AT-1 3-Channel ECG Unit

Service Handbook

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AT-1 Service Handbook

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Issue 1: July 1995

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Associated Documents

Guide to SCHILLER Interpretation and Measurement Program E / D / F	Article No.	2. 510 179
SCHILLER AT-1 USER GUIDE - English / German / French	Article No.	2. 510 171
SCHILLER AT-1 USER GUIDE - Italian / Spanish / Portuguese	Article No.	2. 510 172
SCHILLER AT-1 USER GUIDE - Swedish	Article No.	2. 510 322

CE 0124 93/42/EEC Medical Devices: 0124
'Notified Body' DEKRA AG

DECLARATION OF CONFORMITY

Diagnostic System :	**Cardiovit AT-1**
Serial numbers starting with:	190.
Year of manufacture:	1995 Onwards

We, the undersigned, hereby declare that the medical device (class IIa) specified above conforms with the essential requirement listed in Annex 1 of EC Directive 93/42/EEC.

This declaration is supported by:

Certificate of approval No.:

11425-02	ISO 9001 / EN 46001 by SQS valid date 17.01.2001
45112-60-01	ISO 9001/07.94, EN 46001 / 08.96 by DEKRA valid date 30.04.2003 - and -
45112-16-01	Annex II, Section 3 of the directive 93/42/EEC valid date 30.04.2003

CE 0124

Baar (Switzerland) Dated 06.05.1998

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Where to Obtain Service

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Warranty

Disclaimer

The Information in this guide has been carefully checked for reliability; however no guarantee is given as to the correctness of the contents and SCHILLER makes no representations or warranties regarding the contents of this manual. We reserve the right to revise this document and make changes in the specification of the product described within at any time without obligation to notify any person of such revision or change.

Trademarks

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Copyright Notice

Terms of Warranty

The SCHILLER AT-1 is warranted against defects in material and manufacture for the duration of one year (as from date of purchase). Excluded from this guarantee is damage caused by an accident or as a result of improper handling. The warranty entitles free replacement of the defective part. Any liability for subsequent damage is excluded. The warranty is void if unauthorized or unqualified persons attempt to make repairs.

In case of a defect, send the apparatus to your dealer or directly to the manufacturer.

The manufacturer can only be held responsible for the safety, reliability, and performance of the apparatus if:

° assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by him, and

° the unit and approved attached equipment is used in accordance with the manufacturers instructions.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES WHICH EXTEND BEYOND THE WARRANTIES HEREINABOVE SET FORTH. SCHILLER MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE PRODUCT OR PARTS THEREOF.

Safety Notices

TO PREVENT ELECTRIC SHOCK DO NOT DISASSEMBLE THE UNIT. NO SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL ONLY.

DO NOT USE THIS UNIT IN AREAS WHERE THERE IS ANY DANGER OF EXPLOSION OR THE PRESENCE OF FLAMMABLE GASES SUCH AS ANAESTHETIC AGENTS.

THIS PRODUCT IS NOT DESIGNED FOR STERILE USE.

SWITCH THE UNIT OFF BEFORE CLEANING AND DISCONNECT FROM THE MAINS.

DO NOT, UNDER ANY CIRCUMSTANCES, IMMERSE THE UNIT OR CABLE ASSEMBLIES IN LIQUID.

DO NOT OPERATE THE UNIT IF THE EARTH CONNECTION IS SUSPECT OR IF THE MAINS LEAD IS DAMAGED OR SUSPECTED OF BEING DAMAGED.

DO NOT USE HIGH TEMPERATURE STERILISATION PROCESSES (SUCH AS AUTOCLAVING). DO NOT USE E-BEAM OR GAMMA RADIATION STERILISATION.

DO NOT USE SOLVENT CLEANERS

USE ONLY ACCESSORIES AND OTHER PARTS RECOMMENDED OR SUPPLIED BY SCHILLER AG. USE OF OTHER THAN RECOMMENDED OR SUPPLIED PARTS MAY RESULT IN INJURY INACCURATE INFORMATION AND/ OR DAMAGE TO THE UNIT.

THE AT-1 COMPLIES WITH EMC REGULATIONS FOR MEDICAL PRODUCTS WHICH AFFORDS PROTECTION AGAINST EMISSIONS AND ELECTRICAL INTERFERENCE. HOWEVER SPECIAL CARE MUST BE EXERCISED WHEN THE AT-1 IS USED WITH HIGH FREQUENCY EQUIPMENT.

IT MUST BE ENSURED THAT NEITHER THE PATIENT NOR THE ELECTRODES (INCLUDING THE NEUTRAL ELECTRODE) COME INTO CONTACT WITH OTHER PERSONS OR CONDUCTING OBJECTS (EVEN IF THESE ARE EARTHED).

THERE IS NO DANGER WHEN USING THE ECG UNIT FOR A PACEMAKER PATIENT OR WITH SIMULTANEOUS USE OF OTHER ELECTRICAL STIMULATION EQUIPMENT. HOWEVER, THE STIMULATION UNITS SHOULD ONLY BE USED AT A SUFFICIENT DISTANCE FROM THE ELECTRODES. IN CASE OF DOUBT, THE PATIENT SHOULD BE DISCONNECTED FROM THE RECORDER.

THIS UNIT IS CF CLASSIFIED ACCORDING TO IEC 601-1. THIS MEANS THAT THE PATIENT CONNECTION IS FULLY ISOLATED AND DEFIBRILLATION PROTECTED. SCHILLER CAN ONLY GUARANTEE PROTECTION AGAINST DEFIBRILLATION VOLTAGE, HOWEVER, WHEN THE ORIGINAL SCHILLER PATIENT CABLE IS USED.

Safety Notices

BEFORE USING THE UNIT, ENSURE THAT AN INTRODUCTION REGARDING THE UNIT FUNCTIONS AND THE SAFETY PRECAUTIONS HAS BEEN PROVIDED BY A SCHILLER REPRESENTATIVE.

THE GUIDELINES FOR PATIENT ELECTRODE PLACEMENT ARE PROVIDED AS ON OVERVIEW ONLY. THEY ARE NOT A SUBSTITUTE FOR MEDICAL EXPERTISE.

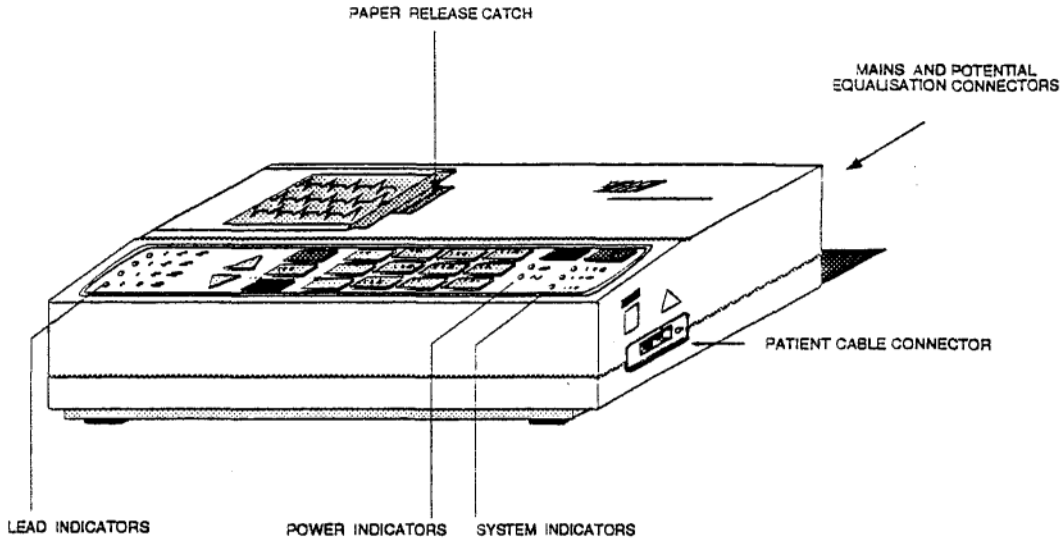
THE AT-1 ECG UNIT IS PROVIDED FOR THE EXCLUSIVE USE OF QUALIFIED PHYSICIANS OR PERSONNEL UNDER THEIR DIRECT SUPERVISION. THE NUMERICAL AND GRAPHICAL RESULTS AND ANY INTERPRETATION DERIVED FROM A RECORDING MUST BE EXAMINED WITH RESPECT TO THE PATIENTS OVERALL CLINICAL CONDITION. THE RECORDING PREPARATION QUALITY AND THE GENERAL RECORDED DATA QUALITY, WHICH COULD EFFECT THE REPORT DATA ACCURACY, MUST ALSO BE TAKEN INTO ACCOUNT.

IT IS THE PHYSICIANS RESPONSIBILITY TO MAKE THE DIAGNOSIS OR TO OBTAIN EXPERT OPINION ON THE RESULTS, AND TO INSTITUTE CORRECT TREATMENT IF INDICATED.

Chapter 1
Operating Elements

Contents

Introduction



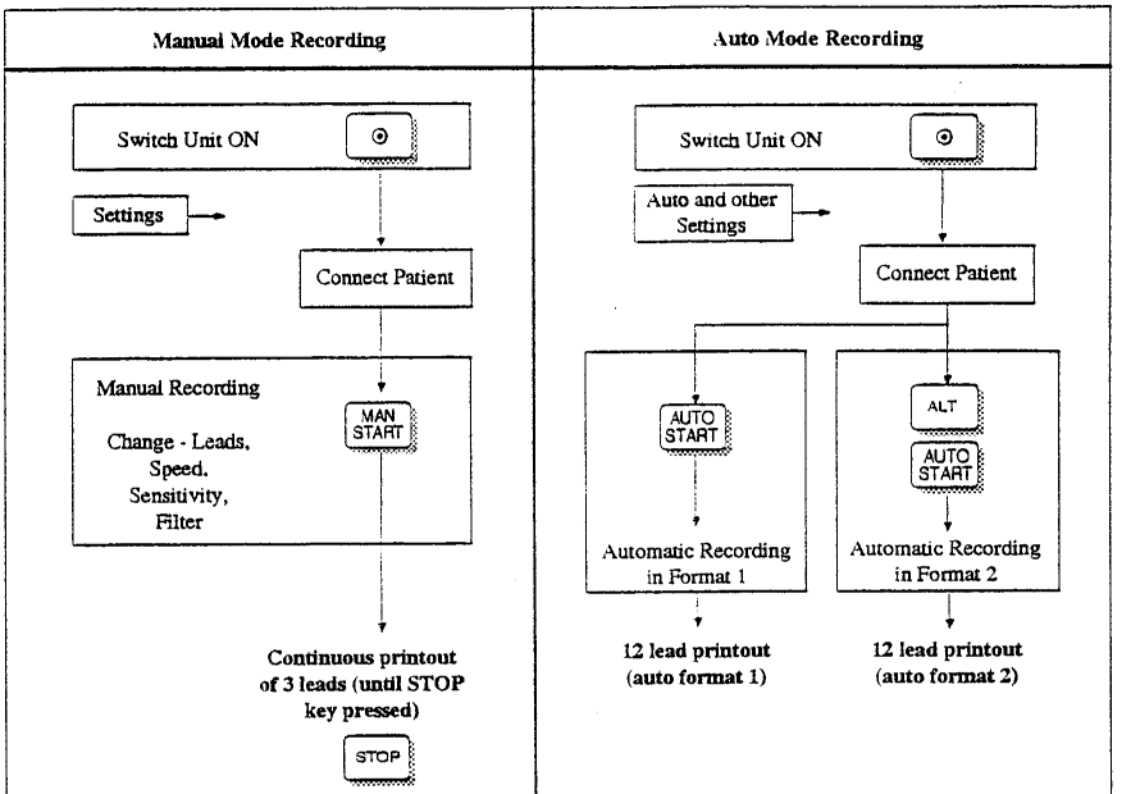
The CARDIOVIT AT-1 is a 3-channel portable ECG recorder with built-in rechargeable battery. The keyboard provides one touch operation of all major functions with LEDs and an audible beeper giving visual and audible indications of settings and alarms. Two methods of recording ECGs are provided by the AT-1:

Manual Mode:	any three leads selected by the user can be printed continuously in real time . The leads selection can be changed at will during and before printout.
Auto Mode	a printout is obtained of all 12 leads in a predefined format specified by the user.

The battery gives up to 8 hours of mains-independent use. An optional measurement program gives detailed measurements of the ECG recording for accurate analysis of results.

Operating Modes

Two basic modes of operation are used with the AT-1:



Manual Mode

Manual Mode provides a real time printout of 3 leads that are selected and indicated on the keyboard.
The following can be freely selected before or during recording:

- Lead Group
- Chart Speed
- Sensitivity
- Myogram Filter

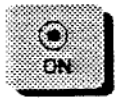
Automatic Mode

Automatic Mode provides a printout giving 10 seconds of ECG recording of all 12 leads.
The following can be programmed freely before recording:

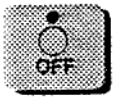
- Lead Format
- Chart Speed
- Sensitivity
- Measurements
- Average Cycles

Full details of all operating modes and settings are provided in the AT-1 User Guide.

Function Keys



Switch unit on



Switch unit off

Printout stored ECG

Start automatic recording

Start manual recording

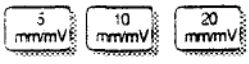
Stop recording

Switch myogram filter (muscle tremor) on or off

Lead group selector

Cancel or enable QRS beeper

Automatic ECG sensitivity adjustment **in automatic mode only**



ECG sensitivity selector (5, 10 or 20 mm/mV) **for manual and automatic recording**

Chart speed selector (5, 25 or 50 mm/s) **for manual recording only**

Key for 1 mV indication mark on output during manual recording

Key for initiation of setups and selection of second format for Auto printout

Indicators

○ ~	Mains indicator (*lit when mains connected*)
○ 🔋	Battery lamp (lit when running on battery power - mains not connected)
○ PAPER	Warning lamp for end of paper or paper jam
○ LEAD OFF	Warning lamp for loose electrode connection
○ FILT	Myogram filter (lit when filter ON)
○ I II III (aVL I -aVR)	Indicator lamp for selected lead group I, II, III (Cabrera: aVL, I, -aVR)
○ aVR aVL aVF (II aVF III)	Indicator lamp for selected lead group aVR, aVL, aVF (Cabrera: II, aVF, III)
○ V1 V2 V3	Indicator lamp for selected lead group V1, V2, V3
○ V4 V5 V6	Indicator lamp for selected lead group V4, V5, V6

When the lead group aVR, aVL, aVF is selected, no lead-off alarm beep is sounded, only the LEAD OFF indicator is lit.

A special lead group (V1, II and V5) can be selected for manual mode by pressing

ALT -  (downwards lead selector)

When this combination is selected, both indicator lamps V1-V3 and V4-V6 are lit.

Note: The lead indicator lamps show the lead group f**or manual mode only.** In auto mode all 12 leads are printed as defined in the auto mode format.

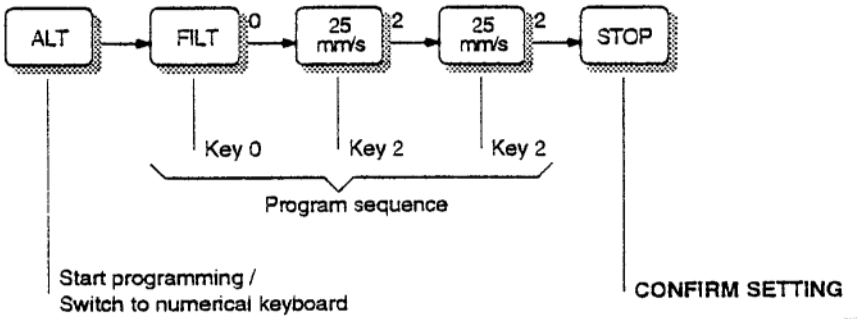
Settings

Each of the programmable parameters is set by means of a code. This code comprises a number for the required format, a section number and one or more parameter numbers. This combined code number then selects a specific parameter setting.

As soon as the **ALT** key is pressed, the keyboard is dedicated to the programming function.

The setting is remembered and the keyboard is only released for other functions when the **STOP** key is pressed. Once the settings have been confirmed, they are stored in the memory even when the unit is switched off.

As an example, if you want to set the language on your AT-1 to English, proceed as follows:



On the following pages the programmable parameters and the programming sequences are given.

Settings

Language

Select Language				
Entry Key Sequence				*Language*
ALT	0	2	1	German
			2	English
			3	French
			4	Swedish
			5	American
			6	Italian
			7	Spanish
			8	Portuguese
			9	Dutch *
			0	Russian **

Confirm the selection by pressing STOP.

* from software version 1.7. Please note that the Setup Printout (ALT-0-1-1) will appear in English.

** from software version 1.9

Settings

Filters

There are three different filters which can be set individually as follows:

- Baseline filter
- Mains filter
- Myogram filter

Baseline Filter			
Entry Key Sequence			*Filter Setting*
ALT	5	0	0.05 Hz (Default)
		1	0.15 Hz
		3	0.30 Hz

Mains Filter			
Entry Key Sequence			*Filter Setting*
ALT	8	5	Mains Filter 50 Hz
		6	Mains Filter 60 Hz
		9	Mains Filter off

Myogram Filter			
Entry Key Sequence			*Filter Setting*
ALT	8	2	Myogram Filt. 25 Hz
		3	Myogram Filt. 35 Hz

Baseline

The set value is the lower limit of the frequency range and is normally set to 0.05 Hz. The settings 0.15 and 0.30 Hz should only be used when absolutely necessary, as the possibility exists that they could affect the original ECG signal, especially the ST segments.

Mains Filter

The **Mains filter** is an adaptive digital interference filter designed to suppress AC interference without attenuating or distorting the ECG.

Myogram Filter

The **Myogram filter** suppresses disturbances caused by strong muscle tremor. The set value will be the new upper limit of the frequency range as soon as the **FILT** key is switched on.

The recorded ECG is stored unfiltered, which means that the myogram filter has no effect on the averages.

As the unfiltered ECG is stored in Automatic mode, it is therefore possible to print the stored ECG either with or without passing the myogram filter. Filter ON is indicated by the control lamp marked **'FILT'**. When the **FILT** key is pressed again, the filter is switched off and the indicator lamp goes out. The cutoff frequency of the myogram filter is set to either 25 or 35 Hz.

Confirm all selections by pressing the STOP key.

Settings

Lead Sequence

Printout

Paper

Sequences, Print & Paper			
Entry Key Sequence			*Definition*
ALT	7	1	Standard Lead Sequence
		2	Cabrera Lead Sequence
		3	Simultaneous Print
		4	Sequential Print
		5	Auto-Centering ON
		6	Auto-Centering OFF
		7	Z-Fold Paper
		8	Paper Roll

Confirm the selection by pressing STOP.

Simultaneous All 12 ECG leads are printed as 4 groups of 3 leads. All ECG leads are printed in the same time segment (**in automatic mode only**).

Sequential All 12 ECG leads are printed as 4 groups of 3 leads. Each group is a contiguous time segment of approximately 2.5 seconds (**in automatic mode only**).

Auto-Centering ON All ECG traces are centred dynamically for optimal use of paper width.

Auto-Centering OFF ECG traces are set to the baseline and may possibly overlap.

Z-folded Z-folded paper, 90 mm wide, 20 m long

Roll Paper roll, 90 mm wide

Standard / Cabrera Lead sequence

Some physicians are used to study the electrode signals in a different order (sequence) called the Cabrera Lead sequence. The standard and Cabrera lead groups for the AT-1 are:

Lead Groups							
Standard				*Cabrera*			
I	V1	II	V4	aVL	V1	II	V4
II	V2	aVF	V5	I	V2	aVF	V5
III	V3	III	V6	-aVR	V3	III	V6
aVR	V4	V2	V7	II	V4	V2	V7
aVL	V5	V4	V8	aVF	V5	V4	V8
aVF	V6	V5	V9	III	V6	V5	V9

Settings for Automatic Mode

Two separate formats for the automatic ECG output can be selected (1 or 2 immediately after the ALT key)as follows:

Automatic ECG Format		
Entry Key Sequence		*Setup Format*
ALT	1	Setup Format 1
	2	Setup Format 2

ECG Format

ECG Format				
Entry Key Sequence				*Output Format*
ALT	1 or 2	1	5	No leads are printed
			6	Leads are printed in short form (3 sheets of 70 cm)
			7	Leads are printed in long form (6 sheets of 70 cm)
			8	Chart speed is 25 mm/s
			9	Chart speed is 50 mm/s

*Confirm the selection by pressing **STOP**.*

Average Cycles

Average Cycles (Measurement Option only)				
Entry Key Sequence				*Output Format*
ALT	1 or 2	2	5	No average cycles are printed.
			6	4 * 3 (25 mm/s) The average complexes are printed out in four groups of three leads at a chart speed of 25 mm/s.
			7	4 * 3 (50 mm/s) The average complexes are printed out in four groups of three leads at a chart speed of 50 mm/s.
			8	6 * 2 (50 mm/s) + 1 * Rhy The average complexes are printed out in six groups of two leads with one rhythm lead at a chart speed of 50 mm/s.
			9	1 * 12 (25 mm/s) + 2 * Rhy The average complexes are printed out for all 12 leads individually with two rhythm leads at a chart speed of 25 mm/s.

*Confirm the selection by pressing **STOP**.*

Note: Lead selection for the 2 rhythm leads are defined on the next page.

Settings for Automatic Mode

Measurements

Measurements and Markings (Measurement Option only)				
Entry Key Sequence				Output Format
ALT	1 or 2	3	5	Detailed table of measurement results is omitted (However, the values of electrical axes, intervals, and heart rate are not suppressed.).
			6	Detailed table of measurement results is printed.
				Reference markings (beginning and end of P wave and QRS as well as end of T wave) are omitted.
				Reference markings (beginning and end of P wave and QRS as well as end of T wave) are added to the ECG cycles.

Confirm the selection by pressing STOP.

Selecting Rhythm Leads

Rhythm Leads (Measurement Option only)		
Entry Key Sequence		Setup Lead
ALT	3	Setup Rhythm Lead 1
	4	Setup Rhythm Lead 2

Extremity Leads				
Entry Key Sequence				Lead
ALT	3 or 4	8	1	I
			2	II
			3	III
			4	aVR
			5	aVL
			6	aVF

Precordial Leads				
Entry Key Sequence				Lead
ALT	3 or 4	9	1	V1
			2	V2
			3	V3
			4	V4
			5	V5
			6	V6

Confirm the selection by pressing STOP.

Printout of all Settings

The defined formats and settings can be checked as follows:

ALT - 0 - 1 - any number

A printout of the defined settings will be produced and gives the following information, depending on the installed software:

- Unit designation (AT-1), software options installed (M=Measurement) and software version
- Serial number
- Leads: Standard (S) or Cabrera (C)
- ECG format: Long (ooo), Short (o) or Suppressed (-)
- Patient data form: Enabled (+) or Suppressed (-)
- MECG: Average cycles as defined in auto ECG recording setup (e.g. 4 * 3 (25 mm/s))
- Measurements: Enabled (+) or Suppressed (-)
- Marks: Enabled (+) or Suppressed (-)
- Selected rhythm leads: Leads selected for R1, R2 resp.
- Automatic centring: Enabled (+) or Suppressed (-)
- Paper type: Z-Folded or Roll
- Printout of signals: Sequential or Simultaneous
- Baseline filter: 0.05, 0.15, or 0.30 Hz
- Mains filter: 50Hz, 60Hz or OFF(-)
- Myogram filter: 25Hz or 35Hz, On (+) or Off (-)

Default Settings

The default settings are as follows:

Default Settings		
Setting	*AT-1 S*	*AT-1 M*
Language	English	English
Leads	Standard (S)	Standard (S)
Format 1	ECG: 25 mm/s, Short (o)	ECG: 25 mm/s Short (o)
		MECG: 2*6 (50 mm/s) +1
	Patient data form (+)	Measurements: Suppressed (-)
		Marks: Enabled (+)
Format 2	ECG: 25 mm/s, Long (000) Patient data form	ECG: 25 mm/s, Long (ooo)
		MECG: none (-)
	Patient data form (+)	Measurements: Suppressed (-)
		Marks: Enabled (+)
Rhythm Leads	-	V1, II
Autom. Centering	Enabled (+)	Enabled (+)
Paper Type	Z-folded	Z-folded
Printout of Signals	Sequential	Sequential
Baseline Filter Setting	0.05 Hz	0.05 Hz
Mains Filter Setting	50 Hz	50 Hz
Myogram Filter Setting	35 Hz OFF	35 Hz OFF

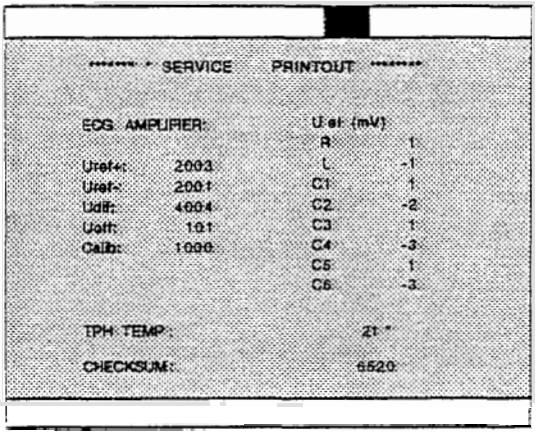
To reset the unit to the basic default settings, press

ALT - 0 - 6 - any number

Service Printout

The service printout provides information of the patient cable and electrodes and gives the value of certain reference voltages and important internal offset values. These values are for information only. To obtain the service printout press

ALT - 0 - 3 - 3



See also Chapter 5.

Installing Software Options

To upgrade the AT-1 from, for example standard to M version type the following:

ALT - 0 - 4 - followed by the upgrade code (obtainable from Schiller)

Acceptance of the code is indicated by a series of beeps.

CAUTION

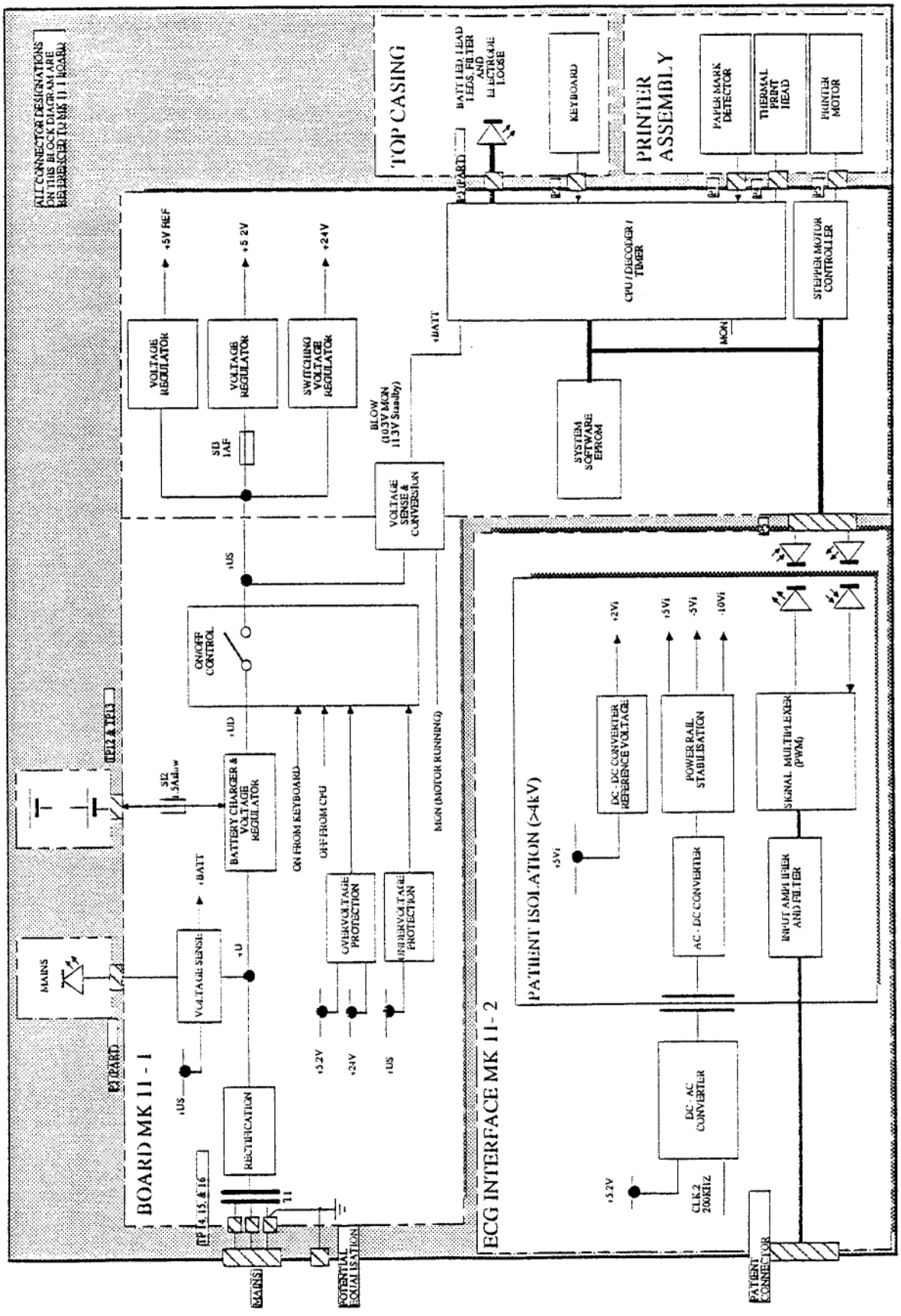
MORE THAN 10 ATTEMPTS TO ENTER THE INCORRECT CODE BLOCKS THE UNIT

Chapter 2
Functional Overview

Contents

Introduction

This chapter provides a functional overview of the AT-1 electronics. The aim of this overview is to enable the service engineer to identify processing paths in order to help identify possible faulty modules. A functional block diagram supports the text.


ALL CONNECTOR DESIGNATIONS ON THIS BLOCK DIAGRAM ARE REFERENCED TO MK 11-1 BOARD
TOP CASING
BATTERY LEAD LEADS, FILTER AND ELECTRODE LOOSE
KEYBOARD
PRINTER ASSEMBLY
PAPER MARK DETECTOR
THERMAL PRINT HEAD
PRINTER MOTOR
+5V REF
+5.2V
+24V
VOLTAGE REGULATOR
VOLTAGE REGULATOR
SWITCHING VOLTAGE REGULATOR
SD 1AF
BLOW (10.3V MON 11.3V Standby)
+BATT
CPU / DECODER / TIMER
STEPPER MOTOR CONTROLLER
MON
SYSTEM SOFTWARE EPROM
VOLTAGE SENSE & CONVERSION
+US
ON/OFF CONTROL
+UD
TP1 & TP13
SD 5A slow
BATTERY CHARGER & VOLTAGE REGULATOR
ON FROM KEYBOARD
OFF FROM CPU
MON (MOTOR RUNNING)
OVERVOLTAGE PROTECTION
UNDERVOLTAGE PROTECTION
MAINS
VOLTAGE SENSE
+U
+BATT
+US
+52V
+24V
+US
RECTIFICATION
TP 14, 15 & 16
T1
MAINS
POTENTIAL EQUALISATION
BOARD MK 11-1
ECG INTERFACE MK 11-2
PATIENT ISOLATION (>4kV)
+2Vi
+5Vi
-5Vi
-10Vi
+5Vi
DC-DC CONVERTER REFERENCE VOLTAGE
POWER RAIL STABILISATION
SIGNAL MULTIPLEXER (PWM)
AC-DC CONVERTER
INPUT AMPLIFIER AND FILTER
DC-AC CONVERTER
+5.2V
CLK 2 200kHz
PATIENT CONNECTOR

Control and Power Supply board MK 11 - 1

Power Supply

The mains supply is full wave rectified to produce an unregulated dc supply of approximately 35V(+U). This voltage is used by a switched voltage generator to produce +UD (13.5V). +UD charges the battery when mains is connected. When mains is not connected, +UD is the battery voltage.

An ON/OFF control logic switches +UD to three voltage regulators. The unit is switched on directly from the keyboard and then held on from the CPU (signal µPOFF). Detection of overvoltage on either the 5.2V or 24V supplies directly switches the unit off. Similarly when an undervoltage is detected on +US (indicating over current) the unit is directly switched off.

The mains LED is lit directly when mains is connected. The same circuit also monitors the switched dc supply (+US) and activates signal +BATT when the unit is switched on and mains is not connected (i.e. the unit is running on battery power).

A Battery low signal (BLOW) is generated when battery voltage (+US) falls to 11.3V. A circuit compensates for voltage drop when the printer stepper motor is active and the Blow signal is active only at 10.3V.

Note: The battery voltage is also monitored directly by the CPU which switches the unit off (µPOFF) when the voltage falls below approximately 9.4V.

CPU and Processing Circuits

Overall control and coordination of the AT-1 is by 68332 CPU which performs all timing and control functions.

Memory

Program Memory

An EPROM contains the unit software. The EPROM has 128 kByte of memory.

Static RAM Memory

The RAM memory stores the ECG data and comprises two 128 kbyte RAM chips. All data are lost when the unit is switched off.

Serial EEPROM

The serial EEPROM (U12) stores the unit base settings.

Control and Power Supply board MK 11 - 1

Thermal Print Head Controller

The Thermal Print Head is controlled by a print head controller and timer circuit. The print head controller serialises the data for the print head and the timer circuit controls how long current is applied to the head, and thus the intensity of the printout. Both applications, print head controller and printer timing are performed by the CPU.

Paper Mark

The Paper Mark signal from the printer is fed to a comparator. The paper mark detection voltage input to the comparator is approximately 3.5V and when this is present the PMARK signal is logic 1.

Power On Reset

The Power on reset circuit controls the master reset of the CPU. This circuit has two functions as follows:

- To provide a delay on initial switch-on to ensure that the power supply is fully stabilized and give the 200ms reset time required by the 68332 processor.
- To disable the unit if the +5V rail drops below +4.75V.

Stepper Motor Controller

The printer stepper motor speed is controlled by a timer circuit.

ECG Amplifier MK 11-2

ECG Isolated Power Supplies

DC/DC converter circuits produce all the isolated power voltages required by the ECG Amplifier circuit.

The -2.0Vi and the 2Vi isolated reference voltages are generated from the -5Vi supply. The voltages are stabilised by a Zenor diode and voltage follower circuit.

Servicing Note: When taking measurements always ensure that the isolated ground is used for reference.

ECG Signal

The incoming ECG signals RA, LA, and C1 to C6 are 27 kHz low-pass filtered and applied to non-inverting operational-amplifiers giving a gain of 11. The signals are further low pass filtered (approximately 1 kHz) and amplified by 23 before being applied to the multiplexer.

The multiplexer sampling rate is 1000Hz.

Noise Damping

The right leg electrode to the patient is the signal ground reference signal. To assist in cancelling some patient noise and thus reducing incoming signal distortion, the incoming signal from the patient left leg electrode is phase shifted 180°. This phase shifted signal is then used by the signal ground to cancel (or reduce) patient induced noise.

Chapter 3
Fault Diagnosis and Check Procedures

Contents

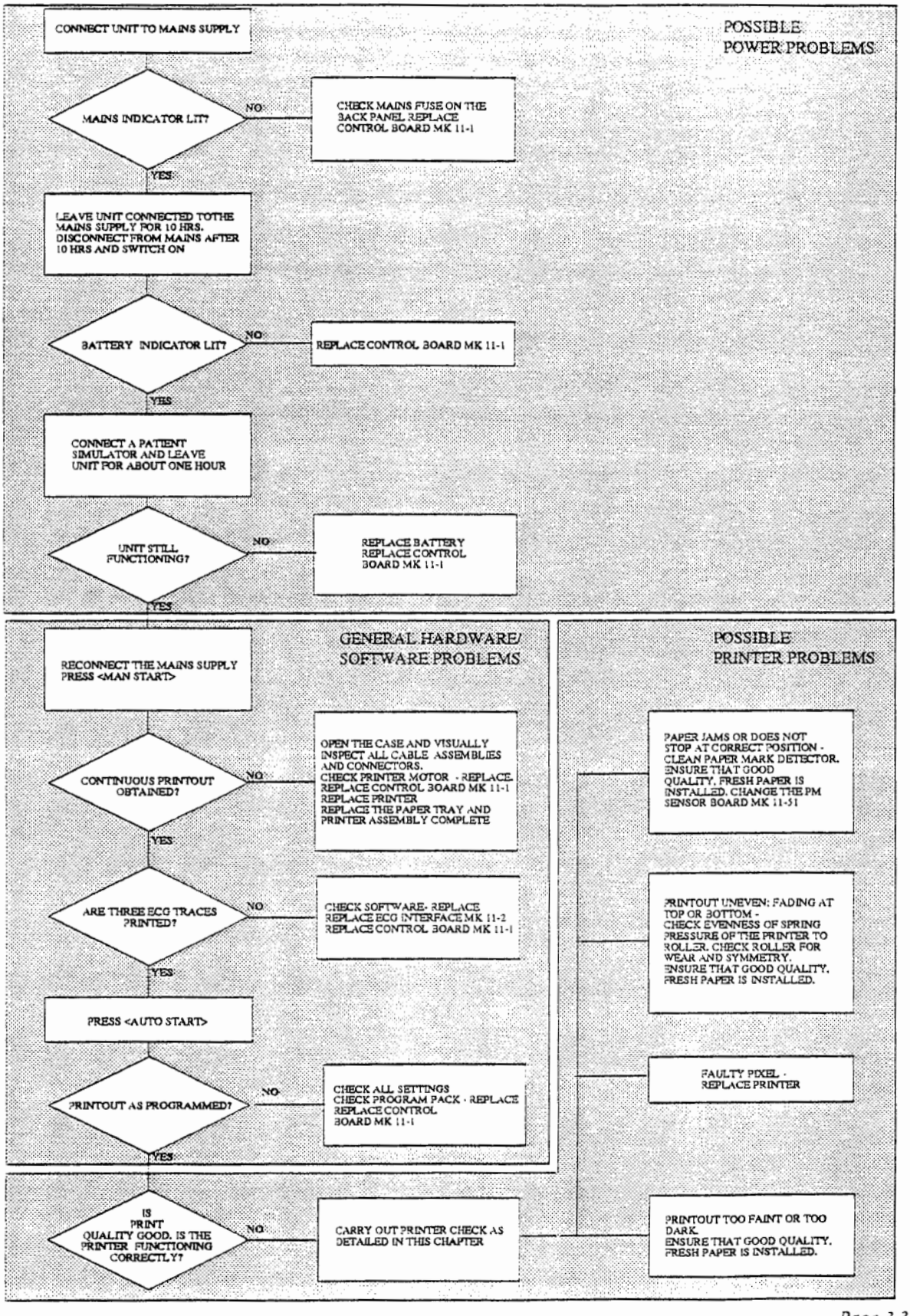
Introduction

The AT-1 is designed to be simple to use and simple to service: the service philosophy of the AT-1 is module replacement and not board repair. The purpose of this chapter is to provide fault-finding procedures that will quickly and efficiently identify a fault to a specific module. Fault-finding procedures are designed so that test equipment is kept to a minimum.

An initial fault diagnosis chart is provided detailing all the general fault indications. Use the fault finding charts and procedures on the following pages to indicate a faulty area or module. In most cases the fault finding charts should indicate the most likely faulty area. When more than one module is stated, the first module given is the one most likely to contain the fault. Other modules given should be checked in the order given. When a module has been replaced specific test parameters and setting-up of the module may be applicable. The removal and replacement instructions for all replaceable modules, along with any setup or check procedures required, are given in Chapters 4 and 5.

If the initial fault-finding chart does not indicate the area where the fault exists, re-check all the settings and parameters that have been entered. If these are correct, check the software.

Fault Diagnosis Chart



General Check Procedures

The procedure detailed here is a general confidence check of the unit after an internal module or board has been replaced. It is not a full functional test (which can only be carried out with dedicated equipment in the factory) but is intended to provide a general confidence check in all the major AT-1 functional areas. The instructions given here are guides to the basic functions. If more operating information is required (general settings, comprehensive menu guides etc.) please refer to the relevant User Manual for the software version applicable.

To carry out the general AT-1 functional check procedure, proceed as follows:

1. Connect mains power to the unit and ensure that the green mains LED lights.
2. Switch the unit on by pressing the **ON** key on the keyboard. Ensure that the LED lights flash for a few seconds
3. Carry out the Printer Check detailed on the next page.
4. Connect an ECG simulator to the ECG connector on the side panel and switch on.
5. Press the **MAN START** key and ensure that the three indicated leads are printed and are of good quality.
6. Press the **AUTO START** key and wait approximately 10 seconds for the printout to commence. Ensure that the printout is accurate and of good quality.
7. Switch the unit off and leave connected to the mains supply for 10 hours or more to charge the battery.
8. Disconnect the mains and switch the unit on. Ensure that the Battery LED is lit. Run the unit on battery power for approximately an hour. Ensure that the battery LED flashes when the battery has limited capacity (not before 45 minutes).

Printer Check

To check the printer and to ensure that every pixel is operational, a built-in printer test is provided. To carry out the printer check press:

ALT - MAN START

A test printout is given. Four test patterns are available - toggle between the test patterns with the lead arrow keys Δ up or down.

Carefully examine the printout and ensure that all the lines are even and uninterrupted. Any faulty print-head pixels will be seen as a horizontal white line. Examine the printout for evenness of print.

If a faulty pixel is detected the printer must be replaced. If the printout is uneven (for example darker at the top than at the bottom), it indicates that the printer alignment is not correct. If the printout is too faint or too dark, check the strobe adjustment. Also check the paper; old paper, paper that has been exposed to light for a long period, or poor quality paper can all adversely effect the print quality.

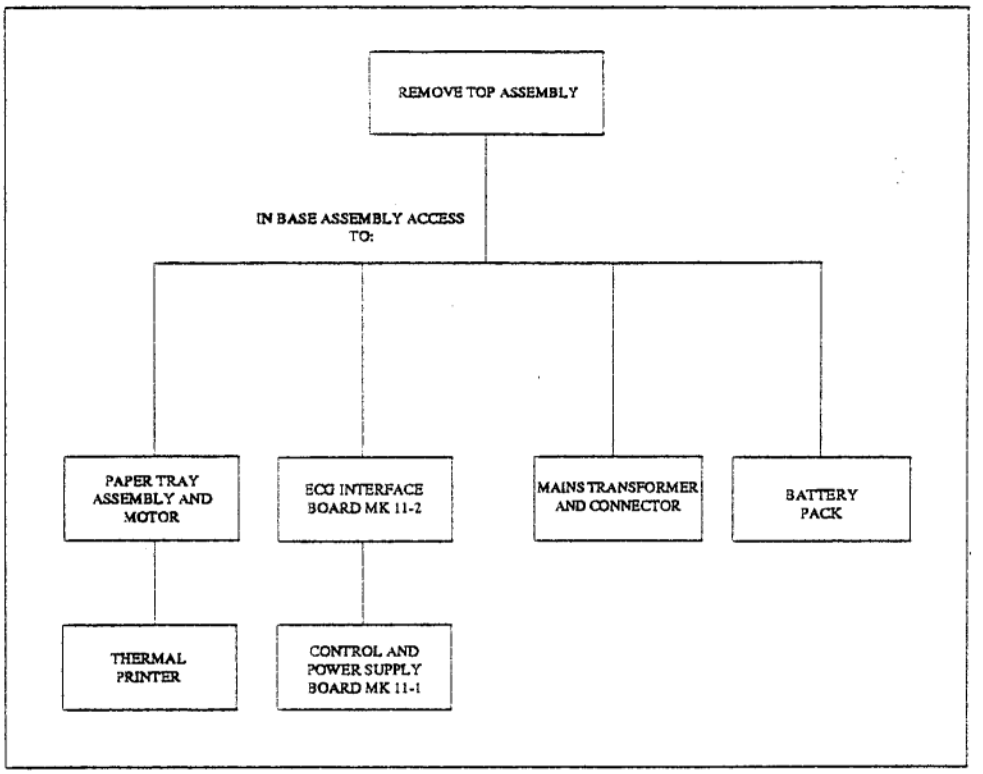
IMPORTANT: THE 'SHELF LIFE' OF THE PRINTER PAPER IS NOT INDEFINITE. OLD PAPER, PAPER THAT HAS NOT BEEN STORED IN A COOL DAMP FREE ENVIRONMENT, OR PAPER THAT HAS BEEN EXPOSED TO EXCESSIVE HEAT CAN ADVERSELY EFFECT THE QUALITY OF THE PRINT

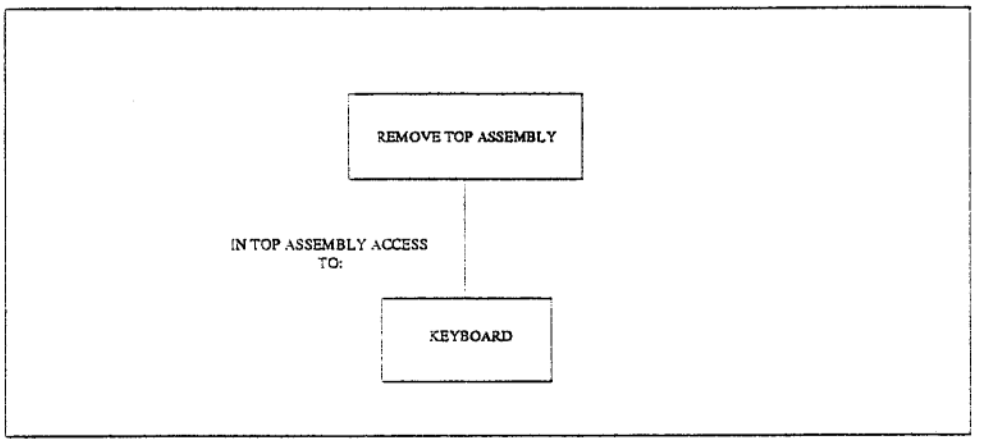
Print Head Alignment and Print Head Tension

The print head tension (the pressure that the print head exerts on the printer paper) is achieved with two spring exerting pressure on the print head: the print head tension cannot be adjusted. Similarly print head alignment is fixed and cannot be adjusted. If the print head tension or print head alignment is not correct change the paper tray and printer assembly.

Chapter 4
Module Removal and Replacement

Contents





Note: The Program EPROM is mounted on the Control and Power Supply board MK 11-1.

Introduction

This Chapter provides an overview of the procedures to remove and replace the modules that are spared at service level. The instructions given in this chapter are autonomous, with each module containing the following:

- The prerequisites that must be fulfilled before removing the module
- Tools and equipment that are required to remove and replace the module and to carry out the functional checks and adjustments
- Removal Procedures
- Replacement Procedures
- Checks and Tests that must be carried out after replacement.

Any adjustments, jumper settings, special checks or functional procedures that are required during a procedure, are detailed in the relevant step.

In-text diagrams support the text where required and provide location details of connectors, test points and adjustment potentiometers.

Specific warnings and cautions are given where applicable. Warnings indicate potential danger that could cause personal injury. Cautions indicate areas that could cause damage to the equipment .

Warnings and Cautions

WARNINGS

BEFORE COMMENCING ANY REMOVAL OR REPLACEMENT PROCEDURES ENSURE THAT THE MAINS POWER SUPPLY IS SWITCHED OFF AND THAT THE MAINS CABLE IS REMOVED.

CERTAIN CHECKS AND ADJUSTMENTS CAN ONLY BE CARRIED OUT WITH THE TOP ASSEMBLY REMOVED AND WITH MAINS CONNECTED. WHEN CARRYING OUT THESE PROCEDURES BEWARE THAT POTENTIALLY LETHAL VOLTAGES ARE PRESENT.

CAUTIONS

THE AT-1 CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTISTATIC PRECAUTIONS:

◊ WHEN CARRYING OUT ANY MAINTENANCE PROCEDURES ALWAYS PLACE THE UNIT ON AN EARTHED ANTISTATIC MAT.

◊ PERSONNEL MUST BE EARTHED WHEN HANDLING ANY BOARDS OR COMPONENTS

◊ ALWAYS USE AN ANTISTATIC BAG WHEN TRANSPORTING BOARDS OR COMPONENTS

THE UNIT IS SUSCEPTIBLE TO ABRASION DAMAGE. TO PREVENT SCRATCHING, ALWAYS PLACE THE UNIT ON A SOFT, NON-ABRASIVE CLOTH WHEN CARRYING OUT MAINTENANCE PROCEDURES.

TAKE CARE NOT TO PLACE ANY STRAIN ON THE CONNECTING RIBBON CABLE WHEN REMOVING THE TOP ASSEMBLY . ENSURE THAT THE CABLE ASSEMBLY IS NOT CRIMPED OR TWISTED AND THAT THE TOP ASSEMBLY IS NOT PLACED ON THE CABLE ASSEMBLY.

CARE MUST BE TAKEN WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

THE PROCEDURAL STEPS GIVEN FOR EACH MODULE MUST BE FOLLOWED IN THE ORDER GIVEN.

Physical Overview

The AT-1 unit is enclosed in a two part, medical standard, moulded plastic case.

The top part contains the keyboard with the base section containing all the electronics of the unit, the thermal printer, the paper tray, the battery and mains transformer.

The electronics of the unit are contained on two printed circuit boards (control and power supply board MK 11-1, and the ECG interface board MK 11-2). The ECG Amplifier board MK 11-2 also supports the patient connector. The PCBs are secured on spacers moulded in the base section.

The battery is secured in position with double sided tape and the mains transformer is secured on spacers.

The thermal printer is mounted on a paper tray/thermal printer assembly which is secured in the base section complete.

Because of the plastic construction of the case, threaded metal inserts are used throughout for all screw fixings.

Test Equipment, Tools, and Accessories

The following list details the tools, test equipment and accessories required to carry out all functional tests, calibration procedures and adjustments that can be carried out on the AT-1. The test equipment given here is general. If specific recommendation for test equipment is required, please contact the SCHILLER service department.

* Digital Voltmeter
* Selection of cross-bladed, posi-drive and flat-bladed screwdrivers
* Cleaning agent such as Tricoetholine
* Selection of spanners
* Double-sided tape
* ECG Patient Simulator

Opening the Case

Prerequisites

- The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the AT-1. The room temperature should be between 18 and 28 degrees.
- THE WARNINGS AND CAUTIONS AT THE BEGINNING OF THE CHAPTER MUST BE OBSERVED.

Tools

- Posi-drive screwdriver

Test Equipment

The following test equipment is required to carry out the functional test after unit assembly

- SCHILLER Patient Cable
- Patient Simulator e.g. phantom 320.

Top Assembly Removal

The Top Assembly is mounted on the Base Assembly and is secured to the Base Assembly with six screws; access to the screws is gained from the underside of the unit. To remove the Top Assembly, proceed as follows

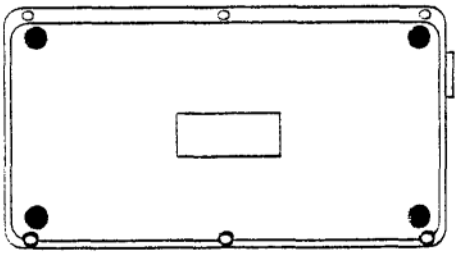
---

WARNING:

ENSURE THAT THE MAINS CABLE IS REMOVED.

---

1. Turn the unit upside-down and rest it on a soft antistatic cloth.



2. Unscrew and remove the six countersunk retaining screws and washers situated in the extreme corners and edges of the unit.

4. Grasping the top and bottom of the unit to ensure that the two assemblies cannot part, carefully return the unit to the standing position.

5. Release the catch and open the paper tray lid with the printer roller.

6. Gently lift the Top Assembly and turn it slightly counter-clockwise so it can be lifted away from the paper tray lid.

7. Disconnect the cable assembly between the Control and Power Supply board MK 11-1 and the keyboard.

7. Place the Top Assembly on a soft cloth.

Opening the case

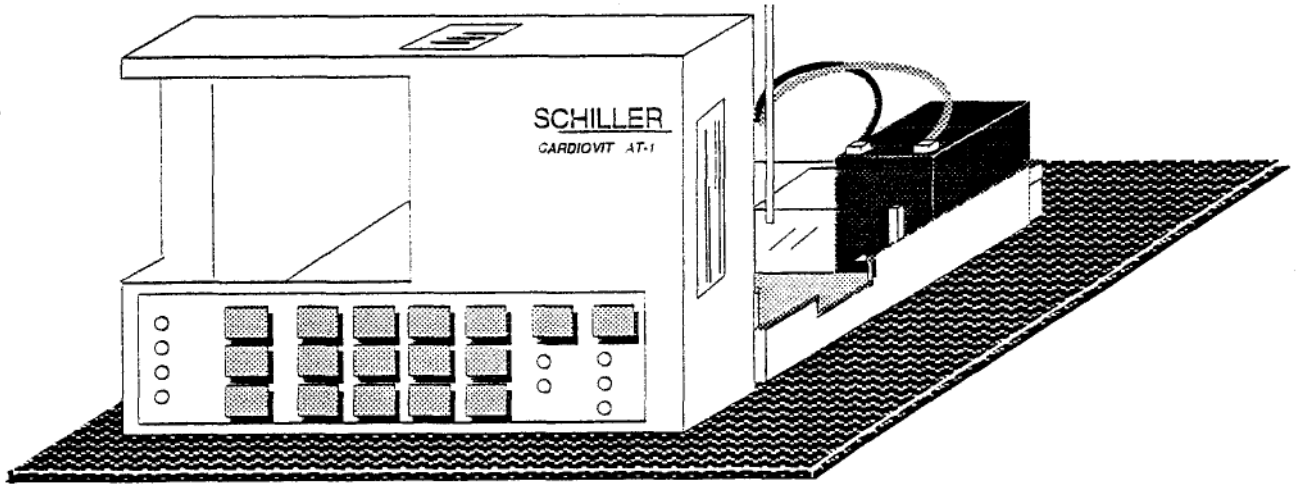
Top Assembly Replacement

To replace the Top Assembly proceed as follows:

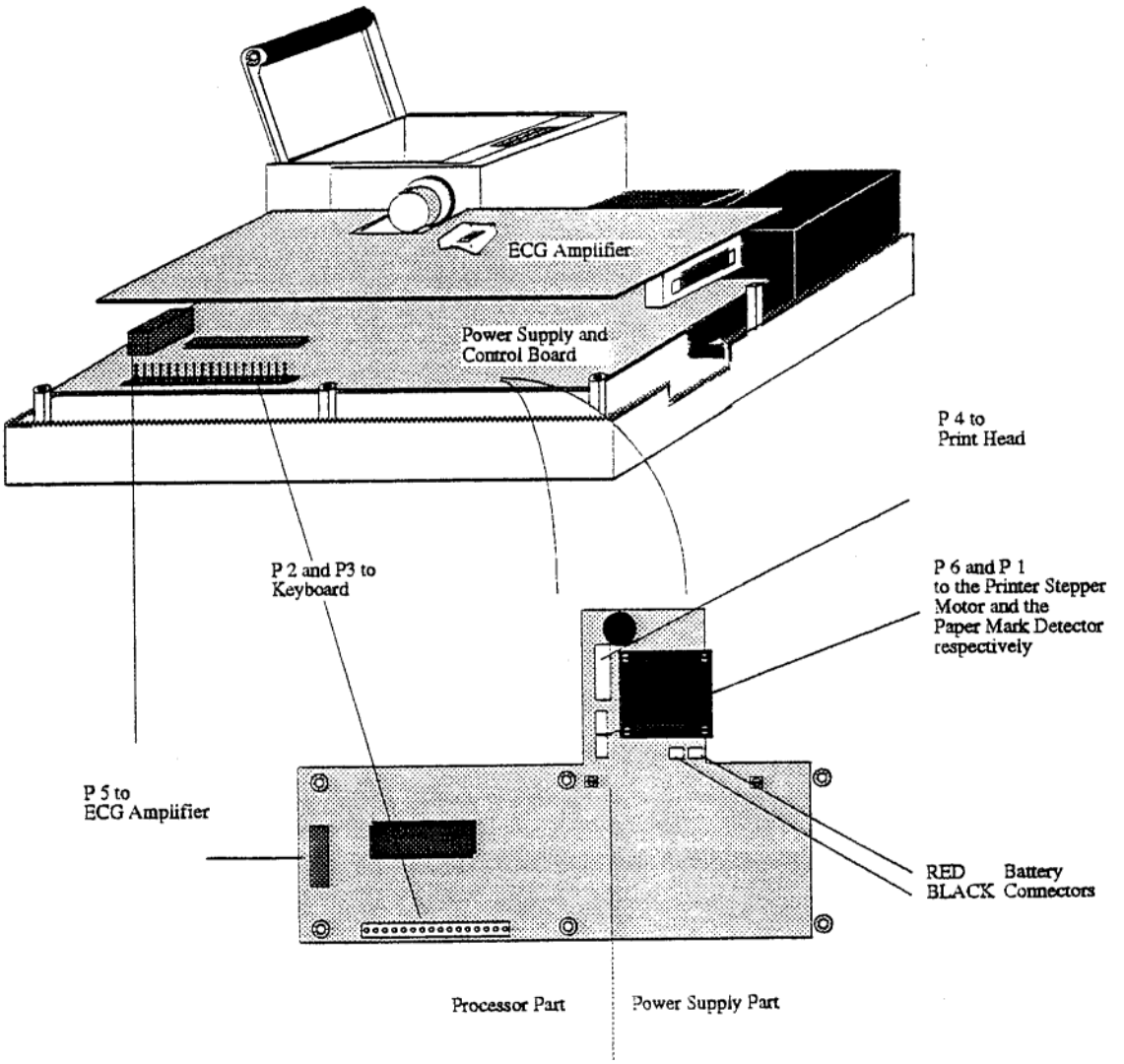
1. Check that all boards and components are firmly secured. Check for loose screws. Ensure that no screws or foreign bodies are loose in the bottom of the case.
2. Inspect all the internal cable assemblies and ensure that they are in good condition and that no visible damage can be seen. Ensure that no cable assemblies are strained, crushed or caught.
3. Ensure that all connectors are firmly home.
4. Position the Top Assembly in front of the Base Assembly and without straining the ribbon cable, plug in the interconnecting cable from the Keyboard to the Control and Power supply board MK 11-1.

   Note: It may be necessary to tilt the Top Assembly for the cable assemblies to reach.

5. Turn the Top Assembly slightly counter-clockwise and lift it over the paper tray lid.
6. Carefully position the Top Assembly on the Base Assembly and close the paper tray lid.
7. Grasping the two assemblies to ensure that they cannot part, carefully turn the unit upside-down and replace the six securing screws and washers in the extreme corners and edges of the unit. Return the unit to the upright position.
8. Carry out the functional check procedure detailed in Chapter 3.



Exploded View



ECG Interface Board MK 11- 2

The ECG Interface is mounted above the Control and Power Supply board MK 11-1 and is secured to six spacers.

Prerequisite

The Warnings and Cautions at the beginning of the Chapter must be observed.

The Top Assembly must be removed and all external cable assemblies disconnected.

Tools and Test Equipment

Cross-bladed posi-drive screwdriver

Parts

ECG Amplifier board. Part number as detailed in Chapter 6.

Board Removal

CAUTION

THE ECG AMPLIFIER CONTAINS STATIC SENSITIVE CMOS COMPONENTS. OBSERVE ANTISTATIC PRECAUTIONS.

To remove the ECG Amplifier proceed as follows:

1. Unscrew the six screws securing the board to the spacers.
2. Gently raise the board to gain access to the cable assembly to the Control board and remove the connector. Remove the board.

Board Replacement

1. Place the ECG Amplifier board component side down over the six spacers and connect the cable assembly to the Control board MK 1-11. Place the board so that the patient cable connector is positioned in the cutout on the side panel.
2. Secure the board to the six spacer supports with the retaining screws.

Checks and Tests after Replacement

To prove the integrity of the replaced board carry out the following functional check procedure:

Switch on the unit and connect a SCHILLER patient cable to the ECG connector. Connect a suitable patient simulator to the ECG connector and press **MAN START**. Ensure that all the leads are printed.

Control and Power Supply Board MK 11-1

The Control and Power Supply Board MK 11-1 is secured to the base tray and positioned under the ECG Interface MK 11-2.

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.
- The ECG Interface must be removed.

Tools and Equipment

Posi-drive screwdriver

Parts

Control and Power Supply board MK 11-1. Part number as detailed in Chapter 6.

Board Removal

WARNING

ENSURE THAT THE MAINS CABLE IS DISCONNECTED BEFORE COMMENCING

To remove the Control and Power Supply board MK 11-1 proceed as follows:

1. Disconnect the following connectors:
   - live and the neutral bayonet connectors to the mains connector
   - live and the neutral bayonet connectors to the battery
   - data connector to the thermal printer
   - paper mark connector
   - printer motor connector
   - ground connector to the print head
   - note: (the power supplies connector to the ECG Amplifier will already have been removed as detailed in the previous paragraph).
2. Unscrew the nine spacer fixations (four on the mains transformer) and remove the board.

Control and Power Supply Board MK 11-1 (cont.)

Board Replacement

To replace the Control and Power Supply board MK 11-1 proceed as follows:

1. Position the board and secure at the nine fixing points (four on the mains transformer)
2. Connect the following:
   - live and the neutral bayonet connectors to the mains connector
   - live and the neutral bayonet connectors to the battery
   - data connector to the thermal printer
   - paper mark connector
   - printer motor connector
   - ground connector to the print head
3. Replace the ECG Amplifier (detailed in the previous paragraph) and reassemble the unit.

Battery Pack

The battery pack is held in position with double sided tape.

Prerequisite

The Warnings and Cautions at the beginning of the Chapter must be observed.

The Top Assembly must be removed and all external cable assemblies disconnected.

Parts

The part numbers of all replaceable items are given in Chapter 6.

Battery Pack Removal

WARNING

THE MAINS SUPPLY MUST BE DISCONNECTED DURING THIS PROCEDURE

To remove the Battery Pack proceed as follows:

1. Ensure that the unit is switched off and that the mains is disconnected.
2. Disconnect the two bayonet connectors and remove the Battery Pack by gently pulling away from the base.

Battery Pack Replacement

1. Position the Battery Pack with the connectors towards the inside of the unit.
2. Remove the double-sided tape protective sheet and secure the Battery Pack to the base.
3. Connect bayonet connectors.

Checks and Tests After Battery Replacement

Program all static settings which will have been lost when the battery was disconnected.

Paper Tray Assembly and Thermal Printer

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed as detailed previously. All external cable assemblies must be disconnected.

Tools

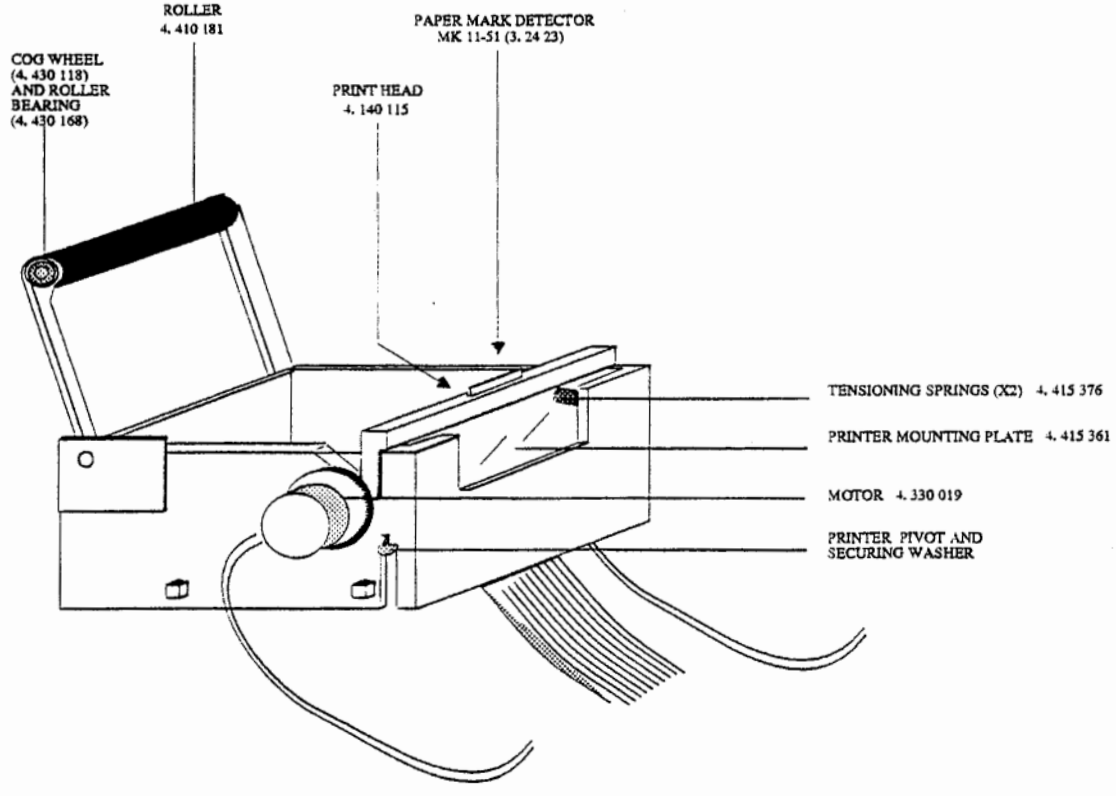
- Cross-bladed screwdriver
- Flat-bladed screwdriver
- Flat ended pliers

Part Numbers

The part numbers for the Thermal Printer Assembly, the print head and the motor are given in Chapter 6.

CAUTION

THE THERMAL PRINTER CONTAINS IS STATIC SENSITIVE; OBSERVE ANTISTATIC PRECAUTIONS



Paper Tray Assembly and Thermal Printer

Printer/Paper tray Assembly Removal

1. Remove the following connectors from the Control and Power Supply board MK 11-1 :
   - data connector to the thermal printer
   - paper mark connector
   - printer motor connector
   - ground connector to the print head
2. Unscrew the four retaining screws and remove the complete paper tray/printer assembly.

Thermal Printer Removal

1. Turn the Paper tray/printer assembly upsidedown and unscrew the two printer retaining screws.
2. Gently remove the printer taking care to retain the two tensioning screws.

Thermal Printer Replacement.

To replace the Thermal Printer proceed as follows:

1. Position the Printer in the paper tray/print assembly so that the printer mounting plate lips slot into the dedicated cutouts in the assembly; secure with the two retaining screws. Ensure that the cable assemblies from the printer to the Interface PCB are not caught and are not strained.
2. Using a spring compressor, insert the two tensioning springs so that the springs are positioned over the moulded spring supports and in the indent (hole) in the printer mounting plate.

Printer/Paper tray Assembly Replacement

1. Position and secure in the base the assembly with the four retaining screws.
2. Reconnect the following connectors to the Control and Power Supply board MK 11-1 :
   - data connector to the thermal printer
   - paper mark connector
   - printer motor connector
   - ground connector to the print head
3. Replace the Top Assembly.

Checks, Tests and Adjustments after Printer Replacement

Check the print quality as described in Chapter 3.

Keyboard

The keyboard comes as a complete assembly with the top casing. The parts numbers of the various keyboards are given in Chapter 6.

Chapter 5
Adjustments

Contents

Introduction

This Chapter provides the procedures necessary to check and adjust all service settings. Every procedure is self-contained and details the tools required to carry out adjustments, and the test equipment necessary. Any adjustments, jumper settings, special checks or functional tests that are required on the module, or on associated modules or software, are also detailed.

In-text diagrams support the text where required and provide location details of connectors, test points and adjustment potentiometers.

Specific warnings and cautions are given in the text where applicable.

The part numbers for all replaceable modules are given in Chapter 6.

The AT-1 has the following adjustments:

- Battery Charge Voltage (VR4 on the Microprocessor/Power supply Board MK 11-1)
- ECG Amplifier reference voltage and (VR2 and VR3 on the ECG Amplifier Board MK11-2)

We recommend that the reference voltages are checked every year.

Warnings, Cautions and Conditions

WARNING

MAINS POWER IS POTENTIALLY LETHAL - DISCONNECT THE MAINS BEFORE DISASSEMBLING THE UNIT. ADDITIONALLY ENSURE THAT THE MAINS IS DISCONNECTED BEFORE CARRYING OUT ANY MAINTENANCE, CALIBRATION, CHECKS, OR ADJUSTMENTS.

CAUTIONS

THE AT-1 CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTISTATIC PRECAUTIONS. WHEN CARRYING OUT ANY MAINTENANCE PROCEDURES ALWAYS PLACE THE UNIT ON AN EARTHED ANTISTATIC MAT. PERSONNEL MUST BE EARTHED WHEN HANDLING ANY BOARDS OR COMPONENTS. ALWAYS USE AN ANTISTATIC BAG WHEN TRANSPORTING BOARDS OR COMPONENTS

CARE MUST BE TAKEN WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

THE PROCEDURAL STEPS GIVEN FOR EACH MODULE MUST BE FOLLOWED IN THE ORDER GIVEN.

THE OUTER SURFACES OF THE AT-1 ARE SUSCEPTIBLE TO ABRASION DAMAGE. TO PREVENT SCRATCHING, ALWAYS PLACE ON A SOFT, NON-ABRASIVE CLOTH.

Conditions

The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the AT-1.

The room temperature should be between 18 and 28° C.

Test Equipment

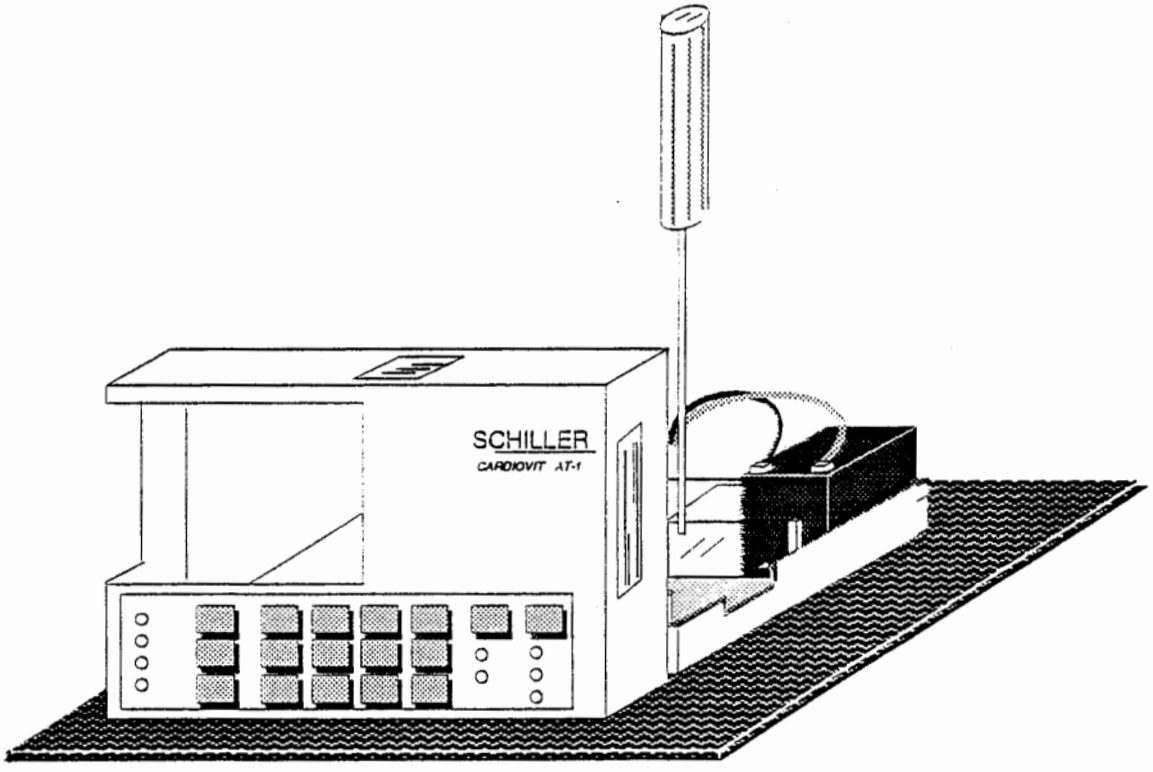
The following proprietary and dedicated test equipment is required to fault find and carry out all board checks and adjustments on the AT-1.

The list of proprietary equipment is not comprehensive. Recommendations of suitable proprietary test equipment can be obtained from the SCHILLER Service Department.

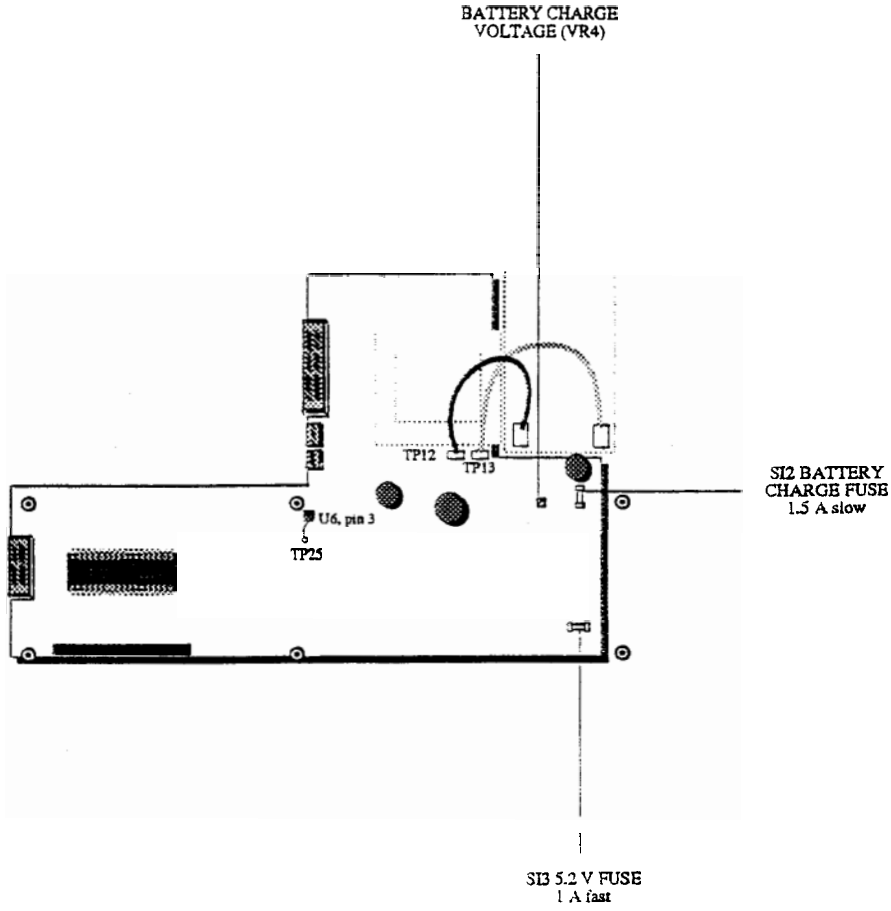
Proprietary Test Equipment/Tools

- ECG Emulator, e.g. Phantom 320
- Oscilloscope
- Digital Multimeter
- Standard tool kit with a selection of cross-bladed, flat-bladed and posi-drive screwdrivers, pliers and general tools
- SCHILLER 10 lead patient cable Number 2.400070 (2. 400071 for USA)

Test Setup



Control Board MK 11-1 Component Location



Battery Charge Voltage

Precautions and Requirements

The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the AT-1. The room temperature should be between 18 and 28° C.

Tools and Equipment

- Digital voltmeter
- Small flat bladed screwdriver
- Resistor 2.7 kOhms, 250 mW

Procedure

The battery charge voltage is nominally 13.5 V (with a nominal maximum current of approximately 5 mA). Adjust and check as follows:

- DISCONNECT THE MAINS SUPPLY
- Disassemble the unit as detailed in Chapter 4 and remove the ECG Amplifier MK11-2.
- Remove the two battery connectors and connect a 2.7 kOhm 250 mW resistor across the two connectors (TP12 and TP13) to simulate a discharged battery. Connect the digital multimeter across the resistor.
- Connect the Mains supply.

WARNING

EXERCISE CARE - BE AWARE THAT POTENTIALLY LETHAL VOLTAGES ARE PRESENT

- Adjust VR4 to obtain a charging voltage of 13.5 V.
- Disconnect the mains supply and reassemble the unit as detailed in Chapter 4.

ECG Amplifier +2V, -2V and PWM Ramp Time Adjustment

The ±2 V voltage rails generated on the ECG Amplifier board are used as a reference by the measurement and PWM (Pulse Width Modulation) circuits.

Note: The ECG board reference voltage is given on the service printout and can be checked without disassembling the unit. Full details of the service printout are given later in this chapter.

IMPORTANT

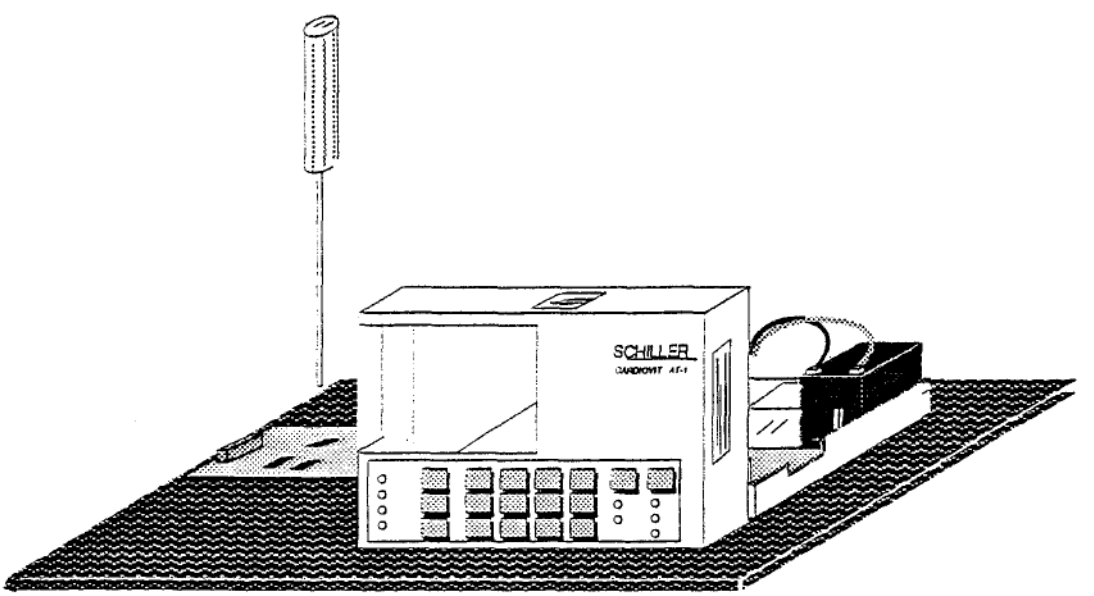
THE ±2V REFERENCE VOLTAGES, AND THE PWM RAMP MUST BOTH BE ADJUSTED AT THE SAME TIME.

Tools, Equipment and Material

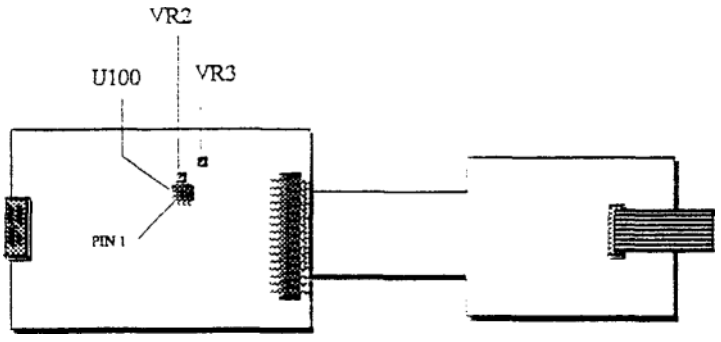
- Digital voltmeter
- Small flat bladed screwdriver

Procedure

- DISCONNECT THE MAINS SUPPLY
- Disassemble the unit as detailed in Chapter 4
- Remove the screws securing the ECG Amplifier board MK11-2 and gently place by the side of the unit component side up. Reconnect the keyboard to the control board and place the top assembly on its side in front of the Base assembly as shown below.
- Remove the EMC shield fron the ECG Amplifier board.

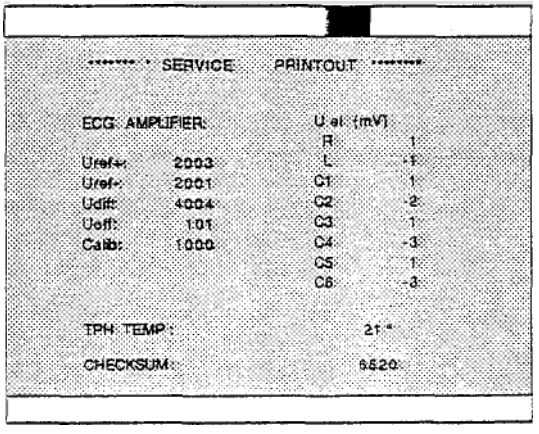


ECG Amplifier reference voltage



- Switch the unit on and measure the voltage difference between the +2V reference and the -2V reference on pins 1 and 7 of operational amplifier U100. Adjust trimmer VR2 to achieve a voltage difference of 4000 mV ±2 mV.
- Obtain a service printout by pressing

ALT - 0 - 3 - any key



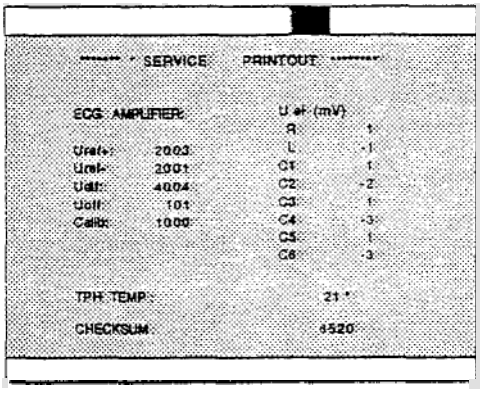
- Ensure that the Uref+ and the Uref- measurements are both 2000 mV ± 20 mV. Ensure that the Udiff reading is 4000 mV . Adjust VR3 to achieve a Udif reading of 4000 mV ± 20 mV.
- Reassemble the unit as detailed in Chapter 4. Recheck the voltage by again obtaining a service printout.

Service Printout

The service printout provides information of the patient cable and electrodes and gives the value of certain reference voltages and important internal offset values. These values are for information only.

The service printout also gives variable settings and measurements that can be set by the service engineer; to carry out these adjustments some of the settings require additional test equipment. To obtain the service printout press the following key sequence:

ALT - 0 - 3 - any key



ECG Ref. Voltage **This provides** measurements and **setting facilities for the reference voltage used** for accurate **measurement** of ECG **signals**

- Uref + **This gives the** value of the **reference voltage used** in the multiplexer circuit on the ECG Amplifier. **The value of the reference** voltage **is** 2000 mV ±20 mV.
- Uref - **This** is **a negative** reference **voltage** used on the **ECG Amplifier board. The value of this** voltage should be -2000 mV ±20 mV.
- Udif **This** is the **sum** of the two reference **values above** (**Uref** +and Uref -). This value must be 4000 mV ± **20 mV**.
- Uoff This is **the value** of offset voltage on the multiplexer **circuit.** This **value** should be in **the range** ± 150.
- Calib This **value** is the Udif **value** divided by 4. **The** nominal value is 1000 ±5.

Electrode dc offset This gives the voltage drop in the **patient cable and can indicate any** faults in **the** patient **cable or patient electrode.** The value given **is the dc voltage between** the left leg **electrode and** all other electrodes. **The measurements** obtained will **indicate any cable short circuits** or open **circuits. The measured voltage value will** depend on **where the electrodes are connected. The voltage readings** that can be expected are as follows:

- With **patient** connected - ± 20 mV

  With patient simulator connected - ± 20 mV - this will depend on the **patient simulator** used and **must** be taken as a **flexible measurement.**
- With all **electrodes shorted** together: - ± 20 mV

  No patient cable connected: ± 400 mV

TPH Temp This is the temperaturee of the **thermal** print head.

Checksum **This** is the EPROM **check sum. The** value may change **after** a software update.

Software and Settings

The software version of the unit and the options installed are printed on the bottom of all printouts. The only option available is the measurements option: an **M** is printed. To obtain a printout of all settings press the following key sequence:

ALT - 0 - 1 - any key

Details of all settings are given in the AT-1 User Guide.

Installing Software Options

To update the AT-1 from, for example standard to M version type the following:

ALT - 0 - 4 - followed by the update code (obtainable from Schiller)

Acceptance of the code is indicated by a series of beeps.

CAUTION

MORE THAN 10 ATTEMPTS TO ENTER THE INCORRECT CODE BLOCKS THE UNIT

Chapter 6
Spare Parts

Contents

Ordering Information

Your local representative stocks all the disposables and accessories available for the AT-1. In case of difficulty or to obtain the address of your local dealer, please contact the head office. Our staff will be pleased to help process your order or to provide any details for all SCHILLER products.

The address for advice is:

SCHILLER AG

Sales Department (Order Processing)

Altgasse 68

CH-6340 Baar

Switzerland

Phone Number : *+41 41 766 42 42*

Fax Number: *+41 41 761 08 80*

When ordering, state that the order is for an AT-1 unit and provide the following:

- Part Description
- Part Number
- Your Address

Service Department

If you need help from our service engineers, please contact the following numbers:

Phone Number : *+41 41 766 42 85*

Fax Number: *+41 41 761 03 34*

If you contact us by fax, be sure to provide the following information:

- serial number for your AT-1
- software version
- accessories used, model and cable number.

Chapter 7
Technical Data

Contents

Spare Parts

DESCRIPTION	PART NUMBER
Microprocessor and Power Supply Board MK 11-1	3. 24 20
ECG Amplifier Board MK 11-2	3. 24 21
Paper Mark Sensor Board MK 11-51	3. 24 23
AT-1 Software (Programmed EPROM)	4. 999 940
Bottom Housing Complete	3. 910 960
Top Housing with Keyboard Complete (German)	3. 910 961
Top Housing with Keyboard Complete (English)	3. 910 962
Top Housing with Keyboard Complete (French)	3. 910 963
Top Housing with Keyboard Complete (Spanish)	3. 910 964
Top Housing with Keyboard Complete (Portuguese)	3. 910 965
Paper Tray and Printer Assembly Complete	3. 910 966
Paper Tray Lid	3. 910 967
Ground Shield	4. 416 028
Transformer Shield	4. 416 027
ECG Isolation Shield	4. 435 198
Mains Socket Complete	4. 270 009
Mains Fuse Holder	4. 210 049
Mains fuse - 200m/AT	4. 210 010
Mains Transformer	4. 320 066
12V Lead Acid Battery	4. 350 024
Printer Motor Complete	4. 330 019
Thermal Print Head	4. 140 115
Thermal Print Head Cable	4. 520 378
Printer Roller	4. 410 181
Potential Equalisation Stud	4. 260 377

21029-0000

Technical Data

Technical data subject to change without notice.

Dimensions (l/w/h):	290 x 210 x 69 mm
Weight:	2.9 kg
Mains Supply:	100 to 115 / 220 to 240 VAC, 50/60 Hz
Battery:	Built-in 12 V lead-acid battery (rechargeable)
Power Consumption:	Recording: 28 VA max.
Leads:	Standard / Cabrera
Paper Speed:	5 / 25 / 50 mm/s (direct)
Sensitivity:	5 /10 / 20 mm/mV, either automatically adjusted or manually selected
Chart Paper:	Thermoreactive - Z-folded, 90 mm wide, perforation 90 mm or - Roll, 90 mm wide (only on certain markets)
Printing Process:	High-resolution thermal print head, 8 dots per mm
Recording Tracks:	3 channels, positioned at optimal width on 80 mm, automatic baseline adjustment
Auto matic Lead Programs:	3 channel representation of 12 simultaneously acquired standard leads
Data Record:	- Listing of ECG recording data *Version M:* *ECG measurement results (intervals, amplitudes, electrical axes), average complexes with optional measurement reference markings.*
ECG Storage:	- Memory for 10 s, 12-lead ECG - Circular input memory for 10 s, 12-lead ECG.
Frequency Range of Digital Recorder:	- 0 to 150 Hz (IEC) - 0 to 150 Hz (AHA)
ECG Amplifier:	- Simultaneous, synchronous registration of all 9 active electrode signals (= 12 standard leads) - Sampling frequency: 1000 Hz - Digital resolution: 5 µV - Dynamic range: ±10 mVAC - Max. electrode potential: ±300 mVDC - Time constant: >3.2 s - Frequency response: 0.05 to 150 Hz (-3 dB) - Input impedance: >10 MΩ
Myogram Filter (muscle tremor filter):	25 Hz or 35 Hz, programmable (not active on averaged waveform). The stored ECGs can be printed with or without filter.
Line Frequency Filter:	Distortion-free suppression of superimposed 50 or 60 Hz sinusoidal interferences by means of an adaptive digital filter.

Technical Data

Patient Input:	Fully floating and isolated, defibrillation protected	
Patient Leakage Current:	<5 µA	
Safety Standard:	BF according to IEC 601-1 and IEC 601-2-25	
Safety Class:	I according to IEC 601-	
Environmental Conditions:	Temperature, Operating:	10° to 40° C
	Temperature, Storage:	-10° to 55° C
	Relative humidity:	25 to 95% (non condensing)
	Atmospheric pressure:	700 to 1060 hPa
Control Panel:	Rubber keys.	

Available Configurations

The CARDIOVIT AT-1 is available in two different versions:

Standard Version:	Unit with ECG recording and printout capabilities.
Version M:	Unit with additional ECG measurement program.
Version C:	Unit with measurement program (M) and interpretation. NOTE ! : THIS VERSION IS ONLY MARKETED IN CERTAIN COUNTRIES.

Chapter 8
Glossary

Contents

Introduction

The following list provides a glossary of the important signals and acronyms used in the circuit diagrams for the SCHILLER instruments. They will not all apply to the AT-1.

Only abbreviations that are specific to SCHILLER equipment are included here. General electrical and electronic abbreviations are not included.

Acronyms

..OS	Offset signal (on the ECG amplifier)
A(1..n)	CPU Address Bus.
ALBEEP	Alarm beeper signal to the audio amplifier. The frequency of this signal is about 1000 Hz.
ANA1, ANA2	Analog input from the experimental inputs DC1 and DC2.
AS	Address strobe
BATT	Signal to CPU indicating battery operation
BATTLC	Analog signal to the processor giving the charge condition of the battery.
BATTV	Battery voltage - analog signal from the power supply used by the processor to assess battery or mains operation.
BLOW	Battery less than 11.3V. LCD flashes when this signal is active. When the battery voltage drops to below approximately 9.4V the unit is switched off. These values apply to equipment with 12 V battery. For other equipment the limits are different.
CHAD ..	ECG signal multiplexer control signals (on the ECG Amplifier)
CIF(0..16)	Communication interface. General control signals for the communication interface circuits.
CI(0..10)	RS interface control lines - input.
CO(0..10)	RS interface control lines - output.
CL1	19 kHz LCD latch pulse.
CL2	3.11 MHz LCD clock frequency.
CLK..	Clock Signal. The number following the CLK indicates the frequency. For example CLK 19 indicates a frequency of 19 MHz.
CS..	Chip select. The general format of the chip select signals is CS followed by some characters. The characters indicate the device to which the chip select signal appertains. For example CSRTC is the chip select signal for the real time clock and CSEPROM is the select signal fot the EPROM etc.
CTS	Clear to send. General signal used in data communication.
D (0..15)	Data Bus
DACWR	Digital / analog converter wire.
DIO..	Data input/output on the Data I/O connector
DMUX	Data multiplexer.
DRAM	Dynamic RAM
DRC(0..6)	Dynamic RAM control.
DS..	Data strobe.

Acronyms

DSP..	Digital signal processor (on program pack).
DTACK	Transfer data acknowledge. Bus signal to acknowledge transfer of data.
DTR	Outgoing serial data, turns modem on.
ECG1	ECG in - serial ECG data to the CPU sent over the optical interface.
ECGMUX	The multiplexed ECG signal from the ECG amplifier.
ECGO	ECG out - serial ECG amplifier control data from the CPU sent over the optical interface.
EF	Empty flag.
EJCT	Eject (paper tray).
EKGRES	Reset signal to the ECG Amplifier. This signal resets the ECG Amplifier to recenter the ECG image on the LCD.
FIFOR	First in first out read.
FLM	Control signal for frame synchronisation of the LCD.
FPIN	Input for floating point co-processor.
FWR	Flag read / write.
HREN	Output enable signal for thermal print head data (History enable).
HSYNC	Horizontal synchronisation (video / VGA output).
IPL0..2	Interrupt priority level (binary encoded).
IREG	Control signal from the current detector and limiter circuit on the power supply to regulate supply.
ISYS	Interrupt system (2 kHz).
KB..	Keyboard data in.
KBBEEP	Keyboard beep (to audio amplifier).
KBCLR	Keyboard clear.
KBCL1	Keyboard clock.
KBCL2	Keyboard clock.
KBIN..	Keyboard data in - serial data from the keyboard to the CPU.
KBS..	Keyboard Strobe.
KONV	Convert - this signal initiates the conversion of the incoming signal from the ECG Amplifier..
LA	Left Arm.
LCA	Liquid crystal address - enable.
LCDAS	LCD Address Strobe.

Acronyms

LCDKONT	LCD contrast - sets the -18 V voltage level (from which the LCD backlight power is generated) and thus the contrast of the screen.
LCDW	LCD Write.
LD1.2.3.4	Lower LCD data.
LDS	Lower data strobe.
LED (0..3)	Operate signals to the LED indicators on the keyboard.
LEDB	Battery LED.
LEDMAINS	Signal indicating mains connected - to operate LED indicator on the keyboard.
LOE	Lower output enable - control signal for static Ram.
LP	Line synchronisation.
LSRAM	Lower output enable - control signal for static RAM.
LWE	Lower Write Enable - control signal for Static Ram.
M	LCD control signal derived from FLM.
MCLK	Motor Clock - speed control for the printer motor.
MOD	Control signal from the battery charging circuit.
MOFF	Motor off.
MON	Motor On - Printer motor enable signal.
NWTZ	Mains supply.
NMI	Non-maskable interrupt - interrupt for U47 (Schiller gate array) activated by the reset button.
OFF	Off signal from the OFF key to switch off the power supply.
PDS	Control signal derived from FLM (unity waveform 1/2 FLM frequency).
PM	Paper mark signal.
PMARK	Paper mark detection signal.
PMPON	Pacemaker detection pulse.
PMNEG	Pacemaker negative - indicates the trailing edge of a pacemaker pulse.
PMPOS	Pacemaker positive - indicates the leading edge of a pacemaker pulse.
PWM	Pulse Width Modulation
QTRRG	QRS trigger - output signal.
RA	Right Arm.
RAS	Row address strobe.
RES	Reset.

Acronyms

RESLCD/	Resets / darkens the LCD.
RES/P	Error reset signal to inactivate the LCD.
RTS	Ready to send - ougoing serial data, handshake with CTS.
RXD	Receive data - incoming serial data.
R / W	Read / Write
SC(0..8)	System control bus - CPU control signals.
SCINV	Screen inversion.
SI	Serial in.
SO	Serial output from the CPU to the ECG amplifier via opto isolators.
SP..	Spirometry control and data signals.
SRAM	Static RAM memory.
STRB1/2	Timing signals for printer control.
SYSEN	System enable - active when the program pack is inserted. The CPU will not work if this signal is not active.
TGATE	Gate pulse for programmable timer. This signal sets the TPDUR signal.
TM	Thermal printer temperature - dc voltage from the print head, pulse width modulation of signal TPTH.
TPC	Thermal printer clock. This is not a continuous clock signal but is active when loading a line of printer data (into shift registers).
TPCLK	Thermal printer clock.
TPD	Thermal printer data - serial data for the printer.
TPDUR	Thermal printer duration - duration of the strobe pulse dependant on the ambient temperature of the print head and the resistance of the print head.
TPCSEL	Thermal printer controller select - control of thermal printer FIFO (input memory buffer).
TPL	Thermal printer latch - print strobe control and data latch signal.
TPRES	Thermal printer reset - FIFO reset for thermal printer controller.
TPS 0 & 1	Thermal Printer Strobe - master timing strobe enable signal.
TPTH	Thermal Printer temperature - dc voltage from the print head to ADC, approximately 3.7V at room temperature.
TS	Temperature sense (from battery).
TXD	Outgoing serial data.

Acronyms

µPOFF	Off control signal. Logic 1 keeps the unit switched on. Logic 0 switches the unit off . Note that the unit is initially switched on directly from the ON key on the keyboard.
U1,2,3,4	Upper LCD data.
+UB	Battery voltage.
UCAS	Upper column address strobe (for dynamic RAM).
UD1, UD2	Upper data strobe - used for generating UOE and UWE.
UDS	Upper Data Strobe - used on the SCHILLER gate array.
UOE, USRAM	Upper output enable - for static RAM.
+UP	Voltage rectified from the mains input and regulated to approximately + 15 V.
UWE	Upper Write Enable - for static RAM.
+U	Unregulated dc supply from mains (approximately 30 V).
+UBU	Back-up voltage for the real time clock and static RAM.
+UD	Unswitched regulated dc voltage used as power source for the switched supply +US. The voltage is 13.5V when mains is connected, or battery voltage when mains is not connected. When mains is connected, this supply charges the battery.
-ULCD	Contrast voltage to LCD.
+US	Switched dc voltage of 13.5V when mains is connected or battery voltage when working from the battery. Input voltage for all PSUs on the power supply board.
VCC	+5 V.
VMA	Valid memory address.
VPA	Valid peripheral address.
VSYNC	Vertical synchronisation - (video / VGA output).
WP0 and WP1	ECG In - the serial multiplexed ECG serial data to the CPU sent over the optical interface, from the ECG Amplifier.
XD0..XD3	Pixel information.
XSCL	Shift clock for XDn.
YD	Frame synchronisation.
YDIS/	LCD off.
ZEROSET	Baseline reset (on the ECG amplifier) from the processor.

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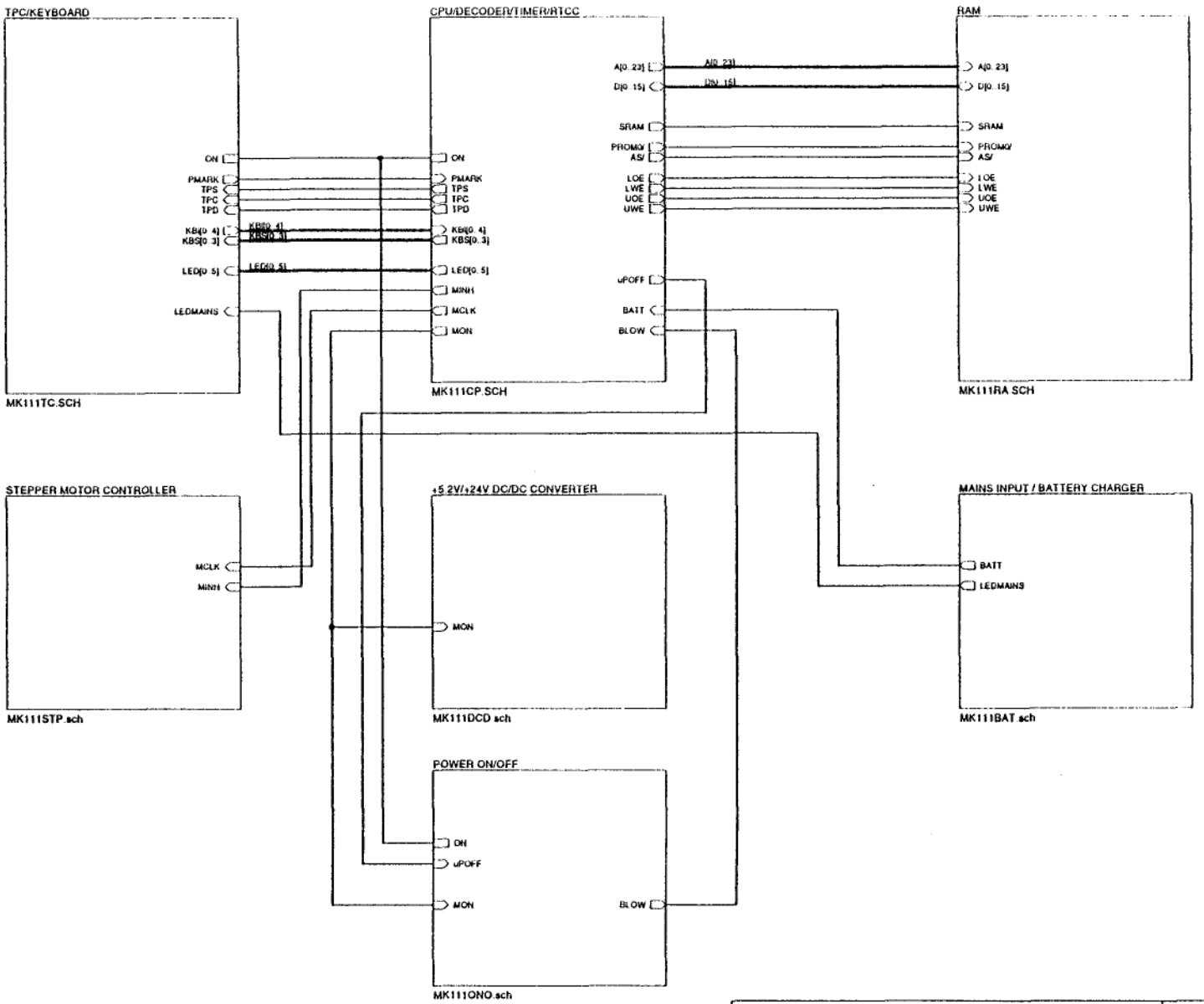
Service Handbook Document History AT-1

Service Handbook Issue 2 July 1998 Art. No. 2.530 033 Delivery date: 10.07.98

							Receipt Acknowledged						
Unit	**Detail**	**Article Number**	**Drawing date**	**Description**	**HW**	**Delivery date**	**DE**	**AU**	**IT**	**FR**	**US**	**CAN**	**CHD**
AT-1	ATIVERB	REV-Aa	21.03.95	Verbindungs-Konzept		10.07.98							
AT-1	MK11-1	2420Aa	08.07.94	Microprocessor									
		2420Ba	30.08.94										
		2420Ca	07.10.94										
		2420Cb	07.10.94										
		2420Cc	30.05.95										
		2420Cd	30.05.95										
		2420Ce	21.06.95										
		2420Da	04.01.96										
		2420DB	30.01.97			10.07.98							
AT-1	MK11-2	2421Aa	04.07.94	ECG-Interface									
		2421Ba	01.02.95										
		2421Bb		keine Schema-Änderung									
		2421Bc		keine Schema-Änderung									
		2421Bd	01.02.96										
		2421Ca	11.03.96			10.07.98							
AT-1	MK11-3	2422Aa	11.07.94	Keyboard Print AT-1 SP-1									
		2422Ba	08.11.95			10.07.98							
AT-1	MK11-51	2423Aa	20.06.94	PM-Detector AT-1/4/104 SP-									
		2423Ba	13.12.94	1		10.07.98							
AT-1	MK11-9	2424Aa	19.10.95	Treiber Print für EKG Trafo		10.07.98							



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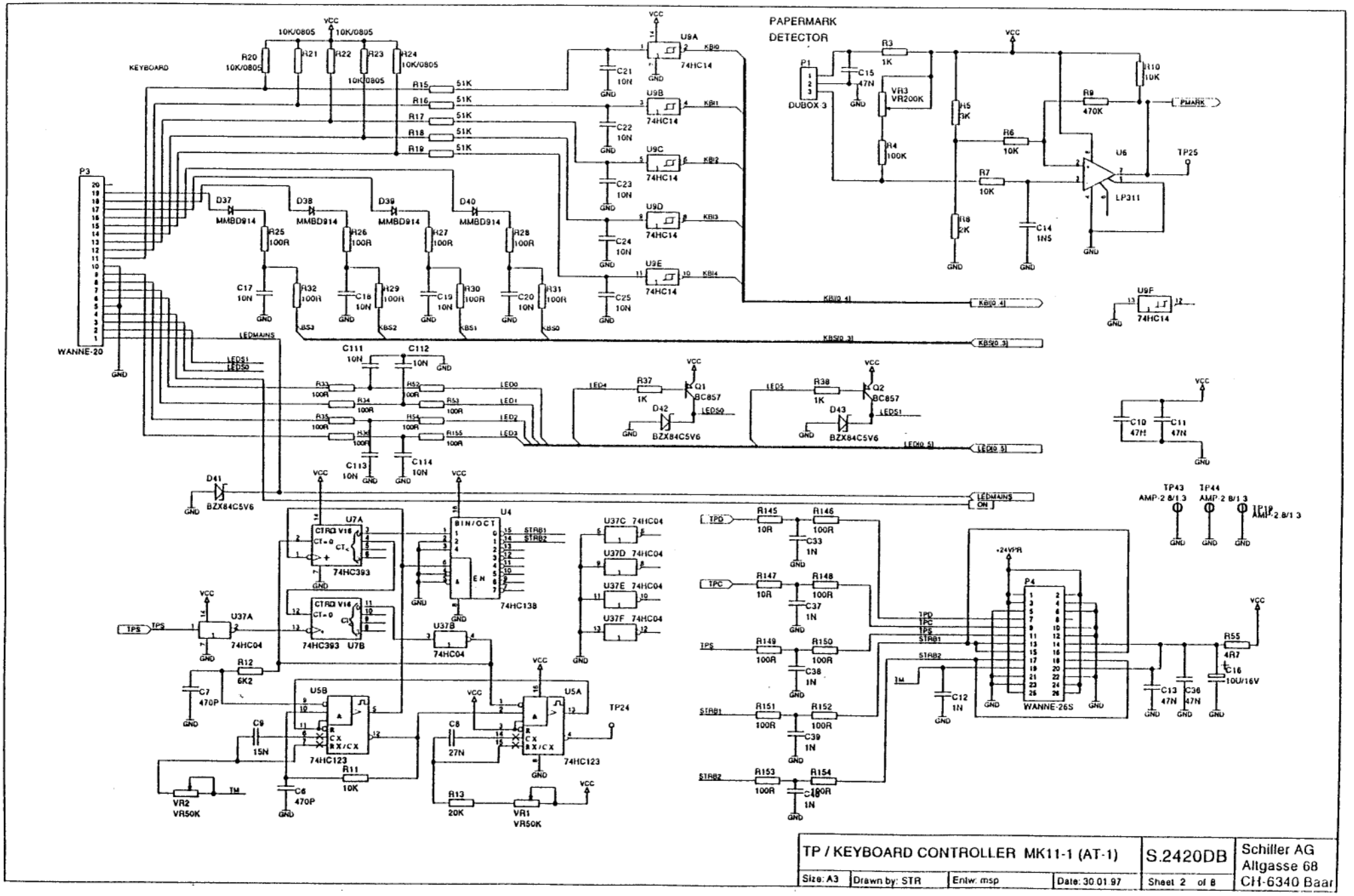
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WANNE-26S
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74HC123
BZX84C5V6
BC857
MMBD914
TP / KEYBOARD CONTROLLER MK11-1 (AT-1)
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Altgasse 68
CH-6340 Baar
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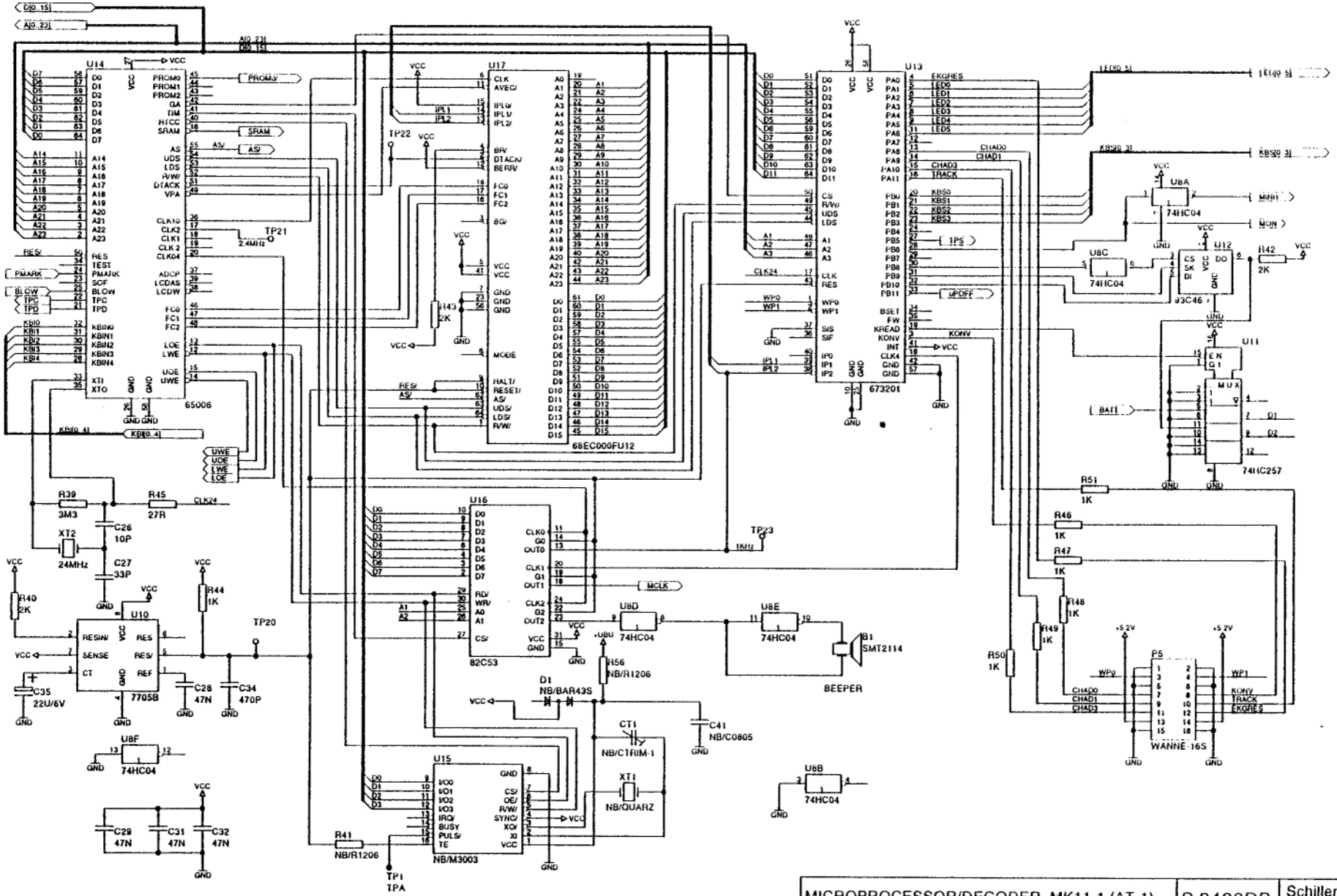
Sheet 2 of 8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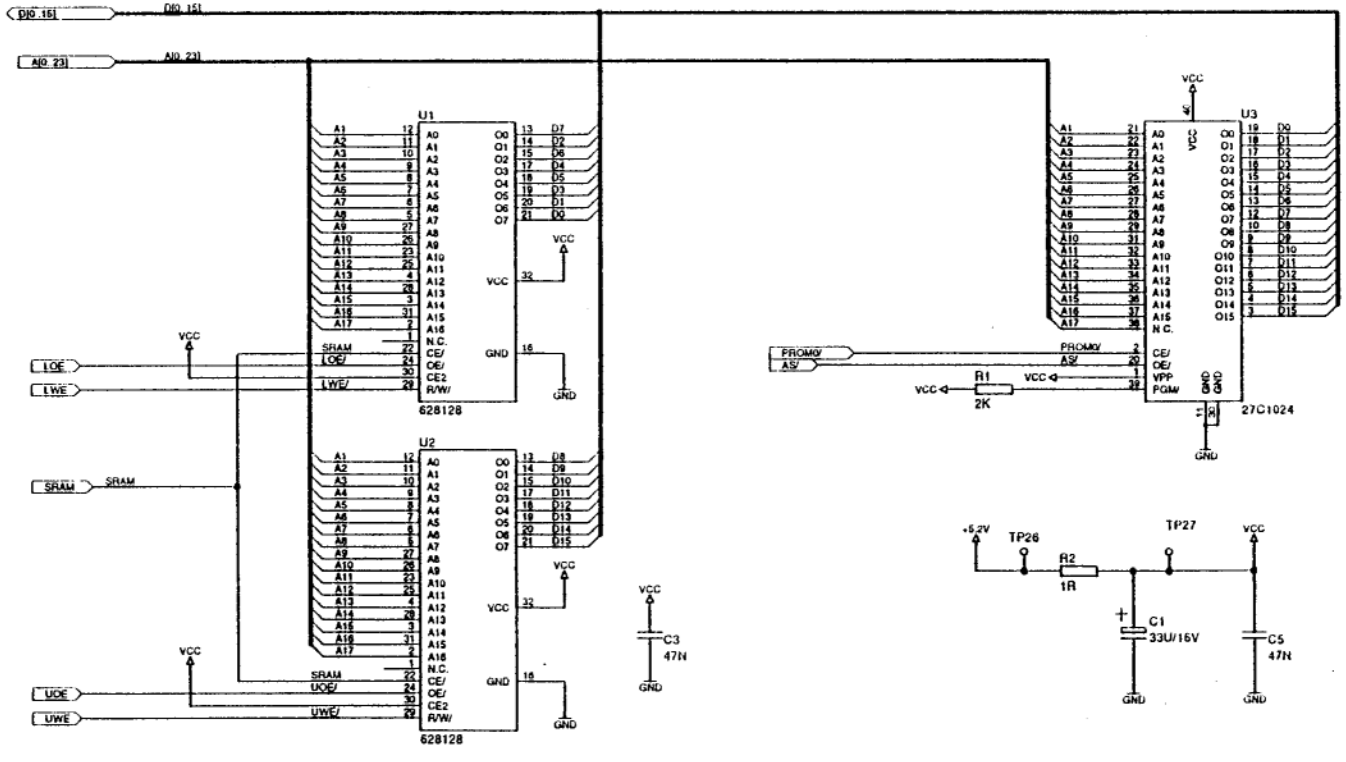

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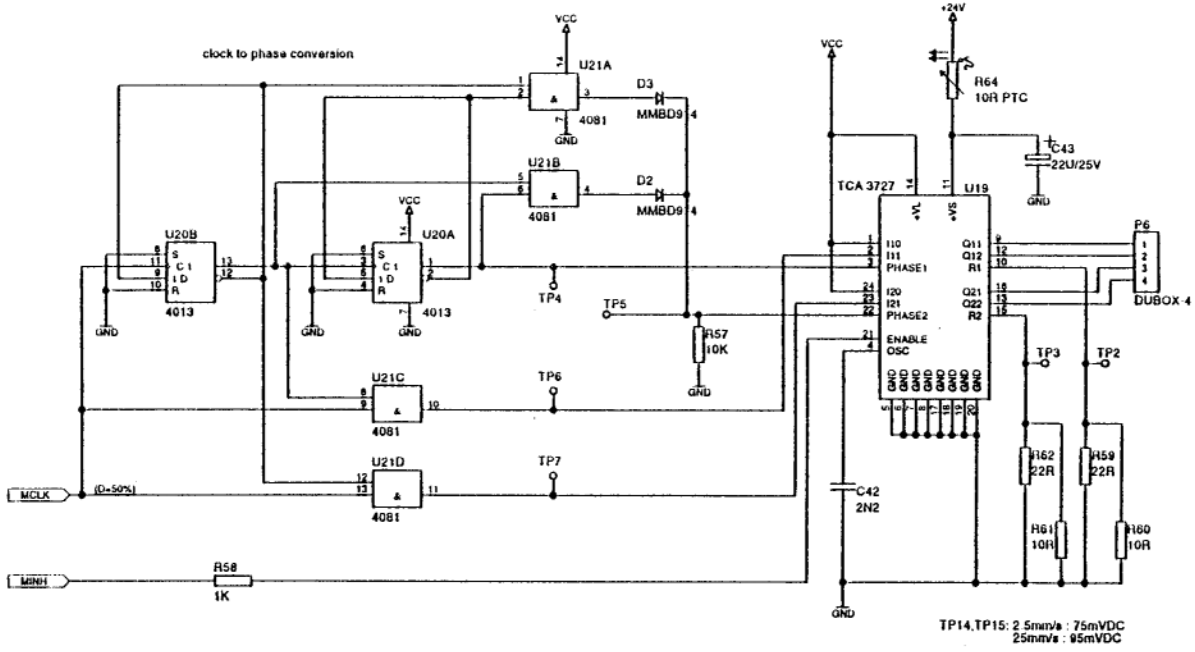

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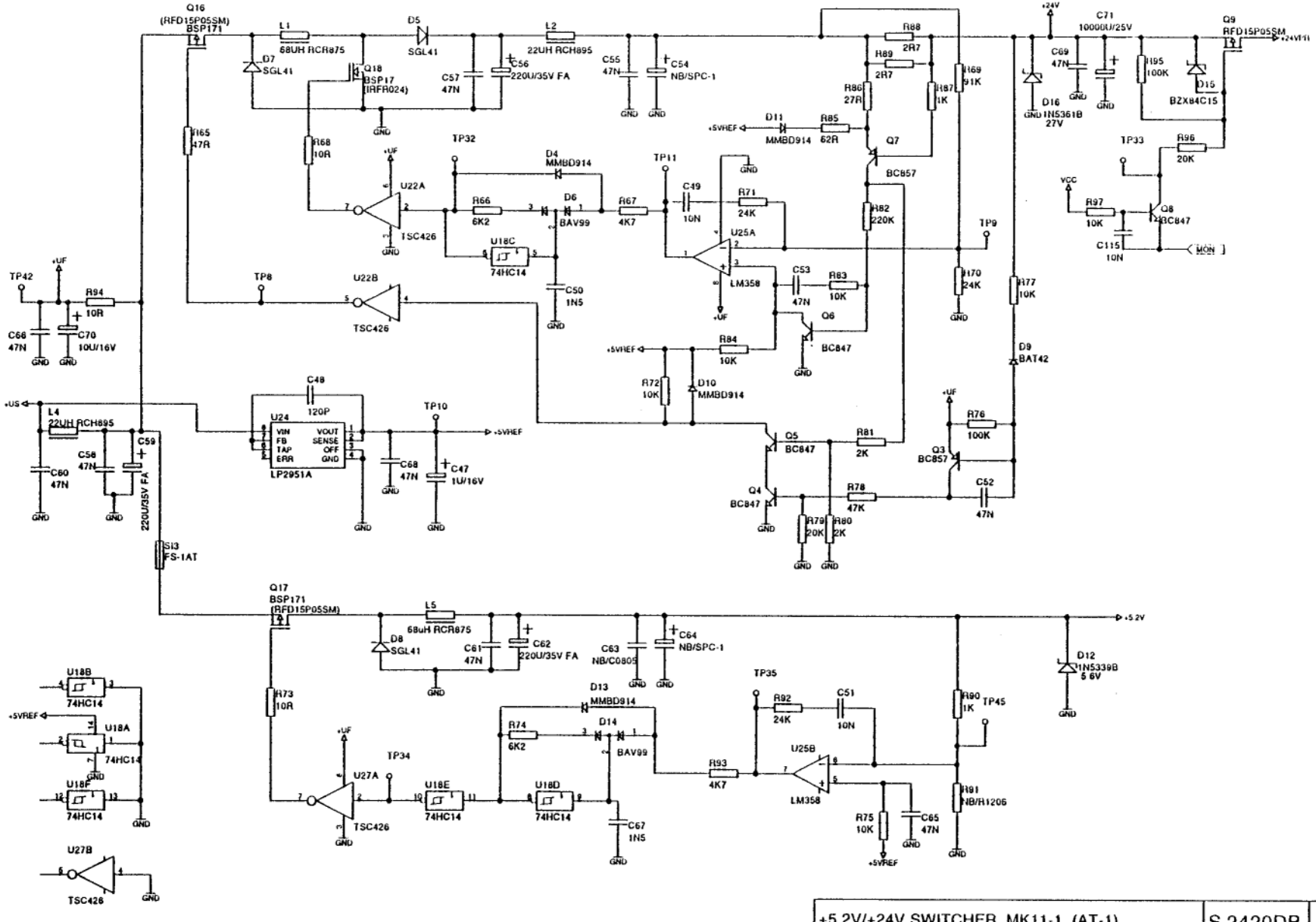

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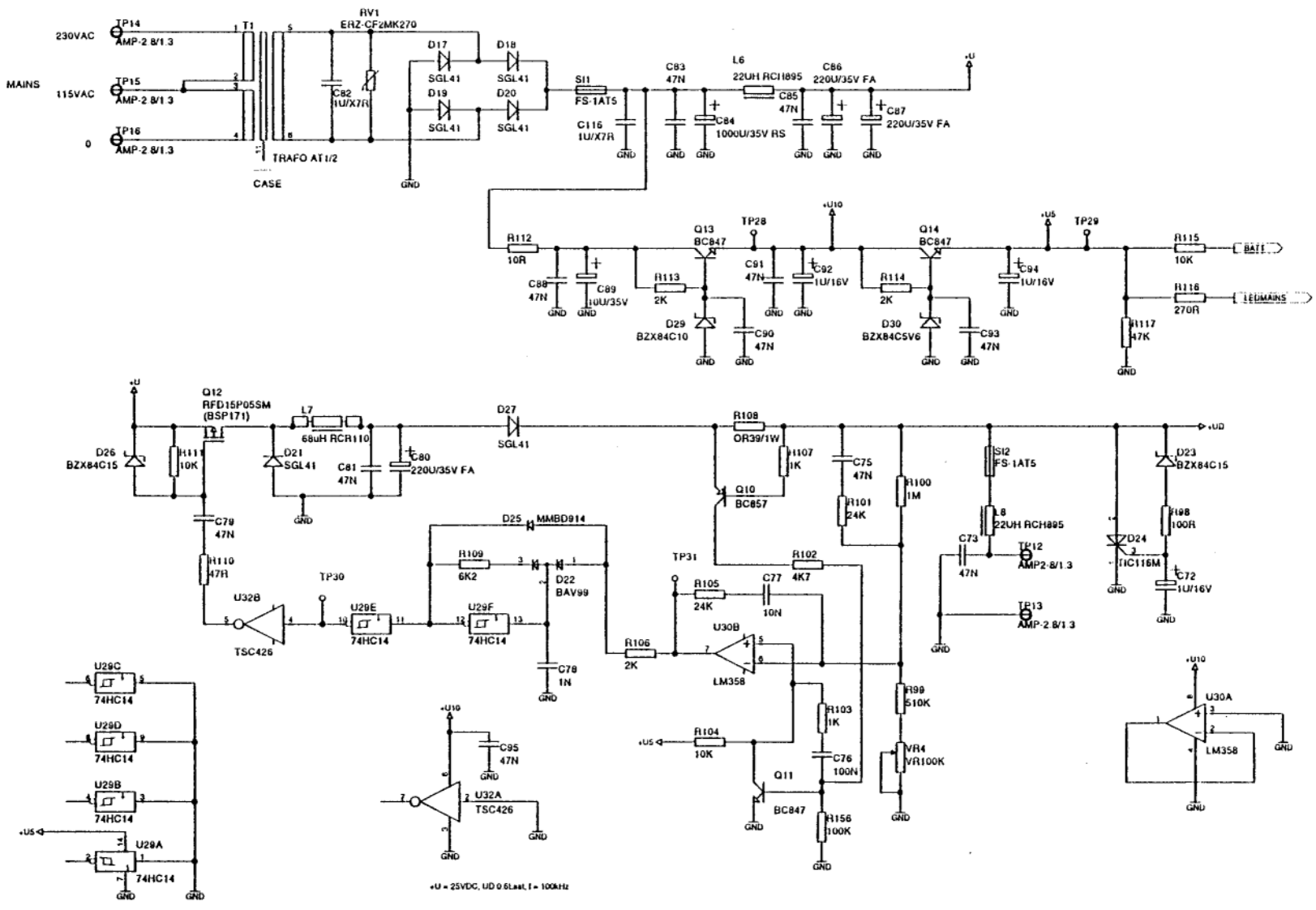

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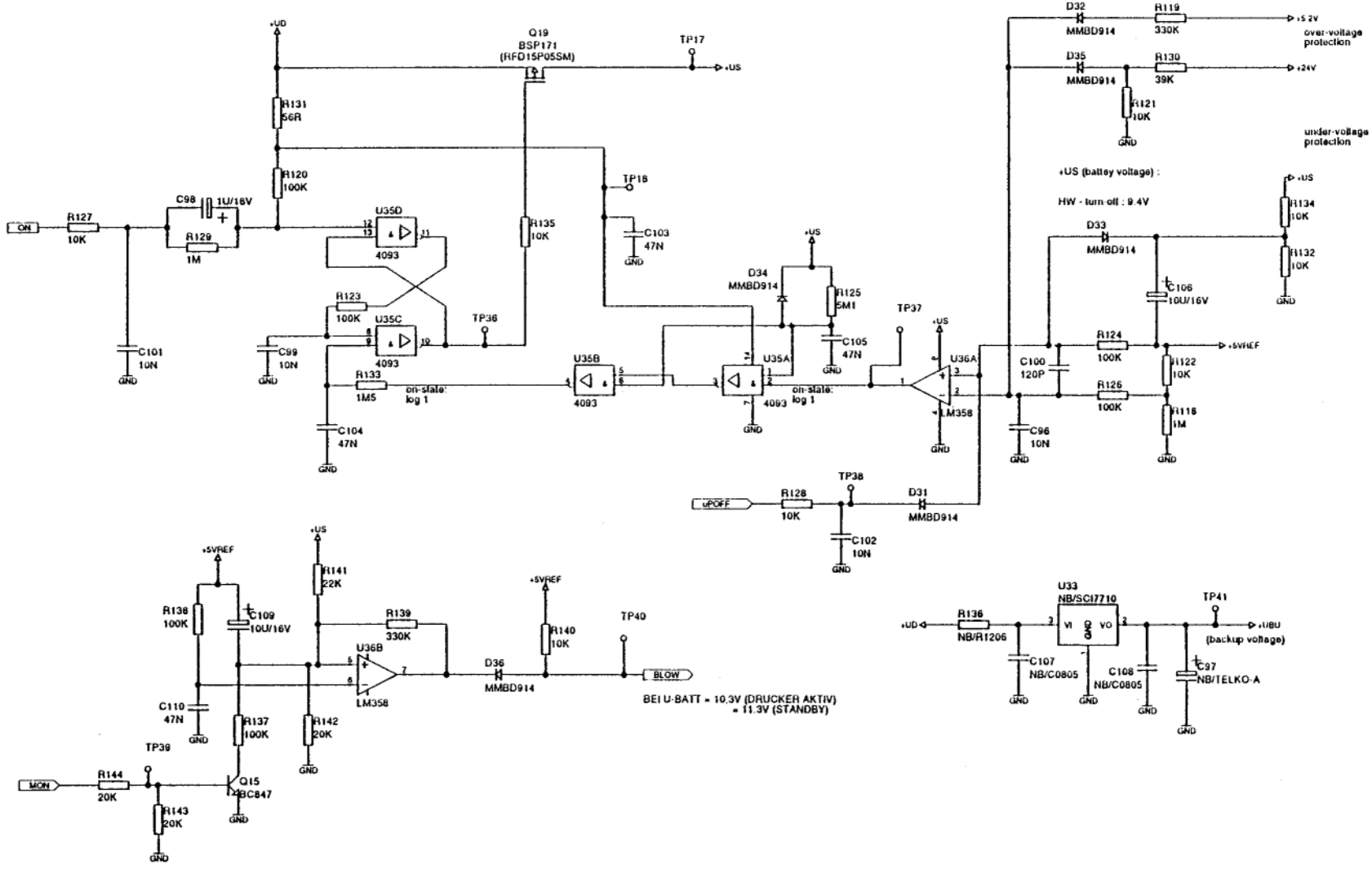

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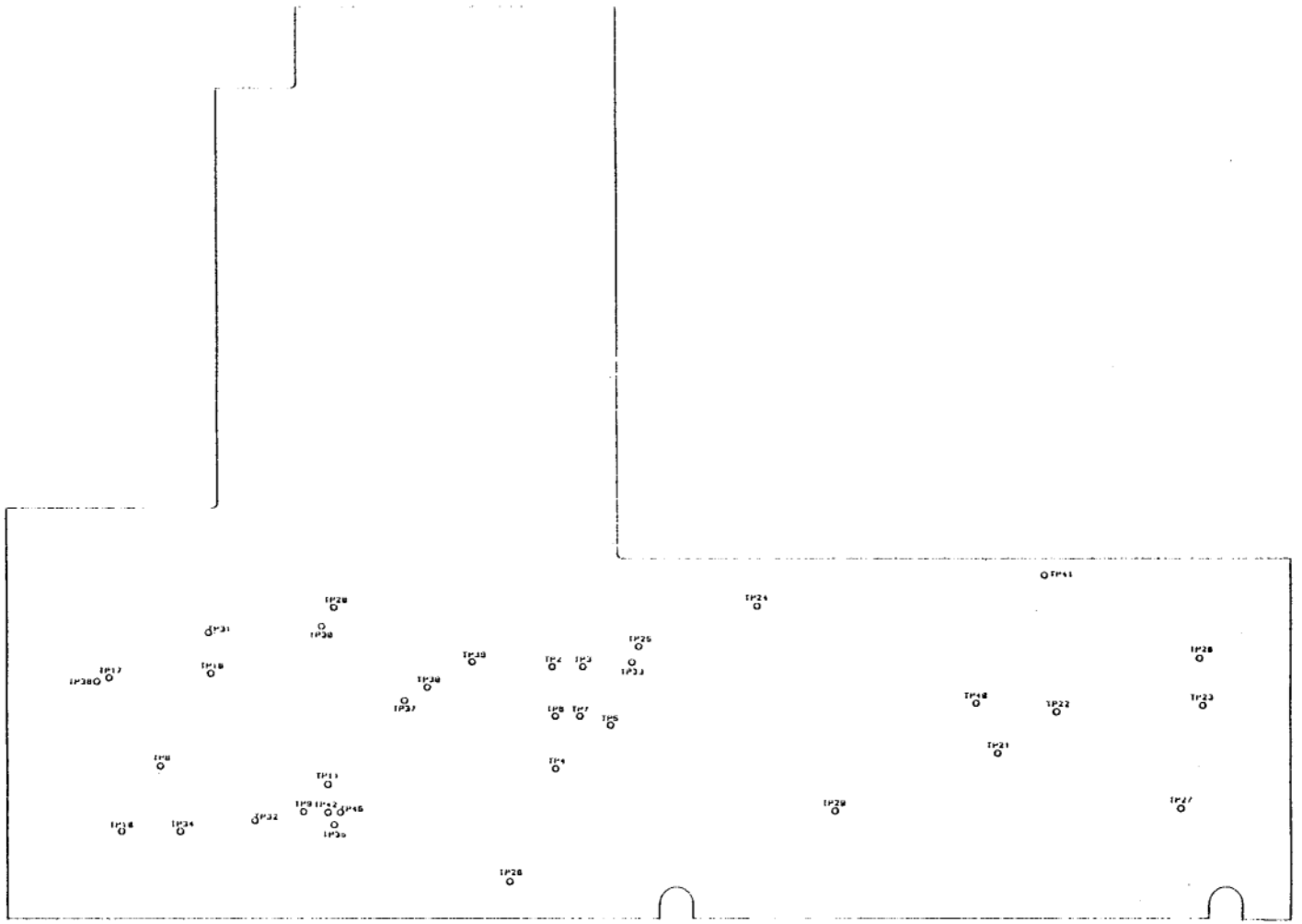

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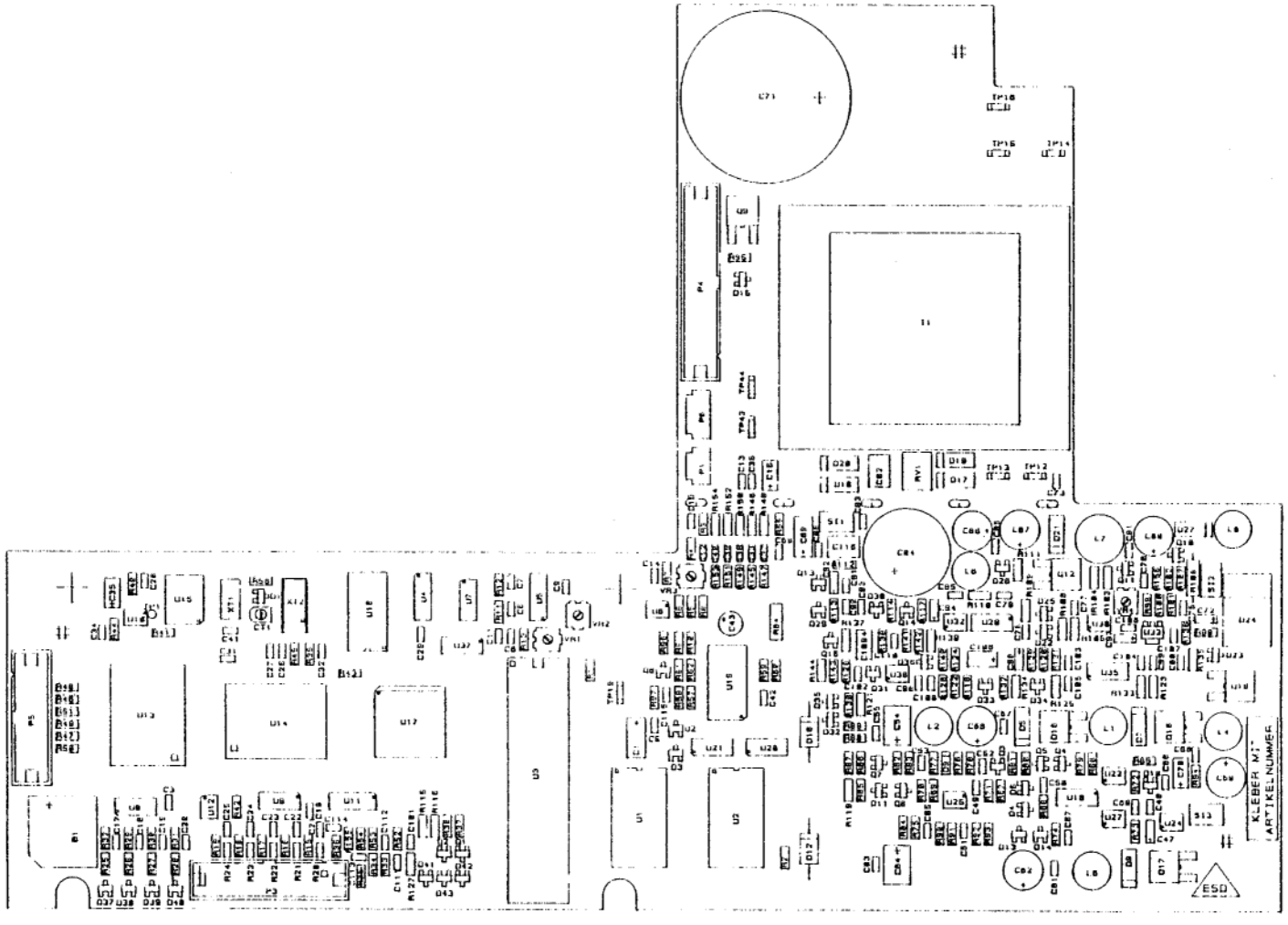

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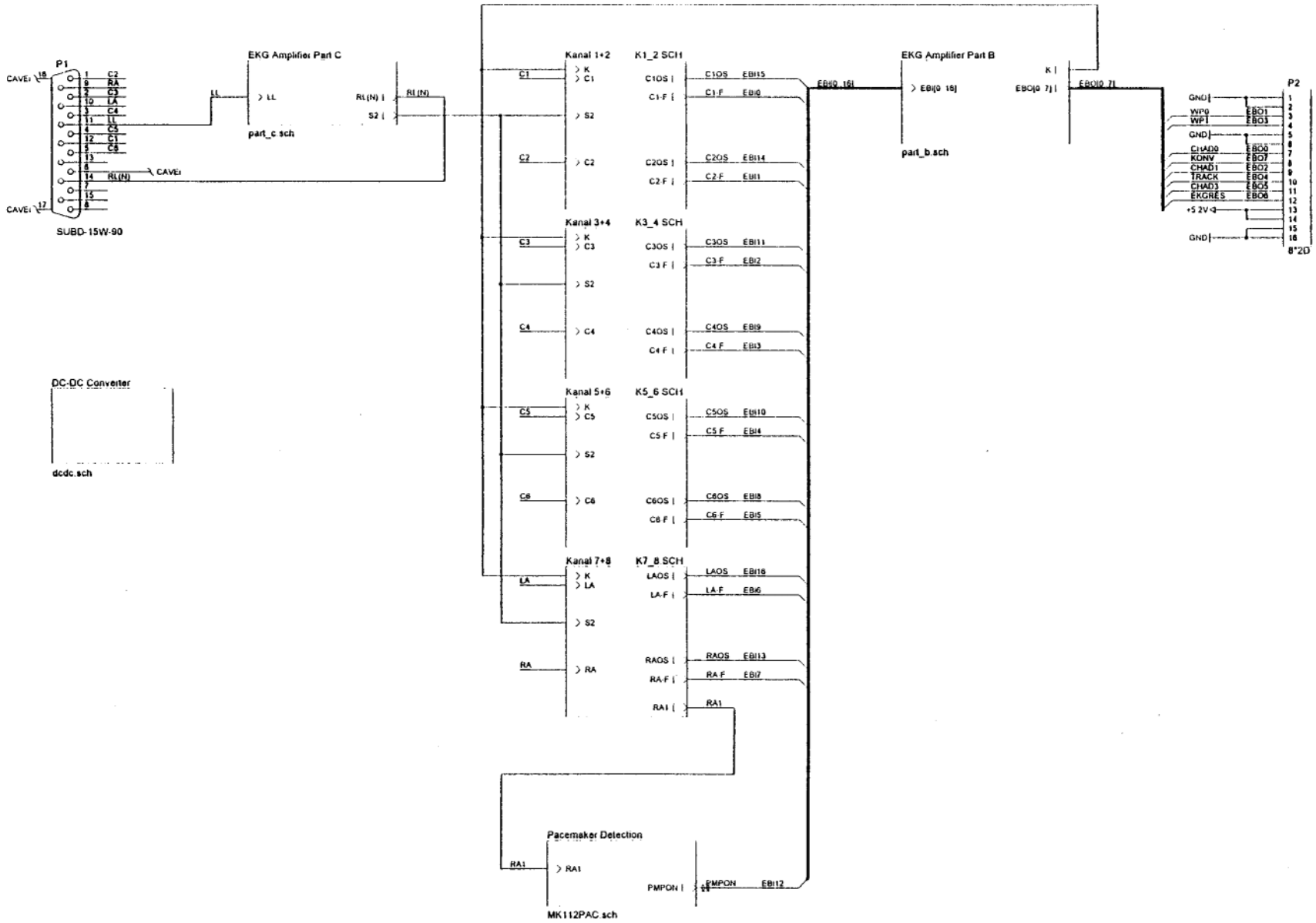

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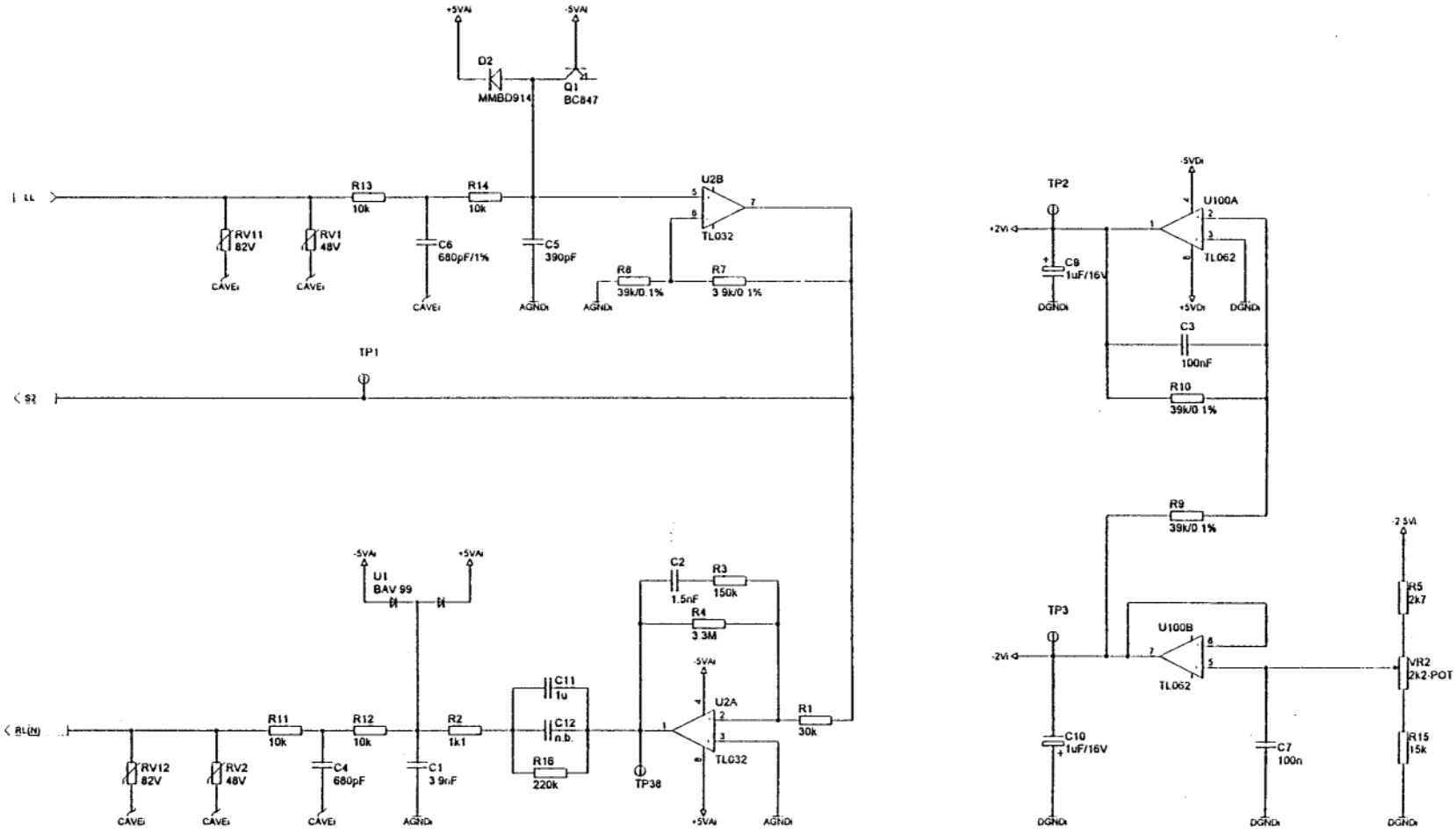

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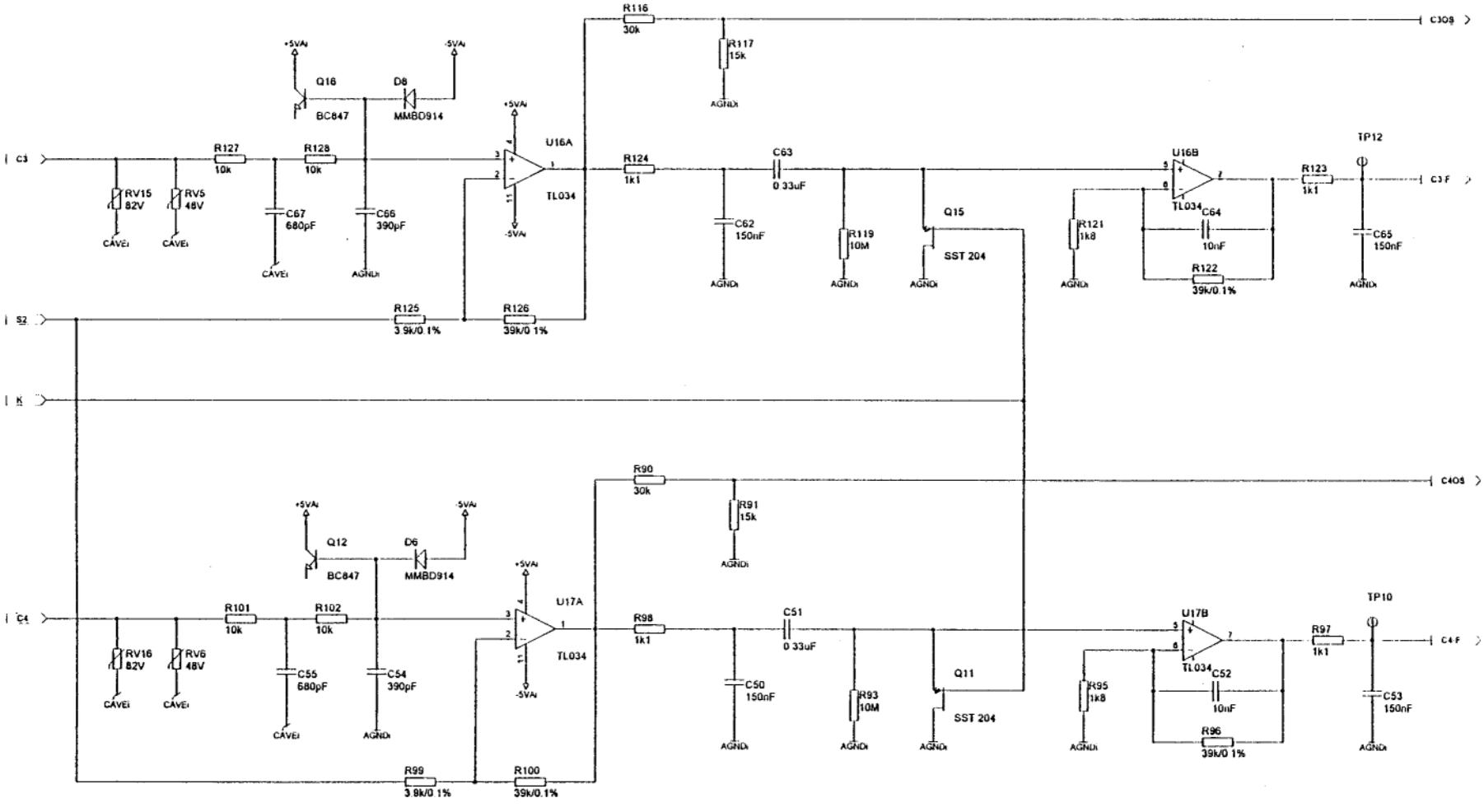

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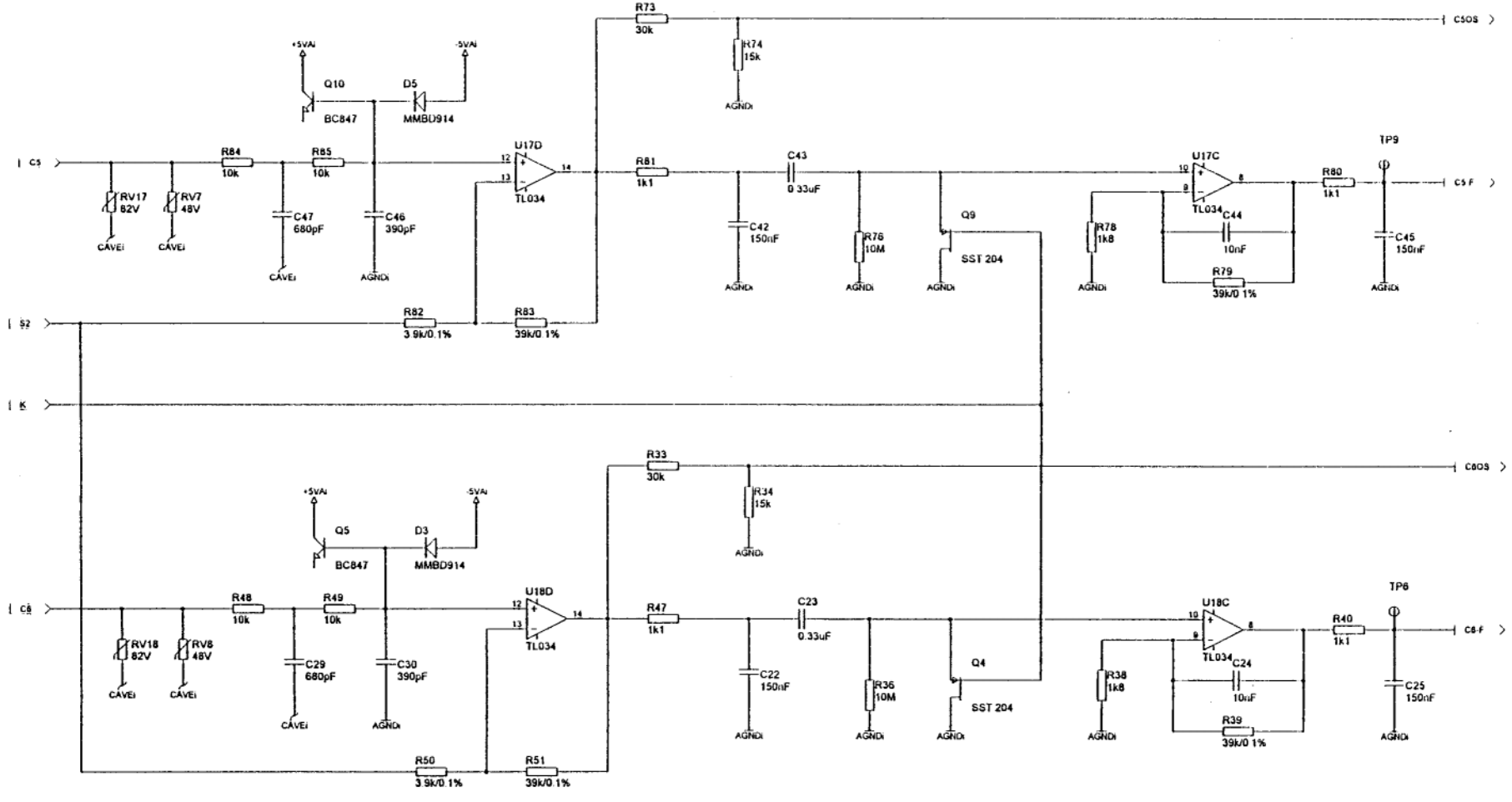

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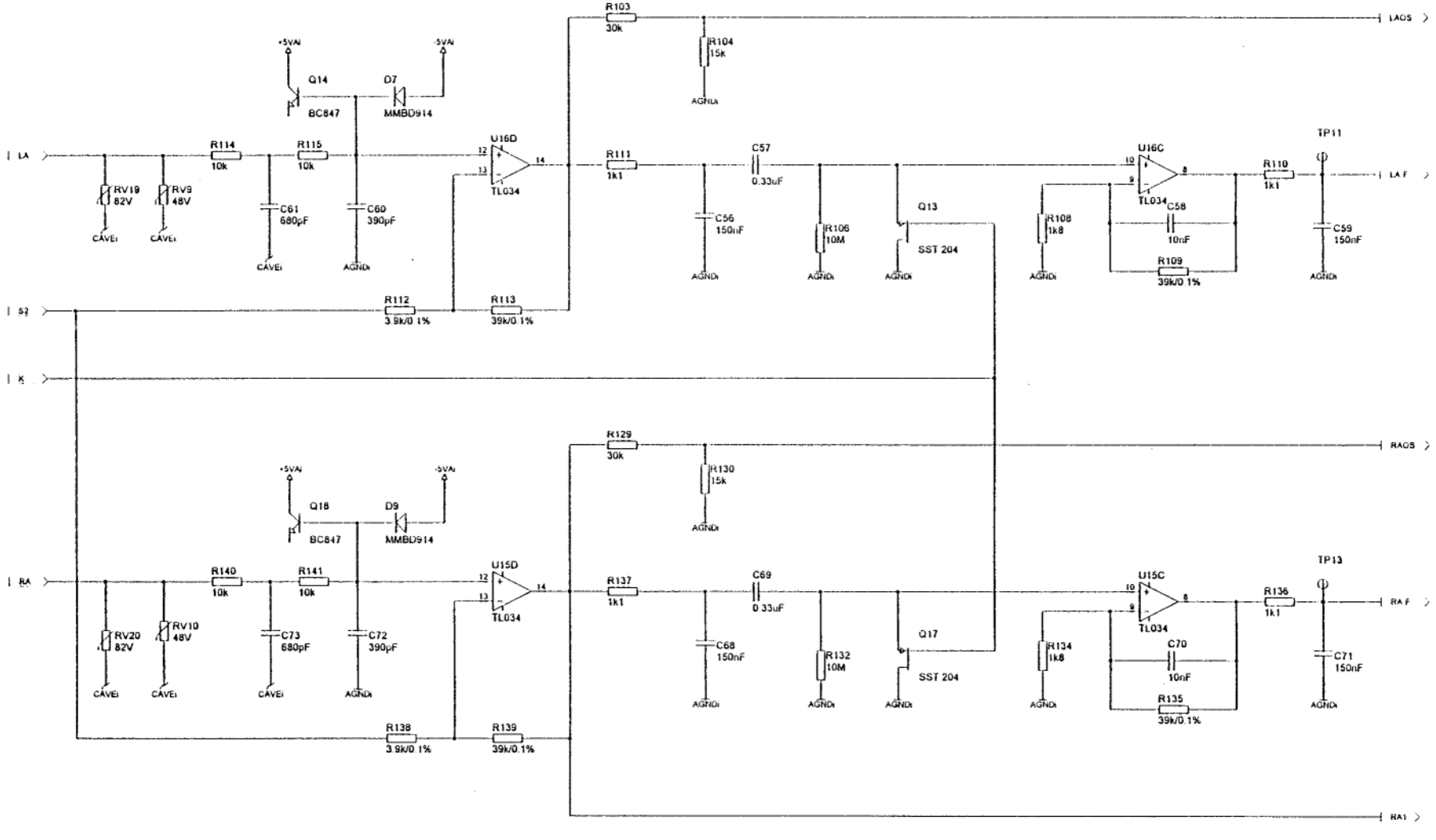

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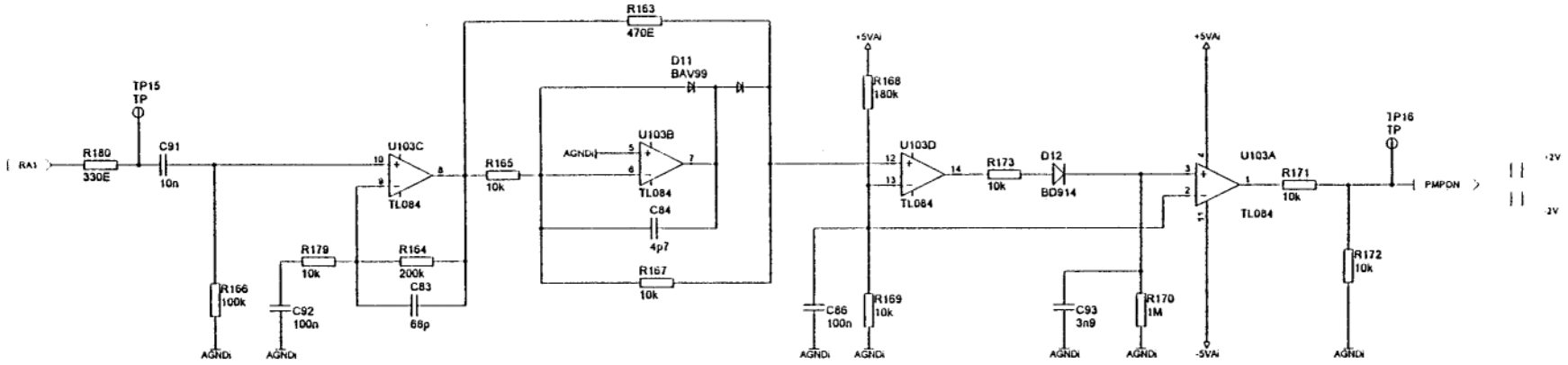
			Switzerland



Title ECG PACEMAKER TRIGGER		MK11-2 (AT-1)		Schiller AG
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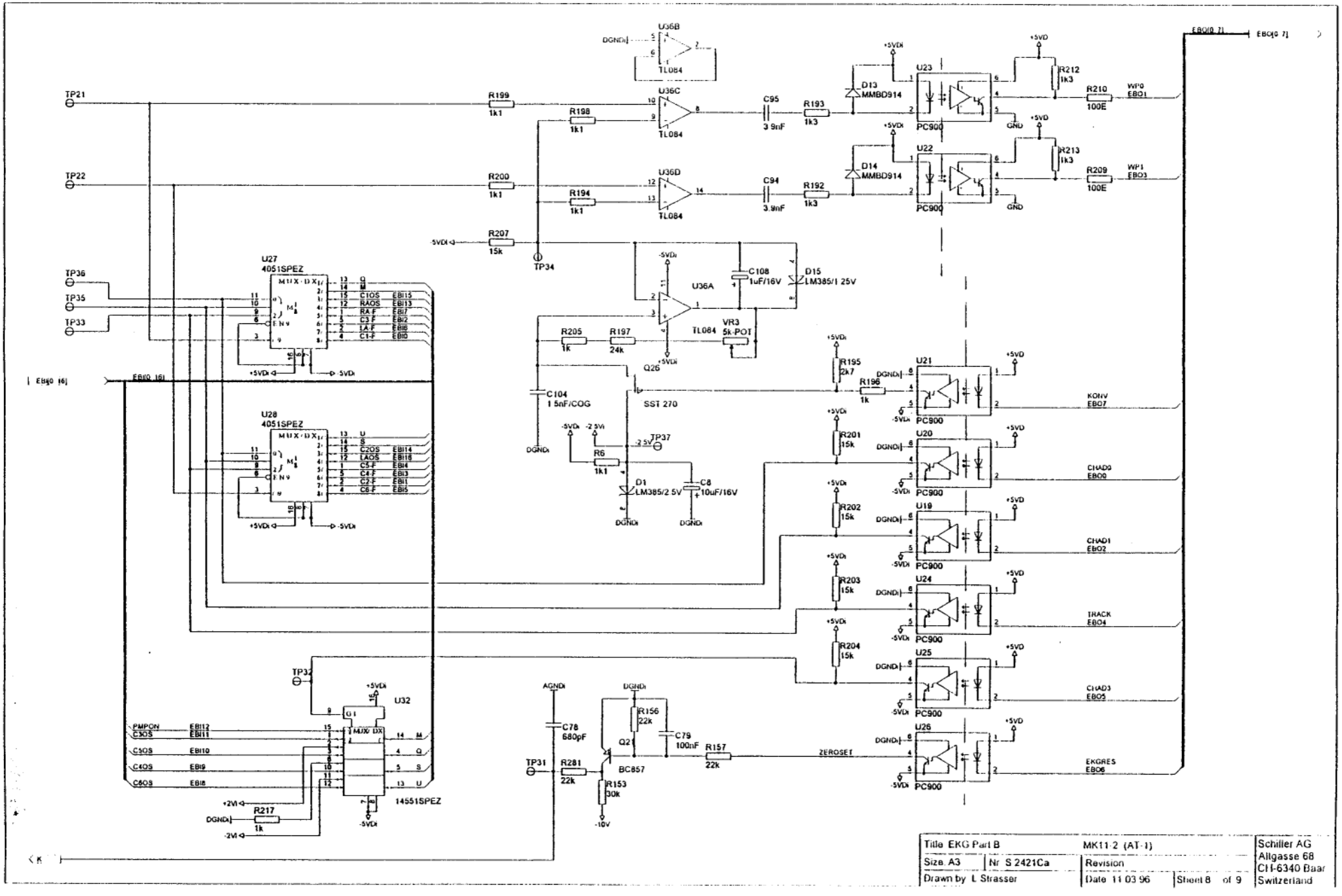
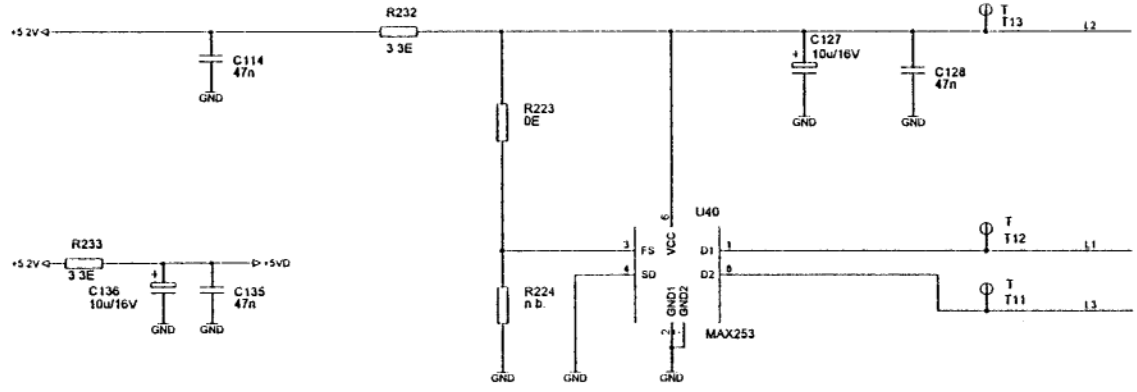
Drawn by L Strasser		Date 11 03 96	Sheet 7 of 9	CH-6340 Baar
				Switzerland

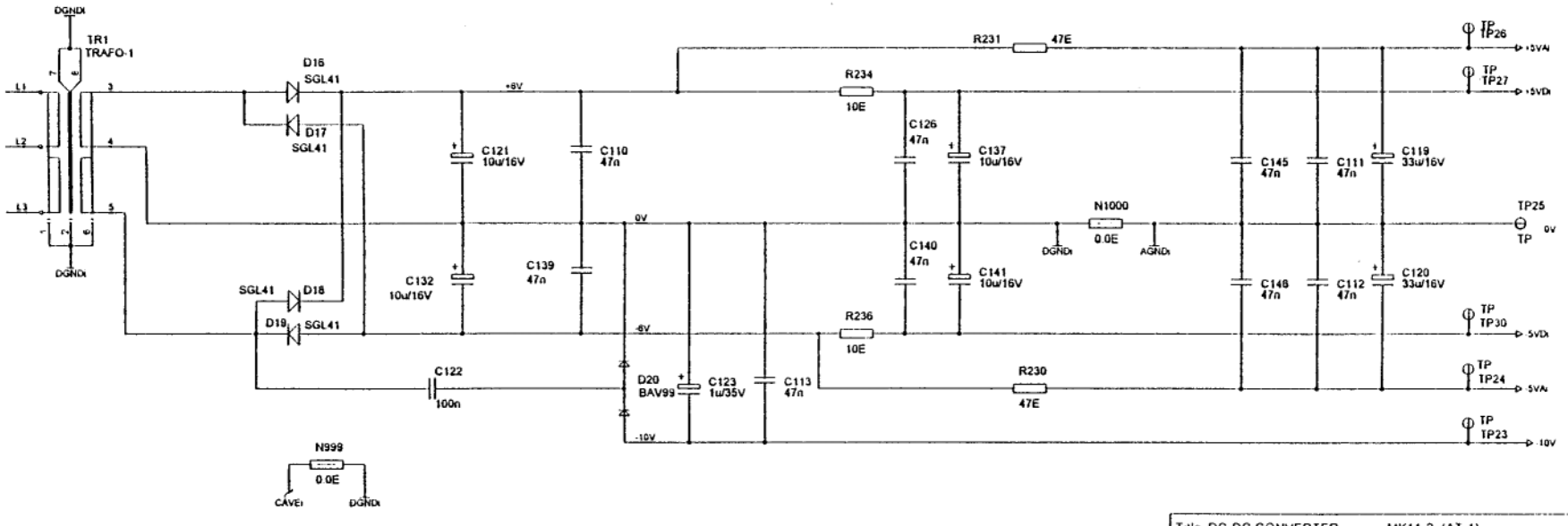


Title EKG Part B		MK11.2 (AT-1)	Schiller AG
Size A3	Nr S 2421Ca	Revision	Allgasse 68
Drawn by L Strasser		Date 11.03.96	Sheet 8 of 9	CH-6340 Baar
			Switzerland

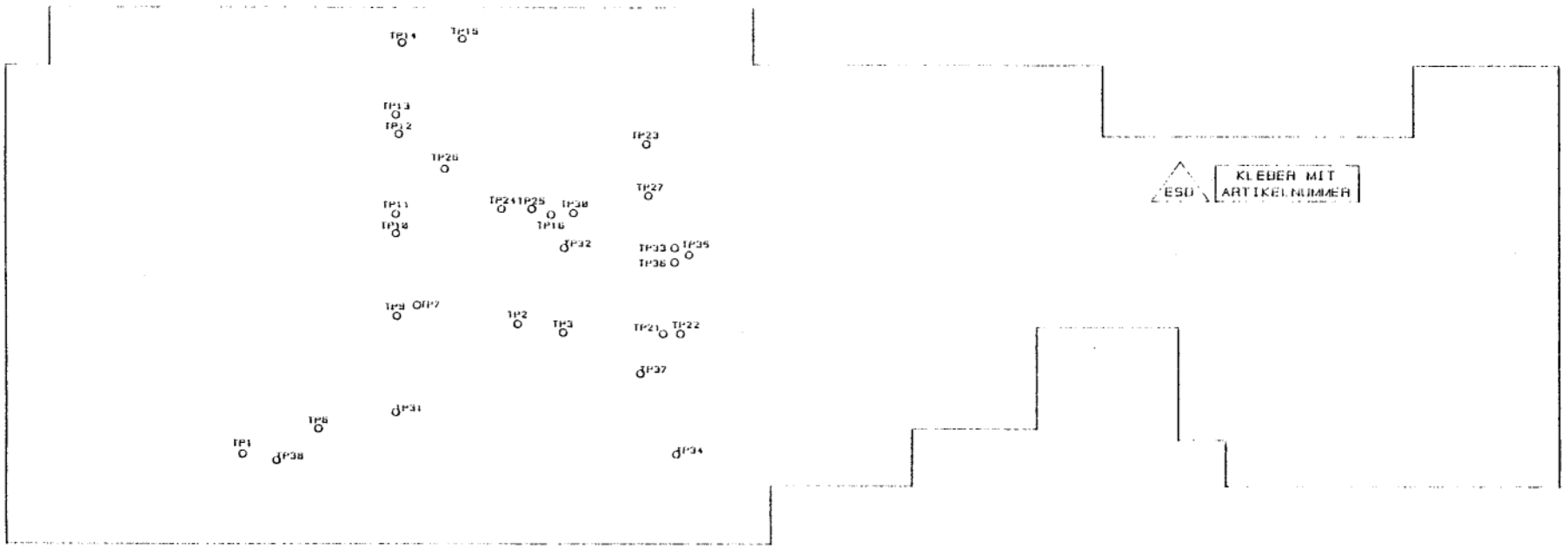


GALVANIC ISOLATION

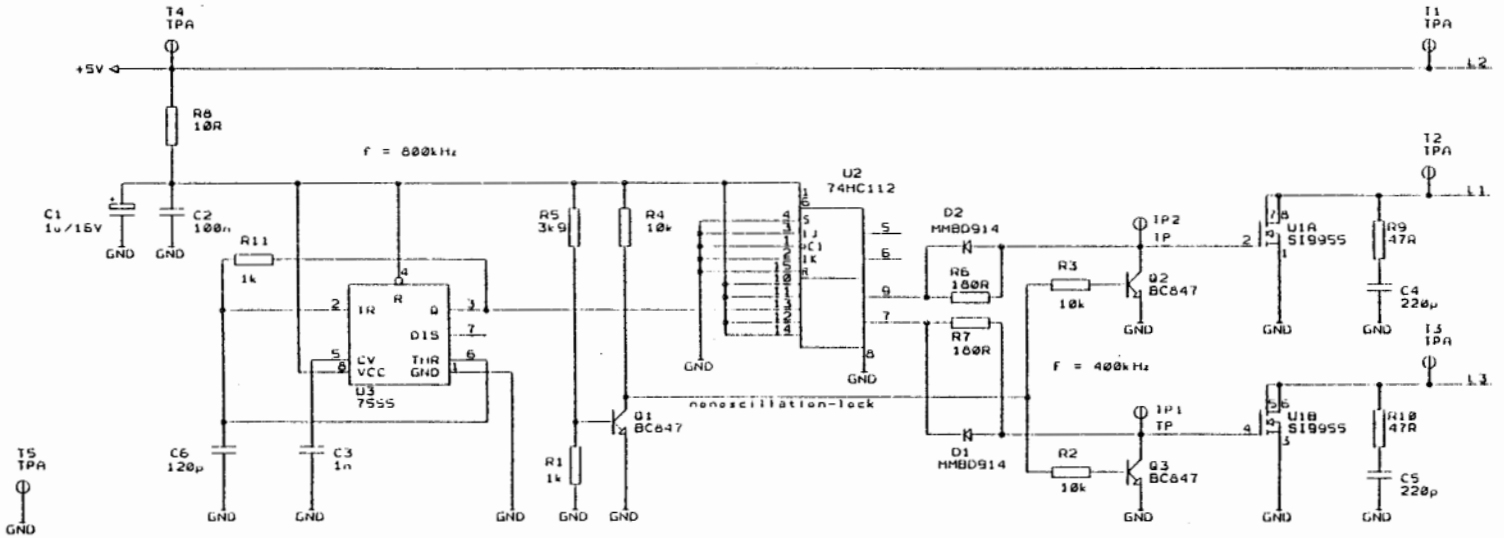
PATIENT APPLIED



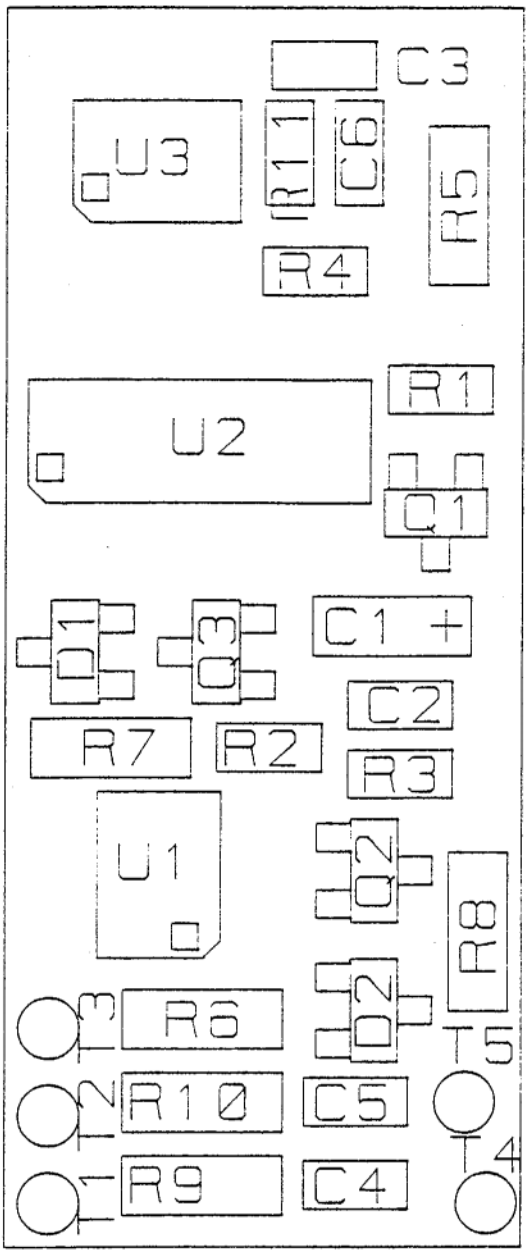
Title DC-DC CONVERTER		MK11-2 (AT-1)	Schiller AG Altgasse 68 CH-6340 Baar Switzerland
Size A3	Nr S 2421Ca	Revision	
Drawn by L Strasser		Date 11.03.96	Sheet 9 of 9



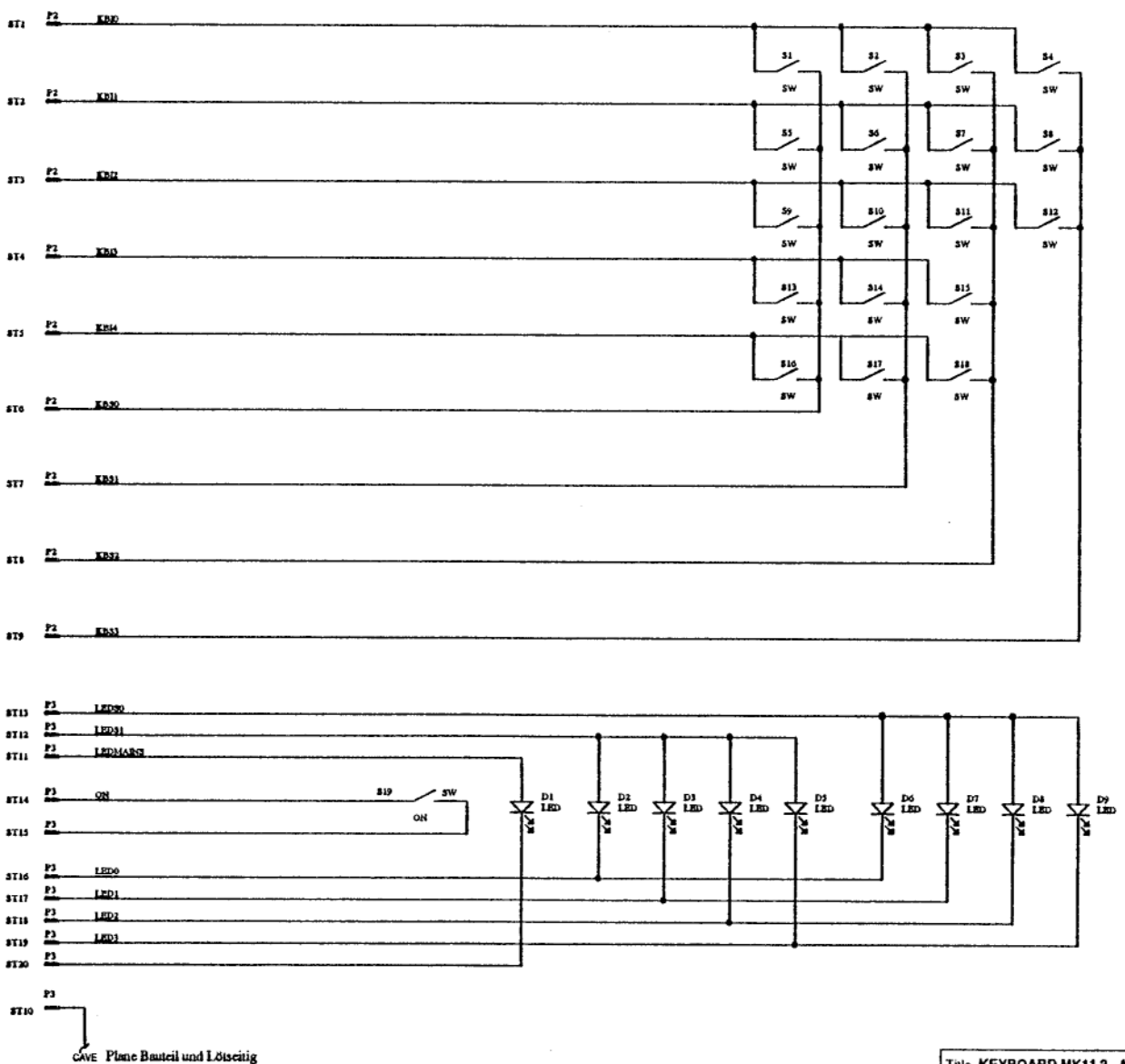
SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland		Visum Gez : STR. Entw : Prod :
Title EKG-INTERFACE MK11-2		AT-1
Size	Document Number D.2421Ca	LOETSEITE
Date: 13.03.1996	Sheet	2 of 2



	SCHILLER AG
	Altgasse 68 6340 Baar Switzerland
Title	TREIBER PRINT FUER EKG TRAFO MK11 9
Size: B	Document Number: S 24240a
Date: October 19, 1995	Sheet 1 of 1

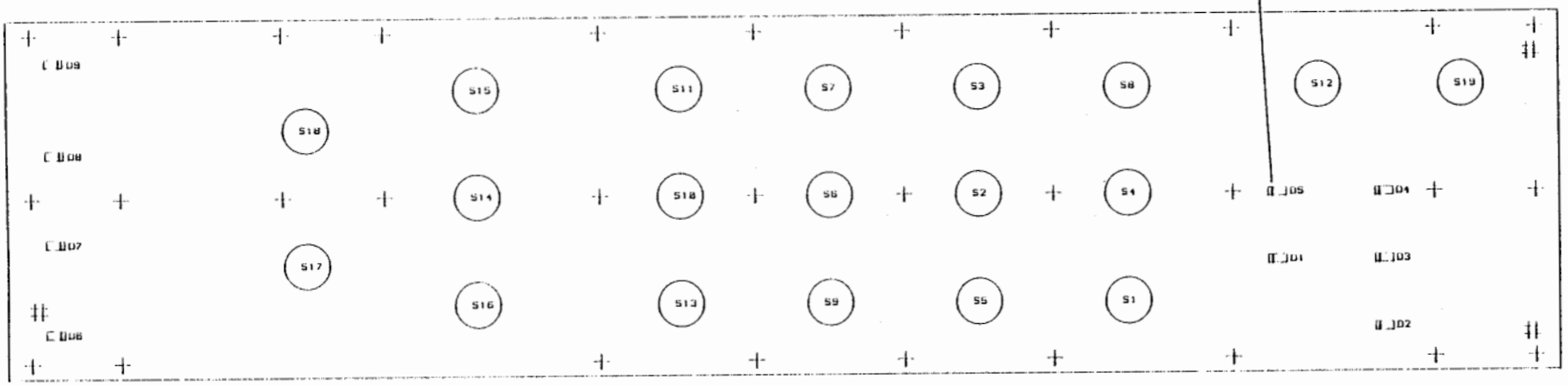


SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland		Visum Gez : GAU Entw : Hfl Prod :
Title TREIBER PRINT FUER EKG-TRAFO		AT-1
Size	Document Number D.2424Aa	
Date: 20.10.95	Sheet	1 of 1

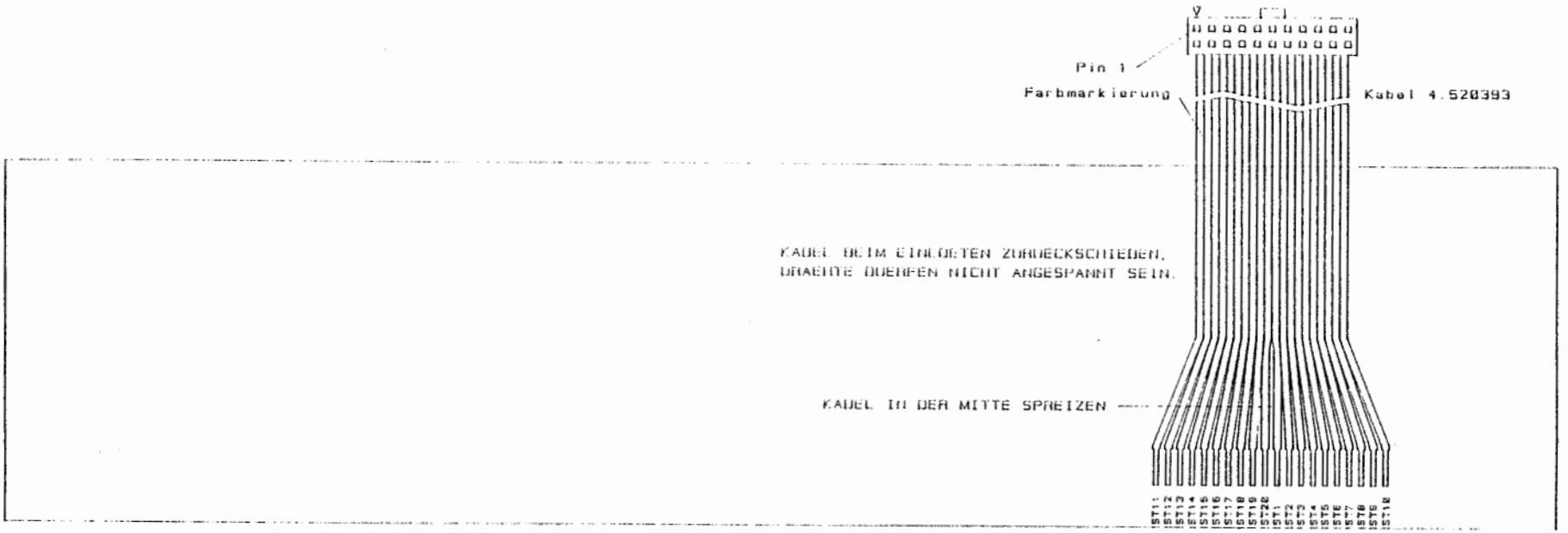


Title KEYBOARD MK11-3 AT-1			Schiller AG Altgasse 68 CH-6340 Baar Switzerland
Size: A3	Nr: S.2422Ba	Revision:	
Drawn by:Gau		Date:8-Nov-1995	Sheet1 of 1

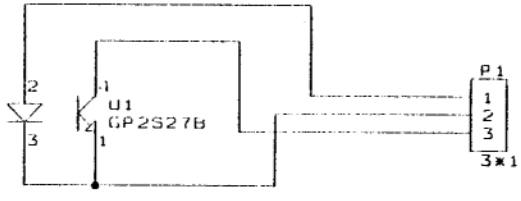
Farbmarkierungen beachten !



SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland		Visum Gez : STR. Entw : Prod :
Title KEYBOARD MK11-3		AT-1/SP-1
Size	Document Number D.2422CA	
Date: 05.11.1996	Sheet	1 of 2



SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland		Visum Gez : STR. Entw : Prod :
Title KEYBOARD MK11-3		AT-1/SP-1
Size	Document Number D.2422CA	
Date: 05.11.1996	Sheet	2 of 2



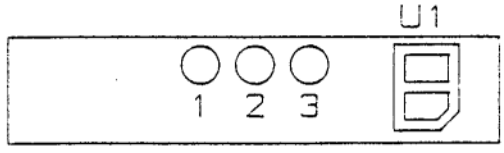
SCHILLER AG

Altgasse 68
CH-6340 Baar
Switzerland

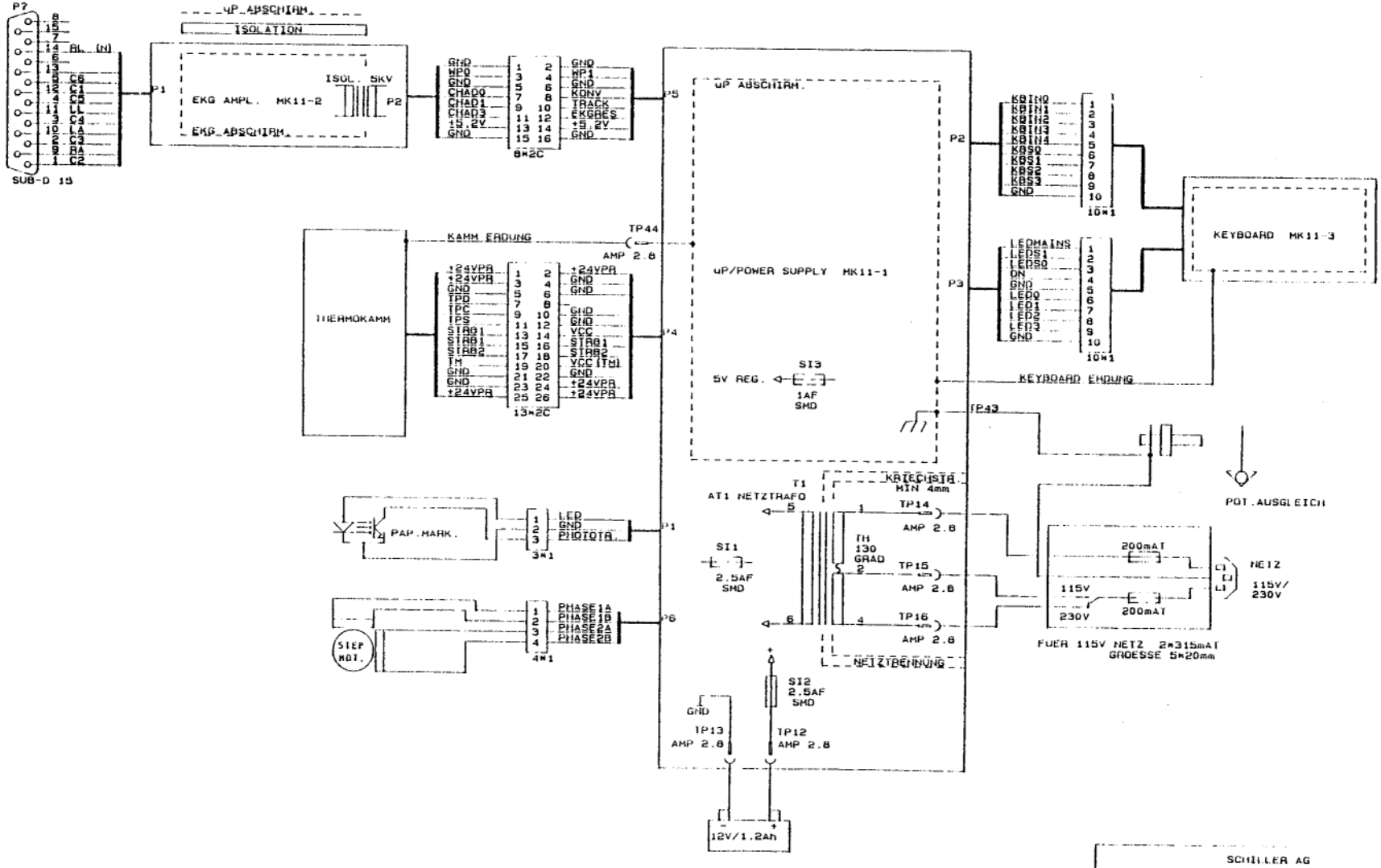
Title

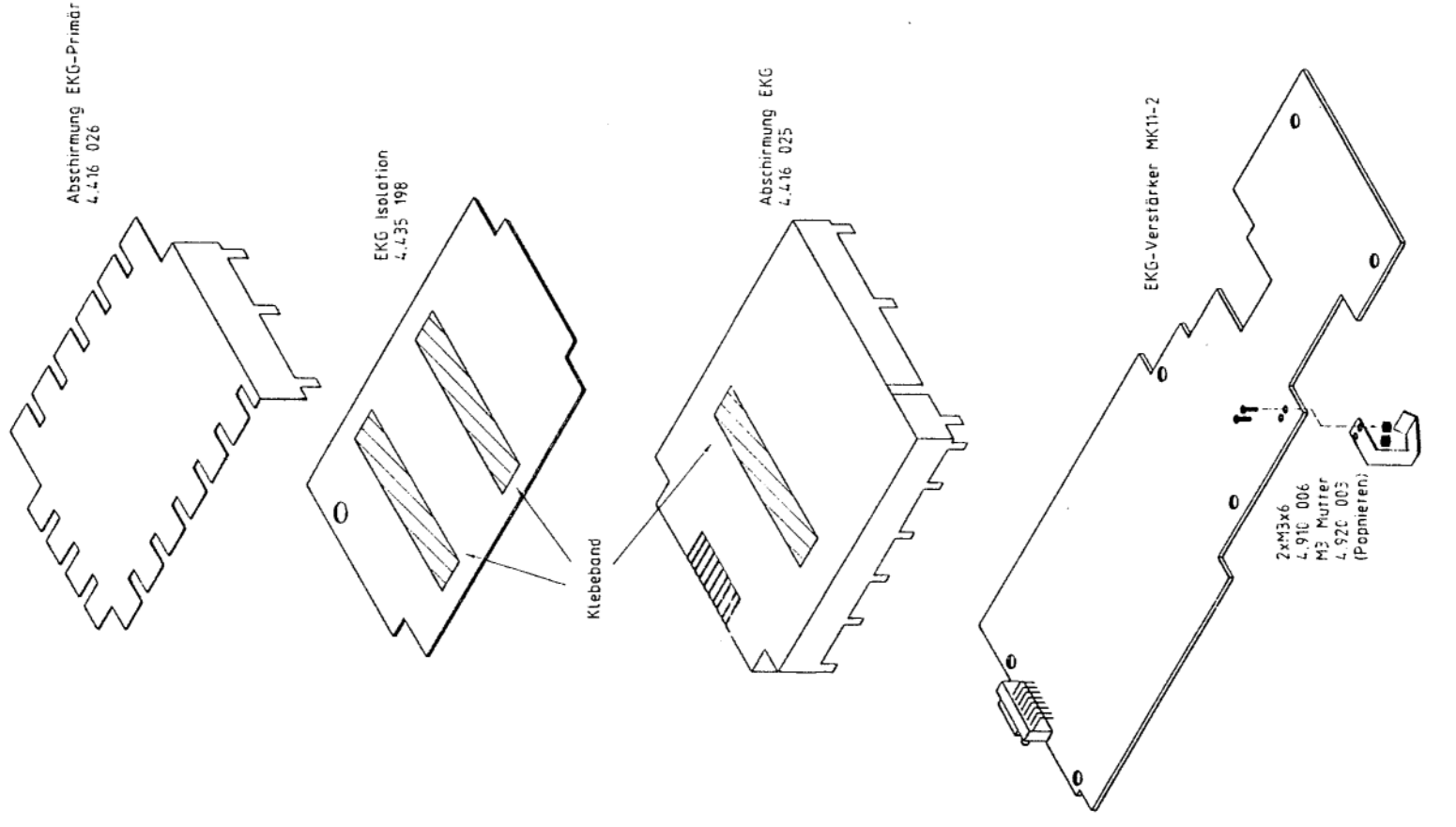
PM-DECODER MK11-51 (A1-1 / A1-4) MB

Size	Document Number	REV
A	S.2423Ba	
Date: December 13, 1994	Sheet 1 of 1	



	SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland	Visum Gez : STR Entw : Prod :
Title PAPIERMARKEN-DETEKTOR MK11-51 AT-1/4		
Size	Document Number D.2423Ba	
Date: 14.12.1994	Sheet 1 of 1	


P?
SUB-D 15
uP_ABSCHIRM
ISOLATION
EKG AMPL. MK11-2
ISOL. SKV
P1
P2
EKG_ABSCHIRM
8x2C
uP ABSCHIRM.
uP/POWER SUPPLY MK11-1
5V REG.
SI3
1AF
SMD
P5
P4
P3
P2
KAMM ERDUNG
TP44
AMP 2.8
THERMOKAMM
13x2C
KEYBOARD MK11-3
KEYBOARD ERDUNG
TP43
POT.AUSGLEICH
PAP.MARK.
3x1
LED
GND
PHOTOTR.
P1
PHASE1A
PHASE1B
PHASE2A
PHASE2B
STEP MOT.
4x1
P6
T1
AT1 NETZTRAFO
KRIECHSTR.
MIN 4mm
TP14
TP15
TP16
TH
130
GRAD
SI1
2.5AF
SMD
NETZBEHNUNG
SI2
2.5AF
SMD
TP13
TP12
12V/1.2Ah
200mAT
115V
230V
NETZ
115V/
230V
FUER 115V NETZ 2x315mAT
GROESSE 5x20mm
SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland
Title
BLOCKDIAGRAM AT-1
Size
B
Document Number
Date: March 21, 1995 Sheet 1 of 1

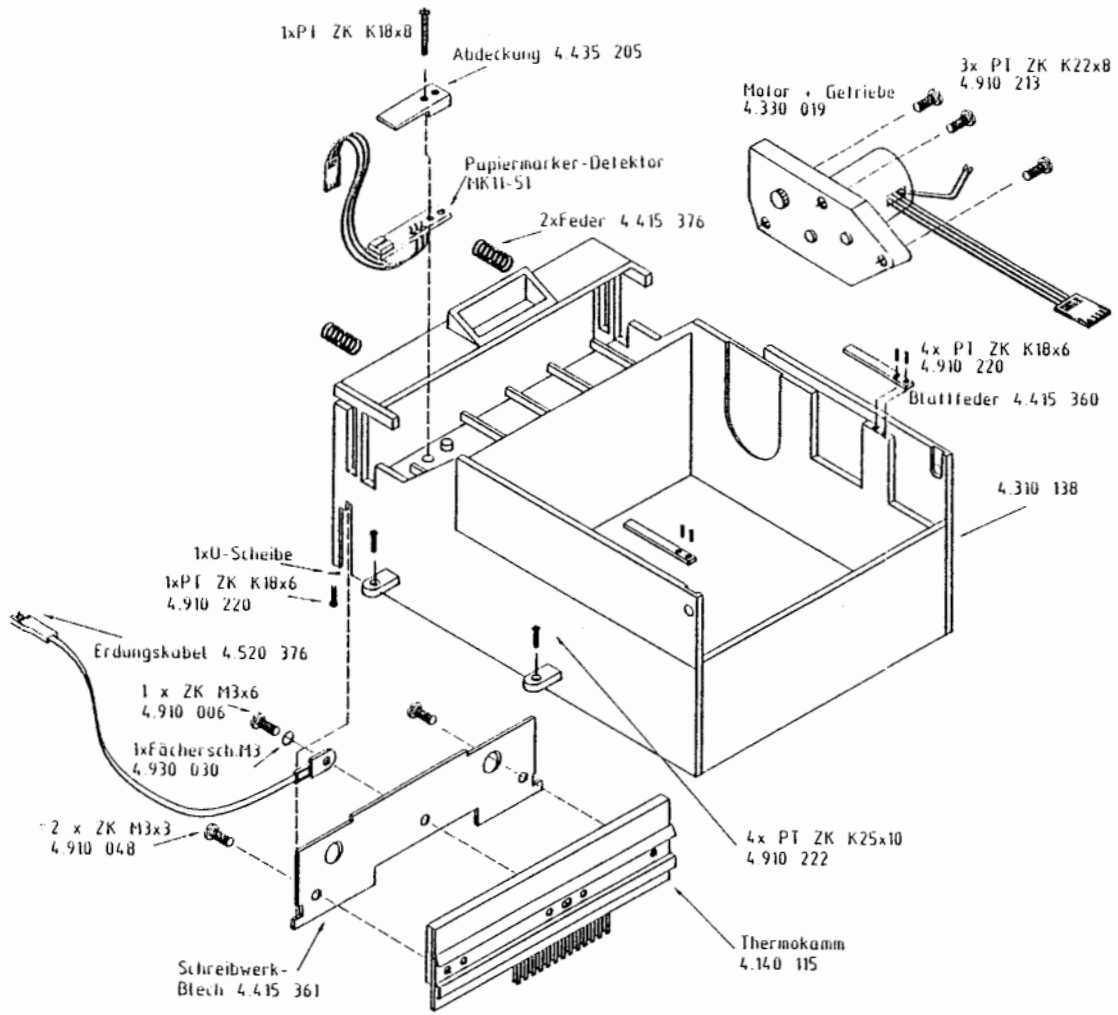


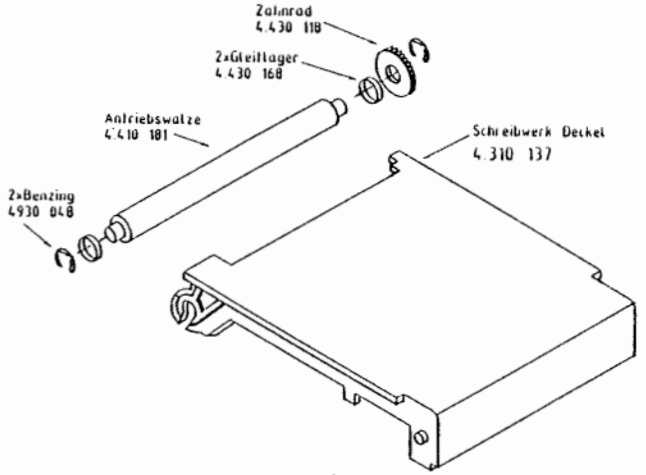
Pos	Menge	Gegenstand	Werkstoff		Oberfläche		Bemerkung	
					Gezeichnet	3 April 1995	RR	Massstab
					Geprüft			
					BG-Zuordnung	AT-1		
					Ersatz für		Anzahl Blatt	Blatt Nr
Index	Aenderung		Datum	Sig	File: AT1\FMK11 2	A3		

SCHILLER AG
CH-6340 BAAR

Titel: Montage MK11-2

Zeichnungs Nr: F.MK11-2





Schreibwerk Blech 4.415 361 und Thermokamm 4.140 115 muss mit der Lehere Montiert werden

Pos	Menge	Gegenstand	Werkstoff		Oberfläche	Bemerkung
					Gezeichnet 26 April 1995	RR Massstab
					Geprüft	
					BG-Zuordnung A1-1	
					Ersatz für	Anzahl Blatt / Blatt-Nr.
Index		Aenderung	Datum	Sig	Fde: A1\F310 138 A3	

SCHILLER AG CH-6340 BAAR	Titel Schreibwerk Montage	Zeichnungs Nr F.310 138

ECG Amplifier MK11-2 complete

6 x PT-screw K25x6
4.910 210

EMC shield uP-transformer
4.416 027

uP Print MK11-1

4xPT-screw K30x30
4.910 224

5 x PT ZK K25x6
4.910 210

Transformotor
4.320 066

blue

green
brown

Battery cable,
black
4.520376

Connection to ther mai print head

Spacer (transformer) 4.410182

Isolation (under transformer)
4.450 176

4xVinyl seal 3.2/9mm 4.120 128

Battery cable, red
4.520 385

Battery cable, black
4.520 386

Battery pack, long
4.350 024

Double-sided tape 12/3.2mm
4.120 022

Bottom EMC shield
4.416 028

Battery mit 2 Double-side tape
an daf to 4.120 024

1xZK M3x6 + Washer

2x PT-screw K25x20
4.910 223

Potential equalisation stud
4.260 377

Socket
4.270 009

Case bottom part
4.310 142

4xRubber feet (black)
4.430 012

3xZK M3x45
4.910 046

3xZK M3x50
4.910 047

Primary shield ECG amplifier
4.416 026

ECG isolation
4.435 198

Klebeband

EMC shield ECG amplifier
4.416 025

ECG Amplifier MK11-2

Metal foil 85,5/75 mm
(self-adhesive)

Contact spring
4.416 029

2x Screw M3x6
4.910 006
Nut M3 (d=0,5)
4.920 003

F.MK11-2

Gear wheel
4.430 118

2xSlide bearing
4.430 168

Printer roller
4.410 181

Paper tray lid
4.310 137

2xWasher
4930 868

1xPT ZK K18x8

Cover paper mark detector 4.435 265

3x PT ZK K22x6
4.910 213

Printer motor complete
4.330 019

Paper mark detector
MK11-51

2xPrinter tension spring
4.415 376

4x PT ZK K18x6
4.910 220

Flat spring 4.415 360

Paper tray
4.310 138

1xU-disc

1xPT ZK K18x6
4.910 220

Grounding cable 4.520 376

1 x ZK M3x6
4.910 006

1 xWasher M3
4.930 030

2 x ZK M3x3
4.910 048

4x PT ZK K25x10
4.910 222

Printer mounting plate
4.415 361

Thermal print head
4.140 115

Printer data cable
4.520 378

annected to u P print

F.310 138

Pos.	Menge	Benennung	Werkstoff	Oberfläche		Bemerkung	
				Gezeichnet	15. April 1996	RR	Maßstab
				Geprüft			
				BG-Zeichnung	AT-1		
				Ersatz für		Ascom Hasler	Blatt-Nr.
Index	Änderung	Datum	Sig.	File: AT1V000L1		A1	

SCHILLER AG
CH-6340 BAAR

Titel: Mon.Unterteil AT-1 Engl.

Zeichnungs-Nr. F.190 041a