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# AEROFLEX

## OPERATION MANUAL

# 429EN

## ARINC 429 TX/RX PORTABLE

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400 New Century Parkway – New Century, Kansas – 66031  
Telephone: (800) 237-2831 / (913) 764-2452 Fax: (913) 782-5104  
[www.aeroflex.com](http://www.aeroflex.com)

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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 $\Omega$  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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**SECTION I  
GENERAL INFORMATION**

**1.1 INTRODUCTION**

This manual provides operational information for the Aeroflex Model 429EN ARINC 429 Transmitter/Receiver.

**1.2 EQUIPMENT DESCRIPTION**

The 429EN provides avionics technicians, engineers and line maintenance personnel with a convenient, easy to use tool for testing and trouble-shooting ARINC 429 avionics systems.

Transmitter features:

- Data entry in Hexadecimal or Engineering Units
- Can transmit up to 10 labels simultaneously
- Individual screens for entry of data, rate, SDI and SSM
- Selectable (Lo or Hi speed) bit rate
- Selectable (Odd or Even) word parity
- Selectable (4 to 59998 ms) word rate
- LED display of transmitted word parity

Receiver features:

- Data display in Hexadecimal or Engineering Units
- Individual screens for display of data, rate, SDI and SSM
- Ability to trap and store up to 255 words
- Automatic scrolling of trapped data
- Selectable (Lo or Hi speed) bit rate
- LED display of received word parity

Other features:

- Liquid crystal display
- Portability
- Self-contained, rechargeable NiCad batteries
- "Low Battery" warning
- Available with either 110 V ac or 230 V ac battery charger
- Rugged, compact case
- Optional carrying case

**1.3 TECHNICAL CHARACTERISTICS**

**Specification**

**Characteristic**

ENVIRONMENTAL SPECIFICATIONS: The environmental specifications are as follows.

OPERATING TEMPERATURE: 5 °C to 40 °C.

RELATIVE HUMIDITY: Maximum of 80% for temperatures up to 31 °C decreasing linearly to 50% at 40 °C.

OPERATING ALTITUDE: Up to 2 000 m.

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IEC OVERVOLTAGE CATEGORY: II

POLLUTION DEGREE: 1

SIZE: 34.9 cm W x 14.2 cm H x 22.6 cm D  
(13.75" W X 5.6 H X 8.9 D)

MASS (Weight) 3.85 kg (8.5 lbs.)

## CABLES AND WIRES

Jumper cable assembly should be fabricated using 2-conductor twisted pair with braided shield. 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 X and Y.

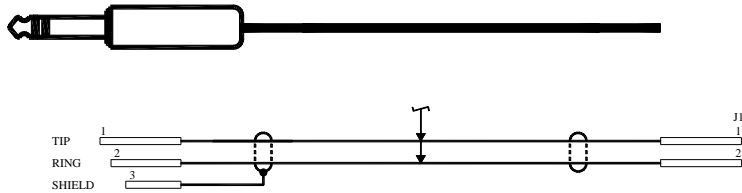


Figure X. Cable Assembly Schematic

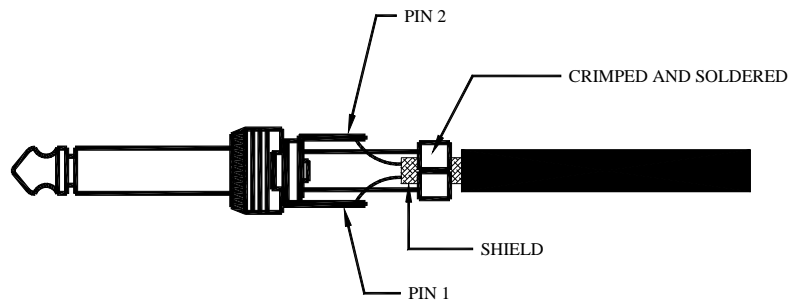




Figure Y. Phone Plug Termination

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## POWER REQUIREMENTS:

110 V/60 Hz/500 mA 

OR

230 V/50 Hz/300 mA 

OR

Six (6) internally mounted  
AA size rechargeable NiCad cells



## ARINC SPECIFICATION:

Conforms to Mark 33 Digital Information Transfer System (DITS) Specification 429-9 (Attachment 2) unless otherwise specified.

## ARINC 429 TRANSMITTER

### Pulse Rise/Fall Times:

Low Speed	10.0 ±5.0 μs
High Speed	1.5 ±0.5 μs

### Voltage Levels (Line A to B):

HI	+10.0 ±1.0 V dc
NULL	0.0 ±0.5 V dc
LO	-10.0 ±1.0 V dc

### Output Impedance (Line A to B): Bit Rate:

75 ±5 Ω	
Low Speed	12.5 kbps ±0.5%
High Speed	100.0 kbps ±0.5%

### Word Rate:

4 to 59998 ms

### Parity:

ODD or EVEN

## ARINC 429 RECEIVER

### Voltage Levels (Line A to B):

HI	+6.5 to +13.0 V dc
NULL	+2.5 to -2.5 V dc
LO	-6.5 to -13.0 V dc

### Bit Rate:

Low Speed	8 to 20 kbps
High Speed	80 to 125 kbps

### Word Rate:

±2 ms average

### Input Impedance:

12 kΩ min. (balanced)

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## 1.4 UNITS AND ACCESSORIES SUPPLIED

The Aeroflex Model 429EN, JPN: 01-1001-60, is supplied with the following:

JcAIR P/N	DESCRIPTION
55-1001-60	Interface Cable, 429EN ARINC 429 TX/RX
24-7002-00	Power Cord 3 Cond 1250W 10A 125V 7.5FT
06-1001-61	429EN Operation Manual



## **SECTION II 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's self test.

### **2.2 UNPACKING AND INSPECTING EQUIPMENT**

Carefully remove the Aeroflex 429E/EN and accessories 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 line cord into an appropriate voltage outlet (110 & 230 volt). A four to five hour charge should refresh the batteries. The 429E/EN may be operated while charging or with the line cord disconnected. With fully charged batteries, the unit will operate for approximately four to six hours.

In the event that the batteries become discharged during use to a level approaching unreliable operation, the display will flash the message LOW BATTERY approximately every ten seconds. At this point, the unit should be reconnected to the charger to refresh the batteries.

#### **2.3.2 CONNECTION TO USER EQUIPMENT**

Connect the Aeroflex Interface cable (JPN: 55-1001-60) to the input connector.

## 2.4 POST INSTALLATION CHECK

### 2.4.1 UNIT SELF TEST

The Aeroflex 429E/EN performs a self test routine on initial power up. The following tests are performed:

1. The red LEDs 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 test, unless an error condition exists, the LEDs are extinguished. If one of the LEDs fails to light, the unit should still function properly, but the LED should be replaced at the earliest opportunity. If all LEDs fail to illuminate and the display is blank or displays random data, then a catastrophic unit failure has occurred or the batteries are completely discharged.
2. The EPROM is checked by summing all memory locations and comparing the result to the known checksum. If the checksums don't 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 check-sum subroutine is bad, the program will not be able to execute properly.
3. The 429E/EN has RAM in two independent ICs. 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. After writing to all locations of the section, it then reads each location and check its value. If all is correct, 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 6116 RAM ERR to the display. This indicates that U3 has failed its test. The PROGRAM will then loop indefinitely reading from the failed location.

4. The 429E/EN 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 loopback circuitry and transmit a word with a label of 0 and a data pattern of AA55AA (hex). After a brief pause, the unit will read its 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.

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 (if any).

## SECTION III OPERATION

### 3.1 GENERAL OPERATION DESCRIPTION

The 429EN is a single channel ARINC 429 transmitter and receiver. It can receive and display all ARINC 429 labels per ARINC Specification 429-9 (Attachment 2). It can simultaneously output up to ten ARINC 429 words. Data can be displayed and entered in either hexadecimal or engineering formats.

The transmitter and receiver can operate at either 100 kbps (HI Speed) or 12.5 kbps (LO 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. An LED indicator will show the parity selected for transmitted words in the TX mode or the parity of the currently displayed word if in the RX mode.

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

#### 3.1.1 HEX MODE

The HEX mode allows entry and display of the data field in hexadecimal format. The data field is specified in up to 6 hex characters (000000-FFFFFF). The characters represent the hexadecimal equivalent of bits 32-9 (starting with bit 32) in six 4-bit nibbles. Each 4-bit nibble is derived from the BCD equivalent of the binary value.

For example: Data Field in Binary - 1001 0010 1111 0001 1010 0101

Equivalent Hex Value - 9 2 F 1 A 5

The 429EN will display (from left to right), the label (bits 1-8) in three octal characters (001-377), followed by the SDI (bits 10-9) in two binary characters (00-11), the data field (bits 32-9) in six hex characters (000000-FFFFFF) and the SSM (bits 31-30) in two binary characters (00-11). The only other screen possible in DATA mode is the RATE screen.

#### 3.1.2 ENG MODE

The ENG (Engineering) mode allows data entry and display in convenient engineering unit formats (feet, knots, MHz, etc.). The label definition will determine the number of screens required for display of all possible fields of the word. See Appendix A for a complete listing of the engineering conversion for each ARINC 429 label defined by the 429EN.

#### 3.1.3 TRANSMIT & RECEIVE MODES

There are two distinct modes of operation: TX (Transmit) mode and RX (Receive) mode. Selection of these modes and all other display operations are accomplished by keypad or slide switch entry as 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. The data for each individual word is easily edited. There is a unique screen for most individual fields of the word. Some words will have more screens than others.

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The word rate for each transmitter slot can be set independently. The word rate can be as fast as 4 ms or as slow as 59998 ms. If the rate is not specified, the unit will set it to the default value as defined as the minimum word rate in the ARINC 429-9 (Attachment 2) specification.

If desired, the word output sequence can be synchronized to be transmitted in a particular order (see the ENT key description in section 3.2.1 for details).

To comply with ARINC standards, the transmitter automatically insures at least a 4 bit time (low speed) separation between adjacent words.

### **3.1.3.2 RX MODE**

There are two modes of operation in the RX mode; NORMAL and TRAP. Each mode has a screen that shows the count of words received, the label and description, or the data field currently selected.

#### **3.1.3.2.1 NORMAL Mode**

NORMAL mode (default) is a dynamic mode that displays all unique labels received, the label and description currently selected, or the data field currently selected. In this mode, the screen is updated 4 times per second with the latest data received.

#### **3.1.3.2.2 TRAP Mode**

TRAP mode is a static mode of operation which captures and stores the data for detailed analysis.

TRAP data may be filtered in 1 of 4 combinations:

1. All Labels/All SDI
2. Specific Label/All SDI
3. All Labels/Specific SDI
4. Specific Label/Specific SDI

Words are received and stored in the trap buffer in their order of occurrence. They will remain in the buffer until the TRAP key is pressed again or until the unit power is turned off, even if disconnected from the user equipment. Up to 255 unique words may be stored. Once the trap buffer is full, all subsequent received words will be ignored. In this mode, the time that has elapsed since the previous word is stored as the rate.

### **3.1.4 MISCELLANEOUS**

#### **3.1.4.1 Speed and Parity Select/Display**

The transmitter and receiver can operate at either 12.5 kbps (Lo Speed) or 100 kbps (Hi 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. The 429EN will automatically correct the entered data to be transmitted if the data entered by the user is in conflict with the selected TX 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.

### 3.1.4.2 Power Saver Mode

To minimize battery drain, the 429EN has the ability to sense when there has been no activity (keypad, TX, or RX) for at least 5 minutes. When this happens, the 429EN will shut down some of its circuitry and go to "sleep". In this state, the unit 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 unit to its normal operation mode.

## 3.2 CONTROL FUNCTIONS

### 3.2.1 429EN CONTROLS AND INDICATORS (Figure 3-1)

- |                           |  |
|---------------------------|--|
| (1) TRAP Mode Key         | Allows the operator to enter any one of four 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. Trapping a "0" label will trap ALL labels. Trapping on all SDIs is accomplished by entering ENT only when prompted for "SDI?".   |
| (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. If in the LABEL mode, steps automatically through the word buffer and displays the number of trapped words as well as the engineering name of the label. If in the DATA mode, the AUTO mode steps to the same data menu for the next trapped word. Scroll keys (UP/DN Arrow keys) allow scanning direction to be selected.<br><br>IN EDIT MODE. Allows the hexadecimal value "C" to be entered. |
| (3) TX Parity Switch      | Allows operator to select ODD or EVEN transmit word parity.  |
| (4) TX SPEED Switch       | Allows selection of HI (100 kbps) or LO (12.5 kbps) speed transmit bit rate.   |
| (5) TX Output Port        | Allows access to transmitter port using standard 3-conductor, 1/4" phone plug.   |
| (6) RX Input Port         | J1 connector allows interface to LRU also Allows access to 429 receiver port .   |
| (7) SCROLL (UP/DOWN) 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. 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 the character).   |
| (8) TX/RX Indicator       | LED indicates that the system is in either the transmit (TX) or receive (RX) mode of operation for display and entry of data.  |
| (9) PARITY Indicator      | IN RX MODE. LED Indicates parity (ODD or EVEN) of word presently displayed.<br><br>IN TX MODE. LED Indicates selected transmit parity.   |

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- (10) HEX/ENG Switch  
Allows selection of hexadecimal or engineering unit display and entry of data.
- (11) TX/RX Key  
Allows selection of TX or RX mode of operation for display and entry of data. After selection, initial display indicates the number of labels being transmitted or received. SCROLL keys should then be used for manual stepping through TX or RX slots. TX/RX LED indicators above display will indicate current mode of operation.
- (12) RX SPEED Switch  
Allows selection of HI (100 kbps) or LO (12.5 kbps) speed receiver bit rate.
- (13) DATA ENTRY Keys  
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 429-9 Attachment 2 specifications 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 discretets and individual bit screens, etc.)
- (14) LAB/DAT Key  
Allows selection of either LABEL 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 access to the data entry mode. If in the data entry mode, the DEL keys allows correction of errors during data entry.
- (16) ON/OFF Key  
Turns the unit ON or OFF.
- (17) ENT (Enter) Key  
DATA ENTRY MODE. Used to complete 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 WORD ORDER SYNCHRONIZATION. If not in the data entry mode and the transmitter is active, pressing the ENT key will reset the counters of each active label 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).
- For example, you want to simulate an LRU that transmits 6 labels in bursts of 100 ms apart. You would enter the first label in the group in TX block 10 with word rate of 100. The second label would go in TX block 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 block 5. Once all the data has been entered and you are ready to synchronize the labels, the ENT key should be pressed. There will be no visible indication that anything has occurred, but the words will have been synchronized and are being transmitted in bursts of 6, 100 ms apart. If any data is changed later, the ENT key must be pressed again to resynchronize the words.

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- (18) Battery Charging Jack                      Allows the internal AA NiCad batteries to be charged by connecting to the 110VAC 60Hz line cord furnished with the 429EN. This Jack will also work with 220VAC 60Hz and 110VAC 400Hz.
- (19) Display Contrast Adj.                      Allows adjustment of the liquid crystal display (LCD) for desired viewing angle.
- (20) UUT Interface Jack (J1).                      Use interface cable JcAIR (Part Number 55-1001-60) to connect to UUT. Also the cable supplies +28VDC power to the 429EN.
- (21) R RES Lamp (DS2).                      Placing a DC voltage on J1-9 with Ground on J1-11 shall illuminate the R RES lamp.
- (22) RT Left/Right Switch (S3).                      In the R position J1-1,2 may have 429 ARINC Receive data.  
In the L position J1-3,6 may have 429 ARINC Receive data.
- (23) WOW Switch (S5).                      Placing the WOW Switch in the on position shall place a Ground on J1-7.
- (24) CAL/RESET R Switch (S2).                      Pressing the Momentary switch up shall place a Ground on J1-5 (Right EPC).
- (25) CAL/RESET L Switch (S1).                      Pressing the Momentary switch up shall place a Ground on J1-6 (Left EPC).
- (26) L RES Lamp (DS1).                      Placing a DC voltage on J1-8 with Ground on J1-11 shall illuminate the L RES lamp.
- (27) 115/230 Select switch (S4).                      AC Power Select switch.

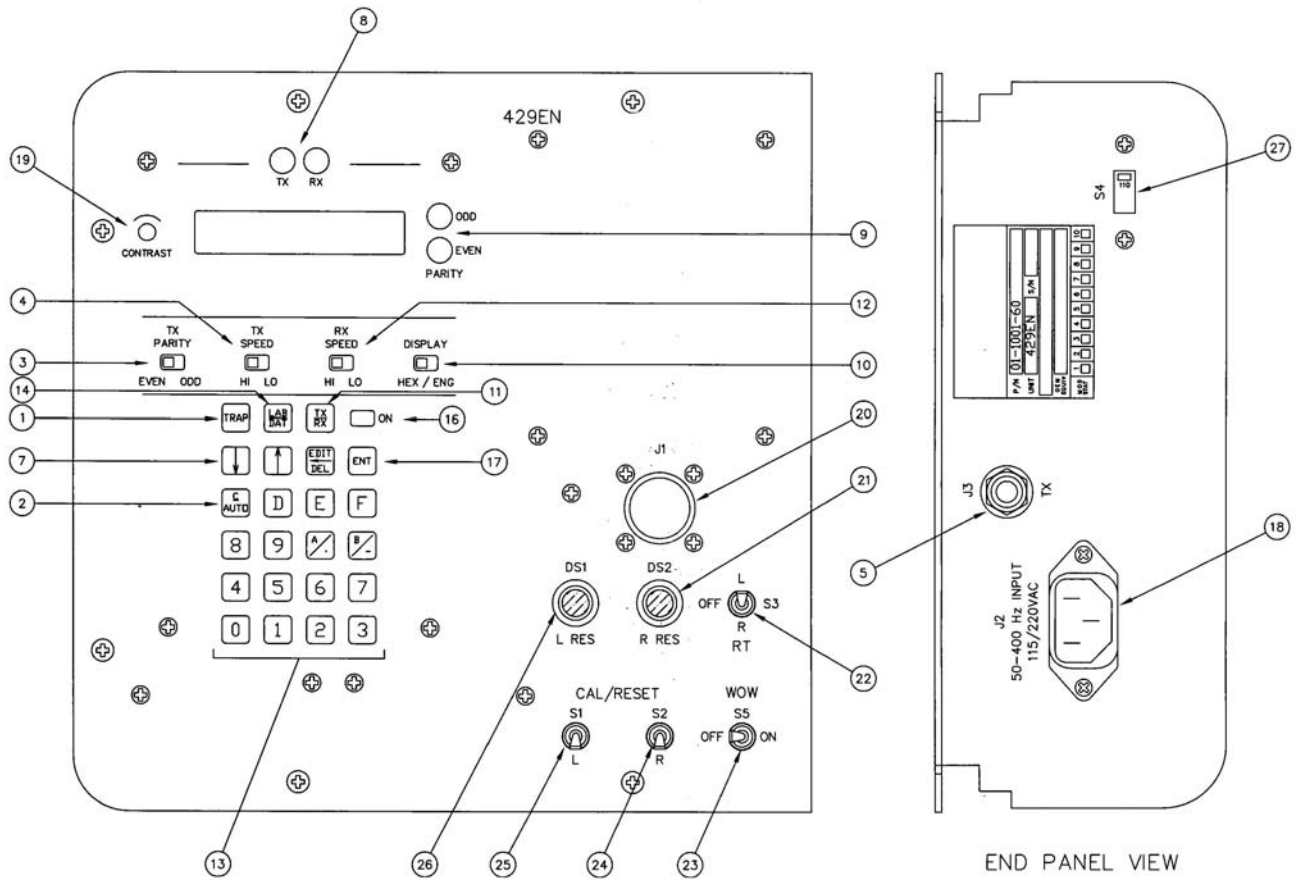


Fig. 3-1: Controls and Indicators



**SECTION IV  
THEORY OF OPERATION**

**4.1 GENERAL CIRCUIT THEORY**

Theory of Operation for the Aeroflex Model 429EN is contained in the 429EN Maintenance Manual (P/N 06-1001-60 for hard copy, E6-1001-60 for CD-ROM), available separately from Aeroflex.

**SECTION V  
MAINTENANCE**

**5.1 INTRODUCTION**

The maintenance section contains maintenance information for the Aeroflex 429EN ARINC 429 Transmitter/Receiver.

**5.2 ALIGNMENT AND CALIBRATION**

No alignment or calibration required.

**5.3 BILLS OF MATERIAL, ASSEMBLY DRAWINGS, SCHEMATICS & TEST PROCEDURE**

To assist in the maintenance of the 429EN, bills of material, assembly drawings, schematics and test procedure are available in the 429EN Maintenance Manual (P/N 06-1001-60 for hard copy, E6-1001-60 for CD-ROM), available separately from Aeroflex.