ncee labs
Product Compliance Solutions

4740 Discovery Drive | Lincoln, NE 68521
tel- 402.323.6233 | tel -888.657.6860 | fax - 402.323.6238
info@nceelabs.com | http://nceelabs.com

EMC Verification Test Report

Prepared for:	**KoreLock, Inc.**
Address:	**7100 E. Bellevue Ave. Suite 203** **Greenwood Village, CO 80111 USA**
EUT:	**KIC Select series locks**
Test Report No.:	**R20240322-70-E3E**
Approved By:	 **Fox Lane,** **EMC Test Engineer**
Date:	18 October 2024
Total Pages:	15

ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

Revision Page

Rev. No.	Date	Description
Original	17 July 2024	Reviewed and Issued by FLane Prepared by ESchmidt
A	31 July 2024	Updated Device Type and EUT Name - FL
B	7 August 2024	Checked settings – FL
C	12 August 2024	Updated Model Name - FL
D	15 August 2024	Added C2PC statement to section 1.1 - FL
E	18 October 2024	Removed Setup Photos – FL

TABLE OF CONTENTS

1 Summary of Test Results

The EUT was tested for compliance with the following standards and/or regulations.

1.1 Emissions Test Results

The EUT was tested for compliance to:

FCC eCFR Title 47 Part 15

Below is a summary of the test results. Complete results of testing can be found in Section 3.

Table 1 – Emissions Test Results

Emissions Tests	Test Method and Limits	Result
Radiated Emissions	FCC 15.209 FCC 15.247 KDB 996369 D04	Complies

These tests were completed with the intention of a Class 2 Permissive Change.

2 EUT Description

2.1 Equipment under Test (EUT)

Table 2 – Equipment under Test (EUT)

EUT	KIC Select series locks
FCC ID	2BBNS-KLKIC
EUT Received	23 April 2024
EUT Tested	28 May 2024 - 16 July 2024
Serial No.	011633 (NCEE Assigned Serial number)
Operating Band	2400 – 2483.5 MHz
Device Type	☐ GMSK ☒ GFSK ☐ BT BR ☐ BT EDR 2MB ☐ BT EDR 3MB ☐ 802.11x
Power Supply / Voltage	Internal Batteries 4xAA batteries

2.2 Laboratory Description

Testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

A2LA Certificate Number:	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A-1
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of 35 ± 10%
Temperature of 24 ± 3° C

2.3 EUT Setup

The EUT was powered by internal batteries and programmed via serial port to transmit the GFSK 1MB and 2MB modulations.

3 Test Results

3.1 Radiated Emissions

Test:	15.209, ICES-003 Issue 7 KDB 996369 D04
Test Specifications:	Class B
Test Result:	Complies

3.1.1 Test Description

Radiated emissions measurements were made from 30MHz to 1GHz at a distance of 10m inside a semi-anechoic chamber. The EUT was rotated 360°, the antenna height varied from 1-4 meters and both the vertical and horizontal antenna polarizations examined. The results were compared against the limits. Measurements were made by first using a spectrum analyzer to acquire the signal spectrum; individual frequencies were then measured using a CISPR 16.1 compliant receiver with the following bandwidth setting:

30MHz – 1GHz:120kHz IF bandwidth, 60kHz steps

3.1.2 Test Results

No radiated emissions measurements were found in excess of the limits. Test result data can be seen below.

3.1.3 Test Environment

Testing was performed at the NCEE Labs Lincoln facility in the 10m semi-anechoic chamber. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of 35 ± 5%

Temperature of 23 ±2^{o} C

3.1.4 Test Setup

The EUT was tested while powered with 120V 60Hz. See Section 2.3 for further details.

3.1.5 Test Equipment Used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	July 17, 2023	July 17, 2025
Com-Power Hybrid Antenna	ACL-6000	10350002	April 29, 2024	April 29, 2025
ETS-Lindgren Red Horn Antenna	3117	00029616	May 16, 2024	May 16, 2025
ETS Red Preamplifier (Orange)*	3115-PA	00218576	January 22, 2024	January 22, 2026
RF Cable (preamplifier to antenna)*	MFR-57500	01-07-002	June 5, 2023	June 5, 2025
ETS – Lindgren- VSWR on 10m Chamber	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	May 15, 2024	May 15, 2027
NCEE Labs-NSA on 10m Chamber*	10m Semi-anechoic chamber-NSA	NCEE-001	May 22, 2024	May 22, 2026
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	June 5, 2023	June 5, 2025
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3874	June 5, 2023	June 5, 2025
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	June 5, 2023	June 5, 2025
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	June 5, 2023	June 5, 2025
N connector bulkhead (control room)*	PE9128	NCEEBH2	June 5, 2023	June 5, 2025
TDK Emissions Lab Software	V11.25	700307	NA	NA

*Internal verification

3.1.6 Test Pictures and/or Figures

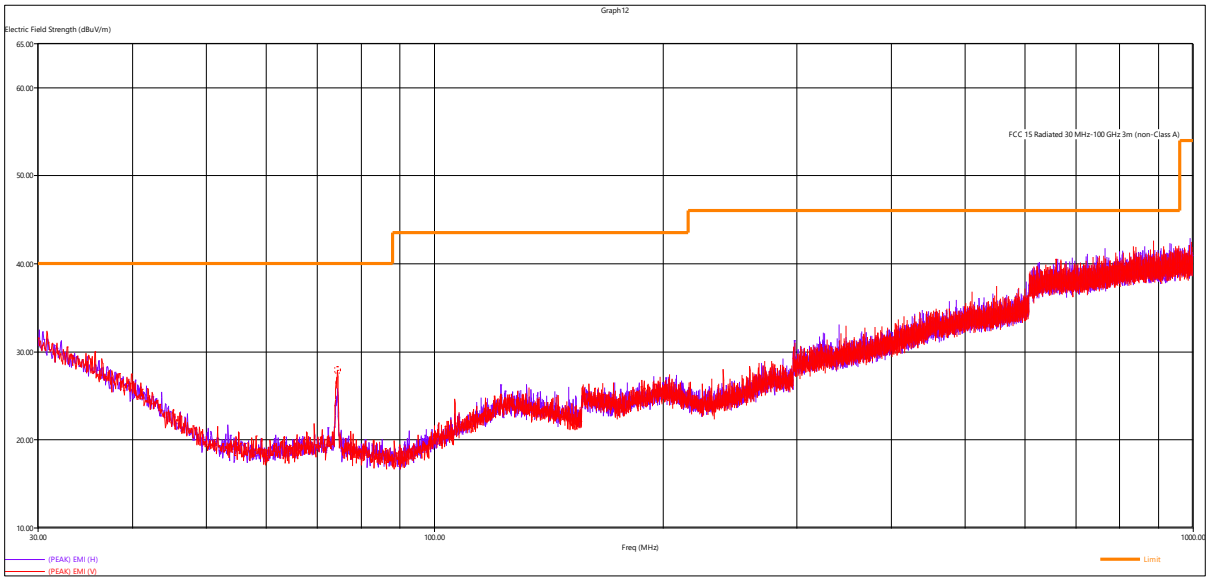

Figure 1 – Radiated Emissions Plot, BLE 1MB, High

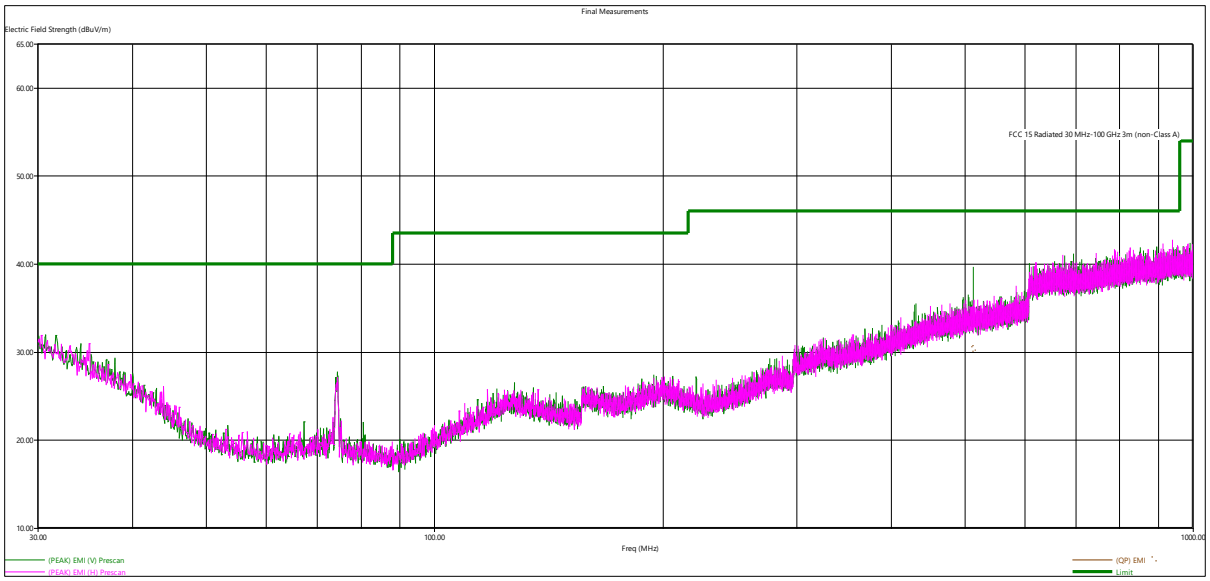

Figure 2 – Radiated Emissions Plot, BLE 2MB, Mid

Table 3 – Radiated Emissions QP Data

Freq	(QP) EMI	Limit	(QP) Margin	Twr Ht	Ttbl Ang	Pol	Channel	Modulation
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(deg)			
512.594880	30.31	46.02	15.71	343.50	74.00	V	Mid	BLE 2MB

Peak Measurements, 802.11x								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
2402.004000	92.41	N/A	N/A	207.02	36.00	V	Low	BLE 1MB
2440.278000	97.12	N/A	N/A	245.41	111.50	H	Mid	BLE 1MB
2479.830000	95.54	N/A	N/A	133.35	55.00	H	High	BLE 1MB
2401.508000	95.10	N/A	N/A	252.88	108.50	H	Low	BLE 2MB
2439.526000	96.55	N/A	N/A	246.01	110.75	H	Mid	BLE 2MB
2479.600000	95.08	N/A	N/A	130.13	50.50	H	High	BLE 2MB
7320.354000	51.70	73.98	22.28	165.77	343.75	V	Mid	BLE 1MB
7439.200000	51.57	73.98	22.41	527.92	348.75	H	High	BLE 1MB
7318.534000	51.45	73.98	22.53	556.22	120.50	H	Mid	BLE 2MB
7441.412000	49.11	73.98	24.87	212.52	290.25	H	High	BLE 2MB

Average Measurements, 802.11x								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
2402.004000	91.02	N/A	N/A	207.02	36.00	V	Low	BLE 1MB
2440.278000	93.86	N/A	N/A	245.41	111.50	H	Mid	BLE 1MB
2479.830000	93.62	N/A	N/A	133.35	55.00	H	High	BLE 1MB
2401.508000	88.24	N/A	N/A	252.88	108.50	H	Low	BLE 2MB
2439.526000	90.79	N/A	N/A	246.01	110.75	H	Mid	BLE 2MB
2479.600000	90.09	N/A	N/A	130.13	50.50	H	High	BLE 2MB
7320.354000	42.37	53.98	11.61	165.77	343.75	V	Mid	BLE 1MB
7439.200000	41.52	53.98	12.46	527.92	348.75	H	High	BLE 1MB
7318.534000	39.90	53.98	14.08	556.22	120.50	H	Mid	BLE 2MB
7441.412000	37.63	53.98	16.35	212.52	290.25	H	High	BLE 2MB

Worst case radiated spurious emissions were investigated for internal module, FCC ID: SQGBL654, and found to be compliant.

3.2 Band edges

Test Method:

All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of band-edge measurements:

For FCC Part 15.247 Device:

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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test procedures:

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. The restricted band edge compliance is shown by comparing it to the general limit defined in Part 15.209. The level shown in the graph accounts for the antenna gain of the device.

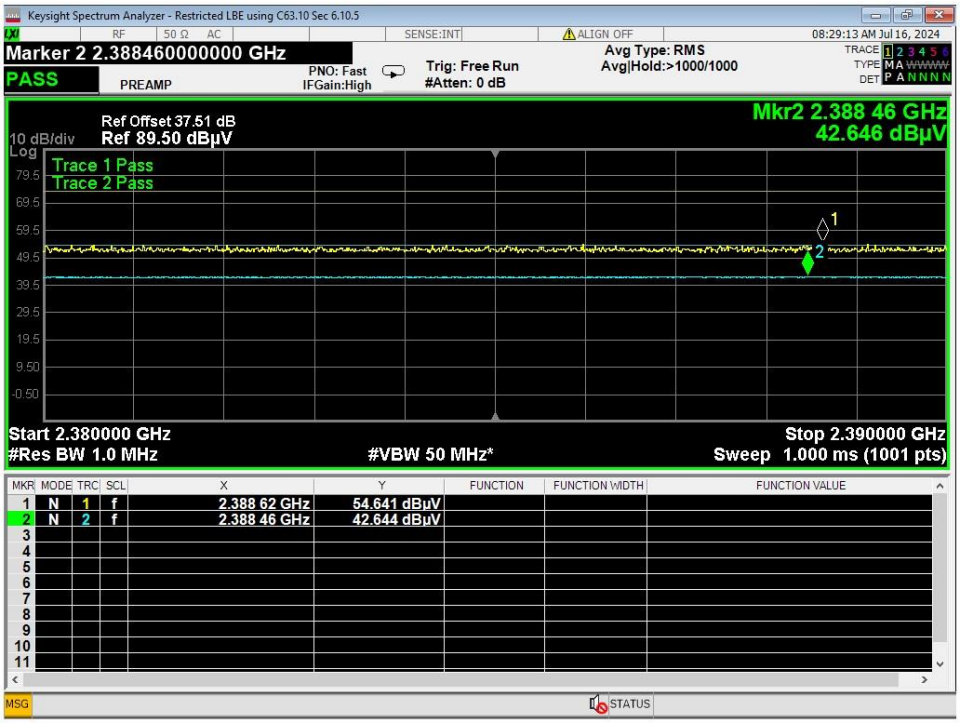

Figure 3 – LBE Restricted, BLE 1MB

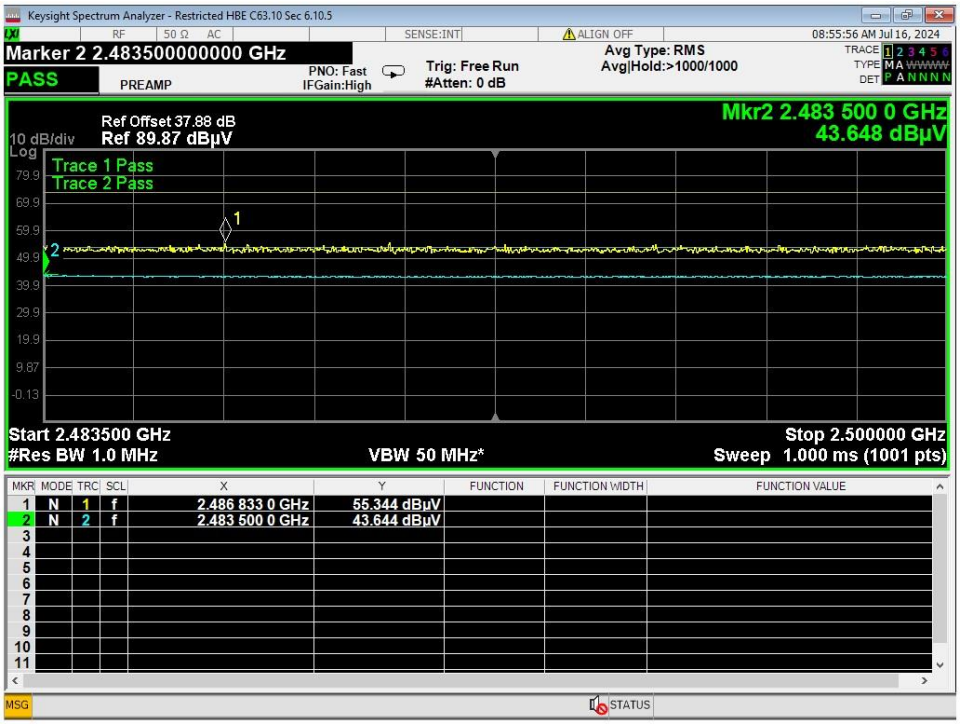

Figure 4 – HBE Restricted, BLE 1MB

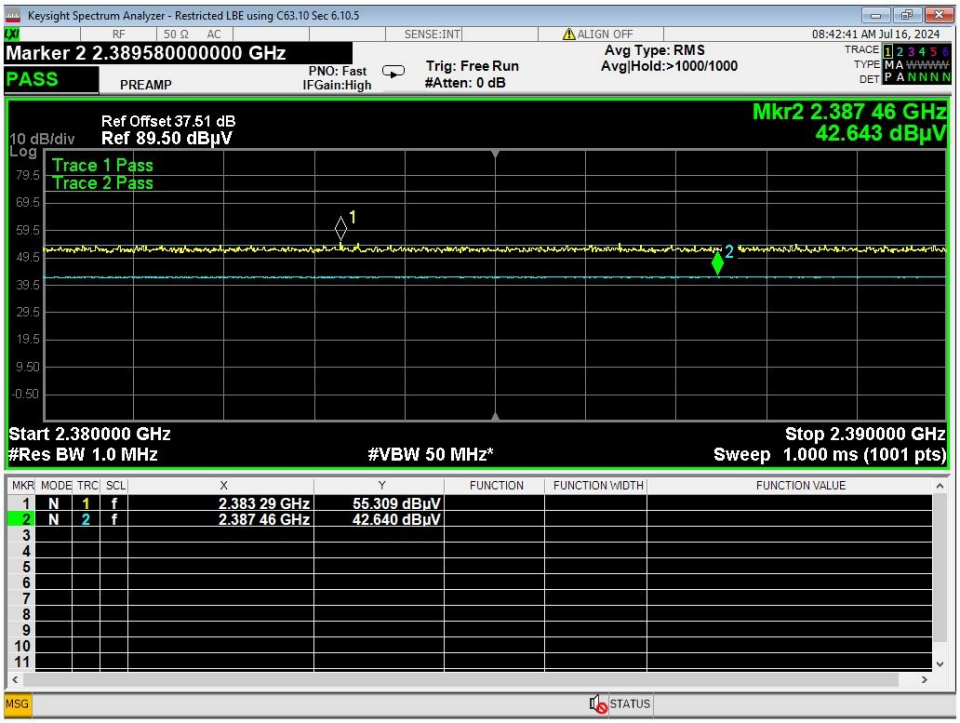

Figure 5 – LBE Restricted, BLE 2MB

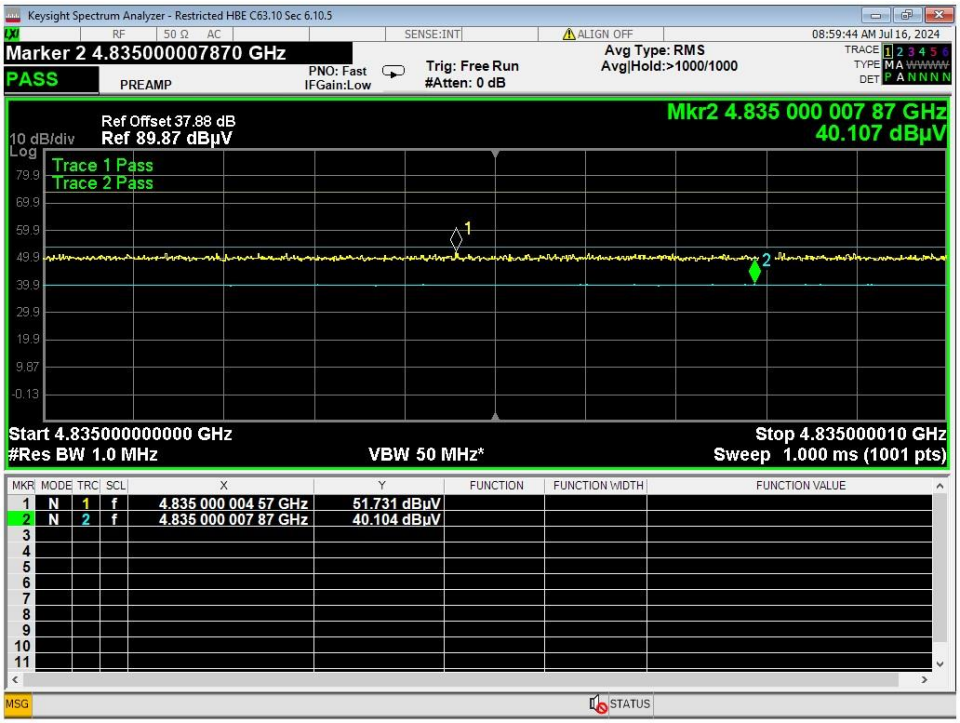

Figure 6 – LBE Restricted, BLE 2MB

Annex A: Measurement Uncertainty

NCEE Labs does not add uncertainty to measurement levels.
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	±4.31
Radiated Emissions, 3m	1GHz - 18GHz	±5.08

Expanded uncertainty values are calculated to a confidence level of 95%.

Annex B: Sample Field Strength Calculation

Radiated Emissions

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

FS = R + AF – (-CF + AG)

where FS = Field Strength
R = Receiver Amplitude Receiver reading in dBμV
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Preamplifier Amplifier Gain

Assume a receiver reading of 55.00 dBμV is obtained. The Antenna Factor of 12.00 and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.10 dBμV/m.

FS = 55.00 + 12.00 – (-1.10 + 20.00) = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 254.1 μV/m

Conducted Emissions

Receiver readings are compared directly to the conducted emissions limits in decibels (dB) by adding the cable loss and LISN insertion loss to the receiver reading. The basic equations with a sample calculation is as follows;

FS = R + IL – (-CF)

where V = Conducted Emissions Voltage Measurement
R = Receiver reading in dBμV
IL = LISN Insertion Loss
CF = Cable Attenuation Factor

Assume a receiver reading of 52.00 dBμV is obtained. The LISN insertion loss of 0.80 dB and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBμV/m.

V = 52.00 + 0.80 – (-1.10) = 53.90 dBμV/m

The 53.90 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 495.45 μV/m

Margin is calculated by taking the limit and subtracting the Field Level.

REPORT END