



OPERATION MANUAL

429EBP ARINC 429 TX/RX

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REVISION: A2

DATE: 06/04/2015

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ATG 429EBP Operation Manual

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ATG 429EBP Operation Manual

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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 through a conductive wrist strap, or a similar grounding device, using a 1 M Ω 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 circuit 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.

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1 GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides operational procedures and maintenance information for the ATG Model 429EBP - ARINC 429 Transmitter/Receiver.

1.2 EQUIPMENT DESCRIPTION

The ATG 429EBP Transmitter/Receiver provides avionics technicians and line maintenance personnel with an easy method for troubleshooting ARINC 429 avionics systems. The 429EBP has unique label definitions designed to facilitate the testing of Boeing aircraft avionics. The 429EBP can transmit up to 10 independent ARINC 429 labels simultaneously and can receive and store up to 4096 words (8192 words without label or rate information in the DATA ONLY TRAP mode). A special 'Trigger Trap' feature allows selective trapping of block data protocols and alpha-numeric messages. The unit has a non-volatile memory and automatic scrolling to enable the user to store and review the trapped labels at his or her discretion. The user may also print the trapped words on a printer through the simplified handshake Centronics parallel printer port. Internal batteries are provided for portable operation of the 429EBP and the unit is housed in a rugged, compact case. Selection of the data, transmitted or received, can be in either hexadecimal or engineering formats. A more detailed description of the unit's capability can be found in Section 3 of this manual.

1.3 TECHNICAL CHARACTERISTICS

<u>Specifications</u>	<u>Characteristics</u>
WEIGHT:	3 lbs (1.36 kgs)
DIMENSIONS:	
Height:	7.25 in (18.42 cm)
Width:	4.5 in (11.43 cm)
Depth:	2.5 in (6.35 cm)
POWER REQUIREMENTS:	Six (6) internally mounted AA rechargeable NiCad batteries.
OPERATING TEMPERATURE:	-10 to +60 degrees C

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429 TRANSMITTER:

Bit Rate: 12.5 or 100 kbps +/- 0.5% (selectable)

Pulse Rise/Fall Time: Low Speed -10 +/- 5.0 usec
High Speed -1.5 +/- 0.5 usec

NOTE: Pulse rise and fall times are measured between the 10% and 90% voltage points on the leading and trailing edges of the pulse.

Pulse Amplitude (Line A to B): HI = +10 +/- 1.0VDC
LO = -10 +/- 1.0VDC
NULL = 0 +/- 0.5VDC

Output Impedance: 75 Ohms (Line A to B) Nominal

Repetitive Word Rate: 4 to 59998 msec

Parity: ODD or EVEN (selectable)

429 RECEIVER:

Voltage Levels (Line A to B): HI +6.5 to +13 VDC
NULL +2.5 to -2.5 VDC
LO -6.5 to -13 VDC

Bit Rate: Low Speed 8 to 20 kbps
High Speed 80 to 125 kbps

Word Rate: ±2 msec. average

Input Impedance: 12K ohms minimum (balanced)

1.4 UNITS AND ACCESSORIES APPLIED

1. ATG Model 429EBP - ARINC 429 Transmitter Receiver JPN 01-1001-12
2. STANDARD Accessory: 110V/60Hz to 9VDC Battery Charger
JPN 15-0009-03

OPTIONAL Accessory: 220V/60Hz to 9VDC Battery Charger
JPN 15-0009-02
3. 429 EBP Operation Manual, JPN E6-1001-13

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2 INSTALLATION

2.1 GENERAL INFORMATION

This section contains information relating to the unpacking and inspection of the unit. Also included is information concerning charging of the internal batteries and an explanation of the Unit Self Test routine.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Carefully remove the ATG 429EBP and battery charger from the packing box. Visually inspect the units for any damage incurred during shipment. Should there be damage, save the packing box to show the shipping company when submitting your claim. It is generally a good idea to save the packing box should it become necessary to store or ship the unit.

2.3 EQUIPMENT INSTALLATION

2.3.1 BATTERY CHARGING

The batteries were fully charged when the unit was shipped from the factory. However, if the unit has been stored for an extended period of time, the batteries may have become discharged. Plug the charger into an appropriate voltage outlet (U.S. as well as international voltage chargers are available). A 4 to 5 hour charge should refresh the batteries. The 429EBP may be operated while charging or with the charger disconnected. With fully charged batteries, the unit will operate for approximately four to six hours.

2.3.2 CONNECTION TO USER EQUIPMENT

Connect the ATG 429EBP output (TX jack) to the input of the UUT and the 429EBP input (RX jack) to the output of the UUT using standard 1/4 inch stereo phone jacks.

2.3.3 JUMPER PLUG FABRICATION

Jumper plugs should be fabricated using 2-conductor braided shield cable. The shield should be folded back onto the insulation and the clamp on the connector should be crimped around the shielding. Also, once the shield is clamped, solder should be added to ensure a stable connection is made between the clamp and wire shield. Refer to figures 2-1 and 2-2.

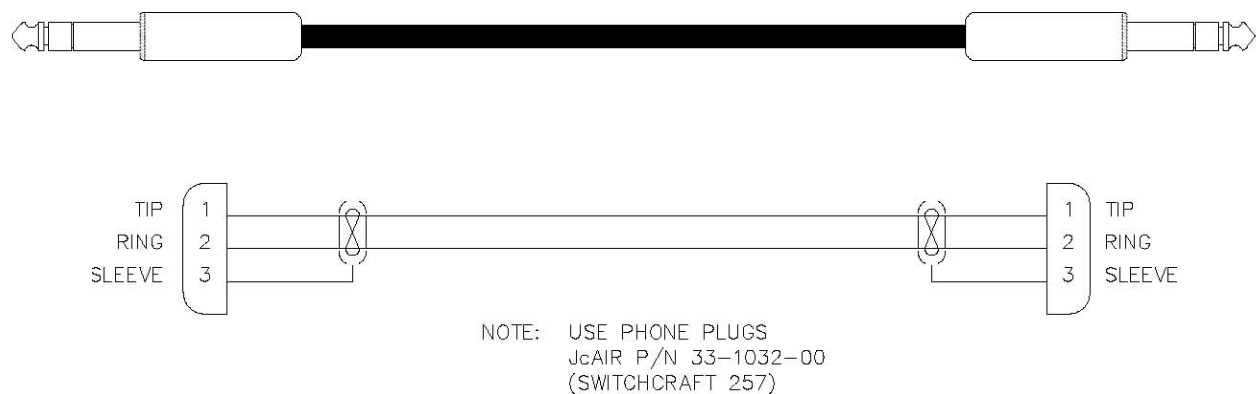


Figure 2-1. Phone Jack Jumper Plug

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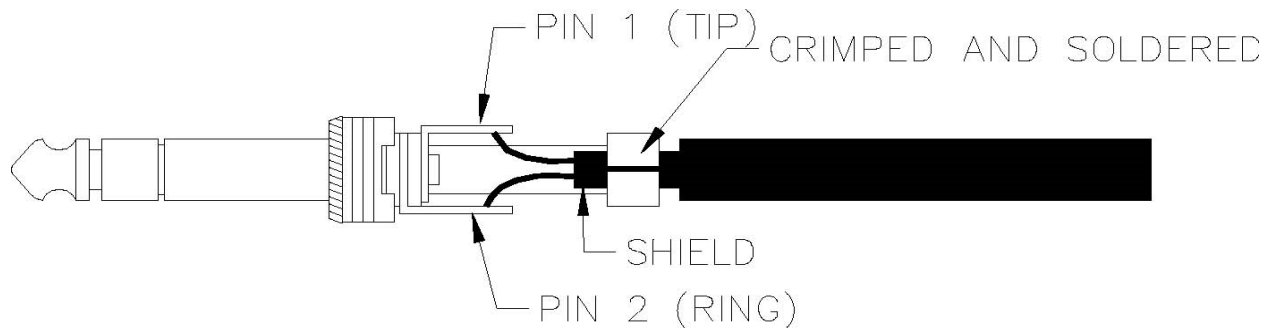


Figure 2-2. Phone Plug Termination

2.4 POST INSTALLATION CHECK

2.4.1 UNIT SELF TEST

The 429EBP performs a self test routine on initial power up. The following tests are performed:

1. The message **EBP VERSION *.*** is displayed. (*.* = software revision). Red LED's on the front of the unit will be lit for approximately 0.5 seconds each in the following order: EVEN and ODD Parity, TX and RX. For the remainder of the self test, unless an error condition exists, the LED's are extinguished. If one of the LED's fails to light, the unit should still function properly, but the LED should be replaced at the earliest opportunity. If all LED's fail to illuminate and the display is blank or display's random data, then a catastrophic unit failure has occurred or the batteries are completely discharged.
2. The EPROM is checked by summing all the memory locations and comparing the result to the known checksum. If the checksums do not match, the unit will signal a checksum error by flashing the RX LED and will attempt to write "CHECKSUM ERROR" to the display. (If the entire EPROM has failed, however, or if one of the locations in the checksum subroutine is bad, the program will not be able to execute properly.)
3. The 429EBP has RAM in two independent IC's. The unit tests each RAM section separately for data retention and address integrity. It begins by writing the lower 8 bits of the location address to the location. It completely writes all locations of the section. It will then read each location and check its value. If all is OK, it will repeat this sequence with the exception that it will write the complement of the lower 8 bits of the location address to the location. It performs this sequence for each RAM section.
If the first IC fails this test, the unit will flash the EVEN parity LED and attempt to write "NSC RAM ERR" to the display. This indicates that U5 has failed its test. If the second IC fails this test, the unit will flash the ODD parity LED and will attempt to write "MAIN RAM ERR" to the display. This indicates that U3 has failed its test. The unit will then loop indefinitely reading from the failed location.
4. The 429EBP has a loop back feature on the digital board to completely test the digital portion of the transmit and receive circuitry. The unit will turn on the loop back circuitry and transmit a word with a label of 0 and a data pattern of AA55AA. After a brief pause, the unit will read it's receive buffer and check the data against the transmitted data. If the data is not what is expected, the unit will flash the TX LED and attempt to write "LOOP BACK FAILED" to the display. No further operations will be possible until the cause of the failure is corrected.

The Loop test and Ram tests are not performed if the unit Trap mode is active.

If all tests have been successfully completed, the unit will display **"SELF TEST OK"** for approximately 2 seconds and will then enter the operational receive mode and display the number of different labels currently being received (or number of words in the trap buffer if TRAP mode is active).

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3 OPERATION

3.1 GENERAL OPERATION DESCRIPTION

The ATG 429EBP is a single channel ARINC 429 transmitter and receiver. It can receive and display all ARINC 429 labels. It can simultaneously output up to ten 429 words. Data can be displayed and entered in hexadecimal or engineering formats.

3.1.1 HEX MODE

The HEX mode has two types of data entry and display. The first type allows display and entry of bits 32 - 9 in hexadecimal format, reading left to right as 32 - 9. The label will be displayed in octal. The SDI (bits 10 - 9) is then displayed in binary. Bits 32 - 9 of the word are then displayed in HEX. On the far right of the display will be the SSM bits (31 - 30) of the word. The second type in HEX mode allows display and entry of bits 31 - 9 in binary format. The SDI bits (10 - 9) and SSM bits (31 - 30) each have their own screen. The remaining bits (29 - 11) each have their own individual screen. Word rate for the word is also available on a dedicated screen in the HEX mode.

3.1.2 ENG MODE

ENG (Engineering) mode allows data entry and display in engineering unit formats (Feet, Knots, MHZ, etc.). The label definition will determine the number of screens required for display of the possible fields of the word. Label definition may be changed by entering a new 'EQID' (Equipment Identifier). If the new ID is valid (per ARINC 429-11 attachment 2 or is included in Appendix A of this manual (Special Boeing Labels)) for the currently selected label then the label will be decoded and displayed according to that definition. If the ID is invalid for the label, a default definition will be used. The last ID entered will remain active until changed or until the unit is turned off (unless in Trap or Protect mode).

NOTE: BITE Status Word (Label 356) has been assigned the same ID (7E) as the BITE Command Word (Label 227) and will be displayed in engineering format. However, due to the many variations of data types for the word, it must be entered in HEX format.

3.1.3 TRANSMIT & RECEIVE MODES

There are two distinct modes of system operation. The **RX** mode is the receiver mode of operation. The **TX** mode is the transmit mode of operation. Selection of these modes and all other display operations are accomplished by keypad or slide switch entry. The transmitter and receiver can operate at either 100kbps (High Speed) or 12.5 kbps (Low Speed). Each mode's speed can be set independently of the other. The parity of the words being transmitted can be set for either ODD or EVEN parity. An LED indicator will show the parity selected for transmitted words if in the TX mode or the parity of the currently displayed word if in the RX mode. These modes are described in the following sections.

3.1.3.1 TX MODE

The transmitter is capable of outputting up to ten 32 bit words in ARINC 429 or 419 bipolar RZ (Return-to-Zero) format.

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3.1.3.1.1 TRANSMISSION RATES

The word rate for each of the ten TX Slots can be set independently. The repetitive word rate can be as low as 4 msec or as long as 59998 msec. On label entry the word rate defaults to the minimum word rate defined in the ARINC 429-11 specs. The 429EBP also has the capability of transmitting words only on user command (SINGLE SHOT). Each slot can be programmed independently for this mode by programming the word rate for that slot to 1ms (SNGL SHOT). The user then presses the SINGLE SHOT key on the front panel whenever he (she) wants to transmit all words programmed for single shot. Each subsequent press of this key will retransmit all words programmed for single shot mode. This mode will not interfere with any words that have been programmed for repetitive transmission. The transmitter automatically insures at least a 4 bit time (Low Speed) separation between adjacent words.

NOTE: The ten TX slots are priority weighted. Slot ten has the most priority and slot one has the least. The advantage of this method is that it allows synchronized bursts of words. The disadvantage is that words programmed into lower numbered slots than a slot with a 4ms word rate (fastest rate possible) will not be transmitted. e.g. If slot ten is programmed to a 4ms word rate then the words in slots one through nine will not be transmitted.

3.1.3.1.2 PROTECTED MODE

The transmitter section may be placed into a 'PROTECTED' mode of operation. This mode protects the user entered parameters from changing when the unit is powered off. When power is restored to the unit it will resume operation where it was at when the unit was powered off. If 'Protect' mode is off then the unit will clear the transmitter section on power up. The unit will stay in the selected mode until changed by the user, even if the unit power is cycled.

3.1.3.1.3 DATA SLEWING

The data for most labels with engineering definitions can be 'SLEWED'. This means that the data will dynamically change value according to user defined parameters. There will be 4 slew screens in the data mode for any label with slew capability. The first screen is a 'SLEW' screen that defines the amount of change in data. When this parameter is set to '0' (default) then no slewing will occur. The second screen is the 'MAX' screen which defines the upper limit that the data is allowed to slew to. The third screen is the 'MIN' screen which defines the lower limit that the data is allowed to slew to. Either parameter may be positive or negative (dependent on ARINC definition for the label) but the 'MAX' parameter MUST be larger than the 'MIN' parameter. Note that only bits 28 - 17 of the limits will be used in the limit check. All other bits are ignored and will be truncated upon user entry of new limit values.

The fourth screen turns the 'ALT' (Alternate) mode on and off. If this mode is on, the data will slew to the limit in the direction it is going. When the limit is reached, the data will be set to that limit and then slew to the opposite limit. When this limit is reached, the data will again reverse itself. If 'ALT' is off, the data will slew in the direction entered in the 'SLEW' parameter (positive or negative) to the limit and then reset to the value defined for the opposite limit (data wraps around). NOTE: Any ARINC BCD type words will only slew by 1 in the negative direction regardless of the SLEW value setting.

3.1.3.2 RX MODE

The receiver has the capability of receiving and storing up to 4096 (8192 in 'DATA ONLY' mode) high or low speed 32 bit words in ARINC 429 or 419 RZ format. There are three mutually exclusive receiver modes of operation. Each mode has a screen that shows the count of words received, the label and description, or the data field currently selected.

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3.1.3.2.1 NORMAL MODE

Normal mode (default) is a dynamic mode that displays all unique labels received (255 possibilities, 000 label is invalid). In this mode the screen is updated 4 times per second with the latest data received.

3.1.3.2.2 FILTER MODE

FILTER mode is identical to normal mode with the exception that words received will be displayed according to label and SDI. This allows up to 1020 combinations (000 Label is invalid).

3.1.3.2.3 TRAP MODE

The third and most powerful mode is the 'TRAP' mode. This is a static mode of operation which captures and stores the data for detailed analysis. Words are received and stored in the trap buffer in their order of occurrence. They will remain in the buffer until the trap mode is turned off, even if the unit power is turned off. In normal trap mode up to 4096 unique words may be stored. In this mode the time that has elapsed since the previous word is stored as the rate. In 'DATA ONLY' trap mode up to 8192 words (must be the same label) are stored. The rate is invalid in this mode of operation. Normally the trap will fill to capacity with received words and stop. All subsequent words received will be discarded. A secondary mode of operation is possible where all words pass through the trap until the trigger parameter is met (or the CONT TRAP key is pressed). This mode is called CONTinuous Trap. This allows viewing the bus activity prior to the trigger. If the trap 'rolls over' (receives more than the trap capacity allows) prior to the trigger being met, the last 4096 words (or 8192 in Data Only mode) will be captured. The 429EBP will then adjust so that the first word scrolled UP to from the count screen will be the oldest word and the first word scrolled DOWN to will be the newest word regardless of their position in the buffer.

3.1.3.2.3.1 TRAP TRIGGERS & FILTERS

The trap has user definable trigger and filter parameters. Triggering specs may be set in 1 of 4 combinations: Don't Care Label/Don't Care Data (No Trigger), Specific Label/Don't Care Data, Don't Care Label/Specific Data Pattern, Specific Label/ Specific Data Pattern. Filtering specs may be set to filter the data in 1 of 4 combinations: All Labels/All Data, Specific Label/ All Data, All Labels/ Specific Data Pattern, and Specific Label/Specific Data pattern. The data pattern for each spec can be from 1 to 24 bits. If a data pattern is entered for either spec the user will be prompted for a 'CARES' mask. If a bit is set in this mask, the corresponding bit in the received data will be checked against the same bit in the desired data pattern. The user may simply press the enter key if the prompted parameter is a don't care to the user. Data and care patterns must be entered in hexadecimal (up to 6 chars) if used. As an example, if a DATA pattern of 000001 and a CARES pattern of 000003 (default) is used then only the SDI bits (10 - 9) will be checked for an SDI of 01. The status of a bit in the DATA pattern is irrelevant if the corresponding bit in the CARES pattern is not set.

3.1.3.2.3.2 PRINT MODE

The data stored in the trap buffer may be printed out on an IBM compatible parallel printer through the 25 pin female DSUB connector on the side of the 429EBP. There are two print drivers available in the 429EBP. The default driver makes the 429EBP compatible with a Seiko DPU-201G thermal 27 column printer. The second driver makes the unit compatible with an IBM compatible 80 column printer. The 429EBP will print data from the current slot displayed to the end of the buffer (or valid data). A print sequence may be aborted early by turning the unit off. Since data is retained in non-volatile memory, no data will be lost.

3.1.4 IDLE MODE

To minimize battery drain, the 429EBP has the capability to sense when there has been no activity (keypad, TX, or RX) for at least 5 minutes. When this happens, the 429EBP will shut down some of its circuitry and go to 'Sleep'. In this state, the 429EBP is fully functional, but it is in a low current drain wait state. The LCD screen will be blank, but either the TX or RX LED will be lit. Any keypad or RX activity will reawaken the 429EBP to its normal operation mode.

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3.2 CONTROL FUNCTIONS

3.2.1 429EBP CONTROLS AND INDICATORS

(1) TRAP Mode Key

IN RX MODE:

Start/Stop/Off control for the TRAP mode. Pressing 'ENT' key for any of the prompted parameters will cause a don't care to be used for that parameter. Data is automatically protected if unit is powered off when TRAP is on.

IN TX MODE:

On/Off key for TX data PROTECT mode. If Protect is on the Transmit parameters will be protected when the 429EBP is powered off.

(2) AUTO Mode Key

IN RX MODE:

On/Off key for 'AUTO' scrolling mode. Allows the operator to scroll through labels that have been received by TRAP mode. AUTO mode steps 'Automatically' through the word buffer and displays the number of trapped words as well as the engineering name of the label, if it is in the 'Label' mode. If in the 'Data' mode, the AUTO mode steps to the same data screen for the next trapped word. Scroll keys will allow scanning direction to be selected.

IN EDIT MODE:

While in the EDIT mode, this key allows the hexadecimal value 'C' to be entered.

(3) TX Parity Switch

Allows operator to select ODD or EVEN transmission parity.

(4) TX SPEED Switch

Allows operator to select HI (100 kbps) or LO (12.5 kbps) transmission rate.

(5) TX Output Port

Allows access to transmitter port using standard 3-conductor, 1/4" phone plug.

(6) RX Input Port

Provides input to receiver port using standard 3-conductor, 1/4" phone plug.

(7) SCROLL Keys

Allows operator to scroll through display menus (10 transmitter slots, up to 8192 receiver slots, or data menus). Allows selection of the scanning direction in AUTO mode. If editing data of an ISO Alpha label (356 or 357), the SCROLL keys will allow selection of the Alpha character to be entered (SCROLL to the desired character and press 'ENT' to select a character).

NOTE: See EDIT/DEL key also.

(8) TX/RX Indicator

LED indicates that the system is in either the transmitter or receiver mode of operation for display and entry of data.

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- | | |
|------------------------|---|
| (9) PARITY Indicator | IN RX MODE:
LED Indicates parity (ODD or EVEN) of word presently displayed.

IN TX MODE:
LED Indicates selected transmit parity. |
| (10) HEX/ENG Switch | Allows operator to select hexadecimal or engineering unit display and entry of data. |
| (11) TX/RX Key | Allows operator to select whether the system is in transmit or receive mode of operation for display and entry of data. After selection of the TX/RX key, initial display indicates the number of labels being transmitted, received, trapped, or filtered. SCROLL keys should then be used for manual stepping through transmitter or receiver slots. TX/RX LED indicators above display will indicate current mode of operation. |
| (12) RX SPEED Switch | Allows operator to select HI (100 kbps) or LO (12.5 kbps) receiver speed. |
| (13) DATA ENTRY Switch | Allows operator to enter various data in hexadecimal or engineering formats. Keys 0 - 9 and the '.' and '-' keys are valid while in ENG mode. Keys 0 - F are valid while in HEX mode. (Hex mode will be forced regardless of switch position if the label is currently undefined by ARINC specs. or is a label not supported in ENG mode. (Discrete data, Maintenance Data, etc.). Keys 0 - 7 are valid for LABEL entry since all labels are entered in octal format. The '0' and '1' keys allow clearing and setting, respectively, bits of discrete bit screens (SDI, SSM, RF management labels, frequency discretes and individual bit screens, etc.) and turning various modes on and off (e.g. slew ALTERNATE).

Several keys have secondary functions while not in the EDIT mode. |
| (14) LAB/DAT Key | Allows operator to select either LABEL mode or DATA mode of display. LABEL mode displays octal number and engineering definition of labels being transmitted or received. DATA mode allows viewing of data of the currently selected label being transmitted or received. |
| (15) EDIT/DEL Key | Allows operator access to the data entry mode. If in the data entry mode, the DEL keys allows correction of errors during data entry.

NOTE: While in TRAP mode the current slot displayed may be edited using normal editing procedures as an alternative to using the scroll keys. |
| (16) ON/OFF Key | Turns unit ON and OFF |

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(17) ENT Key

IN EDIT Mode:

Completes an entry sequence. Until the ENT key is pressed, an entry may be edited with the DEL key. If an entry is not allowed for some reason (out of range, illegal key), the old data will be retained.

TX MODE (Non-Edit):

Resets the TX timer counters of each active slot to their initial value. This allows the TX labels to be synchronized in their output order if all have the same word rate. They will be sent out in descending TX block order (10 through 1), e.g.: The user wants to simulate a DME LRU that transmits 6 labels in bursts 100 msec. apart. The user would enter the first label in the group in the TX slot 10 with a word rate of 100. The second label would go in the TX slot 9 with a word rate of 100. This would continue for the remaining labels with the last label of the group being entered in TX slot 5.

Once all the data has been entered correctly and the user is ready to synchronize the labels, he (she) should press the ENT key.

There will be no visible indication that anything has occurred, but the words have been synchronized and are being transmitted in bursts of 6, 100 msec apart. If any data is changed later, the ENT key should be pressed again to resynchronize the words.

(18) Battery Charging Jack

Allows the internal batteries to be charged by connecting to the battery charger furnished with the 429EBP.

(19) Parallel Printer Output Port

Allows connection to an IBM compatible parallel printer using a standard IBM/CENTRONICS parallel interface cable.

(20) D.O. Key

IN EDIT MODE:

While in the EDIT mode, this key allows the hexadecimal value 'D' to be entered.

IN RX MODE:

Pressing this key when trap mode is first activated (before entering the Trap Label) will activate the DATA ONLY trap mode. This mode expands the trap capacity to 8192 words, however, no label or rate information is stored. This means that the user must enter a trap label when prompted. This mode will be cleared when trap mode is turned off.

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(21) EQID Key

IN EDIT MODE:

While in the EDIT mode, this key allows the hexadecimal value 'E' to be entered.

NON EDIT MODE:

While in any mode other than edit mode pressing this key will 'Pop Up' the 'EQPMT ID' (Equipment Identifier) screen. This may then be edited using the normal edit procedure. Up to 3 hex characters may be entered. Pressing this key again or any other mode control key will clear this screen.

The Equipment Identifier is used by the 429EBP to determine which ARINC definition to use for the received and transmitted labels when displaying and entering data.

(22) FILT Key

IN EDIT MODE:

While in the EDIT mode, this key allows the hexadecimal value 'F' to be entered.

IN RX NON-TRAP MODE:

On/Off control for the FILTER mode.

IN RX TRAP MODE:

If in trap mode and the trap has not yet filled to capacity, this key activates the CONTinuous TRAP mode. Pressing this key a second time will cause the trap to close on the words currently held in the trap buffer.

(23) SINGLE SHOT Key

IN NON-EDIT MODE:

Activates transmission of any TX words that have been set to 1ms word rate (SNGL SHOT).

IN EDIT MODE:

While in the EDIT mode, this key allows the hexadecimal value 'B' or the '-' (ENG mode) key to be entered.

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(24) PRINT Key

IN RX MODE:

If in trap mode and there are valid words trapped, pressing this key will initiate a printer dump sequence starting at the currently displayed slot. If a printer is not connected to the 429EBP or is off-line the 429EBP will indicate this for 2 seconds and abort the print sequence.

NOTE: The LED's will act 'Erratically' and the keypad will be disabled during the print dump. This is normal and should be ignored. The 429EBP will continue to print until there are no remaining words or until the end of the buffer is reached.

To abort a print sequence just turn the unit off since the data will still be valid on restoration of power.

IN EDIT MODE:

While in the EDIT mode, this key allows the value '7' to be entered.

(25) PRINTER SELECT Key

IN NON-EDIT MODE:

Pressing this key while in any mode other than edit mode will 'Pop Up' the printer select screen. This allows selection of different printer type drivers. To select a different type press the EDIT key and enter a '0' (For 27 Column Seiko) or a '1' (for an 80 column IBM compatible) and the 'ENT' key. Pressing this key again or any other mode control key will clear this screen.

IN EDIT MODE:

While in the EDIT mode, this key allows the value '3' to be entered.

3.3 OPERATING EXAMPLE

The following section is a series of instructions designed to guide the user through some of the features of the 429EBP.

NOTE: For these instructions we will use four ARINC labels throughout for the sake of consistency. The user is free to configure additional labels if desired. These labels are as follows:

033 ILS FREQUENCY
034 VOR FREQUENCY
035 DME FREQUENCY
102 SEL ALTITUDE

The 429EBP hand held, transmitter/receiver features are designed to allow the user greater flexibility when working with ARINC 429 data buses. These features are outlined below.

1. Expanded screen displays of data and information.
2. User definable Equipment ID codes.
3. Labels defined to ARINC 429-11 Air Transport specifications.
4. Data slewing or ramping capabilities.
5. Positive or negative slewing.

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6. Non-volatile memory that stores previously entered information when protection feature is turned on.
7. Additional, expanded selective trap capabilities.
8. Dynamic display of slewed and ramped data.
9. Individual display and control of bits 11 to 29.
10. Separate screens for SDI and SSM.
11. Non-volatile memory for RX and TRAP mode.

3.3.1 TRANSMITTER FUNCTIONS

3.3.1.1 Entering Transmit Labels and Protecting Data

- 1) Turn on the 429EBP (unit will self test and go to the receive mode). To clear the transmitter if it contains labels, depress the trap key displaying NOT PROTECTED and turn unit off for 5 seconds then back on.
- 2) Depress the TRAP key for PROTECTED or NOT PROTECTED data mode. When data is NOT PROTECTED it will not be retained in the 429EBP memory when it is turned off. Set unit to PROTECTED.
- 3) Depress scroll up arrow to access transmitter #1 which will display TX 1 INACTIVE.

NOTE: Arrow keys are scroll up/down keys.

- 4) Depress the EDIT/DEL key and LABEL ? will appear. Enter the first label: LABEL ?. Enter 033 and depress ENT key. Unit now displays 033 ILS FREQ and you can view the default data for this label by depressing the LAB/DAT key. To scroll through the data use the UP/DOWN arrows. This step is the same for all future labels to be entered. To correct an incorrect label, simply edit over it and enter correct label. To clear a transmitter and show the TX INACTIVE, edit and enter 0.
- 5) Depress the LAB/DAT key and return to label 033. Use the scroll up key to access TX 2 INACTIVE. Depress EDIT/DEL and enter label 034 VOR FREQ. Repeat this procedure and enter LABEL 035.
- 6) Scroll to TX 4 and enter Label 102 SEL ALTITUDE. The following sequence is to slew and ramp the data within a selected non-RF label. For demonstration purposes we will limit this to label 102.

NOTE: For all data entry that follows it will be necessary for the user to follow the previous sequence of depressing the appropriate keys such as EDIT/DEL and ENT as well as the scroll keys to access all of the data displays for editing.

- a) Depress LAB/DAT key. Depress the up arrow key as required until SLEW appears.
- b) SLEW defines the value that our data will change by. Enter 100 ft. (EDIT - 100 - ENT).
- c) Scroll to MAX=65520. This is the default limit in the ARINC specification truncated to 12 bits. Enter 10000 ft.
- d) Scroll to MIN=00000 and enter 9000 ft. The display will now announce 08992 instead of 9000. This is due to the program using only the first 12 bits of significant data (bits 28 to 17). Other bits are truncated and this results in a resolution of 8 ft for limit checking for this label.
- e) Scroll to SLEW ALT OFF. To turn this feature on simply depress EDIT and enter 1. (1 turns ALT ON and 0 turns ALT OFF). When SLEW ALTERNATING is on, slewing will continuously occur bi-directional reversing itself when upper and lower limits are reached. When this feature is off, slewing will occur in only one direction, up/down, positive/negative.

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- f) Scroll to the next screen and there will be a dynamic display of the slewing from 9000 ft to 10000 ft. up and down in increments of 100 feet.
- g) Scroll to the rate screen and RATE = 100 MS. Enter 500 MS to slow the updating speed down for additional visibility.
- h) Scroll to the SDI screen which will display 00. Edit as required.
- i) Scroll to the SSM screen which will display 11 / NORM which is the ARINC default norm for this label. Enter 00 and watch the display change to 00 / FAIL. Re-enter 11 and SSM returns to normal.
- j) Scroll once more to return to SLEW then depress LAB/DAT key to return to the label.
- k) Depress TX/RX key to go to the receiver mode.

NOTE: When entering data, it is possible to view and turn on or off individual bits 11 to 29. To access this feature depress the LAB/DAT key to go to the data mode and move the display switch from Eng to Hex then scroll till the desired bit is reached. Edit each bit individually with 0 for off and 1 for on.

3.3.2 RECEIVER FUNCTIONS

3.3.2.1 Using the Receiver Functions

1. To use the receiver port it is necessary to loop the unit to itself by connecting the transmitter port to the receiver port. In this manner you will see displayed the four labels entered previously on the transmitter side.

NOTE: If there are any labels trapped in the memory of the 429EBP they will enunciate on the screen. To clear the memory depress the TRAP key; or the F/FILT key if XX FILTERED WORDS appears.

2. Once this is accomplished the receiver will display 4 RX LABELS.
3. To view the labels, simply depress the scroll/arrow key in the direction you wish to scroll. You will see displayed the four labels entered; 033, 034, 035, and 102.
4. To view data, depress the LAB/DAT key. For this exercise we will view label 102.
5. Label 102 will display data that is being slewed at the rate of 100ft every 500 MS as was previously programmed.
6. Scrolling through the data will sequentially display RATE, SDI and SSM.
7. By switching the unit from the ENG mode to the HEX mode it is possible to scroll through the data mode and individually view bits 11 through 29. These bits can also be viewed and edited individually on the transmitter side.

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3.3.3 USING THE RECEIVER TRAP FUNCTIONS

3.3.3.1 General Trap Mode

1. To trap the first 4096 labels received, depress the TRAP key. Unit will display TRAP LABEL, depress ENT, unit will display DATA ?, depress ENT, unit will display TRIG LABEL, depress ENT, unit will display DATA ?, depress ENT and unit will begin trapping. It is necessary to depress ENT for the unit to default to the general trap mode. No data needs to be entered.
2. To view the trapped labels, depress the appropriate scroll key. To auto-scroll, depress the C/AUTO key and display will automatically display one label approximately every second. You can reverse the scroll direction by using the opposite scroll key. The display will show the number of the trapped word. To stop auto-scroll, depress the C/AUTO key again.
3. By holding down either of the scroll keys, it is possible to speed up the sequence to reach a specific label more quickly or, as an alternative, the current slot displayed may be edited using the standard editing procedures.
4. To clear the trap memory, depress the TRAP key and the unit will return to receiving 4 labels only.

3.3.3.2 Data Trap Mode

1. Depress the TRAP key Then the D/D.O. key and watch the display which will flash DATA ONLY. The unit will now trap one word 8192 times. Enter TRAP LABEL 102 and depress the ENT key until unit starts to trap. The unit is trapping label 102, 8192 times and the label is transmitted at the rate of 500 MS. It is possible to start viewing individual labels while the unit is still trapping by scrolling to the first few labels trapped. This does not interfere with the unit which will continue to trap incoming labels.
2. Once the unit is finished trapping it is possible to scroll through each label trapped and view them individually. By depressing the LAB/DAT key and then the C/AUTO key you can view label 102 which was trapped as it slewed from 9000 ft. to 10000 ft. It is also possible to view all data on each individual label trapped including bits 11 to 29, SDI, SSM, etc.
3. To clear the trap memory depress TRAP.

NOTE: When trapping using the DATA ONLY mode, it is necessary to enter a label as this mode traps off of the label it is searching for.

3.3.3.3 Trapping Using the Data Mode

1. To trap when only data is known, depress the TRAP key. Depress the ENT key until DATA ? is displayed.
2. Enter the data you wish trapped. (For our purposes, we will use 627100 which represents 10000 ft. in label 102 which we are transmitting and simultaneously slewing from 9000 ft. to 10000ft.)
3. The next screen will ask CARES ?. It is now necessary to enter 7FFFFFFF which is to mask parity off to allow the unit to search for specific data. Depress ENT (it is necessary to depress ENT three times) until the unit begins to trap.

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Cares is a 24 bit hex mask to determine if a bit in the data word will be checked for status. This function is particularly useful for trapping block data protocols. For example the Williamsburg Protocol, Bite Memory Transfer and Alpha-numeric messages. It is also useful for monitoring a bus for a specific flag such as an auto- pilot armed flag, where a specific bit in a specific word arms an auto-pilot and it is necessary to determine when this event occurs.

In the example we have used, we are searching for a specific data field and the cares function is masked by the entry of 7FFFFFFF. Some useful cares patterns follow:

7FFFFFFF = Masks parity off and allows for checking all bits in the data field.

000003 = Default bit which means only the SDI bits 9 & 10 will be checked.

600003 = SSM and SDI bits only checked, (bits 31 & 32 and 9 & 10)

Other bit parameters may be set as desired.

When viewing the 429EBP screen the display in the hex mode shows the following information:

XXX	XX	XXXXXX	XX
LABEL	SDI	DATA	SSM

The SSM is in binary, the DATA in hex, the SDI in binary and the LABEL in octal.

4. The unit will now look for only this data and trap those words it receives with this data. It may take a few moments for the first word to be received. As soon as the first word is received it is possible to view the word by scrolling to it and viewing the data. The word should be 102 at an altitude of 10000 ft. By selecting HEX on the switch, you can view the data which is 627100.
5. To turn off the trap mode depress the TRAP key.

3.3.3.4 Trapping Using the Trigger Trap Mode

1. To trap a string of data triggering from either a label and/or from data the trigger must be armed. Depress the TRAP key depress ENT twice, then enter the data in label 102 for 10000ft which is 627100 and for CARES turn off the parity mask using 7FFFFFFF.
2. When the information is entered the screen will display TRIGGER IS ARMED and the unit will wait till it receives this data. As soon as the data is received, the unit will go into the normal trap mode and it will trap the first label immediately following the data that was in the trigger. This should be label 035 which has the fastest time out at a rate of 100 MS.
3. This can then be viewed in the normal manner by scrolling through the labels. The first label trapped will be 035 DME FREQ as it is transmitted at the fastest rate which is 100 MS and it is followed by 034 and 033. Label 102 will only be caught in the string very sparingly as its rate was set earlier at 500 MS.
4. When trapping using the data only mode, note that it is necessary to enter the label first as this mode traps only the label it is looking for. To trap label 102 starting when it reaches 10,000ft depress TRAP then the D key. Enter label 102, scroll TRIGGER DATA and enter 627100 then mask parity in cares with 7FFFFFFF. The first label 102 trapped by the unit will be 102 at 10,000 ft. (data 627100).

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3.4 FILTER MODE

1. Depress the F/FILT key. The 429EBP will now display all received words by their Label/SDI values instead of by label only.
2. To clear the filter mode depress the F/FILT key.

3.5 CHANGING EQUIPMENT ID CODES

The 429EBP has the capability to change equipment ID codes to any Air Transport Equipment Identifier Specification codes defined in ARINC 429-11, attachment 2 or Appendix A of this manual (Boeing Special Labels). To change these codes, the following procedure is used.

1. When the unit is in the TX mode scroll to label 035 that was entered previously and it will display 035 DME FREQ.
2. Depress the E key and the unit will display EQPMT ID = 000.
3. Depress the EDIT/DEL key and unit will display EQPMT ID ?. Enter 6 and depress the ENT key (006 is the ID code found in the ARINC specification that identifies labels used for Air Data Systems.)
4. The 429EBP will now display 035 BARO (IN) which is inches of mercury used for air data testing. Note that label 034 has also been changed and it now displays 034 BARO (MB).
5. To return to the original ID simply use the same steps to enter 000 which is the original ID to which the unit will default. The display will again show 035 DME FREQ.

The 429EBP changes the definition of all labels that are defined in the ARINC 429 Air Transport specification with the same ID. In the above example, the definitions identified with an ID of 006 would be desirable when working with Air Data Systems. It is also possible to change the ID codes while in the receiver mode by following the same sequence.

NOTE: If the Equipment ID is changed while in TX mode for a specific label the label should be reentered following entry of the new equipment ID. This insures that the proper parameters are being used as default in subsequent operations.

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4 THEORY OF OPERATION

4.1 GENERAL CIRCUIT THEORY

The ATG Model 429EBP, P/N 01-1001-10, ARINC 429 single channel transmitter and receiver consists of three board level sub-assemblies and a battery pack. The three boards are:

1. Display Board (P/N 20-6782-10)
2. Digital Board (P/N 20-6784-40)
3. Analog Board (P/N 20-6783-00)

4.1.1 DISPLAY BOARD

The Display board performs the human interface function for the 429EBP. It has three major sections of circuitry:

1. Display circuits
2. Keypad circuits
3. Slide Switch circuits

The Display circuits output data in visual form. The display circuit consists of the liquid crystal display (DS1). The Keypad switches allow data to be input to the unit. The keypad circuits consist of 23 momentary contact switches (S1 - S23). The switches are arranged in an X/Y matrix and are decoded by the firmware on the digital board. The slide switches allow various I/O information (Parity, TX Baud, etc.) to be changed and to turn the unit on and off. The slide switch circuits consist of 5 SPST slide switches (S24 - S28) and various discrete components (resistors, transistors and capacitors).

4.1.2 DIGITAL BOARD

The Digital board contains the digital circuitry for the 429EBP. This circuitry has three major sections:

1. Control circuits
2. 429 Receive Buffer
3. 429 Generator

The Control circuits are the 'Heart' of the system that controls and monitors all other circuits in the system. The control circuits consist of the following components:

1. Microcontroller (U1)
2. Firmware EPROM (U2)
3. RAM (U3)
4. Address Latch (U4)
5. RAM IO (U5)

The control circuits monitor the number of 'bits' received and upon completion, will read the receive buffer.

The 429 Receive buffer stores the 429 bit stream data (Converted to TTL levels by the Analog board). The following components make up the 429 receive buffer.

1. Bit Latch (1/2 U8)
2. Serial Register (1/2 U6)
3. Mux (U14)

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The 429 Generator circuits send TTL level bit stream data to the Analog board, where it is converted to the correct levels for output. The Generator is loaded and started by the Control circuits. The Generator consists of the following components:

1. Digital drivers (U9)
2. Serial Register (1/2 U6)
3. Baud Clock/Bit Counter (U5)
4. Driver Enable (1/2 U8)

4.1.3 ANALOG BOARD

The Analog board contains the analog circuitry for the 429EBP. This circuitry has three major sections:

1. Power Circuits
2. 429 Receiver
3. 429 Driver

The Power circuits supply power to the system from one of two sources. If the battery charger is disconnected, the circuits supply power to the system from the battery pack. The battery voltage is monitored by the power circuits. Should the voltage drop to an insufficient level it is the power circuits that will indicate this to the Control circuits. An indication of low power will be seen on the display board should the afore mentioned conditions exist. If the charger is connected, the power circuits will supply power to the system from the charger and will also trickle charge the NiCad batteries. The power circuits consist of the following components:

1. Low Drop Out Regulator (U5)
2. Voltage converter (U6)
3. Monitor (U7)

The 429 Receiver circuits convert ARINC 429 RZ transmitted signals from 10V levels (between A & B) to TTL level signals for use by the 429 Receiver Buffer on the Digital board. The 429 receiver circuits consist of a Comparator and a number of discrete components. The 429 driver circuits convert the TTL level signal from the digital board into 10V (between A and B) ARINC 429 compatible signal levels.

The 429 Driver circuits consist of the following components:

1. "1" Driver (U2, Q1, Q2)
2. "0" Driver (U3, Q3, Q4)
3. Speed Switch (U1)

The battery Pack supplies power to the system and consists of the following components:

1. Battery Holder
2. Six (6) 'AA' NiCad rechargeable batteries.

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5 MAINTENANCE

5.1 BILLS OF MATERIAL, ASSEMBLY DRAWINGS, SCHEMATICS & TEST PROCEDURES

To assist in the maintenance of the 429EBP, bills of material, assembly drawings, schematics and test procedures are contained in the 429EBP Maintenance Manual (P/N E6-1001-12 / 75554), available separately from ATG.

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6 Appendix

EBP Ver 1.0 BOEING SPECIAL LABELS

LABEL	See Note 1		DESCRIPTION	See Note 2	
	EQ ID/SDI	BUS		RANGE	UNITS
001	029/0	EICAS	Ail Pos Inner L	0-360	Degrees
001	029/1	EICAS	Ail Pos Outer L	0-360	Degrees
001	029/2	EICAS	Ail Pos Inner R	0-360	Degrees
001	029/3	EICAS	Ail Pos Outer R	0-360	Degrees
002	029/0	EICAS	APU Battery Current	±256	Amps DC
002	029/1	EICAS	APU Battery Voltage	0-50	Volts DC
002	029/2	EICAS	APU Bus AC Volts	0-256	Volts AC
002	029/3	EICAS	APU Bus AC Frequency	0-512	HZ
003	029/0	EICAS	APU EGT	0-2048	Deg. C.
003	029/1	EICAS	APU Load	0-256	% Load
003	029/2	EICAS	APU Oil Level	0-6	Inches
003	029/3	EICAS	APU RPM	0-256	% RPM
004	029/0	EICAS	Brake 1 Temp.	0-256	% FSD
004	029/1	EICAS	Brake 2 Temp.	0-256	% FSD
004	029/2	EICAS	Brake 3 Temp.	0-256	% FSD
004	029/3	EICAS	Brake 4 Temp.	0-256	% FSD
005	029/0	EICAS	Brake 5 Temp.	0-256	% FSD
005	029/1	EICAS	Brake 6 Temp.	0-256	% FSD
005	029/2	EICAS	Brake 7 Temp.	0-256	% FSD
005	029/3	EICAS	Brake 8 Temp.	0-256	% FSD
005	0D0/0	EIS	BITE Status	Discrete	N/A
006	029/0	EICAS	Bus AC Volts Left	0-256	Volts AC
006	029/1	EICAS	Bus AC Volts Right	0-256	Volts AC
006	029/2	EICAS	Bus Freq. Left	0-256	HZ
006	029/3	EICAS	Bus Freq. Right	0-256	HZ
006	0D0/0	EIS	Engine ID-L	Discrete	N/A
006	0D0/0	EIS	Engine ID-R	Discrete	N/A
007	029/0	EICAS	Crew Ox. Pressure	0-4096	PSI
007	029/1	EICAS	Discrete Word #1	N/A	N/A
007	029/2	EICAS	Discrete Word #2	N/A	N/A
007	029/3	EICAS	Discrete Word #3	N/A	N/A
010	029/0	EICAS	Discrete Word #4	N/A	N/A
010	029/1	EICAS	Discrete Word #5	N/A	N/A
010	029/2	EICAS	Discrete Word #6	N/A	N/A
010	029/3	EICAS	Discrete Word #7	N/A	N/A

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LABEL	EQ ID/SDI BUS		DESCRIPTION	RANGE	UNITS
011	029/0	EICAS	Discrete Word #8	N/A	N/A
011	029/1	EICAS	Discrete Word #9	N/A	N/A
011	029/2	EICAS	Discrete Word #10	N/A	N/A
011	029/3	EICAS	Discrete Word #11	N/A	N/A
012	029/0	EICAS	Discrete Word #12	N/A	N/A
012	029/1	EICAS	Discrete Word #13	N/A	N/A
012	029/2	EICAS	Discrete Word #14	N/A	N/A
012	029/3	EICAS	Discrete Word #15	N/A	N/A
013	029/0	EICAS	Discrete Word #16	N/A	N/A
013	029/1	EICAS	Discrete Word #17	N/A	N/A
013	029/2	EICAS	Discrete Word #18	N/A	N/A
013	029/3	EICAS	Discrete Word #19	N/A	N/A
014	029/0	EICAS	Discrete Word #20	N/A	N/A
014	029/1	EICAS	Discrete Word #21	N/A	N/A
014	029/2	EICAS	Discrete Word #22	N/A	N/A
014	029/3	EICAS	Discrete Word #23	N/A	N/A
015	029/0	EICAS	Discrete Word #24	N/A	N/A
015	029/1	EICAS	Discrete Word #25	N/A	N/A
015	029/2	EICAS	Discrete Word #26	N/A	N/A
015	029/3	EICAS	Discrete Word #27	N/A	N/A
016	029/0	EICAS	Discrete Word #28	N/A	N/A
016	029/1	EICAS	Discrete Word #29	N/A	N/A
016	029/2	EICAS	Discrete Word #30	N/A	N/A
016	029/3	EICAS	Elevator Pos. Left	0-360	Degrees
017	029/0	EICAS	Elevator Pos. Right	0-360	Degrees
017	029/1	EICAS	Engine EGT Left	±2048	Deg. C.
017	029/2	EICAS	Engine EGT Right	±2048	Deg. C.
017	029/3	EICAS	Eng Fuel Flow Left	0-32768	Lbs/Hour
020	029/0	EICAS	Eng Fuel Flow Right	0-32768	Lbs/Hour
020	029/1	EICAS	Eng N1-Actual Left	0-256	% RPM
020	029/2	EICAS	Eng N1-Actual Right	0-256	% RPM
020	029/3	EICAS	Eng N2-Actual Left	0-256	% RPM
021	029/0	EICAS	Eng N2-Actual Right	0-256	% RPM
021	029/1	EICAS	Eng N3-Actual Left	0-256	% RPM
021	029/2	EICAS	Eng N3-Actual Right	0-256	% RPM
021	029/3	EICAS	Eng Oil Press Left	0-4098	PSI
022	029/0	EICAS	Eng Oil Press Right	0-4098	PSI
022	029/1	EICAS	Eng Oil Quan Left	0-128	US Pints
022	029/2	EICAS	Eng Oil Quan Right	0-128	US Pints
022	029/3	EICAS	Eng Oil Temp Left	0-4098	PSI
023	029/0	EICAS	Eng Oil Temp Right	±2048	Deg. C.
023	029/1	EICAS	Eng Vibr. Left	0-5.12	Ratio
023	029/2	EICAS	Eng Vibr. Right	0-5.12	Ratio
023	029/3	EICAS	Eng EPR Act. Left	0-4	Ratio

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LABEL	EQ ID/SDI BUS		DESCRIPTION	RANGE	UNITS
024	029/0	EICAS	Eng EPR Act. Right	0-4	Ratio
024	029/1	EICAS	Eng Fuel Press L	0-4	Ratio
024	029/2	EICAS	Eng Fuel Press R	0-4	Ratio
024	029/3	EICAS	Eng EPR Cmd Left	0-4	Ratio
025	029/0	EICAS	Eng EPR Cmd Right	0-4	Ratio
025	029/1	EICAS	Eng EPR Limit Left	0-4	Ratio
025	029/2	EICAS	Eng EPR Limit Right	0-4	Ratio
026	029/0	EICAS	Eng N1 Target-FMC	0-256	% RPM
026	029/1	EICAS	Gen. Load Left	0-256	% Load
026	029/2	EICAS	Gen. Load Right	0-256	% Load
026	029/3	EICAS	GPU AC Volts	0-256	Volts AC
027	029/0	EICAS	GPU Frequency	0-512	HZ
027	029/1	EICAS	APU Load	0-256	% Load
027	029/2	EICAS	Hy Oil Pres Center	0-4098	PSI
027	029/3	EICAS	Hy Oil Pres Left	0-4098	PSI
030	029/0	EICAS	Hy Oil Pres Right	0-4098	PSI
030	029/1	EICAS	Hy Oil Quan Center	0-256	% Full
030	029/2	EICAS	Hy Oil Quan Left	0-256	% Full
030	029/3	EICAS	Hy Oil Quan Right	0-256	% Full
031	029/0	EICAS	IDG Oil Temp Left	±2048	Deg. C.
031	029/1	EICAS	IDG Oil Temp Right	±2048	Deg. C.
031	029/2	EICAS	Inverter AC Volts	0-256	Volts AC
031	029/3	EICAS	Inverter Frequency	0-512	HZ
032	029/0	EICAS	Main Batt Current	±256	Amps DC
032	029/1	EICAS	Main Batt Voltage	±128	Volts DC
032	029/2	EICAS	Pack Out Temp Left	±2048	Deg. C.
032	029/3	EICAS	Pack Out Temp Right	±2048	Deg. C.
033	029/0	EICAS	Rudder Position	0-360	Degrees
033	029/1	EICAS	TRU Current Left	±256	Amps DC
033	029/2	EICAS	TRU Current Right	±256	Amps DC
033	029/3	EICAS	TRU Voltage Left	±128	Volts DC
034	029/0	EICAS	TRU Voltage Right	±128	Volts DC
034	029/1	EICAS	Eng EPR Ref-TMC L	0-4	Ratio
034	029/2	EICAS	Eng EPR Ref-TMC R	0-4	Ratio
034	029/3	EICAS	Filter 3 Vib Left	0-5.12	Ratio
035	029/0	EICAS	Filter 3 Vib Right	0-5.12	Ratio
035	029/1	EICAS	Filter 2 Vib Left	0-5.12	Ratio
035	029/2	EICAS	Filter 2 Vib Right	0-5.12	Ratio
035	029/3	EICAS	Filter 1 Vib Left	0-5.12	Ratio
036	029/0	EICAS	Filter 1 Vib Right	0-5.12	Ratio
036	029/1	EICAS	L Bleed Duct Press	0-128	PSI
036	029/2	EICAS	R Bleed Duct Press	0-128	PSI
036	029/3	EICAS	Discrete Word #31	N/A	N/A

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LABEL	EQ ID/SDI BUS		DESCRIPTION	RANGE	UNITS
037	029/0	EICAS	Discrete Word #32	N/A	N/A
037	029/1	EICAS	Discrete Word #33	N/A	N/A
037	029/2	EICAS	Discrete Word #34	N/A	N/A
037	029/3	EICAS	Discrete Word #35	N/A	N/A
040	029/0	EICAS	Aft Trim Valve	0-128	% Open
040	029/1	EICAS	Flight Deck Trim	0-128	% Open
040	029/2	EICAS	Forward Trim Valve	0-128	% Open
040	029/3	EICAS	L Pack Air Flow	0-2560	Cuft/Min
041	029/0	EICAS	L Pack Temp Valve	0-128	% Open
041	029/1	EICAS	L Ram In Door	0-128	% Closed
041	029/2	EICAS	Baro Altitude	±131072	Feet
041	029/3	EICAS	L Ram Out Door	0-128	% Closed
042	029/0	EICAS	R Pack Air Flow	0-2560	Cuft/Min
042	029/1	EICAS	R Pack Temp Valve	0-128	% Open
042	029/2	EICAS	R Ram In Door	0-128	% Closed
042	029/3	EICAS	Computed Airspeed	±1024	Knots
043	029/0	EICAS	R Ram Out Door	0-128	% Closed
043	029/1	EICAS	Aft Duct Temp	±2048	Deg. C.
043	029/2	EICAS	Bulk Cargo Temp	±2048	Deg. C.
043	029/3	EICAS	Flight Deck Duct Tm	±2048	Deg. C.
044	029/0	EICAS	Fwd Duct Temp	±2048	Deg. C.
044	029/1	EICAS	L Comp Out Temp	±2048	Deg. C.
044	029/2	EICAS	L Precool Out Temp	±2048	Deg. C.
044	029/3	EICAS	L Prim Hx In Temp	±2048	Deg. C.
045	029/0	EICAS	L Prim Hx Out Temp	±2048	Deg. C.
045	029/1	EICAS	L Sec Hx Out Temp	±2048	Deg. C.
045	029/2	EICAS	L Turb In Temp	±2048	Deg. C.
045	029/3	EICAS	R Comp Out Temp	±2048	Deg. C.
046	029/0	EICAS	Precool Out Temp	±2048	Deg. C.
046	029/1	EICAS	Prim Hx In Temp	±2048	Deg. C.
046	029/2	EICAS	R Prim Hx Out Temp	±2048	Deg. C.
046	029/3	EICAS	R Sec Hx Out Temp	±2048	Deg. C.
047	029/0	EICAS	R Turb In Temp	±2048	Deg. C.
047	029/1	EICAS	C Air Pump Temp	±2048	Deg. C.
047	029/2	EICAS	C Elec 1 Pump Temp	±2048	Deg. C.
047	029/3	EICAS	C Elec 2 Pump Temp	±2048	Deg. C.
050	029/0	EICAS	C Hyd Rsvr Temp	±2048	Deg. C.
050	029/1	EICAS	L Elec Pump Temp	±2048	Deg. C.
050	029/2	EICAS	L Eng Pump Temp	±2048	Deg. C.
050	029/3	EICAS	L Hyd Rsvr Temp	±2048	Deg. C.
051	029/0	EICAS	R Elec Pump Temp	±2048	Deg. C.
051	029/1	EICAS	R Eng Pump Temp	±2048	Deg. C.
051	029/2	EICAS	R Hyd Rsvr Temp	±2048	Deg. C.
051	029/3	EICAS	Mach	0-4.096	Mach

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LABEL	EQ ID/SDI BUS		DESCRIPTION	RANGE	UNITS
052	029/0	EICAS	Gross Weight	0-1310720	Lbs.
052	029/1	EICAS	IDG Temp Rise-L	±2048	Deg. C.
052	029/2	EICAS	IDG Temp Rise-R	±2048	Deg. C.
052	029/3	EICAS	Inlet Tot Press-L	0-32	PSI
053	029/0	EICAS	Inlet Tot Press-R	0-32	PSI
053	029/1	EICAS	Static Pressure-L	0-32	PSI
053	029/2	EICAS	Static Pressure-R	0-32	PSI
053	029/3	EICAS	Inlet Tot Temp-L	±128	Deg. C.
054	029/0	EICAS	Inlet Tot Temp-R	±128	Deg. C.
054	029/1	EICAS	Stator Vane Pos-L	0-4	Inches
054	029/2	EICAS	Stator Vane Pos-R	0-4	Inches
054	029/3	EICAS	Thrust Rev. Ang-L	0-360	Degress
055	029/0	EICAS	Thrust Rev. Ang-R	0-360	Degress
055	029/1	EICAS	Eng Scav Press-L	0-4096	PSI
055	029/2	EICAS	Eng Scav Press-R	0-4096	PSI
055	029/3	EICAS	Mid Duct Temp	±2048	Deg. C.
056	029/0	EICAS	Mid Trim Valve	0-128	% Open
056	029/1	EICAS	Bus Activity Word	Discrete	N/A
056	029/2	EICAS	Burner Pressure-L	0-512	PSI
056	029/3	EICAS	Burner Pressure-R	0-512	PSI
057	029/0	EICAS	Thrust Reverser-L	±128	% Deploy
057	029/1	EICAS	Thrust Reverser-R	±128	% Deploy
057	029/2	EICAS	Hyd Gen AC Volts	0-256	Volts AC
057	029/3	EICAS	Hyd Gen Frequency	0-512	HZ
060	029/0	EICAS	Hyd Gen DC Volts	0-50	Volts DC
060	029/1	EICAS	Discrete Word #36	Discrete	N/A
060	029/2	EICAS	BLD Actuator Pos-L	±128	% Stroke
060	029/3	EICAS	BLD Actuator Pos-R	±128	% Stroke
061	029/0	EICAS	N2 Corrected-L	0-128	% RPM
061	029/1	EICAS	N2 Corrected-R	0-128	% RPM
073	029/0	EICAS	Eng Oil Quantity-L	0-128	US Pints
073	029/1	EICAS	Eng Oil Quantity-R	0-128	US Pints
103	01B/x	FSEU	Left PDU Flap	0-360	Degrees
104	01B/x	FSEU	Right PDU Flap	0-360	Degrees
105	01B/x	FSEU	Left PDU Slat	0-360	Degrees
106	01B/x	FSEU	Right PDU Slat	0-360	Degrees
107	01B/x	FSEU	Flap/Slat Lever	0-360	Degrees
173	0D0/1	EIS	Hy Oil Quantity-L	0-128	US Pints
173	0D0/2	EIS	Hy Oil Quantity-R	0-128	US Pints

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LABEL	EQ ID/SDI BUS		DESCRIPTION	RANGE	UNITS
174	0D0/1	EIS	Hy Oil Pressure-L	0-4096	PSI
174	0D0/2	EIS	Hy Oil Pressure-R	0-4096	PSI
227	03D/x	AVM	AVM Command Word	Discrete	
241	04D/x	FQIS	Unique Decoding in Trap Mode		
247	04D/x	FQIS	Tot Fuel Quantity	0-655360	Lbs.
256	04D/x	FQIS	Fuel Quantity	0-163800	Lbs.
270	03D/x	AVM	Status Word	Discrete	
277	029/0	EICAS	Wraparound Word	Discrete	N/A
300	029/0	EICAS	L EPR Actual-TMC	0-4	Ratio
300	03D/x	AVM	Flight History	Multiple Fields	
301	029/0	EICAS	R EPR Actual-TMC	0-4	Ratio
301	03D/x	AVM	Flight History	Multiple Fields	
302	029/0	EICAS	L N3 Actual-TMC	0-256	% RPM
303	029/0	EICAS	R N3 Actual-TMC	0-256	% RPM
304	029/0	EICAS	L N1 Actual-TMC	0-256	% RPM
305	029/0	EICAS	R N1 Actual-TMC	0-256	% RPM
306	029/0	EICAS	L Fuel Flow-TMC	0-32768	Lbs/Hr
307	029/0	EICAS	R Fuel Flow-TMC	0-32768	Lbs/Hr
316	0D0/1	EIS	Eng Oil Temp-L	0-2048	Deg. C.
316	0D0/2	EIS	Eng Oil Temp-R	0-2048	Deg. C.
317	0D0/1	EIS	Eng Oil Press-L	0-4096	PSI
317	0D0/2	EIS	Eng Oil Press-R	0-4096	PSI
344	0D0/1	EIS	N2-L	0-256	% RPM
344	0D0/2	EIS	N2-R	0-256	% RPM
345	0D0/1	EIS	EGT-L	0-2048	Deg. C.
345	0D0/2	EIS	EGT-R	0-2048	Deg. C.
346	0D0/1	EIS	N1-L	0-256	% RPM
346	0D0/2	EIS	N1-R	0-256	% RPM
347	029/1	EICAS	Eng Fuel Flow-R	0-32768	Lbs/Hr
347	029/2	EICAS	Eng Fuel Flow-L	0-32768	Lbs/Hr
347	0D0/1	EIS	Fuel Flow-L	0-32768	Lbs/Hr
347	0D0/2	EIS	Fuel Flow-R	0-32768	Lbs/Hr
350	03D/x	AVM	Maintenance Data 1	Discrete	N/A

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LABEL	EQ ID/SDI BUS		DESCRIPTION	RANGE	UNITS
353	0D0/1	EIS	Vibration-L	0-5.12	Scaler
353	0D0/2	EIS	Vibration-R	0-5.12	Scaler
353	03D/x	AVM	Highest Vibration	0-5.12	Scaler
354	03D/x	AVM	N1 Vibration	0-5.12	Scaler
355	03D/x	AVM	N2 Vibration	0-5.12	Scaler
356	03D/x	AVM	N3 Vibration	0-5.12	Scaler
357	03D/x	AVM	BB Vibration	0-5.12	Scaler
360	03D/x	AVM	N1 Rotor Imb Ang	0-360	Degrees
361	03D/x	AVM	LPT Rotor Imb Ang	0-360	Degrees

Note1: x = Any SDI

Note 2: The number entered in the Range Column is the nearest whole binary number greater than the parameter range required. The weight of the most significant bit of the two's complement fractional notation binary word will be one half this value, and the actual maximum value of the parameter capable of being encoded will be the number in the range column less one least significant bit value.