EMCC™ DR. RAŠEK

TEST REPORT # EMCC-950004DC, 2002-11-20

EQUIPMENT UNDER TEST:

Trade Name:	Flash Link
Model No.:	3910
Serial No.:	6
Equipment Category:	Transceiver
Manufacturer:	Hensel Studiotechnik
Address:	Robert Bunsen Str. 3 97076 Würzburg Germany
Phone:	+49 931-27881-0
Fax:	+49 931-27881-58

RELEVANT STANDARD: 47 CFR Part 15

MEASUREMENT PROCEDURE USED:

☒ ANSI C63.4-1992 ☐ FCC/OET MP-4 (1987) ☐ Other

TEST REPORT PREPARED BY:

Wolfgang Döring
EMCC DR. RAŠEK
Moggast 72-74
91320 Ebermannstadt
Germany
Phone: +49-9194-9016
Fax: +49-9194-8125
E-mail: w.doering@emcc.de

TEST PERSONNEL: Wolfgang Döring

HEAD OF LABORATORY: Winfried Hoffmann

CONTENTS

Page

1 GENERAL INFORMATION 3
1.1 Purpose 3
1.2 Limits and Reservations 3
1.3 Test Location 3
1.4 Manufacturer 3
1.5 Dates 3
2 PRODUCT DESCRIPTION 4
2.1 Equipment Under Test (EUT) 4
2.2 EUT Peripherals 5
2.3 Mode of Operation During Testing 5
2.4 Modifications Required for Compliance 5
3 TEST RESULTS SUMMARY 6
4 ANTENNA REQUIREMENT 7
4.1 Regulation 7
4.2 Result 7
5 CONDUCTED EMISSIONS TESTS 8
5.1 Regulation 8
5.2 Test Equipment 8
5.3 Test Procedures 9
5.4 Test Results 9
6 RADIATED EMISSIONS 11
6.1 Regulation 11
6.2 Test Equipment 14
6.3 Test Procedures 14
6.4 Calculation of Field Strength Limits 15
6.5 Calculation of Average Correction Factor 15
6.6 Field Strength Calculation 15
6.7 Test Results 17
7 PRODUCT LABELING AND INFORMATION TO THE USER 19
7.1 Labeling 19
7.2 Information to the User 19
8 FURTHER PRODUCT INFORMATION 19
8.1 Theory of Operation 19
8.2 Block Diagram 19
8.3 Schematics, Parts Lists, Assembly Drawing 19
9 MISCELLANEOUS COMMENTS AND NOTES 20
10 LIST OF ANNEXES 20

1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance to the FCC regulations for unlicensed devices operating under section 15.249 of the Code of Federal Regulations title 47.
Furthermore the receiver part was investigated to the requirements of section 15.109.

1.2 Limits and Reservations

The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCC DR. RAŠEK.

1.3 Test Location

Company Name:	EMCC DR. RAŠEK
Street:	Moggast 72-74
City:	91320 Ebermannstadt
Country:	Germany
Laboratory:	Test Laboratory of EMCC DR. RAŠEK FCC Registration Number: 90566 This site has been fully described in a report submitted to the FCC, and accepted in the letter dated February 09, 2000 Registration Number 90566.
Phone:	+49-9194-9016
Fax:	+49-9194-8125
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Manufacturer

Company Name:	Hensel Studiotechnik
Street:	Robert Bunsen Str. 3
City:	97076 Würzburg
Country:	Germany
Name for contact purposes:	Mr. J. Renschke
Phone:	+49 931-27881-12
Fax:	+49 931-27881-58
E-mail:	jrenschke@hensel.de

1.5 Dates

Date of receipt of EUT:	CW 31/2002
Test date:	CW 31, 35, 36/2002

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Manufacturer:	Hensel Studiotechnik
Device:	Remote Control System Flash Link
Model No.:	3910
Serial Number:	6
FCC ID:	QP2-RF-01Y-XXXX-U
Application:	Wireless remote control system for professional photo flash systems
Power:	5.0 V (external DC supply via USB or RS485 port)
Transmit Frequency:	915.00 MHz, 915.09 MHz, 915.18 MHz (three RF channels; all tests performed on the middle channel)
Receive Frequency:	915.00 MHz, 915.09 MHz, 915.18 MHz (three RF channels; all tests performed on the middle channel)
Internal clock frequencies:	8 MHz, 12 MHz
Antenna:	external, dedicated monopole: SMA/868MHz manufact. Jyebao, #868ANT-90AM, permanently attached by factory-application of adhesive
Interface ports:	Antenna port (SMA female), RS485 (8 pin socket Mini-DIN 8), USB (mini USB), SYNC (2 pole phone socket 6,35mm)
Variants:	none
Remarks:	none

The EUT controls settings of photo flash equipment. The FLASH LINK system consists of two identical transceivers: one connected to the USB port of a control PC, the second connected to the flash equipment via the RS485 port. Both units are power supplied via these data ports. The USB connected unit works as a controller (MASTER mode), the RS485 connected as a controlled unit (SLAVE mode). The MASTER unit operates in transmit mode during system standby in order to hold the receiving SLAVE unit in synchronized mode. For data transfer the MASTER unit inserts the appropriate control data into the modulation bitstream. After transmitting these control data the MASTER unit ceases transmitting and changes into receive mode waiting for an acknowledge from the SLAVE unit. The SLAVE unit is in receive mode during system standby and transmits only on request from the MASTER unit.
The maximum duty cycle of the EUT (MASTER) is 100%.

2.2 EUT Peripherals

The EUT was tested in the MASTER mode with a laptop PC. For SLAVE mode (supplied via RS485 port) the EUT was powered by an adapter and an external DC power supply (AC/DC Adapter) submitted by the manufacturer.

2.2.1 External DC power supply (for RS485 powered EUT mode, only)

Device: Direct Plug-In Transformer Unit Art.-No 2040
Type: FW 1199
Manufacturer: FRIWO
Serial Number: none

2.2.2 Notebook Computer

Type: PCG-F403VAIO
Manufacturer: SONY
Serial Number: 28306651 5319639

2.2.3 AC Adapter (for Notebook)

Type: PCGA-ACX1
Manufacturer SONY
Serial Number: 0558237

2.2.4 Adapter (RS485 to AC/DC Adapter)

Type: none
Manufacturer Münzinger
Serial Number: none

2.3 Mode of Operation During Testing

The transceiver was tested in a test modes as provided from the manufacturer.
The transceiver settings/modes were controlled via the USB port by the laptop PC.
For all control and communication functions the software PCOMM VERSION 1.09 (J. Münzinger) was used.

2.4 Modifications Required for Compliance

For compliance with the fundamental emissions limit the transmitter output power setting was reduced by about 2.5 dB using manufacturer supplied firmware.
(Firmware update using file "rf1.hex V1.6" plus file "rf1_send_4db.ini").

3 TEST RESULTS SUMMARY

Summary of Test Results for the following EUT:

Manufacturer: **Hensel Studiotechnik**
Device: **Flash Link**
Model No.: **3910**
Serial Number: **6**

Requirement	CFR Section	Report Section	Test Result
Antenna Requirement	15.203	4	Pass
AC Line Conducted Emissions	15.107, 15.207	5	Pass
Field Strength Limits (Fundamental and Harmonics)	15.249	6	Pass
Transmitter Radiated Spurious Emissions	15.209, 15.249	6	Pass
Receiver Radiated Emissions	15.109	6	Pass

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the procedure ANSI C63.4 - 1992 and all applicable Public Notices received prior to the date of testing. All emissions from the device were found to be within the limits outlined in this report.
The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report.

Test Personnel: Wolfgang Döring
Issuance Date: 2002-11-20

4 ANTENNA REQUIREMENT

Test Requirement: FCC CFR47, Part 15C

4.1 Regulation

15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

4.2 Result

Manufacturer: **Hensel Studiotechnik**
Device: **Flash Link**
Model No.: **3910**
Serial Number: **6**

Antenna: monopole antenna SMA/868MHz manuf. Jyebao, #868ANT-90AM

The dedicated antenna is connected via SMA connector. Permanent attachment will be achieved by factory-application of a permanent cement or epoxy to this standard antenna connector.

Type of adhesive to be used: Metaflux ® Anaerober Kleber Art. Nr. 76-38.

The manufacturer confirms that the adhesive will be applied at the factory (prior to shipment).

The EUT meets the requirements of this section.

5 CONDUCTED EMISSIONS TESTS

Test Requirement: FCC CFR47, Part 15C

Test Procedure: ANSI C63.4:1992

5.1 Regulation

Section 15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak (QP)	Average (AV)
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

Section 15.207 (c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

5.2 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
EMI Receiver	Rohde & Schwarz ESS	837010/001	05/2001	11/2002
Protector Limiter 10 dB	Rohde & Schwarz ESH3-Z2 357.8810.52	844.165/032	n.a.	n.a.
V-LISN 50 ohms//(50 uH + 5 ohms)	Schwarzbeck NSLK 8126	8126228	03/2002	03/2004
Mains Interference Tester (Mains Power Source 115 VAC 60 Hz)	Haefely LFP6	081972-04	n.a.	n.a.

5.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Ceiling or wall-mounted devices also is positioned on a tabletop for testing purposes. Floor standing equipment is placed either directly on the groundplane or on insulating material if normally placed on a nonconducting floor. The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter. The EUT is connected to a dedicated LISN and all peripherals are connected to a second separate LISN circuit. The LISNs are bonded to the groundplane.
Conducted measurements are made on each current carrying conductor with respect to ground.
Per ANSI C63.4-1992 clause 6.1.2.1 Remotely Located Devices. In certain applications, a remotely located device may be connected to the EUT. In these cases, it is permissible for cabling to the EUT or accessories to be placed directly upon the conducting ground plane or, if normally installed beneath the conducting ground plane, beneath it. The remotely located device shall be located at a distance sufficient to ensure that is does not contribute to the measured level.
Distributed networks, e.g. a local area network, may be simulated on the test site by a length of cable and an actual peripheral or a remote network communications simulator located at a distance sufficient to ensure that it does not contribute to the measured level.

The EUT was tested as a tabletop equipment in two configurations:

a) connected via its USB port to a SONY Notebook computer (MASTER mode),
b) connected via its RS485 port and adapter cable to the supplied AC/DC Adapter (SLAVE mode).

Both tests performed in RX/TX mode (normal data transfer using a second supplied unit as the counterpart. Whilst connected to the RS485 port a continuous test mode was used receiving a test string from the controller unit (mode "e") and transmitting and acknowledge back.
The initial step in collecting conducted data is a peak scan of the measurement range with an EMI test receiver. The significant peaks are then measured with quasi-peak detector.
Worst case conducted emissions are listed under chapter: test results.

5.4 Test Results

Manufacturer: **Hensel Studiotechnik**
Device: **Flash Link**
Model No.: **3910**
Serial Number: **6**

PRODUCT EMISSIONS DATA MASTER mode (powered via USB and Notebook PC)										
No	Tested Line	Emission Frequency	Receiver Bandwidth	Quasi-peak (QP)			Average (AV)			Remarks
				Result	Spec Limit	Margin	Result	Spec Limit	Margin	
		[MHz]	[kHz]	[dBµV]	[dBµV]	[dB]	[dBµV]	[dBµV]	[dB]	
1	N	0.15	10	50.9	66	15.1	-	56	-	
2	L1	0.17	10	47.7	65	12.3	-	55	-	
3	N	0.205	10	48.8	63.4	14.6	35	53.4	18.4	
4	L1	0.205	10	47.0	63.4	16.4	35.4	53.4	18	
5	N	0.41	10	-	57.7	-	30.6	47.7	17.1	
6	L1	0.545	10	-	56	-	33.8	46	12.2	
7	L1	0.615	10	-	56	-	33.4	46	12.6	

PRODUCT EMISSIONS DATA SLAVE mode (powered via RS485 and AC/DC Adapter)										
No	Tested Line	Emission Frequency	Receiver Bandwidth	Quasi-peak (QP)			Average (AV)			Remarks
				Result	Spec Limit	Margin	Result	Spec Limit	Margin	
		[MHz]	[kHz]	[dBµV]	[dBµV]	[dB]	[dBµV]	[dBµV]	[dB]	
1	L1	0.15	10	<30	66	>36	<15	56	>41	
2	L1	0.5	10	<15	56	>41	<5	46	>41	
3	L1	7	10	<25	60	>35	<10	50	>40	
4										
5										
6										
7										

All emissions more than 25 dB below limits.

The EUT meets the requirements of this section.

Test Personnel: Wolfgang Döring
Test Date: 2002-08-30

6 RADIATED EMISSIONS

Test Requirement: FCC CFR47, Part 15C
Test Procedure: ANSI C63.4:1992

6.1 Regulation

Section 15.33 Frequency range of radiated measurements:
(a) Unless otherwise noted in the specific rule section under which the equipment operates for an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:
(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1)-(a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this Section, whichever is the higher frequency range of investigation.

(b) For unintentional radiators *[Remark: Applies to the receiver part / receive mode]*:
(1) Except as otherwise indicated in paragraphs (b)(2) or (b)(3), for an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement (MHz)
Below 1.705	30
1.705 - 108	1000
108 - 500	2000
500 - 1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

(3) Except for a CB receiver, a receiver employing superheterodyne techniques shall be investigated from 30 MHz up to at least the second harmonic of the highest local oscillator frequency generated in the device. If such receiver is controlled by a digital device, the frequency range shall be investigated up to the higher of the second harmonic of the highest local oscillator frequency generated in the device or the upper frequency of the measurement range specified for the digital device in paragraph (b)(1) of this Section.

Section 15.35 Measurement detector functions and bandwidths.
The conducted and radiated emission limits shown in this Part are based on the following, unless otherwise specified elsewhere in this Part:
(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrument using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on

Radio Interference (CISPR) of the International Electrotechnical Commission. As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, as long as the same bandwidths as indicated for CISPR quasi-peak measurements are employed.
Note: For pulse modulated devices with a pulse-repetition frequency of 20 Hz or less and for which CISPR quasi-peak measurements are specified, compliance with the regulations shall be demonstrated using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, using the same measurement bandwidths that are indicated for CISPR quasi-peak measurements.
(b) On any frequency of frequencies above 1000 MHz, the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules in this part, e.g., see § 15.255. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. Measurement of AC power line conducted emissions are performed using a CISPR quasipeak detector, even for devices for which average radiated emission measurements are specified.
(c) Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Section 15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength	Measurement distance
(MHz)	(microvolts/meter)	(meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

(b) In the emission table above, the tighter limit applies at the band edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.
(f) In accordance with Section 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in Section 15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in Section 15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in Section 15.109 that are applicable to the incorporated digital device.

Section 15.109 Radiated emission limits *[Remark: Applies to the receiver part / receive mode].*
(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency	Field Strength
(MHz)	(microvolts/meter)
30–88	100
88–216	150
216–960	200
Above 960	500

Section 15.249 Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz.
(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field Strength of Fundamental	Field Strength of Harmonics
(MHz)	(millivolts/meter)	(microvolts/meter)
902 - 928	50	500
2400 - 2483.5	50	500
5725 - 5875	50	500
24,000 – 24,250	250	2500

(c) Field strength limits are specified at a distance of 3 meters.
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.
(e) As shown in Section 15.35(b), for frequencies above 1000 MHz, the above field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

6.2 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Antenna (30 MHz - 1 GHz)	EMCO Model 3143	9604-1269	06/2002	12/2003
Receiver (30 MHz - 1 GHz)	Rohde & Schwarz ESS	832808/004	07/2002	01/2004
EMI Receiver / Analyzer (1 GHz – 10 GHz)	Rohde & Schwarz ESAI-D ESMI-RF ESMI-B1	833771/008 833827/002 832504/005	05/2002	11/2003
Antenna (1 GHz – 10 GHz)	Schwarzbeck BBHA 9120 D	248	09/2001	09/2003

6.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Ceiling or wall-mounted devices also is positioned on a tabletop for testing purposes. Floor standing equipment is placed either directly on the groundplane or on insulating material if normally placed on a nonconducting floor. *[Remark: Not applicable].* The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter.
Per ANSI C63.4-1992 clause 6.1.2.1 Remotely Located Devices. In certain applications, a remotely located device may be connected to the EUT. In these cases, it is permissible for cabling to the EUT or accessories to be placed directly upon the conducting ground plane or, if normally installed beneath the conducting ground plane, beneath it. The remotely located device shall be located at a distance sufficient to ensure that is does not contribute to the measured level.
Distributed networks, e.g. a local area network, may be simulated on the test site by a length of cable and an actual peripheral or a remote network communications simulator located at a distance sufficient to ensure that it does not contribute to the measured level.

The EUT was tested on a 0.8 meter high tabletop connected via its USB port to a Notebook computer. Measurement above 1 GHz performed placing the EUT at 1.5 meter high for better alignment with the antenna. RX mode tests performed additionally with the EUT connected via its RS485 port to a external AC/DC Adapter.

With the EUT operating in "worst case" mode, emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions *[Remark: Not applicable].* All tests performed with the EUT placed in horizontal polarizations on the nonconductive table.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz - 10,000 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1,000 MHz - 10,000 MHz)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

* According to Section 15.31 (f)(1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near

field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. (...) When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

6.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the restricted band 108-121.94 MHz:

µV/m at 3 meters = 150

150 µV/m corresponds with 43.5 dBµV/m.

6.5 Calculation of Average Correction Factor

The average correction factor is computed by analyzing the "worst case" on time in any 100 mSec time period and using the formula:

Corrections Factor (dB) = 20*log (worst case on time/100 mSec)

Section 15.249 Info: For the fundamental carrier in the 902-928 MHz, no duty cycle correction factor is permitted.

The transmitter has a worst case duty cycle of 100%; therefore an average correction factor is not applicable.

The relationship between average and peak mode reading has been confirmed by direct measurement using the receiver's average and peak detectors.

All emission measurements performed using the test receiver's average detector and the max. hold facility; i.e. the average value measured directly without the necessity of additional correction factor.

6.6 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assume a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 39.8

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

FS = RA + AF + CF + DF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB
DF = Distance Extrapolation Factor in dB,
where DF = 20 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified Distance

Assume the tests performed at a reduced Test Distance of 1.5 m instead of the Specified Distance of 3 m giving a Distance Extrapolation Factor of DF = 20 log(1.5m/3m) = -6 dB.
Assuming a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m), the Cable Factor of 1.1 dB and the Distance Factor of -6 dB are added, giving a field strength of 26 dBµV/m. The 26 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 - 6 = 26 [dBµV/m]
Level in µV/m = Common Antilogarithm (26/20) = 20

6.7 Test Results

Manufacturer: **Hensel Studiotechnik**
Device: **Flash Link**
Model No.: **3910**
Serial Number: **6**

PRODUCT EMISSIONS DATA, TRANSMIT MODE, FUNDAMENTAL AND HARMONICS

No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading RA [dB(µV)]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	915.08	120, AV **120, PK**	3	AV 66.2 **PK 66.4**	27.6	0	0	AV 93.8 **PK 94.0***	**QP 94.0**	h	**QP 0**
2	1830.16	1000, AV 1000, PK	1.5	AV 16.2 PK 22.6	25.3	-6	0	AV 35.5 PK 41.9	AV 54.0 PK 74.0	h	AV 18.5 PK 32.1
3											
4											
5											
6											

ALL OTHER HARMONICS MORE THAN 20 dB BELOW CORRESPONDING LIMIT

Remark: *Compliance with QP limits demonstrated using equipment employing a peak detector function, according to Section 15.35. AV measurement informative only.

PRODUCT EMISSIONS DATA ABOVE 30 MHz, TRANSMIT MODE, (except fundamental and harmonics)

No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading RA [dB(µV)]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit * 15.209 / 15.249 [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	48	120, QP	3	5.5	8	0	0	13.5	40.0 / **44.0**	h	30.5
2	72	120, QP	3	7.5	8.7	0	0	16.2	40.0 / **44.0**	h	27.8
3	192	120, QP	3	8.7	11.5	0	0	20.2	43.5 / **44.0**	h	23.8
4	216	120, QP	3	13.9	12.6	0	0	26.5	43.5 / **44.0**	h	17.5
5	914.64	120, QP	3	12.7	27.6	0	0	40.3	**46.0** / 44.0	h	5.7
6	927	120, QP	3	4.2	27.5	0	0	31.7	**46.0** / 44.0	h	14.3
7	1592	1200, PK	1	31.8	25.1	-9.5	0	47.4	**54.0** / 44.0	v	6.6**
8											
9											
10											
11											

ALL EMISSIONS ABOVE 1 GHz MORE THAN 20 dB BELOW CORRESPONDING LIMIT

Remarks: * The less stringent limit (in **bold letters**) applies.
** Emissions caused by SONY notebook PC.

PRODUCT EMISSIONS DATA ABOVE 30 MHz, RECEIVE MODE											
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading RA [dB(µV)]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit 15.209 [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	48	120, QP	3	5.5	8	0	0	13.5	40.0	h	26.5
2	72	120, QP	3	7.5	8.7	0	0	16.2	40.0	h	23.8
3	192	120, QP	3	8.7	11.5	0	0	20.2	43.5	h	23.3
4	216	120, QP	3	13.9	12.6	0	0	26.5	43.5	h	17.0
5	914.64	120, QP	3	12.7	27.6	0	0	40.3	46.0	h	5.7
6	1592	1200, PK	1	31.8	25.1	-9.5	0	47.4	54.0	v	6.6*

Remark: * Emissions caused by SONY notebook PC.

For transmitter bandwidth plots and band-edge compliance plots refer to **Annex 4**.

The EUT meets the requirements of this section.

Test Personnel: Wolfgang Döring

Test Date: 2002-08-02, 2002-08-28, 2002-09-02

7 PRODUCT LABELING AND INFORMATION TO THE USER

7.1 Labeling

See **Annex 0** for label and label placement information.

7.2 Information to the User

Refer to **Annex 8** for the User Manual. This manual contains compliance information and is shipped with each product.

8 FURTHER PRODUCT INFORMATION

8.1 Theory of Operation

Proprietary HENSEL STUDIOTECHNIK document. Confidentiality requested for this document. Refer to **Annex 5**.

8.2 Block Diagram

Proprietary HENSEL STUDIOTECHNIK document. Confidentiality requested for this document. Refer to **Annex 6**.

8.3 Schematics, Parts Lists, Assembly Drawing

Proprietary HENSEL STUDIOTECHNIK documents. Confidentiality requested for these documents. Refer to **Annex 7**.

9 MISCELLANEOUS COMMENTS AND NOTES

None.

10 LIST OF ANNEXES

The following annexes are separated parts to this test report. These annexes may be file attachments for electronic filing.

Annex	Description	File name	Pages
Annex 0	Label and Label Placement Diagrams	950004DC_Annex0.pdf	2
Annex 1	Photographs of test setups	950004DC_Annex1.pdf	3
Annex 2	Photographs of equipment under test (EUT) external views	950004DC_Annex2.pdf	7
Annex 3	Photographs of equipment under test (EUT) internal views	950004DC_Annex3.pdf	5
Annex 4	Transmitter conducted measurement plots: Bandwidth and Band-edge Compliance	950004DC_Annex4.pdf	4
Annex 5	Theory of Operation	950004DC_Annex6.pdf	4
Annex 6	Block Diagram	950004DC_Annex7.pdf	2
Annex 7	Schematics, Parts List, Assembly Drawings	950004DC_Annex8.pdf	7
Annex 8	User Manual	950004DC_Annex9.pdf	3