M-TRACE ECG APPLIANCE

Service Manual and Repair Guide

EDITION 1.02

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Revisions:
Pre-release edition

General information
Precautions, Technical Specification, Tools and Parts

To keep the maintenance and repair process correct and faultless it is essential to meet the information enclosed in this manual and follow them during everything you do with the ECG appliance, before any action or activity is taken.

Precautions and Safety

Familiarizing with the safety basics is the most vital to avoid any disturbing and unexpected cases during service maintenance process of the ECG appliance. It also has a purpose to keep the technical personnel away from any danger and unnecessary complications.

To make it easy, read and follow the information below:

- First of all, one is to ensure that work stand is clean, well ventilated, and lamp-lit properly.
- All the operations should be performed by personnel, skilled at electronics and electricity basics, equipped with necessary tools.
- Before performing any maintenance, servicing or repairing actions personnel should be trained in by manufacturer according to the servicing duties regarding the M-TRACE appliance.
- Hygiene precautions are vital. Handling the product, keep your hands and working surfaces clean of any dirt, dust, debris and hand oil.
- Before removing the external cover, disassembling or making any mechanical maintenance – disconnect the appliance from external power source by turning off the main switch on the back of it located just by the power socket and unplugging main power cord from it. If any specific operation requires the appliance to be connected to mains please **DO FOLLOW STRICTLY THE INSTRUCTIONS INCLUDED IN THE RELAYING PARAGRAPH OF THIS MANUAL**.

To get any necessary, and not included in this publication user's maintenance instructions, please refer to most-up-to-date user's manual. To get the latest information contact the manufacturer as well.

Tools

M-TRACE is characterized by simple, modular construction, however upon maintaining any service process some certain tools might be found helpful.

Here's the list with tools which might be required to perform any maintenance described in this manual:

 PH1 (Phillips type) magnetic-tip screwdriver	 Square-tip screwdriver
 Pliers	 Tweezers
 Pen-drive	 Multimeter

Technical specification
Appliance description

M-TRACE electrocardiograph is a sophisticated and modern electronic device. It is dedicated to record ECG impulses in full range of 12 standard channels. Printout is made on thermal paper. The device is equipped with high resolution linear thermal printing unit and color LCD. The built-in battery allows to use it quickly wherever it is necessary. Aesthetic plastic cover together with membrane keyboard makes the device easy to keep clean.

Specification

Dimensions (W x H x D)	60 W x 52 H x 220 D mm
Weight	<1,5 kg
Power supply	AC 90-240 V @50-60 Hz
Built-in battery	Li-ion 7,2 V 2,2 Ah Can be replaced only by qualified servicing personnel
Power consumption	<35 VA
ECG leads	12 Standard ECG leads: • Einthoven's limb leads I, II, III • Goldberger's limb leads aVR, aVL, aVF • Wilson's precordial leads V1, V2, V3, V4, V5, V6
Sensitivity	2,5/5/10/20 mm/mV 5%
Recording speed	5/10/25/50 mm/s 5%
Common Mode Rejection Ratio	>100 dB
Frequency band	0,05-150 Hz
Input impedance	>10 MΩ
Control range	>300 mVpp 10 mVpp
Resolution	2,5 µV
Sampling frequency	1000 Hz
Digital filters	50Hz, 60Hz, 35Hz, 25Hz, anti-drift
LCD screen	Color graphic display, 320x240
Safety	Protection Type CF (EN60601-1) Class I Protector Class II (EN60601-1)
Class / Group	Class A / Group 1 (CISPR-11)
Operating environment	Temperature: +10 to +40˚C (+50 to +104˚F)
Conditions	Relative Humidity: 25 to 95% (non-condensing)

M-TRACE unit top view

M-TRACE unit's structure

Both external (power grid) and internal (built-in battery) sources are used to power the appliance. Battery charger is integrated with the mainboard. It is vital to notice the right internal battery type during its replacing. Using any but the right one can cause bad damage done by explosion being natural behaviour for Li-ion type cells that are wrongly matched or not properly installed. Li-ion type batteries are highly fragile to overcharging so be sure the required parameters of the mounted one are strictly met. The built-in power supply unit delivers DC 9 V to its output connector. It is wired to mainboard where the proper elements produce all the other voltage levels required by the M-TRACE to be fully operational.

There are four following major voltage converters responsible for the above:

Voltage level	**Powered sections**
DC 3,3 V	Most of the digital elements
DC 5 V	• Printing thermal head • USB controller
DV 1,5 V	FPGA on-board programmable logic
DC 10,4 V	LCD backlit
Directly from power supply unit output or from internal battery	• Thermal printer's motor drive • Analog amplifier's board

ECG signals, collected from patient, after being amplified by amplifiers and AD converted on analog board, are passed using SPI opto-isolated (which is eligible and essential to separate patient from the device's circuits) transmission to mainboard.
Mainboard's duties are to keep all the internal modules communication running properly, analyse and show all the computed data and interact with the user and patient.
None of the components requires any adjustments or tuning. All of them are ready instantly to serve as properly assembled and powered.

Parts list

No.	Part	Symbol
1.	Power supply unit	MBU30-104
2.	Analog amplifiers module	X300-20-xx
3.	Mainboard	X300-10-xx
4.	Thermal printer	LTPV-445
5.	Battery	CGR18650CF-2S1P-PCB 7,2 V 2,2 Ah
6.	LCD screen	AM-320240N1TMQW-30H
7.	Keyboard	
8.	Power socket	
9.	Casing	

Power supply unit MBU30-104

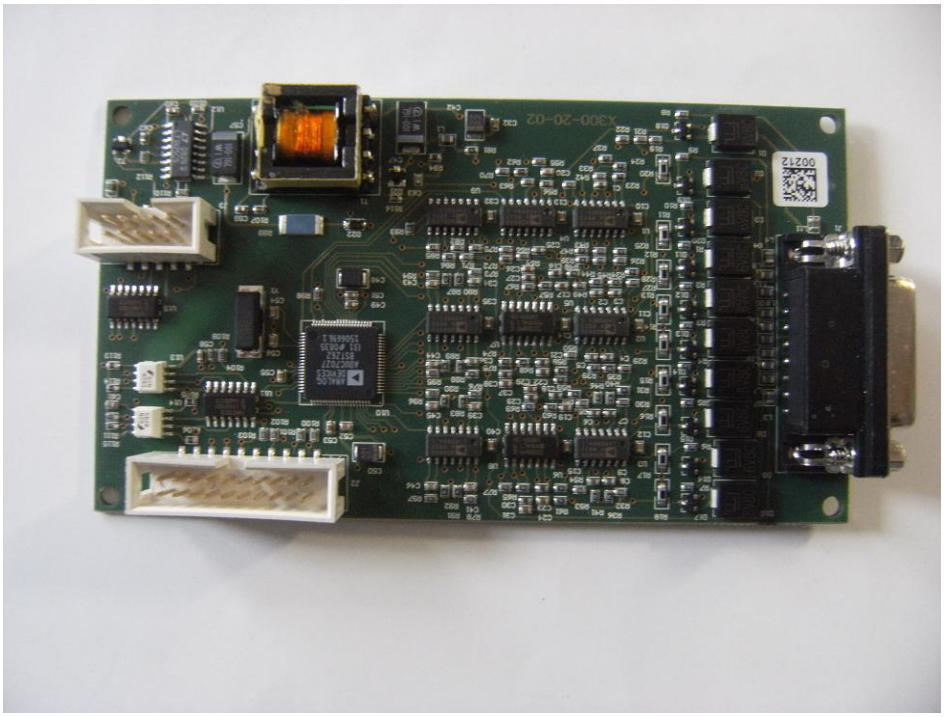
P1 connector: AC 90-240 V input

Pin	Symbol	Description
1	L	Power line L (live)
2	N	Power line N (neutral)

P2 connector: DC 9 V output

Pin	Symbol	Description
1	+9 V	+U power supply
2	+9 V	+U power supply
3	+9 V	+U power supply
4	GND	
5	GND	
6	GND	

Analog amplifiers module - X300-20-xx



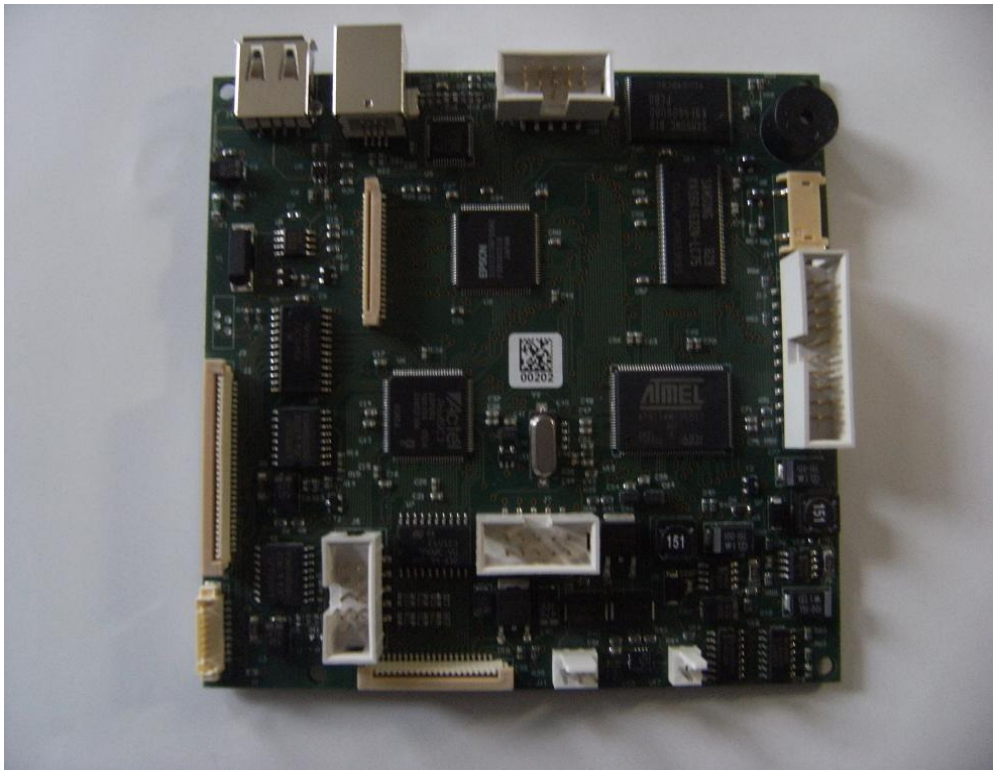
J1 DA15 type connector – patient's ECG signal cable

Pin	Symbol	Description
1	V2	Precordial V2 lead
2	V3	Precordial V3 lead
3	V4	Precordial V4 lead
4	V5	Precordial V5 lead
5	V6	Precordial V6 lead
6	GND	Ground
7		
8		
9	R	Right upper limb (arm) lead
10	L	Left upper limb (arm) lead
11	F	Left lower limb (leg) lead
12	V1	Precordial V1 lead
13		
14	N	Right lower limb (leg) lead
15		

J2 Molex type connector – processor programming lines
J3 Molex type connector – wiring with X300-10-xx mainboard

Pin	Symbol	Description
1	SCLK	Clock output
2	GND	Ground
3	MOSI	Data output
4	GND	Ground
5	MISO	Data input
6	ENABLE	Data transmission enabling signal
7	POWEROFF	Analog module on/off switching line
8	3V3	Opto-isolators power supply
9	GND	Ground
10	+U power supply	Voltage converter power supply

Mainboard – X300-10-xx



J1 connector Thermal printer's unit motor drive control line
J2 connector Thermal printer's unit heating head's control line
J3 connector Not connected – for future use
J4 connector USB host – External PCL5/6 printer output
J5 connector FPGA circuit programming lines
J6 connector USB slave – M-TRACE-PC data transmission
J7 connector Keyboard
J8 connector LCD data signal
J9 connector wiring with analog amplifiers module X300-20-xx (J3)
J10 connector USB host programming lines
J11 connector Internal battery socket

Pin	Symbol	Description
1	TERM	Thermistor protector
2	GND	Ground
3	+U battery	Battery power supply +7,2 V

J12 connector Power supply unit socket

Pin	Symbol	Description
1	L	Power line L (live)
2	N	Power line N (neutral)

J13 connector ARM CPU programming lines
J14 connector LCD backlit power supply line

Electrocardiograph appliance meets all the required following standards:

- EN 60601-1,
- EN 60601-2-25,
- EN 60061-2-51.

DO NOT test an insulation resistance with B-d (EN 60601-1) procedures – it can cause appliance damage. To perform insulation resistance, tests should be checked as follows:

- External power supply SIP/SOP section with AC 4000 V charge – 60 seconds duration,
- Application circuits SIP/SOP section with AC 2500 V charge – 60 seconds duration.

Analog amplifiers frequency band check should be performed with isoline filters turned off (refer to user's manual).

TROUBLESHOOTING

For usage

Lack of paper	ECG paper is out. Put new roll of paper. Follow the instruction 'Paper loading' in this manual.
Paper cover	The paper cover is not closed properly, Open the cover and close it again properly.
LED diode on the keyboard doesn't light	The accumulator is not charging. 1. Check switch on/off button (1/0) at the back side of the unit. It should be switchd on in the position '1'. 2. Check if there is voltage in the power sypply socket.

For service

Lack of ECG recording	• Check the patient cable • Check PC board X300-20-xx
LCD disturbances	• Check PC board X300-10-xx
The unit doesn't work as described in the manual	• Check PC board X300-10-xx
The unit doesn't charge	• Check PC board MBU-104
The unit doesn't print on the printer – printer breaks the printouts	• Check ECG paper • Check PC board X300-10-xx • Check printer LTPV-445