# LOTUS-PX

SHAREABLE I WATERLESS I RELIABLE

Robotic solar panel cleaning solutions

GREENLEAP

ROBOTICS

# LOTUS / P4000


# The solar panel cleaning companion to count on!

### Superior cleaning

The microfiber cleaning fins along with the airflow flicks off the dust or debris without scratching or dragging them over the panel surface, thus protecting the A.R.C.

### Energy Independent

A solar-based “charging point” is provided with each robot which can be set up at any location on the site to charge a single battery pack in as few as 2 hours.

### Robust & Reliable

All the parts are meticulously designed, manufactured, sourced, rigorously tested and assembled to perform at the optimum level even in the harshest conditions.

### Easy to use

LOTUS P4000 is an ergonimically designed robot which comes with accessories which makes it super easy to lift, operate, move, switch-rows, bridge table-gaps and park.

### Customisable

The modular design and unique drive unit allows our robot to have length ranging from 2 m to 8 m. It can fit on an existing solar plant without any construction.

### Cloud connected

All robots can be monitored from anywhere and on any device via web-dashboard. It can be integrated with plant’s existing SCADA system.

### Safe on panels

The 39 kg weight of the cleaning robot is well distributed via durable and wide wheels made of TPU material. It runs on the solar panel frame.

### Irregularities tolerant

Our patented design involving dual-drive motion system enables the robot to overcome panel-to-panel irregularities of upto 40 mm.

### Quick ROI

Our R&D at every stage towards engineering and production has resulted in a product which conservatively provides ROI under 9 months.

# Cleaning system

**LOTUS P4000 cleaning system is based on ultra-soft microfiber cloths rotating along the length direction of the robot. The microfiber cleaning fins generate an airflow and a controlled impact which flicks off the dust particles from the panels without any scratching or dragging.**

- **Cleaning via airflow + flicking action**
- **Durable microfiber cloth with upto 2 years life**
- **Easy microfiber replacement upon end-of-life**
- **Upto 98% cleaning in a single pass**
- **Customisable brushes for other type of dust**

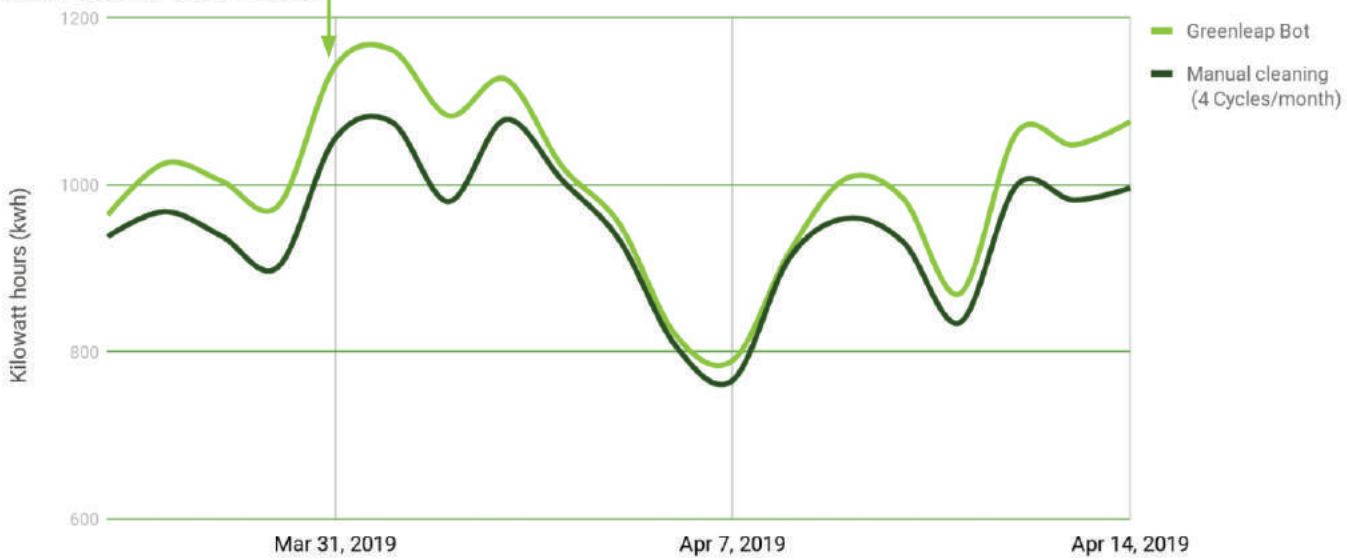
## Real Stats Back Us

**5%** **Increase** Against Weekly cleaning cycle

**10%** **Increase** Against Bi-weekly cleaning cycle

Daily generation increase

IIT Delhi - Rooftop Solar Plant scaled to 220KW



# Machine Design

**DRIVE UNIT LOTUS P4000**

This aluminum and steel made drive unit is custom designed to be strong and lightweight.

**Our attention to details and support from IIT Delhi has resulted in a precision engineered machine which delivers performance while consuming less power.**

### Patented technology

We have patented our unique dual-drive system with real-time orientation control which helps to overcome the module irregularities upto 40 mm.

### Precision engineered

The precision engineered parts provide desired features of high-strength and reliable operation while minimising the weight and power loss.

### Materials

High-grade aluminum & stainless steel is used in parts and fasteners to achieve exceptional durability and corrosion-resistant product.

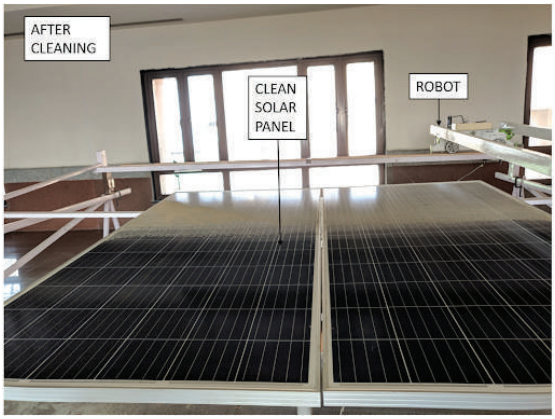
### Motors

Imported high-performance BLDC motors provide more than 5000 hours of life under extreme conditions with high power to weight ratio and zero maintenance.

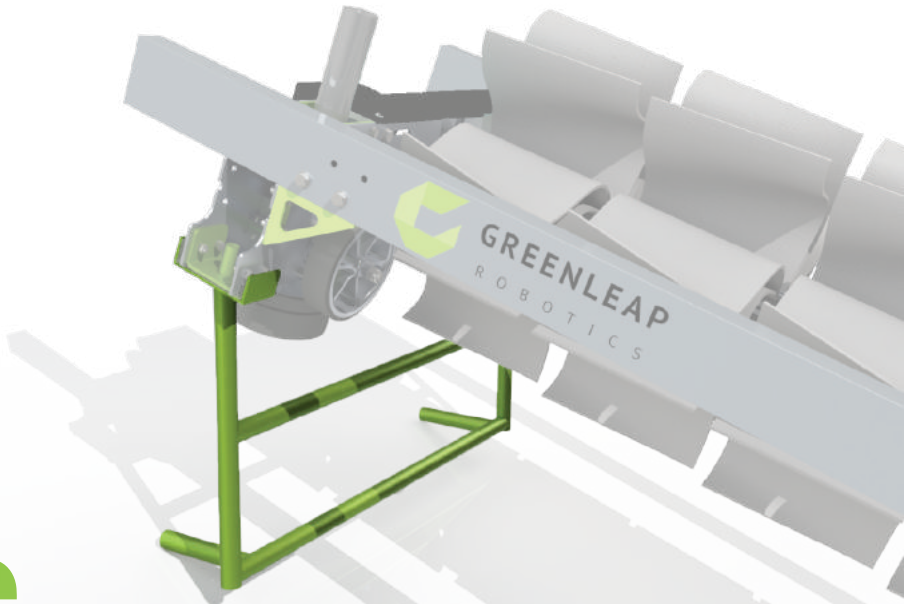
### Frame

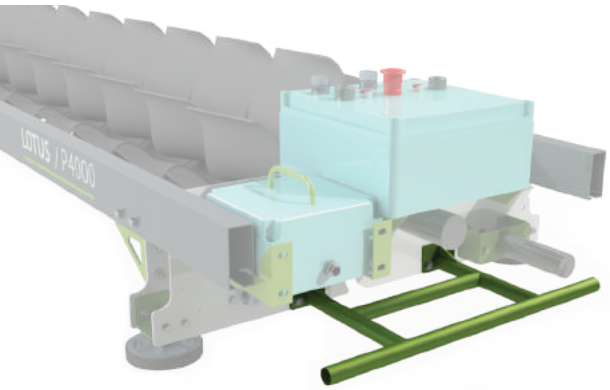
Our robots have a rigid open-body frame which doesn't slack while lifting and produce minimal shading with stable operation under 50 kmph wind.


**Our robots have passed 100 + hours of continuous-operation test in our lab**



# Easy to handle and move

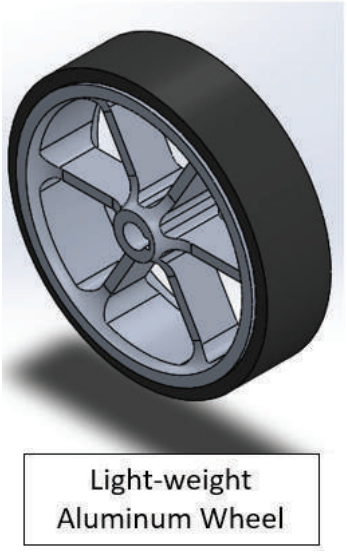


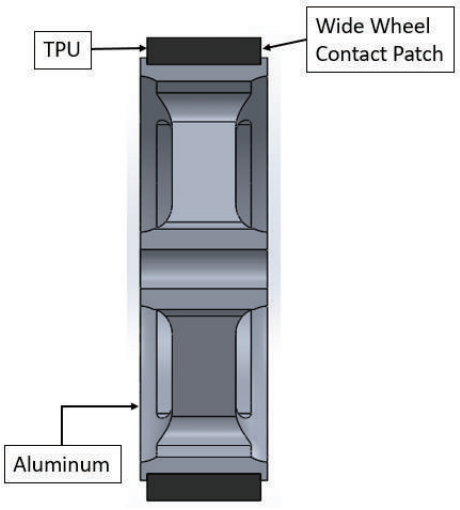



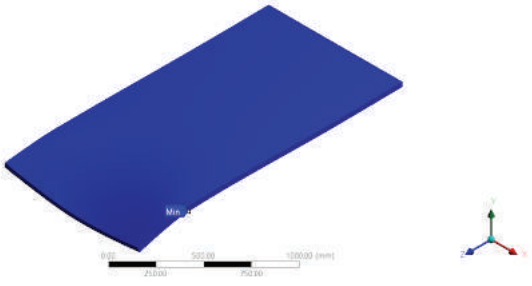

**Carefully designed detatch-able handles provide row-shifting time as low as 25 secs while minimising the weight of the robot.**

- **Ergonomic design**
- **Lightweight**
- **Detatch-able**
- **25 sec row-shifting time**

# Maintains the SAFETY and INTEGRITY of solar PV module

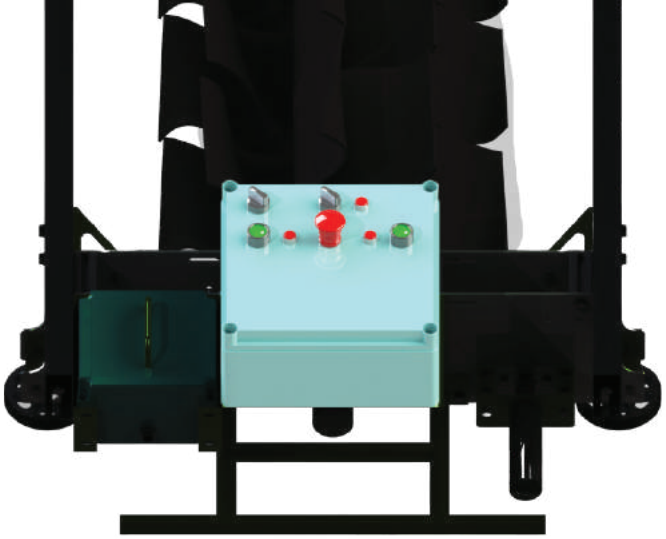



Stress analysis of PV module with the robot (FOS = 5.62)

- The wheels of the robot run on module frame to transfer the load from the frame to the underlying structure.
- Adjustable wheels provide on-site adjustments for better localisation of the wheels contact.
- Microfiber cleaning fins flicks-off the dust and debris to prevent any damage to the Anti-Reflective Coating (ARC).
- Appropriate hardness of the wheel coating material (TPU) provides cushion as well as durability.
- In-lab simulations result in a Factor-of-Safety (FOS) value of 5.62.



**All robots are equipped with automotive grade**

# electronics

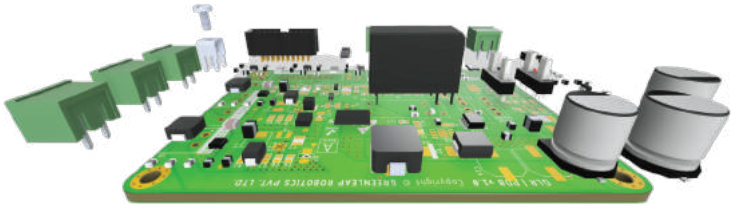
**and** 4G **based**

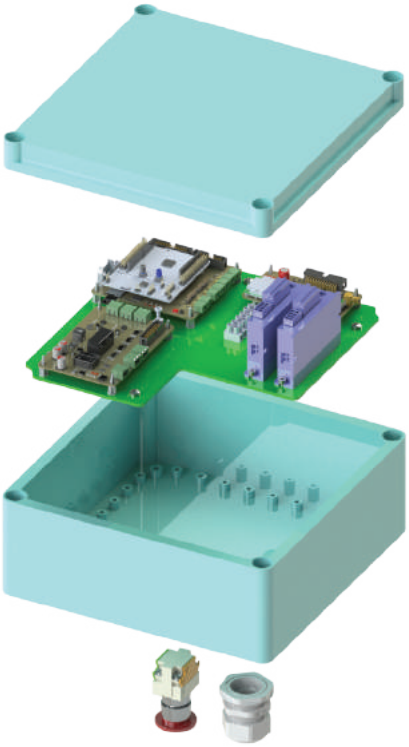
# communication

**system**

## Performance

- ARM Cortex M4 based processor
- 4G LTE communication system
- Low current consumption
- High-endurance parts and switches
- Noise & Interference cancellation design
- Advanced firmware

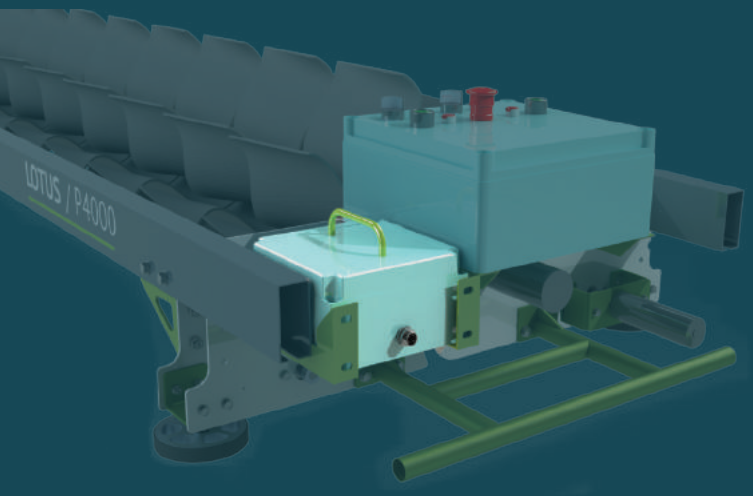




## Safety

- Automotive grade Q1 components
- Extended temperature operation
- Over current & voltage protection
- Lightning surge protection
- Impact-resistant enclosure (IK 07)
- RoHS and CE certified parts
- IP65 ingress protection

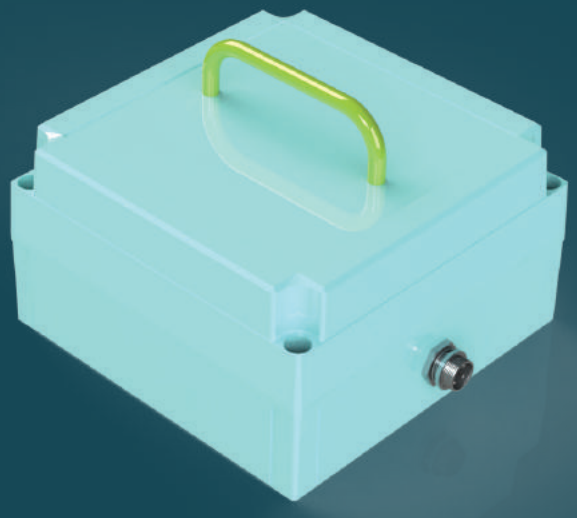
# Longer cleaning time with lesser battery size




**Upto 4 hours of cleaning time with 12Ah @ 25.6V (Std. range)**

**Upto 6 hours of cleaning time with 18Ah @ 25.6V (Exd. range)**

With a **swappable** and **high energy-dense** lithium battery pack, the cleaning never stops! A single cleaning cycle of standard **1 MWp** solar plant is done under **2.5 hours**!

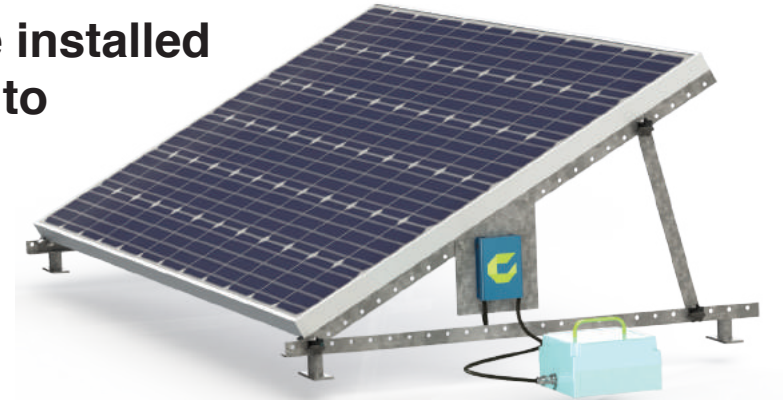


**Tech Specs**

| | |
|---|---|
| Cell chemistry | Lithium Ferro Phosphate |
| Weight | 3.25 Kgs for 12Ah |
| Operating temp. | upto 60 degree Celsius |
| Cycles (chg.-dischg.) | >2500 @ 100% DOD (at 25 deg C) |
| Warranty | 2 years |
| BMS features | Over charge, under charge and short-circuit protection |
| Charge time | < 2 hrs (normal sunny conditions) |
| Ingress protection | IP65 |
| Impact resistance | Enclosure (IK 07) |

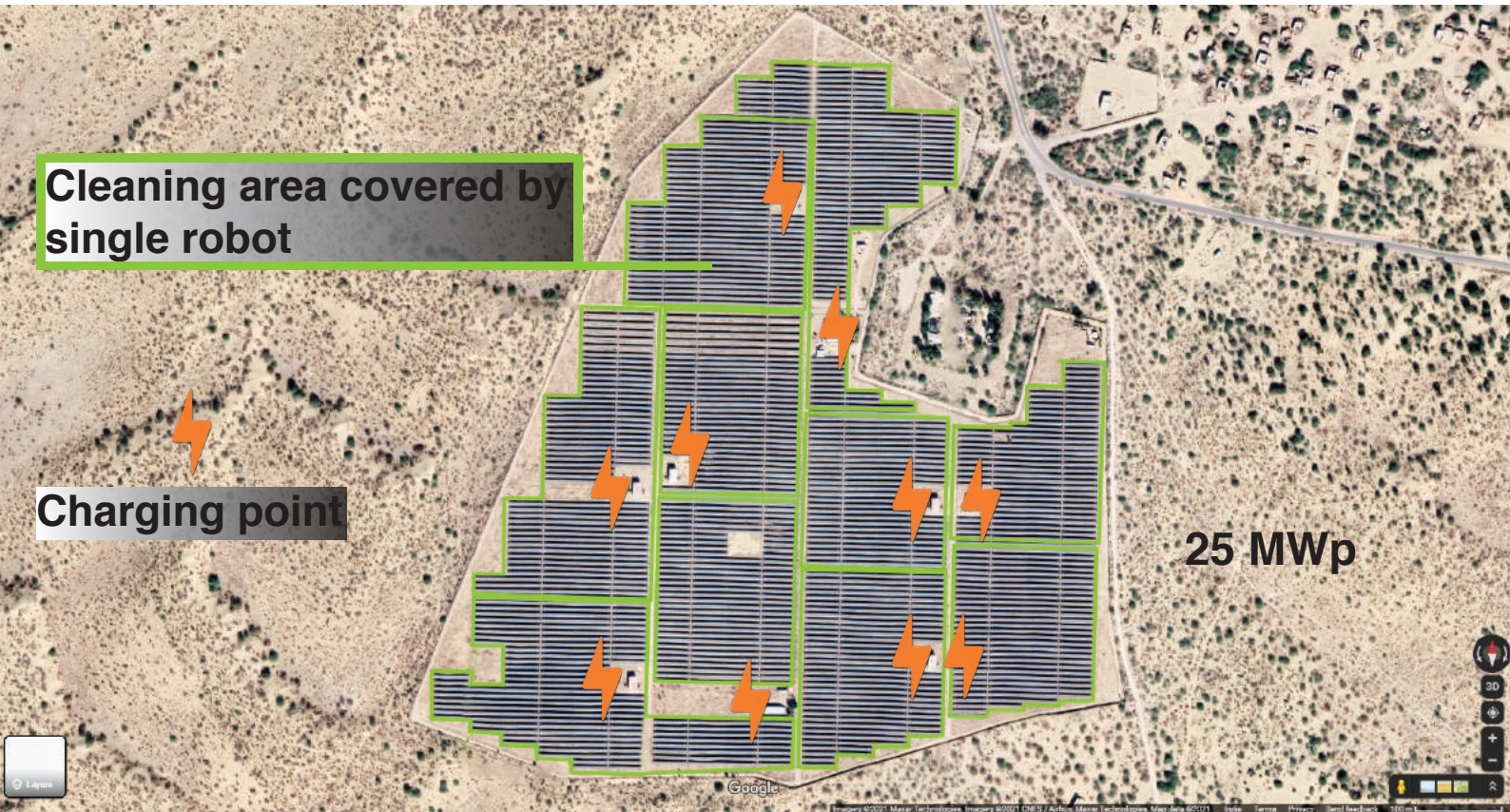
# The Charging point

**Solar-based charging points are installed at designated points on the site to charge the robots' batteries, thus achieving true energy independence.**



- **Solar-based charging**
- **Full battery charge under 2 hours**
- **Charges multiple batteries**
- **Set-up at any location on the site**
- **Fast installation**
- **All weather proof**

Below is a **25 MWp** solar plant which can be daily-cleaned (single cycle) by **10** LOTUS P4000 robots, assuming 6 hours of cleaning time per day.




# DASHBOARD

## Real-time monitoring

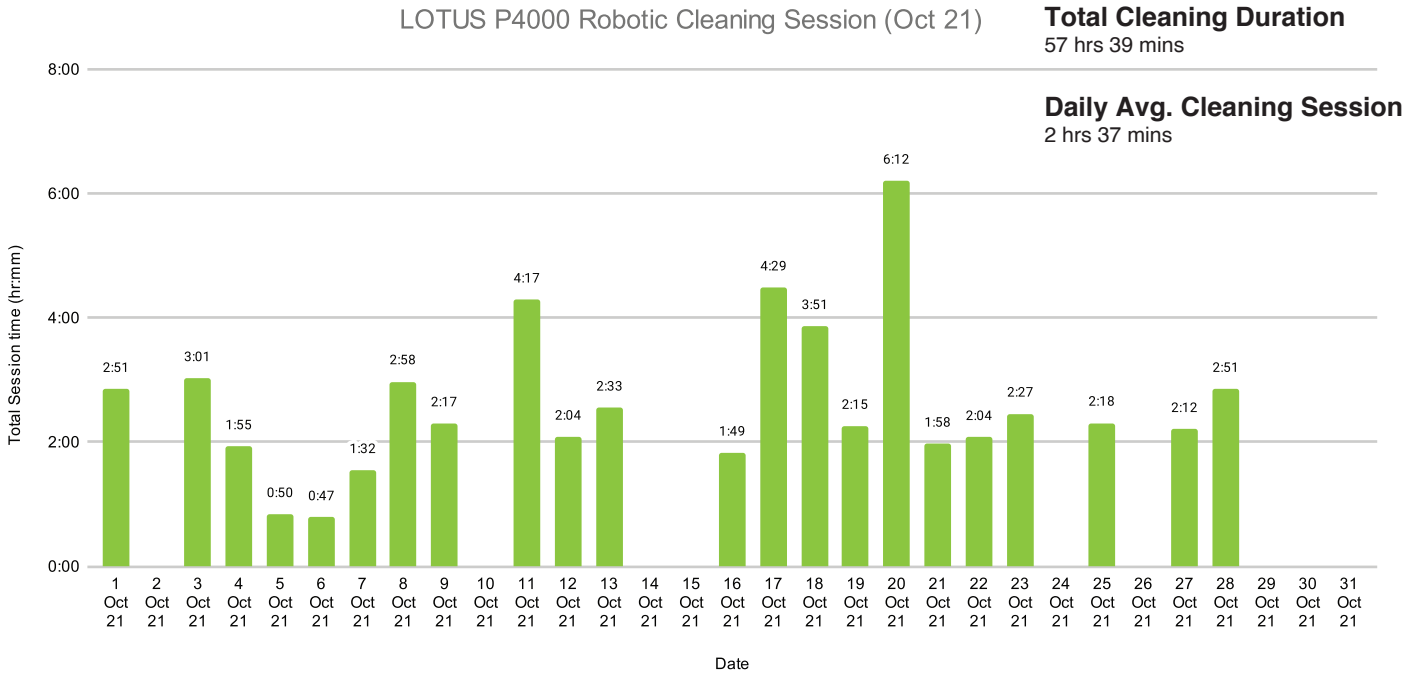
All LOTUS P4000 robots can be monitored simultaneously from anywhere and on any device using on-board TCP/IP communication. It can be integrated with plant's existing SCADA system.

## Error notification

All robots are smart to identify, log and notify as soon as an error occurs to enable a quick maintenance response.

## Reporting

All robots transmit the power, system and cleaning session logs to secure AWS servers which enable data analytics and comprehensive report generation.

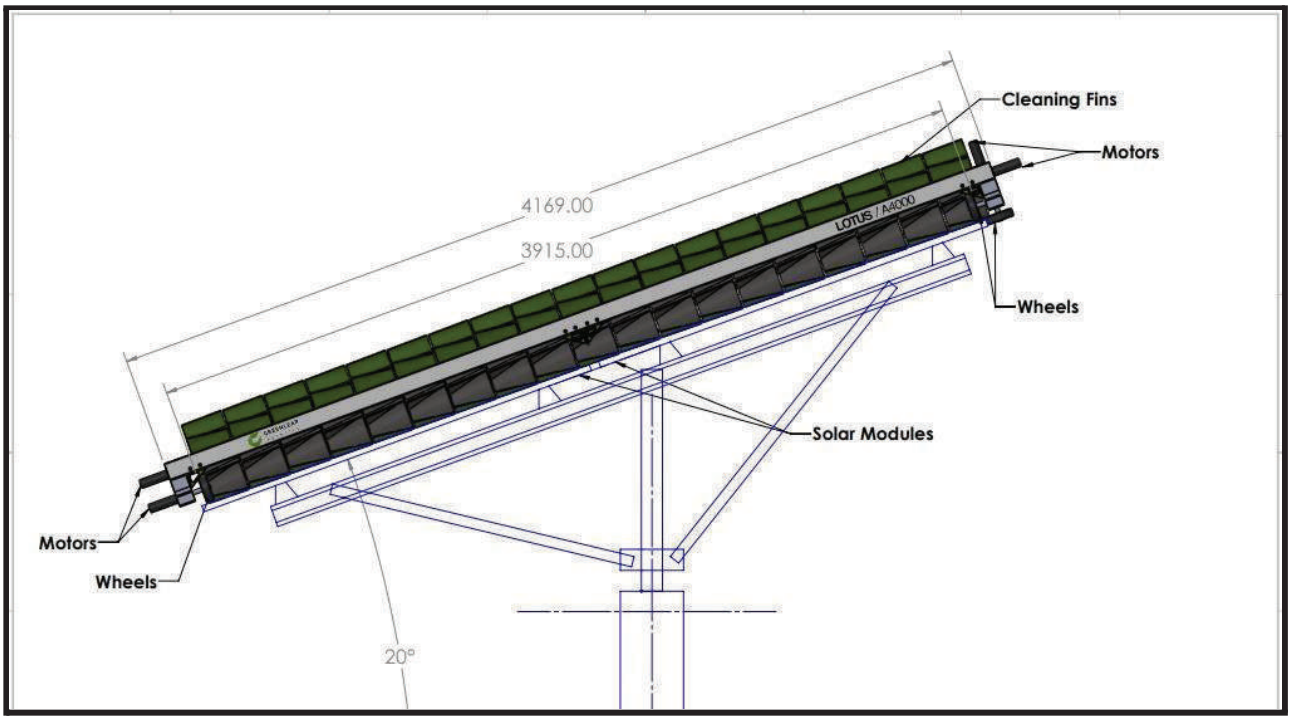


# TECHNICAL SPECIFICATIONS - LOTUS P4000 (shareable)

| | |
|---|---|
| **Machine** | |
| Dimensions- Length X Width X Height | 4500 X 660 X 370 mm |
| Solar Table Width Adaptability | Yes |
| Weight | 39 Kgs (Std. range) \|\| 41 Kgs (Extd. Range) |
| Body | Aluminum Frame |
| | |
| **Motion** | |
| Motion System | Real-Time Orientation Control (ROCS) |
| Tilt Capacity | 0° to 35° |
| Motors | 24V High-performance Brushless DC |
| Wheels | Aluminum-core |
| Panel Misalignments Tolerance | 40mm (Surface and Lateral) |
| Variable Ground Slope Compatiblity | +/- 10° |
| | |
| **Cleaning System** | |
| Cleaning Type | Waterless |
| Cleaning Material | Microfiber cleaning cloth or Nylon |
| Cleaning Speed | 0.2 m/s |
| Cleaning Range (Std. range) | 2700 meters |
| Cleaning Range (Extd. range) | 4200 meters |
| Bird Droppings Cleaning | Yes, 80-90% reduction in 4 cycles |
| | |
| **Power supply and Battery** | |
| Rated Power / Max. Power | 100W / 300W |
| Battery (Std. range) | 12Ah @ 25.6V Lithium |
| Battery (Extd. range) | 18Ah @ 25.6V Lithium |
| Battery type | Swappable |
| Charger | Solar charge or **Wall Charger (IP67)** |
| Runtime (Std. range) | Upto 4 hours |
| Runtime (Extd. range) | Upto 6 hours |
| Charge Time | 2 hours |
| | |

| | |
|---|---|
| **Communication and Control** | |
| Protocol | 4G LTE |
| Remote Control and Commands | Yes, through a web-based dashboard |
| | |
| **Other** | |
| Protection | IP65 |
| Mounting | Rails or Solar panels directly |
| | |
| **Replacement Schedules** | |
| Cleaning Material | 2 years |
| Batteries | 5-7 years (depending upon environmental conditions and use case) |
| Motors | 5000 hrs |
| PCB and Electronics | 10-12 years |

### Product Simplified Drawing



# SUPPLIERS

We use high performance, robust and reliable components sourced from TIER - 1 suppliers all across the world.















And many more.....

# CONTACT US

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