



Multi-Role – Single Solution.

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 **GENERAL ATOMICS**
AERONAUTICAL
Leading The Situational Awareness Revolution

CERTIFIABLE PREDATOR B MULTI-ROLE – SINGLE SOLUTION

The Certifiable Predator B® (CPB) class of Remotely Piloted Aircraft Systems (RPAS) has been optimized for Intelligence, Surveillance, and Reconnaissance (ISR) through the development of SeaGuardian™ and SkyGuardian™ to support a variety of homeland security and other non-military roles.

While the General Atomics Aeronautical Systems, Inc. (GA-ASI) Predator B is closely associated with military missions, the air vehicle performance and sensor-carrying capabilities it offers make the airframe a natural choice for a wide spectrum of non-military uses. GA-ASI has developed an unarmed SeaGuardian RPAS for non-kinetic roles to advance the capabilities of a range of government agencies; it includes recent developments in sensor, communications, air space integration and flight control technology.

The Certifiable Predator B RPAS family includes two variants: SkyGuardian and SeaGuardian. Both RPAS utilize the same airframe as Certifiable Predator B including the long-span wings for increased range/ endurance and airworthiness flight/ mission system improvements to enhance safety and operational effectiveness. Both Guardian models typically carry the same communications systems and sensors. SeaGuardian includes a long range multi-mode 360° maritime radar such as the Raytheon SeaVue™ mounted beneath the fuselage. The 360° maritime radar provides a highly detailed real-time operational picture for domain awareness, supporting roles including border protection, anti-trafficking, search and rescue, mapping, fishery patrols, resource management and pollution monitoring.

The new SeaGuardian will carry the Lynx® Multi-Mode Radar that is optimized for similar over land Intelligence, Surveillance and Reconnaissance requirements including border protection, potential humanitarian assistance and disaster relief. Lynx also has littoral surveillance capability including an Inverse Synthetic Aperture Radar (ISAR) mode, as well as multi-contact detection, cueing and tracking functions.

The unique functionality of the Certifiable Predator B design allows SkyGuardian to be fitted with a maritime radar when needed to become a SeaGuardian, while the SeaGuardian radar can be removed as needed, providing true MULTI-ROLE – SINGLE SOLUTION.



Multi-Role Legacy

Albeit scratching the surface of the potential roles for SkyGuardian and SeaGuardian, Predator B models have been used extensively in non-military roles by NASA and U.S. Customs and Border Protection (CBP). These activities serve to highlight the wide variety of non-military or civil work that Guardian aircraft can perform, including supporting humanitarian assistance and disaster relief, as well as other unforeseen emergencies.

NASA uses a Predator B designated Ikhana on numerous scientific and research programmes. The ability of Predator B to integrate a wide range of sensors allows it to operate as a platform for numerous scientific experiments, which can be performed at a much lower cost than with manned aircraft. Its endurance and range also allows it to operate in difficult-to-access areas.

CBP's Office of Air and Marine operates a mixed fleet of Predator Bs and earlier variants of Guardians on the daily mission of protecting the borders and coastlines of the continental United States. CBP aircraft guard against a range of illegal cross-border activities, including the smuggling of people and narcotics. CBP Guardians perform a similar task along the coast, employing their multi-role maritime radar to detect and track surface activity.

In addition to this routine work, CBP's fleet has been called into use during

emergencies, as requested by the U.S. Federal Emergency Management Agency (FEMA). Flying from Grand Forks, North Dakota, CBP aircraft have flown over hurricane and flood-hit areas in the U.S. to provide imagery and intelligence to the U.S. Geological Survey and Army Corps of Engineers. In these missions, the Lynx radar has been used in Synthetic Aperture Radar (SAR) mode to produce accurate mapping of flood extents and levee status. The CBP Predator B mapped the flooded Red River valley in Minnesota and North Dakota, as well as flying over flood-threatened areas of Illinois and Arkansas.

Persistent Eye in the Sky

Operations of both NASA and CBP Guardian have highlighted the value of having an RPAS capability before, during, and in the aftermath of natural disasters. By providing a persistent oversight, the RPAS can inform emergency response commanders of where assets need to be deployed for maximum effect. Furthermore, the data can be used at a local level by individual response teams to assist operations and enhance their own safety.

Communications Umbrella

Certifiable Predator B RPAS can also provide communications relay to first responders where mobile phone and radio towers have been rendered inoperative. This capability includes enabling communications between dissimilar radio systems

which ordinarily could not work together. The “mobile tower” in the sky directly helps those most affected in emergencies to be able to reach out quickly for help, closing the time for responders to find and assist.

Through the use of imaging and radar mapping, the RPAS can also compile detailed data of a vulnerable area immediately prior to an impending disaster and, through flying similar profiles afterwards and the use of change-detection software, can rapidly identify areas of significant damage, or locations where further damage is likely to occur.

In an emergency situation, utilizing a Guardian RPAS with high-definition sensors and wide-reaching communications capabilities can significantly enhance the ability of responding agencies to handle the containment and relief activities. From wildfires to flooding, through hurricanes and volcanic eruptions, to earthquakes and tsunamis, Guardian can be a powerful asset in efforts to protect infrastructure and livelihoods, and ultimately save lives.

Guardian is described as an “aerial pick-up truck.” Its utility and versatility has been confirmed in multiple non-military missions,

and its ability to carry large payloads suits it to many other applications in both government and commercial sectors, offering significant savings in comparison to manned platforms.

Guardian RPAS provides unmatched persistence, versatility and cost-effectiveness across a broad spectrum of requirements.

GA-ASI Guardian: Multi-Role - Single Solution.

REMOTELY PILOTED AIRCRAFT SYSTEMS

Lynx

GA-ASI is one of the world’s leading companies in the development of sensors and sensor technology. Among its portfolio is the Lynx Multi-Mode Radar, which has been fitted to Predator A and Predator B RPAS, and also to manned platforms. Weighing less than 37 kg, Lynx delivers photographic-quality SAR imagery in a compact package.

Operating in Ku-band, Lynx provides either broad-area stripmap coverage out to a range of more than 80 km, with a high-resolution spot capability down to an exceptionally fine resolution. The radar also has a Ground Moving Target Indicator (GMTI) mode that exploits the Doppler effect to detect and track moving vehicles out to a range of 23 km. GMTI offers arc and spot scan capabilities and can be used to cross-cue other sensors.

Lynx also contains dedicated littoral search and imaging modes including Maritime Wide Area Search (MWAS), ISAR and Maritime Moving Target Indicator (MMTI). In addition, Lynx incorporates a change detection capability that can be integrated with GA-ASI’s Claw® sensor payload control and analysis software.

Due Regard Radar

A crucial attribute for RPAS operating in non-segregated airspace is to be able to navigate safely through the sky without endangering other aircraft, and an ability to resolve potential conflicts reliably as they develop. While systems such as Traffic Collision Avoidance System (TCAS)

and Automatic Dependent Surveillance-Broadcast (ADS-B) meet a cooperative detect-and-avoid requirement, not all aircraft are fitted with these systems.

A non-cooperative detect-and-avoid system is required that can adequately replace a pilot’s eyes; a need that has led to GA-ASI developing the Due Regard Radar (DRR), which presents information in the Ground Control Station (GCS).

DRR was first tested aboard NASA’s Ikhana RPAS, a Predator B used for trials and research programmes, and more recently on a CBP Guardian. The system employs an X-band Active Electronically Scanned Array (AESA) radar in the nose, integrated with the TCAS system. It is able to track small aircraft such as gliders and ultralights.

DRR provides the remote pilot with the kind of situational awareness that would otherwise only be possible in a manned aircraft. With a detection range against small aircraft of more than 10 nautical miles, the system allows appropriate avoiding actions to be taken long before a potential conflict becomes critical. The system also

allows a pilot to monitor automatic conflict resolutions generated by the TCAS system, and override them if necessary.

Advanced Cockpit Ground Control Station

Building on its successful earlier systems, GA-ASI has developed an Advanced Cockpit GCS (ACGCS) for various GA-ASI RPAS, offering superb situational awareness to the pilot. High-definition graphics and imagery provide a 270° field of view across multiple screens, and the pilot has Hands On Throttle and Stick (HOTAS) and touchscreen technology for ease of aircraft and sensor control. The RPAS can switch easily between autonomous “point and click” control and “hands on” manual control.

The ACGCS can fuse data from a variety of sources into a Common Operational Picture to provide a pilot with enhanced situational awareness of the battlespace, and incorporate special overlays for functions such as terrain avoidance and threat awareness. The system is built to function with the DRR and other detect-and-avoid systems.



CERTIFIABLE PREDATOR B

Civilian Airspace Compliant



SOLUTION

Performs over-the-horizon long-endurance, medium-altitude Intelligence, Surveillance and Reconnaissance (ISR) missions.

CHARACTERISTICS

Wing Span:	79 ft (24m)
Length:	38 ft (11.7m)
Powerplant:	Honeywell TPE331-10 Turboprop
Max Gross Takeoff Weight:	12,500 lb (5670 kg)
Fuel Capacity:	6,000 lb (2721 kg)
Payload Capacity:	4,800 lb (2177 kg) across 9 hardpoints (8 wing, 1 centerline) 800 lb internal (363 kg) 4,000 lb external (1814 kg)
Power:	45 kVA
Backup power:	2.2 kW

PERFORMANCE

Max Altitude:	>40,000 ft MSL
Max Endurance:	40 hr
Max Air Speed:	210 KTAS

CONTROL/DATA LINKS

Line-of-Sight:	C-Band
Over-the-Horizon:	X-, Ku-, or Ka-Band BLOS Backup BLOS capable

FEATURES

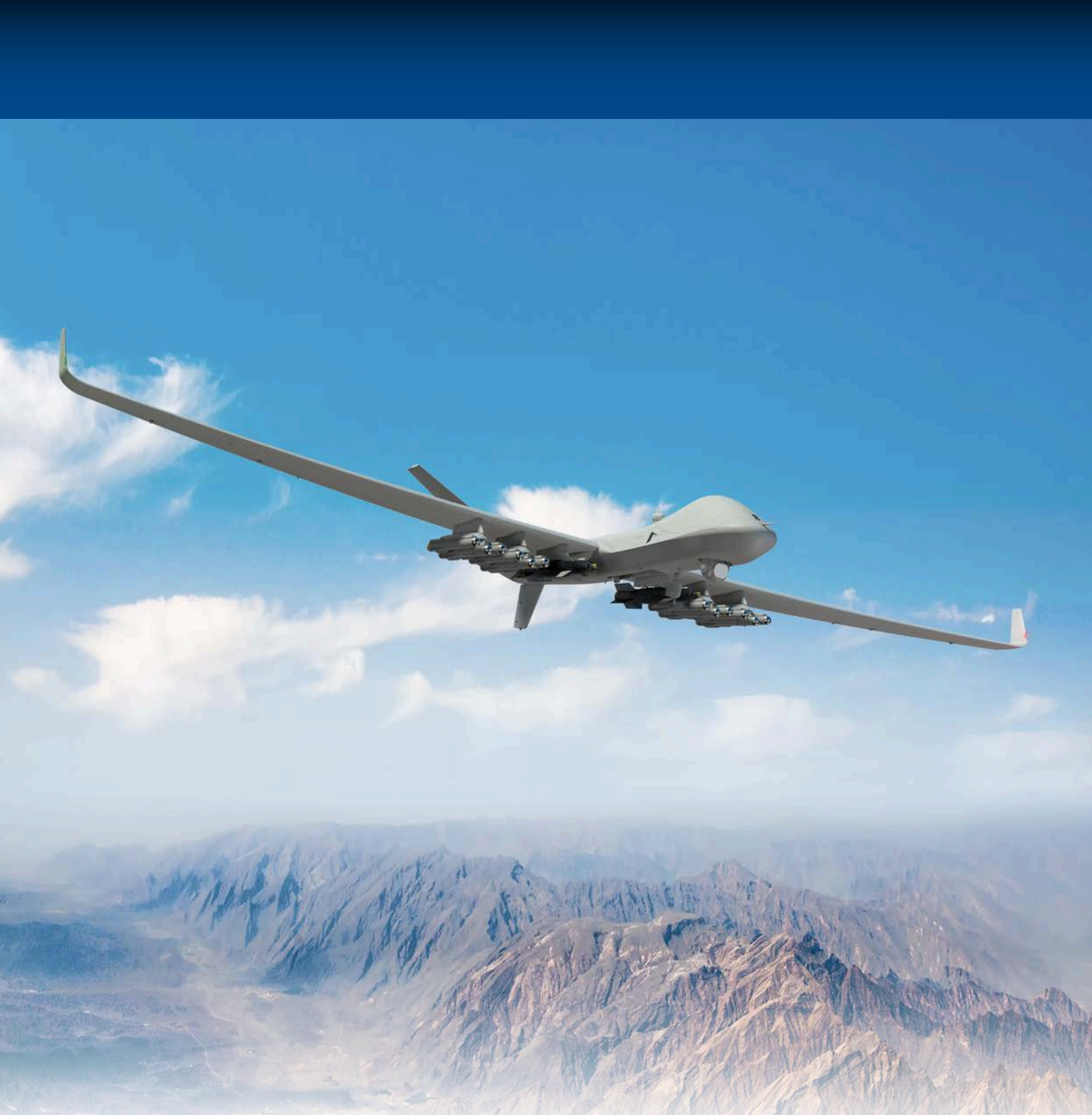
- Raytheon MTS-B EO/IR
- GA-ASI Lynx Multi-mode Radar and/or 360° maritime surveillance radar
- Precision guided munitions
- VHF/UHF certified radios
- DO-178 and DO-254 design assurance for software and avionics
- De-ice/Anti-ice system
- Detect and Avoid (TCAS/ADS-B/IFF – with provisions for Due Regard Radar)
- STANAG 4671 compliant type certifiable design
- 40,000 hour design service life
- All-weather capable
- Damage tolerant airframe
- Lightning protection
- Automatic takeoff and land
- Fire protected engine bay
- Other customer specific payloads

SeaGuardian Mission Kit: (Optional)

- Multimode Maritime Surface Search Radar
- Automatic Information System



Integrated Mission and Civil Certified Avionics



Multi-Mission – Single Solution.

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SkyGuardian

MULTI-MISSION – SINGLE SOLUTION

SkyGuardian™ is the latest in a distinguished line of Remotely Piloted Aircraft Systems (RPAS) that have been developed by the privately-owned General Atomics Aeronautical Systems, Inc. (GA-ASI). Equipped with powerful sensors and a weapons capability, SkyGuardian can be used for a wide variety of critical military missions.

Medium-Altitude Long-Endurance (MALE) RPAS have been in greater demand due to a range of factors including geo-political influences.

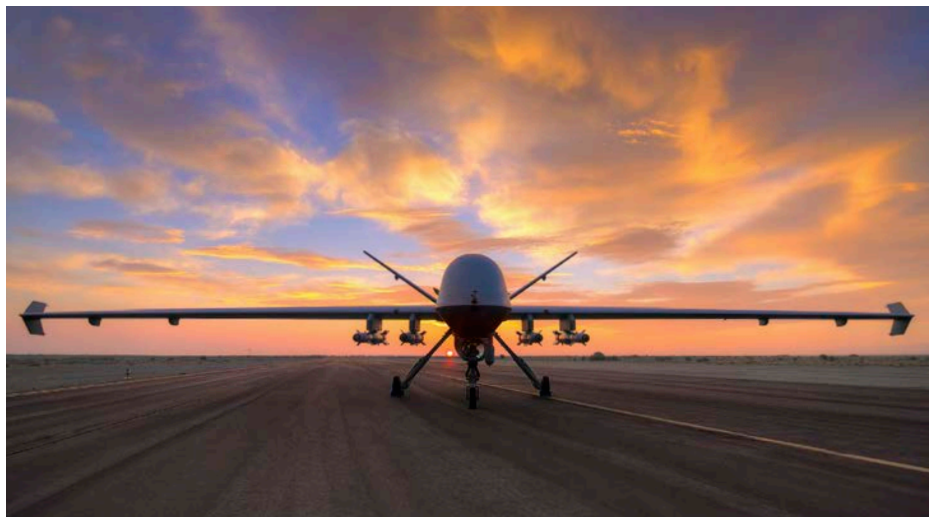
The requirement for intelligence – from high-definition, full-motion electro-optical video, mapping radar, signals intelligence, electronic support measures or maritime surveillance sensors – has never been higher, and continues to grow. Concurrently, the requirement to network that data and intelligence between platforms and the terrestrial operations has also intensified, as has the requirement for RPAS to strike threats as they appear.

RPAS must be capable of operations in national and international airspace, integrating seamlessly with manned aircraft, and able to respond in a similar manner to air traffic directions. To achieve that, the aircraft must be certified to meet airworthiness engineering and safety standards. GA-ASI has developed SkyGuardian to meet this goal. A holistic, nose-to-tail approach has created a new generation of RPAS; SkyGuardian is prepared for operations within increasingly national airspace, while providing vastly improved operational capabilities.

Mission success

With its long endurance, SkyGuardian provides persistent Intelligence, Surveillance, Reconnaissance (ISR) at a significantly lower cost than is possible with manned aircraft where endurance is typically limited by the onboard crew. Alternatively, the RPAS can use its endurance to reach areas that are far from base, at a fraction of the cost of dispatching a manned aircraft.

SkyGuardian can carry a wide variety of sensor payloads providing highly detailed intelligence from a significant standoff range. Other advanced technologies such as change detection allow the exploitation of raw data to meet a variety of military requirements, and are particularly applicable to the changing nature of the future battlefield.



Through its ability to carry a large weapon load and advanced automated control systems, SkyGuardian can launch attacks against detected threats, greatly reducing the kill-chain between detection and an armed response. Additionally, it can prosecute a mission over a lengthy period of time without needing to return to base for refueling or crew changes.

SkyGuardian was designed for a focused military purpose and was created for use in operational theatres.

SkyGuardian leverages the Predator® family legacy of 4,000,000 flight hours, 90% of which have been flown in combat.

The Predator series is currently being flown in theatre by the U.S. Air Force, France, Italy, and the United Kingdom.

While the aircraft has admirably met those pressing operational demands, its further evolution into other missions, and use for training purposes requires the ability to operate outside of military-controlled airspace.

Airspace integration

GA-ASI has been at the forefront of RPAS airworthiness and certification issues for more than a decade. Large-scale investment has been made by the company in this sector, and a number of key

technologies have been developed, such as the Due Regard Radar (DRR) to provide separation from non-cooperative aircraft.

Platform performance is another area that must be assured when flying in civil airspace. The ability of the RPAS to climb and descend at similar rates as manned commercial aircraft, and to execute standard-rate turns, is an important factor in seamless airspace integration. If an air vehicle cannot achieve such performance, it would be treated as a special case, immediately diminishing its ability to integrate seamlessly. Another factor is the ability to meet the requirements of a changing air traffic world, in which Required Navigation Performance (RNP) and reduced vertical separation minima are a reality. The sophisticated mission planning and accurate navigation systems of SkyGuardian and its Ground Control Station (GCS) are on the cutting edge of these technology needs and a natural fit with advances in airspace management.

Certification

Much of SkyGuardian's design is driven by the requirements of airworthiness regulations. Each aircraft part comes with the 'paper-trail' necessary to trace its provenance and manufacturing processes. All elements, including the Honeywell TPE331

engine and the McCauley four-bladed propeller, require airworthiness certification in the SkyGuardian installation.

Compared with the 'legacy' aircraft, SkyGuardian uses approved conforming airworthiness materials, similar to those employed in airliner construction. Overall maintainability is improved, and airframe design life is extended from 20,000 to 40,000 flight hours. Enhanced safety features include better protection against lightning strikes and an improved anti-icing system. Hardened external radomes increase resistance to bird strikes while internally there are improved thermal management and fire-zones including stainless steel walls.

A significant systems change is the partition between mission and flight applications allowing for isolation of flight technologies from payload systems. This change enables a roll-on, roll-off like capability for emerging sensor systems

that is not possible with an integrated flight and mission application. A 'black box' flight data recorder is included.

SkyGuardian has an Automatic Take-Off and Landing system, with the option of a back-up conventional manual flight system that may be required by some customers. The GA-ASI Advanced Cockpit GCS also has been modified to meet approval requirements, with some hardware changes required for flight-critical functions similar to what is seen on today's modern business aircraft.

Performance enhancements

In developing SkyGuardian, GA-ASI also has improved the performance and capabilities of the baseline air vehicle. Longer span wings fitted with winglets allow nearly 1360 kg (3,000 lb) of additional fuel to be carried internally. Endurance in an ISR unarmed configuration rises from 27 to more than 40 hours. This increase allows the aircraft to be used in a greater number

of roles and to operate in difficult-to-reach regions.

At the same time, the new wings have extra hard points, raising the total number of external stores/payload-carrying stations to nine (four under each wing and one under the centreline). Another external difference of SkyGuardian is a slightly lengthened fuselage that creates space for the installation of the DRR. Although SkyGuardian is fitted with Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Collision Avoidance System (TCAS) II as standard, the DRR is catered for as an option to provide a detect-and-avoid capability in a non-cooperative environment.

SkyGuardian offers unmatched persistence, versatility and cost-effectiveness across a broad spectrum of military requirements.

**GA-ASI SkyGuardian:
Multi-Mission: Single Solution.**



MQ-9 REAPER



Leveraging the Legacy of a Persistent Multi-Mission ISR and Strike Aircraft

SOLUTION

Perform multi-mission Intelligence, Surveillance and Reconnaissance (ISR) and “Hunter-Killer” missions over land or sea.

CHARACTERISTICS

Wing Span:	66 ft (20m)
Length:	36 ft (11m)
Powerplant:	Honeywell TPE331-10
Max Gross Takeoff Weight:	11,700 lb (5307 kg)
Fuel Capacity:	3,800 lb (1724 kg)
Payload Capacity:	850 lb int. (386 kg) 3,750 lb ext. (1700 kg) across 7 hard points (Six wing-mount, one centerline)
Payloads:	MTS-B EO/IR Lynx Multi-mode Radar Multi-mode maritime radar Automated Identification System (AIS) SIGINT/ESM system Communications relay
Power:	11.0 kW/45.0 kVA (Block 5) (redundant)
Weapons:	Hellfire missiles GBU-12 laser-guided bombs GBU-38 JDAM GBU-49 laser-JDAM

FEATURES

- Triple-redundant flight control system
- Redundant flight control surfaces
- Remotely piloted or fully autonomous
- MIL-STD-1760 stores management system
- Seven external stations for carriage of payloads
- C-Band line-of-sight data link control
- Ku-Band beyond line-of-sight/SATCOM data link control
- Over 90% system operational availability
- C-130 transportable (or self-deploys)

PERFORMANCE

Max Altitude:	45,000 ft (13716m)
Max Endurance:	ISR Mission: 27 hr/35 hr with Extended Range kit
Max Air Speed:	240 KTAS