The Document Company
Xerox

EMC Test Group

FCC Part 15, Subpart C and Industry Canada RSS-210 Compliance Report for Xerox Corporation Short Range Radio Frequency Identification (RFID) Device Model: TLST

Judgement: The Device Under Test (DUT) met the requirements specified in FCC Part 15, Subpart C, Sections 15.207, 15.209 and 15.225, and Industry Canada RSS-GEN, Sections 6 and 7.2.2. The FCC and Industry Canada specified frequency stability tests were not performed as part of this assessment.

ACCREDITED

Accreditation Certificate Number: 1248-01
Electrical (EMC) Testing

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EMC Test Report Number EMC05006

Type of Report: Electromagnetic Emissions Compliance Test Report

Product: Xerox Corporation RFID Device, Model TLST

Abstract: This report documents the testing completed on an RFID Model TLST as supplied by the client. The DUT was found to conform with the Federal Communications Commission, and Industry Canada regulatory limits for an intentional radiator and low power licence-exempt radiocommunication device, respectively. FCC is an acronym for "Federal Communications Commission. The FCC acronym is used throughout the document in lieu of the CFR 47 Part 15 Subpart C terminology. The IC acronym is used throughout the document in lieu of the Industry Canada RSS-GEN and RSS-210 terminology.

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Heiko Rommelmann, Product Manager

Prepared By: David Spencer **Date:** 11/15/05
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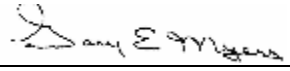
Approved By:  **Date:** 11/15/05
Gary E. Myers, Manager
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Table of Contents

1 GENERAL INFORMATION

1.1 Product Description

The DUT is a 13.56Mhz Short Range Radio Frequency Identification (RFID) Reader/Writer Device that uses inductive loop coupling and an integral transmitter/receiver for information exchange between the host Xerox printing system and a passive tag placed on an internal Customer Replaceable Unit (CRU) such as a toner cartridge. The DUT is intended for use within a copier or printer placed in a Class A (EME) business environment. The DUT is intended to communicate within the host equipment only.

Operating frequency: 13.56MHz +/-7KHz.

Number of Channels: One

Modulation: 10% ASK (Amplitude Shift Keying)
BPSK (Binary Phase Shift Keying).

Antenna: Two Loop Inductive Coil.

Field Strength: 2.7uA/m (at 3m) Maximum.

Power Supply: 5Vdc, +/- 500mA (min).

Duty Cycle: System-Defined by the host control algorithm.
ASK_ Based on 106Kbits data rate.

Equipment Type: Category I.

Model Number: TLST

The following table reflects the PWBA's which contain crystals, oscillators or switcher circuitry.

PWB	PART IDENTIFIER	FREQUENCY	DESCRIPTION
RFID	Model TLST	13.56MHz	RFID for Xerox Printer

1.2 Related Reports / Approvals

This report is the initial compliance report for the Xerox RFID Model TLST. The test data has been filed under Compliance Test File Number EMC05006.

1.3 Tested System Details

The DUT is intended for use in the following classes of electromagnetic emission environment:
Class A = Limits derived for typical commercial establishments.
Class B = Limits derived for typical domestic establishments for which a 10m protection distance is used.

MODEL NAME	Device	CLASS
TLST	13.56MHz RFID	N/A

1.3.1 Host Equipment

List any test support equipment that will be used during testing and specify its connection specification. Test support equipment is equipment, which is not part of the DUT but is required to enable representative operation of the DUT during test.

NAME	DEVICE	MODEL	SERIAL NO.	CABLE TYPE	CABLE LENGTH	PORT NAME
CRUM Read/Write Circuit Interface	I^2C Adapter	703T05001	None	Twisted Pair Ribbon	1.3M	I^2C
Power Supply	Stacor Power Supply	STA-4850	None	2 wire DC	2.1M	DC Power
Personal Computer	Host PC	E3100	000824709	Unshielded and Shielded	1.3M. 2.3M, 1.7M, 1.7M, and 2.1M	Parallel, AC, Keyboard, mouse, Video

1.4 Test Methodology / Reference Standards

Radiated emission testing was performed in accordance with the procedures in ANSI C63.4-2003. Testing was performed at an antenna to DUT distance of 3 meters (9Khz to 1GHz).

Applicable Documents

(a) Federal Communications Commission Rules and Regulations CFR 47 Part 15, Subpart C.
(b) ANSI C63.4-2003, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 KHz to 40 GHz".
(c) Industry Canada, RSS-210 Issue 6, Sept 2005: Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands).
(d) Industry Canada, RSS-Gen Issue 1: Sept 2005: General Requirements and Information for the Certification of Radiocommunication Equipment.

1.5 Test Facility

The EMC Group main offices are located at Xerox Corporation's building 843, 800 Salt Road, Webster, NY 14580. The Semi-Anechoic chamber test site, building 199, located in Webster, NY was used to collect the data. This facility has been fully described in a report submitted to the FCC and accepted in a letter dated February 4, 2004 (Registration # 91070); additionally, submitted to Industry Canada and accepted in a letter dated February 17, 2005 (File # IC 482).

2 SYSTEM TEST CONFIGURATION

2.1 Justification

The system was configured for testing in a stand-alone arrangement. The RFID was connected to an I^2C adaptor and energized using a DC power supply. The RF carrier was configured such that it was transmitting continuously with no modulation in accordance with ANSI C63.4-2003, Section 13.1.1.1. In the product application the RF would only be energized 3-5 times daily with 10% AM Modulation (max.).

2.2 Run Mode(s)

The photograph(s) / drawing(s) in Section 4 reflect the following Configuration(s) and Run Mode(s) which produced the highest radiated and conducted emission levels:

Test	Run Mode
Radiated Emissions	RF Carrier 100%, No modulation, Continuously Transmitting

2.3 Video Mode Justification

Not Applicable

2.4 DUT Exercise Software

Not Applicable

2.5 Special Accessories

Not Applicable

2.6 Equipment Modifications

No equipment modifications were made to the DUT during testing to achieve compliance.

3 CONDUCTED EMISSION DATA

Test Personnel:

Tester Signature David Spencer Date of Testing: 11 / 14 / 05

David Spencer, EMC Engineer
EH&S EMC Test Group

3.1 Test Procedure

The EUT is grounded in accordance with the user manual and is powered at it's nominal voltage via a LISN. All remaining accessories, peripherals and host devices are powered through separate LISN(s) for proper power mains isolation. The LISN(s) used for testing are 50 ohm / 50 uH, the lines not being tested are terminated in a 50 ohm impedance. The initial step in collecting conducted data is a spectrum analyzer peak scan of the frequency range 150 KHz to 30 MHz for each of the EUT's power cord(s) which includes the Neutral and all Hot lines. The associated EUT cabling is manipulated to ensure that the maximum emissions are recorded. The significant peaks on the Neutral Line and each Hot line are marked, quasi-peaked and averaged as necessary. Testing is performed while the EUT is in the standby mode and each available run mode. Run mode(s) are chosen in order to exercise the EUT's available options and to maximize the emission profile. When multiple run modes exist, prescanning is performed to identify the worse case emission profile. The worse case emission profile is then used to complete the compliance evaluation. The conducted emissions photographs / drawings in Section 5 reflect the worse case configuration and cabling needed to ensure that the emissions don't vary more than 2dB due to additional cabling being installed.

3.2 Measured Data

Conductor	Frequency [MHz]	Measured Value * [dB(uV)]	CFR 47 Part 15 Quasi-Peak Limit [dB(uV)]	CFR 47 Part 15 Average Limit [dB(uV)]
Neutral	0.150	46.1	66.0	56.0
Neutral	6.985	33.7	60	50
Neutral	10.446	25.9	60	50
Neutral	13.5645	44.1/43.5***	60	50
Neutral	20.34	20.1	60	50
Neutral	27.13	37.6/36.8***	60	50
Line 1	0.150	45.3	66	56
Line 1	10.446	24.9	60	50
Line 1	10.567	24.0	60	50
Line 1	13.564	43.3/42.8***	60	50
Line 1	20.35	22.5	60	50
Line 1	27.13	38.9/37.9***	60	50

***** All readings are peak unless stated otherwise.
****** Identifies a quasi-peak reading.
******* Identifies an average reading.

3.3 Test Instruments Used, Conducted Measurements

Type	EMC Group Barcode	Manufacturer / Model Number	Serial Number	Last Cal Date (M/D/Y)	Cal Interval
EME Receiver	042783	Rohde & Schwarz / ESBI	DE11158	6/28/05	1 Year
LISN	36823	Fischer Custom Communications/ FCC-LISN-50/250-100-4	9703	2/10/05	1 Year
Temperature & Relative Humidity Sensor	101224	Omega / CT485	412000738W1	12/22/04	1 Year

This equipment complies with the requirements of ANSI C63.4-2003.

3.4 Environmental Conditions

Temperature (ºC)	Relative Humidity (%)
21	45

4 RADIATED EMISSION DATA

Test Personnel:

Tester Signature David Spencer Date of Testing: 05 / 05 / 05

David Spencer, EMC Engineer
DSSG / EH&S / EMC Test Group

4.1 Test Procedure

The antenna to DUT distance is 3 Meters. The antenna mast and turntable are automated. The antenna mast is capable of searching from 1 to 4 Meters and the turntable can rotate a full 360 degrees. A magnetic loop antenna is used below 30MHz, a Biconical antenna is used for the 30 to 200 MHz frequency range and Log Periodic antenna is used for the 200 to 1000 MHz frequency range. A Horn antenna is used from 1GHz to 40GHz. Correction factors are entered into the automated receiver which include cable loss, attenuators, pre-amplifiers and antenna factors. While the operator is taking data, the correction factors are always present within the receiver's non-volatile memory. The appropriate antenna is placed on the antenna mast at a height of 1 Meter in the vertical polarity. The initial step in collecting radiated data is through the use of an automated receiver scan. As applicable, the automated receiver scans are broken into the following frequency ranges: 150Khz – 30Mhz, 30-200, 200-1000 MHz and 1-40 GHz (split up for appropriate display resolution). Significant peaks are then marked and evaluated using a CISPR quasi-peak detector while the unit is rotated 360 degrees to find the maximum emission angle. While the DUT is at the maximum emission angle and orthogonal axes, the antenna height is operated from 1 to 4 meters to determine the maximum emission height. For testing with the magnetic loop antenna: loop antenna remains at 1 meter from the center of the loop and is rotated about its vertical center axis while the signal level is maximized. The associated DUT cabling is manipulated to ensure that the maximum emissions are recorded. The maximum quasi-peak signal level, angle, height and polarity are then recorded. The procedure is then repeated with the antenna placed in the horizontal polarity. The antenna is placed at a height of 4 Meters for the horizontal automated receiver scan. While the antenna is in the horizontal polarization, the emissions are maximized as described for the vertical polarity. All scans are performed with the DUT operating in the run mode. Run mode(s) are chosen in order to exercise the DUT's available options and to maximize the emission profile. When multiple run modes exist, pre-scanning is performed to identify the worse case emission profile. The worse case emission profile is then used to complete the compliance evaluation. The radiated emissions photographs / drawings in Section 4 reflect the worse case configuration and cabling needed to ensure that the emissions don't vary more than 2dB due to additional cabling being installed.

DUTs operating above 100 MHz are evaluated against the applicable FCC limits above 1 GHz using a 1 MHz resolution bandwidth. Both peak and average detectors are used to determine compliance. When testing above 1 GHz, a boresight antenna mast is used and the operator pays particular attention to the beamwidth of the Horn antenna and the size of the DUT. The antenna mast and turntable positioning / sequencing is the same as the 30 - 1000 MHz frequency range, except for the boresight capability.

The following data lists the significant emission frequencies, antenna polarity, corrected reading (includes measured reading, cable correction factor, attenuator factor, preamplifier factor and antenna correction factor) and the legal limit. Explanation of the Corrected Reading is given in paragraph 3.4. The frequency range investigated was 9KHz to 1000MHz.

4.2 Measured Data

Freq [MHz]	Antenna Height [Meters]	Antenna Polarity [V/H]	DUT Angle [Degrees]/ DUT Axis	* Corrected Reading [dB(uV/m)]	FCC Part 15 3 Meter Limit [dB(uV/m)
13.56	1	V	0/X	73.2**	104
40.68	1	V	0/X	26.2	40
54.24	1	V	29/X	28.3	40
67.81	1	V	180/X	21.5	40
81.39	1	V	57/X	20.5	40
94.94	1	V	0/X	20.7	43.5
167.75	1	V	40/X	24.4	43.5
189.90	1	V	315/X	28.1	43.5
13.56	1	V	0/Y	76.3**	104
40.68	1	V	0/Y	25.2	40
54.24	1	V	30/Y	27.4	40
67.81	1	V	176/Y	22.1	40
81.39	1	V	56/Y	17.3	40
94.94	1	V	0/Y	21.3	43.5
162.77	1	V	43/Y	24.9	43.5
189.90	1	V	320/Y	28.1	43.5
13.56	1	V	0/Z	70.8**	104
40.68	1	V	0/Z	23.2	40
54.24	1	V	30/Z	20.1	40
67.81	1	V	180/Z	20.2	40
81.39	1	V	60/Z	17.5	40
94.94	1	V	0/Z	19.8	43.5
135.64	1	V	0/Z	27.3	43.5
162.77	1	V	0/Z	23.7	43.5
189.90	1	V	0/Z	28.5	43.5

***** All readings are quasi-peak, using a 120kHz resolution bandwidth, unless stated otherwise.

****** Identifies a quasi-peak reading, using a 9kHz resolution bandwidth.

******* Identifies an average reading, using a 1 MHz resolution bandwidth.

4.3 Test Instruments Used, Radiated Measurements

Type	EMC Group Barcode	Manufacturer / Model Number	Serial Number	Last Cal Date (M/D/Y)	Cal Interval
EME Receiver	24086	Rohde & Schwarz / ESIB 40	100090	1/3/2005	1 Year
RF Preamplifier	30907	Hewlett Packard / 8447D	2944A08955	9/9/2004	1 Year
RF 6 dB Attenuator	30828	Hewlett Packard / 8491A	37347	3/21/2005	1 Year
Biconical Antenna	30862	EMCO / 3109	9503-2891	9/5/2004	1 Year
Log Periodic Antenna	30850	EMCO / 3146	9305-3621	9/12/2004	1 Year
Temperature & Relative Humidity Sensor	101920	Omega / CT-485B	509005420D	5/27/2004	1 Year
Magnetic Loop Antenna	030998	Rohde & Schwarz/ HFH2-Z2	880665/005	04/05/05	1 Year

This equipment complies with the requirements of ANSI C63.4-2003.

4.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, Attenuator Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows.

FS = RA + AF + CF + ATF- AG

where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
ATF = Attenuator Factor
AG = Amplifier Gain

Assume a receiver reading of 52.5 dBuV/m is obtained. The Antenna Factor of 6.4 dB, a Cable Factor of 1.1 dB and an Attenuator Factor of 1 dB is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/m.

FS = 52.5 + 6.4 + 1.1 + 1 - 29 = 32 dBuV/m

The 32 dBuV/m value can be mathematically converted to its corresponding level in uV/m.

Level in uV/m = Common Antilogarithm [(32 dBuV/m)/20] = 39.8 uV/m

4.5 Environmental Conditions

Temperature (°C)	**Relative Humidity (%)**
20	42

5 MEASUREMENT PHOTOGRAPH(S) / DIAGRAM(S)

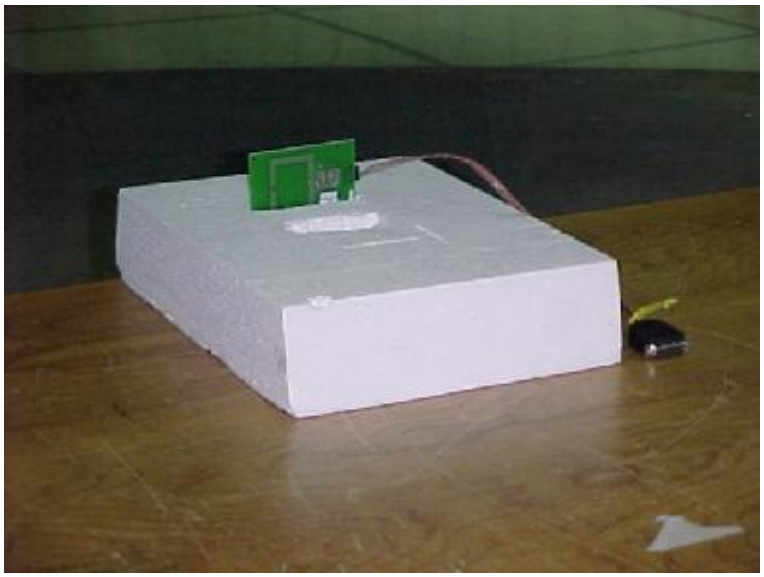

Figure 1 - DUT Arrangement During Final Radiated Emission Measurements, Rear View

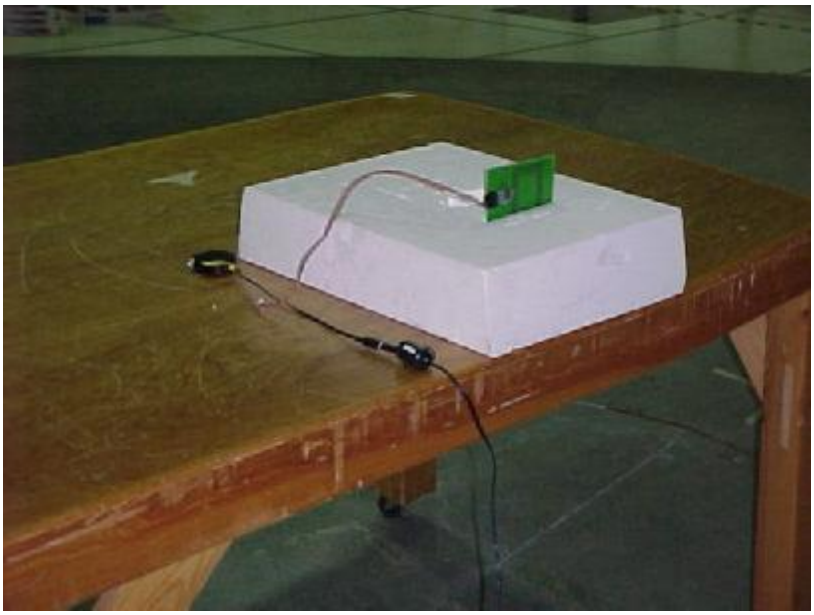

Figure 2 - DUT Arrangement During Final Radiated Emission Measurements, Front View

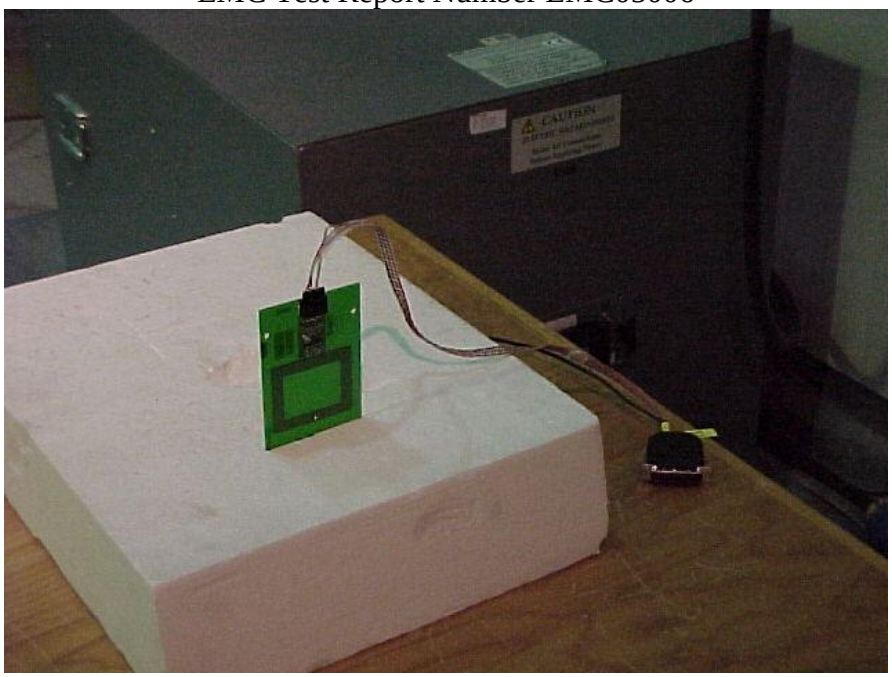

Figure 3 DUT Arrangement During Final Conducted Emission Measurements

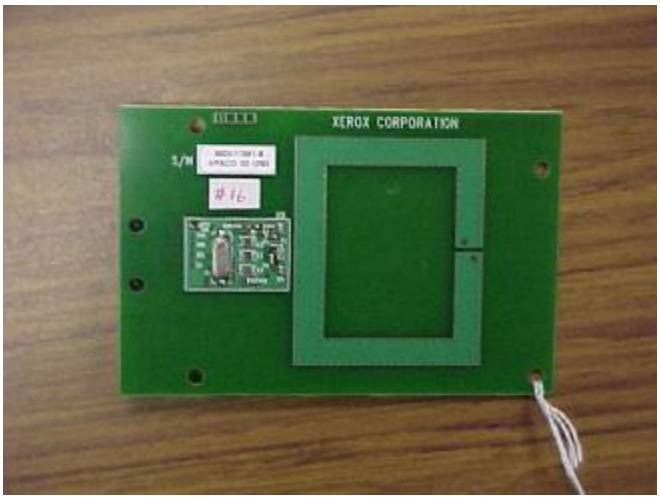

Figure 4 PWBA Detail

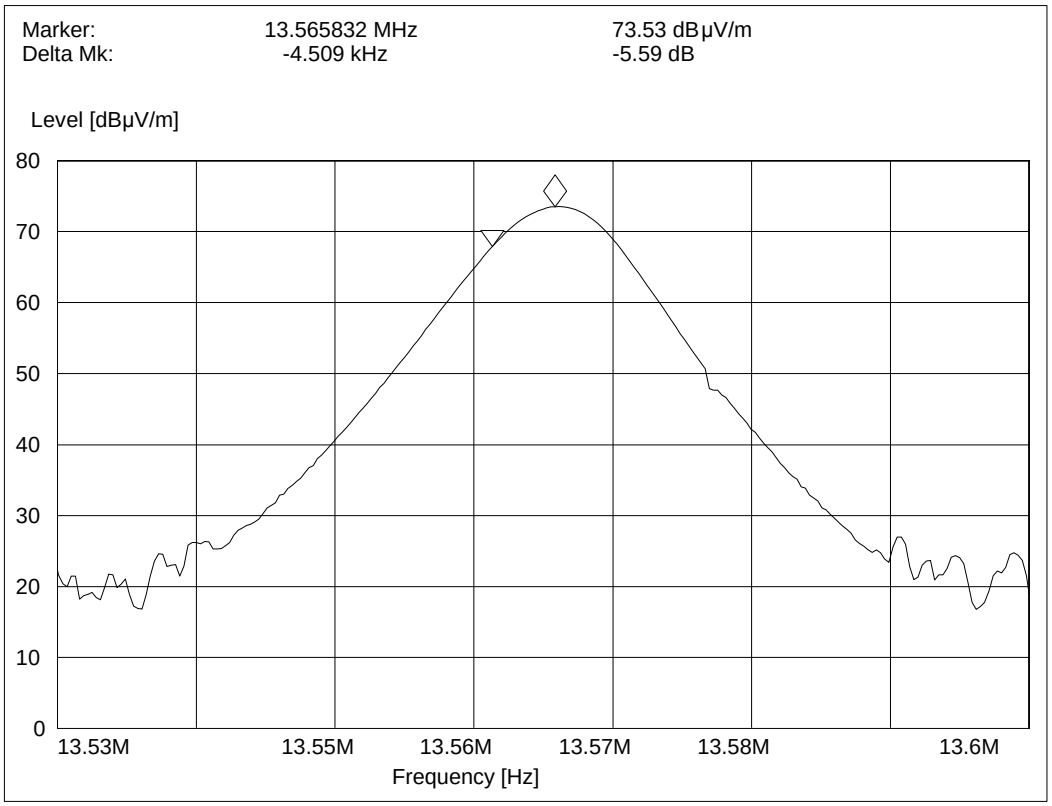

Figure 5 13.56MHz Bandwidth
Resolution BW: 9KHz, Video BW: 30KHz

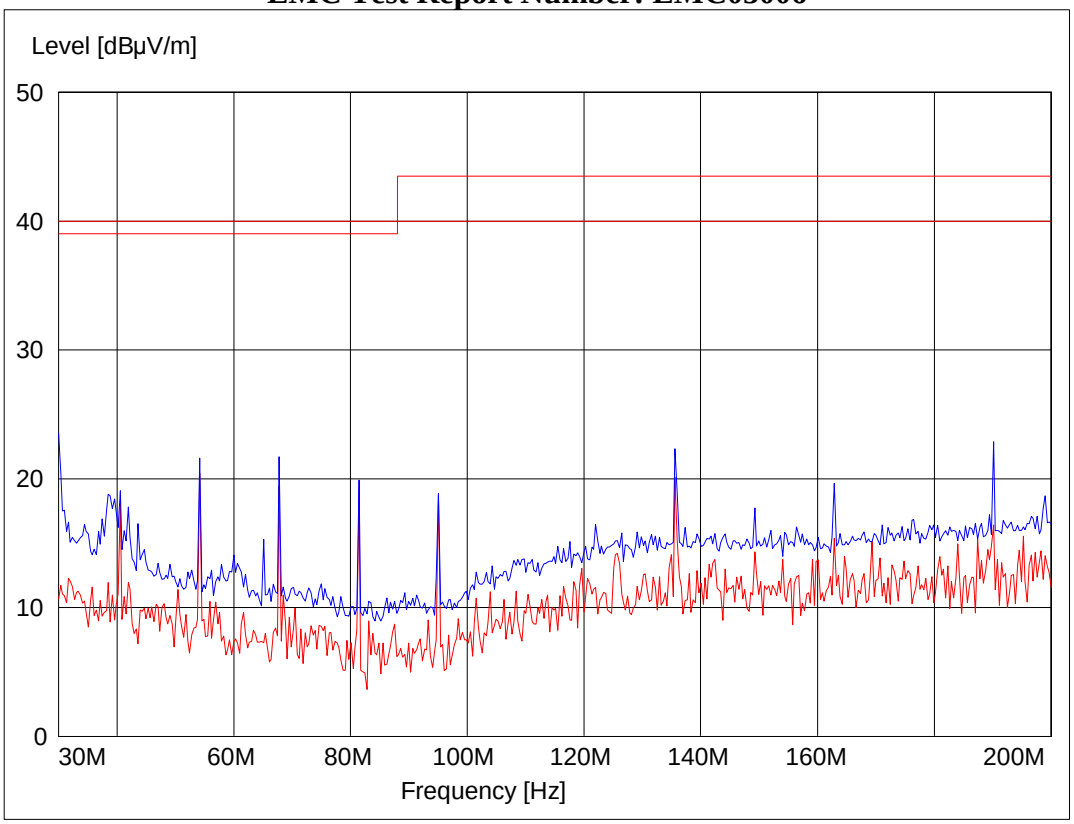

Figure 6 DUT X Axis Vertical Receive Antenna Polarization

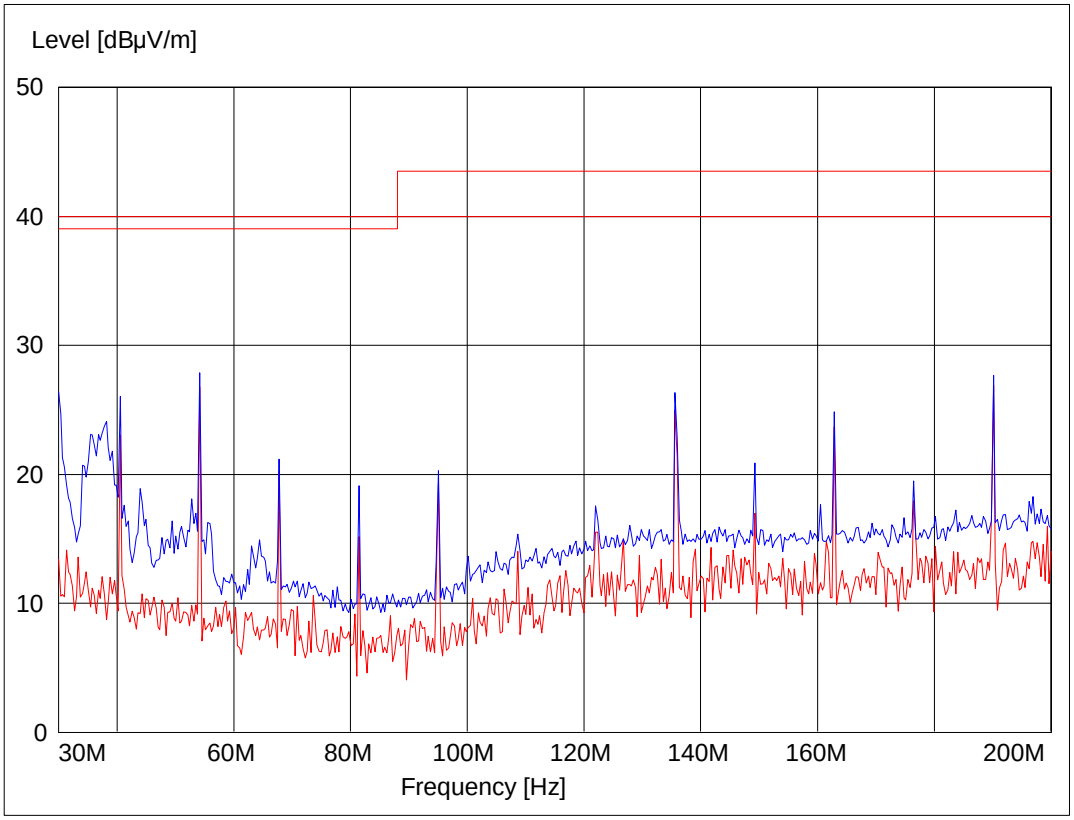

Figure 7 DUT X Axis Horizontal Receive Antenna Polarization

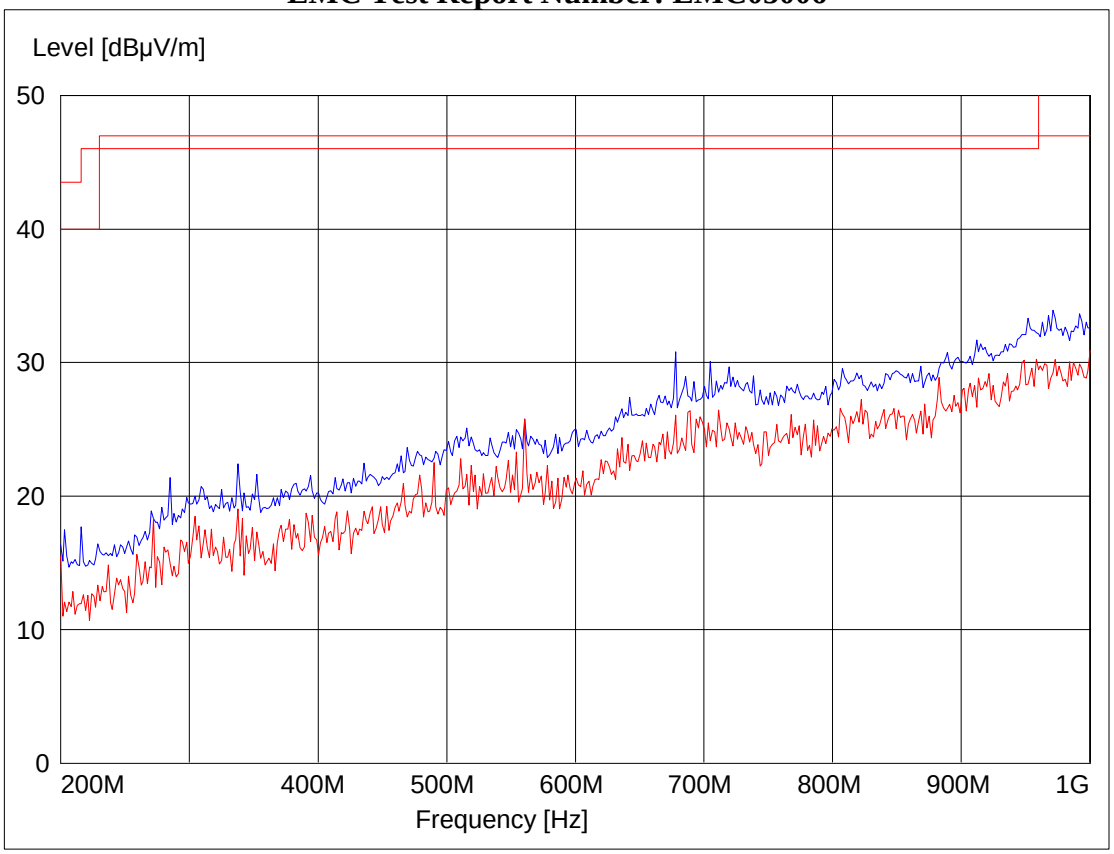

Figure 8 DUT X Axis Vertical Antenna Polarization

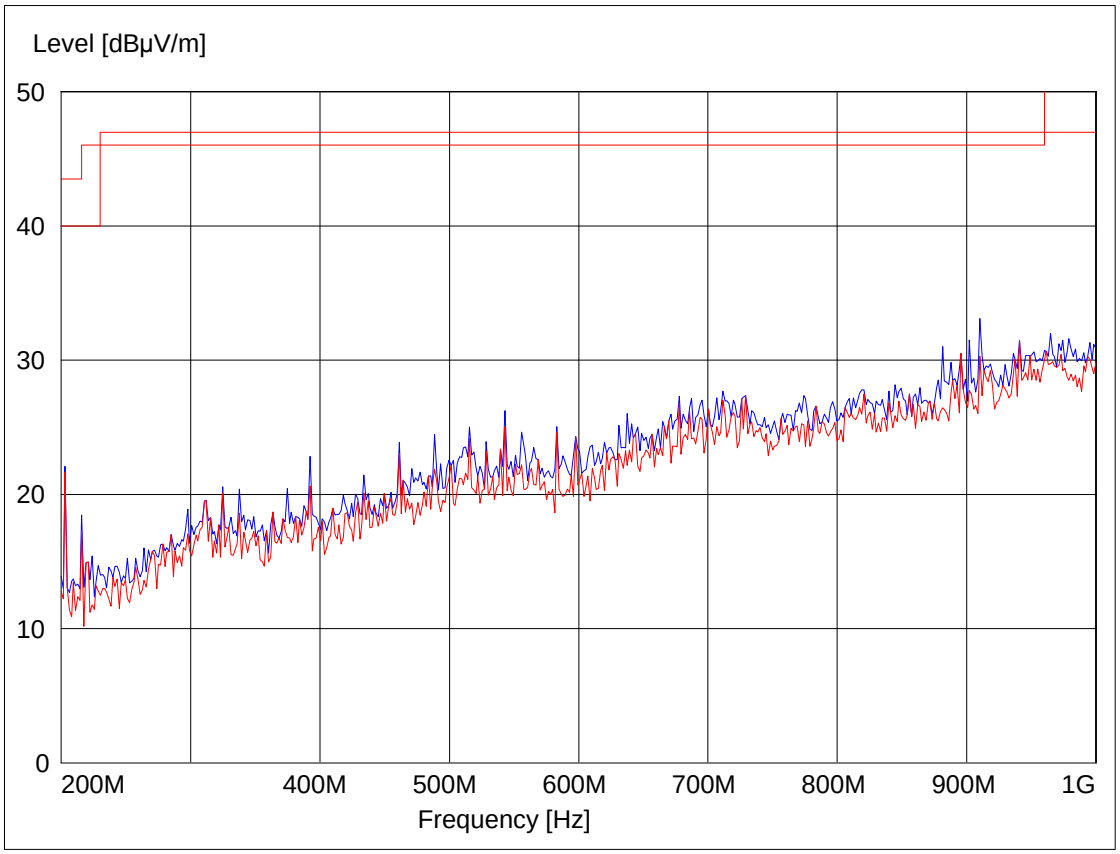

Figure 9 DUT X Axis Vertical Receive Antenna Polarization

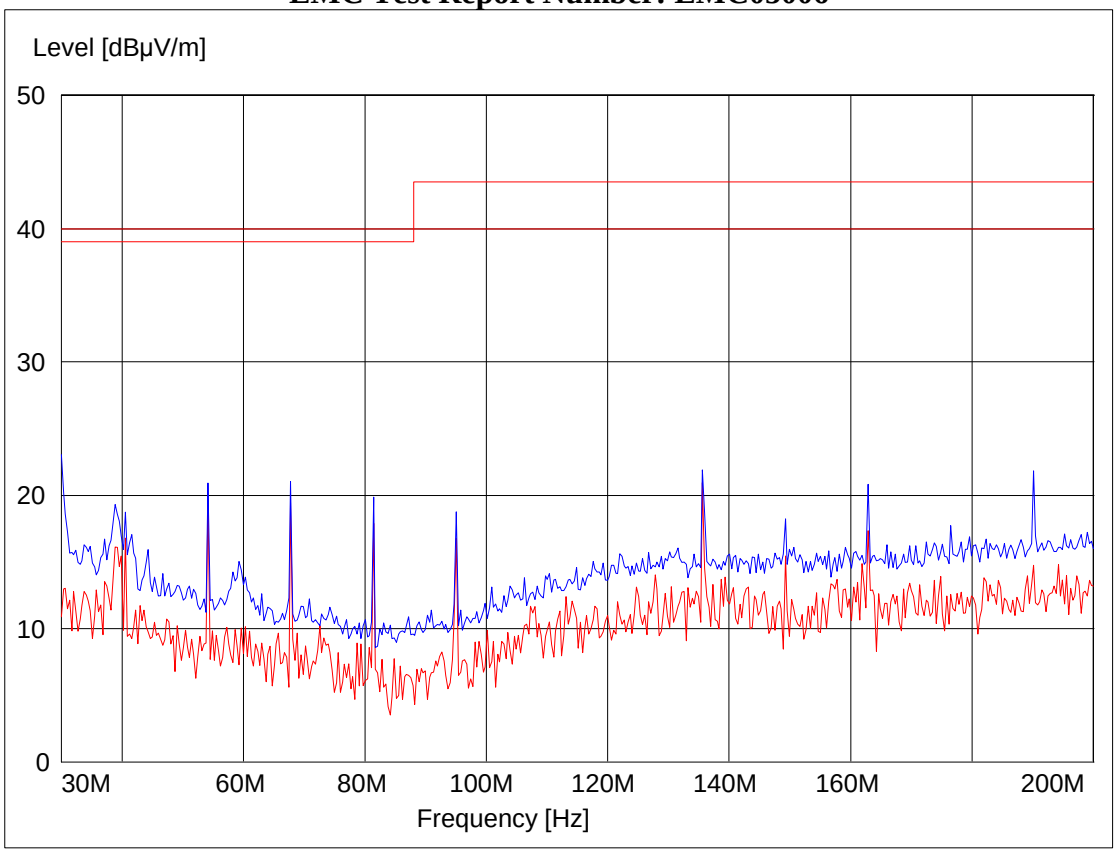

Figure 10 DUT Y Axis Vertical Receive Antenna Polarization

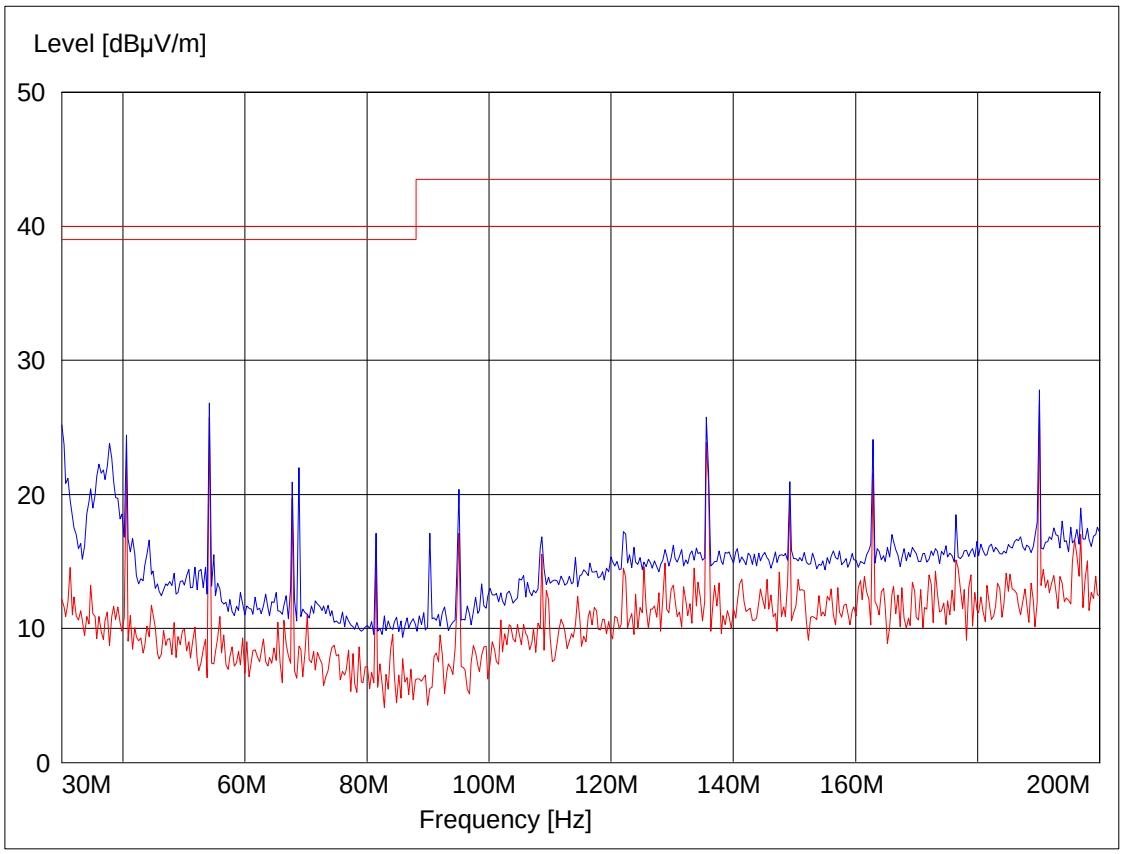

Figure 11 DUT Y Axis Horizontal Receive Antenna Polarization

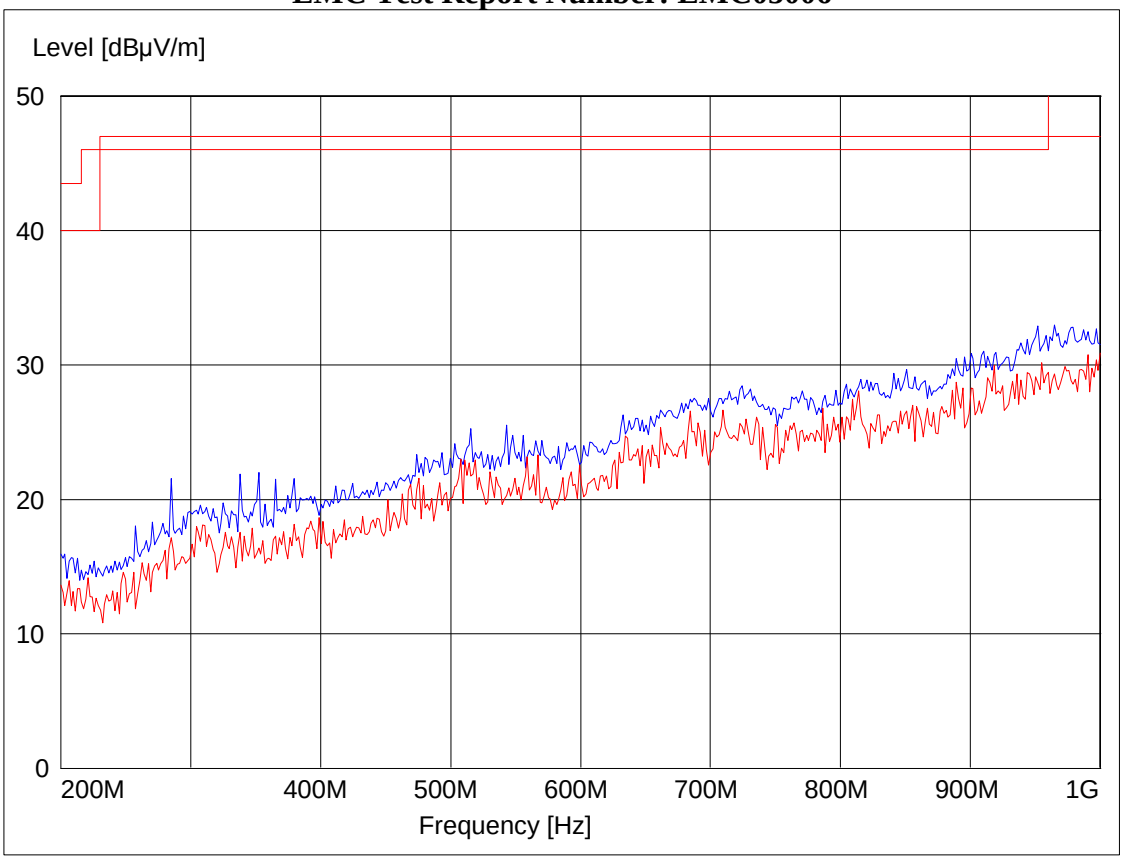

Figure 12 DUT Y Axis Horizontal Receive Antenna Polarization

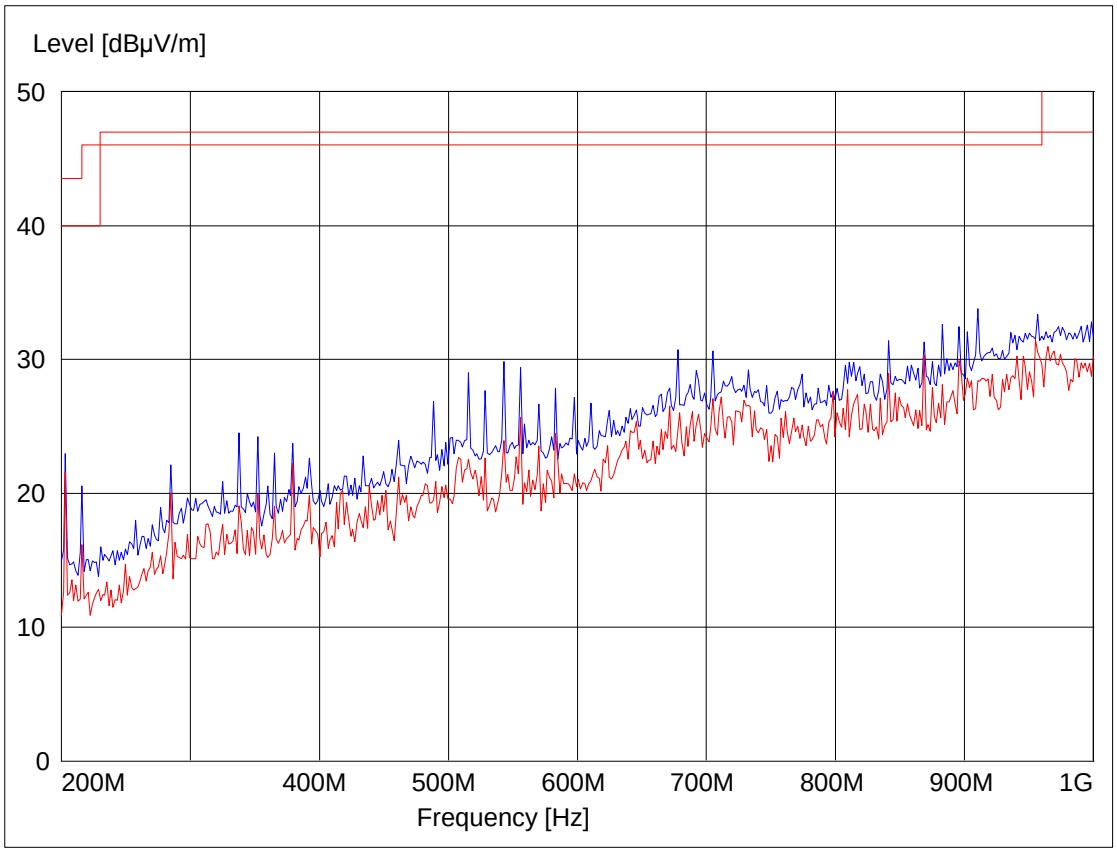

Figure 13 DUT Y Axis Vertical Receive Antenna Polarization

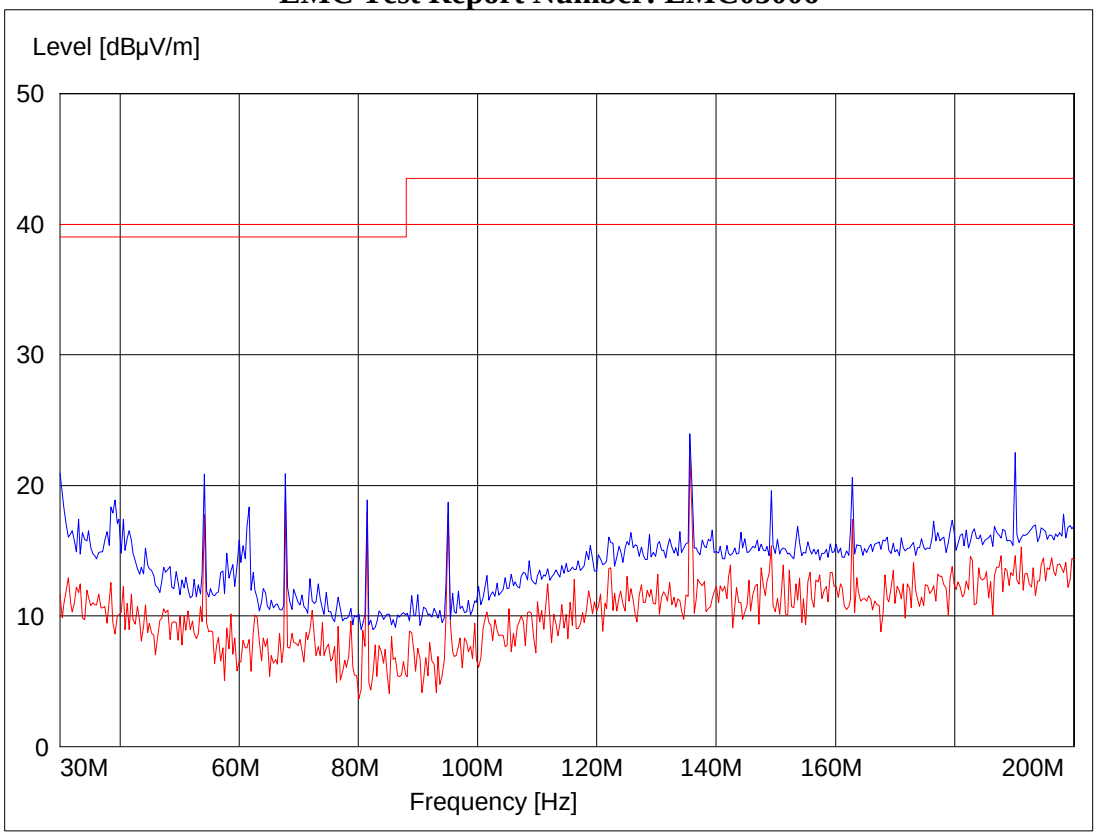

Figure14 DUT Z Axis Vertical Receive Antenna Polarization

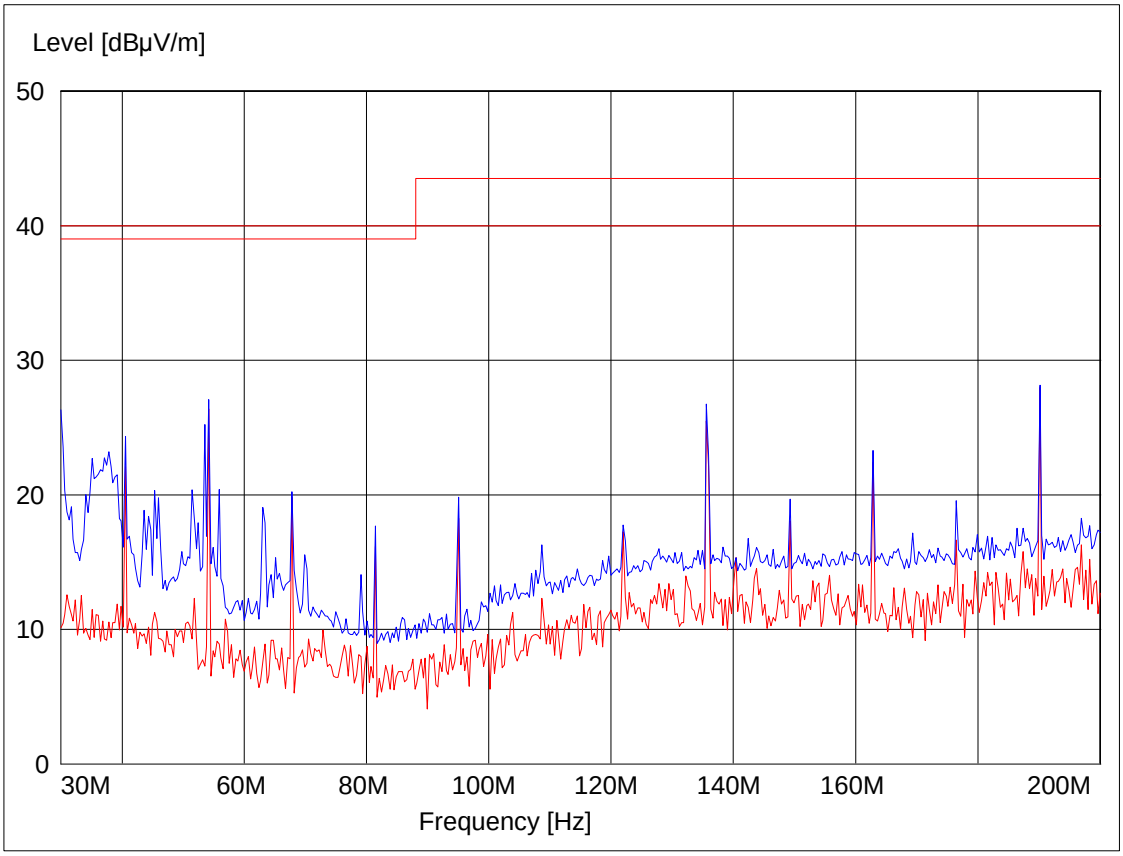

Figure15 DUT Z Axis Horizontal Receive Antenna Polarization

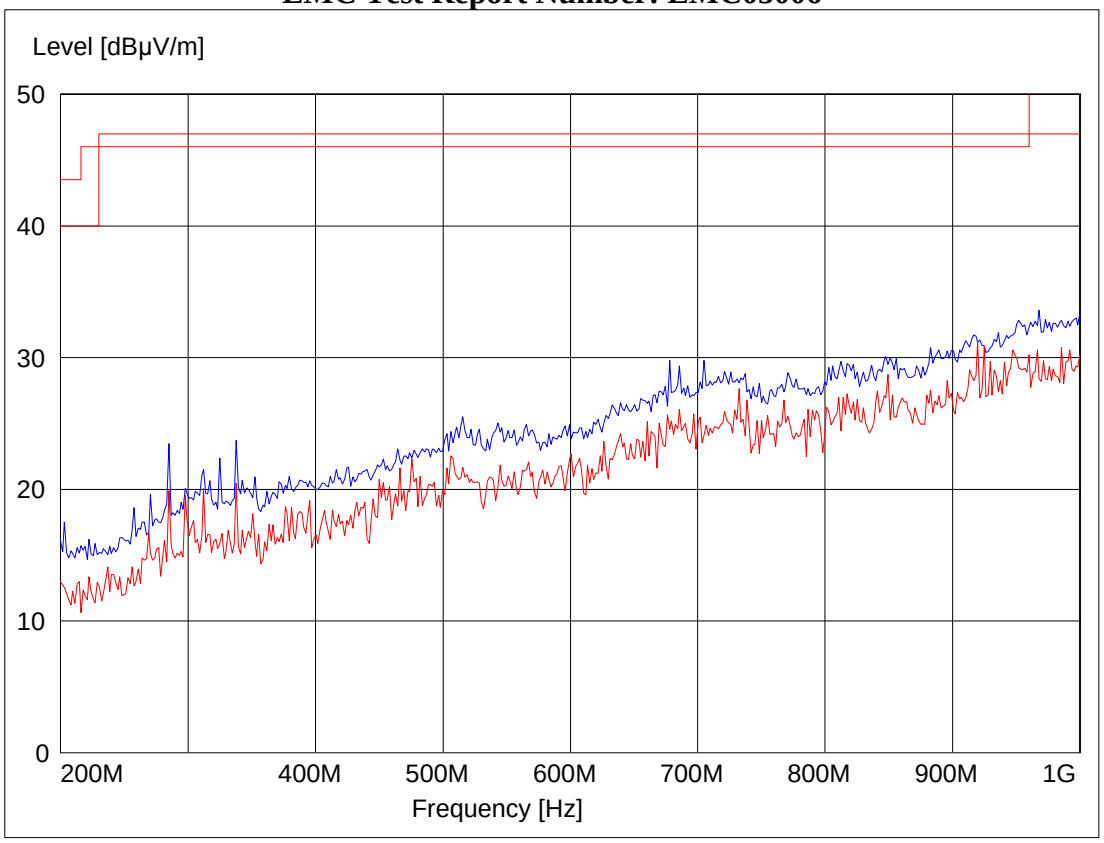

Figure16 DUT Z Axis Vertical Receive Antenna Polarization

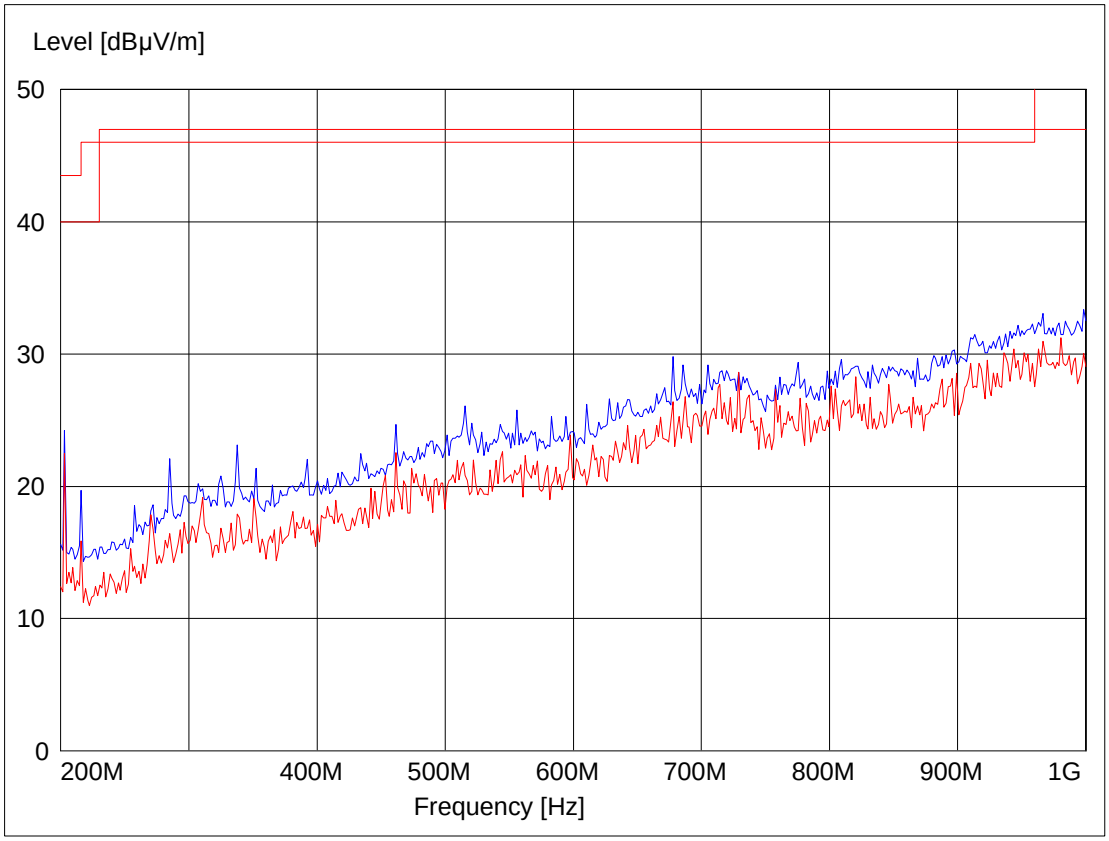

Figure 17 DUT Z Axis Horizontal Receive Antenna Polarization

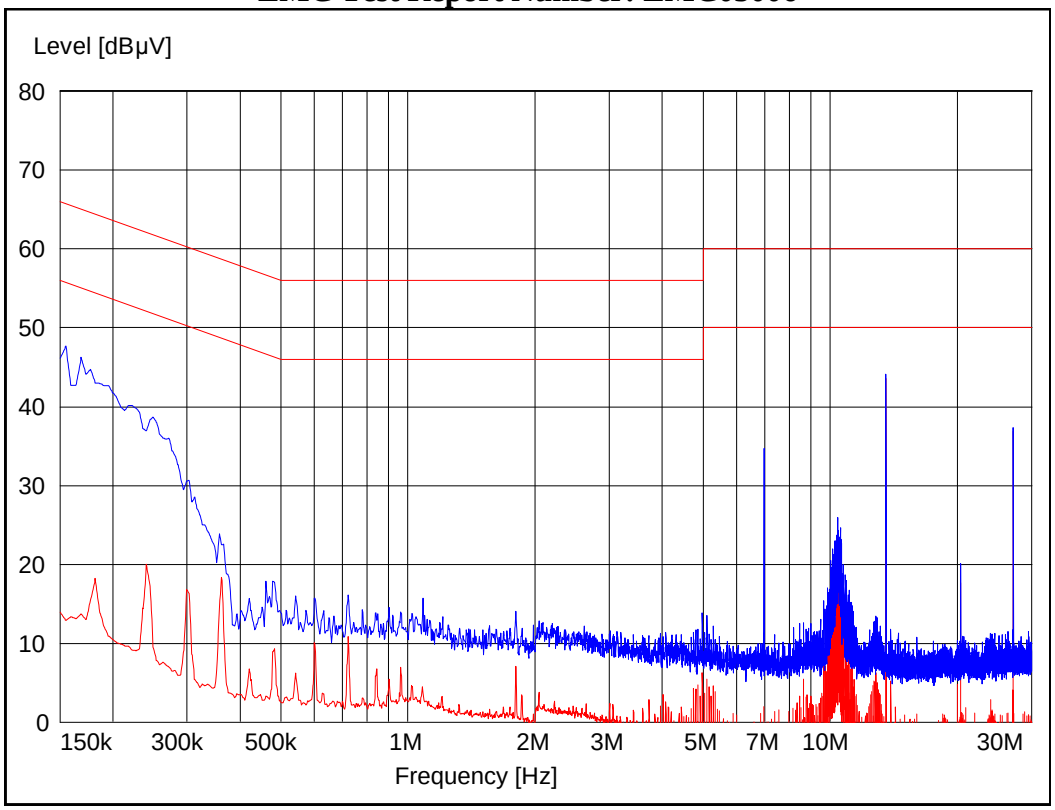

Figure 18 Conducted Emission Line 1

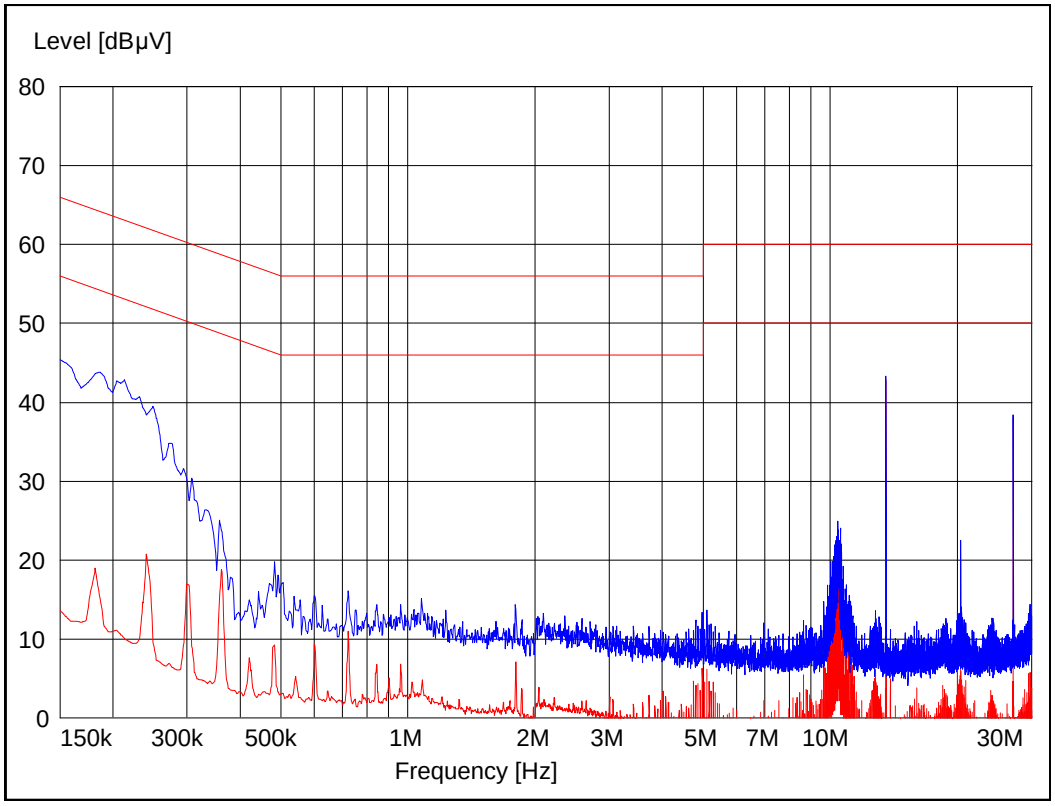

Figure 19 Conducted Emissions Line 2