SENSITIVITY MEASUREMENTS OF MIXERS FOR THE VLA LO SYSTEM

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Introduction

The LO system described in the VLA proposals requires mixers with two unusual requirements: 1) The sensitivity when both signals to the mixer are weak must be above a minimum level; 2) the second harmonic of either input signal must be > 35 dB below the level of the input signals.

These quantities were measured with input signals at 165 Mc and 205 levels at power levels from +9 dBm to -45 dBm.
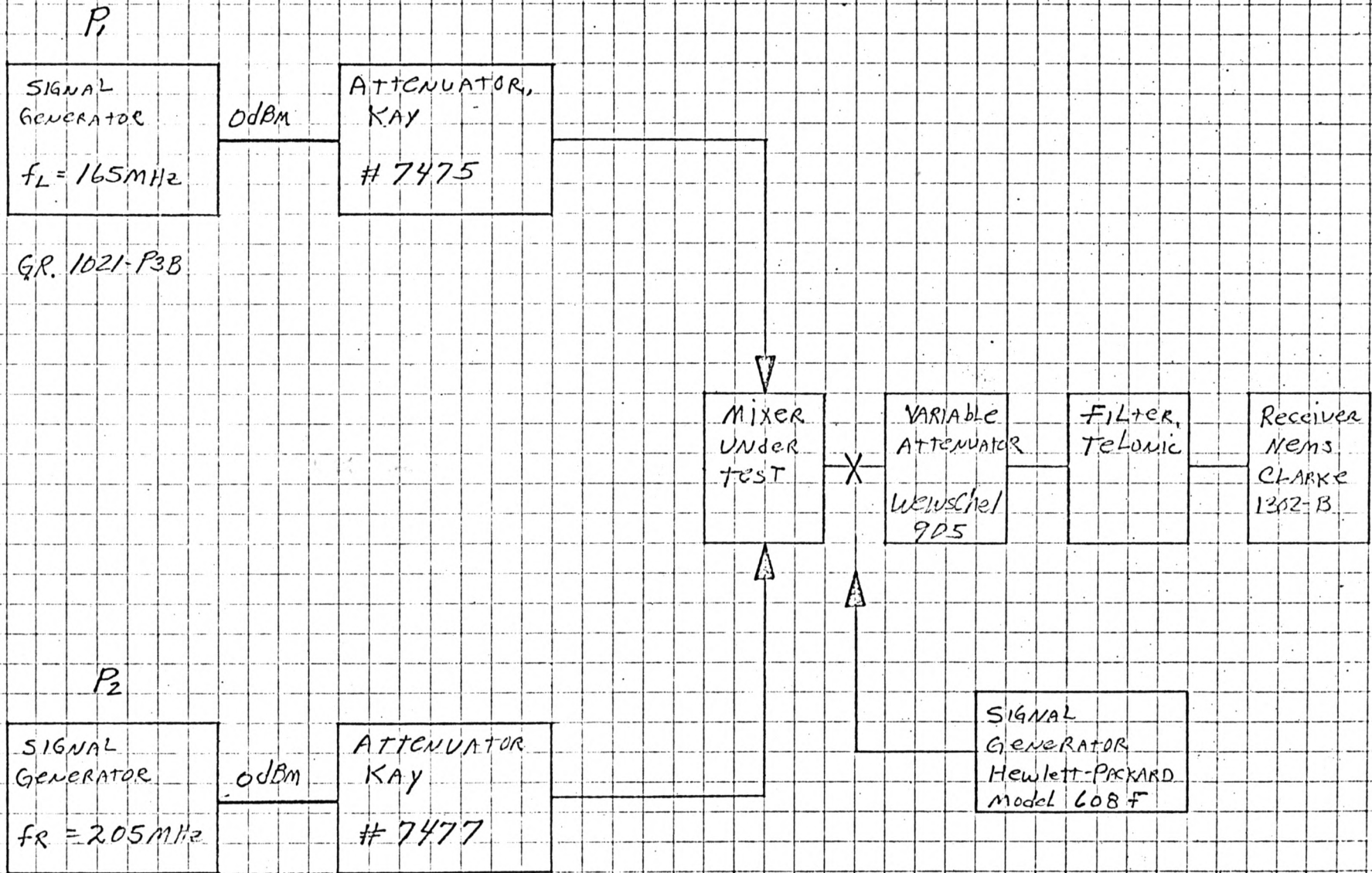
The results indicate that the HP 10514A mixer well exceeds the 2nd harmonic rejection requirements but is ∿ 5 dB short of the sensitivity assumed in the proposal design.

List of Equipment Used

Item	Manufacturer	Type	Serial No.
Receiver	Nems Clarke	1302-B	798
Extension unit	Nems Clarke	REU-300C	446
Signal generator	General Radio	1021-P3B	2281
Signal generator	General Radio	1021-P3B	2010
Signal generator	Hewlett-Packard	608F	610-00260
Attenuator, bar	Kay	--	7475
Attenuator, bar	Kay	--	7477
Attenuator, bar	Weinschel	905	618
Attenuator, fixed	Microlab	AA (assorted)	--
Power meter	Boonton	41A	130
Filter, tunable	Telonic	--	9194
Filter, bandpass	Telonic	--	A258
Frequency meter	Narda	804	01001

Units Under Test

(1) Mixer	Hewlett-Packard	10514A
(2) Mixer	Relcom	M1
(3) Mixer	Adams Russell	ICH-50-1

P_1

SIGNAL GENERATOR $f_L = 165 MHz$	0dBm	ATTENUATOR, KAY # 7475

GR. 1021-P3B

MIXER UNDER TEST	X	VARIABLE ATTENUATOR Weinschel 905	FILTER, TeLonic	Receiver Nems CLARKe 1302-B

P_2

SIGNAL GENERATOR $f_R = 205 MHz$	0dBm	ATTENUATOR KAY # 7477

GR. 1021-P3B

SIGNAL GENERATOR Hewlett-Packard Model 608F

BLOCK DIAGRAM OF TEST SET-UP

FIGURE 1

L

R

CR₁ CR₂

CR₄ CR₃

T₁

T₂

X
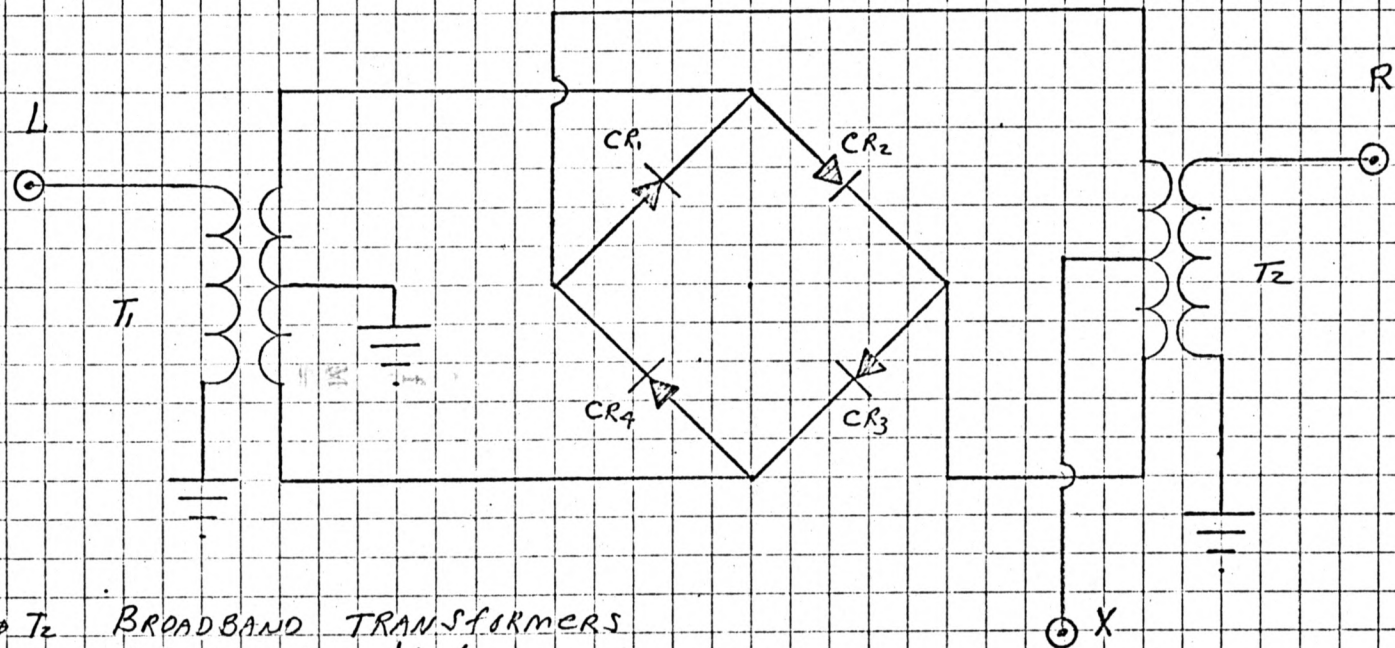
T₁ & T₂   BROADBAND TRANSFORMERS
CR₁ - CR₄   Hot CARRIER diodes.

typical   RING   ModuLAToR   Schematic

FIGURE 2

- 3 -

TABLE 1

HEWLETT-PACKARD 10514A

P_1*	P_2*	$2f_L$*	$f_L + f_R$*	$2f_R$*
165 Mc	205 Mc	330 Mc	370 Mc	410 Mc
+9	-75	-49	-80.5	<-115
0	-75	-68	-83	<-115
-10	-65	-89.5	-90	<-115
-20	-55	-110	-89.5	≈-115
-30	-45	<-115	-89.5	-101
-40	-35	<-115	-90	-91
-45	-30	<-115	-89.5	-86
-40	-40	<-115	-96	-96
-40	-30	<-115	-85	-86
-35	-30	<-115	-81	-86

* All levels in dBm.

TABLE 2

RELCOM MODEL M1

P_1, f_L*	P_2, f_R*	$2f_L$*	$f_L + f_R$*	$2f_R$*
165 Mc	205 Mc	330 Mc	370 Mc	410 Mc
+9	-75	-41	-81	<-115
0	-75	-54	-83	<-115
-10	-65	-85	-96	<-115
-20	-55	-103	-97	<-115
-30	-45	≈-107	-97	-102
-40	-35	<-115	-97	-90
-45	-30	<-115	-97	-85

* All values in dBm.

TABLE 3

ADAMS-RUSSELL MODEL ICH-50-1

P_1, f_L *	P_2, f_R *	$2f_L$ *	$f_L + f_R$ *	$2f_R$ *
165 Mc	205 Mc	330 Mc	370 Mc	410 Mc
+9	-75	-45	-80	<-115
0	-75	-64	-82	<-115
-10	-65	-79	-90	<-115
-20	-55	-98	-91	<-115
-30	-45	<-115	-90.5	<-115
-40	-35	<-115	-90	<-115
-45	-30	<-115	-91	<-115
-40	-40	<-115	-98	-102
-40	-30	<-115	-87	-90
-35	-30	<-115	-86	-85

* All values in dBm.

Procedure

1)   Set up equipment as shown in Figure 1.

2)   Adjust the power output of the General Radio signal generators
     to 0 dBm.

3)   Adjust the signal generators to the desired frequencies —
     f_L = 165 Mc, f_R = 205 Mc.

4)   Select the frequency to be measured by means of the Telonic filters.

5)   Tune the receiver to the filter frequency.

6)   Adjust the power input to the receiver to approximately 10 dB above
     the receiver noise. Do not operate the receiver near saturation.
     Saturation can be avoided in the following manner: With the receiver
     input terminated, adjust the IF gain until the front-end noise can be
     observed on the indicator. Do not adjust the gain during the measure-
     ment steps. The power to the receiver is controlled by the Weinschel
     variable attenuator and the Microlab fixed pads (if necessary).

7)   After a reference point has been established on the receiver indicator,
     usually near mid-scale, break the circuit at point X on the block
     diagram.

8)   Insert the output of the 608F signal generator at point X.

9)   Adjust the output attenuator on the 608F until the receiver indicator has
     returned to the reference point.

10) Record the power output of the 608F. This is the power delivered by
     the mixer under test at the selected frequency. See tables 1 through 3
     for the frequencies used in this test.

Conclusion

     Of the three mixers checked during this experiment, the Hewlett-Packard
10514A and the Adams-Russell ICH-50-1 are very close. Possibly the 10541A is a
little more sensitive, but the ICH-50-1 has better second harmonic attenuation. The
Relcom M1 averaged about 6 or 7 dB less sensitivity at low power levels than the
other two units.