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RA-03-24216/A/ST

FCC CERTIFICATION
E.M.C. Measurement
Technical Report

standard to apply:
FCC Part 15

Equipment under test:
PROBE FOR MACHINE TOOLS
RMP60

FCC ID: KQGRMP60

Company:
RENISHAW SA

TRANSMIT TO: Mr CRESSON **Company: RENISHAW SA**

Number of pages: 11 + 4 appendixes

Ed.	Date	Modified pages	Editing Name	Editing Visa	Verification Approval Name	Verification Approval Visa
0	29-Sep-03	Creation	D. GRATON	DG	Y. JUDEAUX	

Duplication of this test report is only permitted for an integral photographic facsimile. It includes the number of pages referenced here above.

This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole manufactured products of the tested sample.

***PRODUCT*:**	**PROBE FOR MACHINE TOOLS**
***Reference / model*:**	RMP60
***Serial number*:**	Y68723
MANUFACTURER:	RENISHAW PLC New Mills, Wotten Under Edge GLOUCESTERSHIRE GL12 8JR UNITED KINGDOM

COMPANY SUBMITTING THE PRODUCT:

***Company*:**	RENISHAW SA
***Address*:**	15, rue Albert Einstein 77437 MARNE LA VALLEE CEDEX 2 FRANCE
***Responsible*:**	Mr CRESSON
DATE(S) OF TEST:	01 and 02 September 2003
TESTING LOCATION:	EMITECH ATLANTIQUE laboratory at ANGERS (49) FRANCE EMITECH ATLANTIQUE open area test site in LA POUEZE (49) FRANCE EMITECH laboratory at MONTIGNY LE BRETONNEUX (78) FRANCE Registration Number by FCC: 101696/FRN: 0006 6490 08 Registration Number by Industry Canada: IC4379
TESTED BY:	D. GRATON P. BONNENFANT

CONTENTS

TITLE **PAGE**

1.INTRODUCTION

This document presents the result of E.M.C. test carried out on the following equipment: PROBE FOR MACHINE TOOLS RMP60 in accordance with normative reference.

2.PRODUCT DESCRIPTION

ITU Emission code: 1M00F7D

Classe: A (paragraph FCC part 15.3)

Utilization: radio probe for machine tools.

Antenna type: incorporated antenna

Operating frequency range: from 2400 MHz to 2483.5 MHz

Number of channels: 80

Channel spacing: 1 MHz

Frequency generation: O SAW Resonator O Crystal ⊙ Synthetiser

Modulation: Frequency Hopping Spread Spectrum
O Amplitude O Digital ⊙ Frequency O Phase

Power source: batteries power (2 x 1.5 VAA alcaline type) or (2 x 3.6 VAA lithium type)

Power level, frequency range and channels characteristics are not user adjustable.

The details pictures of the product, the circuit boards and antennas are joined with this file.

3.NORMATIVE REFERENCE

FCC Part 15 (2003)	Code of Federal Regulations Title 47 - Telecommunication Chapter 1 - Federal Communications Commission Part 15 - Radio frequency devices Subpart C - Intentional Radiators
RSS 210	Low Power Licence - Exempt Radiocommunication Devices (All Frequency Bands)

4.TEST METHODOLOGY

Radio performance tests procedures given in part 15:

Paragraph 33: frequency range of radiated measurements
Paragraph 35: measurement detector functions and bandwidths
Paragraph 207: conducted limits
Paragraph 205: restricted bands of operation
Paragraph 209: radiated emission limits; general requirements
Paragraph 247: operation within the band 2400 – 2483.5 MHz

5.RELATED SUBMITTAL GRANT

This equipment operates with an radio interface for machine tools, RMI: KQGRMI.

6.ADD ATTACHMENTS FILES

"Synoptic"
"Block diagram"
"External photos and Product labeling"
"Assembly of components"
"Internal photos"
"Layout pcb"
"Bil of materials"
"Schematics"
"Product description"
"User guide"

7.TESTS AND CONCLUSIONS

Test procedure	Description of test	Criteria respected ?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.205	RESTRICTED BANDS OF OPERATION	X				
FCC Part 15.207	CONDUCTED LIMITS			X		*Note 4*
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements			X		*Note 5*
FCC Part 15.247	OPERATION WITHIN THE BAND 2400-2483.5 MHz					
FCC Part 15.247	(a) (1) *hopping mode*	X				*Note 1*
FCC Part 15.247	(a) (1) (iii) *hopping timing*	X				*Note 2*
FCC Part 15.247	(b) (1) *max output power*	X				
FCC Part 15.247	(b) (1) *RF exposure compliance*			X		*Note 3*
FCC Part 15.247	(c) *intentional radiator*	X				

NAp: Not Applicable NAs: Not Asked

Note 1: see appendix 1, the frequency hopping system have hopping channel carrier frequencies separated by 1 MHz. The system hop to channel frequencies from a pseudo randomly ordered list of hopping frequencies. Each frequency is used equally on the average by the transmitter.

Note 2: the frequency hopping system use more than 15 non-overlapping channels.
The hopping frequency channel is every 20 ms, the timing by channel is 202 µs (see appendix 2). During 80 channels × 0.4 s (part 15) = 32 s, any channel is used 32 s ÷ 1.6 s = 20 times, then 20 × 202 µs = 4.04 ms, thus the average time of occupancy on any channel is less than 400 ms within a period of 0.4 s multiplied by the number of hopping channels employed, in normal operating mode.*
** 80 channels × 20 ms = 1.6 s.*

Note 3: this type of equipment use less than 0.5 W of output power with a high signal transmitting duty factor (section 3 from Oet 65c).

Note 4: battery source power.

Note 5: see FCC part 15.247 (c).

Conclusion:

The sample base station of PROBE FOR MACHINE TOOLS RMP60 submitted to the tests complies with the regulations of the standard FCC Part 15 in accordance with the limits or criteria defined in this report.

8.PEAK OUTPUT POWER

Standard: FCC Part 15 (03)

Test procedure: paragraph 15.247

Test equipment:

TYPE	BRAND	EMITECH NUMBER
Spectrum analyzer FSEM 30	Rohde & Schwarz	1244
Diode detector OD20004A	Omniyig	2469
Oscilloscope THS 720	Tektronix	0940
Antenna RGA60	Electrometrics	1938
Antenna RGA60	Electrometrics	1204
Open site	EMITECH	1274
Radio frequency generator SME06	Rohde & Schwarz	1669
Low-noise amplifier 1 to 18 GHz	ALC	2648
Hight pass filter HPM11630	Micro-tronics	1673
Micro wattmeter 4200 RF	Boonton	2559
Probe micro wattmeter 42004E	Boonton	2560

Test set up:

The system is tested in an open area test site (OATS).
The test unit is placed on a rotating table, 1.5 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.
We use for this measure outdoor test site, by substitution method. The measuring distance between the equipment and the test antenna is 3 m. The antenna have been oriented in the two polarizations, we have recorded only highest level. Height support of the equipment: 1.5 m.
The spectrum analyzer is replaced by a diode detector which is connected to the vertical channel of an oscilloscope.
The equipment under test is substituted by a signal generator with a calibrated double ridged guide antenna, and its level adjusted such that the deviation of the Y-trace of the oscilloscope.
The output power level of the signal generator is measured with a calibrated RF power meter.

Distance of antenna: 3 meters

Antenna height: 1 to 4 meters

Antenna polarization: vertical and horizontal

Equipment under test operating condition:

The equipment is in continuous transmission mode at the highest power level which the transmitter is intended to operate (hopping mode).
The equipment is fitted with an internal antenna, without connector.

Results:

Ambient temperature (°C): 18
Relative humidity (%): 58

Sample N° 1

We used for the power source the internal battery of the equipment and we noted:

Voltage at the beginning test (V): 7.2
Voltage at the end test (V): 7.1

		Peak Output Power radiated at these frequencies (W): from 2402 MHz to 2481 MHz	**Limits (W)**
Normal test conditions	Nominal power source (V): 7.2	1.51×10^{-3}	1*

Polarization of test antenna: horizontal (height: 104 cm)
Position of equipment: use position (azimuth: 0 degree)

* the frequency hopping systems use at least 75 hopping channel.

Test conclusion:

RESPECTED STANDARD

9.RADIATED EMISSION PORTABLE

Standard: FCC Part 15 (03)

Test procedure: paragraph 15.205
paragraph 15.209
paragraph 15.247

Test equipment:

TYPE	BRAND	EMITECH NUMBER
Test receiver ESH3	Rohde & Schwarz	1058
Test receiver ESVS 10	Rohde & Schwarz	1219
Spectrum analyzer FSEM 30	Rohde & Schwarz	1244
Loop antenna	EMCO	1406
Biconical antenna HP 11966C	Hewlett Packard	728
Log periodic antenna HL 223	Rohde & Schwarz	1999
Open site	Emitech	1274
Multimeter 8840A	Fluke	1018
Antenna RGA-60	Electrometrics	1204
Low-noise amplifier	Microwave DB	1922
High pass filter HP12/3200-5AA	Filtek	
Antenna WR42	IMC	1939

Test set up:

The system is tested in an open area test site (OATS).
The test unit is placed on a rotating table, 1.5 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

Frequency range: from 9 kHz to harmonic 10 ($F_{carrier} \leq 10$ GHz)

Detection mode: Quasi-peak (F < 1 GHz)
Average (F > 1 GHz)

Bandwidth: 120 kHz (F < 1 GHz) or 100 kHz, following 15.205 or 15.247
1 MHz (F > 1 GHz) or 100 kHz, following 15.205 or 15.247

Distance of antenna: between 30 m and 3 m according the frequencies and the limits.

Antenna height: 1 to 4 meters

Antenna polarization: vertical and horizontal

Equipment under test operating condition:

The equipment is in continuous transmission mode, is locked at the lowest frequency, and this trial is repeated at the highest frequency.

Results:

Ambient temperature (°C): 18
Relative humidity (%): 58

Power source (V): 7.2

Not any spurious has been observed during this test.

Applicable limits: 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the power produced by the equipment, in 100 kHz bandwidth outside the frequency band in which the spread spectrum is operating. In addition radiated emissions which fall in the restricted band, as defined in section 15.205 (c), must also comply with the radiated emission limits specified in section 15.209 (a).

10.APPENDIXES

***Appendix 1*: "CHANNEL SEPARATION"**
This appendix contains 2 pages.

***Appendix 2*: "TIMING HOPPING AND TIMING CHANNEL"**
This appendix contains 3 pages.

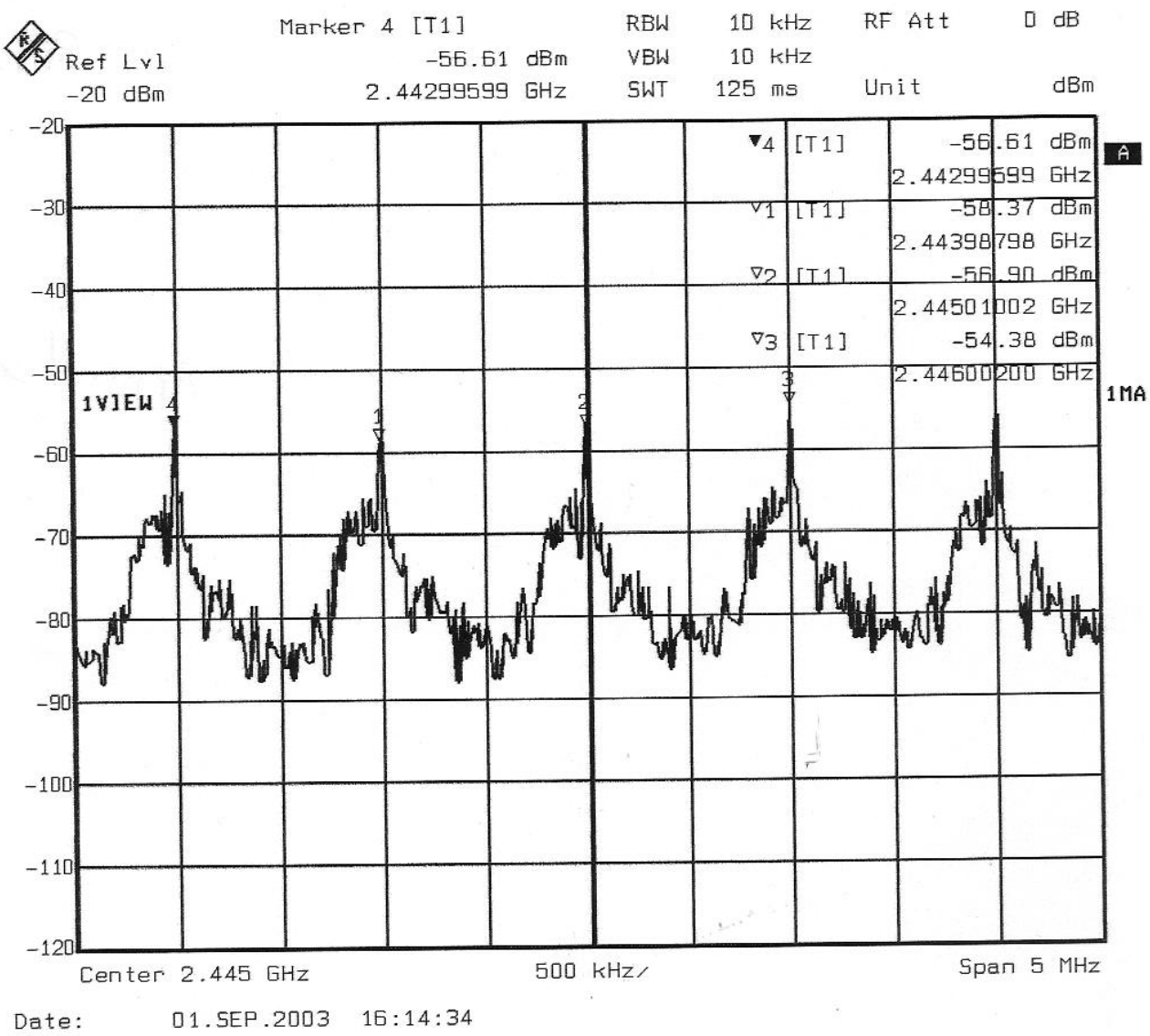
***Appendix 3*: "PHOTOGRAPHIES OF THE EQUIPEMENT UNDER TEST"**
This appendix contains 4 pages.

***Appendix 4*: "PHOTOGRAPHY OPEN AREA TEST SITE"**
This appendix contains 2 pages.

□□□ End of report, 4 appendixes to be forwarded □□□

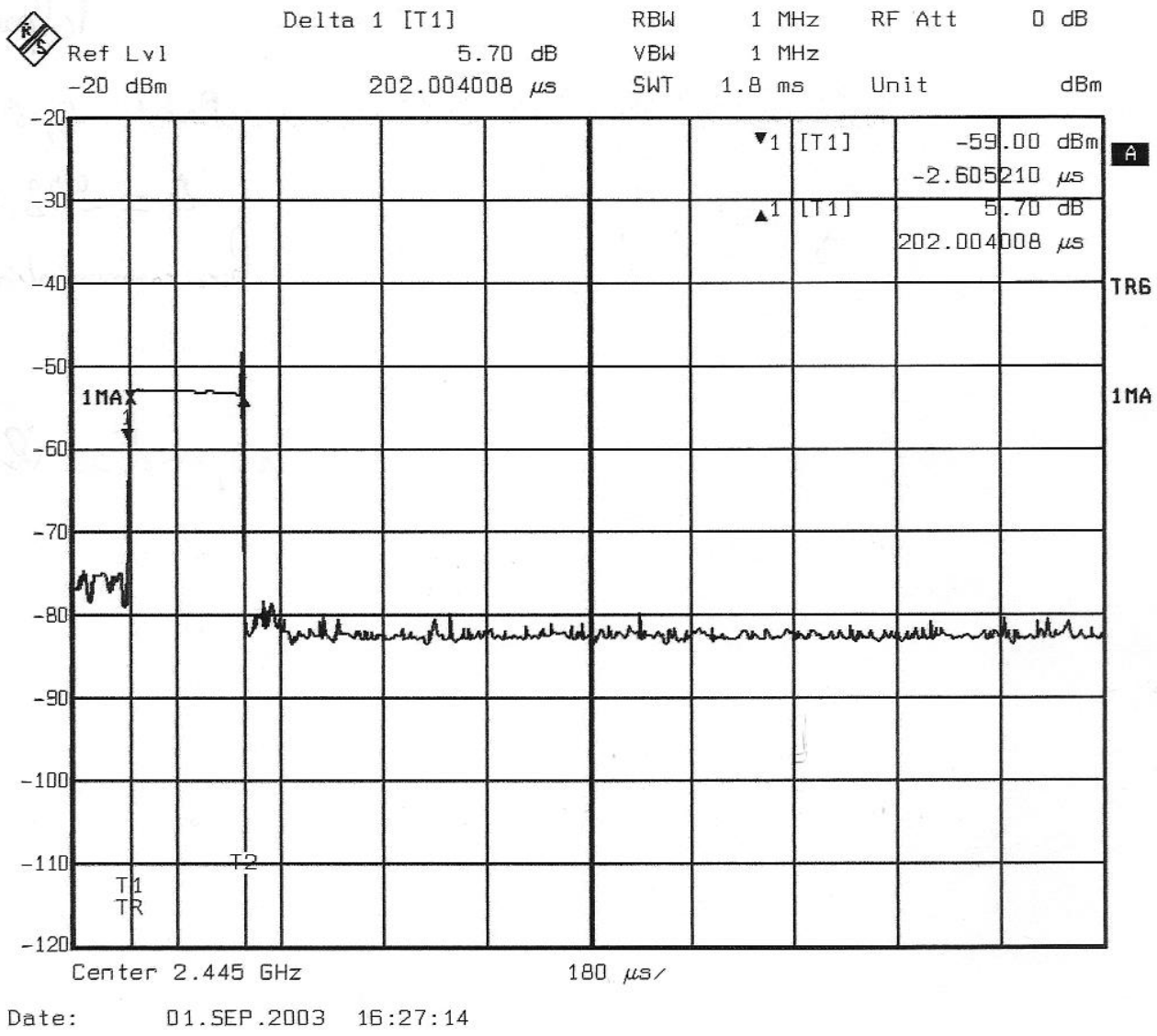
APPENDIX 1

CHANNEL SEPARATION


Marker 4 [T1]
Ref Lvl
-20 dBm
-56.61 dBm
2.44299599 GHz
RBW 10 kHz
VBW 10 kHz
SWT 125 ms
RF Att 0 dB
Unit dBm
▼4 [T1] -56.61 dBm 2.44299599 GHz
▽1 [T1] -58.37 dBm 2.44398798 GHz
▽2 [T1] -56.90 dBm 2.44501002 GHz
▽3 [T1] -54.38 dBm 2.44600200 GHz
A
1MA
1VIEW
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Center 2.445 GHz
500 kHz/
Span 5 MHz
Date: 01.SEP.2003 16:14:34

APPENDIX 2

TIMING HOPPING AND TIMING CHANNEL


Delta 1 [T1]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
5.70 dB
VBW 1 MHz
-20 dBm
202.004008 µs
SWT 1.8 ms
Unit dBm
▼1 [T1]
-59.00 dBm
-2.605210 µs
▲1 [T1]
5.70 dB
202.004008 µs
A
TRG
1MA
1MAX
T2
T1
TR
Center 2.445 GHz
180 µs/
Date: 01.SEP.2003 16:27:14

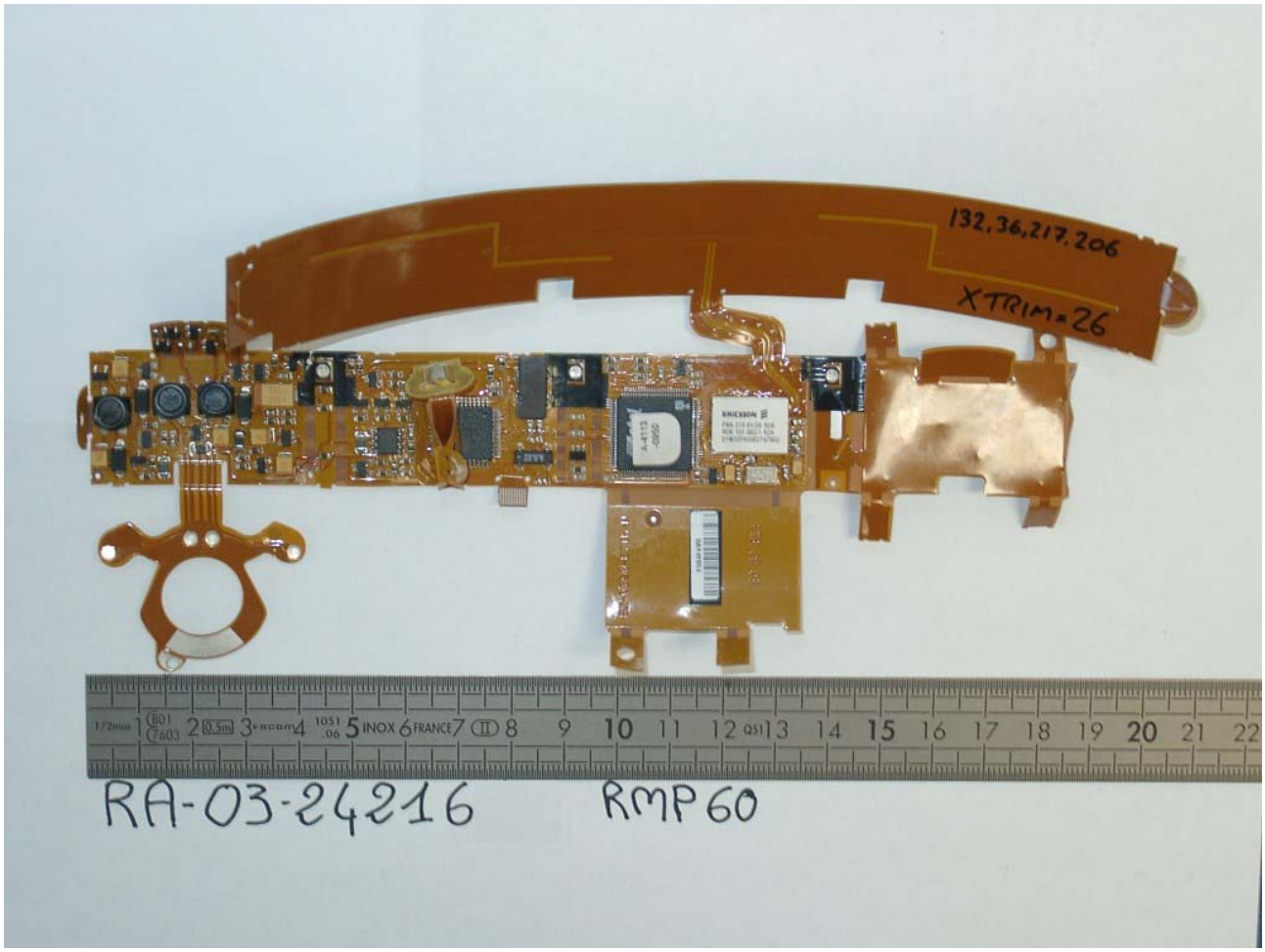

File Edit Scope Help
THS 720
Cursor Positions
X1
Y1
160.00 µS
-400.00 mV
X2
Y2
-20.00 mS
-13.52 V
delta X
delta Y
20.16 mS
13.12 V
Acquire
Configure
Zoom
Restore
W1:
Wave A
2.00 V
10.00 mS
W2:
1.00 mV
1.00 ns
1.00 mV
1.00 ns
1.00 mV
1.00 ns

APPENDIX 3

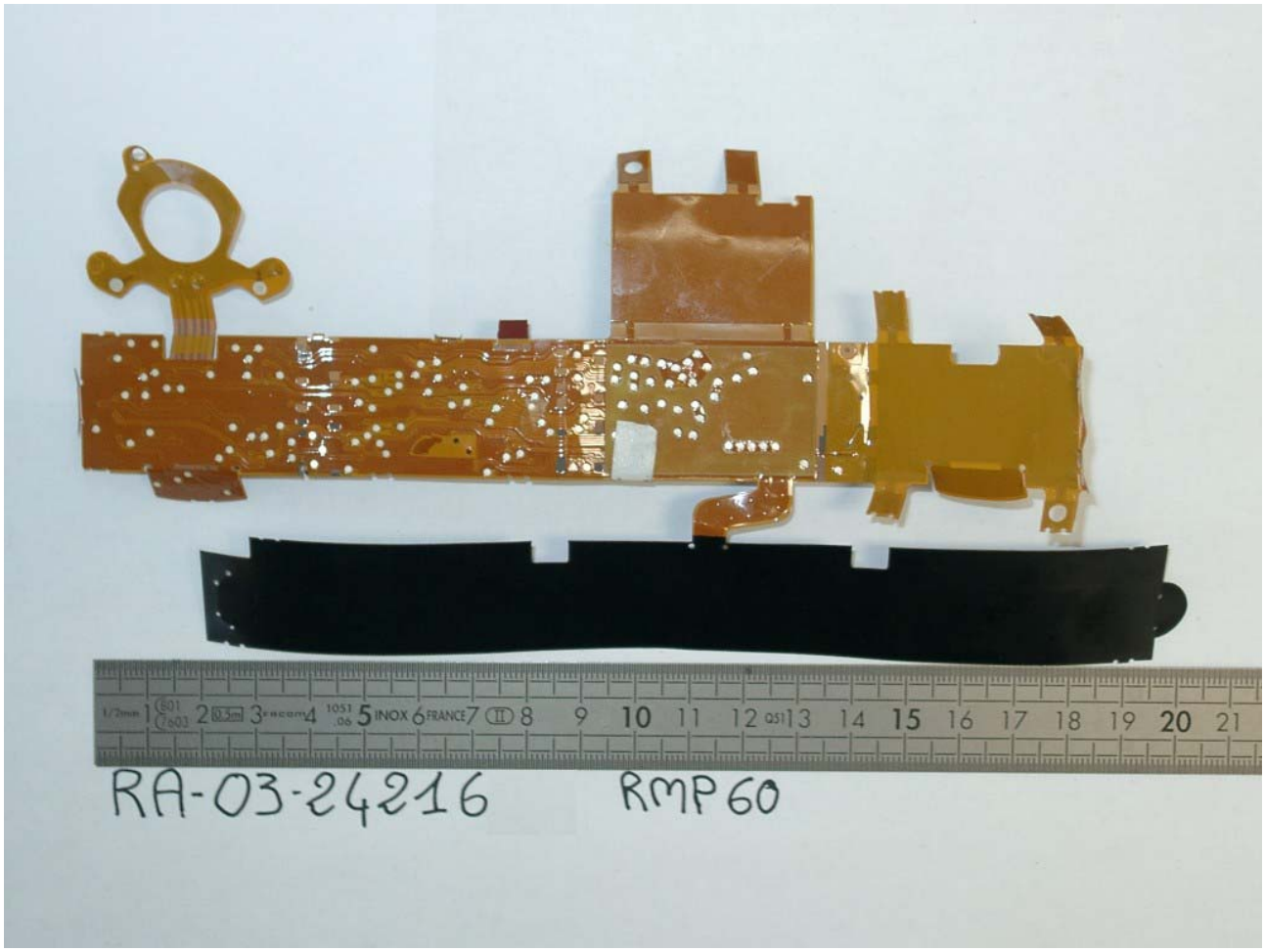
PHOTOGRAPHIES OF THE EQUIPMENT UNDER TEST

PHOTOGRAPHY OF THE EQUIPMENT UNDER TEST RMP60

Printed circuit board transmitter: face 1



Printed circuit board transmitter: face 2



APPENDIX 4

PHOTOGRAPHY OPEN AREA TEST SITE

PHOTOGRAPHY OPEN AREA TEST SITE