



Guardian™ S Fact Sheet

About the Guardian S The Guardian S is a revolutionary, first-of-its kind cloud-connected mobile Internet of Things (IoT) and sensor platform that provides inspection and surveillance capabilities to augment human-based inspections in challenging environments. With a uniquely capable, cost-effective and versatile form factor, the Guardian S can be tele-operated from miles away, can reliably traverse challenging terrain including stairs, culverts, pipes, tanks and ferromagnetic vertical surfaces (magnetic version only), and can facilitate two-way real-time video, voice and data communication between the human operator and robot. It assists workers on the job by removing them from direct involvement in hazardous situations, reducing their risk of injury and saving lives.

Weighing ~17 lbs., the Guardian S robot is designed specifically to navigate uneven or challenging terrain and to access small, confined spaces with a 7" diameter opening, going where humans either cannot or should not go. It has garnered industry recognition from Fast Company, Best in Biz, TechConnect Defense and others for its design innovation.

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- Key Product Attributes** The Guardian S makes inspections and remote surveillance safer and more effective:
- Multi-purpose, man-portable mobile IoT platform
 - Built-in, customizable sensor module gathers real-time information
 - Able to transport up to ~10-pounds of additional task-specific sensors while traversing a horizontal surface via an optional payload platform
 - Optional advanced analytics and predictive maintenance functionalities enabled through Sarcos Command Center
 - All-terrain, state-of-the-art visual surveillance
 - Tele-operates & traverses challenging terrain: stairs, culverts, pipes, tanks, and vertical ferromagnetic surfaces
 - Slim form factor enables access to confined spaces (7" diameter openings)
 - Up to 12 hours of surveillance time or ~ 3-mile travel range
 - High resolution visual inspection enabled by six 4K cameras with digital zoom & autofocus with 360° color
 - IP65 certification makes it water protected (dust-tight and protected from water projected from a nozzle)
 - Two-way, real-time video, voice, and data communication
 - Built-in, enhanced WiFi and radio connection between the OCU and robot
 - Built-in LTE modem for future cloud-based services (700MHz)
 - Two-way audio between OCU and robot (half duplex PTT)
 - Audio signals and video streams encrypted using state-of-the-art 256-bit AES encryption

- Optional cloud-computing functionality
 - Implemented through the Sarcos Command Center; incorporates all aspects of robot control, data gathering and analysis in an easy-to-use cloud-based platform:
 - Asset management: Trace, track and understand asset location and health
 - Authorization and Authentication: Authorizes access to robotic control or sensor data
 - Mission Management and Review: Set-up, execution and post-operation review of the sequences of missions and operations
 - Data Collection and Storage: Managed collection and storage
 - Data Analysis: Easy-to-use tools for analyzing collected data
 - Future ability to leverage machine learning, artificial intelligence and enhanced sensors for advanced analytics and predictive maintenance in industrial inspection applications

Industry Applications

The Guardian S robot is a versatile, multi-purpose platform designed to address a wide number of uses cases. It has applicability in industries ranging from defense, public safety, security, non-destructive testing, disaster recovery, infrastructure inspection and maintenance, aerospace, maritime, oil and gas, petrochemical and mining.

Availability and Pricing

The Guardian S robot is commercially available now. The base robot (before options) is \$60,000 to purchase.

Information and Images

For more information on the Guardian S robot, please visit:

www.sarcos.com/guardian-s

For imagery of the Guardian S, please visit:

www.sarcos.com/media-kit/

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Guardian™ GT Fact Sheet

About the Guardian GT

Sarcos' Guardian GT robot is a first-of-its-kind large scale industrial exoskeleton robot that provides an unparalleled combination of dexterity and strength for the operator. Mounted on an agile vehicle base that can be powered by batteries, diesel, or natural gas, the single or dual-armed system can lift and manipulate payloads up to 1,000 pounds, dexterously, and with little human effort. Utilizing Sarcos' proprietary high-fidelity force reflection technology, the operator feels the scaled forces experienced by the robot arms, whether the operator is riding inside the robot or the system is tele-operated from miles away.

The Guardian GT robot has been successfully demonstrated to significantly improve material handling and assembly, safely completing in minutes tasks that typically take several workers many hours to perform, while minimizing the risk of human injury. It is relevant to a magnitude of global markets including commercial/industrial, public safety, logistics, disaster recovery, nuclear, maritime, petroleum, construction and heavy equipment manufacturing, and others. The Guardian GT earned Frost & Sullivan's 2017 North American Technology Innovation Award in the dexterous mobile robot category because of the impact it will have across all these industries and was named IEEE Spectrum's "[Robot of the Week](#)" in November 2018.

Key Product Attributes

Intuitive to Use

The Guardian GT's seven-foot arm boasts seven degrees of freedom, plus a task set-specific end effector that allows the operator to reach objects seven feet in front and to the sides of the mobile platform. These arms act as a natural extension of the operator's own arms and are kinematically equivalent to the human body so that the Guardian GT's arms move in the same direction, with the same speed and at the same time, as the human operator's movement. As a result, the Guardian GT's system is intuitive, robust, and safe to operate even in dangerous or hazardous environments. It requires minimal training and enables handling of difficult-to-manipulate objects with a high degree of control.

Highly Dexterous

The Guardian GT robot can execute an almost limitless number of dexterous tasks such as utilizing off-the-shelf power tools to perform mission-specific functions like cutting, grinding and finishing, plasma cutting, cleaning, and joining. It can also acquire and empty a disposal bin, turn valves, push buttons, place pipes for connection, and assemble large pipe flanges on to mating flanges with studs.

Energetically Autonomous

The Guardian GT robot is energetically autonomous, using batteries, diesel fuel, or propane for the energy source, allowing it to be truly mobile, with seven hours or more of continuous operation.

Use Cases / Tasks

Examples of dexterous tasks that could be performed by the Guardian GT robot include:

- Allows ship-building workers to accomplish in one to three minutes what it takes two or three people eight to 12 hours to complete, and do it far more safely (e.g. picking up plates for welding, extracting pieces from a burn table, handling heavy materials, etc.)
- Provides nuclear power plant cleanup and decommissioning by performing precision removal and disposal of parts and hazardous materials; Can be tele-operated for nuclear reactor inspection and maintenance
- Utilizes off-the-shelf power tools to perform mission-specific functions like cutting, welding, grinding and finishing, plasma cutting, cleaning, joining, and applying protective coatings
- Turns knobs, pushes buttons, places pipes for connection, assembles large pipe flanges onto mating flanges with studs
- Palletizes and de-palletizes, loads and unloads supplies
- Erects temporary shelters and repairs equipment
- Provides humanitarian assistance, safely moves heavy rocks and debris in a controlled manner and assists with Med-Evac

Availability

The Guardian GT robots are built to order based on each customer's unique requirements.

Information and Images

For more information on the Guardian GT, please visit:

www.sarcos.com/guardian-gt

For imagery of the Guardian GT, please visit:

www.sarcos.com/media-kit/



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Guardian™ XO® and XO® MAX Robots Fact Sheet

About the Guardian XO and XO MAX

Sarcos' Guardian XO and XO MAX are the first untethered, battery-powered exoskeletons that enhance human productivity while keeping workers safe. Building off of Sarcos' award-winning XOS-2 exoskeleton robot, the Sarcos Guardian XO and XO MAX robots represent the next step in the evolution of high-performance, highly dexterous, mobile robots. An early prototype was selected by Time Magazine as the Innovation of the Year.

The Guardian XO and XO MAX robots enable workers to perform hours of physical activity that would otherwise be impossible for a single human to perform. The Guardian XO robot is capable of repeatedly lifting and supporting up to 80 lbs. without fatigue or strain for up to a four-hour work session, while the XO MAX is capable of lifting and supporting up to 200 lbs. without fatigue or strain for up to an eight-hour work session. The human operator bears none of the load of the exoskeleton or its payload, and can be donned and doffed in 30 seconds. These exoskeletons require minimal operator training because they permit natural, fluid and intuitive movement.

The Guardian XO line of robots are relevant to a multitude of large global markets, including manufacturing of all types, construction, health care, logistics, oil & gas, public safety and defense industries.

Offered via a robot-as-a-service (RaaS), the XO and XO MAX delivers multiples of an individual employee's productivity for the cost of a single employee, while reducing costly occupational injuries, creating a clear and compelling return-on-investment for customers.

Key Product Attributes

Energetic Autonomy

The Guardian XO and XO MAX are designed to augment human strength and endurance without restricting the operator's precision or freedom of movement. The Guardian XO and XO MAX robots do not add weight or inertia (metabolic drag) like unpowered exoskeleton technology, rather they supply the energy to handle themselves (energetically autonomous). They are designed to operate for two to eight hours on one charge. The Guardian XO robot can operate for up to a four-hour work session, and the Guardian XO MAX robot can operate for up to an eight-hour work session.

Safety

The Guardian XO and XO MAX robots enable workers to safely and easily lift up to 200 pounds (80 pounds for XO and 200 pounds for XO MAX) repeatedly without an exertion, strain or injury, and prevent both daily fatigue and long-term physical degradation from humans performing physically taxing jobs. They are equipped with scaled dexterous end effectors and force feedback features, so an operator can perform highly precise tasks with heavy tools or

components. The Guardian XO and XO MAX robots contain built-in software controls that manage what should and shouldn't be done in the suits, preventing the performance of tasks that would not be good for a person to do even without the suit.

Ease of use

The Guardian XO and XO MAX robots allow humans wearing the suit to move in a natural, fluid, intuitive manner, and they work in a variety of terrains, as they are almost as capable as the human body. They can access tight, confined spaces or challenging terrain that big machinery can't access, but that humans can. The Guardian XO and XO MAX robots' battery will last two to eight hours on one charge, and can be hot-swapped during use.

Availability

The Guardian XO and XO MAX robots are currently under development and are expected to be commercially available in late 2019.

Information and Images

For more information on the Guardian XO and XO MAX, please visit: www.sarcos.com/products/guardian-xo/

For imagery of the Guardian XO and XO MAX, please visit: www.sarcos.com/media-kit/

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