NRSC REPORT

NATIONAL RADIO SYSTEMS COMMITTEE

NRSC-R35
67 kHz-Compatible High-speed Data System Laboratory Test Report
November 12, 1997

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CONSUMER ELECTRONICS ASSOCIATION
Technology & Standards Department
1919 S. Eads St.
Arlington, VA 22202

NATIONAL ASSOCIATION OF BROADCASTERS
Science and Technology Department
1771 N Street, NW
Washington, DC 20036

FOREWORD

NRSC-R35, 67 kHz-Compatible High-speed Data System Laboratory Test Report, is the third of three test reports submitted to the NRSC's High-Speed FM Subcarrier (HSSC) Subcommittee. Three digital FM subcarrier systems were evaluated during these tests—DARC (submitted by Digital DJ, Inc.), STIC (submitted by Mitre Corporation), and HSDS (submitted by Seiko, Inc.). The co-chairmen of the HSSC Subcommittee at the time of the submission of NRSC-R35 were Michael Rau and David Kelly. The NRSC Chairman at the time of the submission of NRSC-R35 was Charles Morgan.

The NRSC is jointly sponsored by the Consumer Electronics Association and the National Association of Broadcasters. It serves as an industry-wide standards-setting body for technical aspects of terrestrial over-the-air radio broadcasting systems in the United States.

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High-speed FM Subcarrier Subcommittee

67 kHz-Compatible High-speed Data System Laboratory Test Report

November 12, 1997

Thomas B. Keller, Consultant
David M. Londa, RF Test Manager

Sponsored by the Electronic Industries Association and the National Association of Broadcasters

(Attachment 2)

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NATIONAL RADIO SYSTEMS COMMITTEE

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High-speed FM Subcarrier Subcommittee

67 kHz-Compatible High-speed Data System Laboratory Test Procedure

(As adopted by the Subcommittee on June 25, 1997)

Sponsored by the Electronic Industries Association and the National Association of Broadcasters

67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS TEST OUTLINE

- Tests with ~~strikethrough~~ were performed during the initial round of laboratory tests but will be skipped for 67 kHz compatible system tests; tests that are underlined are new for the 67 kHz compatible system tests.

- Acronyms used in test procedure:
  MER - Message error rate
  POF - Point of failure
  BLER - Block error rate (only used with RDS)
  OME - Onset of message errors
  OAME - Onset of additional message errors

A. Calibration
   1. Check signal injection/power (daily)
   2. Plot RF spectrum (daily)
   3. Noise check (daily)
   4. Weak signal check (daily)
   5. Analog channel proof (bi-weekly)
   6. Calibrate modulation monitors (monthly)
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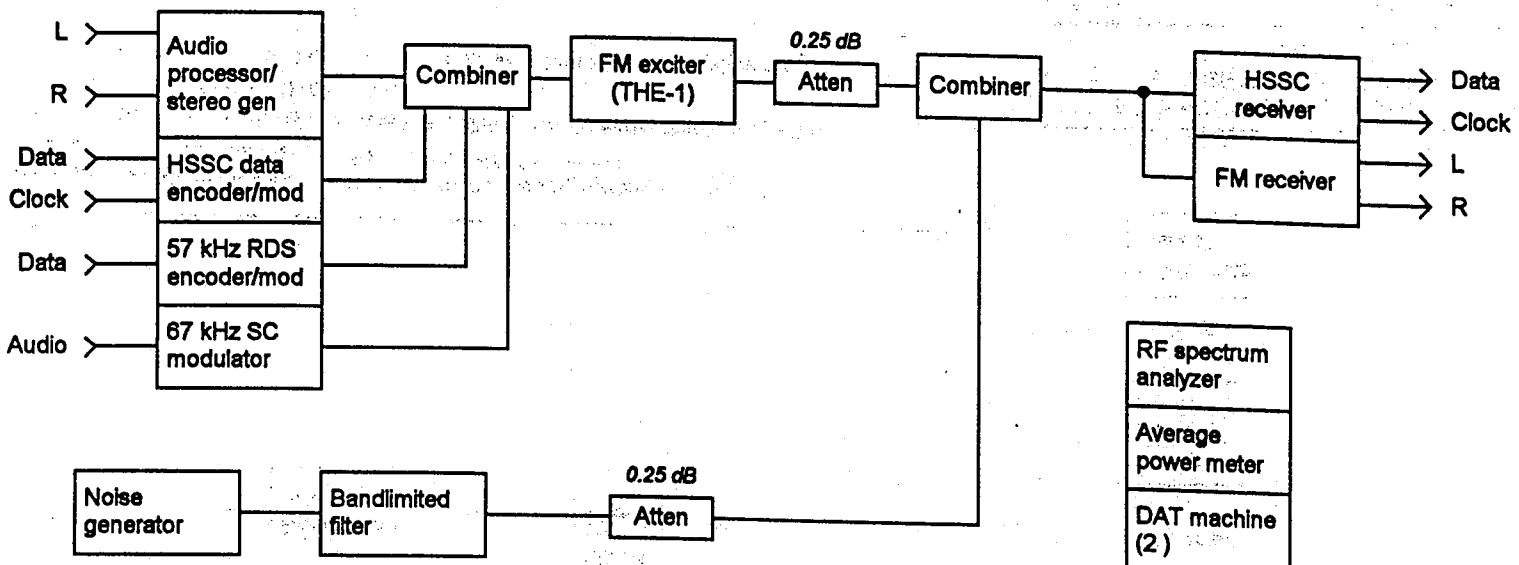
67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
A Calibration	1. HSSC subcarrier injection (daily)	The injection will be determined by percentage of modulation and peak deviation.	Objective	As needed	X 10%	X 10%		Injection
	2. Spectrum (daily)	An RF plot of each system will be taken daily. Baseband spectrum analyzer settings: Span 100 kHz, res. BW 300 Hz, video BW 30 Hz, sweep time 30 sec. RF spectrum analyzer settings: Span 200 kHz or 500 kHz, res. BW 1000 Hz, video BW 30 Hz, sweep time auto. Subcarrier groups C or D will be used for this test.	Objective	M (-65 dBm)	X 10%	X 10%		Spectrum plots (FM baseband and modulated FM carrier)
	3. Noise (daily)	Gaussian noise will be added to the signal in 0.25 dB steps until the onset of message errors (OME) is observed. Subcarrier groups C and D will be used for this test.	Objective	M (-65 dBm)	X 10%	X 10%		Co/No, MER at the OME
	4. Weak signal (daily)	Starting with a medium signal level, the signal will be reduced until the OME is observed. Subcarrier group C will be used for this test.	Objective	M (-65 dBm)	X 10%	X 10%		Signal level, MER at the OME
	5. Proof host transmitters (bi-weekly)	An automated proof of performance will be conducted on the analog transmitters. The test will include the analog system performance with and without subcarrier group C. A high quality demodulator will be used for the test.	Objective	M (-65 dBm)	NA	NA		Record of frequency respons, separation, and distortion
	6. Monitor calibration (monthly)	The FM analog modulation monitors will be calibrated monthly.	Objective	NA	NA	NA		Calibration record in lab log
	7. Proponent self check (optional)	This test will use the proponent self-certification routine to determine if the system is operating within specified limits.	Objective	System need	X	X		Note in lab log
	8. Test bed calibration (monthly)	All of the critical components in the test bed including the multipath simulator, attenuators, combiners, filters, generators, and measuring instruments will be calibrated on a monthly schedule.	Objective	NA	NA	NA		Calibration record in lab log

67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
B Character-ization of HS digital subcarrier signal failure	1. Noise	1. Using clipped pink noise for main channel modulation and subcarrier groups C and D, Gaussian noise will be added to the signal and increased to a level that produces the OME and POF, and HSSC MER will be recorded. 2. The 67 kHz analog subcarrier channel audio S/N will be measured with no noise added to the RF channel and with the noise added that produced the OME and POF recorded in step 1. 3. HSSC MER will be plotted versus Co/No from OME to POF.	Objective	M (-65 dBm)	X 10%	X 10%		Co/No, MER at the OME and POF 67 kHz subcarrier analog S/N at the OME and POF
	3. Multipath and noise	1. This test will be conducted four times, each with a different multipath scenario. The scenarios will be those used by the EIA DAR Subcommittee for testing DAR systems, and are urban slow, urban fast, rural fast, and terrain obstructed. 2. Using subcarrier group C and without added noise, MER performance of each systems will be assessed for each multipath scenario. 3. If the MER is non-zero, MER will be recorded. Then, Gaussian noise will be added to the signal until the OAME is observed. The noise will be increased in four 1 dB steps, and the MER will be recorded at each point. 4. If the MER is zero (with no added noise), then noise will be added to the signal (in 0.5 dB steps) until the OME. Data will be taken at OME and with the noise increased in four 1 dB steps	Objective	M (-65 dBm)	X 10%	X 10%		MER (no noise); Co/No, MER, for OAME or Co/No, MER with added noise (OME and OAME)
	6. Weak signal	1. Starting with the medium signal level (-65 dBm), the signal level will be reduced (in 0.25 dB steps) until the OME and POF are observed. 2, Subcarrier groups C, D, and no subcarriers, will be used for this test	Objective	Varying	X 10 %	X 10 %		Signal level, MER at OME and POF



RF spectrum analyzer
Average power meter
DAT machine (2)
Stereo monitor/ amplifier
Audio analyzer
HSSC data test set

NOTES

1) To minimize possible measurement variations caused by hysteresis, the noise will be increased rather than decreased when finding HS data errors.
2) Noise source not needed for test B-6 (replace with 50Ω termination).

TITLE	67 kHz-COMPATIBLE HSSC LAB TESTS B-1 / SIGNAL FAILURE W/NOISE B-6 / WEAK SIGNAL FAILURE
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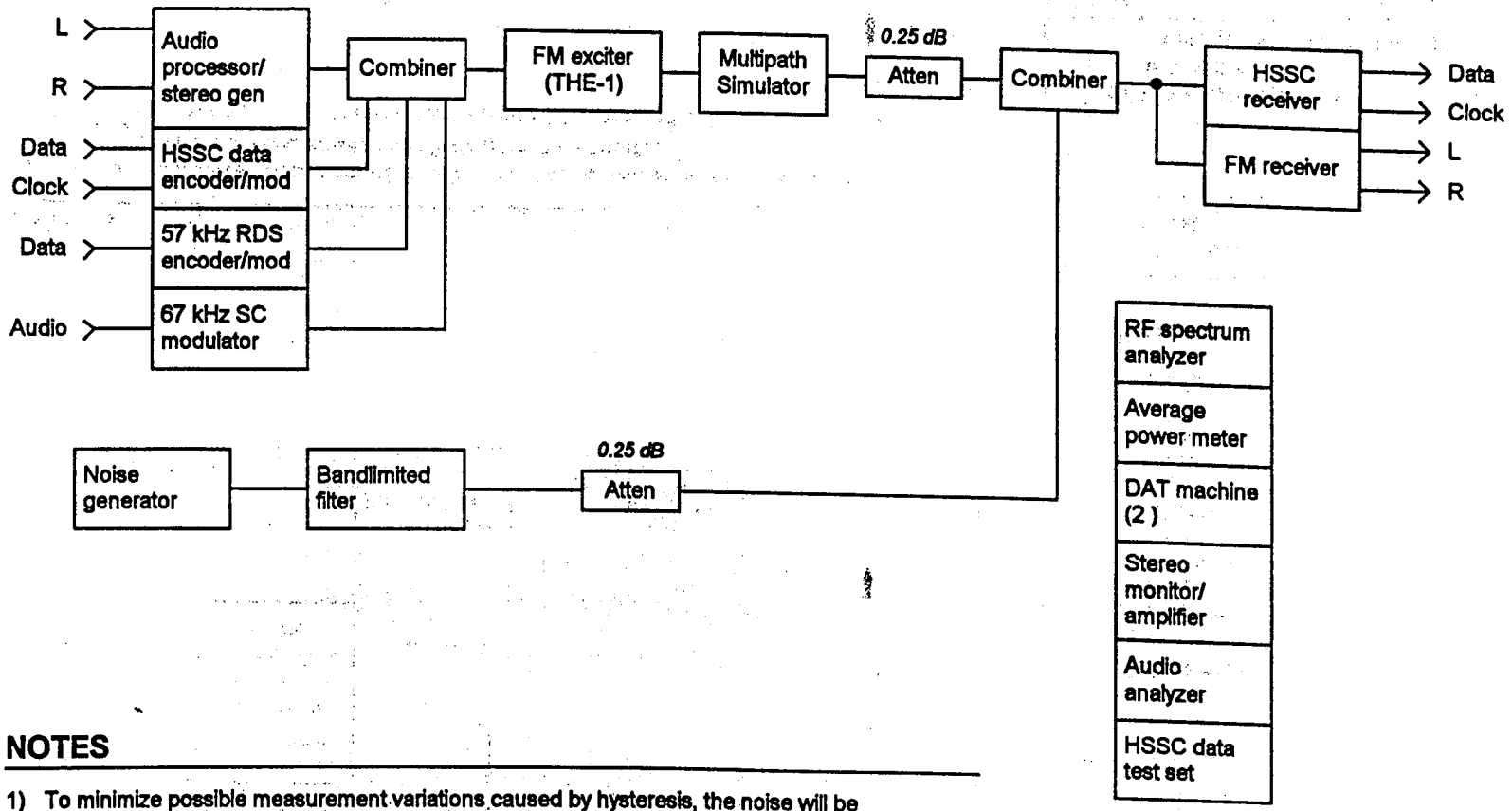

NOTES

1) To minimize possible measurement variations caused by hysteresis, the noise will be increased rather than decreased when finding HS data errors.
2) The multipath simulator consists of two HP 11759C RF Channel Simulators - 9 RF paths (out of an available 12) are utilized.
3) Four multipath scenarios will be used - urban slow, urban fast, rural fast, terrain obstructed.

TITLE	67 kHz-COMPATIBLE HSSC LAB TESTS B-3 / SIGNAL FAILURE W/MULTIPATH AND NOISE
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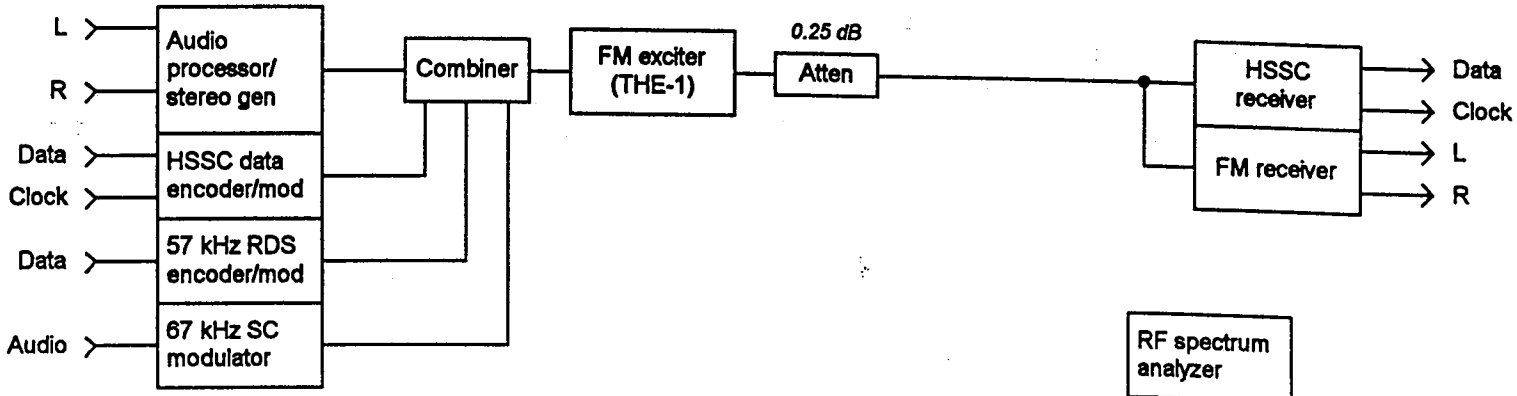
67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment 3	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
C Reacqui-sition	1. Simulated signal failure and acquisition	1. Continuous music will be used for the FM audio modulation, and subcarrier group C will be used. 2. The HSSC signal will be connected to the HSSC receiver and acquisition time recorded. 3. EO&C comments will be recorded by the laboratory specialists.	EO&C in lab	M (-65 dBm)	X 10%	X 10%		Acquisition time



- RF spectrum analyzer
- Average power meter
- DAT machine (2)
- Stereo monitor/ amplifier
- Audio analyzer
- HSSC data test set

NOTES

1) Continuous music will be used for the FM audio modulation.
2) These tests will be conducted using subcarrier group C.

TITLE	67 kHz-COMPATIBLE HSSC LAB TESTS C/ REACQUISITION
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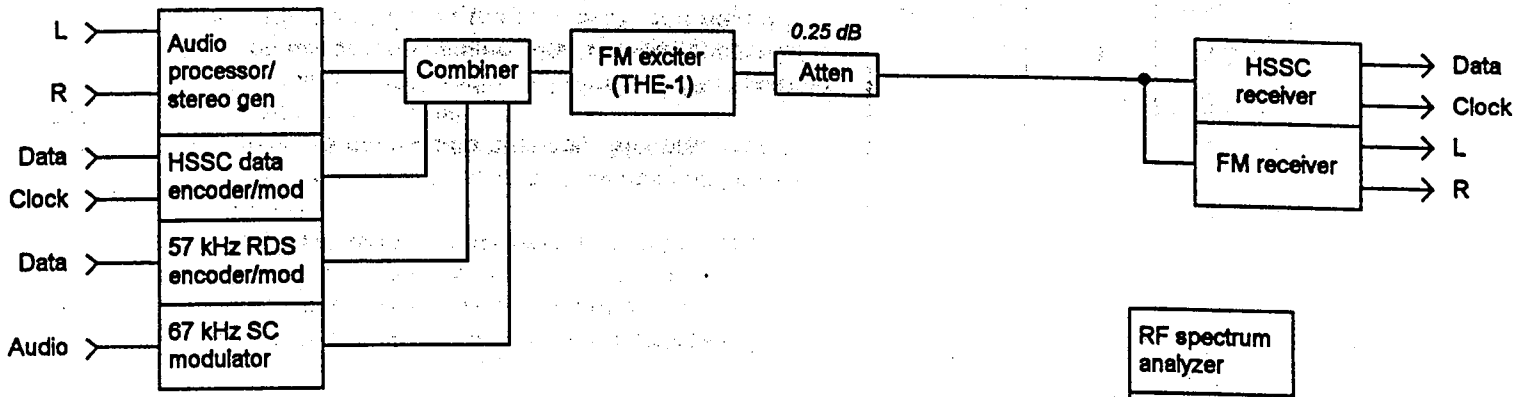
67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
D HSSC subcarrier -> host analog	1. HSSC subcarrier -> host analog	1. Four consumer FM stereo receivers will be used for the tests: one competitive home hi-fi, one high-end home hi-fi, and two auto. (The performance of these receivers has been characterized by the EIA DAR Subcommittee Working Group B.) The high-end hi-fi receiver will have a built-in RDS decoder. A 67 kHz analog subcarrier receiver will be available for these tests. 2. The main audio channel S/N will be measured with no subcarriers, for each receiver. 3. The main audio channel S/N will then be measured with the HSSC (as the only SCA) turned on, for each receiver. 4. The main audio channel S/N will then be measured using subcarrier group C, for each receiver.	Objective	M (-65 dBm) & W (-75 dBm)	X 10%	X 10%		Main channel audio S/N for each receiver: without subcarriers with HSSC (as only SCA) with subcarrier group C
	3. HSSC to host analog with distortion in RF path	1. The receivers used in test D-1 will be used for this test. 2. This test will be conducted utilizing three different RF path distortion scenarios – narrow band, moderate amplitude slope, and severe amplitude slope. The multipath simulator will be used to create these distortions. 3. Moderate classical music and silence will be used to modulate the main audio channel. Moderate audio processing will be used. 4. The main channel audio S/N ratio will be measured for each distortion scenario, first without subcarriers, then with the HSSC as the only SCA, and then with subcarrier group C, for each receiver.	Objective	M (-65 dBm)	X 10 %	X 10 %		Main channel audio S/N for each receiver under each test condition



RF spectrum analyzer
Average power meter
DAT machine (2)
Stereo monitor/ amplifier
Audio analyzer
HSSC data test set

NOTES

1) Four consumer FM stereo receivers will be used - one competitive home Hi-Fi, one high-end home Hi-Fi, and two auto.
2) Main channel audio S/N ratio is measured in each receiver under three conditions:
   - no subcarriers
   - with HSSC signal present (as only SCA)
   - with subcarrier group C present

TITLE
67 kHz-COMPATIBLE HSSC LAB TESTS
D-1 / HSSC -> HOST ANALOG

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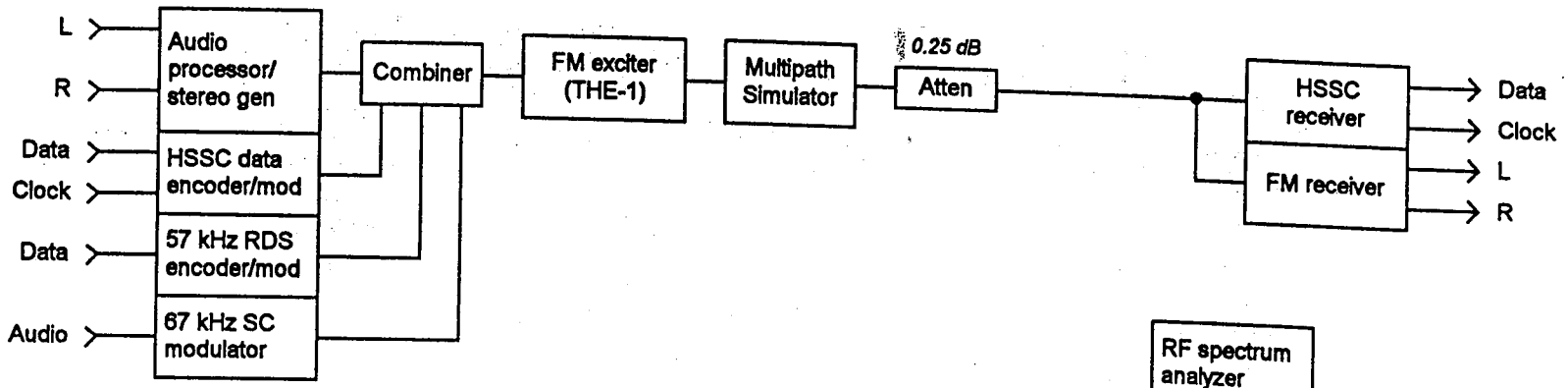

- RF spectrum analyzer
- Average power meter
- DAT machine (2)
- Stereo monitor/ amplifier
- Audio analyzer
- HSSC data test set

NOTES

1) Four consumer FM stereo receivers will be used - one competitive home Hi-Fi, one high-end home Hi-Fi, and two auto.
2) Three distortion scenarios will be used - narrowband, moderate amplitude slope, and severe amplitude slope .
3) The multipath simulator (used to realize the RF distortions) consists of two HP 11759C RF Channel Simulators.
4) Main channel audio S/N ratio is measured in each receiver under three conditions:
   - no subcarriers
   - with HSSC signal present (as only SCA)
   - with subcarrier group C present

TITLE	67 kHz-COMPATIBLE HSSC LAB TESTS D-3 / INTERFERENCE TO HOST ANALOG WITH DISTORTION IN RF PATH
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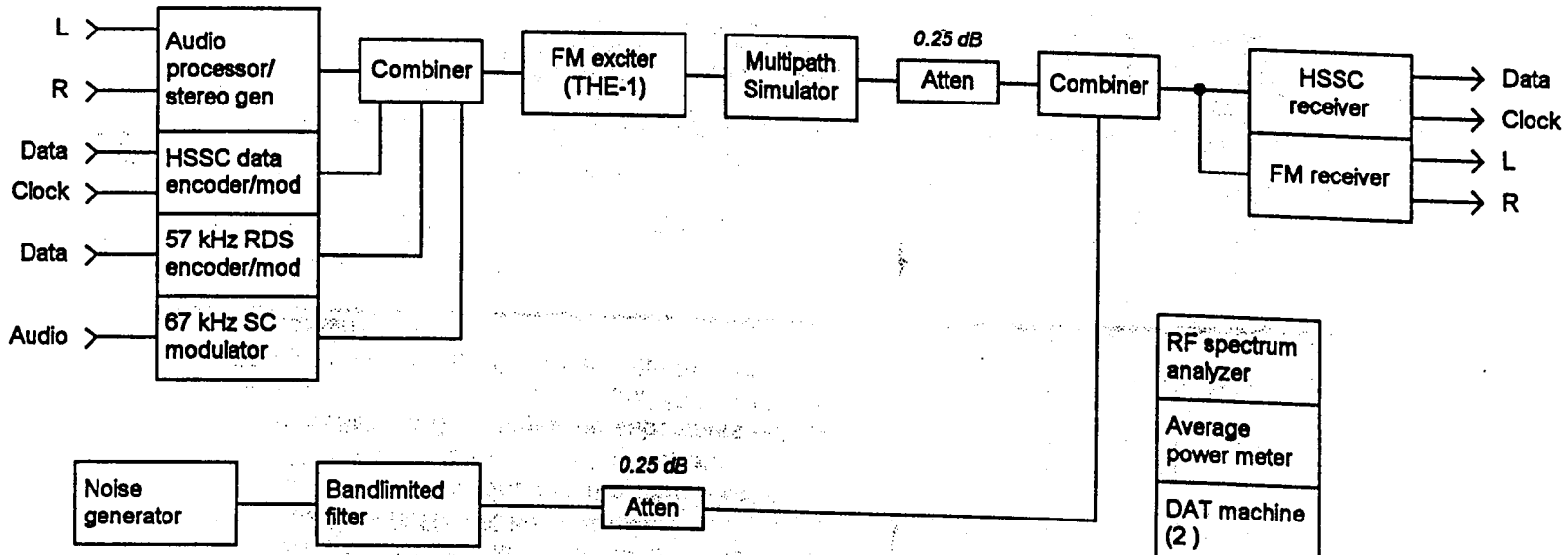
DATE 5/29/97	REV x.2

67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
E Host analog -> digital subcarrier	3. Host analog to HSSC with distortion in RF path	1. This test will be conducted utilizing three different RF path distortion scenarios – narrow band, moderate amplitude slope, and severe amplitude slope. The multipath simulator will be used to create these distortions. 2. ABBA and silence will be used to modulate the main audio channel. Moderate audio processing will be used. 3. Using an undistorted RF channel, Gaussian noise will be added to the RF signal until the OME and POF are observed. 4. Using noise levels required for OME and POF found in step 3, each of the distortion scenarios will be switched in, and the HSSC MER will be recorded.	Objective	M (-65 dBm)	X 10%	X 10%		Co/No, MER at OME and POF (undistorted RF path) MER with distortions (at OME and POF as determined in step 3)



NOTES

1) Three distortion scenarios will be used - narrowband, moderate amplitude slope, and severe amplitude slope.
2) The multipath simulator (used to realize the RF distortions) consists of two HP 11759C RF Channel Simulators.

TITLE	67 kHz-COMPATIBLE HSSC LAB TESTS E-1 / HOST ANALOG TO HSSC WITH DISTORTION IN RF PATH
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REV	x.2

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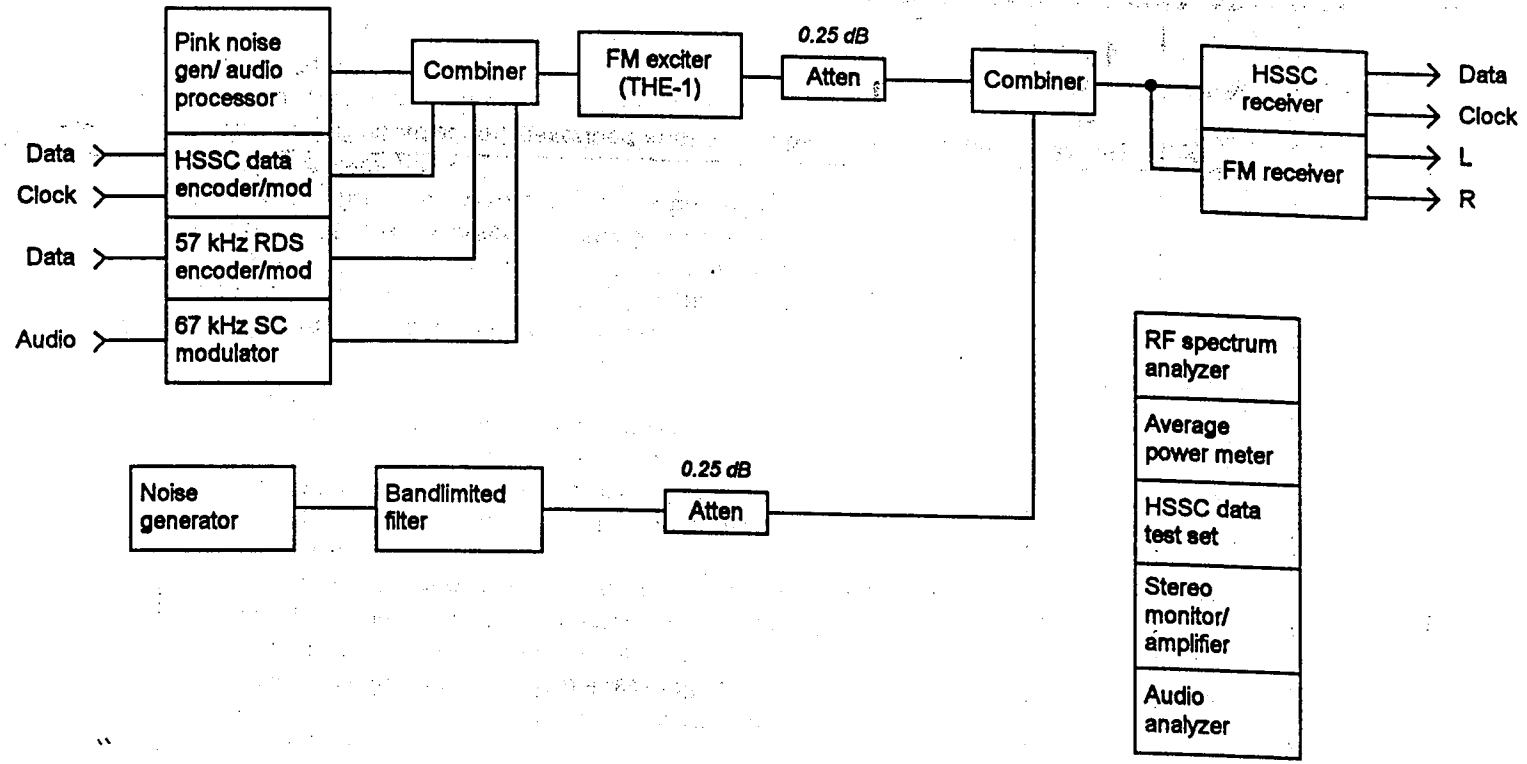
67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
F HSSC subcarrier -> RDS and 67 kHz analog subcarrier	1. HSSC -> 67 kHz analog subcarrier	1. Subcarrier group C will be used for this test. 2. With all the subcarriers in group C operating, the audio S/N ratio for the 67 kHz analog subcarrier channel will be measured. 3. The HSSC and RDS subcarriers will be alternately turned on and off. Each time, the audio S/N ratio for the 67 kHz analog subcarrier channel will be measured.	Objective	M (-65 dBm)	X 10%	X 10%		Audio S/N ratio in 67 kHz analog subcarrier
	2. HSSC -> RDS subcarrier	1. Subcarrier group C will be used for this test. 2. With all the subcarriers in group C operating, and no noise, HSSC MER and RDS BLER will be recorded. 3. The HSSC and 67 kHz analog subcarriers will be alternately turned on and off (no noise case). Each time, the RDS BLER will be recorded. 4. Noise will then be added to the signal until the OME and POF are observed in the HSSC signal. 3. The HSSC and 67 kHz analog subcarriers will be alternately turned on and off, at the HSSC OME and POF operating points. Each time, the RDS BLER will be recorded.	Objective	M (-65 dBm)	X 10 %	X 10 %		Co/No, MER at OME and POF (HSSC) BLER (RDS)



NOTES

1) Test for compatibility with 67 kHz analog, RDS, and paging subcarriers
2) 67 kHz analog compatibility: measure audio S/N for 67 kHz analog subcarrier, then re-measure while altenately turning off HSSC and RDS subcarriers (noise generator not used)
3) RDS compatibility: add noise until OME in HSSC system, then observe RDS errors while altenately turning off HSSC and 67 kHz analog subcarriers

TITLE	67 kHz-COMPATIBLE HSSC LAB TESTS F-1, 2 / HSSC -> OTHER SUBCARRIERS
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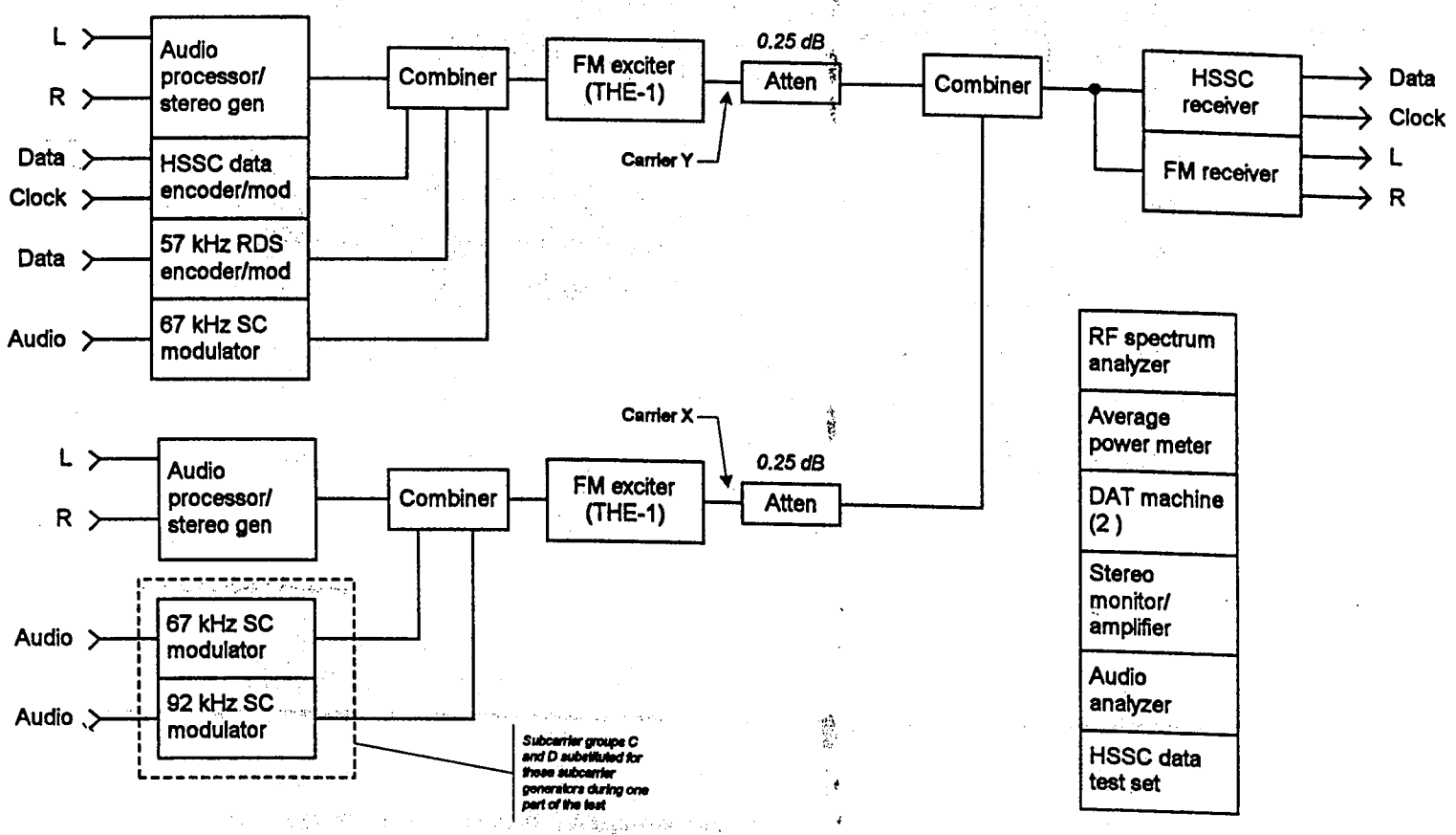
67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
G Adjacent channel interference	1. First adjacent	1. The receivers used in test D-1 will be used for this test. 2. Two 1st adjacent RF carriers are used, both with clipped pink noise main channel modulation. In addition, carrier X has 67 kHz and 92 kHz analog subcarriers each at 10% injection, and carrier Y has subcarrier group C. 3. With carrier Y (desired) at moderate signal level (-65 dBm), the level of carrier X (undesired) will be increased in 0.5 dB steps until a main channel audio S/N ratio in carrier Y of 45 dB is measured. The S/N ratio of the 67 kHz subcarrier on carrier Y (desired) will also be measured. 4. Subcarrier groups C and D will be substituted for the two analog subcarriers on carrier X (undesired). Each time, the S/N ratio in carrier Y (desired) main channel audio and 67 kHz analog subcarrier will be measured. 5. The level of carrier X (undesired), again using the 67 kHz and 92 kHz analog subcarriers, will be increased until the OME on the HSSC signal of carrier Y (desired). Then, carrier X will be further increased until the OAME is observed. Carrier X level will be increased in four 1 dB steps, and the MER will be recorded at each point.	Objective	M (-65 dBm) (desired)	X 10%	X 10%		D/U at main channel audio 45 dB S/N ratio (desired channel) S/N ratios in main channel audio, 67 kHz analog subcarrier of desired channel D/U, MER at OME, OAME (HSSC)
	2. Second adjacent	1. Test G-1 (first adjacent) described above, will be repeated, this time with carrier X and carrier Y 2nd adjacent to one another.	Objective	M (-65 dBm) (desired)	X 10 %	X 10 %		(Same as test G-1 above)



NOTES

1) Main channel audio modulated with clipped pink noise for both carriers
2) 67 kHz and 92 kHz subcarrier generators used for carrier X each set for 10 % injection
3) The receivers used in test D-1 will be used for this test

TITLE	67 kHz-COMPATIBLE HSSC LAB TESTS G-1, 2 / ADJACENT CHAN. INTERFERENCE
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67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
H System specific	1. Phase, HSSC to 19 kHz pilot	1. The following tests will be conducted with the HSSC signal NOT locked to the stereo 19 kHz pilot: - B-1 (signal failure with noise) - D-1 (HSSC -> host analog, interference to host analog)	Objective	M (-65 dBm)	X 10%			(refer to tests B-1 and D-1)

67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS								
Test Group	Test & Impairment	TEST PROCEDURE	Type of Eval	Sig Lev	System: Seiko	System: MITRE		Test results Data to be recorded
I Proponent receiver character-ization	1. Baseband tests	1. Frequency response (DC to 100 kHz) 2. THD/frequency 3. Limiting threshold 4. Two-tone intermodulation 5. First adjacent rejection 6. Second adjacent rejection	Objective	M (-65 dBm)	X	X		(Quantities referred to under test procedure)

J. Additional information

1. Subcarrier groups:

67 kHz COMPATIBLE HIGH SPEED DATA LABORATORY TESTS							
Subcarrier Group C (RDS)							
System: Seiko				System: Mitre			
RDS	57.0 kHz	3 %		RDS	57.0 kHz	3 %	
Data	88.5 kHz	10%		Data	88.5 kHz	10%	
FM	67 kHz	7 %		FM	67 kHz	7 %	
Subcarrier Group D (Paging)							
System: Seiko				System: Mitre			
Paging	57.0 kHz	10 %		Paging	57.0 kHz	10 %	
Data	88.5 kHz	10 %		Data	88.5 kHz	10 %	

2. Test signal levels:

W	Weak	-75 dBm
M	Moderate	-65 dBm
S	Strong	-50 dBm (not used in these tests)

3. Onset of message error (OME) definition:

OME is defined as the first operating point (in a test) at which a system exhibits a message completion rate of less than 100 %, or equivalently, the operating point at which a system exhibits a message error rate greater than 0 %.

4. Onset of additional message error (OAME) definition:

OAME is defined as the first operating point (in a test) at which the message completion rate of a system decreases with respect to the message completion rate measured at the OME.

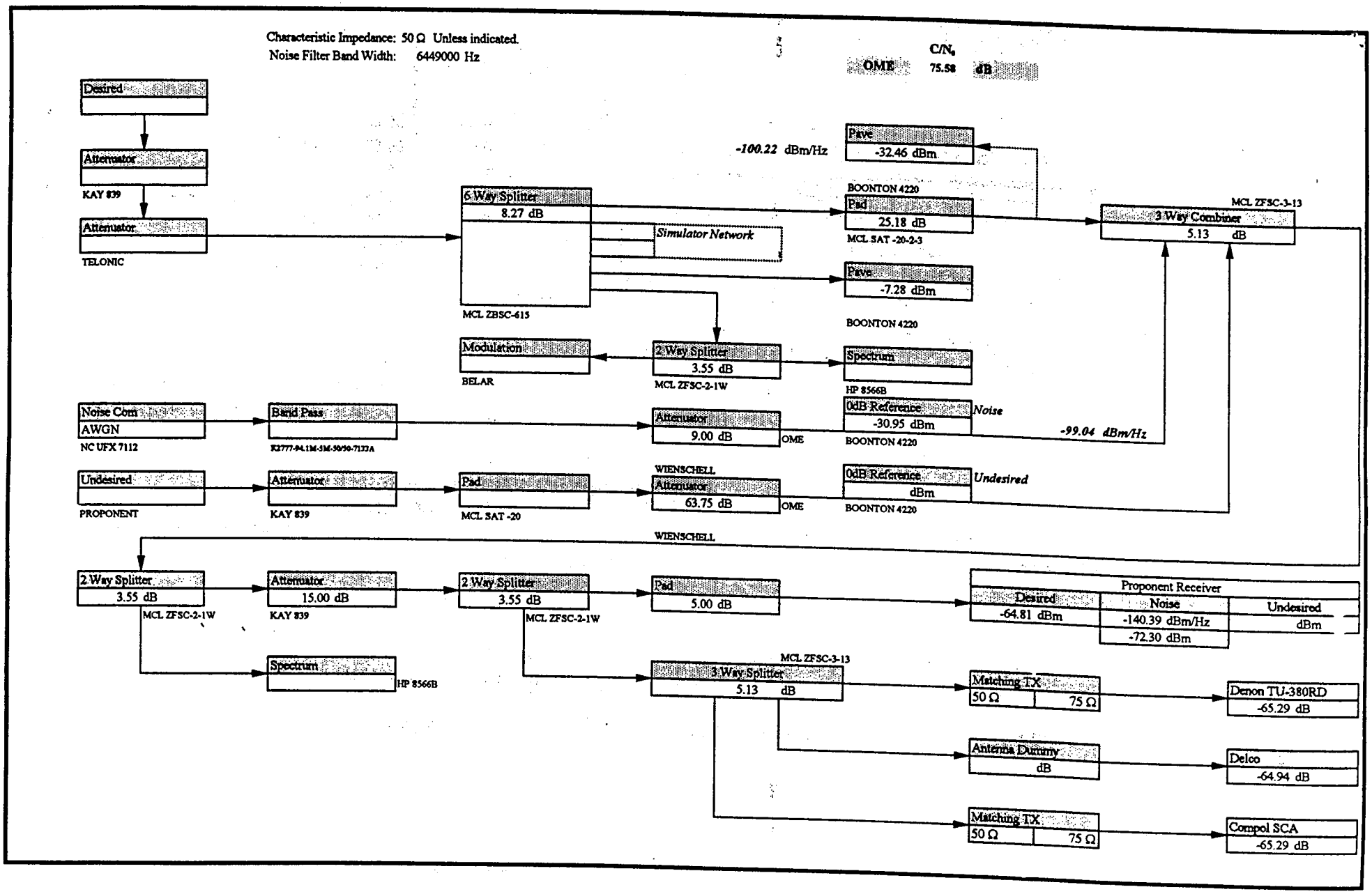
5. Point of failure (POF) definition:

POF is defined as the point where a system exhibits a message completion rate of 90 % ± 5 %, or equivalently, where a system exhibits a message error rate of 10 % ± 5 %.

3.0
Test Data

Test B-1

Signal Failure with Noise


Characteristic Impedance: 50 Ω Unless indicated.
Noise Filter Band Width: 6449000 Hz
C/N₀
OME 75.58 dB
Desired
Attenuator
KAY 839
Attenuator
TELONIC
6 Way Splitter
8.27 dB
MCL ZBSC-615
Simulator Network
-100.22 dBm/Hz
Pave
-32.46 dBm
BOONTON 4220
Pad
25.18 dB
MCL SAT -20-2-3
3 Way Combiner
5.13 dB
MCL ZFSC-3-13
Pave
-7.28 dBm
BOONTON 4220
Modulation
BELAR
2 Way Splitter
3.55 dB
MCL ZFSC-2-1W
Spectrum
HP 8566B
Noise Com
AWGN
NC UFX 7112
Band Pass
Attenuator
9.00 dB
OME
0dB Reference
-30.95 dBm
BOONTON 4220
Noise
-99.04 dBm/Hz
Undesired
PROPONENT
Attenuator
KAY 839
Pad
MCL SAT -20
WIENSCHELL
Attenuator
63.75 dB
OME
0dB Reference
dBm
BOONTON 4220
Undesired
WIENSCHELL
2 Way Splitter
3.55 dB
MCL ZFSC-2-1W
Attenuator
15.00 dB
KAY 839
2 Way Splitter
3.55 dB
MCL ZFSC-2-1W
Pad
5.00 dB
Proponent Receiver
Desired
-64.81 dBm
Noise
-140.39 dBm/Hz
-72.30 dBm
Undesired
dBm
Spectrum
HP 8566B
MCL ZFSC-3-13
3 Way Splitter
5.13 dB
Matching TX
50 Ω
75 Ω
Denon TU-380RD
-65.29 dB
Antenna Dummy
dB
Delco
-64.94 dB
Matching TX
50 Ω
75 Ω
Compol SCA
-65.29 dB

(Mitre)

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Digital Radio Test Laboratory

B-1 Additive White Gaussian Noise
Characterization of HS Digital Subcarrier Signal Failure

Test Date	Engineer(s):
7/22/97	DML

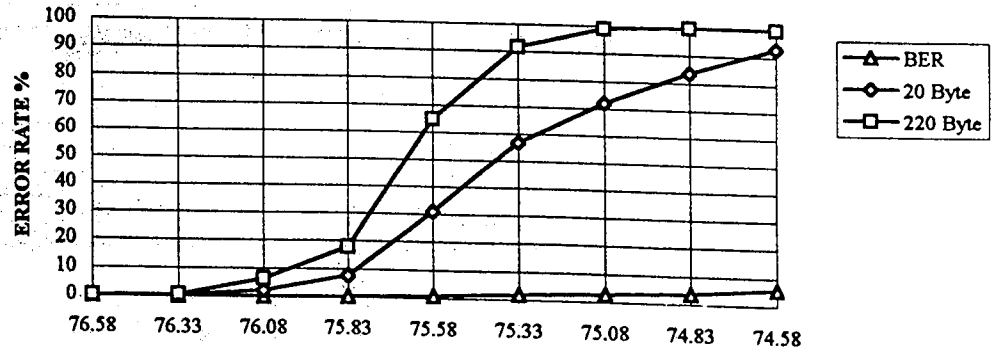
Basic Test Parameters:

SIGNAL		PROPONENT SPECIFIC	COMPOSITE SIGNAL
Center Frequency:	94.1 MHz		
RF Level:	-65 dBm	Interleaver Level 2	5-Band Medium Processed
Main Channel Mod:	CPN		ORBAN #2
SCA Group:	Proponent Only		COMP OUT 1: Proponent Only
Measurement Duration:	2.5 minutes		COMP OUT 2: Prop + SCA
			Main Channel modulation adjusted for 110%

Analog Receivers: Delco RX 7
Dayton 67kHz SCA Receiver
Denon RX 2 RBDS Receiver W/RDS Check software utilty

B1.1a **Noise Failure Characterization** – Proponent only

C/N,	Noise Level Attn	Error Level (%) BER	20 Byte	220 Byte	
76.58	10.00	0	0	0	
76.33	9.75	0.004	0.196	0.571	OME
76.08	9.50	0.059	2.038	6.333	
75.83	9.25	0.215	7.530	17.73	
75.58	9.00	0.923	30.92	65.00	
75.33	8.75	1.893	56.74	91.58	
75.08	8.50	2.683	71.95	99.14	
74.83	8.25	3.714	83.57	100.0	
74.58	8.00	5.713	92.97	100.0	



(Mitre)
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5.1.1b

Digital Radio Test Laboratory

Error with other SCAs

Main Channel Mod: CPN		Noise Level		Error Level (%)		
SCA Group: C		C/N$_o$	Attn	BER	20 Byte	220 Byte
		76.33	9.75	0.006	0.269	0.762
		75.33	8.75	1.630	52.55	91.29
		74.58	8.00	4.827	89.08	100.0

Main Channel Mod: CPN		Noise Level		Error Level (%)		
SCA Group: D		C/N$_o$	Attn	BER	20 Byte	220 Byte
		76.33	9.75	0.096	3.584	10.43
		75.33	8.75	3.352	79.42	100.0
		74.58	8.00	8.700	98.26	100.0

5.1.2a

67kHz S/N Ratio (Dayton AF200-SCA Receiver)

SCA Group: C	S/N	
Main Channel Mod: CPN	(dB)	
Best Case 67 kHz Only	46 ✓	No MCM
Best Case 67 kHz	44 ✓	
RBDS & 67 kHz	30.8 ✓	
Proponent & 67 kHz	36.5 ✓	
RBDS, Proponent & 67 kHz	29.8 ✓	
RBDS, Proponent & 67 kHz	20	OME

EO&C

RMS with 15kHz Low Pass Filter

Deviation = 5.5 kHz: Fmod=1 kHz

Also in test F-1

1.2b (not in test procedure)

Main Channel S/N Ratio (Denon RX 2)

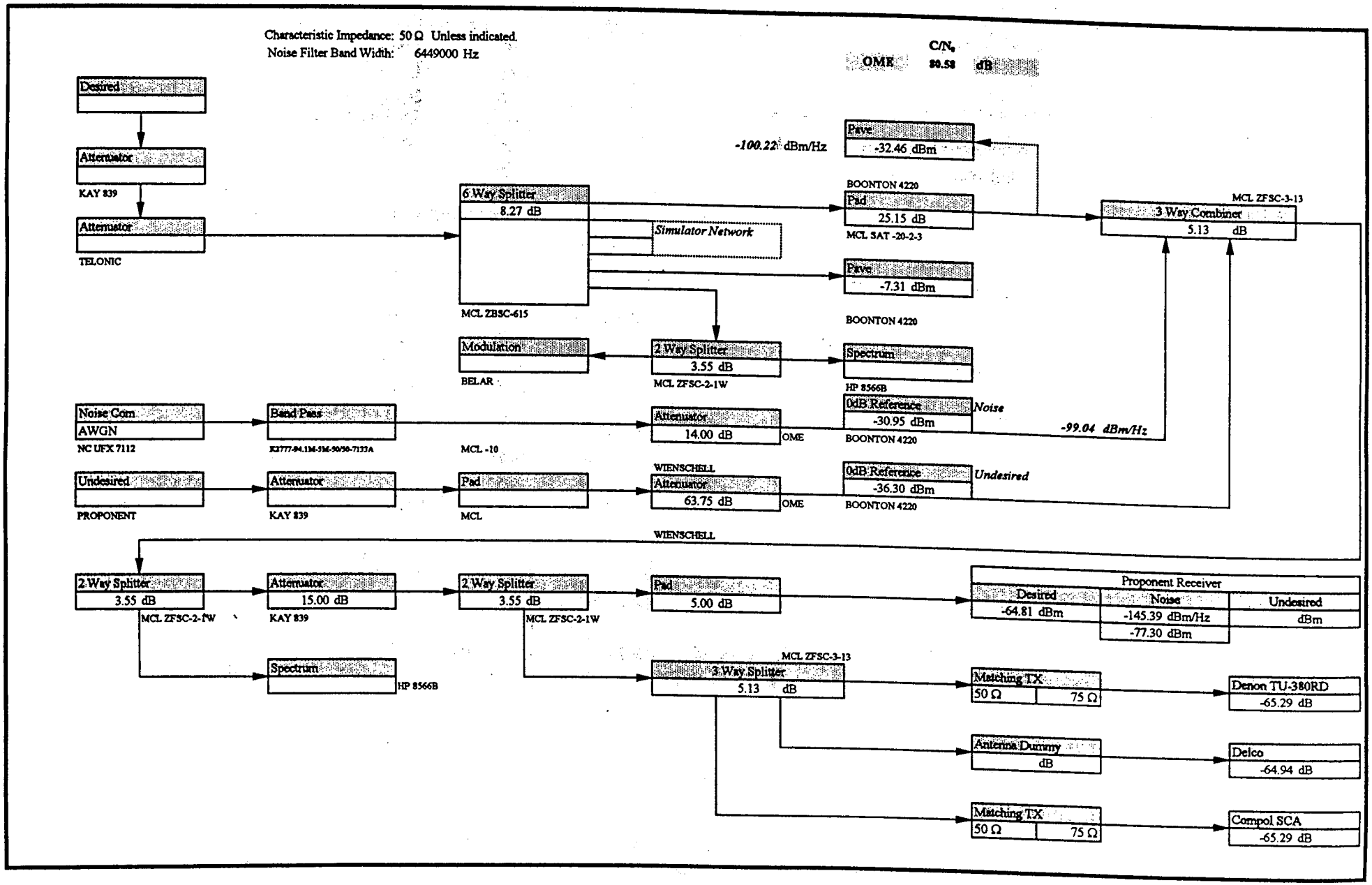
	S/N (dB)
SCA Group: None	61
Proponent Only	61
C	60.3
D	59.7
C @ OME	38

RMS with 15 kHz Low Pass Filter
0dB taken with 1 kHz Mod Souce

(Mitre)

3

Digital Radio Test Laboratory



(Seiko)

Digital Radio Test Laboratory

B-1 Additive White Gaussian Noise
Characterization of HS Digital Subcarrier Signal Failure

Test Date: 7/23/97
Engineer(s): DML

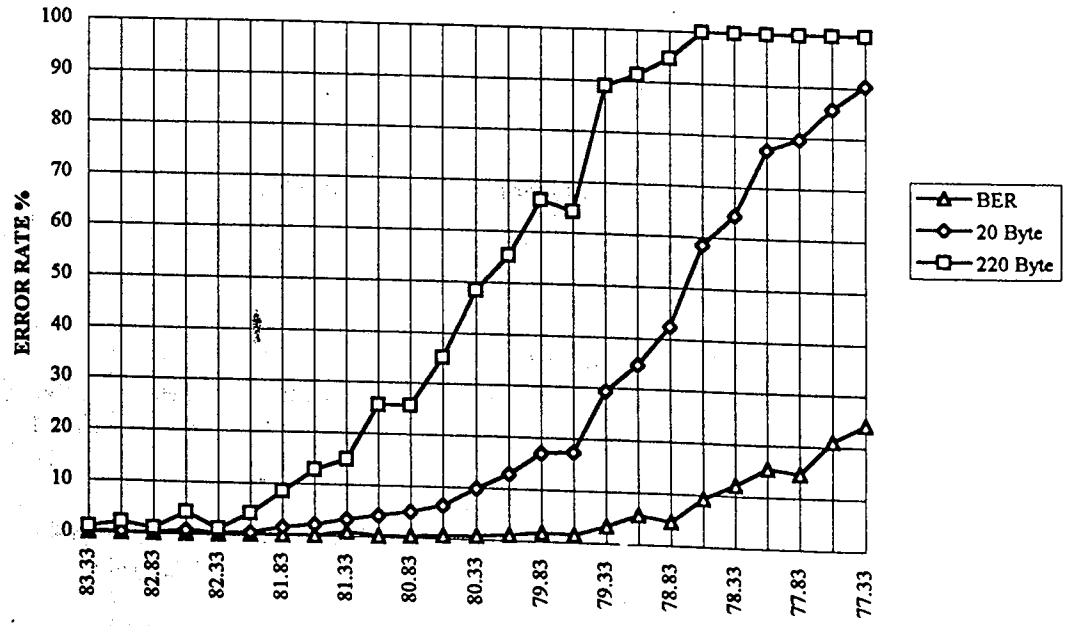
Basic Test Parameters: **SIGNAL**

Center Frequency: 94.1 MHz
RF Level: -65 dBm
Main Channel Mod: CPN
SCA Group: Proponent Only
Measurement Duration: 2.5 minutes

COMPOSITE SIGNAL
5-Band Medium Processed
ORBAN #2
COMP OUT 1: Proponent Only
COMP OUT 2: Prop + SCA
Main Channel modulation
adjusted for 110%

31.1a **Noise Failure Characterization** – Proponent only

Noise Level		Error Level (%)			
C/N$_o$	Attn	BER	20 Byte	220 Byte	
83.58	17.00	0	0	0	
83.33	16.75	0.011	0.193	1.064	OME
83.08	16.50	0.011	0.193	2.128	
82.83	16.25	0.011	0.182	1.000	
82.58	16.00	0.051	0.774	4.255	
82.33	15.75	0.012	0.196	1.075	
82.08	15.50	0.119	0.484	4.255	
81.83	15.25	0.114	1.644	8.511	
81.58	15.00	0.182	2.224	12.77	
81.33	14.75	0.876	3.288	14.89	
81.08	14.50	0.267	4.159	25.53	
80.83	14.25	0.370	5.029	25.53	
80.58	14.00	0.620	6.480	35.11	
80.33	13.75	0.753	9.873	48.39	
80.08	13.50	1.126	12.86	55.32	
79.83	13.25	1.697	17.00	66.30	
79.58	13.00	1.430	17.39	64.13	
79.33	12.75	3.397	29.37	89.01	
79.08	12.50	5.661	34.78	91.30	
78.83	12.25	4.583	42.42	94.62	
78.58	12.00	9.338	58.54	100.00	
78.33	11.75	12.17	64.34	100.00	
78.08	11.50	15.46	77.47	100.00	
77.83	11.25	14.58	79.59	100.00	
77.58	11.00	20.92	85.76	100.00	
77.33	10.75	24.23	90.28	100.00	



Digital Radio Test Laboratory

31.1b [redacted]

Error with other SCAs

Main Channel Mod: CPN
SCA Group: C

Noise Level		Error Level (%)		
C/N₀	Attn	BER	20 Byte	220 Byte
83.33	16.75	0	0	0
80.33	13.75	0.828	10.07	44.09
77.33	10.75	22.88	91.92	100.0

Main Channel Mod: CPN
SCA Group: D

Noise Level		Error Level (%)		
C/N₀	Attn	BER	20 Byte	220 Byte
83.33	16.75	0.011	0.193	1.064
80.33	13.75	1.489	15.93	63.44
77.33	10.75	34.25	96.36	100.0

31.2a [redacted]

67kHz S/N Ratio (Dayton AF200-SCA Receiver)
SCA Group: C
Main Channel Mod: CPN

	S/N (dB)		EO&C
Best Case 67 kHz Only	46 ✓	No MCM	
Best Case 67 kHz	43 ✓		RMS with 15kHz Low Pass Filter
RBDS & 67 kHz	30.6 ✓		3 % RPS
Proponent & 67 kHz	31.4 ✓		Deviation = 5.5 kHz: Fmod=1 kHz
RBDS, Proponent & 67 kHz	28 ✓		
RBDS, Proponent & 67 kHz	25	OME	

Also measured in F-1

31.2b (not in test procedure) [redacted]

Main Channel S/N Ratio (Denon RX 2)

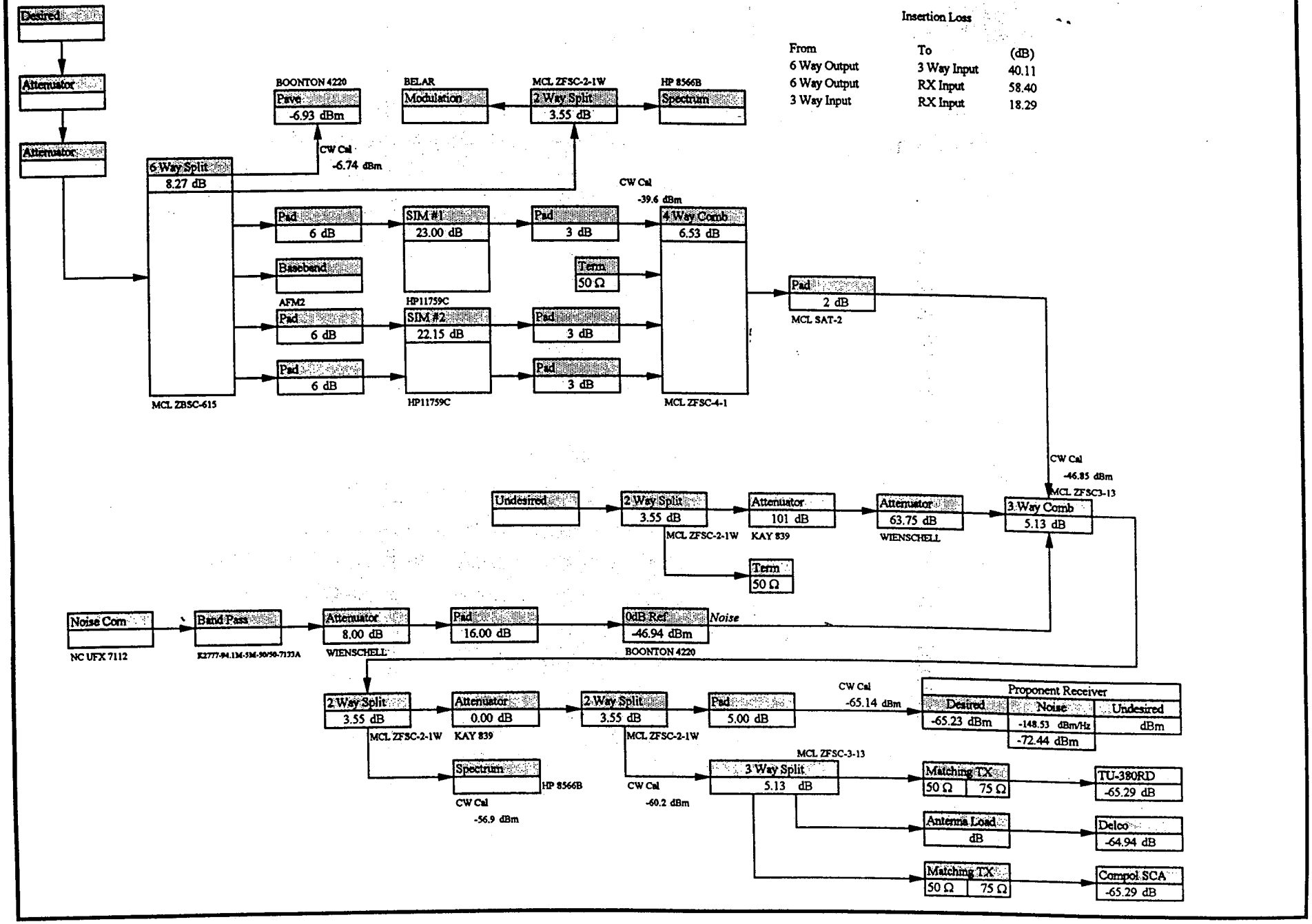
	S/N (dB)	
SCA Group: None	61	RMS with 15 kHz Low Pass Filter
Proponent Only	61	0dB taken with 1 kHz Mod Souce
C	60.3	
D	59.7	
C @ OME	45	

(Seiko)

Test B-3

Signal Failure with Noise and Multipath

Digital Radio Test Laboratory



(Mitre)

3.9

Digital Radio Test Laboratory

B-3 Multipath 7/25/97

Characterization of HS Digital Subcarrier Signal Failure

Basic Test Parameters: **SIGNAL** **PROPONENT SPECIFIC** **COMPOSITE SIGNAL**

One Path Zero Phase Reference: -65dBm
Main Channel Mod: CPN
SCA Group: C Analog SCA modulated with ABBA.
Error Measurement Duration: 2.5 minutes

ORBAN #2
COMP OUT 1: Proponent Only
COMP OUT 2: Prop + SCA
Main Channel modulation adjusted for 110%
5 Band Medium Fast Processing

	Noise Level		Error Level (%)		
	C/N₀	Attn	BER	20 Byte	220 Byte
Urban Slow	**131.93**	63.75	0.000	0.000	0.000
	89.18	21.00	0.000	0.000	0.000
	88.18	20.00	0.014	0.572	1.867
	87.18	19.00	0.182	6.727	14.80
	86.18	18.00	0.447	15.86	27.87
	85.18	17.00	1.242	30.68	40.82
	84.18	16.00	2.295	40.73	51.73
Urban Fast	**131.93**	63.75	0.000	0.000	0.000
	87.18	19.00	0.000	0.000	0.000
	86.18	18.00	0.010	0.333	0.941
	85.18	17.00	0.179	6.227	14.50
	84.18	16.00	1.058	30.37	50.75
	83.18	15.00	3.647	73.72	95.25
	82.18	14.00	8.820	96.41	100.0
Rural Fast	**131.93**	63.75	0.000	0.000	0.000
	90.18	22.00	0.000	0.000	0.000
	89.18	21.00	0.009	0.304	0.933
	88.18	20.00	0.491	17.24	38.67
	87.18	19.00	2.850	69.95	96.67
	86.18	18.00	6.976	95.43	100.0
Obstructed	**131.93**	63.75	49.83	100.0	100.0

Δ = -2 dB (with urban slow)

Δ = +1 dB (with urban slow)

File Name: MIT855AA.XLS
(Mitre)

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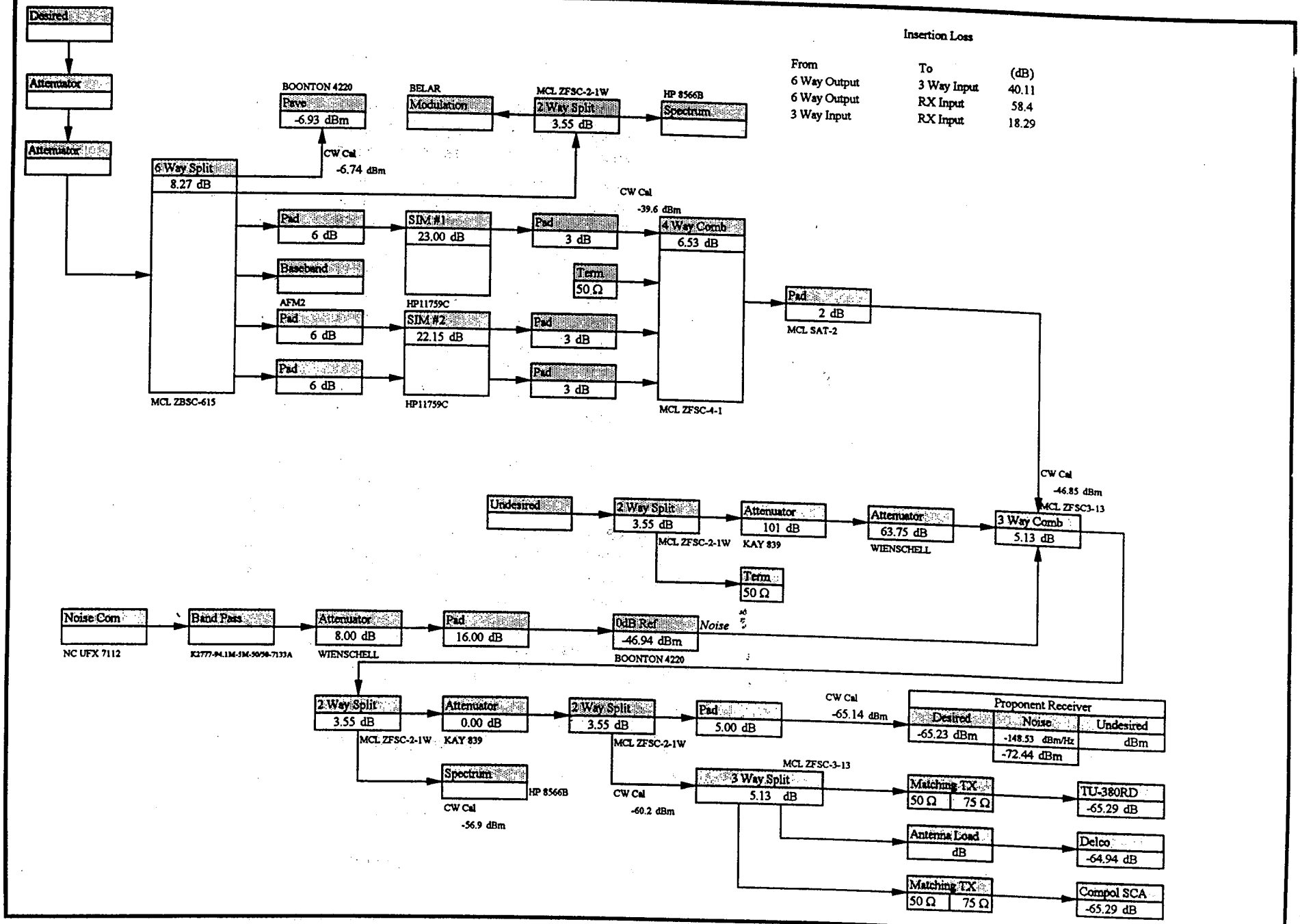
Digital Radio Test Laboratory



Digital Radio Test Laboratory

B-3 Multipath
Characterization of HS Digital Subcarrier Signal Failure
Basic Test Parameters: **SIGNAL** **PROPONENT SPECIFIC** **COMPOSITE SIGNAL**

One Path Zero Phase Reference: -65dBm
Main Channel Mod: CPN
SCA Group: C Analog SCA modulated with ABBA.
Error Measurement Duration: 2.5 minutes

ORBAN #2
COMP OUT 1: Proponent Only
COMP OUT 2: Prop + SCA
Main Channel modulation adjusted for 110%
5 Band Medium Fast Processing

	Noise Level		Error Level (%)		
	C/N$_o$	**Attn**	**BER**	**20 Byte**	**220 Byte**
Urban Slow	**131.93**	63.75	4.771	10.91	24.44
	89.18	21.00	15.87	35.84	52.33
	88.18	20.00	19.35	41.88	57.14
	87.18	19.00	21.25	43.72	63.10
	86.18	18.00	25.38	48.52	65.00
Urban Fast	**131.93**	63.75	39.41	54.10	96.30
	87.18	19.00	70.51	86.04	100.0
Rural Fast	**131.93**	63.75	41.55	60.02	96.15
	90.18	22.00	75.65	90.91	100.0
Obstructed	**131.93**	63.75	99.96	100.0	100.0

Test B-6

Weak Signal Sensitivity

Digital Radio Test Laboratory

B-6 Weak Signal Sensitivity 8/26/97

CPN :	91 %	81 %	81 %
pilot:	9 %	9 %	9 %
proponent:	10 %	10 %	10 %
57 kHz:	0 %	3 %	10 %
67 kHz:	0 %	7 %	0 %
Total Injection:	110 %	110 %	110 %

Proponent Only	Group C	Group D	
23 dB	23 dB	22 dB	
-88 ≤OME< -87 dBm	-88 ≤OME< -87 dBm	-87 ≤OME< -86 dBm	Simulator Mode

Digital Radio Test Laboratory

B-6 Weak Signal Sensitivity 8/25/97

CPN:	91 %	81 %	81 %
pilot:	9 %	9 %	9 %
proponent:	10 %	10 %	10 %
57 kHz:	%	3 %	10 %
92 kHz:	%	7 %	%
Total Injection:	110 %	110 %	110 %

Proponent Only	Group C	Group D
13 dB	13 dB	13 dB
-78 ≤OME< -77 dBm	-78 ≤OME< -77 dBm	-78 ≤OME< -77 dBm

(Seiko)

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C-3

Test ~~C-1~~

Re-acquisition

Digital Radio Test Laboratory

C-3

~~C-1~~ **Re-Acquisition** 8/26/97

	Re-Acquisition Time (s)
	11.35
	17.84
	12.15
	16.66
	15.01
Average	14.60

Desired Signal Level at Receiver -65 dBm

ABBA Used as Modulation Source on Main Channel
Medium CHR Processing

Digital Radio Test Laboratory

C-3

~~C-1~~ **Re-Acquisition** 8/25/97

	Re-Acquisition Time (s)
	2.77
	2.40
	2.46
	2.27
	2.43
Average	2.47

Desired Signal Level at Receiver -65 dBm

ABBA Used as Modulation Source on Main Channel
Medium CHR Processing

Test D-1

HSSC → Host Analog

Digital Radio Test Laboratory

D-1 HSSC -> Host Analog

Main Channel:	91	%	91	%	81	%	81	%
Pilot:	9	%	9	%	9	%	9	%
92 kHz:	0	%	0	%	7	%	0	%
57 kHz:	0	%	0	%	3	%	10	%
Proponent:	0	%	10	%	10	%	10	%
Total:	100	%	110	%	110	%	110	%

	0 dB= 2.06 V					0 dB= 1.86 V					
	Pilot Only		Proponent + Pilot			Group C			Group D		
RF Level dBm	S/N	Units	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)
-65	50.3	dB	50.3		50.2	49.2		49.2	49.0		49.0
-75	47.7	dB	47.7		47.7	46.5		46.5	46.3		46.3

Measurements made psophometrically (Q-Peak detected with CCIR weighting and 15 kHz low pass filters).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements made on Left Channel.
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 8/11/97

D-1 HSSC -› Host Analog

Main Channel:	91	%	91	%	81	%	81	%			
Pilot:	9	%	9	%	9	%	9	%			
92 kHz:	0	%	0	%	7	%	0	%			
57 kHz:	0	%	0	%	3	%	10	%			
Proponent:	0	%	10	%	10	%	10	%			
Total:	100	%	110	%	110	%	110	%			

	0 dB= 2.37 V					0 dB= 2.15 V					
	Pilot Only		Proponent + Pilot			Group C			Group D		
RF Level dBm	S/N	Units	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)
-65	56.3	dB	54.1		52.7	53.6		52.2	52.5		51.7
-75	55.2	dB	54.2		53.3	54.1		53.3	53.5		52.6

Measurements made Q-Peak detected with CCIR weighting and 15 kHz low pass filters (psophometric).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 8/11/97

D-1 HSSC -› Host Analog

Main Channel:	91 %		91 %		81 %		81 %	
Pilot:	9 %		9 %		9 %		9 %	
92 kHz:	0 %		0 %		7 %		0 %	
57 kHz:	0 %		0 %		3 %		10 %	
Proponent:	0 %		10 %		10 %		10 %	
Total:	100 %		110 %		110 %		110 %	

	0 dB= 757.0 mV					0 dB= 682.0 mV					
	Pilot Only		Proponent + Pilot			Group C			Group D		
RF Level dBm	S/N	Units	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)
-65	48.7	dB	48.5		48.7	47.7		47.7	47.6		47.6
-75	39.0	dB	39.0		39.0	38.0		38.0	38.0		38.0

Measurements made Q-Peak detected with CCIR weighting filter (psophometric).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 8/11/97

Digital Radio Test Laboratory

D-1 HSSC → Host Analog

Main Channel:	91 %		91 %		81 %		81 %
Pilot:	9 %		9 %		9 %		9 %
92 kHz:	0 %		0 %		7 %		0 %
57 kHz:	0 %		0 %		3 %		10 %
Proponent:	0 %		10 %		10 %		10 %
Total:	100 %		110 %		110 %		110 %

	0 dB= 654.0 mV					0 dB= 588.0 mV					
	Pilot Only		Proponent + Pilot			Group C			Group D		
RF Level dBm	S/N	Units	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)
-65	52.5	dB	52.0		52.3	50.4		50.6	50.2		50.5
-75	43.0	dB	43.0		43.0	41.9		41.9	41.9		41.9

Measurements made Q-Peak detected with CCIR weighting and 15 kHz low pass filters (psophometric).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation
Clipped Pink Noise on 67 kHz SCA.

Engineer(s): DML
Tests Conducted: 8/11/97

Test D-3

HSSC → Host Analog w/distortion

D-3 HSSC -› Host Analog with RF Distortion

Main Channel:	91 %		91	%		81	%	
Pilot:	9 %		9	%		9	%	
92 kHz:	0 %		0	%		0	%	
57 kHz:	0 %		0	%		10	%	
Proponent:	0 %		10	%		10	%	
Total:	100 %		110	%		110	%	

		Pilot Only		Proponent			Group C		
	RF Level (dBm)	S/N (dB)		MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)
No Distortion	-61.7	50.4		50.4		50.4	49.4		49.5
Narrow Band	-61.6	50.6		50.5		50.6	49.5		49.6
No Distortion	-63.0	50.7		50.7		50.7	49.7		49.7
Moderate Slope	-63.5	50.8		50.8		50.8	49.7		49.7
Large Slope	-63.3	50.8		50.8		50.8	49.7		49.7

Measurements made psophometrically (Q-Peak detected with CCIR weighting and 15 kHz low pass filters).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation for Group C measurements.
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 8/21/97

D-3 HSSC -› Host Analog with RF Distortion

Main Channel:	91 %		91	%		81	%	
Pilot:	9 %		9	%		9	%	
92 kHz:	0 %		0	%		0	%	
57 kHz:	0 %		0	%		10	%	
Proponent:	0 %		10	%		10	%	
Total:	100 %		110	%		110	%	

		Pilot Only	Proponent			Group C		
	RF Level (dBm)	S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)
No Distortion	-61.7	56.3	54.1		52.9	53.3		52.0
Narrow Band	-61.6	56.3	54.8		54.3	53.5		53.0
No Distortion	-63.0	56.4	54.2		53.0	53.3		52.0
Moderate Slope	-63.5	56.3	54.3		53.4	53.5		52.6
Large Slope	-63.3	56.3	54.3		53.6	53.4		52.5

Measurements made psophometrically (Q-Peak detected with CCIR weighting and 15 kHz low pass filters).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation for Group C measurements.
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 8/21/97

D-3 HSSC -› Host Analog with RF Distortion

Main Channel:	91 %		91 %			81 %		
Pilot:	9 %		9 %			9 %		
92 kHz:	0 %		0 %			0 %		
57 kHz:	0 %		0 %			10 %		
Proponent:	0 %		10 %			10 %		
Total:	100 %		110 %			110 %		
		Pilot Only	Proponent			Group C		
	RF Level (dBm)	S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)
No Distortion	-61.7	50.5	50.3		50.5	49.5		49.6
Narrow Band	-61.6	50.6	50.5		50.6	49.4		49.7
No Distortion	-63.0	49.9	49.6		49.8	48.7		49.0
Moderate Slope	-63.5	49.3	49.2		49.3	48.3		48.4
Large Slope	-63.3	49.4	49.2		49.4	48.4		48.6

Measurements made Q-Peak detected with CCIR weighting filter (psophometric).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation for Group C measurements.
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 8/21/97

D-3 HSSC -› Host Analog with RF Distortion

Main Channel:	91 %		91 %			81 %		
Pilot:	9 %		9 %			9 %		
92 kHz:	0 %		0 %			0 %		
57 kHz:	0 %		0 %			10 %		
Proponent:	0 %		10 %			10 %		
Total:	100 %		110 %			110 %		

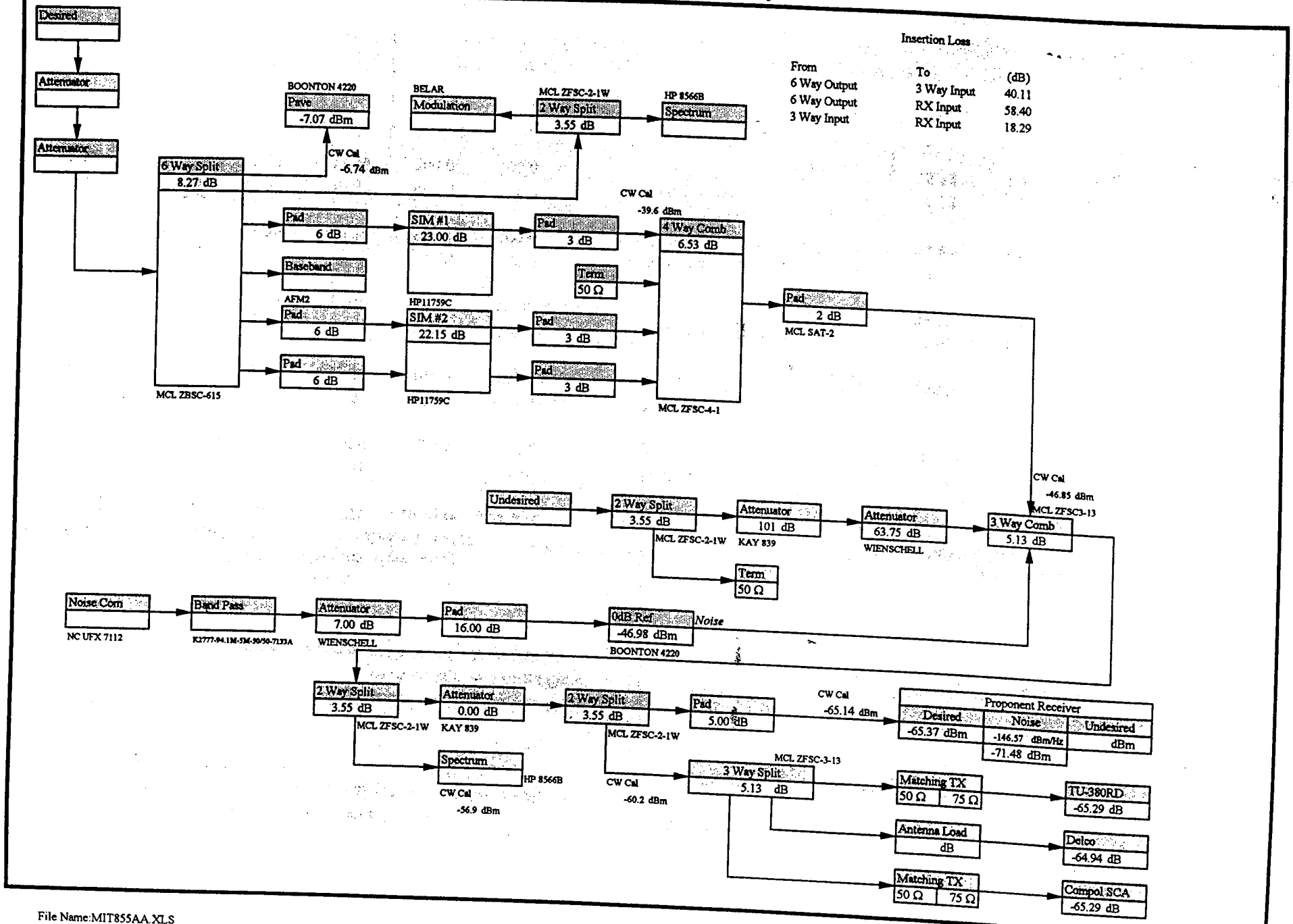
		Pilot Only	Proponent			Group C		
	RF Level (dBm)	S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)	MITRE S/N (dB)		SEIKO S/N (dB)
No Distortion	-61.7	55.5	54.3		55.0	52.3		52.8
Narrow Band	-61.6	55.6	55.1		55.5	53.6		53.8
No Distortion	-63.0	54.8	53.7		54.2	51.8		52.3
Moderate Slope	-63.5	54.1	53.0		53.6	51.2		51.6
Large Slope	-63.3	54.2	52.9		53.6	51.0		51.5

Measurements made psophometrically (Q-Peak detected with CCIR weighting and 15 kHz low pass filters).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation for Group C measurements.
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 8/21/97

Test E-3

Host Analog → Digital Subcarrier

Digital Radio Test Laboratory



File Name:MIT855AA.XLS

(Mitre)

Level E-3

57

Digital Radio Test Laboratory

E-3

[redacted] Host Analog -› HSSC with RF Distortion 8/26/97

Characterization of HS Digital Subcarrier Signal Failure

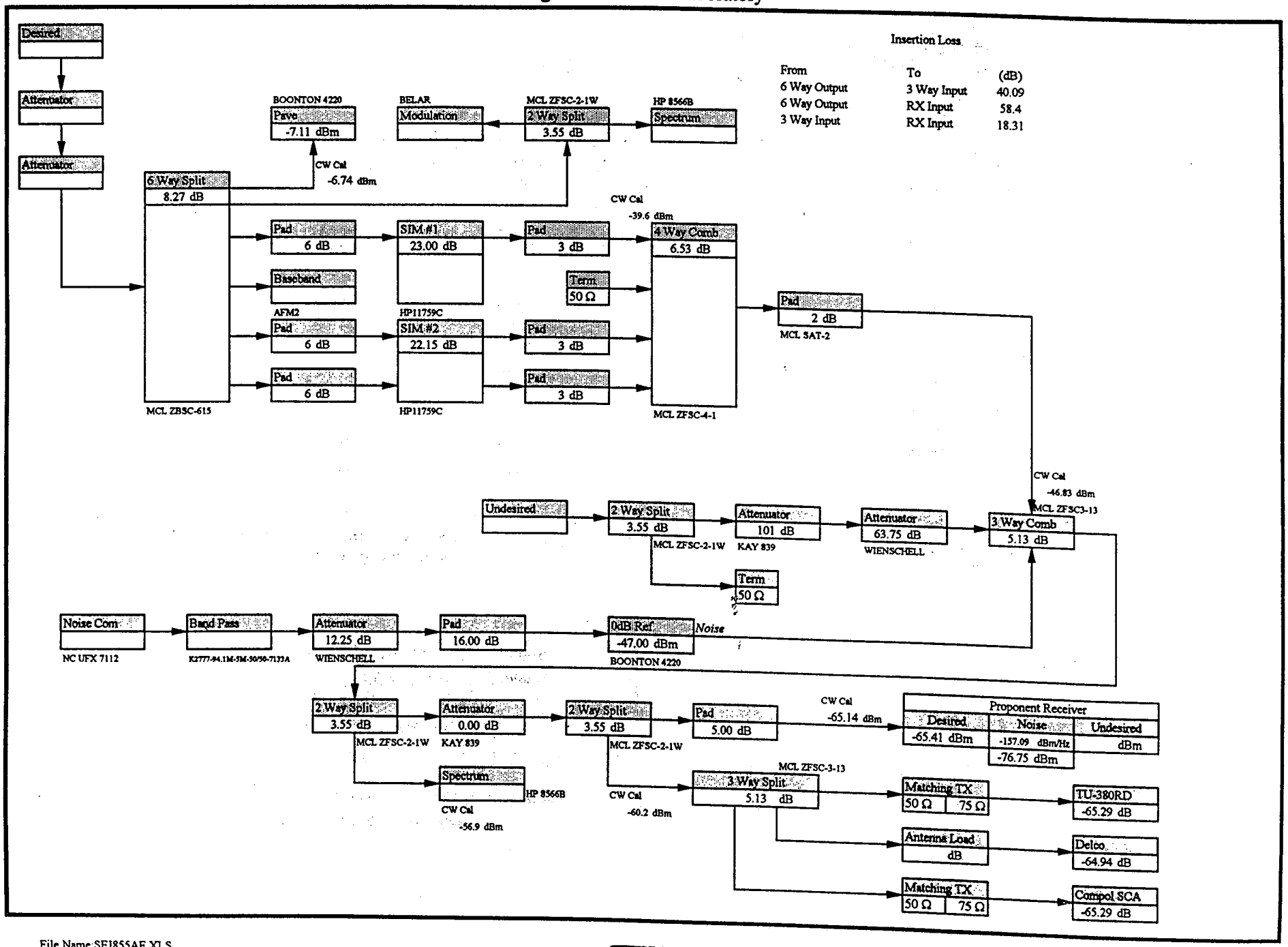
Basic Test Parameters: **SIGNAL** **PROPONENT SPECIFIC** **COMPOSITE SIGNAL**

Main Channel Mod: Silence or Music
SCA Group: Proponent Only
Error Measurement Duration: 2.5 minutes

ORBAN #2
COMP OUT 1: Proponent Only
COMP OUT 2: Prop + SCA
Main Channel modulation
adjusted for 110%
Medium Contemporary Hit Radio

CW Calibration Level @ RX (dBm)	No Main Channel Modulation Noise Level C/N₀	Attn	Error Level (%) BER	20 Byte	220 Byte		ABBA Main Channel Modulation Noise Level C/N₀	Attn	Error Level (%) BER	20 Byte	220 Byte
-60.5	76.37	3.50	0.001	0.073	0.267	Undistorted RF Path	76.87	4.00	0.002	0.073	0.267
-60.5	75.37	2.50	1.008	33.15	65.33		75.87	3.00	1.013	34.42	70.00
-60.4	76.47	3.50	17.60	99.79	100.0	Narrow Band	76.97	4.00	11.81	99.45	100.0
-60.4	75.47	2.50	32.52	100.0	100.0		75.97	3.00	26.99	99.98	100.0
-61.6	76.02	4.25	0.007	0.231	0.667	Undistorted RF Path	76.52	4.75	0.009	0.365	1.333
-61.6	75.02	3.25	1.910	56.79	90.00		75.52	3.75	1.745	54.87	91.73
-62.2	75.42	4.25	14.95	99.88	100.0	Moderate Slope	75.92	4.75	10.70	99.09	100.0
-62.2	74.42	3.25	30.34	99.99	100.0		74.92	3.75	24.65	100.0	100.0
-62.0	75.62	4.25	20.60	99.99	100.0	Large Slope	76.12	4.75	15.28	99.84	100.0
-62.0	74.62	3.25	35.59	100.0	100.0		75.12	3.75	31.65	100.0	100.0

Digital Radio Test Laboratory



Digital Radio Test Laboratory

E-3

[redacted] Host Analog -> HSSC with RF Distortion

Characterization of HS Digital Subcarrier Signal Failure

8/25/97

Basic Test Parameters: **SIGNAL** **PROPONENT SPECIFIC** **COMPOSITE SIGNAL**

One Path Zero Phase Reference: -65dBm
Main Channel Mod: CPN
SCA Group: Proponent Only
Error Measurement Duration: 2.5 minutes

ORBAN #2
COMP OUT 1: Proponent Only
COMP OUT 2: Prop + SCA
Main Channel modulation
adjusted for 110%
Medium Contemporary Hit Radio

CW Calibration Level @ RX (dBm)	No Main Channel Modulation Noise Level C/N$_o$	Attn	Error Level (%) BER	20 Byte	220 Byte		ABBA Main Channel Modulation Noise Level C/N$_o$	Attn	Error Level (%) BER	20 Byte	220 Byte
-60.5	**80.91**	8.00	0.023	0.387	2.128	Undistorted RF Path	**82.41**	9.50	0.097	0.097	1.064
-60.5	**79.91**	7.00	1.748	4.493	20.43		**81.41**	8.50	0.148	1.547	8.511
-60.4	**81.01**	8.00	11.78	67.27	100.0	Narrow Band	**82.51**	9.50	7.873	47.58	97.78
-60.4	**80.01**	7.00	34.15	95.89	100.0		**81.51**	8.50	16.70	75.96	100.00
-61.6	**81.06**	9.25	0.011	0.193	1.064	Undistorted RF Path	**82.06**	10.25	0.017	0.193	2.128
-61.6	**80.06**	8.25	0.233	2.998	14.89		**81.06**	9.25	0.125	1.934	11.70
-62.2	**80.46**	9.25	0.633	9.286	46.24	Moderate Slope	**81.46**	10.25	1.461	9.973	37.63
-62.2	**79.46**	8.25	5.696	39.92	94.57		**80.46**	9.25	4.261	33.04	86.02
-62.0	**80.66**	9.25	1.921	8.407	33.33	Large Slope	**81.66**	10.25	1.303	8.124	41.49
-62.0	**79.66**	8.25	4.412	33.70	90.22		**80.66**	9.25	2.964	25.34	76.60

Test F-1

HSSC → Analog SCA

Digital Radio Test Laboratory

(These results superceded by 12/17/97 data which follows)

F-1 HSSC -> Analog SCA

Test Date: 7/28/97

Engineer(s): DML

	Group C	(67 kHz + pilot only) Main Channel Off	(Main + 67 kHz only) HSSC & RBDS Off	HSSC Off	RBDS Off
Main Channel:	81 %	0 %	81 %	81 %	81 %
Pilot:	9 %	9 %	9 %	9 %	9 %
67 kHz:	7 %	7 %	7 %	7 %	7 %
57 kHz:	3 %	0 ~~3~~ %	0 %	3 %	0 %
Proponent:	10 %	0 %	0 %	0 %	10 %
Total Modulation:	110 %	16 ~~19~~ %	97 %	100 %	107 %

	67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)	
	Medium	Weak	Medium	Weak	Medium	Weak	Medium	Weak	Medium	Weak
SEIKO:	28.0 ✓	27.5	46.0 ✓	37.0	43.8 ✓	36.2	30.8 ✓	29.8	31.5 ✓	30.3
MITRE:	29.9 ✓	29.0							36.5 ✓	33.5

Main Channel: Clipped Pink Noise

67 kHz: 1 kHz THD+Noise: 2.2 %

S/N measurements made RMS detected with 15kHz low pass filter.

Digital Radio Test Laboratory

F-1 HSSC -› Analog SCA

(67 kHz +pilot only) Test Date: 7/28/97 (Main +67 kHz only) Engineer(s): DML

	Group C	Main Channel Off	HSSC & RBDS Off	HSSC Off	RBDS Off
Main Channel:	81 %	0 %	81 %	81 %	81 %
Pilot:	9 %	9 %	9 %	9 %	9 %
67 kHz:	7 %	7 %	7 %	7 %	7 %
57 kHz:	3 %	0 %	3 %	3 %	0 %
Proponent:	10 %	0 %	0 %	0 %	10 %
Total Modulation:	110 %	16 %	100 %	100 %	107 %

	67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)	
	Medium	Weak	Medium	Weak	Medium	Weak	Medium	Weak	Medium	Weak
SEIKO:	28.0	27.5	46.0	37.0	43.8	36.2	30.8	29.8	31.5	30.3
MITRE:	29.9	29.0							36.5	33.5

Receiver: Dayton production model.
Main Channel: Clipped Pink Noise
67 kHz: 1 kHz THD+Noise: 2.2 %

S/N measurements made RMS detected with 15kHz low pass filter.

THD+Noise measurement made RMS without filter.
Revised (12-17-97) to reflect 0% 57kHz injection under Main Channel Off condition.

(Attachment 2) 62a

F-1 HSSC -› Analog SCA

Test Date: 12/17/97

Engineer(s): DML, TK

	Group C	Main Channel Off	HSSC & RBDS Off	HSSC Off	RBDS Off
Main Channel:	81 %	0 %	81 %	81 %	81 %
Pilot:	9 %	9 %	9 %	9 %	9 %
67 kHz:	7 %	7 %	7 %	7 %	7 %
57 kHz:	3 %	0 %	0 %	3 %	0 %
Proponent:	10 %	0 %	0 %	0 %	10 %
Total Modulation:	110 %	16 %	97 %	100 %	107 %

	67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)		67 kHz S/N (dB)	
	Medium	Weak	Medium	Weak	Medium	Weak	Medium	Weak	Medium	Weak
SEIKO:	45.5	40.0	50.0	41.5	49.6	41.2	47.8	40.8	47.1	40.4
MITRE:	46.0	40.0							47.2	40.4

Receiver: Dayton modified
Main Channel: Clipped Pink Noise
67 kHz: 1 kHz THD+Noise: 2.85 %

S/N measurements made RMS detected.
Subcarrier receiver modified to provide narrow band characteristics.

Additional test to demonstrate narrow band subcarrier receiver performance.

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Test F-2

HSSC → RDS Subcarrier

Digital Radio Test Laboratory

(Data invalid - see following data sheets)

F-2 HSSC ->RBDS Test Date: 7/28/97 Engineer(s): DML

	Group C	(67 kHz + RDS) HSSC Off	(HSSC + RDS) 67 kHz Off
Main Channel:	81 %	81 %	81 %
Pilot:	9 %	9 %	9 %
67 ~~92~~ kHz:	7 %	7 %	0 %
57 kHz:	3 %	3 %	3 %
Proponent:	10 %	0 %	10 %
Total Deviation:	110 %	100 %	103 %

	RBDS Block Error (%)		RBDS Block Error (%)		RBDS Block Error (%)	
	Medium	Weak	Medium	Weak	Medium	Weak
SEIKO:	14	19	16	16	13	18
MITRE:	18	16			11	13

Main Channel: Clipped Pink Noise
Noise Attenuator: 8.00 dB

Noise: 0 dB Ref -30.97 dBm

Signal Reference: 3W in -32.50 dBm; 6W out -7.30 dBm

Errors accumulated over a 2.5 minute measurement period.
EBU SQAM Disk Track 69 (ABBA) used to exercise the 67 kHz subcarrier.

-65 dBm at receiver

F-2 HSSC ->RBDS Test Date: 7/28/97 Engineer(s): DML

	Group C	(67 kHz + RDS) HSSC Off	(HSSC + RDS) 67 kHz Off
Main Channel:	81 %	81 %	81 %
Pilot:	9 %	9 %	9 %
67 ~~92~~ kHz:	7 %	7 %	0 %
57 kHz:	3 %	3 %	3 %
Proponent:	10 %	0 %	10 %
Total Deviation:	110 %	100 %	103 %

	RBDS Block Error (%)		RBDS Block Error (%)		RBDS Block Error (%)	
	Medium	Weak	Medium	Weak	Medium	Weak
SEIKO:	14	19	16	16	13	18
MITRE:	18	16			11	13

Main Channel: Clipped Pink Noise

Noise Attenuator: 8.00 dB

74.56 dB·Hz C/No

Noise	Signal Reference	
0 dB Ref	3W in	6W out
-30.97 dBm	-32.50 dBm	-7.30 dBm

Errors accumulated over a 2.5 minute measurement period.
EBU SQAM Disk Track 69 (ABBA) used to exercise the 67 kHz subcarrier.
Revised (12-17-97) to include C/No performance calculation.

(-65 dBm at receiver input)

F-2 HSSC ->RBDS Test Date: 12/10/97 Engineer(s): DML

	Group C	HSSC Off	67 kHz Off
Main Channel:	81 %	81 %	81 %
Pilot:	9 %	9 %	9 %
67 kHz:	7 %	7 %	0 %
57 kHz:	3 %	3 %	3 %
Proponent:	10 %	0 %	10 %
Total Deviation:	110 %	100 %	103 %

	Maximum Block Error Independent of Error Correction					
	RBDS Block Error (%)		RBDS Block Error (%)		RBDS Block Error (%)	
	Medium	Weak	Medium	Weak	Medium	Weak
SEIKO:	6	7	6	7	6	6
MITRE:	6	8			7	8

Denon TU380-RD receiver modification removed on 12-10-97 and re-tested.

			Noise	Signal Reference	
Main Channel:	Clipped Pink Noise		0 dB Ref	3W in	6W out
Noise Attenuator:	7.50 dB		-31.70 dBm	-32.66 dBm	-7.44 dBm
	74.63 dB-Hz	C/No			

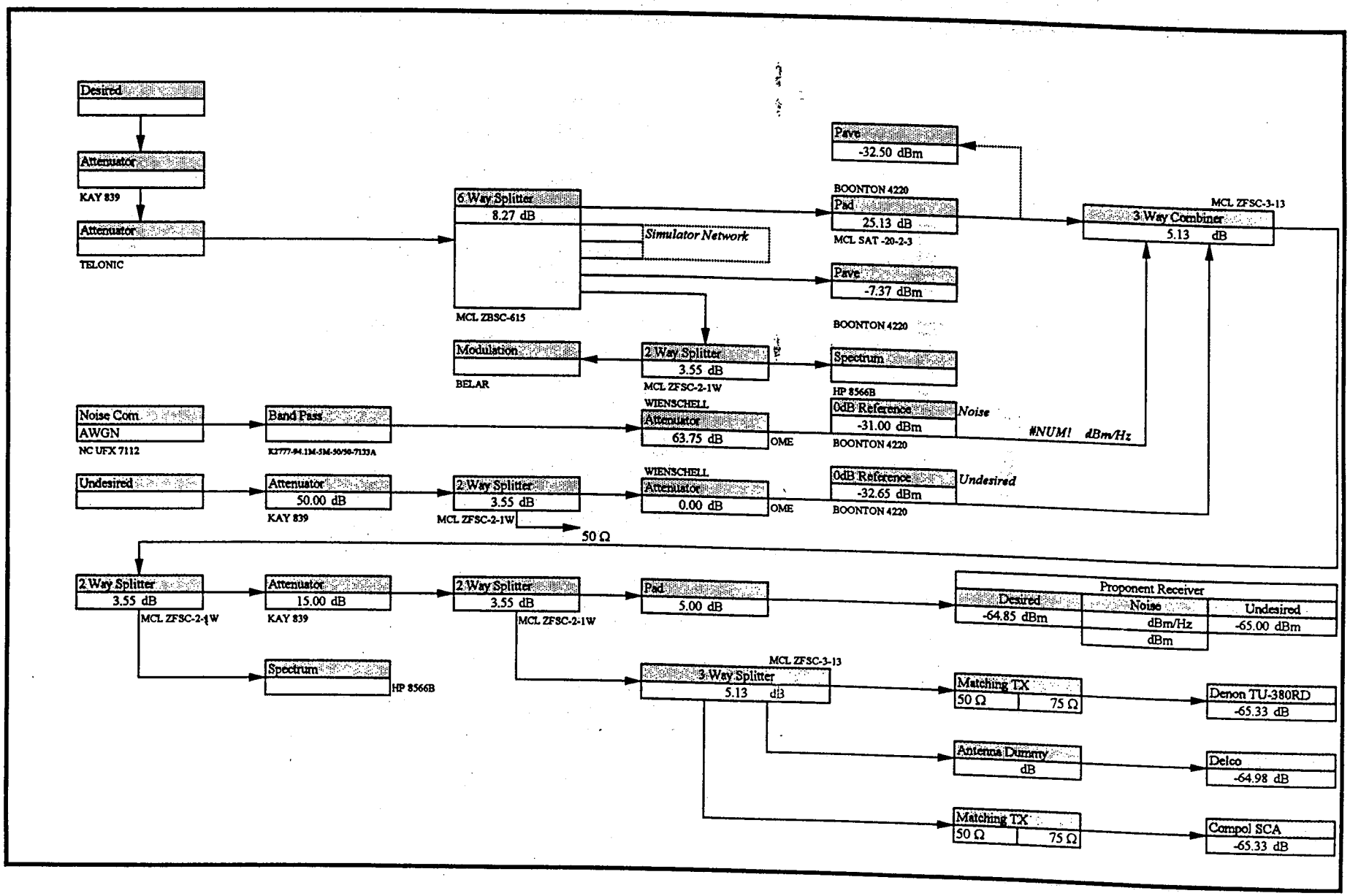
Errors accumulated over a 2.5 minute measurement period.
EBU SQAM Disk Track 69 used to exercise the 67 kHz SCA.

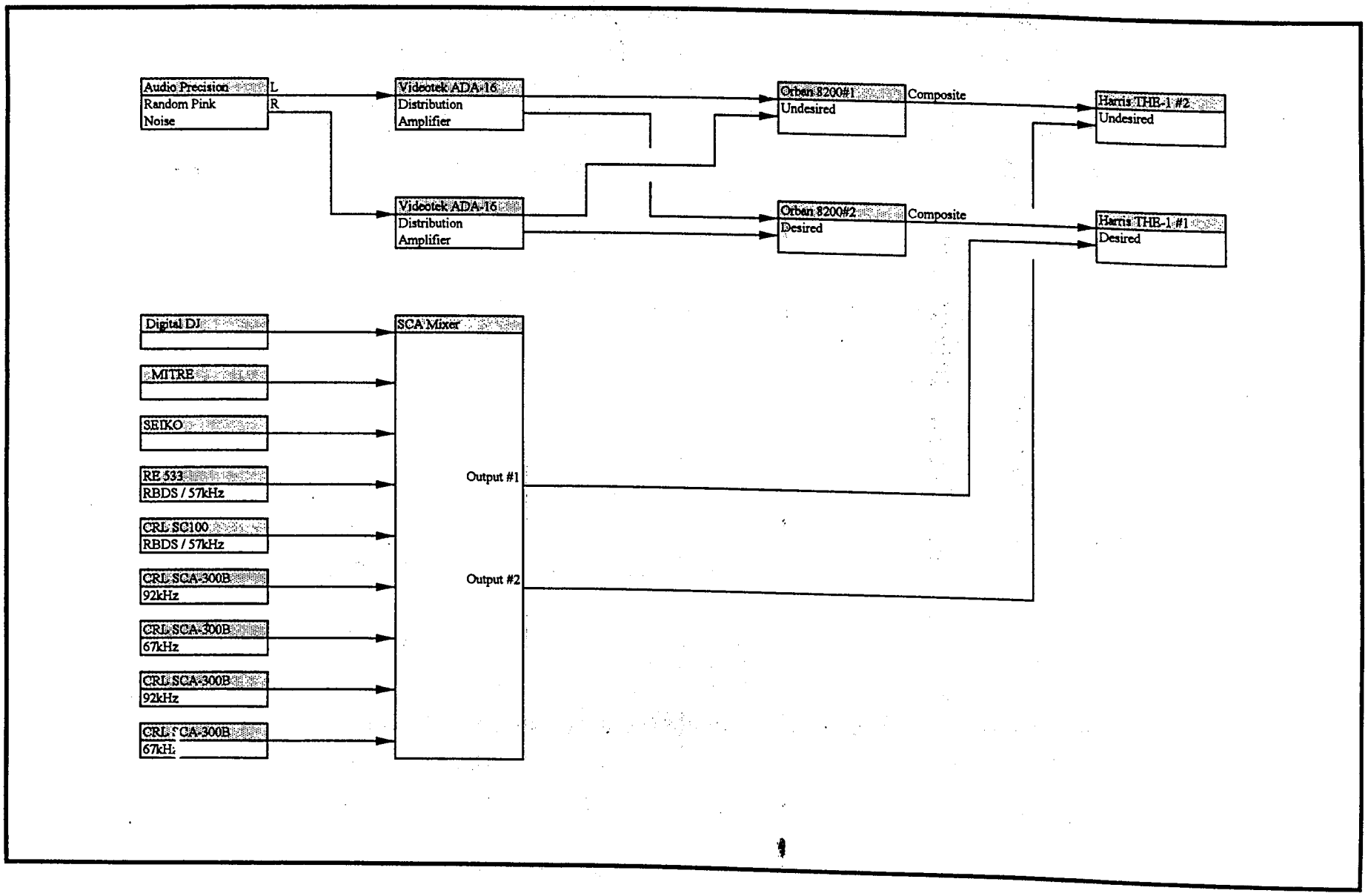
Revised (12-17-97) to include C/No calculation.

Test G

Interference tests - block diagram

Digital Radio Test Laboratory





File Name:HS855G.XLS
Index: COMP

Test G-1

1st Adjacent Channel Interference

Digital Radio Test Laboratory

(desired - 94.1 MHz)

G-1.5

Lower First Adjacent

Analog -> HSSC	93.9 MHz		
	Desired	Undesired	
Main Channel:	81	81	%
Pilot:	9	9	%
67 kHz:	7	10	%
92 kHz:	0	10	%
57 kHz:	3	0	%
Proponent:	10	0	%
Total Deviation:	110	110	%

Upper First Adjacent

Analog -> HSSC	94.3 MHz		
	Desired	Undesired	
Main Channel:	81	81	%
Pilot:	9	9	%
67 kHz:	7	10	%
92 kHz:	0	10	%
57 kHz:	3	0	%
Proponent:	10	0	%
Total Deviation:	110	110	%

Clipped pink noise on undesired subcarriers.
ABBA on Desired analog subcarrier.

MITRE Lower 1st Adjacent

ATTN (dB)	D/U (dB)	BER (%)	20 Byte (%)	220 Byte (%)
13.50	-6.35	0.026	0.985	3.067
12.50	-7.35	13.35	99.78	100.0

MITRE Upper 1st Adjacent

ATTN (dB)	D/U (dB)	BER (%)	20 Byte (%)	220 Byte (%)	EO&C	8/6/97
9.50	-10.35	0.009	0.365	1.067		
8.50	-11.35	0.318	11.64	25.07		
7.50	-12.35	1.539	44.18	67.07		
6.50	-13.35	4.003	78.92	97.26		
5.50	-14.35	9.517	96.64	100.0		

FCC rules: +6 d/u at protected contour

SEIKO Lower 1st Adjacent

ATTN (dB)	D/U (dB)	BER (%)	20 Byte (%)	220 Byte (%)
8.50	-1.35	0.011	0.193	1.064
7.50	-2.35	0.745	1.257	2.128
6.50	-3.35	1.041	3.675	12.77
5.50	-4.35	12.31	62.83	100.0
4.50	-5.35	94.55	100.0	100.0

SEIKO Upper 1st Adjacent

ATTN (dB)	D/U (dB)	BER (%)	20 Byte (%)	220 Byte (%)	8/5/97
10.50	0.65	0.125	0.580	3.191	Clean at 9.0 dB. Upper 1st OME, Clean at 11.0 dB
9.50	-0.35	0.102	1.451	8.511	
8.50	-1.35	43.03	94.74	100.0	
7.50	-2.35				
6.50	-3.35				

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Digital Radio Test Laboratory

G-1 First Adjacent 7/30/97

Analog -› Analog & HSSC -› Analog

	Desired	Undesired		Desired	Undesired		Desired	Undesired	
Main Channel:	81	81	%	81	81	%	81	81	%
Pilot:	9	9	%	9	9	%	9	9	%
67 kHz:	10	10	%	10	0	%	10	0	%
92 kHz:	10	10	%	10	7	%	10	0	%
57 kHz:	0	0	%	0	3	%	0	10	%
Proponent:	0	0	%	0	10	%	0	10	%
Total Deviation:	110	110	%	110	110	%	110	110	%
3 W Input	-32.4	-32.4	dBm						
Kay #3		51.0	dB						
		18.6							

Main Channel measurements are Q-Peak detected with CCIR and 15 kHz low pass filters .
SCA Measurements are RMS detected with 15kHz low pass filter.
Best Case Main Channel S/N=50dB.
Clipped Pink Noise on the Undesired main and sub carriers.
At 5 dB D/U S/N measurements vary from 35 - 47 dB. Lower 1st.
92 kHz 0dB signal measurement 3 dB low. Upper 1st.

G-1.3 G-1.4

94.3 MHz (upper)	Analog -› Analog Reference			HSSC -› Analog Group C			HSSC -› Analog Group D			
	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	
	0	28	25	0	30	26	0	31	25	MITRE:
				0	31	27	0	32	25	SEIKO:

93.9 MHz (lower)	Analog -› Analog Reference			HSSC -› Analog Group C			HSSC -› Analog Group D			
	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	
	5	28	32	5	29	33	5	29	33	MITRE:
				5	29	34	5	29	34	SEIKO:

Digital Radio Test Laboratory

G-1 First Adjacent 7/31/97

Analog -› Analog & HSSC -› Analog

	Desired	Undesired		Desired	Undesired		Desired	Undesired	
Main Channel:	81	81	%	81	81	%	81	81	%
Pilot:	9	9	%	9	9	%	9	9	%
67 kHz:	10	10	%	10	0	%	10	0	%
92 kHz:	10	10	%	10	7	%	10	0	%
57 kHz:	0	0	%	0	3	%	0	10	%
Proponent:	0	0	%	0	10	%	0	10	%
Total Deviation:	110	110	%	110	110	%	110	110	%
3 W Input	-32.4	-32.4	dBm						
Kay #3		51.0	dB						
		18.6							
		G-1.3							

Main Channel measurements are Q-Peak detected with CCIR filter .
SCA Measurements are RMS.

G-1.4

94.3 MHz (Upper)	Analog -› Analog Reference			HSSC -› Analog Group C			HSSC -› Analog Group D			
	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	
	21	44	46	21	45	47	21	45	46	MITRE:
				21	45	47	21	45	46	SEIKO:

93.9 MHz (Lower)	Analog -› Analog Reference			HSSC -› Analog Group C			HSSC -› Analog Group D			
	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	
	36	46	52	36	46	52	36	46	52	MITRE:
				36	46	52	36	46	52	SEIKO:

Digital Radio Test Laboratory

G-1 First Adjacent 7/31/97

Analog -› Analog & HSSC -› Analog

	Desired	Undesired		Desired	Undesired		Desired	Undesired	
Main Channel:	81	81	%	81	81	%	81	81	%
Pilot:	9	9	%	9	9	%	9	9	%
67 kHz:	10	10	%	10	0	%	10	0	%
92 kHz:	10	10	%	10	7	%	10	0	%
57 kHz:	0	0	%	0	3	%	0	10	%
Proponent:	0	0	%	0	10	%	0	10	%
Total Deviation:	110	110	%	110	110	%	110	110	%
3 W Input	-32.4	-32.4	dBm						
Kay #3		51.0	dB						
		18.6							

Main Channel measurements are Q-Peak detected with CCIR filter .
SCA Measurements are RMS.

G-1.3 G-1.4

94.3 MHz	Analog -› Analog Reference D/U (dB) s/n=45dB	Reference S/N (dB) 67 kHz	Reference S/N (dB) 92 kHz	HSSC -› Analog Group C D/U (dB) s/n=45dB	Group C S/N (dB) 67 kHz	Group C S/N (dB) 92 kHz	HSSC -› Analog Group D D/U (dB) s/n=45dB	Group D S/N (dB) 67 kHz	Group D S/N (dB) 92 kHz	
	14	40	40	11	39	38	11	40	37	MITRE:
				11	40	39	11	40	38	SEIKO:

93.9 MHz	Analog -› Analog Reference D/U (dB) s/n=45dB	Reference S/N (dB) 67 kHz	Reference S/N (dB) 92 kHz	HSSC -› Analog Group C D/U (dB) s/n=45dB	Group C S/N (dB) 67 kHz	Group C S/N (dB) 92 kHz	HSSC -› Analog Group D D/U (dB) s/n=45dB	Group D S/N (dB) 67 kHz	Group D S/N (dB) 92 kHz	
	24	42	48	24	43	49	24	43	49	MITRE:
				24	43	49	24	43	49	SEIKO:

Test G-2

2nd Adjacent Channel Interference

G-2.5

Lower Second Adjacent

Analog -› HSSC	Desired	93.7 MHz Undesired	
Main Channel:	81	81	%
Pilot:	9	9	%
67 kHz:	7	10	%
92 kHz:	0	10	%
57 kHz:	3	0	%
Proponent:	10	0	%
Total Deviation:	110	110	%

Upper Second Adjacent

Analog -› HSSC	Desired	94.5 MHz Undesired	
Main Channel:	81	81	%
Pilot:	9	9	%
67 kHz:	7	10	%
92 kHz:	0	10	%
57 kHz:	3	0	%
Proponent:	10	0	%
Total Deviation:	110	110	%

MITRE Lower 2nd Adjacent

ATTN (dB)	D/U (dB)	BER (%)	20 Byte (%)	220 Byte (%)
2.50	**-47.35**	0.013	0.513	1.875
1.50	**-48.35**	0.959	32.94	66.93
0.50	**-49.35**	4.336	86.86	100.0
0.00	**-49.85**	7.329	96.65	100.0

MITRE Upper 2nd Adjacent

ATTN (dB)	D/U (dB)	BER (%)	20 Byte (%)	220 Byte (%)	EO&C 8/6/97
0.00	**-49.85**	Unable to achieve OME.			

SEIKO Lower 2nd Adjacent

ATTN (dB)	D/U (dB)	BER (%)	20 Byte (%)	220 Byte (%)
20.00	**-29.85**	0.023	0.387	3.191
19.00	**-30.85**	0.250	3.191	19.15
18.00	**-31.85**	5.536	33.47	89.01
17.00	**-32.85**	22.49	81.29	100.0
16.00	**-33.85**	55.79	96.74	100.0

SEIKO Upper 2nd Adjacent

ATTN (dB)	D/U (dB)	BER (%)	20 Byte (%)	220 Byte (%)	8/5/97
13.00	**-16.85**	0.017	0.291	2.128	
12.00	**-17.85**	0.449	6.452	30.11	
11.00	**-18.85**	4.772	33.07	85.71	
10.00	**-19.85**	10.72	58.48	98.89	
9.00	**-20.85**	14.24	64.86	98.88	

Digital Radio Test Laboratory

G-2 Second Adjacent 7/30/97

Analog -› Analog & HSSC -› Analog

	Desired	Undesired		Desired	Undesired		Desired	Undesired	
Main Channel:	81	81	%	81	81	%	81	81	%
Pilot:	9	9	%	9	9	%	9	9	%
67 kHz:	10	10	%	10	0	%	10	0	%
92 kHz:	10	10	%	10	7	%	10	0	%
57 kHz:	0	0	%	0	3	%	0	10	%
Proponent:	0	0	%	0	10	%	0	10	%
Total Deviation:	110	110	%	110	110	%	110	110	%
3 W Input	-32.64	-32.67	dBm						
Kay #3		51.0	dB						

Main Channel measurements are Q-Peak detected with CCIR and 15 kHz low pass filters .
SCA Measurements are RMS detected with 15kHz low pass filter.
Best Case Main Channel S/N=50dB.
Clipped Pink Noise on the Undesired main and sub carriers.
At -40 dB D/U S/N=47 dB.
Best Case 67kHz S/N = 46 dB & 92 kHz S/N=52.5dB.
92 kHz signal and noise measuremnents similar.

G-2.3 G-2.4

94.5 MHz (upper)	Analog -› Analog Reference D/U (dB) s/n=45dB	Reference S/N (dB) 67 kHz	Reference S/N (dB) 92 kHz	HSSC -› Analog Group C D/U (dB) s/n=45dB	Group C S/N (dB) 67 kHz	Group C S/N (dB) 92 kHz	HSSC -› Analog Group D D/U (dB) s/n=45dB	Group D S/N (dB) 67 kHz	Group D S/N (dB) 92 kHz	
	-40	36	5	-40	36	5	-40	36	5	MITRE:
				-40	36	5	-40	36	5	SEIKO:

93.7 MHz (lower)	Analog -› Analog Reference D/U (dB) s/n=45dB	Reference S/N (dB) 67 kHz	Reference S/N (dB) 92 kHz	HSSC -› Analog Group C D/U (dB) s/n=45dB	Group C S/N (dB) 67 kHz	Group C S/N (dB) 92 kHz	HSSC -› Analog Group D D/U (dB) s/n=45dB	Group D S/N (dB) 67 kHz	Group D S/N (dB) 92 kHz	
	-40	22	6	-40	32	5	-40	32	5	MITRE:
				-40	33	5	-40	33	5	SEIKO:

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G-2 Second Adjacent 7/31/97

Analog -› Analog & HSSC -› Analog

	Desired	Undesired		Desired	Undesired		Desired	Undesired	
Main Channel:	81	81	%	81	81	%	81	81	%
Pilot:	9	9	%	9	9	%	9	9	%
67 kHz:	10	10	%	10	0	%	10	0	%
92 kHz:	10	10	%	10	7	%	10	0	%
57 kHz:	0	0	%	0	3	%	0	10	%
Proponent:	0	0	%	0	10	%	0	10	%
Total Deviation:	110	110	%	110	110	%	110	110	%
3 W Input	-32.4	-32.4	dBm						
Kay #3		51.0	dB						
		18.6							

Main Channel measurements are Q-Peak detected with CCIR filter .
SCA Measurements are RMS.

G-2.3

G-2.4

94.5 MHz	Analog -› Analog Reference			HSSC -› Analog Group C			HSSC -› Analog Group D			
	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	
	-15	46	36	-15	46	39	-15	46	39	MITRE:
				-15	46	40	-15	46	40	SEIKO:

93.7 MHz	Analog -› Analog Reference			HSSC -› Analog Group C			HSSC -› Analog Group D			
	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	D/U (dB) s/n=45dB	S/N (dB) 67 kHz	S/N (dB) 92 kHz	
	-12	46	49	-14	46	49	-15	46	49	MITRE:
				-15	46	49	-16	46	49	SEIKO:

Digital Radio Test Laboratory

G-2 Second Adjacent 7/31/97

Analog -› Analog & HSSC -› Analog

	Desired	Undesired		Desired	Undesired		Desired	Undesired	
Main Channel:	81	81	%	81	81	%	81	81	%
Pilot:	9	9	%	9	9	%	9	9	%
67 kHz:	10	10	%	10	0	%	10	0	%
92 kHz:	10	10	%	10	7	%	10	0	%
57 kHz:	0	0	%	0	3	%	0	10	%
Proponent:	0	0	%	0	10	%	0	10	%
Total Deviation:	110	110	%	110	110	%	110	110	%
3 W Input	-32.4	-32.4	dBm						
Kay #3		51.0	dB						
		18.6							

Main Channel measurements are Q-Peak detected with CCIR filter .
SCA Measurements are RMS.

G-2.3

G-2.4

94.5 MHz	Analog -› Analog Reference D/U (dB) s/n=45dB	Reference S/N (dB) 67 kHz	Reference S/N (dB) 92 kHz	HSSC -› Analog Group C D/U (dB) s/n=45dB	Group C S/N (dB) 67 kHz	Group C S/N (dB) 92 kHz	HSSC -› Analog Group D D/U (dB) s/n=45dB	Group D S/N (dB) 67 kHz	Group D S/N (dB) 92 kHz	
	-33	41	0	-33	41	0	-33	41	0	MITRE:
				-33	41	0	-33	41	0	SEIKO:

93.7 MHz	Analog -› Analog Reference D/U (dB) s/n=45dB	Reference S/N (dB) 67 kHz	Reference S/N (dB) 92 kHz	HSSC -› Analog Group C D/U (dB) s/n=45dB	Group C S/N (dB) 67 kHz	Group C S/N (dB) 92 kHz	HSSC -› Analog Group D D/U (dB) s/n=45dB	Group D S/N (dB) 67 kHz	Group D S/N (dB) 92 kHz	
	-29	41	9	-29	41	12	-29	41	12	MITRE:
				-29	41	13	-29	41	13	SEIKO:

Test H (B-1)

Signal Failure with Noise (pilot unlocked)

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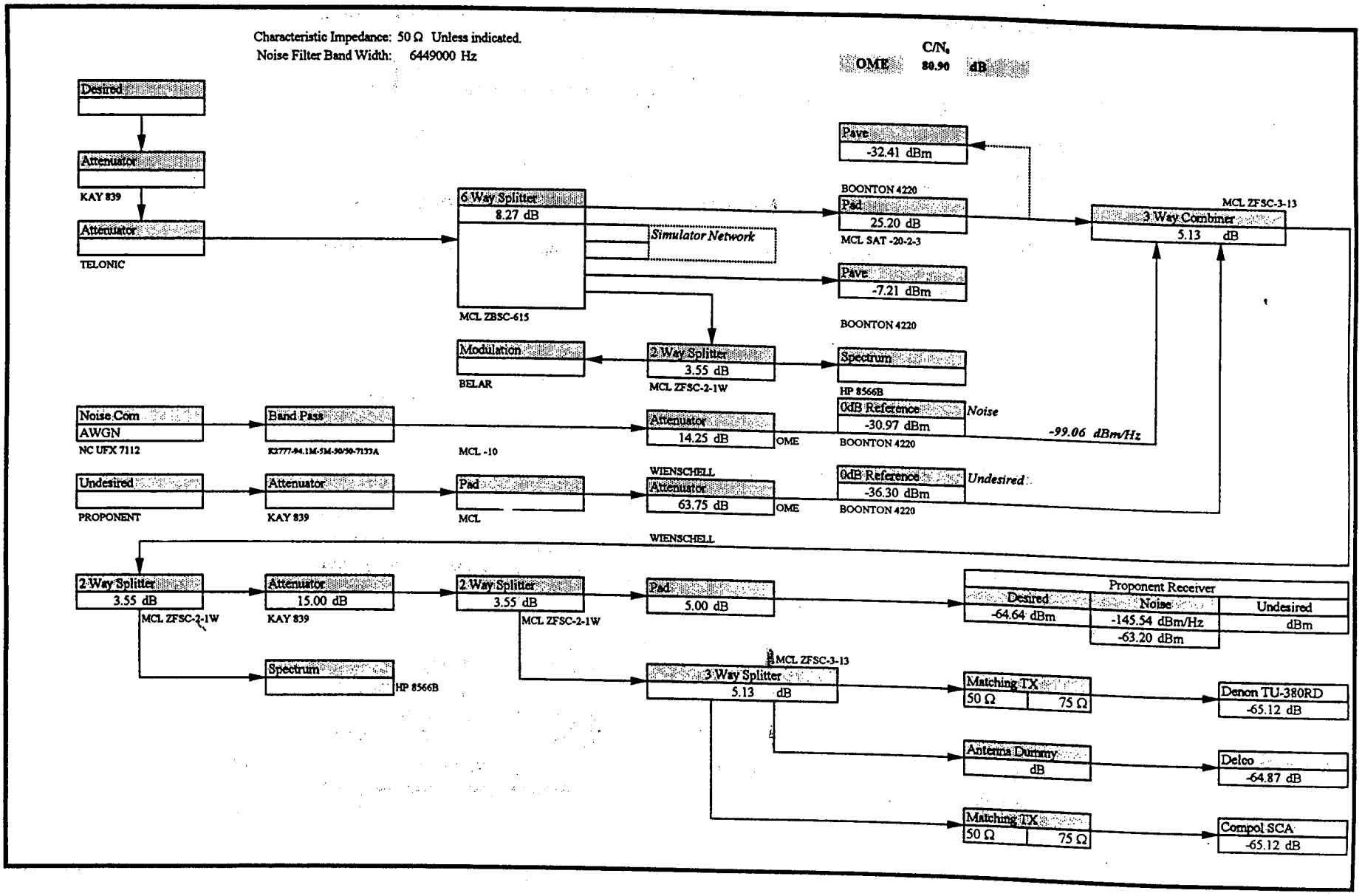

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(H) **B-1 Additive White Gaussian Noise**
Characterization of HS Digital Subcarrier Signal Failure

Test Date: 9/3/97
Engineer(s): DML

Basic Test Parameters: **SIGNAL** **PROPONENT SPECIFIC** **COMPOSITE SIGNAL**

Center Frequency: 94.1 MHz
RF Level: -65 dBm
Main Channel Mod: CPN
SCA Group: Proponent Only
Measurement Duration: 2.5 minutes

5-Band Medium Processed
ORBAN #2
COMP OUT 1: Proponent Only
COMP OUT 2:
Main Channel modulation adjusted for 110%

Analog Receivers: Delco RX 7
Dayton 67kHz SCA Receiver
Denon RX 2 RBDS Receiver W/RDS Check software utilty

(H) **B1.1a** **Noise Failure Characterization** – proponent only

Noticed increase in HCorrected Packets with CPN modulation.
System exhibits inconsistent performance with previous noise tests.

Noise Level		Error Level (%)			
C/N$_o$	Attn	BER	20 Byte	220 Byte	
87.65	21.00	0.000	0.000	0.000	Locked to on-air pilot.
86.65	20.00	0.011	0.193	1.064	Locked to on-air pilot.
87.65	21.00	0.000	0.000	0.000	Not locked to on-air pilot.
86.65	20.00	0.017	0.290	2.128	Not locked to on-air pilot.

Test H (D-1)

HSSC → Host Analog (pilot unlocked)

Digital Radio Test Laboratory

(H) D-1 HSSC -› Host Analog

Main Channel:	91 %		91 %		81 %		81 %	
Pilot:	9 %		9 %		9 %		9 %	
92 kHz:	0 %		0 %		7 %		0 %	
57 kHz:	0 %		0 %		3 %		10 %	
Proponent:	0 %		10 %		10 %		10 %	
Total:	100 %		110 %		110 %			

	0 dB= 2.06 V					0 dB= 1.86 V					
	Pilot Only		Proponent + Pilot			Group C			Group D		
RF Level dBm	S/N	Units			SEIKO S/N (dB)			SEIKO S/N (dB)			SEIKO S/N (dB)
-65	50.4	dB			50.3			49.3			49.2
-75	47.6	dB			47.6			46.7			46.8

Measurements made psophometrically (Q-Peak detected with CCIR weighting and 15 kHz low pass filters).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements made on Left Channel.
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 9/2/97 18.999929 kHz On Air
19.000009 kHz Seiko Locked

Digital Radio Test Laboratory

(H) D-1 HSSC -› Host Analog

Main Channel:	91	%	91	%	81	%	81	%
Pilot:	9	%	9	%	9	%	9	%
92 kHz:	0	%	0	%	7	%	0	%
57 kHz:	0	%	0	%	3	%	10	%
Proponent:	0	%	10	%	10	%	10	%
Total:	100	%	110	%	110	%		

	0 dB= 2.37 V					0 dB= 2.15 V								
	Pilot Only			Proponent + Pilot			Group C			Group D		
RF Level dBm	S/N	Units			SEIKO S/N (dB)			SEIKO S/N (dB)				SEIKO S/N (dB)
-65	56.2	dB			52.4			52.0				51.3
-75	54.7	dB			52.6			53.2				52.7

Measurements made Q-Peak detected with CCIR weighting and 15 kHz low pass filters (psophometric).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 9/2/97 18.999929 kHz On Air
19.000009 kHz Seiko Locked

Digital Radio Test Laboratory

(H) D-1 HSSC -> Host Analog

Main Channel:	91 %		91 %		81 %		81 %	
Pilot:	9 %		9 %		9 %		9 %	
92 kHz:	0 %		0 %		7 %		0 %	
57 kHz:	0 %		0 %		3 %		10 %	
Proponent:	0 %		10 %		10 %		10 %	
Total:	100 %		110 %		110 %			

	0 dB= 757.0 mV					0 dB= 682.0 mV					
	Pilot Only		Proponent + Pilot			Group C			Group D		
RF Level dBm	S/N	Units			SEIKO S/N (dB)			SEIKO S/N (dB)			SEIKO S/N (dB)
-65	49.1	dB			49.1			48.3			48.3
-75	39.4	dB			39.4			38.6			38.6

Measurements made Q-Peak detected with CCIR weighting filter (psophometric).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation
Unit Not in Screen Box
Clipped Pink Noise on 67 kHz SCA.
Engineer(s): DML
Tests Conducted: 9/2/97 18.999929 kHz On Air
19.000009 kHz Seiko Locked

Digital Radio Test Laboratory

(H) D-1 HSSC -› Host Analog

Main Channel:	91 %		91 %		81 %		81 %	
Pilot:	9 %		9 %		9 %		9 %	
92 kHz:	0 %		0 %		7 %		0 %	
57 kHz:	0 %		0 %		3 %		10 %	
Proponent:	0 %		10 %		10 %		10 %	
Total:	100 %		110 %		110 %			

RF Level dBm	0 dB= 654.0 mV		Proponent + Pilot			0 dB= 588.0 mV					
	Pilot Only					Group C			Group D		
	S/N	Units			SEIKO S/N (dB)			SEIKO S/N (dB)			SEIKO S/N (dB)
-65	52.6	dB			52.2			50.5			50.3
-75	43.0	dB			43.0			41.9			41.9

Measurements made Q-Peak detected with CCIR weighting and 15 kHz low pass filters (psophometric).
0 dB Reference Measurements made with 1 kHz Mod Source on Main Channel L+R.
Measurements on Left Channel
Orban #2 Composite output #1 Set for 91% Main Channel Modulation
Orban #2 Composite output #2 Set for 81% Main Channel Modulation
Clipped Pink Noise on 67 kHz SCA.

Engineer(s): DML
Tests Conducted: 9/2/97

18.999929 kHz On Air
19.000009 kHz Seiko Locked

4.0
Injection Level Calibration and Analog Subcarrier Deviation Plots

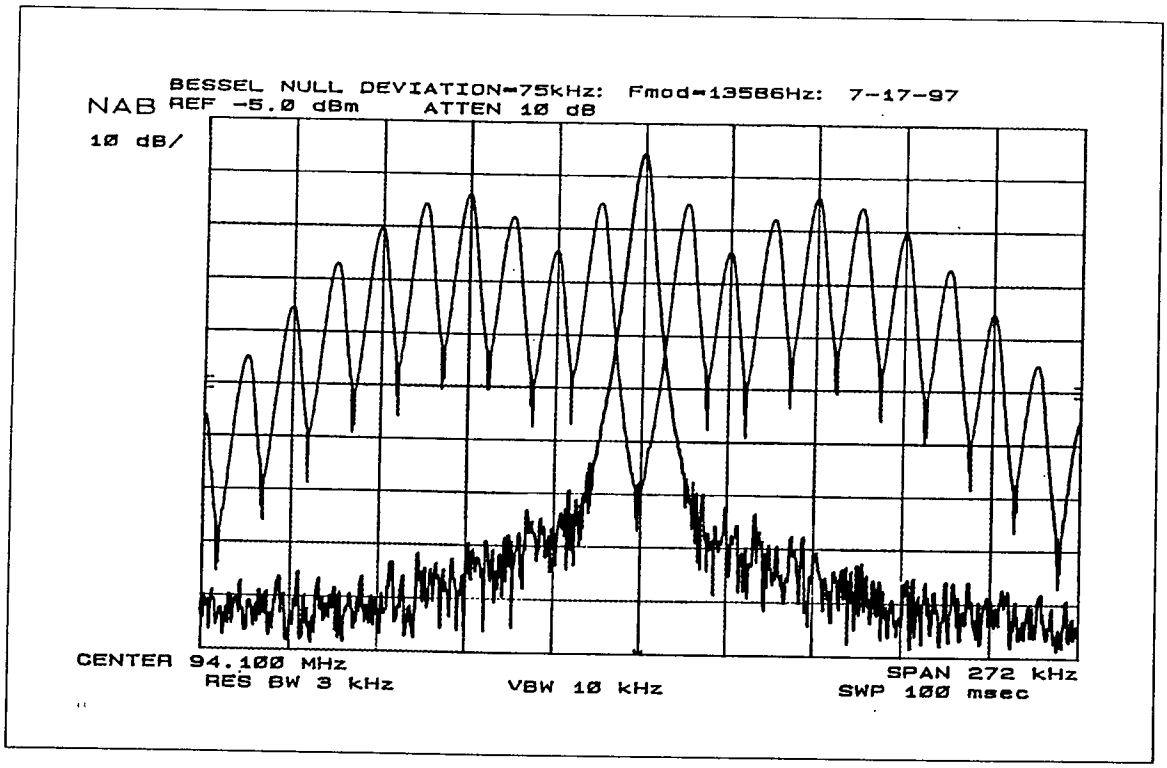


Figure 1: RF Carrier Wave & 2nd Bessel Null

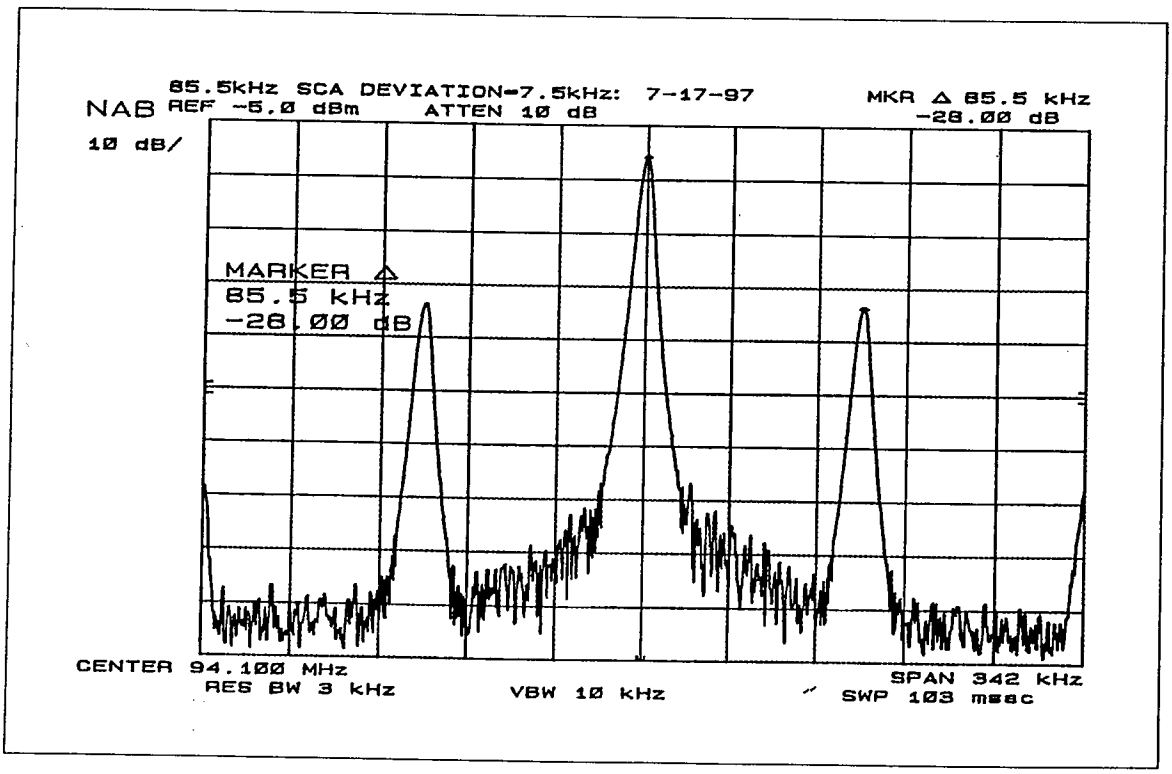


Figure 2: 85.5 kHz Subcarrier at 10 % Injection

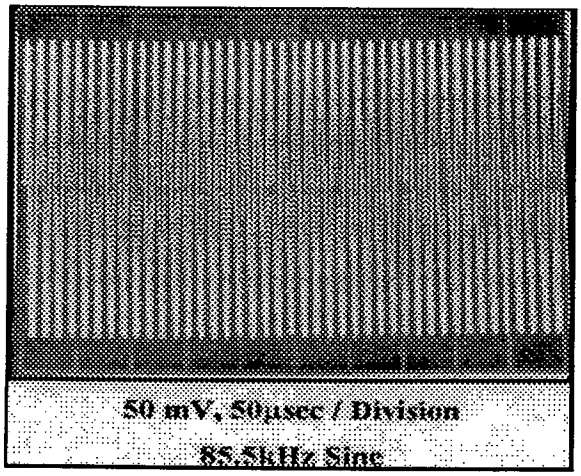


Figure 3: Sine 10 % Injection

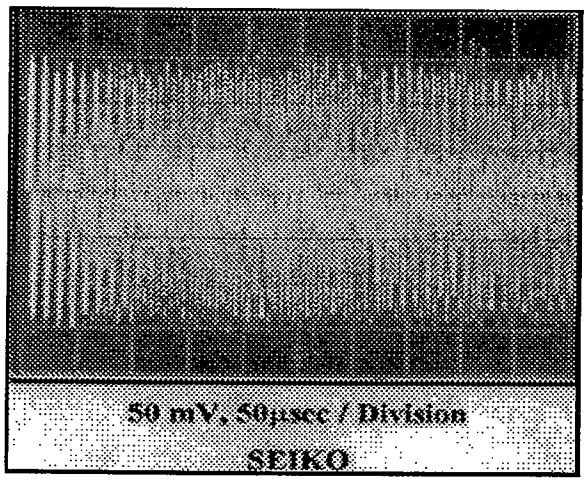


Figure 4: Seiko at 10 % Injection

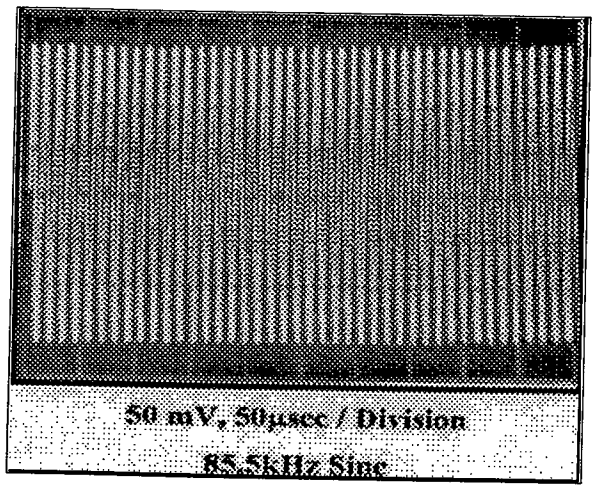


Figure 3: Sine 10 % Injection

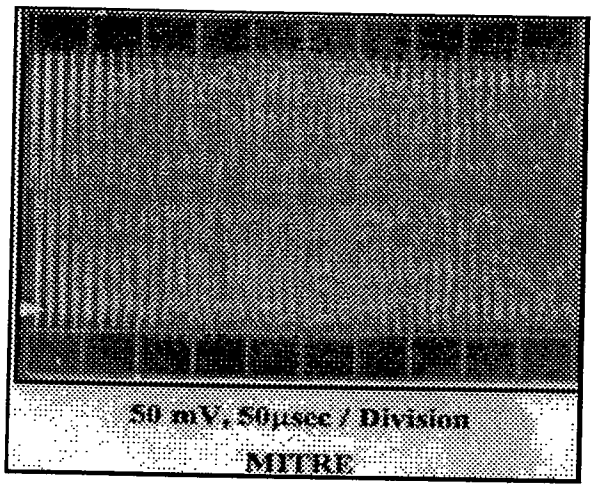


Figure 5: Mitre at 10 % Injection

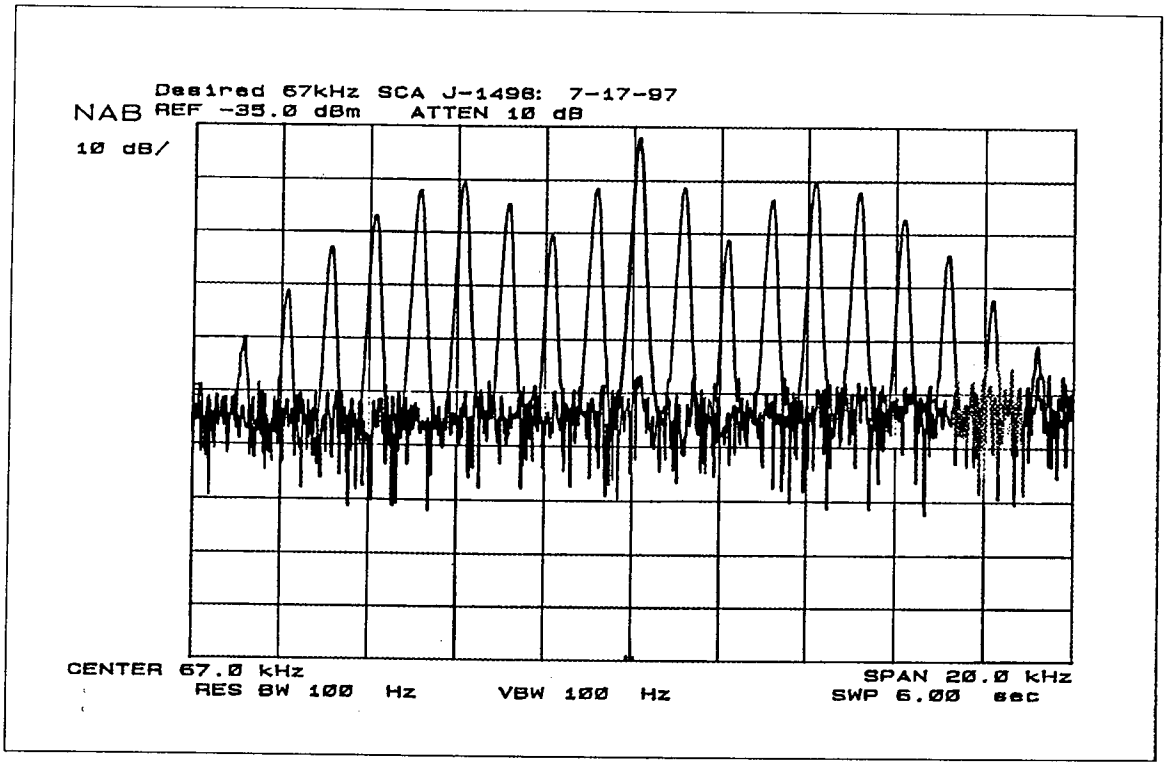


Figure 6: 67 kHz Subcarrier CW and with 5.5 kHz Deviation 1 kHz Sine.

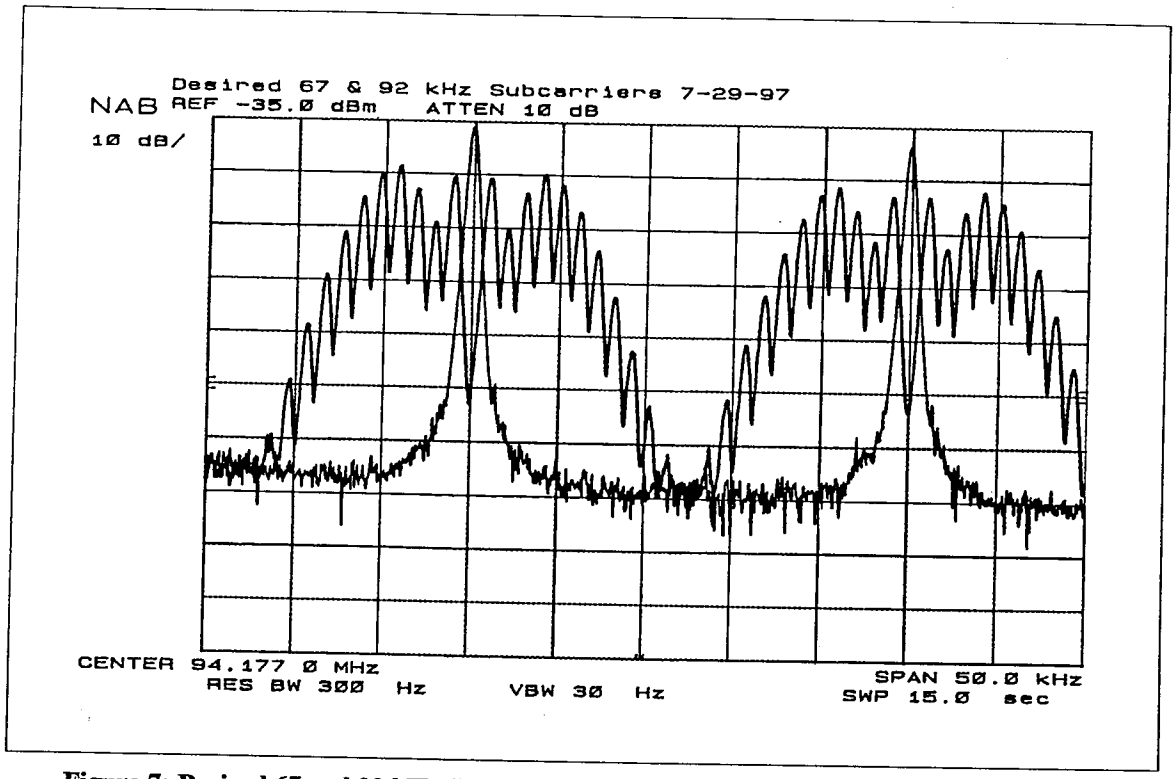


Figure 7: Desired 67 and 92 kHz Subcarriers CW and with 5.5 kHz Deviation 1 kHz Sine.

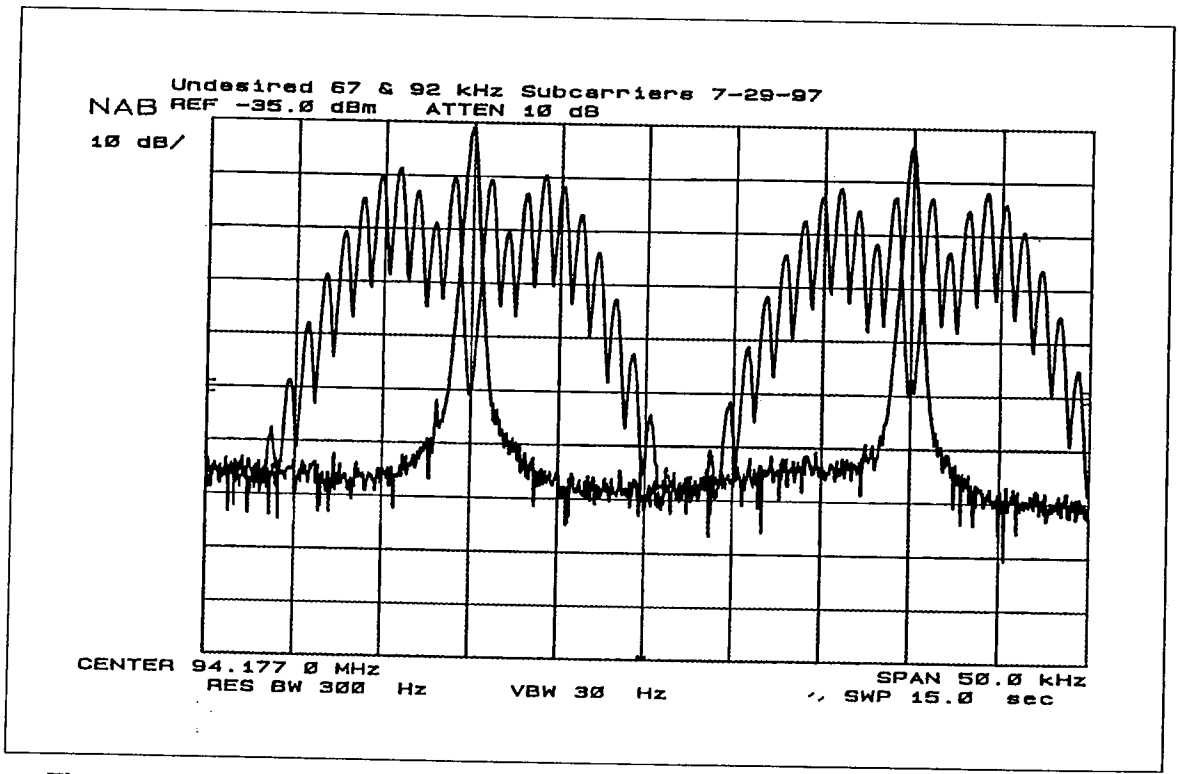


Figure 8: Undesired 67 and 92 kHz Subcarriers CW and with 5.5 kHz Deviation 1 kHz Sine.

5.0
67 kHz Subcarrier Receiver Characteristics at Moderate Signal Level (-65 dBm)

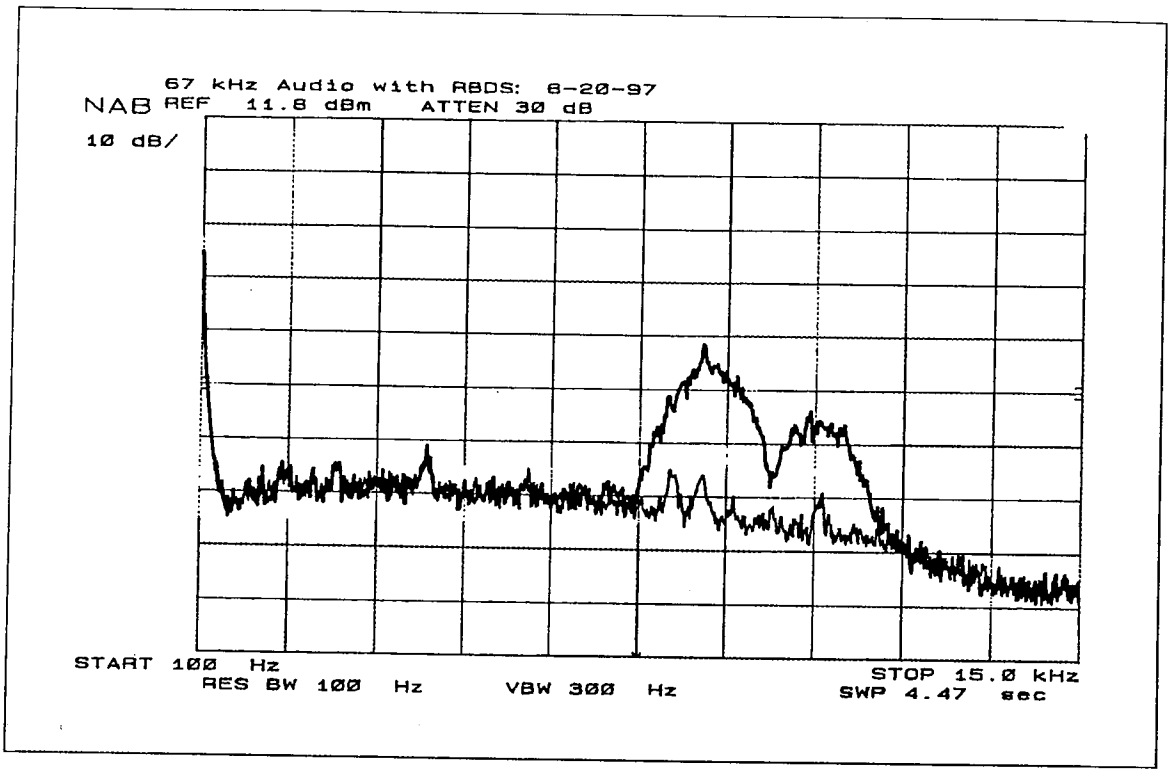


Figure 9: Noise Floor with and without RBDS at 3%

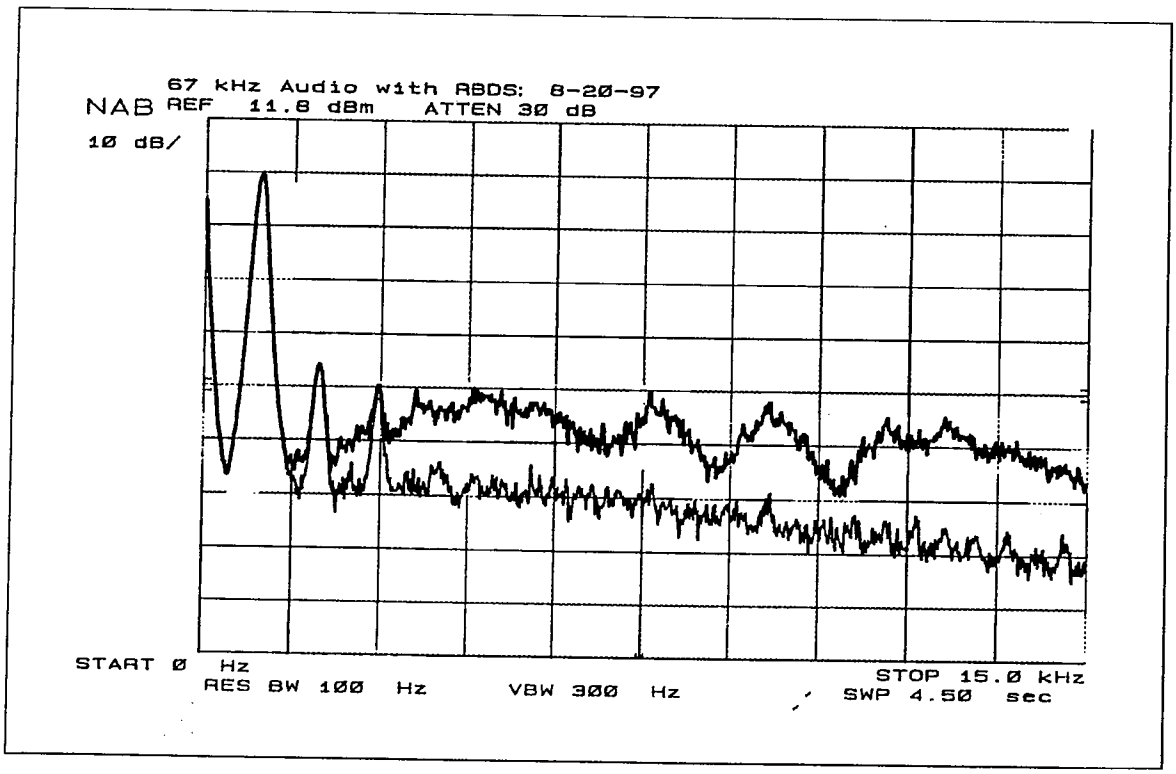


Figure 10: Audio with and without RBDS at 3%

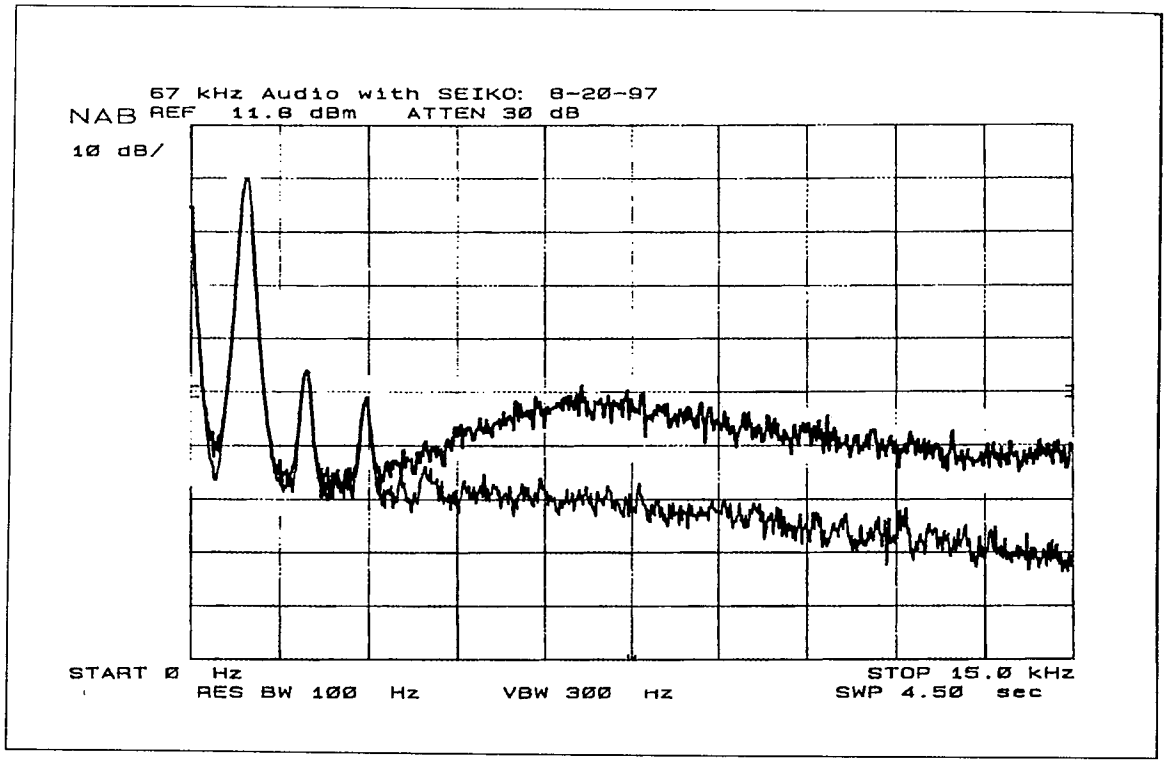


Figure 11: Audio with and without Seiko at 10%

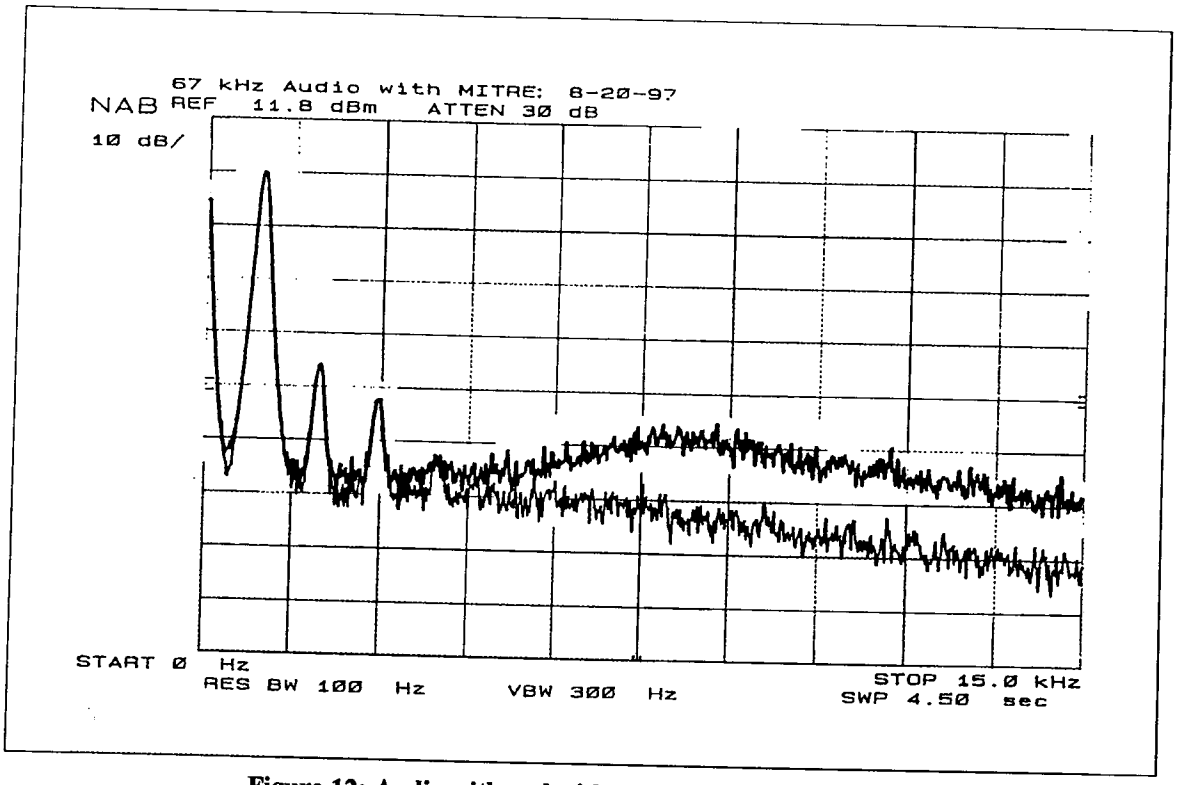


Figure 12: Audio with and without Mitre at 10%

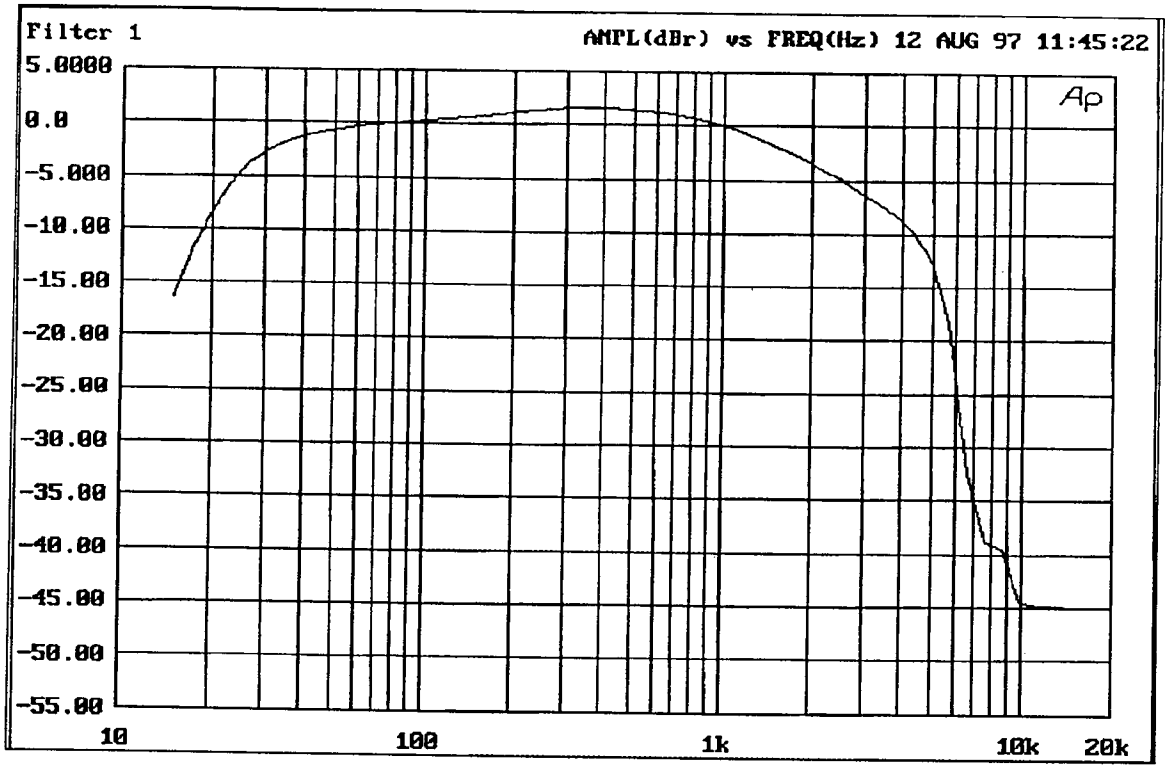


Figure 13: Frequency Response

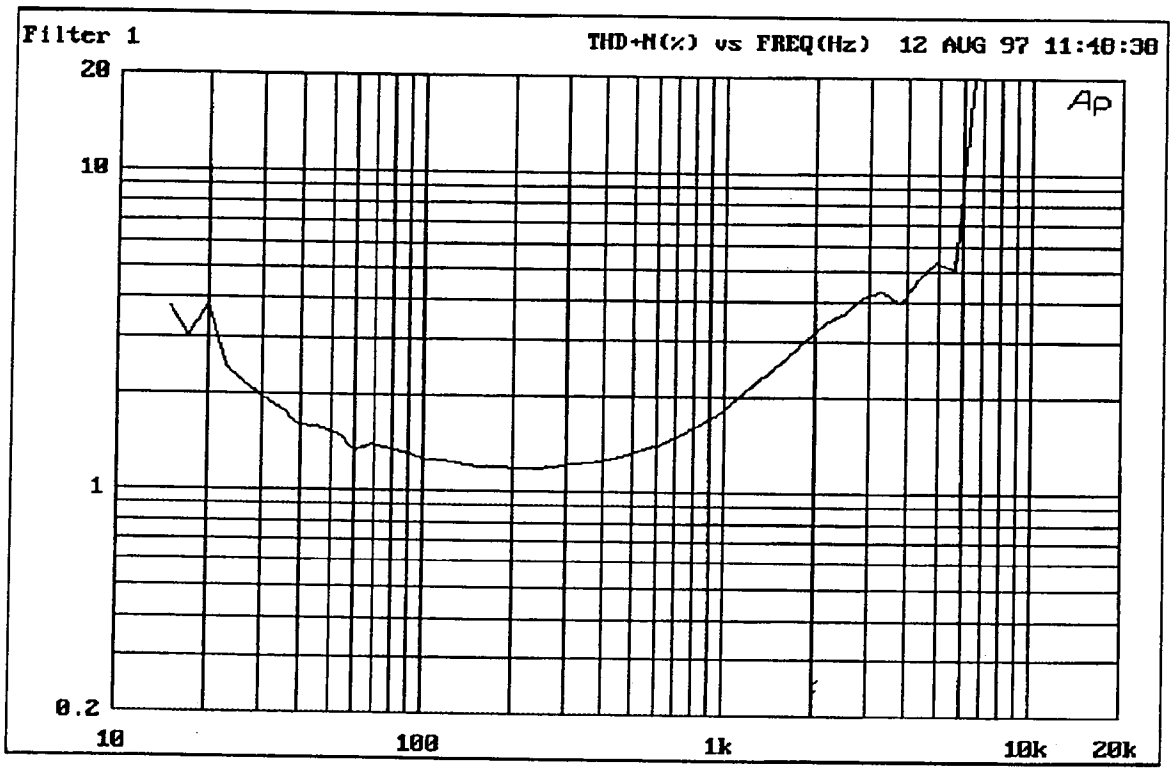


Figure 14: Distortion + Noise

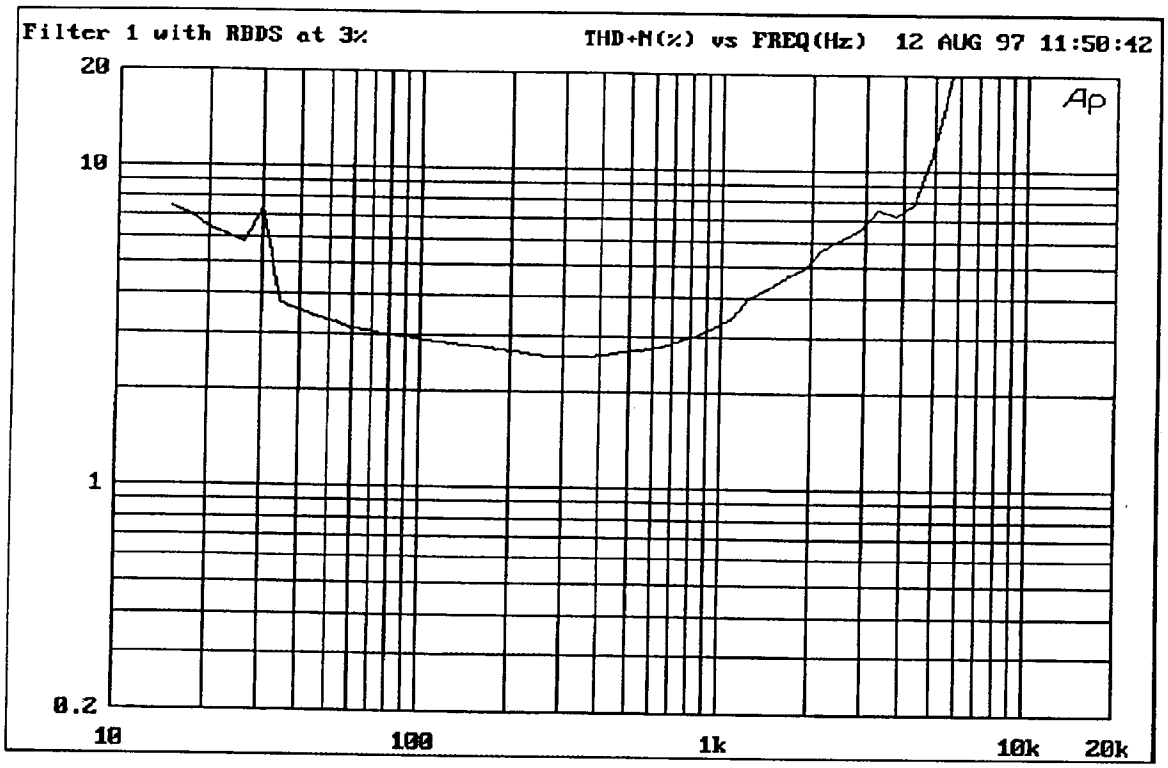


Figure 15: Distortion + Noise with RBDS at 3%

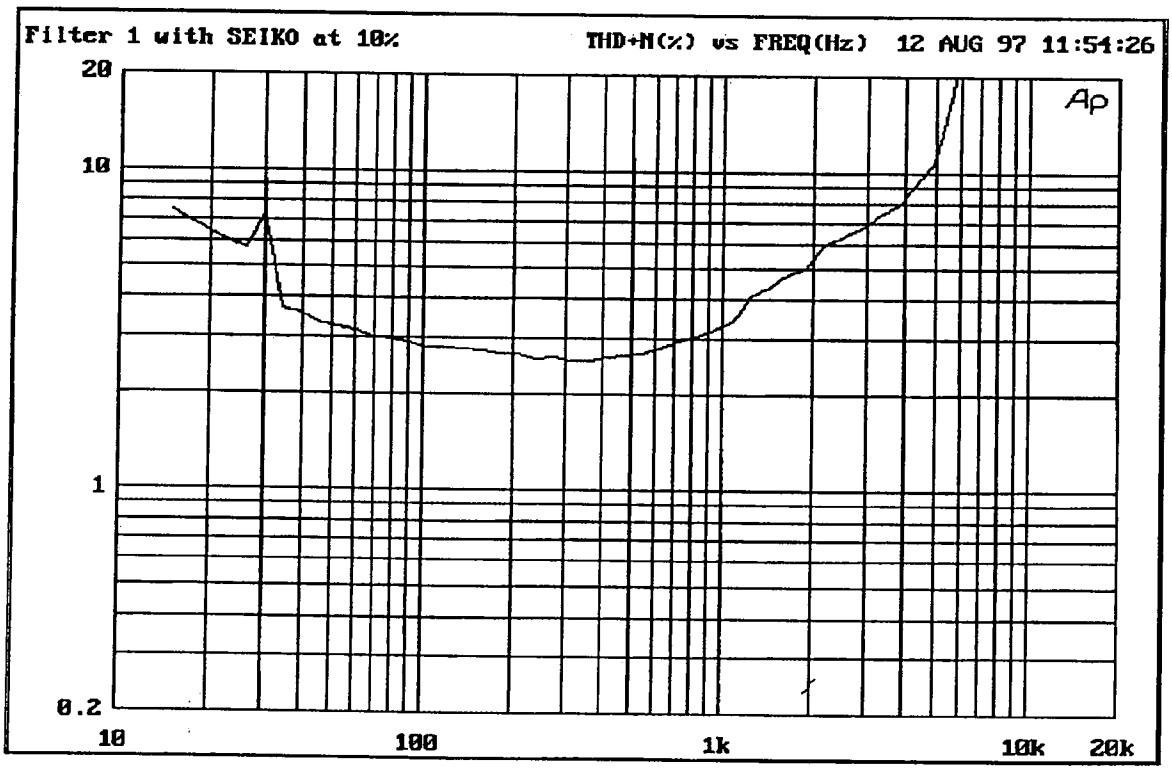


Figure 16: Distortion + Noise with Seiko at 10%

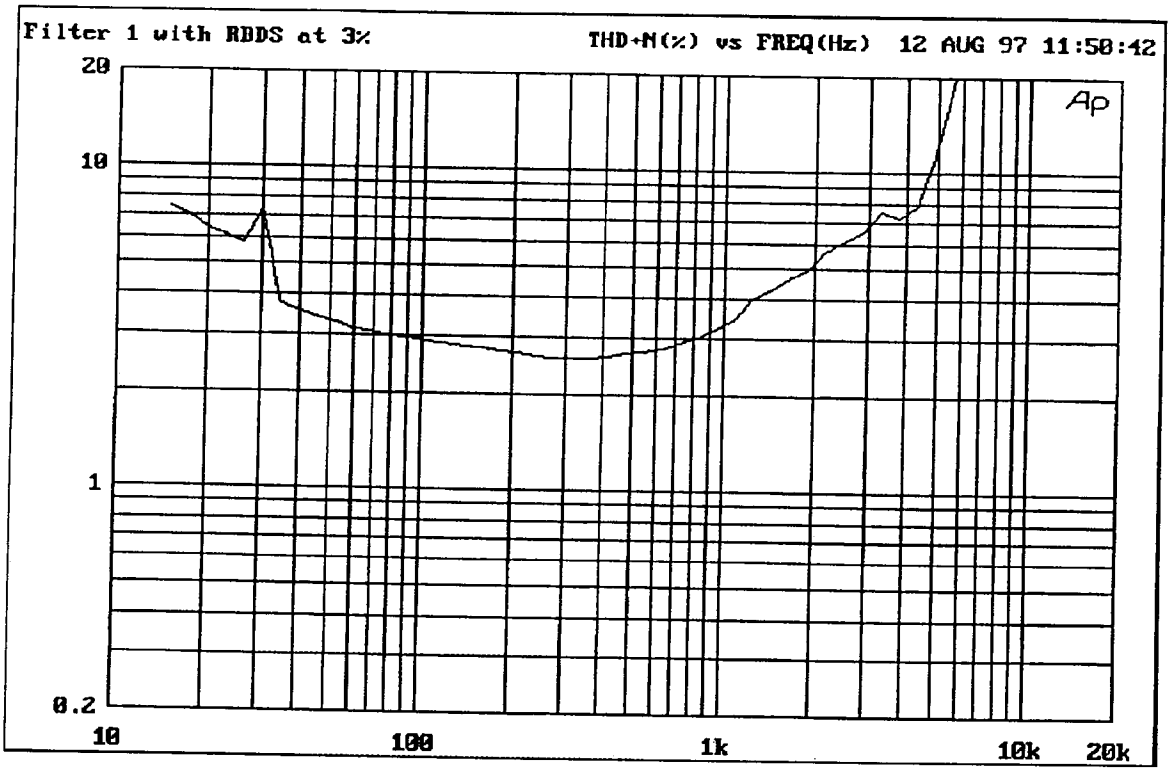


Figure 15: Distortion + Noise with RBDS at 3%

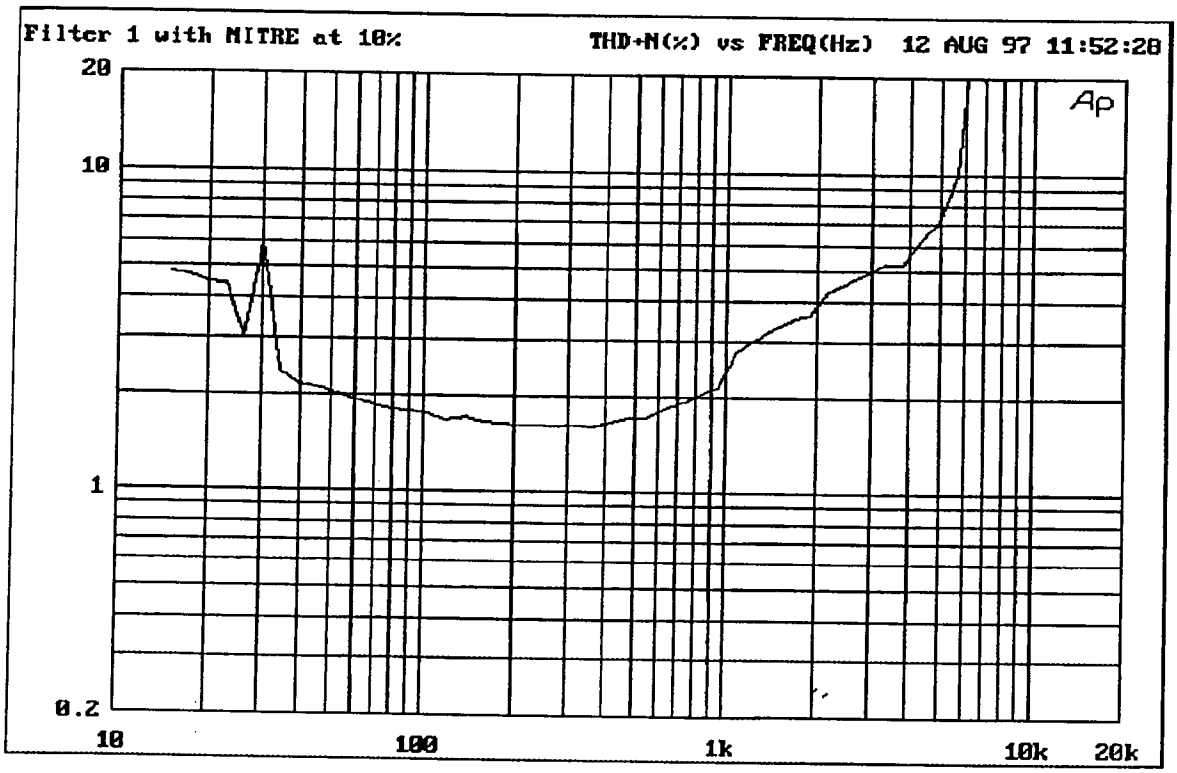


Figure 17: Distortion + Noise with Mitre at 10%

6.0
Proponent-only RF, Baseband, and Analog Proof Plots (Seiko)

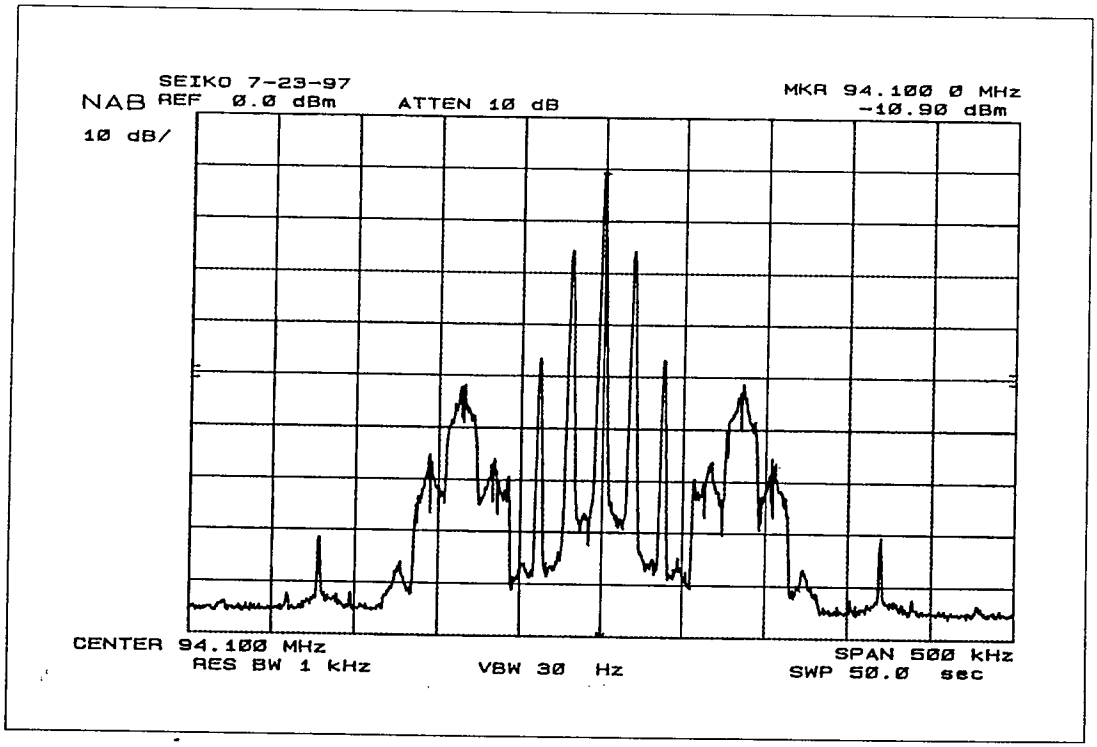


Figure 18: Seiko RF

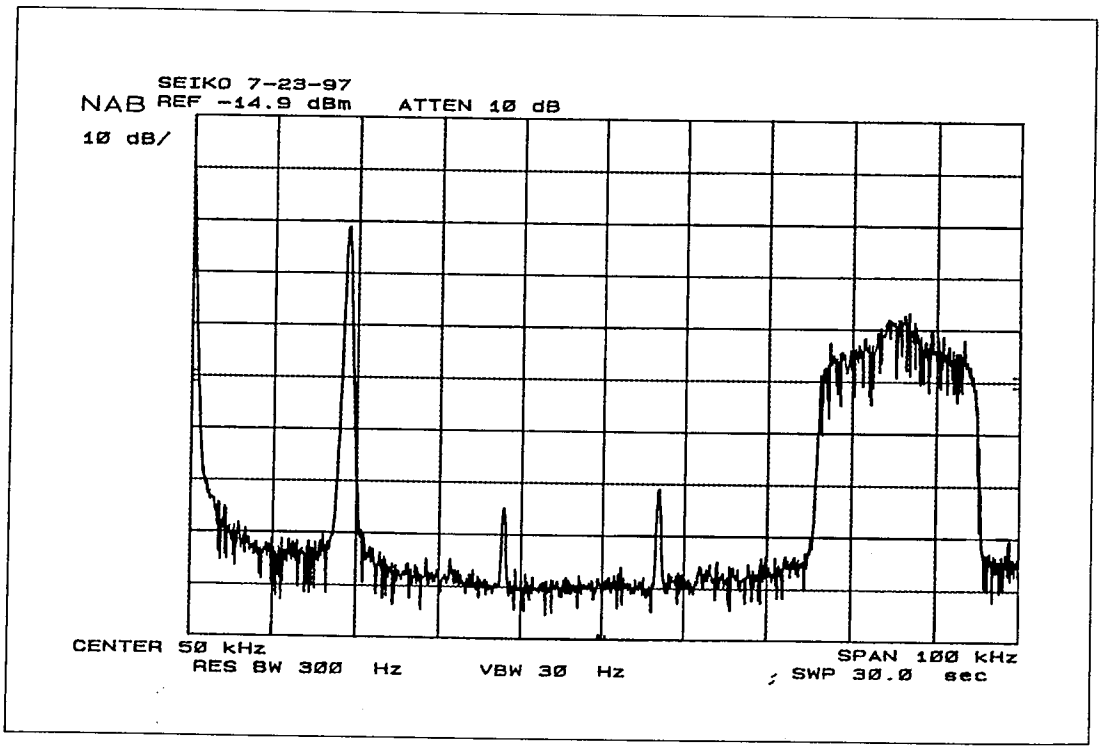


Figure 19: Seiko AFM2 Baseband

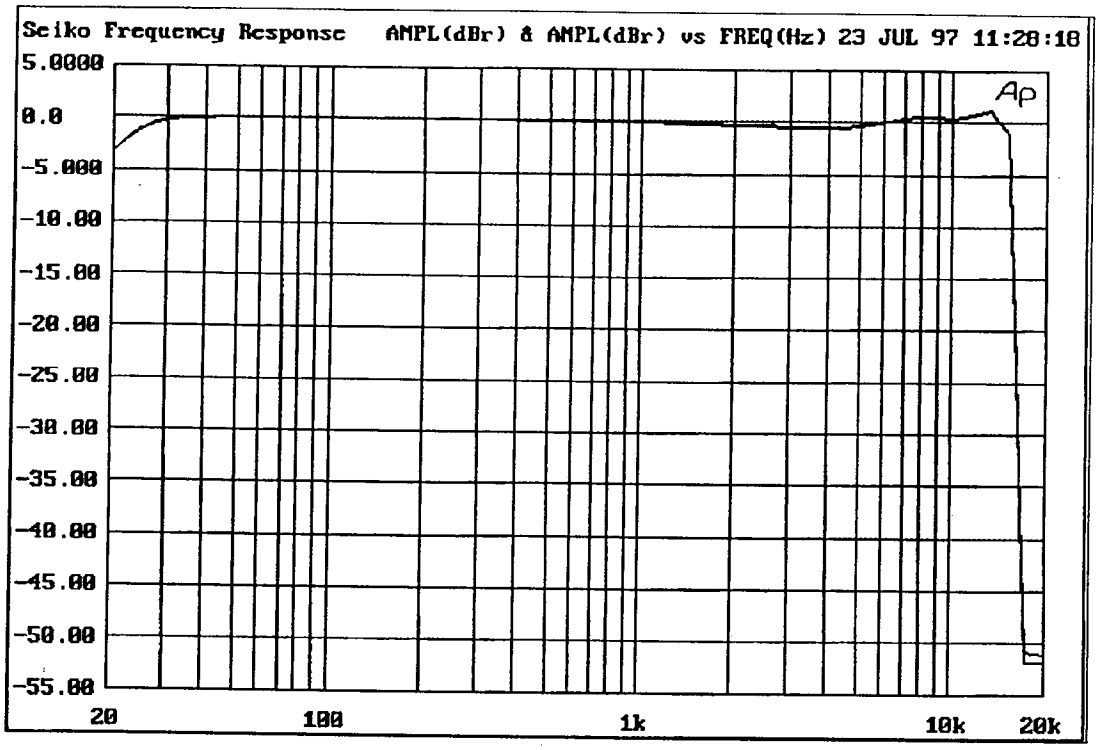


Figure 20: Seiko Frequency Response

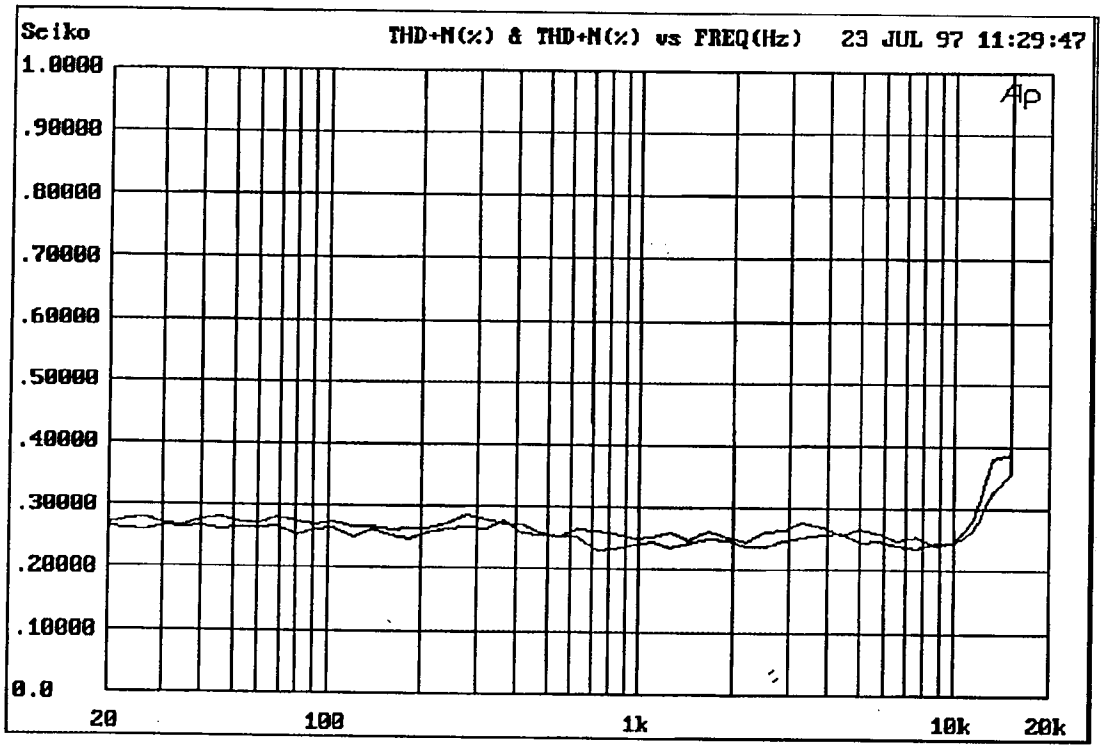


Figure 21: Seiko Distortion + Noise

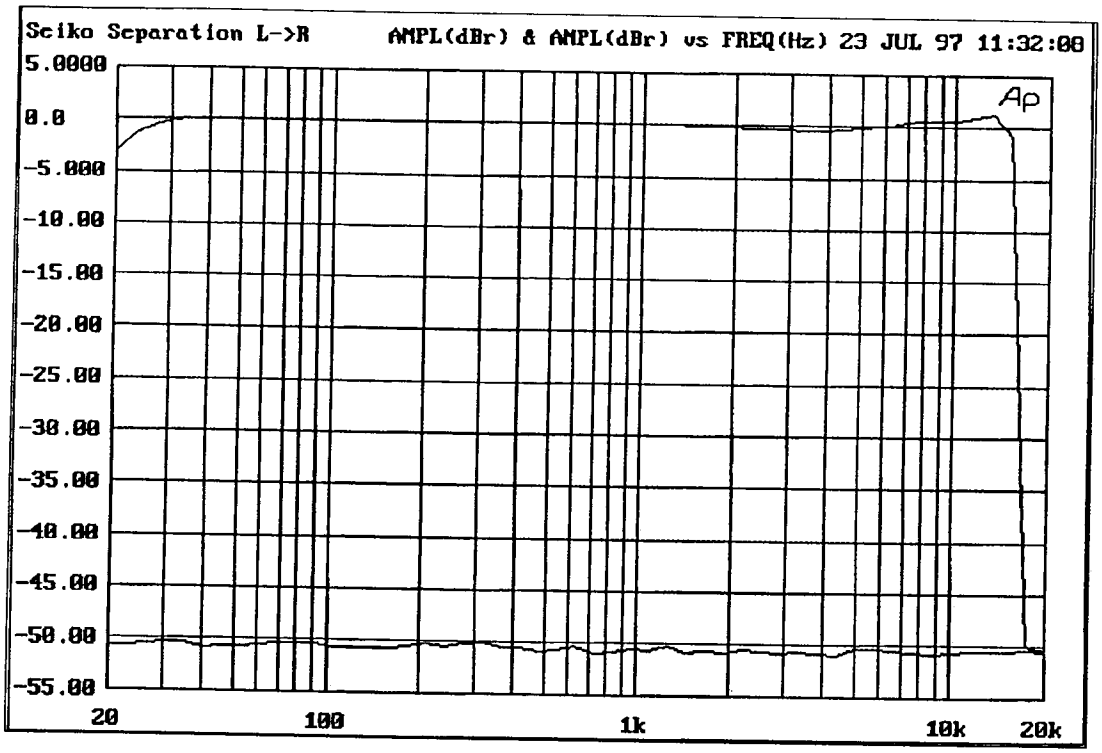


Figure 22: Seiko Separation

7.0
SCA Group C RF, Baseband, and Analog Proof Plots (Seiko)

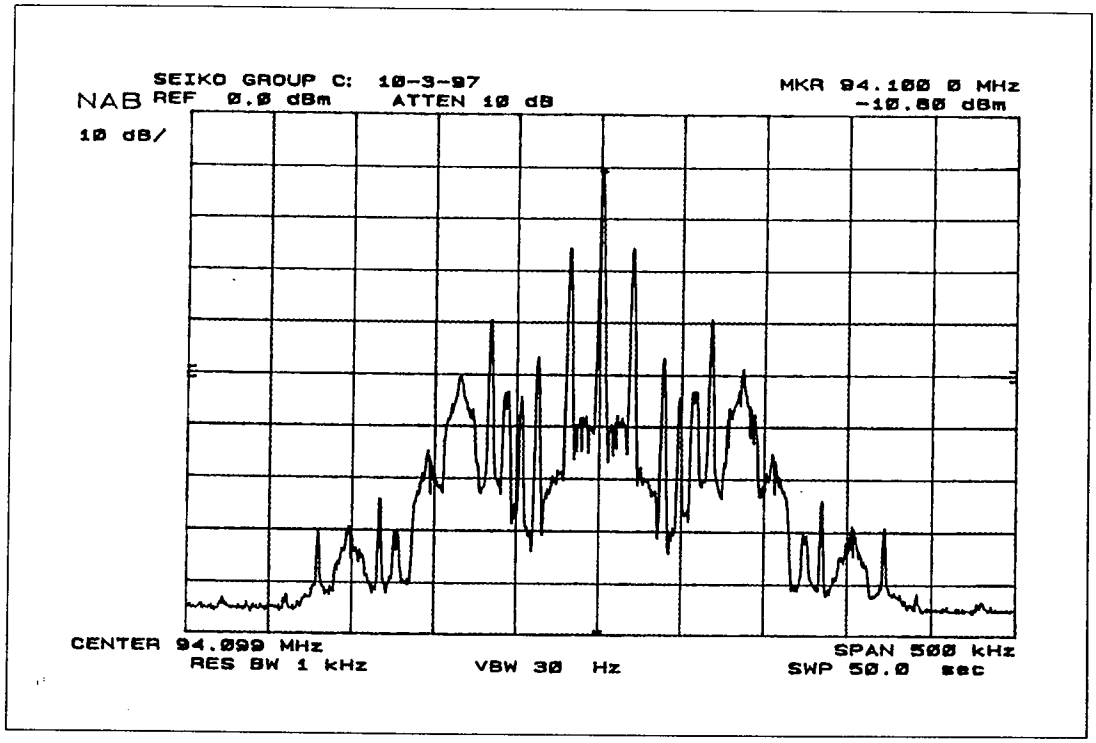


Figure 23: Seiko RF Group C

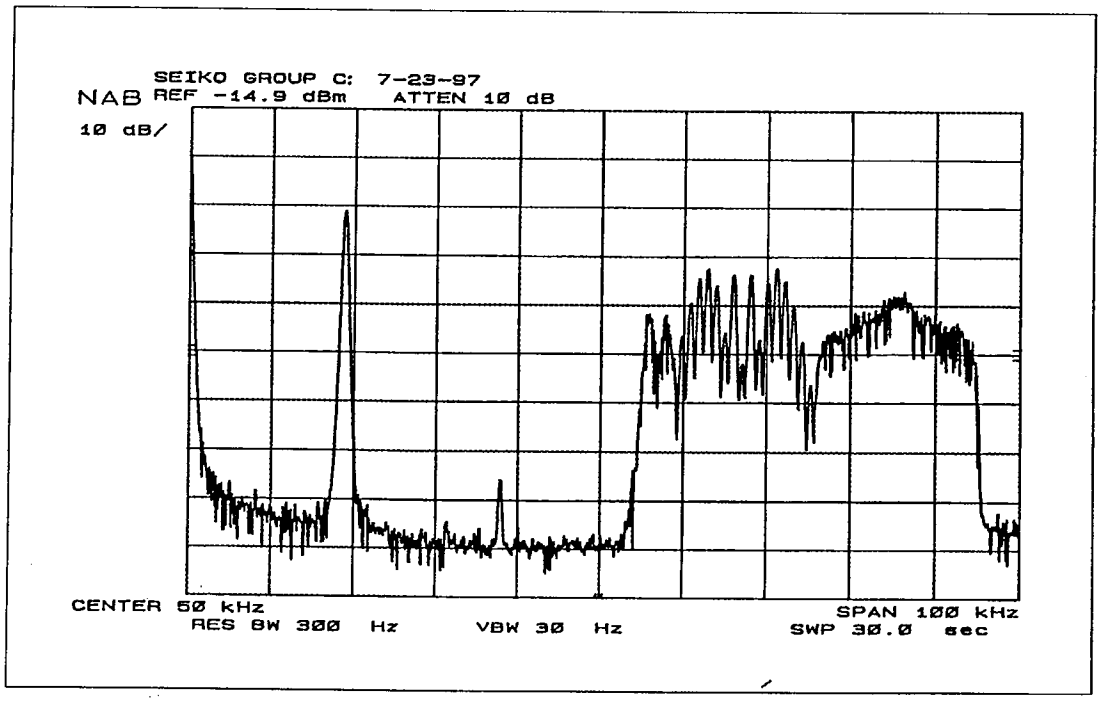


Figure 24: Seiko AFM2 Baseband Group C

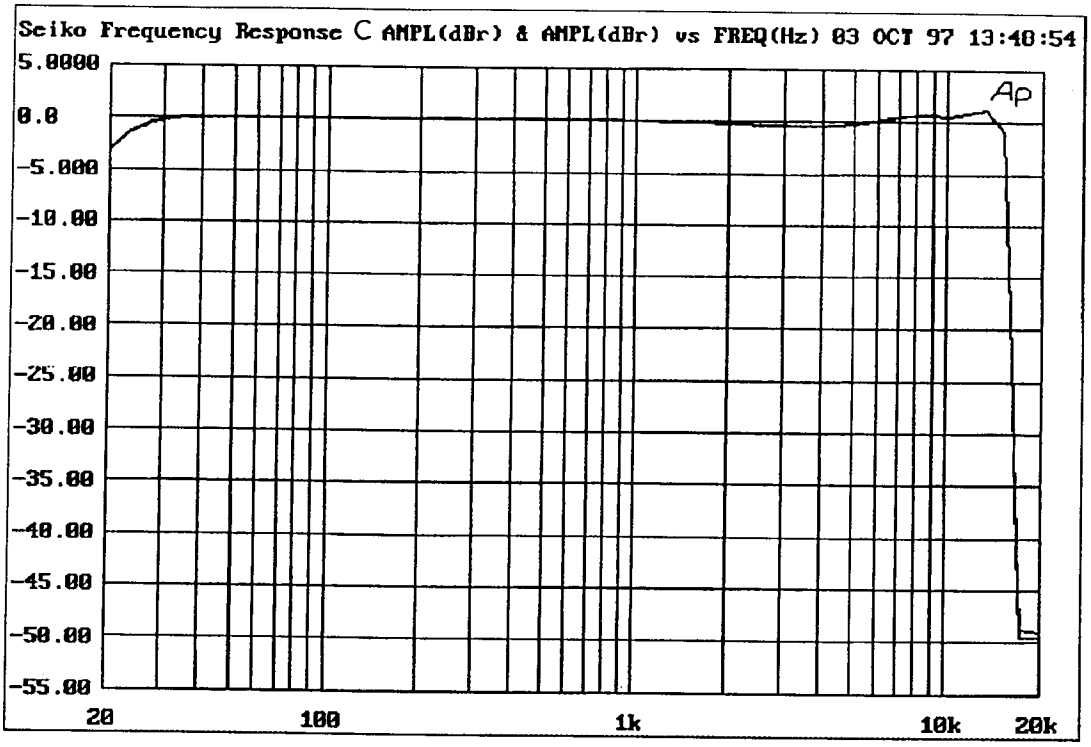


Figure 25: Frequency Response

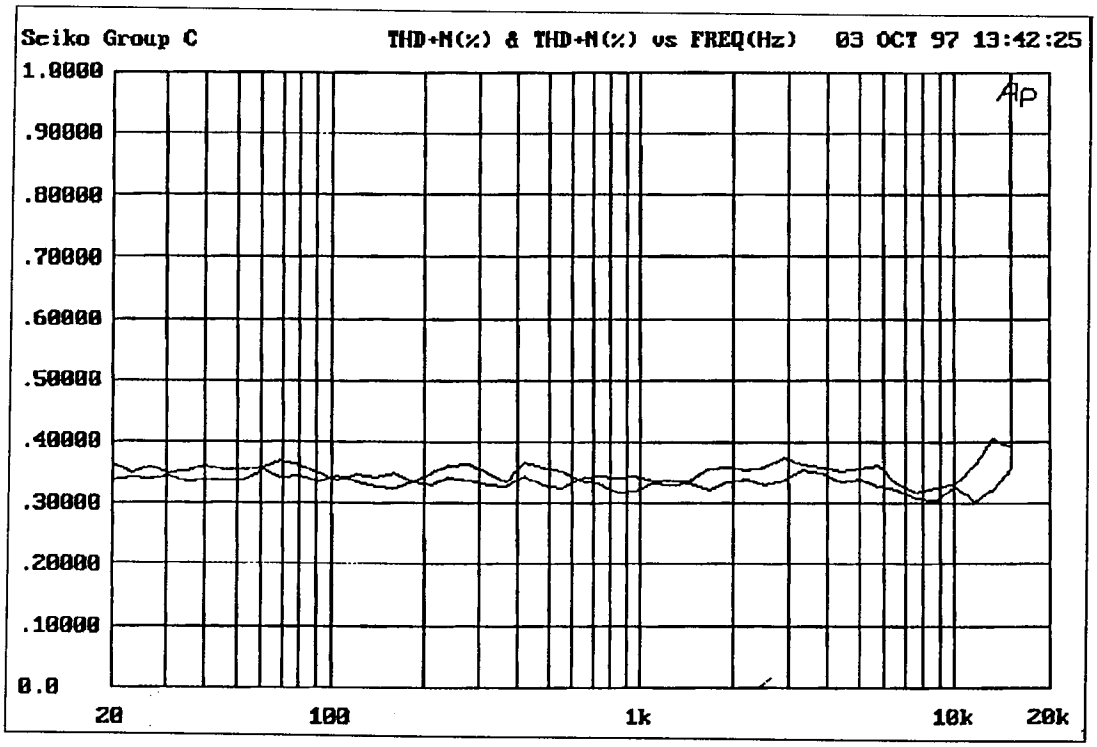


Figure 26: Distortion + Noise

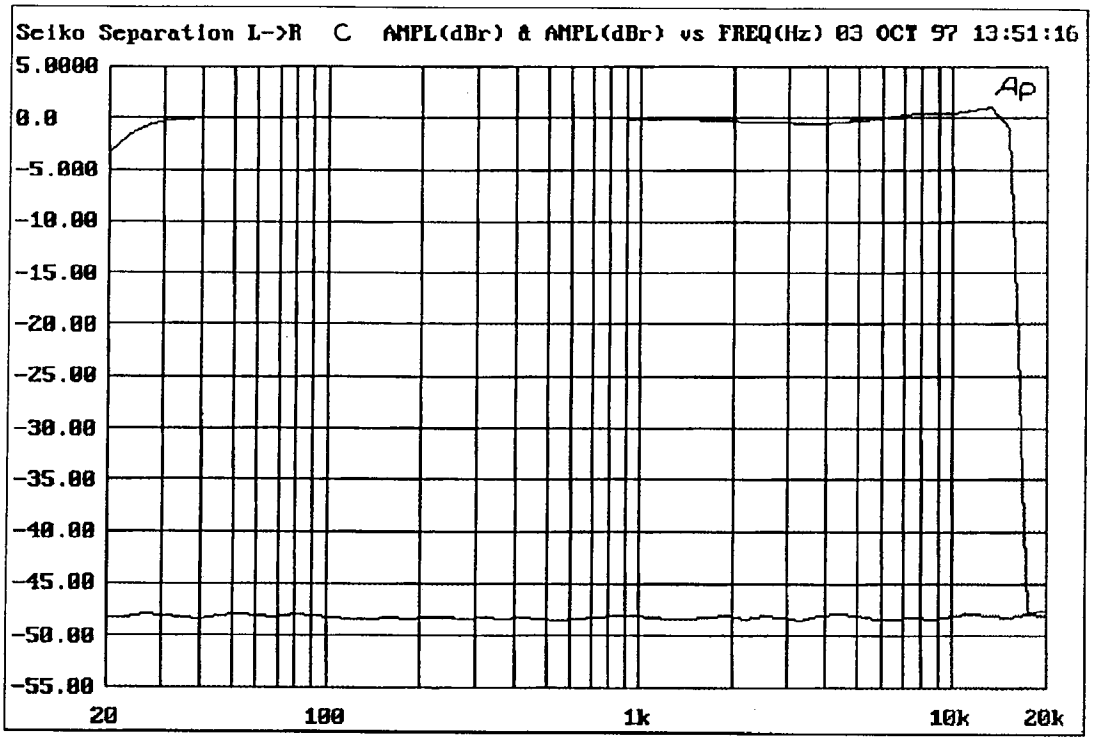


Figure 27: Separation

8.0
SCA Group D RF, Baseband, and Analog Proof Plots (Seiko)

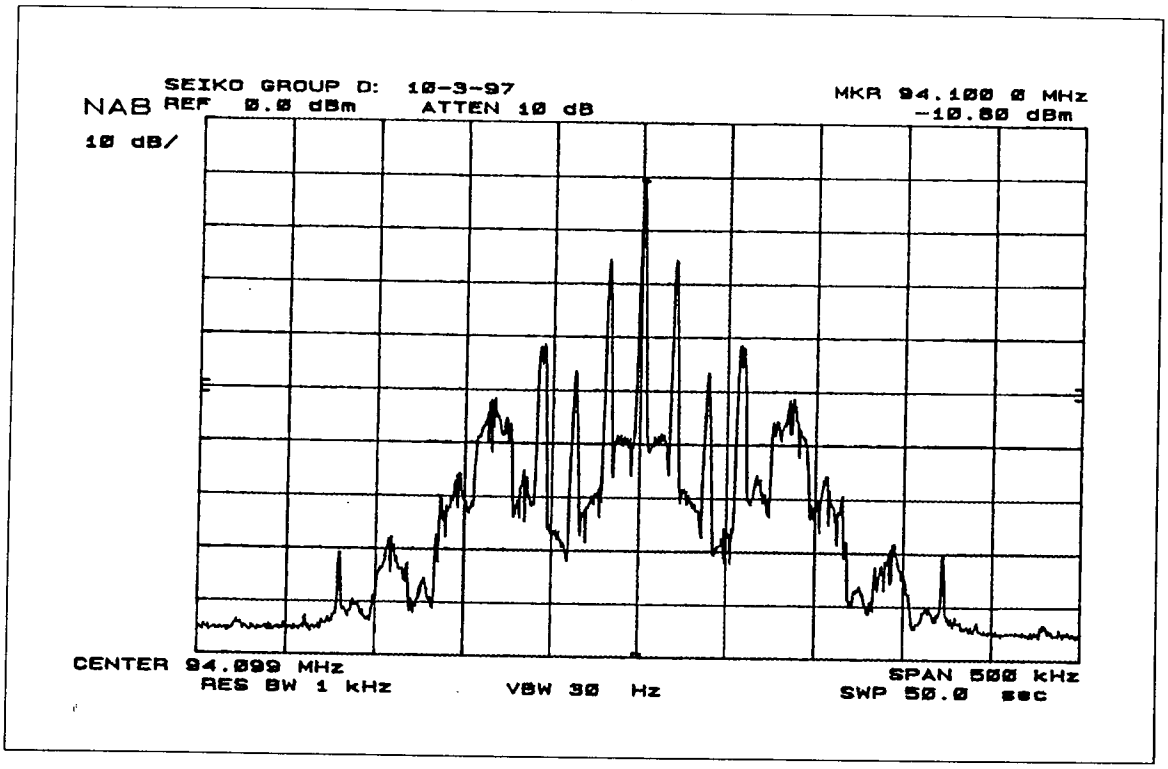


Figure 28: Seiko RF Group D

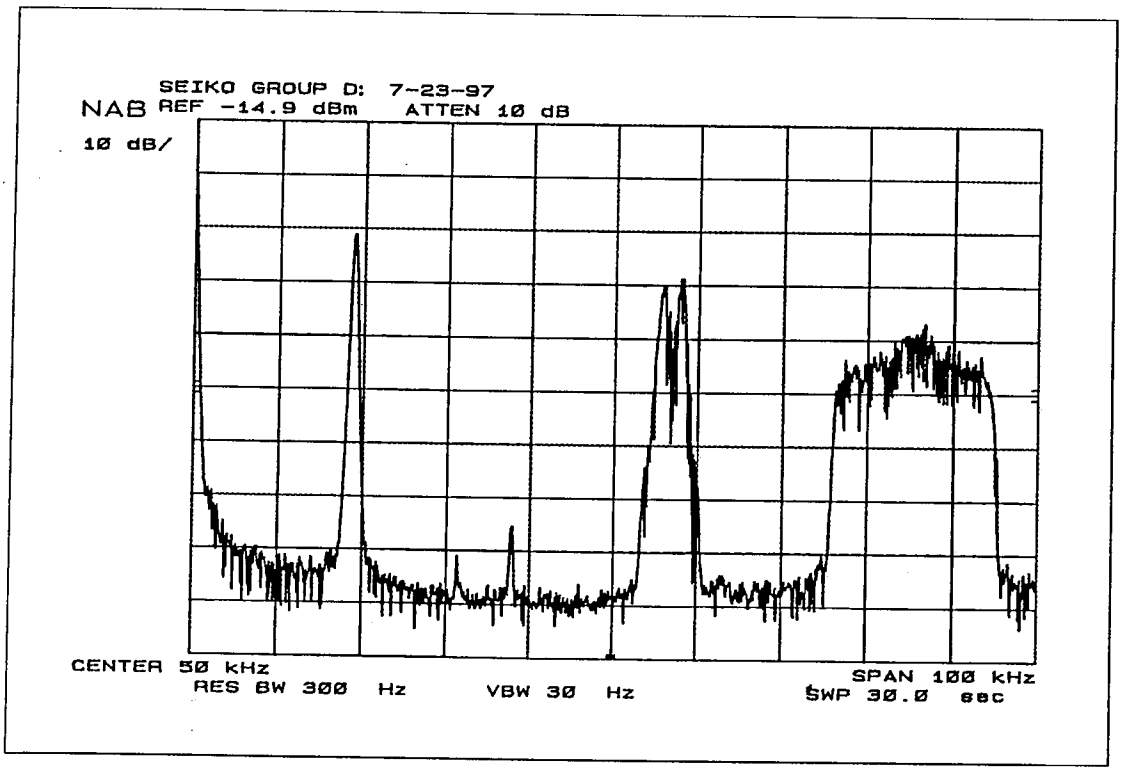


Figure 29: Seiko AFM2 Baseband Group D

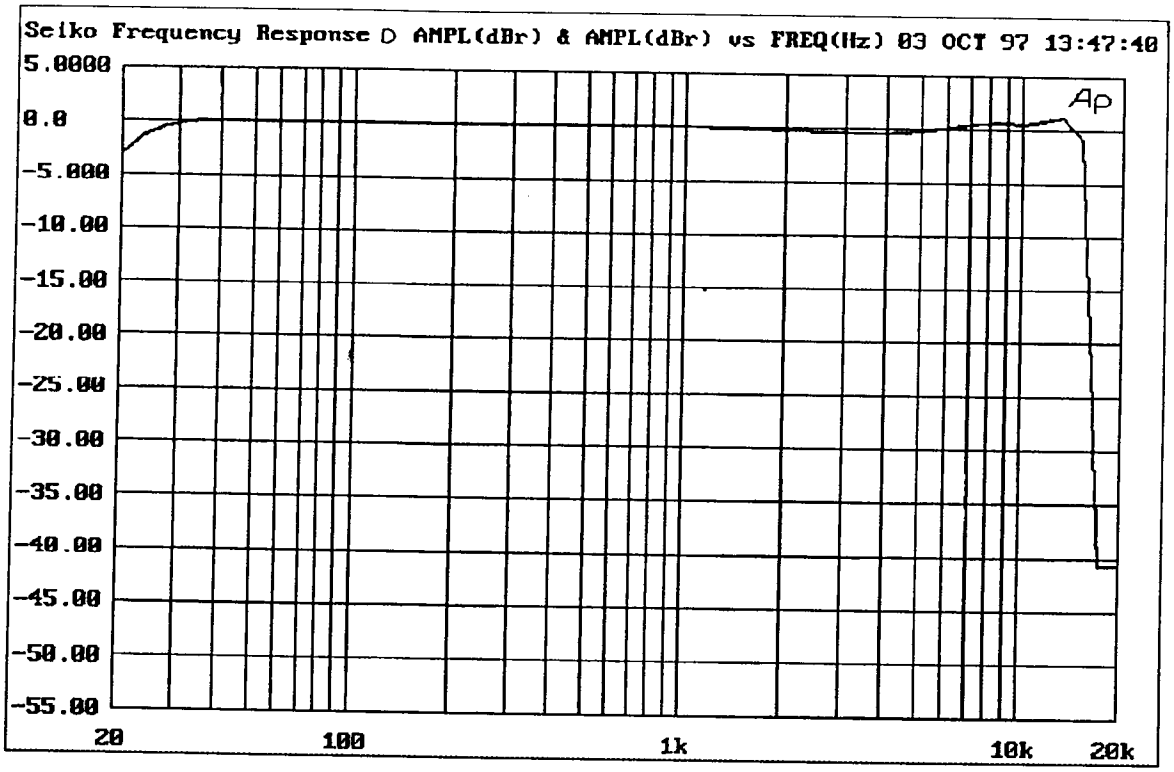


Figure 30: Frequency Response

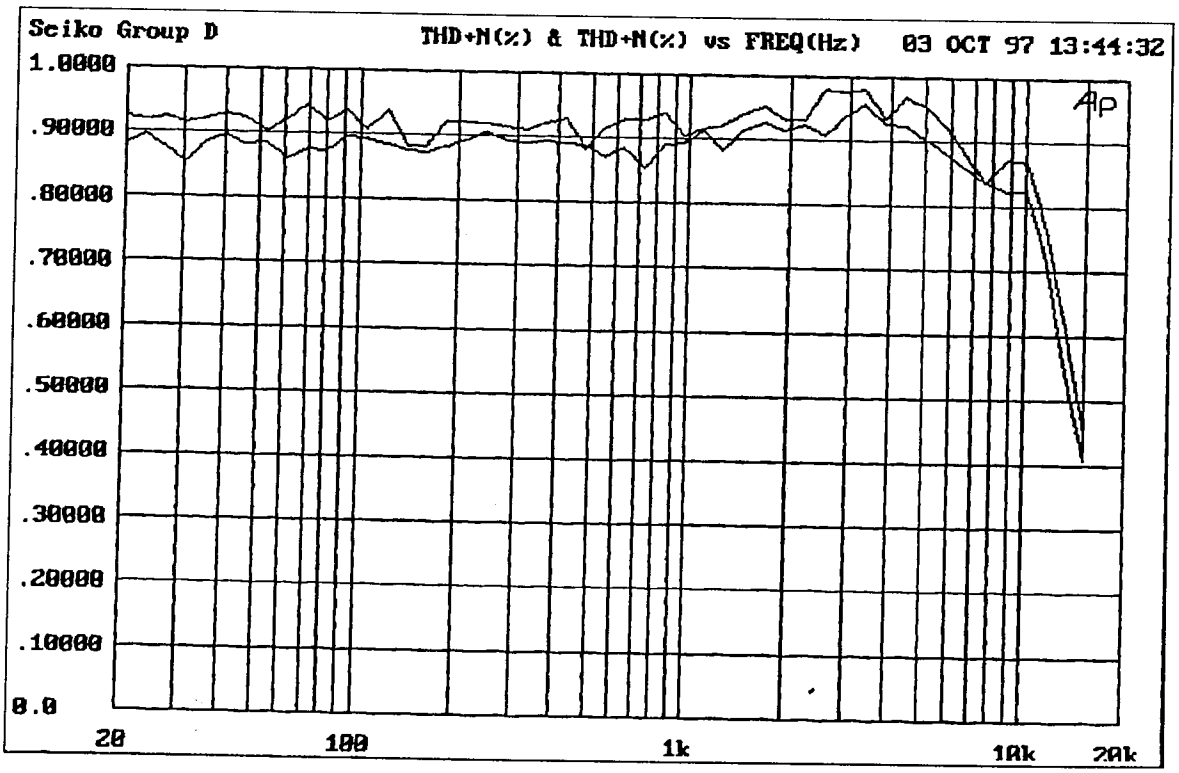


Figure 31: Seiko Distortion + Noise

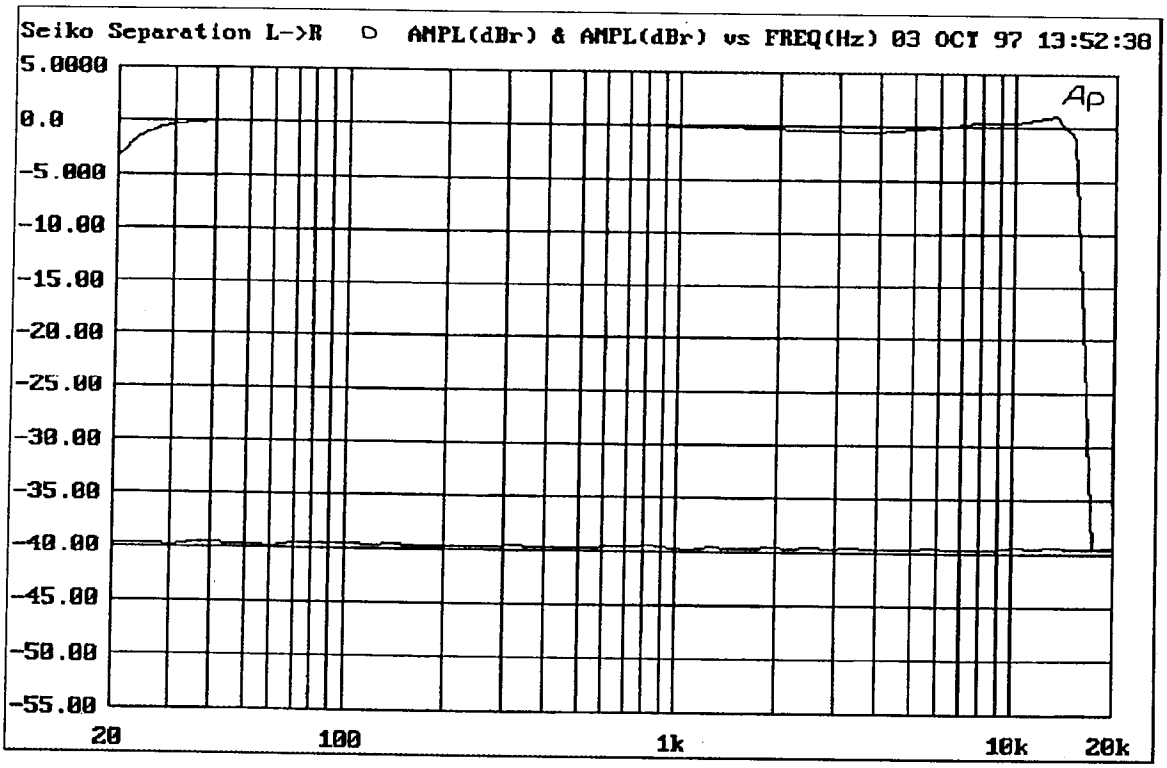


Figure 32: Seiko Separation

9.0
Proponent-only RF, Baseband, and Analog Proof Plots (Mitre)

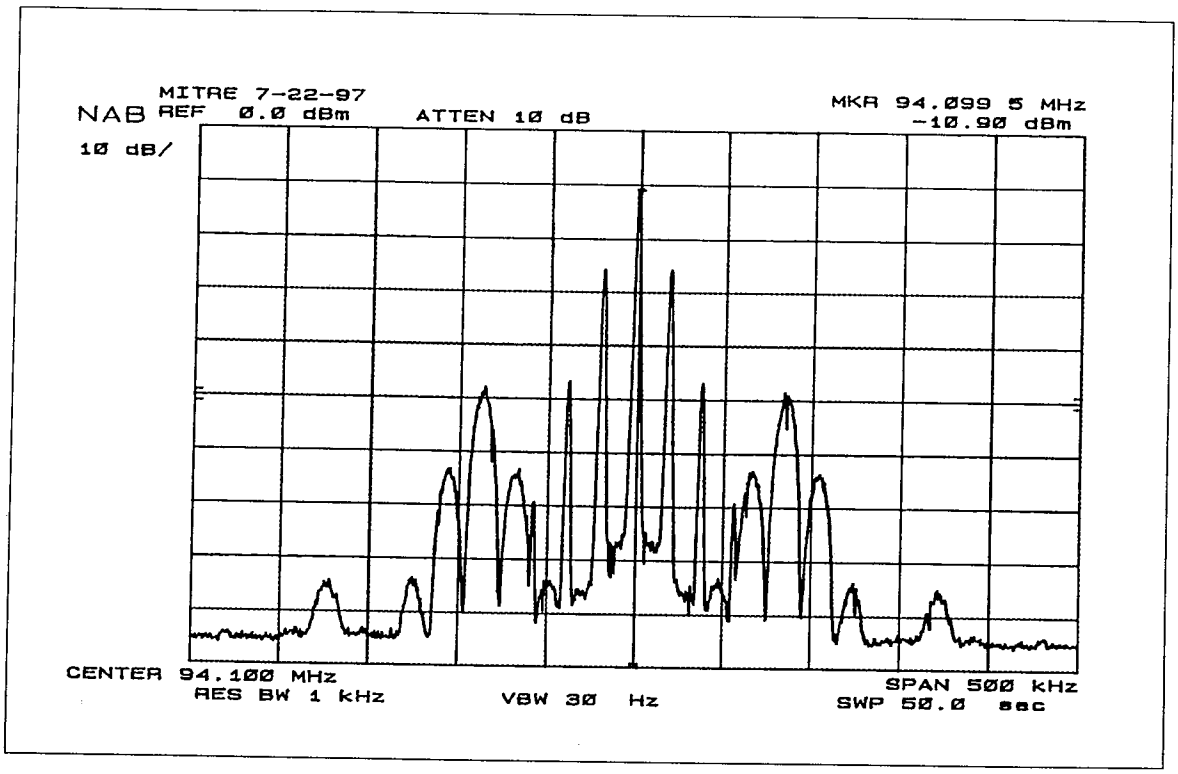


Figure 33: Mitre RF

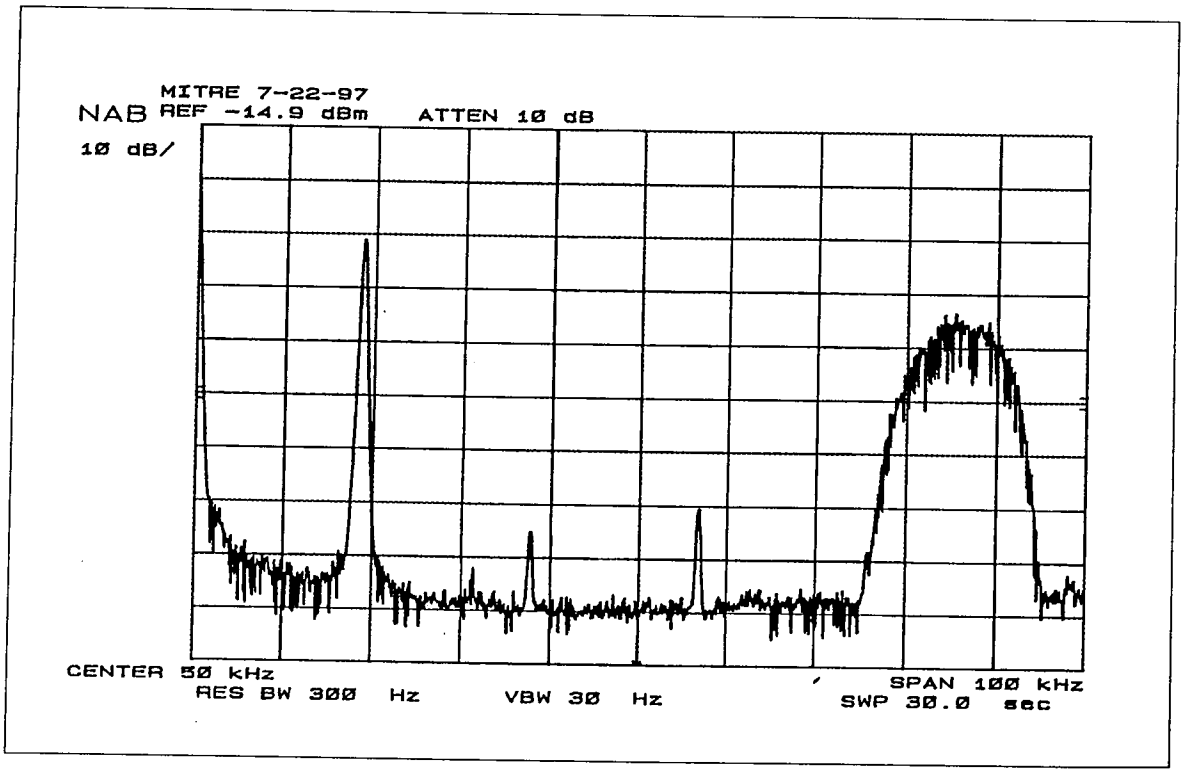


Figure 34: Mitre AFM2 Baseband

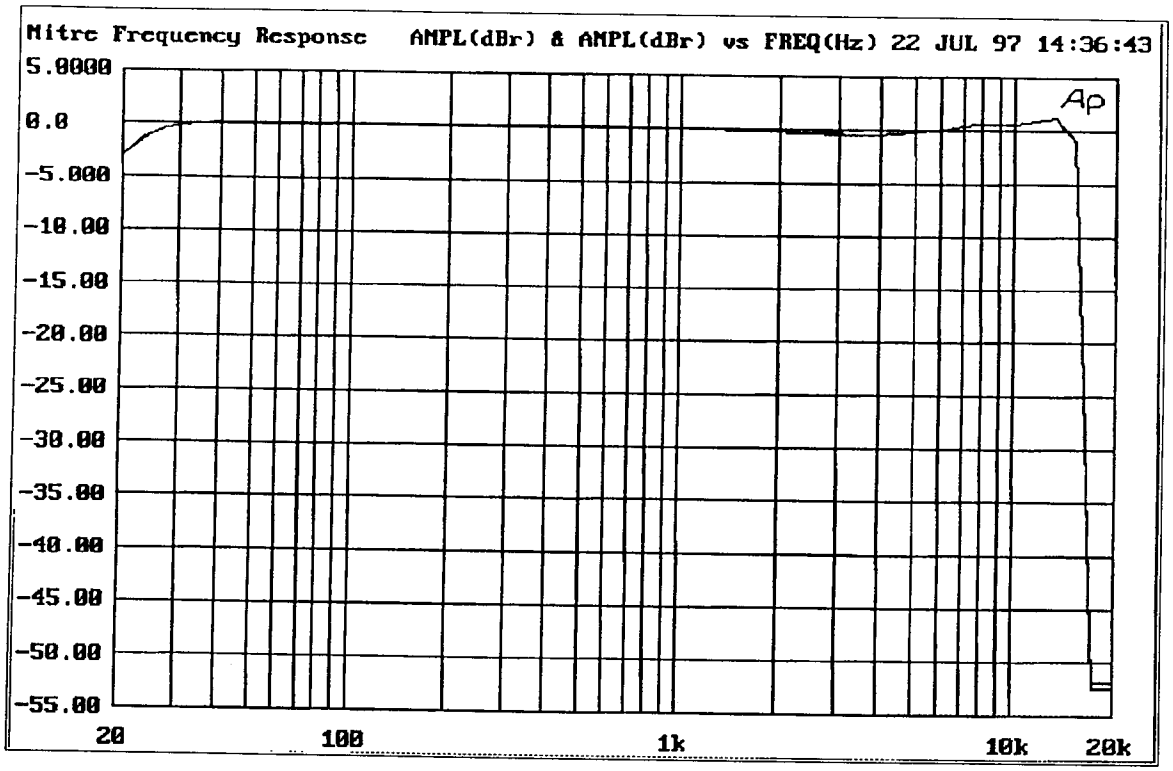


Figure 35: Mitre Frequency Response

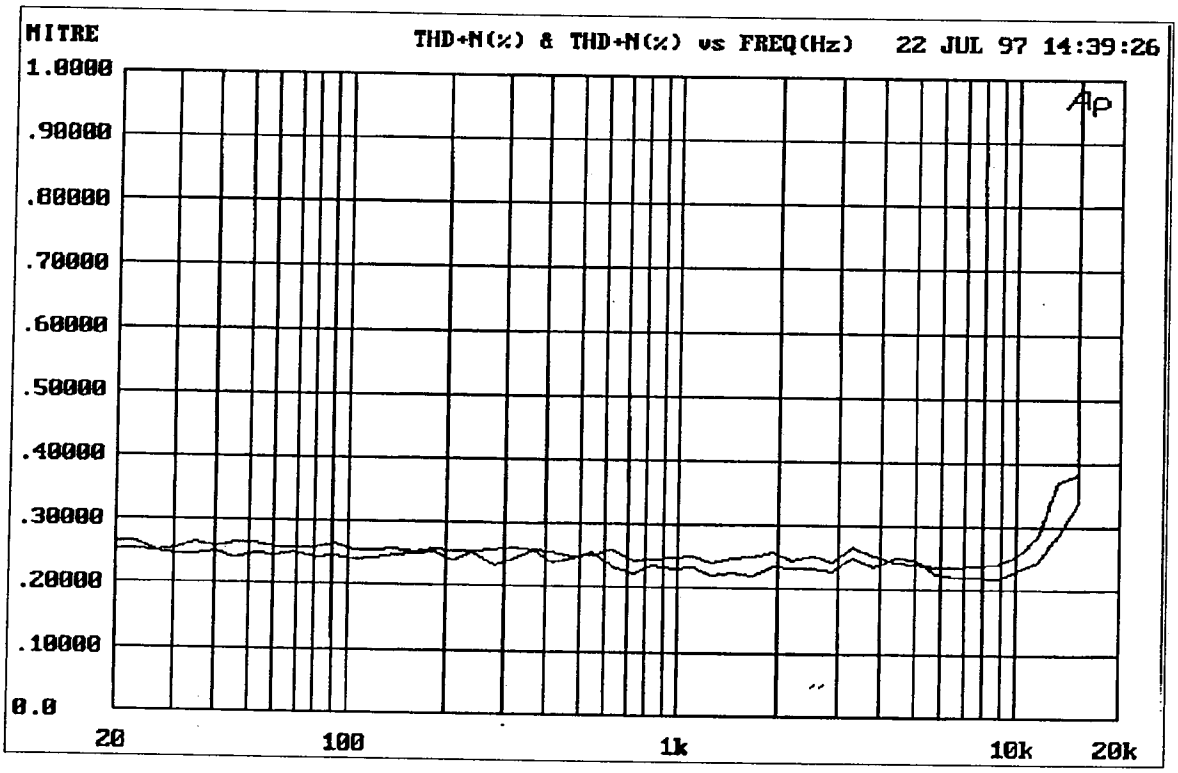


Figure 36: Mitre Distortion + Noise

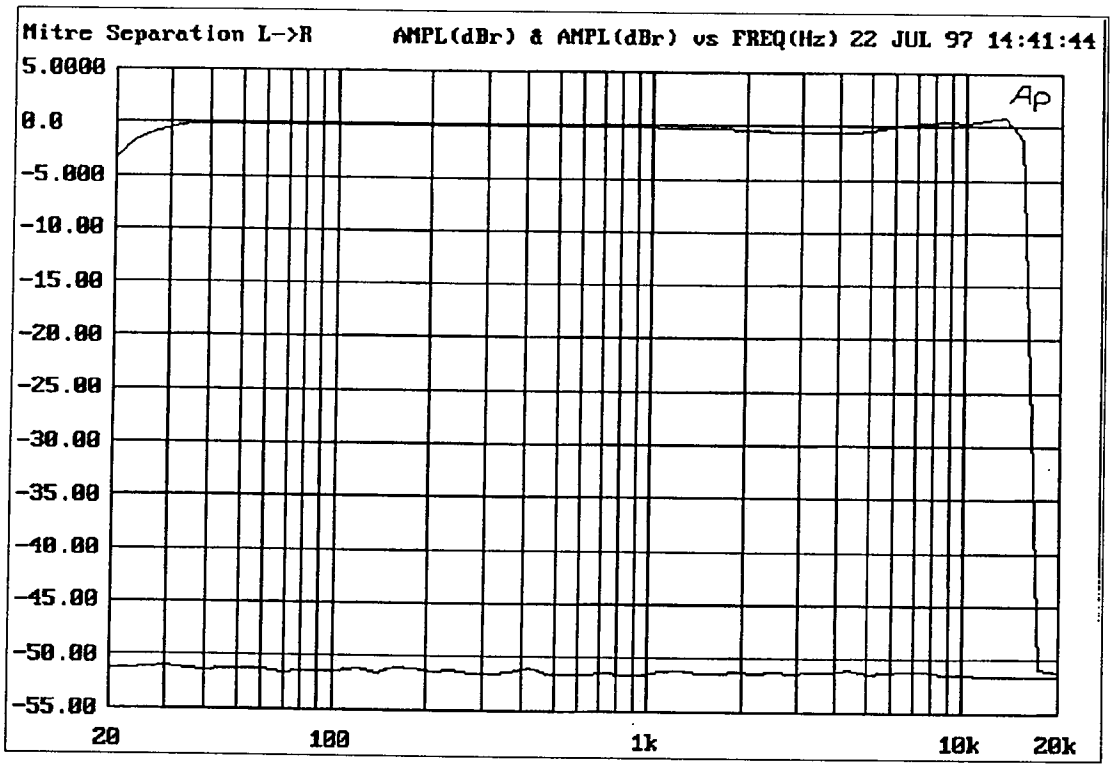


Figure 37: Mitre Separation

10.0
SCA Group C RF, Baseband, and Analog Proof Plots (Mitre)

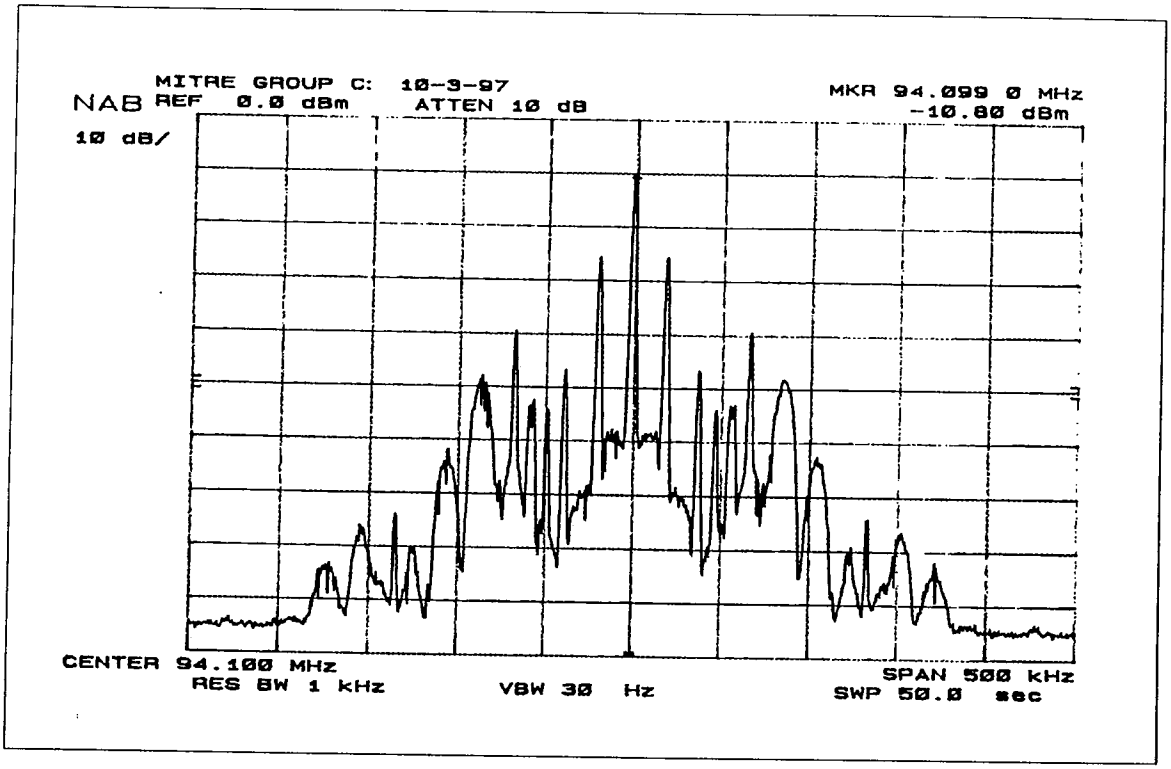


Figure 38: Mitre RF Group C

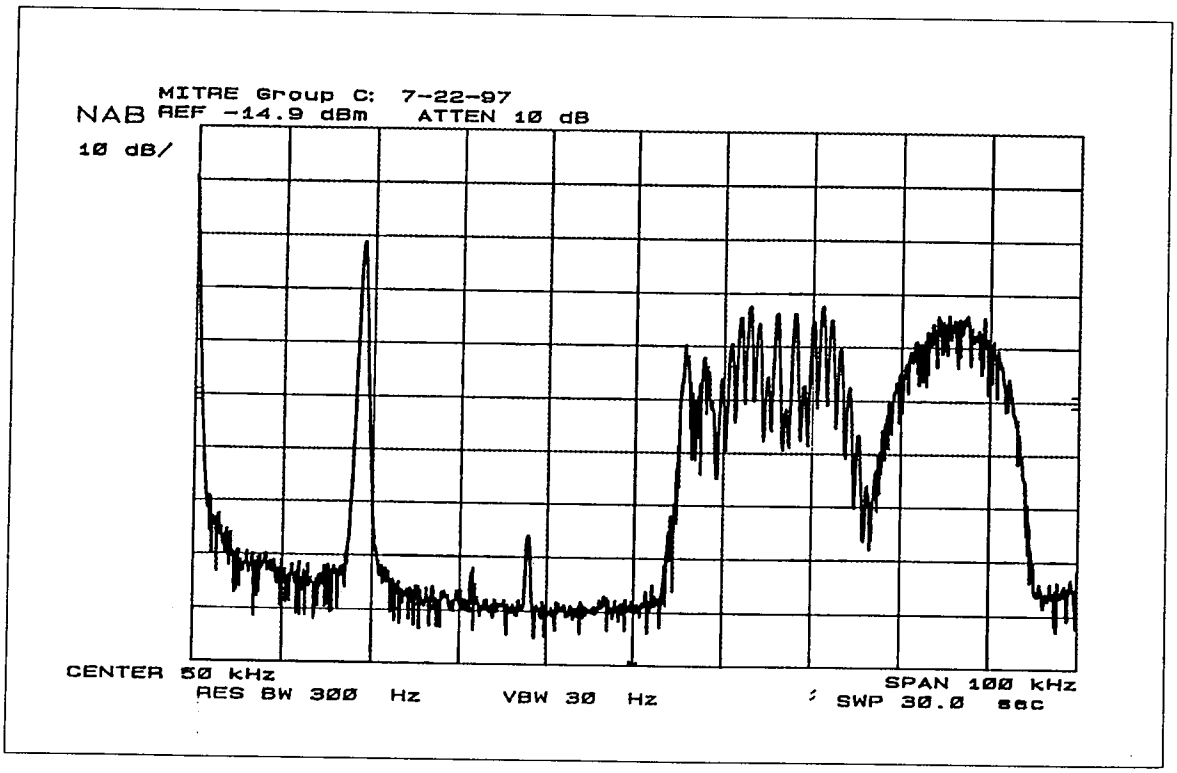


Figure 39: Mitre AFM2 Baseband Group C

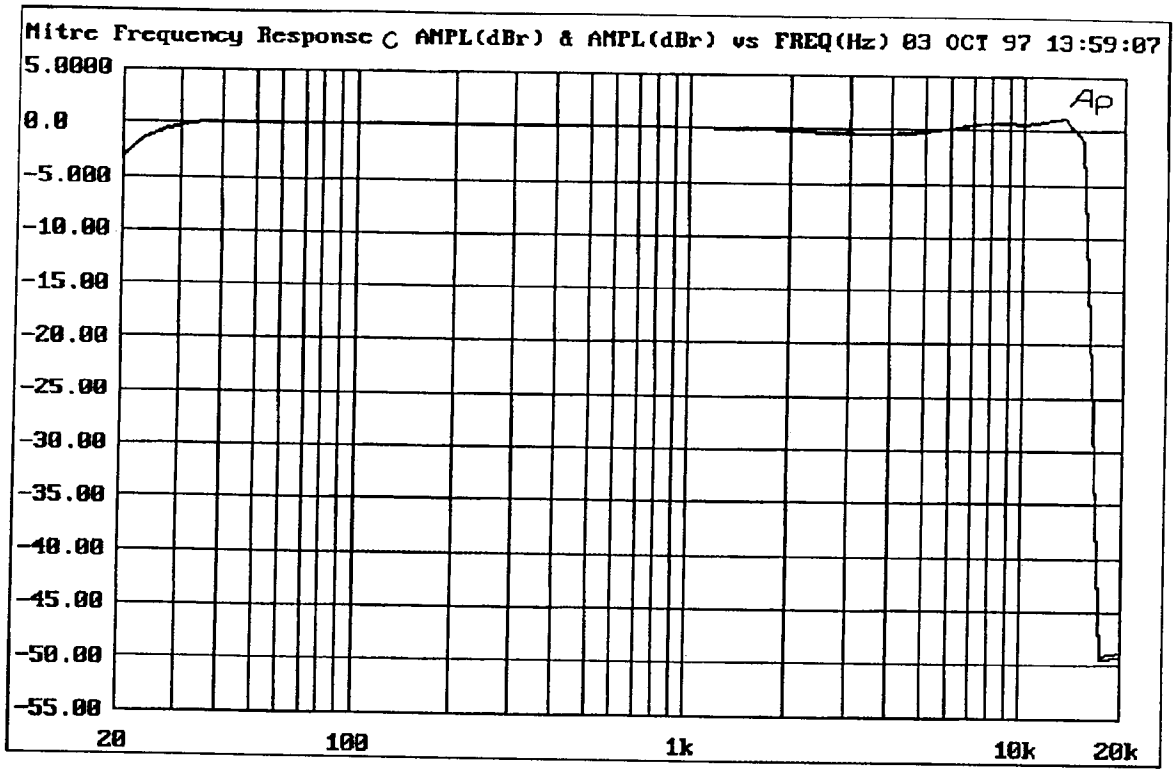


Figure 40: Frequency Response

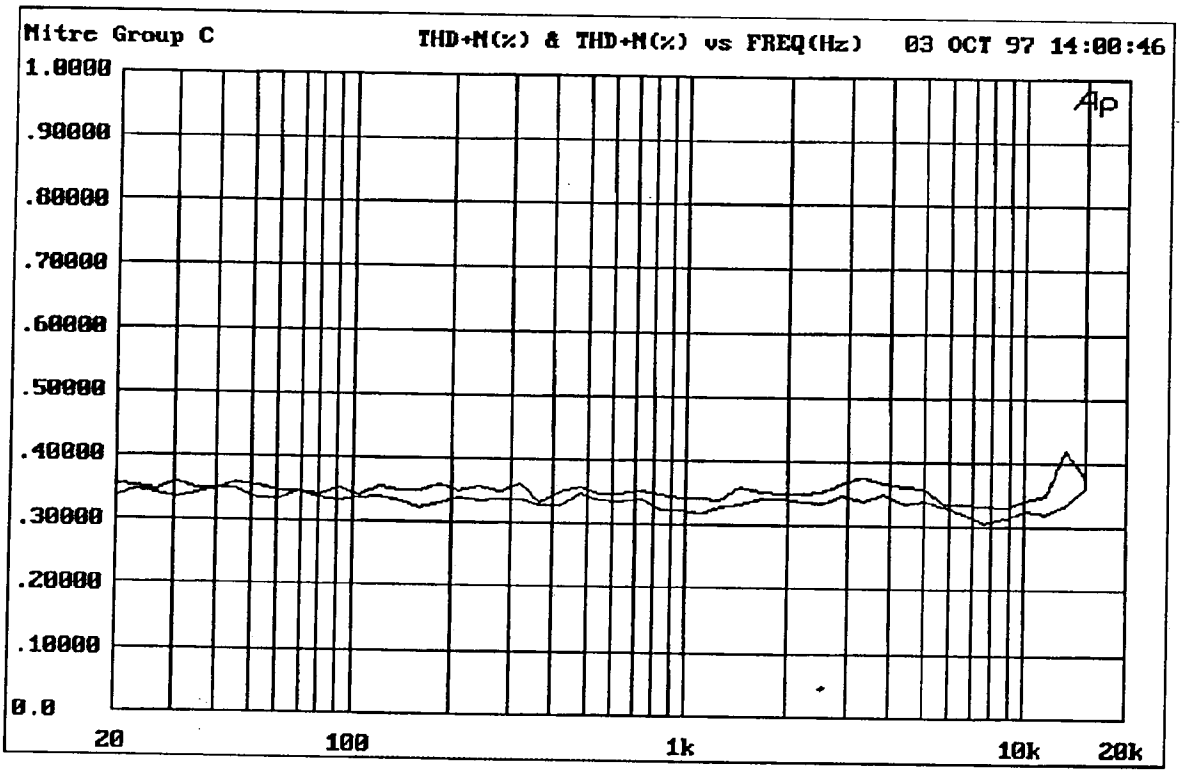


Figure 41: Distortion + Noise

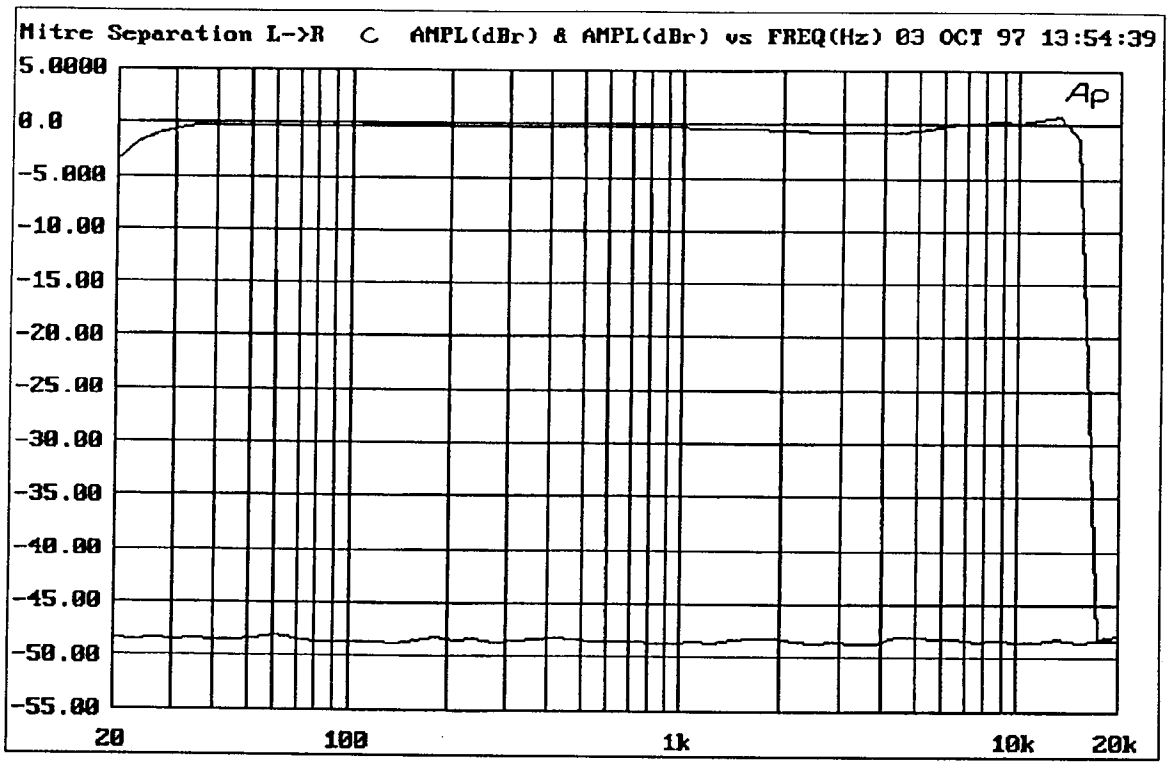


Figure 42: Separation

11.0
SCA Group D RF, Baseband, and Analog Proof Plots (Mitre)

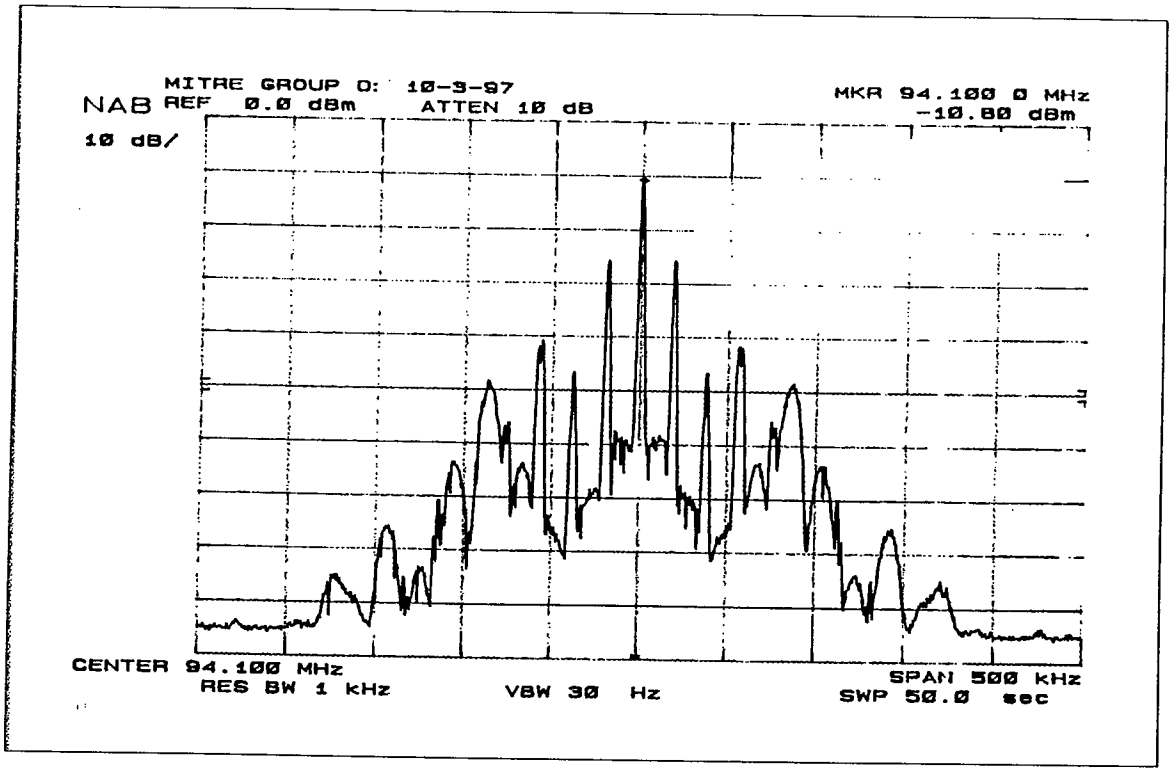


Figure 43: Mitre RF Group D

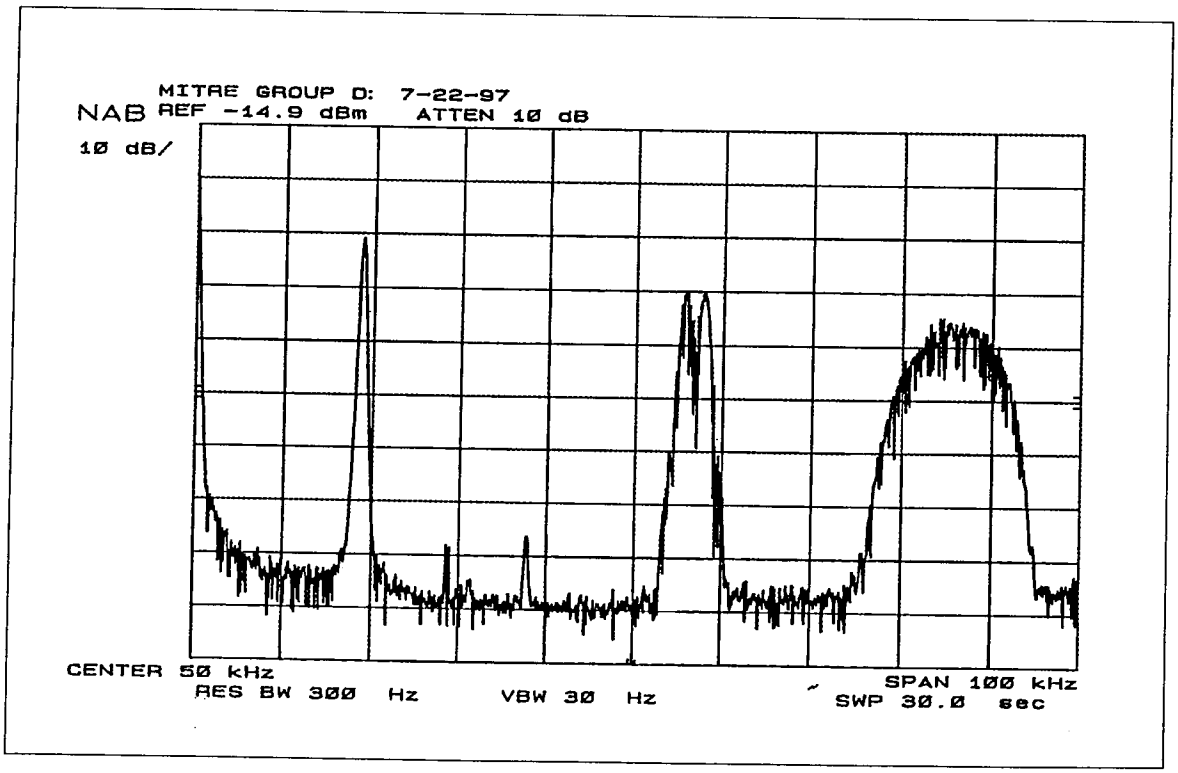


Figure 44: Mitre AFM2 Baseband Group D

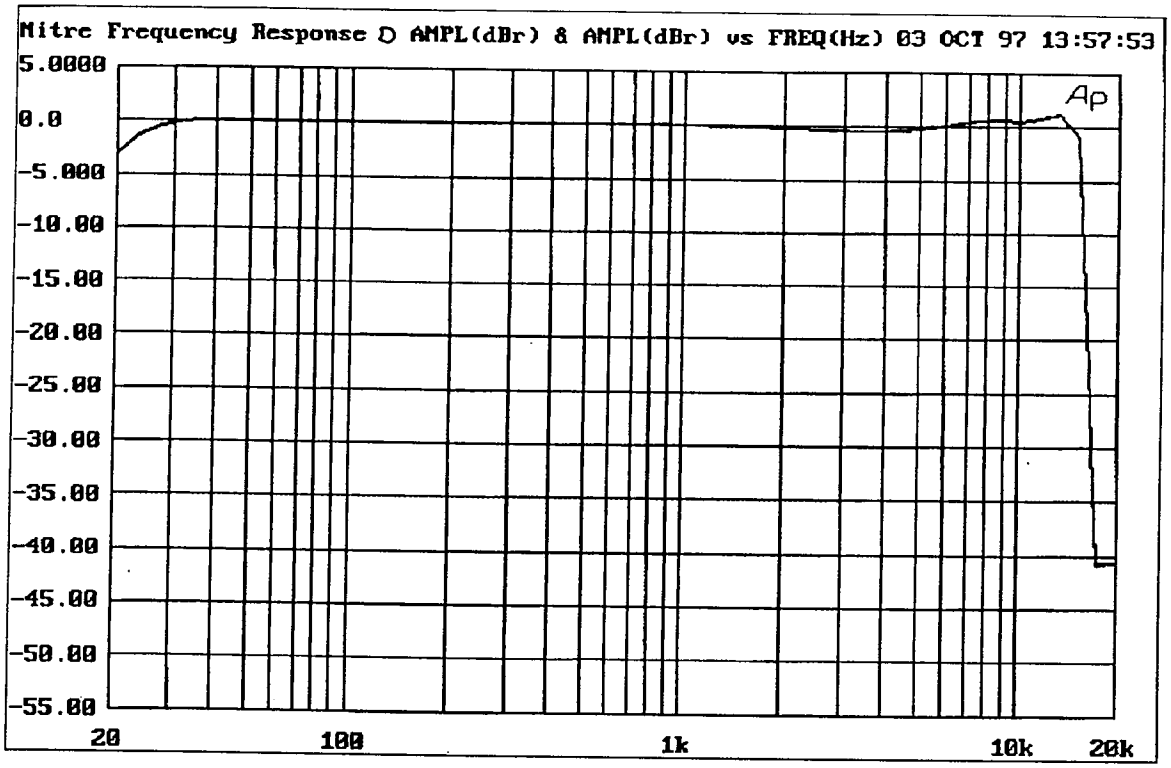


Figure 45: Frequency Response

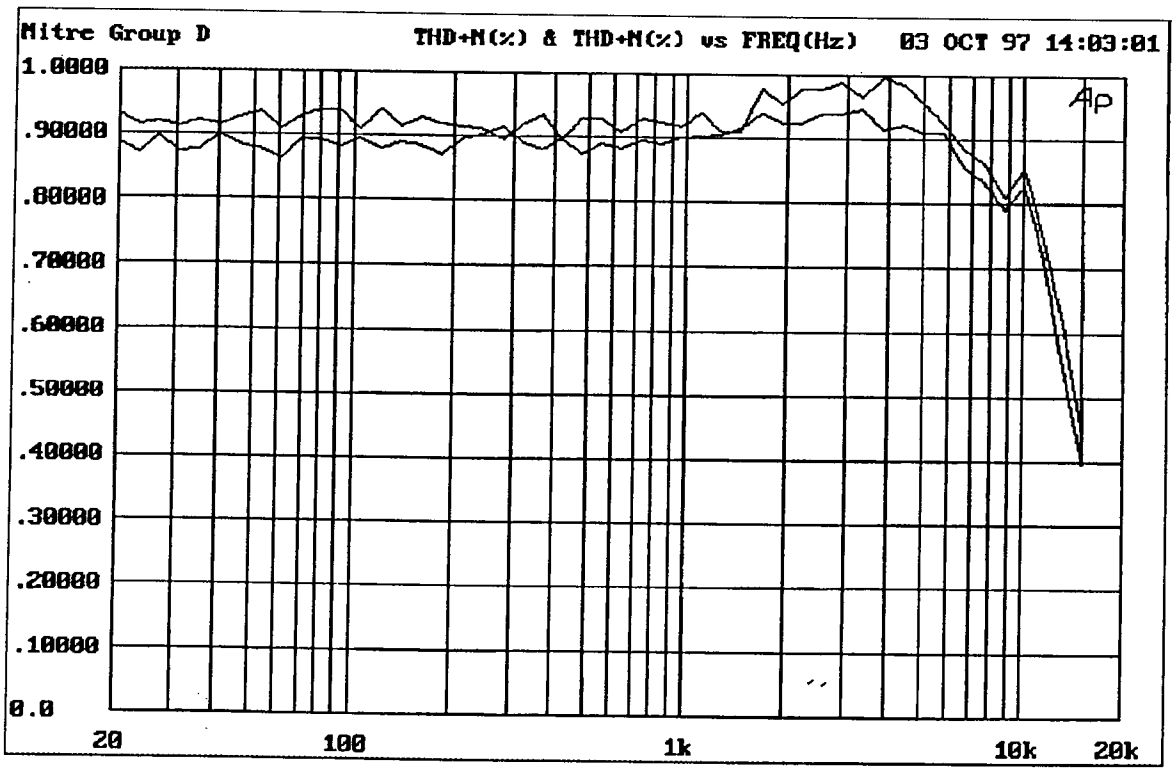


Figure 46: Distortion + Noise

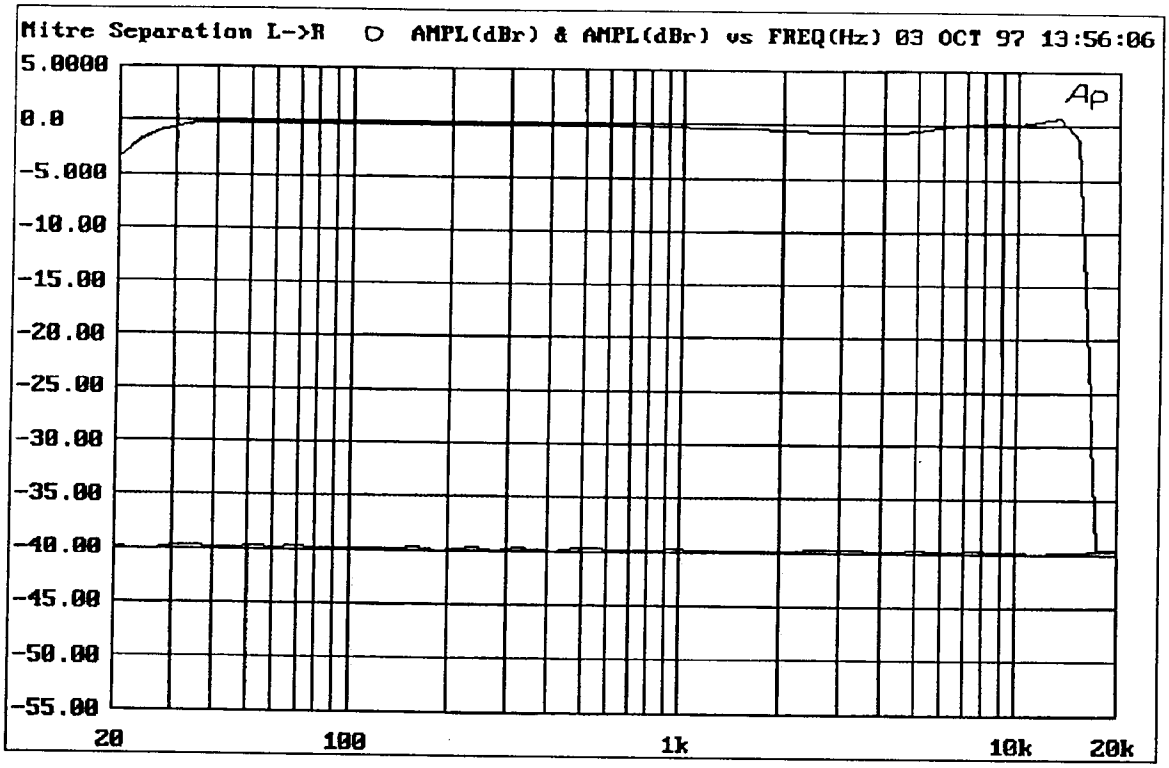


Figure 47: Separation

Appendix A
Test B-3 Data with Simulator Offsets

Digital Radio Test Laboratory

B-3 Multipath 7/25/97

Characterization of HS Digital Subcarrier Signal Failure

Basic Test Parameters: **SIGNAL** **PROPONENT SPECIFIC**

One Path Zero Phase Reference: -65dBm
Main Channel Mod: CPN
SCA Group: C Analog SCA modulated with ABBA.
Error Measurement Duration: 2.5 minutes

COMPOSITE SIGNAL

ORBAN #2
COMP OUT 1: Proponent Only
COMP OUT 2: Prop + SCA
Main Channel modulation
adjusted for 110%
5 Band Medium Fast Processing

	Noise Level		Error Level (%)		
	C/N$_o$	Attn	BER	20 Byte	220 Byte
Urban Slow	**129.48**	63.75	0.000	0.000	0.000
	86.73	21.00	0.000	0.000	0.000
Offset	**85.73**	20.00	0.014	0.572	1.867
-2.45 dB	**84.73**	19.00	0.182	6.727	14.80
	83.73	18.00	0.447	15.86	27.87
	82.73	17.00	1.242	30.68	40.82
	81.73	16.00	2.295	40.73	51.73
Urban Fast	**129.48**	63.75	0.000	0.000	0.000
	84.73	19.00	0.000	0.000	0.000
Offset	**83.73**	18.00	0.010	0.333	0.941
-2.45 dB	**82.73**	17.00	0.179	6.227	14.50
	81.73	16.00	1.058	30.37	50.75
	80.73	15.00	3.647	73.72	95.25
	79.73	14.00	8.820	96.41	100.0
Rural Fast	**126.40**	63.75	0.000	0.000	0.000
	84.65	22.00	0.000	0.000	0.000
Offset	**83.65**	21.00	0.009	0.304	0.933
-5.53 dB	**82.65**	20.00	0.491	17.24	38.67
	81.65	19.00	2.850	69.95	96.67
	80.65	18.00	6.976	95.43	100.0
Obstructed	**131.93**	63.75	49.83	100.0	100.0

Digital Radio Test Laboratory

B-3 Multipath
Characterization of HS Digital Subcarrier Signal Failure

Basic Test Parameters: **SIGNAL** **PROPONENT SPECIFIC**

One Path Zero Phase Reference: -65dBm
Main Channel Mod: CPN
SCA Group: C Analog SCA modulated with ABBA.
Error Measurement Duration: 2.5 minutes

COMPOSITE SIGNAL

ORBAN #2
COMP OUT 1: Proponent Only
COMP OUT 2: Prop + SCA
Main Channel modulation
adjusted for 110%
5 Band Medium Fast Processing

	Noise Level		Error Level (%)		
	C/N$_o$	**Attn**	**BER**	**20 Byte**	**220 Byte**
Urban Slow	**129.48**	63.75	4.771	10.91	24.44
Offset	**86.73**	21.00	15.87	35.84	52.33
-2.45 dB	**85.73**	20.00	19.35	41.88	57.14
	84.73	19.00	21.25	43.72	63.10
	83.73	18.00	25.38	48.52	65.00
Urban Fast	**129.48**	63.75	39.41	54.10	96.30
Offset	**84.73**	19.00	70.51	86.04	100.0
-2.45 dB					
Rural Fast	**126.40**	63.75	41.55	60.02	96.15
Offset	**84.65**	22.00	75.65	90.91	100.0
-5.53 dB					
Obstructed	**127.93**	63.75	99.96	100.0	100.0

Appendix B
RF Distortion Scenario Frequency Response

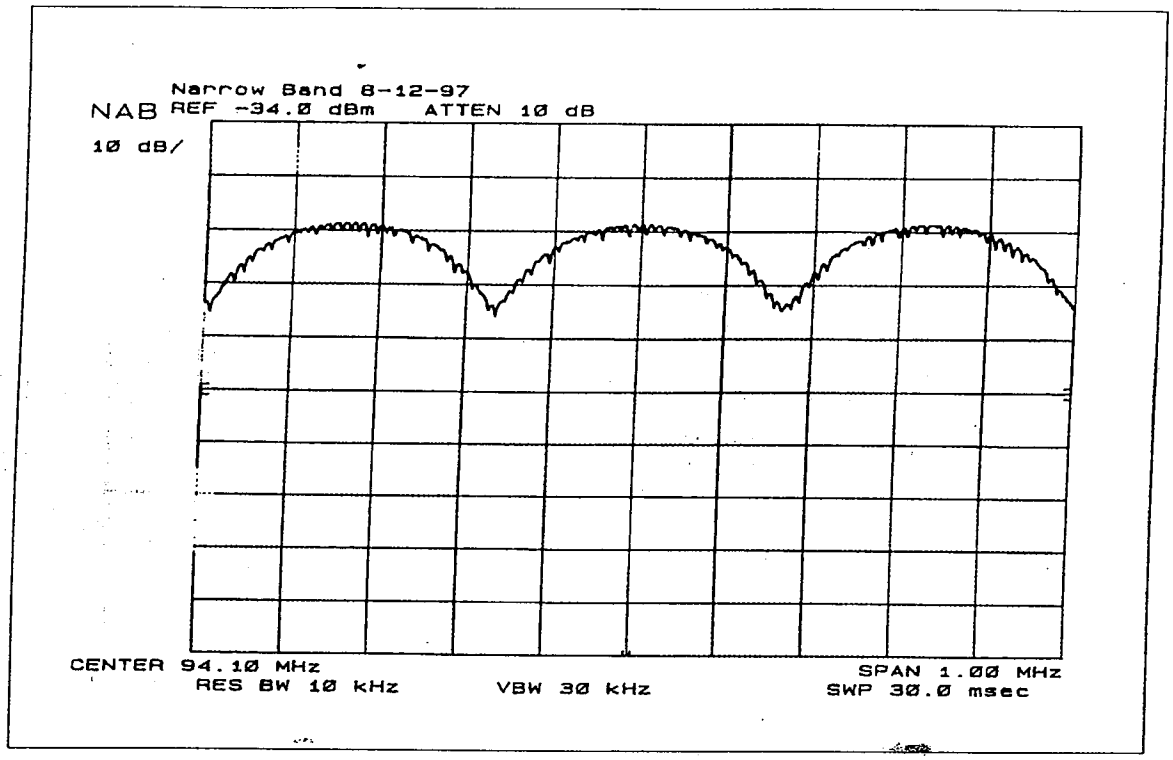


Figure 61: Narrow Band

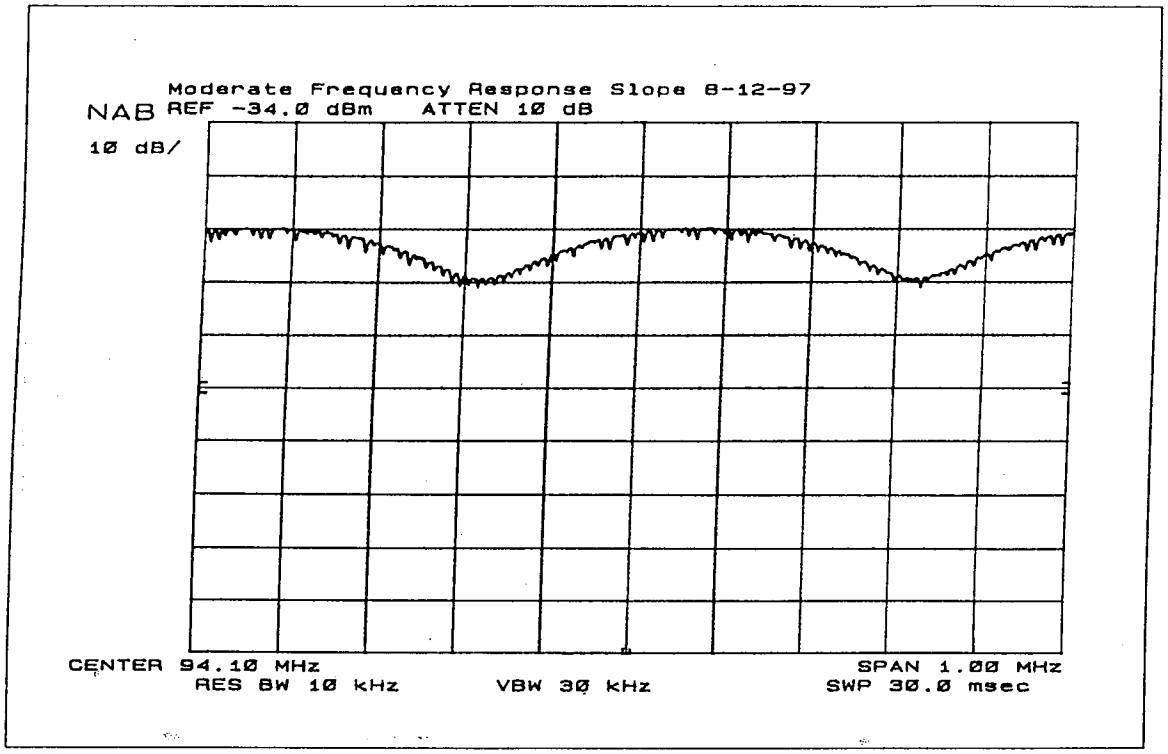


Figure 62: Moderate Frequency Response Slope

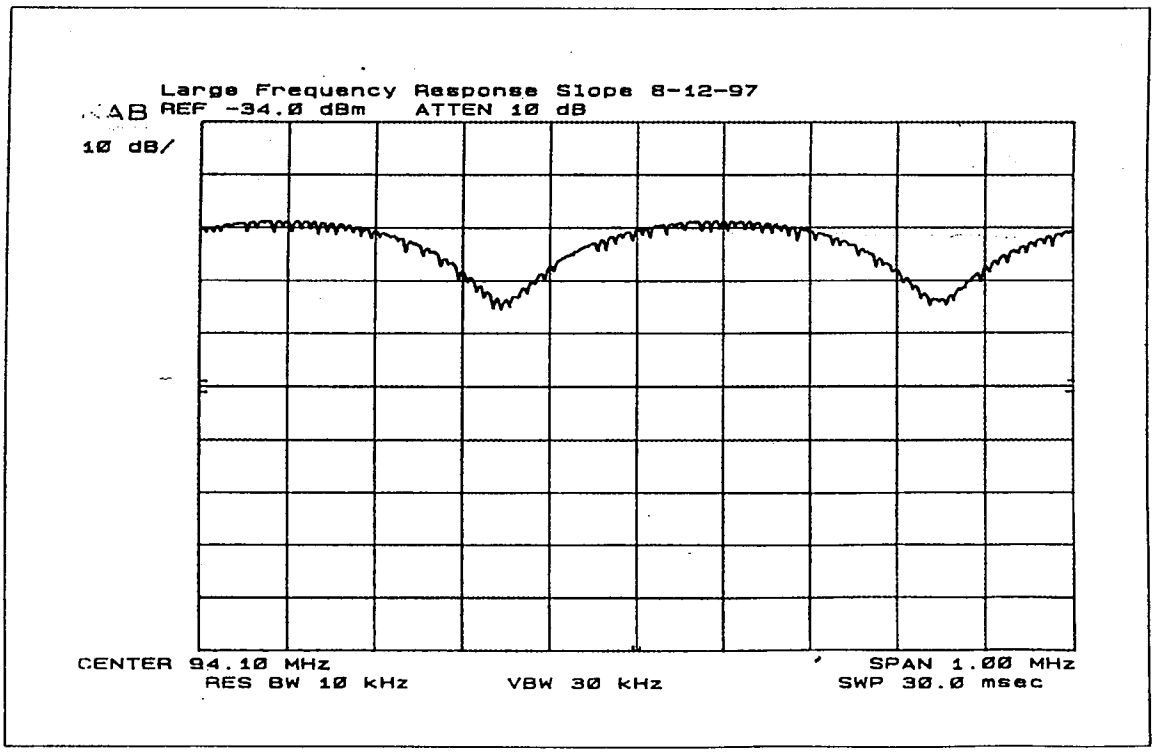


Figure 63: Large Frequency Response Slope

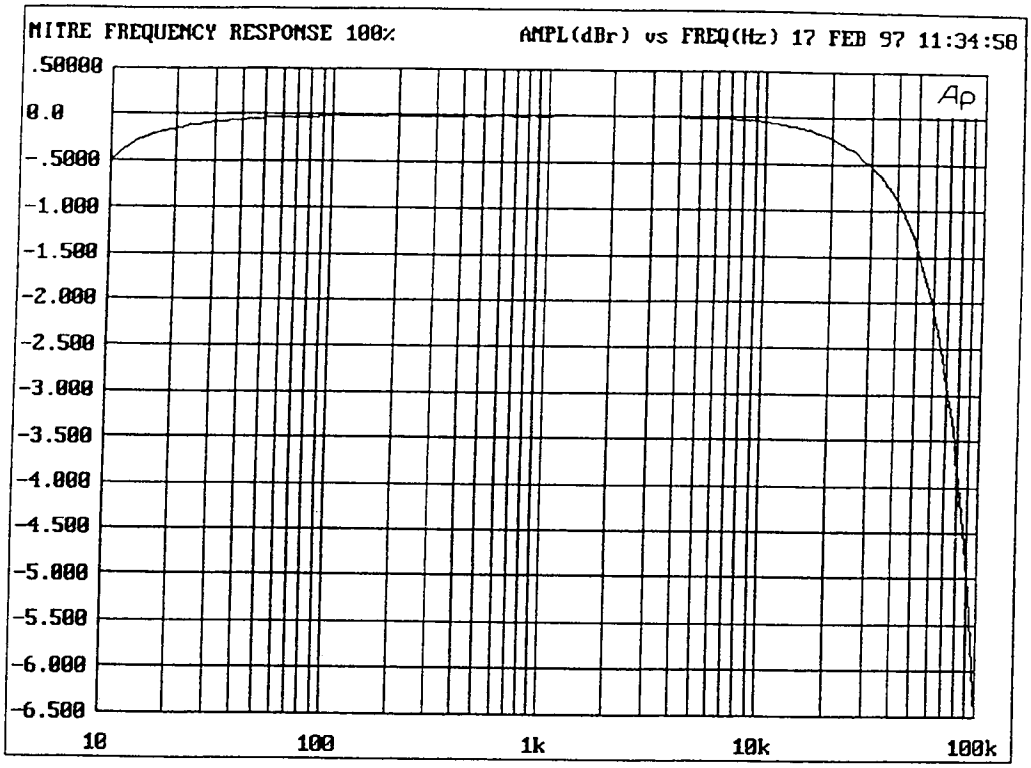
Appendix C
Proponent Receiver Characterization Data

Proponent - Mitre

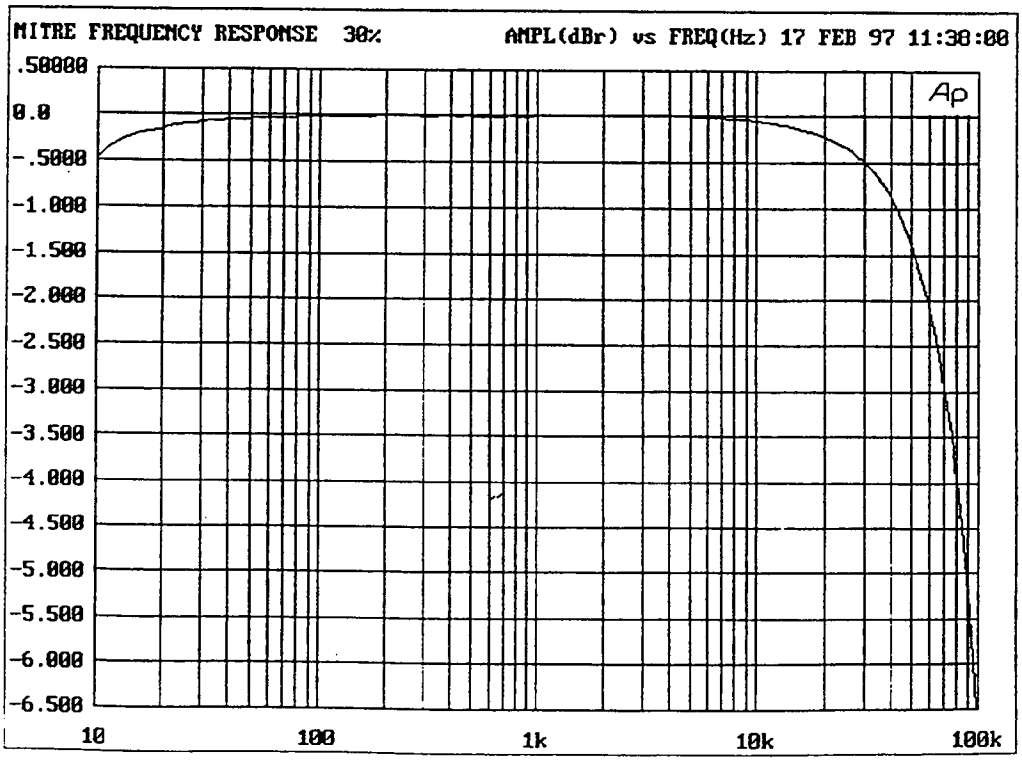
(Handed out at tutorial) C-3

(3)

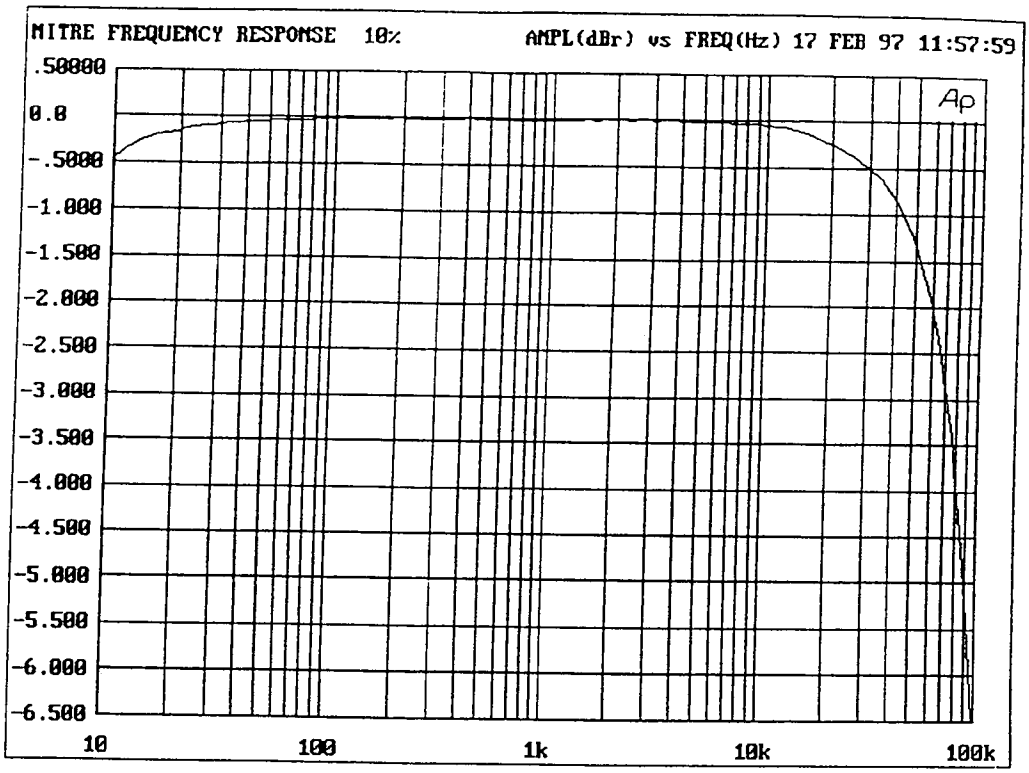
0dB = 403m V_{rms}

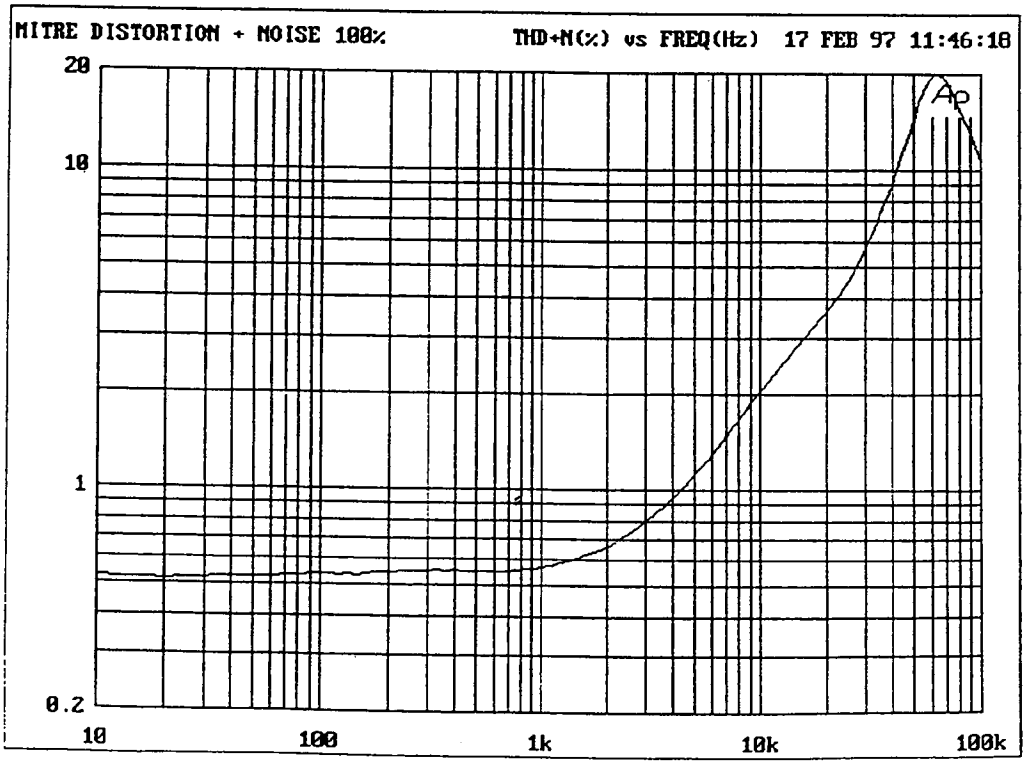


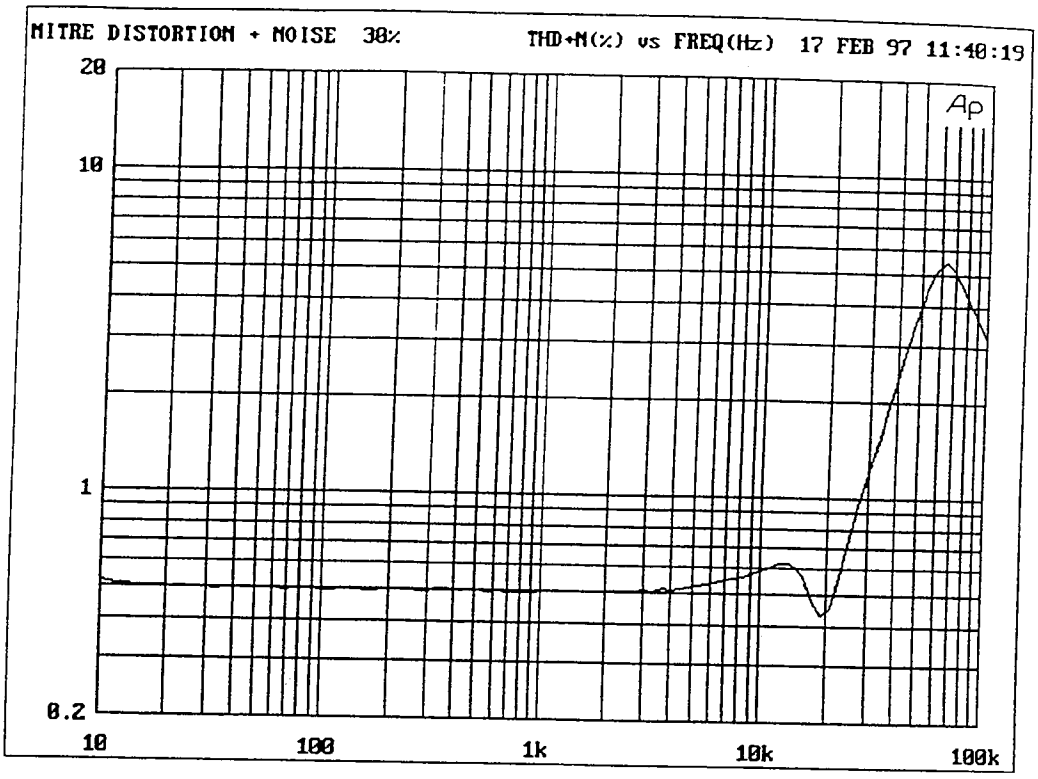
0dB = 119m V_{rms}

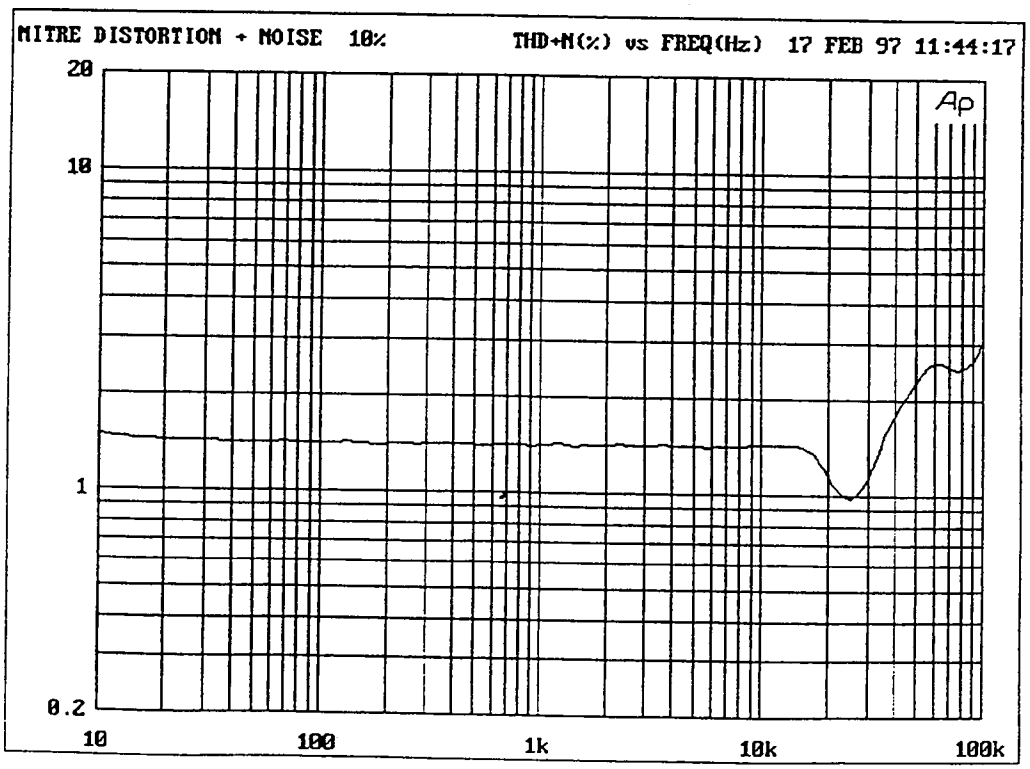


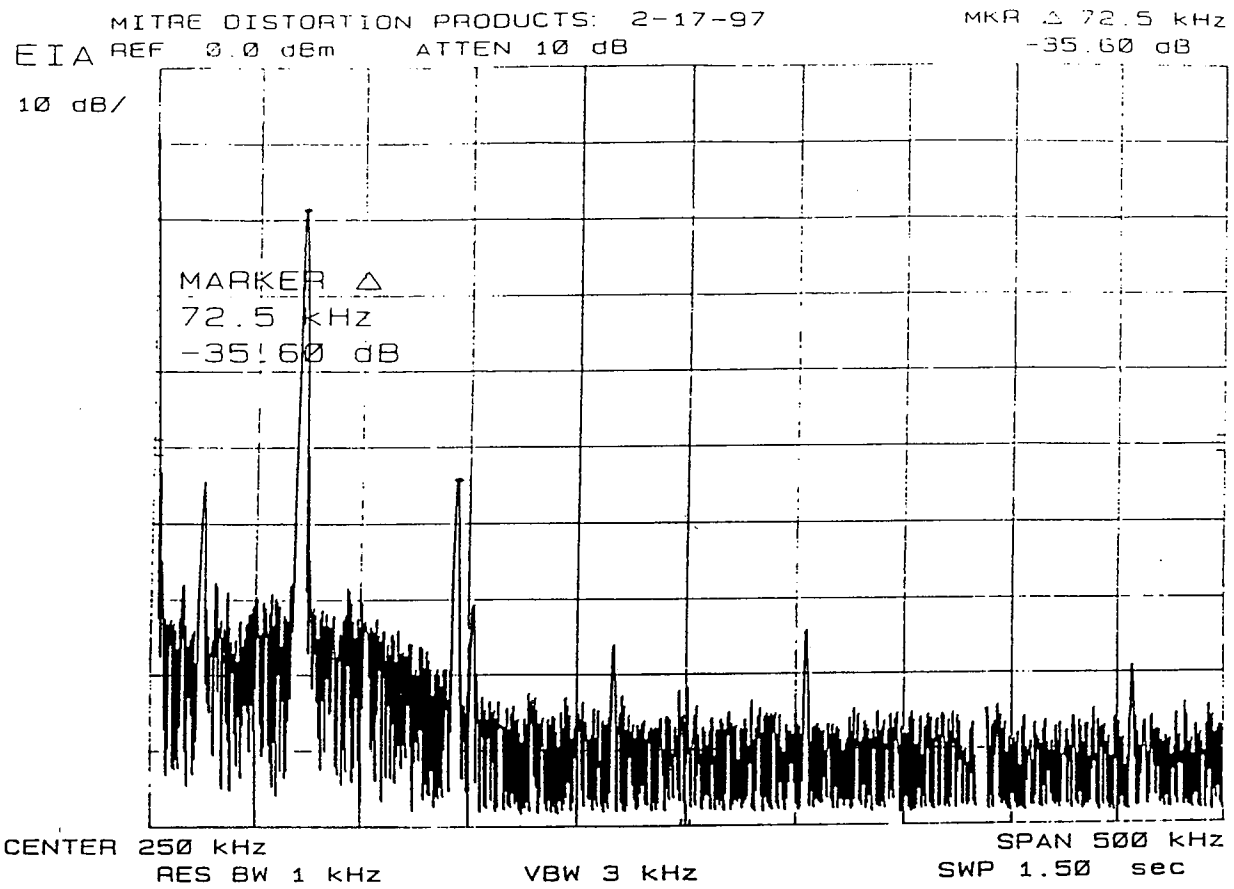
0dB = 39.7 mVrms

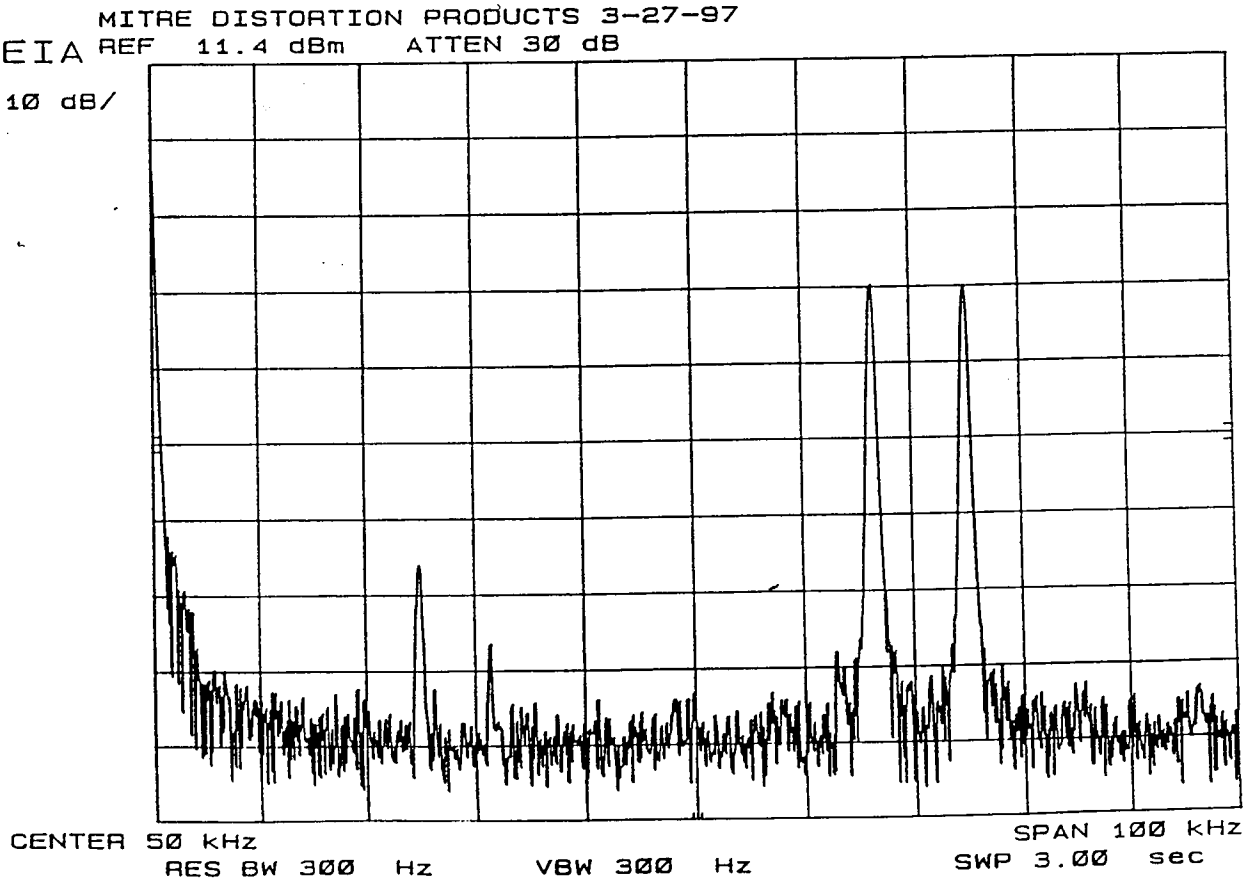





MITRE DISTORTION + NOISE 30%
THD+N(%) vs FREQ(Hz) 17 FEB 97 11:40:19
Ap
20
10
1
0.2
10
100
1k
10k
100k


MITRE DISTORTION + NOISE 10%
THD+N(%) vs FREQ(Hz) 17 FEB 97 11:44:17
Ap
20
10
1
0.2
10
100
1k
10k
100k


MITRE DISTORTION PRODUCTS: 2-17-97
MKR Δ 72.5 kHz
-35.60 dB
EIA REF 0.0 dBm
ATTEN 10 dB
10 dB/
MARKER Δ
72.5 kHz
-35.60 dB
CENTER 250 kHz
SPAN 500 kHz
RES BW 1 kHz
VBW 3 kHz
SWP 1.50 sec


MITRE DISTORTION PRODUCTS 3-27-97
EIA REF 11.4 dBm
ATTEN 30 dB
10 dB/
CENTER 50 kHz
SPAN 100 kHz
RES BW 300 Hz
VBW 300 Hz
SWP 3.00 sec

Digital Radio Test Laboratory

HSSC Proponent Receiver Characterization

Date: 2/17/97
By: DML

Desired Signal: 94.10 MHz
Modulation: 1 kHz
Injection: 100 %
0dB: 403 mV

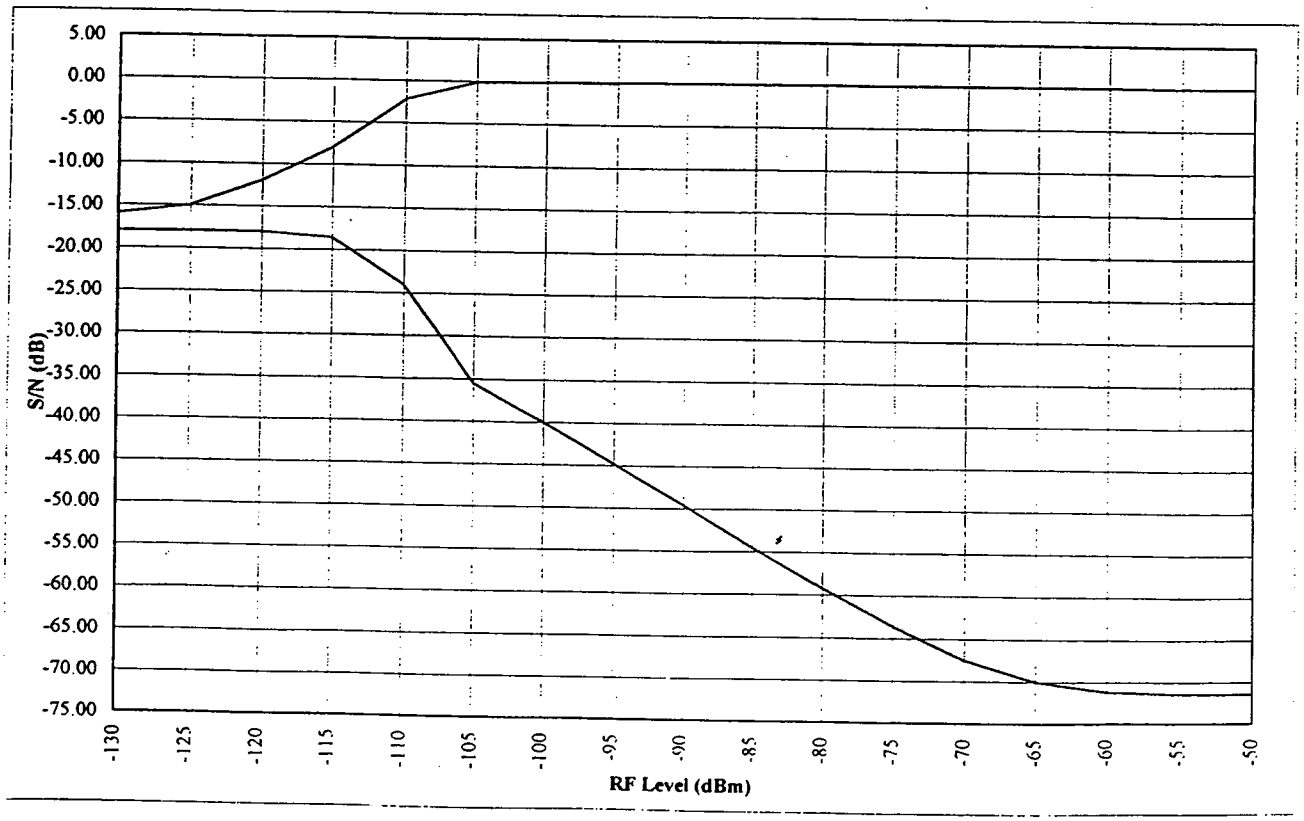
Measurement: Level; RMS, with 15kHz Low Pass Filter

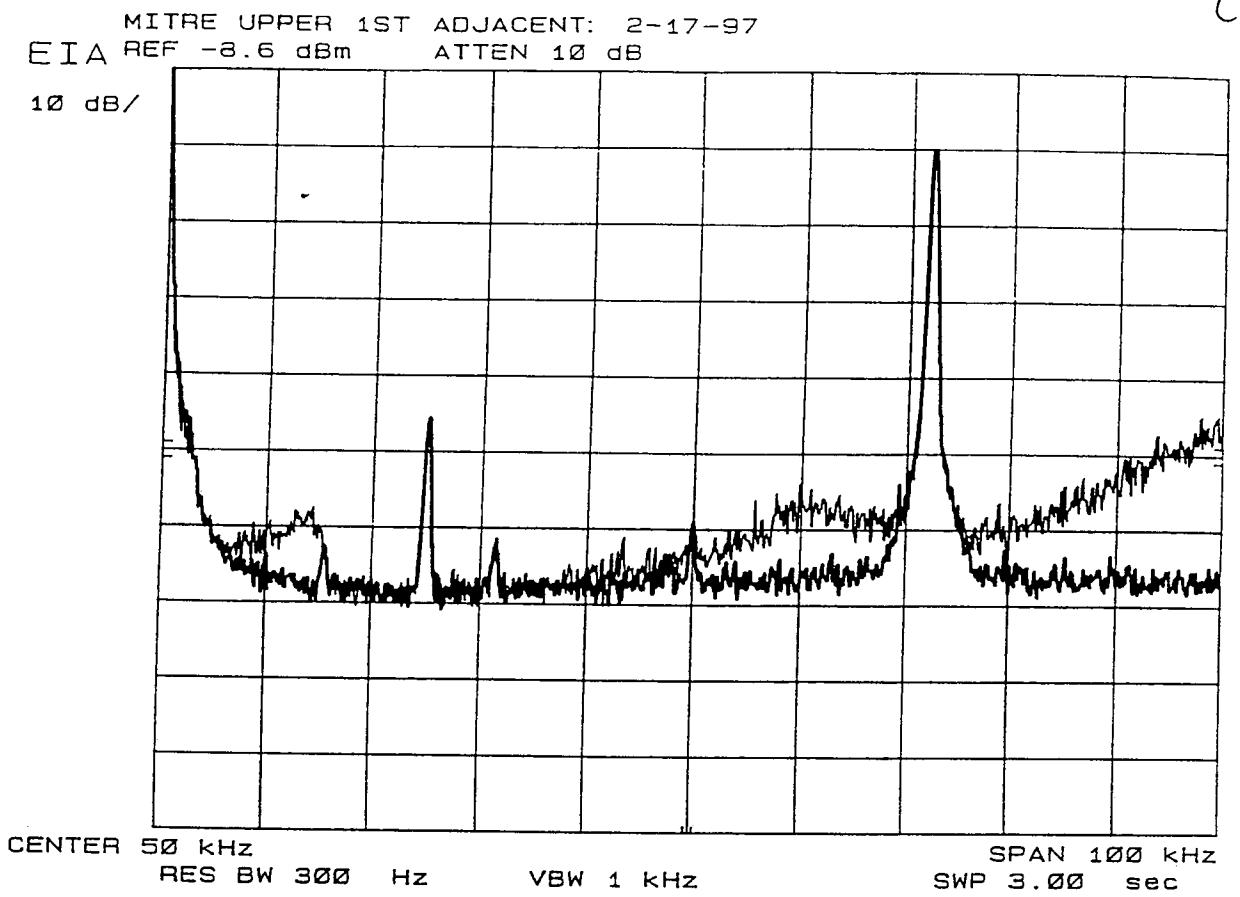
Results: S/N vs RF Level

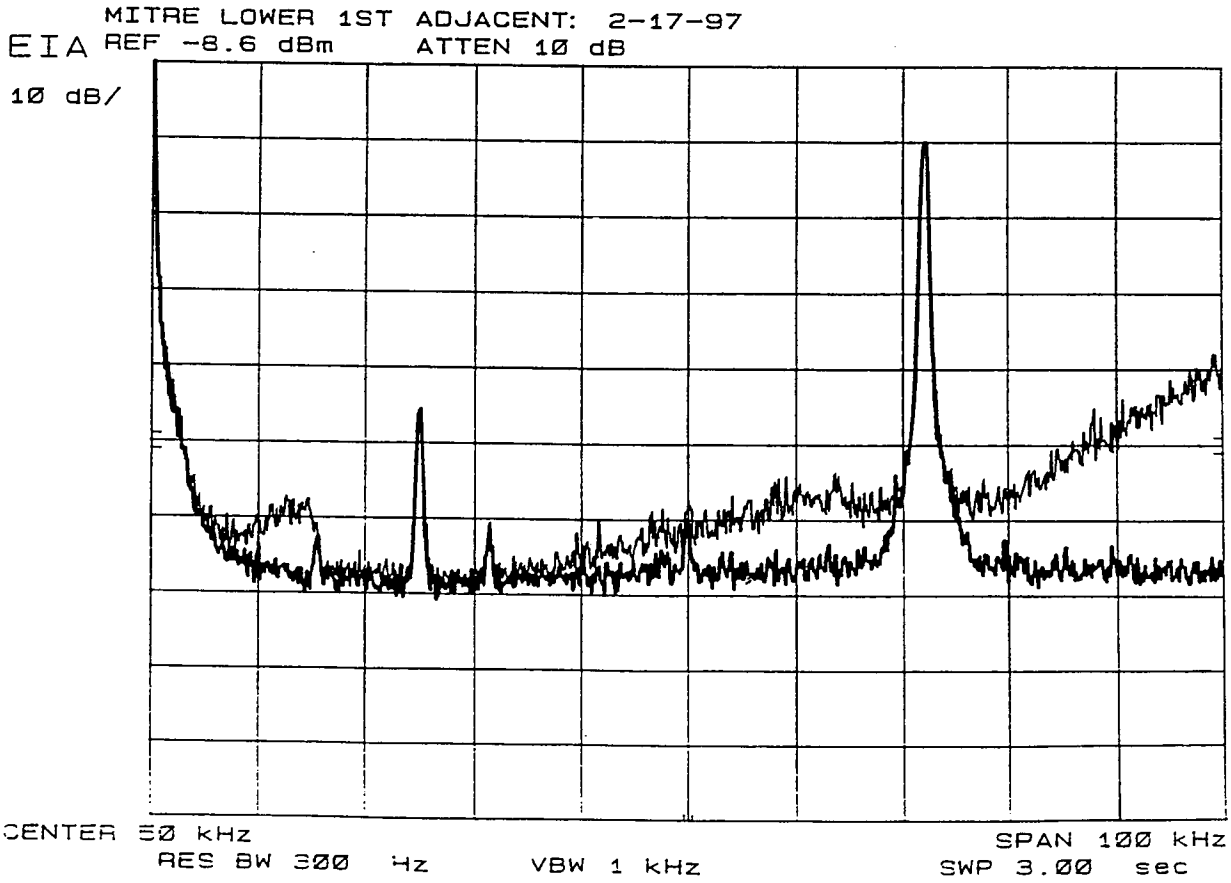
Radio Type: Alpine 7502

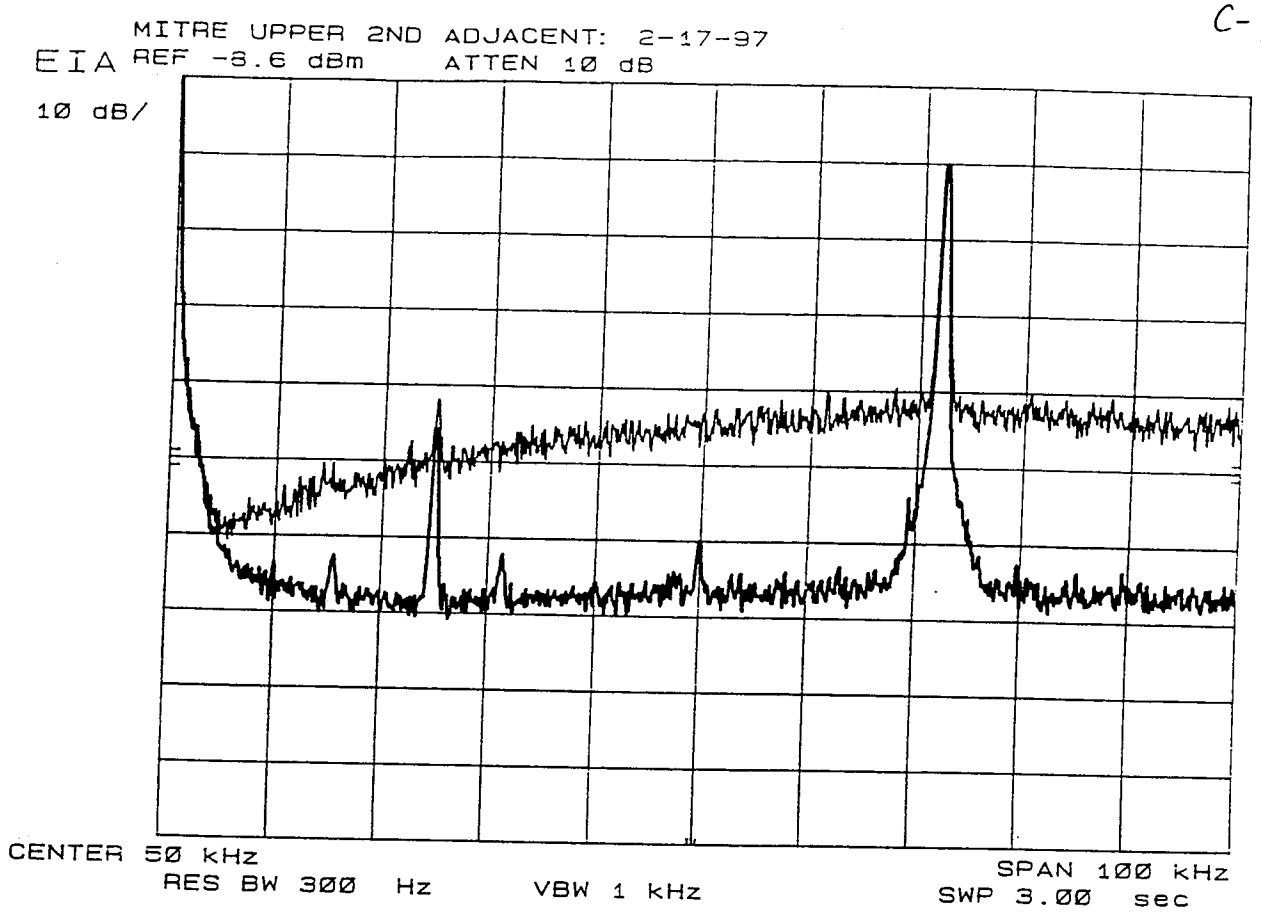
	RF (dBm)	Signal (dB)	Noise (dB)
	-50	0.00	-71.50
	-55	0.00	-71.50
	-60	0.00	-71.20
	-65	0.00	-70.00
	-70	0.00	-67.50
	-75	0.00	-63.60
	-80	0.00	-59.20
	-85	0.00	-54.50
	-90	0.00	-49.50
	-95	0.00	-44.80
	-100	-0.03	-40.00
Limiting	-105	-0.13	-35.50
Threshold	-110	-2.20	-24.00
	-115	-8.00	-18.60
	-120	-12.00	-18.00
	-125	-15.00	-18.00
	-130	-16.00	-18.00

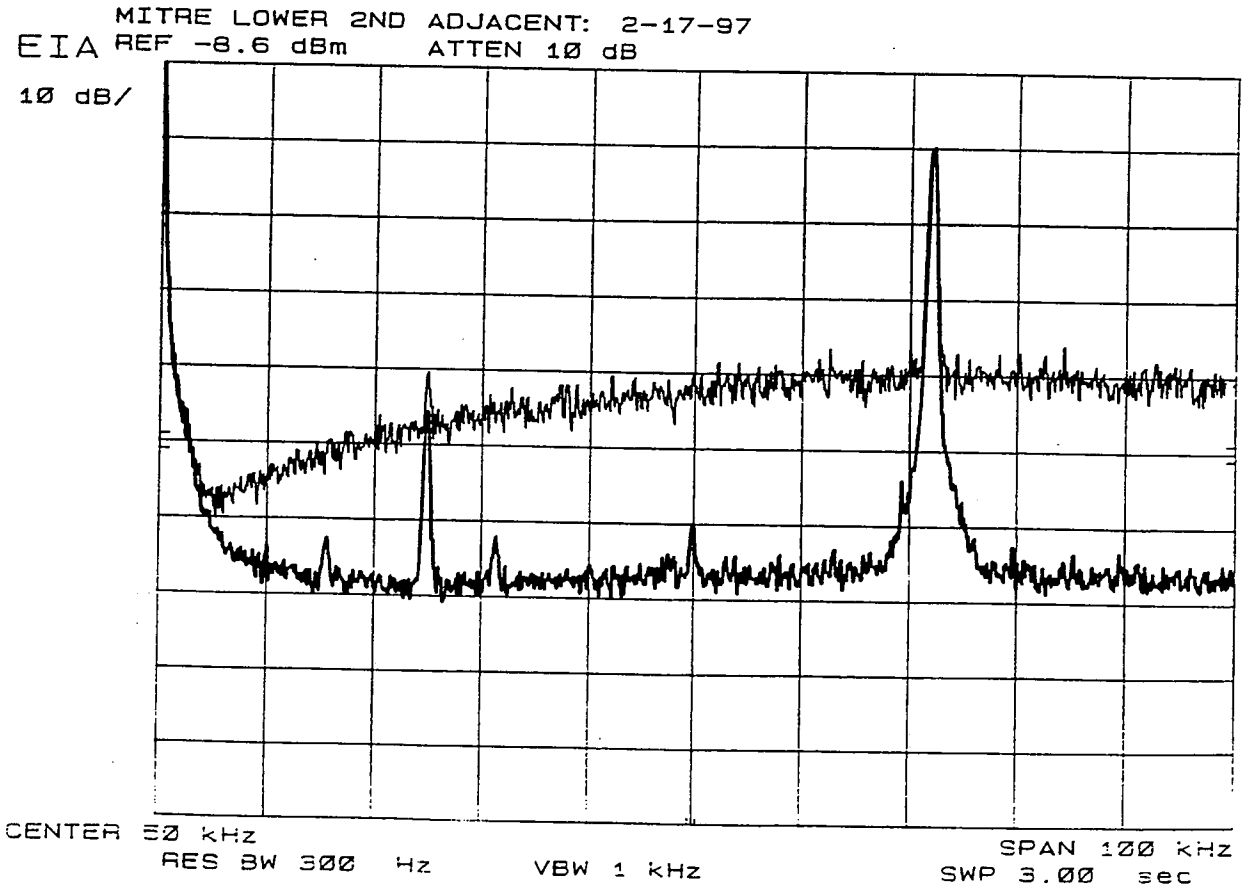
Digital Radio Test Laboratory




MITRE UPPER 1ST ADJACENT: 2-17-97
EIA REF -8.6 dBm
ATTEN 10 dB
10 dB/
CENTER 50 kHz
RES BW 300 Hz
VBW 1 kHz
SPAN 100 kHz
SWP 3.00 sec


MITRE LOWER 1ST ADJACENT: 2-17-97
EIA REF -8.6 dBm
ATTEN 10 dB
10 dB/
CENTER 50 kHz
RES BW 300 Hz
VBW 1 kHz
SPAN 100 kHz
SWP 3.00 sec


MITRE UPPER 2ND ADJACENT: 2-17-97
EIA REF -8.6 dBm
ATTEN 10 dB
10 dB/
CENTER 50 kHz
RES BW 300 Hz
VBW 1 kHz
SPAN 100 kHz
SWP 3.00 sec


MITRE LOWER 2ND ADJACENT: 2-17-97
EIA REF -8.6 dBm
ATTEN 10 dB
10 dB/
CENTER 50 kHz
RES BW 300 Hz
VBW 1 kHz
SPAN 100 kHz
SWP 3.00 sec

Proponent - Seiko

0dB= 828mV

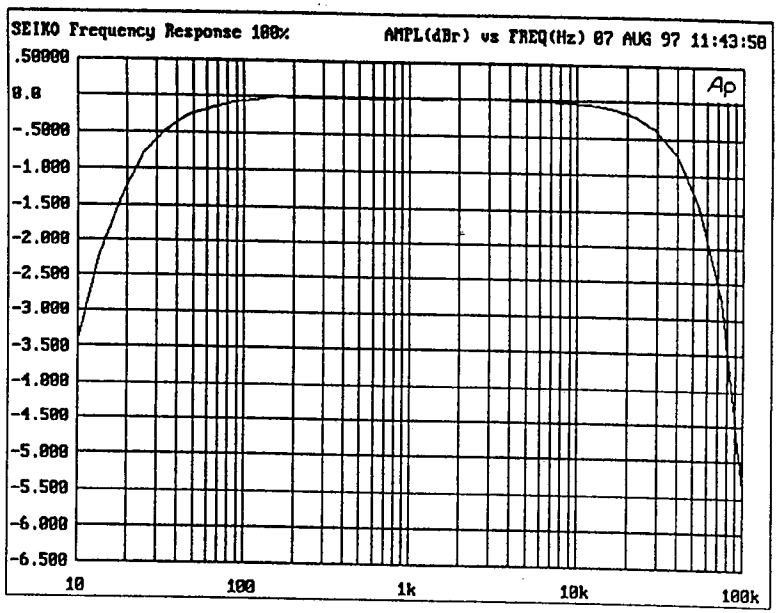


FIGURE 48:

0dB= 257mV

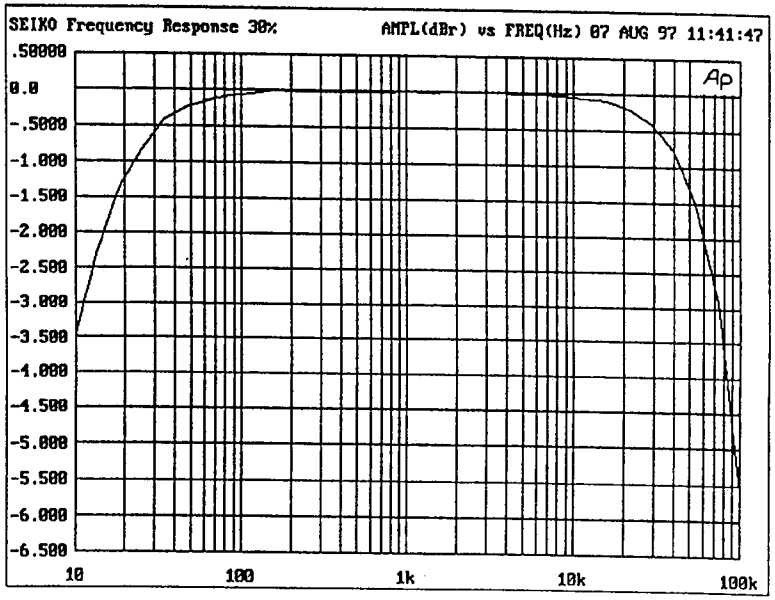


FIGURE 49:

0dB= 86mV

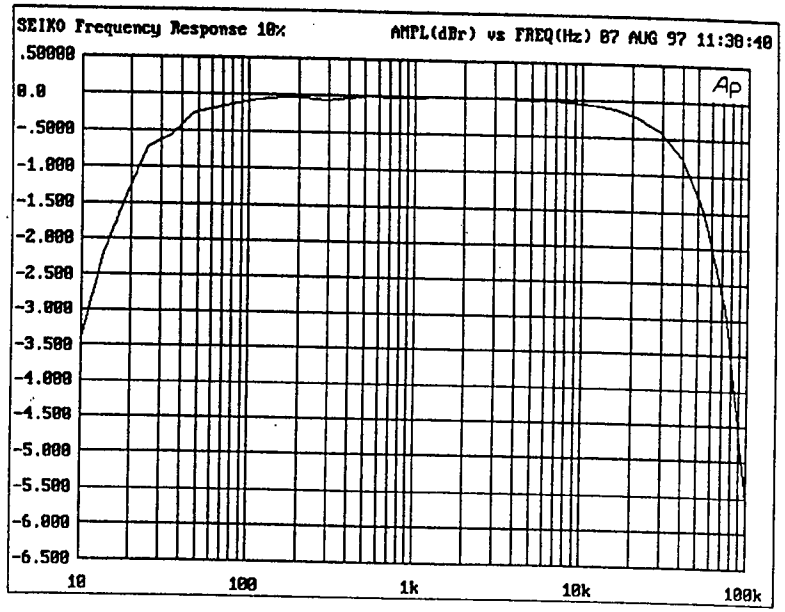


FIGURE: 50

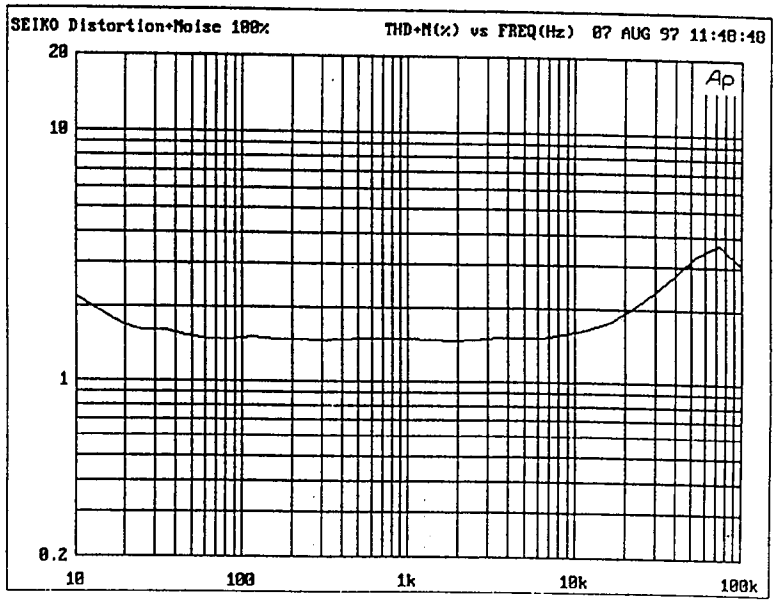


FIGURE: 51

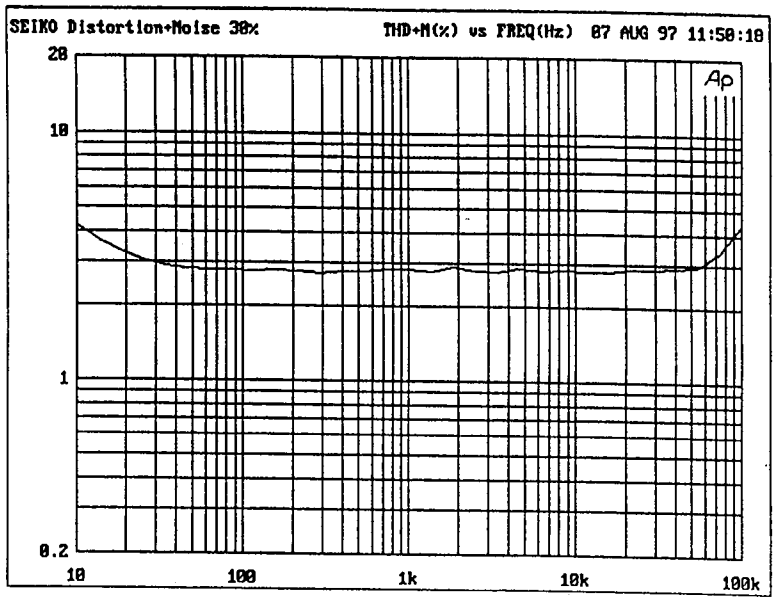


FIGURE: 52

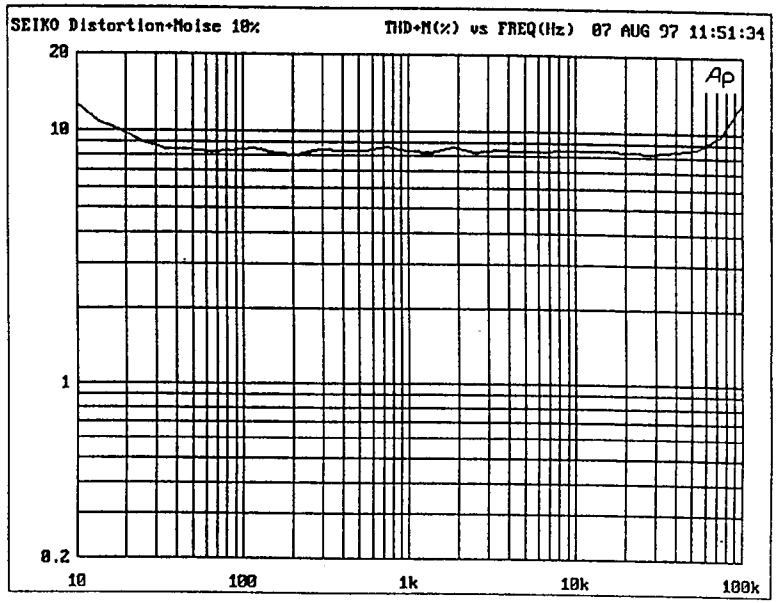


FIGURE: 53

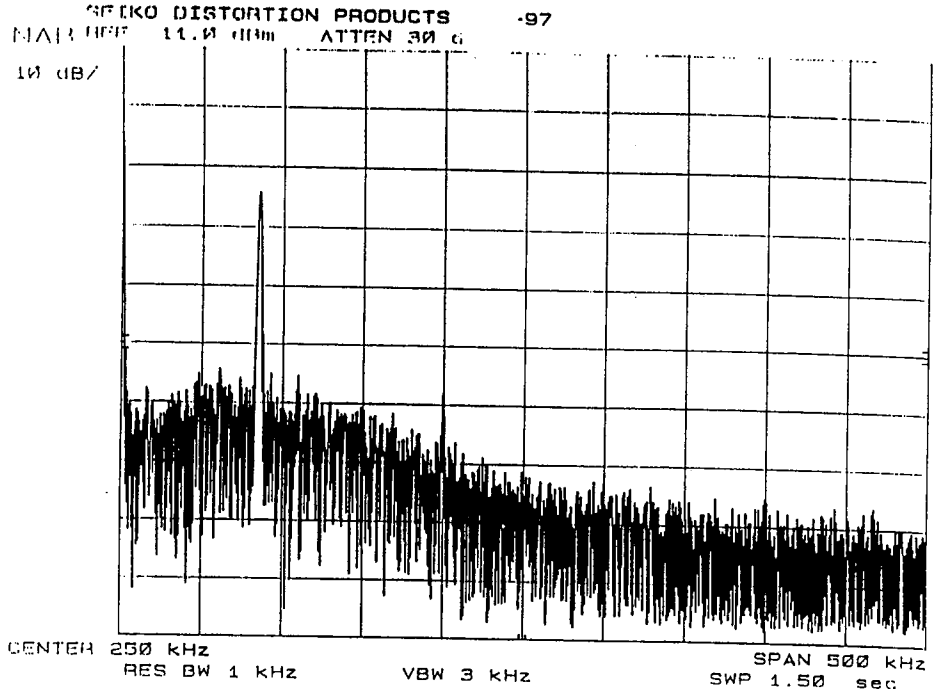


FIGURE 54

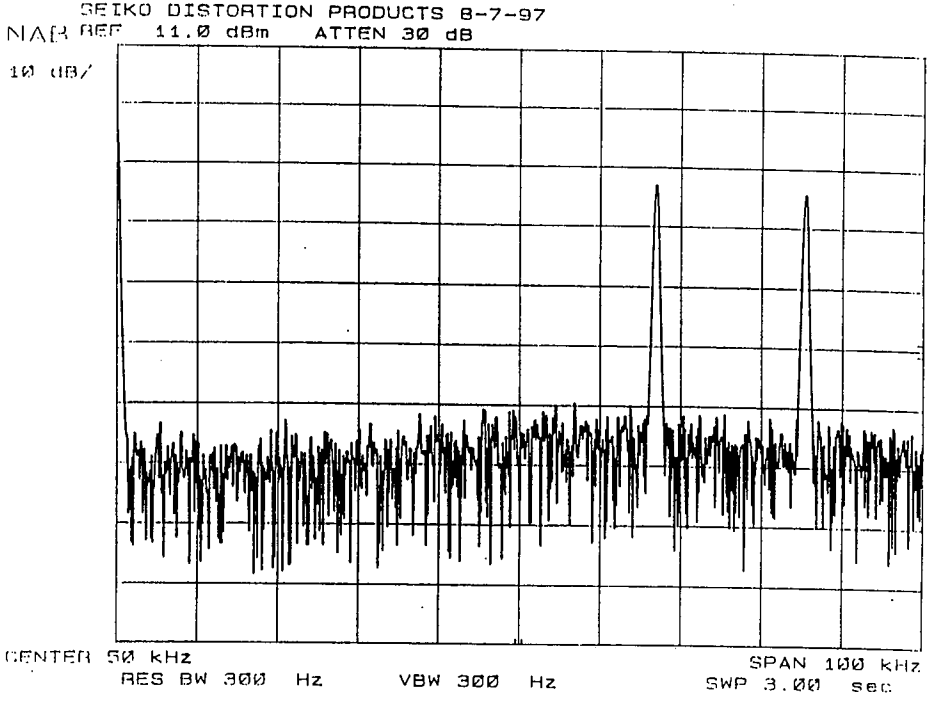


FIGURE 55

Proponent Receiver Characterization
Date: 8/7/97
Engr: DML

Desired Signal: 94.10 MHz
Modulation: 1 kHz
Deviation: 100 %
0dB: 828 mV

Measurement: Level, RMS with 15kHz Low Pass Filter

Results: S/N vs RF Level

Radio Type: PC Expansion Card

RF (dBm)	Signal (dB)	Noise (dB)
-50	0.00	-48.20
-55	0.00	-48.20
-60	0.00	-48.20
-65	-0.01	-48.20
-70	-0.03	-48.20
-75	-0.03	-48.00
-80	-0.04	-47.30
-85	-0.07	-45.60
-90	-0.09	-42.60
-95	-0.14	-38.10
Limiting -100	-0.55	-23.00
Threshold -105	-2.80	-8.00
-110	-3.40	-3.90
-115	-2.90	-2.40
-120	-2.50	-1.90
-125	-2.30	-1.70
-130	-2.30	-1.70

Digital Radio Test Laboratory

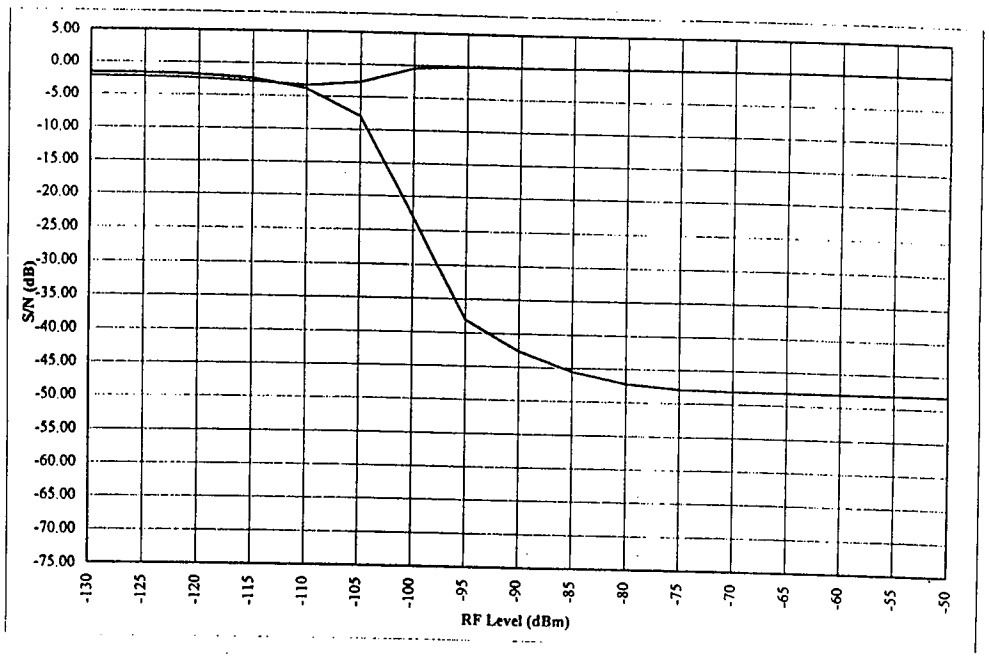


FIGURE 56

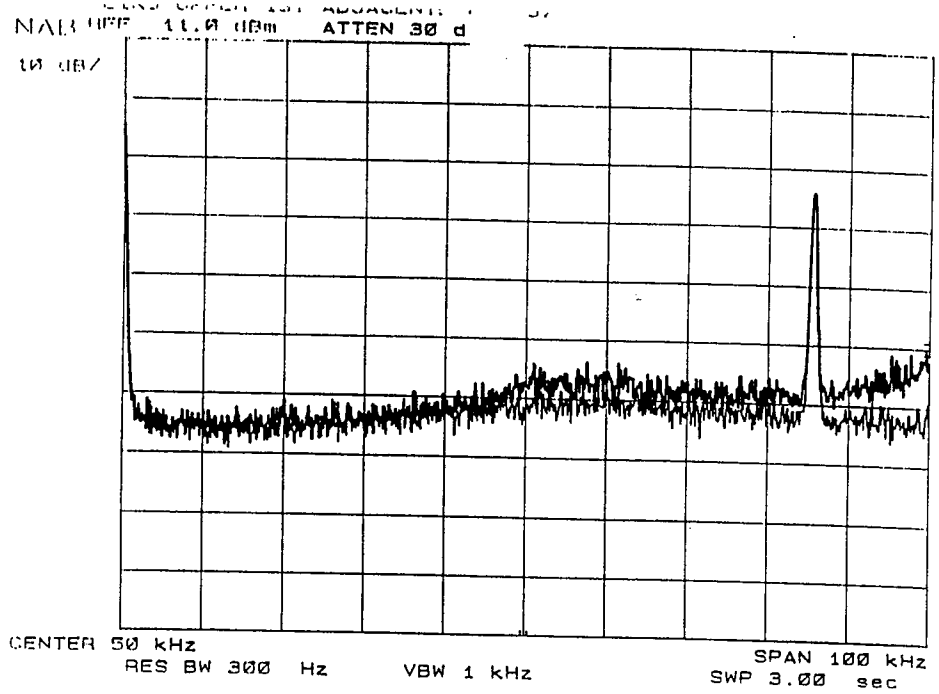


FIGURE 57

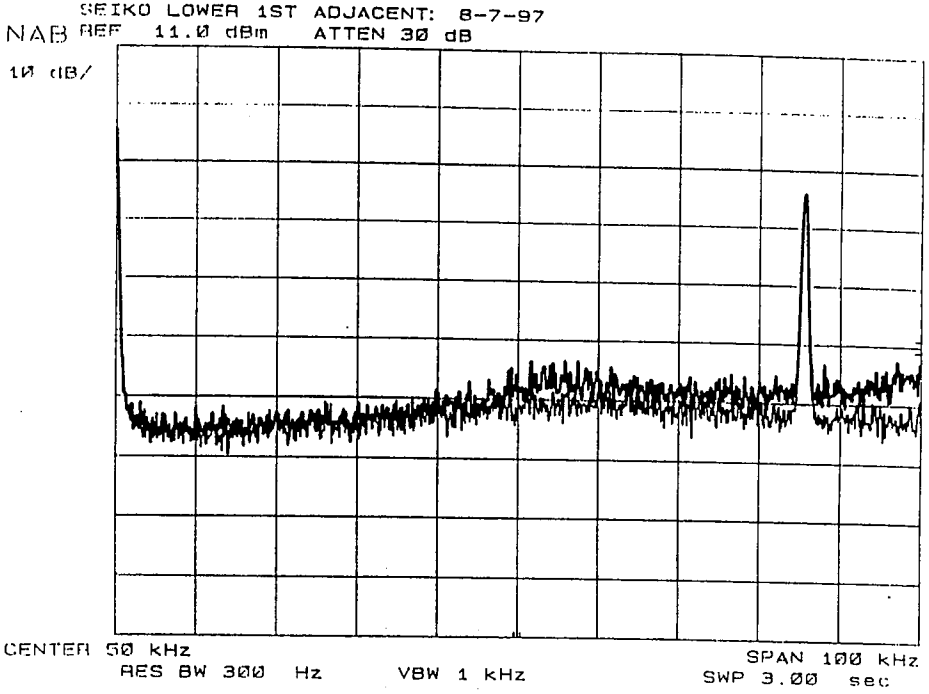


FIGURE 58

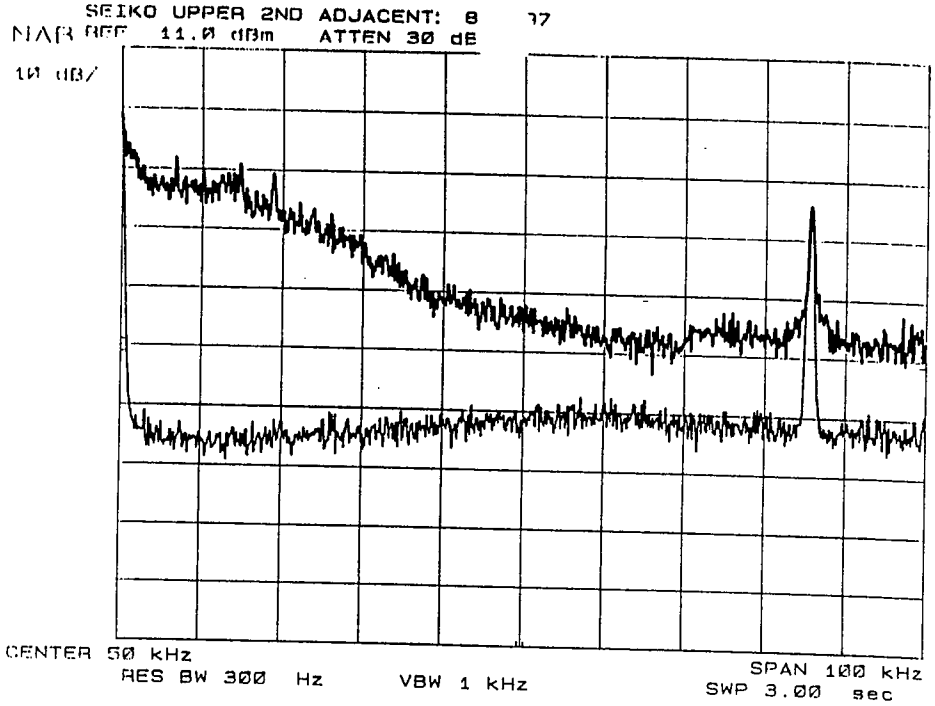


FIGURE 59

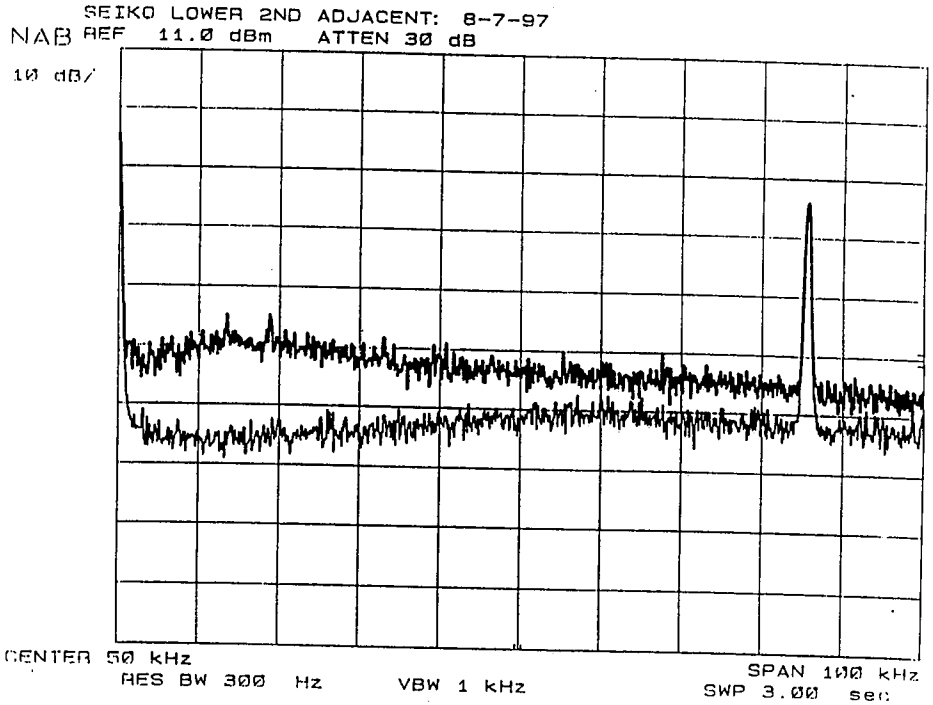


FIGURE 60

NRSC Document Improvement Proposal

If in the review or use of this document a potential change appears needed for safety, health or technical reasons, please fill in the appropriate information below and email, mail or fax to:

National Radio Systems Committee
c/o Consumer Electronics Association
Technology & Standards Department
1919 S. Eads St.
Arlington, VA 22202
FAX: 703-907-4190
Email: standards@ce.org

DOCUMENT NO.	DOCUMENT TITLE:
SUBMITTER'S NAME: COMPANY:	TEL: FAX: EMAIL:
ADDRESS:	
URGENCY OF CHANGE: _____ Immediate _____ At next revision	
PROBLEM AREA (ATTACH ADDITIONAL SHEETS IF NECESSARY): a. Clause Number and/or Drawing: b. Recommended Changes: c. Reason/Rationale for Recommendation:	
ADDITIONAL REMARKS:	
SIGNATURE:	DATE:

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Date forwarded to NAB S&T: _____
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CEA
Consumer Electronics Association


NAB
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