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## 58.1 ARINC-429 overview

ARINC-429 is the standard for the predominant avionics data bus used on most high-end commercial and transport aircraft.

Connected to the busses is a transmitter (source), a receiver (sink), or a transmitter and receiver (see the following figure). All data is transmitted over a single, twisted pair in one direction only.

**NOTE:** The first revision of the ARINC-429 mark 33 Digital Information Transfer System (DITS) was generated on 11 April 1978. The current specification is ARINC-429-10.

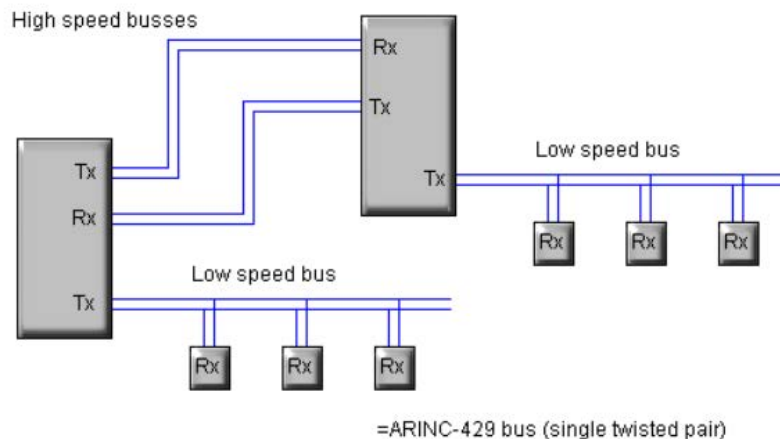


Figure 58-1: An example of ARINC-429 architecture

A transmitter (Tx) may transmit to up to 20 Receivers (Rx). If an Rx is required to acknowledge reception of data, another ARINC-429 Tx is required in the opposite direction.

Data is sent in single words identified by one of 255 Labels and a two-bit source/destination identifier.

### 58.1.1 Physical layer

Data is transmitted in a bipolar Return-to-Zero (RZ) format. This is a trilevel code (see the following figure).

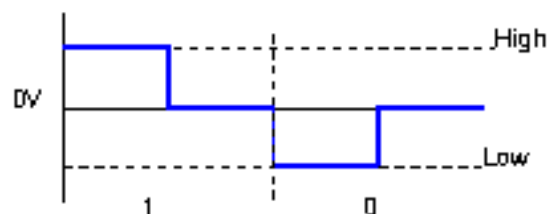


Figure 58-2: ARINC-429's bipolar, RZ code

For a Tx, the high (low) voltage must be +10V ±10% (-10V ±10%). A receiver must be specified to a minimum level of ±5V. The Tx output impedance is 75Ω (±5Ω) and a suitable 75Ω cable should be used.

Typically, there are two bit-rates: the high speed bus is 100 kbps and the low speed bus is between 12 and 14.5 kbps. Only one data rate is allowed per bus.

ARINC-429 also specifies the data rate tolerances and rise and fall times.

### 58.1.2 Word definition

The following figure illustrates the generic format of an ARINC-429 word.

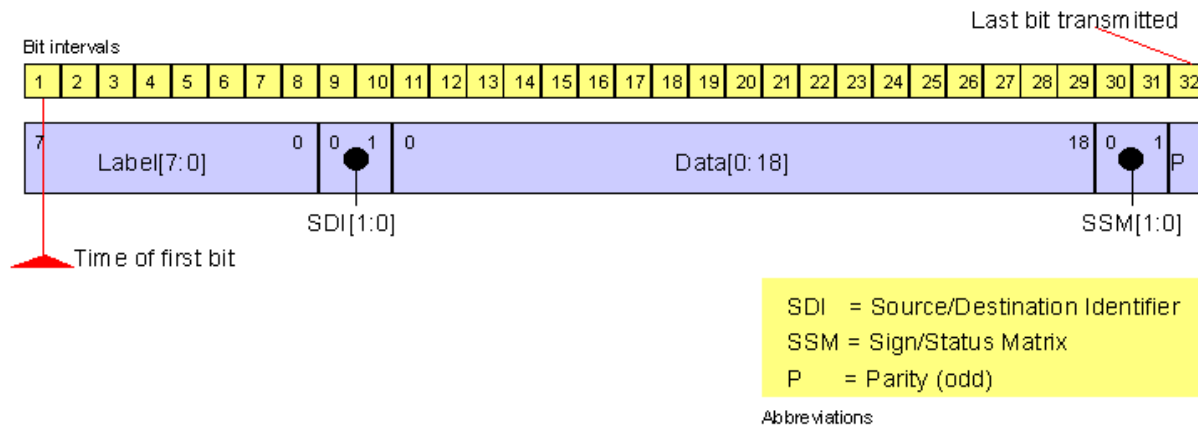


Figure 58-3: Generic word definition for ARINC-429

As shown in the previous figure, the eight-bit Label identifies the parameter being transmitted.

The main purpose of the Source/Destination Identifier (SDI) bits are to direct data words to a particular Rx. The SDI bits are not used with certain types of data.

The Sign/Status Matrix (SSM) bits are used to indicate plus or minus, north, south, east or west and so on for certain types of data, the word type for AIM (Acknowledge, ISO alphabet No. 5 and Maintenance) data and the status of the Tx. For binary data, bit 29 (Data18) is used to indicate sign.

There are five types of data words:

- Binary
- BCD subset of ISO Alphabet No. 5
- Discrete
- Maintenance
- AIM

Also, file transfer is supported.

## 58.2 Module overview

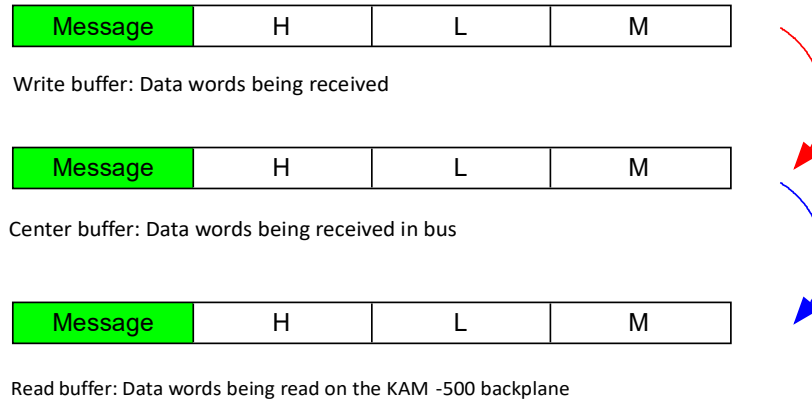
The AXN/ABM/401 is a 24-channel ARINC-429 bus monitor, which can parse and/or packetize each channel at the same time. It can coherently parse traffic and tags for up to 24575 messages and it can transmit aperiodically packetized ARINC-429 messages including tags as iNET-X parser-aligned, Chapter 10, IENA D Type, or IENA N Type payload structures per channel or per instrument.

The sections below show screen shots and descriptions of settings in DAS Studio 3 software. DAS Studio 3 is used to create a configuration, which contains the various elements which make up your data acquisition system. You then use this configuration file to manage and program these elements. To see how hardware is represented in the DAS Studio 3 graphical user interface, see Figure 1 in the DAS Studio 3 User Manual.

## 58.3 Parser operation

### 58.3.1 How parsing works

Like other Curtiss-Wright bus monitors, the AXN/ABM/401 uses a triple buffer for parsing. The following figure illustrates the triple buffering of data words (green) and message tags (white) used for each bus in the AXN/ABM/401's parser.



*Figure 58-4: Triple buffering of traffic and associated message tags*

Message corresponds to MessageDataStyle as described in the module data sheet.

The time tags H, L, M correspond to High time, Low time and Micro time, which is the time at the end of the first transmitted bit. It has a 1-µsec resolution.

The way triple buffering works is as follows:

Time message tags are added to each message received and stored in separate buffers for each of the busses. As soon as a message is received with no errors, the contents of the write buffer is transferred to the center buffer. If the data in the center buffer has not been transferred to a read buffer, a skipped flag is set.

As soon as the last parameter of interest has been read from the buffer being read by the backplane (read buffer), the contents of the center buffer (if new) are transferred to the read buffer. If no new data word has been received, the stale flag is set. A center and read buffer exist for every message ID (parser slot). Skipped and stale bits can be found in the Message Info register to indicate whether messages have been lost or repeated (undersampling or oversampling situations).

A Message Count register is also available as additional information and can be added from DAS Studio's ARINC-429 Builder application as explained in section Defining parsing rules. For further information regarding this register, refer to the AXN/ABM/401 data sheet.

### 58.3.2 Module Settings tab

**NOTE:** To view the screen shots shown in this section in DAS Studio 3, ensure the AXN/ABM/401 module is in context and the Settings tab is selected.

Before using the module, you need to define the Parity Check.

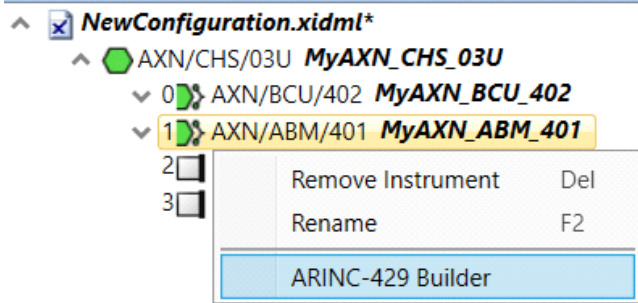
Setting	Description
Parity Check Parity Check ▾ Not checked ▾ Odd Even Not checked	Parity settings configures whether parity bit is present in incoming data. It can be set to Not checked, Even Parity, or Odd Parity. Not checked means the parity bit in the ARINC-429 message parser/packetizer is not checked. Odd Parity/Even Parity means the parity bit in the ARINC-429 message is checked against the bits received. If there's a parity error, the REPORT word reports it and the error code is set accordingly in the packetizer packet.

The module will automatically detect the ARINC-429 signaling rate which can be either 12.5, 50, or 100 kbps.

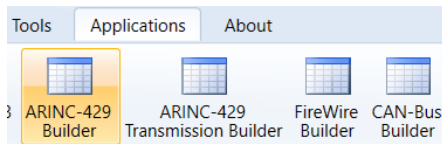
### 58.3.3 Defining parsing rules

After you have all channel settings configured, refer to the following to define rules to identify messages.

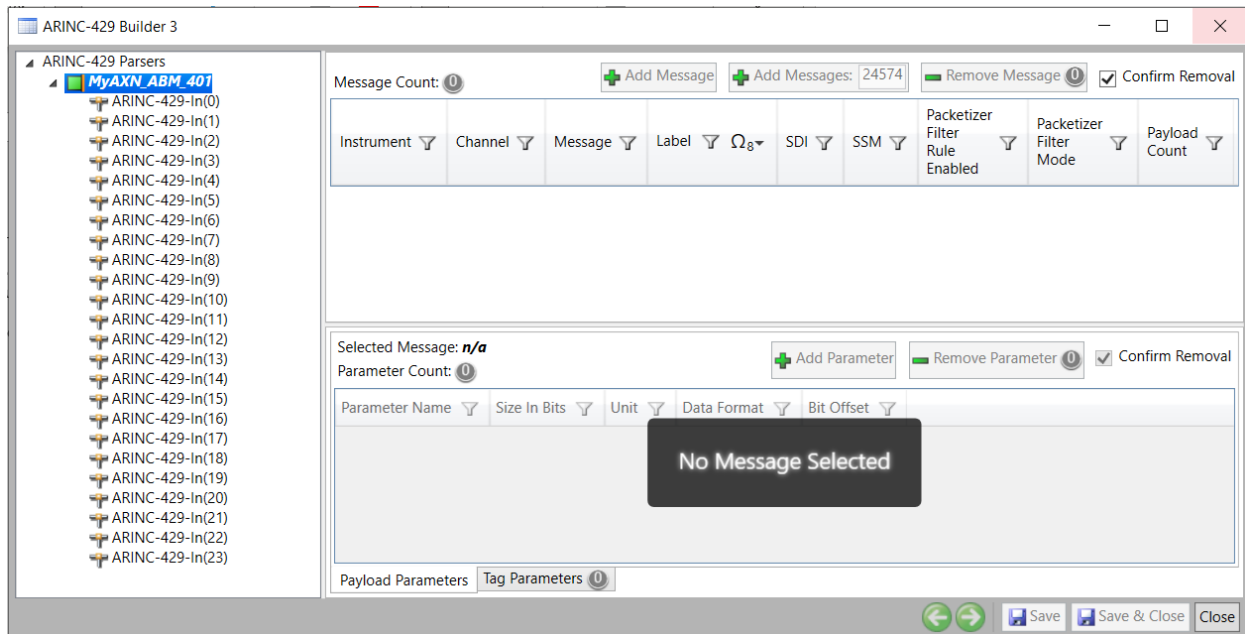
- Do one of the following.
  - In the Navigator, right-click the AXN/ABM/401 module and then click **ARINC-429 Builder**.



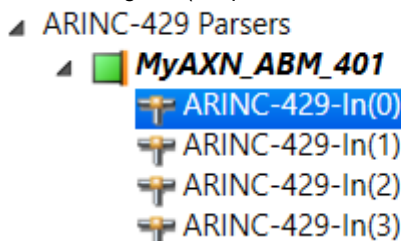
- On the **Applications** menu click **ARINC-429 Builder**.



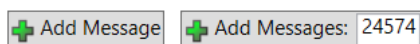
The **ARINC-429 Builder** application opens.



- In the Navigator (left pane of Builder application), select the channel on the AXN/ABM/401 that you want to parse data off.



- Click **Add Message** to add a single message. To add multiple messages (up to 8191), click **Add Messages** (typing the number of packages in the field).



Now you must define the rules to identify or parse the desired message.

4. Define **Label**.

The default is **Octal** as indicated by  $\Omega_8$ . Values can be from **0** to **255** in decimal.

Label	$\Omega_8$	SDI	SSM
0	All	All	

5. Define **SDI** and **SSM**.

These can be either **All**, **00**, **01**, **10** or **01**. **All** being the wildcard.

6. Click **Add Message** to add the message.

When the message is added, ARINC-429 Builder automatically creates a 32-bit parameter.

The screenshot shows the ARINC-429 Builder interface. At the top, there are buttons for '+ Add Message', '+ Add Messages: 24573', '- Remove Message', and a checked 'Confirm Removal' box. Below this is a table with columns: Instrument, Channel, Message, Label,  $\Omega_8$ , SDI, SSM, Packetizer Filter Rule Enabled, Packetizer Filter Mode, and Payload Count. A row is highlighted with 'MyAXN\_ABM\_401', 'ARINC-429-In(0)', 'MyARINC-429Message', '0', 'All', 'All', an unchecked checkbox, 'Pass All', and a green arrow icon. Below the table, it says 'Selected Message: MyARINC-429Message' and 'Parameter Count: 1'. There are buttons for '+ Add Parameter', '- Remove Parameter', and a checked 'Confirm Removal' box. At the bottom, a parameter table is shown with columns: Parameter Name, Size In Bits, Unit, Data Format, and Bit Offset. A row is highlighted with 'MyARINC-429Message.MyParameter', '32', 'BitVector', 'BitVector', and '0'.

Although the parameter has 32 bits, it has a different layout than the 32-bit ARINC-429 message defined in "58.1 ARINC-429 overview" on page 1. This is because the message is parsed using the label; the parameter itself doesn't contain the label.

7. Select the **Packetizer Filter Rule Enabled** check box to allow the messages to be either Blocked or Passed in the packetizer (depending on the channel Packetizer Filter Mode set in the setting tab) when they meet the packetizer filtering condition referenced by this process.

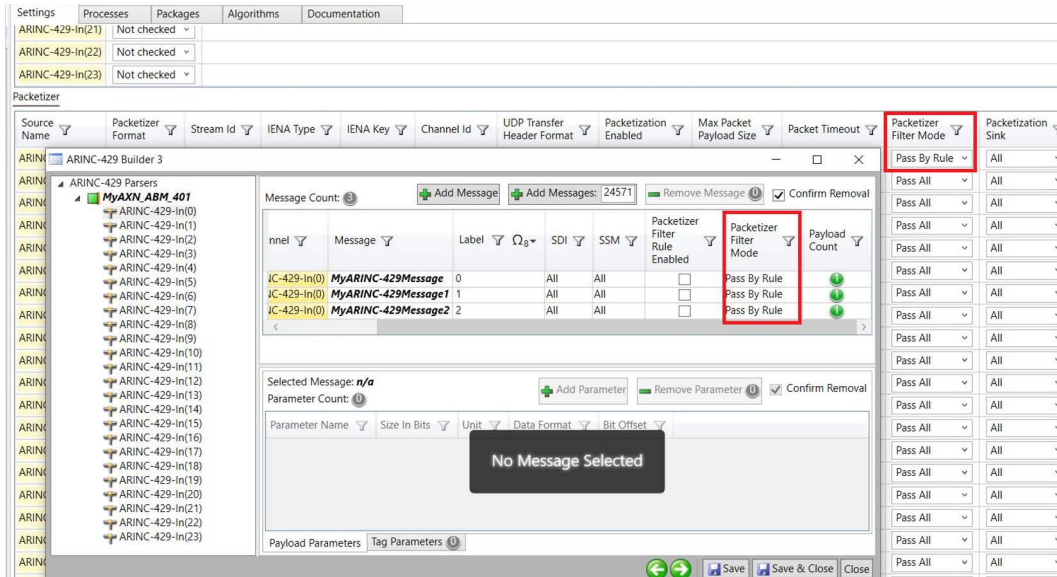
**NOTE:** **Packetizer Filter Rule Enabled** and **Packetizer Filter Mode** are only applicable when Packetization is enabled.

8. Specify the **Packetizer Filter Mode**:

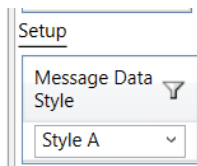
- **Block By Rule** means that messages that match defined filter rules are blocked and all other messages are passed through in the packetizer.
- **Pass By Rule** means that messages that match defined filter rules are passed through and all other messages are blocked in the packetizer.
- **Pass All** means that all messages are passed through the packetizer.

In Packetization/Combined mode, the filtering rules from individual channels are applied to the combined packetizer output.

Packetizer Filter Mode is a channel setting; this field must be set to the same rules in both the Settings tab and ARINC-429 Builder. To avoid a discrepancy between ARINC-429 Builder and the channel settings, DAS Studio automatically changes Packetizer Filter Mode for all messages in the same channel and in the Settings tab as shown in the following example.



9. Click **Save & Close** to save your changes and close **ARINC-429 Builder**.
10. With AXN/ABM/401 selected, click the **Settings** tab.
11. To program Message Data Style, click the **Message Data Style** drop-down arrow and choose **Style A** or **Style B**.



Style A = MessageDataStyleA and is defined as:

- R[31:0]
- R[31:30] SSM - Sign/Status Matrix.
- R[29:11] Data - Data Word.
- R[10:9] SDI - Source Destination Identifier.
- R(8) Empty - This parser slot has not been written to yet.
- R(7) Stale - This parser slot has been read before.
- R(6) Skipped - This parser slot has been overwritten without being read.
- R[5:1] Bus - The bus the message was received on.
- R(0) Parity - The parity bit received.

**NOTE:** MessageDataStyleA is the default style

Style B = MessageDataStyleB (see MessageStyleB) and is defined as:

- R[31:0]
- R(31) Parity - The parity bit received.
- R[30:29] SSM - Sign/Status Matrix.
- R[28:20] Data[18:10] - Bits 18 to 10 of the Data Word.
- R[19:17] Bus - The bus the message was received on (3 least significant bits only).
- R(16) Reserved
- R[15:6] Data[9:0] - Bits 9 to 0 of the Data Word.

- R[5:4] SDI - Source Destination Identifier.
- R(3) Empty - This parser slot has not been written to yet.
- R(2) Stale - This parser slot has been read before.
- R(1) Skipped - This parser slot has been overwritten without being read.
- R(0) Reserved

Messages are saved to the configuration file and parameters become available to be placed to any sinks in the chassis such as a PCM stream or placed packet.

**NOTE:** Tags such as Message Time and Message Count can be enabled on the Tag Parameters tab of the ARINC-429 Builder as shown in the following figure. The tags are described in the AXN/ABM/401 data sheet.

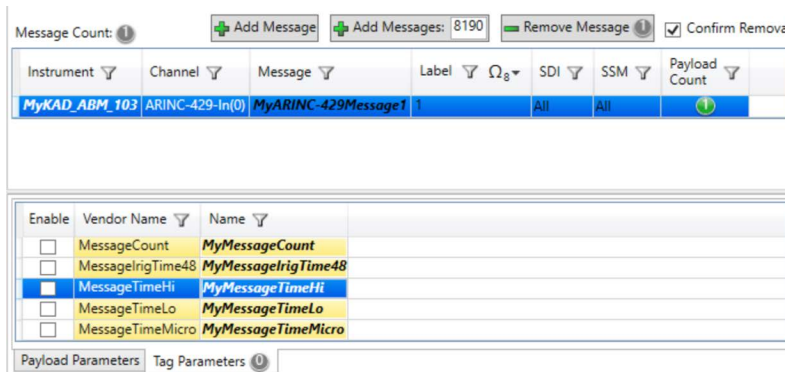


Figure 58-5: Tag Parameters tab

## 58.4 Packetizer operation

Independently of the parser, a packetizer stream can be generated for each channel or per instrument. All received ARINC-429 messages are encapsulated in an iNET-X parser-aligned, Chapter 10, or IENA Type N/D payload structure. A block header attached to each sequence stores the channel index, length, and the time each message is received. These parser-aligned packets may be transmitted aperiodically to optimize network bandwidth utilization and memory usage when recording ARINC-429 traffic.

There are many settings available to configure or tune packetizer behavior.

**NOTE:** To view the screen shots shown in this section in DAS Studio 3, ensure the AXN/ABM/401 module is in context and the Settings tab is selected.

The Packetizer Format settings are shown in the following figure.

Options: iNET-X, IENA or Chapter 10.

Source Name	Packetizer Format	Stream Id	IENA Type	IENA Key	Packetization Enabled	Packet Size	Packet Timeout	Utilization	Packetization Sink
ARINC-429-In(0)	iNET-X	FFFFFFF	N/A	0	<input type="checkbox"/>	511	50	1.00	All
ARINC-429-In(1)	iNET-X	FFFFFFF	N/A	0	<input type="checkbox"/>	511	50	1.00	All
ARINC-429-In(2)	iNET-X	FFFFFFF	N/A	0	<input type="checkbox"/>	511	50	1.00	All
ARINC-429-In(3)	iNET-X	FFFFFFF	N/A	0	<input type="checkbox"/>	511	50	1.00	All

Figure 58-6: Packetizer Format settings

**NOTE:** DAS Studio automatically creates packetizer packets on the aperiodic transmitter (such as the AXN/BCU/402). The packet rate is always 1 Hz but this value is only required for XidML. This value is not used by AXN hardware.

Instrument Name	Channel Name	Bit Rate	Connection Name	Connected Instrument	Connected Channel	Package Count
MyAXN_BCU_402_C	Ethernet(1)	n/a	MyAXN_CHS_03U_Packetizing			1
MyAXN_BCU_402_C	Ethernet(2)	n/a	MyAXN_CHS_03U_1_Packetizing			1

Name	Rate (Hz)	Type	Sub Type	Stream ID	Source IPA	Source UDP Port	Destination MAC	Destination IPA	Destination UDP Port	Data Type	Size In Bytes
AXNABM401_1	1	iNet-X	Parser aligned	1	192.168.28.1	1023	01-00-5E-00-01-64	235.0.1.100	8010	ARINC-429	n/a

### 58.4.1 Packetizer format: iNET-X

When iNET-X packetizer format is selected, the following fields are enabled.

Source Name	Packetizer Format	Stream Id	IENA Type	IENA Key	Channel Id	UDP Transfer Header Format	Packetization Enabled	Max Packet Payload Size	Packet Timeout	Packetizer Filter Mode	Packetization Sink
ARINC-429-In(0)	iNET-X	FFFFFFF	N/A	0	FFFF	N/A	<input type="checkbox"/>	511	50	Pass All	All
ARINC-429-In(1)	iNET-X	FFFFFFF	N/A	0	FFFF	N/A	<input type="checkbox"/>	511	50	Pass All	All
ARINC-429-In(2)	iNET-X	FFFFFFF	N/A	0	FFFF	N/A	<input type="checkbox"/>	511	50	Pass All	All
ARINC-429-In(3)	iNET-X	FFFFFFF	N/A	0	FFFF	N/A	<input type="checkbox"/>	511	50	Pass All	All

Setting	Description
Stream ID	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is only active when the Packetizer Format is set to iNET-X.
Packetization Enabled	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. DAS Studio automatically creates a packetizer packet after verification/programming.
Max Packet Payload Size	The number of words in the packet buffer; ranges from 200 words to 511 words. The default value is 511 words; reducing this value results in smaller and therefore generally more frequent packets.
Packet Timeout	Generates a packet when the oldest data recorded is this old (ms). Reducing this value results in more frequent and generally smaller packets. Increasing the value results in less frequent, but generally bigger packets.
Packetizer Filter Mode	Specifies the filtering mode for the channel: Block By Rule means that messages that match defined filter rules are blocked and all other messages are passed through. Pass By Rule means that messages that match defined filter rules are passed through and all other messages are blocked. Pass All means that all messages are passed through. This is only applicable when Packetization is enabled. In Packetization/Combined mode, the filtering rules from individual channels are applied to the combined packetizer output.
Packetization Sink	Selects which modules the packetizer package is sent to for transmission or storage. The choices are <b>Controller Only</b> , <b>All</b> (slots), or a slot in which a sink module supports packetizer logging.

For further information regarding iNET-X parser aligned packets used by the packetizer, refer to *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

To turn on packetizer operation on any channel, define a unique stream ID for that channel and then select the **Packetization Enabled** check box for that channel as shown in the following figure. The packetizer is enabled the next time the module is programmed.



Source Name	Packetizer Format	Stream Id	IENA Type	IENA Key	Channel Id	UDP Transfer Header Format	Packetization Enabled
<b>MyAXN_ABM_401.MyARINC-429-In(0)Link</b>	iNET-X	1	N/A	0	FFFF	N/A	<input checked="" type="checkbox"/>
ARINC-429-In(1)	iNET-X	2	N/A	0	FFFF	N/A	<input checked="" type="checkbox"/>
ARINC-429-In(2)	iNET-X	3	N/A	0	FFFF	N/A	<input checked="" type="checkbox"/>

Figure 58-7: Packetization Enabled setting

### 58.4.2 Packetizer format: Chapter 10

When Chapter 10 packetizer format is selected, the following fields are enabled.

Source Name	Packetizer Format	Stream Id	IENA Type	IENA Key	Channel Id	UDP Transfer Header Format	Packetization Enabled	Max Packet Payload Size	Packet Timeout	Packetizer Filter Mode	Packetization Sink
ARINC-429-In(0)	Chapter 10	FFFFFFF	N/A	0	1	Format 1	<input checked="" type="checkbox"/>	511	50	Pass All	All
ARINC-429-In(1)	Chapter 10	FFFFFFF	N/A	0	2	Format 1	<input checked="" type="checkbox"/>	511	50	Pass All	All
ARINC-429-In(2)	Chapter 10	FFFFFFF	N/A	0	3	Format 1	<input checked="" type="checkbox"/>	511	50	Pass All	All

Setting	Description
Channel ID	Chapter 10 channel ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is only active when the Packetizer Format is set to Chapter 10.
UDP Transfer Header Format	UDP Transfer Header Format used to wrap Chapter 10 packets for streaming. The module only supports Format 1.
Packetization Enabled	Enables the transmission of a packetizer packet containing the contents of this channel if an aperiodic transmitter is present in the chassis. DAS Studio automatically creates a Chapter 10 packetizer packet after verification/programming.
Max Packet Payload Size	The number of words in the packet buffer; ranges from 200 words to 511 words. The default value is 511 words; reducing this value results in smaller and therefore generally more frequent packets.
Packet Timeout	Generates a packet when the oldest data recorded is this old (ms). Reducing this value results in more frequent and generally smaller packets. Increasing the value results in less frequent, but generally bigger packets.
Packetizer Filter Mode	Specifies the filtering mode for the channel: Block By Rule means that messages that match defined filter rules are blocked and all other messages are passed through. Pass By Rule means that messages that match defined filter rules are passed through and all other messages are blocked. Pass All means that all messages are passed through. This is only applicable when Packetization is enabled. In Packetization/Combined mode, the filtering rules from individual channels are applied to the combined packetizer output.
Packetization Sink	Selects which modules the packetizer package is sent to for transmission or storage. The choices are <b>Controller Only</b> , <b>All</b> (slots), or a slot in which a sink module supports packetizer logging.

The AXN/ABM/401 data sheet explains the Chapter 10 packetizer format generated by the module.

**NOTE:** IADS does not currently support the Chapter 10 format.

### 58.4.3 57.5.2 Packetizer format: IENA

When IENA packetizer format is selected, the following fields are enabled:

Source Name	Packetizer Format	Stream Id	IENA Type	IENA Key	Channel Id	UDP Transfer Header Format	Packetization Enabled	Max Packet Payload Size	Packet Timeout	Packetizer Filter Mode	Packetization Sink
ARINC-429-In(0)	IENA	FFFFFFF	N	0	FFFF	N/A	<input type="checkbox"/>	511	50	Pass All	All
ARINC-429-In(1)	IENA	FFFFFFF	N	0	FFFF	N/A	<input type="checkbox"/>	511	50	Pass All	All
ARINC-429-In(2)	IENA	FFFFFFF	N	0	FFFF	N/A	<input type="checkbox"/>	511	50	Pass All	All

Setting	Description
IENA Type	Describes the IENA parameter type of the packet payload: D or N. This is a conditional setting and is active when the Packetizer Format is set to IENA. Refer to the AXN/ABM/401 data sheet for a description of IENA packetizer packets.
IENA Key	IENA Key for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is active when the Packetizer Format is set to IENA.
Packetization Enabled	Enables the transmission of a packetizer packet containing the contents of this channel if an aperiodic transmitter is present in the chassis. DAS Studio automatically creates an IENA packetizer packet after verification/programming.
Max Packet Payload Size	The number of words in the packet buffer; ranges from 200 words to 511 words. The default value is 511 words; reducing this value results in smaller and therefore generally more frequent packets.
Packet Timeout	Generates a packet when the oldest data recorded is this old (ms). Reducing this value results in more frequent and generally smaller packets. Increasing the value results in less frequent, but generally bigger packets.
Packetizer Filter Mode	Specifies the filtering mode for the channel: Block By Rule means that messages that match defined filter rules are blocked and all other messages are passed through. Pass By Rule means that messages that match defined filter rules are passed through and all other messages are blocked. Pass All means that all messages are passed through. This is only applicable when Packetization is enabled. In Packetization/Combined mode, the filtering rules from individual channels are applied to the combined packetizer output.
Packetization Sink	Selects which modules the packetizer package is sent to for transmission or storage. The choices are <b>Controller Only</b> , <b>All</b> (slots), or a slot in which a sink module supports packetizer logging.

The AXN/ABM/401 data sheet explains the IENA D and N packetizer format generated by the module.

**NOTE:** IADS doesn't support these IENA formats.

### 58.4.4 Packetization Individual/Combined

Packetization ▼  
 Combined ▼

When Packetization/Combined mode is selected, messages from all busses are placed in a single stream of packets, with a single stream ID for iNET-X (respectively Key for IENA and Channel ID for Chapter 10). The bus ID field identifies on which bus a message was received.

Source Name	Packetizer Format	Stream Id	IENA Type	IENA Key	Channel Id	UDP Transfer Header Format	Packetization Enabled	Max Packet Payload Size	Packet Timeout	Packetization Sink
ARINC-429-In-Combined	iNET-X	FFFFFFF	N/A	0	FFFF	N/A	<input checked="" type="checkbox"/>	511	50	All

Using Combined is recommended if IADS is used to decom in real time and if many buses are connected to the module.

**WARNING:** Using Combined is recommended if IADS is used to decom in real time and if many buses are connected to the module.

## 58.5 MessageStyleB

MessageStyleB was specifically designed for 12 bits of PCM. From this 32-bit parameter in IRIG-106 Ch4 PCM, you can reduce bandwidth by reducing it to the most necessary information such as Parity, SSM, Data, and SDI.

When MessageStyleB is selected in the AXN/ABM/401 module Settings tab and you add parameter(s) using ARINC-429 Builder, DAS Studio 3 automatically and transparently creates 24-bit discrete parameters. These parameters are then available to be placed in the PCM as shown in the following figure.

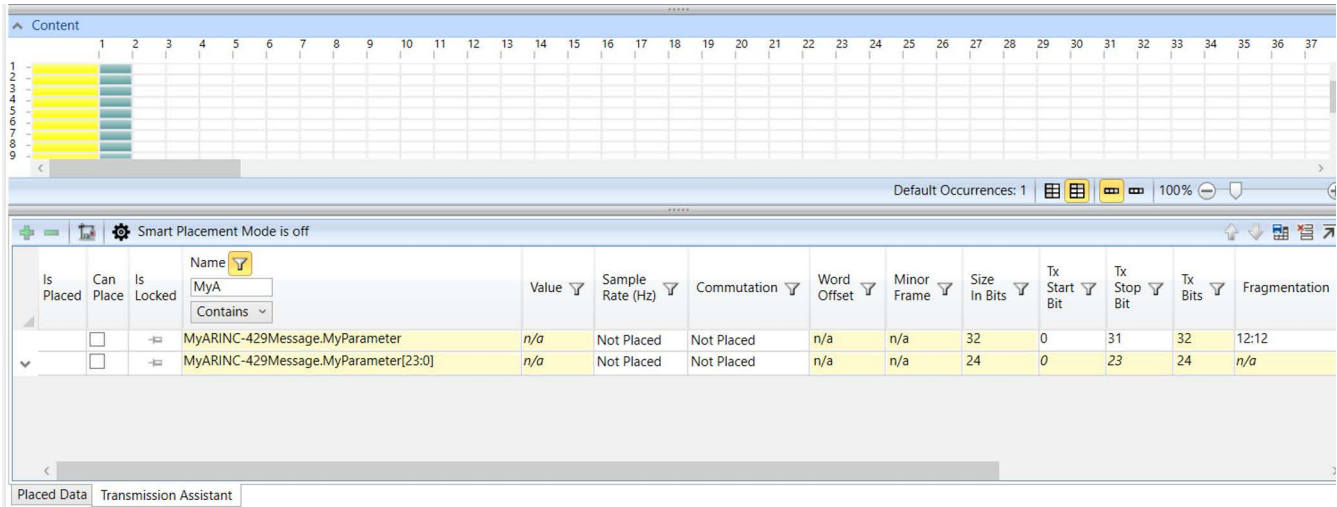


Figure 58-8: MyARINC-429Message.MyParameter[23:0] 24-bit discrete parameter

The previous figure shows the MyARINC-429Message.MyParameter[23:0] 24-bit discrete parameter. The following figure shows the bits that are used (gray bits are masked out).

	Parity	SSM		Data								Bus			R	
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

	Data											SDI	Empty	Stale	Skipped	R
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

R = Reserved

Figure 58-9: MyARINC-429Message.MyParameter[23:0] used bits

## 58.6 Troubleshooting

The common issues while parsing are:

The bus +/- is physically inverted.

The wrong bus is being parsed.

The label is defined in the ARINC-429 builder in decimal while in the ICD avionics it is defined in octal.

The BusActiveAll parameter can be monitored to help on the port where the bus is connected. The REPORT parameter can help demonstrate if there are errors on the bus. A packetizer packet can also be configured on the suspected bus to check if the module sees the ARINC-429 bus.

## 58.7 Related documentation

To better understand this paper, read the following documents.

Table 58-1: Data sheets

Document	Description
AXN/ABM/401	ARINC-429 bus monitor parser/packetizer - 24ch

Table 58-2: Technical notes

Document	Description
TEC/NOT/002	ARINC-429
TEC/NOT/063	Grounding and shielding of the Axon and Acra KAM-500
TEC/NOT/067	IENA and iNET-X packet payload formats

Table 58-3: User manual

Document	Description
DOC/MAN/030	DAS Studio 3 User Manual