ELECTRONIC MEASUREMENT & INSTRUMENTATION (BEC-29)

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UNIT-3

Data Logger

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Introduction

- The term ‘Data Logging' refers to collecting or gathering data over a period of time.
- A data logger is a device that can be used to store and retrieve the data.
- Data loggers capture, measure, and analyze physical phenomena from the real world.
- Light, temperature and pressure are examples of the different types of signals that a Data logger can measure.
- A data logger is often a hand-held battery operated device which has a large amount of memory.

Data Loggers

- A **data logger** (also **data logger** or **data recorder**) is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer). They generally are small, battery powered, portable, and equipped with a microprocessor, internal memory for data storage, and sensors. Some data loggers interface with a personal computer, and use software to activate the data logger and view and analyze the collected data, while others have a local interface device (keypad, LCD) and can be used as a stand-alone device.
- **Basic Operation of Data Logger**: For proper understanding of a Data Logger Operation, it is essential to understand the difference between analog and digital signals. For example, measurement of temperature by a milli voltmeter, whose needle shows a reading directly proportional to the emf generated by the thermocouple, is an analog signal.
- However, digital equipment presents a digital output in terms of pulses and involves an electronic pulse counting equipment which counts the number of pulses. The pulses are generated such that each pulse corresponds to the smallest value of the parameter being measured.

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- The Data Logger Operation senses only digital signals and hence analog signals, if any, have to be converted to digital signals. The digital technique is employed because it measures very small (or large) signals accurately and fast.
- The recording device may be a printed log or a punched paper tape. The printed output can be either line by line on a paper strip or on a type written page.

➢ **Basic parts of a Data Logger Operation:**

- Input scanner
- Signal conditioner
- A/D converter
- Recording equipment
- Programmer
- The block diagram of a Data Logger Operation involving all these parts is shown in Fig.

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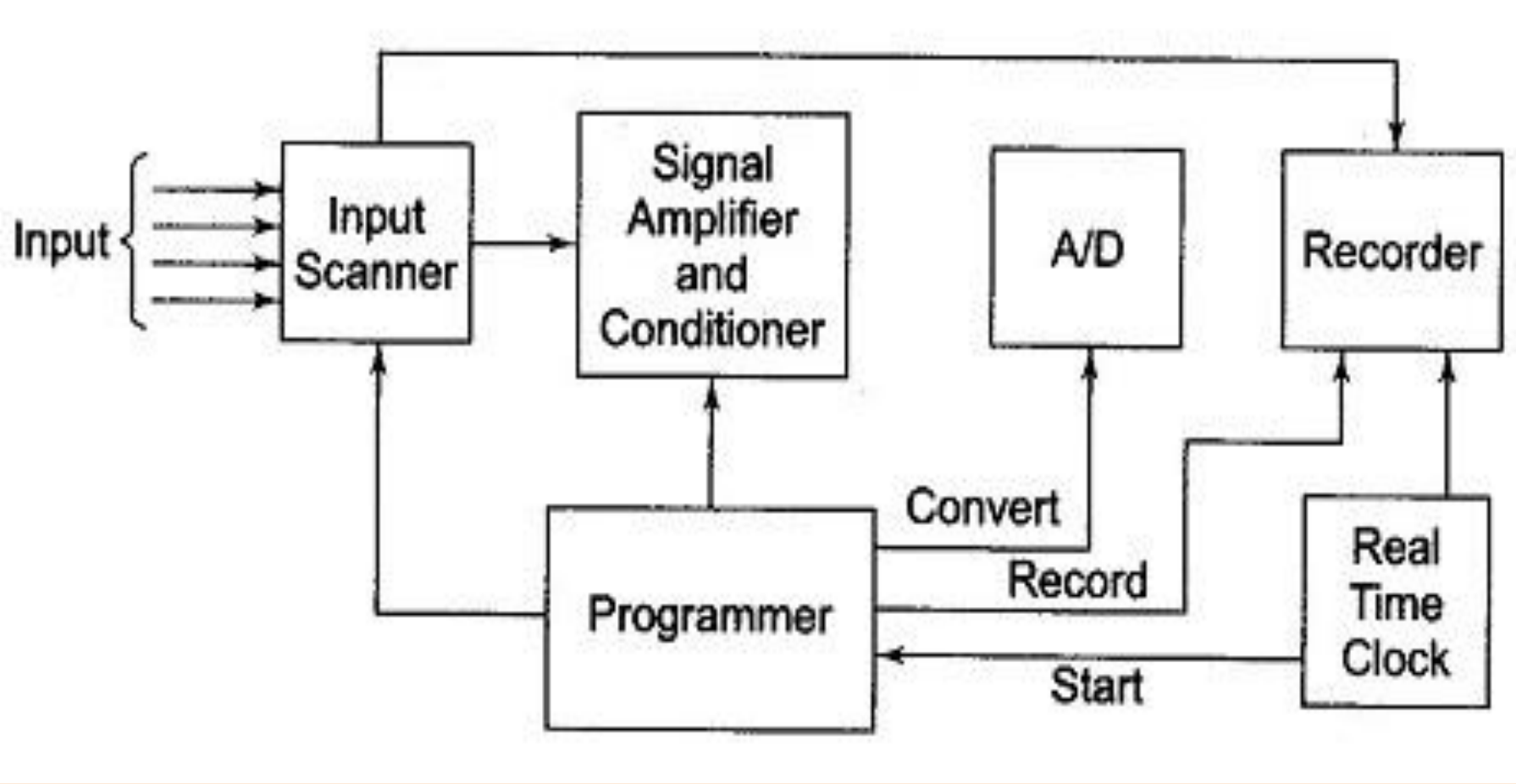
Input
Input Scanner
Signal Amplifier and Conditioner
A/D
Recorder
Convert
Record
Programmer
Real Time Clock
Start

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- **INPUT SIGNAL** : The input signals fed to the input scanner of the Data Logger Operation can be of the following types.

- High level signals from pressure transducers
- Low level signals from thermocouples
- ac signals
- Pneumatic signals from pneumatic transducers
- On/off signals from switches, relays, etc.
- Pulse train from tachometer
- Digital quantities
- The last three signals (5, 6 and 7) are of the digital type and are handled by one set of input scanners and the remaining signals are of the analog type and are handled by a different set of input scanner.
- Low level dc signals are first amplified and then conditioned by the law network and finally fed to the A/D converter.
- High level signals are fed straight to law network and converter.
- The ac and pneumatic signals are first converted to electrical dc signals, conditioned and then converted.

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- **INPUT SCANNER**: Because the scanner select each input signal in turn, the Data Logger Operation requires only one signal amplifier and conditioner, one A/D converter and a single recorder. Modern scanners have input scanners which can scan at the rate of 150 inputs/s, but the rate of scanning has to be matched with the rate of change of input data, and the time required by the recorder and the output devices to print one output.
- The various switching elements available commercially are as follows.
- Rotary selector switch
- Electromagnetic operated relays
- Dry Reed type
- Mercury wetted reed type
- Solid state switches

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- **Scanner Drive**

- The most common arrangement for selecting individual input one after another, is to use a matrix, as shown in Fig.
- The matrix is formed by using two energizing lines, X and Y, corresponding to horizontal and vertical respectively, each having 10 contacts. Hence a 10 x 10 matrix is formed, giving 100 input channels per scanner unit or module. The only relay at the intersection of the energized X and Y lines is operated. The timing pulse thus consists of two signals, one for the X line and the other for the Y line. Each relay has a diode in series with its coil, to prevent other relays being energized via other paths.

- **Input Conditioning**

- Since Data Logger Operation give their readout in the units of measurements concerned, there are two requirements:
- Scaling linear transducers
- Correcting the curvature of a non-linear transducer, such as a thermocouple.

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- **Recorders**

- The output from the Data Logger Operation can be printed on any of the following.
- Typewriter
- Strip printer and/or digitally recorded on punched tape or magnetic tape for further analysis in a digital computer.
- The typewriter provides a conventional log sheet with tabulated results, and prints in two colors.
- The signals obtained from the A/D converters are applied to the electro- magnetic operated levers of a typewriter. Plus, Minus, characters which can be printed one at a time, decimal point shift, line shift, type color and spacing are controlled by the EM solenoids which are energized from the programmer unit. Punched paper tape or magnetic tape is used when the recorded data is to be further analyzed or where the rate of data acquisition is too great for a printer.

- **Programmer**

- This can be considered as an automatic sequence switch which controls the operation of all other units of the data logger. The sequential operations performed by a programmer are as follows. Set amplifier gain for individual input, i.e. gain of the amplifier has to be so adjusted that for a maximum value of input signal, the A/D converter records a full scale reading.

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- Set linearization factor so that the adjusted output from the signal amplifier is directly proportional to the measured quantity.
- Set high and low alarm limit.
- Initiate alarm for abnormal condition.
- Select input signal scanner switching is set normally by a timing pulse to select the reset input.
- Start A/D conversion
- Record reading channel identify and time (in order that the readings may be identified at a later stage, a number identifying that the input has been normally recorded, with the actual reading and the time during the beginning of each complete scan).
- Display reading
- Reset logger. (At the end of cycle the A/D converter sections of the logger are reset to their initial conditions and the cycle, starts again.)

Data logging vs data acquisition

- The terms data logging and data acquisition are often used interchangeably. However, in a historical context they are quite different. A data logger is a data acquisition system, but a data acquisition system is not necessarily a data logger.
- Data loggers typically have slower sample rates. A maximum sample rate of 1 Hz may be considered to be very fast for a data logger, yet very slow for a typical data acquisition system.
- Data loggers are implicitly stand-alone devices, while typical data acquisition system must remain tethered to a computer to acquire data. This stand-alone aspect of data loggers implies on-board memory that is used to store acquired data. Sometimes this memory is very large to accommodate many days, or even months, of unattended recording. This memory may be battery-backed static random access memory, flash memory or EEPROM. Earlier data loggers used magnetic tape, punched paper tape, or directly viewable records such as "strip chart recorders".
- Given the extended recording times of data loggers, they typically feature a mechanism to record the date and time in a timestamp to ensure that each recorded data value is associated with a date and time of acquisition in order to produce a sequence of events. As such, data loggers typically employ built-in real-time clocks whose published drift can be an important consideration when choosing between data loggers.

Assignment Questions

- What are data loggers?
- What are functions of data loggers?
- State the different elements of a data logger.
- Explain with block diagram the operation of a data logger . state the functions of each block.

Conceptual Questions

Which of the following is not correct for data loggers?

a) Portability

b) Battery less

c) Small

d) All of the mentioned

Which of the following devices are similar to electronic data loggers?

a) Chart recorders

b) Flip flop

c) Memory

d) None of these

Which of the following protocol allow the instrument to connect to a data logger?

a) SDI-10

b) SDI-12

c) SAI-10

d) SAI-12

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Which of the following statement is false?

a) All data loggers are data acquisition system

b) All data acquisition systems are data loggers

c) Data logger and Data acquisition systems are same is operation

d) All of the mentioned

Data logger system have _____

a) Slow sampling rate

b) Fast sampling rate

c) Unpredictable sampling rate

d) None of the mentioned

Which of the following is correct for data loggers?

a) Simple single channel instrument

b) Medium channel instrument

c) Complex multiple channel instrument

d) All of the mentioned

THANK YOU