MICROSADIC is a data acquisition and handling system. It is, therefore, the link between the test object and the electronic computer in an advanced scientific or technical study. Fig. 1 shows the cabinet which contains the central data processing electronics of the MicroSADIC system. It contains the data sources for time and selectable title constants. It also contains the commutators, the digitizer, the central program unit, and a power supply. Data are coming in through transducers from the test directly or through frequency modulated-pulse duration modulation (FM-PDM) radio link through telemetering equipment. The MicroSADIC output is usually magnetic tape. The tape unit is of the same size as the unit shown in Fig. 1. The MicroSADIC meets the need for high speed in data processing, high accuracy, compatibility with all standard computers, reliability, and outstanding flexibility. Its design for universal use allows the build-up of a variety of complete data handling systems. The following paragraphs will show how these characteristics are achieved. Special attention is given to the characteristic of flexibility which makes it possible for the MicroSADIC to create basically different data output formats as required for different computers with their contrasts in format and input specifications.

Data Sequencing and Coding

The operation of the over-all system is illustrated by Fig. 2. The test object may be a missile, a wind tunnel model, a power engine, a chemical plant, or any other complex system. The transducers feeding the MicroSADIC system provide electrical signal proportional to the test values. Examples of the great variety of these are pressure, temperature, stress, and angle of attack. Two different types of test have to be considered, the air-borne test and the ground test.

In case of an air-borne test, see Fig. 3. The transducer outputs may be fed into an air-borne commutator. This switching device sequences the data and feeds its output into the air-borne signal converter. The air-borne signal transmission normally use pdm and FM modulations. A ground station records such signals on magnetic tape. The tapes are brought to the test center and played back into a demodulator. The demodulator provides straight pdm outputs for a pdm digitizer. It also demodulates the FM-FM signals into amplitude modulated (AM) signals. Another MicroSADIC digitizer converts these signals into digital data in the desired code. The operation is simpler in the normal ground test, (see Fig. 4). In that case the analog transducer outputs are given to a standard commutator which feeds directly into the analog digitizer.

Digital transducer outputs are also brought to a commutator. Thereby, the sequence of their recording is controlled. This sequence is important since the later computer program has to be established on this order in the incoming data flow. In Fig. 5 note how the different data sources feed into the central program unit. The pdm digitizer had been mentioned before. The commutator for analog signals is connected to the digitizer which feeds into the programmer.

Another data source is the time information. Most tests are of the "dynamic" type and, therefore, require time information for each data point. Static tests make use of the time unit for counting test points and other purposes. There are also switch combinations which give digital constants and may be used for test identification (date) or special computer information (program selection).

In summary, then, there are five digital data types:

1. Constants.
2. Counter output from time accumulator or decoder.
3. Digitized data from the analog digitizer.
4. Other data.
   (a). From the subcommutator for digital inputs.
   (b). From the PDM digitizer.

Types 4(a) and 4(b) will not normally be used together. Therefore, normal MicroSADIC build-ups use four types of data. The sequence within each group is determined by the commutator and the code is determined by the digitizer. Straight binary or binary-coded decimal are mostly preferred. The sb/bed translator in Fig. 5 is used in cases where both codes are wanted simultaneously. It might also be that the general system is selected to be straight binary but that for a special test bed output is wanted.

The translator is based on the "doubling" principle. The numbers are serially shifted from an sb register into a bed.
register and the content of the bcd register is doubled with each step.

Fig. 6 shows possible output uses. The output tapes of the MicroSADIC system can be played back directly into one of the standard computers and they can also be played back into a tape to card converter and the cards may be sent to the computer. In this conversion again a code translator may be used for the same reasons as mentioned before.

The Programmer for Operation Mode and Format

The programmer is the link between the digital data sources and the tape, hence, the computer. This determines its task as follows:

1. Operational control of the MicroSADIC System.
2. Format control of the data flow.

The great variety of test applications and especially the contrasts between different computer characteristics require an exceptional flexibility of the programmer.

Operational Control

The operational control determines the chronological length of the test and, thereby, the length of the computer problem. It also determines what types of data are to be handled in each data block. The computer program has to conform to this selection.

Two types of operational control are provided: data-sequence control, and time-sequence control. The data-sequence control allows the writing of one of the following data combinations:

1. Constants only.
2. Time, digitized data, other data.
3. Constants, time, digitized data, other data.
4. File mark only.

Program 1 is used in order to flag the data flow to the computer or the magnetic tape. This can have the meaning of a computer instruction, title, identification numbers, etc.

Program 2 is typical for a normal test run.

Program 3, with the repetition of the constants in each data block, is useful in formats for punched card output.

Program 4 marks the end of test and serves to stop the computer at this point.

The time-sequence control offers three selections:

1. One sampling period only.
2. Repeated sampling periods.
3. Continuous operation.

Selection 1 is used for system check-outs. It might also be useful in static tests where one data point characterizes sufficiently each setup.

Selection 2 signifies that at any given time only one sampling period is recorded. But such commutation periods are triggered periodically, controlled by the time unit of the MicroSADIC system. Repetition rates can be anywhere between milliseconds and hours.

Selection 3 is the normal operation for a dynamic test with continuous data acquisition. It requires separate start and stop commands. The start-stop function is another operational control of the over-all system.

Format Control

Data are commonly stored in the form of pulses on a magnetic tape. The magnetic pulses are all identical. It is their location on the tape which determines the content of their message. Therefore, a strict order of writing pulses on the magnetic tape must be determined. This order is called the "format" and is different for different computers. These contrasts in computers become more important as more computers come into use and as more computer types appear on the market. It is hoped that computer manufacturers will give attention to the point of format standardization. Standard values should be decided upon for the number of tracks, types and location of parity checks, length of data words, alignment of writing heads for magnetic tape, and quantitative characteristics of the magnetic pulses. The remaining variable of number of words in a data block should be sufficient to take care of necessary contrasts in computer characteristics.

Fig. 7 shows 16 formats which a normal MicroSADIC programmer is able to write. They are grouped around the main computers and their peripheral equipment. This concerns the International Business Machines (IBM) 704 and 709 with IBM card punch or printer, IBM 650 with IBM card punch or printer, MilliSADIC card punch, Remington Rand 1103A with Remington Rand card punch or printer, and some special formats for high-data handling speed, which require special editing equipment. More formats can be written in as far as they represent a combination of the characteristics of the 16 formats which have been shown in Fig. 7.

The great flexibility of the MicroSADIC programmer is achieved by its operational design philosophy. This means that the over-all operation is subdivided into a number of fundamental suboperations. Each such suboperation is performed by a special building block. These building blocks again are designed to offer great flexibility. Some of these subunits are:
1. The digit counter which counts the number of characters in a word (optional 5, 6, 10, or 12).
2. The data group counter (optional any number from 1 to 10).
3. The sample counter (optional 1, 10, 15, 20, 30, 45, 60).
4. The block gap generator (optional, any time).
5. The parity check generator (optional odd or even check) and several more.

The selection of a specific performance is done by two means, patchboard and switch.

**Patchboard**

A 100-point patchboard allows the selection of all formats in Fig. 7 and additional specific modifications. Normally, one format is needed corresponding to the local computer. However, in some places there are different computers available, for instance, a smaller local computer for quick evaluation and a big central computer for final evaluation. Sometimes two different central computers are available and the selection depends upon their workload, so a fast format change is then needed. Some tests may be made twice in two different formats in order to make greatest use of the computer facilities. Then, the number of wanted formats is patched and specific points patched to the switch inputs.

**Format Switch**

This is a multiple, double-throw switch, which effects a fast change of the patching pattern. Two or more different formats may, thereby, be selected by the turn of a knob.

Standard selections could be:

- a. IBM 704, sb (format 1)
- b. IBM peripheral, hcd (format 6) or
- a. IBM 704, and peripheral (format 4)
- b. Remington Rand 1103, s.b. (format 13) or
- a. IBM 650 (format 12)
- b. MilliSADIC card punch (format 8) or any other combination

It should be kept in mind that the data processing speed is different for the different formats. This may motivate the computer and format selection. It also shows the influence of the “contrasts in computers” on the data-acquisition systems and thereby on the original test itself. It is believed that the MicroSADIC system succeeds in giving the liberty to scientists and engineers to select the best way for their data processing problem. However, the limitations inherent in the computer characteristics can not be avoided.

**The Over-All System**

The beginning of this paper mentioned the importance of high speed in data processing, high accuracy, reliability, flexibility, and completeness as main system characteristics. The following figures show how MicroSADIC is able to realize the following goals:

**Maximum Speed:** Format 16: 10,000 samples per second average, s.b. code, each corresponding to 3 decimal digits. (20-kc clock rate)

**Accuracy:** ±0.1%

**Reliability**

Industrial reliability can be defined as the ratio of working time to trouble-shooting time for the system. The working time is mostly given by the components' life time. MicroSADIC uses only long life components and transistors as active elements. The circuit design tolerances correspond to the known end-of-life values for each components for instance *±15%* for resistors. The trouble shooting time is greatly reduced by MicroSADIC’s modular and operational design and numerous checking and test facilities, marginal checks included.

**Flexibility**

The writing of 16 different formats is standard. Additional modifications are possible. Two different codes can be written. Input data can be digital, analog, or pdm.

**Completeness**

Special equipment (specific transducers, code transformers, etc.) allows system combinations for practically all tests. The standard equipment covers the essential applications as known from the past and expected in the future.

**Experience**

In order to give an idea of the background of the data acquisition technique, it can be stated that 30 data-preparation systems (SADIC and MilliSADIC) have been installed during the last 5 years by this company only. MicroSADIC represents the latest state of the art in components, manufacturing, and systems design.

The MicroSADIC provides an efficient input means to many computers with their contrasting input conditions.

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**A Computer-Integrated Rapid-Access Magnetic Tape System with Fixed Address**

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This paper describes the internal tape library system planned for the TX-2 computer at Lincoln Laboratory, Massachusetts Institute of Technology (MIT). One hundred magnetic tape transports will be under the control of a central electronic system; the system will have a storage capacity of 10^9 bits and an access time of about 30 seconds. It is particularly well suited for use with a computer of large random-access storage capacity such as TX-2, which has a core memory of 21/2 million bits. A simple tape transport having a high-speed search mode with redundant information transfer will make the ultimate library system for a computer, reliable and relatively inexpensive.

The tape transports are controlled by electronic circuits closely integrated with the computer. A permanent, constant-density timing track on the tape provides the speed reference for the control circuits and makes possible fixed position address-