MODEL 2500 INSTRUMENTATION SYSTEM

USER REFERENCE MANUAL

DANIEL MEASUREMENT AND CONTROL
HOUSTON, TEXAS

Part Number: 3-9000-591
Revision 5 Series
Revision H

NOVEMBER 1998

DANIEL

Year 2000 Warranty

The Company represents and warrants that computer programs in any medium, software, firmware and combinations thereof ("Deliverables") manufactured by the Company and incorporated into or supplied by the Company for use with goods manufactured by the Company will, under normal use and care:

      i)   recognize and accept dates falling on or after 1 January 2000;

      ii)   recognize and accept the year 2000 and every succeeding fourth year as leap years;

      iii)   recognize and accept 29 February in the year 2000 and every succeeding fourth year;

      iv)   record, store, process, sequence, present and output calendar dates and data related to dates falling on or after 1 January 2000, in the same manner and with the same functionality as they do on or before 31 December 1999 and without errors or omissions; and

      v)   lose no functionality with respect to the introduction into them of dates or data related to dates falling on or after 1 January 2000;

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THE FOREGOING CONSTITUTES THE COMPANY'S SOLE AND EXCLUSIVE WARRANTY IN RELATION TO THE PERFORMANCE OF THE DELIVERABLES AS IT RELATES TO THE CHANGE FROM YEAR 1999 TO YEAR 2000 OR THE OCCURRENCE OF LEAP YEARS THEREAFTER, AND THE PURCHASER'S EXCLUSIVE REMEDY FOR BREACH THEREOF. IN NO EVENT WILL THE COMPANY BE LIABLE FOR INDIRECT, CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES, INCLUDING LOSS OF USE, BUSINESS INTERRUPTION OR LOSS OF PROFITS, IRRESPECTIVE OF WHETHER THE COMPANY HAD NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

The foregoing warranty shall remain valid until the later of December 31, 2000 or one year after the date that the Deliverable was shipped.

DANIEL INDUSTRIES, INC.
MODEL 2500 INSTRUMENTATION SYSTEM
USER REFERENCE MANUAL

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Extended warranty - Models 2470, 2480 and 2500 are warranted for a maximum of twenty-four (24) months. The Danalyzer valves are warranted for the life of the instrument and the columns for five years.

The warranties specified herein are in lieu of any and all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

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*MODEL 2500*_____

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INTRODUCTION

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER is an advanced state-of-the-art, microprocessor-based computer used to control and measure the numerous physical and dynamic characteristics of fluids, such as liquids and gases. Compatible with most process flowmeters and transmitters, the MODEL 2500 is a state-of-the-art instrument with both a large input/output capacity and a powerful processor possessing the programmable capabilities necessary for the hundreds of applications required for a demanding environment.

The DANIEL INDUSTRIES MODEL 2500 software can be configured to:

- Perform a broad range of flow measurement and process applications without compromising the exact needs of the application and without the expense of a custom instrument.

- Monitor and read live transmitter inputs, both analog and digital.

- Produce multiple calculated outputs.

- Act as a controller for meter prover applications.

- Serve as a Remote Terminal Unit (RTU) furnishing calculated data on demand to a "Host" computer or a Supervisory Control and Data Acquisition (SCADA) system.

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The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER consists of the following:

- MODEL 2500 computer

- BASE25 operating system (resident in the EPROM of the MODEL 2500 microcomputer)

- Specialized application software that provides for customized configuration of the microcomputer for specific tasks

MODEL 2500 HARDWARE

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER hardware comes in either a one-board system or a two-board system. Both systems function identically with the same baseline and software. The number of inputs and outputs required by the user will dictate whether a one- or a two-board system is needed.

Refer to Figures 1-1 and 1-2 for a graphic depiction of the differences between the two systems. For more detailed specifications, refer to the MODEL 2500 Microcomputer Hardware Manual, Daniel P/N 3-9000-590.

INPUT   OUTPUT

6 ANALOG   2 ANALOG
                                               4-20 mA

6 CONTACT
CLOSURE   6 CONTROL

3 FREQUENCY   1 FORM ''C''
                                               ALARM CONTACT

1 PROVER

RS232C/RS422/RS485   RS232C

TWO BIDIRECTIONAL PORTS

- COMMUNICATION -

Figure 1-1

INPUT   OUTPUT

18 ANALOG

24 CONTACT
CLOSURE

8 FREQUENCY

2 PROVER

4 ANALOG
4-20 mA

24 CONTROL

1 FORM ''C''
ALARM CONTACT

RS232C/RS422/RS485   RS232C

THREE BIDIRECTIONAL PORTS

- COMMUNICATION -
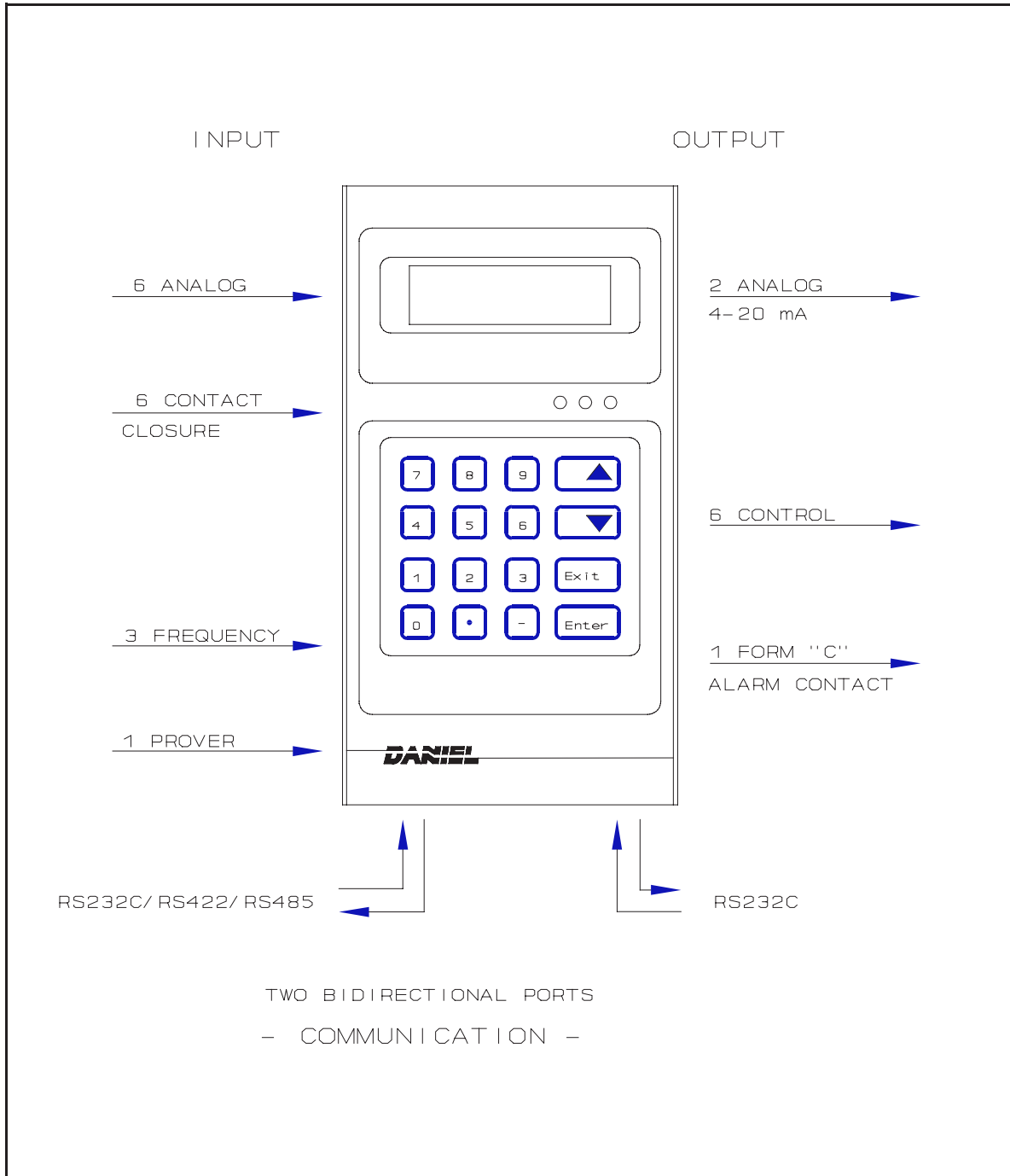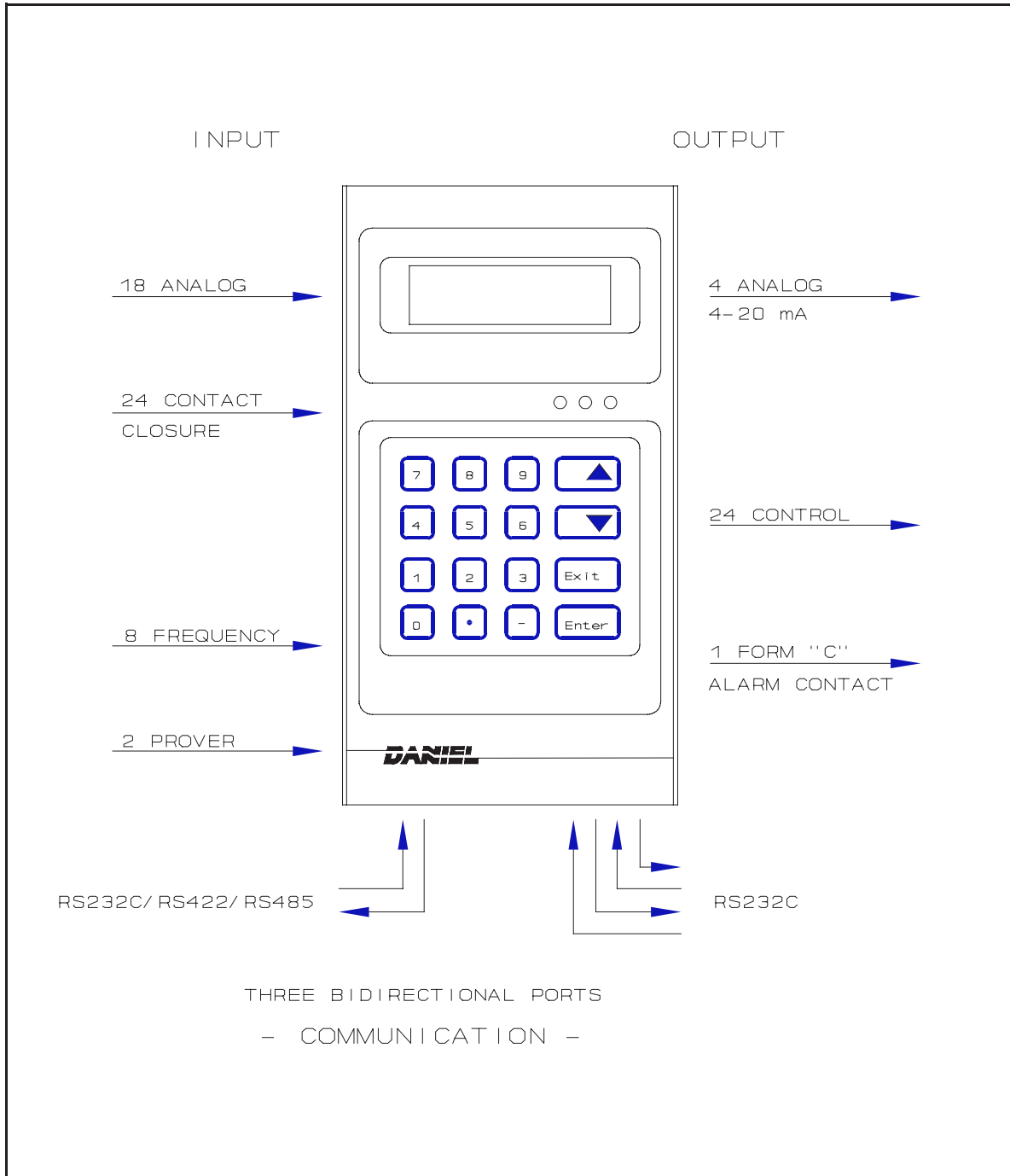
Figure 1-2

_____

MODEL 2500 SOFTWARE

The DANIEL INDUSTRIES MODEL 2500 specialized application software is developed in conjunction with the CONFIG25 program. The CONFIG25 program is designed to run on an IBM PC or compatible personal computer.

This manual provides the basic operational information to download and operate software in the MODEL 2500, which contains a Revision 5.00 level or higher. The new generation of BASE25 allows the user to download any Revision K.2 or higher applications without requiring a new analysis of an application under a different Config25.

Prior to Revision 5.00 baseline, applications had to be developed, analyzed, and run on software that was of the same revision level. Revision 5.00 and higher firmware (hereafter referred to as 5.nn), is designed to support applications developed on multiple Daniel CONFIG25 software releases.

The following table lists the CONFIG25 software releases that are supported and the baseline used for execution. The following compatibility rules are imposed by the download routine.

CONFIG25 Revision	Release Date	Compatible BASE25 Revisions				
		K.2	L.7	L.8	N	5.nn
K.2	12/86	yes	no	no	no	yes
L.7	6/87	no	yes	yes	yes	yes
L.8	10/87	no	yes	yes	yes	yes
N	2/88	no	no	no	yes	yes
5.nn	12/89	no	no	no	yes	yes

MODEL 2500 CONTROL AND DISPLAY DEVICES

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER operating commands and data are entered, changed, and displayed on the instrument's front panel as illustrated in Figure 2-1. The front panel is composed of the following:

-   Three status light-emitting diodes (LED)

-   Backlighted, two-line liquid crystal display (LCD)

-   16-key keypad (symmetrically arranged in four columns with four keys in each column)

Additionally, The MODEL 2500 instrument may be controlled from either the local front panel on the instrument itself or from a remote front panel connected to the MODEL 2500 by means of a serial port.
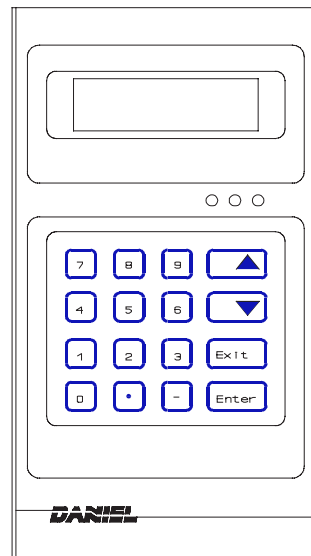
Figure 2-1

MODEL 2500 LED STATUS LIGHTS

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER front panel has three LED status lights arranged horizontally above the keypad and colored, from left to right, green, yellow, and red. The different colors indicate different conditions or situations.

GREEN LIGHT — Indicates that the correct password has been properly entered (and not timed out), or that the MODEL 2500 system will accept keyboard entries for modifying application data and system parameters.

YELLOW LIGHT — Indicates that an alarm signal has been sensed, but has not been acknowledged.

RED LIGHT — Indicates that an alarm signal is currently active.

MODEL 2500 DISPLAY SCREEN

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER front panel has a LCD screen located at the top of the front panel which is electro-luminescent backlighted for readability under various ambient lighting conditions.

This screen displays two lines of alphanumeric characters with 16 characters in each line, which provide for the readout of data, system command and prompts, and computation results. Numeric values are displayed in appropriate engineering units when applicable.

The display also has an adjustable viewing angle so that instruments, which are mounted either at a relatively low or high height, may be adjusted for comfortable viewing.

To adjust the LCD for comfortable viewing after installation:

-   Release the catch located at the bottom of the panel

-   Pull the display unit forward approximately one inch

-   Locate the small potentiometer on the left hand side of the display board in the center, approximately 1/2 " from the front, as illustrated below. With a small screwdriver adjust the angle for the most comfortable viewing.

MODEL 2500 KEYPAD

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER front panel has a 16-key keypad which gives the user the ability to enter and change data and system commands. The keypad is located approximately in the center of the panel, and is symmetrically arranged in four columns of four keys each.

Ten of the 16 keys are marked with the numbers 0 through 9, arranged in descending order. The remaining keys are marked with a decimal point, a minus sign, an UP arrow, a DOWN arrow, and the command words of EXIT and ENTER.

The UP arrow, DOWN arrow, EXIT and ENTER keys have been assigned specific functions. The keys and their functions are defined below:

UP/DOWN
Arrow Keys   Sequences the front panel display forward or backward through a menu or sub-menu. The display can be changed one step at a time by depressing a key repeatedly, or it can be sequenced rapidly by holding down a key.

EXIT Key   Moves the display to the next higher menu.

ENTER Key   Selects the sub-menu displayed on the front panel, enters the data that has been keyed-in on the display, and initiates a printout of a report when the name of the report is displayed on the front panel.

A further discussion of the keypad is provided later when operation of the instrument is explained in greater detail.

MODEL 2500 REMOTE FRONT PANEL

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER remote front panel is an external terminal connected to the MODEL 2500 by means of a serial port. The same functions that are possible on the front panel of an on-site MODEL 2500 are also possible with the remote front panel. However, only one front panel may be active at a given time.

Activation of the remote front panel is made possible by assigning it to a serial port using one of the PORTUSE selections in the Serial Ports sub-menu. Control is returned to the front panel of the on-site unit from the remote front panel by changing the PORTUSE selection to an option other than the remote front panel.

Selecting the remote front panel or returning control to the front panel of the on-site unit may take as long as 30 seconds before the operation is complete. The remote front panel responds more slowly than the front panel of the on-site unit to both keyboard entry and display refreshing.

When the remote front panel is selected, the LCD screen of the on-site unit displays the following message:

```
┌─────────────────────────┐
│                         │
│      REMOTE FRONT       │
│    PANEL SELECTED       │
│                         │
└─────────────────────────┘
```

_____

NOTE!   If the remote front panel fails when the remote unit is in control or if for some other reason, communications is lost between the on-site unit and the remote front panel, control can be returned to the front panel of the on-site unit by simultaneously pressing the zero, decimal, and minus keys.

_____

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STARTUP AND APPLICATION DOWNLOAD

After the DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM has been mechanically and electrically installed, startup and application download procedures can begin. For instructions, refer to Daniel Industries Manual, P/N 3-9000-590.

Unless the MODEL 2500 has been supplied with a resident program at the factory, there must be a computer available (IBM PC or equivalent), which is connected to the communications port on the Model 2500. If the MODEL 2500 has been supplied with a resident program at the factory, a computer (IBM PC or equivalent) will not be necessary.

Your software is delivered on 360 KB diskette(s) or on 3.5" diskette(s) archived in a compressed format which cannot be directly executed until properly installed. In most cases the installed software on the hard disk will be the working copy and the distribution diskette will serve as a backup. The following instructions enable you to install your software on a hard drive or on another diskette.

a. Insert the distribution diskette in drive A and type:

   A: <⎯⌐   <ENTER>

b.   A:\>INSTALL   <⎯⌐   <ENTER>

c. Follow the instructions on your screen.

INITIALIZING SEQUENCE

After power is applied to the DANIEL INDUSTRIES MODEL 2500 INSTRUMENT SYSTEM, it automatically performs an initializing sequence, whether the startup is considered to be a "cold" or "warm".

In a "cold" startup, power is switched on to the MODEL 2500, and the initializing sequence:

- Determines if the instrument is configured for a specific application

- Performs a series of self-diagnostic tests

The self-diagnostic tests ensure that all internal circuitry and devices in the instrument are operational.

In a "warm" startup, which occurs after the power supply has been briefly interrupted or a "watchdog" message has indicated a problem in the program, the initializing sequence, again:

- Determines if the instrument is configured for a specific application

- Performs a series of self-diagnostic tests

During a "warm" startup, the front panel displays a copyright message and copyright date for several seconds before performing the initializing sequence. However, during a "cold" startup, the copyright message does not appear.

TEST MALFUNCTIONS

In the case of an internal malfunction detected within the MODEL 2500:

- Alarm contact is actuated and the red LED glows on the front panel.

- Unit automatically ceases operation and no longer accepts data from the keypad.

- Cause of the failure is displayed in English on the LCD screen.

Malfunctions indicating failure in the self-diagnostic test, or a specific application are illustrated below:

1. The following illustrated message of the MODEL 2500 LCD screen indicates that a memory test of the Random Access Memory (RAM) has failed. The characters XXXX indicate the RAM integrated circuit where the error occurred.

```
┌─────────────────────┐
│ MEMORY ERROR        │
│ BLOCK XXXX          │
└─────────────────────┘
```

2. The following illustrated message of the MODEL 2500 LCD screen indicates that a required programmable read-only memory (PROM) is not installed in the unit, or is improperly installed.

```
┌─────────────────────┐
│   PROM MISSING      │
│                     │
└─────────────────────┘
```

3.　The following illustrated message of the MODEL 2500 LCD screen indicates that a PROM has been changed since installation, or is being read improperly. The message on line 2 (XXXX) is the location of the error.

```
CHECKSUM ERROR
     XXXX
```

4.　If the MODEL 2500 is not configured for an application:

-　Alarm contact closure inside the case can be heard opening and closing.

-　Red LED light on the front panel flashes on and off.

-　Following illustrated message of the MODEL 2500 LCD screen is displayed.

```
AWAITING CONFIG
PX BXXXX IDXXX
```

Line 2 of the display message indicates:

-　PX is the Port (for example, P2 or Port 2).
-　BXXXX is the baud rate (for example, B2400 or 2400 baud).
-　IDXXX is the COMMID (for example, ID001 or COMMID 001).

If this message is displayed when power is applied to the MODEL 2500, the instrument must be configured before proceeding.

FILE TYPES

Each application for the MODEL 2500 has three files composed of an application name and a file name extension, indicated by the three letters following the file name and separated by a dot or decimal point, to indicate the type of information contained in the file. The extensions are defined in the following table.

EXTENSION	DEFINITION
.CFG	This file contains a configuration and should not be erased unless the configuration is no longer needed.
.BTA	This file contains an analyzed configuration in a format that is ready to be downloaded to a MODEL 2500 microcomputer.
.LST	This file contains documentation that describes a configuration in a format that can be listed on a printer. Listing a .LST file on a printer provides a hard copy record of the configuration.

MEMORY RESIDENT SOFTWARE

Frequently, utility software packages such as "Sidekick" and "Prokey" are loaded by the user and remain resident in the Random Access Memory (RAM) of a PC-compatible computer when the computer is booted (activated). Usually these resident utilities do not interfere with running the DANIEL IPL25 program.

However, if the resident utility software package requires an excessive amount of memory or a utility software package with serial communications, which causes problems when downloading a configuration to a MODEL 2500 instrument, then both of these problems may be corrected by removing the user's resident utility software package(s).

HARD DRIVE USE

When using an IBM PC (or compatible computer) equipped with a hard drive, standard practice suggests that regularly used programs should be grouped in a sub-directory which is separate from the data sub-directory. The DANIEL application program IPL25 supports this practice and all the files on the distribution disk for IPL25 should be copied to the program sub-directory on the hard drive.

However, to do this proper MS-DOS PATH commands must be used to indicate the sub-directory where the files for IPL25 are located. If necessary, refer to the applicable computer manuals for details on the proper use of PATH commands.

DOWNLOADING INSTRUCTIONS

The application software may be downloaded with the DANIEL program on the application diskette, designated as IPL25. The IPL25 program, which is a new window's program, invokes the LOAD2500 program that can also be used directly.

Before attempting to download the application to the MODEL 2500, the user should complete the following preliminary procedures:

- Activate both the PC and the MODEL 2500.

- Make certain the communications link between the PC and the Model 2500 is established. If necessary, refer to the Hardware Manual, Daniel P/N 3-9000-590, for system wiring diagrams.

- Ensure that the MODEL 2500 has the proper communication ports and baud rates installed and that a communications identification number is designated.

- Make a working copy of the application diskette(s).

- Copy the application diskette(s) onto the hard drive, if the PC has a hard drive installed.

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NOTE!   Since diskette(s) wear out over time, file copies should be made and stored in safe place.

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Once these preliminary procedures have been completed, the user should perform the following steps to download the application.

1.   Place the working copy of the application diskette into the A drive.

2.   From the A:\> prompt, type IPL25 and press the ENTER key.

The following MAIN MENU screen will appear on the PC monitor.

```
┌─────────────────────────────IPL25─────────────────────────────┐
│                                                                │
│                     2500 SERIES INSTRUMENT                     │
│                LOAD2500 APPLICATION CONFIGURATION              │
│                        COPYRIGHT 1989                          │
│                                                                │
│                                                                │
│                       IPL25  Rev: 1.01                         │
│                                                                │
│                ┌──────────────────────────────┐               │
│                │   Main Menu                   │               │
│                │  ┌───────────────────────┐    │               │
│                │  │ EDIT CONFIGURATION     │    │               │
│                │  │ LOAD 2500              │    │               │
│                │  │ EXIT Program           │    │               │
│                │  │                        │    │               │
│                │  └───────────────────────┘    │               │
│                └──────────────────────────────┘               │
│                                                                │
│                                                                │
│                                                                │
│   rev 1.01       DANIEL Industries Inc.,   Copy Right 1989.────┘
└────────────────────────────────────────────────────────────────┘
```

3.   At the MAIN MENU, use the arrow keys to highlight the EDIT CONFIGURATION and press the ENTER key.

To escape back to the MAIN MENU, press the ESC (escape) key twice.

At the MAIN MENU, when the EDIT CONFIGURATION is selected and entered, the following screen appears.

```
┌─────────────────────────────────────────────────────────────────┐
│ COMMPORT   DISK-DRIVE    APPLICATIONS    BAUDRATE    COMM-ID    F1=HELP │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
└─────────────────────────────────────────────────────────────────┘
```
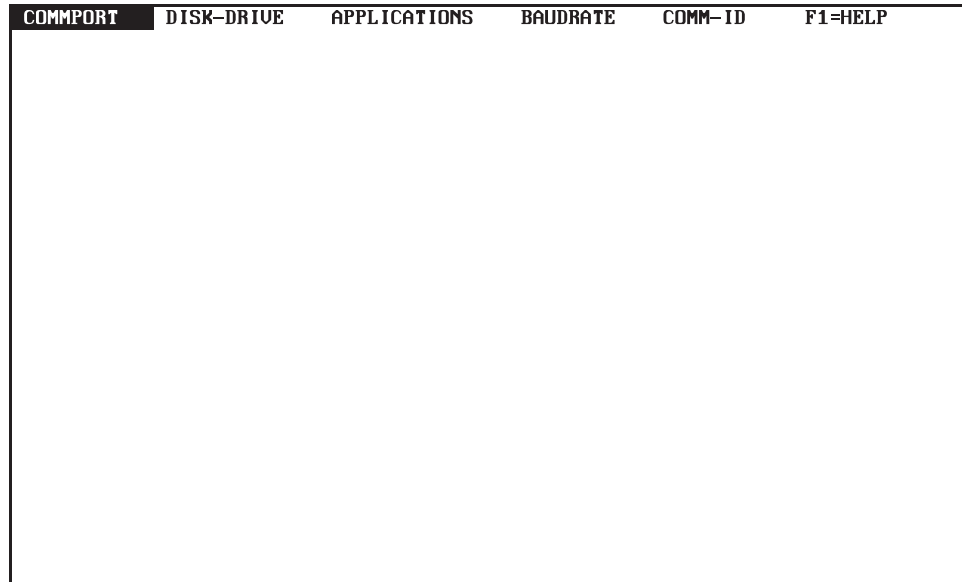
4.   Highlight the desired COMMPORT selections with the arrow keys. COMMPORT refers to the PC communications port used for serial data transfer, which is Port 1 or Port 2.

5.   After selecting the correct COMMPORT port press the ENTER key.

The reference screen at the bottom will indicate the selection. This reference screen, which shows default entries, now indicates that the user will be loading the Model 2500 on COM1. Other default entries on this reference screen indicate a baud rate of 2400 with a COMMID of 1.

_____

6.   Press the F1 function key.

      As indicated on the screen below, this causes a HELP screen to be overlaid
      in a window at the upper right portion of the screen being viewed.

```
 COMMPORT    DISK-DRIVE    APPLICATIONS    BAUDRATE    ┌──────────────────┐
┌────────┐                                            │      HELP        │
│ Com1   │                                            │                  │
│ Com2   │                                            │ ENTER = Selection│
└────────┘                                            │                  │
                                                      │ F1  = Help Window│
                                                      │                  │
                                                      │ <— = Previous Menu│
                                                      │                  │
                                                      │ —> = Next Menu   │
                                                      │                  │
                                                      │                  │
                                                      │ Press Escape     │
                                                      └──────────────────┘

        ┌──────────────────────────────────────────────────┐
        │ LOAD2500  1    B2400   ID1                        │
        └──────────────────────────────────────────────────┘
```
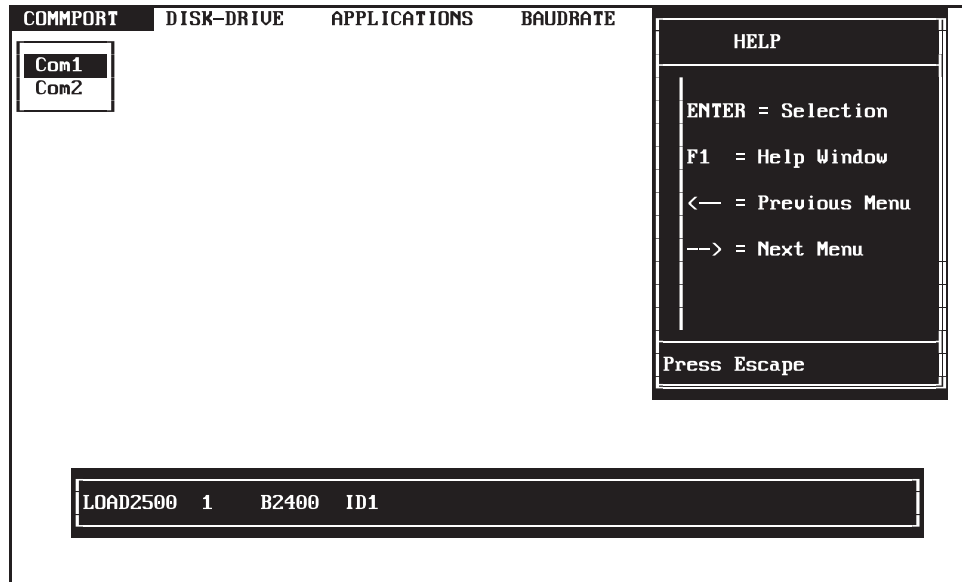
7.   At this point, the user may select and highlight the desired choice on the
      HELP screen with the arrow keys, press the ENTER key, or press the ESC
      (escape) key to exit from the HELP screen.

By using this procedure, a HELP screen is available whenever the user needs to
refer to it.

8.   After removing the HELP screen, use the arrow keys to move from the
      COMMPORT option window at the top of the screen to the DISK-DRIVE
      option window, and press the ENTER key.

_____

As indicated in the illustrated screen below, this causes a PATH screen to be overlaid in a window in the right center portion of the screen being viewed. This is a valid path if this IPL25 program is maintained on a diskette and not transferred to the hard drive.

```
COMMPORT    DISK-DRIVE    APPLICATIONS    BAUDRATE    COMM-ID    F1=HELP
              Select Path

                        Path:
                        A:\*.BTA




              LOAD2500  1    B2400  ID1
```
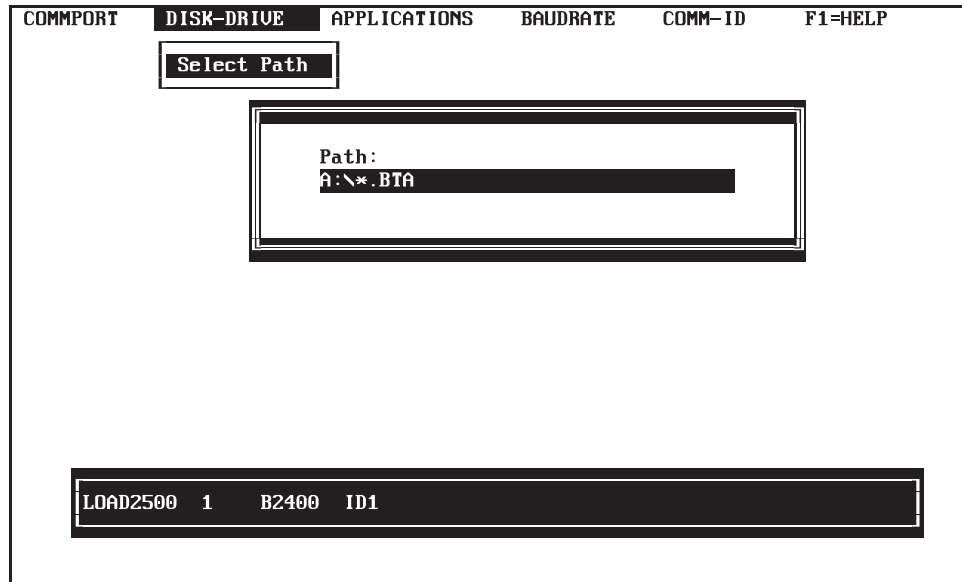
If the IPL25 program is transferred to the hard drive, the user will need to add a directory\subdirectory to the program path.

9.   At the PATH screen create a program path similar to

        C:\"directory"\"subdirectory"*.BTA

        and press the ENTER key.

A reference window at the bottom of the screen will indicate whether the newly created program path is a "Valid Path" or an "Invalid Path".

10.   Once the reference window indicates a "Valid Path" has been created, use the arrow keys to move from the DISK-DRIVE option window at the top of the screen to the APPLICATIONS option window and press the ENTER key.

As indicated in the illustrated screen below, this causes a FILES screen to be overlaid in a window in the center portion of the screen being viewed. One or more files may be listed with the BTA extension, which means that they can be downloaded to the Model 2500. Also, there may be two or more diskettes, depending on the number of applications and their size.

```
COMMPORT    DISK-DRIVE    APPLICATIONS    BAUDRATE    COMM-ID    F1=HELP
                          Select File

                                      FILES

                                         D511168A.BTA
                                         E533102B.BTA





            LOAD2500  1  A:\*.*  B2400  ID1
```
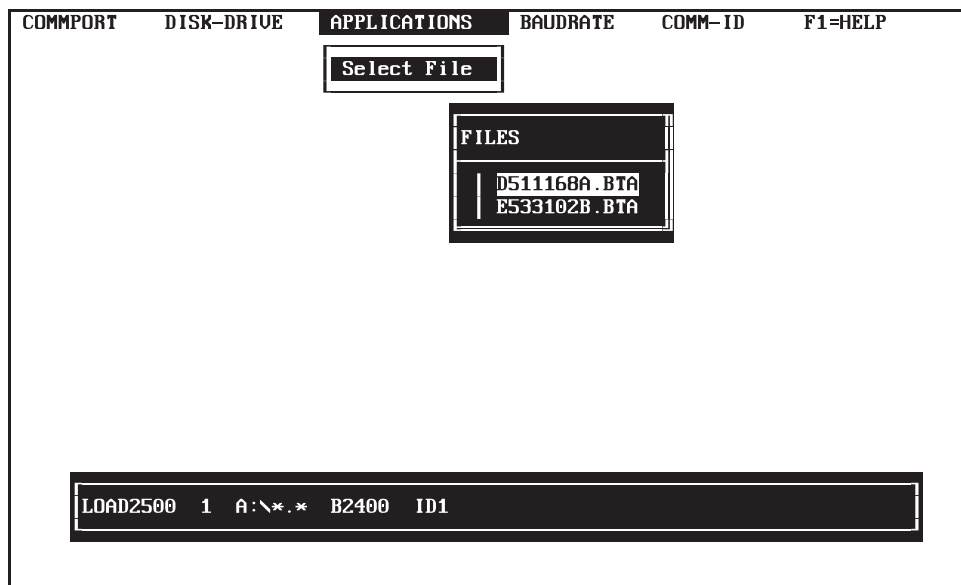
11.   At the FILES screen, select the desired application to be downloaded and press the ENTER key. The selected application will be displayed in the path number in the bottom reference screen.

12.   Once the desired application has been selected and entered, use the arrow keys to move from the APPLICATIONS option window at the top of the screen to the BAUDRATE option window. Select the desired baud rate and press the ENTER key.

_____

If the Model 2500 has no configuration program, its default baud rate is normally 2400. If the downloaded application replaces a resident program, the baud rate must match the slave baud rate on the Model 2500 receiving the application.
As indicated in the illustrated screen below, this causes a baud rate list to be overlaid in a window beneath the BAUDRATE option window at the top of the screen.

```
┌──────────────────────────────────────────────────────────────────┐
│  COMMPORT    DISK-DRIVE    APPLICATIONS   BAUDRATE    COMM-ID     F1=HELP │
│                                         ┌─────────┐                │
│                                         │  300    │                │
│                                         │  1200   │                │
│                                         │  2400   │                │
│                                         │  4800   │                │
│                                         │  9600   │                │
│                                         └─────────┘                │
│                                                                    │
│                                                                    │
│                                                                    │
│   ┌──────────────────────────────────────────────────────────┐    │
│   │ LOAD2500  1  A:\E533102B  B300  ID1                       │    │
│   └──────────────────────────────────────────────────────────┘    │
│                                                                    │
└──────────────────────────────────────────────────────────────────┘
```
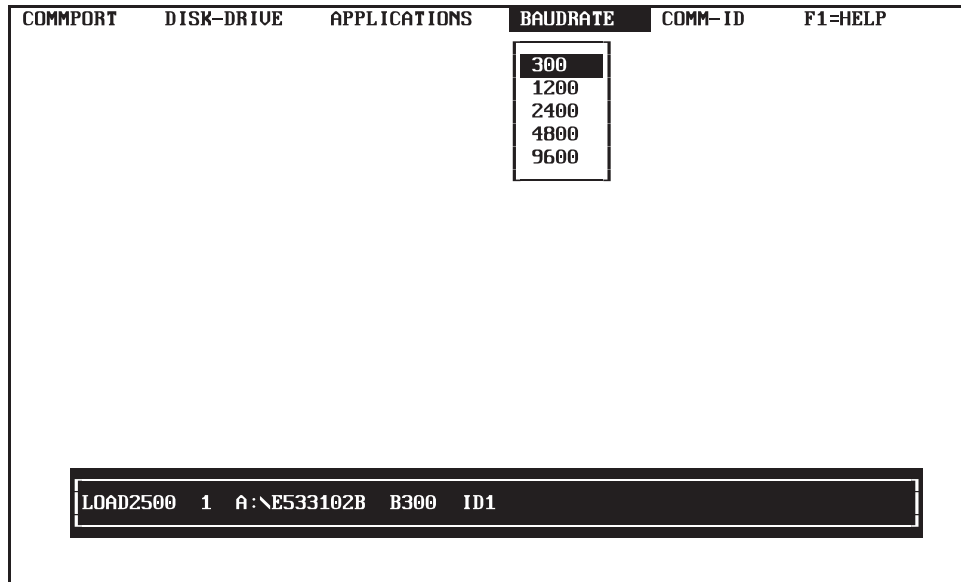
If the user selects a baud rate different than 2400, a "b" prefix, which is a code that changes the baud rate in the Model 2500, will appear just before the baud rate number in the reference screen. At this point, the user should press the ENTER key.

13.   Once the desired baud rate has been selected and entered, use the arrow keys to move from the BAUDRATE option window at the top of the screen to the COMMID option window and press the ENTER key.

As indicated in the screen below, this causes a COMMID number screen to be overlaid in a window beneath the COMMID option window at the top of the screen.

```
COMMPORT   DISK-DRIVE   APPLICATIONS   BAUDRATE   COMM-ID    F1=HELP
                                                 ┌─────────────┐
                                                 │ Enter: COMM-ID │
                                                 └─────────────┘

                        ┌──────────────────────┐
                        │                      │
                        │   Select Comm ID     │
                        │   Range (1-247)      │
                        │              █1      │
                        │                      │
                        └──────────────────────┘



        ┌──────────────────────────────────────────────────────┐
        │ LOAD2500  1  A:\E533102B  B300  ID1                   │
        └──────────────────────────────────────────────────────┘
```
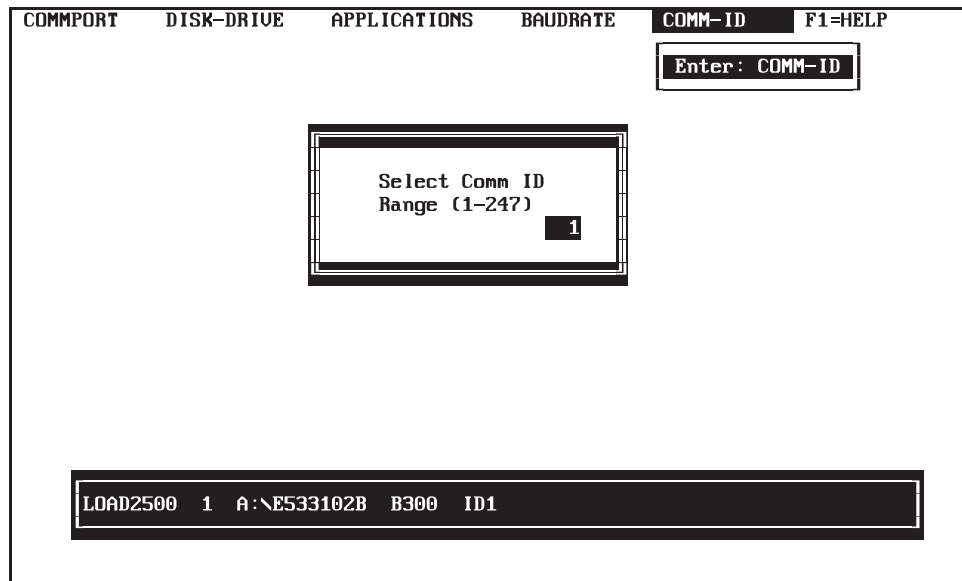
The default COMMID number is 1, but a communications identification number from 1 through 247 may be assigned. However, if an active program is resident in the user's Model 2500, the number assigned must match the COMMID number as indicated in the System Command Menu.

14.   When changing the COMMID number, the user must type in the number assigned and press the ENTER key.

       The following rules apply when changing the COMMID number:

       -      Do not place a "0" in front of one or two digit numbers.

       -      Delete mistakes by using the delete function or by typing over the error.

_____

- Correct erroneously entered numbers by pressing the ENTER key again and re-entering the number.

At this point, the user must check all entries in the reference window at the bottom of the screen. If all entries are correct, the user is ready to download the application to the Model 2500.

15. When all entries are correct, the user must press the ESC (escape) key twice to return to the MAIN MENU.

16. If the MODEL 2500 is set up and ready, at the MAIN MENU use the arrow keys to select and highlight the LOAD 2500 option and press the ENTER key to load the application.

If a problem occurs, recheck the communications link, COMMPORT, COMMID, etc., and the steps described above for loading the application.

17. When the downloading of the application is complete, use the arrow keys to select and highlight the EXIT option and press the ENTER key to leave the program.

LOAD 2500 - STAND-ALONE DOWNLOAD PROGRAM

A stand-alone utility program, LOAD2500, is provided on the DANIEL software diskette to download configurations into the DANIEL INDUSTRIES MODEL 2500.

After the MODEL 2500 has been activated and the system prompt appears, the LOAD2500 program is invoked by using the command line illustrated and explained below.

Command line: **LOAD2500 n cccccccc [Byyyy IDzzz A]**

n   Number of the computer communications port

cccccccc   BTA file name of the configuration, with the possible subdirectory location. The file extension is not entered.

Byyyy   Optional entry to set the baud rate to yyyy. Valid baud rates are 300, 1200, 2400, 4800, and 9600. If the baud rate is omitted or entered incorrectly in the command line, LOAD2500 defaults to a 2400 baud rate.

IDzzz   Optional entry to set Comm ID to zzz. Comm ID is valid from 1 to 247. If the Comm ID is omitted or entered incorrectly, LOAD2500 defaults to 1.

A   Optional entry required only for loading a configuration created with Revision G of CONFIG25.

STAND-ALONE DOWNLOAD PROGRAM EXAMPLES

Following are several examples of the command line for the downloading of
LOAD2500 configurations:

-       LOAD2500 1 D533011B B1200 ID12

        This example illustrates the downloading of application number
        D533011B through communications port 1, at a 1200 baud rate, and
        sets the Comm ID to 12.

-       LOAD2500 2 D533011B ID24

        This example illustrates the downloading of application number
        D533011B through communications port 2, at the default baud rate of
        2400, and sets the Comm ID to 24.

-       LOAD2500 1 C511009A B300

        This example illustrates the downloading of application number
        C511009A through communications port 1, at a 300 baud rate, and
        sets the Comm ID to the default value of 1.

_____

NOTE!   If all of the preceding steps have been properly
              executed and the MODEL 2500 does not accept the
              new program, make certain that the revision level of
              the BASE25 EPROMs matches the revision level of the
              Config25 program used to build the BTA file.

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The following table lists the CONFIG25 software releases that are supported and the baseline used for execution. The following compatibility rules are imposed by the download routine.

CONFIG25 Revision	Release Date	Compatible BASE25 Revisions				
		K.2	L.7	L.8	N	5.nn
K.2	12/86	yes	no	no	no	yes
L.7	6/87	no	yes	yes	yes	yes
L.8	10/87	no	yes	yes	yes	yes
N	2/88	no	no	no	yes	yes
5.nn	12/89	no	no	no	yes	yes

SYSTEM READY

If the results of the automatic initializing sequence have been satisfactory, the MODEL 2500 LCD screen gives a message similar to the following illustration, which indicates that front-panel operation can begin.

```
53301510
13-JAN-89 08:34
```

Line 1 of the display (in this example, 53301510) is the designation for the alphanumeric configuration that has been downloaded to the Model 2500. Line 2 gives the current date and time.

DATA ENTRY SECURITY

Data entry security is provided by:

- Three-position security switch

- Two-level password system consisting of a lower-level password and a restricted-user password

The lower-level password provides for changing constants and variable values that are not designated as limited-access variables. The restricted-user password provides access for changing the limited-access variables. Functioning of the passwords is controlled by the three-position security switch.

SECURITY SWITCH

A three-position security switch controls operator changes to variables in the system through the front panel. The switch is located at the rear of CPU I/O board.

The three selections provided by the switch are defined in the table below.

POSITION	DEFINITION
DOWN	Lower-level security password entry is not required to change data. Restricted-user password entry may be required.
CENTER	Password entry is allowed and required to change data.
UP	Password entry is not allowed. Data cannot be changed at the front panel of the instrument.

LOWER-LEVEL SECURITY PASSWORD

If the security switch, which is located at the rear of CPU I/O board, is in the center position, an operator must enter the lower-level security password before entering or changing variable values in the system. The lower-level security password remains active for five minutes after the last key is pressed. The system command "Unit Lock" disables the unit password and the password must be entered again in order to change data.

When the instrument is downloaded, the default lower-level password is eight 1s, (11111111). Installing a new, user-originated, lower-level password at the initial startup of the MODEL 2500 system, is recommended.

RESTRICTED-USER PASSWORD

The restricted-user password provides an additional level of security for user-specified, limited-access variables. The restricted-user password may not be entered until the lower-level password is activated.

Until the restricted-user password is entered, limited-access variables can be displayed, but cannot be changed, regardless of the state of the lower-level password. After the restricted-user password is entered, limited-access variables can be changed.

If the three-position security switch is in the center position, the restricted-user password remains active for five minutes after the last key is pressed. In this switch position, the system command "Unit Lock" disables the restricted-user password and the lower-level password.

If the three-position security switch is in the up position, the restricted-user password will not automatically time-out after five minutes, and must be disabled using the "Unit Lock" command.

The factory-installed restricted-user password is "11111111". A new, user-originated, restricted-user password should be entered at initial startup.

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CAUTION!   Since neither the standard-unit password, nor the
restricted-user password can be retrieved after
being entered, a record of each should be kept in
a secure location for future reference. However,
the standard unit password may be over-written
if the security switch is in the down position.

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DATA ENTRY AT INITIAL STARTUP

Before a DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM is placed in service, constants and variables for the application must be entered in the microcomputer memory, or changed if this data differs from factory-installed values. Data entry is made through the MODEL 2500 front panel keypad.

The following occurs when a MODEL 2500 system is configured for a specific application:

- Default value for each constant and variable required for that configuration is stored in the computer memory.

- Variables are stored in either a fixed or a dynamic mode, depending on how the values are specified when the Model 2500 is initially configured with CONFIG25.

- Variables will remain as configured until modified.

- All variables and constants are named and are available for display in real time on the front panel.

- Calculation variables are displayed only if units for the variables are assigned.

- Calculation variables can be changed manually only if units for the variables were assigned the first time the variables were defined.

PROCEDURE OF DATA ENTRY AT INITIAL STARTUP

The procedural steps for entering data during initial startup of the DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM are as follows:

1. Turn on the MODEL 2500 and ensure that the normal start-up message, which is illustrated below, is displayed.

> D513024A
> 13-JAN-89 08:34

2. Unlock the front panel for data entry by pressing the DOWN arrow on the front panel keypad several times until the message "SYSTEM COMMANDS" appears on the lower text line of the LCD screen display.

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> **NOTE!**   Continuously holding down the key, rather than pressing it several times will cause the display to scroll rapidly through the MAIN MENU and may result in overshooting the SYSTEM COMMANDS sub-menu. If this occurs, continue to press the DOWN arrow one step at a time until the message SYSTEM COMMANDS reappears.

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3. Press the ENTER key once.

4. Press the DOWN arrow one step at a time until the message "UNIT PASSWORD" appears.

5. Pressing the ENTER key once.

_____

6.   Press the number 1 key 8 times, which will cause the default password, "11111111" to appear on the LCD screen,

7.   Press the ENTER key. This will cause the green LED on the front panel to glow.

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NOTE!   The password may be changed at this time by keying in eight numbers on the front panel keypad. (The MODEL 2500 accepts prefixed zeros as discrete, which means the instrument requires all eight digits of a number such as 00000004 in order to interpret the number 4 as the password.) When the new password has been keyed in, press the ENTER key. The keyboard now can be unlocked for data entry only with the new password. The password cannot be retrieved once entered, and should be recorded in a secure location.

_____

8.   Scroll to the desired sub-menu and lower sub-menu by pressing the arrow keys.

9.   Key in new or revised data, and enter the data by pressing the ENTER key.

_____

CAUTION!   Changing values in the Model 2500 system may activate alarms, which must be cleared before placing the unit in service.

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10.   Press the arrow keys when data entry is complete to find the lower sub-menu UNIT LOCK located in the sub-menu SYSTEM COMMANDS.

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11.   Press the ENTER key when the message "UNIT LOCK" appears on the LCD screen.

_____

NOTE!   After approximately five minutes with no keyboard activity, the MODEL 2500 automatically disables the keyboard for data entry until the password is re-entered.

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TYPICAL START-UP DATA CHANGES

The following list represents data that is often changed from the factory-installed default values at the initial start-up of a MODEL 2500 configured for a specific application:

- Measured or hand-entered values of process variables

- Definitions of the metering arrangement, including:

    - Flange or pipe-tap differential pressure transmitters
    - Upstream or downstream static pressure transmitters
    - Single or dual-range differential pressure transmitters

- Settings for zero (4 mA) and full-scale (20 mA) values (in engineering units) of transmitter inputs

- Desired multipliers for readouts of flow rates and flow accumulators

- High and low alarm limits

- Calibration units for frequency-type densitometers

- Base values for temperature and pressure

- Barometric pressure for the measurement site

- Unit ID number for printout identification

- Time and date

- Contract hour and time period between printouts

TIME-OF-DAY CLOCK CHIP

DANIEL INDUSTRIES MODEL 2500 microcomputer units that have a time-of-day clock chip will continue to provide the time even when the unit is without power either because of a power failure or because the instrument is in storage.

When the MODEL 2500 is in operation, the clock chip is updated several times a day as follows:

- Approximately two-hour intervals

- Shortly after midnight each day

- Whenever the time of day is changed

The clock chip is additional and secondary to the time of day maintained by the software clock, which is an integral part of the MODEL 2500 operating system.

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MENU SELECTION

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM microcomputer enters, changes and displays operating commands and data by making selections from various menus displayed on the LCD screen located on the front panel of the instrument.

Individual menus, which are organized into groups of related data and functions, are configured for each specific application, and only appear on the display screen when required by the specific application.

MAIN MENU

The highest level menu in the MODEL 2500 is the MAIN MENU, which is activated after the completion of diagnostic testing and when the "TIME and DATE" message is displayed on the LCD screen.

Depending on the MODEL 2500 configuration, the MAIN MENU contains up to 11 sub-menus, each of which either provides a functional category for accessing system data or for controlling the instrument.

SUB-MENUS

The MAIN MENU's 12 possible sub-menus are listed below with those menus that appear in all system configurations marked with an asterisk (*).

- INPUT CHANNELS
- OUTPUT CHANNELS
- ALARMS*
- OPERATOR ENTRY
- CALCULATIONS*
- REPORTS
- TABLES
- TUBE SWITCHING
- MODBUS MASTER
- SERIAL PORTS*
- ARCHIVE
- SYSTEM COMMANDS*

When required by an application, each sub-menu may have one or more lower sub-menus that provides for specific data entry, or system control in the category covered by that sub-menu.

The following flow-chart graphically illustrates how to enter and exit each of the 11 sub-menus, and refers the user to other diagrams, which are listed at the end of this section, that illustrate the lower level sub-menus within the 11 main sub-menus.

The following is a detailed explanation of the MAIN MENU's 12 sub-menus.

INPUT CHANNELS

The INPUT CHANNELS sub-menu, which is the first selection listed on the MAIN MENU, has three lower level sub-menus. They are:

ANALOG INPUTS   The ANALOG INPUTS lower level sub-menu displays the variable names, values, units, alarm limits, scaling factors, and default values of the analog input channels.

STATUS INPUTS   The STATUS INPUTS lower level sub-menu provides for changing the states of status (discrete) input channels, and for displaying the variable names, states, and units.

PULSE INPUTS   The PULSE INPUTS lower level sub-menu allows the values of the pulse input channels to be changed, and displays the channel variable names, values, and units.

OUTPUT CHANNELS

The OUTPUT CHANNELS sub-menu, which is the second selection on the Main menu, has two lower level sub-menus. They are:

ANALOG OUTPUTS   The ANALOG OUTPUTS lower sub-menu provides for changing the values of the analog output channels and for displaying the variable names, values, units, alarm limits, and scaling factors of the channels.

CONTROL OUTPUTS The CONTROL OUTPUTS lower level sub-menu provides for changing the values of the control output channels and for displaying the variable names, values, and units.

ALARMS

The ALARMS sub-menu, which is the third selection on the MAIN MENU, has two lower sub-menus. They are:

UNACKED ALARMS The UNACKED (unacknowledged) ALARMS lower level sub-menu displays all alarms that have not been acknowledged by the operator.

CURRENT ALARMS The CURRENT ALARMS lower level sub-menu displays currently active alarms.

OPERATOR ENTRY

The OPERATOR ENTRY sub-menu, which is the fourth sub-menu on the MAIN MENU, has two lower sub-menus. They are:

NUMERIC ENTRIES The NUMERIC ENTRIES lower level sub-menu allows the values of numeric operator entries to be changed and displays the names, values, units, and alarm limits of the entries. Typical numeric entries for a MODEL 2500 configuration, which measures orifice mass and volume of a liquid, are the specific gravity of the liquid, the hour when daily reports are printed, base temperature and pressure for calculations, and pipe and orifice diameters.

SELECTION
ENTRIES   The SELECTION ENTRIES lower level sub-menu displays the name, units, and startup selection of selection list operator entries, and allows for changing the startup selections. For example, in a MODEL 2500 configured to measure orifice mass and volume, selection list operator entries are typically the type and location of orifice taps. Startup selections for tap type are pipe and flange. Startup selections for tap location are upstream and downstream.

CALCULATIONS

The CALCULATIONS sub-menu, which is the fifth sub-menu on the MAIN MENU, has the names of individual calculation sheets as lower level sub-menus. Individual calculation sheets provide programming instructions for data processing by the MODEL 2500. Representative calculation sheets include those that:

- Perform initialization routines
- Process status inputs
- Process operator entries
- Process timer functions
- Perform flow rate, volume, and mass calculations
- Process report scheduling

REPORTS

The REPORTS sub-menu, which is the sixth sub-menu on the MAIN MENU, has lower level sub-menus composed of each report produced by a MODEL 2500 configuration.

A complete report can be printed by pressing the ENTER key when the report name is displayed on the front panel.

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NOTE!   Applications in which report lengths are in excess of
one page require a printer with an 8k buffer capacity,
or the baud rate of the printer output signal must be
lowered to 300, and the RPTGAP lower level sub-menu
must be set to SPACES.

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TABLES

The TABLES sub-menu, which is the seventh sub-menu on the MAIN MENU, has
a lower level sub-menu for each data table defined in the configuration.

TUBE SWITCHING

The TUBE SWITCHING sub-menu, which is the eighth sub-menu on the MAIN
MENU, provides the following list of variables that define common switching
parameters for all tube sets and individual switching parameters for each tube in
a set.

Common switching parameters for all tube sets:

Time delay variable   The time delay variable is a user-entered interval
that allows time for a valve to change position, and
for the position change to affect the differential
pressure across the tube set before the position of
the next valve in the set is changed. The default
value for this variable is 120 seconds.

Verify DP variable   The verify DP variable enables or disables
automatic verification of the differential pressure

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level after a valve position change is ordered by the MODEL 2500. When the variable is OFF, no verification is performed.

Verify level variable	The verify level variable specifies the cutoff value for differential pressure across a tube set to be used in verifying a valve position change. The default value of this variable is 2.
Control number variable	The control number (#) variable displays the number of the tube assigned as the current control tube.

Individual tube switching parameters are listed for the first tube in a set in the following order and repeat in that same order for each subsequent tube. Tubes are listed in the desired sequence for switching the valves.

DP name	Differential pressure name is the analog input variable with a value that represents the current differential pressure transmitted.
Low	Low differential pressure switchpoint (expressed in engineering units) across a tube when the valve controlling the tube is closed. The default value for this variable is 2.
High	High differential pressure switchpoint (expressed in engineering units) across a tube when the valve controlling the tube is opened. The default value for this variable is 98.
State	Operational status of the tube being displayed (i.e., enabled, disabled, fault). The default status of this variable is "enabled".

Open   Boolean variable that opens the valve when set

Close   Boolean variable that closes the valve when set

MODBUS MASTER

The MODBUS MASTER sub-menu, which is the ninth sub-menu on the MAIN MENU, has a lower level sub-menu for defining two remote units. The remote unit definition sub-menu provides for identifying or changing the remote name ID, the communications address and state variable, and the control option for each of the two remote units.

Name   Identifies the remote unit

Communications
Address   Integer variable for the communications address of the slave unit. If a communications address is not entered, the default variable is zero. When the communications address is zero, communications with the remote unit is disabled.

State   Integer variable that contains the current MODBUS function code transmitted and received for the remote unit. The state entry provides a means of monitoring the activity between the master and remote units. Error conditions are also visible by means of this variable.

Control   Three options available here are:

                         IDLE   Indicating no communications in progress

                         ACTIVE   Indicating communications in progress

                         FAULT   Indicating failure to communicate with a slave unit

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SERIAL PORTS

The SERIAL PORTS sub-menu, which is the tenth sub-menu on the MAIN MENU, is categorized by, and divided into one-board units and two-board units.

One-board units have thirteen lower level sub-menus, which are COMMID BAUD1, BAUD2, PORTUSE1, PORTUSE2, PARITY1, PARITY2, STOPBIT1, STOPBIT2, PRTCLSLV, PRTCLMAS, RPTGAP, and COMMWAIT.

Two-board units have twenty lower level sub-menus, which are COMMID, COMMID2, BAUD1, BAUD2, BAUD3, PORTUSE1, PORTUSE2, PORTUSE3, PARITY1, PARITY2, PARITY3, STOPBIT1, STOPBIT2, STOPBIT3, PRTCLSLV, PRTCLSLV2, PRTCLMAS, RPTGAP, COMMWAIT AND COMMWAIT2.

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NOTE!   Applications with reports exceeding one page require that the printer has an 8k buffer capacity, or the baud rate of the printer output signal is lowered to 300 with the RPTGAP lower level sub-menu set to SPACES. This note applies to BAUD1 and BAUD2 of the SERIAL PORTS sub-menu for one-board units and BAUD1, BAUD2, and BAUD3 of the SERIAL PORTS sub-menu for two-board units.

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The SERIAL PORTS Lower Level Sub-Menus are as follows:

COMMID   COMMID lower sub-menu provides a specific communications address for the connected device. The addresses allowed are 1-247 without zeros in front of the one and two digit numbers. The default setting is 1.

COMMID2   (Two board units only) COMMID2 lower sub-menu provides a specific communications address for the connected device. The addresses allowed are 1-247 without zeros in front of the one and two digit numbers. The default setting is 1.

BAUD1   BAUD1 lower level sub-menu provides for displaying or changing the baud rate settings for serial port number 1. The baud rate selections are 300, 1200, 2400, 4800, and 9600, with the default rate being 1200.

BAUD2   BAUD2 lower level sub-menu provides for displaying or changing the baud rate settings for serial port number 2. The baud rate selections are 300, 1200, 2400, 4800, and 9600, with the default rate being 2400.

BAUD3   (Two-board units only) BAUD3 lower level sub-menu provides for displaying or changing the baud rate settings for serial port number 3. The baud rate selections are 300, 1200, 2400, 4800, and 9600, with the default rate being 1200.

_____

NOTE!   When changing serial port assignments using
PORTUSE1, PORTUSE2, and PORTUSE3, selecting
remote front panel (REMOTEFP) for a serial port,
which is not actually connected to a remote front panel,
results in loss of control of the unit. Control is regained
by simultaneously pressing the zero, decimal, and
minus keys on the unit's front panel keypad.

Downloading the Model 2500 can only be done through the
SLAVE port, *not SLAVE #2*. If 2 SLAVE ports are required
with one SLAVE port assigned to each board, a two-board unit
is required.

_____

PORTUSE1   PORTUSE1 lower level sub-menu provides for displaying
or changing the way serial port number 1 is being used
(NONE, REPORTS, SLAVE, MASTER, REMOTEFP,
USERCOMM), with the default being REPORTS.

PORTUSE2   PORTUSE2 lower level sub-menu provides for displaying
or changing the way serial port number 2 is being used
(NONE, REPORTS, SLAVE, MASTER, REMOTEFP,
USERCOMM), with the default being SLAVE.

PORTUSE3   PORTUSE3 lower level sub-menu provides for displaying
or changing the way serial port number 3 is being used
on a two-board unit (NONE, REPORTS, SLAVE,
MASTER, REMOTEFP, USERCOMM), with the default
being NONE.

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PARITY1   PARITY1 lower level sub-menu provides for displaying or changing the parity of serial port number 1 (EVEN, ODD, NONE), with the default parity being EVEN.

PARITY2   PARITY2 lower level sub-menu provides for displaying or changing the parity of serial port number 2 (EVEN, ODD, NONE), with the default parity being EVEN.

PARITY3   PARITY3 lower level sub-menu provides for displaying or changing the parity.

STOPBIT1   STOPBIT1 lower level sub-menu provides for displaying or changing the number of stopbits transmitted from serial port number 1 (1, 1 1/2, 2), with the default stopbit setting being 1.

STOPBIT2   STOPBIT2 lower level sub-menu provides for displaying or changing the number of stopbits transmitted from serial port number 2 (1, 1 1/2, 2), with the default stopbit setting being 1.

STOPBIT3   (Two-board units only) STOPBIT3 lower level sub-menu provides for displaying or changing the number of stopbits transmitted from serial port number 3 (1, 1 1/2, 2), with the default stopbit setting being 1.

PRTCLSLV   PRTCLSLV lower level sub-menu provides for displaying or changing the type of communications used by any one of the serial ports, which is defined in the portuse section as a SLAVE (MODASCII or MODRTU), with the default type being MODASCII.

PRTCLSLV2   (Two-board units only) PRTCLSLV2 provides the same function as PRTCLSLV for two-board units.

PRTCLMAS	PRTCLMAS lower level sub-menu provides for displaying or changing the type of communications used by any one of the serial ports, which is defined in the portuse section as a MASTER (MODASCII or MODRTU), with the default type being MODASCII.
RPTGAP	RPTGAP lower level sub-menu provides for selecting SPACES, FORMFEED, or ANSIHOME with SPACES, with the latter being the default setting, and also with providing spaces between report printouts, providing, through FORMFEED, a formfeed command between reports, and providing, through ANSIHOME, printing reports with special control characters to permit reports to be displayed on an ANSI-type terminal.
COMMWAIT	COMMWAIT provides a delay (in tens of milliseconds) between receiving a message and transmitting a response. The COMMWAIT default value is 20 (200 milliseconds).
COMMWAIT2	(Two-board units only) COMMWAIT2 provides the same function as COMMWAIT for two-board units.

ARCHIVE

The ARCHIVE sub-menu, which is the eleventh sub-menu on the MAIN MENU, provides for data storage and retrieval similar to a file.

SYSTEM COMMANDS

The SYSTEM COMMANDS sub-menu, which is the twelfth sub-menu on the MAIN MENU, has nine lower level sub-menus. They are:

DATE/TIME PARAMETERS	Sets the date and time

UNIT PASSWORD

Allows entering and/or changing the eight-digit lower-level password that unlocks the front panel to change data other than limited access variables. Default is "11111111".

RESTRICTED PSWD

Allows entering and/or changing the eight-digit restricted-user password that permits a user to change limited access variables. Default is "11111111".

UNIT LOCK

Allows locking the keyboard after an authorized user has entered or changed data in the MODEL 2500.

UNIT ID NUMBER

Provides a four-character identification number that appears on all reports. Default is "0".

COMM PASSWORD

Provides a security handshake for communications. Default is "11111111".

COMMID NUMBER

Provides a communications address that can be any number from 1 through 247. Default is "1".

LOGGER

Provides for either calculation-initiated or automatic printing of current alarm conditions and operator changes.

Logs are printed on the serial port selected for REPORTS. Five selection entries are provided for the LOGGER command. They are shown in the chart below:

Selection	2500 Operation
NO LOG	No logging is performed.
ALRM SET	Alarm set logging is performed.
ALRM S/R	Alarm set and reset logging is performed.
OPCHANGE	Operator change logging is performed.
ALRM&OPR	ALRM S/R and OPCHANGE selections are combined.

Log formats are illustrated below:

ALARM SET Logging:

```
----------------------------------------------------------------------------------------------------------------
      53301510      UNIT:0000    ALARM SET LOGGER      JAN 13 1987 09:14
      TEMP LO-LO LIMIT         =       -2              -3.
----------------------------------------------------------------------------------------------------------------
```

ALARM RESET Logging:

```
----------------------------------------------------------------------------------------------------------------
      53301510      UNIT:0000    ALARM RESET LOGGER  JAN 13 1987 09:14
      TEMP LO-LO LIMIT         =       -2              103.
----------------------------------------------------------------------------------------------------------------
```

OPERATOR CHANGE Logging:

```
----------------------------------------------------------------------------------------------------
      53301510   UNIT:0000  OPERATOR CHANGE LOGGER  JAN 13 1987 09:14
      TEMP  FIXED VALUE                                        103.
----------------------------------------------------------------------------------------------------
```

CURRENT ALARMS Logging:

```
----------------------------------------------------------------------------------------------------
      53301510   UNIT:0000  CURRENT ALARMS LOGGER  JAN 13 1987 09:14
      TEMP LO-LO LIMIT         =      -2            -3.
      TEMP LO LIMIT            =      -2            -3.
----------------------------------------------------------------------------------------------------
```

If a log is requested and no alarms or operator changes are present, the normal log header is printed, followed by the message: "The list is empty".

CHECKSUM	Detects changes made to configurations provided by DANIEL INDUSTRIES, INC. and is generated from fixed data tables in the configuration following a download. When changes are made to a configuration and downloaded, the checksum changes, even if the configuration appears to remain the same.

MENU DISPLAY AND SELECTION PROCEDURE

Menu selections are selected and displayed on the DANIEL INDUSTRIES MODEL 2500 by pressing the UP and DOWN, and the EXIT and ENTER keys.

A detailed explanation of the functioning of each of these four keys follows:

ENTER Key

- Enters data and selects entry options displayed on the MODEL 2500 front panel LCD screen.

- Prints a line report when the name of the report is displayed on the LCD screen.

- Provides access to selections on the menu levels.

  For example, if the TIME and DATE message is displayed, which indicates that the MAIN MENU is currently active, pressing any key one time displays the first selection of the MAIN MENU. This first selection is INPUT CHANNELS, if INPUT CHANNELS is active in the configuration, which is then displayed on the LCD screen.

  Pressing the ENTER key again displays the first selection of the INPUT CHANNELS sub-menu. This first selection is ANALOG INPUTS, if ANALOG INPUTS is active in the configuration, and which is then displayed on the LCD screen.

EXIT Key

-         Moves the display to the next higher level menu.

          For example, if INPUT CHANNELS and ANALOG INPUTS
          are active in the configuration, and if the message "ANALOG
          INPUTS" is displayed on the bottom line of LCD screen, this
          indicates that the current menu level is the INPUT
          CHANNELS.

          Pressing the EXIT key one time displays the message "INPUT
          CHANNELS" on the bottom line, indicating the current menu
          level is now the MAIN MENU.

UP ARROW Key

-         Steps the display up through the selections on the active menu.

          For example, if the MAIN MENU is active and the last
          selection, SYSTEM COMMANDS is displayed, pressing the UP
          ARROW key one time displays the next higher selection on the
          MAIN MENU, and the message "ARCHIVES" appears, if
          ARCHIVES is active in the configuration.

          Pressing the UP ARROW key another time will display the next
          higher MAIN MENU selection, SERIAL PORTS.

          Holding down the UP ARROW key rather than pressing it one
          step at a time causes the display to continue moving up through
          the menu selections rather than displaying one selection at a
          time. If INPUT CHANNELS is active in the configuration, and
          if the UP ARROW key is pressed when the first selection,
          INPUT CHANNELS, is displayed, the display does not loop to
          the last selection, but continues to read INPUT CHANNELS.

_____

DOWN ARROW Key

-                     Displays through the selections of the menu level that is active.

For example, if INPUT CHANNELS and OUTPUT CHANNELS are both active in the configuration, and if the MAIN MENU is active with one of the menu selections, such as INPUT CHANNELS, being displayed, pressing the DOWN ARROW key one time displays the next selection on the MAIN MENU, and the message "OUTPUT CHANNELS" appears.

Pressing the DOWN ARROW key again will display the next MAIN MENU selection, ALARMS. Holding down the DOWN ARROW key rather than pressing it one step at a time causes the display to continue moving down through the menu rather than displaying one selection at a time. If the DOWN ARROW key is pressed when the last selection, SYSTEM COMMANDS, is displayed, the display will loop back to the first selection, INPUT CHANNELS, if INPUT CHANNELS is active in the configuration.

MENU FLOW CHART DIAGRAMS

The following flow chart diagrams illustrate the following:

-   Relationship of the MAIN MENU's 11 sub-menus

-   Relationship of these 11 sub-menus to the lower level sub-menus

```
                    ┌──►DATE & TIME
         ┌──────────┘
    │ENTER │
    └─────────┐
              │
         ┌────┴──►INPUT CHANNELS ─────────────│ENTER │──────────►(SEE SHEET  -2)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     OUTPUT CHANNELS ···············│ENTER │··········►(SEE SHEET  -3)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     ALARMS ························│ENTER │··········►(SEE SHEET  -4)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     OPER ENTRY ····················│ENTER │··········►(SEE SHEET  -5)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     CALCULATIONS ··················│ENTER │··········►(SEE SHEET  -6)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     REPORTS ·······················│ENTER │··········►(SEE SHEET  -7)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     TABLES ························│ENTER │··········►(SEE SHEET  -8)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     TUBE SWITCHING ················│ENTER │··········►(SEE SHEET  -9)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     MODBUS MASTER ·················│ENTER │··········►(SEE SHEET  -10)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     SERIAL PORTS ··················│ENTER │··········►(SEE SHEET  -11)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     ARCHIVES ·····················│ENTER │··········►(SEE SHEET  -12)
         │  ┌───┐  ┌───┐
         │  │ ▲ │  │ ▼ │
         │  └───┘  └───┘
         │          │
         │     SYSTEM COMMANDS ···············│ENTER │··········►(SEE SHEET  -13)
         │        ┌───┐
         │        │ ▲ │
         │        └───┘
         └◄─────────┘
```

11 SUB-MENUS CHART
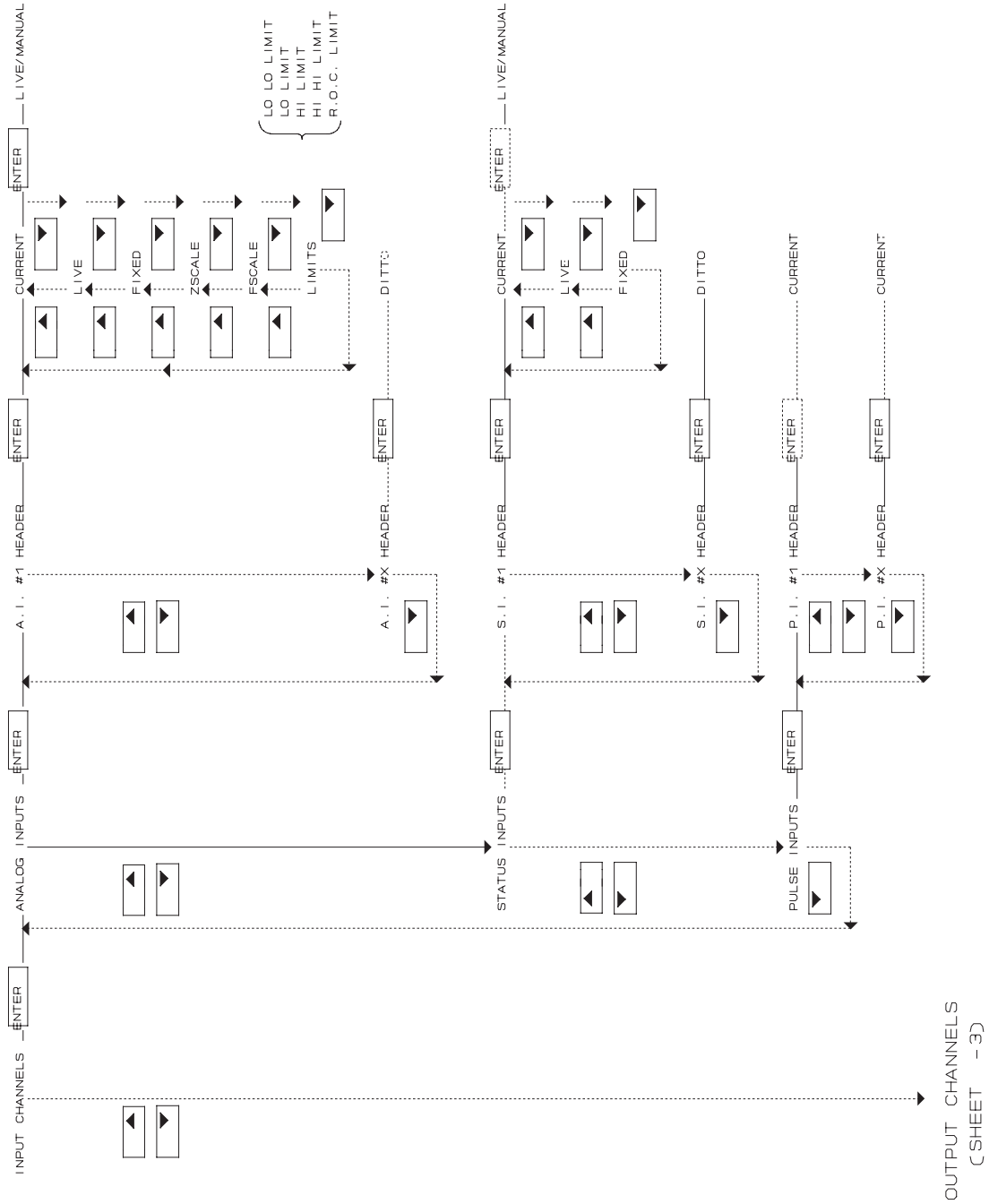
INPUT CHANNELS CHART
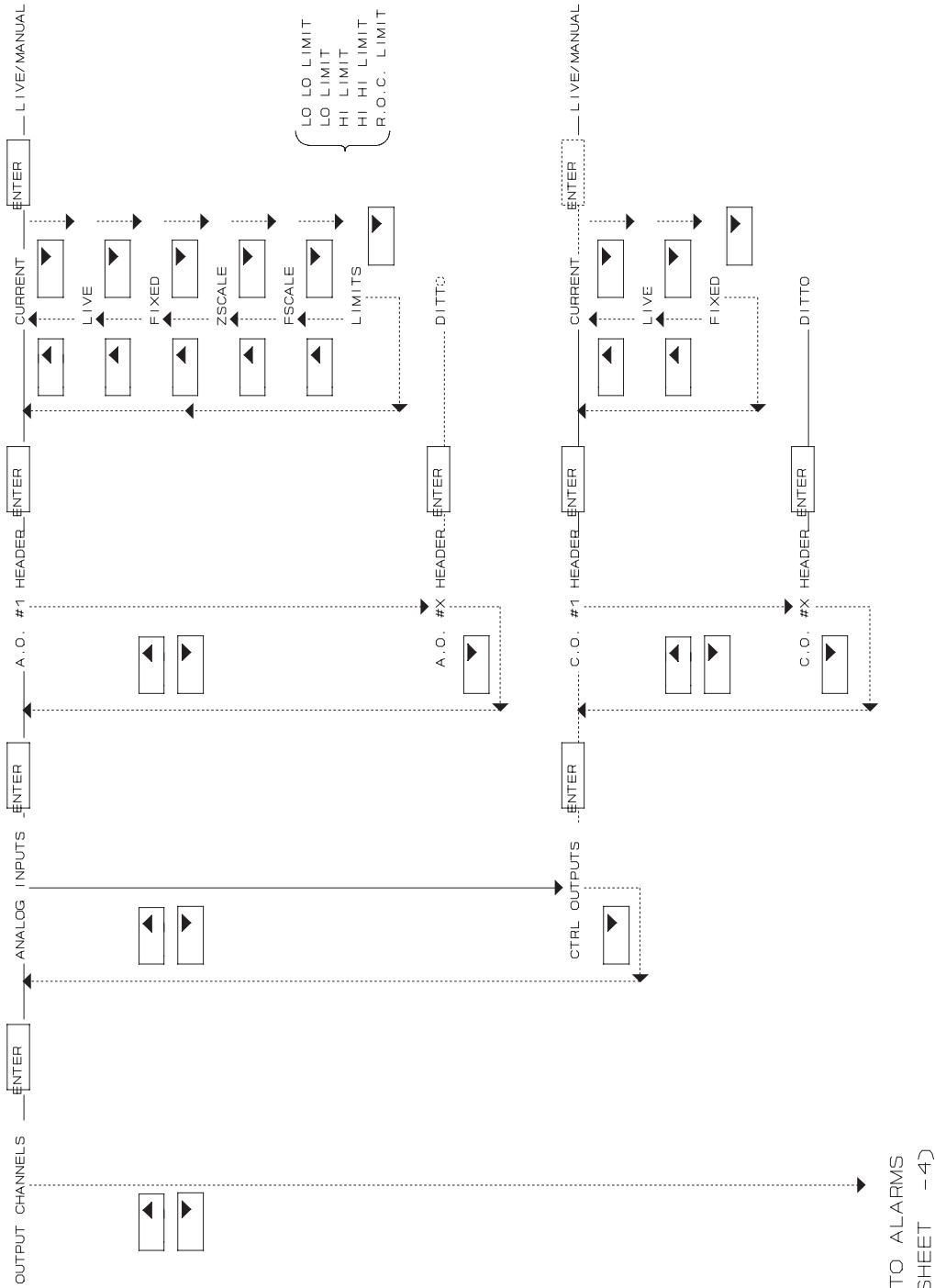
OUTPUT CHANNELS CHART

ALARMS CHART

OPERATOR ENTRY CHART

CALCULATIONS CHART

REPORTS ....ENTER   REPORT 1 _____ENTER _____ PRINT REPT NO. 1

▲   ▲

▼   ▼

REPORT X ....ENTER .... PRINT REPT NO. X

▼

TO TABLES
(SHEET -8)

REPORTS CHART

TABLES .... [ENTER]   TABLE 1   [ENTER]   STRT. ROW _____ [EXIT] _____ STRT. ROW

[▲]   [▲]   NEW VALUE OF   NEW VALUE OF
[▼]   [▼]   STRT. ROW   STRT. ROW

                                                                        [ENTER]   [ENTER]
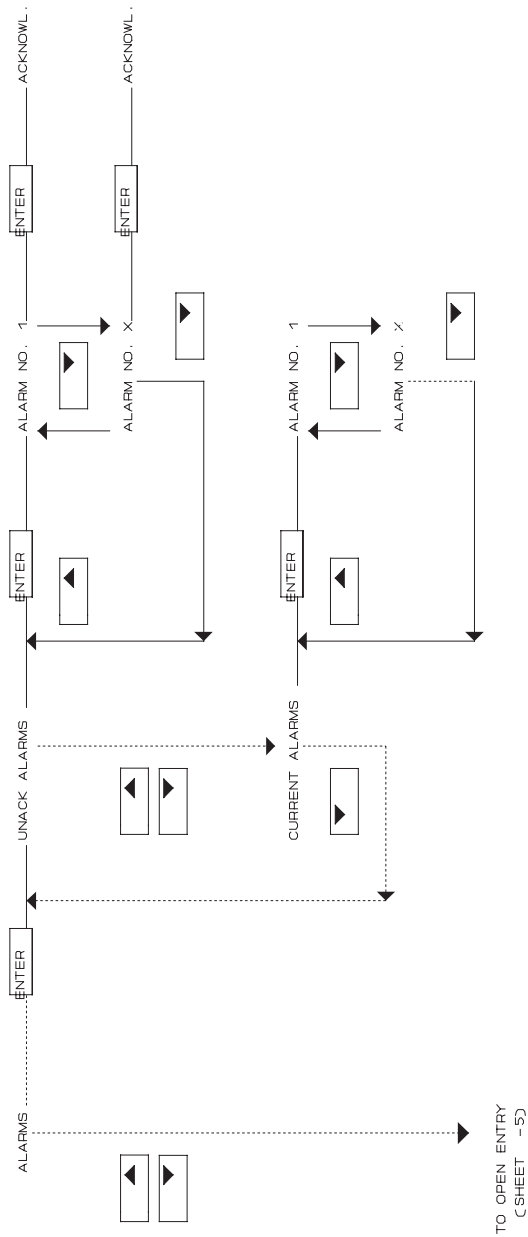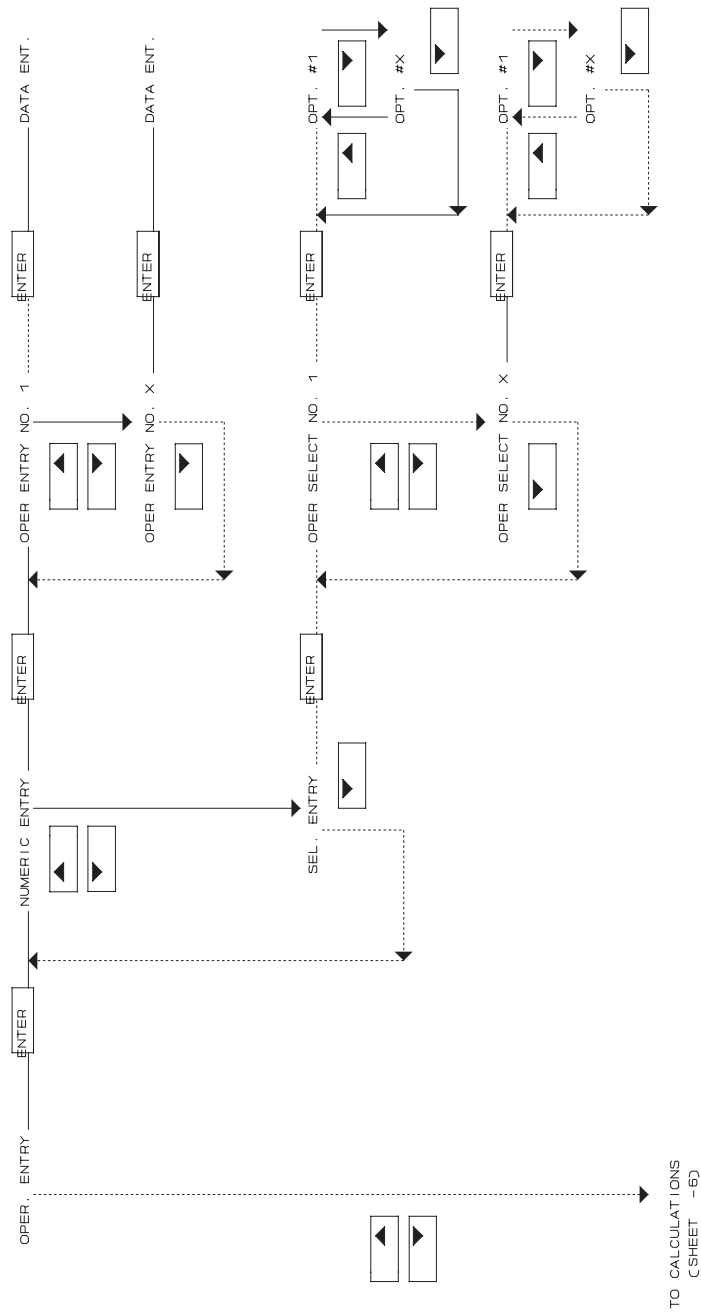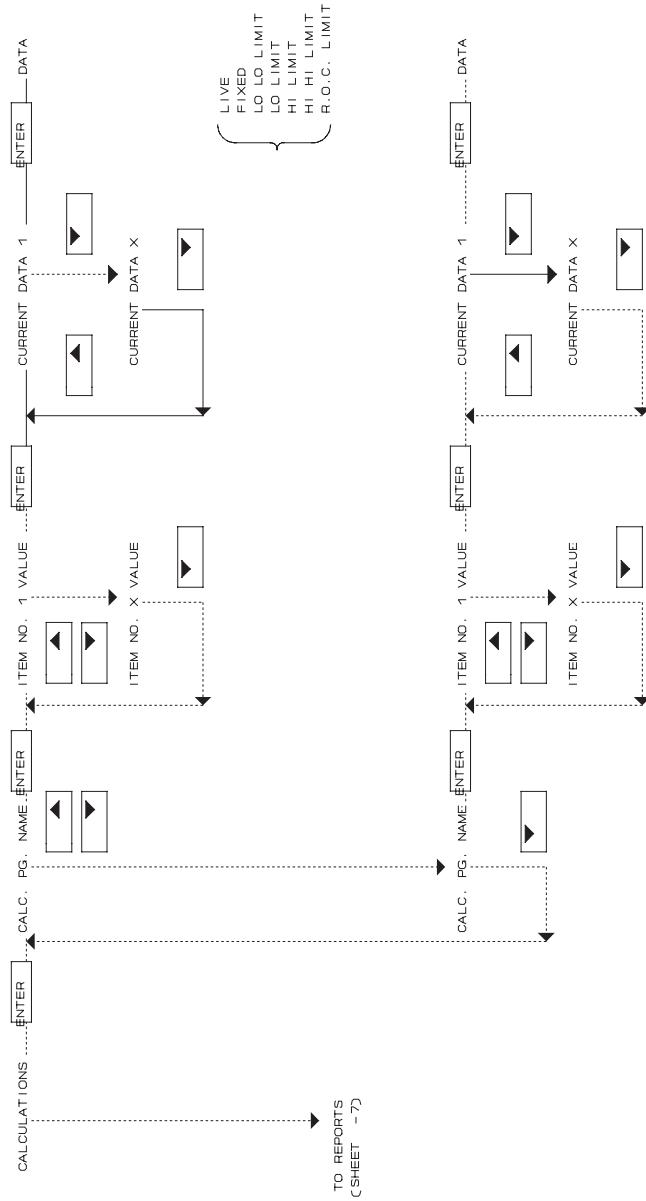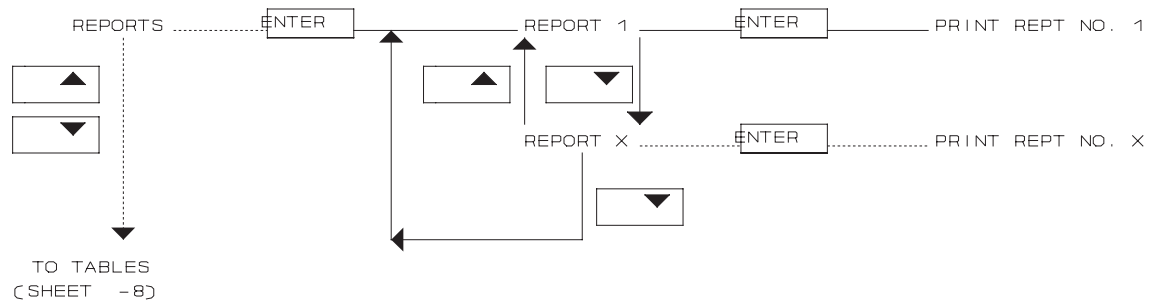
                                 TABLE X .... [ENTER] .... DITTO

TO TUBE
SWITCHING
(SHEET -9)   [▼]

                    [EXIT]   ROW 1 REF NAME   [ENTER]   ROW 1/COL 1   [ENTER]   R1/C1 VALUE

                                    [▲]   [▲] [▼]
                                    [▼]
                                                                           ROW 1/COL X   [ENTER]   R1/CX VALUE

                                                                                [▼]

                                    ROW X REF NAME .... [ENTER]   ROW X/COL1   [ENTER]   RX/C1 VALUE

                                         [▼]   [▲] [▼]

                                                                           ROW X/COL X   [ENTER]   RX/CX VALUE

                                                                                [▼]

TABLES CHART

TUBE SWITCHING —————— ENTER   TIME DELAY VAR ————— ENTER

▲
▼

VERIFY ON/OFF VAR. ———— ENTER
▲
▼

VERIFY VALUE VAR. ———— ENTER
▲
▼

CNTRL TUBE VAR. ———— ENTER
▲
▼

DP TUBE 1 ————— ENTER
▲
▼

LOW TUBE 1 ————— ENTER
▲
▼

HIGH TUBE 1 ————— ENTER
▲
▼

STATE TUBE 1 ———— ENTER
▲
▼

OPEN TUBE 1 ———— ENTER
▲
▼

CLOSE TUBE 1 ———— ENTER
▲
▼

DITTO TUBE "N" ———— ENTER
▼

▲
▼

TO MODBUS MASTER
(SHEET -10)

TUBE SWITCHING CHART
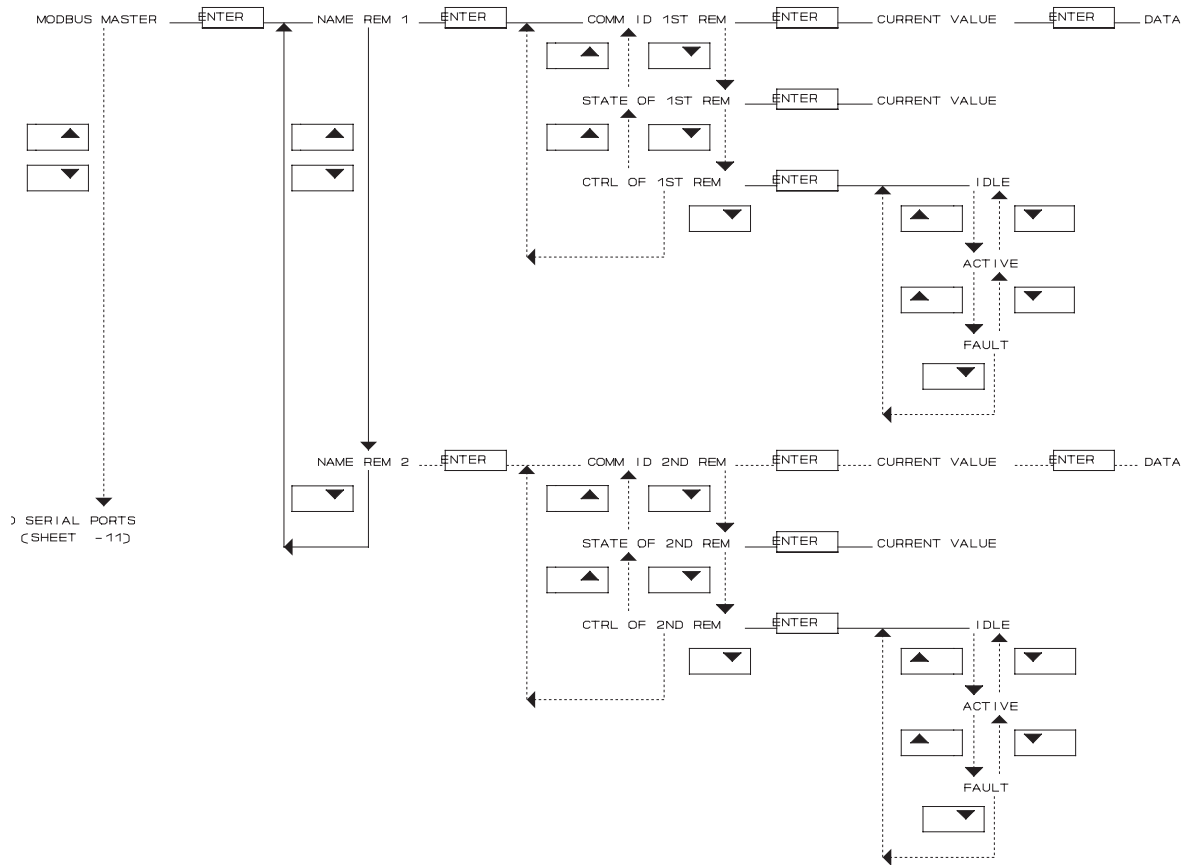
MODBUS MASTER CHART

SERIAL PORTS   ENTER .... BAUD 1 HEADER .... ENTER   BAUD1 CURR.

BAUD1 1200

BAUD1 2400

BAUD1 4800

BAUD1 9600

BAUD1 30C

BAUD X HEADER   ENTER   DITTO

PORT USE 1 .... ENTER   NONE

REPORTS

SLAVE

MASTER

REMOTE FP

USERCOMM

PORT USE X   ENTER   DITTO

PARITY1   ENTER   EVEN

ODD

NONE

PARITYX   ENTER   DITTO

(SHEET 11B)   (SHEET 11B)   (SHEET 11B)
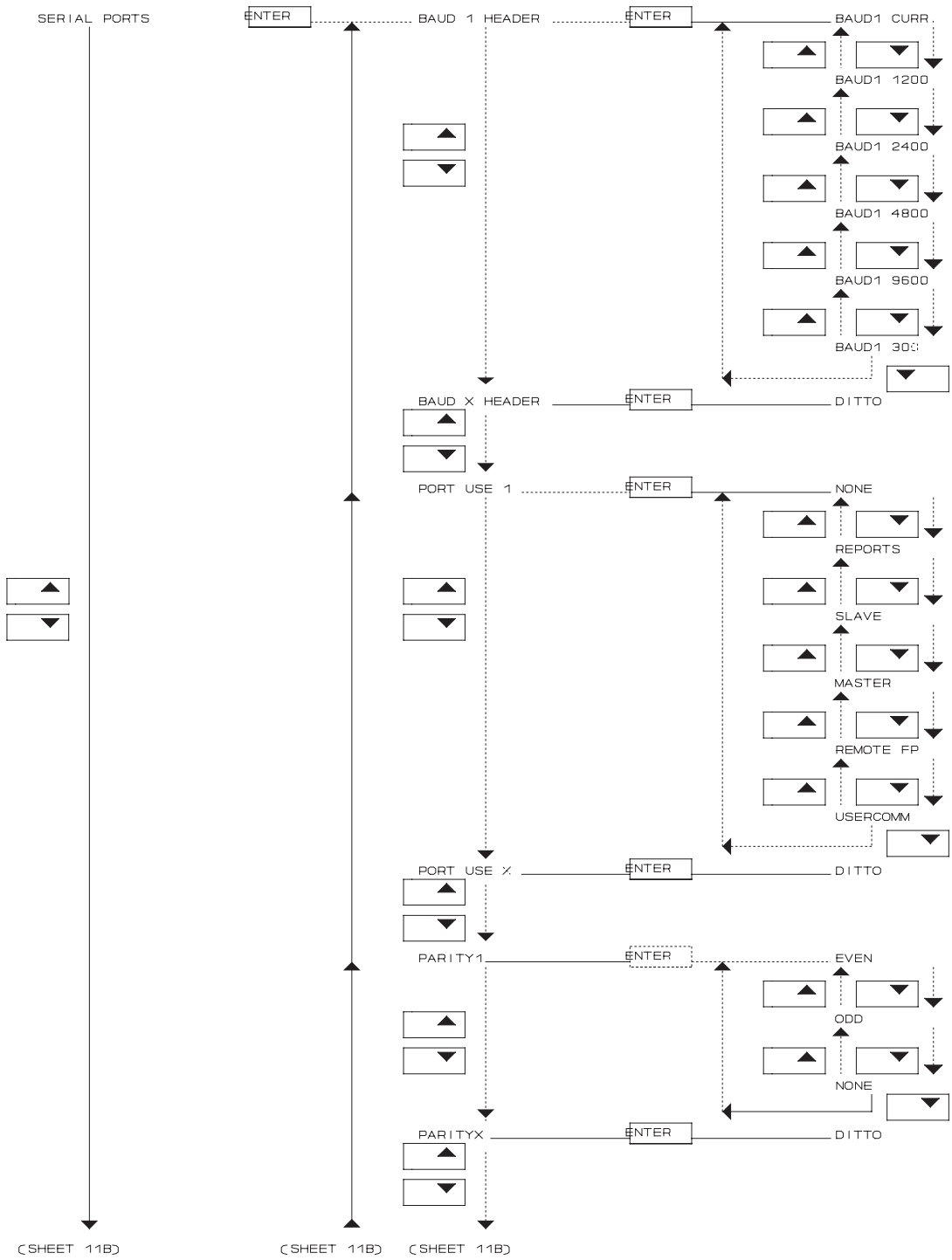
SERIAL PORTS CHART A
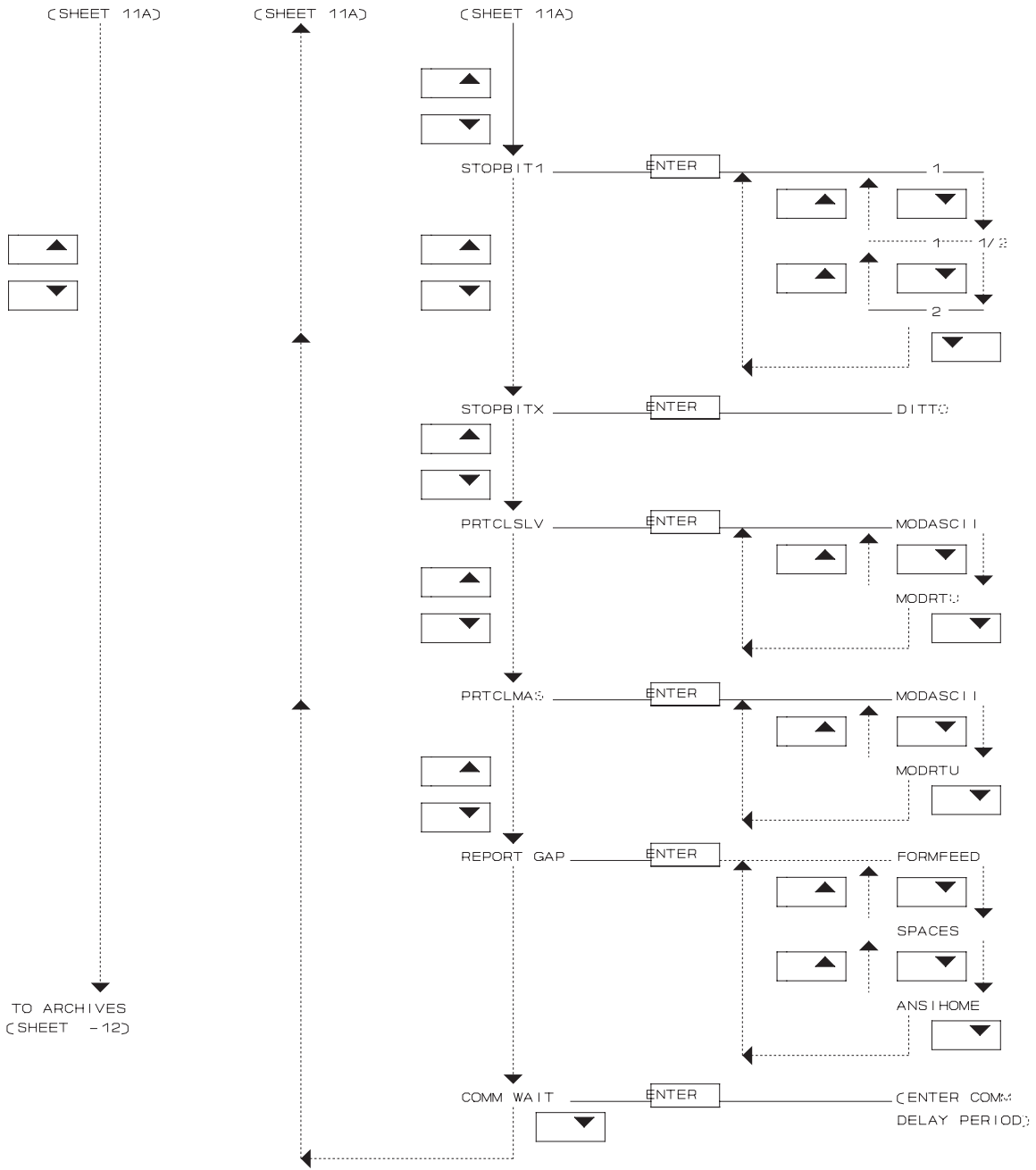
SERIAL PORTS CHART B

ARCHIVES .... | ENTER | .... ARC NAME 1 .... | ENTER | .... STRT. ROW ─── | ▼ |

| ▲ |
| ▼ |

┌ EXIT ┐

SYSTEM
COMMANDS
(SEE SHEET 13)

ARC NAME 1

| ▲ |
| ▼ |

NEW VALUE OF
STRT. ROW

| ENTER |

ARC NAME X ──── | ENTER | .... DITTO

| ▼ |

STRT. ROW ──── | ▼ |
| EXIT |

RECORD 1 ── | ENTER | ── DATA 1

NEW VALUE OF
STRT. ROW

| ▲ | | ▲ |
| ▼ | | ▼ |

| ENTER |

DATA X

| EXIT |

RECORD X ───── | ENTER | ─── DITTO
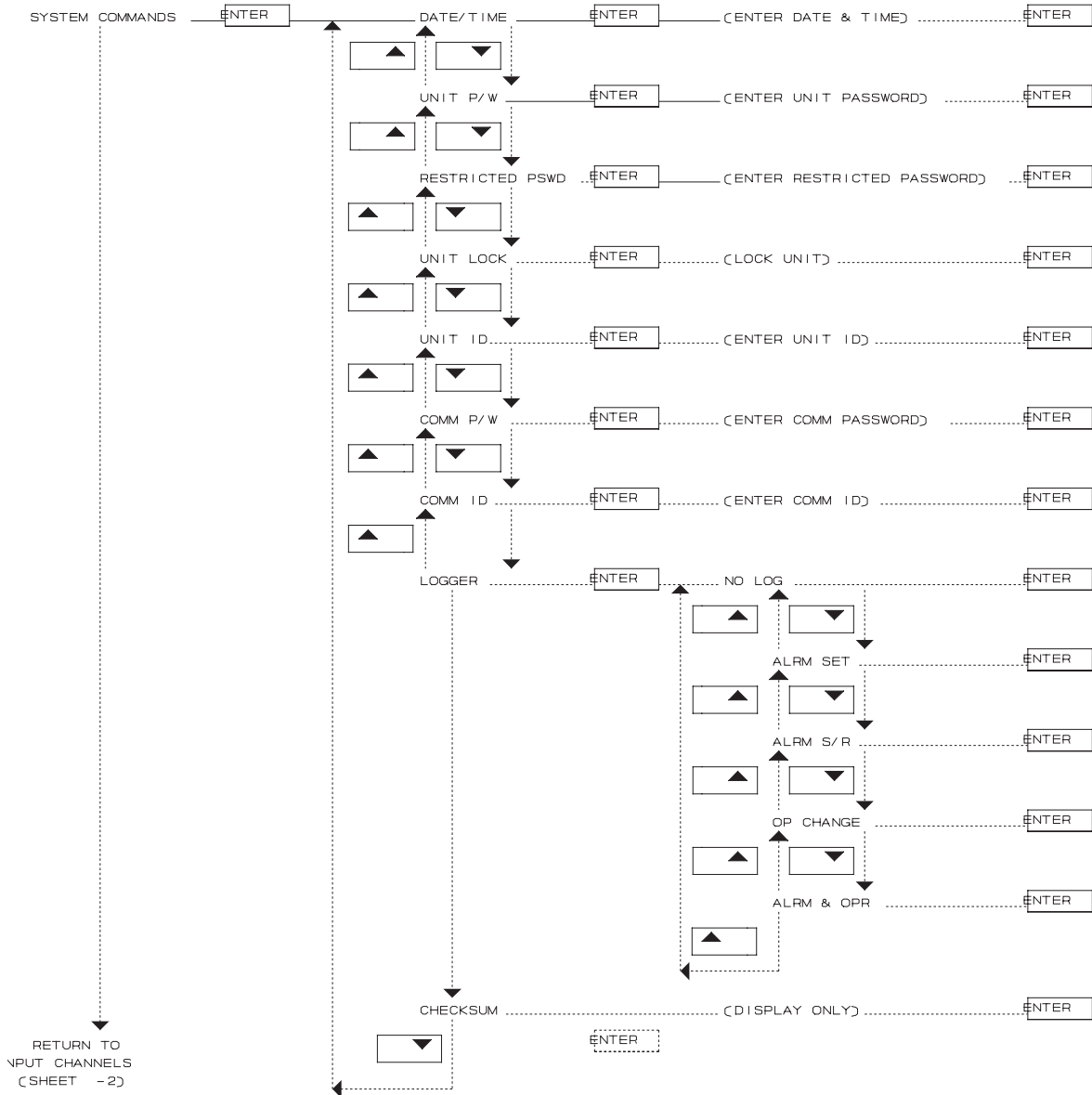
| EXIT |
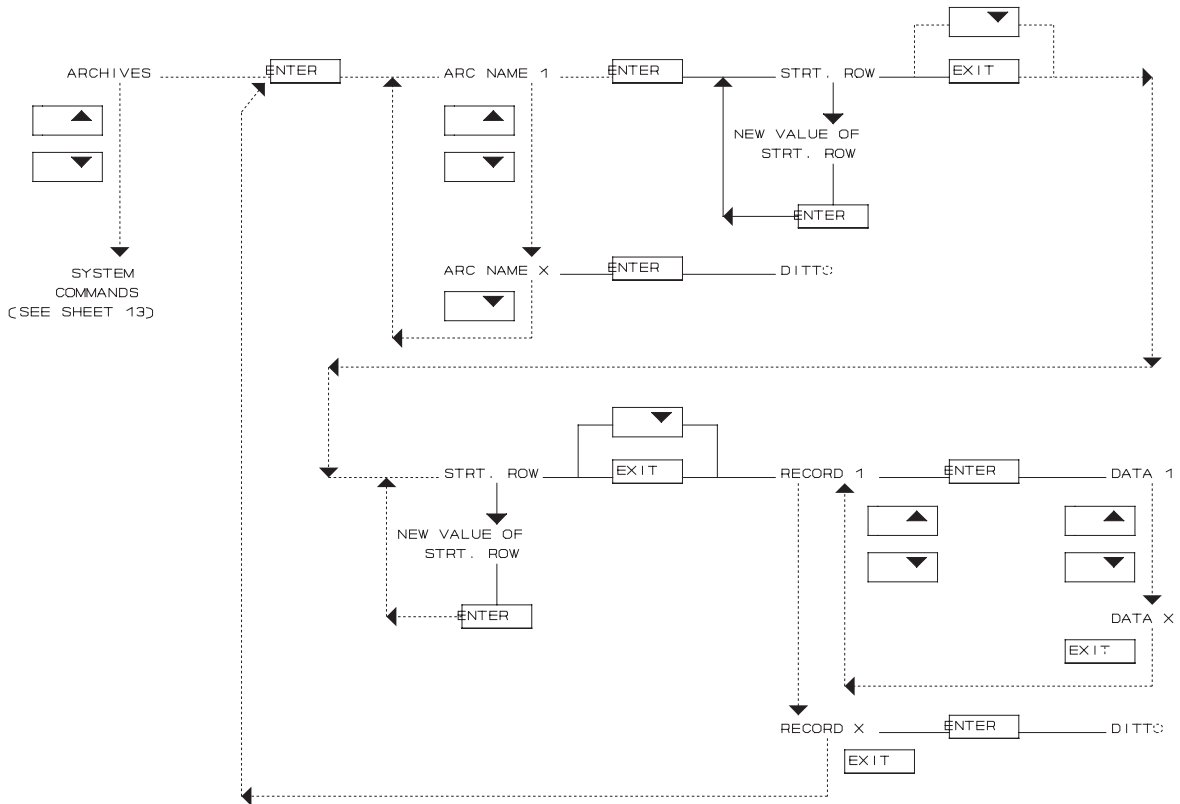
ARCHIVE CHART

SYSTEM COMMANDS CHART

This page intentionally left blank.

DATA DISPLAY

The constants and variables for the DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM are displayed on the front panel LCD screen and include the name, status, current value, and engineering units for constants and variable. These constants and variables will all be explained in detail in the following section.

CONSTANT/VARIABLE NAME

The name of the constant or variable can be from 1 to 8 characters in length, and in the illustrations in the following sub-section entitled TYPE OF DISPLAY, the names are represented by the characters "nnnnnnnn".

CONSTANT/VARIABLE STATUS

The status of the constant or variable can be from 1 to 8 characters in length, and in the illustrations in the following sub-section entitled TYPE OF DISPLAY, the statuses are represented by the characters "sssssss". Definitions of typical status display abbreviations are shown in the following table.

Status Display Abbreviation	Definition
MANUAL	Value used in the calculations is currently the FIXED value.*
blank	Value used in the calculations is currently the LIVE value.*
LIVE	Current value from transmitter input*
FIXED	Operator-entered over-ride value*
Z SCALE	Zero-scale value
F SCALE	Full-scale value
LO LO	Lo Lo alarm limit
LO	Lo alarm limit
HI	Hi alarm limit
HI HI	Hi Hi alarm limit
RATE	Rate of change limit

*   Detailed explanations of the status abbreviations MANUAL, blank, LIVE, and FIXED are provided in Section 6, under the sub-section entitled, CHANGING THE STATUS OF A VARIABLE.

CONSTANT/VARIABLE VALUE

The value of the constant or variable can be from 1 to 11 characters in length, and in the illustrations in the following sub-section entitled TYPE OF DISPLAY, the current values are represented by the characters "vvvvvvvvvvv".

CONSTANT/VARIABLE UNITS

The engineering units of the constant or variable can be from 1 to 4 characters in length, and in the illustrations in the following sub-section entitled TYPE OF DISPLAY, the units are represented by the characters "uuuu".

TYPE OF DISPLAY

The manner in which constants and variables are displayed on the MODEL 2500 LCD screen indicates whether the data shown is for display only, or if data entry is also allowed. If the variable/constant name (nnnnnnnn) and status (sssssss) are on line 1 of the LCD screen, as shown in the following illustration, then data can be entered on the keypad.

```
nnnnnnnn sssssss
vvvvvvvvvv uuuu
```

If the variable/constant name (nnnnnnnn) and status (sssssss) are on line 2 of the LCD screen, as shown in the following illustration, then data is for display only and no data can be entered on the keypad.

```
vvvvvvvvvv uuuu
nnnnnnnn sssssss
```

The following illustration, which shows a display that can be changed by operator entry:

-       Gives a current value of 1740.2 for the variable PLINE1.

-       Lists the engineering units in pounds per square inch, gauge (PSIG).

-       Leaves the status field blank, which indicates that the value used for PLINE1 in calculations is the live value.

Changing and entering data is explained in Section 6, along with an explanation of live value in the sub-section entitled, CHANGING THE STATUS OF A VARIABLE.

```
PLINE1
1740.2        PSGI
```

The following illustration, which contains the same constant and variable data as displayed in the preceding illustration, but with the display lines reversed (or inverted), cannot be changed by operator entry, and is for display only.

```
1740.2        PSGI
PLINE1
```

ALARMS FOR VARIABLES AND CONSTANTS

The following illustration gives the general format for the display of alarms for variables and constants:

-        Line 1 (nnnnnnnn) represents the name of the variable or constant which can be from 1 to 8 characters in length.

-        Line 2 (xxxxxxxxxxxxxxxx) represents the alarm message, which can be from 1 to 16 characters in length.

```
┌─────────────────────────┐
│  nnnnnnnn                │
│  xxxxxxxxxxxxxxxx        │
└─────────────────────────┘
```
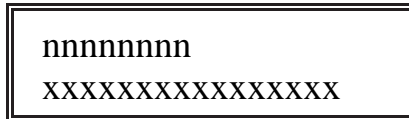
Typical alarm messages are:

-        SYSTEM ALARM
-        RATE LIMIT
-        HI-HI LIMIT
-        HI LIMIT
-        LO LIMIT
-        LO-LO LIMIT
-        USER ALARM

The following illustration shows an example of an alarm display for a variable:

-        O I L H I H I   is the name of the variable alarm (high-high oil level):

-        H I - H I   L I M I T   is the alarm message indicating the oil level is above the high-high alarm limit.

```
┌─────────────────────────┐
│  O I L H I H I          │
│  H I-H I  L I M I T     │
└─────────────────────────┘
```

_____

OPERATING EXAMPLES

This section contains examples of the steps involved in various applications that have been configured for the DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM MICROCOMPUTER.

Examples will be given for applications related to:

- Changing and displaying variables

- Calculations

- Displaying and entering tabular data

EXAMPLES FOR CHANGING AND DISPLAYING VARIABLES

This section presents examples involved in changing and displaying variables. In addressing the steps or procedures involved in accomplishing this, the specific application example chosen to demonstrate this will be "Application Number 53301510". In this application example, the MODEL 2500 has been configured to measure the mass and volume flow rate of a process gas containing a mixture of natural gas liquids and carbon dioxide.

In this case, the MODEL 2500 will calculate liquid propane and liquid butane flow based on analog input variables for the following:

-        Propane temperature (C3TEMP)
-        Propane pressure (C3PRESS)
-        Butane temperature (C4TEMP)
-        Butane pressure (C4PRESS)

The propane input variables C3TEMP is read by ANALOG INPUT channel 1, and the propane input variable C4TEMP is read by channel 2.

The butane input variable C3PRESS is read by ANALOG INPUT channel 3, and the butane input variable C4PRESS is read by channel 4.

ANALOG INPUT channels 1 and 2 are the first and second selections in lower sub-menu ANALOG INPUTS, which is the first lower sub-menu of INPUT CHANNELS, which is the first sub-menu of the MAIN MENU.

DISPLAYING VARIABLES FROM THE MAIN MENU

The steps involved in displaying the C3TEMP and C4TEMP variables on the MODEL 2500 LCD screen beginning with the MAIN MENU are as follows:

- Turn on or activate the MODEL 2500 to display the following illustrated display message, which indicates that the instrument has been configured for application number 53301510, and that it is now ready for operation.

```
53301510
22-JAN-87   13:05
```

- Press the ENTER key to display the following illustrated sub-menu, INPUT CHANNELS, which indicates that the MAIN MENU is active.

```
53301510
INPUT CHANNELS
```

- Press the ENTER key, and the following illustrated sub-menu, INPUT CHANNELS, appears on the top line of the display screen, and the first lower sub-menu, ANALOG INPUTS, of the INPUT CHANNELS sub-menu appears on the bottom line, which indicates that the INPUT CHANNELS menu is active.

```
┌─────────────────────────┐
│    INPUT CHANNELS        │
│    ANALOG INPUTS         │
└─────────────────────────┘
```

- Press the ENTER key, and in the following illustrated sub-menu, channel 1 of the ANALOG INPUTS lower sub-menu, C3TEMP, appears on the display screen.

```
┌─────────────────────────┐
│    20.          DEGF     │
│  C3TEMP                  │
└─────────────────────────┘
```

A blank appears in the status field on the second line of the display screen, which indicates that the value being transmitted by the transmitter, the LIVE value, is the value currently being used in calculations by the MODEL 2500. If the message "MANUAL" appears in the status field, this indicates that the live value of the variable has been overridden, and the value being shown is a fixed value used for calculations.

- Press the DOWN arrow key, and the following illustrated sub-menu, the second selection of the ANALOG INPUTS menu, C4TEMP, appears on the display screen.

```
┌─────────────────────────┐
│    25.          DEGF     │
│  C4TEMP                  │
└─────────────────────────┘
```

Pressing the DOWN arrow key when the first, or a subsequent, selection is displayed on a menu, causes the next selection on the same menu to appear, pressing the UP arrow causes the preceding selection on the same menu to appear.

Pressing the EXIT key causes the display data to return to the menu from which it was selected. In the case of the above illustrated display screen, pressing the EXIT key once would cause it to return to the ANALOG INPUTS sub-menu, and pressing the EXIT key a second time would cause it to return to the INPUT CHANNELS sub-menu.

CHANGING THE STATUS OF A VARIABLE

The steps involved in changing the status of a variable on the MODEL 2500 are as follows:

-       Begin with the following illustrated display screen message, which indicates the first channel of the lower level sub-menu ANALOG INPUTS.

```
    20.           DEGF
C3TEMP
```

-       Press the ENTER key to display the following illustrated sub-menu, C3TEMP, of the ANALOG INPUTS lower level sub-menu.

```
C3TEMP
    20.           DEGF
```

On line 1 of the display screen, the variable name, C3TEMP, and the status field, which has been left blank, indicate that the parameters related to the variable can now be examined and changed if the unit password has been entered and has not yet timed out.

- Press the ENTER key to display the following illustrated sub-menu showing that the status field message, which was blank, is now changed to "MANUAL", and the operator-entered fixed value (30.0 DEGF) has replaced the value, 20.0 DEGF, being received from the transmitter.

```
C3TEMP  MANUAL
 30.         DEGF
```

_____

NOTE!   If an input value, or any variable, is manually overridden, the fixed value is the value actually used for computations.

_____

- Press the ENTER key and notice that the LIVE status and value are again shown, which indicates that the value used in the calculations can be changed from live to fixed, or from fixed to live, as required.

- With MANUAL status displayed, press the EXIT key to display the following illustrated display screen, which indicates that the value being used in the calculations is the fixed value for this variable, and that the display has returned to channel 1 of the ANALOG INPUTS lower sub-menu.

```
 30.         DEGF
C3TEMP  MANUAL
```

DISPLAYING A LIVE VALUE WHEN THE VARIABLE HAS BEEN MANUALLY OVERRIDDEN

The steps involved in displaying a LIVE value on the MODEL 2500 LCD screen when the variable has been manually overridden are as follows:

- Begin with the following illustrated display screen message.

```
30.           DEGF
C3TEMP  MANUAL
```

- Press the ENTER key to monitor the LIVE value of the variable, and then press the DOWN arrow key to change to the following illustrated display screen.

```
C3TEMP       LIVE
 20.0        DEGF
```

This display is useful when instruments are being serviced, because the value displayed is unaffected by manual override. This means that the actual value of a variable can be monitored during system calibration or troubleshooting procedures even though the live value has been manually overridden, and an operator-entered value is being used for calculations.

CHANGING AND DISPLAYING A FIXED VALUE

The steps involved in changing and displaying a FIXED value on the MODEL 2500 LCD screen are as follows:

-	Begin with the following illustrated display screen message.

```
C3TEMP      LIVE
 20.0       DEGF
```

-	Press the DOWN arrow key to move to the third selection of the C3TEMP menu and display the FIXED value of the variable as illustrated in the following display screen.

```
C3TEMP      FIXED
 30.0       DEGF
```

The status field has changed from LIVE to FIXED, and the operator-entered value (30.0 DEGF) has replaced the value being sent by the transmitter (20.0 DEGF).

If the password has been entered, the operator may change this value by keying in a new value and then pressing the ENTER key. If an error is made while keying in the new value, the DOWN arrow key may be used to backspace the cursor over the error.

CHANGING AND DISPLAYING THE ZERO-SCALE VALUE FOR A VARIABLE

The steps involved in changing and displaying the zero-scale value for a variable on the MODEL 2500 LCD screen are as follows:

- Begin with the following illustrated display screen message.

```
C3TEMP       FIXED
 30.          DEGF
```

- Press the DOWN arrow key to move to the fourth selection of the C3TEMP menu and display the zero selection value of the variable as illustrated in the following display screen.

```
C3TEMP     ZSCALE
 25.0         DEGF
```

The data displayed in the illustration above are the value and engineering units displayed when the C3TEMP transducer sends a zero-scale signal (25.0 DEGF) to the MODEL 2500 instrument.

If the password has been entered, an operator may change this value by keying in a new value and then pressing the ENTER key. If an error is made while keying in the new value, the DOWN arrow key may be used to backspace the cursor over the error.

CHANGING AND DISPLAYING THE FULL-SCALE VALUE FOR A VARIABLE

The steps involved in changing and displaying the full-scale value for a variable on the MODEL 2500 LCD screen are as follows:

- Begin with the following illustrated display screen message.

```
C3TEMP    ZSCALE
  25.0         DEGF
```

- Press the DOWN arrow key to move to the fifth selection of the C3TEMP menu and display the full-scale value of the variable as illustrated in the following display screen.

```
C3TEMP    FSCALE
  125          DEGF
```

The data displayed in the illustration above are the value and engineering units displayed when the C3TEMP transmitter sends a full-scale signal (125 DEGF) to the MODEL 2500.

If the password has been entered, an operator may change this value by keying in a new value and then pressing the ENTER key. If an error is made while keying in the new value, the DOWN arrow key may be used to backspace the cursor over the error.

CHANGING AND DISPLAYING THE LOW-ALARM VALUE FOR A VARIABLE

The steps involved in changing and displaying the low alarm value for a variable on the MODEL 2500 LCD screen are as follows:

- Begin with the following illustrated display screen message.

```
C3TEMP    FSCALE
  125       DEGF
```

- Press the DOWN arrow key to move to the sixth selection of the C3TEMP menu and display the low alarm value of the variable as illustrated in the following display screen.

```
C3TEMP    LOLIMIT
  0.0       DEGF
```

The data displayed in the illustration above are the value and engineering units of the C3TEMP low alarm level.

If the password has been entered, an operator may change this value by keying in a new value and then pressing the ENTER key. If an error is made while keying in the new value, the DOWN arrow key may be used to backspace the cursor over the error.

CHANGING AND DISPLAYING THE HIGH-ALARM VALUE FOR A VARIABLE

The steps involved in changing and displaying the high alarm value for a variable on the MODEL 2500 LCD screen are as follows:

- Begin with the following illustrated display screen message.

```
C3TEMP    LOLIMIT
   0.0        DEGF
```

- Press the DOWN arrow key to move to the seventh selection of the C3TEMP menu and display the high alarm value of the variable as illustrated in the following display screen.

```
C3TEMP    HILIMIT
   125        DEGF
```

The data displayed in the illustration above are the value and engineering units of the C3TEMP high alarm level.

If the password has been entered, an operator may change this value by keying in a new value and then pressing the ENTER key. If an error is made while keying in the new value, the DOWN arrow key may be used to backspace the cursor over the error.

EXAMPLES FOR FINDING, FIXING AND CHANGING CALCULATIONS

This section presents examples involved in finding, fixing and changing calculations. In addressing the steps or procedures involved in accomplishing this, the specific application example chosen to demonstrate this will be "Application Number 51119110". In this application example, the MODEL 2500 has been configured to measure the mass and volume flow rate of a process gas containing a mixture of natural gas and carbon dioxide.

The MODEL 2500 computes a variable named CURSCF (current standard cubic feet) based on analog input variables, and the following procedures find, fix, and change the value of the calculated volume.

FINDING THE CALCULATION

The calculation for current volume appears as CURSCF on the display, and is displayed, fixed, and changed in the CALCULATIONS menu, which is a sub-menu of the MAIN MENU.

The CALCULATIONS sub-menu is accessed with the following procedure.

Begin with the following illustrated display screen, which shows the first menu selection on the MAIN MENU, and indicates that the MAIN MENU is active:

```
51119110
INPUT CHANNELS
```

Press the DOWN arrow key to move to the second selection on the MAIN MENU and display the OUTPUT CHANNELS sub-menu as illustrated in the following display screen.

```
┌─────────────────────────┐
│  51119110               │
│  OUTPUT CHANNELS        │
└─────────────────────────┘
```

Press the DOWN arrow key to move to the third selection on the MAIN MENU and display the ALARMS sub-menu as illustrated in the following display screen.

```
┌─────────────────────────┐
│  51119110               │
│  ALARMS                 │
└─────────────────────────┘
```

Press the DOWN arrow key to move to the fourth selection on the MAIN MENU and display the OPERATOR ENTRY sub-menu as illustrated in the following display screen.

```
┌─────────────────────────┐
│  51119110               │
│  OPERATOR ENTRY         │
└─────────────────────────┘
```

Press the DOWN arrow key to move to the fifth selection on the MAIN MENU and display the CALCULATIONS sub-menu as illustrated in the following display screen. The CALCULATIONS sub-menu must be accessed to display calculated values, including CURSCF.

```
┌─────────────────────────┐
│  51119110               │
│  CALCULATIONS           │
└─────────────────────────┘
```

Press the ENTER key to access the first selection, STARTUP, on the CALCULATIONS menu and display the following screen.

```
┌─────────────────────────┐
│ ┌─────────────────────┐ │
│ │   CALCULATIONS      │ │
│ │   STARTUP           │ │
│ └─────────────────────┘ │
└─────────────────────────┘
```

_____

NOTE!   The MODEL 2500 displays only those calculation
              variables that have been assigned engineering units.
              Variables with no assigned engineering units are
              not displayed.

_____

Press the DOWN arrow key to access the second selection, OPERATOR, on the CALCULATIONS menu and display the following screen.

```
┌─────────────────────────┐
│ ┌─────────────────────┐ │
│ │   CALCULATIONS      │ │
│ │   OPERATOR          │ │
│ └─────────────────────┘ │
└─────────────────────────┘
```

Press the DOWN arrow key to scroll down the CALCULATIONS menu until accessing the following illustrated display screen showing TOTALS, which is the selection that contains the calculated variable, CURSCF.

```
┌─────────────────────────┐
│ ┌─────────────────────┐ │
│ │   CALCULATIONS      │ │
│ │   TOTALS            │ │
│ └─────────────────────┘ │
└─────────────────────────┘
```

_____

Press the ENTER key to access the TOTALS menu selection and display the following screen.

```
┌─────────────────────────┐
│  6458          SCF      │
│  CURSCF                 │
└─────────────────────────┘
```

6458 SCF is the total volume measured since the last daily report, when the totalizer was reset to zero. CURSCF is the variable name of the calculated total.

FIXING THE VALUE OF A CALCULATION

Calculated values may or may not be fixed depending on the configuration. In some configurations, fixing a calculated value is not permitted in order to protect total values.

If the password has been entered correctly in the configuration, the steps involved in fixing a calculated value are as follows:

Press the ENTER key to manually override the calculated value and display the following illustrated display screen, which indicates the total calculated volume along with a blank status field.

```
┌─────────────────────────┐
│  6458          SCF      │
│  CURSCF                 │
└─────────────────────────┘
```

A blank status field indicates that the value has not been manually overridden.

Press the ENTER key again to display the following screen.

```
┌──────────────────────┐
│ CURSCF   MANUAL      │
│ 6500      SCF        │
└──────────────────────┘
```

The value used for calculations by the MODEL 2500 is now the operator-entered value for CURSCF, and not the live value based on the volume calculated from input data received from the process stream. Both the live and fixed values of CURSCF are displayed by pressing the arrow keys, while following the same procedures as described in the section above on CHANGING AND DISPLAYING A FIXED VALUE for displaying process stream temperature.

CHANGING A FIXED VALUE

Changing a fixed value, such as CURSCF, is performed by displaying the fixed value and entering the new value manually in the same way as described in the section above on CHANGING AND DISPLAYING A FIXED VALUE for displaying process stream temperature.

EXAMPLES FOR LOCATING AND ENTERING DATA TABLES

This section presents examples involved in locating, displaying and entering data on data tables. In addressing the steps or procedures involved in accomplishing this, the specific application example chosen to demonstrate this will be "Application Number 51119110".

In this application example, a typical table, TABLE 18, is used. TABLE 18 contains values of K, which are used in determining a Reynolds number factor by means of a calculation. K values depend on the orifice meter tap type and the value of BETA, which is the ratio between the orifice diameter and the pipe diameter.

TABLE 18, as it would typically appear in printed form, is illustrated below.

TABLE 18

	TAPTYPE	
	1	2
BETA 0.100	0.607	0.604
BETA 0.125	0.608	0.604
BETA 0.150	0.611	0.604
BETA 0.175	0.614	0.604
BETA 0.200	0.618	0.604
BETA 0.225	0.623	0.605
BETA 0.250	0.628	0.605
BETA 0.275	0.634	0.606
BETA 0.300	0.641	0.606
BETA 0.325	0.650	0.607

LOCATING A DATA TABLE

Data tables are located and entered from the TABLES sub-menu located on the MAIN MENU. To display and enter table data from TABLE 18, the table must first be located.

The steps for locating the TABLES sub-menu are as follows:

Begin with the following illustrated display screen, which shows the first menu selection on the MAIN MENU, and indicates that the MAIN MENU is active:

```
51119110
INPUT CHANNELS
```

Press the DOWN arrow key to move to the second selection on the MAIN MENU and display the OUTPUT CHANNELS sub-menu as illustrated in the following display screen.

```
51119110
OUTPUT CHANNELS
```

Press the DOWN arrow key to move to the third selection on the MAIN MENU and display the ALARMS sub-menu as illustrated in the following display screen.

```
51119110
ALARMS
```

Press the DOWN arrow key to move to the fourth selection on the MAIN MENU and display the OPERATOR ENTRY sub-menu as illustrated in the following display screen.

```
51119110
OPERATOR ENTRY
```

Press the DOWN arrow key to move to the fifth selection on the MAIN MENU and display the CALCULATIONS sub-menu as illustrated in the following display screen.

```
51119110
CALCULATIONS
```

Press the DOWN arrow key to move to the sixth selection on the MAIN MENU and display the REPORTS sub-menu as illustrated in the following display screen.

```
51119110
REPORTS
```

Press the DOWN arrow key to move to the seventh selection on the MAIN MENU and display the TABLES sub-menu as illustrated in the following display screen.

```
51119110
TABLES
```

Press the ENTER key to gain access to and to display the TABLES sub-menu as illustrated in the following display screen.

```
┌─────────────────────┐
│╔═══════════════════╗│
│║     TABLES        ║│
│║ TABLE 18          ║│
│╚═══════════════════╝│
└─────────────────────┘
```

In this application example, TABLE 18 is the only table, but in an application containing more than one table, it would be necessary to continue pressing the DOWN arrow key until the name of the desired table was displayed.

GAINING ACCESS TO THE DATA TABLE

After locating the TABLES sub-menu, access must be gained to TABLE 18. The steps for gaining access to TABLE 18, are as follows:

Begin with the newly accessed and displayed TABLES sub-menu as illustrated in the following display screen.

```
┌─────────────────────┐
│╔═══════════════════╗│
│║     TABLES        ║│
│║ TABLE 18          ║│
│╚═══════════════════╝│
└─────────────────────┘
```

Press the ENTER key, which displays information on the following illustrated screen display and indicates that the current value, or row position, of STRT_ROW is 1.

```
┌─────────────────────┐
│╔═══════════════════╗│
│║  STRT_ROW         ║│
│║              1    ║│
│╚═══════════════════╝│
└─────────────────────┘
```

_____

If access is desired to a row in the table other than row number 1, the user must type in the new row number and press the ENTER key. (This example assumes the user entered a new row number of 5.) When the new row number is visible in the display screen, the user presses the EXIT or DOWN arrow key, which causes the following illustrated display screen to appear, displaying data that indicates the current value, or column position, of STRT_COL is 1.

```
STRT_COL

               1
```

If access is desired to a column in the table other than column 1, the user must type in the new column number and press the ENTER key. (This example assumes the user entered a new column number of 1.) When the new column number is visible in the display screen, the user presses the EXIT or DOWN arrow key, which causes the following illustrated display screen to appear.

```
TABLE 18        5 / 1
BETA           0.200
```

For the purpose of this example, the above display screen data indicates that the user is in TABLE 18, and is positioned on row number 5 and column number 1.

As shown in the following illustrated table, rows are numbered from top to bottom, and columns are numbered from left to right.

TABLE 18

	TAPTYPE	
	1	2
BETA 0.100	0.607	0.604
BETA 0.125	0.608	0.604
BETA 0.150	0.611	0.604
BETA 0.175	0.614	0.604
BETA 0.200	0.618	0.604
BETA 0.225	0.623	0.605
BETA 0.250	0.628	0.605
BETA 0.275	0.634	0.606
BETA 0.300	0.641	0.606
BETA 0.325	0.650	0.607

SELECTING A TABLE ROW

After the desired table, TABLE 18, has been accessed and an initial row and column has been indicated, different table rows can be accessed. The steps for gaining access to different table rows are as follows:

Begin with the newly accessed table screen displayed below with its initial row and column designations.

TABLE 18	5 / 1
BETA	0.200

To select a different table row, press the DOWN arrow key until the desired row number appears on the display screen in the position to the left of the slash. In this example, press the DOWN arrow key four times to display the following illustrated display screen, which indicates that row number 9 is BETA 0.3.

```
┌─────────────────────────┐
│ TABLE 18        9 / 1   │
│ BETA           0 . 3    │
└─────────────────────────┘
```

Press the ENTER key to select the ninth row and display the following illustrated display screen.

```
┌─────────────────────────┐
│ TABLE 18        9 / 1   │
│ TAPTYP            1     │
└─────────────────────────┘
```

The 9/1 configuration indicates that the table is positioned in the ninth row and the first column, and TAPTYP indicates the table definition of column number 1.

Press the ENTER key to indicate the first column and display the following illustrated display screen.

```
┌─────────────────────────┐
│ TABLE 18        9 / 1   │
│ 0.641             1     │
└─────────────────────────┘
```

0.641 is the table value defined by row number 9 and column number 1 as illustrated in the following table.

TABLE 18

| | TAPTYPE | |
	1	2
BETA 0.100	0.607	0.604
BETA 0.125	0.608	0.604
BETA 0.150	0.611	0.604
BETA 0.175	0.614	0.604
BETA 0.200	0.618	0.604
BETA 0.225	0.623	0.605
BETA 0.250	0.628	0.605
BETA 0.275	0.634	0.606
BETA 0.300	0.641	0.606
BETA 0.325	0.650	0.607

SELECTING A TABLE COLUMN

After the desired table row has been accessed and an initial row and column has been indicated, different table columns can be accessed. The steps for gaining access to different table columns are as follows:

Begin with the newly accessed table screen with its initial row and column designations as illustrated in the following display screen.

```
TABLE 18        9 / 1
TAPTYP             1
```

Select the table column by pressing the DOWN arrow key until the desired column number appears on the display screen in the position to the right of the slash. (This example assumes the user entered a new column number of 2.)

When the new column number is visible in the display screen, the user presses the EXIT key, and then the DOWN arrow key once, which causes the following illustrated display screen to appear.

```
TABLE 18          9 / 2
TAPTYP              2
```

Press the ENTER key to indicate the second column and display the following illustrated display screen.

```
TABLE 18          9 / 2
0.606
```

The 9/2 configuration indicates the row and column position being displayed in TABLE 18. The bottom right portion of the display screen is blank, because the variable has no units. If the table value had engineering units, the values would appear in the blank space.

0.606 is the table value defined by row number 9 and column number 2 as illustrated in the following display table.

TABLE 18

	TAPTYPE	
	1	2
BETA 0.100	0.607	0.604
BETA 0.125	0.608	0.604
BETA 0.150	0.611	0.604
BETA 0.175	0.614	0.604
BETA 0.200	0.618	0.604
BETA 0.225	0.623	0.605
BETA 0.250	0.628	0.605
BETA 0.275	0.634	0.606
BETA 0.300	0.641	0.606
BETA 0.325	0.650	0.607

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REPORTS

The DANIEL INDUSTRIES MODEL 2500 INSTRUMENTATION SYSTEM possesses the capability to produce and print reports. The number of reports that can be printed is limited only by the memory capacity of the instrument.

REPORT TYPES

The MODEL 2500 can also be configured to generate individual reports in two different formats, which are identified by a user-assigned report name with a maximum of eight alpha-numeric characters. (For example, a morning report might be identified as AMREPORT.) The three report formats produced by the MODEL 2500 are shown as examples in the following sections.

LINE REPORT Contains a variable number of lines, including blank lines, to improve readability. A typical report of this type is illustrated in Figure 7-1.

```
----------------------------------------------------------------
Unit:0000    PROCESS    DEC10    1986   21:02

 Name                    Value     Units    F/L

 -INPUT-
 PT167                    1000.     PSIG      F
 TT147                      20.     DEGF      F
 -OUTPUT-
 AP                   738.3016      PSIG      L
 AT                   31.25332      DEGF      L
 AG                  0.5055318      SGOL      L
 IG                     0.5018      SGOL      L
 -RATES-
 FR153                5412.522      GBPH      L
 FR153                10826.61      GBPH      L
 FR157                21653.22      GBPH      L
 -TOTALS-
 L153                    12251      BBLS      L
 L155                    19427      BBLS      L
 L157                    32575      BBLS      L
 STG                     64853      BBLS      L
 SCG                     66732      BBLS      L
----------------------------------------------------------------
```

Figure 7-1 Typical Line Report

TABLE REPORT   Contains a variable number of lines, which can be of different lengths, with a maximum width of 80 characters including row definitions and blank spaces left for column separation, and blank lines to improve readability. A typical report of this type is illustrated in Figure 7-2.

```
-------------------------------------------------------------------------------------
  Unit:0000              ALARMS REPORT              JAN 01 1987 00:03

TMPALMLO    L   TMPALMHI    L   PRALML     L   PRSALMHI    L
       OFF                 OFF               OFF               OFF
DPALMLO     L   DPALMHI     L   DENALMLO   L   DENALMHI    L
       OFF                 OFF               OFF               OFF
FLOALMLO    L   FLALMHI     L   PSIALM     L   SAMALM      L
       OFF                 OFF               OFF               OFF
PFAIL       L   WTDOG       L
-------------------------------------------------------------------------------------
```

Figure 7-2 Typical Table Report

ARCHIVE REPORT A table report may also contain data stored in an archive area, in addition to individual variable data items. Figure 7-3 demonstrates a typical report of this type.

```
--------------------------------------------------------------------------------
UNIT:0000            30-DAY HISTORY       JAN 30  1986 08:02

C5110063A   L

                        HISTORY
  REC NO     MONTH     DAY     YEAR          SCF          LBS
   30          1        30     1986         43434         2215
    1          1         1     1986             0            0
    2          1         2     1986     107369254      5475685
    3          1         3     1986         36266         1849
    4          1         4     1986         28410         1655
    5          1         5     1986         28052         1448
    6          1         6     1986         39905         1431
    7          1         7     1986         60468         2035
    8          1         8     1986         27275         1853
    9          1         9     1986         25303         3083
   10          1        10     1986         43830         1391
   11          1        11     1986         30830         1291
   12          1        12     1986         51365         2235
   13          1        13     1986         30060         1572
   14          1        14     1986         58078         2620
   15          1        15     1986         30839         1533
   16          1        16     1986         30048         2962
   17          1        17     1986         41447         1572
   18          1        18     1986         41902         1533
   19          1        19     1986         37145         2114
   20          1        20     1986         67555         2137
   21          1        21     1986         25266         1894
   22          1        22     1986         20956         3445
   23          1        23     1986         24890         1289
   24          1        24     1986         42251         1068
   25          1        25     1986         48990         1270
   26          1        26     1986         31214         2155
   27          1        27     1986         35159         2498
   28          1        28     1986                       1592
   29          1        29     1986                       1793
--------------------------------------------------------------------------------
```

Figure 7-3 Typical Archive Report

REPORT PRINTOUTS

Reports are normally printed on a serial printer connected to a RS-232 port on the MODEL 2500.

A report printout can be initiated by using four different methods. They are:

- Automatically by including a report command statement on a Calculation Entry Sheet in the configuration program

- Operator command from the front panel

- Remote terminal or computer attached to the REPORTS serial port

- MODBUS communications link

AUTOMATIC REPORTS

Automatic reports are initiated by report command statements in the configuration program. The report command statements are used in either of two ways. They are:

- Part of a program that performs a specific function associated with the MODEL 2500 application configuration

- Independent statement that initiates a report printout when a specific condition is met

An example of the first type of automatic report would be a report added to a calculation program so the report will be printed each time the calculation is made. An example of the second type of automatic report would be a report printed at a specified time each day.

Program command statements are explained in detail in the CONFIG25 USER MANUAL.

OPERATOR COMMAND REPORTS

An operator can print a report manually at the front panel of the MODEL 2500 by performing the following procedure.

- Begin with the MAIN MENU

- Locate and display the sub-menu REPORTS using the arrow keys

- Press the ENTER key

- Locate and display the report name (for example, AMREPORT) by using the arrow keys

- Press the ENTER key

At this point, the report should be printed out on the line printer.

REMOTE TERMINAL OR COMPUTER REPORTS

A report can be requested using a remote terminal or computer attached to the reports serial port on the MODEL 2500. A modem can also be attached to the reports serial port to permit transmission of the report by telephone. A remote report is initiated by performing the following procedure.

- Simultaneously press Control (^) and B (Shift 6 and B for some keyboards) on the terminal/computer keyboard

- Enter the communications identification number (COMMID) of the MODEL 2500 followed by an optional minus (-) sign and the number of the report desired

- Press the ENTER key

The MODEL 2500 identification number must be three digits in length and the report number must be four digits in length. Unit numbers with fewer than three digits, and report numbers with fewer than four digits must have additional zeros added at the beginning of the number series to make them long enough. For example, an extra zero must be added to unit number 23 to be transmitted as 023, and three extra zeros must be added to report number 1 to be transmitted as 0001. Including the optional minus (-) sign requests a checksum that uses every character transmitted to generate the report. For example, entering "^B023-0001<LF>" or "^B023-0001<LF><CR>" is the correct format for requesting report 1 from unit 23, including the checksum request, which is printed at the end of the report, and can be used by the computer receiving the report to check for transmission errors. The line feed command (<LF>) is required if <LF> is not included in the <CR> command of the computer or terminal.

Requesting report 1 from unit 23 without the checksum is entered as "^B0230001<LF>" or "^B0230001<LF><CR>". Again, the line feed command (<LF>) is required if <LF> is not included in the <CR> command of the computer or terminal.

PRINTING REPORTS FROM A COMPUTER USING MACROS

Using a communications package that supports macros, this request could be entered as a macro. Depending on your hardware in use, refer to the information on macros. For several communication packages the following table shows equivalents.

STX = Start of text
LF = Line feed
CR = Carriage return

			CODE	**HEX**
SHIFT 6 = ^				
CTRL B	= ^B	STX		02
LF	= ^J		LF	0A
CR	= ^M		CR	0D

An example of a request generated for a standard communication package is as follows.

^B0010001^J^M

A line feed command (<LF>) is required if <LF> is not included in the <CR> command of the computer or terminal.

GLOSSARY OF STANDARD VARIABLE NAMES

VARIABLE NAME   **VARIABLE NAME DEFINITION**

-A-

AFR#   Actual flow rate
APIGRAV   API gravity
ATOT   ACF tube total
ATOT#   Actual volume total, meter run #
ATTACH   Control output to attach chromatograph
AV_BTU#   Average BTU for run #
AV_CO2#   Average CO2 for run #
AV_GRAV#   Average gravity for run #
AV_N2#   Average N2 for run #
AV_PRES#   Average pressure for run #
AV_TEMP#   Average temperature for run #
AVG_MF#   Average meter factor for meter #

-B-

BTU   Energy content of process gas/liquid
BTU#   Analog BTU input
BUSY#   Status input from busy flag for unit #

VARIABLE NAME   VARIABLE NAME DEFINITION

-C-

CCF	Combined correction factor
CLOSE#	Control output to close valve #
	Status input that valve # is closed
CMV	Correction factor for meter volume
CO#ALM	Control output # overspeed alarm
CO2	Carbon dioxide content of process gas
CONTRACT	Contract hour
CONTROL	PID control output signal
COP	Coefficient of the pipe material for calculating the orifice thermal-expansion factor (F_a)
CPLM	Correction factor for effect of pressure on liquid meter
CPLP	Correction factor for effect of pressure on liquid prover
CPRIME#	Flow coefficient for line #
CPS	Correction for the effect of pressure on steel
CPV	Correction factor for prover volume
CTL#	Temperature correction factor for meter #
CTLP	Correction factor for effect of temperature on liquid prover
CTLM	Corrrection factor for effect of temperature on liquid meter
CTS	Correction factor for the effect of temperature on steel

_____

VARIABLE NAME   **VARIABLE NAME DEFINITION**

-D-

DATOT#	Daily actual cubic feet total per meter line
DCF#	Densitometer correction factor, run #
DDMMYY	Date: DD=day (1 through 30); MM=month (1 through 12); YY=year minus 1900
DETOT	Total daily station energy
DETOT#	Total daily energy, run #
DGTOT	Daily gross total volume
DGTOT#	Daily gross total volume, run #
DMTOT#	Daily mass total, run #
DPCUT#	Differential pressure cutoff as a percent of full scale, run #
DPCUTOFF	Differential pressure cutoff as a percent of full scale
DPT#	Differential pressure transducer # (or run #)
DPT#H	High range differential pressure transmitter, line #
DPT#L	Low range differential pressure transmitter, line #
DSTOT	Total daily station volume
DSTOT#	Total daily volume, run #
DT#	Densitometer pulse input #

-E-

ECO	Energy Control Output
ECO#	Energy Control Output, run #
EFR	Energy flow rate
EFR#	Energy flow rate, run #
ETOT	Total station energy
ETOT#	Total energy, run #

_____

VARIABLE NAME   VARIABLE NAME DEFINITION

-F-

FACOEF	Orifice thermal expansion coefficient
FPV#ALM	Fpv alarm, adjusted temperature or pressure out of limits for meter #
FWD	Prover forward launch

-G-

GAMMA	Coefficient of cubical expansion
GCALARM	Chromatograph alarm
GCDELAY	Time delay between messages from the gas chromatograph
GCO	Gross volume control output
GCO#	Gross volume control output for meter #
GF	Specific gravity at flowing temperature (G_f)
GF#	Specific gravity at flowing temperature (G_f), run #
GFR	Gross volume flow rate
GFR#	Gross volume flow rate, run #
GL	Specific gravity at base temperature (G_l)
GL#	Specific gravity at base temperature (G_l), run #
GTOT	Total gross volume
GTOT#	Total gross volume, run #

-H-

H2O	Water content of process gas

-K-

KN#	Meter K factor, meter #

VARIABLE NAME   VARIABLE NAME DEFINITION

-M-

MCO	Mass control output
MCO#	Mass control output, run #
MF#	Meter factor, meter #
MFR#	Mass flow rate, meter #
MODELAS	Modulus of elasticity
MPRS	Meter pressure
MTMP	Meter temperature
MTOT	Mass total
MTOT#	Mass total, run #
MU	Viscosity
MU#	Viscosity, run #

-N-

N2	Nitrogen content of process gas
N2#	Nitrogen content of process gas, run #
NCO	Net volume control output
NETDELAY	Network Delay - Delay between 2500 access to 2251
NFR#	Net flow rate run #
NFR	Net volume flow rate
NRMTOT#	Non resetting mass total meter #
NTOT	Net total
NTOT#	Net total run #

-O-

O2	Oxygen content of process gas
O2#	Oxygen content of process gas, run #
OPEN#	Control output to open valve #
	Status input that valve # is open
ORIF#	Orifice diameter, run #

_____

VARIABLE NAME   VARIABLE NAME DEFINITION

-P-

PIDGAIN	PID control loop gain
PIDTGT	Flow control target rate
PIDPVMAX	PID loop process variable maximum value
PIDPVMIN	PID loop process variable minimum value
PIDTR	PID loop control integral gain in repeats per minute
PIPE#	Pipe diameter, run #
PRESBASE	Pressure base
PROVER	Prover pulse input
PRVOLUME	Prover volume
PT#	Pressure transducer # (or run #)
PVLEFTI	Rotate prover four-way valve left input
PVLEFTO	Rotate prover four-way valve left output
PVMAX	PID control loop maximum value for process variable
PVMIN	PID control loop minimum value for process variable
PVRIGHTI	Rotate prover four-way valve right input
PVRIGHTO	Rotate prover four-way valve right output

-R-

REV	Prover reverse launch
RESTART	Number of restart cycles allowed
RHO	Density
RHOB	Density at base conditions
RHOB#	Density at base conditions, run #
RHOF	Density at flowing conditions
RHOF#	Density at flowing conditions, run #
RSHEAT	Specific heat ratio of process gas
RSHEAT#	Specific heat ratio of process gas, run #

_____

VARIABLE NAME   **VARIABLE NAME DEFINITION**

-S-

SAMPLER	Sampler control output
SAMPLE	Sample size
SCO	Station volume control output, run #
SCO#	Volume control output, run #
SEQTRIAL	Sequential prover trial number
SG	Specific gravity
SG#	Specific gravity analog input for meter tube # in specific gravity units
STOT	Total station volume
STOT#	Total volume, run #

-T-

TEMPBASE	Temperature base
TESTING	Boolean alarm showing test on
THICKNES	Prover wall thickness
TM#	Turbine meter, run #
TM#A	Turbine meter # A pulse train
TM#B	Turbine meter # B pulse train
TRIAL	# of trials
TRIALDEV	Trial deviation
TSDELAY	Tube switching delay
TT#	Temperature transducer # (or run #)

-V-

VP100	Vapor pressure

_____

VARIABLE NAME   VARIABLE NAME DEFINITION

-Z-

ZB	Base compressibility factor (Z_b)
ZF	Compressibility at flowing conditions (Z_f)
ZFTINC	Z_f table temperature entry increments
ZFTSTRT	Z_f table starting temperature entry
ZFPINC	Z_f table pressure entry increments
ZFPSTRT	Z_f table starting pressure entry

GLOSSARY OF STANDARD UNIT ABBREVIATIONS

ABBREVIATION   **UNIT ABBREVIATION DEFINITION**

-A-

ACFH	Actual cubic feet per hour
API	American Petroleum Institute gravity units

-B-

B/#D	BTUs per pound-degree Fahrenheit
B/F3	British thermal units per cubic foot
B/CF	British thermal units per cubic foot
BB/H	Barrels per hour
BBL	Barrels
BBLD	Barrels per day
BBLH	Barrels per hour
BBLS	Barrels
BL/P	Barrels per pulse
BPCF	British thermal units per standard cubic foot
BPH	Barrels per hour
BTU	British thermal units
BTUF	British thermal units per standard cubic foot
BTUS	British thermal units

-C-

CNTS	Counts
CP	Centipoise

ABBREVIATION   **UNIT ABBREVIATION DEFINITION**

-D-

DEGC   Degrees centigrade (Celsius)
DEGF   Degrees Fahrenheit
^{o}F   Degrees Fahrenheit
DTH   Dekatherms
DTHH   Dekatherms per hour
DTHD   Dekatherms per day

-F-

FREQ   Frequency
FT^{3} Cubic feet

-G-

G/F3   Gallons per cubic foot
GPM   Gallons per minute

-H-

HZ or Hz   Hertz

-I-

"H2O   Inches of water
"WC   Inches, water column
INCH   Inches

ABBREVIATION   **UNIT ABBREVIATION DEFINITION**

-K-

KSC   Kilograms per square centimeter

-L-

B/G   Pounds per gallon
LB/M   Pounds per minute
LB(S)   Pound (LB) or Pounds (LBS)
LBSH   Pounds per hour

-M-

/R   Minutes per repeat
M#/D   Thousand pounds per day
MCF   Thousands of standard cubic feet
MCFD   Thousands of standard cubic feet per day
MCFH   Thousands of standard cubic feet per hour
MIN   Minutes
MLBS   Thousands of pounds
MMBF   Millions of British thermal units per thousand standard cubic feet
MMBH   Millions of British thermal units per hour
MMBP   Millions of British thermal units per pulse
MMCD   Millions of cubic feet per day
MMSD   Millions of standard cubic feet per day
MMSC   Millions of standard cubic feet
MPH   Miles per hour
MSCD   Daily total volume rate in thousands of standard cubic feet per day
MSCH   Hourly total volume rate in thousands of standard cubic feet per hour
MSCF   Thousands of standard cubic feet

_____

ABBREVIATION   UNIT ABBREVIATION DEFINITION

-N-

N/HR	Flow units per hour
NCM	Normal cubic meters
NCMH	Normal cubic centimeters per hour
NSEW	North, South, East, West

-P-

%	Percent
%FS	Percent full scale
#	Pounds
#/F3	Pounds per cubic foot
#/FS	Pounds per foot-second
#/gl	Pounds per gallon
#/HR	Pounds per hour
#M/P	Pound mass per pulse
#MAS	Pound mass
#PH	Pounds per hour
P/BB	Pulses per barrel
P/BL	Pulses per barrel
P/F3	Pulses per cubic foot when used with K factor (KN)
P/GL	Pulses per gallon
PACF	Pulses per actual cubic foot
PPB	Pulses per barrel
PPG	Pulses per gallon
PSI	Pounds per square inch
PSIA	Pounds per square inch, absolute
PSIG	Pounds per square inch, gauge
PULS	Pulses

ABBREVIATION   UNIT ABBREVIATION DEFINITION

-S-

SCF	Standard cubic feet
SCFD	Standard cubic feet per day
SCFH	Standard cubic feet per hour
SCFM	Standard cubic feet per minute
SEC	Seconds
SG	Specific gravity
SGU	Specific gravity units

-U-

USEC	Microseconds
US/C	Microseconds per degree Celsius

-Symbols-

"H2O	Inches of water
"WC	Inches of water column
%	Percent
%FS	Percent full scale
#	Pounds
#/F3	Pounds per cubic foot
#/FS	Pounds per foot second
#/gl	Pounds per gallon
#/HR	Pounds per hour
#M/P	Pound mass per pulse
#MAS	Pound mass
#PH	Pounds per hour

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GLOSSARY OF STANDARD SELECTION LIST OPERATOR ENTRIES

ENTRY   **EXPLANATION**

-A-

ACFSCALE   ACFSCALE provides for selecting the units scaling factor for a volume in actual cubic feet (ACF). Selections indicate the scale by which the volume in ACF is divided. In other words, selecting X10 divides the volume in ACF by 10; selecting X100 divides the volume by 100: selecting X1000 divides the volume by 1000, etc.

-B-

BATCH   BATCH provides for selecting a batch change. The selections are CHANGE, which causes a batch change, and IDLE, which does not cause a batch change.

BTUSCALE   BTUSCALE provides for selecting the scaling factor for energy in British thermal units (BTU). Selections indicate the scale by which the energy in BTU is divided. In other words, selecting X10 divides the energy in BTU by 10; selecting X100 divides the energy in BTU by 100; selecting X1000 divides the energy in BTU by 1000, etc.

ENTRY	EXPLANATION

-C-

CLEAR   CLEAR provides for clearing totalizers. Two different sets of selections are possible:

-            CLEAR and IDLE

-            YES and NO

CLEAR resets the totalizer, and IDLE maintains cumulative totals on the totalizer.

YES resets the totalizer after printing a report, and NO maintains cumulative totals on the totalizer.

CLEARALL   CLEARALL provides for clearing all totalizers (accumulators). The selections are NO, which does not clear totalizers, and YES, which clears totalizers.

-I-

INTERVAL   INTERVAL provides for selecting the frequency for printing timed reports. Selections are identified by an abbreviation of the time interval between report printouts. In other words, HOUR1 (sometimes HOURX1) provides for a 1 hour interval between printouts.

ENTRY	EXPLANATION

<div align="center">-L-</div>

LBSCALE   LBSCALE provides for selecting the internal mass units scaling factor. Selections indicate the scale by which the mass units are divided. In other words, selecting X10 divides the mass units by 10; selecting x100 divides the mass units by 100; X1000 divides the mass units by 1000, etc.

<div align="center">-M-</div>

METERS   METERS provide for selecting the number of meter runs. Typical selections are ONE, which provides for one meter run, TWO, which provides for two meter runs, etc.

<div align="center">-S-</div>

SCFSCALE   SCFSCALE provides for selecting the standard cubic foot (SCF) volume units scaling factor. Selections indicate the scale by which the volume in SCF is divided. In other words, selecting X10 divides the volume in SCF by 10; selecting X100 divides the volume in SCF by 100; X1000 divides the volume by 1000, etc.

STREAMID   STREAMID provides for selecting one of several possible product streams. Typical selection options are ONE, TWO, THREE, etc., each of which selects the stream indicated by the option.

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ENTRY	**EXPLANATION**

-T-

TAPLOC#   TAPLOC# provides for choosing the tap location for orifice meter runs. Multiple runs may be designated by number or letter suffixes (accompanied with the symbol # in TAPLOC#). For example, TAPLOC1 is the variable name used to select the tap location for run number 1. The selections for TAPLOC# are UPSTREAM and DNSTREAM (downstream).

TAPTYPE#   TAPTYPE provides an operator selection entry for choosing the tap type for orifice meter runs. The selections for TAPTYPE# are pipe and flange.

TESTPULS   TESTPULS provides a turbine meter test signal. The selections are ON, which initiates the test signal, and OFF, which turns off the signal.

WARRANTY CLAIM REQUIREMENTS

To make a warranty claim, you, the Purchaser, must:

1. Provide Daniel with proof of the Date of Purchase and proof of the Date of Shipment of the product in question.

2. Return the product to Daniel within twelve (12) months of the date of original shipment of the product, or within eighteen (18) months of the date of original shipment of the product to destinations outside of the United States. The Purchaser must prepay any shipping charges. In addition, the Purchaser is responsible for insuring any product shipped for return, and assumes the risk of loss of the product during shipment.

3. To obtain Warranty service or to locate the nearest Daniel office, sales, or service center call (713) 467-6000, Fax (281) 897-2901, or contact:

    Daniel Measurement and Control
    P. O. Box 55435
    Houston, Texas 77255

    When contacting Daniel for product service, the purchaser is asked to provide information as indicated on the following "Customer Problem Report".

    Daniel Measurement and Control offers both on call and contract maintenance service designed to afford single source responsibility for all its products.

    Daniel Industries, Inc. reserves the right to make changes at any time to any product to improve its design and to insure the best available product.

DANIEL INDUSTRIES, INC.
CUSTOMER PROBLEM REPORT

FOR FASTEST SERVICE, COMPLETE THIS FORM, AND RETURN IT ALONG WITH THE AFFECTED EQUIPMENT TO CUSTOMER SERVICE AT THE ADDRESS INDICATED BELOW.

COMPANY NAME:_____

TECHNICAL CONTACT:_____ PHONE:_____

REPAIR P. O. #:_____ IF WARRANTY, UNIT S/N:_____

    INVOICE ADDRESS:_____

                    _____

                    _____

    SHIPPING ADDRESS:_____

                    _____

                    _____

RETURN SHIPPING METHOD:_____

EQUIPMENT MODEL #:_____ S/N:_____FAILURE DATE:_____

DESCRIPTION OF PROBLEM:_____

_____

_____

WHAT WAS HAPPENING AT TIME OF FAILURE?_____

_____

ADDITIONAL COMMENTS:_____

_____

_____

REPORT PREPARED BY:_____ TITLE:_____

IF YOU REQUIRE TECHNICAL ASSISTANCE, PLEASE FAX OR WRITE THE MAIN CUSTOMER SERVICE DEPARTMENT AT:

DANIEL MEASUREMENT AND CONTROL   PHONE: (281) 897-2900
ATTN: CUSTOMER SERVICE   FAX: (281) 897-2901
19203 HEMPSTEAD HIGHWAY
HOUSTON, TEXAS 77065

The sales and service offices of Daniel Industries, Inc. are located
throughout the United States and in major countries overseas.
Please contact the Daniel Industries, Inc., Measurement and Control at
P. O. Box 55435, Houston, Texas 77255, or phone (713) 467-6000
for the location of the sales or service office nearest you.
Measurement and Control offers both on-call and contract
maintenance service designed to provide single-source
responsibility for all Measurement and Control products.

DANIEL