

Radio Test Report: 99420830

Applicant: Tyro bv
Bedrijvenpark Twente 1B
7602 KA Almelo
The Netherlands

Equipment Under Test: TRX 2021, Remote Control Transmitter and Receiver

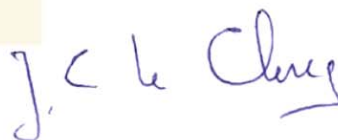
FCC ID: SQL RXTX-01

In Accordance With: **FCC Part 15, Subpart B, 15.109 (03-10-01 edition)**
For receivers operating within the frequency range of 30-960 MHz.

FCC Part 15, Subpart C, 15.231 (03-10-01 edition)
For low power transmitters operating periodically in the band 40.66 - 40.77 MHz and above 70 MHz

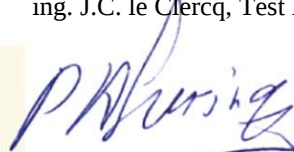
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Test Engineer:



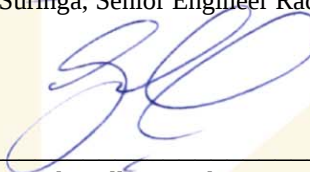
ing. J.C. le Clercq, Test Engineer

Reviewed by:



ing. P.A. Suringa, Senior Engineer Radio/EMC

Authorized by:



J.P. van de Poll, Co-ordinator Test Group

Date: 7 July 2004

Total Number of Pages: 43

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

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EQUIPMENT: Remote Control Transmitter and Receiver
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EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 1. Summary of Test Results

Manufacturer: Tyro bv

Model No.: TRX 2021

Serial No.: 01 03 71

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart B Paragraph 15.109 and Subpart C, Paragraph 15.231. All tests were conducted using measurement procedure ANSI C63.4-1992. Radiated emissions are made on an open area test site.

A description of the test facility is on file with the FCC (FCC listed 90828).



New Submission



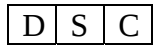
Production Unit



Class II Permissive Change



Pre-Production Unit



Equipment Code

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

See " Summary of Test Data".



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EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Summary of Test Data

Receiver:

Name of test	Paragraph number	Results
Radiated emissions	15.109	Complies
Antenna power conducted limits for receivers	15.111	Complies

Transmitter:

Name of test	Paragraph number	Results
Antenna requirement	15.203	Complies
External radio frequency power amplifiers and antenna modifications	15.204	Complies
Power line conducted emissions	15.207	Complies
Transmission requirements	15.231(a)	Complies
Radiated emissions	15.231(b)	Complies
Occupied bandwidth	15.231(c)	Complies
Frequency tolerance	15.231(d)	N/A
Periodic alternate field strength requirements	15.231(e)	N/A

Footnotes for N/A's:

Par. 15.231(d) has not been tested, because the Equipment Under Test does not operate within the frequency band 40.66-40.70 MHz.

Par. 15.231(e) has not been tested, because the Equipment Under Test complies with par. 15.231(a)

Test Conditions:

Indoor Temperature: 19 °C
 Humidity: 44 %

Outdoor Temperature: 2 °C
 Humidity: 41 %

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 2. Equipment under Test (E.U.T.)

General Equipment Information

Frequency range:	433.92 MHz
Operating frequency of sample:	433.92 MHz
Type of emission:	FM
Emission designator:	300KF1D
Supply power requirement:	receiver 12 - 24 V _{dc} transmitter 14 - 26 V _{dc}
Duty cycle calculation:	< 1 %

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Description of E.U.T.

The Equipment Under Test consists of a small transmitter and a receiver. Its intended use is remote control of professional equipment. The transmitter batteries can be charged with an AC mains adapter.

Modifications incorporated in E.U.T.

To achieve compliance the following change(s) were made by the manufacturer during compliance testing:

The Effective Radiated Power of the transmitter has been reduced in order to comply with par. 15.231. Resistor R15 on AB_main_9_2TX has been reduced from 100 k Ω to 0 Ω .

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Theory of Operation

This (wireless remote) control is intended to be used to control machinery from a distance. The Tyro Systems (wireless remote) control uses the 433.92 MHz frequency. The (wireless remote) control is FM modulated and is thus less accessible for interference of other transmitting sources.

EQUIPMENT: Remote Control Transmitter and Receiver
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Justification

The E.U.T. was configured for testing as per typical installation.

The following combinations were investigated to establish worst-case configuration:

- (1) Receiver, as stand-alone
- (2) Transmitter, with mains adapter attached

Exercise Program

The E.U.T. exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to typical use.

Exercise mode:

- (1) Receiver, in receiving mode
- (2) Transmitter, continuously transmitting

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 3. Equipment Configuration

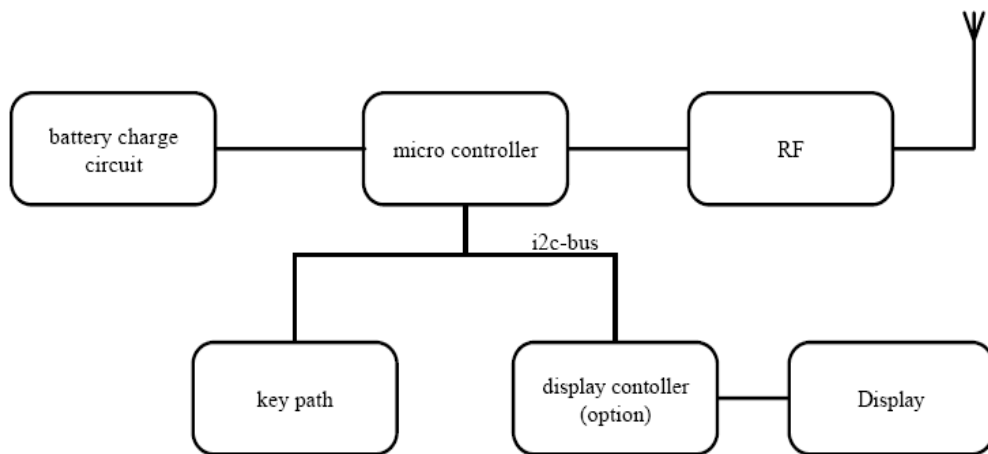
Equipment Configuration List:

Item	Description	Model No.	Serial.	Rev.
(A)	Receiver	TRX 2021	010371	
(B)	Transmitter	TRX 2021	010371	
(C)	Mains adapter	FW7238/24	--	
(D)				
(E)				
(F)				
(G)				

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

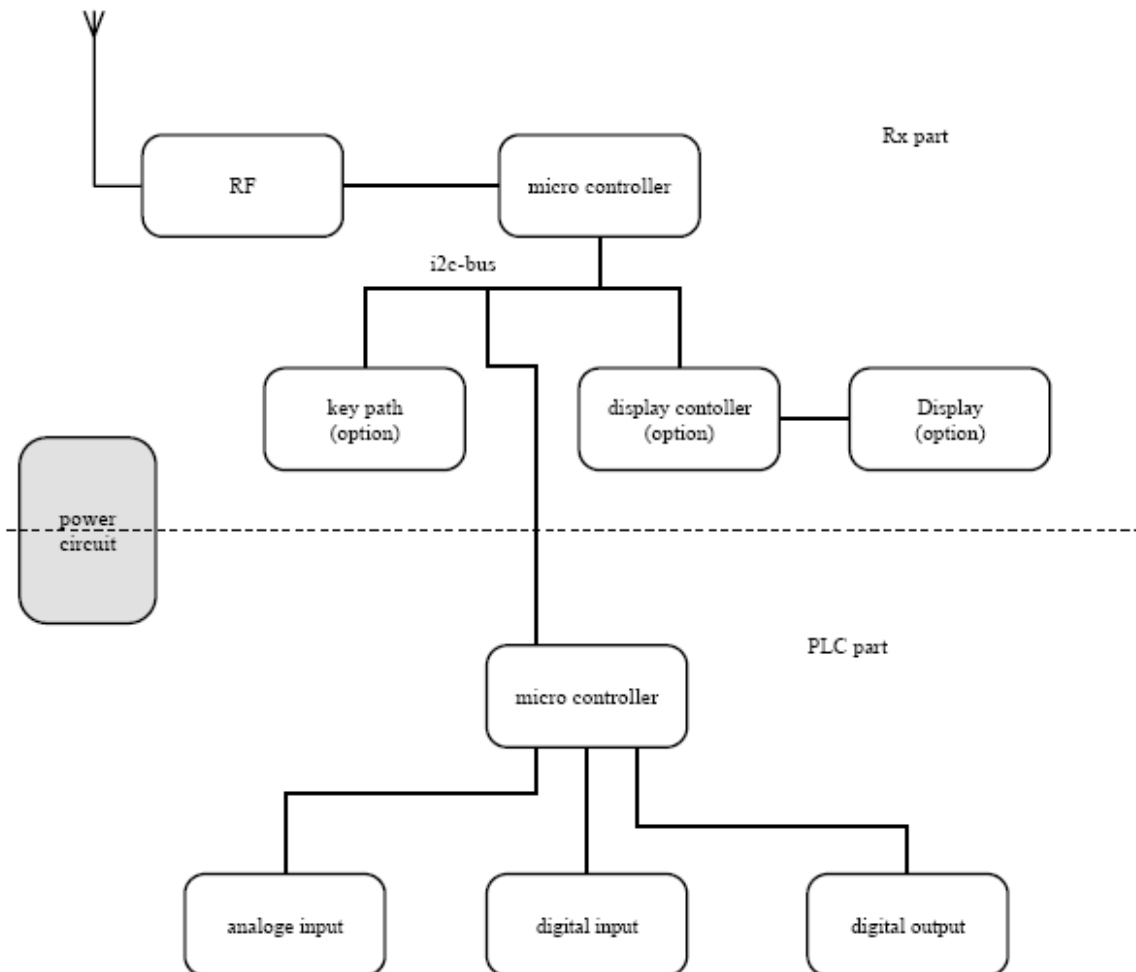
Configuration of the Equipment under Test (E.U.T)

Tx block diagram



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Rx block diagram



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 4. Radiated emissions for receivers

NAME OF TEST: Radiated emissions

PARA. NO.: 15.109

TESTED BY: ing. J.C. le Clercq

DATE: 2 December 2003

The field strength of radiated emissions from unintentional radiators at a distance of 3 metres shall not exceed the following values:

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)
30-88	100
8-216	150
216-960	200
Above 960	500

Test Results: Complies.

Test Data: No radiated emissions have been found

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 5. Antenna power conduction limits for receivers

NAME OF TEST: Antenna power conduction	PARA. NO.: 15.111
TESTED BY: ing. J.C. le Clercq	DATE: 2 December 2003

With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range 30 – 1000 MHz shall not exceed 2.0 nanoWatts (i.e. -57 dBm)

Test Results: Complies.

Test Data: See attached table.

Frequency (MHz)	Average (dBm)
423.32558	-84
846.64000	-99

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 6. Antenna requirement for intentional radiators

NAME OF TEST: Antenna requirement	PARA. NO.: 15.203
TESTED BY: ing. J.C. le Clercq	DATE: 2 December 2003

An intentional radiator shall be designed to ensure that no other than that furnished by the responsible party shall be used with the device.

Test Results: Complies.

Test Data: Permanently attached antenna.

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 7. Antenna modifications

NAME OF TEST: Antenna modifications	PARA. NO.: 15.204
TESTED BY: ing. J.C. le Clercq	DATE: 2 December 2003

Only the antenna with which an intentional radiator is authorized may be used with the product.

Test Results: Complies.

Test Data: Permanently attached antenna.

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 8. Power line conducted emissions

NAME OF TEST: Power line conducted emissions	PARA. NO.: 15.207
TESTED BY: ing J.C. le Clercq	DATE: 18 November 2003

Minimum Standard:

Frequency (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 - 30.0	60	50

*Decreases with the logarithm of the frequency.

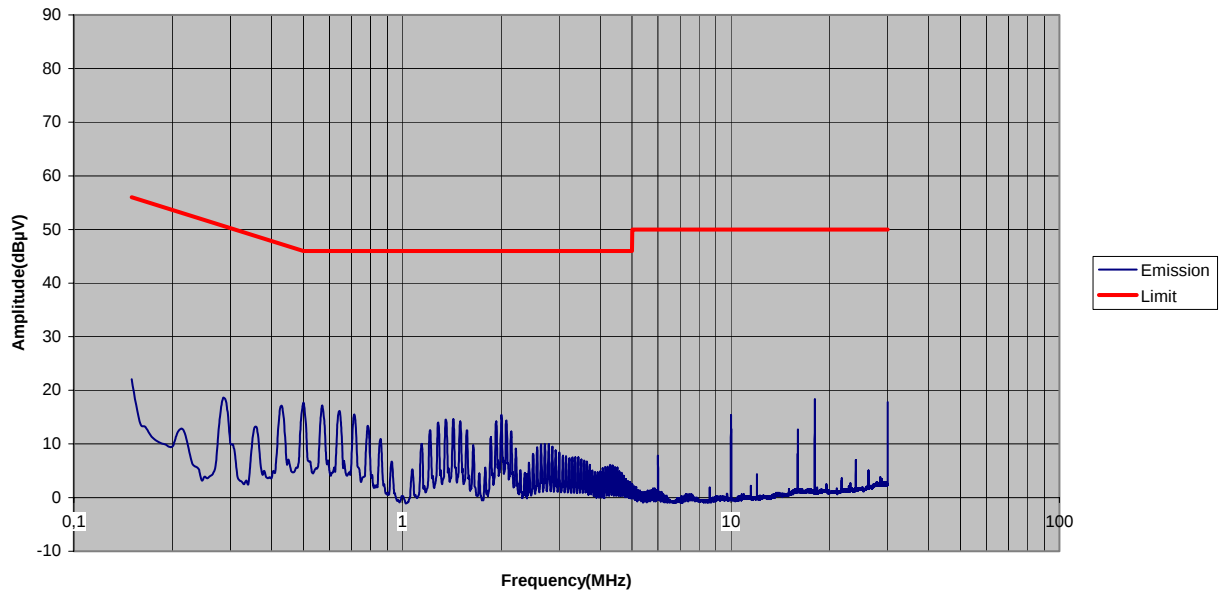
Test Results: Complies.

Test Data: See attached graphs and table.

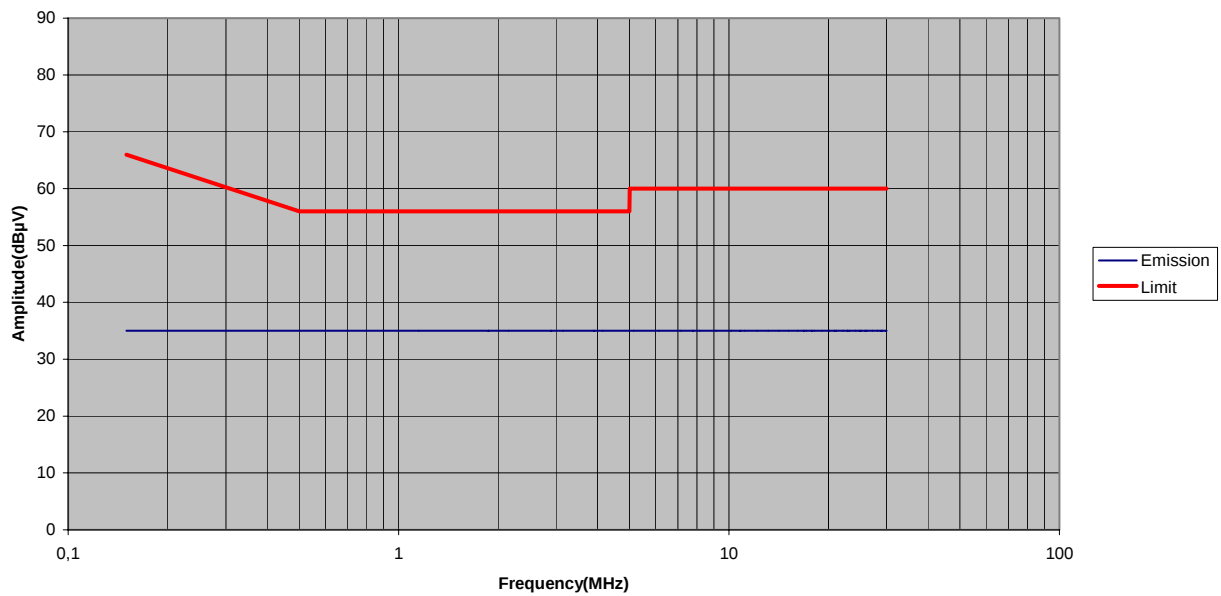
EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Measurement Data:

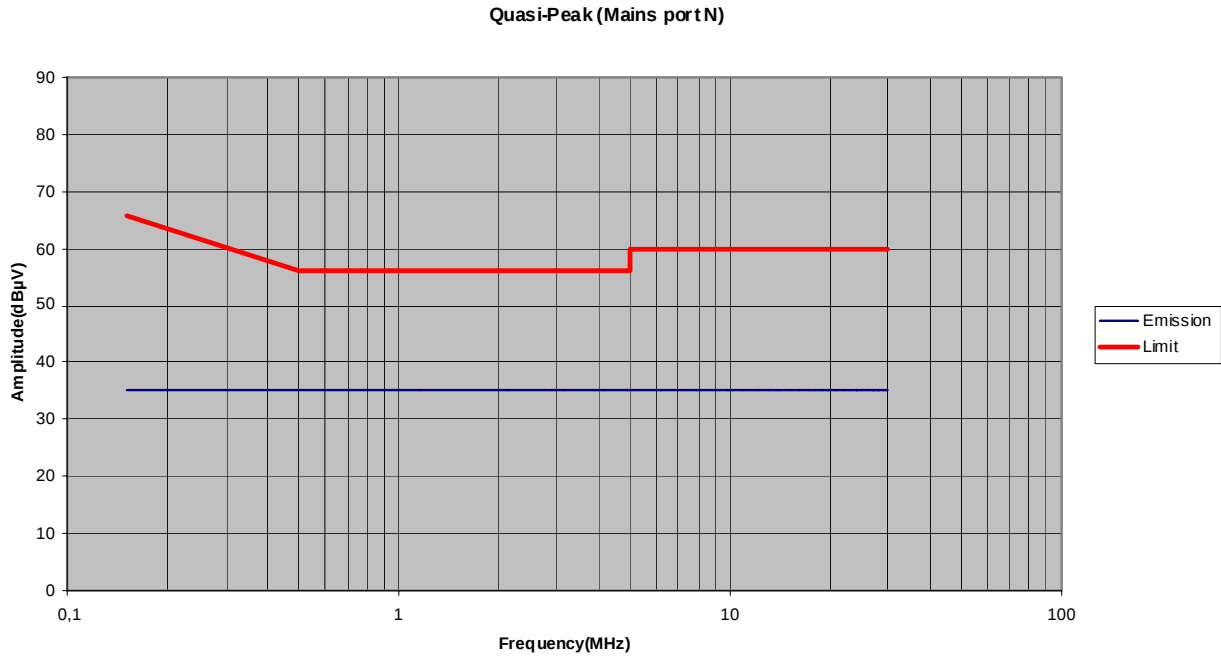
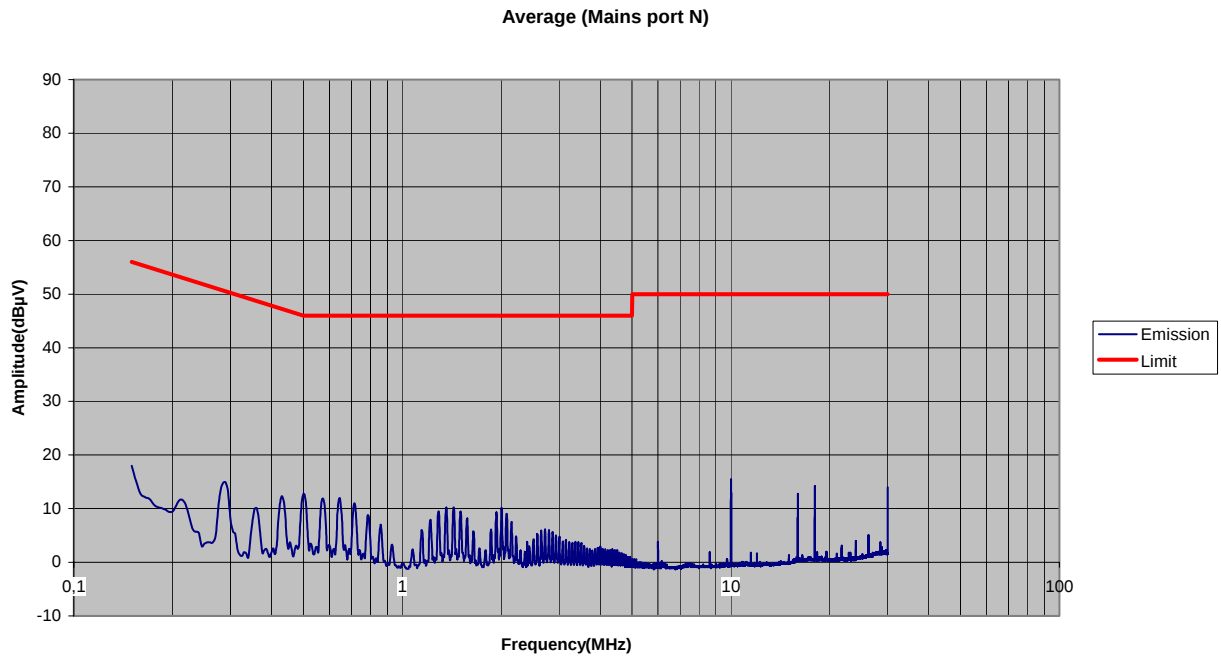
Average (Mains port L1)



Quasi-Peak (Mains port L1)



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01



All conducted spurious emissions on the AC power adapter are more than 10 dB below the limit.

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Conducted photographs (Worst case configuration)

OVERVIEW



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 9. Transmission requirements

NAME OF TEST: Transmission requirements	PARA. NO.: 15.231(a)
TESTED BY: ing. J.C. le Clercq	DATE: 2 December 2003

- Minimum Standard:**
- 15.231(a) Continuous transmissions such as voice, video or data transmissions are not permitted.
- 15.231(a)(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds after being released.
- 15.231(a)(2) A transmitter activated automatically shall cease transmission within 5 seconds of activation.
- 15.231(a)(3) Periodic transmissions at regular pre-determined intervals are not permitted. However polling or supervisory transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.
- 15.231(a)(4) Intentional radiators, which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm.

Test Results: Complies

Test Data: Compliance was determined by verification of technical specifications and a functional test on the equipment.

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Rationale for compliance with transmission requirements

15.231(a) : complies

15.231(a)(1) : complies, deactivation within 5 seconds after release

15.231(a)(2) : not applicable

15.231(a)(3) : not applicable

15.231(a)(4) : not applicable

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 10. Radiated Emissions

NAME OF TEST: Radiated Emissions	PARA. NO.: 15.231(b)
TESTED BY: ing. J.C. le Clercq	DATE: 26 January 2004

Minimum standard:

Permissible field strength limits (Momentarily operated devices)

Fundamental Frequency (MHz)	Field Strength of Fundamental Microvolts/Meter at 3 meters	Field Strength of Unwanted Emissions Microvolts/Meter at 3 meters
40.66 - 40.70	2,250	225
70-130	1, 250	125
130-174	1,250 to 3,750 [#]	125 to 375
174-260	3,750	375
260-470	3,750 to 12,500*	375 to 1,250
Above 470	12,500	1,250

Notes:

Use quasi-peak or averaging meter.	[#] For 130 - 174 MHz: FS (microvolts/m) = (56.82 x F) - 6136
Linear interpolation with frequency F in MHz	*For 260 - 470 MHz: FS (microvolts/m) = (41.67 x F) - 7083

Any emissions that fall within the restricted bands of 15.205 shall not exceed the following limits:

Frequency (MHz)	Field Strength (μV/m @ 3m)	Field Strength (dB @ 3m)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

Test Results: Complies. The worst-case emission level is
80 dBμV/m @ 3m at 433.92 MHz.
This is 0.8 dB below the specification limit.

Test Data: See attached graphs and table.

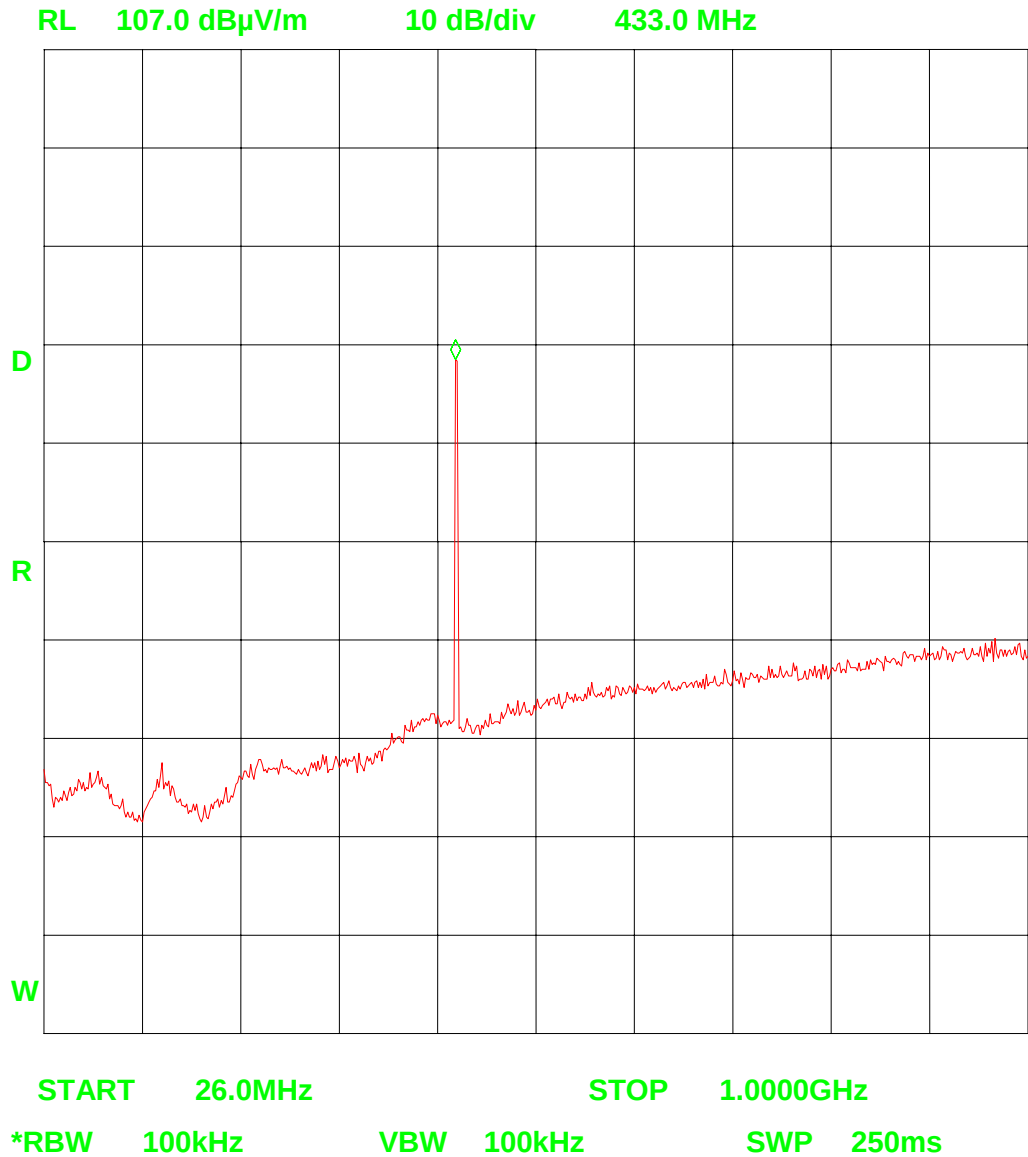
Above 1 GHz a spectrum analyzer and low noise amplifier are used to measure emission levels. The spectrum analyzer resolution bandwidth was set to 1 MHz and video bandwidth was 1 MHz.

In the case of handheld equipment, the E.U.T. is rotated in three planes to obtain worst-case results.

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

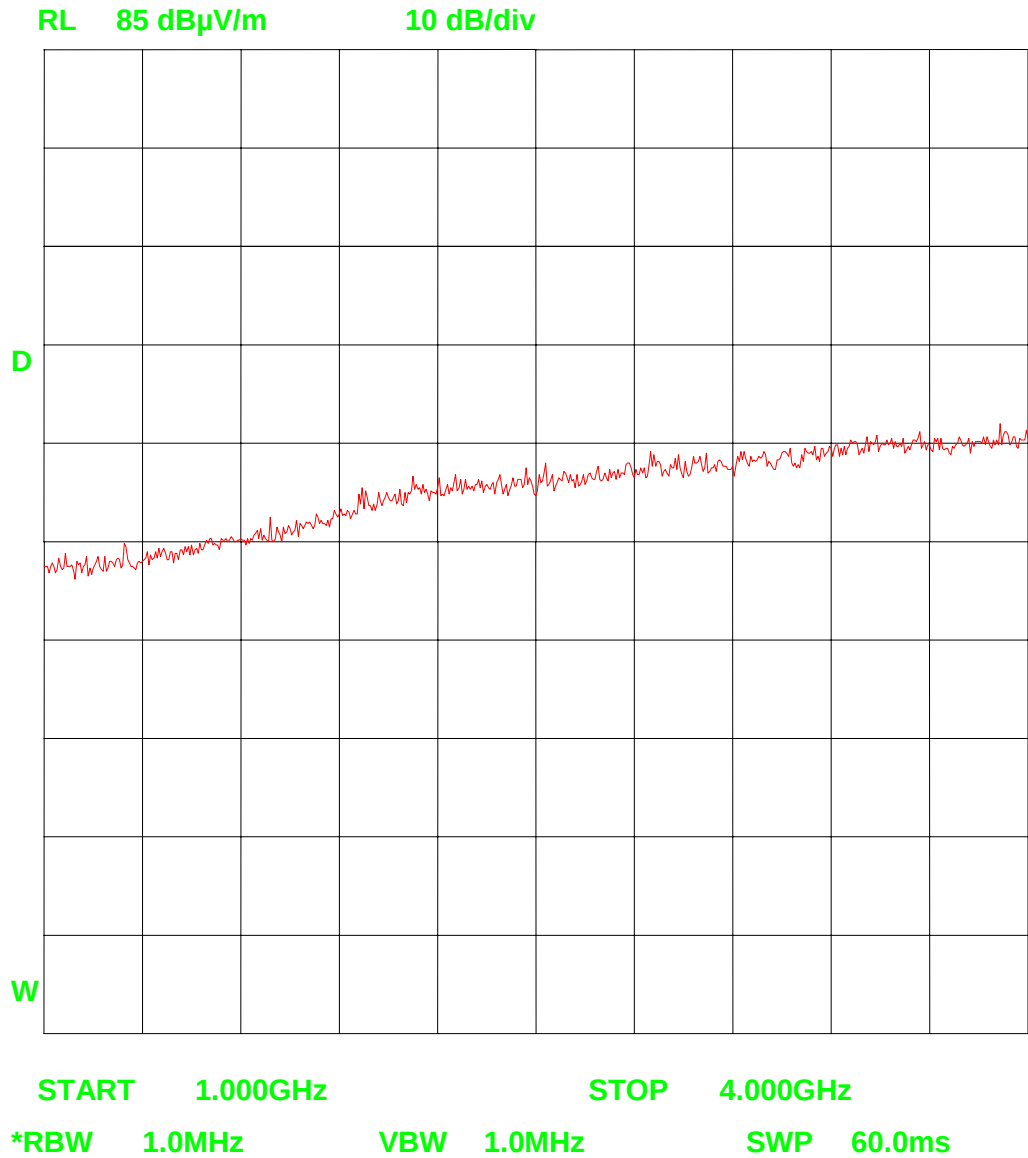
Test Data - Radiated Emissions

PRESCAN GRAPH 30 MHZ TO 1 GHZ



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

PRESCAN GRAPH 1 GHZ AND ABOVE



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

[illegible]

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Radiated Photographs (Worst case configuration)

OPEN AREA TEST SITE



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 11. Occupied bandwidth

NAME OF TEST: Occupied bandwidth

PARA. NO.: 15.231(c)

TESTED BY: ing. J.C. le Clercq

DATE: 2 December 2003

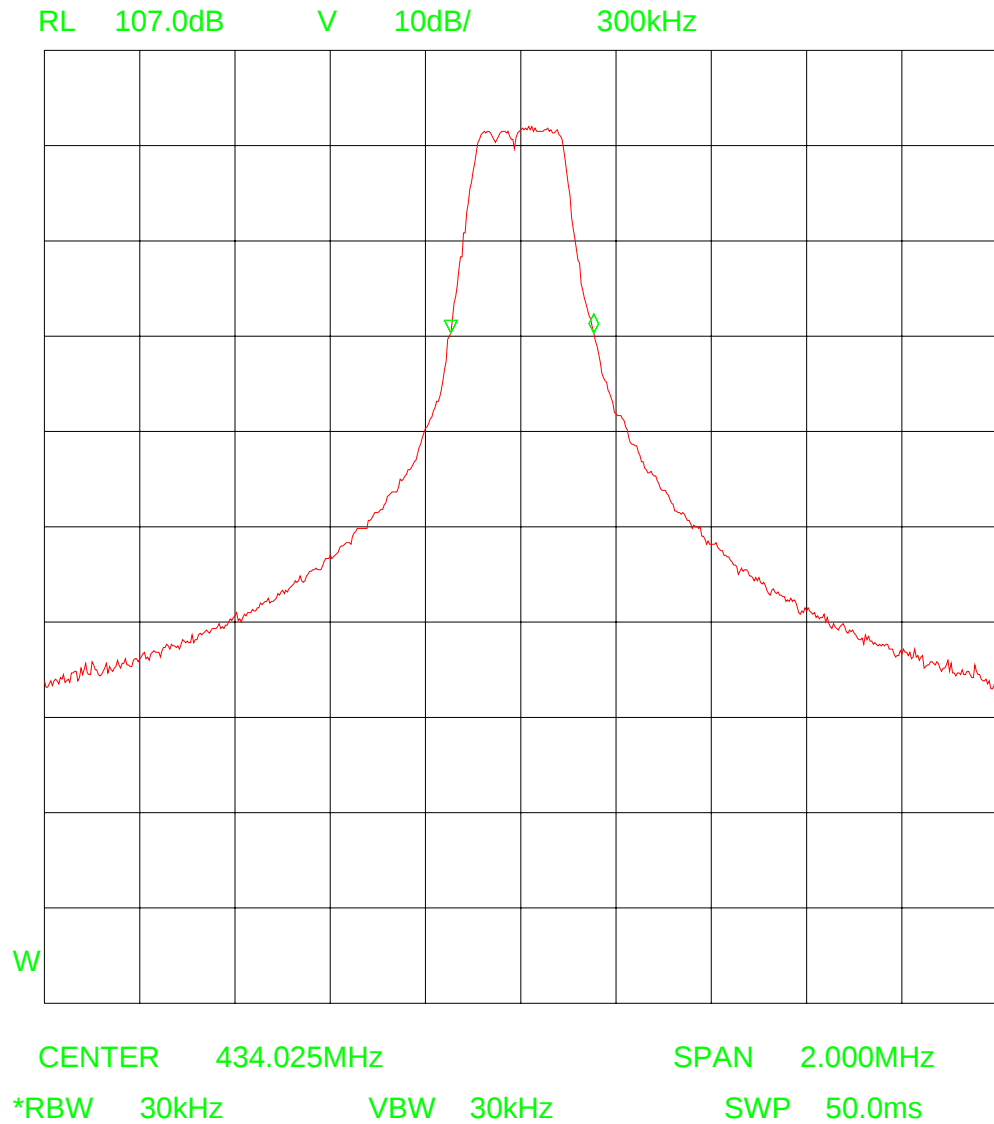
Minimum Standard: 15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test Results: Complies. See attached graph.

Test Data: See attached graph.

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

BANDWIDTH GRAPH

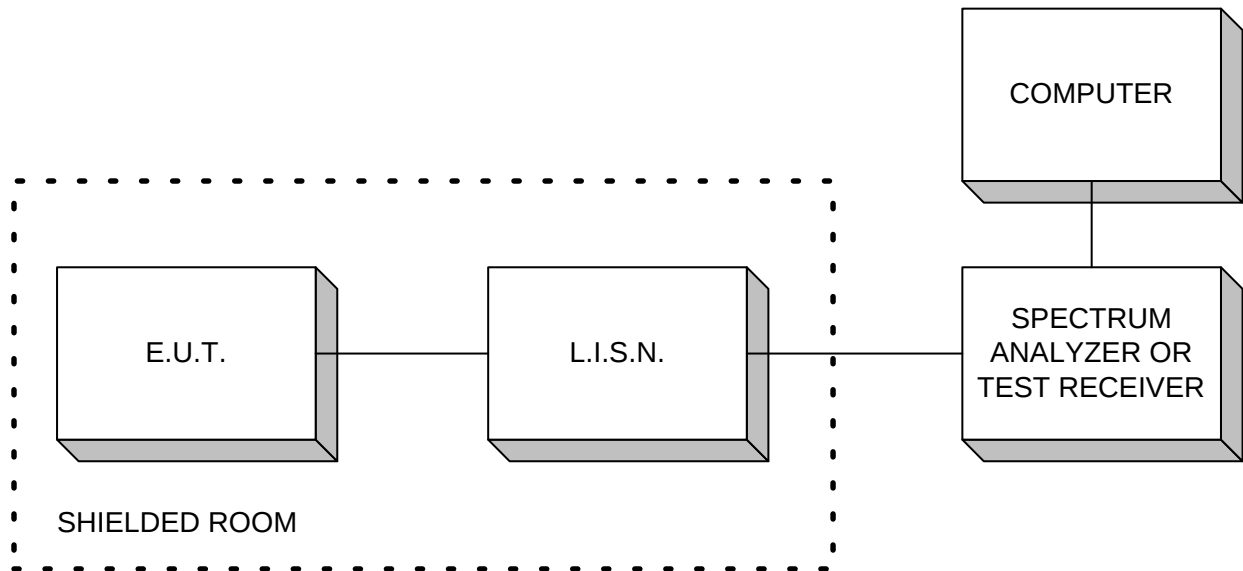


Measured bandwidth: 300 kHz

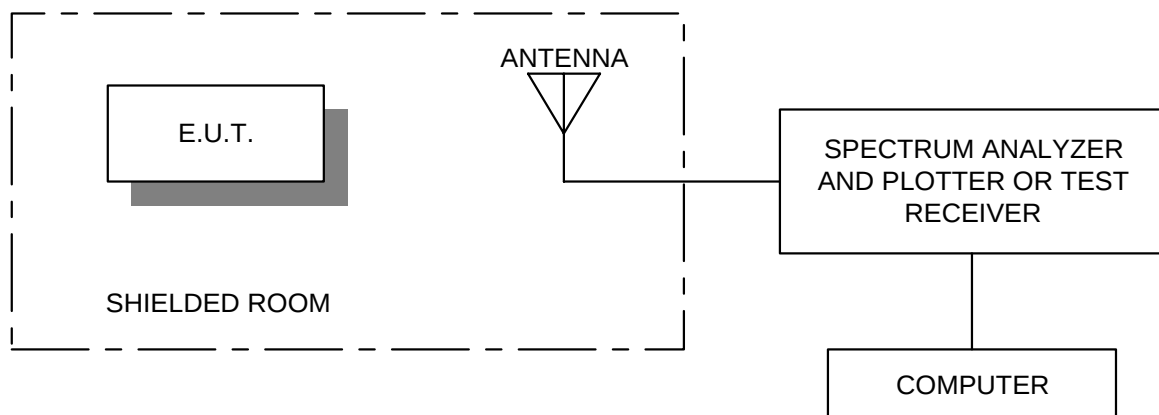
EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 12. Block Diagrams

Conducted Emissions

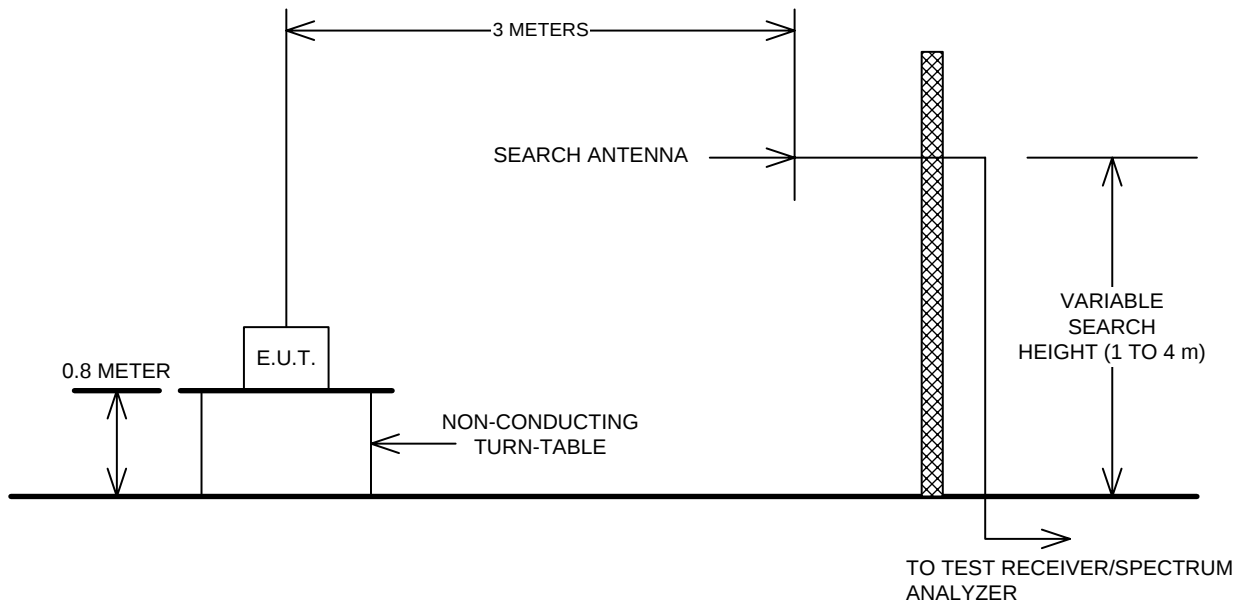


Radiated Prescan



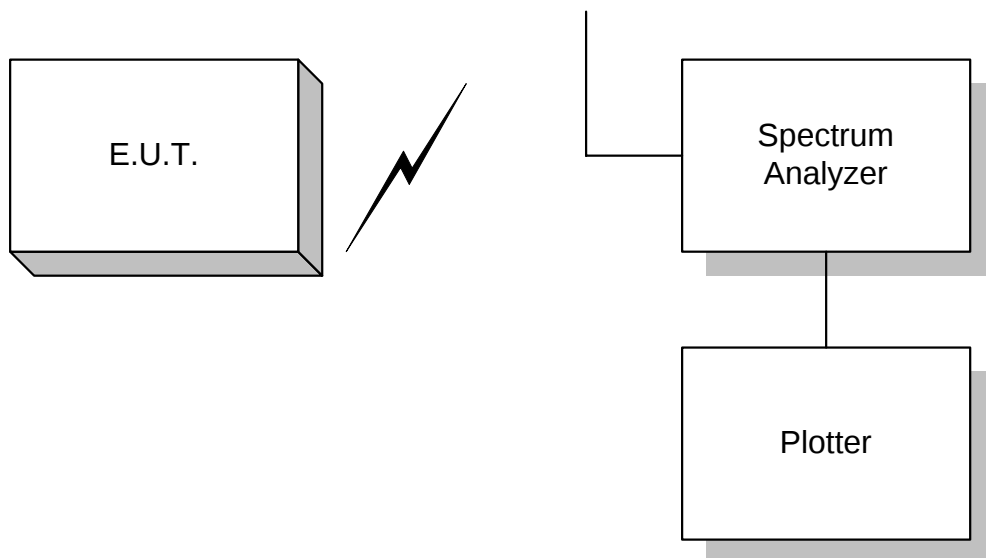
EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Outdoor Test Site For Radiated Emissions



The spectrum was searched up to the 10th harmonic of the fundamental frequency of operation.

Occupied Bandwidth



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section 13. Test Equipment List

Description	Manufacturer	Model	Identification	Used at
Anechoic chamber	Euroshield	RFD-F-100	--	15.109, 15.205, 15.231
Open Area Test Site	--	KEMA	ORS118126	15.109, 15.205, 15.231
Spectrum analyzer	Hewlett Packard	8563E	TE 00481	15.109, 15.111, 15.205, 15.231
Test receiver	Rohde & Schwarz	ESVP	TE 00091	15.231
Test receiver	Rohde & Schwarz	ESH3	TE 00205	15.207
Test receiver	Rohde & Schwarz	ESVS10	845165	15.109, 15.205, 15.231
Biconilog antenna	EMCO	3143	TE 00744	15.109, 15.205, 15.231
Logperiodic antenna	VULB	9161	EMC116982	15.109, 15.205, 15.231
Double ridged guide horn antenna	EMCO	3115	TE 00531	15.109, 15.205, 15.231
Pre-amplifier	Hewlett Packard	8449B	TE 00092	15.109, 15.111, 15.205, 15.231
Pre-amplifier	Rohde & Schwarz	ESV-Z3	TE 00098	15.109, 15.111, 15.205, 15.231
Pulse limiter	Rohde & Schwarz	ESH3-Z2	TE 00027	15.207
Artificial Mains Network	Rohde & Schwarz	ESH3-Z5	TE 00208	15.207

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

ANNEX A

RESTRICTED BANDS

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Section A Restricted bands of operation

NAME OF TEST: restricted bands of operation	PARA. NO.: 15.205
TESTED BY: ing J.C. le Clercq	DATE: 18 November 2003

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.15
0.49 - 0.51	16.69475-16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425-16.80475	960-1240	7.25-7.75
3.020 - 3.026	25.5-25.67	1300-1427	8.025-8.5
4.125 - 4.128	37.5-38.25	1435-1626.6	9.0-9.2
4.17725 - 4.17775	73-74.6	1645.5-1646.5	9.3-9.5
4.20725 - 4.20775	74.8-75.2	1660-1710	10.6-12.7
6.215 - 6.218	108-121.94	1718.8-1722.2	13.25-13.4
6.31175 - 6.31225	123-138	2220-2300	14.47-14.5
8.291 - 8.294	149.9-150.05	2310-2390	15.35-16.2
8.362 - 8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625 - 8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425 - 8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29 - 12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975 - 12.52025	240-285	3345.8-3358	36.43-36.5
12.57675 - 12.57725	322-335.4	3600-4400	Above 38.6
13.36 - 13.41			

No signals in the restricted bands emitted by the transmitter have been found.

No signals in the restricted bands emitted by the receiver have been found.

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

ANNEX B

PRODUCT PHOTOGRAPHS

EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Test sample, receiver, overview



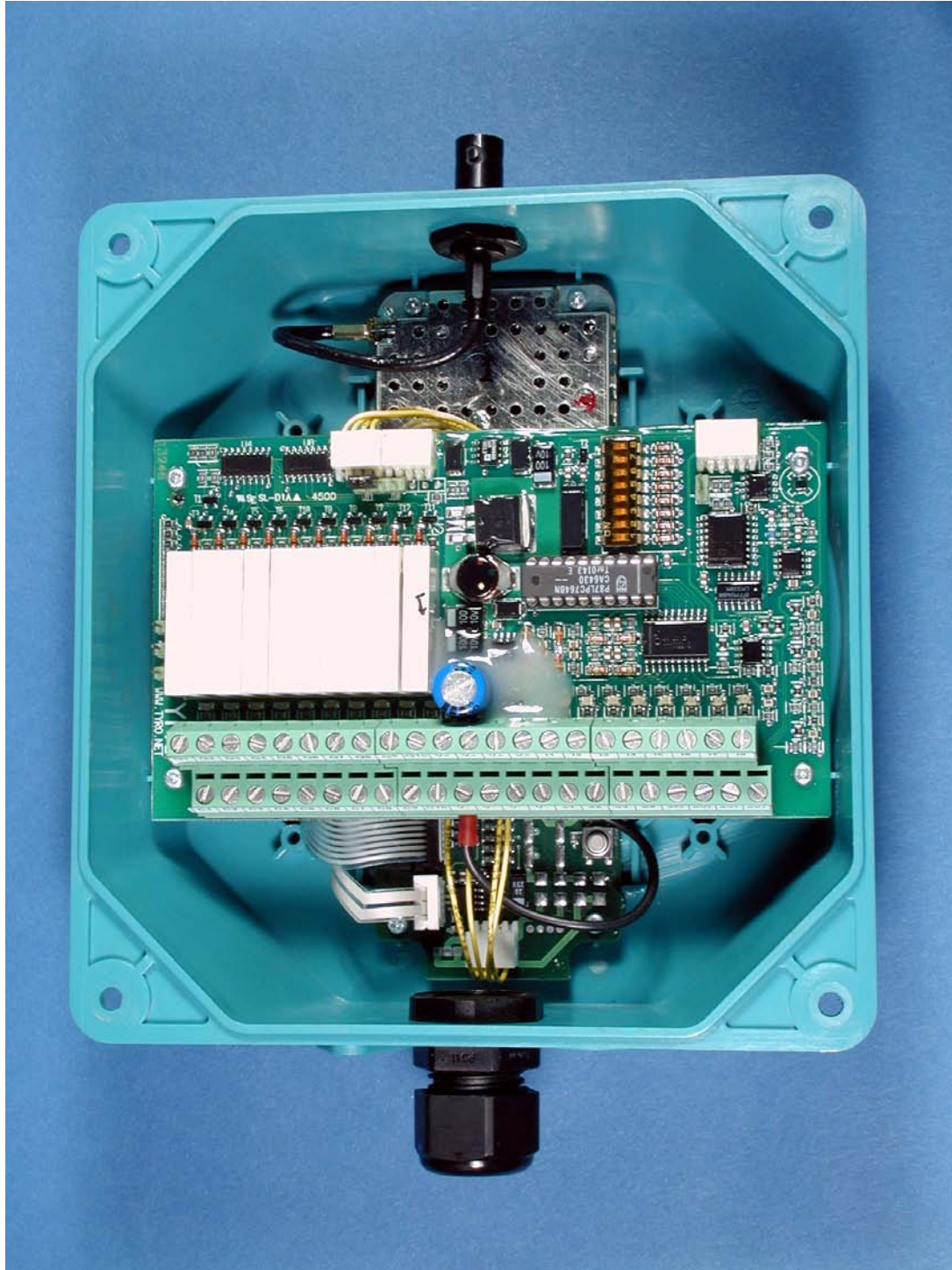
EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Test sample, receiver antenna



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Test sample, receiver, interior view



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Test sample, transmitter, front view



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Test sample, transmitter, back view



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Test sample, transmitter, interior view



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Test sample, AC mains adapter of transmitter



EQUIPMENT: Remote Control Transmitter and Receiver
FCC ID: SQL RXTX-01

Test sample, AC mains adapter

