

*FCC PART 15, SUBPART B and C  
TEST REPORT*

*for*

**REMOTE CONTROL**

**MODEL NUMBER: K24A-PRF+RFTM**

Prepared for

ELECTRONIC SOLUTIONS, INC.  
 11811 UPHAM STREET, UNIT #2  
 BROOMFIELD, COLORADO 80020-2710

Prepared by:\_\_\_\_\_

KYLE FUJIMOTO

Approved by:\_\_\_\_\_

MICHAEL CHRISTENSEN

COMPATIBLE ELECTRONICS INC.  
 114 OLINDA DRIVE  
 BREA, CALIFORNIA 92823  
 (714) 579-0500

DATE: JULY 15, 2004

	REPORT BODY	APPENDICES					TOTAL
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## GENERAL REPORT SUMMARY

This electromagnetic emission test report is generated by Compatible Electronics Inc., which is an independent testing and consulting firm. The test report is based on testing performed by Compatible Electronics personnel according to the measurement procedures described in the test specifications given below and in the "Test Procedures" section of this report.

The measurement data and conclusions appearing herein relate only to the sample tested and this report may not be reproduced without the written permission of Compatible Electronics, unless done so in full.

This report must not be used to claim product endorsement by NVLAP, NIST or any other agency of the U.S. Government.

Device Tested: Remote Control  
Model Number: K24A-PRF+RFTM  
S/N: N/A

Product Description: See Expository Statement.

Modifications: The EUT was not modified in order to meet the specifications.

Manufacturer: Electronic Solutions, Inc.  
11811 Upham Street, Unit #2  
Broomfield, Colorado 80020-2710

Test Date: July 14, 2004

Test Specifications: EMI requirements  
CFR Title 47, Part 15 Subpart B; and Subpart C, Sections 15.205, 15.209, and 15.231

Test Procedure: ANSI C63.4

Test Deviations: The test procedure was not deviated from during the testing.

## SUMMARY OF TEST RESULTS

TEST	DESCRIPTION	RESULTS
1	Conducted RF Emissions, 150 kHz - 30 MHz	This test was not performed because the EUT operates on DC power only and cannot be plugged into the AC public mains.
2	Radiated RF Emissions, 10 kHz - 4340 MHz	Complies with the Class B limits of CFR Title 47, Part 15, Subpart B; and Subpart C, sections 15.205, 15.209, and 15.231.



## 1. PURPOSE

This document is a qualification test report based on the Electromagnetic Interference (EMI) tests performed on the Remote Control Model Number: K24A-PRF+RFTM. The EMI measurements were performed according to the measurement procedure described in ANSI C63.4. The tests were performed in order to determine whether the electromagnetic emissions from the equipment under test, referred to as EUT hereafter, are within the **Class B** specification limits defined by CFR Title 47, Part 15, Subpart B; and Subpart C, sections 15.205, 15.209, and 15.231.



## **2. ADMINISTRATIVE DATA**

### **2.1 Location of Testing**

The EMI tests described herein were performed at the test facility of Compatible Electronics, 114 Olinda Drive, Brea, California 92823.

### **2.2 Traceability Statement**

The calibration certificates of all test equipment used during the test are on file at the location of the test. The calibration is traceable to the National Institute of Standards and Technology (NIST).

### **2.3 Cognizant Personnel**

Electronic Solutions, Inc.

Gary F. Skinner      President

Compatible Electronics, Inc.

Kyle Fujimoto	Test Engineer
Benigno Chavez	Test Technician
Michael Christensen	Sr. Test Engineer

### **2.4 Date Test Sample was Received**

The test sample was received prior to its qualification testing on July 13, 2004.

### **2.5 Disposition of the Test Sample**

The test sample has not yet been returned to Electronic Solutions, Inc. as of the date of this report.

### **2.6 Abbreviations and Acronyms**

The following abbreviations and acronyms may be used in this document.

RF	Radio Frequency
EMI	Electromagnetic Interference
EUT	Equipment Under Test
P/N	Part Number
S/N	Serial Number
HP	Hewlett Packard
ITE	Information Technology Equipment
CML	Corrected Meter Limit
LISN	Line Impedance Stabilization Network
PCB	Printed Circuit Board
TX	Transmit
RX	Receive



### **3. APPLICABLE DOCUMENTS**

The following documents are referenced or used in the preparation of this EMI Test Report.

<b>SPEC</b>	<b>TITLE</b>
CFR Title 47, Part 15	FCC Rules – Radio frequency devices (including digital devices)
ANSI C63.4: 2001	Methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz



## **4. DESCRIPTION OF TEST CONFIGURATION**

### **4.1 Description of Test Configuration - EMI**

Setup and operation of the equipment under test.

Specifics of the EUT and Peripherals Tested

The Remote Control Model: K24A-PRF+RFTM (EUT) was connected to the keypad. The EUT was continuously transmitting.

Two antennas were tested with the EUT, the Linx Antenna and the Callisto Electronics Antenna. Please see section 5.1 for a description of the antennas.

The final radiated data was taken in the mode above for both antennas for harmonic emissions. For spurious emissions, it was determined that the Callisto Electronics Antenna was the worst case and final spurious data was taken with that antenna. Please see Appendix E for the data sheets.



#### **4.1.1      Cable Construction and Termination**

**Cable 1**

This is a 2.5 meter unshielded cable connecting the EUT to the keypad. It has RJ-11 connectors at each end. The cable was bundled to a length of 1.1 meters.



**5. LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT****5.1 EUT and Accessory List**

EQUIPMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID
REMOTE CONTROL (EUT)	ELECTRONIC SOLUTIONS, INC.	K24A-PRF+RFTM	N/A	<b>P7RRFTM433</b>
KEYPAD (EUT)	ELECTRONIC SOLUTIONS, INC.	K24A-PRF+RFTM	N/A	<b>P7RRFTM433</b>
ANTENNA (EUT)	LINX TECHNOLOGIES, INC.	ANT-433-CW-RH	N/A	<b>N/A</b>
ANTENNA (EUT)	CALLISTO ELECTRONICS	RA-80037 (C9-038/A)	N/A	<b>N/A</b>



## 5.2 EMI Test Equipment

EQUIPMENT TYPE	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. DUE DATE
Radiate Emissions Data Capture Program	Compatible Electronics	2.0	N/A	N/A	N/A
Conducted Emissions Program	Compatible Electronics	2.3 (SR19)	N/A	N/A	N/A
Spectrum Analyzer – Main Section	Hewlett Packard	8566B	3638A08768	June 24, 2004	June 24, 2005
Spectrum Analyzer – Display Section	Hewlett Packard	85662A	3701A22262	June 25, 2004	June 24, 2005
Quasi-Peak Adapter	Hewlett Packard	85650A	2811A01363	June 24, 2004	June 24, 2005
EMI Test Receiver	Rohde & Schwarz	ESIB40	100172	July 22, 2003	July 22, 2004
Horn Antenna	Antenna Research	DRG-118/A	1053	January 16, 2004	Jan. 16, 2005
Microwave Preamplifier	Com Power	PA-122	25195	August 19, 2003	Aug. 19, 2004
Preamplifier	Com Power	PA-102	1017	January 6, 2004	Jan. 6, 2005
Biconical Antenna	Com Power	AB-100	1548	October 8, 2003	Oct. 8, 2004
Log Periodic Antenna	Com Power	AL-100	16089	October 8, 2003	Oct. 8, 2004
Antenna Mast	Com Power	AM-100	N/A	N/A	N/A
Turntable	Com Power	TT-100	N/A	N/A	N/A
Computer	Hewlett Packard	4530	US91912319	N/A	N/A
Monitor	Hewlett Packard	D5258A	TW74500641	N/A	N/A
Loop Antenna	Com Power	AL-130	17070	July 8, 2003	July 8, 2005



**6. TEST SITE DESCRIPTION****6.1 Test Facility Description**

Please refer to section 2.1 and 7.1 of this report for EMI test location.

**6.2 EUT Mounting, Bonding and Grounding**

The EUT was mounted on a 1.0 by 1.5 meter non-conductive table 0.8 meters above the ground plane.

The EUT was not grounded.



## 7. TEST PROCEDURES

The following sections describe the test methods and the specifications for the tests. Test results are also included in this section.

### 7.1 Radiated Emissions (Spurious and Harmonics) Test

The spectrum analyzer was used as a measuring meter along with the quasi-peak adapter. Amplifiers were used to increase the sensitivity of the instrument. The Com Power Preamplifier Model: PA-103 was used for frequencies from 30 MHz to 1 GHz, and the Com-Power Microwave Preamplifier Model: PA-122 was used for frequencies above 1 GHz. The spectrum analyzer was used in the peak detect mode with the "Max Hold" feature activated. In this mode, the spectrum analyzer records the highest measured reading over all the sweeps.

The measurement bandwidths and transducers used for the radiated emissions test were:

FREQUENCY RANGE	EFFECTIVE MEASUREMENT BANDWIDTH	TRANSDUCER
9 kHz to 150 kHz	200 Hz	Active Loop Antenna
150 kHz to 30 MHz	9 kHz	Active Loop Antenna
30 MHz to 300 MHz	120 kHz	Biconical Antenna
300 MHz to 1 GHz	120 kHz	Log Periodic Antenna
1 GHz to 4.34 GHz	1 MHz	Horn Antenna

The open field test site of Compatible Electronics, Inc. was used for radiated emission testing. This test site is set up according to ANSI C63.4. Please see section 6.2 of this report for mounting, bonding and grounding of the EUT. The turntable supporting the EUT is remote controlled using a motor. The turntable permits EUT rotation of 360 degrees in order to maximize emissions. Also, the antenna mast allows height variation of the antenna from 1 meter to 4 meters. Data was collected in the worst case (highest emission) configuration of the EUT. At each reading, the EUT was rotated 360 degrees and the antenna height was varied from 1 to 4 meters (for E field radiated field strength). The gunsight method was used when measuring with the horn antenna in order to ensure accurate results. The loop antenna was also rotated in the horizontal and vertical axis in order to ensure accurate results.



**Radiated Emissions (Spurious and Harmonics) Test (con't)**

The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT. The EUT was tested at a 3 meter test distance to obtain final test data. The final qualification data sheets are located in Appendix E.



## 7.2 Bandwidth of the Fundamental

The -20 dB bandwidth was checked to see that it was within 0.25% of the fundamental frequency for the EUT. Data sheets of the -20 dB bandwidth are located in Appendix E.



## 8. CONCLUSIONS

The Remote Control Model Number: K24A-PRF+RFTM meets all of the Class B specification limits defined in CFR Title 47, Part 15, Subpart B; and Subpart C, sections 15.205, 15.209, and 15.231.



**APPENDIX A**

***LABORATORY RECOGNITIONS***



## **LABORATORY RECOGNITIONS**

**Compatible Electronics has the following agency accreditations:**

National Voluntary Laboratory Accreditation Program - Lab Code: 200528-0

Voluntary Control Council for Interference - Registration Numbers: R-983, C-1026, R-984 and C-1027

Bureau of Standards and Metrology Inspection - Reference Number: SL2-IN-E-1031

Conformity Assessment Body for the EMC Directive Under the US/EU MRA Appointed by NIST

**Compatible Electronics is recognized or on file with the following agencies:**

Federal Communications Commission

Industry Canada

Radio-Frequency Technologies (Competent Body)



## **APPENDIX B**

### ***MODIFICATIONS TO THE EUT***



## MODIFICATIONS TO THE EUT

The modifications listed below were made to the EUT to pass FCC 15.231 or FCC Class B specifications.

All the rework described below was implemented during the test in a method that could be reproduced in all the units by the manufacturer.

Modification:

- Resistor R1 was changed from  $430 \Omega$  to  $570 \Omega$



## APPENDIX C

### ***ADDITIONAL MODELS COVERED UNDER THIS REPORT***



## **ADDITIONAL MODELS COVERED UNDER THIS REPORT**

### **USED FOR THE PRIMARY TEST**

Remote Control  
Model Number: K24A-PRF+RFTM  
S/N: N/A

There were no additional models covered under this report.



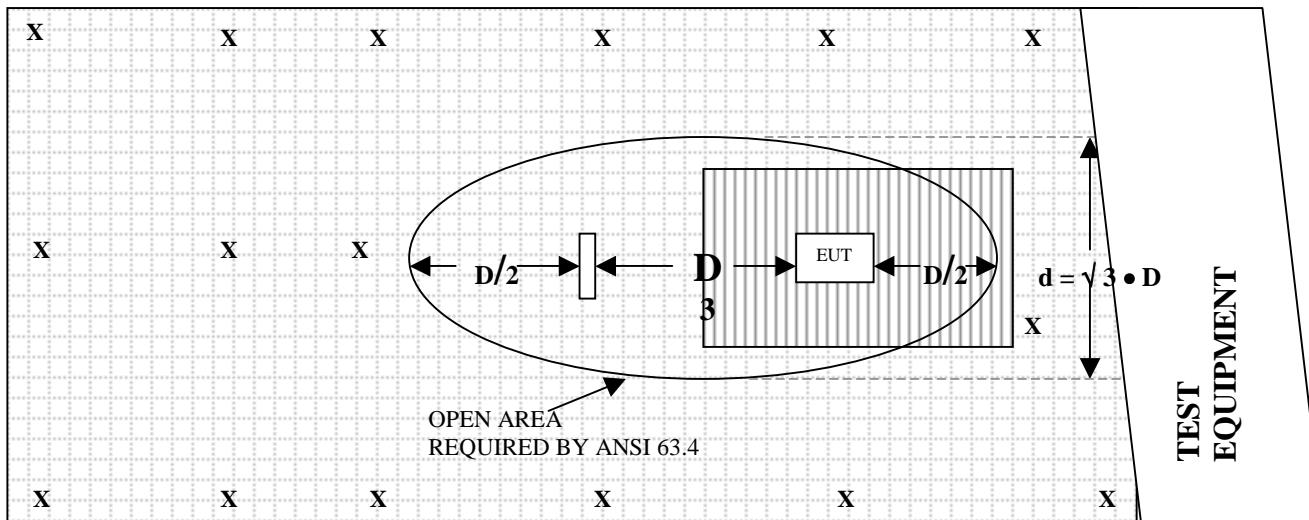
## **APPENDIX D**

### ***DIAGRAMS, CHARTS, AND PHOTOS***



## FIGURE 1: PLOT MAP AND LAYOUT OF RADIATED TEST SITE

## **OPEN LAND > 15 METERS**



## **OPEN LAND > 15 METERS**



**COM-POWER AL-130****LOOP ANTENNA****S/N: 17070****CALIBRATION DATE: JULY 8, 2003**

<b>FREQUENCY (MHz)</b>	<b>MAGNETIC (dB/m)</b>	<b>ELECTRIC (dB/m)</b>
0.009	-40.0	11.5
0.01	-40.1	11.4
0.02	-41.3	10.2
0.05	-41.7	9.8
0.07	-41.3	10.2
0.1	-41.5	10.0
0.2	-43.8	7.7
0.3	-41.4	10.1
0.5	-41.3	10.2
0.7	-41.2	10.3
1	-40.8	10.7
2	-40.3	11.2
3	-40.6	10.9
4	-40.7	10.8
5	-40.1	11.4
10	-40.5	11.0
15	-41.3	10.2
20	-41.1	10.4
25	-41.7	9.8
30	-43.1	8.4



**COM-POWER AB-100****BICONICAL ANTENNA****S/N: 1548****CALIBRATION DATE: OCTOBER 8, 2003**

<b>FREQUENCY (MHz)</b>	<b>FACTOR (dB)</b>	<b>FREQUENCY (MHz)</b>	<b>FACTOR (dB)</b>
30	13.1	120	9.9
35	12.9	125	11.4
40	14.6	140	12.0
45	12.8	150	13.0
50	12.9	160	13.9
60	9.3	175	14.2
70	8.2	180	14.3
80	8.0	200	14.9
90	8.1	250	16.6
100	8.8	300	19.7



**COM-POWER AL-100****LOG PERIODIC ANTENNA****S/N: 16089****CALIBRATION DATE: OCTOBER 8, 2003**

<b>FREQUENCY (MHz)</b>	<b>FACTOR (dB)</b>	<b>FREQUENCY (MHz)</b>	<b>FACTOR (dB)</b>
300	12.8	700	20.0
400	14.4	800	21.2
500	16.0	900	20.8
600	17.7	1000	21.7



**COM-POWER PA-102****PREAMPLIFIER****S/N: 1017****CALIBRATION DATE: JANUARY 6, 2004**

<b>FREQUENCY (MHz)</b>	<b>FACTOR (dB)</b>	<b>FREQUENCY (MHz)</b>	<b>FACTOR (dB)</b>
30	37.8	300	37.6
40	37.5	350	37.5
50	37.7	400	37.5
60	37.5	450	37.0
70	37.5	500	37.1
80	37.5	550	37.3
90	37.5	600	37.1
100	37.5	650	37.4
125	37.8	700	37.1
150	37.5	750	37.1
175	37.5	800	36.8
200	37.6	850	36.2
225	37.6	900	35.3
250	37.5	950	35.9
275	37.6	1000	35.3



## COM-POWER PA-122

### MICROWAVE PREAMPLIFIER

S/N: 25195

CALIBRATION DATE: AUGUST 19, 2003

FREQUENCY (GHz)	FACTOR (dB)	FREQUENCY (GHz)	FACTOR (dB)
1.0	30.8	6.0	33.3
1.1	30.9	6.5	32.7
1.2	30.9	7.0	31.8
1.3	30.4	7.5	31.6
1.4	30.7	8.0	30.3
1.5	31.0	8.5	29.0
1.6	31.2	9.0	29.0
1.7	30.3	9.5	29.5
1.8	28.9	10.0	30.9
1.9	31.2	11.0	30.2
2.0	30.9	12.0	28.7
2.5	30.4	13.0	30.3
3.0	31.7	14.0	28.7
3.5	32.6	15.0	29.5
4.0	32.6	16.0	31.1
4.5	32.2	17.0	30.1
5.0	31.1	18.0	28.6
5.5	30.6		



**ANTENNA RESEARCH DRG-118/A****HORN ANTENNA****S/N: 1053****CALIBRATION DATE: JANUARY 16, 2004**

<b>FREQUENCY (GHz)</b>	<b>FACTOR (dB)</b>	<b>FREQUENCY (GHz)</b>	<b>FACTOR (dB)</b>
1.0	24.4	9.5	38.6
1.5	25.2	10.0	38.7
2.0	28.2	10.5	39.0
2.5	28.5	11.0	38.9
3.0	30.1	11.5	41.3
3.5	31.0	12.0	40.5
4.0	31.2	12.5	40.0
4.5	31.9	13.0	40.2
5.0	33.2	13.5	40.5
5.5	33.7	14.0	41.6
6.0	34.3	14.5	44.8
6.5	35.0	15.0	41.4
7.0	36.7	15.5	39.2
7.5	37.3	16.0	39.4
8.0	37.1	16.5	40.9
8.5	37.3	17.0	42.6
9.0	37.7	17.5	45.1
		18.0	41.7



**FRONT VIEW**

ELECTRONIC SOLUTIONS, INC.  
REMOTE CONTROL  
MODEL NUMBER: K24A-PRF+RFTM  
FCC SUBPART B AND C – LAB B – RADIATED EMISSIONS – 07-14-04

**PHOTOGRAPH SHOWING THE EUT CONFIGURATION  
FOR MAXIMUM EMISSIONS**



**REAR VIEW**

ELECTRONIC SOLUTIONS, INC.  
REMOTE CONTROL  
MODEL NUMBER: K24A-PRF+RFTM  
FCC SUBPART B AND C – LAB B – RADIATED EMISSIONS – 07-14-04

**PHOTOGRAPH SHOWING THE EUT CONFIGURATION  
FOR MAXIMUM EMISSIONS**





**FRONT VIEW**

ELECTRONIC SOLUTIONS, INC.  
REMOTE CONTROL  
MODEL NUMBER: K24A-PRF+RFTM  
FCC SUBPART B AND C – LAB D – RADIATED EMISSIONS – 07-14-04

**PHOTOGRAPH SHOWING THE EUT CONFIGURATION  
FOR MAXIMUM EMISSIONS**





#### **REAR VIEW**

ELECTRONIC SOLUTIONS, INC.  
REMOTE CONTROL  
MODEL NUMBER: K24A-PRF+RFTM  
FCC SUBPART B AND C – LAB D – RADIATED EMISSIONS – 07-14-04

#### **PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS**



**APPENDIX E**

***DATA SHEETS***



***RADIATED EMISSIONS***

***DATA SHEETS***



FCC 15.231

## Electronic Solutions, Inc.

## Remote Control

Model: K24A-PRF+RFTM

## Configuration: Transmit Mode with Linx Antenna

Date: 7/14/04

## Lab: B

Tested By: Kyle Fujimoto

Duty Cycle: 41.098901%

**FCC 15.231**

Electronic Solutions, Inc.

Remote Control

Model: K24A-PRF+RFTM

Configuration: Transmit Mode with Linx Antenna

Date: 7/14/04

Lab: B

Tested By: Kyle Fujimoto

Duty Cycle: 41.098901%

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
433.92	87.63	H	100.8	-13.17	Peak	1.25	90	
433.92	79.91	H	80.8	-0.89	Avg	1.25	90	
867.84	47.34	H	80.8	-33.46	Peak	1.25	180	
867.84	39.62	H	60.8	-21.18	Avg	1.25	180	
1301.76	42.37	H	74	-31.63	Peak	2.45	180	
1301.76	34.65	H	54	-19.35	Avg	2.45	180	
1735.7	41.1	H	80.8	-39.7	Peak	3.41	0	
1735.7	33.38	H	60.8	-27.42	Avg	3.41	0	
2169.6	43.64	H	80.8	-37.16	Peak	2.81	90	
2169.6	35.92	H	60.8	-24.88	Avg	2.81	90	
2603.52	39.83	H	80.8	-40.97	Peak	2.23	315	
2603.52	32.11	H	60.8	-28.69	Avg	2.23	315	
3037.44	40.38	H	80.8	-40.42	Peak	2.22	0	
3037.44	32.66	H	60.8	-28.14	Avg	2.22	0	
3471.36	45.88	H	80.8	-34.92	Peak	2.51	90	
3471.36	38.16	H	60.8	-22.64	Avg	2.51	90	
3905.28	40.6	H	74	-33.4	Peak	2.51	135	
3905.28	32.88	H	54	-21.12	Avg	2.51	135	
4339.2	42.2	H	74	-31.8	Peak	2.51	180	
4339.2	28.39	H	54	-25.61	Avg	2.51	180	

FCC 15.231

## Electronic Solutions, Inc.

Date: 7/14/04

## Remote Control

## Lab: B

Model: K24A-PRF+RFTM

Tested By: Kyle Fujimoto & Benigno Chavez

#### Configuration: Transmit Mode with Callisto Electronics Antenna

Duty Cycle: 41.098901%

**FCC 15.231**

Electronic Solutions, Inc.

Date: 7/14/04

Remote Control

Lab: B

Model: K24A-PRF+RFTM

Tested By: Kyle Fujimoto &amp; Benigno Chavez

Configuration: Transmit Mode with Callisto Electronics Antenna

Duty Cycle: 41.098901%

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
433.92	86.32	H	100.8	-14.48	Peak	1.25	90	
433.92	78.6	H	80.8	-2.2	Avg	1.25	90	
867.84	52.69	H	80.8	-28.11	Peak	1.25	180	
867.84	44.97	H	60.8	-15.83	Avg	1.25	180	
1301.76	46.82	H	74	-27.18	Peak	1	180	
1301.76	39.1	H	54	-14.9	Avg	1	180	
1735.7	40.93	H	80.8	-39.87	Peak	2.5	225	
1735.7	33.21	H	60.8	-27.59	Avg	2.5	225	
2169.6	43.32	H	80.8	-37.48	Peak	1.25	315	
2169.6	35.6	H	60.8	-25.2	Avg	1.25	315	
2603.52	41.19	H	80.8	-39.61	Peak	2.5	315	
2603.52	33.47	H	60.8	-27.33	Avg	2.5	315	
3037.44	41.97	H	80.8	-38.83	Peak	2	270	
3037.44	34.25	H	60.8	-26.55	Avg	2	270	
3471.36	49.93	H	80.8	-30.87	Peak	2.25	45	
3471.36	42.21	H	60.8	-18.59	Avg	2.25	45	
3905.28	42.72	H	74	-31.28	Peak	3.25	315	
3905.28	35	H	54	-19	Avg	3.25	315	
4339.2	45.19	H	74	-28.81	Peak	2	225	
4339.2	37.47	H	54	-16.53	Avg	2	225	

***-20 dB BANDWIDTH***

***DATA SHEETS***

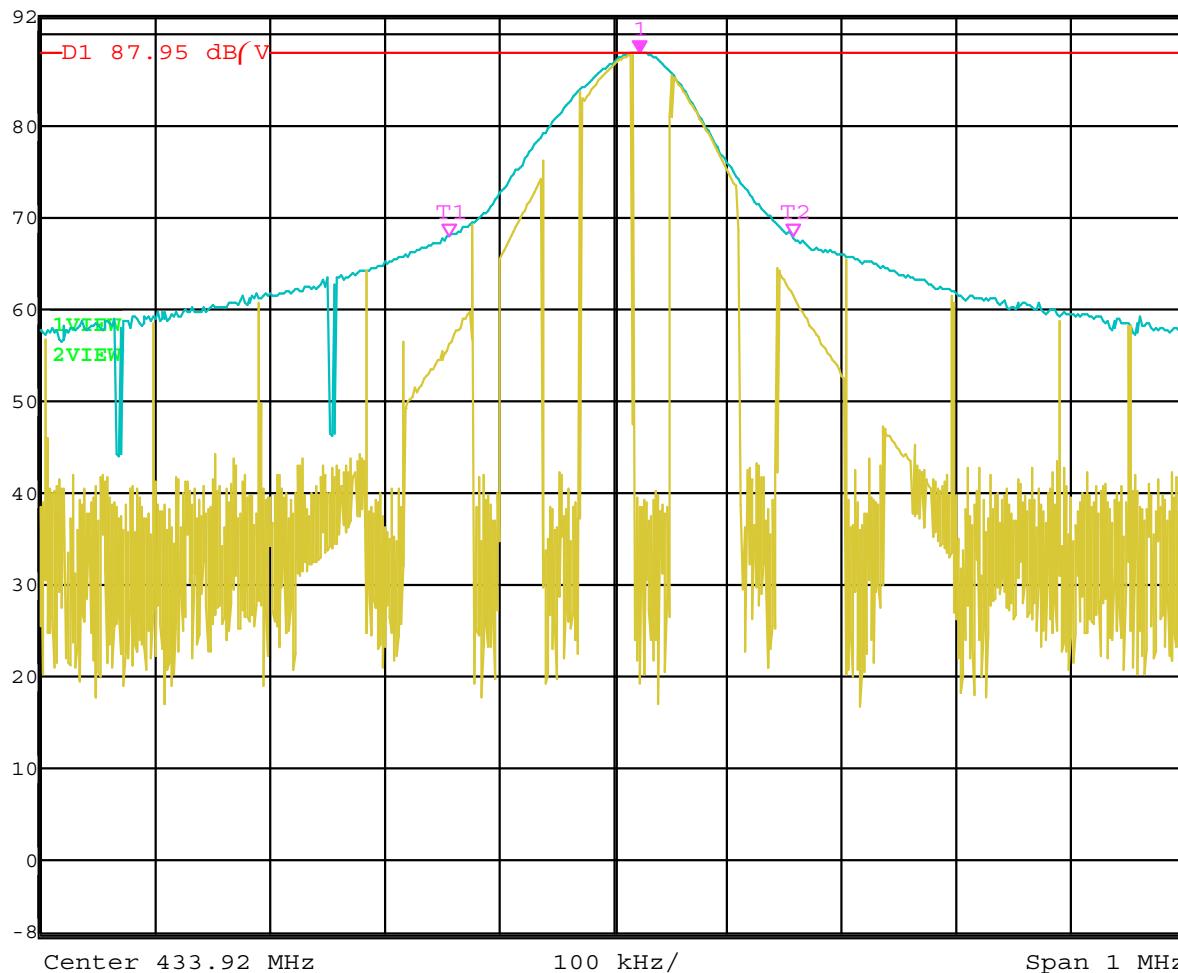




Ref Lvl  
92 dB/V

Marker 1 [T2 dB]  
dB 20.00 dB  
BW 300.60120240 kHz

RBW 100 kHz  
VBW 100 kHz  
SWT 5 ms  
Unit dB/V



Date: 14.JUL.2004 16:18:15

-20 dB Bandwidth of the Fundamental Emission