EXDA-4201 Digital + Analog Expansion

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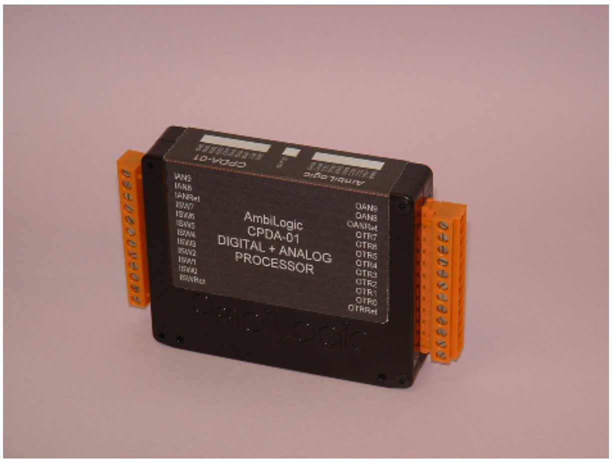
Features:-

10 inputs and outputs:-

- 4 digital inputs
- 2 differential 25 mA or 375 mV analogue inputs
- 2 SPCO relay outputs
- 2 4-20 mA non-isolated analogue outputs.



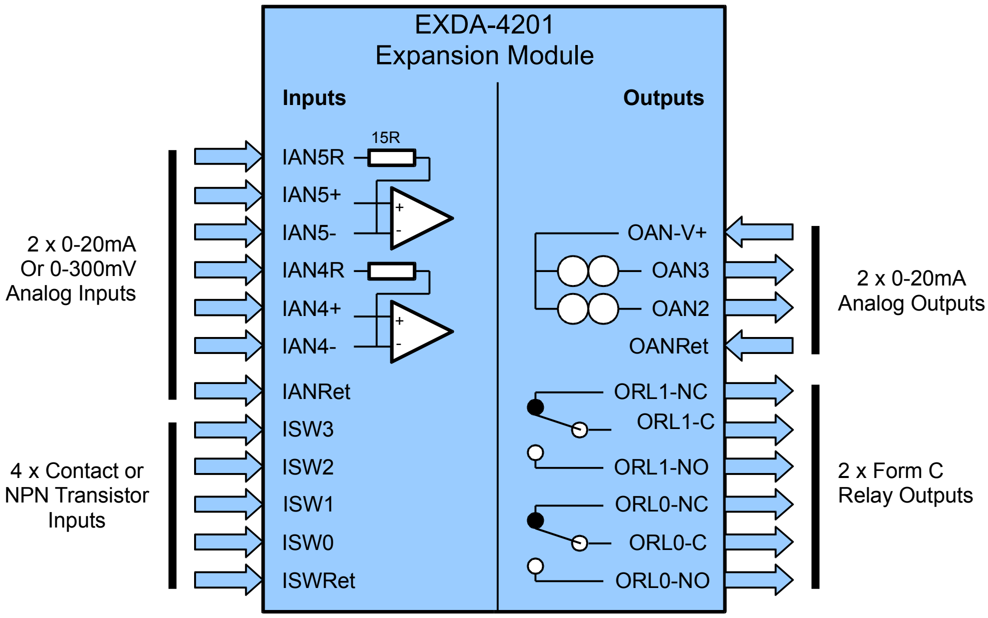
Low 2W power consumption.

Connections via detachable screw terminals.

The EXDA-4201 is a digital + analogue expansion module which plugs into any numbered slot in any of the AmbiLogique backplanes, and takes its internal power from the backplane. The power supply for the 4-20 mA outputs is externally supplied, and may be at a different voltage from the PLC power supply.

The EXDA-4201 Slot address is picked up automatically from the backplane, and its facilities then become available to diagrams running in the Processor module on the backplane.

This module is targetted at process control applications, and at marine applications where an analog+digital interface (e.g. to Dynamic Positioning Systems) is required.



Connection Diagram

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Connections:

Note: The Subslot, Register and Mask values are needed to map the physical inputs and outputs into the Control Diagram.

Terminal	Signal	Description	Subslot	Register	Mask
A12	IAN5R	25 mA termination resistor	0	3	0
A11	IAN5+	375 mV Analog Non-inv. Input			
A10	IAN5-	375 mV Analog Invert Input			
A09	IAN4R	25 mA termination resistor	0	2	0
A08	IAN4+	375 mV Analog Non-inv. Input			
A07	IAN4-	375 mV Analog Invert Input			
A06	IANRet	Analog Return	Return (Gnd) for above signals		
A05	ISW3+	Contact / NPN Input	0	1	8
A04	ISW2+	Contact / NPN Input	0	1	4
A03	ISW1+	Contact / NPN Input	0	1	2
A02	ISW0+	Contact / NPN Input	0	1	1
A01	ISWRet	Contact / Switch Return	Return (Gnd) for above signals		
C01	OAN V+	10-32V Analog Out Supply +	Supply (+) for signals below		
C02	OAN3	0-20 mA Analog Output	0	6	0
C03	OAN2	0-20 mA Analog Output	0	5	0
C04	OANRet	Analog Output Return	Return (Gnd) for above signals		
C05	ORL1 NC	Relay Normally Closed	0	4	2
C06	ORL1 C	Relay Common			
C07	ORL1 NO	Relay Normally Open			
C08	ORL0 NC	Relay Normally Closed	0	4	1
C09	ORL0 C	Relay Common			
C10	ORL0 NO	Relay Normally Open			

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Interface to Diagram:

The Slot address for all facilities is taken from the slot into which the EXDA-4201 is plugged. In practice this will be 1 upwards.

Subslot 0: Input/Output

Register 0: Device Identifier: returns hex A542 (42306) for EXDA-4201
Register 1: Contact/NPN Inputs: bit mapped: use mask to select required input
Register 2: Analog Input 4: returns 0 to 25.5 (input current)
Register 3: Analog Input 5: returns 0 to 25.5 (input current)
Note that writing (outputting) to the above registers has no effect
Register 4: Relay Outputs: bit mapped: use mask to select required output
Register 5: Analog Output 2: 0 to 25.00 corresponds to output current
Register 6: Analog Output 3: 0 to 25.00 corresponds to output current

NOTE: Processing of Analog Inputs:-

To provide a 0 to 100 scale for a 4-20 mA input signal, use the following control diagram functions after the TERMIN which delivers the analog signal:-
SUBtract a constant 4.00 to remove the 4 mA base signal
MULTiply the result by a constant 6.25 to bring the 16 mA range to 100.

For current sensing, a 15 Ω resistor is provided. The input actually senses 300 mV for a 20 mA input signal. When used in voltage mode, use the following control diagram functions to read voltage directly:-
MULTiply the signal from the TERMIN by constant 0.015

To achieve a 0 to 100 scale:-
MULTiply the signal from the TERMIN by constant 5.00

Other scales can be produced by feeding different constants into the MULT function.

EXAMPLE
A thermocouple transmitter is installed which outputs 4-20 mA for a 0 to 250°C range. We need to generate an internal signal in °C.
From the TERMIN, SUBtract a constant 4.00
MULTiply the result by a constant 15.625 to transform the 16 mA range to 250°C.

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Specifications

1. Power Input: +14V 160 mA, +7V 150 mA.
   This is the standard output from the AmbiLogique Power/Comms modules – so you don't have to worry about it.
   Power for 20mA output: +10 to 32 Vdc. These modules are calibrated at +24V.

2. Contact / NPN Transistor Digital Inputs:
   Excitation voltage: 6.0 to 9.0 V.
   Sink current: 3.0 to 5.0 mA.
   Maximum Input voltage: -1.0 to +120 V.
   Protection: Blocking diode.
   Internal (control diagram) signal: open = FALSE; closed = TRUE.
   Thresholds: 5.0 V (open); 3.0 V (closed) typical.

3. Analogue Inputs:
   Resolution: 12 bits: 91.5 μV per bit.
   Range: 0 to 0.375 V.
   Common Mode voltage: -5.0 to + 10.0 V: both inputs must be kept within this range.
   Input resistance: 100 kΩ.
   Current sensing resistor: 15 Ω (25 mA full scale).
   Total errors not exceeding: 4 bits: 400 μV: 0.12 % of full range.
   Protection: Transient suppressor diode.
   Internal (control diagram) signal: 0 to 0.375

4. Relay Digital Outputs:
   Max working voltage: ± 150 Vpeak.
   Max current: 3.0 A resistive.
   Protection: None.
   Internal (control diagram) signal: FALSE = relay off; TRUE = relay ON.

5. Analogue Outputs:
   Resolution: 12 bits : 6 μA per bit.
   Supply Voltage Range: +10 to +32 V.
   Max Overhead Voltage: 2.0 V at 25 mA output.
   Compliance: 0 to (supply – 3.0) V.
   Max Current: 25 mA.
   Protection: Transient suppressor diode.
   Total errors not exceeding: 6 bits :40 μA : 0.2 % of full range.
   Internal (control diagram) signal: 0.0 to 25.0

6. Dimensions:
   Heights: 83 mm above backplane.
   97 mm above mounting base when assembled.
   on to an AmbiLogique backplane on TS35 rail.

   Width: 25.0 mm max.

   Depths: 103 mm over body.
   125 mm over terminals.

7. Ambient temperature: -10 to +60 °C.

Indicators

There are 3 groups of indicators on the top panel of the EXDA-01.

Contact / NPN Input Group:
These are labelled "**ISW0**" through "**ISW3**"
The indicators are ON when the input is TRUE, i.e. switched to Return.

Analog Input Group:
These are labelled "**IAN4**" and "**IAN5**"
The indicators glow with an intensity proportional to the input current.

Comm:
This indicator flashes each time the module is interrogated or commanded via the backplane bus. The indicator lights when it recognises a packet addressed to its slot, and goes out when the response has been transmitted.
If this indicator is not flashing, the module is not being addressed. This is not necessarily a fault condition if the processor is not reading the module's inputs or adjusting its outputs. That is to say, if the control diagram makes no reference to any of the EXDA-4201's inputs or outputs, no packets will be sent to the module, and the Status indicator will not flash.
If the outputs alone are referenced, even if the outputs are unchanging, the backplane communications protocol ensures that they are refreshed periodically, so the Status indicator will flash.

Analog Output Group:
These are labelled "**OAN2**" and "**OAN3**"
The indicators glow with an intensity proportional to the output current.

Relay Output Group:
These are labelled "**ORL1**" and "**ORL0**"
These indicators are ON when the corresponding output relay is energised.

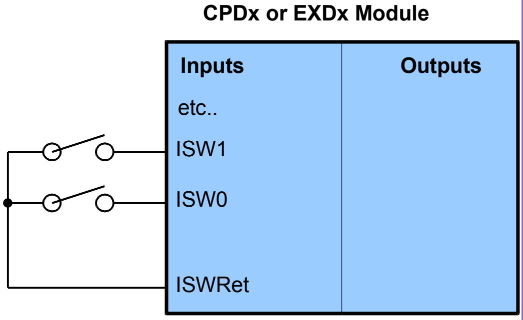
Connecting External Devices

1. **Switch Inputs ISW0..7**

   a) **Contact Input:**

   Wire the contact between ISW.. and ISWRet.

   The input will be TRUE when the contact is closed.

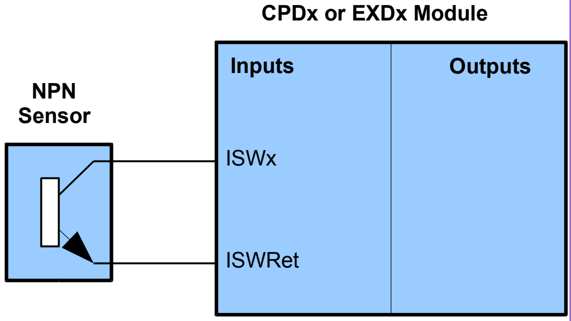


Switch Inputs

   b) **NPN Transistor Input:**

   Collector to ISW..
   Emitter to ISWRet

   The input will be TRUE when the transistor is ON.



NPN Transistor Inputs

Connecting External Devices (continued)

2. **Analog Inputs IAN4, 5:**

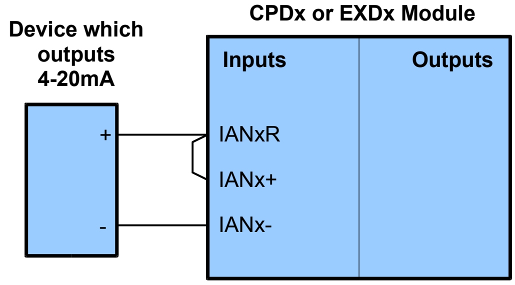
   a) **20 mA Input:**

(i) Device which sources 4-20 mA:

Note the link between IANx+ and IANxR which connects the internal 15 Ω sensing resistor across the input.

The voltage dropped across the internal resistor will be 375 mV when the external device sources 25 mA.

Both the input terminals must remain within -5.0 to +10.0V with respect to IANRet (the PLC common negative).



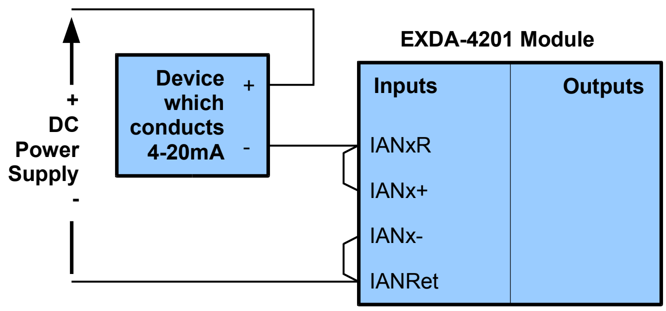
20mA Analogue Inputs

(ii) Device which conducts 4-20 mA:

Note the link between IANx+ and IANxR which connects the internal 15 Ω sensing resistor across the input.

An external DC power supply is needed for this circuit. The negative return of this power supply must connect to IANRet.

Note that this circuit automatically guarantees compliance with the requirement that the inputs are within -5.0 to +10.0V with respect to IANRet (the PLC common negative).



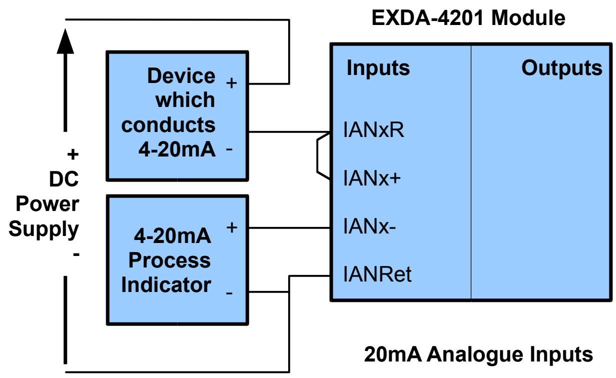
20mA Analogue Inputs

(iii) Sharing a loop with other devices:

Note the link between IANx+ and IANxR which connects the internal 15 Ω sensing resistor across the input.

Here we have used an example where a 4-20 mA process indicator is sharing the loop with our PLC input. The example process indicator has a constraint that it must be wired in the negative end of the loop.

We see from the indicator specification that it places a burden of (example) 5.0V on the loop at 20 mA. This burden appears as a common-mode voltage on the PLC inputs. This is within the -5.0 to +10.0 common-mode range of the PLC inputs so the circuit will work properly. The burden of the EXDA4201 input is only 0.3V at 20 mA.



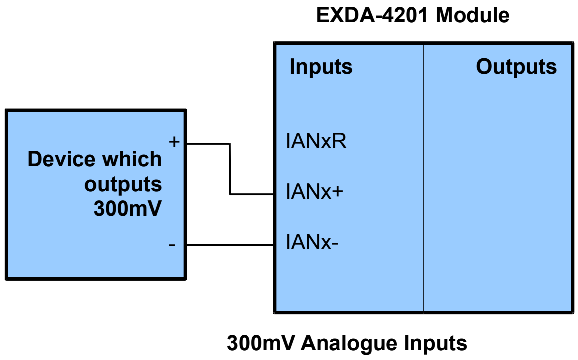
20mA Analogue Inputs

Connecting External Devices (continued)

b) 300 mV Differential Input:

Here the internal current-sensing resistor is unconnected: the circuit input resistance is 100 kΩ.

You need to check the specifications of the external device to ensure that its common-mode output voltage falls within the -5.0 to +10.0 specification of the EXDA4201.

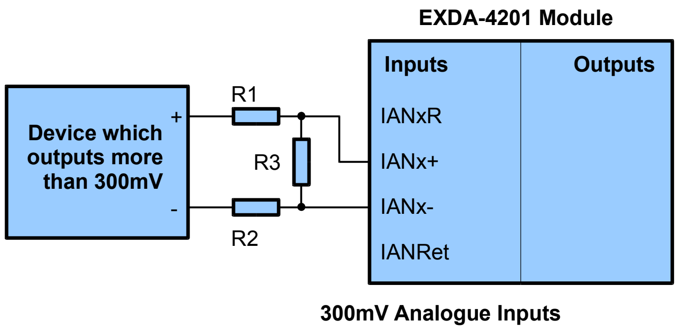


c) Higher Voltage Differential Input:

(i) Common-mode voltage within -5.0 to +10.0

Here a 3-resistor voltage divider is used to reduce the signal voltage to bring it into the 300mV range of the EXDA-01.

The common-mode voltage on the inputs of the EXDA-01 approximates to the mean of the source device terminal voltages. Sensing is truly differential without the need to exactly match resistors R1 and R2.

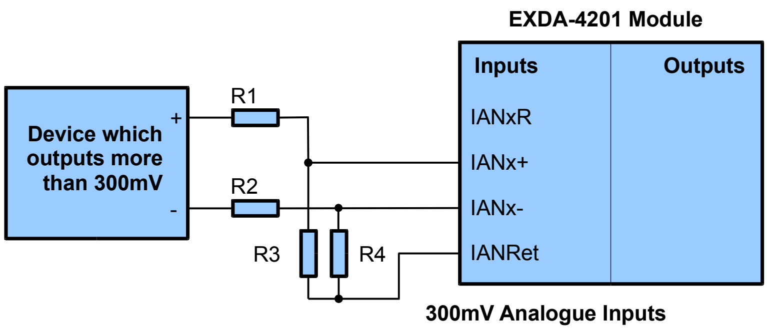


EXAMPLE. If the device sources a voltage of 0 to 10V, we could choose R1 and R2 each to be 150 kΩ, and R3 to be 10 kΩ.
R3 in parallel with the internal resistance of 100 kΩ gives an effective input resistance of 9.09kΩ.
The total divider resistance is therefore 309.1 kΩ. The divider ratio is 309.1/9.09 = 34.0 and the input range is therefore 0 to (0.3 * 34.0) = 10.2V.
In the control diagram the output of the TERMIN needs to be MULTiplied by a constant 0.51 to provide a signal which reads actual input differential voltage.

(ii) Common-mode voltage outside EXDA-01 Specification

Here a pair of voltage dividers is used to reduce the signal voltage to bring it into the 300mV range of the EXDA-4201.

The common-mode voltage on the inputs of the EXDA-4201 is now the source device terminal voltage divided by the resistor ratio. Sensing is truly differential only if the two voltage dividers exactly match.



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Connecting External Devices (continued)

EXAMPLE. If the device sources a voltage of 0 to 10V, we could choose R1 and R2 each to be 270 kΩ; and R3 and R4 each to be 10 kΩ.
Each voltage divider reduces the input voltage by a factor of 28.0 and has an output resistance of 9.706 kΩ. The output of the voltage dividers is further reduced by a factor of (100 / 119.41) due to the 100 kΩ input resistance of the EXDA-4201. This gives a differential input voltage range of 0.3 * 28.0 * (119.41 / 100) = 10.03 .
In the control diagram the output of the TERMIN needs to be MULTiplied by a constant 0.5015 to provide a signal which reads actual input differential voltage.

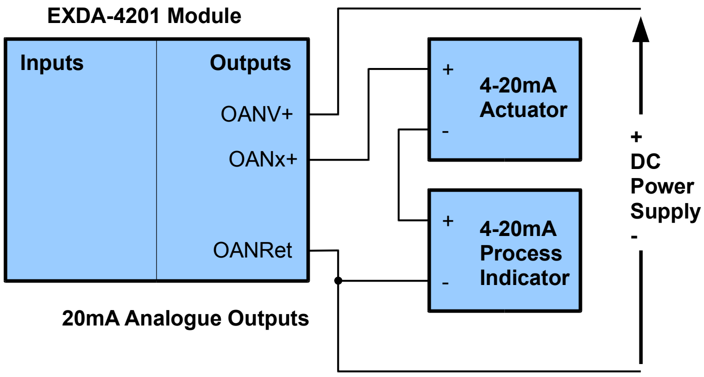
3. Digital Relay Outputs ORL0, ORL1

These outputs are floating dry contacts. The terminal designations NO and NC refer to the state when the relay is unenergised, i.e. when the signal into its TERMOUT device reads FALSE or zero.

4. Analog 4-20 mA Outputs OAN2, OAN3

These outputs are designed to supply a current-sensing load or loop which is returned to the OANRet terminal.

The drivers are supplied with a dedicated positive voltage via the OANV+ terminal. This supply is common to the two Analog Output circuits.



The example shown here illustrates the EXDA-4201 output driving an actuator and a process indicator in series.

The DC supply must be high enough to provide sufficient voltage for all of the devices in the loop, plus 3.0V for the EXDA-4201 internal driver circuit.

In the control diagram, the signal to the TERMOUT function block defines the output current. If you want to provide say a percentage signal to a 4-20 mA output device, you need to perform the following functions prior to the TERMOUT:-

a) MULTiply the percentage signal by constant 0.16 to convert it to a 16 mA range
b) ADD constant 4.00 to base the output on 4 mA.

WARNING
SAFETY-CRITICAL SYSTEMS

A Safety-Critical system is a system whose failure or malfunction could cause death, significant injury or loss of property.

AmbiLogique products incorporate electronic hardware and software, both of which carry a remote but real possibility of failure. AMBILOGIQUE DOES NOT WARRANT, CLAIM OR REPRESENT THAT ITS PRODUCTS ARE INFALLIBLE.

It is therefore THE RESPONSIBILITY OF THE DESIGNER of any safety-critical system which incorporates AmbiLogique products to ensure that:-

1. The system is designed so that any failure of an AmbiLogique component will not cause death, injury or loss of property.
2. The system incorporates independent monitoring means which detect the failure of any of the electronic control elements.
3. The system has alternative and independent means of control which enable it to be controlled and shut down in an orderly manner.
4. Any and all other industry-specific safety requirements are fully implemented.

Revision History:

R 0.0	2012-01-17	Initial issue.
R 0.1	2013-02-08	Shared input diagram corrected.
R 0.2	2016-01-25	Editorial.