2286/2285
DATA LOGGER

User Guide

P/N 870170
JANUARY 1990

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Section 1
How to Use This Guide

CONTENTS

INTRODUCTION

This user guide contains operating information and instructions, and program designs for the 2286A and 2285B Data Loggers. The term 2286/5 as used in this manual refers to both instruments. Where a difference between the two occurs, the specific model number is used. The manual is written in clear, non-technical language. The easy-to-access information is arranged by tasks.

The term programming as used throughout this manual, refers to setting up a process, although you won't need to know a computer language. The 2286/5 is entirely menu driven, which means that when you are designing a program, you only need to respond to the prompts as they appear then make selections from the menus.

Before you begin programming, read the introductory sections about data logging to familiarize yourself with the information presented in this manual. The section with general information about data logging helps you understand some basic concepts about the instrument.

If you've used a 2280 Series Data Logger before, this guide may best serve as a quick reference. Locate the information you need by using the index and looking up specific tasks.

HOW THIS MANUAL IS ORGANIZED

Section 1. How To Use This Manual

This first section describes the organization of the User Guide and provides descriptions of the types of information contained in the other 2286/5 manuals.

Section 1 also contains a brief explanation of the principles involved in data acquisition systems and includes a general introduction to data logging.

Section 2. Introduction to Programming and Operations

Section 2 is for new users and operators; it includes an introduction to the user interface and explains the keypad, the menus and programming modules, and the Programming Form.

Section 2 begins with a discussion of the most prominent programming characteristics of the 2286/5, and includes an introduction to the 2280 Series Programming Form along with an explanation of how to use it. This programming form helps clarify and simplify the programming process.

Section 2a is a tutorial that provides you with step-by-step instructions for some of the most commonly used tasks. The tutorial is designed for someone with little or no experience with the 2286/5. You may spend more time on the tutorial than initially planned, but consider it time well spent. If you work your way through the tutorial, you should be knowledgeable enough to design almost any program on your own, without the use of a guide.

Section 3. Programming and Menu Reference

Section 3 presents programming options and menus available to you as a Data Logger user. The section is divided into sections 3a through 3f and contains information about the menus that can be accessed on the Data Logger. The program menus appear in the same sequence as you see them when operating the instrument.

Section 4. Programming with the Math Coprocessor Option

Section 4 discusses programming capabilities and functions available when the Math Coprocessor (Option -211) is installed. Advanced programming techniques as well as specific examples and sample programs are also included.

Section 5. Operating the 2286/5 From the Front Panel

Section 5 tells you what you need to know to operate the 2286/5 when you've finished programming it. The available input and output capabilities and auxiliary functions are discussed in detail.

Section 6. Recording Information

Section 6 explains how to use the various data recording features of the 2286/5 Data Loggers. Included are programming and switch setting instructions for the printer and the disk drive, and instructions explaining how to transfer data to external data collection systems.

Section 7. Remote Programming and Operation

This section describes how to program and operate the 2286/5 from RS-232 terminals and computers as well as an IEEE-488 computer. Section 7 also includes prompting and concise command strings, remote access and lockout, and provides programming examples.

Section 8. Error Messages and System Alarms

Section 8 contains brief error and alarm definitions followed by an alphabetical reference of all error messages and system alarms. Included in the reference is a description of the alarm message, its cause, and what action you need to take when you see a message.

Section 9. Appendices

Section 9 consists of the subsections 9a through 9c.

9a is a glossary, which contains 2286/5-related terminology definitions and additional reference information.

9b discusses the distinctions between the 2286A and 2285B Data Loggers. These appendices also lists which options cannot be used with the 2285B.

9c is an options chart, which lists the available options for the Data Logger and their part numbers.

9d is an ASCII-to-Decimal conversion chart.

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HOW TO USE THE MANUAL SET

2286/5 User Guide

The 2286/5 User Guide describes the 2286/5 from top to bottom. A beginner could use the guide as a complete course in programming and operating the 2286/5 in a data acquisition system, whereas a more experienced user would probably only need parts of this manual for orientation and quick reference.

How To Use This Guide

2286/5 System Guide

The 2286/5 System Guide describes all aspects of installing the 2286/5 in a data logging system. This guide serves as a complete course in defining the user's data logging functions, identifying system requirements, making the necessary hardware connections, and verifying correct operation. Specifications and performance verification procedures are also found in the 2286/5 System Guide.

An inexperienced user may need all of this information to get the Data Logger up and running. A user already familiar with data logging may only need incidental reference to this information. In either case, each element of the installation process is easily accessible and fully referenced.

2280 Series Service Manual

The 2280 Series Service Manual is primarily a maintenance guide to the instrument and must be ordered separately. The manual covers theory of operation for mainframe and option assemblies, general maintenance and cleaning, performance testing, calibration, troubleshooting, and repair. Parts lists and schematics are also included.

LOGGING DATA WITH A 2286/5

Data collection tools can range from a strip of litmus paper, to a notebook, to a huge mainframe computer. In an industrial process environment, data is gathered from a variety of sources. In the research laboratory, any experiment is meaningless unless the resulting data can be collected.

The ability to make extremely accurate measurements is critical to modern technology. These more accurate measurements though, require more accurate and sophisticated tools. The more accurate the tool, the more precise the measurement, which in turn permits tighter control and observation of the variables we measure.

The Fluke 2286/5 Data Loggers are the precision tools for the job. From simple data collection to fairly complex control functions, the 2286/5's provide the necessary precision for both industrial process monitoring and research tasks.

The Data Logger Environment

One use of the Data Logger is to simultaneously monitor several channels of data and log the returned values. Each channel is connected to some type of physical transducer such as a flowmeter, thermocouple, strain gauge, or RTD.

The 2286/5 can perform scaling or data conversion functions on this raw data to render it more meaningful and useful. For example, many transducers output a voltage or resistance to indicate a physical value such as foot-pounds of force or cubic feet per minute.

Collected information can later be analyzed to pinpoint failure causes, generate histograms or frequency distributions of various recurring phenomena, or as a performance record of individual specimens.

How To Use This Guide

Almost any manufacturing process could require some form of continuous quality monitoring. The 2286/5 has been used in a tremendous variety of environments, such as continuously monitoring autoclave temperature in sterilizing pharmaceutical products; comparing signal reproduction characteristics of digital audio disks against a reference standard; recording power supply performance under simulated forced-air cooling conditions; and recording the performance characteristics of helicopter-rotor air-speed sensors.

These types of environments have several features in common. They all require programming so that many channels of information are monitored, read frequently, and checked continually and simultaneously. The 2286/5 forms the heart of these various process-monitoring systems. In many instances the Data Logger is programmed to trigger alarm conditions which begin recording data performance only during out-of-range operating conditions.

By using these and other features of the 2286/5, you can achieve the maximum utility possible in your application. Think of the 2286/5 as a data sponge you can use to soak up information from virtually any process. If you can find a transducer for the phenomena you want to monitor, the 2286/5 can probably read it.

Research Data Logging

The 2286/5 has also been used in a number of research applications, including automobile performance tests. The 2286/5 is frequently used to monitor a variety of engine and chassis parameters under actual road conditions. The portability and 12V dc operation allow it to be used in both unusual and demanding environments.

In situations similar to automobile road tests, the 2286/5 can be used to collect real-time data under experimental conditions for later study and analysis with data processing equipment.

The Data Logger will continue to play an important role in the test and measurement industry. In the future Data Loggers will be increasingly used in industrial process monitoring and control applications. Data Loggers continue to become easier to use and they pack increasing power into smaller and smaller packages.

Section 2
Introduction to Programming and Operations

CONTENTS

INTRODUCTION

Basic data logging essentially consists of a person using a pen and notebook jotting down numbers displayed on meters or gauges -- not a very complicated process. The 2286/5 Data Logger works similarly except that it is capable of jotting down many more numbers much faster than the person with the pen and notebook. Also, depending on the number of options used, a process could become too complicated to perform by hand.

The 2286A and 2285B Data Loggers are a major step forward from the guy with a notebook. The 2286/5 communicates information and data on the 40 character display. It can plot and record measurements on the internal printer or store them on a disk. Using the IEEE port A or port B, it can send the data to a host system or control an external process. It can even do all of these things simultaneously.

In addition to all the above, the Data Logger can be programmed to make measurements and then draw some conclusion about the measurement. For example, if the measurement meets a given condition, (e.g., too high or too low), the Data Logger can be instructed to measure another process variable it would not otherwise check.

Section 2a provides a detailed tutorial, with step-by-step instructions for commonly-used tasks. The tutorial concludes with instructions on saving the program to disk, and then reloading the saved program.

If you're already familiar with menu-driven programmable instruments, you may wish to skip the tutorial and refer to appropriate sections for information on specific features.

PROGRAMMING OVERVIEW

Programming the 2286/5 is as simple as pushing a few buttons to set up monitor and scanning processes. The display prompts you with a series of menu choices; you respond by typing in the name or number of the feature you wish to select. It's all much easier than you might infer from the word "programming", which usually suggests learning and invoking a complex and cryptic computer language.

This section starts with a look at the Data Logger's programmable features and introduces the 2280 Series Programming Form.

The 2280 Series Programming Form is an excellent aid to programming. It provides a reproduction of each menu and its selections, along with worksheet space to help you figure out how the program fits together before you enter it.

If you press a key that is not a choice when programming or operating the Data Logger (for example, if you try to select a 5 and the current menu doesn't offer a 5), you'll hear three beeps in quick succession. The Data Logger is alerting you that the wrong key is being used. Refer to the current menu and select from the available choices. Your program will not be erased or damaged when this happens.

If you wish to program or operate the 2286/5 from a remote terminal or computer, refer to Section 7, Remote Programming and Operations.

THE FRONT PANEL

The front panel of the Data Logger is arranged with the display and disk drive on the top half of the instrument and the printer and keypad on the bottom. The disk drive, printer and keypad are covered by doors.

Keyswitch

The Data Logger has a security feature to lock access to the programming functions. To lock access, program the Data Logger as you normally would, turn the key to RUN, and remove it from the lock. You can continue to monitor processes and log data, but now only selected users can alter programs or enter new ones. Only certain programmed characteristics and values can be altered while the key is in the RUN position (see Section 5, Operating the 2286/5 From the Front Panel, for more information about this feature).

The keyswitch is located on the lower left side of the front panel. The Data Logger is off when the keyswitch is retated fully counterclockwise to the OFF position. With the keyswitch rotated fully clockwise to the PROGRAM position, you have access to all the available programming and operating features.

Keypad Controls

The 2286/5 Data Loggers are programmed and operated through the front panel keypad. The two keypad areas are OPERATOR and PROGRAMMER (see illustration.) The OPERATOR keys can be used at any time, but the front panel programming door must be open to access the PROGRAMMER keys.

The operating portion of the keypad contains numerical keys, SCAN, SINGLE SCAN, MONITOR and PLOT keys, along with the ALARM ACK (alarm acknowledgment) and REMOTE/LOCAL user function keys.

The programming portion of the keypad consists of the alphabetical characters and six programming module keys,

- CHANNEL PROGRAM
- SCAN GROUP PROGRAM
- ALARM LIST PROGRAM
- OUTPUT DEVICE PROGRAM
- PLOT PROGRAM
- SYSTEM PROGRAM

The programming portion of the keypad also consists of additional programming and operating keys. They are: LIST, DATA TRANSFER, DELETE CHAR (delete character), MENU, DISK, and SPACE.

HOW THE MENUS WORK

The 2286/5 Data Loggers are menu-driven, which makes programming and operating easier for most users. The programming selections are made from menus and there are few user-defined entry fields. This type of system helps reduce the learning curve associated with setting up process-monitoring.

The menus are read on the display and consist of the menu title and the previous setting (if already programmed), or the preset default selection.

Some menus simply list the programmable features available in a given section, while other menus allow you to set characteristics and limits, specify output devices, and the like.

Programming is divided into six groups, or modules. A module contains sets and then subsets of menu choices available for the options present in each module. You select the desired option by pressing the indicated key. Each menu displays what is available, while simultaneously narrowing the entire field as you descend into the chosen menu subset.

Each of the six modules is designed to handle specific programming situations: channel programming is for programming channels, output device programming is for specifying output device characteristics and formats, and so on.

THE PROGRAMMING FORM

The 2280 Series Programming Form is provided to help plan and edit your program. Refer to it as you enter or edit your program. The Programming Form makes editing easier by allowing you to pinpoint the module and specific menu you need to change. The form also serves as a written record of the programs you implement.

Using the form while programming the modules will make the menus and displayed prompts seem clearer and more cohesively linked together because you have something in front of you to refer to. The Programming Form is a also great aid in following your progress through the menus.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1400 or C# C#	(see menu below) EXAMPLE (J/T/C) TJ	< 1 > ALARM LIST# 0-1400	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
  <1> 64.000 V dc
  <2> 8.0000 V dc
  <3> 512.00 MVDC
  <4> 64.000 MVDC
  <5> 64.0 MA
  <6> 250.0 VAC
  <7> 64.000 MV/OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
<R> RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 OHM CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425.00 C
  <5> 10 OHM CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425.0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
  User Defined RTD constants
    1st RO (default = 100.0)
    2nd ALPHA (default = 3.90E-3)
    3rd DELTA (default = 1.494)
    4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512.00 OHMS DC VOLTS SCANNER
  <2> 64.000 OHMS DC VOLTS SCANNER
  <3> 256.00 OHMS RTD SCANNER
  <4> 2048.0 OHMS RTD SCANNER
  <5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan #	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D, or L, 0-8	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C#..C# Channel and Blocks C# C# C#..C# C# C# C#..C#	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device <1>	<2>	<3>	<4>	<5>	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L.	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
0-1400	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
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	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

< Z > SYSTEM PROGRAM

SYSTEM MENU CHOICE < 1-7 >?

< 1 > LINE FREQUENCY	< 2 > CALENDAR DATE & TIME	< 3 > TEMPERATURE UNITS:	< 4 > ACCESS CODE:	< 5 > SCAN TRIGGER ENABLE TIMES:	< 6 > INTERPOLATION TABLES:		< 7 > SELECT MENU OPTIONS	
					1st TBL# (0-9)	2nd TABLE ENTRY FORMAT input//output e.g. 1.9378//346.084	1st AUTOMATICALLY DISPLAY MENU? No Yes	2nd DESCEND MENUS WITHOUT ENTER? No Yes
<1> 60 Hz <2> 50 Hz	1st) Time = __ __ __ HH MM SS 2nd) Date = __ __ __ e.g. 12 AUG 84	<1> Degrees C <2> Degrees F <3> Comp mV	(0-6 characters) ________	1st) Start Time __ __ __ 2nd) Stop Time __ __ __ HH MM SS				

< P > PLOT PROGRAM

PLOT MENU CHOICE < 1,2 >?

< 1 > PARAMETERS PLOT NUMBER <1-4> ?					< 2 > COMMON PLOT INTERVAL FOR ALL FOUR PLOTS
PLOT #: SYMBOL:	<1>	<2>	<3>	<4>	PLOT INTERVAL __ __ __ HH MM SS
Channel to Plot					
Leftmost Value					
Rightmost Value					

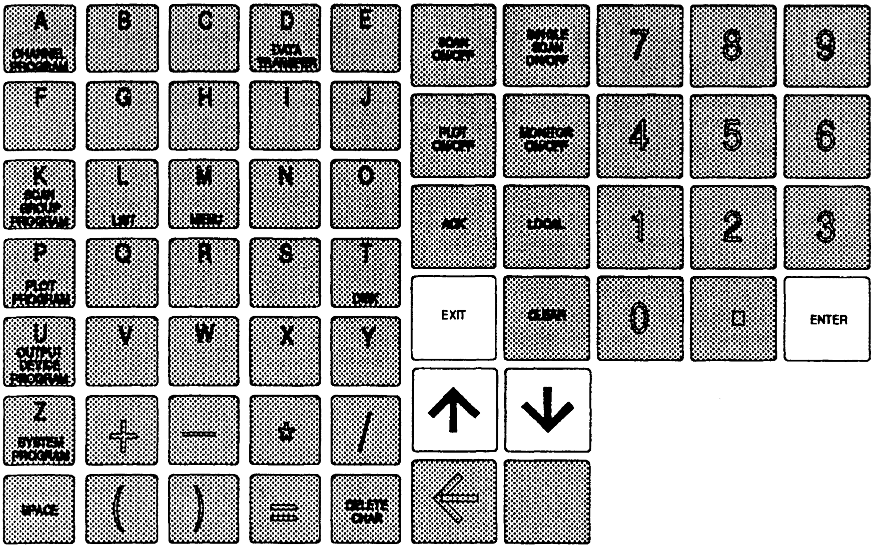
< U > OUTPUT DEVICE PROGRAM

OUTPUT MENU CHOICE <1-8>?

< 1 > PRINTER FORMAT	MENU ←	< 2 > PORT A DATA FORMAT	< 3 > PORT B DATA FORMAT	< 4 > DISK/TAPE DATA FORMAT	MENU ←	< 5 > PORT A CHARACTERISTICS	< 6 > PORT B CHARACTERISTICS	< 7 > ALARM ACKNOWLEDGEMENT LOGGING DEVICE	<8> DATA TRANSFER FILTER
<N> Normal <T> Compressed	<1> COMPRESSION FORMAT <1> Chan Label Value Units Alrm-Flg <2> Chan Value Units Alrm-Flg <3> Chan Value <4> Value				< 1 > DEVICE TYPE < 1 > IEEE-488 < 2 > PARALLEL I/F < 1 > DATA ENCODING < 1 > ASCII Odd < 2 > ASCII Even < 3 > EBCDIC < 4 > BCDIC Odd < 5 > BCDIC Even < 2 > RECORD TYPE < 1 > Fixed Record Length (1-4096) < 2 > Variable Record Length < 3 > RS-232-C < 1 > BAUD RATE < 1 > 110 < 2 > 300 < 3 > 600 < 4 > 1200 < 5 > 2400 < 6 > 4800 < 7 > 9600 < 8 > 19200 < 2 > PARITY < 1 > None < 2 > Even < 3 > Odd < 3 > NUMBER OF FILL CHARACTERS (0-99)			<1> None <2> Printer <3> Port A <4> Port B	Search __//__//__//__ Replace __//__//__//__
	<2> DATA TYPE INDICATORS? Yes No								
	<3> CHAN READINGS/LINE (1-99)								
	<4> START OF DATA SEQUENCE __//__//__//__								
	<5> END OF DATA SEQUENCE __//__//__//__								
	<6> LINE TERMINATION SEQUENCE __//__//__//__				< 2 > TIME OUT < 1 > ENABLED Timeout Period < 2 > DISABLED				

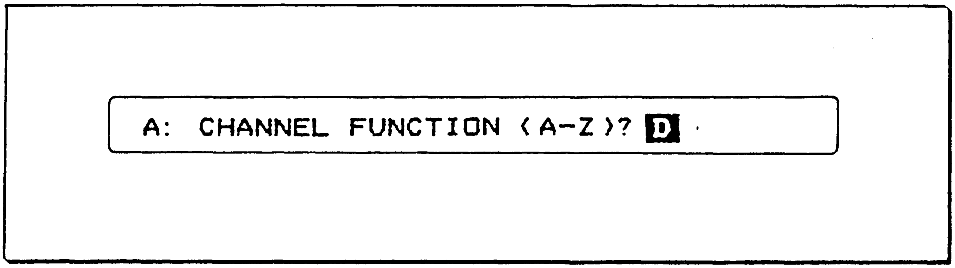
KEYS THAT MOVE YOU THROUGH THE MENUS

The ENTER key steps through the menus and is used to make selections or choices. The term "steps through" refers to moving through the menu hierarchy to either view or choose the selections. Most menus have a default setting that displays when you make a selection. When you press ENTER, this default setting is automatically selected.



KEYS THAT MOVE YOU THROUGH THE MENUS

Each program module consists of a menu tree that allows you to display menu selections on the front panel. Use the up or down arrow keys to scroll through the menus and see what your selection choices are.



A: CHANNEL FUNCTION (A-Z)? D

The example menu above illustrates which channel functions (A-Z) can be selected. In this case, the cursor is highlighting channel function D. This function will be selected when you press ENTER. If you wish to select another channel function, press the appropriate letter (A-Z), and then ENTER.

The cursor-highlighted letter represents either the last selection made, or (if no selection have been made), the default setting.

Press EXIT repeatedly to quit the program. Each time you press EXIT you step up one level in the menu hierarchy. Depending upon which menu level you are at, the number of times you need to press EXIT will vary.

Pressing EXIT does not alter programs or select items.

PROGRAMMING KEYS

Some of the keys on the keypad are marked with specific functions as well as alphabetical characters. These dedicated keys allow you to select programming modules, menus, or other functions without searching for the corresponding letter key. You can use either the programming keys or their alphabetical characters; the labels are strictly an added cue for making selections easier to find.

Miscellaneous Programmer Keys

The 2286/5 keypads contain a number of other dual-use keys. LIST, DISK, and DATA TRANSFER keys provide convenient access to common utility tasks and are discussed in the Operating section of this guide (Section 5).

The Menu Key

An especially helpful key is the MENU key. When you see bracketed numbers or letters on the display (which indicates a choice of selections), you can usually print the current menu by pressing 'M'. The available menu selection will be printed or sent to whatever menu listing device you've specified.

Space, Delete Character, and Clear Keys

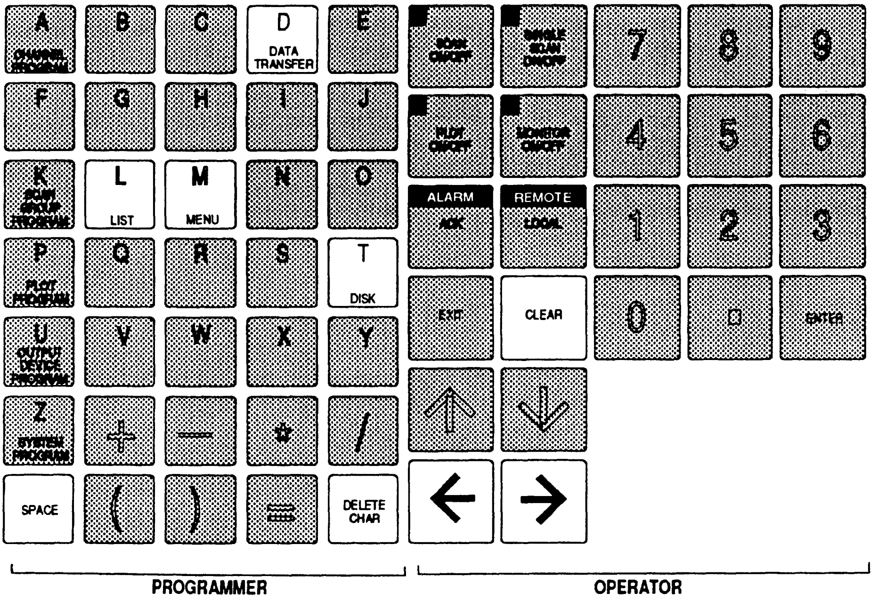
Use SPACE, DELETE CHAR, and CLEAR keys for editing programming entries. The SPACE key puts spaces between words or expressions when entering characters into user defined fields.

The DELETE CHAR key removes characters one at a time as they appear under the cursor. If the cursor is at the end of a string being edited, the characters to the left of the cursor will be deleted.

The CLEAR key deletes the entire field being edited and returns the cursor to the beginning position.

Right → and Left ← Arrow Keys

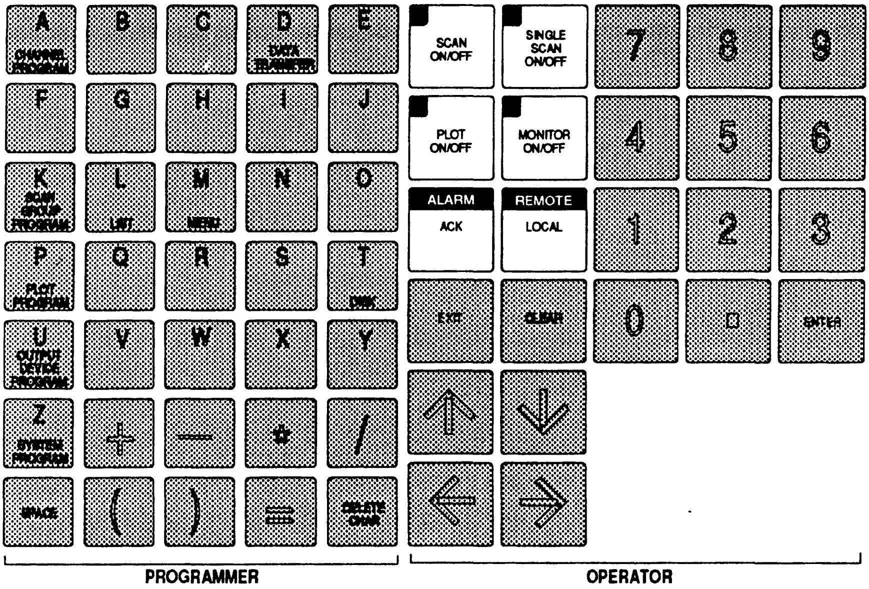
The right arrow and left arrow keys are primarily used to position the cursor when changing an entry. Use these keys after you've entered a menu to move to a specific point in an entry field without disturbing the existing characters. From this point, you can delete characters or insert new characters. These cursor control keys won't alter an entry or a program.



MISCELLANEOUS KEYS

THE OPERATOR KEYPAD

The right side of the 2286/5 front panel keypad consists of the following Operator keys: numeric, ENTER, EXIT, up arrow and down arrow (move you through the menus), and the operating and user function keys.



OPERATING KEYS

The Operating and User Function Keys

The Operating keys are SCAN, SINGLE SCAN, PLOT, and MONITOR. They toggle on and off and have a light indicating their status. These keys are discussed in greater detail in the Operating section of this guide (Section 5).

The ALARM ACK and REMOTE/LOCAL keys are referred to as user function keys. They are discussed in the Operating section of this guide (Section 5)

THE PROGRAMMING MODULES

This section provides introductory descriptions of each of the six modules and how they work together. The six programming modules are accessed directly from their respective keys or from the main menu. More detailed module descriptions are found in Section 3, the Programming Reference Section of this guide.

Channel Program

A channel is the building block for a scan group. Each channel can be defined as a measurement channel, an output channel, or as a pseudo (dummy) channel used to perform calculations between other channels.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or C# C#	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1 8 + 32 0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)

CHANNEL FUNCTION MENU	USER DEFINED RTD CONTANTS					LOGGING FORMAT MENU
<P> PSEUDO CHANNEL <D> VOLTS/CURRENT <1> 64 000 V dc <2> 8 0000 V dc <3> 512 00 MVDC <4> 64 000 MVDC <5> 64 0 MA <6> 250 0 VAC <7> 64 000 MV OTD <A> A/D CALIBRATION <1> CALIBRATION <2> SPECIAL <T> THERMOCOUPLE <J> J (NBS) <K> K (NBS) <T> T (NBS) <E> E (NBS) <R> R (NBS) <S> S (NBS) <B> B (NBS) <N> N (NBS) <C> W-5RE VS W-26RE <H> J (DIN) <V> T (DIN) <R> RTD <1> 385 DC VOLTS SCANNER <2> 10 OHM CU DC VOLTS SCANNER <3> USER DEFINED DC VOLTS SCANNER <4> 385 RTD SCANNER TEMP LT 425 00 C <5> 10 OHM CU RTD SCANNER LO RANGE <6> USER DEFINED RTD SCANNER LO RANGE <7> 385 RTD SCANNER TEMP GT 425 0 C <8> USER DEFINED RTD SCANNER HI RANGE User Defined RTD constants 1st RO (default = 100 0) 2nd ALPHA (default = 3 90E-3) 3rd DELTA (default = 1 494) 4th C4 (default = 20598E-11) <C> COUNTER/TOTALIZER <1> COUNTS <2> FREQUENCY <S> STATUS OUTPUT 1st Zero Result (1-14 chars.) 2nd Nonzero Result (1-14 chars) <I> STATUS INPUT 1st Zero Result (1-14 chars.) 2nd Nonzero Result (1-14 chars) <O> ANALOG OUTPUT <B> BCD/BINARY INPUT <Z> RESISTANCE <1> 512 00 OHMS DC VOLTS SCANNER <2> 64 000 OHMS DC VOLTS SCANNER <3> 256 00 OHMS RTD SCANNER <4> 2048 0 OHMS RTD SCANNER <5> 64 000 kΩ RTD SCANNER	Chan#	RO	Alpha	Delta	C4	<1> Auto
						<2> nnnnn
						<3> n nnnn
						<4> nn nnn
						<5> nnn nn
						<6> nnnn n
						<7> nnnnn

Channel programming refers to the set of instructions telling the Data Logger what its inputs are and where those inputs are physically located. Alphanumeric labels, engineering units scaling, and the location of the decimal point for logging are defined here. If a channel input is to be checked against an alarm list, those limits are also referenced through channel programming.

Scan Group Program

Press the Scan Group Program key when you have several measurements to make. A scan group is a list of channels to be processed or scanned. A scan group program, in turn, tells the Data Logger what inputs to read, what calculations to make, what outputs to set, where to route collected data, whether additional scan groups are to be started, and so on. You can program up to ten different scan groups on the 2286/5.

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?								
P.C.D. or L.	< 1 > SCAN GROUP LABEL	< 2 > SCAN GROUP CHANNEL LIST	< 3 > SCAN TRIG MODE	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device					< 5 > OTHER SCAN GROUP TRIGGER
0-9	0-40 Alphanumeric characters EXAMPLE ENGINE 2 TEST	FORMAT: One Channel only C# Channel Block only C#..C# Channel and Blocks C# C# C# C# C# C# C# C#	(pick only one see menu below)	<1> Display	<2> Printer	<3> Disk/Tape	<4> Port A	<5> Port B	Scan Group to Trigger (#)	Trigger Condition (see menu below)
<1> On Demand Only <2> Time Interval HH MM SS		<3> Continuous <4> Discrete Time HH MM SS	<5> Externally Triggered <6> Scan Once	<1> No Data <3> Alarm Data <2> All Data <4> Alarm Trans Data					<1> Never <3> Any Alarm Transition <2> Any Alarm <4> Always	

A scan group can consist of input channels, output channels, pseudo channels,or any of these that you want processed as a group can be considered a scan group. Scan groups can be created using any combinations of input, output, and pseudo channels.

The 2286/5 can only perform one task at a time, so setting priorities is important in the scan groups. The lower the assigned scan group number, the higher the priority. For example, if you've programmed groups 4 and 5 to be scanned at the same time, group 4 will be executed first. This priority only occurs if more than one scan group is used.

Alarm List Program

Alarm List Programming affords you tremendous flexibility and control over the monitoring and scanning processes that you set up because the alarm condition can trigger further action. Each conditional task to be performed is programmed as an alarm list.

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L.	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
		<1>	<2>	<3> ALARM MESSAGE	<4> ALARM SCAN TRIGGER		<5>	
					1st	2nd		
0-1499	LIMIT #	SENSE H/L	LIMIT VALUE	0-40 characters EXAMPLE EXHAUST TEMP OVER LIMIT	TRIG GROUP #	TRIG MODE (see menu below)	DELETE LIMIT	
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

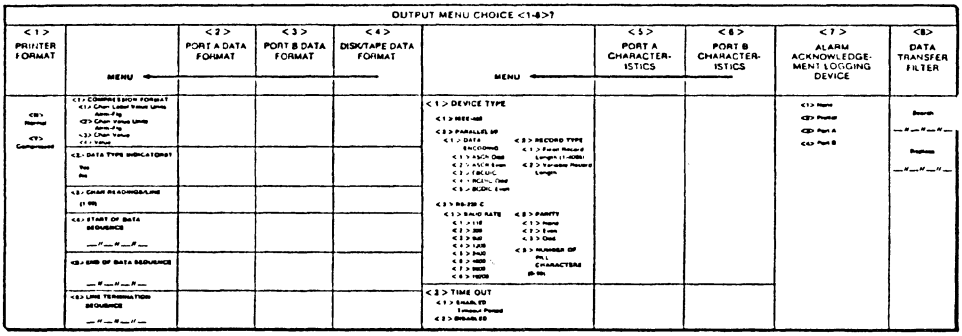
<1> Never <2> During Alarm <3> On Alarm Transition

An alarm list program contains instructions that set high and low channel/value limits to be checked. It also determines which high or low values will trigger an alarm, whether a message will accompany an alarm, and if there is to be any dead band or hysteresis associated with it. An alarm list can also be set up to initiate other scan groups.

Output Device Programs

The Output Device Program determines the format that logged data assumes on the printer, the devices connected to ports A and B, and on the disk. In addition, various device characteristics may be determined for ports A and B.

< U > OUTPUT DEVICE PROGRAM

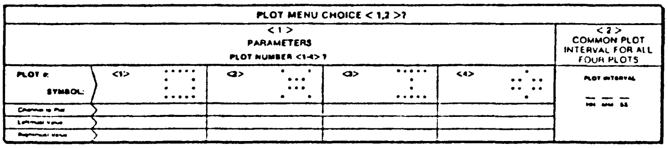


The output device module is also used to select hardware configurations, such as RS-232 or IEEE-488 cards. For example, the data sent simultaneously to the disk drive and to the RS-232 port can differ in format, the number of readings per line, and the sequence of characters used to indicate the end of a line.

Plot Program

The internal printer can be programmed to plot fluctuating values obtained from up to four different channels.

< P > PLOT PROGRAM

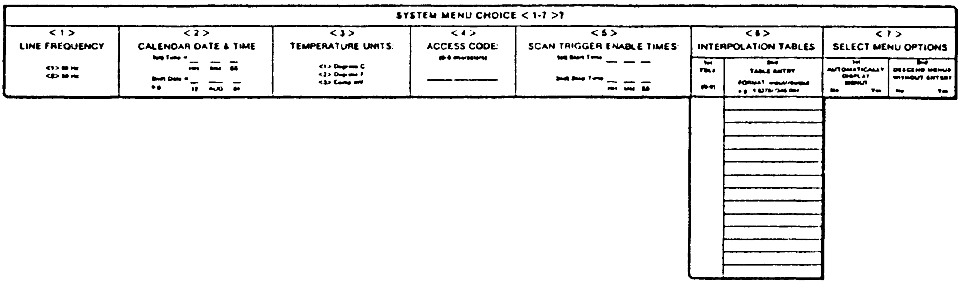


Plotting is a relatively simple matter to set up. You only need to specify the left and right most values for each channel to be plotted, then set the common plotting interval. The plotting interval can be independent of any other scanning activity.

System Program

The System Program key provides access to several system housekeeping functions. These functions allow programming of date and time, temperature units, access code, and line frequency.

< Z > SYSTEM PROGRAM



TUTORIAL

This tutorial is designed to teach the fundamental techniques for programming and operating the 2286/5 Data Loggers. Several sample programs are included here. See Section 3 for a more detailed programming reference.

Creating a Program

The following three-step approach will help you to set up a monitor and scanning process:

1. Determine exactly what you want the program to accomplish.
2. Fill out the 2280 Series Programming Form. Decide which of the Data Logger's capabilities you need to use. These capabilities will make the program do precisely what you want it to do.
3. Key the program into the Data Logger.

When you're writing a new program, use the 2280 Series Programming Form as a worksheet. Try various combinations of program options to analyze the program as you're writing it. This will help you determine whether what you want is what will actually work.

Once you have determined what data you want to log and have written the program on paper exactly as you want it, you need to key it in.

Follow the displayed prompts, and refer to the form for help in locating menus and fields within the six modules. Don't worry if you make an error in putting together a program--errors rarely create serious problems and are generally easy to find and repair.

Before you start the following lesson, please make certain the 2286/5 hardware you are using contains an analog to digital converter (set at address "0"), a scanner, and thermocouples connected to channels 8 and 9. Refer to the 2286/5 System Guide for answers to hardware configuration questions.

Turn to the error and alarm definitions in Section 8 of this guide if you see an error message you don't understand. They are listed alphabetically by the first letter of the displayed message.

A Program to Measure and Average Two Thermocouples

In this lesson, you'll program three different kinds of channels to measure temperature with two thermocouples. This sample program involves programming channels 8, 9 and 10, one scan group (which you designate as scan group number 5), an alarm list (number 10), and plotting the input results of the programmed channels.

First, the 2286/5 needs to accept the measurements on input channels. The reading obtained from channel 8 (labeled Temperature 1), is displayed as degrees Celsius. The channel 9 reading (Temperature 2) is converted mathematically and displayed in degrees Fahrenheit.

Next you'll write a pseudo channel procedure to change the resulting input values by manipulating them with further computations. Channel 10 (labeled Difference), is programmed as a pseudo channel to convert channel 8 input to Fahrenheit, compute the difference in temperature between channels 8 and 9, and then display that difference during scanning.

Scan group number 5 is set up to execute a scan of the three channels every fifteen seconds. You'll program the alarm list to trigger an alarm any time the difference measured by channel 10 exceeds fifteen degrees Fahrenheit.

Finally you'll program the printer to plot the values of the three programmed channels.

Listing the Program and Configuration

The LIST function lists the Data Logger's current hardware and programmed configuration on the built-in printer. This not only provides a printed record of the Data Logger configuration, it also serves as a verification of the hardware installed and your program.

In addition to the printer the LIST output device can be changed to Port A or Port B.

Open the front panel keypad door and turn the keyswitch to PROGRAM. The display reads,

MAIN MENU CHOICE <M FOR MENU>? A

This main menu is the starting point for programming each of the six modules and is also the point you return to when you've completed programming. Press the MENU key to list the main menu choices onto the printer.

From the main menu prompt, press,

L
LIST

The display will respond with,

<L> LIST PROGRAM AND CONFIGURATION

Press **ENTER** and the display will read,

L: LIST MENU CHOICE <A-Z>? E

Press **MENU** to print the menu of LIST choices. They will be listed as follows:

<A> LIST CHANNEL PARAMETERS
<F> LIST ALARM LIST PARAMETERS
<K> LIST SCAN GROUP PARAMETERS
<P> LIST PLOT PARAMETERS
<U> LIST OUTPUT DEVICE PARAMETERS
<Z> LIST SYSTEM PARAMETERS
<C> LIST HARDWARE CONFIGURATION
<D> SELECT LIST OUTPUT DEVICE
<E> LIST EVERYTHING

Pressing a menu key other than E followed by ENTER lists only selected configuration or program information. Pressing E followed by ENTER lists all information in the other menu choices at once.

Press

C

the display will read,

L<C> LIST HARDWARE CONFIGURATION

Press **ENTER**. This lists the present hardware configuration of the Data Logger on the printer. Be sure that the following four lines are contained in the hardware listing before entering the program described in the following pages.

BEGINNING CHANNEL NUMBER = 0
TYPE = ISOTHERMAL
BEGINNING CHANNEL NUMBER = 10
TYPE = ISOTHERMAL

The LIST function will be used to verify the program entered on the following pages.

Erasing the Program Memory

We recommend that you remove any earlier programming instructions from the instrument memory before entering the tutorial program.

To delete programming currently in the 2286/5 memory, select,

E

The display now reads,

<E> ERASE ALL OF PROGRAM MEMORY

Press **ENTER** and the display changes to,

REALLY ERASE ALL MEMORY <Y,N>? N

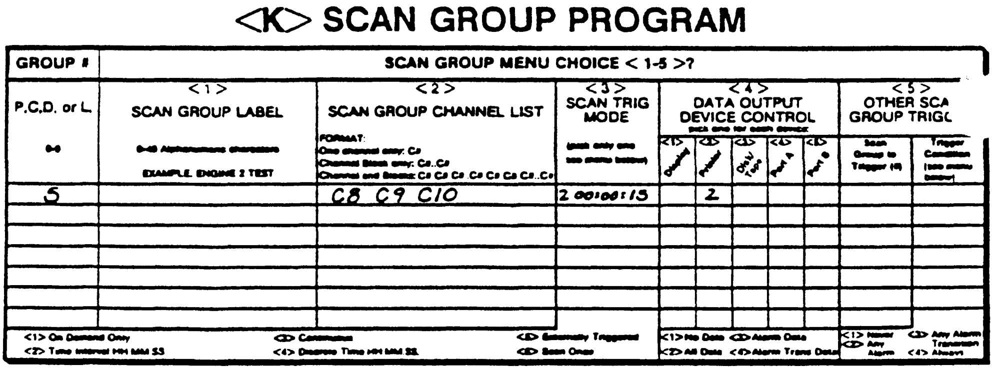
This step is to remind you that erasing the memory permanently removes it; make certain it's what you want to do. You can view the existing programming using the LIST function described above.

To proceed with deleting the program memory, press,

Y and ENTER

Now the main menu is displayed again and you're ready to begin programming. Remember to keep the 2280 Series Programming Form nearby to refer to if you have difficulty following the menu prompts.

Programming a Scan Group



<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L.	<1> SCAN GROUP LABEL	<2> SCAN GROUP CHANNEL LIST	<3> SCAN TRIG MODE	<4> DATA OUTPUT DEVICE CONTROL (pick one for each device)					<5> OTHER SCA GROUP TRIG	
	0-40 Alphanumeric characters EXAMPLE ENGINE 2 TEST	FORMAT: One channel entry: Cx Channel Block entry: Cx..Cx Channel and Blocks: Cx Cx Cx .Cx Cx Cx Cx..Cx	(pick only one see menu below)	<1> Display	<2> Printer	<3> Disk/Tape	<4> Port A	<5> Port B	Scan Group to Trigger (#)	Trigger Condition (see menu below)
5		C8 C9 C10	2 00:00:15		2					

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data <3> Alarm Data
<2> All Data <4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

In this first exercise you'll program scan group 5 to scan three channels every fifteen seconds and send the output to the printer.

To enter and program the scan group module (from the main menu), select,

K
SCAN
GROUP
PROGRAM

The display responds with,

<K> PROGRAM A SCAN GROUP

Press the **ENTER** key to choose the displayed selection.

In addition to choosing the selection displayed, each time you hit **ENTER** you are automatically advanced to the next menu choice whether you've entered something in a field or have chosen to leave the field blank.

The display reads,

SCAN GROUP NUMBER = 0

You're designating this group as number 5, so press,

5 and then ENTER

The display now reads,

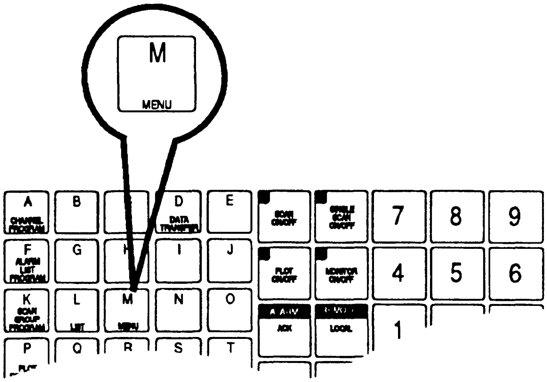
PROGRAM,COPY,DELETE OR LIST <P,C,D,OR L>? P

You plan to PROGRAM scan group 5. The cursor always highlights the preset (or default) selection. Since PROGRAM is the selection you want, choose it by pressing **ENTER**.

The display reads,

K: SCAN GROUP MENU CHOICE <1-5>? 1

If bracketed numbers or letters follow a displayed menu title (e.g., scan group), you can usually list the menu selections onto the printer by pressing,



Press the **MENU** key now to see the scan group menu choices. The selections are also printed in the corresponding module sections on the 2280 Series Programming Form.

. Scan group label is the first menu encountered in this section; you're not adding a label to scan group 5, so to move to the second menu, press 2. The display reads,

K<2> SCAN GROUP CHANNEL LIST

Press **ENTER** to enter the menu and specify the list of channels. The scan group is to be composed of channels 8, 9, and 10. At the prompt **CL:** (channel list), key in,

C8 C9 C10 and then **ENTER**

After you've entered the channel numbers, you'll see another **CL:** on the display, followed by a blank line. Enough space has been allotted in this field for unlimited lines of channel numbers (with each line containing up to 75 characters), but since you're entering only one line, hit **ENTER** again to move on.

The third menu, scan trigger mode, allows you to specify how often and under what circumstances you want the list of channels scanned. Our program calls for scanning every fifteen seconds.

ENTER the third menu and the prompt is,

K3: TRIGGER MODE <1-6>? 1

In addition to using the MENU key to view your choices, you can display the current selections by pressing any o the menu choice indicators. In this case, those indicators are the digits, 1 through 6.

Press 2 now to select the time interval scan, and then press **ENTER** again. The format is hours, minutes, and then seconds. Use the right arrow key to scroll across the displayed default time and change the field to read,

TIME INTERVAL = 00:00:15

ENTER this. Next, you'll go on to menu four to specify which data is logged to which physical device. In this program, all scan group data is to go to the printer. Press **ENTER** and at the prompt,

K4: DEVICE <1-5>? 1

press the **MENU** key to see a list of the five devices. You want to program the printer, which is the second choice. Press 2, and then press **ENTER**. The prompt now reads,

K42: TYPE OF DATA <1-4>? 1

Again, press **MENU** if you wish to see what choices are available here. You want all data generated to go to the printer, so select 2, and then press **ENTER**. You don't need to change anything in the remaining fields, so our scan group is now completely programmed. Use the **EXIT** key to return to the main menu.

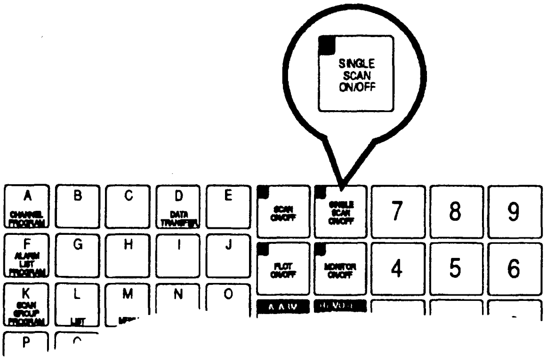
To verify that you have programmed the scan group into the Data Logger properly press **L**, **ENTER**, **K**, **ENTER**.

The LIST function will list the scan program parameters they should look like:

```
***** SCAN GROUP PROGRAM *****

SCAN GROUP NUMBER = 5
CHANNEL LIST:
C8 C9 C10
TRIGGER MODE = TIME INTERVAL SCAN
TIME = 00:00:15
DEVICE = PRINTER
TYPE OF DATA = ALL DATA
SCAN GROUP TO TRIGGER = 0
TRIGGER CONDITION = NEVER
```

To execute the scan from the front panel press,



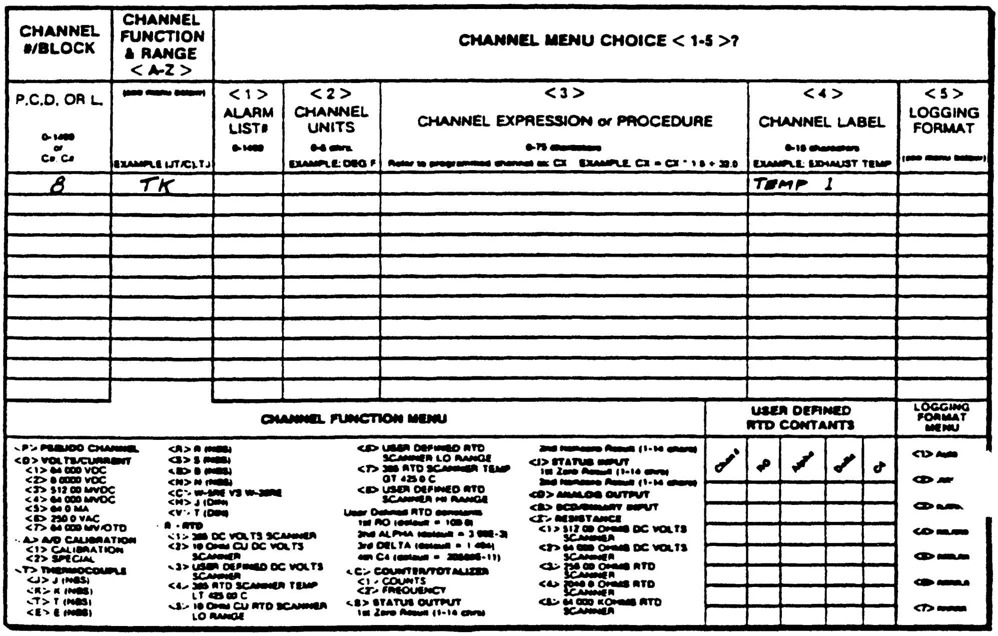
and watch the printer. There isn't any input data to log since the channels listed in this group haven't been programmed yet, but you can get a feeling for the format of the channel readings by running a scan now.

This scan executes every fifteen seconds (as it was programmed), and it's stopped when you press the **SCAN** key again.

The operating keys toggle on and off and a light indicates when they are on. The lesson will continue by programming channels 8, 9, and

Programming Channels

<A> CHANNEL PROGRAM



CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1400 or C0-C9	(see menu below) EXAMPLE (JT/C),TJ	< 1 > ALARM LIST# 0-1400	< 2 > CHANNEL UNITS 0-6 chrs. EXAMPLE: DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1 8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE: EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
8	TK				TEMP 1	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
  <1> 64 000 VDC
  <2> 8 0000 VDC
  <3> 512 00 MVDC
  <4> 64 000 MVDC
  <5> 64 0 MA
  <6> 250 0 VAC
  <7> 64 000 MV/OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
R - RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 Ohm CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425 00 C
  <5> 10 Ohm CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425 0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
  1st RO (default = 100 0)
  2nd ALPHA (default = 3 85E-3)
  3rd DELTA (default = 1 [illegible])
  4th C4 (default = [illegible]-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chrs)
  2nd Nonzero Result (1-14 chrs)
<I> STATUS INPUT
  1st Zero Result (1-14 chrs)
  2nd Nonzero Result (1-14 chrs)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512 00 OHMS DC VOLTS SCANNER
  <2> 64 000 OHMS DC VOLTS SCANNER
  <3> 256 00 OHMS RTD SCANNER
  <4> 2048 0 OHMS RTD SCANNER
  <5> 64 000 KOHMS RTD SCANNER

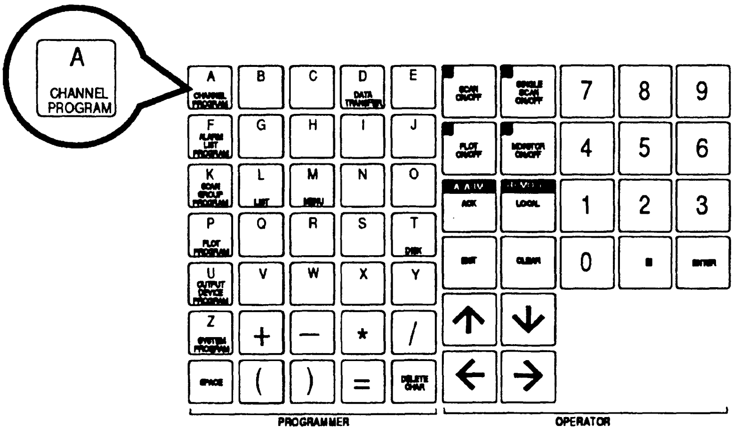
USER DEFINED RTD CONTANTS

Chan#	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> [illegible]
<3> [illegible]
<4> [illegible]
<5> [illegible]
<6> [illegible]
<7> [illegible]

From the main menu, press,



to access the channel programming module. You can also use the **ENTER** key to choose channel programming since it's the default selection.

You're working with channel 8 first and will program it to receive input on a K-type thermocouple, and to have a channel label of TEMP 1.

When prompted for the CHANNEL NUMBER (OR BLOCK), press:

8 and then **ENTER** (keys)

The prompt now reads,

PROGRAM,COPY,DELETE OR LIST <P,C,D,OR L>? P

You're going to program channel 8, and **program** is the default setting, so press **ENTER** to choose it. The display reads,

A: CHANNEL FUNCTION <A-Z>? P

Press **MENU** to list the selections available. The default selection is P for pseudo channel, and since you're using a thermocouple in this program, change the entry to T, and then press **ENTER**. The display reads,

AT: TC TYPE <J,K,T,E,R,S,B,N,C,H,V>? J

Program settings are available for a large array of thermocouple types; press **MENU** to see the complete list.

In this exercise you're using a K type thermocouple (CHROMEL vs ALUMEL), so press **K**, and then press **ENTER**.

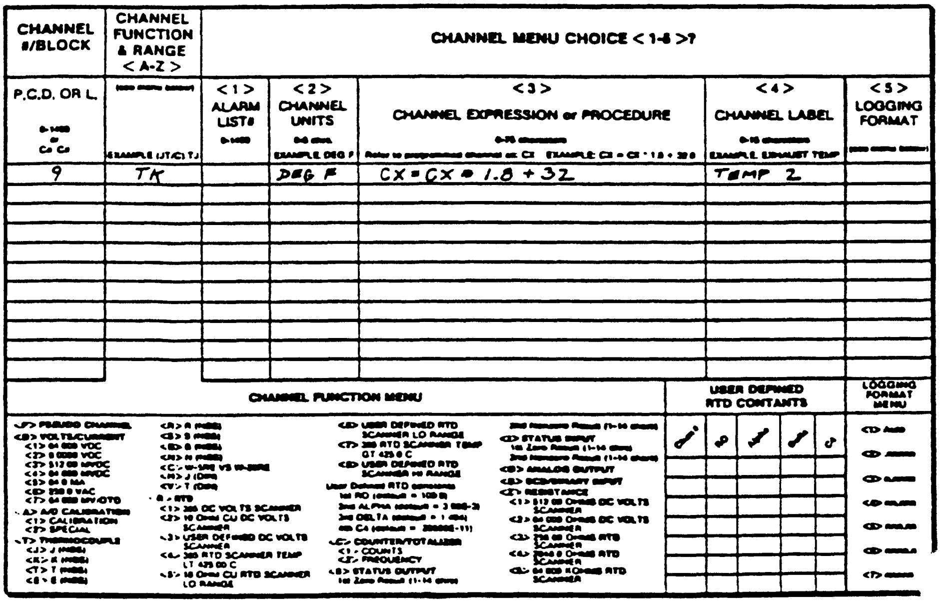
The program for channel 8 doesn't call for an alarm list number, channel units, or a channel procedure, so press 4, followed by **ENTER**, to bypass those programming options and advance to the fourth menu choice. The prompt is,

CHANNEL LABEL <15 CHRS MAX> =

The label for channel 8 is **TEMP 1**. Locate the alphanumeric characters on the 2286/5 front panel now and key them in. Use the right and left arrow and delete character keys if you need to make corrections as you type. When the label appears correct, press **ENTER**.

Channel 8 is programmed now; use **EXIT** to return to the main menu to program channel 9.

<A> CHANNEL PROGRAM



CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE <A-Z>	CHANNEL MENU CHOICE <1-6>?				
P.C.D. OR L.		<1> ALARM LIST#	<2> CHANNEL UNITS	<3> CHANNEL EXPRESSION or PROCEDURE	<4> CHANNEL LABEL	<5> LOGGING FORMAT
9	TK		DEG F	CX = CX * 1.8 + 32	TEMP 2	

CHANNEL FUNCTION MENU

USER DEFINED RTD CONTANTS

LOGGING FORMAT MENU

As you get further along in this lesson, you have more and more responsibility for moving through the menus on your own to locate needed entry fields. Starting at the main menu, use the same techniques for programming channel 9 as for channel 8, except, of course, when the prompt asks for the CHANNEL OR BLOCK NUMBER, enter 9.

Like channel 8, this program is for a type K thermocouple and it isn't associated with an alarm list. Key in **T** and **K** in the channel function menu, and then press **ENTER**. Leave the field for alarm list number blank.

You want channel 9 to log values in degrees Fahrenheit and in order for it to do so, you need to add channel units and a channel expression.

Press 2 (when presented with the prompt CHANNEL MENU CHOICE <1-5>), and then press **ENTER** to advance to the second selection in the menu choice. When the prompt is,

AT<2> CHANNEL UNITS

Press **ENTER** and the display will read,

CHANNEL UNITS <6 CHRS MAX> =

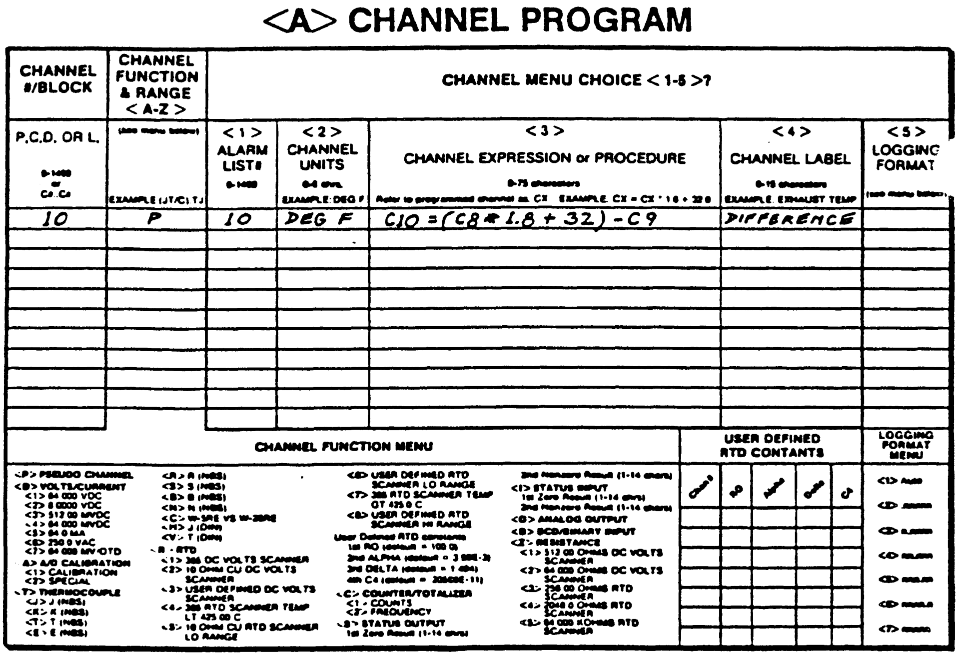
The temperature units are **DEGREES FAHRENHEIT** for this channel, but you're limited to six characters in this field so you have to abbreviate the entry. Following the displayed equal sign, type in,

DEG F and then press **ENTER**.

You're ready to program the third menu in this section now. Press the **ENTER** key again to access it. The mathematical expression entered here converts channel 9 input from degrees Celsius to degrees Fahrenheit. When the display reads **CX** =, key in, **CX*1.8+32**.

Entering spaces in a channel expression is optional. Review the expression you've keyed in, and when you're satisfied it's correct, press **ENTER** to store it and to move to the next menu. The label for this channel is, **TEMP** 2.

ENTER it in the manner used for the channel 8 label. **EXIT** to the main menu. Channel 9 is now programmed.



<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1400 or C0..C9	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1400	< 2 > CHANNEL UNITS 0-6 chrs. EXAMPLE: DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE: EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
10	P	10	DEG F	C10 =(C8*1.8 + 32) - C9	DIFFERENCE	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<B> VOLTS/CURRENT
<1> 64.000 VDC
<2> 8.0000 VDC
<3> 512.00 MVDC
<4> 64.000 MVDC
<5> 64.0 MA
<6> 250.0 VAC
<7> 64.000 MV-OTD
<A> A/D CALIBRATION
<1> CALIBRATION
<2> SPECIAL
<T> THERMOCOUPLE
<J> J (NBS)
<K> K (NBS)
<T> T (NBS)
<E> E (NBS)
<R> R (NBS)
<S> S (NBS)
<B> B (NBS)
<N> N (NBS)
<C> W-5RE VS W-26RE
<M> J (DIN)
<V> T (DIN)
<R> RTD
<1> 385 DC VOLTS SCANNER
<2> 10 OHM CU DC VOLTS SCANNER
<3> USER DEFINED DC VOLTS SCANNER
<4> 385 RTD SCANNER TEMP LT 425.00 C
<5> 10 OHM CU RTD SCANNER LO RANGE
<6> USER DEFINED RTD SCANNER LO RANGE
<7> 385 RTD SCANNER TEMP GT 425.0 C
<8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
1st R0 (default = 100 Ω)
2nd ALPHA (default = 3.85E-3)
3rd DELTA (default = 1.494)
4th C4 (default = [illegible])
<C> COUNTER/TOTALIZER
<1> COUNTS
<2> FREQUENCY
<S> STATUS OUTPUT
1st Zero Result (1-14 chrs)
2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
1st Zero Result (1-14 chrs)
2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<D> BCD/BINARY INPUT
<Z> RESISTANCE
<1> 512.00 OHMS DC VOLTS SCANNER
<2> 64.000 OHMS DC VOLTS SCANNER
<3> 256.00 OHMS RTD SCANNER
<4> 2048.0 OHMS RTD SCANNER
<5> 64.000 KOHMS RTD SCANNER

USER DEFINED RTD CONTANTS

Chan#	R0	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> [illegible]
<3> [illegible]
<4> [illegible]
<5> [illegible]
<6> [illegible]
<7> [illegible]

Channel 10 is to be programmed as a pseudo channel and will perform calculations between channels 8 and 9. It doesn't have anything physically connected to it.

From now on in this tutorial, instructions to press the **ENTER** key appear only in new situations. Continue to use the **ENTER** key to store entered selections and to move through the menu hierarchy.

From the main menu, enter the channel programming module, choose this channel as 10, and advance to the channel function prompt. Select **P** here to indicate that channel 10 is a pseudo channel. Channel 10 is associated with an alarm list that we'll designate as alarm list number 10. At the prompt,

ALARM LIST NUMBER =

type in **10**, and press **ENTER**. The units that channel 10 displays are in degrees Fahrenheit, so at the channel unit prompt, enter **DEG F**.

This pseudo channel converts channel 8 input from degrees Celsius to degrees Fahrenheit, computes the difference between channels 8 and 9, and then displays the difference when scanned. At the channel procedure field, the prompt is,

CP:

Type in **C10=(C8*1.8+32)-C9** and then **ENTER**.

After you've entered the procedure, you'll see another **CP:** on the display, followed by a blank line. Enough space has been allotted in this field for unlimited lines of procedures (with each line containing up to 75 characters), but since you're entering only one line, hit **ENTER** again to move on.

The only other field you need to worry about for channel 10 is the label. At the channel label prompt, type in the label, which is, **DIFFERENCE**.

When you've completed these steps, **EXIT** back to the main menu and verify the channel programming by pressing **L**, **ENTER**, **A**, **ENTER**. The listing should look as follows:

```
***** CHANNEL PROGRAM *****

CHANNEL NUMBER (OR BLOCK) = C8
CHANNEL FUNCTION = THERMOCOUPLE
TC TYPE = K (NBS)
CHANNEL LABEL = TEMP 1
LOGGING FORMAT = AUTO

CHANNEL NUMBER (OR BLOCK) = C9
CHANNEL FUNCTION = THERMOCOUPLE
TC TYPE = K (NBS)
CHANNEL UNITS = DEF F
CHANNEL LABEL = TEMP 2
LOGGING FORMAT = AUTO
CHANNEL MATH:
CX= CX*1.8+32

CHANNEL NUMBER (OR BLOCK) = C10
CHANNEL FUNCTION = PSEUDO CHANNEL
ALARM LIST NUMBER = 10
CHANNEL UNITS = DEF F
CHANNEL LABEL = DIFFERENCE
LOGGING FORMAT = AUTO
CHANNEL MATH:
C10= (C8*1.8+32)-C9
```

EXIT back to the main menu prompt to program the alarm list.

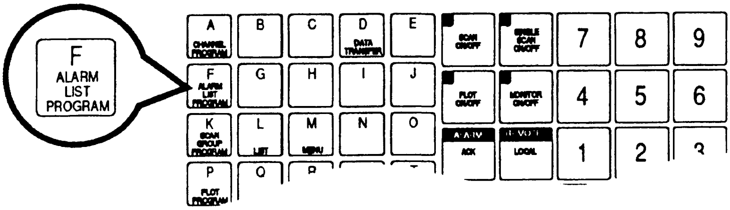
Programming an Alarm List

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L.	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
0-1400	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE: EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE	<5> DELETE LIMIT	
10	1	H	15	DELTA TEMP OVER LIMIT				
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							

This alarm list program is designed to trigger an alarm any time the difference between channel 8 and channel 9 (as compared and displayed by channel 10) exceeds fifteen degrees Fahrenheit.

From the main menu display, select,



then use the **ENTER** key to reach the prompt,

ALARM LIST NUMBER = 0

You're designating this alarm list program as number **10**, so enter it over the displayed default. When you've finished, press **ENTER**. A lot of default selections work for us in this program so you'll be using the **ENTER** key frequently.

You're **programming** this alarm list, so use **ENTER** to select the P. When you've advanced to the prompt,

F: ALARM LIST MENU CHOICE <1,2>? 1

use the **MENU** key to list the two programming choices available. You want to program the limits information (which is the default setting), so use **ENTER** again to indicate this.

You have the capability of assigning up to four limits per channel here. You're only programming one limit, so press **ENTER** and then use **MENU** again to print the list of menu choices.

Use **ENTER** again to set the alarm for values exceeding the HIGH sense. **ENTER** the second menu of the limit menu choice to indicate exactly how high the limit value should be to trigger an alarm. At the prompt,

LIMIT VALUE = 0.0

key in **15**, and then press **ENTER**. Alarm list 10 is now programmed to indicate an alarm condition whenever scanning or monitoring occurs and the difference between channel 8 and channel 9 exceeds fifteen degrees Fahrenheit. It helps to have a message corresponding to the alarm condition, especially if more than one alarm list is programmed. Press **ENTER** to access the third menu, and to assign a message to this alarm. When the display reads,

ALARM MESSAGE <40 CHRS MAX> =

type in the message **DELTA TEMP OVER LIMIT**, and press **ENTER**. Use the right and left arrow and delete character keys to edit or to correct typing errors.

This program doesn't call for triggering other scan groups, deleting earlier programmed limits, or working with a dead band, so leave the remaining fields unchanged and **EXIT** to the main menu.

Use the LIST function to confirm your alarm list program by pressing L, ENTER, F, ENTER. The listing should look as follows:

```
***** ALARM LIST PROGRAM *****

ALARM LIST NUMBER = 10
DEAD BAND = 0.0

LIMIT NUMBER = 1
LIMIT SENSE = H
LIMIT VALUT = 15
ALARM MESSAGE:
DELTA TEMP OVER LIMIT
SCAN GROUP TO TRIGGER = 0
TRIGGER MODE = NEVER
```

Exit back to the main menu prompt.

Press the **SCAN** key again now and watch the printed results. Experiment a bit if you like by dipping the end of the channel 9 thermocouple into hot coffee. Or heat it slightly with other available means during scanning.

Experimenting may cause an alarm to be triggered, which can easily be acknowledged by pressing the front panel **ACK** (alarm acknowledgement) key.

When you're finished experimenting with your scan group, press the **SCAN** key again to stop the scan. Return to the main menu.

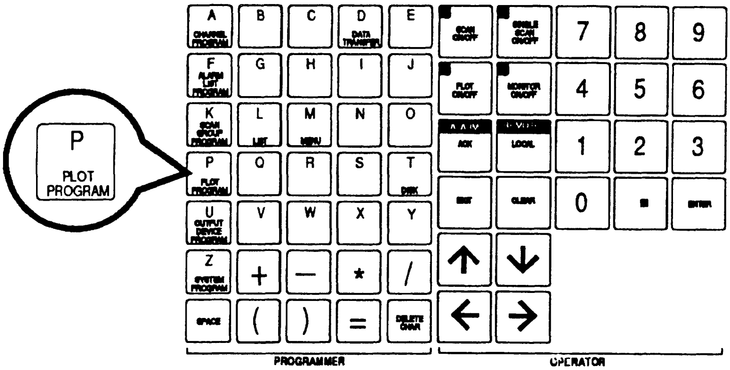
Writing a Plot Program

< P > PLOT PROGRAM

<table>
<tr><td colspan="6">PLOT MENU CHOICE < 1,2 >?</td></tr>
<tr><td colspan="5">< 1 >
PARAMETERS
PLOT NUMBER <1-4> ?</td><td>< 2 >
COMMON PLOT INTERVAL FOR ALL FOUR PLOTS</td></tr>
<tr><td>PLOT #:
SYMBOL:</td><td><1> □</td><td><2> ⨯</td><td><3> I</td><td><4> ◇</td><td rowspan="4">PLOT INTERVAL
00:00:15
HH MM SS</td></tr>
<tr><td>1st) Channel to Plot</td><td>8</td><td>9</td><td>10</td><td></td></tr>
<tr><td>2nd) Leftmost Value</td><td>20</td><td>50</td><td>-20</td><td></td></tr>
<tr><td>3rd) Rightmost Value</td><td>50</td><td>100</td><td>+20</td><td></td></tr>
</table>

A plot program is perhaps the easiest of all to put together for the 2286/5. To plot from 1 to 4 channels, specify the channel numbers, the right and left values to plot between, and the time interval you wish between executions of plotting. This program is designed to plot the values of the three channels (8 through 10) that you've already programmed.

From the main menu, press,



and then press **ENTER**. Use the **MENU** key to list onto the printer the two programming choices available here. You can also use the up and down arrow keys to view the menu selections.

Identify the channel numbers and the parameters for each channel for the first step. Press **ENTER** again, and the display reads,

PLOT NUMBER <1-4>? 1

Use **ENTER** to access the first menu and at the prompt,

CHANNEL TO PLOT =

type in **C8** and press **ENTER**. Channel 8 input is read in degrees Celsius, and the range you'll plot will be from twenty to fifty degrees.

When the display reads,

```
LEFT MOST VALUE =
```

type in **20**, and press **ENTER**.

At the prompt,

```
RIGHT MOST VALUE =
```

enter **50** and press **ENTER** again. That's all there is to specifying plotting parameters. You'll be advanced by the system to the next menu to program another channel to plot. Follow the same entry procedures now on your own to specify left and right most values for channels 9 and 10.

As the handwritten program at the beginning of this plotting section indicates, the left most value for channel 9 (**C9**) is **50**, the right most value is **100**.

When the parameters for channel 9 are entered, type in the plotting range for channel 10 (**C10**). Set the left most value to **-20** and the right most value to **+20**.

You're not programming plot number 4, so press **EXIT** to return to the prompt,

```
P: PLOT MENU CHOICE <1,2>? 2
```

As you can see from the display, you've been advanced t the second menu of the plot menu choice. Press **ENTER** now to access it so you can set the plotting interval. At the display,

```
PLOT INTERVAL = 00:00:01
```

use the right arrow key to scroll across the display to the position indicating seconds. The format is hours, minutes, and then seconds. This program calls for plotting every five seconds, so, the display to change to read,

```
00:00:05
```

Press **ENTER**, and the plot program is complete.

Verify you PLOT program by listing the programmed PLOT parameters. Press **L, ENTER, P, and ENTER**. The listing should look as follows:

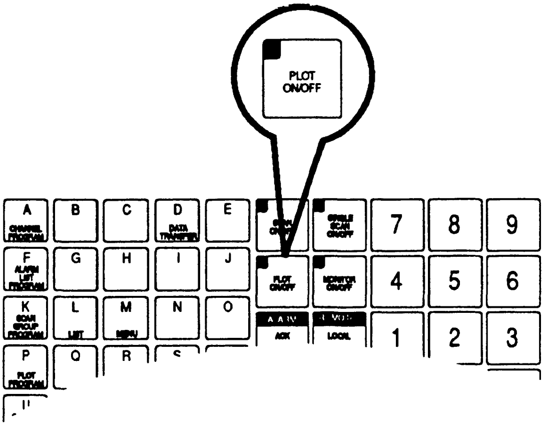
```
***** PLOT PARAMETERS *****

PLOT NUMBER = 1
CHANNEL TO PLOT = 8
LEFT MOST VALUE = 20
RIGHT MOST VALUE = 50

PLOT NUMBER = 2
CHANNEL TO PLOT = 9
LEFT MOST VALUE = 50
RIGHT MOST VALUE = 100

PLOT NUMBER = 3
CHANNEL TO PLOT = 10
LEFT MOST VALUE = -20
RIGHT MOST VALUE = 20
```

To execute the plot program you've just written, return to the main menu and press,



The values from the three programmed channels will be displayed onto the printer at intervals of five seconds. Press the **PLOT** key again to stop plotting.

Use the LIST key, as demonstrated at the beginning of this tutorial, to print the program you've just written onto the built-in printer. Press **L**, **ENTER**, **E**, **ENTER** to list everything.

Turn the instrument off (using the keyswitch) and your program is stored in the 2286/5 memory for at least thirty (and up to ninety) days.

Section 3
Programming and Menu Reference

CONTENTS

INTRODUCTION

This section takes you through each entry field of each menu available from the six programming modules. The menus are presented in the same sequence that they are encountered while you are programming. This section is organized in a reference format to help you easily find a menu or entry field you may have questions about.

Use the 2280 Series Programming Form as a worksheet and to assist you in orienting yourself as you step through the menus. Sometimes the entry fields and varying levels within different menus can be a bit confusing. The Programming Form also provides a convenient program reference of values and characteristics you've assigned to the 2286/5.

If the reference information provided here doesn't answer your questions, refer to the tutorial in Section 2a for introductory information.

MENU REFERENCE OVERVIEW

The 2286/5 Data Loggers are programmed by using a menu-driven system--you don't have to learn a computer software language to set up monitor and scanning processes. The programs are divided into six modules (or groups) of programmable features, each accessed by the 2286/5 front panel keypad.

Using the 2280 Series Programming Form helps you to plan your entry before you enter it in the Data Logger. If you change your mind once you've written and entered a program, it's an easy matter to alter programs after they've been keyed in.

This section takes you through the modules detailed on the 2280 Series Programming Form and explains each set of options available under the different menus. If you have questions about a menu entry, locate information for that field in the following sequence,

1. Identify the program module first (CHANNEL, ALARM LIST, SCAN GROUP, etc.). Turn to the corresponding module section on the following pages.
2. Find the menu in question within the tabbed module section. Refer to the 2280 Series Programming Form if you need assistance in finding the menu title.
3. Pinpoint the specific menu (or entry field within a menu) that you need information about. The menus are presented in the same sequence in which they are encountered while programming.

This reference section covers the entry fields of each of the menus and modules available when programming the 2286/5 Data Loggers. Using this reference and the 2280 Series Programming Form, will help you quickly put together an individualized program for data acquisition and monitoring.

CHANNEL PROGRAMMING

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or C# C#	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1 8 + 32 0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
  <1> 64 000 V dc
  <2> 8 0000 V dc
  <3> 512 00 MVDC
  <4> 64 000 MVDC
  <5> 64 0 MA
  <6> 250 0 VAC
  <7> 64 000 MV/OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
<R> RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 OHM CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425 00 C
  <5> 10 OHM CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425 0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
  1st RO (default = 100 0)
  2nd ALPHA (default - 3 90E-3)
  3rd DELTA (default = 1 494)
  4th C4 (default = 20598E-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
  1st Zero Result (1-14 chars)
  2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512 00 OHMS DC VOLTS SCANNER
  <2> 64 000 OHMS DC VOLTS SCANNER
  <3> 256 00 OHMS RTD SCANNER
  <4> 2048 0 OHMS RTD SCANNER
  <5> 64 000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan#	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> nnnnn
<3> n nnnn
<4> nn nnn
<5> nnn nn
<6> nnnn n
<7> nnnnn

Channel programming refers to the set of instructions telling the Data Logger what its inputs are and where those inputs are physically located. Alphanumeric labels, engineering units scaling, and the location of the decimal point for logging are within a channel program. If a channel input is to be checked against an alarm list, those limits are also referenced through channel programming.

A channel is the building block for a scan group. Each channel can be defined as a measurement (or input) channel, an output channel, or as a pseudo (or dummy) channel used to perform calculations between other channels.

Program each channel as an input, output, or pseudo channel, and then combine them into a scan group.

PROGRAM A CHANNEL OR A BLOCK

Specify the numeric channel, or group of channels (referred to as a block), that you wish to work with. The assigned number or numbers may be up to four digits long, from 0 to 1499 for the 2286 Data Logger (0 to 99 for the 2285 Data Logger).

Program each channel separately (for example, C9) or in blocks of related channels for ease of reference (for example, C1..25). A program encompassing a block of channels uses less program memory space than separate programs for each channel.

If you select a channel or block that has already been programmed, the existing program will be displayed when you enter each menu.

P,C,D, or L

Program, Copy, Delete, or List the Channel or Block number you've specified.

PROGRAM

When you select program, you have access to each menu in the same sequence as you see on the Programming Form. Use program to enter a new program, or to change values or characteristics entered earlier.

Program is the default selection for this field so you can select it by merely pressing the ENTER key.

COPY

If you choose copy, the system first checks to see if the channel designated to receive the copied parameters is already programmed. If so, the old program must be deleted before new parameters can be copied into it.

The prompt is,

CHANNEL EXISTS, DELETE<Y,N>? N

If you press Y, then press ENTER (or if the channel wasn't previously programmed), the prompt becomes,

CHANNEL TO COPY FROM =

Now, enter the channel number whose program you want copied to the new channel. Press ENTER, and the channel program is completed.

The system responds with the prompt,

CHANNEL OR BLOCK COPIED

When you press ENTER, the system returns the prompt,

CHANNEL NUMBER (OR BLOCK) =

This indicates that you can now enter the number of another channel to be programmed. Press the EXIT key when you're finished to return to the main menu.

DELETE

Delete removes the program from the channel or block number you've chosen. The program is permanently deleted when you press this key.

Delete also frees space in the 2286/5 memory for other program parameters.

LIST

Listing a channel or block prints the current program parameters onto the printer (or other listing device, if installed and selected).

CHANNEL FUNCTION

The channel function entry defines the category of input and output hardware associated with a given channel. Measurement input and output functions are assigned here also.

A channel may also be designated a pseudo channel here. A pseudo channel doesn't have anything physically connected to it; it's generally used as a mathematical expression for a specified channel, or between that channel and any other channel.

Enter the program specifications you desire (from the printed menu or from the Programming Form) by entering the letter shown for the function you wish to choose. Section 5 of the 2286/5 System Guide provides several measurement and output examples.

CHANNEL MENU CHOICE

The channel menu choice contains five programmable fields. They are alarm list number, channel units, channel expression or procedure, channel label, and logging format.

Alarm List Number

This field is for the number of the alarm list associated with the channel or block of channels being programmed. If no alarm list is programmed in connection with this channel number, leave the entry field blank and no limits checking will occur when this channel is scanned.

For ease of reference, you can use the same number for the alarm list as you do for the programmed channel or channels associated with it.

Channel Units

You can enter up to six characters indicating the engineering units used in programming this channel or block of channels.

The channel function has a default channel unit that corresponds to it; if you leave this field blank, the default will be indicated when you scan or monitor this channel or group of channels. The preset selections are as follows:

DEFAULT CHANNEL UNITS

Function and Range	Default Units
64.000V dc	V
8.000V dc	V
512.00mV dc	MV
64.000mV dc	MV
64.0 mA	MA
250.0V ac	VAC
64.000 mV/OTD	MV/OTD
Thermocouples	F, or C, or CMV
RTD	F, or C
Pseudo	none
Counts	none
Frequency	HZ
Status Output	none
Status Input	none
Analog Output	none
BCD/Binary	none
Resistance	OHMS

Channel Label

You can program a channel label to identify or describe any channel. One label, containing up to 15 characters, may be used for each channel or block of channels.

Once programmed, the label is then included whenever channel information is displayed or recorded. The exception is when the compressed output format is selected, in which case the label is omitted in order to save space.

Logging Format

The logging format automatically used with the chosen channel function (choice 1 below) can be changed, if desired, to any of the other choices.

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

In cases 3 through 7, one leading zero to the left of the decimal point is displayed where appropriate. When format 2 is used, there is no leading zero. The '+' sign is never displayed. The automatic logging formats for each of the channel functions are listed below.

The floating decimal format always displays 5 digits, along with the appropriate decimal location. If one of the fixed formats is assigned and the value of that channel exceeds the range of that format, the format will shift to an appropriate decimal location.

The logged number is usually a rounded representation of the number inside the 2286/5. Since the display and logging space is limited to 5 digits, numbers must be rounded off. A number such as .000004 is displayed as .00000. Also, if the internal number 46.895 is logged with the format nnn.nn, it will come out as 46.90.

Automatic Logging Formats for Each Channel Function

FUNCTION/CONDITION	AUTO FORMAT
Input Channels WITHOUT Expressions	
DC Volts, DC Current, AC Volts, Resistance	(As appropriate for each measurement range)
RTD	nnn.nn
Thermocouple	nnnn.n
Counts, BCD/Binary Input	nnnnn
Frequency	Floating Decimal
Input Channels with Expressions	Floating Decimal
Analog Output or Pseudo Channels	Floating Decimal
Status Input and Output	
zero result	ZERO
nonzero result	ONE

Channel Expression or Procedure

Channel expressions allow you to convert the results of a channel measurement from a raw number to a more meaningful value. Any math or scaling function (any combination of addition, subtraction, multiplication, or division, in an algebraic form), can be applied to the reading obtained from the channel.

With the Math Coprocessor option installed, more complex computations, math manipulations, and trigonometric functions are possible. See section 4 of this guide, Advanced Math Programming, or refer to Option -211 of the options section in the 2286/5 System Guide for more information.

In any simple math expression with multiple operations, the Data Logger will evaluate the operations in the following order.

1. Negation

2. Multiplication and Division

3. Addition and subtraction

Also, operations inside parentheses are evaluated before those outside parentheses.

The range for valid numbers is between 2.72E-20 and 9.22E18. Numbers smaller than 2.72E-20 are set to zero, and numbers larger than 9.22E18 cause a MATH OVERFLOW ERROR (see section 8 of this guide, Error Messages and System Alarms).

A measurement or input channel may have an expression in which an assignment operator (=) causes the logged value of the channel to be some function of its raw reading. It is only one line long. It cannot reference any channels by number, and it must refer to itself as CX.

An output or pseudo channel may have a multi-line procedure. Each line (or statement) contains an assignment channel number, an assignment operator, and an expression. When the expression is evaluated, the result is assigned to the assignment channel (which may be an output or a pseudo channel). It may refer to multiple channels by number as well as to itself by number, or as C". Each line in a procedure, and the one line of an expression, may be up to 75 characters long. Channel expressions and procedures are further defined in the following paragraphs.

INSERTING AND EDITING LINES OF TEXT

Channel procedures and interpolation tables can exist as multiple lines in a configuration program. Use the following steps when these lines need editing, or if you want to insert additional lines.

Editing and Deleting Lines

To edit or delete lines in a set, call up the desired parameter so the first line is displayed. Use the <up arrow> and <down arrow> keys to display the line you wish to edit or delete.

To delete a line, press the CLEAR key, and then press ENTER.

There are two ways to edit lines.

1. To replace a line, simply start keying in new characters over the old ones. The old characters will be deleted.

2. Use the <right arrow> or <left arrow> key to move the cursor to the character you want to change.

   Remove the character with the DELETE CHAR key and then enter the new characters. When the line appears the way you want it to, press ENTER. If the syntax is correct you will be prompted for another line. Use EXIT to return to the main menu.

Inserting Lines Into Current Set of Lines

To insert lines into a set that is already programmed, call up the desired parameter so the first line in the set is displayed.

Use the <up arrow> and <down arrow> keys to scroll to the line after which the insertion is to take place.

Press the ENTER key. A blank field is now available for entry of the new line. When you're finished inserting lines, move to a new line and press EXIT.

If you are inserting a new line at the beginning of a set, use the <up arrow> key to scroll up past the top line. All lists wrap around from the top to the bottom and have an empty line separating the two.

INPUT CHANNEL EXPRESSION

For input channels, the expression must refer to no channel other than the one for which it is written. The channel in question is written in the expression as CX. For example, an mx+b scaling for channel 23 might be entered as CX=3*CX+4, (CX= is the displayed prompt). The expression translates to,

> Assign a new value to the channel which is 3 times its measured value plus 4. (If programming in the block mode, then CX refers to the channel number being processed at that time).

For example, assume that you are programming the block of input channels 4 through 7, and you have assigned to them the simple expression CX=5*CX+9. When the reading for channel 4 is taken during scanning, the expression is evaluated as 5*C4+9. When the channel 5 reading is taken, the expression is evaluated as 5*C5+9, and so on for channels 6 and 7.

OUTPUT/PSEUDO CHANNEL MATH PROCEDURE

The procedure programmed for an output or pseudo channel follows the same rules for the order of operation evaluation as channel expressions do. It differs from the input channel expression as follows.

The output or pseudo channel procedure may contain, in addition to CX, any other input, output or pseudo channel numbers. It must refer to itself as CX if you are programming in the block mode. Any other channel in the procedure is referred to by number.

The most recently assigned value is used for any output channel or pseudo channel that appears in the procedure on the right hand side of an assignment operator (=). Any input channel on the right hand side of an assignment operator will be read by the system to obtain a current value.

An example of a procedure is a running average of the last three readings of channel 20. Write the procedure for channel 100 as,

```
C100 = (C101 + C102 + C20)/3  ENTER
C101 = C102  ENTER
C102 = C20   ENTER  ENTER
```

Pressing ENTER a second time enters a blank line that signifies the end of the procedure.

This example illustrates that,

- A procedure may have multiple lines, each of which is ENTERED.
- Explicit channel numbers may be used both in reference to the channel being programmed and in reference to other channels in the procedure.

To save memory space, you can use pseudo channels in procedures without having any channel programming for them.

BASIC OPERATORS FOR CHANNEL EXPRESSIONS AND PROCEDURES

Basic operators that can be used in channel expressions and procedures without the Math Coprocessor option are addition, subtraction/negation, multiplication, division and parentheses.

ADDITION

Format: (operand1) + (operand2)

Usage: Operates between two operand to form their algebraic sum. If an operand doesn't appear directly to the left of the addition character, then the '+' character is interpreted as the positive unary operator (it signifies multiplication by +1).

Examples:

```
C23+6.34
+C256
```

SUBTRACTION/NEGATION

Format: (operand1) - (operand2)

Usage: Operates between two operands, forming the result by subtracting the right operand from the left. If an operand doesn't appear directly to the left of the subtraction character, or if it is preceded by another operator, then the minus sign is interpreted as a negative unary operator, which simply inverts the algebraic sign of the operand following it (negation).

Examples:

```
C9-C452
-C29
C5*-3.17
```

MULTIPLICATION

Format: (operand1) * (operand2)

Usage: Operates between two operands, giving the product of multiplying one by the other.

Examples:

```
C39*68.03E3
C2*C9
```

DIVISION

Format: (operand1) / (operand2)

Usage: Operates between two operands such that the one on the left of the division operator is the dividend, while the one on the right is the divisor. The dividend is divided by the divisor to produce the result.

Examples:

```
C35/C4
100/C28
```

PARENTHESES

Format: (expression)

Usage: Encloses multiple operands and causes all enclosed operators to be executed before those that are outside this operator. Parentheses may be nested three deep.

Examples:

C20 = (C1+C2+C3+C4)/4 is the average of 4 channels.

C20 = C1+C2+C3+C4/4 is not the average of 4 channels.

SPECIAL MATH FUNCTIONS WITHOUT THE MATH COPROCESSOR

The special capabilities available when performing math expressions (without the Math Coprocessor option installed) are alarm status, error status, reference voltage, linearization, and RTD function.

ALARM STATUS

Format: `ALMn(1x//2x//3x// etc.)`

Usage: The alarm status function, when evaluated, gives the status (1 = exceeded, 0 = not exceeded) of a particular limit (n) of the channel or block designated in the function. The format of the function is ALMn (channel list), where n is a number from 1 to 4, and the channel list is a single channel, a block of channels, or a combination of blocks and single channels separated (//). For example, the function written as,

```
ALM2(C98//C100..102//C200)
```

when evaluated, will tell whether channel 98, 100 to 102, or 200 has exceeded limit #2 of its assigned alarm list.

Examples:

```
ALM1(C9)
ALM4(C9..C15)
```

A typical use of this function is to connect a status output channel with a limit on an input channel. For example, consider the following function, where C20 is a status output channel,

C20 = ALM2(C1)

This becomes an alarm output indicating the state of alarm 2 on input channel 1. C20 should then be included in a scan group channel list. The inclusion of C20 will cause C1 to be read and processed to provide an immediate update of the status output channel based on the input channel's alarm state.

THERMOCOUPLE REFERENCE VOLTAGE

Format: REFn(temperature)

Usage: This function can be used in applications where temperature is being monitored with thermocouples that are terminated in an external isothermal block. When the function is evaluated, it gives the compensating millivolts for specified thermocouple terminated at a specific temperature.

These compensating millivolts, when added to the millivolts measured from the thermocouple, provide the necessary correction to cancel out the effect of the secondary thermocouple formed at the thermocouple termination.

The format of the function is REFn(t) where n is a single letter corresponding to the desired thermocouple type (as shown in the thermocouple selection menu), and (t) one of the following,

- A constant temperature---for cases where the thermocouple is terminated in an isothermal block at a fixed temperature.

- A channel number---where the channel is an input channel measuring the actual temperature of the external isothermal block.
- An expression---that, when evaluated gives the temperature of the external reference block.

The temperature units used in these cases are the same as programmed in the system program. If the system temperature units are compensated millivolts, degrees Celsius is assumed.

For example, this function is used in applications where the thermocouples measure temperatures physically distant from the Data Logger.

As a cost saving measure, the thermocouples can be terminated in an isothermal block close to the temperatures being monitored. The millivolt signals from the thermocouples can then be connected to the 2286/5 with copper wire.

If the isothermal block used is kept at a constant temperature (for example in an oven at 50 degrees Celsius, and NBS type R thermocouples are used), the reference junction correction can be determined by the following expression,

```
REFR(50)
```

If in this example, the temperature of the isothermal block is not held at a constant, but is being measured by the 2286/5 (using a platinum RTD, for instance) the reference junction correction can be determined by,

```
REFR(C100)
```

where C100 is the RTD channel measuring the temperature of the isothermal block.

THERMOCOUPLE LINEARIZATION

Format: LINn(millivolts)

Usage: When evaluated, this function gives the temperature as measured by a specific type of thermocouple. Use this in applications where temperature is being measured with thermocouples not terminated on the standard Isothermal Input Connector (Option -175).

Example:

```
CX = LINR(CX+REFR(C100))
```

The format is LINn(m), where n is a single letter corresponding to the type of thermocouple used (as shown in the thermocouple selection menu) and 'm' is one of the following:

- A channel number---where the channel is an input channel measuring the millivolt signal of a thermocouple.
- An expression---that, when evaluated, gives the millivolts to be converted to temperature for the specified thermocouple type.

The temperature units used in these cases is the same one programmed in the system program. If the system temperature units are compensated millivolts, the value of the argument is returned unchanged.

For example, this function is used in applications where thermocouples measure temperatures located physically distant from the Data Logger.

As a cost saving measure, the thermocouples can be terminated in an isothermal block close to the temperatures being monitored. The millivolt signals from the thermocouples can then be connected to the 2286/5 with copper wire.

If the isothermal block used is kept at a constant temperature (for example in an oven at 50 degrees Celsius, and NEBS type R thermocouples are used), the temperature being measured by the thermocouples can be determined by the following expression,

```
CX = LINR(CX + REFR(50))
```

where the current channel is programmed to measure millivolts on the 64-millivolt range with an open thermocouple detection (MV/OTD).

If in this example, the temperature of the isothermal block is not held at a constant, but is being measured by the 2286/5 (using a platinum RTD, for instance) the temperature can be determined by,

```
CX = LINR(CX + REFR (C100))
```

where C100 is the RTD channel measuring the temperature of the isothermal block.

LIN1

Format: LIN1 (ohms)

Usage: When evaluated in an expression, the LIN1 function applies a 385 DIN platinum linearization on the value of the parameter which is expected to be the resistance of the RTD probe in ohms.

Example:

```
LIN1(CX)
```

LIN2

Format: LIN2(ohms)

Usage: When evaluated in an expression, the LIN2 function applies a 10 ohm Cu RTD linearization on the value of the parameter which is expected to be the resistance of the probe in ohms.

Example:

```
LIN2(CX)
```

RTD

Format: RTD(ohms//RO//alpha//delta//c4)

Usage: When evaluated in an expression, the RTD function applies a user defined platinum RTD linearization on the value of the resistance of the RTD probe.

Example:

```
RTD(CX//100.00//0.00390//1.494//-0.205984E-11)
```

This function returns the temperature of a calibrated RTD. The following probe characteristics are required.

ohms	(ohms)
RTD ice-point resistance	(RO)
RTD alpha value	(alpha)
RTD delta value	(delta)
C4 value	(c4)

If any of the last four parameters above are omitted the following defaults will be used.

RO	100.00
alpha	0.00390
delta	1.494
c4	-0.205984E-11

The RTD constants must be specified in order. For example, if you need to specify a C4 that differs from the default, you must also specify RO, alpha, and delta. This is true even if they are the same as the default settings.

The temperature unit used in this function is the same one programmed in the system program. If the system temperature units are compensated millivolts, degrees Celsius is assumed.

ERROR STATUS

Format: ERR (1x//2x//3x//etc.)

Usage: The error status function is used to find the lowest valued error number (the one with the highest priority) currently active on the channel or block of channels listed.

These errors aren't fatal to system operation, but do indicate that something is wrong. The priority (ranging from 0 through 5) indicates the severity of the problem. The delimiter "//" is used to separate the various channels listed. An error value of zero indicates that none of the channels in the list are in error.

Error reporting numbers are as follows:

(1) Dead Serial Link Device
(2) Broken Thermocouple
(2) Propagated Error
(3) No Reading
(4) Out of Measurable Range
(4) Out of Temperature Range
(5) Argument Out of Range
(5) Bad RTD Constants
(5) Arithmetic Overflow
(5) Denominator of Zero
(5) Negative Argument
(5) Zero Argument

Example:

The function ERR(C99//C100...104), when evaluated, gives the lowest valued error number currently active of channel 99 or 100 through 104.

SCAN GROUP PROGRAMMING

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L.	< 1 > SCAN GROUP LABEL	< 2 > SCAN GROUP CHANNEL LIST	< 3 > SCAN TRIG MODE	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device					< 5 > OTHER SCAN GROUP TRIGGER	
0-9	0-40 Alphanumeric characters EXAMPLE: ENGINE 2 TEST	FORMAT: One Channel only: C# Channel Block only: C# C# Channel and Blocks: C# C# C# C# C# C# C# C#	(pick only one see menu below)	<1> Display	<2> Printer	<3> Disk/Tape	<4> Port A	<5> Port B	Scan Group to Trigger (#)	Trigger Condition (see menu below)
<1> On Demand Only <2> Time Interval HH MM SS		<3> Continuous <4> Discrete Time HH MM SS	<5> Externally Triggered <6> Scan Once	<1> No Data <3> Alarm Data <2> All Data <4> Alarm Trans Data					<1> Never <2> Any Alarm	<3> Any Alarm Transition <4> Always

A scan group is a collection of input, output, and pseudo channels you program to be monitored or scanned and recorded as a group. A given channel may be included in any or all scan groups and may appear more than once in a list, but input channels are only measured once each time a scan is executed.

A scan group is really a procedure. Each programmed step reads an input channel, performs the calculations in a pseudo channel, and sends a value to an output channel. Each scan group is given a channel list showing the channel data to be collected and specifying the order in which the channels within a scan group will be logged.

Each scan group behaves as an independent task with its own trigger conditions. To program a scan group, enter all of the attributes needed to spell out what those conditions are.

GROUP NUMBER

Up to ten scan groups (numbered 0 through 9) can be programmed. You can group channels together for process monitoring, data acquisition and recording, or because they have a logical association with one another.

The number of a scan group also indicates its priority. The lower the number, the higher the scan group priority.

The priority affects the scheduling of scan groups when more than one scan group is triggered for execution. The scan group triggered with the highest priority becomes active when the current active scan group is completed. Only one group can be actively scanning at any time.

P,C,D, or L

Program, Copy, Delete, or List the Scan Group number you've specified.

PROGRAM

When you select program, you have access to each menu in the same sequence as you see on the Programming Form. Use program to enter new scan group parameters or to change values or characteristics entered earlier.

Program is the default setting for this field so you can select it by merely pressing the ENTER key.

COPY

If you choose copy, the system first checks to see if the scan group designated to receive the copied parameters is already programmed. If so, the old program must be deleted before new parameters can be copied into it.

The prompt is,

```
SCAN GROUP EXISTS, DELETE<Y,N>? N
```

If you press Y, then ENTER (or if the scan group wasn't previously programmed), the prompt becomes,

```
SCAN GROUP TO COPY FROM =
```

Now, enter the scan group number whose program you want copied to the new scan group. Press ENTER and the scan group is programmed completely.

The system responds with,

```
SCAN GROUP COPIED
```

When you press ENTER, the system returns the prompt,

```
SCAN GROUP NUMBER =
```

This indicates that you can now enter the number of another scan group to be programmed. Press the EXIT key when you're finished to return to the main menu.

DELETE

Delete removes the program from the scan group number you've chosen. The program is permanently deleted, so use this selection judiciously.

Delete also frees space in the 2286/5 memory for other program parameters.

LIST

The list function prints the current scan group program onto the printer (or other listing device, if installed and selected).

SCAN GROUP MENU CHOICE

There are five areas of programming available through the scan group menu choice. These parameters can be programmed in any order, but by following the system prompts you will automatically be stepped forward to the next programming option each time you press ENTER.

Scan Group Label

Each scan group can have a label consisting of up to 40 characters. If no previous label has been programmed, an empty field will be displayed. If you want to change a label for a given scan group, key in the new label over the old one.

During scanning the label appears before the logged data. The label is optional, and scanning is not affected if you leave it off.

Scan Group Channel List

Enter the number of the channel, or block of channels, you want to scan. This list is a series of channel identifiers (numbers and/or blocks), and each channel or block specified here will produce one or more lines of logged data. If more than one identifier is included, you can separate them with spaces to make them easier to read.

The scan group channel list can be of any length and specify channels in any sequence. It can contain multiple lines, each of which can be up to 75 characters long.

Single channel numbers and blocks must start with a 'C', but the second channel of a block doesn't need it. The second channel number listed must be larger than the first. Following are examples of three different (but acceptable) ways to enter a scan group channel list.

```
C37
C10..20  C78  C1300..1350
C43..C52
```

INSERTING AND EDITING LINES OF TEXT

Scan group channel lists can exist as multiple lines in a configuration program. Use the following steps when these lines need editing, or if you want to insert additional lines.

Editing and Deleting Lines

To edit or delete lines in a set, call up the desired parameter so the first line is displayed. Use the <up arrow> and <down arrow> keys to display the line you wish to edit or delete.

To delete a line, press the CLEAR key, and then press ENTER.

There are two ways to edit lines.

1. To replace a line, simply start keying in new characters over the old ones. The old characters will be deleted.

2. Use the <right arrow> or <left arrow> key to move the cursor to the character you want to change. Remove the character with the DELETE CHAR key and then enter the new characters. When the line appears the way you want it to, press ENTER. If the syntax is correct you will be prompted for another line. Use EXIT to return to the main menu.

Inserting Lines into Current Set of Lines

To insert lines into a set that is already programmed, call up the desired parameter so the first line in the set is displayed.

Use the <up arrow> and <down arrow> keys to scroll to the line after which the insertion is to take place.

Press the ENTER key. A blank field is now available for entry of the new line. When you're finished inserting lines, move to a new line and press EXIT.

If you are inserting a new line at the beginning of a set, use the <up arrow> key to scroll up past the top line. All lists wrap around from the top to the bottom and have an empty line separating the two.

Execution Sequence of Scan Group Channel Lists

A scan group channel list is in fact a program. Like a program, the precise sequence in which the channels are measured and then processed is important. When a channel list is executed, it is done in two stages,

1. Scan Sequence

First, the input channels specified directly in the channel list, or indirectly in the channel procedures of the list, are read only once regardless of the number of times a channel may appear in the list. The values of these readings are then used in the execution sequence.

2. Execution Sequence

After the required channels are read, the scan group channel list is executed in the same order the channels appear in the list. The values read in the scan sequence for input channels are logged as they are encountered in the execution sequence.

If a pseudo or output channel has a procedure in its channel programming, the procedure is first executed top to bottom. Then the pseudo or output channel is logged.

If, in a procedure, any assignments are made to pseudo channels, their storage locations are overwritten with the updated values.

If any assignments are made to an output channel, its storage location is overwritten, and the output device is programmed with the new value. This is done each time an assignment is made to the output channel.

Following is an example of a scan group channel list, with the accompanying channel expressions or procedures. The explanation column below shows how scans are executed, and in what sequence. The channel list for this example would be entered as,

```
C36 C41..48 C59 C217 C172 C84..89
```

In this example, channels 0 through 99 are input channels, 100 through 199 are output channels, and 200 through 299 are pseudo channels.

LINE #	LIST	EXPLANATION
1	C36 Expression: None	Channel 36 is measured and results are logged. Since there is no channel expression, the decimal point position is determined by the type of measurement.
2	C41..48 Expression: None	Channels 41 through 48 are measured and logged in that order.
3	C59 Expression: C59 is part of the programmed block C55..70. Its programmed expression is: 3*CX+4	Channel 59 is measured. Then the expression is applied, with CX being the C59 measurement. The result is logged in the format chosen in Channel Programming.
4	C217 Procedure: C217=C217+1	This is a pseudo channel with an attached channel procedure. First, the procedure is executed (i.e., C217 is incremented). Then the result is logged in the programmed format.
5	C172 Procedure: CX=C64*2+17.3 C204=C204-1	This is an output channel with an attached channel procedure. The first procedure statement is an assignment to CX (C172). First, the right side of the assignment is evaluated using the measured value of C64. The result is then assigned to location C172. The second statement in the procedure decrements C204. This is done next. Then, finally, the current value of C172 is logged in its programmed format.
6	C84..89 Expression: These input channels are programmed individually. Only 1 of them, C88, has an attached expression: CX*1.5	First, channels 84 to 87 are measured and logged. Then C88 is measured, its expression applied, then logged in its programmed format. Finally, C89 is measured and logged.

Scan Trigger Mode

For each scan group, you can program specific conditions for triggering to occur, or you can design a scan to trigger on demand only. In the latter case, scanning and recording take place on the group only when a single scan request is made from the front panel, or remote device, or when triggered by another scan.

ON DEMAND ONLY

With this feature, scanning is triggered by someone going to the front panel, pressing the single scan button, and requesting a scan group number. It's also possible to program another scan to trigger a scan group.

A single scan can always be triggered on demand from the front panel even if it has a different trigger mode programmed.

TIME INTERVAL HH.MM.SS.

Time Interval causes the scan group to be executed at a given interval ranging from 1 second to 24 hours. Entry is made in hours, minutes, and seconds.

Scanning will be repeated each time the programmed interval has expired, starting from the time scanning is enabled. For example, an entry of 00.01.30 would trigger the scan group every one minute and 30 seconds, from the time scanning is enabled.

CONTINUOUS

This mode causes the scan group to be continuously active and should be used with caution. If applied to a high priority scan group, it will keep lower priority scan groups from ever being allowed to execute. The minimum scan cycle time is the length of one scan.

DISCRETE TIME HH.MM.SS.

This tells the Data Logger to scan once at a certain time each day. The 2286/5 uses a 24 hour clock.

Time values are entered in the form of hours, minutes and seconds, with a "wild digit" allowed for each digit position.

EXAMPLES

o	09.00.00	causes the scan group to trigger every day at 9 am.
o	XX.00.00	causes a trigger once every hour on the hour, since X matches all digits 0 through 9.
o	"08.XX.00"	causes a trigger once every minute, on the minute, between 8 am and 9 am. The last scan would occur at 8:59:00 am.

EXTERNALLY TRIGGERED

The external trigger is the fifth choice of scan trigger mode. This feature causes the scan group to be triggered as a result of the hardware trigger input line changed from a low to a high state. The change in state could be accomplished by using a normally closed relay or switch. This input line is located in connector J25 on the rear panel of the 2286/5 and is discussed in detail in section 3 of the 2286/5 System Guide.

When the external trigger is used, a scan occurs according to the scan group's priority. If it is next in the queue, it is executed after the current scan or within one second if no scan is running. The "scheduler" for scan priority looks for the waiting scan groups after a mode being used. If you want it acknowledged faster than one second, negate the delay by using scan group 9 as a continuous scan (no channel list is required). The "scheduler" looks at the queue after each scan of group 9; this takes less than a second.

The minimum scan cycle time is the length of one scan.

SCAN ONCE

This setting causes the Data Logger to trigger the specified group once only when the scan button is pushed. This is useful as an initialization scan group for PID equations or to preset strain gauges or counters.

SHORTCUTS TO KEYING IN TIME

When you are entering times for time intervals or discrete times, you can use shortened entries.

EXAMPLES

- 01.30.00 can be entered as 1.30 or 1.3
- 0X.00.00 can be entered as X

Shortened entries should be left justified. A 1 or 2 digit entry gives the hour, not the seconds, and a 3 or 4 digit entry gives hours and minutes, not minutes and seconds.

THE SYSTEM PROGRAM SOMETIMES AFFECTS SCANNING

All of the scan trigger modes, except scan on demand and scan once, are affected by the scan trigger window parameters programmed in the system programming module. If the trigger window is programmed to allow scanning only within a particular time window, then these scan triggering modes are disabled outside of that window.

Any scan group can always be triggered on demand by means of the SINGLE SCAN ON/OFF key.

Data Output Device Control

In order to log or display data, the data output device control parameters must be programmed.

For each available output device---the display, the printer, the disk drive, Port A or Port B---select one of the following types of data output.

1. No Data

2. All Data

3. Alarm Data---This records any channel that is out of limits when scanned.

4. Alarm Transition Data---This selection records individual channel data only when that channel undergoes an alarm transition (goes out of limit, or comes back within limit).

Each output device can be programmed independently, so an RS-232-C printer at port B could be logging alarm data while a computer at port A has access to all data.

In addition, while data may be sent to any or all available devices in a particular configuration, the data throughput rate, and therefore the scanning speed, will be no faster than the slowest device.

Other Scan Group to Trigger

Another scan group (or the same one) can be programmed to be triggered at the completion of the current scan. This feature is programmed in two stages.

1. Program the number of the scan group to be triggered on completion of the current scan.

2. Program the conditions under which you want that scan group to trigger upon completion of the current scan. You have four choices here,

    a. Never (default). The scan group is not triggered at completion of the current scan.

    b. Any Alarm. The selected scan group is triggered upon completion of the current scan if there were any channels in alarm in the current scan.

    c. Any Alarm Transition. The selected scan group is triggered upon completion of the current scan if any channel underwent a transition (went out or came back in limit) during it.

    d. Always. The selected scan group is triggered upon completion of the current scan.

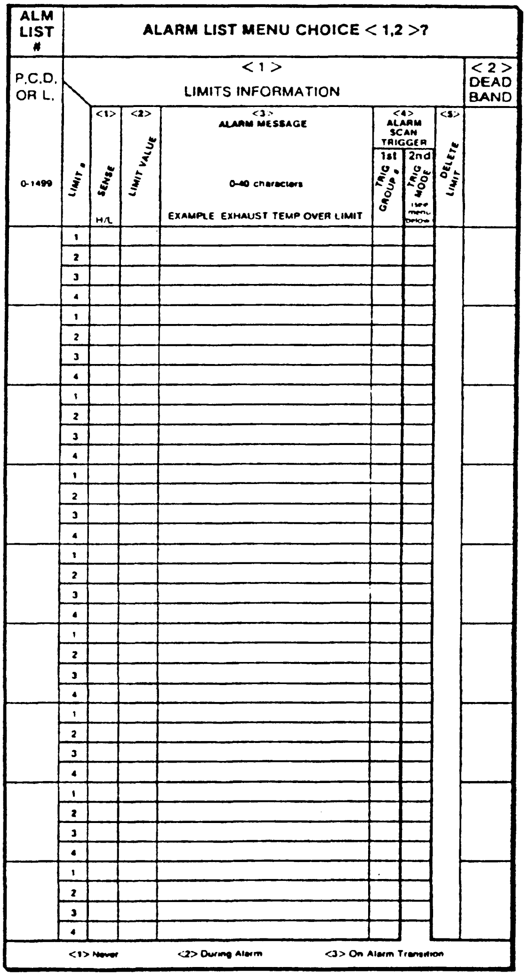
Conditions 2 and 3 are useful for obtaining additional data when limits are being exceeded. For example, by using condition 2 to trigger the same scan group, you can obtain a continuous scan-on-alarm configuration.

Two scan groups might have the same channels in them. One might scan continuously for alarms but log no data. When an alarm occurs, it can trigger the higher priority group, which could log all data on alarms.

Condition 4 is useful for chaining scan groups together. Use this to set up a loop of scan groups, each triggering the next in turn.

ALARM LISTS

<F> ALARM LIST PROGRAM



ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L.	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
0-1499	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never <2> During Alarm <3> On Alarm Transition

An alarm list contains instructions setting high and low limits to be checked against measured or computed channel values. It also determines whether high or low values will generate an alarm, whether a message will accompany an alarm, and whether there is to be any dead band or hysteresis associated with the limits.

An alarm list can also be set up to trigger a scan group. Each alarm list is programmed for the purpose of assigning it to one or more channels during channel programming.

You can specify any number of alarm lists, and each can contain from one to four individual limits. For each limit, four types of information are entered: sense, value, alarm message and alarm scan to trigger. In addition, a dead band value may be entered to apply to all four limits in the list. These are all detailed in the following paragraphs.

Limit values can be changed while the Data Logger is scanning. This is especially useful for situations where the 2286/5 is being used for monitoring and emergency shutdowns.

ALARM LIST NUMBER

Assign each alarm list a number between 0 and 1499 for a 2286 (and between 0 and 99 for a 2285). Since all alarms will be referenced by a channel program you can use the same number for both the alarm list and the corresponding channel, but it is not necessary.

P,C,D, or L

Program, Copy, Delete, or List the alarm list number you've specified.

PROGRAM

When you select program, you have access to each menu in the same sequence as you see on the Programming Form. Use program to enter new alarm list parameters, or to change values or characteristics entered earlier.

Program is the default setting for this field so you can select it by merely pressing the ENTER key.

COPY

If you choose copy, the system first checks to see if the alarm list designated to receive the copied parameters is already programmed. If so, the old program must be deleted before new parameters can be copied into it.

The prompt is,

```
ALARM LIST EXISTS, DELETE<Y,N>? N
```

If you press Y, then ENTER (or if the alarm list wasn't previously programmed), the prompt becomes,

```
ALARM LIST TO COPY FROM =
```

Now, enter the alarm list number whose program you want copied to the new alarm list. Press ENTER and the scan group is programmed completely.

The system responds with the prompt,

```
ALARM LIST COPIED
```

When you press ENTER, the system returns the prompt,

```
ALARM LIST NUMBER =
```

This indicates that you can now enter the number of another alarm list to be programmed. Press the EXIT key when you're finished to return to the main menu.

DELETE

Delete removes the program from the alarm list number you've chosen. The program is permanently deleted, so use this selection judiciously.

Delete also frees space in the 2286/5 memory for other program parameters.

LIST

The list function prints the current alarm list program onto the printer (or other listing device, if installed and selected).

ALARM LIST MENU CHOICE

This section contains the limits information and dead band menus.

Limits Information

Up to four limits can be specified in a single alarm list. Each of the limits is programmed with a high or low sense, a value, a message, and a trigger condition.

SENSE

Enter H for a high value or L for a low value.

LIMIT VALUE

The limit value, entered in floating point or scientific notation, is the reference value for any channel programmed to that particular alarm list. The magnitude of the limit value, which can be expressed in up to 11 characters, is between 2.8E-20 and 9.22E18.

After any linearization, scaling or math expressions have been performed on the channel (or when assignments are made to channels on the left side of a math statement in channel procedures), the result is compared to the limit value(s) of that channel's alarm list. If none of the limits are exceeded, no further action takes place.

If the reading is outside one or more limits, the alarm information (ALM), is added to the log of the channel whose value tripped the limit.

ALARM MESSAGE

The alarm message feature allows you to add relevant alarm messages for the channel or block of channels associated with the limit value being exceeded. From 0 to 40 characters can be used. This feature is optional.

A message must be programmed in order for a limits exceeded condition to be entered in the alarm queue and for the master alarm output relay to turn on.

For example, suppose the alarm list being programmed is associated with a channel measuring the temperature of liquid oxygen to ensure that the temperature doesn't elevate enough to convert the oxygen back to gas. The associated alarm message might be,

OXYGEN NEAR BOIL, ADD COOLANT

The message is logged after the channel reading and then added to the alarm queue, lighting the front panel ALARM LED and energizing the master alarm output relay.

When you acknowledge the alarm by pressing the ACK key, the message is displayed on the 2286/5 front panel.

If multiple messages are queued up, the ALARM LED stays on. Press the ALARM ACK key to receive each message in the queue. After the last message is displayed, the ALARM LED will go out and the master alarm output relay will turn off (see Section 3 of the System Guide for master alarm output relay connections).

ALARM SCAN TRIGGER

The alarm scan trigger allows you to select by number a scan group to be triggered due to a channel's limit condition. The conditions to choose from are,

1. Never (default). The alarm state of a channel will not cause the selected scan group to be triggered.
2. During Alarm. The selected scan group is triggered each time the associated limit is exceeded.
3. On Alarm Transition. The selected scan group is triggered only when the associated limit changes by going out of limit or by coming back within limit.

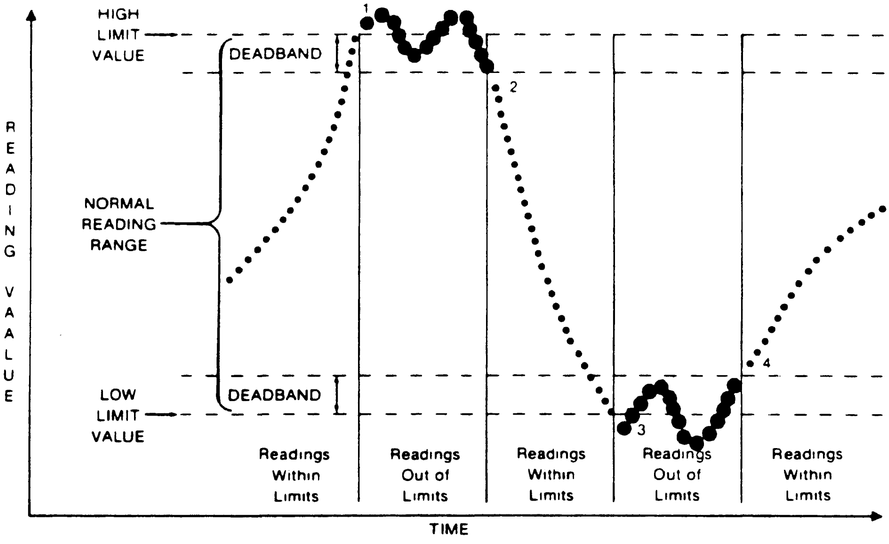
Choices 2 and 3 above can be used to trigger a higher priority scan group with the same scan group channel list, to create an "all data on alarm" or "all data on alarm transition" function. Channel alarms that occur while plotting is active won't trigger another scan group.

Dead Band Value

The dead band applies to all limits of an alarm list, and is entered in floating point or scientific notation.

It causes a difference in the thresholds at which a channel goes out of limits and comes back within limits. This difference is a kind of buffer zone that must be passed through before an alarm transition is acknowledged by the Data Logger. The hysteresis introduced may be used to minimize nuisance transitions caused by noisy or fluctuating inputs.

With a dead band, the value at which a channel passes out of limits is not the same as the value at which it comes back within limits.

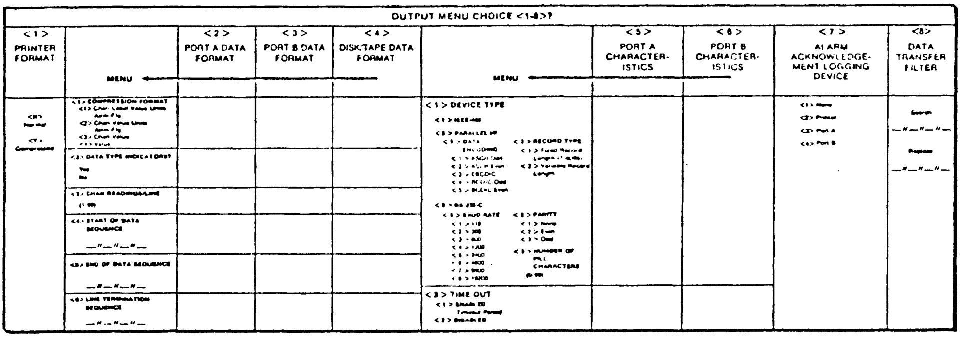


Deadband

Alarm data is logged during the time intervals labeled Readings Out of Limits.

OUTPUT DEVICE PROGRAMMING

< U > OUTPUT DEVICE PROGRAM



If the default device characteristics and logging formats in the following section satisfy your needs, no output device programming is necessary. If, however, you want to change some of the settings this information in this section will explain how.

OUTPUT MENU CHOICE

Output device programs determine the format that logged data assumes on the printer, the devices connected to port A and B, and on the microfloppy disk. In addition, various device characteristics may be determined for ports A and B.

Some choices are simple. For the printer, for example, the choice is between normal or compressed printing. For other devices though, there are a number of selections that can be made for other formats and for port characteristics.

The front panel display doesn't require programming. It displays data one channel at a time, and is updated 2 1/2 times per second. The data is displayed in the following sequence.

DATA TYPE	MAXIMUM CHARACTERS
Channel number	5
Channel label	15
Value	7
Channel units	6
Alarm flag	3

You can program any or all of the following devices to log data.

Printer Format

You can choose between the normal format, which is the same as the display, or the compressed format (channel number and value), with 3 channels given in one line.

If the limited information provided in the compressed format is enough for you, try to use it. It reduces the amount of paper used and increases the printer's useful throughput, since the printer speed is determined in lines per seconds, not channels per second.

Port A, Port B, and Disk Data Formats

The following list of data format characteristics are used for both the 2286 and 2285 Data Loggers. For Port A and Port B output devices, choose the desired characteristics from the first six parameters. For the 2286 disk, choose the desired characteristics from the following seven parameters.

1. Compression Format

Choose one of four levels of compression for logged channel data. Number 1 is the default choice.

1. channel #, label, value, units, alarm flag (40 characters)
2. channel #, value, units, alarm flag (24 characters)
3. channel #, value. (13 characters)
4. value only. (8 characters)

2. Data Type Indicators (choose YES or NO)

Logged data is a mixture of channel data, scan group information, and alarm messages. While the mixture may be easily distinguished by you, it may be difficult for a computer to sort out and identify. You can simplify the reading operation by tagging the beginning of each line with an identifying character. This function simply inserts a tag character before each type of logged message if YES is selected here. The default choice is NO.

The tag corresponding to each type is as follows,

TAG	LOGGED MESSAGE
A	Alarm Message
B	Begin Scan Group Message
C	Channel Reading
E	End Scan Group Message
H	Scan Group Header Message
K	Alarm Acknowledgement Message
Z	Scan or Single Scan is Turned Off.

3. Channel Readings per Line

Specify how many channel readings are to appear on each line before a line terminator is recorded. The choice is made based on the level of data compression chosen (see compression format #1, above), and the fact that the Data Logger inserts four spaces between channel readings when there is more than one reading per line.

Enter any number between 1 (which is the default selection) and 99.

4. SD -- Start of Data

A sequence of up to four characters can be used to flag the beginning of a scan group. The sequence is sent prior to a begin scan group message. The default is an empty sequence. More details on programming SD are given in Sequence Programming below.

5. ED -- End of Data

Up to four characters may be used in a sequence to flag the end of a scan group. If the sequence is used, it will be sent after an end scan group message. The default is an empty sequence. More details on programming ED are given in Sequence Programming below.

6. LT -- Line Termination

This sequence of up to four characters ends each logged message or line of output. LT defaults to the ASCII <CR> and <LF>. More details on programming LT are given in Sequence Programming below.

7. Record Scan Headers (choose YES or NO)

The 2286 Disk Data Output Format menu provides this additional selection. It allows you to eliminate the scan group headers that procede and end every scan made by the Data Logger. The BEGIN SCAN... header is replaced with only the date and time and the END SCAN... and STOPPED SCAN... headers are not recorded at all if NO is selected here. One reason for this selection is to allow more data to be recorded in the finite disk space. The defult choice is YES.

Sequence Programming

Each character in the sequence is entered in its decimal equivalent representation, and individual characters are separated by "//". The sequence consists of a decimal number (containing up to 2 digits) for each ASCII character. For example, the default line termination sequence would read,

13//10

Appendix 9d of this guide contains an ASCII-to-decimal conversion chart.

Port Characteristics

Ports A and B can have a variety of devices plugged into them. Each device has its own operating characteristics that require programming. Port A and port B are individually programmed in one of three areas, according to the type of device being used.

When the time comes to actually trigger a scan, the interface installed and the characteristics programmed must agree, or an error will occur. These characteristics are detailed in the following paragraphs.

If a port is programmed for one type of interface, but if a different one (or none at all) is installed, an error message will be created when a scan is attempted.

The output device characteristics do not take on their new values until you exit back to the main menu level.

IEEE-488 INTERFACE

The IEEE-488 Interface requires no front panel programming.

PARALLEL INTERFACE CHARACTERISTICS

The parallel recording characteristics allow you to define the type of data encoding, and the record type.

1. Data Encoding Choices

The default for this field is the first selection, ASCII Odd Parity.

1. ASCII Odd Parity
2. ASCII Even Parity
3. BCDIC
4. BCDIC Odd Parity
5. BCDIC Even Parity

2. Record Type Choices

The default selection for this field is a fixed record length of 1024 characters.

1. Fixed Record Length. Use this to specify the number of characters recorded before a record gap signal is generated. When a scan group is completed, the current record contains the fill character,

   $

   and is then terminated with a record gap signal. The range of possible entries is from 1 to 4095 characters.

2. Variable Record Length. In this mode a record gap signal is given at the end of each scan group.

RS-232-C INTERFACE CHARACTERISTICS

The RS-232-C interface card is equipped with a stall feature. If the device it's connected to sends a Control S (ASCII X-OFF, DC3 or decimal 19), the character stream to the device is suspended. The stream is only resumed after the device receives a Control Q (ASCII X-ON, DC1 or Decimal 17). Alternatively, the RS-232-C device may use the modem control lines (Data Set Ready, Clear to Send, Received Line Signal Detect) to stall the 2286/5.

To control the flow of data from the 2286/5 in this manner, send the stall signal two or three characters before the buffer overflows. The 2286/5 can't stall instantly; it takes a few milli-seconds to respond.

If a printer is connected, it can use Control S and Q to regulate the character flow to suit its printing speed. If scan data is being logged, a stalled RS-232-C I/F will eventually halt the scan until it's unstalled.

Halting a scan in this manner may also cause critical alarm checking to stop. To avoid this, a device timeout (allows scanning to pause and wait for the interface to unstall) can be programmed. If the unstall does not occur within the programmed device timeout period, the 2286/5 resumes scanning and discards all output data to the interface until the stall condition is removed.

The RS-232-C I/F requires programmed parameters for:

1. Baud Rate. 110 (default), 300, 600, 1200, 2400, 4800, 9600, or 19200.
2. Parity. Even, Odd, or None (default).
3. Number of Fill Characters. Enter the number of null fill characters to be sent to the RS-232-C device after each line termination (LT) sequence. Possible entries are 0 through 99 (default = 0).

TIMEOUT

Device timeout programming provides the capability for the 2286/5 to continue critical scanning and limit checking when the RS-232 or IEEE-488 interface halts scanning.

Output or data from the RS-232 interface can be stalled (temporarily suspended) using the modem control signals or when the interface receives a Control S character from the computer or peripheral. This can also occur with the IEEE-488 interface if the bus controller does not read all the data from the interface.

An enabled device timeout allows the 2286/5 to resume scanning and discard output data after scanning has been suspended for the programmed time period. The data output will resume when the stall condition is removed.

If the device timeout is disabled, scanning will be suspended until the stall condition is removed. No data will be discarded.

PORT A CHARACTERISTICS ARE SAVED

Port A characteristics are saved when an "erase all programming" function is performed even though you won't see the characteristics when you list the program. Using the ENTER key to scroll through the menus to check the settings causes you to select the default characteristics and override any earlier program settings. Make certain the default characteristics are what you want. To reprogram, simply select different characteristics.

Alarm Acknowledgement Logging Device

It is sometimes desirable to keep a log of alarm messages and the times at which they occur and are acknowledged. This can be done with an alarm acknowledgement logging device connected to the 2286/5.

Acknowledgement information includes the channel number, the alarm limit, the time an alarm occurred, and the time it was acknowledged. You can choose which acknowledgement device, if any, will log this information. Select from,

1. None (default)
2. Printer
3. Port A
4. Port B

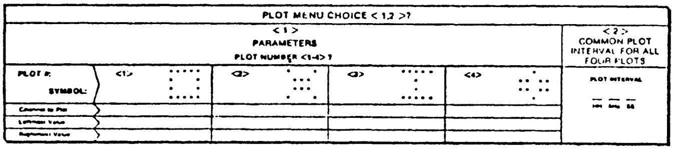
Data Transfer Filter

It's possible for you to transfer data from a disk or Kennedy magtape to some other device. In most instances you'll enter the same character strings for the start of data, end of data, and line termination for both the source and destination devices. However, it may be necessary to have different strings for different devices.

If it is necessary to have different strings for different devices, the data transfer filter can convert a sequence of ASCII characters used for the source device into the sequence used by the destination device. Only one sequence can be changed with the data transfer filter, and the programming specifics are discussed in the Sequence Programming portion of this section.

PLOT PROGRAMMING

< P > PLOT PROGRAM



With the 2286/5, you can plot the values of four separate channels simultaneously onto the built-in printer. To write a plot program, simply specify the 0% and 100% values of up to four plot channels, and indicate the desired plotting interval. These channels are then plotted whenever the plot function is requested.

A plot program is treated by the system as the highest priority scan group; when it's activated, its channels are scanned at the programmed interval before any other scan group. If a scan group is currently active when the plot interval occurs, the plot group will be the next one scanned when the current group is finished.

PLOT MENU CHOICE

Parameters

Plot channels can consist of any combination of input, output, or pseudo-channels. Remember that the math procedure of a pseudo or output channel can include several assignments using other measurement, output, or pseudo channels.

If pseudo channels are being plotted, the channel procedure for the channel of plot #1 is executed first, then the channel procedure for the channel of plot #2, and so on. This means that if the channel procedure for channel 0 is,

C0 = C0+1
and
Plot #1 = C0
Plot #2 = C0

the plotted value for plot #2 will be 1 greater than that for plot #1.

CHANNEL TO PLOT

For each plot channel (1 through 4), enter the number of the channel whose reading you wish to plot.

LEFT MOST AND RIGHT MOST VALUES

Specify the left and right most values between which the channel readings will be plotted. These values are entered in floating point or scientific notation corresponding to the channel values that will fall at the left and right edges of the paper. For example, an entry may read, 500.0 or 1.25E3.

Common Plot Interval for All Four Channels

The channels are plotted as a group. Enter the plotting interval for the selected channels in the hours, minutes, and seconds format.

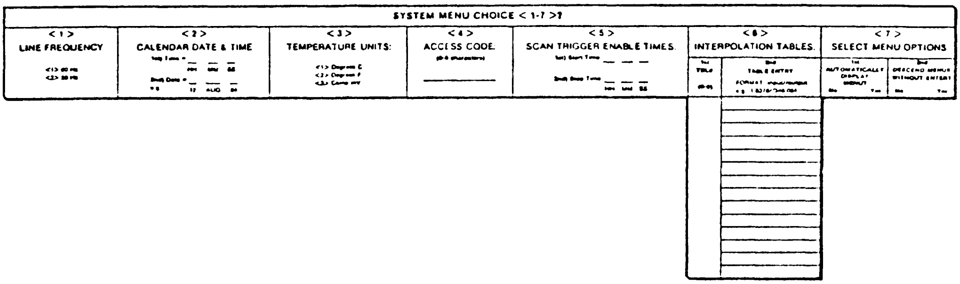
For example, if you want the readings taken every 30 seconds, the plot interval entry is **00.00.30**. If you want the reading taken every 90 minutes, the plot interval entry is **01.30.00** (or 1.30). Plotting has higher priority than scanning, so if the plot interval time is smaller than the time required to log and plot the four channels, no scan groups will become active. This is referred to as continuous plotting.

Keep in mind when you're plotting that the printer isn't available for other uses. If a long scan group is active at the time plot is triggered, the actual time plotting begins will be delayed.

SYSTEM PROGRAMMING 3f-1

SYSTEM PROGRAMMING

< Z > SYSTEM PROGRAM



System programs are a sort of catchall for selecting instrument characteristics that don't relate specifically to any one of the other five groups. Time and calendar date, temperature units, access code, and line frequency are all determined in a system program. These values probably won't need to be changed very often.

SYSTEM MENU CHOICE

The system program module is divided into seven different menus, each for programming specific system-wide parameters.

Line Frequency

Choose either 50 or 60 Hz.; only Analog to Digital Converters need this information for maximum noise rejection.

All measurement nodes (A/D converters) in the system are assumed to be operating with the same line frequency. If the system is battery operated, and there are ac power lines in the area, the frequency should be the same as the power lines. If the local line frequency is 400 Hz, program the system for 50 Hz, since 400 is a multiple of 50.

The frequency entered has no effect on the internal clock, which is crystal operated.

Calendar Date and Time

The date is entered as day (1 or 2 digits), month (3-letter abbreviation), and year (2 digits). Entering a space (for clarity) between the day, month, and year is optional.

Enter the time as hours, minutes, and then seconds, with the minutes and seconds being optional entries. The 2286/5 uses a 24-hour clock.

Some entry examples are,

Date - 3 DEC 85, 24 JUL 85, or 10MAY85

Time - 7.43.39 (for 7 hours, 43 minutes, 39 seconds)

2.32 (for 2 hours, 32 minutes, 0 seconds)

13 (for 13 hours, 0 minutes, 0 seconds)

Once programmed, the date and time are correctly maintained with the power on and for at least 30 days with the power off.

Temperature Units

The temperature unit entered here affects the system-wide temperature units for the Data Logger. You can select degrees Celsius, degrees Fahrenheit, or compensated millivolts. This selection causes implicit translation of numeric data on analog measurement channels whose input function is a thermocouple or RTD.

Degrees Celsius is assumed for RTDs if compensated millivolts is selected.

Access Code

The access code, if entered, allows you to control access to the scan, plot, changing limits or pseudo channel values while scanning, and single scan functions. The code consists of an alphanumeric string of one to six characters.

Once an access code is programmed, an operator must correctly enter the code string whenever starting or stopping a process. The default is no code if the programmer chooses not to enter one, in which case the access code is neither requested nor required when a command is entered by the operator.

Scan Trigger Enable Times

This feature allows you to enable scanning and plotting only between the start and stop times entered. The start and stop times define a scan window.

The default start and stop times are both 00:00:00 and when they are equal, the scan window is always open. The scan window affects only the continuous, time interval, discrete time, and hardware triggering mechanisms. The start and stop times have no effect on the single scan function. You can scan on demand by using the front panel SINGLE SCAN ON/OFF key, regardless of the scan window setting.

A scan group executing when the window closes is completed normally. Scan groups that are triggered before the window closes (but which haven't been executed because they have lower priority than the group now running), will be executed.

Interpolation Tables

You can define up to ten interpolation tables, each labeled with a number from 0 to 9. The contents of a table are entered as pairs of numbers, and you must enter at least two pairs. The pairs consist of an input value followed by an output value.

The pairs must be in ascending or descending order of the input; they encompass the maximum and minimum values expected from channels that use the table.

A table should not contain two entries with the same input value since that implies a discontinuity. Table conversion is initiated when a channel expression references the table number as a function. The argument of the expression is the input measurement to be converted.

For example, the expression TBL7(CX)+3.14 indicates that the raw input reading of the channel will be converted to an output using the values in interpolation table 7. The value 3.14 will then be added to produce the resulting reading for the channel.

Interpolation tables can be programmed at any time, but the program that uses them won't run without a Math Coprocessor (Option -211) installed.

If the input measurement falls between points in the table, a linear interpolation is used to determine the output. You might, for instance, use the interpolation table function for a channel with a transducer, which must convert input volts to a pressure output in a non-linear relationship.

In a chosen interpolation table, you could program at least the minimum and maximum input values expected, each paired with its corresponding output value. For example, if a transducer is used which outputs between 0.1 and 0.2V dc, corresponding to an input of 10 to 200 pounds per square inch (in a non-linear fashion), the table might look like this,

```
0.100//10
0.120//30
0.140//60
0.160//100
0.180//150
0.200//200
```

Notice that the relationships are non-linear, and thus cannot be converted with a simple mx+b scaling. Further details on this and other Math Coprocessor features are covered in Math Coprocessor Programming (section 4 of this guide) and the Options section (Option -211) of the 2286/5 System Guide.

Select Menu Options

AUTOMATICALLY DISPLAY MENU

Selecting this option instructs the system to printout the choices available for the selected menu. While in this mode, a printout occurs to display the set of choices offered during programming.

DESCEND MENUS WITHOUT ENTER

You can speed the keypressing mechanics of programming by eliminating the need to press ENTER after each entry is chosen. This step should probably only be used by an experienced 2286/5 programmer, since it takes away the option of checking your menu choices before they're entered.

Section 4
Advanced Math Programming

CONTENTS

INTRODUCTION

This section contains a summary of additional functions and operations available when the 2286 Data Logger has the Math Coprocessor (Option -211) installed. The 2285 Data Logger does not support the Math Coprocessor option. It discusses operational details and syntax and uses typical expressions and situations for illustration.

This section also offers programming techniques that allow your 2286/5 Data Logger to perform both advanced data reduction and analysis, and to enhance its operational flexibility. The 2286/5 is unique in that it can be programmed to perform custom calculations without requiring the user to learn (and debug) a computer language.

The capabilities of the 2286/5 Data Loggers extend beyond their ability to perform calculations upon input data. Pseudo channels allow calculations ranging from the averaging of a group of channels, to calculating Fo (equivalent sterilization time) to computing the mass flow of a gas. Pseudo channels also augment the ability of the 2286/5 to perform specialized data acquisition and logging tasks. The data logging rate can be changed on detection of an alarm or preset condition, or even after a period of time has elapsed. This section explains how.

FUNCTIONS AVAILABLE WITH THE MATH COPROCESSOR OPTION

With the Math Coprocessor Option installed, the speed with which your 2286 Data Logger can perform calculations is increased. Special functions that are available without the math board (which are described in Channel Programming, Section 3a) are still available with the option installed and execute more rapidly and more efficiently. They are,

ALMx	Alarm Status
ERR	Error Status
LINx	Thermocouple Linearization
LIN1	385 DIN Platinum RTD
LIN2	10 ohm Copper RTD
REFx	Thermocouple Reference Voltage
RTD	User Defined Platinum RTD

In addition, the Math Coprocessor Option allows for a number of extra functions that can be performed on channel or pseudo channel data. These additional functions are also described in this section.

ABS	Absolute Value
ACOS	Inverse Cosine
ASIN	Inverse Sine
ATAN	Inverse Tangent
COS	Cosine
EXP	Exponential
GAV	Group Average
INT	Integer Part
LOG	Common Logarithm
LN	Natural Logarithm
MAX	Maximum Value
MIN	Minimum Value
SD	Standard Deviation
SIN	Sine
SQR	Square Root
TAN	Tangent
TBL	Interpolation Table
TIME	Elapsed Time

ALARM STATUS

Format: `ALMn(1x//2x//3x//etc.)`

Usage: The alarm status function, when evaluated, gives the status (1 = exceeded, 0 = not exceeded) of a particular limit (n) of the channel or block designated in the function. The format of the function is ALMn (channel list), where n is a number from 1 to 4, and the channel list is a single channel, a block of channels, or a combination of blocks and single channels separated (//). For example, the function written as,

```
ALM2(C98//C100..102//C200)
```

when evaluated, will tell whether channel 98, 100 to 102, or 200 has exceeded limit #2 of its assigned alarm list.

Examples:

```
ALM1(C9)
```

ERROR STATUS

Format: ERR(1x//2x//3x//etc.)

Usage: The error status function is used to find the lowest valued error number (i.e., the one with the highest priority) currently active on the channel or block of channels listed.

These errors aren't fatal to system operation, but do indicate that something is wrong. The priority (ranging from 0 through 6) indicates the severity of the problem. The delimiter "//" is used to separate the various channels listed.

An error value of zero indicates that none of the channels in the list are in error.

Error reporting codes are as follows:

(1)	Dead Serial Link Device
(2)	Broken Thermocouple
(2)	Propagated Error
(3)	No Reading
(4)	Out of Measurable Range
(4)	Out of Temperature Range
(5)	Argument Out of Range
(5)	Bad RTD Constants
(5)	Arithmetic Overflow
(5)	Denominator of Zero
(5)	Negative Argument
(5)	Zero Argument

Example:

The function ERR(C99//C100...104), when evaluated, gives the lowest valued error number currently active of channel 99 or 100 through 104.

THERMOCOUPLE LINEARIZATION

Format: LINn(millivolts)

Usage: When evaluated, this function gives the temperature as measured by a specific type of thermocouple. Use this in applications where temperature is being measured with thermocouples not terminated on the standard 2286/5 Isothermal Input Connector (Option -175).

Example:

```
CX = LINR(CX+REFR(C100))
```

The format is LINn(m), where n is a single letter corresponding to the type of thermocouple used (as shown in the thermocouple selection menu) and 'm' is one of the following,

- A channel number---where the channel is an input channel measuring the millivolt signal of a thermocouple.
- An expression---that, when evaluated, gives the millivolts to be converted to temperature for the specified thermocouple type.

The temperature units used in these cases is the same one programmed in the system program. If the system temperature units are compensated millivolts, the value of the argument is returned unchanged.

LIN1

Format: LIN1(ohms)

Usage: When evaluated in an expression, the LIN1 function applies a 385 DIN platinum linearization on the value of the parameter which is expected to be the resistance of the RTD probe in ohms.

Example:

```
LIN1(CX)
```

LIN2

Format: LIN2(ohms)

Usage: When evaluated in an expression, the LIN2 function applies a 10 ohm Cu RTD linearization on the value of the parameter which is expected to be the resistance of the RTD probe in ohms.

Example:

```
LIN2(CX)
```

THERMOCOUPLE REFERENCE VOLTAGE

Format: REFn(temperature)

Usage: This function can be used in applications where temperature is being monitored with thermocouples that are terminated in an external isothermal block. When the function is evaluated, it gives the compensating millivolts for a specified thermocouple terminated at a specific temperature.

These compensating millivolts, when added to the millivolts measured from the thermocouple, provide the necessary correction to cancel out the effect of the secondary thermocouple formed at the thermocouple termination.

The format of the function is REFn(t) where n is a single letter corresponding to the desired thermocouple type (as shown in the thermocouple selection menu), and (t) is one of the following,

- A constant temperature---for cases where the thermocouple is terminated in an isothermal block at a fixed temperature.
- A channel number---where the channel is an input channel measuring the actual temperature of the external isothermal block.
- An expression---that, when evaluated, gives the temperature of the external reference block.

The temperature units used in these cases is the same one programmed in the system program. If the system temperature units are compensated millivolts, degrees Celsius is assumed.

RTD

Format: `RTD(ohms//RO//alpha//delta//c4)`

Usage: When evaluated in an expression, the RTD function applies a user defined platinum RTD linearization on the value of the resistance of the RTD probe.

Example:

```
RTD(CX//100.00//0.00390//1.494//-0.205984E-11)
```

This function returns the temperature of a calibrated RTD. The following probe characteristics are required.

ohms	(ohms)
RTD ice-point resistance	(RO)
RTD alpha value	(alpha)
RTD delta value	(delta)
C4 value	(c4)

If any of the last four parameters above are omitted the following defaults will be used.

RO	100.00
alpha	0.00390
delta	1.494
c4	-0.205984E-11

The RTD constants must be specified in order. For example, if you need to specify a C4 that differs from the default, you must also specify RO, alpha, and delta. This is true even if they are the same as the default settings.

The temperature unit used in this function is the same one programmed in the system program. If the system temperature units are compensated millivolts, degrees Celsius is assumed.

FUNCTIONS AVAILABLE ONLY WITH THE MATH COPROCESSOR OPTION

The following functions are only available in the 2286 Data Logger when the Math Coprocessor Option is installed The 2285 Data Logger does not support the Math Coprocessor option.

ABSOLUTE VALUE

Format: ABS(x)

Usage: When evaluated in an expression, an ABS function gives the absolute value of x.

Example:

ABS(C16)
The absolute value of C16 is returned.

SQUARE ROOT

Format: SQR(x)

Usage: When evaluated in an expression, a square root function gives the number which, when multiplied by itself, results in the value of x. The expression must always be a positive value.

Example:

SQR(C23)
The Square Root of C23 is determined.

EXPONENTIAL

Format: EXP(x)

Usage: When evaluated in an expression, an exponential function gives the base of the natural log, "e", raised to the power x. The value returned is always positive.

Examples:

```
EXP(.707)
EXP(C8)
EXP(ABS(C6))
```

SINE

Format: SIN(x)

Usage: When evaluated in an expression, a sine function gives the sine of angle x. X is assumed to be in radians.

Examples:

```
SIN(314.16E-02)
SIN(C8)
```

COSINE

Format: COS(x)

Usage: When evaluated in an expression, a COS function gives the cosine of angle x. X is assumed to be in radians.

Examples:

```
COS(7.07E-01)
COS(C3+C4)
```

TANGENT

Format: TAN(x)

Usage: When evaluated in an expression, a TAN function gives the tangent of angle x. X is assumed to be in radians.

Examples:

```
TAN(SIN(.707))
TAN(3.14+C6) (note the use of the value of Pi)
TAN(C9)
```

INVERSE SINE

Format: ASIN(x)

Usage: When evaluated in an expression, an inverse sine function gives the angle, in radians, whose sine is x. The value of the expression must be between -1 and +1, and the value returned will between -Pi/2 and Pi/2.

Examples:

```
ASIN(1)
ASIN(C23)
```

INVERSE COSINE

Format: ACOS(x)

Usage: When evaluated in an expression, an inverse cosine function gives the angle, in radians, whose cosine is x. The value of the expression must be between -1 and +1, and the value returned will be between 0 and Pi.

Examples:

```
ACOS(0.986E-01)
ACOS(SIN(C3))
```

INVERSE TANGENT

Format: ATAN(x)

Usage: When evaluated in an expression, an inverse tangent function gives the angle, in radians, whose tangent is x. The magnitude of the value returned will always be between -Pi/2 and Pi/2.

Examples:

```
ATAN(3.6872E+15)
ATAN(SIN(2.3)+C6)
```

COMMON LOGARITHM

Format: LOG(x)

Usage: When evaluated in an expression, a common logarithm function gives the value by which ten must be raised to obtain the value of x. X must have a positive non-zero value.

Examples:

```
LOG(1.0E06)
LOG(C3)
```

NATURAL LOGARITHM

Format: LN(x)

Usage: When evaluated in an expression, a natural logarithm gives the value by which the irrational constant "e" must be raised to obtain the value of x. X must have a value that is positive and non-zero.

Examples:

```
LN(C12)
LN(2+LOG(84.3E+02))
```

TABLE INTERPOLATION

Format: TBLn(x)

Usage: This function uses x as the independent variable to perform a linear interpolation in the user-defined table n; n is a pre-programmed interpolation table numbered between 0 and 9. When performed it returns a corresponding dependent variable value.

If x is outside the input range of the table, a linear extrapolation is performed to get a dependent variable value. It is not recommended that you allow the independent variable to be outside the values encompassed by the table. If so, large errors and unpredictable results could occur.

- If the interpolation table contains no points, zero is always returned.
- If the table only contains one pair of points, the dependent value of that pair is returned.

Examples:

```
TBL1(5.0)
TBL9(C45)
```

INTEGER PART

Format: INT(x)

Usage: When evaluated in an expression, the INT function gives the integer part of operand x.

Examples:

```
INT(C34)
INT(5.3 + 7/2)
```

MAXIMUM VALUE

Format: MAX(1x//2x//3x//etc)

Usage: When evaluated in an expression, the MAX function gives the maximum value among all the operands specified as x. If a single channel is specified, the function is evaluated as that channel's current reading. Channel numbers can be specified individually or in block form (with the format: Cx..y).

- o The various operands specified in x are separated by the delimiter: //.

Examples:

```
MAX(C987)
MAX(C1..23)
MAX(C4//C7//C23)
MAX(C34//C48..57//C67)
MAX(C21//5.0//LOG(C37))
```

MINIMUM VALUE

Format: MIN(1x//2x//3x//etc)

Usage: When evaluated in an expression, the MIN function gives the minimum value among all the operands specified as x. Channel numbers may be specified in individual or block form. If a single channel is specified then the function is evaluated as that channel's current reading.

- The various operands specified in x are separated by the delimiter: //

Examples:

```
MIN(C98)
MIN(C6..9//C234)
```

STANDARD DEVIATION

Format: SD(1x//2x//3x//etc)

Usage: When evaluated in an expression, this function gives the standard deviation over all the operands specified as x. Channel numbers may be specified individually or in block form.

- The various operands specified in x are separated by the delimiter: "//"

Examples:

```
SD(C3..25)
SD(C2//C5..9//7.4)
```

GROUP AVERAGE

Format: GAV(x)

Usage: When evaluated in an expression, this function gives the group average of all the operands specified as x. If only one operand is entered as x, the evaluation of that operand itself is the group average.

If the value of any of the operands is invalid because of an error (open TC, RTD over/under temperature, DC voltage over range, divide by zero, etc) that operand is excluded from the calculation of the average.

- The delimiter "//" is used to separate the various operands specified.

Examples:

```
GAV(C0..9)
GAV(C23)
GAV(5.3//5.9/C10)
```

ELAPSED TIME

Format: TIME

Usage: The elapsed time in seconds since the scan was initiated is determined. The elapsed time is set to zero when the SCAN key is pressed, or when plotting begins and scanning is inactive.

- Elapsed times shorter than 194 days will have 1 second resolution.
- Elapsed times between 195 and 388 days will have two second resolution.
- Elapsed times between 389 days and 776 days will have four second resolution.

Example: TIME

OPERATORS AVAILABLE WITH THE MATH COPROCESSOR OPTION

Basic operators used in channel expressions-- addition, subtraction, multiplication, and parentheses --are always available when programming the 2286/5 Data Loggers. Installing the Math Coprocessor Option in a 2286 also adds exponentiation, logical operators (OR, AND, XOR, etc.), and relational operators (Greater Than, Less than, etc.) to your programming capabilities. The following pages cover the use of these additional operators.

EXPONENTIATION

Format: (operand1) ** (operand2)

Usage: The exponentiation operator works between two operands by raising operand1 to the power indicated by operand2.

Examples:

```
3.6 ** C7
C98 ** LOG(C10)
```

CAUTION

Operand1 must be greater than zero. If operand1 is zero or negative in value, an argument negative error is reported.

LOGICAL OPERATORS

The following logical operators are available when the Math Coprocessor (Option -211) is installed in a 2286.

AND
NOT
OR
XOR

NOTE

Be careful when using logical operators with numbers other than 1 and 0. Logical operators look at whether or not a number is equal to zero. To a logical operator, the numbers .000001 and 100 are the same, since neither is equal to zero. The 2286 only logs 5 digits so the first number would be logged as .00000 (zero). Thus, you could get a number logged as zero, but evaluated as 1 by a logical operator.

AND

Format: (operand1) AND (operand2)

Usage: The AND operator performs the logical "and" function between the operands on either side of it.

Any operand having a non-zero value is interpreted as a logical "1". Otherwise it is interpreted as a logical "0".

Operand		Result
1	2	
0	0	0
1	0	0
0	1	0
1	1	1

Examples:

ALM1(C34) AND C501 (where C501 is a Status Output)

If limit number 1 on channel 34 is exceeded and status output C501 is set, a logic 1 is returned. Otherwise, a logic 0 is returned.

NOT

Format: NOT (operand)

Usage: The NOT operator performs an inversion of the logical value of the operand it precedes.

Operand	Result
1	
0	1
1	0

Example:

NOT C6

OR

Format: (operand1) OR (operand2)

Usage: The OR operator performs the logical "or" function between the operands. Any operand having a non-zero value is interpreted as a logical "1". Otherwise it is interpreted as a logical "0".

Operand		Result
1	2	
0	0	0
1	0	1
0	1	1
1	1	1

Examples:

C3 OR C7
ALM2(C3) OR ALM3(C3)

If limit number 2 or number 3 of channel C3 is exceeded, then return a logic 1, otherwise return a logic 0.

EXCLUSIVE OR

Format: (operand1) XOR (operand2)

Usage: The XOR operator performs the logical exclusive or function between operands on either side of it. Any operand having a non-zero value is interpreted as a logical "1". Otherwise it is interpreted as a logical "0".

Operand 1	Operand 2	Result
0	0	0
1	0	1
0	1	1
1	1	0

Example: C2 XOR C14

RELATIONAL OPERATORS

The following relational operators are available with the Math Coprocessor Option installed in a 2286.

EQ	Equal
GE	Greater than or equal
GT	Greater than
LE	Less than or equal
LT	Less than
NE	Not equal

Since the 2286 Data Logger has 5-digit logging resolution, differences could be created between logged data and relational operators.

For example, 10.0002 > 10.0 is clearly satisfied, but the number 10.0002 is logged as 10.000, with the 2 truncated. As a result, the number is treated as greater than 10.0 internally, even though it is logged as 10.000.

EQ (Equal)

Format: (operand1) EQ (operand2)

Usage: The EQ operator returns a value of one if the values of the two operands are equal. Otherwise a value of zero is returned.

Examples:

```
C2 EQ C48
LOG(C24) EQ 2
```

CAUTION

Take extreme care when using the EQ operator. You may want to test for 10.0 EQ CX and have that condition trigger something. But it's very possible the value of CX will vary around 10.0 without ever being equal to 10.0.

GE (Greater than or equal)

Format: (operand1) GE (operand2)

Usage: The GE operator returns a value of one if the value of operand1 is greater than or equal to that of operand2. Otherwise, a value of zero is returned.

Examples:

```
C329 GE -10.87
C49 GE C58
```

GT (Greater Than)

Format: (operand1) GT (operand2)

Usage: The GT operator returns a value of one if the value operand1 is greater than that of operand2. Otherwise, a value of zero is returned.

Examples:

```
C4 GT MAX(C5..9)
C5 GT C100
```

LE (Less Than Or Equal)

Format: (operand1) LE (operand2)

Usage: The LE operator returns a value of one if the channel value of operand1 is less than or equal to that of operand2. Otherwise, a value of zero is returned.

Examples:

```
C496 LE 3.87
C34 LE C695
```

LT (Less Than)

Format: (operand1) LT (operand1)

Usage: The LT operator compares operand1 with operand2 and returns a value of one if operand1 is less than that operand2. Otherwise, a value of zero is returned.

Examples:

```
C3 LT C45
```

NE (Not Equal)

Format: (operand1) NE (operand2)

Usage: The NE operator returns a value of one if the values of the two operands are not equal. Otherwise a value of zero is returned.

Example:

```
C45 NE C69
387.6 NE LOG(C16)
```

MATH COPROCESSOR PROGRAMMING TECHNIQUES AND EXAMPLES

The following paragraphs discuss advanced programming techniques that help to ensure user-created equations can be executed by the 2286 Data Logger. The equations and procedures programmed for pseudo channels allow solutions to a large number of application problems, and allow almost infinite variation. In short, there are no right or wrong solutions to almost any problem. Programming forms with suggested programming solutions are offered for each problem shown here.

Following are some suggested building blocks that should prove useful in approaching an applications problem. Most problems can be broken into smaller segments that usually contain at least one of these three fundamentals: the integrator, the counter, the shift register.

Integrate a Value

Integrating, or summing the value of a measured channel over time is the first programming building block. It can be directly used in computing statistics such as average and standard deviation, along with many other applications. Pseudo channels are used to perform the integration, each time the measured value is scanned, its value is added to the current value of the pseudo channel. When scanning or plotting is begun, the 2286 Data Logger initializes the value of pseudo channels to 0. Because of this, no special provision needs to be made for initialization.

Problem

An automobile manufacturer wants to accurately measure the distance a car travels during a test. A fifth wheel that generates a pulse every 10 feet has been installed on the car and connected to a Counter/Totalizer (Option -167). Scan the Counter/Totalizer channels every 20 seconds and accumulate the total distance traveled.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or Cx..Cx	(see menu below) EXAMPLE (J/T/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as: CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
10	C - 1		FEET	CX = 10 * CX	WHEEL INPUT	
100	P		FEET	C100 = C 100 + C10	DISTANCE TRAVEL	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
  <1> 64.000 V dc
  <2> 8.0000 V dc
  <3> 512.00 MVDC
  <4> 64.000 MVDC
  <5> 64.0 MA
  <6> 250.0 VAC
  <7> 64.000 MV/OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
<R> RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 OHM CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425.00 C
  <5> 10 OHM CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425.0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
  1st RO (default = 100 C)
  2nd ALPHA (default = 3.90E-3)
  3rd DELTA (default = 1.494)
  4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512.00 OHMS DC VOLTS SCANNER
  <2> 64.000 OHMS DC VOLTS SCANNER
  <3> 256.00 OHMS RTD SCANNER
  <4> 2048.0 OHMS RTD SCANNER
  <5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan #	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L. 0-9	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE: ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: Cx Channel Block only: Cx..Cx Channel and Blocks: Cx Cx Cx..Cx Cx Cx..Cx Cx	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL (pick one for each device) <1> Display	<2> Printer	<3> Disk/Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)
5		C100	200:00:20		2					

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L. 0-1499	< 1 > LIMITS INFORMATION LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE: EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	< 2 > DEAD BAND
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never <2> During Alarm <3> On Alarm Transition

Counter

The second major building block, a simple variation on the integrator, is a counter. Instead of adding a measured value to a pseudo channel each time, a constant--usually 1--is added.

Counters can be used to keep track of how many times a channel has been scanned or how often events occur. For example, how many times a measured channel has been scanned. By placing the counter in a scan group that is scanned on a periodic basis, the elapsed time associated with an event can also be measured.

Problem

A brewery is monitoring the pH of its effluent. They want to know the number of minutes the pH spends over limit and how often the excess occurs. The pH is monitored every 30 seconds.

To determine the total time the pH exceeds its programmed alarm limit, the ALM function is used instead of a constant. Every time channel 10 is scanned and the pH is over limit, ALM1(C10)=1, and every time the value is below the limit value, ALM1(C10)=0.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or C#..C#	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
10	0-5			Cx = 0.875 * Cx - 3.5	EFFUENT PH	
100	P			C100 = C100 + ALMS (C10) 12	MINUTES IN ALARM	
101	P			C101 = C101 + ALM1 (C10)	TIMES IN ALARM	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
  <1> 64.000 V dc
  <2> 8.0000 V dc
  <3> 512.00 MVDC
  <4> 64.000 MVDC
  <5> 64.0 MA
  <6> 250.0 VAC
  <7> 64.000 MV-OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
<R> RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 OHM CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425.00 C
  <5> 10 OHM CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425.0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
  1st RO (default = 100.0)
  2nd ALPHA (default = 3.90E-3)
  3rd DELTA (default = 1.494)
  4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512.00 OHMS DC VOLTS SCANNER
  <2> 64.000 OHMS DC VOLTS SCANNER
  <3> 256.00 OHMS RTD SCANNER
  <4> 2048.0 OHMS RTD SCANNER
  <5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan#	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L. 0-9	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C#..C# Channel and Blocks: C# C# C# C# C# C# C# C#	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL (pick one for each device) <1> Display	<2> Printer	<3> Data Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)
6		C10 C100	200:00:30							
7		C101	1							

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
P.C.D. OR L. 0-1499	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	
10	1	H	8.5	PH OVER LIMIT	7	3		
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

Shift Register

The third major building block is a shift register. A shift register allows measured or calculated values from previous scans to be saved for future logging or calculations.

For example, a shift register can be used to save the previous ten readings for a measured channel. When that channel goes into alarm, the ten readings preceding the alarm can be recorded. The shift register operates by moving the measured value into a pseudo channel, and then moving the previous value of that pseudo channel into another pseudo channel, and so on.

When defining a shift register, it is neither necessary nor desirable to define a different pseudo channel for each cell of the shift register. Instead, use the ability of the 2286 Data Logger to use multiple line channel procedures to define the cells.

Problem

An electronics company wants to monitor the temperature of a component on a power supply during a destructive test. When the supply fails, log the previous eight seconds of readings. In this example, when the output of the power supply drops below 4.5 V (the failure point), the alarm triggers scan group 3 which logs onto the printer the temperatures leading up to the failure.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P,C,D, OR L, 0-1499 or C# C#	(see menu below) EXAMPLE (J,T,C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-8 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE: EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
0	T-J	0			COMPONENT TEMP	
C100	P			C100 = C101	8 SEC 010	
C101	P			C101 = C102	7 SEC 010	
C102	P			C102 = C103	6 SEC 010	
C103	P			C103 = C104	5 SEC 010	
C104	P			C104 = C105	4 SEC 010	
C105	P			C105 = C106	3 SEC 010	
C106	P			C106 = C107	2 SEC 010	
C107	P			C107 = C108	1 SEC 010	
C108	P			C108 = C0	0 SEC 010	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
  <1> 64.000 V dc
  <2> 8.0000 V dc
  <3> 512.00 MVDC
  <4> 64.000 MVDC
  <5> 64.0 MA
  <6> 250.0 VAC
  <7> 64.000 MV-OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
<R> RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 OHM CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425.00 C
  <5> 10 OHM CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425.0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
  1st RO (default = 100.0)
  2nd ALPHA (default = 3.90E-3)
  3rd DELTA (default = 1.494)
  4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512.00 OHMS DC VOLTS SCANNER
  <2> 64.000 OHMS DC VOLTS SCANNER
  <3> 256.00 OHMS RTD SCANNER
  <4> 2048.0 OHMS RTD SCANNER
  <5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan#	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
	< 1 >	< 2 >	< 3 >	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device					< 5 > OTHER SCAN GROUP TRIGGER	
P.C.D. or L. 0-9	SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE ENGINE 2 TEST	SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C# C# Channel and Blocks: C# C# C# C# C# C# C# C#	SCAN TRIG MODE (pick only one see menu below)	<1> Display	<2> Printer	<3> Data Tape	<4> Port A	<5> Port B	Scan Group to Trigger (#)	Trigger Condition (see menu below)
4		C0 C100 .. C108	200:00:01						3	3
3	COMPONENT HISTORY	C100 .. 108	1		2					

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
P.C.D. OR L. 0-1499	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	<4> ALARM SCAN TRIGGER 2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	
0	1	H	100	COMPONENT HISTORY				
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

Average Value

Use the GAV function (available with the Math Coprocessor Board) to determine the average of a measured or calculated value. The function is primarily useful for determining the average of a group of channels, not one channel over time.

One method of calculating an average over time is to integrate the measured or calculated value, count how many times the measured value has been scanned, and then divide the contents of the integrator by the contents of the counter.

Problem

An oven is being monitored during a 1 hour test. Measure the oven temperature every 10 seconds and compute the average temperature at the end of the test.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or C#..C#	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
8	T-K				OVEN TEMP	
C50	P			C50 = C50 + C8	SUMMED TEMP	
51	P	51		C51 = C51 +1	N	
52	P			C52 = C50/C51	AVERAGE TEMP	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
<1> 64.000 V dc
<2> 8.0000 V dc
<3> 512.00 MVDC
<4> 64.000 MVDC
<5> 64.0 MA
<6> 250.0 VAC
<7> 64.000 MV/OTD
<A> A/D CALIBRATION
<1> CALIBRATION
<2> SPECIAL
<T> THERMOCOUPLE
<J> J (NBS)
<K> K (NBS)
<T> T (NBS)
<E> E (NBS)
<R> R (NBS)
<S> S (NBS)
<B> B (NBS)
<N> N (NBS)
<C> W-5RE VS W-26RE
<H> J (DIN)
<V> T (DIN)
<R> RTD
<1> 385 DC VOLTS SCANNER
<2> 10 OHM CU DC VOLTS SCANNER
<3> USER DEFINED DC VOLTS SCANNER
<4> 385 RTD SCANNER TEMP LT 425.00 C
<5> 10 OHM CU RTD SCANNER LO RANGE
<6> USER DEFINED RTD SCANNER LO RANGE
<7> 385 RTD SCANNER TEMP GT 425.0 C
<8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
1st RO (default = 100.0)
2nd ALPHA (default = 3.90E-3)
3rd DELTA (default = 1.494)
4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
<1> COUNTS
<2> FREQUENCY
<S> STATUS OUTPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
<1> 512.00 OHMS DC VOLTS SCANNER
<2> 64.000 OHMS DC VOLTS SCANNER
<3> 256.00 OHMS RTD SCANNER
<4> 2048.0 OHMS RTD SCANNER
<5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan #	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L. 0-9	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE: ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C#..C# Channel and Blocks: C# C# C# C# C# C# C# C#	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device <1> Display	<2> Printer	<3> Disk/Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)
5	DATA COLLECTION	C50 C51	200:00:10						4	3
4	OVEN TEST	C52	1							

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L.	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
0-1499	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE: EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	
51	1	H	359	TEST OVER				
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

Rolling Average

Instead of an average over a period of time, often a rolling average, or the average over the last several readings is desired. Use the shift register building block for calculations of this type. The number of previous values to be averaged determines the number of cells in the shift register. To compute the rolling average the number of previous values are added together and then divided by the number of cells.

Problem

A rolling average is desired for profiling a refrigerator under test. Measure the temperature every second, and compute and output the rolling average for the last 4 readings.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or C# C#	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as: CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE: EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
5	T-T				REFRIDGTEMP	
50	P	50		CX = CX +1	COUNTER	
51	P			C51 = 5	READING BUFFER	
60	P			C60 = 61		
61	P			C61 = 62		
62	P			C62 = 63		
63	P			C63 = C51		
70	P			C70 = (C60+C61+C62+C63)/4	ROLLING AVG	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
  <1> 64.000 V dc
  <2> 8.0000 V dc
  <3> 512.00 MVDC
  <4> 64.000 MVDC
  <5> 64.0 MA
  <6> 250.0 VAC
  <7> 64.000 MV/OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
<R> RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 OHM CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425.00 C
  <5> 10 OHM CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425.0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
  1st RO (default = 100.0)
  2nd ALPHA (default = 3.90E-3)
  3rd DELTA (default = 1.494)
  4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512.00 OHMS DC VOLTS SCANNER
  <2> 64.000 OHMS DC VOLTS SCANNER
  <3> 256.00 OHMS RTD SCANNER
  <4> 2048.0 OHMS RTD SCANNER
  <5> 64.000 KΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan #	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L. 0-8	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE: ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C# C# Channel and Blocks: C# C# C# C# C# C# C# C#	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL (pick one for each device) <1> Display	<2> Printer	<3> Disk/Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)
7		C50 C51 C60 .. 63	3						6	2
6	ROLLING AVG REPORT	C70	1							

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L. 0-1499	< 1 > LIMITS INFORMATION Limit #	<1> Sense H/L	<2> Limit Value	<3> ALARM MESSAGE 0-40 characters EXAMPLE: EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st Trig Group #	2nd Trig Mode (see menu below)	<5> Delete Limit	< 2 > DEAD BAND
50	1	H	35					
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

Change Logging Interval with Time

Sometimes it is desirable to change a data logging interval after a period of time has elapsed. To accomplish this, multiple counters are required, one to serve as a master counter, and one counter for each of the different logging intervals desired. In general, the master counter is scanned at the largest common non-fractional time interval for the two logging rates.

Problem

Log the temperature from a group of thermocouples every 10 seconds for the first five minutes, and then log the temperatures once every 45 seconds.

In this example, scan group 3 is scanned every 5 seconds which is the largest common non-fractional time interval for the two logging rates. Channel 100 is the master counter and has two alarms, a low alarm at 59, and a high alarm at 60. Scan group 4 is scanned every 10 seconds, and triggers scan group 6 when ALM1(C100)=1. Scan group 5 is scanned every 45 seconds and triggers scan group 6 when ALM2(C100)=1.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or C# C#	(see menu below) EXAMPLE (JT/C):TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE. CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
.						
C100	P	100		CX = CX + 1	MASTER COUNTER	
C101	P	101		CX = ALM 2 (C100)		
C102	P	101		CX = ALM 1 (C100)		
C0..5	T-T				TEMP INPUTS	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
<1> 64.000 V dc
<2> 8.0000 V dc
<3> 512.00 MVDC
<4> 64.000 MVDC
<5> 64.0 MA
<6> 250.0 VAC
<7> 64.000 MV/OTO
<A> A/D CALIBRATION
<1> CALIBRATION
<2> SPECIAL
<T> THERMOCOUPLE
<J> J (NBS)
<K> K (NBS)
<T> T (NBS)
<E> E (NBS)
<R> R (NBS)
<S> S (NBS)
<B> B (NBS)
<N> N (NBS)
<C> W-5RE VS W-26RE
<H> J (DIN)
<V> T (DIN)
<R> RTD
<1> 385 DC VOLTS SCANNER
<2> 10 OHM CU DC VOLTS SCANNER
<3> USER DEFINED DC VOLTS SCANNER
<4> 385 RTD SCANNER TEMP LT 425.00 C
<5> 10 OHM CU RTD SCANNER LO RANGE
<6> USER DEFINED RTD SCANNER LO RANGE
<7> 385 RTD SCANNER TEMP GT 425.0 C
<8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
1st RO (default = 100.0)
2nd ALPHA (default = 3.90E-3)
3rd DELTA (default = 1.494)
4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
<1> COUNTS
<2> FREQUENCY
<S> STATUS OUTPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
<1> 512.00 OHMS DC VOLTS SCANNER
<2> 64.000 OHMS DC VOLTS SCANNER
<3> 256.00 OHMS RTD SCANNER
<4> 2048.0 OHMS RTD SCANNER
<5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan#	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L. 0-9	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE. ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C#..C# Channel and Blocks: C#,C#,C#..C#,C#,C#..C#,C#	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device <1> Display	<2> Printer	<3> Disk/Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)
3		C100	200:00:05							
4		C101	200:00:10						6	2
5		C102	200:00:45						6	2
6		C0..5	1		2					

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L.	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
0-1499	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE. EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE	<5> DELETE LIMIT	
100	1	H	60					
	2	L	59					
	3							
	4							
101	1	H	0.5					
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

Changing Logging Rate on Alarm

Changing the logging rate on the detection of an alarm is similar to changing the rate after a period of time. Instead of a master counter the channel (or channels) to be monitored for the alarm condition are put into the scan groups and checked for alarm conditions.

Problem

An battery manufacturer wants to record the voltages from a bank of batteries every 60 minutes. When the voltage on channel 3 drops below 1.3V log the voltages every 10 minutes.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK P.C.D. OR L. 0-1499 or C#..C#	CHANNEL FUNCTION & RANGE < A-Z > (see menu below) EXAMPLE (JT/C) TJ	CHANNEL MENU CHOICE < 1-5 >? <1> ALARM LIST# 0-1499	<2> CHANNEL UNITS 0-6 chars EXAMPLE DEG F	<3> CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE: CX = CX * 1.8 + 32.0	<4> CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	<5> LOGGING FORMAT (see menu below)
C0	D - 2				BATTERY 1	
C1	D - 2				BATTERY 2	
C2	D - 2				BATTERY 3	
C3	D - 2	3			BATTERY 4	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
  <1> 64.000 V dc
  <2> 8.0000 V dc
  <3> 512.00 MVDC
  <4> 64.000 MVDC
  <5> 64.0 MA
  <6> 250.0 VAC
  <7> 64.000 MV/OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
<R> RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 OHM CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425.00 C
  <5> 10 OHM CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425.0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
  1st RO (default = 100.0)
  2nd ALPHA (default = 3.90E-3)
  3rd DELTA (default = 1.494)
  4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512.00 OHMS DC VOLTS SCANNER
  <2> 64.000 OHMS DC VOLTS SCANNER
  <3> 256.00 OHMS RTD SCANNER
  <4> 2048.0 OHMS RTD SCANNER
  <5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan#	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<F> ALARM LIST PROGRAM

ALM LIST # P.C.D. OR L. 0-1499	ALARM LIST MENU CHOICE < 1,2 >? <1> LIMITS INFORMATION LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	 2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	<2> DEAD BAND
3	1	L	1.3	VOLTAGE UNDER LIMIT				
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never <2> During Alarm <3> On Alarm Transition

<K> SCAN GROUP PROGRAM

GROUP # P.C.D. or L. 0-9	SCAN GROUP MENU CHOICE < 1-5 >? <1> SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE: ENGINE 2 TEST	<2> SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C#..C# Channel and Blocks: C# C# C# C# C# C# C# C#	<3> SCAN TRIG MODE (pick only one see menu below)	<4> DATA OUTPUT DEVICE CONTROL pick one for each device <1> Display	 <2> Printer	 <3> Data Tape	 <4> Port A	 <5> Port B	<5> OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	 Trigger Condition (see menu below)
7	HOURLY REPORT	C0..C3	201:00:00		2					
9	BACKGROUND SCAN	C3	3						5	3
5		C3	200:10:00						4	2
4	10 MINUTE REPORT	C0..C3	1							

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

Compute Standard Deviation of a Channel Over Time

Although a standard deviation function (SDV) is available with the Math Coprocessor Option, it's very inefficient for determining the standard deviation of a channel over time. Using the SDV function requires a shift register to hold all the desired readings. If the standard deviation of many channels is desired, or if the standard deviation is desired for many readings, the shift register may become very large and consume a large portion of program memory.

An alternate method for calculating the standard deviation makes use of two integrators and a counter. The equation for the standard deviation is:

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or C#..C#	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
5	T-T				TEMPERATURE /	
100	P			CX = CX + C5 * C5	SUM OF SQUARES	
101	P			CX = CX + C5	SUM	
102	P	102		CX = CX + 1		
200	P			CX = SQR (C100-(C101* C101/C100))/(C100-1)	SDV	
201	P			CX = C101 / C102	MEAN	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
<1> 64.000 V dc
<2> 8.0000 V dc
<3> 512.00 MVDC
<4> 64.000 MVDC
<5> 64.0 MA
<6> 250.0 VAC
<7> 64.000 MV/OTD
<A> A/D CALIBRATION
<1> CALIBRATION
<2> SPECIAL
<T> THERMOCOUPLE
<J> J (NBS)
<K> K (NBS)
<T> T (NBS)
<E> E (NBS)
<R> R (NBS)
<S> S (NBS)
<B> B (NBS)
<N> N (NBS)
<C> W-5RE VS W-26RE
<H> J (DIN)
<V> T (DIN)
<R> RTD
<1> 385 DC VOLTS SCANNER
<2> 10 OHM CU DC VOLTS SCANNER
<3> USER DEFINED DC VOLTS SCANNER
<4> 385 RTD SCANNER TEMP LT 425.00 C
<5> 10 OHM CU RTD SCANNER LO RANGE
<6> USER DEFINED RTD SCANNER LO RANGE
<7> 385 RTD SCANNER TEMP GT 425.0 C
<8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
1st RO (default = 100.0)
2nd ALPHA (default = 3.90E-3)
3rd DELTA (default = 1.494)
4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
<1> COUNTS
<2> FREQUENCY
<S> STATUS OUTPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
<1> 512.00 OHMS DC VOLTS SCANNER
<2> 64.000 OHMS DC VOLTS SCANNER
<3> 256.00 OHMS RTD SCANNER
<4> 2048.0 OHMS RTD SCANNER
<5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan#	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L. 0-8	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C#..C# Channel and Blocks: C# C# C#.. C# C# C# C#.. C#	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device <1> Display	<2> Printer	<3> Data Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)
8	DATA COLLECTION	C5 C100..102	200:01:00						6	3
6	REPORT	C200 C201	1		2					

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L. 0-1499	< 1 > LIMITS INFORMATION LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE. EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	< 2 > DEAD BAND
102	1	H	08.5	# OF RDGS W SDV				
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

ADDITIONAL PROGRAMMING TECHNIQUES

While the following techniques do not easily fit into the integrator, counter, and shift register building blocks previously covered, they may prove useful.

Save Maximum Value of a Channel

The following programming illustrates how to keep track of the largest value of a channel since the SCAN key was pressed.

This example takes advantage of the fact that the 2286/5 Data Loggers always reset pseudo channel values to 0 when scanning is started. The measured value in channel 10 is compared to the contents of the pseudo channel, and the larger of the two is saved. This example will work whenever the value of C10 is greater than zero.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P,C,D, OR L, 0-1499 or C#..C#	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE: CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE: EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
C10	T-K					
C100	P			CX = MAX (C100 // 210)		

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<O> VOLTS/CURRENT
  <1> 64.000 V dc
  <2> 8.0000 V dc
  <3> 512.00 MVDC
  <4> 64.000 MVDC
  <5> 64.0 MA
  <6> 250.0 VAC
  <7> 64.000 MV/OTD
<A> A/D CALIBRATION
  <1> CALIBRATION
  <2> SPECIAL
<T> THERMOCOUPLE
  <J> J (NBS)
  <K> K (NBS)
  <T> T (NBS)
  <E> E (NBS)
  <R> R (NBS)
  <S> S (NBS)
  <B> B (NBS)
  <N> N (NBS)
  <C> W-5RE VS W-26RE
  <H> J (DIN)
  <V> T (DIN)
<R> RTD
  <1> 385 DC VOLTS SCANNER
  <2> 10 OHM CU DC VOLTS SCANNER
  <3> USER DEFINED DC VOLTS SCANNER
  <4> 385 RTD SCANNER TEMP LT 425.00 C
  <5> 10 OHM CU RTD SCANNER LO RANGE
  <6> USER DEFINED RTD SCANNER LO RANGE
  <7> 385 RTD SCANNER TEMP GT 425.0 C
  <8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
  1st RO (default = 100.0)
  2nd ALPHA (default = 3.90E-3)
  3rd DELTA (default = 1.494)
  4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
  <1> COUNTS
  <2> FREQUENCY
<S> STATUS OUTPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
  1st Zero Result (1-14 chars.)
  2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
  <1> 512.00 OHMS DC VOLTS SCANNER
  <2> 64.000 OHMS DC VOLTS SCANNER
  <3> 256.00 OHMS RTD SCANNER
  <4> 2048.0 OHMS RTD SCANNER
  <5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan #	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L.	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
					<4> ALARM SCAN TRIGGER			
0-1499	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE: EXHAUST TEMP OVER LIMIT	1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never <2> During Alarm <3> On Alarm Transition

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?										
P.C.D. or L. 0-9	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE: ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C#..C# Channel and Blocks: C# C# C# C#..C# C#..C# C#	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device <1> Display	<2> Printer	<3> Disk/Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

Save Minimum Value of a Channel

The routine to save the minimum value of a channel since SCAN was pressed requires somewhat more work. -

In this example, scan group 5 is triggered when the SCAN key is pushed and is used to initialize the value of C100 to a large positive number. The measured value is compared to that large number and saved. All further values are compared against the first and the smallest is saved.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P,C,D, OR L, 0-1499 or Cn.Cn	(see menu below) EXAMPLE (JT/C) TJ	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
C10	T-K					
C100	P			CX = MIN (C100//C10)		
C101	P			C100 = 99999		

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<D> VOLTS/CURRENT
<1> 64.000 V dc
<2> 8.0000 V dc
<3> 512.00 MVDC
<4> 64.000 MVDC
<5> 64.0 MA
<6> 250.0 VAC
<7> 64.000 MV/OTD
<A> A/D CALIBRATION
<1> CALIBRATION
<2> SPECIAL
<T> THERMOCOUPLE
<J> J (NBS)
<K> K (NBS)
<T> T (NBS)
<E> E (NBS)
<R> R (NBS)
<S> S (NBS)
<B> B (NBS)
<N> N (NBS)
<C> W-5RE VS W-26RE
<H> J (DIN)
<V> T (DIN)
<R> RTD
<1> 385 DC VOLTS SCANNER
<2> 10 OHM CU DC VOLTS SCANNER
<3> USER DEFINED DC VOLTS SCANNER
<4> 385 RTD SCANNER TEMP LT 425.00 C
<5> 10 OHM CU RTD SCANNER LO RANGE
<6> USER DEFINED RTD SCANNER LO RANGE
<7> 385 RTD SCANNER TEMP GT 425.0 C
<8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
1st RO (default = 100.0)
2nd ALPHA (default = 3.90E-3)
3rd DELTA (default = 1.494)
4th C4 (default = .20598E-11)
<C> COUNTER/TOTALIZER
<1> COUNTS
<2> FREQUENCY
<S> STATUS OUTPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
<1> 512.00 OHMS DC VOLTS SCANNER
<2> 64.000 OHMS DC VOLTS SCANNER
<3> 256.00 OHMS RTD SCANNER
<4> 2048.0 OHMS RTD SCANNER
<5> 64.000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS

Chan #	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P,C,D, or L, 0-8	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only. Cn Channel Block only. Cn. Cn Channel and Blocks. Cn Cn Cn Cn Cn Cn Cn Cn	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL pick one for each device <1> Display	<2> Printer	<3> Data Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)
5	INITIALIZATION	C101	6							
6	DATA COLLECTION	C100	200:01:00		2					

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
	< 1 > LIMITS INFORMATION							< 2 > DEAD BAND
P.C.D. OR L. 0-1499	LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE: EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
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	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

Exclude Open Thermocouples from Calculations

A potential difficulty can occur when a thermocouple input is the measurement used for an integrator or shift register. If the thermocouple is broken, an OPEN TC message is generated. If the value from that channel is being used in any calculations, a PROPAGATED ERROR will occur and the previous contents of the integrator or shift register will be lost. One method to circumvent this is to use the GAV function available with the Math Coprocessor Option.

Problem

Compute the mean and standard deviation for a thermocouple input. Ignore all open TC conditions and exclude that reading from the calculations.

The GAV function automatically ignores any invalid readings it operates upon. Averaging the channel with 0 and then multiplying by 2 will result in the original reading when the measurement is valid, and in 0 if an open TC error is detected.

<A> CHANNEL PROGRAM

CHANNEL #/BLOCK	CHANNEL FUNCTION & RANGE < A-Z >	CHANNEL MENU CHOICE < 1-5 >?				
P.C.D. OR L. 0-1499 or C# C#	(see menu below) EXAMPLE (JT/C) T	< 1 > ALARM LIST# 0-1499	< 2 > CHANNEL UNITS 0-6 chars. EXAMPLE DEG F	< 3 > CHANNEL EXPRESSION or PROCEDURE 0-75 characters Refer to programmed channel as CX EXAMPLE CX = CX * 1.8 + 32.0	< 4 > CHANNEL LABEL 0-15 characters EXAMPLE EXHAUST TEMP	< 5 > LOGGING FORMAT (see menu below)
5	T - T				TEMPERATURE 1	
50	P			CX = GAV(C5,10) * 2		
100	P			CX = CX + C50 * C50	SUM OF SQRS	
101	P			CX = CX + C50	SUM	
102	P			CX = CX + (ERR (C5) EQ 0)	N	
200	P			CX = SQR((C100-(C101(C101 * C102))/(C102-1))	SDV	
201	P			CX = C101/C102	MEAN	

CHANNEL FUNCTION MENU

<P> PSEUDO CHANNEL
<Q> VOLTS/CURRENT
<1> 64 000 V dc
<2> 8 0000 V dc
<3> 512 00 MVDC
<4> 64 000 MVDC
<5> 64 . MA
<6> 256 00 VAC
<7> 64 000 MV/OTD
<A> A/D CALIBRATION
<1> CALIBRATION
<2> SPECIAL
<T> THERMOCOUPLE
<J> J (NBS)
<K> K (NBS)
<T> T (NBS)
<E> E (NBS)
<R> R (NBS)
<S> S (NBS)
<B> B (NBS)
<N> N (NBS)
<C> W-5RE VS W-26RE
<H> J (DIN)
<V> T (DIN)
<R> RTD
<1> 385 DC VOLTS SCANNER
<2> 10 OHM CU DC VOLTS SCANNER
<3> USER DEFINED DC VOLTS SCANNER
<4> 385 RTD SCANNER TEMP LT 425 00 C
<5> 10 OHM CU RTD SCANNER LO RANGE
<6> USER DEFINED RTD SCANNER LO RANGE
<7> 385 RTD SCANNER TEMP GT 425 0 C
<8> USER DEFINED RTD SCANNER HI RANGE
User Defined RTD constants
1st RO (default = 100 0)
2nd ALPHA (default = 3.90E-3)
3rd DELTA (default = 1.494)
4th C4 (default = 20598E-11)
<C> COUNTER/TOTALIZER
<1> COUNTS
<2> FRECUENCY
<S> STATUS OUTPUT
1st Zero Result (1-14 chars.)
2nd Nonzero Result (1-14 chars)
<I> STATUS INPUT
1st Zero Result (1-14 chars)
2nd Nonzero Result (1-14 chars)
<O> ANALOG OUTPUT
<B> BCD/BINARY INPUT
<Z> RESISTANCE
<1> 512 00 OHMS DC VOLTS SCANNER
<2> 64 000 OHMS DC VOLTS SCANNER
<3> 256 00 OHMS RTD SCANNER
<4> 2048 0 OHMS RTD SCANNER
<5> 64 000 kΩ RTD SCANNER

USER DEFINED RTD CONTANTS				
Chan #	RO	Alpha	Delta	C4

LOGGING FORMAT MENU

<1> Auto
<2> .nnnnn
<3> n.nnnn
<4> nn.nnn
<5> nnn.nn
<6> nnnn.n
<7> nnnnn

<K> SCAN GROUP PROGRAM

GROUP #	SCAN GROUP MENU CHOICE < 1-5 >?									
P.C.D. or L. 0-9	< 1 > SCAN GROUP LABEL 0-40 Alphanumeric characters EXAMPLE ENGINE 2 TEST	< 2 > SCAN GROUP CHANNEL LIST FORMAT: One Channel only: C# Channel Block only: C#. C# Channel and Blocks: C# C# C# C# C# C# C# C#	< 3 > SCAN TRIG MODE (pick only one see menu below)	< 4 > DATA OUTPUT DEVICE CONTROL (pick one for each device) <1> Display	<2> Printer	<3> Data Tape	<4> Port A	<5> Port B	< 5 > OTHER SCAN GROUP TRIGGER Scan Group to Trigger (#)	Trigger Condition (see menu below)
8	DATA COLLECTION	C5 C50 C100.. 102	200:01:00						6	3
6	REPORT	C200 C201	1							

<1> On Demand Only
<2> Time Interval HH MM SS
<3> Continuous
<4> Discrete Time HH MM SS
<5> Externally Triggered
<6> Scan Once

<1> No Data
<2> All Data
<3> Alarm Data
<4> Alarm Trans Data

<1> Never
<2> Any Alarm
<3> Any Alarm Transition
<4> Always

<F> ALARM LIST PROGRAM

ALM LIST #	ALARM LIST MENU CHOICE < 1,2 >?							
P.C.D. OR L. 0-1499	< 1 > LIMITS INFORMATION LIMIT #	<1> SENSE H/L	<2> LIMIT VALUE	<3> ALARM MESSAGE 0-40 characters EXAMPLE: EXHAUST TEMP OVER LIMIT	<4> ALARM SCAN TRIGGER 1st TRIG GROUP #	2nd TRIG MODE (see menu below)	<5> DELETE LIMIT	< 2 > DEAD BAND
102	1	H	28.5	# of RDGS IN SDY				
	2							
	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							
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	3							
	4							
	1							
	2							
	3							
	4							
	1							
	2							
	3							
	4							

<1> Never
<2> During Alarm
<3> On Alarm Transition

Section 5
Operating the 2286/5 From the Front Panel

CONTENTS

INTRODUCTION

Operation of the 2286/5 has been refined and streamlined through generations of Data Loggers. The scaled down front panel, with clearly marked operating and programming keys, the vacuum fluorescent display, and a menu-driven programming structure all contribute to the improved ease of use.

Users of the 2286/5 Data Loggers essentially customize their own data acquisition systems using the menu-driven user interface. In most cases, running the program they've set up is simple; the 2286/5 operating and user functions keys are clearly marked and conveniently accessed. This section contains basic operating instructions and describes the use of each of the operating keys.

TURNING THE 2286/5 ON AND OFF

Before turning on the 2286/5, make certain the interface cables and the power supply (whether battery or line power) are correctly connected. Please refer to the 2286/5 System Guide for information on hooking everything up.

To turn the Data Logger on, insert the key into the lower right front panel keyswitch and turn the key to the right. Turn the key to the RUN position (for operating) or the PROGRAMMING position depending upon what you intend to do. You have access to all of the operating functions with the key set to PROGRAMMING, but only a few programming functions when the key is set to the RUN position.

With the instrument off, turn the key to RUN, and the display will show the prompt,

DATA LOGGER SELF-TEST

This prompt remains on the display until the 2286/5 initialization and self test have been completed. The version of software that is installed is briefly displayed next. After that, scanning or plotting are resumed if they were in progress when the 2286/5 was turned off. If they weren't running before, the following prompt is displayed,

SELECT RUN MODE OPERATION

This prompt indicates that only run mode operations may take place. Press one of the four operating keys now--SCAN, SINGLE SCAN, PLOT, or MONITOR--(depending on what you want to do), and enter the data you're prompted for. If the keyswitch is turned to PROGRAM when the 2286/5 is turned on, the opening prompt is,

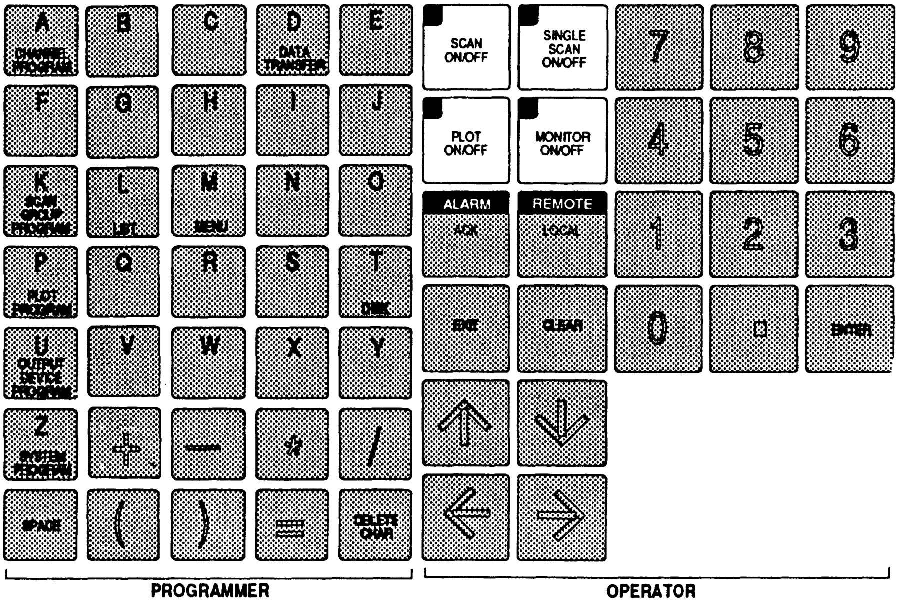
MAIN MENU CHOICE <M FOR MENU>? A

In this case, both the programming and the operating modes are available, and an access code (if programmed) isn't required to operate the instrument. If any auxiliary functions are being run, don't turn the data logger off until they're completed, or until you stop them by pressing the EXIT key. The SCAN and PLOT front panel lights should be off before you turn the system off.

To turn the 2286/5 off, insert the key into the keyswitch and turn it to the left to the OFF position. Turning the machine off this way won't clear or alter the configuration program that's been entered.

OPERATING MODES

The 2286/5 contains four operating modes, monitor, scan, single scan, and plot. Each mode has a clearly labeled key on the instrument front panel, and a light indicator which is illuminated when a run mode has been selected and remains active. The operating keys toggle on and off. Push a key once to begin an operation and push it again to end the operation.



Monitoring

Use the monitor function to access a selected channel to continuously display the data generated from it. The information is updated after the completion of each scan, or two and a half times per second, whichever is slower.

Data acquired while monitoring goes to the display; if you're operating from remote it goes to port A. You can run monitor whether the 2286/5 is in scan, single scan, or plot modes, but if a scan is active when monitoring begins, the data output to the display is preempted. The data generated from the channel being monitored will appear on the display.

To request the monitor function, turn the instrument on, and press the MONITOR ON/OFF key on the front panel.

Key in the desired channel number when the system prompts for it and press the ENTER key. At this point the 2286/5 verifies that the selected channel physically exists, and that it's programmed consistent with the hardware configuration. If it isn't a valid channel number, or if the channel you've requested isn't programmed, an error message will be displayed until acknowledged. Refer to Section 8 of this guide for handling of error messages.

If it's a valid channel number, the MONITOR key light indicator remain on, and the number of the monitored channel will be displayed until data is available for display.

You can change the monitored channel by using the up or down arrow keys. Pressing the up arrow key increments the channel number by one and pressing the down arrow key decrements the channel number by one.

Data from other scan groups that normally goes to the display will not appear. That data is displaced by data from the channel you're monitoring. Also, the current alarm status of the monitored channel will be displayed, but no alarm messages will be logged, and no alarm scans triggered or channel procedures executed, until the channel comes up in a normal scan.

Stop the monitor function by pressing the MONITOR ON/OFF key again. The light indicator will then go out.

Scanning

The scan function causes the 10 scan groups (0-9) to be activated according to the trigger conditions specified in the configuration program.

Before starting a scan it's a good idea to get a copy of the program currently contained in the 2286/5 memory. The 2280 Series Programming Form should have all of this information, including the access code, the channel labels and file names and so forth.

With the Data Logger turned on and the SELECT RUN MODE OPERATION prompt displayed, activate the Scan function by pressing the front panel SCAN ON/OFF key. If an access code has been programmed the system will prompt for it at this point. Key it in and then press the ENTER key. If the access code is entered incorrectly, the message ACCESS DENIED will appear on the display and remain there until the EXIT key is pressed.

If an access code hasn't been programmed, or if the power keyswitch is in the PROGRAM position, pressing the SCAN ON/OFF key takes you directly to the SELECT RUN MODE prompt.

Scan group functions are checked for conformance to the actual physical configuration of the 2286/5 Data Logger. If consistent, you'll be allowed to proceed with your scan request. If not, an error message will be displayed, and the scan request will be denied. Operation cannot proceed until the problem is fixed.

If any of the scan groups are programmed for output to the disk, you'll be asked to enter a disk file name. The name must adhere to the MS-DOS* file name convention of a 1 to 8 character file name followed by an optional 3 letter file name extension (e.g., filename.ext). When the system requests a name, key in the desired file name, and press the ENTER key.

If each step is taken correctly the SCAN key light indicator will remain on and the display will return to the SELECT RUN MODE OPERATION prompt until data becomes available and is displayed. Individual scan groups are triggered by their programmed trigger conditions, not by turning on the scan function.

To turn the scan function off, simply press the SCAN ON/OFF key. The key toggles on and off. If no access code was programmed, the SCAN key light indicator will go off and scanning will stop.

If an access code was programmed, type it in at the prompt and press ENTER. At this point the SCAN LED goes out, scanning stops, and the message, STOPPED AT <Date> <Time> is sent to all logging devices used since scanning began. If the access code is entered incorrectly, the ACCESS DENIED prompt is displayed again, and scanning continues.

If data was being recorded to a disk file when the scan is turned off, then the file is closed. If the scan is turned back on later, the data will have to be entered into a new disk file, with another name if on the same disk.

*MS-DOS is a registered trademark of Microsoft

Single Scan

Use this feature when you want to execute only one of a scan group, regardless of the programmed trigger order. If a scan group is currently active under the scan or plot function, the group requested by the single scan waits for completion of that current scan group before it begins.

If other scan groups are queued up, the scan group requested by the single scan function takes its place in the queue according to its priority and other preprogrammed parameters.

To request a single scan, turn the instrument on and press the front panel SINGLE SCAN ON/OFF key. If an access code is required, the system will prompt for it; key it in and press ENTER. If the code entered is incorrect, the ACCESS DENIED message will appear and remain on the display until either the ALARM ACK or EXIT key is pressed.

When access to the single scan function is granted, the prompt reads,

SCAN GROUP TO TRIGGER = 0.

Group 0 is the default choice. Displayed defaults are always selected by pressing ENTER. If another group is desired, key in the number, and then press ENTER.

If the scan mode was off when you requested a single scan, the 2286/5 checks the parameters of the selected scan group against the physical configuration of the Data Logger. If the disk wasn't programmed as an output device for the selected scan group, and no configuration error occurs, the scan becomes active.

If the scan mode was on when the SINGLE SCAN LED comes on, and there are other scan groups queued up to become active, then the single scan group is assigned a place in the queue based on its group number, with lower numbers getting higher priority.

When the disk drive is programmed as an output device for the selected scan group, the system will ask for the file name. Type in the desired file name at the prompt following the DOS file name convention of a 1 to 8 character file name followed by an optional 3 letter file name extension (e.g., filename.ext) and then press the ENTER key. If the single scan group has the disk drive programmed as an output device (and scan is on), the data from the single scan will also go into the file that was opened when the scan mode was turned on.

Any single scan of a scan group will not trigger any other groups to scan after it regardless of the programming.

Single scan can be aborted before it's completed by pressing the SINGLE SCAN ON/OFF key again. If the scan function was off when single scan is aborted, the following message is sent to every logging device used during the single scan,

STOPPED AT <Date> <Time>

Also, if a disk file was opened, aborting the single scan function closes the file unless it was opened for scan and scan remains active after aborting the single scan. When the single scan is completed, the SINGLE SCAN LED will go out.

Plotting

The 2286/5 Data Loggers have the capability of plotting the activity of up to four programmed plot channels onto the built-in printer. Plotting is available only within the window specified by the scan trigger enable times.

Each of the channels being plotted has its own individual symbol or character (see the 2280 Series Programming Form) that represents its value between the two boundaries over the programmed time interval. When one of the trend plots exceeds a boundary, the plot symbol for that channel changes to an overrange character (distinct from the assigned plot character), and the plot is pegged along that boundary until its data again comes back into the range of the plot.

While the PLOT key light indicator is on, all other logging output to the printer is preempted. This data will still be output to the other devices if it's been programmed to do so during scan group programming.

To request the plot function, turn the instrument on, and press the front panel PLOT ON/OFF key. If an access code is required, type it in at the prompt, and press ENTER. If the code is incorrectly entered, the ACCESS DENIED message will be displayed, and remain until the ALARM ACK or EXIT key is pressed.

If an access code hasn't been programmed, or if the keyswitch is turned to the PROGRAM position, plotting will begin as soon as you request it and the display will read,

SELECT RUN MODE OPERATION

When the plot function is activated, the channels programmed in the plot group are checked against the actual 2286/5 configuration. If they don't agree, an error message is displayed. See section 8 of this guide for error message guidance. If they do agree, the PLOT key light indicator remains illuminated, and the 2286/5 prints out the following preliminary information,

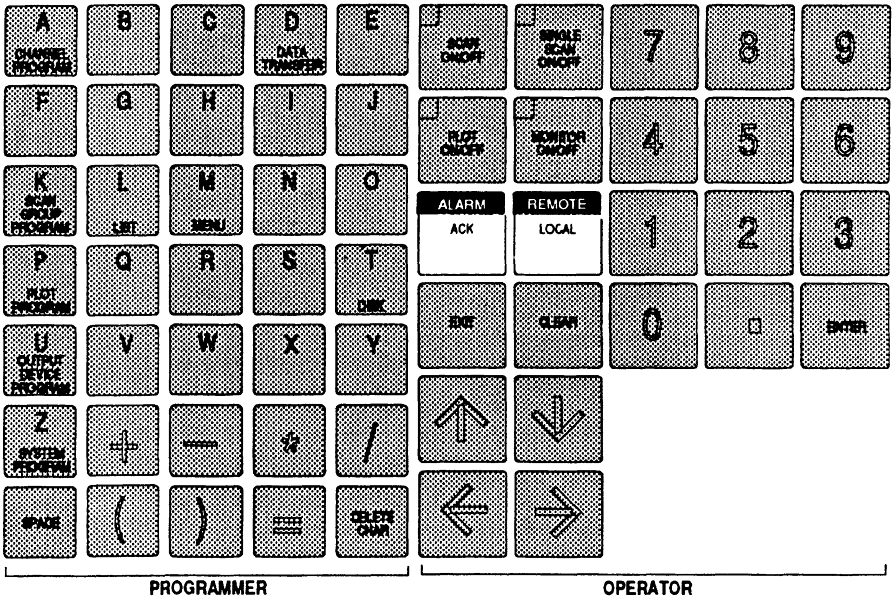
- The current date and time.
- The plot interval time.
- The numbers of the 1-4 channels whose values are about to be plotted and the symbol to be used for each.
- The leftmost values of each plot channel.
- The rightmost values of each plot channel.

After this preliminary information, the Data Logger prints the relative values of the channels programmed for trend analysis.

To turn off the plot function, press the PLOT ON/OFF key again. If an access code was programmed, type it in when requested, and then press the ENTER key. The PLOT key light indicator will go off and plotting will stop. If the 2286/5 is in the scan mode, normal data output to the printer is resumed if data is programmed to go to it.

USER STATUS FUNCTIONS

The 2286/5 contains three user status functions, alarm acknowledgement, return to local control, and system status. Two of them, alarm acknowledgement, and return to local are accessed from the front panel keyboard and the other one, system status, is used only when operating from a remote location.



Alarm Acknowledgement

If a limit on an alarm list has a programmed alarm message the message is placed in the alarm queue whenever its limit is exceeded. At the same time, the ALARM LED on the front panel will light and the alarm message can be viewed by pressing the ALARM ACK key.

The number of messages that can be stored in the alarm queue is limited only by the amount of unused system memory. When they've all been acknowledged, the LED goes out and the alarm output is turned off. The last alarm message displayed is cleared from the display by pressing EXIT.

The ALARM ACK key light indicator will be illuminated when,

- Out-of-limit data is received from a programmed channel during the scan, single scan or plot modes (if an alarm message has been programmed for that limit).
- A system alarm occurs.

When the ALARM light indicator comes on, the message associated with it is placed in the queue until the ALARM ACK key is pressed. Once acknowledged, the message remains on the display until the ALARM ACK key is pressed again to acknowledge another alarm message in the queue. The number of alarm messages that can be stored in the queue at any one time is limited only by the amount of user memory left available by the configuration program.

While it is not imperative that alarm messages are acknowledged, they are assumed to be of some importance. If the ALARM ACK key is pushed when the ALARM LED is off, the display will indicate ALL ALARMS ACKNOWLEDGED.

If there are still unacknowledged alarms in the queue (the light indicator is on) when the scan mode is terminated, they can still be acknowledged in the normal manner. However, any time all four operating modes (scan, single scan, monitor and plot) are turned off, and then scan or plot is turned back on, any unacknowledged messages in the queue are erased. They will also be erased if any programming or auxiliary functions are performed. If scan is turned on while plot is on, any messages in the queue are retained.

Logged data that is destined for the display while an alarm message is viewed is preempted from the display. However, any data that is preprogrammed (during scan group programming) for other output devices will be recorded there normally.

If an alarm acknowledgement device has been programmed, each acknowledged alarm message is logged onto that device along with,

- The time the message entered the queue.
- The time it was acknowledged.
- An indication of what caused the alarm.

If the user-defined alarm message is longer than 36 characters, the left part of the message may not appear on the front panel 40 character display. By moving the cursor to the beginning of the line with the left arrow key, you can view the first part of the line.

Return to Local

When the 2286/5 is under remote control through port A of an RS-232-C or IEEE-488 device, the REMOTE key light indicator on the front panel will be illuminated.

If the remote operator hasn't locked out the front panel, it can be returned to local control by simply pressing the LOCAL key on the front panel. Refer to section 7 of this guide for more detailed information on local and remote programming.

System Status

When operating the 2286/5 from the front panel, you can easily see which features are active by simply viewing the indicator lights. When operating from a remote location the system status function must be used to determine which operating functions are active. (The six functions are scan, single scan, plot, monitor, alarm acknowledge and remote.) Section 7 of this guide discusses the System Status function in greater detail.

OPERATING NOTES

Power Failure and Power Up

Whenever power to a 2286/5 is interrupted in any manner, the configuration program and clock will be backed up in nonvolatile memory for at least 30 days.

Whenever a power-on or watchdog timeout occurs, the 2286/5 comes up in the following state,

- All hardware assemblies are RESET, then released.
- The 2286/5 will be in local control.
- If power was lost while the SCAN or PLOT key front panel light indicators were illuminated, the scan or plot will automatically re-start. Before they restart, the following message will be placed in the alarm queue for acknowledgement:

  POWER FAILURE AT <DATE> <TIME>

The message is also sent to all data output devices associated with the scan group, with a line termination sequence sent before it to close any partially logged lines.

If a plot is to be restarted, the message is sent to the printer.

If the 2286/5 was in an operating mode when it lost power, it may be prevented from restarting that mode by an error condition when power is returned. If any system errors are detected at power-up, they will be displayed on the front panel.

You can acknowledge the error by pressing the EXIT key, and the 2286/5 will continue normal operation. However, depending on the nature of the error, you may need to take further action. See section 8 of this guide for assistance with error handling if necessary.

Initialization of Outputs

All output and pseudo channels are initialized to zero when the 2286/5 is turned on. They are also reset under the following circumstances,

- SCAN is off and PLOT or SINGLE SCAN is turned on.

- SCAN is turned on.

If an output is in a 2281A Extender Chassis with its own power supply, and power cycles off and back on at that 2281A, then all outputs in that 2281A Extender Chassis are reset to zero.

Changing Limit Values While Scanning

It's possible to fine tune the 2286/5 operation while it's running by altering the programmed setpoints. To change limit values while scanning is active, press the front panel ALARM LIST PROGRAM key. You will see the prompt,

CHANGE LIMIT VALUE <ENTER OR EXIT>

Press the ENTER key to change a value. Next you'll be asked for the alarm list number you wish to alter. Key in the number and change the value. Scanning continues during this procedure.

You can alter values when the keyswitch is in either the RUN or PROGRAM position, but if it's in RUN, and an access code has been programmed, you will be asked to type it in before you are allowed to continue. Press the EXIT key to return to normal operating conditions.

Changing Pseudo Channel Values While Scanning

Use the same steps as changing limit values above. The only difference is that you need to press the front panel CHANNEL PROGRAM key to access the channel values you want to change.

Scan Output To 2286 Disk

Occasionally the 2286 may need to pause its scanning briefly to update the disk file allocation table. It tries to perform this 'housekeeping' during time that scan data is not being sent to the disk. During continuous scan to the disk, however, this opportunity is not available. The disk file allocation table must be updated routinely to avoid any loss of data should a power loss during a scan occur.

If a scan is started or in progress and fewer than 100 sectors remain available on the disk, the 2286 will generate a 'DISK ALMOST FULL' alarm. This warns the user that the scan must be stopped, in order to close the disk file, and a new disk, with room for additional data, installed. The scan may then be restarted.

An alternative to having to stop and restart the scan is to allow the 2286 to continue recording scan data to the disk until the disk becomes completely full. The 2286 will then close the data file and generate a 'DISK FULL' alarm to alert when this occurs. Further data will now be buffered allowing time to replace the disk with a preformatted disk that has enough room for additional data.

How long and how much data can be buffered depends on the scan interval, the number of channels being scanned, the disk data format, and the type of data file format. If a DIF file format is used, scan channel organization is also a determining factor. However, even the worst case allows sufficient time for prompt action.

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Ejecting the disk, or a power failure, in the middle of a disk write operation may result in an-incomplete sector being written to the disk. This will result in a disk read error when that sector is read.

During scan, if the disk is reinstalled in the microfloppy drive or 2286 power is restored, this sector will be recovered. However, there may be additional 'garbage' characters in this part of the file, which can be removed by editing the file on an IBM PC or compatible. If the incomplete sector is part of the disk directory or the disk file allocation table, some data on the disk may not be recoverable using the 2286. Software tools are available for IBM PCs and compatibles to help reclaim lost data and files.

NOTE

> Should the disk data file not be closed for the above causes, you can take advantage of one feature on power-up that the 2286 performs on the disk. Turn the 2286 off, insert the disk into the microfloppy drive, and turn the 2286 back on. It will close the first file it finds on the disk that is not closed, if any.

Ejecting the disk or a power failure in the middle of a disk write operation may result in an incomplete sector being written to the disk. This will result in a disk read error when that sector is read.

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AUXILIARY FUNCTIONS

You have access to the following 2286/5 Data Logger auxiliary functions only when the front panel keyswitch is turned to the PROGRAM mode. The four operator modes (scan, single scan, monitor and plot) must be turned off as well. At this point, you can use any of the auxiliary functions by pressing a single key. The auxiliary functions are,

- **Data transfer**
- **Disk**
- **List**
- **Erase all programming**

Refer to Section 6 for information on Data Transfer and Disk auxiliary functions. The auxiliary functions LIST and ERASE are described in the Tutorial in Section 2 of this guide.

Section 6
Recording Information

CONTENTS

INTRODUCTION

The 2286/5 Data Loggers allow you to record information in a variety of ways. This section discusses techniques for uploading data to other systems, along with the various interfaces used, and practical considerations involved with conditioning other system devices to receive data from the 2286/5 Data Loggers.

Most of this section contains detailed information on using the 2286 disk drive and the 2286/5 built-in thermal printer.

PRINTER OPERATION

The 2286/5 contains a 40-column thermal printer that provides logging of multiple channels per line and can be programmed to plot values from one to four channels. While programming, the printer can be used to show available menu choices by simply pressing the MENU key. It is also available as an output device to LIST back the configuration program and the existent hardware.

Printer ON/OFF Settings

The 2286/5 printer has a separate power switch which must be turned to ON to be activated. It's located on the front right side of the Printer Drive board and can only be accessed when the printer drawer is pulled out. Push in the spring-loaded latch on the left side (just behind the printer window) and pull the drawer towards you. You'll see the ON/OFF switch (see Figure 6-1). When the printer power switch is set to OFF, data sent to the printer will not be printed. The printer can be turned off without affecting the rest of the 2286/5 logging operation.

The printer ON/OFF switch provides a convenient method of selectively recording data onto the printer. Program the scan group so that all output goes to the printer and then turn the printer on only when you wish to print the data generated.

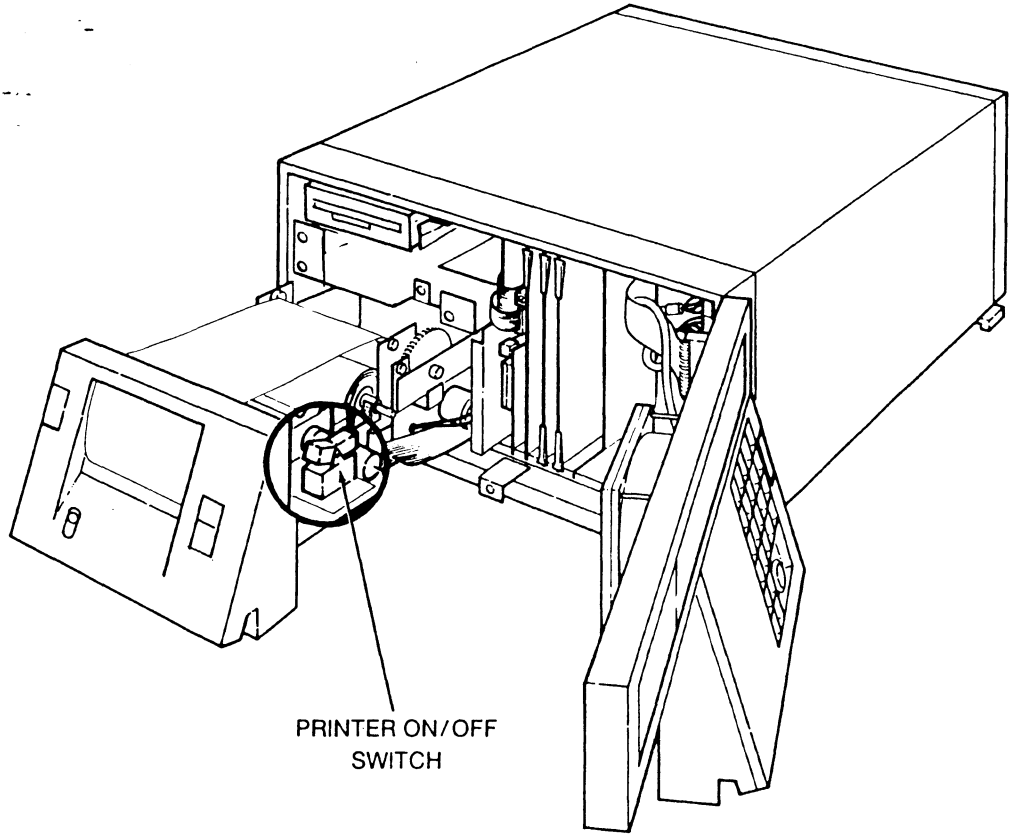

Figure 6-1. Printer ON/OFF Switch

The Printer Operator Switch

The printer operator switch is accessed when the front panel printer door is open. The main printer switch must be ON before any of the paper switch settings are operable. The switch contains three settings. The bottom (TAKE UP OFF) and middle (TAKE UP ON) positions are stationary settings. The top position (PAPER ADVANCE) is spring-loaded, and must be held down to advance the paper.

PAPER ADVANCE

You can advance the printer paper by continuously pressing the printer button to the PAPER ADVANCE position. The paper continues to advance as long as the button is pressed. If data is being printed when PAPER ADVANCE is pushed, the 2286/5 finishes printing the current line first, and then advances the paper. While the paper is advancing, all data destined for the printer is held until the paper advance is terminated. No data is lost.

However, use of PAPER ADVANCE during plotting can cause one or more plot data lines to be lost.

TAKE UP OFF

This switch setting deactivates the motor powering the action of the take-up spindle. It has no effect on the printing of data. This setting allows you to go into the take-up spindle and examine previously printed data (or pull paper out of the roll) while the printer continues to log current data.

TAKE UP ON

This switch setting activates the motor that powers the take-up spindle. Thus, used printer paper is stored on the take-up spindle, to be removed when the paper on the supply spindle is exhausted.

Printer Paper Removal and Loading

When a new paper supply must be loaded the following steps should be taken. Also, refer to the detailed illustration inside the printer door.

Release the printer "drawer" by pressing the printer slidelatch located to the left of and behind the printer cover door latch. Pull the printer out as far as it will come.

Deactivate the printer by moving the main printer power switch to the OFF position. This switch is located in the right corner of the Printer Drive board.

PAPER REMOVAL

If used paper must be removed, tear it off at the serrated edge where the paper re-enters the inside of the printer. Locate the spring plate that holds the take-up spindle in place and pull this spring plate out with one hand while lifting the take-up spindle (with the used paper) out of its position.

Pinch the split end of the spindle together. (The spindle is opposite the gear). Slide the used paper off the take-up spindle and reinsert the spindle the same way you took it out.

Push the spring-loaded printer door latch (on the left side of the printer window) to the right and fold down the printer cover door.

Release the print head by pushing down on the print head release lever, located in the lower left corner of the printer's panel area.

Remove the supply spindle by putting your thumb on the thumb rest while pushing up on the spindle with your forefinger. Dispose of the old paper reel and any remaining paper.

INSTALLING NEW PAPER

When you install the new roll of paper on the supply spindle make certain the loose end comes out from the bottom of the roll.

For best results, tear the loose end of the paper at a 45 degree angle, and insert it into the opening of the paper loading tray.

Use the slot in the tray to push the paper through the printer so the paper holds the switch arm down. Push the paper through until it slides past the print head and continues outside of the printer.

Once the paper is showing outside the printer, pull it out a few inches more. Run the paper through the return slot at the top of the printer, under the nylon paper guides (above the paper loading tray), and pull it all the way back over the rear shaft.

Insert the paper through the slot in the take-up spindle. Secure it by turning the gear a few revolutions in a counterclockwise direction.

Secure the paper at the print head by pushing the print head release lever up into the operating position. Make sure the printer rocker switch is in the TAKE UP ON position.

Turn the main printer power switch to the ON position, close the printer cover door, and slide the printer back into the unit until it snaps into place.

Caution

We recommend that you use NCR 3-AT-22010-RI paper or the equivalent in the 2286/5 printers. This paper is available through John Fluke Mfg. Co., Inc. (Fluke Accessory Y2046). Using other types of paper may degrade the print quality.

DISK DRIVE OPERATION

The 2286 Data Logger's built-in 3.5 inch MS-DOS* compatible microfloppy drive stores system programs or logged data. The disk drive operates at both 1.44M (high) and 720k (low) MS-DOS format densities.

Data may be recalled anytime and transferred to the system printer, an external computer, or recorder by using the optional communication interfaces. The 2286 transfers data from the disk at roughly 180 characters per second.

Since the disk is MS-DOS compatible, data and system programs can be viewed or edited on any IBM* PC or compatible configured with a 3.5 inch microfloppy drive. The Apple Macintosh* can read an IBM file if the user's Mac has a SWIM drive or Apple FDHD drive. The user can run the Apple File Exchange program to translate the 2286 disk files.

Programs saved on disk allow the 2286 setup to be easily converted to different data acquisition configurations. by simply loading a pre-defined program file.

The disk drive is not available on the 2285 Data Logger.

*MS-DOS is a registered trademark of Microsoft Corporation. IBM is a registered trademark of International Business Machines Corporation. Apple Macintosh is a trademark of Apple Computer, Inc.

Removal and Loading

Gain access to the microfloppy disk slot in the front panel by gently lifting the bottom of the disk drive door. This causes the door to swing up and open.

To remove a disk, open the door and push the disk eject button. The disk will eject and you may pull it straight out of the slot.

To load a disk, open the door and slide the disk straight into the slot until it snaps into place.

Operation

There are essentially six Disk Drive functions that can be performed by a programmer. They are,

- Storing logged data.
- Requesting a directory of stored files.
- Deleting files on the disk.
- Formatting the disk.
- Writing a configuration program on the disk.
- Loading a configuration program from the disk.

Disk Data Format Programming

Instructions for programming disk data storage in the format you want are provided in the scan group and output device programming portions of Section 3 of this manual.

Disk Functions

Disk functions can only be performed when all operating functions are turned off, the keyswitch is turned to the PROGRAM position, and the system is at the main menu.

To request a disk function, press the **T (DISK)** key in response to the main menu prompt. The system acknowledges with the prompt,

<T> PERFORM A DISK FUNCTION

Press **ENTER** and the prompt becomes,

T: DISK FUNCTION <1-6>? 1

You can now choose from six activities in the disk function menu. Press the **MENU** key to list the six choices onto the printer. The choices are,

<1> DISK DIRECTORY
<2> ELETE FILE(S)
<3> ORMAT DISK
<4> ROGRAM SAVE
<5> ROGRAM LOAD
<6> DIRECTORY OUTPUT DEVICE

The following paragraphs describe how to use each disk function from the front panel.

LISTING DISK DIRECTORIES

The first function available through the disk function menu is Disk Directory. Selecting this feature allows you to obtain a directory of all program and data files stored in the root directory of the disk. Since the 2286 only accesses files in the root directory, a directory listing of a subdirectory is not possible.

The directory is listed on the printer, port A, or port B. The disk directory listing looks like:

```
 VOLUME IN DRIVE IS:  FLUKE 2286A

DATA1    .DIF        738  10 FEB 90  14:27
DATA2    .DIF      53024  10 FEB 90  08:14
TEMP     .PRG       8729  01 MAR 90  12:49
DATA3    .DAT     419117  04 MAR 90  21:03
PRESSURE.PRG        9346  22 MAR 90  17:25

          5 FILE(S)    480256 BYTES FREE
```

The directory listing format is similar to that produced by MS-DOS. The first line indicates the volume label given the disk. Next, files in the root directory of the disk are printed. The file name and its extension are followed by the file byte size and the file creation date and time. The time is printed in a 24 hour format.

The last line tells how many files are in the root directory and how much space, in bytes, is available on the disk. Bad disk sectors are considered not available.

SPECIFYING OUTPUT DEVICES

You may want to list a disk directory many times but will most likely use the same device each time.

To specify the output device you want a directory listing sent to, press **6** in response to the disk function prompt. The system acknowledges with the display,

T<6> DIRECTORY OUTPUT DEVICE

Press **ENTER** and the prompt becomes,

DIRECTORY OUTPUT DEVICE <1-3>? 1

You can now choose which output device your directory will be sent to. Press **MENU** and the printer list the choices:

<1> PRINTER
<2> PORT A
<3> PORT B

Choose the device you want by pressing the corresponding number key, and press **ENTER** again.

DELETE FILE(S)

This function allows you to selectively delete files on the disk.

To do so, enter the disk function menu from the main menu by pressing T, followed by **ENTER**, and then select function 2. The system will acknowledge with,

T<2> DELETE FILE(S)

Press the **ENTER** key. The display reads,

FILE NAME =

Enter the file name that you wish to delete.

This function supports 'wildcard' characters similar to those used in MS-DOS. Wildcard characters replace characters in a file name allowing multiple files, that fit the wildcard description, to be deleted at once.

These characters are:

/ Matches any one character in the file name or extension.

For example, to delete all DIF* files whose root names are three characters long, enter:

///.DIF

* Matches any number of remaining characters in the file name or root extension.

---

*DIF is a trademark of Lotus Development Corp.

For example, to delete all files whose names begi
with an A and whose extension begins with B,
enter:

A*.B*

These two wildcard characters can be used in combination as well. To delete all files whose root names are six characters long and end in YZ, enter:

////YZ.*

Key in the file name and press **ENTER**. The system will delete the requested files from the disk. When finished, the 2286 will return to the disk function menu prompt.

FORMATTING A DISK

When performed on a blank disk, this function simply prepares the disk to accept data. If a disk already contains data or program information, all existing files are erased when the disk is formatted. Make sure there's nothing on the disk you want saved before you format it.

To format a disk, insure that its write protect tab is in the unprotected position. Insert the disk into the microfloppy drive. Press 3 from the disk function menu. The prompt reads,

T<3> FORMAT DISK

Press **ENTER** and the display becomes,

REALLY FORMAT DISK <Y,N>? N

This step prompts the operator if a disk format is actually desired. This insures against accidental disk erasure. If the operator answers 'Y', the disk format proceeds.

The 2286 will display either:

FORMATTING HIGH DENSITY ...

or

FORMATTING LOW DENSITY ...

message depending on whether the microfloppy installed is high density or not.

The format process takes nearly two minutes to perform. The format may be aborted by pressing EXIT or by ejecting the disk from the microfloppy drive. Doing either will leave a partially formatted disk and can not be used until reformatted. The system returns to the disk function menu when the format is complete.

SAVING A PROGRAM ONTO DISK

This function allows you to save a configuration program onto a disk for future use. The program is written on the disk as a specific program file, and must be given a name at the time the save function is performed. This name should be recorded on the 2280 Series Programming Form for future reference.

When the entire configuration program on the Programming Form has been correctly entered into the 2286 memory, insert a properly labeled and formatted disk. The program can be saved onto disk by pressing 4 from the disk function menu. The display reads

T<4> PROGRAM SAVE

Then press **ENTER**. The display will prompt,

FILE NAME =

Enter the name you want the program file to be saved under on the disk. The ".PRG" extension is automatically assigned to the file name to identify it as a program file. Refer to the section titled, Disk File Names and Program Files, for information on naming your disk files.

When you've keyed in the program name press **ENTER.** The system will then write the entire configuration program onto the disk and, when it's finished, return to disk function menu. The disk can now be removed and stored, or used to configure any 2286 Data Logger.

Use the **EXIT** key to abort the save operation. Once aborted, the file should be deleted from the disk since it will be an incomplete configuration program.

LOADING A PROGRAM FROM A DISK

This function allows you to transfer an entire configuration program from a disk into the 2286 memory, thus preparing the Data Logger for data acquisition and processing.

First, retrieve the disk containing the desired configuration program, and insert it into the 2286. From the main menu prompt, access the disk function menu by pressing **T** and then **ENTER**.

Choose program load by pressing **5** in response to the disk function menu. The system acknowledges with the prompt,

T<5> PROGRAM LOAD

Press **ENTER** and the display reads,

FILE NAME =

Key in the name of the program file you wish to load into 2286 memory. Press **ENTER** and the 2286 will load that program from the disk. When finished, the system returns to the main menu prompt. The system is now programmed for data logging.

Use the **EXIT** key to halt the load operation. Using **EXIT** however, leaves you with a partially programmed instrument. You can erase this partial program by pressing the **E** key.

DISK FILE NAMES

There are a few rules to remember when naming disk files. The file name root must consist of from one to eight characters. You may use an optional extension name of three characters. If you use the three-character extension, you must separate it from the root with a period.

The following characters may be used in a file name:

Alpha characters A to Z (lower case characters are converted to upper case).
Numeric characters 0 to 9.
Special characters #%&@()-

The Data Logger will not allow a space or the following char to be used:

|<>\^+=/[]":;,?*$!{}'_`~

Some of the characters not allowed by the 2286 are vali MS-DOS file name characters, however, they are not available on the 2286 keypad. Be aware of this limitation when naming files on an IBM PC or compatible for use in the 2286.

Make each file name in the root directory unique.

If you enter an invalid file name, the 2286 will display the message "BAD FILE NAME." You will then have to edit and reenter the file name.

An example of a legal file name is: TEST1.DAT

DISK FILES

The 2286 microfloppy disk is MS-DOS compatible, however, the 2286 only uses the disk's root directory for file access. There are two files created and used by the 2286: program files and data files.

Program Files

Program files contain commands to configure the 2286 Data Logger to perform a pre-programmed task. These files contain only ASCII characters and can be viewed, printed, or edited. The program file is made up of short 2286 concise command strings surrounded by tags.

Concise commands consist of uppercase characters that function nearly identical to their corresponding 2286 front panel programming keys. These characters are documented in section 7 of this guide and will not be discussed here.

No carriage returns or line feeds are used when the 2286 stores its configuration program to its internal disk drive: it is stored as one long line. The Concise commands are surrounded with two tags. These tags are the lowercase 'y' and the lowercase 'z'. The 'y' identifies the beginning of a Concise command string, the 'z' identifies its end.

A 2286 program file can be created or edited with a text editor on IBM PC or compatible with a 3.5 inch microfloppy drive by users familiar with 2286 Concise commands. These files only have a few requirements:

- Proper Concise command syntax and 2286 programming procedures must be followed.
- All Concise command characters must be uppercase.
- No spaces are allowed except in labels, alarm messages, and channel procedures.

- A command string must be 80 characters, or less, in length.
- A command string must be surrounded by the tags described above or must end in a carriage return instead of using tags (line feeds are ignored). These characters are not included in the 80 character line length limit.
- A program file name must have the extension ".PRG" to be complete.

The best way to start a configuration program is with the Concise command string:

```
y!E,Y,!z   or   !E,Y,!<CR>
```

to erase the 2286 program memory before the new configuration program is loaded. The 2286 will warn if there are any illegal characters in the program file when it is loaded by displaying

UNEXPECTED CHARACTER FROM DISK

Data Files

The 2286 data files contain logged scan data. Like program files, data files contain only ASCII characters and can be viewed, printed, or edited. Two formats of data files can be written: 2286 format and Data Interchange Format (DIF).

Data Files -- 2286 Format

The 2286 format can be recorded on disk and has the same appearance that all 2286 scan data output devices record (as you would normally see it on the display or printer or as shown in the Output Format Examples at the end of this section). Data recorded in this file format is useful when no advanced data analysis is required. It is a comprehendable record of logged data and events.

The exact information recorded to the disk in this file format is user programmable using the Disk Data Format function menu in the Data Output Programming module (see section 3d of this guide). This menu offers: channel compression formats; data type indicators; channel readings per line; start of data character sequence; end of data character sequence; line termination character sequence; and scan headers.

Data Files -- DIF

The Data Interchange Format (DIF) was developed to allow different database and spreadsheet programs to share data. Programs that support DIF can usually read from and write to DIF files.

The 2286 Data Logger can write DIF files directly as scan data is recorded to its internal MS-DOS compatible microfloppy drive. This gives the 2286 user the ability to take a disk containing 2286 scan data and translate it directly into a database or spreadsheet file on a PC for further data analysis.

2286 data files being recorded in DIF store only the following information:

- begin scan date
- begin scan time
- scan group number
- channel values

The following information is not recorded:

- channel number
- channel label
- channel units
- alarm messages
- end scan time
- scan stopped time
- start of data characters
- end of data characters
- line termination characters

Using DIF file format therefore makes the user programmable Disk Data Format selections irrelevant.

DIF files contain strictly ASCII characters and therefore can be viewed, printed, and edited. However, the format in which the data is stored may not be useful or understandable to the 2286 user.

Data Files -- Selection

The 2286 will record scan data on the disk in DIF format by default. 2286 disk data files that are written in DIF are stored with a '.DIF' extension on the file name. If you do not specify an extension for a data file name, the 2286 will appended the '.DIF' extension and the data will be recorded in DIF.

To store data on the disk in 2286 format, a file name with an extension other than '.DIF' must be entered when the scan is initiated. Just specifying the '.' after a file name root is adequate.

USING DIF FILES

DIF files are organized for use with row and column application programs. The 2286 DIF data files may be thought of as organized into 1503 columns and an unspecified number of rows.

DIF Data File Columns

The first and second columns in a 2286 DIF data file contain the scan date and time, respectively. The third column contains the scan group number for which the scan took place. The remaining 1500 columns contain the channel values for channels 0 through 1499 in that order.

Refer to Figure 6-1 as an example of column organization (this is NOT what the actual DIF data file looks like).

```
  scan       scan    scan group
  date       time      number  ch.0    ch.1   ch.2   ch.1499
--------------------------------------------------...-----
17-MAY-90 12:05:38       2     14.02   NA    .00719   0
17-MAY-90 12:05:48       2     13.99   NA    .00721   1
17-MAY-90 12:05:58       2     13.99   NA    .00727   3
17-MAY-90 12:06:08       2     14.05   NA    .00720   5
```

Figure 6-1. 2286 DIF data file column organization

Since readings are put into columns corresponding to channel numbers, some type of 'column filler' must be used. For example, in Figure 6-1 channels 0 and 2 are programmed in scan group 2 but, channel 1 is not. In order to enter channel 2 into the proper column (and all remaining channels in the scan group), channel 1 must be 'filled'. The column is assigned the DIF data type NA for 'Not Available'. Columns after the last channel in a scan group are not assigned NA nor is there any need since there is no more data entered in that row.

The necessity of using NA in 2286 DIF data files requires the 2286 user to choose channel numbers for use in a scan group, whose output includes the microfloppy disk, with care. For example, a scan group is defined to output a single channel reading to the disk. The scan is started and the file name TEST1 is entered. Since no file name extension was specified, the file is recorded on disk as TEST1.DIF, a DIF data file.

If the channel number in the scan was channel 1499, the DIF data file will record channels 0 through 1498 as NA in order to record the single reading on channel 1499. This is very inefficient as 1,499 useless channel entries must be written on the disk, wasting much disk space, and creating enormous databases or spreadsheets for just one channel.

At the other extreme, if the channel number in the scan was channel 0, there would be no need to record any channels as NA, allowing space for many more scans to to be recorded on the disk as well as database and spreadsheets no larger than necessary. Of course, choosing a channel number anywhere between 0 and 1499 will yield varying levels of DIF efficiency.

In general, keep channel numbers being recorded to disk in DIF data files as close to channel 0, and as close together, as possible.

Many databases and spreadsheet programs support less than 1503 columns. A data logging application may require less channels than the number of columns a user's program supports. In this case, as long as the highest channel number recorded to disk is three less than the columns supported (allowing for scan date, time, and group number), all information in the DIF data file can be read by the program.

Another way to read more columns than the database or spreadsheet program supports is to swap the rows and columns of the DIF data file when it is translated by the program. Many programs support this feature when translating DIF files.

DIF Data File Rows

Each row recorded in a 2286 DIF data file contains the data from an individual scan. There is no maximum number rows allowed, however, the number of rows that will fit on one disk will depend on the number of channels scanned, the channel number sequence (as described above), and the space available on the disk when the scan was started. Also, database and spreadsheet programs have a maximum number of rows they can support.

DATA TRANSFER OPERATION

The data transfer function allows you to transfer a data or program file from one of three source devices:

- Parallel I/F programmed as a mag tape at port A.
- Parallel I/F programmed as a mag tape at port B.
- Disk drive

If the disk is selected as the source device, you need to input the specific name of the file to be transferred. If the file is a data file, the logged data recorded within a time window may be singled out later for transfer.

If you choose not to enter specific start and stop times for a data transfer (when the disk is the source device), then all of the data in the file is transferred. The data transfer function continues until completed, or until the EXIT key is pressed. When you are transferring a program file, start and stop times are not relevant.

To start a data transfer procedure, press the **D** (DATA TRANSFER) key in response to the main menu prompt. The system acknowledges with the prompt,

<D> TRANSFER DATA

Press the **ENTER** key and the display becomes,

D: SOURCE DEVICE <1-3>? 1

You can now choose which of the three possible source devices you intend to use. Pressing the **MENU** key will show that the three choices are,

<1> DISK

<2> PORT A

<3> PORT B

Choose the desired source device by pressing the appropriate number key. The display then shows the choice taken.

Port A or B as Source Device

If port A or B is chosen as the source device, press the **ENTER** key. The choice is then stored, and the displayed prompt is,

D: DESTINATION DEVICE <1-3>? 1

Pressing the MENU key shows that the three possible destination devices are,

<1> PRINTER

<2> PORT A

<3> PORT B

Choose the device you want by pressing the appropriate number key, followed by **ENTER**. The 2286/5 will begin transferring data from the source to the destination device until all data is transferred, or until the exit key is pressed. The main menu prompt will be displayed when it's finished.

Disk As Source Device

If the disk is chosen as the source device, press the **ENTER** key and the prompt asks for the file name. Enter the file name that represents the desired data on the disk. When you've correctly typed it in, press **ENTER**. The prompt becomes,

BEGIN AT: 01 JAN 00

If the complete data file is to be transferred, press **ENTER** for the current prompt and next three prompts. The prompts are,

BEGIN AT: 00:00:00

END AT: 31 DEC 99

END AT: 23:59:59

If only a portion of the data file is to be transferred, edit the begin and end times in the preceding prompts. Only those scan groups with a begin date and time between the edited begin and end dates and times will be transferred. If a file contains a saved program then the begin and end times will have no effect.

When the desired **END AT: <time>** is displayed, press **ENTER**. The parameter is then programmed, and the file is searched for on the disk. When the file is found the prompt becomes,

D: DESTINATION DEVICE <1-3>?

Choose the destination device now according to the previous instructions.

OUTPUT FORMAT EXAMPLES

Measurement data generated during a scan sequence can be sent to the front panel display, internal printer, disk drive, or to an external data recording device or computer using an RS-232 or IEEE-488 interface installed in port A or B.

With the exception of a disk DIF data file, the data formats for the recording devices are very similar. An example of the output format is shown below.

```
Line        Output
Number

1
2
3     BEGIN SCAN GROUP 1   01 JAN 82   12:28:51
4     ENGINE PERFORMANCE TEST
5
6     C   1 RUN SPEED          750.3 RPM     ALM
7     RPM TOO LOW
8     C   2 EXHAUST MAN        390.3 DEGREES C
9
10    END SCAN GROUP 1     01 JAN 82   12:28:54
```

This format is determined by the disk, or port A or B data format selections made in output device programming. The components of this output are further explained in the following table.

In all lines, the following conventions are used:

- (lts) is used to represent the output of the programmed line termination sequence. The default is carriage return followed by line feed.
- The symbols H, B, C, A, and E are the data type indicators and will be output if the recording of data type indicators has been enabled.
- (sods) represents the start of data sequence. The defaults is none programmed.
- (eods) represents the end of data sequence. The default is none programmed.

Line Number	Output and Explanation
1	**H(lts)**
	(blank line)
2	**H(lts)**
	(blank line)
3	**(sods)BBEGIN SCAN GROUP n dd mmm yy hh:mm:ss(lts)**

If (sods) is programmed, it will be output at the beginning of each BEGIN SCAN line.

Line Number	Output and Explanation
4	**H(scan group label)(lts)**

This line will be output if a scan group label has been programmed.

5	**H(lts)**
	(blank line)
6	**CCnnnn label .... -x.xxxx units ALM(lts)**

This is a channel reading. The characters ALM will be recorded at the end of the line if any of the channels limits have been exceeded. This line, and the one following (if appropriate) will be recorded for each channel in the scan group's channel list.

7	**A(channel alarm message)(lts)**

This line is output if a limit (with programmed alarm message) is exceeded.

```
   8      CCnnnn label ....
          -x.xxxx units ALM(lts)

              (another channel reading)

   9      H(lts)
          (blank line)
  10      EEND SCAN GROUP n
          dd mmm yy hh:mm:ss(lts)(eods)
```

The last line of a scan group output. If (eods) is programmed, it will be output last.

Section 7

Programming and Operation From a Terminal or Computer

CONTENTS

INTRODUCTION

Once you've become comfortable programming and operating the 2286/5 Data Logger from the front panel keypad, it will be easy to carry the same principles over to a situation where the Data Logger is controlled from a terminal or a computer. The commands used to program and operate the Data Logger from remote are nearly identical to those used from the front panel keypad.

REQUIRED HARDWARE

Remote control of the 2286/5 Data Loggers can be accomplished using either serial or parallel communication.

The RS-232 Interface (Option -341) provides an RS-232 capability in addition to 20 mA current loop. The IEEE-488 Interface (Option -342) is the parallel interface.

The interface option used for remote control must be installed in the port A position; the port B position is used for data output only. Port A is the vertical slot closest to the center and furthest away from the power supply when viewed from the rear of the instrument.

FRONT PANEL AND REMOTE CONTROL

The 2286/5 can be programmed and operated from the front panel keyboard or from a terminal or computer. Front panel operation is referred to as **local control** and terminal or computer operation is referred to as **remote control**. The 2286/5 can successfully be operated either locally or in remote but not by a mixture of both modes. Therefore, we must have some means of establishing and controlling whether the Data Logger is to respond to local or remote commands.

Figure 7-1 presents an overview of the remote-local state transitions. When the 2286/5 is initially turned on it enters the local state and the front panel keypad is used to program or operate the instrument. If remote control is desired, you need to switch the instrument from the local state to remote, or to the remote with lockout state. The method of causing this change to occur depends on the type of interface used.

```
              +---------+                     +--------------+
              |         |-------------------->|              |
power on ---->| local   |<--------------------| remote       |
              | state   |<--------------------| state        |
              +---------+                     +--------------+
                        ^                            |
                        |                            |
                        +---------+  +---------------+
                                  |  |
                                  |  v
                         +---------------+
                         |               |
                         | remote with   |
                         | lockout state |
                         +---------------+
```

Figure 7-1 General Remote-Local State Diagram

With the RS-232 interface non-printing control characters, control-W, control-X, control-Y and control-Z are used. The IEEE-488 communication standard directly supports the remote-local state changes using messages defined within the standard.

In the local state, control of the instrument is through the front panel keyboard. The remote state allows control of the instrument from the computer or terminal connected at port A. All programming and operation of the 2286/5 is done using the terminal or the computer and most front panel controls are inoperative.

When the 2286/5 first enters the remote state, the front panel display will read,

IN REMOTE

While in remote, the LED indicator on the LOCAL key is illuminated and it becomes the only operative front panel key. Pressing LOCAL returns control of the instrument to the front panel keyboard. If any other key is pressed the internal beeper sounds three times to indicate that the key is inoperative.

The remote with lockout state is very similar to the remote state except that the LOCAL key also becomes inoperative. Control of the 2286/5 cannot be taken away from the terminal or computer using the front panel keypad. If LOCAL is pressed while the 2286/5 is in remote with lockout, the front panel display will read,

IN REMOTE WITH LOCKOUT

When local is entered again and control is returned to the front panel keypad, the light indicator on the LOCAL key is extinguished. If the keyswitch is in the PROGRAM position, the message,

MAIN MENU CHOICE <M FOR MENU>? A

appears on the display. If the keyswitch is in the RUN position, the display reads,

SELECT RUN MODE OPERATION

When control is returned to local, front panel operations and programming begin at the first menu regardless of the menu that was active when the return to local took place. This is also true when entering the remote state. Remote is entered at the main menu regardless of what menu level was active.

When the terminal or computer puts the 2286/5 into the remote control state the output timeout function for port A is disabled. Timeouts are described in Section 3 of this guide.

Programming and operating from remote using an RS-232 terminal or computer, or an IEEE-488 computer are described in detail in the following paragraphs.

PROMPTING AND CONCISE COMMAND MODES

There are two modes of remote control available with the 2286/5 Data Loggers. One, called concise command mode, is used when the instrument is controlled using a computer. The other, called prompting mode, is used when the instrument is controlled using a terminal.

Concise mode involves the computer sending a string of characters to the 2286/5 to perform some function, and then reading back a response from the 2286/5 indicating whether the command was successful or not.

The following example illustrates that to program 2286/5 channel 100 to the 512 mV range, the computer would send the character string,

```
!A,100,P,D,3,!<carriage return>
^^^ ^ ^^^^^^^^  ^
||| | ||||||||  |
||| | ||||||||  +- terminate the command
||| | |||||||+---- return to main menu
||| | ||||||+----- ENTER key
||| | |||||+------ 512.00 MVDC range
||| | ||||+------- ENTER key
||| | |||+-------- DC RANGE
||| | ||+--------- ENTER key
||| | |+---------- PROGRAM the channel
||| | +----------- ENTER key
||| +------------- channel 100
||+--------------- ENTER key
|+---------------- select CHANNEL PROGRAMMING
+----------------- return to the main menu
```

When received, the 2286/5 responds with the string,

:<lts>

where <lts> is used to indicate the programmed line termination sequence programmed for port A.

The prompting mode is very similar to front panel operation. All prompts and menu listings normally sent to the front panel are sent instead to the terminal.

For example, to program 2286/5 channel 100 to the 512 mV range, you would type the characters in response to the prompts appearing on the terminal as follows.

Terminal Prompt	**Character(s) Typed**
MAIN MENU CHOICE <M FOR MENU>? A	A
<A> PROGRAM A CHANNEL OR BLOCK	<return>
CHANNEL NUMBER (OR BLOCK) = C0	100<return>
PROGRAM COPY DELETE OR LIST<P,C,D,L>? P	P<return>
A: CHANNEL FUNCTION <A-Z>? P	D
A<D> DC VOLTS/CURRENT	<return>
AD: DC RANGE <1-5>? 1	3
AD<3> 512.00 MVDC	<return>
AD: CHANNEL MENU CHOICE <1-5>? 1	^
A: CHANNEL FUNCTION <A-Z>? D	^
CHANNEL NUMBER (OR BLOCK) = C100	^
MAIN MENU CHOICE <M FOR MENU>? A	

If you're using a computer for remote control you'll want to use the concise command mode. Use the prompting mode when the 2286/5 is programmed and operated interactively using a terminal. These operating characteristics are explained in more detail further on in this section of the manual.

The prompting mode is only available using the RS-232 Interface. The IEEE-488 Interface does not provide prompting mode.

More on Concise Commands

The following paragraphs describe concise command mode operation. They should be read and understood before you start programming a computer to control the 2286/5 from remote. The material is of a reference nature so skip ahead if you're reading this just to gain overall familiarity with the 2286/5's remote operation.

Concise command strings consist of a sequence of characters that are equivalent to keys that would be pressed on the 2286/5 front panel keypad to perform a particular programming or operating function. For example, the concise command for front panel keys,

L ENTER E ENTER would be, **L,E,<cr>**

with <cr> being the carriage return character.

A concise command must end with a carriage return and optional line feed character. The 2286/5 doesn't begin execution of the concise command until the carriage return is received. Within a concise command, the command character ' , ' is synonymous with the front panel ENTER key.

During execution of concise commands, all characters sent from the computer or terminal are discarded. The computer must wait for the current concise command to complete before sending another command. The device clear and return to local single character commands are exceptions to this--they can both be sent from the computer at any time.

After a concise command has completed, a colon ':' character followed by the programmed line termination sequence is sent to the computer to indicate that the command has completed. This informs the computer that the next command can be sent. The colon character followed by the programmed line termination sequence is referred to as the command completion prompt.

When an error is detected during the execution of a concise command, the remainder of the command string is discarded. One or more error messages (lines of text terminated with the programmed line termination sequence) will be sent to the computer before the command complete prompt.

A concise command may be aborted at any time. A command in execution or a command only partially sent from the computer can be aborted by sending a device clear, or by performing a remote control to local control change.

There is no command completion prompt sent if the command is aborted. However, it's possible the device clear or remote-local change was sent just after the completion of the concise command. In this case the completion prompt may have been sent but not yet received by the computer. Therefore, your computer program must be prepared to receive some or no characters if a command is aborted while in execution. Also, note that the command will have been executed to the point where the command was aborted.

Concise command strings have a maximum length of 80 characters. If more than 80 characters are received before the command ending carriage return character, the command will be discarded, an error reported (?COMMAND TOO LONG), and the command completion prompt sent. The error message and completion prompt is sent after the command ending carriage return character is sent by the computer.

Sending the '$' character to the 2286/5 when in the concise command mode (RS-232 Interface only) also aborts the command. The concise command mode is automatically enabled when the remote state is entered.

Character Set

Commands used in programming or operating the 2286/5 from a terminal or computer are very similar to the commands typed on the front panel keypad. For example, the terminal or computer sending the ASCII character 'A' to the 2286/5 is the same as depressing the 'A' key on the front panel keypad. Most keys on the front panel keypad have a one for one equivalence to ASCII characters. The front panel keys labeled SCAN, SINGLE SCAN, MONITOR, and PLOT don't have direct equivalent ASCII characters.

Table 7-1 identifies the relationship between front panel keypad labels and ASCII characters. The end of the table has some additional characters that are meaningful when controlling the 2286/5 from a terminal or computer. These characters are included in the table for reference and are explained in greater detail in the following paragraphs.

Table 7-1 ASCII Character Equivalents for Front Panel Keyboard Keys and Other Important Codes

2286/5 Keyboard Key (or Function Performed)	ASCII	Decimal Code
SPACE	SPACE	32
*	*	42
+	+	43
-	-	45
/	/	47
0 through 9	0 through 9	48 through 57
=	=	61
A through Z	A through Z	65 through 90
SCAN	&	38
SINGLE SCAN	#	35
PLOT	;	59
MONITOR	%	37
ACK	@	64
EXIT	^	94
CLEAR	\	92
Up Arrow	[	91
Down Arrow	]	93
Left Arrow	<	60
Right Arrow	>	62
ENTER	<return> (Prompting)	13
	, (Concise)	46
DELETE CHARACTER	DEL	127
Return to Main Menu	!	33
Send System Status	"	34

Special Characters Used With RS-232

Several characters are required to program and operate the 2286/5 using the RS-232 option that don't appear on the instrument front panel. These characters are listed in table 7-2. Uses of most of the special characters are described later in this section.

Two of the characters, Control-S and Control-Q, allow the computer or terminal to pause and continue the output of data from the 2286/5 RS-232 interface. This flow control capability can be used by the computer to temporarily stop the 2286/5 from sending data if the 2286/5 is sending data too fast.

Table 7-2. RS-232 Special Command Characters

2286/5 Function Performed	Equivalent ASCII Character	Decimal Code
Enter Prompting Mode	$	36
Send System Status	"	34
Device Clear	Control-C	3
Local to Remote	Control-X	24
Remote to Local	Control-Y	25
Remote to Local	Control-Z	26
Remote to Remote With Lockout	Control-W	23
Remote With Lockout to Local	Control-Z	26
Stall data output	Control-S	19
Unstall data output	Control-Q	17

PROGRAMMING/OPERATING WITH AN RS-232 TERMINAL

Getting Started

It'll be easier for you to become familiar with programming and operating the 2286/5 from an RS-232 terminal if you take the steps described in the paragraphs below. First of all, verify that the 2286/5 can communicate with your terminal.

1. Make certain the RS-232 Interface (Option-341) is installed in the port A position. This is the vertical slot nearest the center of the Data Logger when viewed from the rear.

2. Connect a cable between the RS-232 connector on the port A RS-232 Interface and your terminal.

3. Next, turn on the 2286/5 and set the front panel keyswitch to the PROGRAM position. Using the output device programming module, program the baud rate and parity of port A to match your terminal settings. The 2286/5 sends and receives seven data bits and one parity bit. If no parity is selected the parity bit position is always sent as zero.

4. Type a SPACE character and look for:

   ```
   ?TYPE CTRL-X FOR REMOTE CONTROL
   ```

   If no message appears, your cable probably isn't making the proper connections between the terminal and the RS-232 Interface. The problem is usually solved by swapping pins 2 and 3 (data transmit and receive) on one of the cable ends. If some other message appears (usually nonsense character sequences) the baud rate of the terminal and the 2286/5 are probably different and need to be corrected. Once you can get the above message displayed you're ready to proceed.

Remote Access and Lockout

To program or operate the 2286/5 from a terminal the terminal first has to gain control of the Data Logger. As shown in the RS-232 remote/local state diagram (Figure 7-2), the terminal sends the Control-X character to put the instrument into remote. This makes all keys on the 2286/5 front panel inoperative except the LOCAL key.

While in the remote state, press the front panel LOCAL key to override the terminal and return programming and operating control to the front panel keypad. The remote-local state diagram shows what characters need to be typed from the terminal to move from the remote with local lockout state and cause other state transitions.

```
              +---------+                    +--------------+
              |         |--- Control-X ----->|              |
power on  --->| local   |<-- Control-Y ------| remote       |
              | state   |<-- Control-Z ------| state        |
              |         |<-- Front Panel ----|              |
              +---------+    LOCAL Key       +--------------+
                      ^                         |
                      |                         Control-W
                      +---- Control-Z -------+  |
                                             |  |
                                             |  v
                                 +---------------+
                                 |               |
                                 | remote with   |
                                 | lockout state |
                                 +---------------+
```

Figure 7-2 RS-232 Remote-Local State Diagram

As an example, turn the 2286/5 keyswitch to the PROGRAM position and type the SPACE character on your terminal. Your terminal screen will read,

?TYPE CTRL-X FOR REMOTE CONTROL

and the front panel display on the Data Logger will read,

MAIN MENU CHOICE <M FOR MENU>? A

Type Control-X from the terminal. The 2286/5 display will now show,

IN REMOTE

You've successfully entered the remote state. Now type Control-Y or Control-Z. The 2286/5 display reads,

MAIN MENU CHOICE <M FOR MENU>? A

You've successfully returned control of the 2286/5 to th front panel keypad.

Entering the Prompting Mode

Once you've changed programming and operation control of the 2286/5 from the front panel to the terminal by typing Control-X, the next step is to put the Data Logger into the prompting command mode. This allows the 2286/5 to be programmed and operated in very nearly the same way as it is operated from the instrument front panel.

When the Data Logger first enters the remote state the command mode defaults to concise mode. To enter the prompting mode, type the dollar sign ($) character. The terminal screen should display the message,

```
MAIN MENU CHOICE <M FOR MENU>? A
```

Now programming and operation can proceed in the same fashion as front panel keypad operation. All menus requested while in the prompting mode are sent to the terminal instead of the 2286/5 printer. A useful feature for beginning programmers is the auto menu enable. This displays the current menu each time a new set of menu choices are available. Table 7-1 is a handy reference to determine what keys on your terminal access 2286/5 functions.

Special Commands

There are two commands available through RS-232 remote terminal programming and operation that are not accessible through the 2286/5 front panel keypad.

STATUS COMMAND (")

The status command causes the 2286/5 to send information indicating what operating modes are currently active. You can see which of these are active when operating from the front panel by looking at the corresponding light indicators on the SCAN, SINGLE SCAN, PLOT, MONITOR, and ACK keys.

The status command consists of the double quote character '"'. It is recognized by the 2286/5 when the system is at at the main menu only. When the command is sent from the terminal, the 2286/5 sends a single character followed by the line termination sequence programmed for the port A device. The single character will be coded as follows.

(least significant bit)	**bit 0**	**always a 1**
	bit 1	**ALARM indicator (ACK key)**
	bit 2	**MONITOR indicator**
	bit 3	**PLOT indicator**
	bit 4	**SINGLE SCAN indicator**
	bit 5	**SCAN indicator**
	bit 6	**always a 1**
(most significant bit)	**bit 7**	**always a 0**

The bit positions corresponding to the indicator are a one when the indicator is on and a zero when it's off. The resulting character value will be somewhere in the range from decimal 65 (hex 41) to decimal 127 (hex 7F).

DEVICE CLEAR COMMAND (Control C, decimal value 3)

The device clear command provides a mechanism to reset the 2286/5 to a known condition. This command can be issued at any time; it's not a main menu command. The device clear is a single Control-C character.

When the 2286/5 receives the device clear it,

1. Turns off scanning, plotting, single scan, and monitor.

2. Aborts any auxiliary function such as list, data transfer, load, and save.

3. Turns off the ALARM LED.

4. Resets all status outputs and analog outputs to their power up conditions.

5. Returns to the MAIN MENU CHOICE <M FOR MENU>? A or SELECT RUN MODE OPERATION prompt.

PROGRAMMING/OPERATING WITH AN RS-232 COMPUTER

Getting Started

The first thing you want to accomplish when using a computer to control the 2286/5 from remote is to ensure that the computer and the 2286/5 can exchange characters using their RS-232 interfaces. Perform the following steps to verify that the computer and the 2286/5 work together.

1. Make sure that the RS-232 Interface is installed in the port A position. This is the vertical slot nearest the center of the Data Logger as viewed from the rear.
2. Connect a cable between the RS-232 connector on the port A RS-232 option and your computer or modem.
3. Next, turn on the 2286/5 and turn the keyswitch to the PROGRAM position. Using the output device program module, program the baud rate and parity of port A to match the setting of your computer interface. The 2286/5 sends and receives seven data bits and one parity bit. If no parity is selected the parity bit position is always sent as zero.
4. Write a short program on your computer that sends a character to the 2286/5. Have the program send a Control-X (decimal value 24) to the 2286/5.

5. Verify that the 2286/5 front panel displays the message,

   IN REMOTE

   If this prompt isn't displayed the cables probably aren't properly connected between the computer and the RS-232 Interface. The problem is almost always solved by swapping pins 2 and 3 (data transmit and receive) on one of the cable ends. You may want to double check the baud rate settings too.

   Once you get the above message displayed you have verified the ability of the 2286/5 to receive characters sent from the computer.

6. Turn the 2286/5 power switch off, then on, or press the LOCAL key on the front panel keypad. This puts the instrument back into the local state.

   Write a short program on your computer that will receive a character from the 2286/5. Using it and the program from step 4, send a Control-X character and then a carriage return character to the 2286/5, and then read the characters from the 2286/5. The 2286/5 will send,

   :<lts>

   to the computer where <lts> is the line termination sequence for port A. If you haven't reprogrammed the line termination sequence it will consist of the two character default value which is the carriage return character followed by the line feed character.

   When the above steps are successfully completed, you've demonstrated that the computer can receive characters from the 2286/5.

Remote Access and Lockout

Operations required for a computer to take control of the Data Logger are identical to those used when a terminal is controlling the 2286/5. These steps are summarized in Figure 7-3.

Most state transitions are caused by single characters sent from the computer to the 2286/5. The front panel LOCAL key can be used to move from the remote state to the local state. The 2286/5 does not send any characters in response to receiving these single character commands.

```
             +---------+                    +--------------+
             |         |--- Control-X ----->|              |
power on --->| local   |<-- Control-Y ------| remote       |
             | state   |<-- Control-Z ------| state        |
             |         |<-- Front Panel ----|              |
             +---------+    LOCAL Key       +--------------+
                       ^                        |
                       |                        Control-W
                       +---- Control-Z -------+ |
                                              | |
                                              | v
                                        +---------------+
                                        |               |
                                        | remote with   |
                                        | lockout state |
                                        +---------------+
```

Figure 7-3 RS-232 Remote-Local State Diagram

Concise Command Strings

When a computer is used to control the 2286/5, concise commands should be used. The detailed description of the concise command mode operation that appears earlier in this section should be read before you begin writing computer programs to control the 2286/5.

Special Commands

There are two commands available through RS-232 remote computer programming and operation that are not accessible through the 2286/5 front panel keypad.

STATUS COMMAND ("<carriage return>)

The status command causes the 2286/5 to send information indicating what operating modes are currently active. From the front panel you can see which of these are running by looking at the corresponding light indicators on the SCAN, SINGLE SCAN, PLOT, MONITOR, and ACK keys.

The status command consists of the double quote character (") followed by the carriage return character. It's recognized by the 2286/5 at the main menu only.

When the command is sent from the computer, the 2286/5 sends a single character followed by the line termination sequence programmed for the port A device and the ':', followed by the line termination sequence, to indicate the completion of the concise command. The single character containing the status information are coded as follows.

(least significant bit)	bit 0	always a 1
	bit 1	ALARM indicator (ACK key)
	bit 2	MONITOR indicator
	bit 3	PLOT indicator
	bit 4	SINGLE SCAN indicator
	bit 5	SCAN indicator
	bit 6	always a 1
(most significant bit)	bit 7	always a 0

The bit positions corresponding to the indicator are a one when the indicator is on and a zero when it's off. The resulting character value will be somewhere in the range from decimal 65 (hex 41) to decimal 127 (hex 7F).

DEVICE CLEAR COMMAND (Control C, decimal value 3)

The device clear command provides a mechanism to reset the 2286/5 to a known condition. This command can be issued at any time--it's not a main menu command. The device clear is a single Control-C character. There's no response from the 2286/5 to the device clear command.

When the 2286/5 receives the device clear it,

1. Turns off scanning, plotting, single scan, and monitor.
2. Aborts any auxiliary function such as list, data transfer, load, and save.
3. Turns off the ALARM LED.
4. Resets all status outputs and analog outputs to their power up conditions.
5. Returns to the MAIN MENU CHOICE <M FOR MENU>? A or SELECT RUN MODE OPERATION prompt.

Programming Examples

The following program is written in BASIC to run on either the Fluke 1720A or the 1722A Instrument Controller. Translation of the program to run on any computer is easily accomplished.

ERASING PROGRAM MEMORY

This sample program puts the 2286/5 into remote, erases program memory, and then returns control to the front panel.

```
10  ! open rs-232 port KB1 on the 1720 or 1722 for output
20  ! to the 2286/5
30  OPEN "KB1:" AS NEW FILE 1%
40  !
50  ! open rs-232 port KB1 on the 1720 or 1722 for input
60  ! from the 2286/5
70  OPEN "KB1:" AS OLD FILE 2%
80  !
90  ! put the 2286/5 into the remote state by sending a
100 ! a Control-X character (decimal 24) and an
110 ! unstall character (decimal 17).
120 PRINT #1%, CHR$(24%); CHR$(17);
130 !
140 ! send the concise command to the 2286/5
150 ! followed by a carriage return
160 PRINT #1%, "!E,Y,!"
170 !
180 ! read the response to the command
190 INPUT LINE #2%, R$
200 !
210 ! if this is not the last line of the command
220 ! response, read more lines until we encounter the
230 ! one starting with the colon character
240 IF INSTR(1%, R$, ":") <> 0) THEN GOTO 280
250 PRINT "IMPROPER RESPONSE:"; R$
260 GO TO 180
270 !
280 ! return control to the front panel keypad
290 ! by sending a Control-Z character (decimal 26).
300 PRINT #1%, CHR$(26%);
310 !
320 END
```

PROGRAMMING A SCAN GROUP

Programming a scan group is a simple extension of the above program. If you wanted a scan group with the following attributes,

Scan Group Number: 0
Channel List: 0..99
Trigger Mode: Interval
  10 second period
Data Output: Disk
  all data

You can program this scan group by replacing line 130 of the sample BASIC program with the line,

```
130 PRINT #1%,"!K,0,P,2,C0..99,,3,2,00:00:10,4,3,2,!"
```

PROGRAMMING A CHANNEL

Programming a channel is straight forward also. To program channel 0 as a current input with the measurement scaled such that a 4mA input will be recorded as 0.0 and a 20mA input as 500, with engineering units of PSI, replace line 130 of the previous sample program with the line,

```
130 PRINT #1%,"!A,0,P,D,5,2,PSI,3,CX*31.25-125,!"
```

TRANSFERRING DATA RECORDED ON DISK

To transfer recorded data on the disk, a program must perform the following steps.

1. Send the command to the 2286/5 to initiate the data transfer. The command will be something like,

   **!D,1,<file name>,<start date>,<start time>,
   <end date>,<end time>,2,!<carriage return>**

   where <file name> is the name of the file to be transferred, and the <start ...> and <end ...> are sent if only a portion of the recorded file is to be transferred. All the comma characters must be included in the command. This initiates the transfer of data.

2. Read the data back a line at a time.

3. Read data lines until a line beginning with the ':' character is encountered signifying the completion of command execution.

COLLECTING DATA FROM A SINGLE SCAN

It's a little more involved to collect data output to port A from a single scan. First of all, the scan group must be programmed (from either the front panel or from remote) to output data to port A. Then the remote computer program must perform the following steps.

1. Start the single scan. The following command string starts a single scan on group 0.

```
!#0,!<carriage return>
```

2. Read back the command completion prompt from the above command. If no errors were encountered, it will be the string,

```
:<lts>
```

3. Now read the data from the single scan. Read lines one at a time. The last line of the scan group output data will be of the form,

```
STOPPED SINGLE SCAN    0 JAN 00   00:00:00
```

   Your program must look for a string starting with 'STOPPED SINGLE' in each of the lines of data and stop reading data when this line is encountered.

Programming Hints and Suggestion

START AND COMPLETE EACH COMMAND AT THE MAIN MENU

To avoid confusion regarding menu position, it's best to always begin and end each command execution at the main menu. Each command should have the following general format.

! <command characters> !<carriage return>

As an example, the character sequence,

!E,Y,!<carriage return>

will erase the program memory within the 2286/5. The first and the last '!' characters returns programming to the main menu.

DON'T EXECUTE THE DIAGNOSTICS FROM REMOTE

The system diagnostics were designed to work from the front panel only and they won't work properly if executed from remote.

PROGRAMMING AND OPERATING WITH AN IEEE-488 COMPUTER

Getting Started

First, when using a computer to control the 2286/5 from remote, ensure that the computer and the 2286/5 can exchange characters using their IEEE-488 interfaces. Perform the following steps to verify that the computer and the 2286/5 work together.

1. Make sure that the IEEE-488 Interface (Option -342) is installed in the port A position. This is the vertical slot nearest the center of the Data Logger as viewed from the rear.

2. Select the IEEE-488 bus address for the 2286/5 by positioning the thumbwheel switches on the rear panel of the IEEE-488 Interface.

3. Connect a shielded IEEE-488 cable between the IEEE-488 connector (port A) and your computer.

4. Next, turn the keyswitch to the PROGRAM position.

5. Write a short program on the computer putting the 2286/5 into remote. The program needed to do this depends on the computer you're using. For example, if you were using the Fluke 1720A or 1722A Instrument Controller the BASIC statement,

```
10 REMOTE @2%
```

   puts the IEEE-488 instrument with bus address 2 into the remote state.

6. The 2286/5 front panel display should read,

```
IN REMOTE
```

   With this message, you've demonstrated that the computer used can communicate with the 2286/5.

IEEE-448 Functional Capabilities Supported

The 2280A-342 IEEE-488 interface supports the following IEEE-488 functional subsets when installed in the port A position.

SH1	Source Handshake	complete capability
AH1	Acceptor Handshake	complete capability
T5	Talker	talk only included
TE0	Extended Talker	no capability
L4	Listener	no listen only
LE0	Extended Talker	no capability
SR1	Service Request	complete capability
RL1	Remote/Local	complete capability
PP0	Parallel Poll	no capability
DC1	Device Clear	complete capability
DT0	Device Trigger	no capability
C0	Controller	no capability

Concise Command Strings

Use concise commands when a computer is used to control the 2286/5. Read the detailed description of concise command mode operation found earlier in this section before you begin writing computer programs to control the 2286/5.

IEEE-488 Unique Commands

There are several concise commands that pertain to IEEE-488 operation only. These are,

Command	Function
?ER	Send Error Status Data Logger
?ID	Send Data Logger Model Name and Software Version
?AD	Enable SRQ Generation on Data Ready
?DD	Disable SRQ Generation on Data Ready
?AA	Enable SRQ Generation on an Alarm Condition
?DA	Disable SRQ Generation on an Alarm Condition
?AS	Enable SRQ Generation on Single Scan Complete
?DS	Disable SRQ Generation on Single Scan Complete
?AX	Enable SRQ Generation on All Events
?DX	Disable SRQ Generation on All Events
?ST	Send Data Logger Status
?TC	Set Carriage Return as Terminator
?TL	Set Line Feed as Terminator

Following are complete descriptions of each command. "Command" identifies the sequence of characters that must be sent to the 2286/5 to execute the command.

"Response" indicates what characters the 2286/5 will send when the command completes execution. In each paragraph, <lts> is used to represent the line termination sequence of characters programmed for port A and <cr> represents the carriage return character.

Send Error Status

```
Command:      ?ER<cr>
Response:     <status byte><lts>:<lts>
```

Sends a status character containing the same information as the IEEE-488 status byte that can be read using an IEEE-488 serial poll. Table 7-4 identifies the coding of the status character.

Send Data Logger Model Name and Software Version

```
Command:       ?ID<cr>
2286 Response: 2286<model designator><space>
               V<version string><lts>:<lts>
2285 Response: 2285<model designator><space>
               V<version string><lts>:<lts>
```

This command reports the version number of the 2286/5 mainframe software. The field <model designator> will be a single character--like A, B, or C.

<space> is a single space character. The <version string> will be something like '3.2' or '4.0'.

Enable or Disable SRQ Generation on Data Ready

```
Commands:     ?AD<cr>  and  ?DD<cr>
Response:      :<lts>
```

The ?AD command enables the 2286/5 to generate a service request whenever data is available for reading by the host computer. The ?DD command disables the generation of the SRQ.

Enable or Disable SRQ Generation on an Alarm Condition

```
Command:       ?AA<cr>  and  ?DA<cr>
Response:      :<lts>
```

The ?AA command enables the 2286/5 to generate a service request when the 2286/5 detects an alarm condition. The ?DA disables the generation of an SRQ.

Enable or Disable SRQ Generation on Single Scan Complete

```
Command:   ?AS<cr>  and  ?DS<cr>
Response:  :<lts>
```

The ?AS command enables the 2286/5 to generate a service request whenever a single scan completes. The ?DS command does just the opposite.

Enable or Disable SRQ Generation on All Events

```
Command:      ?AX<cr>  and  ?DX<cr>
Response:     :<lts>
```

The ?AX command is synonymous with executing the ?AD, ?AA, and ?AS commands in sequence. The ?DX command has the same effect as executing the ?DD, ?DA, and ?DS commands in sequence.

Send Data Logger Status

Command: ?ST<cr>
Response: <status character><lts>:<lts>

The response to this command is a single character followed by <lts> that provides the status of the 2286/5 front panel indicators, followed by a ':' and another <lts>. The single character coding is:

(least significant bit)	**bit 0**	**always a 1**
	bit 1	**ALARM (ACK key)**
	bit 2	**MONITOR**
	bit 3	**PLOT**
	bit 4	**SINGLE SCAN**
	bit 5	**SCAN**
	bit 6	**always a 1**
(most significant bit)	**bit 7**	**always a 0**

The bit position corresponding to the front panel indicator is a one when the indicator is on and a zero when it's off. The resulting character value will be in the range from decimal 64 (hex 40) to decimal 127 (hex 7F). For example, when the SCAN indicator is the only one on, the character 'a' is sent in response to the command.

Set Carriage Return as Terminator; Ignore Line Feed

Command: ?TC<cr>
Response: :<lts>

This command sets the command termination character to the carriage return character. All line feed characters received by the 2286/5 are ignored. The IEEE-488 EOI message may optionally be sent with the carriage return character.

Set Line Feed as Terminator; Ignore Carriage Return

```
Command:      ?TL<cr>
Response:     :<lts>
```

This command sets the command termination character to the line feed character. All carriage return characters received by the 2286/5 are ignored. The IEEE-488 EOI message may optionally be sent with the line feed character.

IEEE-488 Interface Commands

Several interface commands or messages are defined within the IEEE-488 standard. These commands are used to manage the IEEE-488 interface system, however, some of these commands affect the operation of the 2286/5. Table 7-3 identifies what the 2286/5 does in response to receiving the commands.

Table 7-3 2286/5 Response to IEEE-448 Commands

MNEMONIC	NAME	2286/5 ACTIONS
DCL	Device Clear	See description in preceding paragraphs.
GET	Group Execute Trigger	No action, message ignored.
GTL	Go to Local	Enter the local state.
LLO	Local Lockout	Disables the front panel LOCAL key.
MLA	My Listen Address	Addresses the 2286/5 to listen.
MTA	My Talk Address	Addresses the 2286/5 to talk.
PPC	Parallel Poll Configure	No action, message ignored.
PPE	Parallel Poll Enable	No action, message ignored.
PPU	Parallel Poll Unconfigure	No action, message ignored.
REN	Remote Enable	When REN is sent with the MLA message the 2286/5 will enter remote.
SDC	Selective Device Clear	Same as device clear.
SPD	Serial Poll Disable	Exits the serial poll mode.
SPE	Serial Poll Enable	Enters the serial poll mode; if the 2286/5 is addressed to talk, it sends the status byte to the system controller.
TCT	Take Control	No action, message ignored.
UNL	Unlisten	Releases the 2286/5 from being addressed to listen.
UNT	Untalk	Releases the 2286/5 from being addressed to talk.

Serial Poll

Information sent from the 2286/5 to the IEEE-488 system controller in the serial poll status byte is defined in table 7-4. There are four operating conditions or events in 2286/5 programming or operation that can cause a service request. These are,

- Alarm condition
- Single scan complete
- Data available for reading
- Illegal command

Table 7-4. Serial Poll Status Byte Coding

BIT POSITION	MEANING
8765 4321	
xxxx xxx1	data available for reading
xxxx xx11	alarm message available for reading
xxxx 00xx	command accepted
xxxx 01xx	not in remote, can't process commands
xxxx 10xx	illegal control character in command
xxx1 xxxx	single scan complete
xx1x xxxx	alarm condition
x1xx xxxx	requesting service
0xxx xxxx	interface installed in port A
1xxx xxxx	interface installed in port B

Programming Examples

A few brief programming examples illustrating RS-232 computer control of the 2286/5 appear earlier in this section. These examples can easily be translated to provide some guidance for IEEE-488 control.

Programming Hints and Suggestions

READ ALL THE DATA YOU ASK FOR

It's important to read all of the data that you request from the 2286/5. You can't continue to send commands to the 2286/5 without reading the response from the previous commands. If this is attempted, the data output buffers of the 2286/5 become full and the communication path will stop working.

Section 8
Error Messages and System Alarms

CONTENTS

INTRODUCTION

When the 2286/5 detects that an error has occurred during programming or scanning, it lets you know. If the error occurs during programming, the Data Logger displays an ERROR message. If the error occurs during scanning, the Data Logger puts an ALARM message in the alarm queue and generates an alarm.

This section lists error and alarm messages exactly as they appear on the 2286/5 display or output device, and then gives a cause description and the appropriate response. For ease of reference, all messages are listed in alphabetical order, by the first letter of the first word in each message.

Errors or over-limit inputs cause alarms, and when they first occur, the Data Logger lights up the front panel ALARM LED. The 2286/5 can be programmed to write the alarm message to the alarm acknowledgement device after you've acknowledge the alarm.

ERRORS AND ALARMS

Alarms

Data Logger alarms alert users when trouble is detected. When an alarm occurs while the 2286/5 is scanning, an alarm message is logged, and the alarm front panel alarm indicator light is illuminated. All alarms are classified as either channel alarms or system alarms. Channel alarms are traced directly to a specific channel or to a block of channels. A channel alarm can be easily recognized by a channel number appearing to the left of the error message. System alarms are not associated with any specific channel.

An alarm can be generated by a condition defined by the user, such as a measurement exceeding a limit, and this is referred to as a user programmed alarm. A user programmed alarm is a type of channel alarm. An alarm can also be generated by an error in the 2286/5 system itself while scanning or plotting is active. An error that occurs before scanning is started, or after it's stopped, won't generate an alarm.

Most alarm messages may be programmed to be logged on the alarm acknowledgment device. The device can be either port A or B (RS-232 or IEEE-488), or the printer. Alarm messages for a specific channel are also recorded on the data output device when that channel is logged.

Errors

Errors can occur for a variety of reasons. Some are due to physical faults with the system, such as power-up errors, auxiliary functions errors or start/stop errors, and some are caused by programming errors.

In general, two types of programming errors can occur. They are,

- Pressing an invalid key, for instance, attempting to select an item which doesn't appear on the current menu.
- Attempting to enter syntactically unacceptable data, or data that conflicts with a previous entry.

The 2286/5 beeps once to acknowledge a correct entry, and it sounds three short beeps when you try to make an invalid entry. It won't accept invalid entries.

If incorrect syntax is entered, when you press ENTER an error message is displayed instead of a prompt for the next line. When you understand the error message, do the following,

- Press the EXIT key. This brings the erroneous line back to the display, with the cursor positioned at the first error in the line.
- Correct the error and press ENTER. If the line had more than one error, the process will have to be repeated until the entire line is correct.

Channel Alarms

As stated before, channel alarms are associated with a specific channel or block of channels. All messages generated by channel alarms are sent to the data output device(s) when the channel is logged.

Channel alarms may be grouped into three categories,

1. Serial Link Alarms -- Caused by a fault on the serial link, an input voltage or temperature out of range, a broken thermocouple, or a faulty A/D converter.

2. Math Execution Alarm -- Caused by a math argument out of range, arithmetic overflow, or division by zero.

3. User Programmed Alarms -- Caused by a user programmed limit being exceeded. The alarm message itself is written by the user.

The first two categories of alarms have error priority levels from 1 to 5 associated with their messages, with level 1 being the highest and 5 being the lowest priority alarms.

You can write a program to check the error priority level on a channel and take action only on a high priority error, ignoring all lower priority errors. To obtain the priority level of the error on a given channel, use the ERR function described in the Channel programming portion of section 3 of this guide.

If an error is present, the ERR function returns the priority of the error. If no error is present, the ERR function returns a value of 0.

The third category, user programmed alarms, has no error priority level associated with it.

Channel alarms and system alarms generate messages that are stored in an alarm queue until they are acknowledged by the operator. When the alarm is acknowledged, the associated message is sent to the alarm acknowledgment device.

A channel alarm message is placed in the alarm queue when the following conditions occur.

- Each time a user programmed alarm changes from a non alarm state to an alarm state. This is true for each of the four limits per channel that the user can program. The alarm must have an alarm message programmed in order for it to be entered in the queue.
- Whenever a new serial link alarm or a math execution alarm occurs on a channel. The queue will not accept another alarm message on that channel until after the channel has been scanned without a serial link or math execution error.

User Programmed Alarm Messages

A user programmed alarm occurs when an input voltage or temperature exceeds a user defined limit. When inputs change from a normal state to an alarm state, the user's message (for example, TOO HOT--ADD COOLANT) is placed in the alarm queue, and the alarm LED lights up.

User programmed alarms are also recorded on the alarm acknowledgment device and data output device in generally the same format as all other errors.

System Alarms

System alarms are alarms not associated with any specific channel. They may indicate running out of paper, a faulty disk drive, full alarm queue, or power failure. System alarms are placed into the alarm queue each time they occur.

The causes and suggested solutions for these system errors are detailed in the following alphabetical listing of errors and alarms.

Logged Messages That Generate No Alarm

Certain messages are recorded on the data output device like any other alarm, but are not otherwise indicated to the user. These messages don't turn on the alarm LED, get placed in the alarm queue, or get sent to the alarm acknowledgment device. In this sense, they are warnings, not alarms.

For example the message,

```
CO    PROPAGATED
```

indicates the procedure for channel 0 depends upon the value of another channel that has an error. The message is sent to the data output device but an alarm is not generated. To rectify the error, determine which dependent channel contains the error and correct it.

ALPHABETICAL LISTING OF ERROR MESSAGES

ALARM AND ERROR MESSAGES AND THEIR CAUSES

ACCESS DENIED

Cause

The access code you've entered is different than the one currently listed in the system program.

Solution

Enter the correct access code. It may be on the 2280 series Programming Form, if not, you can turn the Data Logger keyswitch to PROGRAM and list the system program to read it or re-enter the access code.

ALARM LIST NOT FOUND, RE-ENTER

Cause

The alarm list number you requested to copy from hasn't been programmed.

Solution

Program the alarm list directly, or enter the correct number for the alarm list you want to copy.

ALARM LIST NOT PROGRAMMED

Cause

While scanning is active, you've attempted to change a limit value of an alarm list number that is not programmed.

Solution

Make certain you're entering the correct number. If the number isn't programmed, stop the scan, program the alarm list and then start scanning again.

ALARM MESSAGES LOST

Cause

An alarm occurred when the alarm message queue was full and the new alarm message can't be stored.

Solution

Acknowledge one or more of the messages in the alarm queue to make room for new alarms as they occur.

ALARM NUMBER 1-4 NEEDED

Cause

You need to enter a number from 1 through 4 at ALMn (where "n" is between 1 and 4). The alarm number is either missing, or the digit you've specified is outside the range 1 through 4.

Solution

Add 1, 2, 3, or 4 to the function ALMn, or change the existing digit n to be within the range 1 to 4.

ALL ALARMS ACKNOWLEDGED

Cause

You pressed the ACK key when there weren't any alarms to be acknowledged.

Solution

Press the EXIT key.

ALM

See Cn <user-defined message>

ARGMT NEG

See Cn ARGUMENT NEG IN <operation>

ARGMT OVER

See Cn ARG OUT OF RANGE IN <operation>

ARGMT ZERO

See Cn ARGUMENT ZERO IN <operation>

ASSIGNMENT OPERATOR NEEDED

Cause

The equal sign is missing after the assignment channel (Cx or Cn) at the beginning of the channel procedure statement. This error message also occurs if you fail to enter the assignment channel and assignment operator.

Solution

Change the line at the channel procedure to read:

CX= <expression> or CN= <expression>

BAD DISK

Case 1

Cause

During a disk format operation the directory, file allocation table, or a MS-DOS boot sector cannot be created on the disk.

Solution

The first cylinder of the disk is probably bad. Replace the damaged disk and perform the format operation again.

Case 2

Cause

The disk directory or the disk file allocation table has been corrupted.

Solution

Retry operation or use software tools that are available for the IBM PC or compatibles to recover information.

BAD FILE NAME

Case 1

Cause

The file name entered is not compatible with MS-DOS file names.

Solution

Reenter or modify the file name so that it is compatible with MS-DOS file names. (See section 6, in this guide for a description of disk file names.)

BLANK STRING

Cause

After you press EXIT, a blank line is displayed. You've apparently entered a line consisting of one or more blank spaces, and nothing else.

Solution

Press the CLEAR key, then press ENTER to delete the blank line.

CHANNEL NOT A PSEUDO CHANNEL

Cause

You've attempted to change the value of a pseudo channel while scanning is active, and the channel number you entered is programmed to some function other than a pseudo channel.

Solution

Make certain you're entering the correct channel number. To program the channel as a pseudo channel, stop the scan, enter the new program and then start the scan again.

CHANNEL NOT IN ANY SCAN GROUP

Cause

While scanning is active, you've attempted to change the value of a pseudo channel that is not associated with any of the scan groups or channels programmed for plotting.

Solution

You can change the value of a pseudo channel when the 2286/5 is scanning or plotting as long as the channel meets one of the following criteria.

1. The number appears in a scan group channel list.

2. The number appears in a channel procedure. The channel procedure appears in a channel whose number is included in a scan group channel list.

3. The number is one of the channels to plot.

CHANNEL (OR BLOCK) NOT FOUND, RE-ENTER

Cause

The channel number you're trying to copy from hasn't been programmed.

Solution

Program the channel directly, or enter the correct number for the channel you want to copy.

CHANNEL NUMBER NEEDED

Cause

One of the following has occurred,

- A channel number, Cn, doesn't appear to the left of the channel procedure statement.
- The letter C is not in front of a number.
- There are no parameters for math functions that require one or more channel numbers.

When EXIT is pressed, the cursor is positioned where the channel number is expected.

Solution

Add the channel number, Cn, or insert the missing letter C.

Cn <user-defined message>

Cause

The value assigned to channel Cn has exceeded a user-defined alarm limit value.

Solution

Respond to the message, or redefine the alarm limit value.

Cn ARG OUT OF RANGE <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn ARG OUT OF RANGE IN <operation> alarm using the ALARM ACK key.

Cn ARG OUT OF RANGE IN <operation>

Cause

During execution of Cn's channel expression or procedure, one of the operands for the <operation> was found to be too large or too small.

There is no value assigned to the channel appearing on the left hand side of the channel expression or procedure statement.

Solution

Modify the channel expression or procedure to bring the operand back into range.

Cn ARGUMENT NEG <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn ARGUMENT NEG IN <operation> alarm using the ALARM ACK key.

Cn ARGUMENT NEG IN <operation>

Cause

While executing Cn's channel expression or procedure, a negative operand for the <operation> was found. A negative operand is not allowed.

There is no value assigned to the channel appearing on the left hand side of the channel expression or procedure statement.

Solution

Modify the channel expression or procedure so the operation does not have a negative operand.

Cn ARGUMENT ZERO <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn ARGUMENT ZERO IN <operation> alarm using the ALARM ACK key.

Cn ARGUMENT ZERO IN <operation>

Cause

While executing Cn's channel expression or procedure, a zero operand for the <operation> was found. A zero operand isn't allowed here.

There is no value assigned to the channel appearing on the left hand side of the channel expression or procedure statement.

Solution

Modify the channel expression or procedure so the operation doesn't have a zero operand.

Cn DENOMINATOR ZERO <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn DENOMINATOR ZERO <operation> alarm using the ALARM ACK key.

Cn DENOMINATOR ZERO IN <operation>

Cause

During execution of Cn's channel expression or procedure, the <operation> appearing there attempted a division by zero.

There is no value assigned to the channel appearing on the left hand side of the channel expression or procedure statement.

Solution

Modify the channel expression or procedure so the operation does not have a zero argument.

If the <operation> is INTERPOLATION, then the table has two adjacent entries with the same input measurement value. Delete one of the entries or change one of the input measurement values.

Cn FUNC DISAGREES WITH CONFIGURATION

Cause

The programmed channel function for channel Cn is not one of the allowed functions for the serial link device responding for channel Cn.

This error is detected whenever you attempt to start scan, single scan, monitor, or plot.

For example, this error occurs if you programmed Channel 0 as an analog output with the hardware configured with an A/D converter at address 0.

Solution

Do a list hardware configuration to find out what serial link device is responding for channel Cn.

If the wrong device is being listed, check all the serial link address switches to make sure they're correctly set.

If the wrong device is installed, install the correct serial link device. Also, make certain you've programmed channel Cn to respond to the desired function.

Cn HAS NO SERIAL LINK DEVICE

Cause

The serial link device that is to respond to channel Cn is either not installed, not connected to the system, has an incorrect address switch setting, or has failed.

This error is detected whenever you attempt to start scan, single scan, monitor, or plot.

Solution

Check all the serial link address switches, cabling, and power supply (if the device is in a 2281A with an optional power supply).

If necessary, call service personnel.

Cn ILLEGAL BCD NO <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn ILLEGAL BCD NO <operation> alarm using the ALARM ACK key.

Cn ILLEGAL BCD NO

Cause

During a scan, a bcd digit with binary value greater than 9 is present on one or more of the digit fields for the digital input.

There is no value assigned to the channel Cn.

Solution

Check digital input line wiring.

Cn Lm INPUT CHANNEL IN LHS

Cause

There is a measurement channel appearing on the left hand side (LHS) of line m in the channel procedure of channel Cn. This error is detected when you attempt to start a scan, single scan, monitor, or plot.

You cannot output to a measurement channel.

Solution

Change the channel number appearing on the left-hand side (LHS) of the procedure to a pseudo channel number or output channel number, or

Delete the programming for the measurement channel.

Cn Lm MATHBOARD REQUIRED

Cause

Line m of the procedure programmed for channel Cn requires the Math Coprocessor board (Option -211), and the option is either not installed or has failed.

This error is detected when attempting to start a scan, single scan, monitor, or plot.

Solution

Perform one of the following:

- Change the channel procedure statement so the Math Coprocessor option isn't needed.
- Install the Math Coprocessor board.
- If installed, have the Math Coprocessor board repaired.

Cn MATH OVERFLOW <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn MATH OVERFLOW <operation> alarm using the ALARM ACK key.

Cn MATH OVERFLOW IN <operation>

Cause

While executing Cn's channel expression or procedure, the result of the <operation> was outside the range of -9.22E18 to 9.22E18.

There is no value assigned to the channel appearing to the left of the channel expression or procedure statement.

Solution

Modify the channel expression or procedure so the result of the operation is within the allowable range.

Cn NO CONVERGENCE <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn NO CONVERGENCE <operation> alarm using the ALARM ACK key.

Cn NO CONVERGENCE

Cause

Using the measured RTD resistance and the programmed RTD constants, the RTD temperature calculation cannot converge to a solution. This can happen while scanning, doing a single scan, monitoring, or plotting.

There is no value assigned to the channel Cn.

Solution

Check the programmed RTD constants for channel Cn to see if they are correct. If the constants seem okay, change the channel function of channel Cn to the resistance function, and then monitor channel Cn and determine if a valid RTD resistance is being measured for the RTD temperature.

If the resistance is okay, verify that the correct RTD constants are being programmed.

Cn NO DEVICE REPLY <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn NO DEVICE REPLY <operation> alarm using the ALARM ACK key.

Cn NO DEVICE REPLY

Cause

While scanning, monitoring, plotting, or doing a single scan, a serial link device associated with channel Cn has stopped communicating over the serial link.

There is no value assigned to the channel Cn.

Solution

Check to see if the serial link cable has been disconnected, the address switch altered, or whether the device has lost power.

If the device is an A/D, it has power if the LED at the rear edge of the card next to the address switch is on.

If the device is installed in an extender chassis, 2281A, then the device has power if the LED on the front of the 2281A is on.

Cn NO MEASUREMENT <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn NO MEASUREMENT <operation> alarm using the ALARM ACK key.

Cn NO MEASUREMENT

Cause

The A/D converter and scanner card associated with channel Cn can't complete a measurement because they aren't working properly. This alarm message can happen during scanning, single scan, monitoring, or plotting.

There is no value assigned to the channel Cn.

Solution

Have service personnel repair the a/d and scanner cards.

Cn NOT ON SERIAL LINK DEVICE

Cause

The channel number n is outside the range of channels for the serial link device associated with the block of ten channels that Cn is in.

This can occur with bcd/binary input, counter/totalizer input, and analog output when attempting to start a scan, single scan, monitor, or plot.

Solution

Change your channel number to within the range of channels for the serial link device.

Cn OPEN TC <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn OPEN TC alarm using the ALARM ACK key.

Cn OPEN TC

Cause

The thermocouple for channel Cn is broken or damaged. This alarm message can occur during scanning, single scan, monitoring, or plotting.

There is no value assigned to the channel Cn.

Solution

Repair or replace the thermocouple or the thermocouple wiring.

Cn OVER RANGE <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn OVER RANGE alarm using the ALARM ACK key.

Cn OVER RANGE

Cause

The input voltage for channel Cn exceeds the range programmed for it. This alarm message can occur during scanning, single scan, monitoring, or plotting. There is no value assigned to the channel Cn.

Solution

Program channel Cn with a higher voltage range or check and adjust the input voltage.

Cn OVER TEMP <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn OVER TEMP alarm using the ALARM ACK key.

Cn OVER TEMPERATURE

Cause

The temperature for channel Cn is outside the specified range for the thermocouple or RTD being used. This can occur during scanning, single scan, monitoring, or plotting.

Solution

Reduce the temperature being measured by the sensor, or replace the sensor with one that measures the higher or lower temperature.

If a different type of sensor is used, programming for channel Cn must be changed.

Cn PREVIOUSLY DEFINED
Cn..m PREVIOUSLY DEFINED

Cause

The channel (Cn) or channels from the range specified (Cn..m) have already been programmed.

Solution

You have the following options,

- Delete the previously programmed channel or channel block.
- Program two blocks instead of just one.
- Split the previously programmed channel block in two: copy the block to a temporary channel; delete the channel block; copy the temporary channel into the two new blocks.

Cn SERIAL LINK FAILURE OR OVERLAP

Case 1

Cause

Two or more devices are responding to the same serial link address.

Solution

Remove the serial link device associated with channel Cn and restart the operation.

If the error changes to Cn FUNC DISAGREES WITH CONF, or there is no error, then some other device is also addressed to respond for channel Cn.

Find the serial link device and change the address so it doesn't conflict with channel Cn.

Case 2

Cause

The serial link device associated with channel Cn is faulty. This error occurs when you are trying to start a scan, single scan, monitor, or plot.

Solution

Remove the serial link device associated with channel Cn and restart the operation.

If the error changes to Cn HAS NO SERIAL LINK DEVICE, then the device you disconnected is faulty.

Cn SERIAL LINK SELF-TEST FAILED

Cause

The serial link device associated with channel number Cn is faulty.

Solution

Have the serial link device repaired.

Cn UNKNOWN SERIAL LINK DEVICES

Cause

The serial link device associated with channel Cn is not known to this version of software.

Solution

The 2285 Analog Output (Option -170) or the Counter/Totalizer (Option -167).

Cn LIMIT m <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn <user defined message> alarm using the ALARM ACK key.

Cn OUT OF RANGE <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the Cn OUT OF RANGE alarm using the ALARM ACK key.

Cn OUT OF RANGE

Case 1

Cause

The input frequency for channel Cn is below 2 Hz. There is no channel value assigned to channel Cn.

Solution

Increase the frequency to a value above 2 Hz.

Case 2

Cause

The number of counts for channel Cn has exceeded 8,388,607 counts. There is no channel value assigned to channel Cn.

Solution

Read channel Cn more often.

COMMAND ERROR

Cause

A logging device did not understand what the 2286/5 Controller requested.

Solution

Internal 2286/5 communications were probably disrupted. Retry the operation. If this alarm persists, service may be required.

COMMAND TOO LONG

Cause

A concise command string longer than 80 characters was received. The concise command is aborted.

Solution

Break the concise command string up into two or more substrings.

CX SYMBOL NEEDED

Cause

Channel number Cn was entered in a channel expression. The channel self reference, CX, is the only channel reference allowed in channel expressions.

When EXIT is pressed, the cursor is positioned where the channel self reference, CX, is expected.

Solution

Change the math so that no other channel number is used except CX.

If information from more than one channel is required in the computation, use a pseudo channel to perform the operation.

CURSOR POINTS TO ENTRY ERROR

Cause

A parsing error has occurred for a feature added to the Math Coprocessor board option, and your version of the 2286/5 Controller software doesn't have the appropriate error message.

DATA LOGGER SELF-TEST

Cause

The 2286/5 SELF-TEST message is displayed by the software whenever the Display Interface board receives a bus reset.

If working properly, this message is displayed 3 to 4 seconds after the Data Logger has been turned on. If the message continues, the Data Logger is locked up. A device on the device bus is hanging up the bus. The Controller cannot communicate with the display to update the prompts.

Solution

If the message continues to be displayed, have the unit repaired.

DELIMITER NEEDED

Cause

The delimiter "//" is missing, or another character is located where the delimiter should be. When EXIT is pressed, the cursor is positioned where the delimiter is expected.

Solution

Remove unnecessary characters and add the delimiter.

DENOM ZERO

See Cn DENOMINATOR ZERO IN <operation>

DESTINATION DEVICE NOT AVAILABLE

Cause

The destination device you're trying to send data to is not installed, or has failed.

Solution

Request a valid destination device or install the one you've specified.

If the device you requested is installed, and you still get this error message, it probably needs repair.

DIGIT EXPECTED
DIGIT OR . EXPECTED

Cause

Another character is present where a digit or "." is expected in a floating point constant.

When EXIT is pressed, the cursor is positioned where the digit or "." is expected.

Solution

Remove the unwanted characters, or add characters to create the correct syntax.

DISK ALMOST FULL <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the DISK ALMOST FULL alarm using the ALARM ACK key.

DISK ALMOST FULL

Cause

The disk is almost full of logged data. Less than 100 sectors remain available on the disk. This message occurs only during scan or single scan on a 2286.

The 2286 continues recording scan data on the disk until the disk is completely full. When the disk is full a DISK FULL alarm is generated.

Solution

Let the disk become full: the DISK FULL alarm will alert you when this occurs. Eject the disk and insert a preformatted disk, one with enough space for additional recording of logged data. Scan data will be written on the new disk under the same file name with no loss of data if this is done before the internal disk data buffer becomes full.

If a preformatted disk is not available, the scan should be stopped before the disk becomes completely full and a new disk formatted. The scan can then be restarted.

DISK DEVICE MALFUNCTION <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the DISK DEVICE MALFUNCTION alarm using the ALARM ACK key.

DISK DEVICE MALFUNCTION

Cause

A fault occurred while the disk device was performing an operation that it could not recover from.

Solution

Retry the operation. If the alarm persists, execute system diagnostics on the disk device. Service may be required.

DISK DEVICE NOT AVAILABLE

Cause

The Microfloppy Interface Assembly is not installed or has failed.

Solution

Install or repair the Microfloppy Interface Assembly.

DISK EJECTED

Case 1

Cause

The disk in the drive was ejected while performing a disk function.

Solution

Install disk back into drive and perform the disk function again.

Case 2

Cause

The disk was ejected from the disk drive during a program save. Part of the user's program may be left on the disk.

Solution

The program saved thus far will not operate properly if loaded into the Data Logger. Reinsert the disk and delete the file containing the user's partial program.

You can now repeat the program save operation.

DISK FULL <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the DISK FULL alarm using the ALARM ACK key.

DISK FULL

Case 1

Cause

There is no more room available on the disk to store data while a scan or single scan is in progress.

Solution

Scan data will be buffered as scanning continues. Eject the disk and insert a preformatted disk with space for additional recording of logged data. Scan data will be written to the new disk under the same file name with no loss of data if this is done before the internal disk data buffer becomes full.

Case 2

Cause

There is not enough room on the disk to store an entire program during a program save function. A partial program will be saved onto the disk.

Solution

Delete the file containing the partial program. Remove the disk and insert another one with more available space. Save the program onto the second disk.

DISK READ ERROR

Cause

A sector of data on the disk cannot be read during a data transfer, or a program load, even after several attempts.

If this error occurs during a data transfer, the sector of data is skipped and the data transfer continues with the next sector.

If this error occurs during a program load, the load is aborted.

Solution

Retry the operation. If the error persists, the data sector is corrupted. It may be possible to recover this data with some software tools available for the IBM PC or compatibles.

If the disk continues to have intermittent disk-read errors, replace it.

DISK REMOVED <time discovered> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the DISK REMOVED alarm using the ALARM ACK key.

DISK REMOVED

Cause

The disk was ejected while a scan or single scan was in progress.

Solution

Reinstall the disk or another preformatted disk into the drive as soon as possible. Data recording will resume under the same file name with no loss of data if this is done before the internal disk data buffer becomes full.

If the same disk is not reinstalled into the drive, the file will not be closed and some data may be lost.

Also, the scan can be stopped and restarted after reinstalling a disk in the drive.

DISK SELF-TEST FAILED

Cause

Upon power up of the 2286, the disk device discovered and reported that it had a fault.

Solution

Run the 2286 system diagnostics for the disk drive. Report the diagnostics test results to the nearest Fluke Service center and have the disk device serviced.

As a temporary solution, data can continue to be logged as long as the disk is not an output device for the data.

DISK WRITE PROTECTED

Cause

The disk installed in the drive has its write protect tab in the protected position during an operation that required information to be written onto the disk.

Solution

Eject the disk and move its write protect tab to the unprotected position. Reinstall the disk and attempt the operation again.

Caution

The disk may have been write protected because the files are not to be erased.

EMPTY STRING

Cause

No file name or floating point number was present when the ENTER key was pushed.

Solution

Add the desired file name or floating point number before pressing ENTER.

FILE IS READ ONLY

Cause

An individual file to be deleted from a disk is marked READ ONLY. The file can not be deleted.

Solution

Reset the READ ONLY file attribute bit in the file's directory entry using software tools available on an IBM PC or compatible. The 2286 does not set this bit, however, it abides by its meaning.

FILE NAME ALREADY EXISTS

Cause

The file name you entered when requesting a program save, or when beginning a scan or single scan, has already been used on this disk for another file.

Solution

Use a file name unique to the disk. To find out which names have already been used, list the disk directory.

FILE NAME NOT FOUND

Cause

The file_name you requested for a program load or data transfer doesn't exist on this disk.

Solution

List the disk directory to determine what files are on this disk.

FUNCTION NOT AVAILABLE

Cause

The requested data transfer or disk functions, or selected channel functions, aren't available in this model of the Data Logger.

ILLEG BCD

See Cn ILLEGAL BCD NO

IN REMOTE

Cause

You pressed a key on the front panel, other than LOCAL when the REMOTE light is on.

Solution

If you want front panel control of the data logger, press the LOCAL key first.

IN REMOTE WITH LOCKOUT

Cause

You pressed a front panel key while the 2286/5 was in the "remote with front panel lockout" state. The Data Logger is put into this state by a remote terminal or computer.

Solution

To return the Data Logger to local control, follow the instructions for "return-to-local" in the Remote Programming and Operations section of this user guide.

INCOMPATIBLE MATH BOARD SOFTWARE

Cause

The versions of Math Coprocessor board software and 2286/5 Controller board software are incompatit

Solution

Contact the nearest Fluke Service Center.

LAST CHAN MUST BE GREATER THAN FIRST

Cause

The channel block Cn..m uses a first number (n) that is larger than the second number (m).

When you press EXIT, the cursor is positioned at the incorrect channel block.

Solution

Edit the channel block so the first number is smaller than the second.

LEFT PARENTHESIS NEEDED

Cause

When EXIT is pressed, the cursor is positioned where the left parenthesis is expected.

Solution

Edit the line to correct the syntax error.

LIMIT NOT PROGRAMMED

Cause

While scanning is active, you've attempting to change a limit value in a number that has not been programmed.

Solution

Enter the correct alarm list or limit number, or stop scanning, program the limit number, and restart scanning.

LISTING DEVICE NOT AVAILABLE

Cause

You have requested the list function or list of disk directory from a device that is either not installed, or that has failed its self test.

Solution

Select one of the following:

- Choose a different output device. Select from menu choices in the list or disk function.
- If necessary, install the requested device.
- If the device is already installed, and the error persists, have the device repaired.

LOSS OF DATA TO DISK <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the LOSS OF DATA TO DISK alarm using the ALARM ACK key,

LOSS OF DATA TO DISK

Cause

When scan data has filled a disk or the disk is removed from the drive while scan data is sent to it, further data is buffered. As long as a disk is installed in the drive before this buffer becomes full, no data will be lost. However, if this buffer overflows, further data is lost. This alarm reports this occurrence.

Solution

Install a preformatted disk with space for additional recording of logged data. The buffered data will be recorded on the disk under the original file name. Then further data will be recorded. There will, however, be a gap of lost data.

Math Execution Alarms

Math function alarms occur for a specific channel. The error message is followed by the <operation> being performed when the error occurred.

For example, a possible error message is MATH OVERFLOW IN ADDITION. The <operation> is ADDITION. Other possible operations are,

- ADDITION
- ARC COSINE
- ARC SINE
- COMMON LOG
- DIVISION
- EXPONENTIATION
- GROUP AVERAGE
- INTEGER PART
- INTERPOLATION
- LINEARIZATION
- MULTIPLICATION
- NATURAL LOG
- POWER OF E
- REFERENCE VOLTAGE
- SQUARE ROOT
- STD DEVIATION
- SUBTRACTION
- TANGENT

MATH BOARD APU TEST FAILED

Cause

The arithmetic processing unit on the Math Coprocessor option is not functioning properly.

The Data Logger will try to operate without using the Math Coprocessor board.

Solution

Have the Math Coprocessor board repaired. As a temporary solution, try starting a scan and plot, if plot is also programmed.

If there are no start-up errors, you can use the data logger without using the Math Coprocessor board, but with a possible reduced throughput rate.

MATH BOARD DOES NOT RESPOND

Cause

The Math Coprocessor board is installed, but does not interrupt the 2286/5 Controller board at power-up.

The Data Logger will try to operate without using the Math Coprocessor board.

Solution

Have the Math Coprocessor board repaired. As a temporary solution, try starting a scan and plot if plot is also programmed.

If there are no start-up errors, you can use the data logger without using the Math Coprocessor board, but with a possible reduced throughput rate.

MATH BOARD INTERFACE FAILED

Cause

The Math Coprocessor board is installed, but cannot communicate with the 2286/5 Controller board.

The Data Logger will try to operate without using the Math Coprocessor board.

Solution

Have the Math Coprocessor board repaired. As a temporary solution, try starting a scan and plot, if plot is also programmed.

If there are no start-up errors, you can use the data logger without using the Math Coprocessor board, but with a possible reduced throughput rate.

MATH BOARD RAM TEST FAILED

Cause

There is a bad RAM or a faulty RAM control circuit on the Math Coprocessor board.

The Data Logger will try to operate without using the Math Coprocessor board.

Solution

Have the Math Coprocessor board repaired. As a temporary solution, try starting a scan and plot, if plot is also programmed.

If there are no start-up errors, you can use the Data Logger without using the Math Coprocessor board, but with a possible reduced throughput rate.

MATH BOARD ROM CHECKSUM TEST FAILED

Cause

There is a bad ROM or a faulty ROM control circuit on the Math Coprocessor board.

The Data Logger will try to operate without using the Math Coprocessor board.

Solution

Have the Math Coprocessor board repaired. As a temporary solution, try starting a scan and plot, if plot is also programmed. If there are no start-up errors, you can use the Data Logger without using the Math Coprocessor board, but with a possible reduced throughput rate.

MATH OVER

See Cn MATH OVERFLOW IN <operation>

NO CONVRG

See Cn NO CONVERGENCE

NO DISK INSTALLED

Cause

You've requested a data transfer or disk operation, or attempted to start a scan or single scan, whose output is the disk, when there is no disk inserted in the drive.

Solution

Insert a disk into the drive.

NO MEASMNT

See Cn NO MEASUREMENT

NO REPLY

See Cn NO DEVICE REPLY

NO ROOM ON DISK

Cause

When you attempt to do a program save, or start a scan or a single scan, no room is available on the inserted disk. Either the disk directory is full or there are no more sectors available on this disk.

Solution

Delete some of the files on the disk (this is one of the function menu disk choices) or remove the disk and insert one with room on it.

NO SCAN GROUPS PROGRAMMED

Cause

You've attempted to start a scan when there are no scan groups programmed.

Solution

Program one or more scan groups before you press the SCAN key.

NOT A PROGRAM FILE

Cause

The file name selected for a program load is not a 2286 configuration program file.

Solution

Enter the name of a program file. Listing the disk directory will show you which files are program files.

NOT PROGRAMMED

Cause

You're trying to delete a channel, channel block, alarm list, or scan group that is not currently programmed.

Solution

Enter the correct number.

OPEN TC

See Cn OPEN TC

OPERAND EXPECTED

Cause

Two math operators, (i.e., +, -, /, *, etc.) appear next to each other, or an operator was misspelled. When EXIT is pressed, the cursor is positioned where the operand is expected.

Solution

Correct the math expression.

OPERATOR EXPECTED

Cause

An operator, (i.e., +, -, /, *, etc.) is missing from the math expression or is misspelled.

When EXIT is pressed, the cursor is positioned where the operand is expected.

Solution

Correct the math expression.

OUT OF RANGE

See Cn OUT OF RANGE

OUT OF USER MEMORY

Cause

The amount of information that can be stored by the 2286/5 has been exceeded, or there is not enough room in user memory to store the channel values as they are read, along with the other information needed during scanning.

Solution

Reduce the program size by eliminating any unused channel programs, scan groups, alarm lists, plot programming, or interpolation tables.

You can also delete or shorten any of the channel or scan group labels, channel expressions and procedures, or alarm messages.

OVER RANGE

See Cn OVER RANGE

OVER TEMP

See Cn OVER TEMPERATURE

PLOT NOT PROGRAMMED

Cause

You are attempting to plot parameters that haven't been programmed.

Solution

Program the desired parameters before beginning to plot.

PORT <A or B> SELF-TEST FAILED

Cause

The designated port is faulty.

Solution

Have the device that is installed in the designated port repaired.

As a temporary solution, you can keep using the logger as long as you don't output data to the faulty port. The Data Logger will try to work without the port.

POWER FAILED <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device (if programmed) in response to acknowledging the POWER FAILED alarm using the ALARM ACK key.

POWER FAILED <Date> <Time>

Cause

Power was lost while the Data Logger was scanning or plotting, and then was restored at the specified date and time.

Solution

Use a 12 volt battery as a power backup to the 2286/5 Data Logger.

PRINTER NOT AVAILABLE

Cause

The printer has a fault associated with it when attempting to start the plot function.

Solution

Have the printer repaired.

PRINTER OUT OF PAPER

Cause

The printer ran out of paper during a scan, single scan, plot, listing, or data transfer.

Solution

Replace the printer paper as described in the Recording chapter (section 6) of this user guide.

PROPAGATED

Cause

A channel procedure statement that assigns a value to the channel Cn is dependent upon another channel, Cm, which has an error.

The channel Cm has no value associated with it; therefore no value can be calculated for channel Cn.

Solution

Correct the problem associated with channel Cm.

RAM TEST FAILED

Cause

There is a bad RAM or a faulty RAM control circuit on the 2286/5 Controller or Memory board.

The Data Logger will attempt to continue operation, but there is no guarantee as to what might happen.

Solution

Have the 2286/5 Controller and Memory boards repaired.

RIGHT PARENTHESIS NEEDED

Cause

You've entered a line missing a right parenthesis, or having too many left parenthesis.

When you press EXIT, the cursor is positioned where the right parenthesis is expected.

Solution

Add a right parenthesis, or remove a left one.

ROM CHECKSUM TEST FAILED

Cause

There is a bad ROM or a faulty ROM control circuit on the 2286/5 Controller or Memory board.

The Data Logger attempts to continue operation, with no guarantee what might happen.

Solution

Have the 2286/5 Controller and Memory boards repaired.

SCAN GROUP NOT FOUND, RE-ENTER

Cause

The scan group you wish to copy from isn't programmed.

Solution

Program the scan group directly, or enter the correct number for the existing scan group you wish to copy.

SGn PORT <A or B> NOT PROGRAMMED FOR IEEE
SGn PORT <A or B> NOT PROGRAMMED FOR PARALLEL
SGn PORT <A or B> NOT PROGRAMMED FOR RS-232

Cause

The device installed in the indicated port is not the same as that selected in output device programming. SGn identifies the scan group number.

Solution

Change the device type specified in output device programming or have the correct option installed.

SGn PRINTER NOT AVAILABLE
SGn PORT A NOT AVAILABLE
SGn PORT B NOT AVAILABLE
SGn DISK DEVICE NOT AVAILABLE

Cause

The printer, port A, port B, or the disk has been selected as an output device in scan group SGn and the device is not installed or has failed.

Solution

Install or repair the output device.

SGn NOT PROGRAMMED

Cause

You are attempting to start up a single scan for scan group SGn, which has not been programmed.

Solution

Enter the correct scan group number, or if it doesn't exist, program the desired scan group.

SINGLE CHANNEL NUMBER NEEDED

Cause

The channel number you've entered has too many C's in it.

Solution

Delete the extra C's. The channel number shouldn't have more than one C.

SOURCE DEVICE MUST BE MAGTAPE

Cause

You are requesting a data transfer from port A or port B that has an IEEE-488 (Option -342) or RS-232-C (Option -341) installed.

Solution

Install a Parallel Interface (Option -343/AA) to a Kennedy magtape. This is the only port A or port B device that data can be transferred from during a data transfer.

SOURCE DEVICE NOT AVAILABLE

Cause

You are trying to transfer data from a device that is either not installed or that has failed.

Solution

Do one of the following,

- Check to be certain you're entering the correct device number.
- Install the desired device if it isn't present.
- If the device is installed and you're entering the correct number, the device needs repair.

SOURCE SAME AS DESTINATION

Cause

When starting a data transfer, you specified the same device for both the destination and the source.

Solution

Select the correct source and destination devices.

TABLE NUMBER 0-9 NEEDED

Cause

The "n" part of the interpolation table, TBLn, is not present, or is not a digit between 0 and 9.

When you press EXIT, the cursor is positioned where the table number n is expected.

Solution

Correct (or add) the table number.

TOO MANY OPERATOR LEVELS OR PARENTHESES

Cause

The math expression or statement has more than three pairs of nested parentheses.

When press EXIT, the cursor is positioned where the unexpected parentheses begin.

Solution

Change the expression or statement so there are no more than three levels of nested parentheses.

UNEXPECTED ADDITIONAL CHARACTERS

Cause

There are extra characters after the x-y number pair in the interpolation table entry.

For example, in,

3.4//5.6//6.1.

The string "//6.1" are extra characters.

When you press EXIT, the cursor is positioned where the unexpected additional characters begin.

Solution

Remove the extra characters.

UNEXPECTED CHARACTER FROM DISK

Cause

While loading a program file from disk, an inappropriate character was discovered.

Solution

An error was introduced while the program file was edited or created on an IBM PC or compatible. Correct the error in the file. See section 6 of this manual regarding program files for rules on creating/editing program files.

UNFORMATTED DISK

Cause

The disk in the drive has not been formatted or the format cannot be identified.

Solution

Format the disk as described in Section 6 of this guide.

USE FORMAT DD MMM YY

Cause

Parts of the date are left out or mistyped, or the day of month is incorrect.

When you press EXIT, the cursor is positioned where the incorrect date format is located.

Solution

Edit the date so the numerical day of the month isn't too large for the month. For example, no month contains more than 31 days.

October 30, 1986 will read: 30 OCT 86

The three letters in the middle should be abbreviations of the month, with the year as the last two digits.

USE FORMAT HH.MM.SS WHERE HH<24

Cause

The time string entered contains hours larger than 23 or minutes or seconds larger than 59. Too many decimals may also be present.

When you press EXIT, the cursor is positioned where the incorrect time format is located.

Solution

Edit the time so hours are less than 24 and minutes and seconds are less than 60.

Make sure there is a decimal point located between the hours and minutes and between the minutes and-seconds.

USE FORMAT NN//NN//... WHERE NN<96

Cause

The numbers entered for ASCII values are too large or the delimiters are incorrect.

Solution

Use ASCII values less than 96, and use delimiters as shown in the error message.

USE NO MORE THAN SIX NUMBERS

Cause

There are more than six ASCII values in the ASCII sequence.

Solution

Use an ASCII sequence that is no longer than six ASCII values.

USER PROGRAM CORRUPTED

Cause

The user program was altered unintentionally. This can happen if RAM becomes faulty or if there is a fault with the user memory backup battery.

A minimum program is saved for the user.

Solution

Re-enter your program from the 2280 Series Programming Form or load it from disk.

If the problem continues, contact service personnel.

USER PROGRAM LOST

Cause

The user program is no longer present when the Data Logger is turned on. This can happen when the 2286/5 Data Logger is turned off for a period longer than 30 days. It may also occur if there's a fault with the memory backup battery. A minimum program is saved for the user.

Solution

Re-enter your program from the 2280 Series Programming Form or load it from disk.

The Data Logger should retain your program in memory for at least thirty days. If the program isn't retained, the 2286/5 probably needs repair.

WATCH-DOG TIMEOUT <time occurred> <time acknowledged>

Cause

This message is recorded on the alarm acknowledgement device in response to acknowledging the WATCH-DOG TIMEOUT alarm using the ALARM ACK key.

WATCH-DOG TIMEOUT <Date> <Time>

Cause

While the instrument was scanning or plotting, a hardware or software fault occurred, causing a hardware watch-dog timer to reset the Data Logger.

Solution

Contact service personnel, especially if the watch-dog timeout keeps occurring.

1499 IS THE LARGEST CHANNEL ALLOWED

Cause

A channel number larger than 1499 was entered in a 2286.

Solution

Enter a channel number <= 1499.

1499 IS THE LARGEST NUMBER ALLOWED

Cause

An alarm list number larger than 1499 was entered in a 2286. If the alarm list number was less than 1499, check your channel programming. A number in a channel expression or procedure statement may be larger than 1499. When you press EXIT, the cursor is positioned where the incorrect number is located.

Solution

Change the alarm list number or channel number so it is less than or equal to 1499.

2.8E-20 IS SMALLEST CONSTANT ALLOWED

Cause

The magnitude of the constant that was entered, or that appears in a channel expression or procedure statement, is too small to be represented internally by the 2286/5 Data Logger.

When you press EXIT, the cursor is positioned where the incorrect constant is located.

Solution

Change to an absolute value larger than 2.71E-20.

4095 IS LARGEST NUMBER ALLOWED

Cause

A fixed record length number greater than 4095 characters was entered for the parallel I/O.

Solution

Change the number to be less than, or equal to, 4095.

9.2E18 IS LARGEST CONSTANT ALLOWED

Cause

The magnitude of the entered constant, or one that appears in a channel expression or procedure statement, is too large to be represented internally by the 2286/5 Data Logger.

When you press EXIT, the cursor is positioned where the incorrect constant is located.

Solution

Change the number so its absolute value is smaller than 9.22E18.

99 IS THE LARGEST CHANNEL ALLOWED

Cause

A channel number larger than 99 was entered in a 2285.

Solution

Change to a channel number <= 99.

99 IS THE LARGEST NUMBER ALLOWED

Cause

An alarm list number larger than 99 has been entered, or a channel number larger than 99 appears in a channel expression or procedure statement. This occurs in a 2285.

When you press EXIT, the cursor is positioned where the incorrect number is located.

Solution

Enter an alarm list (or channel) number <= 99.

+, - OR DIGIT EXPECTED
+, -, . OR DIGIT EXPECTED

Cause

Some other character is present where a

"+"
"-"
"."

or digit is expected in a floating point constant.

When you press EXIT, the cursor is positioned where the "+","-","."; or digit is expected.

Solution

Remove the unwanted characters or add characters to create the correct syntax.

Appendix 9a
Glossary

A/D converter

Analog-to-Digital Converter. A circuit used to convert information in analog form (such as voltage or current measurements) into digital form.

ADC

See a/d converter.

address

The channel number that represents an I/O channel.

alarm acknowledgement device

The device (printer, disk drive, port A, or port B) where alarm messages are acknowledged and the time of the alarm is recorded.

analog

The representation of numerical quantities that do not have discrete values but that are continuously variable. Electrical measurements are analog in nature until converted into digital signals by an a/d converter. See digital.

ANSI

American National Standards Institute; an industry supported U.S. organization that primarily serves to coordinate and publish technical standards requested by its members.

arithmetic expression

An equation with arithmetic operators producing a numerical result.

arithmetic operator

A process to be applied to numerical values in an equation (+,-,/, etc.).

array

A group of numbers sharing the same variable name, followed by a subscript.

ASCII

American Standard Code for Information Interchange; ASCII is a standardized code set of 128 characters, including upper and lower case alphabet, numerals, and a set of control characters (line feed, carriage return, etc.)

baud

Originally used to express the capabilities of a telegraph transmission facility in terms of "modulation rate per unit of time." For practical purposes, it is now used interchangeably with "bits per second" as a unit of measure for data flow.

BCD

Binary Coded Decimal; BCD is a digital data format in which each digit of a decimal (base 10) number is represented in order, by its binary equivalent. For example, the decimal number 597 is represented as (0101 1001 0111) in BCD. See binary.

binary

The base two number system; binary numbers are made up of ones and zeros. The least significant digit represents one, the next digit represents twos, the next digit represents fours, and so on with each digit of the binary number corresponding to the next higher exponent of two. See also BCD.

bit

The smallest element of a binary number; a bit (contraction of "binary digit") either represents a high or a low state (one or zero, also mark or space).

boot sector

The boot sector is a disk sector that consists of a short machine-language program that is responsible for loading MS-DOS into memory on a IBM PC or compatible.

bridge

In a measuring system, an instrument in which part or all of its circuit measures one or more electrical quantities. In a 2286/5 system, quarter-, half-, and full-bridge strain gauges can be used. See microstrain, strain gauge.

CCITT

Comite Consulatif International Telegraphic et Telephonique; an international organization concerned with devising and proposing standards for international telecommunications.

CD

Carrier Detect; RS-232-C, line 8. This signal is sent by DCE to tell DTE that a suitable carrier is present at the DCE. See also DTE, DCE.

channel expression

A computation applied to the raw input of same (measurement) channel.

channel procedure

A set of expressions involving more than one channel.

concise command string

A set of commands used when the 2286/5 is controlled remotely be a computer.

Controller, 2286/5

The central "brain" of the Data Logger. It is a single assembly located behind the front access panel of the Data Logger.

Counter/Totalizer

The option that measures frequency and totalizes event occurrences.

CTS

Clear to Send; RS-232-C line 5. Sent by DCE to DTE when it is ready to accept data. See also DCE, DTE.

current shunt

Traditionally, a precision, low-value resistor placed across an ammeter's terminals to increase its range. The 2286/5 uses a current shunt resistor in the input circuitry of each channel of the Current Input Connector (Option -171). The shunt resistor allows the current input to develop a voltage which the Analog to Digital Converter (Option -161) can measure.

DAV

Data Valid; an IEEE-488 bus handshake signal, bus line 6. Indicates the availability data byte. See also handshake, NDAC, NRFD.

DCE

Data Communication Equipment; the RS-232-C term for computer equipment that sends or receives data. Modems are examples of DCE. The other type of computer equipment specified by RS-232 is DTE, Data Terminal Equipment.

DCL

Device Clear, IEEE-488 Universal Command, ASCII code 20. This message, from the Controller, causes all instruments on the bus to reset the IEEE-488 interface of each instrument on the bus to a known state. The action taken by each instrument is unique for that instrument.

default

The value or state selected by system software (or firmware) when the user doesn't specify one.

delimiter

A character that sets the beginning and end of a string, and is not considered to be a part of the string. the two delimiters allowed by the 2286/5 are // (double slash) and : (colon).

DIF

Data Interchange Format. A file format readable by many database and spreadsheet programs. The files contain only ASCII characters and follow a specific protocol. These files use the file name ".DIF" extension.

digital

A circuit or device concerned only with high or low states (or pulses), generating a logical or numerical result. Digital computers, calculators, and digital watches use digital circuitry. See analog.

directory

Disk directories hold most of the basic information concerning the files stored on the disk. This information includes: a file's name, type, size, the time and date it was created, plus a pointer to the start of the file.

DSR

Data Set Ready; RS-232-C line 6. Indicator from DCE to DTE that a suitable line connection has been made, that all preliminary line protocol is complete, and that it is ready for data transfer. See also DCE, DTE.

DTE

Data Terminal Equipment; the RS-232-C Standard term for computer equipment where digital information originates or terminates. The 2286/5, terminals, and computers are examples of DTE. The other type of computer equipment specified by RS-232-C is DCE, Data Communication Equipment.

DTR

Data Terminal Ready; RS-232-C line 20. Sent by DTE to DCE when it is ready to transfer data.

EIA

Electronic Industries Association; the organization that devises electrical and data communication standards including RS-232-C and RS-422.

EOI

End Or Identify, IEEE-488 bus line 5. Often used by a Talker to designate the end of a data transfer sequence.

expression

A combination of variables, constants, numbers, or function references, separated by operators and parentheses in such a way that the whole can be reduced to a single result. See also arithmetic expression, logical expression, relational expression.

file allocation table

The file allocation table holds a record of how disk data space is utilized by storing the exact location of the clusters, or data sectors, that make up a file.

floating point

A numerical notation useful for computer calculations. In the 2286/5, the resolution of a floating point number is 7 digits, and its range is up to 38 places either side of the decimal. When the decimal point is out of range of the displayed digits, the number is displayed in exponential form (E+mn or E-mn, where mn represents the number of places the decimal point must be moved; + for right and - for left). See also floating point variable, integer variable.

frequency

The cycles-per-second (Hertz) of ac signal. Can be measured in a 2286 system using the Counter/Totalizer (Option -167).

gauge factor

A strain gauge parameter, gauge factor specifies the characteristics of the strain gauge material being used.

GND

Ground; RS-232-C line 1. A chassis connection intended for the cable shield. Not to be used for signal reference.

GPIB

General Purpose Interface Bus. This is a commonly used name for the IEEE-488 instrument interconnection bus.

handshake

The three-wire hardware protocol used to exchange data on the IEEE-488 Bus. Three bus lines (DAV, NRFD, NDAC) coordinate sending and receiving of data.

IBM PC or compatible

IBM personal computer or any computer manufactured to be compatible with an IBM personal computer.

IEEE

Institute of Electrical and Electronic Engineers, Inc., 345 East 47th Street, New York, NY 10017. The IEEE is the publisher of Standard IEEE-488-1978, for interconnection of electronic instruments.

IEEE-488 Bus

A parallel bus system agreed upon by participating instrument manufacturers for interconnecting instruments to form a system.

IFC

Interface Clear; IEEE-488 Bus line 9. Set high by the controller to reset the IEEE-488 interface of each instrument on the bus to a known state. The action taken by each instrument on the bus is unique for that instrument.

interface

A hardware and software connection of a device to a system. For example, either the Serial Interface or the IEEE-488 Interface must be used to connect a host computer to the 2286/5.

interference

The presence of undesirable energy in a circuit, caused by electrostatically or electromagnetically coupled external circuits.

I/O

Input/Output.

isothermal

Means an area of equal temperature. The 2286/5 Thermocouple Input Connector (Option -175) uses an alloy isothermal terminal block to stabilize and equalize input lead temperatures.

Limit Values

Reference points used in alarm list programming.

Listener

IEEE-488 bus device designated by a Controller to receive data or instructions from a designated Talker or controller. There can be more than one Listener on a bus at the same time.

logical expression

An expression that can contain variables, constants, and function references, and is separated by logical operators and parentheses, yielding a logical result (true or false).

logical operator

A function that compares, selects, or matches. In the 2286, the logical operators are AND, OR, and NOT. These are used for Boolean operation. See also Boolean Algebra.

MS-DOS

MS-DOS stands for Microsoft Disk Operating System and is an operating system used by IBM PCs and compatibles.

microstrain

The unit of strain measured by a strain gauge in a 2286/5 system.

MLA

My Listen Address; IEEE-488 Bus Listen Address. ASCII codes 32 through 62 correspond to MLA 0 to MLA 30, respectively. Each instrument on the bus must have a unique Listen Address. See also MTA.

modem

A transmitter and receiver of digital data. One modem receives data from an attached computer terminal and sends the data on a modulated carrier signal to another modem. The other modem demodulates the received carrier and sends the recovered data to another computer terminal.

MTA

My Talk Address; IEEE-488 Talk Address. ASCII codes 64 through 94 correspond to MTA 0 to MLA 30, respectively. Each instrument on the bus must have a unique Talk Address. See also MLA.

NDAC

Not Data Accepted; IEEE-488 handshake signal, bus line 8. Held high by each Listener until the current data byte is accepted. Only when all Listeners on the bus have released NDAC will it go low. See also DAV, handshake, NRFD.

NRFD

Not Ready For Data; IEEE-488 handshake signal, bus line 7. Held high by each Listener until it is ready to receive a data byte. Only when all listeners on the bus have released NRFD will it go low. See also DAV, handshake, NDAC.

operand

The components of a mathematical expression. Each, when evaluated, has an arithmetic value.

operator

A term for symbols within an application program (such as + or <) that identify operations to be performed. Also see arithmetic operator, logical operator.

overrange

The state indicated by a measurement instrument when an input signal is greater (or lower) than the range that the instrument can measure.

parallel data

The system where each bit is sent on a separate line. The IEEE-488 Bus transfers parallel data. See also serial data.

parity

A method of error detection that uses one extra bit for each unit of information (such as a character). The parity bit is set to one or zero so that the total number of one-bits in the byte is even or odd, depending on the type of parity in use.

Poisson's ratio

A strain gauge parameter; the ratio of the lateral strain to the longitudinal strain in a specimen subjected to a longitudinal stress.

port

A connection point used for data transfer. See interface.

port A

The right-hand interface port on the 2286/5 rear panel. Used for remote control and measurement data acquisition.

port B

The left-hand interface port on the 2286/5 rear panel. Used for measurement data acquisition only.

protective ground

The common chassis ground that is connected to earth ground through the ground wire in the line power cord. See also signal ground.

pseudo channel

A channel dedicated to special tasks performed on measurement information supplied by other channels.

REC

Received Data, RS-232-C line 3. This line carries the stream of serial data from DCE to DTE. See also serial data, DCE, DTE.

relational expression

An expression containing variables, constants, numbers, and function references, separated by relational operators and parenthesis in such a way that the whole can be reduced to a single (true or false) result. See also relational operator.

relational operator

An operator that compares the relative value of one variable, constant, number, or expression with another variable, constant, number or expression. Examples of relational operators are "EQ","GT","LT","GE", and "LE". See also operator, relational expression.

RET

Return; RS-232-C line 7. A signal return line that serves as a zero voltage reference point for all other signals.

RFI

Radio Frequency Interference; see interference.

root directory

The directory that contains all sub-directories and files on a disk. See directory.

RS-232-C

A digital communications standard agreed upon by participating manufacturers of data communication equipment for the transfer of serial digital data between data communication equipment (DCE) and data terminal equipment (DTE). The 2286/5 is a DTE device. The standard is published and maintained by the Electronic Industries Association, 2001 Eye Street, N.w., Washington, D.C. 20006. See also DCE, DTE, serial data.

RTD

Resistance Temperature Detector; a device with a resistance that varies predictably with changes in temperature. Made of various materials, with platinum the most popular and accurate.

RTS

Request To Send; RS-232-C line 4. The signal from DTE to DCE when it has data to transmit. See also DTE, DCE.

scanner

An option in the 2286/5 system that selects a desired analog input channel for measurement.

SDC

Selective Device Clear; IEEE-488 Addressed Command, ASCII code 4. From the controller, this command causes the addressed Talker or Listener to reset to some defined state. The action taken by the device is unique to that instrument.

sector

A segment of data organized on a disk. The 2286 microfloppy disk contains 512 bytes of data per sector.

serial data

Information transmitted one bit at a time over a single line at a predefined bit rate (baud). See also baud.

serial link address

Address for a serial link device. The address range is manually set on the A/D Converter, Analog Output, and Digital I/O Assemblies.

serial link device

A 2286/5 assembly performing an output or measurement input function. There are positions (horizontal slots) for six such devices in each 2286/5.

serial port

A connection point on a computer that is used to transfer information in a serial manner. Data transmission through a serial port in the 2286/5 is in the form of asynchronous ASCII codes.

shield input

The input lead on various Data Logger options that can be grounded or connected to the low lead at a measurement point to reduce interference. The shield input is attached to the braided shield wire surrounding the conductor in the cable.

signal ground

A conductor establishing electrical ground reference potential for all transmitting circuits in a communications network.

SRQ

Service Request; IEEE-488 bus line 10. This line allows a Talker or Listener (such as the 2286/5) to interrupt the host computer when ever necessary.

strain gauge

A resistive transducer the electrical output of which is proportional to the amount it is deformed under stress or strain. Strain gauge circuits use fixed precision resistors and resistors bonded to a surface to be mechanically loaded, in quarter-, half-, or full-bridge configuration. See also bridge, gauge factor, microstrain.

Talker

An IEEE-488 connected instrument that has been designated by the Controller on the bus to send data to Listeners.

thermocouple

A pair of dissimilar conductors joined together, forming form a junction that generates a voltage when the opposite conductors are at different temperatures. The 2286/5 has provisions for 12 different types of thermocouples.

transducer

A device that converts energy from one form to another. An example of a transducer is a strain gauge.

XMT

Transmitted Data, RS-232-C line 2. The line that carries the stream of serial data from DTE to DCE. See also RS-232-C, serial data, DCE, DTE.

X-OFF

CTRL/S or DC3 ASCII code (decimal 19); sent by the receiving station to halt transmission from the sending station when information is coming too fast for the receiver to process. When able to receive more information, the receiving station sends X-ON to restart the transmitting station. See also X-ON.

X-ON

CTRL/Q or DC1 ASCII code (decimal 17); sent by the receiving station to cause the transmitting station to resume transmission of data after being halted by an X-OFF command. See also X-OFF.

Appendix 9b
Documentation for 2285B

INTRODUCTION

The 2286/5 User Guide and System Guide, document the 2286A and 2285B Data Loggers. These manuals describe both instruments, however, some features can be used with the 2286A, but not with the 2285B. Also, the 2285B does not support some option assemblies. This Appendix is provided to describe these differences.

FEATURES

The 2285B is an economical solution to a data logging system not requiring the expansion capabilities of the 2286A.

The limitations of the 2285B are listed below:

- A maximum of 100 channels
- A maximum of 100 alarm lists
- The 3.5 inch floppy disk is not supported
- The DISK and DATA TRANSFER keys are not supported

Options Not Supported

The 2285B does not support the following option assemblies:

- Math Coprocessor (Option -211)
- Counter/Totalizer (Option -167)
- Analog Output (Option -170)

OPTION COMPATIBILITY TABLE

The following table lists the available Data Logger options and indicates which model uses which option(s).

OPTION	2285B	2286A
AC Voltage Input Connector (2280A-160)	C	C
High Performance A/D Converter (2280A-161)	C	C
Thermocople/DC Volts Scanner (2280A-162)	C	C
RTD/Resistance Scanner (2280B-163)	C	C
Transducer Excitation (2280A-164)	C	C
Counter/Totalizer (2280B-167)		C
Digital I/O Assembly (2280A-168)	C	C
Status Output Connector (2280A-169)	C	C
Analog Output (2280B-170)		C
Current Input Connector (2280A-171)	C	C
Transducer Excitation Connector (2280A-174)	C	C
Isothermal Input Connector (2280A-175)	C	C
Voltage Input Connector (2280A-176)	C	C
RTD/Resistance Input Connector (2280B-177)	C	C
Digital Status Input Connector (2280A-179)	C	C
Math Coprocessor [formerly Advanced Math Processor] (2280A-211)		C
DC-100 Cartridge Tape Drive (2280A-214)		C
RS-232-C Interface (2280A-341)	C	C
IEEE-488 Interface (2280A-342)	C	C

C = Compatible

Appendix 6c
ASCII/IEEE-488 Character Set

ASCII CHAR.	DECIMAL	OCTAL	HEX	BINARY 7654 3210	DEV. NO.	MESSAGE ATN=TRUE	
NUL	0	000	00	0000 0000			ADDRESSED COMMANDS
SQH	1	001	01	0000 0001		GTL	
STX	2	002	02	0000 0010			
ETX	3	003	03	0000 0011			
EOT	4	004	04	0000 0100		SDC	
ENQ	5	005	05	0000 0101		PPC	
ACK	6	006	06	0000 0110			
BELL	7	007	07	0000 0111			
BS	8	010	08	0000 1000		GET	
HT	9	011	09	0000 1001		TCT	
LF	10	012	0A	0000 1010			
VT	11	013	0B	0000 1011			
FF	12	014	0C	0000 1100			
CR	13	015	0D	0000 1101			
SO	14	016	0E	0000 1110			
SI	15	017	0F	0000 1111			
DLE	16	020	10	0001 0000			UNIVERSAL COMMANDS
DC1	17	021	11	0001 0001		LLO	
DC2	18	022	12	0001 0010			
DC3	19	023	13	0001 0011			
DC4	20	024	14	0001 0100		DCL	
NAK	21	025	15	0001 0101		PPU	
SYN	22	026	16	0001 0110			
ETB	23	027	17	0001 0111			
CAN	24	030	18	0001 1000		SPE	
EM	25	031	19	0001 1001		SPD	
SUB	26	032	1A	0001 1010			
ESC	27	033	1B	0001 1011			
FS	28	034	1C	0001 1100			
GS	29	035	1D	0001 1101			
RS	30	036	1E	0001 1110			
US	31	037	1F	0001 1111			

ASCII CHAR.	DECIMAL	OCTAL	HEX	BINARY 7654 3210	DEV. NO.	MESSAGE ATN=TRUE	
SPACE	32	040	20	0010 0000	0	MLA	LISTEN ADDRESSES
!	33	041	21	0010 0001	1	MLA	
"	34	042	22	0010 0010	2	MLA	
#	35	043	23	0010 0011	3	MLA	
$	36	044	24	0010 0100	4	MLA	
%	37	045	25	0010 0101	5	MLA	
&	38	046	26	0010 0110	6	MLA	
'	39	047	27	0010 0111	7	MLA	
(	40	050	28	0010 1000	8	MLA	
)	41	051	29	0010 1001	9	MLA	
*	42	052	2A	0010 1010	10	MLA	
+	43	053	2B	0010 1011	11	MLA	
,	44	054	2C	0010 1100	12	MLA	
-	45	055	2D	0010 1101	13	MLA	
.	46	056	2E	0010 1110	14	MLA	
/	47	057	2F	0010 1111	15	MLA	
0	48	060	30	0011 0000	16	MLA	
1	49	061	31	0011 0001	17	MLA	
2	50	062	32	0011 0010	18	MLA	
3	51	063	33	0011 0011	19	MLA	
4	52	064	34	0011 0100	20	MLA	
5	53	065	35	0011 0101	21	MLA	
6	54	066	36	0011 0110	22	MLA	
7	55	067	37	0011 0111	23	MLA	
8	56	070	38	0011 1000	24	MLA	
9	57	071	39	0011 1001	25	MLA	
:	58	072	3A	0011 1010	26	MLA	
;	59	073	3B	0011 1011	27	MLA	
<	60	074	3C	0011 1100	28	MLA	
=	61	075	3D	0011 1101	29	MLA	
>	62	076	3E	0011 1110	30	MLA	
?	63	077	3F	0011 1111		UNL	

ASCII CHAR.	DECIMAL	OCTAL	HEX	BINARY 7654 3210	DEV. NO.	MESSAGE ATN=TRUE	
@	64	100	40	0100 0000	0	MTA	TALK ADDRESSES
A	65	101	41	0100 0001	1	MTA	
B	66	102	42	0100 0010	2	MTA	
C	67	103	43	0100 0011	3	MTA	
D	68	104	44	0100 0100	4	MTA	
E	69	105	45	0100 0101	5	MTA	
F	70	106	46	0100 0110	6	MTA	
G	71	107	47	0100 0111	7	MTA	
H	72	110	48	0100 1000	8	MTA	
I	73	111	49	0100 1001	9	MTA	
J	74	112	4A	0100 1010	10	MTA	
K	75	113	4B	0100 1011	11	MTA	
L	76	114	4C	0100 1100	12	MTA	
M	77	115	4D	0100 1101	13	MTA	
N	78	116	4E	0100 1110	14	MTA	
O	79	117	4F	0100 1111	15	MTA	
P	80	120	50	0101 0000	16	MTA	
Q	81	121	51	0101 0001	17	MTA	
R	82	122	52	0101 0010	18	MTA	
S	83	123	53	0101 0011	19	MTA	
T	84	124	54	0101 0100	20	MTA	
U	85	125	55	0101 0101	21	MTA	
V	86	126	56	0101 0110	22	MTA	
W	87	127	57	0101 0111	23	MTA	
X	88	130	58	0101 1000	24	MTA	
Y	89	131	59	0101 1001	25	MTA	
Z	90	132	5A	0101 1010	26	MTA	
[	91	133	5B	0101 1011	27	MTA	
\	92	134	5C	0101 1100	28	MTA	
]	93	135	5D	0101 1101	29	MTA	
^	94	136	5E	0101 1110	30	MTA	
_	95	137	5F	0101 1111		UNT	

ASCII CHAR.	DECIMAL	OCTAL	HEX	BINARY 7654 3210	DEV. NO.	MESSAGE ATN=TRUE	
`	96	140	60	0110 0000	0	MSA	SECONDARY ADDRESSES
a	97	141	61	0110 0001	1	MSA	
b	98	142	62	0110 0010	2	MSA	
c	99	143	63	0110 0011	3	MSA	
d	100	144	64	0110 0100	4	MSA	
e	101	145	65	0110 0101	5	MSA	
f	102	146	66	0110 0110	6	MSA	
g	103	147	67	0110 0111	7	MSA	
h	104	150	68	0110 1000	8	MSA	
i	105	151	69	0110 1001	9	MSA	
j	106	152	6A	0110 1010	10	MSA	
k	107	153	6B	0110 1011	11	MSA	
l	108	154	6C	0110 1100	12	MSA	
m	109	155	6D	0110 1101	13	MSA	
n	110	156	6E	0110 1110	14	MSA	
o	111	157	6F	0110 1111	15	MSA	
p	112	160	70	0111 0000	16	MSA	
q	113	161	71	0111 0001	17	MSA	
r	114	162	72	0111 0010	18	MSA	
s	115	163	73	0111 0011	19	MSA	
t	116	164	74	0111 0100	20	MSA	
u	117	165	75	0111 0101	21	MSA	
v	118	166	76	0111 0110	22	MSA	
w	119	167	77	0111 0111	23	MSA	
x	120	170	78	0111 1000	24	MSA	
y	121	171	79	0111 1001	25	MSA	
z	122	172	7A	0111 1010	26	MSA	
{	123	173	7B	0111 1011	27	MSA	
|	124	174	7C	0111 1100	28	MSA	
}	125	175	7D	0111 1101	29	MSA	
~	126	176	7E	0111 1110	30	MSA	
	127	177	7F	0111 1111			

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