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## RA-06-24141-2/A Ed. 1

“This report cancels and replaces the test report n° RA-06-24141-2/A Edition 0”

### FCC CERTIFICATION RADIO Measurement Technical Report

standard to apply:  
FCC Part 15.247

Equipment under test:  
INTERFACE  
“RMI”

FCC ID:  
KQGRMIV2

Company:  
RENISHAW SAS

1 |

DISTRIBUTION: Mr CRESSON

Company: RENISHAW SAS

Number of pages: 26 including 4 annexes

| Ed. | Date     | Modified page | Written by  |      | Technical Verification Quality Approval |      |
|-----|----------|---------------|-------------|------|---|------|
|     |          |               | Name        | Visa | Name                                    | Visa |
| 1   | 5-Jul-06 | 1             | L. BERTHAUD | LB   |   |      |

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SIEGE SOCIAL : EMITECH S.A.

***PRODUCT:*** INTERFACE

**Reference / model:** RMI

**Serial number:** 3T6359

***MANUFACTURER:*** RENISHAW PLC (United Kingdom)

***COMPANY SUBMITTING THE PRODUCT:***

**Company:** RENISHAW SAS

**Address:** 15, rue Albert Einstein  
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**Responsible:** Mr CRESSON

***DATE(S) OF TEST:*** 25 and 27 April 2006

***TESTING LOCATION:*** EMITECH ATLANTIQUE laboratory at ANGERS (49) FRANCE  
EMITECH ATLANTIQUE open area test site in LA POUEZE  
(49) FRANCE

Registration Number by FCC: 101696/FRN: 0006 6490 08

***TESTED BY:*** L. BERTHAUD

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## **1.INTRODUCTION**

This document presents the result of RADIO test carried out on the following equipment: INTERFACE "RMI" in accordance with normative reference.

## **2.PRODUCT DESCRIPTION**

ITU Emission code: 1M00F7D

Class: A (commercial, industrial or business environment)

Utilization: Interface to use with sensor for machine tools

Antenna type: incorporated antenna

Operating frequency range: I.S.M. band from 2400 MHz to 2483.5 MHz

Number of channels: 79

Channel spacing: 1 MHz

Frequency generation:  SAW Resonator  Crystal  Synthetiser

Modulation: Frequency hopping spread spectrum (FHSS)

Amplitude  Digital  Frequency  Phase

Power source: 24 Vd.c.

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

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

## **3.NORMATIVE REFERENCE**

The standards and testing methods related throughout this report are those listed below. They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

FCC Part 15 (2006) Code of Federal Regulations  
Title 47 - Telecommunication  
Chapter 1 - Federal Communications Commission  
Part 15 - Radio frequency devices  
Subpart C - Intentional Radiators

ANSI C63.4 (03) American National Standard for Methods of measurement of Radio-Noise from low-voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

**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 203: antenna requirement
- Paragraph 205: restricted bands of operation
- Paragraph 209: radiated emission limits; general requirements
- Paragraph 247: operation within the bands 2400-2483.5 MHz

**5. 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 “***

**6. 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            |                      |    |     |     |               |
|                 | (a) (1) hopping systems                              | X                    |    |     |     | Notes 1 and 2 |
|                 | (a) (2) digital modulation techniques                |                      |    | X   |     |               |
|                 | (b) max output power                                 | X                    |    |     |     | Note 6        |
|                 | (c) operation with directional antenna gains > 6 dBi |                      |    | X   |     | Note 3        |
|                 | (d) intentional radiator                             | X                    |    |     |     |               |
|                 | (e) peak power spectral density                      | X                    |    |     |     | Notes 6 and 8 |
|                 | (f) hybrid system                                    |                      |    | X   |     |               |
|                 | (g)  | X                    |    |     |     |               |
|                 | (h)  | X                    |    |     |     |               |
|                 | (i) RF exposure compliance                           | X                    |    |     |     | Note 7        |

NAp: Not Applicable

NAs: Not Asked

Note 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, and separated by a minimum of 20 dB bandwidth of the hopping channel (see annex 1).

Note 2: the frequency hopping system use more than 15 channels.  
 The timing by channel is 565 μs.  
 During 79 channels × 0.4 s (part 15) = 31.6 s, any channel is used 400 times, then 400 × 565 μs = 226 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 (see annex 2).

Note 3: the antenna gain is lower than 6 dBi.

Note 4: power supply: 24 Vd.c.

Note 5: see FCC part 15.247 (d).

Note 6: conducted measurement is not possible (integral antenna), so we used the method in open field.

Note 7: this type of equipment uses less than 0.5 W of output power with a high signal transmitting duty factor (section 3 from Oet 65c).

Note 8: for information only.

**Conclusion:**

The sample of INTERFACE “RMI” 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.

**7. PEAK OUTPUT POWER****Standard:** FCC Part 15**Test procedure:** paragraph 15.247**Test equipment:**

| TYPE                            | BRAND           | EMITECH NUMBER |
|---------------------------------|-----------------|----------------|
| Spectrum analyzer FSP 40        | Rohde & Schwarz | 4088           |
| Diode detector ODZ0004A         | 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           |
| High pass filter HPM11630       | Micro-tronics   | 1673           |
| Low-noise amplifier 1 to 18 GHz | ALC             | 2648           |
| Power meter 8541B               | Gigatronics     | 3479           |
| Power sensor 80401A             | Gigatronics     | 3182           |
| Power source EX354D             | TTI             | 2148           |

**Test set up:**

The system is tested in an open area test site (OATS).

The test unit is placed on a rotating table, 0.8 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 has been oriented in the two polarizations, we have recorded only highest level.

In first 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 reaches the level obtained with the E.U.T.

The output power level of the signal generator is measured with a calibrated RF power meter.

Then a measurement of the electromagnetic field is realized, with a resolution bandwidth and video bandwidth adjusted at 1 MHz.

**Distance of antenna:** 3 meters**Antenna height:** 1 to 4 meters**Antenna polarization:** vertical and horizontal**Equipment under test operating condition:**

The equipment is blocked in continuous transmission mode, modulated by internal data signal.

**Results:**

Ambient temperature (°C): 18

Relative humidity (%): 55

Polarization of test antenna: vertical (height: 177 cm)

Position of equipment: wall position (azimuth: 0 degree)

Sample N° 1

|                        |                              | Peak Output Power radiated at these frequencies (W):<br>from 2403 MHz to 2481 MHz | Limits<br>(W) |
|------------------------|------------------------------|---|---------------|
| Normal test conditions | Nominal power source (V): 24 | $2.793 \times 10^{-3}$  | 1*            |

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

Sample n° 1 Channel 1

|                        |                              | Level (dBμV) | Cable loss (dB) | Antenna factor (dB) | Electromagnetic field (dBμV/m) | P* (W)                 |
|------------------------|------------------------------|--------------|-----------------|---------------------|--------------------------------|------------------------|
| Normal test conditions | Nominal power source (V): 24 | 64.52        | 4.41            | 27.77               | 96.7                           | $0.856 \times 10^{-3}$ |

Sample n° 1 Channel 40

|                        |                              | Level (dBμV) | Cable loss (dB) | Antenna factor (dB) | Electromagnetic field (dBμV/m) | P* (W)                 |
|------------------------|------------------------------|--------------|-----------------|---------------------|--------------------------------|------------------------|
| Normal test conditions | Nominal power source (V): 24 | 64.49        | 4.41            | 27.77               | 96.67                          | $0.849 \times 10^{-3}$ |

Sample n° 1 Channel 79

|                        |                              | Level (dBμV) | Cable loss (dB) | Antenna factor (dB) | Electromagnetic field (dBμV/m) | P* (W)                 |
|------------------------|------------------------------|--------------|-----------------|---------------------|--------------------------------|------------------------|
| Normal test conditions | Nominal power source (V): 24 | 65.4         | 4.41            | 27.77               | 97.58                          | $1.048 \times 10^{-3}$ |

$$* \quad P = \frac{(E \times d)^2}{30 \times G} \quad \text{with } G = 1.64 \text{ and } d = 3 \text{ m}$$

**Test conclusion:**

RESPECTED STANDARD



**8. PEAK POWER DENSITY**

**Standard:** FCC Part 15

**Test procedure:** paragraph 15.247

**Test equipment used:**

| TYPE                           | MANUFACTURER    | EMITECH NUMBER |
|--------------------------------|-----------------|----------------|
| Spectrum analyzer FSP 40       | Rohde & Schwarz | 4088           |
| Open site                      | Emitech         | 1274           |
| Radiofrequency generator SME06 | Rohde & Schwarz | 1669           |
| Antenna RGA-60                 | Electrometrics  | 1938           |
| Antenna RGA-60                 | Electrometrics  | 1204           |
| Power meter 8541B              | Gigatronics     | 3479           |
| Power sensor 80401A            | Gigatronics     | 3182           |
| Power source EX354D            | TTI             | 2148           |

**Measured condition:**

We used the same method of the peak output power, but the oscilloscope and the diode is replaced by a spectrum analyzer used in combination with an RF power meter.

Resolution bandwidth: 3 kHz

Video bandwidth: 10 kHz

**Test operating condition of the equipment:**

The equipment is blocked in continuous transmission mode, modulated by internal data signal.

**Results:**

Ambient temperature (°C): 18

Relative humidity (%): 55

Power source: 24 V.d.c.

Sample n° 1 Channel 1

|                               | <b>Peak power density at frequency:<br/>2403 MHz</b> |
|-------------------------------|--|
| <b>Normal test conditions</b> | -13.58 dBm   |
| <b>Limits</b>                 | +8 dBm   |

Sample n° 1 Channel 40

|                               | <b>Peak power density at frequency:<br/>2442 MHz</b> |
|-------------------------------|--|
| <b>Normal test conditions</b> | -10.54 dBm   |
| <b>Limits</b>                 | +8 dBm   |

Sample n° 1 Channel 79

|                               | <b>Peak power density at frequency:<br/>2481 MHz</b> |
|-------------------------------|--|
| <b>Normal test conditions</b> | -12.2 dBm  |
| <b>Limits</b>                 | +8 dBm   |

**Test conclusion:**

RESPECTED STANDARD

**9. RADIATED EMISSION OF TRANSMITTER****Standard:** FCC Part 15**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 FSP 40         | Rohde & Schwarz | 4088           |
| Loop antenna                     | EMCO            | 1406           |
| Biconical antenna HP 11966C      | Hewlett Packard | 728            |
| Log periodic antenna HL 223      | Rohde & Schwarz | 1999           |
| Open site                        | Emitech         | 1274           |
| Antenna RGA-60                   | Electrometrics  | 1204           |
| Low-noise amplifier 2 to 18 GHz  | Microwave DB    | 1922           |
| High pass filter HP12/3200-5AA   | Filtek          |                |
| Antenna WR42                     | IMC             | 1939           |
| Power source EX354D              | TTI             | 2148           |
| Low-noise amplifier 18 to 26 GHz | ALC             | 3036           |

**Test set up:**

The system is tested in an open area test site (OATS).

The test unit is placed on a rotating table, 0.8 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 ( $F_{\text{carrier}} \leq 10 \text{ GHz}$ )**Detection mode:** Quasi-peak ( $F < 1 \text{ GHz}$ )  
Average or Peak ( $F > 1 \text{ GHz}$ ), following 15.205 or 15.247**Bandwidth:** 120 kHz ( $F < 1 \text{ GHz}$ ) or 100 kHz, following 15.205 or 15.247  
1 MHz ( $F > 1 \text{ GHz}$ ) 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 blocked in continuous transmission mode, modulated by internal data signal.

**Results:**

Ambient temperature (°C): 19  
Relative humidity (%): 51

Power source: 24 Vd.c.

The polarity column refers to the antenna polarity at which the maximum emissions level is measured.

| FREQUENCIES (MHz) | Antenna height (cm) | Azimuth (degree) | resolution bandwidth (kHz) | Polarization<br>H: Horizontal<br>V: Vertical | Field strength (dB $\mu$ V/m) | Limits (dB $\mu$ V/m) | Margin (dB) |
|-------------------|---------------------|------------------|----------------------------|--|-------------------------------|-----------------------|-------------|
| 631.99            | 100                 | 30               | 100                        | V  | 42.2                          | 77.6                  | 35.4        |
| 647.99            | 100                 | 0                | 100                        | V  | 45.1                          | 77.6                  | 32.5        |
| 687.99            | 100                 | 30               | 100                        | V  | 43.8                          | 77.6                  | 33.8        |
| 711.99            | 150                 | 100              | 100                        | H  | 40.6                          | 77.6                  | 37          |
| 4806.06           | 102                 | 0                | 1000                       | V  | 47.72                         | 54*                   | 6.28        |
| 4884.06           | 232                 | 0                | 1000                       | V  | 47.74                         | 54*                   | 6.26        |
| 4962.08           | 180                 | 0                | 1000                       | V  | 45.15                         | 54*                   | 8.85        |

\* restricted bands of operation.

Applicable limits: in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The highest level recorded in a 100 kHz bandwidth is 97.6 dB $\mu$ V/m on channel 79, so the applicable limit is **77.6 dB $\mu$ V/m**.

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205 (a), must also comply with the radiated emission limits specified in Section 15.209 (a) (see Section 15.205 (c)).

**TEST CONCLUSION:**

RESPECTED STANDARD

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