

PRELIMINARY KNOWLEDGE

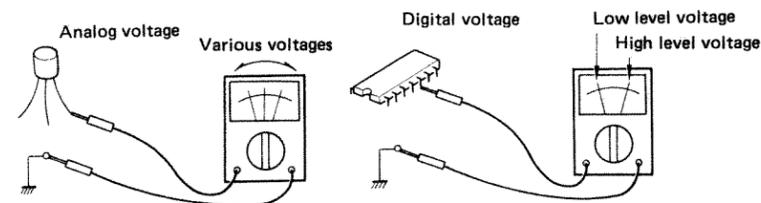
Digital & analog

The difference between the analog system and digital system can be understood, for example, by considering the difference between the hand-indicating-type watch and digital watch. That is, it can be said to be the difference between a quantity that varies continuously and a quantity that varies by intervals of a certain pitch.



Analog voltage

When you refer to an electrical circuit as being "digital", the matter is not so simple as in the case of a watch. In the case of analog voltages, values that assume importance are those of a wide range, such as 3.14V, or 12.34V when measured by a tester. On the other hand, digital voltages consist of only two kinds, higher voltages and lower voltages.



"1" and "0"

For this reason, for digital voltages, higher voltages are simply denoted by "H", or "1", and lower voltages by "L", or "0".

			+Logic	-Logic
Digital voltage	HIGH	H or	1	0
	LOW	L or	0	1
Analog voltage	DC XX V) Various voltages exist.		
	AC XX V			

1. EXPRESSES VALUES BY THE DIGITAL SYSTEM

As we have seen, digital voltages consist of only two kinds, "H" and "L", (or "1" and "0"). Thus, a value such as "how many volts" is expressed by several sets of "H" and "L" (or "1" and "0") combinations. This system is known as the binary method. For example, with two sets (2-digit binary number), it is possible to obtain 4 combinations as shown below.

UPPER BIT	L	L	H	H
LOWER BIT	L	H	L	H

or

Upper bit	Lower bit
00	01 10 11

2-bit binary number

Bit

Such combinations are called "2-digit binary numbers", or "2 bits". As "bit" is the more commonly used expression of the binary digits, try to remember it here. While with 2 bits it is only possible to express four values, an increasingly large number of values can be expressed as the number of bits is increased. Since the Programmable Synthesizer uses "8 bits" to express values, it can express as many as 256 types of values.

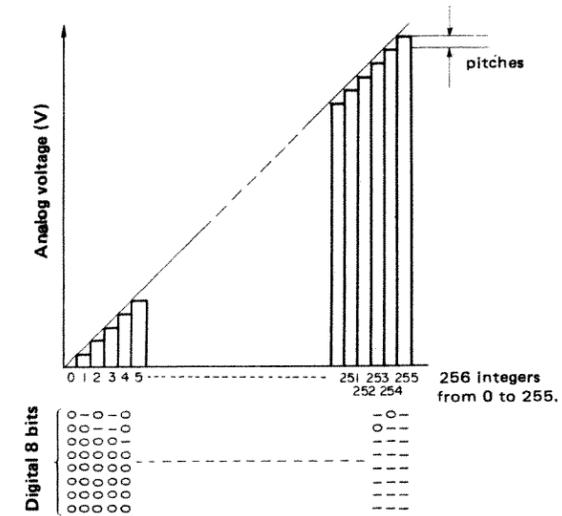
A/D CONVERTER AND D/A CONVERTER

A/D

The A/D converter plays the role of converting analog amounts into digital amounts. The roughness of the digital amount is determined depending on how many digits (bits) the binary number consists. The more the number of digits are increased, the higher the accuracy will become. But the circuit will be required to have a higher accuracy in this case, so that it will get more complex as a result.

As it is possible to divide a value into 256 types of combinations when 8 bits are used, if we should express "4V" with 8 bits, the result will be approximately 0.0156 V, as the resolution shall be 4/256. Values lower than this shall be disregarded.

* A/D conversion, in some cases, is also referred to as quantification.



D/A

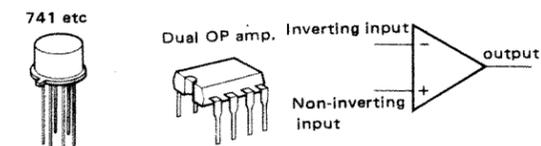
Conversely to the A/D converter, the D/A converter has the function of converting a digital amount into an analog amount. In terms of circuit operation, this job is usually performed by changing the reference voltage that has been applied to a ladder resistor into an electronic resistance by means of a switch. In this way, the D/A converter converts 8-bit digital values such as 00101000 into an analog value such as 0.625 V.

HINTS *****

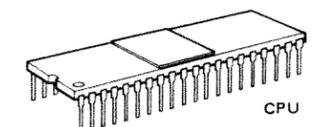
* Analog Synthesizers and Digital Synthesizers

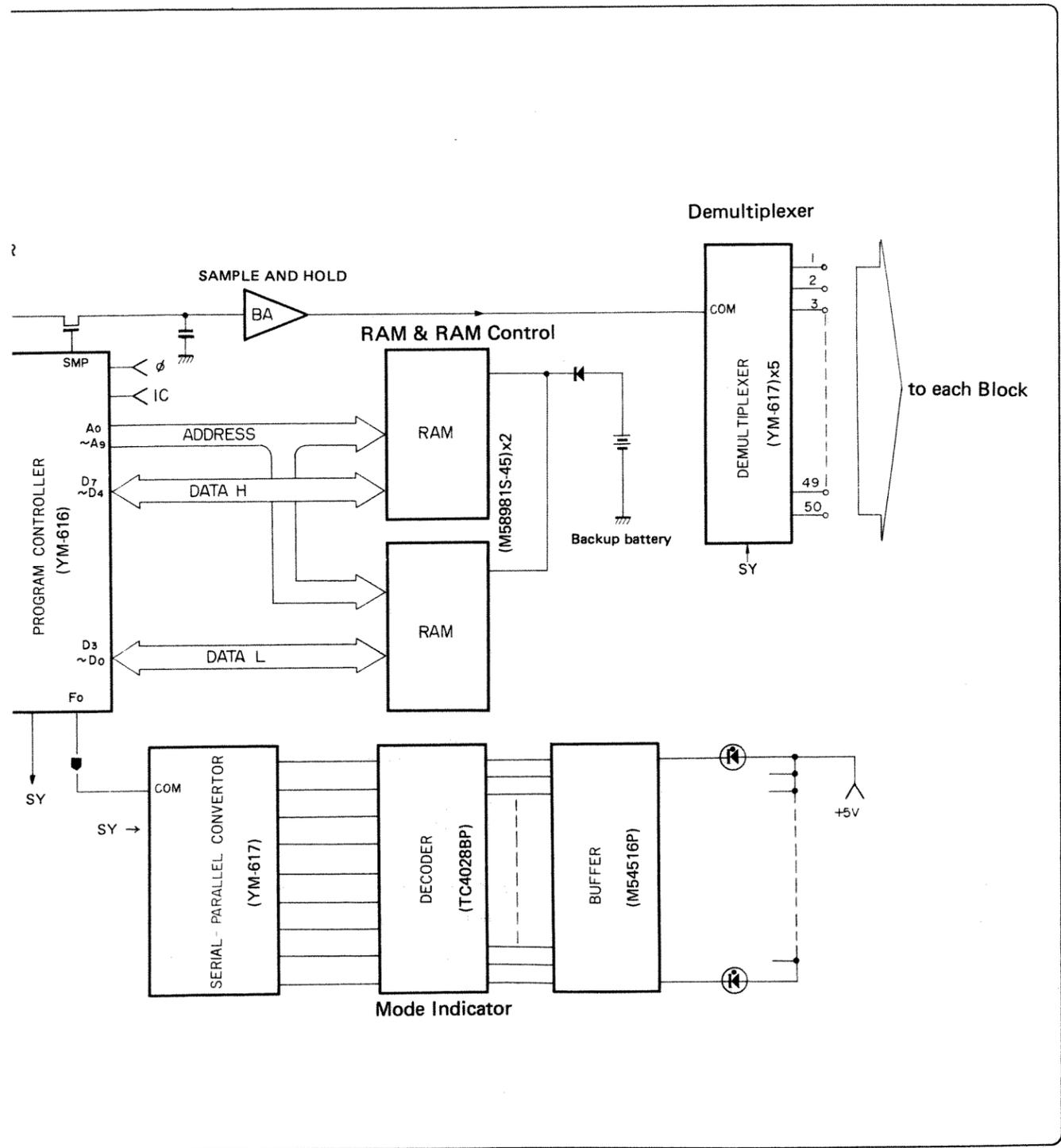
An ordinary synthesizer, in which the respective blocks that are chiefly composed of OP amplifiers (operational amplifiers) are controlled by voltages, is called an analog synthesizer. By contrast, a synthesizer which employs a microcomputer, for example, for control and in which practically all data processing is carried out digitally, is called a digital synthesizer. Although it is not as yet in popular use, it may be replaced by analog synthesizers sometime in the near future. According to the above classification, the CS-20M and CS-40M can be said to be analog synthesizers as each block is controlled finally by voltages.

The star performer in analog synthesizer



The star performer in digital synthesizer





1. FUNCTIONS OF PROGRAMMER

- 1) It functions to control the tones of the synthesizer by controlling 50 different kinds of programmable parameters, using the control voltage parameter that is generated by the control panel.
- 2) After being subjected to A/D conversion, the control voltage parameters are memorized into RAM (random access memory). The memorized data is then D/A-converted to control the blocks in order to bring the synthesizer to a setting that corresponds to the data.
- 3) As the programmer incorporates a cassette interface, it enables transfer of the voice data memorized into RAM onto a cassette tape, as well as transfer of the data recorded on the cassette tape to RAM.

5 mode function — The above operations are selected by working the operating buttons provided on the programmer to set the function modes of the CS-40M.

1. **PANEL Mode** The tone set on the control panel is produced.
2. **VOICE-WRITE Mode** 20 voices set by the panel using the 50 parameters are memorized.
3. **VOICE Mode** After selecting and reading out voice data from the 20 that have been memorized by RAM, the respective programmable voice data of the synthesizer are set.
4. **STORE Mode** Voice data memorized into RAM are transferred to the cassette tape using 3KHz tone burst signals. When this operation is completed, the synthesizer is restored to the PANEL mode.
5. **LOAD Mode** Voice data recorded on the cassette tape are transferred to RAM. On completion of this, the synthesizer is set to the PANEL mode.

MODE	OPERATION	FLOW OF CONTROL VOLTAGE
PANEL	1. Depress the PANEL button. 2. Or, set it automatically by switching on the POWER SW. 3. Simultaneously with completion of STORE and LOAD, the PANEL mode is recovered.	Control voltage generated → Multiplexer Sample Hold ← A/D, D/A conversions Demultiplexer → Control of blocks CS-20M: 32 parameters; CS-40M: 50 parameters
VOICE-WRITE	Push the PROGRAM select button (M1, M2 and 1 - 10) and depress WRITE button.	Control voltage parameters that have been A/D converted in the PANEL mode are memorized into RAM. CS-20M: 8 voices, 32 parameters CS-40M: 20 voices, 50 parameters
VOICE	Depress the PROGRAM SELECT button.	RAM → D/A conversion → Sample Hold Control of blocks ← Demultiplexer
STORE	With the cassette recorder set to the RECORD mode, depress STORE and WRITE buttons simultaneously.	3KHz tone burst wave RAM → Cassette tape
LOAD	With the cassette recorder set to the PB mode, depress LOAD and WRITE buttons simultaneously.	Cassette tape → waveform shaping → RAM