Siargo Ltd.

TSP1000L User Manual VA.0

MEMS differential pressure transducer

MEMS Differential Pressure Transducer

with MEMS thermal sensing technology and LoRaWAN

TSP1000L Series

User Manual

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Attention!

- Please carefully read this manual prior to operating this product.
- Do not open or modify any hardware which may lead to irrecoverable damage.
- Do not use this product if you suspect any malfunctions or defection.
- Do not use this product for corrosive media or in a strong vibration environment.
- Use this product according to the specified parameters.
- Only the trained or qualified personnel shall be allowed to perform product services.

Use with caution!

- Be cautious for electrical safety, and even it operates at a low voltage, any electrical shock might lead to some unexpected damages.
- The gas to be measured should be clean and free of particles, as even light particles may be accumulated inside the tiny pressure port that may result in inaccuracy in metrology, clogging, or other irrecoverable damage.
- Do not apply for any unknown or non-specified gases that may damage the product.

Table of Contents

1. Overview

All contact information can be found at the end of this manual.

This manual provides essential information for the FSP1000L series of differential pressure transducers with LoRaWAN for various applications. The product performance, maintenance, and troubleshooting, as well as the information for product order, technical support, and repair, are also included.

The FSP1000L differential pressure transducer is manufactured with the company's proprietary MEMS (micro-electro-mechanical systems) sensing and package technology that offers unique very low differential pressure sensing.

2. Receipt / unpack of the products

Upon receipt of the products, please check the packing box before dismantling the packing materials. Ensure no damages during shipping. If any abnormality is observed, please contact and notify the carrier who shipped the product and inform the distributors or sales representatives if the order is not placed directly with the manufacturer; otherwise, the manufacturer should be informed. For any further actions, please refer to the return and repair section in this manual.

If the packing box is intact, proceed to open the packing box, and you shall find the product (either

Figure 2.1: FSP1000L differential pressure transducer

the sensor formality per the actual order), together with any other accessories if the order is included.

Please check immediately for the integrity of the product; if any abnormality is identified, please notify the distributor/sales representative or manufacturer as soon as you can. If any defects are confirmed, an exchange shall be arranged immediately via the original sales channel. This user manual shall also be included in the packing box or via an online link for an electronic version which

should be sent by your sales agent. In most cases, this manual shall be made available to the customer before the actual order.

3. Power and data pinout description

Table 3.1: FSP1000L pin assignment.

COLOR	DEFINITION
RED	VCC, power supply (+)
BLACK	GND, ground
YELLOW	RS485A (+)
WHITE	RS485B (-)

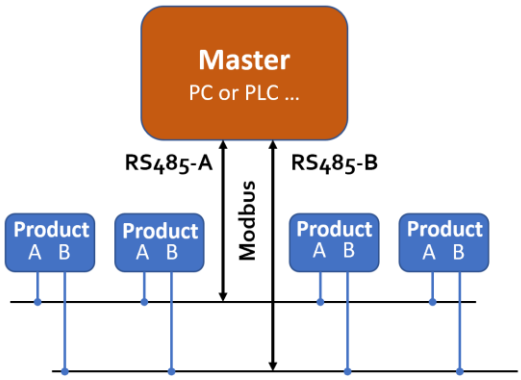
4. Basic operation

4.1 RS485 Modbus communication protocol

The digital communication protocol is based on standard Modbus RTU Half-plex mode. A master (PC or PLC) can communicate with multiple slaves (the current product) for data exchange and communication parameter configuration.

4.1.1 Hardware connection

The hardware layer is TIA/EIA-485-A, as illustrated below. In this configuration, the product (PSP1000L) is a slave.



4.1.2 Communication parameters

The PC UART communication parameters are listed in the following table.

Parameters	Protocol
	RTU
Baud rate (Bits per second)	9600 bps
Start bits	1
Data bits	8
Stop bits	1
Even/Odd parity	None
Bits period	104.2 µsec
Bytes period	1.1458 msec
Maximum data length	20
Maximum nodes	247

4.1.3 Frame

The frame function is based on the standard Modbus RTU framing:

Start_bits	Address	Function codes	Data	CRC	Stop_bits
T1-T2-T3-T4	8 bit	8 bit	N 8 bit (20≥n≥0)	16 bit	T1-T2-T3-T4

Start_bits: 4 periods of bit time, for a new frame.

Address: The address can be set from 1 to 255 except for 157 (0x9d). 0 is the broadcast address.

Function codes: Define the product (FSP1000L)'s functions/actions (slaves), either execution or response.

Data: The address of the register, length of data, and the data themselves.

CRC: CRC verification code. The low byte is followed by the high byte. For example, a 16-bit CRC is divided into BYTE_H and BYTE_L. In the framing, the BYTE_L will come first, then followed by the BYTE_H. The last one is the STOP signal.

Stop_bits: 4 periods of bit time, for ending the current frame.

4.1.4 Function codes

The Modbus function codes applied for the product are the sub-class of the standard Modbus function codes. These codes are used to set or read the registers of the product:

Code	Name	Functions
0x03	Read register	Read register(s)
0x06	Set single register	Write one single 16-bit register
0x10	Set multiple registers	Write multiple registers

4.1.5 Registers

The product (FSP1000L) has multiple registers available for the assignment of the various functions. With these functions, the user can obtain the data from the products, such as *product address* and *differential pressure* from the registers, or set the product functions by writing the corresponding parameters.

The currently available registers are listed in the following table, and the registers may be customized upon contacting the manufacturer. Where R: read; W: write-only; W/R: read and write.

Note: At the time of shipping, the write protection function is enabled except for address and baud rate. Once the user completes the register value change, the write protection will be automatically enabled once again to prevent incidental data loss.

Functions	Description	Register	Modbus reference
Address	Product address (R/W)	0x0081	40130 (0x0081)
Serial number	Serial number of the product	0x0030	40049 (0x0030)
Differential pressure	Current differential pressure (R)	0x0043 ~ 0x0044	40068 (0x0043)
Baud rate	Communication (R/W)	0x0082	40131 (0x0082)
Offset calibration *	Offset reset or calibration (W)	0x00F0	40241 (0x00F0)
Write protection	Write protection of selected parameters (W)	0x00FF	40256 (0x00FF)

Notes: 1, R – Read-only, W – Write only, R/W – Read and write.

2, For the * marked functions, please disable the write protection before executing the command.

The detailed information of each register is described below: Y: enabled; N: disabled

Product address	0x0081	Write	Y
		Read	Y
Description	Address of the product		
Value type	UINT 16		
Notes	Values from 1 to 247 except for 157 (0x9d). Broadcast address 0 is not enabled.		

SN, Serial number	0x0030	Write	N
		Read	Y
Description	Series Number of the product, SN		
Value type	UINT8 (12 bits)		
Notes	SN= value(0x0007), value(0x0008),....,value (0x000C); **e.g.,** Receiving 12 bits as: 0x2A47, 0x3741, 0x4549, 0x3032, 0x3035, 0x382A, the corresponding Serial Number is **G7AEI02058**.		

Differential pressure	0x0043 ~ 0x0044	Write	N
		Read	Y
Description	Current differential pressure		
Value type	UINT 16		
Notes	Differential pressure rate = [Value (0x0043)*65536 + value (0x0044)]/1000 **e.g.,** for a differential pressure of 20.340 Pa, the user will read "0" from register 0x0043 and "20340" from register 0x0044, therefore Current differential pressure = (0*65536+20340)/1000 = 20.340 Pa		

Baud rate	0x0082	Write	Y
		Read	Y
Description	Communication baud rate with a PC		
Value type	UINT 16		
Notes	0 - 4800; 1 - 9600; 2 - 19200; 3 - 38400; 4 - 57600; 5 - 115200. The default value is 1, the baud rate is 9600. **e.g.,** When the user reads "2 (0x0002)" from register 0x0082, the baud rate is 19200.		

Offset calibration	0x00F0	Write	Y
		Read	N
Description	Reset or calibrate the offset		
Value type	UINT 16, Fixed value 0xAA55		
Notes	To reset or calibrate the offset, write 0xAA55 to register 0x00F0. **When you execute this function, make sure there is NO flow in the flow channel.** **Notes: please disable the write protection before executing this command.**		

Write protection	0x00FF	Write	Y
		Read	N
Description	Write protection disabler for a set value to a specific register.		
Value type	UINT 16, Fixed value 0xAA55		
Notes	This function is enabled at the time of product shipment. To enable the write function of a specific parameter, such as GCF, the user needs to send 0xAA55 to the register 0x00FF, and then the write function will be enabled (write protection is disabled). After the write execution is completed, the firmware will automatically re-enable the write protection.		

4.2 LoRaWAN

The default wireless communication is LoRaWAN. Other options can be customized. Available options such as WIFI, NB-IoT, BT LE, etc. Please contact the manufacturer for further information.

The default LoRaWAN parameters are:

DEVEUI: Unique product ID, 2D code on the product label, ⚠ **please do not modify!**

APPKEY: printed on the product label

APPEUI: 0000000000000000 (default)

Network access method: OTAA

Band mask: 0001

Uplink and Downlink Mode: Same Frequency Mode

Class: Class A

The communication is based on the Modbus protocol:

Code	Function	Notes
0x30~0x35	Product serial number	ASCII
0x43~0x44	Differential pressure	(/1000) Pa
0x81	Modbus address	Default: 0xFF
0xA6	Auto data transmission to the initial register	Default: 0x30
0xA7	Data register length	0x0E
0xA8	Auto data time interval (minutes)	Default: 1 min.

At the time of shipping, the auto data transmission function is enabled. Once the product is connected with the LoRaWAN, the data will be sent per 1 minute, and the data registers 0X30~0X44 are corresponding to

FF 03 1C SN SN SN SN SN SN SN SN SN SN SN 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 DP DP DP DP CRC CRC

FF:	Frame header
03:	Read the command
1C:	Number of data bytes
SN SN SN SN SN SN SN SN SN SN SN:	Serial number (**********)
00 00 … 00 00:	Reserved
DP DP DP DP:	Differential pressure
CRC CRC:	MODBUS CRC Check, X16 + X15 + X2 + 1

5. Technical specifications

All specifications listed in the following table, unless otherwise noted, apply for calibration conditions at 20°C and 101.325 kPa absolute pressure with air.

	Value	Unit
Differential pressure	±500	Pa
Power supply	8 ~ 24	Vdc
Output	Linear, RS485, LoRaWAN	
Response time	20	msec
Span accuracy	±(2.0+0.5FS)	%
Span repeatability	±0.5	%
Span temperature shift	<0.16	%/°C
Temperature range	-5~+65	°C
Altitude correction	Full compensated	
Pressure rating	2.0	bar
Humidity	<95, no condensation	%RH
Warm-up time	<500	msec
Storage temperature	-20~70	°C
Vibration	20g; MIL-STD-883E, Method 2002.4.	
Compliance	RoHS; REACH	

Note: *FS = full scale in one direction. A customized differential pressure range is available upon request.

6. Warranty and Liability

(Effective January 2018)

Siargo warrants the products sold hereunder, properly used, and properly installed under normal circumstances and service. As described in this user manual, it shall be free from faulty materials or workmanship for 180 days for OEM products and 365 days for non-OEM products from the date of shipment. This warranty period is inclusive of any statutory warranty. Any repair or replacement serviced product shall bear the same terms in this warranty.

Siargo makes no warranty, representation, or guarantee and shall not assume any liability regarding the suitability of the products described in this manual for any purposes that are not specified in this manual. The users shall be held full responsibility for validating the performance and suitability of the products for their particular design and applications. For any misusage of the products out of the scope described herein, the user shall indemnify and hold Siargo and its officers, employees, subsidiaries, affiliates, and sales channels harmless against all claims, costs, damages, and expenses or reasonable attorney fees from direct or indirect sources.

Siargo makes no other warranty, express or implied, and assumes no liability for any special or incidental damage or charges, including but not limited to any damages or charges due to installation, dismantling, reinstallation, etc. other consequential or indirect damages of any kind. To the extent permitted by law, the exclusive remedy of the user or purchaser, and the limit of Siargo's liability for any and all losses, injuries, or damages concerning the products, including claims based on contract, negligence, tort, strict liability, or otherwise shall be the return of products to Siargo, and upon verification of Siargo to prove to be defective, at its sole option, to refund, repair or replacement of the products. Regardless of form, no action may be brought against Siargo more than 365 days after a cause of action has accrued. The products returned under warranty to Siargo shall be at the user or purchaser's risk of loss and will be returned, if at all, at Siargo's risk of loss. Purchasers or users are deemed to have accepted this limitation of warranty and liability, which contains the complete and exclusive limited warranty of Siargo. It shall not be amended, modified, or its terms waived except by Siargo's sole action.

This manual's product information is believed to be accurate and reliable at the time of release or made available to the users. However, Siargo shall assume no responsibility for any inaccuracies and/or errors and reserves the right to make changes without further notice for the relevant information herein.

This warranty is subject to the following exclusions:

(1) Products that have been altered, modified, or have been subject to unusual physical or electrical circumstances indicated but not limited to those stated in this document or any other actions which cannot be deemed as proper use of the products;

(2) Products that have been subject to chemical attacks, including exposure to corrosive substances or contaminants. In the case of battery usage, long-term discharge, or leakage-induced damages;
(3) Products that have been opened or dismantled for whatever reasons;
(4) Products that have been subject to working conditions beyond the technical specification as described by this manual or related datasheet published by the manufacturer;
(5) Any damages incurred by the incorrect usage of the products;
(6) Siargo does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies;
(7) Products that are re-sold by unauthorized dealers or any third parties.

7. Service/order contact and other information

Siargo Ltd. is making every effort to ensure the quality of its products. In case of questions and or product support, please contact your direct sales, or in case you need additional assistance, please contact customer service at the address listed below. We will respond to your request in a timely fashion and work with you toward your complete satisfaction.

For sales or product orders, please contact the local sales representatives or distributors that can be found on the company's webpage: www.Siargo.com.

For any returns, please contact your direct sales to obtain an RMA. In case you need any further assistance, please contact info@siargo.com to obtain additional information or a Return Materials Authorization (RMA) before shipping the product back to the factory for factory services such as calibration. Please specify as clearly as possible in your email message about the product's status that you intend to ship back to the factory, and include your shipping address. Be sure to write the RMA on the returned package or include a letter with the RMA information.

Direct customer service request(s) should be addressed to

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For further information and updates, please visit www.Siargo.com.

Appendix: Document history

Revision VA.0 (July 2023)

- First released.