IO-LINK BLOCK

IOLB-7214

4 Channel Analog Input/Output

User Guide

COMTROL®

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Overview

IOLB-7214 Module Overview

The IOLB-7214 features two analog inputs and two analog outputs, which can be parameterized individually. Signals range from -10V to +10V or from 0/4 to 20mA and can be processed or generated.

The resolution for the current and voltage signals is 16 bit (signed).

For the outputs the voltage or output current is fed to the process level, electrically isolated with a resolution of 15 bit (default).

The IOLB-7214 is intended to be connected directly to an IO-Link Master.

The small IOLB-7214 form factor (H126 x W30 x D26.5 mm) means that they are suitable for use where space is at a premium. The small mass of the IOLB-7214 module facilitates applications with mobile I/O interface, for example, a robot arm.

The robust design of the IOLB-7214 module enables them to be used directly at the machine. Control cabinets and terminal boxes are now no longer required. The module is fully sealed and therefore ideally prepared for wet, dirty or dusty conditions (IP67).

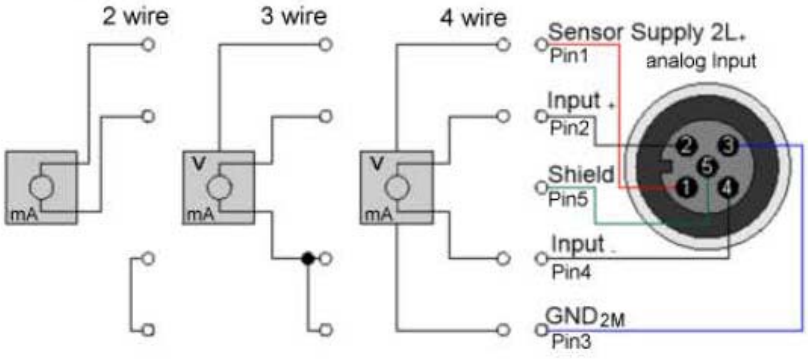
Pre-assembled cables significantly simplify IO-Link and signal wiring. Very few wiring errors are made, so that commissioning is optimized. In addition to pre-assembled IO-Link, power and sensor cables, field-configurable connectors and cables are available for maximum flexibility. Sensors and actuators are connected through M12 connectors.

Analog Inputs

One input per socket from the following options:

- 0 to 10V
- -10 to 10V
- 0 to 20mA
- 4 to 20mA

The sensor is connected via Input+ and Input-. The sensor can optionally be operated/supplied with 24VDC.

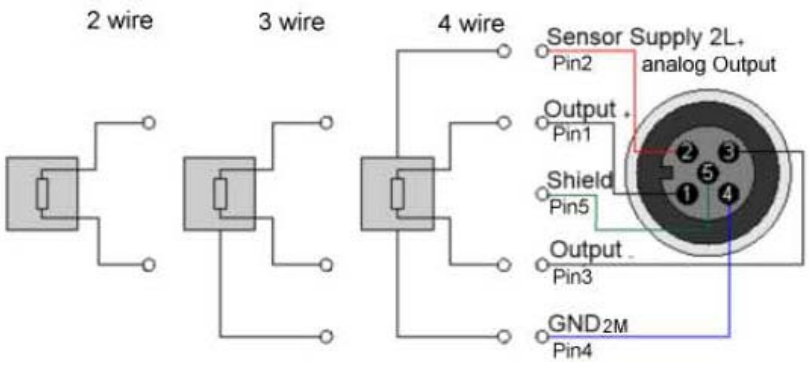


Analog Outputs

One output per socket from the following options:

- 0 to 10V
- -10 to 10V
- 0 to 20mA
- 4 to 20mA

The actuator is connected via output +/- and output ground (GND). The actuator can optionally be operated/supplied with 24VDC.



IOLB-7214 LEDs

This subsection provides information about the IOLB-7214 LEDs.

X1 (IO-Link LED) 	Description
Off	IO-Link communications not active.
Flashing green (1 Hz)	IO-Link communications active.
Lit (Red)	Short circuit on C/Q line or overheating.

Power Supply LEDs 		Description
24V (L+)	Off	Voltage L+ Unavailable
	Green	Voltage L+ Ok
	Red	Voltage L+ Too Low
24V (2L+)	Off	Voltage 2L+ Unavailable
	Green	Voltage 2L+ Ok
	Red	Voltage 2L+ Too Low, Short Circuit

Analog LED 	Led Status	Description
R (Left LED)	Off	No data transmission to the A / D converter.
	Green	Data transfer to the A / D converter.
E (Right LED)	Off	Functioning properly.
	Red	Error: Wire break or measured value out of range.

IOLB-7214 Technical Specifications

IOLB-7214	Technical Data
Communication	IO-Link
Data Transfer Rate	230.4 KBaud (COM 3)
IO-Link Connection	1 x M12 connector, A-coded
Specification Version	IO-Link V1.1, Class B
Requirements for IO-Link Master	V1.1
Number of Inputs	2
Input Connections	M12 sockets
Input Signal Type	Configurable: 0V to +10V -10V to +10V 0mA to 20mA 4mA to 20mA
Input Resistance of the Inputs	> 200 KΩ or 85Ω typ. + diode voltage
Input Resolution	16 bit (including sign)
Input Filter Limit Frequency	5 kHz
Input Conversion Time	~100 µs
Input Measuring Error	< 0.1% (relative to full scale value)
Number of Outputs	2
Output Connections	M12 sockets

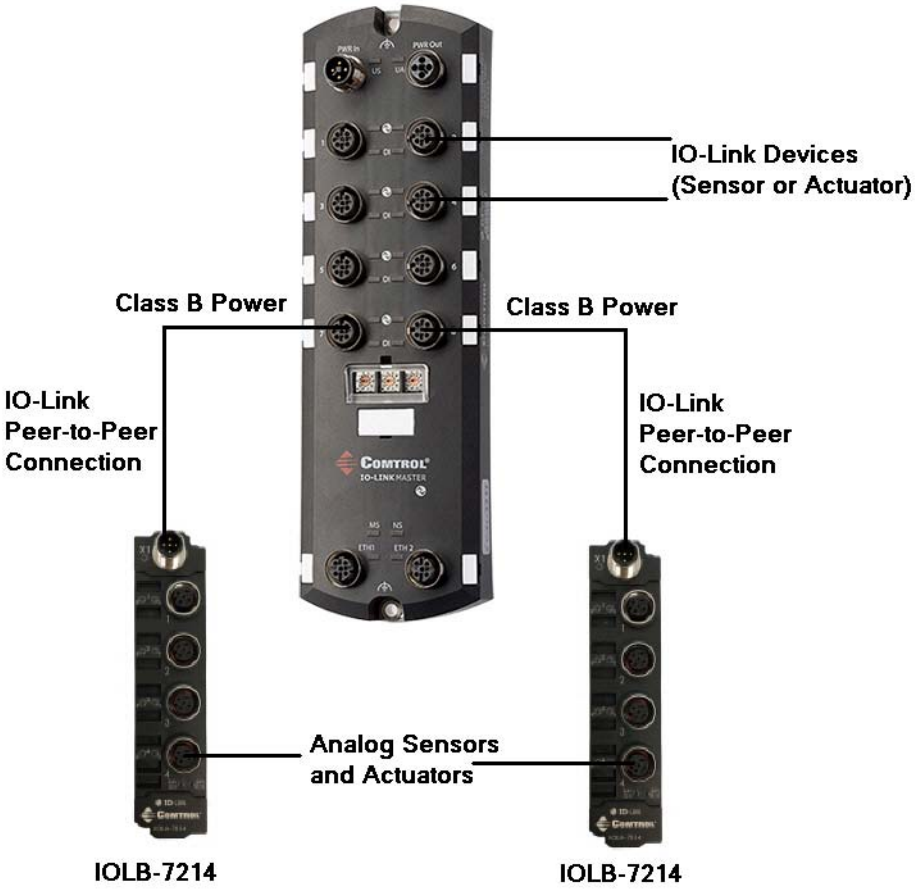
IOLB-7214	Technical Data (Continued)
Output Signal Type	Configurable: 0V to +10V -10V to +10V 0mA to 20mA 4mA to 20mA
Output Load	> 5 KΩ
Output Resolution	15 bit
Output Conversion Time Approx.	40 µs
Output Measuring Error	< 0.1% (relative to full scale value)
Special Features	Combination module, current or voltage parameterizable for each channel
Current Consumption of the Module Electronics	Typically 100mA from L+
Supply of the Module Electronics	L+
Supply of the Sensors	2L+
Supply of the Actuators	2L+
Process Image	Inputs: 2 x 16 bit Outputs: 2 x 16 bit
Electrical Isolation	L+/2L+: yes
Housing Industrial Housing	Plastic PA6
Weight	180 g
Ambient Operating Temperature	-25°C to +60°C
Ambient Storage Temperature	-40°C to +85°C
Vibration / Shock Resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC Immunity / Emission	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection Class	IP65, IP66, IP67 (conforms to EN 60529)

IO-Link Basics

IO-Link is a communications system for connecting intelligent sensors and actuators to an automation system in IEC 61131-9 under the name *Single-drop digital communication interface for small sensors and actuators* (SDCI). Both the electrical connection data and the communication protocol are standardized and in the IO-Link specification summarized.

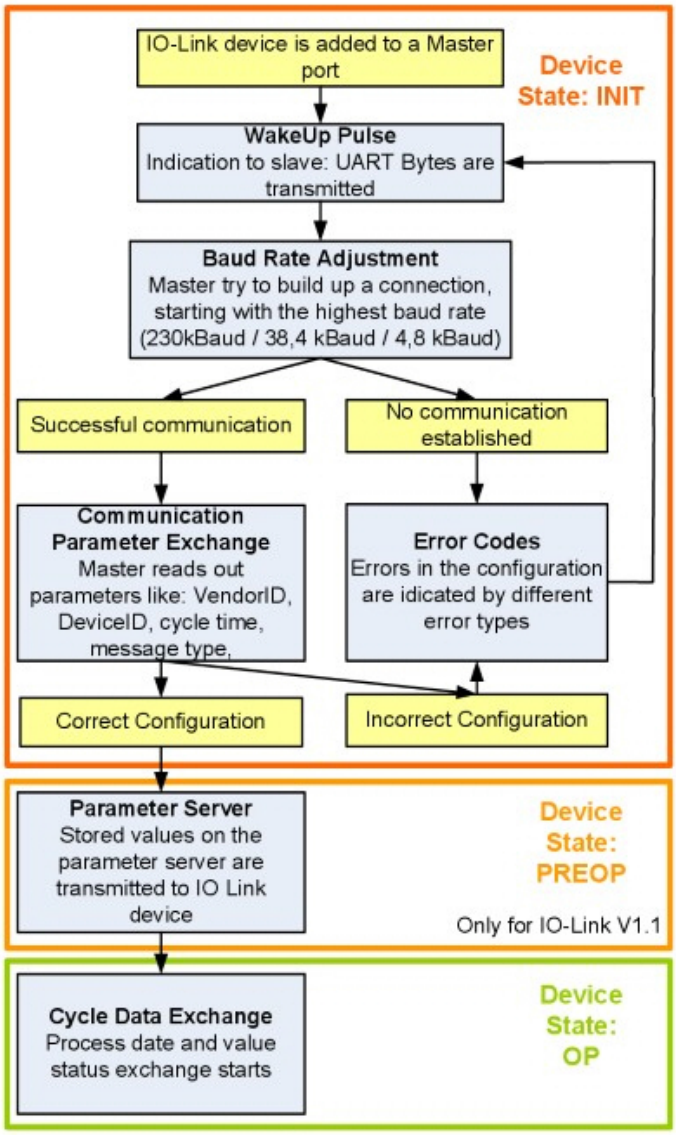
The IOLB-7214 meets the IO-Link specification 1.1. The IO-Link specification is included in the IEC standards and is accepted as IEC 61131-9 in an extended form. In this case, the new designation voltage SDCI is introduced.

An IO-Link system consists of an IO-Link Master, one or more IO-Link devices and sensors or actuators. The IO-Link Master provides the interface to the higher-level controller and controls the communication with the connected IO-Link devices. The Comtrol IO-Link Master series has four or eight IO-Link ports at which each one IO-Link device can be connected. Therefore, IO-Link is not a fieldbus, but rather is a peer-to-peer connection as shown in the figure below.



The connected IO-Link devices have individual parameter information detected during automatic scanning with the Comtrol IO-Link Master. Refer to *Configuring the IOLB-7214* on Page 19 for more information.

The structure of the IO-Link communication is shown in the following figure. In particular, this represents the sequence in the automatic scanning of the IO-Link ports.



The Pre-operate State occurs if the IO-Link device is v1.1 and if Data Storage is enabled then the device parameters are uploaded or downloaded.

Hardware Installation

This section provides installation information for the IOLB-7214.

Mounting the IOLB-7214

The following table provides information that you may require for installation.

IOLB-7214	
Housing material	PA6 (polyamide)
Casting compound	Polyurethane
Mounting	Two fastening holes Ø 3 mm for M3
Metal parts	Brass, nickel-plated
Contacts	CuZn, gold-plated
Installation position	Any
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Dimensions (H x W x D)	126 x 30 x 26.5 mm
Weight	180g 6.4oz

Note: *While mounting the IOLB-7214, protect all connectors against contamination. All connectors must have either a cable or plug to guarantee IP67 rating.*

Keep the following in mind when mounting the IOLB-7214.

- Mount the IOLB-7214 with two M3 bolts.
- The bolts must be longer than 15 mm. The fixing holes of the modules are not threaded.
- When assembling, remember that the connectors increases the overall height.

Connecting the IOLB-7214

Use the appropriate procedure to connect the IOLB-7214 to an IO-Link Master.

- *Installation With an IP67 Class A IO-Link Master* on Page 13
- *Installation With a Class A IP20 IO-Link Master* on Page 15

IOLB-7214 Power Supply Requirements

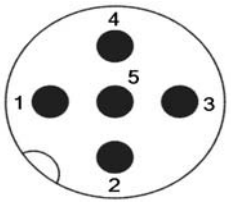
The power supply/supplies that you connect to the IOLB-7214 must meet the following requirements:

- 24VDC supplied by an isolating source and protected by means of a fuse (in accordance with UL248), rated maximum 4A or a 24VDC power source that satisfies NEC Class 2.
- A NEC Class 2 power supply shall not be connected in series or parallel with another (Class 2) power source.
- To meet the UL requirements, the IOLB-7214 must not be connected to unlimited power sources!

Note: *To meet the UL requirements, the IOLB-7214 must not be connected to telecommunications networks and must be operated at the ambient temperature range specified in the specifications.*

For additional information, see *IOLB-7214 Technical Specifications* on Page 7.

Pin	Input - Male
1	24V (L+) - electronics power
2	24V (L2+) - sensor or device power
3	GND (L-)
4	IO-Link (C/Q)
5	GND (2M)



The following Comtrol cables and M12 Y-splitter can be used to connect the IOLB-7214 to the Class A IP67 IO-Link Master models.

Comtrol Part Number	Description
1200143	Y Splitter, M12 5-poles, A-Coded, M to 2F
Varies by length†	Sensor cable, M12 5-poles, A-coded, M to F
Varies by length†	Power Cable, Comtrol IOLB, M12 A-Coded to wires
† Contact Comtrol Sales for the part number.	

Note: *It is recommended to pull the M12 connectors tight with a nut torque of 0.6 Nm.*

Installation With an IP67 Class A IO-Link Master

Use the following procedure to connect the IOLB-7214 to a Class A IP67 IO-Link Master.

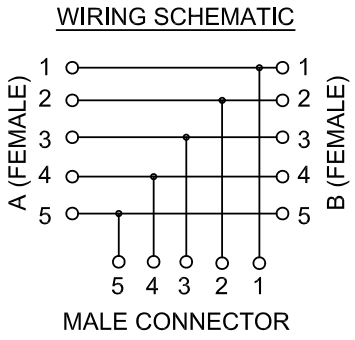
The images in this subsection shows connecting the 8-port IP67 model. Please note that the same procedures work for the 4-port model.

Note: *This procedure assumes that the IO-Link Master is powered on, connected to the network and the IP address has been programmed for your environment.*

1. Connect the M12 Y splitter to an available Comtrol IO-Link Master IO-Link port.

   This image shows:

   - IO-Link sensor cable connected between the IO-Link Master port and the Y Splitter (1200143).
   - Y Splitters connected directly to Ports 4 and 5.



Note: *In the next step, make sure that the 24V power supply or is not energized during the wiring.*

2. Connect the white and green wires of the Comtrol IOLB power cable to a U_a power source.
   a. Connect the white wire to the positive 24V terminal.
   b. Connect the green wire to the negative 24V terminal.
3. Connect the M12 connector end of the Comtrol IOLB power cable to one of the connectors on the Y-Splitter.

Note: *Connectors A and B are interchangeable on the Y Splitter.*

4. Connect the 5-pole (M12) sensor cable between the remaining M12 connectors on the Y-splitter and the IOLB-7214 IO-Link Port X1.
5. Apply power to the U_a power source connected to the IOLB-7214.
6. Verify that the following LEDs are lit:
   - Green 24V (L+) and 24V (2L+) LEDs on the IOLB-7214
   - Green IO-Link on the Comtrol IO-Link Master is lit

Note: *Refer to IOLB-7214 LEDs on Page 6 for detailed LED information.*

Installation With a Class A IP20 IO-Link Master

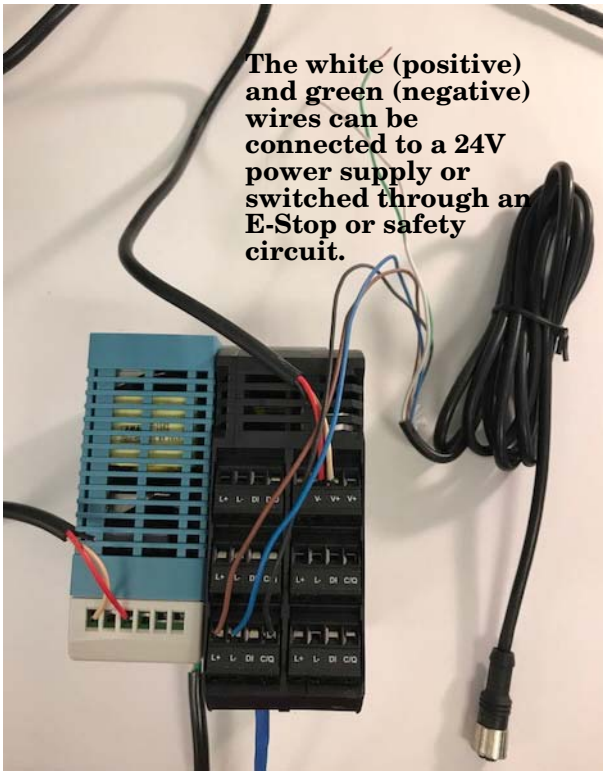
Use the following procedure to connect the IOLB-7214 to a Class A IP20 (DIN rail model) IO-Link Master.

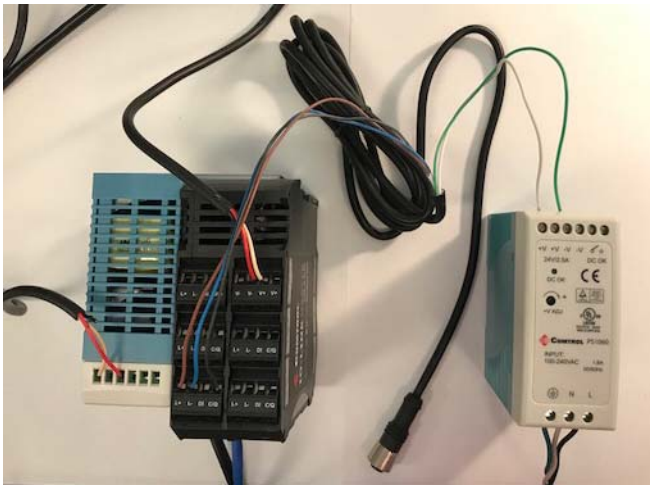
Note: *This procedure assumes that the IO-Link Master is powered on, connected to the network and the IP address has been programmed for your environment.*

1. Connect a M12 A-coded to bare wire cable to the IO-Link Master:
   - Black to C/Q
   - Blue to L-
   - Brown to L+

Note: *In the next step, make sure that the 24V power supply or is not energized during the wiring.*

2. Connect the white and green wires of the IO-Link cable to a U_a power source. The image below illustrates connecting to a power supply.
   c. Connect the white wire to the positive 24V terminal.
   d. Connect the green wire to the negative 24V terminal.
   e. Apply power to the U_a power source.

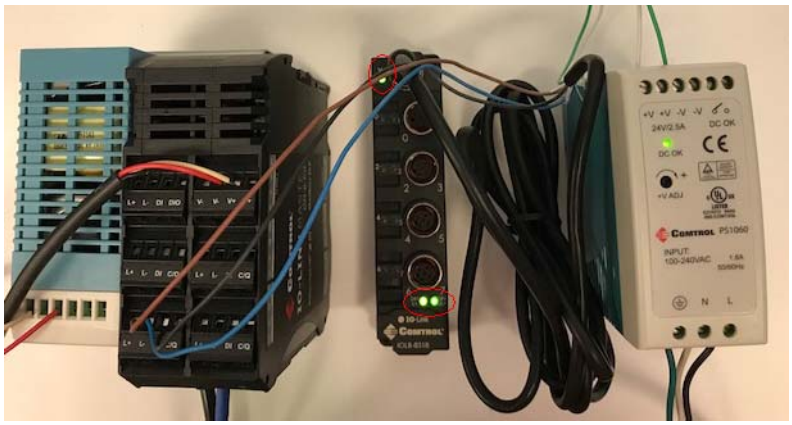




3. Connect the M12 connector from the IO-Link Master to the IOLB-7214 X1 connector.

4. Verify that the following LEDs are lit:
   - Green 24V (L+) and 24V (2L+) LEDs on the IOLB-7214
   - Green IO-Link on the Comtrol IO-Link Master is lit

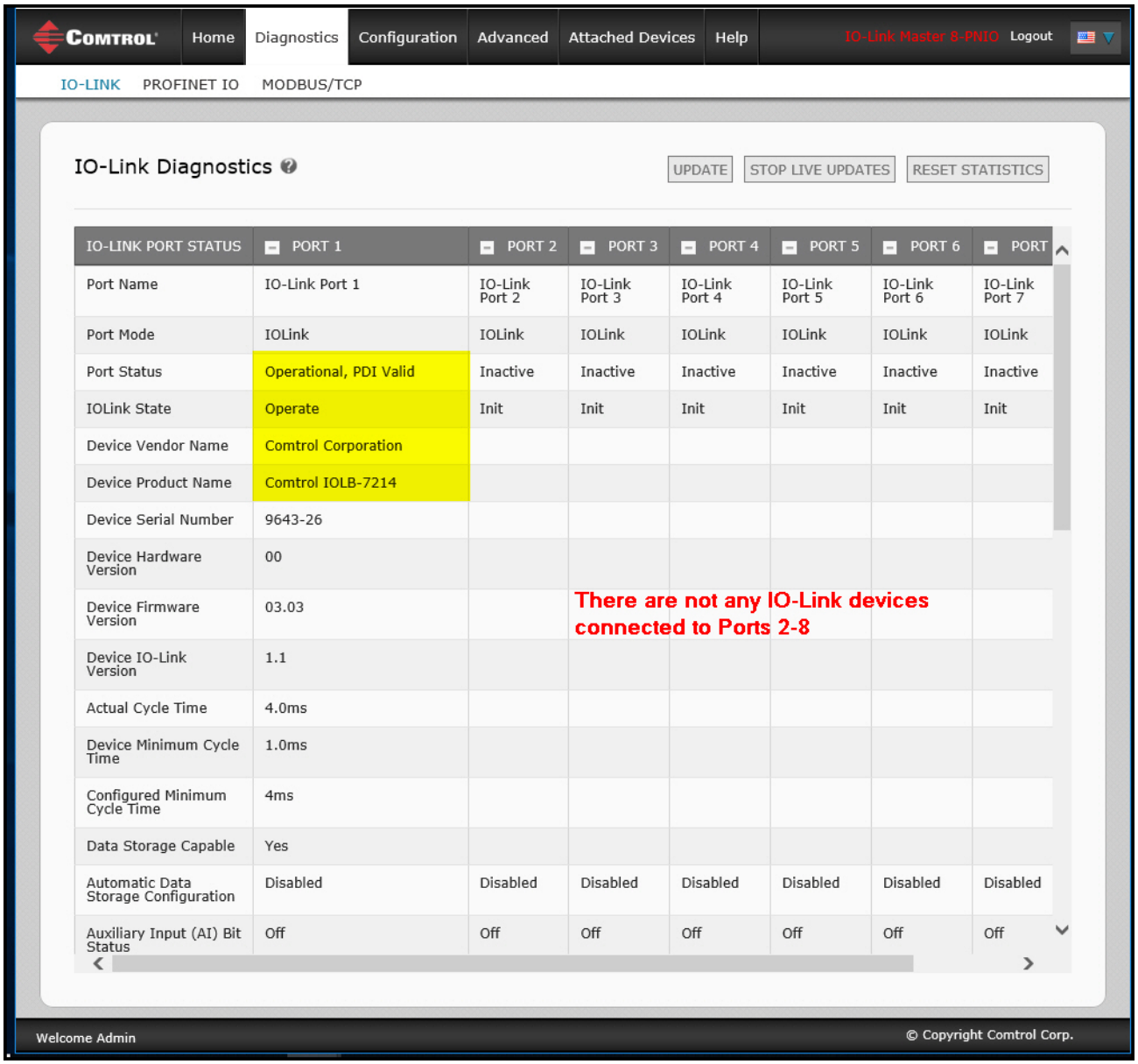
Note: *Refer to IOLB-7214 LEDs on Page 6 for detailed LED information.*



Comtrol IO-Link Master Diagnostic Page

You can also verify IOLB-7214 operation by viewing the Comtrol IO-Link Master **IO-Link Diagnostics** page.

1. Log into the Comtrol IO-Link Master using the IP address.
2. Click **Diagnostics | IO-Link**.



IO-LINK PORT STATUS	PORT 1	PORT 2	PORT 3	PORT 4	PORT 5	PORT 6	PORT
Port Name	IO-Link Port 1	IO-Link Port 2	IO-Link Port 3	IO-Link Port 4	IO-Link Port 5	IO-Link Port 6	IO-Link Port 7
Port Mode	IOLink	IOLink	IOLink	IOLink	IOLink	IOLink	IOLink
Port Status	Operational, PDI Valid	Inactive	Inactive	Inactive	Inactive	Inactive	Inactive
IOLink State	Operate	Init	Init	Init	Init	Init	Init
Device Vendor Name	Comtrol Corporation						
Device Product Name	Comtrol IOLB-7214						
Device Serial Number	9643-26						
Device Hardware Version	00						
Device Firmware Version	03.03						
Device IO-Link Version	1.1						
Actual Cycle Time	4.0ms						
Device Minimum Cycle Time	1.0ms						
Configured Minimum Cycle Time	4ms						
Data Storage Capable	Yes						
Automatic Data Storage Configuration	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled
Auxiliary Input (AI) Bit Status	Off	Off	Off	Off	Off	Off	Off

Configuring the IOLB-7214

This section discusses loading the IODD on the Comtrol IO-Link Master.

Locating the IOLB-7214 IODD Files

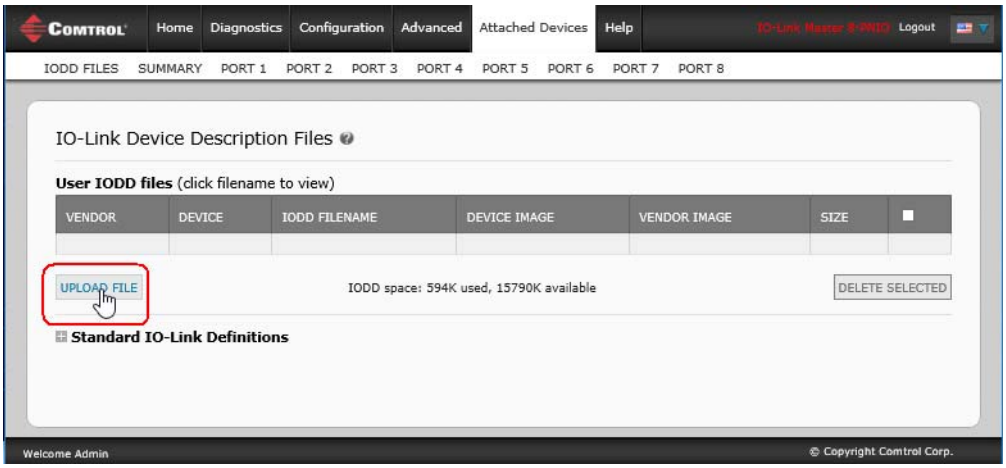
The IOLB-7214 IODD files are located on the Comtrol download site using one of these addresses:

- http://downloads.comtrol.com/IO_Link_Block/IOLB_7214/IODD/
- ftp://ftp.comtrol.com/IO_Link_Block/IOLB_7214/IODD/

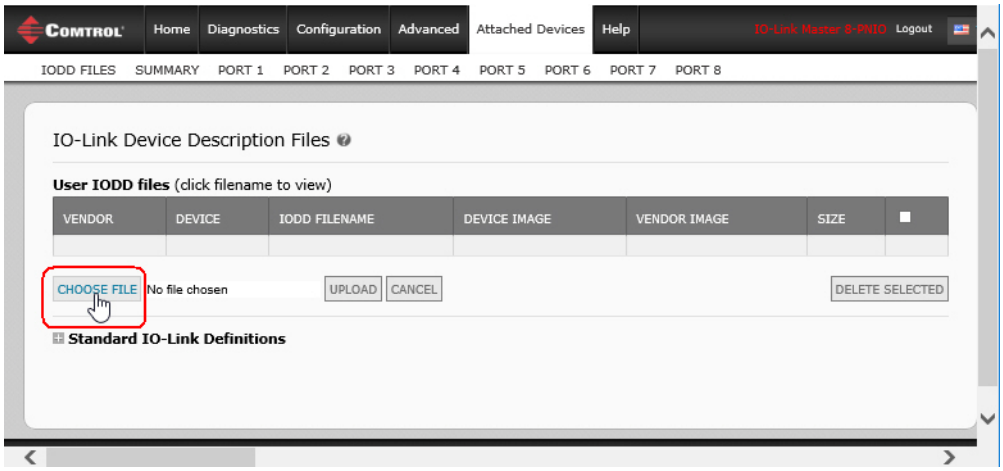
Loading the IODD Files Onto the Comtrol IO-Link Master

Use the following procedure to load the IOLB-7214 IODD file.

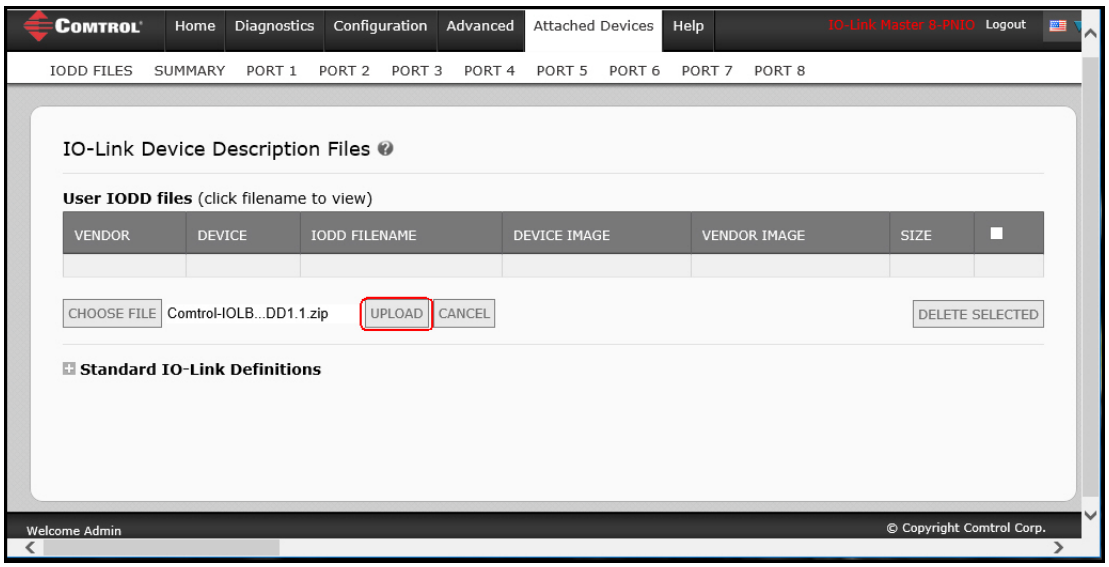
1. If necessary, download the IOLB-7214 IODD files.
2. Log into the Comtrol IO-Link Master using the IP address.
3. Click **Attached Devices**.
4. Click the **UPLOAD FILE** button.



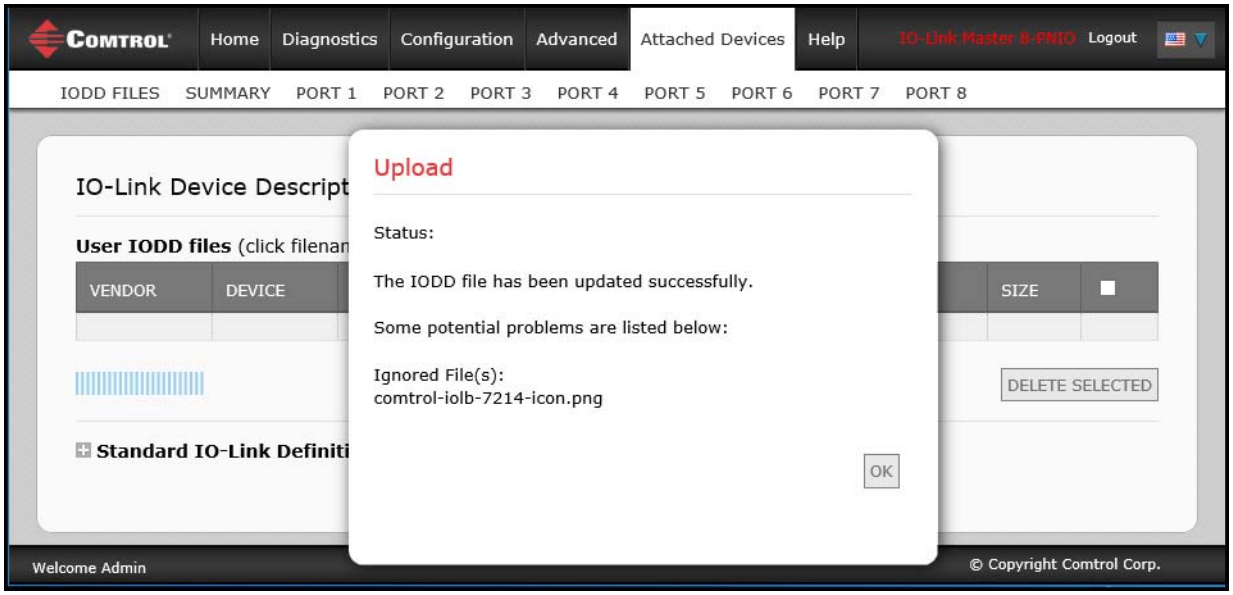
5. Click the **CHOOSE FILE** button.



6. Browse to the location you saved the IODD file and select the file.
7. Click the **UPLOAD** button.

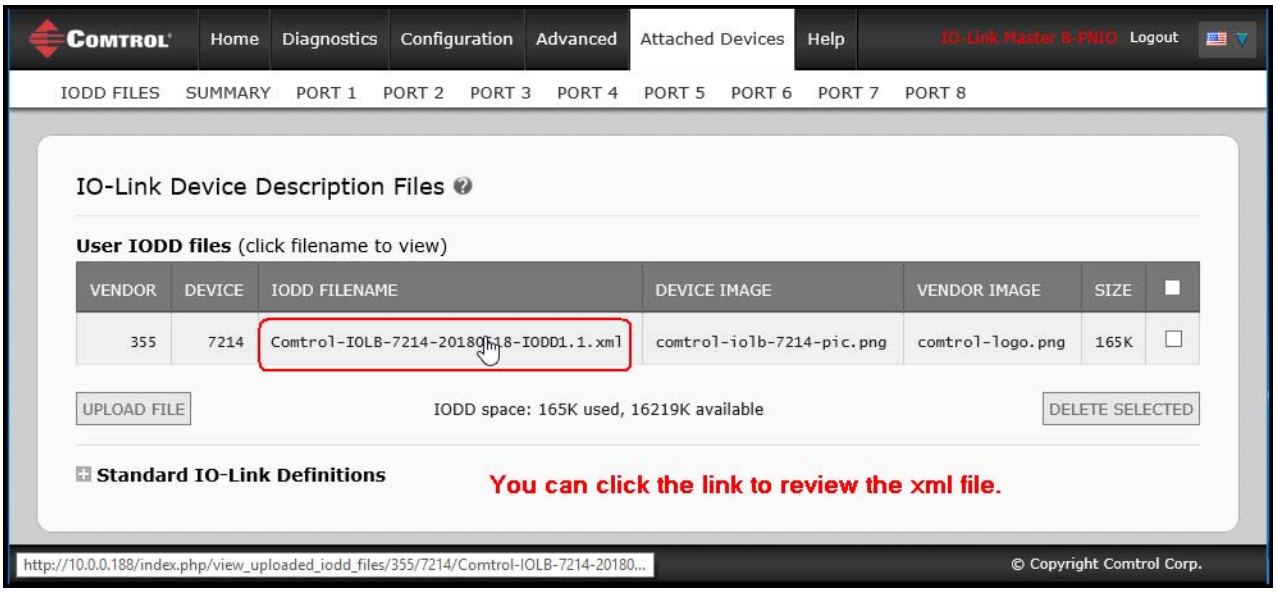


8. Click the **Ok** button.

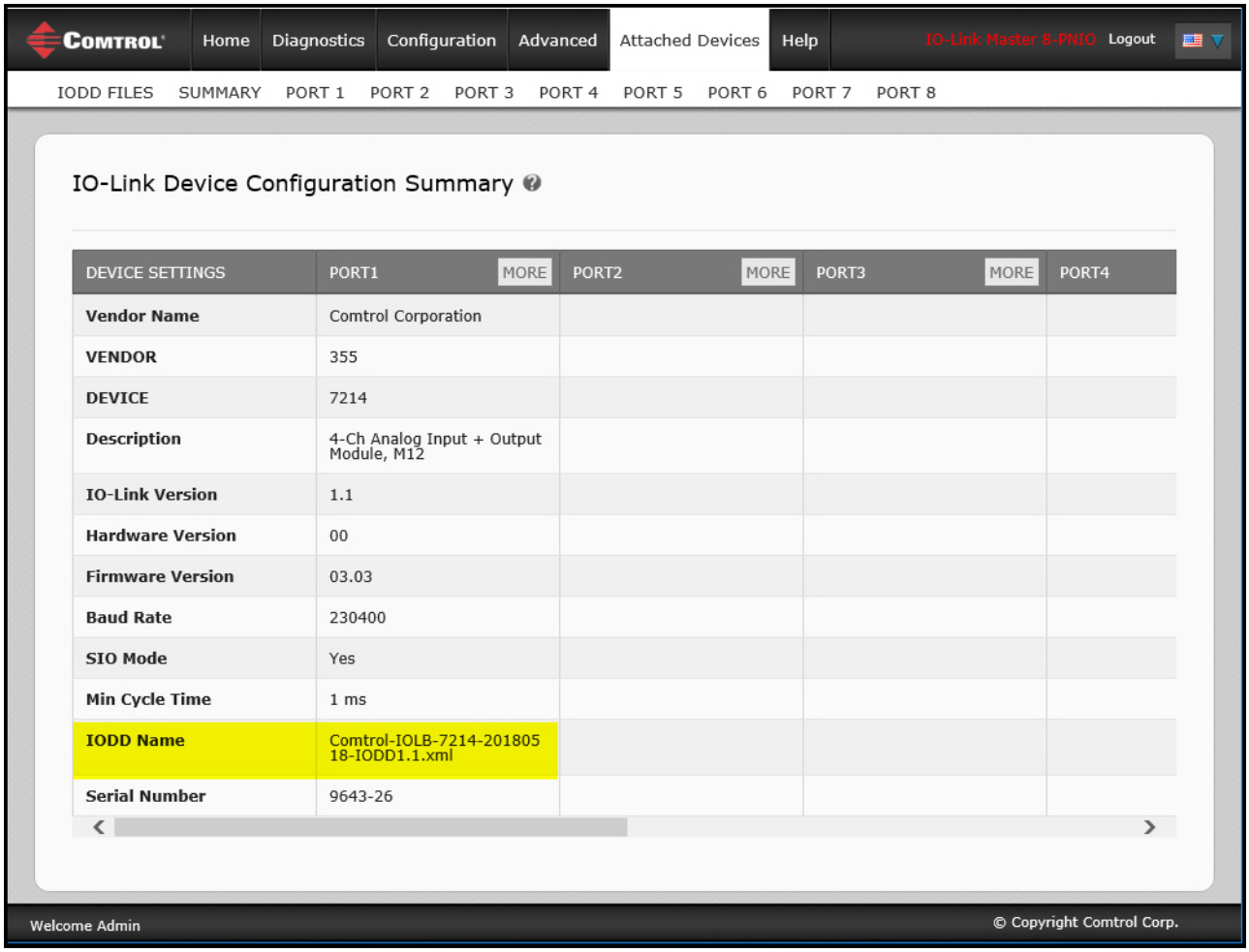


Note: *The above message is expected behavior because the .icon file is not required by the XML file.*

9. Optionally, click the file name if you want to view the xml file.



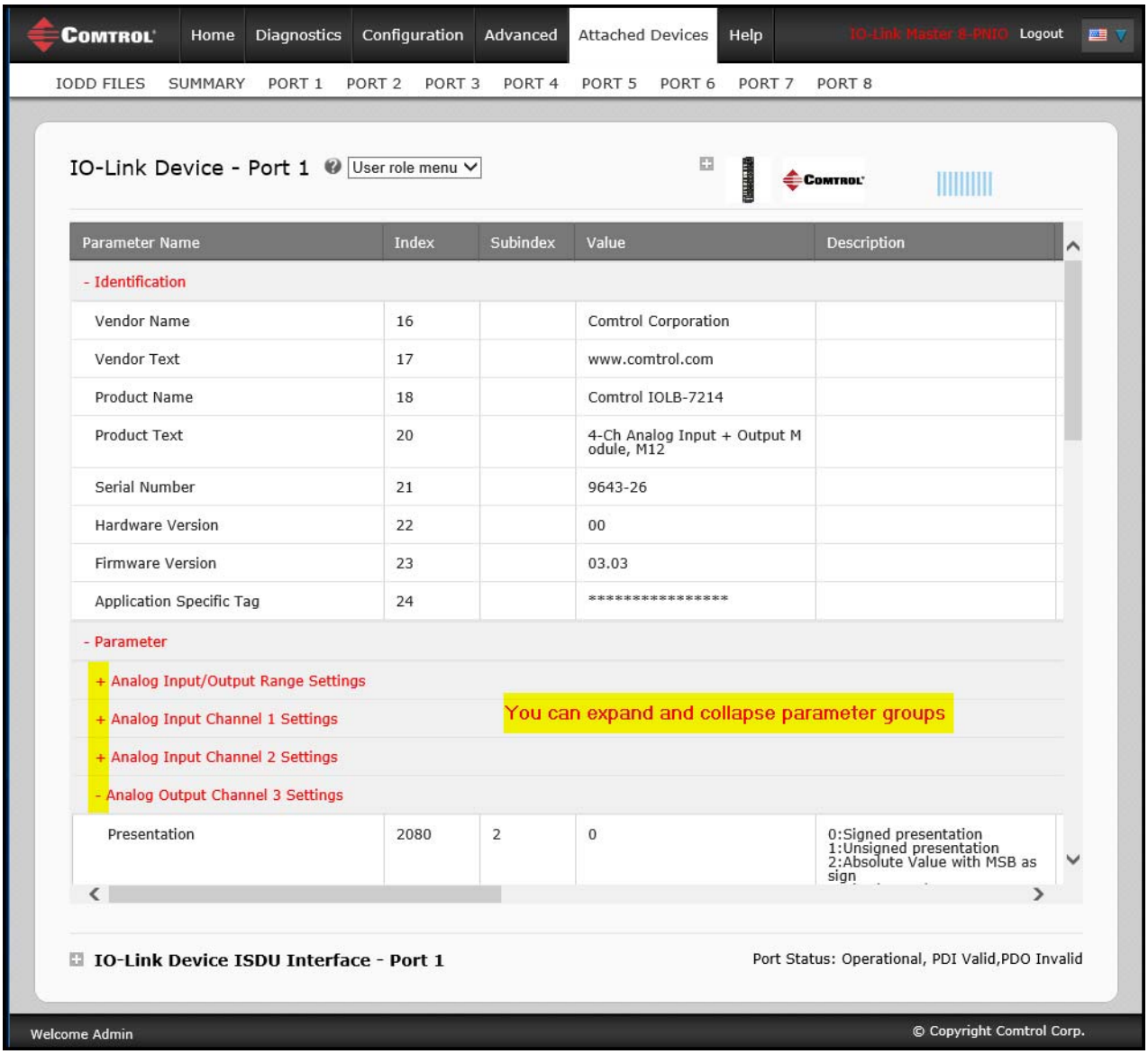
10. Click the **SUMMARY** link to verify that the correct IODD file loaded. If a file name displays in the IODD Name field that means that the correct IODD file is loaded.



Configuring the IOLB-7214

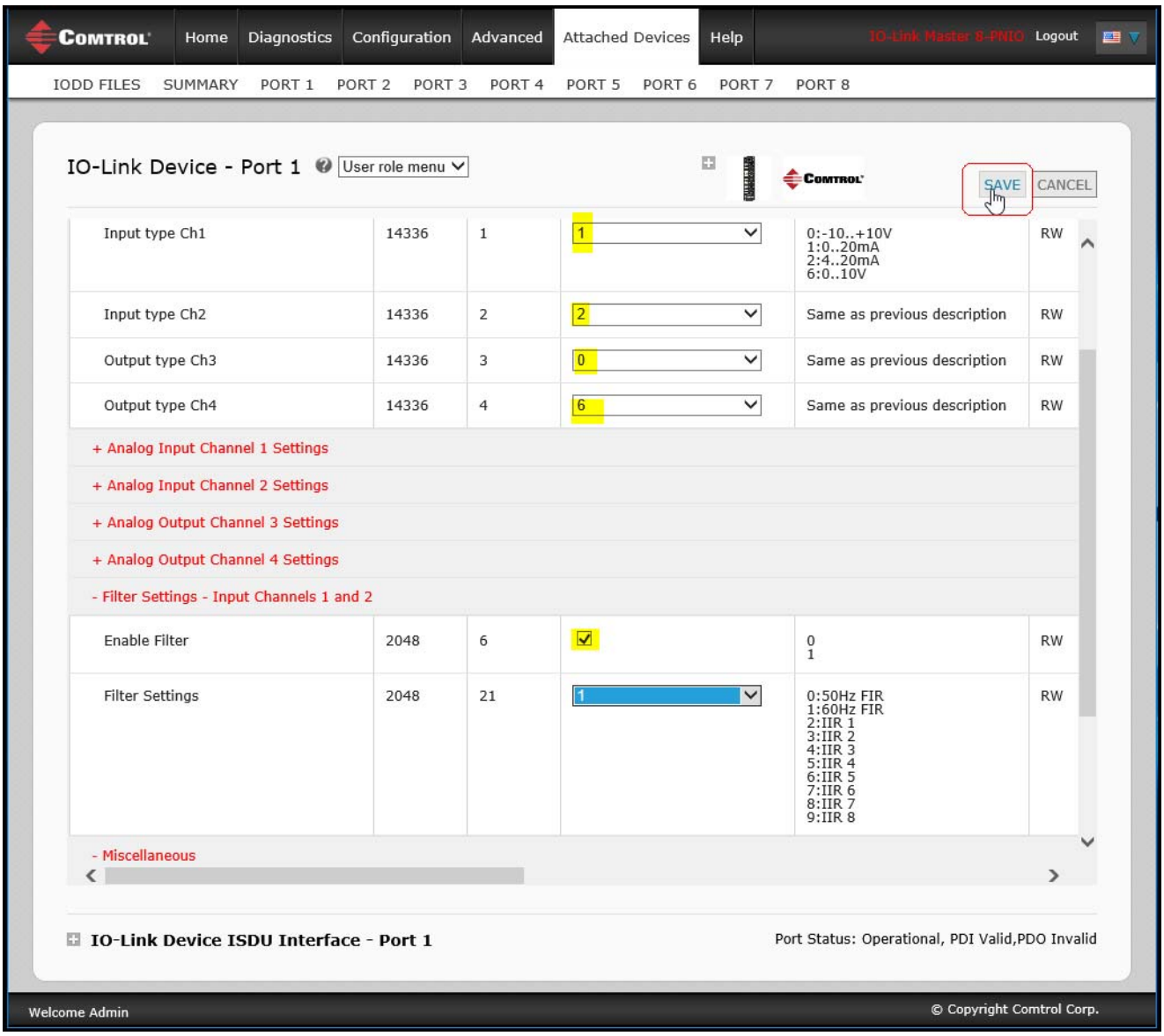
After loading the IODD file, you are ready to configure the channels on the IOLB-7214.

1. If necessary, log into the Comtrol IO-Link Master.
2. Click **Attached Devices | Port x,** where x is the IO-Link port that you have attached the IOLB-7214.
3. Click the **EDIT** button.



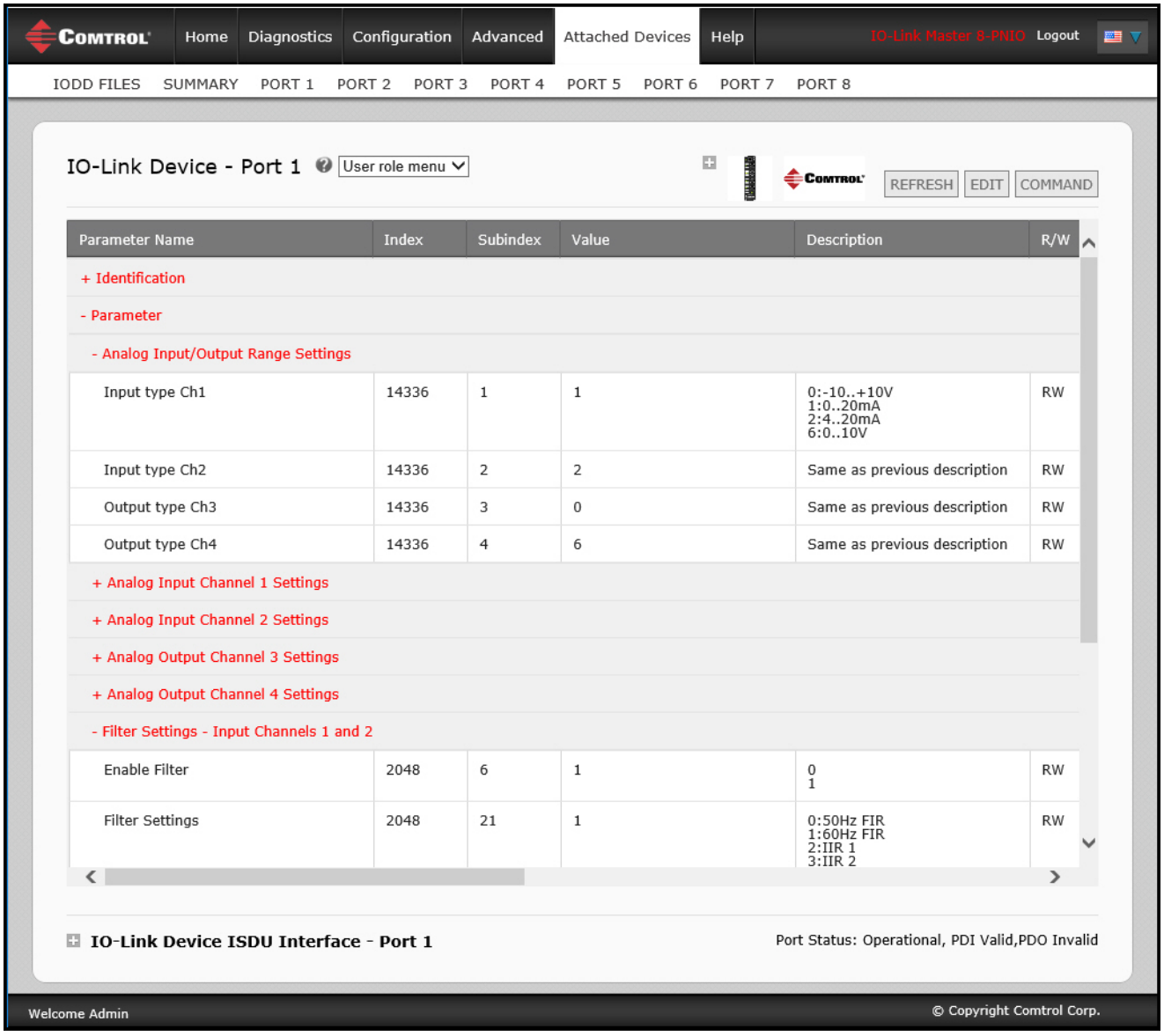
Note: *For information about using the Comtrol IO-Link Master, refer to the help system or appropriate User Guide for the model.*

4. Make the necessary changes to reflect the analog devices that you intend on connecting and click the **SAVE** button.



Note: *See Filters (Common to All Input Channels) on Page 31 and IOLB-7214 Parameters on Page 45 for more information.*

After the page is saved, note that the changes have been implemented.



Technical Data Overview

This section provides supporting information for the IOLB-7214:

Note: *Refer to Object Descriptions on Page 45 for more information.*

Analog Input/Output Range Settings (Index 14336)

Use Index 14336 (Sub-Indexes 1-4) to set the appropriate voltage or current range for each channel.

Analog Input Channels 1 & 2 Parameters

The following subsections provide detailed channel parameter information that you may need.

The following subsections discuss common Sub-Indexes for the these channel parameter Indexes.

Analog Input Channels	Index
1	2048
2	2064

Note: *See Filters (Common to All Input Channels) on Page 31 for information about filtering.*

Presentation (Sub-Index 02)

Measured value can be output in the following formats: Signed integer (default), Unsigned integer, and Absolute Value with MSB.

- **Signed Integer Representation:** The negative output value is represented in two's complement (negated + 1). Maximum representation range for 16 bits = -32768 to +32767dec.

Input signal				Value	
+/- 10V	**0 - 20mA**	**4 - 20mA**	**0 - 10V**	**Decimal**	**Hexadecimal**
10V	20mA	20mA	10V	32767	0x7FFF
5V	10mA	12mA	5V	16383	0x3FFF
0V	0mA	4mA	0V	0	0x0000
-5V	-	-	-	-16383	0xC001
-10V	-	-	-	-32767	0x8000

- **Unsigned Integer Representation**: The output value is represented with 15-bit resolution without sign, therefore polarity detection is no longer possible. Maximum representation range for 16 bits = 0 to $+32767_{dec}$.
- **Absolute Value With MSB**: The output value is displayed in magnitude-sign format: MSB=1 (highest bit) in the case of negative values. Maximum representation range for 16 bits = -32768 to $+32767_{dec}$.

Input values (+/- 10V)	Representation (values dec. / values hex.)	
	Unsigned Integer	**Absolute Value With MSB As Sign**
10V	32767 / 0x7FFF	32767 / 0x7FFF
5V	16383 / 0x3FFF	16383 / 0x3FFF
0V	0 / 0x0000	0 / 0x0000
-5V	16384 / 0x4000	[-16384] / 0xC000
-10V	32767 / 0x7FFF	[-32767] / 0xFFFF

The Presentation types, *Unsigned integer* and *Absolute Value With MSB*, have no function for unipolar modes. There is no change in the presentation in the positive range.

Siemens Bits (Sub-Index 05)

When set to 1, the status displays are superimposed on the lowest three bits of the process data input. In the event that an **overrange** or **underrange** occurs, Bit 0 is set. See *Input Data Flow and Correction Calculations* on Page 32 and *PDI (Process Data Input) Channel Information* on Page 36 for more information.

Enable Limit 1 | Enable Limit 2 (Sub-Indexes 7 and 8)

Sub-Index 7 or 8 respectively serve to enable the Limit 1 and Limit 2 value monitoring.

Swap Limit Bits (Sub-Index 14)

When set to 1, the limits are inverted. See *Limit 1 | Limit 2 (Sub-Indexes 19 and 20)* on Page 29.

Limit 1 | Limit 2 (Sub-Indexes 19 and 20)

When the analog value (Y_S) exceeds or falls below the value entered in Limit 1 and Limit 2, then the Limit bits in the PDI are set according to the table below. See *PDI (Process Data Input) Channel Information* on Page 36.

Limit Swap (Sub-Index 14)	Limit Bits (2 Bits) Value
FALSE (default)	0: not active
	1: value <limit
	2: value> limit
	3: value = limit value
TRUE	0: not active
	1: value> limit
	2: value <limit
	3: value = limit value

Note: *The limit evaluation is based on a Signed representation. The conversion to the desired presentation (Sub-Index 02) takes place only after the limit evaluation.*

Limit Analysis Example:

Port1, channel 1; Limit 1 and Limit 2 enabled, limit 1 = 2.8V, limit 2 = 7.4V, presentation: signed integer, swap = false.

Input Channel 1	Limit 1 Bits	Limit 2 Bits
1.8V	0x01hex	0x01hex
2.8V	0x03hex	0x01hex
4.2V	0x02hex	0x01hex
8.5V	0x02hex	0x02hex

Enable Vendor Calibration (Sub-Index 11)

When vendor calibration is enabled, the factor calibration (offset and gain) is applied to the raw input signal. Vendor calibration parameters cannot be changed. The following tables provide information about vendor calibration values, which is displayed under the Observation group for each channel.

Channel	Index
1	2063
2	2079

Sub-Index	Description
01	R0 offset (vendor compensation)
02	R0 gain (vendor compensation)
03	R1 offset (vendor compensation)
04	R1 gain (vendor compensation)
05	R2 offset (vendor compensation)
06	R2 gain (vendor compensation)

Enable User Scale (Sub-Index 1)

User scaling is enabled using Sub-Index 1. **User scale** provides offset and gain as discussed in the next two subsections.

Refer to *Input Data Flow* on Page 32 for related information.

User Scale Offset (Sub-Index 17)

When **User Scale** is enabled using Sub-Index 1, use Sub-Index 17 to configure the offset.

User Scale Gain (Sub-Index 18)

When **User Scale** is enabled using Sub-Index 1, use Sub-Index 18 to configure the gain.

$$\text{Gain} = \frac{\text{Sub-Index 18}}{65536}$$

Enable User Calibration (Sub-Index 10)

User calibration is enabled using Sub-Index 10. User calibration provides offset and gain as discussed in the next two subsections.

Refer to *Input Data Flow* on Page 32 for related information.

User Calibration Offset Sub-Index 23)

When user calibration is enabled using Sub-Index 10, use Sub-Index 23 to configure the offset.

User Calibration Gain (Sub-Index 24)

When user calibration is enabled using Sub-Index 10, use Sub-Index 24 to configure the gain.

$$\text{Gain} = \frac{\text{Sub-Index 24}}{16384}$$

Filters (Common to All Input Channels)

This subsection provides the following information:

Filter Enable (Index 2048 | Sub-Index 6)

When the filter is enabled, the filter settings are applied to all input channels.

Filter Setting (Index 2048 | Sub-Index 21)

The IOLB-7214 incorporates a digital filter which, depending on the selected setting, can adopt the characteristics of a Finite Impulse Response filter (FIR filter), or an Infinite Impulse Response filter (IIR filter). The filter can also be deactivated (default).

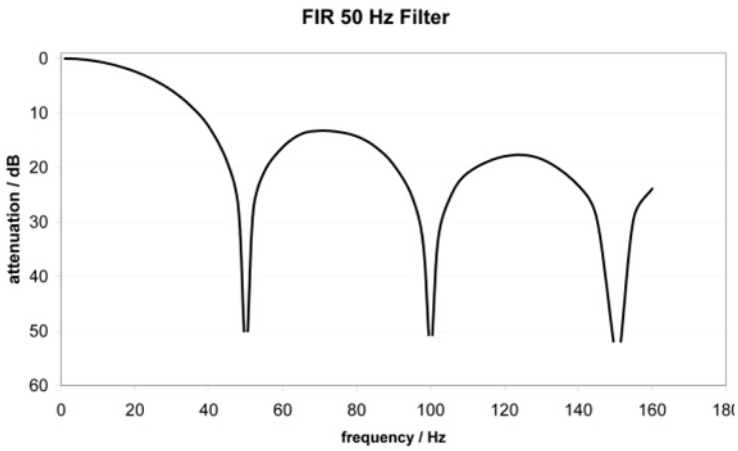
Note: *The filter frequencies are set for all channels of the IOLB-7214.*

FIR Filter

The filter performs a notch filter function and determines the conversion time of the module. The higher the filter frequency, the faster the conversion time. A 50 Hz and a 60 Hz filter are available.

Notch filter means that the filter has zeros (notches) in the frequency response at the filter frequency and multiples thereof, that is, it attenuates the amplitude at these frequencies.

The FIR filter functions as a non-recursive filter.



Note: *Typical attenuation curve of notch filter at 50 Hz*

Filter characteristics FIR filter (Channels 1- 4)			
Filter	Attenuation	Limit frequency (-3 dB)	Conversion time
50 Hz FIR	> 50 dB	22 Hz	625 µs
60 Hz FIR	> 40 dB	26 Hz	521 µs

IIR Filter

The filter with IIR characteristics is a discrete time, linear, time invariant filter that can be set to eight levels (level 1 = weak recursive filter, up to level 8 = strong recursive filter).

The IIR can be understood to be a moving average value calculation after a low-pass filter.

IIR Filter	-3 dB Limit Frequency (50 µs Sample Time)
IIR 1	400 Hz
IIR 2	220 Hz

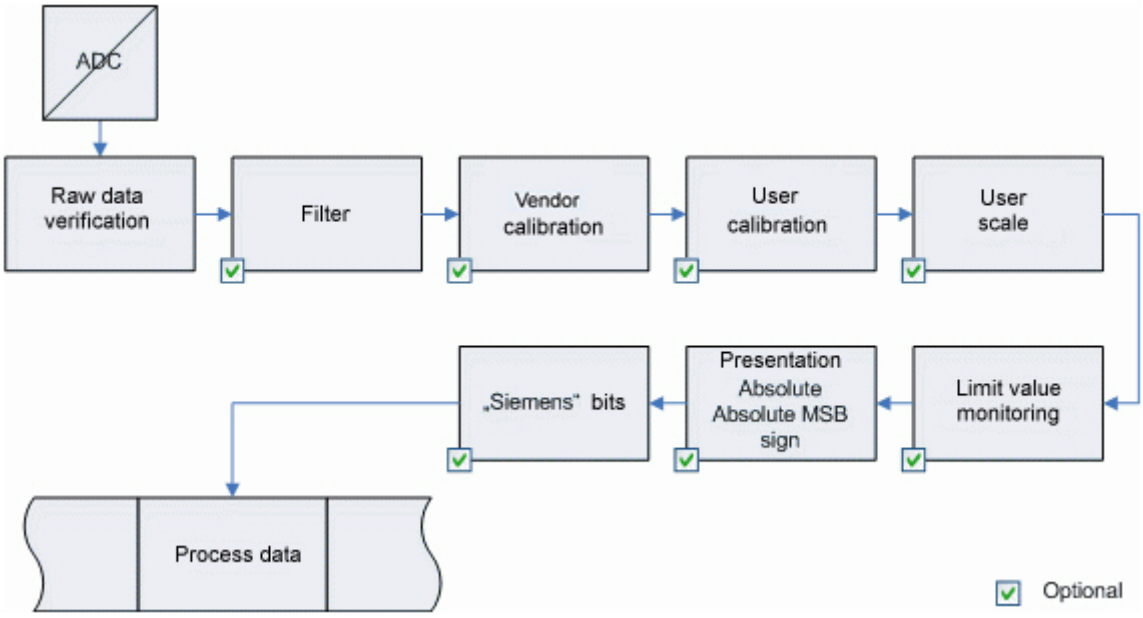
IIR Filter	-3 dB Limit Frequency (50 µs Sample Time)
IIR 3	100 Hz
IIR 4	50 Hz
IIR 5	24 Hz
IIR 6	12 Hz
IIR 7	6,2 Hz
IIR 8	3,0 Hz

Input Data Flow and Correction Calculations

This subsection contains the following topics:

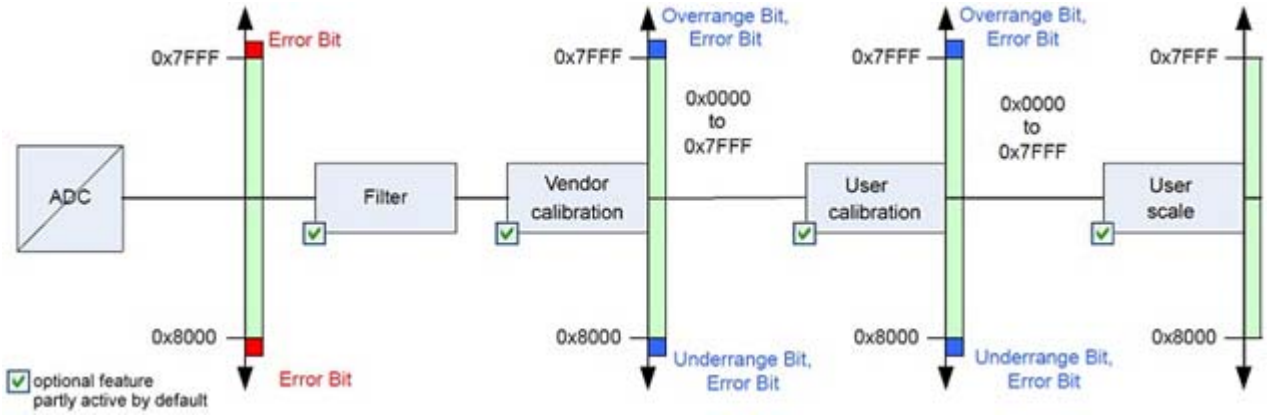
Input Data Flow

The flowchart below shows the input data flow of the IOLB-7214 (processing of the raw data).



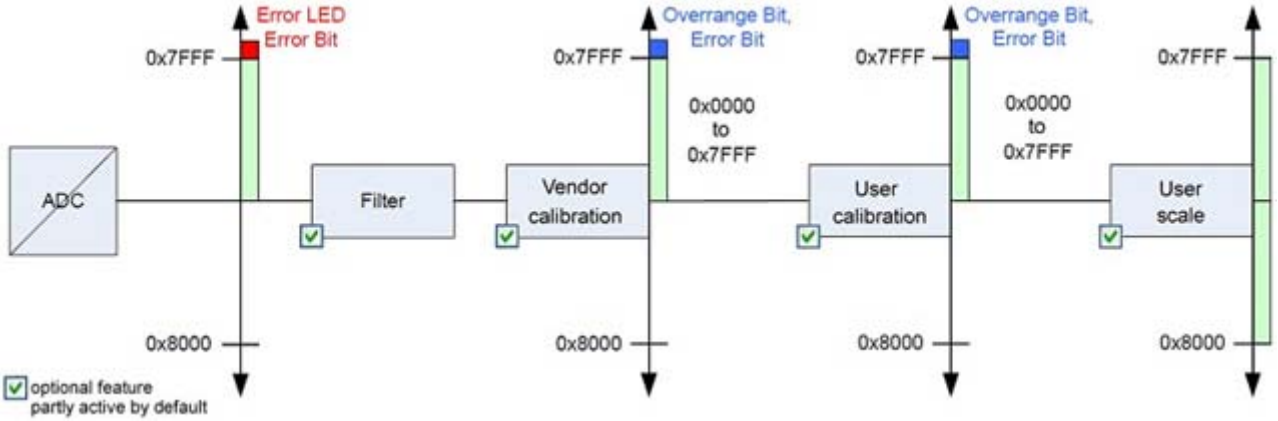
Correction Calculation (-10V to +10V)

This figure shows the correcting calculation of the raw values to the output values if the range is over- or undershot.



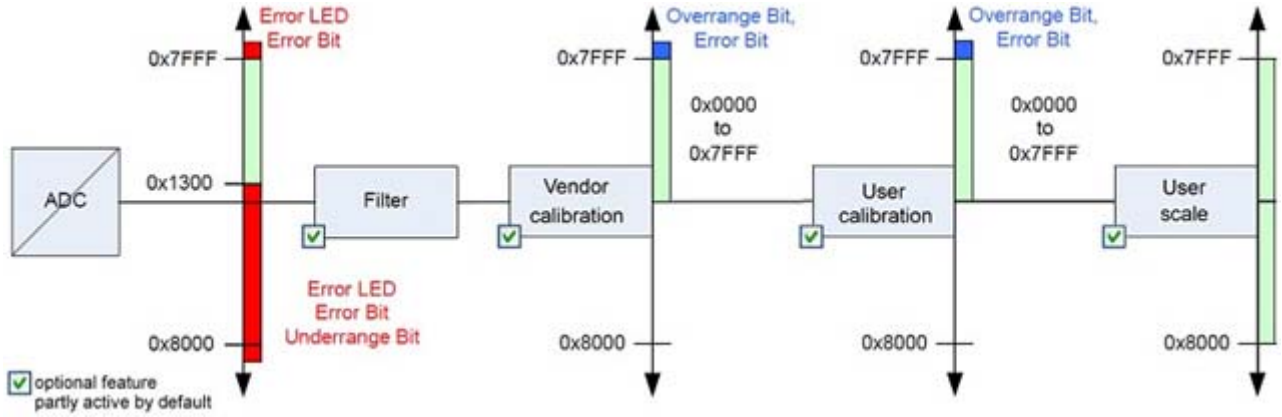
Correction Calculation (0 to 20mA)

This figure shows the correcting calculation of the raw values to the output values if the range is over- or undershot.



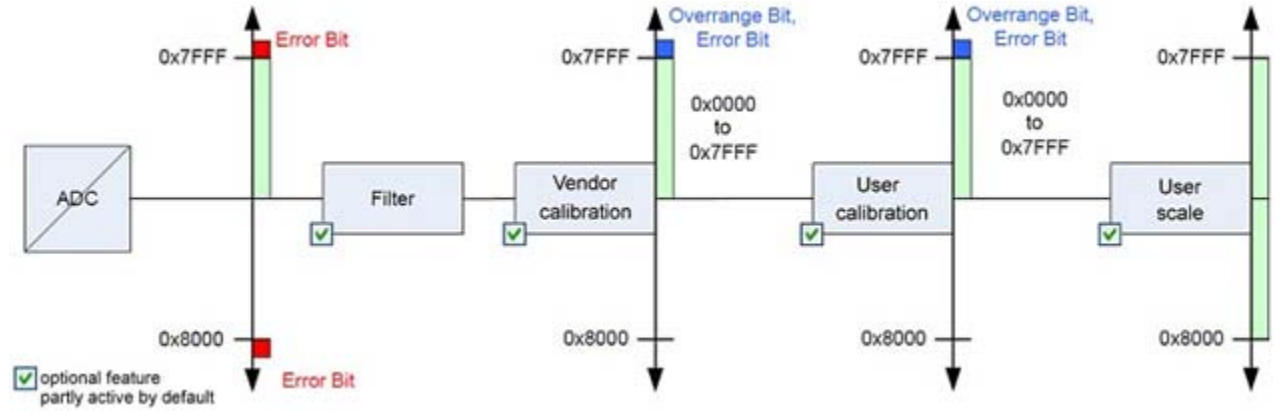
Correction Calculation (4 to 20mA)

This figure shows the correcting calculation of the raw values to the output values if the range is over- or undershot.



Correction Calculation (0 to 10V)

This figure shows the correcting calculation of the raw values to the output values if the range is over- or undershot.



Process Data Calculations

The IOLB-7214 records measured values continuously and places the raw value of its A/D converter into the ADC raw value objects 2062, 2078, 2094, and 2110. The calculation of the correction with the vendors calibration values takes place after each acquisition of the analog signal. User scaling then follows (optionally):

$$Y_H = (X_{ADC} - B_H) * A_H$$

Measured value following vendor calibration ($Y_H = X_{ADC}$), if vendor calibration is disabled.

$$Y_A = (Y_H - B_A) * A_A$$

Measured value following user calibration ($Y_A = Y_H$), if user calibration is disabled.

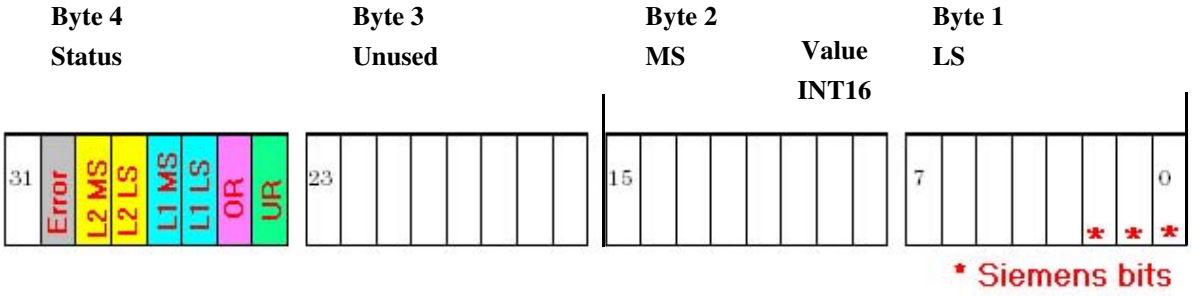
$$Y_S = Y_A * A_S * 22^{-16} + B_S$$

Measured value following user scale $Y_S = Y_A$, if user scale is disabled.

Name	Designation	Index	Sub-Index
X_{ADC}	Output value of the A/D converter	2062, 2078, 2094, 2110	01
B_H	Vendor calibration offset (only changeable if Indexes 2048, 2064, 2080, or 2096; Sub-Index 11 is set)	2063, 2079, 2095, 2111	01, 03, 05
A_H	Vendor calibration gain (only changeable if Indexes 2048, 2064, 2080, or 2096; Sub-Index 11 is set)	2063, 2079, 2095, 2111	02, 04, 06
Y_H	Measuring value after manufacturer calibration	-	
B_A	User calibration offset	2048, 2064, 2080, 2096	23
A_A	User calibration gain	2048, 2064, 2080, 2096	24
Y_A	Measuring value after user calibration	-	
B_S	User scaling offset (can be activated via indexes 2048, 2064, 2080, or 2096 Sub-Index: 1)	2048, 2064, 2080, 2096	14
A_S	User scaling gain (can be activated via indexes 2048, 2064, 2080, or 2096 Sub-Index: 1)	2048, 2064, 2080, 2096	18
Y_S	Process data for controller, measuring value after user scale	-	

PDI (Process Data Input) Channel Information

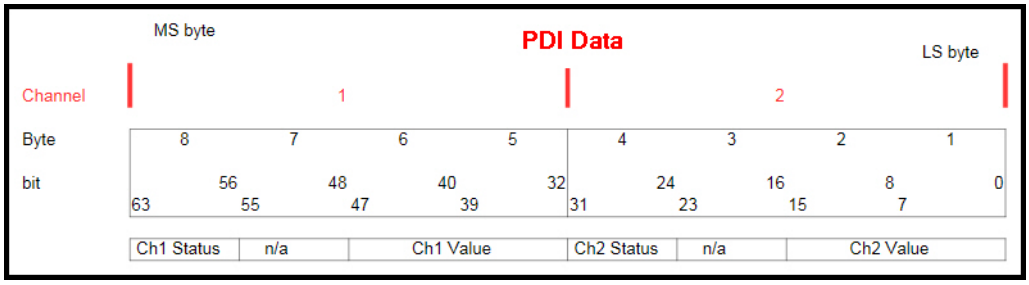
This image illustrates the PDI channel data for one channel on the IOLB-7214.



Where:

- **UR** is Under-range
- **OR** is Over-range
- **L1LS** is Limit 1 LS
- **L1MS** is Limit 1 MS
- **L2LS** is Limit 2 LS
- **L2MS** is Limit 2 MS
- Siemens bits are superimposed over 3 bits of PDI

This image illustrates all 16 PDI data bytes from the IOLB-7214.

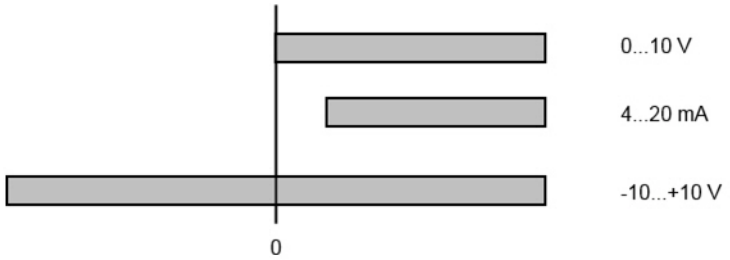


Analog Specifications

This subsection contains the following information:

Full Scale Value

An I/O device with an analog input measures over a nominal measuring range that is limited by an upper and a lower limit (initial value and end value); these can usually be taken from the IOLB-7214 designation. The range between the two limits is called the measuring span and corresponds to the equation (end value - initial value). Analogous to pointing devices this is the measuring scale (see IEC 61131) or also the dynamic range.



For the above examples this means:

- Measuring range 0 to 10V: asymmetric unipolar, full scale value = 10V, measuring span = 10V
- Measuring range 4 to 20mA: asymmetric unipolar, full scale value = 20mA, measuring span = 16mA
- Measuring range -10 to +10V: symmetric bipolar, full scale value = 10V, measuring span = 20V

± Measuring Error [% of the Full Scale Value] (Also: Measurement Error)

The relative measuring error is referenced to the full scale value and is calculated as the quotient of the largest numerical deviation from the true value (**measuring error**) referenced to the full scale value.

Measurement Error = Maximum Deviation/Full Scale Value

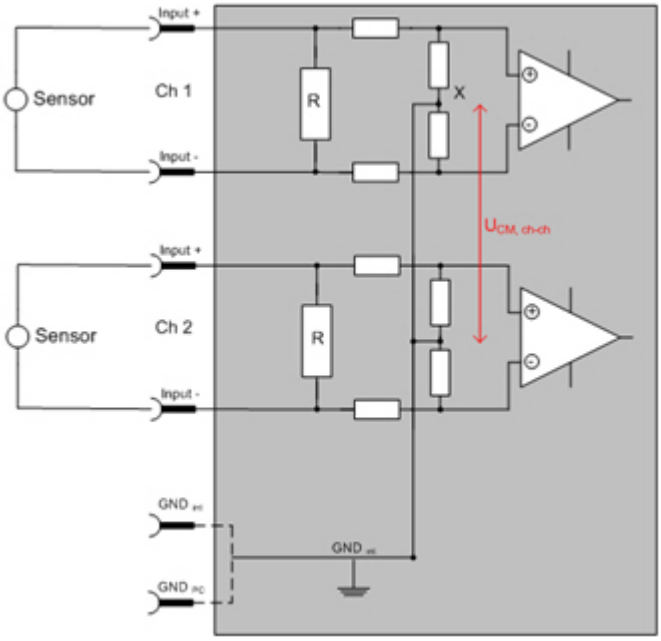
The measuring error is generally valid for the entire permitted operating temperature range, also called the *usage error limit* and contains random and systematic portions of the referred device (that is, all influences such as temperature, inherent noise, aging, etc.).

It is always to be regarded as a positive/negative span with ±, even if it is specified without ± in some cases. The maximum deviation can also be specified directly.

Example: Measuring range 0 to 10V and measuring error < ± 0.3 % full scale value - maximum deviation ±30mV in the permissible operating temperature range.

Differential Typification

This diagram shows the DIFF module.



Note: *Dashed lines indicate that the respective connection may not necessarily be present in each DIFF module.*

The basic rule:

- Analog measurements always take the form of voltage measurements between two potential points. For voltage measurements a large R is used, in order to ensure a high impedance. For current measurements a small R is used as shunt. If the purpose is resistance measurement, corresponding considerations are applied.
  - Comtrol generally refers to these two points as input+/signal potential and input-/reference potential.
  - For measurements between two potential points two potentials have to be supplied.
  - Regarding the terms *single-wire connection* or *three-wire connection*, please note the following for pure analog measurements: three- or four-wire connections can be used for a sensor supply, but are not involved in the actual analog measurement, which always takes place between two potentials/wires.
- The term *electrical isolation* should be clarified in advance with regard to the channel connection a distinction is made in terms of how the channels:
  - Within a module relate to each other, or
  - Of several modules relate to each other.

The property of electrical isolation indicates whether the channels are directly connected to each other.

- The IOLB-7214 features electrical isolation between the field/analog side and the IO-Link side.
- Differential channels are not electrically isolated channel to channel.
- Analog measuring channels are subject to technical limits, both in terms of the recommended operating range (continuous operation) and the destruction limit. Refer to *IOLB-7214 Technical Specifications* on Page 7 for information about channel limits.

Differential Explanation

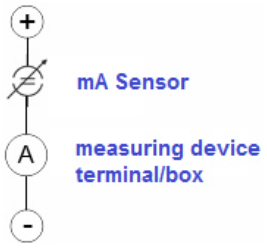
- Differential measurements provide the most flexibility. You can choose both connection points, input+/ signal potential and input-/reference potential, within the framework of the technical specification.
- Since a differential input is configured symmetrically internally (see diagram), there will be a mid-potential (X) between the two supplied potentials that is the same as the internal ground/reference ground for this channel. The technical property VCM (common-mode voltage) indicates the degree to which the mean voltage of the channels may differ.

- The internal reference ground may be accessible as connection point at the IOLB-7214, in order to stabilize a defined GND potential in the IOLB-7214. In this case it is particularly important to pay attention to the quality of this potential (noiselessness, voltage stability). At this GND point a wire may be connected to make sure that $V_{CM\ max}$ is not exceeded in the differential sensor cable. If differential channels are not electrically isolated, usually only one $V_{CM\ max}$ is permitted.
- Differential measurement in combination with correct sensor wiring has the special advantage that any interference affecting the sensor cable (ideally the feed and return line are arranged side by side, so that interference signals have the same effect on both wires) has very little effect on the measurement, since the potential of both lines varies jointly (hence the term common mode). In simple terms: Common-mode interference has the same effect on both wires in terms of amplitude and phasing.
- Nevertheless, the suppression of common-mode interference within a channel or between channels is subject to technical limits, which are specified in the *IOLB-7214 Technical Specifications* on Page 7.

Typification of the 2/3/4-Wire Connection of Current Sensors

Current transducers/sensors/field devices (referred to in the following simply as *sensor*) with the industrial 0/4-20mA interface typically have internal transformation electronics for the physical measured variable (temperature, current, etc.) at the current control output. These internal electronics must be supplied with energy (voltage, current). Thus separates the sensors into self-supplied (2-wire) or externally supplied sensors (3-wire or 4-wire):

- Self-supplied sensors
  - The sensor draws the energy for its own operation via the sensor/signal wires + and -. So that enough energy is always available for the sensor's own operation and open-circuit detection is possible, a lower limit of 4mA has been specified for the 4-20mA interface; i.e. the sensor allows a minimum current of 4mA and a maximum current of 20mA to pass.
  - For a 2-wire connection; see IEC60381-1
  - Such current transducers generally represent a current sink and thus like to sit between + and – as a *variable load*. Refer also to the sensor manufacturer's information.

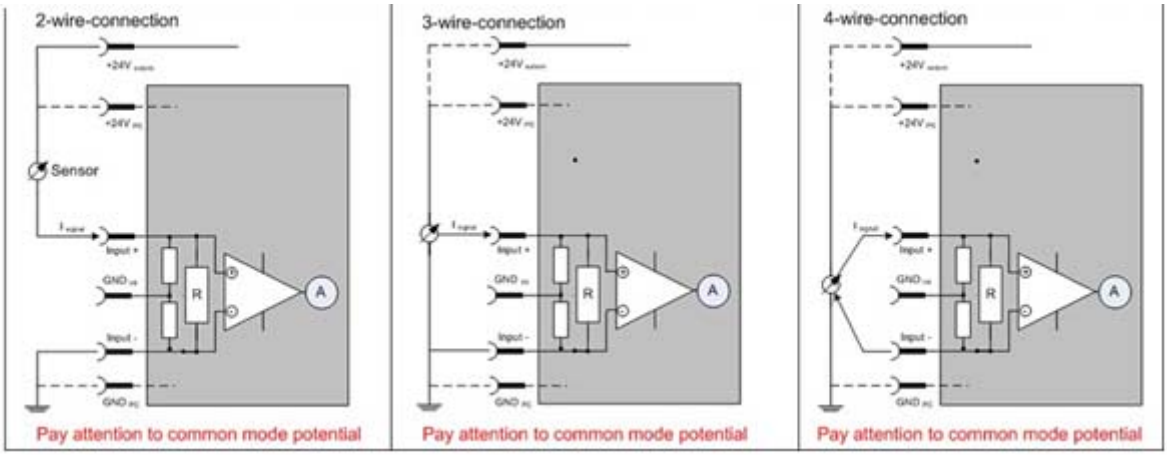


Therefore, they are to be connected accordingly:

- The sensor draws the energy/operating voltage for its own operation from two supply wires of its own. One or two further sensor wires are used for the signal transmission of the current loop:
- Sensor cable: according to the terminology such sensors are to be connected to *single- ended* inputs in 3 wires with +/-/Signal lines and if necessary a cable shield
- Sensor cables: In the case of sensors with 4-wire connection according to +-/+Signal/-Signal, you must check whether +Signal may be connected to +Supply or –Signal to –Supply.
  - Yes: then you can connect accordingly to a Comtrol *single-ended input*.
  - The *differential input* for +Signal and –Signal is to be selected; +Supply and –Supply are to be connected via additional wires.

Note: *Expert organizations such as NAMUR demand a usable measuring range <4mA / >20mA for error detection and adjustment, see also NAMUR NE043.*

Differential



Analog Output Channels 3 & 4 Parameters

The following subsections provide detailed channel parameter information that you may need.

The following subsections discuss common Sub-Indexes for the these channel parameter Indexes.

Analog Output Channels	Index
3	2080
4	2096

Presentation (Sub-Index 02)

PDO data can have output signals in the following formats: Signed integer (default), Unsigned integer, Absolute Value, and Absolute Value with MSB.

- **Signed Integer Representation:** The negative output value is represented in two's complement (negated + 1). Maximum representation range for 16 bits = -32768 to +32767dec.

Input signal				Value	
+/- 10V	0 - 20mA	4 - 20mA	0 - 10V	Decimal	Hexadecimal
10V	20mA	20mA	10V	32767	0x7FFF
5V	10mA	12mA	5V	16383	0x3FFF
0V	0mA	4mA	0V	0	0x0000
-5V	-	-	-	-16383	0xC001
-10V	-	-	-	-32767	0x8000

- **Unsigned Integer Representation**: The output value is represented with 15-bit resolution without sign, therefore polarity detection is no longer possible. Maximum representation range for 16 bits = 0 to $+32767_{dec}$.
- **Absolute Value**: The Absolute Value of the signed representation is formed.

- **Absolute Value With MSB**: The output value is displayed in magnitude-sign format: MSB=1 (highest bit) in the case of negative values. Maximum representation range for 16 bits = -32768 to $+32767_{dec}$.

Input values (+/- 10V)	Representation (values dec. / values hex.)	
	Unsigned Integer	**Absolute Value With MSB As Sign**
10V	32767 / 0x7FFF	32767 / 0x7FFF
5V	16383 / 0x3FFF	16383 / 0x3FFF
0V	0 / 0x0000	0 / 0x0000
-5V	16384 / 0x4000	[-16384] / 0xC000
-10V	32767 / 0x7FFF	[-32767] / 0xFFFF

The Presentation types, *Absolute value*, *Unsigned integer* and *Absolute Value With MSB*, have no function for unipolar modes. There is no change in the presentation in the positive range.

Watchdog (Sub-Index 05)

This is the action to take in the event of a watchdog fault.

If a watchdog fault occurs, one of the following actions is taken:

Value	Action
0	Output is set to the Default output
1	Output is changed to the default output.
2	Output is *ramped* to the Default Output.

Default Output (Sub-Index 19)

The output is set to this value (watchdog=0) or ramped to this value (watchdog=1) if a watchdog fault occurs.

Default Output Ramp (Sub-Index 20)

This value defines the ramp rate from the current to the default value. The value is specified in digits/ms.

For example, if the value is set to 100 and the default value is 0, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.

Enable User Scale (Sub-Index 1)

User scaling is enabled using Sub-Index 1. User scale provides offset and gain as discussed below.

Enable User Calibration (Sub-Index 7)

Sub-Index 7 enables user calibration.

Enable Vendor Calibration (Sub-Index 8)

Sub-Index 8 enables vendor calibration.

User Scale Offset (Sub-Index 17)

When User Scale is enabled using Sub-Index 1, use Sub-Index 17 to configure the offset.

User Scale Gain (Sub-Index 18)

When **User Scale** is enabled using Sub-Index 1, use Sub-Index 18 to configure the gain.

$$\text{Gain} = \frac{\text{Sub-Index 18}}{65536}$$

User Calibration Offset Sub-Index 21)

When user calibration is enabled using Sub-Index 7, use Sub-Index 21 to configure the offset.

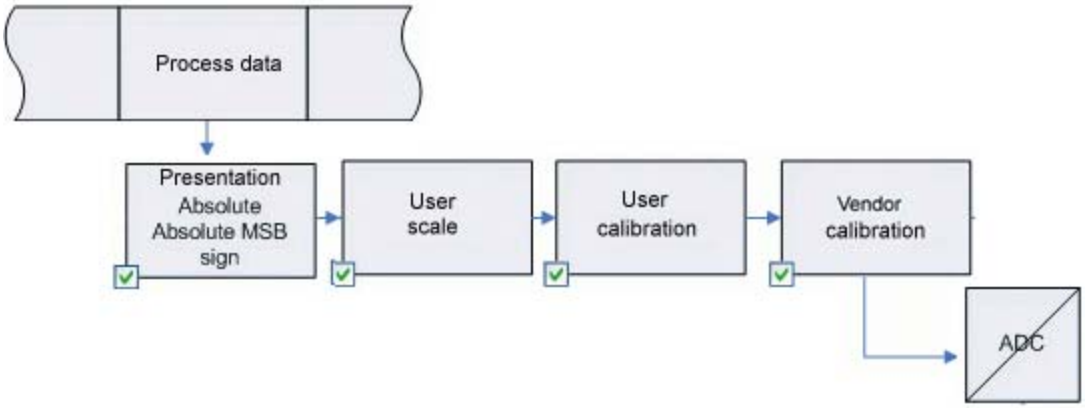
User Calibration Gain (Sub-Index 22)

When user calibration is enabled using Sub-Index 7, use Sub-Index 22 to configure the gain.

$$\text{Gain} = \frac{\text{Sub-Index 24}}{16384}$$

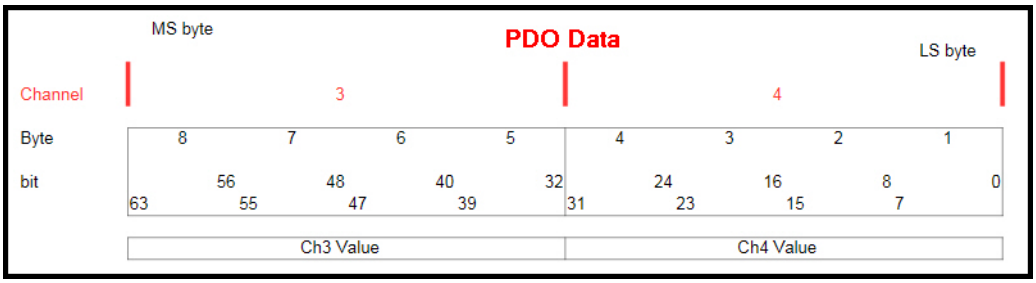
Output Data Flow

The flowchart below shows the output data flow of the IOLB-7214 (processing of the raw data).



PDO (Process Data Output) Channel Information

This image illustrates all 16 PDO data bytes from the IOLB-7214.



Object Descriptions

This section provides supporting information for the IOLB-7214 object descriptions.

IOLB-7214 Parameters

Note: *The Index and Sub-indexes are displayed as decimal numbers, which match the Comtrol IO-Link Master.*

Hardware and firmware versions may be different than what is displayed in this table.

Index	Subindex	Name	Meaning	Data type	Flags	Default
Identification						
16		Vendor Name	Comtrol Corporation	StringT64	RO	N/A
17		Vendor Text	www.comtrol.com	StringT64	RO	N/A
18		Product Name	Comtrol IOLB-7214	StringT64	RO	N/A
20		Product Text	4-Ch Analog Input + Output Module, M12	StringT64	RO	N/A
21		Serial Number	9643-XXXXXX	StringT16	RO	N/A
22		Hardware Version	00	StringT64	RO	N/A
23		Firmware Version	03.03	StringT64	RO	N/A
24		Application Specific Tag	**********	StringT32	RO	N/A
Analog Input/Output Range Settings						
14336	01	Input type Ch1	Input signal range for Channel 1 0 -10 to +10V 1 0 to 20mA 2 4 to 20mA 6 0 to 10V	UINT16	RW	0x0000 (0dec)
14336	02	Input type Ch2	Input signal range for Channel 2 (values see Channel 1)	UINT16	RW	0x0000 (0dec)
14336	03	Input type Ch3	Input signal range for Channel 3 (values see Channel 1)	UINT16	RW	0x0000 (0dec)
14336	04	Input type Ch4	Input signal range for Channel 4 (values see Channel 1)	UINT16	RW	0x0000 (0dec)

Index	Subindex	Name	Meaning		Data type	Flags	Default
Analog Input Channel 1 Settings							
2048	01	Enable user scale	1	User scale is enabled	BOOLEAN	RW	0x00 (0dec)
2048	02	Presentation	0	Signed presentation	UINT3	RW	0x00 (0dec)
2048			1	Unsigned presentation			
2048			2	Absolute value with MSB as sign			
2048	05	Siemens bits	1	Status displays are superimposed on the lowest three bits in the status word.	BOOLEAN	RW	0x00 (0dec)
2048	07	Enable limit 1	1	Limit 1 is enabled	BOOLEAN	RW	0x00 (0dec)
2048	08	Enable limit 2	1	Limit 2 is enabled	BOOLEAN	RW	0x00 (0dec)
2048	10	Enable user calibration	1	User calibration is enabled	BOOLEAN	RW	0x00 (0dec)
2048	11	Enable vendor calibration	1	Vendor calibration is enabled	BOOLEAN	RW	0x01 (1dec)
2048	14	Swap limit bits	1	Swaps the two limit bits to be compatible to older hardware versions.	BOOLEAN	RW	0x00 (0dec)
2048	17	User scale offset	User scale offset		INT16	RW	0x0000 (0dec)
2048	18	User scale gain	The User Scale Gain is represented in fixed- point format, with the factor 2^{-16}. A value of 1 for the gain factor therefore corresponds to 65535dec (0x00010000hex) and is limited to 0x7FFFF.		INT32	RW	0x00010000 (65536dec)
2048	19	Limit 1	First limit value for setting the status bits		INT16	RW	0x0000 (0dec)
2048	20	Limit 2	Second limit value for setting the status bits		INT16	RW	0x0000 (0dec)
2048	23	User calibration offset	User calibration offset		INT16	RW	0x0000 (0dec)
2048	24	User calibration gain	User calibration gain		INT16	RW	0x4000 (16384dec)

Index	Subindex	Name	Meaning		Data type	Flags	Default
Analog Input Channel 2 Settings							
2064	01	Enable user scale	1	User scale is enabled	BOOLEAN	RW	0x00 (0dec)
2064	02	Presentation	0	Signed presentation	UINT3	RW	0x00 (0dec)
2064			1	Unsigned presentation			
2064			2	Absolute value with MSB as sign			
2064	05	Siemens bits	1	Status displays are superimposed on the lowest three bits in the status word.	BOOLEAN	RW	0x00 (0dec)
2064	07	Enable limit 1	1	Enable Limit 1	BOOLEAN	RW	0x00 (0dec)
2064	08	Enable limit 2	1	Enable Limit 2	BOOLEAN	RW	0x00 (0dec)
2064	10	Enable user calibration	1	User calibration is enabled	BOOLEAN	RW	0x00 (0dec)
2064	11	Enable vendor calibration	1	Vendor calibration is enabled	BOOLEAN	RW	0x01 (1dec)
2064	14	Swap limit bits	1	Swaps the two limit-bits to be compatible to older hardware versions.	BOOLEAN	RW	0x00 (0dec)
2064	17	User scale offset	User scale offset		INT16	RW	0x0000 (0dec)
2064	18	User scale gain	The gain is represented in fixed-point format, with the factor 2-16. A value of 1 for the gain factor therefore corresponds to 65535dec (0x00010000hex) and is limited to 0x7FFFF.		INT32	RW	0x00010000 (65536dec)
2064	19	Limit 1	First limit value for setting the status bits		INT16	RW	0x0000 (0dec)
2064	20	Limit 2	Second limit value for setting the status bits		INT16	RW	0x0000 (0dec)
2064	23	User calibration offset	User calibration offset		INT16	RW	0x0000 (0dec)
2064	24	User calibration gain	User calibration gain		INT16	RW	0x4000 (16384dec)

Index	Subindex	Name	Meaning		Data type	Flags	Default
Analog Output Channel 3							
2080	01	Enable user scale	1	User scale is enabled	BOOLEAN	RW	0x00 (0dec)
2080	02	Presentation	0	Signed presentation	UINT3	RW	0x00 (0dec)
			1	Unsigned presentation			
			2	Absolute value with MSB as sign			
			3	Absolute value of the signed representation is formed.			
2080	05	Watchdog	0	Default watchdog value The default value (Sub-Index 19) is active.	BIT2	RW	0x00 (0dec)
			1	Watchdog ramp active The ramp (Sub-Index 20) for changing to the default value (Sub-Index 19) is active.			
			2	Last output value active In the event of a fault (watchdog drop) the last process data is issued.			
2080	07	Enable User Calibration	1	Enable user calibration	BOOLEAN	RW	0x00 (0dec)
2080	08	Enable Vendor Calibration	1	Enable Limit 2	BOOLEAN	RW	0x01 (1dec)
2080	17	User scale offset	User scale offset		INT16	RW	0x0000 (0dec)
2080	18	User scale gain	The gain is represented in fixed-point format, with the factor 2^{-16}. A value of 1 for the gain factor therefore corresponds to 65535dec (0x00010000hex) and is limited to +/- 0x7FFFF.		INT32	RW	0x00010000 (65536dec)
2080	19	Default Output	Output value in watchdog case, if activated via Sub-Index 5.		INT16	RW	0x0000 (0dec)

Index	Subindex	Name	Meaning	Data type	Flags	Default
2080	20	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits / ms. For example, if the entry is 100 and the default value 0, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.	INT16	RW	0xFFFF (65535dec)
2080	21	User calibration offset	User calibration offset	INT16	RW	0x0000 (0dec)
2080	22	User calibration gain	User calibration gain	INT16	RW	0x4000 (16384dec)

Index	Subindex	Name	Meaning		Data type	Flags	Default
Analog Output Channel 4							
2096	01	Enable user scale	1	User scale is enabled	BOOLEAN	RW	0x00 (0dec)
2096	02	Presentation	0	Signed presentation	UINT3	RW	0x00 (0dec)
			1	Unsigned presentation			
			2	Absolute value with MSB as sign			
			3	Absolute value of the signed representation is formed.			
2096	05	Watchdog	0	Default watchdog value The default value (Sub-Index 19) is active.	BIT2	RW	0x00 (0dec)
			1	Watchdog ramp active The ramp (Sub-Index 20) for changing to the default value (Sub-Index 19) is active.			
			2	Last output value active In the event of a fault (watchdog drop) the last process data is issued.			
2096	07	Enable User Calibration	1	Enable user calibration	BOOLEAN	RW	0x00 (0dec)
2096	08	Enable Vendor Calibration	1	Enable Limit 2	BOOLEAN	RW	0x01 (1dec)
2096	17	User scale offset	User scale offset		INT16	RW	0x0000 (0dec)
2096	18	User scale gain	The gain is represented in fixed-point format, with the factor 2^{-16}. A value of 1 for the gain factor therefore corresponds to 65535dec (0x00010000hex) and is limited to +/- 0x7FFFF.		INT32	RW	0x00010000 (65536dec)
2096	19	Default Output	Output value in watchdog case, if activated via Sub-Index 5.		INT16	RW	0x0000 (0dec)

Index	Subindex	Name	Meaning	Data type	Flags	Default
2096	20	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits / ms. For example, if the entry is 100 and the default value 0, it takes 327 ms (32767/100) for the output value to change from the maximum value (32767) to the default value in the event of a fault.	INT16	RW	0xFFFF (65535dec)
2096	21	User calibration offset	User calibration offset	INT16	RW	0x0000 (0dec)
2096	22	User calibration gain	User calibration gain	INT16	RW	0x4000 (16384dec)
Filter Settings - All Channels (See *Filters (Common to All Input Channels)* on Page 31 for more information)						
2048	06	Enable filter	1 Filter enabled, the cycle-synchronous data exchange is not applied	BOOLEAN	RW	0x00 (0dec)
2048:	21	Filter settings	This object defines the digital filter settings of all the modules channels, if it is activated with index 2048:06. The possible settings are numbered consecutively. 0 50 Hz FIR 1 60 Hz FIR 2 IIR 1 3 IIR 2 4 IIR 3 5 IIR 4 6 IIR 5 7 IIR 6 8 IIR 7 9 IIR 8	UINT16	RW	0x0000 (0dec)
MISCELLANEOUS SETTINGS						
2		Standard Command	130 - Restore factory defaults	UINT8	WO	0x0000 (0dec)
12	02	Data Storage Lock		BOOLEAN	RW	0x0000 (0dec)

Observation Parameters

Index	Subindex	Name	Meaning	Data type	Flags	Default
Analog Input Channel 1						
2062	01	ADC raw value	Raw value of the analog/digital converter	INT16	RO	0x0000 (0dec)
2063	01	R0 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2063	02	R0 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
2063	03	R1 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2063	04	R1 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
2063	05	R2 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2063	06	R2 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
Analog Input Channel 2						
2078	01	ADC raw value	Raw value of the analog/digital converter	INT16	RO	0x0000 (0dec)
2079	01	R0 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2079	02	R0 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
2079	03	R1 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2079	04	R1 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
2079	05	R2 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2079	06	R2 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)

Index	Subindex	Name	Meaning	Data type	Flags	Default
Analog Input Channel 3						
2094	01	ADC raw value	Raw value of the analog/digital converter	INT16	RO	0x0000 (0dec)
2095	01	R0 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2095	02	R0 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
2095	03	R1 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2095	04	R1 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
2095	05	R2 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2095	06	R2 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
Analog Input Channel 4						
2110	01	ADC raw value	Raw value of the analog/digital converter	INT16	RO	0x0000 (0dec)
2111	01	R0 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2111	02	R0 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
2111	03	R1 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2111	04	R1 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)
2111	05	R2 offset	offset (vendor calibration)	INT16	RW	0x0000 (0dec)
2111	06	R2 gain	gain (vendor calibration)	INT16	RW	0x4000 (16384dec)

Contacting Technical Support

Comtrol Technical Support is available from 8:00AM to 6:00PM (CST), Monday through Friday, excluding major USA holidays.

Contact	Information
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Web Site	http://www.comtrol.com