TK1024S

DATA SHEET

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1 INTRODUCTION

The TK… device is a tracker for single-axis solar trackers. It has to be installed integral with the panel supports to control the east-west movement in order to maximize the panels' exposure to solar radiation during the day.

The device is plugged into an RS485 communication network of which it becomes a slave node. This means that it expects to receive commands from a master device (coordinator) that will have the task of managing the network of devices.

Each tracker is equipped with a motor driver that moves the axis, as well as an inclinometer that detects the inclination of the panels with respect to the horizontal plane. Moreover, the inclinometer receives the set point position from the network master and drives the motor to reach and maintain it, returning the operating status and any alarms to the master.

The tracker is equipped with a small keypad featuring three keys and two signalling LEDs. The MAN/AUTO key allows selection between manual or automatic operation.

1.1 Manual Operation

Manual operation is used in the event of plant maintenance to manually control the movement of the panels, and it is signalled by a fast flashing of the LED. The arrow keys control UP or DOWN movement, and pressing one of the keys starts the motor until it is released.

1.2 Automatic Operation

Automatic operation is performed during normal use of the plant, it is signalled by a slow flashing of the LED, and pressing the arrow keys has no effect. The tracker receives the set point position from the master and drives the motor to reach and maintain it.
The tracker is equipped with various safety mechanisms to prevent damage to the motor or structure, in particular :

- two limit switches (IN and OUT) that interrupt the movement if they are activated

- two software limit switches: the tracker does not accept set points beyond these limits

- encoder inputs : if activated, they can detect any failure to start the motor

- timeout at start : further control of actual motor start

- positioning timeout : signals an alarm if the motor does not reach the position within the preset time

- position error : signals an alarm if the set point position is not reached

Description of STATUS bits

The tracker returns a **STATUS** variable to the master that contains the current status of the device and the presence of any alarms (see paragraph 3.5 >> STATUS).

Description of the COMMAND bits

The tracker can also receive particular commands from the master in a COMMAND word (see paragraph 3.5 >> COMMAND).

Description of configuration variables

Various parameters can be set to configure the device and adapt it to different plant requirements (see paragraph 3.5).

2 HARDWARE CHARACTERISTICS

This chapter describes the hardware characteristics of TK1024S :

2.1 Electric Characteristics

ELECTRIC CHARACTERISTICS	
Power supply voltage	**24** Vdc +/- 10 %
Maximum Permitted Power Supply	**27** Vdc
Current Consumption	x
Microprocessor	ARM GD **F303**
Digital Inputs	**4** digital inputs
Analog Inputs	x
Digital Outputs	x
Analog Outputs	**2** outputs to manage an engine
Serial Lines	**1** Serial Line : RS 485 Supports the communication protocols : KERNEL / KNP and MODBUS RTU
Led	**2** leds on the keyboard
Addressing	**12** Dip-switches (of which only **8** for the addressing from 1 to 255)

2.2 Mechanics Characteristics

MECHANICS CHARACTERISTICS	
Temperature Range	From -10 ^C to +70^C
Humidity Range	From 10 % to 90 % (non-condensing)
Operating Atmosphere	Without corrosive gas
Noise Immunity	According to rules in force
Box Protection degree	IP66
Box Weight	n.d.
Keyboard	3 buttons (MAN/AUTO – UP Arrow – DOWN Arrow)
Display	No Display

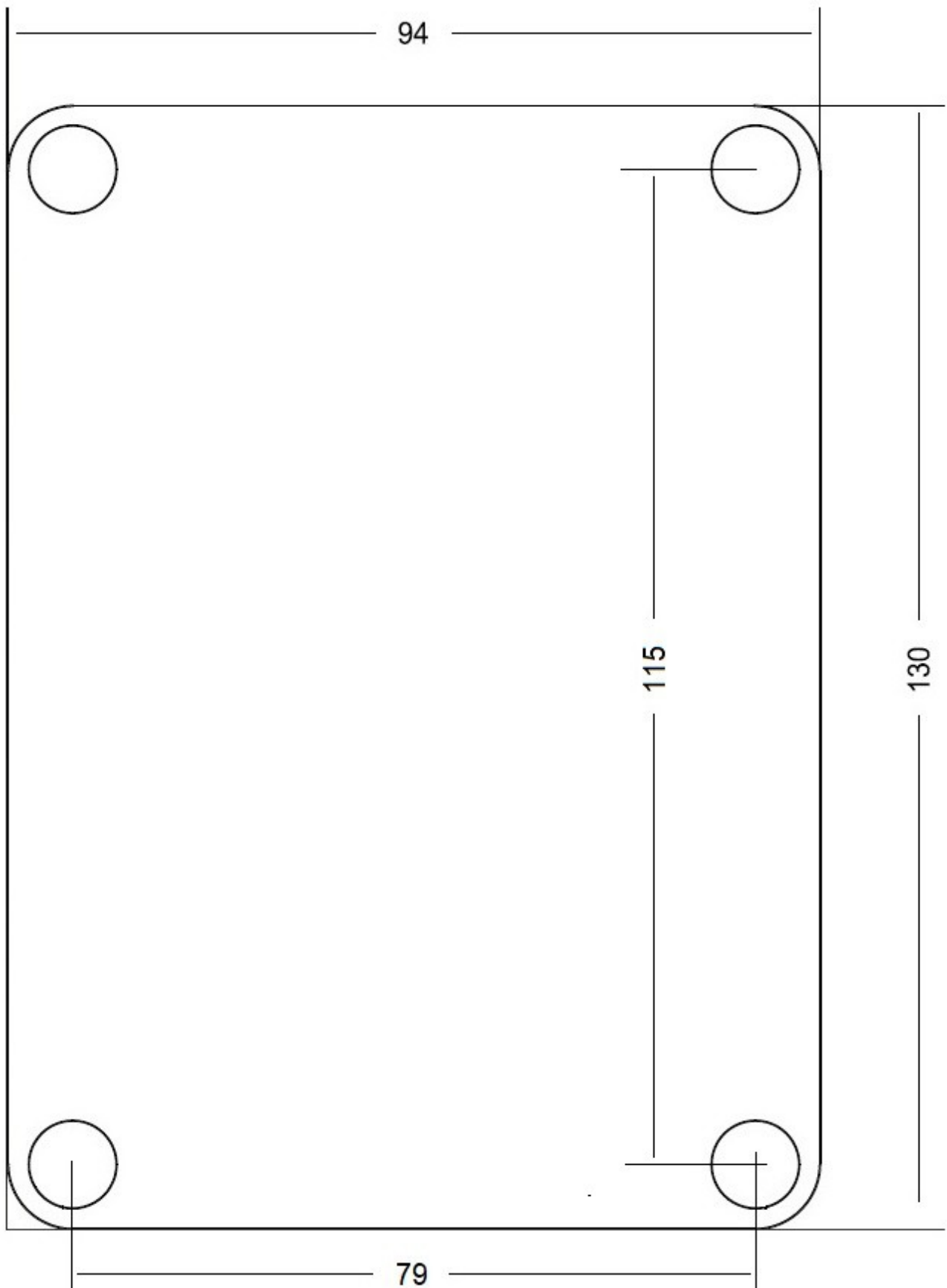### 2.3 I/O Connections
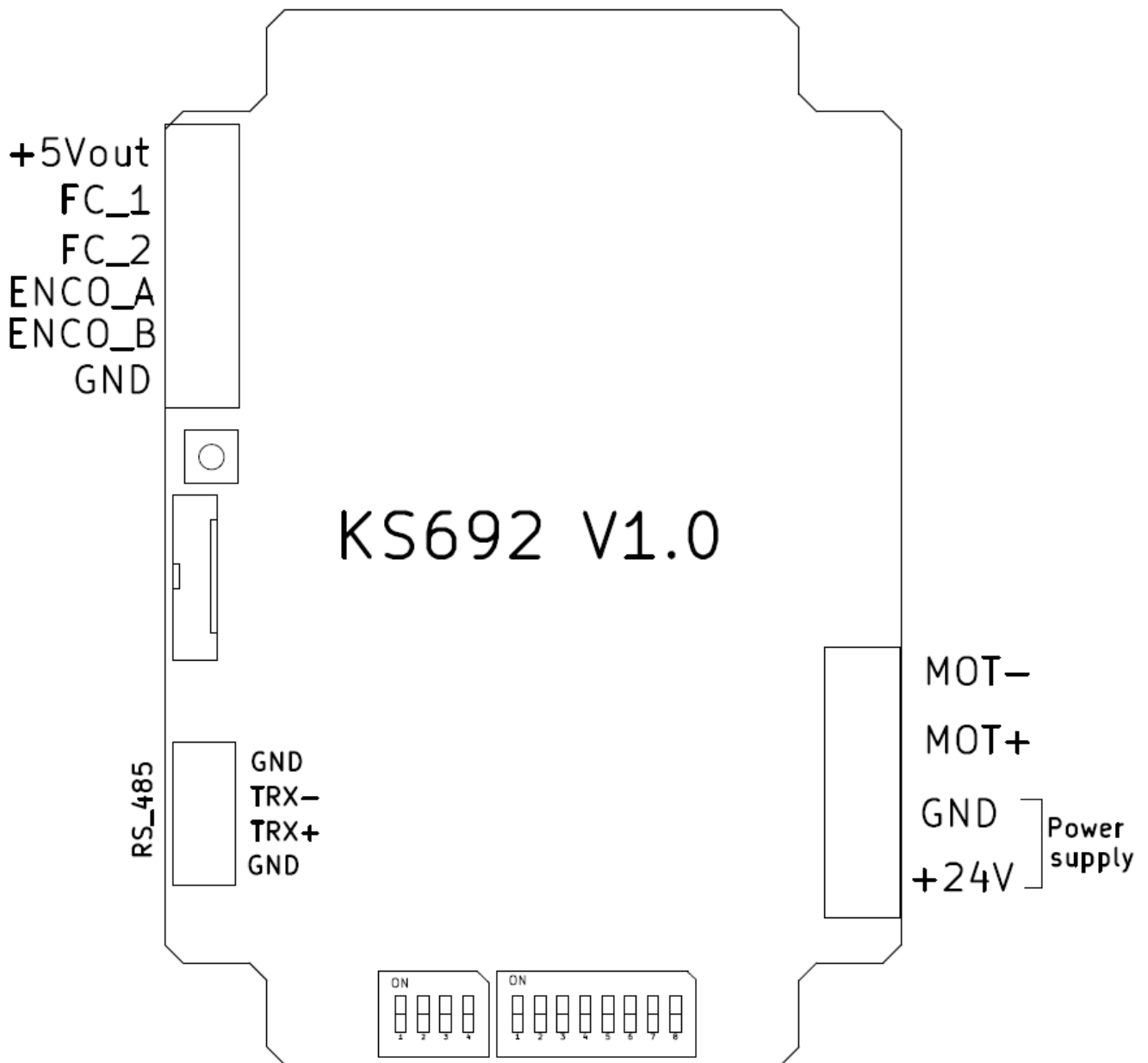
TK1024S

Where :

TK = tracker

10 = rated current 10 Amps

24 = 24 VDC nominal power supply

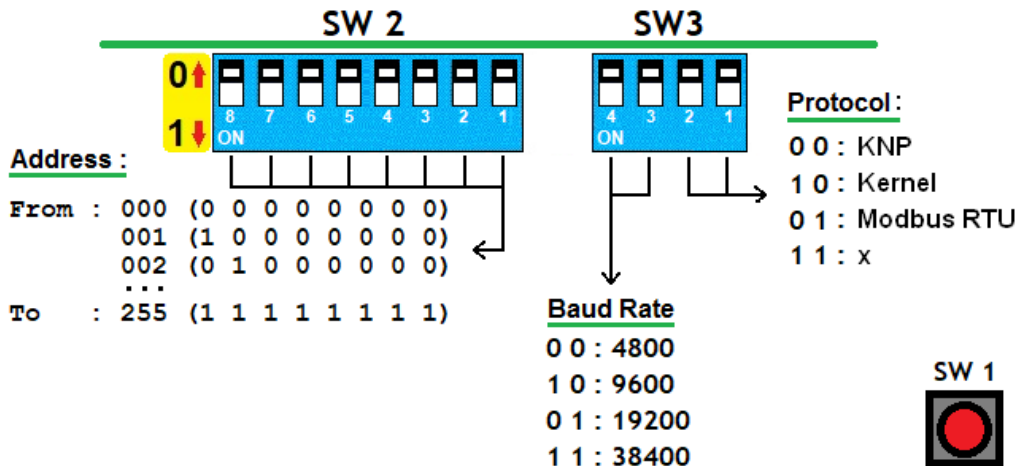S = Serial RS_485

2.4 Fixing Instructions
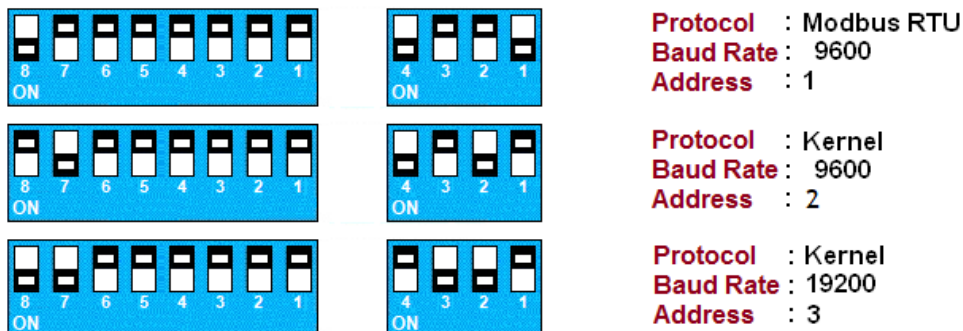
4 mm SCREWS NOT SUPPLIED

3 GENERAL NOTES

3.1 DIP-SWITCHES

You can configure for each TK1024S its own node address, baud rate and protocol, through the 8 suitable dip-switches (see hardware characteristics and the following figure).

Here are some examples that help to understand :

	Protocol	: Modbus RTU
	Baud Rate	9600
	Address	: 1

	Protocol	: Kernel
	Baud Rate	9600
	Address	: 2

	Protocol	: Kernel
	Baud Rate	19200
	Address	: 3

3.2 Communication

The serial communication occurs only via RS 485. It will be necessary to set the Protocol and Baud Rate (4800 / 9600 / 19200 / 38400, N, 8, 1) on the external device.

With the dip-switches 1 and 2 of SW3 you select the COMMUNICATION PROTOCOL and with the dip-switches 3 and 4 of SW3 you choose the BAUD RATE; according to the protocol set with the dip-switches, you need to select the corresponding protocol (within the PLC project) in the COM used between PLC and expansions. Also in this case it's necessary to open the PLC project to select the correct protocol :

```
DIP-SWITCH 1 and 2 of SW3         - PLC Protocol
---------------------------------------------------------------------------
00 = KNP                          - KNP
01 = KERNEL Protocol              - KERNEL
10 = MODBUS RTU Protocol          - RTU MASTER
11 = x                            - x
```

3.3 RS485 Communication cable

Everything about the RS485 connection, must meet certain features :

Maximum cable length
it must be no longer than 600 mt (it means the entire line length, and not the connection between two nodes)

Technical characteristics of the cable to use
It must be a three-wire cable 3 x 0.75 mm

How to do the RS485 connection
The RS485 connection must be a three wires connection (TX+, TX- and GND) with a shielded cable. The cable shield must be leaved float, it means that the shield must be not connected neither one side nor the other one.

**Shield not connected
Leaved float**
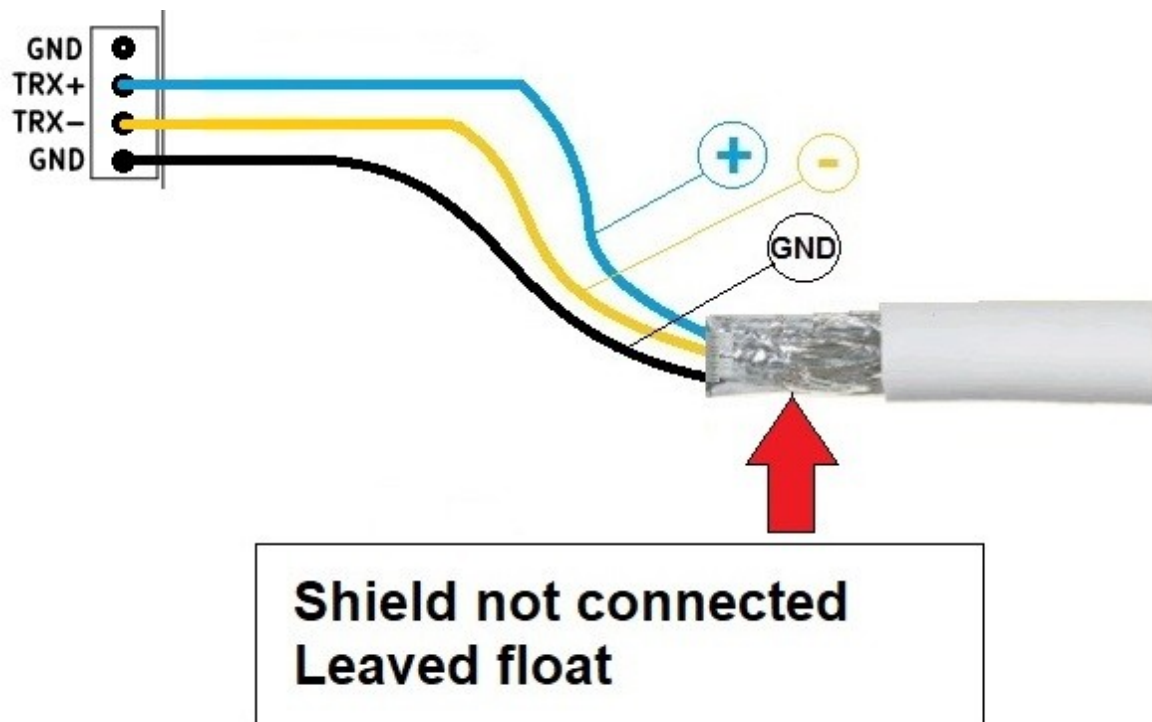
Notes

1. You can connect up to a maximum of 25-30 trackers for each RS 485 COM port of the PLC.

2. You may need to connect the 120 Ohm termination resistor.

3. The maximum communication distance is 600 meters (maximum distance means the complete distance of the network, not the distance between two nodes).

3.4 Photocells

If the motor has internal LIMIT SWITCHES, the 2 digital inputs are not used :

*   **FC_1**
*   **FC_2**

In this case, the inputs must be jumpered to GND.

3.5 Memory

By default, the operating mode set is : **AUTOMATIC**.
In this mode it is necessary to write the **SET POINT** in **DATA.08** and the motor will be piloted in order to set and maintain the inclination (by an Inclinometer) written in this register.
In **DATA.24** it is always possible to read the current position in degrees.
In **DATA.136** and **DATA.137** there are, respectively, the MINIMUM limit and the MAXIMUM limit beyond which the new set point is not accepted.

The **MANUAL** functioning mode, on the other hand, is activate by resetting **Bit 0 and Bit 1 of DATA.01 (COMMANDS)**.
In this mode, just activate **Bit 2 of DATA.01 (COMMANDS) to go UP** or **Bit 3 of DATA.01 (COMMANDS) to go DOWN**.

The TK1024S has some internal 16 bit memory locations (word) called "REGISTERS". Because each REGISTER is composed by 16 bits, its maximum value will be 65535.

MODBUS Register	Description

DATA.00	**STATUS – READ ONLY**
	`Bit 01 + Bit 00 : Operating Mode`
	`      0 –      0 = MANUAL`
	`      0 –      1 = AUTOMATIC`
	`      1 –      0 = REMOTE`
	`      1 –      1 = x`
	`Bit 02 : Indicates if it is going UP`
	`Bit 03 : Indicates if it is going DOWN`
	`Bit 04 : FTC IN`
	`Bit 05 : FTC OUT`
	`Bit 06 : Encoder A`
	`Bit 07 : Encoder B`
	`Bit 08 : Encoder signal missing ERROR`
	`Bit 09 : Engine not started ERROR`
	`Bit 10 : Movement timeout ERROR`
	`Bit 11 : Motor stopped out of position ERROR`
	`Bit 12 : V Batt OK`

DATA.01	**COMMANDS – WRITE ONLY**
	`Bit 00 + Bit 01 : Operating Mode`
	`Bit 02 : GO UP`
	`Bit 03 : GO DOWN`

DATA.08	**SET POINT** : Inclination value to be set in degrees, An engine is piloted in order to set and maintain the inclination (using an Inclinometer) written in this register.
DATA.24	Current position in degrees
DATA.136	MINIMUM limit beyond which the new set point is not accepted
DATA.137	MAXIMUM limit beyond which the new set point is not accepted
DATA.138	V_BAT_MIN : minimum battery voltage
DATA.139	TIM_ENCO : timout encoder [1/10] sec (0 = Disabled)
DATA.140	TIM_START : start timeout (0 = Disabled)
DATA.141	MOTOR TIMEOUT : positioning timeout (0 = Disabled)
DATA.142	POSITION DELTA : position error threshold (0 = Disabled)

MODBUS Register	Description
DATA.147	MIN_SPEED
DATA.148	MAX_SPEED
DATA.149	RAMP

3.6 Keyboard

The "**MAN / AUTO**" key sets the operating mode of the TK1024S tracker :

AUTO : (it is in AUTOMATIC at startup)
The LED above the key flashes slowly (1 sec. ON / 1 sec. OFF).
The DATA.08 is used as Set Point :

DATA.08	**SET POINT** : Inclination value to be set in degrees, An engine is piloted in order to set and maintain the inclination (using an Inclinometer) written in this register.

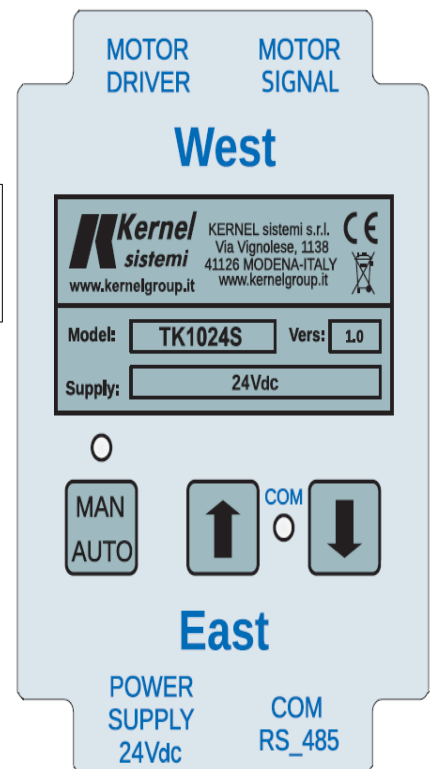**Pressing the button, switches to MANUAL mode :**
The LED above the key flashes quickly.
With the 2 arrow keys you can set the direction of movement
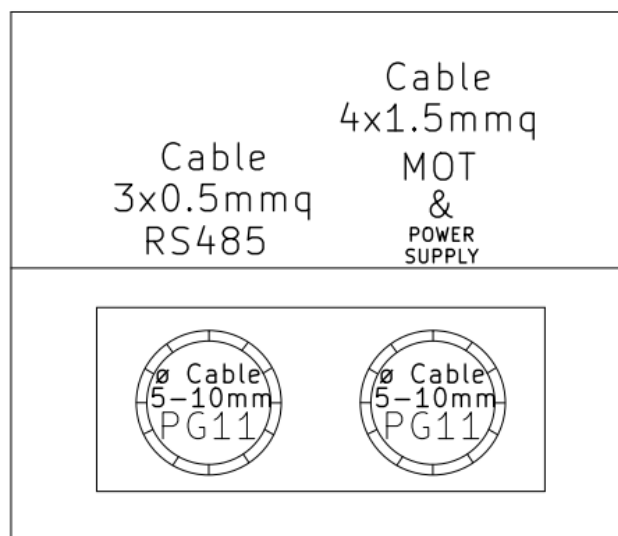(UP / DOWN)

COM LED :
If there is no serial communication, the COM LED flashes slowly.

If communication is active, the COM LED lights up with each packet received via serial port.

3.7 Cables

Recommended cables :

4 CONTACTS

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