OPERATION MANUAL

DATATRAC 400

ARINC 429 DATABUS ANALYZER

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WARNING: INFORMATION SUBJECT TO EXPORT CONTROL LAWS

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Declaration of Conformity

DECLARATION OF CONFORMITY

Manufacturer's Name:	BFGoodrich Aerospace, JcAIR Test Systems Division
Manufacturer's Address:	400 New Century Parkway New Century, KS 66031-0009 USA

Declares that the products

Product Name:	DT400 Data Bus Analyzer
Model Number(s):	01-1403-00 and 01-1403-02
Product Options:	All options associated with listed models are covered.

Conform to the following product specifications and carry the CE-marking accordingly.

Low Voltage Directive 73/23/EEC:	IEC 61010-1:1990 / EN 61010-1:1993
EMC Directive 89/336/EEC:	EN 61326:1998 IEC 61326:1997

Date: October 10, 2000 Charles C. Nehring

Chuck Nehring, Director
Quality Assurance/Customer Support

Safety and Regulatory Information

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate this equipment.

WARNING The **WARNING** notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

CAUTION The **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

Caution (refer to accompanying documents). Attention – refer to the manual. This symbol indicates that information about usage of a feature is contained in the manual.

IMPORTANT!

WARNING The mains (ac) fuse holder and the dc fuse holder are located on the Rear Panel. An accessory kit of fuses and fuse carriers (caps) is provided, see item ACC4.

For international requirements for JPN 01-1403-00 and 01-1403-02 units the following fuses must be used: Install an IEC style, 5 mm X 20 mm, 1.6 A, 250 V, Type F fuse (ACC4F3) into the ac fuse holder, A12XF2 (fuse A12F2), with the proper fuse carrier (ACC4MP2). Also install an IEC style, 5 mm X 20 mm, 1.6 A, 250 V, Type F fuse (ACC4F3) into the dc fuse holder, A12XF1 (fuse A12F1), with the proper fuse carrier (ACC4MP2).

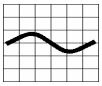
For the USA: Install a ¼ X 1 ¼ inch, 1.5 A, 250 V, slow-blow fuse (ACC4F2) into the ac fuse holder, A12XF2 (fuse A12F2), with the proper fuse carrier (ACC4MP1). Also install a ¼ X 1 ¼ inch, 1.5 A, 250 V, fast-blow fuse (ACC4F1) into the dc fuse holder, A12XF1 (fuse A12F1), with the proper fuse carrier (ACC4MP1).

For all other markets check with the proper authorities for which of these kinds of fuses to use.

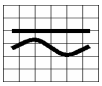
Equipment Markings

The following markings may appear on this equipment:

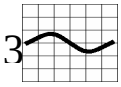
Direct current. This symbol indicates that the equipment requires direct current input.



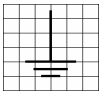
Alternating current. This symbol indicates that the equipment requires alternating current input.



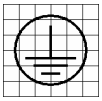
Both direct and alternating current. This symbol indicates that the equipment requires either ac or dc input at the same connector.



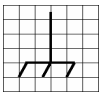
Three-phase alternating current. This symbol indicates that the equipment requires 3-phase ac input.



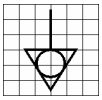
Earth (ground) terminal. This symbol indicates the ground (earth) terminal.



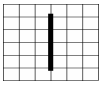
Protective conductor terminal. This symbol indicates the protective ground (earth) terminal.



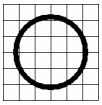
Frame or chassis terminal. This symbol indicates the frame or chassis terminal for connection to ground.



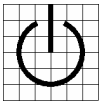
Equipotentiality. This symbol indicates an equipotentiality terminal.



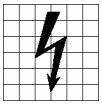
On (Supply). This symbol indicates that the power line switch is ON.



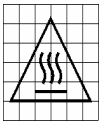
Off (Supply). This symbol indicates that the power line switch is OFF.



Standby. This symbol indicates that the power line switch is in STANDBY.

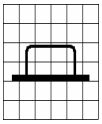


Caution, risk of electric shock. Danger – high voltage.

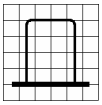


Caution, hot surface. Danger – high temperature surface.

Caution (refer to accompanying documents). Attention – refer to the manual. This symbol indicates that information about usage of a feature is contained in the manual.



In-position of a bistable push control. This symbol indicates the in (on) position of a bistable push control.



Out-position of a bi stable push control. This symbol indicates the out (off) position of a bi stable push control.

CE Mark. ™ of the European Community.

Fuse Symbol. To indicate a fuse.

Warnings

WARNING Do not use the equipment in a manner not specified in this manual!

WARNING Equipment should only be serviced by authorized personnel.

WARNING

To avoid fire hazard, use only a fuse identical in type, voltage rating, and current rating as specified in this manual.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate the equipment in an atmosphere of explosive gas.

Do Not Attempt to Operate if Protection may be Impaired.

If the equipment appears damaged or operates abnormally, protection may be impaired. Do not attempt to operate it. When in doubt, have the equipment serviced.

WARNING Keep the equipment dry to avoid electrical shock to personnel or damage to the equipment. To prevent damage, never apply solvents to the equipment housing. For cleaning, wipe the equipment with a cloth that is lightly dampened with water, mild detergent, or alcohol. Do not use aromatic hydrocarbons, chlorinated solvents, or methanol-based fluids.

Ventilation Requirements

For proper ventilation do not block openings in bottom cover or back panel.

WARNING This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket-outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

WARNING Equipment has recharging circuit for a rechargeable battery. Use only a sealed lead-acid battery as specified by JcAIR Test Systems.

WARNING Equipment contains a sealed lead-acid rechargeable battery not replaceable by an operator. Replace only with a sealed lead-acid battery as specified by JcAIR Test Systems. Observe polarity of battery when reconnecting.

WARNING Equipment is not intended for wet locations. Miscellaneous liquids on or in the equipment could cause hazardous conditions.

Safety Maintenance.

The operator should check the detachable power supply cord condition. The equipment should not be operated if the appliance inlet is cracked or broken. Any obvious damage to the case (from a drop or fall) should be checked by service personnel for loose or damaged parts inside. See individual parts lists for approved replacement parts.

WARNING The ON/OFF switch (A12S1) only controls dc voltage to the switch mode power supply (A2) that sources the operating circuitry. The battery (A13A2BT1) is always charging when there is mains power or dc power applied.

WARNING To effect primary (mains) disconnect unplug the detachable power supply cord at the appliance coupler or the mains plug.

WARNING Connect unit to only one external source at a time, either mains power supply or dc power supply.

CAUTION Connection to the dc power supply input dual banana jack (A12J10) shall be with a dual plug so that both conductors can be disconnected at the same time.

WARNING If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

ELECTROSTATIC DISCHARGE GENERAL WARNINGS FOR ALL EQUIPMENT

CAUTION: THIS EQUIPMENT MAY CONTAIN ELECTROSTATIC DISCHARGE (ESD) SENSITIVE COMPONENTS. TO PREVENT ESD SENSITIVE EQUIPMENT FROM POSSIBLE DAMAGE, OBSERVE THE FOLLOWING PRECAUTIONS WHEN HANDLING ANY ESD SENSITIVE COMPONENTS, OR UNITS CONTAINING ESD SENSITIVE COMPONENTS:

a. Maintenance or service personnel must be grounded though a conductive wrist strap, or a similar grounding device, using a 1 MΩ series resistor for equipment protection against static discharge, and personal protection against electrical shock.

b. All tools must be grounded (including soldering tools) that may come into contact with the equipment. Hand contact will provide sufficient grounding for tools that are not otherwise grounded, provided the operator is grounded through an acceptable grounding device such as a wrist strap.

c. Maintenance or service of the unit must be done at a grounded, ESD workstation.

d. Before maintenance or service of the equipment, disconnect all power sources, signal sources, and loads connected to the unit.

e. If maintenance or service must be performed with power applied, take precautions against accidental disconnection of equipment components. Specifically, do not remove integrated circuits or printed circuit boards from equipment while the equipment has power applied.

f. All ESD sensitive components are shipped in protective tubes or electrically conductive foam. The components should be stored using the original container/package when not being used or tested. If the original storage material is not available, use similar or equivalent protective storage material.

g. When ESD sensitive components are removed from a unit, the components must be placed on a conductive surface, or in an electrically conductive container.

h. When in storage or not being repaired, all printed circuits boards must be kept in electrically conductive bags, or other electrically conductive containers.

i. Do not unnecessarily pick up, hold, or directly carry ESD sensitive devices.

Failure to comply with these precautions may cause permanent damage to ESD sensitive devices. This damage can cause devices to fail immediately, or at a later time without apparent cause.

REVISION HISTORY BY DRAWING NUMBER

MANUAL: DATATRAC 400 ARINC 429 Databus Analyzer Operation

REVISION: 0 – September 26, 2006

DRAWING NO.	REV. LEVEL	DRAWING NO.	REV. LEVEL
Section I	00		
Section II	00		
Section III	00		
Section IV	00		
Section V	00		
Section VI	00		
Section VII	00		
Section VIII	00		
Appendix A	00		
Appendix B	00		
Appendix C	00		
Appendix D	00		
Appendix E	00		
Appendix F	00		

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SECTION I

1.0 INTRODUCTION TO THE DATATRAC 400

This manual is furnished to customers of Aeroflex to provide detailed instructions for the operation of the DATATRAC 400 ARINC 429 bus analyzer. It contains all necessary illustrations and information to allow the unit to be properly interfaced with appropriate electronic equipment. The general capabilities of the DATATRAC 400 are discussed in the paragraphs below.

1.1 SUMMARY OF FEATURES

DATATRAC 400 is a four receiver channel and four transmit channel ARINC 429 bus analyzer (Channels 3 & 4 are optional for both receive and transmit functions).

The primary modes are Receive, Transmit, Record, Break, and BITE. Also available is an optional Williamsburg Protocol Analyzer mode. This option is addressed in a separate user manual.

The Receive mode allows data to be read from all installed channels at either low (12.5 kHz) or high (100 kHz) speed. All labels on the bus will be received. The data may be viewed in nine different formats: hex, binary, engineering (standard and user defined). ASCII. And graphic time plots. Data can be downloaded via an RS-232C port and a D/A converter port.

The Transmit mode allows up to 128 labels per channel to be transmitted at either low or high speed. Other modes supported are dynamic data, prestored tables, burst, and retransmission of recorded data.

The Record mode allows up to 16 labels to be recorded at a selected sample interval between 1 ms to 10 s. Up to 120 kbytes of memory are available for storage.

The Break mode permits intermittent conditions to be trapped and history data to be collected in memory. Multi-level break conditions can be defined for trapping data.

The BITE mode, supports systems on 737-300/400/500, 747-400, MD-11, and A320-330/340 aircraft. Up to 240 BITE screens can be saved for later viewing or downloading. ARINC 604 normal and interactive modes are supported.

Product specification is in Appendix B.

A database corresponding to ARINC 429-16 is prestored in the DATATRAC 400 EPROM memory. This defines range, scaling, units, etc. to be used in displaying data for various modes. Also included in the database are special Boeing labels used by equipment in Boeing aircraft. A complete list of definitions for these labels is included in Appendix D.

1.2 REFERENCE DOCUMENTS

The following is a list of references referred to in this manual:

1. ARINC 429-16 SPECIFICATION
2. SPECIAL BOEING LABEL DEFINITIONS FOR ARINC 429
3. DATATRAC 400 WILLIAMSBURG PROTOCOL ANALYZER USER'S MANUAL - VERSION B

1.3 PHYSICAL DESCRIPTION

1.3.1 GENERAL

The DATATRAC 400 is packaged in an aluminum enclosure complete with handle, front panel, rear panel, and an internal card cage configuration consisting of mother board and plug-in application boards. Units may be configured with optional front acrylic cover and rear plastic cover.

1.3.2 FRONT PANEL DESCRIPTION

The front panel configuration shown in Figure 1 contains a LCD, a keyboard area, display contrast control, and the receiver/transmitter connectors.

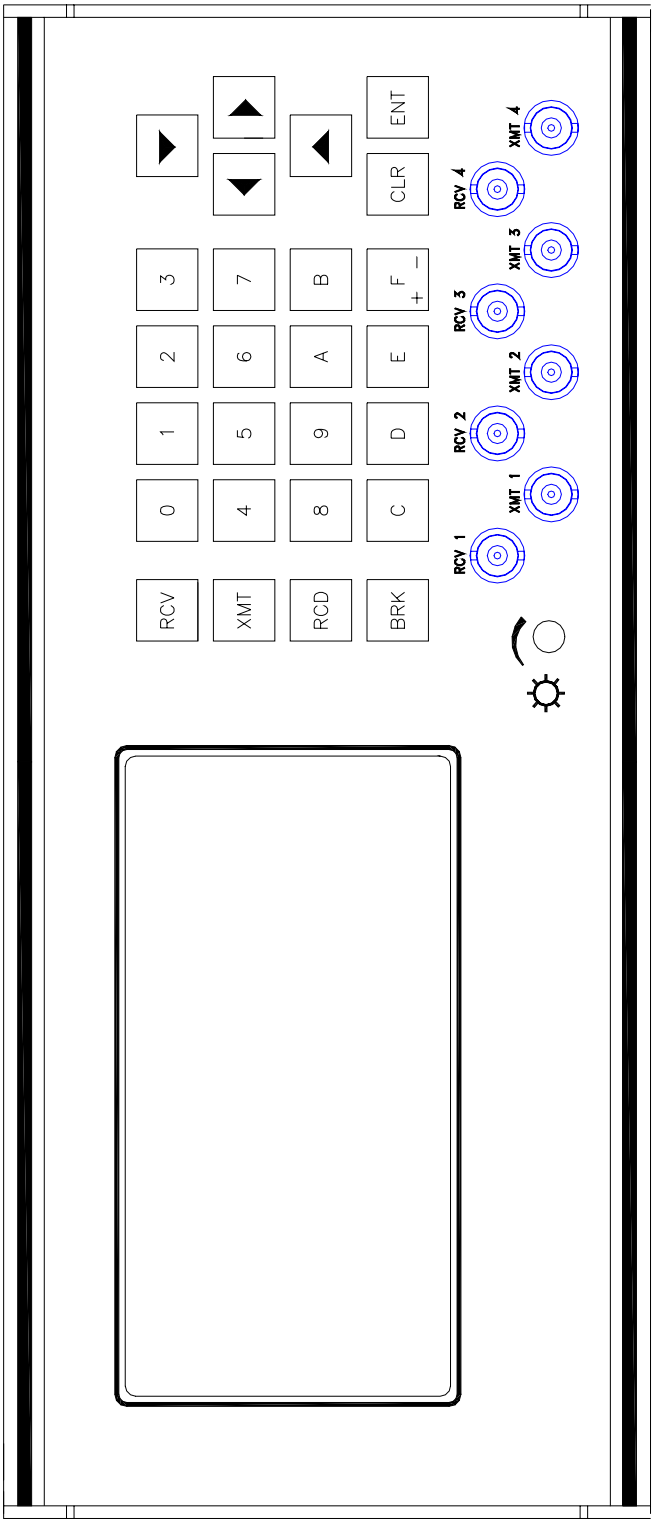
LCD

The liquid crystal display (LCD) provides 16 lines x 40 characters in the character mode. It can also be operated in a graphics mode to display time plots of data, with a resolution of 240 dots by 128 dots.

The contrast control for the display is located to the lower right of the display. This may be adjusted at any time to optimize the viewing of the display.

Keyboard

Three key areas are located to the right of the display. The first is a vertical column of four function keys (RCV, XMT, RCD, and BRK). The next key area consists of a 4 x 4 hexadecimal keypad for general data entry. The third key area consists of the six keys to the far right. Four buttons contain up, down, left, and right arrows and are used for various utility functions dependent on mode. Generally, the up/down keys are used to increment vertically through data lists. The left and right buttons are used to move the cursor laterally, sequence through setup options, or call help menus appropriate to the existing mode of screen. Located below the arrow keys are the clear (CLR) and enter (ENT) buttons.



DATATRAC 400 FRONT PANEL OVERVIEW
FIGURE 1

Databus Connectors

Two rows of four BNC connectors provide the databus interfaces for the input receive and output transmit channels. The inner conductor on each BNC connector is the A signal (High), of the ARINC 429 bus. The outer conductor is the B signal (Low). The channels are labeled appropriately.

1.3.3 REAR PANEL DESCRIPTION

The rear panel shown in Figure 2 contains the ON/OFF switch, power connector for dc power, power connector for mains power, the fuse holders, RS-232C connector, the DAC port connectors, and the unit serial number tag.

ON/OFF Switch

The ON/OFF switch applies power to the display and all electronic circuits.

Dc Power Input

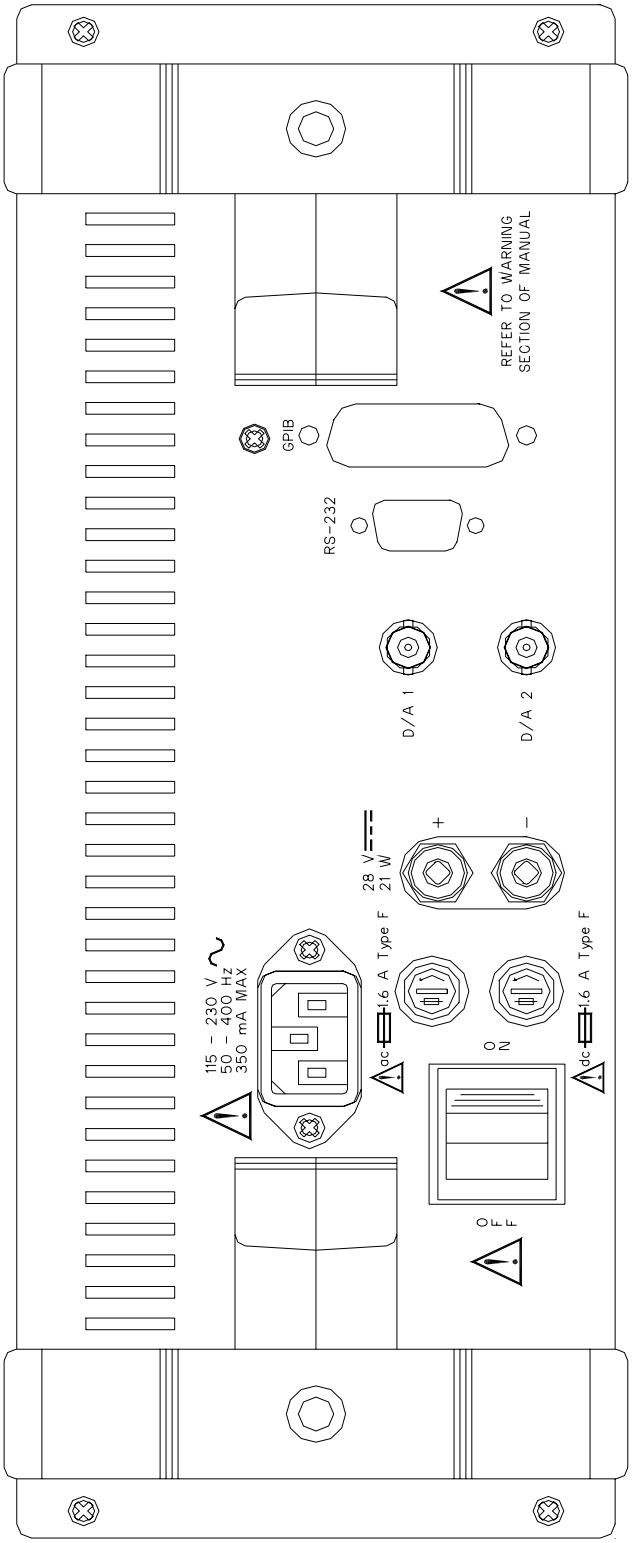
The red and black banana jacks can be used to apply an input of 28 V dc. The power source should be capable of supplying up to 21 W.

Mains Power Input

Mains power can be applied to the three prong connector. The range of this input is 115 to 230 V ac, 50 to 400 Hz, at a maximum of 350 mA.

Internal Battery Power

The unit may also be operated from the internal battery. The battery is a 12 V, 7 Ah sealed lead-acid battery. A fully charged battery will normally provide up to 6 h of operation. This battery is also used to retain RAM memory for an indefinite period. RAM memory will be retained even when the battery has discharged below the level required to operate the unit. The internal battery can be charged with the application of either dc or mains power. The charge function employs three levels for rapid and efficient charging. The lower maintenance level may be left on indefinitely.



DATATRAC 400 REAR PANEL OVERVIEW

FIGURE 2

Fuses

Two power input fuses (dc and ac) are located on the rear panel. These fuses should be checked after any failure of the unit to power up properly.

RS-232 Connector

An RS-232 connector is located on the rear panel and can be configured by the operator to output received or recorded data. Appendix A contains detailed information on interfacing this output to other RS-232 devices.

DAC Connector

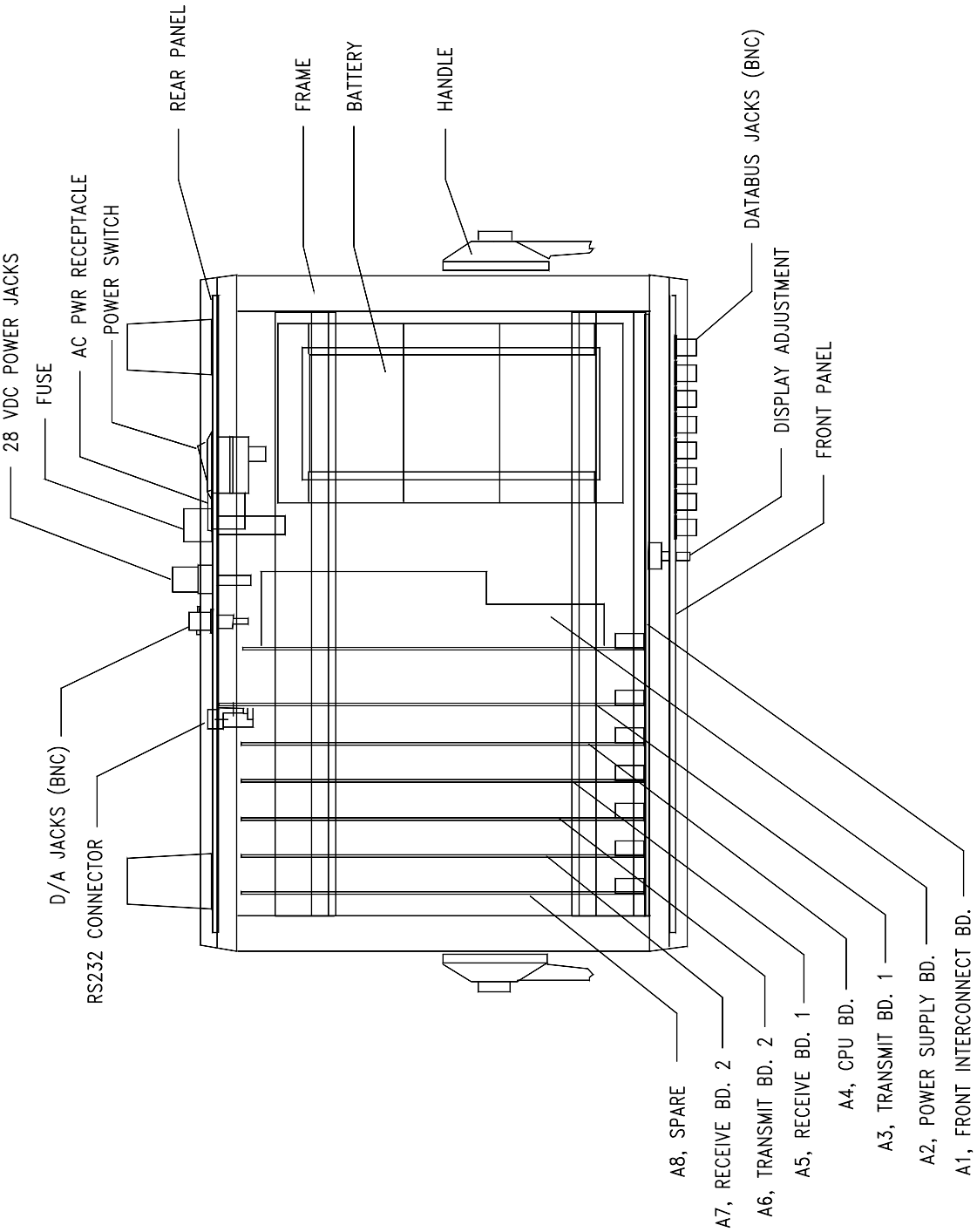
Two BNC connectors are located on the rear panel and each provides a DAC (digital to analog converter) channel that can be configured by the operator to output converted data or a trigger pulse (refer to sections 3-7 for more detail). The inner conductor is the signal side. The outer conductor is connected to ground. DAC channel 1 is available when Receive Board 1 (RCV channel 1 and 2) is present. DAC channel 2 is available when Receive Board 2 (RCV channels 3 and 4) is present.

1.3.4 INTERNAL ARCHITECTURE

Internally, the unit contains a card cage, and the battery assembly. The card cage arrangement consists of a front plane and the following plug in cards:

- Power supply
- CPU/memory
- Receiver Ch. 1/2
- Transmitter Ch. 1/2
- Receiver Ch. 3/4 (optional)
- Transmitter Ch. 3/4 (optional)

The internal configuration is illustrated in Figure 3.



DATATRAC 400 INTERNAL CONFIGURATION

FIGURE 3

SECTION II

2.0 INSTALLATION INFORMATION

2.1 UNPACKING AND INSPECTION

The DATATRAC 400 has been carefully packed to survive all normal shipping and handling conditions. It is important that the customer immediately inspect the received shipment to ensure that all items are present and undamaged.

Contents:

1. DATATRAC 400 unit
2. RS Read program for data download to a PC
3. Power Cord
4. Manual

WARNING

Inspect all items thoroughly for physical damage. If no damage is evident, apply mains or dc power to the unit and change on/off switch to ON. A power on screen should appear on the display (see section 2.2). If a problem is encountered at this point, contact an Aeroflex representative for assistance. DO NOT OPEN THE UNIT AND ATTEMPT REPAIRS AS THIS WILL VOID THE WARRANTY.

CAUTION

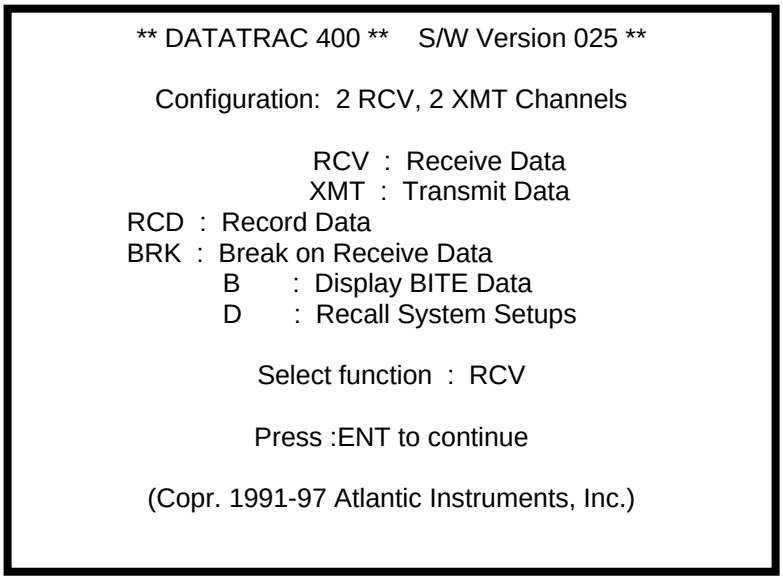
The internal battery should be in a charged state when it is received. However, as a precaution it is recommended that the unit be connected to external power overnight before attempting to operate from the internal battery.

2.2 GENERAL POWER ON PROCEDURES

External power (dc or mains) can be applied or the unit can be operated on the internal battery. If a unit fails to operate properly on power up, the fuses located on the rear panel should be checked.

Upon initial power up of the unit, the various mode setup values will be in indeterminate states. To reset these values to their defaults, first press the CLR key, then the 0 key. This initialization may also be necessary if an erroneous data condition is suspected during real-time operation of the unit, possibly caused by an inadequate battery backup.

After turning the on/off switch to the ON position, the following screen will appear on the display (a reminder: the contrast control may be adjusted at any time to optimize the viewing of the display).



The version number of the current software package contained in the DATATRAC 400 unit is always displayed on the first line of the power on menu. This information may be useful when reporting problems experienced in the field.

The configuration of the DATATRAC 400 unit is given on the second line of the menu. The number of received channels and the number of transmit channels contained on the unit and available for operation are listed.

The desired function can be selected from the list of options by pressing one of the four keys, the B key (for BITE mode operation), or the D key (for recalling system table) from the hexadecimal keypad. When the desired selection is displayed on the screen, the user “enters” the choice by pressing the ENT key. Control will proceed to the appropriate setup screen based on the function selected.

SECTION III

3.0 RECEIVE MODE

The receive mode consists of a primary setup screen, a secondary setup screen (referred to as the "Defaults" screen) and a real-time data display screen. There are also various help screens associated with each setup parameter. Depending on the system setup, the real-time screen may also be shared by one or more transmit channels. Additional setup screens are provided for special modes that may be selected.

3.1 PRIMARY RECEIVE SETUP

After a receive mode selection (RCV), the following receive setup screen will appear.

```
                    * RECEIVER SETUP *

Channel: 1

          On/Off:  : OFF          Select Lbls:  ALL
        Bus Speed:  12.5        Equipment ID:  002

          >      To step through options
          <      To see Help screen for each line
        ^ v      To move to next/previous line
          D      To edit defaults

Press ENT to continue or any
                        function key to change functions
```

Each setup parameter will initially contain its default value unless changed by a previous setup session. Before the operator can proceed to the real-time data display screen, a receive channel must be enabled by setting On/Off to ON. If the user does not wish to change the other default settings, the ENT key may be pressed to continue to the data display (real-time) screen.

At any time while in the setup screens, pressing the CLR key will reset all the parameters to their default values. The unit will ask for a confirmation (the C key confirms the action) before continuing with the reset.

Another function of the CLR key is to return to the Main Menu screen. This permits accessing the system setup recall function (since there is no dedicated key for this function). After pressing the CLR key, the unit will ask for a confirmation. Pressing F at this point will cancel the initialization and return to the Main Menu.

To change the current settings, the arrow keys should be pressed as instructed on the setup screen. The right arrow sequentially steps through the setup options. The left arrow presents a HELP menu with information pertinent to the particular parameter selection. The user may return from a help menu at any time by pressing ENT.

There is an additional list of parameters, accessible in the Receiver Default menu (section 3.2), that control aspects of the receive function.

The following sections describe each parameter listed in the Receiver Setup screen along with the help screens associated with each. The help screens are invoked by pressing the HELP key.

3.1.1 RECEIVER CHANNEL SELECTION

This setup line allows the user to select channels 1 or 2 (1-4 if the additional receiver card is installed) for setting up that channel. The channel number may be selected by typing the value directly or by using the > (right arrow) key to step through the options. Once a channel has been selected, all other parameter selections will apply only to that channel. This allows each individual channel to be uniquely configured. The help screen for this setup line is shown below (assuming a single receive board is installed) :

```
* RECEIVER HELP SCREEN *

Receiver Channel Selection:

  1 - To select channel 1
  2 - To select channel 2
  3 – Not installed
  4 – Not installed

Press ENT to return to setup screen
```

3.1.2 RECEIVER CHANNEL ON/OFF

This setup line is used to enable the currently selected channel for receiving and displaying data. The help screen for this parameter is shown here:

```
* RECEIVER HELP SCREEN *

Receiver Channel On/Off Options:

ON - To enable the channel for
     receiving data.

OFF - To disable the channel.

Press ENT to return to setup screen
```

Turning a channel OFF will not affect the other setup parameters for that channel. However, since the channel is disabled, it will not be displayed on the real-time screen. The remaining active channel windows (receive and transmit, if any) on the real-time screen will be resized to their default values. This will insure that the full screen is always utilized. Consequently, any non-standard display configuration that was defined will need to be redefined if the new real-time screen layout is undesirable.

3.1.3 RECEIVER BUS SPEED SELECTION

This setup line allows the user to select the bus speed for the receiver bus. The proper bus speed must be selected for the receiver to correctly display data. The help screen for this parameter appears below:

```
                * RECEIVER HELP SCREEN *

                Receiver Bus Speed Selection:

12.5    -       To select 12.5 KHz low speed
                bus
100     -       To select 100 KHz high speed
                bus

            Press ENT to return to setup screen
```

The current bus speed is always displayed on the respective channel header line in the real-time screen.

3.1.4 RECEIVE SELECT LABELS

This setup parameter allows the user to control which labels will be displayed on the real time screen. ALL mode causes every label being received on the bus (up to 256 labels x 4 SDI's) to be displayed in numerical order. Common labels with different SDIs are displayed on separate lines. SEL mode causes only the selected labels (up to 16 labels per channel) to be displayed in any desired order. The help screen for this parameter is:

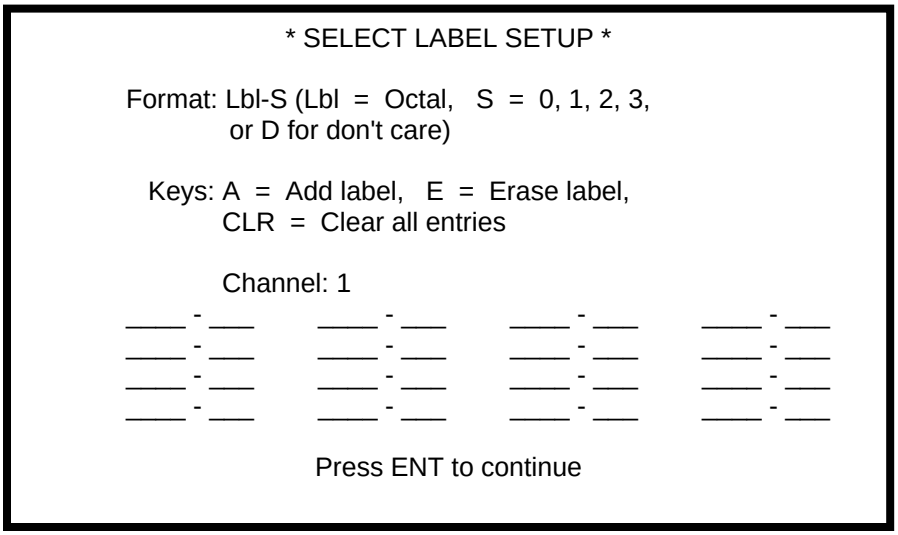
```
* RECEIVER HELP SCREEN *

Receive Select Labels Selections:

ALL    -    Display all incoming labels
            for current channel.

SEL    -    Display previously selected
            labels for current channel.

EDIT   -    Setup/edit selected labels.

Press ENT to return to setup screen
```

EDIT is selected when the operator needs to access the list of labels being selected either to review them or to make changes to the list. The next section details this operation.

3.1.4.1 SELECT LABEL SETUP

The select-labels facility permits the operator to filter out any unnecessary labels that would otherwise clutter up the real time display screen. It also enables the operator to organize the displaying for some order other than numeric by label (which is the case in ALL mode). This permits the viewing of two related labels next to each other and eliminates the inconvenience of scrolling the display from one label to the other.

To utilize this feature, the operator must first define which labels are to be displayed and their order. This is accomplished in the Select Label Setup screen. This screen is accessed by selecting EDIT as the Select Lbls option and pressing ENT. The following menu then allows the user to enter new labels or edit previously entered labels. The arrow keys (^ , < , > , v) are used to move the cursor position to the desired label field. The cursor cannot move beyond an undefined label field. The A key is used to add (insert) at the current cursor position. The E key is used to erase the label at the current cursor position. The CLR key is used to clear all labels for the currently selected channel only (the unit will request a confirmation of this action). Up to 16 label/SDI combinations can be selected for each channel.



When EDIT is selected at the Receiver Setup screen, the unit will automatically set the Select Lbls parameter back to SEL after the above screen is exited. The user is not required to return to the Receiver Setup screen to change this parameter from EDIT to SEL.

3.1.5 EQUIPMENT ID CODES

The equipment ID code should be entered for the unit to select the proper scaling for each ARINC 429 label. The DATATRAC-400 contains a full implementation of the ARINC 429-16 specification for stand alone words. Some labels may have multiple interpretations when displayed in engineering units and the equipment ID determines the correct interpretation. A help menu provides a reference list of all equipment ID's supported. Equipment ID codes are three-digit hexadecimal values. A new value is directly entered using the 0-F keys.

A portion of the help menu listing of all currently defined equipment ID codes that are supported by the DATATRAC 400 appears below. The full listing is contained in Appendix D. The user may scroll through the list one line at a time using the up and down arrows. The F (forward) and B (back) keys move the list 10 lines at a time and may be used to scroll more rapidly. It may be more convenient for the operator to have the list organized alphabetically rather than numerically. This may be accomplished by pressing A as noted in the help screen header message.

```
* HELP SCREEN * Equipment ID Codes *
        Press ^,v,B,F to scroll list,
    A for alphabetic order, 0 for numeric
    Press ENT to return to setup screen

001     Flight Control Computer
002     Flight Management Computer
003     Thrust Control Computer
004     Inertial Reference System
005     Attitude and Heading Ref System
006     Air Data System
007     Radio Altimeter
008     Airborne Weather Radar
009     Airborne DME
00A     FAC (A310)
00B     Global Positioning System
00D     AIDS Data Management Unit
010     Airborne ILS Receiver
```

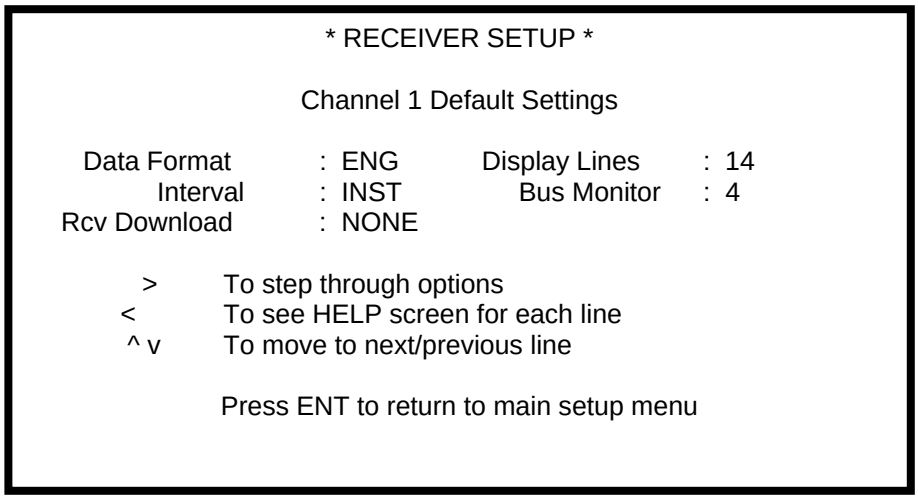
3.1.6 LABEL DATA DEFINITIONS

Since the user may not always be familiar with label assignments for parameters he is viewing, a help menu gives label data definitions based on equipment ID. This menu is accessed from the Receive, Transmit, Record or break data review screens by pressing the D key. The following example shows the label definitions for equipment ID 004.

```
Label Definitions  *  Equipment ID  =  004
  Inertial Reference System
Lbl          Parameter Definition
010      Present Position-Latitude
011      Present Position-Longitude
012      Ground Speed
013      Track Angle-True
014      Magnetic Heading
015      Wind Speed
016      Wind Direction-True
041      Set Latitude
042      Set Longitude
043      Set Magnetic Heading
044      True Heading

Press ^,v.F,B to scroll, ENT to return
```

3.2 DEFAULT RECEIVER SETUP OPTIONS

If the D key is pressed on the primary receiver setup menu, the following menu will appear, allowing the user to edit additional defaults of the receive mode. (Note: pressing D at the equipment ID field will be interpreted as a data entry.) These receive parameters are listed in a separate screen since they typically will be left in their default settings.



The following sections describe the settings of the various parameters above.

3.2.1 RECEIVER DATA FORMAT SELECTION

This setup line selects the format to be used initially by the receiver real-time display screen. The format may also be changed in the display screen by pressing the right arrow (>) key. Two options for this parameter that are not accessible from the real-time screen are EDIT and GRAPH. EDIT is used to create or modify a user-defined data format (see next section). GRAPH enables the real time graphic time plots of specified labels in lieu of the numerical display. The help screen for this parameter gives examples of data lines displayed in each format:

```
                * RECEIVER HELP SCREEN *
                 Data Display Format Options:

                    ENG  -  Engineering units
                  HEX19L  - 19 bit data field-hex-LSB 1st
                  HEX19M  -  19 bit data field-hex-MSB 1st
                   HEX32  -  32 bit hexadecimal
                  BIN19L  -  19 bit data field-bin-LSB 1st
                  BIN19M  -   19 bit data field-bin-MSB 1st
                   BIN32  -   32 bit binary
                    USER  -   Previously defined user format
                    EDIT  -  Define/edit user format
                  GRAPH  -   Realtime graphic plot

                                  Press v for examples
Press ENT to return to setup screen
```

```
                * RECEIVER HELP SCREEN *
                Examples of Display Format Selections
                given the following sample ARINC word:

          Data: Label 210              Equip. ID = 06
Bit   32          24          16          9  8          1
      01010100    11011001    10100010    00010001

  ENG  - Engineering units
  Lbl  SDI  11 -----  Eng Data  ---  *   SSM    Par    msec
  210  10          -1427.19 Kts          10       1    0062

                        Press v for more examples
                      Press ENT to return to setup screen
```

```
                    * RECEIVER HELP SCREEN *

    HEX19L - 19 bit data field  -  hex  -  LSB 1st
Lbl   SDI    11-Hex Data-29         SSM      Par     msec
210    10         166CA                 10          1      0062

    HEX19M - 19 bit data field  -  hex  -  MSB 1st
Lbl   SDI   29-Hex Data-11          SSM      Par     msec
210    10         A6CD0                 10          1      0062

    HEX32  - 32 bit hexadecimal
          Lbl   SDI   32-Hex Data-1           SSM       Par     msec
          210    10    54 D9 A2 11             10          1      0062

                    Press v for more examples
                  Press ENT to return to setup screen
```

```
                    * RECEIVER HELP SCREEN *

    BIN19L - 19 bit data field  -  bin  -  LSB 1st
Lbl   SDI     11- -Binary Data - -29      SSM    Par    msec
210    10      00010110011011001O1     10       1     0062

    BIN19M - 19 bit data field  -  bin  -  MSB 1st
Lbl   SDI      29- -Binary Data- -11      SSM    Par    msec
210    10      10100110110011011000     10       1     0062

    BIN32  - 32 bit binary
Lbl    32- * --- * --- * Bin * Data --- * --- * --- 1msec
210    01010100110110011010001000010001  062

                    Press ENT to return to setup screen
```

The up and down-arrow keys page through the different help screens above. The USER format presents data as ENG unless a different "sub-format" was defined for that label (see next section).

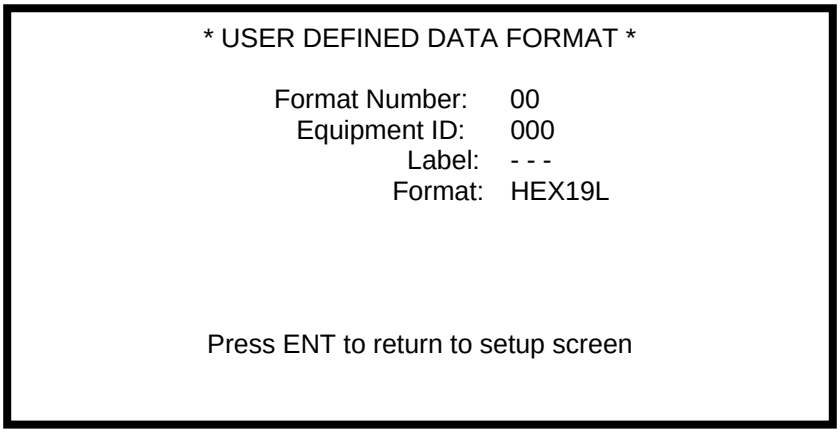
The ENG format (and USER format, if so defined) has the capability of displaying discrete bits if the label definition in the ARINC 429-16 document specifies it. Note above that the ENG header line contains an "11" just to the left of the data field. A discrete bit in the data word (bit 11) would be displayed in this column as a 0 or 1. Additional discretes -from bit 12 and up are displayed to the right.

In the BIN32 format, the asterisks (*) on the header line are intended as a reference to a bit's position in the data word. The asterisks mark the boundaries between nibbles (every four bits), namely, bit 5, 9, 13, 17, 21, 25, and 29. Also note that in the BIN32 data display format, the receive interval (msec) displays only three digits instead of four in other formats. The most significant digit is not displayed on the data line due to screen width limitations. If the receive interval is greater than 999 msec, the value will be displayed as 999. The operator should switch to another display format to see the full rate value.

3.2.1.1 USER DEFINED DATA FORMAT SETUP

The user-defined format facility gives the operator the ability to bypass the standard ARINC 429 data interpretation for a particular label and equipment. Up to 16 different format definitions can be entered and stored at a time. When the data display format is set to USER DATA in the header of the active receive channel window of the real time screen, the incoming labels and selected equipment IDs for that channel are scanned for any labels that match those stored in the user-defined scaling memory. If a match is found, the ARINC 429 scaling information is replaced with the user-defined format.

The data types available within a user definition are the two engineering types, BNR and BCD, as well as the direct data display formats HEX19L, HEX19M, HEX32, BIN19L, BIN19M, and BIN32. When the operator selects EDIT at the Data Format setup line of the Receive Defaults menu, the following screen is presented for defining the data format:



The format number is a value between 00 and 15 to be entered by the user. It serves as an index to the sixteen format definitions.

If the equipment ID is left at 000, then all occurrences of the specified label will be processed regardless of the equipment ID selected in the channel's setup screen.

An octal label must be entered before the cursor can advance to the format line. The > key is used to step through the format options. If the engineering formats, BNR or BCD, are selected, additional lines are displayed to enable the user to fully specify the bit format of the data word. For a BCD data type, the format screen appears as follows:

```
                * USER DEFINED DATA FORMAT *

                    Format Number:      00
                     Equipment ID:      00
                            Label:      377
                           Format:      BCD
          Max Digit (1, 3, 7, 9):       7
        Number of Digits (0-6):         5
   Number of Discretes (0-7):           0
                            Range:      1234560
                            Units:      USR

Press ENT to return to setup screen
```

The Max Digit parameter is used to determine how many bits will de dedicated to the most significant digit (MSD). The MSD always starts with bit 29 and occupies 1, 2,3, or 4 bits for a max digit of 1, 3, 7, and 9, respectively. Thus for a max digit of 7, the MSD will occupy 3 bits, namely bits 27, 28, and 29. This parameter controls the alignment of the other digits in the data word. See the ARINC 429 specification for the complete explanation of the BCD and BNR data formats.

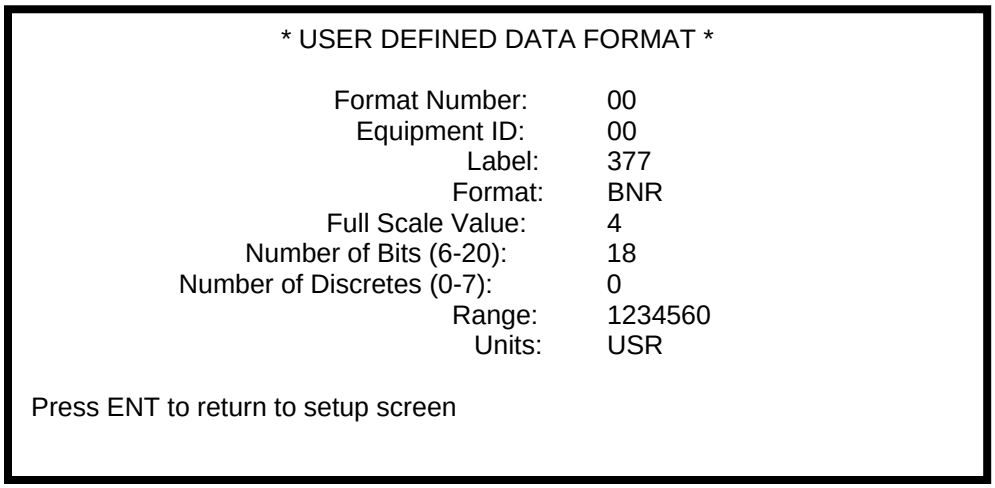
Beyond the MSD, all remaining digits are packed contiguously with 4 bits per digit. If the number of digits is set to less than 6, the remainder of the field is packed with zeros on the right. The position of the decimal point is specified by the range parameter. The > key is used at the range line to adjust the magnitude of the number. The choices for range are the following:

1234560
123456.
12345.6
1234.56
123.456
12.3456
1.23456
.123456

If the number of digits is less than 6, the undefined digits are set to 0. A 0 in the range indicates a dummy place holder and not a decoded digit.

Discretes can be defined beginning with bit 11 as the first discrete. If, for instance, three discretes are desired, entering a 3 for this parameter would decode bits 11, 12, and 13 and display these as binary digits. The Units parameter allows the user to specify a three character string to either indicate the units of the decoded value, or to simply identify the format definition. When the cursor is moved to this line, the DATATRAC 400 will print keystroke instructions for incrementing or decrementing through the ASCII table using the F and B keys. The > key is used to step to the next character when the current character has been set.

The BNR format screen displays a slightly different set of parameters:



Full Scale Value specifies the magnitude (+ and -) of the decoded value. The full scale values are discrete values that are predefined in the DATATRAC. They include all the full scale values currently listed in the ARINC 429 specification. The > key is used to step through the options until the desired full scale value is displayed. The choices currently defined are (in order they are stored):

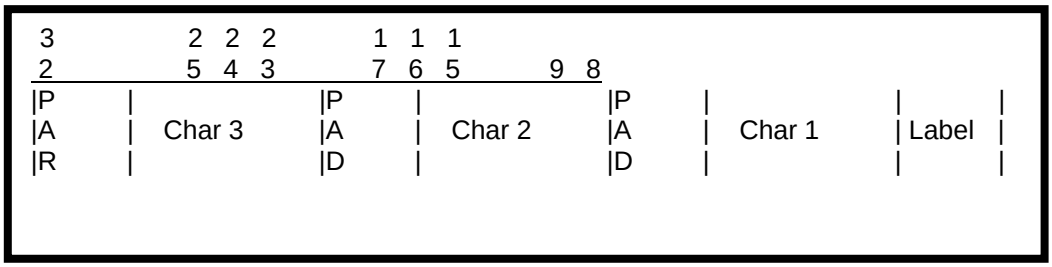
4	8	32	64	128
180	256	512	1024	2048
4096	8192	16384	32768	131072
360	65536	262144	16	

Beyond the last defined value (16), the unit will display integers followed by a question mark (?), such as "19?", "20?", and so on up to "31?". These are full scale value storage areas yet to be defined. The operator should avoid selecting one of these as the scaling will be unpredictable.

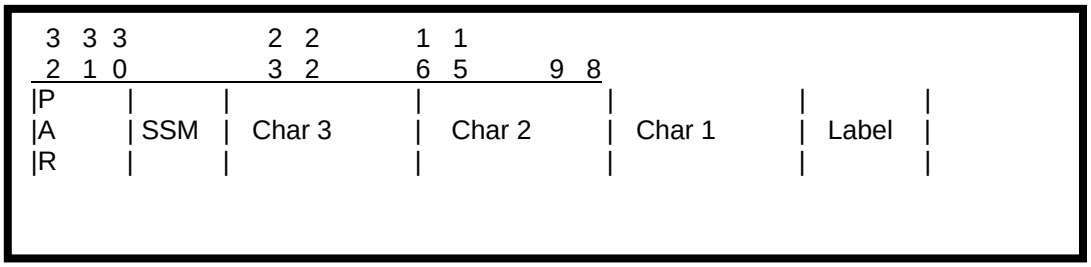
The number of bits specifies the number of significant bits (excluding the sign bit) to utilize in the decode. The sign bit is always bit 29, and the most significant bit of data is 28. Refer to the ARINC specification for a complete description.

Another user-defined format that may be specified is the ASCII format. This format is provided to support character-oriented data encoding. There are actually two slightly different schemes in common use for encoding 7-bit ASCII character data, namely PADDED and UNPADDED, as illustrated below.

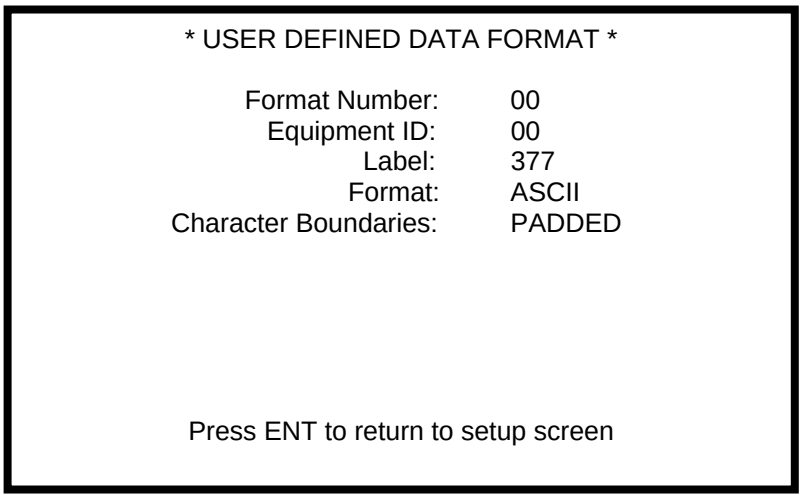
PADDED ASCII Encoding:



UNPADDED ASCII Encoding:

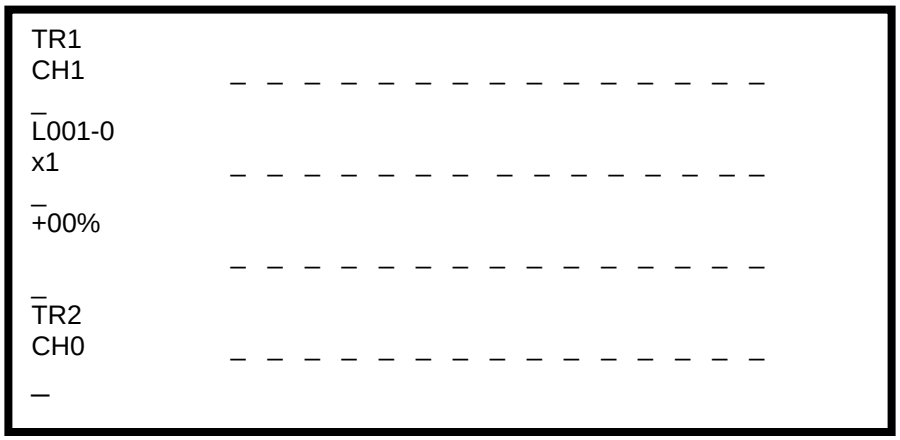


When the user selects ASCII as the user-format, the screen will appear as follows:



3.2.1.2 RECEIVE MODE GRAPHICS FORMAT

Instead of viewing the received data numerically, the operator has the option of displaying incoming labels as graphic time plots. To view graphics data, select GRAPH data format option in the default menu. When the ENT button is pressed twice, the following screen is displayed:



Four fields can be edited to achieve the desired graph. These are:

CH# - Channel Number. The options are 0, 1, and 2, 3, or 4 (assuming 4 receive channels are available). This is the receive channel that contains the data to be displayed graphically. A selection of 0 on trace 2 will turn the second trace off, enabling the entire screen to be used for trace 1 only (this is the default).

L001-0 - Label/SDI. Enter the octal Arinc 429 label and SDI to be displayed graphically.

x1 - Data scaling. The options are 1, 2, 4, 8, 16, 32, 64, and 128. An option of 1 means that the full scale value of the word is contained within the vertical height of the display, an option of 2 means that +/-50% of the full scale word is displayed, and so forth. The > key steps through the options.

+00% - Data offset. This is a percentage of full scale that becomes the zero point when the data is graphed. The data offset is applied before the data scaling is applied. Any number from 00% to 99% (+/-) may be entered using the 0-9 keys. The > key can be used to step to the next character.

The horizontal resolution of the graph is 200 dots. Therefore, for a receive interval of 100 ms it will take 20 s to complete one sweep. When it reaches the end, the display will clear and the plot will resume at the beginning. The relative time from the beginning of the sweep is displayed in seconds on the display.

The vertical resolution of the graph is 64 dots for dual trace mode and 128 dots for single trace mode.

In addition to the keystrokes described above, other keystrokes that are active while in the graph mode are:

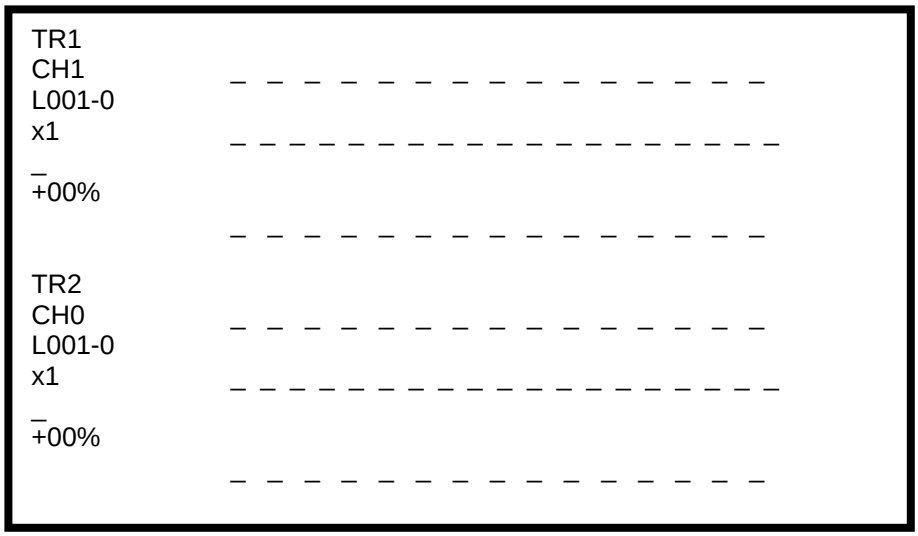
^,v - Moves the cursor up or down through the setup fields.

ENT - Freezes the graphic plot. Toggle to unfreeze. HOLD will be displayed in the upper right hand corner of the display. The elapsed time continues to tick off internally when data is on HOLD.

CLR - Data trace clears and starts over.

RCV, XMT, RCD, or BRK - Control is passed to the setup screen of the selected function.

It is possible to display two separate plots simultaneously by enabling trace 2. The default is trace 2 off. This is indicated by the channel number of 0. To enable the trace, move the cursor down to the channel of trace 2 and select the desired receive channel. The remaining setup lines will appear, prompting the operator to define the plot parameters:



When two plots are enabled, the two sweeps will run at the same speed to permit time response comparisons. The speed is dictated by the receive time interval of trace 1. The vertical position of the trace 2 plot will remain at its last value received.

3.2.2 INTERVAL (RECEIVE RATE) FORMAT SELECTION

The receive rate is the time interval between successive receipts of a particular label for a given channel. It is computed in milliseconds and displayed on the real time display line along with the data. The user may select the format of this receive interval to be the instantaneous, minimum, or maximum interval. The help menu below is available by pressing < at the setup line.

```
* RECEIVER HELP SCREEN *

Receive Interval Format Selections:

INST  -   To display instantaneous
          interval in ms
MIN   -   To display minimum interval
MAX   -   To display maximum interval

Press ENT to return to setup screen
```

3.2.3 RECEIVE DATA DOWNLOAD SELECTION

The user may select one of two modes for downloading received data in real time for further evaluation, processing, or archiving. The DAC option allows the user to select a real time conversion (12 bit) of digital data to an analog signal. The RS232 option allows the real time download of data to the RS-232C port. The help screen for this parameter is:

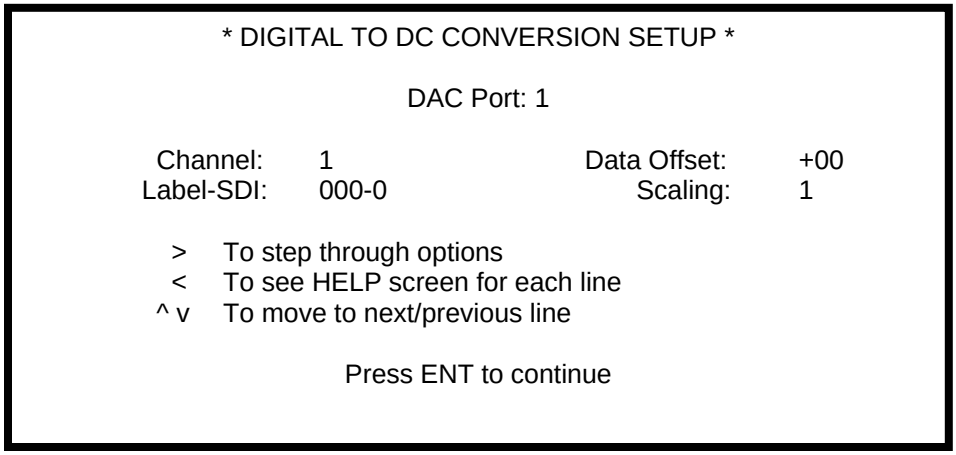
```
* RECEIVER HELP SCREEN *

Receive Data Download Selections:

NONE   -   Data Download is disabled.

DAC    -   Realtime digital to analog
           conversion of one data word.

RS232  -   Realtime download of received
           data on RS-232C port.

Press ENT to return to setup screen
```

The following sections detail the two download utilities available.

3.2.3.1 DIGITAL TO ANALOG CONVERSION SETUP

The DATATRAC 400 is configured with at least one digital-to-analog converter port. A second port is included with an optional second receive board. The DAC is a 12-bit converter with a range of +/- 10V.

The real-time download function of the DAC utilizes the most significant 12 bits of a specified label/SDI combination. The DAC download function is selected from the Receiver Defaults menu. The following screen for setting up the DAC port will then appear just before control is passed to the real time data display screen:



It is possible to enter a "don't care" for the SDI (using the D key). The data offset is expressed as a percentage of full scale from 0% to +/-99%. The F key is used to toggle the sign. There are discrete settings for the scaling (data multiplier) of 1 (data left unchanged), 2, 4, 8, 16, 32, 64, and 128. The > key is used to step through these values and select the desired scaling.

3.2.3.2 DIGITAL TO RS-232 DATA CONVERSION

Real time download of received data through the RS-232C port is enabled when the operator selects RS-232 at the Receiver Defaults menu. The download is channel specific, i.e., only the data pertaining to the channel under which the RS-232 was enabled will be downloaded. However, it is possible to enable the RS-232C port for more than one channel at a time. Each data record (label receipt) is transmitted over the RS-232C with the channel number as part of the data, so a host computer receiving the data can distinguish which channel the data line pertains to.

There are different modes which utilize the RS-232C download, namely, recorded data download and real time data download described here. In both cases, the bit format of a transmitted byte is the same. These are:

1 start bit
8 data bits
1 parity bit (odd)
0 stop bits
Baud rate = 9600 bps

Just before control passes to the real time data display, the unit will display the following message prompting the user to verify that the host is ready to receive data:

> Make sure the RS232 port is connected properly and that the RS232 receive port is ready to accept data. Press ENT to begin download or any other key to abort the transfer

The receiving program on the host should be invoked at this time to insure that no data is lost. Because this is a real-time operation, the DATATRAC 400 is unable to wait for the host. If the DATATRAC 400 detects that the host is not ready, it will simply skip the transmission of the record pending. To abort the download, any key other than ENT is pressed at the screen above and the DATATRAC 400 will return to the Receiver Setup screen. Note, however, that RS-232 download is still selected in the default screen. An attempt to proceed to the real-time display will again present the above message. To cancel the download, the operator must return to the Receiver Default menu and select a download of "NONE."

The unit will only download data while control remains in the real time data display screen. If a function keystroke causes control to pass to another screen, the RS-232C download will cease until control passes back to the real time screen via the Receive Setup. That is, only when the operator presses ENT from the Receiver Setup screen to proceed to the real time screen will the DATATRAC 400 check to see if the RS-232 download is enabled. If the operator enters the real time screen from the Transmit Setup screen, the RS-232 port will stay in a standby mode and not transmit any data.

For real time data download, a total of eight bytes are sent over the RS-232 port per label received. The structure of the record as it is transmitted on the RS-232C is defined as follows:

Byte	Description
0	Channel # (1, 2, 3, or 4)
1	Label
2	Data 1 (bits 9-16)
3	Data 2 (bits 17-24)
4	Data 3 (bits 25-32)
5	Time 0
6	Time 1
7	Time 2

Label, Data 1, Data 2, and Data 3 are the four bytes of the ARINC word received. The bit order of the label byte is already swapped to read directly as the octal ARINC label.

Time 0, Time 1, and Time 2 are the BCD encoded values for the relative time the label was received. Time 0 is the least significant byte, Time 2 is the most significant byte. The timer is a countdown timer such that subsequent label receipts will have a smaller time value. The range is 999,999 ms to 000,000 ms, or roughly 17 minutes. Upon reaching a time value of 000000, the timer will wrap around to 999999 and resume counting down. All values are transmitted as binary numbers, not their ASCII representation.

When the receiver is operating in the ALL mode, all incoming labels will be downloaded to the RS-232C port. When the receiver is operating in SELECT mode, only the selected labels will be downloaded.

> NOTE: Due to the finite baud rate (9600), the user must be careful not to overload the RS-232C port with real-time data at an average rate that exceeds the capacity of the bus. Since there are eight bytes per record, it takes the RS-232C port approximately 9 ms per record. Thus for a single label, a transmit interval less than 9 ms would cause an RS-232 overflow resulting in incorrect data being downloaded.

3.2.4 RECEIVE DATA DISPLAY LINES SELECTION

This setup line allows the user to customize the receiver display screen when multiple channels are being displayed. The user may select the number of labels (one label per line) to be displayed for each channel. The size of the display windows on the real time screen are set automatically by the unit each time a receive or transmit channel is enabled (or disabled). The default values are (as a function of the number of channels enabled):

1 channel on - 14 lines per channel
2 channels on - 6 lines per channel (or 12 lines total)
3 channels on - 3 lines per channel (or 9 lines total)
4 channels on - 2 lines per channel (or 8 lines total)

As an example, the user may choose to display one label for one channel and 11 labels for a second channel.

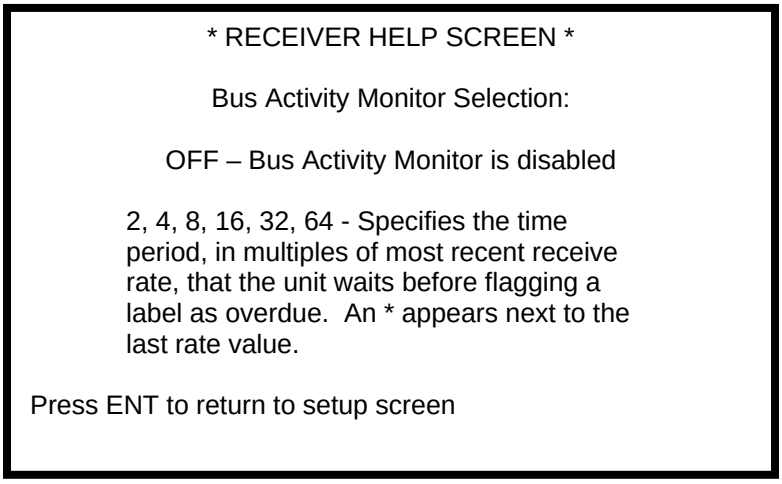
It is possible to have more than four channels enabled at one time if an optional second transmit or receive board is installed. In this case, the receive channels take priority over the transmit channels for allocating space in the real-time screen. Any transmit channels that are omitted from the real-time display are handled just as if the DISPLAY parameter for that channel was set to OFF (see Transmit Defaults menu description).

Before the Display Lines parameter value for a channel can be increased (assuming multiple channel operation), space must be freed from another channel. The operator must decrease the Display Lines value of another enabled channel(s) (receive or transmit) by an equal amount so as to maintain the maximum total for the number of enabled channels listed above. The help screen for this setup line follows.

```
* RECEIVER HELP SCREEN *

Display Line Count Selection:

    Selects the number of data lines to display for this
    channel. This parameter permits the channel
    display window sizes to be tailored to
    accommodate special viewing requirements. The
    total number of lines cannot exceed 14, 12, 9 or 8
    for 1, 2, 3, or 4 channels active, respectively.

Press ENT to return to setup screen
```

3.2.5 RECEIVE BUS MONITOR SENSITIVITY SELECTION

The DATATRAC 400 continuously monitors each label that is being displayed for activity. If the unit detects that a label receipt is overdue, it will flag this inactivity to the operator. An asterisk (*) is displayed next to the rate value for that label on the real time screen until the label is detected again. The Bus Monitor setup line allows the user to select the sensitivity of this monitor or to disable the monitor completely. The sensitivity is defined in terms of multiples of the last receive interval measured for a particular label. The options are described in the help screen:



The > key is used to step through the options.

3.3 REAL-TIME DATA DISPLAY SCREEN

The real-time data display screen is invoked any time the operator presses ENT from the receive setup or transmit screens and there is at least one channel enabled. If a DAC or RS-232 download was enabled, an intermediate screen will be displayed first before control is passed to this screen. Also, if the user selected EDIT as a Select Lbls parameter value, the Select Label Setup screen will appear first. The real time screen will not be invoked if the user chooses GRAPH as a receive data format.

The following sections describe the layout of the display screen, the active keys that take advantage of the display features, and other information necessary for proper operation. This section concentrates on the receive function, although the real time display supports transmit channels also. For a description of the transmit data editing features on the real time screen, refer to section 4.3.

3.3.1 DATA DISPLAY

The real-time screen consists of channel "windows." There are up to four windows for the enabled receive and/or transmit channels. If more than four channels have been enabled (with an optional receive or transmit board), the receive channels will take priority.

The windows consist of a channel header, a format header, and the data area. The following is an example of the real time screen with one channel active:

- - - - - - - - - RCV CHANNEL 1 (ALL) - - - - - - - - 12.5

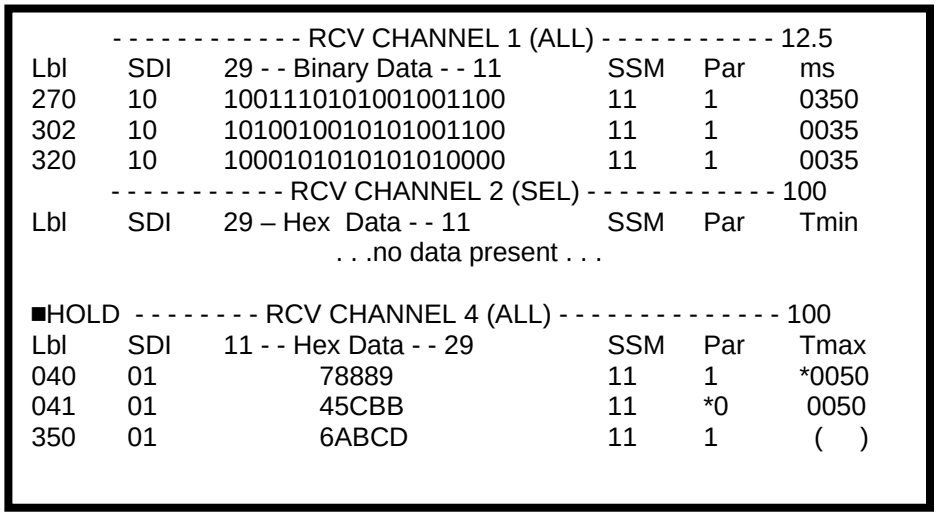
Lbl	SDI	29 - - Binary Data - - 11	SSM	Par	ms
270	10	10011101010010010 01	11	1	0350
302	10	10100100101010010 01	11	1	0035
320	10	10001010101010100 00	11	1	0035
324	10	00000100010001001 00	11	1	0035
325	10	01010101010010100 10	11	1	0035
326	10	00000000000000100 00	11	1	0035
327	10	01000001001001001 00	11	1	0035
330	10	00010100010101111 00	11	1	0350
331	10	11111111111000110 10	11	1	0350
332	10	11010101000011100 00	11	1	0350

The channel header line contains channel specific information. The solid box at the left extreme is termed the "active window indicator". When more than one channel is enabled, the active window indicator indicates which window is being affected by the operator's keystrokes. Note that even though a window is not "active", it is still receiving and displaying data in real time. It is only the operator's keystrokes that are confined to one channel so that other channels are not affected.

In this example, the channel's Select Lbls parameter was set to ALL as is indicated on the header. This parameter is displayed to avoid confusion that might arise if the operator has selected SEL mode. In SEL mode, the window will only display the selected labels. If the user had inadvertently left SEL mode active, labels might be missing from the list. By referring to the header, the user will know immediately which mode is active.

The bus speed setting (in KHz) is displayed at the right extreme of the header. Upon entering the real-time screen, the user should check the bus speed on each channel window to verify that they are correct.

Below is an example of multiple channel operation, in this case with three receive channels enabled (with the optional second receive board installed).



In the example above, channel 4 is the active window. Any keystrokes affect only this window. The HOLD utility is currently active, as indicated in the header. This is described in the next section. Channels 2 and 4 above have in the format header Tmin and Tmax.

This appears when the operator selects MIN (in channel 2) and MAX (in channel 4) under Interval in the Receiver Default menu. In the case of channel 2.,the DATATRAC 400 will latch the minimum receive interval for each label and display them. In channel 4, the maximum interval is latched and displayed. When the instantaneous rate is being displayed, the format header will simply display “ms” (see channel 1).

The bus inactivity marker (*) is visible next to the rate of channel 4's label 040. If the bus monitor was set to 4 for this channel, the asterisk indicates that at least 200 ms have elapsed since the last receipt of label 040-01. See the next section for relevant keystrokes that affect this interval display.

If only one data word for a label is received and the unit is unable to compute an interval, an infinity ( ) sign is displayed in the rate field (see label 350 in the example).

Another feature illustrated in this example is the parity error flag. Label 041 indicates an even parity on the last receipt. This is highlights by the adjacent asterisk. In a typical application, a parity error might occur once in a stream of data for a particular label. When is does, the unit will display the asterisk for about three seconds, even though the parity returns to “odd”. The “0” alone would flash too quickly for the operator to detect that an error has occurred. In this way, the operator can catch parity errors that would otherwise go unnoticed.

3.3.2 REAL TIME SCREEN KEYSTROKES

The following is a list of all the keystrokes defined for use in the real time display while in a receive channel window.

1, 2, 3, 4 - Change active receive channel. To change the channel affected by keystrokes (shown by the solid box or "active window indicator"), the operator simply presses the key of the desired channel. Of course, the channel must have been enabled in the setup and thus present in the real time screen. If the channel is not enabled, the keystroke is ignored.

^, v - Scroll data up/down. The up/down arrows allow a long list of labels to be scrolled on the active display window. Note: if Tmax or Tmin interval display is active for the window, scrolling will reset the values currently displayed.

CLR - Clear/reset data. At any time, the CLR key may be used to remove all data from the active display window. The rates are reset (any latched min or max interval is cleared). This might be useful if spurious transmissions from an external source cluttered the display, and the user wished to refresh the display with current input data.

ENT - Freeze (hold) data. When this key is pressed, data in the current active window ceases to be updated. This state is indicated by the "HOLD" on the channel header (see previous example). This utility permits the operator to examine rapidly changing or noisy data. During the hold, the receiver does not scan the intervals for minimum or maximum, parity error are ignored, and there is no monitoring for inactivity. Toggling ENT releases the hold and resumes normal operation.

> - Change data format. The data display format for the active channel window can be changed at the real time screen by pressing the right arrow key. The formats will cycle through the sequence in the following order: ENG, HEX19L, HEX19M, HEX32, BIN19L, BIN19M, BIN32, & USER. Note that for BIN32 format, a limitation on screen width forces the most significant digit (1000 ms) to be dropped. If USER format is selected, the unit will scan the incoming labels on that channel to see if any match the list of user-defined data format labels defined earlier by the operator. If there is no match, the label is displayed in ENG format using standard ARINC 429-16 decode for that label/equipment. See section 3.2.1.1 for a complete explanation of user-defined data types.

RCV - Return to the receiver setup screen. This keystroke will exit the real time display and present the receive setup screen for the last active receive channel. If an RS-232 download was being performed, it will be disabled until control is returned to the real time screen. If the active window indicator had been in a transmit window, the first push of RCV would move the active window indicator to a receive window and the second push of RCV would invoke the receive setup screen.

XMT - Make transmit window the active window. If the transmit channel is enabled and is being displayed on the real time screen, this keystroke will move the active window indicator to the transmit window. Any subsequent keystrokes will affect the transmit window. The receive channels will continue displaying real time data. Control is passed back to the receive channel window by pressing RCV. If no transmit channel is present in the real time screen, control is passed to the transmit setup screen and any RS-232C download is terminated.

RCD, BRK - Record, Break functions. These keystrokes will cause control to pass out of the real time screen and to the respective setup screen. Any current RS-232 download is terminated. The operator can return to the real time screen by pressing RCV or XMT and then ENT.

> - Help menu. The help key calls up the help screen for the real time receive display as shown below:

```
                * RECEIVER HELP SCREEN *

  ■          Symbol at header indicates
             current active channel.

                    * KEY DEFINITIONS *
  1,2,3,4    Change the active RCV channel.
      ^, v   Scrolls data in active channel.
         >   Steps through data formats in
             active channel.
       ENT   Holds (freezes) data in active
             channel.  Toggle to release.
       CLR   Clears receive buffer of active
             channel.

                    Press ENT to continue
```

SECTION IV

4.0 TRANSMIT MODE

The transmit mode is invoked by pressing XMT and ENTER from the main power-on menu, or by pressing XMT from any other screen. The transmitter setup features are much like the receiver setup, consisting of a setup screen, various optional menus and help screens, and the real-time data display screen. The transmit setup parameters commonly edited are presented on the primary setup screen and lesser used function are displayed on the transmit default screen. The default options are accessed from the primary screen by pressing D for default setups.

4.1 PRIMARY TRANSMIT SETUP SCREEN

The primary transmit setup screen is shown below:

```
                    *TRANSMITTER SETUP
                        Channel :  1
          On/Off :          ON      Transmit Mode  :KEY
       Bus Speed :          12.5     Equipment ID  : 002


          >       To step through options
          <       To see help screen for each line
          ^v      To move to next/previous line
          D       To edit defaults

                  Press ENT to continue or any
                 function key to change functions
```

Each setup parameter will initially contain its default value unless changed by a previous setup session. Before the operator can proceed to the real-time display screen (or in special cases the alternate transmit edit Screen), a transmit channel must be enabled by setting On/Off to ON. The ENT key can then be pressed to proceed to the data display and edit screen (either real-time screen of alternate edit screen).

At any time while in the setup screens, pressing the CLR key will reset all the parameters to their default values. The unit will ask for a confirmation before continuing with the reset. The user can return to the main (power on) menu from the setup screen by pressing CLR then F. This sequence will not reset the transmit setup.

The following sections detail the function of each setup parameter.

4.1.1 TRANSMITTER CHANNEL SELECTION

This setup line allows the user to select channels 1 or 2 (1-4 if the additional transmitter card is installed) for setting up that channel. The channel number is selected by typing the channel number directly of by using the > key to step through the options. Once a channel has been selected, all subsequent parameter edits will apply only to that channel. Below is the help menu for this parameter (assuming a single transmit board is installed) :

*TRANSMITTER HELP SCREEN

Transmitter Channel Selection :

1 - To select channel 1
2 - To select channel 2
3 - Not installed
4 - Not installed

Press ENTER to return to setup screen

4.1.2 TRANSMITTER CHANNEL ON/OFF

This setup line is used to enable the currently selected channel for editing and transmitting data. The help screen for this parameter is :

*TRANSMITTER HELP SCREEN

Transmitter Channel On/Off Options

ON - To enable the channel for transmitting data.

OFF - To disable the channel.

Press ENTER to return to setup screen.

4.1.3 TRANSMITTER BUS SPEED SELECTION

The transmitter bus speed setup is explained by the following setup help screen.

*TRANSMITTER HELP SCREEN

Transmitter Bus Speed Selection Options :

12.0	- To select 12.0 KHz low speed bus.
12.5	- To select 12.5 KHz low speed bus.
14.5	- To select 14.5 KHz low speed bus.
100	- To select 100KHZ high speed bus.

Press ENTER to return to setup screen

The current bus speed is displayed on the channel headers of the real-time display screen.

4.1.4 TRANSMITTER MODE SELECTION

There are three modes of data transmission available, namely, static data (termed KEY because it is entered on the keyboard in the real-time screen), dynamic data, and data prestored in tables.

With static data, the operator enters the four ARINC bytes in any of the available formats. The unit will then repeatedly transmit (unless burst mode is enabled, see section 4.3.5) that same data pattern until it is changed, of halted by the operator.

Dynamic data mode allows the operator to define a waveform to be transmitted for a specified label. Section 4.4 details this function.

Prestored table transmission causes a predefined list of data to be transmitted. This is particularly useful when a test application requires several different and extensive transmit setups with long lists of labels. TBL mode permits the user to simply reference a table number in lieu of entering all of the data associated with a setup. Section 4.5 details this function.

Below is the help screen for this parameter.

*TRANSMITTER HELP SCREEN

Transmitter Mode Selection :

KEY - Keyboard entered data.

DYN - Dynamic data.

TBL - Prestored transmit tables.

Press ENTER to return to setup screen

4.1.5 EQUIPMENT ID CODES

As with the receive mode, the equipment ID must be set up to support the engineering format option. See section 3.1.5 for a list of the equipment supported.

4.2 TRANSMITTER DEFAULT SETUP OPTIONS

The transmitter default screen is accessed by pressing the D key while in the primary setup screen. This menu allows the user to edit additional transmit setup parameters these transmit parameters are listed in a separate screen since they typically will be left in their default settings.

*TRANSMITTER SETUP

Channel : 1 Default Settings

Data Format :	ENG	Display Lines :	14
Display :	ON	Bit Gap :	4

>	To step through options
<	To see help screen for each line
^v	To move to next/previous line

Press ENT to return to main setup menu

The following sections describe the functions of the different parameters above.

4.2.1 TRANSMITTER DATA FORMAT

This parameter determines the format of the data when editing static data. The operator can enter data in any of the eight formats provided. The same format options used in the receive mode are also available in the transmit mode, with the exception of the graphic data format. The format can also be selected at the data editing screen by pressing the > key when the cursor is on the channel header. An explanation of the different formats is detailed in section 3.2.1. Section 3.2.1.1 describes the user-defined formatting that also applies to the transmitter. Editing of static data in the different formats is covered in section 4.3.

> Note : The user defined format storage area is common between the receiver and the transmitter. Any formats defined while in the receive setup (of any channel) will apply equally to all enabled transmit channels. Thus if the operator types a label for editing while the user-format is enabled, and a label/equipment ID match is found with a record in the common storage area (even receiver), the format information in the user format record will be used instead of the standard ARINC 429 format information.

4.2.2 TRANSMIT DISPLAY ON/OFF

Normally, when an operator enables a transmit screen, the real-time display screen will contain a window for that channel to provide a means of editing the data to be transmitted. Unlike receiving data in real-time, however, it is sometimes not necessary to view transmit data in the real-time screen after it has been defined. The unit can be directed to transmit data in the background while the display is dedicated to other tasks. This permits the user to free up needed display space on the real-time screen for displaying receiver data or for providing additional lines to another transmit channel. The “display” parameter specifies whether of not the particular channel is to appear on the real-time display screen.

If the parameter is set to OFF, the unit will first present the alternate transmit edit screen before proceeding on to the real-time screen. The alternate edit screen is very similar to the real-time screen. However, only the transmit channels that have displayed set to OFF, or transmit channels that were omitted from the real-time screen for lack of space, are displayed.

Any previously defined data can be reviewed or new data specified on this screen before control passes to the real-time screen. Section 4.3.2 discusses the alternate transmit edit screen. Section 4.3.3 details the editing of static data, which is the same on this screen as in the real-time screen.

When the display parameter is set to ON, space is allocated on the real-time screen for displaying and editing data for the transmit channel selected.

Note : A limit of four receive and/or transmit channels can be displayed on the real-time screen at a time. If more than four channels are enabled, the overflow transmit channels are deferred to the alternate edit screen just as if the display was set to OFF (when this occurs, the display lines parameter is set to 0).

There are certain limitations in using the alternate edit screen with which the operator must be familiar :

- Since the channels defined in this screen are to be transmitted in the background, there is no means of toggling transmit on and off as is possible on the real-time screen. The alternate edit screen windows are always defaulted to ON. Any edits terminated by the ENT keystroke begin transmitting immediately. They continue transmitting until the channel is turned off at the setup screen.

- The burst mode of transmission is not functional since it requires access to the channel window in the real-time screen for sending a burst of data. See section 4.3.5 for the description of burst mode.

- Since all edits to a channel are performed outside the real-time screen, it is difficult to monitor the immediate reaction of a receive channel to a transmit edit. If it is necessary to monitor changes in the received data as a function of changes in the transmitted data, it is recommended that the display parameter be set to ON so that edits can be performed on the real-time screen with the received data being displayed.

Section 4.3.2 describes the alternate transmit edit screen in more detail. Below is the help screen for the display parameter :

```
* TRANSMITTER HELP SCREEN *
Transmitter Display On/Off Options :

ON  -  This enables the transmit data to be
       edited or viewed on the display.

OFF -  This only disables the displaying of
       transmit data. It does not affect the
       state of the transmitter.

Press ENT to return to setup screen
```

4.2.3 TRANSMIT DISPLAY LINES SELECTION

This setup parameter gives the user the capability of customizing the layout of the real-time screen when multiple channels are enabled. This is similar to the display lines parameter for the receive setup. See section 3.2.4 for a complete explanation of this parameter. The help screen is the same for the receive setup. Setting display lines to 0 is equivalent to setting display to OFF.

4.2.4 TRANSMIT WORD BIT GAP SELECTION

The operator can specify with this parameter the spacing between adjacent transmissions of words. The value is expressed as a multiple of a bit interval or width. The default bit gap is 4 bits, but the operator can adjust the gap to be any of the integers : 2, 3, 4, 5, 6, 8, or 12. Either direct keypad entry to the > key can be used to select the bit gap. The help screen associated with this parameter is shown below :

```
* TRANSMITTER HELP SCREEN *

Transmit Word Bit Gap Selection

Selects the number of bits between words being
transmitted.

Options :  2, 3, 4, 5, 6, 8, 12

Make selection by direct keyboard entry or > to
scroll through options.

Press ENT to return to setup screen
```

4.3 STATIC TRANSMIT DATA KEYBOARD ENTRY AND DISPLAY

This section describes the utilities available for editing and controlling the transmission of data. Transmit data editing (of static, i.e. non-dynamic, Data) can be performed from two logically different yet very similar screens. These are real-time data display screen and the alternate transmit edit screen. Both screens are described below.

4.3.1 REAL-TIME DATA DISPLAY SCREEN

When the setup of the transmitter is complete and the operator pressed ENT, control passes to the real-time data display screen unless one of the following is true :

- One of the transmit channels has the “display” default parameter set to OFF,
- One of the transmit channels has the display lines parameter set to 0,
- More than 4 channels are enabled, causing the real-time screen to omit one or more channels.

If any of the above are true, control passes first to the alternate edit screen to give the operator a chance to review and/or edit the channel(s) before proceeding to the real-time screen.

Below is an example of the real-time screen with one receive and one transmit channel enabled:

```
------------------------------  RCV CHANNEL 1 (ALL) ------------------12.5
Lbl      SDI         :11-Eng Data-:       SSM        Par      Ms
                                  No data present:




■ 0N ---------------------- XMT CHANNEL 1 --------------------------- 12.5
Lbl      SDI     11 ---- ENG Data-----*     SSM       Par      ms
100      00              +123.442 Deg      01         1       0100
034      00      0000     100.00  Mhz       +         1       0100
001      00              +5432.1  NM        +         1       0500
. . .    00                                           1       0100
```

Section 3.3 describes the general aspects of the real-time screen and will serve as a reference for terms used throughout this section.

When the transmit window is made active, a cursor appears at the channel number (in the header). Certain keystrokes only apply when the cursor is at the header. These are :

1, 2, 3, 4 – Change active transmit channel. If more than one transmit channel is being displayed on the real-time screen, the active window indicator (and thus key control) can be moved from one window to another by typing the channel number. If the channel selected is not on the real-time screen, the keystroke is ignored.

ENTER - Toggle transmit on/off. This keystroke halts (or resumes) the active channel's transmission of data. The current status of the channel is displayed on the header (ON in the example above).

> - Change data format. The data display format for the active channel's is changed to the next format in the sequence. The formats available are ENG, HEX19L, HEX19M, HEX32, BIN19L, BIN19M, BIN 32, and USER. Note that for BIN32, a limitation on screen width forces the most significant digit of the rate to be dropped.

v (down arrow) - Enter data edit field. When this key is pressed, the cursor leaves the header and moves into the first position of the data area. At this point the unit is ready to accept edit keystrokes. Since the data editing is the same in the real-time and alternate edit screens, it is described in a separate section (4.3.3).

B - Channel burst command. Causes a burst of all burst-mode labels defined to be transmitted. See section 4.3.5 for a complete explanation of burst mode.

There are other keystrokes (aside from editing keystrokes described in section 4.3.3) that apply while in the transmit window of the real-time screen whether the cursor is at the header or in the data field :

XMT - Return to the transmit setup screen. Any edits that were performed are implemented in the transmit data fields for the active channel and control passes to the transmit setup screen. If an RS-232C real-time received data download was being performed by a receive channel, it will be disabled.

RCV - Make receive window the active window. If a receive window is present on the real-time screen, key control is passed to it. If more than one receive channel is enabled, control is passed to the receive channel that was last active. If no receive channel is enabled, control passes to the receive setup screen. Data transmission continues uninterrupted for all enabled transmitter regardless of whether control is in the real-time screen of not.

RCD, BRK, - Record, Break, function. Any edits that were performed are implemented in the transmit stream for the active channel and control passes to the corresponding setup screen. If an RS-232C real-time received data download was being performed by a receive channel, it will be disabled. Data transmission will continue uninterrupted.

Note that the header for each transmit channel display contains an indication of the bus speed previously selected for that channel.

4.3.2 ALTERNATE TRANSMIT EDIT SCREEN

This screen is invoked automatically by the unit when any of the following conditions are true :

- One of the transmit channels has the DISPLAY default parameter set to OFF,
- One of the transmit channels has the display lines parameter set to 0,
- More than 4 channels are enabled, causing the real-time screen to omit one or more channels.

The alternate edit screen uses the same keystrokes for editing (when the cursor is in the data field, not the header) as the real-time screen. These are described in the next section. However, some hearer keystrokes are interpreted differently. Furthermore, only one channel is displayed at a time for reviewing and/or editing. Here is a sample of a alternate edit screen :

```
-ON ---------------------------- XMT CHANNEL 1 ------------------
12.5
Lbl      SDI     11--------ENG Data-------*          SSM     PAR      Rate
. . .     00                                                  1       0100
```

It is essentially identical to the real-time screen except for the missing active window indicator (solid block at the left extreme of the header). The keystrokes that are active when the cursor is at the header are :

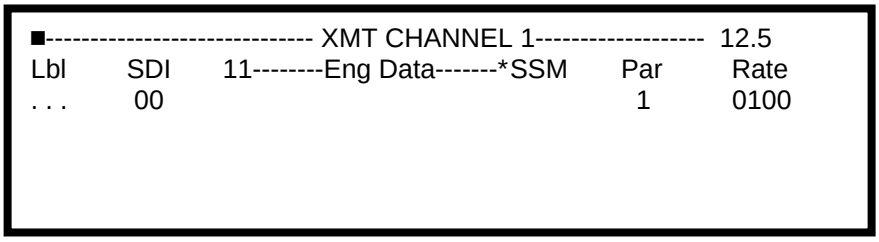
1, 2, 3, 4 – Edit new channel. If more than one transmit channel was allocated to the alternate edit screen, typing the channel number causes the corresponding channel to be displayed on the alternate edit screen. The alternate edit screen always uses all 14 display lines for each channel.

ENT – Proceed to real-time display screen. This keystroke terminates the alternate edit screen and passes control to the real-time screen. The transmit data just defined (or reviewed) will continue to transmit in the background.

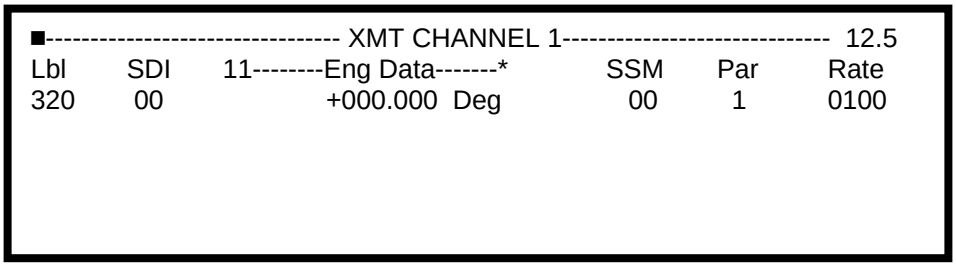
4.3.3 TRANSMIT DATA EDITING

Editing transmit data (whether from the real-time screen of the alternate edit screen) commences when the operator presses the down arrow key to move the cursor from the header to the data field. At this point, the octal label can be typed at the first line. When the label is typed, a set of zero default values appear for each bit position. The user moves the cursor to desired locations and edits the contents. Pressing the down arrow increments the cursor to a blank line for a new label. The cursor can be returned to a previously entered label and the contents edited by using the up and right/left arrows. Transmission being (with the new edited data replacing the existing data) after the ENT key is pressed for a given channel.

Before a label is entered :



After a label is entered :



The data field will display dependent on the data format that has been selected for editing. If ENG data format is selected, the data field will be displayed appropriately for the given label and equipment ID. At this point, the user should use the cursor keys to move to the fields to be edited. Up to 128 labels may be entered on each of the active transmit channels.

Key Definitions :

<, > - Move cursor left or right to edit data

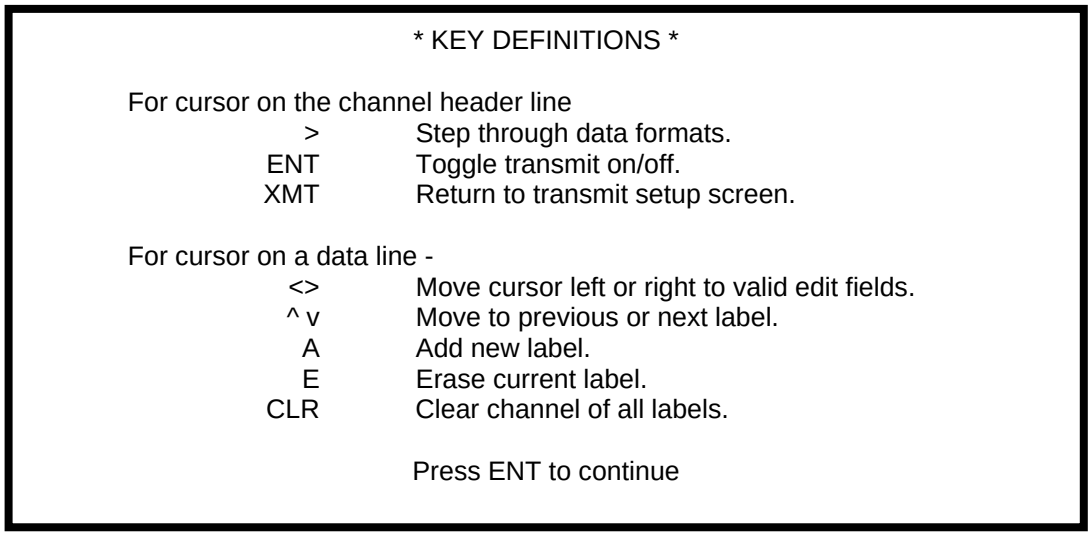
^, v - Move to previous, next label for current channel for editing or adding label.

CLR - Clear all data for current channel (must be confirmed with C entry).

ENT - Begin transmission of current channel. Cursor will move into header field. At this point, 1, 2, 3, or 4 may be entered to move to channel 1, 2, 3, or 4 respectively. When the cursor is in the header field, the v key will move to first line to start data editing.

XMT - Go to transmit setup screen.

The following help screen is available when the cursor is at the transmit header line.



4.3.4 SAMPLE TRANSMIT DATA SCREENS

Transmit channel active :

```
■ ON  ---------------------- XMT CHANNEL 1 ---------------------------------- 12.5
Lbl      SDI        11 ---- Eng Data-----*          SSM       Par       ms
210      10               -1427.12 Kts              10        1       0062
320      10               +123.456 Deg              10        1       0020
324      10               +001.010 Deg              10        1       0020
```

2 Transmit Channels active:

```
■ ON  ---------------------- XMT CHANNEL 1 ---------------------- 12.5
Lbl      SDI        11 ---- Eng Data-----* SSM       Par     ms
210      10               -1427.12 Kts      10        1     0062
320      10               +123.456 Deg      10        1     0020
324      10               +001.010 Deg      10        1     0020

-ON  ---------------------- XMT CHANNEL 2 -------------------------100
Lbl      32  - * - - - * - - - *  Bin  *  Data  - - - * - - - * - - - - - - 1ms
322      01010100110110011010001000010001  020
323      11000010110010110101110111010011  020
324      11111111100001001110101101110010  020
325      00001001111110001011101110000000  020
```

3 Transmit channels active :

```
■ ON  ---------------------- XMT CHANNEL 1 ---------------------- 12.5
Lbl       SDI         11 ---- Eng Data-----   SSM        Par       ms
210        10                -1427.12 Kts      10         1        0062
320        10                +123.456 Deg      10         1        0020
324        10                +001.010 Deg      10         1        0020

- ON  ---------------------- XMT CHANNEL 2 ---------------------- 100
Lbl       32  - * - - - * - - - * Bin  *  Data  - - - * - - - * - - - - - - 1ms
322       01010100110110011010001000010001  020
323       11000010110010110101110111010011  020
324       11111111100001001110101101110010  020
325       00001001111110001011101110000000  020
- ON  ---------------------- XMT CHANNEL 3 ---------------------- 100
322       01010100110110011010001000010001  020
323       11000010110010110101110111010011  020
323       11111111100001001110101101110010  020
```

4 Transmit Channels active :

```
■ ON  ---------------------- XMT CHANNEL 1 ----------------------12.5
Lbl       SDI         11 ---- Eng Data-----   SSM        Par       ms
320        10                +123.456 Deg:     10         1        0020
324        10                +001.010 Deg      10         1        0020

- ON  ---------------------- XMT CHANNEL 2 ---------------------- 100
Lbl       32  - * - - - * - - - * Bin  *  Data  - - - * - - - * - - - - - - 1ms
324       11111111100001001110101101110010  020
325       00001001111110001011101110000000  020
- ON  ---------------------- XMT CHANNEL 3 ---------------------- 100
322       01010100110110011010001000010001  020
323       11000010110010110101110111010011  020
- OFF ---------------------- XMT CHANNEL 4 ---------------------- 12.5
Lbl       SDI         11 ---- Eng Data----*  SSM        Par       ms
210        10                -1427.12 Kts      10         1        0062
320        10                -123.456 Deg      10         1        0020
```

4.3.5 BURST MODE TRANSMISSION

Burst mode is usually associated with such functions as radio tuning and is a technique involving transmitting a label for a limited number of times and at a specified rate before ceasing transmission. The DATATRAC 400 provides the capability of defining a burst mode condition for a label as an alternative to the normal transmit rate selection.

To set up a burst transmission, enter the label and edit the transmit data field normally. When the cursor is moved to the rate (ms) field, press a B and observe that the B is immediately followed by 16. This is the default number of transmissions of the label that will occur. This number can be edited (a value between 01 and 99) or the cursor simply moved to the right to edit the transmit rate. Any number of burst mode labels may be set up and entered. The burst transmission will occur each time the user presses B while cursor control is on the transmit window.

4.3.6 FRAMING LABEL TRANSMISSIONS

The DATATRAC 400 provides a transmit framing feature that permits the operator to control the timing of multiple label transmissions. This is useful for simulating LRU's that output several labels at different time intervals.

A brief explanation of the DATATRAC's method of framing labels of varying transmit periods is helpful for taking full advantage of this powerful feature. Figure 4 illustrates the relation between a frame and a cycle. There are always 60 frames in each cycle. The frame, and thus the frame period is defined by the fastest label on the channel. For example, if label 100 was set up with a 50 ms interval, and all other labels were 200 ms, the frame period for this channel would be 50 ms. If a new label is defined with an interval of 10 ms, the frame period would change to 10 ms.

Given the base (minimum) interval, all other labels' intervals must be one of the following multiples of the base: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, or 60. For example, if the minimum interval is 50 ms, other labels in the channel are permitted to have only the following periods :50, 100, 150, 200, 250, 300, 500, 600, 750, 1000, 1500, and 3000 ms. If a label is specified with an interval that does not fall on one of the allowed multiples, its interval will be adjusted to the nearest allowed rate. Note that the display will still indicate the rate entered by the user but will transmit at a different rate. Say, in the above example, that a label is defined with a rate of 80 ms, since only certain multiples of 50 ms are permitted, that label will transmit at 100 ms even though the display will still indicate 80 ms.

As mentioned before, the minimum interval will define the frame period. At some arbitrary point in time, frame 0 will begin. The transmitter will check all defined labels to see which ones are to be transmitted in this frame. After the minimum interval has elapsed, frame 1 begins, and the transmitter again scans through the list to transmit the labels of this frame, and so on to frame 59. The cycle repeats with frame 0 after frame 59.

Figure 5 gives an example of how to specify which frames will contain which labels. In this example, five labels are defined :

Label	Interval (ms)	Starting Frame
100	0100	01
101	0050	00
102	0200	02
103	0100	00
104	0500	12

The interval and starting frame number are the two parameters that the operator sets to control the timing of the label transmissions. The base interval is 50 ms due to label 101. Thus, each frame period will be 50 ms, and a complete cycle will take 3 seconds (50 ms X 60 frames) to elapse.

The figure shows the order in which each label will be transmitted. Beginning with frame 0, label 101 will be transmitted first, then label 103, since the latter's start frame is given to be frame 0. Since label 101 is the minimum interval, it will be transmitted on every frame (this is true regardless of what its starting frame is). Note, however, in frame 1, that label 100 (with starting frame = 1) is transmitted before 101 on the list. When several labels are scheduled to transmit the same frame, the order in which they are transmitted is the same as the order in which they are listed on the screen.

Frame 2 will contain label 101 first, then 102 with its starting frame = 2, then 103 since its interval of 100 ms has elapsed since its last transmission in frame 0. Also, if this was not the first cycle of the transmit list, label 104 would be transmitted at this point since 500 ms would have elapsed since its last transmission in frame 52 of the previous cycle.

In summary, given each labels transmit interval and starting frame number, a diagram similar to the figure above can be constructed to illustrate the bus timing. Since all intervals, and these multiples of the minimum interval, and these multiples are factors of 20, the timing of every cycle (consisting of 20 frames each) is the same.

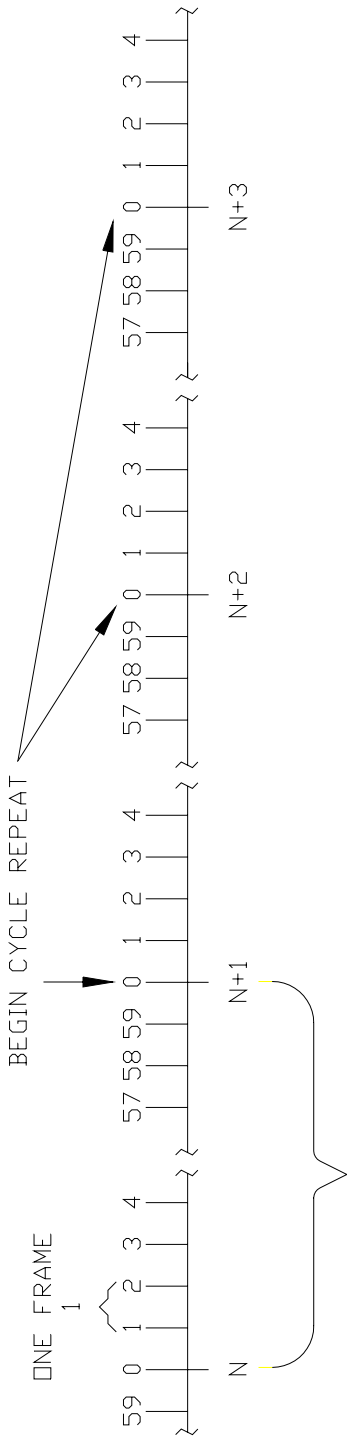
The interval and starting frame number are specified on the label data line of a transmit edit window. The rate is given under the "ms" column. The starting frame number field is off the screen to the right of the rate value. To access it, the cursor is moved to the right from the last rate digit to skew the data line and display the frame number (indicated by an "F") this number can be 00 to 19. The figure below illustrates a data line (above 101) that is skewed to reveal the starting frame number.

Lbl	SDI	29- -HEX - -11	SSM	Par	ms
01		00000 00	1	0100	F00
101	01	11110	00	1	0100
102	01	22222	00	1	0100

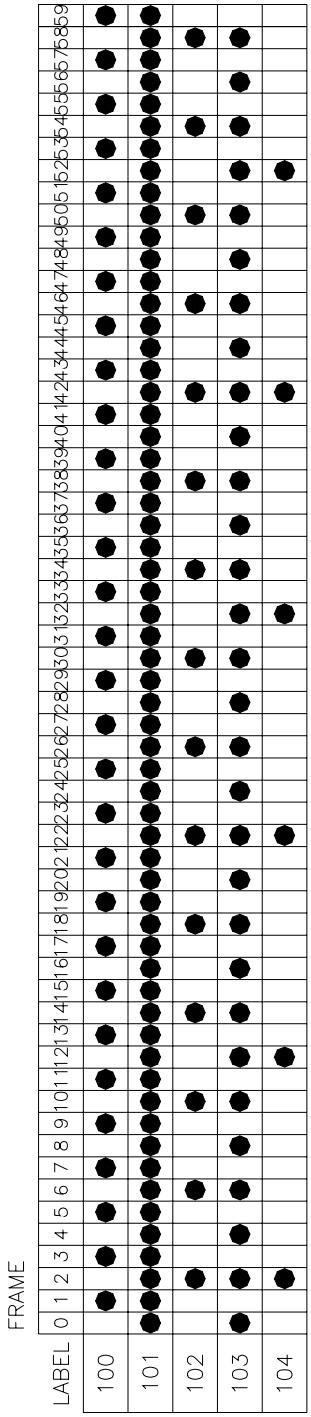
The frame counter in the transmitter that continuously counts from 0 to 59 is reset to 0 to begin a new cycle each time a new minimum interval is specified.

Otherwise, adding a new label and/or changing an existing interval of frame number will not affect the sequencing of other labels.

For this reason, a delay may be experienced between entering a new data edit and observing the change at the transmitter output. The delay is due to the transmitter waiting for the transmit count to equal the starting frame number of the new label before transmitting it. In any case, the delay will be no longer than 60 times the minimum interval.



RELATIONSHIP BETWEEN FRAMES AND CYCLES FIGURE 4

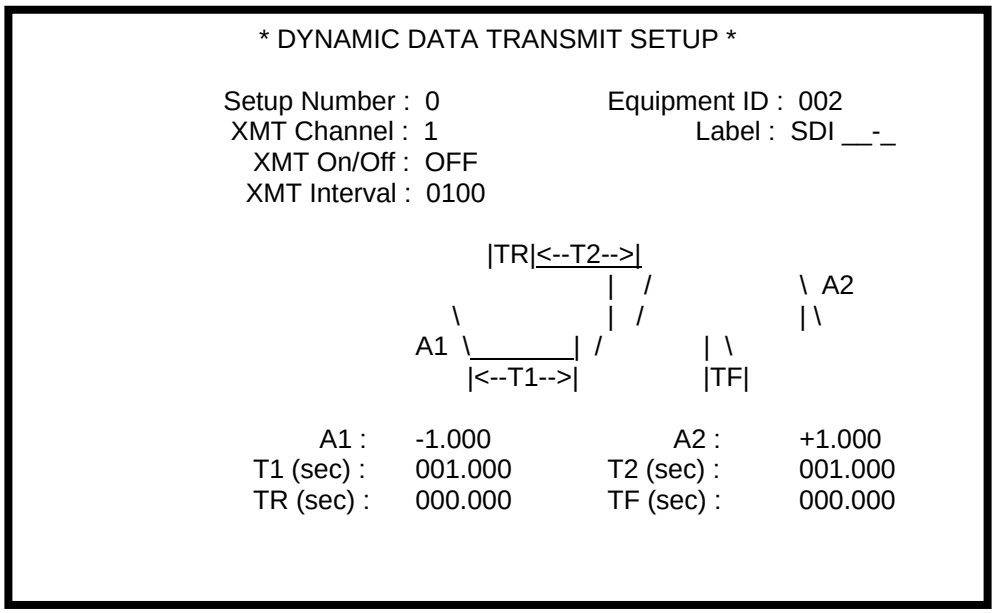


EXAMPLE OF TRANSMIT FRAMING WITH
LABELS OF VARYING RATES AND STARTING FRAMES

FIGURE 5

4.4 DYNAMIC DATA TRANSMISSION

In addition to static value, the transmit mode allows the user to transmit a programmed dynamic pattern. This form of transmission is selected from the primary transmit setup screen by setting up DYN at the TRANSMIT MODE line and pressing ENT. The following secondary transmit screen then appears and allows the user to enter up to 10 setups.



4.4.1 LABEL AND CONTROL INFORMATION SETUP

Setup number selection. Each setup (0-9) of a dynamic transmission is given a unique number. In subsequent editing sessions, entering this number causes all associated selections to be displayed for either review or editing purposes.

Channel selection. The desired transmit channel is entered numerically or by incrementing with the right arrow.

XMT ON/OFF Selection. This selection is toggled by using the right arrow. It allows a dynamic transmit setup to remain completely defined and turned on and off as desired.

XMT Interval Selection. The transmit interval may be entered numerically or incremented with the right arrow.

Equipment ID Selection. The equipment ID is entered numerically using the 0-F keys.

Label-SDI Selection. The transmit label and SDI are entered numerically.

SSM Selection. A decimal number is entered for the SSM if a label corresponding to a BNR word has been selected. If a BCD label is selected, this setup line disappears. The SSM may be entered numerically or by incrementing with the right arrow.

4.4.2 WAVEFORM DEFINITIONS

The user moves the cursor through the A1, T1, TR, A2, T2, and TF setup lines using the up and down arrows. Levels (A1 and A2) are set up as decimal values within the range of +/-1.000. The various time segments may lie between 0.000 and 999.999 seconds. Numeric values are entered in the usual way.

4.4.3 TRANSMIT DATA DISPLAY

After entering all setup selections, the following display will appear if the display option has been set to ON.

```
■ ON ----------------- XMT Channel 1 ----------------- 12.5 KHz
Lbl      SDI  11 -------- Eng Data -------* SSM     Par      ms
100       00              +090.000       11       1       0100
200       00  DYNAMIC                                      0100
210       00  DYNAMIC                                      0100
220       00  DYNAMIC                                      0100
```

In this example, a single static label has been set up along with three dynamic labels.

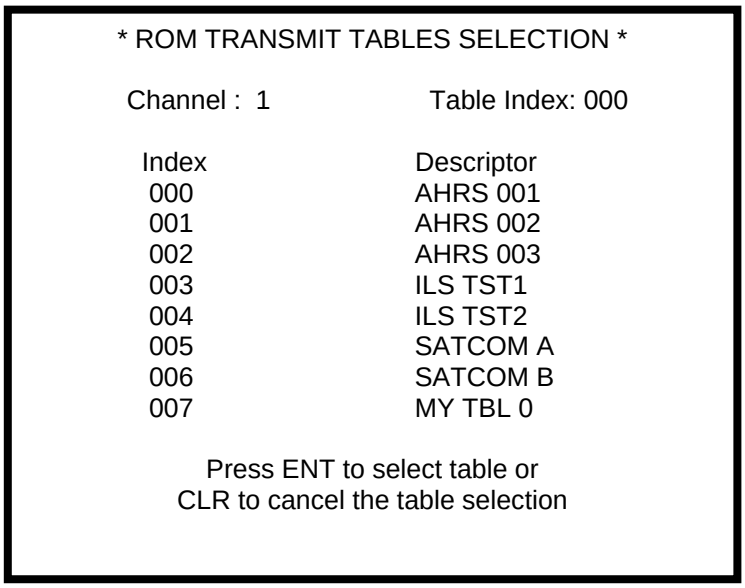
Note : When a transmit setup for channels 1 or 2 has already been defined and the user desires to change the transmit channel number to 3 or 4. The XMT ON/OFF selection field must be toggled On and OFF to load the setup to the new channel and delete it from the old channel.

4.5 PRESTORED TRANSMIT TABLES

The DATATRAC 400 has the capability of transmitting data tables that have been programmed into ROM. This feature makes it possible to enter long lists of data in a matter of seconds with a few keystrokes instead of manually entering data from the keypad. This is particularly useful in a systematic test environment where the user repeatedly performs a series of tests.

Before this feature can be used, the transmit tables must have been programmed into the DATATRAC 400 ROM. Aeroflex provides a program called PCTOOLS-400 that enables the operator to define their own tables. The output is a binary file that can then be loaded onto a PROM. See Appendix C for a description of PCTOOLS-400.

The table selection screen is shown below. It is accessed from the transmit setup screen by selecting Mode = TBL and pressing ENT.



The mode will remain as TBL until it is changed by the operator. Thus, the table selection screen can always be accessed quickly by simply pressing XMT then ENT. This is desirable in a test environment where the operator needs to call up different tables quickly. Although the channel may be set to TBL mode, static labels can always be added to the table's data in the transmit edit window.

The table selection screen provides a directory of all the tables currently defined in ROM. It permits the operator to scan the names and indices of the ROM tables. The name, or descriptor, is an 8-character string used to identify a table. The operator can press the up and down cursor keys to scroll the list and change the index of the table to be selected. The index that is displayed at the top of the screen will always correspond to the first directory line displayed. It also indicates which table is being selected when ENT is pressed. The right cursor key is used to move between the channel and index fields. The channel field allows the operator to select a target transmit channel. At the index field, the 0-9 keys can be used to enter a table index directly instead of scrolling the list.

When ENT is pressed, the selected table begins transmitting and the DATATRAC 400 proceeds to the real-time data display and edit screen. If the user does not want the selected table to be transmitted, then the CLR key is pressed to exit the selection screen without reading the ROM table.

When ENT is pressed to begin the tables transmission, any labels that may have been transmitting previously on the target channel will be deleted. On the real-time display screen (or the transmit edit screen if any of the enabled transmit channels has display set to OFF) the selected table's descriptor is displayed at the channel's header. The table's data appears on the screen exactly as if it had been entered by hand. From this point on, the channel can be edited as before from the keypad.

Any changes made to the original table will cause an asterisk (*) to appear to the left of the descriptor. This serves to flag the user that the table has been corrupted by a manual edit. The original table can be restored (or a new one activated) by pressing XMT to return to the transmit setup, then ENT to pass to the table selection screen. The currently selected table will be displayed on the top line. Pressing ENT again at this point will restore the original table and delete any edits that were done on the target channel.

SECTION V

5.0 RECORD MODE

The record mode allows data from the various input channels to be saved at a user specified rate and then played back on the screen or downloaded in various formats. The following sections describe the setup and operation of the record mode.

5.1 PRIMARY RECORD SETUP SCREEN

Selection of record mode causes the display of the following primary setup screen. Up to 16 labels selected from various channels may be recorded at an interval selected by the user.

```
                    * RECORDER SETUP *

Function      : RECORD          Channel      : 1
Rcd Interval  : 0050            Bus Speed    : 12.5
                                Equipment ID : 002

Label-SDI (SDI = 0-3 or D don't care):

320-X         324-X         325-X         330-X
210-X         ___-_         ___-_         ___-_
___-_         ___-_         ___-_         ___-_
___-_         ___-_         ___-_         ___-_

                  Press ENT to continue
```

5.1.1 FUNCTION SETUP

Three functions are available in addition to the RECORD function shown above. These are described by this line's help screen presented below.

```
                  * RECORD HELP SCREEN *

RECORD   -   The memory is cleared and new
             data is acquired.
REVIEW   -   Directly displays the data
             previously acquired.
   DAC   -   Ports the data in the buffer
             to the DAC output.
 RS232   -   Ports the data in the buffer
             to the RS232 port.

          Press ENT to return to setup screen
```

5.1.2 CHANNEL SELECTION

The channel setup line provides additional pages in which unique bus speed, label-SDI, and equipment ID entries may be made. The channel value may be entered numerically or incremented with the right arrow.

5.1.3 RECORD INTERVAL

The record interval is specified in milliseconds and can lie with the range of 1 to 9999 milliseconds. This interval will be used for all labels and channels. The interval value may be entered numerically or incremented with the right arrow.

5.1.4 BUS SPEED

The right arrow should be used to toggle between 12.5 or 100 to set up the bus speed appropriate for the recorded channel.

5.1.5 EQUIPMENT ID CODES

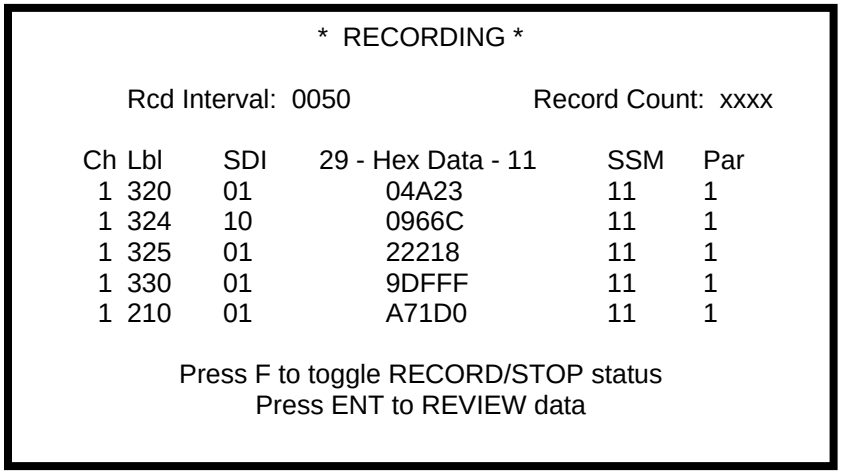
The desired equipment ID is entered numerically using the 0-F hex keys.

5.1.6 LABEL-SDI

Up to 16 label-SDI's may be selected for recording. These are entered by moving the cursor to an empty position and entering the octal label and decimal value for the SDI. Pressing CLR clears all label-SDI setups.

5.2 ACTIVE RECORDING SCREEN

If the user has set up the RECORD function, pressing the ENT key initiates the recording of data and the following screen is displayed.



Activity of the selected labels may be viewed while they are being recorded and the record count integer increments up at the selected rate. When the available 32768 bytes of record memory are filled, data recording and the record count halt. At any time prior to this, the user may elect to press F to interrupt the recording process or press ENT to review data already recorded. While pressing F halts the record process, entering the review mode does not. The RCD key may also be pressed to return to the setup screen and restart the process.

5.3 RECORD CAPACITY

When the record mode is activated, data recording will continue until the entire 32768 available bytes of record memory are used. This means that a greater record time is possible when fewer labels are selected and/or a lower record rate is set up. The user may calculate this record capability with the knowledge that for every label receipt four bytes of storage are used. When a single label is recorded at once per second, 8192 seconds or 2.28 hours of record time are available. For four labels at twice per second, the record time would be reduced by eight and so forth.

5.4 RECORDED DATA PROTECTION

After data has been recorded, all mode selections which might overwrite the data are inhibited by the following message.

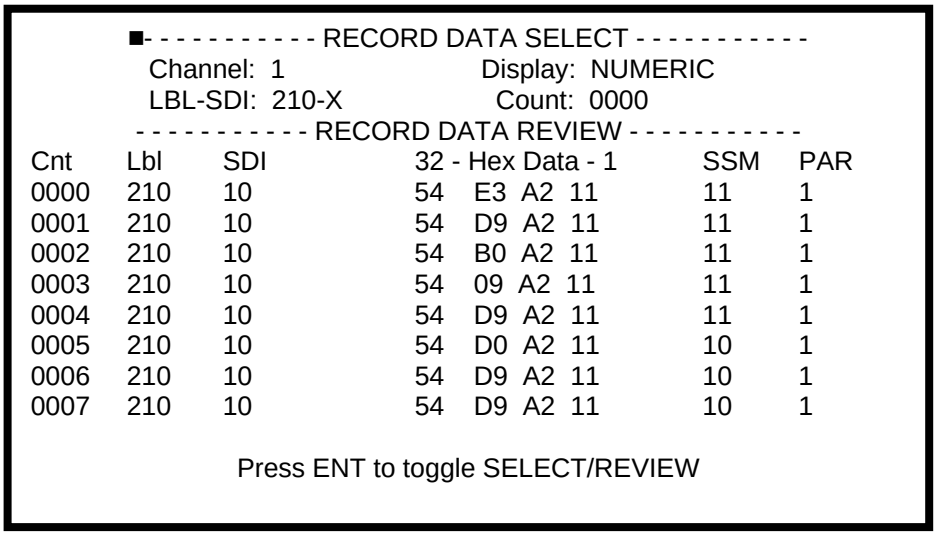
> WARNING: Continuing with this function
> will overwrite data currently stored in
> RCD/BRK memory. Press C to continue or
> any other key to abort . . .

This includes reinitiating the record mode or returning to receive mode.

5.5 RECORDED DATA REVIEW

5.5.1 NUMERICAL DATA REVIEW

At any time during the recording of data, the ENT key may be pressed to move to the data review screen. The following screen allows the user to select channels, labels, initial count, and data format and then view the appropriate recorded words. The user may move the cursor control (the solid square toggled by the ENT key) to either the SELECT (upper half of the screen) or the REVIEW (lower half of the screen).



In the SELECT area of the screen, the indicated selections may be made.

Channel - May be selected by entering the channel number directly or using the > key to scroll through the valid channels.

Label-SDI - May be selected using the > key to scroll through the recorded labels for the currently selected channel.

Display - Option may be selected using the > key to toggle between the options of NUMERIC and GRAPHIC. NUMERIC is the normal list of data; GRAPHIC allows data to be viewed as a time plot.

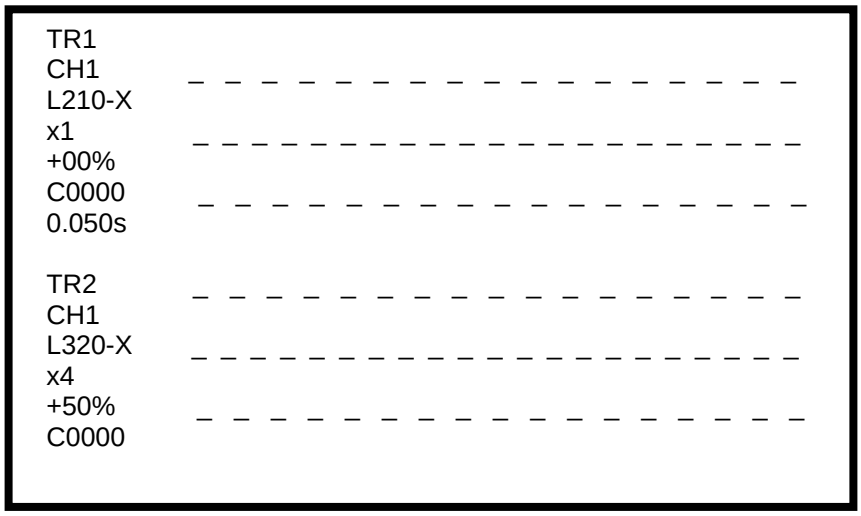
Count - Setup allows the recorded data to be displayed beginning at any recorded count. This is accomplished by entering a numerical value directly or pressing the > key to scroll the data list.

When the cursor control is moved to the REVIEW area of the screen, displayed data may be scrolled by using the F (forward) and B (back) keys to step through eight count blocks of data (one full screen) or the up/down arrows to scroll one count at a time. The data format may be changed similar to the real time receive data using the > key.

In this record data review screen, the recorder may be restarted by pressing CLR and then C (to confirm). Pressing the RCD key takes control back to the previous RECORDING screen. If data recording is in process when the user elects to REVIEW data, recording will continue while data is being examined. Upon returning to the RECORDING screen, the current count will be displayed.

5.5.2 GRAPHIC DISPLAY OF RECORDED DATA

To view graphics data, select GRAPH as the data format in the above screen. When the ENT button is pressed, the following (example) screen will appear:



5.5.2.1 GRAPHICS SCREEN SETUP

In this example the user has edited the set up options for the display of two labels simultaneously. Five fields can be edited to achieve the desired graph. These are:

CH # - Channel Number. The options are 0, 1, 2, 3, or 4. This is the receive channel number that contains the data to be displayed graphically. A selection of 0 turns the trace off (trace 2 only).

LXXX-X - Label. Toggle through valid record labels using > key.

x128 - Data scaling. Options of 1, 2, 4, 8, 16, 32, 64 and 128 are available to magnify the data. Use > key to step through options.

+50% - Data offset. A number from 00% to +/-99% may be entered. This is a percentage of full scale that becomes the zero point when the data is graphed. The data offset is applied before the data scaling is applied.

C0001 - Data Counter. The F (forward) and B (back) keys may be used to scroll through an entire page at a time or a numerical value may be entered directly to scroll to a precise point in the record memory. The cursor must be on this line to scroll data.

5.5.2.2 TIME SCALE

The horizontal resolution of the graph is 200 dots. The full scale value in seconds may be computed by simply multiplying 200 by the selected record interval displayed to the left of the plot.

5.5.2.3 VERTICAL SCALE

The vertical resolution of the graph is 64 dots for dual trace mode and 128 dots for single trace mode. The data range is the full scale value of the label (defined by the ARINC 429 document) divided by the scaling integer selected by the user. The value of each dot is then this range, divided by either 64 or 128. For example, if the heading label 320 which has a scale factor of +/-180 deg is presented in one half of the display area, a scale factor of 1 would mean that the full +/-180 deg range occupied half of the screen with each dot worth 360/64 = 5.62 deg. Likewise, a scale factor selection of 32 would mean the graph range was +/-5.622 deg and the value of each dot, 0.17 deg.

5.5.2.4 UTILITY FUNCTIONS

The following utility functions are available:

^ , v - Moves up or down through the set up fields.

> - Steps through the options for certain set up fields.

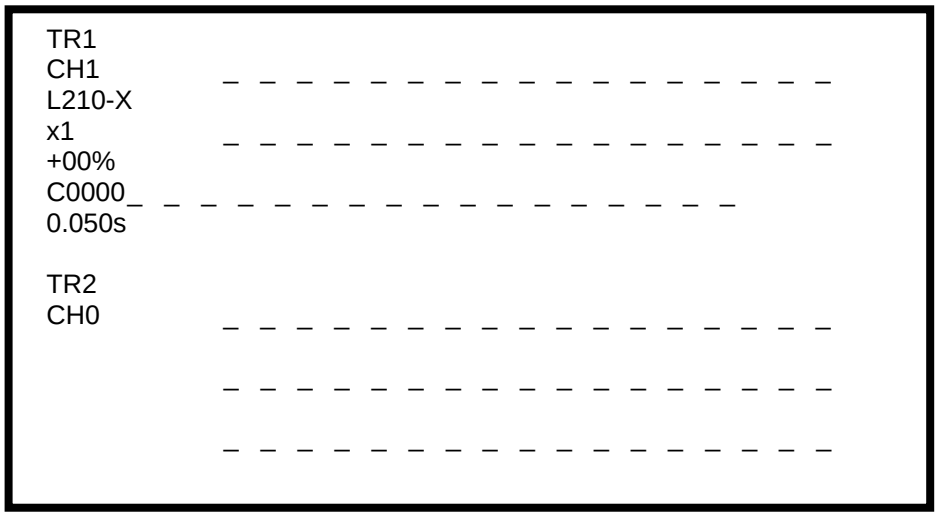
CLR - Data trace clears and starts at a count of 0000.

RCD - Exit graphics mode and return to the Record Data Review screen.

RCV,
XMT,
BRK - Record mode will be turned off and the new mode will be selected.

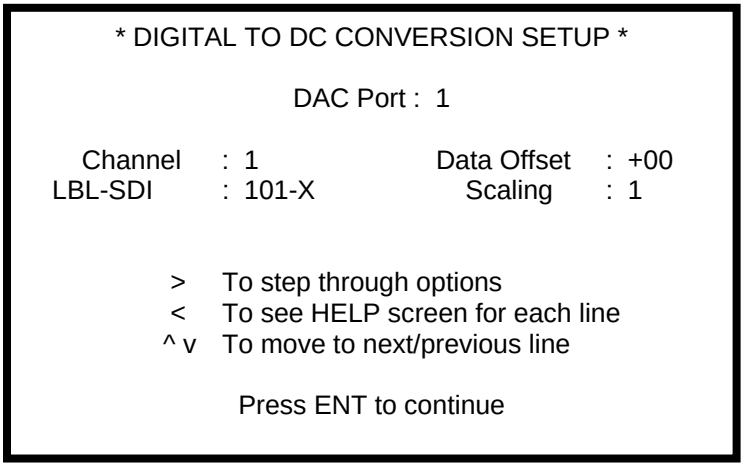
If trace 2 is turned off (by entering a 0 for the channel number), the active trace 1 will use the entire display for graphing data.

One trace active:



5.5.3 DAC DOWNLOAD OF RECORDED DATA

In the initial record mode set up screen, one of the four function options allows the downloading of recorded data via the DAC port. Pressing ENT with this function selected results in the DAC screen below. When the DAC function is selected, further set up is performed on the following screen:



The set up options control the download of data through the DAC port which begins when the operator presses ENT.

DAC 2 may be selected only if a second receive board is installed. The desired channel and label-SDI selected by using the > key to step through valid selections. The data offset may be 00% through +/-99% and will cause the output electrical null to be positioned within the word's full scale range as indicated. Scaling options are 1, 2, 4, 8, 16, 32, 64 and 128. These magnify the data within the output electrical range. The offset adjustment is applied first and then the scaling adjustment. The DAC performs a 12 bit to +/-10.0 VDC conversion.

Pressing ENT after all set up options are selected will begin the download. Data is output at one record data point every 100 ms, regardless of the record interval.

5.5.4 RS-232C DOWNLOAD OF RECORDED DATA

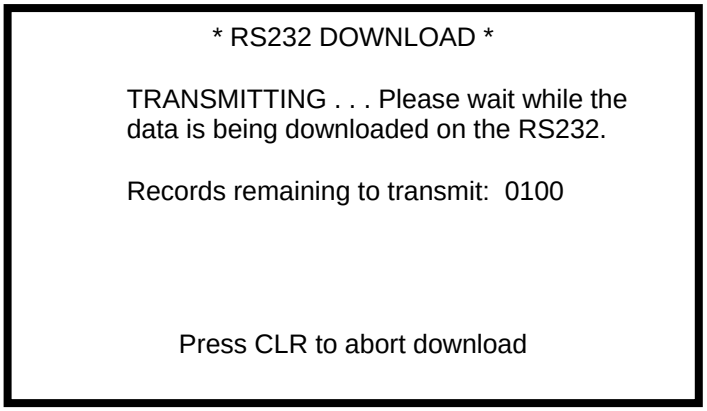
In the initial record mode set up screen, one of the four function options allow a download of recorded data via the RS-232C port. Pressing ENT with this function selected causes all recorded memory to be output immediately. The output format consists of data records each representing a single label/data sample. The output begins with the first data sample for the first record word set up. Subsequent data samples for this label are output and after completing the output for a particular label, the next label in the selection sequence is output. The record structure consists of 8 bytes arranged as follows:

Byte	Data
1	Status = 0, 1
2	Channel = 1, 2, 3 or 4
3	Label
4	Data 1 (bits 9-16)
5	Data 2 (bits 17-24)
6	Data 3 (bits 25-32)
7	Sample Count (low byte)
8	Sample Count (high byte)

Status indicates if the label was actually received during the sample interval. If the label was not received, status = 0. This is indicated on the review screen as " . . . " on the data line. If the label was received, then status = 1. When status = 0, the data in Data 1-3 of the record is invalid and should be disregarded.

The sample count is a 16-bit unsigned binary word that specifies the record's relative position in memory. The first sample of a recording session has a count of zero.

When the RS-232 selection is entered, a message is displayed to remind the user to make sure the RS-232C port is connected properly, and then after pressing the ENT key the following screen is displayed:



See Section 3.2.3.2 for the RS-232 interface format specification.

SECTION VI

6.0 BREAKPOINT MODE

The Breakpoint mode is a versatile tool for troubleshooting avionics equipment. It involves the use of breakpoints, history data, and trigger pulses. The breakpoint may be manually initiated by the user or consist of a complex programmed condition involving one or more labels, event sequences, and data values.

6.1 BREAKPOINT SETUP

Entering a BRK function selection results in the following screen:

```
            * BREAK MODE/TRIGGER PULSE SETUP *

        Function  : BREAK          Real Time  : OFF
 Brk Sequence     : A                History  : ALL
 Brk Position     : --*--          Event Cnt  : 01

*A*     Channel: 1      Label:  000          Cond:  EQ
        Data:  XXXX  XXXX XXXX XXXX       XXXX XXXX
        Bit:    32          25 24          17 16  9
*B*     Channel: 1      Label:  000          Cond:  EQ
        Data: XXXX  XXXX XXXX XXXX        XXXX XXXX
        Bit:   32          25 24          17 16  9

              Data = 0, 1, or X (D-Don't care)
                  Press ENT to continue
```

6.1.1 FUNCTION SETUP

The various function options are illustrated in the following help menu:

```
          * BREAK MODE / TRIGGER HELP SCREEN *

Function Selections:
  BREAK     -   To setup a break condition and
                save history data.
 REVIEW     -   To review previously collected
                history data.
TRIGGER     -   To setup a condition for a trigger
                pulse output on received data.
  RS232     -   Enable RS-232 history data download.
  XMT       -   Permit ARINC 429 transmission
                of history data.

          Press ENT to return to setup screen
```

The trigger option is a related function that does not involve an actual break but provides trigger pulses whenever the programmed label/data conditions occur.

6.1.2 BREAK SEQUENCE

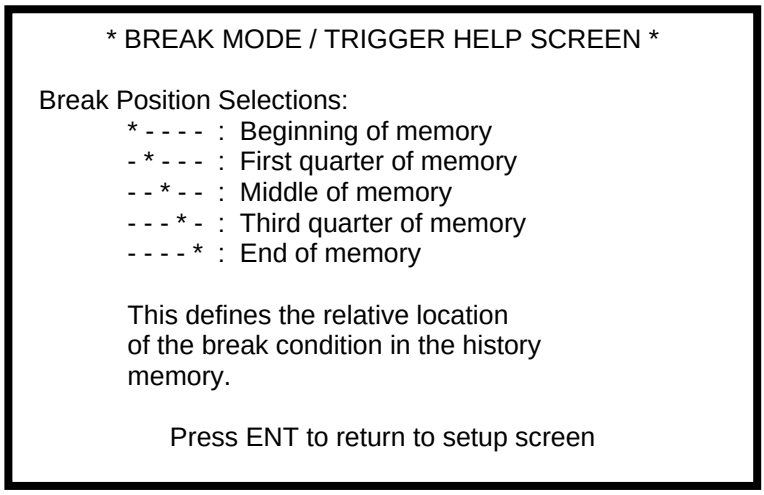
Two labels and corresponding data may be set up and are referred to as the A and B conditions. The break sequence options described in the following help screen are allowed.

```
        * BREAK MODE / TRIGGER HELP SCREEN *

     Break Sequence Selections:

          A      -    Break only on condition A
          B      -    Break only on condition B
       A or B    -    Break on either condition A
                      or condition B
     A then B    -    Break on condition B after
                      condition A has occurred
     A Imm B     -    Break on condition B occurring
                      immediately after cond A


            Press ENT to return to setup screen
```

The break condition known as “A Imm B” is defined as condition B occurring on the very next data word read after condition A has occurred. No other labels may be read between the A and B conditions.

6.1.3 BREAK HISTORY

The history involves a time window of data including not only the specified labels but all other labels on all channels. This window can be programmed to precede the break, follow the break, or consist of some combination of the two. The options are described in the following help menu.



6.1.4 RELATIVE TIME

The relative time option allows a "time stamp" to be saved along with each history word. In this way the time associated with each data receipt may be reviewed along with the data. Two time stamp options are available: 1 ms or 10 μs. When 1 ms is selected the max range of time is 999.999 seconds. When 10 μs is selected the max range of time is 9.99999 seconds. By turning off the option, more memory is available for data storage. With the time stamp ON, 8 bytes of memory are required for each history point; with the time stamp OFF, 5 bytes are required for each point.

6.1.5 SELECTED HISTORY LABELS

A set up line allows the user to restrict the history retention to selected labels rather than all labels. User options are therefore:

ALL - Save all data on all active channels. A channel is turned on or off in the appropriate RCV setup menu.

SEL - Save only those labels previously setup.

EDIT - Set up the select labels.

Entering the EDIT option cause the identical set up menu described for the receive mode to be displayed (see section 3.1.4.1). Break mode uses the same select labels list that receive mode uses.

6.1.6 EVENT COUNT

The event count set up has a default of 01 which means the breakpoint will occur on the first occurrence of the programmed conditions. Entering an integer up to 99 will require the conditions to occur that number of times before the breakpoint will be generated.

6.1.7 LABEL/DATA SETUP

In the "A" and "B" label fields, the user is allowed to select the channel, label, condition, and data pattern (bits 9 through 32). An X in a data bit location means that it will be ignored and only those bits containing 0's or 1's will be compared with received words. The breakpoint conditions options are as described in the following help menu:

```
        * BREAK MODE / TRIGGER HELP SCREEN *

          Condition Selections:
   EQ  -      All defined bits are equal.
  NEQ  -      Any defined bit is not equal.
   OR  -      Any defined bit is equal.
   GT  -      The received word is greater
              than the defined word.
   LT  -      The received word is less than
              the defined word.
  /GT/ -      The absolute value of the rcv'd
              word is > the defined word.
  /LT/ -      The absolute value of the rcv'd
              word is < the defined word.

          Press ENT to return to setup screen
```

6.2 BREAKPOINT REVIEW

After specifying all breakpoint setup options, the ENT key is pressed to initiate the breakpoint. The following message will be displayed at the bottom of the setup screen until the break occurs or until another key is entered.

```
**   Waiting on Break condition . . .  **
**  Press ENT for manual break         **
**    or CLR to abort acquisition      **
```

When the break occurs, the message changes to:

```
**  Break detected.  Wait for history   **
**  data to fill or press ENT to stop   **
```

When the break occur, a 5 volt, 0.1 ms trigger pulse is transmitted from the No. 1 D/A port. After history has filled, the following history display screen appears:

■- - - - - - - - BREAK HISTORY DATA SELECT - - - - - - - -

Channel : ALL Time : ELAPSED

Label-SDI : XXX-X Count : 00336

- - - - - - - - BREAK HISTORY DATA REVIEW - - - - - - - -

Cnt	C	Lbl	S	11- - - Eng Data - - - *	S	P	ms
336	1	300	3	80 00 03 03	3	1	0423
337	1	100	3	+090.000	3	1	0517
338	1	200	3	-090.000	3	1	0520
339	1	300	3	80 00 03 03	3	1	0523
340	1	100	3	+090.000	3	1	0617
341	1	200	3	-090.000	3	1	0620
342	1	300	3	80 00 03 03	3	1	0623
343	1	100	3	+090.000	3	1	0717

Press ENT to toggle SELECT/REVIEW

Various utility features are available to review history data. These include:

Cursor control	-	The dark square is toggled between the upper SELECT area and the lower DATA REVIEW area by pressing the ENT key.
←	-	This arrow next to the CNT field indicates data point where break occurred.
CLR Key	-	The CLR key returns control to Break setup menu.

Select Field:

Channel:

The user may view data from ALL channels or individual channels. The right arrow key selects the options.

Label-SDI:

The user may view all received labels integrated into a time sequence or view the time sequence of individual selected labels. To view individual labels, the user may type in the label-SDI using 0-F keys. "D" may be used for don't care in the SDI field. When D is typed into the first digit field the label goes to XXX-X, which mean all labels. When the data history was set to SEL in the setup menu, the > key may be used to scroll through valid labels for the selected channel. When a new label is entered, the display of the label begins at the current count. If the message " . . not found . . " is displayed, this means that no occurrences of this label were found from the current count to the end of memory. It does not indicate that none existed in the entire history buffer. The user should set the count to zero to check if any occurrences of the selected label are found anywhere in the history buffer.

Time:

ELAPSED or DELTA may be selected for reviewing data. When ELAPSED is selected, the time given for each data point is the total elapsed time from data point zero. When DELTA is selected, the time given is the time from the previous data point on the display. The units of the time stamp is dependent on the selection made on the Break setup screen (1 ms or 10 μs) and is shown in the review header.

Count:

The Count selection line allows the user to enter a count value. The displayed data in the lower part of the screen responds to changes to the count value.

Review Field Keystrokes:

0	-	The 0 key always returns the data list to the beginning of the history buffer, count zero.
1	-	The 1 key always returns the data list to the count value at which the break occurred. The break point is indicated by the arrow next to the Cnt column.
E	-	The E key always returns the data list to the end of the history buffer.
>	-	The right arrow key steps through the data format options.
<	-	The left arrow key displays the HELP menu for Break Review.

UP - The up arrow key scrolls back through data history one data point at a time.

DOWN - The down arrow key scrolls forward through data history one data point at a time.

B - The B key scrolls back through 8 data points at a time.

F - The F key scrolls forward through 8 data points at a time.

6.3 RS-232 DOWNLOAD OF BREAK HISTORY DATA

One of the options available under function in the break setup screen is RS-232 download of history data. Pressing ENT with this function selected causes the RS-232 "ready screen" to be displayed, prompting the user to insure that the port is connected and the receiving port is ready to accept data. Upon pressing ENT once more, the data will immediately begin downloading. The output format consists of a header record, then data records for each label sample stored.

The header record consists of 5 bytes defined as follows:

Byte	Data
0	Number of samples (low byte)
1	Number of samples (high byte)
2	Trigger position (low byte)
3	Trigger position (high byte)
4	Bytes per sample (5 or 8)

All values are passed as binary numbers. The bytes-per-sample parameter is necessary because the sample size varies depending on whether the data was collected with a time stamp or not. The time stamp occupies three bytes.

The data records consist of 5 or 8 bytes, as specified by bytes-per-sample above.
The record structure is:

Byte	Data
0	Sample count (low byte)
1	Sample count (high byte)
2	Channel number (1-4)
3	Label
4	Data bits 9-16 (Data1)
5	Data bits 17-24 (Data2)
6	Data bits 25-32 (Data3)

If sample size = 8, also:

Byte	Data
7	Time in BCD (low byte)
8	Time in BCD (middle byte)
9	Time in BCD (high byte)

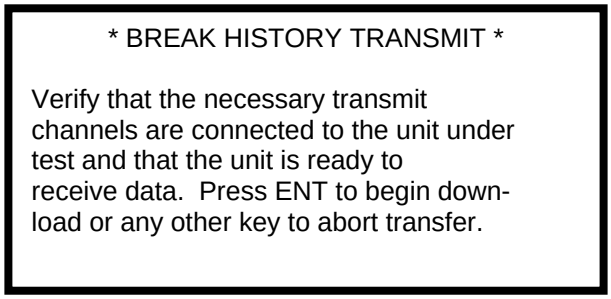
All values (except the BCD time) are transmitted as binary values.

The sample count is a 16-bit unsigned binary word that specifies the record's relative position in memory. The first record in memory has a sample count of 0000. The trigger position given in the header record is the sample count of the label record that caused the break. See section 3.1.2.3.2 for the RS-232 interface format specification. Also, Appendix A gives information on the cabling and the PC program RSREAD provided for reading the RS-232 download.

6.4 BREAK HISTORY TRANSMIT FUNCTION

A useful feature available as part of the Break mode utility on the DATATRAC 400 is the retransmission of previously acquired break history data. With this function, the operator can direct the DATATRAC to output labels found in buffer memory at the same relative timing at which they were received during a previous acquisition. All of the labels received on a certain receive channel will be output on the corresponding transmit channel, e.g., data received on RCV1 will be output on XMT1.

To utilize this feature, a break history acquisition must be performed first. It is necessary to enable the time stamp to either 1 ms or 10 μs so that the relative timing can be referenced during later transmission. When the acquisition is complete, return to the break setup screen by pressing the CLR or BRK key from the data review screen. At the Function field, select "XMT" with the right arrow key and press ENT. Assuming a proper acquisition with time stamp was performed, the following message screen will appear prior to beginning the transmission:

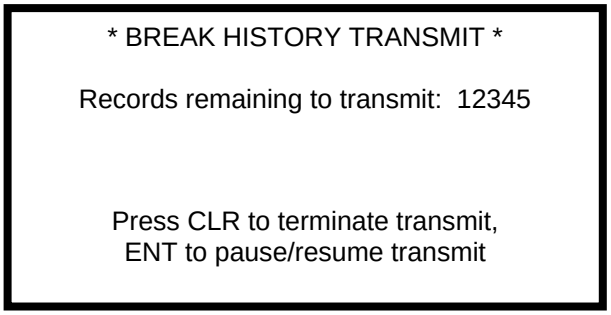


Upon verifying that the transmit channels are properly connected to the unit under test, the operator presses ENT to begin the buffer retransmission.

Just prior to beginning the transmission, the DATATRAC will reference the RCV channel bus speeds and set the corresponding XMT channels to these same values. The operator must therefore insure that the RCV channel bus speeds are not changed after an acquisition is performed. If the RCV bus speed is changed before the break history transmit is initiated, the data will be retransmitted at the new bus speed specified in the corresponding RCV channel.

TIP: It is possible to convert data from a low-speed bus to a high-speed bus or visa-versa by first performing a break acquisition at the source unit's bus speed. Then the DATATRAC's RCV channel bus speed is edited to the new desired value. The break history transmit will then output the previously acquired data at the newly selected bus speed.

When the download begins, the following screen will appear:



At any time during the download, the operator can press CLR to abort the transmission and return to the break setup screen. The transmission can be paused and resumed by toggling the ENT key without missing any labels.

During the retransmission of history data, the XMT channels affected are temporarily disabled from normal operation for the duration of the download. Any table that was transmitting at the time on the affected channel will stop transmitting. When the download is complete, the XMT channels' original bus speeds are restored and any table transmission that was interrupted is resumed.

SECTION VII

7.0 BITE MODE

The DATATRAC 400 provides an interactive databus communication function to support the BITE systems used in the newer air transport aircraft. The DATATRAC 400 supports three versions of BITE: CFDS, CMC and a 737-300 menu BITE mode. The CFDS and CMC modes are described by ARINC 604.

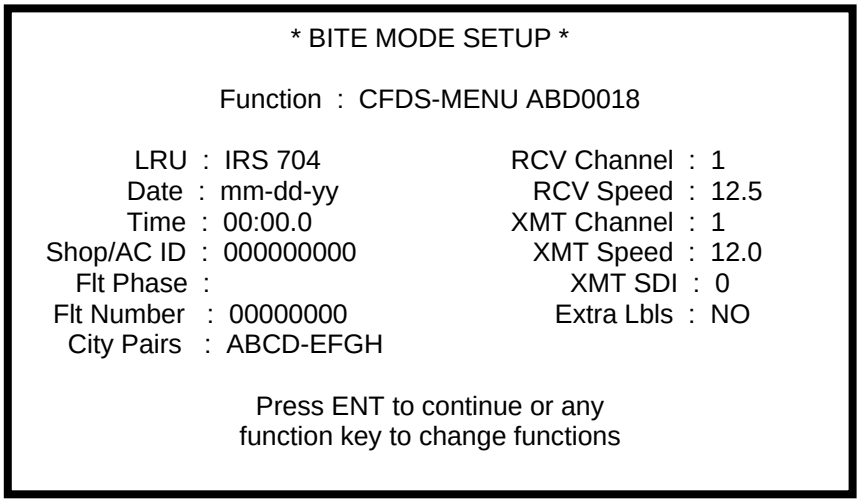
CFDS is based on the fault isolation function residing in individual LRU's. ASCII text messages are transmitted from LRU's on command and provide a series of maintenance descriptions based on data stored in the LRU's non-volatile memory.

The second BITE mode is CMC. With this system, the packed discrete maintenance information in 350 series labels is normally transmitted from LRU's to a central maintenance computer for fault processing and isolation. When this system is selected, the DATATRAC 400 unpacks and displays the maintenance words along with bit definitions prestored and available for all 700 series avionics equipments.

The third BITE version is the 737-300. Similar to the CFDS BITE with a different handshake protocol, ASCII text messages are transmitted from LRU's non-volatile memory.

7.1 BITE SETUP MENUS

Pressing B from the initial mode selection screen or the receive setup menu causes the BITE MODE SETUP screen below to be presented.



The choices available for the Function setup line are:

CFDS-MENU	ABD0018	777-OMS
CFDS-MENU	ABD0048	737-BITE
CFDS-NORM	ABD0018	TDR94_350
CFDS-NORM	ABD0048	REVIEW
ABD0048 DISCRETE		RS232
747-CMC		

The LRU options are:

704	IRS
706	DADC
707	RALT
708	WXR
709	DME
710	ILS
711	VOR
712	ADF
716	VHF
718	ATC
718	ATC/S
719	HF
723	GPWS
724	ACARS
727	MLS
735	TCAS
740	PRNTR
741	SATCM
000	ALL CALL

ID xxx, where the equipment ID, xxx, may be typed directly in using the 0-F keys.

DATE: The date may be entered on the third setup line using the 0-9 keys. Data is entered as mm-dd-yy, where mm is the month (00 . . 12), dd is the day (00 . . 31), and yy is the year (00 . . 99). This date is then transmitted on label 260 at a frequency one-tenth of label 227 (typically 1 s).

TIME: The time may be entered on the fourth setup line using the 0-9 keys. Data is entered as hh:mm.m, where hh is the hour (00 . . 23) and mm is the minutes (00.0 . . 59.9). This time is then transmitted on label 125 at a frequency one-tenth of label 227 (typically 1 s).

SHOP CODE: A shop code may be entered as a 7 digit code using keys 0-F. This code is then transmitted as ASCII data in labels 301, 302, and 303 at a frequency of one-thirtieth of label 227 (typically 3 s).

Label 155 is also transmitted at one-tenth the frequency of label 227, where is the printer device enable label.

FLIGHT PHASE: The flight phase may be selected for transmission on label 126. Flight phase is valid only for 747/777 and CFDS BITE Modes. The right arrow key scrolls through flight phase selections.

FLIGHT NUMBER: The flight number may be selected for transmission on labels 223-236 for ABD0018, or on labels 223-237 for ABD0048. Flight number is valid only for CFDS BITE Modes. Use the F and B keys to scroll forward and backward through the ASCII character set.

CITY PAIRS: The city pair may be selected for transmission on label 040-042. City pairs is valid only for CFDS BITE Modes. Use direct key entry, or the F and B keys to scroll through the ASCII character set.

The receive and transmit channels and corresponding speeds must be indicated to the BITE program. These parameters are setup using the right arrow key to step through the available options. The SDI to be used in the 227 command label must also be selected using the right arrow key.

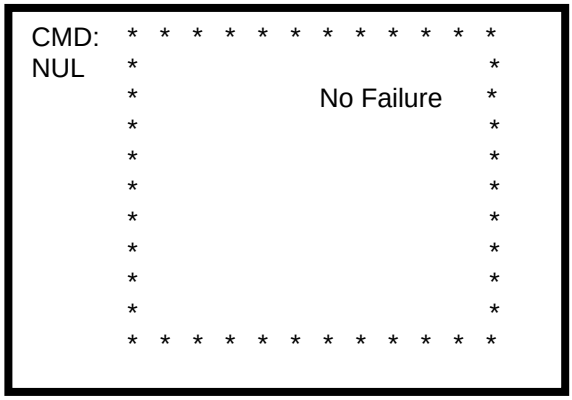
7.2 CFDS OPERATION

In describing the CFDS mode operation, examples will be based on the ILS 710 LRU but comments apply to all equipment with the BITE function implemented.

7.2.1 CFDS NORMAL MODE

In NORMAL mode, the DATATRAC 400 passively listens to the avionics unit and displays the ASCII fault message which is repetitively transmitted.

When the BITE setup screen with CFDS-NORM function is entered, the following typical screen would appear:



Likewise, detected failures would produce an appropriate message.

The command contained in the 227 word can be changed by pressing the right arrow key and selecting the new command with the down arrow key. When the > key is pressed, a new command will appear in brackets (e.g., [DC1]) to indicate that it is not yet selected. The > key can continue to be pressed until the desired command appears. Upon pressing the down arrow key the brackets will disappear and the DATATRAC 400 will begin transmitting the new command.

The available commands are:

NUL (00h)	DC1 (11h)
DC2 (12h)	DC4 (14h)

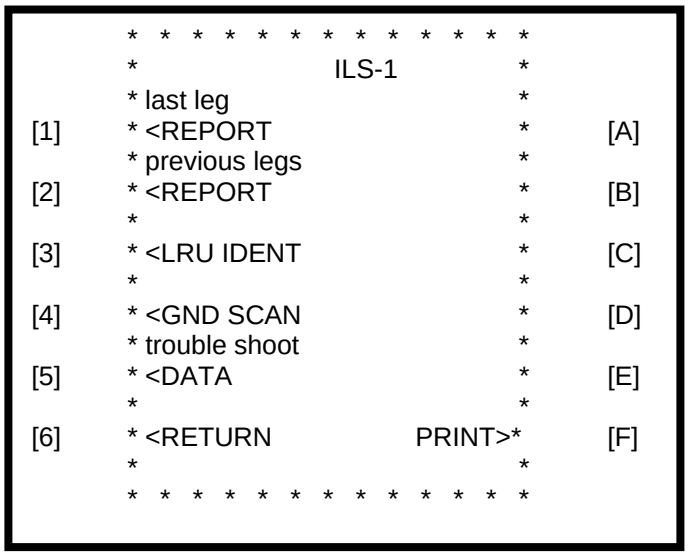
Key Definition Summary:

>	-	Step through command options
DOWN	-	Select new command option
<	-	Go to HELP menu
ENT	-	Save current screen in memory (memory location number appears on the lower right-hand corner of the display)
CLR	-	Return to BITE setup screen
RCV, XMT, RCD or BRK	-	Go to the selected function
0	-	Exit NORMAL mode and go to MENU mode. The 227 command word output from the DATATRAC 400 will remain uninterrupted upon transitioning between MENU and NORMAL modes in this fashion.

7.2.2 CFDS MENU MODE

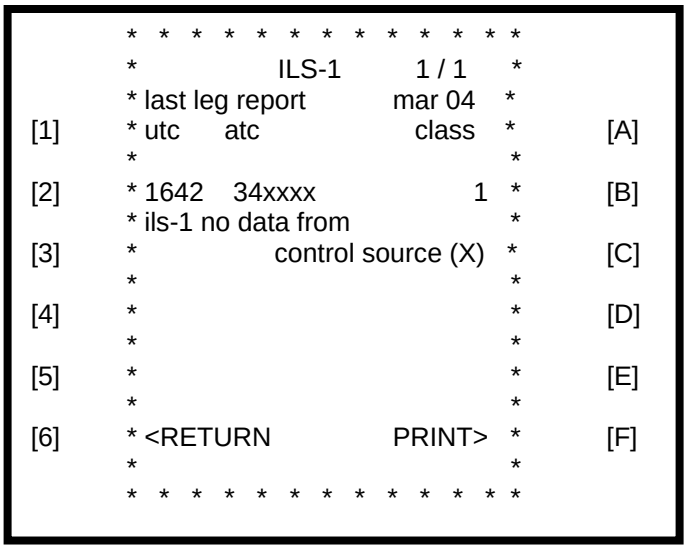
In MENU mode, the DATATRAC 400 automatically sends a menu request to the avionics unit with a 227 label command word. The LRU responds with its sequence of 356 labels containing the ASCII text of the initial menu. The user may then enter line select keys which will be transmitted on label 227 as a LSK command and the new corresponding ASCII message will be displayed.

When the CFDS-MENU selection is entered in the set up screen, the following typical LRU menu would appear:



The six squares on each side of the display, symbolize pushbuttons on a control display unit and are used for making menu selections. Pressing a 1-6 or A-F key causes a Line Select Key command to be transmitted on label 227 to the LRU with a code signifying that pushbutton. The LRU responds with the appropriate action or new menu transmission.

An example of the response to a last leg report selection is shown below.



The number of pages to the message are usually indicated in the upper right corner of the screen. The user may transition between pages by using the right (next page) and left (previous page) arrow keys. The RETURN menu selection returns the main menu to the screen. The 0 key issues a log off command to the LRU which then returns to the NORMAL mode transmission.

A special feature with the CFDS-MENU mode on the DATATRAC 400 is the SAVE SCREEN (or PRINT) function. By pressing the ENT key, a complete copy of the screen is saved to RAM. A memory location number is printed in the lower right-hand corner of the display when a menu is saved. Up to 255 screens can be saved. The screens can then be reviewed or downloaded over the RS232 port, as described in section 7.5 and 7.6.

Key Definition Summary:

1-6	-	Line Select Key command 1L-6L
A-F	-	Line Select Key command 1R-6R
>	-	Next page command
<	-	Previous page command
ENT	-	Save current screen in memory (memory location number appears on lower right-hand corner of the display)
CLR	-	Return to BITE setup screen
RCV, XMT, RCD or BRK - Go the selected function.		
0	-	Exit MENU mode and go to NORMAL mode. The 227 command word output from the DATATRAC 400 will remain uninterrupted upon transitioning between MENU and NORMAL modes in this fashion. A log-off command will be issued.

The up arrow (^) key puts the DATATRAC into Alphanumeric Mode. The Cursor moves to the scratched area at the bottom of the menu.

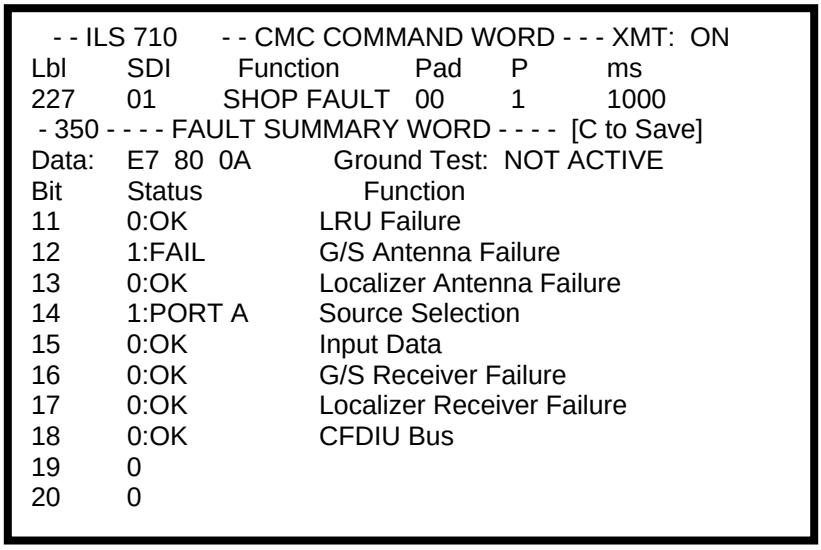
Key Definition Summary (Alphanumeric Mode):

^	-	Enters Alphanumeric Mode
ENT	-	Exits Alphanumeric Mode
F & B	-	Scrolls forward and backward through the ISO character set. The characters are not transmitted until the right arrow key or the ENT key is pressed.
>	-	Transmits current character and moves cursor to next position.
<	-	HELP Menu

7.3 CMC BITE OPERATION

In CMC BITE mode, 350 maintenance labels are received with packed discrete information. Based on the selected LRU, the bits are displayed with the appropriate status and function definition. Ground Test and Shop Fault menus compatible with the 747-400 and 777 avionics are also supported in this CMC mode.

A typical CMC BITE display screen is shown below.



The LRU is selected from the main menu before entering this screen. The display screen is divided into two fields: an upper command word field and a lower fault summary word field. Cursor control indicated by the solid square (■) is transferred between the two fields by toggling the ENT key.

The command word options are:

Transmitter ON/OFF - The right arrow toggles between ON and OFF.

SDI - May be entered by the user.

Function - When the cursor is moved to this word, the down arrow is used to select one of the following choices:

NO REQUEST
GROUND TEST
ENQUIRY
NEW FLT LEG
SHOP FAULT
LOG OFF

Parity, Pad, Rate - These fields may all be edited by the user.

The fault summary word (label 350) is unpacked and each bit definition presented along with its status. The bit definitions are prestored for each 700 series equipment. The user may scroll through the full list by using the up and down arrows. The F (forward) and B (back) keys may also be used to scroll a full page at a time. The maintenance bits dynamically indicate monitor and status results in the transmit NO REQUEST mode. When in the GROUND TEST mode, the results of a self test are indicated. Flight recall data is displayed with the NEW FLT LEG command.

RCV, RCD & BRK keys are recognized in this screen and control is transferred to the selected mode.

The XMT key is reserved in this screen to allow for burst transmissions of the 227 word. The 227 would normally be transmitted at a regular fixed interval. However, it may be set up as a burst mode transmission which may be useful for the troubleshooting operation. Whenever the XMT key is pressed, the burst transmission would begin.

The E (erase) key resets all setup parameters to their default setting and clears the screen of any diagnostic data that was being displayed.

The CLR key returns control to the initial BITE setup menu.

7.3.1 GROUND TEST

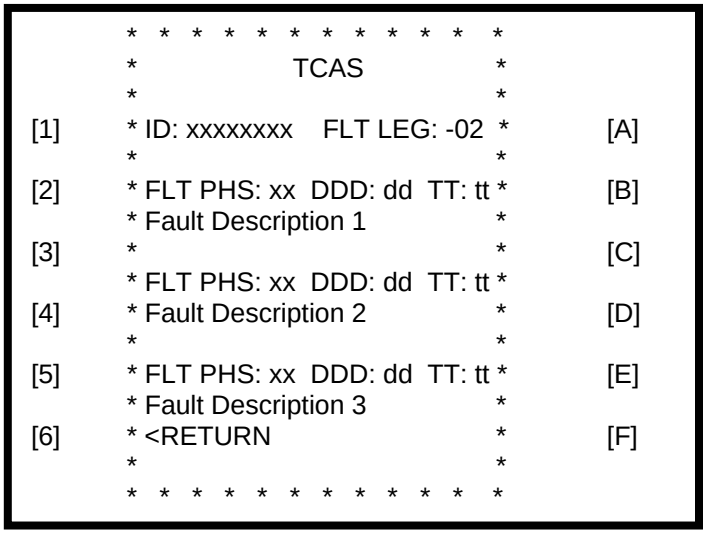
When the GROUND TEST function is selected and the ENT key pressed from the 227 edit field, label 227 is sent with a ground test command three times or until a response is received. The status of the ground test is always displayed on line 5 of the display. The possible status definitions are:

Status	Definition
NOT ACTIVE	No ground test currently active.
WAITING . . .	Ground Test command sent; < 12 seconds.
IN PROGRESS	SSM bits = Test (10) received.
NO RESPONSE	> 12 seconds and no SSM = Test received.

Note: After the ground test has entered the IN PROGRESS status, status will return to NOT ACTIVE when a normal SSM (00) is received on label 350.

7.3.2 SHOP FAULT MENU

A typical Shop Fault menu is shown below:



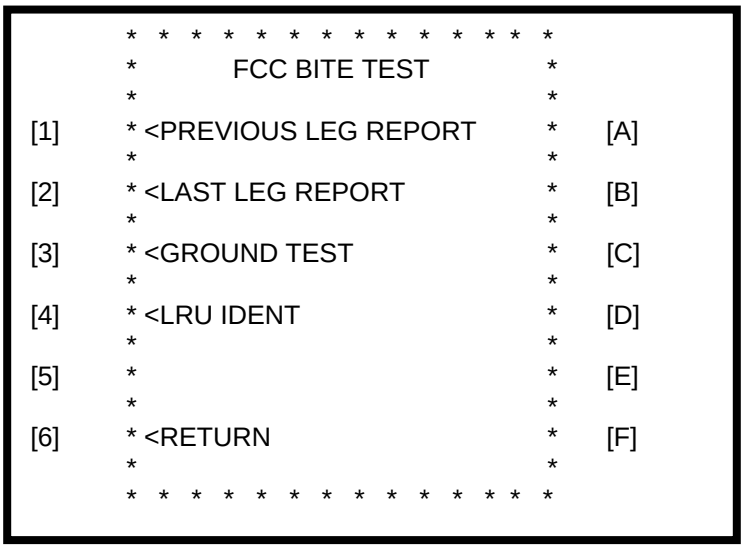
Key Definition Summary:

6 - Return Key; return to CMC Command screen.
> - Next page command.
< - Previous page command.
ENT - Save current screen in memory (memory location number appears on the lower right-hand corner of the display).
CLR - Return to CMC Command screen.
RCV, XMT, RCD or BRK - Go to the selected function.

7.4 737-BITE MODE

In 737-BITE mode, the DATATRAC 400 automatically sends a menu request with the appropriate LRU ID to the avionics unit with a 357 label command word. Label 303 is also transmitted immediately preceding label 357 with data set to zero. Both labels are transmitted at a 50 ms update rate. The LRU responds with its sequence of 356 labels containing the ASCII text of the initial menu. When a 356 label is received with an STX and word count of nonzero, the data following is the message to be displayed. The DATATRAC 400 buffers this information and when a complete message is received, it is displayed. The user may then enter line select keys which will be transmitted on label 357 as a LSK command and the new corresponding ASCII message will be displayed.

A typical first menu is shown below:



The six squares on each side of the display symbolize pushbuttons on a control display unit and are used for making menu selections. Pressing a 1-6 or A-F key causes a Line Select Key command to be transmitted on label 357 to the LRU with a code signifying that pushbutton. The right and left arrow keys may also be used to send NEXT PAGE and PREVIOUS PAGE commands. The LRU responds with the appropriate action or new menu transmission.

The Command Codes are:

1L	20	1R	26
2L	21	2R	27
3L	22	3R	28
4L	23	4R	29
5L	24	5R	2A
6L	25	6R	2B
PREV	1C	NEXT	1D

A special feature with the 737-BITE mode on the DATATRAC 400 is the SAVE SCREEN (or PRINT) function. By pressing the ENT key, a complete copy of the screen is saved to RAM. An index number is printed in the lower right-hand corner of the display when a menu is saved. Up to 240 screens can be saved. The screens can then be reviewed or downloaded over the RS-232 port, as described in sections 7.5 and 7.6.

Transmission of Extra Characters

Along with the LSK commands that may be transmitted on label 357, certain additional characters may also be transmitted. These characters may be entered by typing in the DOWN arrow key which places the cursor in the lower left-hand corner of the display. The 0-F keys may then be used to enter characters. The UP arrow key exits this mode. These extra characters will then be transmitted on labels 357 when the next LSK command or NEXT, PREVIOUS page command is sent. The characters automatically clear after transmission. The CLR key may also be used to clear characters when in the edit field. Either three or four characters may be entered for transmission.

The format of transmission of these extra characters is shown below:

```
3  3 3  2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0
2  1 0  9 8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3 2 1
```

P	SSM 0 1	STX 0 0 0 0 0 0 1 0	LRU ADDR	WORD COUNT BNR EQUIVAL.	LABEL 357 1 1 1 1 0 1 1 1
P	SSM 0 0	00	00	LSK OR PAGE COMMAND	LABEL 357 1 1 1 1 0 1 1 1
P	SSM 0 0	DATA CH #3	DATA CH #2	DATA CH #1	LABEL 357 1 1 1 1 0 1 1 1
P	SSM 1 0		DATA CH #4		LABEL 357 1 1 1 1 0 1 1 1

The diagram above shows the format for a transmission of four characters. The format for the data characters is ASCII. If only three characters are transmitted, the last 357 would not be sent and the SSM value for the third 357 would be 10 indicating final word. The word count for the first 357 is set to the number of 357 labels to follow. When this data is transmitted, each 357 label is transmitted immediately after the other (rather than the standard 50 ms spacing when no command is being sent).

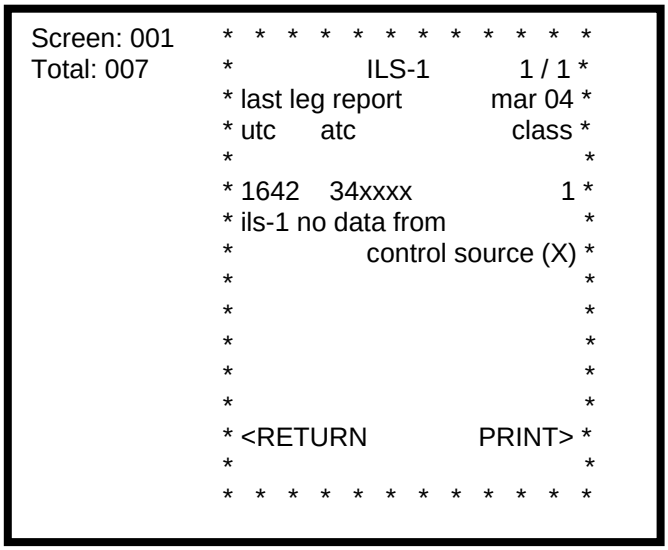
Key Definition Summary:

1-6	-	Line Select Key command 1L-6L (non char edit mode)
A-F	-	Line Select Key command 1R-6R (non char edit mode)
0-F	-	Enter character (character edit mode)
>	-	Next page command
<	-	Previous page command
ENT	-	Save current screen in memory (memory location number appears on lower right-hand corner of the display)
DOWN	-	Enter character edit mode
UP	-	Exit character edit mode
CLR	-	Return to BITE setup screen (non char edit mode)
CLR	-	Clear all characters and exit edit mode (char edit mode)

RCV, XMT, RCD or BRK - Go the selected function.

7.5 BITE SCREEN RECORDING AND REVIEW

To review menu screens that were saved with the SCREEN SAVE function described in the previous sections, the user must select Function = REVIEW at the main BITE setup screen. Upon pressing ENT, the display presents the first screen saved:



This is a recorded ASCII file, thus there are no interactive bus operations being performed. The screens may be reviewed by stepping through the saved screens using the up and down arrow keys for decrementing and incrementing the screen displayed. The screen number may also be entered directly using the 0-9 keys.

Pressing the E (erase) key will erase the currently displayed screen, and all following screens will shift to fill in the erased location. Pressing the CLR key returns the unit to the BITE setup screen. The function keys also will pass control to the respective setup screens.

7.6 RS-232 DOWNLOAD OF SAVED SCREENS

The DATATRAC 400 has the capability of downloading over the RS-232 port the menu screens saved with the SCREEN SAVE function. The RS-232 download consists of an ASCII file without the carriage-returns and line feeds. The receiving program must then re-insert the carriage-return/line feeds after each 26-byte line record to allow review using an editor. The RSREAD program (Version 1.04 or higher) will support the download and review of the BITE screens. In addition to inserting the line feeds, the program will also insert an identification header with the date at the top of the output disk file. See Appendix A for more information on the RSREAD program.

8.0 BILLS OF MATERIALS, ASSEMBLY DRAWINGS, AND SCHEMATICS

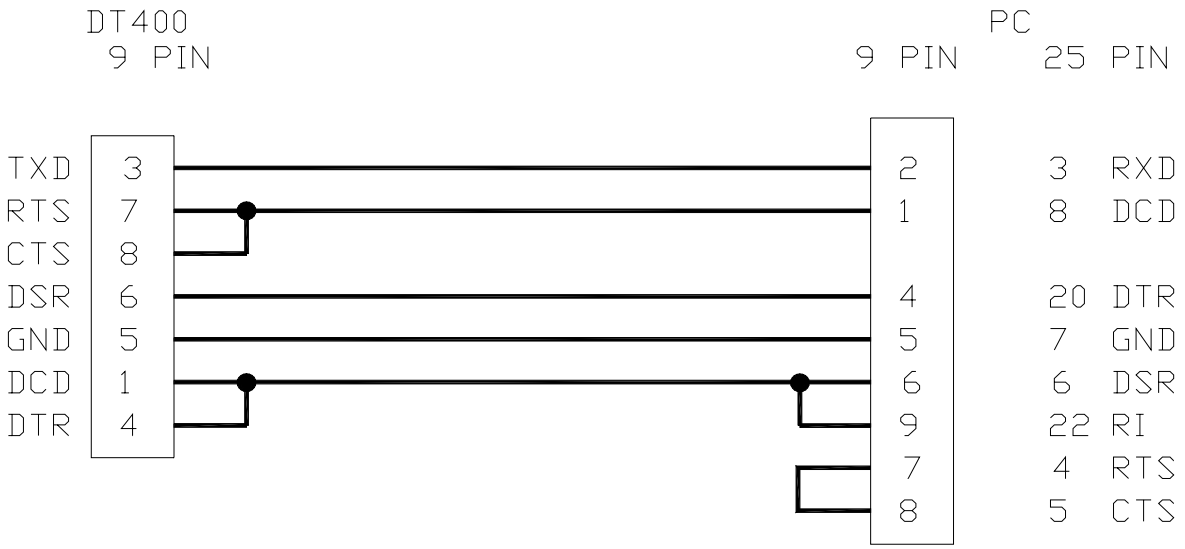
To assist in the maintenance of the Datatrac 400, Bills of Materials, Assembly Drawings, and Schematics are available in the DT-400 Maintenance Manual (P/N 06-1403-00 for hard copy, E6-1403-00 for CD), available separately from Aeroflex.

APPENDIX A

RS-232C INTERFACE DEFINITION

RS232 Cable Schematic

Below is the schematic for wiring the RS232 cable. The DATATRAC 400 RS232 uses a 9-pin male D-sub type connector. The schematic shows the wiring from the DT400 to both a standard 9-pin (as found on some PC AT's) and 25-pin connector. Each signal's acronym is listed next to the pin.



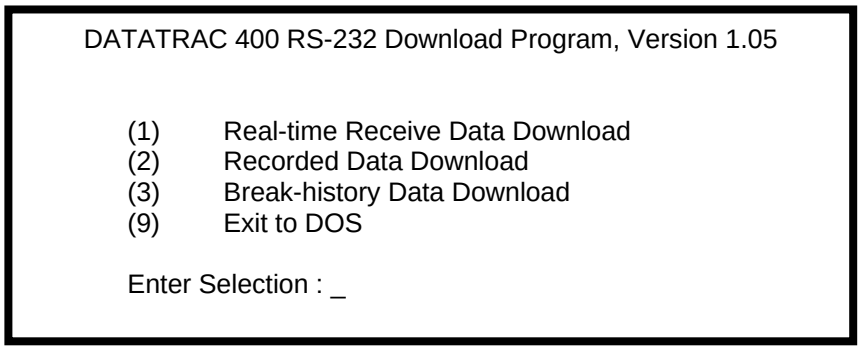
The PC's DTR (Data Terminal Ready) line is a modem output line that can be used to temporarily disable the DATATRAC 400 download. Setting this pin high will enable the download, while clearing it will disable it. The download will resume uninterrupted after a disable then a re-enable of the DTR line. This is useful if the receiving computer cannot keep up with the download and must periodically freeze it to process the data. Refer to the computer's serial port documentation for information on toggling this bit. Note that for real-time data download, freezing the DATATRAC 400 download will necessarily cause data to be missed. Record and Break data download is unaffected by periodic DTR disables.

To give the receiving computer time to initiate the download freeze and thus avoid loss of data due to an overflow, the DATATRAC transmits data bytes on every other byte position in the serial stream. Therefore, even though the baud rate is 9600, only 4800 useful bits are transmitted per second.

RSREAD Download Program

A program is provided on diskette for IBM PC or compatible that can be used for reading the data downloaded by the DATATRAC 400 over the RS-232C interface. The program, called RSREAD, reads the stream of bytes and assembles them to produce an ASCII test file with the data organized in table fashion. The output file can then be printed out or used as an input file to some other data processing program.

The program is invoked by typing RSREAD. It will first initialize the COM1 serial port on the PC to the proper baud rate, parity, etc. (See section 3.2.3.2 for a complete specification of the RS232 data format). The main menu will then appear as follows:



There are three forms of data download supported, namely, real-time download of received data, download of the recorded data, and download of break history data. For either selection, the program will return and ask for an output file name. Upon entering the file name, the program will begin “listening” over the COM1 port for data. It is at this time that the DATATRAC 400 download should be initiated. At any time during the download, the operator can press any key on the computer's keyboard to terminate the download. Note that the DATATRAC 400 will continue downloading data although the computer is no longer recording it.

This program should not be invoked while the DATATRAC 400 is actively downloading data since a phase error will likely result. See section 3.2.3.2 for instructions on stopping and starting the received data download and section 5.5.4 for operating the recorded data download.

Real-time Data Download

Due to timing restrictions involving the real-time download, the program will buffer all the data being downloaded in the computer's RAM before accessing the disk. The program is capable of buffering up to 1000 label records. When the buffer becomes full or the operator aborts the data collection, the program will write the data to the file and return to the main menu. Below is an example of the ASCII file produced when three labels on two different channels were downloaded.

DATATRAC 400 Receive Data Download Wed Jun 13 15:58:15 1991

Count	Chan	Lbl	SDI	32-Hex Data- 1	Time Stamp
00000	1	100	0	00 00 00 02	618409
00001	1	130	1	90 00 01 1A	618406
00002	2	210	0	11 99 00 11	618405
00003	1	100	0	00 00 00 02	618309
00004	1	130	1	90 00 01 1A	618306
00005	2	210	0	11 99 00 11	618305
00006	1	100	0	00 00 00 02	618209
00007	1	130	1	90 00 01 1A	618206
00008	2	210	0	11 99 00 11	618205

The count is just an index to the record and is generated by the program for bookkeeping. It is not transmitted by the DATATRAC 400. The data is presented in HEX32 format with the label byte shown as it is transmitted on the bus. The time stamp marks the relative time that the label was received. The timer is a count-down timer that begins at 999 999 ms and is decremented each ms. Observe in the example above that the transmit interval for all three labels is 100 ms.

Record Data Download

Since downloading of recorded data is not real-time event, the program can be perform the disk access while data is being received. Therefore, the program will continue collecting data until either the user aborts the acquisition or the DATATRAC 400 completes the download. While the data is being downloaded, the program will display the number of records collected so far. The following is a example of the ASCII output file generated :

DATATRAC 400 Recorded Data Download Wed Jun 13 15:59:47 1991

Record Interval = 0050 Number of Samples = 4

Count	Chan	Lbl	SDI	32-Hex Data- 1
0000	1	100	0	…
0000	1	130	1	…
0000	2	210	0	…
0001	1	100	0	00 00 00 02
0001	1	130	1	90 00 01 1A
0001	2	210	0	11 99 00 11
0002	1	100	0	…
0002	1	130	1	…
0002	2	210	0	…
0003	1	100	0	00 00 00 02
0003	1	130	1	90 00 01 1A
0003	2	210	0	11 99 00 11

The record interval is displayed in milliseconds. The number of samples tells how many sample counts were recorded. This value multiplied by the number of label per sample (in this case 4 x 3) gives the number of label records in the file unless the operator aborted the download. The count is the sample number for that line. Note that there are three labels per sample in the example. The ellipsis (. . .) indicate that no data was received for that label during that sample interval.

Break History Data Download

As with recorded data download, the program can perform the disk access while break history data is being received. Therefore, the program will continue collecting data until either the user aborts the acquisition or the DATATRAC 400 completes the download. While the data is being downloaded, the program will display the number of records collected so far. The following is a sample of the ASCII output file generated (with time stamp downloaded).

DATATRAC 400 Break History Data Download Fri Oct 12 15:23:54 1991

Number of Samples = 1541 Trigger Location = 4

Count	Chan	Lbl	SDI	32-HexData-1	Time	
0000	0	210	0	11 99 00 11	618505	
0001	0	100	0	00 00 00 02	618409	
0002	0	130	1	90 00 01 1A	618406	
0003	0	210	0	11 99 00 11	618405	
0004	1	100	0	00 00 00 02	618309	**TRIGGER**
0005	1	130	1	90 00 01 1A	618306	
0006	2	210	0	11 99 00 11	618305	
0007	1	100	0	00 00 00 02	618209	
0008	1	130	1	90 00 01 1A	618206	
0009	2	210	0	11 99 00 11	618205	

The data is presented in HEX32 format with the label byte shown as it is transmitted on the bus. The time stamp marks the relative time that the label was received. The timer is a count-down timer that begins at 999 999 ms and is decremented each μs. Observe in the example above that the transmit interval for all three labels is 100 ms.

APPENDIX B

APPENDIX B
DATATRAC 400 Specifications

Alternating current:..... 115-230 V 
50-400 Hz
350 mA maximum

Direct Current..... 28 V 
21 W

 ..... For international requirements for JPN 01-1403-00 and 01-1403-02 units the following fuses must be used: For the ac (mains) fuse (A12F2) install an IEC style, 5 mm X 20 mm, 1.6 A, 250 V, Type F. For the dc fuse (A12F1) install an IEC style, 5 mm X 20 mm, 1.6 A, 250 V, Type F.

For the USA: For the ac (mains) fuse (A12F2) install a ¼ X 1 ¼ inch, 1.5 A, 250 V, slow-blow. For the dc fuse install a ¼ X 1 ¼ inch, 1.5 A, 250 V, fast-blow.

For all other markets check with the proper authorities for which of these kinds of fuses to use.

 ..... On the 24 V dc power supply there is a replaceable fuse (A2PS201F1) with specifications as follows: IEC style, 3.1 A, 250 V ac, fast acting.

 ..... On the Inverter power supply board there is an axial leaded soldered in fuse (A13A1F1) with the following specifications: 1 A, 125 V, quick acting (Bel Fuse type MQ 1).

Ac Power Source: ..... The equipment is intended to operate from an ac power source that will not apply more than 253 V ac between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is required for safe operation.

Dc Power Source: ..... The equipment may be operated from a 28 V dc power source.

Proper Power Cord: ..... Use only the power cord and mains plug appropriate for the voltage and plug configuration in your country. Use only a power cord that is in good condition. Refer cord and connector changes to qualified service personnel.

Power Cord: ..... The detachable power supply cord used shall be ≤ 3 m in length.

Equipment Meets These Listed Standards:	EN 61010-1 (IEC 61010-1) EN 61326 Class A EN 61326-1 Controlled EM Portable EN 50082-1:1992 EN 55011 Class A FCC
WARNING:	Equipment has recharging circuit for a rechargeable battery. Use only a sealed lead-acid battery as specified by Aeroflex.

Mechanical:

Construction	All aluminum, high strength enclosure w/ mother board and 7 card slot architecture
Display	High contrast, twisted nematic LCD; 240 x 120 dot graphics 16 lines X 40 char.

Environmental:

Operating Temperature	5 °C to 40 °C.
Relative Humidity	Maximum relative humidity of 80% for temperatures ≤ 31 °C decreasing linearly to 50% relative humidity at 40 °C.
Operating Altitude	≤ 2000 m.
Size	14.5 cm H x 36.2 cm W x 30.5 cm D (5.7” H x 14.25” W x 12” D).
Mass (Weight)	8.2 kg (18 lb.).
IEC Overvoltage Category	II
Pollution Degree	1

Receive Operation:

Ports	2
Bus Frequency	12-14.5 kHz or 100 kHz
Input Levels	± 6.5 to ± 13.5 V dc (A to B)
Input Impedance	12.0 kΩ
Word Update	1 ms to 10 s, update rate displayed as instantaneous minimum or maximum values
Display Format	Engineering units with prestored scaling based on equipment IDs, hexadecimal (full or data field); binary (full or data field) user defined; graphic plots.
Maximum Words	256 per SDI per channel
Bus Activity Monitor	Monitors loss of individual words, with selectable sensitivity
Real-time Download/ Conversion	RS-232C or 12 bit DAC

Breakpoint Operation:

Label Sequences	A, B, A or B, A then B, B then A
Data Conditions	EQ, NEQ, OR, GT, LT, /GT/, /LT/
Event Count	1 to 99 before break
History	Up to 6,553 words in a programmable window about the breakpoint; selectable time stamp
Trigger Pulse	5 V, 0.1 ms

Record Operation:

Channels	Up to 16 selectable labels
Sample Interval	1 ms to 10 s (selectable)
Record Capacity	32 kbytes (e.g. 2.25 h of single label at 1/s)
Playback Options	Graphic plots, data list, DAC or RS-232C download

Reference: ARINC 429-16; Boeing labels for AVM, EIS, FSEU, EICAS, and FQIS

Transmit Operation:

Ports	2 Standard, expandable to 4 with additional board
Bus Frequency	12.0 kHz, 12.5 kHz, 14.5 kHz or 100 kHz
Output Levels	± 10.0 V dc (A to B)
Word Update	1 ms to 10s output at selectable rate
Display Format	Engineering units with prestored scaling based on equipment IDs; hexadecimal (full or data field); binary (full or data field); user defined
Maximum Words	128
Transmit Word Gap	2, 3, 4, 5, 6, 8, 12 bits
Dynamic Transmit	Repeat pattern of ramps and flat segments. Levels programmable between ± full scale and segment times of 0 to 999.999 s

Bite Operation:

BITE Formats	Compatible with distributed and centralized BITE concept equipments
Menu Display	Standard 14 line by 24 character menu, with selectable menu choices
Recording Feature	BITE screens may be saved for later viewing or downloading
Maintenance Words	Displays 350/351 label maintenance bits. Bit status along with prestored text presented.

External Cables and Wires ..... It is recommended that all cables connecting to the RCV ports (4), XMT ports (4), and D/A ports (2) use double shielded cable, such as M17/84-RG223 (or equivalent), with the shield properly terminated 360 ° at both connectors.

The RS-232 cable should be shielded, with the shield properly terminated 360 ° at both connectors. The shield is not to be connected to any terminals of the connectors.

The wires for connection of a dc supply do not require shielding.

GPIB ..... If the optional A8 circuit card assembly is installed, the GPIB (General Purpose Interface Bus) connector (A8W1J1) is installed on the rear panel. The GPIB/IEEE 488 bus is a bidirectional, TTL level serial communications port.

APPENDIX C

DESCRIPTION OF PCTOOLS-400 PROGRAM

PCTOOLS-400 program was developed to give the DATATRAC-400 user the capability of customizing the DATATRAC's firmware to meet special requirements. Three aspects of the DATATRAC's firmware can be customized, namely, transmit data tables, system setup tables, and engineering format scaling definitions. The output of PCTOOLS-400 us a 125K binary file containing the user-defined data as well as other code and data required by the DATATRAC-400. The operator can then "burn" the binary file into a 27C101 (1024 bit) type PROM with a PROM programmer (not supplied).

Transmit Data Tables

The DATATRAC-400 has the capability of invoking previously defined data tables for transmitting on the ARINC 429 bus. Typical applications might include routine test procedures where multiple transmit tables are repeatedly used. Instead of the operator entering the labels from the keypad each time, the operator can call up different data tables with just a few keystrokes. This feature is particularly useful of the data tables are numerous or extensive as it greatly minimizing testing time and the chance for error on data entry.

System Setup Tables

Some procedures may require fairly complex DATATRAC-400 system setups to accomplish a desired test. There may be, for example, several dynamic transmit label definitions as well as some user-defined formats that are used for a particular test. Similar to the transmit tables, the DATATRAC-400 provides for calling up predefined system setups in lieu of setting all the parameters from the keypad. Each system setup specifies the state of the receivers (including selected labels), transmitters (including dynamic labels), user-defined formats, recorder, break-mode function, and BITE function.

Scaling Formats

When the ARINC 429 data is displayed in engineering units on the DATATRAC-400 (ENG format), the scaling table is referenced given the label and equipment ID specified. By default, this table contains all of the scaling information defined in the ARINC 429-16 specification. However, there may be applications where the user will want to specify their own non-standard scaling for a particular label/equipment ID combination. PCTOOLS-400 provides the capability for editing the standard ARINC table to either modify existing label formats or add new equipment Ids to a particular label definition.

For more technical information on the PCTOOLS-400 product, contact an Aeroflex representative

APPENDIX D

IMPLEMENTATION OF SPECIAL BOEING LABELS

In addition to the standard ARINC 429 database, the DATATRAC 400 also supports special labels used by equipment on Boeing airplanes. These are:

AVM	Equipment I.D. 03D
EICAS	Equipment I.D. 029
EIS	Equipment I.D. F03
FQIS	Equipment I.D. 04D
FSEU	Equipment I.D. F02

Where label definitions for these equipments match allowable structures involving scaling, packed discretes, units, ect. they have been fully implemented in the DATATRAC 400 database. In a limited number of cases where this is not possible, the DATATRAC defaults to a binary or hexadecimal format. The following sections describe label definitions and implementations for each of the equipments above.

AVM Data
Equipment ID : 03D

Label : 277 Command Word
Decoding : Data field displayed in binary format.
Word Definition :

Bit Definition
- Bits 1-8 = Label Number
- Bits 9-10 = SDI
- Bits 11-12 = PADS
- Bits 13-24 = AVM Hex (Equip) ID
- Bits 25-31 = Command/Control Bits
- Bit 32 = Parity

Label Number

Bit 8	7	6	5	4	3	2	1	
1	0	0	1	0	1	1	1	= Label 227 (Octal)

SDI

Bit 10	9	
0	0	= Engine 4 (or All Call)
0	1	= Engine 1 (or Engine 1 and 2)
1	1	= Engine 2
1	1	= Engine 3 (or Engine 3 and 4)

PADS

Bit 12	11
0	0

AVM Hex (Equipment) ID = 03D Hex

Bit 24	23	22	21	20	19	18	17	16	15	14	13
0	0	0	0	0	0	1	1	1	1	0	1

Command/Control Bits

Bit 31	30	29	28	27	26	25	
0	0	0	0	0	0	0	= Not Used
0	0	0	0	0	0	1	= Unit Self Test
0	0	0	0	0	1	0	= Use Accelerometer A
0	0	0	0	0	1	1	= Use Accelerometer A
0	0	0	0	1	0	0	= PAD
0	0	0	0	1	0	1	= Erase Fault History
0	0	0	0	1	1	0	= Erase Flight History
0	0	0	0	1	1	1	= Read Fault History
0	0	0	1	0	0	0	= Read Flight History
0	0	1	0	0	1	0	= New Flight Leg

Parity
- Bit 32 = 10
- Resolution = 0.01

AVM Data
Equipment ID : 03D

Label : 270 Status Word
Decoding : Data field displayed in binary format.
Word Definition :

Bit Definition
- Bits 1-8 = Label Number
- Bits 9-10 = SDI
- Bits 11-28 = Data
- Bits 30-21 = Status Matrix
- Bit 32 = Parity

Label Number

Bit	8	7	6	5	4	3	2	1	
	1	0	1	1	1	0	0	0	= Label 270 (Octal)

SDI

Bit	10	9	
	0	0	= Engine 4 (or All Call)
	0	1	= Engine 1
	1	1	= Engine 3 (or Engine 3 and 4)

Data
- Bit 11 = PAD
- Bit 12 = AVM System Fault
- Bit 13 = AVM Engine 1 Alert
- Bit 14 = AVM Engine 2 Alert
- Bit 15 = AVM Engine 1 Double Channel Fault
- Bit 16 = AVM Engine 2 Double Channel Fault
- Bit 17 = PAD
- Bit 18 = PAD
- Bit 19 = Engine 1 High Broadband Alert
- Bit 20 = Engine 2 High Broadband Alert
- Bit 21 = NVRAM Failrue
- Bit 22 = Fault History Erase
- Bit 23 = PAD
- Bit 24 = PAD
- Bit 25 = PAD
- Bit 26 = PAD
- Bit 27 = PAD
- Bit 28 = PAD
- Bit 29 = PAD

Status Matrix

Bit	31	30
	0	0

Parity
- Bit 32 = Odd

AVM Data
Equipment ID : 03D

Label : 300 History Data
Decoding : Bits 19 through 28 displayed as a dimensionless 0-15.2 decimal word.
Bits 11 through 17 displayed as discretes.
Word Definitions :

Bit Definition

Bits 1-8	=	Label Number
Bit 9	=	Engine ID
Bits 10-14	=	Flight Number
Bits 15-18	=	Data ID
Bits 19-28	=	Data
Bits 29-31	=	SSM
Bit 32	=	Parity

Label Number

Bit 8	7	6	5	4	3	2	1	
1	1	0	0	0	0	0	0	= 300 (Octal)

Engine ID

Bit 9	
0	= Engine 2
1	= Engine 1

Flight Number

Bit 14	13	12	11	10	
0	0	0	0	0	= Most Recent Flight
0	0	0	0	1	= (Most Recent Flight) –1
					thru
1	1	1	1	0	= (Least Recent Flight) +1
1	1	1	1	1	= Least Recent Flight

Data ID

Bit 18	17	16	15	
0	0	0	0	= N1 Vibration (Label 354)
0	0	0	1	= N2 Vibration (Label 355)
0	0	1	0	= N3 Vibration (Label 356)
0	0	1	1	= BB Vibration (Label 357)
0	1	0	0	= N1 Speed
0	1	0	1	= N2 Speed
0	1	1	0	= Flight Duration

Data

Bit 28 27 26 25 24 23 22 21 20 19
MSB < - - - - - - - - - - - - - - - - - - -> LBS

Bit Encoding for Vibration Labels

Bit = 10
Resolution = 0.01
Range = 0 to 5.12
Units = Scalar Units

Bit Encoding for Tachometer Speed

Bit = 10
Resolution = 1.0
Range = 0 to 512
Units = RPM

Bit Encoding for Flight Duration

Bit = 10
Resolution = 0.1
Range = 0 to 51.2
Units = Hours

SSM

Bit 31 30 29
0 0 0

Parity

Bit 32 = Odd

AVM Data
Equipment ID : 03D

Label : 301 Fault History Data
Decoding : Data field displayed in binary format.
Word Definition :

Bit Definition

Bits 1-8	=	Label Number
Bits 9-10	=	SDI
Bits 11-15	=	Fault Sequence
Bits 16-24	=	PADS
Bits 25-29	=	Fault Codes
Bits 30-31	=	Status Matrix
Bit 32	=	Parity

Label Number

Bit 8	7	6	5	4	3	2	1		
1	1	0	0	0	0	0	1	=	Label 301 (Octal)

SDI

Bit 10	9		
0	0	=	Engine 4
0	1	=	Engine 1
1	0	=	Engine 2
1	1	=	Engine 3

Fault Sequence

Bit 15	14	13	12	11		
0	0	0	0	0	=	Fault 0
0	0	0	0	0	=	Fault 1
			thru			
1	1	1	1	0	=	Fault 30
1	1	1	1	1	=	Fault 31

PADS

Bit 24	23	22	21	20	19	18	17	16
0	0	0	0	0	0	0	0	0

Fault Codes

Bit 29	28	27	26	25		
0	0	0	0	0	=	Not Used
0	0	0	0	1	=	Unit Failure
0	0	0	1	0	=	N1 Tachometer Signal Loss
0	0	0	1	1	=	N2 Tachometer Signal Loss
0	0	1	0	1	=	N3 Tachometer Signal Loss
0	0	1	0	1	=	Not Used
0	0	1	1	0	=	Ch A Accelerometer High Noise
0	0	1	1	1	=	Ch B Accelerometer High Noise
0	1	0	0	0	=	Channel A < > Channel B
0	1	0	0	1	=	Ch A Accelerometer Low Signal
0	1	0	1	0	=	Ch B Accelerometer Low Signal

Status Matrix

Bit 31	30
0	0

Parity

Bit 32 = Odd

AVM Data
Equipment ID : 03D

Label : 350 Maintenance Data 1
Decoding : Data field displayed in binary format.
Word Definition :

Bit Definition
- Bits 1-8 = Label Number
- Bits 9-10 = SDI
- Bits 11-28 = Data
- Bits 30-31 = Status Matrix
- Bit 32 = Parity

Label Number

Bit	8	7	6	5	4	3	2	1
	1	1	1	0	1	0	0	0

= Label 350 (Octal)

SDI

Bit	10	9
	X	X

Data
- Bit 11 = Signal Conditioner Status
- Bit 12 = N1 Tachometer Signal Loss
- Bit 13 = N2 Tachometer Signal Loss
- Bit 14 = N3 Tachometer Signal Loss
- Bit 15 = Ch A Accelerometer High Noise
- Bit 16 = Ch B Accelerometer High Noise
- Bit 17 = Channel A < > Channel B
- Bit 18 = High Broadband Levels
- Bit 19 = Ch A Accelerometer Low Signal
- Bit 20 = Ch B Accelerometer Low Signal
- Bit 21 = PAD
- Bit 22 = PAD
- Bit 23 = PAD
- Bit 24 = PAD
- Bit 25 = PAD
- Bit 26 = PAD
- Bit 27 = PAD
- Bit 28 = Unit Not Available
- Bit 29 = Command Word Acknowledge

Status Matrix

Bit	31	30
	0	0

Parity
- Bit 32 = Odd

AVM Data
Equipment ID : 03D

Label : 353 Highest Vibration
Decoding : Bits 20 through 28 displayed as a dimensionless 0-2.56 decimal word
Bits 11 and 12 displayed as discretes.
Word Definition :

Bit Definition

Bits 1-8	=	Label Number
Bits 9-10	=	SDI
Bits 11-12	=	Accelerometer Source
Bits 13-17	=	PADS
Bits 18-19	=	Data ID
Bits 20-28	=	Data
Bits 29-31	=	SSM
Bit 32	=	Parity

Label Number

Bit 8	7	6	5	4	3	2	1	
1	1	1	0	1	0	1	1	= Label 353 (Octal)

SDI

Bit 10	9	
0	0	= Engine 4
0	1	= Engine 1
1	0	= Engine 2
1	1	= Engine 3

Accelerometer Source

Bit 12	11	
0	0	= No Channel in command
0	1	= Channel A
1	0	= Channel B

PADS

Bit 17	16	15	14	13
0	0	0	0	0

Sata ID

Bit 19	18	
0	0	= N1 Vibration (Label 354)
0	1	= N2 Vibration (Label 355)
1	0	= N3 Vibration (Label 356)
1	1	= BB Vibration (Label 357)

Data

Bit 28	27	26	25	24	23	22	21	20
MSB < - - - - - - - - - - - - - - - > LSB								

Bit Encoding for Vibration Labels

Bit = 9
Resolution = 0.01
Range = 0 to 2.56
Units = Scalar Units

SSM

Bit 31	30	29	
1	0	0	= Self Test
1	1	0	= Normal Operation

Parity

Bit 32 = Odd

AVM Data
Equipment ID : 03D

Label : 345 N1 Vibration
355 N2 Vibration
356 N3 Vibration
357 BB Vibration
Decoding : Bits 20 through 28 displayed as a dimensionless 0-2.56 decimal
Bits 11 and 12 displayed as discretes.
Word Definition :

Bit Definition
Bits 1-8 = Label Number
Bits 9-10 = SDI
Bits 11-12 = Accelerometer Source
Bits 13-19 = PADS
Bits 20-28 = Data
Bits 29-31 = SSM
Bit 32 = Parity

Label Number

Bit 8	7	6	5	4	3	2	1	
1	1	1	0	1	1	X	X	= Label Nos. 354 through 357 (Octal)

SDI

Bit 10	9	
0	0	= Engine 4
0	1	= Engine 1
1	0	= Engine 2
1	1	= Engine 3

Accelerometer Source

Bit 12	11	
0	0	= No Channel in command
0	1	= Channel A
1	0	= Channel B

PADS

Bit 19	18	17	16	15	14	13
0	0	0	0	0	0	0

Data

Bit	28	27	26	25	24	23	22	21	20
MSB < - - - - - - - - - - - - - - - > LSB									

Bit Encoding for Vibration Labels
Bit = 9
Resolution = 0.01
Range = 0 to 2.56
Units = Scalar Units

SSM

Bit 31	30	29		
1	1	0	=	Normal Operation

Parity

Bit 32 = 10

AVM Data
Equipment ID : 03D

Label : 360 N1 Rotor Imbalance Angle
361 LPT Rotor Imbalance Angle
Decoding : Bits 20 through 28 displayed as 0-360 deg. Decimal word.
Bits 11 and 12 displayed as discretes.
Word Definition :

Bit Definition
Bits 1-8 = Label Number
Bits 9-10 = SDI
Bits 11-12 = Accelerometer Source
Bits 13-19 = PADS
Bits 20-28 = Data
Bits 29-31 = SSM
Bit 32 = Parity

Label Number
Bit 8 7 6 5 4 3 2 1
1 1 1 1 0 0 0 X = Label Nos. 360 through 361 (Octal)

SDI
Bit 10 9
0 0= Engine 4
0 1= Engine 1
1 0= Engine 2
1 1= Engine 3

Accelerometer Source
Bit 12 11
0 0= No Channel in command
0 1= Channel A
1 0= Channel B

PADS
Bit 19 18 17 16 15 14 13
0 0 0 0 0 0 0

Data
Bit 28 27 26 25 24 23 22 21 20
MSB < - - - - - - - - - - - - - - - > LSB

Bit Encoding for Vibration Labels
Bit = 9
Resolution = 1.0
Range = 0 to 360
Units = Degrees

N1 Rotor Imbalance Angle BNR
LPT Rotor Imbalance Angle BNR
(Continues)

SSM

Bit 31 30 29
1 1 0 = Normal Operation

Parity

Bit 32 = 10

EICSA Data
Equipment ID : 029

LABEL	SDI	DESCRIPTION	FORMAT	BITS	RES	UNITS	RANGE
001	0	Ail Pos Inner L	BNR	12	0.044	Degrees	+/- 180
	1	Ail Pos Outer L	BNR	12	0.044	Degrees	+/- 180
	2	Ail Pos Inner R	BNR	12	0.044	Degrees	+/- 180
	3	Ail Pos Outer R	BNR	12	0.044	Degrees	+/- 180
002	0	APU Battery Current	BNR	12	0.062	Amps DC	+/- 256
	1	APU Battery Voltage	BNR	12	0.01	Volts DC	0 to 50
	2	APU Bus AC Volts	BNR	12	0.062	Volts AC	0 to 256
	3	APU Bus AC Frequency	BNR	12	0.125	Hz	0 to 512
003	0	APU EGT	BNR	12	0.5	Degrees C	0 to 2048
	1	APU Load	BNR	12	0.062	% LOAD	0 to 256
	2	APU Oil Level	BNR	12	0.0015	Inches	0 to 6
	3	APU RPM	BNR	12	0.062	%RPM	0 to 256
004	0	Brake 1 Temperature	BNR	12	0.062	%FSD	0 to 256
	1	Brake 2 Temperature	BNR	12	0.062	%FSD	0 to 256
	2	Brake 3 Temperature	BNR	12	0.062	%FSD	0 to 256
	3	Brake 4 Temperature	BNR	12	0.062	%FSD	0 to 256
005	0	Brake 5 Temperature	BNR	12	0.062	%FSD	0 to 256
	1	Brake 6 Temperature	BNR	12	0.062	%FSD	0 to 256
	2	Brake 7 Temperature	BNR	12	0.062	%FSD	0 to 256
	3	Brake 8 Temperature	BNR	12	0.062	%FSD	0 to 256
006	0	Bus AC Volts-L	BNR	12	0.062	Volts AC	0 to 256
	1	Bus AC Volts-R	BNR	12	0.062	Volts AC	0 to 256
	2	Bus Frequency-L	BNR	12	0.062	Volts AC	0 to 256
	3	Bus Frequency-R	BNR	12	0.062	Volts AC	0 to 256
007	0	Crew Oxygen Pressure	BNR	12	1.0	PSI	0 to 4096
	1	Discrete Word #1	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #2	DIS	N/A	N/A	N/A	N/A
	3	Discrete Word #3	DIS	N/A	N/A	N/A	N/A
010	0	Discrete Word #4	DIS	N/A	N/A	N/A	N/A
	1	Discrete Word #5	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #6	DIS	N/A	N/A	N/A	N/A
	3	Discrete Word #7	DIS	N/A	N/A	N/A	N/A
011	0	Discrete Word #8	DIS	N/A	N/A	N/A	N/A
	1	Discrete Word #9	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #10	DIS	N/A	N/A	N/A	N/A
	3	Discrete Word #11	DIS	N/A	N/A	N/A	N/A

LABEL	SDI	DESCRIPTION	FORMAT	BITS	RES	UNITS	RANGE
012	0	Discrete Word #12	DIS	N/A	N/A	N/A	N/A
	1	Discrete Word #13	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #14	DIS	N/A	N/A	N/A	N/A
	3	Discrete Word #15	DIS	N/A	N/A	N/A	N/A
013	0	Discrete Word #16	DIS	N/A	N/A	N/A	N/A
	1	Discrete Word #17	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #18	DIS	N/A	N/A	N/A	N/A
	3	Discrete Word #19	DIS	N/A	N/A	N/A	N/A
014	0	Discrete Word #20	DIS	N/A	N/A	N/A	N/A
	1	Discrete Word #21	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #22	DIS	N/A	N/A	N/A	N/A
	3	Discrete Word #23	DIS	N/A	N/A	N/A	N/A
015	0	Discrete Word #24	DIS	N/A	N/A	N/A	N/A
	1	Discrete Word #25	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #26	DIS	N/A	N/A	N/A	N/A
	3	Discrete Word #27	DIS	N/A	N/A	N/A	N/A
016	0	Discrete Word #28	DIS	N/A	N/A	N/A	N/A
	1	Discrete Word #29	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #30	DIS	N/A	N/A	N/A	N/A
	3	Elevator Position L	BNR	12	0.044	Degrees	+/- 180
017	0	Elevator Position R	BNR	12	0.044	Degrees	+/- 180
	1	Engine EGT L	BNR	12	0.5	Degrees C	+/- 2048
	2	Engine EGT R	BNR	12	0.5	Degrees C	+/- 2048
	3	Engine Fuel Flow L	BNR	12	8.00	Lbs/Hr	0 to 32768
020	0	Engine Fuel Flow R	BNR	12	8.00	Lbs/Hr	0 to 32768
	1	Engine N1-Actual-L	BNR	12	0.062	%RPM	0 to 256
	2	Engine N1-Actual-R	BNR	12	0.062	%RPM	0 to 256
	3	Engine N2-Actual-L	BNR	12	0.062	%RPM	0 to 256
021	0	Engine N2-Actual-R	BNR	12	0.062	%RPM	0 to 256
	1	Engine N3-Actual-L	BNR	12	0.062	%RPM	0 to 256
	2	Engine N2-Actual-R	BNR	12	0.062	%RPM	0 to 256
	3	Engine Oil Pressure L	BNR	12	1.0	PSI	0 to 4096
022	0	Engine Oil Pressure R	BNR	12	1.0	PSI	0 to 4096
	1	Engine Oil Quantity-L	BNR	12	0.03	US Pints	0 to 128
	2	Engine Oil Quantity-R	BNR	12	0.03	US Pints	0 to 128
	3	Engine Oil Temperature L	BNR	12	0.5	Degrees C	+/- 2048
023	0	Engine Oil Temperature R	BNR	12	0.5	Degrees	0 to 4096
	1	Engine Vibration L	BNR	9	0.01	Ratio	0 to 5.12
	2	Engine Vibration R	BNR	9	0.01	Ratio	0 to 5.12
	3	Engine EPR Actual L	BNR	12	0.001	Ratio	0 to 4

LABEL	SDI	DESCRIPTION	FORMAT	BITS	RES	UNITS	RANGE
024	0	Engine EPR Actual R	BNR	12	0.001	Ratio	0 to 4
	1	Engine Fuel Pressure L	BNR	9	0.001	Ratio	0 to 4
	2	Engine Fuel Pressure R	BNR	9	0.001	Ratio	0 to 4
	3	Engine EPR Command L	BNR	12	0.001	Ratio	0 to 4
025	0	Engine EPR Command R	BNR	12	0.001	Ratio	0 to 4
	1	Engine EPR Limit L	BNR	12	0.001	Ratio	0 to 4
	2	Engine EPR Limit R	BNR	12	0.001	Ratio	0 to 4
	3	Not Defined	N/A	N/A	N/A	N/A	N/A
026	0	Engine N1 Target-FMC	BNR	14	0.0156	%RPM	0 to 256
	1	Generator Load L	BNR	12	0.062	% Load	0 to 256
	2	Generator Load R	BNR	12	0.062	% Load	0 to 256
	3	GPU AC Volts	BNR	12	0.062	Volts AC	0 to 256
027	0	GPU Frequency	BNR	12	0.125	Hz	0 to 512
	1	APU Load	BNR	12	0.062	% Load	0 to 256
	2	Hydraulic Oil Pressure C	BNR	12	1.0	PSI	0 to 4096
	3	Hydraulic Oil Pressure L	BNR	12	1.0	PSI	0 to 4096
030	0	Hydraulic Oil Pressure R	BNR	12	1.0	PSI	0 to 4096
	1	Hydraulic Oil Quantity C	BNR	12	0.06	%Full	0 to 256
	2	Hydraulic Oil Quantity L	BNR	12	0.06	%Full	0 to 256
	3	Hydraulic Oil Quantity R	BNR	12	0.06	%Full	0 to 256
031	0	IDG Oil Temperature L	BNR	12	0.5	Degrees C	+/- 2048
	1	IDG Oil Temperature R	BNR	12	0.5	Degrees	0 to 4096
	2	Inverter AC Volts	BNR	12	0.062	Volts AC	0 to 256
	3	Inverter Frequency	BNR	12	0.125	Hz	0 to 512
032	0	Main Battery Current	BNR	12	0.062	Amps DC	+/- 256
	1	Main Battery Voltage	BNR	12	0.03	Volts DC	+/- 128
	2	Pack Out Temperature L	BNR	12	0.5	Degrees C	+/- 2048
	3	Pack Out Temperature R	BNR	12	0.5	Degrees	0 to 4096
033	0	Rudder Position	BNR	12	0.044	Degrees	+/- 180
	1	TRU Current L	BNR	12	0.062	Amps DC	+/- 256
	2	TRU Current R	BNR	12	0.062	Amps DC	+/- 256
	3	TRU Voltage L	BNR	12	0.03	Volts DC	+/- 128
034	0	TRU Voltage R	BNR	12	0.03	Volts DC	+/- 128
	1	Engine EPR Refer.-TMC L	BNR	12	0.001	Ratio	0 to 4
	2	Engine EPR Refer.-TMC R	BNR	12	0.001	Ratio	0 to 4
	3	Filter 3 Vibration L	BNR	9	0.01	Ratio	0 to 5.12
035	0	Filter 3 Vibration R	BNR	9	0.01	Ratio	0 to 5.12
	1	Filter 2 Vibration L	BNR	9	0.01	Ratio	0 to 5.12
	2	Filter 2 Vibration R	BNR	9	0.01	Ratio	0 to 5.12
	3	Filter 1 Vibration L	BNR	9	0.01	Ratio	0 to 5.12

LABEL	SDI	DESCRIPTION	FORMAT	BITS	RES	UNITS	RANGE
036	0	Filter 1 Vibration R	BNR	9	0.01	Ratio	0 to 5.12
	1	L Bleed Duct Pressure	BNR	12	0.03	PSI	0 to 128
	2	R Bleed Duct Pressure	BNR	12	0.03	PSI	0 to 128
	3	Discrete Word #31	DIS	N/A	N/A	N/A	N/A
045	0	L Prim Hx Out Temp.	BNR	12	0.5	Degrees C	+/- 2048
	1	L Sec Hx Out Temp.	BNR	12	0.5	Degrees C	+/- 2048
	2	L Turb In Temperature	BNR	12	0.5	Degrees C	+/- 2048
	3	R Comp Out Temperature	BNR	12	0.5	Degrees C	+/- 2048
046	0	R Precool Out Temp.	BNR	12	0.5	Degrees C	+/- 2048
	1	R Prim Hx In Temperature	BNR	12	0.5	Degrees C	+/- 2048
	2	R Prim Hx Out Temp.	BNR	12	0.5	Degrees C	+/- 2048
	3	R Sec Hx Out Temp.	BNR	12	0.5	Degrees C	+/- 2048
047	0	R Turb In Temperature	BNR	12	0.5	Degrees C	+/- 2048
	1	C Air Pump Temperature	BNR	12	0.5	Degrees C	+/- 2048
	2	C Elec 1 Pump Temp.	BNR	12	0.5	Degrees C	+/- 2048
	3	C Elec 2 Pump Temp.	BNR	12	0.5	Degrees C	+/- 2048
050	0	C Hyd Rsvr Temperature	BNR	12	0.5	Degrees C	+/- 2048
	1	L Elec Pump Temperature	BNR	12	0.5	Degrees C	+/- 2048
	2	L Eng Pump Temperature	BNR	12	0.5	Degrees C	+/- 2048
	3	L Hyd Rsvr Temperature	BNR	12	0.5	Degrees C	+/- 2048
051	0	R Elec Pump Temp.	BNR	12	0.5	Degrees C	+/- 2048
	1	R Eng Pump Temperature	BNR	12	0.5	Degrees C	+/- 2048
	2	R Hyd Rsvr Temperature	BNR	12	0.5	Degrees C	+/- 2048
	3	Mach	BNR	15	0.00013	Mach	4.096
052	0	Gross Weight	BNR	15	40.0	Pounds	0 - 1,310,720
	1	IDG Temperature Rise-L	BNR	12	0.5	Degrees C	+/- 2048
	2	IDG Temperature Rise-R	BNR	12	0.5	Degrees C	+/- 2048
	3	Inlet Total Pressure-L	BNR	13	0.004	PSI	0 to 32
037	0	Discrete Word #32	DIS	N/A	N/A	N/A	N/A
	1	Discrete Word #33	DIS	N/A	N/A	N/A	N/A
	2	Discrete Word #34	DIS	N/A	N/A	N/A	N/A
	3	Discrete Word #35	DIS	N/A	N/A	N/A	N/A
040	0	Aft Trim Valve	BNR	12	0.03	%Open	0 to 128
	1	Flight Deck Trim Valve	BNR	12	0.03	%Open	0 to 128
	2	Forward Trim Valve	BNR	12	0.03	%Open	0 to 128
	3	L Pack Air Flow	BNR	12	0.625	Cuft/min	0 to 2560
041	0	L Pack Temp Valve	BNR	12	0.03	%Open	0 to 128
	1	L Ram In Door	BNR	12	0.03	%Closed	0 to 128
	2	Baro Altitude	BNR	12	4.00	Feet	+/-131,072
	3	L Ram Out Door	BNR	12	0.03	%Closed	0 to 128

LABEL	SDI	DESCRIPTION	FORMAT	BITS	RES	UNITS	RANGE
042	0	R Pack Air Flow	BNR	12	0.625	Cuft/min	0 to 2560
	1	R Pack Temp Valve	BNR	12	0.03	%Open	0 to 128
	2	R Ram In Door	BNR	12	0.03	%Closed	0 to 128
	3	Computed Airspeed	BNR	14	0.0625	Knots	+/-1024
043	0	R Ram Out Door	BNR	12	0.03	%Closed	0 to 128
	1	Aft Duct Temperature	BNR	12	0.5	Degrees C	+/-2048
	2	Bulk Cargo Temperature	BNR	12	0.5	Degrees C	+/-2048
	3	Flight Deck Duct Temp.	BNR	12	0.5	Degrees C	+/-2048
044	0	Fwd Duct Temperature	BNR	12	0.5	Degrees C	+/-2048
	1	L Comp Out Temperature	BNR	12	0.5	Degrees C	+/-2048
	2	L Precool Out Temperature	BNR	12	0.5	Degrees C	+/-2048
	3	L Prim Hx In Temperature	BNR	12	0.5	Degrees C	+/-2048
053	0	Inlet Total Pressure-R	BNR	13	0.004	PSI	0 to 32
	1	Static Pressure-L	BNR	14	0.002	PSI	0 to 32
	2	Static Pressure-R	BNR	14	0.002	PSI	0 to 32
	3	Inlet Total Temperature-L	BNR	11	0.06	Degrees C	+/-128
054	0	Inlet Total Temperature-R	BNR	11	0.06	Degrees C	+/-128
	1	Stator Vane Position-L	BNR	11	0.002	Inches	0 to 4
	2	Stator Vane Position-R	BNR	11	0.002	Inches	0 to 4
	3	Thrust Reverser Angle-L	BNR	12	0.044	Degrees	+/-180
055	0	Thrust Reverser Angle-R	BNR	12	0.044	Degrees	+/-180
	1	Eng Scav Pressure-L	BNR	12	1.00	PSI	0 to 4096
	2	Eng Scav Pressure-R	BNR	12	1.00	PSI	0 to 4096
	3	Mid Duct Temperature	BNR	12	0.5	Degrees C	+/-2048
056	0	Mid Trim Valve	BNR	12	0.03	%Open	0 to 128
	1	Bus Activity Word	DIS	N/A	N/A	N/A	N/A
	2	Burner Pressure-L	BNR	14	0.03	PSI	0 to 512
	3	Burner Pressure-R	BNR	14	0.03	PSI	0 to 512
057	0	Thrust Reverser-L	BNR	12	0.03	%Deployed	+/-128
	1	Thrust Reverser-R	BNR	12	0.03	%Deployed	+/-128
	2	Hyd Gen AC Volts	BNR	12	0.062	Volts AC	0 to 256
	3	Hyd Gen Frequency	BNR	12	0.125	Hz	0 to 512
060	0	Hyd Gen DC Volts	BNR	12	0.01	Volts DC	0 to 50
	1	Discrete Word #36	DIS	N/A	N/A	N/A	N/A
	2	BLD Actuator Position-L	BNR	12	0.03	%Stroke	+/-128
	3	BLD Actuator Position-R	BNR	12	0.03	%Stroke	+/-128
061	0	N2 Corrected-L	BNR	12	0.03	%RPM	0 to 128
	1	N2 Corrected-R	BNR	12	0.03	%RPM	0 to 128

LABEL	SDI	DESCRIPTION	FORMAT	BITS	RES	UNITS	RANGE
277	0	Wraparound Word	DIS	N/A	N/A	N/A	N/A
300	0	L EPR Actual-TMC	BNR	12	0.001	Ratio	0 to 4
301	0	R EPR Actual-TMC	BNR	12	0.001	Ratio	0 to 4
302	0	L N3 Actual-TMC	BNR	12	0.06	%RPM	0 to 256
303	0	R N3 Actual-TMC	BNR	12	0.06	%RPM	0 to 256
304	0	L N1 Actual-TMC	BNR	12	0.06	%RPM	0 to 256
305	0	R N1 Actual-TMC	BNR	12	0.06	%RPM	0 to 256
306	0	L Fuel Flow-TMC	BNR	12	8.00	Lbs/Hr	0 to 32,768
307	0	R Fuel Flow-TMC	BNR	12	8.00	Lbs/Hr	0 to 32,768
347	1	Engine Fuel Flow-R	BNR	12	8.00	Lbs/Hr	0 to 32,768
	2	Engine Fuel Flow-L	BNR	12	8.00	Lbs/Hr	0 to 32,768
005	1	Engine ID-L	DIS				
	2	Engine ID-R	DIS				
006	0	BITE Status	DIS				
073	1	Engine Oil Quantity-L	BNR	9	0.25	US Pint	0 to 128
	2	Engine Oil Quantity-R	BNR	9	0.25	US Pint	0 to 128
173	1	Hydraulic Oil Quantity-L	BNR	9	0.25	US Pint	0 to 128
	2	Hydraulic Oil Quantity-R	BNR	9	0.25	US Pint	0 to 128
174	1	Hydraulic Oil Pressure-L	BNR	12	25	PSI	0 to 4096
	2	Hydraulic Oil Pressure-R	BNR	12	25	PSI	0 to 4096
316	1	Engine Oil Temperature-L	BNR	12	0.5	Degrees C	0 to 2048
	2	Engine Oil Temperature-R	BNR	12	0.5	Degrees C	0 to 2048
317	1	Engine Oil Pressure-L	BNR	14	0.25	PSI	0 to 4096
	2	Engine Oil Pressure-R	BNR	14	0.25	PSI	0 to 4096
344	1	N1-R	BNR	13	0.03	%RPM	0 to 256
	2	N1-L	BNR	13	0.03	%RPM	0 to 256
345	1	EGT-L	BNR	12	0.5	Degrees C	0 to 2048
	2	EGT-R	BNR	12	0.5	Degrees C	0 to 2048
346	1	N2-R	BNR	13	0.03	%RPM	0 to 256
	2	N2-L	BNR	13	0.03	%RPM	0 to 256

LABEL	SDI	DESCRIPTION	FORMAT	BITS	RES	UNITS	RANGE
347	1	Fuel Flow-L	BNR	12	8	LBS/HR	0 to 32,768
	2	Fuel Flow-R	BNR	12	8	LBS/HR	0 to 32,768
353	1	Vibration-L	BNR	8	0.02	Scalar	0 to 5.12
	2	Vibration-R	BNR	8	0.02	Scalar	0 to 5.12

FQIS Data
Equipment ID : 04D

Label : 241 Tank Unit Data
Decoding : The tank unit data for the FQIS is organized into 21 word strings for each tank. The left, right, or center tanks are indicated by coding of the SDI bits. Various information is transmitted in the string of 32 bit words with the position within the string determining word content, scaling, units, ect. the DATATRAC uses a change of SDI bits or receipt of a complete string to resynch to the beginning of a new word string. Since the string of words share the same label and SDI bits for a given tank, the DATATRAC uses the break mode to capture and present the string. When the user has selected the 04D equipment ID in the receiver setup, performing a manual breakpoint will allow him to observe the series of 241 label words with word sequence numbers attached. Parameters are displayed in engineering units according to the following definitions
Word Definitions :

Bit Definition
- Bits 1-8 = Label Number
- Bit 9-10 = SDI
- Bits 11-16 = PADS
- Bits 17-28 = Data
- Bits 29-31 = SSM
- Bit 32 = Parity

Label Number

Bit	8	7	6	5	4	3	2	1	
	1	0	1	0	0	0	0	1	= 241 (Octal)

SDI

Bit	10	9	
	0	0	= Undefined
	0	1	= Left Tank
	1	0	= Right Tank
	1	1	= Center Tank

PADS

Bit	16	15	14	13	12	11
	0	0	0	0	0	0

Data

Bit	28	27	26	25	24	23	22	21	20	19	18	17
	MSB < - > LSB											

Bit Encoding for Capacitance
- Bit = 12
- Resolution = 0.078
- Range = 0 to 320
- Units = Picofarads

Bit Encoding for Weight

Bit = 3 bit BCD
Resolution = 100
Range= 0 to 11,100
Units = Lbs

Bit Encoding for Fuel Density

Bits = 12
Resolution = 0.00098
Range= 0 to 4
Units = Lbs/Gal

SSM

Bit 31 30 29

0 0 0 = Failure Warning
1 1 1 = Normal Operation

Parity

Bit 32 = Odd

Word Sequence Table

Word Number	SDI	Description	Units
1	1	Tank Unit #1	pF
2	1	Tank Unit #2	pF
3	1	Tank Unit #3	pF
4	1	Tank Unit #4	pF
5	1	Tank Unit #5	pF
6	1	Tank Unit #6	pF
7	1	Tank Unit #7	pF
8	1	Tank Unit #8	pF
9	1	Tank Unit #9	pF
10	1	Tank Unit #10	pF
11	1	Tank Unit #11	pF
12	1	Tank Unit #12	pF
13	1	Tank Unit #13	pF
14	1	Tank Unit #14	pF
15	1	BITE Capacitor	pF
16	1	Compensator	pF
17	1	Load Select	Lbs
18	1	Load Select	Lbs
19	1	Load Select	Lbs
20	1	Undefined	-
21	1	Fuel Density	Lbs/Gal

22	2	Tank Unit #1	pF
23	2	Tank Unit #2	pF
24	2	Tank Unit #3	pF
25	2	Tank Unit #4	pF
26	2	Tank Unit #5	pF
27	2	Tank Unit #6	pF
28	2	Tank Unit #7	pF
29	2	Tank Unit #8	pF
30	2	Tank Unit #9	pF
31	2	Tank Unit #10	pF
32	2	Tank Unit #11	pF
33	2	Tank Unit #12	pF
34	2	Tank Unit #13	pF
35	2	Tank Unit #14	pF
36	2	Compensator	pF
37	2	BITE Capacitor #2	pF
38	2	Load Select	Lbs
39	2	Load Select	Lbs
40	2	Load Select	Lbs
41	2	Undefined	-
42	2	Fuel Density	Lbs/Gal
43	3	Tank Unit #1	pF
44	3	Tank Unit #2	pF
45	3	Tank Unit #3	pF
46	3	Tank Unit #4	pF
47	3	Tank Unit #5	pF
48	3	Tank Unit #6	pF
49	3	Tank Unit #7	pF
50	3	Tank Unit #8	pF
51	3	Tank Unit #9	pF
52	3	Compensator	pF
53	3	BITE Capacitor #3	pF
54	3	Undefined	-
55	3	Undefined	-
56	3	Undefined	-
57	3	Undefined	-
58	3	Undefined	-
59	3	Load Select	Lbs
60	3	Load Select	Lbs
61	3	Load Select	Lbs
62	3	Undefined	-
63	3	Fuel Density	Lbs/Gal

FQIS Data
Equipment ID : 04D

Label : 247 Total Fuel Quantity
Decoding : Bit 20 through 29 displayed as 0-655, 360 Lbs.
Word Definition :

Bits = 14
Resolution = 40
Range = 0 to 655,360
Units =Lbs

FQIS Data
Equipment ID : 04D
Label : 256
Decoding : Bits 17-28 displayed as 0-163,840 Lbs.
Word Definitions :

Bit Definition
- Bits 1-8 = Label Number
- Bit 9-10 = SDI
- Bits 11-16 = FQIS Health Status Bits
- Bits 17-28 = Data
- Bits 29-31 = SSM
- Bit 32 = Parity

Label Number

Bit	8	7	6	5	4	3	2	1	
	1	0	1	0	0	1	1	0	= 241 (Octal)

SDI

Bit	10	9	
	0	0	= Undefined
	0	1	= Left Tank
	1	0	= Right Tank
	1	1	= Center Tank

FQIS Health Status Bits
- Bit 11 = Channel 1 Fault
- Bit 12 = Channel 2 Fault
- Bit 13 = Cross Comparison Fault
- Bit 14 = Left Tank Accuracy
- Bit 15 = Right Tank Accuracy
- Bit 16 = Center Tank Accuracy

Data

Bit	28	27	26	25	24	23	22	21	20	19	18	17
	MSB < - > LSB											

Bit Encoding for Weight
- Bit = 12
- Resolution = 40
- Range = 0 to 163,840
- Units = Lbs

SSM

Bit 31 30 29

0 0 0 = Failure Warning

1 1 0 = Normal Operation

Parity

Bit 32 = Odd

FSEU Data
Equipment ID : F02

Label : 005 Resolver NO. 8 Cos
Label : 006 Resolver NO. 5 Sine
Label : 007 Resolver NO. 5 Cos
Label : 010 Resolver NO. 5 Sine
Label : 011 Resolver NO. 4 Cos
Label : 012 Resolver NO. 4 Sine
Label : 013 Resolver NO. 1 Cos
Label : 014 Resolver NO. 1 Sine
Decoding : Bits 14 through 29 displayed as +/- 48.64 full scale decimal word.
Word Definitions : Example using Resolver No. 8 Cos

32	Always 1	
31	Always 1	
30	Always 1	
29	SIGN BIT	
28	RS8COS	2 ** -1
27	RS8COS	2 ** -2
26	RS8COS	2 ** -3
25	RS8COS	2 ** -4
24	RS8COS	2 ** -5
23	RS8COS	2 ** -6
22	RS8COS	2 ** -7
21	RS8COS	2 ** -8
20	RS8COS	2 ** -9
19	RS8COS	2 ** -10
18	RS8COS	2 ** -11
17	RS8COS	2 ** -12
16	RS8COS	2 ** -13
15	RS8COS	2 ** -14
14	RS8COS	2 ** -15
13	Always 0	
12	Always 0	
11	Always 0	
10	Always 0	
9	Always 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 015 Inboard Slat Position
Label : 016 Inboard Slat Position Side 1
Label : 017 Inboard Slat Position Side 2
Label : 020 Outboard Slat Position
Label : 021 Outboard Slat Position Side 1
Label : 022 Outboard Slat Position Side 2
Label : 023 Flap Lever Position
Label : 024 Flap Lever Position Side 1
Label : 025 Flap Lever Position Side 2
Label : 031 Inboard Slat Magnitude of Dif
Label : 032 Outboard Slat Magnitude of Dif
Label : 050 Flap Lever Position
Label : 051 Flap Lever Position Side 1
Label : 052 Flap Lever Position Side 2
Label : 070 Inboard Slat Position
Label : 071 Inboard Slat Position Side 1
Label : 072 Inboard Slat Position Side 2
Label : 073 Outboard Slat Position
Label : 074 Outboard Slat Position Side 1
Label : 075 Outboard Slat Position Side 2
Decoding : Bits 14 through 29 displayed as +/- 50.47 volt decimal word.
Word Definitions : Example using Inboard Slat Position

32	Always 1	
31	Always 1	
30	Always 1	
29	SIGN BIT	
28	ISLTPS	2 ** -1
27	ISLTPS	2 ** -2
26	ISLTPS	2 ** -3
25	ISLTPS	2 ** -4
24	ISLTPS	2 ** -5
23	ISLTPS	2 ** -6
22	ISLTPS	2 ** -7
21	ISLTPS	2 ** -8
20	ISLTPS	2 ** -9
19	ISLTPS	2 ** -10
18	ISLTPS	2 ** -11
17	ISLTPS	2 ** -12
16	ISLTPS	2 ** -13
15	ISLTPS	2 ** -14
14	ISLTPS	2 ** -15

13	Always 0
12	Always 0
11	Always 0
10	Always 0
9	Always 0
8	LABEL
7	LABEL
6	LABEL
5	LABEL
4	LABEL
3	LABEL
2	LABEL
1	LABEL

FSEU Data
Equipment ID : F02

Label : 026 Flap Position
Label : 053 Flap position
Label : 076 Flap Magnitude of Dif
Label : 077 Flap Magnitude of Dif
Label : 100 Flap Position
Decoding : Bits 14 through 29 displayed as +/- 40.00 volt decimal word.
Word Definitions : Example using Flap Position

32	Always 1	
31	Always 1	
30	Always 1	
29	SIGN BIT	
28	FLAPOS	2 ** -1
27	FLAPOS	2 ** -2
26	FLAPOS	2 ** -3
25	FLAPOS	2 ** -4
24	FLAPOS	2 ** -5
23	FLAPOS	2 ** -6
22	FLAPOS	2 ** -7
21	FLAPOS	2 ** -8
20	FLAPOS	2 ** -9
19	FLAPOS	2 ** -10
18	FLAPOS	2 ** -11
17	FLAPOS	2 ** -12
16	FLAPOS	2 ** -13
15	FLAPOS	2 ** -14
14	FLAPOS	2 ** -15
13	Always 0	
12	Always 0	
11	Always 0	
10	Always 0	
9	Always 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 027
Decoding : Bits 14 through 29 displayed as +/- 10.00 volt decimal word.
Word Definitions :

32	Always 1	
31	Always 1	
30	Always 1	
29	FLVPOS	
28	FLVPOS	2 ** -1
27	FLVPOS	2 ** -2
26	FLVPOS	2 ** -3
25	FLVPOS	2 ** -4
24	FLVPOS	2 ** -5
23	FLVPOS	2 ** -6
22	FLVPOS	2 ** -7
21	FLVPOS	2 ** -8
20	FLVPOS	2 ** -9
19	FLVPOS	2 ** -10
18	FLVPOS	2 ** -11
17	FLVPOS	2 ** -12
16	FLVPOS	2 ** -13
15	FLVPOS	2 ** -14
14	FLVPOS	2 ** -15
13	Always 0	
12	Always 0	
11	Always 0	
10	Always 0	
9	Always 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

BTYE 1 % % % % % % % %
BYTE 2 0 0 0 0 0 0 % %
+10 V = 000H
-10 V = 3FFH

FSEU Data
Equipment ID : F02

Label : 030 Airspeed
Decoding : Bits 16 through 29 displayed as +/- 8192 knot decimal word.
Word Definitions :

32	Always 1	
31	Always 1	
30	Always 1	
29	SIGN BIT	AIRSPEED
28	AIRSPE	2 ** -1
27	AIRSPE	2 ** -2
26	AIRSPE	2 ** -3
25	AIRSPE	2 ** -4
24	AIRSPE	2 ** -5
23	AIRSPE	2 ** -6
22	AIRSPE	2 ** -7
21	AIRSPE	2 ** -8
20	AIRSPE	2 ** -9
19	AIRSPE	2 ** -10
18	AIRSPE	2 ** -11
17	AIRSPE	2 ** -12
16	AIRSPE	2 ** -13
15	AIRSPE	2 ** -14
14	AIRSPE	2 ** -15
13	Always 0	
12	Always 0	
11	Always 0	
10	Always 0	
9	Always 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 033
Decoding : Data field displayed in binary format.
Word Definitions :

32	(PARITY)	Always 1
31	(ALTFCY)	ALTN FLAP CYCLED
30	(ALTSCY)	ALTN SLAT CYCLED
29	(BUCMSH)	BASIC UCM SHUTDOWN
28	(COSTRT)	COLD START
27	(FLELNM)	FLAP & LEVER AGREE & LEVER HASN'T MOVED
26	(FPASSH)	FLAP ASYM SHUTDOWN
25	(FPASY)	FLAP ASYM
24	(FPUCSH)	FLAP DISAGREE WITH LEVER IN DETENT
23	(FPUCSH)	FLAP UCD SHUTDOWN
22	(FSIN60)	FSPM IN BITE 60
21	(INASH)	INBD ASYM SHUTDOWN
20	(INLETO)	INBD LET T/O
19	(INBMOT)	INBD MOTION
18	(INUCSH)	INBD UCM SHUTDOWN
17	(LAFPAS)	LATCHED FLAP ASYM
16	(LINASY)	LATCHED INBD ASYM
15	(LALFP5)	LATCHED LAST FLAP AGREE AT 5
14	(LONASY)	LATCHED OUTBD ASYM SHUTDOWN
13	(OUTASH)	OUTBD ASYM SHUTDOWN
12	Always 0	
11	Always 0	
10	Always 0	
9	Always 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 034
Decoding : Data field displayed in binary format.
Word Definitions :

32	(PARITY)	Always 1
31	(BADFLV)	FLRVDT FAIL
30	(BADISL)	ISRVDT FAIL
29	(BADOSL)	OSRVDT FAIL
28	(OULETO)	OUTBD LE T/O
27	(OUTMOT)	OUTBD MOTION
26	(OUUCSH)	OUTBD UCM SHUTDOWN
25	(QFPSH)	QUICK FLAP UCM SHUTDOWN
24	(SLISH)	SLAT INTERLOCK SHUTOFF
23	(SWATCH)	400HZ INTERRUPT FLAG
22	(FPRET)	FLAP RETRACTING
21	(FPEXT)	FLAP EXTENDTIN
20	(FLPMOT)	FLAP MOTION
19	(BACFLT)	BACKGROUND FAULT
18	ZERO	(NOT USED)
17	(R8FAIL)	RESOLVER 8 FAIL
16	(R5FAIL)	RESOLVER 5 FAIL
15	(R4FAIL)	RESOLVER 4 FAIL
14	(R1FAIL)	RESOLVER 1 FAIL
13	ZERO	(NOT USED)
12	Always 0	
11	Always 0	
10	Always 0	
9	Always 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 035
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		PORT OD IMAGE
29	(OUTDS2)	FSEU GOOD/LRUS BAD
28	(OUTDS2)	SLAT ASYM INDICATION
27	(OUTDS2)	FLAP ASYM INDICATION
26	(OUTDS2)	DON'T CARE
25	(OUTDS2)	SLAT ISLNVAL
24	(OUTDS2)	RVDT RIG CHECK ENABLE
23	(OUTDS2)	OUTBD BYPASS IN NORM
22	(OUTDS2)	INBD BYPASS IN NORM
		PORT OC IMAGE
21	(OUTDS1)	FLAP BYPASS IN NORM
20	(OUTDS1)	LOAD RELIEF
19	(OUTDS1)	OUTBD UCM/ASYM SHUTDOWN
18	(OUTDS1)	INBD UCM/ASYM SHUTDOWN
17	(OUTDS1)	FLAP UCM/ASYM SHUTDOWN
16	(OUTDS1)	SLAT SHUTOFF
15	(OUTDS1)	FLAP SHUTOFF
14	(OUTDS1)	DISCRETE INPUT BITE TEST
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 036
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		DISCRETE INPUT PORT 1 REPLICA
29	(INDSC1)	ALTN POS SEL SW IN LDG
28	(INDSC1)	ALTN POS SEL SW IN T/O
27	(INDSC1)	ALTN POS SEL SW IN RET
26	(INDSC1)	OUTBD ASYM
25	(INDSC1)	INBD ASYM
24	(INDSC1)	ALTN FLAP
23	(INDSC1)	C FSPM BITE
22	(INDSC1)	ALTN SLAT *
		PORT 26 IMAGE
21	(OUTDS3)	BITE 1 IN PROGRESS
20	(OUTDS3)	SLAT DISAGREE INHIBIT
19	(OUTDS3)	SECTION 1 GOOD
18	(OUTDS3)	C FSPM BITE LIGHT
17	(OUTDS3)	OUTBD RETRACTING
16	(OUTDS3)	OUTBD EXTENDING
15	(OUTDS3)	INBD RETRACTING
14	(OUTDS3)	INBD EXTENDING
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 037
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		FLAP DETENT
29	(FLPDET)	NID
28	(FLPDET)	30
27	(FLPDET)	25
26	(FLPDET)	20
25	(FLPDET)	15
24	(FLPDET)	5
23	(FLPDET)	RETRACTED
22	(FLPDET)	RETRACTED
		FLAP LEVER DETENT
21	(FLVDET)	NID
20	(FLVDET)	30
19	(FLVDET)	25
18	(FLVDET)	20
17	(FLVDET)	15
16	(FLVDET)	5
15	(FLVDET)	1
14	(FLVDET)	0
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 040
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		INBD FLAP DETENT
29	(ISLDET)	NID
28	(ISLDET)	30
27	(ISLDET)	25
26	(ISLDET)	20
25	(ISLDET)	15
24	(ISLDET)	5
23	(ISLDET)	RETRACTED
22	(ISLDET)	RETRACTED
		OUTBE SLAT DETENT
21	(OSLDET)	NID
20	(OSLDET)	LAND
19	(OSLDET)	LAND
18	(OSLDET)	T/O
17	(OSLDET)	T/O
16	(OSLDET)	T/O
15	(OSLDET)	T/O
14	(OSLDET)	RETRACTED
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 041
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		DISCRETE INPUT PORT 2
29	(INDSC2)	SPARE
28	(INDSC2)	SPARE
27	(INDSC2)	BIT/VERIFY CROSSFEED
26	(INDSC2)	PRESS TEST
25	(INDSC2)	SPARE
24	(INDSC2)	-300ER TPYR (*1 + ER -)
23	(INDSC2)	-300ER
22	(INDSC2)	-300
		FSEU BITE WORD
21	(FSEUBT)	FSEU GOOD (-“ + 80 *)
20	(FSEUBT)	DON’T CARE
19	(FSEUBT)	POWER SUPPLY/MUX FAULT
18	(FSEUBT)	DON’T CARE
17	(FSEUBT)	BIT/VERIFY CROSSFEED
16	(FSEUBT)	RAM FAULT
15	(FSEUBT)	INPUT FAULT
14	(FSEUBT)	OUTPUT FAULT
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 054
Decoding : Data field displayed in binary format.
Word Definitions :

32	(PARITY)	ALWAYS 1
31	(TESTS)	TESTING S
30	(SWATCH)	400Z INTERRUPT FLAG
29	(SLMOIQ)	SLAT MOVING INHITIB Q
28	(PFMVTW)	PRIMARY FLAP MOVING TOWARD
27	(PFMVTW)	PRIMARY FLAP DISAGREE INDICATION
26	(INTBIT)	INTERRUPT-FLIP FLOP STATUS
25	(FSVAL)	FSPM VALID
24	(FSIN60)	FSPM BITE IN 60
23	(FSFAIL)	FSPM FAIL
22	(FSBITE)	FSPM BITE
21	(FPLTS)	FLAP LT 5
20	(FLPSMO)	FLAP SLOW/FAST MOTION
19	(FLPSDI)	FLAP SLOW/FAST DIRECTION
18	(COSTRT)	COLD START
17	(BACFLT)	BACKGROUND FAULT
16	(ENABQ)	ENABLE Q
15	(DISFIG)	FLAP DISAGREE FLAG
14	(BADFLV)	BAD FLAP LEVER RVDT FLAG
13	(ALTDET)	ALTERNATE IN DETENT
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 055
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		PORT OD IMAGE
29	(OUTDS2)	FLAP LEVER NOT IN RETRACT
28	(OUTDS2)	DON'T CARE
27	(OUTDS2)	DON'T CARE
26	(OUTDS2)	DON'T CARE
25	(OUTDS2)	SLAT LIGHT
24	(OUTDS2)	LOAD RELIEF INOP
23	(OUTDS2)	FLAP DISAGREE
22	(OUTDS2)	BIT/VERIFY CROSSFEED
		PORT OC IMAGE
21	(OUTDS1)	SLATS COMMAMD TO LAND
20	(OUTDS1)	SLATS COMMAND TO T/O
19	(OUTDS1)	SLATS COMMAND TO RETRACT
18	(OUTDS1)	FLAP LIGHT
17	(OUTDS1)	FLAP DISAGREEMENT LIGHT
16	(OUTDS1)	LE SLAT DISAGREE
15	(OUTDS1)	SECTION 2 GOOD
14	(OUTDS1)	DISCRETE INPUT BITE TEST
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 056
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		DISCRETE INPUT PORT 1 REPLICA
29	(INDSC1)	INBD OR OUTBD SLAT LT T/O
28	(INDSC1)	FLAP ASYMMETRY
27	(INDSC1)	SLAT ASYMMETRY
26	(INDSC1)	BITE 3 IN PROGRESS
25	(INDSC1)	SLAT DISAGREE INHIBIT
24	(INDSC1)	FSPM BITE
23	(INDSC1)	SLAT/FLAP LEVER DISAGREE *
22	(INDSC1)	BITE 1 IN PROGRESS
		DISCRETE INPUT PORT 2 REPLICA
21	(INDSC2)	SPARE
20	(INDSC2)	SPARE
19	(INDSC2)	BIT/VERIFY
18	(INDSC2)	PRESS TEST
17	(INDSC2)	SECTION 3 FSEU GOOD/LRUS BAD
16	(INDSC2)	SECTION 1 FSEU GOOD/LRUS BAD
15	(INDSC2)	-300
14	(INDSC2)	LOAF RELIEF
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 057
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		DISCRETE INPUT PORT 3 REPLICA
29	(INDSC3)	SPARE
28	(INDSC3)	SPARE
27	(INDSC3)	ALT FLAP SW IN 25
26	(INDSC3)	ALT FLAP SW IN 20
25	(INDSC3)	ALT FLAP SW IN 15
24	(INDSC3)	ALT FLAP SW IN 25
23	(INDSC3)	ALT FLAP SW IN 1
22	(INDSC3)	ALT FLAP SW IN UP
		DISCRETE INPUT PORT 4 REPLICA
21	(INDSC4)	SPARE
20	(INDSC4)	SPARE
19	(INDSC4)	SPARE
18	(INDSC4)	SPARE
17	(INDSC4)	-300ER
16	(INDSC4)	SLAT ALT ARM *
15	(INDSC4)	FLAP ALT ARM
14	(INDSC4)	ALT FLAP SW IN 30
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

* INDICATES BIT INVERTED

FSEU Data
Equipment ID : F02

Label : 060
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		FLAP LEVER DETENT WORD
29	(FLVDET)	NOT IN DETENT
28	(FLVDET)	DETENT 30
27	(FLVDET)	DETENT 25
26	(FLVDET)	DETENT 20
25	(FLVDET)	DETENT 15
24	(FLVDET)	DETENT 5
23	(FLVDET)	DETENT 1
22	(FLVDET)	DETENT 0
		FLAP DETENT
21	(FLPDET)	NOT IN DETENT
20	(FLPDET)	DETENT 30
19	(FLPDET)	DETENT 25
18	(FLPDET)	DETENT 20
17	(FLPDET)	DETENT 15
16	(FLPDET)	DETENT 5
15	(FLPDET)	RET
14	(FLPDET)	RET
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 061
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		FSEU BITE STATUS WORD
29	(FSEUBT)	FSEU GOOD (“GOOD” = 80)
28	(FSEUBT)	DON’T CARE
27	(FSEUBT)	POWER SUPPLY/MUX FAULT
26	(FSEUBT)	DON’T CARE
25	(FSEUBT)	DON’T CARE
24	(FSEUBT)	RAM FAULT
23	(FSEUBT)	INPUT FAULT
22	(FSEUBT)	OUTPUT FAULT
		PORT 23 IMAGE
21	(PT23WD)	SPARE
20	(PT23WD)	L FSPM BITE LIGHT
19	(PT23WD)	TESTING BITE LIGHT
18	(PT23WD)	XMNTR1 BITE LIGHT
17	(PT23WD)	TEST GOOD BITE LIGHT
16	(PT23WD)	FSUE FAIL BITE LIGHT
15	(PT23WD)	INTERRUPT POLARITY
14	(PT23WD)	SAMPLE AND HOLD
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 101
Decoding : Data field displayed in binary format.
Word Definitions :

32	(PARITY)	ALWAYS 1
31	(OSLMOT)	OUTBD SLAT MOTION
30	(OSLDIR)	OUTBD SLAT DIRECTION
29	(ISLMOT)	INBD SLAT MOTION
28	(ISLDIR)	INBD SLAT DIRECTION
27	(FSIN60)	FSPM IN BITE 60
26	(FSBITE)	FSPM BITE BOOLEAN
25	(FLPSMO)	FLAP SLOW MOTION
24	(FLPSDI)	FLAP SLOW DIRECTION
23	(FLPFMO)	FLAP FAST MOTION
22	(FFLPFDI)	FLAP FAST DIRECTION
21	(BADOSL)	BAD OUTBD SLAT RVDT FLAG
20	(BADISL)	BAD INBD SLAT RVDT FLAG
19	(BACFLT)	BACKGROUND FAULT
18	(COSTRT)	COLD START
17	ZERO	(* NOT USED *)
16	ZERO	(* NOT USED *)
15	ZERO	(* NOT USED *)
14	ZERO	(* NOT USED *)
13	ZERO	(* NOT USED *)
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 102
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		PORT OC IMAGE
29	(OUTDS1)	FSEU 3 GOOD/LRUS BAD
28	(OUTDS1)	OUTBD SLAT ALT RET ENABLE
27	(OUTDS1)	OUTBD SLAT ALT EXT ENABLE
26	(OUTDS1)	INBD SLAT ALT RET ENABLE
25	(OUTDS1)	INBD SLAT ALT EXT ENABLE
24	(OUTDS1)	TE FLAP ALT RET ENABLE
23	(OUTDS1)	TO FLAP ALT EXT ENABLE
22	(OUTDS1)	DISCRETE INPUT BITE TEST PULSE
		PORT OD IMAGE
21	(OUTDS2)	FSEU 3 IND INHIBIT
20	(OUTDS2)	BITE 3 IN PROGRESS
19	(OUTDS2)	SLATS LT T/O
18	(OUTDS2)	FLAP POS IND REF TX SELECT
17	(OUTDS2)	OUTBD SLATS RET
16	(OUTDS2)	OUTBD SLATS EXT
15	(OUTDS2)	INBD SLATS RET
14	(OUTDS2)	INBD SLATS EXT
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 103
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		DISCRETE INPUT PORT 1 REPLICA
29	(INDSC1)	ALT FLAP SW = 30
28	(INDSC1)	ALT FLAP SW = 25
27	(INDSC1)	ALT FLAP SW = 20
26	(INDSC1)	ALT FLAP SW = 15
25	(INDSC1)	ALT FLAP SW = 5
24	(INDSC1)	ALT FLAP SW = 10
23	(INDSC1)	ALT FLAP SW = UP
22	(INDSC1)	ALT FLAP SW = NORMAL
		DISCRETE INPUT PORT 2 REPLICA
21	(INDSC2)	DON'T CARE
20	(INDSC2)	DON'T CARE
19	(INDSC2)	BIT/VERIFY CROSSFEED
18	(INDSC2)	PRESS TEST
17	(INDSC2)	RVDT RIG CHECK ENABLE
16	(INDSC2)	SECTION 2 GOOD
15	(INDSC2)	SECTION 1 GOOD
14	(INDSC2)	FSPM BITE
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 104
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		FSEU BITE STATUS WORD
29	(FSEUBT)	FSEU GOOD (* “GOOD” = 80 *)
28	(FSEUBT)	DON’T CARE
27	(FSEUBT)	POWER SUPPLY/MUX FAULT
26	(FSEUBT)	DON’T CARE
25	(FSEUBT)	FSEU FAULT
24	(FSEUBT)	RAM FAULT
23	(FSEUBT)	INPUT FAULT
22	(FSEUBT)	OUTPUT FAULT
		DISCRETE INPUT PORT 3 REPLICA
21	(INDSC3)	SPARE
20	(INDSC3)	SPARE
19	(INDSC3)	SPARE
18	(INDSC3)	SPARE
17	(INDSC3)	SPARE
16	(INDSC3)	SPARE
15	(INDSC3)	-300ER
14	(INDSC3)	-300
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 105
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		FLAP DETENT
29	(FLPDET)	NOT IN DETENT
28	(FLPDET)	DETENT 30
27	(FLPDET)	DETENT 25
26	(FLPDET)	DETENT 20
25	(FLPDET)	DETENT 15
24	(FLPDET)	DETENT 5
23	(FLPDET)	DETENT 1
22	(FLPDET)	DETENT 0
		PORT 23 STATUS WORD
21	(PT23WD)	SPARE
20	(PT23WD)	SPARE
19	(PT23WD)	OUTBD SLAT RVDT MISRIG BITE LIGHT
18	(PT23WD)	R FSPM BITE LIGHT
17	(PT23WD)	OUTBD SLAT RVDT BITE LIGHT
16	(PT23WD)	INBD SLAT RVDT BITE LIGHT
15	(PT23WD)	INTERRUPT POLARITY
14	(PT23WD)	SAMPLE AND HOLD
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

FSEU Data
Equipment ID : F02

Label : 106
Decoding : Data field displayed in binary format.
Word Definitions :

32	ALWAYS 1	
31	ALWAYS 1	
30	ALWAYS 1	
		INBOARD SLAT DETENT
29	(ISLDET)	NOT IN DETENT
28	(ISLDET)	DETENT 30
27	(ISLDET)	DETENT 25
26	(ISLDET)	DETENT 20
25	(ISLDET)	DETENT 15
24	(ISLDET)	DETENT 5
23	(ISLDET)	DETENT 1
22	(ISLDET)	DETENT 0
		OUTBOARD SLAT DETENT
21	(OSLDET)	NOT IN DETENT
20	(OSLDET)	LAND
19	(OSLDET)	LAND
18	(OSLDET)	T/O
17	(OSLDET)	T/O
16	(OSLDET)	T/O
15	(OSLDET)	T/O
14	(OSLDET)	RETRACT
13	ALWAYS 0	
12	ALWAYS 0	
11	ALWAYS 0	
10	ALWAYS 0	
9	ALWAYS 0	
8	LABEL	
7	LABEL	
6	LABEL	
5	LABEL	
4	LABEL	
3	LABEL	
2	LABEL	
1	LABEL	

APPENDIX E

MODE-S TRANSPONDER
350 MAINTENANCE WORD
&
SELF-TEST FAULT CODE DEFINITIONS

TABLE E-1

MODE-S TRANSPONDER
350 MAINTENANCE WORD DISPLAY

Data : 80 00 00 Fault Code : 00

Bit	Status	Function
11	0:OK	Transponder Fail
12	0:OK	RAM Error
13	0:OK	ROM Error
14	0:OK	Serial Control Port B Fail
15	0:OK	Serial Control Port A Fail
16	0:OK	Serial Control Port C Fail
FC:	No Failure	
25	0:OK	Serial Altitude Port A Fail
26	0:OK	Serial Altitude Port B Fail
27	0:OK	Serial ADLP Bus Failure
28	0:OK	Serial TCAS Bus Failure

Press ENT to save screen : 000

TABLE E-2

SELF-TEST FAULT CODE DEFINITIONS

PRIMARY FAULT CODE	SEC FAULT CODE	FAULT DESCRIPTION (REF. SECTION)	DIAG. WORD SSM	FAIL/ WARN ACTIVE	TRANS PONDER INHIBIT
00		NO FAILURE	1 1	NO	NO
10		POWER SUPPLY FAILURE	{1}	NO	NO
	11	+5 VDC. FAILURE	0 0	YES	YES
	12	+70 VDC. TRANSMITTER POWER FAILURE	1 1	NO	NO
	13	+35 VDC. TRANSMITTER POWER FAILURE	1 1	NO	NO
	14	LVPS FAILURE (OTHER THAN 5 VDC.)	1 1	NO	NO
	15-1F	NOT ASSIGNED	1 1	N/A	N/A
20		TRANSMITTER/MODULATOR FAILURE (3.7.1.2.0.0)	{2}		
	21	FINAL STAGE OVER-CURRENT FAILURE (3TIMES)	0 0	YES	YES
	22	TOP ANTENNA LOW POWER OUTPUT FAILURE	1 1	NO	NO
	23	BOTTOM ANTENNA LOW PWR OUTPUT FAILRUE	1 1	NO	NO
	24	TRANSMITTER OVERTEMP FAILURE	1 1	NO	NO
	25-2F	NOT ASSIGNED	1 1	N/A	N/A
30		SYNTHESIZER FAILURE (3.7.1.3.0.0)	1 1	NO	NO
	31	SYNTH. LOCK DETENT FAIL	1 1	NO	NO
	32	SYNTH. LOW POWER DETENT FAILURE	1 1	NO	NO
	33-3F	NOT ASSIGNED	1 1	N/A	N/A
40		RECEIVER/IF FAILURE (3.7.1.4.0.0)	1 1	NO	NO
	41	TOP RECEIVER CHANNEL FAILURE	1 1	NO	NO
	42	BOTTOM CHANNEL RECEIVER FAILURE	1 1	NO	NO
	43	DPSK DEMODULATOR FAIL. (TOP CHANNEL)	1 1	NO	NO
	44	DPSK DEMODULATOR FAIL. (BOTTOM CHANNEL)	1 1	NO	NO
	45-4F	NOT ASSIGNED	1 1	N/A	N/A
50		PROGRAM MEMORY (ROM) FAILURE (3.7.1.5.0.0)	0	YES	YES
	51	HIGH-BYTE ROM FAILURE	0 0	YES	YES
	52	LOW-BYTE ROM FAILURE	0 0	YES	YES

PRIMARY FAULT CODE	SEC FAULT CODE	FAULT DESCRIPTION (REF. SECTION)	DIAG. WORD SSM	FAIL/ WARN ACTIVE	TRANS PONDER INHIBIT
	53	BOTH ROM CHIPS FAILED	0 0	YES	YES
	54-5F	NOT ASSIGNED	1 1	N/A	N/A
60		VOLATILE MEMORY (RAM) FAILURE (3.7.1.6.0.0)	0 0	YES	YES
	61	HIGH-BYTE RAM FAILURE	0 0	YES	YES
	62	LOW-BYTE RAM FAILURE	0 0	YES	YES
	63	BOTH RAM CHIPS FAILED	0 0	YES	YES
	64	CACHE RAM FAILURE	0 0	YES	YES
	65	CACHE RAM AND HIGH-BTYE RAM FAILURE	0 0	YES	YES
	66	CACHE RAM AND LOW-BYTE RAM FAILURE	0 0	YES	YES
	67	CACHE RAM AND BOTH RAM CHIP FAILURE	0 0	YES	YES
	68	DUAL PORT RAM FAILURE	0 0	YES	YES
	69-9F	NOT ASSIGNED	1 1	N/A	N/A
70		NONVOLATILE MEM (NVRAM) BOTTOM ANTENNA LOW PWR FAILURE (3.7.1.7.0.0	1 1	NO	NO
	71-7F	NOT ASSIGNED	1 1	N/A	N/A
80		SERIAL INPUT CNTRL. BUS FAILURE (3.7.1.8.0.0)	11/01{3}	NO	YES
	81	ARINC-429 CONTROL INPUT UART FAILURE	11/01{3}	NO	YES
	82	ARINC-429 CONTRL. PORT B INACTIVE	11/01{3}	NO	YES
	84	ARINC-429 CNTRL. PORT C INACTIVE	11/01{3}	NO	YES
	85	CSDB CNTRL INPUT INACT.	11/01{3}	NO	YES
	86-8F	NOT ASSIGNED	11	N/A	N/A
90		SERIAL ALTITUDE INPUT FAILURE (3.7.1.9.0.0)	1 1	NO	NO
	91	ARINC-429/575 ALTITUDE INPUT UART FAILURE	1 1	NO	NO
	92	ARINC-429/575 INPUT PORT A INACTIVE	1 1	NO	NO
	93	ARINC-429/575 INPUT PORT B INACTIVE	1 1	NO	NO
	94	CSDB ALTITUDE INPUT PORT B INACTIVE	1 1	NO	NO
	95	CSDB ALTITUDE INPUT PORT B INACTIVE	1 1	NO	NO
	96-9F	NOT ASSIGNED	1 1	N/A	N/A

PRIMARY FAULT CODE	SEC FAULT CODE	FAULT DESCRIPTION (REF. SECTION)	DIAG. WORD SSM	FAIL/ WARN ACTIVE	TRANS PONDER INHIBIT
A0		ADLP COMM. FAIL. (3.7.1.11.0.0)	1 1	NO	NO
	A1	ADLP COMM. A/B UART FAIL	1 1	NO	NO
	A2	ADLP COMM. A/B BUS INACTIVE	1 1	NO	NO
	A3	ADLP COMM. C/D UART FAILURE	1 1	NO	NO
	A4	ADLP COMM. A/B BUS INACTIVE	1 1	NO	NO
	A5-5F	NOT ASSIGNED	1 1	N/A	N/A
B0		TCAS COMMUNICATION FAILURE (3.7.1.11.0.0)	1 1	NO	NO
	B1	TCAS UART FAILURE	1 1	NO	NO
	B2	TCAS UART FAILURE	1 1	NO	NO
	B3	TCAS BUS INACTIVE	1 1	NO	NO
	B4	TCAS PROTOCOL ERROR	1 1 {6}	NO {6}	NO
	B5-BF	NOT ASSIGNED	1 1	N/A	N/A
C0		SQUITTER FAILURE (3.7.1.12.0.0)	0 0	YES	NO
	C1	TOP CHANNEL SQUITTER FAILURE	0 0	YES	NO
	C2	BOTTOM CHANNEL SQUITTER FAILURE	0 0	YES	NO
	C3-CF	NOT ASSIGNED	1 1	N/A	N/A
D0		DIVERSITY FAILURE (3.7.1.13.0.0)	0 0	YES	NO
	D1-DF	NOT ASSIGNED			
E0		MESSAGE PROCESSOR FAILURE	1 1	NO	NO
	E1	TOP CHANNEL MESSAGE PRO-CESSOR FAILURE	1 1	NO	NO
	E2	BOTTOM CHANNEL MESSAGE PROCESSOR FAILURE	1 1	NO	NO
	E3	TOP CHANNEL HARD MESSAGE PROCESSOR FAILURE	0 0	YES	YES
	E4	BOTTOM CHANNEL HARD MES-SAGE PROCESSOR FAILURE	0 0	YES	YES
	E5-EF	NOT ASSIGNED	1 1	N/A	N/A
F0		CONFIGURATION (3.7.1.13.0.0)	1 1	NO	NO
	F1	MODE-S DISCRETE ADDRESS CHANGED	1 1	NO	NO
	F2	TCAS SELECTION CHANGED	1 1	NO	NO
	F3	ALTITUDE UNITS SELECTION CHANGED	1 1	NO	NO

PRIMARY FAULT CODE	SEC FAULT CODE	FAULT DESCRIPTION (REF. SECTION)	DIAG. WORD SSM	FAIL/ WARN ACTIVE	TRANS PONDER INHIBIT
	F4	MAX AIRSPEED PROGRAM SELECTS CHANGED	1 1	NO	NO
	F5	PORT SELECTS CHANGED	1 1	NO	NO
	F6	SDI SELECTS CHANGED	1 1	NO	NO
	F7	SINGLE ANTENNA SELECTION CHANGED	1 1	NO	NO
	F8	ADLP SELECTION CHANGED	1 1	NO	NO
	F9-FE	NOT ASSIGNED	1 1	N/A	N/A
	FF	UNACCEPTABLE MODE-S ADDRESS	0 0 {4}	YES {4}	YES
	F3	ALTITUDE UNITS SELECTION CHANGED	1 1	NO	NO

NOTE: (1) FOR POWER SUPPLY FAILURE THE “SSM” IS SET TO :00”, THE “FAIL WARN” SET TO ACTIVE, AND THE TRANSPONDER OPERATION INHIBITED ONLY IF A +5 VDC POWER SUPPLY FAILURE IS DETECTED.

(2) FOR TRANSMITTER/MODULATOR FAILURE, THE “SSM” IS SET TO “00”. THE “FAIL WARN” SET TO ACTIVE, AND THE TRANSPONDER OPERATION INHIBITED ONLY IF A FINAL STAGE OVER-CURRENT FAILURE IS DETECTED.

(3) FOR SERIAL INPUT CONTROL FAILURE, THE “SSM” IS SET TO “01”. THE “FAIL WARN” SET TO INACTIVE, AND THE TRANSPONDER PLACED IN THE “STANDBY” MODE ONLY IF THE CONTROL BUS FAILURE IS DETECTED ON THE SELECTED CONTROL BUS.

APPENDIX F
DATATRAC 400/400H
WILLIAMSBURG PROTOCOL ANALYZER

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION.

The Williamsburg protocol analyzer feature on the DATATRAC 400/400H is an optional software module that is incorporated into the standard software package for the DATATRAC 400/400H. It provides full capability for interfacing to devices utilizing the new file transfer protocol presented in the ARINC 429 Version 12 specification. The protocol defines the transfer of data from one unit, termed "source," to another unit receiving the data, termed "sink." The role of source and sink can be exchanged between the two interconnected units. The devices communicate over two serial, unidirectional, ARINC 429 type busses. When two devices (Unit 1 and Unit 2) are interconnected, one ARINC 429 channel is dedicated to commands, responses and data being transmitted from Unit 1 to Unit 2. The second channel is dedicated to messages transmitted from Unit 2 to Unit 1.

The reader is referred to the ARINC 429 Version 12 Specification Document Section 2.5 and Attachments 10, 11, 11A, 11B, 11C, and 12 for a complete description of the Williamsburg protocol for file transfer. This document assumes a general knowledge of the information presented in those pages.

The protocol analyzer function in the DATATRAC 400/400H allows it to be used as an active device on the bus, as well as a bus monitor. The latter mode consists of the DATATRAC acting as a passive listener to a dialogue between two devices. For operating the unit as an interactive device on the bus, the user an either define their own response file or have the DATATRAC respond automatically to messages from a device acting as a source.

Entire dialogues can be stored in memory for later review or can be downloaded in real-time on the RS232 port. There is also the capability of downloading the memory buffer on the RS232 port after an acquisition has been recorded. The review of a recorded dialogue is similar to the DATATRAC 400/400H's Break History Data Review. The dialogue review presents the data in a variety of formats and highlights any violations of the protocol pacification.

If desired, the user can program the various parameters that control the file transfer timing and error handling. The analyzer provides trigger-on-error and trigger-on-data filtering for capturing error and specific data conditions during file transfers.

A very useful feature provided is the planned-response file assembly and edit. This utility allows the user to extract the messages received on one of the channels from a previously recorded dialogue for creating a planned-response file for a future transfer. The operator can then edit this file to insert error conditions or modify data to stimulate the device under test.

As in the BITE mode, when the protocol analyzer mode is entered, any label previously set up in the transmit edit mode will continue to be transmitted. This feature is required by some equipment as a "keep alive" signal for proper operation.

The following sections describe the details of operating the DATATRAC 400/400H protocol analyzer beginning with the setup menu.

2. SETUP MENU SELECTIONS.

The Setup Menu for the protocol analyzer is accessed from the DATATRAC 400/400H's Main Menu. By pressing ‘F' then 'ENT', the unit will display the screen shown in Figure 1.

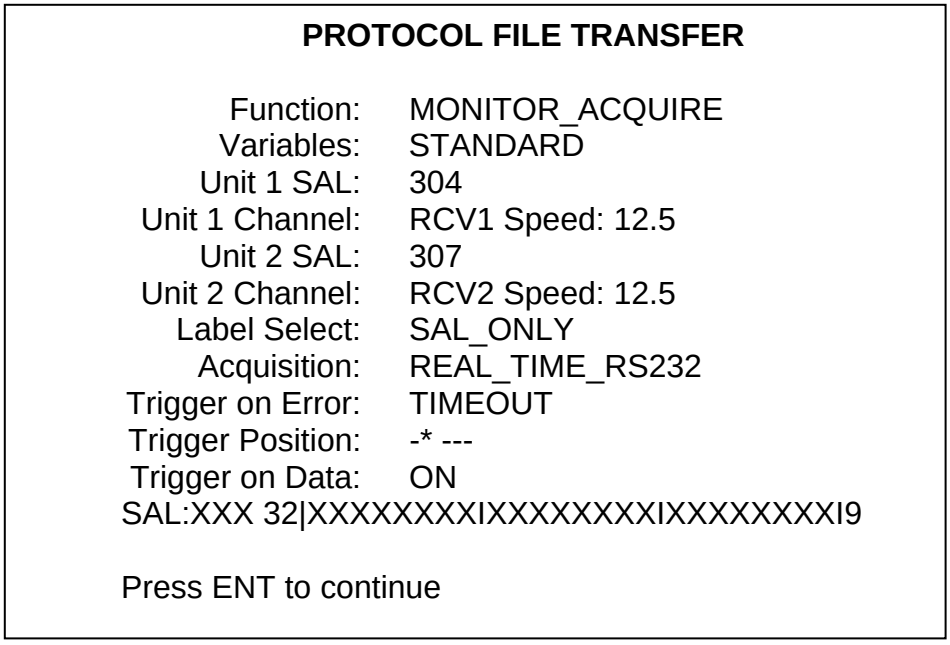


Figure 1. Protocol File Transfer Main Setup Screen.

The cursor can be positioned at the different setup fields by using the up and down cursor keys. The right-arrow key is used to cycle through the discrete values of each parameter. The meaning and possible values of each parameter are given below:

Function. This parameter sets the operating mode of the analyzer. The selections available are:

MONITOR _ ACQUIRE -- The DATATRAC-400 acts as passive listener on busses.
AUTO _ RESPONSE -- The DATATRAC-400 acts as a sink, responding automatically according to protocol.
PLANNED _ RESPONSE -- The DATATRAC utilizes a previously defined planned-response file to communicate with an external unit.
DEFINE _ RESPONSE -- Invokes a menu for assembling and editing the planned response files.

EDIT _ VARIABLES -- Accesses the screen that permits editing the protocol repeat-count and timing parameters.
RS232 _ DOWNLOAD -- Requests download of memory buffer on serial port.
REVIEW - DIALOGUE -- Permits viewing of a previous dialogue acquisition.

The functions above are invoked by pressing the ENT key after the desired selection is made. Sections 3 through 7 present the details of each function available.

Variables. This parameter selects which list of protocol variables to reference when performing an acquisition. The protocol variables define the communication timing and error handling. The selections are:

STANDARD -- The default timing and repeat counts are referenced. These are the values given in the ARINC 429-12 specification. See Section 5 for a list of the default values.
CUSTOM -- The timing and repeat count variables shown in the Edit-Variables screen are referenced.

Section 5 explains each variable and the usage of STANDARD and CUSTOM.

Unit 1 SAL. This is the Source Address Label corresponding to Unit 1.

Unit I Channel and Speed. This parameter selects which DATATRAC 400/400H channel is to receive messages from Unit 1 and its corresponding bus speed of 12.5 or 100 KHz.

Unit 2 SAL. This is the Source Address Label corresponding to Unit 2. When the function selected is one of the response modes (i.e., AUTO _ RESPONSE or PLANNED _ RESPONSE), then Unit 2 corresponds to the DATATRAC's transmit channel for outgoing messages.

Unit 2 Channel and Speed. This parameter selects which DATATRAC 400/400H channel is to receive messages from Unit 2 (if in monitor mode) or transmit messages to an external unit (if in one of the response modes).

Label Select. Allows the user to select whether all incoming labels are to be saved or only the file SAL (source address label) words are to be saved. The choices are presented as ALL or SAL _ ONLY, respectively.

Acquisition. There are two possible methods of acquiring a dialogue using the DATATRAC 400/400H. This parameter controls the destination of the data acquired. The choices are:

SAVE _ TO _ MEMORY -- All data acquired is buffered in memory for later review on the DATATRAC 400/400H.

REAL-TIME _ RS232 -- Similar to the real-time download of received data, this acquisition mode dumps all the dialogue information to the RS232 port. Since the data is not buffered, it cannot be reviewed later on the DATATRAC.

Trigger on Error. Selects which type of protocol error to trigger on for acquiring data. The choices are:

OFF -- The Trigger-on-Error utility is disabled.
PARITY -- Trigger on an even parity condition.
INVALID -- Trigger on an unexpected or illegal word.
TIMEOUT -- Trigger when the corresponding timing constraint value (in the list of protocol variables) is exceeded.
REPEAT -- Trigger when the corresponding repeat count (in the list of protocol variables) is exceeded.
COUNT -- Trigger when the count specified in the RTS word is found to be incorrect.
CRC -- Trigger if the cyclic redundancy check (CRC) value given in the EOT word is incorrect.
ANY -- Trigger if any of the above conditions are encountered.

Trigger Position. This parameter specifies where in memory the trigger event will be located. Five positions are available from the beginning of the acquisition to the end. This position is referenced for both error triggers and data triggers.

Trigger on Data. This parameter enables or disables the trigger-on-data utility. The choices are OFF/ON. When ON, the DATATRAC 400/400H will trigger an acquisition if the data condition is met. The condition is specified in the next line as an SAL in octal and a data field in binary 0's, 1's and X's (don't cares). The 'D' key is used to enter a don't care bit.

3. PERFORMING A FILE TRANSFER DIALOGUE ACQUISITION.

The three dialogue acquisition functions selectable at the main setup menu are MONITOR _ ACQUIRE, AUTO _ RESPONSE, and PLANNED _ RESPONSE. An acquisition utilizes two ARINC-429 channels.

On the main setup screen, the user must select which channels will be used during the acquisition. The DATATRAC will restrict the channel selection for Unit 2 to either a transmit channel or a receive channel depending on the function selected. If MONITOR _ ACQUIRE is chosen as the function, then both the Unit 1 and Unit 2 channel choices are restricted to receive channels since the DATATRAC will only be receiving messages in this configuration. When one of the response functions are selected, the choice for the Unit 1 channel is restricted to one of the receive channels and the Unit 2 channel is limited to one of the DATATRAC's transmit channels.

Before commencing the dialogue acquisition, the user must connect the corresponding channels to the unit under test (or units.- if performing a MONITOR-type acquisition). The appropriate bus speeds must be set at the main setup screen.

Upon pressing the ENT key at the main setup menu, the DATATRAC will proceed with the dialogue acquisition. A screen that may be presented before the acquisition begins is the warning message in Figure 2. This message screen is displayed when there is valid dialogue data in memory from a previous acquisition and the acquisition mode selected was SAVE _ TO _ MEMORY. The user can press C at this point to continue with the new acquisition or press any other key to prevent losing the data.

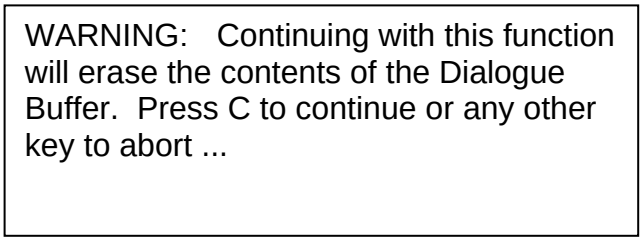


Figure 2. Warning Message Displayed Before Acquisition when Valid Data Present in Dialogue Buffer.

During a file transfer dialogue acquisition, the File Transfer Status screen is displayed with the number of Unit 1 and Unit 2 records received since the start of transfer. It also displays the number of protocol errors detected as well as the status of the break-trigger if a trigger condition was specified. This screen is shown in Figure 3.

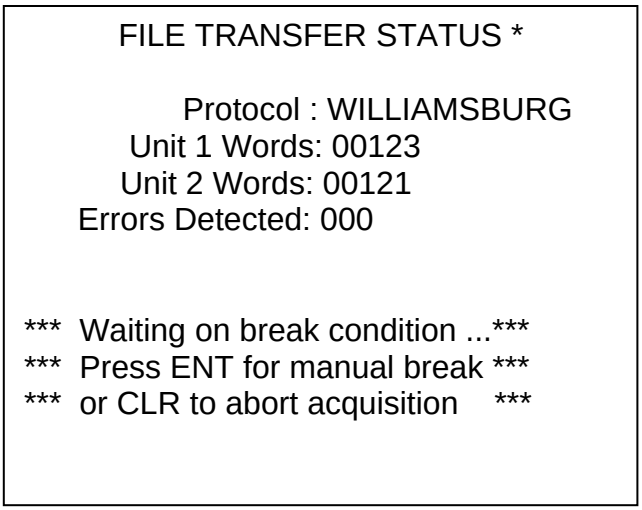


Figure 3. The File Transfer Status Screen Displayed During a Dialogue Acquisition.

If a trigger condition was specified, the operator can force a manual break by pressing the ENT key. If no trigger condition as defined or the condition was already satisfied, the ENT key serves to terminate the acquisition and move control to the dialogue review screen. The CLR key can be pressed at any time to cancel the acquisition and return to the main setup menu.

The following sections provide information specific to each acquisition function.

3.1. Monitor-Type Acquisition

The MONITOR _ ACQUIRE function is the simplest method of acquiring file transfer dialogue. The only tasks required of the DATATRAC 400/400H is to receive data from the external units and monitor the messages for protocol errors. Therefore, it is not necessary nor applicable to define a planned-response file. The operator can define custom repeat-count and timing variables (see section 4) as with the other acquisition functions.

3.2. Auto-Response Mode Acquisition

The second form of acquiring data is the auto-response mode of operation. In this configuration, the DATATRAC will respond according to the Williamsburg specification to messages being received from a device. Naturally, the DATATRAC will be acting solely as a sink device since it has no file to transmit out. The device under test is designated Unit 1 (a receive channel) while the DATATRAC is designated Unit 2 (a transmit channel).

The time interval that the DATATRAC will delay between receiving message from Unit 1 and transmitting the response is termed the "auto-response time delay." This value has a default of 50 sec. It can be changed to any value by selecting the function

EDIT-VARIABLES and editing Tr in this menu. See Section 5 for a description of the protocol variables edit function.

When reviewing an auto-response acquisition, the Unit 1 messages will be displayed along with the DATATRAC's responses just as if a monitor-mode acquisition had been performed.

3.3. Planned-Response Mode Acquisition

The third form of acquiring a dialogue is the planned-response mode. Here the DATATRAC has a complete definition of what it will place on the bus in response to (or in anticipation of) messages from a device under test. Each record of the response buffer corresponds to an ARINC 429 message on the bus. The response record contains the data to transmit as well as the time to delay between the previous message and the transmission of the current record.

A planned-response record also contains information on how to string messages together. Records can be transmitted contiguously (after the prescribed delay times), or can be transmitted only after a message is received from the device under test. See Section 4 for a complete description.

Similar to auto-response mode, the planned-response mode of acquisition designates the DATATRAC as Unit 2 while the device under test is Unit 1. The acquisition review presents the data from both units. Any errors intentionally (or accidentally) inserted into the response file will be flagged in the review screen just as if the DATATRAC was a second, external unit and a monitor-mode acquisition was performed.

The following section describes the details of defining a planned-response file.

4. DEFINING THE PLANNED-RESPONSE BUFFER.

The planned-response mode of operation requires the user to first define a response buffer that the DATATRAC will use to communicate with an external device (Unit 1). To access the response buffer handling utilities, the function parameter in the main menu must be set to DEFINE _ RESPONSE. When the ENT key is pressed, the select screen of Figure 4 is presented.

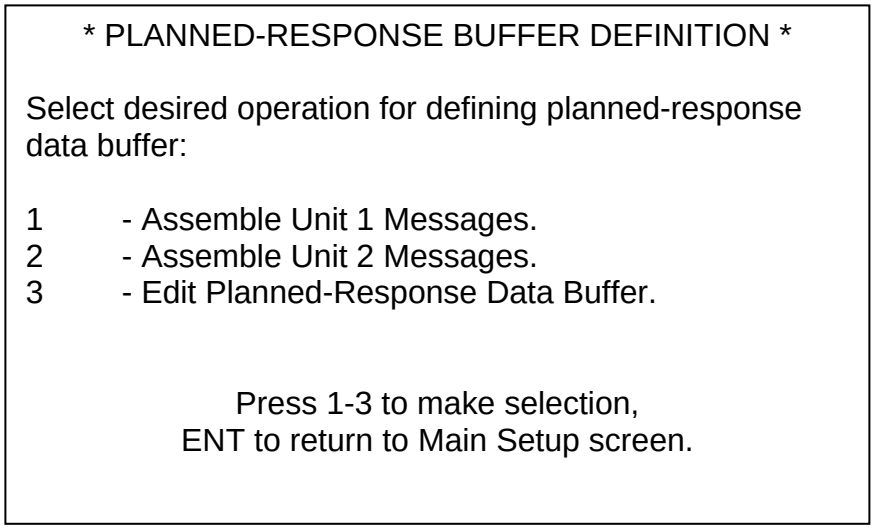


Figure 4. Planned-Response Buffer Definition Select Screen.

4.1. Assembling Unit Messages from Dialogue Buffer.

The first two selections in the menu screen of Figure 4 are the response file assembly utilities. These utilities serve to collect all of the messages present in the dialogue buffer corresponding to a particular unit, or channel, and assemble them with the proper delay times and link status (explained below) to produce a resultant planned-response file that will simulate the previous acquisition. Any errors in the dialogue of the unit being assembled will be present in the resultant planned-response buffer. When the assembly is complete, the DATATRAC will pass automatically to the edit screen described in the sections that follow.

TIP: For lengthy planned-response files, it might be easier to first acquire a dialogue between two devices utilizing the MONITOR _ ACQUIRE or AUTO-RESPONSE function. Then the assembly utilities under DEFINE _ RESPONSE function can be invoked to extract the Unit 1 or Unit 2 messages from the dialogue and assemble them into a separate planned-response buffer. The buffer can then be edited to insert error conditions (or correct existing errors) instead of typing in a complete file definition.

4.2. Planned-Response Buffer Edit Screen.

The third selection in Figure 4 invokes the response buffer editor to permit modifying a previous assembly or defining a completely new file. Figure 5 illustrates a sample edit screen with a small planned-response file defined. Note that although the term "response" implies that the DATATRAC will be acting as a transfer sink, the messages defined can correspond to a source device, as shown in the edit screen example.

Each field of the edit screen is explained in the sections below.

4.2.1. Edit Line Number.

When the cursor is positioned in this field, the user can enter a decimal value for a file line number to jump to that position in the file. The value entered is processed when the cursor is moved outside of this field or a complete number is entered.

```
                * PLANNED-RESPONSE BUFFER EDIT *

        Edit Line: 00000                          Format: ENG
Lk    SAL    Type + -------  Decode ------- +    P      Delay
C     304     RTS  Dest='A'      Count=06h      1       00000
S     304     SOT  GFI=9  F#=01  LDU=01         1       00050
C     304     FULL  n1> 4  4  5  4  6    DE∏     1       00050
C     304     FULL  n1> 4  7  4  8  4    FGH     1       00050
C     304     CHAR  c1> 'A'  'B'  'C'            1       00050
C     304     PART  GFI=9 n1>0  3  1  3  01     1       00050
C     304     EOT FLBit=0 CRC=1FC7               1       00050
```

Figure 5. Planned-Response Buffer Edit Screen with Sample File.

4.2.2. Data Display Format.

This field permits the data display format to be changed. When the cursor is located in this field, the right-arrow key (>) can be pressed to cycle through the formats. The allowed formats are ENG, HEX, and BIN. The different edit fields are explained in detail later in sections 4.4 and 4.5. Here are samples of the HEX and BIN editing formats:

```
HEX:        Lk  SAL      32--HEX--9          P  Delay
             S  304        7F FF FF          1  00100

BIN:        Lk  SAL   32 ------|--BIN--|------ 9   P  Delay
             S  304   0111111111111111 1   1  00100
```

The ENG Format is described in detail in Section 4.5.

4.3. Response File Edit Keystrokes.

To edit the response buffer, the cursor is moved down into the data area with the down-arrow key. The cursor will move to the first position of the data line (the link field). Several edit keystrokes are defined in this screen and are a function of the position of the cursor on the data line. Many of the keystrokes are similar to those found in the edit of static transmit labels on the DATATRAC 400/400H. Below is a summary of the available keystrokes and the columns (fields) in which they are permitted:

A - - In the first column (the link field) this keystroke signifies "Add (insert) a new line." When a new line is inserted, a question mark ("?") will appear in the link field indicating that the record is yet to be defined. When an increment (F) or decrement (B) key is pressed, the new record will be defined and its SAL, word type, and delay will be the same as the last message edited. In data fields permitting direct hexadecimal entry, this key is used for entering the hex value A.

E - - In the link field, this keystroke signifies "Erase (delete) current line." All succeeding lines will be bumped up one position. In data fields permitting direct hexadecimal entry, this key is used for entering the hex value E.

Down/Up Arrow -- This key repositions the cursor at the link field of the succeeding/preceding line. If the current line is undefined, it will be deleted before the cursor is moved.

Right/Left Arrow -- This key moves the cursor to the next/previous permitted column position in the data line. If the line is undefined, this keystroke will be ignored.

F or B -- When the format is ENG, and the cursor is located at an enumerated field (the word-type or an ISO-5 character field) these keys are used to increment (F) or decrement (B) the value of the field by one. In a direct hexadecimal entry field, these keys represent the Hex digit.

C - - This is a special key used when the cursor is located on the “1C" of the CRC field in an EOT type word. It directs the DATATRAC 400/400H to calculate the correct CRC for the preceding file LDU. Of course the file LDU must have been completely defined so that the resultant CRC is representative of the LDU.

0 Through F -- These keys, aside from their special functions mentioned above, are used to enter values directly in the fields that permit direct data entry. Some fields naturally will restrict the maximum value to a digit less than hex F, such as the SAL field or a binary bit field.

ENT --When the cursor is in the data edit region, this keystroke moves the cursor up to the format field without scrolling the data. If the cursor is in the header region (edit line or format), the ENT keystroke causes control to pass back to the main setup screen.

CLR --This keystroke can be pressed at any time. It instructs the DATATRAC to erase the entire contents of the planned-response buffer. The DATATRAC will prompt for a confirmation before performing the action.

RCV, XMT, RCD, BRK -- These keys pass control to the respective setup screens. The contents of the buffer are not changed.

4.4. Description of Format Independent Edit Fields.

A planned-response edit line can be divided into several fields, some of which are a function of the format selected and the word-type of the record if displaying in the engineering format. The fields that are common to all three formats are the link, SAL, parity, and delay time. These fields are explained below.

4.4.1. Link Field.

The first column of the edit line contains the link status. This parameter specifies how the associated message is linked to the previous record. It also specifies special handling conditions for the message or LDU. There are three possible values for most word-types. These are:

S (Standby). This link status instructs the DATATRAC to wait for a valid message to be received on the Unit 1 channel before processing the current response word. A valid Unit 1 message is defined only by the presence of the correct parity and the SAL for Unit 2 (the DATATRAC). Note that the contents of the word (other than the SAL and parity) is not considered when processing a standby-link message. The DATATRAC will still monitor the file transfer for protocol error. However, the planned-response file is read literally.

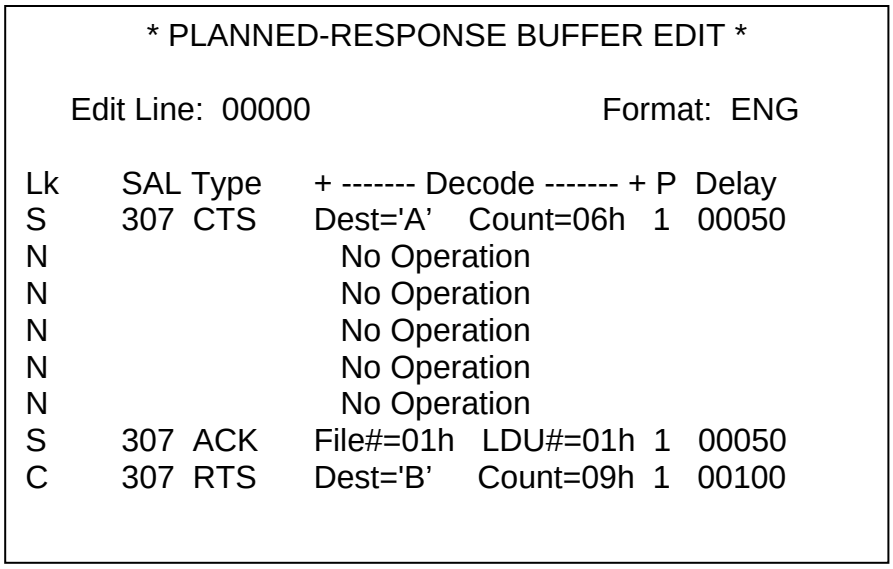
C (Contiguous). This link status instructs the DATATRAC to begin processing the associated message immediately without waiting for a message from Unit 1. This is used typically on all of the data-type words and the EOT word of an LDU, where one wants the records transmitted contiguously. It can also be used in the first record of a file (usually an RTS) if that record is to be sent immediately (after the specified delay) upon initiating the transfer acquisition.

N (No operation). This link value is necessary to act as a peacekeeper in the response file when no message is to be placed on the bus in response to an incoming word. It is typically used when the DATATRAC is acting as the file sink, and many source records are to be received before the DATATRAC issues the message containing the ACK word. For each received message, the planned response buffer pointer is incremented by one position and the new record's link status is read. If a no-operation word is encountered, the DATATRAC will not transmit and will wait until another message is received before incrementing the response buffer pointer again.

Figure 6 presents a typical response file. It corresponds to the response that would likely be defined if the external unit transmitted the LDU sequence shown in Figure 5.

In the response buffer of Figure 6, the DATATRAC will first wait for a message to arrive from Unit 1 (the RTS) since the CTS has a standby (S) link defined. As soon as the RTS is received, the DATATRAC will delay 50 msec before transmitting the CTS record. The buffer pointer is then incremented to point to the next record. Upon encountering the no-operation record, the DATATRAC will wait until the source transmits the next record (the SOT word), similar to the standby link. When the SOT word is received however, the DATATRAC will simply increment the buffer pointer to the next record without transmitting data. This sequence is repeated for the four data bytes: each time a source record is received, the DATATRAC simply increments the response buffer pointer without transmitting data.

After the last data word is received (the PARTial binary word) and the response buffer pointer is incremented, the ACK word is encountered with the S-link status. The DATATRAC will thus wait for another message from the source (the EOT word) before beginning the 50 msec delay to transmit the ACK word.



```
        * PLANNED-RESPONSE BUFFER EDIT *

   Edit Line:  00000                          Format:  ENG

Lk     SAL Type     + ------- Decode ------- + P  Delay
S      307  CTS     Dest='A'    Count=06h   1   00050
N                     No Operation
N                     No Operation
N                     No Operation
N                     No Operation
N                     No Operation
S      307  ACK     File#=01h   LDU#=01h  1   00050
C      307  RTS     Dest='B'    Count=09h  1   00100
```

Figure 6. Planned-Response Buffer Edit Screen with Sample Sink Messages in Response to the Source LDU of Figure 5.

As soon as the ACK word is transmitted, the response buffer pointer is once again incremented. This time it encounters the RTS word with a contiguous, or C-link status. This instructs the DATATRAC to immediately begin the time delay countdown (100 msec) for transmitting the RTS word without waiting for a message from Unit 1. This record, of course, is not a required response to the file in Figure 5. It is included here only to illustrate the use of the C-link status. When the last response buffer is read, the unit will terminate the acquisition and proceed to the review screen.

R (Repeat). This final link status is available only on RTS-type and EOT-type words. The effect of the R-link for these two words is slightly different. For an RTS word type, the R-link is identical to an S-link unless an error occurs. For an RTS word with an R-link, if the DATATRAC detects an NCTS, BUSY, or an incorrect response to the RTS, the RTS command will repeat until a correct CTS is encountered. Only then will the response buffer pointer be incremented to the next record. The RTS will repeat after the corresponding time delay given by the time values specified in the variables table (either custom or standard).

TIP: There may be instances when it is desirable to define an RTS word with a C-link but with the error handling capability of an R-link. This can be effectively accomplished by defining two adjacent RTS records. The first RTS would possess the C-link and so would be transmitted immediately (as in Figure 6 above). The next record would be a second RTS with an R-link. This would result in two RTS messages on the bus, even though the first RTS may have been properly responded to. This is not a violation of the protocol, however, and no error would be flagged. If the first RTS was not responded to properly, then the second RTS would "take over" to handle any further response errors.

The EOT-type word with an R-link is handled under normal circumstances as a C-link unless a protocol error occurs in response to the EOT message. The R-link instructs the DATATRAC to repeat the transmission of the entire LDU if a NAK word or an erroneous message is received in response to the EOT. The response buffer pointer will reset itself to the RTS word at the beginning of the corresponding LDU and retransmit it.

4.4.2. SAL Field.

This field accepts the direct entry of the octal source address label. When an SAL is changed, all succeeding response buffer records will be changed to the new SAL entered. This simplifies performing a global change of SAL value on the response buffer if necessary.

4.4.3. Parity Field.

Similar to the parity field in the editing of static transmit labels, this field accepts a 0 or 1 to force the word's parity to even or odd, respectively. Note that for the HEX and BIN formats, a data field edit of bit 32 will be overridden by the parity field's value to achieve the indicated parity.

4.4.4. Delay Time Field.

This field accepts direct entry of a decimal value. This value represents the amount of time in milliseconds to delay upon receiving a message from Unit 1 (if the word has an S-link) or upon transmitting the previous word (if the new word has a C-link).

4.5. Description of ENG Format Data Fields for Different Word Types.

When the ENG format is selected, the response buffer records are decoded and displayed as a function of word type. There are 16 possible word types which include all of the word types given in the ARINC-429 Version 12 specification. The word type formats are described in this section. A word type is changed by positioning the cursor at the word type field and pressing either the F or B key to increment or decrement the word type value.

4.5.1. FULL -- Full Binary Word.

This word type corresponds to the full binary word format containing five 4-bit nibbles of data. It also outputs the ISO-5 character equivalent to the right of the data nibbles since some applications use the full and partial binary types to transmit character files. The “nl>" text is a reminder that the nibbles are displayed in ascending order beginning with the least significant nibble (nl). The hexadecimal values can be entered directly from the keypad. See Section 4.6 for information on the ISO-5 character encoding into binary words.

4.5.2. PART -- Partial Binary Word.

This word type corresponds to the partial binary word type containing up to four nibbles of binary data. The GFI (General Format Identifier) is the coded nibble occupying bits 25-28 that specifies how many significant nibbles are encoded in the word. The ARINC 429 specification requires bit 28 to be set for a partial data word, however, the user is given the freedom to set this nibble to any value for testing purposes. As with the full data word, the nibbles are presented beginning with “n1." All the nibbles are available for edit regardless of the value of the GFI. The nibbles are entered directly from the hexadecimal keypad. The ISO-5 character decode is also presented (see Section 4.6).

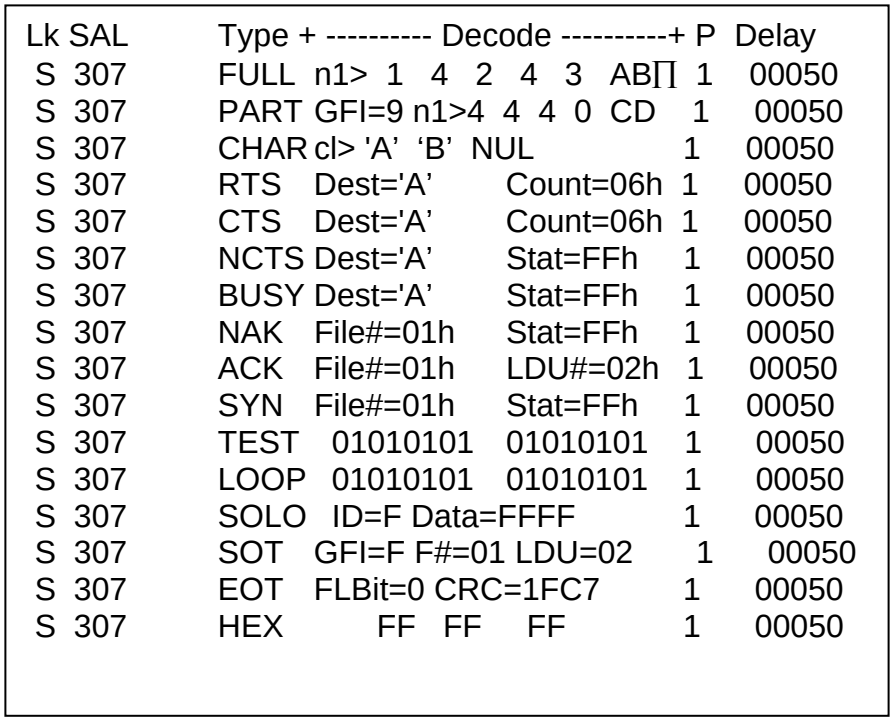


Figure 7. The 16 Different Word Types Available when ENG Format is Selected.

4.5.3. CHAR -- Character Data Word.

The third data type is the character data word. This word format consists of three, 7-bit ISO-5 characters. The characters are presented as either the displayable ISO-5 character (in quotes), or if a non-displayable character, the ISO-5 pneumonic such as NUL, SOH, STX, etc. The latter representations are not enclosed in quotes. The value of a character is changed by positioning the cursor and pressing F or B to increment or decrement the character.

4.5.4. RTS -- Request to Send.

There are two data fields associated with the RTS word. The destination code is an ISO-5 character that is edited with the F and B keys. The count field corresponds to the 8-bit binary count specifying the number of data words in the succeeding LDU (including the SOT and EOT words). This is a hexadecimal number and can be edited directly from the keypad.

4.5.5. CTS -- Clear to Send.

There are two data fields associated with the CTS word. The destination code is an ISO-5 character that is edited with the F and B keys. The count field corresponds to the 8-bit binary count specifying the number of data words in the succeeding LDU (including the SOT and EOT words). This is a hexadecimal number and can be edited directly from the keypad.

4.5.6. NCTS - Not Clear to Send.

There are two data fields associated with the NCTS word. The destination code is an ISO-5 character that is edited with the F and B keys. The Stat field corresponds to the 8-bit status code that gives the sink's reason for sending the NCTS. This is a hexadecimal number and can be edited directly from the keypad.

4.5.7. BUSY -- Sink Device Busy.

Similar to the NCTS response word, there are two data fields associated with the BUSY word. The destination code is an ISO-5 character that is edited with the F and B keys. The Stat field corresponds to the 8-bit status code that gives the sink's reason for sending the BUSY. This is a hexadecimal number and can be edited directly from the keypad.

4.5.8. NAK -- LDU Not Acknowledged.

The NAK response word includes two data fields. The first is the file sequence number and the second is the status code. Both values are in hexadecimal and thus allow direct data entry from the hex keypad.

4.5.9. ACK -- LDU Acknowledged.

The ACK response word includes two data fields. The first is the file sequence number and the second is the Link Data Unit (LDU) sequence number. Both values are in hexadecimal and thus allow direct data entry from the hex keypad.

4.5.10. SYN -- Synchronize Process.

This is the sink command to synchronize, or restart, the transmission of an LDU. There are two fields associated with this word. The first is the file sequence number and the second is the status code. Both values are in hexadecimal and thus allow direct data entry from the hex keypad.

4.5.11. TEST and LOOP.

These are standalone words used for testing. The data field consists of 16 bits which are edited using the 0 and 1 keys. The most significant bit (bit 24) is on the left.

4.5.12. SOLO -- Standalone Data Word.

The SOLO word type consists of two fields. The first is the ID. This is a 4-bit value represented as a hexadecimal digit. The data portion is a 16-bit hexadecimal value with the most significant digit on the left. Both fields are edited with the hex keypad.

4.5.13. SOT -- Start of Transmission of LDU.

The SOT word consists of a general format identifier (GFI) nibble,followed by the file and LDU sequence numbers. All values are in hexadecimal and take direct data entry from the keypad.

4.5.14. EOT -- End of Transmission of LDU.

The EOT word consists of two data fields. The first is a single bit corresponding to the final-LDU bit (bit 25). The second field is the 16-bit cyclic redundancy check (CRC) digits, displayed as a hex number with the most significant digit first. A special keystroke is available on this word type when the cursor is positioned over the first C in "CRC." By pressing C at this position, the DATATRAC will calculate the correct CRC for the corresponding LDU.

4.5.15. HEX -- Hexadecimal Data Display.

This is a special word type that is not part of the ARINC 429 specification for file transfer protocol. It simply sets a flag that tells the DATATRAC 400/400H to display the data record in the HEX format instead of decoding it into one of the protocol word types above. This is convenient when embedding non-file related labels into the data stream, where the data is more easily interpreted in a hexadecimal format.

4.6. Encoding and Displaying of ISO-5 Characters in Binary Data Words.

Some Williamsburg Protocol implementations transmit ISO-5 text files as a sequence of 4-bit nibbles using the full and partial data word types instead of the character data type. When transmitting characters in the full data word, each character consists of eight bits (two nibbles). Thus, a full data word will contain 2 1/2 characters. The third character will contain its low nibble in one message and its high nibble in the next full data word. This is illustrated in Figure 8.

In Figure 8, ten characters are encoded into 4 full data words. The characters are represented as C1 through C10. Observe that in the first message, only the low nibble of C3 is sent. The character cannot be decoded until the second message arrives with the first nibble containing the high part of C3. The same holds for C8 in words #3 and #4. Note that with each consecutive full word, the alignment of the character nibbles (i.e., whether a low or a high character nibble is located in N1 and N3) alternates between low and high for each corresponding nibble in the full words. This "phasing" of the characters is critical for the proper decode of the text file being transmitted. The full words containing a low character nibble in N1 can be termed "odd phase" records. Likewise, full words containing a high character nibble in N1 can be termed "even phase."

WORD #	N1	N2	N3	N4	N5	Phase
1	C1 lo	C1 hi	C2 lo	C2 hi	C3 lo	ODD
2	C3 hi	C4 lo	C4 hi	C5 lo	C5 hi	EVEN
3	C6 lo	C6 hi	C7 lo	C7 hi	C8 lo	ODD
4	C8 hi	C9 lo	C9 hi	C10 lo	C10 hi	EVEN

Figure 8. Packing of Character Data into FULL Binary Data Words.

When a full data word record is being displayed in either the response buffer edit screen or the data review screen, the DATATRAC 400/400H first determines the phase by searching backwards through the LDU for all of the preceding (and contiguous) full data words. When the alignment has been established, the full data word is then decoded and the ISO-5 characters are displayed on the data line. Odd-phased data words, with the third character undetermined, displays the first two characters only. The third character position contains a special arrow character (→) indicating that the next line will contain the completed byte. Even-phased data words display three ISO-5 characters, the first character being the split character from the previous word.

Each time a non-full data word is encountered in an LDU, the phase is reset to odd. Thus, any full data word following another non-full protocol word will signal the beginning of a new string and will be decoded as an odd-phased word. In the case of a partial binary word, its character decode will follow the proper phase as if it was a full binary word, however, the phase is subsequently reset to odd.

When inserting and deleting full data words from a response buffer containing a string of full data words, the user must insure that the resulting decode of ISO-5 characters is as desired. It may be necessary to insert an extra full word to re-establish the proper phasing so that the characters are displayed properly.

The ISO-5 character set contains many non-displayable characters. These values are displayed as a period (.) when decoding a full (or partial) data word. When editing a response buffer record, the character can be incremented or decremented by pressing the F or B key with the cursor on the corresponding ISO-5 character. The values will cycle from 00 to 7F hex. It is possible to increment a non-displayable character in this manner. Even though the new character may also be non-displayable (and thus a period will continue to be displayed at that position), the data can be observed to change in the binary nibble portion of the data line.

Partial data words are allowed only at the end of a string. They are handled just like a full data word except that they terminate a string. Any full word that follows is treated as an odd-phase word. Partial words can contain up to two characters.

If an implementation does not utilize the ISO-5 encoding into full data words, the operator can simply ignore the ISO-5 character display portion of the data line. The phasing only affects the display of the characters. It has no effect on the actual nibbles in the data word.

5. EDITING PROTOCOL VARIABLES.

Another function that is available from the main setup screen is EDIT _ VARIABLES. This function permits the operator to customize the protocol variables that control the timing and error handling of the file transfer. Two protocol variable tables are kept in the DATATRAC's memory at all times. The first table consists of the standard default values for the variables. This table is referenced when the main setup parameter "Variables" is set to STANDARD. The default values are listed in Figure 9. The second table of protocol variables is the custom variables set by the user. When the main setup screen indicates CUSTOM variables, this list is referenced for analyzing the protocol.

The custom variables table can be reviewed and edited by selecting function = EDIT _ VARIABLES at the main setup screen. Upon pressing ENT, the edit screen in Figure 9 will be presented. The actual values might be different due to previous edits (the custom variables are stored in nonvolatile memory). Actually, only part of this menu will be displayed since the number of lines exceeds the display capacity. The up and down cursor keys are used to position the cursor and scroll the menu. The numeric keypad (keys 0-9) are used to enter the desired value.

```
          * CUSTOM VARIABLES EDIT *
   Press ^ v to scroll, ENT to return to Main Setup,
              CLR to reset to defaults

Max Repeat Counts  ----------------------------------------
N1 -    RTS repeats after NCTS                      005
N2 -    RTS repeats after BUSY                      020
N3 -    RTS repeats after NO RESPONSE               005
N4 -    NAK words before FAIL                       003

Time    Variables ------------------------------------msec
Tr -    Auto-Response time delay                   00050
T1 -    CTS/NCTS send time delay                   00100
T2 -    RTS delay after NCTS                       00500
T3 -    BUSY send time delay                       00100
T4 -    RTS delay following BUSY                   15000
T5 -    RTS delay after NO RESPONSE                00500
T8 -    Max ACK/NACK delay                         00200
T9 -    Max message time after CTS                 02500
T10-    Max ACK/NACK time after CTS                02700
T11-    Max echo loop back time                    00100
```

Figure 9. Protocol Variables Edit Screen Showing Default Values.

All variables except Tr correspond to the variables explained in Attachment 10 of the ARINC 429 Version 12 specification. These will not be explained here. The variable Tr corresponds to the auto-response time delay. When the function AUTO _ RESPONSE is selected, this value is referenced (if variables = CUSTOM) to determine the amount of time to delay between receiving a source word and transmitting the proper response.

The custom variables can be reset to the standard values given in the ARINC specification by pressing the CLR key. The DATATRAC will return with a message asking the operator to confirm the action. Pressing C at this point will reset all variables to the values shown in Figure 9.

When the edits are complete, the ENT key returns the user to the main setup screen. The function parameter will automatically reset to MONITOR _ ACQUIRE, the first of the acquisition modes. Also, the variables parameter will be set to CUSTOM automatically.

There are two timing variables given in the ARINC 429 specification's Attachment 10 that are not supported on the DATATRAC 400/400H. These are the T6 and T7 variables for resolving RTS conflicts. The nature of the two interactive acquisition modes on the DATATRAC, namely auto-response and planned-response, renders it impossible to encounter an RTS conflict on the bus.

6. REVIEWING DIALOGUE DATA.

When an acquisition has been performed and the data stored in the dialogue buffer, the operator can proceed to the dialogue review screen to review the data. The review screen can be accessed from the main setup menu by selecting function = REVIEW _ DIALOGUE and pressing ENT. If an acquisition is being performed and the user presses ENT (after the trigger condition as been satisfied if performing a break-mode capture), the DATATRAC will automatically proceed to the dialogue review screen. Also, when a planned-response acquisition is being performed, the DATATRAC will automatically proceed to the review screen upon transmitting the last response record. Figure 10 gives a sample dialogue review screen.

```
------- DIALOGUE FILE/LDU SELECT ------
 File# :  00h      LDU#:00h          Count:00000

-----------------DIALOGUE DATA REVIEW-----------------
Ch   SAL   Type + ------- Decode -------+     E    Time
 R1   307    RTS   Dest ='A'   Count=05h          89200
 T1   304    CTS   Dest ='A'   Count=05h          89250
 R1←307    SOT   GFI=F  F#=01 LDU=02          89300
 R1   270              2E 11 0C                P  89305
 R1   307     FULL n1> 1  4  2  4   3    AB→     89310
 R1   307     PART GFI=9 n1>4 4 4 0 CD          89320
 R1   307     CHAR c1> 'A'  'B'  'C'            89330
 R1   307     EOT   FLBit=0   CRC=1FC8          89340
 T1   304     NAK   File#=01h  Stat=FFh         89390
 R1   270           00  81  00                 89400
```

Figure 10. Sample Dialogue Acquisition Review Screen.

The operation of the review screen is very similar to the break-history data review screen on the DATATRAC 400/400H. There are two windows in the screen, namely, the file position select and the data review windows. The cursor can be toggled between the select and the review window by pressing the ENT key. The operator can return to the main setup screen by pressing CLR.

The select window allows the user to jump to a specific location in the dialogue buffer. The position can be expressed as either a file/LDU sequence number or a buffer line count. The file and LDU sequence numbers are expressed in hexadecimal. When a file and/or LDU number is entered, the DATATRAC searches the dialogue buffer from the beginning to the first occurrence of an SOT word with matching file/LDU sequence numbers. It then displays the data with the SOT word at the first line. If the search is unsuccessful, a message is printed on the display indicating that the file/LDU was not found. Pressing any key will erase the message and restore the previous file/LDU numbers and buffer position.

If it is more convenient to specify a line (sample) count, the operator can enter a decimal number at the count field to jump to that position in the buffer. If the number entered exceeds the size of the acquisition, the DATATRAC will set the count to the maximum. The screen data will be redisplayed at the new count and the corresponding file and LDU sequence numbers will be determined and displayed as well.

When the cursor is on the Dialogue Data Review window, several actions can be performed. The up and down arrows can be used to scroll the data. The B and F keys can be used to page up and down, respectively, ten lines at a time. The 0 key is used to jump to line count 00000 (the beginning of the acquisition). The E key is used to jump to the end. If a break-mode acquisition was performed, the I key can be used to jump to the trigger position, indicated by a small arrow next to the channel identifier. Each time the data is scrolled or paged, the buffer is scanned to check if the file or LDU sequence number needs to be updated.

The data formats for the dialogue review are almost identical to the planned-response buffer edit formats. The three formats HEX, BIN, and ENG are available. With the cursor on the dialogue data review window, the right arrow increments through the different formats. See Section 4.2 for an explanation of the different fields of the data line. There are some differences from the response buffer edit format, however. These are the channel identifier, the error status, and the time stamp.

6.1. Channel Identifier (Ch).

This field indicates the source of the message. The identifier consists of a T or R for Transmit or Receive, and the channel number (1-4).

6.2. Error Status (E).

This column serves to flag any protocol errors that may have occurred with (or just before) the receipt (or transmission) of the message. The errors are indicated by one of the letter codes listed below:

ERROR STATUS	DESCRIPTION
blank	No error
P	Even parity error
I	Invalid word, not expected
T	Timing violation
R	Repeat count maximum exceeded
N	Incorrect word count in LDU
C	Incorrect CRC in EOT word

A few of the errors listed require further explanation.

I (Invalid). An invalid word is any word that possesses the proper SAL but whose word type or data does not match what is expected. Examples of this include a FULL word following and RTS, or a CTS with a destination code that is different from the preceding RTS word.

T (Timing Violation). This flag indicates that one of the timing constraints (T1 – T11) was violated. Which particular timing variable was exceeded can be determined by the word type it appears in.

R (Repeat Violation). This error flag appears when one of the repeat counts in the protocol variables list (N1-N4) was exceeded.

N (Incorrect Word Count). This error appears on an EOT word when it is determined that the number of records in an LDU (including the SOT and EOT) does not match the word count given in the corresponding RTS word at the beginning of the LDU.

6.3. Time Stamp (Time).

This field displays the system time, in milliseconds, when the Data word was detected on the bus. This applies to messages received from an external unit under test or messages that originated on the DATATRAC 400/400H. The time given is relative to the moment of system power-up (the system time at power-up is 0 msec).

6.4. Display of Non-SAL Words.

Labels that are present on the bus but that do not correspond to the expected source address label (SAL) are displayed as HEX. It is possible to instruct the DATATRAC 400/400H to ignore non-SAL messages by setting the label select parameter in the main setup menu to SAL _ ONLY.

7. RS232 OPERATION.

Two methods for downloading data on the RS-232 serial port are provided under the protocol analyzer function of the DATATRAC 400/400H. The first method is to download the data previously acquired in memory. This utility also downloads any planned-response data that may be defined. The second method consists of downloading the data that is present on the bus in real-time in lieu of saving the acquisition to memory.

A special program for an IBM PC compatible is provided with the DATATRAC 400/400H for reading data from the serial port. The program, RSREAD, performs the necessary handshaking on the RS232 line for reading data from the DATATRAC 400/400H. It assembles the data into an ASCII file that can later be printed out or processed. The record format for the two downloads are provided in the following sections for those users that desire to implement their own application program for reading the data from the DATATRAC 400/400H.

See the DATATRAC 400/400H Manual for a description of the physical link layer of the RS-232 port.

7.1. Planned-Response and Dialogue Buffer Data Download.

The DATATRAC 400/400H has the capability of downloading the planned-response buffer and the dialogue buffer over the RS-232 port to a host computer. This is convenient for archiving dialogues and obtaining a hardcopy of the buffers for reviewing.

To perform a memory download, the operator selects Function RS232 _ DOWNLOAD at the main setup menu and presses ENT. As with the real-time download function, the screen shown in Figure 11 is then presented before the download begins.

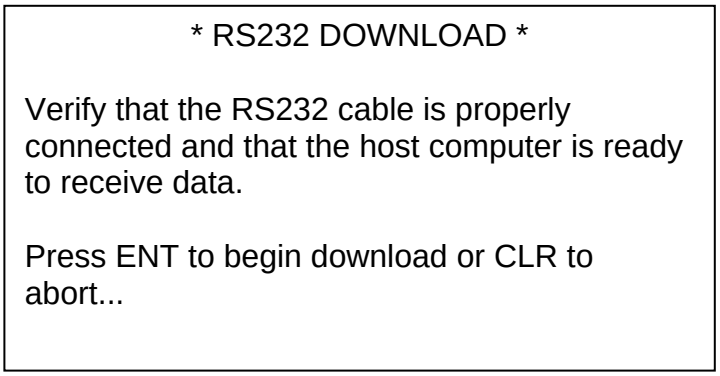


Figure 11. RS-232 Download Preparatory Message Screen.

The RS-232 cable must be wired correctly as specified in the DATATRAC 400/400H Manual. When the physical link has been verified, the operator presses ENT to commence the data download. The CLR key can be pressed at any time before or during the download to abort the operation and return to the main setup menu. Upon pressing ENT, the screen in Figure 12 is displayed. This screen indicates the combined number of response and dialogue records remaining to transmit.

The output of the RSREAD program is an ASCII text file. A sample file listing is given in Figure 13. In this example, there are four response buffer records and six dialogue buffer records.

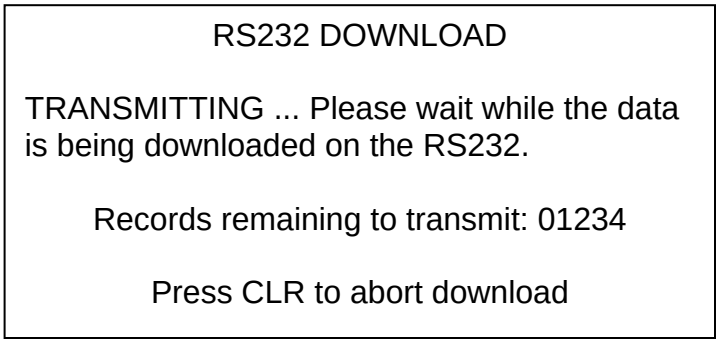


Figure 12. RS-232 Download Status Screen.

DATATRAC 400/400H Protocol File Transfer Data Download
Mon Sep 09 11:09:00 1991

Number of Planned-Response Records = 4
Number of Dialogue Acquisition Samples = 6
Trigger Location = 0

Planned-Response Buffer Data:

Count	Link	SAL	32-Hex-9	Time Delay
00000	C	304	41 41 03	00000
00001	S	304	60 01 01	00050
00002	C	304	03 42 41	00050
00003	C	304	F0 C6 CC	00050
00004	N	304	00 00 00	00000

File Transfer Dialogue Acquisition Data:

Count	Unit#	SAL	32-Hex-9	Error Time Stamp
00000	2	304	41 41 03	015597 ** TRIGGER **
00001	1	307	42 41 03	015647
00002	2	304	60 01 01	015658
00003	2	304	03 42 41	015668
00004	2	304	F0 C6 CC	015678
00005	1	307	45 01 02	015739

Figure 13. Sample Listing of Output File from RSREAD Program of DATATRAC 400/400H Buffer Containing Response and Dialogue Data.

If the operator is using the RSREAD application, it is not necessary to know the structure of the data being downloaded. The format is presented here in the event that the user will be creating a custom program to read the data download from the DATATRAC 400/400H. The data download consists of three parts. First is the file header that contains Information on the number of records contained In the download and the trigger position. The second block of data is the planned-response buffer records. The third block of data contains the dialogue buffer records. Below is a detailed look at the record structure of the download.

Initial Header Record. This record occupies the first six bytes of the download. The record's structure is:

Byte	Definition
0	Number of response records, low byte
1	Number of response records, high byte
2	Number of dialogue records, low byte
3	Number of dialogue records, high byte
4	Trigger position in dialogue, low byte
5	Trigger position in dialogue, high byte

Planned-Response Buffer Record. These records immediately follow the header record above. Each record consists of eight bytes. The number of records downloaded is given in bytes 0 and 1 of the header. The structure of each record is as follows:

Byte	Planned-Response Record Definition
0	Status bits (defined below)
1	Source Address Label (SAL)
2	Data Byte, bits 16-9
3	Data Byte, bits 24-17
4	Data Byte, bits 32-25
5	BCD Time Delay, low digits (see below)
6	BCD Time Delay, middle digits
5	BCD Time Delay, high digits

The individual bits of the status byte are defined as follows:

Bit	Response Record Status Byte Definition
7-6	Not Used, set to 1
5	Unit# of originator (0 = Unit 1)
4-3	Link Status: 00 = Standby (S-link) 01 = Contiguous (C-link) 10 = Repeat (R-link) 11 = No Operation (N-link)
2-0	Not Used

The delay time bytes are given in BCD format with the lower significant digit in the low nibble position.

Dialogue Buffer Record, These records immediately follow the last planned-response record. Each record consists of eight bytes. The number of records downloaded is given in bytes 2 and 3 of the header. The structure of each record is as follows:

Byte	Dialogue Buffer Record Definition
0	Status bits (defined below)
1	Message Label
2	Data Byte, bits 16-9
3	Data Byte, bits 24-17
4	Data Byte, bits 32-25
5	BCD Receive/Transmit Time, low digits
6	BCD Receive/Transmit Time, middle digits
7	BCD Receive/Transmit Time, high digits

The individual bits of the status byte are defined as follows:

Bit	Dialogue Record Status Byte Definition
7	Not Used, set to 1
6	Set when the label is the correct SAL
5	Unit# of originator (0 = Unit 1)
4-3	Not Used
2-0	Protocol Error Status Value: 0 = no error 1 = parity error (P) 2 = invalid/unexpected word (I) 3 = timing violation (T) 4 = repeat count violation (R) 5 = word count error in EOT (N) 6 = CRC error in EOT (C) 7 = not used

The receive/transmit time bytes are given in BCD format with the lower significant digit in the low nibble position. This is the system time (time elapsed since power-on) in milliseconds for when the label was detected on the bus.

7.2. Real-Time Data Download

The real-time download of an acquisition enables the user to perform an acquisition of indefinite length or to utilize a host computer for real-time processing of a dialogue. All data that is present on the bus is sent to the RS-232 port. This includes messages that originate at the DATATRAC 400/400H in the case of a response-mode acquisition.

To perform a real-time download, the operator selects Acquisition = REALTIME_RS232 at the main setup menu with the Function parameter set to the desired acquisition mode (Monitor, Auto-Response, or Planned-Response). When the ENT key is pressed, the screen shown in Figure 11 is present before the download begins.

The RS-232 cable must be wired correctly as specified in the DATATRAC 400/400H Manual. When the physical link has been verified, the operator presses ENT to commence the acquisition and data download. The CLR key can be pressed at any time before or during the acquisition to abort the operation and return to the main setup menu.

The download consists of a contiguous string of eight-byte records. Each record corresponds to a label message detected on the bus. The record structure is identical to the dialogue buffer record described in Section 7.1. There is no header record associated with this download.

The output of the RSREAD program is an ASCII text file. For a real-time download of a file transfer acquisition, the format of the output file is shown in Figure14.

DATATRAC 400/400H Real-time File Transfer Data Download
Mon Sep 09 11:09:00 1991

Count	Channel	SAL	32-Hex-9	Error	Time Stamp
00000	R1	304	41 41 03		015597
00001	T1	307	42 41 03		015647
00002	R1	304	60 01 01		015658
00003	R1	304	03 42 41		015668
00004	R1	304	F0 C6 CC	C	015678
00005	T1	307	45 01 02		015739

Figure 14. Sample Listing of Output File from RSREAD.EXE Program of DATATRAC 400/400H Real-time Acquisition Download.