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Testing of

Electromagnetic Emissions

per

USA: CFR Title 47, Part 15.249
Canada: RSS-210/GEN

are herein reported for

Schlage Lock Company / Allegion
BE468 and BE469

Test Report No.: 20150807-TRPALEG10006r0

Applicant/Provider:
Schlage Lock Company / Allegion
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Contact Person: Frank Nardelli; Frank.Nardelli@allegion.com

Measured by: Dr. Joseph Brunett, EMC-002790-NE

Report Approved by: Dr. Joseph Brunett, EMC-002790-NE

Report by: Dr. Joseph Brunett, EMC-002790-NE

Report Date of Issue: August 7, 2015

Results of testing completed on (or before) August 6, 2015 are as follows.

Emissions: The transmitter intentional emissions **COMPLY** with the regulatory limit(s) by no less than 0.9 dB. Transmit chain spurious harmonic emissions **COMPLY** by no less than 4.0 dB. Radiated spurious emissions associated with the receive chain of this device **COMPLY** the regulatory limit(s) by no less than 20 dB. Unintentional spurious emissions from digital circuitry **COMPLY** with radiated emission limit(s) by more than 10.3 dB.

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1 Test Specifications, General Procedures, and Location

1.1 Test Specification and General Procedures

The ultimate goal of Schlage Lock Company / Allegion is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Schlage Lock Company / Allegion BE468 and BE469 for compliance to:

Country/Region	**Rules or Directive**	**Referenced Section(s)**
United States	Code of Federal Regulations	CFR Title 47, Part 15.249
Canada	Industry Canada	RSS-210/GEN

Schlage Lock Company / Allegion has determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

ANSI C63.4:2009 (USA)	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
ANSI C63.4:2014 (CAN)	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
Industry Canada	"The Measurement of Occupied Bandwidth"
ICES-003; Issue 5 (2012)	"Information Technology Equipment (ITE) Limits and methods of measurement"

1.2 Test Location and Equipment Used

Test Location The EUT was fully tested by **Willow Run Test Labs, LLC**, 8501 Beck Road, Building 2227, Belleville, Michigan 48111 USA. The Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: 688478) and with Industry Canada, Ottawa, ON (File Ref. No: IC 8719A-1).

Test Equipment Pertinent test equipment used for measurements at this facility is listed in Table 1. The quality system employed at Willow Run Test Labs, LLC has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 1: Willow Run Test Labs, LLC Equipment List

Description	Manufacturer/Model	SN	Quality Num.	Last Cal By / Date Due
Spectrum Analyzer	Rhode-Schwarz / FSV30	101660	RSFSV30001	RS / Apr-2016
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Lib. Labs / April-2016
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Lib. Labs/ April-2016
Quad Ridge Horn	ETS Lind. / 3164-04	00066988	HRNQR316401	Lib. Labs / Apr-2016
Quad Ridge Horn	Singer / A6100	C35200	HQR2TO18S01	Lib. Labs / Apr-2016

2 Configuration and Identification of the Equipment Under Test

2.1 Description and Declarations

The EUT is a Z-Wave Transceiver enabled electronic door lock. The EUT is approximately 8 x 26 5 cm in dimension, and is depicted in Figure 1. It is powered by a 6 VDC alkaline batteries. This device is used as an entry door lock that can be operated via LF key card. Table 2 outlines provider declared EUT specifications.

Figure 1: Photos of EUT.

Table 2: EUT Declarations.

General Declarations			
Equipment Type:	Electronic Door Lock	**Country of Origin:**	USA
Nominal Supply:	6 VDC	**Oper. Temp Range:**	-40^o to $+66^oC$
Frequency Range:	908.4 MHz	**Antenna Dimension:**	Not Declared
Antenna Type:	PCB Trace	**Antenna Gain:**	Not Declared
Number of Channels:	1	**Channel Spacing:**	Not Applicable
Alignment Range:	Not Declared	**Type of Modulation:**	GFSK
United States			
FCC ID Number:	XPB-NGCHEE	**Classification:**	DXT
Canada			
IC Number:	8053B-NGCHEE	**Classification:**	Low Power Device (902 to 928 MHz)

2.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

2.1.2 Modes of Operation

This device is capable of only a single mode of radio operation, as a Z-wave transceiver.

2.1.3 Variants

There are two variants of the EUT. Both are electrically identical except for a change of digital component population. Sample BE468 populates an LED light while sample BE469 populates a piezo speaker. Each variant may employ one of two different escutcheon faceplates (Camelot - rounded and Century - squared). Highest radio emissions were observed from the BE468 variant employing the two escutcheon faceplates.

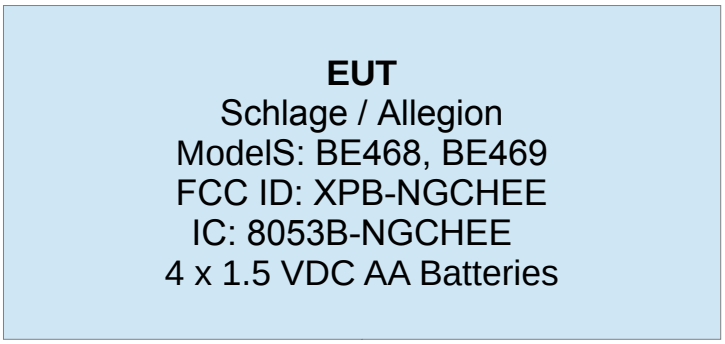

Figure 2: EUT Test Configuration Diagram.

2.1.4 Test Samples

Eight samples of the EUT were provided for emissions testing, four of each variant. Each sample can employ one of two different escutcheon faceplates. For each variant, one CW sample, one continuously modulating sample, one Rx only sample, an one locking-unlocking sample was supplied. All configurations were evaluated and the worst case face-plate (escutcheon) configurations were fully tested to demonstrate compliance.

2.1.5 Functional Exerciser

Functionality was verified by observation of automatic locking and unlocking, as programmed by the manufacturer.

2.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

2.1.7 Production Intent

The EUT appears to be a production ready sample.

2.1.8 Declared Exemptions and Additional Product Notes

None.

3 Emissions

3.1 General Test Procedures

3.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our shielded anechoic chamber. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.2 are employed. After indoor pre-scans, emission measurements are made on our outdoor 3-meter Open Area Test Site (OATS). If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded.

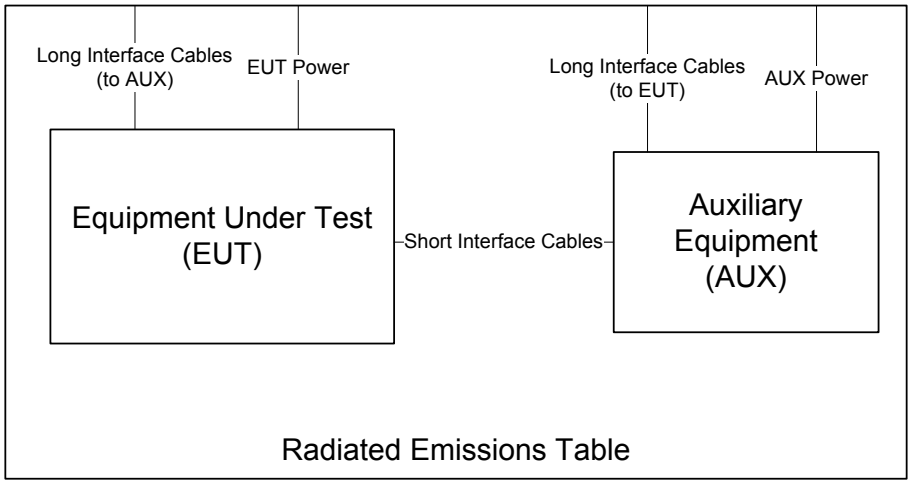

Figure 3: Radiated Emissions Diagram of the EUT.

If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied. For devices with intentional emissions below 30 MHz, a shielded loop antenna is used. It is placed at a 1 meter receive height. Emissions between 30 MHz and 1 GHz are measured using tuned dipoles and/or calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360^o in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain horn antennas or calibrated broadband ridge-horn antennas on our OATS with a 2.4m x 2.4m square of AN-79 or H-4 absorber placed over the ground screen between the EUT and the test antenna. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dBμV/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

Figure 4: Radiated Emissions Test Setup Photograph(s).

3.1.2 Conducted Emissions Test Setup and Procedures

Battery Power Conducted Spurious The EUT is not subject to measurement of power line conducted emissions as it is powered solely by its internal battery.

3.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case the EUT is designed for operation from a battery power source, the extreme test voltages are evaluated over the range specified in the test standard; no less than $\pm 10\%$ of the nominal battery voltage declared by the manufacturer. For all battery operated equipment, worst case intentional and spurious emissions are re-checked employing a new (fully charged) battery.

3.1.4 Thermal Variation

Tests at extreme temperatures are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report. The provider has declared that the EUT is designed for operation over the temperature range -40^o to $+66^o$C. Before any temperature measurements are made, the equipment is allowed to reach a thermal balance in the test chamber, temperature and humidity are recorded, and thermal balance is verified via a thermocouple based probe.

3.2 Intentional Emissions

3.2.1 Fundamental Emission Pulsed Operation

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 1.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Duty cycle is reported for all relevant modes of operation. The test equipment employed includes RSFSV30001, DIPEMC001.

Measurement Results The details and results of testing the EUT are summarized in Table 3. Plots showing the measurements made to obtain these values are provided in Figure 5.

Table 3: Fundamental Emission Pulsed Operation.

Detector	Span	IF Bandwidth	Video Bandwidth
Pk	0	1 MHz	3 MHz

Test Date: 25-Jul-15
Test Engineer: Joseph Brunett
EUT: Allegion NGChee
EUT Mode: Modulated
Meas. Distance: 10 cm

FCC/IC

#	EUT Test Mode	Overall Transmission: Min. Repetition Rate (sec)	Overall Transmission: Max. No. of Frames	Overall Transmission: Total Transmission Length (sec)	Internal Frame Characteristics: Max. Frame Length (ms)	Internal Frame Characteristics: Min. Frame Period (ms)	Internal Frame Characteristics: Frame Encoding	Computed Duty Cycle (%)	Computed Duty Cycle (dB)
1	Cont. Modulation	Cont.	1	Inf.	Inf.	N/A	Worst case continuous on-time employed. No duty cycle applied.	100.0	0.0

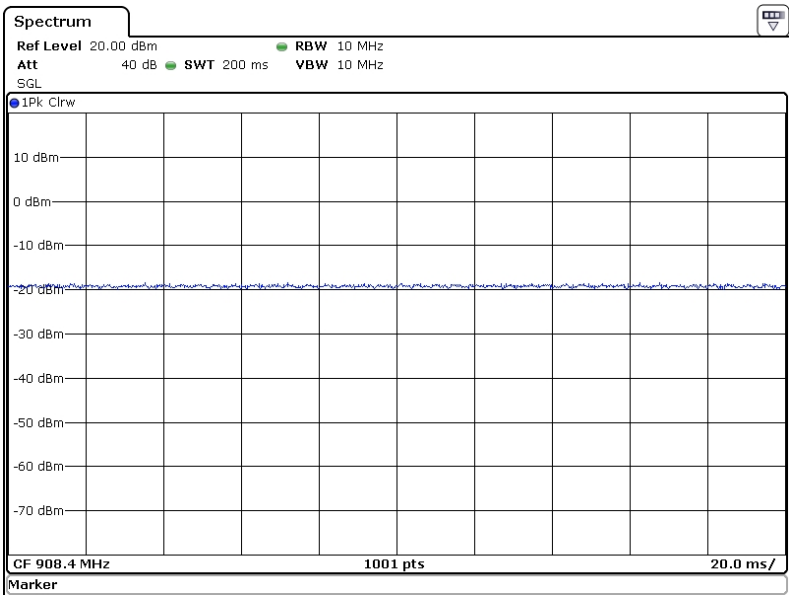

Figure 5: Fundamental Emission Pulsed Operation.

3.2.2 Fundamental Emission Bandwidth

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 1.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Emission bandwidth (EBW) of the EUT is measured with the device placed in the test mode(s) with the shortest available frame length and minimum frame spacing. The 20 dB EBW is measured as the max-held peak-detected signal when the IF bandwidth is greater than or equal to 1% of the receiver span. For complex modulations other than ASK and FSK, the 99% emission bandwidth per IC test procedures has a different result, and is also reported. The test equipment employed includes RSFSV30001, DIPEMC001.

Measurement Results The details and results of testing the EUT are summarized in Table 4. Plots showing the measurements made to obtain these values are provided in Figure 6.

Table 4: Fundamental Emission Bandwidth.

Detector	**IF Bandwidth**	**Video Bandwidth**
Pk	10 kHz	30 kHz

Test Date:	25-Jul-15
Test Engineer:	Joseph Brunett
EUT:	Allegion NGChee
EUT Mode:	Cont. Modulated
Meas. Distance:	10 cm

						FCC/IC	
#	Modulation	Center Frequency (MHz)	20 dB EBW (kHz)	99% OBW (kHz)			
1	GFSK	908.4	130.9	122.9			
2							

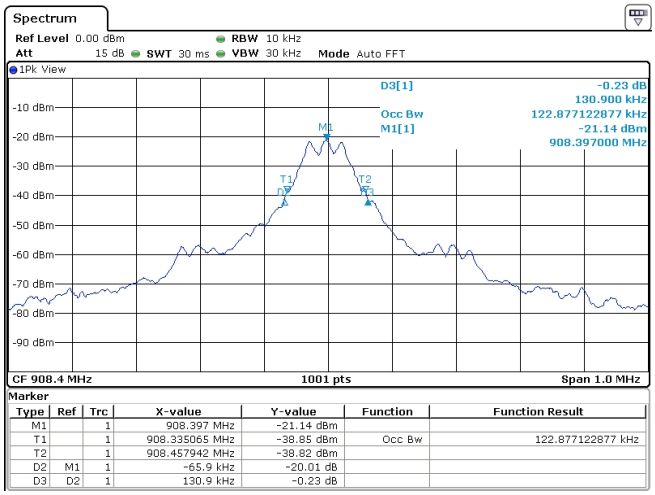

Figure 6: Fundamental Emission Bandwidth.

3.2.3 Fundamental Emission Field Strength

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 1.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Fundamental emissions are measured at the regulatory distance on our OATS. The test equipment employed includes RSFSV30001, DIPEMC001.

Measurement Results The details and results of testing the EUT are summarized in Table 5.

Table 5: Fundamental Emission Field Strength.

Frequency Range	Det	IF Bandwidth	Video Bandwidth		
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Test Date:**	27-Jul-15
f > 1 000 MHz	Pk	1 MHz	3MHz	**Test Engineer:**	Joseph Brunett
f > 1 000 MHz	Avg	1 MHz	10kHz	**EUT:**	Allegion NGChee
				EUT Mode:	Cont. Mod.
				Meas. Distance:	3 meters

												FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr (Pk) dBm	Pr (Qpk)* dBm	Ka dB/m	Kg dB	E3(Pk) dBµV/m	E3(Avg) dBµV/m	FCC/IC E3(Avg) Lim. dBµV/m	Pass dB	Comments
1	**Rounded**											
2	908.4	Dip	H	-14.9	-14.9	28.4	27.6	92.9	92.9	94.0	1.1	side
3	908.4	Dip	V	-19.2	-19.2	28.4	27.6	88.6	88.6	94.0	5.4	end
4	**Square**											
5	908.4	Dip	H	-14.7	-14.7	28.4	27.6	93.1	93.1	94.0	**0.9**	side
6	908.4	Dip	V	-24.7	-24.7	28.4	27.6	83.1	83.1	94.0	10.9	end
#	Freq. MHz	DC Supply Voltage			Relative Pr (Pk) dBm**							
7	908.4	4.00			-14.7							
8	908.4	5.00			-14.7							
9	908.4	6.00			-14.7							
10	908.4	7.00			-14.7							
11	908.4	8.00			-14.7							

*QPk data measured on Continously Modulated device.

3.3 Unintentional Emissions

3.3.1 Transmit Chain Spurious Emissions

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 1.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Spurious radiated emissions measurements are performed to 10 times the highest fundamental operating frequency. The test equipment employed includes RSFSV30001, HRNQR316401, HQR2TO18S01.

Measurement Results The details and results of testing the EUT are summarized in Table 6.

Table 6: Transmit Chain Spurious Emissions.

Frequency Range	Det	IF Bandwidth	Video Bandwidth		
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Test Date:**	25-Jul-15
f > 1 000 MHz	Pk	1 MHz	3 MHz	**Test Engineer:**	Joseph Brunett
f > 1 000 MHz	Avg	1 MHz	10kHz	**EUT:**	Allegion NGChee
				EUT Mode:	CW
				Meas. Distance:	3 meters

Transmitter Unintentional Spurious Emissions												FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr (Pk) dBm	Pr (Avg)* dBm	Ka dB/m	Kg dB	E3(Pk) dBµV/m	E3(Avg) dBµV/m	FCC/IC E3lim (Avg) dBµV/m	Pass dB	Comments
1	**Square**											
2	1816.8	HRNQR316401	H/V	-94.4	-94.4	29.1	-0.2	41.9	41.9	54.0	12.1	side
3	2725.2	HRNQR316401	H/V	-100.2	-100.2	34.8	-0.3	41.9	41.9	54.0	12.1	side
4	3633.6	HRNQR316401	H/V	-100.3	-100.3	35.2	-0.4	42.3	42.3	54.0	11.7	max all
5	4542.0	HRNQR316401	H/V	-100.5	-100.5	33.0	-0.5	40.0	40.0	54.0	14.0	max all
6	5450.4	HRNQR316401	H/V	-99.7	-99.7	32.9	-0.5	40.7	40.7	54.0	13.3	max all
7	6358.8	HQR2TO18S01	H/V	-99.6	-99.6	32.8	-0.6	40.8	40.8	54.0	13.2	max all
8	7267.2	HQR2TO18S01	H/V	-105.2	-105.2	33.3	-0.7	35.8	35.8	54.0	18.2	max all
9	8175.6	HQR2TO18S01	H/V	-107.4	-107.4	34.1	-0.8	34.5	34.5	54.0	19.5	max all
10	9084.0	HQR2TO18S01	H/V	-107.5	-107.5	34.8	-0.8	35.1	35.1	54.0	18.9	max all
11	**Rounded**											
12	1816.8	HRNQR316401	H/V	-94.4	-94.4	29.1	-0.2	41.9	41.9	54.0	12.1	side
13	2725.2	HRNQR316401	H/V	-97.9	-97.9	34.8	-0.3	44.2	44.2	54.0	9.8	end
14	3633.6	HRNQR316401	H/V	-92.6	-92.6	35.2	-0.4	50.0	50.0	54.0	**4.0**	flat
15	4542.0	HRNQR316401	H/V	-99.7	-99.7	33.0	-0.5	40.8	40.8	54.0	13.2	max all
16	5450.4	HRNQR316401	H/V	-98.6	-98.6	32.9	-0.5	41.8	41.8	54.0	12.2	max all
17	6358.8	HQR2TO18S01	H/V	-100.2	-100.2	32.8	-0.6	40.2	40.2	54.0	13.8	max all
18	7267.2	HQR2TO18S01	H/V	-106.3	-106.3	33.3	-0.7	34.7	34.7	54.0	19.3	max all
19	8175.6	HQR2TO18S01	H/V	-106.1	-106.1	34.1	-0.8	35.8	35.8	54.0	18.2	max all
20	9084.0	HQR2TO18S01	H/V	-107.4	-107.4	34.8	-0.8	35.3	35.3	54.0	18.7	max all
21												
22												
23												
24												
25												
26												

*Avg data computed from Peak Measured Data and EUT Duty Cycle. EUT in CW mode.

3.3.2 Radiated Receiver Spurious

The results for the measurement of radiated receiver spurious emissions (emissions from the receiver chain, e.g. LO or VCO) at the nominal voltage and temperature are reported in Table 7. Receive chain emissions are measured to 5 times the highest receive chain frequency employed or 4 GHz, whichever is higher. If no emissions are detected, only those noise floor emissions at the LO/VCO frequency are reported.

Table 7: Receiver Chain Spurious Emissions $\geq$ 30 MHz.

Frequency Range	**Det**	**IF Bandwidth**	**Video Bandwidth**	**Test Date:**	25-Jul-15
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Test Engineer:**	Joseph Brunett
f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz/10kHz	**EUT:**	Allegion NGChee
				EUT Mode:	Cont. Mod.
				Meas. Distance:	3 meters

Receive Chain Spurious Emissions													FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr (Pk) dBm	Pr (QPk/Avg) dBm*	Ka dB/m	Kg dB	E3(Pk) dBµV/m	E3(Qpk/Avg) dBµV/m	FCC/IC E3lim dBµV/m	CE E3lim dBµV/m	Pass dB	Comments
1													
2													
3	NOTE: No emissions within 20 dB of the Class B (54 dBuV/m) limit were observed with EUT placed in Rx Only mode by manufacturer												
4													
5													
6													

*QPk detection below 1 GHz, Avg detection at or above 1 GHz with receiver bandwidth as specified at top of table.

3.3.3 Radiated Digital Spurious

The results for the measurement of digital spurious emissions (emissions arising from digital circuitry) at the nominal voltage and temperature are provided in Table 8. Radiation from digital components has been measured to 4 GHz, or to five times the maximum digital component operating frequency, whichever is greater.

Table 8: Radiated Digital Spurious Emissions.

Frequency Range	Det	IF Bandwidth	Video Bandwidth		
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Test Date:**	28-Jul-15
f > 1 000 MHz	Pk	1 MHz	3 MHz	**Test Engineer:**	Joseph Brunett
f > 1 000 MHz	Avg	1 MHz	10kHz	**EUT:**	Allegion NGChee
				EUT Mode:	Active (Lock Cycling)
				Meas. Distance:	3 meters

Digital Spurious Emissions FCC/IC + CE(CISPR)

	Test	Antenna		Pr (Pwr Rx.)				E-Field @ 3m		FCC/IC Class B		CE Class B		FCC/IC Class A		CE Class A		
#	Freq. MHz	Type Used	Test Pol.	Pk dBm	QPk/Avg	Ka dB/m	Kg dB	Pk dBµV/m	QPk/Avg dBµV/m	E3lim dBµV/m	Pass dB	E3lim dBµV/m	Pass dB	E3lim dBµV/m	Pass dB	E3lim dBµV/m	Pass dB	Comments
1	142.3	Bic	V			12.4	36.5	32.6		43.5	10.9	40.5	7.9	54.0	21.4	50.5	17.9	
2	245.9	Bic	V			16.9	34.8	27.4		46.0	18.6	47.5	20.1	56.9	29.5	57.5	30.1	
3	331.3	Log	H			14.4	33.6	29.4		46.0	16.6	47.5	18.1	56.9	27.5	57.5	28.1	
4	508.3	Log	H			17.6	31.6	31.5		46.0	14.5	47.5	16.0	56.9	25.4	57.5	26.0	
5	549.0	Log	V			18.2	31.2	32.4		46.0	13.6	47.5	15.1	56.9	24.5	57.5	25.1	
6	593.0	Log	H			18.9	30.8	30.3		46.0	15.7	47.5	17.2	56.9	26.6	57.5	27.2	
7	625.1	Log	H			19.4	30.5	27.2		46.0	18.8	47.5	20.3	56.9	29.7	57.5	30.3	
8	636.1	Log	V			19.5	30.4	31.4		46.0	14.6	47.5	16.1	56.9	25.5	57.5	26.1	
9	642.9	Log	H			19.6	30.3	26.9		46.0	19.1	47.5	20.6	56.9	30.0	57.5	30.6	
10	661.2	Log	H			19.9	30.2	41.2	32.9	46.0	13.1	47.5	14.6	56.9	24.0	57.5	24.6	
11	704.2	Log	V			20.4	29.8	37.8	30.1	46.0	15.9	47.5	17.4	56.9	26.8	57.5	27.4	
12	709.2	Log	H			20.5	29.7	42.6	35.7	46.0	**10.3**	47.5	11.8	56.9	21.2	57.5	21.8	
13	732.0	Log	H			20.8	29.5	39.7	30.4	46.0	15.6	47.5	17.1	56.9	26.5	57.5	27.1	
14	842.0	Log	H			21.9	28.5	39.8	32.1	46.0	13.9	47.5	15.4	56.9	24.8	57.5	25.4	
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*QPk detection below 1 GHz, Avg detection at or above 1 GHz with receiver bandwidth as specified at top of table.