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User Guide
DAT 3025
MODBUS RTU/ASCII SERVER MODULE – STRAIN GAUGE INPUT

GENERAL DESCRIPTION

All the data shared by a remote module communicating with the Modbus RTU / Modbus ASCII protocol are mapped in tables, where a specific address is associated with each data.
Each data can be of two types:
- "REGISTER", made up of 2 bytes (16-bit word), can be associated with analog inputs or outputs, variables, set-points, etc...
- “COIL”, consisting of 1 single bit, can be associated with digital inputs, digital outputs or logic states.

A register can also contain the image (mirror) of several coils, for example the 16 digital inputs of a device can be read or written as bits, therefore individually, addressing the coil relating to each input, or they can be read or written as a single port by addressing the associated register, where each bit corresponds to a coil.
In the Modbus protocol, registers and coils are divided into the following address banks:

0xxxx and 1xxxx = Coils (bits)
3xxxx and 4xxxx = Registers (word)

To use the register and coil reading and/or writing functions, refer to the tables in this manual.
It is possible to access the internal registers of the module by direct Modbus RTU / Modbus ASCII command.
The module configuration can be performed through the master unit (PLC, SCADA, etc…) or, more simply, through the *“Modbus_3000_10000”* configuration software which can be downloaded from the website *www.datexel.it* in the *“Software & Drivers”* section.
For correct installation of the device, refer to the product datasheet which can be downloaded from the website *www.datexel.it*
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SUPPORTED MODBUS FUNCTIONS

Modbus Function Code	Modbus Function	(*) Maximum Reading/Writing
01	Read Coil Status	16 coils
02	Read Input Status	16 coils
03	Read Holding Register	16 registers
04	Read Input Register	16 registers
05	Write Single Coil	1 coil
06	Write Single Register	1 register
15 (0x0F)	Write Multiple Coils	16 coils
16 (0x10)	Write Multiple Registers	16 registers

(*) The maximum number of registers that can be written to or read using the modbus functions is to be referred to in relation to the registers/coils in the *“Modbus Register Mapping”* and *“Coils Mapping”* tables. If registers that are not present in the tables are read or written, the device provides an exception message.

REGISTERS STRUCTURE

The internal registers of Modbus devices are mainly represented in two formats: ***Unsigned Integer*** or ***Signed Integer***. In the signed registers (Signed Integer), the most significant bit represents the sign of the contained value therefore the values represented are between ±32767 while in the unsigned ones (Unsigned Integer) the values represented are between 0 and 65535. Therefore, in the case where Signed Integer registers are read and the value is greater than 32767, it is necessary subtract 65536 from the read value to obtain the true signed value.
The registers have the following 16-bit structure (WORD):

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Descr	MSB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	LSB
Byte	HB (1 byte)								LB (1 byte)							

Legenda:
MSB → Most Significant Bit
LSB → Least Significant Bit
HB → High Byte
LB → Low Byte

MODBUS REGISTERS MAPPING

Modbus Register (base 1)	Modbus Register (base 0)	Description	Register Type/Format	Access	Storage
40001	0	Test	-	R/W	RAM
40002	1	Firmware[0]	-	RO	FW
40003	2	Firmware[1]	-	RO	FW
40004	3	Device Name [0]	-	R/W	EEPROM
40005	4	Device Name [1]	-	R/W	EEPROM
40006	5	Communication	16-bit, Unsigned	R/W	EEPROM
40007	6	Address / Node	16-bit, Unsigned	R/W	EEPROM
40008	7	Delay RX/TX	16-bit, Unsigned	R/W	EEPROM
40009	8	Watchdog Timer	16-bit, Unsigned	R/W	EEPROM
40010	9	System Flags	16-bit, Unsigned	R/W	RAM/EEPROM
40011	10	Input Type	16-bit, Unsigned	R/W	EEPROM
40012	11	Rise-Fall Latch / Button State Tare – Digital Input State	16-bit, Unsigned	R/W	RAM
40013	12	Options Alarm/PowerUp/Safe	16-bit, Unsigned	R/W	EEPROM
40014	13	Vexc Measure	16-bit, Unsigned	RO	RAM
40015	14	Input Measure	16-bit, Signed	RO	RAM
40016	15	Alarm Threshold 1	16-bit, Signed	R/W	EEPROM
40017	16	Alarm Threshold 2	16-bit, Signed	R/W	EEPROM
40018	17	Threshold Delay	16-bit, Unsigned	R/W	EEPROM
40019	18	Digital Output / Alarm State	16-bit, Unsigned	R/W	RAM
40020	19	Tare/Offset Measure	16-bit, Signed	R/W	EEPROM
40021	20	Real Input Span	16-bit, Signed	R/W	EEPROM
40022	21	Real Input Zero	16-bit, Signed	R/W	EEPROM
40023	22	Scaled Physical Input Span	16-bit, Signed	R/W	EEPROM
40024	23	Scaled Physical Input Zero	16-bit, Signed	R/W	EEPROM

COILS MAPPING

Modbus Coil (base 1)	Modbus Coil (base 0)	Description	Register Type/Format	Access	Storage
00009	8	Watchdog Enable	1-bit	R/W	EEPROM
00010	9	Watchdog Event	1-bit	R/W	RAM
00011	10	PowerUp Event	1-bit	R/W	RAM
00012	11	Vexc (5V / 10V)	1-bit	R/W	EEPROM
00013	12	Digital Input Tare Enable	1-bit	R/W	EEPROM
00014	13	Vexc Correction	1-bit	R/W	EEPROM
00033	32	Rise Latch Digital In	1-bit	R/W	RAM
00037	36	Fall Latch Digital In	1-bit	R/W	RAM
00041	40	Digital Input	1-bit	RO	RAM
00048	47	Button P State (Tare)	1-bit	RO	RAM
00057	56	Alarm Enable	1-bit	R/W	EEPROM
00058	57	Alarm Type (High or Low)	1-bit	R/W	EEPROM
00059	58	PowerUp Digital Output	1-bit	R/W	EEPROM
00060	59	Safe Digital Output	1-bit	R/W	EEPROM
00153	152	Digital Output	1-bit	R/W	RAM

NOTE:

1. The registers and coils marked in the 'Access' column with the wording RO are read only registers.
2. The registers and coils marked in the 'Access' column with the wording R/W are read and write registers (Read / Write).
3. The registers and coils marked in the 'Storage' column with the wording EEPROM reside in the non-volatile memory therefore they retain their value permanently even in the event of a power failure.
   Note: these registers / coils must not be written continuously because the EEPROM could be irreparably damaged.
4. For the modules of the DAT8000 series, the bank 0xxxx is the mirror of the bank 1xxxx, as the bank 3xxxx is the mirror of the bank 4xxxx, so for example the first register can be addressed indifferently as 30002 (with function 04) or 40002 (with function 03).
5. FW → fixed by firmware. The value is defined in the firmware.
6. EEPROM → the value is stored in a non-volatile memory permanently (see note 3).
7. RAM → the value is stored in a volatile memory. In the absence of power supply, the stored value is cleared.

MODBUS REGISTERS DESCRIPTION

40001: TEST
This register is used to perform functions during the testing procedure.

40002 / 40003: FIRMWARE VERSION
Read-only 2-register field, that hold the manufacturer firmware identifier.
- Manufacturer default: DB00 (ASCII)

40004 / 40005: DEVICE NAME
2-registers field (4 byte or 4 ASCII characters) user free, that can hold the device name or a function identifier. Each byte can be written with each value from 0 to 255, than ASCII characters too.
- Manufacturer default: “3025” (ASCII).

40006: COMMUNICATION
If the user wants to set the communication parameters by PC, it is necessary to set the bits of this register referring to the table below in order to configure baud-rate, parity and mode.
- Default of manufacturer: 38400 bps, mode RTU, parity NONE, stop bit 1

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Descr	-	-	-	-	-	-	-	-	-	M	P1	P0	N	B2	B1	B0

Modbus Protocol	M
ASCII	0
RTU	1

MODBUS RTU

Stop bit	Parity	P1	P0
1	None	0	0
1	Even	0	1
1	Odd	1	0
2	None	1	1

N° bit	N
7 bit	0
8 bit	1

MODBUS ASCII

Stop bit	Parity	P1	P0
1	Mark (*)	0	0
1	Even	0	1
1	Odd	1	0
1	Space	1	1

Baud Rate	B2	B1	B0
2400	0	0	1
4800	0	1	0
9600	0	1	1
19200	1	0	0
38400	1	0	1
57600	1	1	0
115200	1	1	1

NOTE:
- the number of bits is ignored, in ASCII mode is fixed to 7; in RTU mode is fixed to 8.
- RTU mode and ASCII mode, the "Stop bit" number is fixed in relation to the parity selected.
- (*) In ASCII mode, the "Mark" parity configuration with 1 stop bit is equivalent to the "No Parity" configuration with 2 stop bit

40007: ADDRESS
Specify the net address of the device; there are allowed the address from 1 to 254.
Each device connected to the same net must have a unique address.
- Manufacturer default: 01

40008: RX/TX DELAY
Specify the value of the delay between the reception of a command and the response transmission, indicated in milliseconds.
- Manufacturer default: 1 (1 ms.)

40009: WATCHDOG TIMER
Specify the value of the WatchDog Timer (see the “Procedures” section), indicated in steps of 0.5 seconds.
- Manufacturer default: 10 (5 sec.)

40010: SYSTEM FLAGS
This register contains the mirror of the Coils table: each bit of the register corresponds to a coil according to the table below.
It is possible to use this register to read or write all the coils at the same time without having to implement the specific coil write/read functions (01-02-15).

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Coil (*)	-	-	-	-	-	-	-	-	-	-	13	12	11	10	09	08
Descr	-	-	-	-	-	-	-	-	-	-	Vexc Corr	TARE Enable	Vexc	PW-UP Event	WDT Event	WDT Enable

WATCHDOG ALARM Enable (WDT Enable)
Enables the Watchdog alarm. If the alarm is enabled and the device doesn't receive commands for a time higher than the one specified in register 40009, the Watchdog Alarm will be activated (refer to section "Procedures").
0 → Watchdog disabled.
1 → Watchdog enabled.

WATCHDOG ALARM Event (WDT Event)
Indicates the state of the Watchdog Alarm. If the alarm is enabled and the device doesn't receive commands for a time higher than the one specified in register 40009, this bit is forced to 1. To erase the alarm set this bit to 0. If the bit is forced to 1 by a command of the Master unit, a Watchdog event will be simulated and consequently an alarm condition will be created.
0 → Normal condition
1 → Alarm condition

POWER-UP Event (PW-UP Event)
This bit is forced to 1 each time the device is powered-on in order to indicated that the device has been switched-off or a reset is occurred. By the set of this bit to 0 and check its state it is possible to monitor if a reset of the device is occurred.
0 → reset not occurred
1 → reset not occurred

Bridge excitation voltage (Vexc)
This coil allows the user to choose the bridge excitation power supply in relation to the load cell data.
0 → Vexc = 10V
1 → Vexc = 5V

Enabling TARE FROM DIGITAL INPUT (TARE Enable)
Enables the TARE function via digital input. If this coil is at 1, it is possible to use the digital input to TARE the weight, for example by controlling the digital input via PLC.
0 → The TARE function from digital input is disabled. The input behaves like a standard digital input.
1 → The TARE function from digital input is enabled.

Bridge Excitation Voltage Correction (Vexc Corr)
This bit allows you to enable the correction of the bridge excitation voltage as it is not exactly 5Vdc or 10Vdc
0 → correction disabled.
1 → correction enabled

NOTE: (*) Coils in base 0

40011: INPUT RANGE SETTING

Contains the configuration of the input range in mV.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Descr	**Input Range**															

Input Range	Value (Hex)	Value (Dec)	Decimals
± 30 mV	01	1	3
± 200 mV	02	2	2

In order to identify which input scale range, it is necessary to use the following formula:

$$Input\ Range = Vexc * S_{cell}$$

Vexc → Load cell excitation voltage (5 V or 10 V)
Scell → Load cell sensitivity (mV/V)

Example:

- Vexc=10V
- S_{cell}= 2mV/V

Input Range = 10V * 2mV/V = 20mV

Value to write to the register → **01 Hex** (± 30 mV)

40012: DIGITAL INPUT / BUTTON TARE (P) / FALL LATCH / RISE LATCH

This register shows the status of the digital input and of the button to perform the TARE manually (0 = OFF, 1 = ON).
The same inputs can also be read via the coil table, of which this register is a mirror.
It is possible to use this register to read all the inputs simultaneously without having to implement the specific coil reading functions (01-02). In this register, in addition to the status of the input, also the status of the rise and fall latches referring to the digital input is available.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Descr	Fall Latch				Rise Latch				Digital Input Status / Button TARE (P)							
Input	-	-	-	Digital In	-	-	-	Digital In	Tare (P)	-	-	-	-	-	-	Digital In
Coil (*)	-	-	-	36	-	-	-	32	47	-	-	-	-	-	-	40

NOTE: (*) Coils in base 0

40013: ALARM THRESHOLD / POWERUP / SAFE DIGITAL OUTPUT

This register allows you to enable the digital output as an alarm threshold, configure the type of alarm (minimum or maximum threshold) and set the PowerUp and Safe values for the digital output (when the alsrm threshold is disabled).
The PowerUp and Safe parameters work if the alarm threshold is disabled.
These bits can also be read or written via the coil table, of which this register is a mirror.
It is possible to use this register to simultaneously read/write all parameters without having to implement the specific coil reading/writing functions (01-02-05-15).

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Coil (*)													59	58	57	56
Descr	-	-	-	-	-	-	-	-	-	-	-	-	Safe Out	PowerUp Out	Alarm Type	Alarm Enable

ALARM THRESHOLD ENABLE

Enables the alarm threshold on the digital output. If the alarm threshold is disabled, the digital output must be controlled via Modbus commands from the PLC or master.
0 → Alarm threshold disabled
1 → Alarm threshold enabled

ALARM TYPE

When the alarm threshold is enabled, this bit allows you to configure the type of alarm, i.e. whether the threshold is Maximum or Minimum.
0 → Minimum Alarm: the output is activated if the input exceeds the intervention threshold and is deactivated when the input value goes below the release threshold.
1 → Maximum Alarm: the output is activated if the input value goes below the intervention threshold and is deactivated when the input returns above the release threshold.

POWERUP OUT

Upon power-up and if the alarm threshold is disabled, the digital output goes to the value specified in this bit.
0 → When switched on, the digital output goes to logical 0 state
1 → When switched on, the digital output goes to logical state 1

SAFE OUT

In the event of a watchdog alarm and if the alarm threshold is disabled, the digital output goes to the value specified in this bit.
0 → In case of watchdog alarm the digital output goes to logical 0 state
1 → In the event of a watchdog alarm, the digital output goes to logical 1 state

NOTE: (*) Coils in base 0

40014: Vexc MEASURE

Indicates the real value of the bridge supply voltage expressed in mV.

40015: INPUT VALUE

This register returns the input measurement scaled and converted in relation to the values entered in the SpanIn, ZeroIn, SpanOut and ZeroOut registers.

40016: THRESHOLD 1

This register allows you to enter the intervention threshold value when the threshold is Maximum or release when the threshold is Minimum.
This value is considered if the alarm threshold is enabled. The difference between Threshold 1 and Threshold 2 allows you to create hysteresis.
For further information, see the *“Alarm threshold operating”* section.

40017: THRESHOLD 2

This register allows you to enter the release threshold value when the threshold is Maximum or intervention when the threshold is Minimum.
This value is considered if the alarm threshold is enabled. The difference between Threshold 1 and Threshold 2 allows you to create hysteresis.
For further information, see the *“Alarm threshold operating”* section.

40018: THRESHOLD INTERVENTION DELAY

This register allows you to set the intervention and release delay of the alarm threshold. This value is expressed in ms and can take values up to 60000 ms (60 s). This delay is the time between exceeding the alarm threshold and the actual activation of the output or when the input returns from the alarm state and the output is deactivated.
Minimum value allowed: 200 ms
For further information, see the *“Alarm threshold operating”* section.

40019: DIGITAL OUTPUT/ALARM STATUS
This register allows you to directly control the status of the digital output (0 = OFF; 1 = ON).
The digital output can also be read or written via coil, of which this register is a mirror.
It is possible to use this register to read/write the digital output without having to implement the specific coil reading/writing functions (01-02-05-15).
When the alarm threshold is enabled, this register indicates the alarm state of the threshold.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Coil (*)																152
Descr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Digital Output

NOTE: (*) Coils in base 0

40020: TARE VALUE/OFFSET MEASURE
This register contains the tare weight value. This register is written either via Modbus command or via Manual TARE (button on the front) or from Input (appropriately configured digital input).
If the value of this register is 0, the value displayed in register 40015 is the gross weight (in case you are measuring a weight).
For more information on how to TARE the weight, consult the *"Procedures"* section.

40021: REAL INPUT SPAN
40022: RAEL INPUT ZERO
40023: SCALED PHYSICAL SPAN
40024: SCALED PHYSICAL ZERO

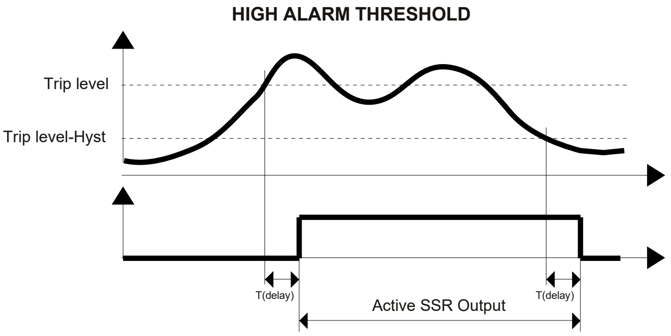
Sets input register scaling (40015) in its physical parameter.
Scaling makes an association of the real parameters to the physical parameters to which the measured quantity refers.
Set the measurement range of the electrical value measured by the device in the "Input Real Zero" (start of scale value) and "Input Real Span" (full scale value) fields and in the "Scaled Physical Zero" (start of scale value) fields. scale) and "Scaled Physical Span" (full scale value) the measurement range of the converted value.

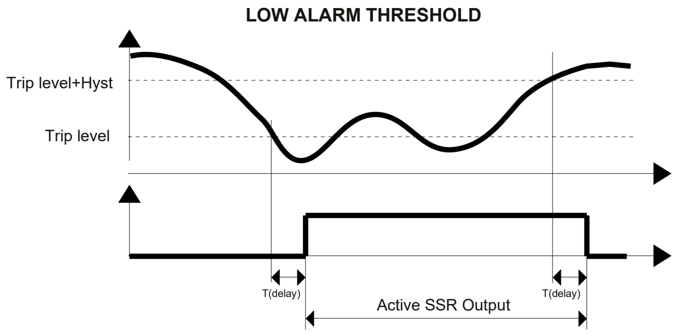
Example:
To convert the 0-50mV input to 0-2000 kg physical parameters, set the following parameters:
40022 = 0 40021 = 5000 40024 = 0 40023 = 2000
The following results are obtained:
0 mV = "0"kg 25 mV = "1000" kg 50 mV = "2000"kg

If you want to display the bridge unbalance mV without scaling the measurement, write the value 1 in the SPAN registers (40021-40023) and the value 0 in the ZERO registers (40022-40024).

Attention: these registers reside in EEPROM, so it is not necessary to overwrite them at every PLC cycle as they can irremediably damage the EEPROM.

ALARM THRESHOLD OPERATING





For the **high alarm** the relay goes on when the input signal is higher than the trip level and after the delay time. The relay goes off only when the input signal is lower than the trip level minus the hysteresis value or when reaches the minimum value of the input scale and after the delay time.

For the **low alarm** the relay goes on when the input signal is lower than the trip level and after the delay time. The relay goes off only when the input signal is higher than the trip level plus the hysteresis value or when reaches the maximum value of the input scale and after the delay time.

HOW TO USE THE "INIT" FUNCTION

If the exact configuration of a module is unknown, it can result impossible to establish a communication with it.
The "INIT" function gives a solution to this trouble:

- Connect to the RS485 net only the device to configure.
- Turn off the device.
- Connect the INIT pin (D) to the GND pin (C).
- Turn on the device.
- Ensures that the "PWR" green LED on the front of the enclosure is lighted.

If not, control the voltage supply connections (I and J pins).

- Set the communication port to these values:
    baud-rate = 9600 bps
    parity = None
    n° bits = 8
    stop bit = 1
- The device now communicates at the address 01 with the RTU protocol.
- Read or program the desired settings on the registers:
    40006: "Communication" for the baud-rate setting
    40007: "Address" for the net address of the device
- Turn off the device.
- Disconnect the INIT pin from the GND pin.
- Turn on the device.
- Set the communication port at the baud-rate programmed in the 40006 register.
- The device now communicates with the address programmed in the 40007 register.

NOTE: The default manufacturer configuration is the following:

- Address: 01
- Baud-rate: 38400 bps
- Protocol: RTU
- Parity: None
- Stop bit: 1

WATCHDOG

The device is equipped with a Watchdog timer which, if enabled, triggers an alarm every time the communication between the module and the master remains inactive for a time longer than that configured in register 40009.
In an alarm condition, the "Watchdog Event" coil is set to 1 and, when the alarm threshold is disabled, the digital output goes to the value set in the Safe Out bit in register 40013.
To exit the alarm condition, send a command to the device and reset the "Watchdog Event" coil.

TARE WEIGHT

The device has two modes to tare the weight and display only the net weight in the input register (40015).
The two modes are as follows:

- ***Manual Tare Mode:*** the tare is carried out by pressing the P button on the front for at least 6 seconds or in any case until the STS LED lights up and the PWR turns off. After carrying out the tare, the LEDs go to standard condition (STS LED off and PWR LED on). As long as the button is held down, the device does not carry out additional tares. In order for the device to be ready for a new tare, the button must be released and the procedure must be followed again.

Procedure for Manual Tare:

a) Set the Zero and Span parameters appropriately in the appropriate registers
b) Place the TARE to be weighed on the load cell
c) Press the P button on the front of the device for at least 6 seconds.
d) Release the button so that the device is available to carry out a new tare.

- Tare Mode from Input: the tare is performed by enabling the digital input as tare (see register 40010) and providing a value between 10 Vdc and 30 Vdc (logical state 1) for at least 6 seconds at the digital input. As long as the input signal is kept high (logical state 1), the device does not carry out additional tares. In order for the device to be ready for a new tare, the input must be brought to logical state 0.

Procedure for Tare from Digital Input:

a) Set the Zero and Span parameters appropriately in the appropriate registers
b) Enable tare from input via the "TARE Enable" bit in register 40010 (System Flag).
c) Place the TARE to be weighed on the load cell
d) Impose a voltage of at least 10Vdc between the digital input terminals for at least 6 seconds (logical state 1).
e) Impose a voltage of 0 Vdc (logical state 0) so that the device is available to carry out a new tare.

CALIBRATION PROCEDURE

In order to minimize measurement errors due to excitation voltage tolerances, it is necessary to calibrate the device in the field.

If you have known sample weights available, follow the procedure below:

a) Launch the Modbus 3000_10000 configuration software which can be downloaded from the website *www.datexel.it* in the *"Software & Driver"* menu.
b) Connect to the module by setting the appropriate communication parameters (Serial or Ethernet based on the converter used) and open the DAT3025 configuration mask from the *"Model"* menu.
c) Make sure that in *"Zero In"* and *"Zero Out"* there is the value 0 and in *"Span In"* and *"Span Out"* there is the value 1;
d) After having configured the excitation voltage of the load cell (5V or 10V), with the cell discharged, write the measured value in full without commas on a piece of paper; place the sample weight corresponding to the full scale value of the cell on the load cell and write the measured value in full without commas on a piece of paper.
e) Write the value measured with the discharged cell in **Zero In** (register 40022) → click on "Write";
Write the value measured with the sample weight in **Span In** (register 40021) → click on "Write";
Write the value 0 in **Zero Out** (register 40024) → click on "Write";
Write the full scale value of the cell (sample weight) in **Span Out** (register 40023) → click on "Write";

Note: *if the sample weight corresponds to half the scale, multiply the measured and full scale values by two in order to maintain the proportion.*

If you do **not** have known sample weights available, follow the procedure below:

a) Launch the Modbus 3000_10000 configuration software which can be downloaded from the website www.datexel.it in the "Software & Driver" menu.
b) Connect to the module by setting the appropriate communication parameters (Serial or Ethernet based on the converter used) and open the DAT3025 configuration mask from the "Model" menu.
c) Make sure that in "Zero In" and in "Zero Out" there is the value 0 and in "Span In" and "Span Out" there is the value 1;
d) After configuring the excitation voltage of the load cell (5V or 10V), with the cell discharged, write the measured value in full without commas in **Zero In** (register 40022) → click on "Write";
e) Calculate the maximum theoretical value in mV to be written in **Span In** (register 40021) using the following formula:

Span In = (Sens(cell) * Vexc(real)) - Zero In

Sens(cell)→ Cell sensitivity (mV/V)
Vexc(real)→ Measured cell excitation voltage (Vexc Measured → register 40014)
Zero In → Value measured with the cell discharged

Write the value 0 in **Zero Out** (register 40024) → click on "Write";
Write the full scale value of the cell in **Span Out** (register 40023) → click on "Write";

Note: this method does not consider the error due to the sensitivity of the cell as the nominal value is considered in the calculation.

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