MEDTEC | SCIENCE GMBH

VERSION 1.9

INSTRUCTION MANUAL

MS410 ECG Simulator

This instruction manual is an essential part of the system, in accordance with EN61010-1. Comply with it and keep it.

TABLE OF CONTENTS

1 | PRODUCT INFORMATION

The MS410 ECG Simulator is a high-performance, handy device for simulating normal and pathological beat series at:

- **ECG and prolonged ECG devices**
- **monitors**
- **ECG recorders**
- **arrhythmia computers etc.**

The device can be used in many ways, such as for:

- **functional tests in development and production**
- **sales demonstrations of ECG devices or display systems**
- **education and training.**

Six beat series with 37 normal and pathological beat types are available. The mixprogram offers a typical selection of normal and pathological beat types. It provides various ECG beat forms for more than 20 minutes.

Furthermore, the MS410 can simulate “artificial” beat types, in accordance with IEC 60601-2-25/Appendix GG requirements for testing the measurement system of ECG devices or display systems. The MS410 provides six beat series with 114 beat types according to this standard.

The beat series and beat types are shown and selected in a display. For the display language, you can select English or German. The default is German.

The device to be tested or the terminal is connected to the MS410 via ten electrode plugs (banana plugs). With pushbutton contacts (see page 9 and 10), you can also connect patient cables with electrode clips. The pushbutton contacts are available as an accessory.

The device is battery-powered.

2 | SAFETY PRECAUTIONS, CLEANING, CALIBRATING

Proper use

- **Check if the device is free of damage.**
- **Check if the batteries or rechargeable batteries are free of damage, such as dents or leaks.**

Liability exclusion in case of improper use

NOTE

In case of improper use or maintenance, MedTec & Science GmbH will not be liable!

The manufacturer is only responsible for the security and reliability of the device if:

- **all changes, enhancements, repairs and any other work on the device is performed by a person authorized by MedTec & Science GmbH, e.g. a distribution partner or service technician of MedTec & Science GmbH and**
- **the user complies with this instruction manual when using the device.**

Safety precautions

WARNING

We direct your attention to the following safety precautions.

- **Do not touch the signal output jacks when patient or signal cables are connected.**
- **Do not connect external voltages to the signal output jacks.**
- **Do not keep or use the device near strong electrical fields (e.g. near X-ray or diathermy machines).**
- **Do not spill liquids on the device.**

- **Avoid direct solar radiation.**
- **Do not expose the device to extreme heat or cold (e.g. sauna, refrigerator or freezer).**
- **Remove the batteries from the battery compartment if you will not be using the device for a long time.**
- **Use only rechargeable batteries and batteries of the same type. Do not mix them.**

NOTE

The MS410 is not protected against any defibrillation impulse!

Cleaning

NOTE

Clean the device only with a soft, lint-free cloth and a common cleaner for plastics. The cloth should be moist, not dripping wet. Do not spray the cleaner directly onto the device.

Do not use spray cleaners, solvents, benzenes, spirits or similar agents.

Calibrating

NOTE

We recommend calibrating the device every five years.

3 | OPERATING ELEMENTS, SIGNAL OUTPUT JACKS AND ACCESSORIES

Front-panel operating elements

The following figure shows the operating elements of the MS410:

Figure 3-1: Operating elements of the MS410

Beat series and beat types are shown and selected in the display. Select beat series and beat types by pressing the mainmenue and submenue buttons.

Not all of the available beat series and beat types are shown in the display at the same time. Use the mainmenue and submenue buttons to scroll through the beat series and beat types.

To scroll in the mainmenue and submenue, use the up-arrow ⬆ and down-arrow ⬇ buttons.

The currently selected beat series is shown in the top row of the display.

The currently selected beat type is shown in the lower part of the display, in inverse video.

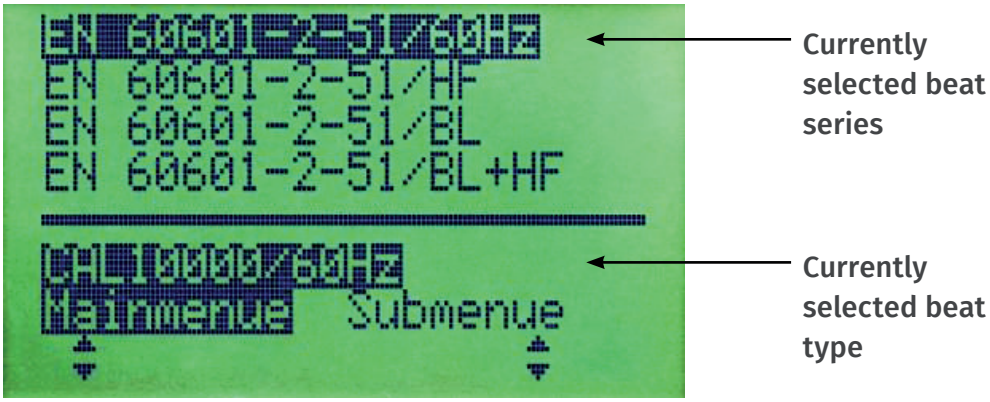


Figure 3-2: Currently selected beat series and beat type Signal

Signal Output Jacks

The MS410 provides signal output jacks for ten electrode plugs (banana plugs) with the following output voltages:

Code1 (Europe):

R, L, F, C1, C2, C3, C4, C5, C6, N

Code2 (America):

RA, LA, LL, V1, V2, V3, V4, V5, V6, RL

With pushbutton contacts, you can also connect patient cables with electrode clips.

The signal output jacks are labelled with the alphanumeric code for Code1 and Code2:

Figure 3-3: Signal output jacks on the reverse side of the MS410

If there is no alphanumeric code on the electrode plugs or clips, the following colours are used (in accordance with IEC 60601-2-25):

Code 1 (usual in Europe)		Code 2 (usual in America)	
Electrode label	**Colour Code**	**Electrode label**	**Farbcode**
R	red	RA	white
L	yellow	LA	black
F	green	LL	red
C1	white/red	V1	brown/red
C2	white/yellow	V2	brown/yellow
C3	white/green	V3	brown/green
C4	white/brown	V4	brown/blue
C5	white/black	V5	brown/orange
C6	white/purple	V6	brown/purple
N	black	RL	green

Accessories

Pushbutton contacts with extractor for electrode clips are inculuded.

The pushbutton contacts can also be ordered as a set of ten contacts, including the extractor (order number 46.715).

The extractor for the pushbutton contacts can be stored inside the battery cover. Press the bent side of the extractor towards the stop spring of the battery cover.

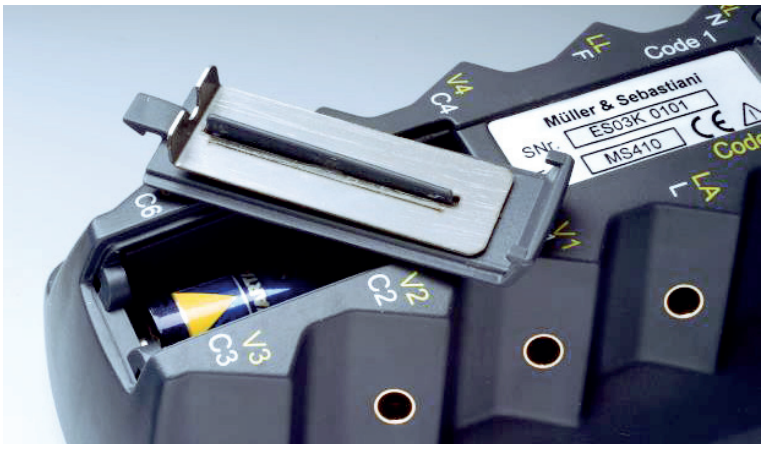


Figure 3-4: Extractor for pushbutton contacts

4 | CONNECTING AND SWITCHING ON THE MS410

Connecting electrode plugs

- Connect the patient or connecting cable to the device to be tested or to the terminal.
- Connect the electrode plugs to the signal output jacks on the reverse side of the MS410.

Connecting electrode clips

- Connect the patient or connecting cable to the device to be tested or to the terminal.
- Plug the pushbutton contacts into the signal output jacks on the reverse side of the MS410.

Figure 4-1: Plugging in the pushbutton contacts

- Insert the pushbutton contacts all the way (to the stop).
- Place the electrode clips on the pushbutton contacts.

Arranging the cables

- On each side, arrange the cables parallel to one another. This way, you can handle the MS410 comfortably.

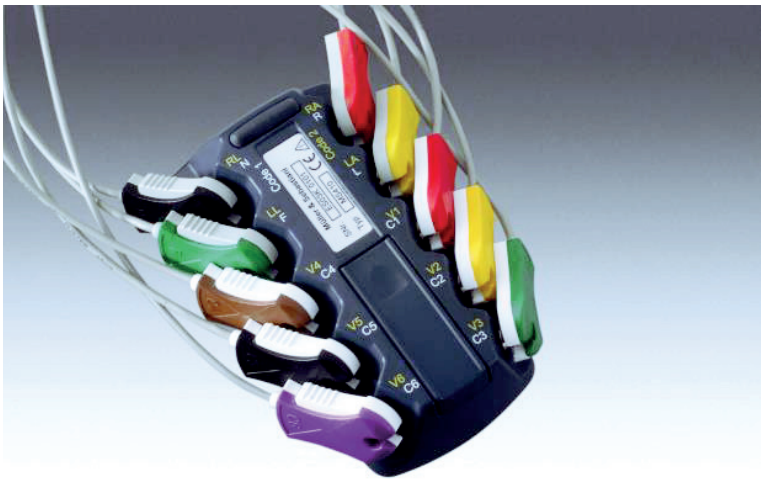


Figure 4-2: Arranging the cables - example with electrode clips

Switching on the MS410

- Press the On/Off button. ⏻

  Above “Mainmenue”, the beat type is shown which was selected before the device was switched off most recently. This beat type is output to the signal output jacks. Each time you switch off the MS410, the device stores the current settings. They are available immediately the next time you switch the device on.

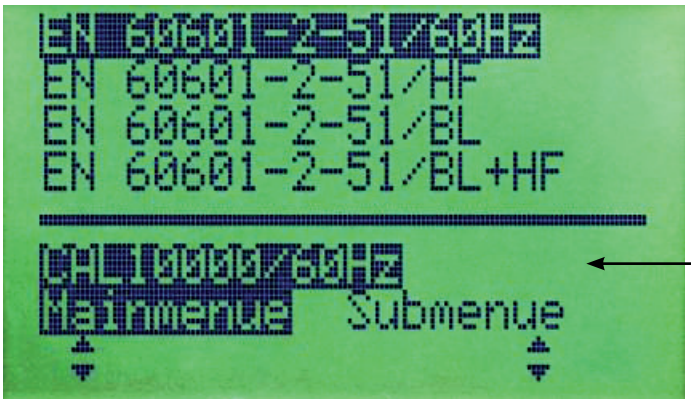
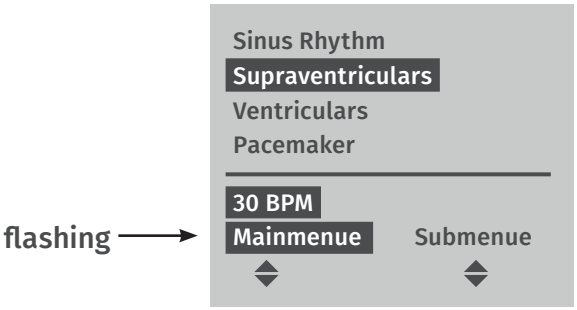


Figure 4-3: Last selected beat type

5 | SELECTING BEAT SERIES AND BEAT TYPES

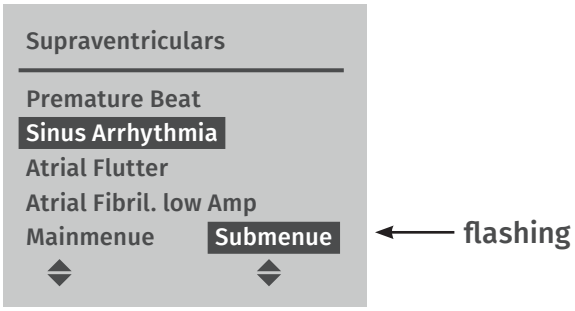
Selecting beat series

- **Press one of the mainmenue buttons – ∩ or ∪ – until the desired beat series is shown in inverse video.**

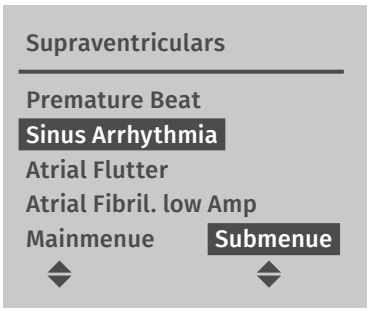


Selecting beat types

- **Press one of the submenue buttons – ∩ or ∪ – until the desired beat type is shown in inverse video.**



After approx. 1 second, “Submenue” stops flashing and the selected beat type is output at the MS410. The measurement of the device under test can be performed now.



Selecting another beat type

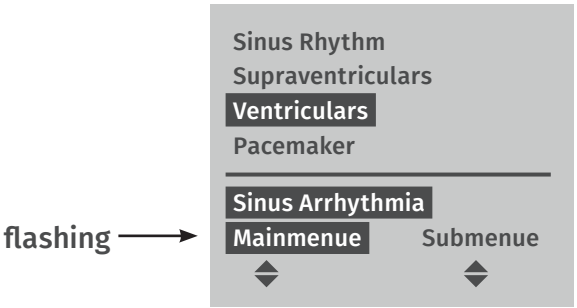
- **Press one of the submenue buttons – ∩ or ∪ – until the desired beat type is shown in inverse video.**

After approx. 1 second, “Submenue” stops flashing and the selected beat type is output at the MS410. The measurement of the device under test can be performed now.

Selecting another beat series

- **Press one of the mainmenue buttons – ∩ or ∪.**

  The display shows the available beat series. The most recently selected beat series is shown.
- **Press one of the submenue buttons – ∩ or ∪ – until the desired beat series is shown in inverse video.**



6 | SWITCHING OFF AND DISCONNECTING THE MS410

Switching off the MS410

Note If you do not need the MS410, always switch it off to save battery power.

- **Press the On/Off button**
  The symbol in the display disappears.

Removing electrode plugs

- **Disconnect the patient or connection cable from the device under test.**
- **Disconnect the electrode plugs from the signal output jacks on the reverse side of the MS410.**

Removing electrode clips and pushbutton contacts

- **Disconnect the patient or connection cable from the device under test.**
- **Remove the electrode clips from the pushbutton contacts.**
- **Take the extractor from the battery cover.**
- **Place the round cut-out on the bent side of the extractor behind the pushbutton and pull the pushbutton contact straight out. Do not see-saw!**

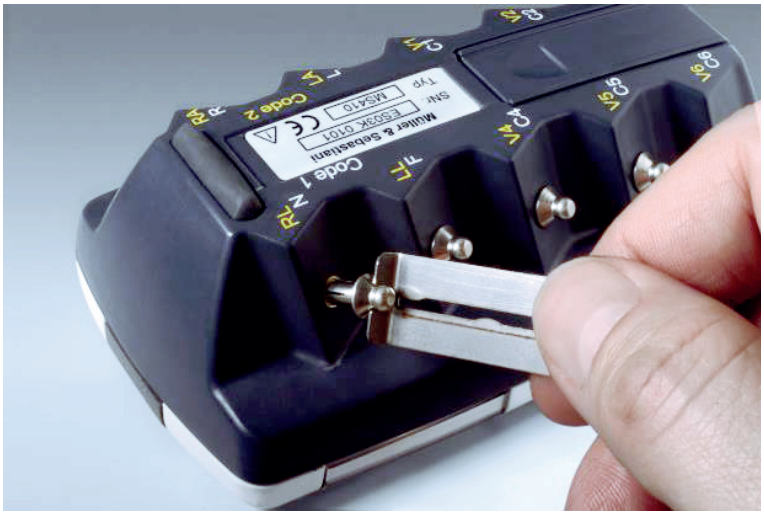


Figure 6-1: Removing the pushbutton contacts with the extractor

7 | CHANGING ADJUSTMENTS

In the **Adjustment** menue you can change the following settings:

- **Language of the display: English or German**
- **Contrast of the display.**

Calling the adjustment menue

- **Select *Adjustment* from the mainmenue.**
- **Press the submenue button.**

Note The MS410 automatically branches to language selection if you do not select another submenue.

Setting the language

The default language is German.

- **In the submenue Language, select English or German (Englisch or Deutsch).**
- **Press the mainmenue button.**

Setting the contrast

- **Select Contrast from the submenue.**
- **Press the down-arrow button to increase the contrast.**
  – oder –
- **Press the up-arrow button to decrease the contrast.**

8 | REPLACING THE BATTERIES

The following symbol indicates the charge left in the battery: 

If the symbol is flashing, the voltage is low. The signal outputs of the MS410 are active, however. If the symbol is no longer flashing, the signal outputs are no longer active and the batteries must be replaced.

Replacing the batteries

- **Open the battery cover on the reverse side of the device and remove the batteries.**
- **Put in the new batteries (2 Mignon (AA) NiMH, NiCd rechargeable batteries (1.2 V) or 1.5-V batteries), as indicated in the battery compartment.**

Figure 8-1: Battery compartment of the MS410

- **Close the battery compartment.**

Please bring consumed batteries to a recycling centre.

9 | OVERVIEW: BEAT SERIES AND BEAT TYPES

The following table provides an overview of the standard beat series and beat types which you can simulate with the MS410:

Beat series	Beat types	
Sinus Rhythm	30 BPM 45 BPM 60 BPM 75 BPM	90 BPM 120 BPM 150 BPM 180 BPM
Supraventriculars	Premature Beat Sinus Arrhythmia Atrial Flutter Atrial Fibrillation low Amplitude Atrial Fibrillation high Amplitude AV-Block, First Degree AV-Block, Second Degree Artial Pauses (>2,5 s)	
Ventriculars	Unifocal Premature Beats Multifocal Premature Beats Rhythm Bigeminy R-on-T Phenomena Premature Beats-Couplets Beats-Runs of 3 VPB's Tachycardia Fibrillation	
Pacemaker	Artificial Rhythm Ventricular Demand Malfunction	
S-T	Elevation Depression	
Distortion/Mix	1 mV Cal-Signal Interference 50 Hz Interference 60 Hz Baseline Variation Electrode Malfunction Spikes Mixprogram	

to be continued: Overview beat series and beat types >>

Beat series	Beat types	
EN 60601-2-51 (now EN 60601-2-25)	CAL05000 CAL10000 CAL15000 CAL20000 CAL20002 CAL20100 CAL20110 CAL20160 CAL20200 CAL20210	CAL20260 CAL20500 CAL20502 CAL30000 CAL40000 CAL50000 ANE20000 ANE20001 ANE20002
EN 60601-2-51/50Hz (now EN 60601-2-25) overlaid with interference 50 Hz	CAL05000/50Hz CAL10000/50Hz CAL15000/50Hz CAL20000/50Hz CAL20002/50Hz CAL20100/50Hz CAL20110/50Hz CAL20160/50Hz CAL20200/50Hz CAL20210/50Hz	CAL20260/50Hz CAL20500/50Hz CAL20502/50Hz CAL30000/50Hz CAL40000/50Hz CAL50000/50Hz ANE20000/50Hz ANE20001/50Hz ANE20002/50Hz
EN 60601-2-51/60Hz (now EN 60601-2-25) overlaid with interference 60 Hz	CAL05000/60Hz CAL10000/60Hz CAL15000/60Hz CAL20000/60Hz CAL20002/60Hz CAL20100/60Hz CAL20110/60Hz CAL20160/60Hz CAL20200/60Hz CAL20210/60Hz	CAL20260/60Hz CAL20500/60Hz CAL20502/60Hz CAL30000/60Hz CAL40000/60Hz CAL50000/60Hz ANE20000/60Hz ANE20001/60Hz ANE20002/60Hz

to be continued: Overview beat series and beat types

Beat series	Beat types	
EN 60601-2-51/HF (now EN 60601-2-25) overlaid with high-frequency	CAL05000/HF CAL10000/HF CAL15000/HF CAL20000/HF CAL20002/HF CAL20100/HF CAL20110/HF CAL20160/HF CAL20200/HF CAL20210/HF	CAL20260/HF CAL20500/HF CAL20502/HF CAL30000/HF CAL40000/HF CAL50000/HF ANE20000/HF ANE20001/HF ANE20002/HF
EN 60601-2-51/BL (now EN 60601-2-25) overlaid with baseline variation	CAL05000/BL CAL10000/BL CAL15000/BL CAL20000/BL CAL20002/BL CAL20100/BL CAL20110/BL CAL20160/BL CAL20200/BL CAL20210/BL	CAL20260/BL CAL20500/BL CAL20502/BL CAL30000/BL CAL40000/BL CAL50000/BL ANE20000/BL ANE20001/BL ANE20002/BL
EN 60601-2-51/BL+HF (now EN 60601-2-25) overlaid with baseline variation and high-frequency	CAL05000/BL+HF CAL10000/BL+HF CAL15000/BL+HF CAL20000/BL+HF CAL20002/BL+HF CAL20100/BL+HF CAL20110/BL+HF CAL20160/BL+HF CAL20200/BL+HF CAL20210/BL+HF	CAL20260/BL+HF CAL20500/BL+HF CAL20502/BL+HF CAL30000/BL+HF CAL40000/BL+HF CAL50000/BL+HF ANE20000/BL+HF ANE20001/BL+HF ANE20002/BL+HF

10 | OVERVIEW: MIXPROGRAM

The following table provides an overview of the sequence of the beat types in the mixprogram and their length:

No.	Beat type	Start time/min,s approx.	Length/s approx.
1	Normal Sinus Rhythm 75 BPM	0'00''	25''
2	Normal Sinus Rhythm 60 BPM	0'25''	25''
3	Normal Sinus Rhythm 45 BPM	0'50''	27''
4	Normal Sinus Rhythm 75 BPM	1'17''	11''
5	Normal Sinus Rhythm 90 BPM	1'28''	20''
6	Normal Sinus Rhythm 120 BPM	1'48''	20''
7	Atrial Fibrillation	2'08''	66''
8	AV-Block, First Degree	3'14''	18''
9	Interference 50 Hz	3'32''	15''
10	Artial Pauses	3'47''	29''
11	ST Elevation horizontal	4'16''	12''
12	ST Elevation descending	4'28''	18''
13	Electrode Malfunction on C3	4'46''	55''
14	Unifocal Premature Beats	5'41''	30''
15	Normal Sinus Rhythm 30 BPM	6'11''	30''
16	Bigeminy	6'41''	56''
17	Atrial Flutter	7'37''	38''
18	R-on-T Phenomena	8'15''	45''
19	Interference 60 Hz	9'00''	53''
20	ST Elevation horizontal	9'53''	15''
21	ST Elevation ascending	10'08''	14''
22	Normal Sinus Rhythm 75 BPM	10'22''	25''
23	Normal Sinus Rhythm 60 BPM	10'47''	25''
24	Normal Sinus Rhythm 45 BPM	11'12''	27''
25	Normal Sinus Rhythm 75 BPM	11'39''	11''
26	Normal Sinus Rhythm 90 BPM	11'50''	20''
27	Normal Sinus Rhythm 120 BPM	12'10''	20''
28	Multifocal Premature Beats	12'30''	96''
29	ST Depression horizontal	14'06''	18''
30	ST Depression descending	14'24''	13''
31	Baseline Variation	14'37''	34''
32	Normal Sinus Rhythm 45 BPM	15'11''	29''
33	Beats-Runs of 3 VPBs	15'40''	64''

to be continued: Overview mixprogram >>

No.	Beat type	Start time/min,s approx.	Length/s approx.
34	AV-Block, Second Degree	16'44''	64''
35	ST Depression horizontal	17'48''	15''
36	ST Depression ascending	18'03''	21''
37	Electrode Malfunction I	18'24''	60''
38	Premature Beat	19'24''	26''
39	Sinus Arrhythmia	19'50''	32''
40	Spikes	20'22''	30''
41	Premature Beats-Couplets	20'52''	51''
42	Rhythm	21'43''	116''
	Restart with No. 1	23'39''	

11 | SPECIFICATION

LCD display	132x64 dots on 50x30 mm
Digital resolution	16 bits, 38 µV/digit
Precision of output signals at 25 °C	± (1,0% + 8 µV) from the respective value of the standard ECGs in IEC 60-601-2-25/Appendix GG (EN 60601-2-25)
Output impedance	RA, LA, LL, V1-V6 115 Ohm
Temporal resolution	Sampling rate 1 ms, 0.2 %
Dimensions (LxWxH)	approx. 120 x 70 x 47 mm
Weight (including rechargeable batteries or batteries)	approx. 200 gram
Environmental conditions	Temperature: +10 °C – +40 °C Air humidity: 5 % - 90 % noncondensing
Power supply	2 x Mignon (AA) NiMH-, NiCd-rechargeable batteries (1.2 V) or 1.5 V batteries

12 | TROUBLESHOOTING AND ERROR CORRECTION

If the device to be tested or the terminal indicates no signal, check the following items:

- **Is the device switched on?**
- **Are the cables connected correctly?**
- **Is the MS410 switched on?**
- **Do the batteries in the MS410 have enough voltage?**

9 | DECLARATION OF CONFORMITY

MEDTEC|SCIENCE GMBH

EU-Konformitätserklärung
EU-Declaration of Conformity

Hersteller / manufacturer: MedTec & Science GmbH | Maria-Merian-Str. 6 | 85521 Ottobrunn, Germany

Wir erklären hiermit in alleiniger Verantwortung, dass das Produkt/ die Produkte
We hereby declare under our sole responsibility that the product/ the products

Typ / *type*	Bezeichnung / *description*	Artikelnummer / *part number*
EKG-Simulator ECG-Simulator	**Phantom 320 Code1**	59.009
EKG-Simulator ECG-Simulator	**Phantom 320 Code2**	59.010
EKG-Simulator ECG-Simulator	**MS 410**	59.022
Defibrillations-Simulator Defibrillation-Simulator	**Zeus V1**	59.101
Defibrillations-Simulator Defibrillation-Simulator	**Zeus V2**	59.102

den Bestimmungen der nachstehenden EG/EU-Richtlinie(n)/Verordnung(en) entspricht/entsprechen:
is/are in conformity with the following EG/EU-Directive(s)/Regulation(s):

2014/35/EU	EU-Niederspannungs-Richtlinie Electrical Equipment designed for use within certain voltage limits
2014/30/EU	Elektromagnetische Verträglichkeit Electromagnetic Compatibility
2011/65/EU (inkl. (EU) 2015/863)	Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten (ROHS II und Änderungsrichtlinie 2015) Restriction of the use of certain hazardous substances in electrical and electronic equipment with amendment 2015

Angewandte (harmonisierte) Normen / *Applied (harmonised) standards:*

EN IEC 61010-1	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel-, und Laborgeräte Safety requirements for electrical equipment for measurement, control, and laboratory use
EN IEC 61326-1	Elektrische Mess-, Steuer-, Regel-, und Laborgeräte – EMV Anforderungen Electrical equipment for measurement, control and laboratory use – EMC requirements
EN IEC 63000	Technische Dokumentation zur Beurteilung von Elektro- und Elektronikgeräten hinsichtlich der Beschränkung gefährlicher Stoffe Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Ottobrunn, 2021-04-28

Michael Ecker
Geschäftsführer / Director

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