

Accredited Testing Laboratory

**DAR-Registration number:
TTI-P-G 166/98-00**

**Test report no.: 5-3355-A/01
FCC Part 15.231
MANDOLYN Thermostation
WS 260,WS 220, WS 240 and WS 410**

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1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

1.2 Testing laboratory

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Accredited testing laboratory

DAR-registration number : TTI-P-G 166/98-00

1.3 Details of applicant

Name : Mandolyn Electronic Technology Inc.
Street : 108-250 Shields CRT.
City : Markham, Ontario, L3R 9W7
Country : CANADA
Telephone : +905 305 0923
Telefax : +905 305 0924
Contact : Mr. CM Yip
Telephone: +905 305 0923

1.4 Application details

Date of receipt of application : 07.03.2001
Date of receipt of test item : 07.03.2001
Date of test : 09.03.- 19.03.2001

1.5 Test item

Type of equipment : **Wireless Thermostation**
Type designation : **WS 260, WS 220, WS 240, WS 410**
Manufacturer : applicant
Street :
City :
Country :
Serial number :

Additional informations: :

Frequency : 433,925 MHz
Type of modulation : 20K0A1D
Number of channels : 1
Antenna : integral print antenna
Power supply : TX: 3V DC, RX: 3V DC
Output power : max 68 dBµV/m at 3m
Type of equipment : Temperature range : -20°C - +55°C

1.6 Test standards: FCC Part 15 §15.231

2 Technical test**2.1 Summary of test results**

The thermostation family consists of one transmitter and three receivers that use all the same RX-board.

The same TX (WS260) is sold either with WS220, WS240 or WS410.

The radiated measurements were performed vertical, horizontal results are about 5 dB lower over the whole frequency range.

All measurement settings are according to FCC 15.35, 15.205, 15.207, 15.209 and 15.231.

Measurements below 1 GHz were performed with a CISPR Quasi Peak Adapter, over 1 GHz we used peak measurements. At peaks we did an second, average measurement.

ResBW and VBW were according FCC requirements.

No deviations from the technical specification(s) were ascertained in the course of the tests performed.

Technical responsibility for area of testing :

23.03.01 RSC 8414 Ames H.



Date	Section	Name	Signature
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Technical responsibility for area of testing :

23.03.01 RSC8411 Berg M.



Date	Section	Name	Signature
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2.2 Testreport

TEST REPORT

Testreport no. : 5-3355-A/01

TEST REPORT REFERENCE**LIST OF MEASUREMENTS**

Paragraph	PARAMETER TO BE MEASURED	PAGE
	Transmitter parameters	
§15.231 (a) (2)	Automatic deactivation	7
§ 15.231 (e)	Time of occupancy	8
§ 15.231 (c)	Bandwidth of emission	9
§ 15.231 (e)	Restricted field strength for periodic TX	10
§ 15.231 (e)	Restricted field strength for spurious	10
	Receiver parameters	
§ 15.209	Spurious radiations - Radiated	11
	Test equipment listing	15
	Photographs of the equipment	17

Equipment under test : WS 260, WS 220, WS 240 and WS 410

Ambient temperature : 20 °C

Relative humidity : 31%

Automatic deactivation

SUBCLAUSE §15.231 (a) (2)

SUBCLAUSE §15.231 (e)

The transmitter is activated automatically every 60 seconds for a duration of 210.9 ms.

Encoding: 2 pulses of 0.976 ms for low, 0.976 ms high for logic 1
1 pulse of 1.952 ms low, 1.952 ms high for logic 0

Word format: 36 bits/word (70.3 ms)

Operating period: One transmission of 3 words (3*70.3 ms) every 60 s.

So we have $3 \times 70.3 \text{ ms} = 210.9 \text{ ms}$ every 60 s.

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

-

Equipment under test : WS 260, WS 220, WS 240 and WS 410

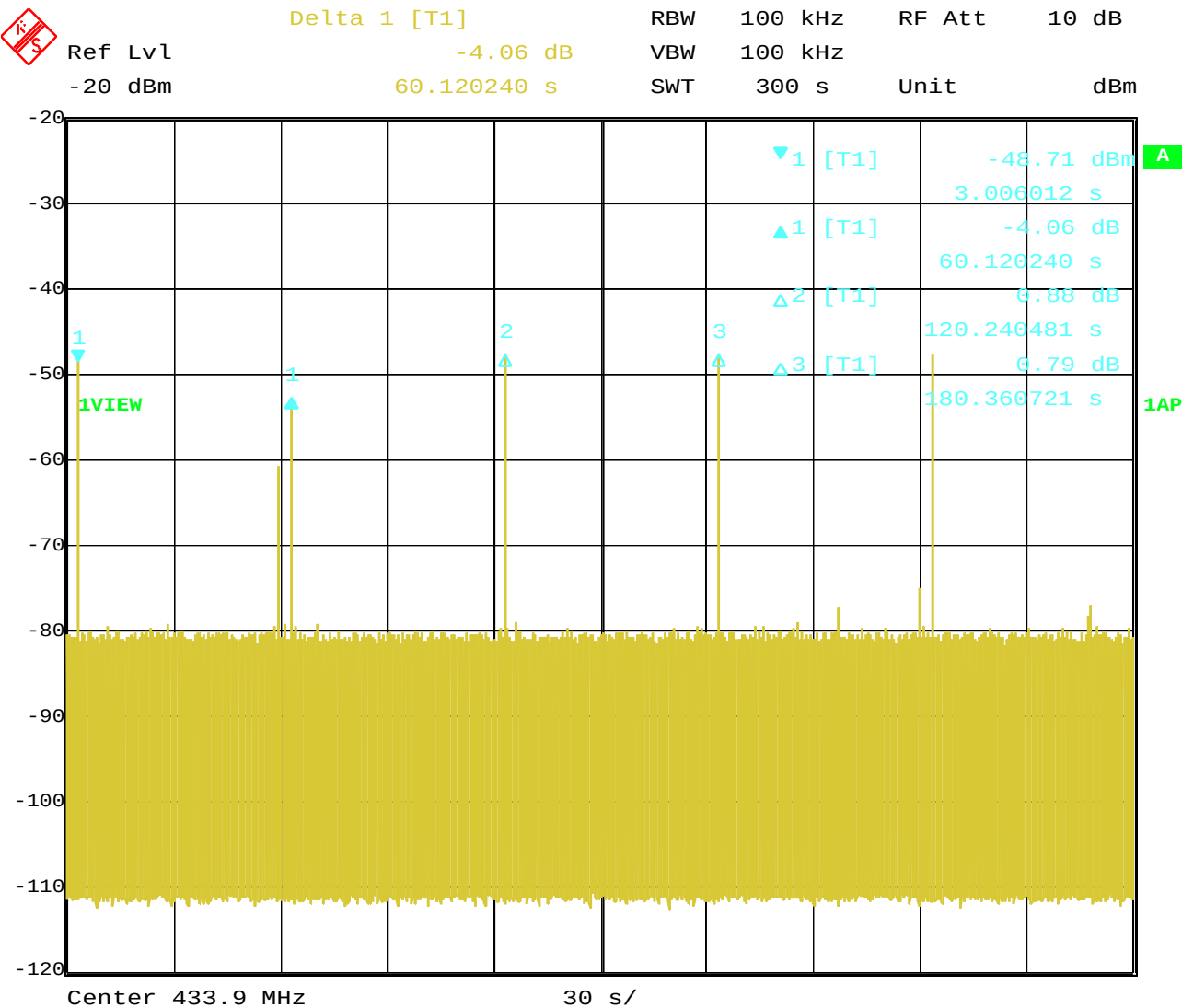
Ambient temperature : 20 °C

Relative humidity : 31%

Time of occupancy

§ 15.231 (e)

Cursor 1 to cursor 2 ~60.1 s; cursor 2 to cursor 3 ~60.1 s etc.



Date: 13.MAR.2001 08:19:06

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : WS 260, WS 220, WS 240 and WS 410

Ambient temperature : 20 °C

Relative humidity : 31%

Bandwidth of Emission

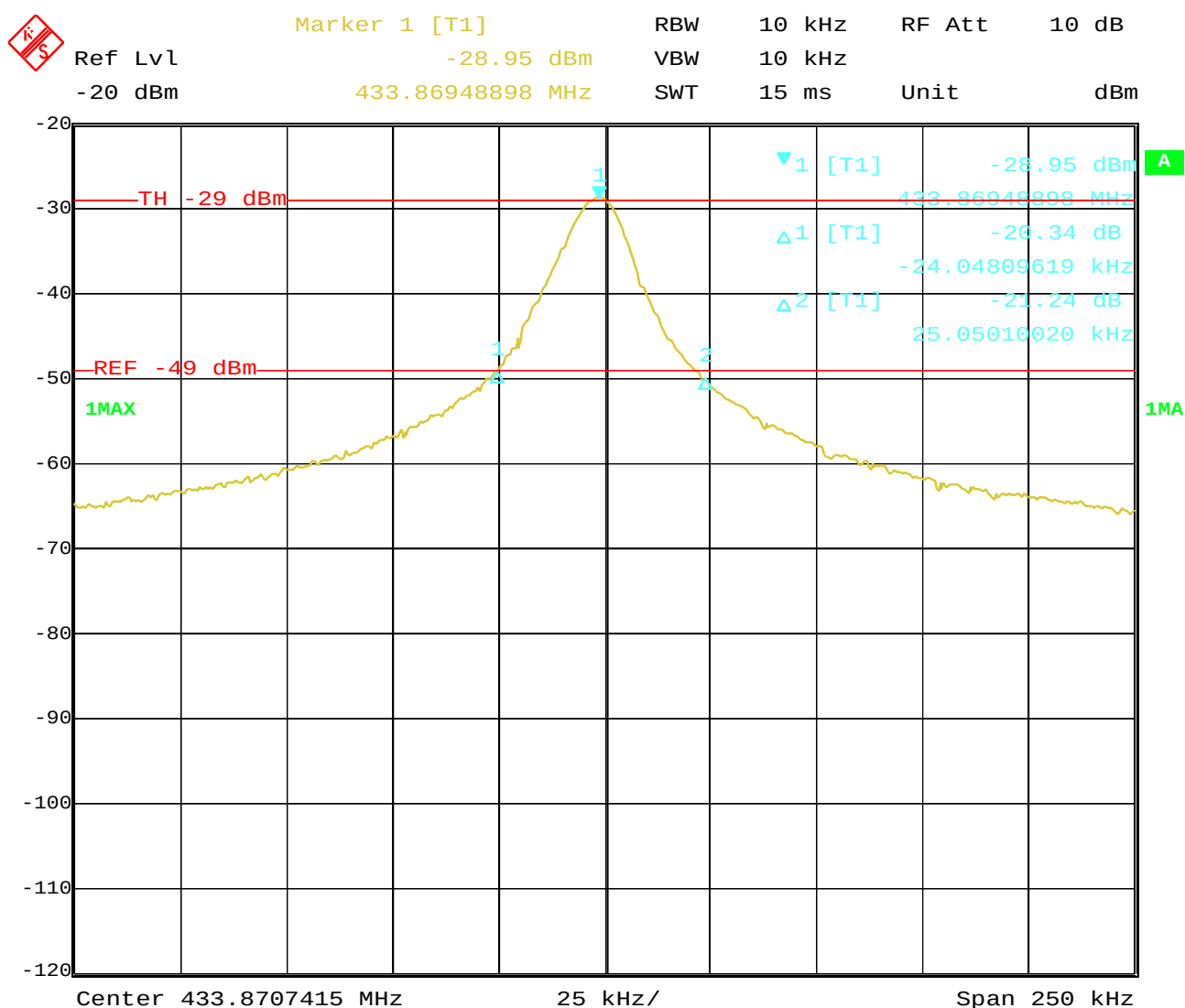
§ 15.231 (c)

The red threshold line shows the relative maximum peak output power.

The red reference line is -20 dBc.

Both cursors are at the crossing from ref line with signal curve.

So we have a BW of 49.1 kHz, limit is 1.08 MHz.



Date: 20.MAR.2001 11:02:49

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Equipment under test : WS 260, WS 220, WS 240 and WS 410

Ambient temperature : 20 °C

Relative humidity : 31 %

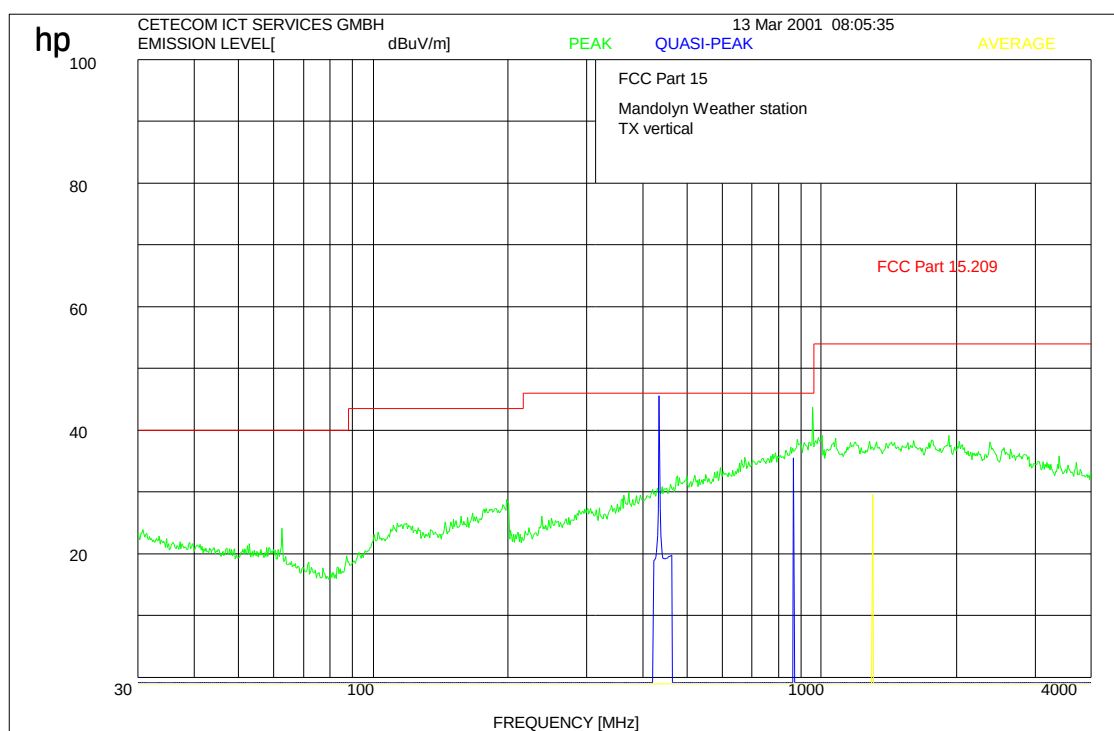
Restricted field strength for periodic TX

§ 15.231 (e)

The calculated limit for 433.9 MHz is 72.9 dB μ V/m (4400 μ V/m) at 3m for fundamental signal and 52.9 dB μ V/m (440 μ V/m) at 3m for spurious emissions.

The green line is the peak curve. The signal at 950 MHz was caused by a GSM mobile phone nearby.

The red line is the limit of §15.209



433.9 MHz Quasi peak = 46.5 dB μ V/m

867.8 MHz Quasi peak = 37.1 dB μ V/m

1301.7 MHz Average = 30.2 dB μ V/m

no other peaks found

ResBW / VBW below 1 GHz = 100 KHz with Quasi peak adapter,

ResBW / VBW over 1 GHz 1MHz peak / average

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Equipment under test : WS 260, WS 220, WS 240 and WS 410

Ambient temperature : 20 °C

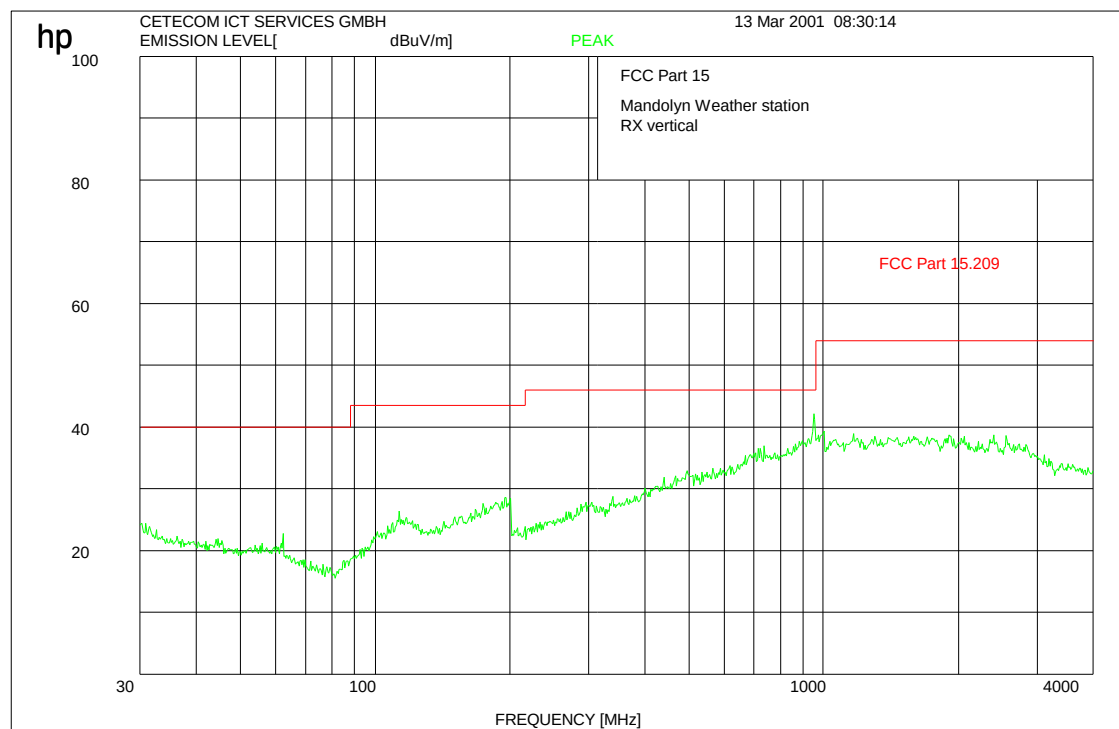
Relative humidity : 31%

Receiver spurious emissions

§ 15.209

The green line is the peak curve. The signal at 950 MHz was caused by a GSM mobile phone nearby.

The red line is the limit of §15.209



no peaks found.

ResBW / VBW below 1 GHz = 100 KHz with Quasi peak adapter,
ResBW / VBW over 1 GHZ 1MHZ peak / average

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Spectrum Analyzer	8566 A	Hewlett-Packard	1925A00257
02	Analyzer Display	8566 A	Hewlett-Packard	1925A00860
03	Oscilloscope	7633	Tektronix	230054
04	Radio Analyzer	CMTA 54	Rohde & Schwarz	894 043/010
05	System Power Supply	6038 A	Hewlett-Packard	2848A07027
06	Signal Generator	8111 A	Hewlett-Packard	2215G00867
07	Signal Generator	8662 A	Hewlett-Packard	2224A01012
08	Funktionsgenerator	AFGU	Rohde & Schwarz	862 480/032
09	Regeltrenntrafo	MPL	Erfi	91350
10	Netznachbildung	NNLA 8120	Schwarzbeck	8120331
11	Relais-Matrix	PSU	Rohde & Schwarz	893 285/020
12	Power-Meter	436 A	Hewlett-Packard	2101A12378
13	Power-Sensor	8484 A	Hewlett-Packard	2237A10156
14	Power-Sensor	8482 A	Hewlett-Packard	2237A00616
15	Modulationsmeter	9008	Racal-Dana	2647
16	Frequenzzähler	5340 A	Hewlett-Packard	1532A03899
17	Absorber Schirmkabine	---	MWB	87400/002
18	Spectrum Analyzer	85660 B	Hewlett-Packard	2747A05306
19	Analyzer Display	85662 A	Hewlett-Packard	2816A16541
20	Quasi Peak Adapter	85650 A	Hewlett-Packard	2811A01131
21	RF-Preselector	85685 A	Hewlett-Packard	2833A00768
22	Biconical Antenne	3104	Emco	3758
23	Log. Per. Antenne	3146	Emco	2130
24	Double Ridge Horn	3115	Emco	3088
25	EMI-Testreceiver	ESAI	Rohde & Schwarz	863 180/013
26	EMI-Analyzer-Display	ESAI-D	Rohde & Schwarz	862 771/008
27	Biconical Antenne	HK 116	Rohde & Schwarz	888 945/013
28	Log. Per. Antenne	HL 223	Rohde & Schwarz	825 584/002
29	Relais-Switch-Unit	RSU	Rohde & Schwarz	375 339/002
30	Highpass	HM985955	FSY Microwave	001
31	Amplifier	P42-GA29	Tron-Tech	B 23602
32	Absorber Schirmkabine		Frankonia	
33	Steuerrechner	PSM 7	Rohde & Schwarz	834 621/004
34	EMI Test Receiver	ESMI	Rohde & Schwarz	827 063/010
35	EMI Test Receiver	Display	Rohde & Schwarz	829 808/010

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
36	Controler	HD 100	Deisel	100/322/93
37	Relais Matrix	PSN	Rohde & Schwarz	829 065/003
38	Control Unit	GB 016 A2	Rohde & Schwarz	344 122/008
39	Relais Switch Unit	RSU	Rohde & Schwarz	316 790/001
40	Power Supply	6032A	Hewlett Packard	2846A04063
41	Spektrum Monitor	EZM	Rohde & Schwarz	883 720/006
42	Meßempfänger	ESH 3	Rohde & Schwarz	890 174/002
43	Meßempfänger	ESVP	Rohde & Schwarz	891 752/005
44	Biconi Ant. 20-300MHz	HK 116	Rohde & Schwarz	833 162/011
45	Logper Ant. 0.3-1 GHz	HL 223	Rohde & Schwarz	832 914/010
46	Amplifier 0.1-4 GHz	AFS4	Miteq Inc.	206461
47	Logper Ant. 1-18 GHz	HL 024 A2	Rohde & Schwarz	342 662/002
48	Polarisationsnetzwerk	HL 024 Z1	Rohde & Schwarz	341 570/002
49	Double Ridge G Horn Antenne 1-26.5 GHz	3115	EMCO	9107-3696
50	Microw. Sys. Amplifier 0.5- 26.5 GHz	8317A	Hewlett Packard	3123A00105
51	Audio Analyzer	UPD	Rohde & Schwarz	1030.7500.04
52	Steuerrechner	PSM 7	Rohde & Schwarz	883 086/026
53	DC V-Netzwerk	ESH3-Z6	Rohde & Schwarz	861 406/005
54	DC V-Netzwerk	ESH3-Z6	Rohde & Schwarz	893 689/012
55	AC 2 Phasen V- Netzwerk	ESH3-Z5	Rohde & Schwarz	861 189/014
56	AC 2 Phasen V- Netzwerk	ESH3-Z5	Rohde & Schwarz	894 981/019
57	AC-3 Phasen V- Netzwerk	ESH2-Z5	Rohde & Schwarz	882 394/007
58	Stromversorgung	6032A	Rohde & Schwarz	2933A05441
59	HF-Test Empfänger	ESVP.52	Rohde & Schwarz	881 487/021
60	Spectrum Monitor	EZM	Rohde & Schwarz	883 086/026
61	HF-Test Empfänger	ESH3	Rohde & Schwarz	881 515/002
62	Relais Matrix	PSU	Rohde & Schwarz	882 943/029
63	Relais Matrix	PSU	Rohde & Schwarz	828 628/007
64	Spectrum Analyzer	FSIQ 26	Rohde & Schwarz	119.6001.27
65	Spectrum Analyzer	HP 8565E	Hewlett Packard	3473A00773
66				

Test site
RADIATED EMISSIONS



Test site
RADIATED EMISSIONS

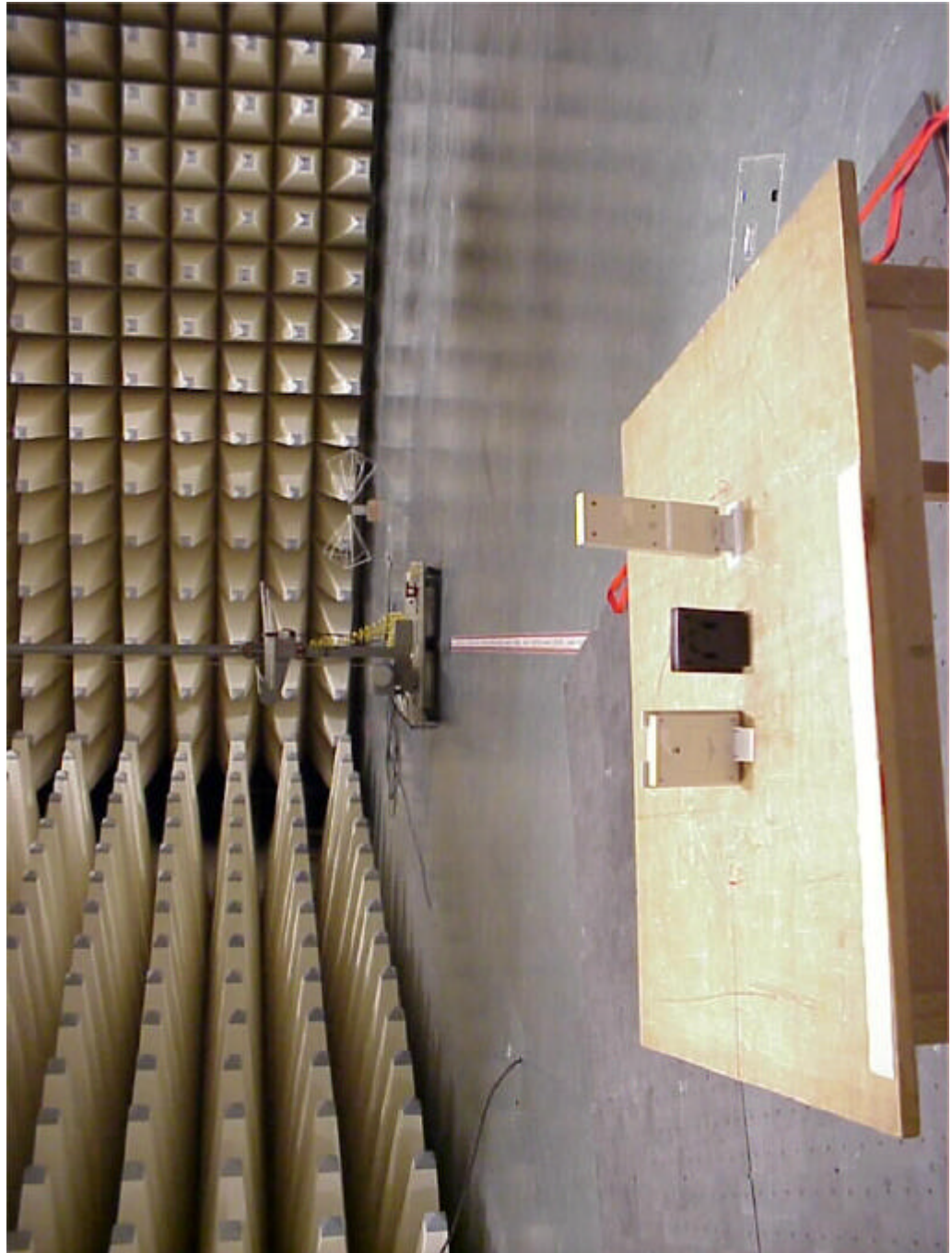


Test site

RADIATED EMISSIONS



Test site
RADIATED EMISSIONS



Photographs of the equipment: Thermostaton family

Photograph no.: 1



Photographs of the equipment: Transmitter WS260

Photograph no.: 2



Photographs of the equipment: Transmitter WS260

Photograph no.: 3



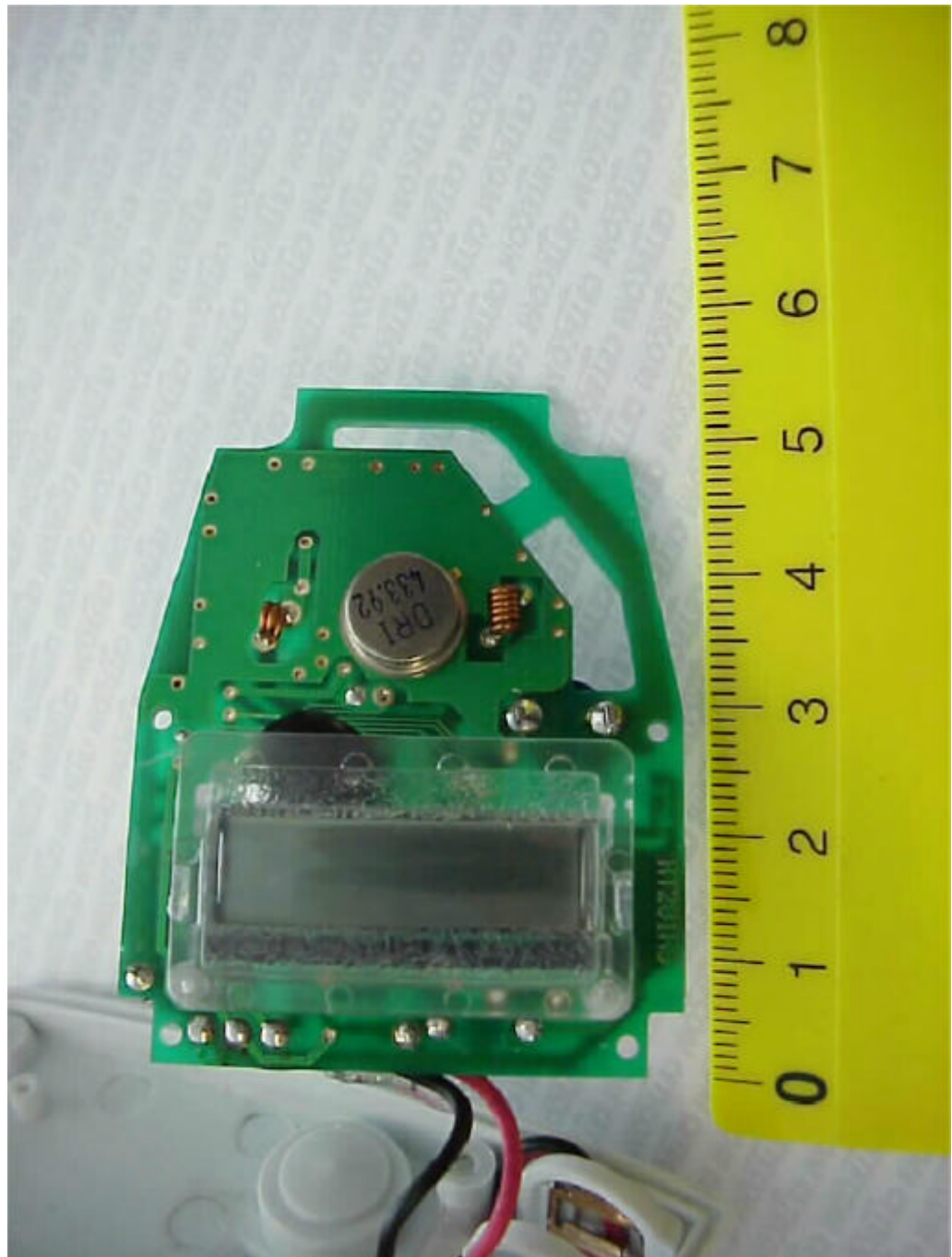
Photographs of the equipment: Transmitter WS260

Photograph no.: 4



Photographs of the equipment: Transmitter WS260

Photograph no.: 5



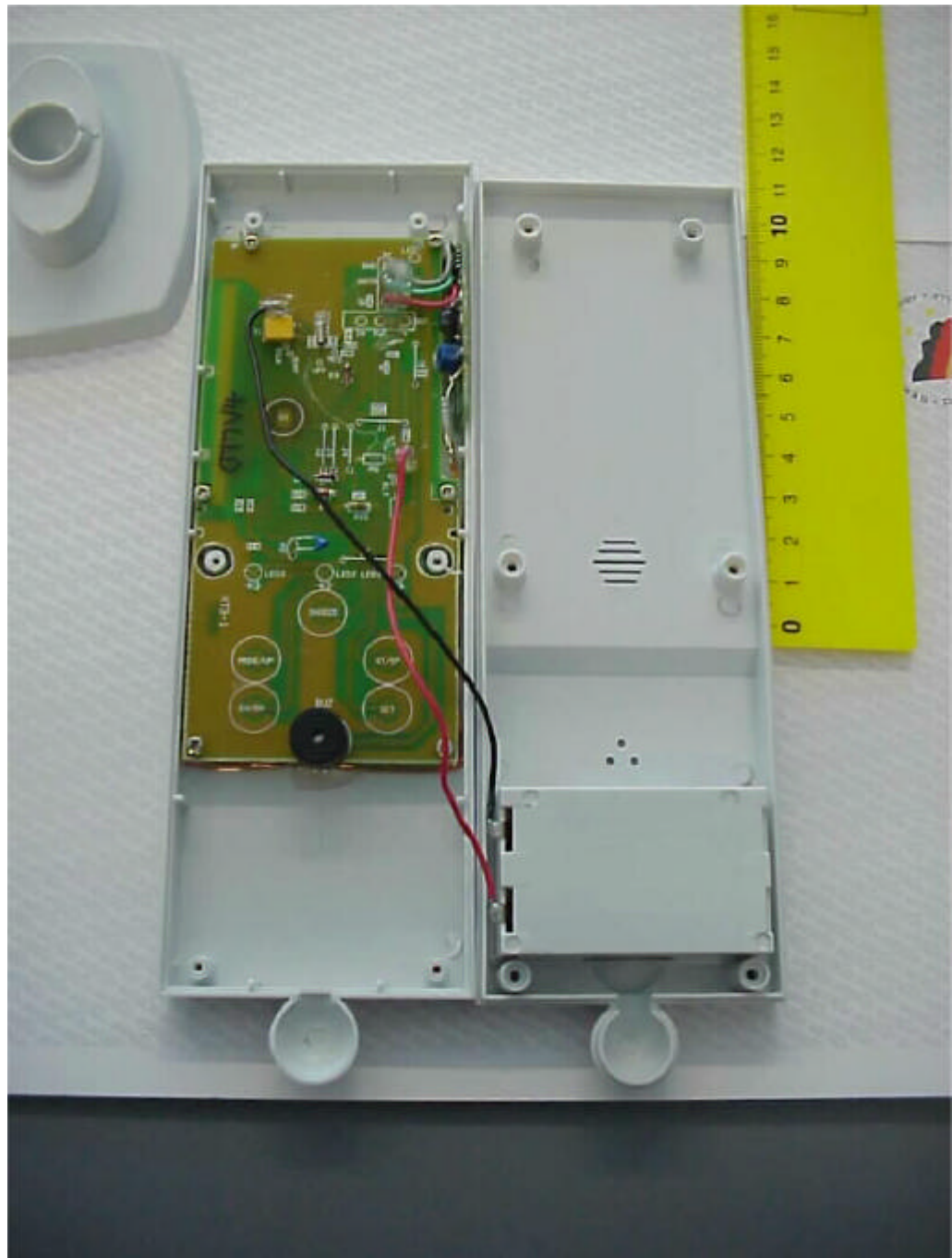
Photographs of the equipment: Receiver WS240

Photograph no.: 6



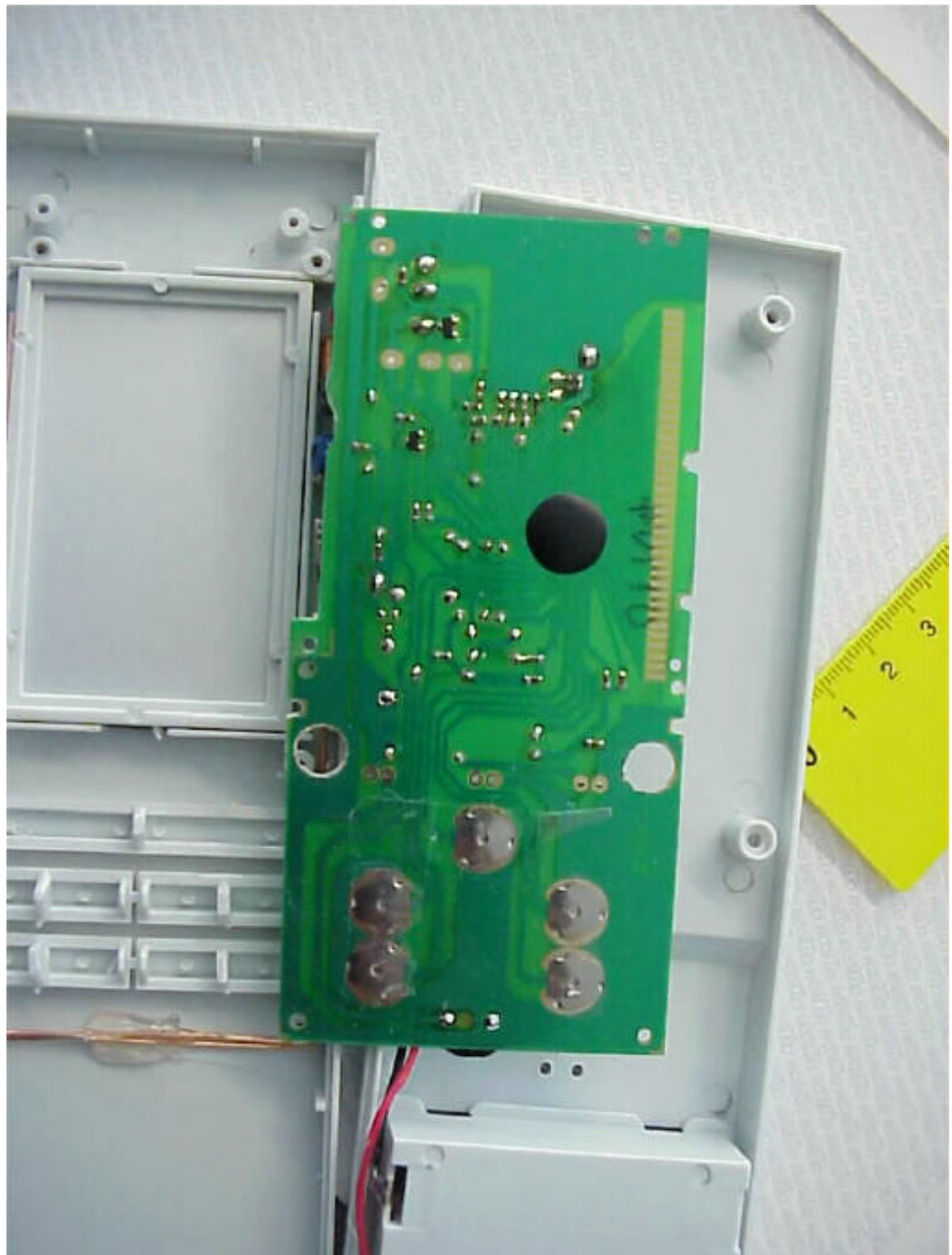
Photographs of the equipment: Receiver WS240

Photograph no.: 7



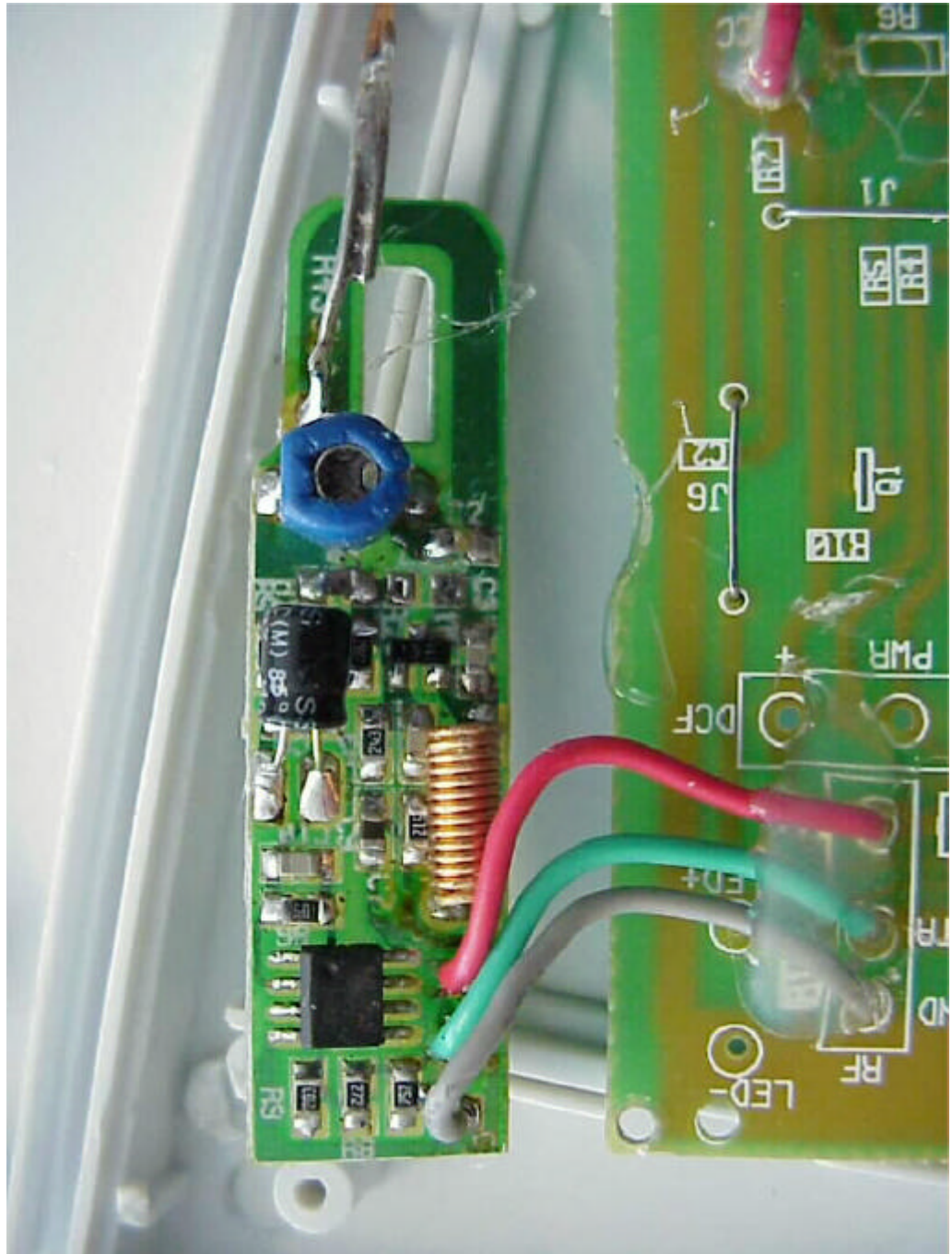
Photographs of the equipment: Receiver WS240

Photograph no.: 8



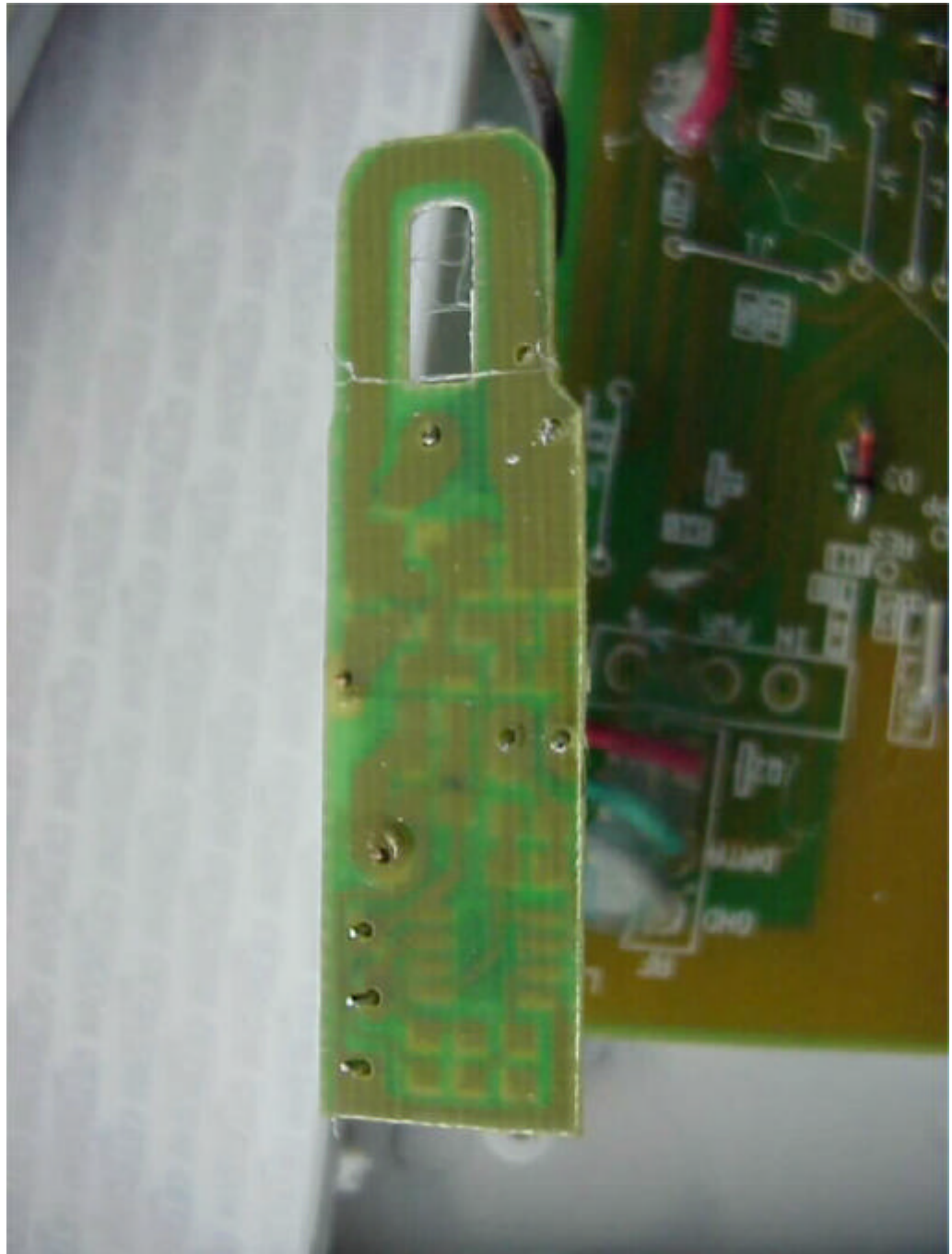
Photographs of the equipment: Receiver WS240, RF part, same in each receiver

Photograph no.: 9



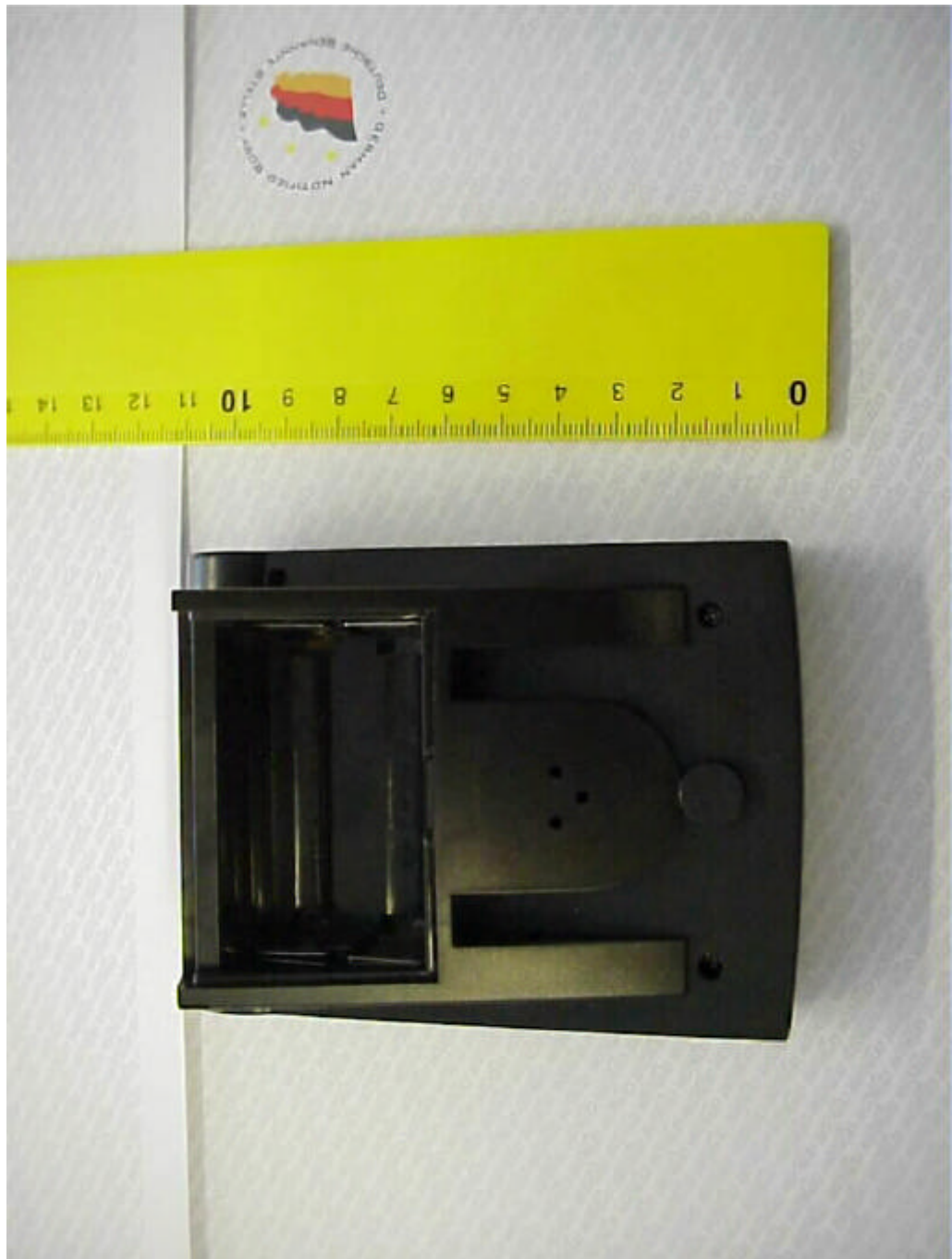
Photographs of the equipment: Receiver WS240, RF part, same in each receiver

Photograph no.: 10



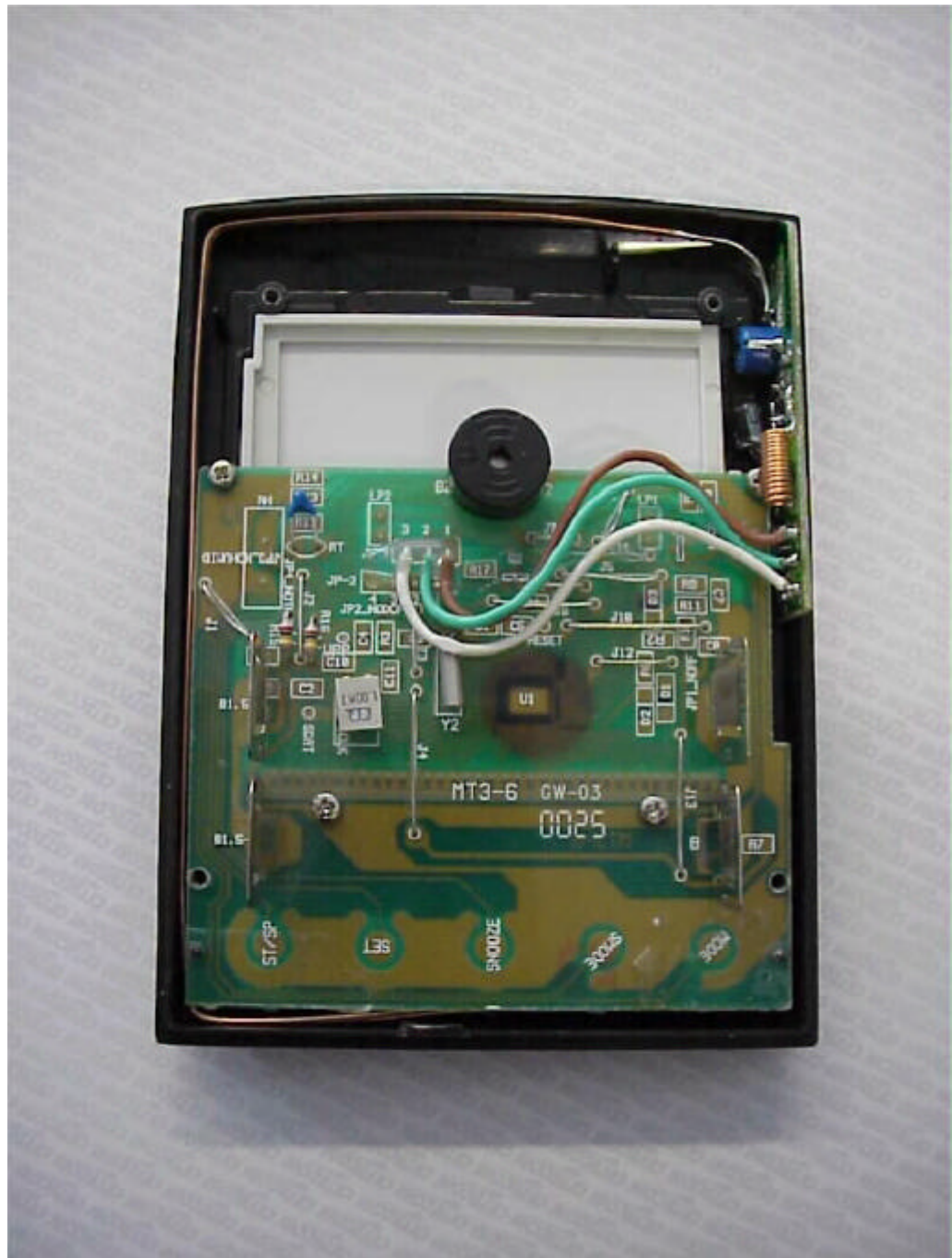
Photographs of the equipment: Receiver WS220

Photograph no.: 11



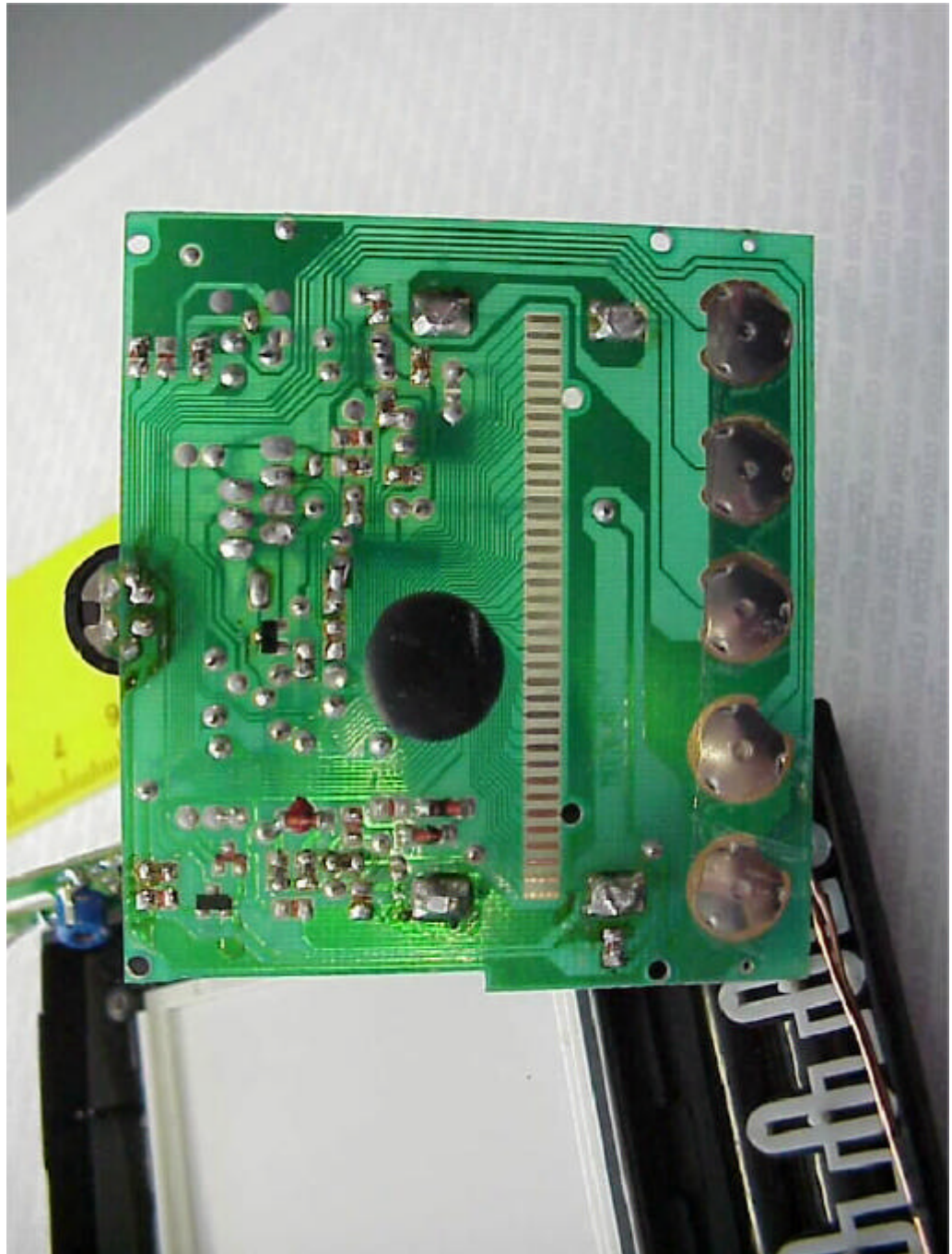
Photographs of the equipment: Receiver WS220

Photograph no.: 12



Photographs of the equipment: Receiver WS220

Photograph no.: 13



Photographs of the equipment: Receiver WS410

Photograph no.: 14



Photographs of the equipment: Receiver WS410

Photograph no.: 15



Photographs of the equipment: WS410

Photograph no.: 16

