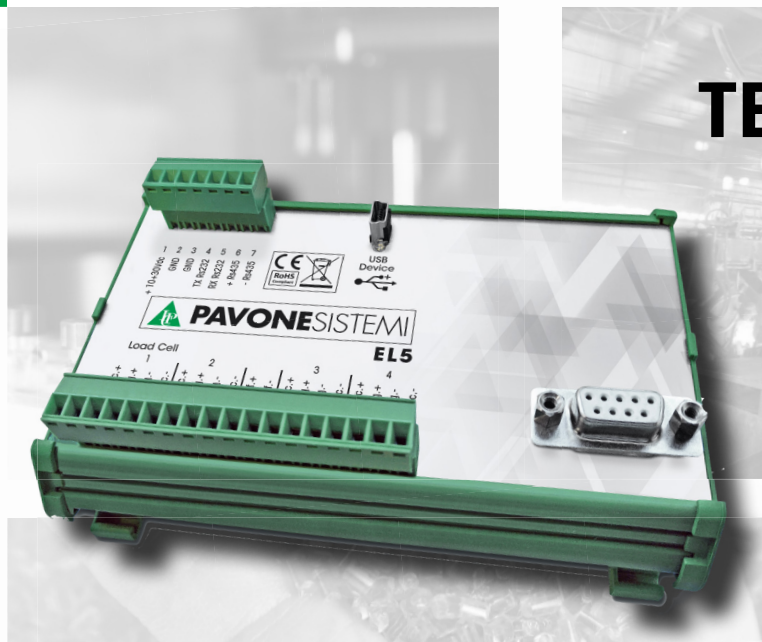
TECHNICAL MANUAL



EL5 Weight transmitter with serial and Fieldbus output

Software version P35001

PAVONESYSTEMS

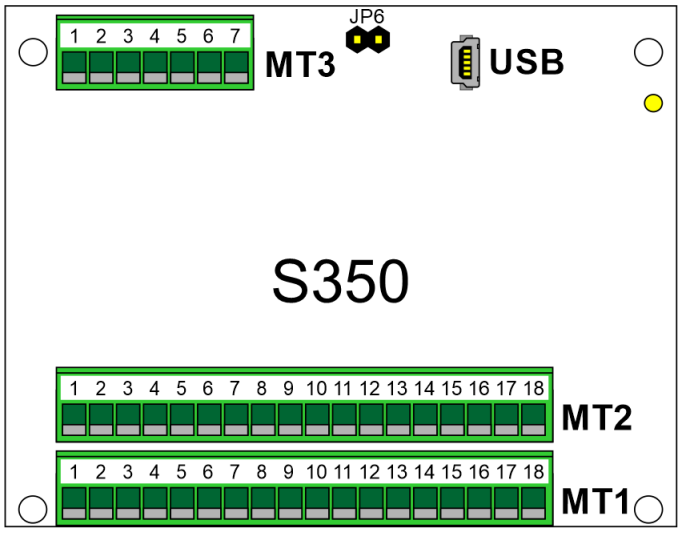
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TECHINICAL CHARACTERISTICS

Transducer supply:	5 Vcc (max 16 load cells 350 Ohm, in total)
Measurement field:	-3.9 mV/V ÷ +3.9 mV/V
Input sensitivity:	0.02 µV min
Linearity:	< 0.01% FS
Thermal drift:	< 0.0003% FS/ °C
A/D converter:	24 bit
Internal resolution:	> than 8,000,000 divisions
Signal acquisition frequency:	25 ÷ 400 Hz (4 load cells)
Digital filter:	Selectable from 0.25 Hz to 25 Hz
Equipment supply:	12-24 Vcc ±15% - absorbed power 3 W
Insulation:	Class III
Installation category:	Cat. II
Operating temperature:	-10/+50 °C (max humidity 85% without mist)
Storage temperature:	-20/+60°C
Serial ports:	1 USB device + 1 RS232C + 1 RS485
Field bus options:	ETHERNET 10/100 (with TCP, MODUBUS/TCP,UDP, IP, ICMP, ARP protocols); PROFIBUS DP; PROFINET; ETHERNET/IP; ETHERCAT; CANOPEN
Microcontroller:	32 bit ARM Cortex M0+, 128KB Flash reprogrammable on-board from USB
Data storage capacity:	4 Kbytes
Compliance to regulations:	EN61000-6-2, EN61000-6-3 per EMC; EN61010-1 for electrical safety
Electrical connections:	removable screw terminal, 3.81 mm pitch
Size:	98 x 90 x 40 mm (L x H x P)
Size with Fieldbus:	134 x 90 x 40 mm (L x H x P)
Type of mounting:	Fixing with 4 screws or on support for DIN bar or OMEGA bar

POWER SUPPLY CONNECTIONS, SERIALS USB AND LOAD CELLS



MT1
(Cells 1-4)

1	+ Pwr supply (5V)
2	+ Signal Cell 1
3	- Signal Cell 1
4	GND
5	+ Pwr supply (5V)
6	+ Signal Cell 2
7	- Signal Cell 2
8	GND
9	+ Reference (C1-C4)
10	- Reference (C1-C4)
11	+ Pwr supply (5V)
12	+ Signal Cell 3
13	- Signal Cell 3
14	GND
15	+ Pwr supply (5V)
16	+ Signal Cell 4
17	- Signal Cell 4
18	GND

MT2
(Cells 5-8)

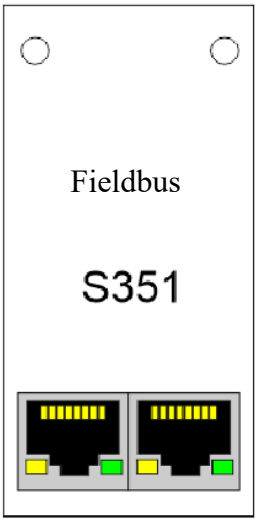
1	+ Pwr supply (5V)
2	+ Signal Cell 5
3	- Signal Cell 5
4	GND
5	+ Pwr supply (5V)
6	+ Signal Cell 6
7	- Signal Cell 6
8	GND
9	+ Reference (C5-C8)
10	- Reference (C5-C8)
11	+ Pwr supply (5V)
12	+ Signal Cell 7
13	- Signal Cell 7
14	GND
15	+ Pwr supply (5V)
16	+ Signal Cell 8
17	- Signal Cell 8
18	GND

MT3
(Pwr supply / Serials)

1 + 12/24 VDC
2 GND
3 GND
4 TX RS232
5 RX RS232
6 + RS485
7 - RS485

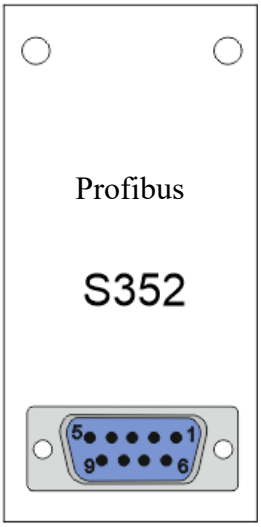
If the used cells have 4 wires make a jumper between Power supply + and Reference +, and between Power supply – and Reference -.

FIELDBUS CONNECTIONS





Additional board for Fieldbus (Profinet, EtherCAT, Ethernet-IP) and Ethernet connections.





Additional board for for Profibus and CanOpen connections.

INTRODUCTION

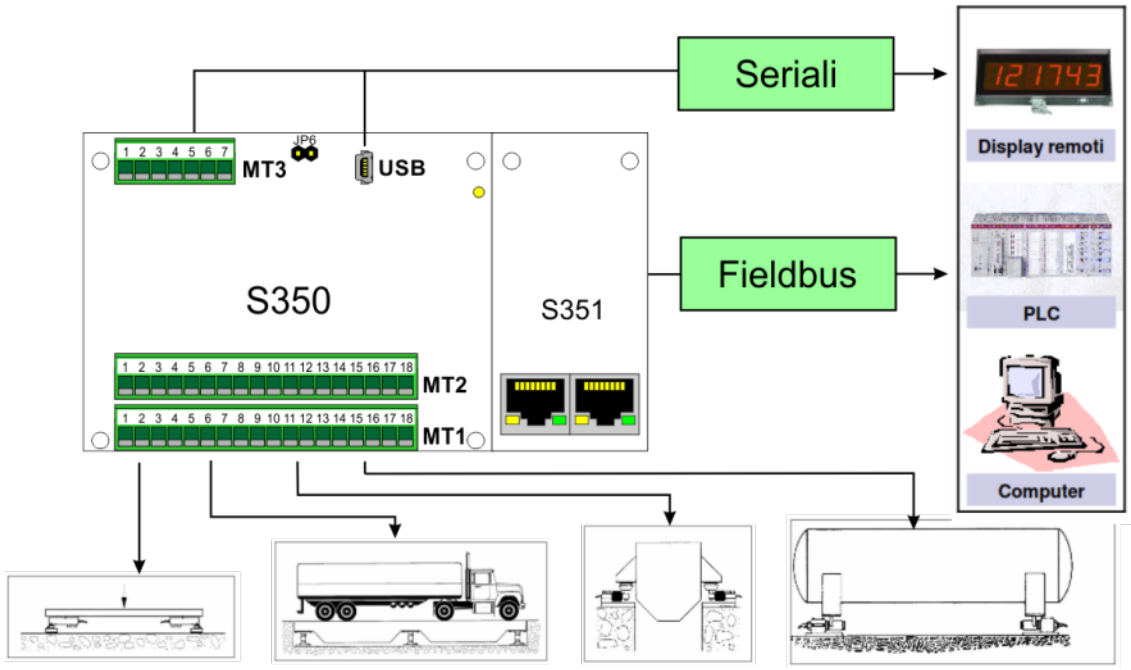
This device is a precision transmitter, for weighing and force measurement systems using load cells. It allows to acquire analogic cells separately (up to maximum 8 cells).

The device converts the mV signal of the load cells into a high resolution (24 bits) digital signal; the sum of the divisions will therefore provide more accurate information on the acquired weight value.

The transmitter can be integrated as slave in different types of networks, through various Serial or Fieldbus communication protocols.

The transmitter is connected to ordinary analogic load cells, instead of expensive digital load cells. Such combination offers the following benefits:

1. Independent acquisition of the output in mV/V and of the weight value of each single load cell.
2. Monitoring of all the load cells and generation of alarms for excessive drifts of the load cell signals, missed connections, fault of the load cells.

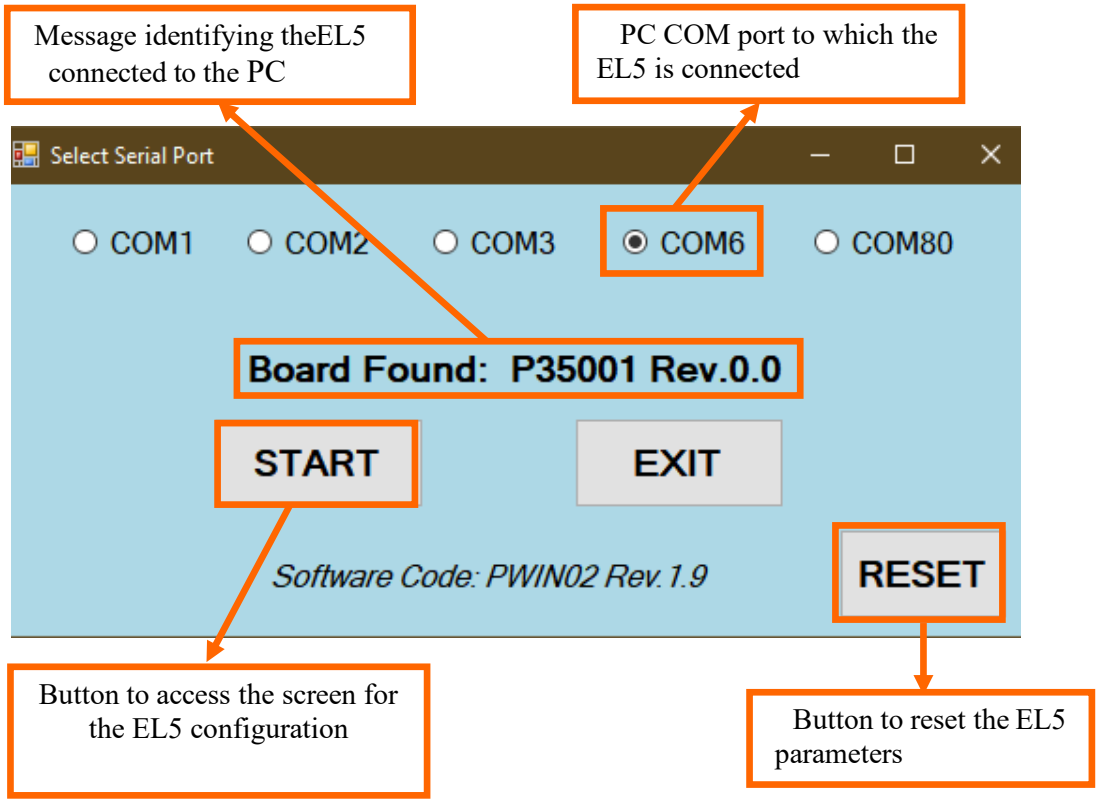


LED STATUS

LED	Status	Description
	Flash 0.5 sec	Normal functioning
	Flash 0.5 sec	No fieldbus connection (only if a Fieldbus is present)
	Fixed	Fieldbus error (only if a Fieldbus is present)
	“Indicating Flash”	Load cell error (the number of flashings “indicates” the cell)
	Rapid Flash	Boot loader activated

DEVICE CONFIGURATION

To configure this device use the program PC "PWIN02", through which it is possible to set the various weighing and serial communication parameters described in the following pages.



First of all connect the EL5 through the serial **RS232 or USB** to a port of the PC. The connection with the PC configurator is established with baudrate at 38400 baud.

Start the program and the above screen will appear.

Then select the COM port on which the device has been connected and wait for the device to recognize the connected EL5.

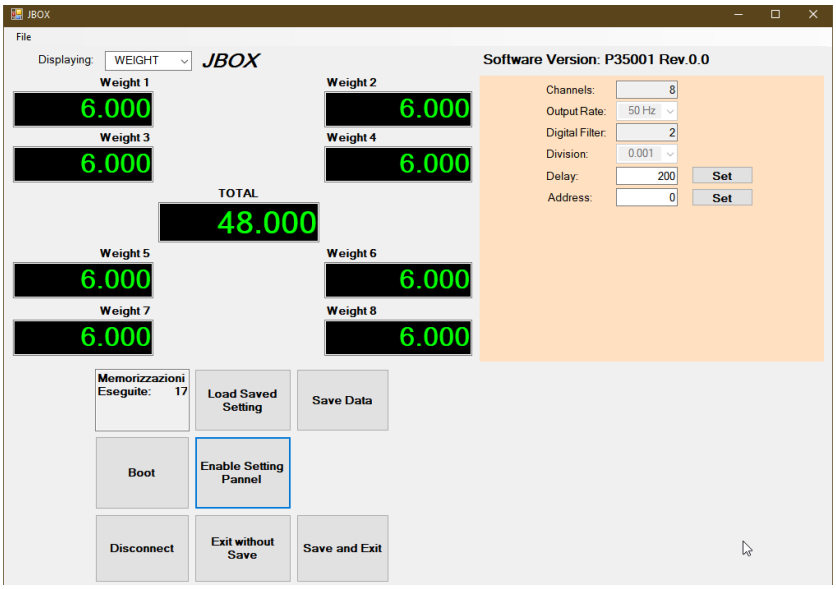
At this point, the message "Board Found" will appear, indicating also the program installed on the device.

Finally, press START to start the configuration of the EL5.

It is also possible to reset all the configuration parameters of the EL5 by pressing the RESET button (before the reset, a confirmation message will be displayed).

To end the application, press EXIT or the X located on the top right part of the window.

DEVICE CONFIGURATION (continued)



After starting the configuration, the above screen will appear, through which it is possible to set the weighing and communication parameters and to calibrate the connected cells.

The top left part displays the weight/dots/signal value (selectable with the relevant pull down menu) measured on each single cell; it also displays the totalizing in kg/dots of all the connected cells.

With the buttons located on the bottom left part, it is possible to carry out various operations, like saving the configuration data file of the EL5, enabling the change of such parameters and calibrating the load cells, or booting the device.
After pressing the button “Enable Setting Pannel”, it will be possible to set the parameters indicated in the top right part:

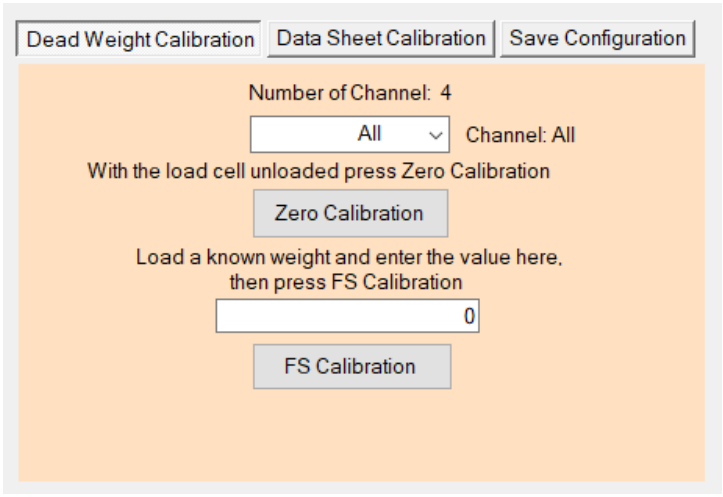
- **Channels**: number of channels currently enabled, value ranging from 1 to 8;
- **Output Rate (Hz)**: frequency of weight acquisition currently set, value selectable between 50 Hz,100 Hz, 200 Hz, 400Hz and 800Hz . (reference value for 4 load cells)
- **Digital Filter**: digital filter currently set, value ranging from 0 to 9;
- **Display Division**: number of divisions currently set, minimum 0.0001 and maximum 50;
- **Address** (1-255): address of the device for the active/available protocols

N.B.

The parameters in red can be set only after enabling the “SettingPanel”, by pressing the button “Enable Setting Panel”

DEAD WEIGHT CALIBRATION

In this first window it is possible to calibrate the cells with the dead weight.



With the corresponding pull-down menu it is possible to select whether the calibration is to be carried out only on a specific cell or at the same time on all the cells.

For zero calibration, make sure that the cells are unloaded and subsequently press **ZERO CALIBRATION**.

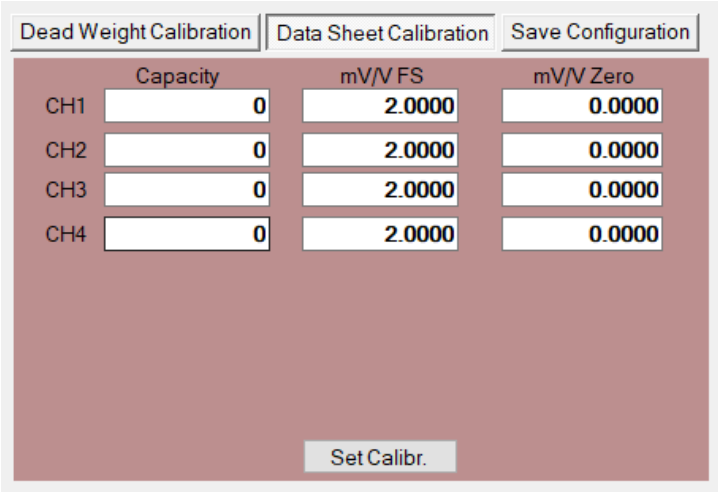
For full scale calibration, load a known weight on the cells and enter this weight value (in kg) in the text box F.S.: by pressing **FS CALIBRATION** the channels will be calibrated.

LOAD SETTING FOR EACH CELL

With the second window it is possible to set the maximum load and the maximum signal value for each connected cell; this data is used by the device to calibrate each enabled channel.

It is possible to also specify a signal value related to the Zero.

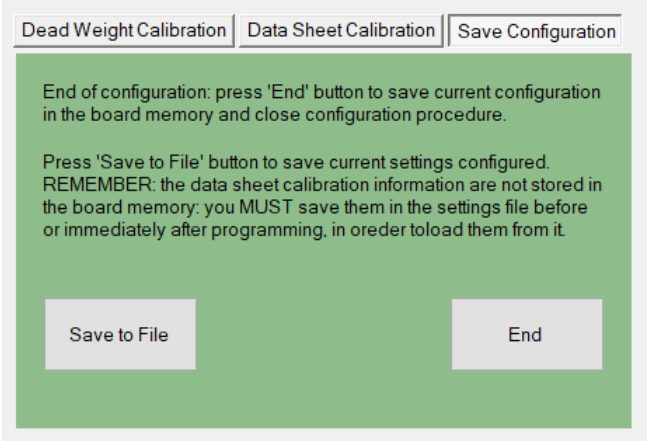
After entering all the parameters, press Set Calibr. to carry out the calibration.



LOAD SETTING FOR EACH CELL SAVE CONFIGURATION

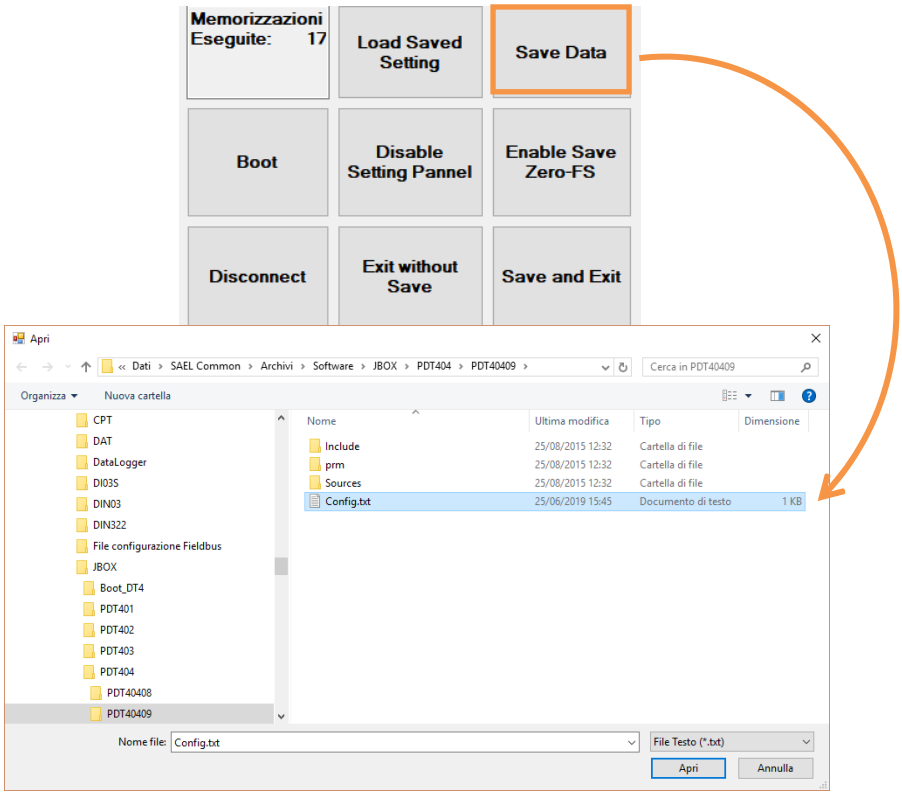
In this last submenu it is possible to save the configuration parameters of the device;by pressing END, a command will be sent to save to the device.

By pressing SAVE TO FILE, it is possible to save these parameters to a text file, so that the same configuration can be applied to different devices, without having to set each value every time.



After saving such configuration file and pressing LOAD SAVED SETTING, a resource exploration window will appear, in which it is possible to search the configuration file to be applied to the connected device; select the file and press APRI.

The parameters will be automatically read and sent to the board and at the end of the procedure, if carried put correctly, a notification will appear indicating that the operation was successful.
In case of errors or timeout, the procedure stops and an error message is displayed.



SLAVE PROTOCOL (RS232)

The unit connected to the device (typically a personal computer) act as a MASTER and it is the only unit that can start a communication procedure. The communication procedure must always include a string from the MASTER, followed by a response from the relevant SLAVE. The RS232/RS485 ports have a fixed rate at 38400 Baud.

DESCRIPTION OF THE COMMANDS FORMAT:

The inverted commas include constant characters (case sensitive); the symbols < e > include variable numerical fields. The field **<ck>** is the sum of data control of the string. It is calculated executing the exclusive OR (XOR) of all the characters from STX (or from <Ind>) to ETX excluding the latters; the result of the XOR is broken down into 2 characters considering separately the 4 upper bits (first character) and the 4 lower bits (second character); the 2 characters obtained are then ASCII coded; (example:XOR = 5Dh; <csum> = "5Dh" namely 35h and 44h).

List of available commands:

1- Boot

PC: STX "BOOT" EOT
EL5: STX ACK EOT (ok) or STX NAK EOT (error)

2- Temperature reading

PC: STX "T" EOT
EL5: STX T <ggg> ETX <ck> EOT where <ggg> is the temperature in degrees

WARNING:
The data programmed with the following configuration commands are not stored directly but they must be confirmed with the programmed data storage command, before switching off the board.

3- Channel number programming

PC: STX C <n> EOT where <n> indicates the number of channels to be used
EL5: STX ACK EOT (ok) or STX NAK EOT (error)

4- Output Rate programming

PC: STX R <n> EOT where <n> indicates the output rate value as per the following table
EL5: STX ACK EOT (ok) or STX NAK EOT (error)

<n>	Output rate
0	12.5 Hz
1	25 Hz
2	50 Hz
3	100 Hz
4	200 Hz

The output rate is related to the conversion rate of single load cell. Internally if for example there are 4 load cells, the conversion rate will be 4 times faster.

5- Digital filter programming

PC: STX F <n> EOT where <n> indicates the filter value to be used on the weight
EL5: STX ACK EOT (ok) or STX NAK EOT (error)

The following table displays the weight output frequency after the digital filter (dependent on the conversion frequency)

<n>	0	1	2	3	4	5	6	7	8	9
12.5Hz	6.25Hz	4Hz	2.5Hz	1.8Hz	1.4Hz	0.8Hz	0.6Hz	0.4Hz	0.35Hz	0.25Hz
25Hz	12.5Hz	8Hz	5Hz	3.6Hz	2.8Hz	1.6Hz	1.2Hz	0.8Hz	0.7Hz	0.5Hz
50Hz	25Hz	16Hz	10Hz	7.2Hz	5.6Hz	3.2Hz	2.4Hz	1.6Hz	1.4Hz	1Hz
100Hz	50Hz	32Hz	20Hz	14.4Hz	11.2Hz	6.4Hz	4.8Hz	3.3Hz	2.8Hz	2Hz
200Hz	100Hz	64Hz	40Hz	28.8Hz	22.4Hz	12.8Hz	9.6Hz	6.6Hz	5.6Hz	4Hz

6- Zero calibration

PC: STX "Z" <n> <nV/V> EOT where <n> indicates the cell number and <nV/V> is a 8 character field of the theorical value in nV/V (1.000.000 nanovolt = 1 volt) corresponding to zero. If this value is 0, the channel current signal is assumed (real zero calibration). **EL5**: STX ACK EOT (ok) or STX NAK EOT (error)

7 -Full scale calibration

PC: STX "S" <n> <nV/V> <Value>EOTwhere <n> indicates the cell number and <nV/V> a 8 character field of the theorical value in nV/V (1.000.000 nanovolt = 1 volt) corresponding to the programmed value. If this value is 0, the channel current signal is assumed (full scale calibration).
<value> = 8 characters field of the whole weight value corresponding to the specified signal. This value cannot be higher than the signal expressed in nV/V.
EL5: STX ACK EOT (ok) or STX NAK EOT (error)

8- Division value programming

PC: STX "D" <vd> EOT where <nn> indicates the index in the table of the division value to be used
EL5: STX ACK EOT (ok) or STX NAK EOT (error)

<vd>	"00"	"01"	"02"	"03"	"04"	"05"	"06"	"07"	"08"
Division	0.0001	0.0002	0.0005	0.001	0.002	0.005	0.01	0.02	0.05

<vd>	"09"	"10"	"11"	"12"	"13"	"14"	"15"	"16"	"17"
Division	0.1	0.2	0.5	1	2	5	10	20	50

9- Programmable data reading

PC: STX "L" EOT
EL5: STX "L" <n> <r> <f> <vd> <add> <b> <p> ETX <ck> EOT
Where:
<n>, <r>, <f> = 3 total characters for channel number, output rate and digital filter.
<vd> = 2 characters corresponding to a division value as per the shown coding.
<add> = 3 characters corresponding to the address of the serial port rs485
<b>, <p> = 2 total characters for baud rate and RS485 protocol.

10 - RS485 address programming

PC: STX "I" <a> EOT where <addr> is a character expressed in decimal (accepted addresses from 1 to 255). E.g. to set the address = 60, send the string STX I chr(60) EOT. The new address is taken only after sending the command "E" for the storage of programmed data.

EL5: STX ACK EOT (ok) or STX NAK EOT (error)

11 – Default calibration restoration

PC: STX "X" <n> EOT where <n> indicates the number of the channel to be restored. With this operation the default calibration is restored: 0 = 0mV/V, 2.000.000 = 2mV/V.

EL5: STX ACK EOT (ok) or STX NAK EOT (error)

12- Programmed data storage

PC: STX "E" EOT

With this operation, the programmed data is definitively stored in a permanent safety memory, although with a limited number of programmings (>= 10.000).

EL5: STX ACK EOT (ok) or STX NAK EOT (error)

13 – Channel values reading

PC: STX "N" EOT

EL5: STX "N" <values> <Status>< CellError > ETX <ck> EOT

Where <values> is a string of characters with the values, calibrated and filtered, of the active channels (from 1st to nth). Each field includes 8 characters justified to the right. These values are filtered based on the programmed digital filter.

< Status > = weight status < CellError > = Error in Cells

14 – Channel ADC reading

PC: STX "P" EOT

EL5: STX "P" <punti> ETX <ck> EOT

Where <dots> is a string of characters with the values of ADC dots of the active channels (from 1st to nth). Each field includes 8 characters justified to the right. These values are not filtered. The values of the dots ranges from 0 (equivalent to approx. –5.2mV/V) a 16777215 (equivalent to approx.+5.2mV/V).

15 – Channel mV/V signals reading

PC: STX "M" EOT

EL5: STX "M" < mV/V > ETX <ck> EOT

Where <mV/V> is a string of characters with the signal values in mV/V of the active channels (from 1st to nth). Each field includes 8 characters justified to the right. The values are expressed in mV/V with 4 decimals (from approx. –5.2000mV/V to approx. 5.2000mV/V).

16 – Firmware version reading

PC: STX "V" EOT

EL5: STX "V" <version> ETX <ck> EOT

Where <version> is a 16 character string with the code and the version of the firmware installed in the board.

17 – MEMORY RESET COMMAND

PC: STX "RESET" EOT

EL5: STX ACK EOT (ok) or STX NAK EOT (error)

The device executes the memory reset restoring all data to factory settings.

18 – IP ADDRESS AND SUBNET MASK READING

PC: STX "t" EOT

EL5: STX "t" <addr IP> <sub mask> ETX <ck> EOT

<addr IP> is a 4 character string with the values of the IP address (for example IP address = 192.168.0.100, the field includes the following hexadecimal values: 0xC0, 0xA8, 0x00, 0x64).

<sub mask> is a 4 character string with the values of the subnet mask (for example subnet mask = 255.255.255.0, the field includes the following hexadecimal values: 0xFF, 0xFF, 0xFF, 0x00).

19 - IP ADDRESS AND SUBNET MASK PROGRAMMING

PC: STX "t" <addr IP> <sub mask> ETX <ck> EOT

Where <addr IP> and <sub mask> are like the reading command (see command "t" above).

EL5: STX ACK EOT (ok) or STX NAK EOT (error)

20 – STORAGE NUMBERS READING COMMAND

PC: STX "J" EOT

EL5: STX "J" <counter> ETX <ck> EOT

Where <counter> is a 8 character string containing the number of writing of the device's memory.

MODBUS COMMUNICATION PROTOCOL

The devices parameters that can be read or programmed through the communication interfaces available on the device, based on the hardware configuration, are listed in the following table.
The R type registers are the readable ones, while the W type ones are the writable ones.
If the ETHERNET option is present, it is possible to use the protocol "MODBUS TCP" with the same registers, the ETHERNET settings (iP, subnet, Gateway and protocol) are made through the program PC "PWIN33".

REGISTERS FOR MODBUS RTU PROTOCOL UP TO 4 CHANNELS

MODBUS address	Holding Register	R/W	Notes
0001	Status Register	R	See corresponding table.
0002	Total weight (MSW)	R	INT. value - Most significant Word
0003	Total weight (LSW)	R	INT. value - Least significant Word
0004	Weight of channel 1	R	INT. value - Divisions
0005	Weight of channel 2	R	INT. value - Divisions
0006	Weight of channel 3	R	INT. value - Divisions
0007	Weight of channel 4	R	INT. value - Divisions
0008	Filter	R/W	Value 0 to 9
0009	Average sensitivity	R/W	Cell sensitivity average value max. 40000 uV/V
0010	Cell Capacity (MSW)	R/W	INT. value - Most significant Word
0011	Cell capacity (LSW)	R/W	INT. value - Least significant Word
0012	Channel number	R/W	Value 1 to 8
0013	Division val. reference	R/W	See corresponding table.
0014	Cell situation	R	See corresponding table.
0015	Profibus Address	R/W	Value 1 to 255
0016	Release Firmware	R	Application version
0017	Baud Rate Canbus	R/W	Value 0 to 7
0030	Data Register (MSW)	W	INT. value - Most significant Word
0031	Data Register (LSW)	W	INT. value - Least significant Word
0032	Command Register	W	See corresponding table.

<status register> : character coded as per the following table (bit = 1 in case of true condition).

Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Flag Memory	0	0	0	Weight error	OverLoad	Underload	Emulated cell	Zero band	Stable weight

0x0001 = Stable weight = the weight is in a stable condition
0x0002 = Zero band = the weight is within the zero band
0x0004 = Emulated cell = One cell is faulty and emulation is being used to allow a correct functioning
0x0008 = Underload = Cell in negative value
0x0010 = Overload = Cell in overload beyond its capacity
0x0020 = Weight error = Error in the acquisition of the weight value
0x0100 = Flag Memory = if 1 some parameters have not been stored (used only in ASCII transmission)

Cell situation	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Meaning
0000	0	0	0	0	0	0	0	0	No error
0001	0	0	0	0	0	0	0	**1**	Fault Cell 1
0002	0	0	0	0	0	0	**1**	0	Fault Cell 2
0004	0	0	0	0	0	**1**	0	0	Fault Cell 3
0008	0	0	0	0	**1**	0	0	0	Fault Cell 4
0010	0	0	0	**1**	0	0	0	0	Fault Cell 5
0020	0	0	**1**	0	0	0	0	0	Fault Cell 6
0040	0	**1**	0	0	0	0	0	0	Fault Cell 7
0080	**1**	0	0	0	0	0	0	0	Fault Cell 8
	Bit15	**Bit14**	**Bit13**	**Bit12**	**Bit11**	**Bit10**	**Bit9**	**Bit8**	
0100	0	0	0	0	0	0	0	1	ADC1 Timeout
0200	0	0	0	0	0	0	1	0	ADC1 No Reference
0400	0	0	0	0	0	1	0	0	ADC2 Timeout
0800	0	0	0	0	1	0	0	0	ADC2 No Reference

REGISTERS FOR MODBUS RTU PROTOCOLS 5 TO 8 CHANNELS

MODBUS address	Holding Register	R/W	Notes
0001	Status Register	R	See corresponding table.
0002	Total weight (MSW)	R	INT. value - Most significant Word
0003	Total weight (LSW)	R	INT. value - Least significant Word
0004	Weight of channel 1	R	INT. value - Divisions
0005	Weight of channel 2	R	INT. value - Divisions
0006	Weight of channel 3	R	INT. value - Divisions
0007	Weight of channel 4	R	INT. value - Divisions
0008	Weight of channel 5	R	INT. value - Divisions
0009	Weight of channel 6	R	INT. value - Divisions
0010	Weight of channel 7	R	INT. value - Divisions
0011	Weight of channel 8	R	INT. value - Divisions
0012	Filter	R/W	Value 0 to 9
0013	Average sensitivity	R/W	Cell sensitivity average value max. 40000 uV/V
0014	Cell capacity (MSW)	R/W	INT. value - Most significant Word
0015	Cell capacity (LSW)	R/W	INT. value - Least significant Word
0016	Channel number	R/W	Value 1 to 8
0017	Division val. reference	R/W	See corresponding table.
0018	Cell situation	R	See corresponding table.
0019	Profibus Address	R/W	Value 1 to 255
0020	Release Firmware	R	Application version
0021	Baud Rate Canbus	R/W	Value 0 to 7
0030	Data Register (MSW)	W	INT. value - Most significant Word
0031	Data Register (LSW)	W	INT. value - Least significant Word
0032	Command Register	W	See corresponding table.

Command Register (0032)	Description
1	Zero calibration
2	FS calibration (after writing the dead weight in the Data Register (addresses 0030 and 0031)
3	Cell emulation

The cell emulation is needed if a platform is used and one of the cells is faulty. By sending this command, the faulty cell is disconnected and replaced with an emulation (average of the other cells).
This allows to keep working until the faulty cell is replaced.

FIELDBUS COMMUNICATION PROTOCOLS

The following table lists the registers in the input area (produced by the device and read by the master), common to all fieldbuses PROFINET, ETHERCAT, ETHERNET/IP and PROFIBUS. The size of registers is 16 bit. The input area is updated with a maximum frequency of 125 Hz (80 Hz in case of PROFIBUS fieldbus). The size of the input area configured in the master fieldbus must match the size configured in the device.

Register address	INPUT AREA REGISTER 4 CHANNELS	Status Register	
0 - 1	Status Register	1.0	Weight stability
2 - 3	Total weight (MSW)	1.1	Empty scale
4 - 5	Total weight (LSW)	1.2	Emulated cell
6 - 7	Weight of channel 1	1.3	Underload
8 - 9	Weight of channel 2	1.4	Overload
10 - 11	Weight of channel 3	1.5	OffRange
12 - 13	Weight of channel 4	1.6	
14 - 15	Filter	1.7	
16 - 17	Average sensitivity		
18 - 19	Cell capacity (MSW)		
20 - 21	Cell capacity (LSW)		
22 - 23	Channel number		
24 - 25	Division val. reference		
26 - 27	Cell situation (see table)		
28 - 29	Profibus Address		
30 - 31	Baud Rate RS485		
32 - 33	Release Firmware		

Register address	INPUT AREA REGISTER 8 CHANNELS	Status Register	
0 - 1	Status Register	1.0	Weight stability
2 - 3	Total weight (MSW)	1.1	Empty scale
4 - 5	Total weight (LSW)	1.2	Emulated cell
6 - 7	Weight of channel 1	1.3	Underload
8 - 9	Weight of channel 2	1.4	Overload
10 - 11	Weight of channel 3	1.5	OffRange
12 - 13	Weight of channel 4	1.6	
14 - 15	Weight of channel 5	1.7	
16 - 17	Weight of channel 6		
18 - 19	Weight of channel 7		
20 - 21	Weight of channel 8		
22 - 23	Filter		
24 - 25	Average sensitivity		
26 - 27	Cell capacity (MSW)		
28 - 29	Cell capacity (LSW)		
30 - 31	Channel number		
32 - 33	Division val. reference		
34 - 35	Cell situation (see table)		
36 - 37	Profibus Address		
38 - 39	Baud Rate RS485		
40 - 41	Release Firmware		

FIELDBUS COMMUNICATION PROTOCOLS (continued)

The following table lists the registers in the output area (written by the master and acquired by the device), common to all the fieldbuses PROFINET, ETHERCAT, ETHERNET/IP and PROFIBUS. The size of registers is 16 bit. The registers written by the master in the output area are read by the device frequency of 12.5 Hz (8.0Hz in case of PROFIBUS fieldbus). The size of the output area configured in the master fieldbus must match the size configured in the device.

Register address	OUTPUT AREA REGISTER	Command Register	
0 - 1	Command Register	1	Zero calibration
2 - 3	Data Register (MSB)	2	Full scale calibration
4 - 5	Data Register (LSB)	3	Cell emulation
6 - 7	Digital filter	4	Digital filter writing
8 - 9	Average cell sensitivity	5	Average cell sensitivity writing
10 - 11	Cell capacity (MSB)	6	Cell capacity writing
12 - 13	Cell capacity (LSB)	7	Cell number writing
14 - 15	Cell number	8	Division value writing
16 - 17	Division value (index)	9	Fieldbus address writing
18 - 19	Fieldbus address	10	Fieldbus Baud Rate writing
20 - 21	Baud Rate Fieldbus		

CANOPEN COMMUNICATION PROTOCOL

The CANopen protocol is implemented by means of the optional board S230 acting as a serial-CANopen communication interface for the EL5.

This interface allows to set various parameters in the device and to read the process values through the CANopen protocol. The firmware implemented in the S230 board is P23002.
The following pages describe the function of the device's registers managed by the protocol and included in the Object Dictionary described further on.
It is important to consider that some parameters differ from the ones described above compared to the modbus protocol.

EDS FILE

The configuration EDS file to be used is: **PCAN0201.EDS**

WARNINGS ON CANOPEN PROTOCOL

When the RESET command is sent to the device, wait at least 1,5 seconds before sending other commands to the slave.

Canbus BaudRate

Val.	Canopen Baudrate
0	LSS
1	20 K
2	50 K
3	125 K
4	250 K
5	500 K
6	800 K
7	1 M
8	AUTO

CONSTANT WEIGHING DATA (THEORICAL CALIBRATION)

<table>
<tr><td>UD_CAPAC</td><td>WEIGHING SYSTEM LOAD

Set the value corresponding to the sum of the rated loads of the load cells. This datum is the full scale value of the weighing system. After changing the maximum load value the weight theorical calibration is carried out. Refer to the register in the Object Dictionary (OD) called UD_CAPAC</td></tr>
<tr><td>UD_SENS</td><td>LOAD CELLS SENSITIVITY

Set the value corresponding to the average of the sensitivities to the rated load of the load cells, in mV/V. Acceptable values range from 0.5 and 4mV/V. If no value is programmed 2mV/V is assumed.
After changing the sensitivity value the weight theorical calibration is carried out.
Refer to the register in the OD called UD_SENS</td></tr>
<tr><td>UD_DIV</td><td>DIVISION VALUE

The division value is expressed in units of measure, selectable from 0.0001 to 50.
Refer to the register in the OD called UD_DIV
<table>
<tr><td>Register value</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td>Division value</td><td>0.0001</td><td>0.0002</td><td>0.0005</td><td>0.001</td><td>0.002</td><td>0.005</td><td>0.01</td><td>0.02</td><td>0.05</td></tr>
<tr><td>Register value</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr>
<tr><td>Division value</td><td>0.1</td><td>0.2</td><td>0.5</td><td>1</td><td>2</td><td>5</td><td>10</td><td>20</td><td>50</td></tr>
</table></td></tr>
<tr><td>AI_DEC_DGT_PV</td><td>DECIMAL VALUES

It represents the number of displayed decimal figures.
After changing the system’s load value, a division value and a number of decimal figures are automatically selected at the best of 10000 divisions. The value transmitted by the register AI_INPUT_PV will be an integer, where the last figures are the desired decimals. It is up to the user to divide the received value based on the required decimals, in order to obtain the correct weight.
Refer to the register in the OD called AI_DEC_DGT_PV</td></tr>
</table>

WEIGHT ACTUAL CALIBRATION

UD_ZERO_CAL (*)	**ZERO CALIBRATION** Carry out this operation when the cell is not loaded. The displayed weight must go to zero. It is possible to repeat this operation various times. The calibration is done writing 6F72657Ah ('o','r','e','z') in the relevant sub-register of UD_ZERO_CAL. **Refer to the register in the OD called UD_ZERO_CAL**
UD_W_CAL (*)	**DEAD WEIGHT CALIBRATION** Before carrying out the operation, load the cell with a dead weight. If the set value is higher than the resolution offered by the device, the value is not accepted and the calibration is not carried out. It is always possible to repeat the calibration operations. The calibration is executed by writing in the register UD_W_CAL 6E617073h ('n', 'a', 'p', 's') and in the register UD_SPAN_VAL the weight value. This value must be multiplied by a 10 power depending on the number of the set decimals (e.g.: if 3 decimals are set and I want to set a weight of value 2, I will have to write $2x10^3$=2000). **Refer to the register in the OD called UD_W_CAL**
UD_ZERO_S	**SEMI-AUTOMATIC ZERO** This function is used to correct small drifts of the zero in the scale. **Refer to the register in the OD called UD_ZERO_S**

(*) the calibration commands can be executed both on single cells and on the whole system (based on the sub-index of the indicated register). Refer to the registers indicated in the pages describing the CANOPEN protocol registers.

WARNING: the above-described operational functions are immediately effective once the corresponding register is accessed, but to store definitively the values of the new registers data must be saved (refer to the register **STORE_PAR** in the Object Dictionary).

FILTER

AI_FILT_CON	**WEIGHT FILTER** This parameter is used to adjust the action of the digital filter applied to the detected weight. The filter's values range from '0' top '9'. The greater the value, the greater the digital filter's action (0: minimum, 9:maximum). **Refer to the register in the OD called FILT**

CELL NUMBER

UD_N_CELLS	**SYSTEM CELL NUMBER** This parameter is used to indicate the number of cells connected to the system. **Refer to the register in the OD called UD_N_CELLS**

CONVERTER OUTPUT RATE

AI_ADC_RATE

CONVERTER OUTPUT RATE

This parameter is used to indicate the converter's output rate

Value to be entered in the register	Hz
0	50
1	100
2	200
3	400
4	800

Refer to the register in the OD called AI_ADC_RATE

WARNING: the above-described operational functions are immediately effective once the corresponding register is accessed, but to store definitively the values of the new registers data must be saved (refer to the register **STORE_PAR** in the Object Dictionary).

PROTOCOL CANOPEN

DESCRIPTION

The protocol implementation supports the “communication profile area” (CiA DS301) and the “Device profile area” (CiA DS404).

The Network management (NMT) manages the statuses of Pre-Operational, Operational, Stopped, Reset and Reset Communication with the relevant protocols.

The Heartbeat protocol is supported, set by default at 1 second; it can be disabled by programming to 0 the intervention time. (Index = 1017h).

The management of the Emergency message intervenes when the following events take place or stop:

- Sensor Fault (code = 5030h based on DS404), when the load cell sensor is not detectable due to absent or faulty connection or due to a failure in the device’s hardware.

- Input Overload (code = F001h based on DS404), when the signal of the load cell is outside the reading field of the device.

3 TPDOs are managed, with the following types of transmission:

- Synchronous acyclic (00h): the device’s measure is transmitted in response to the signal of SYNC only if the datum has been updated from the previous transmission.

- Synchronous cyclic (01h): the device’s measure is always transmitted in response to the signal of SYNCeven if it has not been updated.

- Asynchronous (FFh): it is the default functioning that envisages PDO transmission at a predetermined frequency programmable in the communication parameters (default = 10 Hz).

The TPDO1 is mapped by default to transmit the following values:

- Analog Input Process Value (index = 9130h—sub1), namely the current detected weight formatted as **Signed int 32 bit**. The weight is related to the global system (sum of each single cell).

- Analog Input Status (index = 6150h—sub1), namely the status register of the current measure as described in the object dictionary. **Unsigned int 8 bit**.

- Cell Identification Register (index = 2009h—sub1), namely the register that indicates the number of the cell where a fault occurred . **Unsigned int 8 bit.**

PROTOCOL CANOPEN (continued)

DESCRIPTION

The TPDO2 is mapped by default to transmit the following values:

- Analog Input Process Value (index = 9130h—sub2), namely the current detected weight, expressed in the process unit of measure (kg), formatted as **Signed int 32 bit**. The weight is related cell 1.

- Analog Input Process Value (index = 9130h—sub3), namely the current detected weight, expressed in the process unit of measure (kg), formatted as **Signed int 32 bit**. The weight is related cell 2.

The TPDO3 is mapped by default to transmit the following values:

- Analog Input Process Value (index = 9130h—sub4), namely the current detected weight formatted as **Signed int 32 bit**. The weight is related cell 3.

- Analog Input Process Value (index = 9130h—sub5), namely the current detected weight formatted as **Signed int 32 bit**. The weight is related cell 4.

CANopen SPECIFICATIONS

NMT	NMT slave
Error control	Heartbeat producer
Boot-up	Yes
Node ID range	1 - 127
Node ID assignment	User interface settings
CANopen bit-rates	10 – 500 kbit/sec
Type of bit-rate adjustment	User interface settings
No. of PDO	3 TPDO
PDO modes	Event-triggered (Triggered by event-timer) Synchronous (cyclic) Synchronous (acyclic)
PDO mapping	Yes (3 obj/PDO for PDO1, 2 obj/PDO for PDO2, PDO3)
Emergency message	Yes (Producer)
No. of SDO	1 Server SDO (Expedited and Segmented transfer) No Client SDO
Sync	Sync producer:no Sync counter: no
Time stamp	No
Additional functions	None
Supported application layer	CiA 301 V 4.0.2
Supported frameworks	None
Supported profiles	CiA DS-404
Certified	No

OBJECT DICTIONARY

Communication Profile Area

Generic parameters

Index	Sub-Index	Name	Description	Type	Attribute
1000h	0	DEV_TYPE	Device Type information (*)	U32	ro
1001h	0	ERR_REG	Error Register	U8	ro
1005h	0	COB_ID SYNC	COB_ID Sync message (=80h)	U32	rw
1009h	0	HW_VER	Manufacturer Hardware Version	Visible String	ro
100Ah	0	HW_VER	Manufacturer Hardware Version	Visible String	ro
1010h	0	STORE_PAR	Largest sub-index supported (1-7Fh)	U8	ro
	1		Save All Parameters (**)	U32	rw
	2		Save Communication Pars (**)	U32	rw
	3		Save Application Pars (**)	U32	rw
1014h	0	COB_ID EMCY	COB_ID Emergency msg (=80+Node_ID)	U32	ro
1017h	0	HBT_TIME	Heartbeat Time	U16	rw
1018h	0	OBJ_ID	Number of sub-index entries (=3)	U8	Const
	1		Vendor ID	U32	Const
	2		Product Code	U32	Const
	3		Revision Number	U32	Const

(*) The value is 00020194h compliant with DS-404.
(**) Signature: 65766173h ('a','v','e','s').

SDOs Server parameters

Index	Sub-Index	Name	Description	Type	Attribute
1200h	0	SDO_PAR	Number of SDO entries (=2)	U8	ro
	1		COB_ID Client->Server (rx) (= 600h + Node_ID)	U32	ro
	2		COB_ID Server->Client (tx) (= 580h + Node_ID)	U32	ro

T_PDOs Communication parameters

Index	Sub-Index	Name	Description	Type	Attribute
1800h	0	T_PDO_CPAR1	Largest sub-index supported (=5)	U8	ro
	1		COB_ID used by PDO (= 180h + Node_ID)	U32	ro
	2		PDO transmission type (*)	U8	ro (rw)
	3		Inhibit Time (=0)	U16	rw
	4		Reserved	U8	rw
	5		Event Timer (mS)	U16	rw

Index	Sub-Index	Name	Description	Type	Attribute
1801h	0	T_PDO_CPAR2	Largest sub-index supported (=5)	U8	ro
	1		COB_ID used by PDO (= 280h + Node_ID)	U32	ro
	2		PDO transmission type (*)	U8	ro (rw)
	3		Inhibit Time (=0)	U16	rw
	4		Reserved	U8	rw
	5		Event Timer (mS)	U16	rw

Index	Sub-Index	Name	Description	Type	Attribute
1802h	0	T_PDO_CPAR3	Largest sub-index supported (=5)	U8	ro
	1		COB_ID used by PDO (= 380h + Node_ID)	U32	ro
	2		PDO transmission type (*)	U8	ro (rw)
	3		Inhibit Time (=0)	U16	rw
	4		Reserved	U8	rw
	5		Event Timer (mS)	U16	rw

(*) Transmission type:

00h = synchronous acyclic (PDO is transmitted following the reception of SYNC, but only of a new measure has been acquired).

01h = synchronous cyclic (PDO is transmitted always following the reception of SYNC).

FFh = asynchronous (DEFAULT) (PDO is transmitted periodically based on a event timer)

Other transmission types as per Cia DS-301 are not supported.

T_PDOs Mapping parameters

Index	Sub-Index	Name	Description	Type	Attribute
1A00h	0	T_PDO_MPAR1	n. of mapped applic. Objects in PDO (=3)	U8	ro
	1		Applic.Obj.map 1 (*)	U32	ro
	2		Applic.Obj.map 2 (*)	U32	ro
	3		Applic.Obj.map 3 (*)	U32	ro

The structure of the entries from sub-index 1h – 40h is as follows:

Byte: MSB		LSB
index (16 bit)	sub-index (8 bit)	object length (8 bit)

(*) the following default values are defined:
- Sub-index 0 = 3h.
- Sub-index 1 = 9130 0120h (Index = 9130h, sub-index 01, 32 bit length). (TOTAL WEIGHT)
- Sub-index 2 = 6150 0108h (Index = 6150h, sub-index 01, 8 bit length). (Analog Input Status)
- Sub-index 3 = 2009 0108h (Index = 6150h, sub-index 01, 8 bit length). (Cell Identification Register)

Index	Sub-Index	Name	Description	Type	Attribute
1A01h	0	T_PDO_MPAR2	n. of mapped applic. Objects in PDO (=2)	U8	ro
	1		Applic.Obj.map 1 (*)	U32	ro
	2		Applic.Obj.map 2 (*)	U32	ro

(*) the following default values are defined:
- Sub-index 0 = 2h.
- Sub-index 1 = 9130 0220h (Index = 9130h, sub-index 02, 32 bit length). (WEIGHT OF CELL 1)
- Sub-index 2 = 9130 0320h (Index = 9130h, sub-index 03, 32 bit length). (WEIGHT OF CELL 2)

Index	Sub-Index	Name	Description	Type	Attribute
1A02h	0	T_PDO_MPAR3	n. of mapped applic. Objects in PDO (=2)	U8	ro
	1		Applic.Obj.map 1 (*)	U32	ro
	2		Applic.Obj.map 2 (*)	U32	ro

(*) the following default values are defined:
- Sub-index 0 = 2h.
- Sub-index 1 = 9130 0420h (Index = 9130h, sub-index 02, 32 bit length). (WEIGHT OF CELL 3)
- Sub-index 2 = 9130 0520h (Index = 9130h, sub-index 03, 32 bit length). (WEIGHT OF CELL 4)

Manufacturer defined parameters

Index	Sub-Index	Name	Description	Type	Attribute
2001h	0	UD_CAPAC	Largest sub-index supported (1-7Fh)	U8	ro
	1		Load Cell Capacity	U32	rw
2002h	0	UD_SENS	Largest sub-index supported (1-7Fh)	U8	ro
	1		Load Cell Sensitivity	REAL32	rw
2003h	0	UD_DIV	Largest sub-index supported (1-7Fh)	U8	ro
	1		Weight Division Value	U8	rw
2004h	0	UD_W_CAL	Largest sub-index supported (1-7Fh)	U8	ro
	1		Weight calibration command (**all cells**) (**)	U32	rw
	2		Weight calibration command (**cell 1**) (**)	U32	rw
	...		...	U32	rw
	5		Weight calibration command (**cell 4**) (**)	U32	rw
2005h	0	UD_ZERO_CAL	Largest sub-index supported (1-7Fh)	U8	ro
	1		Zero calibration command (**all cells**) (*)	U32	rw
	2		Zero calibration command (**cell 1**) (*)	U32	rw
	...		...	U32	rw
	5		Zero calibration command (**cell 4**) (*)	U32	rw
2008h	0	UD_N_CELLS	Largest sub-index supported (1-7Fh)	U8	ro
			Number of Cells	U8	rw
2009h	0	UD_ID_CELL	Largest sub-index supported (1-7Fh)	U8	ro
			Cell Identification Register (***)	U8	ro
200Ah	0	UD_SPAN_VAL	Largest sub-index supported (1-7Fh)	U8	ro
			Value of Sample Weight (**)	U32	rw
200Bh	0	UD_ZERO_S	Largest sub-index supported (1-7Fh)	U8	ro
	1		Zero calibration command (**all cells**) (*)	U32	rw

(*) Signature: 6F72657Ah ('o','r','e','z').

(**) For the weight calibration: enter the value of the dead weight loaded on the cell in the register 200Ah and afterwards program the value 6E617073h ('n', 'a', 'p', 's') in the register 2004h

(***) This value identifies the cell in which a malfunctioning occurred. See the following table:

Cell Identification Register table (2009h—sub 1)

Register hexadecimal value	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Meaning
00	0	0	0	0	0	0	0	0	Regular functioning -no error -
01	0	0	0	0	0	0	0	1	Fault Cell 1
02	0	0	0	0	0	0	1	0	Fault Cell 2
04	0	0	0	0	0	1	0	0	Fault Cell 3
08	0	0	0	0	1	0	0	0	Fault Cell 4

Device specific parameters

Analog input function block

Index	Sub-Index	Name	Description	Type	Attribute
6114h	0	AI_ADC_RATE	Number of SDO entries (=1)	U8	ro
	1		Analog Input ADC Sample Rate	U32	rw
6132h	0	AI_DEC_DGT_PV	Number of SDO entries (=1)	U8	ro
	1		Analog Input Decimal digit of Process Value 1 (= 0 – 4)	U8	ro
6150h	0	AI_STATUS	Number of SDO entries (=1)	U8	ro
	1		Analog Input Status (*)	U8	ro
61A1h	0	AI_FILT_CON	Number of SDO entries (=1)	U8	ro
	1		Analog Input Filter Constant	U8	rw
9130h	0	AI_INPUT_PV	Number of SDO entries (= 4)	U8	ro
	1		Analog Input Process Value (total weight) (**)	S32	ro
	2		Analog Input Process Value (channel 1) (**)	S32	ro
	3		Analog Input Process Value (channel 2) (**)	S32	ro
	4		Analog Input Process Value (channel 3) (**)	S32	ro
	5		Analog Input Process Value (channel 4) (**)	S32	ro

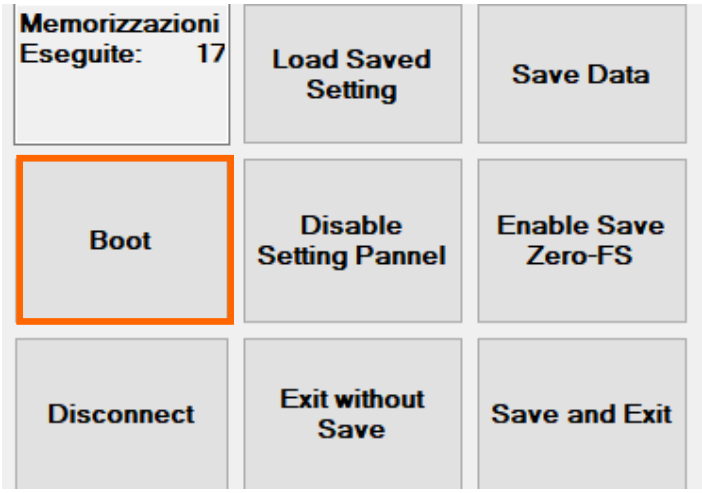
(*) Table for the coding of the Register "Analog Input Status" (6150h—sub 1) (Related to the total weight)

Bit	Description
0	Offrange
1	Overload
2	Underload
3	Memory flag (Registers modified not yet saved with register STORE_PAR)
4	Zero band (Total weight < 20 div)
5	Not used
6	Not used
7	Not used

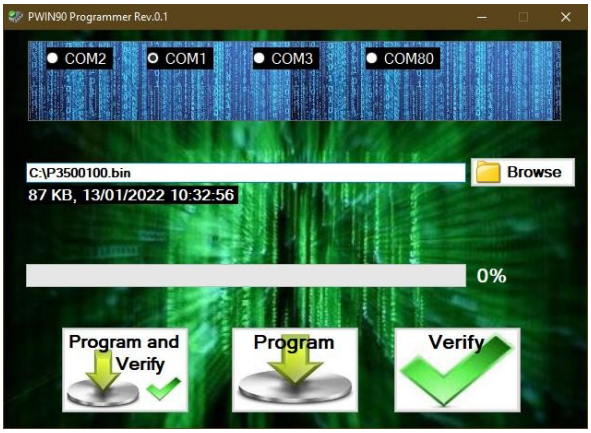
(**) The weight value is automatically multiplied by 10^n, where n is the number of the set decimals. For example with 3 decimals and a 1.001 kg weight, the register will contain the value 1001.

FIRMWARE UPDATE

To reprogram the device start the bootloader of the board, by pressing the “Boot” button from the PC app.



The board enters the BOOT mode, with the led on the board flashing quickly. The software PWIN90 “Programmer” will be started, and it will be possible to proceed with the programming.



Press “Browse” to choose the firmware to be programmed, then press “ Program and Verify”.

During the programming, the following progress statuses will be displayed:

ERASING □ PROGRAMMING □ VERIFYING □ OPERATION COMPLETED



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