FdxCompact I/O modules specifications

Introduction

The FdxCompact-line of products from Fidelix, are aimed to suit better the modern 21st century requirements for I/O modules in terms of speed, size, protective encasing and even their look has been altered drastically compared to the classic line of Fidelix products.
FdxCompact modules all have the exact same size,

Installation on DIN-rail

There is a signal led, blinking once a second, which indicates that microcontrollers program is running

Power supply

There is a signal led, blinking once per second, which indicates that microcontrollers program is running

Communication bus

Each module has signal LEDs for received (RxD) and transmitted (TxD) data.
Fidelix modules support addresses from 1 to 63.
Fidelix modules support following function codes:

0x03	read multiple registers
0x06	write single register
0x10	write multiple registers
0x16	mask write register
0x2B	read device identification

Physical connection of field devices

FdxCompact AI-8-C

The FdxCompact AI-8-C module is used to measure resistance, voltage or current signals from external field sensors. Each channel's input connector is marked with its number (1..8). Each terminal block also has a DC, AUX and GND connector. The DC- and GND-connectors provide easy access to the 24 VDC and 0 VDC with which the module is powered from the click-on DIN-rail connectors. The AUX connectors are all connected to each other in a galvanically isolated loop, and can be used to provide, for instance, an external AC supply voltage to your sensors.
The AI-8-C module used a delta sigma analogue to digital converter to convert the analogue measurements to 20-bit values. More details about how and where to read these digital values can be found in the Modbus registers section.

Resistance measurement

A reference voltage of 3.33V is put through the internal 4.7kΩ resistor and the voltage drop over that resistor + the resistive sensor connected to the cannel is measured. This means the resistance of the connected sensor, when using only 16-bit accuracy (using only values from registers 0..7) can be calculated as follows:
$\mathrm{R} = \frac{4\,700\ \Omega * \mathrm{RegValue}}{65\,535 - \mathrm{RegValue}}$. When 20-bit accuracy is required, use following equation: $\mathrm{R} = \frac{4\,700\ \Omega * 20\mathrm{bitValue}}{1\,048\,575 - 20\mathrm{bitValue}}$

Voltage measurement

The voltage measurement range is from 0..10V. The input impedance is about 8.8 kΩ. The voltage measured can be converted from the single register value (using only values from registers 0..7) from 0..65535 to 0..10V.
This means the voltage can be calculated using following equation with the 16-bit register value:
$\mathrm{V} = \frac{\mathrm{RegValue}}{6\,553.5}$. When 20-bit accuracy is needed, use following equation: $\mathrm{V} = \frac{20\mathrm{bitValue}}{104\,857.5}$

Current measurement

The current measurement range is from 0mA to 25mA. The incoming current will flow through a 100Ω resistor and the voltage over that resistor is measured. This means the incoming current can be calculated using following equation with the 16-bit register value: $\mathrm{I} = \frac{\mathrm{RegValue}}{2\,621\,400}$. When 20-bit accuracy is needed, use following equation: $\mathrm{I} = \frac{20\mathrm{bitValue}}{41\,943\,000}$

FdxCompact AO-8-C

The FdxCompact AO-8-C module is used to send out voltage levels from 0..10V. The module has 8 independently controlled analogue output channels, which are galvanically isolated from other circuits on the module (the control circuit and power supply), but there is a galvanic connection between each output channel. Each channel's output connector is marked with its number (1..8). Each terminal block also has a DC, AUX and GND connector. The DC- and GND-connectors provide easy access to the 24 VDC and 0 VDC with which the module is powered from the click-on DIN-rail connectors. The AUX connectors are all connected to each other in a galvanically isolated loop, and can be used to provide, for instance, an external AC supply voltage to your sensors.
When the module has not received any Modbus packages for 2 minutes, each channel's output voltage can change to a predefined value, or keep its old voltage.

FdxCompact DI-16-C

The FdxCompact DI-16-C module has 16 optically isolated input loops. Only potential free contacts should be connected to the inputs. Each channel has an individual pulse counter register and a corresponding configurable minimum pulse width value between 5 and 1275 msec.
Each channel's Sx connector (S1..S16) provide +/- 20-24VDC that is detected by its corresponding numbered input (1..16).
The module has 1 green and 1 red LED per channel. The LEDs can either be controlled locally by the module itself (indication mode), or by the Modbus master (alarm mode). When on local control, the green LED will light up instantaneously when the loop between the Sx and the numbered connector is closed. When controlled by the Modbus master, the green or the red LED can be lit as a reaction to the channel's activation freely.
Each LED can also be individually set to blink or stay on steadily when active, regardless of it being controlled by the Modbus master or locally.

FdxCompact DO-8-C

The FdxCompact DO-8-C module has 8 relay outputs. Each relay has its own indication LED to show its status, the LED being lit meaning the xCOM and xNO (normally open) connectors are closed. This we call the active state of the relay. Each channel has 2 common connectors (market with “xCOM”), 1 normally open (xNO), and 1 normally closed (xNC) connector. This means you can connect two circuits to the same relay when needed.

Each channel is galvanically isolated. The maximum load per relay is 1 A at 30V.

If the module hasn’t received any Modbus communication for 30 seconds (30 is the default value; this can however be changed), the relays can be configured to go to a certain status (active / non-active), or to remain at their old value (the last value received from the Modbus master).

The FdxCompact DO-8-C module also has a watchdog function. The module’s watchdog can reboot for instance the controller it is connected to, in case of a rupture in communication. This can be done by connecting the controller’s power supply through the 8th relay.

FdxCompact DOOC-16-C

The FdxCompact DOOC-16-C module has 16 open collector outputs. Each output has its own indication LED to show its status. Connect your indicating lamp or LED, or help relay between a connector marked “DC” and a number connector to connect the 24VDC from the module’s power supply.

The maximum load per output is 100 mA at 24VDC. The minimum load per output is 2.5 mA.
Any smaller load will be detected as a short circuit. The detection of a short-circuit will cause the module to interrupt the short-circuited connection (de-activate the output) for a few seconds. The channel’s LED indicator will be red during this time. After that, the module will activate the channel’s output again. If a short-circuit is still detected, the same cycle of actions is repeated.
Not having any load on the channel, will cause the green LED to blink.

If the module hasn’t received any Modbus communication for 30 seconds (30 is the default value; this can however be changed), the relays can be configured to go to a certain status (active / non-active), or to remain at their old value (the last value received from the Modbus master).

The FdxCompact DOOC-16-C module also has a watchdog function. The module’s watchdog can reboot for instance the controller it is connected to, in case of a rupture in communication. This can be done by connecting the controller’s power supply through the 8th relay.

FdxCompact TRIAC-8-C

The FdxCompact TRIAC-8-C module is used to send out TRIAC time-based control signals. The module has 8 independently controlled output channels.
To use the TRIAC outputs, provide 24 VAC from an external power source to the AC / G0 connectors of one of the channels. This same power source voltage will we shared by all channels.
The 24VAC provided to an AC connector will also be set directly to all of the Vx outputs.

When the module has not received any Modbus packages for 2 minutes, each channel’s output voltage can change to a predefined value, or keep its old voltage.

Modbus registers

All FdxCompact I/O modules solely work with Modbus holding registers (40 000 +).
FdxCompact I/O modules use a 0-based register numbering, meaning the first available register is register 0 (not register 1).
Read and write normal register values with Modbus function codes 3, 6 and 16 (16x0010).
Described registers are numbered from 0, meaning holding register 0 (or 40 000) onwards.

FdxCompact AI-8-C

Read only registers 0..7 contain the 16 most significant bits (MSB) of the measurement values of channels 1..8. For most applications, this value is accurate enough to use.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 0	CH1 MSB	CH1 BIT19	CH1 BIT18	CH1 BIT17									CH BIT8	CH1 BIT7	CH1 BIT6	CH1 BIT5
REG 1	CH2 MSB															CH2 BIT5
…																
REG 7	CH8 MSB	CH8 BIT19	CH8 BIT18	CH8 BIT17									CH8 BIT8	CH8 BIT7	CH8 BIT6	CH8 BIT5

Read only registers 8 and 9 contain the 4 least significant bits (LSB) of the measurement values of channels 1..8. These 4 bits can be combined with the corresponding 16-bit value (from registers 0..7), to get 20-bit measurement data accuracy.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 8	CH4 BIT4	CH4 BIT3	CH4 BIT2	CH4 LSB	CH3 BIT4	CH3 BIT3	CH3 BIT2	CH3 LSB	CH2 BIT4	CH2 BIT3	CH2 BIT2	CH2 LSB	CH1 BIT4	CH1 BIT3	CH1 BIT2	CH1 LSB
REG 9	CH8 BIT4	CH8 BIT3	CH8 BIT2	CH8 LSB	CH7 BIT4	CH7 BIT3	CH7 BIT2	CH7 LSB	CH6 BIT4	CH6 BIT3	CH6 BIT2	CH6 LSB	CH5 BIT4	CH5 BIT3	CH5 BIT2	CH5 LSB

Read/Write register 10 controls the enabling or disabling of analogue input channels. If a bit is set to 1, the corresponding input channel is enabled. The first channel will always be enabled. This option is present to enable faster reading times of a small number of analogue channels, for applications where this is necessary; one measurement (per channel) takes about 170ms. This means that when all 8 channels are enabled, each measurement is repeated every 1.36 seconds. Using less channels will thus result in a shorter polling time. Disable as many channels as needed to achieve the required speed in response time is achieved. Only the 8 least significant bits of this register are used.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 10	not used	not used	not used	not used	not used	not used	not used	not used	CH8 ENA	CH7 ENA	CH6 ENA	CH5 ENA	CH4 ENA	CH3 ENA	CH2 ENA	not used

Read/Write registers 12 and 13 define the type of measurement signal that is connected to each channel. Bits at 1 in register 12 set the corresponding channel's measurement type to voltage measurement, bits at 1 in register 13 set the corresponding channel's measurement type to current measurement. If neither bit is set to 1, resistance is measured.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 12	not used	not used	not used	not used	not used	not used	not used	not used	CH8 V	CH7 V	CH6 V	CH5 V	CH4 V	CH3 V	CH2 V	CH1 V
REG 13	not used	not used	not used	not used	not used	not used	not used	not used	CH8 I	CH7 I	CH6 I	CH5 I	CH4 I	CH3 I	CH2 I	CH1 I

Be careful to only set 1 bit per channel (so never set both register 12 and 13 to 1!), as setting the bit triggers physical connections on the module to be made. Also, setting 1 channel to the wrong input type can cause wrong values on all channels!

FdxCompact AO-8-C

Read/write registers 0..7 control the output voltage of channels 1..8. Only the 10 least significant bits are used, meaning that the maximum value you can set a register to is 1023. When the channel's value is set to 1023, the channel will send out 10V. The 0..10V output value is a linear function of the 0..1023 register value.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 0	not used	not used			not used	not used	CH1 BIT10	CH1 BIT9					CH1 BIT4	CH1 BIT3	CH1 BIT2	CH1 LSB
REG 1	not used	not used			not used	not used	CH2 BIT10	CH2 BIT9					CH2 BIT4	CH2 BIT3	CH2 BIT2	CH2 LSB
…																
REG 7	not used	not used			not used	not used	CH8 BIT10	CH8 BIT9					CH8 BIT4	CH8 BIT3	CH8 BIT2	CH8 LSB

Read/write registers 9..16 contain the pre-set values for channels 1..8 and 1 bit to indicate whether or not that value is used when the module has not received any Modbus messages for more than 120 seconds.

If the bit is not set, the corresponding channel's output will continue to send out the same voltage level as the last received value in the channel's corresponding register. When the bit is set to 1, the channel's output voltage will be set to the value (0..1023) from bits 1..10.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 9	CH1 default used	not used			not used	not used	CH1 default BIT10	CH1 default BIT9					CH1 default BIT4	CH1 default BIT3	CH1 default BIT2	CH1 default LSB
REG 10	CH2 default used	not used			not used	not used	CH2 default BIT10	CH2 default BIT9					CH2 default BIT4	CH2 default BIT3	CH2 default BIT2	CH2 default LSB
…																
REG 16	CH8 default used	not used			not used	not used	CH8 default BIT10	CH8 default BIT9					CH8 default BIT4	CH8 default BIT3	CH8 default BIT2	CH8 default LSB

FdxCompact DI-16-C

Read only register 0 contain the current status of inputs 1..16, where a 1 means the channel is not active (loop is open), and a 0 means the channel is active (loop closed).

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 0	CH16 status	CH15 status	CH14 status											CH3 status	CH2 status	CH1 status

Read/write registers 1 and 2 determine for each channel whether the corresponding LED indicator is locally controlled or by the remote Modbus master. Just like the measurement type registers for the FdxCompact AI-8-C module, make sure only 1 of these registers has the corresponding bit set for each channel. If neither bit is set, the channel works with local LED control. The bits in register 1 should be set to 1 for the channels that have their LEDs controlled by the Modbus master, the bits in register 2 for those channels that the DI-16-C module will control itself (local).

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 1	CH16 master LEDctrl	CH15 master LEDctrl	CH14 master LEDctrl											CH3 master LEDctrl	CH3 master LEDctrl	CH1 master LEDctrl
REG 2	CH16 local LEDctrl	CH15 local LEDctrl	CH14 local LEDctrl											CH3 local LEDctrl	CH2 local LEDctrl	CH1 local LEDctrl

Read/write registers 3 and 4 determine for each channel the colour of the LED when the channel is active (the loop is closed). The bits in register 3 should be set to 1 for the channels that will have their LEDs light up red, and those of register 4 for those channels that will have their LEDs light up green.
Note that when on local control, the LED will always be green when the loop for the according channel is closed. When the received impulse is longer than 2 seconds and the “red LED” bit is set, the LED will be red for two seconds when the loop is cut, before the LED goes off completely, indicating the opened loop for that channel.

Here also, make sure to only set the bit in 1 of the 2 registers at a time!

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 4	CH16 red	CH15 red	CH14 red											CH3 red	CH2 red	CH1 red
REG 5	CH16 green	CH15 green	CH14 green											CH3 green	CH2 green	CH1 green

Read/write register 5 contains the blinking status of each channel’s LED. This is independent of the LED being controlled locally or from the Modbus master. Whenever the corresponding LED is on, it will blink if the bit is set to 1.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 5	CH16 blink	CH15 blink	CH14 blink											CH3 blink	CH2 blink	CH1 blink

Read/write registers 6..13 contain the required minimum pulse width for channels 1..16. All pulses shorter than set in these registers are discarded. The pulse width is measured in both rising and falling edges of the pulse. Per register, 2 channels’ minimum pulse width is defined. The 1-byte value per channel is multiplied by 5 ms to get the actual minimum pulse width, meaning that these can be defined between 5..1275 ms.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 6	CH2 MPW BIT8	CH2 MPW BIT8					CH2 MPW BIT2	CH2 MPW BIT1	CH1 MPW BIT8	CH1 MPW BIT7					CH1 MPW BIT2	CH1 MPW BIT1
REG 7	CH4 MPW BIT8	CH4 MPW BIT8					CH4 MPW BIT2	CH4 MPW BIT1	CH3 MPW BIT8	CH3 MPW BIT7					CH3 MPW BIT2	CH3 MPW BIT1
…																
REG 13	CH16 MPW BIT8	CH16 MPW BIT8					CH16 MPW BIT2	CH16 MPW BIT1	CH15 MPW BIT8	CH15 MPW BIT7					CH15 MPW BIT2	CH15 MPW BIT1

Read/write registers 14..29 contain the number of pulses longer than the minimum pulse width detected for channels 1..16. Pulses shorter than the minimum pulse width defined in registers 6..13.
Since the registers are 16-bit values, each counter will reset to 0 after 65535 pulses.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 14	CH1 counter BIT16	CH1 counter BIT15	CH1 counter BIT14											CH1 counter BIT3	CH1 counter BIT2	CH1 counter LSB
REG 15	CH2 counter BIT16	CH2 counter BIT15	CH2 counter BIT14											CH2 counter BIT3	CH2 counter BIT2	CH2 counter LSB
…																
REG 29	CH16 counter BIT16	CH16 counter BIT15	CH16 counter BIT14											CH16 counter BIT3	CH16 counter BIT2	CH16 counter LSB

FdxCompact DO-8-C

Read/write register 0 contains the values of outputs (relays) 1..8. 1 means the relay is active, 0 for an inactive relay.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 0	not used						not used	not used	CH8 status						CH2 status	CH1 status

Read/write register 1 contains the pre-set values for channels 1..8 (in bits 1..8), and 1 bit per channel (bits 9..16) to indicate whether or not that value is used after the module has not received any Modbus messages for more than 30 seconds (or for the number of seconds defined in register 3). If the pre-set value is not to be used (bit at zero), the old value stays after a communication fallout.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 1	CH8 default used						CH2 default used	CH1 default used	CH8 default						CH2 default	CH1 default

Read/write register 3 contains the “communication failure timeout” value in seconds. This is the number of seconds after which the values defined in register 1 will be applied to the relays. The value can be set to any value between 30 and 120.

Read/write register 4 contains the value (in seconds) after which the watchdog functionality will be deployed. The watchdog works as follows: if the value of register 4 is zero, the watchdog is disabled (as it is by default). Setting a value bigger than 120 will activate the watchdog functionality; if the module has not received any Modbus messages for the number of seconds specified in register 4, (either for the module itself, or even messages for other devices on the network,) the module will activate relay number 8 for 2 seconds. Note that even if the module itself is not polled, but there is Modbus master activity on the network, the watchdog will NOT “bark”. The Modbus master’s power supply should be connected through the Normally Closed (NC) connector of this channel 8, causing the controller to reboot when the relay is activated. The expectation is that causing the Modbus master to reboot, will also restart the Modbus communication.

Register 5 contains the number of times the Watchdog has “barked”, meaning the number of times it has cut off power to the controller.

FdxCompact DOOC-16-C

Read/write register 0 contains the values of outputs (relays) 1..8. 1 means the relay is active, 0 for an inactive relay.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 0	CH16 status														CH2 status	CH1 status

Read/write register 1 contains the pre-set values for channels 1..8 (in bits 1..8), and 1 bit per channel (bits 9..16) to indicate whether or not that value is used after the module has not received any Modbus messages for more than 30 seconds (or for the number of seconds defined in register 3). If the pre-set value is not to be used (bit at zero), the old value stays after a communication fallout.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 1	CH8 default used						CH2 default used	CH1 default used	CH8 default						CH2 default	CH1 default

Read/write register 3 contains the “communication failure timeout” value in seconds. This is the number of seconds after which the values defined in register 1 will be applied to the relays. The value can be set to any value between 30 and 120.

Read/write register 4 contains the value (in seconds) after which the watchdog functionality will be deployed. The watchdog works as follows: if the value of register 4 is zero, the watchdog is disabled (as it is by default). Setting a value bigger than 120 will activate the watchdog functionality; if the module has not received any Modbus messages for the number of seconds specified in register 4, (either for the module itself, or even messages for other devices on the network,) the module will activate relay number 8 for 2 seconds. Note that even if the module itself is not polled, but there is Modbus master activity on the network, the watchdog will NOT “bark”. The Modbus master’s power supply should be connected through a help relay connected to channel 8, causing the controller to reboot when the relay is activated. The expectation is that causing the Modbus master to reboot, will also restart the Modbus communication.

Register 5 contains the number of times the Watchdog has “barked”, meaning the number of times it has cut off power to the controller.

Read/write register 6 contains the pre-set values for channels 9..16 (in bits 1..8), and 1 bit per channel (bits 9..16) to indicate whether or not that value is used after the module has not received any Modbus messages for more than 30 seconds (or for the number of seconds defined in register 3). If the pre-set value is not to be used (bit at zero), the old value stays after a communication fallout.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 6	CH16 default used						CH10 default used	CH9 default used	CH16 default						CH10 default	CH9 default

FdxCompact TRIAC-8-C

Read/write registers 0..7 control the output voltage of channels 1..8. Only the 10 least significant bits are used, meaning that the maximum value you can set a register to is 1023. Each channel is activated for a percentage of the cycle time of approximately 1 second. Each cycle, all channels are first activated (that is, as long as the channel’s value is not zero), and stay active for the time defined in the channel’s register.
The time a channel’s output stays active for, is a linear function of the 0..1023 register value.
A value of 256 will have the channel’s output active for +/- 250 ms, a value of 512 for +/- half a second, etc.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 0	not used	not used			not used	not used	CH1 BIT10	CH1 BIT9					CH1 BIT4	CH1 BIT3	CH1 BIT2	CH1 LSB
REG 1	not used	not used			not used	not used	CH2 BIT10	CH2 BIT9					CH2 BIT4	CH2 BIT3	CH2 BIT2	CH2 LSB
…																
REG 7	not used	not used			not used	not used	CH8 BIT10	CH8 BIT9					CH8 BIT4	CH8 BIT3	CH8 BIT2	CH8 LSB

Read/write registers 9..16 contain the pre-set values for channels 1..8 and 1 bit to indicate whether or not that value is used when the module has not received any Modbus messages for more than 120 seconds.

If the bit is not set, the corresponding channel’s output will continue to be active for the percentage of time defined in the last received value in the channel’s corresponding register. When the bit is set to 1, the channel’s output value will be set to the value (0..1023) from bits 1..10.

BIT	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
REG 9	CH1 default used	not used			not used	not used	CH1 default BIT10	CH1 default BIT9					CH1 default BIT4	CH1 default BIT3	CH1 default BIT2	CH1 default LSB
REG 10	CH2 default used	not used			not used	not used	CH2 default BIT10	CH2 default BIT9					CH2 default BIT4	CH2 default BIT3	CH2 default BIT2	CH2 default LSB
…																
REG 16	CH8 default used	not used			not used	not used	CH8 default BIT10	CH8 default BIT9					CH8 default BIT4	CH8 default BIT3	CH8 default BIT2	CH8 default LSB