



**FCC Part 1 Subpart I
FCC Part 2 Subpart J
INDUSTRY CANADA RSS 102 ISSUE 5**

RF EXPOSURE REPORT

FOR

CONSOLE WIRELESS REMOTE CONTROL

MODEL NUMBER: 420128

**FCC ID: A94420128
IC: 3232A-420128**

REPORT NUMBER: R11244355-E5

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**Prepared for
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: BOSE CORP.
100 THE MOUNTAIN ROAD
FRAMINGHAM, MASSACHUSETTS, 01701, USA

EUT DESCRIPTION: CONSOLE WIRELESS REMOTE CONTROL

MODEL: 420128

SERIAL NUMBER: 073247961390014AE (Radiated & Line-conducted sample);
0115 (Antenna-port sample)

DATE TESTED: 2016-05-09 through 2016-07-19

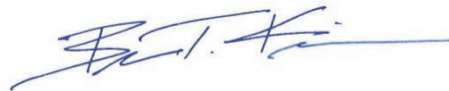
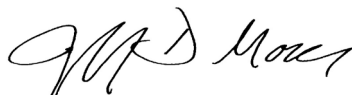
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 1 SUBPART I & PART 2 SUBPART J	Pass
INDUSTRY CANADA RSS 102 ISSUE 5	Pass

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL LLC based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released
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2. TEST METHODOLOGY

All calculations were made in accordance with FCC Parts 2.1091, 2.1093 and KDB 447498 D01 v06 and IC Safety Code 6, RSS 102 Issue 5.

3. REFERENCES

All measurements were made as documented in test report UL LLC Report R11244355-E1 (FCC ID: A94420128/IC: 3232A-420128).

Measurements for previously certified radios were performed under UL LLC Report R11005838-E1 (FCC ID: A94420128RM/IC: 3232A-420128RM) and 14M19686-E2 (FCC ID: A94416549/IC:3232A-416549) for operation in the 2.4 GHz band.

Output power, Duty cycle and Antenna gain data is excerpted from the applicable test reports.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA and 2800 Suite B Perimeter Park Dr., Morrisville, NC 27560 and 47173 Benicia Street, Fremont, California, USA.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2002460.htm>.

5. MAXIMUM PERMISSIBLE RF EXPOSURE

5.1. FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.2. IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of the below table, if the field strength exceeds the value given in Column 2 or 3 of the below table, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of the below table, when averaged spatially and over time.

**Table 4: RF Field Strength Limits for Devices Used by the General Public
 (Uncontrolled Environment)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}
<p>Note: <i>f</i> is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).</p>				

5.3. EQUATIONS

POWER DENSITY

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * \text{D}^2)$$

Where

S = Power density in mW/cm²

EIRP = Equivalent Isotropic Radiated Power in mW

D = Separation distance in cm

Power density in units of mW/cm² is converted to units of W/m² by multiplying by 10.

DISTANCE

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \text{Pi} * S))$$

Where

D = Separation distance in cm

EIRP = Equivalent Isotropic Radiated Power in mW

S = Power density in mW/cm²

SOURCE-BASED DUTY CYCLE

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

$$\text{Source-based time-averaged EIRP} = (\text{DC} / 100) * \text{EIRP}$$

Where

DC = Duty Cycle in %, as applicable

EIRP = Equivalent Isotropic Radiated Power in W

MIMO AND COLOCATED TRANSMITTERS (IDENTICAL LIMIT FOR ALL TRANSMITTERS)

For multiple chain devices, and colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the EIRP (in linear units) of each transmitter.

$$\text{Total EIRP} = (\text{EIRP1}) + (\text{EIRP2}) + \dots + (\text{EIRPn})$$

where

$$\text{EIRPx} = \text{Source-based time-averaged EIRP of chain x or transmitter x}$$

The total EIRP is then used to calculate the Power Density or the Distance as applicable.

MIMO AND COLOCATED TRANSMITTERS

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply:

The Power Density at the specified separation distance is calculated for each transmitter chain or transmitter.

The fraction of the exposure limit is calculated for each chain or transmitter as (Power Density of chain or transmitter) / (Limit applicable to that chain or transmitter).

The fractions are summed.

Compliance is established if the sum of the fractions is less than or equal to one.

5.4. LIMITS AND IC EXEMPTION

RF EXPOSURE LIMITS – GENERAL PUBLIC (UNCONTROLLED ENVIRONMENTS)

FCC:

For operation in the PCS band, the 2.4 GHz band and the 5 GHz bands:

From FCC §1.1310 Table 1 (B), the maximum value of $S = 1.0 \text{ mW/cm}^2$

IC:

For operation in the 300-6000 MHz band:

$$\text{Power Density} = 0.02619f^{0.6834}$$

$$\text{Power Density (2.4 GHz)} = 0.02619(2400)^{0.6834} = 4.4 \text{ W/m}^2$$

$$\text{Power Density (5 GHz)} = 0.02619(5150)^{0.6834} = 9.01 \text{ W/m}^2$$

Note – Lowest frequency that would yield the lowest limit was used.

INDUSTRY CANADA EXEMPTION

RSS-102 Clause 2.5.2 RF exposure evaluation is required if the separation distance between the user and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $22.48/f^{0.5} \text{ W}$ (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834} \text{ W}$ (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

6. RF EXPOSURE RESULTS

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

(Single chain transmitters, no colocation, 20 cm MPE distance)

Radio Device Covered by this Evaluations

FCC ID: A94420128/IC: 3232A-420128

Single Chain and non-colocated transmitters									
Band	Mode	Separation Distance (cm)	Output PK Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Duty Cycle (%)	EIRP (mW)	FCC Power Density (mW/cm ²)	IC Power Density (W/m ²)
2.4 GHz	DTS	20	-2.62	4.42	1.80	100.0	1.5	0.000	0.00

Other Radio Devices

FCC ID: A94416549/IC:3232A-416549

Single Chain and non-colocated transmitters									
Band	Mode	Separation Distance (cm)	Output AVG Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Duty Cycle (%)	EIRP (mW)	FCC Power Density (mW/cm ²)	IC Power Density (W/m ²)
2.4 GHz	DTS	20	4.26	4.00	8.26	64.7	4.3	0.0009	0.0086
2.4 GHz	FHSS	20	10.34	4.00	14.34	77.6	21.1	0.0042	0.0420
2.4 GHz	WLAN	20	13.44	4.00	17.44	50.2	27.8	0.0055	0.0554
5 GHz	WLAN	20	12.83	4.00	16.83	50.2	24.2	0.0048	0.0481

FCC ID: A94420128RM/IC: 3232A-420128RM

Single Chain and non-colocated transmitters									
Band	Mode	Separation Distance (cm)	Output AVG Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Duty Cycle (%)	EIRP (mW)	FCC Power Density (mW/cm ²)	IC Power Density (W/m ²)
2.4 GHz	QPSK	20	5.08	2.20	7.28	100.0	5.3	0.001	0.01
5.2 GHz	QPSK	20	10.83	5.02	15.85	100.0	38.5	0.008	0.08
5.8 GHz	QPSK	20	11.31	5.56	16.87	100.0	48.6	0.010	0.10

Note - FCC Power Density Limit = 1mW/cm².
 IC Power Density Limit = 4W/m² (2.4 GHz) and 9W/m² (5 GHz).

The device operates above 1.5 GHz with a maximum EIRP less than or equal to 5 Watts as a mobile device with a minimum separation distance of 20 cm, therefore it is exempt from routine RF Exposure Evaluation under RSS-102.

(Single chain transmitters, no colocation, MPE distance > 20 cm)

Single Chain and non-colocated transmitters									
Band	Mode (Device)	FCC Limit (mW/cm ²)	IC Limit (W/m ²)	Output AVG Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Duty Cycle (%)	EIRP (mW)	Separation Distance (cm)
2.4 GHz	DTS (128)	1.00	10.0	-2.62	4.42	1.80	100.0	1.5	0.35
2.4 GHz	DTS (549)	1.00	10.0	4.26	4.00	8.26	64.7	4.3	0.59
2.4 GHz	FHSS (549)	1.00	10.0	10.34	4.00	14.34	77.6	21.1	1.30
2.4 GHz	WLAN (549)	1.00	10.0	13.44	4.00	17.44	50.2	27.8	1.49
5 GHz	WLAN (549)	1.00	10.0	12.83	4.00	16.83	50.2	24.2	1.39
2.4 GHz	QPSK (128RM)	1.00	10.0	5.08	2.20	7.28	100.0	5.3	0.65
5.2 GHz	QPSK (128RM)	1.00	10.0	10.83	5.02	15.85	100.0	38.5	1.75
5.8 GHz	QPSK (128RM)	1.00	10.0	11.31	5.56	16.87	100.0	48.6	1.97

Note 42128 Remote Radio power value is PK.

The device operates above 1.5 GHz with a maximum EIRP less than or equal to 5 Watts as a mobile device with a minimum separation distance of 20 cm, therefore it is exempt from routine RF Exposure Evaluation under RSS-102.

(MIMO and/or Colocated transmitters all with same Power Density limit, 20 cm MPE distance)

Multiple chain or colocated transmitters										
Band	Mode	Device	Separation Distance (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	EIRP (dBm)	Duty Cycle (%)	EIRP (mW)	FCC Power Density (mW/cm ²)	IC Power Density (W/m ²)
2.4 GHz	DTS	420128		-2.62	4.42	1.80	100.0	1.5		
2.4 GHz	DTS	416549		4.26	4.00	8.26	64.7	4.3		
2.4 GHz	FHSS	416549		10.34	4.00	14.34	77.6	21.1		
2.4 GHz	WLAN	416549		13.44	4.00	17.44	50.2	27.8		
5 GHz	WLAN	416549		12.83	4.00	16.83	50.2	24.2		
2.4 GHz	QPSK	420128RM		5.08	2.20	7.28	100.0	5.3		
5.2 GHz	QPSK	420128RM		10.83	5.02	15.85	100.0	38.5		
5.8 GHz	QPSK	420128RM		11.31	5.56	16.87	100.0	48.6		
Combined			20					171.4	0.034	0.34

All Radios are single chain.

Note - 420128 Remote radio power value is PK.

(MIMO and/or Colocated transmitters all with same Power Density limit, MPE distance > 20 cm)

Multiple chain or colocated transmitters										
Band	Mode	Device	FCC Limit (mW/cm ²)	IC Limit (W/m ²)	Output AVG Power (dBm)	Ant. Gain (dBi)	EIRP (dBm)	Duty Cycle (%)	EIRP (mW)	Separation Distance (cm)
2.4 GHz	DTS	420128			-2.62	4.42	1.80	100.0	1.5	
2.4 GHz	DTS	416549			4.26	4.00	8.26	64.7	4.3	
2.4 GHz	FHSS	416549			10.34	4.00	14.34	77.6	21.1	
2.4 GHz	WLAN	416549			13.44	4.00	17.44	50.2	27.8	
5 GHz	WLAN	416549			12.83	4.00	16.83	50.2	24.2	
2.4 GHz	QPSK	420128RM			5.08	2.20	7.28	100.0	5.3	
5.2 GHz	QPSK	420128RM			10.83	5.02	15.85	100.0	38.5	
5.8 GHz	QPSK	420128RM			11.31	5.56	16.87	100.0	48.6	
Combined			1.00	10.0					171.4	3.69

All Radios are single chain.

Note - 420128 power value is PK.

Notes:

- 1) For MPE the new KDB 447498 requires the calculations to use the maximum rated power; that power should be declared by the manufacturer, and should not be lower than the measured power. If the power has a tolerance then we also need to check that the measured power is within the tolerance.
- 2) The manufacturer configures output power so that the maximum power, after accounting for manufacturing tolerances, will never exceed the maximum power level measured.
- 3) The output power in the tables above is the maximum power per chain among various channels and various modes within the specific band.
- 4) The antenna gain in the tables above is the maximum antenna gain among various channels within the specified band.

END OF REPORT