TECHNICAL SPECIFICATIONS

Modular Single-Axis Solar Tracker

Mod. INS.M6.1A for 7.5kWp

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1. THE ED7H241A SOLAR TRACKER

The "ED7H241A" solar tracker is the most cost-effective solution with the best price/performance ratio available on the market for large ground-based systems with solar panels. It is also a highly convenient solution to maximize energy production on flat terrace systems.

The product is based on modules moving on a single NORTH-SOUTH axis. The solar tracker automatically follows the sun's East/West movement during the day by means of its central control unit, monitoring and correcting any shading which might occur on a string of panels to the detriment of those adjacent to it. This feature results in a reduction in space between the strings and leads to a significant decrease in ground space use.

The absence of a tilting - or seasonal – movement is less important in terms of energy output. It noticeably simplifies its mechanical frame and makes the system more intrinsically reliable.

The same type of system is employed abroad, especially in larger systems starting from 1 Mega and up.

Its strong points are:

- ✓ A reduced number of moving parts as a result of its single axis movement.
- ✓ A reduction in space compared to double-axis solar trackers and fixed systems.
- ✓ A reduction in costs to install and run the system compared to double-axis solar trackers.
- ✓ 20% increase in energy produced at equal installation power compared to the best fixed solar power systems.
- ✓ Automatic controls for reciprocal shading.
- ✓ Designed in ordinary hot-rolled galvanized steel, strong and weather resistant.
- ✓ System expandability.
- ✓ Tracker modularity: based on the amount space available on the ground, either a standard, approximately 7.5 kWp, configuration solar tracker Mod. INS.M6.1A can be installed (6 modules, approximately 5.5 m long with two 900/1000 series of photovoltaic cells in series equal to approximately 40 180Wp panels) or a 3.7 kWp reduced tracker (3 modules) Mod. INS.M3.1A.
- ✓ Remote central control unit for all function parameters. Energy production, fault alarms, electrical and meteorological measurements, historical report with:
  - o Continuous controls on system performance with constant, real time, monitoring for expected electricity production values.
  - o Inlets/outlets to establish remote connections with fixed or wireless telephone lines.
  - o A specific movement algorithm to maximise surface exposed to the sun even in the hours following dawn and before sunset.
  - o A system to protect it from exceptional meteorological events: the central control unit can measure wind intensity using the meteorological control panel; if it is particularly strong, for example in case of a tornado, it can decide whether it should favour the integrity of the system over energy production and can command it to position itself in order to minimize the amount of surface exposed to the wind. When the wind falls below a predetermined threshold, the system goes back to working as normal. This type of function is all the more important given that the system is fully operational for at least 35 years.
  - o Positioning to favour self-cleaning during rainy periods, using positioning for optimum results. The same holds true in case of snow, where positioning can be used to help snow slide off the panels. Options: the central control unit controls a specific irrigation system which - in case of a prolonged drought - simulates rain and replaces its cleansing effect. Error-free sun position calculations: solar tracker energy outputs are directly dependent on the position of the sun. The sun's position is unequivocally identified and calculated based on data stored in the control system: date, time, longitude, latitude and altitude of the site. The clock is reset remotely on a periodical basis.
  - o Exact calculations on the position of the sun using a temporal algorithm instead of sensors to avoid local variations in solar radiation due to, for example, heterogeneous or rapidly changing cloud formations, or to dust deposited in a non-uniform manner on the sensors.

- The clock is automatically reset to synchronise the Slave cards. Periodic synchronization can be carried out by radio, phone or data connection (internet connection) based on the central control unit's remote connection.
- Local diagnosis: with the aid of an operator in the central control unit, the controller is equipped with a terminal from which the same information can be accessed remotely. Furthermore, manual commands can be sent to all trackers, even individually, during maintenance and testing.

✓ Limited environmental impact: the foundations occupy limited ground space. Each tracker rests on 7 plinths positioned over 34 meters. There are no elevated structures. As such, no application needs to be made to Civil Engineering Departments for the works nor are subsequent static tests on the works necessary. Furthermore, it also has a noticeably reduced environmental impact, leading to a simplification of "Environmental Impact Assessment Procedure". Most of the ground surface in question must only be treated in order to ensure that no plants which could, even partially, shade the panels, can grow on it.

✓ Independent, distributed logic: the system is equipped with a logic card on each tracker and on the central control unit in the Master/Slave version.

- The card on each tracker controls the motor, identifies mechanical faults and contains its own local clock for daily operations and realignment in the evening. The card works by default even if its connection to the Master is interrupted, noticeably diminishing cases where the whole system comes to a standstill as a result of a single fault.
- The central control unit communicates with all the cards, receives information from them (alarms and position measurements), and synchronises them. The central control unit can also issue centralised movement controls, for example during a "strong wind" alarm and can emit an alarm when communication with one of the tracker cards is interrupted.
- Communication between the central control unit and the tracker cards is carried out via cable on an RS485 bus serial.

✓ Energy savings and efficiency in order to maximise energy produced by the system and to enter it into the network.

- All central devices: the control unit, the communication modems, the conditioning device and the inverters, have been selected to consume the least possible amount of energy.
- Tracker cards and motors have also been optimised and have been designed to consume minimum amounts of energy.

✓ Lightening protection: all external cable ditching points and all those used to connect the module strings are protected by surge diverters.

✓ Operator protection: all moving structures are in full compliance with the machine directive and can operate in the photovoltaic sector in complete safety.

✓ All system parts undergo strict manufacturing controls and come complete with CE labelling.

✓ All electronic cards are in full compliance with ROHS (Pb-free) regulations.

2. STRUCTURE OF THE SOLAR TRACKER

Figure 2 – strings of single-axis solar trackers

The solar tracker is comprised of:

- A mechanical frame: to secure and move the modules. Its features render it suitable for use in areas with up to category 4 winds.
- Foundations: the frame is secured to the ground with 30x40x140 foundations. Each foundation is equipped with 4 anchor bolts to adjust the height of the frame and its inclination with respect to the ground. Other methods to secure it are also available, such as: bearing piles, chemical dowels (terraces), and micropiles.
- Motor: solar tracker movements are powered by a linear actuator with a single-phase motor. The frame is equipped with a mechanical locking system to be used while the motor is being mounted and substituted.
- Electronics: the solar tracker is equipped with a control card which is mounted on it, inside a waterproof container. The card sends commands to the motor based on an integrated tracking logic; it identifies the position of the modules and communicates with the central control unit (centralised commands, signalling alarms and measurements).

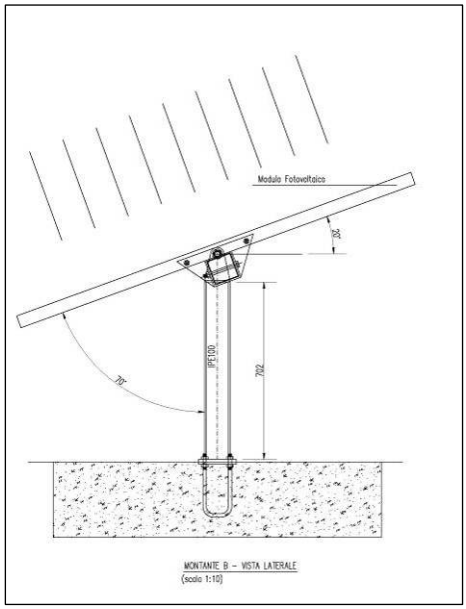

Figure 1 – tracker positioned at 20°

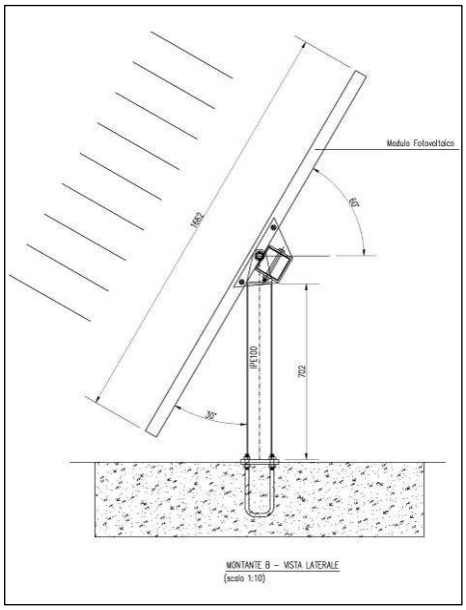

Figure 2 – tracker positioned at 60°

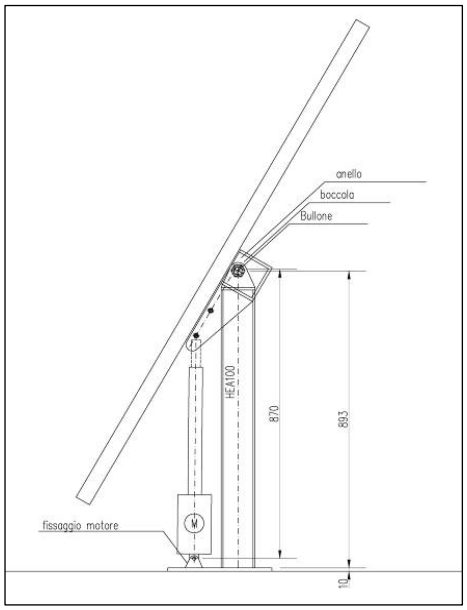

Figure 3 – Motor unit

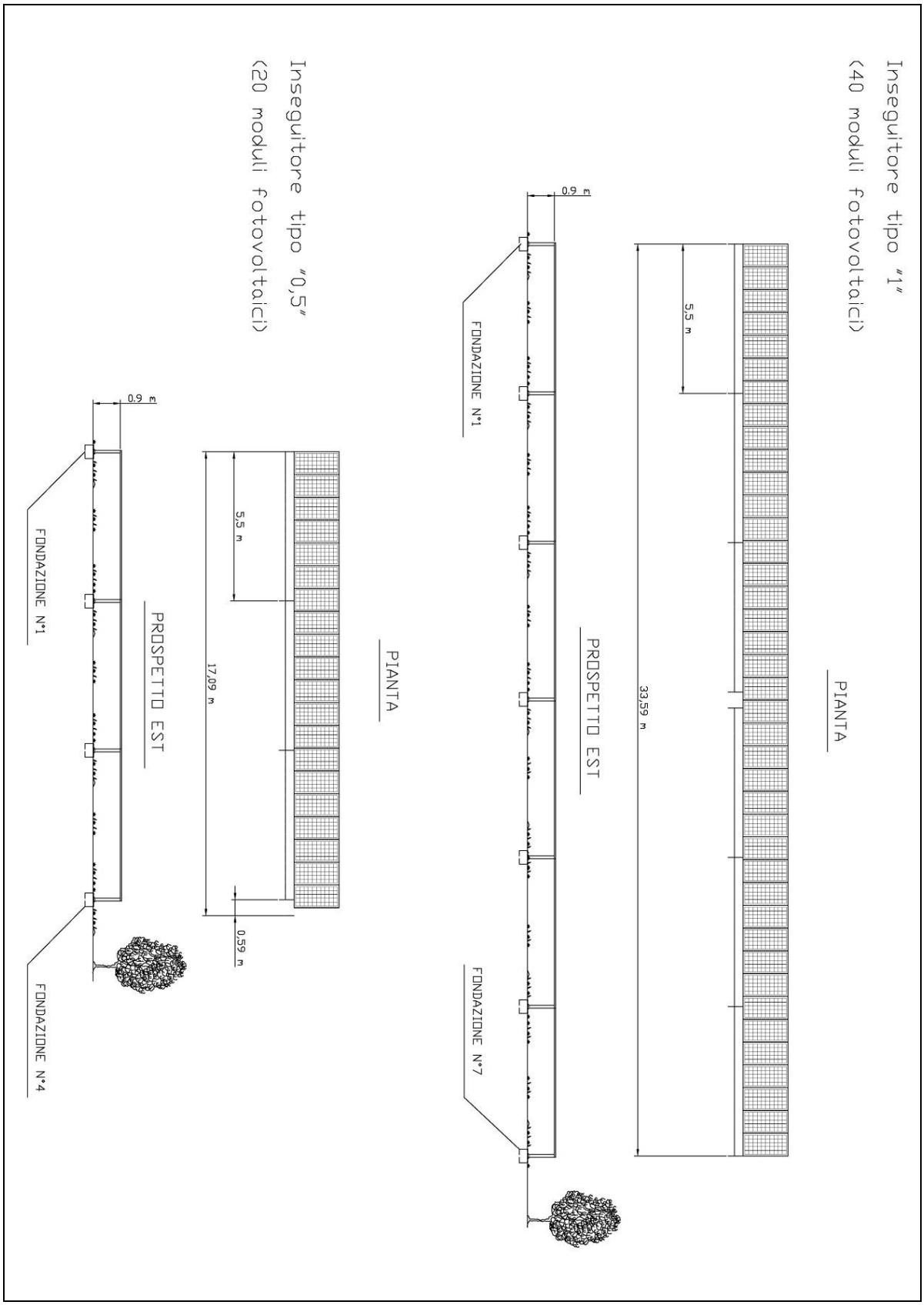

Figure 4 – 7.4 kW tracker plant and view

2.1 TECHNICAL FEATURES OF THE 7.4 KW SOLAR TRACKER

Tracker	
Type of tracker	Azimuthal on a single axis
Pivot shaft tilt	0°
Optimal pivot shaft azimuth	0° (SOUTH)
Pivot range	from + 60° to – 60°
Increase in energy production compared to a fixed system with optimal orientation	+20%
Annual energy production for the central Italy area	1560 kWh/kWp
Tracking error	±1.87 ° (-0.05% in power)
Mechanics	
Installation surface	Ground (with foundations or ballast)
	Flat roof (with chemical dowels or ballast)
Maximum photovoltaic surface	62 m^2
Number of supporting columns for the frame	7
Anchor bolts per column	4 x Φ14 mm
Electrics	
Maximum photovoltaic field voltage	1000 Vdc
Nominal photovoltaic power	7.4 kWp (with efficiency modules 13.4%)
Maximum photovoltaic power	7.6 kWp (with efficiency modules 13.7%)
	8.6 kWp (with efficiency modules 17.2%)
Cable anchorage	on a metal frame
PV isolation housing anchorage	On column 1 (lateral)
Electronic anchoring	On column 4 (central)
Power voltage	230 Vac, IF, 50 Hz (motor)
	24 Vdc (circuit board) Power supplied by the central unit
Data connection	Proprietary protocol on RS485
Tracking method	Linear 340 W (IP) actuator for each tracker with centralised controls.
Circuit board	SMT double sided printed circuit board
Control logic	8 bit – 10MHz micro control unit Parameters saved on a flash memory card (non-volatile)
Lightening protection	1 spark gap to ground 2 varistors

3. CENTRAL CONTROL UNIT

The central control unit is not just responsible for controlling trackers; it also handles measurements, signals, alarms and remote communication.
The central control unit is comprised of a central control which interfaces with a series of sensors and external actuators (see tables below).
The central control unit has been designed based on PC-104 architecture and has a Windows operating system. Each control unit can command up to a maximum of 160 trackers (up to 1.3 MWp).
A maximum of 250 control units can be installed for larger systems and connected using a network (up to 344 MWp).
The SW is proprietary and is comprised of a single application which is both simple and durable, and reduces maintenance interventions and fault-free updates to a minimum.
The application controls the PV field through an RS232 serial port connected to an RS232-RS485 converter. “Embedded” technology reduces consumption to levels similar to those found in palm pilots and the latest generation in mobile phones.
The central unit receives meteorological data from external sensors.
The inlet ports allow it to receive various different types of signals, calculated and transmitted from a distance such as, for example, from cameras used to monitor the photovoltaic field.

Technical characteristics of the central control unit	
Operating system	Windows XP; embedded Windows XP;
Form factor	PC/104
Maximum number of trackers controlled	160
Number of control units which can be connected in a network	250
Processor	AMD LX 800 (500 MHz)
System memory	200-pin DDR SODIMM x 1; (512MB)
Chipset	AMD LX 800+ CS5536
I/O Chipset	ITE IT8712F-A
Ethernet connection	Realtek RTL 8139DL, 10/100Base-TX
BIOS	AWARD 512KB FLASH ROM
Solid state hard disk	CompactFlash™ Type I Slot x 1; (1GB)
Expansion interface	PC/104 socket x 1
Typical consumption	< 10 W
Battery	Lithium
Card size	90mm x 96mm
MTBF (hours)	108795
Video memory	Shared with the system memory (up to 254 MB)
Memory	Up to 1920X1440 @ 32bpp for CRT
	Up to 1024 x 768 @ 24bpp for LCD
External interface	EIDE x 1 (UDMA-33 x 1), Keyboard x 1, Mouse x 1, Floppy Disk Drive x 1, RS-232 x 1, RS-232 / 422 / 485 x 1, Parallel x 1
	One IrDA Tx/Rx header
	Two 5x2 pn connectors supporting 4 USB ports

Inlet-outlet interfaces connectable to the central control unit	
Solar radiation sensor	0 … 1500 W/m^2 Accuracy ± 3% RS485 interface
External air temperature sensor	- 25 ... + 50 °C Accuracy ± 0.5°C RS485 interface
Wind sensor	Measurement 0 … 60 m/s Accuracy ± 5% RS485 interface
Liquid precipitation sensor	Rain precipitation in mm Resolution 0.01 mm Automatic reset RS485 interface
Open door sensor	In the electric substation
Optional interfaces	
Photovoltaic field camera	Video resolution 352 x 288 pixel @ 30 photograms per second. Fixed image acquisition up to 640 x 480 pixels. USB Interface
Smoke sensor	Registers the start of a fire inside a shelter or local exchange Contact interface.
Remote access (based on the availability of the site)	GPRS or UMTS modem on an expansion board
	PSTN 56 kbps modem on an RS232 serial
	ADSL router on Ethernet
Options: automatic main RCD reset	Via a contact interface