APPLICATION NOTE

Improved Pulling Behaviour on OM5719A

AN98084

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Abstract

This report describes the pulling behaviour measurements performed on the OM5719A Digital Satellite-TV Receiver Zero-IF Demo Board with TDA8060, TSA5512 and TDA8044.

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APPLICATION NOTE

Improved Pulling Behaviour on OM5719A

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Summary

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CONTENTS

1. INTRODUCTION

After production and evaluation of the OM5719A (PR38394), improvements were found regarding pulling, also called large wanted signal behaviour. This report describes the difference in performance between the original and the modified OM5719A demo board.

1.1 Modifications of the OM5719A Demo Board

Changing component values mentioned below and adding more groundplane to the existing pcb (see Fig. 1 and Fig. 2) increases the isolation between the RF input stage and the VCO.

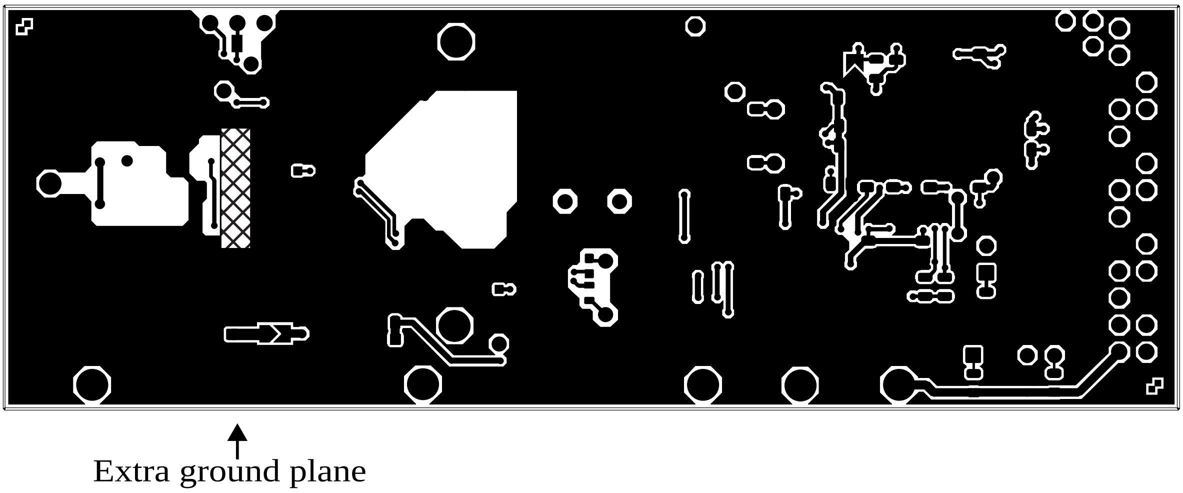


Fig.1 The bottom side of the OM5719A with the extra ground plane

The extra ground plane, a copper strip, is located next to the printed collector coil of the LNA.

Component values changed:
- parallel to C17/C18: 2p2 (local oscillator power supply)
- parallel to C8/C10: 10p (supply for mixers and BB-amps)
- parallel to C9 (0805 size) 10p (supply for input stage)
- replace C48 by 22p parallel to 2p2 (AGC voltage decoupling)

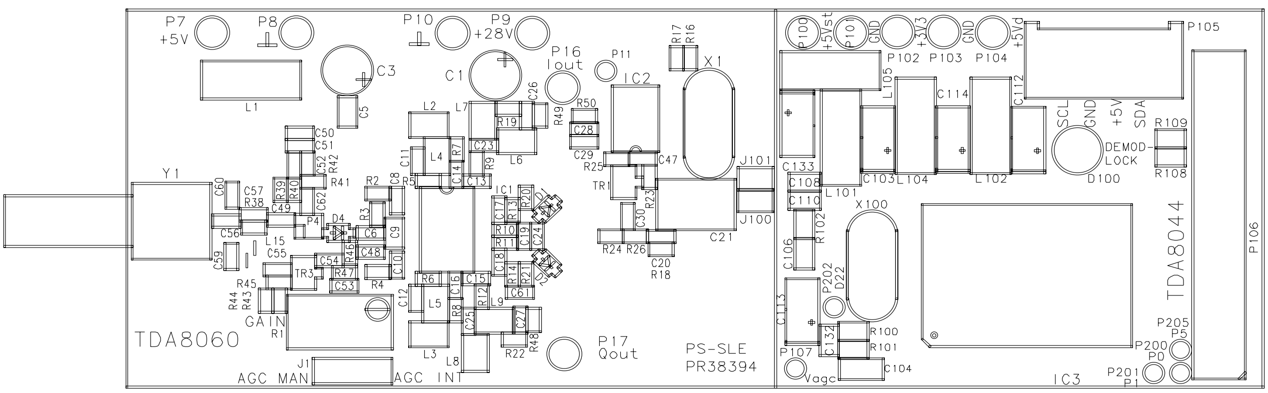


Fig.2 The top side of the OM5719A

See also schematic diagram as shown in APPENDIX 1 for further reference.

2. Measurements

This chapter describes the measurements used to show the difference in performance between the original and the modified board.

Note: Errors due to meas. setup equipment are not taken into account. Therefore these meas. results are for comparative use only.

2.1 C/N as function of Input Power Level

This measurement can be used to compare between the two boards at which QPSK modulated RF input power level (at different frequencies and symbol rates) the BER value degrades or even cycle slips occur.

2.1.1 Measurement setup

The measurement setup is shown in Fig. 3.

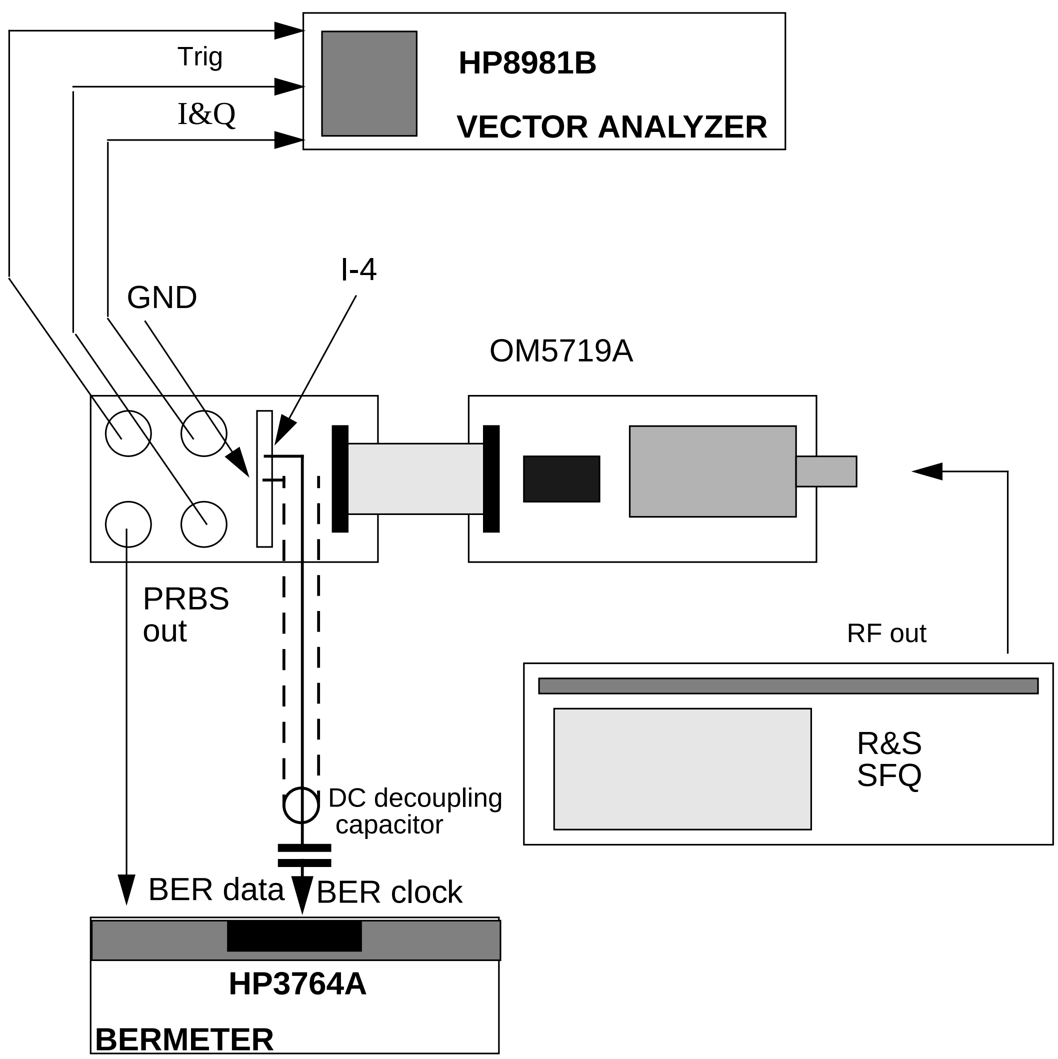


Fig.3 “BER after Viterbi” measurement setup

The Rohde & Schwarz SFQ generator is used to generate the Viterbi encoded PRBS QPSK signal. The Viterbi encoded PRBS QPSK signal is required for implementation margin (IM), also referred to as implementation loss (IL), measurements as described in the CANAL+ specification document.
To be able to measure BER after Viterbi, a number of changes have to be made from the original setup (see application note AN89049) and software configuration, which are discussed step-by-step. Let's assume a setup with a symbol rate (S.R.) of 27.5 MS/s and the puncturing rate (Pr.) is 5/6. For other configurations, change the settings of the SFQ and the software accordingly.

SFQ settings:
INPUT:TS parallel
PACKET LENGHT:188 byte
MODE:PRBS
ROLL-OFF:0.35
RATE:5/6
SPECIAL:Scrambling off, Interleaving off, RS off
SYMBOL RATE:27.5 MS/s
C/N: Adjust and read-out BER value (1e-4)
NOISE BW:27.5 MHz (set always to the same value as Symbol Rate)
NOISE:On

- The BER clock is now derived from the I-4 pin of connector P2 on the measurement interface OM5711/M/C2. A capacitor is required to prevent incorrect operation of the BER meter.
  The capacitor value should be about 10uF.
- Connect the power supplies of the OM5719A.
- Put the AGC jumper (J1) to *AGC INT*. In this mode the AGC is controlled by the TDA8044.
- Load the software OM5719A.
- Select the correct Channel and Tuner related settings. Afterwards disable the "I2C tuner" setting.
- Select the desired puncturing rate in the FEC menu. Only one puncturing rate should be selected as the FEC is not able to automatically select the correct puncturing rate in this test mode.
- Select the "No Spectral Inversion".
- Select in the main menu test mode "C" for Viterbi output measurements.
- Push the "Preset" button in the software until the BER meter is locked.

2.1.2 Measurement procedure

After the SFQ and the software have been setup with a specified symbol rate, puncturing rate and RF frequency, adjust at different QPSK modulated RF input power levels the C/N value of the SFQ until the BER meter reads 1e-4. The value 1e-4 is referring to the CANAL+ specification. A lower C/N value required at a certain input level means a better system performance. There is a linear relationship between the C/N value and the implementation margin value: 0.1 dB more C/N represents 0.1dB more implementation margin.

- "*Pin*" represents the QPSK modulated RF input power level of the SFQ.
- *"C/N"* represents the setting of the C/N value of the SFQ where the BER value is 1e-4.
- *"AGC"* represents the Coarse AGC Level as shown in the software. A value of 0 means minimum gain, 255 means maximum gain.
- *"c.s."* represents the input power level where cycle slips occur frequently. To obtain this value, the noise option of the SFQ is switched OFF. This data is not shown in the C/N(Pin) graphs, but in two separate graphs Fig. 15 and Fig. 16.
- *"a"* represents the roll off factor of the QPSK modulated spectrum (e.g.: a = 0.35).

TABLE 1 Unmodified board: f=1500 MHz, S.R.=27.5 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-20**	**-15**	**-10**	**-11**	
C/N [dB]	9.7		7.8	7.6	7.6	7.6	7.6	7.7	7.8	8.7		c.s.	
AGC	238		145	110	99	87	70	54	40	27		23	

TABLE 2 Modified board: f=1500 MHz, S.R.=27.5 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-20**	**-15**	**-10**	**-8**	
C/N [dB]	9.4	8.1	7.7	7.6	7.6	7.6	7.6	7.6	7.6	7.7		c.s.	
AGC	228	169	133	100	93	72	54	40	25	15		7	

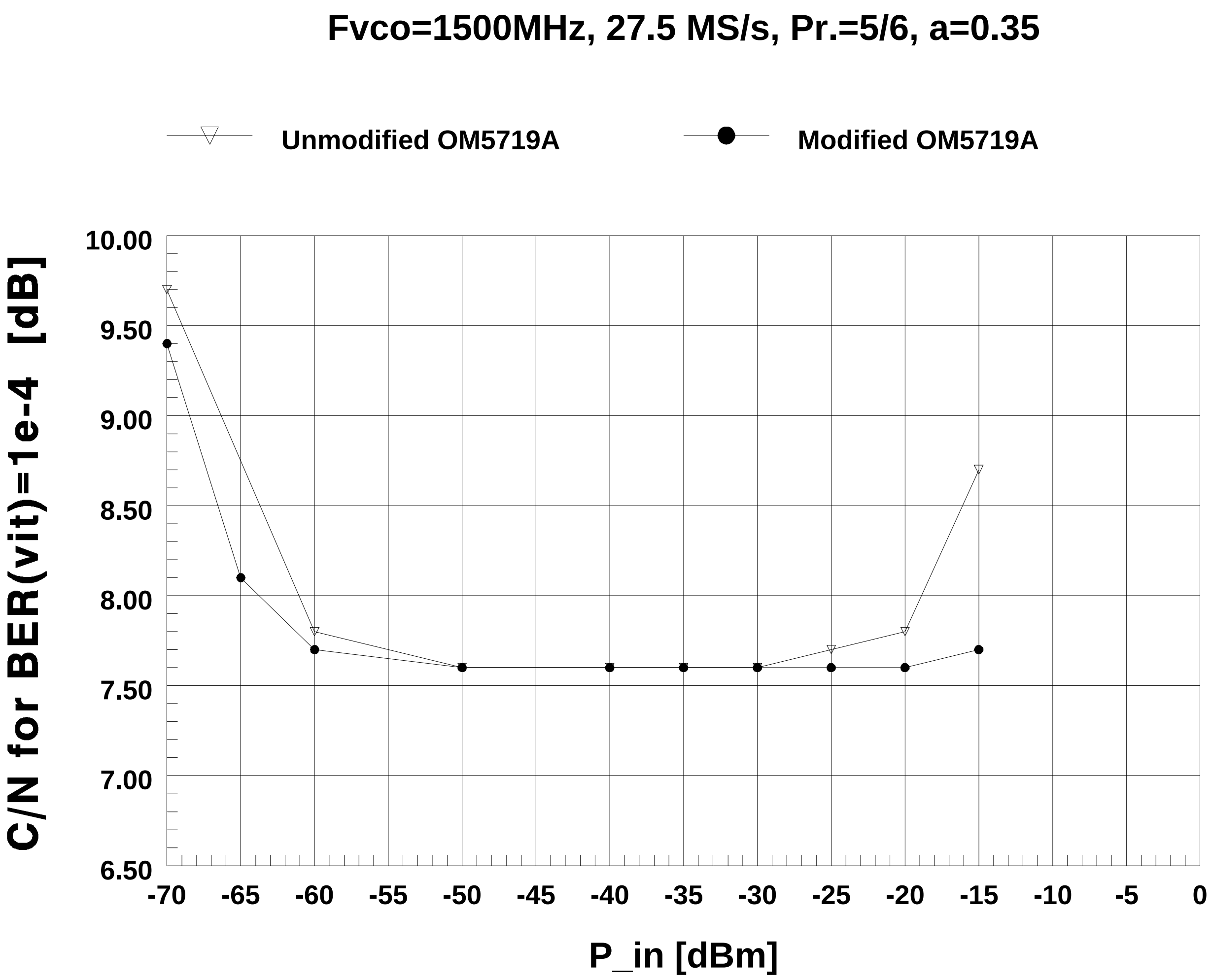


Fig.4

TABLE 3 Unmodified board: f=2150 MHz, S.R.=27.5 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-20	-18			
C/N [dB]	7.9		7.6	7.6	7.6	7.7	7.7	7.9		c.s.			
AGC	255		185	123	101	89	71	56		45			

TABLE 4 Modified board: f=2150 MHz, S.R.=27.5 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-20	-15	-10	-5	-3
C/N [dB]	7.8	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.7	9.6	c.s.
AGC	255	234	170	108	94	72	55	40	27	15	5	3	3

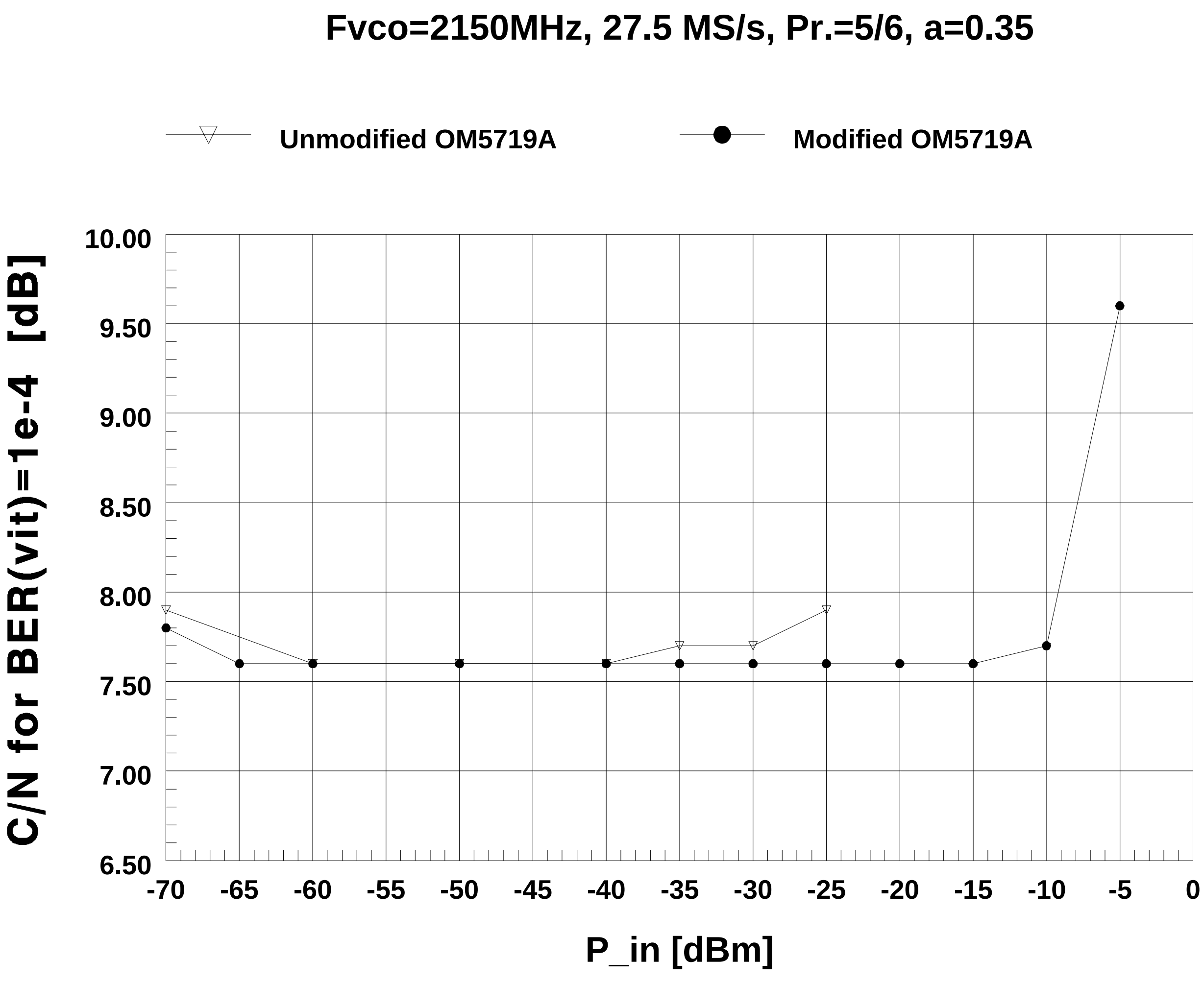


Fig.5

TABLE 5 Unmodified board: f=1500 MHz, S.R.=15.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-20	-17			
C/N [dB]	8.1		7.5	7.4	7.4	7.4	7.5	7.6	8.4	c.s.			
AGC	220		138	107	98	82	65	50	36	30			

TABLE 6 Modified board: f=1500 MHz, S.R.=15.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-20	-15	-10		
C/N [dB]	8.0	7.5	7.4	7.4	7.4	7.4	7.4	7.4	7.5	8.1	c.s.		
AGC	206	156	125	99	87	66	50	36	23	13	10		

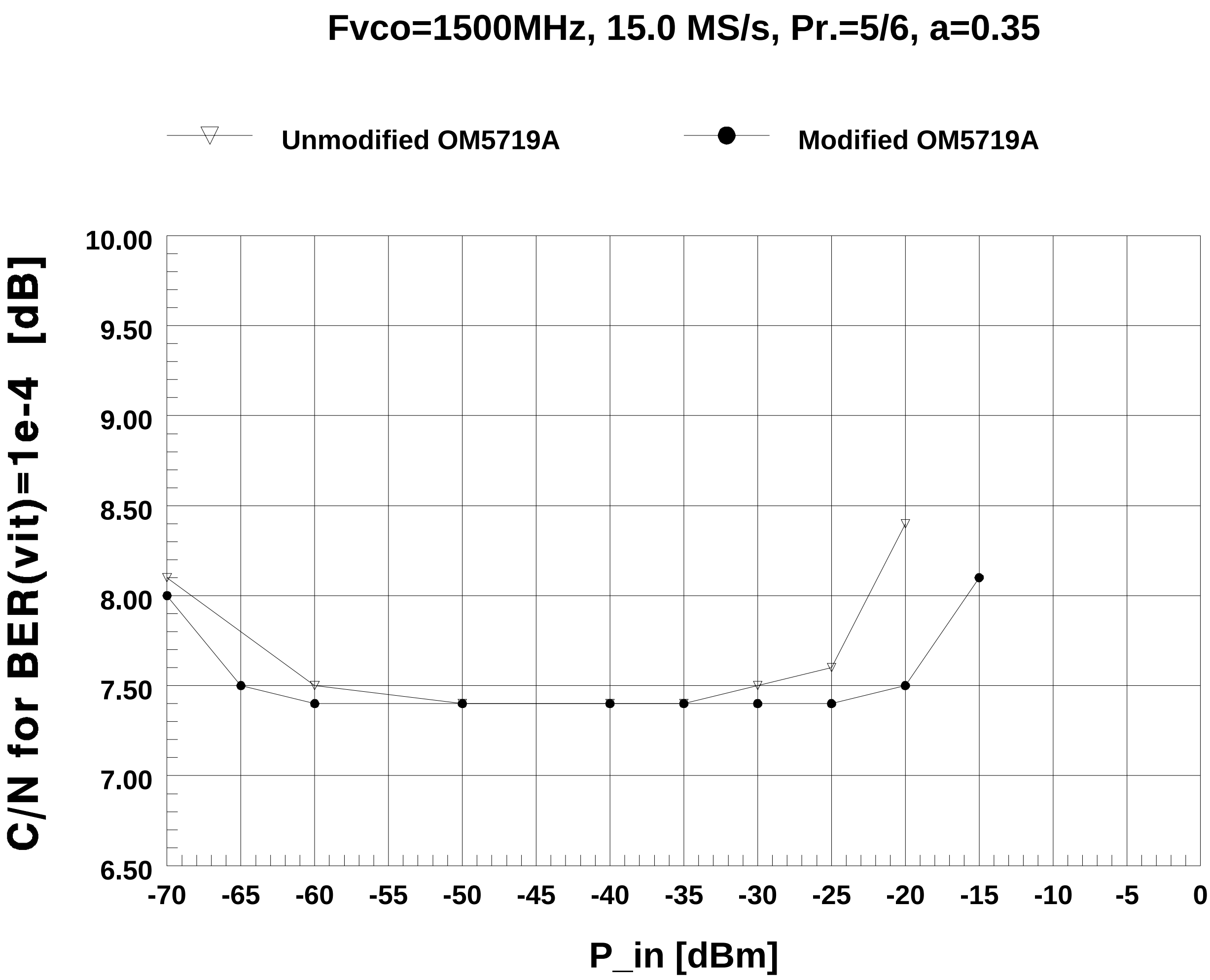


Fig.6

TABLE 7 Unmodified board: f=2150 MHz, S.R.=15.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-23				
C/N [dB]	7.5		7.4	7.4	7.5	7.5	7.8		c.s.				
AGC	255		172	118	100	84	68		59				

TABLE 8 Modified board: f=2150 MHz, S.R.=15.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-20	-15	-10	-5	-4
C/N [dB]	7.5	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.5	7.7		c.s.
AGC	255	205	155	105	88	66	50	36	24	13	5		2

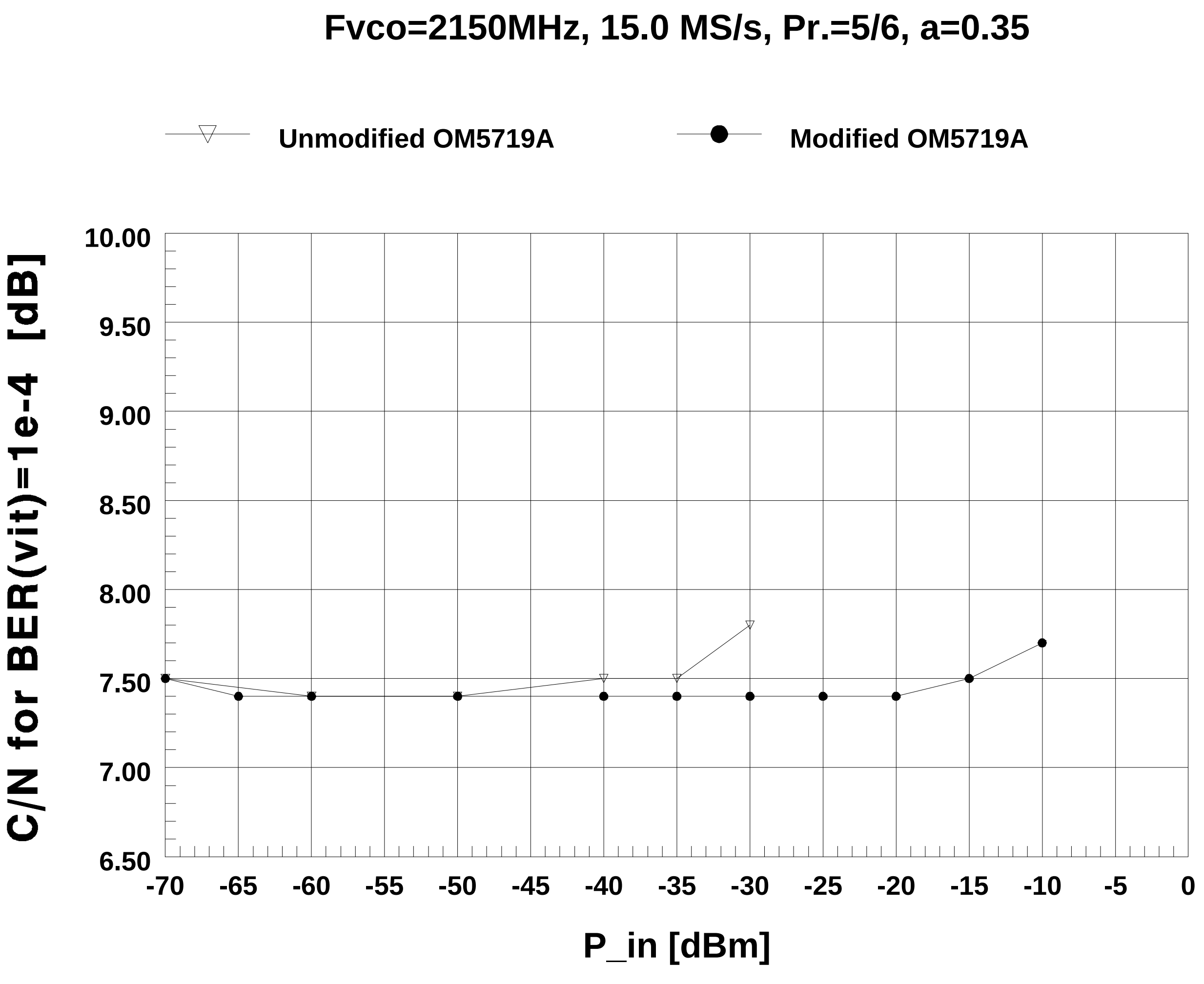


Fig.7

TABLE 9 Unmodified board: f=1500 MHz, S.R.=10.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-20**	**-17**			
C/N [dB]	7.7	7.3	7.1	7.1	7.1	7.1	7.2	7.4		c.s.			
AGC	235	182	144	110	99	87	70	54		40			

TABLE 10 Modified board: f=1500 MHz, S.R.=10.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-20**	**-15**	**-12**		
C/N [dB]	7.4	7.2	7.1	7.1	7.1	7.1	7.1	7.2	7.3		c.s.		
AGC	231	170	133	102	94	72	54	40	27		15		

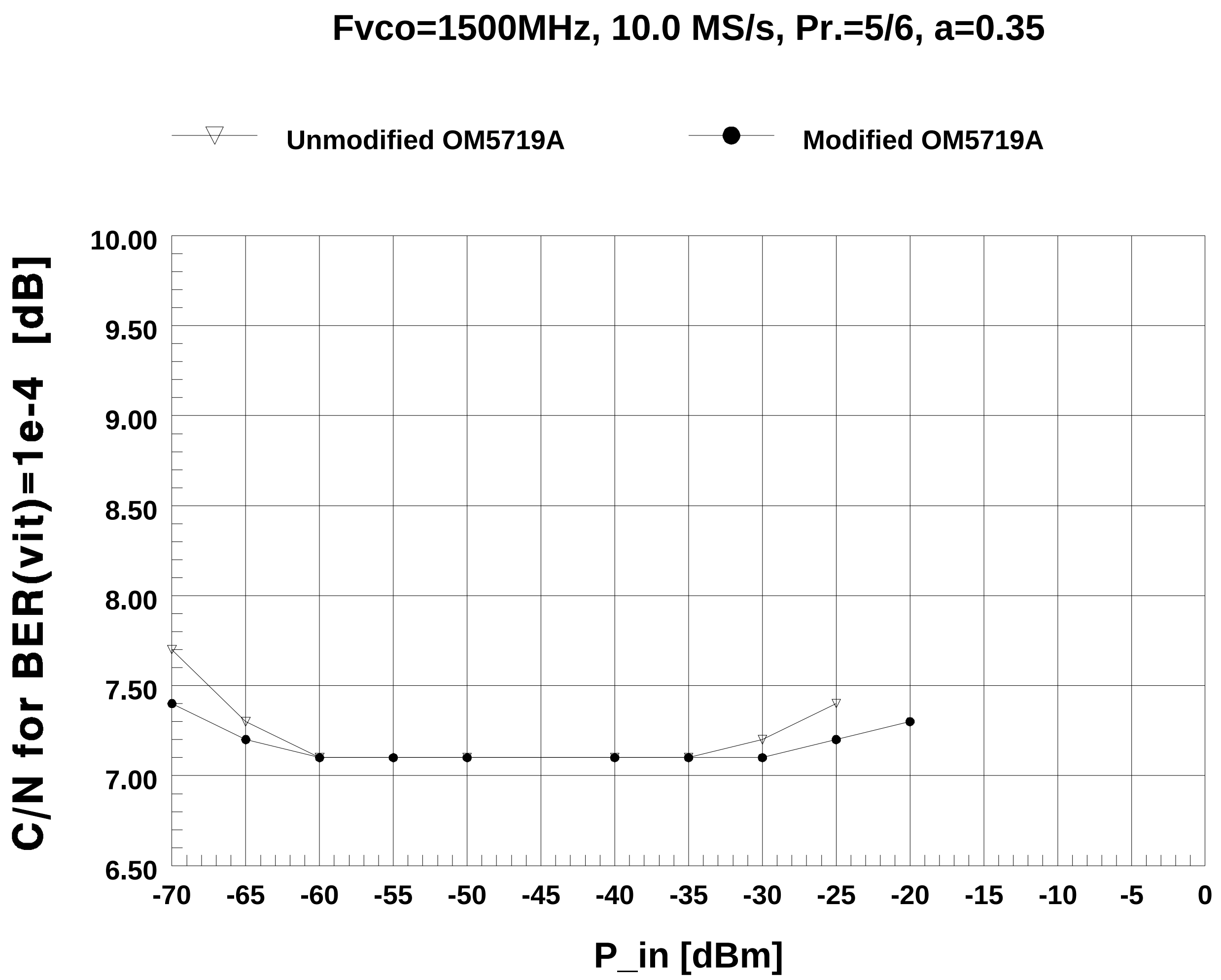


Fig.8

TABLE 11 Unmodified board: f=2150 MHz, S.R.=10.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**					
C/N [dB]	7.2	7.1	7.1	7.1	7.2	7.2	7.7	c.s.					
AGC	255	255	184	123	102	88	71	65					

TABLE 12 Modified board: f=2150 MHz, S.R.=10.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-20**	**-15**	**-10**	**-8**	
C/N [dB]	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.2	7.4		c.s.	
AGC	255	231	169	109	94	71	55	41	27	16		8	

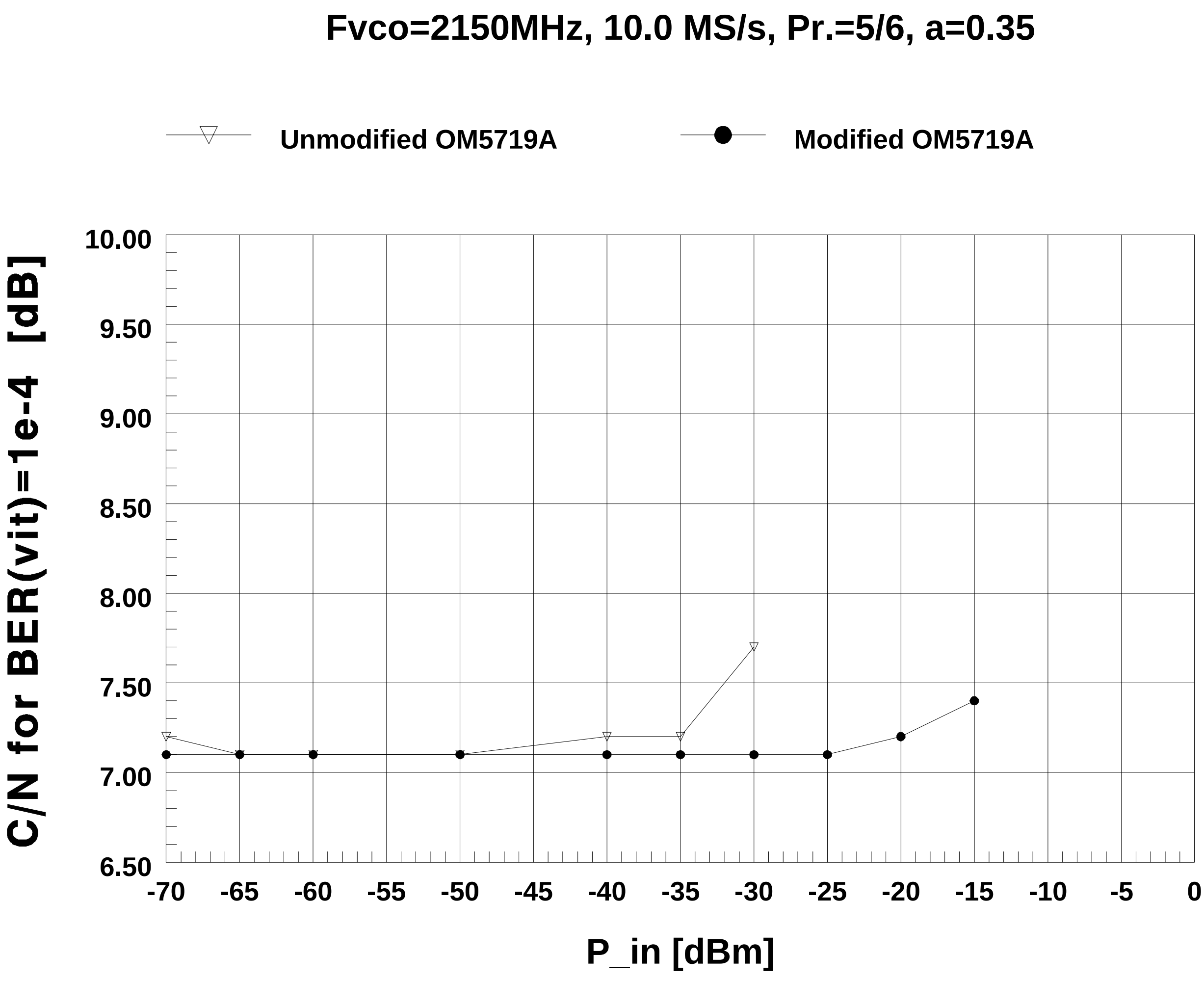


Fig.9

TABLE 13 Unmodified board: f=1350 MHz, S.R.=6.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-20	-15	-14		
C/N [dB]	7.5	7.3	7.2	7.2	7.2	7.2	7.2	7.4	7.9		c.s.		
AGC	210	166	136	108	99	86	69	54	40		36		

TABLE 14 Modified board: f=1350 MHz, S.R.=6.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-20	-18			
C/N [dB]	7.4	7.2	7.1	7.1	7.1	7.1	7.1	7.3		c.s.			
AGC	195	152	124	100	93	71	54	39		31			

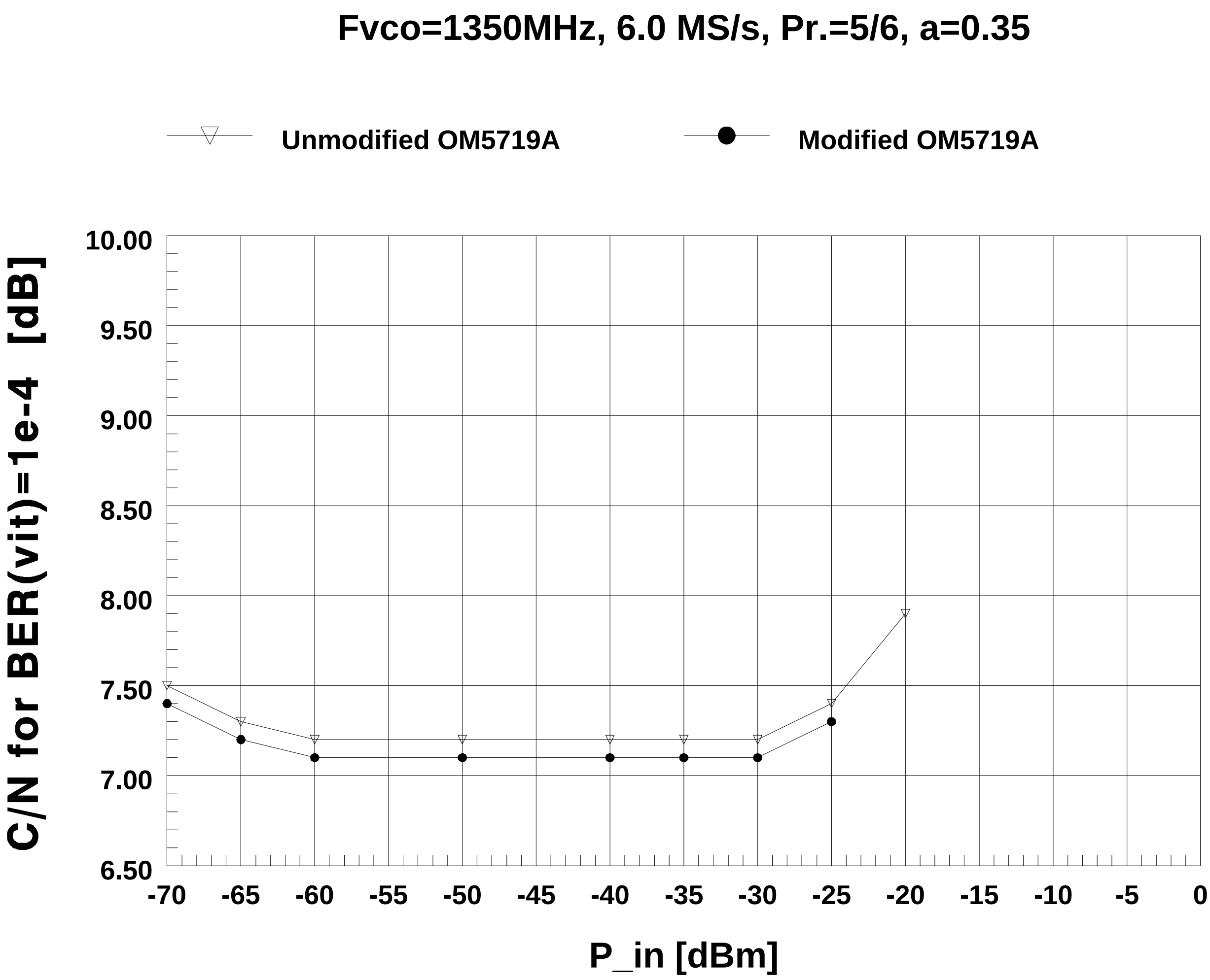


Fig.10

TABLE 15 Unmodified board: f=1500 MHz, S.R.=6.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-21				
C/N [dB]	7.1		7.0	7.0	7.1	7.1	7.3		c.s.				
AGC	225		140	108	98	84	67		52				

TABLE 16 Modified board: f=1500 MHz, S.R.=6.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	-70	-65	-60	-50	-40	-35	-30	-25	-20	-15			
C/N [dB]	7.1	7.1	7.1	7.0	7.0	7.0	7.1	7.2	7.9	c.s.			
AGC	211	159	128	100	89	68	52	37	25	22			

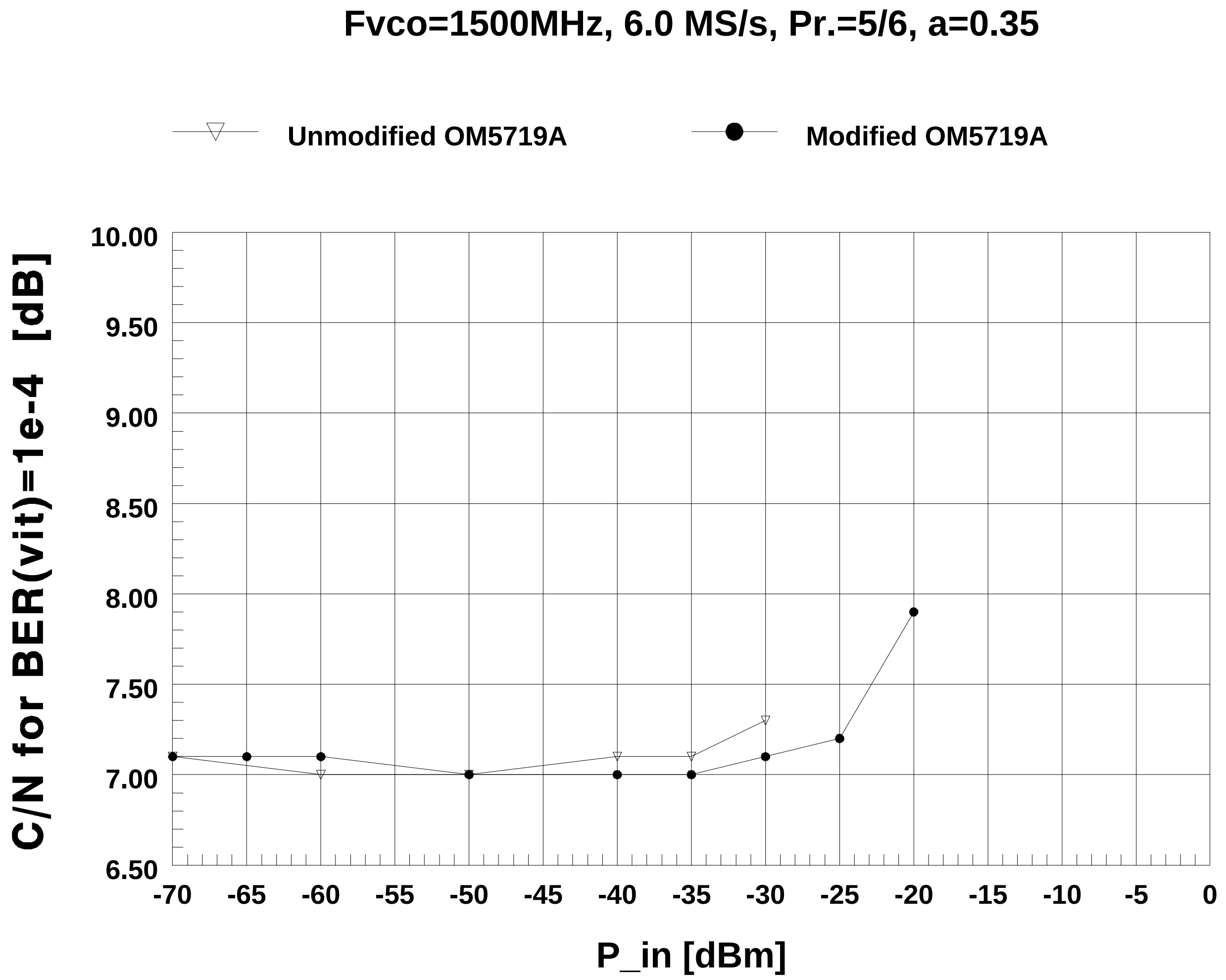


Fig.11

TABLE 17 Unmodified board: f=2150 MHz, S.R.=6.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-29**					
C/N [dB]	7.1		7.0	7.1	7.3	7.5		c.s.					
AGC	255		177	120	100	85		78					

TABLE 18 Modified board: f=2150 MHz, S.R.=6.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-20**	**-15**	**-10**	**-9**	
C/N [dB]	7.1	7.0	7.0	7.1	7.1	7.1	7.1	7.1	7.2	7.6		c.s.	
AGC	255	210	158	106	90	68	52	38	25	13		10	

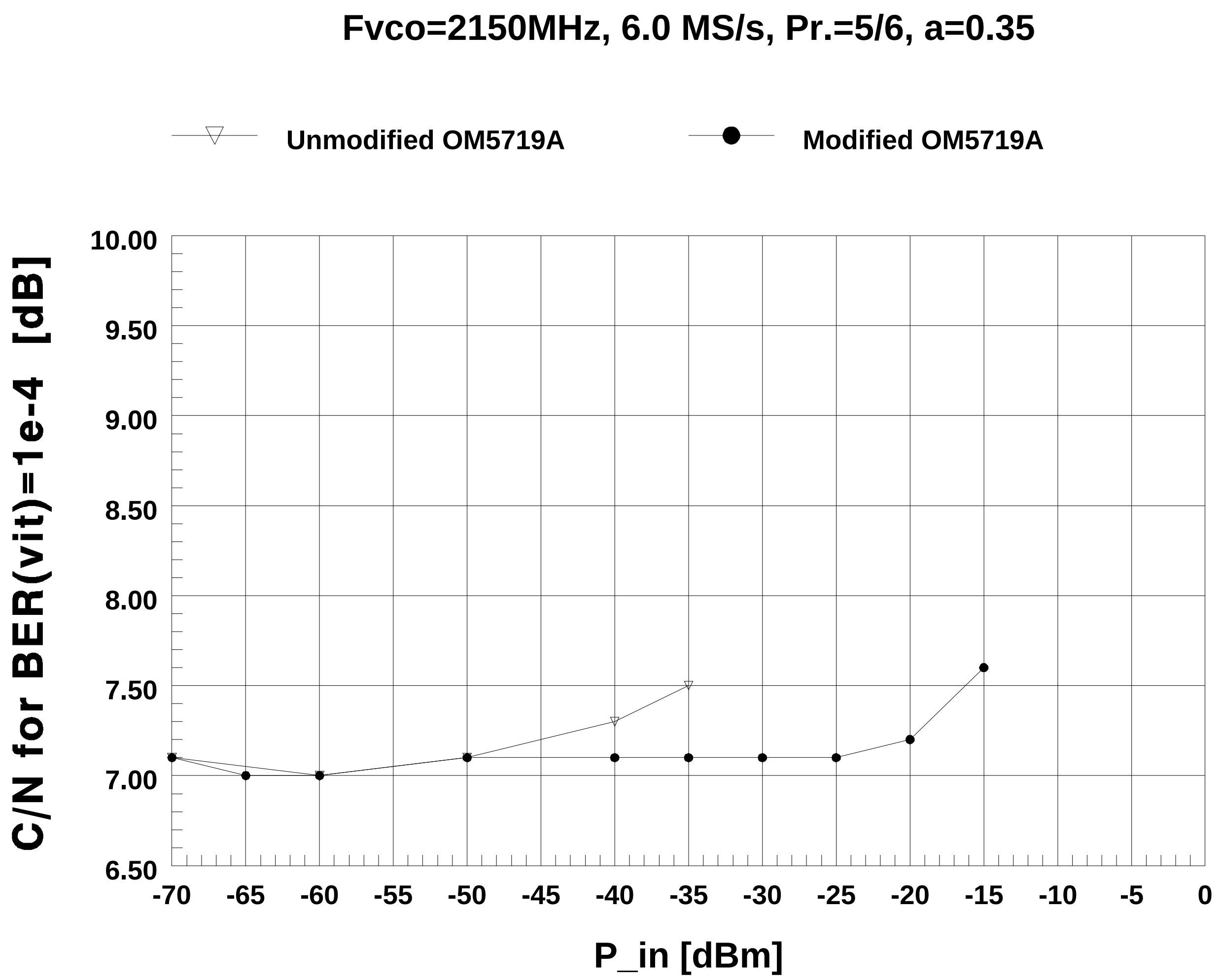


Fig.12

TABLE 19 Unmodified board: f=1500 MHz, S.R.=4.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-24**				
C/N [dB]	7.1	7.1	7.1	7.1	7.1	7.2	7.8		c.s.				
AGC	213	164	135	107	98	80	64		61				

TABLE 20 Modified board: f=1500 MHz, S.R.=4.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-20**	**-19**			
C/N [dB]	7.1	7.0	7.0	7.1	7.1	7.1	7.1	7.5		c.s.			
AGC	199	151	122	99	85	64	48	35		31			

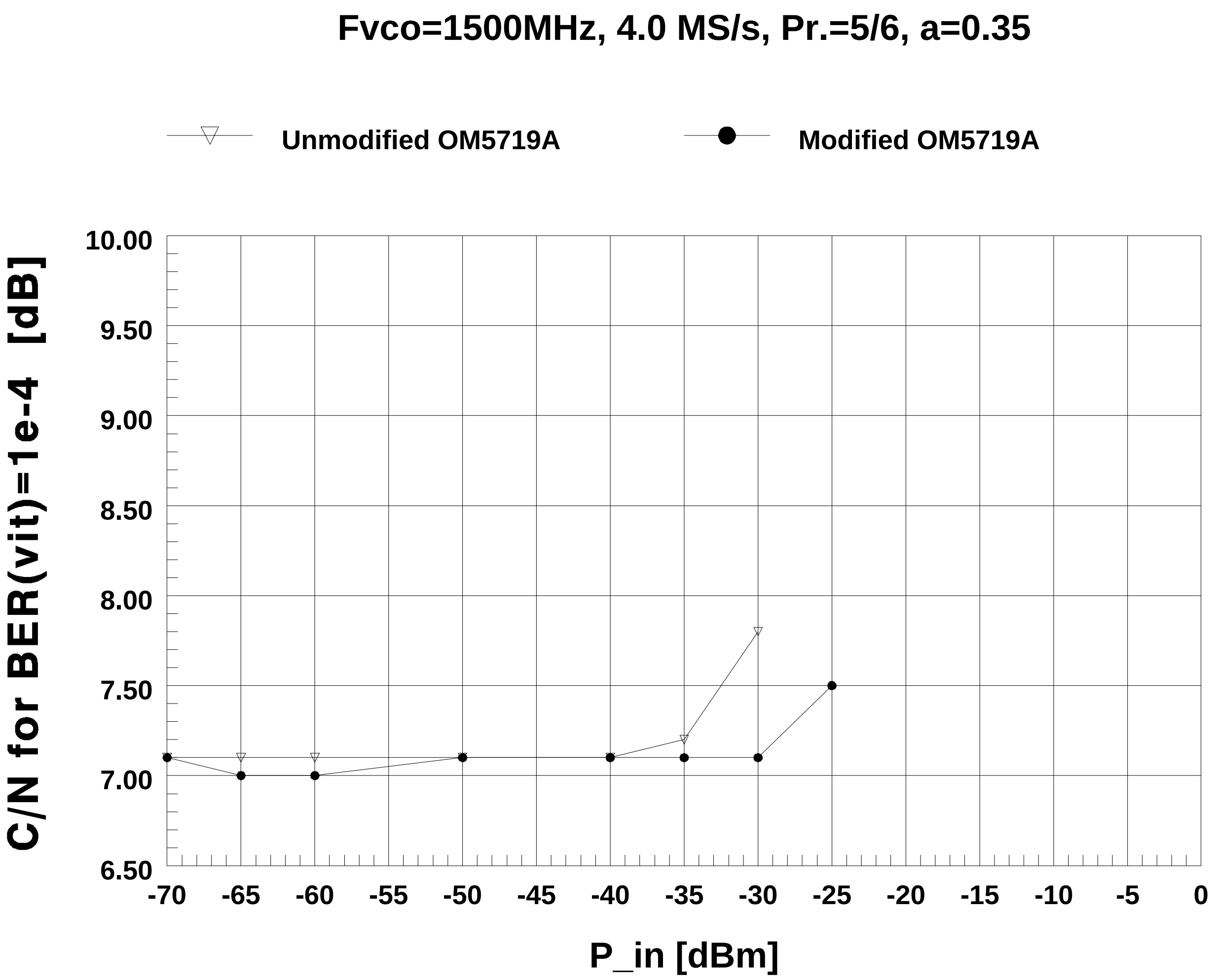


Fig.13

TABLE 21 Unmodified board: f=2150 MHz, S.R.=4.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-31**						
C/N [dB]	c.s.	c.s.	c.s.	7.1	7.5	8.6	c.s.						
AGC				116	99	82	82						

TABLE 22 Modified board: f=2150 MHz, S.R.=4.0 MS/s, Pr.=5/6, a=0.35

Pin [dBm]	**-70**	**-65**	**-60**	**-50**	**-40**	**-35**	**-30**	**-25**	**-20**	**-15**	**-14**		
C/N [dB]	7.1	7.0	7.0	7.0	7.1	7.1	7.1	7.2	7.7		c.s.		
AGC	255	198	150	104	85	65	50	35	23		19		

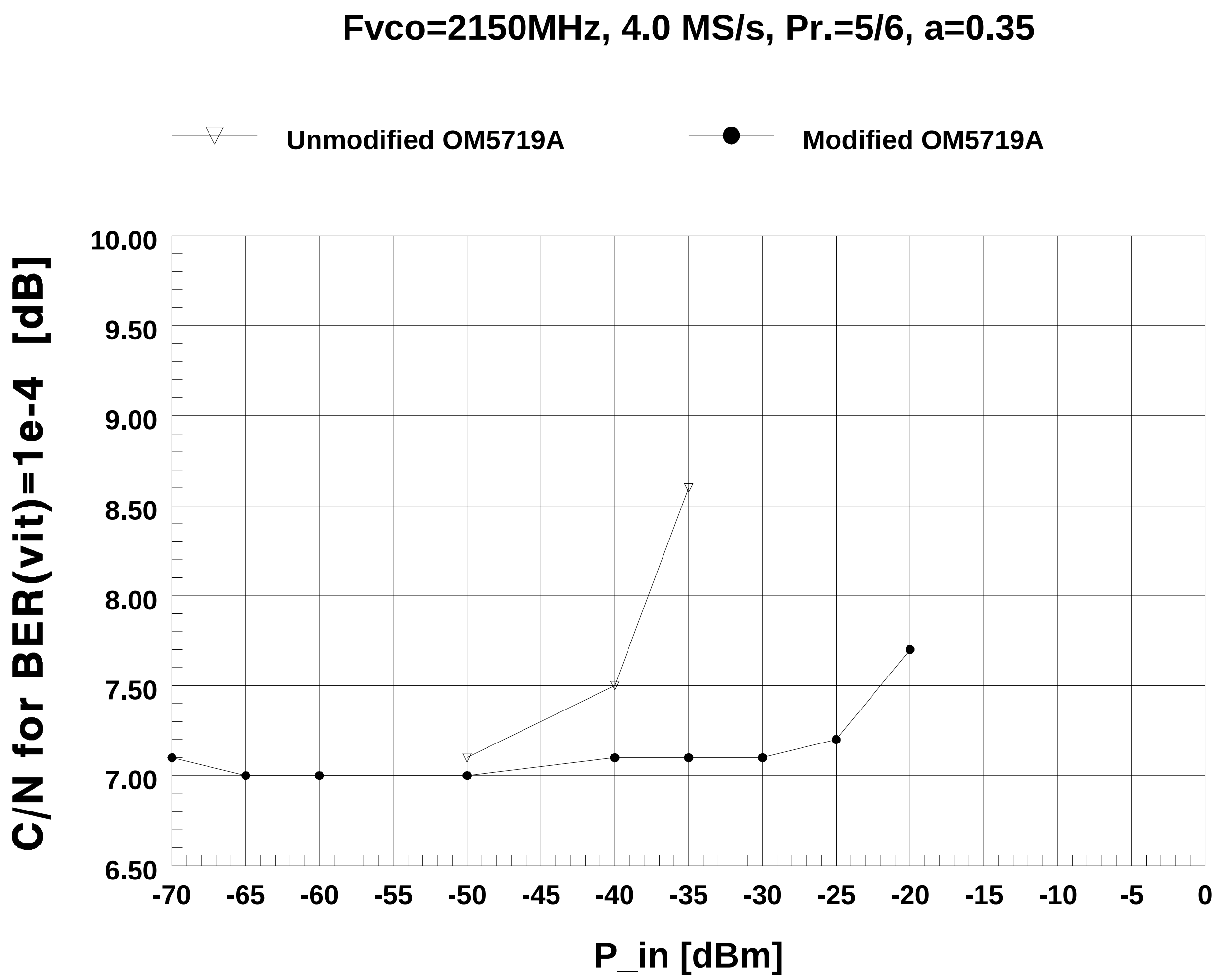


Fig.14

Fig. 15 shows at which input power level cycle slips occur for a certain symbol rate and Fvco = 1500 MHz. Cycle slips measured with BER meter with the same measurement setup as before, but with noise switched off.

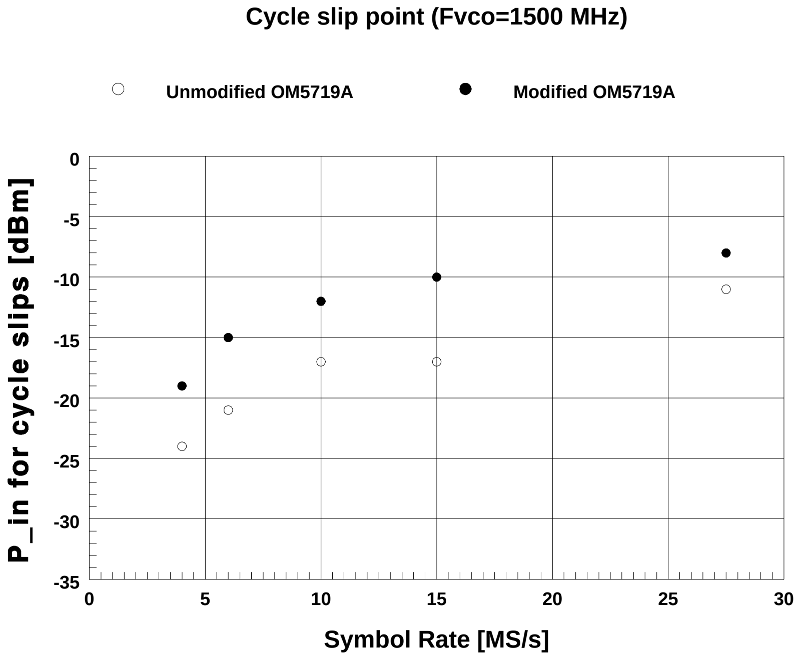


Fig.15

Fig. 16 shows at which input power level cycle slips occur for a certain symbol rate and Fvco = 2150 MHz. Cycle slips measured with BER meter with the same measurement setup as before, but with noise switched off.

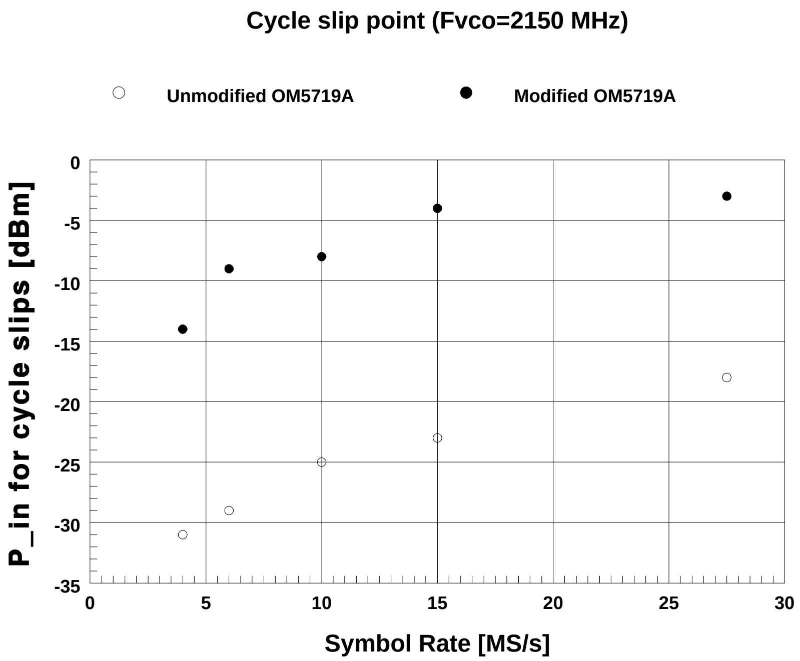


Fig.16

2.2 LO leakage measured at the RF input

The measured LO power at the RF input gives an indication of the amount of isolation from the LO tank circuit to the RF input. Insufficient isolation between the LO tank circuit to the RF input might lead to degraded pulling behaviour.

2.2.1 Measurement setup

The measurement setup is shown in Fig. 17.

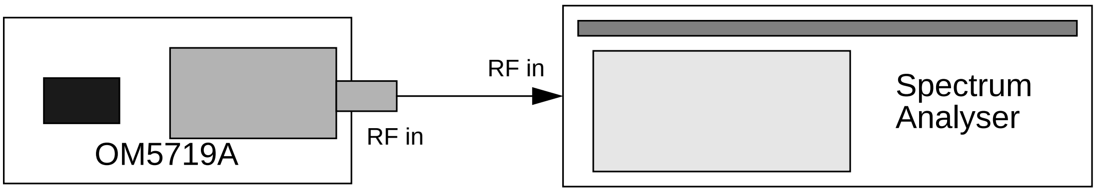


Fig.17 “LO leakage” measurement setup

2.2.2 Measurement procedure

- Connect the power supplies of the OM5719A.
- Put the AGC jumper (J1) to *AGC MAN*. In this mode the AGC is controlled by the *GAIN* potmeter (R1).
- Adjust R1 to +5V or +0.8V.
- Connect a spectrum analyser to the RF INPUT connector of the OM5719A.
- Load the software OM5719A.
- Select the correct Channel and Tuner related settings. Afterwards disable the “I2C tuner” setting.
- Set the frequency of the spectrum analyser to the same frequency as the VCO.
- Measure the absolute leakage power level.

TABLE 23 Unmodified board

Frequency [MHz]	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150
Pout [dBm] Vagc=+5V	-72.0	-77.5	-82.5	-81.5	-82.5	-75.8	-74.5	-72.0	-71.0	-71.2	-70.0	-67.3	-69.0
Pout [dBm] Vagc=+0.8V	-70.5	-78.0	-84.2	-81.0	-83.3	-76.7	-72.3	-70.0	-67.5	-64.5	-64.3	-63.5	-66.5

TABLE 24 Modified board

Frequency [MHz]	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150
Pout [dBm] Vagc=+5V	-71.3	-78.5	-80.5	-81.3	-84.3	-77.5	-74.0	-72.2	-70.5	-72.0	-68.5	-65.7	-68.2
Pout [dBm] Vagc=+0.8V	-69.7	-78.5	-81.8	-80.3	-82.0	-76.3	-72.3	-70.0	-66.8	-64.8	-64.2	-62.7	-65.5

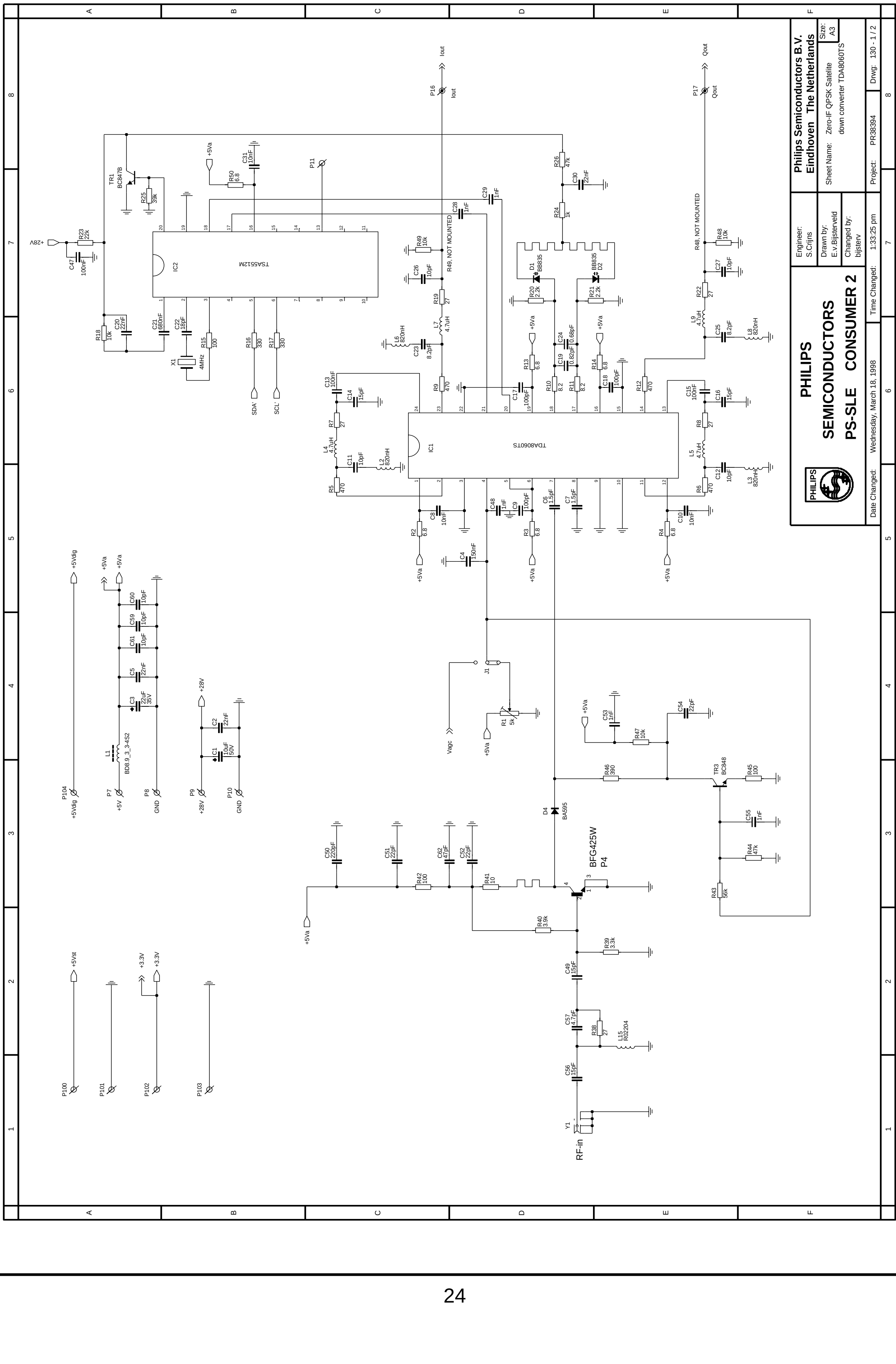
3. Conclusions

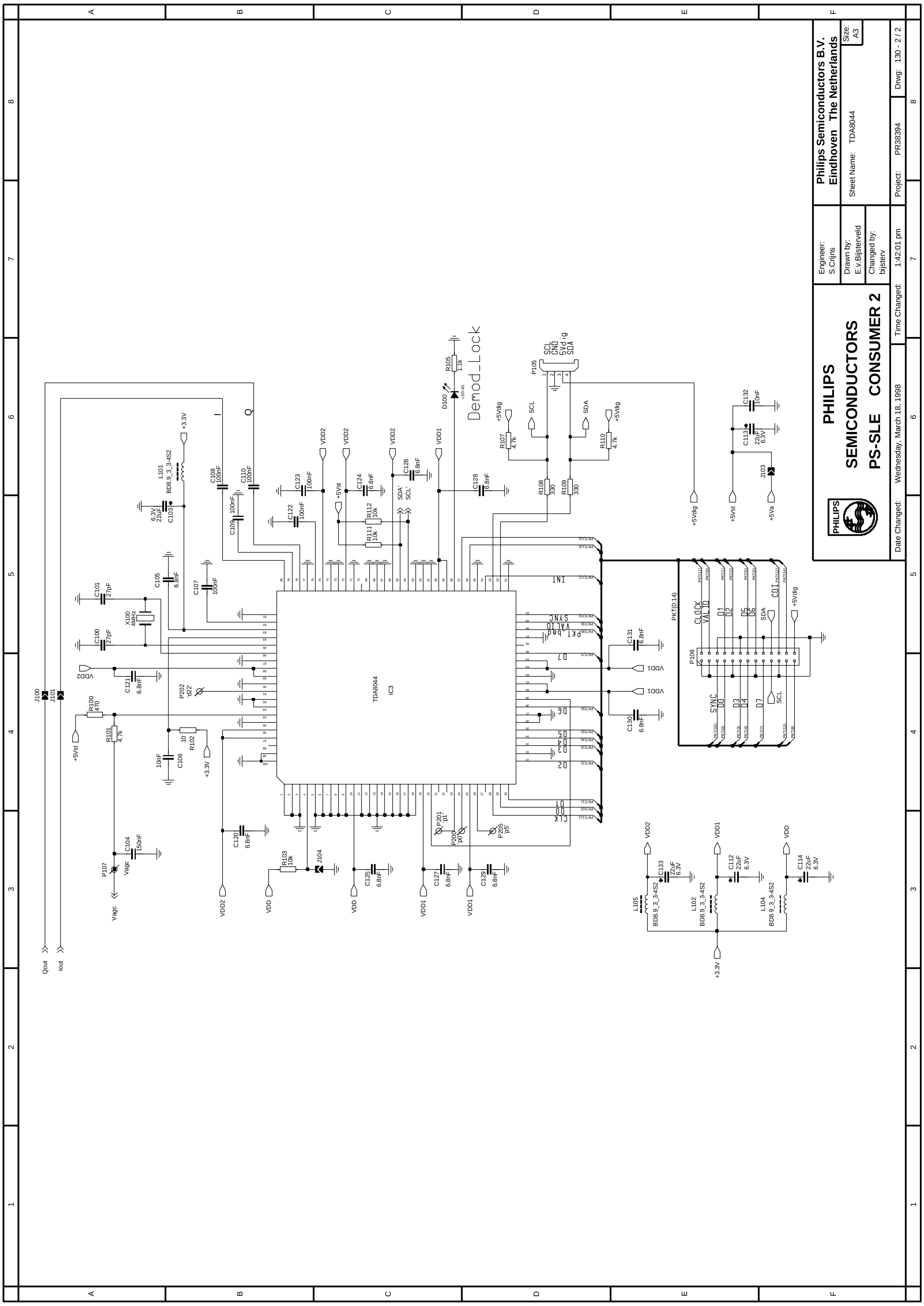
The measurement results show a significant improvement regarding pulling behaviour on the modified board compared to the original OM5719A board. The modified board can handle larger QPSK modulated RF input power levels at different frequencies and symbol rates before the BER value degrades or even cycle slips occur.

Because LO power measured at the RF input (LO leakage) is not dramatically changed after implementation of the modifications, it can be concluded that capacitive coupling between the RF input and the LO tank circuit is not causing the pulling problems.

Further investigations to improve the performance of the OM5719A are ongoing and all improvements found will be implemented on a new release.

APPENDIX 1 Board schematics

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Drwg: 130 - 2 / 2
Date Changed: Wednesday, March 18, 1998
Time Changed: 1:42:01 pm
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