of rubber mat the magnet position is displaces a few millimeters downwards thus causing misalignment with the Hall sensor. Other various causes: Magnet detached from the plate or defective electronic circuit (Board 15-04282-01 & Board 15-04422-01). The serum plate resets correctly but does not respect the positions and the sampling needle descends in the wrong positions. Most likely the serum plate slips on the rubber mat during rotation. Remove and wash the rubber mat with a neutral soap and water. If the problem persists then the causes may be as follows: Transmission problem with one of the following devices: Timing Belt, motor, driver and Control Board (15-04422-01).
The tray does not stop at the container number 1 position and issues an error message "Reset Error...":	**REAGENT TRAY** 1) Defective Hall sensor or the sensor out of range from magnet. Repair or replace. 2) Defective belt drive, stepping motor, driver, or Control Board 15-04313-03. Repair or replace.

14-2. COMPUTER MODULE TROUBLE-SHOOTING

The diagnosis of computer system malfunction should be quite simple, as the problem generally occurs during the powering up of the analyzer. The most frequent problems are generally the loss of files or a hard disk malfunction. Statistically these problems almost always are caused by incorrect operations as follows: Turning off the analyzer incorrectly, using back-up disks that is infected with a virus, incorrect use of the computer, etc.

14-2.1. TROUBLE-SHOOTING THE COMPUTER MODULE

COMPUTER MODULE TROUBLE SHOOTING	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
The analyzer starts up but no LCD display.	1. Probably a defective VGA driver or incorrect connection of the LCD display. Check on the rear of display that the lamp is lit. Check that the VGA board is properly inserted into the slot of mainboard. Make sure that all the cables of display including the inverter cables are properly connected. If necessary replace VGA Board. 2. The inverter of the display lamp power supply defective or incorrectly connected. Check that the inverter cable is correctly connected. If necessary replace inverter. ***NOTE:*** *It is also possible to connect an external CRT monitor to identify the problem.*
The touch-screen functions now and then only in some zones of the screen.	Dirty screen, defective touch-screen driver, or defective serial port where the driver is connected. Gently clean the LCD display screen with a soft lint free cloth moistened with an appropriate neutral detergent and delicately wipe to dry up. Check that the flat cable of touch-screen is properly connected to the driver. If necessary replace driver or serial port.

COMPUTER MODULE TROUBLE SHOOTING	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
After loading Windows, the loading of the process program starts and is visible on the progression bar. The progression bar inactive, followed by an error message "Impossible to Reset Analyzer". All electro-mechanical devices remain motionless.	1. No communication between the computer and the process electronics. Check that the flat cable across IBM and the Main Logic Board (on the rear of the reading station) is properly connected. 2. Defective RS-232 serial communication port of the computer or the micro-controller. Check and replace if necessary. 3. Defective Main Logic Board. Verify and replace if necessary.
No communication between the analyzer and the host computer.	Defective relevant serial ports or interrupted connecting cable. Verify and replace serial port. Check that the interface cable is correctly connected. ***NOTE:*** *If the interface with the host computer is done for the first time then there may be a software problem. To avoid software problems, use specific software protocols for verification of communications.*

14-2.2. TROUBLE-SHOOTING THE BOOTSTRAP

BOOTSTRAP - COMPUTER MODULE TROUBLE SHOOTING	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
After turning on the computer the bootstrap process interrupts and displays an error message: “NTLDR not found press any key to restart".	There is a floppy disk in the floppy disk drive of the computer. Remove floppy disk and press any key.

BOOTSTRAP - COMPUTER MODULE TROUBLE SHOOTING	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
During the bootstrap process, an error message appears on the screen: “Disk boot failure, insert System Disk and press Enter"	1. Hard disk cable disconnected. Connect the hard disk cable properly. **2.** Damaged or unformatted hard disk. If necessary, replace the hard disk. Format the hard disk. **3.** Incorrect configuration in BIOS setup. Verify the STANDARD CMOS SETUP and particularly the configuration of the Hard Disk. ***Note:*** *Guidelines for installation of the operative system or the application programs on the BT3000 PLUS (complete reinstallation and/or substitution of hard disk and/or replacement of motherboard) is required for motherboards of new generation.* 4. Configure the startup sequence in BIOS setup with CD-ROM drive as the first peripheral, the hard disk as second peripheral and the floppy disk drive as the third peripheral. ***Caution****! After installation of the Windows® 2000 PRO operative system, restore the original BOOT configuration.* 5. Install Windows 2000 PRO by starting the computer with the CD and carefully select FAT32 as file system. Insert the user name, organization name and the password: <<administrator enzo>>. 6. Enter Control Panel - System - Hardware and then Device Manager to verify the correct installation of all the devices. Eventually remedy the causes of any conflicts and if necessary, install an appropriate updated driver for any unidentified device (Audio, additional serial port, and touch-screen etc.). 7. Install application software of the external peripherals (i.e. printer, UPS, etc.) 8. Install application software of BT 3000 PLUS.

BOOTSTRAP - COMPUTER MODULE TROUBLE SHOOTING	
SYMPTOMS	**CAUSES AND CORRECTIVE ACTIONS**
After power on and during the bootstrap process, password request window appears on the display.	Enter Control Panel - Users and Passwords – remove the "X" mark from the box corresponding to the <<User must enter name and password to use this computer, and to change passwords and other settings>>.
Possible problems during reinstallation of hardware devices (i.e. additional serial boards, touch-screen etc.)	Correct drivers have not been installed. Previously a board by another manufacturer was installed and is still present in the system even if physically disconnected. ***Note:*** *In the case of serial board, two new gates COM3 and COM4 are assigned to replace COM5 and COM6. In such a case it is necessary to enter the Advanced Settings of the appropriate serial communication port and modify it manually.*

14-3. UNRELIABLE RESULTS OF ANALYSES

General Considerations:

Any errors by the operator in application of method, use of appropriate reagent, or a sample of unknown origin are excluded a priori.

14-4. METHOD FOR VERIFICATION OF PHOTOMETRIC INSTABILITY

It is possible to make quick verification of photometric stability by using the general diagnostic program, excluding sampling problems.

Fill up (in "Photometer" mode) all the cuvettes with H_2O through appropriate command. In case of hydraulic defects, manually fill the cuvettes. Select a pair of interference filters, where 700nm filter is always selected as the second filter. Perform a zeroing and then the consecutive readings, while observing the stability of absorbances of all the cuvettes (last column on the right). Normally the values should be around +/- 1 point. Repeat a few times after short interval of some minute to insure long-term stability of readings.

If considerable variations are observed in a short period of time, then instability in the photometric lamp is to blame. If the instability regards one or more cuvettes, then it is likely that there are foreign debris or moving corpuscles inside. In this case remove the foreign debris or corpuscles by using the aspiration tube of the washing piston plunger (located on the upper end of the piston plunger).

To verify the photometric instability (relevant only to the photometer), execute the command "Reading" followed by "read zero filter". The offset values of all the channels will be displayed. The values should be stable and within the range of 0 to 150 points. If otherwise then one should suspect the infiltration of water in the photometer caused by a defect in the hydraulic circuit. In this case one should assume that the water might also have seeped into the cuvette rotor. In this case it will be necessary to completely remove the cuvette plate and rotor, and then thoroughly dry the whole system including the cuvettes.

14-5. VERIFICATION OF HYDRAULIC SYSTEM OPERATION

The hydraulic circuit consists of the diluter, peristaltic pumps, and pinch valves. The instrument detects any malfunction of the preceding devices during power on. Appropriate alarms indicate the type of problem: dilutor reset error, collapsed or sticking tube in pinch-valve, water lacking etc. The messages are generated during test runs for lack of water and the dilutor reset error.

The poor reproduction of results is generally caused by an imprecise aspiration of sample or reagent, insufficient vacuum level for the reading cuvette washing and drying. In the first case verify the correct operation of the dilutor, correct alternating motion of the piston and the absence of air bubble in the exposed hydraulic circuit. As regards the cuvette washing and drying phase, verify the water consumption necessary for the washing of 34 cuvettes. To verify the water consumption place the water intake tube (from the external water supply container) in a graduated beaker or cylinder filled with at least 500 ml of distilled water and launch the function "Wash Cuvette". At the end one should observe a water consumption of at least 150 ml, which is equivalent to 4,5 ml per cuvette. Any lack in amount of water consumption may depend on scarce vacuum level or a partial occlusion in the washing piston.

A frequently neglected additional cause of photometric instability is due to the poor overall maintenance of the analyzer. Particularly the irregular routine washing of the cuvettes may cause a progressive contamination the cuvettes through deposits, which are difficult to eliminate.

Just consider a gradual stratification of reagents on the inner surfaces of the reading cuvette, their gradual release during tests and the possible consequences. In such cases it is of utmost importance to perform a thorough washing by using hydrochloric acid 0,1N (instead of routine washing solution) and leaving it inside the cuvette for at least 5 minutes. Then follow up with a standard H_2O wash. After having given consideration to the preceding circumstances, an error may emerge during the photometric zeroing phase caused by variable conditions of transparencies of cuvettes during the washing progression. Therefore perform a "SETLAMP" to restore the reference conditions and then a "Zeroing " or "Photometer zeroing".

14-6. ISE TROUBLESHOOTING

If the routine maintenance is performed regularly, the ISE module functions correctly. The most common problems encountered in the ISE Module are as follows:

a) Calibration errors.
b) Unreliable sample results with flags.
c) Error messages of air bubbles.

a) CALIBRATION ERRORS

The causes may be due to various reasons and can be diagnosed through close examination of mV values of slopes.

Typical values of calibration potentials in mV:

K	std low =	-8 mV	
	std high =	+22 mV	difference 30 mV (slope 57 mV)
Na	std low =	-10 mV	difference 15mV (slope 63 mV)
	std high =	+ 5 mV	
Cl	std low =	+6 mV	difference 10mV (slope 50 mV)
	std high =	-4 mV	
CO2	std low =	+4 mV	difference 10mV (slope 32mV)
	std high =	-6 mV	

The above-mentioned values are indicative and may deviate due to the wear and tear of the electrodes.
A positional error or an incorrect concentration of reagents may determine a considerable variation of potentials and slopes.
The mV values (in brackets) in the calibrations printout can give additional indications, which are useful for the diagnostics.

For example:

Std low	-8mV	(-208 -200)
Std high	+22mV	(-178 -200)

One can observe in the above example the Baseline value (-200), which must be always included between two Std values. In fact the value -200 is between the two values -208 and -178.

Various combinations of error

a) Inversion of Buffer / Baseline
Considerable increase of potentials (up to 100mV), decrement of slopes.

b) Insertion of identical reagents: Buffer / Buffer or Baseline / Baseline.
The potentials are almost within norms but there is considerable decrement of slopes.

In the above items a) and b), the Baseline values shown in the preceding example shall not be coherent.

b) OBSTRUCTIONS CAUSED BY PROTEINS IN ELECTRODES CL &CO_2

After approximately 150 to 200 samples, the **Cl** & **CO_2** electrodes may be periodically obstructed. In this case, one observes an increase in the slopes of **K** & **Na**, and decrement in the slopes of **Cl** & **CO_2**. Follow the instructions for the cleaning of electrodes.
A partially occluded Ground electrode may also cause a similar error.
Generally, the obstructions are caused by the foreign matter and not by protein. Carefully observe the cleaning procedures as outlined in the Figures 13 **and** 14 **on the ensuing pages.**

NOTE:
A prolonged obstruction of the **Cl** electrode may progressively obstruct the electrodes below it (**CO_2** and **Bypass**). For cleaning these electrodes, use syringe for the **CO_2** and the cleaning tool on the **Bypass** as shown in the **Figure 14**.

c) BAD RESULTS OF SAMPLES:

Generally, this phenomenon occurs during sampling but it may take place afterwards. Observe the above-mentioned diagnostic procedures.

d) ERROR MESSAGES, AIR BUBBLES, FLAGS

During a calibration or a run an error message "Air bubbles" may appear. The error may be momentary and not appear afterwards. In this case, it means a casual formation of bubbles. If it persists then it may be due to problems of hydraulic nature.

- **a)** ISE funnel takes long time to empty. It may be caused by defective or worn peristaltic pump for draining or an obstruction in the electrodes stack. Repair or replace.
- **b)** Prime operation failure. The Prime also calibrates the bubble sensor. Check that prime is performed properly.
- **c)** Collapsed tube in the ISE pinch-valve. The Baseline solution doesn't enter the Reference electrode and the funnel doesn't empty. The Reference electrode is filled during the prime. Check and correct.

e) RESULTS WITH FLAG "D"

During the reading, the flag "D" on one or more electrodes indicates a drift of potential greater than 2 mV. The phenomenon may be determined by one of the following causes:

- Defective electrode.
- Electrode to be reconditioned.
- Partial occlusion of the electrode.
- Incorrect reagents.
- No washing after a consistent run.
- Correlation with general problems already explained.

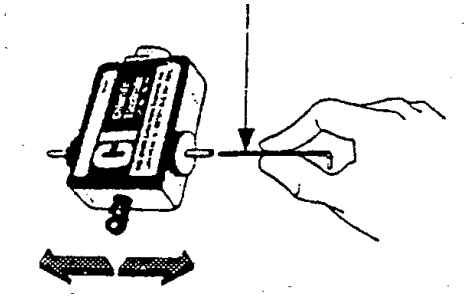
NOTICE

CHLORIDE ELECTRODE
NEEDLE TOOL P/N 03254

It is often possible to extend the life of a chloride electrode by using the supplied **CHLORIDE ELECTRODE NEEDLE TOOL**.

1) Grasp the NEEDLE TOOL as shown. Gently insert the tip of the needle tool into either end of electrode. Keeping your fingers off the opposite end of electrode, slowly but firmly push the needle straight through the electrode's inner core until the needle tip appears at the other end of the electrode (be careful not to bend the needle inside the electrode). Wipe off any debris on the needle tip and gently pull the needle back out of the electrode. Wipe off the needle and remove any debris or moisture from the electrode surface.

CHLORIDE ELECTRODE NEEDLE TOOL



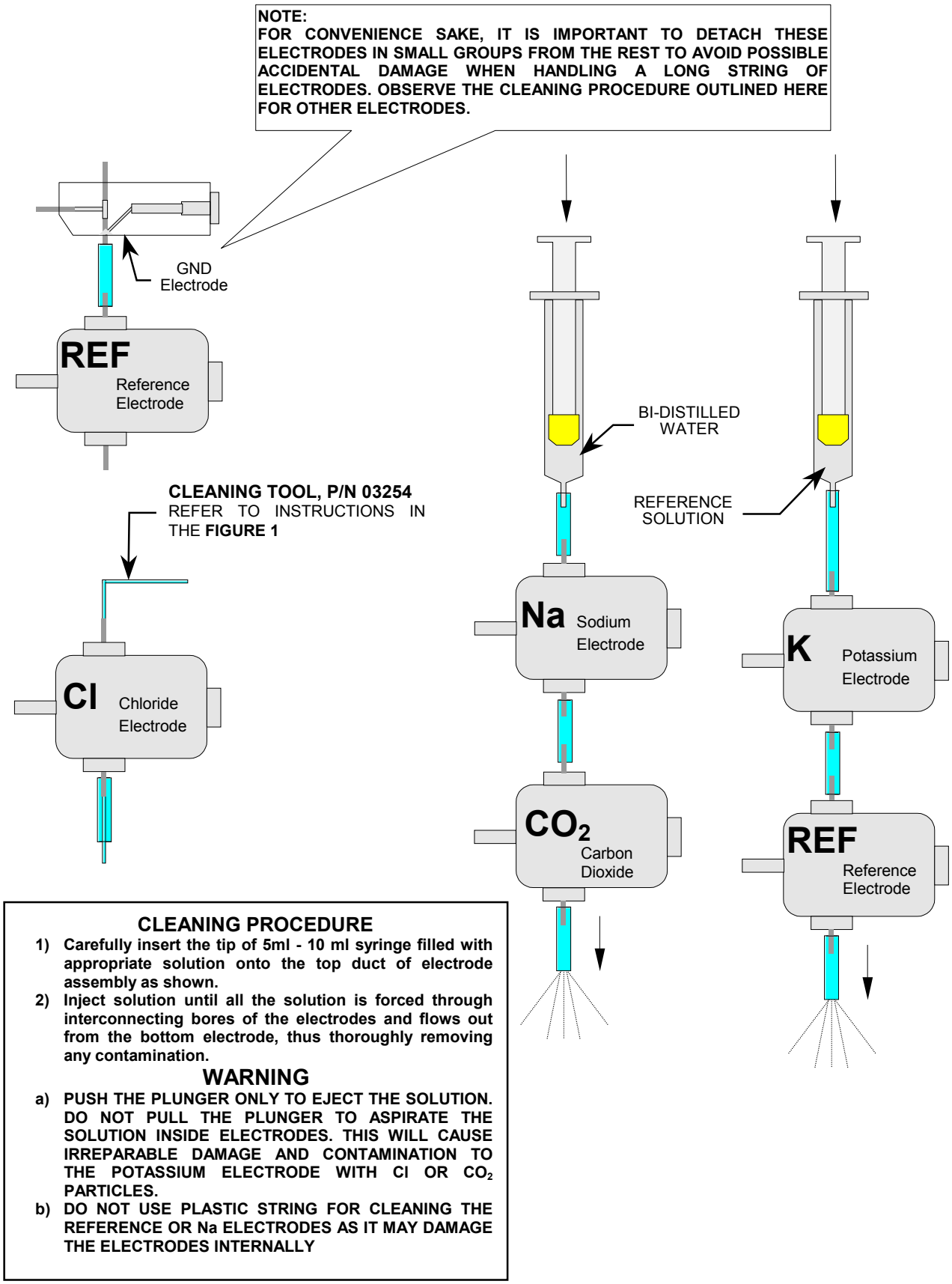
2) Reinstall the electrode into the electrode housing in the correct order.

3) Install the electrode housing into the ISELyte Analyzer. Connect tubing and prime the ISE module completely. If the electrode's performance does not improve, contact your local Technical Support.

WARNING

NEEDLE TOOL can damage all other electrodes (K, Na, CO2, REF). Do not use!

Chloride Electrode Cleaning Procedure
Figure 14-1



CLEANING PROCEDURE

1) **Carefully insert the tip of 5ml - 10 ml syringe filled with appropriate solution onto the top duct of electrode assembly as shown.**
2) **Inject solution until all the solution is forced through interconnecting bores of the electrodes and flows out from the bottom electrode, thus thoroughly removing any contamination.**

WARNING

a) **PUSH THE PLUNGER ONLY TO EJECT THE SOLUTION. DO NOT PULL THE PLUNGER TO ASPIRATE THE SOLUTION INSIDE ELECTRODES. THIS WILL CAUSE IRREPARABLE DAMAGE AND CONTAMINATION TO THE POTASSIUM ELECTRODE WITH Cl OR CO_2 PARTICLES.**
b) **DO NOT USE PLASTIC STRING FOR CLEANING THE REFERENCE OR Na ELECTRODES AS IT MAY DAMAGE THE ELECTRODES INTERNALLY**

ISE ELECTRODES CLEANING PROCEDURE
Figure 14-2

SECTION XV

BT 3000 PLUS
SPARE PARTS FOR REPAIR AND MAINTENANCE

THE FOLLOWING IS LISTING OF SUBASSEMBLIES AND INDIVIDUAL PARTS, WHICH ARE AVAILABLE FOR FIELD REPLACEMENT. INDIVIDUAL PARTS OTHER THAN THOSE LISTED SUCH AS MECHANICAL PARTS, FASTENERS ETC. ARE PROVIDED ONLY AS PART OF SUBASSEMBLY. THIS WIDE SELECTION OF SPARE PARTS ALLOW THE SERVICE ENGINEER TO TAILOR CONFIGURATIONS TO SPECIFIC REPAIR AND MAINTENANCE REQUIREMENTS AND TO PROVIDE REPAIR FLEXIBILITY. PLEASE ASK IF YOU REQUIRE OTHER ITEMS NOT LISTED HERE, AS THIS MAY BE POSSIBLE.

15-1. READING STATION MODULE SPARE PARTS

PART NO.	DESCRIPTION
02634	READING CUVETTE
02765	LAMP RETAINING SPRING CLIP
03-04442-05	READING STATION - BT 3000 PLUS
06-04433-01	MASTER LOGIC MODULE
07-04334-03	CUVETTE ROTOR HUB ASSY
08-04347-01	TEMPERATURE & HALL SENSOR ASSY
08-04533-01	CUVETTE MOTOR ASSY
08-04695-01	QUARTZ PRISM WITH LENS ASSY
08-04981-02	PELTIER FAN ASSY
08-05132-01	REFERENCE DIODE
11-04779-01	CUVETTE PLATE WITH 34 CUVETTES
11-05083-01	CUVETTE FAN KIT
11-05136-01	MASTER POWER BOARD KIT
11-05137-01	MASTER POWER MODULE (ex 06-04434-01)
11-05209-01	CARTUCCIA POMPA PERISTALTICA (ex 330.9072)
15-04270-01	P.C.B. - READING TRAY INTERFACE
30-04570-01	CUVETTE PELTIER - A
30-04570-02	CUVETTE PELTIER - B
330.5708	"O"-RING FOR CUVETTE
330.8688	TIMING BELT 150 TEETH FOR CUVETTE MOTOR
330.9321	TUNGSTEN HALOGEN LAMP 12V, 35 WATTS, 9°
330.9321A	SOCKET FOR HALOGEN LAMP

WASHING MODULE	
PART NO.	**DESCRIPTION**
07-04850-01	WASHING MODULE ASSY
08-04405-01	WASHER PINCH VALVE ASSY (N.C.)
08-04569-01	PERISTALTIC PUMP ASSY FOR DILUTER
08-04572-01	FLUID CHAMBER PUMP
08-04573-01	STEPPING LINEAR ACTUATOR WASHING SYSTEM
08-04574-01	SAMPLING PINCH VALVE ASSY (N.C.)
08-04929-01	LIQUID SENSOR #WASHING STATION
11-04778-01	WASHING PISTON&PLUNGER ASSY
11-05046-01	DILUTER PUMP KIT (EX 08-04568-01)
15-04651-01	P.C.B. - OPTOCOUPLER
330.5664A	PISTON SEAL
330.5703	O-RING FOR DILUTER
662.0610	WASHING PISTON KIT (ex 02586)
PHOTOMETER	
PART NO.	**DESCRIPTION**
04051	INTERFERENTIAL FILTER 700 NM
330.9336	INTERFERENTIAL FILTER 340 NM
330.9337B	INTERFERENTIAL FILTER 380 NM
330.9338	INTERFERENTIAL FILTER 405 NM
330.9339	INTERFERENTIAL FILTER 436 NM
330.9340	INTERFERENTIAL FILTER 478 NM
330.9342	INTERFERENTIAL FILTER 510 NM
330.9344	INTERFERENTIAL FILTER 546 NM
330.9345	INTERFERENTIAL FILTER 578 NM
330.9347B	INTERFERENTIAL FILTER 630 NM
662.1017	FLAT CABLE 16-16C FOR PREAMPLIFIER
06-05133-01	PHOTOMETER – COMPLETE (ex 662.1018)

15-2. REAGENT/REFRIGERATION SYSTEM SPARE

PART NO.	DESCRIPTION
03275	REAGENT PULLEY WITH MAGNET
06-04435-03	REAGENT CONTROLLER MODULE
08-04537-01	CROSS BLOWER FAN ASSY
08-04633-01	REAGENT MOTOR ASSY
08-04699-01	REAGENT BOTTLES TRAY (MARKED 1-8)
08-04699-02	REAGENT BOTTLES TRAY (MARKED 9-16)
08-04699-03	REAGENT BOTTLES TRAY (MARKED 17-24)
08-04699-04	REAGENT BOTTLES TRAY (MARKED 25-32)
08-04699-05	REAGENT BOTTLES TRAY (MARKED 33-40)
11-04892-01	REAGENT BELT/PULLEY KIT (EX 330.8668)
11-05043-01	REAGENT HALL/TEMPERATURE SENSOR KIT (EX 08-04539-02, 08-04540-03)
11-05155-01	REAGENTS REFRIGERATION ASSY
11-05227-01	REFRIGERATOR INTERFACE BOARD KIT (ex 15-04680-01)
12-04578-01	REAGENT CABLE
12-04711-01	REAGENT CONTROLLER CABLE
330.4605	PELTIER MODULE FOR REAGENTS
330.5709	"O"-RING Ø50.47 X 2.62
330.9351	BARCODE READER

15-3. SERUM MODULE SPARE PARTS

PART NO.	DESCRIPTION
02350	SERUM PULLEY
02444	ANTISKID MAT FOR SERUM PLATE
04-04445-04	SERUM MODULE COMPLETE
06-04486-01	SERUM CONTROLLER MODULE
07-04893-01	SERUM PLATE WITH TUBE ADAPTERS
08-04349-01	SERUM MOTOR ASSY
08-04490-01	TENSION PULLEY SERUM
08-04681-01	SERUM PLATE COVER

PART NO.	DESCRIPTION
11-05044-01	WASHING FUNNEL
11-05152-01	FUNNEL CAP WITH O-RING
12-04536-01	FLAT CABLE FOR PRIMARY TUBE SENSOR "RIGHT"
12-04538-01	FLAT CABLE FOR PRIMARY TUBE SENSOR "LEFT"
12-04714-02	SERUM CONTROLLER CABLE
15-04278-01	PRIMARY TUBE SENSOR (RIGHT)
15-04280-01	PRIMARY TUBE SENSOR (LEFT)
15-04282-01	HALL SENSOR ASSY #SERUM
15-04408-01	MOTOR DRIVER BOARD
20-04249-01	SERUM CHAMBER
20-04962-01	TUBE ADAPTER BUSHING #SERUM PLATE
20-04985-01	BOTTOM TUBE SPACER FOR SERUM PLATE
90-05201-01	FUNNEL CAP OPENER (TOOL)
330.8665	TIMING BELT 400 TEETH FOR SERUM PLATE DRIVE PULLEY
330.9351	BARCODE READER WITH CABLE

15-4. SAMPLER ARM SPARE PARTS

PART NO.	DESCRIPTION
03196A	DAMPER KIT
06-04436-03	LEFT SAMPLING ARM COMPLETE WITH ENCODER
06-04437-03	RIGHT ISE ARM COMPLETE WITH ENCODER
06-04872-01	LEFT SAMPLING ARM (WITH ENCODER) WITHOUT ARM HEAD
06-04873-01	RIGHT SAMPLING ARM (WITH ENCODER) WITHOUT ARM HEAD
07-04438-02	ARM HEAD WITH HEATER ASSY
08-04733-01	ARM SWIVEL MOTOR ASSY
08-04891-01	ARM UP/DOWN MOTOR ASSY
15-04408-01	MOTOR DRIVER BOARD
15-04765-01	P.C.B. - ARM CONTROLLER (LEFT ARM)
15-04765-02	P.C.B. - ARM CONTROLLER (RIGHT ARM)
15-04767-01	P.C.B. - ENCODER
20-04148-01	THUMB SCREW FOR NEEDLE
330.8694	TIMING BELT 80
330.8695	TIMING BELT 150
662.0629A	CLEANING TOOL FOR ARM NEEDLE
662.1011	SAMPLING NEEDLE

15-5. ISE MODULE SPARE PARTS

PART NO.	DESCRIPTION
03011	ISE PERISTALTIC PUMP ROTOR #08-04658-01
03254	CLEANING TOOL FOR CHLORIDE ELECTRODE
06-04655-01	ISE MODULE WITH ELECTRODES
07-04665-01	PREAMPLIFIER MODULE
08-04358-01	RESET SENSOR
08-04574-01	ISE DILUTER PINCH-VALVE ASSY (NC)
08-04656-01	ISE 2-WAY PINCH-VALVE ASSY
08-04657-01	DILUTER PERISTALTIC PUMP
08-04658-01	ISE PUMP MOTOR
08-04659-01	ISE LAMP ASSY
08-04760-02	ISE PERISTALTIC PUMP TUBE #03011
08-04978-01	FLUID DISTRIBUTOR MANIFOLD
11-05046-01	ISE DILUTER PUMP KIT (EX 08-04568-01)
11-05135-01	ISE CONTROLLER BOARD KIT
12-04713-01	ISE INTERFACE CABLE
12-05045-01	EXTENSION CABLE FOR ISE DILUTER
15-04408-02	MOTORS DRIVER BOARD #ISE
15-04503-01	ISE INTERFACE BOARD
20-04483-01	ISE FUNNEL
20-04484-01	PLATE FOR REAGENT BOTTLE
30-04763-01	ISE FILTER ASSY
330.5703	O-RING FOR DILUTER
330.9072	CARTRIDGE FOR DILUTER PERISTALTIC PUMP #08-04657-01
662.0705	ISE GROUND ELECTRODE
662.0710	REFERENCE ELECTRODE
662.0711	SODIUM (Na) ELECTRODE
662.0712	POTASSIUM (K) ELECTRODE
662.0713	CHLORIDE (Cl) ELECTRODE
662.0716	CO_2 ELECTRODE
662.1024	ISE DISCHARGE ASSY

15-6. COMPUTER BOX

PART NO.	DESCRIPTION
06-04379-02	COMPUTER MODULE
07-04487-01	MAINBOARD IBM PENTIUM WITH RAM, PROCESSOR AND FAN
08-04594-01	IBM COOLING FAN
08-04738-02	LCD DISPLAY MODULE COMPLETE WITH TOUCH SCREEN
11-05030-01	POWER SUPPLY 300W WITH BRACKET for Pentium IV board only
12-04584-01	IBM SUPPLY CABLE
12-04593-01	ON/OFF PUSHBUTTON ASSY
12-04740-01	POWER SUPPLY CABLE #TOUCH SCREEN
12-04741-01	CABLE FOR TOUCH SCREEN
12-04877-01	EXTENSION CABLE FOR TOUCH SCREEN
330.2144	HARD DISK DRIVE
330.2150	FLOPPY DISK DRIVE 3.5" 1.44 MB
330.2153	DVD/CD-ROM PLAYER
330.2167B	FLAT CABLE 40-40-40 (for connecting DVD/CD ROM Player and Hard Disk to Mother Board)
330.7172	IBM POWER SUPPLY FORTRON 200W for Pentium III board only (old)
330.7173	POWER SUPPLY FORTRON 300W for Pentium IV board only
330.7235A	CPU COOLING FAN for Pentium III board only (old)
330.7260	DIMM 128 Mb (RAM) for Pentium III board only (old)
330.7281	DDR 256 Mb (RAM) for Pentium IV board only
330.9390	TOUCH SCREEN
330.9390A	CONTROLLER FOR TOUCH SCREEN
330.9391	LCD DISPLAY 12.1"
330.9391A	INVERTER FOR LCD DISPLAY
330.9391B	CABLE FOR LCD INVERTER

15-7. CONSUMABLES

PART NO.	DESCRIPTION
392	SURFACTANT WASH CONCENTRATE 2X50 ml
393	CUVETTE WASHING SOLUTION 1 LITER
943	ISE LOW CALIBRATOR 2 x 20 ml
944	ISE HIGH CALIBRATOR 2 x 20 ml
947	ISE STARTER KIT - 600 TESTS: Buffer Conc., Reference Conc., Washing Solution, Enzymatic Solution, ISE Calibrator Low, ISE Calibrator High
03254	CLEANING TOOL FOR CHLORIDE ELECTRODE
11-05209-01	PERISTALTIC PUMP CARTRIDGE (ex 330.9072)
11-05219-01	SIX-MONTHLY MAINTENANCE KIT (TUBING & ACCESSORIES) **(For analyzer with new Vacuum Pump System P/N 06-05161-01/02/03)**
11-05220-01	ANNUAL MAINTENANCE KIT (TUBING & ACCESSORIES) **(For analyzer with new Vacuum Pump System P/N 06-05161-01/02/03)**
330.5703	O-RING FOR DILUTER
330.5810	ELBOW FITTING 2.38mm (READING STATION)
330.5811	ELBOW FITTING 3.2mm (READING STATION)
330.5820	STRAIGHT FITTING 2.24mm (READING STATION)
330.5823	ELBOW FITTING 1.58mm (READING STATION)
330.9321	HALOGEN LAMP 12V/35W FOR PHOTOMETER
330.9614	TUBULAR FILTER FOR H_2O TUBE
330.9615	H_2O FILTER FOR WATER PUMP (REAR OF READING STATION)
662.1002	SIX-MONTHLY MAINTENANCE KIT (TUBING & ACCESSORIES) **(For analyzer with Vacuum Pump System - "OBSOLETE" P/N 662.0788/C/D/E/F)**
662.1009	ANNUAL MAINTENANCE KIT (TUBING & ACCESSORIES) **(For analyzer with Vacuum Pump System - "OBSOLETE" P/N 662.0788/C/D/E/F)**
662.1010	WASTE CONTAINER (10 LITERS CUBITAINER)
662.1011	SAMPLING NEEDLE
662.1016	BIMONTHLY MAINTENANCE KIT (ISE TUBING)
667.1040	SERUM CAPSULE 2 ml
667.1072	REAGENT CONTAINER 80 ml
667.1073	REAGENT CONTAINER 50 ml
667.1074	REAGENT BOTTLE 20 ml
667.1076	REAGENT BOTTLE 10 ml
667.1080	50 ml BOTTLE WITH SCREW CAP

15-8. ELECTRONICS HARDWARE

PART NO.	DESCRIPTION
08-04546-01	LAMP FAN ASSY
08-04747-01	FLUID DISTRIBUTION MANIFOLD (REAR PANEL)
12-04712-01	I2CBUS CABLE
15-04431-01	PERIPHERAL INHIBITION BOARD
15-04661-01	POWER SUPPLY INTERFACE BOARD
330.2057	CORDLESS KEYBOARD/MOUSE KIT
330.2132	UPS 1100 VA
330.2165	PRINTER CABLE
330.2172	PRINTER FOR BT 3000 PLUS
330.6338	FUSE 250 VOLT, 0.5 AT
330.6340	FUSE 250 VOLT, 2AT
330.6342B	FUSE 250 VOLT, 8AT
330.6391	POWER CORD
330.6400	POWER CORD FOR PERIPHERAL DEVICES
330.6450	POWER ENTRY MODULE WITH SWITCH
330.7171	LAMBDA POWER SUPPLY (400W)
330.7220A	MAGNET FOR HALL SENSOR
330.7235A	CPU COOLING FAN
330.9321	TUNGSTEN HALOGEN LAMP 12V, 35 WATTS, 9°

15-9. VACUUM PUMP SYSTEM SPARE PARTS

(REFER TO SECTION XII FOR PRODUCT ILLUSTRATIONS))

VACUUM PUMP SYSTEM P/N 06-05161-01/02/03	
PART NO.	**DESCRIPTION**
06-05161-01	VACUUM PUMP SYSTEM (COMPLETE) FOR BT3000 PLUS
07-05165-01	WASTE PROBE
08-05162-01	VACUUM PUMP ASSY
15-05085-01	VACUUM PUMP SYSTEM CONTROLLER BOARD
20-05145-01	INTERNAL WASTE CHAMBER (TRANSPARENT GLASS)
330.6312	POWER ENTRY MODULE
330.6338	FUSE 250 VOLT, 0.5 AT
330.6400	MAIN POWER SUPPLY CORDSET
330.7175	POWER SUPPLY
330.9099	3-WAY SOLENOID VALVE

VACUUM PUMP SYSTEM P/N 662.0788/C/D/E/F (OBSOLETE)	
PART NO.	**DESCRIPTION**
08-04716-01	H_2O TUBE WITH FILTER
08-04734-01	BLUE TUBE FOR WASTE
08-04735-01	BLACK TUBE FOR WASTE
15-04541-02	VAC.PUMP SYSTEM CONTROLLER BOARD
330.6312	POWER ENTRY MODULE WITH FUSES
330.6340	FUSE 250 VOLT, 2 AT (230 VAC VACUUM PUMP SYSTEM)
330.6342	FUSE 250 VOLT, 4 AT (115 VAC VACUUM PUMP SYSTEM)
330.6400	MAINS POWER SUPPLY CORDSET
330.7175	POWER SUPPLY
330.9088	CARTRIDGE # PERISTALTIC PUMP
330.9614	TUBULAR FILTER FOR H_2O TUBE
330.9622	COUPLING BODY WITH SHUTOFF VALVE - FRONT PANEL
330.9623	ELBOW FITTING FOR PERISTALTIC PUMP CARTRIDGE
330.9624	COUPLING BODY STRAIGHT THROUGH FRONT PANEL
330.9625	SINTERED BRONZE SILENCER
330.9649	COUPLING INSERT FOR WASTE PROBE - FRONT PANEL
330.9659B	VACUUM REGULATOR
662.0777B	VACUUM PUMP 115 VAC WITH FITTINGS
662.0777C	VACUUM PUMP 230 VAC WITH FITTINGS
662.0788	VACUUM PUMP SYSTEM (WITH 2 WASTE PROBES– 230 VAC)
662.0788A	WASTE PROBE-1
662.0788B	WASTE PROBE-2
662.0788E	VACUUM PUMP SYSTEM (WITH 2 WASTE PROBES– 110 VAC)
662.0806	"RESTART" PUSH BUTTON (NOT WIRED)
662.0807	HYDROPHOBIC FILTER ASSEMBLY
662.0808	PERISTALTIC PUMP - LEFT
662.0808A	PERISTALTIC PUMP - RIGHT
662.0810	VACUUM GAUGE ASSY
662.0831	CABLE FOR POWER SUPPLY/BOARD 15-04541-02
662.0831A	CABLE FOR POWER SUPPLIES
662.0831C	FEMALE FISCHER CONNECTOR KIT
662.0831D	"RESTART" PUSH BUTTON KIT
662.0831E	GROUNDING CABLE FOR VAC PUMP
662.0831F	GROUNDING CABLE FOR POWER INLET
662.0831G	GROUNDING CABLE FOR POWER SUPPLY
662.0831H	GROUNDING CABLE FOR PUMP COVER
662.0832	THE INTERNAL WASTE CHAMBER-LEFT
662.0832A	THE INTERNAL WASTE CHAMBER-RIGHT

(Schematics on the Last Pages of this Manual)

15-10. ORDERING INFORMATION

Please contact Biotecnica Instruments S.p.A. for any configuration or special requirement not covered in this manual. For technical or ordering assistance start with our convenient ordering check list located in the above paragraph. For further assistance, don't hesitate to call the Biotecnica Instruments S.p.A. or your local sales/representative office.
To obtain accessories/spare parts, address order or enquiry to your Biotecnica Instruments S.p.A. sales/service representative or to Biotecnica Instruments S.p.A. and supply the following Informations:

a) Instrument Model and Serial Number
b) Quantity of parts desired
c) Part Number
d) Description

Biotecnica Instruments S.p.A.
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NOTE:
DUE TO IMPROVEMENTS IN DESIGN AND/OR SPECIFICATIONS, SOME PRODUCTS MAY DIFFER SLIGHTLY FROM THE PREVIOUS DESCRIPTION.

IMPORTANT NOTICE:

THE BIOTECNICA INSTRUMENTS S.p.A. RESERVES THE RIGHT TO MAKE CHANGES IN DESIGN AND SPECIFICATIONS WITHOUT NOTICE. EVERY EFFORT HAS BEEN MADE TO PROVIDE ACCURATE TECHNICAL AND PRODUCT INFORMATION. THE BIOTECNICA INSTRUMENTS S.p.A. DISCLAIMS RESPONSIBILITY FOR ANY ERROR OR OMISSION REGARDING TECHNICAL AND PRODUCT INFORMATION PRESENTED IN THIS SERVICE MANUAL.