

FIELD STRENGTH CALCULATIONS (FCC)

DESCRIPTION: Receivers 450 - 470 MHz MHz

ITEM TESTED: RFI00002 WIRELESS DOORBELL

MANUFACTURER: LINEAR CORP.

TRADE NAME:

PRODUCT ID: EF4 RFI00002

DATE: 12/19/2001

REFERENCE DOCUMENT: SECTION 15.109(a)

Figure 1, Receiver Radiated Emissions

1 uV/M at 3 meters = 0 dBuV = -107 dBm (reference level).

Field Strength in dBm = dBuV - 107 dBm.

Field Strength in dBuV = dBm + 107 dBm.

Please refer to tables for Antenna Factors not already listed

Preamp gain (.1 to 1300 MHz) = 26dB and (1300-2000 MHz) =21 dB.

For 1 meter to 3 meter conversion use 9.54dB.

Since dBuV = 20 Log (uV/M), uV/M = Antilog (dBuV/20).

Calculation from measurement data:

Field Strength (dBuV) = meter reading (dBm) + Antenna and Loss factor - Preamp gain (26 or 21dB) - 1 meter to 3 meter factor (9.54dB) if needed + 107 dBm.

DISTANCE AT WHICH MEASURED: 3 Meters, 0.8 Meter above ground

A	B	C	D	E	F	G	H	I	K	L	G	H	O	P
Tuned Frequency MHz	Emission Frequency MHz	Ambient Level dBm	FCC Limit dBm	Meter Reading dBm	Antenna Factor dB	Cable Loss dB	Amp Gain dB	Dist Fac dB	Field Strength dBm/mtr	Field Strength dBuV/mtr	uV/mtr	FCC Limit uV/M	dB:FCC dB	FREQ. MHz
467.69	417.69	-98.80	-53.18	-59.50	18.2	1.2	27.2	0.00	-67.30	39.70	96.61	200.00	-6.32	417.69
	835.38	-90.20	-61.78	-65.50	25.6	1.7	26.5	0.00	-64.70	42.30	130.32	200.00	-3.72	835.38
	1253.06	-86.20	-65.78	-75.30	29.1	2.2	26.5	0.00	-70.50	36.50	66.83	200.00	-9.52	1253.06
	1670.75	-91.94	-52.08	-81.90	26.4	2.6	20.4	9.54	-82.84	24.16	16.14	500.00	-29.82	1670.75
	2088.44	-91.54	-52.48	#N/A	28.2	3.0	22.2	9.54	#N/A	#N/A	#N/A	500.00	#N/A	2088.44
	2506.13	-88.14	-55.88	#N/A	29.7	3.3	20.6	9.54	#N/A	#N/A	#N/A	500.00	#N/A	2506.13

The spectrum was searched from 25 to 2000 MHz per 15.33(b)

No other emissions were observed except those shown on this page.

TESTED BY

DATE

ENGINEER

DATE

FILE NAME:

RFI002_RX1

DISK NAME:

FCC DATA

John W. Kuivinen

FIELD STRENGTH CALCULATIONS (FCC)

DESCRIPTION:

Class B Digital Device - FCC Limits

ITEM TESTED:

Wireless Doorbell - Receiver Emissions, FRS Radios

MANUFACTURER:

Linear Corp.

TRADE NAME:

PRODUCT ID:

EF4 RFI00002

DATE:

12/19/2001

REFERENCE DOCUMENT:

SECTION 15.109 (a)

1 uV/M at 3 meters = 0 dBuV = -107 dBm (reference level).

Field Strength in dBm = dBuV - 107 dBm.

Field Strength in dBuV = dBm + 107 dBm.

Please refer to tables for Antenna Factors not already listed

Preamp gain (.1 to 1300 MHz) = 26dB and (1300-2000 MHz) =21 dB.

For 1 meter to 3 meter conversion use 9.54dB.

Calculation from measurement data:
Field Strength (dBuV) = meter reading (dBm) + Antenna and Loss factor - Preamp gain (26 or 21 dB) - 1 meter to 3 meter factor (9.54dB) if needed + 107 dBm.

Since dBuV = 20 Log (uV/M), uV/M = Antilog (dBuV/20).

DISTANCE AT WHICH MEASURED: 3 Meters, 0.8 Meter above ground

A	B	C	D	E	F	G	H	I	K	L	G	H	O	P	
Tuned Frequency MHz	Emission Frequency MHz	Ant. Type	Ambient Level dBm	FCC Limit dBm	Meter Reading dBm	Antenna Factor dB	Cable Loss dB	Amp Gain dB	Dist Fac dB	Field Strength dBm/mtr	dBuV/mtr	uV/mtr	FCC Limit uV/M	dB:FCC dB	FREQ. MHz
	30.00	BI:CON	-110.34	-47.66	#N/A	15.90	0.30	26.00	9.54	#N/A	#N/A	#N/A	100.00	#N/A	30.00
	40.00	BI:CON	-112.84	-45.16	#N/A	13.30	0.40	26.00	9.54	#N/A	#N/A	#N/A	100.00	#N/A	40.00
	50.00	BI:CON	-117.44	-40.56	#N/A	8.70	0.40	26.00	9.54	#N/A	#N/A	#N/A	100.00	#N/A	50.00
	60.00	BI:CON	-117.54	-40.46	#N/A	8.50	0.50	26.00	9.54	#N/A	#N/A	#N/A	100.00	#N/A	60.00
	70.00	BI:CON	-117.24	-40.76	#N/A	8.80	0.50	26.00	9.54	#N/A	#N/A	#N/A	100.00	#N/A	70.00
	80.00	BI:CON	-117.74	-40.26	#N/A	8.30	0.50	26.00	9.54	#N/A	#N/A	#N/A	100.00	#N/A	80.00
	90.00	BI:CON	-117.04	-40.96	#N/A	8.90	0.60	26.00	9.54	#N/A	#N/A	#N/A	100.00	#N/A	90.00
	100.00	BI:CON	-115.84	-42.16	#N/A	10.10	0.60	26.00	9.54	#N/A	#N/A	#N/A	100.00	#N/A	100.00
	110.00	BI:CON	-114.24	-40.24	#N/A	11.70	0.60	26.00	9.54	#N/A	#N/A	#N/A	150.00	#N/A	110.00
	120.00	BI:CON	-112.24	-42.24	#N/A	13.60	0.70	26.00	9.54	#N/A	#N/A	#N/A	150.00	#N/A	120.00
	130.00	BI:CON	-111.44	-43.04	#N/A	14.40	0.70	26.00	9.54	#N/A	#N/A	#N/A	150.00	#N/A	130.00
	140.00	BI:CON	-111.34	-43.14	#N/A	14.40	0.80	26.00	9.54	#N/A	#N/A	#N/A	150.00	#N/A	140.00

NOTE: Minor clocks every 1 MHz up to 64 MHz at zero distance. Not visible at 1 Mtr.

Actual frequency range of testing is from 30 to 1.0 GHz.

Figure 2: Receiver
Microprocessor Emissions

TESTED BY _____ DATE _____

John W. Kuivinen

CONDUCTED EMISSION DATA SHEET
FOR FCC, PART 15.111

DESCRIPTION: FRS Radio Desktop Transmitter
Conducted Receiver Emission Data

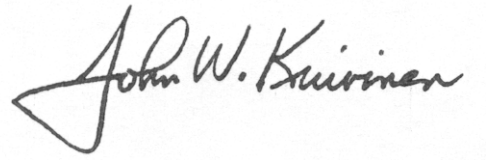
ITEM TESTED: Sample No. 1
MANUFACTURER: LINEAR CORP.
TRADE NAME: N/A
PRODUCT ID: EF4 RFI00002

DATE: 12/19/2001

REFERENCE DOCUMENT: C63.4-1992 Test Procedure

A	B	C	D	E	F	G
Frequency MHz	Level dBm 50 ohm load	Atten. dB	Cable Loss dB	Level dBm	FCC Required Levels 2 nWatt	dB:FCC Limit
417.6900	-70.2	7.8	0.0	-62.4	-57.00	-5.4
835.3800	-72.0	7.8	0.0	-64.2	-57.00	-7.2
1253.0700	-107.0	7.8	0.0	-99.2	-57.00	-42.2 **
1670.7600	-107.0	7.8	0.0	-99.2	-57.00	-42.2 **
2088.4500	-107.0	7.8	0.0	-99.2	-57.00	-42.2 **
2506.1400	-107.0	7.8	0.0	-99.2	-57.00	-42.2 **

** Noise floor measurement



TESTED BY

FILE NAME: RFI002_2.XLS DISK NAME: FCC DATA

LINEAR CORPORATION
FCC ID: EF4 RFI00002

Figure 3: Receiver Conducted Antenna Emissions



FIELD STRENGTH CALCULATIONS - CORRECTED
SIGNAL SUBSTITUTION METHOD, SPURIOUS EMISSIONS

DESCRIPTION: RI-D INTERCOM, FCC TEST SAMPLE NO. 1

ITEM TESTED: RF100002
MANUFACTURER: LINEAR CORP.
TRADE NAME: N/A
PRODUCT ID: EF4 RF100002

ACFdB = Value From Manufacturer
ACFnumeric = 10^(ACFdB/20)
Gnum =(9.76/((300/FMHz)*ACFnum))^2
Gdb = 10*log(Gnum)

DATE: JANUARY 30, 2002

REFERENCE DOCUMENT: TIA/EIA 603

$Pd(dBm) = +AntennaGain(dB)+ConvF(dB)-CableLoss(dB)+Pg(dBm)$

$Pd(watts) = 10^{((Pd(dBm)/10)-3)}$

$Pd(dBuV) = Pd(dBm) + 107$

$EIRP\ Spurious = EIRP\ Carrier * 1/(10^{(dBc/10)})$

$dB:limit = 10*log(Pd\ EIRP\ Spurious/ EIRP\ Pwr.\ Limit)$

A	B	C		C1	D	E								G	G1	G2	H	O	P	
Tuned Frequency MHz	Emission Frequency MHz	Analyzer Reading dBm	Pol. H/V	Conv. Factor dB	Measured Signal Gen. Power Equiv. Pg dBm	Distance		ANT.	ACF	ACF	"G"	Ant.	Measured TX Cable Loss	Ref. Only Amp Gain dB	G Pd Signal Strength dBm	G1 Pd Signal Strength Watts	G2 Pd Signal Strength dBuV	EIRP Pwr. Limit Watts	dB:Limit dB	FREQ. MHz
						Meters		Type	dB	Numeric	Numeric	dBd								
467.69	467.69	-7.8 V		20.0	#N/A	3.0	T3	23.4	14.79	1.06	0.2	0.1	0.0	#N/A	1.00E-01	#N/A	1.00E-01	0.00	467.69	
	935.38	-26.7 V		0.0	-14.50	3.0	T3	29.3	29.17	1.09	0.4	0.3	0.0	-14.4	3.63E-05	92.60	5.01E-05	-1.40	935.38	
	1403.06	-52.0 V		0.0	-19.50	3.0	LP	27.6	23.99	3.62	5.6	0.0 **	0.0	-13.9	4.06E-05	93.09	5.01E-05	-0.91	1403.06	
	1870.75	-58.7 H		0.0	-23.00	3.0	LP	29.9	31.26	3.79	5.8	0.0 **	0.0	-17.2	1.90E-05	89.79	5.01E-05	-4.21	1870.75	
	2338.44	-59.4 H		0.0	-21.00	3.0	LP	31.4	37.15	4.19	6.2	0.0 **	0.0	-14.8	3.33E-05	92.23	5.01E-05	-1.77	2338.44	
	2806.13	-60.8 H		0.0	-21.40	3.0	LP	32.5	42.17	4.69	6.7	0.0 **	0.0	-14.7	3.40E-05	92.31	5.01E-05	-1.69	2806.13	
	3273.81	-70.6 H		0.0	-28.83	3.0	LP	33.6	47.86	4.95	6.9	0.0 **	0.0	-21.9	6.48E-06	85.12	5.01E-05	-8.88	3273.81	
	3741.50	-71.7 H		0.0	-29.50	3.0	LP	34.5	53.09	5.26	7.2	0.0 **	0.0	-22.3	5.90E-06	84.71	5.01E-05	-9.29	3741.50	
	4209.19	-71.3 H		0.0	-27.40	3.0	LP	35.3	58.21	5.53	7.4	0.0 **	0.0	-20.0	1.01E-05	87.03	5.01E-05	-6.97	4209.19	
	4676.88	-75.6 H		0.0	-29.00	3.0	LP	35.9	62.37	5.95	7.7	0.0 **	0.0	-21.3	7.49E-06	85.75	5.01E-05	-8.25	4676.88	

The spectrum was searched from 25 to 4700 MHz
No other significant emissions were observed except those shown on this page.

* = 33 dB spurious = 1/(10^(33/10)) = Watts

1.000E-0330.00
5.012E-0433.00 dB
1.000E-0440.00

** Cable Loss is included in measured power output from signal generator

TESTED BY

DATE

FILE NAME: RF1002_TXSUB_FINAL.XLS

DISK: FCC DATA

John W. Kuivinen

Figure 4: Transmitter Radiated Emissions

CONDUCTED EMISSION DATA SHEET
FOR FCC, PART 95.631

DESCRIPTION: FRS Radio Doorbell Transmitter

ITEM TESTED: Sample No. 1
MANUFACTURER: LINEAR CORP.
TRADE NAME: N/A
PRODUCT ID: EF4 RFI00002

DATE: 1/25/2001

REFERENCE DOCUMENT: C63.4-1992 Test Procedure

A	B	C	D	E	F	G	H	I
Frequency MHz	Level dBm 50 ohm load	Atten. dB	Cable Loss dB	Level dBm	Corrected Level dBc	FCC Required Levels dBc	dB:FCC Limit	
467.5625	-3.2	-17.8	0.0	-20.97	0.0	0.00	0	
935.1250	-58.2	-17.8	0.0	-76.00	-55.0	-33.00	-22.03	
1402.6875	-45.8	-17.8	0.0	-63.60	-42.6	-33.00	-9.63	
1870.2500	-53.5	-17.8	0.0	-71.30	-50.3	-33.00	-17.33	
2337.8125	-77.0	-17.8	0.0	-94.80	-73.8	-33.00	-40.83	
2805.3750	-74.3	-17.8	0.0	-92.10	-71.1	-33.00	-38.13	
3272.9375	-75.4	-17.8	0.0	-93.20	-72.2	-33.00	-39.23	
3740.5000	-67.1	-17.8	0.0	-84.90	-63.9	-33.00	-30.93	
4208.0625	-67.3	-17.8	0.0	-85.10	-64.1	-33.00	-31.13	
4675.6250	-76.5	-17.8	0.0	-94.30	-73.3	-33.00	-40.33	

Levels at the noise floor are reported as -107 dBm.

John W. Kuivinen

TESTED BY _____ DATE _____

FILE NAME: RFI002_2.XLS DISK NAME: FCC DATA

Figure 5: Transmitter Conducted Antenna Emissions



RFI00002 - MODULATION LIMITING CURVES, JOHN KUIVINEN, JAN. 18, 2002											
input V	300 Hz	400 Hz	1000 Hz	1800 Hz	2500 Hz	3500 Hz	4700 Hz				
0.003000				500							
0.005000					500						
0.007000			500								
0.009000											
0.011000											
0.013000		500		1000							
0.015000											
0.017000					1000						
0.019000											
0.021000											
0.023000	500		1000								
0.025000											
0.027000				1250		500					
0.029000											
0.031000											
0.033000											
0.035000											
0.037000		1000									
0.039000			1250								
0.041000					1250						
0.043000											
0.045000											
0.047000											
0.049000											
0.051000											
0.053000											
0.055000											
0.057000											
0.059000		1250									
0.061000											
0.063000											
0.065000											
0.067000											
0.069000											
0.071000	1000						500				
0.073000											
0.075000											
0.077000											
0.079000											
0.081000											
0.083000											
0.085000											
0.087000											
0.089000											
0.091000											
0.093000											
0.095000											
0.100000						1000					
0.125000	1250						900				
0.150000											
0.175000											
0.200000											
0.225000											
0.250000		2000									
0.275000											
0.300000			2000	2000							
0.325000											
0.350000											

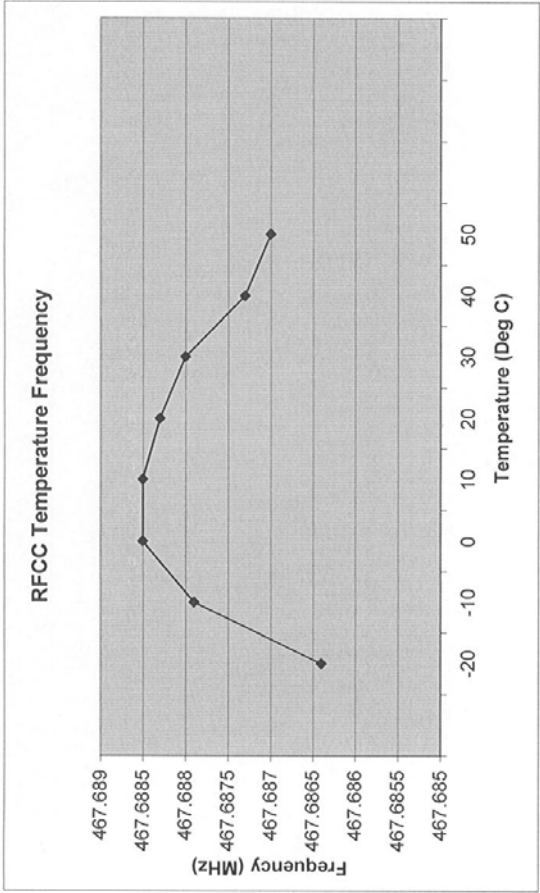
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Figure 7: Transmitter FM Modulation Deviation

John W. Kuivinen

Temp	Freq	PPM Error
-20	467.6864	-2.351998
-10	467.6879	0.855272
0	467.6885	2.13818
10	467.6885	2.13818
20	467.6883	1.710544
30	467.6880	1.06909
40	467.6873	-0.427636
50	467.6870	-1.06909

PILOT 3



Nominal Frequency: 467.6875 MHz

John W. Kuivinen

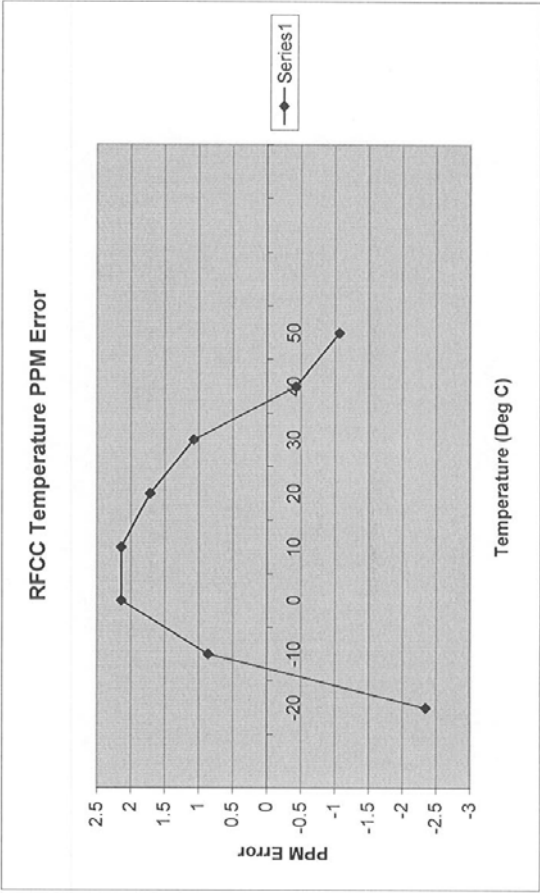


Figure 6: Transmitter Center Frequency with Variable Temperature

Variable Battery Voltage, Center Freq. And Deviation
JWK Data taken on 12/20/2001

Battery Voltage from P.S.	Freq. Error Hertz	Deviation KHz	NOTES
4.00	N/A	N/A	TX Off Air, No Spurious from PLL
4.50	-300	2.00	Power Cycled, TX Recovered
5.00	-200	2.00	
5.50	-200	2.00	
6.00	-80	2.00	
6.50	-80	2.00	
7.02	-80	2.00	
7.52	-80	2.00	
8.01	-70	2.00	
8.55	-60	2.00	
9.00	-50	2.00	
9.62	0	2.00	Reference Frequency-467.5613 MHz
10.20	0	2.00	
10.55	0	2.00	
11.04	0	2.00	
5.09	-100	2.00	
9.62	0	2.00	Reference Frequency-467.6863 MHz
11.01	0	2.00	

Figure 8: Transmitter
Center Frequency with
Variable DC Power

