

IO/5640

Analog/Digital I/O-Extension

Hardware Reference



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1 INTRODUCTION

This document describes the basic hardware components of the IO/5640, the cable connections, the properties of the I/Os as well as the modbus parameters and registers.

1.1 Safety Guidelines

Please read the following safety guidelines carefully! In case of property or personal damage by not paying attention to this document and/or by incorrect handling, we do not assume liability. In such cases any warranty claim expires.



ATTENTION!

Observe precautions for handling – electrostatic sensitive device!

- Do NOT turn on the power supply while connecting any cables, especially the power cables. This could cause damaged board components! First connect the cables and THEN turn the power supply on.
- Discharge yourself before you work with the device, e.g. by touching a heater of metal, to avoid damages.
- Stay grounded while working with the device to avoid damage through electrostatic discharge.

1.2 Conventions

Convention	Usage
bold	Important terms
monospace	Pathnames, internet addresses and program code

Table 1: Conventions used in this document

1.3 Features and Technical Data

Interfaces	
Power	1x via screw terminal
RS485	1x via screw terminal
Digital I/Os	5x Digital input 6x Digital output
Analog I/Os	8x Analog input (4x 0 .. 10 V, 4x 0 .. 20 mA)
Displays / Control Elements	
LEDs	1x Power (green) 1x S1 = RX-traffic + error (green) 1x S2 = TX-traffic (green)
Rotary switch	1x for Modbus/RS485 address
Electrical Characteristics	
Power supply	24 VDC ±10% from external power supply
Power consumption	< 1 W
Mechanical Characteristics	
Protection class	IP20 industrial case for 35 mm DIN-rail mounting
Mass	< 200 g
Dimensions	112 mm x 100 mm x 22,5 mm
Operating temperature	0 .. 70 °C
Standards and Certifications	
EMC	CE
EMC interference immunity	EN 61000 6-2
EMC interference emission	EN 61000 6-4
Environmental standards	RoHS, WEEE

Table 2: Features

1.4 Block Diagram

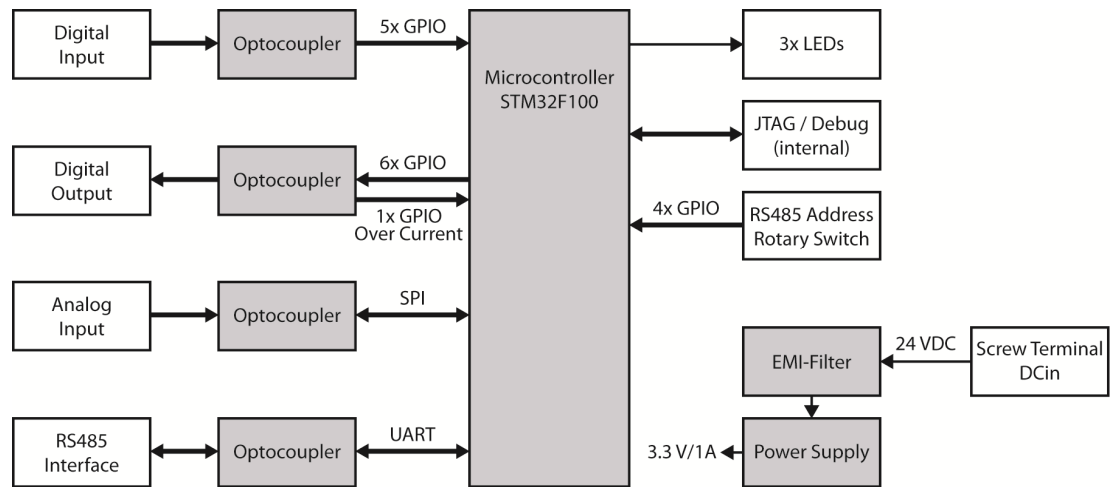


Figure 1: Block diagram of IO/5640

1.5 Galvanic Isolation

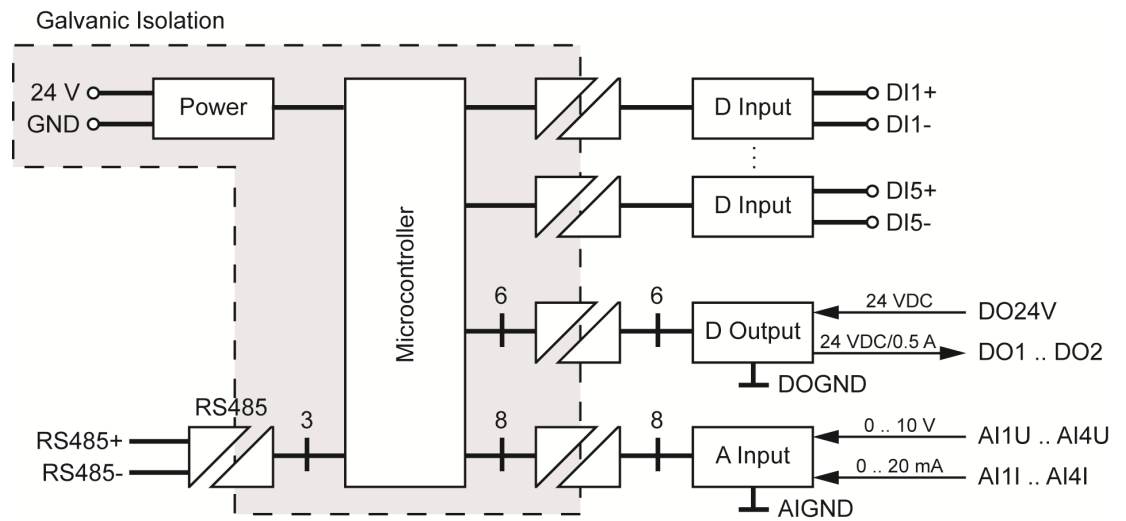
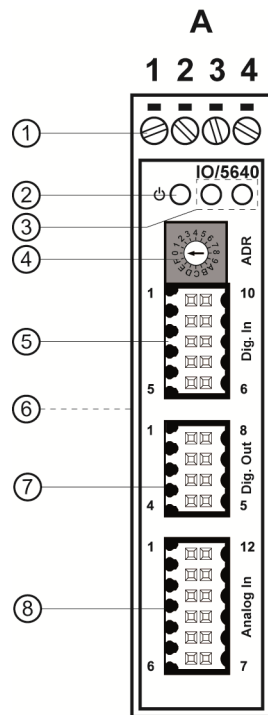


Figure 2: Galvanic isolation of IO/5640

2 OVERVIEW



- ① Screw terminals for Power and RS485
- ② Power LED
- ③ RX/TX traffic LEDs
- ④ Rotary switch for Modbus address
- ⑤ Digital input interface
- ⑥ DIN-rail mounting (back)
- ⑦ Digital output interface
- ⑧ Analog input interface

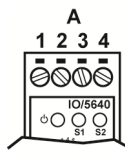
Figure 3: Overview IO/5640

3 INTERFACES

3.1 Screw Terminals

Terminal	Signal
A1	RS485+
A2	RS485-
A3	Vin 24 VDC ±10%
A4	GNDin

Table 3: Pinout screw terminals



3.2 Front Panel LEDs

Name	Color	Function
(Power)	Green	Permanent on when power supply is established
S1	Green	RX-traffic + error
S2	Green	TX-traffic

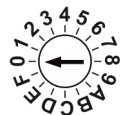
Table 4: Function of front panel LEDs

3.3 Rotary Switch

The rotary switch is used to assign the IO/5640 a device address for the RS485 connection.

Device address	Function
0	For service only
1 to F	User selectable
F	Includes the RS485 termination resistor

Table 5: Function of rotary switch



3.4 Digital Inputs

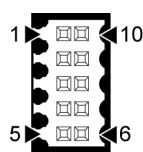
The IO/5640 offers 5 digital inputs. All digital inputs are galvanically isolated. The input signals can be gathered by a counter.

The digital inputs can be connected as **low side switch** (fig. 4) or as **high side switch** (fig. 5).

All other important properties are listed in **table 7**.

Pin	Name	Function
1	DI5+	Digital Input 5+
2	DI4+	Digital Input 4+
3	DI3+	Digital Input 3+
4	DI2+	Digital Input 2+
5	DI1+	Digital Input 1+
6	DI1-	Digital Input 1-
7	DI2-	Digital Input 2-
8	DI3-	Digital Input 3-
9	DI4-	Digital Input 4-
10	DI5-	Digital Input 5-

Table 6: Pinout digital input interface



Onboard connector = **Weidmüller S2L 3.50/10/90G 3.5SN BK BX**
Order code **#1728010000**

Mating plug = **Weidmüller B2L 3.50/10/180 SN BK BX**
Order code **#1727660000**

Properties of Digital Inputs	
Digital Inputs	5
Input Voltage	±50 V max.
V _{in} Logic 0 (Low)	0 .. 8 V
V _{in} Logic 1 (High)	15 .. 30 V
Input Resistance	10 kΩ typ.
Input Current @24 V	2.3 mA typ.
Input Frequency	1 kHz max.

Table 7: Properties of digital inputs

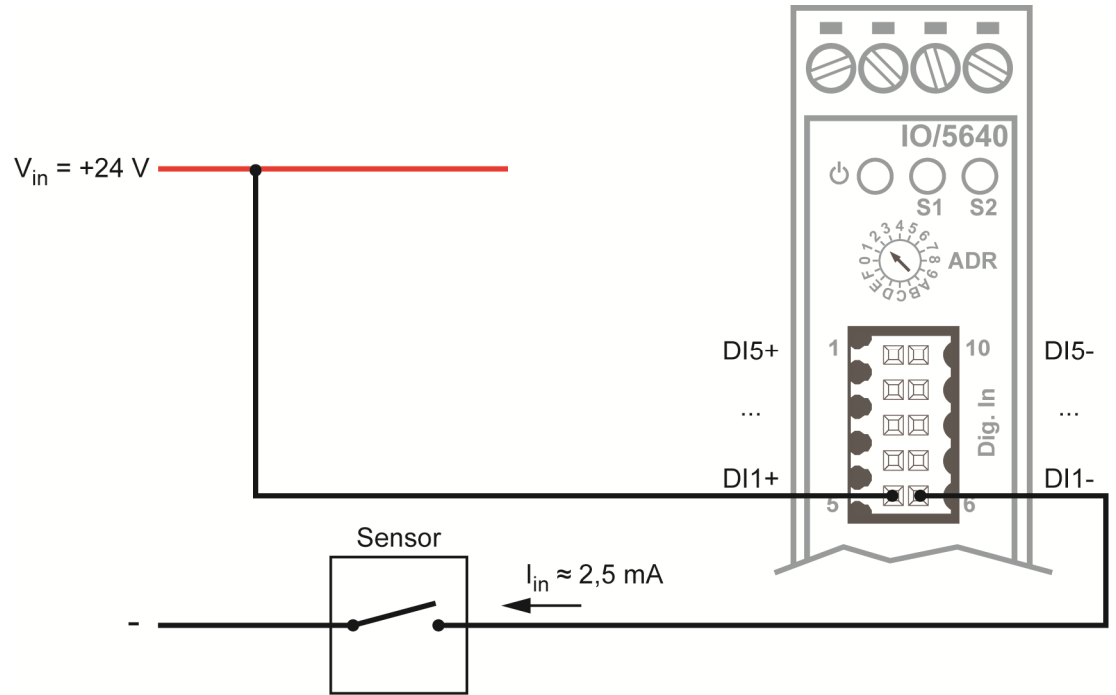


Figure 4: Connection diagram digital input as low side switch (NPN)

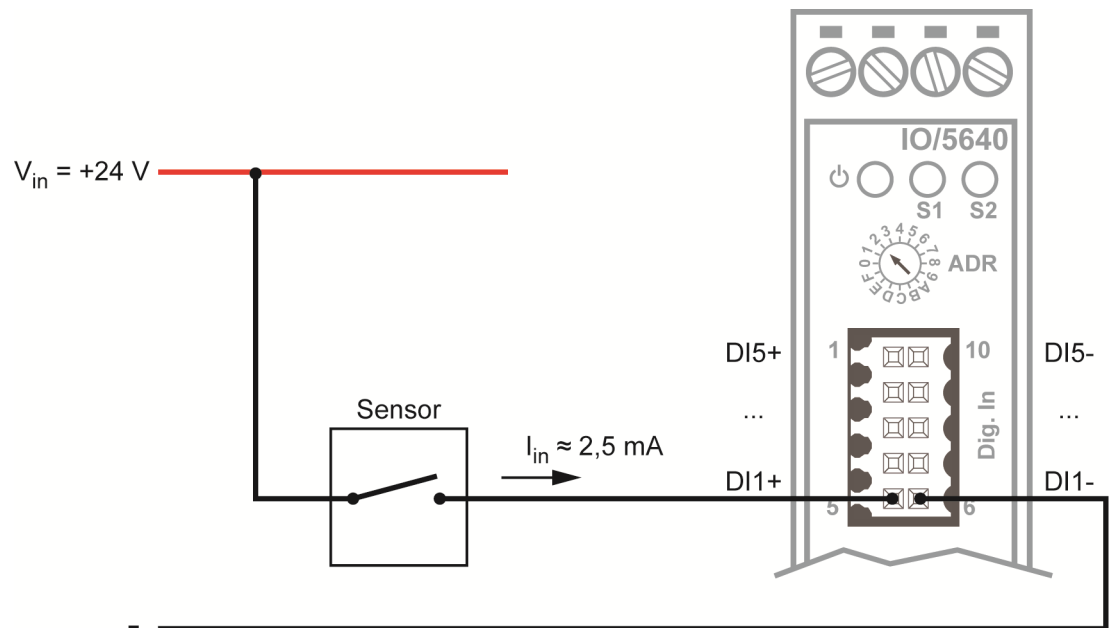


Figure 5: Connection diagram digital input as high side switch (PNP)

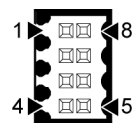
3.5 Digital Outputs

The IO/5640 offers 6 high-side-switch digital outputs. All digital outputs are galvanically isolated.

All other important properties are listed in **table 9**.

Pin	Name	Function
1	DOGND	Digital Output Ground
2	DO5	Digital Output 5
3	DO3	Digital Output 3
4	DO1	Digital Output 1
5	DO2	Digital Output 2
6	DO4	Digital Output 4
7	DO6	Digital Output 6
8	DO24V	Digital Output 24 V

Table 8: Pinout digital output interface

	Onboard connector =	Weidmüller S2L 3.50/08/90G 3.5SN BK BX Order code #1728000000
	Mating plug =	Weidmüller B2L 3.50/08/180 SN BK BX Order code #1727650000

Properties of Digital Outputs	
Digital Outputs	6 high-side-switch (Infineon BTS4880R)
Operating Voltage (Field Side)	24 VDC ±10%
Current Consumption (Field Side)	15 mA (device + load)
Connectable Loads	Resistive (R), capacitive (C), inductive (L)
Switch Frequency	3 kHz max.
Output Current	0.5 A max.
Short Circuit Current	1.1 A typ.
ON Resistance @0.5 A	150 .. 320 mΩ
Diagnosis Feedback	Internal, via Modbus
Absorbable Energy W max.	1 J; $L_{max} = 2 \times W_{max} / I^2$

Table 9: Properties of digital outputs

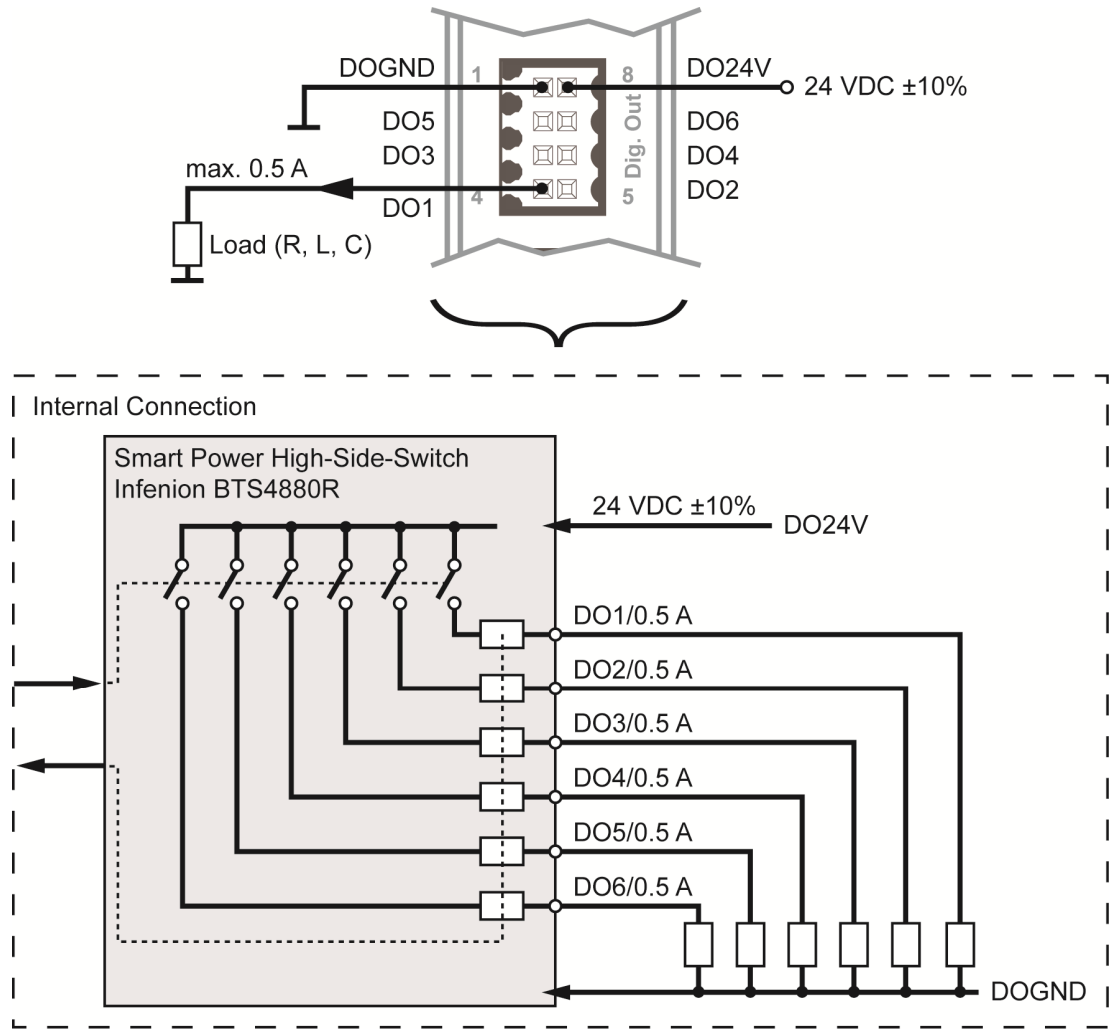


Figure 6: Connection diagram digital outputs

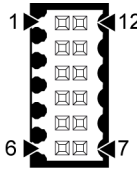
3.6 Analog Inputs

The IO/5640 offers 4 0 .. 10 V and 4 0 .. 20 mA analog inputs with 12-bit ADCs with integrated analog frontend. All analog inputs are galvanically isolated.

All other important properties are listed in **table 11** and **table 12**.

Pin	Name	Function
1	AI4U	Analog Input 4 U
2	AIGND	Analog Input Ground
3	AI3U	Analog Input 3 U
4	AI2U	Analog Input 2 U
5	AIGND	Analog Input Ground
6	AI1U	Analog Input 1 U
7	AI1I	Analog Input 1 I
8	AIGND	Analog Input Ground
9	AI2I	Analog Input 2 I
10	AI3I	Analog Input 3 I
11	AIGND	Analog Input Ground
12	AI4I	Analog Input 4 I

Table 10: Pinout analog input interface

	Onboard connector =	Weidmüller S2L 3.50/12/90G 3.5SN BK BX Order code #1728020000
	Mating plug =	Weidmüller B2L 3.50/12/180 SN BK BX Order code #1727670000

Properties of 0 .. 10 V Analog Inputs	
Analog Inputs	4 (TI ADS8668)
Input Voltage	±17 V max. (with overcurrent/-voltage protection)
Signal Voltage	0 .. 10 V
Input Resistance	1 MΩ typ.
Resolution	12 bit
Conversion Time	10 ms typ.
Measurement Error @25° C	< ±0,2% of full scale
Temperature Coefficient 0 .. 70° C	< ±0,0015%/K of full scale

Table 11: Properties of 0 .. 10 V analog inputs

Properties of 0 .. 20 mA Analog Inputs	
Analog Inputs	4 (TI ADS8668)
Input Voltage	± 10 V (with overcurrent/-voltage protection)
Signal Current	0 .. 20 mA typ.
Shunt Resistance	242 Ω
Resolution	12 bit
Conversion Time	10 ms typ.
Measurement Error @25° C	$< \pm 0,2\%$ of full scale
Temperature Coefficient 0 .. 70° C	$< \pm 0,0025\%/K$ of full scale

Table 12: Properties of 0 .. 20 mA analog inputs

Input Voltage 0 - 10 V	Input Current 0 - 20 mA	Value Hex
$< 0,0$	$< 0,0$	0x7FFF
0,0	0,0	0x0000
2,5	5,0	0x2000
5,0	10,0	0x4000
7,5	15,0	0x6000
10,0	20,0	0x7FF8
$> 10,0$	$> 20,0$	0x7FF9

Table 13: Data format of analog inputs

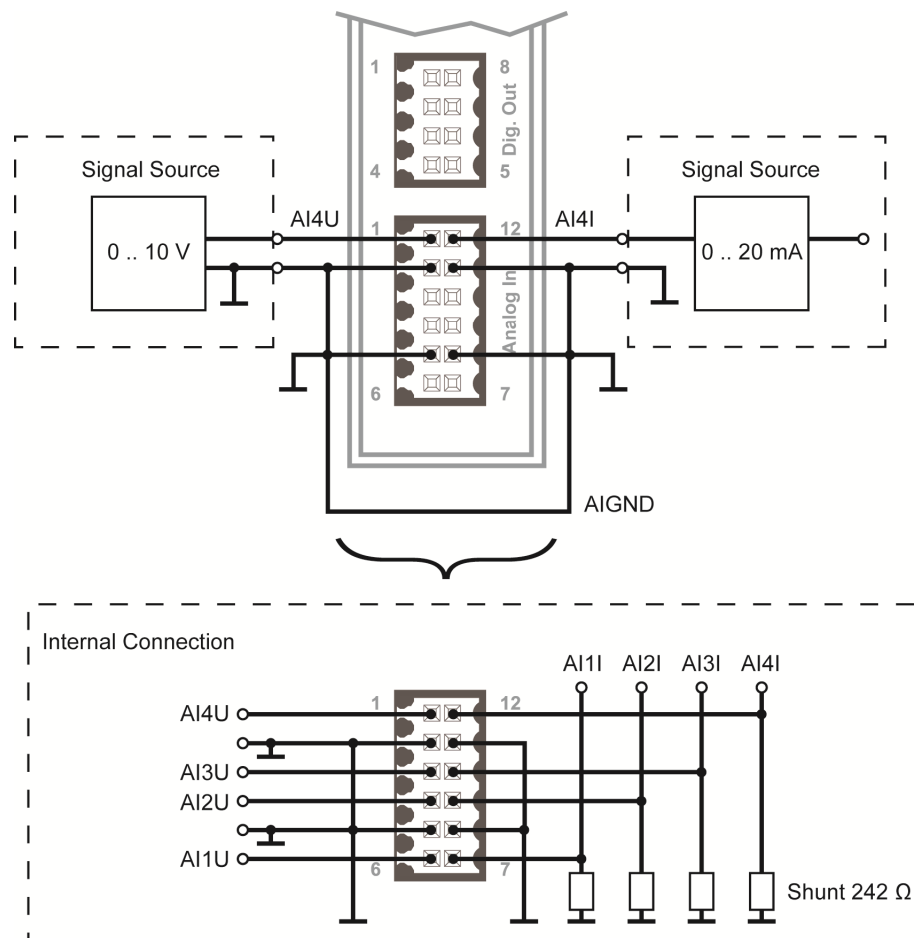


Figure 7: Connection diagram of analog inputs

4 MODBUS/RS485 CONNECTION

The IO/5640 is connected via RS485 half-duplex with the IGW/936 like shown in **figure 8**.

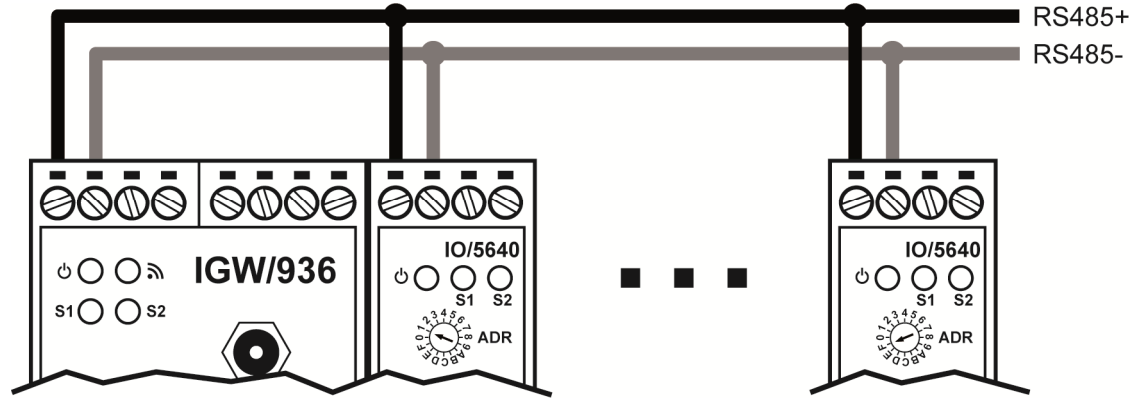


Figure 8: Modbus/RS485 connection between IO/5640 and IGW/936

Terminal IO/5640	Terminal IGW/936-L	Signal
A1	A1 (or B3)	RS485+
A2	A2 (or B2)	RS485-

Table 14: Screw terminals for Modbus/RS485 connection

The devices use **Modbus RTU** as communication protocol. The IO/5640 is the Modbus slave, the IGW/936 is the Modbus master. The data transfer rate is **19.200 baud**.

It is possible to connect **up to 15** IO/5640 to one IGW/936. Therefore each IO/5640 must use a different device address, which can be set with the rotary switch (positions 1 to F).



Please note:

The device address F activates the **termination resistor** within the IO/5640 for the RS485 connection. So if only one IO/5640 is connected with the IGW/936, the device address must be set to F. If two or more IO/5640s are connected, the last IO/5640 must be set to device address F.

The device address 0 is used for service only!

5 POWER SUPPLY

The IO/5640 needs a supply voltage of 24 VDC \pm 10% to work. Use an external power supply to provide the IO/5640 with the necessary power like shown in **figure 9**.

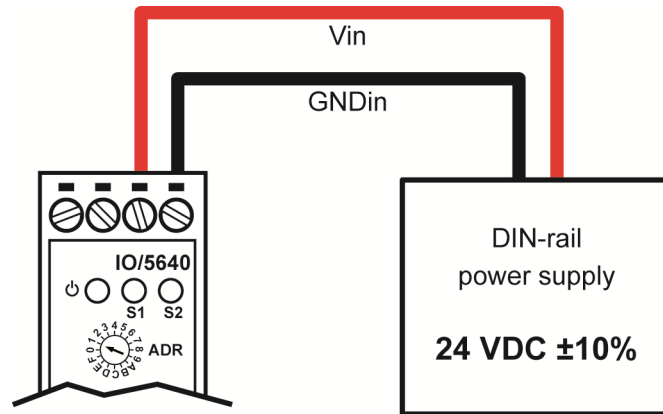


Figure 9: Power supply for the IO/5640

Terminal	Signal
A3	Vin 24 VDC \pm 10%
A4	GNDin

Table 15: Screw terminals for power supply



CAUTION!

Providing the IO/5640 with a higher voltage than the regular 24 VDC \pm 10% could cause damaged device components!

Do NOT turn on the power supply while connecting any cables, especially the power cables. This could cause damaged device components! First connect the (power) cables and THEN turn the power supply on.



IMPORTANT!

The cable for the power supply must not be longer than **3 meters!**

6 MODBUS REGISTERS

The IO/5640 is connected as Modbus RTU slave via RS485 (half duplex) with the gateway/PC. The slave address is set with the rotary switch in the front panel. Address F enables the RS485 termination. Address 0 is for service purposes only.



Please note:

The following Modbus properties refer to firmware version 1.4.

6.1 Transmission Parameters

- Baud rate: 19.200 Baud
- Parity: EVEN
- Stop bit: 1
- Timeout: 2000 μ s

6.2 Definitions

- "S" = Modbus slave (IO/5640)
- "M" = Modbus master
- "FC" = Function code

6.3 Modbus Function Codes

- FC1: Read Coils (0x01)
- FC2: Read Discrete Inputs (0x02)
- FC3: Read Holding Registers (0x03)
- FC5: Write Single Coil (0x05)
- FC6: Write Single Registers (0x06)

6.4 Data Types and Coding

Data Type	Bits	Value Range	Coding/Byte Order
UINT16	16	0 .. 32767	[DB1][DB0] (big endian) – High Byte first
SINT16	16	-32768 .. 32767	[DB1][DB0] (big endian) – High Byte first
UINT8	8	0 .. 255	

Table 16: Modbus data types and coding

6.5 Modbus Register File – Digital Outputs

IO	Direction	Function	Register [dec]	Data Type	Description
DO1	M > S	FC5	0	UINT8	Write Single Coil - Output Level
	S > M	FC1	0	UINT8	Read Coils - Output Level
	M > S	FC6	14 [BIT0]	UINT16	Write Single Register - Output Level
	S > M	FC3	14 [BIT0]	UINT16	Read Holding Register - Output Level
DO2	M > S	FC5	1	UINT8	Write Single Coil - Output Level
	S > M	FC1	1	UINT8	Read Coils - Output Level
	M > S	FC6	14 [BIT1]	UINT16	Write Single Register - Output Level
	S > M	FC3	14 [BIT1]	UINT16	Read Holding Register - Output Level
DO3	M > S	FC5	2	UINT8	Write Single Coil - Output Level
	S > M	FC1	2	UINT8	Read Coils - Output Level
	M > S	FC6	14 [BIT2]	UINT16	Write Single Register - Output Level
	S > M	FC3	14 [BIT2]	UINT16	Read Holding Register - Output Level
DO4	M > S	FC5	3	UINT8	Write Single Coil - Output Level
	S > M	FC1	3	UINT8	Read Coils - Output Level
	M > S	FC6	14 [BIT3]	UINT16	Write Single Register - Output Level
	S > M	FC3	14 [BIT3]	UINT16	Read Holding Register - Output Level
DO5	M > S	FC5	4	UINT8	Write Single Coil - Output Level
	S > M	FC1	4	UINT8	Read Coils - Output Level
	M > S	FC6	14 [BIT4]	UINT16	Write Single Register - Output Level
	S > M	FC3	14 [BIT4]	UINT16	Read Holding Register - Output Level
DO6	M > S	FC5	5	UINT8	Write Single Coil - Output Level
	S > M	FC1	5	UINT8	Read Coils - Output Level
	M > S	FC6	14 [BIT5]	UINT16	Write Single Register - Output Level
	S > M	FC3	14 [BIT5]	UINT16	Read Holding Register - Output Level
DO1 .. 6	S > M	FC3	15 [BIT0]	UINT16	Read Holding Register
			15 [BIT1]		DIAG - Overcurrent (all channel) Read Holding Register 24 V - DO24V OK

Table 17: Modbus register file for digital inputs

6.6 Modbus Register File – Digital Inputs

IO	Direction	Function	Register [dec]	Data Type	Description
DI1+/-	S > M	FC2	0	UINT8	Read Discrete Input - Input Level
	S > M	FC3	8 [BIT0]	UINT16	Read Holding Register - Input Level
	S > M	FC3	9	UINT16	Read Holding Register (Number of LOW-HIGH-Edges)
DI2+/-	S > M	FC2	1	UINT8	Read Discrete Input - Input Level
	S > M	FC3	8 [BIT1]	UINT16	Read Holding Register - Input Level
	S > M	FC3	10	UINT16	Read Holding Register (Number of LOW-HIGH-Edges)
DI3+/-	S > M	FC2	2	UINT8	Read Discrete Input - Input Level
	S > M	FC3	8 [BIT2]	UINT16	Read Holding Register - Input Level
	S > M	FC3	11	UINT16	Read Holding Register (Number of LOW-HIGH-Edges)
DI4+/-	S > M	FC2	3	UINT8	Read Discrete Input - Input Level
	S > M	FC3	8 [BIT3]	UINT16	Read Holding Register - Input Level
	S > M	FC3	12	UINT16	Read Holding Register (Number of LOW-HIGH-Edges)
DI5+/-	S > M	FC2	4	UINT8	Read Discrete Input - Input Level
	S > M	FC3	8 [BIT4]	UINT16	Read Holding Register - Input Level
	S > M	FC3	13	UINT16	Read Holding Register (Number of LOW-HIGH-Edges)

Table 18: Modbus register file for digital inputs

6.7 Modbus Register File – Analog Inputs

IO	Direction	Function	Register [dec]	Data Type	Description
AI1U	S > M	FC3	16	SINT16	Read Holding Register: Voltage 0..0x7FF8 (32760): 0 .. 10 V 0x7FF9 (32761): > 10 V 0x7FFF (32767): < 0 V
AI2U	S > M	FC3	17	SINT16	Read Holding Register: Voltage 0..0x7FF8 (32760): 0 .. 10 V 0x7FF9 (32761): > 10 V 0x7FFF (32767): < 0 V
AI3U	S > M	FC3	18	SINT16	Read Holding Register: Voltage 0..0x7FF8 (32760): 0 .. 10 V 0x7FF9 (32761): > 10 V 0x7FFF (32767): < 0 V
AI4U	S > M	FC3	19	SINT16	Read Holding Register: Voltage 0..0x7FF8 (32760): 0 .. 10 V 0x7FF9 (32761): > 10 V 0x7FFF (32767): < 0 V
AI1I	S > M	FC3	20	SINT16	Read Holding Register: Current 0..0x7FF8 (32760): 0 .. 20 mA 0x7FF9 (32761): > 20 mA 0x7FFF (32767): < 0 mA
AI2I	S > M	FC3	21	SINT16	Read Holding Register: Current 0..0x7FF8 (32760): 0 .. 20 mA 0x7FF9 (32761): > 20 mA 0x7FFF (32767): < 0 mA
AI3I	S > M	FC3	22	SINT16	Read Holding Register: Current 0..0x7FF8 (32760): 0 .. 20 mA 0x7FF9 (32761): > 20 mA 0x7FFF (32767): < 0 mA
AI4I	S > M	FC3	23	SINT16	Read Holding Register: Current 0..0x7FF8 (32760): 0 .. 20 mA 0x7FF9 (32761): > 20 mA 0x7FFF (32767): < 0 mA

Table 19: Modbus register file for analog inputs

6.8 Modbus Register File – Additional Functions

The data type of the additional functions is **UINT16**.

IO	Direction	Function	Register [dec]	Description
LED_S1	M > S	FC6	25	Write Single Register RX-traffic or ON/OFF-timing
	S > M	FC3	25	Read Holding Register RX-traffic or ON/OFF-timing 0xFFFF (RX-traffic of Modbus Interface) LED S1 ON/OFF-timing OFF-time: LOW-Byte LED OFF: 0x00XX or 0x0000 OFF-time: 0x01 .. 0xFE (10 .. 2540 ms) ON-time: HIGH-Byte LED ON: 0xFF00 ON-time: 0x01xx .. 0xFExx (10 .. 2540 ms)
LED_S2	M > S	FC6	26	Write Single Register TX-traffic or ON/OFF-timing
	S > M	FC3	26	Read Holding Register TX-traffic or ON/OFF-timing 0xFFFF (TX-traffic of Modbus Interface) LED S1 ON/OFF-timing OFF-time: LOW-Byte LED OFF: 0x00XX or 0x0000 OFF-time: 0x01 .. 0xFE (10 .. 2540 ms) ON-time: HIGH-Byte LED ON: 0xFF00 ON-time: 0x01xx .. 0xFExx (10 .. 2540 ms)
DT1	S > M	FC3	54	Measurement of the time difference between L-H-edge at DI1 and the following L-H-edge at DI2 Default Value: 0xFFFF Time Resolution: 1 ms
DT2	S > M	FC3	55	Measurement of the time difference between L-H-edge at DI3 and the following L-H-edge at DI4 Default Value: 0xFFFF Time Resolution: 1 ms

Table 20: Modbus register file for additional functions (part 1)

IO	Direction	Function	Register [dec]	Description
SW_SVN	S > M	FC3	0	Software SVN Revision 0x15F7 = Revision 5623
SW_BUILD	S > M	FC3	1	SSV Software Build Number 6729 = 400*16+329 for 24.11.2016
SW_VERSION	S > M	FC3	2	Software Version Major [15-8], Minor [7-0] 0x0104 = Version 1.4
DEVICE_NAME	S > M	FC3	3	Device Name (8 Characters)
	S > M	FC3	4	„IO/5640/0“
	S > M	FC3	5	[3] = 0x4F49
	S > M	FC3	6	[4] = 0x352F [5] = 0x3436 [6] = 0x0030
WATCHDOG	M > S	FC6	7	Write Single Register Activate/Serve Watchdog
	S > M	FC3	7	Read Holding Register Read Out Watchdog Status Modbus Watchdog Activate with 0xA12B and serve after max. 5 min. with 0xA12B

Table 21: Modbus register file for additional functions (part 2)

7 HELPFUL LITERATURE

- IGW/935 hardware reference
- IGW/936(-L) hardware reference

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1.0	2017-04-25	First version	WBU	UJA

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