LABORATORY
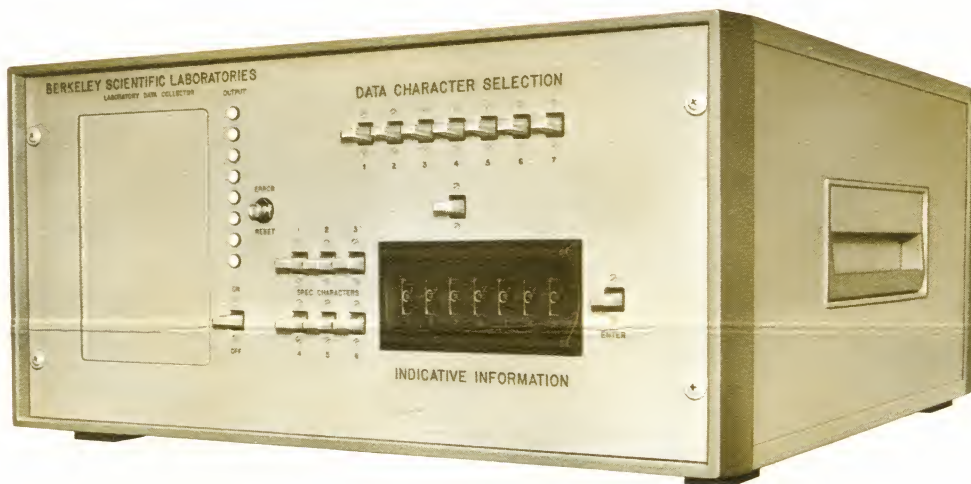# DATA
COLLECTOR™

BERKELEY
SCIENTIFIC
LABORATORIES

General

The LABORATORY DATA COLLECTOR™ will interface the digital output of any computer or device, including A/D converters, digital voltmeters, counters, and pulse height analyzers. It will drive and control any digital recording device such as paper tape, punched card, magnetic tapes, plotters, I/O typewriters and flexowriters, or high-speed core memories.

Input and output data formats, special characters and separator characters (tabs, carriage returns, record marks, stop codes, etc.) and data identification are selected on the front panel and automatically inserted into the output data stream where desired. In addition, there is a separate parallel input channel for a timer, multiplexer address or other indicative data input. Universal code conversion is built in.

Input and Output Data Formats	Analog to Digital Converters Digital Data Compressors Spectrophotometers • Colorimeters Counters • Pulse Height Analyzers Any Digital Output Instrument Direct Computer Output	Test and Sample Identification Information

Magnetic Tape
Punched Paper Tape
Printers • Plotters • Typewriters
Direct Computer Input
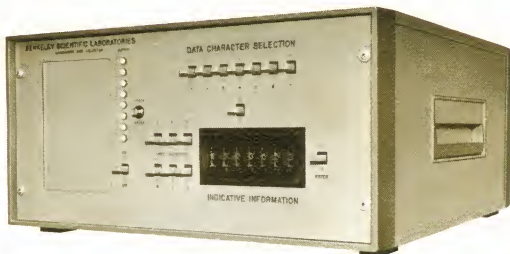**Any Digital Data Recording Device**

Fig. 1

Theory of Operation

An operational block diagram of the LDC is shown in Figure 2. Data enters the PARALLEL TO SERIAL CONVERTER and passes through subsequent stages for processing and formatting. Identification data and special data are merged with the main data channel at various points in the data stream.

The functions of the various submodules are as follows:

Parallel to Serial Conversion

The majority of instruments which generate digital information form their output either in parallel or in random fashion, while most of the digital data recording devices require serial information; thus, one of the most significant functions of the LDC is to serialize the input data. As shown in the block diagram on page 3, the PARALLEL TO SERIAL CONVERTER accepts a maximum of 7 digits of 4 bits each. These input data are scanned 4 bits (1 digit) at a time by the PARALLEL TO SERIAL CONVERTER

and transferred into the INPUT DATA DECODER CIRCUIT. Since the number of digits required per sample is different for each application, the number of digits to be scanned can be selected by the DIGIT SELECTION SWITCHES.

Universal Code Conversion

Another important feature of the LDC is universal code conversion; this permits the unit to accept any type of 4 bit BCD or straight binary information at its input and form any other type of BCD or binary code at its output. The data from the input scanner are decoded, 4 bits at a time into a one-out-of-ten decimal code for BCD (one-out-of-sixteen for binary).This is in turn encoded into the desired output code by the OUTPUT DATA ENCODER CIRCUIT.

Internally generated and externally generated ID-Data Insertion

The LDC has two types of ID-data generators and two separate channels for externally generated ID-data. The insertion of these ID-data is as follows:

PROGRAMMED CHARACTER GENERATOR

The LDC is supplied with six special programmable character generator boards; each one of these boards can be programmed to generate an 8 bit character. Six push button switches located at the front panel have a one-to-one correspondence to these character generator boards. Any one of the six programmed characters can be manually inserted by pressing one of the programmed character entry switches. These programmed characters may be used to identify the beginning and the end of a particular experiment run, generate record and file marks, stop codes, delete codes, etc.

SEVEN DIGIT THUMBWHEEL ID-DATA GENERATOR

Another type of ID-data can be inserted by setting the seven thumbwheel switches located at the front panel and pressing the ID-data entry switch, also located at the front panel. Thumbwheel ID-data may be used to specify the type of data to be recorded, overall gain setting of the system, timing, operator identification, etc.

EXTERNAL BINARY CODED ID-DATA AND EXTERNAL DECIMAL ID-DATA

In order to insert externally generated ID-data, an 8 bit coded ID-data channel or twelve line decimal ID-data channel is used. The externally generated ID-data can be manually inserted by merely pressing the ID-data entry switches located at the front panel or can be automatically inserted by bringing both the ID-DATA MODE CONTROL line and the DISPLAY SIGNAL line to a logical "l." If the externally generated ID-data channels are not being used the data mode control line can be left open. An obvious application of these external ID-data channels are automatic insertion of time or analog multiplexer channel numbers.

Error Detection and Special Characters

The LDC has its own error detection circuitry. If the input data were changed at the input of the LDC before the output device has processed the previous data, either the error lamp is lit and the operation is stopped or an error code is automatically inserted. The LDC is also capable of automatically inserting a special character at the end of each scan of the input signals. This special character can be a tab code, word separator code, or any other type of 8 bit code as desired; the code to be used for this purpose can be programmed on one of the special character generator boards.

Control Circuit and Definition of Terminology

The LDC functions described above are controlled by the CENTRAL CONTROL CIRCUITRY. The CENTRAL CONTROL CIRCUIT receives or transmits various types of control signals from or to digital equipment surrounding the LDC. There are

three main control input signals:

DISPLAY SIGNAL

The DISPLAY SIGNAL must be supplied to the LDC by the equipment supplying the digital information to the LDC in order to notify the LDC that digital information is ready to be read in.

ID-DATA MODE SIGNAL

If external generated ID-data are to be automatically entered, two control signals must be supplied to the LDC: one signal is the ID-DATA MODE SIGNAL; the other is the DISPLAY SIGNAL. The coincidence of these two signals causes the data presented at the output to enter from the ID-data channel rather than from the main data channels. ID-data can be followed by a special character.

WRITE FEEDBACK SIGNAL

The WRITE FEEDBACK SIGNAL must be supplied to the LDC from the equipment connected to the output of the LDC in order to notify the LDC that the information presented at the output has been recorded or has been processed and that the device is ready to accept new data. However, this signal is not necessary if the LDC is operated in a synchronous mode or if the equipment generating the digital data is dictating the data rate of the whole system.

There are two control signals supplied from the LDC to the external instruments. One signal, called READY SIGNAL, will be supplied to the instrument connected to the input of the LDC. The READY SIGNAL will notify that all the signals presented at the input of the LDC have been processed, and that the LDC and recording or data processing devices are ready to accept new data. The other control signal will be connected to the recording device or the data processing device connected at the output of the LDC; this signal is called WRITE COMMAND. This WRITE COMMAND signal notifies the recording or the data processing device that the LDC has new data at its output to be recorded or processed.

Summarized Specifications

Input

MAIN DATA INPUT

BCD: up to seven decimal digits.
Binary: up to 28 bits.
Logical levels: "1" = −3V   "0" = GND

ID-DATA INPUT

Coded ID-data: up to seven bits.
Decimal ID-data: up to twelve lines (ten for decimal numbers and two for sign or other special codes)
Logical levels: "1" = GND   "0" = −3V

CONTROL SIGNAL INPUT

DISPLAY SIGNAL
"1" = GND   "0" = −3V
WRITE FEEDBACK SIGNAL
"1" = GND   "0" = −3V
ID-DATA MODE SIGNAL
"1" = GND   "0" = −3V

Output

DATA OUTPUT

Eight bits maximum per character plus optional parity bit.
"1" = GND   "0" = −3V

CONTROL SIGNAL OUTPUT

READY SIGNAL
"1" = GND   "0" = −3V
WRITE COMMAND SIGNAL
"1" = GND   "0" = −3V

Internally generated Special Code

MANUALLY ENTERED SPECIAL CHARACTERS

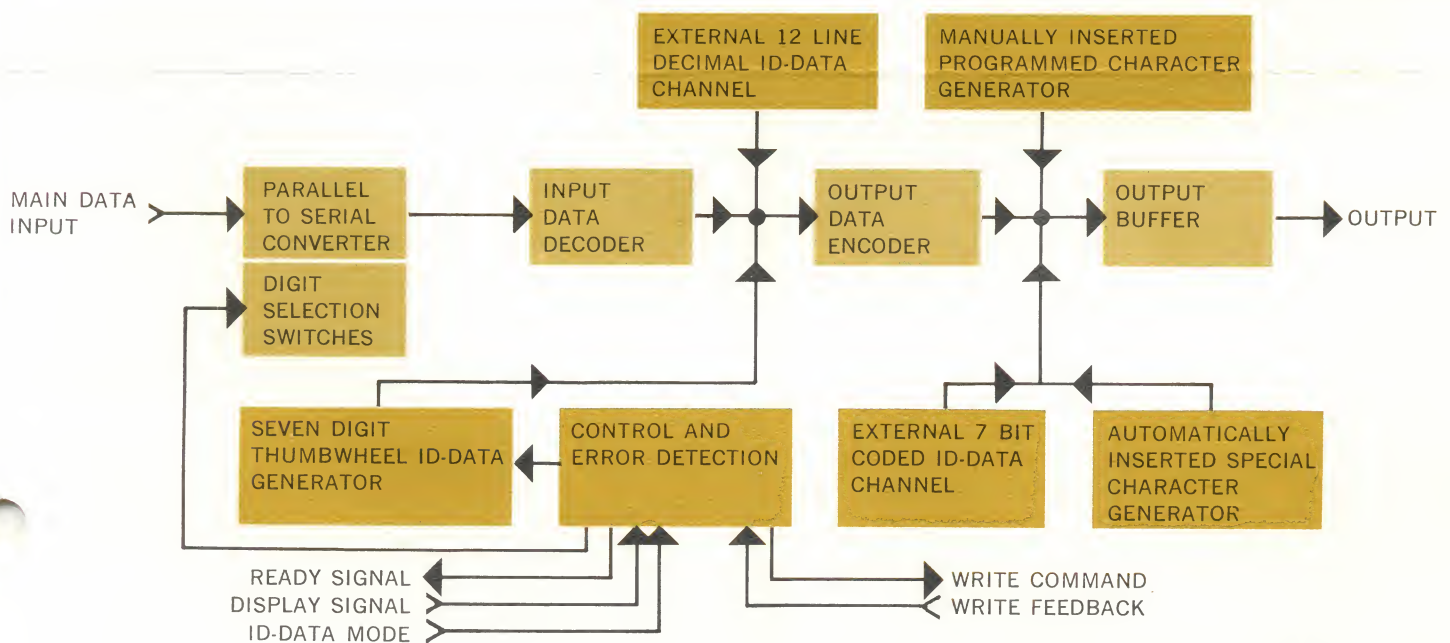Up to six characters in eight bits BCD

OPERATIONAL BLOCK DIAGRAM

Fig. 2

AUTOMATICALLY ENTERED SPECIAL CHARACTERS

Error code and two special characters in eight bits BCD.

Output Rate

500,000 characters per second maximum.

Power Requirement

60 watts at 115V± 10%   60 CPS ±2%

Temperature

—22°C to 85° C.

Physical Size

LDC—100R...fits standard 19″ relay rack 8¾″ panel
LDC—100T...19½×24″×9¼″ cabinet

Options

INPUT

INPUT LEVELS (APPLICABLE TO ALL INPUT LINES)
"1" ≤ +1V   "0" ≥ +3V
"1" ≤0V   "0" ≥ +2V
"1" ≤ −1V   "0" ≥ +1V
7 DIGIT EXTENDER FOR DATA INPUT CHANNEL
7 DIGIT INPUT BUFFER

OUTPUT

SOLENOID DRIVERS:
Maximum current = 600 ma to ground
Maximum voltage = −70 volts d.c.
PARITY GENERATOR (odd or even).

Peripheral Attachments

The LABORATORY DATA COLLECTOR can be delivered with a number of peripheral attachments. For the input a digital data compressor is available. This unit will perform A/D conversion and floating limit data compression on incoming analog data by eliminating all redundant data points and passing only those data which are essential for the reconstruction of the analog signal. This can significantly reduce the volume of data recorded in many applications (see Technical Bulletin 107).

Also for the input, a digital clock is available. Time is given in hours, minutes and seconds, two decimal digits each. The logic levels are compatible with those of the LABORATORY DATA COLLECTOR. Visual display is also provided.

For the output a Universal Data Blocker (UDB) is available. This device is capable of converting continuous synchronous data into blocks of synchronous data separated from each other by an arbitrary adjustable time increment. It is ideal for use in high-speed data acquisition systems in which continuous data from a synchronous source are to be recorded on magnetic tape in blocks.

Automatic Control—The basic LABORATORY DATA COLLECTOR requires manual entry of indicative information. However, addition of one or more model AP-10 automatic programmers to the system will enable the LABORATORY DATA COLLECTOR to cycle through the various data sources automatically and in any random sequence. The programmer consists of a diode programming board whose inputs are driven by a recycling shift register and whose outputs are connected to the various control lines of the LDC. Each AP-10 provides the system with 10 program steps. As many as six AP-10's can be connected in parallel to provide a maximum of 60 program steps.

April 1, 1966

Included with this letter is a new price list for the LABORATORY DATA COLLECTOR and accessories designed and manufactured by Berkeley Scientific Laboratories. The response to our announcement of the LDC and our laboratory data collector systems has been substantial. We now have 12 Laboratory Data Collector systems scheduled for delivery within the next three months. Many of our customers have requested modifications or additions to the basic LDC unit. Some of these are now being offered as standard options and accessories to the LDC. Other features which were previously offered in the standard LDC unit are now being offered as options. Our new price list reflects a reduction in cost for the basic LDC. However, an LDC unit with all options is still $7,700 for a rack-mounted unit and $7,800 for a console unit.

We invite you to examine some of the accessories which are now available for the LDC. In particular, the combined Analog to Digital Converter and Digital Data Compressor is an extremely valuable device for the sampling and recording of digital data from slow varying or quasi-static signals with intermittent high frequency variations. This is a digital device which samples input signals at rates up to 40,000 samples per second, yet passes on only those samples required to reconstruct the original waveform. This device uses a floating aperture limit comparison technique, not an analog filtering technique and automatically eliminates the recording of unnecessary samples.

The Laboratory Data Collector systems now under construction and scheduled for delivery include:

- a portable field laboratory data acquisition and recording system for geomagnetic studies. This system includes an A/D converter with automatic ranging, a 16 channel multiplexer, an LDC unit, and an incremental magnetic tape recorder, all mounted in a single portable rack.

- a test data recording system for clinical pathology laboratories which includes data-entry consoles for each station, two LABORATORY DATA COLLECTOR units with local printers, and a small digital computer for collation and calibration of test results and preparation of the final laboratory reports.

- a high speed digital data acquisition and recording system for a plasma physics laboratory. This system includes high speed analog to digital converters, a digital data compressor, a 16 channel multiplexer, a LABORATORY DATA COLLECTOR unit, and a high speed digital magnetic tape transport.

- six different systems for automatic recording of digital data on incremental magnetic tape transports and high speed punched paper tape units.

- four systems for interfacing laboratory instruments to stored program digital computers.

- a digital output recording system for microdensitometers and pulse height analizers in a biological laboratory.

Do you have an application you would like us to consider? Our Chief Engineer will be glad to call if you will send us a brief description of your problem.

August 1, 1966

<u>LDC – 200</u>   The LDC-200 has been designed as a UNIVERSAL COUPLER and controller for incremental magnetic tape recorders, paper tape punches, and I/O typewriters. The proven performance and reliability of the LDC-100 LABORATORY DATA COLLECTOR has resulted in its use in many data recording systems which did not require its full capabilities. In many cases the LDC-100 is being used as an incremental magnetic tape and/or punch paper tape coupler and controller. Consequently, we have designed a smaller version, the LDC-200, for this purpose. The LDC-200 retains the basic features of the LDC-100, but does not include the features required for general data acquisition systems. Secondly, the LDC-200 uses a new line of <u>fully integrated circuit digital modules</u> designed and manufactured by BSL. (These digital circuit modules are now being sold to other designers and manufacturers of digital devices and systems.) The LDC-200 input and output characteristics for single channel operation are identical to the LDC-100 specifications for main data. In addition, it will process four-bit or eight-bit characters to meet the various requirements of incremental magnetic tapes, paper tape punches, I/O typewriters, and printers. Digital voltmeters, scalers, clocks, etc., and the LDC Data Input Console described below can be connected directly to the LDC-200 input channel (up to 28 bits parallel). Interface options have been designed for a variety of instruments and recording devices. The price:

<div align="center">BASIC LDC-200 UNIVERSAL COUPLER $2,450</div>

We are now delivering complete incremental magnetic digital data recording systems which include both the LDC-200 and the incremental magnetic tape chosen by the customer. A typical system which includes the LDC-200 and the Kennedy Model 1400 incremental magnetic tape sells for $6,950.

<u>LDC DATA INPUT CONSOLE</u>   Sensible data collection and processing within clinical and research laboratories requires an interface unit which allows convenient manual data entry by technicians and operators as well as direct electrical connections to analytical instruments. BSL has desgined the LDC DATA INPUT CONSOLE for this purpose. It allows direct and rapid keyboard entry of experiment or sample identification data as well as direct readout of analytical instrument outputs at the time data is transmitted to the data collection and processing system. A multiplexer has also been designed which will allow up to 32 LDC DATA INPUT CONSOLES to feed one LDC unit for recording and future processing of laboratory data. Data Input Consoles have been designed to interface spectrophotometers, Coulter Counters, digital voltmeters, photometers, etc. The Data Input Consoles have complete electronics for acquiring, storing, displaying, and verifying all data before the data is transmitted to the processing system. This allows off-line operation and verification of test results before they are transmitted to the data recording and processing system. Two complete clinical laboratory data collection and processing systems are now being delivered to major clinical laboratories. The basic price of the LDC DATA INPUT CONSOLE is $3,500.

Product literature will soon be available for these two new units of the Laboratory Data Collector series. We invite your inquiries and a description of the system which you desire. We have designed the individual units within the Laboratory Data Collector series to allow a great deal of flexibility in system design to meet particular laboratory requirements.