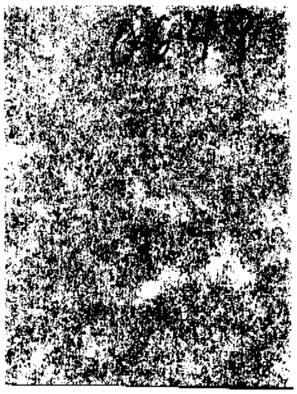

The Appplication of Sector Scanning Sonar Technology to the Mapping of Granular Resources on the Beaufort Shelf Using the Sea-Ice as a Survey Platform

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THE APPLICATION OF SECTOR SCANNING SONAR TECHNOLOGY TO THE MAPPING OF GRANULAR RESOURCES ON THE BEAUFORT SHELF USING SEA-ICE AS A SURVEY PLATFORM

McQuest Marine Research & Development Company Limited was contracted by Steve Blasco, Geological Survey of Canada, Atlantic, to replay and filter Beaufort Sea sector scanning sonar images in an attempt to enhance resolution, enable discrimination between the under ice morphology from the bottom characteristics, and enhance field techniques for the adaptation of sector scanning sonar to through the ice profiling and scanning for the determination of a mapping of seabed granular resources.

BACKGROUND

An Imagenex 330 kHz Sector Scanning Sonar was lowered through a hole in the ice platform. The transducer rotated and collected sonar image data which was displayed in real time on a colour video monitor. Selected scans were stored by recording the sonar signals on a Digital Audio Tape (DAT) recorder for further analysis. The sonar transducer was lowered using a rope to the sea floor to determine the water depth and was then raised "several metres". From discussions with the operational crew, it was determined that the usual distance was 2 to 3 metres. Following the operation in the polar mode, a bracket assembly was attached and the transducer repositioned in a profiling mode in order to determine the under ice characteristics, (ridges etc.) and the seabed bathymetry and morphology.

EQUIPMENT

The Imagenex 330 kHz underwater scanning head has a range of 200+ metres and consists of a fan beam transducer with a vertical beamwidth of 45° and a horizontal beamwidth of 1.9°. (See Figure 1) When the transducer unit is mounted vertically, the centreline of the sonar beam is parallel to the sea floor. (See Figure 2a and 2b) The stepper motor steps the transducer around the vertical axis, thus providing a polar scan. (The type of image displayed is called a Plan Position Indicator (PPI) Display). If a change in bottom type or morphology is encountered, it reflects the acoustic signal back to the transducer where it is converted into an electrical pulse and the signal is processed, displayed and stored, either as a DAT tape record of the sonar signal, or as a digital image (.PCX format). The resolution of the colour monitor display is dependent upon the range selected for the display. As an example, each pixel on the displayed image corresponds to approximately 10.5 cm x 10.5 cm when the range is set for 20 metres.

ACOUSTIC CONSIDERATIONS

An acoustic pulse which impinges on a horizontal surface will be reflected back to the source under certain conditions. If we draw an analogy to optics, a light beam will reflect from a flat horizontal glass surface; beams 1 and 2 on Figure 3. At a certain angle θ, the light beam enters the glass and is not reflected, (beam 3), and at a shallower angle the light beam is refracted as in beam 4. The critical angle is dependent upon the optical differences of the medium of transmission and the glass medium. In the case of an acoustic pulse, if the angle is less than θ critical, then the acoustic pulse will not reflect back to the transducer. As a rule of thumb, for every metre the transducer is above the bottom, the acoustic pulse will still be reflected back to the transducer up to a distance of 10 to 15 metres. If a transducer is mounted 2 metres above the bottom, we would not anticipate receiving a return signal at a distance greater than 15 metres; i.e. the range of the sonar is 10 to 15 times the height of the transducer above the bottom. (This corresponds to an angle of 3.8° to 5.7°.) Because of the fan shaped acoustic beam, objects in the beam which are located the same distance away from the transducer, could be at the top of the beam, or at the bottom of the beam, and their image could not be resolved. (See Figure 4). In the case of the under ice imaging, the top object would be the underside of the ice, while the bottom object would be the seabed.

REPLAY OF BEAUFORT SEA DATA

The data supplied on DAT tapes was replayed through *McQuest's* Imagenex Processor, in order to observe the replayed real-time images and compare them to the processed and printed images contained in the report from the field work. Since the transducer was lowered into the water using a rope, any change in direction of the sonar head rotation induced a torque in the rope. Change of sonar head rotation direction can be initiated by the Processor/Controller during the collection of the data and also when the head steps to the 0° / 360° transition point. If the transducer was stepping in a clockwise direction, for example, the torque would be taken up by rotation of the rope in the counter-clockwise direction. As soon as the transducer reversed direction, the torque taken up in the rope would be released thus rotating the transducer in an anti-clockwise direction (the direction in which it is now stepping) causing a smearing of the acoustic data, until the torque and rotation is taken up in the rope again. (A single point target will appear as an arc.) The smear evident on the records was variable, perhaps due to the freezing of the rope, and averaged over approximately 10°. At 100m range, a single pixel would be smeared over an arc of approximately 34 pixels, or 18 metres. (The screen resolution used to display the sonar data is 480 pixels by 400 pixels. Depending on the range selected, there are 38 pixels used to represent each range circle. At 100 metre range, 38 pixels corresponds to 20 metres.) Because the display is refreshed by the data from the rotating beam, this smear of data is always present on the images, usually displayed near the transition sweep. If the rotation rate is reduced the effect of the smear is reduced. (See Recommendations)

Because the sonar data of the underside of the ice was mixed with the sonar returns from the sea floor, (see following section), it was speculated that it may be possible to filter out the ice reflection data because it may have a higher frequency return. The sonar signal recorded on the DAT tape is already a processed signal, i.e. the 330 kHz signal has been detected and converted to an audio signal which can be recorded on the DAT recorder. Any filtering attempts to remove one set of reflected data from the under-ice surface, from the sea floor data would have to be performed on the raw signal prior to detection and processing. This would not be possible with the data set supplied. (Note: Imagenex has recently supplied a SCSI interface for a hard drive as an accessory to the processor. The raw signal data after some preliminary filtering is available in a digital format, so that digital filtering could be applied. This digital data is being used with a neural network to identify and discriminate reflections from different materials.)

DISCUSSION OF BEAUFORT SEA DATA

As discussed above, the range insonified by the transducer is a function of the height above the sea floor. First we should consider the case of very deep water. If the transducer is 2 metres above the sea floor, then the sea floor that is insonified extends from directly below the transducer out to a range of 20 to 30 metres. The water column range will extend greater than 200 metres. There will be no acoustic returns displayed until the acoustic pulse reflects from the bottom below the transducer (i.e. 2 metres) and then returns will be displayed out to 20 to 30 metres. Beyond 30 metres, little or no returns will be displayed. (Topographic returns beyond the 30 metre range, discussed above, will appear if the height if the object is sufficient to allow the angle θ to exceed the critical angle.) If the transducer is raised to 8 metres above the bottom, the displayed data will be from 8 metres out to 120 metres and the only data beyond 120 metres will be from topographic targets. Now consider an ice-covered water surface with a 10 metre water depth below the ice. If the transducer is mounted 2 metres above the bottom, (i.e. 8 metres below the ice surface), then the data display from 2 metres to 30 metres will be from the sea floor, and the data display from 8 metres to 120 metres will be from the underside of the ice. The two data sets are merged and indistinguishable from 8 metres and beyond. The only data returned from the sea floor itself which can be discriminated is that from 2 metres to 8 metres! If the transducer was raised so as to be 2 metres below the underside of the ice, then the underside of the ice would be displayed from 2 to 30 metres and the sea floor would be displayed from 8 to 120 metres. This would mean that the combined data for the underside of the ice and the sea floor would be displayed from 8 to 30 metres, and the sea floor data would be displayed from 30 to 120 metres. By selecting the ice hole location, successive scans would provide 100% coverage.

For the profiles of the underside of the ice, the transducer in the profile mode should be lowered as close to the bottom as possible so that it images the largest possible profile of the under-ice surface features.

RECOMMENDATIONS

From the discussion of the data smear, it is evident that the suspension equipment for the transducer, either in scanning or profile mode, must be rigid. Using ABS pipe to lower the transducer assembly would provide a non-rotational platform. While the ABS pipe may waver in the current due to its flexibility, replacing the ABS pipe with a piece of aluminium pipe (e.g. electrical conduit) for the profiling mode would reduce this. However, for inserting the unit close to the underside of the ice, a short length of ABS pipe would be more than adequate.

Modifications to the acoustic beam have been carried out in the field under certain conditions. For example, in shallow water, the sonar can pick up the air/water interface and if rough this can mask targets on the sea floor. By mounting a piece of Neoprene diver's wet suit material on the transducer, the beam pattern can be modified so that the acoustic beam is deflected down from the surface, thus reducing the interference. (Note that this assumes the transducer is on top of the unit and is mounted upright on the support.)

Some data should be collected as raw data, either in the field or a test tank in order to test the hypothesis of the higher frequency return from the underside of the ice. Ontario Hydro Technologies have been carrying out experiments with *McQuest*'s unit to develop a neural network processor which can discriminate between various solids which might be found at the intake to a Hydro facility. This work has been done at an acoustic test tank in Toronto and in the field.

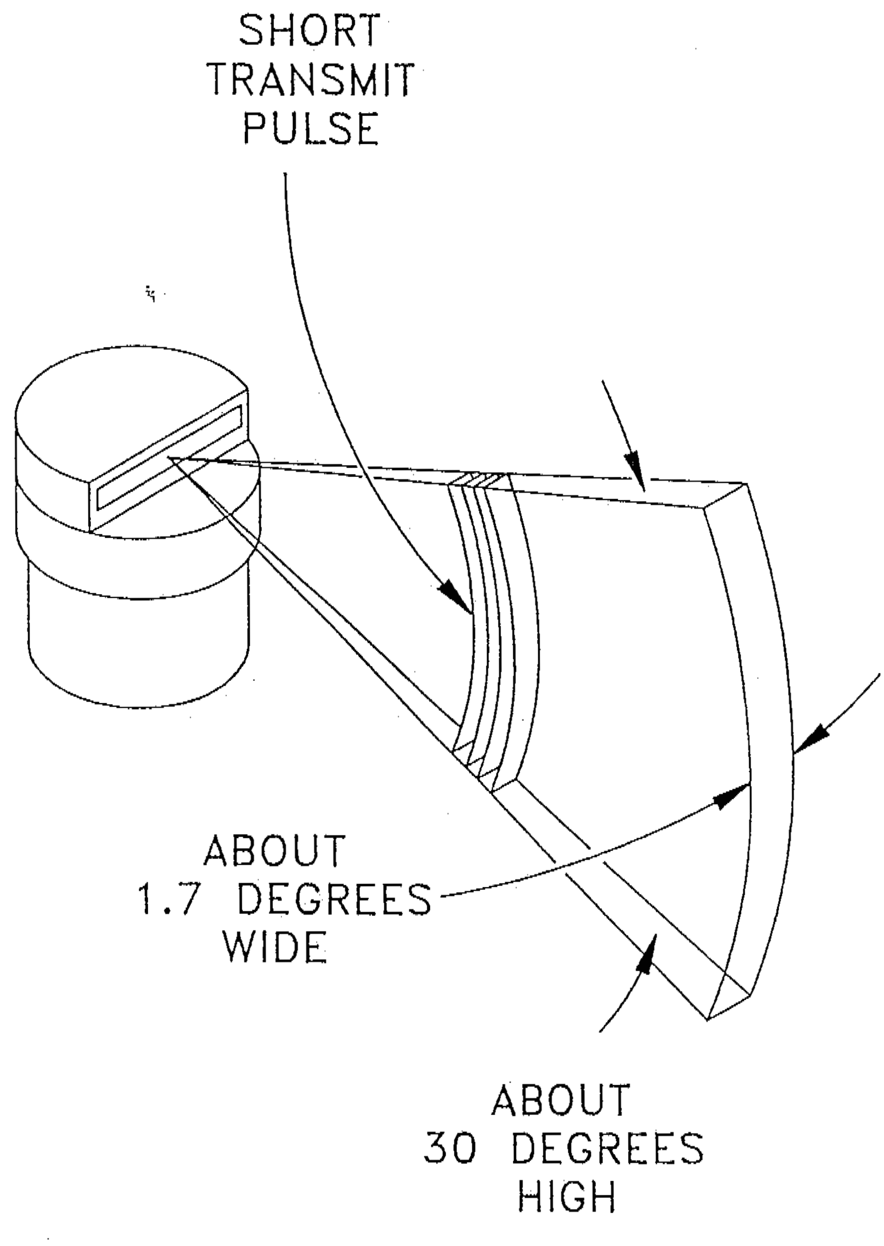
The geometry of the equipment setup must be taken into account during field operations. The height of the transducer, its orientation, and rigidity should be taken into account. Depending upon what is to be imaged the distance away from the surface of interest must be altered as water depth, ice thickness, or other factors influence.

When data is being recorded on DAT tape, the range should be set to the maximum possible. Replaying the DAT tape at shorter ranges after the field collection can provide detail which may not be visible in the long range scan. The rotational speed should be set as slow as practical (it will take much longer to record a complete scan at the slower speeds).

When data is replayed, the image processing software should allow manipulation of the image. The image should be able to be zoomed and manipulated. The colour of the returns should be able to be selected, not to save ink when printing, but rather to portray the image in the best light for interpretation. The attached colour printout is the same image displayed in the Sea Dragon report (Hole 8), and it is evident that more details can be observed.

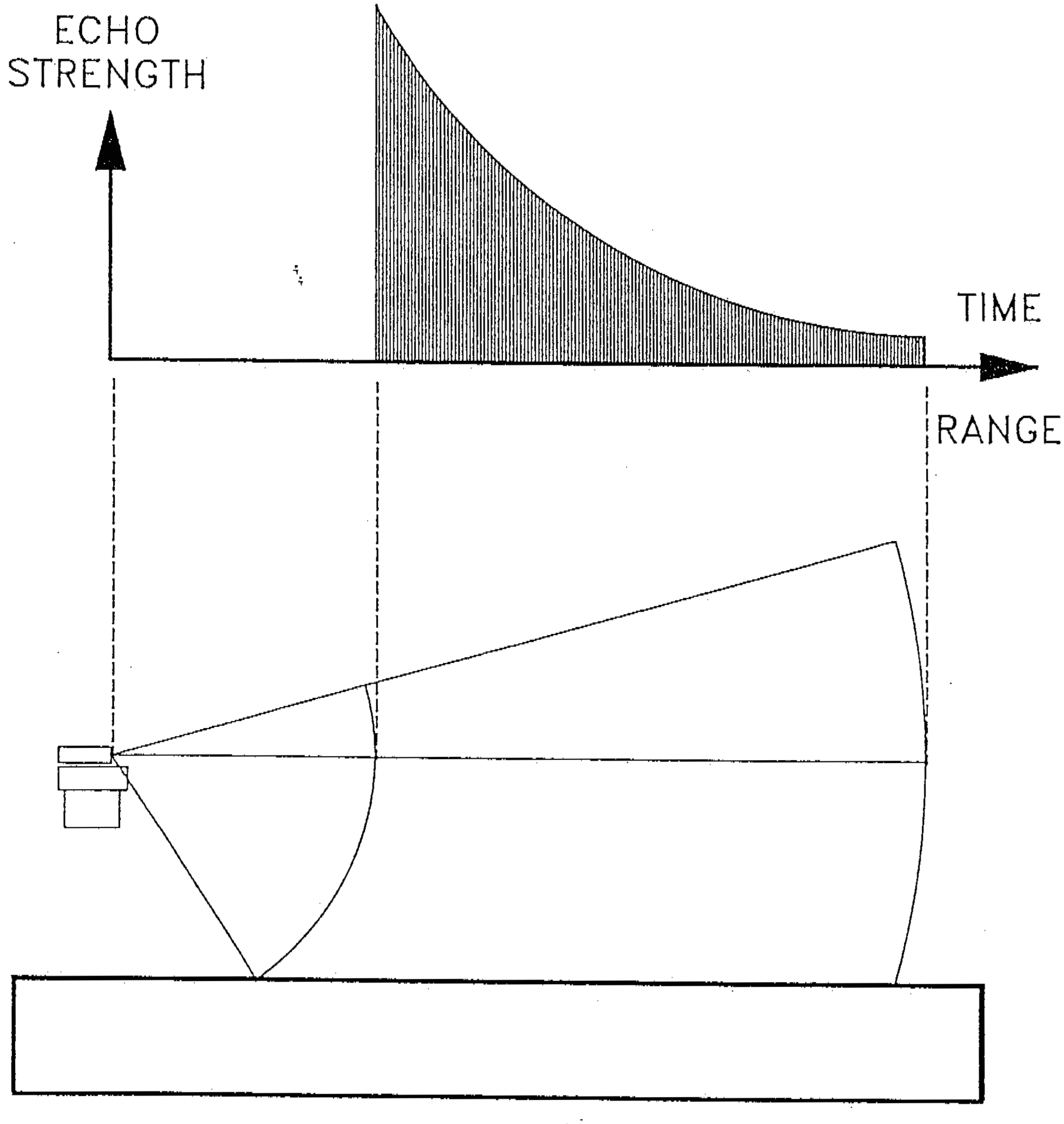
CONCLUSIONS

The data set supplied is not representative of what can be achieved using proper field techniques. In other survey applications in the Great Lakes, the Imagenex scanning sonar was used to discriminate bottom morphology and lithology by interpretation of the sonar images. The equipment can successfully discriminate granular material from silts and clays when used properly.



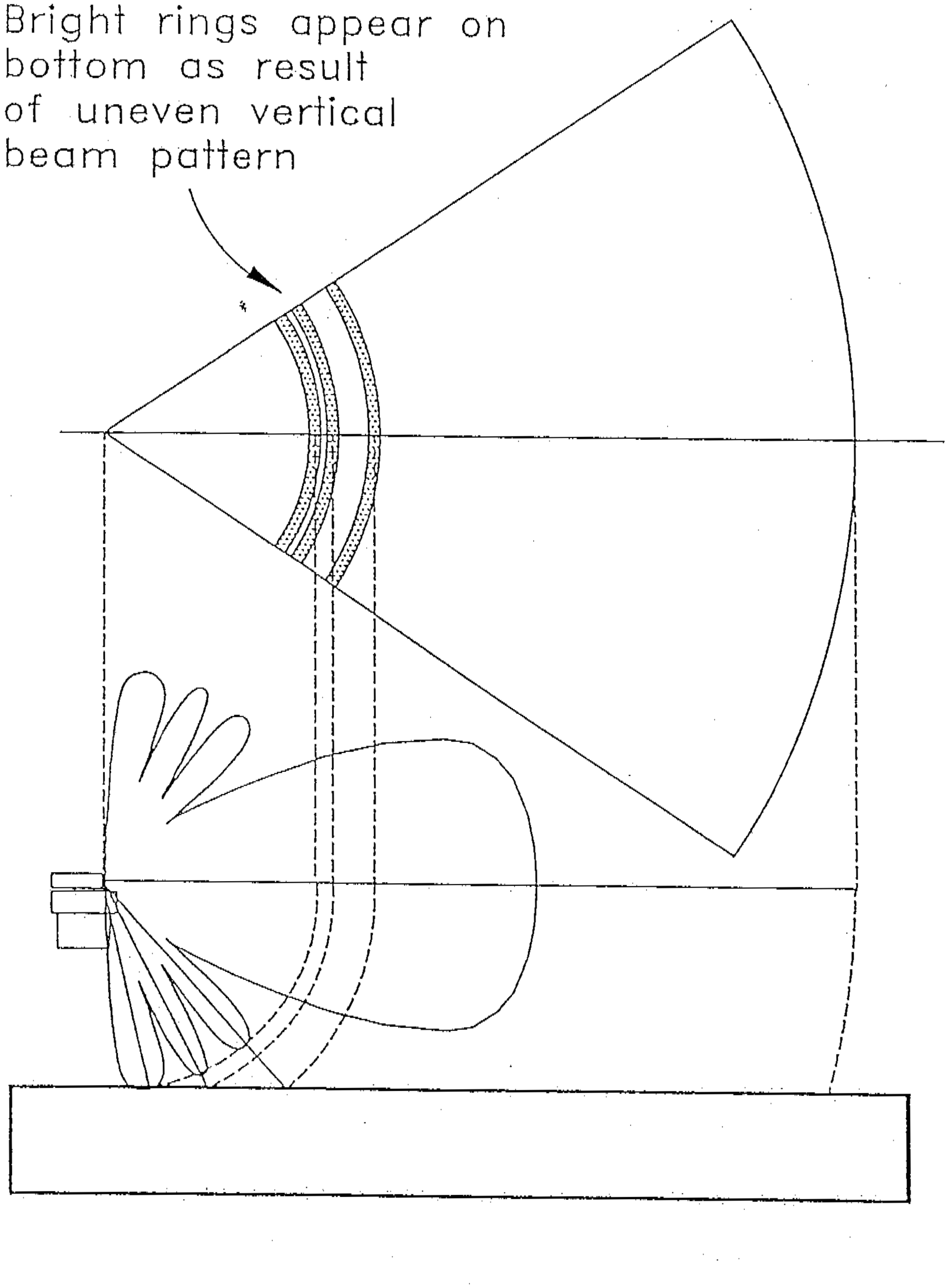
TYPICAL FAN SHAPED BEAM
AS USED ON IMAGING SONARS

FIGURE 1



FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM

FIGURE 2A



ACTUAL SONAR BEAM WITH UNEVEN PATTERN

FIGURE 2B

FIGURE 3

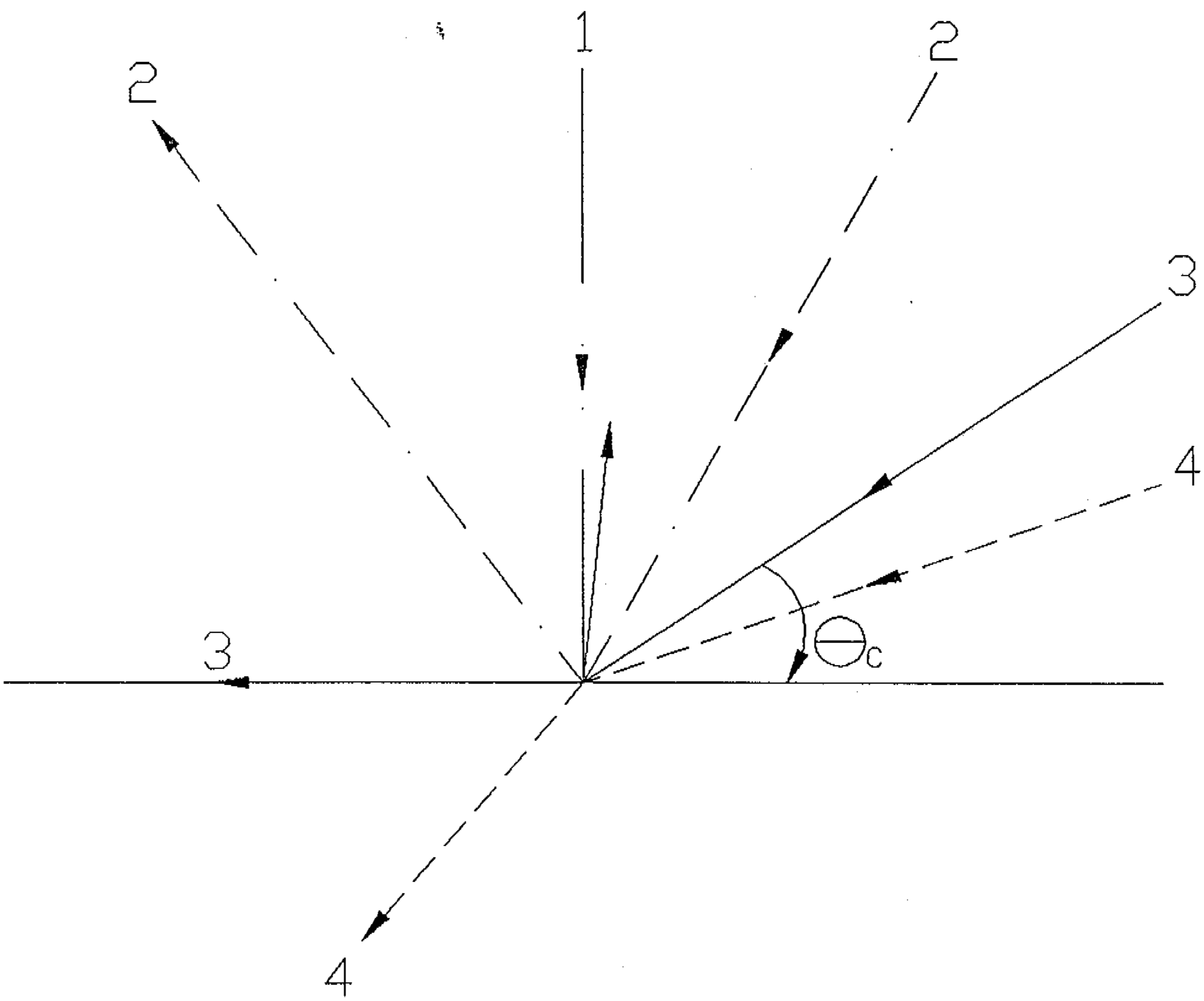
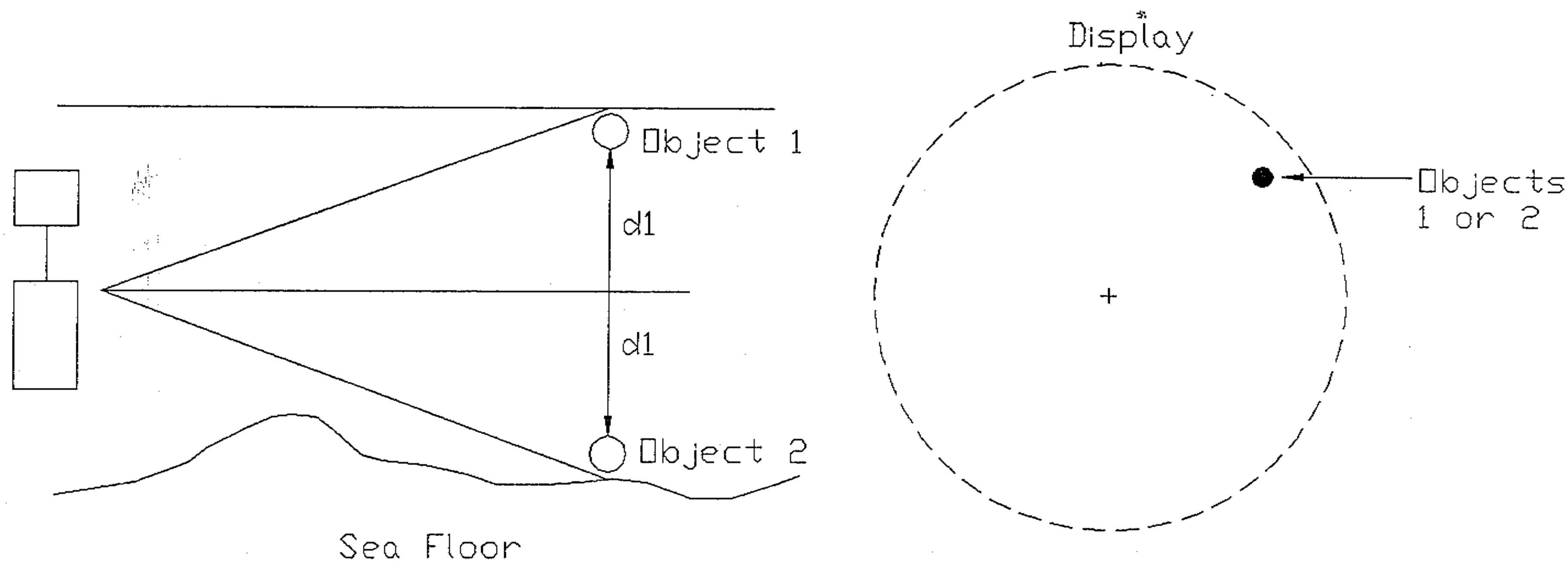


FIGURE 4



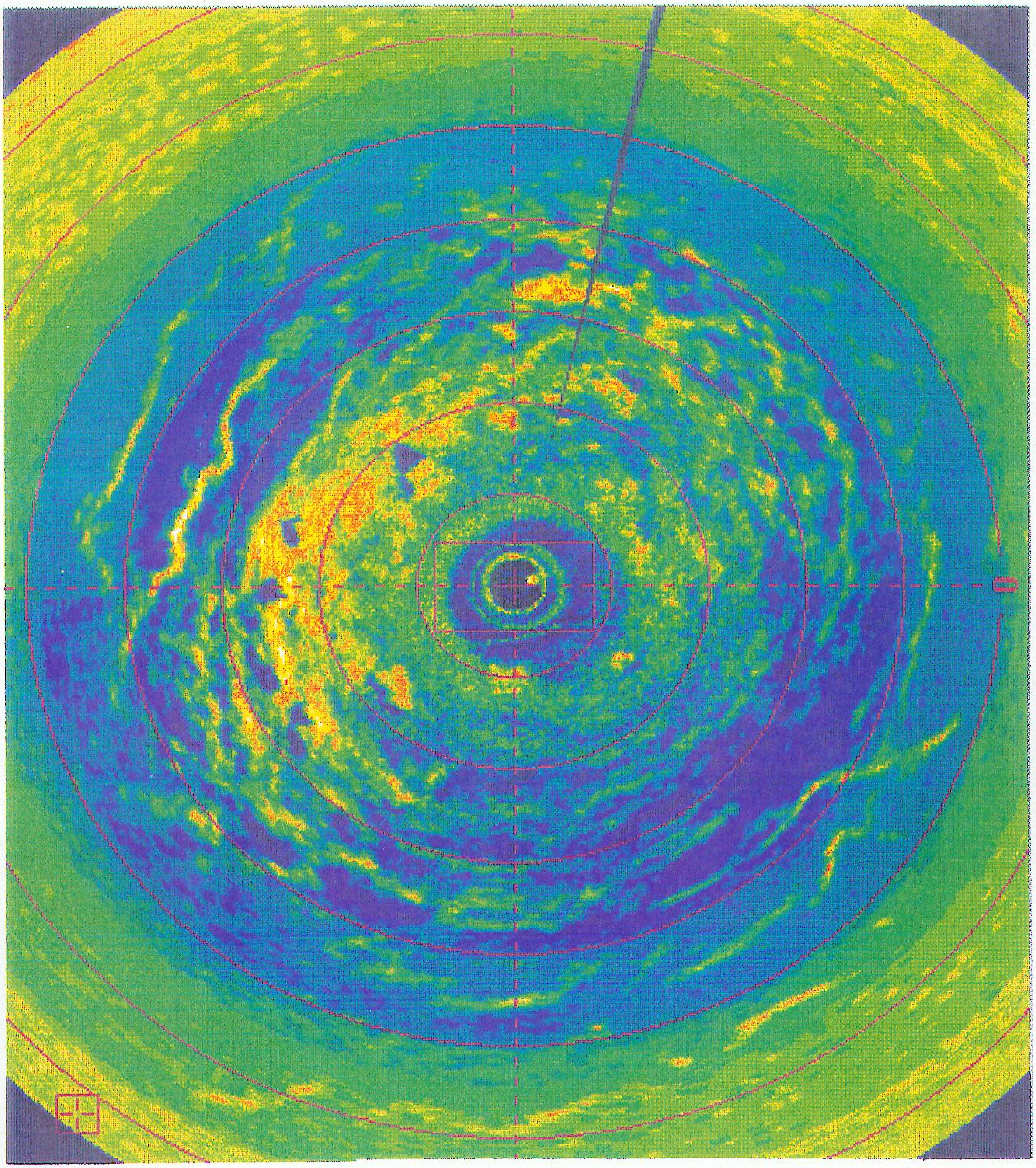


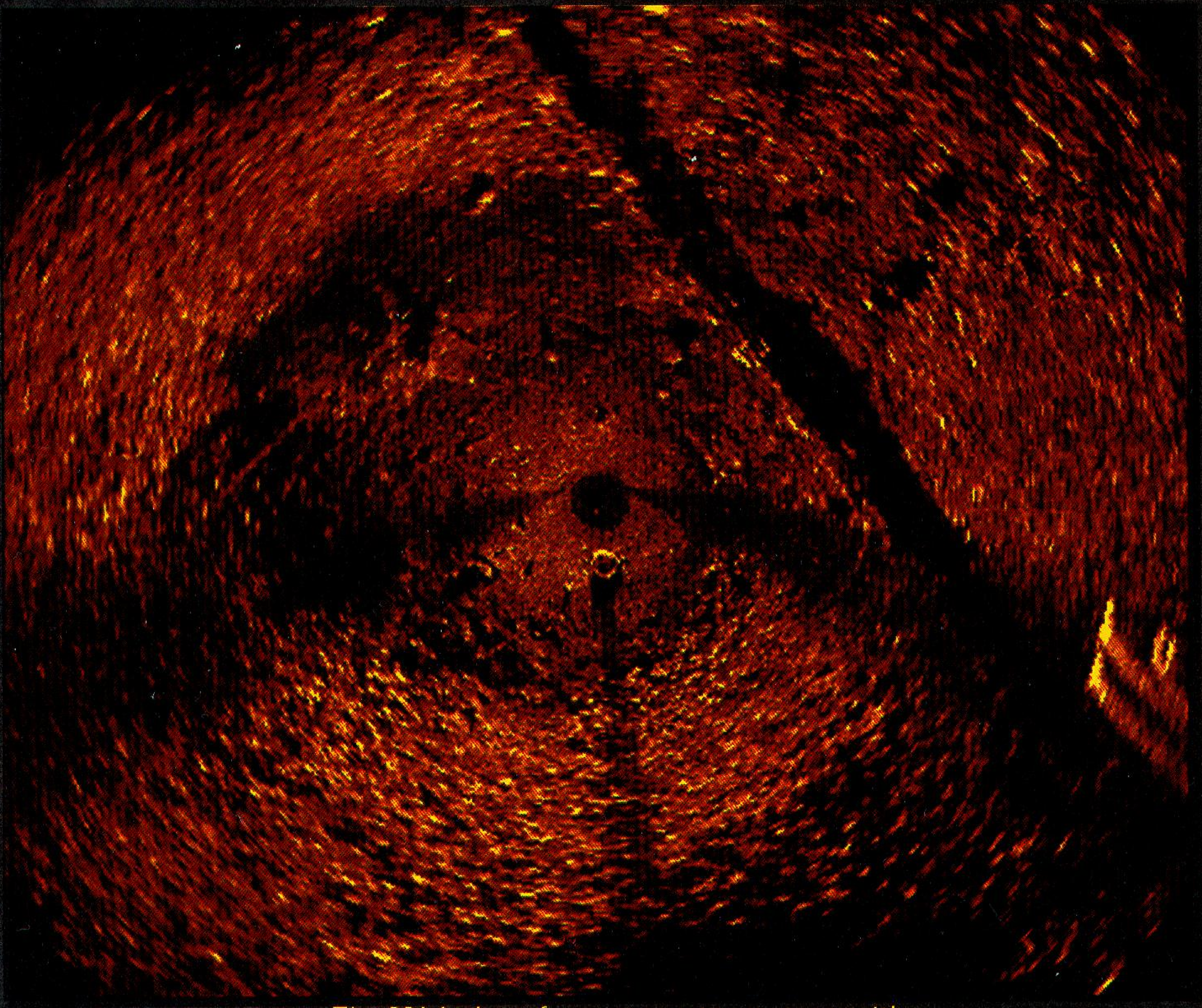
FIGURE 5

IMAGENEX

REDEFINING IMAGE CLARITY

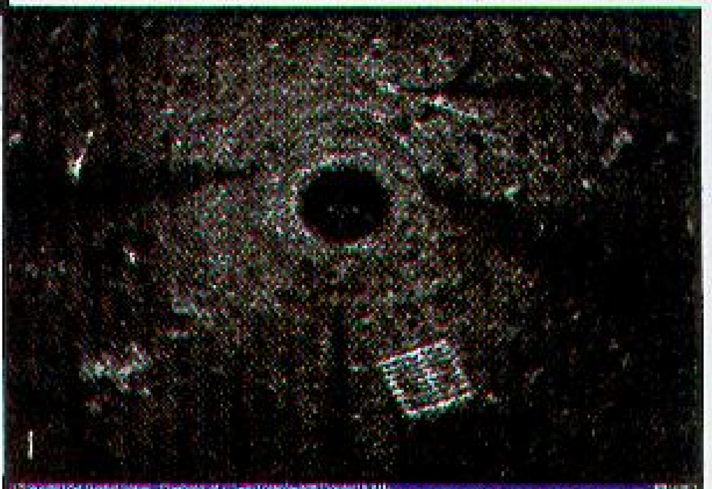
The Imagenex 881

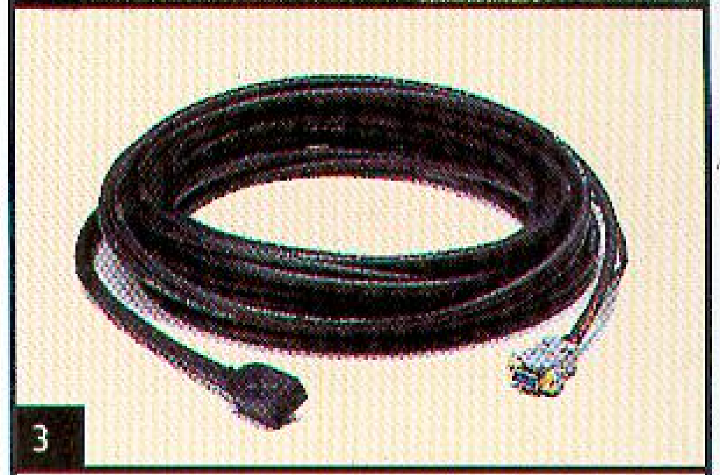
High Res Imaging Sonar



The 881 high performance sector scanner, with a standard serial output for underwater remote sensing, provides the sharpest image, the most re-definable data and is the most flexible system available

At **IMAGENEX**, we think no Sonar feature is more important than **image clarity**. Our design team helped pioneer modern imaging sonar technology, and we continue to lead the way, pushing the **performance** boundaries of our high resolution sonar units. With continuous technological advancements, software and hardware **compatability, portability** and overall ease of use, **IMAGENEX** sonar systems set **the** industry **standard** as the most **specified** sonar systems **world wide.**





IMAGENEX MODEL 881 TECHNICAL SPECIFICATIONS

APPLICATIONS

- ROV
- OFFSHORE OIL & GAS
- SUNKEN TIMBER RECOVERY
- PROFILING
- DIVING SUPPORT
- SURVEYING
- SEARCH & RECOVERY
- INSPECTION
- UNDERWATER ARCHAEOLOGY
- SCIENTIFIC RESEARCH

The 881's superior imaging is supported by the latest analog to digital conversion technology.

Imagenex **Windows™** compatible software controls, displays, and records data from the Model 881 Digital Sonar Head.

OPTION: Supplied with interface source code in "C". Intended to be a starting point for custom programming.

RECOMMENDED COMPUTER SPECIFICATIONS: 100 MHz Pentium, 16 MB Ram, 1 GB Hard Disk, 800 x 600 x 256 colour graphics

REQUIRED: RS 485 serial interface operating at 115.2 K baud

Printed in Canada 04/25/97

SPECIFICATIONS

FREQUENCY: 675 kHz standard, others available

TRANSDUCER: Imaging/Profiling

POWER SUPPLY: 22 - 48 VDC at 1 amp max.

INTERFACE: *RS-485 or RS -422 serial, 2 wire or 4 wire available (* Address up to 30 units on one cable)

CABLE LENGTH: 1000m on typical twisted shielded pair

STANDARD OPERATING DEPTH: 1000M - (3,300 ft.) others available

MATERIALS: Aluminum 6061-T6, 300 series stainless steel, pvc, acetal homopolymer, epoxy

FINISH: Hard anodize, polyester powder

DIMENSIONS: 89mm *(3.5 in)* diameter x 340 mm *(13.4 in)* length

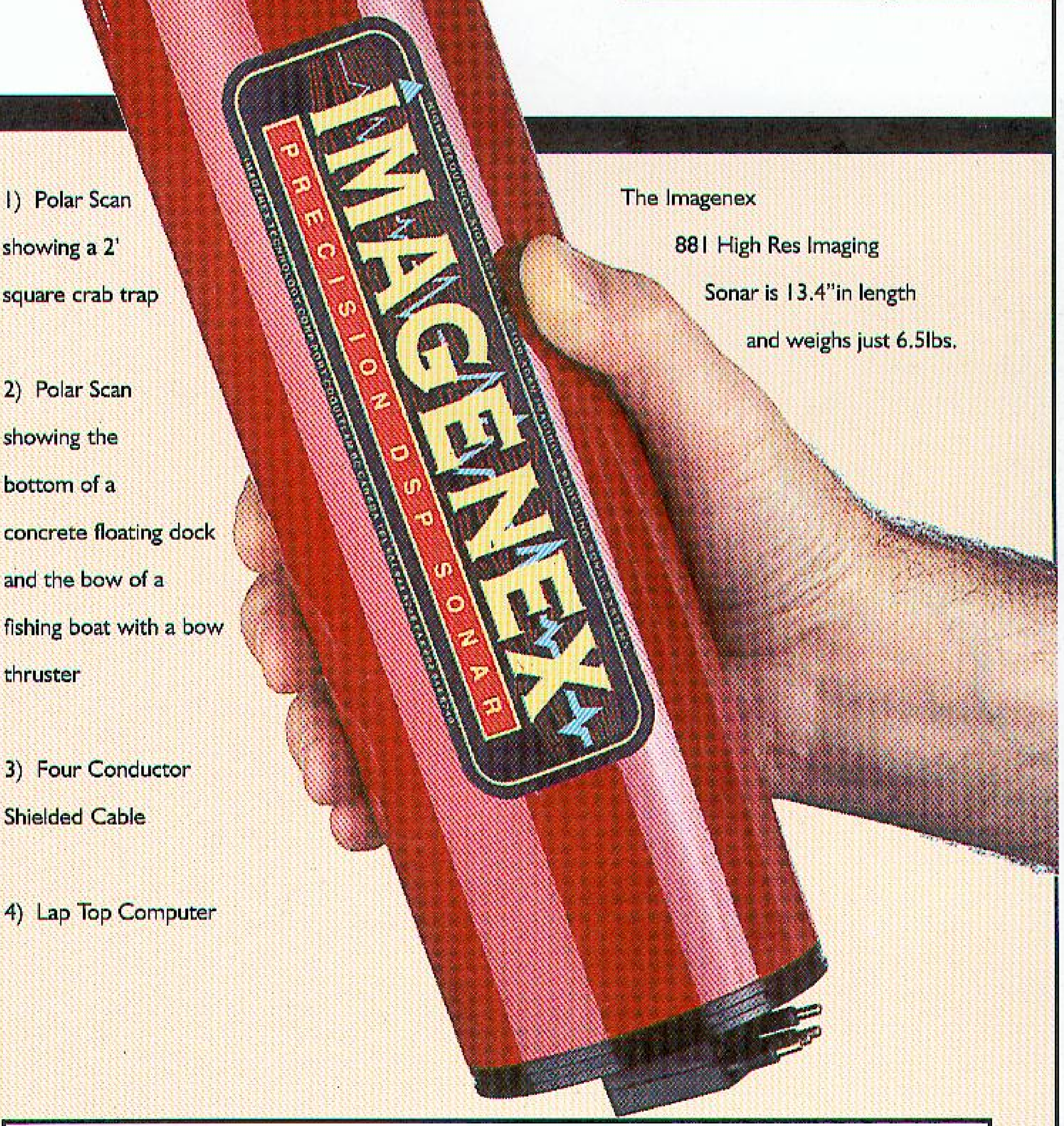
WEIGHT: in air 3kg *(6.5 lbs)* in water 1.5 kg *(3.3 lbs)*

1) Polar Scan showing a 2' square crab trap

2) Polar Scan showing the bottom of a concrete floating dock and the bow of a fishing boat with a bow thruster

3) Four Conductor Shielded Cable

4) Lap Top Computer



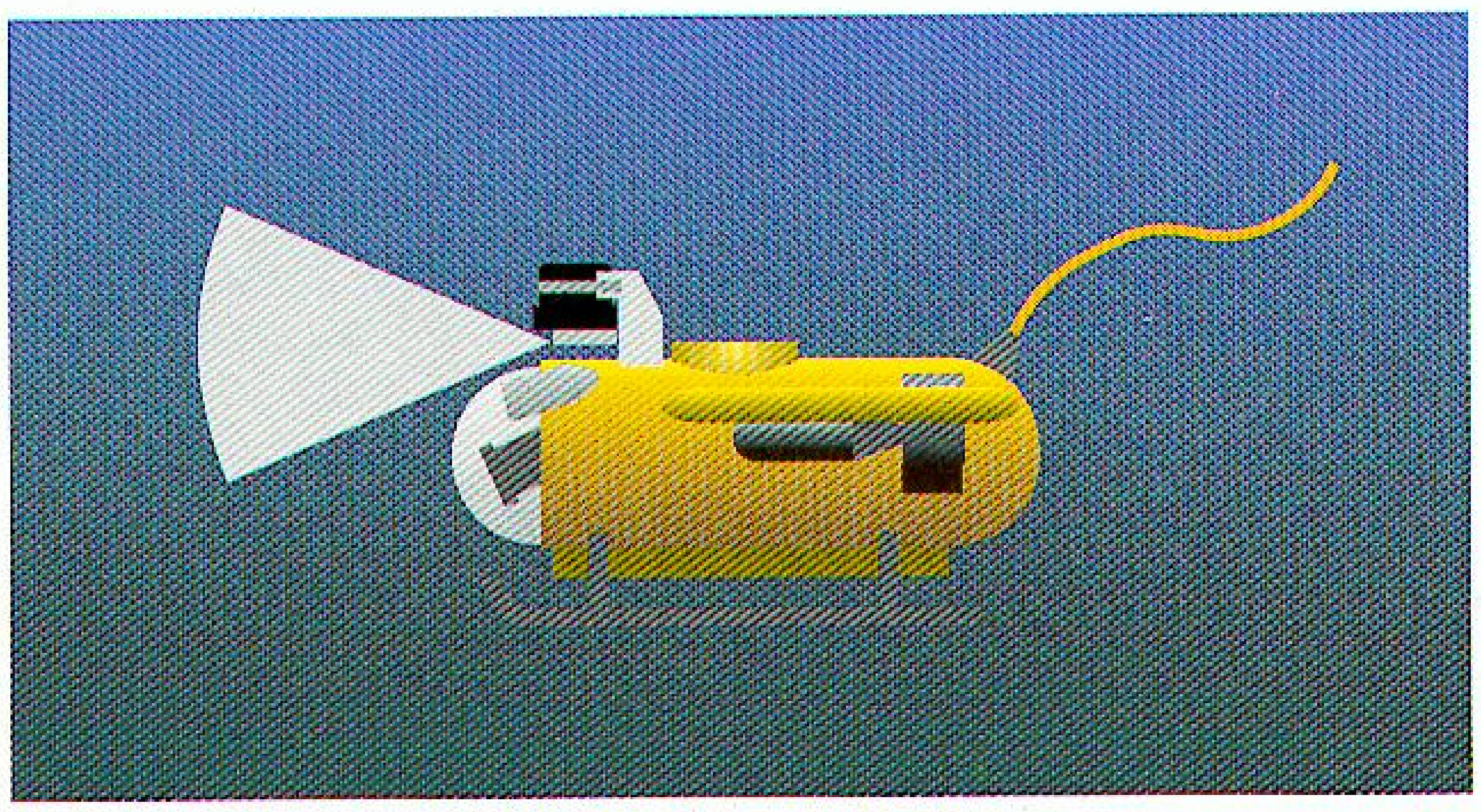
The Imagenex 881 High Res Imaging Sonar is 13.4"in length and weighs just 6.5lbs.

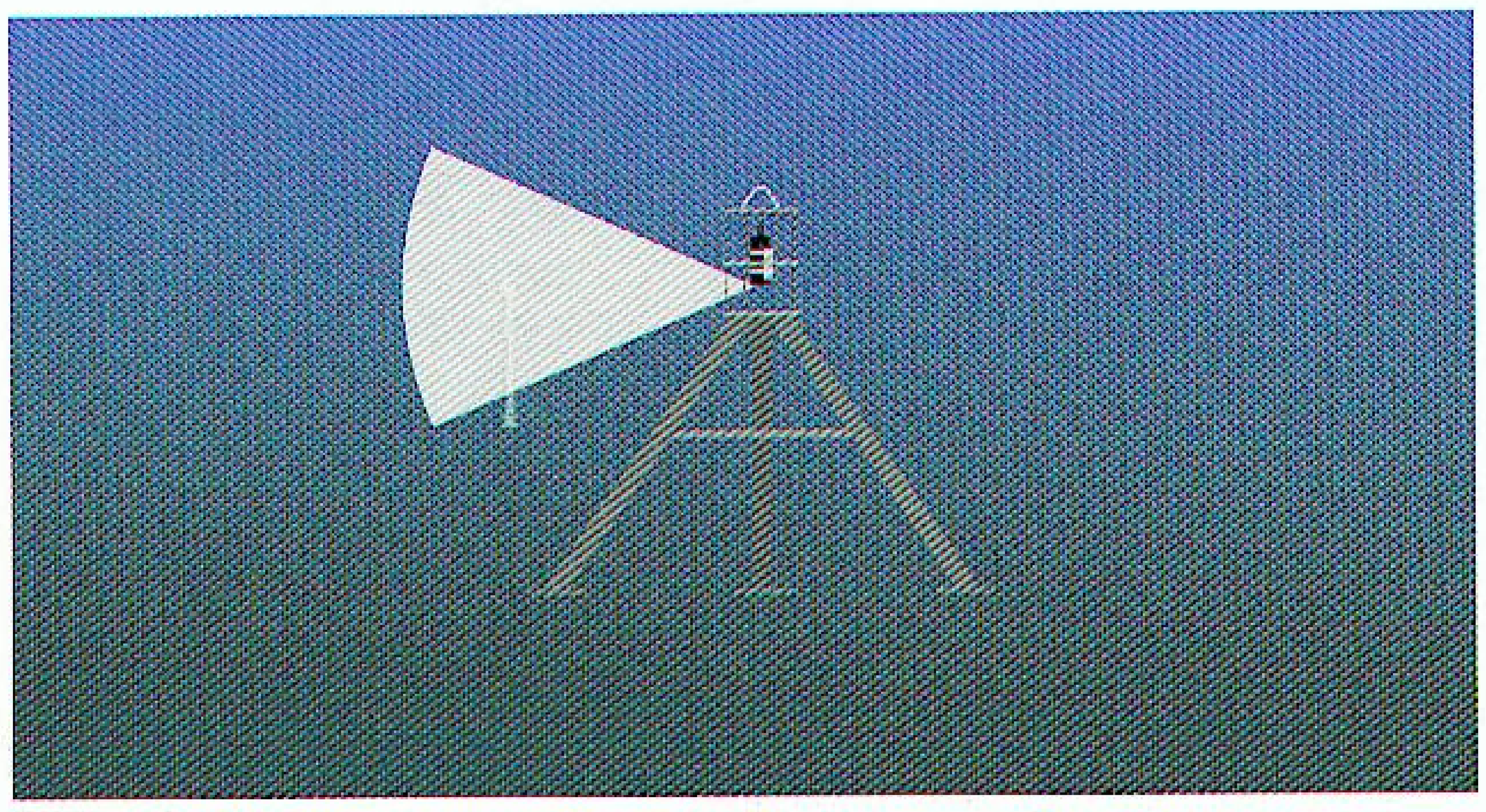
McQUEST MARINE
489 Enfield Road
BURLINGTON, ONTARIO, CANADA
L7T 2X5 Phone (905) 639-0931

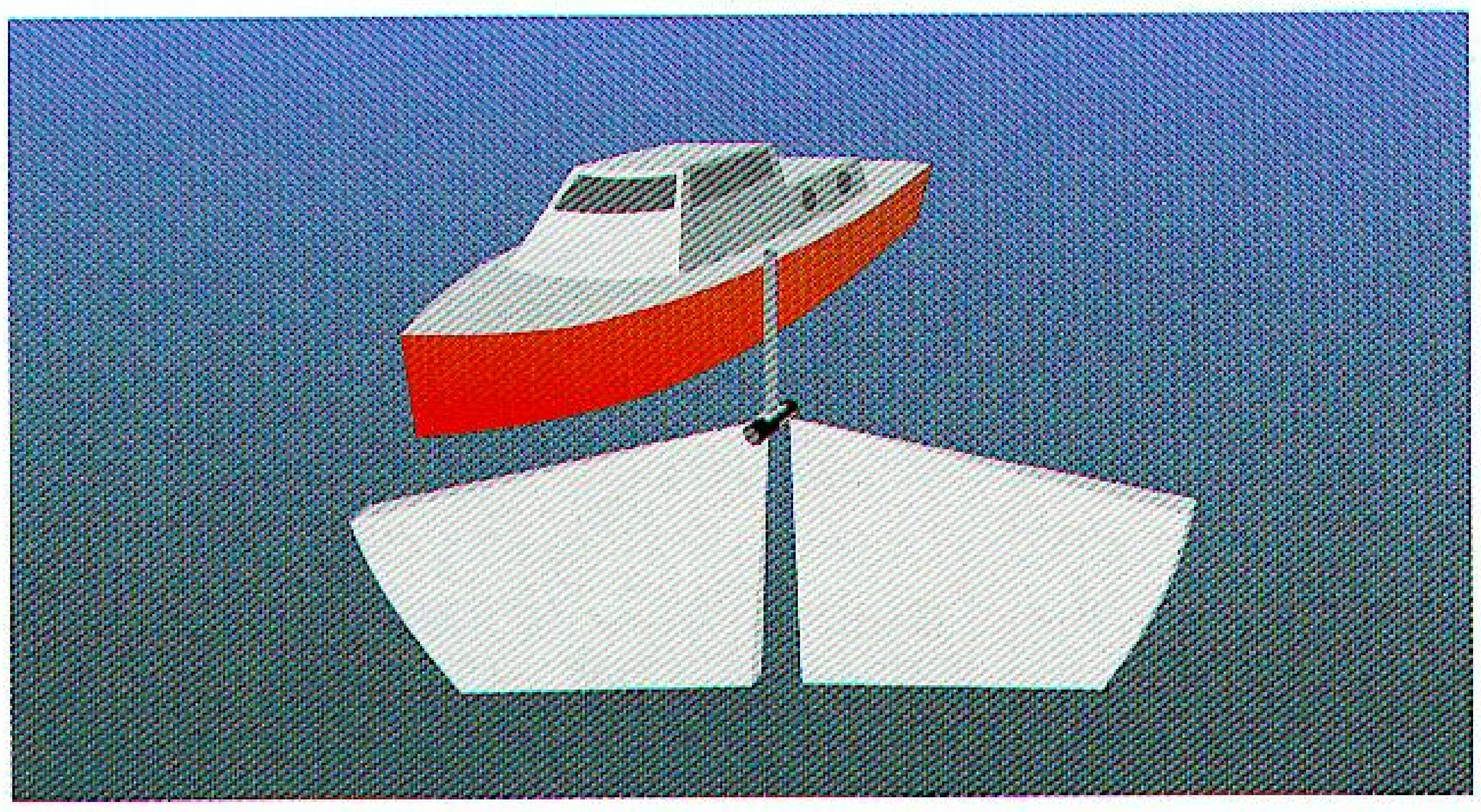
For more information about Imagenex Sonar products, please contact Imagenex Technology Corp. Specifications subject to change without notice. Please contact Imagenex for confirmation.

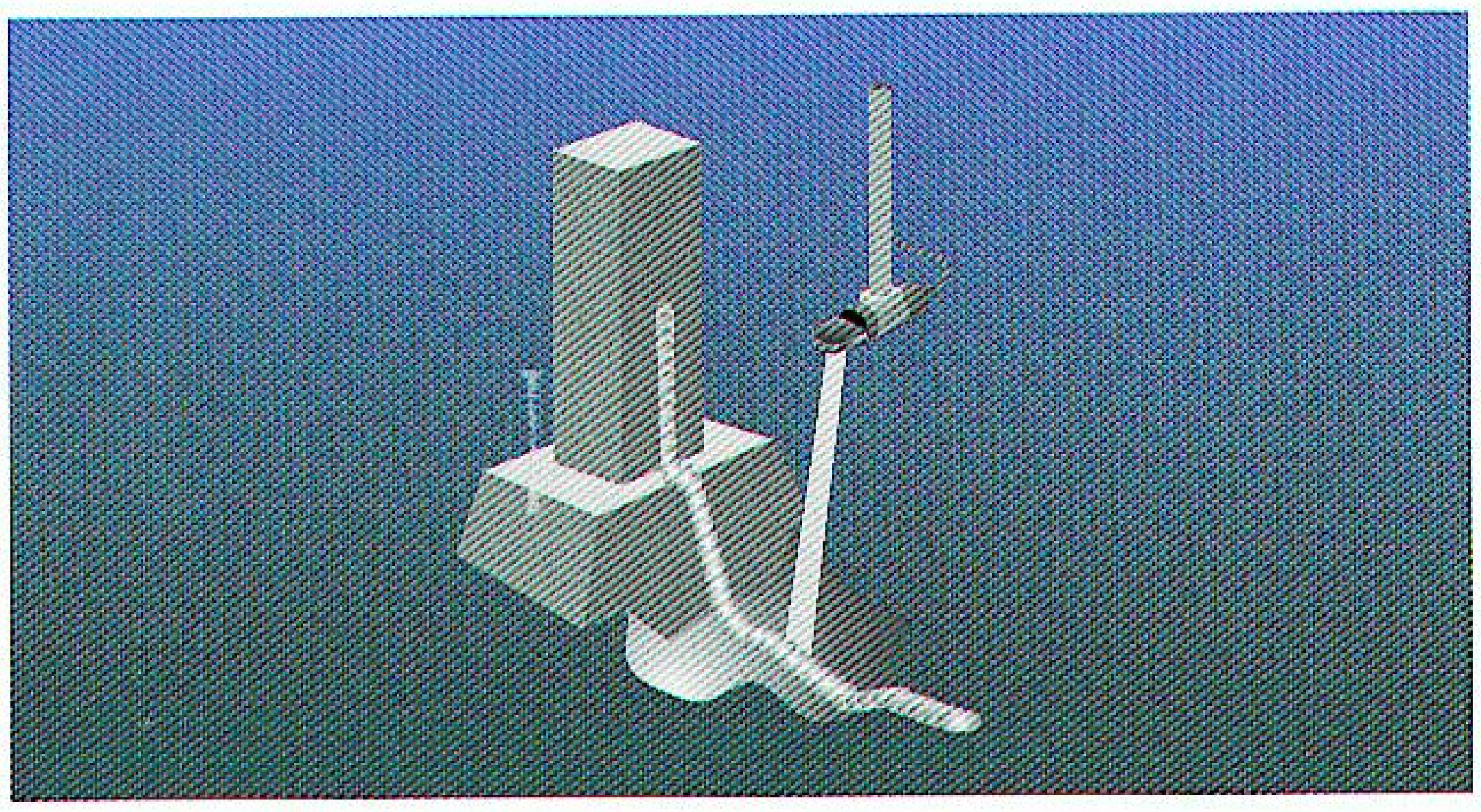
IMAGENEX TECHNOLOGY CORP.
#209 1875 Broadway St., Port Coquitlam, BC V3C 5W2
Tel: 604 944 8248
Fax: 604 944 8249
email: imagenex@npsnet.com

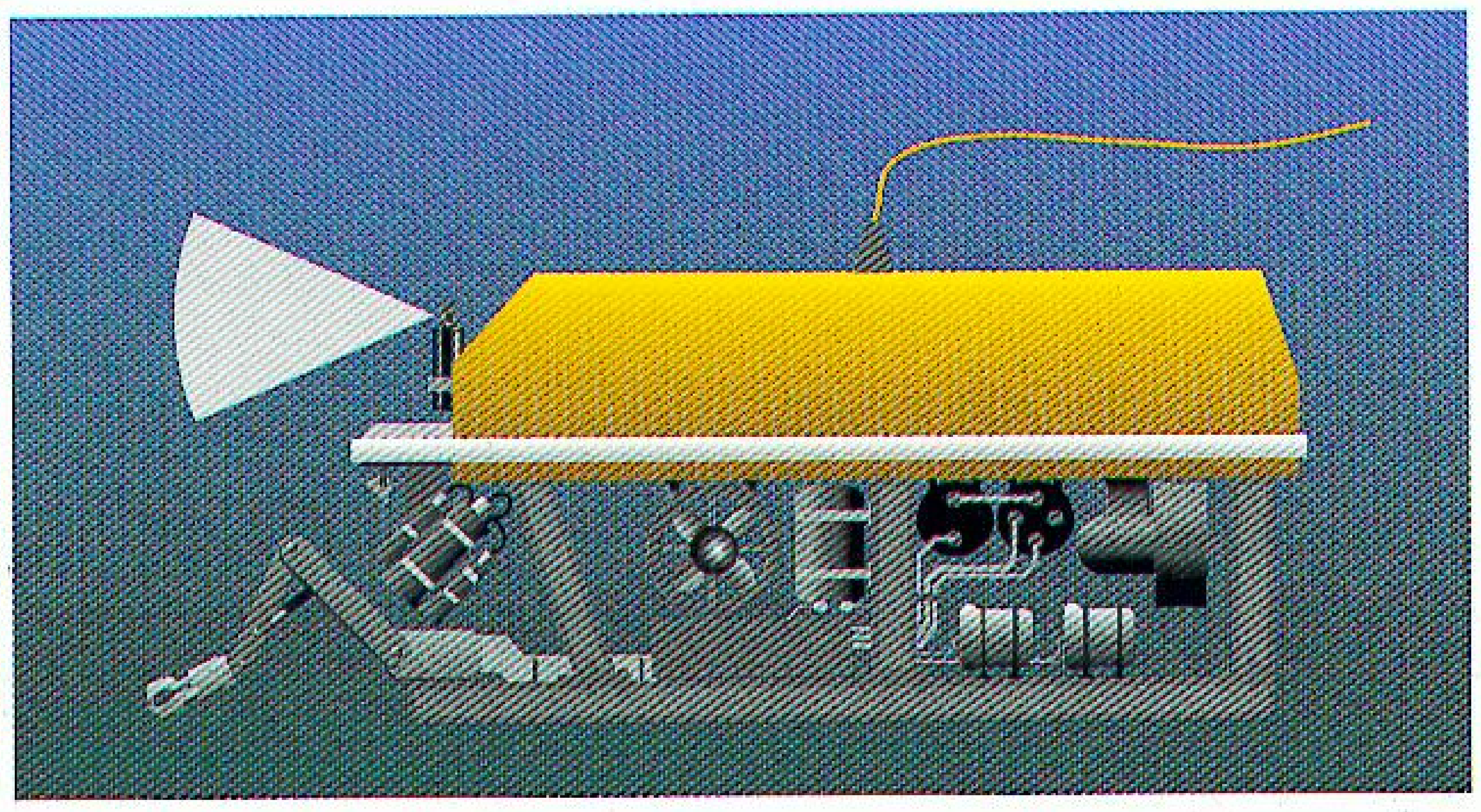
IMAGENEX MODEL 855 COLOR IMAGING SONAR SYSTEM







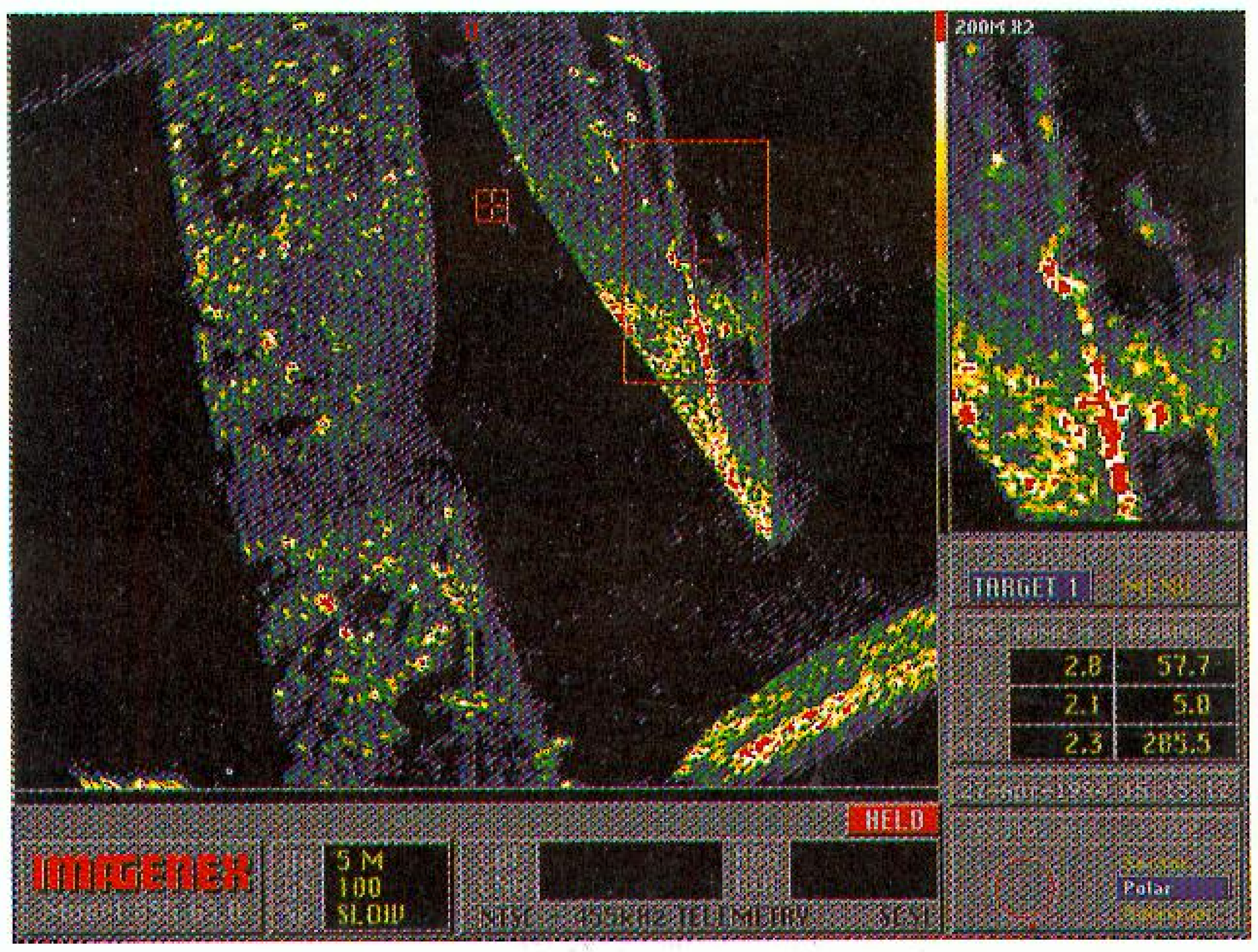




Scanning with precise sonar beams, the Imagenex Model 855 Color Imaging Sonar System produces superb images and profiles, at ranges from a fraction of a meter, to hundreds of meters, in shallow water, or at full ocean depth.

855

Ultra High Resolution sonar image. 5 m polar scan of the bow of a fishing boat and the bottom of a concrete floating dock. Sonar dome visible on fishing boat bow, 675 khz.



CORPORATE EXPERIENCE

The Imagenex design team helped pioneer the development of the modern imaging sonar. We were involved at every step as high resolution imaging sonars and profiling sonars found new applications all over the world. We have constantly pushed the technology to higher levels of performance. We also understand very well the urgent nature of most underwater work, and the need for close and timely customer support.

ROVs

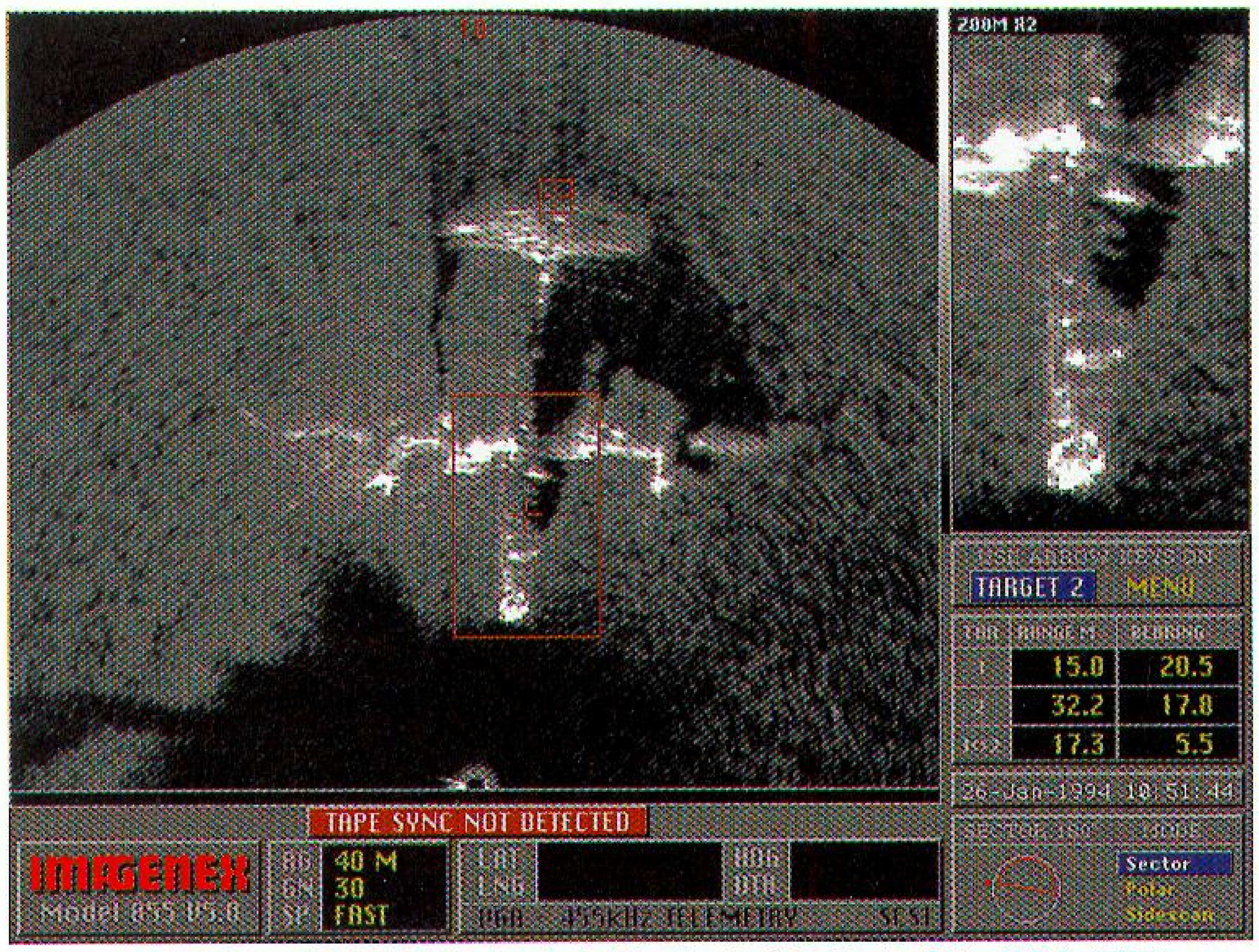
The most important application of the sector scan imaging sonar is to provide extended underwater vision on remotely operated vehicles (ROVs). An ROV that is not equipped with an imaging sonar is very limited in its ability to work underwater. Imagenex can supply affordable high performance sonar equipment for the small low cost ROV operating in shallow water and the large ROV operating at full ocean depth, On an ROV, the imaging sonar provides obstacle avoidance, search, positioning and surveying capabilities.

SEARCH

Shipwrecks, downed aircraft, pipelines, cables, fishing equipment, anchors, automobiles, bodies, lost cargo etc. can all be located and recovered with the aid of side scan and sector scan imaging sonar.

DIVING SUPPORT

The Model 855 gives a clear view of a dive site, even in zero visibility water. A surface sonar operator can see the diver and quickly direct him to targets underwater. The sonar maximizes the safety and efficiency of divers.



40 m sector scan, Convair PB4Y-2 Privateer, Lake Washington, Washington State, U.S.A., 675 khz.

INSPECTION

Any underwater area that is subject to clogging or blockage by debris or unwanted objects can be inspected periodically, or monitored constantly, with the Model 855. Dams, screens, intakes, locks, tunnels, penstocks, pipes, settling ponds, storage tanks or any other fluid filled volumes can be inspected and measured.

UNDERWATER ENGINEERING & CONSTRUCTION

From preliminary inspection and survey, through excavation, compaction, and placement of structures, to final inspection and survey, the Model 855 sonar can play a vital role. It reduces costs and simplifies operations, allowing the user to "see" exactly what is going on underwater.

SURVEYING

The Model 855 Imaging sonar can be used for very accurate range and bearing measurements underwater. The available Transponder Capable version functions very much like an underwater total station. A profiling scan unit can make accurate cross section measurements of underwater surfaces.

OFFSHORE OIL & GAS

Drilling support, pipeline inspection, wellhead and manifold maintenance and rig inspection are all routinely assisted by the use of ROV and non ROV deployed sonar. Imaging sonars have located leaks in oil and gas pipelines.

SUNKEN TIMBER RECOVERY

In many places in the world, timber has been transported and stored on the water for years. It often becomes saturated and sinks to the bottom. The Model 855 Sonar allows salvagers to locate and recover these valuable timbers.

UNDERWATER ARCHAEOLOGY

The Model 855 Sonar is a powerful aid for the underwater archaeologist. It assists in preliminary surveys. It identifies interesting patterns, structures and shipwreck sites. The sonar images help to classify objects and the surveying features allow easy and accurate measurements underwater. During site excavation, the imaging sonar helps control the work, constantly monitoring the location of divers.

ENVIRONMENTAL SURVEY

Imaging and profiling sonars can be used to observe underwater discharge plumes, dump sites, sedimentation processes, scouring, and biological activities.

SCIENTIFIC RESEARCH

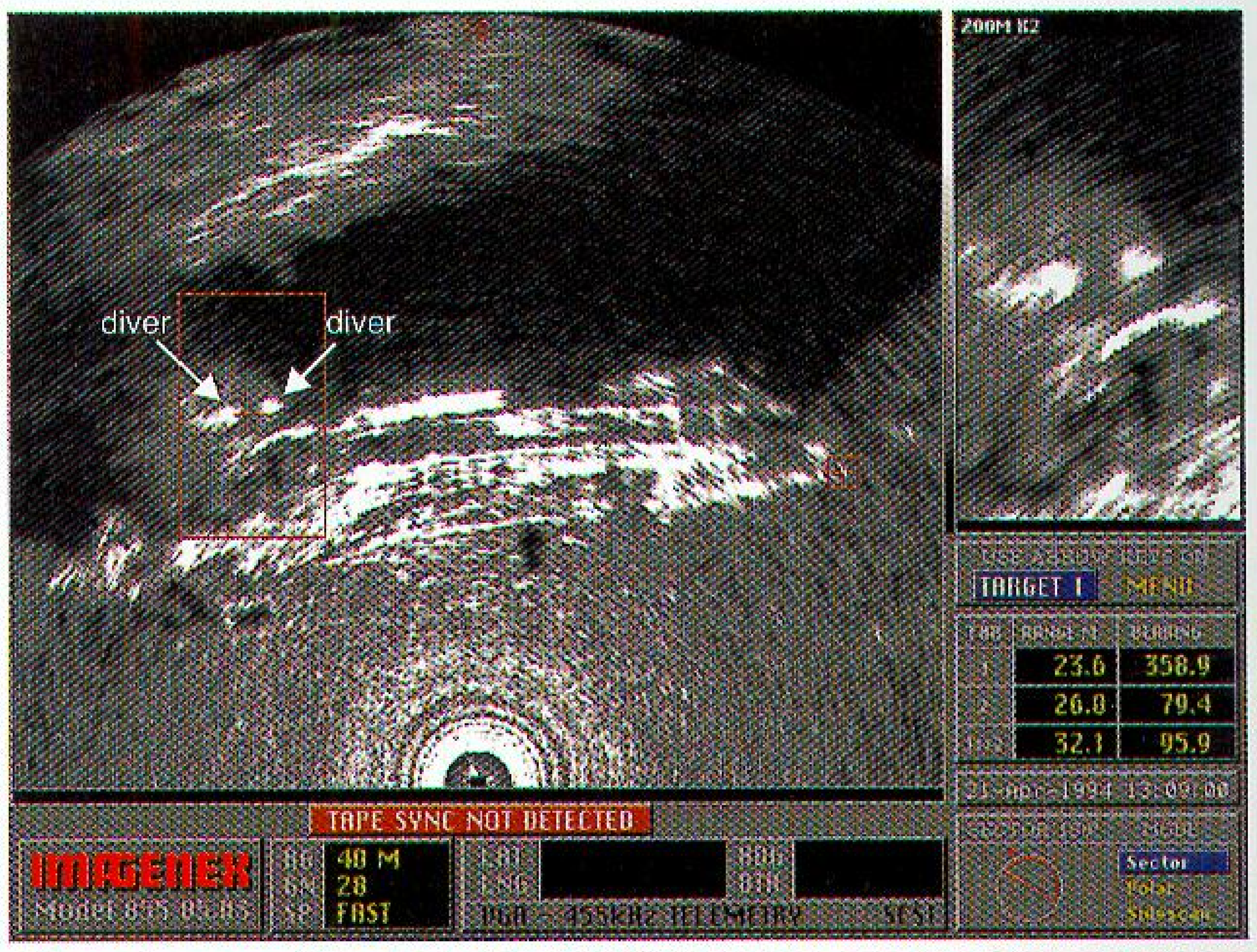
Imaging sonar technology has been in use for about a decade, but because of high cost. and lack of familiarity, it has not often been used to do scientific research. The latest generation of equipment has improved image quality and data recording, playback and image capture capabilities. These features, along with reduced cost, and growing awareness in the scientific community, will finally allow researchers to begin to look through this new window into the underwater world.

NEW APPLICATIONS AND OPPORTUNITIES

We have mentioned just a few of the possible applications of the imaging and profiling sonar. As exploration and work underwater continues, many more new applications will be found for this fascinating instrument. Although we emphasize the practical aspects of this product, we continue to be fascinated and delighted by the beauty of the images this technology can produce. We hope that our customers will share our satisfaction and wonder as we continue to probe and understand the underwater world.

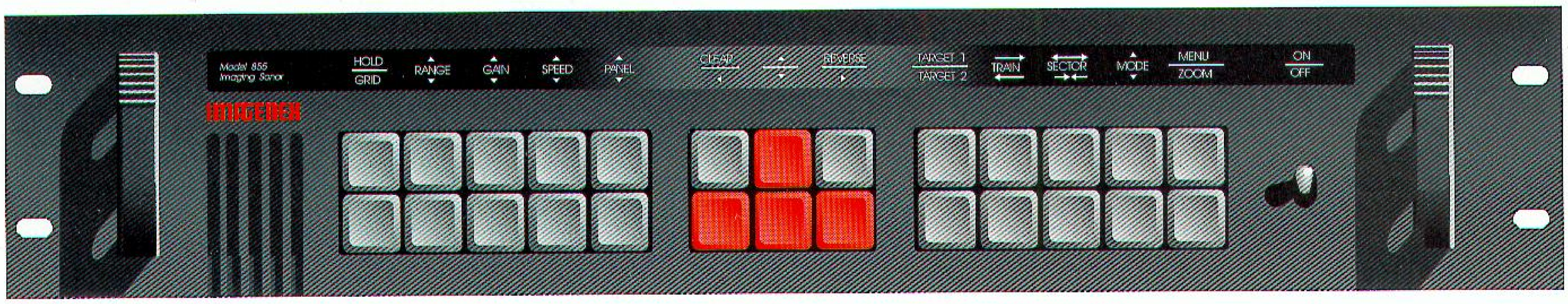
THE MODEL 855 PROCESSOR

Based on an extremely powerful DSP chip, the Model 855 Processor is a machine designed from the chip level with a special architecture adapted for real time image processing.



40 m sector scan of the wreck of the H.M.C.S. Thiepval, a steel fisheries and customs patrol vessel, in Barkley Sound, on the west coast of Vancouver Island. Image shows two SCUBA divers swimming just beyond wreck, 675 khz.

MODEL 855-000-001
SONAR PROCESSOR



DESCRIPTION:
An Imagenex design, based on a high performance digital signal processing (DSP) chip and a graphics processor chip combined in a unique architecture. Optimized for real time image acquisition, enhancement and display. The Model 855 Processor is compatible with the complete range of Model 855 Underwater Scanning units, and can be used to view sector scan images, side scan images and sector scan profiles. The processor outputs standard VGA video so that it can be used with standard computer monitors. Optional interfaces as described below allow full resolution sonar data recording and pl;ayback, connection to external computers, image capture etc. A compact rugged package designed for offshore use. All frequently used controls operated by dedicated keyswitches on the front panel so that new users can easily operate the system. More experienced users can take advantage of the more sophisticated functions available from the menu. No program loading or other computer type operations required. The processor starts instantly from EPROMs. Switch settings stored in nonvolatile memory. A number of different color tables can be selected to represent sonar echo levels.

Ultra High Resolution sonar image, 5 m sector, showing a tire lying on an underwater pipeline, 675 KHz

IMAGENEX MODEL 855-000-001
COLOR IMAGING SONAR PROCESSOR
SPECIFICATIONS:

Display Modes: Freeze Display, clear display, sector mode, polar mode, single channel side scan mode with sector scan units, dual channel side scan mode with side scan units, window zoom (x2, x3, x 4) range/bearing to target cursors
Ranges: 5,10,20,30,40,50,60,80,100,150,200 meters (select also feet)
Transducer Training: 0°±190°
Sector Size: 0° to 360° in 10° increments
Range Resolution: 1 cm (5 meter range, sector mode)
Display Resolution: 640 x 480 pixels, 128 colors
Monitor: supplied by customer, VGA analog RGB, 15 pin D-submin connector
Digital Signal Processing: digital noise filter, digital image enhancement
Color Tables: normal multicolor high level, normal multicolor low level, green monochrome, gray monochrome, reverse gray monochrome
Interfaces: optional RS-232 serial port, optional NTSC or PAL composite video using external adapter, optional recording of sonar data on DAT recorder for full resolution playback through processor, optional SCSI port to external floppy disk for screen capture as PCX image file, optional parallel port to gray scale printer
Dimensions: 482 mm (19.0 in) wide x 89 mm (3.5 in) high x 381 mm (15.0 in) deep
Weight: 15 lb (6.8 kg)
Power Requirement: 110/220 vac 50/60 hz, 0.5 amp

Specifications subject to change without notice

IMAGENEX

IMAGENEX TECHNOLOGY CORP. 209-1875 BROADWAY ST.
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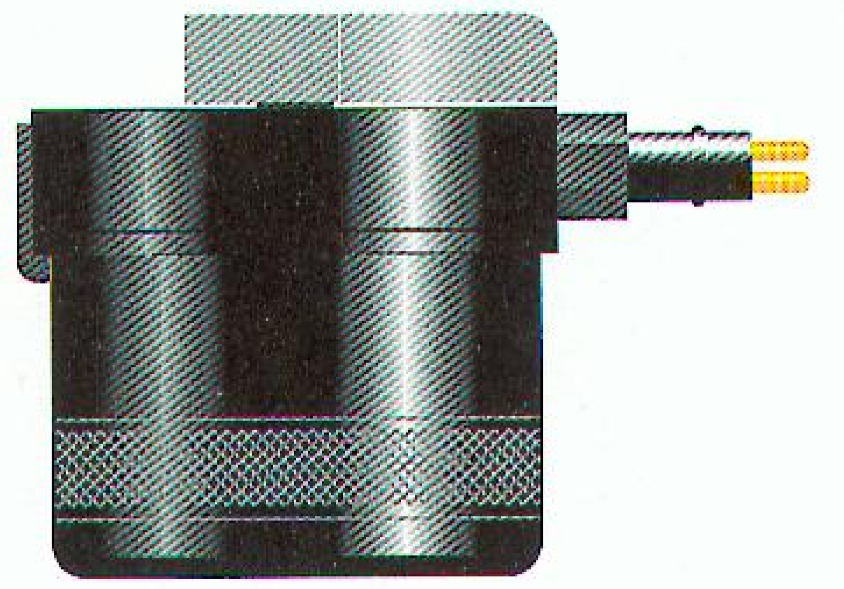
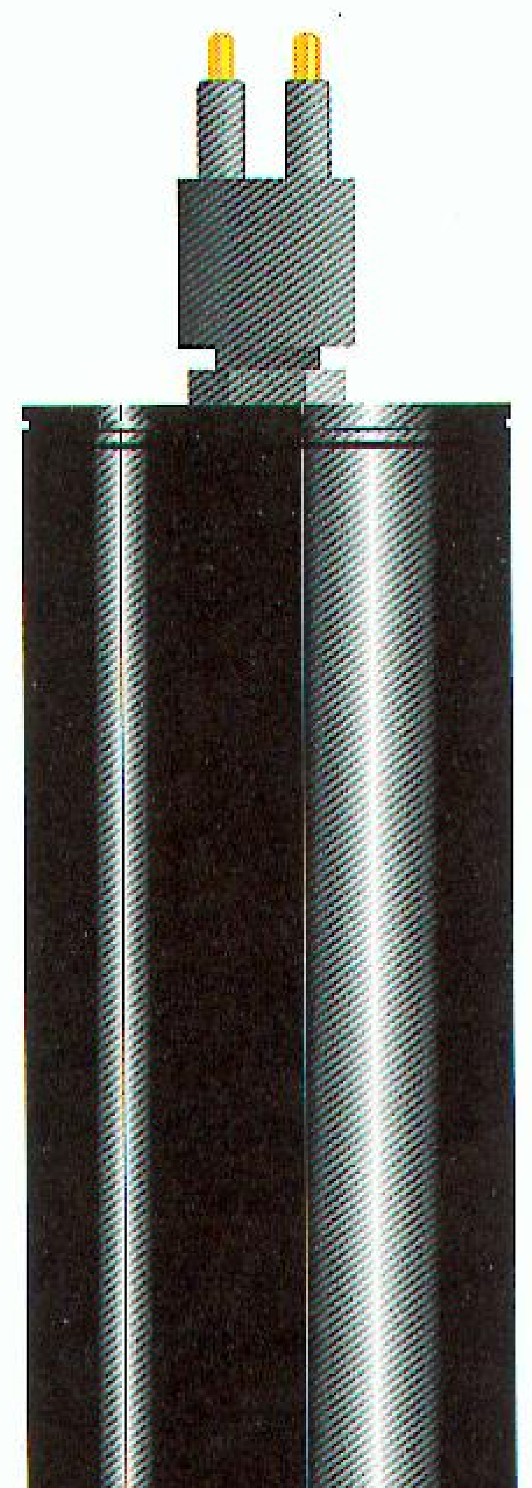


MODEL 855-000-101 SUBMINIATURE UNDERWATER SCANNING UNIT

IMAGENEX MODEL 855-000-101
SUBMINIATURE UNDERWATER SCANNING UNIT
SPECIFICATIONS:
Frequency: 675 khz
Beamwidth: 1.7° horizontal x 30° vertical nominal fan beam for imaging
Typical Maximum Range: to 100 m
Mechanical Resolution: 0.25 °
Mechanical Rotation: 180°
Power Supply: 16-24 vdc at 500 ma max.
Connector: Impulse XSG underwater type
Cable Requirement: four conductors, two for power, shielded twisted pair or coax for telemetry
Cable Length: 600 m (2,000 ft), longer available
Materials: aluminum 6061-T6, 300 series stainless steel, pvc, acetal homopolymer, epoxy
Finish: hard anodize
Maximum Operating Depth: 300 m (1,000 ft)
Dimensions: 89 mm (3.50 in) diameter x 98 mm (3.80 in) high
Weight: in air 1 kg (2.2 lb), in water 0.4 kg (0.8 lb)

DESCRIPTION: A subminiature package containing a complete underwater scanning unit including transducer, transducer drive motor, transmitter, receiver, control processor and telemetry system.
APPLICATION: Designed specifically for very small ROVs and other applications where absolute minimum size, weight and power consumption are required.



MODEL 855-000-110 MINIATURE UNDERWATER SCANNING UNIT

IMAGENEX MODEL 855-000-110
MINIATURE UNDERWATER SCANNING UNIT
SPECIFICATIONS:
Frequency: 675 khz
Beamwidth: 1.7° horizontal x 30° vertical nominal fan beam for imaging
Typical Maximum Range: to 100 m
Mechanical Resolution: 0.25°
Mechanical Rotation: 360°
Power Supply: 22-48 vdc at 1 a max.
Connector: Impulse wet mateable straight or angle
Cable Requirement: four conductors, two for power, shielded twisted pair or coax for telemetry
Cable Length: 600 m (2,000 ft), longer available
Materials: aluminum 6061-T6, 300 series stainless steel, pvc, acetal homopolymer, epoxy
Finish: hard anodize
Maximum Operating Depth: 1000 m (3,300 ft)
Dimensions: 89 mm (3.5 in) diameter x 264 mm (10.38 in) high
Weight: in air 3 kg (6.5 lb), in water 1.5 kg (3.3 lb)

Specifications subject to change witout notice

DESCRIPTION: A miniature package containing a complete underwater scanning unit including transducer, transducer drive motor, transmitter, receiver, control processor and telemetry system.
APPLICATION: Designed for medium and full sized ROVs and many other applications, where greater operating depth, 360° degree scanning, and long service life are important.

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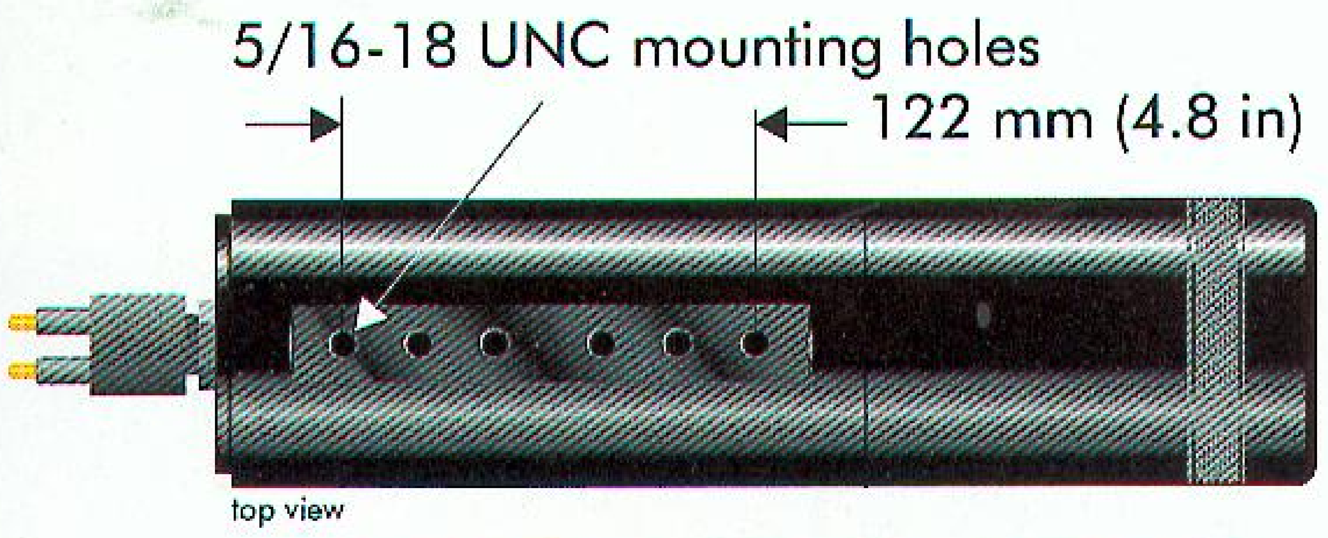
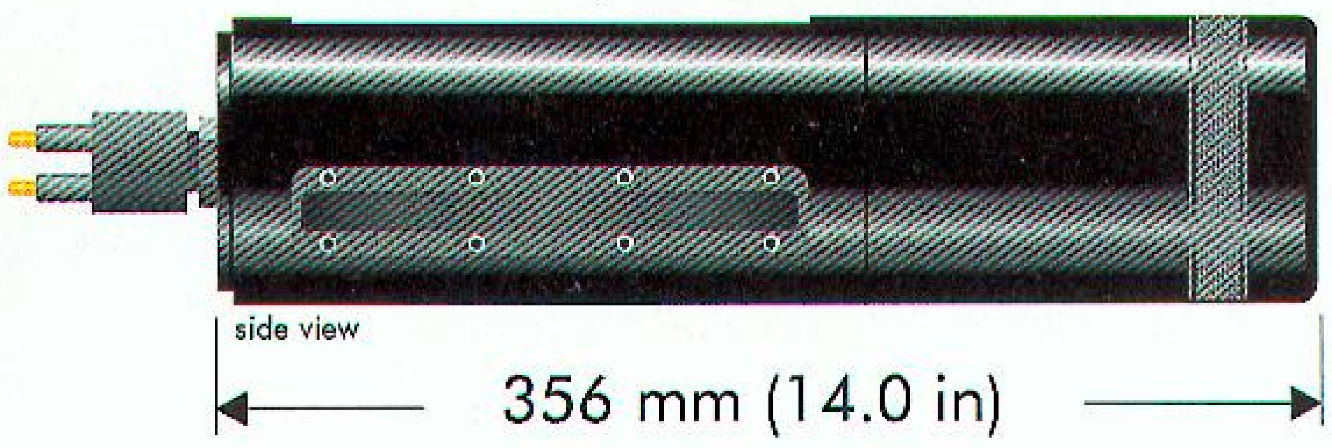
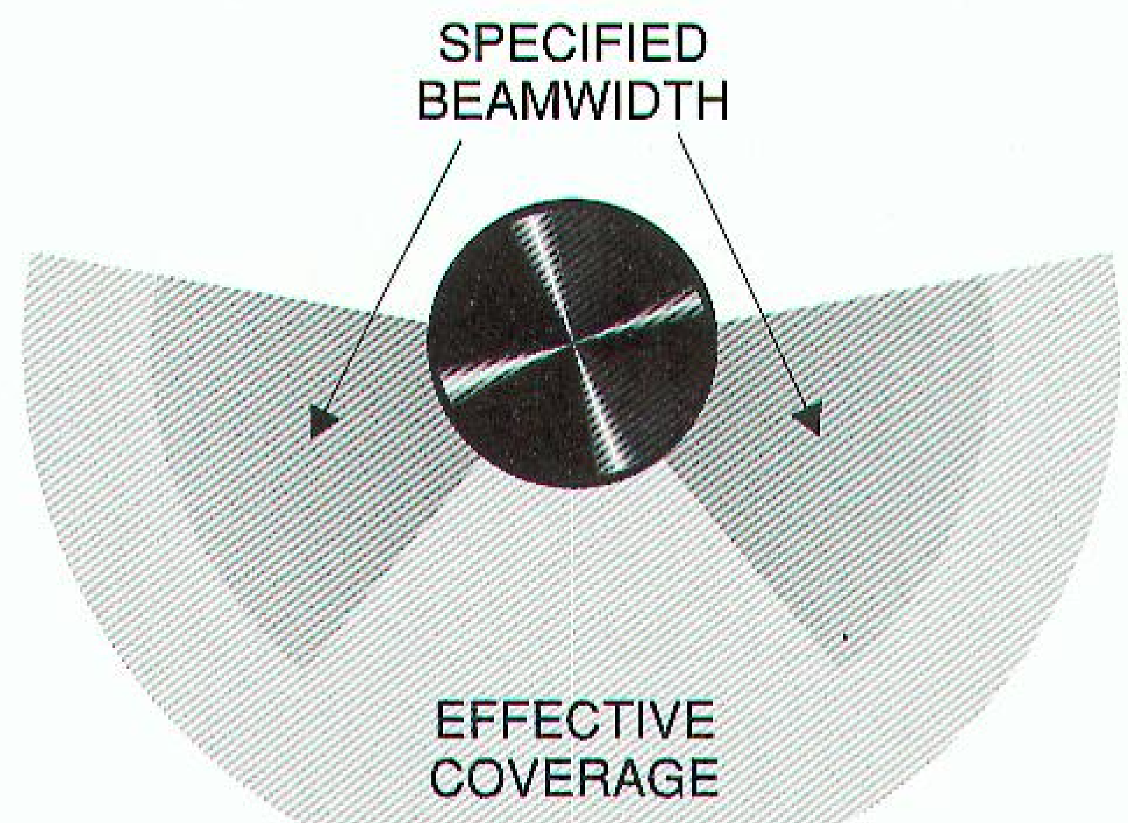
MODEL 855-000-150 DUAL TRANSDUCER SIDE SCAN SONAR MODULES

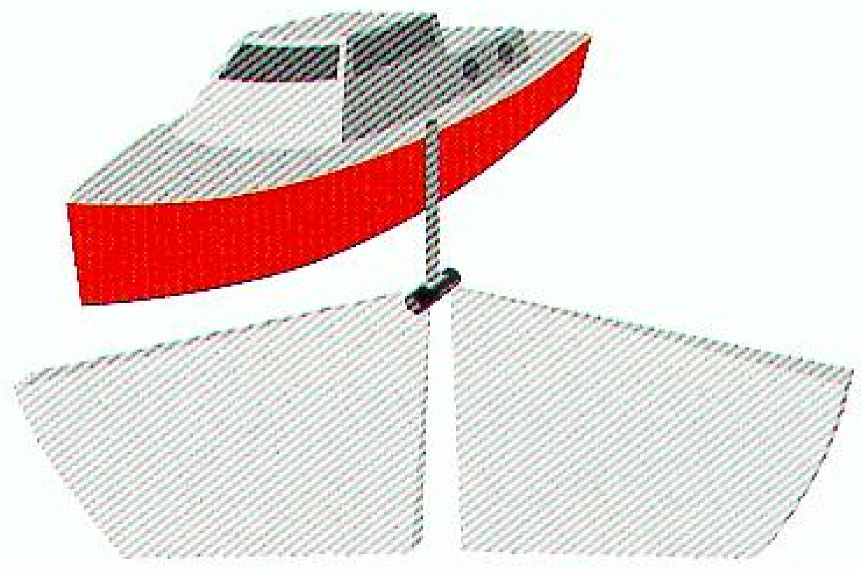


330 KHZ 1.9° BEAMWIDTH VERSION



330 KHZ 0.9° BEAMWIDTH VERSION





IMAGENEX MODEL 855-000-150
DUAL TRANSDUCER SIDE SCAN SONAR
UNDERWATER MODULE SPECIFICATIONS:

Frequency: 330 Khz (675 Khz optional)
Beamwidth: 1.9° horizontal, 60° vertical fan beam, optional 0.9° horizontal, 60° vertical. (675 Khz 0.8° horizontal, 60° vertical)
Maximum Range: 240M at 330 Khz, 100M at 675 KHz
Power Supply: 22-48 vdc at 500 ma maximum
Connector: Impulse wet mateable, 4 conductors, 2 for signal, 2 for power
Cable Length: 600M (2,000 ft) with standard telemetry, longer available
Materials: aluminum 6061-T6, 300 series stainless steel, pvc, epoxy
Finish: hard anodize
Maximum Working Depth: 1,000M (3,300 ft), deeper available
Dimensions: 330 Khz 1.9° version, 89 mm (3.5 in) diameter, 356 mm (14.0 in) length, 330 Khz 0.9° version, 543 mm (21.4 in) length
Weight: 330 Khz 1.9° version, in air 3.8 kg (8.5 lb), in water 2.5 kg (5.5 lb), 330 Khz 0.9° version, in air 6.5 kg (14.5 lb), in water 4.5 kg (9.9 lb)

APPLICATIONS:

Intended for use on ROVs, surface vessel fixed strut and hull mounting, and installation in tow fish and other towed bodies.

Specifications subject to change without notice

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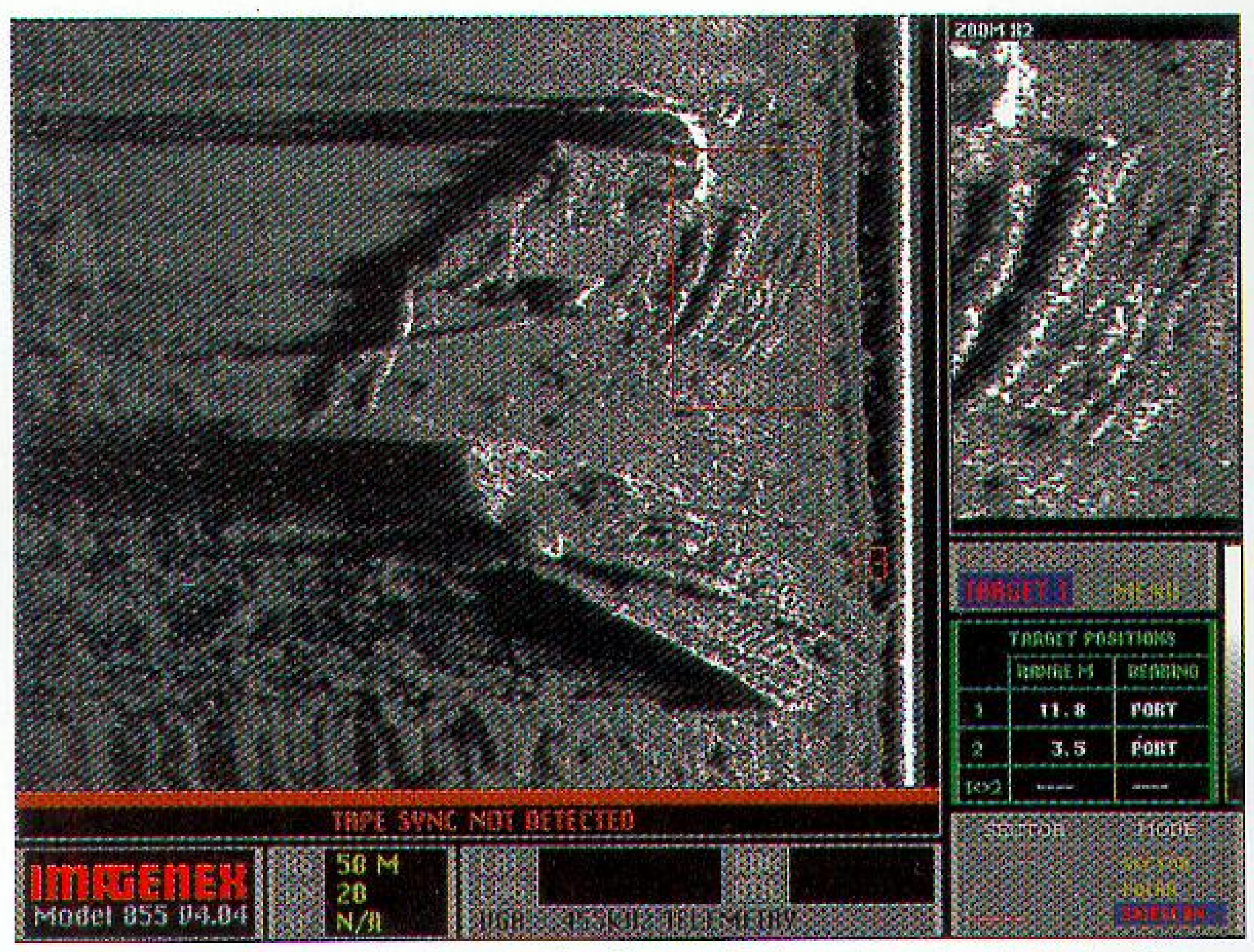
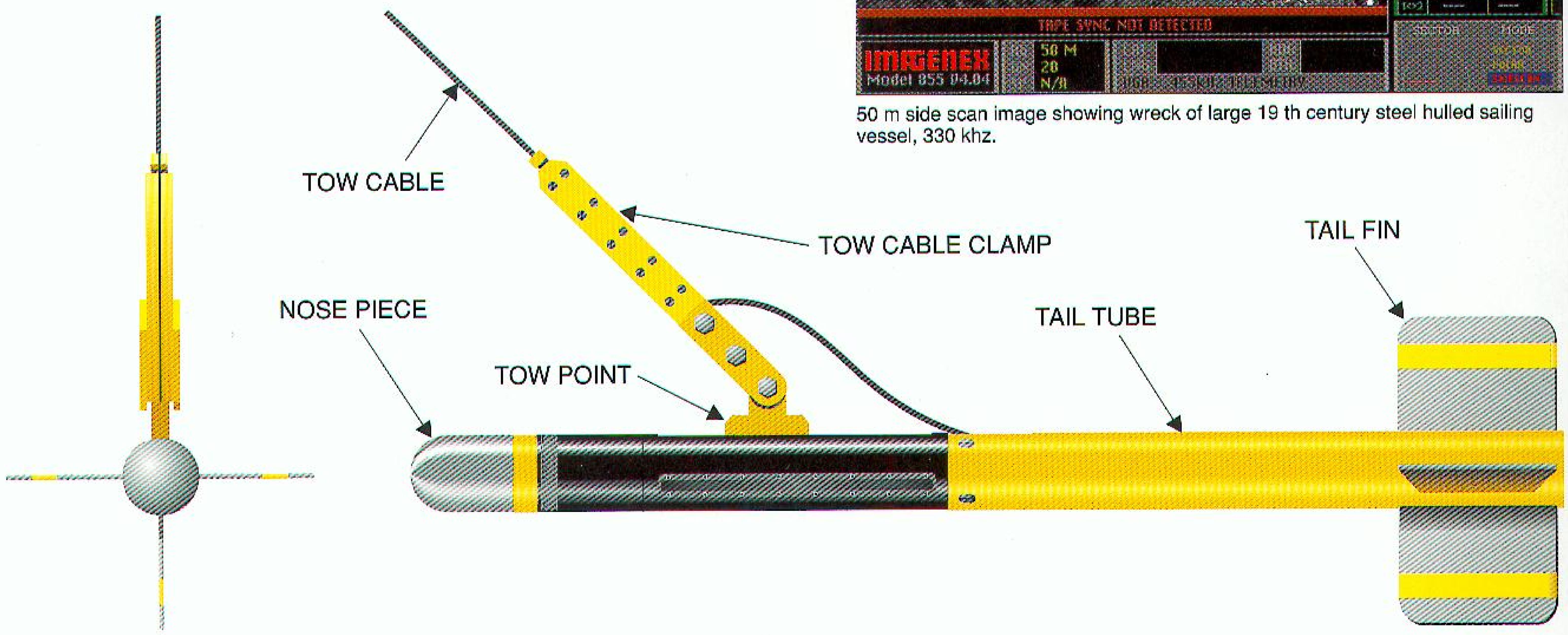
30 m side scan image showing river bottom details, 330 khz.

TOW FISH HARDWARE FOR MODEL 855-000-150 SIDE SCAN MODULES



50 m side scan image showing wreck of large 19 th century steel hulled sailing vessel, 330 khz.



IMAGENEX TOWFISH HARDWARE
FOR IMAGENEX MODEL 855-000-150
SIDE SCAN MODULES

DESCRIPTION:

This Towfish hardware package can be used with Model 855-000-150 Dual Transducer Underwater Modules. The tow cable clamp can be installed on any cable. A simple underwater tape splice can be used to mate the tow cable to the underwater connector pigtail supplied with the Underwater Module. Construction is rugged and the unit has been designed for field maintenance using readily available parts. The Towfish is easily disassembled for transportation and storage.

SPECIFICATIONS:

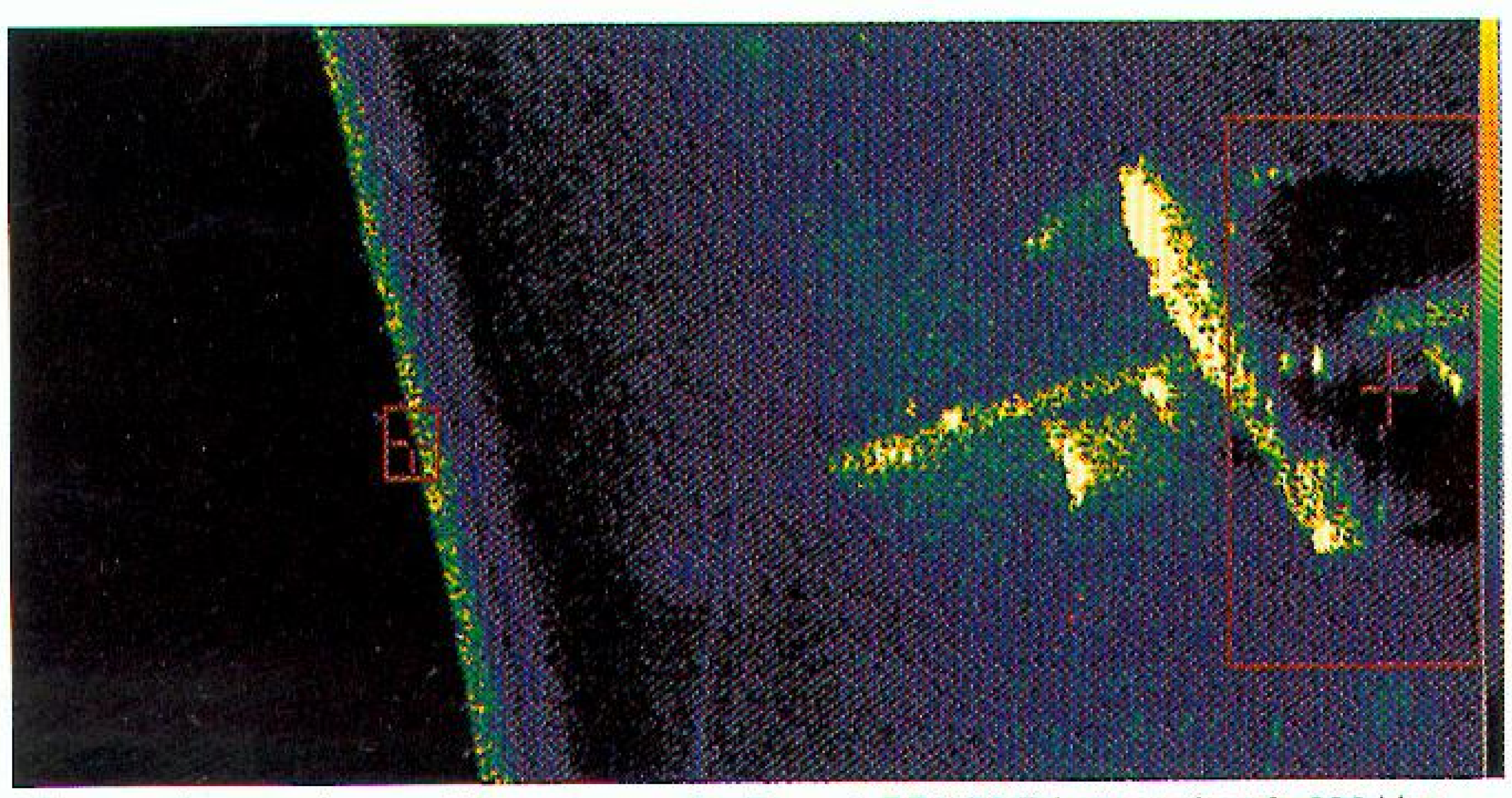
Tow Cable Diameter: 8 mm (5/16 in) nominal, others available

Materials: aluminum 6061-T6, 300 series stainless steel, zinc, polycarbonate

Finish: hard anodize

Dimensions: 330 Khz 1.9° version, 89 mm (3.5 in) diameter, 1245 mm (49 in) length, 330 Khz 0.9° version, 1420 mm (56 in) length

Weight: 330 Khz 1.9° version, in air 13.2 kg (29 lb), in water 10.9 kg (24 lb), 330 Khz 0.9° version, in air 15.5 kg (34 lb) in water 12.7 kg (28 lb)


Side scan image taken on 50 m range scale. Convair PB4Y-2 Privateer aircraft, 330 khz.

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Specifications subject to change without notice

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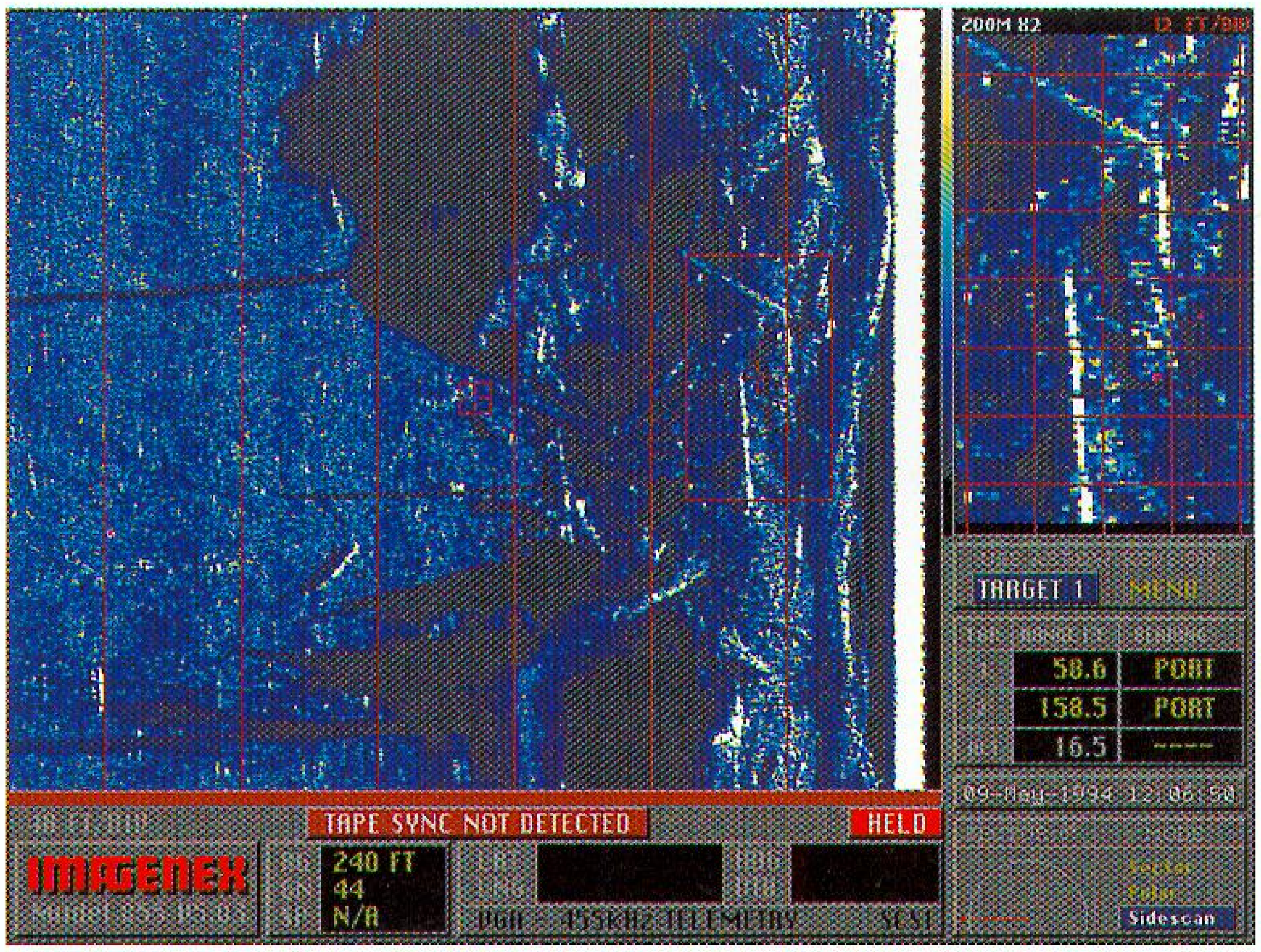
40 m side scan image showing 17 th century wrecks in a Swedish harbor, 330 khz.

Processors based on even the fastest embedded PC hardware cannot come close to the sort of performance possible with the 855. The DSP allows digital noise reduction, image enhancement and ultra fast plotting of the data to the display. With the Model 855 system, a single Model 855 Processor can be used with many different underwater scanning units. The Model 855 Processor is easily controlled by key switches on the front panel. Dedicated keys control frequently used functions like range and scanning speed. A simple menu system controls more sophisticated functions. New users find the Model 855 easy to operate, while experienced users will be amazed by the many features. The Processor is ruggedly constructed and the program loads instantly from EPROMs as soon as the power switch is turned on.



Sunken logs on a lake bottom. This 240 foot single channel side scan image was obtained with a 330 khz sector scan unit in side scan mode.

INTERFACES

The Model 855 Processor has optional interfaces to interconnect with digital audio tape (DAT) recorders for data recording and playback, converters to generate NTSC and PAL video, a SCSI port for disk drive connection to capture digital screen images, a parallel printer port to drive gray scale paper printers, and an RS-232 serial port to output range/bearing cursor data or profile data and input GPS latitude and longitude and other information. A unique remote tape interface circuit board is available which allows connection of a DAT recorder to a scanning unit, without using the Model 855 Processor. With this small circuit board, sonar data can be taped directly from the scanning unit, for later playback through the Model 855 Processor. This remote tape interface is ideal for autonomous vehicles and instrument packages.

UNDERWATER SCANNING UNITS

The Model 855 System includes a large family of compatible underwater scanning units. Dual transducer side scan modules, sector scan imaging and sector scan profiling units are all available. Scan units are available with operating frequencies from 100 khz to 2 mhz, to generate images and profiles at ranges from a fraction of a meter to hundreds of meters. Special systems are available with multiple scan units, transponder capable scan units and 2-axis scanning units.

CABLES, TELEMETRY & POWER SUPPLY

A four conductor cable, with a shielded twisted pair or coax for the telemetry signals, is required to connect the Processor and the underwater scanning unit. For cables up to a few hundred meters long, power can be supplied from an internal power supply in the Processor. For longer cables, an external power supply can be used. For ROV applications, power is usually supplied directly from the ROV. A dedicated shielded twisted pair or coax can be used in the vehicle umbilical. Special versions are available for multiplexed copper conductor and fiber optic telemetry systems.

SIDE SCAN & SECTOR SCAN

Side scan sonars are capable of quickly searching large areas, and in the right conditions can produce excellent images. But the side scan technique relies on straight and steady vessel or towfish motion. In some circumstances, for example in constricted areas like harbors and marinas, or in ice covered waters, it is not possible to make side scan runs. In many of these situations, a sector scan sonar can be used to image the area. A tripod or ROV mounted sector scan sonar can make superb, high quality, and repeatable bottom images. The Model 855 system, capable of working with both side scan and sector scanning units, combines the best of these techniques. Most Model 855 sector scanning units can also function as single channel side scan units.

SONAR DATA STORAGE & PLAYBACK

Until very recently, the storage, playback, and reproduction of high quality side scan and sector scan imaging data was difficult, expensive, and subject to many limitations. The Model 855 incorporates a powerful, flexible and inexpensive data storage and playback system which preserves the full resolution of the sonar data.

IMAGE CAPTURE

With the the available image capture interface, any side scan or sector scan image can be captured in a standard digital form and ported to the PC/Windows /Mac world of image processing. editing and printing. More sophisticated users can easily write code to analyze these bit map sonar images in new and interesting ways.The images in this brochure were captured digitally and imported into a desktop publishing program.

IMAGING

When we refer to sonar imaging, we mean the technique of using a fan shaped sonar beam to generate a detailed image of an underwater area. We may move the sonar beam along a straight line to generate a side scan image or rotate it to generate a sector scan image.

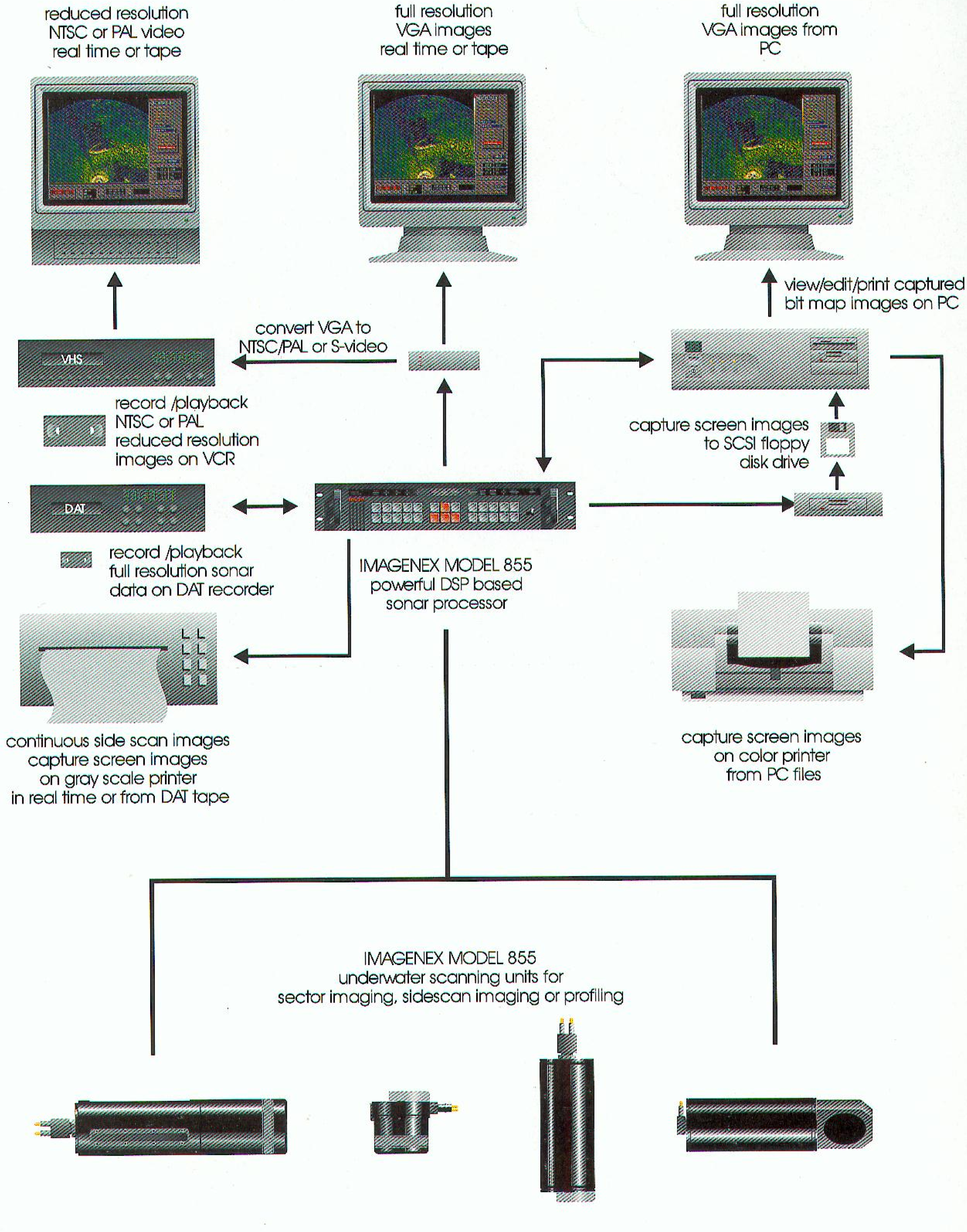
PROFILING

When we refer to sonar profiling, we mean using a narrow pencil shaped beam to measure the range to the bottom at different angles to generate a cross section profile of the bottom. Profiling systems are available with single scanning units, dual scanning units and 2-axis pan and tilt type scanning units.

IMAGE QUALITY

At Imagenex, we think that no sonar feature is more important than the ability to generate the best possible images, full of fine detail. We want our customers to be able to clearly "see" the underwater world. Of course we have included a host of features in our products, but ultimately, an imaging sonar is not a computer game. We know that it is image clarity that really enables our customers to do their work underwater.

MODEL 855 SONAR DATA & IMAGE RECORDING



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