



KLEIN
MARINE SYSTEMS



KLEIN SYSTEM 5900

High-Resolution, Dynamically Focused, Multi-Beam Side Scan Sonar

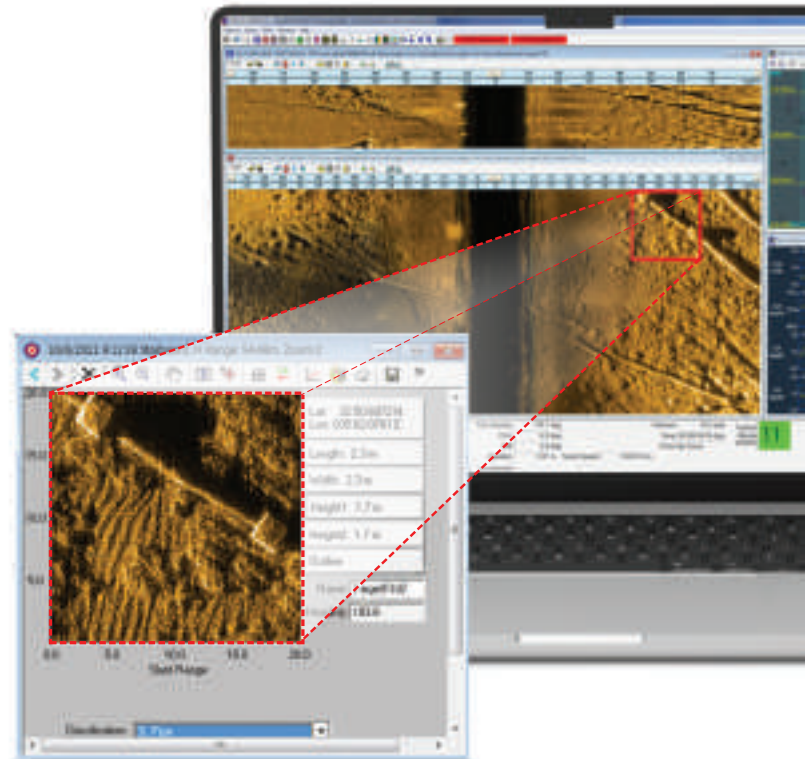
Klein Marine System's 5900 sonar is the flagship in our exclusive family of multi-beam side scan sonar systems.

The system is a highly configurable multi-functional platform that allows high-speed surveys up to 12 knots with 100% bottom coverage. Its non-magnetic tow body is hydro-dynamically designed to provide a stable towing for increased acoustic performance, natural depression capabilities and overall robustness.

The Klein 5900 high-resolution side scan sonar doubles the already legendary resolution of the Klein 5000 for mine countermeasure (MCM) grade images. The 5900 uses more than twice the number of acoustic channels available on its predecessors. This coupled with a carefully selected center frequency of 600 kHz and an acoustic aperture of 182 cm produces high-resolution images of superior quality.

Key Features

- Variable multi-beam (up to 20 beams per side, per ping) for high-speed, high-resolution coverage
- 1.8 m long array, 600 kHz operating frequency, 3.75 cm Across-Track Resolution
- FM-Chirp transmit coding, extremely low-noise acquisition and 28-bit analog-to-digital converter contribute to a very wide dynamic-range sonar system
- Dynamic focusing, high-pixel density imagery provides enhanced contrast for target/shadow definition
- Arrays optimized for multi-path and surface reverberation suppression
- Built-in system test capabilities



Modern and Practical Approach to Mine Countermeasure

The Klein 5900 is comparable to commercial and military SAS systems in the acoustic near field for manned and unmanned towed applications.

Mine Countermeasures in Littoral Waters.

Littoral waters present the frequent challenge of wave-induced motion on the towing vessel causing motion on the towed body. This situation is a major problem for conventional SAS systems inhibiting them from producing a synthetic image due to excessive heave variations. The architecture of the 5900 system relies instead on the known length of its segmented arrays to compute its synthetic beams.

Careful transducer design and narrow vertical beam-widths ensure delivery of outstanding shallow water performance by minimizing surface reflections typical of high sea state conditions of littoral waters.

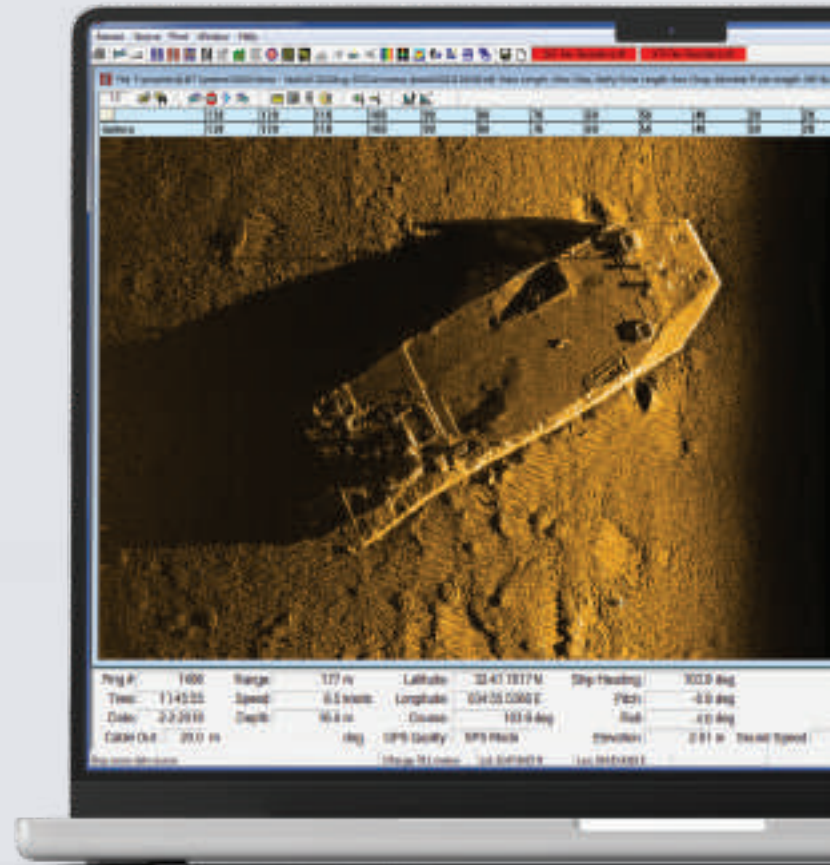
MCM With Any Weather

MCM operations need to be conducted with high efficiency and high coverage rate in all sensible weather conditions. SAS systems compel the MCM Commander to limit operations to windows of good weather or low sea states. The 5900 dramatically expands the window of operations due to its inherent motion tolerance. This shortens the MCM campaign by weeks in some occasions. You go to sea, you get images.

MCM in Unfriendly or Unknown Waters

When towing at 12 knots in unknown waters, the high risk of damaging or even losing valuable equipment when operating is another consideration behind the Klein 5900 design. The sound processing architecture allows Klein Marine Systems to eliminate expensive and sometimes fragile components (high-end motion sensors and stabilization appendices). Furthermore, with the use of MIL-COTS components, Klein can deliver high-resolution systems at commercial prices. The total cost of ownership when including the operational risks of equipment damage or loss, is therefore minimized.

Klein's design philosophy is to avoid the complications, costs and ITAR restrictions of a full SAS implementation, focusing instead on shallow coastal waters and relatively short range MCM operations.

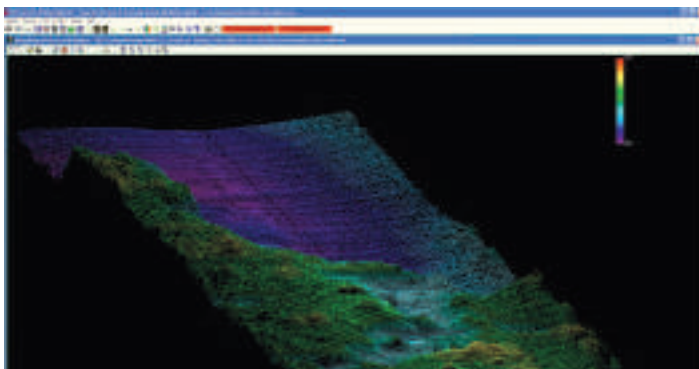


Klein System 5900 at 150 m range.

Beyond Bathymetry: Klein Q-Factor for Unmanned MCM

The Interferometric Swath Bathymetry Sonar option provides a co-registered "third dimension", or topographic information, in addition to the side scan data. Bathymetric data acquired by the Klein 5900 is seamlessly processed by the Klein SonarPro™ Software and by most third party hydrographic software platforms.

However, Klein 5900 bathymetry system can do much more. Bathymetry data is co-registered with the side scan sonar, providing a very important quality factor for the performance of the side scan sonar. In an unmanned scenario, the quality factor, which indicates presence of second returns and other anomalies, can be used to make real-time decisions (even in an automated fashion) which can dramatically increase the productivity of the survey.



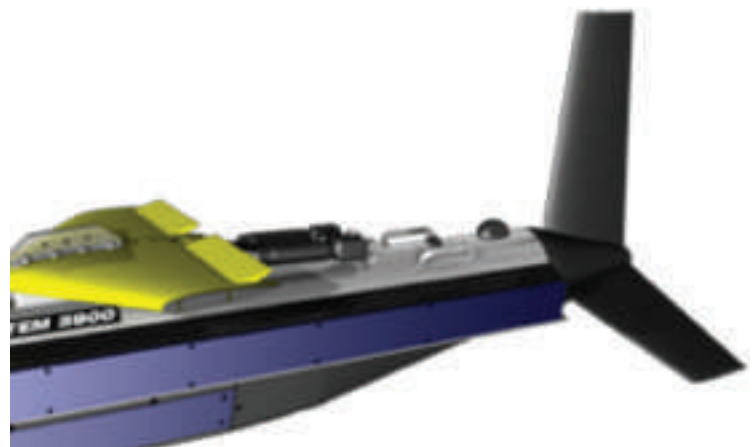
Bathymetry data @ 455 kHz

High Accuracy Positioning Options (DVL, USBL, INS)

The 5900 can be supplied with a fully integrated sensor fusion package - including sensors such as APS/USBL, DVL (for velocity) reported position, IMU - 3-axis linear acceleration and 3-axis gyro rotation. When the information is fused with the vessel GPS, the software reports a high accuracy position necessary for MCM targeting operations.

Remote Monitoring and Control with Klein SP-LINK

SP-Link provides real-time full resolution image transmission for real-time targeting.

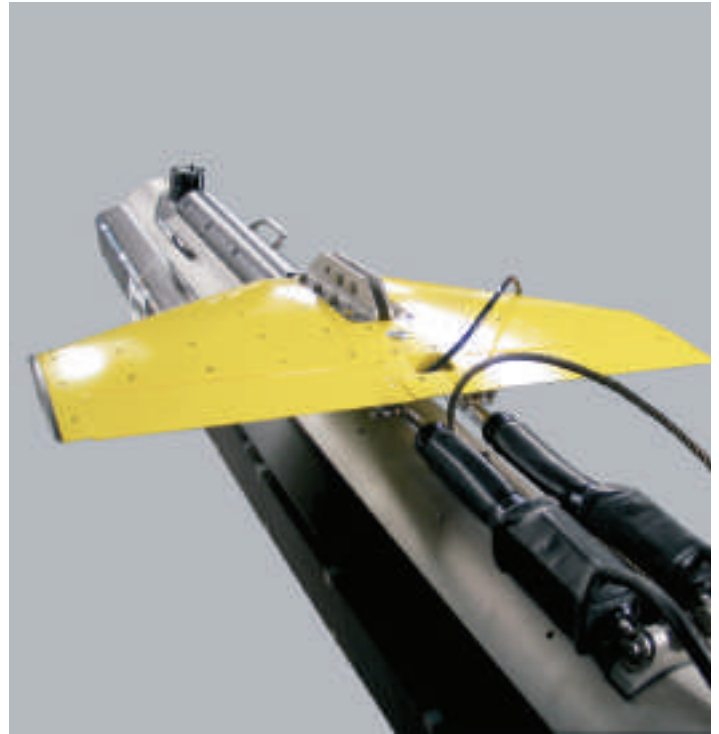


Standard Towfish Accessories:

- Compass - Heading
- Motion Reference Unit
- Dedicated Acoustic Altimeter - 170 kHz
- Depth Pressure Sensor
- Water Temperature Sensor
- Responder Interface
- Magnetometer Interface

Options:

- Gap Filler Sonar - Nadir coverage
- Interferometric Swath Bathymetry Sonar
- K-Wing™ II or K-Wing™ IV - Dynamically Controlled

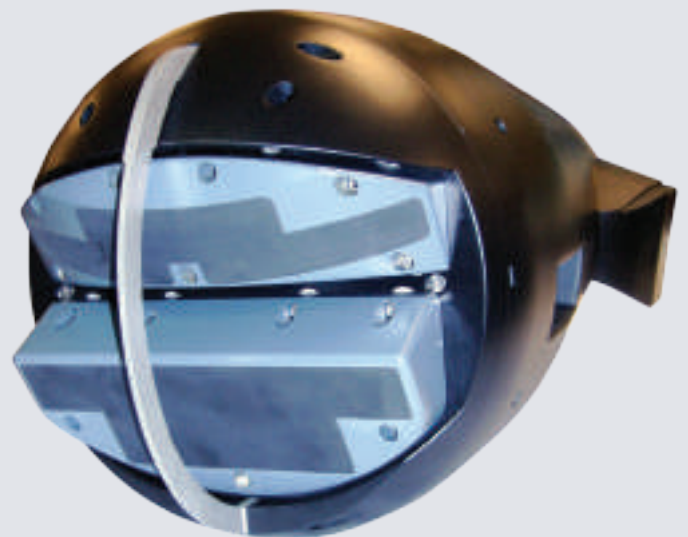
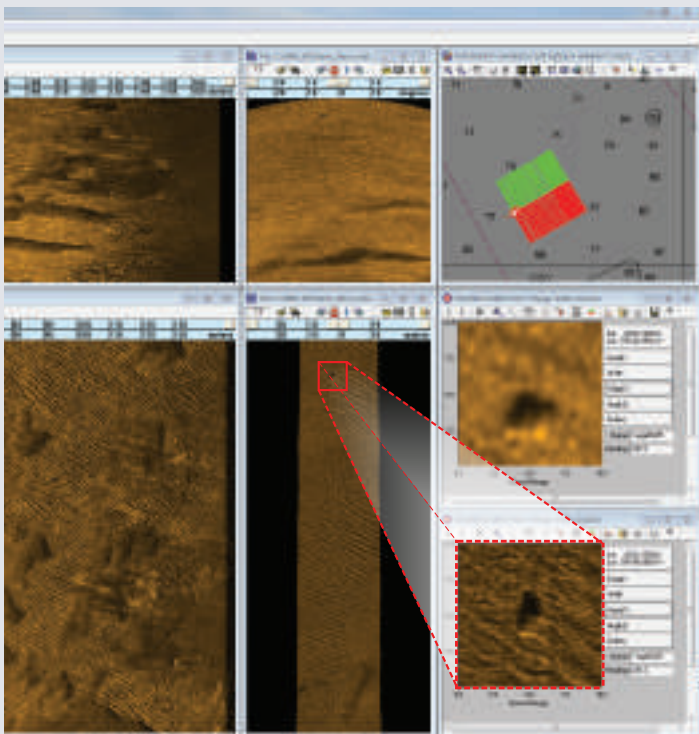


The K-Wing IV uses hydrodynamic forces to depress and steady the towfish while underwater. Dual ailerons are integrated and adjustable in the Klein SonarPro™ software or via SDK to compensate for roll bias, slight adjustments in altitude and fast-rise capability.

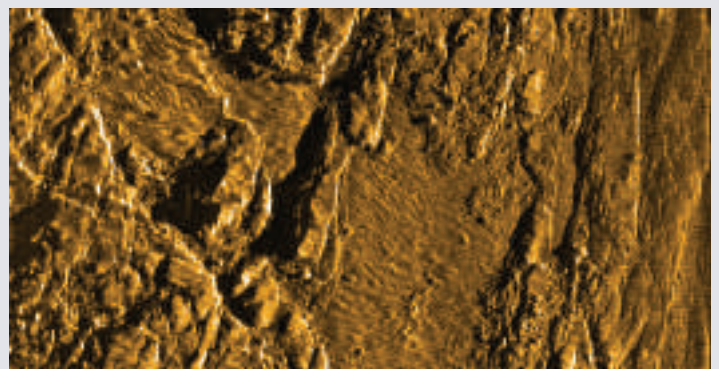
Optional High-Resolution Gap Filler:

The optional Gap Filler increases the rate of coverage by 40%, providing a full swath with gap-less coverage.

Klein System 5900 with optional Gap Filler Sonar:
(quality control and processed beam displays) at 150 m range.



Klein 5900 at 150 m range without optional Gap Filler:



Tow Fish General Specifications	
Construction	316 Stainless Steel
Length Without Gap Filler Sonar (GFS)	2.36 m (93 in)
Length With Gap Filler Sonar (GFS)	2.80 m (110 in)
Outer Diameter	20 cm (8 in)
Weight In air:	238 kg (525 lb with Bathy)
Weight In water:	179 kg (394 lb) nominal
Maximum Depth Rating	750 m 250 m max depth with Bathy
Operating Speed Envelope	2 to 12 knots (with 100% bottom coverage)

Topside Assembly Dimensions / Weight	
Towfish Interface Unit (TIU)	2U 19-in rack-mount chassis
Sonar Processing Unit (SPU)	2U 19-in rack-mount chassis
High-Voltage Power Supply (HVPS)	1U 19-in rack-mount chassis
Workstation PC	2U 19 in rack mount chassis, 27 in monitor, with SonarPro® and Windows installed
System Power Requirements	100-125 or 200-250 VAC, 50/60 Hz at 1,000 W nominal

K-Wing IV (Optional)	
Construction	Aluminum
Dimensions	30.5 in x 15.625 in x 2.5 in
Weight In air:	38 kg (84 lb)
Weight in water:	12 kg (27 lb)

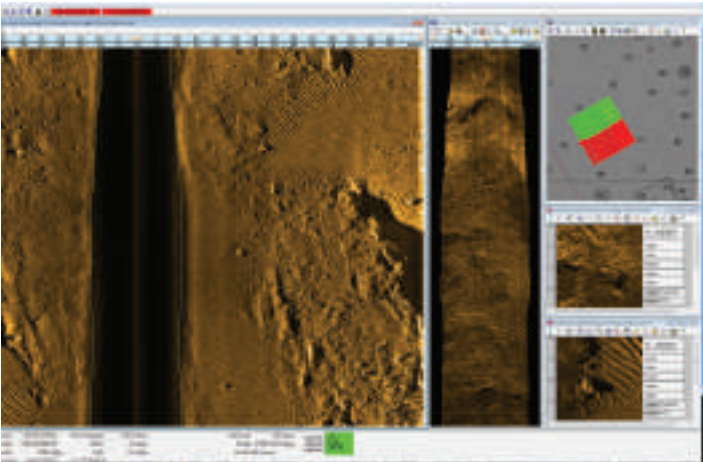
Swath Bathymetry Sonar (Optional)	
Frequency	455 kHz
Transmit Pulse	CW, FM-Chirp
Along-Track Resolution	0.4° [single swath per ping]
Swath Coverage	10 to 12 times altitude

Klein Marine is deeply committed to customer support. We are currently servicing valued customers in 80 countries, and relying on a network of competent International Representatives to meet and exceed the service needs of our customers around the world. We provide 24 hour / 7 day a week support.

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Multi-Beam Side Scan Sonar Specifications	
Technology	Multi-Beam Sonar with dynamic focus and dynamic aperture (maintains 100% bottom coverage, up to 20 beams per side)
Frequency	600 kHz
Along Track Resolution	6.2 cm at 50 m range setting (constant) 9.3 cm at 75 m range scale 15.5 cm at 125 m range scale [0.07° beamwidth]
Across Track	3.75 cm
Transmit Pulse	CW, FM-Chirp
Maximum Operating Range	150 m (nominal)/side
Array Length	1.8 m
Vertical Beamwidth	Optimized for shallow water operations
Background to Shadow Contrast Ratio (CR)	> 10 dB - at detection range of 150 m > 15 dB - at classification range of 75 m
Output Data Format	SDF (Sonar Data Format), XTF (Extended Triton Format) or both, - selectable -also supported via SDK
Tow Cable	750 m coaxial; > 3,000 m fiber-optic cable

Gap Filler Sonar (Optional)	
Frequency	750 kHz
Transmit Pulse	CW, FM-Chirp
Along-Track Resolution	4.8 cm
Across-Track Resolution	< 0.5°
Gap Coverage	To 45° each side
Declination	Tilted down 30° from horizontal



Klein System 5900 Optional Gap Filler Sonar (processed beam displays with targets) at 75 m range.