



RADIO TEST REPORT

Test Report No. : 10131705H-A-R2

Applicant : Mitsubishi Electric Corporation Himeji Works
Type of Equipment : Smart Keyless System (Smart Unit)
Model No. : SKEA7A-01
FCC ID : WAZSKEA7A01
Test regulation : FCC Part 15 Subpart C: 2013
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
6. This report is a revised version of 10131705H-A-R1. 10131705H-A-R1 is replaced with this report.

Date of test: January 22, 2014

Representative test engineer:

Masatoshi Nishiguchi
Engineer of WiSE Japan,
UL Verification Service

Approved by:

Masanori Nishiyama
Manager of WiSE Japan,
UL Verification Service



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
<http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap>

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 10131705H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10131705H-A	February 14, 2014	-	-
1	10131705H-A-R1	February 21, 2014	P.13	Correction of calculating formula of "Result".
1	10131705H-A-R2	February 26, 2014	P.4	Deletion of Frequency band in Section 2.2.

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SECTION 1: Customer information

Company Name : Mitsubishi Electric Corporation Himeji works
Address : 840 Chiyoda-machi Himeji Hyogo, 670-8677, Japan
Telephone Number : +81-79-298-7363
Facsimile Number : +81-79-298-9929
Contact Person : Shinichi Furuta

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : Smart Keyless System (Smart Unit)
Model No. : SKEA7A-01
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC12.0V
Receipt Date of Sample : January 21, 2014
Country of Mass-production : Japan
Condition of EUT : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT : No Modification by the test lab

2.2 Product Description

Model No: SKEA7A-01 (referred to as the EUT in this report) is the Smart Keyless System (Smart Unit).
The clock frequency of EUT is 10 MHz (CPU) and 29.509394MHz (RF receiving IC).

Radio Specification

LF Part

Equipment Type : Transmitter
Type of modulation : ASK
Bandwidth : 2.5kHz
Frequency of operation : 125kHz
Other clock frequency : 29.509394MHz
Antenna Type : Inductive
Method of Frequency Generation : Crystal
Operating voltage (inner) : DC +12.0V

RF Part *

Type of Receiver : Receiver
Frequency of operation : 315MHz
Other clock frequency : 10MHz
Intermediate frequency : 220kHz
Antenna Type : Bar Antenna
Method of Frequency Generation : Crystal
Operating voltage (inner) : DC +5.0V

* EUT also has this function. Please refer to No. 10131705H-C-R2 (FCC15B).

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2013, final revised on September 30, 2013 and effective October 30, 2013

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted Emission
Section 15.209 Radiated emission limits, general requirements

FCC 15.31 (e)

This test was performed with the New Battery (DC 12V) and the constant voltage was supplied to this EUT during the tests. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	Conducted Emission	<FCC> ANSI C63.4:2003 7. AC powerline conducted emission measurements <IC> RSS-Gen 7.2.4	<FCC> Section 15.207 <IC> RSS-Gen 7.2.4	-	N/A *1)	N/A	N/A
2	Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> RSS-Gen 4.8, 4.11	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 7.2.5	Radiated	N/A	10.6dB 0.12500MHz, PK (PK with Duty factor)	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> RSS-Gen 4.9, 4.11	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 7.2.5	Radiated	N/A	21.7dB 80.754MHz, QP Vertical	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> -	<FCC> Reference data <IC> -	Radiated	N/A	N/A	N/A

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

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3.3 Addition to standard

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99% Occupied Band Width	RSS-Gen 4.6.1	RSS-Gen 4.6.1	Radiated	N/A	N/A	N/A

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

Test room (semi-anechoic chamber)	Radiated emission						
	(3m*)(+dB)				(1m*)(+dB)		(0.5m*)(+dB)
	9kHz -30MHz	30MHz -300MHz	300MHz -1GHz	1GHz -10GHz	10GHz -18GHz	18GHz -26.5GHz	26.5GHz -40GHz
No.1	4.0dB	5.1dB	5.0dB	5.1dB	6.0dB	4.9dB	4.3dB
No.2	3.9dB	5.2dB	5.0dB	4.9dB	5.9dB	4.7dB	4.2dB
No.3	4.3dB	5.1dB	5.2dB	5.2dB	6.0dB	4.8dB	4.2dB
No.4	4.6dB	5.2dB	5.0dB	5.2dB	6.0dB	5.7dB	4.2dB

*3m/1m/0.5m = Measurement distance

Radiated emission test (3m)

The data listed in this test report has enough margin, more than the site margin.

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3.5 Test Location

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	FCC Registration Number	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	313583	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	655103	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	148738	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	134570	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	-	4.0 x 4.5 x 2.7m	4.0 x 4.5 m	-
No.6 measurement room	-	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	-	8.0 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	-	6.2 x 4.7 x 3.0m	2.4 x 3.4m	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Data of EMI, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

The mode is used : Transmitting mode (125kHz)

Justification : The system was configured in typical fashion (as a customer would normally use it) for testing.

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4.2 Configuration and peripherals

This page has been submitted for a separate exhibit.

SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

The Radiated Electric Field Strength intensity has been measured on No.4 semi anechoic chamber with a ground plane and at a distance of 3m.

Frequency : From 9kHz to 30MHz at distance 3m

The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for vertical polarization (antenna angle: 0deg., 45deg., 90deg., 135 deg., and 180deg.)

and horizontal polarization.

*Refer to Figure 1 about Direction of the Loop Antenna.

Frequency : From 30MHz to 1GHz at distance 3m

The measuring antenna height varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization.

Measurements were performed with a QP and PK detector.

The radiated emission measurements were made with the following detector function of the test receiver (below 1GHz).

	From 9kHz to 90kHz and From 110kHz to 150kHz	From 90kHz to 110kHz	From 150kHz to 490kHz	From 490kHz to 30MHz	From 30MHz to 1GHz
Detector Type	PK/AV	QP	PK/AV	QP	QP
IF Bandwidth	200Hz	200Hz	9kHz	9kHz	120kHz
Distance factor *1)	-80dB	-80dB	-80dB	-40dB	-

*1) -80dB = 40 x log (3m/300m)

-40dB = 40 x log (3m /30m)

- The carrier level and noise levels were measured at each position of all three axes X, Y and Z, and the position that has the maximum noise was determined.

With the position, the noise levels of all the frequencies were measured.

Test data : APPENDIX 1

Test result : Pass

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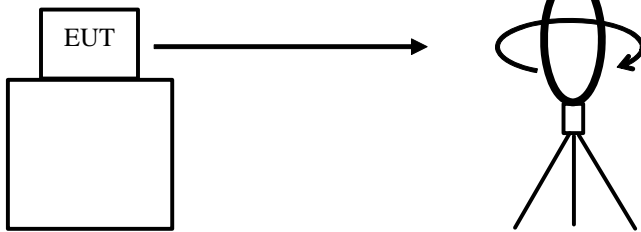
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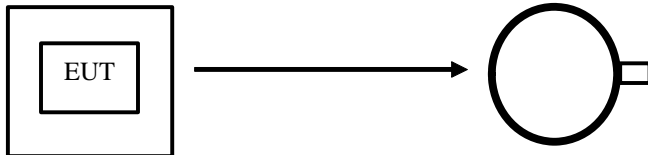
Facsimile : +81 596 24 8124

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

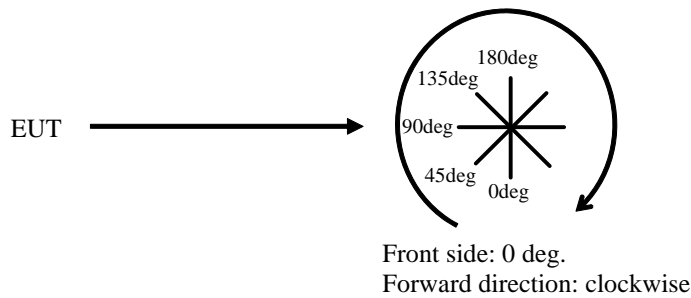


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



SECTION 6: -26dB Bandwidth

Test Procedure

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test data : APPENDIX 1
Test result : Pass

SECTION 7: 99% Occupied Bandwidth

Test Procedure

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test data : APPENDIX 1
Test result : Pass

APPENDIX 1: Data of EMI test

Radiated Emission below 30MHz (Fundamental and Spurious Emission)

Test place : Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 10131705H
Date : 01/22/2014
Temperature/ Humidity : 22 deg. C / 30% RH
Engineer : Masatoshi Nishiguchi
Mode : Tx 125kHz

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	101.0	20.0	-73.9	32.1	-	15.0	45.6	30.6	Fundamental
0	0.25000	PK	74.6	19.9	-73.9	32.1	-	-11.5	39.6	51.1	
0	0.37500	PK	66.9	19.8	-73.9	32.1	-	-19.3	36.1	55.4	
0	0.50000	QP	33.9	19.8	-33.8	32.2	-	-12.3	33.6	45.9	
0	0.62500	QP	50.7	19.8	-33.8	32.1	-	4.6	31.7	27.1	
0	0.75000	QP	33.0	19.8	-33.8	32.1	-	-13.1	30.1	43.2	
0	0.87500	QP	44.3	19.8	-33.8	32.1	-	-1.8	28.7	30.5	
0	1.00000	QP	32.3	19.8	-33.8	32.0	-	-13.7	27.6	41.3	
0	1.12500	QP	39.0	19.8	-33.8	32.0	-	-7.0	26.5	33.5	
0	1.25000	QP	31.6	19.8	-33.8	32.0	-	-14.4	25.6	40.0	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter+ D.Factor) - Gain(Amplifier)

AV (PK with Duty factor)

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	101.0	20.0	-73.9	32.1	0.0	15.0	25.6	10.6	
0	0.25000	PK	74.6	19.9	-73.9	32.1	0.0	-11.5	19.6	31.1	
0	0.37500	PK	66.9	19.8	-73.9	32.1	0.0	-19.3	16.1	35.4	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Although Duty of this product was 100% or less, the result of AV (PK with Duty factor) was calculated by applying Duty 100% as worst.

Result of the fundamental emission at 3m without Distance factor

PK

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	101.0	20.0	6.1	32.1	-	95.0	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier)

* All spurious emissions lower than this result.

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Radiated Emission above 30MHz (Spurious Emission)

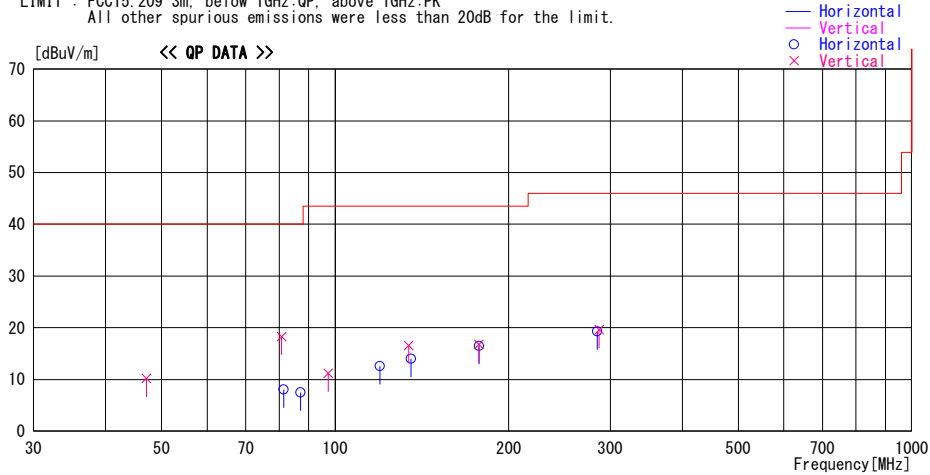
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
 Date : 2014/01/22

Report No. : 10131705H
 Temp./Humi. : 22deg. C / 30% RH
 Engineer : Masatoshi Nishiguchi

Mode / Remarks : Tx 125kHz Worst axis (Hori:Z-Axis , Vert:Z-Axis)

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
 All other spurious emissions were less than 20dB for the limit.



Frequency [MHz]	Reading [dBuV]	DET	Antenna		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
47.100	23.2	QP	11.8	-24.8	10.2	0	100	Vert.	40.0	29.8	
80.754	35.4	QP	7.1	-24.2	18.3	100	100	Vert.	40.0	21.7	
81.393	25.1	QP	7.2	-24.2	8.1	0	400	Hori.	40.0	31.9	
87.150	23.4	QP	8.2	-24.1	7.5	0	400	Hori.	40.0	32.5	
97.275	25.3	QP	9.8	-23.9	11.2	215	100	Vert.	43.5	32.3	
119.550	23.5	QP	12.7	-23.6	12.6	0	400	Hori.	43.5	30.9	
134.177	26.0	QP	14.0	-23.4	16.6	225	100	Vert.	43.5	26.9	
135.300	23.3	QP	14.1	-23.4	14.0	0	400	Hori.	43.5	29.5	
177.599	23.7	QP	16.1	-23.0	16.8	226	100	Vert.	43.5	26.7	
177.599	23.4	QP	16.1	-23.0	16.5	0	400	Hori.	43.5	27.0	
284.700	22.4	QP	19.1	-22.2	19.3	0	400	Hori.	46.0	26.7	
286.950	22.6	QP	19.2	-22.2	19.6	359	100	Vert.	46.0	26.4	

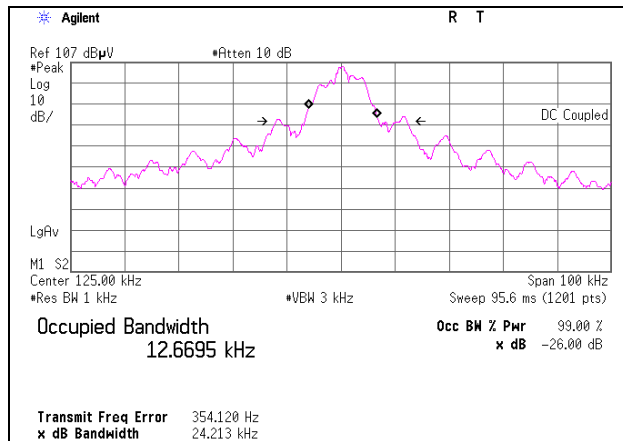
CHART: WITH FACTOR ANT TYPE: -30MHz: LOOP, 30-300MHz: BICONICAL, 300MHz-1000MHz: LOGPERIODIC, 1000MHz-: HORN
 CALCULATION: RESULT = READING + ANT FACTOR + LOSS (CABLE+ATTEN.) - GAIN (AMP)

*The test result is rounded off to one or two decimal places, so some differences might be observed.

-26dB Bandwidth and 99% Occupied Bandwidth

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	10131705H
Date	01/22/2014
Temperature/ Humidity	22 deg. C / 30% RH
Engineer	Masatoshi Nishiguchi
Mode	Tx 125kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Tx 125kHz	125	24.213	12.670



APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2013/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	-	RE	2013/02/26 * 12
MJM-09	Measure	KDS	E19-55	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MRENT-112	Spectrum Analyzer	Agilent	E4440A	MY48250080	RE	2013/10/04 * 12
MTR-01	Test Receiver	Rohde & Schwarz	ESI40	100084	RE	2013/11/12 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2013/10/30 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(5m)/ 421-010(1m)/ sucoform141-PE(1m)/ RFM-E121(Switcher)	-/04178	RE	2013/07/23 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2013/07/22 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2013/03/12 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2013/11/26 * 12
MSA-05	Spectrum Analyzer	Advantest	R3273	160400285	RE	2013/11/08 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2013/11/24 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2013/11/24 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2013/06/18 * 12

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test Item:

RE: Spurious emission

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