



**ELECTRONICS RESEARCH, INC.**

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## **Report of Inter-Modulation Product Measurements**

**For**

**Two Station Pass Band Star Combiner  
WXRK 92.3 MHZ / WCBS 101.1 MHZ**

**Combined Broadcast Facility  
New York, New York**

**JOB # 03922**

**November 20, 2001**

**Received**

**JAN 22 2002**

**CBS Communication Services**

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## **Contents**

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  - A-3 ERI LPX-4AC-SP Installation Drawing
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## Introduction

This report of findings provides evidence to show that the two-station combined facility for the operation of WXRK and WCBS is in compliance with the FCC Rules and Regulations as required by the Code of Federal Regulations (CFR) Title 47 Section 73.317 paragraph (b), (c), and (d). In brief, the collection of measurements presented in this report shows that all possible second order inter-modulation (IM) products generated by this combined system are less than the maximum allowable level as required by section 73.317(d). Thomas B. Silliman of Electronics Research, Inc. performed the measurements summarized herein on October 13, 2001.

IM products can potentially violate section 73.317 paragraph (d) requirements and are commonly generated from radio stations operating into multiplexed facilities and at congested antenna broadcast sites when inadequate transmitter to transmitter isolation is provided. The ERI installed filter/combiner system is designed to provide adequate isolation to ensure that interfering signals and any resulting intermodulation products are sufficiently attenuated to satisfy the section 73.317 paragraph (d) requirement. A Potomac Instruments FIM-71 with a bandpass filter is used to verify compliance with paragraph (d).

Measurements to verify compliance with section 73.317 (d) were made on the Pass Band Star combiner system installed by ERI at the WXRK/WCBS auxiliary transmission site. Schematic diagrams and specification sheets for the combiner system are included in Exhibit A of this report.

The combined system serves as the auxiliary transmitter site for both WXRK and WCBS.

## Pass Band Star Combiner System

Stations WXRK and WCBS were operating at licensed power for the duration of compliance measurements. Measurements were made to determine the level of second order IM products (of the type  $2F_1 - F_2$ ) for the two-station Pass Band Star combiner system combining WXRK (92.3 MHz) and WCBS (101.1 MHz). The combiner system is illustrated in the attached Exhibit A on page A-1.

The inter-modulation products were measured with both system transmitters operating at licensed TPO on the filter/combiner system. Directional couplers were placed at key locations throughout the combiner system to monitor and maintain the combiner performance. All couplers furnished with the system are factory calibrated and capable of delivering accurate and repeatable RF measurements. For the purposes of the measurements for these findings, the coupler located at the system output to the antenna was used. The RF directional coupler installed in the 3-1/8" line section to the antenna output allows forward and reflected readings of the antenna output signal levels. This type of directional coupler used for measurements is factory calibrated with a typical directivity of about 35 dB and a forward signal sample typically attenuated by around 55 dB.

The forward port of the output directional coupler was used for sampling all outgoing carrier levels and IM products. The sampled signal was fed by shielded cable through a band pass filter into a Potomac Instruments FIM-71 field strength meter. Various attenuation pads were used at connection locations to the band pass filter and/or the FIM-71 to ensure adequate signal levels for measurement without overloading the measurement equipment. The selective tuning of the FIM-71 and of the band pass filter was accomplished using a Wavetek Model 3000 signal generator. The measurement setup is illustrated in the attached Exhibit B.

The relative output signal levels for the system carriers are measured first to establish reference levels for other measurements. These levels will be used as a basis for comparing the IM product levels. The resulting signal levels for these measurements are listed in Table 1. The Adjusted Level shown in the last column of the table will be used as the reference level for possible IM products of each carrier.

**Table 1. Carrier Reference Levels – Pass Band Star Combiner System**

Carrier Frequency (MHz)	Pad One (dB)	Bandpass Filter Loss (dB)	Pad Two (dB)	Full Scale Range (dBμ)	Scale Reading (dB)	Adjusted Level (dBμ)
101.1	---	—	—	120	-1.51	118.49
92.3	---	—	—	140	-18.42	121.58

Second-order products due to mixing of system second harmonics with system fundamentals are calculated and listed in Table 2.

**Table 2. Second Order Products for New York, New York  
WXRK/WCBS Pass Band Star Combiner System**

Carrier Frequency (MHz)	Interfering Frequency (MHz)	
	92.3	101.1
92.3	–	83.5
101.1	109.9	–

The IM product measurements using the measurement scheme as previously described were recorded and are listed in Table 3 with the signal level referenced to carrier calculated in the last column. Refer to the figure in Exhibit B for a layout of the measurement equipment. All product levels met requirements.

Additionally, I observed using the forward sample port on the filter system output directional coupler that both WXRK and WCBS met the requirements for section 73.317 paragraph (b) and (c) of the FCC Rules.

Table IM Measurements for Pass Band Star Combiner System

Product Frequency (MHz)	Carrier Frequency (MHz)	Interfering Frequency (MHz)	Pad One (dB)	Filter Loss (dB)	Pad Two (dB)	Full Scale Range (dB $\mu$ )	Scale Reading (dB)	Adjusted Level (dB $\mu$ )	Level Referenced to Carrier (dB)
83.5	92.3	101.1	---	9.5	---	20	$\pm 0$	29.5	89
109.9	101.1	92.3	---	8.0	---	20	<-20	<8	<110
184.6	92.3	---	---	0.6	---	20	<-20	<6	<121
202.2	101.1	---	---	0.6	---	20	<-20	<6	<118

## Conclusions

Based upon the observations and measurements recorded in this document, I, Thomas B. Silliman, find the Pass Band Star Combiner system for the operation of the WXRK auxiliary transmitter and the WCBS auxiliary transmitter to be in proper working order. Furthermore, based on the measured data, it is my opinion there are no inter-modulation products being generated in excess of 80 dB below station carrier levels by the stations operating on the installed system. Based on this recorded data and my observations, I conclude that WXRK and WCBS are in compliance with the requirements of Sections 73.317 paragraph (b), (c), and (d) of the FCC Rules and Regulations.

Respectfully submitted by Electronics Research, Inc.

AFFIDAVIT

WARRICK COUNTY       )  
                                  ) SS:  
STATE OF INDIANA       )

THOMAS B. SILLIMAN, being duly sworn upon his oath deposes and says:

That his qualifications are a matter of record with the Federal Communications Commission;

That he is a registered professional engineer in Indiana, Maryland and Minnesota and is the President of Electronics Research, Inc.;

That this corporation has been retained by Radio Station WXRK, to prepare this engineering statement; and

That he has either prepared or directly observed the preparation of all technical information contained in this engineering statement and that the facts stated in this engineering statement are true of his knowledge except as such statements as are herein stated to be on information and belief and as to such statements he believes them to be true.

Thomas B. Silliman

Thomas B. Silliman

Subscribed and sworn to before me this 29th day of August, 2001

Cindy D. Tomes

Notary Public

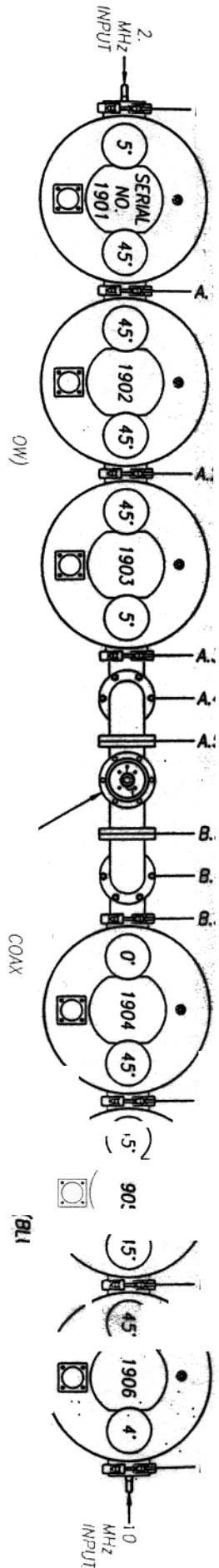
My Commission Expires: 11-06-04  
I Reside in WARRICK County.

Cindy D. Tomes

Printed Name

(Seal)

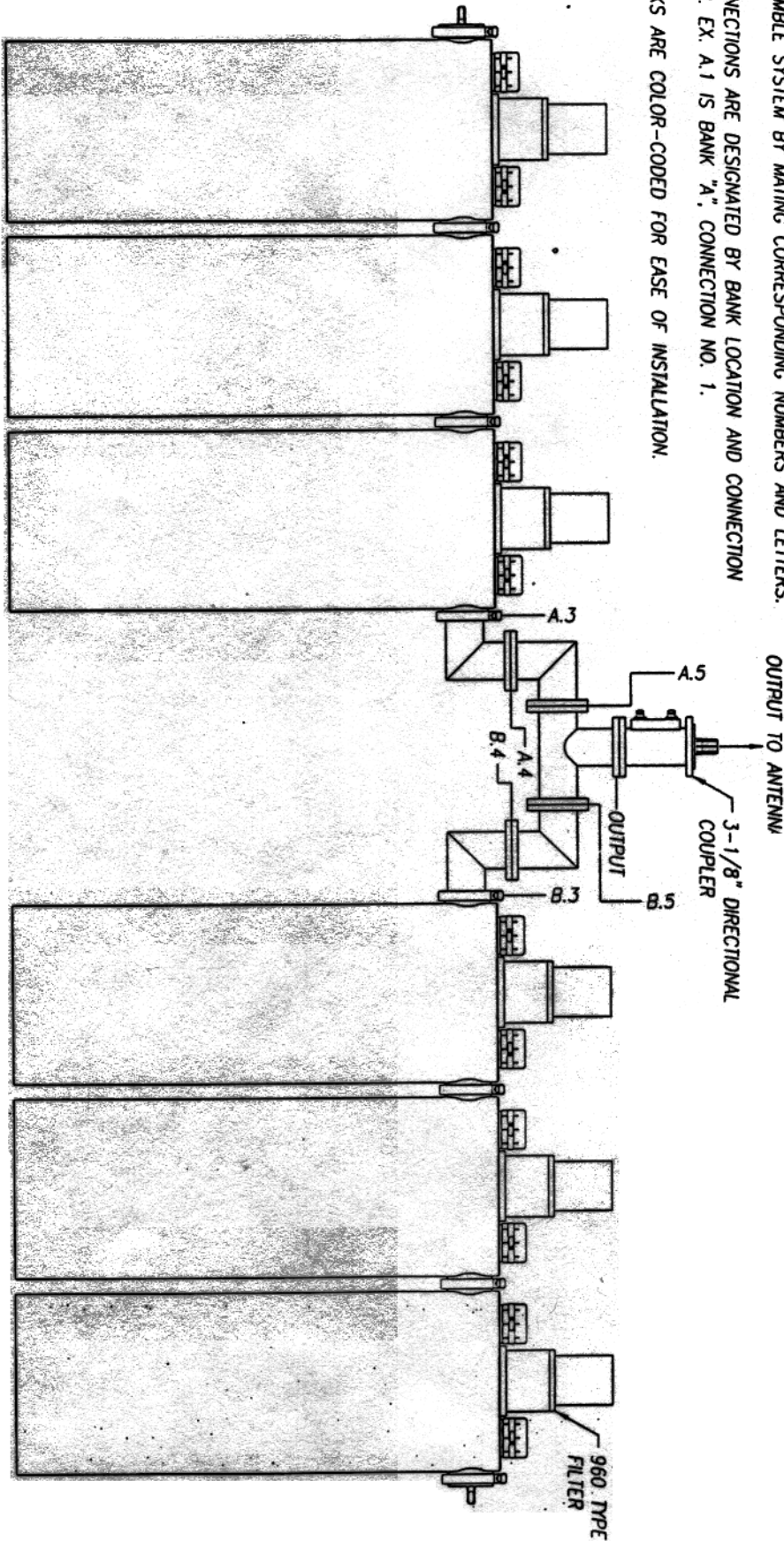




ASSEMBLY SYSTEM BY MATING CORRESPONDING NUMBERS AND LETTERS.

2) CONNECTIONS ARE DESIGNATED BY BANK LOCATION AND CONNECTION NUMBER. EX. A.1 IS BANK "A", CONNECTION NO. 1.

BANKS ARE COLOR-CODED FOR EASE OF INSTALLATION.



**ELECTRONICS RESEARCH, INC.**

Established 1943

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6	5	4	3	2	1	NO	REVISION	APP'D	DATE	NAME	TUNING DETAIL
										STATION: WLTW - NEW YORK, N.Y.	
										FREQUENCY: 92.3/101.1 MHz. PROJECT NO: 03922/2	
										PATH G:\DRAFTING\ALL PROJECT\03922	
										FILE: 1/1 - 2 DRAWN R.A.H. FACTOR NTS	
										DATE 9/14/01 APP'D	
										MODEL 960F06-000-T13	
										1/1 - 2	



**Pass Band Star Combiner System Specification Sheet**  
**WXRK/WCBS**  
**NEW YORK, NEW YORK**

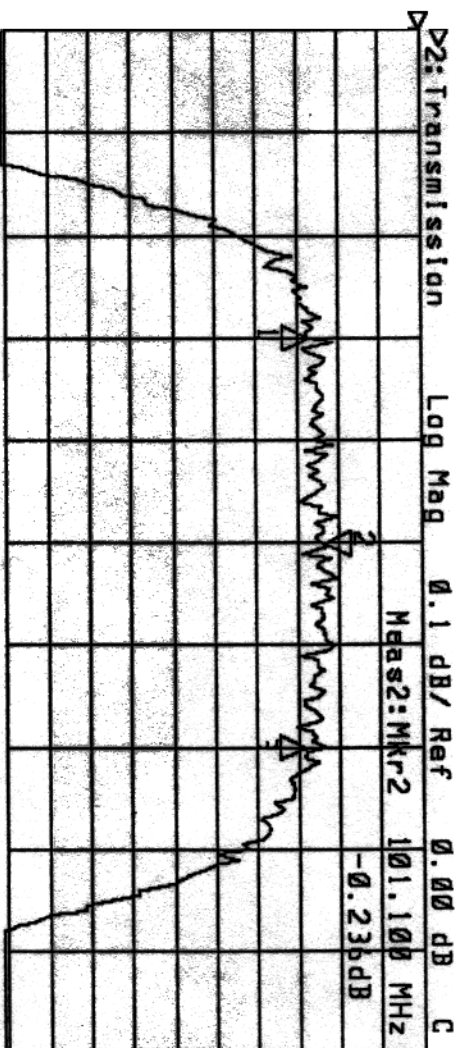
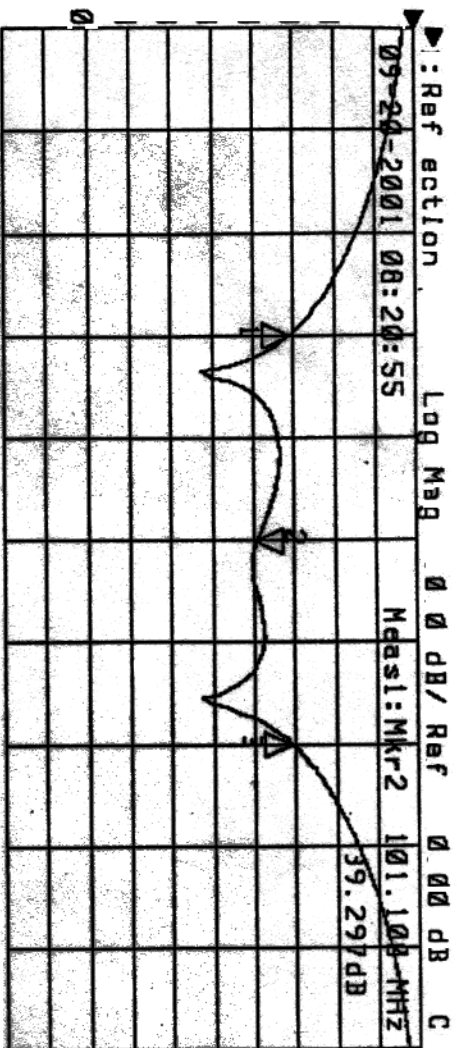
**General Specifications**

Multiplexer Type .....Pass Band Star Combiner  
Number Of Combining Modules Used ..... One, Type 960 Star  
Injected Port to Injected Port Isolation (typical)..... 55 dB  
Output Connector..... 3-1/8" 50Ω EIA (Flanged)  
Output Power .....20 kW  
  
Heat Removal (All Multiplexer Components) ..... Natural Convection  
Physical Arrangement..... All Components Floor Standing

**Injected Port Specifications**

Frequency Assignments .....101.1 and 92.3 MHz  
Power Rating, Each Injected Port (Maximum)..... 10 kW  
Connector ..... 3-1/8" 50 Ohm EIA (Flanged)  
VSWR.....Less than 1.06:1 @ +/-150 kHz<sup>(1)</sup>  
Group Delay (typical) ..... Less than 50 nsec Overall Variation, Carrier @ +/-150 kHz  
Insertion Loss (Measured):  
                    101.1 MHz           -0.236 dB @ +/- 100 kHz  
                    92.3 MHz           -0.210 dB @ +/- 100 kHz

(1) When Terminated in 50 Ohm Resistive Load.



Center 101.100 MHz		Span 1.000 MHz	
1: Mkr (MHz) dB		2: Mkr (MHz) dB	
1: 100.9000	-30.993	1: 100.9000	-0.270
2: 101.1000	-39.297	2: 101.1000	-0.236
3: 101.3000	-30.828	3: 101.3000	-0.282

☒ Match

☒ Insertion Loss

Group Delay

☐ BROAD Port Match

Isolation +/- 800 KHz

Port to Port Isolation

☐ To Injected MHz

☐ To Broad

☐ To Dump

TERMINATION

☐ Load

☐ Cable

☐ Antenna

☐ Other

# Match

☐ Insertion Loss

☐ Group Delay

☐ BROAD Port Match

☒ Isolation +/- 800 KHz

*Port to Port Isolation*

☐ To Injected MHz

☐ To Broad

☐ To Dump

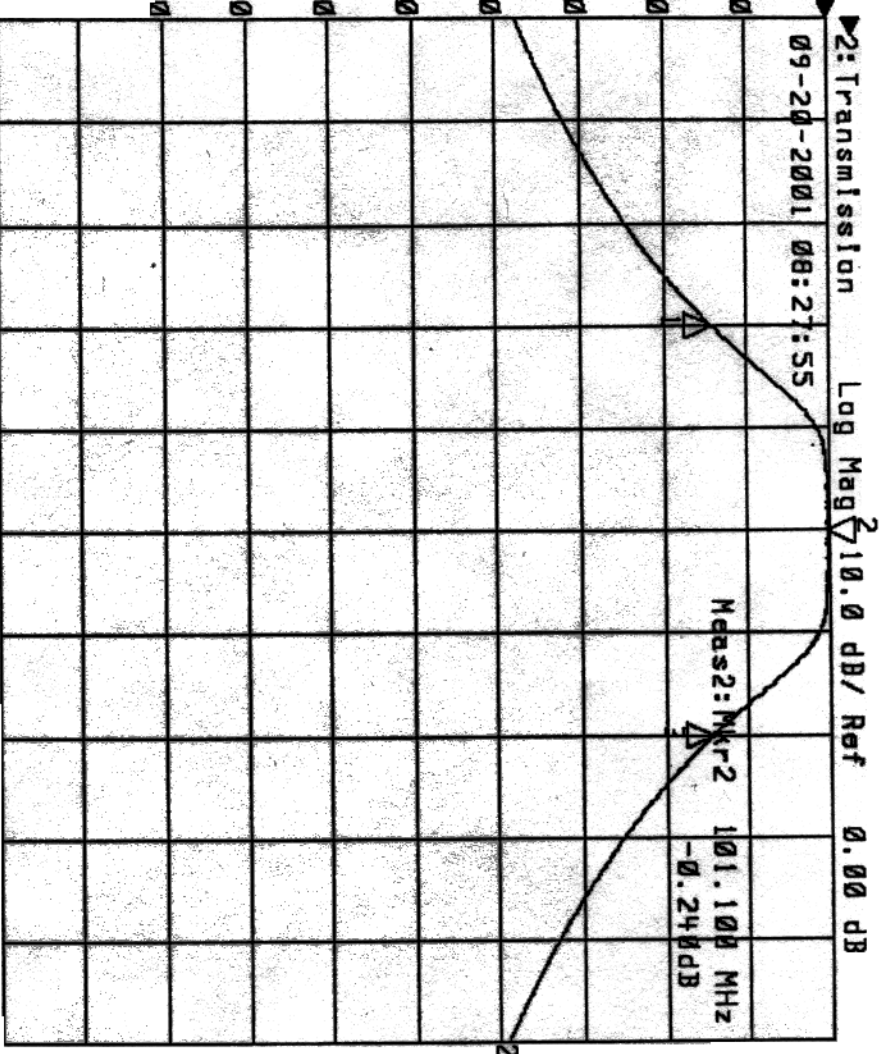
TERMINATION

☐ Load

☐ Cable

☐ Antenna

☐ Other



10 1H:

1: Mkr (MHz)	dB	2: Mkr (MHz)	dB
1:	100.3000	-14.314	
2:	101.1000	-0.240	
3:	101.9000	-14.244	

☐ Match

☐ Insertion Loss

☒ Group Delay

☐ BROAD Port Match

☐ Isolation +/- 800 KHz.

Port to Port Isolation

☐ T Injected MHz

☐ To Broad

☐ To Dump

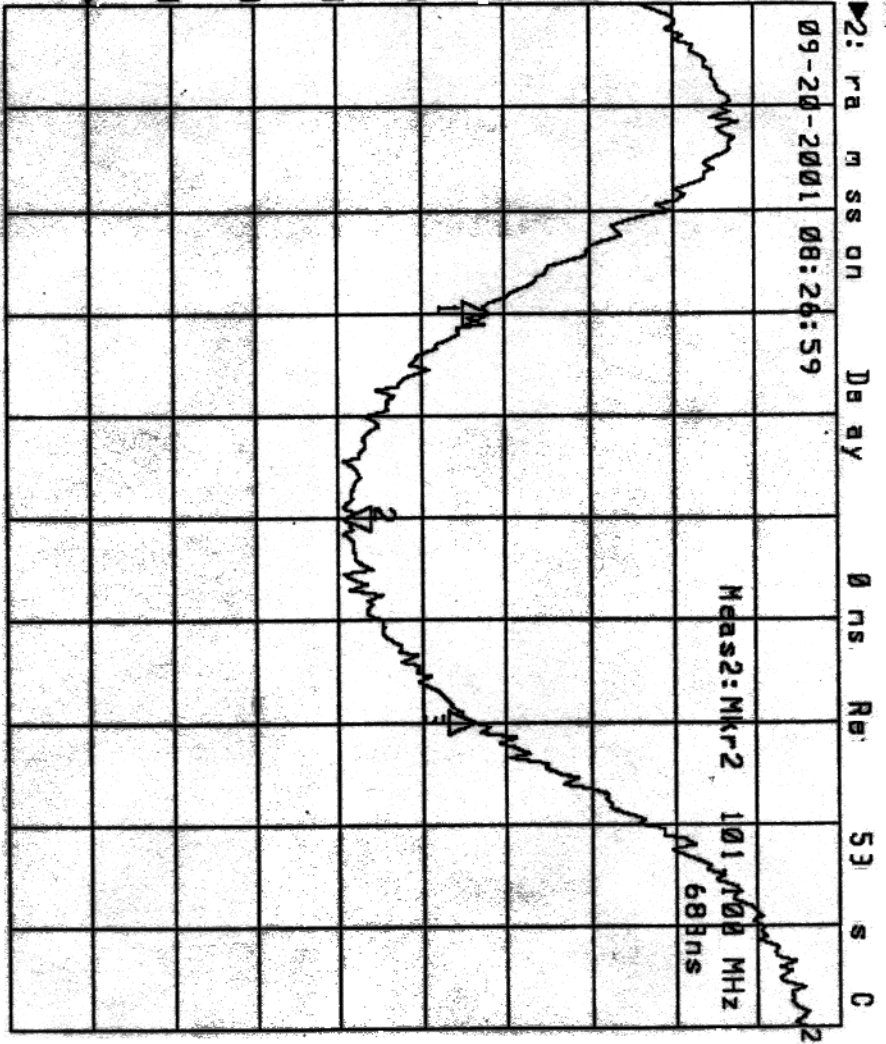
TERMINATION

☐ Load

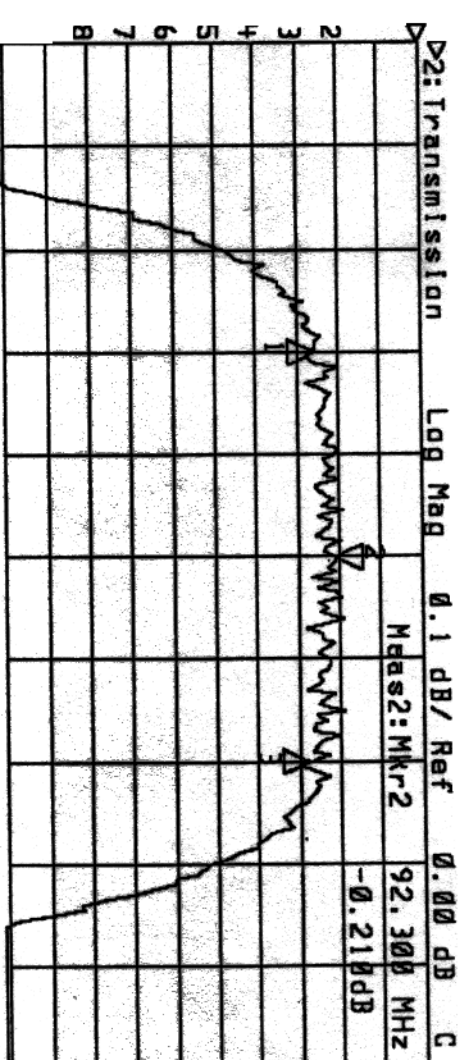
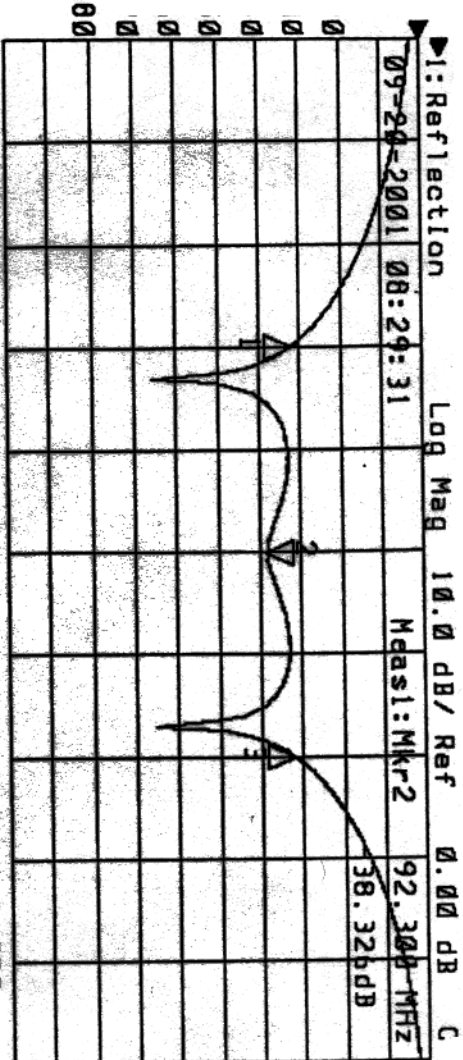
☐ Cable

☐ Antenna

☐ Other



1: Mkr (MHz)	dB	2: Mkr (MHz)	s
1:		100.9000	771n
2:		101.1000	683n
3:		101.3000	761n



Center 92.300 MHz		Span 1.000 MHz	
1: Mkr (MHz)	dB	2: Mkr (MHz)	dB
1: 92.1000	-32.126	1: 92.1000	-0.255
2: 92.3000	-38.326	2: 92.3000	-0.210
3: 92.5000	-31.919	3: 92.5000	-0.273

☒ Match

☒ Insertion Loss

☐ Group Delay

☐ BROAD Port Match

☐ Isolation +/- 800 KHz

Port to Port  
Isolation

☐ To Injected \_\_\_\_\_ MHz

☐ To Broad

☐ To Dump

TERMINATION

☐ Load

☐ Cable

☐ Antennas

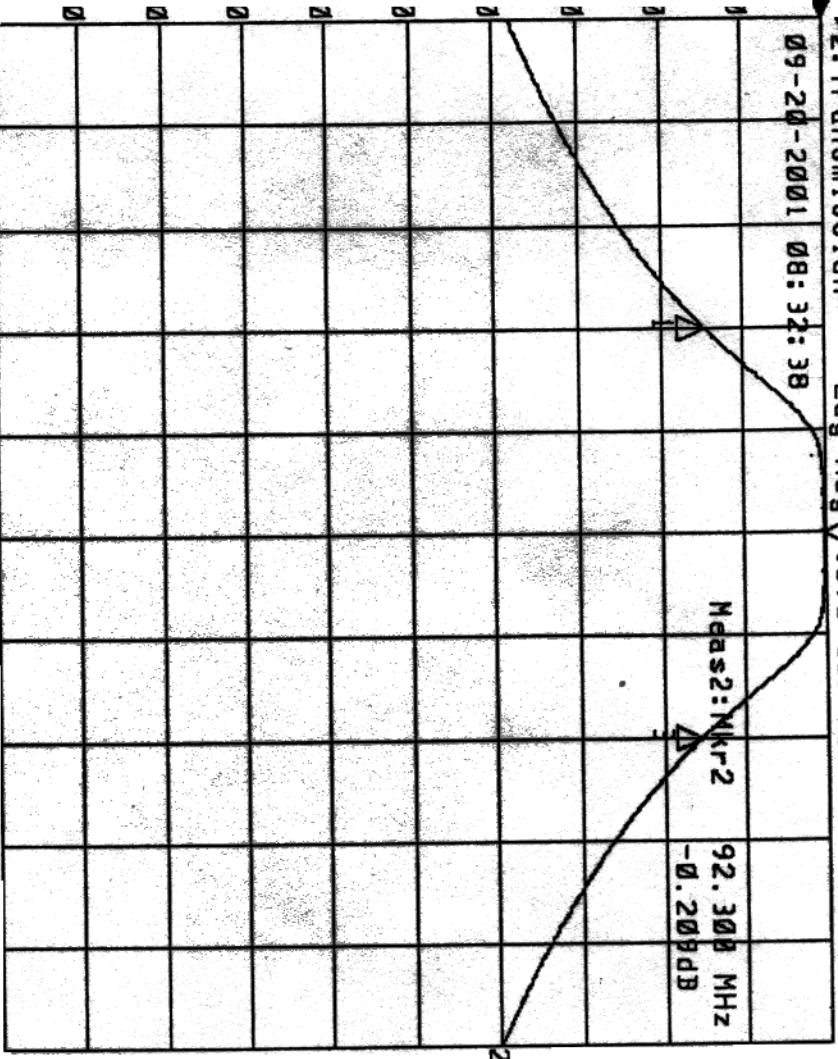
☐ Other



Δ1

Δ2: Transmission Log Mag 10.0 dB/ Ref 0.00 dB C

09-20-2001 08:32:38



1: Mkr (MHz)	dB	2: Mkr (MHz)	dB
1:	91.5000	-14.692	
2:	92.3000	-0.209	
3:	93.1000	-15.367	

☐ Match

☐ Insertion Loss

☐ Group Delay

☐ BROAD Port Match

☒ Isolation +/- 800 KHz

Port to Port Isolation

☐ To Injected \_\_\_ MHz

☐ To Broad

☐ To Dump

TERMINATION

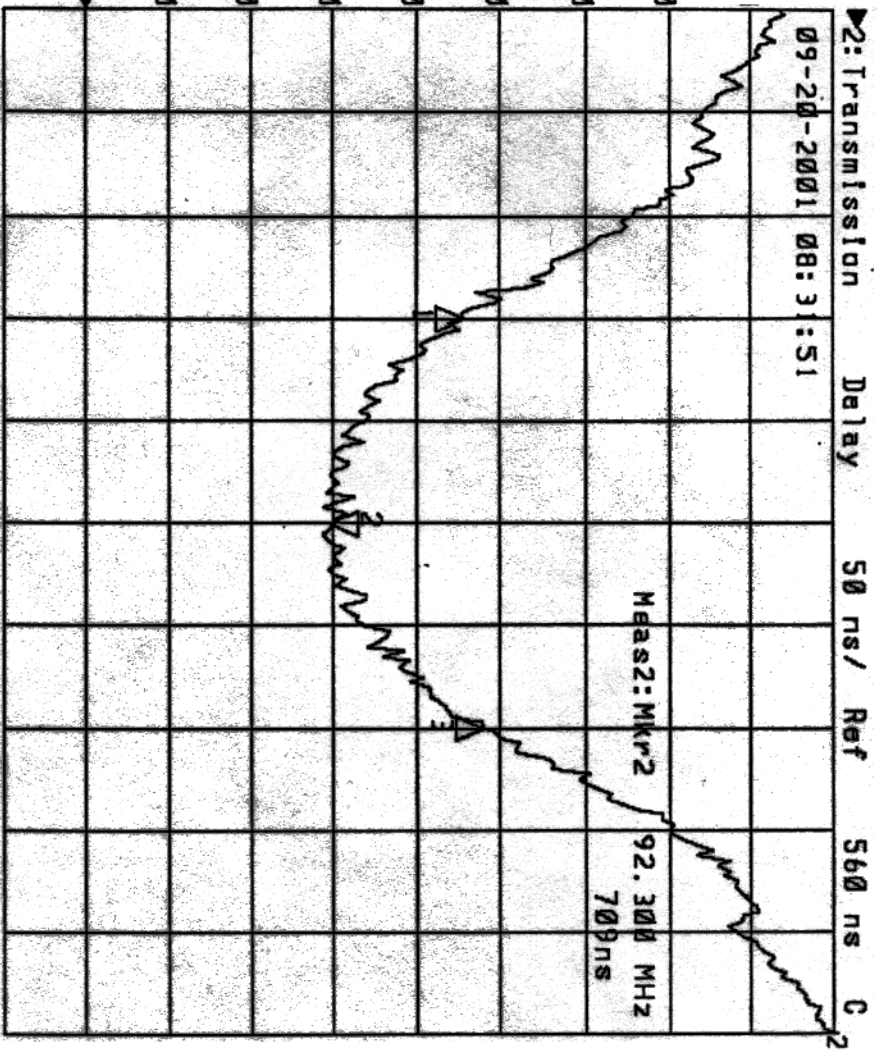
☐ Load

☐ Cable

☐ Antennas

☐ Other

>



1: Mkr (MHz)	U	Reg	2: Mkr (MHz)	s
			1: 92.1000	789n
			2: 92.3000	709n
			3: 92.5000	801n

☐ Match

☐ Insertion Loss

☒ Group Delay

☐ BROAD Port Match

☐ Isolation +/- 800 KHz

Port to Port Isolation

☐ To Injected Mhz

☐ To Broad

☐ To Dump

TERMINATION

☐ Load

☐ Cable

☐ Antenna

☐ Other



**Inter-Modulation Product Measurement  
Equipment Layout**

**Exhibit B**

