OPERATION MANUAL

DATATRAC 400H
ARINC 429 DATABUS ANALYZER

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WARNING: INFORMATION SUBJECT TO EXPORT CONTROL LAWS

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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

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Section I	0		
Section II	0		
Section III	0		
Section IV	0		
Section V	0		
Section VI	0		
Section VII	0		
Section VIII	0		
Appendix A	03		
Appendix B	03		
Appendix C	03		
Appendix D	02		
Appendix E	02		
Appendix F	02		
Appendix G	02		

JcAIR Test Systems

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Declaration of Conformity

DECLARATION OF CONFORMITY

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

Declares that the products

Product Name:	DT400H Data Bus Analyzer
Model Number(s):	01-1404-00 01-1404-01
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: 2000-09-06

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, 1.6A, 250 V, Type F fuse (ACC4F3) into the dc fuse holder, A12XF1 (fuse A12F1), with the proper fuse carrier (ACC4MP2).

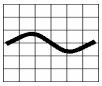
For the USA: Install a ¼ X 1 ¼ inch, 1.5 A, 250 V, slow-blow fuse (ACC4F2) into the ac fuse holder, A12XF2 (fuse A12F2), with the proper fuse carrier (ACC4MP1). Also install a ¼ X 1 ¼ inch, 1.5 A, 250 V, fast-blow fuse (ACC4F1) into the dc fuse holder, A12XF1 (fuse A12F1), with the proper fuse carrier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

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

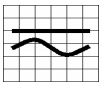
Equipment Markings

The following markings may appear on this equipment:

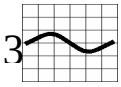
Direct current. This symbol indicates that the equipment requires direct current input.



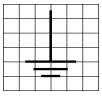
Alternating current. This symbol indicates that the equipment requires alternating current input.



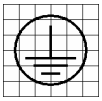
Both direct and alternating current. This symbol indicates that the equipment requires either ac or dc input at the same connector.



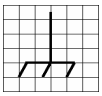
Three-phase alternating current. This symbol indicates that the equipment requires 3-phase ac input.



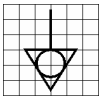
Earth (ground) terminal. This symbol indicates the ground (earth) terminal.



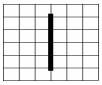
Protective conductor terminal. This symbol indicates the protective ground (earth) terminal.



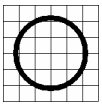
Frame or chassis terminal. This symbol indicates the frame or chassis terminal for connection to ground.



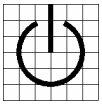
Equipotentiality. This symbol indicates an equipotentiality terminal.



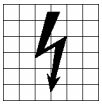
On (Supply). This symbol indicates that the power line switch is ON.



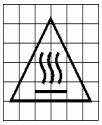
Off (Supply). This symbol indicates that the power line switch is OFF.



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

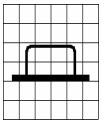


Caution, risk of electric shock. Danger – high voltage.

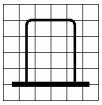


Caution, hot surface. Danger – high temperature surface.

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.

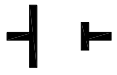
WARNING The ON/OFF switch (A12S1) only controls dc voltage to the switch mode power supply (A2) that sources the operating circuitry. The battery (A13A2BT1) is always charging when there is mains power or dc power applied.

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.

 Battery symbol

CAUTION The 230 V ac 50 Hz Power Pack Adapter (JPN 15-0009-M0) includes a ferrite EMC suppression device. This suppression device must stay on in the location indicated for proper unit operation in accordance with EMC compliance criteria. See Figure 1.

WARNING The dc power switch is not the mains disconnect. Mains disconnect is accomplished by unplugging the power adapter. When servicing equipment, be sure to disconnect the power adapter.

WARNING Do not use the Bail Stand as a handle for lifting or carrying.

CAUTION Only JcAIR Test Systems provided power adapters are to be used with this product.

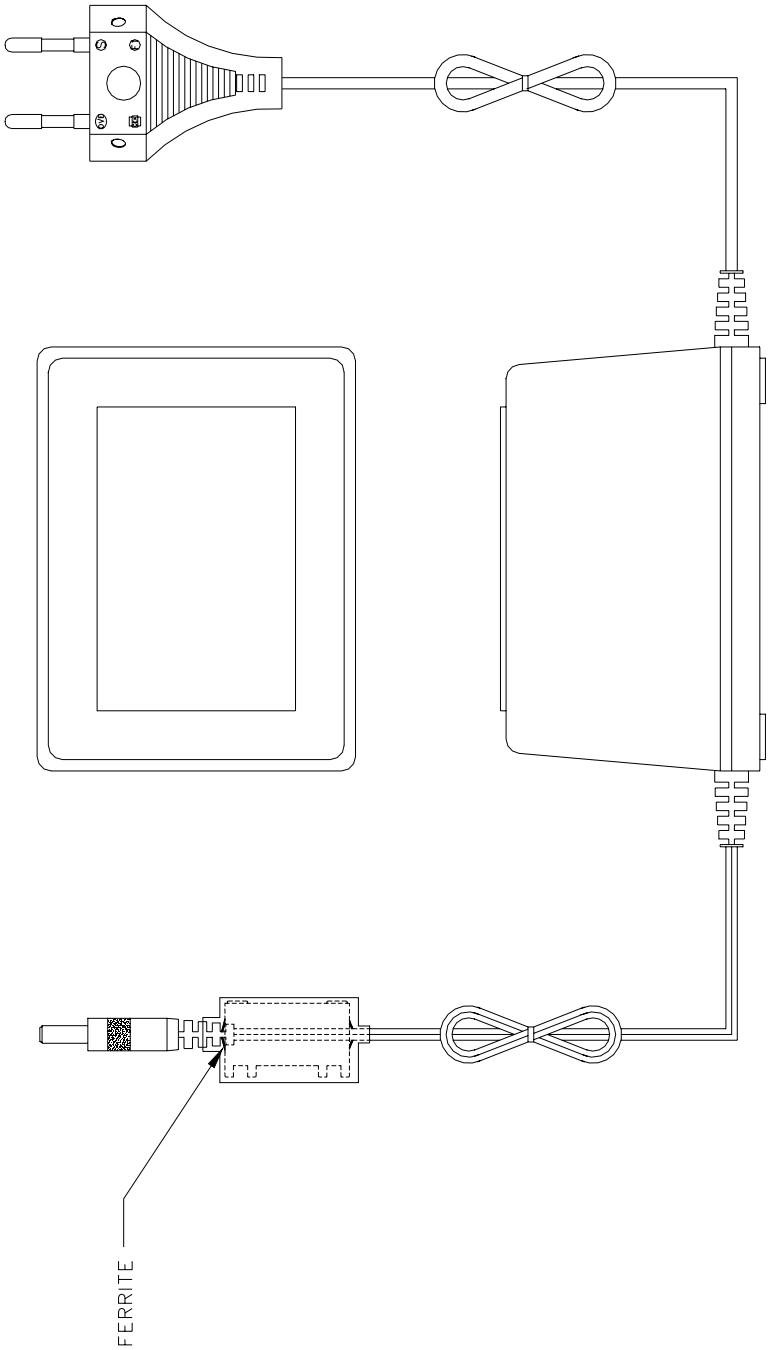
CAUTION Observe polarity of battery pack when installing.

CAUTION This equipment may contain electrostatic discharge (ESD) sensitive components. To prevent ESD sensitive equipment from possible damage, observe the following when handling
any ESD sensitive components, or units containing ESD sensitive components: Maintenance, service, or operator personnel must be grounded through a conductive wrist strap, or a similar ground device, using a 1-MΩ series resistor for equipment protection against static discharge, and personal protection against electrical shock. Failure to comply may cause permanent damage to ESD sensitive devices. This damage can cause devices to fail immediately, or at a later time without apparent cause.

CLEANING WARNING

Keep the equipment dry to avoid 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.

There are no operator replacement fuses. There is a 1 A pico fuse located on the LCD driver board (A3A1).



FERRITE LOCATION
FIGURE 1

TABLE OF CONTENTS

SECTION I

1.	Features of the DATATRAC 400H	1-1
1.1	Operational Description	1-1
1.2	Physical Configuration	1-1
1.2.1	General	1-1
1.2.2	Front Panel Description	1-2
1.2.3	Right Side Panel Description	1-2
1.2.4	Left Side Panel	1-5
1.2.5	Internal Architecture	1-6
1.2.6	Disassembly/Assembly Instructions	1-6
1.2.7	CPU/Receiver Board A1	1-8
1.2.7.1	Theory of Operation	1-8
1.2.8	Transmit/Power Supply Board A2	1-10
1.2.8.1	Theory of Operation	1-10
1.2.9	Padded Carrying Case	1-12
1.3	Internal Battery Power	1-13

SECTION II

2.	Installation Information	2-1
2.1	Unpacking and Inspection	2-1
2.2	General Power On Procedures	2-2

SECTION III

3.	Receive Mode	3-1
3.1	Receive Setup	3-1
3.1.1	Receive Channel Selection	3-2
3.1.2	Receive Channel ON/OFF	3-2
3.1.3	Receive Bus Speed Selection	3-3
3.1.4	Receive Select Labels	3-3
3.1.4.1	Select Label Setup	3-4
3.1.5	Equipment ID Codes	3-5
3.1.6	Data Format Selection	3-10
3.1.6.1	User Defined Data Format Setup	3-12
3.1.6.2	Receive Mode Graphics Format	3-16
3.1.7	Interval (Receive Rate) Format Selection	3-18
3.1.8	Receive Data Download Selection	3-18
3.1.8.1	Digital to Analog Conversion Setup	3-20
3.1.8.2	Digital to RS232 Data Conversion	3-21
3.1.9	Receive Data Display Lines Selection	3-23
3.1.10	Receive Bus Monitor Sensitivity Selection	3-23
3.2	Real-Time Data Display Screen	3-24
3.2.1	Data Display	3-24
3.2.2	Real-Time Screen Keystrokes	3-26

SECTION IV

4. Transmit Mode 4-1
4.1 Transmit Setup Screen 4-1
4.1.1 Transmitter Channel ON/OFF 4-2
4.1.2 Transmitter Bus Speed Selection 4-2
4.1.3 Transmitter Mode Selection 4-3
4.1.4 Equipment ID Codes 4-3
4.1.5 Transmitter Data Format 4-4
4.1.6 Transmit Display Lines Selection 4-4
4.2 Static Transmit Data Display Screen 4-4
4.2.1 Real-Time Data Display Screen 4-4
4.2.2 Transmit Data Enter/Edit 4-6
4.2.3 Sample Transmit Data Screen 4-8
4.2.4 Burst Mode Transmission 4-8
4.2.5 Framing Label Transmission 4-8
4.3 Dynamic Data Transmission 4-13
4.3.1 Label and Control Information Setup 4-13
4.3.2 Waveform Definitions 4-14
4.3.3 Transmit Data Display 4-14
4.4 Prestored Transmit Tables 4-14

SECTION V

5. Record Mode 5-1
5.1 Record Setup Screen 5-1
5.1.1 Function Setup 5-1
5.1.2 Record Interval 5-2
5.1.3 Sync Mode Selection 5-2
5.1.4 Channel Selection 5-2
5.1.5 Bus Speed 5-2
5.1.6 Equipment ID 5-2
5.1.7 Label-SDI 5-3
5.2 Active Recording Screen 5-3
5.3 Record Capacity 5-4
5.4 Recorded Data Protection 5-4
5.5 Recorded Data Review 5-4
5.5.1 Numerical Data Review 5-4
5.5.2 Graphic Display of Recorded Data 5-6
5.5.2.1 Graphics Screen Setup 5-6
5.5.2.2 Time Scale 5-7
5.5.2.3 Vertical Scale 5-7
5.5.2.4 Utility Functions 5-7
5.5.3 DAC Download of Recorded Data 5-8
5.5.4 RS-232C Download of Recorded Data 5-9
5.6 Synchronization with Other DATATRACS 5-10

SECTION VI

6. Breakpoint Mode 6-1
6.1 Breakpoint Setup 6-1
6.1.1 Function Setup 6-1
6.1.2 Sync Mode Selections 6-2
6.1.3 Break Sequence 6-2
6.1.4 Break History 6-2
6.1.5 Relative Time 6-3
6.1.6 Selected History Labels 6-3
6.1.7 Event Count 6-3
6.1.8 Break Conditions Setup 6-4
6.2 Breakpoint Review 6-4
6.3 RS-232 Download of Break History Data 6-7
6.4 Break History Transmit Function 6-8
6.5 Synchronization with Other DATATRACS 6-9

SECTION VII

7.0 Bite Mode 7-1
7.1 Bite Setup 7-1
7.2 CFDS Operation 7-3
7.2.1 CFDS Normal Mode 7-3
7.2.2 CDFS Menu Mode 7-4
7.3 CMC Bite Operation 7-6
7.3.1 Ground Test 7-8
7.3.2 Shop Fault Menus 7-9
7.4 737-Bite Mode 7-9
7.5 Review of Saved Menu Screens 7-12
7.6 RS232 Download of Saved Screens 7-13

SECTION VIII

8.0 Maintenance 8-1

APPENDICES

Appendix A - RS-232C A-1

Appendix B - DATATRAC 400H SPECIFICATIONS B-1

Appendix C - ENGINEERING SCALING DEFINITIONS C-1

Appendix D - DATATRAC 400 ASSOCIATED PRODUCTS D-1

Appendix E - MAINTENANCE WORD DEFINITIONS E-1

Appendix F - EQUIPMENT ID's F-1

Appendix G - WILLIAMSBURG PROTOCOL ANALYZER G-1

SECTION I

1. FEATURES OF THE DATATRAC 400H

This manual is furnished to customers of Aeroflex to provide detailed instructions for the operation of the DATATRAC 400H ARINC 429 data 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 400H are discussed in the paragraphs below.

1.1 OPERATIONAL DESCRIPTION

The DATATRAC 400H is a two receive channel and one transmit channel ARINC 429 bus analyzer. It is a small, hand-held, battery operated version of the earlier DATATRAC 400 bus analyzer.

The main modes are Receive, Transmit, Record, Break, and BITE. The DATATRAC 400H also has an optional Williamsburg Protocol Analyzer Mode.

The Receive mode allows data to be read from either of two 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 the following formats: hex, binary, engineering (standard and user defined), ASCII, and graphic time plots. Data can be downloaded via an RS-232 port and a D/A converter port.

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

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

The break mode allows for trapping intermittent conditions and reviewing data collected in memory. Multi-level break conditions can be defined for trapping data.

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

A specification sheet is provided for quick reference in Appendix B.

1.2 PHYSICAL CONFIGURATION

1.2.1 GENERAL

The DATATRAC 400H is packaged in a gray colored ABS plastic/EMI metal shielded enclosure. A black padded vinyl carrying case is included.

1.2.2 FRONT PANEL DESCRIPTION

The front panel configuration shown in Figure 1 contains a LCD and a keyboard area.

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. An EL Backlight is present to provide backlighting for improved viewing in low light situations.

Keyboard

Three keyboard areas are located to the right of and below the display. The first is a horizontal row of five function keys: Receive, Transmit, Record, Break, and BITE (RCV, XMT, RCD, BRK, and BITE). The next key area consists of a 4 x 4 hexadecimal keypad, the Escape (ESC), the Clear (CLR), and the ENTER keys for general data entry. The third key area consists of the four cursor control keys. These four buttons are 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 or screen.

1.2.3 RIGHT-HAND SIDE PANEL DESCRIPTION

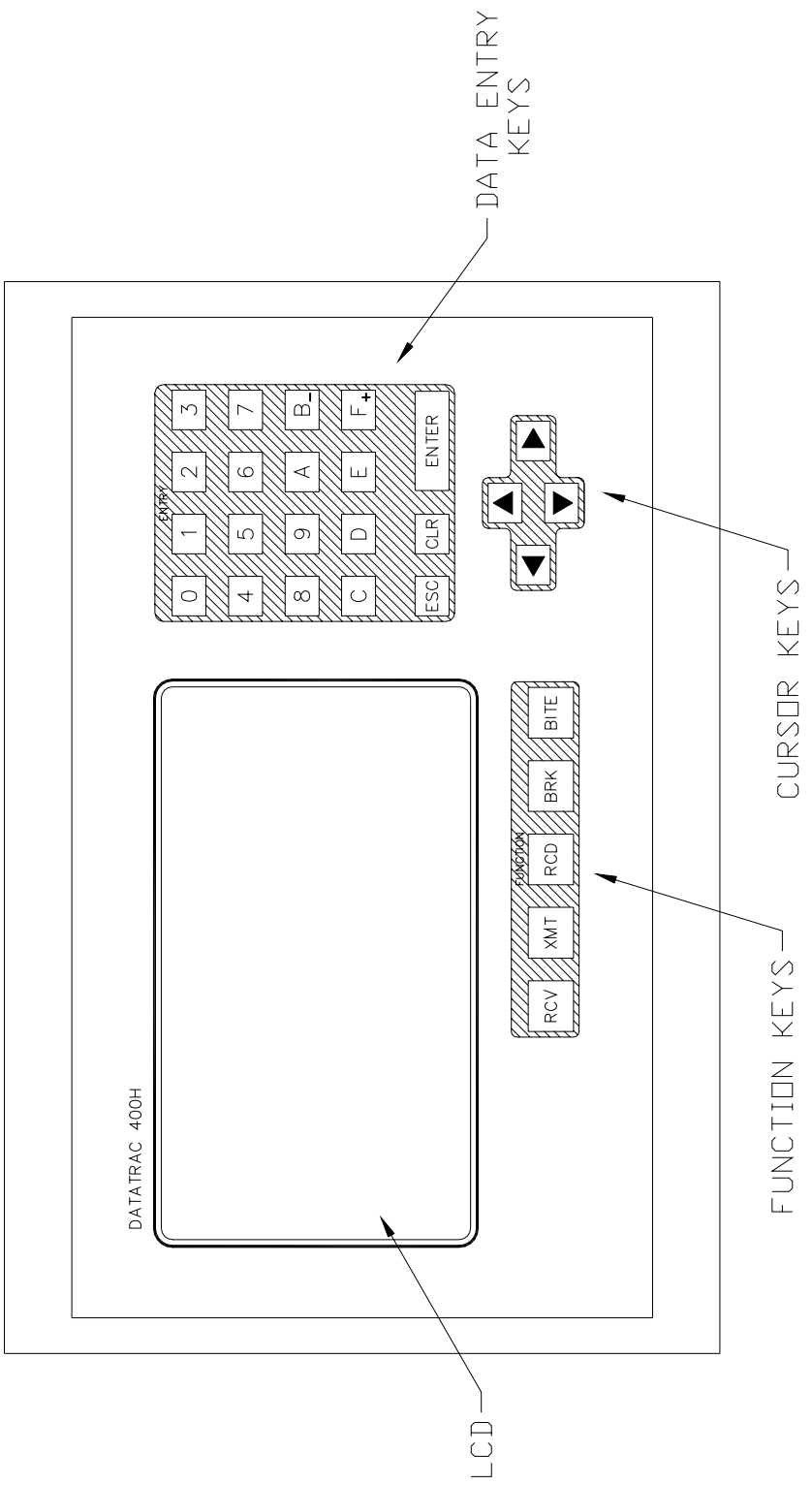
The right-hand side panel shown in Figure 2 contains the DC power switch, the LCD contrast control, the On/Off switch for the EL Backlight, the databus connectors, the DAC port connector, the low battery LED, and the DC input power connector.

DC Power Switch

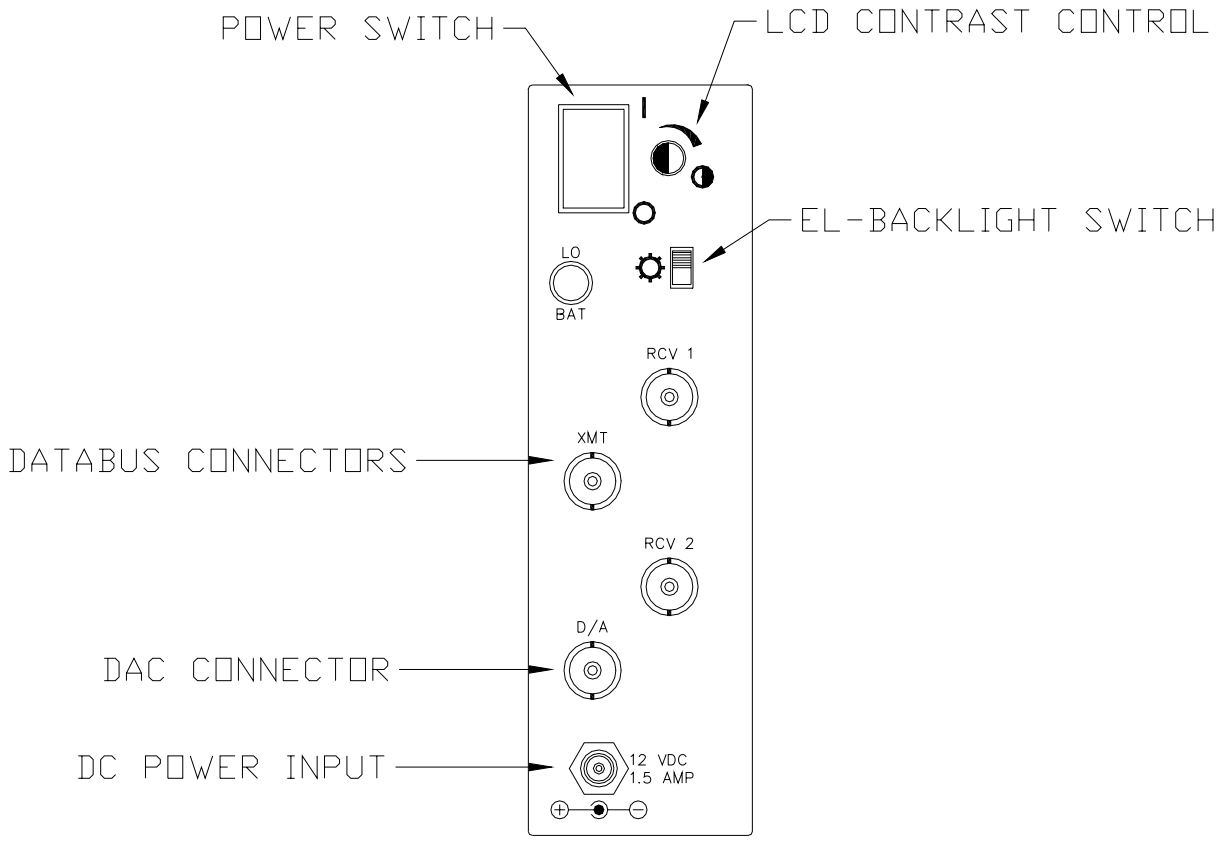
A DC power switch applies power to the display and all electronic circuits.

LCD Contrast Control

The contrast control for the display is located below the DC power switch on the right-hand side panel. This may be adjusted at any time to optimize the viewing of the display.



FRONT PANEL ILLUSTRATION
FIGURE 1



RIGHT-HAND SIDE PANEL ILLUSTRATION
FIGURE 2

EL-Backlight Switch

An On/Off slide switch for the EL-Backlight is provided to aid in the viewing of the LCD in different lighting conditions. The EL-Backlight is recommended for low-lighting conditions. When the unit is operated from the internal battery, the battery life is reduced by approximately 25% when the EL-Backlight is ON.

Databus Connectors

Three BNC connectors provide the databus interfaces for the two input receiver channels and one output transmit channel. 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.

DAC Connector

A BNC connector is located on the right-hand side panel and provides a DAC (digital to analog converter) channel that can be configured by the operator to output converted data or a trigger pulse. The inner conductor is the signal side; the outer conductor is connected to ground.

LOW-BATTERY LED

A flashing LED indicates when the DT400H battery is low. Depending on operating conditions, there is 15 to 30 min of remaining charge in the battery.

DC Power Input

An input jack for applying 12 VDC power is on the lower right-hand side panel. An external ac power adapter is provided with each DATATRAC 400H unit. Either a 120 V ac, 60 Hz or a 230 VAC, 50 Hz adapter is available. Either adapter will provide a 12 V, 1.5 A, power source for unit operation or battery charging. The positive source is connected internally to the center conductor. The ground return is connected to the outer conductor.

**********WARNING**********

Since there are many different DC adapters provided with many different types of electronic equipment, the user should be careful to only use the DC adapter that was provided with the DATATRAC 400H unit. USING THE WRONG ADAPTER COULD CAUSE DAMAGE TO THE UNIT. Replacement or additional spare DC adapters are available from the Aeroflex sales department.

****

1.2.4 LEFT SIDE PANEL

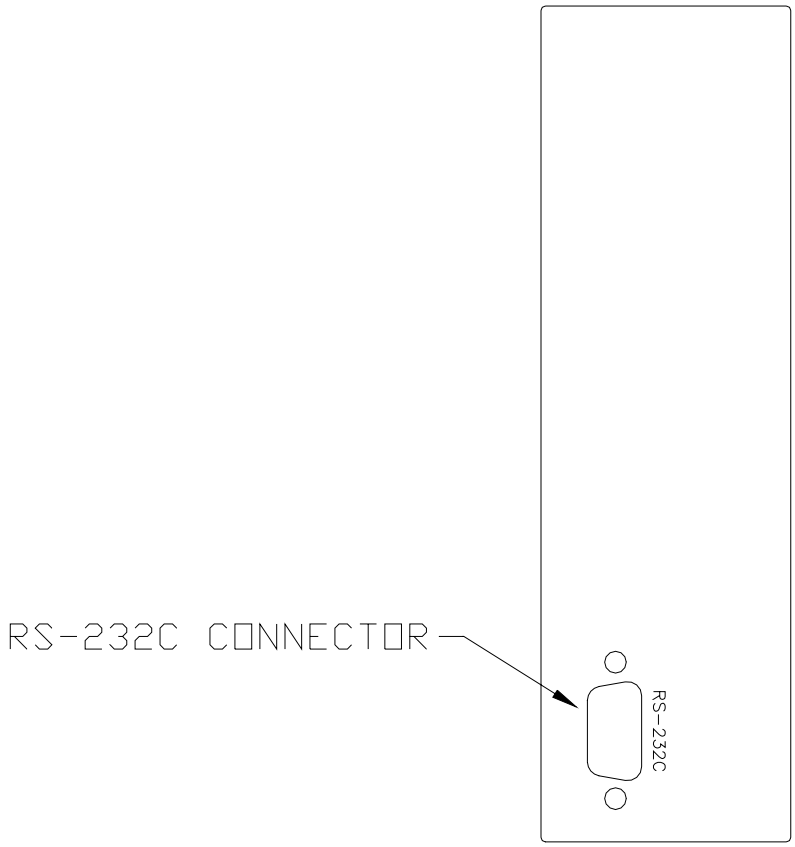
The left-hand side panel shown in Figure 3 contains the RS-232C connector and the serial tag.

RS-232C Connector

An RS-232 connector is located on the left-hand side panel and can be configured by the operator to output received data in several of the operational modes. Appendix A contains detailed information on interfacing this output to other RS-232C devices.

Serial Tag

The unit's model description, DATATRAC 400H, appears on the front of the unit and identifies it as an ARINC 429 bus analyzer. A serial tag on the left-hand side panel provides serial number information. This serial tag must remain attached to the unit and referred to when reporting problems to Aeroflex personnel.



LEFT-HAND SIDE PANEL ILLUSTRATION
FIGURE 3

1.2.5 INTERNAL ARCHITECTURE

Internally, the DATATRAC 400H unit contains two inter-connecting printed circuit boards, a rechargeable NiCAD battery pack, and cable interconnects to the front panel and right-hand side panel.

1.2.6 DISASSEMBLY/ASSEMBLY INSTRUCTIONS

Several stages of disassembly are identified and described in the following paragraphs. All steps refer to the exploded view provided in Figure 4.

WARNING

Before disassembly, remove all power connections and turn the unit's DC POWER SWITCH to OFF. For the following steps, exercise extreme caution to prevent electrostatic damage to the CMOS components contained on the circuit boards. The unit should be on a grounded surface, the operator should be grounded, and boards should be stored in electrostatic bags for their protection. Also be careful that the battery cable does not come in contact with any circuits after it has been disconnected.

1. Remove the four recessed screws from the bottom of the case.

2. Lift off the top of the case and rotate it down to allow access to the internal cables and the A1 board. This provides access to the two EPROMS used for main program and constant storage. If a software update is being performed, these socketed devices may be changed and further disassembly steps ignored.

3. Unplug the 5 pendant cables/connectors from the A1 board.

4. Remove the 5 mounting screws securing the A1 board. Carefully lift it out of the unit by pulling up on it's lower left hand corner and sliding it to the left, observing that there are no mechanical interferences.

5. Remove the screws and nuts securing the battery bracket and the battery pack to the bottom of the case. Lift off the bracket and remove the battery pack.

6. Remove the 5 standoff screws from the A2 board. Lift the two side panels and the A2 board out of the bottom case as a single assembly.

7. Separate the left side panel from the board. Remove the screw securing the heat sink on the A2 board to the right side panel assembly and separate this panel from the board.

   Assembly steps are the reverse of the above disassembly steps.

1.2.7 CPU/RECEIVER BOARD A1

1.2.7.1 THEORY OF OPERATION

The CPU/A429 Receiver board contains the main system processor, RAM memory, EPROM memory, keyboard interface circuits, system clock circuits, and the dual channel ARINC 429 receive channels. An Actel 1020 FPGA implements the interface circuitry.

Microprocessor - A 65C102 microprocessor operating at a clock speed of 4 MHz performs keyboard and display interface functions as well as data receive function. It interfaces with other circuits via a 16 bit address bus and an 8 bit data bus.

RAM Memory - RAM memory consists of two segments : base RAM and segmented RAM. Base RAM is implemented in U6, an 8 k x 8 device, using only 3 k x 8. This is mapped as the first 3 k of memory and serves as the working RAM for general software operations. It is also used to store setup parameters during power down periods. Segmented RAM (U10) consists of a 128 k x 8 area organized as 32, 4-k segments that are selected via a data latch (U13). This large storage area is used for received data, recorded data, break history data, and transmit table.

ROM Memory - ROM consists of two areas : main ROM ands segmented ROM. Main ROM (U8) is a 27C512 (64 k x 8) device. The memory is mapped into address space 4000-FFFF, and is addressed directly. It is used exclusively for program storage. Segmented ROM (U11) is a 27C2001G (256 k x 8) device. It consists of 32 pages each containing 8 k x 8 segments of memory. Addressing is performed by writing the page to latch U14 and then directly addressing the memory area 2000-3FFF. The segmented ROM contains executable code, constants and tables used by the program.

Keyboard Interface Circuits - Two keyboard decoder chips (U22, U34) decode the keyboard inputs and latch (via U23) the data to the 8-bit data bus. U22 is used for keys 0-F while U34 is used for the function keys. A keyboard interrupt is generated whenever a key is pressed or released. A key repeat circuit is implemented by bringing the KEYON signal (the OR of the DATA AVAILABLE outputs from U22 and U34) into a discrete input (implemented in the FPGA device). The processor can then detect a key being continuously pressed and provide display scrolling functions where appropriate.

The KEYDA2 signal is used to generate the FUNCTKEY signal which is then brought into a discrete input to denote when a function key versus a number key is being pressed (performed within the FPGA device).

Clock/Timer Circuit - The 82C54 timer chip (U9) provides a real-time clock for the system. The chip consists of 3, 16-bit timers that are cascaded to form one 48-bit timer. The clock is operating in decimal mode (BCD interface) with a resolution of 10 μs. The range is, therefore, 9 999 999.999 99 s. The timer is used to measure receive intervals and implement record intervals. A 16 MHz crystal (Y1) is used to generate a 16 MHz TTL clock for the microprocessor as well as a 100 kHz clock signal. The 100 kHz clock is used by the timer chip (U9) and the transmitter boards (which then generates other required frequencies).

Interrupt Controller - The receiver interrupts (1-2), the keyboard interrupt, and the timer interrupt are combined in the FPGA device to form the IRQ interrupt to the processor. These signals are also input to a discrete input latch (FPGA device) which is polled by the processor to determine the interrupt source. The interrupts are prioritized by the software with the following order ; RCV1, RCV2, Timer, and Keyboard.

I/O Decode - The Actel FPGA device (U21) is used to generate I/O signals for devices on the CPU card, Front Plane, and Transmit Board interface.

Discrete Input Latch - A discrete latch (FPGA) is used for various inputs to the processor. These include DOR 1-2, which are the Data Out Ready lines from each of the receive channels. These enable the processor to check the status of the Receiver FIFO's. The XMTRDY signal provides the status of the transmit board interface FIFO indicating whether it is ready to accept data. The 2 keyboard discrete inputs were described above. The XMTSYNC signal is from the transmit board indicating loss of synchronization in reading the FIFO data. (The CPU responds by sending a synchronization stream and resending all of the transmit data).

ARINC 429 Receiver Channel - Two similar ARINC 429 receiver channels are contained on the CPU/RCV board. While reference is frequently made to channel 1 components, the following description applies to both channels (refer to the schematic). The front-end receiver circuit will receive the ARINC 429 signal with an input voltage in the range from ±6.5 VDC to ±13.5 VDC (differential from A to B). The input waveform is converted to a NRZ data stream and a corresponding clock signal. At this point and beyond, all signals are HC-CMOS logic levels. A shift register (U26) converts the data from serial to 8-bit parallel data and then loads this into a set of FIFO chips (U24, U25) which buffers the data to the 8-bit microprocessor data bus (64 bytes of buffer memory is available). Synchronization (byte and word) of the data is controlled by two counter chips (FPGA, U19A) and a mono-stable multi-vibrator (U27A) which controls synchronization between 32-bit words. Rxspd-1 is set by software to a logic '1' to receive a low speed bus (12.0-14.5 kHz) and to a logic '0' to receive a high speed bus (100 kHz). Receiver operation will not be accurate for a word gap less than 3 bit times. Each time a data byte is latched into the FIFO, the corresponding byte count (1, 2, 3, or 4) is latched into a third FIFO (U18). An interrupt to the processor is generated each time a full 32-bit word had been loaded into the FIFOs. The processor reads data by writing a logic '0' to the Output Enable (OE) input on the FIFOs. After each data byte has been read, the Shift Out (SO) input of the FIFOs must be strobed to cause the next byte to shift to the output. The processor will continue to read data from the FIFOs until the Data Out Ready (DOR) signal goes low, indicating that the FIFOs are empty.

DAC Circuit - The DAC circuit consists of an AD7248 DAC chip interfacing directly to the data bus, address bus, and the I/O decode line. The AD7248 is a complete voltage output 12-bit digital-to-analog converter which includes a high stability buried zener voltage reference and an on-chip output amplifier. A double-buffered input latch on the chip allows a direct interface to the 8-bit microprocessor bus. The output is configured for a ±5.0 VDC range.

1.2.8 TRANSMIT/POWER SUPPLY BOARD A2

1.2.8.1 THEORY OF OPERATION

The A2 board contains the circuitry for the ARINC 429 transmit channel, the power supply, and the RS-232 port.

The transmit circuitry contains its own microprocessor, RAM, EPROM, timer, I/O decode, main CPU interface FIFO, 1 ARINC 429 transmit channel, and the RS-232C circuit.

Microprocessor and associated circuits - The processor (U22) is a 65C102 operating at a clock speed of 4 MHz. RAM memory consists of a single 8 k x 8 device (U25), and ROM memory (U21) is implemented with a 27C256 (32 k x 8) EPROM device. A single I/O decode IC (U24) provides eight address decode signals used as chip enables for various devices interfacing with the data bus. An 82C54 timer chip (U23) allows interrupts to be programmed by software. Only one of the three 16 bit timers is used to control transmit intervals.

CPU/Transmit board interface - An 8 bit x 64 byte FIFO (located on the CPU [A1] board) is used to transfer data from the main CPU board to the transmit board. The writing of the data to the FIFO is controlled by the CPU while the unloading of data is handled by the transmit processor. An interrupt is generated when a byte is ready at the FIFO output.

Transmit channel - The single ARINC 429 transmit channel can be programmed for high or low speed and operate simultaneously with the 2 receiver channels. The timer chip channel 0 is set up to interrupt the processor at the fastest transmit interval. Each time a timer interrupt is received, the first transmit word is loaded into hardware. Up to 16 words are initially loaded into the transmit FIFOs (U28, U30). Each time a complete word has been transmitted, a transmit interrupt is generated to the processor. If more than 16 words are to be transmitted, another word will be loaded when the interrupt is received. This continues until all words have been loaded to the FIFOs. The U17A counter acts as a bit counter, and the U18A counter acts as a byte counter. The U11A flip-flop enables the transmit clock to clock data. When the signal, TXRES, is high, data transmission is enabled.

RS-232C Circuit - The RS-232C circuit is used to output recordings of on-line received data to external devices. Bytes are written by the processor to UART 65C51 (U33) and clocked as NRZ serial data for output by the drivers Maxim 325 (U31). The baud rate is set to 9600 baud by software. The output drivers and input receivers use a Maxim 235 device with an enable signal. This enable signal allows software to control the state of the device. By disabling the device when not in use, power consumption is reduced. This signal should be set to ground or logical ‘0’ to enable the device.

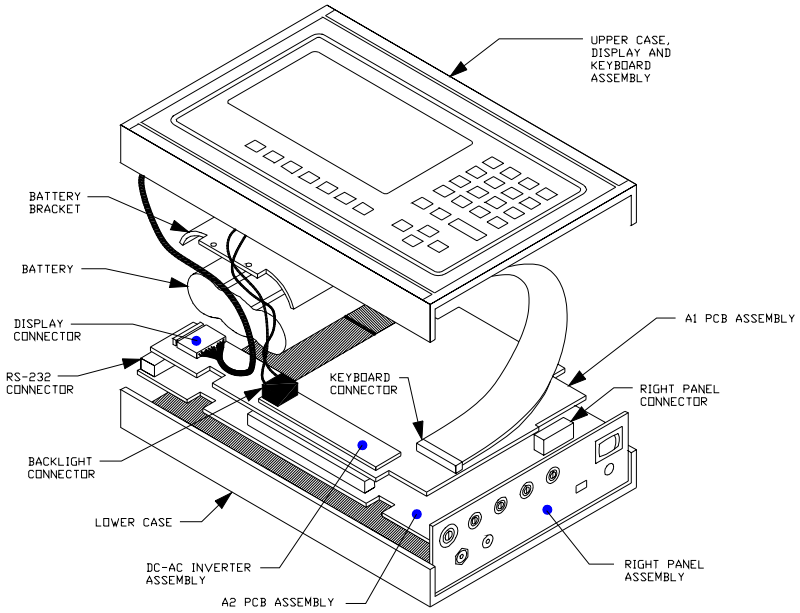
POWER SUPPLY CIRCUITRY

The power supply circuit accepts an unregulated 12 VDC input generated from the external 120 V ac or 230 V ac power adapters specified for use with the DATATRAC 400H. Alternately, an internal 7.2 VDC NiCad battery may be used to power the unit. The external power source supplies a battery charging circuit as well as directly powering the unit.

A two level charging scheme supplies 280 mA (220 mA to 330 mA) in high charge mode and 60 mA (40 mA to 120 mA) in maintenance charge mode. The maintenance level can be applied to the NiCad battery indefinitely. Switching between the two charge modes occurs when the comparator senses the battery voltage mode has increased above an 8.5 VDC level. A feedback signal from the DC power switch causes the battery to be trickle charged when the unit's DC power switch is ON and charge at a higher current mode only when the power switch is OFF.

The external DC source voltage and the internal battery voltage are diode isolated from each other and both drive the DC power switch input point. The downstream side of the DC power switch provides a nominal 8 VDC level to a 5-V linear regulator and a step up DC to DC converter. This DC/DC converter provides a nominal ±15 VDC output. The +5 VDC, +15 VDC and –15 VDC are the main power supplies for the rest of the unit's circuits.

In addition to the three supplies, several other output parameters are provided. A negative logic reset signal for the microprocessor is developed using a delay on the 5-V supply. When the 5-V supply is switched on, the RESETF logic will immediately be low, holding the microprocessor and other devices in the reset condition. After a short delay implemented by R109 and C30, RESETF switches to the high state enabling operation of the processor circuits. A power down logic signal (PWRDWN) is developed using a Maxim 693 device (U5) by comparing the output of the main power switch with a reference voltage from the battery. The PWRDWN logic signal is intended to provide ample warning of the loss of 5-V power to permit disabling of RAM circuits (for memory retention) before a reset. A VCC supply for RAM up (VRAM) is developed using the Maxim 693 devices. It monitors the battery and VCC voltage to always maintain voltage to the RAM devices.

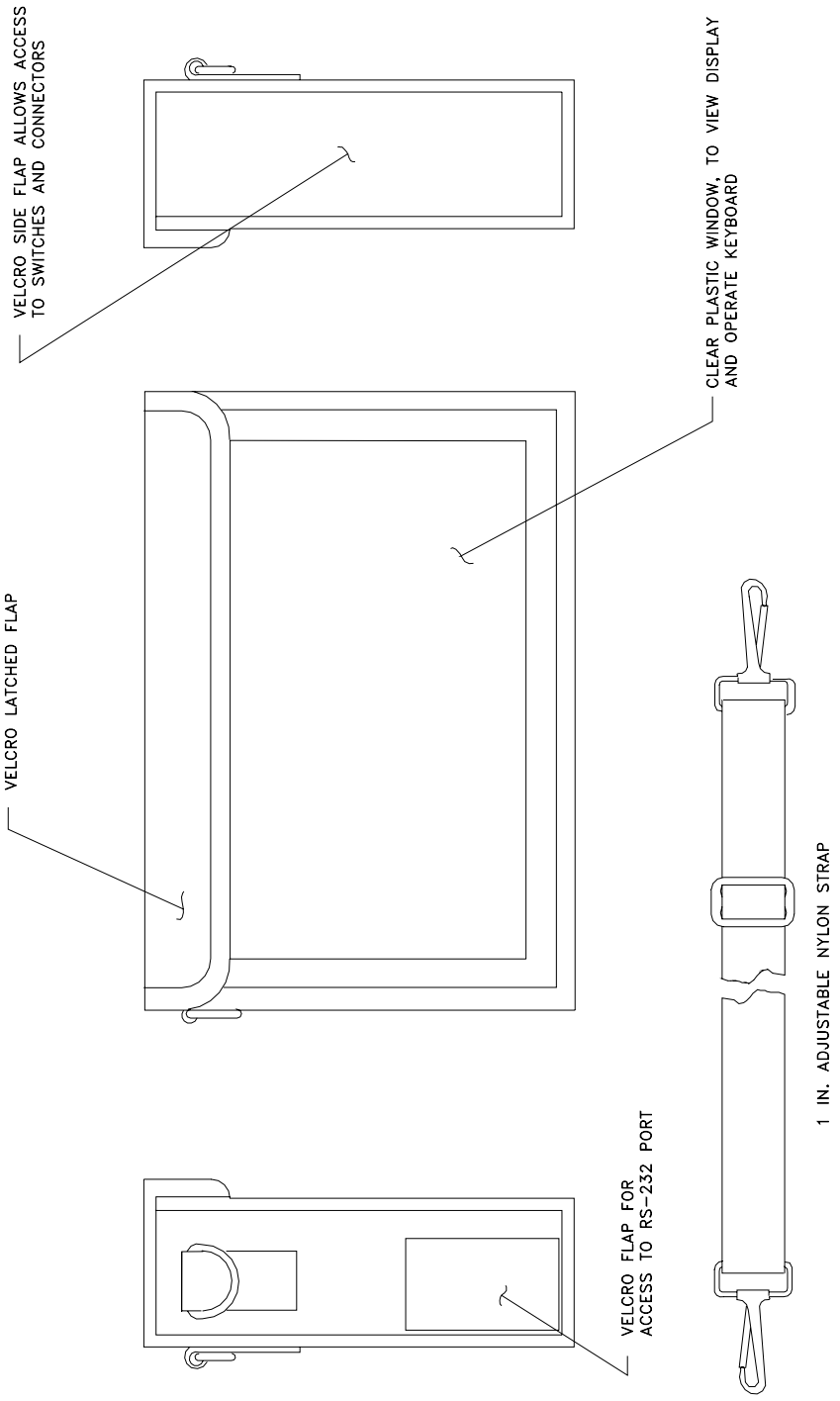


INTERNAL CONFIGURATION ILLUSTRATION
FIGURE 4

1.2.9 PADDED CARRYING CASE

A black padded vinyl carrying case is provided with each DATATRAC 400H. This padded case allows viewing and operation of the unit through a clear front panel and access to the databus ports and RS-232C port via Velcro side flaps. The DATATRAC 400H is kept well protected from the environment and handling during flight-line or various field service type activities.

The carrying case is illustrated in Figure 5.



PADDED CARRYING CASE ILLUSTRATION
FIGURE 5

1.3 INTERNAL BATTERY POWER

In addition to the external DC adapter, the DATATRAC 400H unit may also be operated from the internal battery. The battery is a 2.4 Ah rechargeable NiCAD battery. A fully charged battery will normally provide up to 8 h of operation. This battery is also used to retain RAM memory for an indefinite period (approximately 2 months shelf life on RAM memory backup). RAM memory will be retained even when the battery has discharged below the level required to operate the unit.

The internal battery can be recharged with the application of DC power (12 VDC). The charge function employs two levels for rapid and efficient charging. The higher level charges at a level of 240 mA for a period of 14-16 h for a fully charged battery. The lower maintenance level is at a level of 30-60 mA and may be left on indefinitely.

The charging circuit is operational when 12 VDC power is applied independent of the DC power switch in the ON or OFF state.

WARNING Equipment contains a rechargeable battery pack. Replace only with Aeroflex approved part per the appropriate parts list.

CAUTION Only Aeroflex provided power adapters are to be used with this product.

CAUTION Observe polarity of battery pack when installing.

SECTION II

2. INSTALLATION INFORMATION

2.1 UNPACKING AND INSPECTION

The DATATRAC 400H 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 400H unit
2. 12 V /1.5 A DC adapter (120 VAC or 230 VAC)
3. Black Padded Vinyl Carrying Case
4. Reference Manual

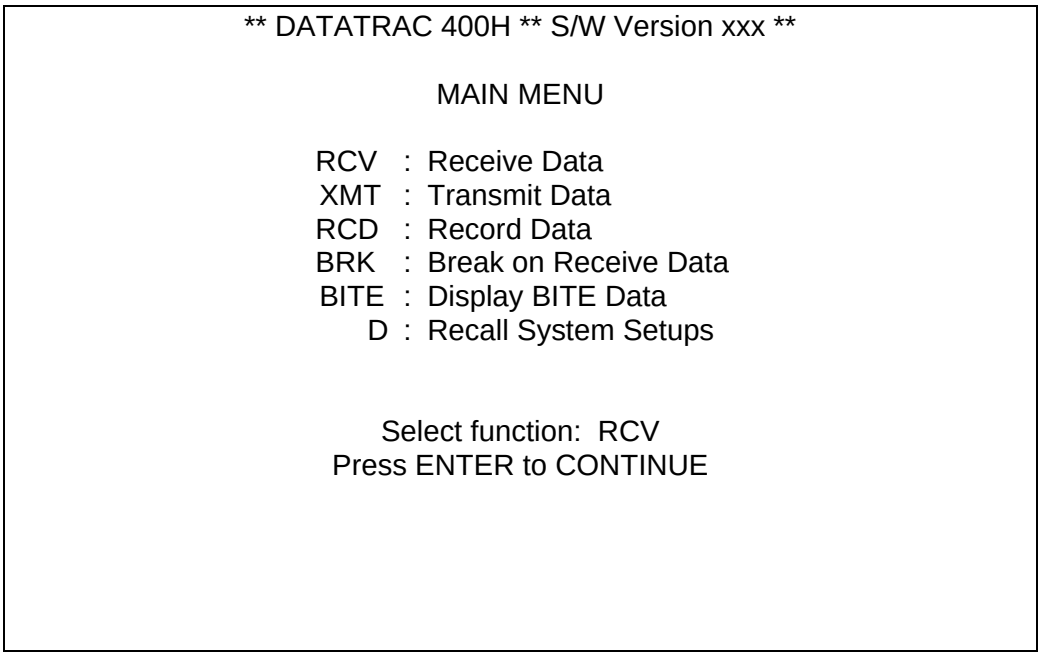
Inspect all items thoroughly for physical damage. If no damage is evident, connect the DC adapter to the unit and turn on DC power. A power on screen should appear on the display (see Section 2.2). If a problem is encountered at this point, contact an Aeroflex representative for assistance. DO NOT OPEN THE UNIT AND ATTEMPT REPAIRS AS THIS WILL VOID THE WARRANTY.

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 the DC adapter overnight before attempting to operate from the internal battery. The battery will be charged with the unit's DC power switch in either the ON or OFF position.

2.2 GENERAL POWER ON PROCEDURES

External power (DC) can be applied or the unit can be operated on the internal battery.

After turning the DC power 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 400H unit is always displayed on the first line of the power on menu (xxx). This information may be useful when reporting problems experienced in the field.

The desired function can be selected from the list of options by pressing one of the five function keys, or the D key (for recalling system setup tables) from the hexadecimal keypad. When the desired selection is displayed on the screen, the user “enters” the choice by pressing the ENTER 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 setup screen and a real-time data display screen. There are also various help screens associated with each setup parameter. The real-time screen may also be shared by a transmit channel if turned ON. Additional setup screens are provided for special modes that may be selected.

3.1 RECEIVER SETUP

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

RECEIVER SETUP

MAIN MENU

Channel :	1	Data format :	ENG
On/Off :	OFF	Interval :	INST
Bus Speed :	12.5	RC Download :	NONE
Select Lbls :	ALL	Display Lines :	00
Equip ID :	002	Bus Monitor :	4

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

Press ENTER 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 ENTER key may be pressed to continue to the data display (real-tine) screen.

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

The ESC (escape) key allows control to return to the Main Menu screen. This permits accessing the system setup recall function (since there is no dedicated key for this function).

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 ENTER.

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 < (left arrow) key.

3.1.1 RECEIVE CHANNEL SELECTION

This setup line allows the user to select channels 1 or 2. The channel maybe selected by typing the channel number directly or by using the > (right arrow key to step through the options. Once a channel has been selected, all other parameters selections will apply only to that channel. This allows each individual channel to be uniquely configured. Below is the help menu for this setup line :

3.1.2 RECEIVE CHANNEL ON/OFF

RECEIVER HELP SCREEN

Receiver Channel Selection:

1 – To select channel 1
2 – To select channel 2

Press ENTER to return to setup screen

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 ENTER 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. Below is the help screen for this parameter :

* RECEIVER HELP SCREEN *

Receiver Bus Speed Selection:

12.5 – To select 12.5 KHz low speed bus.

100 – To select 100KHz high speed bus.

Press ENTER 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 RECEIVER 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 SDI's are displayed in 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 Selection:

ALL – Display incoming labels for current channel.

SEL – Display previously selected labels for current channel.

EDIT – Setup/edit selected labels.

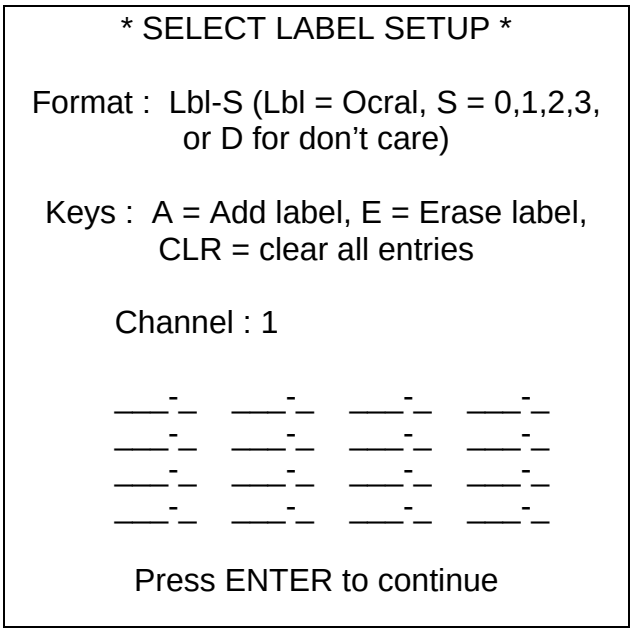
Press ENTER to return to setup screen

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 of the data in an order other than numerical by label (as is done in ALL mode). This permits the viewing of two related labels next to each other instead of having to scroll the display from one label to the other.

To utilize this feature, the operator must first define which labels are to be displayed and the order they are to be displayed in. This is done in Select Label Setup screen. This screen is accessed by selecting EDIT as the Select Lbls option and pressing enter. The following menu then allows the user to enter new labels or edit previously entered labels. The cursor 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) a label 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 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-400H contains a full implementation of the ARINC 429-12 specification for standalone 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 IDs supported.

Equipment ID codes are three-digit hexadecimal values. A new value is directly entered using the 0-F keys.

Appendix C contains a complete definition of the scaling for each ARINC 429 Label/Equipment ID pair.

Below is the help menu listing of all currently defined equipment ID codes that are supported by the DATATRAC 400H :

* HELP SCREEN * Equipment ID Codes *
Press ^,v,B,F, to scroll list
Press ENTER 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
011	Airborne VOR Receiver
012	Airborne ADF System
016	Airborne VHF Comm. Receiver
017	DEFDARS-AIDS
018	ATC Transponder
019	Airborne HF/SSB System
01A	Elect. Supervisory Cntrl. (EEC, PMC)
01B	Digital Slat/Flap Computer (A310)
01C	Engine Parameter Digitizer
01D	A/P & F/D Mode Cntrl. Panel (757/767)
01E	Performance Data Computer (B-737)
01F	Fuel Quantity Totalizer
020	DFS System
023	Ground Prox. Warning System
024	ACARS
025	Electronic Flt. Instruments
026	Flight Warning Computer
027	Microwave Landing System
029	ADDCS and EICAS
02A	Thrust Management Computer
02B	Perf. Nav. Computer System (B-737)
02C	Digital Fuel Gauging System (A310)
02D	EPR Indicator (B-757)
02E	Land Rollout CU/Landing C & LU
02F	Full Authority EEC-A
030	Airborne Separation Assurance System
031	Chronometer
032	Pass. Entertainment Tape Reproduce

033	Propulsion Multiplexer (PMUX)
034	Fault Isolation & Detection System
035	TCAS
036	Radio Management System
037	Weight and Balance System
038	ADIRS
039	MCDU
03A	Propulsion Discrete Interface Unit
03B	Autopilot Buffer Unit
03C	Tire Pressure Monitoring System
03D	Airborne Vibration Monitor
03E	Center of Gravity Control Computer
03F	Full Authority EEC-B
040	Cockpit Printer
041	Satellite Data Unit
04A	Landing Gear Position Interface Unit
04B	Main Electrical System Controller
04C	Emergency Elec. System Controller
04D	Fuel Qty. Indicating Sys. (757/767)
04E	Fuel Qty. Indicating System (747)
05A	Fuel Qty. Indicating System (A-320)
05B	Cargo Smoke Detection Unit (A-320)
05C	Cabin Pressure Unit (A-320)
05D	Zone Controller (A-320)
05E	Cargo Heat (A-320)
05F	CIDS (A-320)
06A	AMU (A-320)
06B	Battery Charge Limiter (A-320)
06C	Flt. Cont. Data Concentrator (A-320)
06D	Landing Gear Prox. (A-320)
06E	Brake Steering Unit (A-320)
06F	Bleed Air (A-320)
07A	APU Engine Control Unit (A-320)
07B	Engine Interface Unit (A-320)
07C	FADEC Channel A (A-320)
07D	FADEC Channel B (A-320)
07E	Central. Fault Data Interface Unit
07F	Fire Detection Unit (A-320)
08A	Window Heat Computer (A-320)
08B	Probes Heat Computer (A-320)
08C	Avionics Cooling Computer (A-320)
08D	Fuel Flow Indicator (B-747)
08E	Surface Position Digitizer (747-400)
08F	Vacuum System Controller

0A1	FCC Controller
0A2	FMC Controller
0A3	Thrust Rating Controller
0A4	IRS Controller
0A8	Airborne WXR Controller
0A9	Airborne DME Controller
0AA	Generator Control Unit (A-320)
0AB	Air Supply Control & Test (747-400)
0AC	Bus Control Unit (747-400)
0AD	ADIRS Air Data Module
0AE	Yaw Damper Module (747-400)
0AF	Stabilizer Trim Module (747-400)
0B0	Airborne ILS Controller
0B1	Airborne VOR Controller
0B2	Airborne ADF Controller
0B6	VHF COM Controller
0B8	ATC Transponder Controller
0B9	HF/SSB System Controller
0BA	Power Supply Module (747-400)
0BB	Flap Control Unit (747-400)
0BC	Fuel System Interface Card (747-400)
0BD	Hydraulic Qty. Monitor Unit (747-400)
0BE	Hydraulic Interface Module (747-400)
0BF	Window Heat Control Unit (747-400)
0C2	PVS Control Unit
0C3	GPWS Controller
0C5	EFI Controller
0CA	Brake Temp. Monitor Unit (747-400)
0CB	Autostart (747-400)
0CC	Brake System Control Unit (747-400)
0CD	Pack Temperature Controller (747-400)
0CE	EICAS/EFIS Interface Unit (747-400)
0CF	Para Visual Display Comp. (747-400)
0DA	Prox. Switch Electronics (747-400)
0DB	APU Controller (747-400)
0DC	Zone Temp. Controller (747-400)
0DD	Cabin Pressure Controller (747-400)
0DE	Windshear Computer (Sperry)
0DF	Equipment Cooling Card (747-400)
0EA	Misc. Environment Control (747)
0EB	Fuel Jettison Control Card (747)
0EC	Advance Cabin Entertain. Serv. Sys.
0ED	Fuel System Controller (MD-11)
0EE	Hydraulic System Controller (MD-11)
0EF	Environ. Sys. Controller (MD-11)

0FA	Misc. System Controller (MD-11)
0FB	Anti-Skid System (MD-11)
0FC	Cabin Press. Control System (MD-11)
0FD	Air Condition Control System (MD-11)
0FE	Pneumatic Control System (MD-11)
0FF	Manifold Fail. Detect. Sys. (MD-11)
10A	Full Authority Engine Control A (GE)
10B	Full Authority Engine Control B (GE)
10C	APU Controller
10D	Data Loader
10E	Fire Detection Unit (MD-11)
10F	Auto Brake Unit (MD-11)
110	Multiplexer PES (A-320)
113	Stall Warning Card (747-400)
114	Fuel Unit Mgmt. System (A330/A340)
115	TACAN
116	Eng. Interface Vib. Mon. (A330/A340)
117	Engine Ctrl Unit Chan. A (A330/A340)
118	Engine Ctrl Unit Chan. B (A330/A340)
119	Centralized Maint. Comp. (A330/A340)
11A	Multi Disk Drive Unit (A330/A340)
123	Ground Power Ctrl Unit (A330/A340)
124	Fuel Management Computer (A330/A340)
125	CG Fuel Control Computer (A330/A340)
126	Circuit Breakers Monitor (A330/A340)
127	Elec. Contr. Mgmt. Unit (A330/A340)
128	Hydraulic Elec Gen Ctrl (A330/A340)
129	Hydraulic Sys Mon Unit (A330/A340)
12A	Cargo Bay Conditioning Card (747)
12B	Predictive Windshear System Sensor
136	Audio Management System
141	Satellite RF Unit
15A	Flight Data Interface U. (A330/A340)
15B	Flight Control Unit (A330/A340)
15C	Flight Ctrl Primary Comp (A330/A340)
15D	Flight Ctrl Second Comp (A330/A340)
15E	Flight Mgmt Guidance Env. (A330/A340)
16A	Display Unit (A330/A340)
16B	Display Mgmt Computer (A330/A340)
16C	Head-Up Display Computer (A330/A340)
16D	ECAM Control Panel (A330/A340)
16E	Clock (A330/A340)
17A	Cabin Ventilation Ctrlr (A330/A340)
17B	Smoke Detection Ctrl U. (A330/A340)
17C	Proximity Sensor Ctrl U. (A330/A340)

18A	Audio Control Panel (A330/A340)
18B	Cockpit Voice Recorder (A330/A340)
18C	Pass. Ent. Sys Main MUX (A330/A340)
18D	Pass Ent Sys Audio Repro (A330/A340)
18E	Pre-rec Announce Mus Rep (A330/A340)
18F	Video Control Unit (A330/A340)
241	High Power Amplifier
341	Satellite ACU
F00	Special : ECAM (A310)
F01	Special : AVM (Boeing 757)
F02	Special : EIS (Boeing 757)
F03	Special : FQIS (Boeing 757)

3.1.6 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 real-time 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 of modify the 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 Option:

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	- Real-time graphic plot

Press v for examples
Press ENTER to return to Setup

---

* RECEIVER HELP SCREEN *

Examples of Display Format Selection
Given the following sample ARINC word:

```
   Data :  Label 210          Equip. ID = 006
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 ENTER 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       10     1    0062
```

Press v for more examples
Press ENTER 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            10100110110011010000   10     1    0062

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

              Press ENTER 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 of the label definition as defined in the ARINC 429-16 specification. Note above that the ENG header line contains an "11" just to the left of the data fields. 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.

3.1.6.1 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 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, ACSII, and the direct data display formats HEX19L. HEX19M, HEX32, BIN19L, BIN19M, and BIN32. When the operator selects EDIT at the Data Format setup line, the following screen is presented for the defining the data format :

```
* USER DEFINED DATA FORMAT *

        Format Number :  00
          Equipment ID :  000
                 Label :  - - -
                Format :  HEX32



Press ENTER to return to set up screen
```

The format number serves as an index to access the 16 different format definitions (00-15).

If the equipment ID is left as 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 one of the formats of BNR, BCD, or ASCII is 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 :  000
                 Label :  377
                Format :  BDC
    Max Digit (1, 3, 7, 9) :  7
  Number of Digits (0-6) :  5
Number of Discretes (0-7) :  0
                 Range :  123456.
                 Units :  USR

Press ENTER to return to set up screen
```

The Max Digit parameter is used to determine how many bits will be 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 a 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 zeroes 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
.012345

where 1-6 refer to the decoded digits. 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 400H will print keystroke instructions for incrementing or decrementing through the ASCII character 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 :

```
* USER DEFINED DATA FORMAT *

          Format Number :  00
            Equipment ID :  00
                   Label :  377
                  Format : BNR
         Full Scale Value :  4
    Number of Bits (6-20) :  18
Number of Discretes (0-7) :  0
                   Range :  123456.
                   Units :  USR

Press ENTER to return to Setup Screen
```

Full Scale Values 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 specifications. The > key is used to step through the options until the desired full scale value is displayed. The choices currently defined are (in the 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 most significant bit of the data is 28. Refer to the ARINC specifications for a complete description.

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

PADDED ASCII Encoding:

32	25	24	23	17	16	15	9	8
PAR	Char 3	PAD	Char 2		PAD	Char 1		Label

UNPADDED ASCII Encoding:

32	31	30	23	22	16	15	9	8
PAR	SSM	Char 3	Char 2			Char 1		Label

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

```
* USER DEFINED DATA FORMAT *

Format Number :  00
Equipment ID :  00
Label :  377
Format : ASCII
Character Boundaries :  PADDED


Press ENTER to return to Setup Screen
```

3.1.6.2 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 the GRAPH data format option in the default menu. When the ENTER button is pressed, the following screen is displayed :

TR1 CH1 L001-0 X1 +00%	_ _
TR2 CH0	_ _

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

CH# - Channel Number. The options are 0, 1, or 2. 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 the 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. D may be entered as a don't care (X) for the SDI.

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 form 00% to 99% (+/-) may be entered using the 0-9 keys (F/B key for sign). 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 msec it will take 20 seconds 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 trace mode.

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

ENTER 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, BRK, or BITE Control is passed to the setup screen of the selected function.

It is possible to display two separate plots simultaneously by enabling trace 2. 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 :

TR1 CH1 L001-0 X1 +00%	_	_	_	_	_	_	_	_	_
	_ _	_ _	_ _	_ _	_ _	_ _	_ _	_ _	_ _
	_	_	_	_	_	_	_	_	_
TR2 CH1 L001-0 X1 +00%	_	_	_	_	_	_	_	_	_
	_ _	_ _	_ _	_ _	_ _	_ _	_ _	_ _	_ _
	_	_	_	_	_	_	_	_	_

When two plots are enabled, the two sweeps will run on the same time base to permit time response comparisons. The speed is dictated by the receive time interval of trace 1. When a new data point is received and plotted for the label defined on trace 1, the data point plotted for trace 2 will be the last received value of the label defined for trace 2.

3.1.7 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 Selection:

  INST  - To display instantaneous
          Interval in msec
  MIN   -  To display minimum interval
  MAX   -  To display maximum interval


Press ENTER to return to Setup Screen
```

3.1.8 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 :

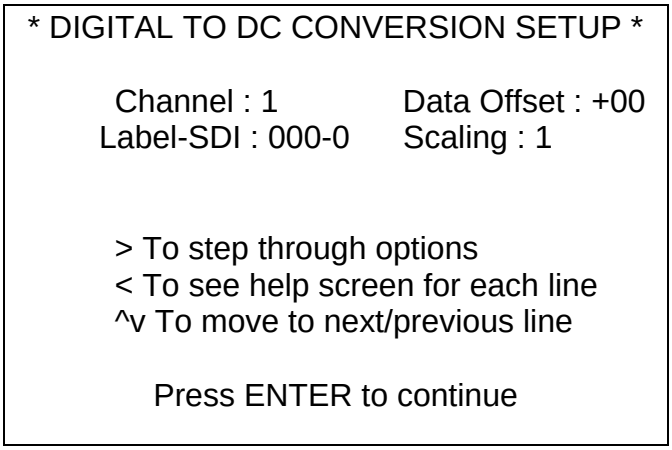
```
* RECEIVER HELP SCREEN *

Receive Data Download Selection:

  NONE   - Data download is disabled.

  DAC    -  Real-time digital to analog
            conversion of one label.

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

Press ENTER to return to Setup Screen
```

The following sections detail the two download utilities available.

3.1.8.1 DIGITAL TO ANALOG CONVERSION SETUP

The DATATRAC 400H is configured with one digital-to-analog converter port. The DAC is a 12-bit converter with a range of +/-5.0V.

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 setup 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 after pressing the ENTER key :



The first set-up line allows the user to select either channel 1 or 2 for the source of data.

The second set-up line allows the user to enter the label from the selected channel that will be output on the DAC port. The numeric keys should be used for the label entry. It is possible to enter a “don’t care” for the SDI (using the D key).

The data offset us expressed as a percentage of full scale from 0% to +/-99%. The F and B keys are used to enter the sign.

There are discrete settings for the scaling (data multiplier) of 1 (data left uncharged), 2, 4, 8, 16, 32, 64, and 128. The > key is used to step through these values and select the desired scaling.

3.1.8.2 DIGITAL TO RS-232 DATA CONVERSION

Real-time download of received data through the RS-232C port is enabled when the operator selects RS232 at the Receiver setup 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 = 9600bps

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 :

> * RS232 DOWNLOAD *
>
> Make sure the RS232 port is connected properly and that the RS232 receive port is ready to accept data. Press ENTER to begin download of 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 400H is unable to wait for the host. If the DATATRAC 400H 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 ENTER is pressed at the screen above and the DATATRAC 400H will return to the Receiver Setup screen. An attempt to proceed to the real-time display will again present the above message. To cancel the download, the operator must 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 ENTER from the Receiver Setup screen to proceed to the real-time screen will the DATATRAC 400H check to see if the RS-232 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 or 2)
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, Data2, and Data3 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 msec to 000,000 msec 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 msec per record. Thus for a single label, a transmit interval less than 9 msec would cause an RS-232C overflow resulting in incorrect data being downloaded.

3.1.9 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 (including both receive and transmit) 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)

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

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 enables channel(s) (receive or transmit) by an equal amount so as to maintain the maximum total for the number of enabled channels listed above. Below is the help screen for this setup line :

* 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 or 9 for 1, 2, or 3 channels active, respectively.

Press ENTER to return to setup screen

3.1.10 RECEIVE BUS MONITOR SENSITIVITY SELECTION

The DATATRAC 400H 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 :

* RECEIVER HELP SCREEN *
Bus Activity Monitor Selection
Specifies the time period, in multiples of most recent received rate, that the unit waits before flagging a label as overdue. An * appears next to the last rate value.
Press ENTER to return to setup screen

The > key is used to step through the options.

3.2 REAL-TIME DATA DISPLAY SCREEN

The real-time data display screen is invoked any time the operator presses ENTER from the receive setup or transmit setup 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 the transmit channel also. For a description of the transmit data editing features on the real-time screen, refer to section 4.3.

3.2.1 DATA DISPLAY

The real-time screen consists of channel “windows.” There are up to three windows for each enabled receive and/or transmit channels.

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 1—(ALL)----------12.5 KHz

Lbl	SDI	29—Binary Data—11	SSM	PAR	Msec
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
350	10	00010100010101111 00	11	1	0350
351	10	11111111111000110 10	11	1	0350
352	10	11010101000011100 00	11	1	0350
353	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 widow indicator.” When more than one channel is enabled, the active widow indicator indicates which widow is being affected by the operator’s keystrokes. Note that even though a widow is not “active,” it is still receiving and displaying data in real-time. It is only the operator’s keystrokes that are confined t 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, 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 both receive channels enabled :

-HOLD----------RCV 1—(ALL)----------12.5 KHz

Lbl	SDI	29—Binary Data—11	SSM	Par	Msec
270	10	10011101010010011 00	11	1	0350
302	10	10100100101010011 00	11	1	0035
320	10	10001010101010100 00	11	1	0035
350	10	10011101010010011 00	11	1	0350
351	10	10100100101010011 00	11	1	0350
352	10	10001010101010100 00	11	1	0350

[ ]----------RCV 2—(SEL)----------100 KHz

Lbl	SDI	29—Binary Data—11	SSM	PAR	Tmin
040	01	78889	11	1	*0050
041	01	45CBB	11	*0	0050
350	01	6ABCD	11	1	~

In the example above, channel 2 is the active widow. Any keystrokes affect only this window. The HOLD utility is currently active on channel 1, as is indicated on the header. This is described in the next section.

Channel 2 above has in the format header Tmin for interval time. This appears when the operator selects MIN under Interval in the Receiver Defaults menu. If MAX was selected Tmax would be displayed. In the case of channel 2, the DATATRAC 400H will latch the minimum receive interval for each label and display them. For MAX, the maximum interval is latched and displayed. When the instantaneous rate is being displayed, the format header will simply display “msec” (see channel 1).

BUS ACTIVITY MONITOR

The bus inactivity marker (*) is visible next to the rate of channel 2’s label 040. If the bus monitor was set to 4 for this channel, the asterisk indicates that at least 200 msec has elapsed since the last receipt of label 040-01. See the next section for relevant keystrokes that effect 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).

PARITY ERROR DETECTION

Another feature illustrated in this example is the parity error flag. Label 041 above indicates an even parity on the last receipt. This is highlighted by the adjacent asterisk. In a typical application, a parity error may occur only once in a stream of data for a particular label. When it 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.

3.2.2 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 – Change active receive channel. To change the channel being affected by keystrokes (shown by the solid box or "active window indicator"), the operator simply pressed 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.

ENTER –Freeze (HOLD) data. When this key is pressed the current active window temporarily stops updating the data field. This state is indicated by the "HOLD" on the channel header (see example above). This utility permits the operator to examine rapidly changing data. During the hold, the receiver does not scan the intervals for minimum or maximum, parity errors are ignored, and there is no monitoring for inactivity. Toggling ENTER releases the hold and resumes normal operation.

> - Change data format. The data display format for the active channel widow 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, and USER. Note that for BIN32 format, a limitation on screen width forces the most significant digit (1000 msec) 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 the standard ARINC 429-12 decode for that label/equipment. See section 3.1.6 for a complete explanation of user-defined data types.

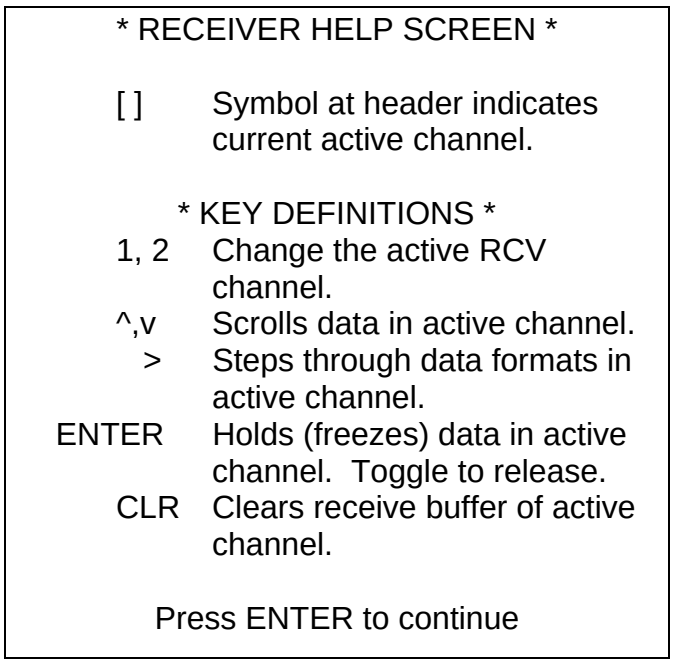
RCV – Return to the receiver setup screen. This keystroke will exit the real-time display and present the receive setup screen for the last active receive channel. If an RS-232C download was being performed, it will be disabled until control is returned to the real-time screen. If the active window indicator 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 a 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, BITE – Record, Break, BITE functions. These keystrokes will cause control to pass out of the real-time screen and to the respective setup screen any current RS-232C download is terminated. The operator can return to the real-time screen by pressing RCV or XMT and then ENTER.

ESC – Escape key. Control will return to either the Receive setup of Transmit setup screen depending on which mode contained the active window.

< -Help menu. The left arrow calls up the help screen for the real-time receive display :



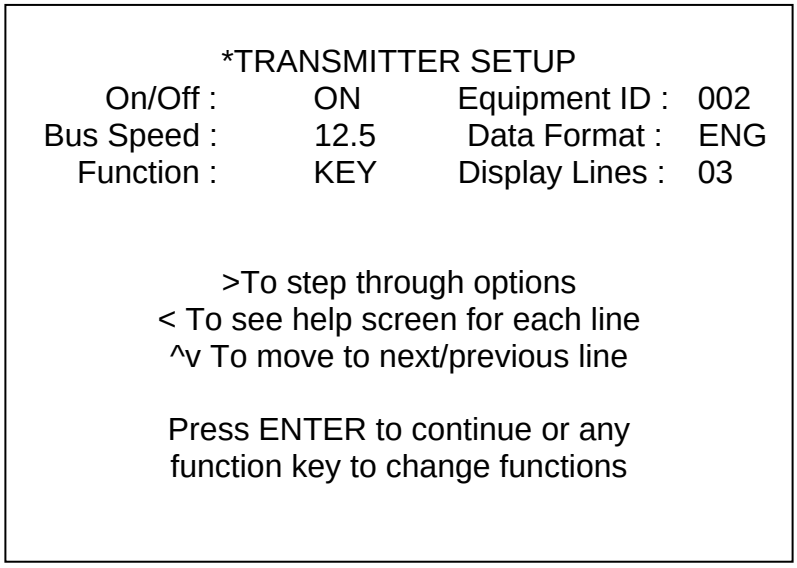
SECTION IV

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.

4.1 TRANSMIT SETUP SCREEN

The transmit setup screen is shown below



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 the transmit channel must be enabled by setting On/Off to ON. The ENTER key can then be pressed to proceed to the data display and 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 ESC (Escape). This sequence will not reset the transmit setup.

The following sections detail the function of each setup parameter.

4.1.1 TRANSMITTER CHANNEL ON/OFF

This setup line is used to enable the transmit 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.

4.1.2 TRANSMITTER BUS SPEED SELECTION

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

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

*TRANSMITTER HELP SCREEN

Transmitter Bus Sped Selection

12.5 - To select 12.5 KHz low speed bus.

100 - To select 100KHZ high speed bus.

Press ENTER to return to setup screen

4.1.3 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

4.1.4 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. See Appendix C for a complete definition of engineering scaling.

4.1.5 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 3.1.6 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 the transmit channel. 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 though it was defined while setting up the receiver), the format information in the user format record will be used instead of the standard ARINC 429 format information.

4.1.6 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 3.1.9 for a complete explanation of this parameter. The help screen is the same for the receive setup.

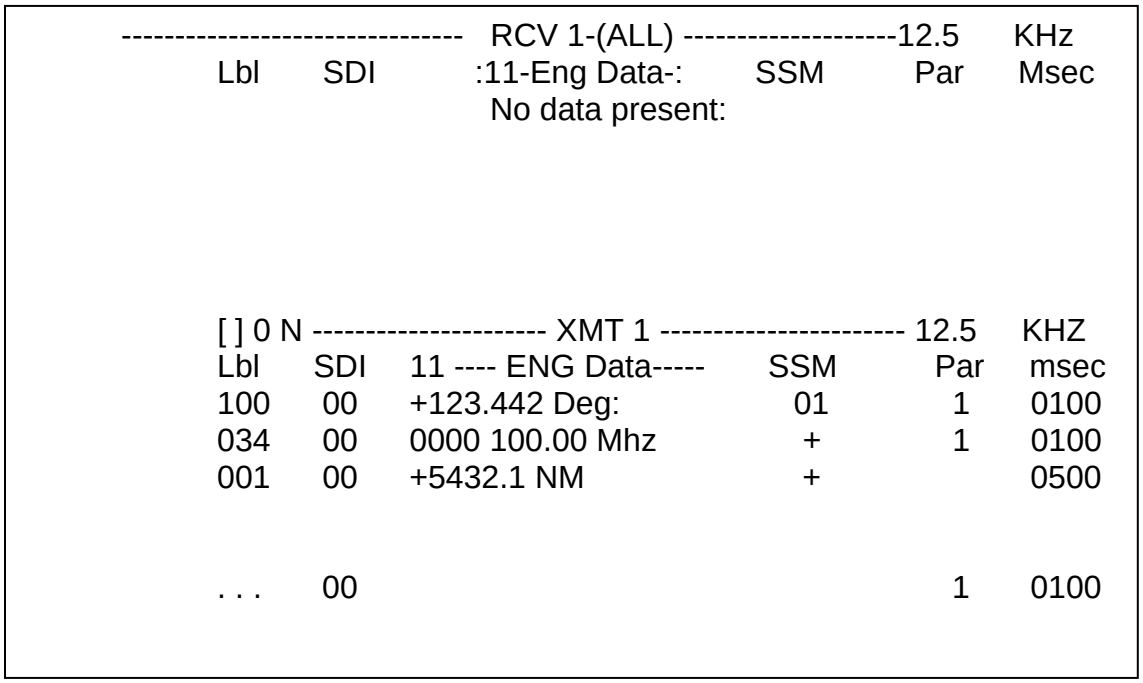
4.2 STATIC TRANSMIT DATA DISPLAY SCREEN

This section describes the utilities available for editing and controlling the transmission of data.

4.2.1 REAL-TIME DATA DISPLAY SCREEN

When the setup of the transmitter is complete and the operator pressed ENTER, control passes to the real-time data display screen.

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



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 :

ENTER - Toggle transmit on/off. This keystroke halts (or resumes) the 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 display format is changed to the next format in the sequence. The formats available are ENG, HEX1 9L, HEX1 9M, HEX32, BIN1 9L, BIN1 9M, 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.

B - Channel burst command. Causes a burst of all burst-mode labels defined to be transmitted. See section 4.2.4 for a complete explanation of burst mode.

There are other keystrokes (aside from editing keystrokes described in section 4.2.3) 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 or ESC - Return to the transmit setup screen. Any edits that were performed are implemented in the transmit data fields 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 an enabled transmitter regardless of whether control is in the real-time screen of not.

RCD, BRK, BITE - Record, Break, BITE function. Any edits that were performed are implemented in the transmit stream 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 display contains an indication of the bus speed previously selected for the transmit channel.

4.2.2 TRANSMIT DATA ENTRY/EDIT

Entering transmit data commences when the operator pressed 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. Men 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 begins (with the new edited data replacing the existing data) after the ENTER key is pressed.

Before a label is entered

```
[ ] ------------------------------ XMT 1 --------------------------  12.5      KHz
Lbl      SDI     11--------ENG Data-------        SSM      PAR      Rate
. . .     00                                                 1       0100
```

After a label is entered -

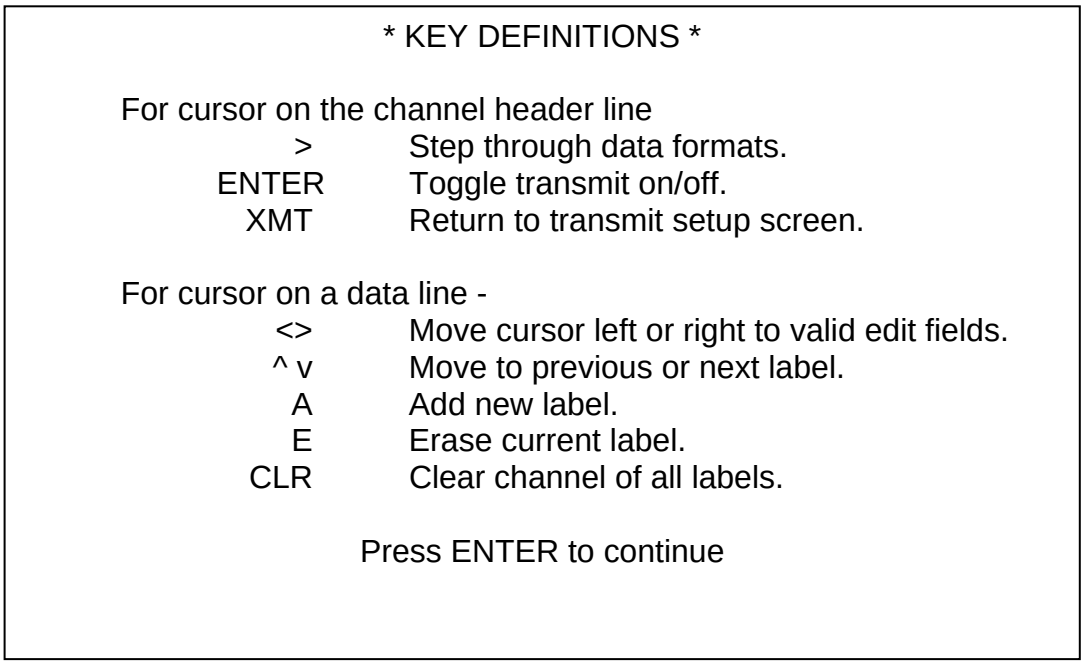
```
[ ]------------------------------ XMT 1------------------------------  12.5     KHz
Lbl      SDI     11--------ENG Data-------        SSM       Par      Rate
320      00              +000.000 Deg            00         1       0100
```

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.

Key Definitions -.

<, >	Move cursor left or right to edit data
^, v	Move to previous, next label for editing of adding label. When the cursor is in the header field, the v key will move to first line to start data editing.
CLR	Clear all data (must be confirmed with C entry).
ENTER	Begin transmission of data. Cursor will move into header field.
XMT, ESC	Go to transmit setup screen.

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



4.2.3 SAMPLE TRANSMIT DATA SCREEN

Transmit channel active -

[ ] ON	----------	XMT 1	----------	12.5	KHz
Lbl	SDI	11 ---- ENG Data-----	SSM	Par	msec
210	10	-1427.12 Kts	10	1	0062
320	10	+123.456 Deg:	10	1	0020
324	10	+001.010 Deg	10	1	0020

4.2.4 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 400H 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 (msec) 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 (all defined burst labels) will occur each time the user presses B while cursor control is on the transmit window. Individual labels may be burst by pressing the B key when the cursor is on the first position of the label to burst in the data edit window.

4.2.5 FRAMING LABEL TRANSMISSIONS

The DATATRAC 400H 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 power feature. Figure 6 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 msec interval, and all other labels were 200 msec, the frame period for this channel would be 50 msec. If a new label is defined with an interval of 10 msec, the frame period would change to 10 msec.

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 msec, 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 msec. 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. For instance, in the above example, if a label is defined with a rate of 80 msec, since only certain multiples of 50 msec are permitted, that label will transmit at 1 00 msec even though the display will still indicate 80 msec.

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 on frame 59.

Figure 7 gives an example of how to specify which frames will contain which labels. In this example, five labels are defined :

Label	Interval (msec)	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 msec due to label 101. Thus, each frame period will be 50 msec, and a complete cycle will take 3 seconds (50 msec X 60 frames) to elapse.

Figure 7 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 on the same 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 msec 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 msec would have elapsed since its last transmission on 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 60, the timing of every cycle (consisting of 60 frames each) is the same.

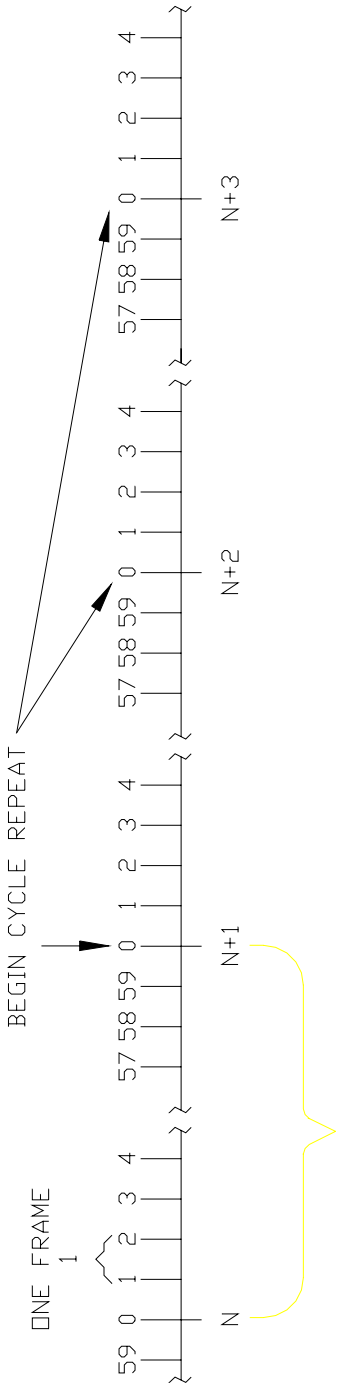
The interval and starting frame number are specified on the label data line of a transmit edit window. The rate is given under the "msec" column. The starting frame number field is off the screen to the right of the rate value. To access it, the cursor is moved to the right from the last rate digit to skew the data line and display the frame number (indicated by an "F") this number can be 00 to 59. The figure below illustrates a data line (above 101) that is skewed to reveal the starting frame number.

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

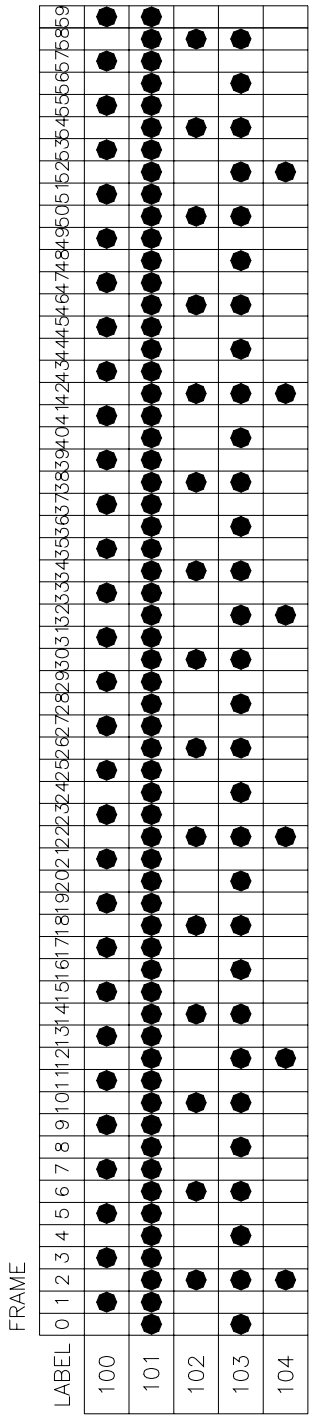
The frame counter in the transmitter that continuously counts from 0 to 59 is reset to 0 to begin a new cycle each time a new minimum interval is specified.

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 6

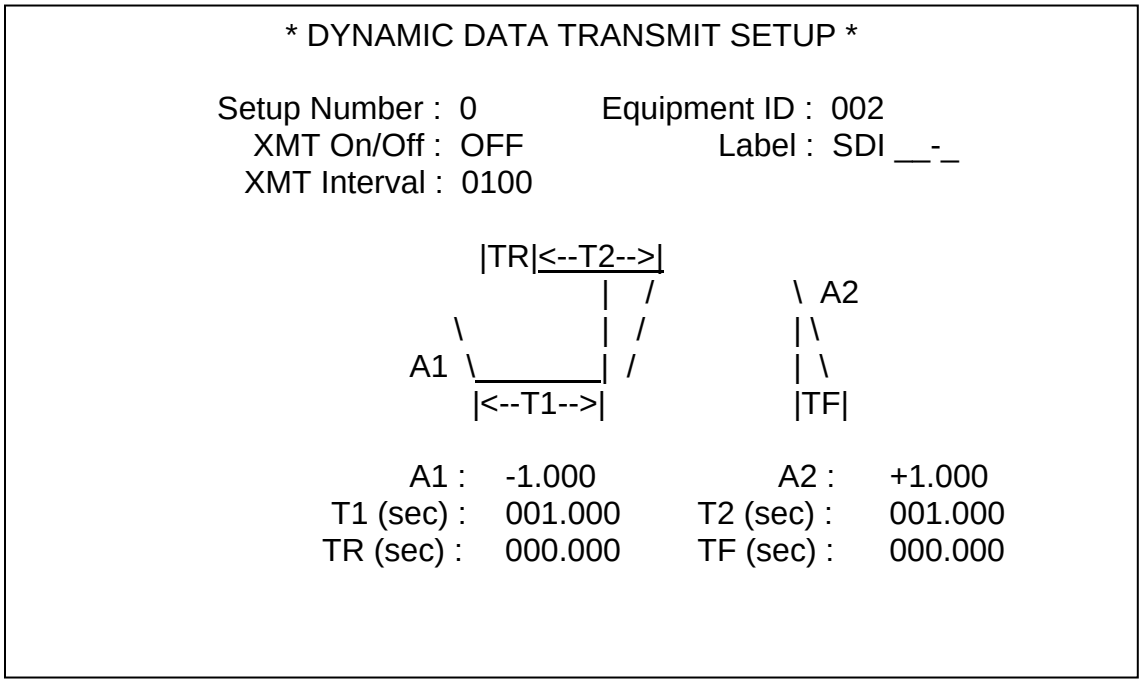


EXAMPLE OF TRANSMIT FRAMING WITH
LABELS OF VARYING RATES AND STARTING FRAMES

FIGURE 7

4.3 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 selecting up DYN at the TRANSMIT MODE line and pressing ENTER. The following secondary transmit screen then appears and allows the user to enter up to 10 setups.



4.3.1 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.

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 and edited using 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. The SDI must be defined as 0, 1, 2, or 3 (D (don't care) is not a valid entry).

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 is entered numerically.

4.3.2 WAVEFORM DEFINITIONS

The user moves the cursor through the Al, T1, TR, A2, T2, and TF setup lines using the up and down arrows. Levels (Al 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.

4.3.3 TRANSMIT DATA DISPLAY

After entering all setup selections, the following display should appear.

```
[ ] ON ------------- XMT1 ------------ 12.5 KHz
Lbl SDI  11 ----- Eng Data ---- SSM  Par  msec
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.
Dynamic labels cannot be edited from this display screen. The user must select XMT to return to the setup screen the ENTER to return to the dynamic edit data screen to edit dynamic labels.

4.4 PRESTORED TRANSMIT TABLES

The DATATRAC 400H 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 400H 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 D 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 ENTER.

*ROM TRANSMIT TABLES SELECTION *

Table Index: 000

Index	Descriptor
000	AHRS 001
001	AHRS 002
002	AHRS 003
003	ILS TST1
004	ILS TST2
005	LORAN A
006	LORAN B
007	MY TBL 0

Press ENTER to select table or
CLR to cancel the table selection

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 ENTER. 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. The above screen shows an example of defined tables. An actual display would show only those tables that have been defined and loaded into ROM. The directory 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 ENTER is pressed. The 0-9 keys can be used to enter a table index directly instead of scrolling the list.

When ENTER is pressed, the selected table begins transmitting and the DATATRAC 400H 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 ENTER is pressed to begin the tables transmission, any labels that may have been transmitting previously on the transmit channel will be deleted. On the real-time display screen 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 from the keyboard. 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 ENTER to pass to the table selection screen. The currently selected table will be displayed on the top line. Pressing ENTER again at this point will restore the original table and delete any edits that were done on the transmit channel.

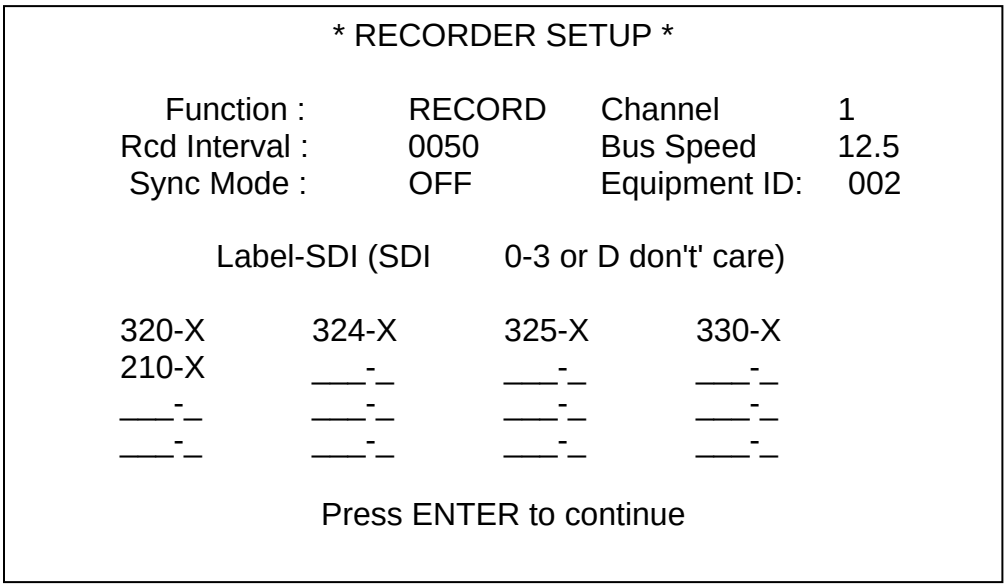
SECTION V

5. 0 RECORD MODE

This record mode allows data from either input channel 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.

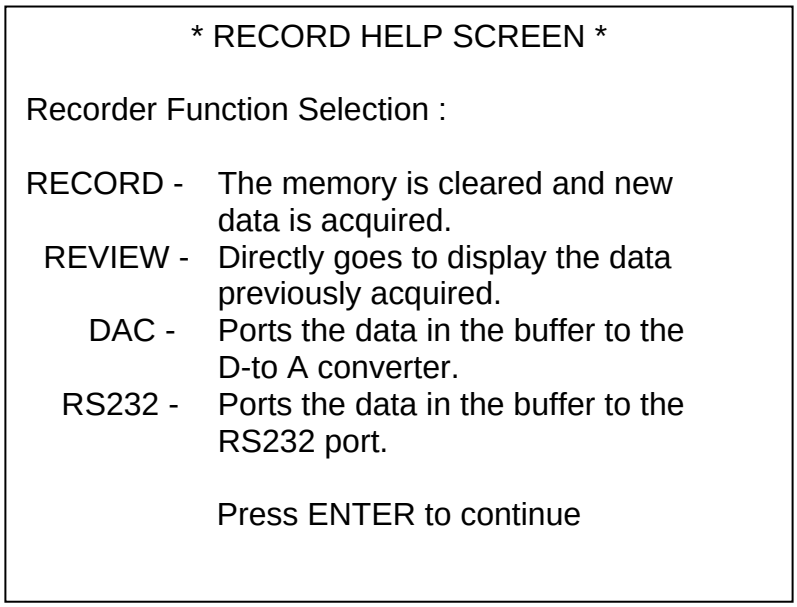
5.1 RECORD SETUP SCREEN

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



5.1.1 FUNCTION SETUP

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



5.1.2 RECORD INTERVAL

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

5.1.3 SYNC MODE SELECTION

The Sync Mode Selection determines if the unit will transmit (MASTER) or receive (SLAVE) a sync pulse before starting the RECORD function. This allows a 350H and a 400H to synchronize their timers before recording data.

5.1.4 CHANNEL SELECTION

The channel setup line provides an additional page 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.

5.1.5 BUS SPEED

The right arrow should be used to toggle between 12.5 or 1 00 to set up the bus speed appropriate for the selected channel.

5.1.6 EQUIPMENT ID

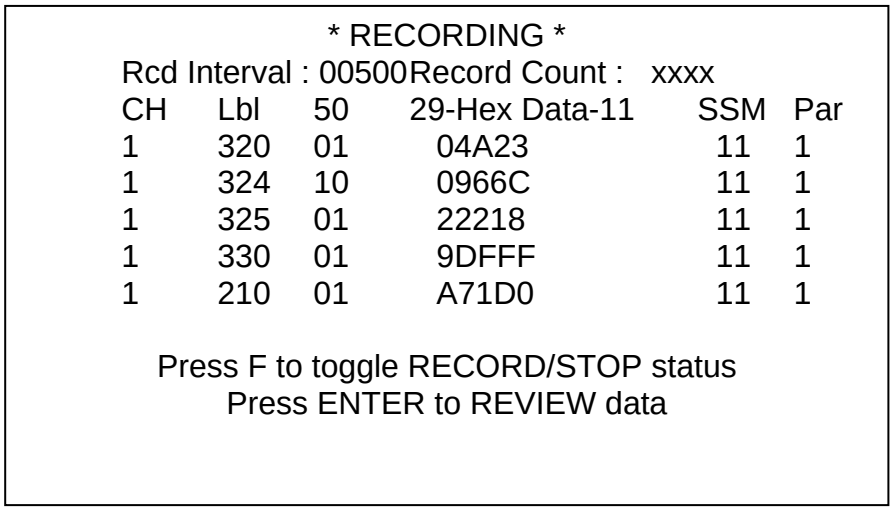
The desired equipment ID is entered numerically using the 0-F hex keys. This is used for formatting the data that is displayed both during the record session and the reviewing of data.

5.1.7 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 the E key will erase the label that is currently selected by the cursor. Pressing the A key will allow the insertion of a label at the cursor position. Pressing CLR clears all label-SDI setups.

5.2 ACTIVE RECORDING SCREEN

If the user has set up the RECORD function, pressing the ENTER 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. Data may be scrolled up or down (when more than eight labels are being recorded) using the cursor keys. The data format may also be changed by pressing the right arrow key to sequentially step through the various formats. None of these keystrokes affect the recording of the data.

When the available 120 Kbytes (30, 720 sample points) 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 pause the recording process (a subsequent F will resume recording) of press ENTER to stop recording and proceed to the data review screen. The RCD key may also be pressed to return to the setup screen and restart the process. The CLR key will immediately restart the record session at count 0.

5.3 RECORD CAPACITY

When the record mode is activated, data recording will continue until the entire 120 Kbytes 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, 30,720 seconds or 8.53 hours of record time are available (30,720 sample points). 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

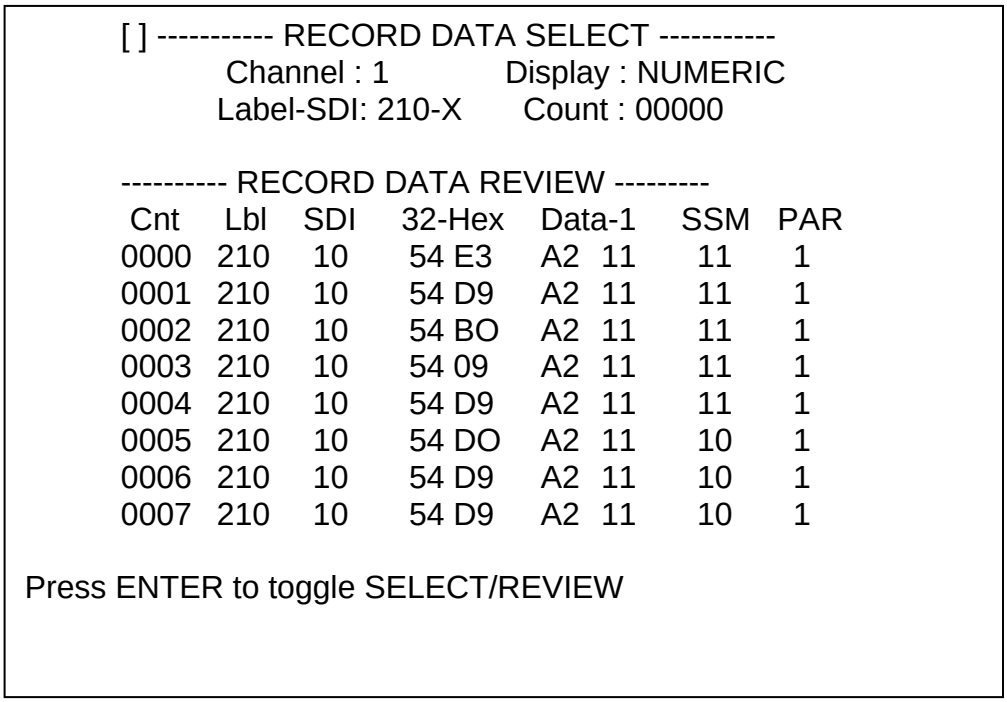
Continuing with this function will overwrite
acquisition data currently stored in buffer memory.
Press C to continue or any other key to abort..

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 ENTER 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 cursor control (the solid square toggled by the ENTER key) to either the SELECT (upper half of the screen) of the REVIEW (lower half of the screen) window.



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.

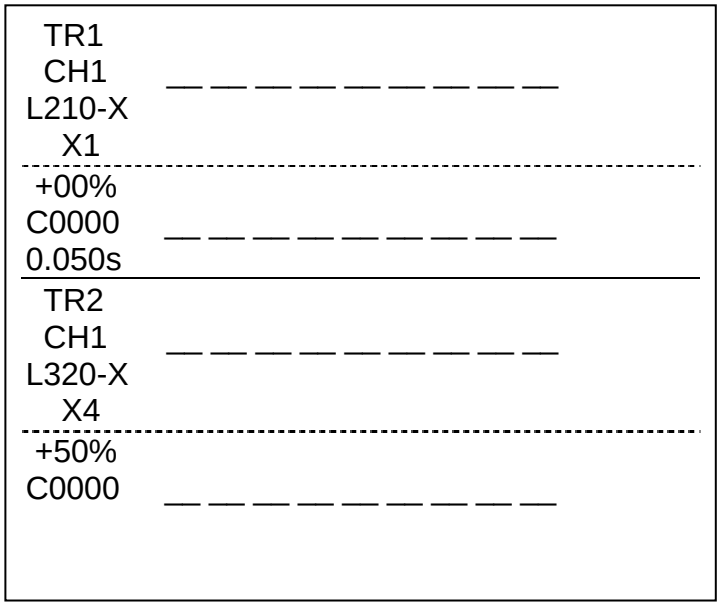
Count - setup allows the recorded data to be displayed beginning at any record count. This is accomplished by entering a numerical value directly or pressing the > key to scroll the data list.

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 RECORD setup screen.

5.5.2 GRAPHIC DISPLAY OF RECORDED DATA

To view graphics data, select GRAPH as the data format in the above screen. When the ENTER 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, or 2. This is the receive channel that contains the data to be displayed graphically. A selection of 0 turns the trace off (trace 2 only).

LXXX-X - Label -SDI. 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 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 (200 data points) 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 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 degree is presented in one half of the display area, a scale factor of 1 would mean that the full +/-180 degree range occupied half of the screen with each dot worth 360/64 = 5.625 degree. Likewise, a scale factor selection of 16 would mean the graph range was 11.25 degree and the value of each dot, 0.3516 degree.

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.

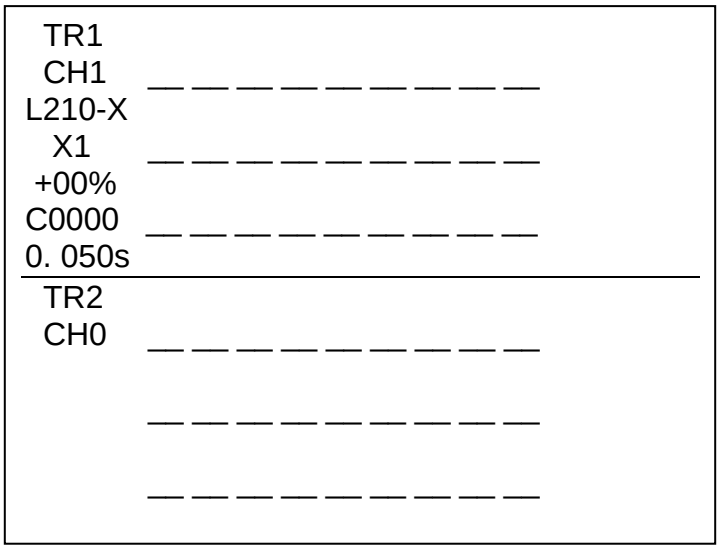
CLR - Data trace clears and starts at a count of 0.

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

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

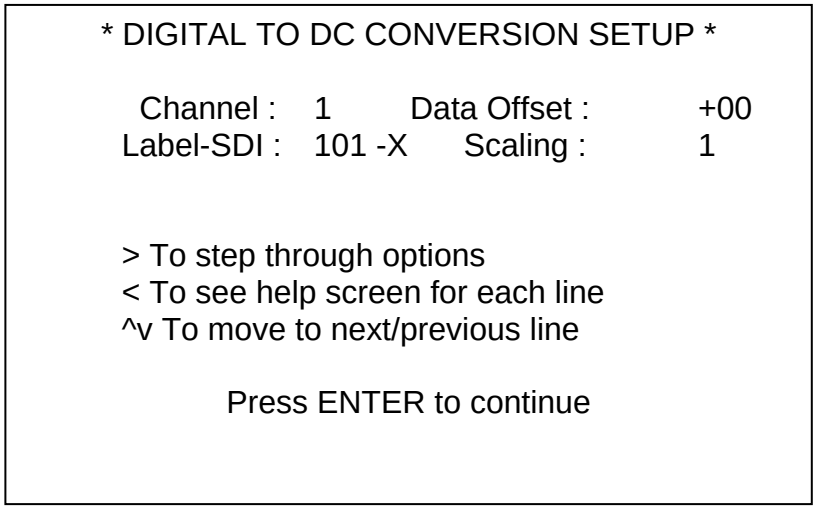
If trace 2 is turned off (by entering a 0 for the channel number), the active trace 1 will use the entire display for graphic data.

Trace 1 only 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 ENTER 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 :



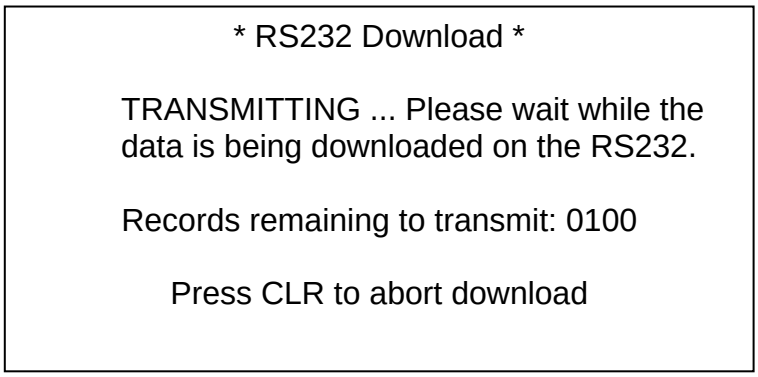
The set up options control the download of data through the DAC port which begins when the operator presses ENTER.

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 +/- 5.0 VDC conversion.

Pressing ENTER after all set up options are selected will begin the download. Data is output at one record data point every 100 msec, 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 allows a download of recorded data via the RS-232C port. Pressing ENTER with this function selected causes a message to be displayed to remind the user to make sure the RS-232C port is connected properly. Then after pressing the ENTER key the following screen is displayed



The output format consists of data records each representing a single label/data sample. The output begins with the first data sample (count zero) for the first record label set up. Each record label data sample for this record count is output and after completing the output for a this particular record count, the next record count (00001) is output and so forth until all record counts have been downloaded. 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 of 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.

See section 3.1.8.2 for the RS-232 interface format specifications.

5.6 SYNCHRONIZATION WITH OTHER DATATRACS

The synchronization feature allows two DATATRAC units to begin the recording process simultaneously. A sync signal is provided on the RS232 connector. When using the sync feature, one unit is set up to be Master and the other unit is Slave. The Slave unit must be set up to record first. It will wait to begin the record operation until it receives a signal from the Master. When the Master is set up, it sends a signal to the Slave and both units begin the Record function. If the record intervals are set to the same value on both units, the recorded data buffer will be filled at the same time and rate, to within the tolerances of the clock crystals of the units. The differences in the clocks may cause a drift of as much as 2 msec per minute of record time.

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 Rel Time :      OFF
     Sync Mode :          OFF                History :      ALL
  Brk Sequence :          A                  Event Cnt :    01
   Brk Position :         --*--

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

    Data = 0, 1, or X (D-don't care)

                      Press ENTER to continue
```

6.1.1 FUNCTION SETUP

The various function options are illustrated in the following help menu

```
              * BREAK MODE/TRIGGER HELP SCREEN *

Function Selection

   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 RS232 history data
               download.
     XMT   -   Permit ARINC 429 transmission
               of history data.

          Press ENTER 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 SYNC MODE SELECTIONS

Sync mode determines if the unit will transmit (MASTER) or receive (SLAVE) a sync pulse before starting the Break function. This allows two units to synchronize their timers before recording data.

6.1.3 BREAK SEQUENCE

Two labels are corresponding data may be set up and are referred to as 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
B then A -	Break on condition A after condition B has occurred

Press ENTER to return to setup screen

6.1.4 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 proceed the break, follow the break, or consist of some combination of the two. The options are described in the following help menu.

```
 * BREAK MODE/TRIGGER HELP SCREEN *

                          Break Position Selections :
 *----  :  Beginning of memory
 -*---  :  First quarter of memory
 --*--  :  Middle of memory
 ---*-  :  Third quarter of memory
 ----*  :  End of memory

This defines the relative location of the
break condition in the history memory.

Press ENTER to return to setup screen
```

6.1.5 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 millisecond (msec) or 1 0 microseconds (usec). When 1 msec is selected the max range of time is 999.999 seconds. When 10 microsec 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.

6.1.6 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 set up.

EDIT - Set up the select labels.

Entering the EDIT option causes 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.

6.1.7 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.

6.1.8 BREAK CONDITION SETUP

Two break conditions named "A" and "B" may be setup and referenced in the break sequence line described above in section 6.1.3. For each break condition, A and B, the user is allowed to select the channel, label, condition, and data pattern (bit 9 through 32).

Channel - Enter an active receive channel (1 or 2).

Label - Enter an octal label using the 0-9 keys.

Condition - Using the right arrow key, step through the desired condition. The options are listed in the help menu below. This help menu will be displayed when the left arrow is pressed. The ENTER key returns to the setup from the 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 < than the defined
             word

    Press ENTER to return to setup screen
```

Data - This is the data field that is compared using the above selected conditions. An X in a data bit location means that it will be ignored and only those bits containing O's or l's will be compared with received words. The data is entered using the 0, 1, or D (for don't care) keys.

6.2 BREAKPOINT REVIEW

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

```
* *  Waiting to Break condition . . .   * *
* *  Press ENTER 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 ENTER to stop & review data.    * *
```

When the break occurs, a 5 volt, 0.02 msec trigger pulse is output to the 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    msec
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 ENTER 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 ENTER 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 of 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 the 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 means 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 msec of 10us) and is shown in the review header.

Count : The count selection line allows the user to enter a count value. The display data in the lower part of the screen responds to changes to the count value. The maximum count possible is dependent on the relative time option setup as shown below :

RELATIVE TIME :	ON	OFF
MAXIMUM COUNT :	15,360	24,570 Data Points

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 though the data format options.
<-	-	The left arrow key displays the HELP menu for Break Review.
UP	-	The up arrow scrolls back through data history one data point at a time.
B	-	The B key scrolls back through data history 8 data points at a time.
DOWN	-	The down arrow key scrolls forward through data history one data point at a time.
F	-	The F key scrolls forward through data history 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 ENTER 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 ENTER once more, the data will immediately begin downloading. The output format consist 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 weather the data was collected with a time stamp of 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 (Data 1)
5	Data bits 17-24 (Data2)
6	Data bits 25-32 (Data3)

If sample size 8, also

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.

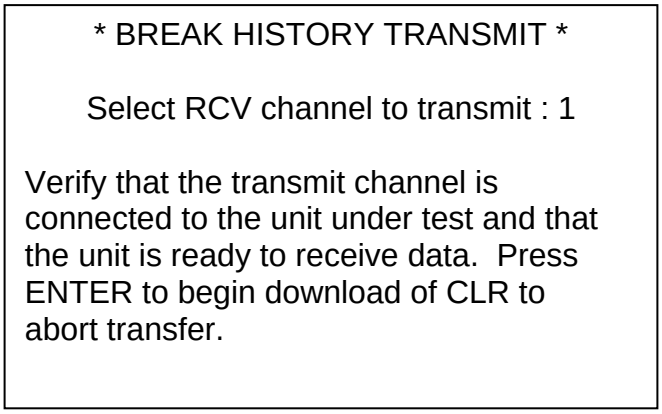
The sample count is a 16-bit unsigned binary word that specifies the record's relative position in memory. The first record in memory has a sample count of 0000. The trigger position given in the header record is the sample count of the label record that caused the break.

See section 3.1.8.2 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 400H is the retransmission of previously acquired break history data. With this function, the operator can direct the DATATRAC to output the 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 together on the transmit channel.

To utilize this feature, a break history acquisition must be performed first. It is necessary to enable the time stamp to either 1 msec or 10 microsec so that the relative timing can be referenced during later transmission. When the data 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 ENTER. Assuming a proper acquisition with time stamp was performed, the following message screen will appear prior to beginning the transmission :



If data from both receive channel was collected in the break acquisition, the user must select which receive channel to retransmit. The right arrow key is used to select the desired channel.

Upon verifying that the transmit channel is properly connected to the unit under test, the operator presses ENTER to begin the buffer retransmission.

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

* BREAK HISTORY TRANSMIT *
Select RCV channel to transmit – 1
Records remaining to process – 12345
Press CLR to terminate transmit, ENTER to pause/resume transmit

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 ENTER key without missing any labels.

During the retransmission of history data, the transmit channel is temporarily disables from normal operation for the duration of the download. Any table that was transmitting at the time on the affected channel will stop transmitting. Men the download is complete, the transmit channel's original bus speed is restored and any table transmission that was interrupted is resumed.

6.5 SYNCHRONIZATION WITH OTHER DATATRACS

The synchronization feature allows two DATATRAC units to begin the Break mode recording process simultaneously. A sync signal is provided to the RS-232 connector. When using the sync feature, one unit is set up to be Master and the other unit the Slave. The Slave unit must be set up first. It will wait to begin the Break record operation until it receives a signal from the Master. When Master is set up, it sends a signal to the Slave, and both units begin the Break.

As both units start the Break function, their clocks are synchronized to within 50 usec of each other. This allows correlation of the time stamp between the two units. Note that there are differences in the clocks between the two units and this may cause a drift of as much as 2 msec per minutes of record time.

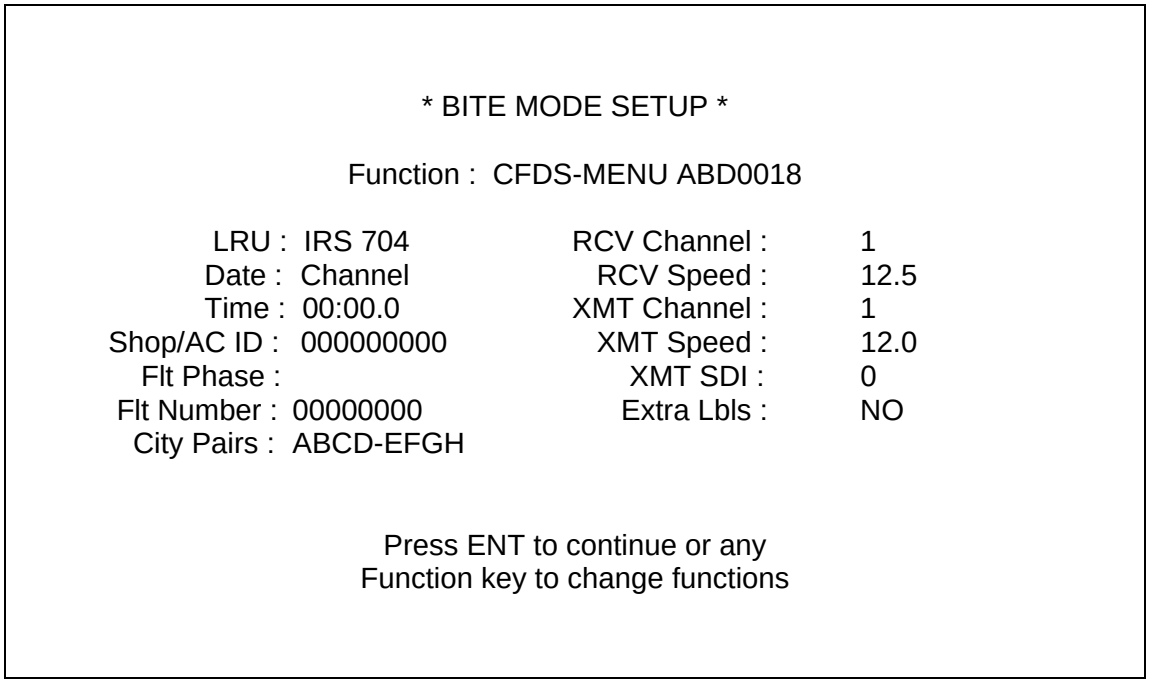
SECTION VII

7.0 BITE MODE

The DATATRAC 400H provides an interactive databus communication function to support the BITE systems used in the newer air transport aircraft. The CFDS modes and CMC modes are described by ARINC 604. The DATATRAC 400H supports three versions of BITE mode : CFDS, CMC, and a 737-300 menu BITE mode. 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 400H unpacks and displays the maintenance words along with bit definitions prestored and available for all 700 series avionics equipment. The third BITE version is the 737-300. Similar to the CFDS BITE with a different hand-shake protocol, ASCII text messages are transmitted from LRUs on command and provide a series of maintenance descriptions based on data stored in the LRU'S non-volatile memory.

7.1 BITE SET UP

Pressing BITE 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	RE232	
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
719 HF
723 GPWS
724 ACARS
727 MLS
735 TCAS
740 PRNTR
741 SATCM
718 ATC/S
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 entered as mm-dd-yy, where mm is the month (00..12),dd is the day (00..31), any yy is the year (00..99). This date is then transmitted on label 260 at a frequency one-tenth of label 227 (typically 1 sec).

TIME : The time may be entered on the fourth setup line using the 0-9 keys entered as hh;mm-m, where hh is the hour (00..23), and mm.m is the minutes (00.0..99.9). This time is then transmitted on label 125 at a frequency one-tenth of label 227 (typically 1 sec).

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 seconds).

Label 155 is also transmitted at one-tenth the frequency of label 227.

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 ADB0018, 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 back through the ASCII character set.

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

The receive channel, received speed, and transmit speed 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.

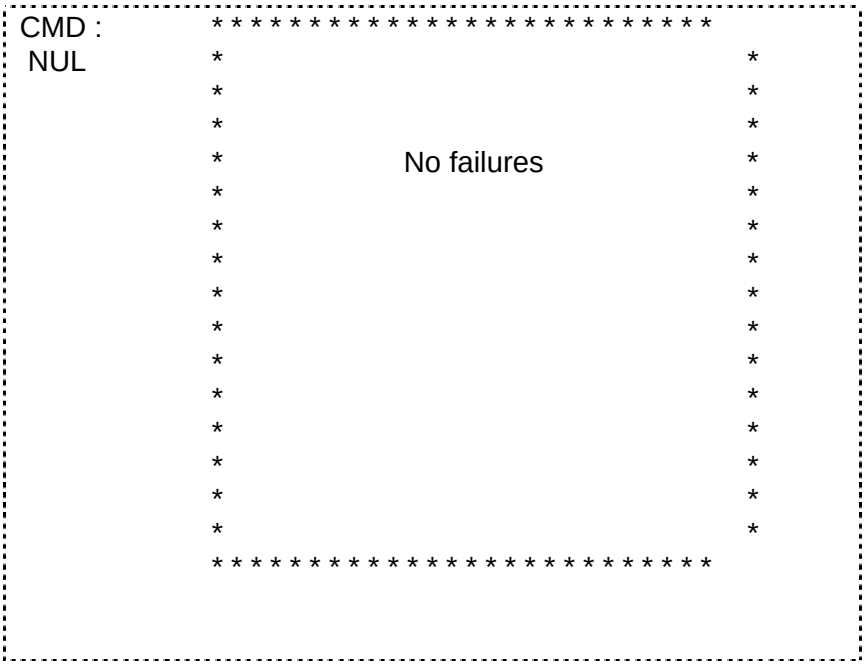
7.2 CFDS OPERATION

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 400H passively listens to the avionics unit and displays the ASCII fault message which is repetitively transmitted.

When the BITE set up screen with CFDS-NORM functions 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., [CD1]) to indicate that it is not yet selected. The > key can continue to be pressed until the desired command appears. Upon pressing DOWN arrow key the bracket will disappear and the DATATRAC 400H will begin transmitting the new command. The available commands are :

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

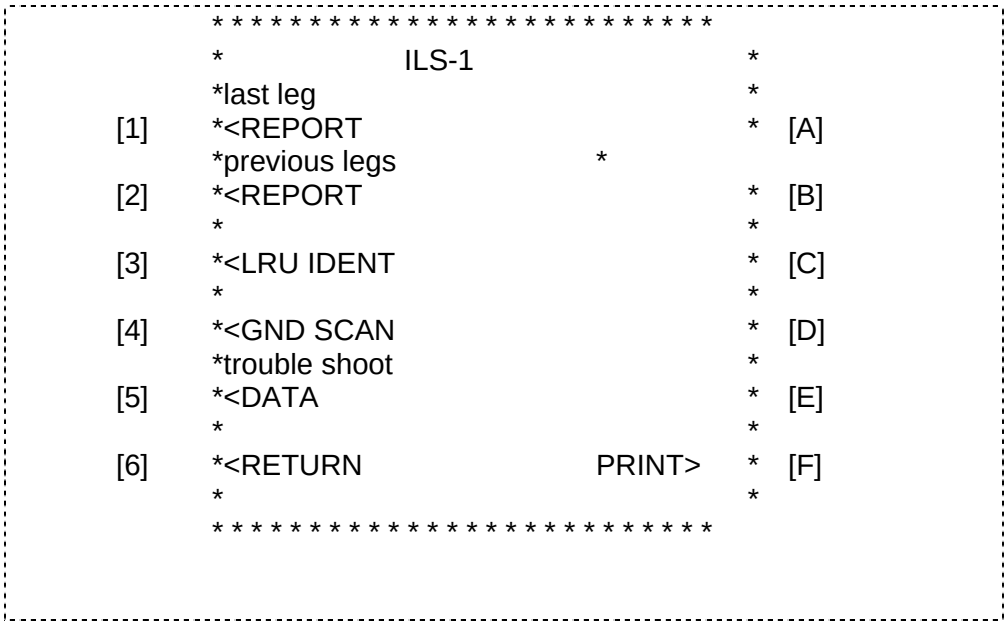
KEY DEFINITION SUMMARY :

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

7.2.2 CFDS MENU MODE

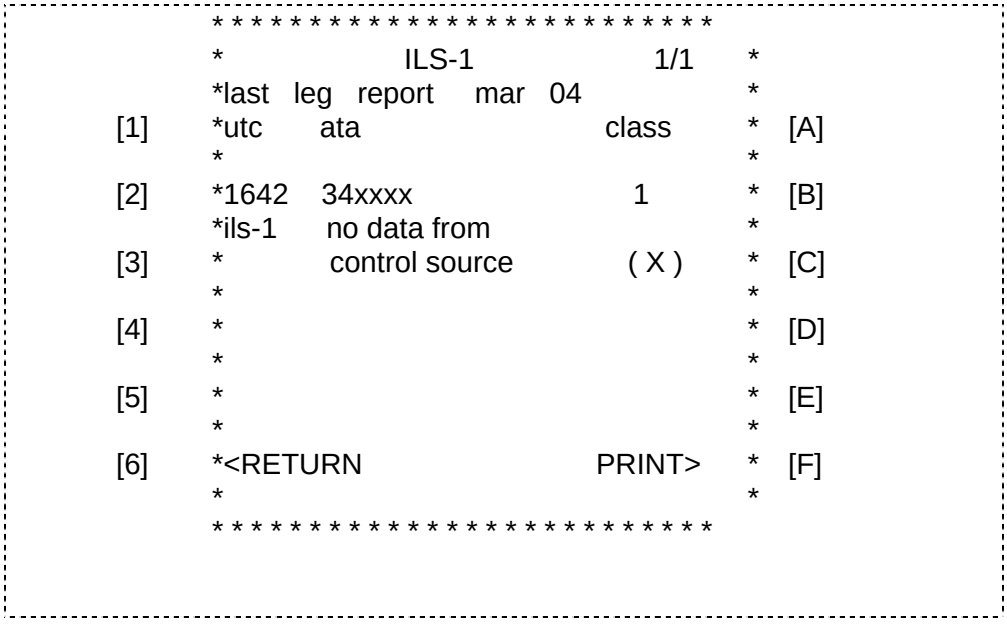
In MENU mode, the DATATRAC 400H automatically sends a menu request to the avionics unit with a 227 label command word. The LRU responds with its sequence of 356 labels containing the ASCII text of the initial menu. The user may then enter line select keys which will be transmitted on label 227 as a LSK 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 within the CFDS-MENU mode on the DATATRAC 400H is the SAVE SCREEN (or PRINT) function. By pressing the ENTER key, a complete copy of the screen is saved on RAM. A memory location 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 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
ENTER	Save current screen in memory (memory location number appears on lower right-hand corner of display)
CLR	Return to BITE setup screen
RCV, XMT, RCD, or BRK	Go to the selected function
0	Exit MENU mode and go to NORMAL mode. The 227 command word output from the DATATRAC 400H 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 scratchpad area at the bottom line of the 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 tests and Shop Fault menus compatible with the 747-400 avionics are also supported in this CMC mode.

A typical CMC BITE display screen is shown below.

```
| - ILS  710      - - CMC  COMMAND  WORD - - - XMT :  ON
Lbl   SDI        Function                Pad     P                msec
227  01        SHOP FAULT              00       1                1000
| - 350 - - - - FAULT SUMMARY WORD  -  -  -  [C  to Save]
Data :   E7   80   0A       Ground Test :   NOT ACTIVE
Bit        Status                Function
11         0 : OK LRU Failure
12         1 : FAIL         G/S Antenna Failure
13         0 : OK Localizer Antenna Failure
14         1 : PORT A     Source Selection
15         0 : OK Input Data
16         0 : OK G/S Receiver Failure
17         0 : OK Localizer Receiver Failure
18         0 : OK CFDIU Bus
19         0
20         0
```

The LRU is selected from the main menu before entering this screen. The display screen is divided into two fields : an upper command word fields and a lower fault summary word field. Cursor control indicated by the solid square (■) is transferred between the two fields by toggling the ENTER 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. Appendix E contains a current definition of each 350/351 word defined in the DATATRAC 400H. 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 (flight) 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 mode 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 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

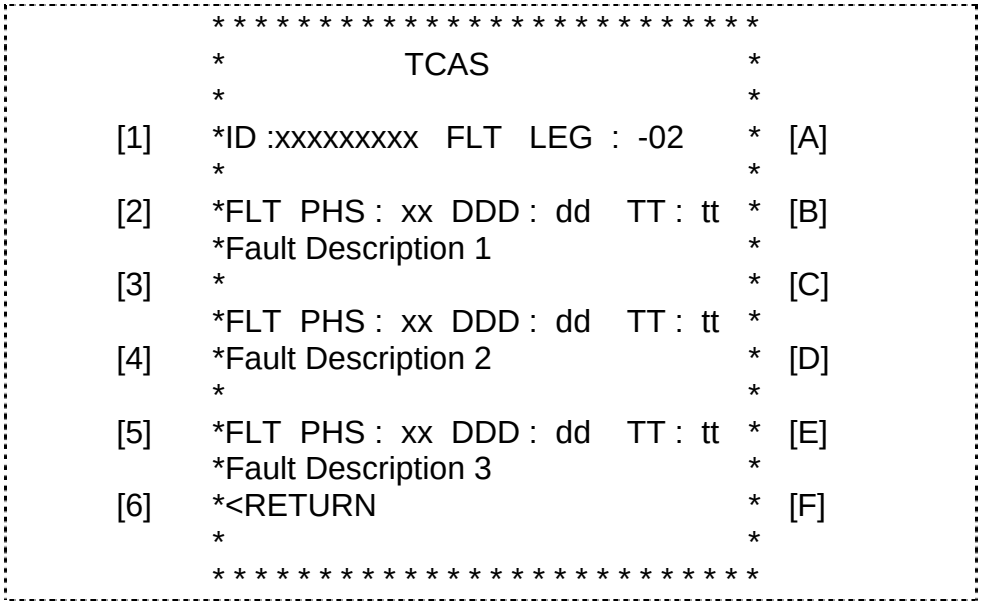
When the GROUND TEST function is selected and the ENTER key pressed from the 227 edit field, label 227 is sent with a ground test command three times or until a response is received. The status of the ground test is always displayed on line 5 of the display. The possible status definitions are :

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

Note : After 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 MENUS

A typical Shop Fault menu is shown below :



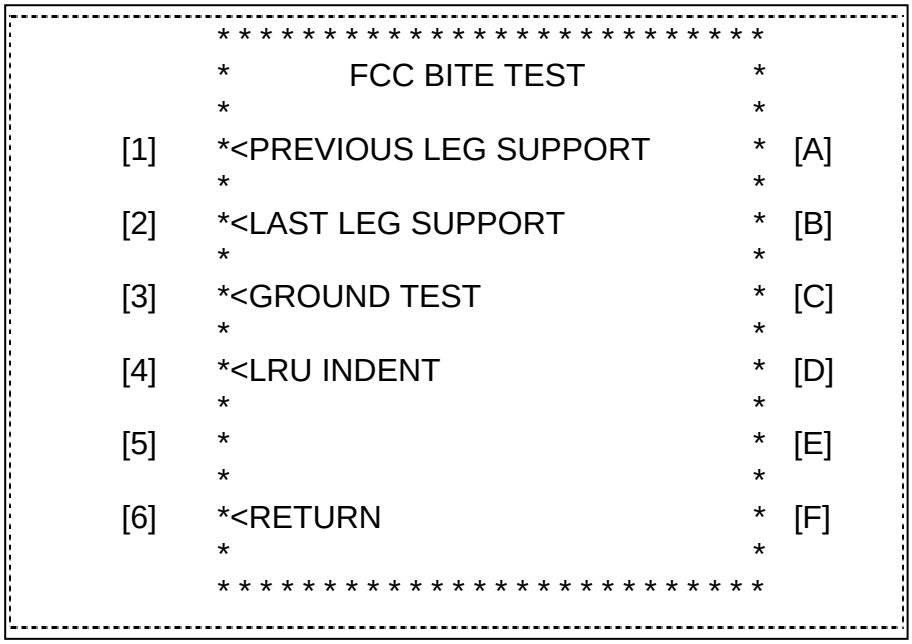
KEY DEFINITION SUMMARY :

6	Return Key; return to CMC Command screen.
->	Next page command.
<-	Previous page command.
ENTER	Save current screen in memory (memory location number appears on lower right-hand corner of 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 400H automatically sends a menu request with the appropriate LRU id to the avionics unit with a 357 label command word. Label 303 is also transmits immediately preceding label 357 with data set to zero. Both labels are transmitted at a 50 msec 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 a STX and word count of nonzero, the data following is the message to be displayed. The DATATRAC 400H 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 of 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.

Command codes :

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

A special feature within the 737-BITE mode on the DATATRAC 400H is the SAVE SCREEN (or PRINT) function. By pressing the ENTER 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 240 screens can be saved. The screens can then be reviewed or downloaded over the RS232 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, special 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 edit field. Either three of four characters may be entered for transmission.

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

BIT : 32 31 30	29 28 27 26 25 24 23	22 21 20 19 18 17 16 15 14 13 12 11	10 9 8 7 6 5 4 3	2 1
P SSM 0 1	STX 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 msec spacing when no command is being sent).

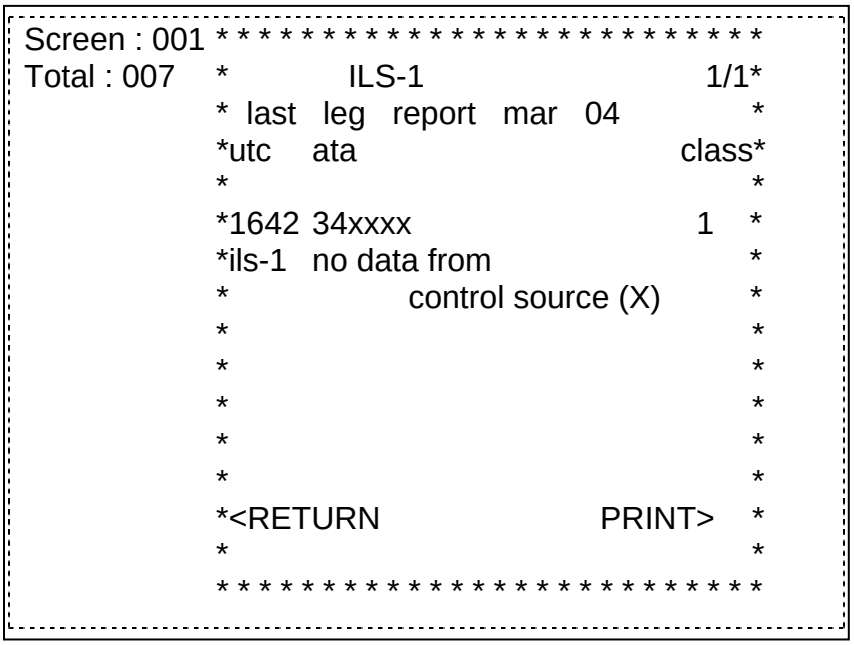
KEY DEFINITIONS SUMMARY :

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
ENTER	Save current screen in memory (memory location number appears on lower right-hand corner of 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 to the selected function

7.5 REVIEW OF SAVED MENU SCREENS

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 ENTER, 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 (v) 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 screens in memory locations after it 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 RS232 DOWNLOAD OF SAVED SCREENS

The DATATRAC 400H has the capability of downloading over the RS232 port the menu screens saved with the SCREEN SAVE function described in previous sections. The RS232 download consists of an ASCII file without the carriage-returns and line feeds. The receiving programs (if desired) must insert the carriage-return/line feeds after each 26-byte line record to then enable direct review using an editor. The user is recommended to use the RSREAD Version 1.05 (or greater) program provided for running the IBM PC compatible computer to interface with the DATATRAC 400H. In addition to inserting the line feeds, the program will 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 MAINTENANCE

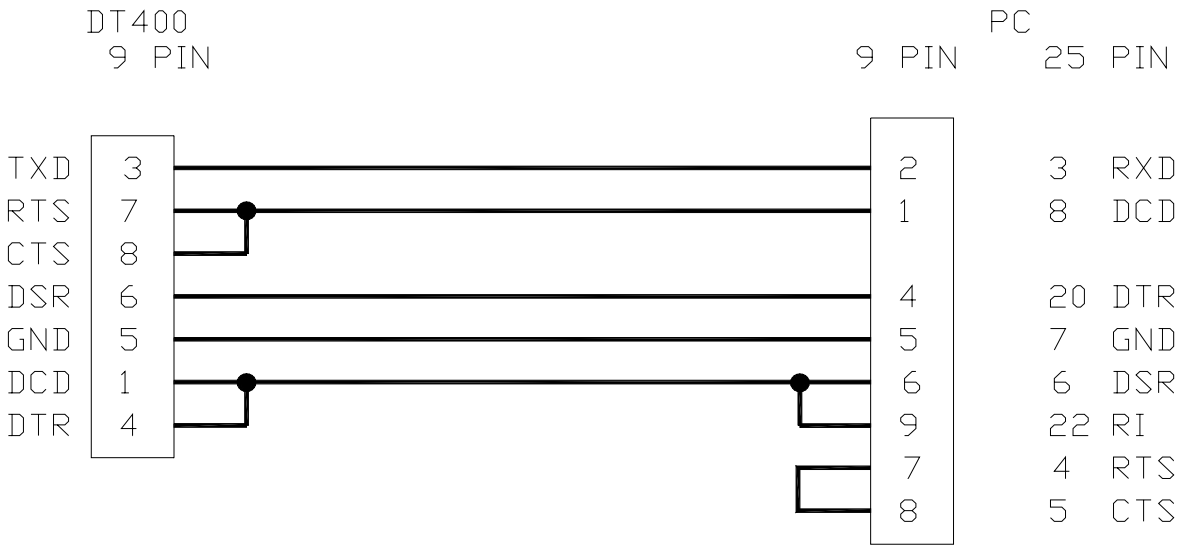
To assist in the maintenance of the Datatrac 400H, Bills of Materials, Assembly Drawings, and Schematics are available in the Datatrac 400H Maintenance Manual (P/N 06-1404-00 for hard copy, E6-1404-00 for CD) available separately from Aeroflex.

APPENDIX A

RS-232C INTERFACE DEFINITION

RS232 Cable Schematic

Below is the schematic for wiring the RS232 cable. The DATATRAC 400H RS232 uses a 9-pin male D-sub type connector. The schematic shows the wiring from the DT400H 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 400H 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 400H 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 400H 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 3.1.8.2 for a complete specification of the RS232 data format). The main menu will then appear as follows:

```
DATATRAC 400H RS-232 Download Program, Version 1.05
Copyright 1991, BFGoodrich Aerospace JcAir Test Systems

    (1)    Real-time Receive Data Download
    (2)    Recorded Data Download
    (3)    Break-history Data Download
    (4)    BITE Screens Download
    (5)    Real-time File Transfer Download
    (6)    File Transfer Buffer Download
    (9)    Exit to DOS

    Enter Selection : _
```

The RSREAD program supports both the DATATRAC 400 and DATATRAC 400H RS232 interface.

There are six forms of data download supported. Only four of them will be covered here. The last two support the Williamsburg Protocol Analyzer function and are covered in the separate manual. The four modes to be covered here are real-time download of received data, download of recorded data, download of break history data, and BITE screens download. For any 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 400H 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 400H will continue downloading data although the computer is no longer recording it.

This program should not be invoked while the DATATRAC 400H is actively downloading data since a phase error will likely result. See section 3.1.8.2 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 400H 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 400H. 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 400H 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 400H 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 400H 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 400H 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.

BITE Screens Download

As with recorded data and break data downloads, the program can perform the disk access while the BITE screens are being received. Therefore, the program will continue collecting data until either the user aborts the acquisition or the DATATRAC 400H completes the download. The following is a sample of the ASCII output file generated (with time stamp downloaded):

```
DATATRAC 400 BITE Screens Download  Fri Oct 12 15:46:54 1991

Screen 001

* * * * * * * * * * * * * * * * * * * * * * * * * * *
*                  EFIS BITE TEST                   *
*                                                   *
* <PREVIOUS FLIGHT LEGS                             *
*                                                   *
* < LAST FLIGHT LEG                                 *
*                                                   *
* < GROUND TEST                                     *
*                                                   *
* < LRU IDENT                                       *
*                                                   *
*                                                   *
*                                                   *
* <RETURN                                           *
*                                                   *
* * * * * * * * * * * * * * * * * * * * * * * * * * *

Screen 002

* * * * * * * * * * * * * * * * * * * * * * * * * * *
*                  EFIS BITE TEST                   *
*                                                   *
```

and so forth until all recorded screens are downloaded.

APPENDIX B

APPENDIX B
DATATRAC 400H Specifications

Mechanical:

Size	16.0 cm H x 24.8 cm W x 5.1 cm D (6.3" H x 9.75" W x 2" D)
Weight	1.6 kg (3.5 lb.)
Construction	Gray ABS, with EMI Shielding
Display	Supertwist, backlit LCD; 16 lines X 40 char.

Environmental:

Operating Temperature	5 to 40 °C
Relative Humidity (Non-Condensing)	≤80% for ≤ 31 °C, decreasing linearly to 50% at 40 °C
Altitude	≤2 000 m
IEC Overvoltage Category	II
Pollution Degree	I

Power:

Direct Current	12 V, 1.5 A 
230 V Adapter	230 V ac, 50 Hz, 35 W maximum input 12 V dc, 1.5 A maximum output
120 V Adapter	120 V ac, 60 Hz, 100 mA maximum input 12 V dc, 1.5 A maximum output
Operating Time	On fully charged internal NiCad battery, Approximately 8 h

Standards:

Equipment meets the following Listed standards

EN 61010-1 (IEC 61010-1)
EN 61326-1
EN 61010-2 Controlled EM and Portable
EN 50082-1: 1992
EN 55011 Class A
FCC

Receive Operation:

Ports	2
NOTE:	For external connection to these two terminals (ports) it is recommended to use M17/84-RG223 double shielded coaxial cable, or equivalent, with the shield terminated 360° at both end connectors.
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 perstored scaling based on equipment IDs, hexadecimal (full or data field); binary (full or data field); user defined; graphic plots, or ASCII character
Maximum Words	256 per SDI per channel
Bus Activity Monitor	Flags loss of individual words, with selectable sensitivity
Real-time Download/ Conversion	RS232C or 12 bit DAC
NOTE:	For external connection to the RS232C terminal (port) use the supplied RS232 cable assembly, JPN 15-1404-00. For external connection to the D/A terminal (port) it is recommended to use M17/84-RG223 double shielded coaxial cable, or equivalent, with the shield terminated 360° at both end connectors.

Breakpoint Operation:

Label Sequences	A, B, A or B, A then B, B then A
Data Conditions	EQ, NRQ, OR, GT, LT, /GT/, /LT/
Event Count	1 to 99 before break
History	Up to 24 540 words in a programmable window about the breakpoint; selectable time stamp
Trigger Pulse	5 V, 0.02 ms

Record Operation:

Channels	Up to 16 selectable labels
Sample Interval	1 ms to 10 s (selectable)
Record Capacity	120 kbytes (e.g. 8.5 h of single label at 1/s)
Playback Options	Graphic plots, data list, DAC or RS232C download

Reference:	ARINC 429-12; Boeing labels for AVM, EIS, FSEU, EICAS, and FQIS

Transmit Operation:

Ports	Single
NOTE:	For external connection to this port it is recommended to use M17/84-RG223 double shielded coaxial cable, or equivalent, with the shield terminated 360° at both end connectors.
Bus Frequency	12.5 kHz or 100 kHz
Output Levels	±10.0 V dc (A to B)
Word Update	1 ms to 10 s (selectable)
Burst Mode	01 to 99 burst 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; or ASCII character
Maximum Words	128
Transmit Word Gap	4 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 used on 747-400, 737-300, MD-11, A320, A330, and A340 aircraft
Menu Display	Standard 14 line by 24 character menu, with selectable menu choices
Simulation	Select NULL, DC1, DC2, or DC4 command outputs to simulate various flight phases
Recording Feature	save up to 240 bite screens for later viewing of downloading
Maintenance Words	Displays 350/351 label maintenance bits. Bit status along with prestored text presented.

Associated Products:

RSREAD	PC program for accepting RS232 download of real-time receive, breakpoint history, or BITE data.
PCTOOL-400	PC program allowing complete user modification of the DATATRAC 400H configuration. Redefine and rescale labels. Create transmit and setup tables.
Protocol Analyzer	Software extension for the DATATRAC 400H, permitting analysis and recording of Williamsburg protocol file transfer functions.

NOTE:

For EMC testing M17/84-RG223 double shielded coaxial cable, 4.5 m long, with BNC connectors was used. The shielding of the coaxial cable was terminated 360° at both end connectors and open circuited at the far end. These cables were used at terminals (ports) RCV 1 (J2), XMT (J4), RCV (J3), and D/A (J5).

The cable used for the RS232C terminal (port) (J1) was that provided with the unit JPN 15-1404-00, which is a 1.8-m long, foil shielded cable with the foil NOT terminated.

APPENDIX C

ENGINEERING SCALING DEFINITIONS

This section contains the ARINC 429 label scaling definitions for each of the 256 possible ARINC 429 labels. For each label, one or more unique scaling definitions exist corresponding to the Equipment ID.

Below is a definitions for the interpretation of the attached table.

Example 1 : BCD scaling

Label 014 - The table contains two entries for label 014 and appears as:

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
005	BDC	7	4		0	359.90	123.456	Kts
000	BDC	7	4		0	359.90	123.456	Deg

ID - Equipment ID
The first piece of information to look at is the column under "ID". This refers to the equipment ID. For this first entry, the ID equals 005. The second entry is 000. An equipment ID of "000" means that for all equipment ID'S that are referenced, if no match is found, then the label will be scaled to the default or 000 definition. Section 3.1.5 contains more information on equipment IDs.

Type - Scaling Type
The next column to look at is the "Type" column. In this example, both entries are BCD. Section 3.1.6 contains definitions of all possible scaling types.

MSD - Most Significant Digit
The next column is MSD. This Is used only for BCD data types. This parameter is used to determine how many bits will be dedicated to he most significant digit. The MSD always starts with bit 29 and occupies 1, 2, 3, or 4 bits for a max digit of 1, 3, 7, 9, respectively. Thus for a max digit of 7, the MSD will occupy 3 bits, namely 27, 28, and 29. This parameter controls the alignment of the other digits in the data word.

ND - Number of Digits
Beyond the MSD, all remaining digits are packed contiguously with 4 bits per digit. This parameter specifies the total number of digits to be displayed. If the number is set to less than 6, the remainder of the filed is packed with zeros on the right.

NB - Number of Bits
This parameter is not used for BCD data types.

Dis - Number of Discretes
Discrete bit data is often packed into either BCD or BNR scaled data to represent status information along with parameter values. This entry specifies the number of discrete bits that are embedded into the data. All discrete bits begin at bit 11 and go up. If, for instance, three discretes are defined, bits 11, 12, and 13 would be displayed as binary digits.

Scale - Full Scale Value
Full Scale Value specifies the magnitude (±) of the decoded value.

Range
This specifies that position of the decimal point.

Units
This specifies the units of the scaled data and is displayed along with the data on the DATATRAC display.

Example : BNR scaling

Label 107 - The table contains two entries for label 107 and appears as:

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
002	BNR			16	0	65536	12345.6	Ft
000	BNR			18	0	180	123.456	Deg

ID - Equipment ID
Same as BCD

Type - Scaling Type
The next column to look at is the "Type" column. In this example, both entries are BNR. Section 3.1.6 contains definitions of all possible scaling types.

MSD - Most Significant Digit
Not applicable to BNR data.

ND - Number of Digits
Not applicable to BNR data.

NB - Number of Bits
The number of bits specifies the number of significant bits (excluding sign bit) to utilize in the decode. The sign bit is always bit 29, and the most significant bit of the data is 28.

Dis - Number of Discretes
Discrete bit data is often packed into either BCD or BNR scaled data to represent status information along with parameter values. This entry specifies the number of discrete bits that are embedded into the data. All discrete bits begin at bit 11 and go up. If, for instance, three discretes are defined, bits 11, 12, and 13 would be displayed as binary digits.

Scale - Full Scale Value
Full Scale Value specifies the magnitude (+/-) of the decoded value.

Range
This specifies that position of the decimal point.

Units
This specifies the units of the scaled data and is displayed along with the data on the DATATRAC display.

```
 ID   Type  MSD ND NB  Dis  Scale    Range  Units
-------------------------------------------------------------------------------
□
 Label: 000
□
 002  RADIO   7   5     0    39999  123.456  MHz
□
 0B9  RADIO   7   5     0    39999  123.456  MHz
□
 000  HEX32
-------------------------------------------------------------------------------
 Label: 001
 000  BCD     3   5     0    39999  1234.56  NM
-------------------------------------------------------------------------------
 Label: 002
 009  BCD     7   4     0    39990  123.456  Min
 000  BCD     7   4     0    39990  123.456  Min
-------------------------------------------------------------------------------
 Label: 003
 000  BCD     3   4     0    39990  123.456  NM
-------------------------------------------------------------------------------
 Label: 004
 000  BCD     7   3     0    79900  12345.6  Ft
-------------------------------------------------------------------------------
 Label: 005
 F03  BIN19L
 000  HEX32
-------------------------------------------------------------------------------
 Label: 006
 F03  BIN19L
 000  HEX32
-------------------------------------------------------------------------------
 Label: 007
 000  HEX32
-------------------------------------------------------------------------------
 Label: 010
 000  BCD     1   6     0  180.000  123.456  Deg
-------------------------------------------------------------------------------
 Label: 011
 000  BCD     1   6     0  180.000  123.456  Deg
-------------------------------------------------------------------------------
 Label: 012
 04D  BCD     7   5     0   7999.9  12345.6  Lbs
 000  BCD     7   4     0     7000  1234.56  Kts
-------------------------------------------------------------------------------
 Label: 013
 04D  BCD     7   5     0   7999.9  12345.6  Lbs
 0B8  HEX32
 000  BCD     7   4     0   359.90  123.456  Deg
-------------------------------------------------------------------------------
 Label: 014
 005  BCD     7   4     0   359.90  123.456  Kts
 000  BCD     7   4     0   359.90  123.456  Deg
-------------------------------------------------------------------------------
 Label: 015
 000  BCD     7   3     0    79900  123.456  Kts
-------------------------------------------------------------------------------
 Label: 016
 0B8  HEX32
 000  BCD     7   3     0   359.00  123.456  Deg
```

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 017								
04D	BCD	7	5		0	7999.9	12345.6	Lbs
000	BCD	7	4		0	359.90	123.456	Deg
Label: 020								
06D	BIN19L							
24D	BCD	7	5		0	7999.9	12345.6	Lbs
000	BCD	7	4		0	6000.0	1234.56	FPM
Label: 021								
002	BCD	7	4		0	3.0000	1.23456	EPR
020	BCD	7	3		0	3.0000	1.23456	EPR
06D	BIN19L							
0A1	BCD	7	3		0	3.0000	1.23456	EPR
000	BCD	7	4		0	3.0000	1234.56	RPM
Label: 022								
04D	BCD	7	5		0	7999.9	12345.6	Kg
06D	BIN19L							
000	BCD	7	4		0	4.0000	1.23456	M
Label: 023								
04D	BCD	7	5		0	7999.9	12345.6	Kg
06D	BIN19L							
000	BCD	7	3		0	359.00	123.456	Deg
Label: 024								
06D	BIN19L							
000	BCD	7	3		0	359.00	123.456	Deg
Label: 025								
04D	BNR			11	0	2048	123456.	
000	BCD	7	5		0	50000	12345.6	Ft
Label: 026								
000	BCD	7	3		0	450.00	123.456	Kts
Label: 027								
04D	BCD	7	5		0	7999.9	12345.6	Kg
000	BCD	7	3		0	359.00	123.456	Deg
Label: 030								
04D	BCD	7	5		0	7999.9	12345.6	Kg
000	RADIO	7	5		0	39999	123.456	MHz
Label: 031								
000	RADIO	3	3		7	79900	1234.56	
Label: 032								
000	RADIO	7	5		3	180.000	1234.56	KHz
Label: 033								
000	RADIO	7	5		0	39999	123.456	MHz
Label: 034								
006	BCD	7	5		0	1050.0	1234.56	mB
000	RADIO	7	4		4	39999	123.456	MHz

```
 ID   Type  MSD ND NB  Dis  Scale    Range  Units
-------------------------------------------------------------------------------
 Label: 035
 006  BCD     7   5     0   31.000  12.3456  In
 055  BCD     7   4     0    19999  123.456  MHz
 000  RADIO   7   4     7    39999  123.456  MHz
-------------------------------------------------------------------------------
 Label: 036
 055  BCD     7   3     0   599.00  123.456
 000  RADIO   1   6     7    79900  123.456
-------------------------------------------------------------------------------
 Label: 037
 000  RADIO   3   5     1    39990  12.3456  MHz
-------------------------------------------------------------------------------
 Label: 040
 000  HEX32
-------------------------------------------------------------------------------
 Label: 041
 000  BCD     1   6     0  180.000  123.456  Deg
-------------------------------------------------------------------------------
 Label: 042
 000  BCD     1   6     0  180.000  123.456  Deg
-------------------------------------------------------------------------------
 Label: 043
 000  BCD     7   3     0   359.00  123.456  Deg
-------------------------------------------------------------------------------
 Label: 044
 000  BCD     7   4     0   359.90  123.456  Deg
-------------------------------------------------------------------------------
 Label: 045
 000  BCD     7   4     0   259.90  123.456  Kts
-------------------------------------------------------------------------------
 Label: 046
 000  BCD     7   4     0   7999.9  123.456
-------------------------------------------------------------------------------
 Label: 047
 000  BCD     7   4     0   7999.9  123.456
-------------------------------------------------------------------------------
 Label: 050
 000  HEX32
-------------------------------------------------------------------------------
 Label: 051
 000  HEX32
-------------------------------------------------------------------------------
 Label: 052
 004  BNR           15  0       64  12.3456
 037  BCD     1   5     0   100.00  123.456   %
 038  BNR           15  0       64  12.3456
 000  HEX32
-------------------------------------------------------------------------------
 Label: 053
 004  BNR           15  0       64  12.3456
 038  BNR           15  0       64  12.3456
 000  BCD     7   3     0   359.00  123.456  Deg
-------------------------------------------------------------------------------
 Label: 054
 004  BNR           15  0       64  12.3456
 037  BNR           15  0    65536  123456.  Kg
 038  BNR           15  0       64  12.3456
 000  HEX32
```

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 055								
000	HEX32							
Label: 056								
002	BCD	7	5		0	7999.9	12.3456	Hrs
005	BCD	7	3		0	359.00	123.456	Deg
056	BCD	7	5		0	7999.9	12.3456	Hrs
060	BCD	7	5		0	7999.9	12.3456	Hrs
000	BCD	7	5		0	19999	12345.6	Kg
Label: 057								
000	HEX32							
Label: 060								
037	BCD	7	4		0	299.90	123.456	%
000	BNR			10	0	1024	1234.56	PSI
Label: 061								
00B	BIN19L							
03C	BNR			10	0	1024	1234.56	PSI
061	BIN19L							
000	HEX32							
Label: 062								
00B	BNR			11	0	256	123.456	M
03C	BNR			10	0	1024	1234.56	PSI
000	HEX32							
Label: 063								
00B	BNR			20	0	4096	1234.56	
03C	BNR			10	0	1024	1234.56	PSI
000	HEX32							
Label: 064								
00B	BNR			20	0	4096	1234.56	M
037	BCD	7	4		0	299.90	123.456	%
000	BNR			10	0	1024	1234.56	PSI
Label: 065								
00B	BIN19L							
037	BCD	1	5		0	19999	12345.6	Lbs
000	BCD	7	5		0	12000	1234560	Lbs
Label: 066								
00B	BNR			14	0	64	12.3456	M
000	BCD	7	5		0	100.00	123.456	%
Label: 067								
000	BCD	7	5		0	100.00	123.456	%
Label: 070								
002	BNR			11	0	512	123.456	Kts
00B	BIN19L							
029	BNR			11	0	512	123.456	Hz
056	BNR			11	0	512	123.456	Kts
060	BNR			11	0	512	123.456	Kts
0CC	BNR			12	0	4096	1234.56	PSI
000	HEX32							

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 071								
002	BNR			11	0	512	123.456	Kts
00B	BNR			14	0	64	12.3456	M
029	BNR			11	0	512	123.456	Hz
033	BNR			12	0	64	12.3456	Deg
0CC	BNR			12	0	4096	1234.56	PSI
000	HEX32							
Label: 072								
002	BNR			11	0	512	123.456	Kts
00B	BIN19L							
029	BNR			10	0	256	123.456	VDC
033	BNR			12	0	64	12.3456	Deg
0CC	BNR			12	0	4096	1234.56	PSI
000	BNR			11	0	180	123.456	Deg
Label: 073								
00B	BNR			14	0	64	12.3456	M
01C	BNR			8	0	32768	12345.6	cc
029	BNR			9	0	128	123.456	Pnt
0CC	BNR			12	0	4096	1234.56	PSI
0D0	BNR			9	0	128	123.456	Pnt
F03	BNR			9	0	128	123.456	Pnt
000	BNR			11	0	512	123.456	Kts
Label: 074								
00B	BIN19L							
033	BNR			10	0	4	1.23456	In
000	BNR			15	0	131072	1234560	Lbs
Label: 075								
008	BIN19L							
00B	BNR			17	0	131072	123456.	Ft
029	BNR			10	0	256	123.456	VDC
000	BNR			15	0	131072	1234560	Lbs
Label: 076								
008	BIN19L							
00B	BNR			17	0	131072	123456.	Ft
029	BNR			10	0	256	123.456	VDC
000	BNR			14	0	16384	123.456	%
Label: 077								
002	BNR			11	0	512	123.456	Kts
008	BIN19L							
00B	BNR			8	0	128	123.456	%
029	BNR			8	0	256	123.456	%
060	BNR			11	0	512	123.456	Kts
056	BNR			11	0	512	123.456	Kts
114	BNR			14	0	16384	123.456	%
037	BNR			17	0	131072	123.456	%
000	BNR			17	0	128	123.456	
Label: 100								
029	BNR			8	0	128	123.456	%
037	BNR			15	0	65536	123456.	Kg
F00	BNR			15	0	65536	123456.	Kg
000	BNR			12	0	180	123.456	Deg

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 101								
00B	BNR			15	0	1024	1234.56	
029	BNR			8	0	256	123.456	Amp
114	BNR			8	0	256	123.456	%
000	BNR			12	0	180	123.456	Deg
Label: 102								
00B	BNR			15	0	1024	1234.56	
029	BNR			8	0	256	123.456	Amp
000	BNR			16	0	65536	12345.6	Ft
Label: 103								
01B	BNR			18	0	180	123.456	Deg
00B	BIN19L							
029	BNR			9	0	128	123.456	VDC
0BB	BNR			12	0	180	123.456	Deg
000	BNR			11	0	512	123.456	Kts
Label: 104								
01B	BNR			18	0	180	123.456	Deg
029	BNR			9	0	128	123.456	VDC
02B	BNR			14	0	16384	12345.6	FPM
0BB	BNR			12	0	180	123.456	Deg
000	BNR			10	0	16384	12345.6	FPM
Label: 105								
01B	BNR			18	0	180	123.456	Deg
029	BNR			12	0	2048	1234.56	DgC
0BB	BNR			12	0	180	123.456	Deg
000	BNR			11	0	180	123.456	Deg
Label: 106								
01B	BNR			18	0	180	123.456	Deg
029	BNR			12	0	2048	1234.56	DgC
0BB	BNR			12	0	180	123.456	Deg
000	BNR			12	0	4096	1234.56	M
Label: 107								
002	BNR			16	0	65536	12345.6	Ft
060	BNR			16	0	65536	12345.6	Ft
056	BNR			16	0	65536	12345.6	Ft
037	BNR			14	0	16384	123.456	%
000	BNR			18	0	180	123.456	Deg
Label: 110								
00B	BNR			20	0	180	123.456	Deg
0BB	BNR			18	0	180	123.456	Deg
000	BNR			12	0	180	123.456	Deg
Label: 111								
00B	BNR			20	0	180	123.456	Deg
000	HEX32							
Label: 112								
00B	BNR			15	0	4096	1234.56	Kts
002	BNR			11	0	2048	12345.6	Ft
0A1	BNR			12	0	4	1.23456	EPR
0BB	BNR			18	0	180	123.456	Deg
000	BNR			12	0	4096	1234.56	RPM

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 113								
000	HEX32							
Label: 114								
002	BNR			12	0	180	123.456	Deg
060	BNR			12	0	180	123.456	Deg
056	BNR			12	0	180	123.456	Deg
029	BNR			11	0	2048	1234.56	DgC
02F	BNR			14	0	32	12.3456	PSI
03F	BNR			14	0	32	12.3456	PSI
0BB	BNR			18	0	180	123.456	Deg
0CC	BNR			12	0	16384	12345.6	Lbs
10A	BNR			11	0	2048	12.3456	PSI
10B	BNR			11	0	2048	12.3456	PSI
13A	BNR			14	0	32	12.3456	PSI
000	BNR			11	0	32768	12.3456	PSI
Label: 115								
002	BNR			12	0	180	123.456	Deg
056	BNR			12	0	180	123.456	Deg
060	BNR			12	0	180	123.456	Deg
029	BNR			11	0	2048	1234.56	DgC
0BC	BNR			8	0	256	123.456	DgC
0CC	BNR			12	0	16384	12345.6	Lbs
000	BNR			11	0	512	123.456	DgC
Label: 116								
00B	BIN19L							
055	BIN19L							
002	BNR			15	0	128	123.456	NM
060	BNR			15	0	128	123.456	NM
056	BNR			15	0	128	123.456	NM
029	BNR			11	0	2048	1234.56	DgC
000	BNR			12	0	16384	12345.6	Lbs
Label: 117								
00B	BNR			14	0	1024	1234.56	Ft
055	BNR			14	0	1024	1234.56	Ft
002	BNR			11	0	2048	1234.56	Ft
056	BNR			11	0	2048	1234.56	Ft
060	BNR			11	0	2048	1234.56	Ft
029	BNR			11	0	2048	1234.56	DgC
000	BNR			12	0	16384	12345.6	Lbs
Label: 120								
00B	BIN19L							
029	HEX32							
000	BNR			15	0	512	123.456	NM
Label: 121								
00B	BIN19L							
029	HEX32							
000	BNR			14	0	180	123.456	Deg
Label: 122								
029	HEX32							
000	BNR			12	0	180	123.456	Deg

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 123								
000	BNR			18	0	256	123.456	D/s
Label: 124								
F00	BNR			14	0	16384	123.456	%
00B	BIN19L							
000	HEX32							
Label: 125								
002	BCD	7	4		0	7999.9	12.3456	Hrs
056	BCD	7	4		0	7999.9	12.3456	Hrs
060	BCD	7	4		0	7999.9	12.3456	Hrs
000	BCD	7	5		0	7999.9	12.3456	Hrs
Label: 126								
002	BNR			15	0	32768	12345.6	Ft
056	BNR			15	0	32768	12345.6	Ft
060	BNR			15	0	32768	12345.6	Ft
000	HEX32							
Label: 127								
002	BNR			16	0	65536	12345.6	Ft
01B	BNR			12	0	180	123.456	Deg
033	BNR			14	0	32	12.3456	PSI
10A	BNR			11	0	2048	12.3456	PSI
10B	BNR			11	0	2048	12.3456	PSI
13A	BNR			12	0	180	123.456	Deg
000	BNR			11	0	32768	12.3456	PSI
Label: 130								
035	HEX32							
00B	BNR			17	0	16	12.3456	NM
F00	BNR			14	0	180	123.456	Deg
10A	BNR			10	0	128	123.456	DgC
10B	BNR			10	0	128	123.456	DgC
000	BNR			11	0	128	123.456	DgC
Label: 131								
035	HEX32							
F00	BNR			14	0	180	123.456	Deg
000	BNR			13	0	32	12.3456	PSI
Label: 132								
033	BNR			14	0	32	12.3456	PSI
035	HEX32							
000	BNR			13	0	32	12.3456	PSI
Label: 133								
00B	BNR			18	0	32768	12345.6	Ft
10A	BNR			11	0	180	123.456	Deg
10B	BNR			11	0	180	123.456	Deg
000	BNR			12	0	180	123.456	Deg
Label: 134								
01C	BNR			12	0	180	123.456	Deg
000	BNR			11	0	180	123.456	Deg

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 135								
01C	BNR			12	0	8	1.23456	IPS
05A	BCD	9	4		0	99990	1234.56	Kg
000	BNR			7	0	128	123.456	%
Label: 136								
05A	BCD	9	4		0	99990	1234.56	Kg
00B	BNR			18	0	32768	12345.6	Ft
01C	BNR			12	0	8	1.23456	IPS
000	HEX32							
Label: 137								
01B	BNR			12	0	180	123.456	Deg
02A	BNR			12	0	180	123.456	Deg
02F	BNR			12	0	128	123.456	%
05A	BCD	9	4		0	99990	1234.56	Kg
140	BNR			12	0	180	123.456	Deg
03F	BNR			12	0	128	123.456	%
000	BNR			11	0	128	123.456	%
Label: 140								
001	BNR			12	0	180	123.456	Deg
00B	BIN19L							
025	BNR			10	0	180	123.456	Deg
114	BIN19L							
140	BNR			20	0	4	.123456	
05A	BCD	9	4		0	99990	1234.56	Kg
000	HEX32							
Label: 141								
001	BNR			12	0	180	123.456	Deg
00B	BIN19L							
114	BIN19L							
025	BNR			10	0	180	123.456	Deg
05A	BCD	9	4		0	99990	1234.56	Kg
000	HEX32							
Label: 142								
025	BNR			8	0	32	12.3456	Kts
05A	BCD	9	4		0	99990	1234.56	Kg
114	BIN19L							
000	BNR			12	0	32	12.3456	Kts
Label: 143								
001	BNR			12	0	180	123.456	Deg
05A	BCD	9	4		0	99990	1234.56	Kg
114	BIN19L							
000	HEX32							
Label: 144								
001	BNR			14	0	8192	1234.56	Ft
02B	BNR			14	0	8192	1234.56	Ft
05A	BCD	9	4		0	99990	1234.56	Kg
114	BIN19L							
000	HEX32							
Label: 145								
000	BIN19L							

```
 ID   Type  MSD ND NB  Dis  Scale    Range  Units
--------------------------------------------------------------------------------
 Label: 146
 000  BIN19L
--------------------------------------------------------------------------------
 Label: 147
 000  BIN19L
--------------------------------------------------------------------------------
 Label: 150
 00B  BIN19L
 056  BIN19L
 060  BIN19L
 114  BIN19L
 000  HEX32
--------------------------------------------------------------------------------
 Label: 151
 002  BNR           11  0      180  123.456  Deg
 055  BIN19L
 056  BNR           11  0      180  123.456  Deg
 060  BNR           11  0      180  123.456  Deg
 002  BNR           11  0      180  123.456  Deg
 114  BIN19L
 000  HEX32
--------------------------------------------------------------------------------
 Label: 152
 055  BIN19L
 114  BIN19L
 000  HEX32
--------------------------------------------------------------------------------
 Label: 153
 055  BNR            9  0      360  123.456  Deg
 002  BNR           16  0    65536  12345.6  Ft
 114  BIN19L
 000  HEX32
--------------------------------------------------------------------------------
 Label: 154
 055  BNR            9  0      512  12.3456  Deg
 056  BNR           16  0      512  123.456  NM
 060  BNR           16  0      512  123.456  NM
 002  BNR           16  0      512  123.456  NM
 114  BIN19L
 000  HEX32
--------------------------------------------------------------------------------
 Label: 155
 055  BNR            9  0      512  12.3456  Deg
 027  BCD     3   4     0   359.90  123.456  Deg
 000  BIN19L
--------------------------------------------------------------------------------
 Label: 156
 000  BIN19L
--------------------------------------------------------------------------------
 Label: 157
 114  BCD     7   4     0   450.00  123.456
 000  BIN19L
--------------------------------------------------------------------------------
 Label: 160
 000  BIN19L
--------------------------------------------------------------------------------
 Label: 161
 000  BIN19L
```

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 162								
012	BNR			12	0	180	123.456	Deg
025	BNR			12	0	180	123.456	Deg
029	BNR			12	0	4096	1234.56	PSI
055	BIN19L							
114	BIN19L							
140	BNR			16	0	131072	123456.	Ft
000	HEX32							
Label: 163								
037	BCD	1	5		0	19999	12345.6	Lbs
055	BIN19L							
114	BIN19L							
000	HEX32							
Label: 164								
025	BNR			12	0	8192	1234.56	Ft
03B	BNR			11	0	32	12.3456	VDC
055	BNR			15	0	4096	12.3456	Deg
114	BIN19L							
F00	BNR			12	0	8192	1234.56	Ft
000	BNR			16	0	8192	1234.56	Ft
Label: 165								
055	BNR			16	0	8192	12.3456	Deg
00B	BNR			15	0	32768	12345.6	FPM
114	BIN19L							
000	BCD	7	5		0	7999.9	1234.56	Ft
Label: 166								
00B	BNR			15	0	4096	1234.56	Kts
114	BIN19L							
000	BNR			10	0	512	123.456	Ft
Label: 167								
002	BNR			16	0	128	123.456	NM
114	BIN19L							
F00	BNR			15	0	65536	123456.	Kg
000	HEX32							
Label: 170								
025	BCD	7	4		0	7000	1234.56	Ft
0C5	BCD	7	4		0	7000	1234.56	Ft
114	BIN19L							
000	BCD	7	3		0	50000	123.456	Ft
Label: 171								
002	BNR			16	0	128	123.456	NM
060	BNR			16	0	128	123.456	NM
056	BNR			16	0	128	123.456	NM
000	HEX32							
Label: 172								
000	HEX32							
Label: 173								
010	BNR			12	0	4	.123456	DDM
055	BNR			12	0	4	.123456	DDM
025	BNR			10	0	4	.123456	DDM

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
03B	BNR			11	0	4	1.23456	Dot
0D0	BNR			9	0	128	123.456	Pnt
F03	BNR			9	0	128	123.456	Pnt
000	BNR			7	0	128	123.456	%
Label: 174								
003	BNR			11	0	512	123.456	Kts
010	BNR			12	0	8	.123456	DDM
00B	BNR			15	0	4096	1234.56	Kts
029	BNR			12	0	4096	1234.56	PSI
055	BNR			12	0	8	.123456	DDM
0D0	BNR			12	0	4096	1234.56	PSI
F03	BNR			12	0	4096	1234.56	PSI
000	BNR			11	0	4	1.23456	Dot
Label: 175								
003	BNR			14	0	1024	1234.56	Kts
029	BNR			11	0	2048	1234.56	DgC
000	BNR			12	0	256	123.456	DgC
Label: 176								
003	BNR			13	0	4096	1234.56	mM
029	BNR			9	0	256	123.456	RPM
05A	BNR			11	0	512	123.456	DgC
114	BNR			11	0	512	123.456	DgC
000	BNR			18	0	2048	1234.56	mB
Label: 177								
003	BNR			17	0	131072	123456.	Ft
029	BNR			9	0	128	123.456	Pnt
055	BNR			16	0	1024	1234.56	NM
05A	BNR			11	0	512	123.456	DgC
114	BNR			11	0	512	123.456	DgC
000	BNR			18	0	2048	1234.56	mB
Label: 200								
05A	BNR			11	0	512	123.456	DgC
114	BNR			11	0	512	123.456	DgC
000	BCD	7	4		0	180.000	123.456	Deg
Label: 201								
05A	BNR			11	0	512	123.456	DgC
114	BNR			11	0	512	123.456	DgC
140	BNR			12	0	4096	1234.56	M
142	BNR			20	0	180	123.456	Deg
000	BCD	7	5		0	39999	123.456	NM
Label: 202								
002	BNR			15	0	512	123.456	NM
009	BNR			16	0	512	123.456	NM
029	HEX32							
140	BNR			12	0	4096	1234.56	
142	BIN19L							
000	BNR			11	0	512	123.456	DgC
Label: 203								
002	BNR			15	0	512	123.456	NM
006	BNR			17	0	131072	123456.	Ft
018	BNR			17	0	131072	123456.	Ft
029	HEX32							

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
035	BNR			17	0	131072	123456.	Ft
038	BNR			17	0	131072	123456.	Ft
05A	BNR			11	0	512	123.456	DgC
114	BNR			11	0	512	123.456	DgC
140	BNR			17	0	131072	123456.	Ft
000	BNR			11	0	32768	12.3456	PSI

Label: 204

002	BNR			11	0	512	123.456	Kts
029	HEX32							
056	BNR			11	0	512	123.456	Kts
060	BNR			11	0	512	123.456	Kts
05A	BNR			11	0	512	123.456	DgC
114	BNR			11	0	512	123.456	DgC
000	BNR			17	0	131072	123456.	Ft

Label: 205

002	RADIO	3	6		1	180.000	12.3456	MHz
029	HEX32							
05A	BNR			11	0	512	123.456	DgC
0B9	RADIO	3	6		1	180.000	12.3456	MHz
10A	BNR			11	0	1024	1.23456	M
10B	BNR			11	0	1024	1.23456	M
000	BNR			16	0	4096	1.23456	M

Label: 206

002	RADIO	3	6		1	180.000	12.3456	MHz
018	BNR			15	0	65536	12345.6	Ft
029	HEX32							
056	BIN19L							
060	BIN19L							
0B9	RADIO	3	6		1	180.000	12.3456	MHz
0CC	BNR			11	0	512	123.456	Kts
000	BNR			14	0	1024	1234.56	Kts

Label: 207

002	BIN19L							
00A	BNR			11	0	512	123.456	Kts
029	HEX32							
0B9	BIN19L							
000	BNR			12	0	1024	1234.56	Kts

Label: 210

006	BNR			15	0	2048	1234.56	Kts
038	BNR			15	0	2048	1234.56	Kts
140	BNR			15	0	2048	1234.56	Kts
000	HEX32							

Label: 211

002	BNR			11	0	512	123.456	DgC
006	BNR			11	0	512	123.456	DgC
01A	BNR			11	0	512	123.456	DgC
029	HEX32							
038	BNR			11	0	512	123.456	DgC
0AD	BNR			12	0	512	123.456	DgC
10A	BNR			10	0	128	123.456	DgC
10B	BNR			10	0	128	123.456	DgC
140	BNR			12	0	512	123.456	DgC
142	BNR			20	0	180	123.456	DgC
000	HEX32							

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 212								
004	BNR			11	0	32768	123456.	FPM
005	BNR			11	0	32768	123456.	FPM
006	BNR			11	0	32768	123456.	FPM
038	BNR			11	0	32768	123456.	FPM
03B	BNR			11	0	32768	123456.	FPM
056	BIN19L							
060	BIN19L							
140	BNR			11	0	32768	123456.	FPM
142	BIN19L							
000	HEX32							
Label: 213								
08D	BNR			18	0	262144	123456.	Lbs
142	BNR			10	0	256	123.456	Min
000	BNR			11	0	512	123.456	DgC
Label: 214								
000	HEX32							
Label: 215								
006	BNR			14	0	512	123.456	mB
01A	BNR			14	0	512	123.456	mB
029	BNR			12	0	4	1.23456	EPR
038	BNR			14	0	512	123.456	mB
0AD	BNR			16	0	512	123.456	mB
140	BNR			14	0	512	123.456	mB
000	BNR			14	0	256	123.456	%
Label: 216								
000	HEX32							
Label: 217								
002	BNR			11	0	32768	12345.6	FPM
006	BNR			16	0	64	12.3456	In
029	BNR			12	0	4	1.23456	EPR
038	BNR			16	0	64	12.3456	In
140	BNR			16	0	64	12.3456	In
000	BNR			14	0	256	123.456	%
Label: 220								
006	BNR			17	0	131072	123456.	Ft
038	BNR			17	0	131072	123456.	Ft
140	BNR			17	0	131072	123456.	Ft
000	HEX32							
Label: 221								
006	BNR			12	0	180	123.456	Deg
038	BNR			12	0	180	123.456	Deg
0AD	BNR			14	0	180	123.456	Deg
12C	BNR			12	0	180	123.456	Deg
140	BNR			12	0	180	123.456	Deg
000	HEX32							
Label: 222								
006	BNR			12	0	180	123.456	Deg
011	BNR			12	3	180	123.456	Deg
115	BNR			11	0	180	123.456	Deg
12C	BNR			12	0	180	123.456	Deg

```
 ID   Type  MSD ND NB  Dis  Scale    Range  Units
 140  BNR           12  0      180  123.456  Deg
 000  HEX32
-------------------------------------------------------------------------------
 Label: 223
 006  BNR           12  0      180  123.456  Deg
 12C  BNR           12  0      180  123.456  Deg
 140  BNR           12  0      180  123.456  Deg
 000  HEX32
-------------------------------------------------------------------------------
 Label: 224
 006  BNR           12  0      180  123.456  Deg
 12C  BNR           12  0      180  123.456  Deg
 140  BNR           12  0      180  123.456  Deg
 000  HEX32
-------------------------------------------------------------------------------
 Label: 225
 002  BNR           11  0      512  123.456  Kts
 006  BNR           12  0      180  123.456  Deg
 02B  BNR           11  0    32768  12345.6  FPM
 056  BNR           11  0      512  123.456  Kts
 060  BNR           11  0      512  123.456  Kts
 140  BNR           12  0      180  123.456  Deg
 000  HEX32
-------------------------------------------------------------------------------
 Label: 226
 000  HEX32
-------------------------------------------------------------------------------
 Label: 227
 019  BIN19L
 053  BIN19L
 F01  BIN19L
 000  ASCII   (PADDED)
-------------------------------------------------------------------------------
 Label: 230
 006  BCD     7   3     0   599.00  123.456  Kts
 038  BCD     7   3     0   599.00  123.456  Kts
 114  BCD     7   4     0   450.00  123.456
 000  HEX32
-------------------------------------------------------------------------------
 Label: 231
 114  BCD     7   4     0   450.00  123.456
 000  BCD     7   3     0   99.000  123.456  DgC
-------------------------------------------------------------------------------
 Label: 232
 002  HEX32
 055  BIN19L
 056  BIN19L
 060  HEX32
 114  BCD     7   4     0   450.00  123.456
 000  BCD     7   4     0    20000  12345.6  FPM
-------------------------------------------------------------------------------
 Label: 233
 002  BIN19L
 006  BCD     9   3     0   99.000  123.456  DgC
 038  BCD     9   3     0   99.000  123.456  DgC
 056  BIN19L
 060  BIN19L
 114  BCD     7   4     0   450.00  123.456
 000  BCD     3   3     0   99.000  123.456  DgC
```

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 234								
002	BIN19L							
006	BCD	7	5		0	1050.0	1234.56	mB
038	BCD	7	5		0	1050.0	1234.56	mB
056	BIN19L							
060	BIN19L							
000	BCD	3	4		0	39990	1234.56	mB
Label: 235								
002	BIN19L							
006	BCD	7	5		0	31.000	12.3456	In
038	BCD	7	5		0	31.000	12.3456	In
056	BIN19L							
060	BIN19L							
000	BCD	3	4		0	39990	12.3456	
Label: 236								
002	BIN19L							
006	BCD	7	5		0	1050.0	1234.56	mB
038	BCD	7	5		0	1050.0	1234.56	mB
056	BIN19L							
060	BIN19L							
000	HEX32							
Label: 237								
002	BIN19L							
006	BCD	7	5		0	31.000	12.3456	In
00B	BNR			17	0	16	12.3456	NM
038	BCD	7	5		0	31.000	12.3456	In
056	BIN19L							
060	BIN19L							
000	HEX32							
Label: 240								
000	HEX32							
Label: 241								
002	BNR			11	0	512	123.456	Kts
006	BNR			12	0	180	123.456	Deg
038	BNR			12	0	180	123.456	Deg
056	BNR			11	0	512	123.456	Kts
060	BNR			11	0	512	123.456	Kts
140	BNR			12	0	180	123.456	Deg
000	HEX32							
Label: 242								
006	BNR			16	0	2048	1234.56	mB
01A	BNR			16	0	2048	1234.56	mB
038	BNR			16	0	2048	1234.56	mB
03B	BNR			11	0	4	1.23456	Dot
0AD	BNR			18	0	2048	1234.56	mB
140	BNR			16	0	2048	1234.56	mB
000	HEX32							
Label: 243								
037	BCD	1	5		0	19999	12345.6	Kg
055	BIN19L							
000	HEX32							

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 244								
01C	BNR			8	0	32768	12345.6	PPH
033	BNR			16	0	32768	12345.6	PPH
03B	BNR			11	0	64	.012345	M
08D	BNR			16	0	32768	12345.6	PPH
10A	BNR			15	0	32768	123.456	
10B	BNR			15	0	32768	123.456	
140	BNR			11	0	2048	1.23456	
000	HEX32							
Label: 245								
002	BNR			12	0	256	123.456	Kts
003	BNR			12	0	256	123.456	Kts
00A	BNR			13	0	512	123.456	Kts
029	BNR			14	0	256	123.456	%
038	BNR			16	0	2048	1234.56	mB
03B	BNR			12	0	4	1.23456	EPR
056	BNR			12	0	256	123.456	Kts
060	BNR			12	0	256	123.456	Kts
0AD	BNR			16	0	2048	1234.56	mB
140	BNR			16	0	2048	1234.56	mB
000	HEX32							
Label: 246								
002	BNR			11	0	512	123.456	Kts
006	BNR			16	0	2048	123.456	mB
009	HEX32							
01C	BNR			12	0	4096	1234.56	RPM
029	BNR			14	0	256	123.456	%
038	BNR			16	0	2048	1234.56	mB
03B	BNR			14	0	180	123.456	Deg
056	BNR			11	0	512	123.456	Kts
060	BNR			11	0	512	123.456	Kts
140	BNR			16	0	2048	1234.56	mB
000	HEX32							
Label: 247								
002	BNR			11	0	512	123.456	Kts
009	HEX32							
00B	BNR			18	0	16	12.3456	NM
03B	BNR			12	0	256	123.456	Kts
056	BNR			11	0	512	123.456	Kts
060	BNR			11	0	512	123.456	Kts
0EB	BNR			14	0	16384	1234560	Lbs
114	BNR			13	0	65536	123456.	Lbs
140	BNR			11	0	512	123.456	Kts
000	BNR			14	0	65536	123456.	Lbs
Label: 250								
002	BNR			14	0	256	123.456	%
02B	BNR			12	0	4	1.23456	EPR
02C	BNR			14	0	65536	123456.	Lbs
038	BNR			12	0	180	123.456	Deg
05A	BNR			14	0	65536	123456.	Lbs
0AD	BNR			14	0	180	123.456	Deg
114	BNR			13	0	65536	123456.	Lbs
000	HEX32							

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 251								
001	BNR			15	0	4096	1234.56	NM
002	BNR			15	0	4096	1234.56	NM
006	BNR			17	0	131072	123456.	Ft
01A	HEX32							
000	HEX32							
Label: 252								
001	BNR			9	0	512	123.456	Min
002	BNR			9	0	512	123.456	Min
006	BNR			17	0	131072	123456.	Ft
01A	BNR			12	0	4	1.23456	EPR
02F	BNR			12	0	4	1.23456	EPR
038	BNR			17	0	131072	123456.	Ft
03F	BNR			12	0	4	1.23456	EPR
0EB	BNR			6	0	64	12.3456	Min
000	HEX32							
Label: 253								
002	BNR			14	0	256	123.456	%
01E	BNR			12	0	4	1.23456	EPR
038	BNR			12	0	180	123.456	Deg
000	HEX32							
Label: 254								
002	BNR			14	0	256	123.456	%
012	HEX32							
04D	BNR			15	0	262144	123456.	Lbs
055	BIN19L							
13A	BNR			14	0	256	123.456	%
140	BNR			13	0	131072	123456.	FPM
000	BNR			12	0	4	1.23456	EPR
Label: 255								
002	BNR			14	0	256	123.456	%
012	HEX32							
04D	BNR			15	0	32768	12345.6	G
055	BIN19L							
08E	BNR			11	0	180	123.456	Deg
13A	BNR			14	0	256	123.456	%
140	BNR			17	0	4096	1234.56	mB
255	BNR			17	0	4096	1234.56	mB
000	BNR			12	0	4	1.23456	EPR
Label: 256								
002	BNR			9	0	512	123.456	Min
00A	BNR			11	0	512	123.456	Kts
027	HEX32							
04D	BNR			12	0	16384	123456.	Lbs
055	HEX32							
056	BNR			9	0	512	123.456	Min
060	BNR			9	0	512	123.456	Min
140	BNR			14	0	1024	1234.56	Kts
F04	BNR			12	6	8192	12345.6	Lbs
000	BNR			15	0	131072	123456.	Lbs
Label: 257								
002	BNR			9	0	512	123.456	Min
027	HEX32							

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
055	HEX32							
056	BNR			9	0	512	123.456	Min
060	BNR			9	0	512	123.456	Min
140	BNR			17	0	4096	1234.56	mB
000	BNR			15	0	131072	123456.	Lbs
Label: 260								
02C	BNR			15	0	131072	123456.	Lbs
033	BNR			12	0	1024	1234.56	DgC
05A	BNR			15	0	131072	123456.	Lbs
10A	BNR			11	0	1024	1234.56	DgC
10B	BNR			11	0	1024	1234.56	DgC
114	BNR			15	0	131072	123456.	Lbs
F00	BNR			15	0	131072	123456.	Lbs
000	HEX32							
Label: 261								
002	BCD	9	4		0	99990	1234.56	
0A2	BCD	9	4		0	99990	1234.56	
033	BNR			14	0	128	123.456	PSI
056	BCD	9	4		0	99990	1234.56	
060	BCD	9	4		0	99990	1234.56	
10A	BNR			11	0	256	123.456	PSI
10B	BNR			11	0	256	123.456	PSI
000	BNR			15	0	131072	123456.	Lbs
Label: 262								
002	HEX32							
00A	BNR			10	0	256	123.456	Kts
01C	BNR			13	0	64	12.3456	PSI
033	BNR			14	0	64	12.3456	PSI
04D	BNR			16	0	65536	123.456	
056	HEX32							
060	HEX32							
10A	BNR			11	0	65536	12.3456	PSI
10B	BNR			11	0	65536	12.3456	PSI
114	BNR			15	0	131072	123456.	Lbs
000	BNR			15	0	131072	123456.	Lbs
Label: 263								
002	BNR			11	0	512	123.456	Kts
00A	BNR			11	0	512	123.456	Kts
010	HEX32							
01C	BNR			12	0	256	123.456	DgC
033	BNR			12	0	256	123.456	DgC
04D	BNR			16	0	65536	123.456	
055	HEX32							
056	BNR			11	0	512	123.456	Kts
060	BNR			11	0	512	123.456	Kts
10A	BNR			11	0	256	123.456	DgC
10B	BNR			11	0	256	123.456	DgC
000	BNR			15	0	131072	123456.	Lbs
Label: 264								
002	BNR			11	0	2048	1234.56	Min
00A	BNR			11	0	512	123.456	Kts
02C	BNR			15	0	131072	123456.	Lbs
04D	BNR			16	0	65536	123.456	
055	HEX32							
056	BNR			11	0	2048	1234.56	Min

```
ID   Type  MSD ND NB  Dis  Scale    Range  Units
060  BNR           11  0     2048  1234.56  Min
10A  BNR           11  0     2048  1234.56  PSI
10B  BNR           11  0     2048  1234.56  PSI
114  HEX32
000  BNR           14  0      512  123.456  PSI
-------------------------------------------------------------------------------
Label: 265
002  BNR           11  0      512  123.456  Kts
004  BNR           20  0      256  123.456  Ft
00A  BNR           11  0      512  123.456  Kts
01C  BNR           12  0     1024  1234.56  DgC
02C  BNR           15  0   131072  123456.  Lbs
033  BNR           12  0     1024  1234.56  DgC
038  BNR           20  0      256  123.456  Ft
04D  BNR           16  0    65536  123.456
056  BNR           11  0      512  123.456  Kts
060  BNR           11  0      512  123.456  Kts
114  BNR           15  0   131072  123456.  Lbs
000  BNR           11  0     1024  1234.56  DgC
-------------------------------------------------------------------------------
Label: 266
04D  BNR           16  0    65536  123.456
114  BNR           15  0   131072  123456.  Lbs
000  HEX32
-------------------------------------------------------------------------------
Label: 267
002  BNR           11  0      512  123.456  Kts
00A  BNR           11  0      512  123.456  Kts
02B  BNR           12  0      180  123.456  Deg
033  BNR           12  0      256  123.456  DgC
04D  BNR           16  0    65536  123.456
056  BNR           11  0      512  123.456  Kts
060  BNR           11  0      512  123.456  Kts
114  BNR           15  0   131072  123456.  Lbs
000  BNR           11  0      256  123.456  DgC
-------------------------------------------------------------------------------
Label: 270
04D  BNR           16  0    65536  123.456
000  BIN19L
-------------------------------------------------------------------------------
Label: 271
04D  BNR           16  0    65536  123.456
000  BIN19L
-------------------------------------------------------------------------------
Label: 272
05A  BCD     9   4     0    99990  1234.56  Kg
04D  BNR           16  0    65536  123.456
000  BIN19L
-------------------------------------------------------------------------------
Label: 273
04D  BNR           16  0    65536  123.456
05A  BCD     1   6     0   100.00  123.456
000  BIN19L
-------------------------------------------------------------------------------
Label: 274
04D  BNR           16  0    65536  123.456
05A  BCD     7   6     0   100.00  123.456
000  BIN19L
```

```
 ID   Type  MSD ND NB  Dis  Scale    Range  Units
-------------------------------------------------------------------------------
 Label: 275
 04D  BNR           16  0    65536  123.456
 05A  BCD     1   6     0   100.00  123.456
 000  BIN19L
-------------------------------------------------------------------------------
 Label: 276
 04D  BNR           16  0    65536  123.456
 000  BIN19L
-------------------------------------------------------------------------------
 Label: 277
 04D  BNR           16  0    65536  123.456
 F02  BIN19L
 000  BIN19L
-------------------------------------------------------------------------------
 Label: 300
 002  RADIO   3   6     1  180.000  12.3456  MHz
 0B9  RADIO   3   6     1  180.000  12.3456  MHz
 10A  BNR           11  0      256  123.456  DgC
 10B  BNR           11  0      256  123.456  DgC
 F01  BNR           10  0      512  123456.
 F02  BNR           12  0        4  1.23456
 000  HEX32
-------------------------------------------------------------------------------
 Label: 301
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 000  HEX32
-------------------------------------------------------------------------------
 Label: 302
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 000  HEX32
-------------------------------------------------------------------------------
 Label: 303
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 000  HEX32
-------------------------------------------------------------------------------
 Label: 304
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 F02  BNR           12  0      256  123.456   %
 000  ASCII   (NO PAD)
-------------------------------------------------------------------------------
 Label: 305
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 F02  BNR           12  0      256  123.456   %
 000  HEX32
-------------------------------------------------------------------------------
 Label: 306
 F02  BNR           12  0    32768  12345.6  PPH
 000  HEX32
-------------------------------------------------------------------------------
 Label: 307
 F02  BNR           12  0    32768  12345.6  PPH
 000  HEX32
```

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 310								
002	BNR		20	0		180	123.456	Deg
004	BNR		20	0		180	123.456	Deg
029	BNR		11	0		180	123.456	Deg
038	BNR		20	0		180	123.456	Deg
04D	BNR		15	0		32768	123.456	
05A	BIN19L							
056	BNR		20	0		180	123.456	Deg
060	BNR		20	0		180	123.456	Deg
114	BNR		15	0		131072	123456.	Lbs
000	HEX32							
Label: 311								
002	BNR		20	0		180	123.456	Deg
004	BNR		20	0		180	123.456	Deg
029	BNR		11	0		180	123.456	Deg
038	BNR		20	0		180	123.456	Deg
03B	BNR		10	0		64	12.3456	Lbs
056	BNR		20	0		180	123.456	Deg
05A	BIN19L							
060	BNR		20	0		180	123.456	Deg
114	BNR		15	0		131072	123456.	Lbs
000	HEX32							
Label: 312								
002	BNR		15	0		4096	1234.56	Kts
004	BNR		15	0		4096	1234.56	Kts
005	BNR		15	0		4096	1234.56	Kts
029	BNR		11	0		180	123.456	Deg
038	BNR		15	0		4096	1234.56	Kts
056	BNR		15	0		4096	1234.56	Kts
05A	BNR		15	0		131072	123456.	Lbs
060	BNR		15	0		4096	1234.56	Kts
114	BNR		15	0		131072	123456.	Lbs
000	HEX32							
Label: 313								
002	BNR		12	0		180	123.456	Deg
004	BNR		15	0		180	123.456	Deg
025	BNR		10	0		180	123.456	Deg
029	BNR		11	0		180	123.456	Deg
038	BNR		15	0		180	123.456	Deg
056	BNR		12	0		180	123.456	Deg
05A	BNR		15	0		131072	123456.	Lbs
060	BNR		12	0		180	123.456	Deg
114	BNR		15	0		131072	123456.	Lbs
000	HEX32							
Label: 314								
002	BNR		12	0		180	123.456	Deg
004	BNR		15	0		180	123.456	Deg
025	BNR		10	0		180	123.456	Deg
029	BNR		11	0		180	123.456	Deg
038	BNR		15	0		180	123.456	Deg
03B	BNR		10	0		64	12.3456	Lbs
05A	BIN19L							
114	BNR		15	0		131072	123456.	Lbs
000	HEX32							

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 315								
001	BNR		12	0		180	123.456	Deg
002	BNR		8	0		256	123.456	Kts
004	BNR		8	0		256	123.456	Kts
005	BNR		8	0		256	123.456	Kts
029	BNR		11	0		180	123.456	Deg
038	BNR		8	0		256	123.456	Kts
056	BNR		8	0		256	123.456	Kts
05A	BIN19L							
060	BNR		8	0		256	123.456	Kts
0A1	BNR		12	0		180	123.456	Deg
000	HEX32							
Label: 316								
002	BNR		12	0		180	123.456	Deg
004	BNR		8	0		180	123.456	Deg
029	BNR		12	0		2048	1234.56	DgC
038	BNR		8	0		180	123.456	Deg
056	BNR		12	0		180	123.456	Deg
060	BNR		12	0		180	123.456	Deg
0D0	BNR		12	0		2048	1234.56	DgC
10A	BNR		11	0		180	123.456	DgC
10B	BNR		11	0		180	123.456	DgC
000	HEX32							
Label: 317								
002	BNR		12	0		180	123.456	Deg
025	BNR		10	0		180	123.456	Deg
029	BNR		12	0		4096	1234.56	PSI
056	BNR		12	0		180	123.456	Deg
060	BNR		12	0		180	123.456	Deg
0D0	BNR		14	0		4096	1234.56	PSI
F03	BNR		14	0		4096	1234.56	PSI
000	BNR		15	0		180	123.456	Deg
Label: 320								
025	BNR		10	0		180	123.456	Deg
029	HEX32							
04D	BNR		13	0		8192	1.23456	Lbs
05A	HEX32							
F00	BNR		10	0		180	123.456	Deg
000	BNR		15	0		180	123.456	Deg
Label: 321								
002	BNR		12	0		180	123.456	Deg
004	BNR		11	0		180	123.456	Deg
005	BNR		11	0		180	123.456	Deg
029	HEX32							
038	BNR		12	0		180	123.456	Deg
056	BNR		12	0		180	123.456	Deg
060	BNR		12	0		180	123.456	Deg
10A	BNR		11	0		2048	1234.56	DgC
10B	BNR		11	0		2048	1234.56	DgC
000	HEX32							
Label: 322								
002	BNR		12	0		180	123.456	Deg
004	BNR		11	0		180	123.456	Deg
005	BNR		11	0		180	123.456	Deg

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
029	HEX32							
038	BNR			12	0	180	123.456	Deg
056	BNR			12	0	180	123.456	Deg
060	BNR			12	0	180	123.456	Deg
10A	BNR			11	0	1024	1234.56	DgC
10B	BNR			11	0	1024	1234.56	DgC
000	HEX32							

Label: 323

002	BNR			17	0	131072	123456.	Ft
004	BNR			12	0	4	1.23456	G
005	BNR			12	0	4	1.23456	G
038	BNR			12	0	4	1.23456	G
056	BNR			17	0	131072	123456.	Ft
060	BNR			17	0	131072	123456.	Ft
10A	BNR			11	0	128	123.456	%
10B	BNR			11	0	128	123.456	%
000	HEX32							

Label: 324

004	BNR			14	0	180	123.456	Deg
005	BNR			14	0	180	123.456	Deg
025	BNR			10	0	180	123.456	Deg
038	BNR			14	0	180	123.456	Deg
04D	BNR			15	0	32768	12345.6	G
05A	BNR			14	0	180	123.456	Deg
10A	BNR			11	0	128	123.456	%
10B	BNR			11	0	128	123.456	%
114	BNR			13	0	180	123.456	Deg
F00	BNR			10	0	180	123.456	Deg
000	HEX32							

Label: 325

004	BNR			14	0	180	123.456	Deg
005	BNR			14	0	180	123.456	Deg
01A	HEX32							
025	BNR			10	0	180	123.456	Deg
02F	BNR			12	0	4	1.23456	In
038	BNR			14	0	180	123.456	Deg
03F	BNR			12	0	4	1.23456	In
05A	BNR			14	0	180	123.456	Deg
10A	BNR			11	0	128	123.456	%
10B	BNR			11	0	128	123.456	%
114	BNR			13	0	180	123.456	Deg
000	HEX32							

Label: 326

004	BNR			13	0	128	123.456	D/s
005	BNR			13	0	128	123.456	D/s
038	BNR			13	0	128	123.456	D/s
04D	BNR			14	0	16384	1234560	Lbs
10A	BNR			11	0	2048	1234.56	PSI
10B	BNR			11	0	2048	1234.56	PSI
000	HEX32							

Label: 327

004	BNR			13	0	128	123.456	D/s
005	BNR			13	0	128	123.456	D/s
038	BNR			13	0	128	123.456	D/s
04D	BNR			13	0	8192	1.23456	Lbs

```
 ID   Type  MSD ND NB  Dis  Scale    Range  Units
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 000  HEX32
-------------------------------------------------------------------------------
 Label: 330
 004  BNR           13  0      128  123.456  D/s
 005  BNR           13  0      128  123.456  D/s
 02F  BNR           12  0      128  123.456   %
 038  BNR           13  0      128  123.456  D/s
 03F  BNR           12  0      128  123.456   %
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 000  HEX32
-------------------------------------------------------------------------------
 Label: 331
 004  BNR           12  0        4  1.23456   G
 005  BNR           12  0        4  1.23456   G
 02F  BNR           12  0      128  123.456   %
 038  BNR           12  0        4  1.23456   G
 03F  BNR           12  0      128  123.456   %
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 000  HEX32
-------------------------------------------------------------------------------
 Label: 332
 004  BNR           12  0        4  1.23456   G
 005  BNR           12  0        4  1.23456   G
 02F  BNR           12  0      128  123.456   %
 038  BNR           12  0        4  1.23456   G
 03F  BNR           12  0      128  123.456   %
 000  HEX32
-------------------------------------------------------------------------------
 Label: 333
 02F  BNR           12  0    32768  12345.6  PPH
 03F  BNR           12  0    32768  12345.6  PPH
 000  BNR           12  0        4  1.23456   G
-------------------------------------------------------------------------------
 Label: 334
 02F  BNR           12  0    32768  12345.6  PPH
 03F  BNR           12  0    32768  12345.6  PPH
 000  BNR           11  0      180  123.456  Deg
-------------------------------------------------------------------------------
 Label: 335
 002  BNR           11  0       32  12.3456  D/s
 02F  BNR           12  0      128  123.456   %
 03F  BNR           12  0      128  123.456   %
 056  BNR           11  0       32  12.3456  D/s
 060  BNR           11  0       32  12.3456  D/s
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 000  BNR           11  0       32  12.3456  D/s
-------------------------------------------------------------------------------
 Label: 336
 002  BNR           15  0       32  12.3456  Deg
 01A  BNR           12  0      256  123.456   %
 02F  BNR           12  0      128  123.456   %
 03F  BNR           12  0      128  123.456   %
 10A  BNR           11  0      128  123.456   %
 10B  BNR           11  0      128  123.456   %
 000  BNR           13  0      128  123.456  D/s
```

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 337								
002	BNR			12	0	4	1.23456	EPR
004	BNR			13	0	128	123.456	D/s
005	BNR			13	0	128	123.456	D/s
01A	BNR			12	0	256	123.456	%
038	BNR			13	0	128	123.456	D/s
10A	BNR			11	0	128	123.456	%
10B	BNR			11	0	128	123.456	%
000	BNR			15	0	256	123.456	%
Label: 340								
004	BNR			13	0	128	123.456	D/s
005	BNR			13	0	128	123.456	D/s
13A	BNR			14	0	256	123.456	%
140	BNR			14	0	16	12.3456	
000	BNR			12	0	4	1.23456	EPR
Label: 341								
003	BNR			12	0	4	1.23456	EPR
004	BNR			15	0	180	123.456	Deg
01A	BNR			12	0	4	1.23456	EPR
029	BNR			12	0	4	1.23456	EPR
02F	BNR			12	0	4	1.23456	EPR
038	BNR			15	0	180	123.456	Deg
03F	BNR			12	0	4	1.23456	EPR
04D	BNR			16	0	65536	12345.6	
10A	BNR			13	0	262144	123.456	%
10B	BNR			13	0	262144	123.456	%
140	BNR			12	0	4	1.23456	
000	BNR			14	0	256	123.456	%
Label: 342								
003	BNR			12	0	4	1.23456	EPR
01A	BNR			12	0	4	1.23456	EPR
029	BNR			12	0	4	1.23456	EPR
02F	BNR			12	0	4	1.23456	EPR
03B	BNR			12	0	4	1.23456	EPR
03F	BNR			12	0	4	1.23456	EPR
04D	BNR			16	0	65536	12345.6	
10A	BNR			13	0	262144	123.456	%
10B	BNR			13	0	262144	123.456	%
140	BNR			12	0	4	1.23456	
000	BNR			14	0	256	123.456	%
Label: 343								
003	BNR			12	0	4	1.23456	EPR
01A	BNR			12	0	256	123.456	%
10A	BNR			13	0	262144	123.456	%
10B	BNR			13	0	262144	123.456	%
000	BNR			14	0	256	123.456	%
Label: 344								
04D	BIN19L							
10A	BNR			12	0	128	123.456	%
10B	BNR			12	0	128	123.456	%
F03	BNR			13	0	256	123.456	%
000	BNR			14	0	256	123.456	%

```
 ID   Type  MSD ND NB  Dis  Scale    Range  Units
-------------------------------------------------------------------------------
 Label: 345
 002  HEX32
 04D  BIN19L
 10A  BNR           11  0     2048  123.456  DgC
 10B  BNR           11  0     2048  123.456  DgC
 000  BNR           12  0     2048  1234.56  DgC
-------------------------------------------------------------------------------
 Label: 346
 04D  BNR           15  0    65536  12345.6
 0D0  BNR           13  0      256  123.456   %
 10A  BNR           12  0      128  123.456   %
 10B  BNR           12  0      128  123.456   %
 F03  BNR           13  0      256  123.456   %
 000  BNR           14  0      256  123.456   %
-------------------------------------------------------------------------------
 Label: 347
 029  BNR           12  0    32768  12345.6  PPH
 0D0  BNR           12  0    32768  12345.6  Lbs
 10A  BNR           11  0      128  1234.56   %
 10B  BNR           11  0      128  1234.56   %
 13A  BNR           14  0    32768  12345.6  Lbs
 F02  BNR           12  0    32768  12345.6  PPH
 F03  BNR           12  0    32768  12345.6  PPH
 000  HEX32
-------------------------------------------------------------------------------
 Label: 350
 114  BCD     7   4     0    99990  .123456
 000  BIN19L
-------------------------------------------------------------------------------
 Label: 351
 114  BCD     7   4     0   450.00  123.456
 000  BIN19L
-------------------------------------------------------------------------------
 Label: 352
 114  BCD     7   4     0   450.00  123.456
 000  BIN19L
-------------------------------------------------------------------------------
 Label: 353
 0D0  BNR           8   0      512  123.456
 114  BCD     7   4     0   450.00  123.456
 F01  BNR           9   2      256  1.23456
 F03  BNR           8   0      512  1.23456
 000  BIN19L
-------------------------------------------------------------------------------
 Label: 354
 03D  BNR          19   0      512  1.23456
 F01  BNR           9   2      256  1.23456
 000  BIN19L
-------------------------------------------------------------------------------
 Label: 355
 00B  BIN19L
 027  BIN19L
 038  BIN19L
 03D  BNR           9   0      512  1.23456
 F01  BNR           9   2      256  1.23456
 000  ASCII   (PADDED)
```

ID	Type	MSD	ND	NB	Dis	Scale	Range	Units
Label: 356								
03D	BNR			9	0	512	1.23456	
F01	BNR			9	2	256	1.23456	
000	ASCII	(PADDED)						
Label: 357								
03D	BNR			9	0	512	1.23456	
F01	BNR			9	2	256	1.23456	
000	ASCII	(NO PAD)						
Label: 360								
002	HEX32							
03D	BNR			9	0	180	123.456	Deg
056	HEX32							
060	HEX32							
10A	BIN19L							
10B	BIN19L							
142	BNR			13	0	16	12.3456	NM
F01	BNR			9	2	360	123.456	Deg
000	BNR			15	0	32768	12345.6	FPM
Label: 361								
005	BNR			18	0	131072	123456.	Ft
03D	BNR			9	0	180	123.456	Deg
10A	BNR			11	0	4096	1234.56	
10B	BNR			11	0	4096	1234.56	
F01	BNR			9	2	360	123.456	Deg
000	BNR			20	0	131072	123456.	Ft
Label: 362								
004	BNR			12	0	4	1.23456	G
038	BNR			12	0	4	1.23456	G
10A	BNR			11	0	16384	12.3456	%
10B	BNR			11	0	16384	12.3456	%
115	BNR			13	0	8192	1234.56	Kts
000	HEX32							
Label: 363								
004	BNR			12	0	4	1.23456	G
038	BNR			12	0	4	1.23456	G
10A	BNR			11	0	131072	12345.6	Lbs
10B	BNR			11	0	131072	12345.6	Lbs
000	HEX32							
Label: 364								
004	BNR			12	0	4	1.23456	G
005	BNR			12	0	4	1.23456	G
038	BNR			12	0	4	1.23456	G
13A	BNR			14	0	256	123.456	%
000	HEX32							
Label: 365								
13A	BNR			14	0	256	123.456	%
000	BNR			15	0	32768	12345.6	FPM
Label: 366								
004	BNR			15	0	4096	1234.56	Kts
038	BNR			15	0	4096	1234.56	Kts
13A	BNR			12	0	180	123.456	Deg

```
ID   Type  MSD ND NB  Dis  Scale    Range  Units
000  HEX32
-------------------------------------------------------------------------------
Label: 367
004  BNR           15  0     4096  1234.56  Kts
038  BNR           15  0     4096  1234.56  Kts
13A  BNR           12  0      180  123.456  Deg
000  HEX32
-------------------------------------------------------------------------------
Label: 370
00B  BNR           20  0   131072  123.456  Ft
025  BNR           16  0     8192  1234.56  Ft
0C5  BNR           17  0    16384  12345.6  Ft
F00  BNR           16  0     8192  1234.56  Ft
000  BNR           13  0        8  1.23456   G
-------------------------------------------------------------------------------
Label: 371
000  HEX32
-------------------------------------------------------------------------------
Label: 372
005  BNR            9  0      180  123.456  Deg
10A  BNR           12  0      128  123.456   %
10B  BNR           12  0      128  123.456   %
000  BNR           11  0      128  123.456   %
-------------------------------------------------------------------------------
Label: 373
005  BNR           15  0     4096  1234.56  Kts
10A  BNR           12  0      128  123.456   %
10B  BNR           12  0      128  123.456   %
000  BNR           11  0      128  123.456   %
-------------------------------------------------------------------------------
Label: 374
005  BNR           15  0     4096  1234.56  Kts
000  BNR           11  0      128  123.456   %
-------------------------------------------------------------------------------
Label: 375
004  BNR           18  0        4  1.23456   G
005  BNR           12  0        4  1.23456   G
033  BNR           12  0       16  12.3456  VDC
038  BNR           18  0        4  1.23456   G
000  BNR           11  0      128  123.456   %
-------------------------------------------------------------------------------
Label: 376
004  BNR           18  0        4  1.23456   G
005  BNR           12  0        4  1.23456   G
038  BNR           18  0        4  1.23456   G
000  BNR           12  0       16  12.3456  VDC
-------------------------------------------------------------------------------
Label: 377
000  BCD     7   5     0   7999.9  12345.6
```

APPENDIX D

DATATRAC 400H ASSOCIATED PRODUCTS

In addition to the basic DATATRAC 400H unit, two optional software packages are available: the PCTOOLS-400 program (runs on a PC) and the Williamsburg Protocol Analyzer software for the 400H unit. These are discussed in the paragraphs below.

DESCRIPTION OF PCTOOLS-400 PROGRAM

The PCTOOLS-400 program was developed to give the DATATRAC 400 and 400H 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 is a 256K binary file containing the user-defined data as well as other code and data required by the DATATRAC 400/400H. The operator can then "burn" the binary file into a 27C2001 (2048 bit) type PROM with a prom programmer (not supplied).

Transmit Data Tables

The DATATRAC 400/400H 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 if the data tables are numerous or extensive as it greatly minimizes test time and the chance for error on data entry.

System Setup Tables

Some procedures may require fairly complex DATATRAC 400/400H systems 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 400/400H provides for calling up predefined systems 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 the BITE function.

Scaling Formats

When the ARINC 429 data is displayed in engineering units on the DATATRAC 400/400H (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 429-12 specifications. 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 a JcAIR Test Systems, Goodrich Corporation, representative.

APPENDIX E

BITE MODE 350/351 MAINTENANCE WORD DEFINITIONS

ACARS 024 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	MU Failure
12	OK	Fail	OOOI #1 Input Failure
13	OK	Fail	OOOI #2 Input Failure
14	OK	Fail	MCDU 1 Failure
15	OK	Fail	PRINTER Failure
16	OK	Fail	FMC 1 Failure
17	OK	Fail	DFDAU Failure
18	OK	Fail	MCDU 2 Failure
19	OK	Fail	MCDU 3 Failure
20	OK	Fail	FMC 2 Failure
21	OK	Fail	CFDIU Failure
22	OK	Fail	Cab Term Failure
23	OK	Fail	SDU Failure
24	OK	Fail	X-Talk Failure
25	OK	Fail	VHF Failure
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

ADF 012 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	LRU Failure
12	OK	Fail	Antenna Failure
13	Port B	Port A	Source Selection
14	OK	Inactive	Input Data
15	OK	Inactive	CFDIU Input Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

DME 009 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	LRU Failure
12	OK	Fail	Antenna Failure
13	Port B	Port A	Source Selection
14	OK	Inactive	Input Data
15	OK	Fail	Indicator Failure
16	OK	Inactive	CFDIU Input Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

GPWS 023 - Label 350

Bit	0 status	1 status	Function
11	OK	Inactive	R/A Bus
12	OK	Inactive	ADC Bus
13	OK	Inactive	IRS Bus
14	OK	Fault	Flaps Discrete
15	OK	Fault	Gear Discrete
16	OK	Inactive	ILS Bus
17	OK	Inactive	CFDIU Input Bus
18	OK	Fault	G/S Discrete
19	OK	Inactive	Stall Warn L Bus
20	OK	Inactive	Stall Warn R Bus
21	OK	Inactive	FMC Bus
22	OK	Fault	Program Pin Config Change
23	OK	Fault	GPWC LRU Failure
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

HF 019 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	Transceiver Failure
12	OK	Fail	Coupler Failure
13	OK	Fail	Antenna Failure
14	OK	Inactive	CFDIU Input Bus
15	Port B	Port A	Source Selection
16	OK	Inactive	Input Data
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

ILS 010 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	LRU Failure
12	OK	Fail	G/S Antenna Failure
13	OK	Fail	Localizer Antenna Failure
14	Port B	Port A	Source Selection
15	OK	Inactive	Input Data
16	OK	Fail	G/S Receiver Failure
17	OK	Fail	Localizer Receiver Failure
18	OK	Inactive	CFDIU Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

MLS 027 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	LRU Failure
12	OK	Fail	#1 Antenna Failure
13	OK	Fail	#2 Antenna Failure
14	OK	Fail	#3 Antenna Failure
15	Port B	Port A	Source Selection
16	OK	Inactive	Input Data
17	OK	Inactive	CFDIU Input Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

Printer 040 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	Status Bit A
12	OK	Fail	Status Bit B
13	OK	Fail	Status Bit C
14	OK	Fail	Spare
15	OK	Fail	Spare
16	OK	Inactive	Input Bus 1 Inactive
17	OK	Inactive	Input Bus 2 Inactive
18	OK	Inactive	Input Bus 3 Inactive
19	OK	Inactive	Input Bus 4 Inactive
20	OK	Inactive	Input Bus 5 Inactive
21	OK	Inactive	Input Bus 6 Inactive
22	OK	Inactive	Input Bus 7 Inactive
23	OK	Inactive	Input Bus 8 Inactive
24	OK	Inactive	Input Bus 9 Inactive
25	OK	Inactive	Input Bus 10 Inactive
26	OK	Inactive	Input Bus 11 Inactive
27	OK	Inactive	Input Bus 12 Inactive
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

RALT 007 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	LRU Failure
12	OK	Fail	Transmit Antenna Failure
13	OK	Fail	Indicator Failure
14	OK	Inactive	CFDIU Input Bus
15	OK	Fail	Receive Antenna Failure
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

SATCOM 041 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	Satellite Data Unit
12	OK	Fail	Radio Frequency Unit
13	OK	Fail	Top/Port High Power Amp
14	OK	Fail	Starboard High Power Amp
15	OK	Fail	LGA High Power Amp
16	OK	Fail	Top/Port Diplexer/LNA
17	OK	Fail	Starboard Diplexer/LNA
18	OK	Fail	LGA Diplexer/LNA
19	OK	Fail	Top/Port BSU
20	OK	Fail	Starboard BSU
21	OK	Fail	Top/Port Hi Gain Antenna
22	OK	Fail	Starboard Hi Gain Antenna
23	OK	Fail	Low Gain Antenna
24	OK	Fail	High Power Relay
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

SATCOM 041 - Label 351

Bit	0 status	1 status	Function
11	OK	Inactive	CFDIU Input Bus
12	OK	Inactive	Left MCDU Bus
13	OK	Inactive	Right MCDU Bus
14	OK	Inactive	Center MCDU Bus
15	OK	Inactive	ACARS Bus
16	OK	Inactive	ADS #1 Bus
17	OK	Inactive	ADS #2 Bus
18	OK	Inactive	ATC Bus
19	OK	Inactive	SDU #2 Bus
20	OK	Inactive	GMT Clock Bus
21	OK	Inactive	Top/Port HPA Bus
22	OK	Inactive	Starboard HPA Bus
23	OK	Inactive	LGA HPA Bus
24	OK	Inactive	Top/Port BSU Bus
25	OK	Inactive	Starboard BSU Bus
26	OK	Inactive	Radio Frequency Unit Bus

TCAS 035 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	TCAS Computer Unit
12	OK	Fail	Upper Antenna
13	OK	Fail	Lower Antenna
14	OK	Inactive	Radio Alt Input Bus 1
15	OK	Inactive	Radio Alt Input Bus 2
16	OK	Inactive	ATC/Mode-S Input Bus 1
17	OK	Inactive	ATC/Mode-S Input Bus 2
18	OK	Inactive	Attitude Input Bus
19	OK	Inactive	Magnetic Heading Input Bus
20	OK	Fail	TCAS System Fail
21	OK	Fail	Spare
22	OK	Fail	Spare
23	OK	Fail	TA 1 Display Discrete
24	OK	Fail	TA 2 Display Discrete
25	OK	Fail	RA 1 Display Discrete
26	OK	Fail	RA 2 Display Discrete
27	OK	Inactive	CMC Input Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

VHF 016 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	Transceiver Failure
12	OK	Fail	Antenna Failure
13	OK	Inactive	CFDIU Input Bus
14	Port B	Port A	Source Selection
15	OK	Inactive	Input Data
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

VOR 011 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	VOR Failure
12	OK	Fail	VOR Antenna Failure
13	Port B	Port A	Source Selection
14	OK	Inactive	Input Data
15	OK	Fail	MB Failure
16	OK	Fail	MB Antenna Failure
17	OK	Inactive	CFDIU Input Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

WXR 008 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	T-R Failure
12	OK	Fail	Antenna Failure
13	OK	Inactive	On-Side Attitude Bus
14	OK	Invalid	Control – 0 Invalid
15	OK	Invalid	Control – 1 Invalid
16	OK	Invalid	Control – 2 Invalid
17	OK	Invalid	Control – 3 Invalid
18	OK	Inactive	CFDIU Input Bus
19	OK	Inactive	Off-Side Attitude Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

XPDR 018 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	LRU Failure
12	OK	Fail	Antenna Failure
13	OK	Fail	Control Input Failure
14	OK	Fail	Altitude Input Failure
15	OK	Inactive	CFDIU Input Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

XPDR, MODE S 018 - Label 350

Bit	0 status	1 status	Function
11	OK	Fail	LRU Failure
12	OK	Fail	Antenna Monitor Top
13	OK	Fail	Antenna Monitor Bottom
14	OK	Fail	Receiver Monitor Top
15	OK	Fail	Receiver Monitor Bottom
16	OK	Fail	Transmitter Monitor Top
17	OK	Fail	Transmitter Monitor Bottom
18	OK	Fail	Squitter Monitor Top
19	OK	Fail	Squitter Monitor Bottom
20	OK	Inactive	Datalink Comm A/B Bus Stat
21	OK	Inactive	Datalink Comm C/D Bus Stat
22	OK	Inactive	TCAS Bus Status

23	Port B	Port A	Control Port Selected
24	OK	Inactive	Control Data Status
25	OK	Inactive	Altitude Side 1 Status
26	OK	Inactive	Altitude Side 2 Status
27	OK	Inactive	Maintenance Bus
28	ENABLE	INHIBIT	Bite Test Inhibit
29	NAK	ACK	Command Word Acknowledge

APPENDIX F

AVM Data
Equipment ID: F01

Label: 300 History Data
Decoding: Bits 28 through 19 displayed as 0-512000 scalar.

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
1	=	Engine 2

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
MBS	<	-	-	-	-	-	-	-	-	> LSB

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	= RMP

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

Label: 301 Fault History Data
Decoding: 19 bit binary, LSB first

Bit Definition

Bits 1-8	=	Label Number
Bit 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	= 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	1	= Fault 1
		through			
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	0	= 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: F01

Label: 350 Maintenance Data 1
Decoding: 19 bit binary, LSB first

Bit Definition

Bits 1-8	=	Label Number
Bit 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

Label: 353 Highest Vibration
Decoding: Bits 29 through 20 displayed as 0-2.56 scalar.

Bit Definition

Bits 1-8	=	Label Number
Bit 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

Data 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 < - - - - - - - - - - - - - - > LBS

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: F01

Label: 354 N1 Vibration
355 N2 Vibration
356 N3 Vibration
357 BB Vibration
Decoding: Bits 28 through 20 displayed as 0-2.56 scalar.

Bit Definition

Bits 1-8	=	Label Number
Bit 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 29	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 = Odd

Label: 360 N1 Rotor Imbalance Angle
361 LFT Rotor Imbalance Angle
Decoding: Bits 28 through 20 displayed as 0-360 deg.

Bit Definition

Bits 1-8	=	Label Number
Bit 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 29	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

SSM

Bit 31	30	29	
1	1	0	= Normal Operation

Parity

Bit 32 = Odd

EICAS 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

Label: 241 Tank Unit Data
Decoding: Hex

241 Tank Unit Data

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 11,000
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

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

247	0	Total Fuel Quantity

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

FQIS Data
Equipment ID: F04

Label: 256
Decoding: Bits 28 through 17 displayed as 0-81920 Lbs.

256 0 Undefined

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 81,920
Units	=	Lbs

SSM

Bit 31	30	29		
0	0	0	=	Failure Warning
1	1	0	=	Normal Operation

Parity

Bit 32 = Odd

APPENDIX G
DATATRAC 400/400H
WILLIAMSBURG PROTOCOL ANALYZER

TABLE OF CONTENTS

1. INTRODUCTION G-5

2. SETUP MENU SELECTIONS G-7
   - Function
   - Variables
   - Unit 1 SAL
   - Unit 1 Channel and Speed
   - Unit 2 SAL
   - Unit 2 Channel and Speed
   - Label Select
   - Acquisition
   - Trigger on Error
   - Trigger Position
   - Trigger on Data

3. PERFORMING A FILE TRANSFER DIALOGUE ACQUISITION G-10
3.1 Monitor-Type Acquisition G-11
3.2. Auto-Response Mode Acquisition G-11
3.3. Planned-Response Mode Acquisition G-12

4. DEFINING THE PLANNED-RESPONSE BUFFER G-13
4.1. Assembling Unit Messages from Dialogue Buffer G-13
4.2. Planned-Response Buffer Edit Screen G-14
4.2.1. Edit Line Number G-14
4.2.2. Data Display Format G-14
4.3. Response File Edit Keystrokes G-15
4.4. Description of Format Independent Edit Keystrokes G-16
4.4.1. Link Field G-16
   - S (Standby) Link
   - C (Contiguous) Link
   - N (No Operation) Link
   - R (Repeat) Link

4.4.2. SAL Field G-19
4.4.3. Parity Field G-19
4.4.4. Delay Time Field G-19
4.5. Description of ENG Format Data Fields for Different Word Types G-20
4.5.1. FULL - - Full Binary Word G-20
4.5.2. PART - - Partial Binary Word G-20

4.5.3. CHAR - - Character Data Word G-21
4.5.4. RTS - - Request to Send G-21
4.5.5. CTS - - Clear to Send G-22
4.5.6. NCTS - - Not Clear to Send G-22
4.5.7. BUSY - - Sink Device Busy G-22
4.5.8. NAK - - LDU Not Acknowledged G-22
4.5.9. ACK - - LDU Acknowledged G-22
4.5.10. SYN - - Synchronize Process G-22
4.5.11. TEST and LOOP G-23
4.5.12. SOLO - - Standalone Data Word G-23
4.5.13. SOT - - Start of Transmission G-23
4.5.14. EOT - - End of Transmission G-23
4.5.15. HEX - - Hexadecimal Data Display G-23
4.6. Encoding and Displaying of ISO-5 Characters in Binary Data Words G-24

5. EDITING PROTOCOL VARIABLES G-26

6. REVIEWING DIALOGUE DATA G-28
6.1. Channel Identifier (Ch) G-29
6.2. Error Status (E) G-29
6.3. Time Stamp (Time) G-30
6.4. Display of Non-SAL Words G-31

7. RS232 OPERATION G-32
7.1. Planned-Response and Dialogue Buffer Data Download G-32
7.2. Real-time Data Download G-37

LIST OF FIGURES

Figure 1. Protocol File Transfer Main Setup Screen G-7

Figure 2. Warning Message Displayed Before Acquisition when Valid Data Present in Dialogue Buffer G-10

Figure 3. The File Transfer Status Screen Displayed During a Dialogue Acquisition G-11

Figure 4. Planned-Response Buffer Definition Select Screen G-13

Figure 5. Planned-Response Buffer Edit Screen with Sample File G-14

Figure 6. Planned-Response Buffer Edit Screen with Sample Sink Messages in Response to the Source LDU of Figure 5 ..... G-18

Figure 7. The 16 Different Word Types Available when ENG Format is Selected G-21

Figure 8. Packing of Character Data into FULL Binary Data Words G-24

Figure 9. Protocol Variables Edit Screen Showing Default Values G-26

Figure 10. Sample Dialogue Acquisition Review Screen G-28

Figure 11. RS232 Download Preparatory Message Screen G-32

Figure 12. RS232 Download Status Screen G-33

Figure 13. Sample Listing of Output File from RSREAD Program of DATATRAC 400/400H Buffer containing Response and Dialogue Data G-34

Figure 14. Sample Listing of Output File from RSREAD.EXE Program of DATATRAC 400/400H Real-time Acquisition Download G-37

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.

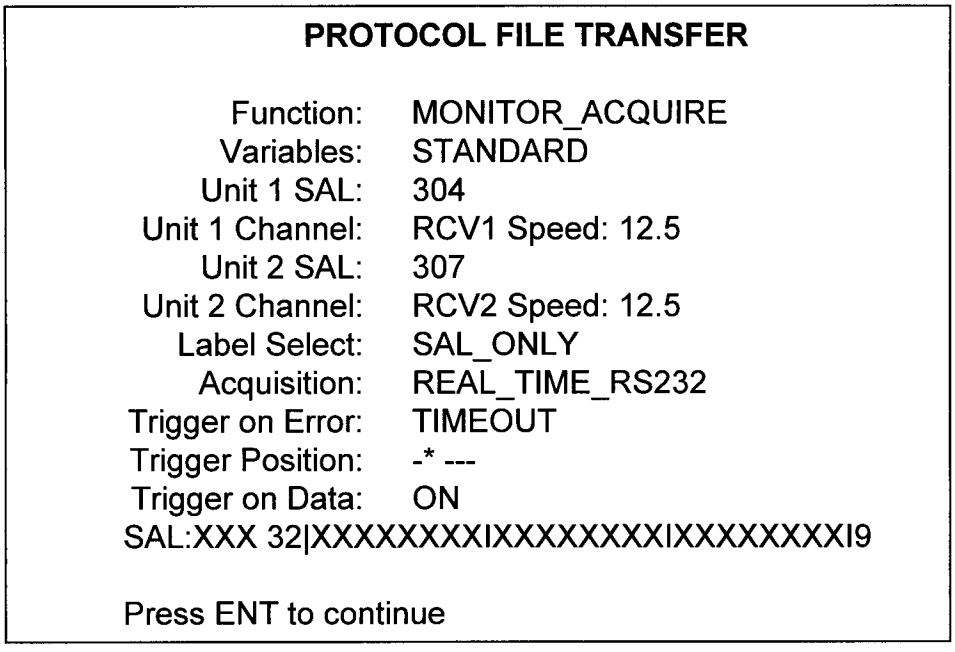


Figure 1. Protocol File Transfer Main Setup Screen.

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.

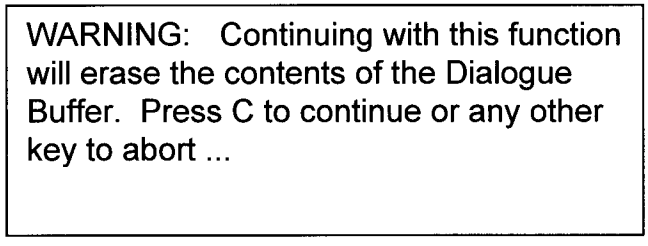


Figure 2. Warning Message Displayed Before Acquisition when Valid Data Present in Dialogue Buffer.

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.

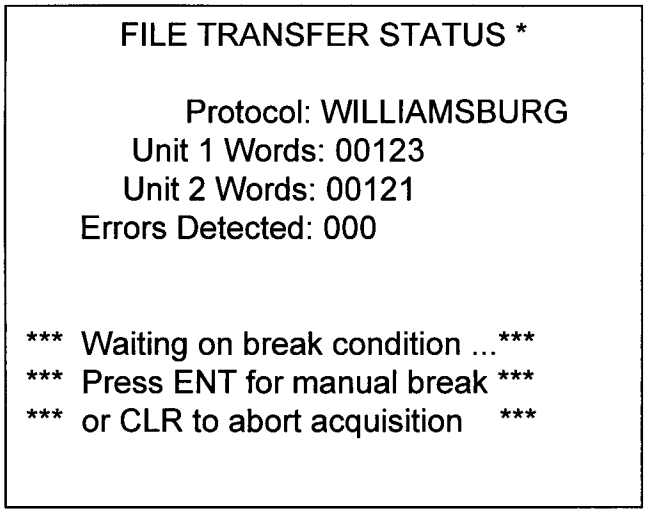


Figure 3. The File Transfer Status Screen Displayed During a Dialogue Acquisition.

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.

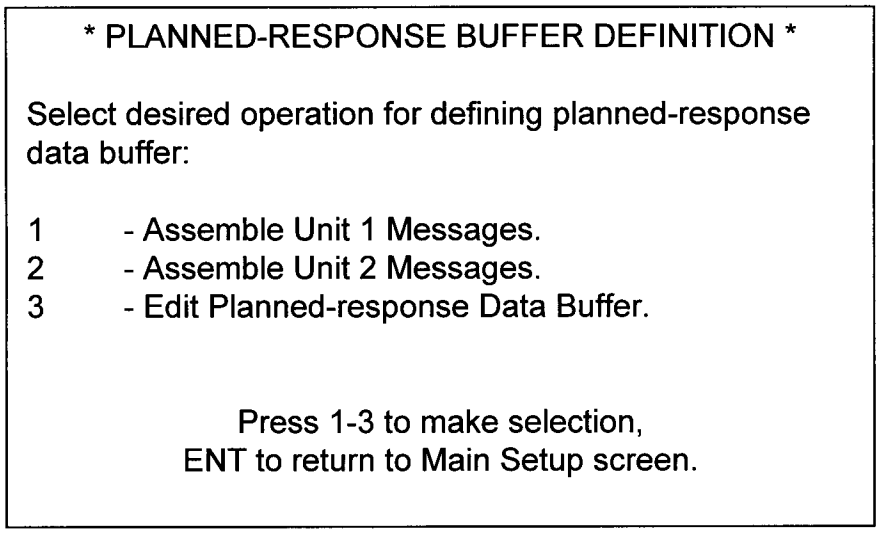


Figure 4. Planned-response Buffer Definition Select Screen.

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 0111111111111111111 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.

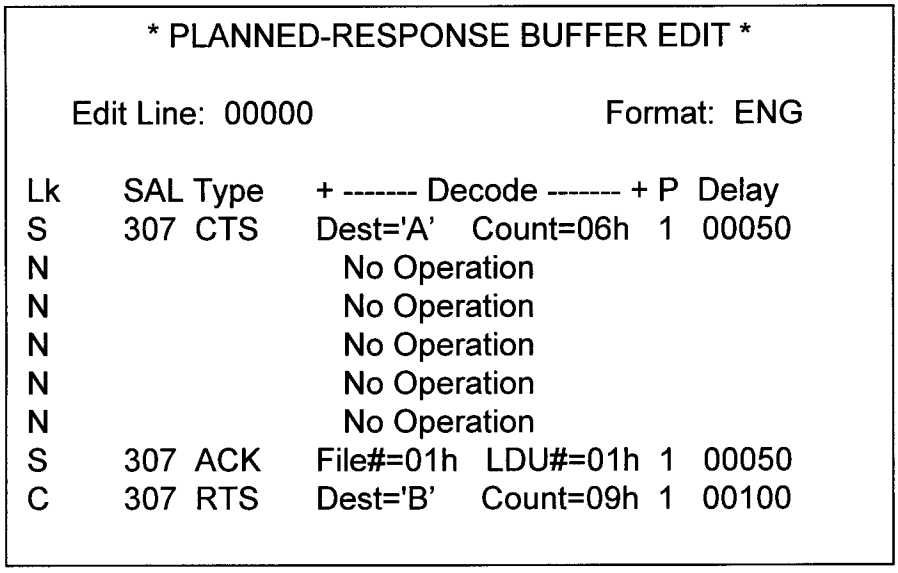


Figure 6. Planned-Response Buffer Edit Screen with Sample Sink Messages in Response to the Source LDU of Figure 5.

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).

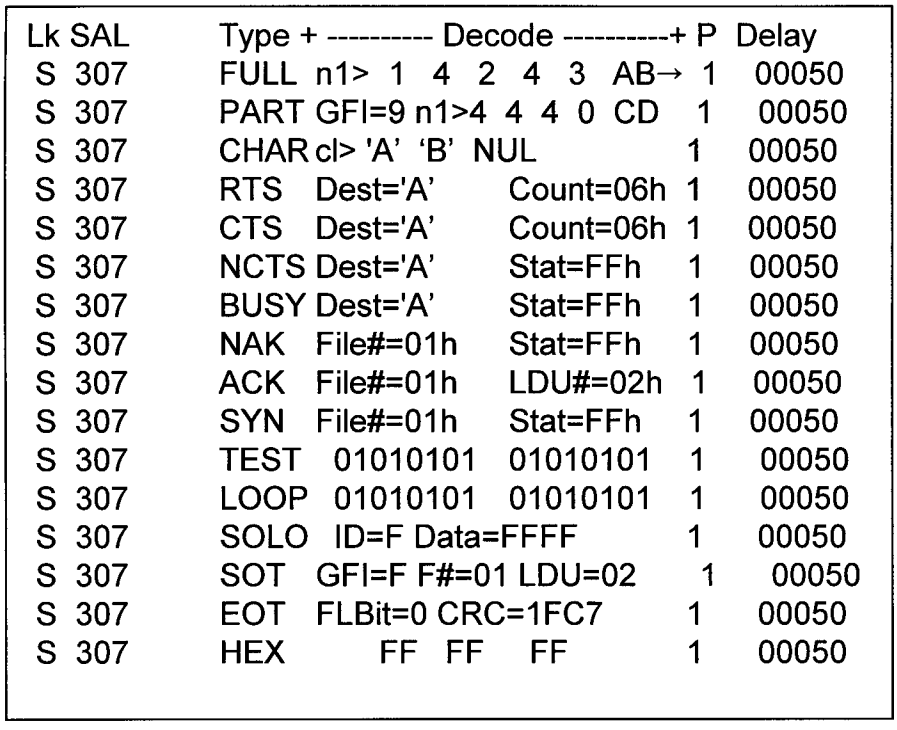


Figure 7. The 16 Different Word Types Available when ENG Format is Selected.

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 stand alone 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 – Stand alone 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 8 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.

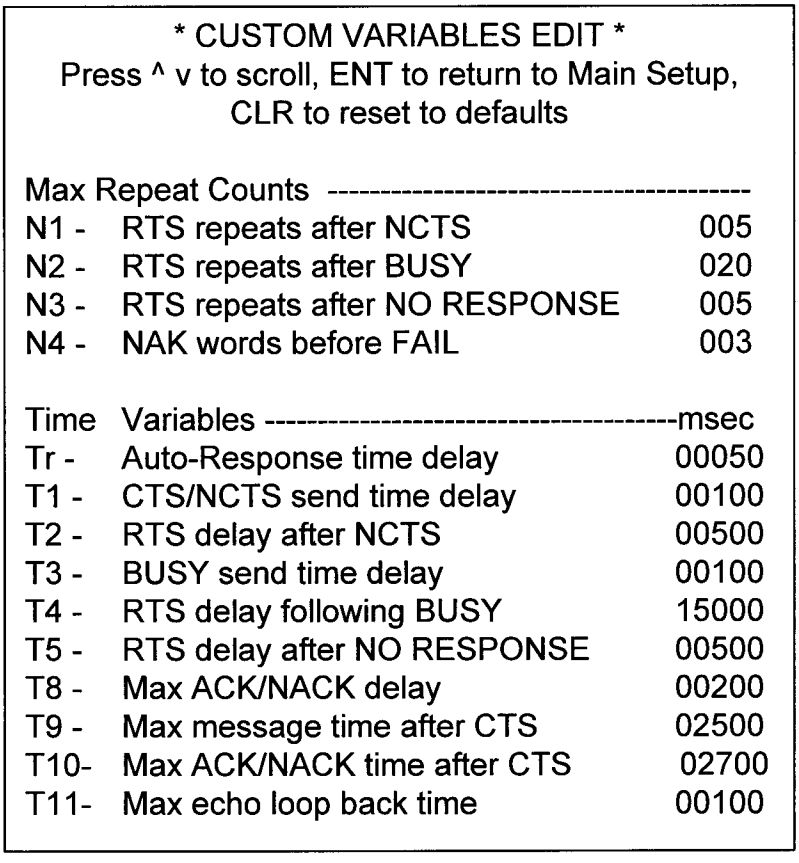


Figure 9. Protocol Variables Edit Screen Showing Default Values.

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.

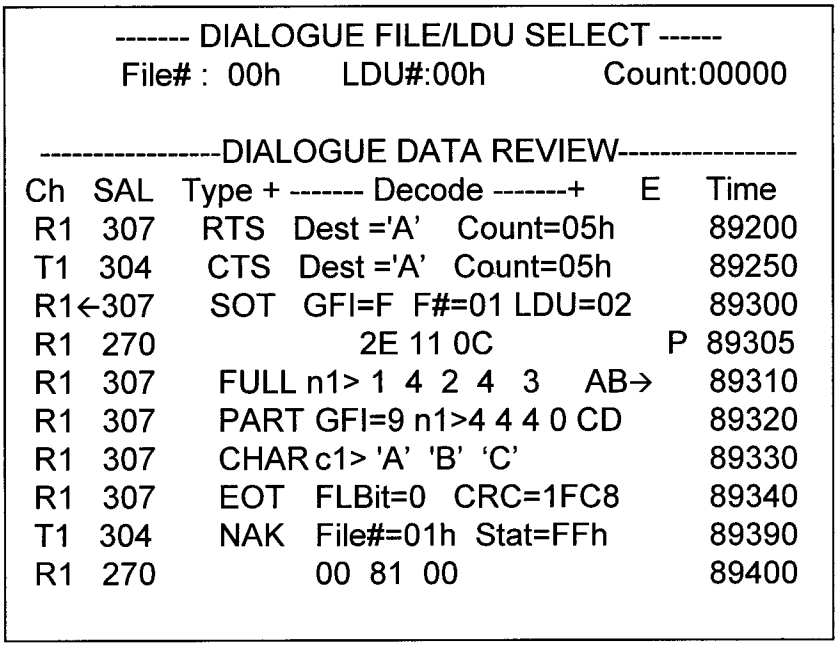
The custom variables can be reset to the standard values given in the ARINC specification by pressing the CLR key. The DATATRAC will return with a message asking the operator to confirm the action. Pressing C at this point will reset all variables to the values shown in Figure 9.

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 RS232 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 RS232 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 RS232 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.

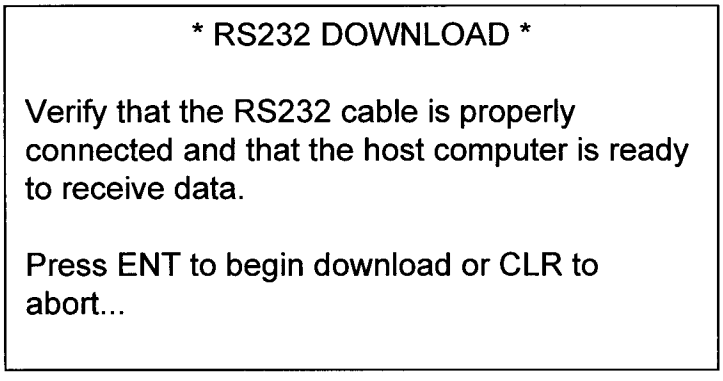


Figure 11. RS232 Download Preparatory Message Screen.

The RS232 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.

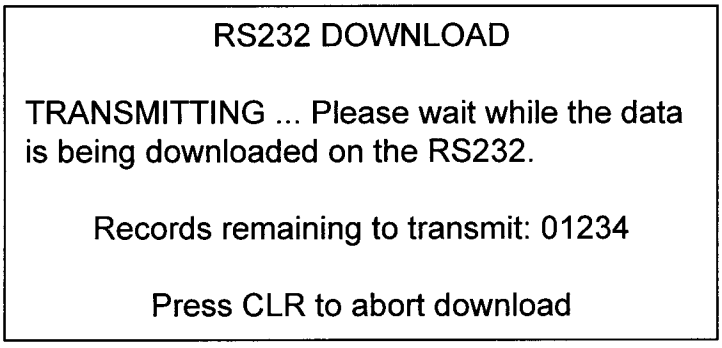


Figure 12. RS232 Download Status Screen.

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 RS232 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 RS232 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.