ARTD-416A

¼-bridge ADC (current excitation, RTD temperature sensors, 1.5625 kHz b/w) - 16ch at 6.25 ksps

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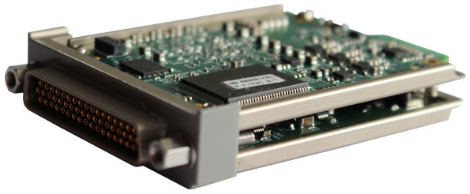

Key Features

- 16 × ¼-bridge 2 or 3-wire input channels for PT50 to PT2000 RTD sensors
- Input range -200°C to 660°C
- High accuracy (0.6°C between -50 and 250°C; 1.0°C between -200 and 660°C)
- Programmable dual range, constant current excitation per channel
- Short on any channel does not affect others
- 16-bit simultaneous sampling with three configurable output streams on each channel
- User defined linearization and compensation for errors in the entire measurement chain

Applications

- Temperature measurements with RTD sensors

Overview

The ARTD-416A provides independent excitation for up to 16 channels and is intended for RTD type sensors.

At the heart of the ARTD-416A is a hard-wired state-machine that oversamples all channels at a rate between 12.5 ksps and 25 ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, 15-tap FIR filters with output rate decimation, followed by a final FIR or IIR filter. If IIR filtering mode is selected, the last digital filter in the filtering chain is an 8th or 16th order (selectable) Butterworth filter. If FIR mode is selected, the last digital filter in the filtering chain is a 49-tap Kaiser window, Beta 6 filter.

There are three independently configurable output streams per channel, allowing different sample rate, cutoff, and filter type to be selected for each output stream.

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle, all channels are aligned.

The excitation current through the RTD is kept constant. As the resistance changes, the voltage across the RTD (and hence as seen by the amplifier) changes linearly. A 3-wire input circuit compensates for the majority of errors related to wire resistances (assuming wire resistances are the same). A 2-wire configuration is also possible, however no wire compensation takes place.

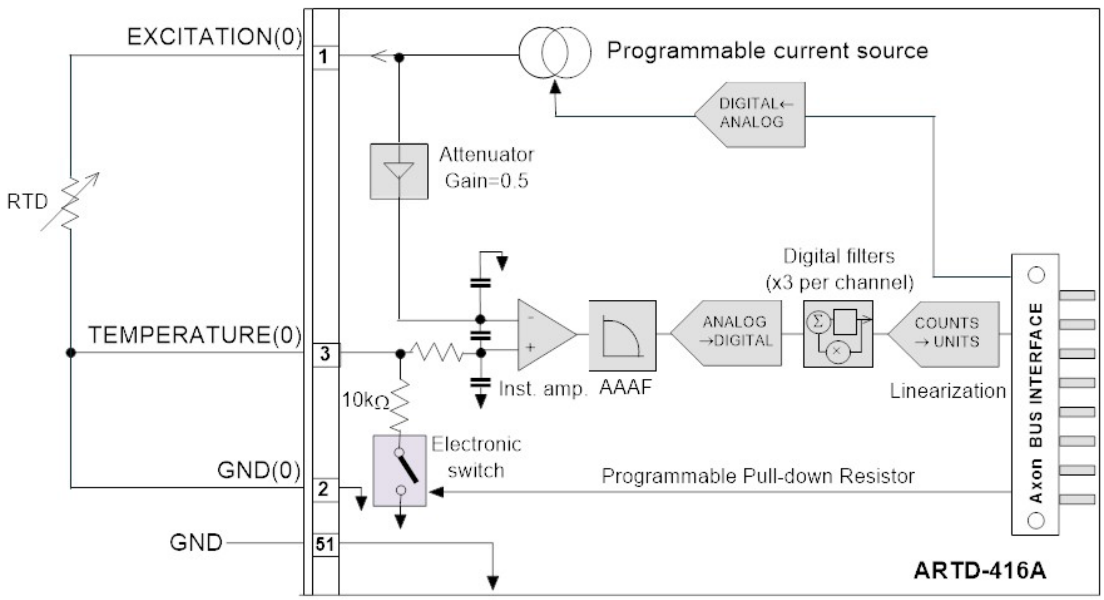

Figure 1: First of 16 channels on the ARTD-416A with RTD sensor connected in 3-wire mode

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	60	–	g	
	–	2.11	–	oz	Design metric is grams.
Height above chassis					
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Power consumption					
+15V	TBD	90	TBD	mA	
total power	TBD	1.35	TBD	W	Particular combinations of ADAU chassis and modules may have power limitations. For details, contact Curtiss-Wright support.
					See *Environmental Qualification Handbook for Axon Products*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	16	–	Applied per channel.
Output current					
operating range	0	–	2.5	mA	0A setting is to be used when channels are not used.
resolution	–	40	–	nA	For high range (amplitude setting above 0.36 mA).
resolution	–	5.8	–	nA	For low range (amplitude setting lower or equal to 0.36 mA).
compliance	0	–	1.0	V	The product of the sensor resistance and the excitation current must not exceed 0.5V (values exceeding this level will overdrive the devices inputs).
short circuit current	–	–	2.5	mA	Depends on user setting.
short circuit duration	–	–	∞	s	
DC error					
error	–	0.1	–	%FSR	Error included within channel accuracy, see DC error in "RTD inputs" on page 3.

TABLE 3	RTD inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
TEMPERATURE(x)	0.5	–	6250	sps	
Input temperature					
full scale range	-200	–	660	°C	
DC error					
for FSR of -200°C to 660°C (PT100)	–	0.4	1.0	°C	When excitation current set to 1.5 mA.
for FSR of -50°C to 250°C (PT100)	–	0.25	0.6	°C	When excitation current set to 2.5 mA.
for FSR of -200°C to 660°C (PT1000)	–	0.4	1.0	°C	When excitation current set to 0.15 mA.
for FSR of -50°C to 250°C (PT1000)	–	0.25	0.6	°C	When excitation current set to 0.25 mA.
Effective number of bits	12	–	–	bits	$0 \le f \le f_c$ (f_c: filter cutoff frequency).
Crosstalk	–	–	-72	dB	Between channels on the same module.
Analog filter					Analog filters are Butterworth.
Anti aliasing filter					
poles	–	–	6	–	
filter cutoff -3 dB	2.37	2.5	2.63	kHz	
Digital filter					For IIR8 setting of Filter Mode, digital filter is Butterworth with output sample stream decimated by 2, 4, 8, 16, 32, 64 or 128.
poles	–	–	8	–	
filter cutoff (f_c) -3 dB	0.1	–	16	f_s	The maximum value is limited to 1.5625 kHz (f_s : sampling frequency). See Filter Cutoff settings in the Instrument settings table on page 6.
0.1 dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1 dB band	–	–	-80	dB	Meets specification for Filter Cutoff settings lower than or equal to 1/4.
aliasing to f_c	–	–	-80	dB	Meets specification for Filter Cutoff settings lower than or equal to 1/4.
Filter delay	1.99	2.0	2.01	ms	Measured for $f_{in} = f_c = f_s / 4 = 1$ kHz (f_{in} : input signal frequency).
Digital filter					For IIR16 setting of Filter Mode, digital filter is Butterworth with output sample stream decimated by 2, 4, 8, 16, 32, 64 or 128.
poles	–	–	16	–	
filter cutoff (f_c) -3 dB	0.1	–	16	f_s	The maximum value is limited to 1.5625 kHz. See Filter Cutoff settings in the Instrument settings table on page 6.
0.1 dB bandwidth	–	0.9	–	f_c	
aliasing to 0.1 dB band	–	–	-80	dB	Meets specification for Filter Cutoff settings lower than or equal to 1/4.

TABLE 3	RTD inputs (continued) (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
aliasing to f_c	–	–	-80	dB	Meets specification for Filter Cutoff settings lower than or equal to 1/4.
Filter delay	2.99	3.0	3.01	ms	Measured for f_{in} = f_c = f_s / 4 = 1 kHz.
Digital filter					For FIR setting of Filter Mode, digital filter is 49-tap Kaiser window, Beta 6 FIR filter with output sample stream decimated by 2.
poles	–	–	–	–	
filter cutoff (f_c) -6 dB	0.1	–	16	f_s	The maximum value is limited to 1.5625 kHz. See Filter Cutoff settings in the Instrument settings table on page 6.
0.1 dB bandwidth	–	0.32	–	f_c	Specified value is for f_c = f_s / 10 filter.
0.1 dB bandwidth	–	0.46	–	f_c	Specified value is for f_c = f_s / 8 filter.
0.1 dB bandwidth	–	0.59	–	f_c	Specified value is for f_c = f_s / 6 filter.
0.1 dB bandwidth	–	0.66	–	f_c	Specified value is for f_c = f_s / 5 filter.
0.1 dB bandwidth	–	0.72	–	f_c	Specified value is for f_c = f_s / 4 or equal or greater than f_s / 2 filters.
0.1 dB bandwidth	–	0.79	–	f_c	Specified value is for f_c = f_s / 3 filter.
0.1 dB bandwidth	–	0.83	–	f_c	Specified value is for f_c = f_s / 2.5 filter.
aliasing to 0.1 dB band	–	–	-80	dB	Meets specification for Filter Cutoff settings lower than 1/4.
aliasing to f_c	–	–	-80	dB	Meets specification for Filter Cutoff settings lower than 1/4.
Filter delay	3.99	4.0	4.01	ms	Measured for f_{in} = f_c = f_s / 4 = 1 kHz.
Pull-down resistor					Pull-down resistor can be enabled between TEMPERATURE(x) and GND. It should be enabled: when the channel is not wired to any sensor; or in the case of 2-wire measurements for high resistance RTD sensors, when compensation of wire resistance is not required and ANALOG(x) input is left floating. Otherwise this resistor must be disabled.
resistance	–	10	–	kΩ	Nominal resistance of pull-down resistor.
error	–	0.1	–	%	Initial resistor tolerance.

TABLE 4	Top-block built-in temperature sensor				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs (Top-block Temperature)	–	–	1	–	From sensor provided within top-block.
Input temperature					
full scale range	-55	–	125	°C	
DC error	–	0.5	1.0	°C	Sensor manufacturer specification.

TABLE 5	On board PCB temperature sensor				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs (ModuleTemperature)	–	–	1	–	From sensor provided on module PCB.
Input temperature					
full scale range	-55	–	125	°C	
DC error	–	0.5	1.0	°C	Sensor manufacturer specification.

Setting up the ARTD-416A

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	CurtissWright	CurtissWright	Name of manufacturer.
PartReference	ARTD-416A	ARTD-416A	The instrument part reference.
SerialNumber	AAB1234	AAB1234	Unique name for each module.
Channels	-	-	-
Temperature(15:0) *Analog Input*	-	-	-
Settings	-	-	-
Filter Mode(0)	FIR IIR8 IIR16	FIR	Specifies the filter mode for a specific channel of the 1st parameter. FIR is Kaiser window Beta = 6, 49-tap FIR filter; IIR8 is 8th order Butterworth IIR filter; and IIR16 is 16th order Butterworth IIR filter.
Filter Mode(1)	FIR IIR8 IIR16	FIR	Specifies the filter mode for a specific channel of the 2nd parameter. FIR is Kaiser window Beta = 6, 49-tap FIR filter; IIR8 is 8th order Butterworth IIR filter; and IIR16 is 16th order Butterworth IIR filter.
Filter Mode(2)	FIR IIR8 IIR16	FIR	Specifies the filter mode for a specific channel of the 3rd parameter. FIR is Kaiser window Beta = 6, 49-tap FIR filter; IIR8 is 8th order Butterworth IIR filter; and IIR16 is 16th order Butterworth IIR filter.
Filter Cutoff(0)	1/4 1/2 1 2 4 8 16 1/10 1/8 1/6 1/5 1/3 1/2.5	1/4	Required cutoff point for the filter is the chosen value referenced to the user sampling frequency. Setting for 1st channel parameter.

SETUP DATA	CHOICE	DEFAULT	NOTES
Filter Cutoff(1)	1/4 1/2 1 2 4 8 16 1/10 1/8 1/6 1/5 1/3 1/2.5	1/4	Required cutoff point for the filter is the chosen value referenced to the user sampling frequency. Setting for 2nd channel parameter.
Filter Cutoff(2)	1/4 1/2 1 2 4 8 16 1/10 1/8 1/6 1/5 1/3 1/2.5	1/4	Required cutoff point for the filter is the chosen value referenced to the user sampling frequency. Setting for 3rd channel parameter.
Excitation Amplitude	0 to 2.5e-3	2.5e-3	Required excitation (in A) for the RTD sensor.
Linearization URL	UTF-8 String	.\Lookup-Files\RTD\PT100_385.LU	Specifies the URL to the linearization lookup file.
User Compensation URL	UTF-8 String		Specifies the URL to the user compensation file.
User Compensation Channel	No compensation Channel indepen-dent Top-block tem-perature sensor Module tempera-ture sensor	No compensation	This setting defines which channel is used as the compensation channel for the linear user calibration.
Pull-down Resistor	Disabled Enabled	Disabled	Specifies if the switch connecting the pull-down resistor is to be enabled between TEMPERATURE(x) and GND nets.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Top-blockTemperature Top-block temperature signal data.	Celsius	OffsetBinary	16	R[15:0]
ModuleTemperature Module temperature signal data.	Celsius	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
ReadCounter Incrementing counter for debug usage.	Count	OffsetBinary	16	R[15:0]
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R(15) ModuleTemperature sensor not responding R(14) Top-blockTemperature sensor not responding R[13:2] Reserved R(1) ADC for Temperature[15:8] not responding R(0) ADC for Temperature[7:0] not responding
Temperature(15:0)(2:0) Parameters				
Temperature(15:0)(2:0) Temperature signal data.	Celsius	OffsetBinary	16	R[15:0]

Configurable parameters

Temperature(15:0)(2:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-200 to 660	250	Range maximum for RTD channel.
Range Minimum	-200 to 660	-50	Range minimum for RTD channel.

NOTE: It is recommended that names do not contain any of the following five characters "/><\.

Getting the most from the ARTD-416A

Lead error compensation

The feedback line TEMPERATURE(x) carries no current. Ideally it should be connected close to the gage to help compensate for lead resistances (assuming that both GND(x) and EXCITATION(x) lead resistances are the same).

Connecting RTD sensors in 2-wire setup

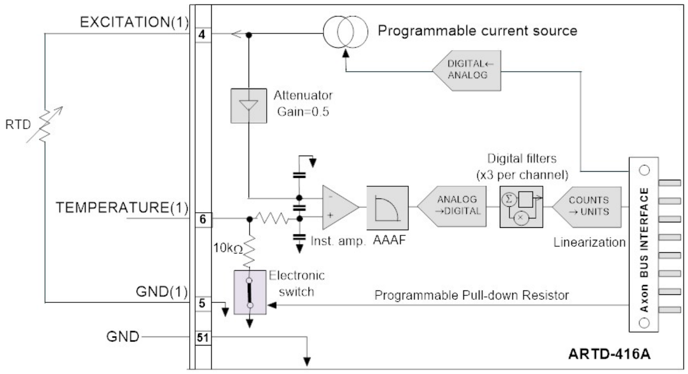

Figure 2: Second channel used in 2-wire configuration

If operating with two wires (with Pull-down Resistor set to Enabled and TEMPERATURE(x) input left floating), so the TEMPERATURE(x) is connected internally in the module to GND(x) (not at the gage), the error introduced is primarily an offset error (because the circuit is linear with respect to resistance) and can be adjusted for.

Use two-wire operation carefully. Estimation of cable resistance should consider temperature drift over the temperature range the cable operates (copper temperature coefficient is approximately 0.4% / °C). Depending on the wire length and diameter, the drift may cause noticeable error of measurement. In general, it may become an issue for thinner and longer cables. Such mode of operation is rather practical for high resistance sensors such as PT500 – PT2000.

Setting the range and excitation

For any temperature range required, errors can be minimized by using as much as possible of the 0 to 0.5V input range of the module (voltage between EXCITATION(x) and TEMPERATURE(x)). For the best accuracy when using PT100 sensors (at narrow temperature ranges of -50 to 250°C) or PT50 sensors (at any range), use 2.5 mA excitation, this is because card calibration was optimized using this excitation during manufacture. Lower excitation settings may be required for sensors with higher resistance (to avoid exceeding the input range of the card) or where specific current settings cause too many self-heating related errors at the sensor.

To minimize errors for high resistance sensors such as PT500 – PT2000, the excitation circuit is dual range. These sensors require much lower currents to fit into the voltage range of the card and thereby avoid too much self-heating. When using low current is required, set Excitation Amplitude to 0.36 mA or below, as this is the threshold where low range is used and accuracy regained.

Digital filters overview

The ARTD-416A samples all channels simultaneously at a high rate, which is defined in the f_p range in the Table 2 on page 2. Sample values are scaled by various blocks (such as internal calibration, user compensation, balance, and user range) and then passed into the digital filter and decimation blocks. These scaled samples pass through a cascade of digital anti-aliasing filters and decimations, which are there to lower the sample rate to the last user-selected filter, while maintaining aliasing at a negligible level. Then, depending on the Filter Mode and Filter Cutoff settings chosen, the sample passes through the final user-selected filter and decimator.

The ARTD-416A offers three types of final filters:

- FIR
- IIR8
- IIR16

Using the Filter Mode setting, each can be individually selected per channel and/or stream.

The FIR filter is a 49-tap Kaiser window Beta 6 filter. The advantage of this filter is constant filter delay versus input signal frequency, which facilitates time correlation of various signals in post-processing and visualization, and guarantees lack of phase distortions for non-sinusoidal input signals. The disadvantage is it has less flat passband, which gets narrower versus f_c for lower f_c settings.

IIR8 and IIR16 filters are Butterworth type filters of 8^{th} and 16^{th} order respectively. These filters offer more flat passband than FIR (especially IIR16), which is constant versus f_c regardless of Filter Cutoff selection. For most Filter Cutoff settings, IIR type filters (especially IIR8) offer a lower filter delay than FIR filters. The disadvantage is that the delay of Butterworth filters is not constant; it varies over input frequency range, making analysis of time correlation of various signals more difficult. Also it causes phase distortions of non-sinusoidal signals.

Each type of filter has seven base cutoff frequencies (Filter Cutoff settings: 1/10, 1/8, 1/6, 1/5, 1/4, 1/3 and 1/2.5), where a different set of filter coefficients is used for digital signal processing (DSP) maths in the final filtering block. These filters operate at twice the specific parameter output sample rate, therefore, the filter sample stream is decimated by a factor of 2 to produce the parameter sample stream. It is possible to output at the maximum sampling rate for these filters.

As for the remaining cutoff frequencies (Filter Cutoff settings: 1/2, 1, 2, 4, 8, 16), the filter uses coefficients as per 1/4 Filter Cutoff setting, but operates at a higher sample rate and uses decimation to produce the final output sample stream. As a result, the target filter cutoff value is effectively achieved. The downside of this approach is that it limits the maximum sampling frequency. Also, the module should not be configured whereby the parameter sample rate and filter cutoff setting would result in the maximum specified f_c for the card being exceeded.

Understanding filter delays (IIR8 and IIR16 filter modes)

The ADAU uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time, independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended Filter Cutoff setting is 1/4 or lower for IIR8 Filter Mode setting, or 1/2.5 or lower for IIR16 Filter Mode setting, as this results in the maximum filtering of aliasing frequencies. The ADAU filters signals using over-sampling signal processing techniques. The following two figures show a delay for an 8^{th} order filter (IIR8 setting) and a 16^{th} order filter (IIR16 setting) normalized to f_c. Charts are plotted up to the Nyquist frequency of the output sample stream where the Filter Cutoff setting is 1/4. Where a higher Filter Cutoff setting is used, a delay chart should be considered only up to the Nyquist frequency of the output sample stream (f_s / 2), as frequencies above the Nyquist frequency are already aliased signals and cannot be easily analyzed.

All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, divide the delay by f_c (expressed in Hz). The frequency axis then needs to be rescaled to the new f_c by multiplying the normalized frequency values by f_c. For example, an 8^{th} order Butterworth filter with an f_c of 1 kHz delays a 1 kHz signal by 1 ms; a filter with an f_c of 10 Hz delays a 10 Hz signal by 0.1 s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

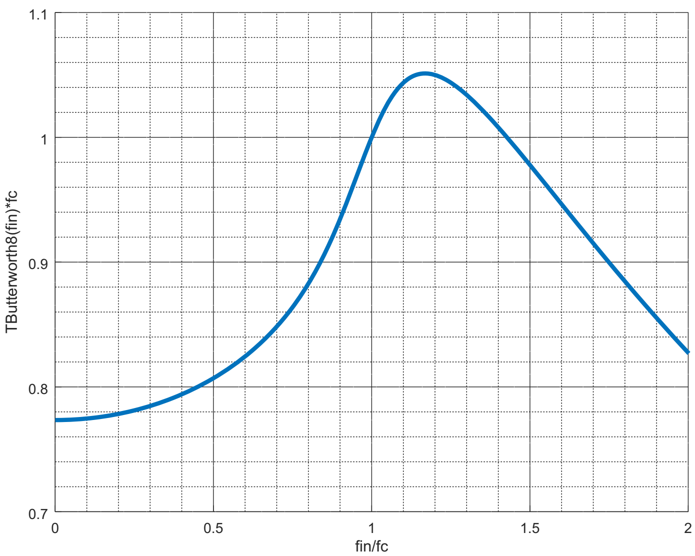

Figure 3: Filter delay for IIR8 Filter Mode setting normalized to f_c

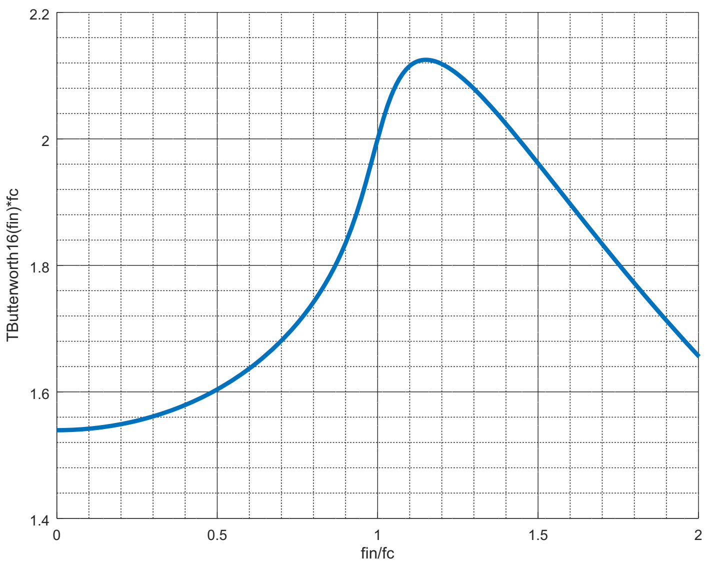

Figure 4: Filter delay for IIR16 Filter Mode setting normalized to f_c

The filter delay for the ARTD-416A is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth}\left(f_{in}\right)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Understanding filter delays (FIR filter mode, Filter Cutoff settings of 1/4, 1/2, 1, 2, 4, 8 and 16)

The ADAU uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended Filter Cutoff setting is 1/4 or lower for FIR Filter Mode setting, as this results in the maximum filtering of aliasing frequencies. The ADAU filters signals using over-sampling signal processing techniques. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c).

The filter delay for this mode and these f_c settings is:

$$T_D \approx T_A + \frac{4}{f_c}$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Aliasing

Aliasing is an effect in signal sampling systems, which can cause sampled signals greater than half the sample rate to become indistinguishable from signals in the bandwidth of interest. To prevent the possibility of aliasing, sampling systems offer filtering. With ADAU modules, filtering consists of a pre-sampler analog anti-aliasing filter and a post-sampler cascaded digital filter. ADAU analog modules support three main types of digital filters: IIR8; IIR16; and FIR. Each can be configured to a various Filter Cutoff frequencies, allowing you to select the cutoff frequency best suited to the application.

One criteria may be aliasing attenuation. Aliasing figures presented in the Specifications tables (starting on page page 2) are met or exceeded for Filter Cutoff settings lower or equal to 1/4. For higher Filter Cutoff settings (1/3 and 1/2.5, which still offer Filter Cutoff below the Nyquist frequency), the worst case figures may be lower due to the proximity of the cutoff frequency to the Nyquist frequency and the limited attenuation a specific filter type can achieve for the closest possible aliasing frequencies.

The following table below presents the theoretical worst case aliasing values for the Filter Cutoff settings for the three main filter types.

TABLE 6 Theoretical worst case aliasing values

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
IIR8					
aliasing to 0.1 dB bandwidth	-80	–	–	dB	Filter Cutoff setting of 1/3.
aliasing to f_c	-72	–	–	dB	Filter Cutoff setting of 1/3.
aliasing to 0.1 dB bandwidth	-60	–	–	dB	Filter Cutoff setting of 1/2.5.
aliasing to f_c	-40	–	–	dB	Filter Cutoff setting of 1/2.5.
IIR16					
aliasing to 0.1 dB bandwidth	-80	–	–	dB	Filter Cutoff setting of 1/3 and 1/2.5.
aliasing to f_c	-80	–	–	dB	Filter Cutoff setting of 1/3 and 1/2.5.
FIR					
aliasing to 0.1 dB bandwidth	-76	–	–	dB	Filter Cutoff setting of 1/3 and 1/2.5.
aliasing to f_c	-74	–	–	dB	Filter Cutoff setting of 1/3 and 1/2.5.

Use of Filter Cutoff settings of 1/2 and higher is not recommended. While using a Filter Cutoff of 1/2 or higher can help to lower filter delays through the system and/or improve AC gain error within the bandwidth of interest, it may cause significant aliasing due to not meeting the Nyquist criteria.

Understanding filter delays (FIR filter mode, Filter Cutoff settings of 1/10, 1/8, 1/6, 1/5, 1/3, 1/2.5)

For this FIR mode and its f_c settings, the filter delay formula is different than in the previous section. The delay is such that the Filter Cutoff is 1/4 for FIR mode (the FIR filters delay is not f_c dependent, but rather dependent on the rate and number of filter taps).The following formula effectively defines the delay:

$$T_D \approx T_A + \frac{16}{f_s}$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

User compensation

The module offers optional user-compensation per channel. It is linear correction, which can be applied at the digital signal processing path, just after the A/D converter and the channel's correction blocks, but before auto-balance, user range scaling, digital filtering, and output linearization. It allows samples to be corrected by first applying multiplication through user-defined gain compensation values and then adding a user-offset compensation value to produce the output value.

The User Compensation Channel setting determines if compensation is disabled (No compensation), if it is constant correction (Channel independent), or if the selected correction coefficients depends on another parameter (any other channel or one of the module temperature sensors).

Examples where this feature can be used include user calibration/correction of module channel and external sensor/cabling errors compensation. Both uses may also be dependent on one of the other parameters of the module (for example, channel correction could depend on module temperature, or external sensor correction on some other channel).

The User Compensation URL setting links to a file with compensation coefficients. This file could contain either a single set of gain and offset compensation coefficients, or could contain multiple sets with information for what value of reference compensation channel, specific set of gain and offset compensation coefficients is valid. In the latter case, the module compensation block interpolates linearly output value for any value of reference compensation channel between defined compensation channel values, allowing smooth correction change. If the correction channel value is outside of the range defined in User Compensation URL, then correction coefficients of closest defined compensation channel value are used.

Two example files of User Compensation are distributed with TTCWare These files contain a set of three values for each defined compensation point: *ReferenceSourceValue*, *Gain* and *Offset*. ReferenceSourceValue is the point at which a specified pair of Gain and Offset is defined. Gain is a gain correction. Offset is the offset value to be applied, expressed in volts.

For the Channel Independent setting of User Compensation Channel, only one set of values is expected in the compensation file, and ReferenceSourceValue could contain any value there (for example 0) as it is effectively ignored. In a situation where compensation depends on an other channel (for example Module temperature sensor), multiple groups of compensation points are expected, each defined for different ReferenceSourceValue.

TTCWare software takes the user defined sets of compensation points, interpolates between them, and extrapolates outside the minimum and maximum ReferenceSourceValue (rails corrections to the nearest), and loads such points into the non-volatile settings of module memory in the form of a compensation table. The module itself uses this table to calculate compensation gain and offset values based on the current output value from the selected User Compensation Channel. This calculation is further interpolated based on the nearest points within the non-volatile memory compensation table.

NOTE: Some corrections may cause demand of very different voltage ranges than if compensation was not used. This may lead to compilation errors when the maximum allowed operating range defined for a specific channel is exceeded.

Unused inputs

It is recommended that unused input channels are not left floating, as this may introduce more noise into the system and so degrade card performance. It is possible to set up each channel in a specific way, so that no external wiring is required to avoid channels floating. In order to do so, set Excitation Amplitude to 0, and then set Pull-down Resistor to Enabled.

Connector pinout of the ARTD-416A

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXCITATION(0)	Single ended DC current excitation outputs	
2	GND(0)	Single ended DC current excitation outputs	
3	TEMPERATURE(0)	RTD inputs	
4	EXCITATION(1)	Single ended DC current excitation outputs	
5	GND(1)	Single ended DC current excitation outputs	
6	TEMPERATURE(1)	RTD inputs	
7	EXCITATION(2)	Single ended DC current excitation outputs	
8	GND(2)	Single ended DC current excitation outputs	
9	TEMPERATURE(2)	RTD inputs	
10	EXCITATION(3)	Single ended DC current excitation outputs	
11	GND(3)	Single ended DC current excitation outputs	
12	TEMPERATURE(3)	RTD inputs	
13	EXCITATION(4)	Single ended DC current excitation outputs	
14	GND(4)	Single ended DC current excitation outputs	
15	TEMPERATURE(4)	RTD inputs	
16	EXCITATION(5)	Single ended DC current excitation outputs	
17	GND(5)	Single ended DC current excitation outputs	
18	TEMPERATURE(5)	RTD inputs	
19	EXCITATION(6)	Single ended DC current excitation outputs	
20	GND(6)	Single ended DC current excitation outputs	
21	TEMPERATURE(6)	RTD inputs	
22	EXCITATION(7)	Single ended DC current excitation outputs	
23	GND(7)	Single ended DC current excitation outputs	
24	TEMPERATURE(7)	RTD inputs	
25	EXCITATION(8)	Single ended DC current excitation outputs	
26	GND(8)	Single ended DC current excitation outputs	
27	TEMPERATURE(8)	RTD inputs	
28	EXCITATION(9)	Single ended DC current excitation outputs	
29	GND(9)	Single ended DC current excitation outputs	
30	TEMPERATURE(9)	RTD inputs	
31	EXCITATION(10)	Single ended DC current excitation outputs	
32	GND(10)	Single ended DC current excitation outputs	
33	TEMPERATURE(10)	RTD inputs	
34	EXCITATION(11)	Single ended DC current excitation outputs	
35	GND(11)	Single ended DC current excitation outputs	
36	TEMPERATURE(11)	RTD inputs	
37	EXCITATION(12)	Single ended DC current excitation outputs	
38	GND(12)	Single ended DC current excitation outputs	
39	TEMPERATURE(12)	RTD inputs	
40	EXCITATION(13)	Single ended DC current excitation outputs	
41	GND(13)	Single ended DC current excitation outputs	
42	TEMPERATURE(13)	RTD inputs	
43	EXCITATION(14)	Single ended DC current excitation outputs	
44	GND(14)	Single ended DC current excitation outputs	
45	TEMPERATURE(14)	RTD inputs	
46	EXCITATION(15)	Single ended DC current excitation outputs	
47	GND(15)	Single ended DC current excitation outputs	
48	TEMPERATURE(15)	RTD inputs	
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

PART NUMBER	MODEL NUMBER	DESCRIPTION
702102100-001	ARTD-416A-1	¼-bridge ADC (current excitation, RTD temperature sensors, 1.5625 kHz b/w) - 16ch at 6.25 ksps

By default, the standard mating connector, CON-AUSR-1, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified.

Revision history

REVISION	DIFFERENCES	STATUS
ARTD-416A	First release	Preliminary draft; contact Curtiss-Wright support for details

Supporting software

SOFTWARE	DETAILS
TTCWare	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related products

PART NUMBER	MODEL NUMBER	DESCRIPTION
770000400-001	CON-AUSR-1	Standard Axon module top block mating connector
770000400-002	CON-AUSR-2	Standard Axon module top block mating connector with rubber grommet for increased strain relief
311050202-001	BAC-AUSR-1	Backshell, nickel-plated aluminum straight-through, for Axon connectors
311230202-001	BAC-AUSR-2	Backshell, nickel-plated aluminum 20 degree, for Axon connectors

Related documentation

DOCUMENT	DETAILS
DOC/HBK/008	Environmental Qualification Handbook for Axon Products. (Contact Curtiss-Wright support for availability of this document.)