

# **USER MANUAL**

## **The CM2 SIDESCAN SONAR SYSTEM**

**(All configurations except  
those using MaxPro software)**



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## 1. SUMMARY OF WARNINGS

The warnings summarised here are intended to prevent injury to personnel and equipment in what can be a hazardous environment.

***OPERATORS OF THIS EQUIPMENT ARE RESPONSIBLE FOR THEIR OWN SAFETY***

***THE SUPPLIER ACCEPTS NO LIABILITY FOR THE CONSEQUENCES OF EQUIPMENT USE OVER WHICH IT HAS NO CONTROL***

***THE GROUND VOLTAGE LEVEL OF ANY EXTERNAL EQUIPMENT, INCLUDING NAV DATA SOURCES OR ECHO SOUNDERS, MUST BE CHECKED BEFORE CONNECTION IS MADE TO THE SERIAL PORT OF ANY ACQUISITION PC OR C-CASE. THE GROUND LEVELS MUST BE EQUAL OR FLOATING; IF NOT THEN THE INTERNAL CPU PCB MAY BE DESTROYED (AND DAMAGE SO CAUSED IS NOT COVERED BY WARRANTY)***

***DO NOT ALLOW THE TOWFISH TO STRIKE THE BOTTOM OR OBSTRUCTIONS; THE TOWFISH SINKS WHEN THE BOAT TURNS OR SLOWS***

***USE GLOVES TO HANDLE ALL STEEL-ARMoured TOW CABLES***

***NEVER ALLOW SLACK IN THE CABLE WHILST THE TOWFISH IS DEPLOYED***

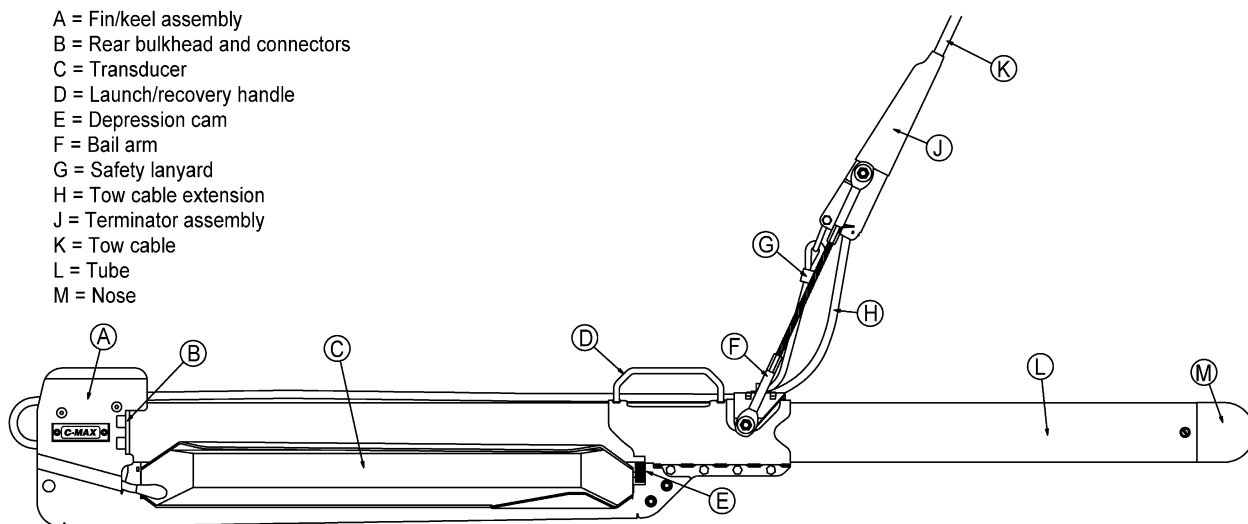
***DO NOT EXPOSE THE TRANSDUCERS TO HEAT FROM STRONG SUNLIGHT***

***ENSURE THAT ALL ELECTRONIC UNITS ARE DRY BEFORE STORAGE***

## 2. SYSTEM COMPONENTS

### Towfish

The towfish is the acoustic sensor head. It transmits a very high frequency acoustic pulse (“ping”) at regular intervals and receives the series of echoes that result from each ping.



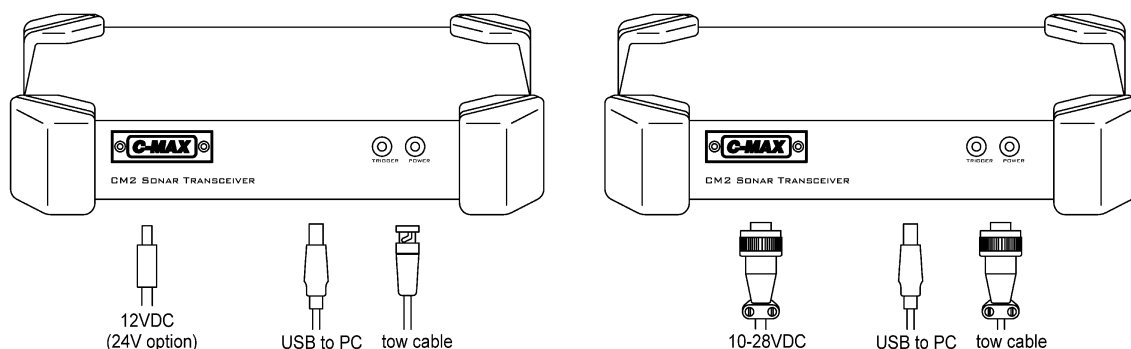
***Towfish and Tow Cable Terminator***

Three types of CM2 towfish are available, namely DF (325/100kHz), EDF (325/780kHz) and HF (325kHz only). All are identical externally. These are digital towfish, communicating with the surface electronics via the tow cable.

Optional additional sensors for the towfish are described in Section 22.

### Sonar Transceiver (STR)

The “top end” (i.e. surface electronics) unit provides power for the towfish via the tow cable, receives the echo data and other information such as the towfish altitude, and sends commands to the towfish. The primary type of top end unit for the CM2 system is the Sonar Transceiver (or STR). As well as communicating with the towfish, the STR communicates with the PC that acquires, records and displays the sonar image. Communication with the PC is via the STR’s USB interface.

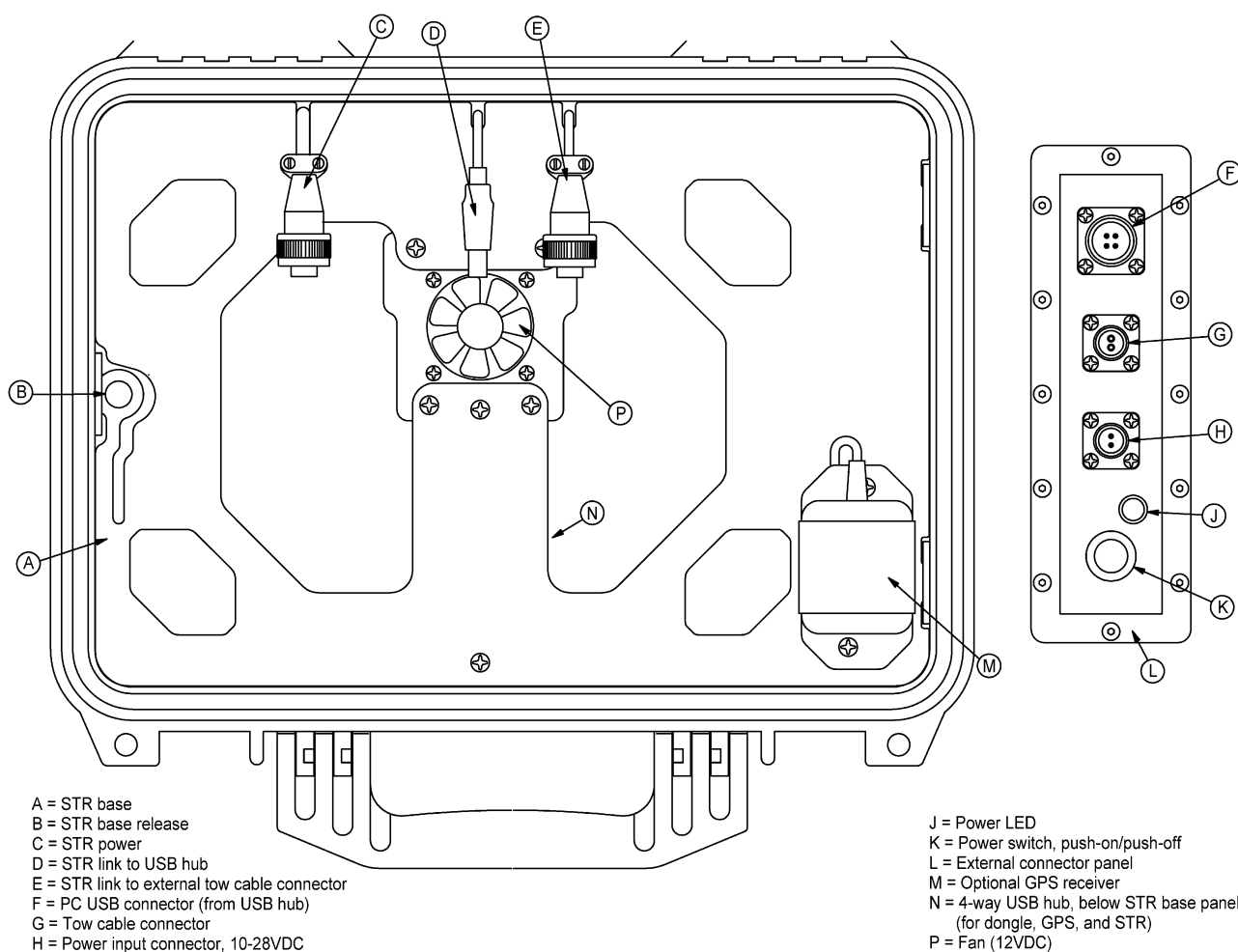


***Sonar Transceiver (STR) Versions***

Two versions of the STR exist, differing in the type of connectors used and in the DC voltage range that they accept. The version fitted with MIL-C-5015 connectors accepts 10-28VDC. The alternative version, identified by its BNC connector, accepts voltages in the range 10-18VDC, with 24VDC as an ordering option. Early versions also featured an analog output, generated from the internal digital signal, for driving “legacy” acquisition systems and thermal printers.

### C-Shell

The C-Shell is an optional polypropylene clamshell enclosure for the STR. The C-Shell converts an STR into a fully waterproof (IP67) unit, complete with waterproof connectors. The STR can be quickly fitted or removed.

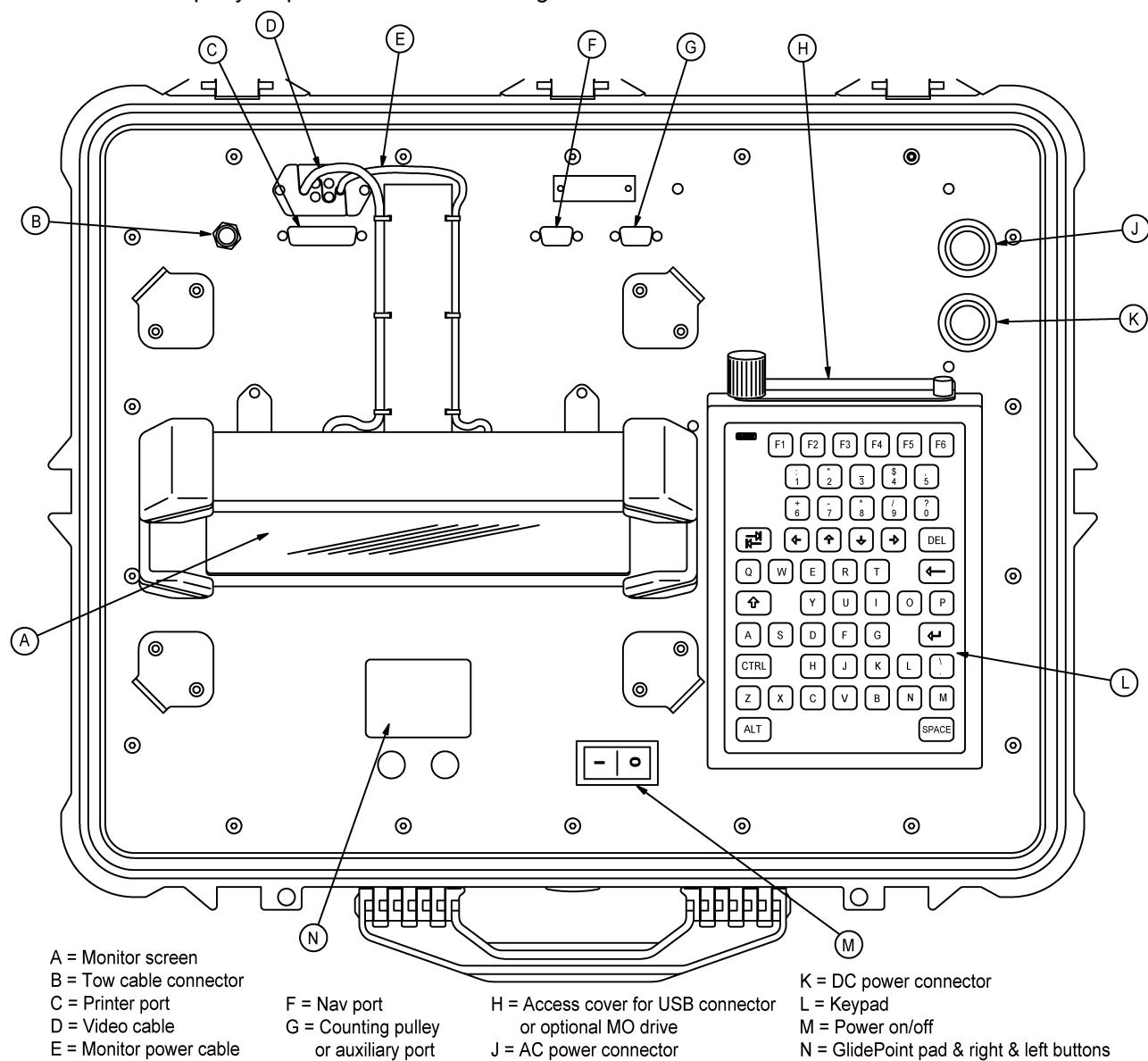


### C-Shell, Panel and Connectors

The C-Shell includes a 4-way USB hub that can be used to house a dongle for the acquisition software. The C-Shell can also be specified with an integral GPS receiver: the GPS output is fed to the hub for transmission to the external USB link.

**C-Case 2**

C-Case 2 is the first successor to the earlier version that ran MaxPro (under DOS). It is an all-in-one data acquisition unit with an integral PC, designed for use in the exposed environment of an open boat. It uses MaxView or third-party acquisition software running under Windows.

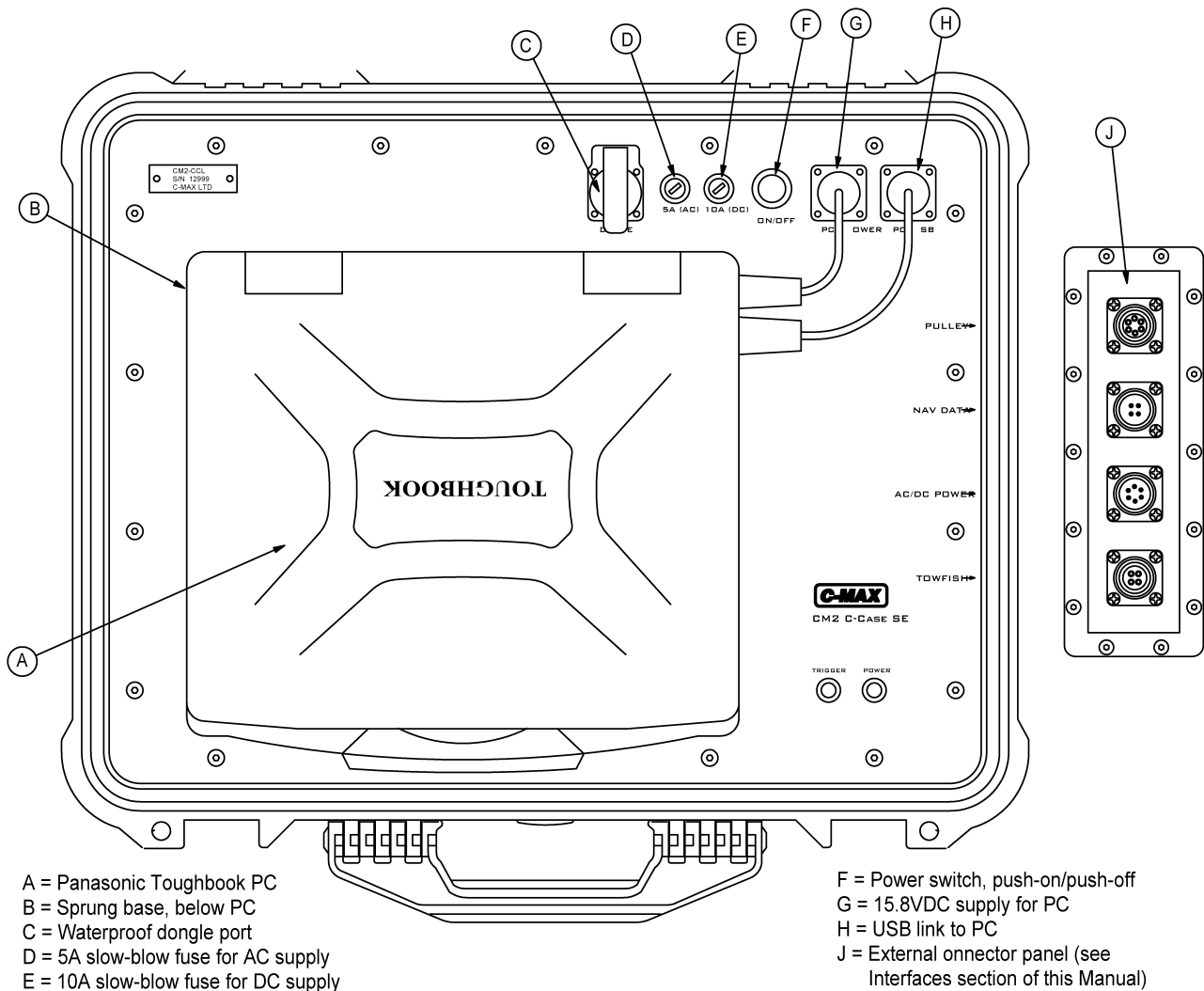


**C-Case 2, Panel and Connectors**



### C-Case SE

The C-Case SE is also an all-weather data acquisition unit. It takes advantage of the availability of ruggedized laptop PC's such as the Panasonic Toughbook series to eliminate the need for the under-panel integral CPU as fitted to the C-Case 2. Like all the later (non-MaxPro) CM2 systems it uses MaxView or third-party acquisition software running under Windows.



**C-Case SE, Panel and Connectors**

### Tow Cables

The CM2 tow cables use a single pair of electrical conductors to carry both data and power. There are two types of tow cable offered with the CM2. "Soft" cable is intended for shallow work, where the cable can be hauled and veered manually. The alternative is steel-armoured cable handled by a winch. Various diameters of steel-armoured cable are available, the smallest being 4.7mm used on the CM2-WIN-300 winch.

### Accessories

Optional accessories including winches, wing depressor, counting pulleys, polemount bracket and USBL bracket, are described in Sections 16-21.

### Specifications

Specifications for the major components and certain accessories are listed in Section 15.

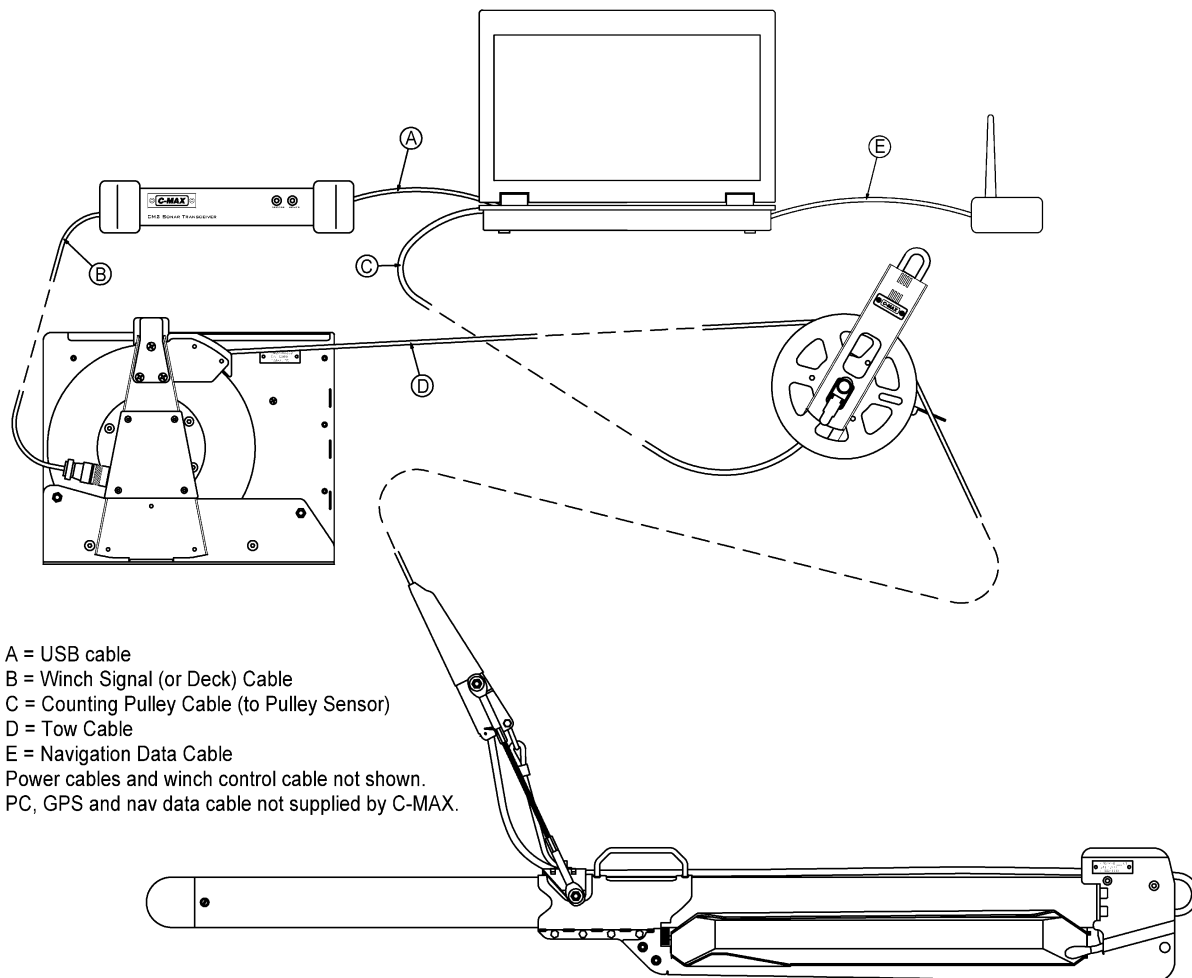
### 3. INSTALLING THE SYSTEM

#### Data Acquisition Subsystem

The CM2 system uses a PC, running Microsoft Windows, to acquire and display the sonar records. The user normally supplies this PC. To install the acquisition software on this PC see the MaxView Installation Guide. For third-party acquisition software see the supplier's manual.

If the CM2 system uses a Sonar Transceiver (STR) or an STR housed in a C-Shell, link it to the acquisition PC via the USB cable supplied.

Prepare to apply dc power to the STR. If powering from an AC supply, use the 60W power brick supplied with the STR.



**System with Optional Winch and Counting Pulley**

Connect the tow cable or winch signal cable (or “deck” cable) to the STR.

Connect a navigation data cable to the PC if required. As GPS and other sources of navigation data often output via an RS232 serial connection, and as serial ports are becoming less common on PCs, this connection may require the use of a serial-to-USB converter. Note that if a CM2 C-Shell (fitted with an STR) is being used, the GPS data from the C-Shell’s optional internal GPS receiver is already mixed with the sonar data on the C-Shell’s USB output.

If a counting pulley is to be used, connect its cable to the PC. This may also require a serial-to-USB converter.

Instead of an STR, some CM2 systems are supplied with all-in-one C-Case 2 or C-Case SE data acquisition subsystems, with integral PC (C-Case 2) or removable panel-mounted PC (C-Case SE). These require tow cables and power cables fitted with the appropriate connectors. Interface details are available in Section 14.

### Tow Cable

Put adhesive tape markers on the tow cable, a few metres above the terminator, to warn when the towfish is close to the vessel.

### Installing a Winch and Pulley (if used)

The tow cable should run directly from the top of the winch drum to a suitable pulley or fairlead.

Any pulley or fairlead must be no smaller than the cable's recommended minimum radius, preferably considerably larger. A pulley is better than a rigid fairlead.

The pulley should normally be suspended above the stern or stern quarter, able to move freely in any direction, and positioned so that neither the towfish nor the tow cable is in danger of fouling the vessel's propeller or rudder or any other structure. A central position minimises tow cable heave caused by the vessel's roll, but may be too close to the propeller wash.

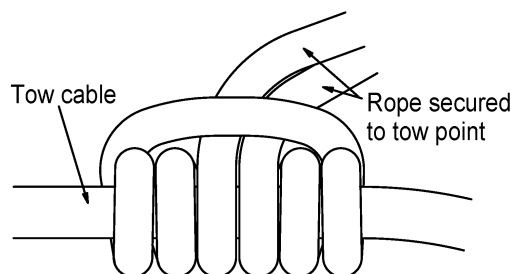
The winch should be mounted as far forward (away from the pulley) as practical, to reduce the maximum off-axis angle of the cable. Also the winch should be located directly ahead of the pulley to minimize the tilting of the pulley and side force on the pulley rim. The winch mounting must be able to withstand the shock of the towfish striking the bottom.

The mounting "footprint" of the CM2-WIN-300 winch is shown in Section 16.

### Securing a "soft" Tow Cable (if used)

Make sure that enough cable is flaked out on the deck so that the towfish can reach its operating depth without the need to disconnect the inboard end of the tow cable. Provide a method of securing the tow cable. One method is to use a loop of 5-6mm diameter rope, one end secured to the deck and the other terminated in a "prusik" knot with 2 or 3 turns around the tow cable. The cable will slip through the hitch until the operator starts to tighten its grip.

To prolong the life of the cable, avoid sharp bends, twisted loops, and shock loads.



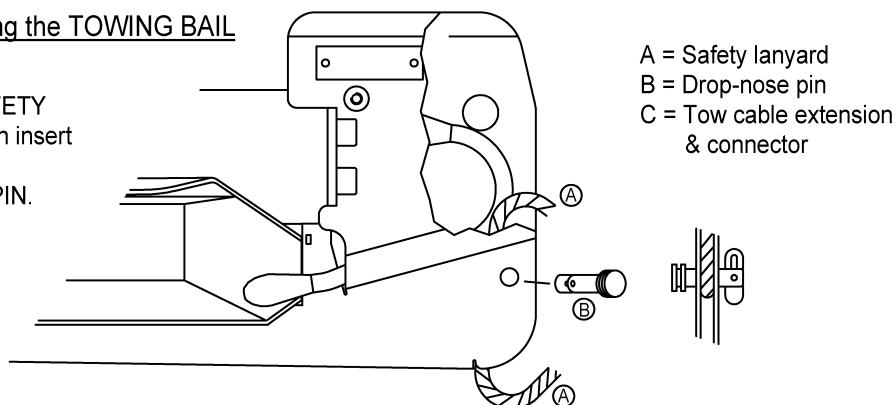
***Securing a Soft Tow Cable with a Prusik Knot***

### Attaching the Towfish

Straighten out the end of the tow cable and, if it is a steel-armoured cable, ensure that there is no more than a half-turn of inherent twist in it.

**BEFORE fitting the TOWING BAIL to the towfish**

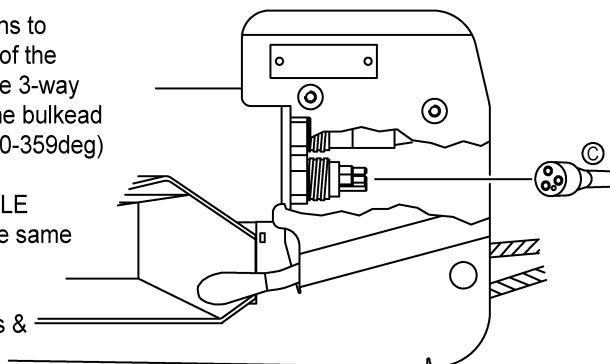
First fit the SAFETY LANYARD, then insert and secure the DROP-NOSE PIN.



Look between the fins to identify the ANGLE of the orientation pin on the 3-way CONNECTOR on the bulkead (may be any angle, 0-359deg)

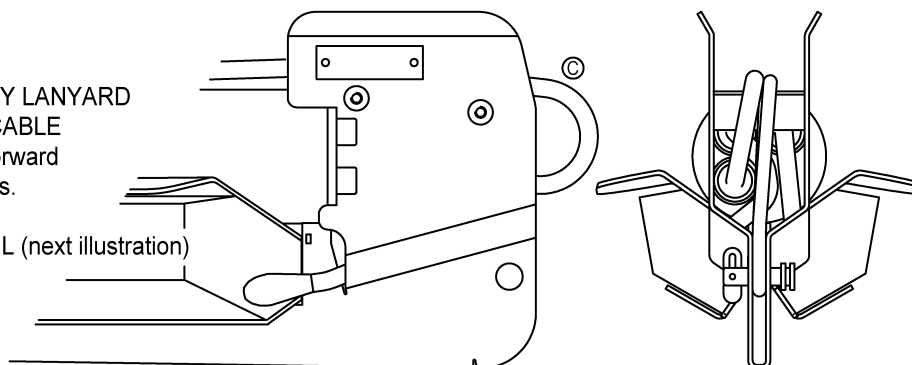
Align the TOW CABLE CONNECTOR at the same angle.

Mate the connectors & push fully home.



Pull the SAFETY LANYARD and the TOW CABLE EXTENSION forward between the fins.

Then fit the BAIL (next illustration)



***Attaching the Safety Lanyard and Tow Cable Extension***

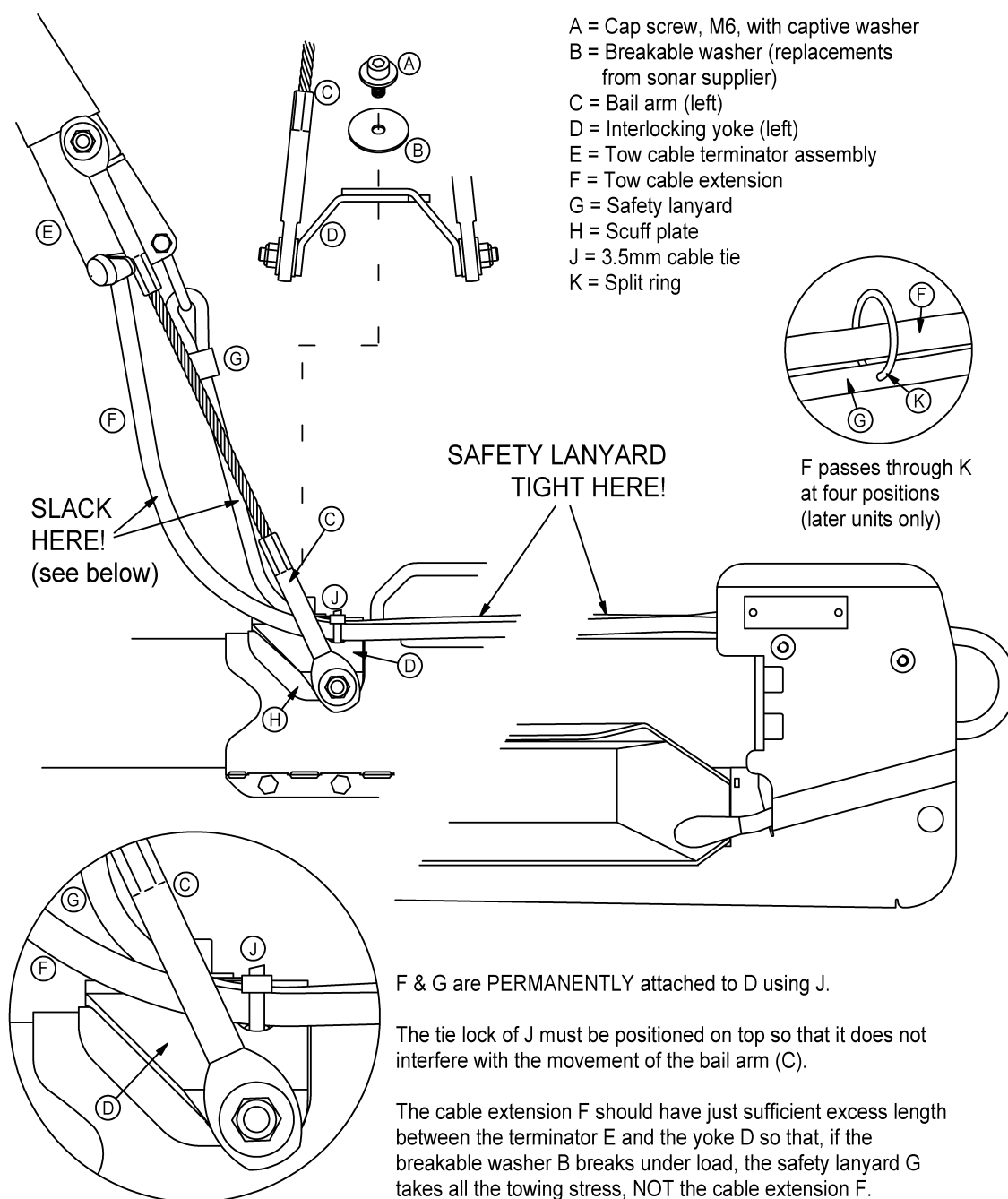
First remove the drop-nose pin from the rear of the keel, feed the loop of the safety lanyard into the end of the keel, and replace the pin to secure the loop. Drop the nose of the pin, to 90 degrees, to ensure that the pin cannot fall out.

Remove the dust cap from the tow cable underwater connector.

Engage the tow cable socket on to the plug on the rear of the towfish, being careful to align the connector correctly. It is good practice to keep this plug clean and occasionally and only very lightly grease the rubber sleeves of the pins with the silicone grease provided.

Attach the towing bail using the breakable “safety” washer, and the M6 cap screw with captive washer. Use the 5mm hex key provided to tighten this screw. The breakable washer is designed to fracture under excessive load.

The safety lanyard and the tow cable extension should be secured to the left-hand yoke with a 3.5mm cable tie so that there is no slack in the lanyard and in the tow cable extension between the yoke and the rear fin.



### Attaching the Towing Bail

#### Checking system operation

With the whole system now connected as described earlier in this Section, apply power to the STR, C-Shell or C-Case. The red Power indicator should light.

If MaxView has been installed, open it and select Start... from the Towfish menu. Alternatively press the spacebar then select Start Towfish from the Quick Select menu. If some other acquisition software is installed instead of MaxView, the towfish can be started using that software.

When the towfish is commanded to start, the green Trigger indicator on the STR should light continuously whilst the Start Towfish dialog displays the Energizing... message. This message should be automatically replaced after a short period by Connecting...

The Energizing... message indicates that a voltage of approximately 42VDC\* is being supplied to the tow cable connector. This voltage is passed to the towfish to charge its internal capacitors and start its operation.

The Connecting... message indicates that the towfish has started its initialisation and that the tow cable telemetry is being set up. This message should disappear when the telemetry link has been established and the towfish has started running.

Note that initially the towfish runs silently, i.e. in the muted mode. This is to allow the telemetry link to complete its optimisation without any interference from the transducer drive voltage. The muted period lasts for the first 80 pings.

As soon as the towfish runs the Trigger indicator flashes, once per ping.

Wait for the gain to rise to a point where the “waterfall” display on the screen has filled in to show “noise” from the environment. At this point the operation of the towfish can be given a basic bench check known as a “rub test”. Without touching the metal of the towfish with either hand, place one hand briefly on the face of one of the transducers. This should result in an increase in signal on the appropriate side of the waterfall display for the time that the hand is that position; at least until the automatic gain control reduces the signal. Then test the other side in the same way. Note that although this is called a rub test, no rubbing action is necessary: the signal is induced capacitively, not by mechanical action.

The Quick Select menu, accessed by pressing the spacebar, can be used to change the sonar range and frequency or to stop the towfish. The spacebar can also be used to clear the Quick Select menu.

(\*If the tow cable is higher in resistance than a certain value, the towfish will detect that its internal voltage has dropped below nominal. In this case it will command the STR, or other unit, to increase its supply to the tow cable by a further 24V.)

### **Spares and Tools**

Always carry spare breakable washers. A 5mm hex key is the only tool required in normal operation. Every towfish is supplied with a kit (CM2-TSK) containing minor spares and consumables.



## 4. PLANNING THE SURVEY

### Survey Plan

Every survey or search needs to be planned in advance. Survey planning and post-processing are topics that are wider than can be covered here. Most sonar acquisition software packages, including MaxView, include the facility to plan survey lines for guiding the helmsman.

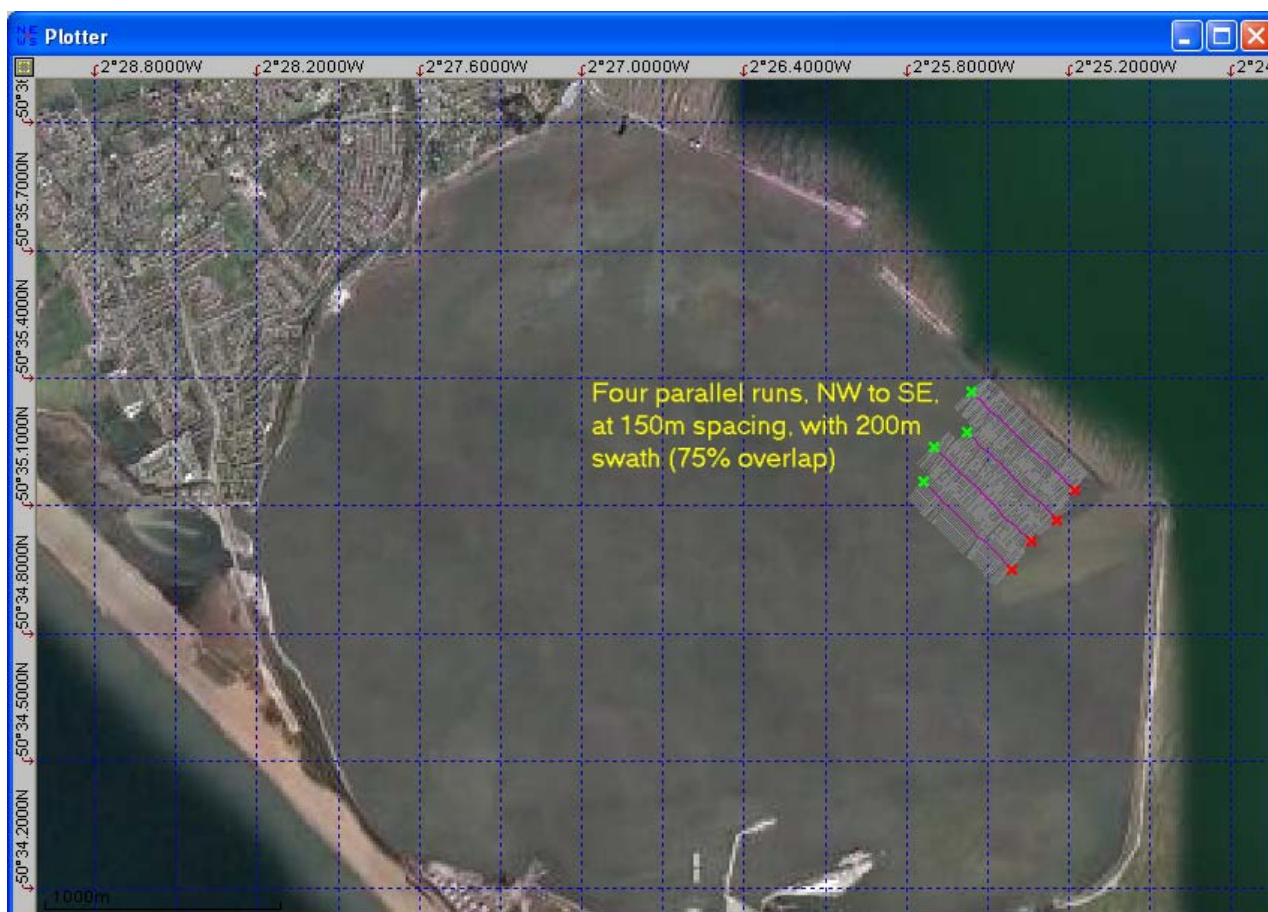
### Line Spacing

The frequency and range settings should be defined for the type of task being planned, whether it is a search for a wreck or lost anchor, or a post-dredge clearance check, for example.

The image quality is reduced in the region below the towfish because the image when received is compressed and also the steep angle results in poorer shadow information. The quality is also reduced at the extremity of the range primarily because of beam spreading. Survey lines should therefore be spaced with sufficient overlap (e.g. 75m when working with 100m range setting) to ensure complete coverage. Overlap is also necessary to compensate for course deviations.

### Line Direction

It is normally preferable to run survey lines in the same direction as any current. Where currents are very strong the lines may need to be run in only one direction, against the stream, as running with the stream would give too high a speed over the ground thereby reducing the number of pings on any target.



***Typical Small Survey; Area Sweep inside a Harbour***

In order to identify a target, or to provide extra assurance of coverage, it may also be necessary to follow the along-current lines with a set of perpendicular, cross-current, lines.

Sometimes the major consideration in planning lines is not the direction of the current but the bathymetry. It is easier to survey along lines of approximately constant depth rather than to be constantly heaving and veering tow cable to keep the towfish at a suitable altitude.

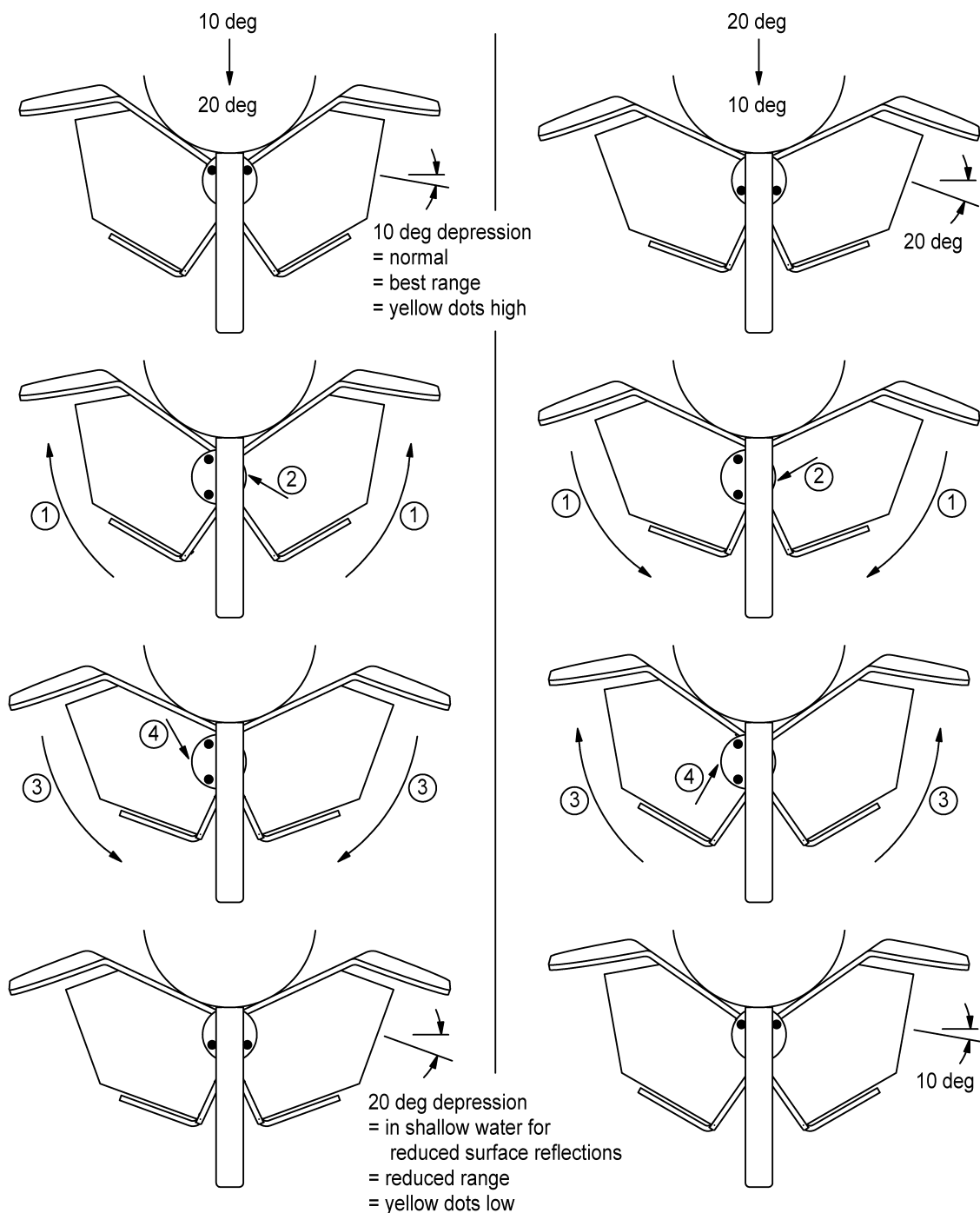
Finally, the wind direction may be the controlling factor. Waves running across, rather than in the same direction as, the survey line will cause a spiralling movement of the tow cable and oscillation of the towfish track. This will have more of an effect on the image than the simple pitching motion if the ship is running into, or directly away from, the waves.



## 5. OPERATING THE TOWFISH

### Pre-launch Check

Check that the towfish transducers are angled high or low, as required, as indicated by the yellow dots on the depression adjuster cam.



Move the cam rearward. Then rotate the cam and transducers as shown by the arrows in the sequence 1 - 2 - 3 - 4. Finally move the cam forward to the locking position.

### **Adjusting the Transducer Depression Angle**

Check that the tow cable connector is firmly home, and that the bail is correctly attached to the towfish.

Check that the tow cable is clear and free from twists, and that the winch is powered and ready to run.

Note that the automatic gain adjustment starts as soon as the towfish is switched on.

## Using the Wing Depressor

If the optional wing depressor is used, refer to Section 18 for advice and important warnings.

### Launch

Launch the towfish astern with the vessel preferably at slow speed.

DO NOT ALLOW ANY SLACK IN A WINCHED TOW CABLE during launch and whenever the towfish is in the water. A slack cable can start to wind outside the winch drum. It can also form loops that can pull tight and SERIOUSLY DAMAGE THE CABLE.

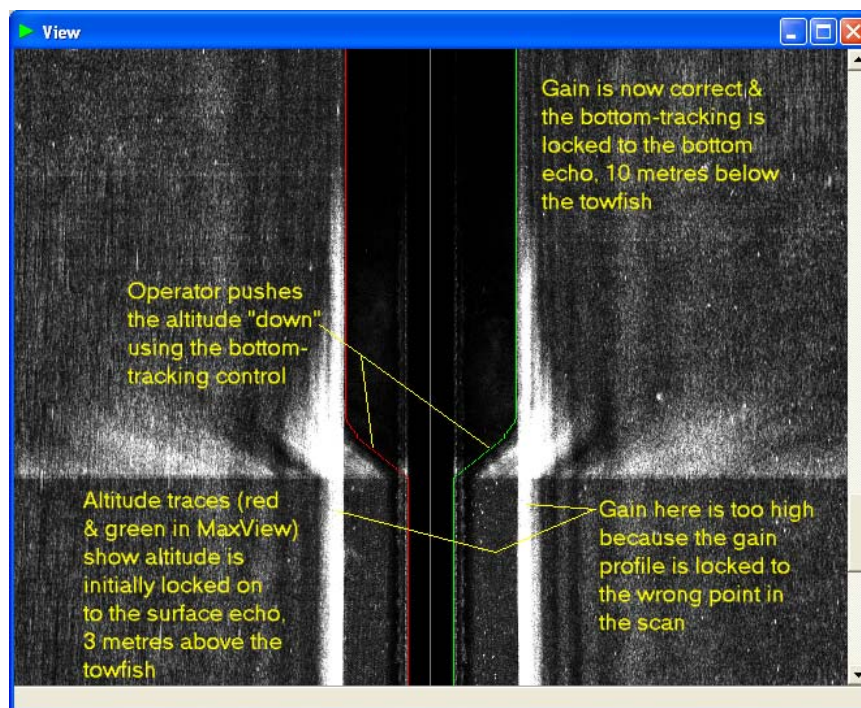
The "soft" tow cable can be handled without gloves but is still capable of giving friction burns if allowed to slip.

### Flying the Towfish

Set the display to show the water column (i.e not slant-range-corrected) then lower the towfish to an altitude in the range 5-15m initially. The indicated altitude (not necessarily the true altitude at this stage) is shown in MaxView's sonar parameters, or equivalent, and may also be also marked on the display by a pair of lines overlying the initial bottom echoes.

Check that the altimeter is locked on the initial bottom echo, not on the surface echo, nor is left in a "neutral" position.

IF THE ALTIMETER INITIALLY FAILS TO LOCK ON TO THE BOTTOM CORRECTLY USE THE FORCE UP – DOWN CONTROL TO PUSH IT INTO LOCK.



***Locking the Bottom-Tracking after Launch***

In MaxView the bottom-tracking control is Towfish – Bottom-Tracking (or Altimeter in early versions).

The indicated altitude cannot exceed 20m for EF operation, 40m for HF, and 60m for LF. If the towfish is operated above these maximum altitudes, the image may be degraded; also the altimeter may try to lock on to surface echo instead of the bottom.

Minimum indicated altitude is 1.4m. MaxView and other acquisition programs may sound an alarm if the altitude falls below a preset value.

As soon as the altimeter has locked to the bottom and the image is normal, wind the cable in or out, or adjust speed, until the towfish flies at an altitude equivalent to 5 -10% of the range limit.

The towfish must be flown high enough to clear any obstacles. Over uneven ground, flying high increases safety and prevents excessive shadowing. Over flat and featureless ground, flying low enhances the shadows of any object that may be present. In shallow water it may be necessary to fly lower to stay below the wake.

In very shallow water it may be better to deploy the towfish alongside, or at the bow, rather than astern, but keep the towfish away from the propeller!

Depending on speed and depth expect to pay out about 3 metres of tow cable for every metre of towfish depth (not altitude). Always keep a reserve of at least 3 turns of cable on the winch drum.

See Notes for the Helmsman.

Tow in the range 2.5 to 6kt (speed through the water; this may differ from speed over the ground or GPS-indicated speed). Low over-the-ground speeds give more scans per metre of travel and a correspondingly better image resolution. Sometimes, however, a higher speed will give a steadier course.

Caution: the towfish will sink towards the bottom whenever the towing vessel slows or turns.

### **Recovering the Towfish**

Slow to 2 to 4 knots before the towfish hits the wake. Watch for the tape marker warning that the towfish is close.

Wash the towfish, cable and winch with fresh water immediately after use in seawater. When the tow cable is disconnected from the towfish, cap the cable connector to keep it clean.

DO NOT EXPOSE THE TRANSDUCERS TO HEAT FROM STRONG SUNLIGHT

### **Action if the Towfish Fouls**

If the towfish hits the bottom or other obstruction, the increased towing force will usually break the breakable washer. The safety lanyard will then apply tension to the rear of the towfish. This will normally cause it to tumble and to free itself of the obstruction. In the meantime the towing vessel should, of course, slow down but without going astern into the cable!

Recover the towfish and replace the breakable washer. Inspect the towfish and tow cable for any damage.

## 6. OPERATING GUIDELINES

Do not allow the towfish to hit the bottom – be very careful when turning

Fly the towfish on as straight a course as possible, to prevent distortion and smearing of the image

Fly the towfish lower (but safely clear of the bottom) to give best image shadows, e.g. 5m altitude; fly it higher to give longest effective range, e.g. 10m altitude or more, except in shallow water

Use the higher frequency for best image resolution, and for small targets; use the lower frequency for longest effective range, and for big targets

Use 10deg transducer depression in normal circumstances; use 20deg depression if the bottom image is being obscured by reflections from the sea surface

Higher tow speeds are ok for LF (100kHz) operations, e.g. up to 6 knots

Use lower tow speed for HF (325kHz) operations, e.g. 4 knots

Use lowest tow speed for EF (780kHz) short-range operations, e.g. 3 knots

Low speed gives more “pings” on each target and gives greater towfish depth for any particular tow cable length

High speed makes it easier to keep the towfish on a straight course

Overlap survey tracks to give best target detection probability; overlap by at least 2x altitude (approximate rule), ideally 100%

Orthogonal survey tracks (e.g. E-W then N-S) may give more information on target shape

During the survey always watch the image in NORMAL geometry to check that the bottom-tracking (automatic altitude measurement) is locked on to the bottom echo

If the bottom-tracking loses lock use altimeter forcing buttons (up-down) to restore the correct indicated altitude

Check the incoming nav data and don't forget to RECORD the sonar data!

## 7. NOTES FOR THE HELMSMAN

### Navigation

Use the sonar's plotter window to show waypoints, the track and the swept ground.

### Steering

The quality of the sonar images depends on the skill of the helmsman. This applies especially to the HF and EF operation.

The helmsman is so important because the towfish can only collect good images if it flies straight. Because of this, steering a sidescan sonar survey is not the same as steering a conventional sounding line.

A turning towfish stretches the image on one side and compresses the other, wasting the high resolution of which the system is capable. (A high power telescope can only be effective if it is held steady!) As well as corrupting the outer areas of the image, a turning towfish also upsets the matching between the gain profile and the beam shape, causing alternate light and dark patches in the inner areas of the image.

Use small, slow wheel movements even if this means that the vessel temporarily leaves the planned survey line. If an autopilot is available it will, under most conditions, steer a better sonar course than a human helmsman, even though the heading may need to be trimmed occasionally.

Remember that the towfish follows the stern, particularly when the tow cable is short, and is therefore affected by rudder movements as well as by course deviations.

At the end of the survey line, the helmsman must warn the sonar operator before turning and must not turn sharply, or the towfish could strike the bottom.

### Emergency Actions

Emergency actions should be discussed in advance of the survey, between the sonar operator and the helmsman. The planned actions will depend on the water depth and depth variation, bottom type and the danger from obstacles.

If sharply rising ground or an obstacle is detected on the ship's echo sounder it may be too late to raise the towfish by hauling in the tow cable, particularly if the cable is several hundred metres long. Here the quickest way to raise the towfish may be to increase the ship's speed as quickly as possible. Of course if, despite this manoeuvre, the towfish still strikes the obstacle or bottom the impact will be at higher speed.

Slowing to avoid an impact with an obstacle will almost certainly drop the towfish on to the bottom, but may reduce the risk of losing the towfish.

If the towfish gets entangled, and the ship is manoeuvring above, beware of catching the tow cable in the propeller.

## 8. TOWFISH COMMANDS

### Towfish Command Set

The CM2 towfish uses the same set of commands regardless of what acquisition software is being used.

Towfish start, stop, range selection and bottom-tracking control must be supported by all acquisition software; other commands may or may not be supported. MaxView offers short-cut keys for range selection and bottom-tracking control, as well as for towfish start and stop.

### Bottom-tracking, Up and Down

These allow the operator to force the indicated altitude to the correct value so that the altimeter can resume lock on to the bottom. .

### Mute, Off or On

Mute allows the towfish to run as normal but with no acoustic transmissions. This is useful for diagnostic purposes where an echo sounder or other acoustic source may be interfering with the image. When muted, indicated altitude is zero.

### Shallow Mode, Off or On

Shallow mode is intended for use only in very shallow water where the user needs to use the towfish at less than the normal altitude limit of 1.4m. In shallow mode the gain profile is started at the towfish position itself instead of at the first bottom echo and the indicated altitude is zero.

### Gain Hold, Off or On

Gain Hold allow the automatic gain to be inhibited, fixing the gain profile as it was when Gain Hold was selected.

Normally the only reason to disable the automatic gain is if the image of a certain target, such as a wreck, needs to be observed without the gain slowly changing. If the gain profile is held whilst the target is in view, the reflectivity of any part of the target can be directly compared. Also if the target has a significant dark area, holding the gain constant avoids the “gain shadow” as the scan moves back on to the relatively light background again.

Caution: If the gain profile is held constant this automatically disables the towfish from measuring its altitude. The reason for this is that changes in bottom reflectivity together with the fixed gain may mean that the altimeter would have difficulty in bottom-tracking. However the altitude can still be adjusted by the operator using the bottom-tracking, up and down controls. Also note that the correction for the shape of the acoustic beams may be wrong if the altitude changes whilst the gain is held.

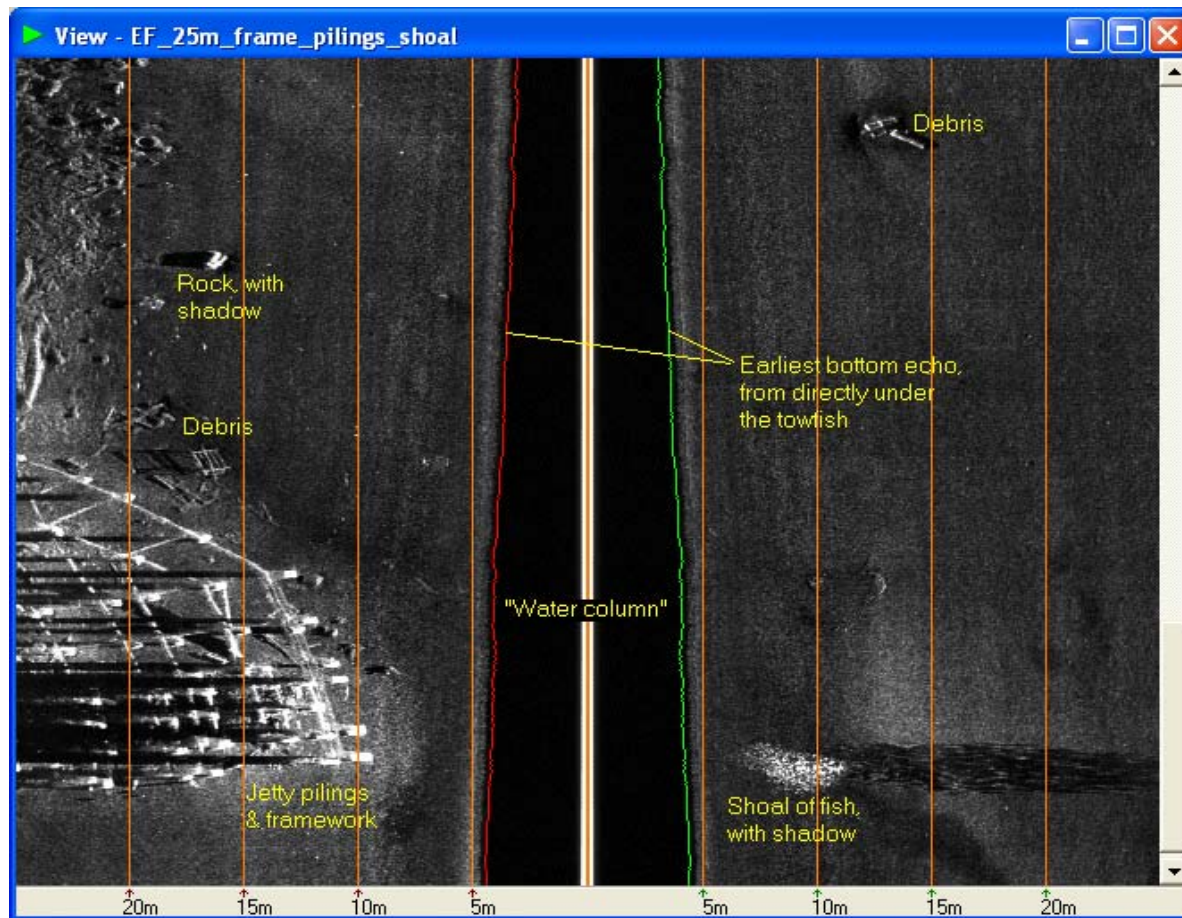
### Gain, Up or Down

When Gain Hold is in the On state the overall gain profile can be adjusted up or down, in 1dB steps.



## 9. INTERPRETING THE SONAR IMAGE

(This topic may be covered in additional detail in help text associated with MaxView or with third-party acquisition software.)



*Typical Sonar Image (780kHz)*

### Water Column and Bottom Image

At the very centre of the image is a line that corresponds to the track of the towfish.

On both sides of the central line, the (normal geometry) picture is occupied by what is called the 'water column'. This represents the time before the echo first returns from the bottom directly below the towfish. The water column normally shows up as a white area. Occasionally, if the towfish is close to the water surface, faint echoes of the surface may show up in the water column. Wake bubbles, fish shoals, and other mid-water objects, may appear in the water column on one or both sides, depending on whether they are to one side of the towfish (but still nearer to the towfish than to the bottom) or are directly below the towfish.

### Highlights and Shadows

The towfish sees most of the bottom in its view at quite a low angle, as little as 5° at the outer regions. This means that the sonar picture normally includes both highlights and shadows.

Highlights, shown as darker points or smudges, indicate that the beam has struck a stronger echo reflector. Hard surfaces reflect more strongly; so do surfaces that face the beam direction. The air-filled swim bladders of fish can also act as good reflectors.

Shadows show up as lighter areas usually lying beyond a highlight or line of highlights. They can indicate the presence of an object and can also provide clues about its height and shape. If there are no associated highlights, the shadow may just indicate a depression in the bottom.

If an object casts a shadow on a flat bottom the height of the object is given by simple geometry, using the shadow length, the towfish altitude, and the true (slant) distance of the object from the centreline. Some acquisition software, including MaxView, includes the ability to calculate the object height by running the cursor along the length of the shadow.

### **Image Corrections**

For safety when gathering sonar records use the uncorrected, normal geometry (not slant-range corrected) image. When reviewing the records, or when taking measurements, corrected geometry may be useful.

Selecting slant-range corrected geometry (SRC) corrects for the 'slant range' distortion, by differentially stretching the image, and removing the water column.

Over rocky or very uneven ground the closure at the centre of the SRC image may not be perfect. If the ground is uneven it cannot be assumed that the whole bottom is varying in unison, so a smoothed altitude value is used. The SRC process exaggerates any mis-closure.

Although SRC geometry corrects for slant range distortion, it does not correct the display 'aspect ratio', i.e. ensure that a square area of the bottom is represented by a square on the display. To do this requires replicating or suppressing ping lines and is not generally desirable.

### **Causes of Image Defects**

It is important that the towfish is towed on a steady track and without excessive heave motion transmitted down the tow cable. Any erratic motion of the towfish will transfer to the image. Roll oscillations may produce light and dark banding, alternating between port and starboard sides. Turning stretches the image on one side and compresses the other.

If the towfish is near the surface it may pick up reflections from the surface waves. This can reduce the maximum range at which a good bottom image is obtained. Also in calm conditions, particularly in shallow water, the echoes can reflect off the surface as well as returning directly. This 'multi-path' effect shows up in the image as ghosting. The CM2 HF towfish has a sharper surface cut-off than most sidescan sonars and is inherently more resistant to both the above effects.

The CM2 towfish transducers are adjustable in angle. In the normal position they are depressed nominally 10° from the horizontal. This angle gives maximum range. In the other position they are depressed approximately 20° from the horizontal. This gives greater immunity from spurious echoes from the surface, which may be useful in shallow water, but sometimes at the cost of reduced effective range.

The wakes of motor vessels contain a vast number of microscopic bubbles, which may take ten minutes or more to dissolve. Wakes left by other vessels can show up prominently on the sonar image and should not be confused with permanent features.

Note that a large object, such as a wreck or a piling structure for example, may appear to be distorted if it tilts towards the direction from which it is being viewed or extends above the altitude of the towfish.

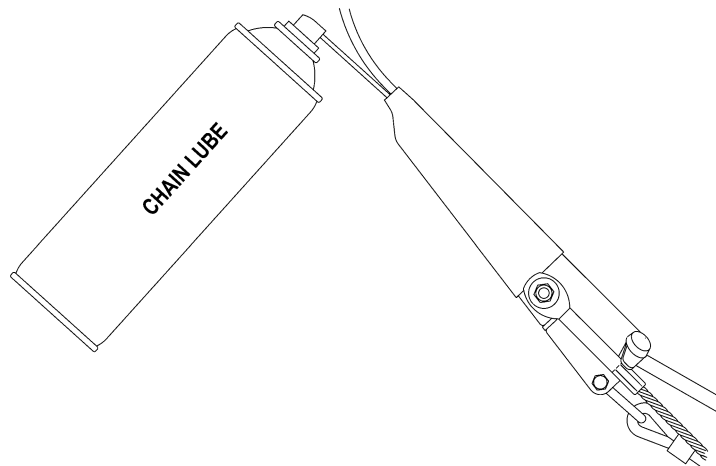


## 10. ROUTINE MAINTENANCE

### Routine Maintenance

Maintenance is simple and is normally limited to the following tasks: -

- (a) Immediately after use, thoroughly wash the towfish with fresh water if it has been exposed to seawater: also wash the tow cable and winch
- b) Daily, or whenever it is suspected that the breakable washer attaching the bail to the towfish has been stressed in use, inspect the washer; refer to the replacement procedure below
- c) Periodically inspect the whole system, particularly the cable, for accidental damage that might otherwise go unnoticed
- d) Clean the exterior of all items, when appropriate; for the STR or C-Case use a cloth lightly damped with fresh water, no solvents
- e) For galvanized steel armoured cable, every 90 days, or every 20 deployments, whichever is more frequent, spray chain lube (or WD40 or similar) into the cable terminator. Insert a small screwdriver (or spike) between the black PVC sheath and the tow cable, then insert the tube extension of the chain lube dispenser alongside the screwdriver and inject enough lubricant to ensure that the internal strands of the cable, hidden by the sheath, are protected from corrosion.



### ***Protecting the Cable Armour from Corrosion, Galvanized Type only***

- f) Follow the winch maintenance instructions.

The towfish O-ring seals may be replaced every 5-7 years. This can be done by the user or by the Factory or local representative. See the section on Replacing the Towfish PCB for advice on opening the towfish.

### **Replacing the Towfish Breakable Washer**

The breakable washer secures the tow cable bail assembly to the spigot on the towfish. It should be replaced if the bail has pulled free or the washer shows signs of stress. This washer should be inspected regularly.

## 11. STORAGE AND TRANSIT

Keep the towfish transducers from becoming excessively hot by keeping them out of direct sunlight.

The system should be stored and transported in purpose-designed containers. Internally padded shipping/storage cases can be supplied for all the system components.

On the optional CM2 or SK172 winches, tape or strap the tow cable to prevent it unreeling from the winch drum.

Ensure that all equipment, particularly the STR, is dry before packing.

Keep the empty cases closed whilst the system is in use so that they do not accumulate condensation.

## 12. REPAIR AND REPLACEMENT

### Replacing the Towfish PCB

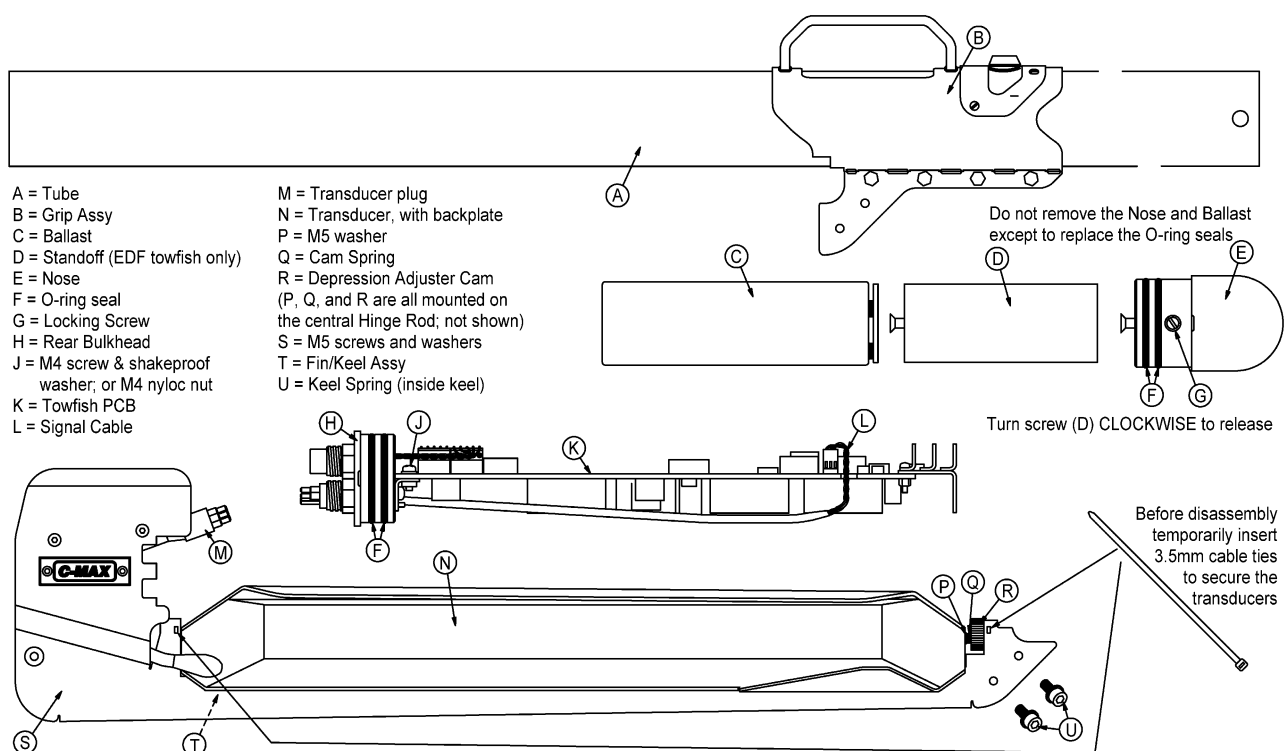
The towfish internally contains only lead ballast and a single printed circuit board (PCB). This PCB can be replaced as a unit by the user. Note that this PCB is complex and is not user-serviceable. Any attempted repair of this PCB by the user will invalidate the warranty and may cause permanent damage.

The towfish should be opened and resealed only in low or moderate humidity conditions to avoid the possibility of condensation forming internally when the towfish is immersed in cold water.

It is assumed that the tow cable and safety lanyard have been disconnected.

Dismantling the towfish is easier if someone is available to hold it in position, resting with its nose and keel on a bench, with the keel held upright.

Set the transducer depression angle to 10° and temporarily put cable ties through the slots shown on the illustration. This secures the transducers to the keel.



### Disassembled Towfish

Remove the two M5 socket cap head screws at the forward end of the keel. This is easier if the towfish tube is pressed down on the keel to keep pressure off the screws.

Push the tube forward and then disconnect the two transducer connectors. Completely separate the tube assembly from the keel/transducer assembly. The rear bulkhead is now free to be extracted from the tube, but it will be retained by the grip of the O-rings. Rotate the rear bulkhead to loosen this grip, pulling outwards at the same time. If necessary use two large screwdrivers, with their blades in the recesses each side of the rear bulkhead, to start the extraction process.

Note that in cold conditions the rear bulkhead may be released more easily from the grip of the O-rings if the tube is heated near the joint, for example by pouring hot water over this area. Note also that if the rear bulkhead and the tube become misaligned (i.e. off axis) they may tend to jam together.

When withdrawing or inserting the PCB (attached to the rear bulkhead) do not allow the black aluminium heatsink on the end of the PCB to scratch the sealing surface of the tube.

Whenever the rear bulkhead (or the nose) has been removed the end of the tube is vulnerable to damage. Even a short drop on to a hard surface may distort the bore.

To remove the PCB, first disconnect all attached connectors. Then remove the M4 screw in the rear bulkhead bracket that retains the PCB. For later units an M4 stud and locknut is used instead of an M4 screw. When removing or re-attaching the PCB be careful not to damage the small thermometer chip on the underside of the PCB by catching it against the bracket.

Reassembly requires care. The two O-ring seals on the rear bulkhead may be renewed using standard nitrile rubber seals of 49.5mm inside diameter, section diameter 3.0mm, medium hardness (Shore Hardness A70). All the sealing surfaces must of course be clean and dry, and they should be very lightly lubricated with the silicone grease provided. The replacement of the rear bulkhead O-rings, and cleaning, are best done with the PCB removed.

Reassemble the tube assembly to the keel/transducer assembly by the reverse process. Rotate the transducers to the 10° depression angle (cam dots high) then remove both cable ties from the slots.

There is normally no need remove the nose of the towfish but, if there is, proceed as follows. Screw the two locking screws inwards (clockwise, lightly) to the full extent. This will release the nose but it will be retained by the grip of the O-rings. Rotate the nose to loosen this grip, pulling outwards at the same time. If necessary use two screwdrivers, with their blades in the recesses each side of the nose, to start the extraction process. Putting a rubber band round the nose may enable it to be gripped more easily.

As the nose is replaced, rotate it to align the locking screws. Wind each screw counter-clockwise just enough to lock the nose in position. Use MINIMUM torque.

### Replacing a Transducer

To replace one or both of the acoustic transducers, do not separate the rear bulkhead from the towfish tube.

Remove the tube assembly as described in the previous section. Remove the two temporary cable ties and then lift out the pair of transducers, still hinged together with the hinge rod. Slide out the hinge rod.

Be careful to retain the adjuster components on the rod. They must be grouped at the front (screw) end, with the screw head on the cam pointing forwards. The assembly order on the rod is the adjuster components (cam, coil spring, M5 washer) then the transducers..

Never remove the angled backplates from the transducers.

Replace the transducers by the reverse procedure, and refit the tube assembly as described earlier.

### Repairing the Tow Cable

In the event that the “wet” end of the cable requires re-termination, this may be performed by the Factory. Alternatively the cable may be re-terminated in the field using the termination kit, available as a standard accessory. Steel-armoured cables cannot normally be repaired mid-way along their length by splicing because the bulk of such a splice would prevent the cable from layering properly. Manually handled “soft” tow cables can, in an emergency, be spliced but it is difficult to ensure that the splice retains sufficient strength and such a repair is not recommended.

If a steel-armoured cable is damaged close to the winch end and the damage is such that the cable is unserviceable, then this damaged inboard section will need to be cut out. The shortened cable will then need to be re-terminated on to the winch. In these circumstances, or if the cable is to be completely replaced, consult Section 16 or 17 for guidance on removing and replacing a tow cable on the CM2-WIN-300 or SK172 winches. The guidance for these winches may also be applied, where appropriate, to larger winches.

### Replacing the Safety Lanyard

A damaged or worn lanyard should be replaced with a factory-produced item to ensure that the dimensions are correct.

The latest design of lanyard is superior to the earlier pattern and is easier to retrofit.

If a lanyard must be constructed locally in emergency, it should have an internal length, measured over 8mm pins, of 98.5cm.

### **Servicing the Surface Electronics**

Some items are SENSITIVE TO ELECTROSTATIC DAMAGE and must be handled accordingly.

Be careful not to stress cables or connectors when disassembling equipment.

Before removing any component or internal cable, observe carefully how it is secured and replace it exactly as found.

Consult the local C-MAX representative or the factory for advice.

### **Servicing the STR**

To gain access to the internal parts of the STR remove the three M3 screws at the lower rear of the unit and carefully slide the chassis out.

Take care when replacing the chassis not to trap the LED leads between the chassis and the top of the enclosure.

### **Servicing the C-Shell**

To gain access to the internal parts of the C-Shell release the black plastic panel (STR base) and then remove the two M3 nuts holding the black anodised cover from the connector panel. This reveals the printed circuit board mounted on the back of the connector panel that carries the 20x5mm 10A fuse in the DC supply to the STR. This PCB also includes the 12V regulator for the fan and power LED.

### **Servicing the C-Case 2**

To gain access to the internal parts of the C-Case 2 remove the eighteen M3 screws securing the edge of the main panel. Do not attempt to remove any of the screws visible on the outside of the case.

Carefully lift out the panel and examine for defective components or connections.

Note that the monitor panel is a sealed unit. Do not attempt to remove the screws on its upper edge. A defective monitor must be returned to C-MAX for repair. An external monitor can be used in the absence of the normal unit.

### **Servicing the C-Case SE**

To gain access to the internal parts of the C-Case SE remove the eighteen M3 screws securing the edge of the main panel. Do not attempt to remove any of the screws visible on the outside of the case.

Carefully lift out the panel and examine for defective components or connections.

## 13. TROUBLESHOOTING

### **STR or C-Case will not power up**

Check the supply voltage.

### **Towfish will not start**

Wait 30 seconds before trying again.

Check all connectors.

Use a DC voltmeter on pins 1 and 2 of the underwater tow cable connector (disconnected from the towfish) to check that approximately 42V appears for a period when the towfish is commanded to start.

If an SK172 winch is present, inspect the slip rings within the winch and, if necessary, clean them.

### **Towfish altimeter locks on to the surface echo**

This can only occur if the towfish is nearer to the surface (or the wake bubbles) than to the bottom while, at the same time, the signal gain has not yet reduced to the correct value for the bottom echo.

Use the towfish bottom-tracking commands to force the indicated altitude to the correct value.

### **Image contrast poor at the longer ranges**

Check that the transducer depression angle is set high (10°).

Check that the transducer faces are clean and free from oil or grease. Clean with mild detergent.

Try greater towfish altitude.

Check system performance in a known environment.

### **Image shows unexpected patterns on outer zones**

If the sea surface is rough and the bottom is smooth then suspect interference from surface echoes. Try setting the transducer depression angle to low (20°).

### **Image shows spots or other interference**

Temporarily mute the towfish to aid diagnosis, and then try switching off echo sounders, pingers or other sonars. Also try throttling back any outboard motors, particularly those with underwater exhaust.

Reduce tow speed.

Ensure that the towfish is below the wake.

Try reducing the towfish altitude.

### **Image shows alternating dark and light bands**

If these bands are at 90° to the towfish track, it indicates that the towfish is not flying steadily.

Try to reduce the heave motion being transmitted down the tow cable. Hold a steady course and heading.

Try increasing towing speed so that the vessel holds a straighter course.

### **Image suddenly goes very erratic**

The towfish has probably struck the bottom, or a mid-water obstacle such as an anchor chain, and broken the breakable washer. Recover the towfish carefully.

**Winch does not operate**

Check the supply voltage and polarity.

Check the operation of the remote control pendant using an ohmmeter between the COMMON and IN and OUT contacts.

**Other troubleshooting advice**

If further advice is required, consult your local representative or the Factory.

## 14. INTERFACES

### Towfish/Tow Cable Interface

#### Wet end interface

Mechanical: CM2 terminator, bail arm assembly and tow cable extension

Electrical: SubConn Micro 3 female (or equivalent)

Data = pins 2 and 3, polarity not significant; balancing signal (in tow cable extension only) = pin 1

### STR Interface (early type)

#### Tow cable or winch deck cable

BNC, polarity not significant

#### PC link

USB type B socket; USB1.1 or 2.0

#### Power input

2.5mm DC jack socket, central pin = +ve; see STR Specifications for power requirements

### STR Interface (later type)

#### Tow cable or winch deck cable

MIL-C-5015, size 10, threaded, 2-way bulkhead connector

Sockets A and B; polarity not significant

#### PC link

USB type B socket; USB1.1 or 2.0

#### Power input

MIL-C-5015 size 14, threaded, 4-way bulkhead connector

Pin A = +ve, pin B = gnd; see STR Specifications for power requirements

### C-Shell Interface

#### PC link

MIL-C-5015, size 14, threaded, 4-way bulkhead connector

Pin A = gnd, pin B = 5V, pin C = data-, pin D = data+ ; USB1.1 or 2.0

#### Tow cable or winch deck cable

MIL-C-5015, size 10, threaded, 2-way bulkhead connector

Sockets A and B; polarity not significant

#### Power input

MIL-C-5015, size 10, threaded, 2-way bulkhead connector

Pin A = +ve, pin B = gnd; see C-Shell Specifications for power requirements

### C-Case 2 Interface

#### Tow cable or winch deck cable

BNC, polarity not significant

#### Navigation data input

9-way D-type serial port

#### Counting pulley input

9-way D-type serial port

#### Printer output

25-way D-type parallel (Centronics) port

#### AC power input (see C-Case Specifications for power requirements)

Bulgin Buccaneer, 3-way male bulkhead connector

Pin L = AC live; pin N = AC neutral; pin E = gnd; see C-Case Specifications for power requirements

#### DC power input (see C-Case Specifications for power requirements)

Bulgin Buccaneer, 2-way male bulkhead connector

Pin L = DC +ve, pin N = DC -ve; see C-Case Specifications for power requirements



**C-Case SE Interface**

Tow cable or winch deck cable

MIL-C-5015, size 14, threaded, 4-way bulkhead connector

Sockets A and B; polarity not significant

Power input input (see C-Case SE Specifications for power requirements)

MIL-C-5015, size 14, threaded, 6-way bulkhead connector

Pin A = - ve DC, pin B = +ve DC, pin C = N/C, pin D = AC (L), pin E = AC (N), pin F = chassis Gnd

Navigation data port (RS232 serial port)

MIL-C-5015, size 14, threaded, 4-way bulkhead connector

Pin A = gnd (= D-type skt 5), pin B = RX (= D-type skt 2), pin C = TX (= D-type skt 3), pin D = N/C

Counting pulley port (RS232 serial port)

MIL-C-5015, size 14, threaded, 6-way bulkhead connector

Skt A = gnd (= D-type skt 5), skt B = RX (= D-type skt 2), skt C = TX (= D-type skt 3),

Skt D = DTR (= D-type skt 4), skt F = RTS (= D-type skt 7)

PC link (internal)

MIL-C-5015, size 14, threaded, 4-way bulkhead connector

Pin A = gnd, pin B = 5V, pin C = data-, pin D = data+ ; USB1.1 or 2.0

PC power, 15.6VDC (internal)

MIL-C-5015, size 10, threaded, 2-way bulkhead connector

Skt A = gnd, skt B = 15.6VDC

**Winch and Counting Pulley Interfaces**

Consult Sections 16, 17 or 19 for interface information on these optional accessories.

## 15. SPECIFICATIONS

### Towfish Specifications

Operating depth  
 0-2500m  
 Acoustic frequencies  
 100kHz -LF  
 325kHz -HF (compatible with industry "500kHz" specs)  
 780kHz -EF  
 Ranges (port and starboard)  
 100m, 150m, 200m, 300m, 400m, 500m -LF; 25m, 50m, 75m, 100m, 150m -HF; 12.5m, 25m -EF  
 Operating speed  
 1-6 knots  
 Maximum towing speed  
 12 knots  
 Acoustic pulse rates  
 500 / [selected range-limit], e.g. 10 scans/second @ 50m  
 Pulse power and length  
 217dB re 1 micropascal @ 1m; range-dependent length, e.g. 53microseconds @ 50m  
 Array length and beamwidths (2-way 3dB points)  
 0.41m -HF & LF; 0.3m -EF; 0.3° horiz.,  
 40° vert. asymmetric -HF; 1.0° horiz., 50° vert. -LF; 0.2° horiz., 50° vert. -EF  
 Lateral resolution  
 39mm-EF, 78mm-HF, 156mm-LF  
 Beam depression (of maximum sensitivity axis)  
 10° or 20°, adjustable without tools  
 Bottom-tracking (altitude) measurement and resolution  
 Automatic altimeter, from integral echo sounder; 78mm altitude resolution  
 Safety features  
 Weak link, breaks to give tail-first towing  
 Sensor options  
 Heading, pitch & roll; depth, 0-200m (other depth ranges available)  
 Construction  
 Stainless steel; no aluminium  
 Towfish dimensions and weights  
 1.24m length; 17.9kg in air, 12.1kg in seawater -DF; 17.1kg in air, 11.3kg in seawater -EDF  
 Towfish temperature range  
 -10 to +45°C operating; -20 to +50°C non-operating

### STR Specifications

The Sonar Transceiver (STR) interfaces the towfish to an external data acquisition computer via a USB link. It makes the sonar appear to the computer as a USB peripheral. The STR also powers the towfish.

USB1 interface  
 Digital echo data plus control and status (contact C-MAX for protocol)  
 Analog interface (early units only)  
 L, R and TRIG phono outputs (outputs in real time and in replay)  
 Dimensions (mm) and weight  
 297W x 204D x 62H, 2.2kg  
 Power  
 10-18V DC, 3A max, <2A typical at 12V, optional 24V DC, 2A max, <1A typical (BNC version)  
 10-28V DC, (MIL-C-5015 version)  
 100-240V AC via external power adapter  
 Environment  
 0 to +45°C; 10 to 80% RH; 5G, operating  
 -10 to +55°C; 2 to 90% RH; 40G, non-op  
 IP64

### C-Shell Specifications

The C-Shell provides a waterproof housing for an operating STR, with waterproof external connectors. It also has an internal location for a dongle for the acquisition software.

#### Interfaces

Tow cable, USB, DC power

#### Dimensions (mm) and weight, including STR

406W x 330D x 174H, 6.4kg

#### Power, single voltage version (with BNC tow cable socket)

12V (10-18V) DC, 3A max, <2A typical @ 12V

optional 24V (20-28V) DC, 2A max, <1A typical @ 24V

100-240V AC via external power adapter

#### Power, wide range voltage version (with MIL-C-5015 tow cable socket)

12-24V (10-28V) DC, 3A max, <2A typical @ 12V; 2A max, <1A typical @ 24V

100-240V AC via external power adapter

#### Environment

0 to +45°C; 10 to 80% RH; 5G, operating

-10 to +55°C; 2 to 90% RH; 40G, non-op

IP67

### C-Case 2 Specifications

The C-Case 2 integrates all transceiver, data recording, track plotting, display driver and power supply functions into a single unit. It is designed to run MaxView or third-party acquisition software.

CPU 1GHz, 256MB RAM, 40GB HDD

#### Interfaces

Tow cable, navigation, counting pulley, parallel printer, USB (for post-survey data export)

AC & DC power (either may be used)

#### Dimensions (mm) and weight

620W x 495D x 225H, 13kg

#### Power

115/230V, 50-60Hz, 100W max, 80W typical

24V DC option, 4A max, 3A typical

#### Environment

0 to +45°C; 10 to 80% RH; 5G, operating

-10 to +55°C; 2 to 90% RH; 40G, non-op

IP64 operating

IP67 closed

### C-Case SE Specifications

The C-Case houses a laptop PC and incorporates STR electronics, power conversion (to power the PC and the STR electronics) together with external waterproof connectors. The PC runs MaxView or third-party acquisition software.

PC Ruggedized laptop (Panasonic Toughbook recommended)

#### External interfaces

Tow cable, navigation, counting pulley, AC & DC power (either may be used)

#### Dimensions (mm) and weight

620W x 495D x 225H, 13kg (without PC)

#### Power

115/230V, 50-60Hz, 150W max, 100W typical

24V DC option, 5A max, 4A typical

#### Environment

0 to +45°C; 10 to 80% RH; 5G, operating

-10 to +55°C; 2 to 90% RH; 40G, non-op

IP65 operating

IP67 closed

**Tow Cable Specifications**

Tow cable, types available

Coaxial or twisted pair; circuit resistance 200ohm max.

Tow cable diameter options

11.4, 8.2, 6.4 or 4.7mm, stainless steel armoured

8mm "soft", polyamide reinforced, PU sheathed

Custom cables also available; also suits some "legacy" cables

Tow cable terminator weak link (breakable washer)

75kgf nominal actuation tension, actuates to reverse-tow the towfish

## 16. CM2-WIN-300 WINCH

### Introduction

The purpose of the optional CM2-WIN-300 portable winch is to handle 4.7mm diameter, steel-armoured tow cable. This type of cable cannot be handled manually.

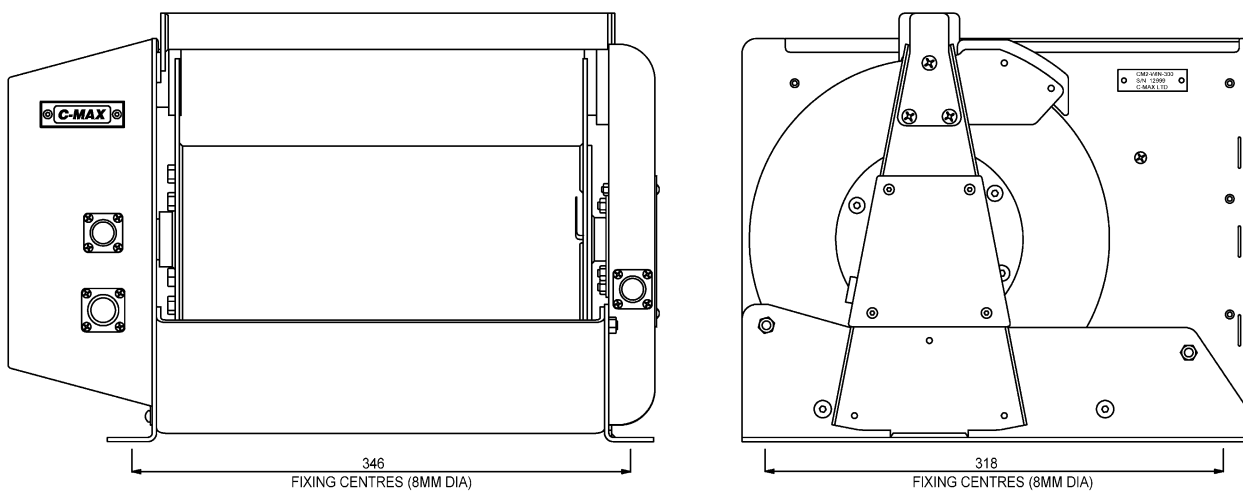
The CM2-WIN-300 portable winch was introduced in 2006, superseding the SK172/SK172E series.

### Installing the Winch

The winch should be secured to a flat surface using four M8 or 5/16" screws on 346 x 318mm centres. The winch should be located at least 1.5m directly forward of the pulley or fairlead so that the angle of the cable remains almost perpendicular to the axis of the drum.

24V DC must be provided via cables of at least 6 sq mm copper cross-sectional area, connected to a pair of 12V automotive batteries in series to give 24V, or a single 24V truck battery. A normal generator is unlikely to be able to supply the peak starting currents.

If the supply is fused the fuses should be slow-blow of at least 50A rating.



**CM2 Winch, Fixing Centres**

### Overload Clutch

The cable drum is driven via an internal clutch that is intended to slip under excessive load. The slipping torque is determined by a pair of internal disc springs. The pre-load on these springs is adjusted by the four hex-headed, clutch tension screws on the flange nearest the motor plate. If the clutch is slipping under normal use tighten these by rotating them all one-half turn clockwise. All four screws must be rotated an equal amount.

As a guide, with the cable almost fully wound on to the drum, the clutch should not slip until the cable is pulled with a force in the range 50-70kg (300m cable) or 60-80kg (200m cable).

Alternatively the clutch tension screws can be reset by unscrewing each until the head is just bearing on the flange but with no force. When all four are at this state, each should be screwed clockwise exactly 2 full turns (720 degrees).

### Soft Start

Later units are fitted with a "soft start" circuit that reduces the initial acceleration of the winch motor and minimizes the starting surge current. The starting current is controlled by a module that is in the electrical path from the -ve terminal of the external power connector to the -ve terminals of the contactors (relays). If this solid-state soft start module were to fail it can be bypassed to allow the winch to continue to operate.

### Temperature Alarm

Later units are fitted with an audible temperature alarm. The alarm is intended to protect the winch motor from excessive temperatures, particularly when recovering cable with the towfish fitted with the optional wing depressor.

The alarm sensor is fitted to the end of the motor casing. If the casing temperature exceeds 80C the alarm sounds intermittently; if it exceeds 90C the alarm sounds continuously. The alarm sound stops when the temperature falls back below these limits.

If the alarm sounds, the user should minimize use of the winch to avoid possible damage. Note that the alarm also sounds briefly when power is initially connected to the winch.

### Signal Cable

The signal cable (or "deck" cable) running from the winch to the STR or C-Case should preferably be a shielded twisted pair. If the cable is no more than 10m an RG58 coaxial cable is suitable. Polarity of connection is not important. Pins B and F are used on the winch connector. The other end of the cable should be fitted with a BNC or MIL-C-5015 connector, depending on the version of the STR, etc.

### Control Pendant

The control pendant supplied with the winch includes a pair of switches, mechanically interlocked so that only one (wind in or wind out) can be operated at any instant. The connections for the control pendant are as follows:-

Pin E...White button (wind out)  
Pin H...Common (+24v)  
Pin A...Black button (wind in)

### Winch Specifications

Capacity  
300m of 4.7mm tow cable

Power  
24V at up to 100A peak, 50A peak if "soft start" fitted

Construction  
Stainless steel

Winch dimensions (mm) and weight  
450W x 350D x 300H  
47kg when fitted with 300m cable  
63kg packed in transit case with control pendant, power cables, etc

Environment  
-10 to +45°C operating  
-20 to +50°C non-operating

### Replacing the Tow Cable

Tools required include metric hex keys, metric combination wrenches (10mm, 8mm, 7mm) and a No2 Pozidrive (or a Phillips) screwdriver. Loctite 243 or equivalent (not high strength Studlock) is also needed.

If a tow cable is fitted, wind its full length, except for a couple of turns, on to another temporary reel.

To remove the cable drum the winch handle has first to be removed. The handle is secured to the motor mounting plate by two M5 screws whose nuts or heads (depending on model) are accessed beneath the motor cover. The motor cover is released by removing the 3 M4 screws at its base then lifting it clear. On later units there is a soft-start controller mounted to the inside of this cover and care must be taken not to pull on any of the attached wires.

Disconnect the handle from the motor mounting plate.

Remove the 4 M4 screws holding the slip ring cover. Pull the white nylon body of the slip ring connector off the black body of the Mercotac slip ring unit. Whilst pulling at the connector hold the black slip ring unit in its

recess; some force may be required. If the slip ring unit is accidentally pulled out of its recess during this process, secure it again afterwards with flexible silicone sealant.

Remove the 4 M6 fasteners holding the bearing support assembly to the two cross braces.

Slide the bearing support assembly, together with the winch drum, off the motor shaft.

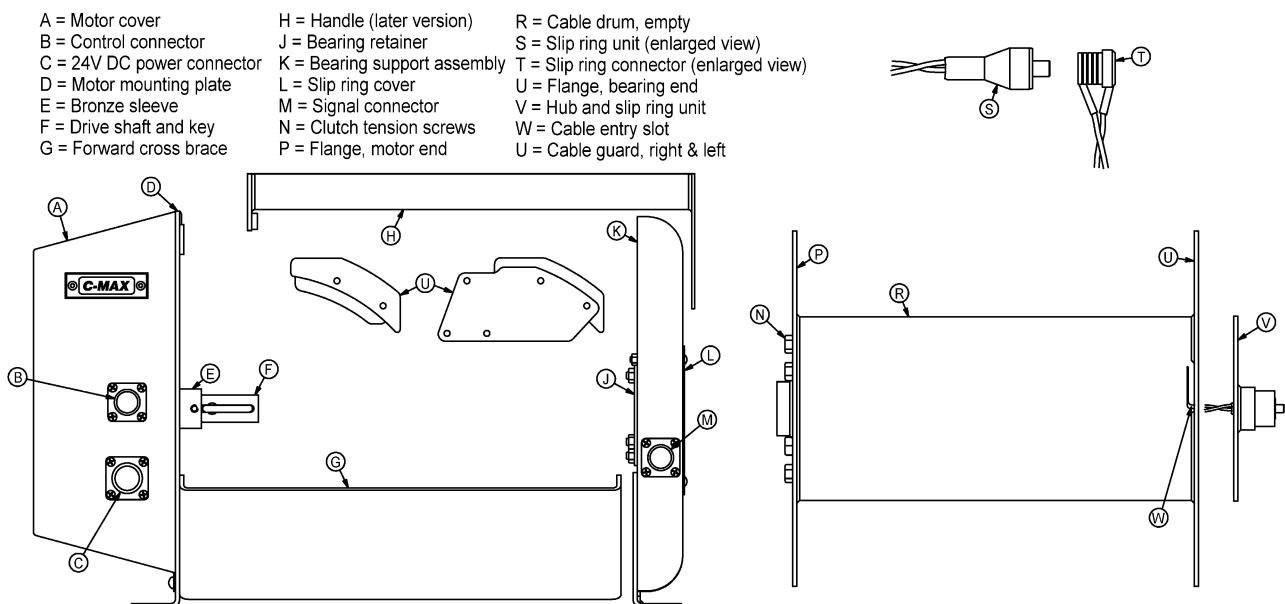
Separate the bearing support assembly carefully from the winch drum. On earlier units, where the handle is not removable from the bearing support assembly, this operation requires some manipulation of the handle and its fasteners. On later units the handle is secured to the bearing support assembly by 3 M5 screws; these screws should be loosened temporarily.

On the inside of the hub identify the pair of wires between the end of armoured tow cable and the rear of the slip ring unit. Cut this pair of wires so as to LEAVE A LENGTH of approximately 100mm still attached to the slip ring unit.

Undo the cable grip on the tow cable and remove the cable from the drum.

Feed the new cable through the slot in the drum. Attach a cable grip to the tow cable to prevent it being withdrawn (in normal use several cable turns must always be present on the drum because the cable grip is not intended to hold full towing forces)

Attach the 2 insulated wires to the pair of wires projecting from the slip ring unit, insulating the joints with heatshrink sleeving. Polarity is not important.



**CM2 Winch Disassembled**

Re-install the hub, drum, bearing support assembly and handle, by the reverse of the disassembly procedure. Those fasteners that are not fitted with nylon lock nuts should be secured using Loctite 243 or equivalent.

Temporarily connect the other end of the tow cable to a towfish, and connect the winch deck cable to an STR. Start the system and check for satisfactory operation. After correct operation has been checked, disconnect the deck cable again.

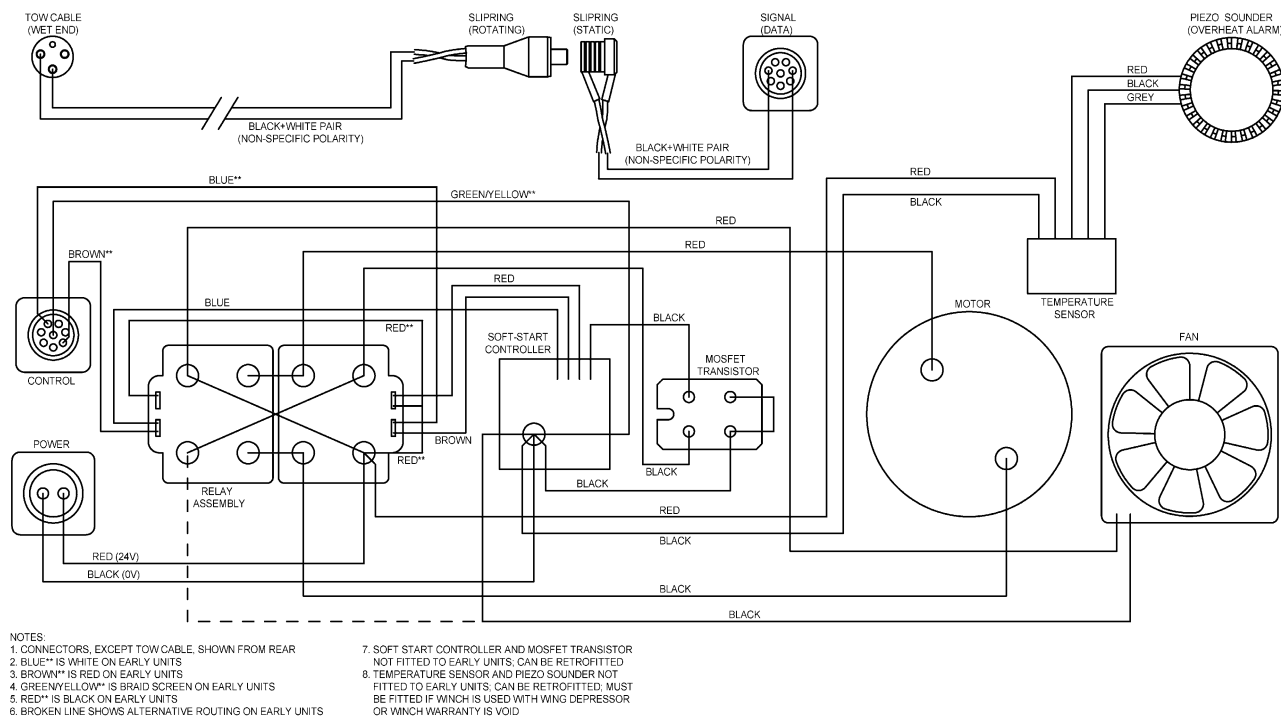
Seal around the cable slot in the drum with flexible silicone sealant and wind at least several turns on to the drum so that the sealant cures in the correct position.

Replace the motor cover, being careful to align the tabs with the slots in the motor plate, and secure it with the three M4 x 6 screws.

## Accessing the Winch Drive Components

The winch drive components include the integrated motor-gearbox unit, pair of switching relays, soft-start module and its power transistor, cooling fan, and motor temperature alarm. These are all accessible beneath the motor cover. Note that some of the components may be absent from early units.

The motor cover is released by removing the three M4 screws at its base then lifting it clear. A soft-start controller is mounted on the inside of this cover (except early units) and care must be taken not to pull on any of the attached wires.



**CM2 Winch, Circuit Schematic**



## 17. SK172 AND SK172E WINCHES

### Freeing the Drum in an Emergency

On the optional SK172 and SK172E portable winches, an extended 5mm A/F key can be used to release the winch drum for hand rotation in an emergency, by unscrewing the two locking screws in the bronze drive bush. When released in this way the slip rings still function normally.

The locking screws should normally be kept tight and their tightness checked as part of the maintenance routine.

### Replacing the Tow Cable

If a tow cable is fitted, wind its full length, except for a couple of turns, on to another temporary reel.

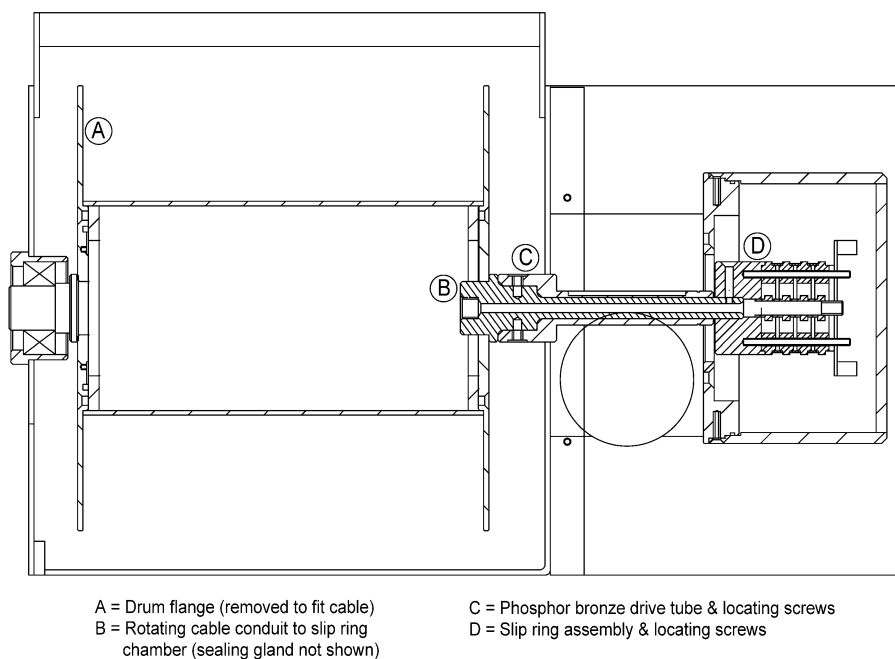
Remove the sheet steel cover that protects the motor, gearbox and sliping assembly, and then remove the sliping cover. Identify the two signal wires that emerge from the central conduit through the drive shaft; these wires are attached to terminal blocks on the (rotating) end of the sliping assembly. Disconnect these signal wires.

Remove the end plate holding the outboard bearing for the drum. Remove the screws securing the drum flange and lay the flange aside. Note how the tow cable is routed.

Reach into the drum, loosen the central sealing gland, and then withdraw the coaxial signal cable that extends from the end of the tow cable. Replace the tow cable by the reverse of the above procedure, first inserting the tow cable in the slot in the winch drum. Identify the two conductors extending from reduced-diameter section of the tow cable. Twist these together and push them down the central conduit.

Connect the conductors to terminals 1 and 2 on the rotating portion of the slip ring. Polarity is not important. Check the slip ring connections through to pins B and F on the external connector.

Use a small amount of silicone rubber compound to fix the two signal cable wires to the rotating section. This will prevent the wires vibrating and fracturing.



**SK172 Winch, Cross-Section**

Reach in to the drum and tighten the central gland.

Temporarily connect the other end of the tow cable to a towfish, and connect the winch deck cable to an STR. Start the system and check for satisfactory operation. After correct operation has been checked, disconnect the deck cable again.

Replace the flange in the end of the drum, and fit the end bearing plate. Rotate the winch several times to position the cable firmly around the drum. Then seal the cable exit slot using silicone rubber compound.

The control pendant connections are as follows: -

Pin E...White button (winding out)

Pin H...Common (+24v)

Pin B...Black button (winding in)

## 18. WING DEPRESSOR

### Introduction

The tow cable of a sidescan sonar is subjected to significant drag forces at normal survey speeds, causing the towfish to rise. Therefore more cable must be veered or the tow speed must be lowered in order to keep the towfish at the desired depth.

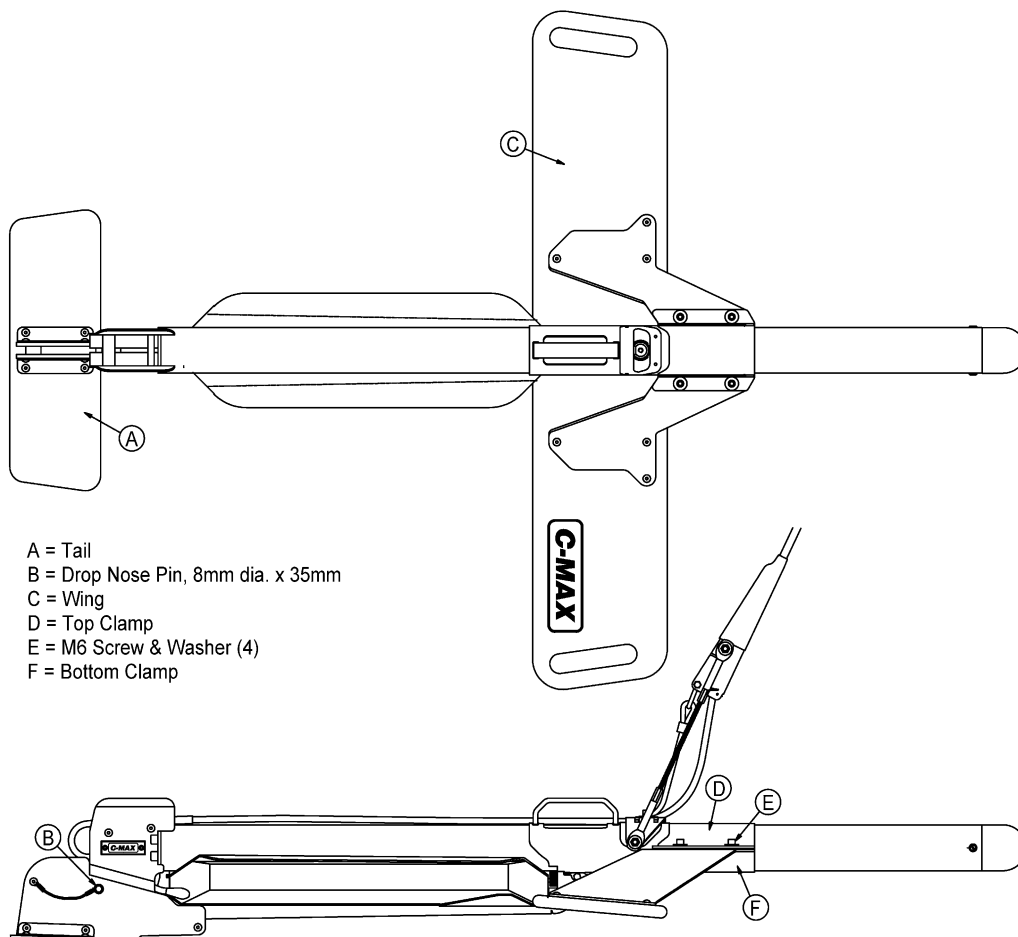
The purpose of the wing depressor is to tension the cable downwards, without attaching additional static weight to the towfish or tow cable. Because almost all of the extra tension is generated dynamically, launching and recovery are far easier than if static ballast weight is used. Also, the load on the winch motor can be eased simply by reducing tow speed whilst heaving, an option that is not available with static ballast.

### Fitting the Wing and Tail to the Towfish

Attach the wing to the towfish as shown in the illustration, with the wing clamp directly in front of the towfish handle assembly. There should be no gap between the towfish handle assembly and the wing clamps. Use the four 20mm M6 screws and washers to secure the wing clamps.

Check that the wing is tight on the towfish tube with no ability to rotate. (There should be a compressed rubber strip inside the bottom clamp to grip the tube. If this is missing it needs to be replaced.)

Attach the tail using the 35mm drop-nose pin instead of the normal 25mm pin. Put the removed 25mm pin in a safe place for future



**CM2 Wing Depressor**

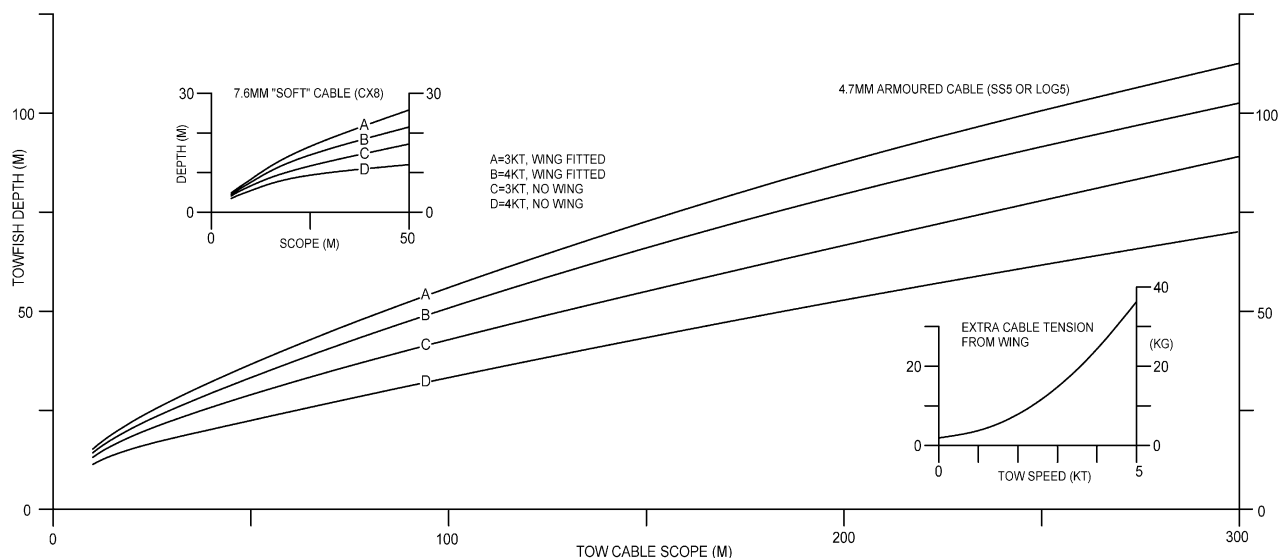
### Launching the Towfish and Wing

Use the handle at the end of the wing when initially lowering the towfish. The wing handles can also be used when reaching for the towfish to recover it.

Be aware that the wing can cause the towfish to glide forward on launch. Be careful that it does not head for a propellor.

### Towing the Towfish when Wing is fitted

Refer to the illustration for the effect of the wing hydrodynamic down-force on the towfish depth. For any particular depth a shorter length of cable can be used, with reduced layback.



### Depth Performance with and without Wing Depressor

Note also the increase in tow cable tension. Extra tension increases the power consumption of the winch (if used) whilst hauling in the cable, and care must be taken not to overheat the winch motor.

The best way to reduce winch power consumption is to reduce tow speed as soon as the towfish is high enough for safety.

## 19. PULLEYS AND COUNTING PULLEYS

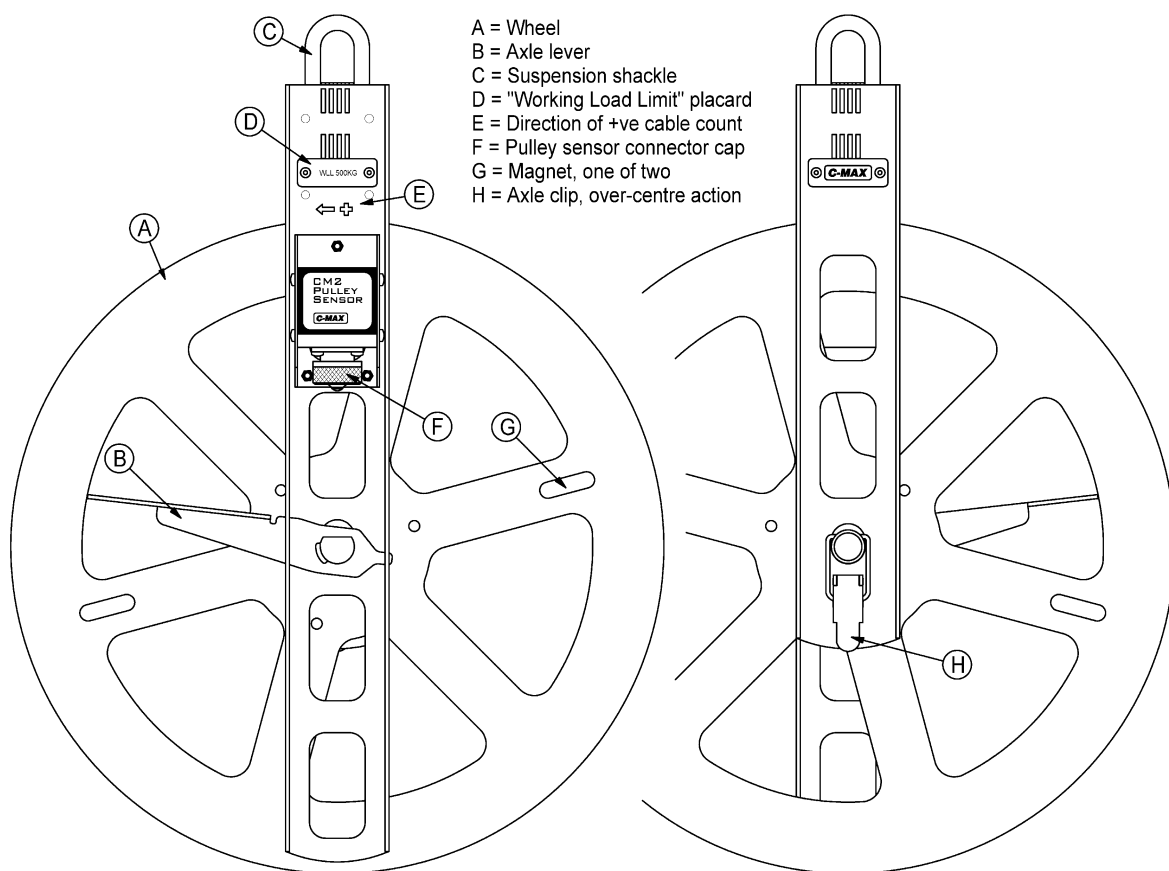
### Pulley Types

There are two sizes of the pulley designed for use with CM2 tow cables. These are snatch-block types; the pulley does not need to be disassembled to fit or remove the cable. There are also two versions of the smaller sized pulley. The three types are Type O, the original pulley. Type S ("small") has the same diameter wheel but has a later style of frame. Type L ("large") has a wheel that is twice the diameter but also has the later style of frame.

Type O and S are suitable for use with "soft" polyamide-reinforced cables up to 8mm diameter and with steel-armoured cables up to 6.4mm diameter.

Type L is suitable for use with "soft" polyamide-reinforced cables and with steel-armoured cables up to 11.5mm diameter.

All types may be used as simple pulleys or, with addition of a Pulley Sensor and cable, are suitable for conversion to counting pulleys.

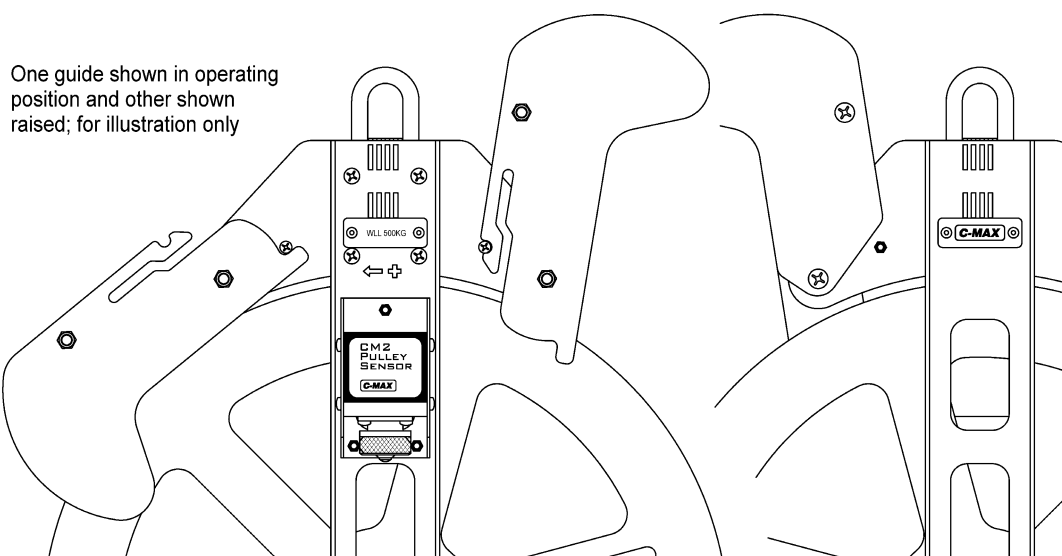


**Counting Pulley, Type L**

### Cable Guides

If a pulley is to be used with a polyurethane-sheathed tow cable there may be circumstances where the "stickiness" of the cable would cause it to ride up on the rim of the pulley and jam where it reaches the supporting arms. This is more likely when the cable is only under light tension, insufficient to pull the pulley into line with its path. This "riding up" is unlikely to occur with a steel-armoured cable in normal use.

To avoid the problem of PU cables riding up, an optional cable guide set is available for fitting to Type L pulleys. These guides are raised for loading the cable, then dropped into position over the pulley rim to guide the cable and ensure that it cannot ride up.



### ***Pulley Cable Guides***

#### **Counting Pulley**

The purpose of the counting pulley is to allow the tow cable scope (i.e. the length currently deployed) to be displayed to the sonar operator and be recorded within the sonar record.

Note that the cable scope (i.e. the length of cable veered) and layback (the horizontal distance of the towfish behind the reference point on the vessel) are not the same. The relationship between scope and layback is complex and depends on the cable and towfish characteristics and on towing speed. Unless a specific cable scope-to-layback conversion program is available layback must be estimated and entered manually.

#### **Installing the Counting Pulley**

The counting pulley consists of a CM2 pulley fitted with a pulley sensor. All CM2 pulleys are all fitted with one magnet (Types O and S) or two magnets (Type L) so the rotation can be detected at intervals equivalent to half-metre intervals at the circumference.

The pulley sensor is connected to a PC's serial port via a counting pulley deck cable. Depending on the PC the deck cable may need to be terminated in a serial-to-USB converter. The PC may be the same PC that is used with an STR or may be a navigation PC for example.

To install the counting pulley software, install the Counting Pulley Display CD that is supplied with the pulley sensor, and follow the on-screen instructions.

Locate the pulley in accordance with the advice given in Section 3. Route the counting pulley cable so that it is not under tension at any point, nor likely to be tripped over.

When the pulley is not in use it is advisable to remove the pulley cable and replace the cap on the pulley sensor.

The pulley cable connections are as follows: -

Pulley sensor connector...conductor...D-type connector

F...red...2  
D...black...3  
C...white...4  
H...screen...5  
A...yellow...7

## 20. POLEMOUNT BRACKET

### Introduction

Some users prefer to use a rigid overside mount for the towfish in certain circumstances, instead of towing it. The advantage is that the towfish is not endangered when manoeuvring in restricted depths or near obstructions.

Note that the disadvantages of rigid mounting are

- a) The towfish motion is not isolated from roll, pitch and yaw of the boat
- b) The towfish altitude cannot be adjusted to give the optimum image; rigid mounting generally means the towfish is too high off the bottom for best central coverage and for best shadow angles
- c) The image from the beam passing under the hull can be affected by reflection from the hull resulting in multipart distortion

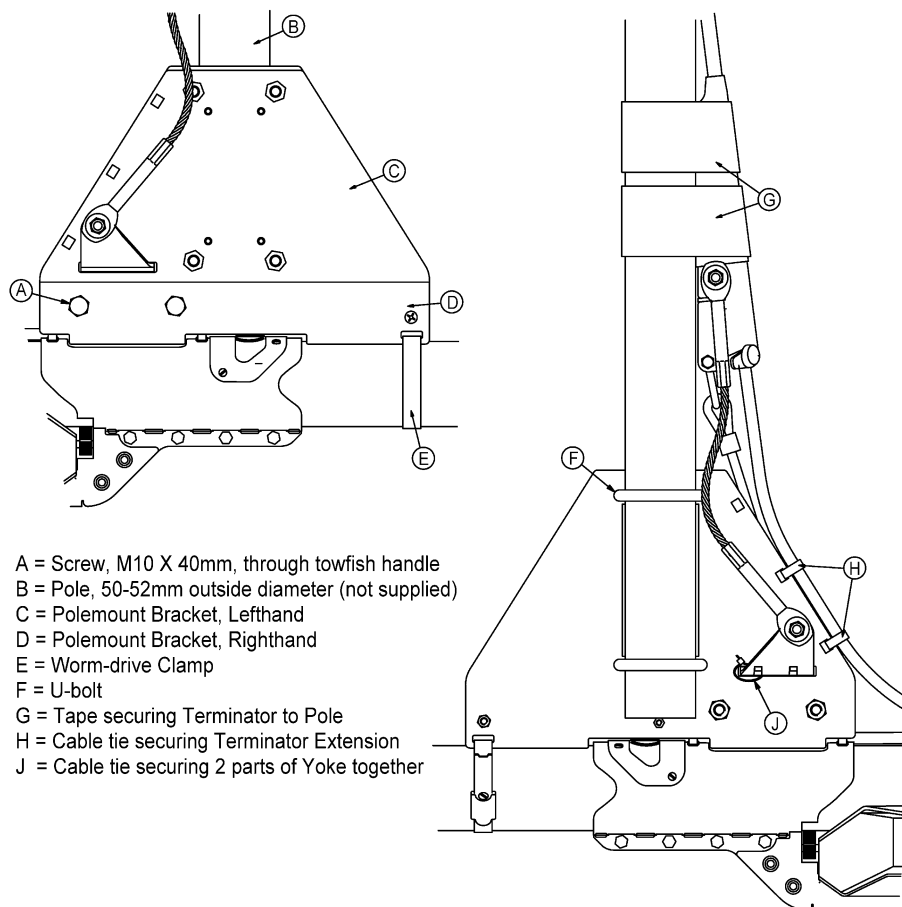
An alternative to rigid mounting is towing from the bow or from the beam.

### Fitting the Polemount Bracket

The positioning of the overside pole and its mounting to the hull is outside the scope of this manual.

Fit the CM2 polemount bracket to the lower end of the pole as shown in the illustration, tightening the U-bolts and ensuring that shakeproof washers are fitted under the M8 nuts.

Tape the terminator in position using duct tape or similar.



### *Fitting the Polemount Bracket*

Use cable ties to secure the tow cable extension, to prevent it oscillating and chafing in the flow.

Use another cable tie to secure the two halves of the yoke assembly together, located in the slot in the bracket.

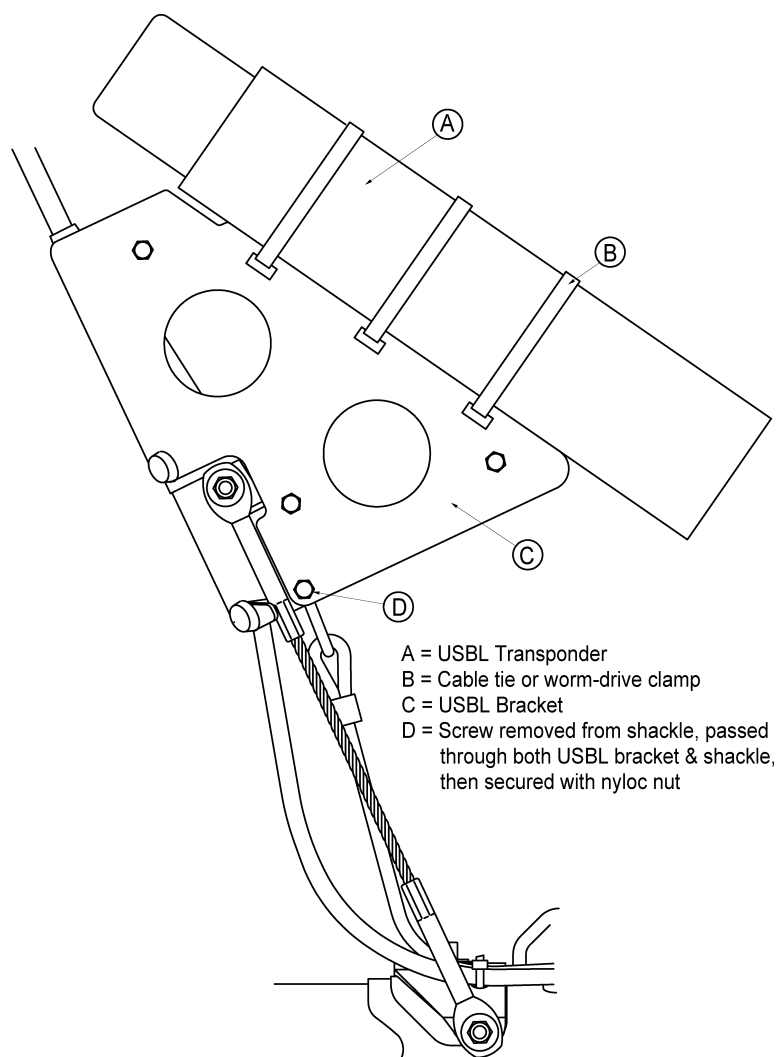
## 21. USBL TRANSPONDER BRACKET

### Introduction

Where accurate tracking of the position of the towfish is required, C-MAX recommends the use of an ultra-short-baseline (USBL) acoustic tracking system. Suitable USBL systems are available from several manufacturers, and should be chosen so that their effective range is at least that of the maximum length of tow cable to be used with the CM2 system. These systems require the use of transponder on or near the towfish.

The purpose of the CM2 USBL bracket is to hold a USBL transponder securely to the tow cable terminator. If the transponder is simply secured to the terminator using duct tape it may generate eddy currents and oscillate; these oscillations may be enough to fracture the bail arms eventually.

The USBL bracket also holds the transponder at an angle so that it is closer to pointing at the USBL transceiver array fitted to the towing vessel.



### *Fitting the USBL Bracket to the Tow Cable Terminator*

#### Fitting the bracket

Remove the screw holding the safety lanyard shackle to the terminator. Slide the transponder bracket over the tow cable and then lower it around the terminator, as shown in the illustration. Replace the screw through both the bracket and terminator and secure it with the original locknut.

Secure the transponder to the bracket using worm drive clamps or cable ties.



## 22. TOWFISH SENSORS

### Heading and Depth Sensors

The towfish heading may be different from the direction of the towfish track if there is a cross-current. Heading information, if available, may be used to correct the apparent location of targets by compensating for the yaw of the towfish relative to its track.

The heading sensor output also includes towfish pitch and roll. These parameters are not relevant to processing the image but can indicate if, for some reason, the towfish is not towing correctly.

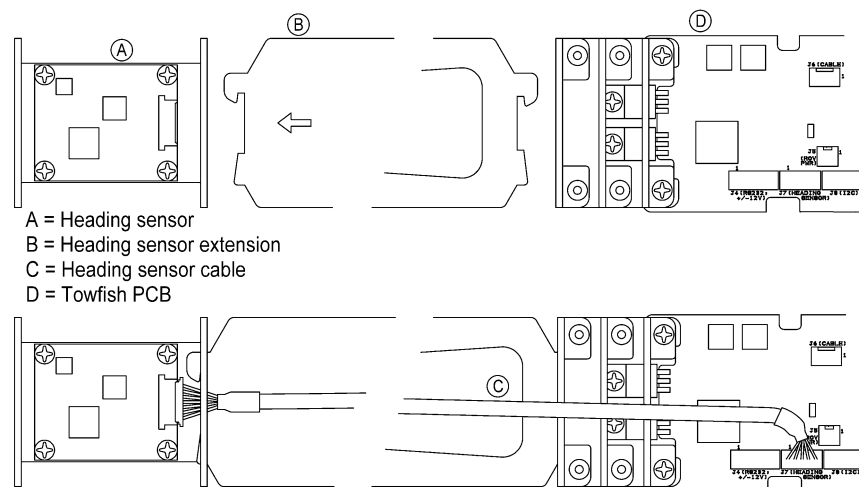
Towfish altitude measurement (bottom tracking) is standard in the CM2 towfish. Towfish depth is generally of secondary importance and can usually be estimated by subtracting towfish altitude from water depth measured by the ship's echo sounder. However sometimes it can be useful to have a direct measurement of towfish depth: for example, a record of towfish depth plus altitude can provide a bathymetry trace for the survey line.

### Towfish Heading Sensor

The optional heading sensor may be already installed in the towfish when delivered or may be retrofitted in the field.

To fit the sensor, first open the towfish to expose the towfish PCB. See the section on Replacing the Towfish PCB for advice on opening the towfish.

Attach the Heading Sensor Extension to the towfish PCB as shown in the illustration. Then attach the Heading Sensor itself to the extension. The heading sensor cable connects to J7 on the towfish PCB.



### ***Fitting the Heading Sensor and Heading Sensor Extension to the Towfish PCB***

Note that towfish PCBs of V.6 onwards accept full RS232 voltage levels, so they can be connected directly to the sensor. Earlier PCBs require a converter built in to the cable, to convert from full sensor voltage to 0-5V levels.

The heading sensor specification is in Section 15.

Note that the output of the heading sensor is “magnetic” not “true”. A suitable offset may be added to correct for local magnetic variation.

The sensor may be re-calibrated using the command available in MaxView. This procedure need only be undertaken once in a new locality. After initiating the command, rotate the towfish twice through 360° over a period of about 2 minutes, holding it approximately horizontal.

### **Towfish Depth Sensor**

The optional depth sensor may be already installed in the towfish when delivered or may be retrofitted in the field.

The sensor is moulded into the rear bulkhead, so retrofitting requires the bulkhead to be replaced. The bulkhead and towfish PCB should be returned to C-MAX for modification. See the section on Replacing the Towfish PCB for advice on opening the towfish.

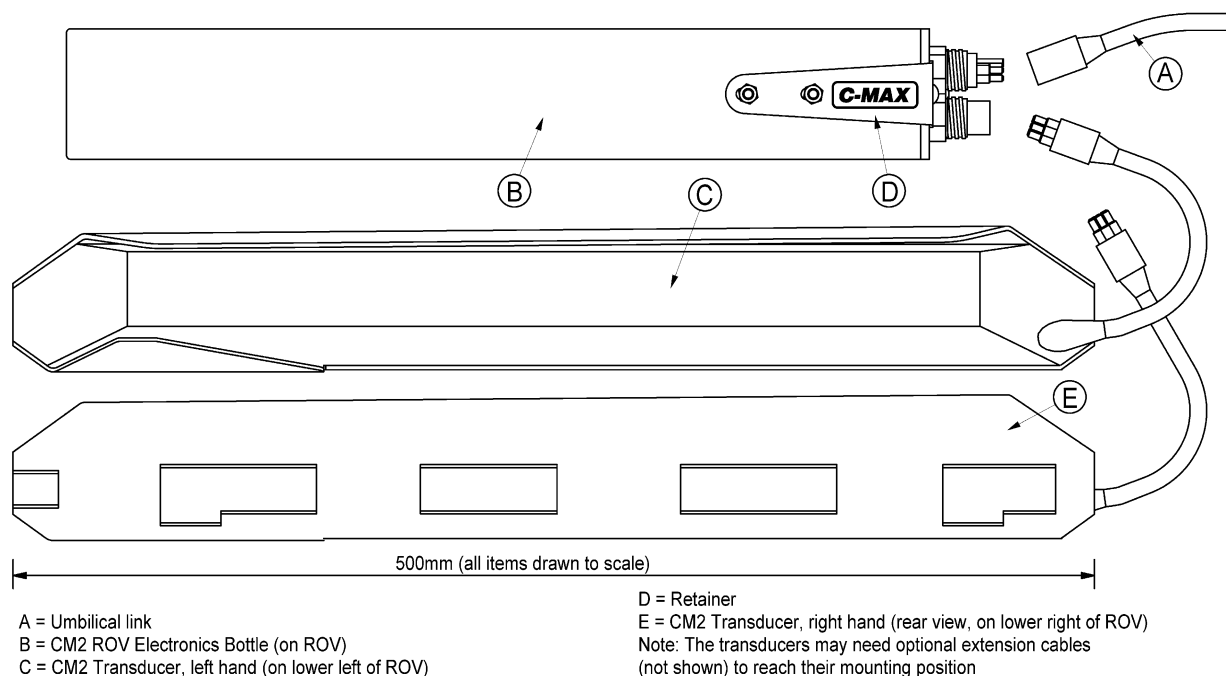
The depth sensor cable connects to J8 on the towfish PCB.

The depth sensor specification is in Section 15. There is no provision for zeroing the depth indication, as it is not intended to be used with the same accuracy as an echo sounder.

## 23. ROV AND AUV CONFIGURATIONS

### ROV Configurations

The CM2 system is suitable for use on remotely-operated vehicles (ROVs). In place of the towfish in a towed system, the “sonar head” consists of the acoustic transducers and an ROV bottle containing the towfish electronics. The transducers may be mounted close together, as they are on the towfish, or apart on either side of the vehicle. Extension cables can be fitted between the bottle and the transducers.



### ROV-mounted Components

The standard ROV configuration relies on the availability of a spare pair of conductors in the umbilical for use in powering the ROV bottle and providing the telemetry link between the bottle and the STR, in the same way as the tow cable in a towed system.

An STR and PC at the surface complete the system.

The bulkhead on the end of the electronics bottle is held in place by a retainer, instead of the fin/keel assembly as on the towfish, but otherwise much of the description of the operation and maintenance of the towed system in this manual is also applicable to the ROV system. Note that the towfish mute command is particularly useful on an ROV, allowing the effect of other sonars and also of mechanical and propulsion noise can be assessed.

Custom configurations are also possible, such as where the telemetry is multiplexed with other ROV functions and the electronics bottle is powered from the vehicle supply.

### AUV Configurations

The CM2 system is suitable for use on autonomous underwater vehicles (AUVs). These are configured to suit the individual requirements of the AUV. AUV configurations are outside the scope of this manual, although sections of the manual may be relevant and be referenced in AUV documentation.

## **24. WARRANTY**

### **Scope**

CM2 components manufactured by C-MAX are warranted for a period of 36 months from the date of dispatch. Winches from third-party suppliers, all cables and all other items are warranted by C-MAX for satisfactory operation for a period of 12 months from the date of dispatch.

MaxView software is warranted for a period of 36 months from the date of dispatch. Defects will be corrected free of charge during this period.

Any item that fails because of a defect in design, material or workmanship will be repaired or replaced by C-MAX without charge.

### **Limitations**

C-MAX is not responsible for any consequential loss, nor for any failure caused by improper use, mishandling, or unauthorised attempts at repair, nor for cosmetic or other damage which may reasonably be classed as normal wear and tear.

In particular, if it is apparent from the condition of the CM2-WIN-300 winch that it has been abused or overheated, then repair or replacement of winch components will not be covered under this warranty.

### **Fault Reporting**

Faults must be reported to C-MAX within the warranty period, quoting the equipment serial number together with a full, detailed description of the fault symptoms.

### **Returns**

The agreement of C-MAX is required before items are returned to the Factory for inspection or repair. The customer is responsible for adequate packing and insurance.

### **Transferability**

The benefits of this warranty are fully transferred to the current legal owner of the equipment.