THAT docu

anabrid

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Welcome to the THAT website, a homepage generated and maintained by anabrid GmbH.

This Wiki contains educational articles for basic understanding of electronic analog computers and documentation about **The Analog Thing** (or THAT for short), an affordable Open Source Analog Computer with a focus on education, hobbyists, programmers, scientists and everybody interested in non-traditional computing architectures. The THAT can be purchased from anabrid or assembled/ recreated by anybody with basic experience in electronics and soldering.

CHAPTER

ONE

BASICS

1.1 Differential equations

1.2 Machine Unit

The **THAT**, as most other electrical analog computers, can compute values in the range from -1 to +1. So every program needs to be checked if it exceeds +/-1 at any point. This check can also happen theoretically as well as experimentally. If a running programm exceeds +/-1, most analog computers will change into an overload state to protect the computing elemtents so no damage is to be expected. However the computing results are useless in case of overload.

The THAT indicates overload state with a red LED light with **OL** marked.

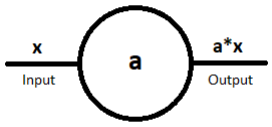
The **machine unit** is a technical variable and **represents the maximum voltage** which can be applied to the computing elements of an electrial analog computer.

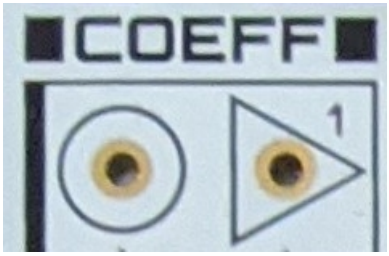
The machine unit is system specific, the **THAT has a machine unit of +/- 10 volts.**

The CHINCH-outputs (x, y , z, u) have a 10 to 1 voltage devider so the results given by those outputs can only give values between -1 and +1.

1.3 Computing elements

1.3.1 Coefficient potentiometer





The simplest and only passive standard component ist the **coefficient petentiometer**.

Commonly realized as precision potenetiometer connected as voltage divider, it is used to multiply a given input with a value between 0 and 1, so **a*x** is generated.

It can also be used as dividing factor so **x/a** is generated.

Round/circular panel –> Input

Triangular panel –> Output

1.3.2 Operation amplifier

The **operation amplifier** is the most important electronic part in electrical analog computers.

The term *operation amplifier* was introduced and defined by *John Ragazzini* in 1947:

> "As an amplifier so connected can perform the mathematical operations of arithmetic and calculus on the voltages aookued ti its input, it is hereafter termed an *Operational Amplifier*."

In it's simplest form, the operation amplifier can be found in analog computers as so called *open amplifiers*, where the positive input is eleictrically grounded while it's negitave input is connected to a resistor. This is used to generate inverse functions (e.g. a multiplier in combination of an open amplifier functions as divider).

1.3.3 Summer

1.3.4 Integrator

Priciple circuit

Practical circuit

1.3.5 Function generators

1.3.6 Creating inverse functions

1.3.7 Multiplier

Devision and root

1.3.8 Comperators

1.3.9 Coordinate converter

1.3.10 Delays

1.3.11 Noise generators

1.3.12 Patch field

1.3.13 Output devices

1.4 Operation modes of analog computers

1.5 Programming analog computers

1.6 Visualization of computing results

CHAPTER

TWO

APPLICATIONS

2.1 Hindmarsh-Rose neuron model

2.2 Lorenz attractor

CHAPTER

THREE

HISTORY

3.1 Early electronic analog computers:

3.2 Mechanical analog computers

3.3 Electronic analog computers since 1950