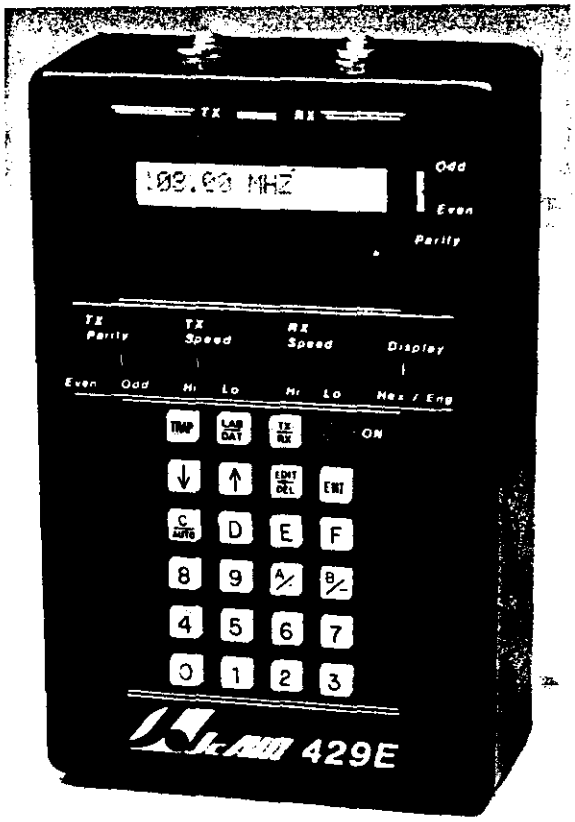
JcAIR 429E

ARINC 429 TRANSMITTER / RECEIVER
and
DATA BUS ANALYZER

- Receives & Stores up to 255 Words
- Transmits 10 Labels Simultaneously
- Data displayed in easy-to-understand engineering units
- Provides easy access to radio system frequency screens (ADF, DME, HF, VHF, VOR/ILS and ATC)



HEXADECIMAL OR ENGINEERING FORMAT LCD DATA DISPLAY

The Model 429 Transmitter/Receiver provides avionics technicians and line maintenance personnel with an easy, low-cost method for troubleshooting ARINC 429 avionics systems. The unit features capability for transmitting up to 10 independent ARINC 429 labels plus the ability to receive and store up to 255 labels. Display of transmitted or received data is via liquid crystal display. Selection of data to be transmitted or display of received data is by hexademimal or engineering format.

The 429E is housed in a rugged, compact case with internal, rechargeable Ni Cad batteries. It comes with either a 115V or 220V plug-in battery charger. An optional carrying case is available for convenience and protection of the unit.

JcAIR

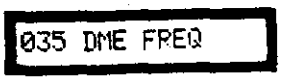
A Subsidiary of The BFGoodrich Company

JcAIR 429E Simplifies ARINC 429 Testing

TRANSMITTER/RECEIVER DISPLAYS

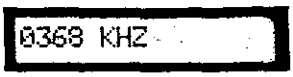
TRANSMITS 10 WORDS

Operator uses scrolling keys to access individual transmitter slots.



TX LABEL SCREEN

After selecting TX slot, operator uses EDIT/ENT key to enter octal number of label to be transmitted.



DATA MODE

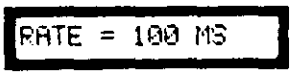
LAB/DAT key allows operator to view or change data of label that is being transmitted or received.

SDI SCREEN

Allows operator to view or change SDI.

SSM SCREEN

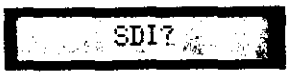
Allows operator to view or change the SSM and annunciates 4 possible designations of bits 30 & 31, i.e., NORM, FAIL, etc.



WORD RATE SCREEN

Allows operator to view or change word rate.

RECEIVER TRAP/STORAGE DISPLAY



SDI SELECT

VIEWING TRAPPED LABELS

Trap Function allows operator to trap and store 255 occurences of a received label. TRAP key allows operator to enter Label/SDI combination to be received. Scrolling keys then allow operator to manually scan stored information (label number or data). Selection of AUTO key allows continual scrolling of stored data.

RADIO SYSTEMS MANAGEMENT DISPLAYS

ILS

FREQUENCY

BIT POSITION

Specialized screens provide user interface menus for accessing bits which have Radio System Frequency Selection and function switching applications. Individual functions for ADF, DME, HF, VHF, VOR/ILS, and ATC are controlled through individual menus by entering a "1" or a "0".

1. **Trap Mode key** - allows operator to enter any one of four label/SDI combinations for selection of received labels for display. A 255 word buffer is provided for receiving and storage of data for display. Access to trap mode is through selection of receiver mode via TX/RX key.

2. **Automatic mode key** - allows operator to scroll through labels that have been received by trap mode. Auto mode steps through word buffer and displays number of trapped words as well as the engineering name of label. Scrolling of the various data menus of the received labels is accessed by the LAB/DAT key.

3. **Transmit parity switch** - allows operator to select odd or even transmission parity.

4. **Transmit speed** - selects hi (100 kbps) or low (12.5 kbps) transmission rate.

5. **Transmitter output port** - allows access to transmitter port using standard 3-conductor, 1/4" phone plug.

6. **Receiver input port** - provides input to receiver port using standard 3-conductor, 1/4" phone plug.

7. **Scrolling keys** - allows operator to scroll through display menus (10 transmitter slots, 255 receiver slots, or data menus). Allows selection of the scanning direction in auto mode.

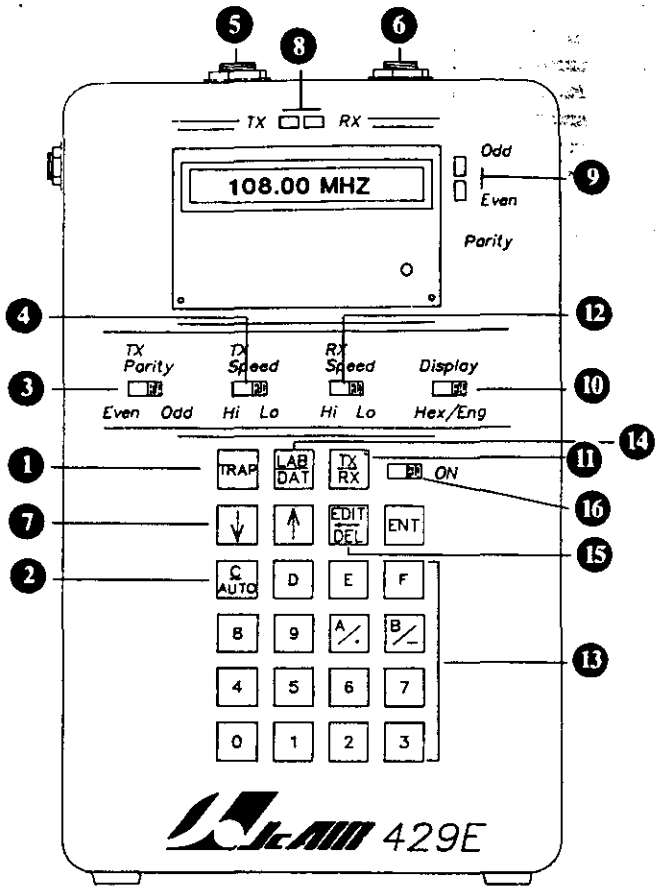
8. **Display indicator** - LED indicates TX or RX information is being displayed.

9. **Parity indicator** - in receive mode, LED indicates parity of word presently displayed. In transmit mode, LED indicates selected Tx parity.

10. **Display selector** - allows operator to select hexadecimal or engineering unit display of data.

11. **Transmitter/receiver display select switch** - selects LCD display or label being transmitted or received. After selection of TX/RX key, initial display indicates number of labels being transmitted or received. Scrolling keys should then be used for manually stepping through transmitter or receiver slots.

12. **Receiver speed select switch** - selects hi (100 kbps) or low (12.5 kbps).



13. **Data entry keys** - allows operator to enter transmitted data in hexadecimal or engineering formats.

14. **Label/Data display key** - Label mode displays octal number and engineering definition of labels being transmitted or received. Data mode allows viewing of data being transmitted or received.

15. **Edit/delete key** - edit key allows operator access to the data entry mode. Delete key allows correction of errors during data entry.

16. **On/Off Switch**

SPECIFICATIONS

Size: 4.5" x 7.25" x 2.5" *Weight:* 3 lbs. *Operating Temperature:* − 10 to + 60 C

429 TRANSMITTER:

Bit rate:	12.5 or 100 kbps ± .5% (selectable)
Rise time:	Low speed - 10 usec. ± 5 usec.
	High speed - 1.5 usec. ± .5 usec.
Output Impedance:	75 ± 5 ohms (Line A to B)
Amplitude Output:	± 10 volts (± 1.0 volt) between A and B terminals open circuit

429 RECEIVER:

Impedance:	12 K ohms minimum (balanced)
Bit Range:	8 to 20 kbps (low speed)
	80 to 125 kbps (high speed)
Voltage Levels:	HI: + 6.5 to + 13 VDC; NULL: + 2.5 to -2.5 VDC; LO: -6.5 to -13 VDC

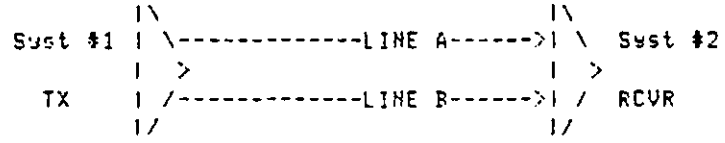
Transmitter Operation:

The 429E provides capability for transmitting up to ten 32 bit words in ARINC 429 or 419 bipolar RZ format. The transmit bit rate can be set for high (100 kbps) or low (12.5 kbps) rate with selectable odd or even parity. The unit allows keypad entry of transmit label (octal) with data entry via hexadecimal (bits 32 thru 9) or by engineering equivalent values. Entry by engineering values allows individual entry of primary data (miles, knots, Mhz, etc.), SDI, SSM, word rate and individual bit switching functions. The transmitter operation is completely independent of the receiver, allowing simultaneous operation of both transmitter and receiver.

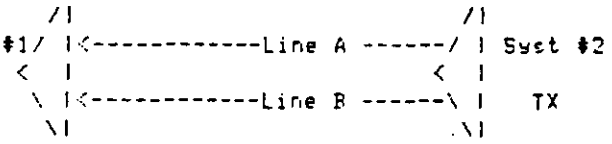
Receiver Operation:

The 429E is capable of receiving and trapping (storing) up to 255 high or low speed 32 bit words in 429 or 419 bipolar RZ format. Receiver bus speed is switch selectable. LCD display of received labels is provided with selection of hexadecimal or engineering formats. Initial receiver screen displays the number of labels that have been received with ability provided for stepping through each label for data display. Trap mode allows operator to select or trap which labels are to be received (up to four label/SDI combinations can be selected). Access to received or stored data is accomplished by single-step scrolling keys or by automatic scrolling mode.

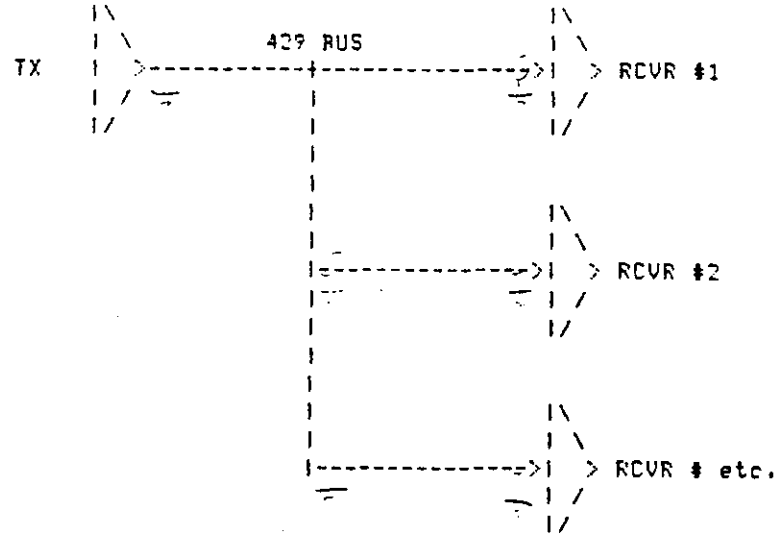
The message must be sent from a transmitter port to a receiver port by using a 2-wire data bus to carry the coded 32-bit serial words. Sending the message over this data bus, which is a single twisted and shielded pair of wires, is not bi-directional but must go from a transmitter port to a receiver port. See figure.



If two way communications is required then a second bus using another Tx-Rx port is required. See figure.



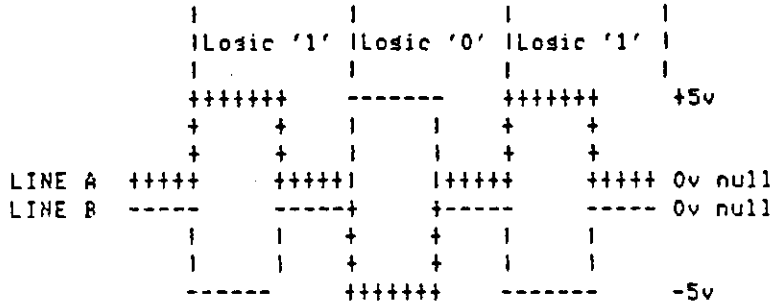
While no restriction is placed on the bus length or on the number of receivers on a bus, it is recommended that no more than 20 receivers are connected to a transmitter port in a aircraft the size of a B-747 or smaller. See figure.



MULTI-SYSTEM INTERCONNECT

A twisted and shielded pair of wires should be used to connect the Tx and the Rx ports. The shield should be terminated to ground at each end and at each break in the bus.
A transmitter, receiver or an installation fault should not cause damage to another unit connected to the bus.

The transmitter-receiver port is a 2-wire, balanced 75 ohm, bus that is designed to run in three RZ bipolar states; Hi, Null, & Lo. See figure.

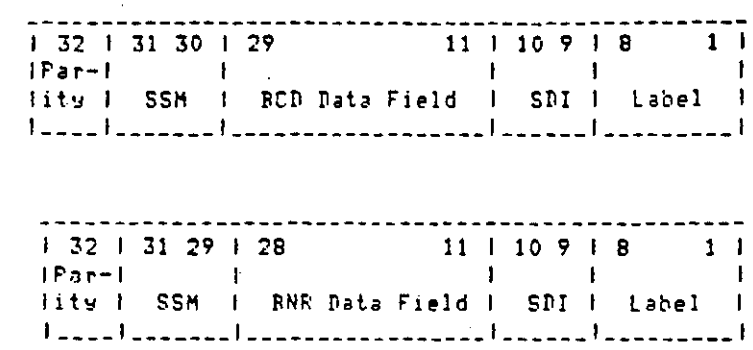


The logic levels are determined by measuring from Line B to Line A. The first one half of each bit defines the logic level and the second one half of the bit returns to the null point. A +10v level is equal to a logic '1' or Hi and a -10v level is equal to a logic '0' or Lo. These voltages were selected to achieve the required performance in an aircraft installation. The transmitter tolerance is +/-5v,+or-0.5v. The receiver tolerance is +/-10v,+3v-3.5v and a +/-2.5v null. The receiver may continue to decode a single Line A or B wire but noise immunity is decreased and intermittant operation may exist. There is an effort to increase the receiver sensitivity threshold to +/-5.5v and eliminate single wire decode problems.

The bit rate for high speed operation is 100Kbits/sec and low speed operation is 12-14.5Kbits/sec. The selected rate should be maintained within 1%. Precise frequencies of 100Khz and 13.6Khz should be avoided to prevent RFI for Omega and Loran C systems.

The clock is recovered from the RZ bi-polar signal. The words are synchronized by a gap consisting of a min. of 4 clocks. Bit #1 is the LSB in the transmission sequence. The transmission rate is defined for each parameter in 429.

The 32-bit digital word contains the identifing Label, the Source/Destination Identifier (SDI), the BCD or BNR Data Field, the Sign/Status Matrix (SSM), and a Parity bit. Arinc 429-7 defines each parameter. See figure.



GENERAL WORD FORMAT

THE LABEL

The characteristics of each parameter are identified by an octal label. The octal label of the parameter is a binary number contained in bits 1-8. The label is read in reverse order as shown in the example below. e.g. GMT is Octal 150

Bit weight	1	2	4	1	2	4	1	2
Bit position	8	7	6	5	4	3	2	1
Data	0	0	0	1	0	1	1	0
GMT label		0			5			1

LABEL EXAMPLE

In some instances different labels share similar parameters. e.g. 125 is BCD GMT and 150 is BNR GMT; 014 is BCD MAG HDG and 320 is BNR MAG HDG. These are cases where the language format is different. The data field must contain the correct language for the labels assigned BCD or BNR in 429-7.

A few parameters share the same label. For example, Octal 320 is MAG HDG for IRS/AHRS systems or Engine Fuel Pressure for EICAS systems. Sharing labels in this case is acceptable because the systems are not functionally compatable and no inter-system communications is allowed.

Some labels are application dependent and the parameter is defined by the user. i.e. Octal 300-307.

THE SDI BITS

Bits #9 and 10 are reserved for Source/Destination Identification. This is used to direct specific words to the proper system in a multi-system configuration.

Bit #10	#9 (LSC)	
0	0	ALL CALL
0	1	System #1
1	0	System #2
1	1	System #3

SDI TABLE

An example would be for the NAV Management System to send the tuning frequencies to the #1 or the #2 NAV Receiver.

The SDI bits may be used to increase the BCD or BNR data field when more resolution is required under a specific label and when SDI is not required. These bits should be set to '0's unless they are used.

THE DATA FIELD

The data field may contain pad bits and/or discrete bits.
The language used will be BCD or BNR as defined in Arinc 429.

32	31-30	29----------	11	10-9	8---1
P	SSM	BCD DATA FIELD-->	<--PAD	<--DISCRETES	SDI	LABEL

32	31-29	28----------	11	10-9	8---1
P	SSM	BNR DATA FIELD-->	<--PAD	<--DISCRETES	SDI	LABEL

BCD AND BNR GENERAL WORD FORMAT EXAMPLES

The discrete bits will always begin at the LSC bit #11. The discretes will contain encoded information associated with the label. e.g. VOR OMNI BEARING (222) uses bits 11, 12, & 13 to indicate a gnd'd MKR light output for 400Hzz, 1300Hz or 3000Hz. All bit positions not used for discretes or for the data field will be '0' for PAD.

The MSC of the BCD data field will begin at bit #29 and fill the field as shown in the following example.

33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	BIT POSITION
P	SSM	MSC		#2 CHAR			#3 CHAR			#4 CHAR			LSC			SDI		LABEL					
		4	2	1	8	4	2	1	8	4	2	1	8	4	2	1							
0	0	0	1	0	1	0	1	1	1	0	0	0	1	1	0	0	1	1	0	0	0	0	0	1
Example 2			5		7	.	8		6								201 DME DST						

BCD WORD FORMAT EXAMPLE

The BNR value is the 2's complement fraction notation. The MSC will represent one half of the maximum range as defined in 429. Each successive bit represents the increments of a binary fraction. Negative numbers are the 2's complement of the positive value with in the SSM sign bit set for a negative number.
The MSC of the BNR data field as shown in the example below will begin at bit #28.

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	DATA FIELD* = 512																	PAD		SDI	LABEL								
0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	1	1	1	0	P	P	0	0	1	0	0	0	0	0	1	1
Example		257.86 NM																				202 DME DST								

*The range value of the data field is defined in the 429 spec. as 512NM. The MSC has a value of 1/2 the range, bit #27 has 1/4 the value, bit #26 has 1/8 the value, etc. until bit #20 has the value of 1/256 of the range.

BNR WORD FORMAT EXAMPLE

The specific digital weight for each bit is also given in the above example with the units, the whole range and resolution of the parameter defined in the 429 spec.

THE SSM BITS

The BCD sign and the status of the transmitter hardware is encoded in the Sign/Status Matrix (SSM) bits 30 and 31. See the table.

Bit #31	30	Designation
0	0	Plus, North, East, Right, To, Above
0	1	No Computed Data
1	0	Functional Test
1	1	Minus, South, West, Left, From, Below

BCD MATRIX TABLE

The BNR labels encode status on bits 30, 31 and sign on bit 29. See the tables.

Bit #31	30	Designation
0	0	Failure Warning
0	1	No Computed Data
1	0	Functional Test
1	1	Normal Operation

BNR STATUS TABLE

Bit #29	Designation
0	Plus, North, East, Right, To, Above
1	Minus, South, West, Left, From, Below

BNR SIGN TABLE

Failure Warning and No Computed Data are two types of invalid data. Failure Warning indicates an internal system malfunction. No Computed Data indicates a problem external to the system including not yet ready or not receiving required input data.
A functional test should produce 1/8 of positive full scale value unless otherwise specific.

The sign designation is addressed to a specific label as required. For example, North or South Latitude and East or West Longitude.

THE PARITY BIT

The Parity bit #32 is used for error detection and correction. It is encoded to give the entire 32-bit word and odd number of '1's or 'odd parity'.

THE MNEMONIC LIST

ARINC	AERONAUTICAL RADIO, INC.
AHRS	ATTITUDE HEADING REFERENCE SYSTEM
BCD	BINARY CODED DECIMAL
BNR	BINARY
DITS	DIGITAL INFORMATION TRANSFER SYSTEM
GMT	GREENWICH MEAN TIME
HDG	HEADING
IRS	INERTIAL REFERENCE SYSTEM
LSB	LEAST SIGNIFICANT BIT
LSC	LEAST SIGNIFICANT CHARACTER
MKR	MARKER RECEIVER
MSB	MOST SIGNIFICANT BIT
MSC	MOST SIGNIFICANT CHARACTER
RX	RECEIVER
RZ	RETURN TO ZERO
SYST	SYSTEM
TX	TRANSMITTER

REFERENCE: MARK 33 DITS ARINC 429-7 APR. 20'83

********** PB JUN 22 '83 **********