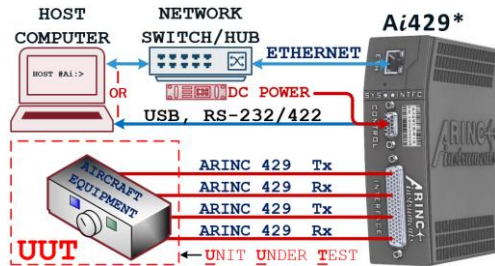


# Ai429TST - TESTER CLASS

■ TRANSMITTER ■ RECEIVER ■ TESTER ■ ANALYZER ■ PATTERN GENERATOR ■ MONITOR ■

## APPLICATIONS

- ✓ Aircraft System Simulation (SIM)
- ✓ Automated Test System (ATS)
- ✓ Ground Support Equipment (GSE)
- ✓ Validation & Verification (V&V)
- ✓ Regression Testing (RT)
- ✓ Extended Stress Testing (ESS)
- ✓ System Diagnostic
- ✓ Software Development
- ✓ Flight Line Diagnostic
- ✓ Portable Tester
- ✓ New Product Development (R&D)



## HARDWARE

The Ai429 is a cross-platform ARINC 429 bus interface, test and management device. It allows the user to interface, transmit & receive ARINC 429 data via any host computer. The host connection can be either Ethernet for speed or serial (USB or RS-232/RS-422) for convenience. Available in 4, 8, 12 and 16 transmit and receive channel pairs, the Ai429 products offer complete and unsurpassed features not found in any other competing products.

There are three classes of Ai429 device: transceiver/XCV, tester/TST and mixer/MXR. The transceiver class (denoted by Ai429XCV) allows the user to monitor, transmit & receive multiple ARINC 429 data buses via cross-platform host interface (Ethernet/serial) using a free GUI, command line interface, scripts or a software API library.

The tester class (denoted by Ai429TST) provides all the features of the transceiver class with the added functionality of testing the buses by auto-generating user specified test patterns and injecting errors on command.

The mixer class (denoted by Ai429MXR) provides all the features of the transceiver and tester products with the added functionality of: mixing, routing, filtering, merging & splitting ARINC 429 buses similar to a managed Ethernet switch.

## RECEIVER

**429** Receives up to 12/twelve simultaneous 429 inputs, the Ai429 can filter received data based on speed and parity. Each channel's input pin pair can be swapped, and speed automatically detected. Once a 429 word is received, it can be routed to the host computer. The host can request for the system to filter which port, labels and SDIs to show/hide, as well as decode and format the received data to be visually interpreted by the user.

## TRANSMITTER

**429** Transmits up to 12/twelve simultaneous 429 outputs. Each output is completely independent from the others and can be set to various speeds, throughput cap, output pin connection swap, parity settings and error injections.

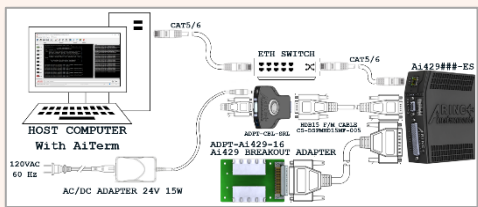
## TEST PATTERN GENERATOR

**429 UUT** Each output is equipped with three pattern generators controlling the data, label and SDI ARINC fields. When enabled, each generator can be set for fix, increment, decrement or random. The generated ARINC 429 word patterns can be transmitted at a programmed interval for testing.

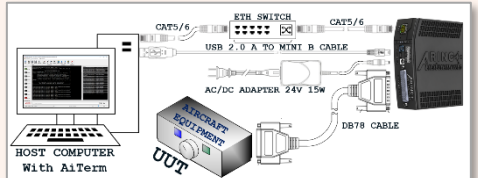
## ERROR INJECTION

**HOST** Under the host computer control, each output can inject up to seven types of errors into the output data by selectively corrupting certain transmit modulation parameters.

## GENERIC Ai429TST-ES SERIAL MODEL SETUP



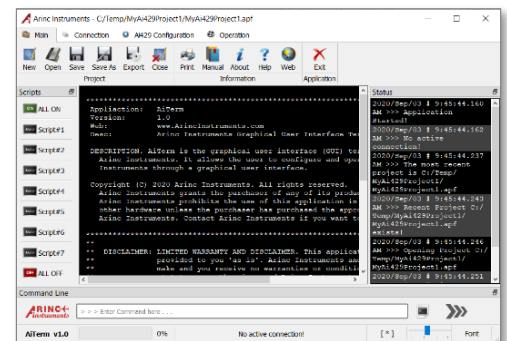
## GENERIC Ai429TST-EU USB MODEL SETUP



## FEATURE LIST

- ✓ Table top, DIN rail, panel and 1U of 19" rack mountable (3 across 19" shelf)
- ✓ Lightweight: less than 1 lbs.
- ✓ Low power: less than 4 Watts
- ✓ Up to 12/Rx & 12/Tx simultaneous ARINC 429 channels
- ✓ Maximum throughput on all channels
- ✓ Independent programmable bit rate on all transmit & receive channels
- ✓ Bridges/converts ARINC 429 bus with RS-232, RS-422, USB or Gig Ethernet
- ✓ Platform independent – no drivers
- ✓ Command line interface (CLI) console
- ✓ Compatible with terminal software such as PuTTY, TeraTerm and similar
- ✓ Human readable data stream
- ✓ Programmable time tag range, format and accuracy
- ✓ Programmable AutoResponder for special protocol (such as ACARS)
- ✓ Programmable Security Level Access
- ✓ Test pattern generator
- ✓ Cross-platform open source C/C++ software API library (Ai429API)
- ✓ Free GUI Terminal Application (AiTerm)

## FREE AiTerm GUI TERMINAL APPLICATION



## AUTORESPONDER



Some transmitters are equipped with an Autoresponder feature which monitors the corresponding receiver port for a pre-programmed trigger word. When the trigger word is received, the transmitter automatically sends out a pre-programmed response word. A mask register is available to pick which bits in the trigger word matters or not.

## RATE LIMITER ■ TRANSMIT SCHEDULER

The transmitter can be set to send 429 data on a preset repeating time interval of up to 16 seconds at a 1 microsecond increment resolution. This effectively sets a transmit schedule which also limits the output throughput. It thereby creates an evenly spaced/distributed 429 data output.

## MONITORING & BUILT-IN-TEST

All ports generate status, warnings, errors and sometimes diagnostic information (when enabled) that can be observed for analysis and troubleshooting. Any port can be mirrored to the host computer for observation.

## TIME STAMP

All data & status going to the host PC can be optionally time tagged in one of three modes (message count, elapsed, delta time) and in two formats (raw hex or decoded). Timing resolution can be from one second to one microsecond with ranges spanning from seconds to years. See sample time stamps below.

```
RAW: [FFFFFFFFFFFFFFFF]
MESSAGE COUNT: [99 999 999 999 999]
DELTA/ELAPSED: [99y:364d:23h:59m:59.999999s]
```

## SECURITY ACCESS LEVEL (SAL)

The Ai429 provides a hardware-level Security Access Level (SAL) resource restriction control. This feature, when enabled, restricts the host computer from certain pre-selected internal resources – preventing test script/software from inadvertently modifying internally restricted settings. An error message is returned when a prohibited access is attempted as shown below.

```
[05.857s] Host Err "Access Denied Error!"
```

## CONNECTIVITY

The Ai429 is cross-platform. It uses existing Ethernet, RS-232, RS-422 or USB ports for connectivity. To achieve the cross-platform compatibility, the device communicates strictly in structured ASCII texts.

## SOFTWARE & USAGE ACCESS METHODS

In order to make use of the Ai429 device, the user must do three things: configure the system, optionally send and/or receive status/data. Sending or receiving is not possible without first configuring the system.

There are four access methods to the **Ai429**: Graphical User Interface (GUI), Command Line Interface (CLI), Script and Application Programming Interface (API). The Software connects through any one of the available connection methods. **Software is optional and free.** User can take the API sample source codes and expand it to meet their own applications. Various sample scripts are also provided.

### GRAPHICAL USER INTERFACE (GUI) ACCESS METHOD

The AiTerm GUI application allows easy configuration and usage without leaning the commands. GUI interface sits on top of console, interpreting and passing data. The GUI presents the system as a simple block diagram that intuitively guides the user through the setup and usage with minimal understanding.

### COMMAND LINE INTERFACE (CLI) ACCESS METHOD

The **Ai429** device allows basic platform independent command line interface with fully decoded and human readable ASCII data. Any console/terminal program capable of accessing either the LAN and/or the serial port will work (Putty, TeraTerm, etc...). This method can be used on any platform. User receives a prompt, types a command, sees responses, status and data streams. The command line data structured is as follows:

```
<Time Stamp> <Port> <Message Type> <Data/Message Text>
```

#### Some command line interface samples (prompt, acknowledge, info & error)

```
[25m:05.888s] Host      Ai429\>_
[21m:38.867s] A429/Rx10 Ack    "Command Acknowledged!"
[35m:56.785s] A429/Tx04 Info   "FIFO Update: = 0000"
[49m:41.092s] Host      Err    "Access Denied Error!"
```

### SCRIPT ACCESS METHOD

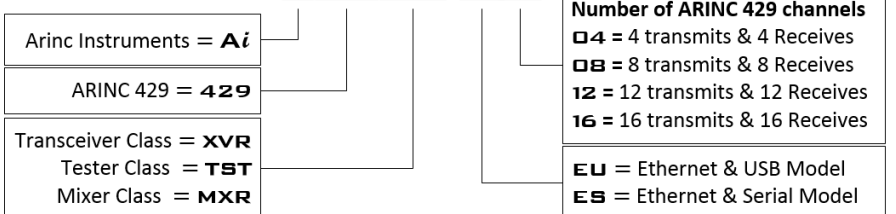
The Ai429 device allows platform independent standard script access. Any scripting language capable of accessing either the LAN and/or the serial port will work (Python, PowerShell, etc...). Through scripting, the user can create platform independent tests sequences.

### APPLICATION PROGRAMMING INTERFACE (API) ACCESS METHOD

An open source API library (Ai429API) provides full platform independent functional access for (C/C++) application development. When using the API access method, the Ai429 goes into a "Raw" communication mode which increases the communication throughput by using a compact data structure.

## Part Numbering Format

### Ai429MXR-EU16



## Ai429TST-#### Tester Class Feature Comparison Table

	ES04	EU04	ES08	EU08	ES12	EU12	ES16	EU16
Receive / Transmit	4/4	4/4	8/8	8/8	12/12	12/12	-	-
Primary Host Port	ETHERNET							
Secondary Host Port	SERIAL	USB	SERIAL	USB	SERIAL	USB	-	-
Transmit Buffer	2048	2048	2048	2048	1024	1024	-	-
Switch / Hub / Filter	No	No	No	No	No	No	-	-
Pattern Generator	Yes	Yes	Yes	Yes	Yes	Yes	-	-
AutoResponder	Yes	Yes	Yes	Yes	Yes	Yes	-	-
Error Injection	Yes	Yes	Yes	Yes	Yes	Yes	-	-

# Ai429TST VERSUS COMPETITORS PRODUCT COMPARISON TABLE

Receiver ■ Transmitter	Ai429MXR	Ai429TST	Ai429XCV	Market
Receive & transmit ARINC 429 data words at High/Low/user defined speeds	✓	✓	✓	✓
Receive & transmit even, odd or no data parity on a per-port basis	✓	✓	✓	✓
Auto detect/select incoming & outgoing data speed (high, low, others)	✓	✓	✓	✗
Enable/disable speed negotiation on a per-port basis	✓	✓	✓	✗
Enable/disable port's connection pins swap on a per-port basis	✓	✓	✓	✗
Seven types of error injection available on a per-port basis	✓	✓	✗	✗
<b>Switcher ■ Filter ■ Multiplexer ■ Demultiplexer ■ Repeater</b>				
Port to port data routing/blocking/switching via Port, Label & SDI filter tables	✓	✗	✗	✗
Multiplex data words from multiple sources based on Port, Label & SDI	✓	✗	✗	✗
Demultiplex data words to multiple outputs based on Port, Label & SDI	✓	✗	✗	✗
<b>Time Stamp</b>				
Optional & configurable 64-bit real-time data time tag with accuracy of one microsecond.	✓	✓	✓	✓
<b>Test Pattern Generator</b>				
Independent ARINC data, Label & SDI pattern generators per transmit port	✓	✓	✗	✗
Optional user defined preloaded test data patterns on a per-port basis	✓	✗	✗	✗
<b>AutoResponder</b>				
Auto-respond to pre-programmed ARINC 429 trigger words	✓	✓	✓	✗
<b>Rate Limiter ■ Transmit Scheduler</b>				
Programmable maximum transmit bandwidth on a per-port basis	✓	✓	✓	✓
<b>Built-in-Test ■ Throughput Analysis</b>				
Internal Analog & Digital loopback test	✓	✓	✓	✓
Real-time port data throughput analysis on a per-port basis	✓	✓	✓	✗
<b>Monitoring</b>				
View of accepted vs. rejected statistics on a per-port basis	✓	✓	✓	✗
View & filter port's errors, warnings & status on a per-port basis	✓	✓	✓	✗
Provides message troubleshooting access	✓	✓	✓	✗
Allows mirrored Ports for monitoring on a per-port basis	✓	✓	✓	✗
<b>Management Features</b>				
Easy access to system's information	✓	✓	✓	✗
Modify transmit ports' forwarding/routing/filter tables	✓	✗	✗	✗
<b>Virtual ARINC 429 Bus</b>				
Setup virtual isolation between ARINC 429 buses/ports groups from the command line	✓	✗	✗	✗
<b>Security</b>				
Programmable Security Access Level (SAL) for internal resource restriction controls	✓	✓	✓	✗
<b>Connectivity</b>				
Connect ARINC 429 devices together in a 10/100/1000based-T Network	✓	✓	✓	✓
Connect ARINC 429 devices together in an USB (v2.0) - (USB Models)	✓	✓	✓	✓
Connect ARINC 429 devices together in a RS-232/RS-422 serial bus - (Serial Models)	✓	✓	✓	✗
<b>Access Methods</b>				
Cross-platform Gig Ethernet TELNET, TCP/IP or raw command-line interface access	✓	✓	✓	✗
Cross-platform Serial RS-232/RS-422 or USB command-line interface	✓	✓	✓	✗
Cross-platform Graphical User Interface (GUI) terminal application (AiTerm)	✓	✓	✓	✗
Cross-platform open source Application Programming Interface (Ai429API) in C/C++	✓	✓	✓	✗
Cross-platform access with any standard scripting language capable of accessing the serial ports or the LAN: PowerShell, Python, Bash, Ruby Rails, Perl, Go, AutoIT, etc...	✓	✓	✓	✗

## SPECIFICATIONS

### ARINC 429 Receive Channels

- Number of channels: 4, 8, 12 up to 16
- Standard Data Rates: 12.5k, 100k & auto detect
- Non-Standard Data Rates: 50 bps to 115 kbps auto detected
- Standard input levels:  $\pm 6.5$  to  $\pm 13$  vdc (A to B)
- Parity: odd, even or none
- Error Detection: Parity and Data Rate.

### ARINC 429 Transmit Channels

- Number of channels: 4, 8, 12 up to 16
- Standard Data rates: 12.5k and 100k
- Non-Standard Data Rates: 50 bps to 115 kbps programmable.
- Standard output levels:  $\pm 11$ vdc (A to B)
- Parity: odd, even or none
- Slew Rate: Automatic slew rate adjustment
- Error injection: Parity, Pin Swap, Bit Count, Word Gap, Data Rate, Duty Cycle & Slew Rate

### Serial Model's Control Port

- Control Port is DB15HD & can change bus type
- Bus: EIA/RS-232
  - Data rate: 50 bauds to 1M baud
  - Flow control: software, hardware or none
- Bus: EIA/RS-422 full duplex
  - Data rate: 50 to 1M bauds
  - Flow control: software or none
- Configuration Strap: four pins are used as configuration straps to choose between modes and PC connectivity.

### USB Model's Control Port

- Bus: USB 2.0 (micro USB connector)
- Power: 2x5.5 mm power barrel jack connector
- Configuration Strap: Hex Rotary Switch

### Ethernet Port

- Bus: 10/100/1000b-T Ethernet full duplex
- Protocol: Raw, TCP/IP Client/Server, with support for DHCP

### Status Indicators

- Tri-color System Status LED
- Tri-color Interface Status LED

### Software / Firmware Interface

- Standard Command Line Interface (CLI)
- Open Source Graphical User Interface (GUI)
- Open Source High-level Software Application Programming Interface (API)
- Script Interface

### Mechanical

- Dimension: 5.8" x 1.7" x 5.4"
- Weight: 1 lbs. max
- Mounting option:
  - Optimal table mount removable Rubber Feet
  - Standard DIN rail adapter
  - Standard 19" 1U rack mount (3 across shelf)
  - Standard Panel Mount

### Environmental

- Storage:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Operating:  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$

### Power

- Voltage: +10 to +36 VDC
- Power: 4 Watts max.

## Ordering Information

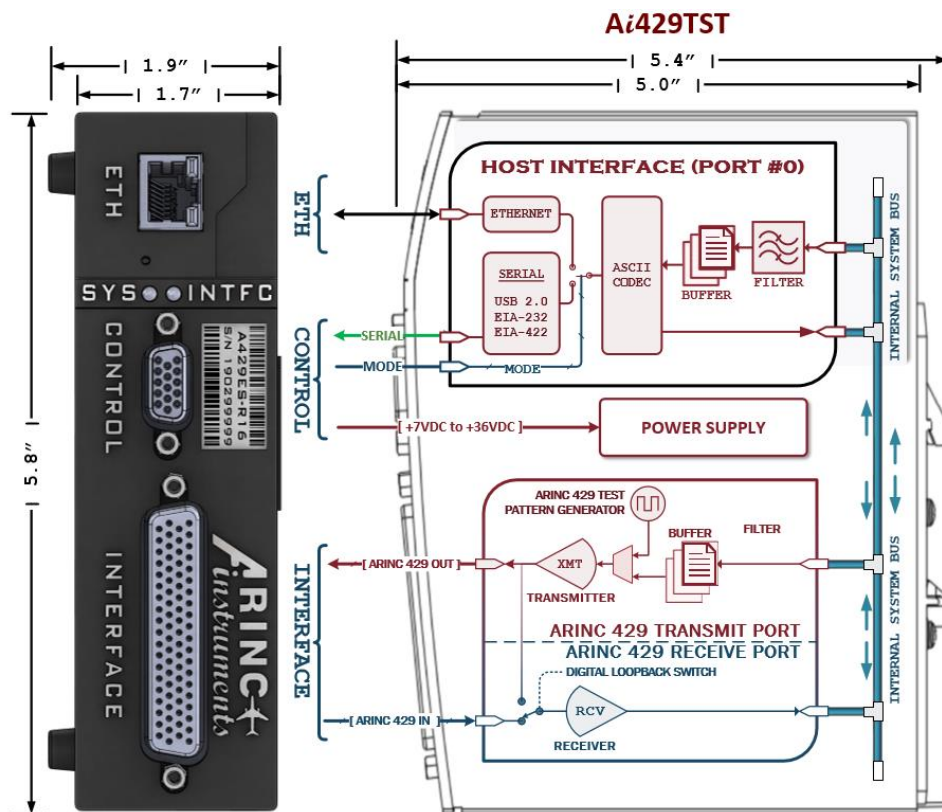
Part Number	Description
Ai429TST-ES04	4Tx/4Rx channels ARINC 429 tester class, RS-232/422 serial model, Gig Ethernet
Ai429TST-EU04	4Tx/4Rx channels ARINC 429 tester class, USB serial model, Gig Ethernet
Ai429TST-ES08	8Tx/8Rx channels ARINC 429 tester class, RS-232/422 serial model, Gig Ethernet
Ai429TST-EU08	8Tx/8Rx channels ARINC 429 tester class, USB serial model, Gig Ethernet
Ai429TST-ES12	12Tx/12Rx channels ARINC 429 tester class, RS-232/422 serial model, Gig Ethernet
Ai429TST-EU12	12Tx/12Rx channels ARINC 429 tester class, USB serial model, Gig Ethernet
AiTerm-Win	(Free) Arinc Instruments Terminal Application for Windows platform
AiTerm-Lnx	(Free) Arinc Instruments Terminal Application for Linux platform
AiTerm-Mac	(Free) Arinc Instruments Terminal Application for Mac OS platform
Ai429API	(Free) Cross-platform open source Application Programming Interface C/C++.
ADP-CBL-SRL	Control Port Cable Adapter for Serial Models (RS-232/422, power & configuration)
ADP-INTFC-Ai429-16	Ai429 16 Ports Interface Breakout Adapter



SERIAL MODEL



USB MODEL



SPARK OF INGENUITY

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