FAD-40

A / D Converter

Technical Manual

Flintec
www.flintec.com

TABLE OF CONTENTS:

RIGHTS AND LIABILITIES

1. SAFETY INSTRUCTIONS

CAUTION READ this manual BEFORE operating or servicing this equipment. FOLLOW these instructions carefully. SAVE this manual for future reference. DO NOT allow untrained personnel to operate, clean, inspect, maintain, service, or tamper with this equipment. ALWAYS DISCONNECT this equipment from the power source before cleaning or performing maintenance. CALL FLINTEC ENGINEERING for parts, information, and service.

WARNING ONLY PERMIT QUALIFIED PERSONNEL TO SERVICE THIS EQUIPMENT. EXERCISE CARE WHEN MAKING CHECKS, TESTS AND ADJUSTMENTS THAT MUST BE MADE WITH POWER ON. FAILING TO OBSERVE THESE PRECAUTIONS CAN RESULT IN BODILY HARM.

WARNING FOR CONTINUED PROTECTION AGAINST SHOCK HAZARD CONNECT TO PROPERLY GROUNDED OUTLET ONLY. DO NOT REMOVE THE GROUND PRONG.

WARNING DISCONNECT ALL POWER TO THIS UNIT BEFORE REMOVING THE FUSE OR SERVICING.

WARNING BEFORE CONNECTING/DISCONNECTING ANY INTERNAL ELECTRONIC COMPONENTS OR INTERCONNECTING WIRING BETWEEN ELECTRONIC EQUIPMENT ALWAYS REMOVE POWER AND WAIT AT LEAST THIRTY (30) SECONDS BEFORE ANY CONNECTIONS OR DISCONNECTIONS ARE MADE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT OR BODILY HARM.

CAUTION OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES.

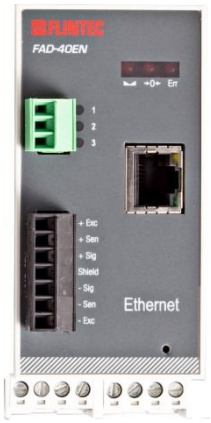
2. INTRODUCTION

2.1. Overview

The type FAD-40 A/D Converter Series consists of powerful and economic state-of-the-art instruments for static and dynamic weighing applications plus force and torque measurements including digital I/O control.
Each instrument of the series converts the analogue low level signal from a load cell or a strain gauge sensor to a digital high-resolution and high-accuracy signal and transmits the digital data to an external PLC or PC system. As a special feature the instruments can switch between unipolar and bipolar input range without affecting the external resolution. Digital I/O ports give further possibilities to extend the bus system with I/O control in the cabinet and fast response setpoint output from the weighing instrument.
The type FAD-40 A/D Converter Series comprises various instruments for different industrial bus systems:

FAD-40 A/D Converter only with RS485 interface

FAD-40PB A/D Converter with Profibus DP interface



FAD-40EN A/D Converter with Ethernet TCP/IP interface

FAD-40MB A/D Converter with Modbus RTU interface

FAD-40PN A/D Converter with Profinet interface

FAD-40CO A/D Converter with CANopen interface

Figure 3.1 – FAD-40 A/D Converter series instruments

2.2. Key features and Specifications

Key Features	FAD-40	FAD-40MB	FAD-40PB	FAD-40PN	FAD-40EN	FAD-40CO
Bipolar signal input in Force and Count modes	Yes	Yes	Yes	Yes	Yes	Yes
500 to 100 000 counts external resolution at calibrated data	Yes	Yes	Yes	Yes	Yes	Yes
Unipolar 1 million and bipolar 2 million counts is adjusted and filtered to external resolution in count mode	Yes	Yes	Yes	Yes	Yes	Yes
High internal resolution up to 8 million counts	Yes	Yes	Yes	Yes	Yes	Yes
Up to 800 conversions per second	Yes	Yes	Yes	Yes	Yes	Yes
2 digital inputs/outputs + 1 additional digital outp. (configurable)	Yes	Yes	Yes	Yes	Yes	Yes
Standard Serial interface RS-232C	No	No	Yes	Yes	Yes	Yes
Serial interface RS-485A	Yes	Yes	No	No	No	No
Modbus RTU interface	No	Yes	No	No	No	No
Profibus DP-V1 interface	No	No	Yes	No	No	No
Profinet interface	No	No	No	Yes	No	No
Ethernet (Modbus TCP/IP) interface	No	No	No	No	Yes	No
CANopen interface	No	No	No	No	No	Yes
BSI data interface	Yes	Yes	No	No	No	No
Bus address selection by setup switch (from 0 to 7)	Yes	Yes	Yes	No	No	Yes
Setup by Flintec xFace PC software	Yes	Yes	Yes	Yes	Yes	Yes
Auto-zero tracking and auto-zero at power-up	Yes	Yes	Yes	Yes	Yes	Yes
Motion detection	Yes	Yes	Yes	Yes	Yes	Yes
Zeroing and Taring by bus commands	Yes	Yes	Yes	Yes	Yes	Yes
Adaptive digital filter for fast and stable reading	Yes	Yes	Yes	Yes	Yes	Yes
Up to 6 load cells (350 Ω) or 18 load cells (1100 Ω)	Yes	Yes	Yes	Yes	Yes	Yes
Electronic calibration (eCal) without test weights	Yes	Yes	Yes	Yes	Yes	Yes
Zero and Span calibrations over bus interface	Yes	Yes	Yes	Yes	Yes	Yes
Zero adjustment	Yes	Yes	Yes	Yes	Yes	Yes
Span adjustment with test weights	Yes	Yes	Yes	Yes	Yes	Yes
Span adjustment with temporary zeroing for unloaded tanks	Yes	Yes	Yes	Yes	Yes	Yes
Power-on testing with setup switch	Yes	Yes	Yes	Yes	Yes	Yes
24 V DC power supply (11 to 28 V DC input voltage range)	Yes	Yes	Yes	Yes	Yes	Yes

Specifications

A/D Converter:	
A/D converter type:	24 bit Delta-Sigma radiometric with integral analog and digital filters
Analog input range:	0 mV to +18 mV (unipolar) ; - 18 mV to +18 mV (bipolar)
Linearity:	< 0.0015 % FS
Temperature coefficient:	< 2 ppm/°C
Min. input per vsi	0.1 µV/d (non approved)
Conversion rate:	Up to 800 measurement values per second
Internal resolution:	Up to 8 million counts
External resolution	Up to 100 000 counts (weight value, force, torque) respective 1 million raw counts (unipolar) respective 2 million counts (bipolar)
Calibration and Weighing Functions:	
Calibration:	Electronic calibration without test weights (eCal) or calibration by test weights
Digital filter:	10 step programmable adaptive filter
Weighing functions:	Tare, zero, auto zero tracking, motion detection, auto-zero at power-up, save tare at power-off, increased resolution
Load cells:	
Excitation:	5 V DC at 58...1200 Ω, max. 100 mA
Number of load cells:	Up to 6 load cells à 350 Ω or 18 load cells à 1100 Ω in parallel
Connection:	4- or 6-wire technique, cable length 250 m/mm² for 6-wire connection

Communication and Setup:	
Serial interface	RS232C with 9600 baud (8,N,1); for FAD-40 and FAD-40MB: RS485 with up to 57600 baud (8N1, 7E1, 7O1)
Other interfaces	Depends on instrument type
Response time	< 4 ms (delay after each read or write command)
Setup and calibration	By PC software via RS232C respective RS485, backup data stored on PC
Digital Inputs + Outputs	
2x configurable I/O	Selectively configured as input (10...26 V DC) or open collector output (24 V DC, max. 100 mA)
1x additional output	Open collector output (24 V DC, max. 100 mA)
Input functions	Zero, tare, clear tare or control input to communication interface
Output functions	Setpoint output with / without hysteresis, tolerance band output or control output from communication interface
Power supply:	
DC power supply	10 to 28 VDC, < 200 mA, not galvanically isolated
Environment and Enclosure:	
Operation temperature:	Between -10 °C and +40 °C at maximum 85% RH max, non-condensing
Enclosure and protection	Polyamide, for DIN-rail mounting, IP20

Instrument with RS485 interface: Type FAD-40	
Communication:	
Serial interface RS485	1200 to 57600 baud (8N1, 7E1, 7O1), bus capability up to 31 units
Communication mode	Requested
Dimensions & weight	99 x 22.5 x 114.5 mm (L x W x H), weighs appr. 110 g

Instrument with Modbus RTU interface: Type FAD-40MB	
Communication:	
Serial interface RS485	1200 to 57600 baud (8N1, 7E1, 7O1), bus capability up to 31 units
Communication mode	Requested or Modbus RTU
Address range	1...31
Dimensions & weight	99 x 22.5 x 114.5 mm (L x W x H), weighs appr. 110 g

Instrument with Profibus DP interface: Type FAD-40PB	
Communication:	
Profibus DP-V0 + DP-V1	9,6 kbit/s to 12 Mbit/s (automatic), galvanically isolated interface
Address range	1...126
Dimensions & weight	99 x 45 x 114.5 mm (L x W x H), weighs appr. 150 g

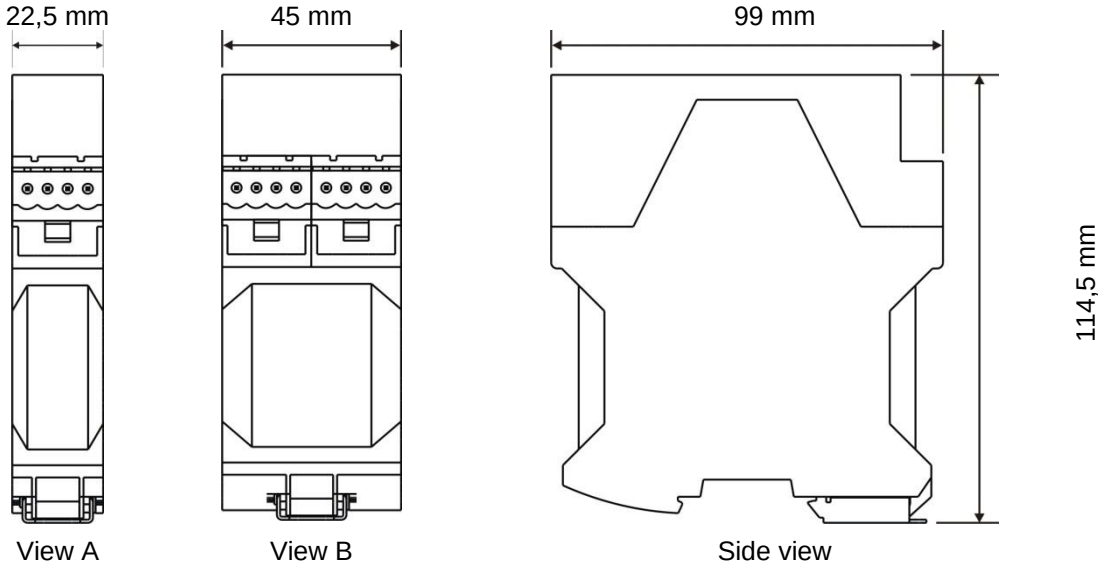
Instrument with Profinet interface: Type FAD-40PN	
Communication:	
Profinet	100 Mbit/s (full duplex), galvanically isolated interface
IP settings	DHCP or manual setup by PC software
Dimensions & weight	99 x 45 x 114.5 mm (L x W x H), weighs appr. 150 g

Instrument with Ethernet TCP/IP interface: Type FAD-40EN	
Communication:	
Ethernet TCP/IP	10 Mbit/s (full duplex), galvanically isolated interface
IP settings	Manual setup by PC software
Dimensions & weight	99 x 45 x 114.5 mm (L x W x H), weighs appr. 150 g
Other	Web client interface

Instrument with CANopen interface: Type FAD-40CO	
Communication:	
CANopen V.2.0	10 kbit/s...1 Mbit/s (automatic), galvanically isolated interface
Address range	1...126
Dimensions & weight	99 x 45 x 114.5 mm (L x W x H), weighs appr. 150 g

2.3. Housing

FAD-40 instruments come within a polyamide housing sealed to IP20. They are prepared for mounting on NS 37/7 or NS 35/15 standard DIN rails (see drawings).



View A: FAD-40, FAD-40MB
View B: FAD-40PB, FAD-40PN, FAD-40EN, FAD-40CO

Figure 3.2 – Dimensions

2.4. Accessories

2.4.1. Accessories supplied with the instrument

The following accessories are supplied together with the instrument. If any part is missing, please contact your supplier.

	FAD-40	FAD-40MB	FAD-40EN	FAD-40PB	FAD-40PN	FAD-40CO
4-pin and 5 mm pitch plug, light gray	1	1	2	2	2	2
7-pin and 3.81 mm pitch plug for load cell cable, black	1	1	1	1	1	1
6-pin and 3.81 mm pitch plug for Digital I/O and RS-485, black	1	1				
3-pin and 3.81 mm pitch plug for Digital I/O, green			1	1	1	1
Installation CD (xFace software, technical documentation)	1	1	1	1	1	1

Table 3.1 – Accessories supplied with instrument

3. INSTALLATION

PRECAUTION: Please read this manual carefully before you install the instrument. If you apply all recommendations in this chapter you will increase the reliability and long term performance of your system.

3.1. Recommendations

3.1.1. Control Cabinet Design

Warning: Please follow the following warnings for designing the control cabinet which will increase the reliability of your system.
The control cabinet should be designed therefor the A/D converters can operate safely. The panel should be placed in a clean area, without getting direct sun light if possible, with a temperature between -10 ºC and +40 ºC, humidity not exceeding 85% non-condensing. All external cables should be installed safely to avoid mechanical damages.
FAD-40 instruments are very low level signal measuring instruments. To avoid electrical noise, the instruments should be separated from equipment that produces electrical noise. Preferably use a metal cabinet against radio frequency interference, to protect against electromagnetic disturbance the cabinet shall be connected to ground. Keep the load cell cable trays separated from others, if possible. If there is noise-generating equipment such as heavy load switches, motor control equipment, inductive loads etc., please be careful against the EMC interference in the cabinet. If possible protect FAD-40 instruments by a Faraday cage or install them in a separate section or install them far away from this kind of equipment. Install parallel reverse diodes to the DC inductive loads like relays, solenoids etc. to minimize voltage peaks on the DC power lines.

3.1.2. Cabling

All cables coming to the control cabinet shall be shielded. Please use separate cable trays for these low signal level cables. Distance from load cell cables, interface cables and DC power supply cables to power line cables shall be 50 cm at minimum.

3.1.3. Mechanical Installation

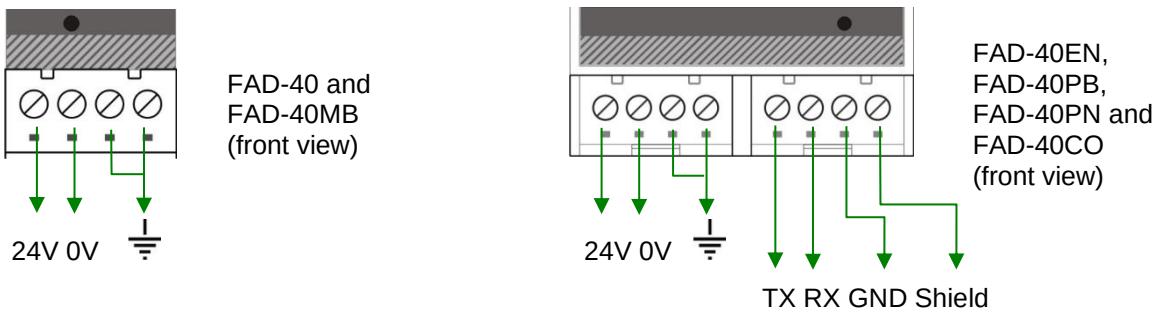
After designing the control panel and installing DIN rails according to the recommendation in this chapter, place the FAD-40 instruments on the DIN rail Be sure that the mechanical installation of the instruments is done properly.

3.2. Electrical Connections

Warning: Please always remember that FAD-40 instruments are very low voltage measuring instruments. Your control cabinet design and proper installation increases the reliability and the performance of the instrument. Please do not forget that the instrument must be powered off before inserting or removing any peripheral connector. All required electrical connections should be done as described below.

3.2.1. Power Supply and Grounding

The power supply voltage of the instrument shall be between 12 V DC and 28 V DC. The current consumption of the power supply will be calculated by multiplying 0.2 A and the quantity of instruments. The pin configuration of the 24 V DC power supply connector located at the bottom front of the instrument is shown below in figure 4.1.



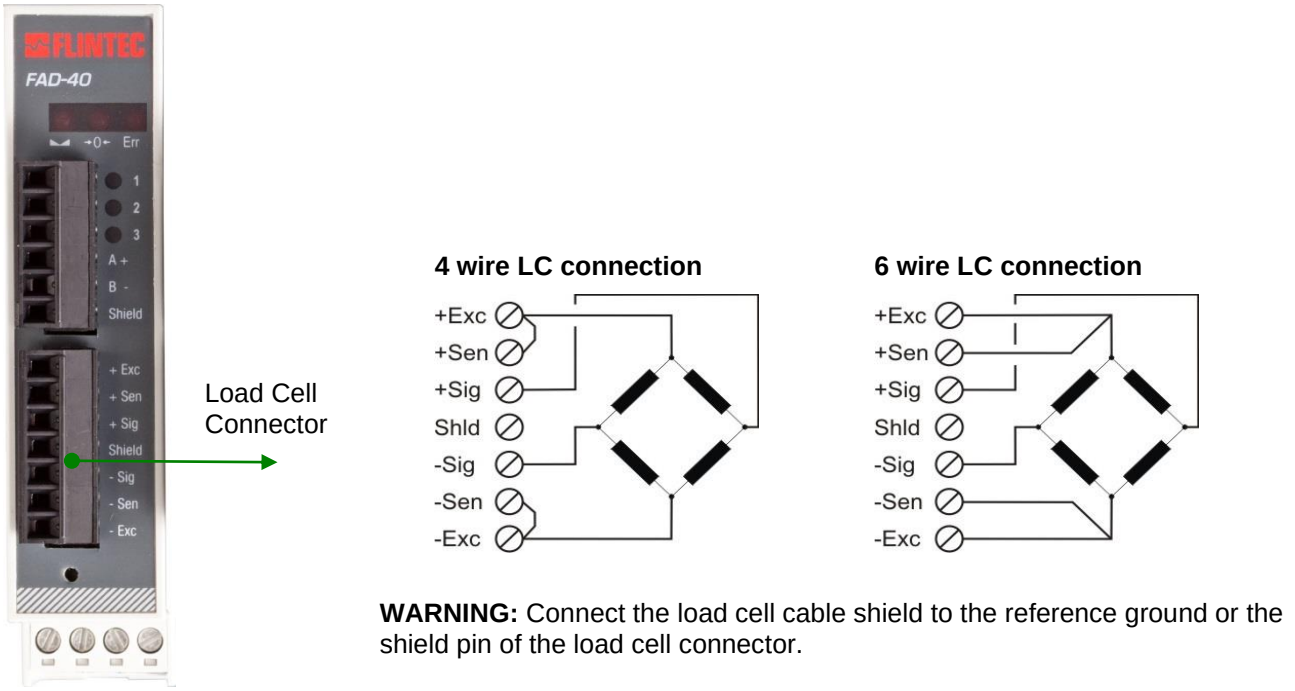
Warning: Do not forget to connect the Shield pin to the reference ground.

Figure 4.1 – The pin layout of 24 V DC connectors

The quality of the instrument's ground will determine the accuracy and the safety of your measuring system. A proper ground connection is needed to minimize extraneous electrical noise effects on the measurement. A poor ground can result in an unsafe and unstable operation. It is important that the instrument should not share power lines with noise-generating equipment such as heavy load switching, motor control equipment, inductive loads, etc. If the condition of the power line in the plant is poor, prepare a special power line and grounding. Before interfering the instrument, turn off the power and wait at least for 30 seconds.

3.2.2. Load Cell Connection

To avoid damages, the load cell wiring should be made carefully before energizing the instrument. Load cell connection details are shown below in figure 4.2. In 4-wire installations the sense and excitation pins with the same polarity should be short circuited at the connector side. If you have a junction box in your system, use a 6 wire cable between FAD-40 and the junction box, and short circuit these pins at junction box for better performance.



WARNING: Connect the load cell cable shield to the reference ground or the shield pin of the load cell connector.

Figure 4.2 – Load cell connection

When you use a junction box and one or more load cells with 4 wires you have to short-circuit the excitation (Exc) and sense wires (Sen) the same polarity as show on the figure 4.21.

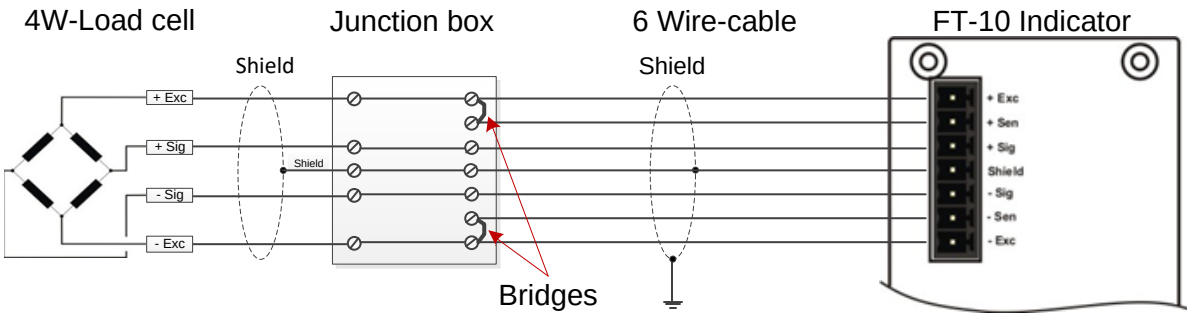


Figure 4.21 – 4 wires load cell connection via connection box

3.2.3. Digital I/O Connection

FAD-40 instruments have the digital I/O connectors on the instrument's front. I/O1 is always an output, I/O2 and I/O3 can be configured for input or output. The I/O connection diagram is shown in Figure 4.3

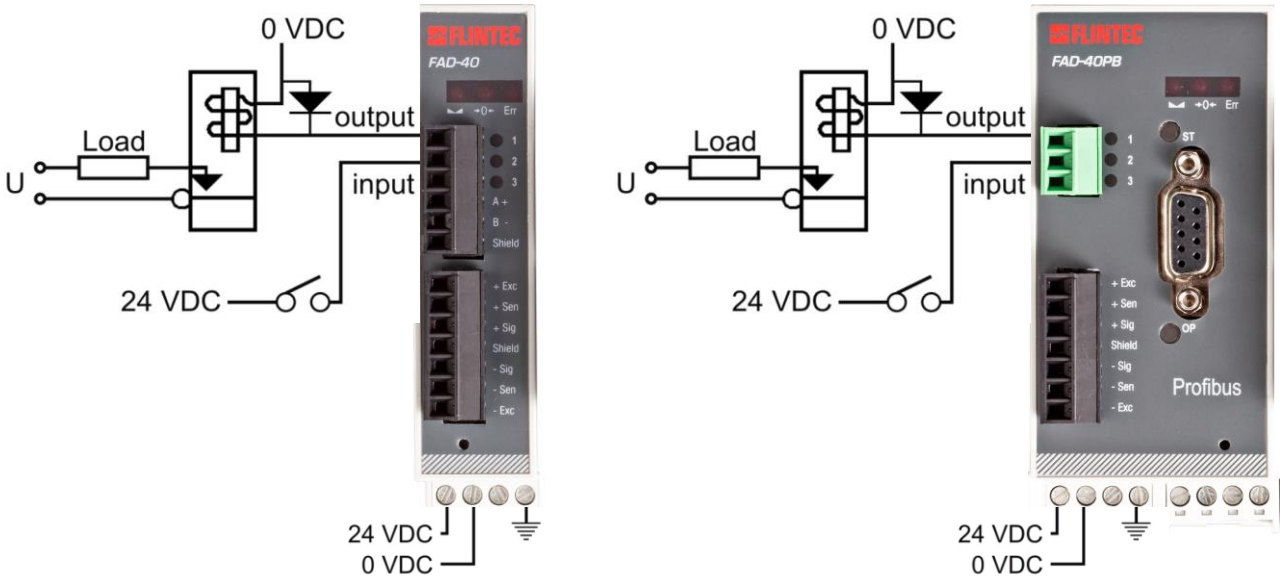


Figure 4.3 – Digital I/O connection

3.2.4. Serial Interface RS232

You can use the serial interface RS232 with the xFace software for configuration and adjustment.

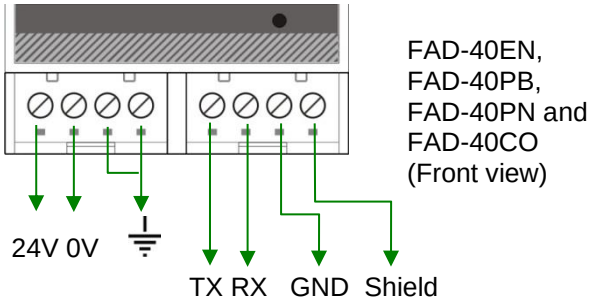


Figure 4.4 – The pin layout of RS232 connector

3.2.5. Communication Interface

Please refer to the corresponding chapter:

FAD-40 (RS485)	see chapter 6.2
FAD-40MB (Modbus RTU)	see chapter 6.2
FAD-40PB (Profibus)	see chapter 7.2
FAD-40PN (Profinet)	see chapter 8.2
FAD-40EN (Ethernet and Modbus TCP)	see chapter 9.2
FAD-40CO (CANopen)	see chapter 10.2

3.3. Commissioning

PRECAUTION: Please read this manual carefully before energizing the instrument. Perform the commissioning operation according the procedure given in this chapter. Only trained persons are allowed for cleaning, commissioning, checking and servicing of the instrument. The interference of untrained person may cause some unwanted damages or injuries.
Before energizing the instrument, please make the required mechanical and electrical installations. After power on, you have to setup your FAD-40 instrument before you can start to use the bus interface.
Install the xFace software onto your PC as described in chapter 5 Setup. The xFace software is used for setup, calibration and testing of FAD-40 instruments.
After you have successfully checked the performance of the instrument with xFace, you can begin to use the instrument in your application.

4. SETUP

PRECAUTION: Please read this manual carefully before energizing the instrument. Perform the commissioning according the procedure given in chapter 4.3. Only trained person are allowed for commissioning, checking, cleaning and servicing of the instrument. The interference of untrained person may cause some unwanted damages or injures.

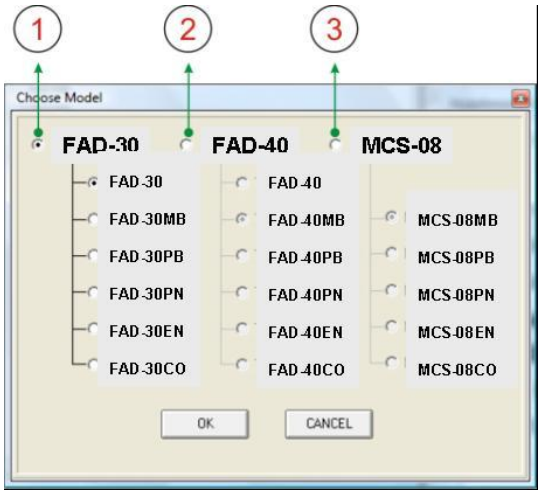
FAD-40 series instruments are setup and calibrated by the xFace software supplied with the instrument. The instruments shall be setup in the sequence described below before you can use the bus interface.

- Install the xFace software onto your PC
- Connect your PC with the instrument over the serial interface (RS232 respective RS485)
- Setup and calibrate the instrument
- Check the performance of the instrument

4.1. Installation of the xFace Software

Please follow following steps to install the xFace software:

- Close all applications on your PC
- Insert the CD that contains the xFace software into the CD-ROM drive
- Double click “Setup.exe” to start the installation. The setup Wizard is displayed.
- Follow the menus in the setup wizard step by step.
- After finishing the installation, the Setup Wizard will inform you about the success of the software installation. Click the OK button.
- After closing the Setup Wizard you can start to use the xFace software.



1 Typ FAD-30

2 Typ FAD-40: Select one of the FAD-40 models and press OK button.

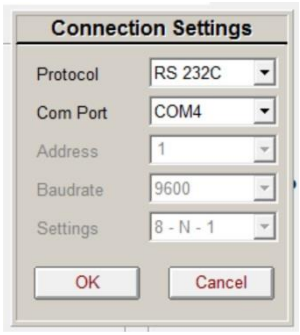
3 Typ MCS-08

Figure 5.1 – xFace type selector window

4.2. Connection to the xFace Software

The connection between FAD-40 and the xFace software is done via the RS485 serial port or the RS-232C service port for all models. Alternatively Ethernet (for FAD-40EN only) can be used for this connection. You can purchase a suitable PC connection cable as an accessory from Flintec (Refer to chapter 3.4.2).

After running the xFace software select the FAD-40 model you use (see figure 5.1.). Select the PC’s communication port within the Connection settings menu in the tools tab (see figure 5.2) and click the connect icon. After the communication between FAD-40 and your PC has successfully started the traffic light of the connect icon turns from red to green.



Protocol: Select the setup port of the instrument. FAD-40 and FAD-40MB instruments can be setup over RS-485. Other models can be setup over RS-232C.

Com Port: Select the communication port of the PC

Address: Select the RS-485 address, if RS-485 is selected

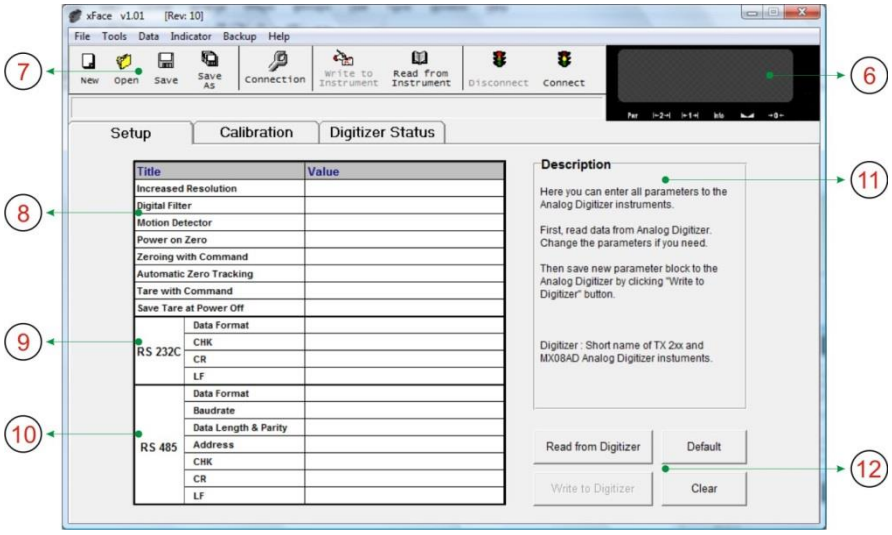
Baud rate: Select the RS-485 baud rate, if RS-485 is selected

Setting: Select the RS-485 communication port setting, if RS-485 is selected

Figure 5.2 – xFace Connection Settings

4.3. Setup and Calibration

WARNING: Read this manual carefully before you setup and calibrate the instrument. This will increase the performance of your weighing system by applying proper setup and calibration.



6	**Visual Weight Display:** Displays the weight, count or force value
7	**Toolbox:** Contains shortcuts of some special commands
8	**A/D Converter Parameters:** This block allows the user to setup the A/D Converter's parameter related to the operation mode. Refer to chapter 5.3.1
9	**RS-232C:** RS-232C serial port communication settings (not for FAD-40 and FAD-40MB)
10	**RS-485:** RS-485 port communication settings. (FAD-40 and FAD-40MB only)
11	**Description:** This block provides some clear-text explanations
12	**Read from A/D Converter:** Click this button to read the parameter settings from the instrument
	Write to A/D Converter: Click this button to save the parameter settings to the instrument
	Default: Click this button to load the factory default settings
	Clear: Empties the parameter settings

Figure 5.3 – FAD-40 Setup Parameters

For entering the parameter values enter the setup tab, adjust the parameter settings and then write this data to the A/D Converter. After changing parameter settings the instrument always requires a re-calibration.

4.3.1. Scale Parameters

In the setup menu the scale parameters of FAD-40 can be viewed, changed or saved to the instrument. These parameter settings are:

Increased External Resolution

For service purposes this parameter enables the 10 times higher resolution of the weight value than the defined interval in weighing and force mode. Increased resolution must be disabled for use in normal operation (Not available in Count Mode). Default setting: 'Disable'.

Digital Filter

Environmental noise like bounding forces, air flow, vibration, motor control instruments etc. may disturb the load cell signal. The selection of proper filter settings determines how quickly the system will react to the load cell signal.**Load cell signal digital filtering is done according to this parameter settings. The settings can be changed from 0 (fastest settling) to 9 (slowest settling). Default setting: '7'.

Setting	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Values/s	1600	800	400	200	100	100	100	50	50	50
Settling time [ms]	80	140	250	180	300	420	380	620	720	1800

Motion Detection

This parameter defines the motion detection window which determines a stable weighing. If motion detection is not required, this parameter can be disabled. The available motion detection window values are:

Weighing and Force Mode:

Disable	± 0.3e	± 0.5e (default setting)	± 1e	± 2e

Count Mode:

Disable	± 60	± 100 (default setting)	± 200	± 400

Power On Zero

This parameter enables automatic zeroing after powering on the instrument. The automatic zeroing is only done if the total zero drift from the calibrated zero signal is in the defined zeroing window. This zeroing window will be defined in the percentage of the scale capacity.

Disable (default setting)	± 2%	± 10%

To avoid unwanted zeroing at power on this parameter should be disabled or carefully set up in applications like silo weighing, tank weighing and automatic weighing applications. If the weight is not within the power on zeroing range, the instrument is powered on without zeroing (Not available in Count Mode).

Zeroing by Key (Zeroing Range)

Zeroing of the scale is performed if the difference between load cell signal value and unloaded load cell signal value at the calibration is in the selected percentage of the scale capacity. Zeroing can be done by zeroing command when the scale is stable. Zeroing can be done by zeroing command when the scale is stable.
The available zeroing ranges in the percentage of the scale capacity are:

Disable	± 2% (default setting)	± 20%	± 40%

Auto Zero Tracking

AZT automatically re-adjusts the scale to zero for compensating defined small deviations around the center of zero. AZT only works within the defined zeroing range and stops working if this range is left.To avoid unwanted zeroing this parameter should be disabled or carefully set up in applications like silo weighing, tank weighing and automatic weighing applications (Not available in Count Mode). The available AZT window values are;

Disable (default setting)	± 0,5e	± 1e	± 3e

Tare

If this function is enabled, the weight is tared when the tare command is received. Additional conditions for taring are positive gross weight and no motion. Multi-taring is possible with FAD-40 series (Not available in Count Mode). Default setting: ‘Enable’.

Save Tare at Power Off

If this function is enabled, the tare value is stored at power off and the instrument starts up in Net mode at power on (Not available in Count Mode). Default setting: ‘Enable’.

4.3.2. RS-485 Serial Interface Setup

Data Format

This parameter defines the serial communication port data format for RS-485. The available data formats are:

Disable:	Port will be disabled. Select “Disable” if this port is not used.
BSI (default setting for FAD40)):	Communicates in BSI data format as a slave. Refer to chapter 5.9 for details.
Modbus RTU (default setting for FAD-40MB)):	Modbus RTU communication (for FAD-40MB only). Refer to chapter 5.11 for details

NOTE: xFace automatically connects to the instrument whatever the data format is. After xFace is disconnected, the instrument returns to operate with the last saved data format.
WARNING: Disable this interface if it is not used to increase the interfacing performance.

Checksum
The checksum can be enabled or disabled within BSI data format. The checksum calculation can be found in the related data format description. Default setting: ‘Enable’.

Carriage Return (CR)
Carriage Return can be enabled or disabled within Continuous output data format. Default setting: ‘Enable’.

Line Feed (LF)
Line Feed can be enabled or disabled within Continuous output data format. Default setting: ‘Enable’.

The RS-485 setup is done by the xFace software as described in this chapter. Select the Setup tab after xFace has established a connection with your instrument. The Setup tab (see figure 5.3) includes all RS-485 settings.

Baud Rate
One of the following baudrate will be selected for the RS-485 communication port.

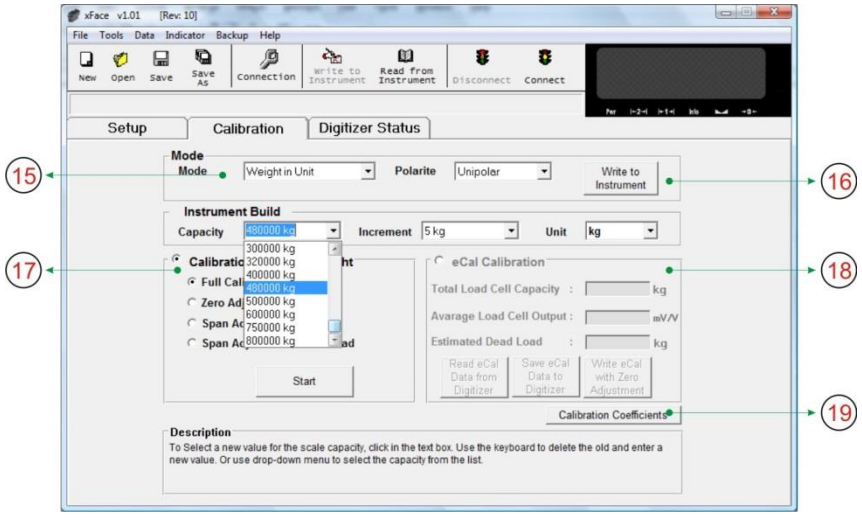
1200	2400	4800	9600 (default setting)
19200	38400	57600	

Data Length and Parity
The data length and parity can be selected as 8 None 1 (default), 7 Odd 1 or 7 Even 1.

Address of A/D Converter
The address range is 01 (default) to 31. If you enter 0, the instrument will operate without address data.

Modbus RTU Setup (for FAD-40MB only)
RS-485 Data Format: ‘Modbus RTU’,
RS-485 Data Length & Parity: ‘8 none 1’,
RS-485 Address: ‘01’ to ‘31’

4.3.3. Scale Build and Calibration
Scale build, operation mode selection and scale calibration is performed in the calibration tab of xFace as shown in figure 5.4. Please follow the procedure in the sequence as described in the following chapters.



15	**Mode:** Here the user selects the operation mode and the polarity.
16	**Write to A/D Converter:** Click this button to save the operation mode and polarity to A/D Converter.
17	**Calibration block:** This block allows the user to calibrate with test weights.
18	**eCal Calibration:** This block allows the user to calibrate without test weights.
19	**Calibration Coefficients:** This function allows the user to restore a calibration if the calibration coefficients have been noted before.

Figure 5.4 – Calibration

Mode Selection

FAD-40 instruments have three operation modes which are:

Count Mode:	Filtered and normalized ADC count data will be transmitted in this mode. The calibration is performed at the PLC, if any.
Weighing Mode:	Unipolar weight data in calibrated weighing unit will be transmitted. This mode is compatible to OIML R76 and EN 45501.
Force Mode:	Bipolar or unipolar force measurement data in calibrated force unit will be transmitted.

Select the scale operation mode and the polarity. Then click the “Write to A/D Converter” button to save your mode selection. The default calibration of FAD-40 instruments is Count Mode and 10 mV unipolar input signal range. If you select the Count Mode, there is no scale build and instrument calibration. Each FAD-40 instrument is adjusted for high accuracy during the production. The FAD-40 input signal ranges and their external resolutions are shown in Table 5.1.

Input signal range	**Input Signal level**	**Polarity**	External resolution
0 to 5 mV	5 mV	Unipolar	1 million counts
-5 to 5 mV		Bipolar	2 million counts
0 to 10 mV	10 mV	Unipolar	1 million counts
-10 to 10 mV		Bipolar	2 million counts
0 to 15 mV	15 mV	Unipolar	1 million counts
-15 to 15 mV		Bipolar	2 million counts
0 to 18 mV	18 mV	Unipolar	1 million counts
-18 to 18 mV		Bipolar	2 million counts

Table 5.1 - Count Mode, Input Signal Ranges and External Resolution

Select the input signal level and polarity for high external resolution. Write your mode selection to the instrument by clicking “Write to A/D Converter” button. Jump to the chapter 5.4.

Scale Build

The scale capacity, the increment and the unit have to be introduced to the FAD-40 instrument before you can perform a calibration in Weighing or Force mode.

Capacity:	To select a new value for the scale capacity, click in the text box. Use the keyboard to enter a new value, or use the drop-down menu.
Increment:	Use the drop-down menu to select the increment.
Unit:	Select the unit

The scale calibration can be performed by using test weights or by electronic calibration (eCal).

Calibration by Test Weights

This calibration method performs zero and span calibrations using test weights. For accurate calibration the test weight value should not be less than 1/10 of the scale capacity.

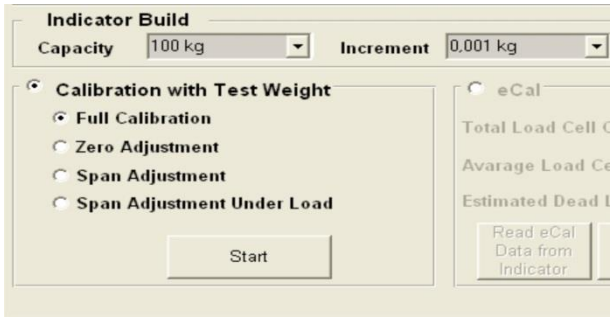


Figure 5.5 – Calibration by test weights

Please note that the scale build values should be entered before you start the calibration.
Select “Full Calibration” for performing a complete scale calibration. Click the “Start” button. Unload the scale for performing the zero calibration and click the “Yes” button. The virtual display will show the [WAIT] message during the zero calibration. During the zero calibration the scale must be stable. Approximately 5 seconds later the span calibration window will be displayed. Load the scale and enter the loaded test weight value, then click the “OK” button. The scale must be stable during the span calibration. Approximately 5 seconds later the new calibration settings are saved automatically.
If any error occurs during the calibration an error message warns you. Click the “Yes” button to reload the previous values or click the “No” button to use the new settings.
You can adjust the zero or the span of your scale without performing a full calibration. Additionally the “span calibration to the unloaded scale” feature is another tool of FAD-40 instruments for after-sale services.

Zero Adjustment

If your scale has a residual zero drift you may perform a zero adjustment only. Select “Zero Adjustment” and press the “Start” button. Then the zero calibration window will be displayed. Unload the scale and click the “OK” button. The [WAIT] message appears on the virtual display during the zero adjustment. Approximately 5 seconds later the zero adjustment will be finalized.
Note**:** Zero adjustment is also performed over the bus interface. Refer to the data structure of the related bus interface.

Span Adjustment

If your scale has a span drift, you may perform a span adjustment only. After selecting “Span Adjustment” and pressing the “Start” button, enter the test weight value; place the test weights on the scale and press the “Yes” button. The [WAIT] message appears on the virtual display approximately for 5 seconds while the span calibration is being performed. After finalizing the span adjustment, the instrument will save the span coefficients automatically.
Note**:** Span adjustment is also performed over the bus interface. Refer to data structure of the related bus interface.

Span Adjustment under Load

This feature is being used to perform a span adjustment without unloading the scale. This operation is especially used for the span adjustment for non-empty tanks to make a span adjustment without emptying the tank. After selecting “Span Adjustment under Load” press the “Start” button. The temporary zeroing message appears on the monitor. This means the instrument will determine the existing load as the temporary zero. If the scale is stable press the “Yes” button. The [WAIT] message appears on the virtual display approximately for 5 seconds to determine the temporary zero. Then the span calibration window will be displayed. Load the scale and enter the loaded test weight value, then click the “OK” button. The scale must be stable in this period. Approximately 5 seconds later, the new calibration settings are saved automatically.
Please refer to the chapter 5.4 A/D Converter Performance Test).

Electronic Calibration (eCal)

eCal allows to perform a calibration without using test weights. FAD-40 is adjusted during production for increased eCal accuracy. The calibration will be done based on the scale capacity, the total load cell capacity, the load cell output and the estimated dead load. If the conditions are convenient for zero calibration, you may perform automatic zero adjustment instead of entering an estimated dead load.

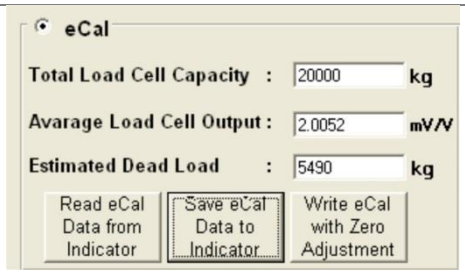


Figure 5.6 – eCal Calibration

After selecting eCal calibration enter the following values as:

Total Load Cell Capacity: Enter the total load cell capacity in kg as shown in the example below.
Example: If the weighing system has 4 pcs 1000 kg load cells, then enter 4000 kg.

Average Load Cell Output: Enter the load cell output in mV/V. If the weighing system has more than one load cell, calculate the mean value of the load cells output as indicated in the certificates of the individual load cells.

Example: If the load cell outputs are LC1: 2.0010, LC2: 1.9998, LC3:1.9986 and LC4:2.0002, the mean value will be LC output = (2.0010 + 1.9998 + 1.9986 + 2.0002) ÷ 4 = 1.9999 mV/V.

Estimated Dead Load: Enter the estimated dead load value of the weighing system in kg. You may perform a zero adjustment in convenient time for exact dead load compensation. After pressing “Save eCal Data to Converter” these data will be transferred to the instrument and eCal will be finalized.
If the scale is empty and you want to make an automatic zero adjustment instead of entering an estimated dead load, then press the “eCal with Zero Adjustment” button for starting the zero calibration. The display will show the [WAIT] message during the zero adjustment for approximately 5 seconds. In this period the scale must be unloaded and stable. The eCal calibration coefficients are saved automatically.

4.4. A/D Status (Performance Test)

The scale performance test should be performed before you install the bus connection. The tests are linearity, repeatability and eccentricity. You can follow the test at the virtual display and/or status tab which show the measurement data, the instrument data and the software version. For convenience keys for Taring, Zeroing and Clear are located in this tab.

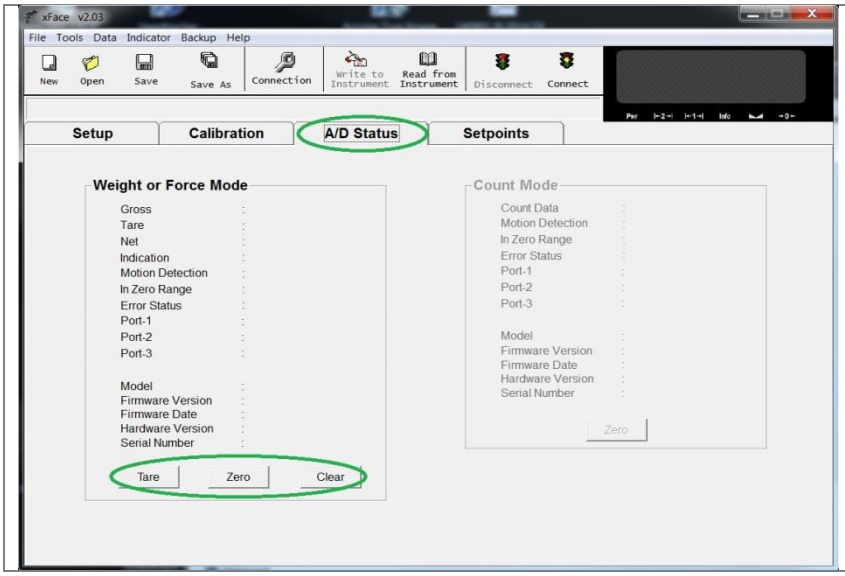
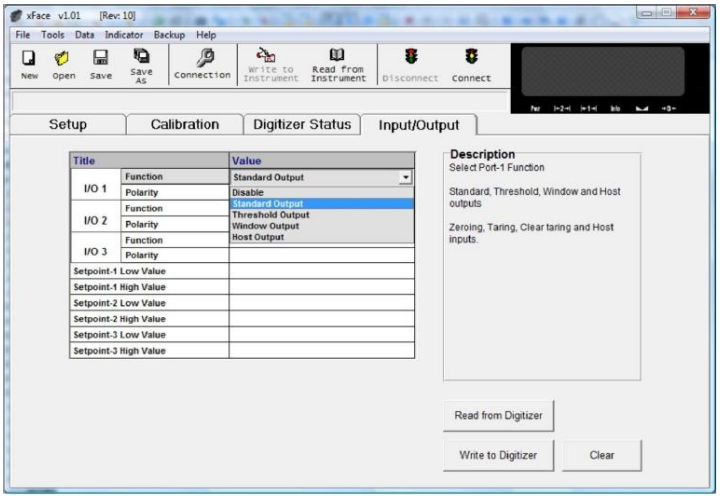


Figure 5.7 – A/D Status

4.5. Setup of Digital I/O

FAD-40 instruments have 3 digital I/O channels. I/O1 is always an output, I/O2 and I/O3 can be configured for input or output. The I/O connection diagram is shown in Figure 4.3



I/O1: Select function and polarity for I/O1 (output only)

I/O2: Select function and polarity for I/O2

I/O3: Select function and polarity for I/O3

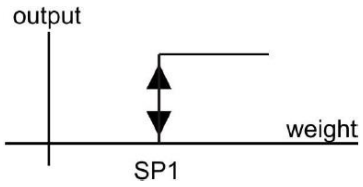
Setpoint entries: Enter setpoints. Setpoint 1 for I/O1, setpoint 2 for I/O2 and setpoint 3 for I/O3.

Figure 5.7 – Digital I/O Setup

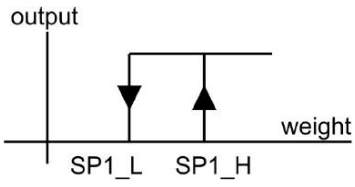
Setup of Digital Output Function

I/O1, I/O2 and I/O3 can be set up with the output functions described below.

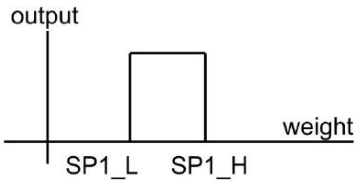
Standard output (Setpoint without hysteresis): Only one value is entered. The output state is forced active (active high or active low, selectable) when the weight is higher than the setpoint SP1, else the output is passive.



Setpoint with hysteresis: 2 values are entered. The output state is forced active when the weight gets higher than the higher setpoint value SP1_H. The output state drops to passive state when the weight gets lower than the smaller setpoint value SP1_L.



Tolerance band: 2 setpoint values are entered. The output is active when the weight is between these two setpoints (SP1_L and SP1_H).



Host Output: Output controlled over field bus commands. Refer to related field bus data structure.
Disable: The ouput will be disabled.
I/O Polarity: The output polarity can be defined for active high (default) or active low (inverses the output).

Enter the setpoint values for the selected output function. Host output needs no setpoint value. Click “Write to Converter” to save the changes.

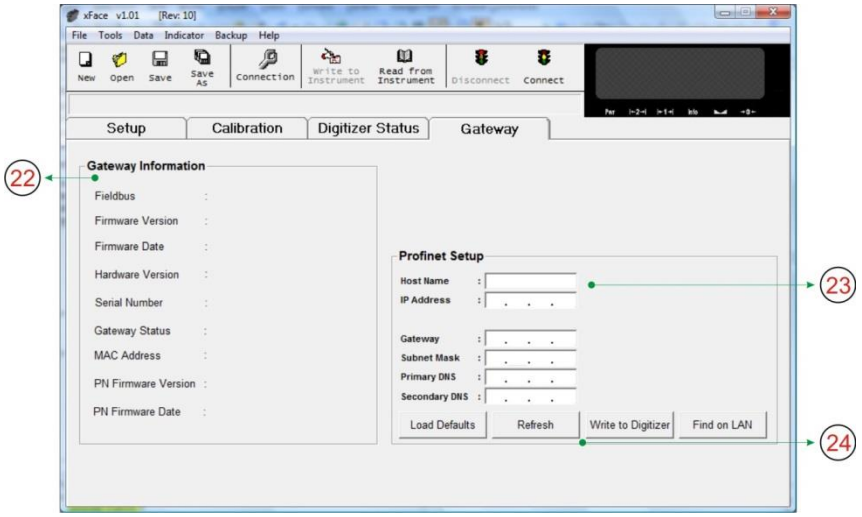
Setup of Digital Input Function

I/O2 and I/O3 can be set up with the input functions described below:

Zeroing	The input zeros the scale.
Taring	The input tares the scale.
Clear Tare	The input clears the tare memory.
Host Input	Input controlled over field bus commands. Refer to related field bus data structure.
Disable	The input will be disabled.
I/O Polarity	The input polarity can be defined for active high (default setup) or active low (inverses the input).

4.6. Bus Interface Setup

FAD-40 instruments have a bus interface and these parameters have to be setup before the bus will be connected. Bus communication settings are done in the Gateway tab.
Bus communication parameters and their descriptions can be found in the related instrument chapters.



22 **Gateway Information:** Gives the user info about the bus interface

23 **Communication setup:** Network parameters

24 **Load Defaults:** Loads the default values

Refresh: Reads the settings from the instrument and updates the window

Write to Converter: Saves and activates the settings to the instrument

Find on Network: Search for the instrument on the network

Figure 5.8 – Bus Interface Setup

4.7. Bus Addressing via Setup Switch

The bus addressing of FAD-40 instruments is done by the xFace software (Refer to chapter 5.3.1). The alternative way for addressing is the setup switch on the front panel for addresses between 0 and 7 for RS-485, Modbus RTU, Profibus and CANopen interfaces. This feature gives you the practical advantage for addressing the instrument up to address 7 without requiring a PC connection.
For addressing via the setup switch, press this switch for 5 seconds. Then the status LEDs indicate the bus address as shown in the table below. If the address is higher than 7 all LEDs are flashing. The address can be changed by pressing the setup switch sequentially. To save and exit, press the setup switch for 5 seconds. To return to normal operation without saving, wait 15 seconds without pressing the switch.

	→0←	Err	Address Number
○	○	○	0 (No address)
○	○	●	1
○	●	○	2
○	●	●	3
●	○	○	4
●	○	●	5
●	●	○	6
●	●	●	7
✸	✸	✸	Higher than 7

○ Off ● On ✸ Flash

Table 5.2 – Bus Addressing via Setup Switch

4.8. Back up Settings and Calibration Data

The parameter settings and the calibration coefficients can be saved to a backup file after reading these data from the FAD-40 instrument. This backup file can be re-written to FAD-40 after opening it by xFace.
The backup feature gives a service advantage to FAD-40 instruments. We propose to burn these files to CD / DVD and save this backup CD / DVD in the control cabinet additionally to a backup file on your PC.

Important note: The previous parameter settings and calibration coefficients in FAD-40 will get lost after loading a backup to the instrument.

5. FAD-40 / FAD-40MB WITH RS-485 INTERFACE

FAD-40 and FAD-40MB instruments are state-of-the-art strain gauge load cell signal digitizers with RS-485 interface. These instruments are used for any type of process weighing and force measurement including tank and silo weighing, dynamic weighing, check weighing, filling, tension /compression force measurement etc.

5.1. Front View of FAD-40 (MB)

There are 3 status LEDs on the front panel which indicate the operational instrument status (Refer to table 6.1). The setup switch on front panel of the instrument is used for RS-485 addressing without PC (Refer to chapter 5.6) and for diagnostics (Refer to chapter 12).
When the error LED is ON, the other two LED indicate the error type (Refer to chapter 11 for details).
Load cell connection, power supply and serial interface terminals are located at the front of the DIN rail mount instrument (See figure 6.1).

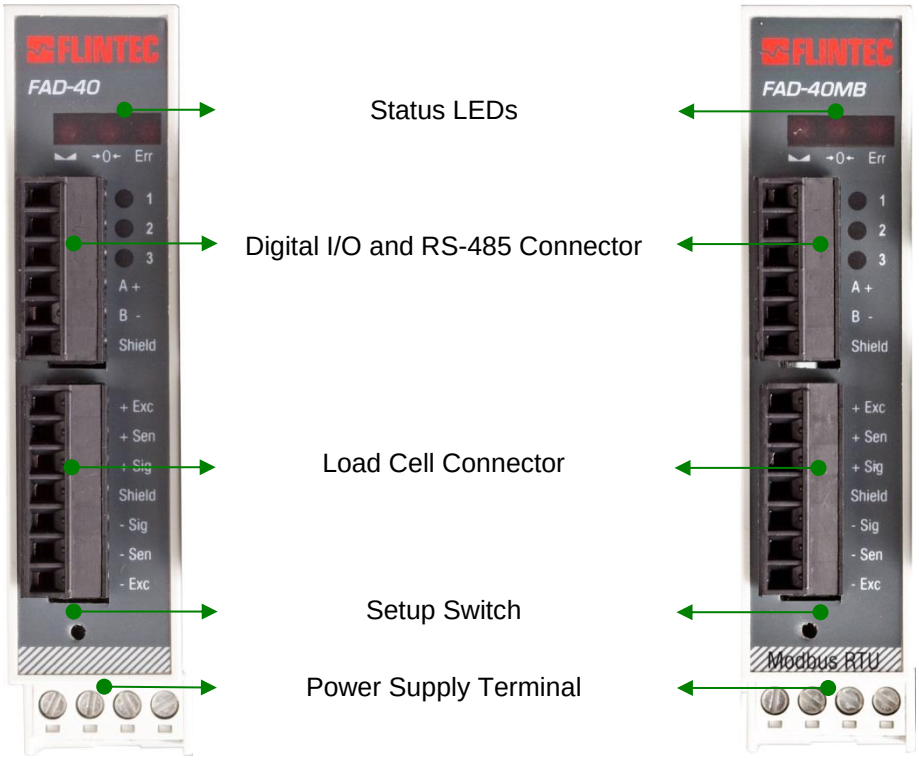


Figure 6.1 – Front view

The meanings of these LEDs in operation are described below.

LED		Operational Mode	
Symbol	**Name**	**Weight / Force**	**Count**
▁▂▁	Stable	● Stable ○ Unstable	◐ Off for 0.3 seconds in 2 seconds period (No stable indication)
→0←	Centre of Zero	● in the center of zero range (-0.25 e < w < 0.25 e) ○ Out of center of zero range	○ Always off (No center of zero indication)
Err	Error (*)	● ADC conversion error ✹ Digital processing error ○ No error	● ADC conversion error ✹ Digital processing error ○ No error

○ Off ● On ✹ Flashing ◐ Off for 0.3 seconds

(*) : Refer to the error table in chapter 11

Table 6.1 – Status LEDs

5.2. Electrical Connections

RS-485 connection is shown in figure 6.2.

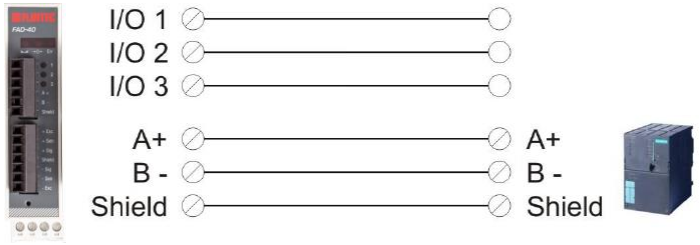


Figure 6.2 – FAD-40 / FAD-40MB serial interface connection

RS-485 Serial Interface

Use	Interfacing with PC or PLC, setup via xFace
Data format	BSI (default for FAD-40), Modbus RTU (for FAD-40MB only, default)
Baud rate	1200 / 2400 / 4800 / 9600 (Default) / 19200 / 38400 / 57600 bps
Length and parity	8 None 1 (default), 7 odd 1, 7 even 1
Start / Stop bits	1 start bit and 1 stop bit

WARNING: Connect the shield to the reference ground.
WARNING: Disconnect xFace PC software for Modbus-RTU interfacing

5.3. RS-485- and Modbus-RTU-Interfacing

FAD-40 and FAD-40MB instruments have one serial interface connector on the front of the instrument: RS-485. The table below describes the data format for interfacing the peripherals and their application:

Data Format	Description	Application	Hardware
BSI	Demand interface on BSI Serial Interface format. Refer to chapter 5.10	Master – Slave data interfacing with PLC or PC.	RS-485
Modbus RTU (FAD-40MB only)	Modbus RTU interfacing. Refer to chapter 5.11	Interfacing with PLC.	RS-485

Table 6.1 – Data output interfacing

Attention: Please disable the interface if not used to increase the performance of the instrument.

5.4. Setup and Calibration

FAD-40 and FAD-40MB instruments are set up and calibrated by xFace. The A/D Converter settings are very important for a good weighing performance. Please refer to chapter 5.3.

5.5. BSI Data Structure (for FAD-40 and FAD-40MB only)

Depending on their functionality all new generation Flintec instruments launched on the market support the standardized command set with BSI data structure. This easy data format gives a reliable and fast interface for communicating with PLC or PC for process control or transactional applications. You can expand your system with additional scales from Flintec without having to change your application program base.

General Rules:

1. Commands are only in CAPITAL letters
2. CHK (2 ASCII char) can be enabled or disabled from both command and response.
3. Weight data is 8-byte with dot and non-significant zeros on the left.
4. Address (2 ASCII char) will be located in the structure if not 00.

Command format:

A general description of the command is the following:
[ADR][COMMAND][CHK][CR][LF]

Response format with weight / force or count data
A general description of the response is the following:
[ADR][COMMAND][STATUS][SIGN][WEIGHT/FORCE/COUNT][CHK][CR][LF]

Response format without weight / force or count data
[ADR][COMMAND][STATUS][CHK][CR][LF]

BSI Command Table:

A	Read all weight data immediately
B	Read Gross weight value immediately
C	Clear the tare memory
D	Read Count value immediately
I	Read current (indicated) weight value immediately
P	Print: Read the current stable weight value
Q	Load Setpoints
R	Read Setpoints
S	Read Status
T	Tare
U	Read digital inputs
V	Read digital outputs
W	Set/reset digital outputs
X	Read current weight value in increased resolution immediately
Z	Zero

BSI Status Table:

A	Acknowledged, the command is operated successfully
D	Unstable weight
E	Errors except of H, L, O, +, −
H	High voltage detected
I	The weight is in range
L	Low voltage detected
N	Not acknowledged, the command couldn't be operated
O	ADC out
S	Stable weight
X	Syntax error (received command not recognized)
+	Overload
−	Underload

Note: CHK, CR and LF will not be shown in the below data format descriptions in this chapter.

BSI Commands and Responses

A	Read all weight data

Command: [ADR][A]
Response: [ADR][A][STATUS][SIGN][NET W][SIGN][TARE W][SIGN][GROSS W]
Example:

Command : 10A
Response : 01AS+000123.4+000111.1+000234.5
01AD+000123.4+000111.1+000234.5
01AO (ADC out error)

Comments: The response is net, tare and gross weight values or error status. All weight data will be transmitted immediately after receiving the command.

B	Read Gross weight

Command: [ADR][B]
Response: [ADR][B][STATUS][SIGN][WEIGHT VALUE]
Example:

Command: 01B
Response: 01BS+000123.4 (gross weight is stable and 123.4)
01BD+000123.4 (gross weight is unstable and 123.4)
01B− (under load)

Comments: The response is the gross weight value (stable or unstable) or error status. Gross weight data will be transmitted immediately after receiving command.

C	Clear the tare memory

Command: [ADR][C]
Response: [ADR][C][A] (Cleared and the scale is in gross mode)
[ADR][C][X] (Clear command is unavailable in count mode)
Comments: The response status is always Ack in weighing or force mode and always X in count mode.

D	Read Count value immediately

Command: [ADR][D]
Response: [ADR][D][STATUS][SIGN][COUNT VALUE]
Example:

Command: 01D
Response: 01DD+00123400
01DO (ADC out error)
01DX (Not in count mode)

Comments: Count value will be sent immediately.

I	Read indicated weight

Command: [ADR][I]
Response: [ADR][I][STATUS][SIGN][WEIGHT VALUE]
Example:

Command: 01I
Response: 01IS+000123.4 (weight is stable and 123.4)
01ID+000123.4 (weight is unstable and 123.4)
01I+ (overload)

Comments: The response is the indicated weight value (stable or unstable). It will be transmitted immediately after receiving the command. The weight value may be in gross or net.

P	Print :Read the stable weight

Command: [ADR][P]
Response: [ADR][P][STATUS][SIGN][WEIGHT VALUE]
Example:

Command: 01P
Response: 01PS+000123.4 (weight is stable and 123.4) or
01PN (could not print)

Comments: Checks status and it must be stable. Else Nack status will be sent. There is no time period for stability checking. Status can be Stable or Nack.

Q	Load setpoints

Command: [ADR][Q][SP NUMBER][SP TYPE][SIGN][SP VALUE]
Response: [ADR][Q][A]
Example:

Command:	01Q01L+000123.4	
Response:	01QA	(123.4 loaded to SP1_L)
	01QN	(could not load)
	01QU	(Mismatch of decimal point of SP VALUE)

Comments: SP No is 2 byte ASCII char. Use 01 for SP1, 02 for SP2 and 03 for SP3.
SP Type is 1 byte ASCII char. Use “L” for SPx_L and use “H” for SPx_H.
SP VALUE data is 8-byte ASCII char with dot and non-significant zeros on the left.

R	Read setpoints

Command: [ADR][R][SP NUMBER][SP TYPE]
Response: [ADR][R][A][SIGN][SP VALUE]
Example:

Command:	01R01L	
Response:	01RA+000123.4	(SP1_L is 123.4)
	01RN	(could not read)

Comments: SP No is 2 byte ASCII char. Use 01 for SP1, 02 for SP2 and 03 for SP3.
SP Type is 1 byte ASCII char. Use “L” for SPx_L and use “H” for SPx_H.
SP VALUE data is 8-byte ASCII char with dot and non-significant zeros on the left.

S	Read Status

Command: [ADR][S]
Response: [ADR][S][STATUS-1][STATUS-2][STATUS-3]
Example:

Command:	01S	
Response:	01SSGI	(Stable, Gross, In Range)
	01SDGL	(Unstable, Gross, Low voltage error)

Comments: The response includes 3 status information.
STATUS-1 can be Stable or Unstable.
STATUS-2 can be Gross or Net.
STATUS-3 can be ‘in range’, ‘out of range’, ‘low voltage’ or ‘high voltage’.

T	Tare

Command: [ADR][T]

Response:	[ADR][T][A]	(Taring is done successfully and scale is in net)
	[ADR][T][N]	(Taring could not be executed)
	[ADR][T][X]	(Taring is disabled or instrument is in count mode)

Comments: The tare value will be overwritten by the new tare weight value. The status must be stable within 2 seconds delay time. If so, Ack will be sent. Otherwise Nack will be sent.

U	Read digital inputs

Command: [ADR][U]
Response: [ADR][U][A][INPUTS]
Example:

Command:	01U	
Response:	01UA6	(Input 2 and input 3 are active)
	01UN	(could not read inputs)

Comments: .

Inputs	IN-3	IN-2	IN-1
Bitwise	1	1	0
ASCII	6		

V	Read digital outputs

Command: [ADR][V]
Response: [ADR][V][A][OUTPUTS]
Example:

Command: 01V
Response: 01VA3 (Output 1 and output 2 are active)
01VN (could not read outputs)

Comments: .

Outputs	OUT-3	OUT-2	OUT-1
Bitwise	0	1	1
ASCII	3		

W	Set/reset digital outputs

Command: [ADR][W][OUTPUTS]
Response: [ADR][W][A]
Example:

Command: 01W03
Response: 01WA3 (Output 1 and output 2 will be set active)
01WN (could not set/reset outputs)

Comments: .

Outputs	OUT-3	OUT-2	OUT-1
Bitwise	0	1	1
ASCII	03		

X	Read weight value in increased resolution

Command: [ADR][X]
Response: [ADR][X][STATUS][SIGN][WEIGHT VALUE]
Example:

Command: 01X
Response: 01XS+00123.41 (weight is stable and 123.41) or
01XD+00123.41 (weight is unstable and 123.41) or
01XE (Error)

Comments: The response includes the weight data with the increment divided by 10.

Z	Zero

Command: [ADR][Z]
Response: [ADR][Z][A] (Zeroed)
[ADR][Z][N] (Zeroing could not be operated)
[ADR][Z][X] (Zeroing is disabled)
Comments: The Zero command does not work in net weighing mode. The Weight or Count must be within the zeroing range for all operating modes. The status must be stable within 2 seconds delay time. If so, Ack will be sent. Otherwise Nack will be sent.

CHK will be transmitted as two ASCII characters calculated with the checksum formula:
Checksum = 0 – (SUM of all response data before CHK)

Example: Read stable current weight data

BSI Examples: (CHK is enabled and instrument address is 01)

Command: 01P[CHK][CR][LF]

Checksum = 0 − (0x30 + 0x31 + 0x50) = 0 − 0XB1 = 0x4F
CHK = Char ‘4’ and ‘F’

Response: 01PS+000123.4[CHK][CR][LF]

Checksum = 0 − (0x30 + 0x31 + 0x50 + 0x53 + 0x2B + 0x30 + 0x30 + 0x30 + 0x31+ 0x32 + 0x33 + 0x2E + 0x34) = 0 − 0x02B7 = 0x49:
CHK = Char ‘4’ and Char ‘9’

5.6. Modbus RTU (for FAD-40MB only)

If the FAD-40MB instrument is setup for Modbus, it can be used as a Modbus RTU slave in a RS-485 communication network. Function codes ‘0x03’ and ‘0x10’ are supported. For RS-485 setup please refer to chapter 5.3.2, for the Modbus data structure please refer to chapter 5.11.

5.7. Modbus Data Structure (for FAD-40MB and FAD-40EN only)

Address	R/W	Word	Command	Definition		
40001	R	2	Weight / Force / Count Data			
40003	R	1	Status	D0	0 – System Ready	1 – System Busy
				D1	0 – Error	1 – Data ok
				D2	0 – Weight Stable	1 – Weight unstable
				D3	0 – Gross Mode	1 – Net mode
				D4		Not Used
				D5	0 – Weight / Force	1 – Count Mode
				D6…D11		Not used
				D12	0 – Out of zero range	1 – Weight is in zero range
				D13 D14 D15	Error Code	0 No Errors
						1 ADC out of range
						2 ADC over range
						3 ADC under range
						4 System error
						5 In setup mode
						6 Low/High voltage det.
40004	R	2	Tare weight			
40006	R	2	Gross weight			
40008	R	1	Status	Motion, Net mode, Data ok, (image of register 40003)		
40009	R/W	1	Control	0	None	
				1	Zero	
				2	Tare	
				3	Clear	
40010	R/W	1	Calibration	0	None	
				188	Adjust Zero Calibration	
				220	Adjust Span Calibration (First load calibration weight on scale and load 40011 with span test weight value)	
40011	R/W	2	Span Calibration Value			
40013	R	1	Calibration Status	D0 .. D7 Calibration Process Status	1	Ready for calibration
					3	Zero calibration in process
					4	Span calibration in process
					9	Error (Refer to D8 ... D15)
				D8…D15 Calibration Errors	1	Calibration Timeout - Restart calibration
					2	ADC Error - Re-energize the instrument - If seen again, change the board.
					3	Instrument cannot be calibrated - Check load cell cable - Re-energize the instrument
					34	Instrument cannot be calibrated - Load cell signal is very low or too high
					35	Calibration Error - Calibration test weight is not enough - Increase calibration weight value (40011) - Check load cell connections
					37	Scale unstable - Wait until scale become stable - Check grounding wiring
40014	R/W	1	Operation Mode Selector	0	Count Mode Unipolar	
				1	Count Mode Bipolar	

				2	Force Mode Unipolar
				3	Force Mode Bipolar
				4	Weight Mode Unipolar

Address	R/W	Word	Command	Definition			
40015	R/W	1	mV operation in Count Mode	0	5 mV		
				1	10 mV		
				2	15 mV		
				3	18 mV		
40016	R/W	1	Digital filters	0	Fast		
				1			
				2			
				3			
				4			
				5	Medium		
				6			
				7	Default		
				8			
				9	Slow		
40017		1	Not used				
40018	R/W	1	Status of Digital I/O	D0	Input of I/O3		
				D1	Input of I/O2		
				D2			
				D3			
				D4			
				D5			
				D6			
				D7			
				D8	Output of I/O1		
				D9	Output of I/O2		
				D10	Output of I/O3		
40019	R/W	1	Setup for I/O1 and I/O2	D0…D6	0000000	Disable	I/O1 output function
					0000001	Standard setpoint	
					0000010	Setpoint without hyster.	
					0000011	Window	
					0000100	Host output	
				D7	0	Active Low	I/O1 polarity
					1	Active High	
				D8…D14	0000000	Disable	I/O2 output function
					0000001	Standard setpoint	
					0000010	Setpoint without hyster.	
					0000011	Window	
					0000100	Host output	
					0000101	Zeroing	I/O2 input functions
					0000110	Taring	
					0000111	Clearing tare	
					0001000	Host input	
				D15	0	Active Low	I/O2 polarity
					1	Active High	
40020	R/W	1	Setup for I/O3	D0…D6	0000000	Disable	I/O3 output function
					0000001	Standard setpoint	
					0000010	Setpoint without hyster.	
					0000011	Window	
					0000100	Host output	
					0000101	Zeroing	I/O3 input function
					0000110	Taring	
					0000111	Clearing tare	
					0001000	Host input	
				D7	0	Active Low	I/O3 polarity
					1	Active High	

Address	R/W	Word	Command	Description	
40021	R/W	2	Setpoint 1 Low for I/O1		
40023	R/W	2	Setpoint 1 High for I/O1		
40025	R/W	2	Setpoint 2 Low for I/O2		
40027	R/W	2	Setpoint 2 High for I/O2		
40029	R/W	2	Setpoint 3 Low for I/O3		
40031	R/W	2	Setpoint 3 High for I/O3		
40033	R/W	1	Save I/O settings	23205 (Dec)	Load 23205 to save and activate I/O settings and setpoints

Note: Standard setpoint output function uses only setpoint low.

EXPLANATION

ATTENTION: For hardware connection details, please refer to the related hardware descriptions in this manual.

In the two word registers the data is stored to the registers in big-endian format. The least significant word is stored to the highest register address; and the most significant word is stored to the lowest register address. Please find Modbus information in the web site of http://www.modbus.org

Exception codes

1: Function code is not supported.
2: Out of address range
3: Invalid value or wrong byte number
4: Operation error

Examples:

Performing Read and Write operations according to hex system with the instrument set to address “0x01”.

Request weight data: 01,03,00,00,00,02,C4,0B
Answer of requested weight: 01,03,04,00,01,86,A0,38,4A
Weight is 100000
Request status data: 01,03,00,02,00,01,25,CA
Taring: 01,10,00,08,00,01,02,00,02,26,D9
Request tare data: 01,03,00,03,00,02,34,0B
Answer of requested tare: 01,03,04,00,00,27,10,E0,0F
Tare is 10000
Weight Mode Selection: 01,10,00,0D,00,01,02,00,04,A6,8E
Count in Unipolar Mode Selection: 01,10,00,0D,00,01,02,00,00,A7,4D
5 mV Input signal range selection: 01,10,00,0E,00,01,02,00,00,A7,7E
Load Medium (5) to Digital filter: 01,10,00,0F,00,01,02,00,05,66,AC
Request Calibration Status: 01,03,00,0C,00,01,44,09
Answer of requested Calibration Status: 01,03,02,00,01,79,84
Instrument is ready for calibration
Zero Calibration Command: 01,10,00,08,00,01,02,00,01,66,D8
Span Calibration with Span Value 50000: 01,10,00,09,00,03,06,00,DC,00,00,C3,50,B7,B0
Read digital I/Os: 01,03,00,11,00,01,D4,0F
Response of digital I/Os: 01,03,02,01,02,38,15
Output 1 and Output 2 is active.
Setup I/Os for Output: 01,10,00,12,00,02,04,82,81,00,83,4A,8B
I/O 1 = Standard, Active High;
I/O 2 = Setpoint with hysteresis, Active High;
I/O 3 = Tolerance window, Active High.
Setup I/Os for Input: 01,10,00,12,00,02,04,05,84,00,06,B3,9D
I/O 1 = Host Output, Active High
I/O 2 = Zeroing Input, Active Low
I/O 3 = Taring Input, Active Low
Load Setpoint 1 Low = 5000 and Set point 1 High = 6000:
01,10,00,14,00,04,08,00,00,13,88,00,00,17,70,6A,E2
Request Setpoint 1 Low and Setpoint 1 High values: 01,03,00,14,00,04,04,0D
Response of Setpoint 1 request: 01,03,08,00,00,17,70,00,00,1B,58,DC,31
Setpoint 1 Low = 6000 and Setpoint 1 High = 7000.
Save and activate I/O settings and Set points: 01,10,00,20,00,01,02,5A,A5,5B,EB

6. FAD-40PB WITH PROFIBUS INTERFACE

FAD-40PB instruments are state-of-the-art strain gauge load cell signal digitizers with Profibus DP interface. These instruments are used for any type of process weighing and force measurement including tank and silo weighing, dynamic weighing, check weighing, filling, tension /compression force measurement etc.
The GSD file is available on a CD which is supplied together with the instrument and unter www.flintec.com.

6.1. Front View of FAD-40PB

There are 5 status LEDs on the front panel which indicate the operational instrument status (Refer to table 7.1).and the Profibus status. The setup switch on front panel of the instrument is used for Profibus addressing without PC (Refer to chapter 5.6) and for diagnostics (Refer to chapter 12).
When the error LED is ON, the other two LED indicate the error type (Refer to chapter 11 for details).
Load cell connection, Profibus connection, power supply and serial interface terminals are located at the front of the DIN rail mount instrument (See figure 7.1).

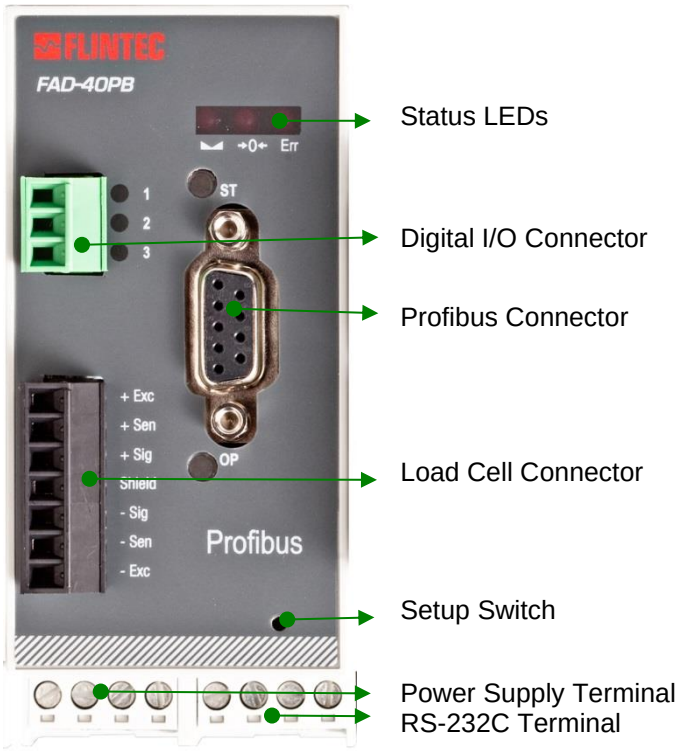


Figure 7.1 – Front view

The meanings of these LEDs in operation are described below.

LED		Operational Mode	
Symbol	**Name**	**Weight / Force**	**Count**
▁◢	Stable	● Stable ○ Unstable	◐ Off for 0.3 seconds in 2 seconds period (No stable indication)
→0←	Centre of Zero	● in the center of zero range (-0.25 e < w < 0.25 e) ○ Out of center of zero range	○ Always off (No center of zero indication)
Err	Error (*)	● ADC conversion error ✹ Digital processing error ○ No error	● ADC conversion error ✹ Digital processing error ○ No error

○ Off ● On ✹ Flashing ◐ Off for 0.3 seconds

(*) : Refer to the error table in chapter 11.

Table 7.1 – Status LEDs

ST Status LED

State	Indication	Comment
Off	No power or not initialized	No power or profibus module is in initializing
Green	Initialized	
Flashing Green	Initialized, diagnostic event(s) present	Diagnostic is active
Red	Exception error	There is an exception error

OP Operation Mode LED

State	Indication	Comment
Off	Not on-line / No power	Check power and cable
Green	On-line, data exchange	-
Flashing Green	On-line, clear	-
Flashing Red (2x)	PROFIBUS configuration error	Check GSD file configuration.

6.2. Electrical Connections

Profibus and RS-232C connections are shown in figure 7.2.PROFIBUS Connector (DB9F)

Pin	Signal	Description
1	-	-
2	-	-
3	B Line	Positive RxD / TxD, RS-485 level
4	RTS	Request to send
5	GND Bus	Ground (isolated)
6	+5V Bus output	+5V termination power (isolated)
7	-	-
8	A Line	Negative RxD / TxD, RS-485 level
9	-	-
Housing	Cable shield	Ground

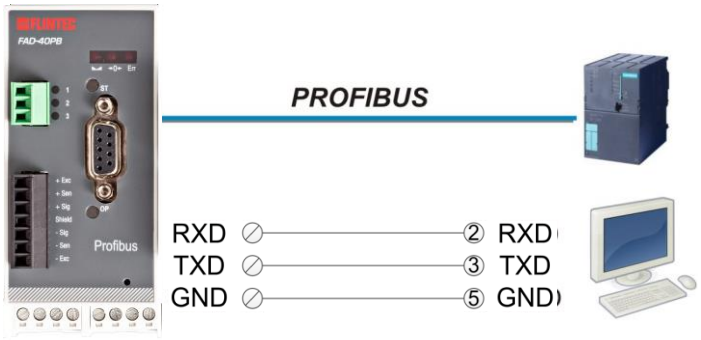


Figure 7.2 – FAD-40PB interface connections

RS-232C Serial Interface

Use	Setup via xFace
Baud rate	9600 bps
Length and parity	8 bit no parity
Start / Stop bits	1 start bit and 1stop bit

Profibus-DP Interface

Use	Interfacing with PC or PLC
Data format	Profibus
Baud rate	Automatically detected and supported baud rates are 9.6 kbps, 19.2 kbps, 45.45 kbps, 93.75 kbps, 187.5 kbps, 500 kbps, 1.5Mbps, 3 Mbps, 6 Mbps and 12 Mbps. No ‘baud rate’ instance exists.

WARNING: Connect the shield to the reference ground or shield pin of the power connector.
WARNING: Disconnect xFace PC software for Profibus interfacing.

6.3. Profibus and RS-232C Interfacing

FAD-40PB instruments have two interface connectors on the front of the instrument: Profibus and RS-232C. The table below describes the data formats for interfacing the peripherals and their application.

Data Format	Description	Application	Hardware
Profibus	Profibus interfacing. Refer to chapter 7.6	Interfacing with PLC	Profibus-DP-V1

Table 7.2 – Data output interfacing

Attention: Please disable the interface you will not use to increase the performance of the instrument.

6.4. Setup and Calibration

FAD-40PB instruments are set up and calibrated by xFace. The A/D Converter settings are very important for a good weighing performance. Please refer to chapter 5.3.

6.5. Profibus Setup

The Profibus setup is done by xFace software as described in this chapter. Select the Gateway tab after connecting xFace to the instrument. You will see the Profibus parameters in this tab.

Profibus Setup

There is only one setup parameter for Profibus network.

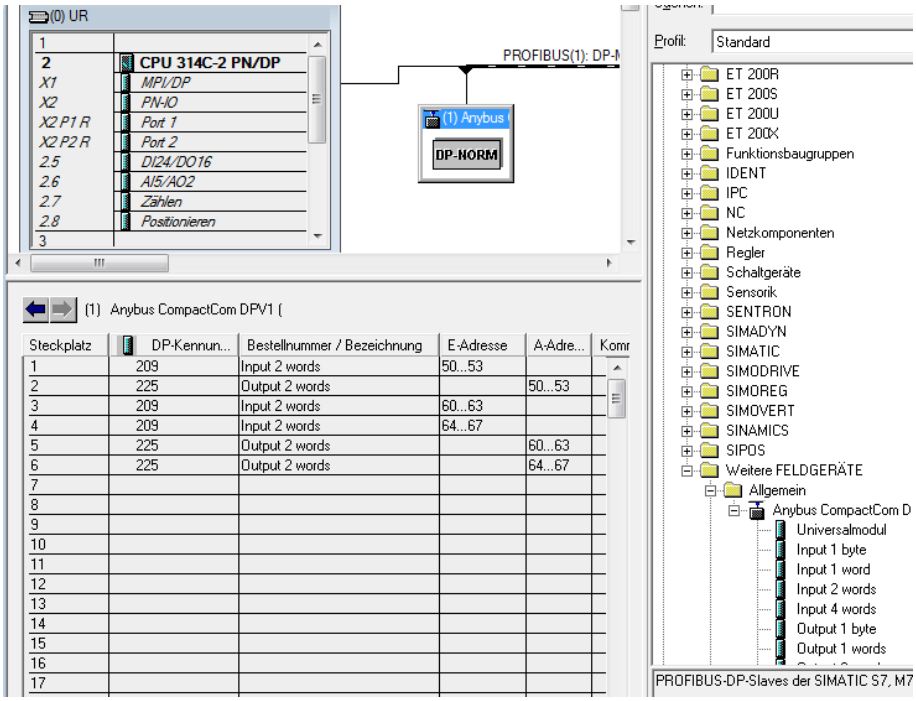
Profibus Rack Address	The address range is 1 (default setting) to 126

6.6. Profibus and Profinet Data Structure (for FAD-40Px only)

Hardware Configuration Hint

To install the FAD-40PB or FAD-40PN into the PLC Hardware Configuration use the GSD (GSDML) file, which is on Product DVD or under www.flintec.com to create **exactly** the following memory structure:

1. Input 2 Words
2. Output 2 Words
3. Input 2 Words
4. Input 2 Words
5. Output 2 Words
6. Output 2 Words



FAD-40Px Output to PLC Input

Dword	D31	D30	D29	D28	D27	D26	D25	D24	D23	D22	D21	D20	D19	D18	D17	D16
	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
1st Dword	Reserved															
2nd Dword	W31 MSB	W30	W29	W28	W27	W26	W25	W24	W23	W22	W21	W20	W19	W18	W17	W16
	W15	W14	W13	W12	W11	W10	W9	W8	W7	W6	W5	W4	W3	W2	W1	W0 LSB
3rd Dword	Not in use											I/O2 in	I/O3 in	I/O3 out	I/O2 out	I/O1 out
	Error codes of converter				Not in use		Op. mode	Zero range	Gross Net	MD	Read command response					Cmd Flag

FAD-40Px Output to PLC Input 2nd Dword

The 2nd Dword contains the weight value respective the calibration information according to the “read command response” (Refer to PLC Output to FAD-40Px Input 3rd Dword).

Calibration Status

Bit no.	2nd Dword descriptions when read command is 'Calibration Status'. Refer to PLC Output to FAD-40Px Input 3rd Dword		
D31…D16	Not in use		
D15…D8	Calibration error	0000 0001	Calibration timeout: - Restart calibration
		0000 0010	ADC error: - Re-energize the instrument
		0000 0011	Instrument cannot be calibrated - Check load cell cable; - Re-energize the instrument
		0010 0010	Instrument cannot be calibrated - Load cell signal is very low or too high
		0010 0011	Calibration Error - Calibration test weight is too small; Increase calibration weight value (Write test weight value from PLC Output to FAD-30Px Input 2nd Dword then restart the calibration) - Check load cell connections
		0010 0101	Scale unstable: - Wait until scale becomes stable - Check ground wiring
D7...D0	Calibration process status	0000 0001	System ready for calibration
		0000 0011	Zero calibration in process
		0000 0100	Span calibration in process
		0000 1001	Error (Calibration error)

FAD-40Px Output to PLC Input 3rd Dword

Bit no.	3rd Dword Description		
D31…D21	Not in use		
D20	Input for I/O2		
D19	Input for I/O3		
D18	Output for I/O3		
D17	Output for I/O2		
D16	Output for I/O1		
D15…D12	Error codes of converter	0000	No error found
		0001	ADC out
		0010	ADC over
		0011	ADC under
		0100	System error
		0101	In setup mode
		0110	Low/High voltage error
		0111	Instrument not found
D11…D10	Not in use		
D9	Operation mode	0	Weight & Force Mode
		1	Count Mode
D8	Zero range	0	Weight is out of zero range
		1	Weight is in of zero range
D7	Indication	0	Gross
		1	Net
D6	MD – Motion detection	0	Stable
		1	Unstable
D5 D4 D3 D2 D1	Read command response	00000	Indicated weight
		00001	Gross weight
		00010	Tare weight
		00011	Indicated weight (floating point type)
		00100	Gross weight (floating point type)
		00101	Tare weight (floating point type)
		10000	Calibration Status (Refer to table 8.2)
D0	CMD flag	A change of Flag indicates: The command is applied successfully	

PLC Output to FAD-40Px Input

Dword	D31	D30	D29	D28	D27	D26	D25	D24	D23	D22	D21	D20	D19	D18	D17	D16
	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
1st Dword	Reserved															
2nd Dword	W31 MSB	W30	W29	W28	W27	W26	W25	W24	W23	W22	W21	W20	W19	W18	W17	W16
	W15	W14	W13	W12	W11	W10	W9	W8	W7	W6	W5	W4	W3	W2	W1	W0 LSB
3rd Dword	Not in use													I/O3 out	I/O2 out	I/O1 out
	Not in use					Command List					Data Selection					New CMD

PLC Output to FAD-40Px Input 2nd Dword

The 2nd Dword contains the setting / parameter value (Refer to “Adjust span calibration” and “I/O configuration” in “Command List”, see PLC Output to FAD-40Px Input 3rd Dword).

I/O Configuration

Bit no.	**2nd Dword description**		
D0…D6	I/O1 output function	0000000	Disable
		0000001	Standard setpoint
		0000010	Setpoint without hysteresis
		0000011	Window (Checkweigher)
		0000100	Host output
D7	I/O1 polarity	0	Active Low
		1	Active High
D8…D14	I/O2 output function	0000000	Disable
		0000001	Standard setpoint
		0000010	Setpoint without hysteresis
		0000011	Window (Checkweigher)
		0000100	Host output
	I/O2 input functions	0000101	Zeroing
		0000110	Taring
		0000111	Clearing tare
		0001000	Host input
D15	I/O2 polarity	0	Active Low
		1	Active High
D16…D22	I/O3 output function	0000000	Disable
		0000001	Standard setpoint
		0000010	Setpoint without hysteresis
		0000011	Window (Checkweigher)
		0000100	Host output
	I/O3 input function	0000101	Zeroing
		0000110	Taring
		0000111	Clearing tare
		0001000	Host input
D23	I/O3 polarity	0	Active Low
		1	Active High

PLC Output to FAD-40Px Input 3rd Dword

Bit no.	3rd Dword descriptions			
D31…D19	Not in use			
D18	Set/reset digital output of I/O3			
D17	Set/reset digital output of I/O2			
D16	Set/reset digital output of I/O1			
D15…D11	Not in use			
D10…D6	Command list	00000	No command is activated	
		00001	Zero	
		00010	Tare	
		00011	Clear	
		00101	Adjust zero calibration	
		00110	Adjust span calibration (First load calibration weight on scale then load 2nd Dword with span test weight value*, then apply this command with New CMD)	
		01000	Operation mode selection (First load 2nd Dword with selected value, then apply this command with New CMD)	Load 2nd Dword with one of these: 0: Count mode unipolar 1: Count mode bipolar 2: Force mode unipolar 3: Force mode bipolar 4: Weight mode unipolar
		01001	mV operation in Count Mode (First load 2nd Dword with selected value, then apply this command with New CMD)	Load 2nd Dword with one of these: 0: 5 mV 1: 10 mV 2: 15 mV 3: 18 mV
		01010	Digital filter (First load 2nd Dword with selected value, then apply this command with New CMD)	Load 2nd Dword with one of these: 0: Fast … 5: Medium … … 7: Default … 9: Slow
		01011	I/O Configuration (First, load 2nd Dword with desired table)	
		01100	Setpoint 1 Low for I/O1 (First load 2nd Dword with desired value)	
		01101	Setpoint 1 High for I/O1 (First load 2nd Dword with desired value)	
		01110	Setpoint 2 Low for I/O2 (First load 2nd Dword with desired value)	
		01111	Setpoint 2 High for I/O2 (First load 2nd Dword with desired value)	
		10000	Setpoint 3 Low for I/O3 (First load 2nd Dword with desired value)	
		10001	Setpoint 3 High for I/O3 (First load 2nd Dword with desired value)	
D5...D1	Read selected data	00000	Indicated weight	
		00001	Gross weight	
		00010	Tare weight	
		00011	Indicated weight (Floating point)	
		00100	Gross weight (Floating point)	
		00101	Tare weight (Floating weight)	
		10000	Calibration status	
D0	New CMD	Apply commands which are listed in “Command list” (Responds on bit changes)		

*Span test weight value has to be entered ignoring the decimal point;
Example: “300.00” has to be entered as “30000”

7. FAD-40PN WITH PROFINET INTERFACE

FAD-40PN instruments are state-of-the-art strain gauge load cell signal digitizers with Profinet interface. These instruments are used for any type of process weighing and force measurement including tank and silo weighing, dynamic weighing, check weighing, filling, tension /compression force measurement etc.
The GSDML file is available on a CD which is supplied together with the instrument and unter www.flintec.com.

7.1. Front View of FAD-40PN

There are 6 status LEDs on the front panel which indicate the operational instrument status (Refer to table 8.1).and the Profinet status. The setup switch on front panel of the instrument is used for Profinet addressing without PC (Refer to chapter 5.6) and for diagnostics (Refer to chapter 12).
When the error LED is ON, the other two LED indicate the error type (Refer to chapter 11 for details).
Load cell connection, Profinet connection, power supply and serial interface terminals are located at the front of the DIN rail mount instrument (See figure 8.1).

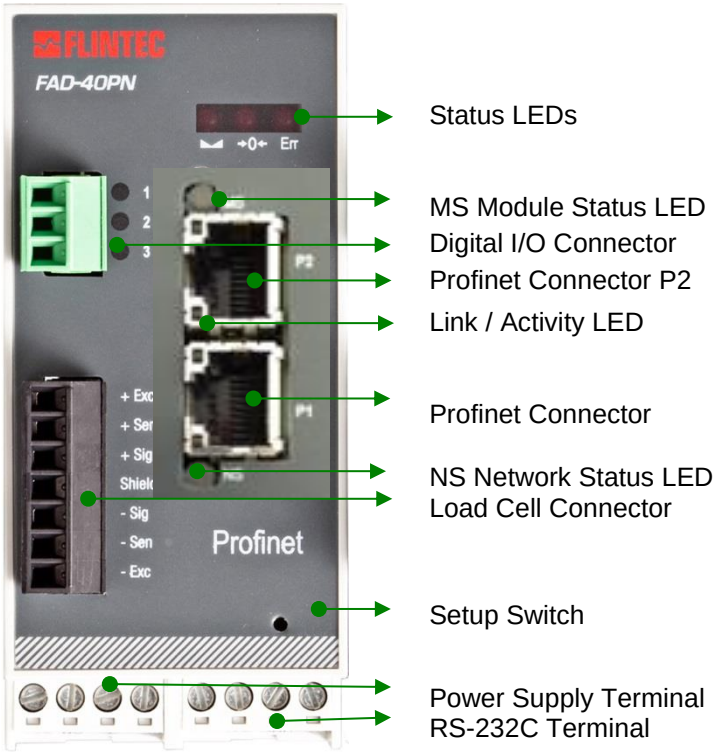


Figure 8.1 – Front view

The meanings of these LEDs in operation are described below.

LED		Operational Mode	
Symbol	**Name**	**Weight / Force**	**Count**
▬	Stable	● Stable ○ Unstable	◐ Off for 0.3 seconds in 2 seconds period (No stable indication)
→0←	Centre of Zero	● in the center of zero range (-0.25 e < w < 0.25 e) ○ Out of center of zero range	○ Always off (No center of zero indication)
Err	Error (*)	● ADC conversion error ✹ Digital processing error ○ No error	● ADC conversion error ✹ Digital processing error ○ No error

○ Off ● On ✹ Flashing ◐ Off for 0.3 seconds

(*) : Refer to the error table in chapter 11.

Table 8.1 – Status LEDs

MS Module Status LED

LED State	Description	Comment
Off	No power or not initialized	No power or Profinet module is in initialization state
Green	Initialized	
Green, 1 flash	Initialized, diagnostic event(s) present	Diagnostic is active
Green, 2 flashes	Blink	Used by engineering tools to identify the node on the network
Red	Exception error	There is an exception error
Red, 1 flash	Configuration error	Check EDS configuration
Red, 2 flashes	IP address error	IP address not set
Red, 3 flashes	Station name error	Station name not set
Red, 4 flashes	Internal module error	Re-energize the instrument. If seen again, change the module.

LINK/Activity LED

LED State	Description	Comment
Off	No Link	No link, no communication present
Green	Link	Ethernet link established, no communication present
Green, flickering	Activity	Ethernet link established, communication present

NS Network Status LED

LED State	Description	Comment
Off	Not online /No power	Check power and cable
Green	On-line (RUN)	-
Green, flashing	On-line (STOP)	-

7.2. Electrical Connections

Profinet and RS-232C connections are shown in figure 8.2.

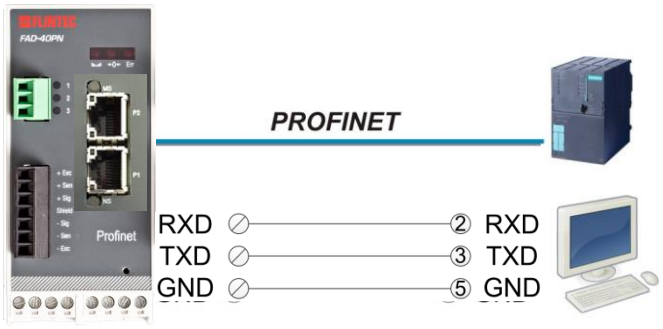


Figure 8.2 – FAD-40PN interface connections

RS-232C Serial Interface

Use	Setup via xFace
Baud rate	9600 bps
Length and parity	8 bit no parity
Start / Stop bits	1 start bit and 1stop bit

Profinet Interface

Use	Profinet interface with PC or PLC
Data format	Profinet
Ethernet	The Ethernet interface operates at 100Mbit, full duplex, as required by Profinet.

WARNING: Connect the shield to the reference ground or the shield pin of the power connector.
WARNING: Disconnect xFace PC software for Profinet interfacing.

7.3. Profinet Interfacing

FAD-40PN instruments have two interface connectors on the front of the instrument: Profinet and RS-232C. The table below describes the data formats for interfacing the peripherals and their application.

Data Format	Description	Application	Hardware
Profinet	Profinet interfacing. Refer to chapter 8.5	Interfacing with PLC.	Profinet

Table 8.3 – Data output interfacing

ATTENTION: Please disable the interface you will not use to increase the performance of the instrument.

7.4. Setup and Calibration

FAD-40PN instruments are set up and calibrated by xFace. The A/D Converter settings are very important for a good weighing performance. Please refer to chapter 5.3.

7.5. Profinet / Ethernet Setup

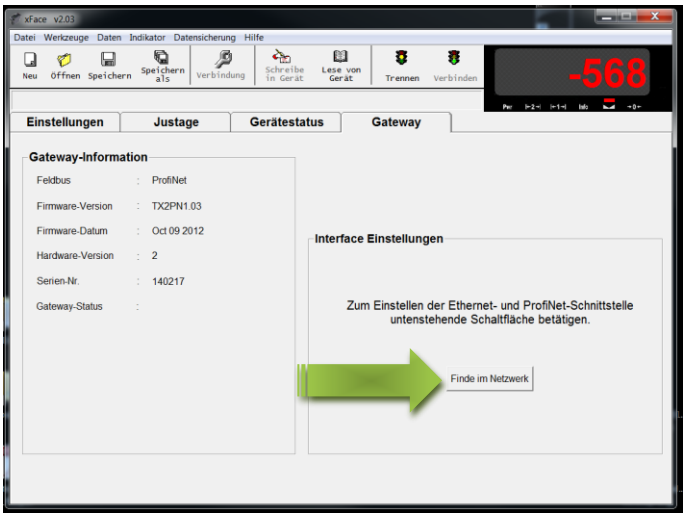
The Profinet setup is done by xFace software as described in this chapter. Select the Gateway tab after connecting xFace to the instrument. You will see the Profinet parameters in this tab.

There are 7 setup parameters for Profinet network.

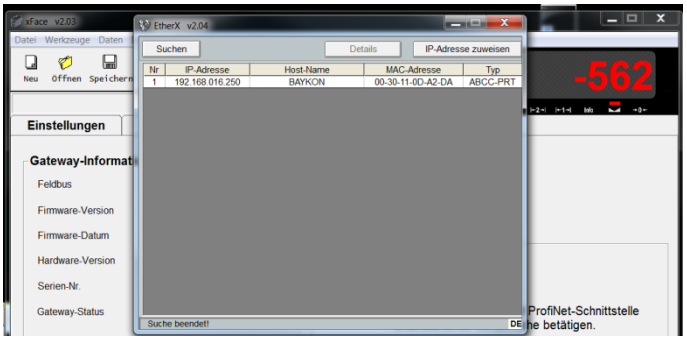
DHCP	Dynamic Host Configuration Protocol automates network parameters if it is enabled. Default is 'Disable'.
IP Address	If DHCP is disabled, define IP address manually. Default is '192.168.16.250'
Subnet Mask	If DHCP is disabled, define subnet mask manually. Default is '255.255.255.0'.
Default Gateway	If DHCP is disabled, define default gateway manually. Default is '192.168.16.254'.
Primary DNS	If DHCP is disabled, define primary DNS manually. Default is '208.67.222.222'..
Secondary DNS	If DHCP is disabled, define secondary DNS manually. Default is '208.67.220.220'.
Host Name	Enter a unique host name to the instrument. Default is ' '

Click on the button „Find on LAN“ in section “Gateway”.

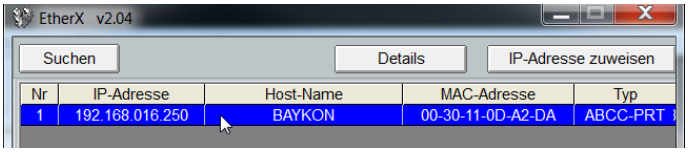
„EtherX“ will automatically be started



All connected FAD-40PN or EN devices will be listed.



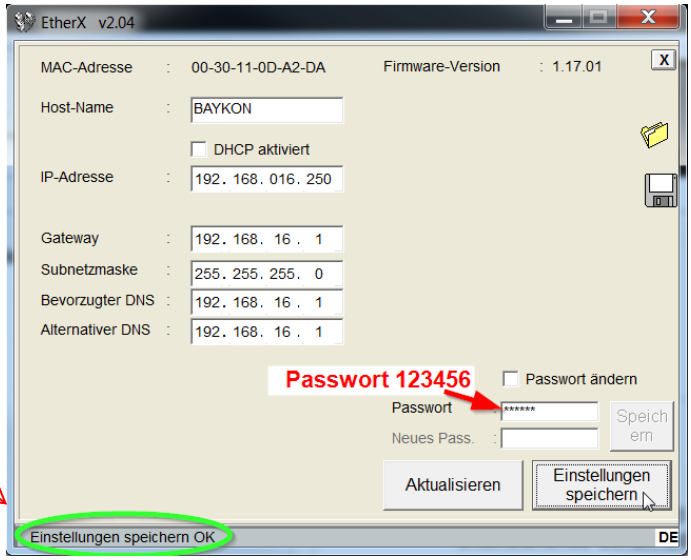
Double click on the device you want to change the parameters.



A new window appears.
The network parameters can be changed.

After the change the password will be required.
The default **password is „123456**“

The status of the storage “OK” will be displayed, as shown below



7.6. Profibus and Profinet Data Structure (for FAD-40Px only)

To install the FAD-40PN into the PLC Hardware Configuration use the GSDML file memory parts to create **exactly** the following memory structure:

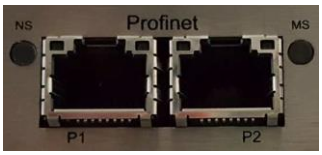
Please refer to **chapter 7.6** “Profibus and Profinet Data Structure (for FAD-40Px only)”.

ATTENTION: Different versions of Profinet and their GSDM files.

until June 2016

GSDML-V2.2-HMS-ABCC-PRT-20100329.xml

since July 2016



GSDML-V2.3-HMS-ABCC-PRT2P-20140703.xml

8. FAD-40EN WITH ETHERNET INTERFACE

FAD-40EN instruments are state-of-the-art strain gauge load cell signal digitizers with Ethernet interface. These instruments are used for any type of process weighing and force measurement including tank and silo weighing, dynamic weighing, check weighing, filling, tension /compression force measurement etc.

8.1. Front View of FAD-40EN

There are 3 status LEDs on the front panel which indicate the operational instrument status (Refer to table 9.1).
The setup switch on front panel of the instrument is used for diagnostics (Refer to chapter 12)
When the error LED is ON, the other two LED indicate the error type (Refer to chapter 11 for details).
Load cell connection, Ethernet, power supply and serial interface terminals are located at the front of the DIN rail mount instrument (See figure 9.1).

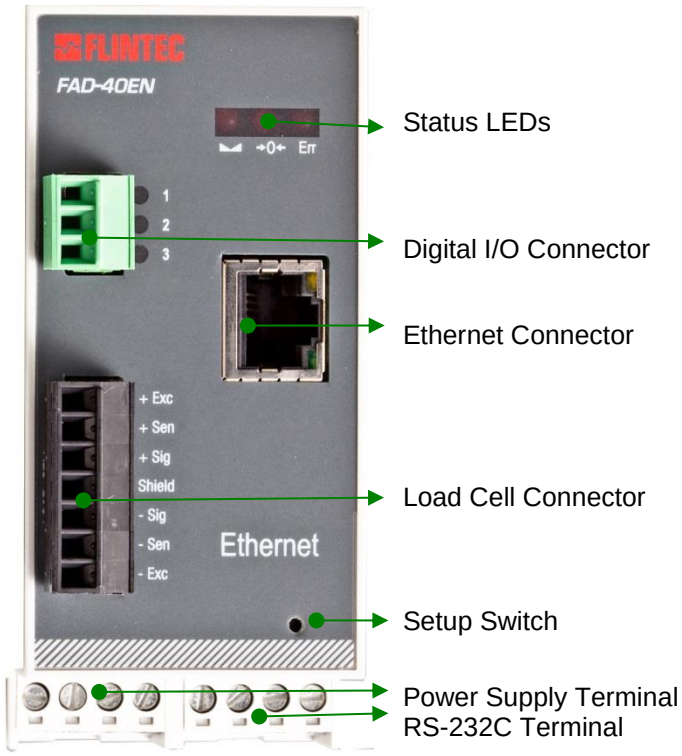


Figure 9.1 – Front view of FAD-40EN

The meanings of these LEDs in operation are described below.

LED		**Operational Mode**	
Symbol	**Name**	**Weight / Force**	**Count**
▂▅▂	Stable	● Stable ○ Unstable	◐ Off for 0.3 seconds in 2 seconds period (No stable indication)
→0←	Centre of Zero	● in the center of zero range (-0.25 e < w < 0.25 e) ○ Out of center of zero range	○ Always off (No center of zero indication)
Err	Error (*)	● ADC conversion error ✹ Digital processing error ○ No error	● ADC conversion error ✹ Digital processing error ○ No error

○ Off ● On ✹ Flashing ◐ Off for 0.3 seconds

(*) : Refer to the error table in chapter 11

Table 9.1 – Status LEDs

8.2. Electrical Connections

Ethernet and RS-232C connections are shown in figure 9.2 to 9.4.

Ethernet Connector (RJ45)

Pin	Signal	DIR	Description
1	TX+	Out	Differential Ethernet transmit data +
2	TX−	Out	Differential Ethernet transmit data −
3	RX+	In	Differential Ethernet receive data +
6	RX−	In	Differential Ethernet receive data −
4	Not used		Terminated
5	Not used		Terminated
7	Not used		Terminated
8	Not used		Terminated
	Shield		Chassis ground

The HUB connection cabling will be a direct connection as shown below:

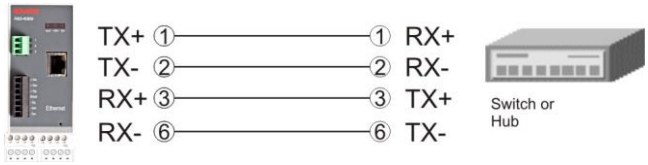


Figure 9.2 – HUB connection

The PC connection cabling will be done via cross cable as shown below:

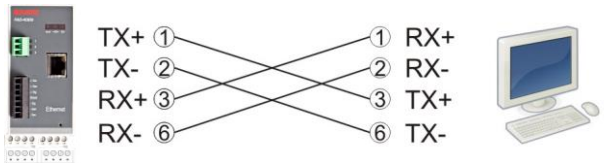


Figure 9.3 – Direct PC connection with cross cable

FAD-40EN interface connections are shown below:

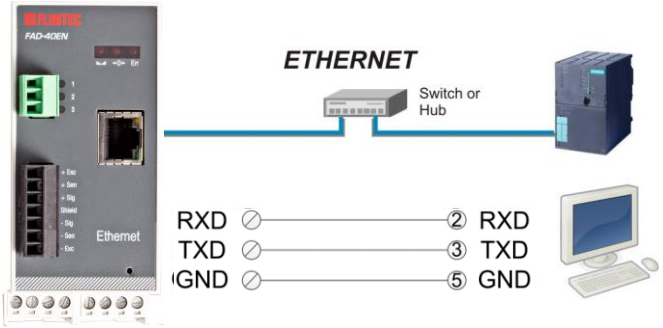


Figure 9.4 – FAD-40EN interface connections

RS-232C Serial Interface

Use	Setup via xFace
Baud rate	9600 bps
Length and parity	8 bit, no parity
Start / Stop bits	1 start bit and 1stop bit

Ethernet Interface

Use	Ethernet interface with PC or PLC
Data format	Modbus TCP/IP
Ethernet	The Ethernet interface operates at 10Mbit, half duplex

WARNING: Connect the shield to the reference ground or shield pin of the power connector.
WARNING: Disconnect xFace PC software for Ethernet interfacing.

8.3. Ethernet Interfacing

FAD-40EN instruments have two interface connectors on the front of the instrument: Ethernet and RS-232C. The table below describes the data formats for interfacing the peripherals and their application:

Data Format	Description	Application	Hardware
Modbus TCP/IP	Ethernet interfacing. Refer to chapter 6.7	Interfacing with PLC	Ethernet

Table 9.2 – Data output interfacing

ATTENTION: Please disable the interface you will not use to increase the performance of the instrument.

8.4. Setup and Calibration

FAD-40EN instruments are set up and calibrated by xFace. The A/D Converter settings are very important for a good weighing performance. Please refer to chapter 5.3.

8.5. Ethernet Setup

The Ethernet setup is done by xFace software as described in this chapter. Select the Gateway tab after connecting xFace to the instrument. You will see the Ethernet parameters in this tab.

Ethernet Setup

There are 11 setup parameters for the Ethernet network as described below:

Host Name	Device name of the instrument. Default is ‘ ’.
Data Format	This parameter defines the data format for the Ethernet port. The available settings are: Disable : No data will be transmitted. Select disable if this port is not used. Modbus-TCP/IP : Modbus TCP/IP communication. Refer to **chapter 6.7** for details.
IP Address	Define IP address manually. Default is ‘192.168.16.250’
Local Port	Ethernet connection port of the instrument. Default is ‘10001.
Gateway	Network point that acts as an entrance to another networks. Default is ‘192.168.16.254’.
Subnet Mask	Defines IP addresses which can be used in network. Default is ‘255.255.255.0’.
Primary DNS	Define primary DNS manually. Default is ‘208.67.222.222’.
Secondary DNS	Define secondary DNS manually. Default is ‘208.67.220.220’.

8.6. Modbus Data Structure

If the instrument is set up for Modbus TCP/IP, it can be used as a Modbus TCP/IP slave on an Ethernet communication network. The function codes ‘0x03’ and ‘0x10’ are supported.
For the Modbus Data Structure please refer to chapter 6.6.

9. FAD-40CO WITH CANOPEN INTERFACE

FAD-40CO instruments are state-of-the-art strain gauge load cell signal digitizers with CANopen interface. These instruments are used for any type of process weighing and force measurement including tank and silo weighing, dynamic weighing, check weighing, filling, tension /compression force measurement etc.
The EDS file is available on a CD which is supplied together with the instrument.

9.1. Front View of FAD-40CO

There are 5 status LEDs on the front panel which indicate the operational instrument status (Refer to table 10.1) and the CANopen status. The setup switch on front panel of the instrument is used for Profinet addressing without PC (Refer to chapter 5.6) and for diagnostics (Refer to chapter 12).
When the error LED is ON, the other two LED indicate the error type (refer to chapter 11 for details).
Load cell connection, CANopen connection, power supply and serial interface terminals are located at the front of the DIN rail mount instrument (See figure 10.1).

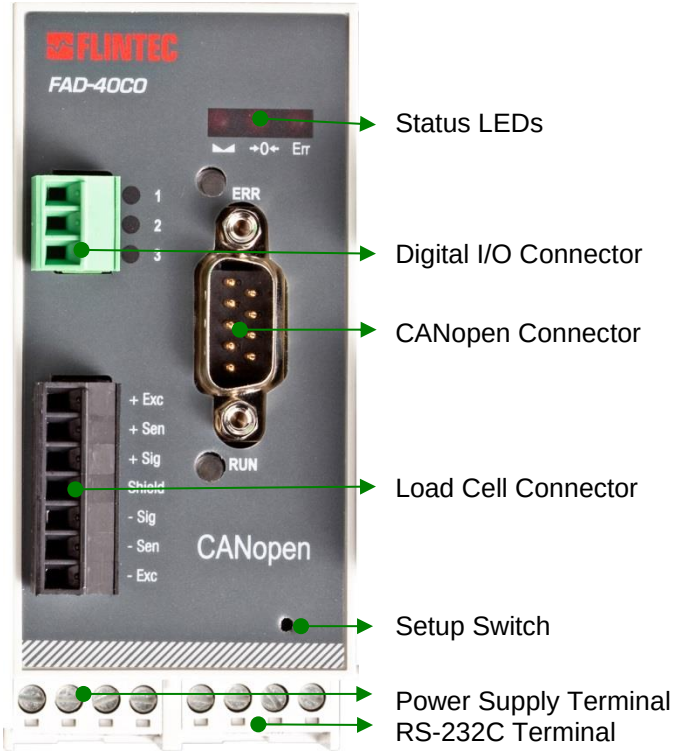


Figure 10.1 – Front view

The meanings of these LEDs in operation are described below.

LED		Operational Mode	
Symbol	**Name**	**Weight / Force**	**Count**
▬	Stable	● Stable ○ Unstable	◐ Off for 0.3 seconds in 2 seconds period (No stable indication)
→0←	Centre of Zero	● in the center of zero range (-0.25 e < w < 0.25 e) ○ Out of center of zero range	○ Always off (No center of zero indication)
Err	Error (*)	● ADC conversion error ✹ Digital processing error ○ No error	● ADC conversion error ✹ Digital processing error ○ No error

○ Off ● On ✹ Flashing ◐ Off for 0.3 seconds

(*) : Refer to the error table in chapter 11.

Table 10.1 – Status LEDs

RUN LED

State	Indication	Comment
Off	No power or not initialized	No power or cable broken
Green	On-line, data exchange	
Green, flashing	On-line, initializing	
Green, single flash	Stopped	Check for hardware damages
Green, flickering	Auto baud rate detection in progress	
Red	Exception error	Check EDS file

ERR LED

State	Indication	Comment
Off	No error	No power or CANopen module is initializing
Red, single flash	Warning limit reached	Bus error counter reached or exceeded its warning limit
Red, flickering	LSS	LSS services in progress
Red, double flash	Error count event	A guard (NMT slave or master) or heartbeat event (hearthas occurred)
Red	Bus off (fatal event)	Bus off

9.2. Electrical Connections

CANopen and RS-232C connections are shown in figure 10.2.

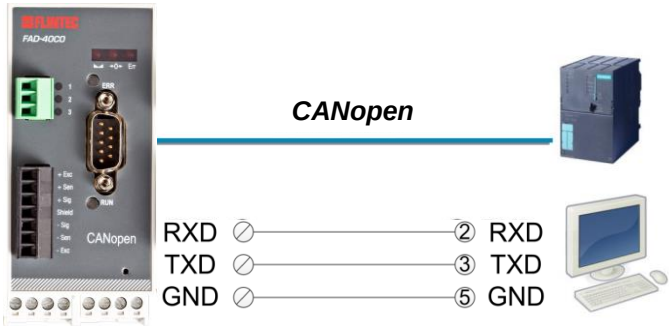


Figure 10.2 – FAD-40CO interface connections

CANopen Connector (DB9M)

Pin	Signal	Description
1	-	-
2	CAN_L	-
3	CAN_GND	-
4	-	-
5	CAN_SHIELD	-
6	-	-
7	CAN_H	-
8	-	-
9	-	-
Housing	Cable shield	-

RS-232C Serial Interface

Use	Setup via xFace
Baud rate	9600 bps
Length and parity	8 bit no parity
Start / Stop bits	1 start bit and 1stop bit

CANopen Interface

Use	Interfacing with PC or PLC
Data format	CANopen
Baud rate	Automatically detected and supported baud rates are 10 kbps, 20 kbps, 50 kbps, 100 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps, 1 Mbps; Autobaud is default setting.

Warning: Connect the shield to the reference ground or shield pin of the power connector.
Warning: Disconnect xFace PC software for Profibus interfacing.

9.3. CANopen Interfacing

FAD-40CO instruments have two interface connectors on the front of the instrument: CANopen and RS-232C. The table below describes the data formats for interfacing the peripherals and their application.

Data Format	Description	Application	Hardware
CANopen	CANopen interfacing. Refer to chapter 5.13	Interfacing with PLC	CANopen

Table 11.3 – Data output interfacing

Attention: Please disable the interface you will not use to increase the performance of the instrument.

9.4. Setup and Calibration

FAD-40CO instruments are set up and calibrated by xFace. The A/D Converter settings are very important for a good weighing performance. Please refer to chapter 5.3.

9.5. CANopen Setup

The CANopen setup is done by xFace software as described in this chapter. Select the Gateway tab after connecting xFace to the instrument. You will see the CANopen parameters in this tab.

CANopen Setup

There is only one parameter for the CANopen network.

CANopen Rack Address	The address range is 1 (default setting) to 127.

9.6. CANopen Data Structure (for FAD-40CO only)

Hardware Configuration Hint

To install the FAD-40CO into the PLC Hardware Configuration use the ESD file memory parts to create **exactly** the following memory structure:

- Input 2 Words
- Output 2 Words
- Input 2 Words
- Input 2 Words
- Output 2 Words
- Output 2 Words

FAD-40CO Output to PLC Input

Dword	D31	D30	D29	D28	D27	D26	D25	D24	D23	D22	D21	D20	D19	D18	D17	D16
	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
TxPDO 1 (T_DW1)	reserved															
TxPDO 2 (T_DW2)	W31 MSB	W30	W29	W28	W27	W26	W25	W24	W23	W22	W21	W20	W19	W18	W17	W16
	W15	W14	W13	W12	W11	W10	W9	W8	W7	W6	W5	W4	W3	W2	W1	W0 LSB
TxPDO 3 (T_DW3)	Not in use											I/O2 in	I/O3 in	I/O3 out	I/O2 out	I/O1 out
	Error codes of converter				Not in use		Op. mode	Zero range	Gross Net	MD	Read command response					Cmd Flag

FAD-40CO Output to PLC Input T_DW2

T_DW2 contains the weight value respective the calibration information according to the “read command response” (Refer to PLC Output to FAD-30CO Input T_DW3).

Calibration Status

Bit no.	**TxPDO 2 (T_DW2) descriptions when read command is ‘Calibration Status’. Refer to PLC Output to FAD-40CO Input R_DW3**		
D31…D16	Not in use		
D15…D8	Calibration error	0000 0001	Calibration timeout - Restart calibration
		0000 0010	ADC error - Re-energize the instrument
		0000 0011	Instrument cannot be calibrated - Check load cell cable - Re-energize the instrument
		0010 0010	Instrument cannot be calibrated - Load cell signal is very low or too high
		0010 0011	Calibration Error - Calibration test weight is too small - Increase calibration weight value (Write test weight value from PLC Output to FAD-40CO Input R_DW2 then restart the calibration) - Check load cell connections
		0010 0101	Scale unstable - Wait until scale becomes stable - Check ground wiring
D7…D0	Calibration process status	0000 0001	System ready for calibration
		0000 0011	Zero calibration in process
		0000 0100	Span calibration in process
		0000 1001	Error (Calibration error)

FAD-40CO Output to PLC Input T_DW3

Bit no.	TxPDO 3 (T_DW3) Description		
D31…D21	Not in use		
D20	Input for I/O2		
D19	Input for I/O3		
D18	Output for I/O3		
D17	Output for I/O2		
D16	Output for I/O1		
D15…D12	Error codes of converter	0000	No error found
		0001	ADC out
		0010	ADC over
		0011	ADC under
		0100	System error
		0101	In setup mode
		0110	Low/High voltage error
		0111	Instrument not found
D11…D10	Not in use		
D9	Operation mode	0	Weight & Force Mode
		1	Count Mode
D8	Zero range	0	Weight is out of zero range
		1	Weight is in zero range
D7	Indication	0	Gross
		1	Net
D6	MD – Motion detection	0	Stable
		1	Unstable
D5 D4 D3 D2 D1	Read command response	00000	Indicated weight
		00001	Gross weight
		00010	Tare weight
		00011	Indicated weight (floating point type)
		00100	Gross weight (floating point type)
		00101	Tare weight (floating point type)
		10000	Calibration Status (Refer to table 8.2)
D0	CMD flag	The command is applied successfully	

PLC Output to FAD-40CO Input

Dword	D31	D30	D29	D28	D27	D26	D25	D24	D23	D22	D21	D20	D19	D18	D17	D16
	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
RxPDO 1 (R_DW1)	Reserved															
RxPDO 2 (R_DW2)	W31 MSB	W30	W29	W28	W27	W26	W25	W24	W23	W22	W21	W20	W19	W18	W17	W16
	W15	W14	W13	W12	W11	W10	W9	W8	W7	W6	W5	W4	W3	W2	W01	W00 LSB
RxPDO 3 (R_DW3)	Not used													I/O3 out	I/O2 out	I/O1 out
	Not used					Command List					Data Selection					New CMD

PLC Output to FAD-40CO Input R_DW2

R_DW 2contains the setting / parameter value (Refer to “Adjust span calibration” and “I/O configuration” in “Command List”, see PLC Output to FAD-40CO Input R_DW 3).

I/O Configuration

Bit no.	R_DW_2 description		
D0…D6	I/O1 output function	0000000	Disable
		0000001	Standard setpoint
		0000010	Setpoint without hyster.
		0000011	Window
		0000100	Host output
D7	I/O1 polarity	0	Active Low
		1	Active High
D8…D14	I/O2 output function	0000000	Disable
		0000001	Standard setpoint
		0000010	Setpoint without hyster.
		0000011	Window
		0000100	Host output
	I/O2 input functions	0000101	Zeroing
		0000110	Taring
		0000111	Clearing tare
		0001000	Host input
D15	I/O2 polarity	0	Active Low
		1	Active High
D16…D22	I/O3 output function	0000000	Disable
		0000001	Standard setpoint
		0000010	Setpoint without hyster.
		0000011	Window
		0000100	Host output
	I/O3 input function	0000101	Zeroing
		0000110	Taring
		0000111	Clearing tare
		0001000	Host input
D23	I/O3 polarity	0	Active Low
		1	Active High

PLC Output to FAD-40CO Input R_DW3

<table>
<tr><th>Bit no.</th><th colspan="4">R_DW3 descriptions</th></tr>
<tr><td>D31…D19</td><td colspan="4">Not in use</td></tr>
<tr><td>D18</td><td colspan="4">Set/Reset digital output of I/O 3</td></tr>
<tr><td>D17</td><td colspan="4">Set/Reset digital output of I/O 2</td></tr>
<tr><td>D16</td><td colspan="4">Set/Reset digital output of I/O 1</td></tr>
<tr><td>D15…D11</td><td colspan="4">Not in use</td></tr>
<tr><td rowspan="16">D10…D6</td><td rowspan="16">Command list</td><td>00000</td><td colspan="2">No command is activated</td></tr>
<tr><td>00001</td><td colspan="2">Zero</td></tr>
<tr><td>00010</td><td colspan="2">Tare</td></tr>
<tr><td>00011</td><td colspan="2">Clear</td></tr>
<tr><td>00101</td><td colspan="2">Adjust zero calibration</td></tr>
<tr><td>00110</td><td colspan="2">Adjust span calibration (First load R_DW2 with span test weight value*, then apply this command with New CMD)</td></tr>
<tr><td>01000</td><td>Operation mode selection
(First load 2nd Dword with selected value, then apply this command with New CMD)</td><td>Load R_DW2 with one of these:
0: Count mode unipolar
1: Count mode bipolar
2: Force mode unipolar
3: Force mode bipolar
4: Weight mode unipolar</td></tr>
<tr><td>01001</td><td>mV operation in Count Mode
(First load 2nd Dword with selected value, then apply this command with New CMD)</td><td>Load R_DW2 with one of these:
0: 5 mV
1: 10 mV
2: 15 mV
3: 18 mV</td></tr>
<tr><td rowspan="2">01010</td><td rowspan="2">Digital filter
(First load 2nd Dword with selected value, then apply this command with New CMD)</td><td colspan="2">Load R_DW2 with one of these:</td></tr>
<tr><td>0: Fast
…
5: Medium
…</td><td>…
7: Default
…
9: Slow</td></tr>
<tr><td>01011</td><td colspan="2">I/O Configuration (First, load 2nd Dword with desired table)</td></tr>
<tr><td>01100</td><td colspan="2">Setpoint 1 Low for I/O1 (First load R_DW2 with desired value)</td></tr>
<tr><td>01101</td><td colspan="2">Setpoint 1 High for I/O1 (First load R_DW2 with desired value)</td></tr>
<tr><td>01110</td><td colspan="2">Setpoint 2 Low for I/O2 (First load R_DW2 with desired value)</td></tr>
<tr><td>01111</td><td colspan="2">Setpoint 2 High for I/O2 (First load R_DW2 with desired value)</td></tr>
<tr><td>10000</td><td colspan="2">Setpoint 3 Low for I/O3 (First load R_DW2 with desired value)</td></tr>
<tr><td>10001</td><td colspan="2">Setpoint 3 High for I/O3 (First load R_DW2 with desired value)</td></tr>
<tr><td rowspan="8">D5...D1</td><td rowspan="8">Read selected data</td><td>00000</td><td colspan="2">Indicated weight</td></tr>
<tr><td>00001</td><td colspan="2">Gross weight</td></tr>
<tr><td>00010</td><td colspan="2">Tare weight</td></tr>
<tr><td>00011</td><td colspan="2">Indicated weight (Floating point)</td></tr>
<tr><td>00100</td><td colspan="2">Gross weight (Floating point)</td></tr>
<tr><td>00101</td><td colspan="2">Tare weight (Floating weight)</td></tr>
<tr><td>10000</td><td colspan="2">Calibration status</td></tr>
<tr><td>D0</td><td>New CMD</td><td colspan="3">Apply commands which are listed in “Command list” (Responds on bit changes)</td></tr>
</table>

*Span test weight value has to be entered ignoring the decimal point;
e.g. “300.00” has to be entered as “30000”

10. ERROR TABLE

The FAD-40 A/D Converters have been designed as very reliable and virtually error free instruments. However if an error occurs do not attempt to repair the equipment before you understand what caused the error. Note the problems you have with your instrument and the error messages shown by the LEDs located on the front panel. Then try to solve the problem according to the error table given below.

Error Code			Description	Actions to undertake / Possible cause
▬	→0←	Err		
○	○	●	ADC error	− Re-energize the instrument. − Instrument could be defective.
○	●	●	Overload	− Check the load. − Load cell or instrument could be defective.
●	○	●	Weight is too low	
●	●	●	ADC out	− Check the load. − Check the calibration. − Load cell or instrument could be defective.
○	○	✲	System error	− Re-energize the instrument. − Instrument could be defective.
●	○	✲	Board identity error	− Re-energize the instrument. − If seen again, repeat the setup of the instrument.
●	●	✲	Internal communication error	− Re-energize the instrument. − If seen again, change the cabling inside the housing.
○	✲	✲	High voltage detected	− Check the power supply, the voltage has to be within the required voltage range.
✲	○	✲	Low voltage detected	− Check the power supply, the voltage has to be within the required voltage range.

○ Off ● On ✲ Flash

Table 11.1 – Error table

11. DIAGNOSTICS

In this test menu serial interface tests (RC-232C and/or RS-485) and load cell signal analog to digital conversion and processing tests are performed sequentially.
For entering the diagnostics mode, press the setup switch before power on and release the switch after the instrument is powered on. The instrument will go into the RS-232C RXD test mode which is indicated by lighted ▂▅ LED and flashed Err LED as shown below. The status of LEDs on the front panel indicate the test steps and the test result as described below. You can go to the next test by pressing the setup switch.

Test	LED's Status			Description
	▂▅	→0←	Err	
RS-232C RxD (not for FAD-40 and FAD-40MB)	◐	○	✸	▂▅ LED gets off 0.3 s after receiving any data. Press the setup switch to go to the next test step.
RS-232C TxD (not for FAD-40 and FAD-40MB)	◐	✸	✸	'A' to 'Z' characters are sent sequentially in 0.8 s intervals. If the same data is received, ▂▅ LED gets off for 0.3 s. Press the setup switch to go to the next test step.
RS-485 RD (for FAD-40 and FAD-40MB only)	◐	○	○	▂▅ LED gets off for 0.3 s after receiving any data. Press the setup switch to go to the next step.
RS-485 TD (for FAD-40 and FAD-40MB only)	●	✸	○	'A' to 'Z' characters are sent sequentially in 0.8 s intervals. Press the setup switch to go to the next step.
Load cell signal	●	◐	●	→0← LED gets off while the load cell signal increases. Press the setup switch to go to the next step.
	◐	●	●	▂▅ LED gets off while the load cell signal decreases. Press the setup switch to return to the RS-232C RxD test.

○ Off ● On ✸ Flash ◐ Off for 0.3 second

Table 12.1 – Diagnostics

12. INDEX

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