CardioSmart/CardioSmart ST

Servicing Instructions

Version 1.2 and 1.3

227 435 11 SA(e) Revision D

marquette

A GE Medical Systems Company

Caution:
During repairs/service interventions, observe the protective measures against damage due to ESD.

* Marquette Hellige GmbH considers itself responsible for the effects on safety, reliability, and performance of the equipment, only if:

  - assembly operations, extensions, readjustments, modifications, or repairs are carried out by Marquette Hellige GmbH or by persons authorized by Marquette Hellige GmbH,

  - the electrical installation of the relevant room complies with the applicable national and local requirements, and

  - the instrument is used in accordance with the instructions for use.

* This manual contains service information; operating instructions are provided in the user manual of the instrument.

* This manual is in conformity with the instrument at printing date.

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Printed in Germany

Contents

Revision History

V 1.0	May 1995	Initial Release
V 1.1	March 1996	Update 1
V 1.2	February 1997	Update 2
V 1.2/1.3	August 1997	Update 3

1. Device description

This Service Manual for device versions V1.2 and V1.3 describes both CardioSmart and CardioSmart ST. Unless indicated specifically, the description applies to both CardioSmart and CardioSmart ST.

The device version V1.3 hardware components are identical to those of device version V1.2. The new combinations of these components in V1.3 result in new models, so-called regional models. Differences between device versions V1.2 and V1.3 are indicated clearly in the relevant sections.

The CardioSmart is a portable electrocardiograph with an integrated printing unit.
It is used to acquire, record and process ECG signals.
It is designed for line-power and battery operation. Operation without a battery is not possible. Power supply unit and battery are integrated into the instrument.

CardioSmart ST has an additional ergometry mode option with its own ergometry keypad.

The patient cable for the acquisition of ECG signals is connected by means of a 15-pin connector as used in earlier ECG recorders. This means that the patient cables used in the past can still be used.

Stored patient data and ECGs can be transmitted to a PC via an RS-232 interface. This requires a CardioProm version with additional patient data memory.

CardioSmart and CardioSmart ST are both based on the same hardware platform V1.2 or V1.3 and represent different types of the basic unit 101 116 xx.

With device version V1.2, the following models are available:

101 116 01	CardioSmart international	230V~	
101 116 02	CardioSmart US Version	115V~	
101 116 03	CardioSmart Russian	230V~	
101 116 04	CardioSmart international	230V~	with integrated pump
101 116 05	CardioSmart Russian	230V~	with integrated pump

101 116 10	CardioSmart ST international	230V~	
101 116 11	CardioSmart ST international	230V~	with integrated pump
101 116 12	CardioSmart ST US Version	115V~	
101 116 13	CardioSmart ST US Version	115V~	with integrated pump

With device version V1.3, the following models are additionaly available:

101 116 06	CardioSmart EUROPE 2	230V~	
101 116 07	CardioSmart EUROPE 2	230V~	with integrated pump

101 116 14	CardioSmart ST Russian	230V~	
101 116 15	CardioSmart ST Russian	230V~	with integrated pump
101 116 16	CardioSmart ST EUROPE 2	230V~	
101 116 17	CardioSmart ST EUROPE 2	230V~	with integrated pump
101 116 18	CardioSmart ST ASIA	115V/230V~	
101 116 19	CardioSmart ST ASIA	115V/230V~	with integrated pump

The CardioSmart entire instrument comprises the following components:
- **CardioSmart Basic Instrument,** without display and CardioProm
- **CardioProm Storage Module**, there are several modules with different features, with or without ECG storage facility
- **CardioVision Display**, there are 2 different displays available:
  - CardioVision Text, LCD module 2-line
  - CardioVision Graphics, graphics LCD

The CardioSmart ST entire instrument comprises the following components:
- **CardioSmart ST Basic Instrument,** without display and CardioProm
- **CardioProm ST Storage Module**, there are several modules with different features, with or without ECG storage facility
- **CardioVision Graphics**, graphics LCD
  CardioSmart ST is not enabled for CardioVision Text

This concept permits the user to configure an instrument himself to meet his own application specifications. It is also possible to upgrade the basic version.

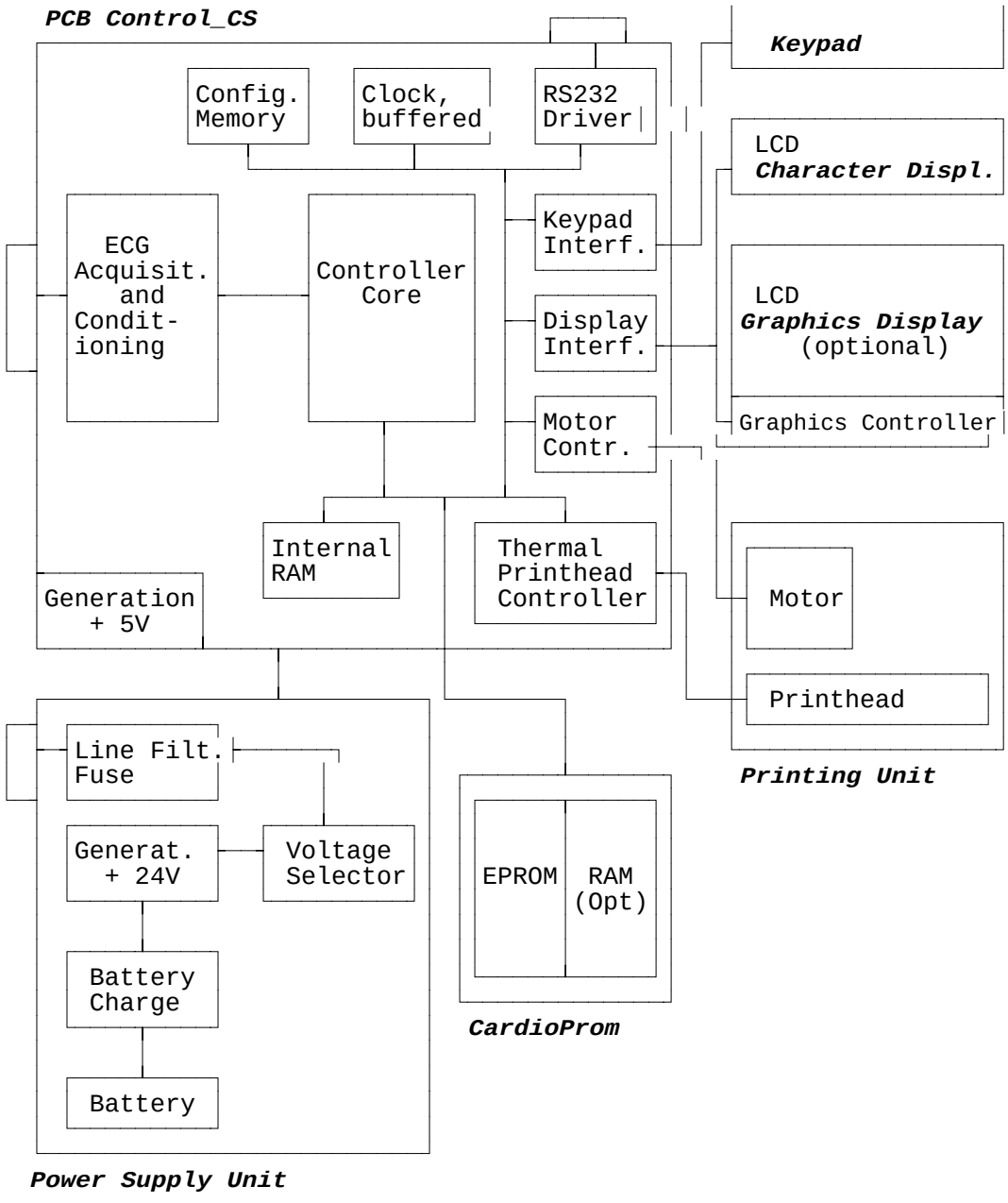
The hardware comprises the following functional blocks:

- PCB Control CS_S (basic instrument)
- Power supply unit with battery (basic instrument)
- Keypad (basic instrument)
- Printing unit (basic instrument)
- PCB Energy Storage_CS (storage module)
- Display (character or graphics display)

The following functional blocks are constructed directly as PCBs:
- PCB Control_CS
- PCB Energy Storage_CS
- PCB Power Supply_CS with battery charging circuit
- PCB Graphics Display_CS

The applications, functions and operation of the CardioSmart are described in the User's Manual.

1.1 Block circuit diagram of entire instrument



1.2 Mechanical Components

The main mechanical components comprise the **upper and lower shell** of the **CardioSmart Basic Instrument**. The lower shell serves as a basic unit to receive the following assemblies:

- Mains input module with instrument On/Off switch
- PCB Power Supply_CS
- Battery
- Thermal printing unit
- Paper container
- PCB Control_CS

The upper shell accommodates the keypad, which is connected to the PCB Control_CS via a 22-pin connector. The display (character or graphics display) is also integrated into the upper shell.

The **CardioProm** (program module) also has its own housing, comprising an upper and lower assembly section. It contains the PCB Energy Storage_CS, which is connected to the PCB Control_CS via a multipoint connector when inserted into the CardioProm slot.

The two available **displays** are also located in a housing, comprising an upper and lower shell. The graphics display contains the graphics LC display itself, as well as the associated control electronics, it can be swivelled within the range from 0° to 45° with 5 lock-in positions. The character display only contains the character LCD and cannot be swivelled. The two displays can be connected to the PCB Control_ CS by insertion into the depression in the upper shell of the basic instrument provided with a female multipoint connector.

The 15-pin input connector to **connect the patient cable** and the 9-pin connector for the **RS-232 interface** are located directly on the PCB Control_CS.

Models 101 116 04/05 have an added integrated suction pump, comprising the pump module 303 442 91 and the PCB Pump 388 029 18.

2. Functional description

The **block circuit diagram** of the entire instrument **in Section 1.1** and the **functional blocks of the P-plans** describe the individual functional blocks.

2.1 PCB Power Supply_CS

The PCB Power Supply provides the following functions:
- Secondary clock-rated power supply unit to generate the fundamental device voltage UVERS
- Device switch on/off circuit
- Charging circuit for NC battery
- Battery almost empty identification
- Battery empty instrument switch-off

2.1.1 Switch on/off circuit

The device on/off switch (momentary toggle switch) supplies the starting pulse. The actual stop signal comes from the PCB Control_CS via the DOFF cable.

In the line-power operating mode CardioSmart can be switched off by:
- Device on/off switch
- Processor (DOFF)

In the battery operating mode CardioSmart can be switched off by:
- Device on/off switch
- Processor (DOFF)
- Battery empty identification

In the line-power operating mode recording can be switched off by:
- Battery empty identification

2.1.2 Charging circuit for NC Battery

A charging IC is used to charge the battery. During charging it monitors the battery voltage function and switches over from rapid charging to trickle charging in conformity with the charging current.

The charging circuit is activated by applying the power supply voltage or battery.
If a recording is made whilst the device is in the operating mode the charging circuit is deactivated.

2.1.3 Device behavoir depending on the state of battery charge

As a general rule the following applies:

No applied line-power voltage:
Operation of the device without a battery is not possible

Applied line-power voltage, battery is charged:
Device completely operational

Applied line-power voltage, battery **depleted**:
Device is only partially operational (everything except recording)

Battery charging is triggered by:
Application of line-power voltage
Switching off a current recording, manually with the Stop key
or automatically when the cutoff voltage has been attained

Device behavoir:

State 1 Battery depleted, power supply system is connected up:
Battery charged in accelerated mode; when full, switchover to conservation charging, no time limit

State 2 Battery full, power supply system is connected up:
Battery charged in accelerated mode; when full, switchover to conservation charging, no time limit

State 3 Battery depleted, no line-power supply, device is switched on:
Device inoperative

State 4 Battery full, no line-power supply, device is switched on:
Device fully operative, when battery almost empty message appears
LEDBAT signal activated, when battery empty message appears the device becomes inoperative

State 5 Battery depleted, power system supply is connected, charging begins, device is switched on:
All functions except recording, as long as the battery cannot supply the printhead with sufficient power.

State 6 Battery full, power supply system is connected, device switched on:
Device fully operative. During recording charging is interrupted, at stop recharging begins until the charging IC switches to conservation charging.

2.2 PCB Control CS_S

2.2.1 Generation of the logic power supply +5V

The logic power supply +5V is generated directly on the PCB Control_CS.
The stabilized voltage UVERS, which is generated by the PCB Power Supply_CS, serves as the input voltage.

The +5V power supply is generated by the clock-rated **voltage controller**.
The **"adjustable version"** of the controller is used in order to be able to use it later for applications requiring other voltages, the output voltage is determined by appropriate dimensioning of the voltage divider at the feedback input of the voltage controller.

2.2.2 ECG recording and front-end processing

The main element of this operational unit is a **set of chips comprising 4 ASICs** located on the PCB.

The **patient lead** is connected with a **15-pin connector**. Overvoltage arresters at the electrode inputs provide high-voltage protection. A hybrid chip acts as a microfuse for each electrode, it serves to identify a disconnected electrode.

The patient input is classified as cardiac floating and is defibrillation-proof.

Each electrode input is preamplified after the hybrid chip with a low-noise operational amplifier with a small input voltage, before it is fed into the two ASICs with the sigma-delta resistors.

The filter time constants can be adjusted by the controller core by a command. 8 time constants are available for selection (system test).

N common-mode compensation ensures suppression of interference, at the same time serving to improve the in-phase suppression of the input electrodes.

To protect patients the ECG recorder and conditioning processor are assembled as floating components. Digital signals from and to the controller core are transmitted via optoelectronic couplers, the floating power supply +/-5V is generated by a flyback converter from the logic power supply +5V.

2.2.3 Controller core

The actual core comprises the **Motorola Controller 68332**, containing the following integrated components:

- CPU32, computer core, internal 32-bit register, external 16-bit processor
- TPU, an independently operative clock generator processor
- QSM with SCI to implement a simple RS-232 interface and a serial QSPI interface with up to 16 channels
- SIM with chipselect generation, system monitoring, clock synthesizer

The **watchdog/reset generation** is implemented with an integrated system monitoring chip. It has the following functions:

- Power-up reset for the 68332 when the instrument is switched on
- Voltage monitoring with reset generation
- Watchdog function
- Switchover to battery for buffered RAMs
- Access protection for buffered RAMs

2.2.4 Real-time clock

This provides the time of day and date. When the device is operative it is powered by the logic power supply, when the device is switched off a 3-V lithium cell is switched in to keep the clock running.

The control signals for the clock (chipselect read/write signal) are generated in the **PAL RTC_Control**, which also contains the release sequence for the character display.

2.2.5 Memory

Static RAMs are used as **RAM memory** with an internal organization 128kbit x 8. They are equipped with 4 chips, providing an organisation of 256kbit x 16. It is possible to add 4 further chips to give a RAM memory area of 1MByte.
The access time is 70 ns, i.e., access **without wait states.**

2.2.6 Printhead control

The printhead controller takes on the complete control of a 216-mm thermal printhead with a line width of 200 mm. It also contains the printhead monitor, which reduces the heating time with increasing printhead temperature, terminating the printhead power supply when the printhead temperature reaches 55°C. The printhead power supply is reactivated only when the printhead temperature drops below 50°C.

The core is a **gate array**, which takes on the heating time management for each dot. The speed-dependent heating parameters are transmitted serially.

For the **printhead monitoring** the temperature of the thermal array printhead is measured by a thermistor located on the printhead. A constant current source effects a temperature-dependent voltage drop at a comparator input, the switching threshold being adjusted by hysteresis at the other comparator input.
If a printhead temperature of 55°C is exceeded, the message PRINTHEADTEMP is activated and the current supply to the printhead prevented by the STROBE signal. Only after the temperature drops below 50°C is the PRINTHEADTEMP message disabled and the current supply via STROBE reenabled.

A second comparator generates a VTEMP signal when the temperature reaches 45°C, it is disabled again when the temperature drops below 40°C. It represents a prewarning signal, so that the quantity of data at the printhead is reduced to prevent it being switched off.

In addition, a continuous reduction in the current activation time occurs with increasing temperature, resulting in a regular type face throughout the entire temperature range.

The **printhead is operated directly at the battery**, i.e., the printhead voltage is dependent on the state of battery charge. Compensation is achieved by reducing or extending the printhead current activation time accordingly, ensuring that the type face is maintained within the fluctuation range of the battery voltage.

2.2.7 Motor controller

This activates the CardioSmart´s DC motor. This motor does not have a speedo, control is achieved according to the principle of current compensation.

The main components are the speed selector, motor controller, and motor current monitoring.

The resistor for the **control** according to the principle of current compensation is attached directly to the motor casing.

The voltage of +/- 12 V required to send control signals is generated from the supply voltage as follows: An in-phase regulator generates + 12 V, due to the small current requirements the voltage -12 V is generated by an inverting voltage pump. The supply voltage +/-12 V is also used for the temperature monitoring system of the printhead controller.
It is only enabled during printing!

When the motor current is raised > 140 mA (e.g., as a result of paper jam, transmission problems) the **motor current monitoring system** terminates paper transport and the message “Please insert paper and press return key” appears on the display.

2.2.8 RS-232 interface

The CardioSmart has an RS-232 interface which, except for the RS-232 driver chip, is directly integrated into the controller.
It has the following attributes:

- Software handshake with XON/XOFF
- No HW handshake
- Transmission speed 1200 .... 19200 Baud

To achieve **protection against ESD up to 10kV**, the interface is equipped with additional suppressor diodes.

2.2.9 Keypad interface

The interface to the keypad is via the **22-pin connector AS**. The keypad itself is a membrane keypad with touch-sensitive check-back.

The keypad comprises a **matrix with 7 columns and 7 rows.**

The CardioSmart ST keypad has additional keys for ergometer/treadmill control. Depending on the keypad used (CardioSmart or CardioSmart ST) the PC receives a corresponding signal, identifying the device used.

Identification of the key pressed is as follows:
The controller activates a column, activation is via low-level, simultaneously it reads out the register for the lines and by a low-level signal identifies whether one or more keys had been pressed. Then the next column is activated. The run procedures are repeated automatically until all columns have been activated.

In addition, the LEDs for start and stop, for the power supply system display and the battery status control are located directly on the keypad.

2.3 PCB Graphics Display_CS

This PCB is only used in connection with the component parts of the CardioSmart graphics display unit. It comprises the following functional units:

- Voltage generation
- CPU interface, display control
- Background illumination
- Contrast control

2.3.1 Power supply

A **negative voltage of -23 V** is required for the power supply of the display. It is generated by an inverting switching controller from the 5-V power supply. The output voltage -23 V is enabled by the additional external wiring of the switching controller. The voltage -23 V also serves as a voltage source for the generation of the **negative contrast voltage.**

The **functional unit LCD BLOCK** ensures that the logic power supply +5 V is active at the graphics display before the negative power supply and the contrast voltage. When the instrument is switched off the negative power supply and the contrast voltage are switched off first.

2.3.2 Background illumination

The background illumination of the graphics display is effected by a **CFL tube,** which requires an alternating voltage of approx. 800 Vss.

The alternating voltage is generated by a voltage inverter, driven by 5 V. Since the CardioSmart is a portable, battery-operated device, the background illumination can be **enabled and disabled** (configuration).

2.3.3 Contrast control

The contrast control has an additional **temperature compensation control.** However, when there are rapid fluctuations in temperature it takes a certain time until the compensation is complete, since the display itself has a greater thermal time constant.

2.4 Internal interfaces

2.4.1 Mechanical interfaces

The 3 following mechanical interfaces are important within the CardioSmart:

- Interface to CardioProm
- Interface to display CardioVision Text
- Interface to display CardioVision Graphics

Interface to CardioProm

The CardioProm has its own housing, which is conducting to prevent damage by ESD. To shunt any possible static charge it has 3 rails on the underside which, on the PCB Control_CS in the CardioSmart basic device, when inserted make contact with the 3 rails on GND, thereby shunting the charge.

This mechanical insertion of the rails ensures that a fail-safe contact is made with the PCB Control_CS.

Furthermore, mechanical coding ensures that the non-compatible CardioProms of the EK56/EK512 series cannot be inserted into the slot. Similarly, the insertion of CardioSmart CardioProms into the EK56/512 slot is not possible.

Interface to display CardioVision Text

The display CardioVision Text is placed into the depression provided in the upper shell of the CardioSmart basic device. The mechanical rail on the outside of the display ensures the electrical contact is automatic and fail-safe. The display CardioVision Text can be replaced, e.g., by a CardioVision Graphics using the appropriate tools without opening the device.

Interface to display CardioVision Graphics

The display CardioVision Graphics is also placed in the above-mentioned depression, the mechanical rail on the outside also ensures a fail-safe contact. In contrast to the CardioVision Text, the CardioVision Graphics can only be replaced by opening the upper shell of the basic device.

2.4.2 Electronic interfaces

This section describes the pinning, function and significance of the signals of the internal interfaces of the functional components.

2.4.2.1 Interface Character Display

The interface to the character display provides all the signals to connect the display CardioVision Text. It comprises the upper 8 bits of the data bus, control signals and the signal for the contrast control.

Connection denotation: **AG/**

Female multipoint connector **2 x 7-pin, upright** (180 °)**,** reverse terminal protection achieved mechanically.

The function of the individual pins is given in the following table. The definition as an Input/Output is seen with reference to PCB Control_CS.

Pin Num-ber	Input/Out-put	Denotation	Function
1	Output	GND	System ground
2	Output	+ 5 V	Voltage supply
3	Output	CHAR_CONTR 0 .... 5V	Contrast character display
4	Output	AD_12	Controller address bus bit 12
5	Output	RW_	Read/write signal
6	Output	ENCHARD	Enable character display
7	Bi-Direct, tristate	DB_8	Controller data bus bit 8
8	Bi-Direct, tristate	DB_9	Controller data bus bit 9
9	Bi-Direct, tristate	DB_10	Controller data bus bit 10

10	Bi-Direct, tristate	DB_11	Controller data bus bit 11
11	Bi-Direct, tristate	DB_12	Controller data bus bit 12
12	Bi-Direct, tristate	DB_13	Controller data bus bit 13
13	Bi-Direct, tristate	DB_14	Controller data bus bit 14
14	Bi-Direct, tristate	DB_15	Controller data bus bit 15

2.4.2.2 Interface Graphics Display

The interface to the graphics display provides all the signals to connect the display CardioVision Graphics. It comprises the upper 8 bits of the data bus, address bus, control signals and the signal for the contrast control.

Connector denotation: **AH/**

2.4.2.3 Interface PCB Power Supply_CS

This has the voltages from the power supply unit to generate the + 5 V and the other voltages, the control of the LEDs for the power lamp and battery monitoring, the control signals for battery charging and switching on the printhead and motor power supply as well as the signal to switch off the device on the controller´s part.

Connector denotation: **AE/**

Male multipoint connector **2 x 10-pin, upright** (180 °), reverse terminal protection and coding with coding pin 12.

The function of the individual pins is given in the following table. The definition as an Input/Output is seen with reference to PCB Control_CS.

Pin Number	Input/Output	Denotation	Function
1	Input	LEDLIN	Control of LED for power supply system "-" = mains not connected "AC" = mains connected
2	Output	REG_ON	Printhead power supply, motor enabled by controller: "0" = Enable battery charging "1" = Enable printhead power supply
3	Output	GOFF_	Switch on device with controller "0" = Device off "1" = Device on
4, 5	Input	UVERS	Input voltage to generate +5 V
6	Output	+ 5 V	Logic power supply
7,8,9, 10	Input	COMMON_IN	Input voltage to generate motor- printhead voltage and +/- 12V
11	Input	REG_OFF	Printhead power supply, motor enabled by power-supply unit: "0" = Enable battery charging "1" = Enable printhead power supply
12		CODE	Coding pin
13, 14, 15, 16	Input	GND	System ground
17	Input	VRAM	Buffered voltage to generate the RAM standby power supply
18	Output	COMMON_S	Voltage switched in from COMMON_IN
19		NC	NC
20	Input	LEDBAT	Charging status display for BATTERY: "0" = battery needs charging "1" = battery charged, normal operat.

2.4.2.4 Option interfaces

Option Power Check

This constitutes a service connector to enable checking of all the voltages active within the system. This **is not an extension port,** the voltages must not be used to supply power to other components!

Connector denotation: **AF/**

Male multipoint connector **1 x 6-pin, upright** (180 °), **for servicing purposes only!**

The function of the individual pins is given in the following table. The definition as an Input/Output is seen with reference to PCB Control_CS.

Pin Num-ber	Input/Out-put	Denotation	Function
1	Output	+ 12 V	Testing point power supply + 12 V
2	Output	GND	System ground
3	Output	- 12 V	Testing point power supply - 12 V
4	Output	COMMON_S	Testing point power supply motor voltage
5	Output	GND	System ground
6	Output	+ 5 V	Testing point logic power supply + 5 V

2.5 Interfaces to peripherals

The CardioSmart has only 3 interfaces for peripherals:

- Mains input
- Patient Input
- RS-232 interface

The **mains input** interface on the device is a 3-pin standard cold appliance socket connection, which is integrated into the mains input module. Connection to the mains is effected via a 3-pin power cord with a non-fused earth conductor.

Although the mains input is not designed as a "wide range input", adjustment to the two mains voltage ranges 110V~ ... 120V~ and 220V~ ... 240V~ is easily achieved without having to open the device or a wiring change of the bridges:

- Check voltage setting in the inspection window of the interrupter of the mains input module
- If the voltage value is not the same as the mains voltage:
- **Disconnect mains plug!**
- Open interrupter with appropriate tool
- Take out fuse holder with fuses
- Insert fuses rated according to the rating plate specifications
- Reinsert holder so that the required voltage is visible
- Close interrupter
- The required mains voltage should now appear in the inspection window

This readjustment is to be carried out by the manufacturer or servicing agent only!

No further description of the mechanical and electronic parameters of the mains input is given in Section 2.5.

The mechanics and the interface configuration as used in the EK53/EK56 and in the EK512 are implemented in the **patient input**. This means that all the patient cables used up to date can still be used, this also being true for the suction system with its integrated pump.

A 9-pin sub-D connector with a standard configuration of the signals TXD, RXD and GND is implemented in the construction of the **RS-232 interface**. In addition, it is attached to the connected plug housing by means of threaded inserts. The EK53/56 and EK 512 RS-232 power cables can thus no longer be used.

The cable 223 362 03 is used as an RS-232 cable to the PC.

2.5.1 Electronic interfaces

2.5.1.1 RS-232 interface

This comprises the transmitter signal TXD, the incoming signal RXD and the reference ground GND. The pin configuration is the same as that used for a standard PC 9-pin sub-D socket. The interface does not operate with a hardware handshake.

Furthermore, a REMOTE START input is provided at pin 8.

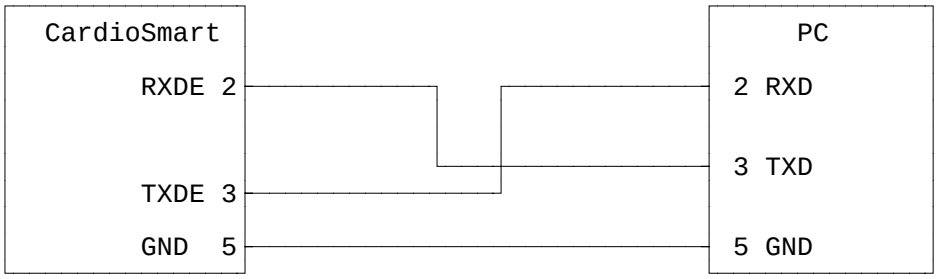
Transmission is in accordance with the standard V-24 protocol, input and output voltages are defined as follows:

- maximum input voltage at RXD: +/- 15V
- minimum output voltage at TXD: +/- 5 V
- additional input protection against ESD effects: +/- 10kV

In addition, there is a REMOTE START input at pin 8 with the following specifications:

- external short-circuiting contact via circuit reference referred to ground
- max. source resistor switch: R_i <300Ω
- make time >100 ms
- continuous load limits +/-10 V
- ESD protection to max. +/-10 kV

Connection principle to PC



Connection cable 223 362 03

The connector is denoted: **AC/**

Male multipoint connector **sub-D socket housing, 9-pin, 90° offset**

The function of the individual pins is given in the following table. The definition as an Input/Output is seen with reference to PCB Control_CS.

Pin Num-ber	Input/Out-put	Denotation	Function
1		NC	NC
2	Input	RXDE	Receive RS-232 data
3	Output	TXDE	Transmit RS-232 data
4		NC	NC
5	Output	GND	System ground
6,7,9		NC	NC
8	Input	REMOTE START	Remote Start Input

2.5.1.2 Patient input

Below is a list of the most important features of the patient input:

- Classification: cardiac floating
- Defibrillation-proof
- Simultaneous data acquisition from all leads
- Individual electrode monitoring
- Voltage feed for floating power supply via floating transformer
- Control and data signals from and to floating part via optoelectronic coupler

The connector is denoted: **AA/**

Male multipoint connector **sub-D socket housing, 15-pin**

The function of the individual pins is given in the following table. The definition as an Input/Output is seen with reference to PCB Control_CS.

Pin Number	Input/Output	Denotation	Function
1	Input	C2	Input electrode C2
2	Input	C3	Input electrode C3
3	Input	C4	Input electrode C4 (Nap for Nehb cables)
4	Input	C5	Input electrode C5
5	Input	C6	Input electrode C6
6	Output	S	Shielding
7	Output	PLGND	Identification of patient cable used
8	Input	PL	Identification of patient cable used
9	Input	R	Input electrode R
10	Input	L	Input electrode L
11	Input	F	Input electrode F
12	Input	C1	Input electrode C1
13	Input	Nst	Input electrode Nst (for Nehb)
14	Output	N	Output electrode N (common mode compensation)
15	Input	Nax	Input electrode Nax (for Nehb)

2.6 Limitations

The following operating modes are not implemented in the CardioSmart:

- No ergometry
- No SAO2
- No spirometry
- No late potentials, no RR variability
- No phono, no US Doppler

A scope output is not available.

No analog inputs.

The existing RS-232 interface does not provide an ECG trigger output.

Recording without or with an empty NC battery is not possible.

Lead accumulators cannot be used.

Primary cells cannot be used.

3. System test functions

With country default setting German all messages displayed during the self-test are in German, in all other country settings they appear in English.

3.1 System test functions with graphics display

3.1.1. General information

The functions for the system test are mostly menu-guided.

For complete execution some tests require special auxiliary resources. These include interface testers or PC, connection cables, signal generators, etc. The tests that are necessary are described in the various test descriptions.

3.1.2 Test start

After simultaneously pressing the keys

Shift + Auto (CardioSmart) or **Shift + Mode** (CardioSmart ST)

the initial display menu appears to enable selection of a specific test. (see below) Keys used for menu selection appear in parenthesis.

System test

Test functions:

(1) Display test
(2) Key test
(3) Motor test
(4) Test results
(5) Recording test
(6) Interface test
(7) Time and date
(8) Electrode test
(9) Time constant test
(V) Device model (from SW V4.21)
(C) 12SL / HEART (from V4.21)
Terminate with SH_MAN or SH_MODE key

3.1.3 Display test (1)

After pressing the “1" key the following menu appears:

Display test

(1) Test pattern
(2) Character set
(3) Delete display
(4) Inverse
(5) Display illumination
Contrast control
- Shift_Cursor_Down
- Shift_Cursor_Up

Terminate with any key

Pressing any other key than one of those listed in the menu above leads back to the initial display menu.

(1) Test pattern

Pressing this key generates a chessboard pattern. Each subsequent pressing generates the inverse display of its predecessor.

(2) Character set

The character set used for the display is output.

(3) Delete display

All display pixels are inactive.

(4) Inverse

The contents of the existing display appear in reverse video.

(5) Display illumination

The illumination is switched on or off by pressing this key.

Contrast control
The contrast setting can always be adjusted as described above (cursor keys).

3.1.4 Key test (2)

By pressing the “2" key the following menu appears:

Key T e s t

(P) Bleeper test
(K) Cover for paper compartment
(E) End

When a key is pressed this key or its function is displayed. This can either occur by a triple character display, e.g., “AAA” or as a text, e.g., "CURS_UP". Moreover, pressing the “P” key tests the bleeper (audible sound) and pressing the “K” key tests a micro key to identify whether the cover for the paper compartment is open or closed. The “E” key terminates this test and simultaneously undergoes a self-test.

3.1.5 Motor test (3)

When the “3" key is pressed the following menu appears:

Motor/Speed Test
- Speed select key
- Start/Stop
- (A) Measurement marking pulse ON
- (S) Measurement marking pulse OFF

The speed select key is used to set the required speed and the motor set into motion with Start/Stop.
Whilst running the motor speed can be controlled by using the “A” key to activate the setting of the measurement marking pulse and to deactivate it with the “S” key. A making pulse is set once every second. The running speed can then be calculated or its accuracy checked from the distance between marking pulses. Any other key pressed not included in this menu leads to the initial display menu.

3.1.6 Test results (4)

Pressing the “4" key triggers the output of the test results.

The output of the test protocol supplies data on the software integrated in the device (Part No., Version No., production date of the firmware), printhead voltage and the test results on the memory test performed during power-up.
The areas listed under RAM have the following meaning:

CardioSmart

0 - 080000h
512 kByte RAM area on the PCB Control CS_S

100000 - 140000h
256 kByte RAM area on the CardioProm (depending on CardioProm type)

140000 - 1C0000h
512 kByte RAM area buffered on the CardioProm (dep. on CardioProm type)

CardioSmart ST

0 - 080000h
512 kByte RAM area on the PCB Control CS_S

100000 - 180000h
256 kByte RAM area on the CardioProm (depending on CardioProm type)

180000 - 200000h
512 kByte RAM area buffered on the CardioProm (dep. on CardioProm type)

Values may deviate from those given above, depending on the device or software version used.

A specification in the form 100000 - 100000 permits the conclusion that this RAM area does not exist in the device. However, if it does exist in conformity with the software version implemented, this means that this RAM cell at address 100000H is defective. The memory could also be defective when the initial and final addresses of the memory area differ and do not correspond to the above-mentioned limits. This then means, for example, that the specification 100000 - 123000 on the defective cell at address 123000H.

Following output the initial display menu reappears automatically.

3.1.7 Self-test

The test results elucidated in Section 3.1.6 are ascertained during the self-test, which is always performed on power-up. Should errors be detected, a message appears on the display after the test, indicating the possible errors. The following error codes are used to identify the error.

Error codes

The following error codes appear on the display together with the message “Self-test failed”:

ERROR_CODES:
0 - reserved
1 VEKT - error in vector table
2 ERAM - RAM error on PCB Control
3 LCDR - LCDRAM error (Graphics Display)
4 - reserved
5 - reserved
6 RAMB - RAM error on the CardioProm
7 GRAM - error in buffered RAM on the CardioProm
8 ROMB - ROM error (checksum) on the CardioProm

9 - 10 not used

3.1.8 Recording test (5)

The recording test is activated by pressing the "5" key and interrupted with the "Start/Stop" key.

Immediately after pressing the "5" key the printer begins to record the first channels at 25mm/s and 20mm/mV.
In addition, the message “Recording test” appears on the display. In this test only the first two channels are passed on to the printer. No other channels can be configured.

3.1.9 Interface test (6)

Several possibilities are available to test the serial interface. Moreover, on the one hand, the signal transmission and receiving of the interface can be tested by an internal feedback from TXD and RXD and, on the other hand, the signal transmission and receiving with a remote station.
For the test with a remote station a standard PC cable is required for a serial interface (zero modem cable). In addition, the following transmission protocol should be adjusted at the remote station:

1 start bit, 8 data bits, parity even
1 stop bit
Baud rate 9600

Pressing the “6" key calls up the following menu:

Interface test

(1) Transmitting and receiving
(2) Transmit test string to device
(3) Transmitting and receiving with device

(1) Transmitting and receiving
This test enables complete testing of the RS232 signal path for transmitting and receiving, including RS232 driver and connector.
This test requires an RS232 connector with an internal bridge from pin 2 (RXDE) to pin (TXDE). Depending on the result of the test, the following message appears:

Test result : OK
or
Test result : Error

This procedure requires a software version as from V4.1. Earlier software versions only permit internal testing of the RS232 interface without including the RS232 driver.

(2) Transmit test string to device
In this test a remote station, e.g., PC must be connected up and have a terminal program which can receive signals and be configured for the above-mentioned protocol. If the remote station is on receive, then every time the “2" key is pressed the test string “Interface test” is transmitted to the remote station. Simultaneously, the following message appears on the display:

Transmitting : interface test

(3) Transmitting and receiving with device
Transmitting and receiving can be tested with a remote device by pressing the “3" key. The device should be connected as described in (2).
After pressing the “3" key a test string is sent the remote station. The following message appears on the display:

Transmitting: interface test

Receiving:

A subsequent input at the remote station is sent back to the device and displayed there. Moreover, it should be noted that an input must take place within 10 s and the input terminated with “return”. If the key is pressed a second time, then the string "CardioSmart Test" is transmitted. Altogether there are three test strings available, which are sent in the following sequence with repeated key activation:
"Schnittstellenest", "CardioSmart-Test", "Sieht doch gut aus, oder?"
("Interface Test", CardioSmart Test", Looks good, doesn't it?")

The last string corresponds to the expected test result.
This test is terminated with any other key not used for a test.

3.1.10 Time and date (7)

This section deals with the quick checking and setting of the time and date.
Pressing the “7" key calls up the following display:

Time / Date

10:12:03 10.11.1994

(S) Set
End with any key

From this screen the clock can be adjusted by pressing the “S” key, the following mask appearing:

Time Date
[ ] [ ]

The first mask is for the time and the second for the date.
Example: [1012] [10119] for 10:12 o´clock and 10.11.94

Pressing the return key terminates the entry. The adjusted data are subsequently accepted and seconds set to zero.

The test is terminated with any other key not used for a test.

3.1.11 Electrode test (8)

The electrode test is started by pressing the “8" key.

The electrode test is terminated by pressing any key.

To evaluate the electrode states the following status WORD is available.

```
Status = 0 -> Electrode OK
Status = 1 -> Electrode disconnected
```

```
Bit15                                                                  Bit0
-------------------------------------------------------------------------
| x | x |DAT|ELN|NAP|NST|NAX| C6 | C5 | C4 | C3 | C2 | C1 | F | L | R |
-------------------------------------------------------------------------
```

And precisely this status WORD extended to LONG is displayed on the screen during the electrode test to be performed. It is important to note, however, that this status WORD is not displayed as a binary number but as a hexadecimal number.

However, to make the status of a particular electrode quickly recognizable, defective electrodes are represented by an ID code.
EX_R, for example, stands for the defective electrode R and C1 for electrode C1. This permits the identification of every individual electrode. Naturally, since several electrodes can become disconnected simultaneously, it was necessary to set a certain priority in the display of disconnected electrodes.

The following display priority was programmed:

EX_R, EL_N, EX_L, EX_F, C1, C2, C3, C4, C5, C6, NAX, NST, NAP

For example, if electrodes R and N have become disconnected, then first R is reported with EX_R as having become disconnected. Only after R is OK is EL_N displayed.

3.1.12 Test time constants (9)

The test is started by pressing the “9" key and interrupted with the "Start/Stop" key.

Immediately after the “9" key has been actuated the printer begins to record the first two channels at 25 mm/s and 20 mm/mV.
Moreover, the message “Testing time constants” appears on the display.
In this test only the first two channels send signals to the printer. No other channels can be configured. The default time constant is output on the printout as a control.

Setting the time constants

As a general rule, the time constants are adjusted to 2.04 s.
This setting can be changed with the CORR_CONFIG key.
The following settings are available:

Time constants:

(1) 0.260s (2) 0.130s (3) 0.033s
(4) 0.004s (5) 4.080s (6) 2.040s
(7) 1.020s (8) 0.510s

The figures given in parentheses indicate the key used to select the corresponding time constant.

Verification of the currently active time constant is only possible by printing out the self-test results (see Section 3.1.6) or by testing the time constants.

3.1.13 Setting the Device models (V)

The setting of the Device model is activated by pressing the “V” key, the following display image appears:

D e v i c e model
(1) INT
(2) USA
(3) EU_2
(4) ASIA
(5) RUSS

Terminate with any key.
The currently selected device model appears in reverse video.

Warning!

Changing the device model affects the selection of the output formats and languages available, can switch the program for Interpretation from HEART to 12 SL, or vice versa. Also affected are the default configuration settings, e.g., override function yes/no, line filter 50/60 Hz.

The device model configured during manufacture should only be changed when deemed really necessary.

The following table shows the most important combinations:

Device model	Interpretation	Output formats	Languages	Default settings	
				Override function enabled	Line filter
01 INT	HEART	International	g,e,f,i,s	no	50 Hz
02 USA	12SL	USA	e,f,s	yes	60 Hz
03 EU_2	12SL	Int. +H1 +H2	e,g,f,sw	yes	50 Hz
04 ASIA	HEART	International	g,e,f	no	50 Hz
05 RUSS	HEART	International	g,e,f	no	50 Hz

Output formats: - International: 12_FS, 12_F1, 12_F2, 6_F1, 6_F2, 3_F1

- USA: STND1, STND3, 1x10, 2x5, 2x5_ex, 3RHY1

The required device model is selected by pressing the appropriate key, “1" to “5".
Quit selection menu by pressing any key.
Quit the self-test with “Shift” + “Man” or “Shift” + “Mode”.
CardioSmart configures the appropriate items and initiates a cold start automatically.
Thus, when the device is rebooted automatically all the new settings are adopted.

Selecting a particular device model leads to the configuration of the program for Interpretation as indicated in the table above, even when the interpretation program was configured differently beforehand as described in section 3.1.14.

Note on saved ECGs when configuring the device model:

Saved ECGs are not lost.
If when a new device model is selected, the program for Interpretation is switched over, however, when printing out the saved ECGs the display in the status line (12SL, or without in the case of HEART) is related to the currently enabled program for

Interpretation, although the results are based on the program previously configured. In this case, the saved ECGs should be printed out or transferred to a PC before configuration of the new model.

3.1.14 Switching over the program for Interpretation(C)

Switching over the program for Interpretation is activated by pressing the “C” key, the following display image appears:

I n t e r p r e t a t i o n

(1) HEART
(2) 12SL

Terminate with any key.

The currently enabled interpretation program appears in reverse video.

Warning!

Switching over to another program for Interpretation affects the measurement results and the interpretation!

The program for Interpretation configured during manufacture should only be changed when deemed really necessary!

The required program for Interpretation is selected by pressing the appropriate key, “1" or “2".
Quit the selection menu by pressing any key.
Quit the self-test with “Shift” + “Man” or “Shift” + “Mode”.
CardioSmart configures the appropriate items and initiates a cold start automatically. Thus, when the device is rebooted automatically all the new settings are adopted.

Note on saved ECGs when switching over the progran for Interpretation:
Saved ECGs are not lost.
After switching over to a different program for Interpretation when printing the saved ECGs the display in the status line (12SL, or without in the case of HEART) is related to the newly selected interpretation program, although the results are based on the program previously configured. In this case the saved ECGs should be printed out or transferred to a PC before switching over to the new program for Interpretation.

3.2 Device test functions with character display
(only CardioSmart)

3.2.1 General information

In contrast to the graphics display, at the current time the device test functions all require menu-guided execution. This is because the rendition of the character display of max. 80 characters is very limited.

To be performed in their entirety some tests require special auxiliary aids, e.g., interface tester or PC, connection cables, signal generators, etc. Just what is required for which test are given in the various test descriptions.

3.2.2 Test start

After simultaneous pressing of the keys

Shift + Auto (CardioSmart) or **Shift + Mode** (CardioSmart ST)

the following initial display image appears:

S Y S T E M T E S T
END TEST: with Shift MAN (CardioSmart) or Shift + Mode (CardioSmart ST)

Key used to select menu options are given in parentheses.

3.2.3 Display test (1)

After pressing the “1" key the following menu appears:

Display test
(3) Delete display (4) Inverse

Pressing any other key than those given above leads back to the initial display image.

(3) Delete display
All the display pixels are disabled.

(4) Inverse
Inverse here does not mean inverse display of the rendered text, but inverse to delete display, i.e., all the display pixels are enabled.

Contrast control

Furthermore, the contrast control can also be adjusted under this option “Display test”. Moreover, there are 7 levels available which can be run though with the CURSOR_UP and CURSOR_DOWN keys.

3.2.4 Key test (2)

Pressing the “2" key calls up the following screen:

K e y T e s t
(E) End

When a key is pressed this or its meaning is displayed. This can either occur by a triple character display, e.g., “AAA” or as a text, e.g., "CURS_UP". Moreover, pressing the “P” key tests the bleeper (audible sound) and pressing the “K” key tests a micro key to identify whether the cover for the paper compartment is open or closed. The “E” key terminates this test and simultaneously undergoes a self-test. The initial display image appears.

3.2.5 Motor test (3)

When the “3" key is pressed the following menu appears:

Motor/Speed Test

The speed select key is used to set the required speed and the motor set into motion with Start/Stop.
Whilst running the motor speed can be controlled by using the “A” key to activate the setting of the measurement marking pulse and to deactivate it with the “S” key. A marking pulse is set once every second. The running speed can then be calculated or its accuracy checked from the distance between marking pulses.
Any other key pressed not included in this menu leads to the initial display menu.

3.2.6 Test results (4)

Pressing the “4" key triggers the output of the test results.

The output of the test protocol supplies data on the software integrated in the device (Part No., Version No., production date of the firmware), printhead voltage and the test results on the memory test performed during power-up.

The areas listed under RAM have the following meaning:

CardioSmart

0 - 080000h
512 kByte RAM area on the PCB Control CS_S

100000 - 140000h
256 kByte RAM area on the CardioProm (depending on CardioProm type)

140000 - 1C0000h
512 kByte RAM area buffered on the CardioProm (dep. on CardioProm type)

CardioSmart ST

0 - 080000h
512 kByte RAM area on the PCB Control CS_S

100000 - 180000h
256 kByte RAM area on the CardioProm (depending on CardioProm type)

180000 - 200000h
512 kByte RAM area buffered on the CardioProm (dep. on CardioProm type)

Values may deviate from those given above depending on the device or software version used.

A specification in the form 100000 - 100000 permits the conclusion that this RAM area does not exist in the device. However, if it does exist in conformity with the software version implemented, this means that this RAM cell at address 100000H is defective. The memory could also be defective when the initial and final addresses of the memory area differ and do not correspond to the above-mentioned limits. This then means, for example, that the specification 100000 - 123000 on the defective cell at address 123000H.

The output can be interrupted with the Start/Stop key. Following output the initial

display menu reappears automatically.

3.2.7 Self-test

The test results elucidated in Section 3.2.6 are ascertained during the self-test, which is always performed on power-up. Should errors be detected, a message appears on the display after the test indicating the possible errors. The following error codes are used to identify the error.

Error codes

The following error codes appear on the display together with the message “Self-test failed”:

ERROR_CODES:
0 - reserved
1 VEKT - error in vector table
2 ERAM - RAM error on PCB Control
3 LCDR - LCDRAM error (Graphics Display)
4 - reserved
5 - reserved
6 RAMB - RAM error on the CardioProm
7 GRAM - error in buffered RAM on the CardioProm
8 ROMB - ROM error (checksum) on the CardioProm

9 - 10 not used

3.2.8 Recording test (5)

The recording test is activated by pressing the "5" key and interrupted with the "Start/Stop" key.

Immediately after pressing the "5" key the printer begins to record the first channels at 25mm/s and 20mm/mV.
In addition, the message “Recording test” appears on the display. In this test only the first two channels are passed on to the printer. No other channels can be configured.

3.2.9 Interface test (6)

Several possibilities are available to test the serial interface. Moreover, on the one hand, the signal transmission and receiving of the interface can be tested by an internal feedback from TXD and RXD and, on the other hand, the signal transmission and receiving with a remote station.
For the test with a remote station a standard PC cable is required for a serial interface (zero modem cable). In addition, the following transmission protocol should be adjusted at the remote station:

1 start bit, 8 data bits, parity even
1 stop bit
Baud rate 9600

Pressing the “6" key calls up the following menu:

Interface test Keys (1), (2), (3)
‘1' key tests transmission and receiving

(1) Transmitting and receiving
This test enables complete testing of the RS232 signal path for transmitting and receiving, including RS232 driver and connector.
This test requires an RS232 connector with an internal bridge from pin 2 (RXDE) to pin (TXDE). Depending on the result of the test, the following message appears:

Test result : OK
or
Test result : Error

This procedure requires a software version as from V4.1. Earlier software versions only permit internal testing of the RS232 interface without including the RS232 driver.

(2) Transmit test string to device
In this test a remote station, e.g., PC must be connected up and have a terminal program which can receive signals and be configured for the above-mentioned protocol. If the remote station is on receive, then every time the “2" key is actuated the test string “Interface test” is transmitted to the remote station. Simultaneously, the following message appears on the display:

Transmitting : interface test

(3) Transmitting and receiving with device
Transmitting and receiving can be tested with a remote device by pressing the “3" key. The device should be connected as described in (2).
After pressing the “3" key a test string is sent the remote station. The following message appears on the display:

Interface test Keys (1), (2), (3)

A subsequent input at the remote station is sent back to the device and displayed there. A received text would then be displayed on the second line of the screen.

Moreover, it should be noted that an input must take place within 10 s and the input terminated with “return”. If the key is actuated a second time then the string "CardioSmart Test" is transmitted. Altogether there are three test strings available, which are sent in the following sequence with repeated key actuation:

"Interface Test", "CardioSmart Test", "Looks good, doesn´t it?"

The last string corresponds to the expected test result.
This test is terminated with any other key not used to start a test.

3.2.10 Time and date (7)

This section deals with the quick checking and setting of the time and date.
Pressing the “7" key calls up the following display:

Time / Date
10:12:03 10.11.1994

From this screen the clock can be adjusted by pressing the “S” key the following mask appearing:

Time Date
[ ] [ ]

The first mask is for the time and the second for the date.
Example: [1012] [10119] for 10:12 o´clock and 10.11.94

Pressing the return key terminates the entry. The adjusted data are subsequently accepted and seconds set to zero.

The test is terminated with any other key not used for a test.

3.2.11 Electrode test (8)

The electrode test is started by pressing the “8" key.

The electrode test is terminated by pressing any key.

To evaluate the electrode states the following status WORD is available.

```
Status = 0 -> Electrode OK
Status = 1 -> Electrode disconnected

Bit15                                                                Bit0
-----------------------------------------------------------------------
| x | x |DAT|ELN|NAP|NST|NAX| C6 | C5 | C4 | C3 | C2 | C1 | F | L | R |
-----------------------------------------------------------------------
```

And precisely this status WORD extended to LONG is displayed on the screen during the electrode test to be performed. It is important to note, however, that this status WORD is not displayed as a binary number but as a hexadecimal number.

However, to make the status of a particular electrode quickly recognizable, defective electrodes are represented by an ID code.
EX_R, for example, stands for the defective electrode R and C1 for electrode C1.

This permits the identification of every individual electrode. Naturally, since several electrodes can become disconnected simultaneously, it was necessary to set a certain priority in the display of disconnected electrodes.

The following display priority was programmed:

EX_R, EL_N, EX_L, EX_F, C1, C2, C3, C4, C5, C6, NAX, NST, NAP

For example, if electrodes R and N have become disconnected, then first R is reported with EX_R as having become disconnected. Only after R is OK is EL_N displayed.

3.2.12 Test time constants (9)

The test is started by pressing the “9" key and interrupted with the "Start/Stop" key.

Immediately after the “9" key has been actuated the printer begins to record the first two channels at 25 mm/s and 20 mm/mV.
Moreover, the message “Testing time constants” appears on the display.
In this test only the first two channels send signals to the printer. No other channels can be configured. The default time constant is output on the printout as a control.

Setting the time constants

As a general rule, the time constants are adjusted to 2.04 s.
This setting can be changed with the CORR_CONFIG key.
The following settings are available:

Time constants:

(1) 0.260s (2) 0.130s (3) 0.033s
(4) 0.004s (5) 4.080s (6) 2.040s
(7) 1.020s (8) 0.510s

The figures given in parentheses indicate the key used to select the corresponding time constant.

Verification of the currently active time constant is only possible by printing out the self-test results (see Section 3.2.6) or by testing the time constants (see Section 5.2.8).

3.2.13 Setting the Device model (V)

This setting is only available form Software Release V4.21.

Setting the Device model is activated by pressing the “V” key, the following display image appears:

D e v i c e M o d e l --> (1) INT

(1) INT (2) USA (3) EU_2 (4) ASIA (5) RUSS

Terminate with any key.
The currently enabled device model appears in line 1.

Warning!

Changing the device model affects the selection of the output formats and languages available, can switch the program for Interpretation from HEART to 12 SL, or vice versa. Also affected are the default configuration settings, e.g., override function yes/no, line filter 50/60 Hz.

The device model configured during manufacture should only be changed when deemed really necessary.

The following table shows the most important combinations:

Device model	Interpretation	Output formats	Languages	Default settings	
				Override function enabled	Line filter
01 INT	HEART	International	g,e,f,i,s	no	50 Hz
02 USA	12SL	USA	e,f,s	yes	60 Hz
03 EU_2	12SL	Int. +H1 +H2	e,g,f,sw	yes	50 Hz
04 ASIA	HEART	International	g,e,f	no	50 Hz
05 RUSS	HEART	International	g,e,f	no	50 Hz

Output formats: - International: 12_FS, 12_F1, 12_F2, 6_1F, 6_F2, 3_F1

- USA: STND1, STND3, 1x10, 2x5, 2x5_ex, 3RHY1

The required device model is selected by pressing the appropriate key, “1" to “5".
Quit selection menu by pressing any key.
Quit the self-test with “Shift” + “Man” or “Shift” + “Mode”.
CardioSmart configures the appropriate items and initiates a cold start automatically.
Thus, when the device is rebooted automatically all the new settings are adopted.

Selecting a particular device model leads to the configuration of the program for Interpretation as indicated in the table above, even when the interpretation program was configured differently beforehand as described in section 3.2.14.

Note on saved ECGs when configuring the device model:
Saved ECGs are not lost.
If when a new device model is selected, the program for Interpretation is switched over, however, when printing out the saved ECGs the display in the status line (12SL, or without in the case of HEART) is related to the currently enabled program for Interpretation, although the results are based on the program previously configured. In this case, the saved ECGs should be printed out or transferred to a PC before configuration of the new model.

3.2.14 Switching over the program for Interpretation (C)

Switching over the program for interpretation is activated by pressing the “C” key, the following display image appears:

I n t e r p r e t a t i o n --> (1) HEART

Terminate with any key.
The currently enabled device model appears in line 1.

Warning!

Switching over to another program for Interpretation affects the measurement results and the interpretation!

The program for Interpretation configured during manufacture should only be changed when deemed really necessary!

The required program for Interpretation is selected by pressing the appropriate key, “1" or “2":
“1" for HEART, or “2" for 12SL.
Quit the selection menu by pressing any key.
Quit the self-test with “Shift” + “Man” or “Shift” + “Mode”.
CardioSmart configures the appropriate items and initiates a cold start automatically. Thus, when the device is rebooted automatically all the new settings are adopted.

Note on saved ECGs when switching over the progran for Interpretation:
Saved ECGs are not lost.
After switching over to a different program for Interpretation when printing the saved ECGs the display in the status line (12SL, or without in the case of HEART) is related to the newly selected interpretation program, although the results are based on the program previously configured. In this case the saved ECGs should be printed out or transferred to a PC before switching over to the new program for Interpretation.

4. Repair instructions

4.1. Safety instructions

Repairs may only be conducted by approved specialist personnel.
Before opening the CardioSmart switch off device and disconnect mains plug!
Never connect mains plug when the when the device is open!

Before replacing the primary fuses in the power input module or when resetting the voltage selector switch to a different voltage range the device should also be switched off and the mains plug disconnected!

When replacing electronic components implement **ESD protection.**
Return replaced PCBs in **ESD packaging** only.

Defective batteries, empty batteries should be **disposed of in accordance with the applicable legal stipulations** or returned to the factory**.**
Batteries returned to the factory should be labeled **"For disposal"**.

4.2 Replacing components

For all the following points the safety instructions in Section 4.1. are to be observed!

The CardioProm (program module) can be unlocked with a coin and then pulled out.
The character display CardioVision Text can be disengaged without opening the device by applying a screwdriver three times left, right and in the middle between the display housing and the upper housing shell of the CardioSmart.
Warning: The device must be switched off!

Opening the device

To open the CardioSmart undo the 5 fastening screws on the underside of the device, open the paper feed flap, carefully raise the upper shell of the housing, disconnect keypad. The display remains in the upper shell of the casing.

During reassembly ensure that no cables are pinched. Exert gentle pressure in the vicinity of the display to ensure that the display is in contact with the PCB and that it remains snapped into position in the upper shell.

Replacing the mains input module

After opening the device undo the screw located on the underside of the housing used to secure the holding angle bracket for the mains input module and the device power-on switch. Disconnect the primary connector DC and switch on/off connector DA from the PCB Power Supply.
Replace mains input module (snap-in connection).

Warning: Only use fuses indicated on the rating plate! (see Chapter 8, Parts List)

For safety reasons insert the fuse holder such that the correct mains voltage range is adjusted!

Visual check at the inspection window of the mains input module. (see Section 2.4)

Replacing the battery

Disconnect and lift out the battery compartment on the underside of the device by raising the middle fastening catch. Remove the battery and disconnect the battery plug DD from the PCB Power Supply.

Warning: Only original Marquette Hellige batteries may be used! (see Chapter 8, Parts List)

Defective batteries, empty batteries should be **disposed of in accordance with the applicable legal stipulations** or returned to the factory**.**
Batteries returned to the factory should be labeled **"For disposal"**.

Before putting in the new battery insert plug DD. Push in battery compartment, secure by pressing on the fastening catch.

Replacing the PCB Power Supply

After opening the device first of all disconnect the primary connector DC and the switch on/off connector DA from the PCB Power Supply. Open the battery compartment and disconnect the battery connector DD (see "Replacing the battery").
Disconnect connector AE from the PCB Control. Remove PCB Control (see "Replacing the PCB Control").
Undo the 2 fastening screws next to the transformer and fuse Si500.

PCB Control has 2 soldered fuses:
- SI 500: Battery fuse
- SI 501: Secondary circuit fuse

No adjustments on the PCB Control are necessary.

Replacing the PCB Control

With the transition to device version V1.2 the PCB Control has a new part number:

PCB Control CS_S equipped: 388 032 13, Spare Part No: 389 004 16

Before replacing the PCB, if still possible, printout the settings configured by the user.

After opening the device first of all disconnect the plug-in connector AE to the power supply unit, then disconnect the remaining connectors to the recording unit. Undo the 6 PCBs fastening screws.
Remove shielding plate under the patient input section (1 screw, 3 x snap-in catches) and assemble it on the new PCB.

Check whether the lithium battery for the real-time clock (BA 500) is correctly soldered. Insert new PCB and plug in connectors.

Since the motor controller is located on the PCB Control, the motor adjustment for speed and compensation must be carried out. Motor adjustment is described in Chapter 6.
In addition, disengage the retaining clips by pressing them together, then remove from the upper shell and plug into the connector AG (character display) or AH (graphics display). However, simpler is a character LCD module connected to connector AG via a flat strip cable.
Connect keypad in the upper shell using connector AS.

Setting the time (Section 3.1.10 / 3.2.10).

If known, adopt the user-programmed configuration; otherwise, default setting.

If known, reset the user-programmed time constants; otherwise by outputting the self-test results (Section 3.1.6 / 3.2.6).
Check default setting is 2.04 s, and adjust to 2.04 s if necessary (Section 3.1.12 / 3.2.12)

Adjust contrast with the appropriate display.

Replacing the motor

After replacing the motor the motor adjustment of speed and compensation must be carried out as described in Chapter 6.

Replacing the graphics display

The CardioSmart must be opened to be able to replace the graphics display.
Disengage the graphics display from the upper shell of the housing by pressing together the retaining clips and remove it.
Reassemble the upper shell. Then carefully insert the graphics display into the basic device until the retaining clips snap securely into place.

Adjust the contrast with the new display.

Replacing the character display

The character display CardioVision Text can be disengaged without opening the device by applying a screwdriver three times to the left, right and in the middle between the display housing and the upper shell of the CardioSmart housing.
Carefully insert the new display (character or graphics) into the basic device until the retaining clips snap securely into place.
Adjust the contrast with the new display.

Replacing pump module

Open device, take care in removing the upper shell to avoid damage to vacuum tubing. Detach the vacuum tubing from the upper shell. Disconnect power plug SA from the pump module. The module can be replaced after unscrewing the two fastening screws and detaching the evacuated air tubes.
After replacement perform a performance check as described in section 7.1.2.11.

Take the negative pressure reading at PTT after approx. 10 s. This value must lie within the range 225...265 mmHg (300...350 mbar).

5. Troubleshooting tips

Device cannot be switched on even though power plug is plugged in

- green power lamp LED is off and device cannot be switched on:
  - power cable defective or not plugged in correctly?
  - primary fuses in the mains input module defective?
  - connecter DC on PCB Power Supply plugged in correctly?
  - mains input module defective?
  - keypad via connector AS on PCB Control plugged in correctly?
  - are all above-mentioned points OK: ===> PCB Power Supply defective (transformer or rectifier)

- green power lamp LED is on, but device still cannot be switched on:
  - device on/off switch or its lead defective?
  - connector DA on PCB Power Supply plugged in correctly?
  - keep device on switch depressed and measure voltage UVERS on connector AE pins 4 + 5 on PCB Control: UVERS greater that 25V-?
    - if not: - fuse SI501 on PCB Power Supply defective?
      - if SI501 OK ===> PCB Power Supply defective.
    - if so: ===> PCB Power Supply defective.

Device cannot be switched on when being battery-operated only

- Is the battery empty?
- Plug in power plug, green power lamp LED should glow and the device can be activated, if not, refer to "Device cannot be switched on even though power plug is plugged in".
- By connecting the power plug rapid charging is activated, LED1 on PCB Power Supply should glow, via the PTC resistor R500 a power supply of approx 1 V should be available on PCB Power Supply.
  (measured with a multimeter):
- if so: battery charging circuit OK.
- if not: battery disconnected or defective?
- if not: ===> error on PCB Power Supply
- After charging for 10 minutes disconnect power plug, can the device be switched on and trigger a recording?
- if not: - fuse SI500 on PCB Power Supply defective? (Device does not switch on)
- if SI500 OK ===> battery defective or capacity too small.

No display on the screen

- does the yellow Stop LED on the keypad glow after the device is switched on?
- if not: - refer to "Device cannot be switched on ...."
(if the green Start LED glows CardioProm can also be defective)
- contrast badly adjusted (adjust contrast)
- graphics display: can the background illumination be activated by pressing a key?
- does a beep sound approx. 10s after switching on the CardioSmart? (indicates that the self-test is over)
- if so: - display correctly engaged?
- if so: ===> display defective?
===> or driver on the PCB Control defective
- if not: - error in basic device:
===> PCB Control defective?
===> or CardioProm defective

Error in self-test identified

When an error is detected during the self-test, in addition to the message “Self-test failed” the error code number and a short description also appear on the display. The meaning of the error codes is described in Section 3.1.7 / 3.2.7. The error codes refer to the PCB Control, graphics display and the CardioProm:

- error code 1, 2: PCB Control
- error code 3: PCB Graphics Display
- error code 6,7,8: CardioProm

CardioSmart fails to give printout, **no paper transport**

Perform the following test in the manual operating mode:

- Paper available? Paper correctly inserted? Paper transport defective?
- Paper feed flap correctly engaged on both sides?
- after pressing the Start key the green Start LED must glow
- if not: ===> CardioProm defective?
===> or PCB Control defective
- Power supply +/-12V at test connector AF/pin 1 and pin 3 of PCB Control available?
- if not: - Signal REG_ON on high-level? (Measure at connector AE/pin 2)
- if not: ===> CardioProm defective?
===> or PCB Control defective
- Signal REG_OFF on high-level (Measure at connector AE/pin 11)
- if not: ===> Battery depleted or defective?
===> or PCB Power Supply defective
- Motor feed line defective? Connector AK plugged in correctly?
- Motor blocked? (check roller, transmission)

- Measuring voltage COMMON_S at test connector AF/pin 4 of the PCB Control available in the range 16V ... 23V?
  - if so: ===> Motor defective?
    ===> or PCB Control defective (Motor controller)
  - if not: - Battery voltage too low, recharge

Paper transport functions, no printout

- Paper feed flap correctly engaged on both sides?
- Printhead impact pressure switch OK? In addition, in the system test Sections 3.1.4/3.2.4 use the “K” key to check whether opening/closing of the switch is identified.
- if not: - Is connector AJ on PCB Control inserted correctly?
- Good feed line contact on printhead impact pressure switch?
- Printhead impact pressure switch defective?
- Printhead power supply on? Measurement at plus terminal of C500 on PCB Control, voltage in range 16V ... 23V
- if not: - Signal REG_ON on high-level? (Measure at connector AE/pin 2)
- if not: ===> CardioProm defective?
  ===> or PCB Control defective
- Signal REG_OFF on high-level? (Measure at connector AE/pin 11)
- if not: ===> Battery depleted or defective?
  ===> or PCB Power Supply defective
- if both signals are on high:
===> PCB Control defective (common/VDD1 switch)
- Printhead power supply cable (connector AO) defective, or not plugged in correctly?
- Printhead data feed line (connector AL) defective, or not plugged in correctly?
- After an extensive printjob, printhead still overheated? Allow to cool.
- none of the above-mentioned errors apply:
  ===> PCB Control defective?
  ===> or thermal array printhead defective

CardioSmart only prints on the upper or lower section of the printout

- Paper feed flap is only engaged on one side.

CardioSmart prints, but only baselines are printed out

- Electrodes applied correctly?
- Electrode cables plugged into the patient trunk cable terminal box correctly?
- Patient trunk cable defective (e.g., N core defective)
- Contact problems at the patient input of the CardioSmart?
- none of the above-mentioned errors apply: ===> PCB Control defective

6. Adjustment instructions

CardioSmart only requires motor adjustment. Adjustment is necessary when a new motor (replacement of paper feed flap) or a new PCB Control is implemented.

Motor Adjustment

What to adjust or to check?	What to measure with?	How to adjust test mode?	Where to turn?	How much and exact?	What else to note?
Motor speed under small load, slow down driving roller by applying a finger (recorder flap open), adjust on stationary motor pinion.	Flash at motor pinion with a stroboscope (LED)	1. Shift + Auto 2. “3" key 3. “A” key 4. With mm/s key adjust to 25mm/s 5. START key	Speed adjuster R505	Stroboscope frequency = 283.6 Hz When an LED driven by a square-wave generator is used-, a small key ratio should be observed.	Motor should be at room temperature be switched on for only 5 s for each adjustment.
Adjust motor speed on the slowed down driving roller, so that there is no difference in the RPM. Slow down the driving roller with a finger sufficiently, so that the LED500 just remains illuminated. (Recorder flap open)	see above	see above	Speed compensation R506	see above	If the RPM has changed after compensation adjustment, it should be corrected again with R505.

When a stroboscope is not available:

What to adjust or to check?	What to measure with?	How to adjust test mode?	Where to turn?	How much and exact?	What else to note?
Adjust motor speed with the recorder flap closed.	Check the measurements of the grid with a ruler. min. 200mm	1. Shift + Auto 2. “3“ key 3. “A” key 4. With mm/s key adjust to 25mm/s 5. START key	Speed adjuster R505	< 0,5%	Motor should be at room temperature be switched on for only 5 s for each adjustment.
With an increased load adjust motor speed (additional speed reduction, finger on the driving roller until LED 500 just goes out)	see above	see above	Speed compensation R506	see above	The adjustment procedure is complete when the RPM is 25 mm/s both under normal and increased load.

7. Servicing and maintenance

7.1 Technical inspection

A technical inspection is to be performed once a year. The following items, including the accessories used, are to be performed:

- Check device and accessories for mechanical defects which impair their function.
- Perform a function check as detailed in Section 3 “System test functions”.
- Check labels and inscriptions on the device relating to safety are clearly legible.
- Measure the resistance of the non-fused earth conductor as per measuring circuit from VDE 0751:1990
- Measure the device leakage current as per measuring circuit from VDE 0751:1990
- Measure the patient leakage current as per measuring circuit fromVDE 0751:1990

Warning!
The following checks may only be performed by persons whose training, knowledge and practical experience enable them to carry out such checks reliably and correctly.

Notes:
The operational and functional reliability of the device is checked using the following checklists.
They serve the experienced technician when checking the device.
A knowledge of device operation as detailed in the “User’s Manual” is assumed.

The checklist items are based on the testing instruments given below.
The tests should be carried out using the customer’s accessories, so that defective accessories are also detected automatically.
If other testing instruments are used besides those mentioned, the items on the check list and tolerance specifications may need to be modified.

7.1.1 Visual check

Device and accessories are to be checked to ensure that
- fuse cartridges comply with vendor’s specifications;
- labels and inscriptions on the device relating to safety are clearly legible;
- the mechanical state of the device permits its further use;
- there is no fouling which could cause any reduction in safety.

7.1.2 Test functions

7.1.2.1 Recommended testing instruments and accessories

1x Multi-parameter simulator Lionheart

1x RS232 interface connector with internal connection between pins 2 and 3 (TXD and RXD)

1x Patient trunk cable and customer electrode leads,
or 1X patient trunk cable, 10-pin 233 402 04
with 1 set of electrode leads (10 leads) with 4 mm plugs 38401129

1x Pneumatic Transdurcer Tester PTT, for example: X - Caliber (Display in mmHg)

1x 1 x Y-Adapter 303 444 89

7.1.2.2 Test preparations

The following descriptions apply to device version V1.2 and software version V4.2.

In general, the device test functions implemented in CardioSmart are used for the tests. These are described in Section “3. Device test functions”.

Connect CardioSmart up to the mains, the green LED for standby must glow.
Switch the device on, the self-test runs automatically, no error message should appear. When the self-test has finished the device is in the automatic mode, the yellow LED for still disabled operating mode must glow.

Modifications in the user-programmed configuration may need to be made in order to carry out the test. Should such a change need to be made to enable testing, make a printout of all the modified configuration lists and mark the changes made.

Important: After completing the test the original user-programmed configuration is to be retrieved and activated.

7.1.2.3 Operating and display unit performance tests

- Carry out the “Display test (1)” as detailed in Sections 3.1.3 and 3.2.3, respectively.
- Carry out the “Keypad test (2)” as detailed in Sections 3.1.4 and 3.2.4, respectively.

7.1.2.4 Test for recording speeds 25 and 50 mm/s

- Carry out the “Motor test (3)” as detailed in Sections 3.1.5 and 3.2.5, respectively.
- Enable measurement marks by pressing the “A” key.
- Should there be feed speed deviations of > 2%, adjust motor as detailed in Section “6 Adjustment instructions”.

7.1.2.5 Device test result check

- Output “Test results 4)” as detailed in Sections 3.1.6 and 3.2.6, respectively.
  - Main parameters:
    - all memory stores free from error?
    - ASIC test O.K?
    - Sample rate 1000?
    - Selected time constants: 2.04 s (or 4.08 s)?
    - Printhead voltage > 18V, battery charge O.K?
    - Printout clearly legible and without any lapses or interference?

7.1.2.6 RS232 interface test

- Carry out the “Interface test (6)” test item “(1) Transmitting and receiving”.
  Note: For devices with CardioProms V3.0x the RS232 driver is not yet tested in this test; therefore, in this case test item “(3) Transmitting and receiving with device” should be carried out.

- Remote start input test:
  - Adapt push button (NO contact) between RS232 interface pin 8 and pin 5
  - Select manual mode
  - Press push button once: initiates recording in manual mode
  - Press again: terminates recording in manual mode

7.1.2.7 Analysis of the ECG signals and HR value

Carry out the following settings on the ECG simulator:
- Amplitude 1 mV
- Heart rate (RATE) 60 bpm

Connect the electrode leads as indicated below:

R	red	----->	RA
L	yellow	----->	LA
F	green	----->	LL
N	black	----->	RL
C1	white/red	----->	V1
:	:	:	
C6	white/violet	----->	V6

Switch in **manual operating mode** and start recording by pressing the Start key.

By pressing the lead scrolling key check whether all leads **are being recorded.**
The ECG traces must be **noise-free**.

Record one page in the “manual” operating mode. The following annotations must be present:

- Heart rate (top right)
- Lower status line
  - date and time
  - recording speed
  - sensitivity
  - active filter, e.g., 50/60 Hz, 35/20 Hz, ADS
  - frequency range of the recording (not at SW level V3.0x)

The **heart rate** of 60 bpm +/- 2 bpm appears on the display and is printed out on the recording.

Activate the square-wave function on the ECG transmitter at 1 mV.
Using the lead scrolling key select lead II. The square-wave pulse trace must correspond in **amplitude** with the displayed 1 mV reference pulse (applicable to named transmitter only).

Switch back to ECG signal on the ECG transmitter.
Start the recording in manual mode.
Increase the **heart rate to 200 bpm** on the ECG transmitter. The acoustic **warning signal** must sound for about 1s. Reduce the heart rate back to 60 bpm, the warning signal no longer sounds.

7.1.2.8 Pacemaker identification test

Make the following settings on the multifunction simulator:
- pace setting
- pace amplitude 6 mV
- pace duration 0.2 ms

Adjust manual mode on CardioSmart device to be tested and select lead groups I, II and III.
Start the recording. The pace pulses must be visible as needles on the recording output.

7.1.2.9 Identification of disconnected electrodes

Reset the simulator to ECG signal at a heart rate of 60 bpm. Remove one electrode after the other from the ECG transmitter.

Activate the automatic mode in the CardioSmart device to be tested without activating it by pressing the Start key.
Check to ensure that each disconnected electrode is displayed correctly and that an acoustic alarm signal sounds.

7.1.2.10 Checking the charge status of the NC battery

The NC battery can, among other things, be checked as follows:
discharging the battery, followed by charging up completelyl (duration 4 h), followed by discharging in standby mode without recording.
If the operating time for this procedure is under 2.5 h, the battery should be replaced.

7.1.2.11 Pump leakage

Start the pump by< blowing against the suction pipe still open and then closing the pipe with your finger as shown in the test setup (within 3 s). Take the negative pressure reading at PTT after approx. 10 s. This value must lie within the range 225...265 mmHg (300...350 mbar). Then switch off the negative pressure pump (ECG recorder or power supply unit). The drop in negative pressure must not exceed max. 1 mmHg/s (1.33 mbar/s).

If this value is not observed, the pump in the CardioSmart must be replaced .

7.1.3. Safety Analysis Test

7.1.3.1 General Information

The suggested Safety Analysis Test refer to the international Standard IEC 601-1.
The tests are generally performed with Safety Testers, on most of them, the measuring circuits according IEC 601 are already implemented.
The tests which have to be performed are described generally, for the handling of your Safety Tester follow the user manual.

The tests may be performed under normal ambient conditions of temperature, humidity and pressure and with line voltage.
The leakage currents correspond to 110 % of rated voltage for the tested unit. Most Safety Testers take this into account, otherwise the measured values have to be calculated.

Recommendet test equipment

- Safety Tester for measurements according IEC 601.
- Testing connector according the following description.

Testing connector for measuring patient leakage current.

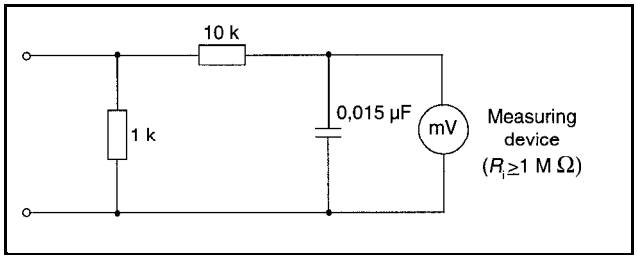
For testing the ECG input,a patient cable, with all leads connected together,is used.

7.1.3.2 Protective earth resistance test

The protective earth resistance test has to be performed including its power cord.
This test determins whether the device has a power ground fault.
- The protective earth resistance from power connector to any protective earth connected exposed conductive part is measured.
- Specs. of test circuit: AC current source 50 Hz/60 Hz of at least 10 A up to 25 A with limited output voltage of 6 V.
- If resistance is greater than 100 mOhm

7.1.3.3 Measuring of leakage current

To proceed the suggested measurements, the unit under test has to be separated from any interconnection to a system. If the unit is part of a system, extended tests according IEC 601-1-1 have to be performed. The following diagram shows the needed Measuring Circuit [M] for leakage current. The reading in mV corresponds to uA (leakage current). The Safety Testers generally work with this Measuring Circuit [M] and the displayed values are already converted to leakage current.



7.1.3.3.1 Enclosure Leakage Current Test

This test is performed to measure leakage current from chassis to ground during normal conditions (N.C.) and single fault conditions (S.F.C.).
In any case, the leakage current is measured from any exposed conductive parts to ground, the unit under test has to be switched on and off.

Connect the unit under test to your Safety Tester.

- During normal conditions (N.C.), referring to the electrical diagram, measurements have to be done under following conditions:

* Polarity switch Norm and RVS
* GND switch GND closed
* S1 closed and open

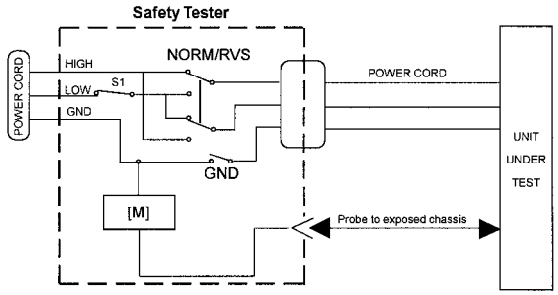
- During single fault conditions (S.F.C.), referring to the electrical diagram, the measurements have to be done under following conditions:

* Polarity switch NORM and RVS
* GND switch GND open
* S1 closed

Test has failed if the measured values are greater than:

N.C.	S.F.C
100 µA	500 µA
	300 µA (U.L. requirements)

Electrical diagram for Enclosure Leakage Current Test



7.1.3.3.2 Patient Leakage Current Test

This test performs a leakage current test under single fault conditions (S.F.C.) dependent of domestic power outlet with 115 or 230 V AC as source into the floating inputs.

In any case, the leakage current is measured from Input Jack, of unit under test, to ground.

For testing the ECG input, a patient cable, with all leads connected together, is used.

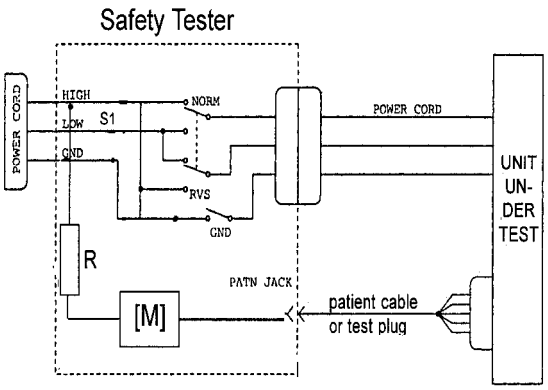
Connect the unit under test to your Safety Tester.

- Referring to the electrical diagram, measurements have to be done under following conditions

* Polarity switch NORM and RVS
* GND switch GND closed
* S1 closed

Test has failed if the measured values are greater than 50 µA

Electrical Diagram for Patient Leakage Current Test



For protection of the test person the following values of resistor R may be used:

Typ BF	22 kOhm (120 to 130 V)
	47 kOhm (220 to 240 V)
Typ CF	100 kOhm (220 to 240 V)

7.2 Maintenance, cleaning, disinfection

CardioSmart maintenance, cleaning, disinfection is performed in accordance with the CardioSmart or CardioSmart ST User's Manual, Chapter 11, "Cleaning, disinfection and maintenance", as applicable.

Applications requiring extensive recordings may result in deposits on the thermal array printhead which normally do not, however, have any adverse effect on the printing quality. This can be removed with a soft, fluff-free cloth soaked in an alcohol-based cleaning agent (e.g., surgical spirit).

8. Parts Lists

Part Number	Description CardioSmart		
101 116 01	CardioSmart	(int.)	Basic unit without Pump
101 116 02	CardioSmart	(USA)	Basic unit without Pump
101 116 03	CardioSmart	(russ.)	Basic unit without Pump
101 116 04	CardioSmart	(int),	Basic unit with Pump
101 116 05	CardioSmart	(russ),	Basic unit with Pump
101 116 06	CardioSmart	(Europe2)	Basic unit without Pump
101 116 07	CardioSmart	(Europe2)	Basic unit with Pump

CardioSmart ST

101 116 10	CardioSmart ST	(int.)	Basic unit Stress Test without Pump
101 116 11	CardioSmart ST	(int.)	Basic unit Stress Test with Pump
101 116 12	CardioSmart ST	(USA.)	Basic unit Stress Test without Pump
101 116 13	CardioSmart ST	(USA.)	Basic unit Stress Test with Pump
101 116 14	CardioSmart ST	(russ.)	Basic unit Stress Test without Pump
101 116 15	CardioSmart ST	(russ)	Basic unit Stress Test with Pump
101 116 16	CardioSmart ST	(Europe 2.)	Basic unit Stress Test without Pump
101 116 17	CardioSmart ST	(Europe 2.)	Basic unit Stress Test with Pump
101 116 18	CardioSmart ST	(ASIA)	Basic unit Stress Test without Pump
101 116 19	CardioSmart ST	(ASIA)	Basic unit Stress Test with Pump

User Manual CardioSmart:

227 435 15	User Manual CardioSmart (d) V 1.1
227 435 16	User Manual CardioSmart (e) V 1.1
227 435 17	User Manual CardioSmart (f) V 1.1
227 435 41	User Manual CardioSmart (d) V 1.3
227 435 42	User Manual CardioSmart (e) V 1.3
227 435 43	User Manual CardioSmart (f) V 1.3

227 435 45	User Manual CardioSmart (i) V 1.3
227 435 46	User Manual CardioSmart (sp) V 1.3
227 43518	User Manual CardioSmart (USA) V 1.3
227 435 52	User Manual CardioSmart (e) for UK V 1.3
227 435 53	User Manual CardioSmart (f) for BeneluxV 1.3
227 435 58	User Manual CardioSmart (sw) V 1.3

User Manual CardioSmart ST:

227 465 01	User Manual Cardio Smart ST (d) V. 1.2
227 465 02	User Manual Cardio Smart ST (e) V. 1.2
227 465 03	User Manual Cardio Smart ST (f) V. 1.2
227 465 11	User Manual Cardio Smart ST (d) V. 1.3
227 465 12	User Manual Cardio Smart ST (e) V. 1.3
227 465 13	User Manual Cardio Smart ST (f) V. 1.3
227 465 15	User Manual Cardio Smart ST (i) V. 1.3
227 465 16	User Manual Cardio Smart ST (sp) V. 1.3
227 465 24	User Manual Cardio Smart ST (US) V. 1.3
227 465 17	User Manual Cardio Smart ST (russ) V. 1.3
227 465 32	User Manual Cardio Smart ST (e) for UK V. 1.3
227 465 33	User Manual Cardio Smart ST (f) for Benelux V. 1.3
227 465 38	User Manual Cardio Smart ST (sw) V. 1.3
227 465 42	User Manual Cardio Smart ST (asia) V. 1.3
227 435 11	Service Manual .d/e, 101116.. Cardiosmart

Housing / Driving unit

432 521 90	Unter -case shell
924 017 14	Rubber foot
432 521 98	Battery cover
303 445 33	Upper case with keypad (russ)
303 443 18	Upper case with keypad (Int)
303 444 50	Upper case with keypad (USA)
303 446 14	Upper case with keypad (Europe 2)
303 445 34	Upper case with keypad ST (Int)
303 446 16	Upper case with keypad ST (Russ)
303 44617	Upper case with keypad ST (Europe2)
303 44615	Upper case with keypad ST (US)
303 446 13	Upper case with keypa ST (ASIA)
303 443 19	Handle
303 443 20	Drive Flap
303 438 29	Code reader

303 442 79	Motor
914 326 69	Microswitch
432 523 54	Stop for Microswitch
801 777 62	Screw for Stop
432 522 05	Plate for Driver Flap
504 657 60	Tinplate
929 166 45	Luer- connection kit (female)
929 166 54	Luer-cap

Electronic components / pcb‘s

929 166 40	Line filter with fuse holder
914 325 94	Rocker switch
303 442 71	Comb
303 442 70	Battery
388 029 10	pcb.Printhead connection
388 028 14	pcb. Power Supply
912 084 37	FuseT 4 A TR5
912 084 35	FuseT 1,25 A
912 084 04	FuseT 0,25 A
912 084 14	FuseT 0,5 A
388 028 12	pcb. Control (usable up to V 1.1)
389 004 05	Exchange pcb. Control (usable up to V 1.1)
303 446 18	pcb. Control ST (compatible for all CardioSmarts)
389 004 16	Exchange pcb. Control ST (compatible for all CardioSmarts)
929 165 73	Battery 3 V 0,8 Ah
303 442 91	Pump 12 V (Standard)

Display-Modul Graphics

235 066 01	CardioVision Graphics -Module for CardioSmart
235 066 02	CardioVision Graphics -Module for CardioSmart(USA)
388 028 87	pcb Mother board
388 028 11	pcb digital Display
930 117 17	LCD-Graphics Display
303 443 1	Upper-Case Part
303 442 80	Joint
432 522 01	Display Bottom Part
423 203 04	Insulation

Display-Modul Text

235 06 701	CardioVision Text Display-Modul for CardioSmart
235 067 02	CardioVision Text Display-Modul for CardioSmart (USA)
388 028 88	pcb. Mother board
303 442 87	LCD Modul
432 522 03	Display Top Part
432 522 04	Display Bottom Part
931 098 80	Instrument Bag for CardioSmart, nylon material, with pockets for accessories

Connectioncable (for CardioSmart)

223 330 04	Connection cable M(L)700 - C'Smart(ST) 5m lang
223 362 03	Connection cable 5 m long for CardioSmart to PC
223 366 04	Connection cable EC1200-CardioSmart(ST) 5m long
223 378 01	Connection cable for ECG- Transmission CardioSmart to Modem ELSA,9 pin.,3m long
223 378 02	Connection cable for ECG- Transmission CardioSmart to Modem Multitech 25 pin.,3m long

Connectioncable (Only for CardioSmart-ST)

223 362 04	Connection cable EC(B)560/561-C'Smart ST 5m long
223 380 02	Connection cable ERG900(L) - C'Smart ST 5m long
223 368 02	Connection cable TM400AC - C'Smart ST 5m long
223 390 03	Connection cable T2000-CardioSmart ST 5m long, (RS232 to RS 232)
384 017 67	Upgrade Interface Kit T 2000 (RS 422 to RS 232) —> CardioSmart for 230 V
384 017 68	Upgrade Interface Kit T 2000 (RS 422 to RS 232) —> CardioSmart für 115 V

9. Technical Specifications

For operation of the CardioSmart it is necessary to plug in one CardioProm module and one of the two available displays. The following technical specifications apply to all CardioSmart versions.

Recording

direct recording of waveforms and alphanumeric characters with rectangular coordinates by means of thermal-array printhead printing on thermosensitive paper.

* recording channels: 3 or 6, 12 in automatic mode; overlapping

* space between baselines3 channels: 62 mm (arrhythmia)
  6 channels: 31 mm (manual)
  12 channels: 16 mm (auto.)

* writing width 200 mm max.

* annotation of device settings, date, time of day and patient name, if entered, in margin of recording strip

* with appropriate software module documentation of analysis results and report in each mode on separate pages

* resolution of the recording:
  vertically 8 dots/mm
  horizontally 25 µm at 25 mm/s

Chart paper

Marquette Hellige CONTRAST® Z-fold pad, 150 pages per pad, equivalent to a chart length of 45 m

paper width 210 mm or 8.5 in. (US format)
sheet length 300 mm or 11 in. (US format)

To prevent debris from collecting on the printhead, use the Marquette Hellige CONTRAST chart paper only!

Chart transport

* paper speed
  5 – 25 – 50 mm/s (key-selectable)
  error limits at 25 and 50 mm/s typically ±1%
  at 5 mm/s ±10% max.

* when supply of chart paper is depleted, recorder switches off and sounds an alarm; the last pages of the pad bear a red stripe in the margin

Membrane keypad

membrane keys with tactile feedback

* function keys for all important routine operations

* alphanumeric keypad for entry of texts

Display

alphanumeric LCD, 2 x 40 characters, contrast adjustable, or

graphics display for 24 x 40 characters, contrast adjustable

resolution of 320 x 240 pixels, backlit

Indicators (LEDs)

for mains supply, battery charge level and start/stop function

Lead selection

manual selection of individual lead groups or automatic sequencing of lead groups

* lead programs (**c**):

EINTHOVEN, GOLDBERGER, WILSON, NEHB, CABRERA lead sequence, custom lead programs in manual mode

Automatic functions

assisting and facilitating device operation:

* automatic amplifier blocking
* automatic lead sequencing, paper feed, calibration (**c**)
* report formatting (**c**)
* automatic baseline adjustment
* anti-drift system compensating for polarization voltage fluctuations (**c**)

Detection of pacing pulses

* pulse duration between 0.1 and 2.5 ms
* marks irrespective of pulse polarity
* pulse amplitude between ±5 mV and ±700 mV

Heart-rate display

derivation of the heart rate from all ECG signals

* display range 30 to 300 BPM
* display update with every heart beat, max. every 2 s

Signal inputs

isolated patient signal input, type CF according to IEC, high-voltage protection for all lead connections and N-electrode connection, interference compensation via neutral electrode (N), monitoring for detection of open leads

* electrode connections for R, L, F, N, C1 to C6, Nax, Nst and Nap (=C4)
* input impedance for differential signals applied between any two electrode connections >10 MΩ for 10 Hz
* input impedance for common-mode signals referred to N >50 MΩ for up to 60 Hz
* dynamic range for differential signals between any two electrode connections for AC voltage ±10 mV, for superimposed DC voltage (polarization voltage) ±600 mV
* dynamic range for common-mode signals referred to N±1V, referred to chassis 263 V AC voltage (rms)
* quiescent input current via any electrode connection for 1-kΩ termination referred to N <50 nA
* patient leakage current (rms values) according to IEC class CF: under normal conditions <10 µA, in single-fault condition (e.g., patient in contact with line voltage) <20 µA
* non-destructive range for lead-electrode connections and the N-connection referred to N ±50 V, referred to chassis ±1500 V
* pulse voltage resistance of all lead-electrode connections and of the N-connection referred to chassis (e.g., defibrillation) 5000 V
* monitoring of each electrode for disconnection: R, L, F, N, C1, C2, C3, C4, C5, C6, Nap, Nax, Nst audible alarm signal upon program start

Data interface

one serial RS 232 interface for exchange of data with adapted peripherals and software handshake

RS 232 interface (standard V.24 interface):

* input voltage range ±15 V max.
* output voltage range ±5 V min.
* ESD interface protection for up to ±10 kV

Remote start

remote start connection for paper feed (irrespective of selected operating mode), external make contact referred to chassis via circuit reference:

* source impedance R_i <300 Ω
* dwell of contact >100 ms
* non-destructive load ±10 V
* ESD interface protection up to ±10 kV max.

Pin assignment of data port

2 RXDE
3 TXDE
5 circuit reference
8 remote start

Signal transmission

Patient signal input to recording

after lead formation and digitization simultaneous transmission of all electrode signals to the digital processing system; muscle filter, AC filter, pacing pulse identification, automatic or manual sensitivity adjustment, automatic baseline adjustment and drift compensation by means of the anti-drift system (A.D.S.) can be enabled or disabled simultaneously for all channels; digital output of processed signals via thermal-array printhead

* low cut-off frequency (-3-dB limits) 0.08 Hz, equivalent to a time constant of 2.04 s
* high cut-off frequency (-3-dB limits)
  in Auto and manual modes: 150 Hz (IEC/AHA)
  in Arrhy mode: 100 Hz (IEC)
* signal sampling rate 1000/s
* resolution, referred to the input, 5 µV
* output rate to recorder 2000/s
* for all leads adjustment of sensitivity in four steps: 40-20-10-5 mm/mV
* with muscle filter (low-pass characteristic) switched on, 3-dB drop of the amplitude frequency response at approx. 35 Hz or 20 Hz
* with AC filter switched on, identification and compensation of periodic 50 or 60-Hz frequency components (depending on recorder model: attenuation > 40 dB)
* non-linear distortion below values specified in IEC and AHA recommendations
* coincidence error limits between any two channels ±0.5 mm
* identification of pacing pulses in C2 or other C-leads and marking in all channels for signals referred to patient input: duration + 0.1 ms, amplitude > 5 mV
* noise in the signal-transmission path below values specified in IEC and AHA recommendations:
  ≤ 2.5 µV rms
* common-mode rejection for 50 or 60-Hz signals (depending on CardioSmart model) with AC filter switched on > 140 dB

ECG calibration

automatic recording of a defined voltage step, valid for all channels

* calibration voltage of 1 mV, referred to ECG signal input

  pulse width depending on paper speed
  25 mm/s 5 mm
  50 mm/s 10 mm
  5 mm/s 1 mm

Automatic sensitivity adjustment of ECG signals

automatic adaption of the signal gain in dependence of the incoming signal; highest amplitude of a lead group or of all leads determines gain

* automatic adjustment range 5 to 40 mm/mV

* amplitude range (6 channels) 18 to 31 mm

Baseline

automatic adjustment of the baseline to the optimal recording range, in dependence of the signal amplitude

Anti-Drift System (A.D.S.)

automatic compensation of baseline fluctuations caused by polarization voltage fluctuations at the lead electrodes (recording delay 4.2 s)

ECG storage

* in automatic mode storage of up to 45 ECGs

* stored ECGs can be deleted (individually or all in one pass), printed, transferred or the patient data can be modified

* when memory is full user is informed of the possible actions

Blocking

rapid charge reversal of the coupling capacitors in the preamplifiers after electrode application

Electrode monitoring

audible and visual indication on the LCD of disconnected electrodes or line break; each single electrode is monitored

Text input

patient and user data as well as comments can be entered via the panel keyboard and are annotated on the recording strip

Copy function

in the automatic mode, after ECG recording, copies of the ECG can be printed from memory and/or transferred to a connected PC (**c**)

Test

automatic performance test upon power up, including verification of the signal path starting at the signal input

stored test data for demonstration of the device functions

Power

from the power line or from a built-in rechargeable battery, automatic switchover; automatic battery charging during line-power operation; no recording when battery depleted or missing

Line-power operation

* instrument design in protection class I according to IEC 601-1, internally powered equipment

rated voltage range **220 to 240 V**

* operating voltage range 198 to 264 V;
  49 to 65 Hz
* rated current 0.16 A
  fuse 2 x T 0.25 A, 5 x 20

rated voltage range **110 to 120 V**

* operating voltage range 99 to 132 V;
  49 to 65 Hz
* rated current 0.32 A
  fuse 2 x D 500 mA, 3 A-G

* power consumption typically:
  during battery charging 15 W
  device turned on 13 W

* max. power consumption 28 W

Battery-power operation

* battery type nickel cadmium

* rated battery voltage 18 V

* rated battery capacity 1.4 Ah

* fully charged battery sufficient for up to 50 automatic ECG recordings, if device is switched on only for
  recording

* battery charging time
  approx. 4 hours

* (min. charging time for recording of one automatic ECG 10 min)

* battery life approx. 2 to 3 years, replacement by service technician only

* battery for built-in clock: lithium battery, life of approx. 5 years, replacement by service technician

Operational readiness

after successful selftest within 10 s of power-up

Operating position

horizontal

Environment

Operation

* ambient temperature between +10 and +40 °C

* rel. humidity between 25 and 95%

* atmospheric pressure between 700 and 1060 hPa

Storage and transport

* ambient temperature between -30 and +60 °C (also with battery)

* rel. humidity between 25 and 95%

* atmospheric pressure between 500 and 1060 hPa

Case dimensions

* width 370 mm

* height 95 mm

* depth 320 mm (incl. handle)

Weight

CardioSmart with battery and text display approx. 5.3 kg
CardioSmart with battery and graphics display approx. 5.6 kg

CardioSmart ST

For operation of the CardioSmart ST it is necessary to plug in one CardioProm module and one of the two available displays. The following technical specifications apply to all CardioSmart ST versions.

Recording

direct recording of waveforms and alphanumeric characters with rectangular coordinates by means of thermal-array printhead printing on thermosensitive paper.

* recording channels: 6, 12 in automatic mode; overlapping

* space between baselines6 channels: 31 mm (manual)
  12 channels: 16 mm (auto.)

* writing width 200 mm max.

* annotation of device settings, date, time of day and patient name, if entered, in margins of recording strip

* with appropriate software module documentation of analysis results and report in each mode on separate pages

* resolution of the recording:
  vertically 8 dots/mm
  horizontally 25 µm at 25 mm/s

Chart paper

HELLIGE CONTRAST® Z-fold pad, 150 pages per pad, equivalent to a chart length of 45 m

paper width 210 mm or 8.5 in. (US format)
sheet length 300 mm or 11 in. (US format)

To prevent debris from collecting on the printhead, use the HELLIGE CONTRAST chart paper only!

Chart transport

* paper speed
  5 – 25 – 50 mm/s (key-selectable)
  error limits at 25 and 50 mm/s typically ±1%
  at 5 mm/s ±10% max.

* when supply of chart paper is depleted, recorder switches off and sounds an alarm; the last pages of the pad bear a red stripe in the margin

Membrane keypad

membrane keys with tactile feedback

* function keys for all important routine operations

* alphanumeric keypad for entry of texts

Display

graphics display for 24 x 40 characters, contrast adjustable

resolution of 320 x 240 pixels, backlit

Indicators (LEDs)

for mains supply, battery condition and start/stop function

Lead selection

manual selection of individual lead groups or automatic sequencing of lead groups

* lead programs (**c**):

  EINTHOVEN, GOLDBERGER, WILSON, NEHB, CABRERA lead sequence and custom lead programs in manual and stress test mode

Automatic functions

assisting and facilitating device operation:

* automatic amplifier blocking
* automatic lead sequencing, paper feed, calibration (**c**)
* report formatting (**c**)
* automatic baseline adjustment
* anti-drift system compensating for polarization voltage fluctuations (**c**)

Detection of pacing pulses

* pulse duration between 0.1 and 2.5 ms
* marks irrespective of pulse polarity
* pulse amplitude between ±5 mV and ±700 mV

Heart-rate display

derivation of the heart rate from all ECG signals

* display range 30 to 300 BPM
* display update with every heart beat, max. every 2 s

Signal inputs

isolated patient signal input, type CF according to IEC, high-voltage protection for all lead connections and N-electrode connection, interference compensation via neutral electrode (N), monitoring for detection of open leads

* electrode connections for R, L, F, N, C1 to C6, Nax, Nst and Nap (=C4)
* input impedance for differential signals applied between any two electrode connections >10 MΩ for 10 Hz
* input impedance for common-mode signals referred to N >50 MΩ for up to 60 Hz
* dynamic range for differential signals between any two electrode connections for AC voltage ±10 mV, for superimposed DC voltage (polarization voltage) ±600 mV
* dynamic range for common-mode signals referred to N±1V, referred to chassis 263 V AC voltage (rms)
* quiescent input current via any electrode connection for 1-kΩ termination referred to N <50 nA
* patient leakage current (rms values) according to IEC class CF: under normal conditions <10 µA, in single-fault condition (e.g., patient in contact with line voltage) <20 µA
* non-destructive range for lead-electrode connections and the N-connection referred to N ±50 V, referred to chassis ±1500 V
* pulse voltage resistance of all lead-electrode connections and of the N-connection referred to chassis (e.g., defibrillation) 5000 V
* monitoring of each electrode for disconnection: R, L, F, N, C1, C2, C3, C4, C5, C6, Nap, Nax, Nst audible alarm signal upon program start

Data interface

one serial RS 232 interface for exchange of data with adapted peripherals and software handshake

RS 232 interface (standard V.24 interface):

* input voltage range ±15 V max.

* output voltage range ±5 V min.

* ESD interface protection for up to ±10 kV

Remote start (hardware)

remote start connection for paper feed (depending on selected operating mode), external make contact referred to chassis via circuit reference:

* source impedance R_i <300 Ω

* dwell of contact >100 ms

* non-destructive load ±10 V

* ESD interface protection up to ±10 kV max.

Pin assignment of data port

2 RXDE
3 TXDE
5 circuit reference
8 remote start

Signal transmission

Patient signal input to recording

after lead formation and digitization simultaneous transmission of all electrode signals to the digital processing system; muscle filter, AC filter, pacing pulse identification, automatic or manual sensitivity adjustment, automatic baseline adjustment and drift compensation by means of the anti-drift system (A.D.S.) can be enabled or disabled simultaneously for all channels; digital output of processed signals via thermal-array printhead

* low cut-off frequency (-3-dB limits) 0.08 Hz, equivalent to a time constant of 2.04 s

* high cut-off frequency (-3-dB limits)
in Auto and manual modes: 150 Hz (IEC/AHA)
in stress test mode: 75 Hz (IEC)

* signal sampling rate 1000/s

* resolution, referred to the input, 5 µV

* output rate to recorder 2000/s

* for all leads adjustment of sensitivity in four steps: 40-20-10-5 mm/mV

* with muscle filter (low-pass characteristic) switched on, 3-dB drop of the amplitude frequency response at approx. 35 Hz or 20 Hz

* with AC filter switched on, identification and compensation of periodic 50 or 60-Hz frequency components (depending on recorder model: attenuation > 40 dB)

* non-linear distortion below values specified in IEC and AHA recommendations

* coincidence error limits between any two channels ±0.5 mm

* identification of pacing pulses in C2 or other C-leads and marking in all channels for signals referred to patient input: duration + 0.1 ms, amplitude > 5 mV

* noise in the signal-transmission path below values specified in IEC and AHA recommendations:
≤ 2.5 µV rms

* common-mode rejection for 50 or 60-Hz signals (depending on CardioSmart ST model) with AC filter switched on > 140 dB

ECG calibration

automatic recording of a defined voltage step, valid for all channels

* calibration voltage of 1 mV, referred to ECG signal input

  pulse width depending on paper speed
  25 mm/s 5 mm
  50 mm/s 10 mm
  5 mm/s 1 mm

Automatic sensitivity adjustment of ECG signals

automatic adaption of the signal gain in dependence of the incoming signal; highest amplitude of a lead group or of all leads determines gain

* automatic adjustment range 5 to 40 mm/mV

* amplitude range (6 channels) 18 to 31 mm

Baseline

automatic adjustment of the baseline to the optimal recording range, in dependence of the signal amplitude

Anti-Drift System (A.D.S.)

automatic compensation of baseline fluctuations caused by polarization voltage fluctuations at the lead electrodes (delay in recording: 4.2 s)

ECG storage

* in automatic mode storage of up to 45 ECGs

* stored ECGs can be deleted (individually or all in one pass), printed, transferred or the patient data can be modified

* when memory is full user is informed of the possible actions

Blocking

rapid charge reversal of the coupling capacitors in the preamplifiers after electrode application

Electrode monitoring

audible and visual indication on the LCD of disconnected electrodes or line break; each single electrode is monitored

Text input

patient and user data as well as comments can be entered via the panel keyboard and are annotated on the recording strip

Copy function

in the automatic mode, after ECG recording, copies of the ECG can be printed from memory and/or transferred to a connected PC (**c**)

Test

automatic performance test upon power up, including verification of the signal path starting at the signal input

stored test data for demonstration of the device functions

Power

from the power line or from a built-in rechargeable battery, automatic switchover; automatic battery charging during line-power operation; no recording when battery depleted or missing

Line-power operation

* instrument design in protection class I according to IEC 601-1

* **rated voltage range 220 to 240 V**
* operating voltage range 198 to 264 V; 49 to 65 Hz
* rated current 0.16 A
  fuse 2x slow-blow 0.25 A, 5 x 20

* **rated voltage range 110 to 120 V**
* operating voltage range 99 to 132 V; 49 to 65 Hz
* rated current 0.32 A
  fuse 2 x D 500 mA, 3AG

* power consumption typically:
  during battery charging 15 W
  device turned on 13 W

* max. power consumption 28 W

Battery-power operation

* rated battery voltage 18 V

* rated battery capacity 1.4 Ah

* fully charged battery sufficient for up to 50 automatic ECG recordings, if device is switched on only for
  recording

* battery charging time approx. 4 hours

* (min. charging time for recording of one automatic ECG 10 min)

* battery life approx. 2 to 3 years, replacement by service technician only

* battery for built-in clock: lithium battery, life of approx. 5 years, replacement by service technician

Operational readiness

after successful selftest within 10 s of power-up

Operating position

horizontal

Environment

Operation

* ambient temperature between +10 and +40 °C

* rel. humidity between 25 and 95%

* atmospheric pressure between 700 and 1060 hPa

Storage and transport

* ambient temperature between -30 and +60 °C (also with battery)

* rel. humidity between 25 and 95%

* atmospheric pressure between 500 and 1060 hPa

Case dimensions

* width 370 mm

* height 95 mm

* depth 320 mm (incl. handle)

Weight

CardioSmart ST with battery and graphics display approx. 5.6 kg

10. Device Documents

The following documents are enclosed:

- Entire instrument mechanical specifications:

- Assembly drawing:		101 116 01...19
- Entire instrument wiring specifications:		101 116 01...07/10...19 S Sheet 1
- Master Record Index:	MRI V1.0	101 116 01...03 S Sh. 2
	MRI V1.1	101 116 01...05 S Sh. 3
	MRI V1.2	101 116 01...05/10...13 S Sheet 4
	MRI V1.3	101 116 01...07/10...19 S Sheet 5,6
- PCB Control CS:		388 028 12 P Sh. 1/8 and Sheet 8/8 388 028 12 R Sh. 1/2 and Sheet 2/2
- PCB Control CS_S:		388 032 13 P Sh. 1/8 and Sheet 8/8 388 032 13 R Sh. 1/2 and Sheet 2/2
- PCB Power Supply CS:		388 028 14 P 388 028 14 R

Note on Master Record Index (MRI)

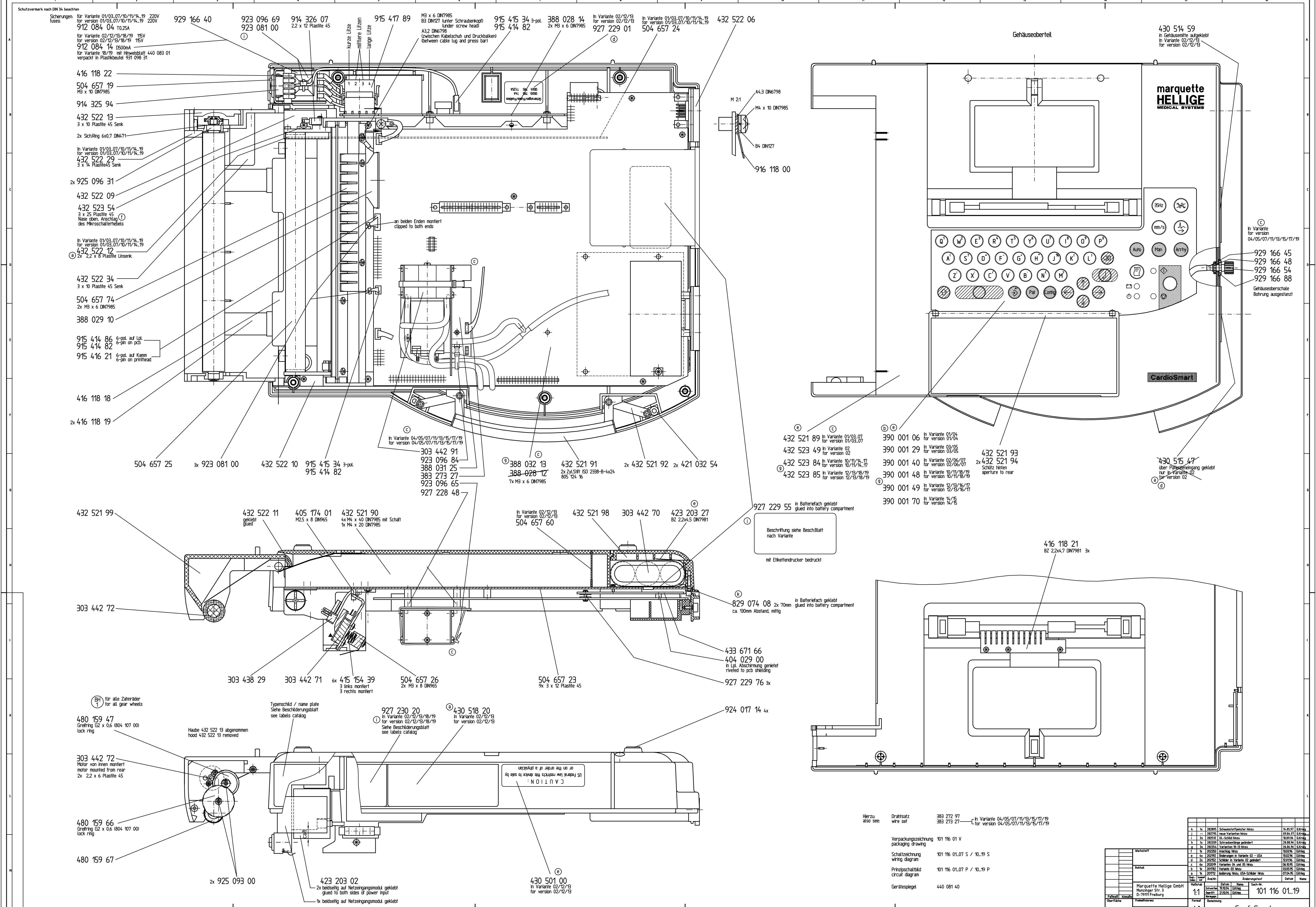
MRI	**modified/new functions**	**PCB Control used**
MRI V1.0	CardioSmart w/o remote start input Device types 101 116 01...03 Device status V1.0	388 028 12, PCB Control CS
MRI V.1.1	CardioSmart with remote start input and optional suction pump Device types 101 116 01...05 Device status V1.1	388 032 12, PCB Control CS_S
MRI V.1.1	CardioSmart with remote start input and optional suction pump Device types 101 116 01...05 Device status V1.1	388 032 13, PCB Control CS_S
MRI V.1.2	CardioSmart ST with remote start input and optional suction pump Device types 101 116 10...13 Device status V1.2	388 032 13, PCB Control CS_S
MRI V.1.3	CardioSmart with remote start input and optional suction pump, additional Regional models Device types 101 116 10...13 Device status V1.2	388 032 13, PCB Control CS_S

and

MRI V.1.3	CardioSmart ST with remote start input and optional suction pump, additional Regional models Device types 101 116 10...13 Device status V1.2	388 032 13, PCB Control CS_S

For reference numbers, compatibilities and correspondence with the respective versions of the device, please refer to the appropriate Master Record Index.

11. Appendix


Schutzvermerk nach DIN 34 beachten
Sicherungen: für Variante 01/03...07/10/11/14...19 220V
fuses: for version 01/03...07/10/11/14...19 220V
912 084 04 T0,25A
für Variante 02/12/13/18/19 115V
for version 02/12/13/18/19 115V
912 084 14 0500mA
für Variante 18/19 mit Hinweisblatt 440 083 01
verpackt in Plastikbeutel 931 098 31
929 166 40
923 096 69
923 081 00
914 326 07
2,2 x 12 Plastite 45
kurze Litze
mittlere Litzen
lange Litze
915 417 89
M3 x 6 DIN7985
B3 DIN127 (unter Schraubenkopf) (under screw head)
A3,2 DIN6798 (zwischen Kabelschuh und Druckbalken) (between cable lug and press bar)
915 415 34 3-pol.
915 414 82
388 028 14
2x M3 x 6 DIN7985
In Variante 02/12/13 for version 02/12/13
927 229 01
In Variante 01/03...07/10/11/14...19 for version 01/03...07/10/11/14...19
504 657 24
432 522 06
416 118 22
504 657 19
M3 x 10 DIN7985
914 325 94
432 522 13
3 x 10 Plastite 45 Senk
2x Sich.Ring 6x0,7 DIN471
In Variante 01/03...07/10/11/14...19 for version 01/03...07/10/11/14...19
432 522 29
3 x 14 Plastite45 Senk
2x 925 096 31
432 522 09
432 523 54
3 x 25 Plastite 45
Nase oben, Anschlag des Mikroschalterhebels
In Variante 01/03...07/10/11/14...19 for version 01/03...07/10/11/14...19
432 522 12
2x 2,2 x 8 Plastite Linsenk.
432 522 34
3 x 10 Plastite 45 Senk
504 657 74
2x M3 x 6 DIN7985
388 029 10
915 414 86 6-pol. auf Lpl. 6-pin on pcb
915 414 82
915 416 21 6-pol. auf Kamm 6-pin on printhead
416 118 18
2x 416 118 19
504 657 25
3x 923 081 00
432 522 10
915 415 34 3-pol.
915 414 82
an beiden Enden montiert clipped to both ends
In Variante 04/05/07/11/13/15/17/19 for version 04/05/07/11/13/15/17/19
303 442 91
923 096 84
388 031 25
383 273 27
923 096 65
927 228 48
388 032 13
388 028 12
7x M3 x 6 DIN7985
432 521 91
2x Zyl.Sti1 ISO 2338-B-4x24
805 124 16
2x 432 521 92
2x 421 032 54
M 2:1
A4,3 DIN6798
M4 x 10 DIN7985
B4 DIN127
916 118 00
Gehäuseoberteil
430 514 59
In Gehäusemitte aufgeklebt
In Variante 02/12/13 for version 02/12/13
marquette HELLIGE MEDICAL SYSTEMS
CardioSmart
In Variante for version 04/05/07/11/13/15/17/19
929 166 45
929 166 48
929 166 54
929 166 88
Gehäuseoberschale Bohrung ausgestanzt
432 521 89 In Variante 01/03...07 for version 01/03...07
432 523 49 In Variante 02 for version 02
432 523 84 In Variante 10/11/14...17 for version 10/11/14...17
432 523 85 In Variante 12/13/18/19 for version 12/13/18/19
390 001 06 In Variante 01/04 for version 01/04
390 001 29 In Variante 03/05 for version 03/05
390 001 40 In Variante 02/06/07 for version 02/06/07
390 001 48 In Variante 10/11/18/19 for version 10/11/18/19
390 001 49 In Variante 12/13/16/17 for version 12/13/16/17
390 001 70 In Variante 14/15 for version 14/15
432 521 93
2x 432 521 94
Schlitz hinten aperture to rear
430 515 47
über Patienteneingang geklebt nur in Variante 02 for version 02
432 521 99
432 522 11
geklebt glued
405 174 01
M2,5 x 8 DIN965
432 521 90
4x M4 x 40 DIN7985 mit Schaft
1x M4 x 20 DIN7985
In Variante 02/12/13 for version 02/12/13
504 657 60
432 521 98
303 442 70
423 203 27
BZ 2,2x4,5 DIN7981
927 229 55 In Batteriefach geklebt glued into battery compartment
Beschriftung siehe Besch.Blatt nach Variante
mit Etikettendrucker bedruckt
303 442 72
829 074 08 2x 70mm In Batteriefach geklebt glued into battery compartment
ca. 130mm Abstand, mittig
433 671 66
404 029 00
In Lpl. Abschirmung genietet riveted to pcb shielding
927 229 76 3x
303 438 29
303 442 71
6x 415 154 39
3 links montiert
3 rechts montiert
504 657 26
2x M3 x 8 DIN965
504 657 23
9x 3 x 12 Plastite 45
416 118 21
BZ 2,2x4,7 DIN7981 3x
BH 1 für alle Zahnräder for all gear wheels
480 159 47
Greifring G2 x 0,6 (804 107 00) lock ring
Haube 432 522 13 abgenommen hood 432 522 13 removed
303 442 72
Motor von innen montiert motor mounted from rear
2x 2,2 x 6 Plastite 45
480 159 66
Greifring G2 x 0,6 (804 107 00) lock ring
480 159 67
Typenschild / name plate Siehe Beschilderungsblatt see labels catalog
927 230 20
In Variante 02/12/13/18/19 for version 02/12/13/18/19
Siehe Beschilderungsblatt see labels catalog
430 518 20
In Variante 02/12/13 for version 02/12/13
924 017 14 4x
CAUTION: US Federal law restricts this device to sale by or on the order of a physician
2x 925 093 00
423 203 02
2x beidseitig auf Netzeingangsmodul geklebt glued to both sides of power input
1x beidseitig auf Netzeingangsmodul geklebt
430 501 00
In Variante 02/12/13 for version 02/12/13

Hierzu also see:

Drahtsatz wire set	383 272 97 383 273 27	In Variante 04/05/07/11/13/15/17/19 for version 04/05/07/11/13/15/17/19
Verpackungszeichnung packaging drawing	101 116 01 V	
Schaltzeichnung wiring diagram	101 116 01...07 S / 10...19 S	
Prinzipschaltbild circuit diagram	101 116 01...07 P / 10...19 P	
Gerätespiegel	440 081 40	

Änd.-Index	kommt vor	Änd.Nr.	Änderungstext	Datum	Name
k	1x	202895	Schaumstoffpolster hinzu	14.05.97	G.Krieg
j	--	202795	neue Varianten hinzu	09.04.97	G.Krieg
i	2x	202512	UL-Schild hinzu	10.09.96	G.Krieg
h	1x	202339	Schraubenlänge geändert	20.08.96	G.Krieg
g	3x	202354	Varianten 10-13 hinzu	26.06.96	G.Krieg
f	1x	202250	Anschlag hinzu	13.03.96	G.Krieg
e	4x	202192	Änderungen in Variante 02 - USA	13.02.96	G.Krieg
d	2x	202152	Schilder in Variante 02 geändert	12.01.96	G.Krieg
c	6x	202019	Varianten 04 und 05 hinzu	06.10.95	G.Krieg
b	1x	201782	Variante 03 hinzu	03.05.95	G.Krieg
a	1x	201712	Isolierung hinzu, USA-Schilder hinzu	07.04.95	G.Krieg

Werkstoff		
Rohteil		
Paßmaß / Abmaße	Marquette Hellige GmbH Munzinger Str. 3 D-79111 Freiburg	Maßstab 1:1
	Entworfen 19.10.94 G.Krieg Geprüft 21.10.94 G.Krieg Normgepr.	Sach-Nr. 101 116 01...19
Oberfläche ---	Freimaßtoleranz ACAD-Nr. 01847Z1k	Format A0
	Benennung	CardioSmart

CardioSmart Grundgerät 101 116 01

Schutzvermerk nach DIN 34 beachten

Geräte Ein/Ausschalter
Power On/Off

Netzeingangsmodul
Power Input Module

388 028 14

Motor
303 442 79

388 028 12

Alu Chassis

303 442 71
930 116 87

Thermokamm 216 mm
Thermal Array Printhead 216mm

Lpl Kammverbindung
PCB Printhead Connection
388 029 10

388 031 25

PCB Power Supply CS
Lpl Stromversorgung
388 028 14

auf A-Seite verlötet.

388 032 13

Akku 18V 1,4Ah
929 166 37

Batterie 303 442 70

388 028 14
Lpl Stromversorgung
PCB Power Supply CS

Lpl Steuerung CS_S
PCB Control CS_S
388 032 13 u. Abschirmplatte 433 671 66
Shielding Plate 433 671 65

Opt. RS232

RS 232

Rom-Box

Lpl Pumpenhalter
PCB Pump Holder
388 031 25

Pumpenmodul
Pump Modul
303 442 91

nur in 101 116 04,05,07,11,13,15,17,19
only in 101 116 04,05,07,11,13,15,17,19

Legende Sicherungen Fuses and ratings		
115V/230V	2 x T0,25A	912 084 04
	2 x T0,5A	912 084 14

Option CARDIOPROM 250 xxx xx

Lpl Speicher CS
PCB Memory CS
388 028 63 oder/or 388 030 49
388 028 65 oder/or 388 030 50
388 028 66 oder/or 388 032 56
oder/or 388 032 57

388 032 13

Option Graphics Display CS
235 066 01 oder/or 235 066 02

Display 930 117 17

Markenleser 303 438 29
Mark Reader

Lpl Grafik Display CS
PCB Graphics Display CS
388 028 11

930 117 17

388 028 11

Lpl Verbindung
PCB Connection
388 028 87

388 032 13

Hierzu Drahtsatz:
Wire Set:
383 272 97
383 273 27, nur in 101 116 04,05,07,11,13,15,17,19
only in 101 116 04,05,07,11,13,15,17,19

Tastatur
Keyboard
390 001 06 oder/or 390 001 48
oder/or 390 001 29 oder/or 390 001 49
oder/or 390 001 40 oder/or 390 001 70

Option Character Display
235 067 01 oder/or 235 067 02

LCD Modul
303 442 87

Lpl Verbindung
PCB Connection
388 028 88

388 032 13

f	-	202795	neue Varianten 06,07,14,19		27.03.97	G.Kaltenb.
e	-	202354	neue Varianten 10..13		26.06.96	G.Kaltenb.
d	-	202308	Masseverbindung auf G/2 geändert.		02.05.96	G.Kaltenb.
c	-	202087	Hinweis Drahtsatz 383 273 27 nur in 04.05.		06.12.95	G.Kaltenb.
b	-	202019	neue Varianten 04,05		10.10.95	G.Kaltenb.
a	-	201782	neue Variante 03		11.05.95	G.Kaltenb.
Änd.-Index	kommt vor	Änd.Nr.	Änderungstext		Datum	Name

Werkstoff
Rohteil
Entw. N.Schnurr

Marquette Hellige GmbH
Munzinger Str. 3
D-79111 Freiburg

Maßstab

	Datum	Name
Entworfen	25.10.94	G.Kaltenbach
Geprüft	25.10.94	N.Schnurr
Normgepr.		

Sach-Nr. 01..07
101 116 10..19 S Bl.1

Paßmaß/Abmaße
Oberfläche
Freimaßtoleranz
ACAD-Nr. 01847S1f

Format A1

Benennung
CardioSmart

1	2	3	4

Diese Tabelle definiert die gültigen Konfigurationen des CardioSmart Version 1.0
This table defines the valid configurations of the CardioSmart Version 1.0

Komponente Component			Sach-Nr. Part No.	Index (Prod.)	Referenz Reference	kompatibel(Service) Compatible(Service)	in Variante in Device Variation
Steuerung CS	Lpl. Steuerung CS Ersatzteil-Nr. Austausch Nr.	PCB Control CS Spare Part No. Replacement No.	388 028 12 - 389 003 99	I	A	E , F1 , H	01...03
Stromver- sorgung CS	Lpl. Stromvers- sorgung CS Ersatzteil-Nr. Austausch Nr.	PCB Power Supply CS Spare Part No. Replacement No.	388 028 14 - -	B	D		01...03
Displays:							
	Cardio Vision Graphics		235 066 01				
Grafik Display CS	Lpl. Grafik Display CS Ersatzteil-Nr. Austausch Nr.	PCB Graphics Display CS Spare Part No. Replacement No.	388 028 11 - -	D	C	C	
oder / or							
	Cardio Vision Text		235 067 01				
	LCD Modul-CS		303 442 87				

Änd.-Index	kommt vor	Änd.Nr.	Änderungstext	Datum	Name
d	--	201999	Index v. Lpl Steuerung auf " I "	20.09.95	G.Kaltenb.
c	--	201780	Index v. Lpl Steuerung auf " G "	17.05.95	G.Kaltenb.
b	--	201810	Index v. Lpl Steuerung auf " F1 "	16.05.95	G.Kaltenb.
a	--	201747	Displays hinzu.	20.04.95	G.Kaltenb.

Schutzvermerk nach DIN 34 beachten

Werkstoff

Rohteil

Entw.
N.Schnurr

HELLIGE GMBH
Postfach 728
D-79007 Freiburg

Maßstab
-

	Datum	Name
Entworfen	17.01.95	G.Kaltenbach
Geprüft	17.01.95	N.Schnurr
Normgepr.		

Sach-Nr.
101 116 01...03 S Bl.2

PaßmaB | AbmaBe

Oberfläche

FreimaBtoleranz

ACAD-Nr. 01847S2d

Format
A4

Benennung
Master Record Index
CardioSmart Version 1.0

Diese Tabelle definiert die gültigen Konfigurationen des CardioSmart Version 1.1
This table defines the valid configurations of the CardioSmart Version 1.1

Komponente Component			Sach-Nr. Part No.	Index (Prod.)	Referenz Reference	kompatibel(Service) Compatible(Service)	in Variante in Device Variation
Steuerung CS	Lpl. Steuerung CS	PCB Control CS	388 028 12	J	A	H , I	01...05
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	389 004 05				
oder / or							
Steuerung CS_S	Lpl. Steuerung CS_S	PCB Control CS_S	388 032 13	B	A		01...05
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	389 004 16				
Stromver-sorgung CS	Lpl. Stromvers-sorgung CS	PCB Power Supply CS	388 028 14	C	D		01...05
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				
Displays:							
	Cardio Vision Graphics		235 066 01				
Grafik Display CS	Lpl. Grafik Display CS	PCB Graphics Display CS	388 028 11	D	C	C	
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				
oder / or							
	Cardio Vision Text		235 067 01				
	LCD Modul-CS		303 442 87				
Pumpenmodul:			303 442 91				04,05
	Lpl. Pumpe	PCB Pumpe	388 029 18	B			04,05
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				

Änd.-Index	kommt vor	Änd.Nr.	Änderungstext	Datum	Name
e	--	202498	Index 388 028 12 von "I" nach "J"	03.09.96	G.Kaltenb.
d	--	202354	Lpl Steuerung neue Sach-Nr. 388 032 13	25.06.96	G.Kaltenb.
c	--	202019	Varianten 04,05 hinzu.	09.10.95	G.Kaltenb.
b	--	201999	Index v. Lpl Steuerung auf "I"	09.08.95	G.Kaltenb.
a	--	201901	Index 388 028 14 von "B" nach "C".	09.08.95	G.Kaltenb.

Werkstoff

Rohteil Entw.

N.Schnurr

HELLIGE GMBH
Munzinger Str. 3
D-79111 Freiburg

	Datum	Name
Entworfen	11.05.95	G.Kaltenbach
Geprüft	11.05.95	N.Schnurr
Normgepr.		

Maßstab: -

Sach-Nr.: 101 116 01...05 S Bl.3

Paßmaß | Abmaße

Oberfläche

Freimaßtoleranz

ACAD-Nr. 01847S3e

Format: A4

Benennung: Master Record Index CardioSmart Version 1.1

Schutzvermerk nach DIN 34 beachten

Diese Tabelle definiert die gültigen Konfigurationen des CardioSmart Version 1.2
This table defines the valid configurations of the CardioSmart Version 1.2

Komponente Component			Sach-Nr. Part No.	Index (Prod.)	Referenz Reference	kompatibel(Service) Compatible(Service)	in Variante in Device Variation
Steuerung CS_S	Lpl. Steuerung CS_S Ersatzteil-Nr. Austausch Nr.	PCB Control CS_S Spare Part No. Replacement No.	388 032 13 - 389 004 16	C	A	B	01...05,10..13
Stromver- sorgung CS	Lpl. Stromvers- sorgung CS Ersatzteil-Nr. Austausch Nr.	PCB Power Supply CS Spare Part No. Replacement No.	388 028 14 - -	C	D		01...05,10..13
Displays:							
	Cardio Vision Graphics		235 066 01				01...05,10..13
Grafik Display CS	Lpl. Grafik Display CS Ersatzteil-Nr. Austausch Nr.	PCB Graphics Display CS Spare Part No. Replacement No.	388 028 11 - -	D	C	C	01...05,10..13
oder / or							
	Cardio Vision Text		235 067 01				nur/only 01...05
	LCD Modul-CS		303 442 87				nur/only 01...05
Pumpenmodul:			303 442 91				04,05,11,13
	Lpl. Pumpe Ersatzteil-Nr. Austausch Nr.	PCB Pumpe Spare Part No. Replacement No.	388 029 18 - -	B			04,05,11,13

Schutzvermerk nach DIN 34 beachten

Werkstoff

Rohteil

Entw. N.Schnurr

HELLIGE GMBH
Munzinger Str. 3
D-79111 Freiburg

Paßmaß | Abmaße

Oberfläche

Freimaßtoleranz

ACAD-Nr. 01847S4a

Maßstab –

Format A4

Änd.-Index	kommt vor	Änd.Nr.	Änderungstext	Datum	Name
a	-	202713	388 032 13 v. Index "B" auf "C" .	04.03.97	G.Kaltenb

	Datum	Name
Entworfen	26.06.96	G.Kaltenbach
Geprüft	26.06.96	N.Schnurr
Normgepr.		

Sach-Nr. 101 116 01..05 10..13 S Bl.4

Benennung: Master Record Index CardioSmart Version 1.2

Diese Tabelle definiert die gültigen Konfigurationen des CardioSmart Version 1.3
This table defines the valid configurations of the CardioSmart Version 1.3

Komponente / Component			Sach-Nr. / Part No.	Index (Prod.)	Referenz / Reference	kompatibel(Service) / Compatible(Service)	in Variante / in Device Variation
Steuerung CS_S	Lpl. Steuerung CS_S	PCB Control CS_S	388 032 13	D	A	B , C	01...07,10..19
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	389 004 16				
Stromver-sorgung CS	Lpl. Stromvers-sorgung CS	PCB Power Supply CS	388 028 14	C	D		01...07,10..19
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				
Graphics Displays:							
	Cardio Vision Graphics		235 066 01				01,03...07,10,11,14...17
oder/or	Cardio Vision Graphics	(US)	235 066 02				02,12,13,18,19
Grafik Display CS	Lpl. Grafik Display CS	PCB Graphics Display CS	388 028 11	D	C	C	01...07,10..19
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				
oder/or Text Displays :							
	Cardio Vision Text		235 067 01				01,04,06,07
oder/or	Cardio Vision Text	(US)	235 067 02				02
	LCD Modul-CS		303 442 87				01,02,04,06,07
Pumpenmodul:			303 442 91				04,05,07,11,13,15,17,19
	Lpl. Pumpe	PCB Pumpe	388 029 18	B			04,05,07,11,13,15,17,19
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				

Änd.-Index	kommt vor	Änd.Nr.	Änderungstext	Datum	Name
a	-	202936	neuer Index Lpl Steuerung	17.06.97	G.Kaltenb

Schutzvermerk nach DIN 34 beachten

Werkstoff

Rohteil

Entw. N.Schnurr

Marquette Hellige GmbH
Munzinger Str. 3
D-79111 Freiburg

Maßstab: -

	Datum	Name
Entworfen	01.04.97	G.Kaltenbach
Geprüft	01.04.97	N.Schnurr
Normgepr.		

Sach-Nr. 101 116 01..07 10..19 S Bl.5

Paßmaß | Abmaße

Oberfläche

Freimaßtoleranz

ACAD-Nr. 01847S5a

Format: A4

Benennung: Master Record Index CardioSmart Version 1.3

Diese Tabelle definiert die gültigen Konfigurationen des CardioSmart Version 1.3
This table defines the valid configurations of the CardioSmart Version 1.3

Referenztabelle der Geräte Versionen zu den zugehörigen CardioProm Software-Versionen

Geräte-Versionen	Software-Versionen					
	V3.0...3.0c	V3.0d	V4.1	V4.11	V4.2	V4.21
V1.0	X					
V1.1		X	X	X		
V1.2		X		X	X	
V1.3						X

X = vorgesehene Verwendungen,vollkomptibel,alle Funktionen entsprechend Gebrauchsanweisung verfügbar.

Generell können alle Software-Versionen in allen Geräte-Versionen verwendet werden,jedoch stehen dann bestimmte Funktionen nicht,oder nur eingeschränkt zur Verfügung.Neue Features der Geräte Versionen werden nur mit den korrespondierenden Software Versionen unterstützt.

Verlauf der Geräte- und Software-Versionen

Geräte-Version	Software-Version	Neue Geräte Funktionen	Neue Software Funktionen	Datum
V1.0	V3.0		CS-MI	12/94
	V3.0a		CS, CS-E, CS-I	12/94
	V3.0b		CS-M, CS-ME	12/94
	V3.0c		italienisch spanisch	02/95
	V3.0d		Fernstart russisch	05/95
V1.1		Fernstart Pumpe		09/95
	V4.1		12SL-Programm Modem Speicherung 45EKGs CSI-Protokoll amerikanische Variante	08/96
V1.2	V4.2	CardioSmart ST mit Ergometrie-Tastatur	Ergometrie	12/96
	V4.11		Override Funktion	02/97
V1.3	V4.21	Gebietsvarianten	schwedisch	04/97

Schutzvermerk nach DIN 34 beachten

Werkstoff

Rohteil Entw. N.Schnurr

Änd.-Index | kommt vor | Änd.Nr. | Änderungstext | Datum | Name

Marquette Hellige GmbH
Munzinger Str. 3
D-79111 Freiburg

Maßstab: –

	Datum	Name
Entworfen	01.04.97	G.Kaltenbach
Geprüft	01.04.97	N.Schnurr
Normgepr.		

Sach-Nr. 101 116 01..07 10..19 S Bl.6

Paßmaß | Abmaße

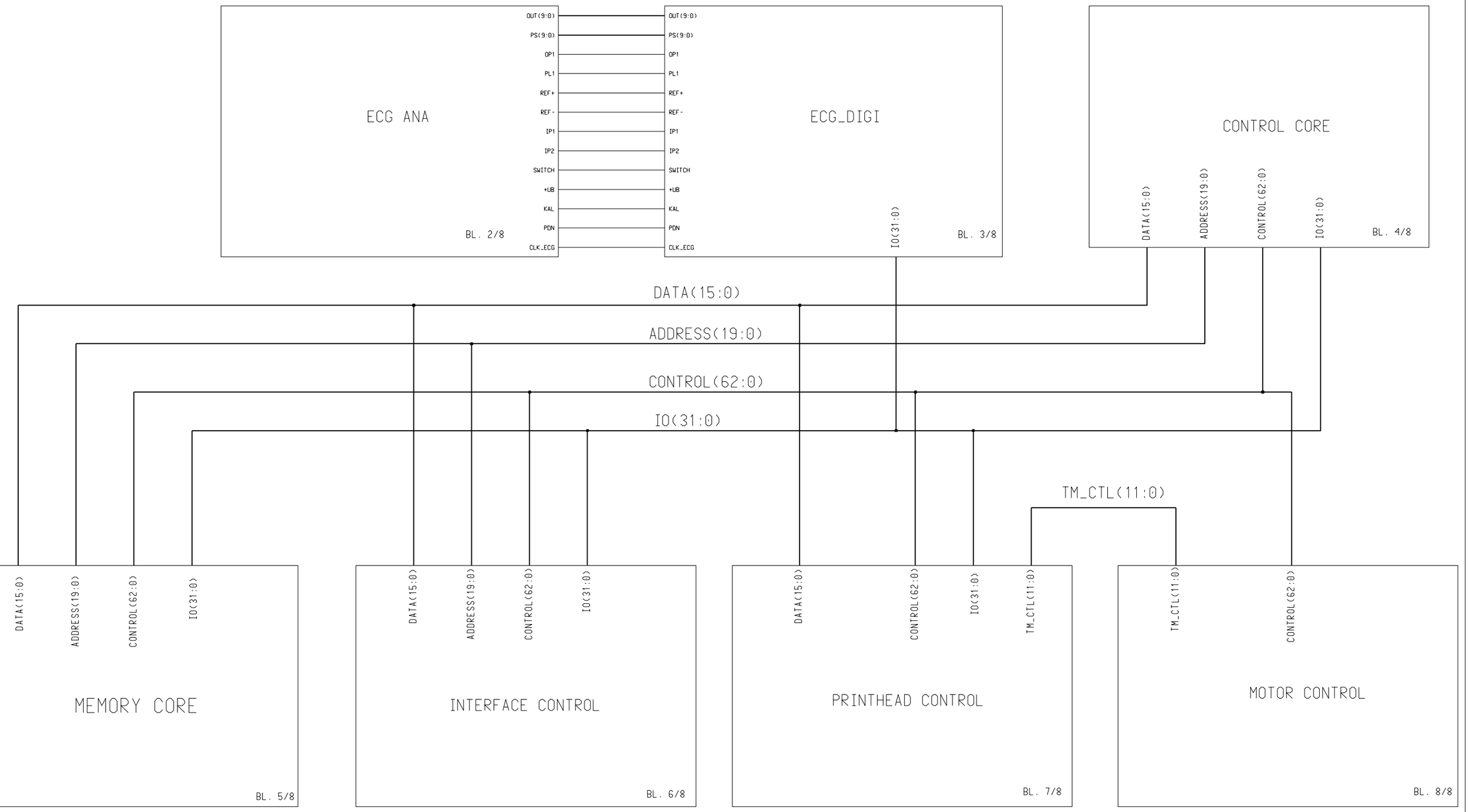
Oberfläche

Freimaßtoleranz

ACAD-Nr. 01847S6_

Format: A4

Benennung: Master Record Index CardioSmart Version 1.3

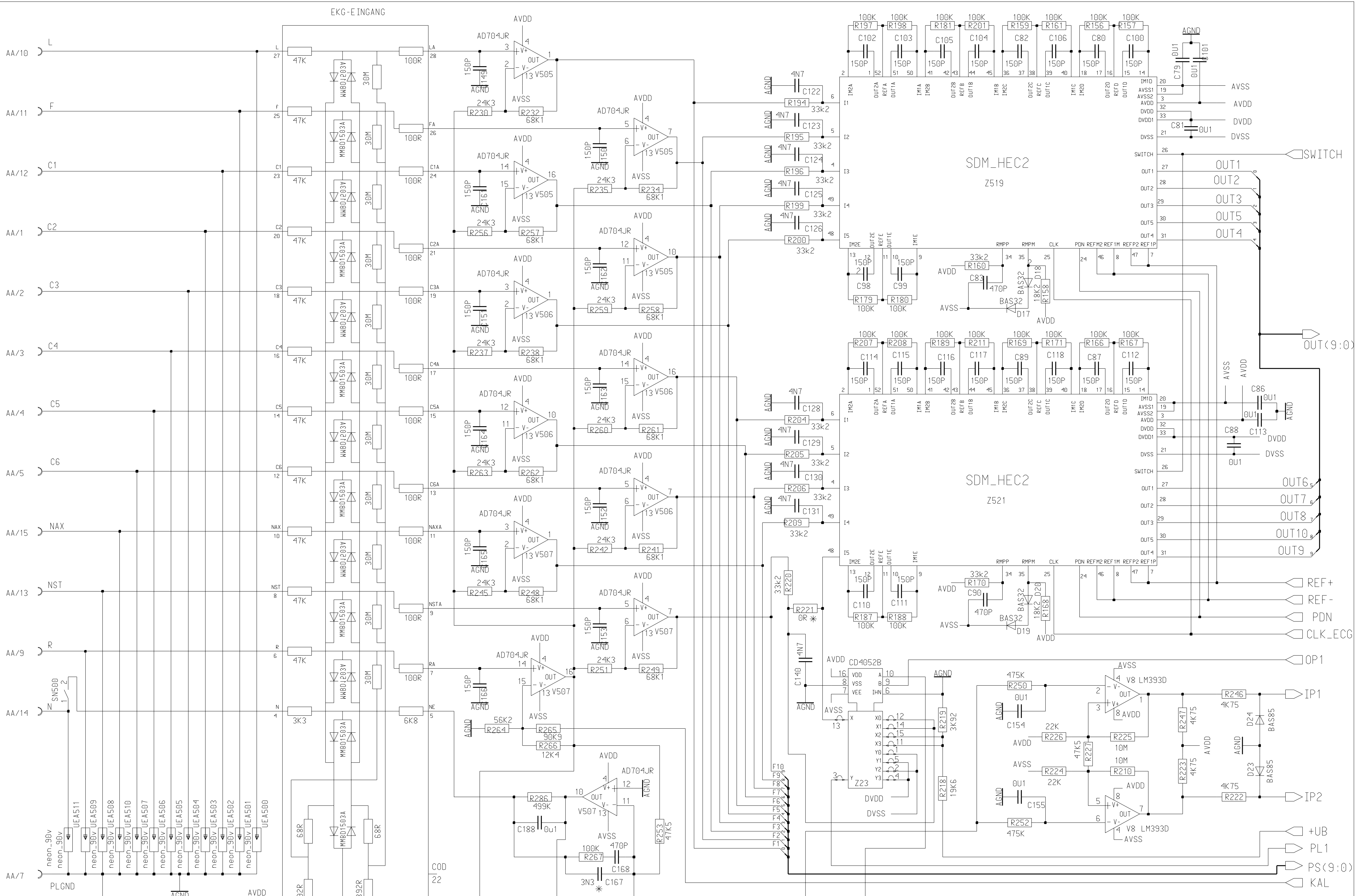


Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH Postfach 728 D-79007 Freiburg				388 028 12 P BL 1/8
AENDERUNGEN			A03	F67139
Antrag vom	Index	Datum/Name		Datum/Name
----------	A	20.04.94/MSG		14.12.93/NTS
201357	B	24.08.94/NTS	gez.	14.12.93/NTS
			gepr.	
			Entw.	SCHNURR

LPL. STEUERUNG CS
PCB CONTROL CS

[1993, 7, 28, 4]
$USER_CAE_D/cardiosmart/controller/design



Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH Postfach 728 D-79007 Freiburg

388 028 12 P BL 2/8

LPL. STEUERUNG CS

PCB CONTROL CS

AENDERUNGEN Antrag vom	Index	Datum/Name		
201357	B	24.08.94/NTS	A03	F67139
201449	C	07.11.94/JOK	gez.	30.03.94/HTW
201478	D	09.12.94/SOP	gepr.	14.12.93/HTW
201501	E	12.12.94/JOK		
201810	F	14.05.95/JOK	Entw.	WEBER
202498	G	04.09.96/JOK		

[1993, 7, 30, 6]

$USER_CAE_D/cardiosmart/controller/ecg_core

Schutzvermerk nach DIN 34 beachten

OUT(9:0)

digi_hec2

Z518

OP1
PL1
IP1
IP2
SWITCH
CLK_ECG
PDN

REF-
REF+
+UB

PS(9:0)

pace_hec2

Z520

KAL

IO(31:0)

125kHz

SCLK_
MOSI_
RESET
PCS0
MISO_
TSYNC_

hcpl2630 X503
hcpl2630 X502
hcpl2630 X501

TL750L05CLP V502
TL750L05CLP V504

30344281 TR500

T502 RFP12N10L

L503 100u

Z18 74HCT14

BC550c T505
BC560c T506
BC560c T503
BC550c T504

lt1013dn8 V503

TL431CLP D505
TL431CLP D506

BAS85 D21
BAS85 D22
BAS85 D15
BAS85 D16

+5VF
-5VF
+5V
-UB
AVDD
AVSS
DVDD
DVSS
AGND
GNDF
GND

HELLIGE GMBH	Postfach 728 D-79007 Freiburg	388 028 12 P BL 3/8
AENDERUNGEN		A03 FG7139
Antrag vom / Index / Datum/Name		Datum/Name
--------- A 20.04.94/NTS		
201357 B 24.08.94/NTS	gez.	30.03.94/HTW
201449 C 10.11.94/JOK	gepr.	14.12.93/HTW
	Entw.	WEBER
		LPL. STEUERUNG CS PCB CONTROL CS

[1993, 7, 30, 6]
$USER_CAE_D/cardiosmart/controller/ecg_core

ADDRESS(19:0)
CONTROL(62:0)
DATA(15:0)
IO(31:0)

CONTROLLER

MC68332

Z511

REAL TIME CLOCK

PAR. EEPROM

SER. EEPROM

ECG INTERFACE

OPTION
EXPERIMENTAL INPUT

DEBUG INTERFACE

WATCHDOG

ADDRESS DECODER

PERI_CONTROL

RTC_CONTROL

RTC_72421

MEM_IMAGE

* not mounted

* = not mounted

CONTROL

Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH	Postfach 728 D-79007 Freiburg	388 028 12 P BL. 4/8
AENDERUNGEN	A03 / F67139	LPL. STEUERUNG CS
Antrag vom / Index / Datum/Name		PCB CONTROL CS
------- / A / 20.04.94/NTS	Datum/Name	
201357 / B / 24.08.94/NTS	gez. 14.12.93/NTS	
	gepr. 14.12.93/NTS	
	Entw. SCHNURR	

[1993, 7, 30, 6]
$USER_CAE_D/cardiosmart/controller/control_core

ADDRESS(19:0)
CONTROL(62:0)
DATA(15:0)
IO(31:0)

RAM INTERNAL

OPTION RAM

INTERFACE
PCB MEMORY

INTERFACE
CHARACTER DISPLAY

INTERFACE
GRAPHICS DISPLAY

* = not mounted

MEMORY CORE

Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH	Postfach 728 D-79007 Freiburg			388 028 12 P BL 5/8
AENDERUNGEN			A03	F67139
Antrag vom	Index	Datum/Name		Datum/Name
----------	A	20.04.94/MSG		
201357	B	24.08.94/NTS	gez.	14.12.93/NTS
			gepr.	14.12.93/NTS
			Entw.	SCHNURR
				LPL. STEUERUNG CS
				PCB CONTROL CS

(1993, 10, 19, 3)
$USER_CAE_D/cardiosmart/controller

ADDRESS(19:0)
CONTROL(62:0)
DATA(15:0)
IO(31:0)

KEYBOARD INTERFACE

GND
R95 221R
Z512 74HCT574
KEYSEL
DB_8 DB_9 DB_10 DB_11 DB_12 DB_13 DB_14 DB_15
BAS85 D6 COLUMN1
BAS85 D7 COLUMN2
BAS85 D8 COLUMN3
BAS85 D12 COLUMN4
BAS85 D11 COLUMN5
BAS85 D13 COLUMN6
BAS85 D14 COLUMN7
AS/ 2 AS/ 3 AS/ 4 AS/ 7 AS/11 AS/13 AS/14
AS_
KEYRD_
Z513 74HCT574
+5V
10K RN513
ROW1 ROW2 ROW3 ROW4 ROW5 ROW6 ROW7
AS/ 1 AS/ 5 AS/ 6 AS/ 8 AS/ 9 AS/10 AS/12
LEDLIN AS/17
LEDBAT 681R R127 AS/15
AS/16
AS/18
R136 330R
R128 681R
* not mounted
BC847B T9 LED_START AS/20
BC857B T8
LED_ST 4K75 R125
4K75 R126
LED_STOP AS/19
TA_KENN1
AS/21 CODE
AS/22

BEEPER

Signalgeber
0R R141
Z5 74HCT14
BEEP
R140 4K75
BC847B T11
LS500

RS232 INTERFACE

max232
C170 0u1
C173 0u1
C172 0u1
C174 0u1
4k75 R270
TxD RxD
T1in T2in R1out R2in
T1out T2out R1in R2out
Z524
SMBJ15C D510
SMBJ15C D511
C185 100p
C186 100p
AC/1 RXDE
AC/2
AC/3 TXDE
AC/4
AC/5 GND
AC/6
AC/7
AC/8 FERN
AC/9 EKTR
SMBJ15C D27
SMBJ15C D28

OPTION RS232 EXTENSION

X68C681
DB_8 DB_9 DB_10 DB_11 DB_12 DB_13 DB_14 DB_15
D0 D1 D2 D3 D4 D5 D6 D7
A1 A2 A3 A4
AD_0 AD_1 AD_2 AD_3
R-W_ CS_ RES_
RW_ RESET_
X1-CLK X2
DTACK_
OP0 OP1 OP2 OP3 OP4 OP5 OP6 OP7
IP0 IP1 IP2 IP3 IP4 IP5
680R RN514
DSACK0_
INT_V24E_ IACKN_
INT_ IACK_
TXAE RXAE TXBE RXBE
GND VCC +5V
Z523
CSRS232E_
C141 15p
C142 10p
3.6864MHz QU502
RT_INT(3:0)
max232
C157 C169 C156 C171 0u1
TXAE TXBE RXAE RXBE
T1in T2in R1in R2in
T1out T2out R1in R2in
TXA_E TXB_E RXA_E RXB_E
Z522
SMBJ15C D508 D512 D507 D509
R255 R254 R268 R269 0R
CODE
AD/ 1 AD/ 2 AD/ 3 AD/ 4 AD/ 5 AD/ 6 AD/ 7 AD/ 8 AD/ 9 AD/10 AD/11 AD/12 AD/13 AD/14 AD/15 AD/16 AD/17 AD/18 AD/19 AD/20

OPTION INTERFACE

Z15 74ACT139 X/Y
AD_13 CSOPT_ CSOPTI_
AD_12
74ACT244 Z505
AD_0 AD_1 AD_2 AD_3 AD_4 AD_5 AD_6 AD_7
ADE_0 ADE_1 ADE_2 ADE_3 ADE_4 ADE_5 ADE_6 ADE_7
AR/ 1 AR/ 2 AR/ 3 AR/ 4 AR/ 5 AR/ 6 AR/ 7 AR/ 8 AR/ 9 AR/10 AR/11
74ACT244 Z502
AD_8 AD_9 AD_10 AD_11
ADE_8 ADE_9 ADE_10 ADE_11
AR/12 AR/13 AR/14 AR/15 AR/16 AR/17
Z510 74ACT245
RW_
DB_8 DB_9 DB_10 DB_11 DB_12 DB_13 DB_14 DB_15
DBE_8 DBE_9 DBE_10 DBE_11 DBE_12 DBE_13 DBE_14 DBE_15
10K RN508
AR/18 AR/19 AR/20 AR/21 AR/22 AR/23 AR/24 AR/25 AR/26 AR/27 AR/28
AR/29 AR/30
CSOPTI1_ CSOPTI2_
AR/31 AR/32
AR/33 AR/34
AR/35 AR/36
AR/37 DSACK0_
AR/38 OPTI_KENN_
AR/39 NC
AR/40 NC
R504 0R
L501 1u
C119 C67 C19 C14 C41 C61 0u1
C11 1u
C12 1n5
C13 4n7

FERNST

RS232E_KENN_
R289 10K
R288 10K
T12 BC847B
R287 100R
BAS85 D25
R291 100R
R290 100R
T13 BC847B
R292 10K
D26 BAS85
EKG_TRIG
0R R88
R37 10K
Z502 74ACT244
R13 10K
R20 10K
+12V

* = not mounted

INTERFACE CONTROL

HELLIGE GMBH	Postfach 728 D-79007 Freiburg	388 028 12 P BL 6/8
AENDERUNGEN	A03 F67139	LPL. STEUERUNG CS
Antrag vom / Index / Datum/Name		PCB CONTROL CS
---------- A 20.04.94/MSG	Datum/Name	
201357 B 24.08.94/NTS	gez. 14.12.93/NTS	
201780 C 12.05.95/JOK	gepr. 14.12.93/NTS	
	Entw. SCHNURR	

[1993, 7, 30, 6]
$USER_CAE_D/cardiosmart/controller/interface_control

Schutzvermerk nach DIN 34 beachten

TAL(10:0)

DATA(15:0)

CONTROL(62:0)

TM_CTL(11:0)

IO(31:0)

TPC INPUT CONTROL

T_INP_CTL(4:0)

TPC_CTL(14:0)

TPC_GA

TPC_PLD

CLOCK GENERATION

TPC_OUT(6:0)

STANDART PRINTHEAD

OPTIONAL PRINTHEAD

PRINTHEAD TEMPERATURE MONITORING

PRINTHEAD CONTROL

STATUS/CONTROL REGISTER

TEST PRINTHEAD VOLTAGE

mounted for optional printhead

mounted for standard printhead

* = not mounted

HELLIGE GMBH	Postfach 728 D-79007 Freiburg			388 028 12P BL. 7/8	
AENDERUNGEN			A03	FG7139	
Antrag vom	Index	Datum/Name		Datum/Name	
----------	A	20.04.94/NTS			
201357	B	24.08.94/NTS	gez.	14.12.93/NTS	LPL. STEUERUNG CS
201478	C	09.12.94/SOP	gepr.	14.12.93/NTS	PCB CONTROL CS
			Entw.	SCHNURR	

[1993, 7, 30, 6]

$USER_CAE_D/cardiosmart/controller/printhead_control

Schutzvermerk nach DIN 34 beachten

+5V POWER SUPPLY

With Heat Sink

LM2575-ADJ

OTPION PUMP

OPTION POWER CHECK

POWER SUPPLY INTERFACE

+12V POWER SUPPLY

-12V POWER SUPPLY

COMMON/VDD1 SWITCH

MARK READER

PRINTHEAD PRESSURE

SPEED SELECT

MOTOR REGULATION

MOTOR CURRENT CONTROL

motor speed

motor compensation

* = not mounted

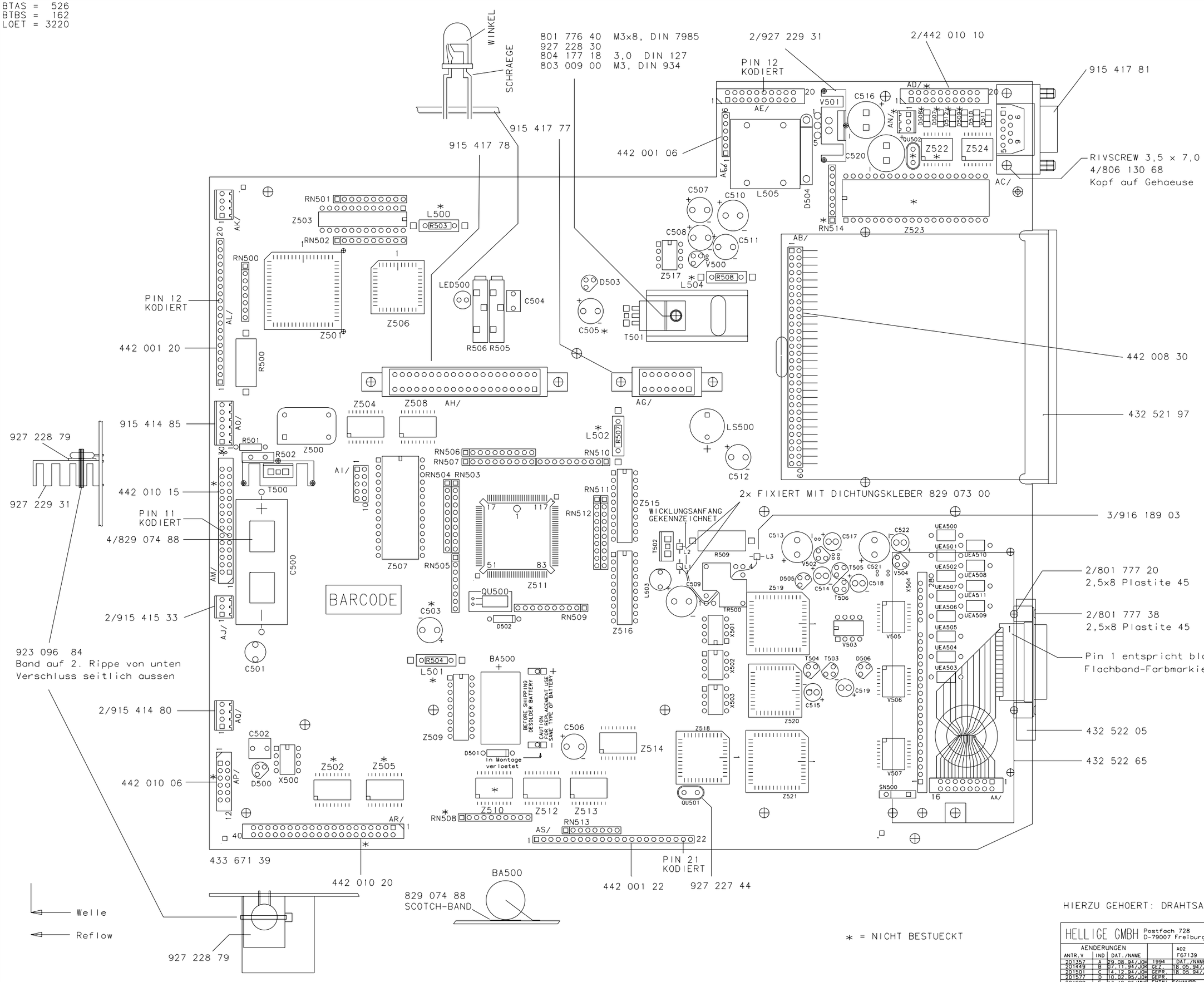
Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH	Postfach 728 D-79007 Freiburg	388 028 12 P BL. 8/8
AENDERUNGEN	A03 FG7139	LPL. STEUERUNG CS
Antrag vom / Index / Datum/Name	Datum/Name	PCB CONTROL CS
---------- A 28.04.94/NTS		
201357 B 24.08.94/NTS	gez. 14.12.93/NTS	
201512 C 13.12.94/JOK	gepr. 14.12.93/NTS	
	Entw. SCHNURR	MOTOR CONTROL

[1993, 7, 30, 6]

$USER_CAE_D/cardiosmart/controller/motor_control

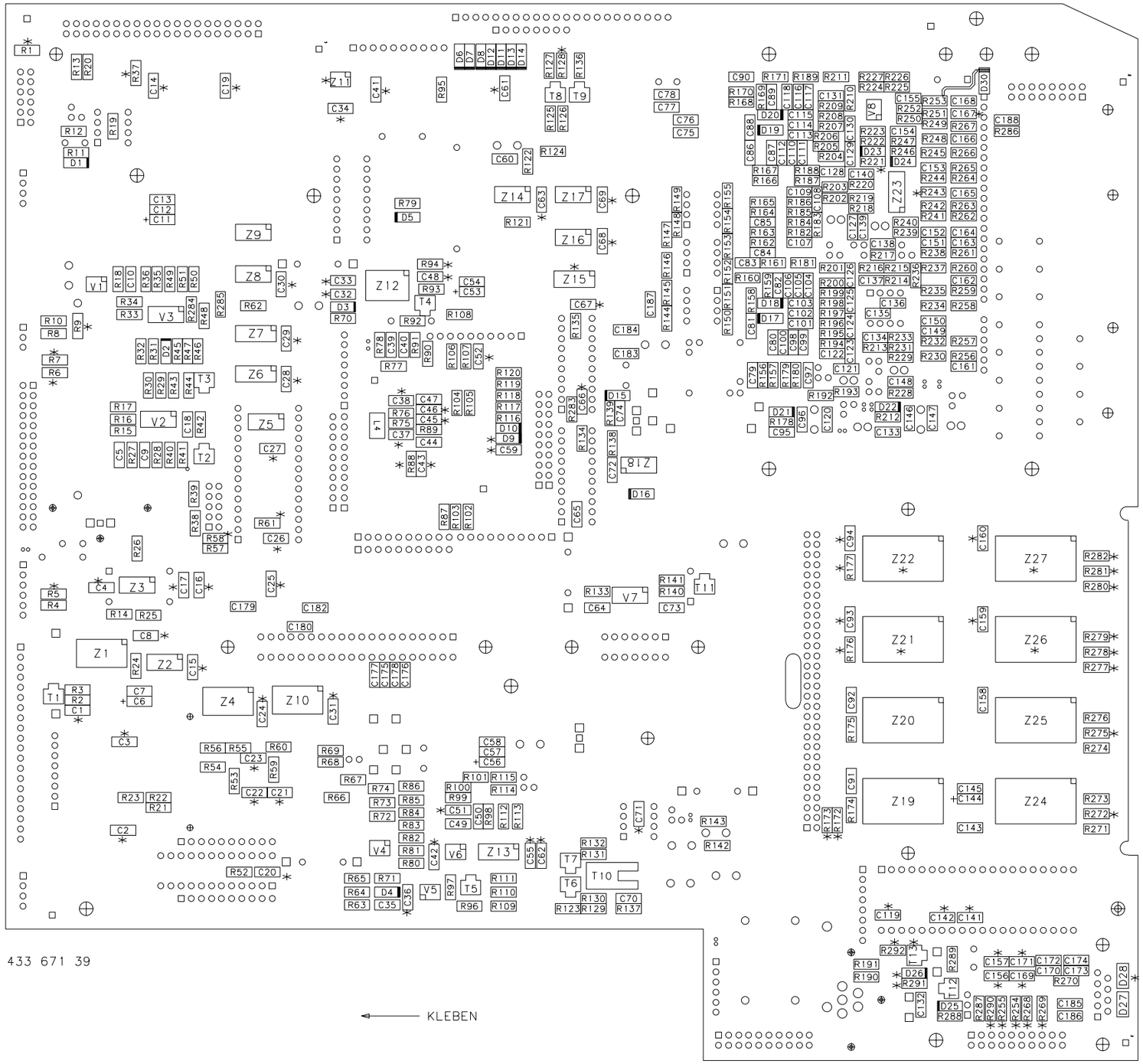
BTAS = 526
BTBS = 162
LOET = 3220



Schutzvermerk nach DIN 34 beachten.

HELLIGE GMBH Postfach 728 D-79007 Freiburg				388 028 12 R BL 1/2
AENDERUNGEN				A02
ANTR.V	IND	DAT./NAME		F67139
201357	A	29.08.94/JOK	1994	DAT./NAME
201449	B	07.11.94/JOK	GEZ.	18.05.94/JOK
201501	C	14.12.94/JOK	GEPR.	18.05.94/JOK
201577	D	10.02.95/JOK	GEPR.	
201999	E	13.10.95/MNS	ENTW.	SCHNURR

LPL. STEUERUNG CS
PCB CONTROL CS



433 671 39

← KLEBEN

* = NICHT BESTUECKT
* = NOT EQUIPPED

Schutzvermerk nach DIN 34 beachten.

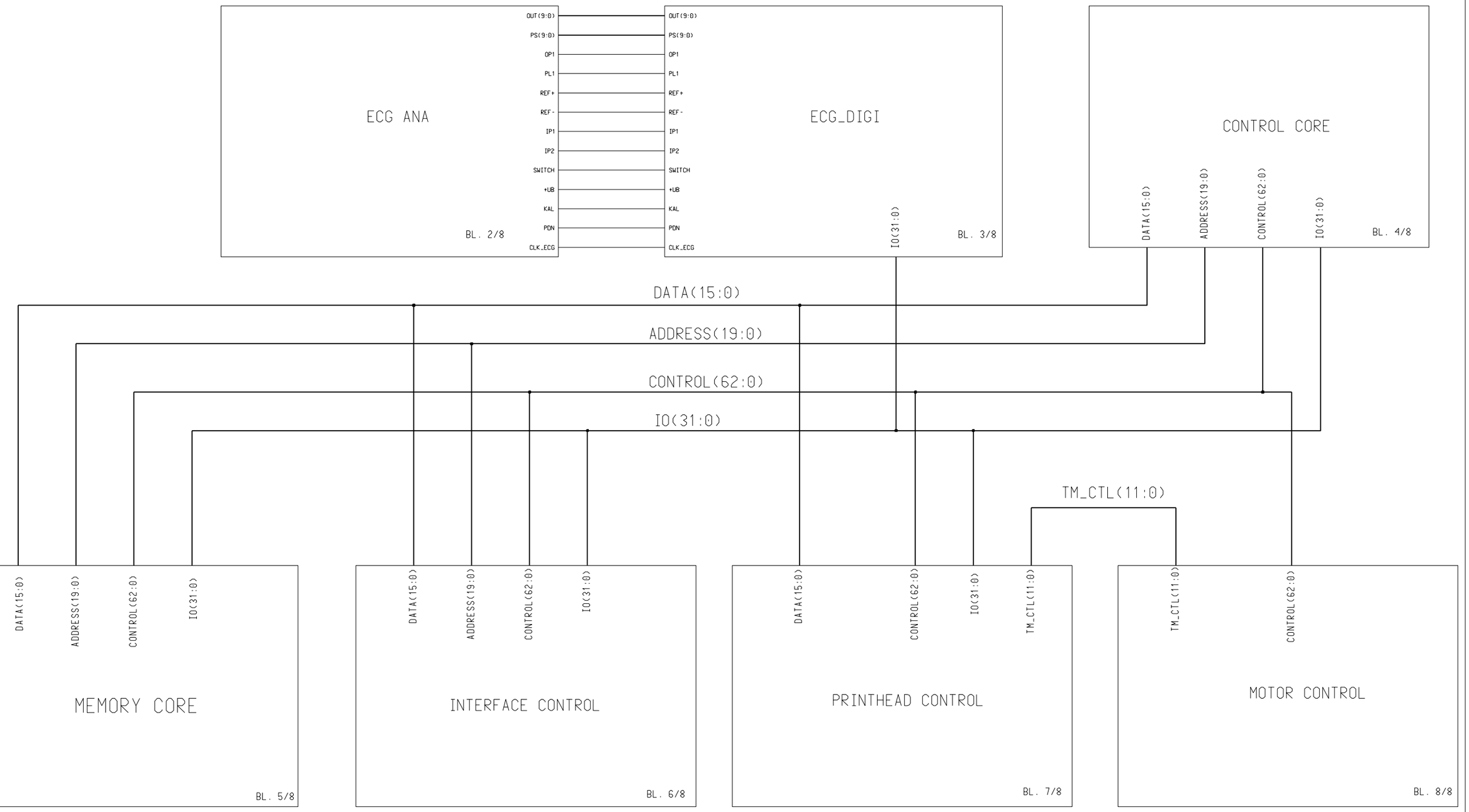
HELLIGE GMBH Postfach 728 D-79007 Freiburg

388 028 12 R BL2/2

LPL. STEUERUNG CS
PCB CONTROL CS

AENDERUNGEN — A02 F67139

ANTR.V	IND	DAT./NAME		DAT./NAME
201810	D	14.05.95/JOK	1994	
201780	E	15.05.95/JOK	GEZ.	18.05.94/JOK
201939	F	13.10.95/MMS	GEPR.	18.05.94/JOK
202000	G	26.10.95/JOK	GEPR.	
202498	H	04.09.96/JOK	ENTW.:	SCHNURR



Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH Postfach 728 D-79007 Freiburg				388 032 13 P BL 1/8
AENDERUNGEN			A03	F67139
Antrag vom	Index	Datum/Name		Datum/Name
			gez.	24.06.96/NTS
			gepr.	24.06.96/NTS
			Entw.	SCHNURR
				LPL. STEUERUNG CS_S
				PCB CONTROL CS_S

[1993, 7, 28, 4]
$USER_CAE_D/cardiosmart/controller/design

EKG-EINGANG

AA/10 L
AA/11 F
AA/12 C1
AA/1 C2
AA/3 C4
AA/2 C3
AA/4 C5
AA/5 C6
AA/15 NAX
AA/13 NST
AA/9 R
LOETBRUECKE
AA/14 N
AA/7 PLGND
AA/8 PL
AA/6 S

47K · 30M · MMBD1203Y / MMBD1503A · 100R · 3K3 · 6K8

LT1114S · V505 · V506 · V507 · 150P · 24K3 · 68K1 · 56K2 · 90K9 · 12K4

68R · 392R · 0R · 1M · 150K

UEA500 … UEA511 · neon_90v

COD 22 · X504

AVDD · AVSS · AGND

4N7 · 33k2 · 150P · 100K · 470P · 18K2 · BAS32 · D18 · D17 · D20 · D19

SDM_HEC2 Z519 · SDM_HEC2 Z521

SWITCH · OUT1 · OUT2 · OUT3 · OUT5 · OUT4 · OUT(9:0) · OUT6 · OUT7 · OUT8 · OUT10 · OUT9

REF+ · REF- · PDN · CLK_ECG

CD4052B · Z23

OP1 · IP1 · IP2 · +UB · PL1 · PS(9:0) · KAL

V8 LM393D · 475K · 22K · 10M · 4K75 · 47K5 · BAS85 · D24 · D23

0R ✳ = NICHT BESTUECKT
0R ✳ = NOT EQUIPPED

Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH	Postfach 728 D-79007 Freiburg			388 032 13 P BL 2/8	
AENDERUNGEN			A03	F67139	
Aend. -Nr.	Index	Datum/Name		Datum/Name	
202498	A	04.09.96/JOK			
202936	B	20.06.97/MSG	gez.	25.06.96/HTW	LPL. STEUERUNG CS_S
			gepr.	25.06.96/HTW	PCB CONTROL CS_S
			Entw.	WEBER	

[1993, 7, 30, 6]
$USER_CAE_D/cardiosmart/controller/ecg_core

OUT(9:0)
OUT1
OUT2
OUT3
OUT5
OUT4
OUT6
OUT7
OUT8
OUT10
OUT9
digi_hec2
CIN1
CIN2
CIN3
CIN5
CIN4
CIN6
CIN7
CIN8
CIN10
CIN9
SCLK
MOSI
RESETIN
CSO*
MISO
OSCIN
OSCOUT
CLKIN
DVSS
DVDD
PACE2
PACE1
TSYNC
KARDMON
OP1
PL1
INP1
INP2
SWITCH
CLKOUT
PDNOUT
Z518
C78 33P
C77 33P
4.096MHz
QU501
C76 0U1
C75 0U1
GNDF
DVSS
DVDD
+5VF
hcpl2630
X503
X502
X501
470R
R148
R149
R146
R147
R150
R151
GND
SCLK_
MOSI_
RESET
PCS0
MISO_
TSYNC_
R153 1K
R152 1K
R155 1K
R154 1K
C187 0U1
R145 1K
R144 1K
+5V
BC550c
T505
T506
R228 6K81
R213 0R
R233 825K
C134 0U1
C135 0U1
AGND
lt1013dn8
V503
C136 0U1
AVDD
AVSS
C518 47U
C148 0U1
R229 1K
R231 36K5
C514 47U
C121 0U1
R193 22K6
R192 2K67
TL431CLP
D505
C97 0U1
BC560c
T503
T504
R217 6K81
R216 0R
R214 825K
C137 0U1
C515 47U
C127 0U1
R236 1K
R215 36K5
C519 47U
C139 0U1
R240 22K6
R239 2K67
D506
C138 0U1
REF-
REF+
+UB
PS(9:0)
pace_hec2
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
CMP2OUT
CMP1OUT
FILINM
FILOUT
CMP1X
CMP2X
CMP1Y
CMP2Y
BUFOUT
FILINP
PDN
CLK
CPLAE
PACE1
PACE2
SCLK
MOSI
CSO*
RESET
AVSS
AVDD
DVSS
AGND
KARDMON
KAL
Z520
R162 124K
R163 249K
R183 5K76
R182 9K31
C107 3N3
R184 2K
C85 68N
R164 143K
R165 1K
R186 100K
R185 1K
C108 0U1
C84 0U1
C109 0U1
TL750L05CLP
D21
D22
BAS85
C517 47U
C120 0U1
C513 220U
C95 0U1
R178 1K
C96 100P
C522 47U
C147 100P
C146 0U1
C521 220U
R212 100K
C133 100P
V502
V504
-UB
-5VF
30344281
TR500
L3
L2
L1
L503
100u
C509 470U
C183 100p
C184 100p
C74 0U1
R139 2K2
D15
BAS85
T502
RFP12N10L
68M
R509
Z18
74HCT14
330P
C72
D16
R138 100K
125kHz
IO(31:0)
Schutzvermerk nach DIN 34 beachten
HELLIGE GMBH
Postfach 728
D-79007 Freiburg
388 032 13 P BL 3/8
AENDERUNGEN
Antrag vom | Index | Datum/Name
A03 FG7139
Datum/Name
gez. 24.06.96/HTW
gepr. 24.06.96/HTW
Entw. WEBER
LPL. STEUERUNG CS_S
PCB CONTROL CS_S
[1993, 7, 30, 6]
$USER_CAE_D/cardiosmart/controller/ecg_core

ADDRESS(19:0)
CONTROL(62:0)
DATA(15:0)
IO(31:0)

CONTROLLER

MC68332

Z511

REAL TIME CLOCK

PAR. EEPROM

SER. EEPROM

ECG INTERFACE

OPTION
EXPERIMENTAL INPUT

DEBUG INTERFACE

WATCHDOG

PERI_CONTROL

RTC_CONTROL

ADDRESS DECODER

RTC_72421

MEM_IMAGE

* not mounted

* = not mounted

HELLIGE GMBH
Postfach 728
D-79007 Freiburg

388 032 13 P BL. 4/8

AENDERUNGEN			A03	F67139
Antrag vom	Index	Datum/Name		Datum/Name
			gez.	24.06.96/NTS
			gepr.	24.06.96/NTS
			Entw.	SCHNURR

LPL. STEUERUNG CS_S

PCB CONTROL CS_S

[1993, 7, 30, 6]

$USER_CAE_D/cardiosmart/controller/control_core

ADDRESS(19:0)
CONTROL(62:0)
DATA(15:0)
IO(31:0)

RAM INTERNAL

OPTION RAM

INTERFACE
PCB MEMORY

INTERFACE
CHARACTER DISPLAY

INTERFACE
GRAPHICS DISPLAY

* = not mounted

MEMORY CORE

HELLIGE GMBH	Postfach 728 D-79007 Freiburg				388 032 13 P BL 5/8
AENDERUNGEN			A03	F67139	
Antrag vom	Index	Datum/Name		Datum/Name	
			gez.	24.06.96/NTS	LPL. STEUERUNG CS_S
			gepr.	24.06.96/NTS	PCB CONTROL CS_S
			Entw.	SCHNURR	

(1993, 10, 19, 3)
$USER_CAE_D/cardiosmart/controller

Schutzvermerk nach DIN 34 beachten

ADDRESS(19:0)
CONTROL(62:0)
DATA(15:0)
IO(31:0)

KEYBOARD INTERFACE

Z512 74HCT574
KEYSEL
DB_8 DB_9 DB_10 DB_11 DB_12 DB_13 DB_14 DB_15
BAS85 D6 COLUMN1 / D7 COLUMN2 / D8 COLUMN3 / D12 COLUMN4 / D11 COLUMN5 / D13 COLUMN6 / D14 COLUMN7 / D29 COLUMN8
AS/ 2 AS/ 3 AS/ 4 AS/ 7 AS/ 11 AS/13 AS/14 AS/22
not mounted
AS_
KEYRD_
Z513 74HCT574
ROW1 ROW2 ROW3 ROW4 ROW5 ROW6 ROW7
AS/ 1 AS/ 5 AS/ 6 AS/ 8 AS/ 9 AS/10 AS/12
LEDLIN AS/17
LEDBAT AS/15 AS/16
AS/18
* not mounted
LED_START AS/20
LED_STOP AS/19
LED_ST
TA_KENN1 AS/21

BEEPER

Signalgeber LS500
Z5 74HCT14
BEEP
BC847B

RS232 INTERFACE

max232
TxD RxD
Z524
AC/1 RXDE
AC/2 TXDE
AC/3
AC/4
AC/5 GND
AC/6
AC/7
AC/8 FERN
AC/9 EKTR

OPTION RS232 EXTENSION

X68C681
DB_8 DB_9 DB_10 DB_11 DB_12 DB_13 DB_14 DB_15
AD_0 AD_1 AD_2 AD_3
RW_ RESET_
3.6864MHz QU502
DSACK0_ INT_V24E_ IACKN_
TXAE RXAE TXBE RXBE
Z523
RT_INT(3:0)
CSRS232E_
max232
TXAE TXBE RXAE RXBE
TXA_E TXB_E RXA_E RXB_E
Z522
CODE
AD/ 1 AD/ 2 AD/ 3 AD/ 4 AD/ 5 AD/ 6 AD/ 7 AD/ 8 AD/ 9 AD/10 AD/11 AD/12 AD/13 AD/14 AD/15 AD/16 AD/17 AD/18 AD/19 AD/20

OPTION INTERFACE

Z15 74ACT139
AD_13 AD_12
CSOPT_ CSOPTI_
74ACT244
AD_0 AD_1 AD_2 AD_3 AD_4 AD_5 AD_6 AD_7 AD_8 AD_9 AD_10 AD_11
ADE_0 ADE_1 ADE_2 ADE_3 ADE_4 ADE_5 ADE_6 ADE_7 ADE_8 ADE_9 ADE_10 ADE_11
Z505 Z502
AR/ 1 AR/ 2 AR/ 3 AR/ 4 AR/ 5 AR/ 6 AR/ 7 AR/ 8 AR/ 9 AR/10 AR/11 AR/12 AR/13 AR/14 AR/15 AR/16 AR/17
Z510 74ACT245
RW_
DB_8 DB_9 DB_10 DB_11 DB_12 DB_13 DB_14 DB_15
DBE_8 DBE_9 DBE_10 DBE_11 DBE_12 DBE_13 DBE_14 DBE_15
AR/18 AR/19 AR/20 AR/21 AR/22 AR/23 AR/24 AR/25 AR/26 AR/27 AR/28
RW_ AR/29 AR/30
CSOPTI1_ CSOPTI2_ AR/31 AR/32
AR/33 AR/34
+12V AR/35 AR/36
DSACK0_ AR/37
OPTI_KENN_ AR/38
NC NC AR/39 AR/40
LS01 1u

FERNST

BC847B T12 R289 10K R288 10K R287 100R BAS85 D25
R291 10K R290 100R
T13 R292 10K BC847B D26 BAS85
EKG_TRIG
RS232E_KENN_ R282 0R
R37 10K 74ACT244 Z502
R13 10K R20 10K
R504 0R
C119 C67 C19 C14 C41 C61 0u1
1u C11 1n5 C12 4n7 C13

* = not mounted

INTERFACE CONTROL

HELLIGE GMBH	Postfach 728 D-79007 Freiburg	388 032 13 P BL 6/8
AENDERUNGEN Antrag vom / Index / Datum/Name	A03 F67139	
	Datum/Name	LPL. STEUERUNG CS_S
	gez. 25.06.96/NTS	PCB CONTROL CS_S
	gepr. 25.06.96/NTS	
	Entw. SCHNURR	

Schutzvermerk nach DIN 34 beachten

[1993, 7, 30, 6]
$USER_CAE_D/cardiosmart/controller/interface_control

TAL(10:0)

DATA(15:0)

CONTROL(62:0)

TM_CTL(11:0)

IO(31:0)

TPC INPUT CONTROL

T_INP_CTL(4:0)

TPC_CTL(14:0)

TPC_GA

TPC_PLD

CLOCK GENERATION

TPC_OUT(6:0)

PRINTHEAD TEMPERATURE MONITORING

STATUS/CONTROL REGISTER

TEST PRINTHEAD VOLTAGE

mounted for optional printhead

mounted for standard printhead

* = not mounted

OPTIONAL PRINTHEAD

PRINTHEAD CONTROL

Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH	Postfach 728 D-79007 Freiburg	388 032 13P BL. 7/8
AENDERUNGEN: Antrag vom / Index / Datum/Name	A03	FG7139
		Datum/Name
	gez.	25.06.96/NTS
	gepr.	25.06.96/NTS
	Entw.	SCHNURR
		LPL. STEUERUNG CS_S
		PCB CONTROL CS_S

[1993, 7, 30, 6]

$USER_CAE_D/cardiosmart/controller/printhead_control

POWER SUPPLY INTERFACE

+5V POWER SUPPLY

LM2575-ADJ — With Heat Sink

OTPION PUMP

OPTION POWER CHECK

+12V POWER SUPPLY

-12V POWER SUPPLY

COMMON/VDD1 SWITCH

MOTOR REGULATION

MOTOR CURRENT CONTROL

SPEED SELECT

MARK READER

PRINTHEAD PRESSURE

* = not mounted

Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH — Postfach 728, D-79007 Freiburg	388 032 13 P BL. 8/8
AENDERUNGEN: Antrag vom / Index / Datum/Name; A03 FG7139; Datum/Name	LPL. STEUERUNG CS_S
gez. 24.06.96/NTS	PCB CONTROL CS_S
gepr. 24.06.96/NTS	MOTOR CONTROL
Entw. SCHNURR	

[1993, 7, 30, 6]
$USER_CAE_D/cardiosmart/controller/motor_control

BTAS = 563
BTBS = 167
LOET-AS = 2602
LOET-BS = 697

801 776 40 M3x8, DIN 7985
927 228 30
804 177 18 3,0 DIN 127
803 009 00 M3, DIN 934

WINKEL
SCHRAEGE

2/927 229 31
2/442 010 10
915 417 81
915 417 77
915 417 78
442 001 06
PIN 12 KODIERT
442 001 20
915 414 85
927 228 79
927 229 31
442 010 15
PIN 11 KODIERT
4/829 074 88
2/915 415 33
923 096 84
Band auf 2. Rippe von unten
Verschluss seitlich aussen
2/915 414 80
442 010 06
433 671 39
442 010 20
829 074 88
SCOTCH-BAND
BA500
927 228 79
442 001 22
927 227 44
442 008 30
432 521 97
2× FIXIERT MIT DICHTUNGSKLEBER 829 073 00
3/916 189 03
2/801 777 20
2,5x8 Plastite 45
2/801 777 38
2,5x8 Plastite 45
Pin 1 entspricht blauer
Flachband-Farbmarkierung
432 522 05
432 522 65
WICKLUNGSANFANG GEKENNZEICHNET
BARCODE
BEFORE SHIPPING DESOLDER BATTERY
CAUTION FOR REPLACEMENT USE SAME TYPE OF BATTERY
In Montage verloetet
NACH PRUEFUNG VERLOETEN
Welle
Reflow
* = NICHT BESTUECKT
HIERZU GEHOERT: DRAHTSATZ 383 273 03

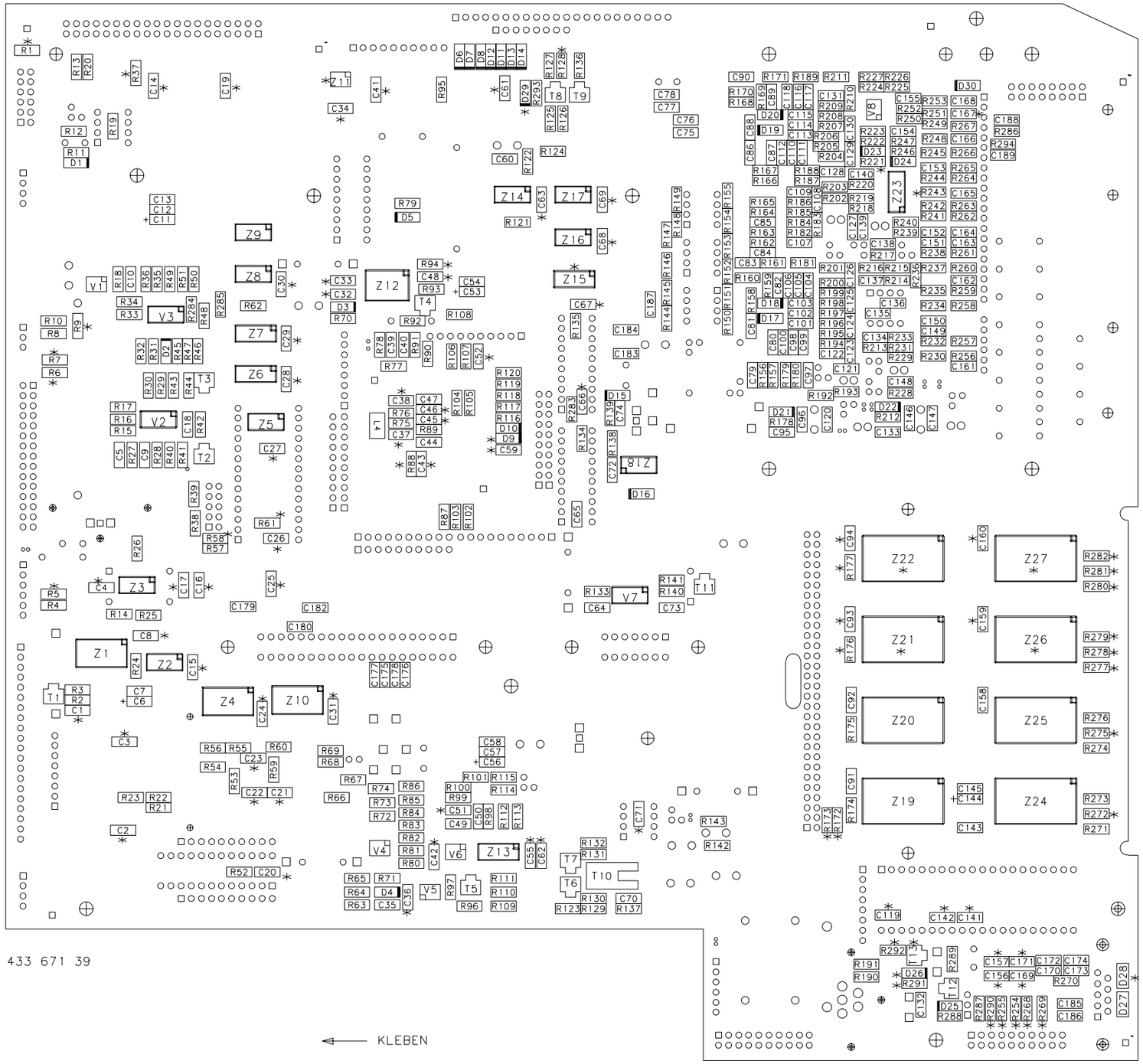
Schutzvermerk nach DIN 34 beachten.

Marquette Hellige GmbH D-79007 Freiburg

388 032 13 R BL 1/2

LPL.STEUERUNG CS_S
PCB CONTROL CS_S

REVISIONS			A02 F67139
Revision-No	Index	Date/Name	Date/Name
202 713	A	06.02.97/JOK	
		Drawn	26.06.96/JOK
		Approved	26.06.96/JOK
		Issued	SCHNURR



433 671 39

KLEBEN

* = NICHT BESTUECKT
* = NOT EQUIPPED

Schutzvermerk nach DIN 34 beachten.

Marquette Hellige GmbH D-79007 Freiburg				388 032 13 R BL2/2
REVISIONS			A02 F67139	LPL.STEUERUNG CS_S
Revision-No	Index	Date/Name	Date/Name	PCB CONTROL CS_S
202 498	A	04.09.96/JOK		
202 713	B	06.02.97/JOK	Drawn 26.06.96/JOK	
			Approved 26.06.96/JOK	
			Issued SCHNURR	

DC/1
DC/2
DC/3
DC/4
KLF_30VA_1x29V
TR500
C7 0U1
GBPC602
GL500
GND
C6 0U1
C504 2200u
GND GND
1.25at
SI501
D11 BAS32
R35 1k
D12 BYM10-100
D10 BYM10-100
LEDLIN
DB/ 1
UVERS
DB/ 4
DB/ 5
DB/ 6
+5V
C5 10n
R40 100K
T14 IRFR9024
R34 100K
R29 100K
R28 100K
R27 100K
BC857B
T9
D6 BAS32
T10
BC847B
T11
BC847B
GND
R22 10K
33K2 R24
GND
D7 BAS32
D8 BAS32
COMMON_S
DB/ 18
GS_EIN
DA/ 1
DA/ 2
GS_AUS
DA/ 3
GND
T15
BC847B
R37 10K
100R R23
R39 16K2
DB/3 GAUS_
R8 2K43
D1 BAS32
R9 100R
D3 BAS32
C500 100u
GND
L501 68u
DB/20 LEDBAT
DB/19 NC
DB/2 REG_ON
+5V
2K43 R26
LM393D
V+ V1 V- OUT
10K R25
100K R36
D9 BAS32
10K R21
C502 10u
GND GND
R32 562R
C501 10u
GND
R38 3K65
GND
R14 1k62
R12 1k62
10K R11
BC847B
T7
T4 IRFR9024
T5
BC847B
T6
BC857B
GND
C505 10u
GND
R13 330R
33K2 R19
BYM12-150
D4
GND
1K R10
4n7 C1
GND
R18 681R
R16 10K
D5 BAS32
T12
BC847B
T13
BC847B
R30 33K2
GND GND
330u L500
0u1 C8
GND
BYM12-150
D2
R500/1t 2R3
R31 33K2
100K R33
GND
REG_OFF
DB/ 11
Code
DB/ 12
DB/ 13
DB/ 14
DB/ 15
DB/ 16
GND
led_ge
R20 1K
LED1
VLIMIT V+ REF DRV THI BATT+ PGM1 FASTCHG_ PGM0 PGM2 PGM3 TEMP TLO CC GND BATT-
MAX712
Z1
BC847B
T8
C3 47p
10K R15
10K R17
C4 0u1
C2 220p
1u C503
4at
SI500
BATT+
DD/ 1
BATT-
DD/ 2
COMMON_IN
R1 10K
DB/ 7
DB/ 8
DB/ 9
DB/ 10
VRAM
DB/ 17
10K R6
BC847B
T3
33K2 R7
33K2 R5
T1
BC847B
10K R3
IRFR024
T2
1R R2
1R R4
C9 0u1
GND

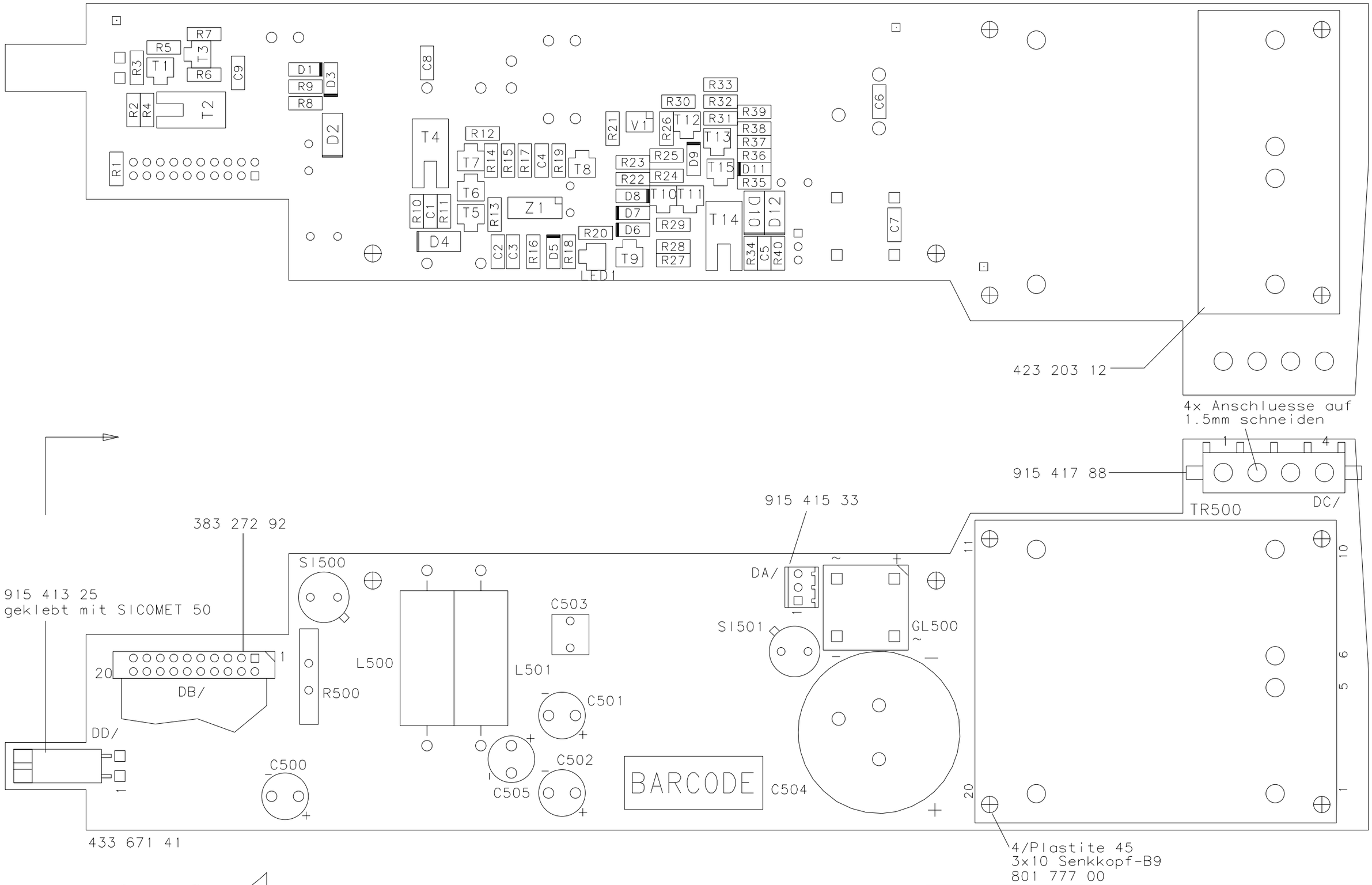
Schutzvermerk nach DIN 34 beachten

HELLIGE GMBH	Postfach 728 D-79007 Freiburg	388 028 14 P BL. 1/1

AENDERUNGEN			A03	F67141
Aend. -Nr.	Index	Datum/Name		Datum/Name
-----	A	30.03.94/bus		
201357	B	15.08.94/JFS	gez.	03.01.94/NTS
			gepr.	03.01.94/JFS
			Entw.	SCHULER

LPL. STROMVERSORGUNG CS
PCB POWER SUPPLY CS

[1993, 7, 28, 4]
$USER_CAE_D/cardiosmart/supply/design



NICHT INS ENGLISCHE UEBERSETZTE HINWEISE NUR FUER FERTIGUNG WICHTIG!
TERMS NOT TRANSLATED INTO ENGLISH
ONLY RELEVANT FOR PRODUCTION!

BT-AS = 82
BT-BS = 17
LOET = 259

HELLIGE GMBH Postfach 728 D-79007 Freiburg

388 028 14 R

AENDERUNGEN			M1.5:1	A03
ANTR.V	IND	DAT./NAME		F67141
——	A	30.03.94/bus	1994	DAT./NAME
201357	B	17.08.04/JOK	GEZ.	12.01.94/JOK
201449	C	07.11.94/JOK	GEPR.	12.01.94/JOK
201901	D	17.07.95/JOK	GEPR.	
			ENTWI.	M&E/SCHULER

LPL. STROMVERSORGUNG CS

PCB POWER SUPPLY CS

Schutzvermerk nach DIN 34 beachten.

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