(NASA-CR-164082) AUTOMATIC GAIN CONTROL (Ohio Univ.) 8 p HC A02/MF A01 CSCL 17G
N81-20053
Unclas
G3/04 41900

TECHNICAL MEMORANDUM (NASA) 79

AUTOMATIC GAIN CONTROL

An automatic gain control has been designed and fabricated to operate with the Loran-C prototype receiver and data collection system currently in use at Ohio University.

by

James P. Roman

Avionics Engineering Center
Department of Electrical Engineering
Ohio University
Athens, Ohio 45701

March 1981

Supported by

National Aeronautics and Space Administration
Langley Research Center
Hampton, Virginia

Grant NGR 36-009-017

TABLE OF CONTENTS

		Page
I.	INTRODUCTION	1
II.	CIRCUIT DESCRIPTION	1
III.	TEST RESULTS	1
	1. Gain Vs. Frequency and Phase Angle Vs. Frequency (Figure 2)	1
	2. Gain Vs. AGC Voltage (Figure 3)	1
	3. Gain Vs. Signal Voltage (Figure 4)	5
	4. Power Dissipation and Circuit Resistance	5
IV.	SUMMARY	5
V.	ACKNOWLEDGEMENTS	5
VI.	BIBLIOGRAPHY	5

I. INTRODUCTION

The NASA Tri-University program at Ohio University is currently involved in the development of a low-cost Loran-C receiver for use in general aviation aircraft. An automatic gain control (AGC) has been designed and built to operate with the prototype Loran-C receiver.

Since there are such extreme distances between Loran stations, the signal strengths coming into the user are at different magnitudes. It is advantageous to have the signal magnitudes equal; therefore, the automatic gain control was designed for the front end of the prototype Loran-C receiver.

II. CIRCUIT DESCRIPTION

The automatic gain control is a three-transistor circuit (see Figure 1) which requires a constant D.C. voltage of 8 volts. Tests conclude that this value may be in the range of 4 to 12 v without change in circuit performance. Transistors Q_1 and Q_2 are cascaded to pass and amplify the input signal. The gain of Q_1 and Q_2 is controlled by Q_3 which itself is controlled by an external AGC voltage between 0 and 8 volts D.C. The integrated circuit used is an RCA CA3028A, an 8-pin chip, which is a differential cascode amplifier designed for use in communications operating at frequencies from D.C. to 120 MHz. The integrated circuit has been balanced for AGC capabilities, and has a wide operating current range. The maximum input current at pins 1 and 5 is 0.1 mAmps. The absolute maximum dissipation at $T_a \leq 85°$ C is 450 mWatts. At $T_a > 85°$ C the integrated circuit is derated linearly 5 mW/°C. The ambient temperature for operation is -55° C to +125° C and -65° C to +150° C for storage.

III. TEST RESULTS

1. Gain Vs. Frequency and Phase Angle Vs. Frequency (Figure 2)

The frequency response and phase angle is measured with the input signal voltage held constant at 50 mV, and is an average of all AGC voltages from 1 V to 8 V. The band width of the automatic gain control is 20 KHz to 2 MHz, with a standard deviation of no greater than ± 0.4 dB. The phase angle increases linearly at frequencies between 70 KHz to 120 KHz, from 0° to +21.6° respectively.

2. Gain Vs. AGC Voltage (Figure 3)

This test was performed at a constant frequency of 105.4 KHz and a constant input signal voltage of 50 mVolts. The gain is approximately -26 dB from 0 to +2.5 volts, between 1 and 2.5 volts the gain increases rapidly from -22 dB to +2.5 dB, between 3 and 8 volts the gain increases from 2.5 dB to 25 dB. Distortion and gain compression occurs at 8.4 volts AGC and loss of gain occurs at AGC voltages greater than 12 volts.

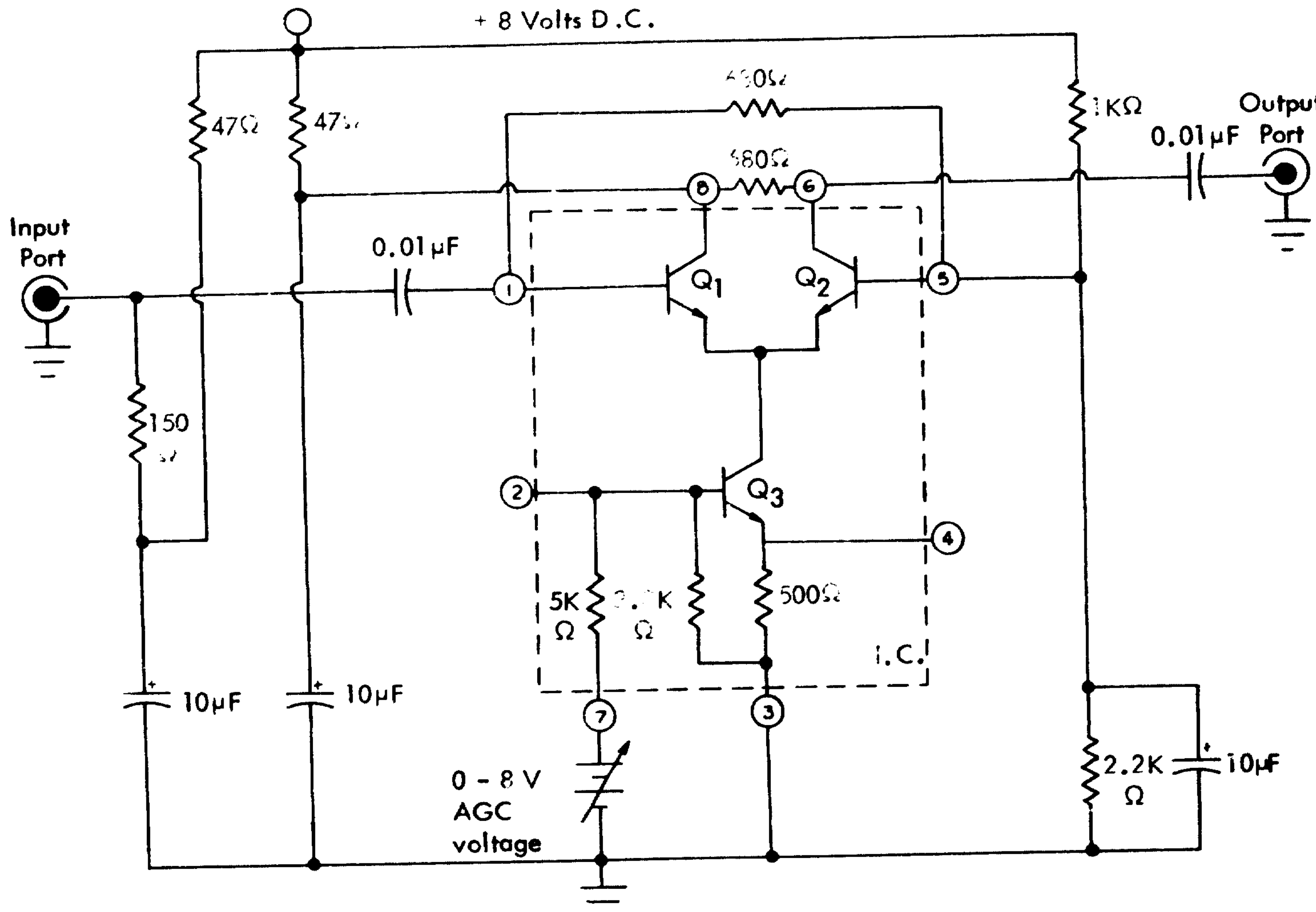

Figure 1. Automatic Gain Control Circuit.

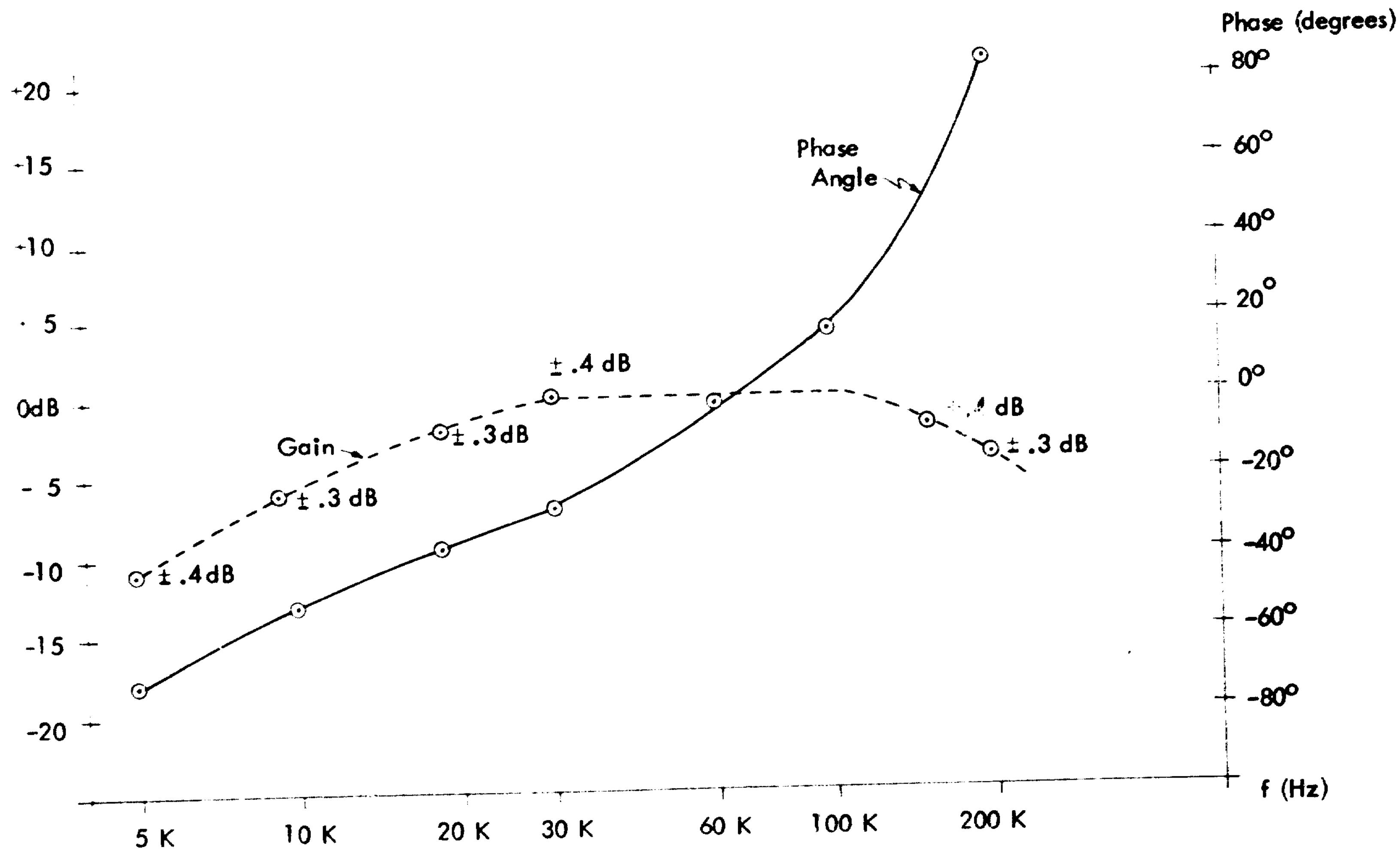

Figure 2. Phase Angle Vs. Frequency.

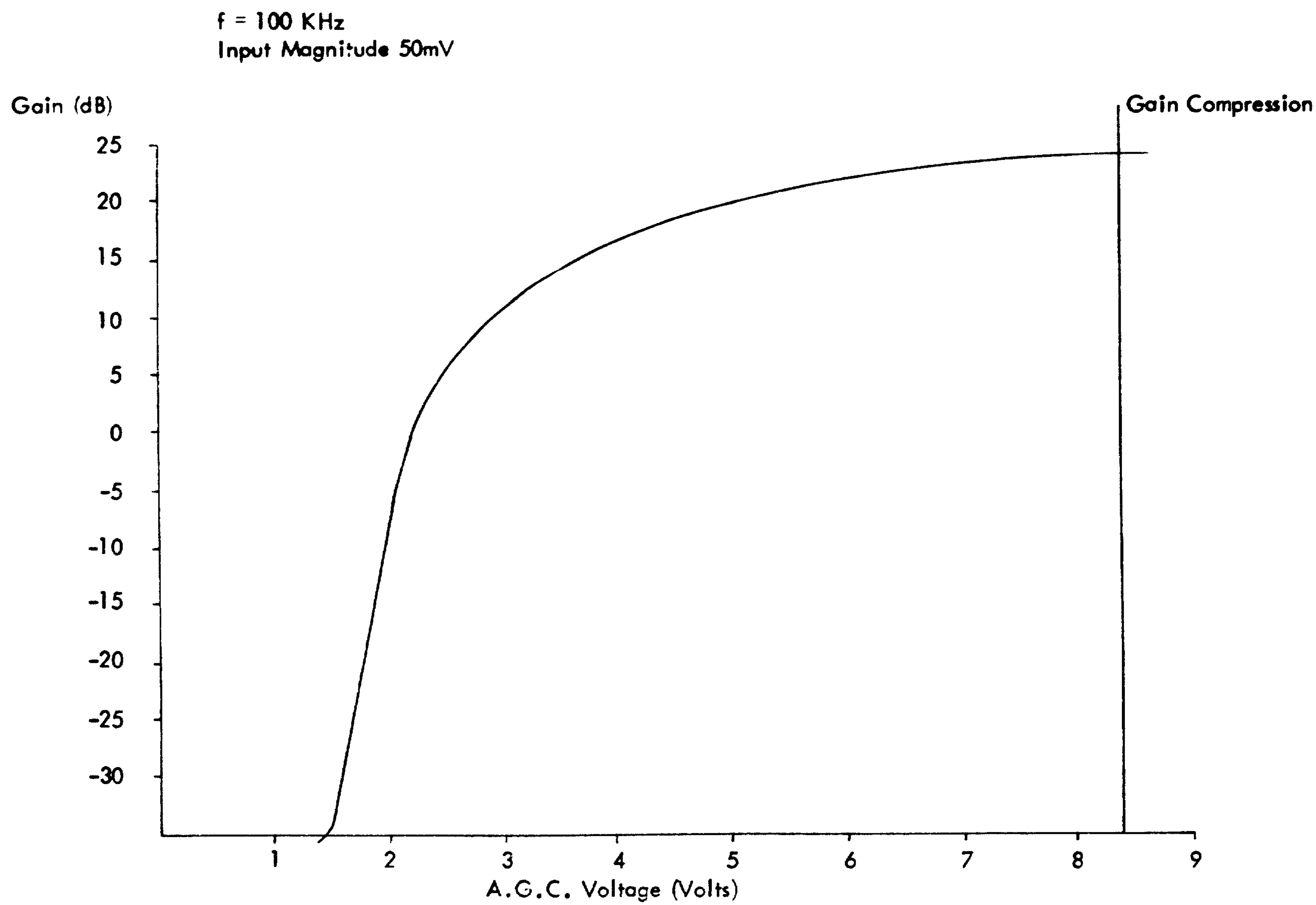

Figure 3. Gain Vs. A.G.C. Voltage.

3. Gain Vs. Signal Voltage (Figure 4)

This test was performed at a constant frequency of 100 KHz and is an average of AGC voltages from 3 to 8 volts. The operating recommended input voltages are between 5mV and 75 mV. In this range there was a constant gain with a standard deviation of only $\pm$ 0.109 dB.

4. Power Dissipation and Circuit Resistance

This test was performed at a frequency of 100 KHz with an input signal voltage of 50 mVolts. The circuit draws 50 mAmps constant current. The D.C. power dissipation was 59 mWatts (Max. $P_{D.C}$ dissipation 450 mWatts). A.C. current at pins 1 and 5 is approximately 61.21 μA at 100 KHz. The A.C. power dissipation is approximately 3.035×10^{-6} watts with a power factor of .9 leading calculated error for A.C. power is 4.1%.

Circuit Resistance

Input Resistance $R_i' = 140\ \Omega$

Output Resistance $R_o' = 740\ \Omega$

IV. SUMMARY

The automatic gain control was designed specifically to operate with the prototype Loran-C receiver and data collection system. The use of the automatic gain control is intended to eliminate error which occurs when signals are received at different magnitudes.

V. ACKNOWLEDGEMENTS

The design and construction of the automatic gain control was supported by the NASA Tri-University program and is part of the development of a low-cost Loran-C navigation receiver for general aviation aircraft. The author would like to thank Mr. Ralph Burhans of the Ohio University Avionics Engineering Center who designed the automatic gain control.

VI. BIBLIOGRAPHY

"R.C.A. Integrated Circuits", R.C.A. Solid State, Somerville, New Jersey, Pub. 1976.

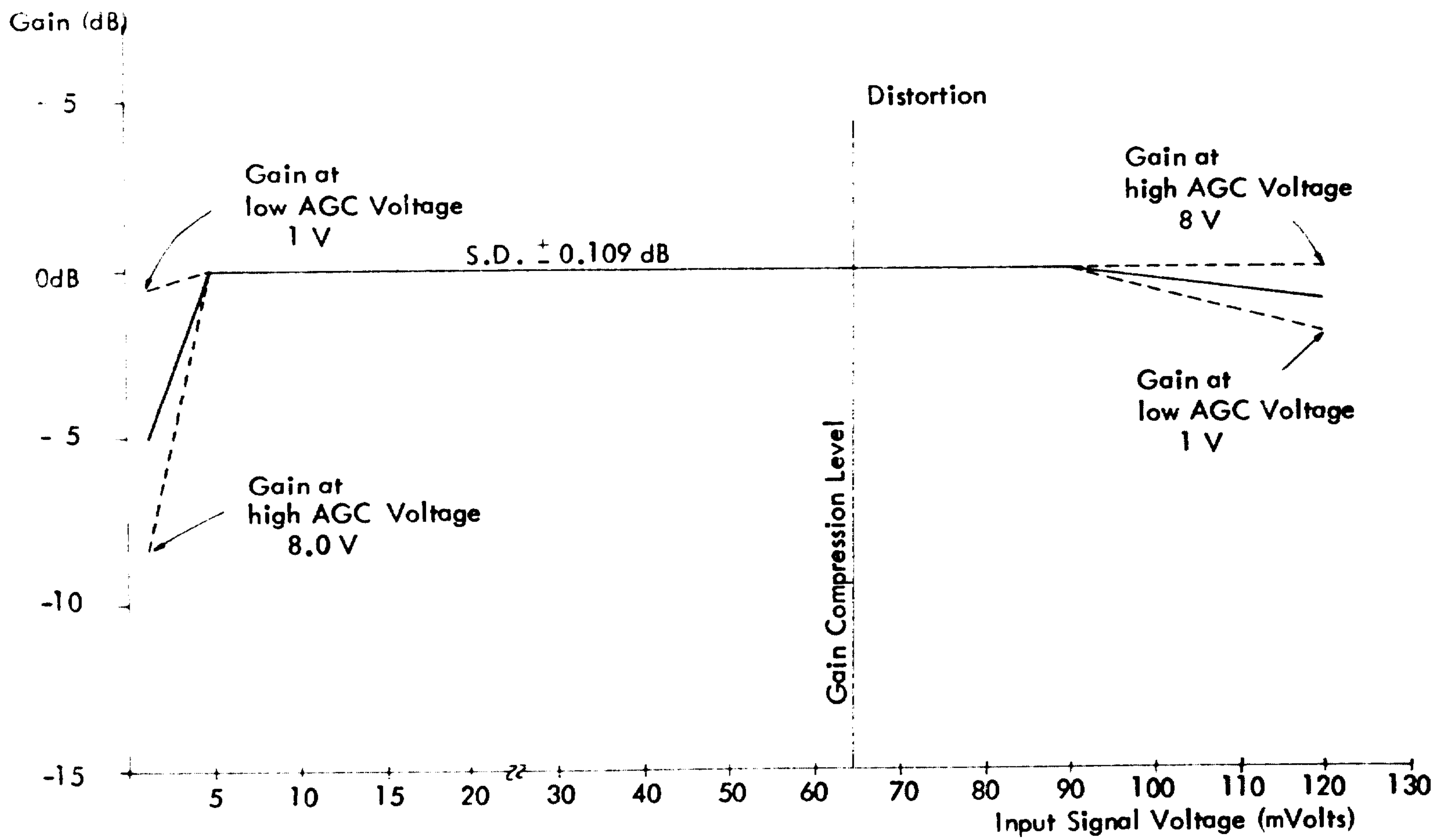

Figure 4. Gain Vs. Signal Voltage f = 50.0KHz.