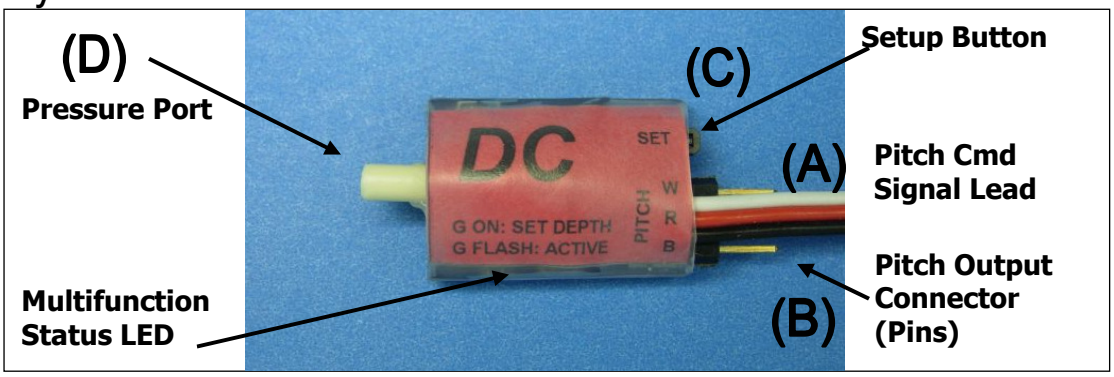
Depth Cruiser

General layout



Quick Setup Guide

1. Install and setup your receiver and bowplane pitch servo. (Setup your end-points as required.)
2. Plug the **Pitch Command Signal Lead (A)** into the bowplane pitch channel of your receiver.
3. Plug the bowplane pitch servo into the **Pitch Output Connector (B)** on the DC taking note of the correct polarity.
4. Use the **Setup Button (C)** to set the planes neutral, full rise and full dive servo positions and planes sensitivity settings.
5. Connect the **Pressure Port (D)** to the pressure pickup tube.

Features

- Maintains operating depth of your submarine by directly measuring depth (pressure).
- Plugs-in inline with existing bow-plane control channel, no additional channels required.
- Can be turned off for surfacing or for use with retractable bowplanes.
- Learns your servo's travel limits and won't exceed them.

Multifunction Status LED

When power is initially switched on the green LED will light as part of a power on self test. During normal operation the function of the Multifunction Status LED changes to indicate:

GREEN (solid)	DC Active - Depth update mode
GREEN (rapid flash)	DC Active - Depth maintaining mode

During setup operation the function of the Multifunction Status LED changes to indicate:

2 blinks GREEN	Set pitch neutral command
3 blinks GREEN	Set pitch full rise command
4 blinks GREEN	Set pitch full dive command

Depth Cruiser Theory of Operation

The Depth Cruiser uses a very simple control algorithm to help keep your boat at a constant depth. It is designed to not interfere with your ability to control your boat or actively adjust your operating depth, but (when active) will assist your boat to maintain the operating depth you last achieved. Using the bow-planes drive your boat to the desired depth, and once there let go of the control stick. When the Depth Cruiser sees a rise- or dive command to the bow-planes it passes that command along and updates the "reference depth/pressure" that it will seek. When the Depth Cruiser sees a neutral command to the bow-planes it will compare the current depth to the reference depth it has in memory and generate a command to the bow-planes in the appropriate direction to reduce that depth error. To the operator this means it does not get in your way when you want to change depth, and will simply hold the depth you left off at when you last released the control stick.

Depth Cruiser Installation

The Depth Cruiser can be mounted any place that's convenient, front or aft in your watertight compartment. (The point at which the depth/pressure is sensed will be within the pressure pick-up tube, not the location of the pressure sensor.) The DC is not affected by ambient pressure changes so it does not need to be located in a separate compartment if you're using an RCABS- or SAS-type ballast system. It is recommended that you choose a location that will allow easy access to the setup button should any tweaking be required and has a view of the LEDs as these can be helpful for diagnostic purposes.

Pressure Pick-up Tube Fabrication and Installation

The Depth Cruiser must be connected to an external pressure pick-up tube to correctly sense the depth of your submarine. Although the diameter of this pick-up tube is not critical its shape and location is – the pick-up tube must end with a vertical run of tube that's at least 2 inches long and be open at the bottom. (The 2" vertical rise is necessary to ensure a bubble of

air is trapped in the tube.) The top end of the pressure pick-up tube will be plumbed back to the DC. You will also have to make a pressure port through a bulkhead as part of the connection from the pressure pick-up to the Depth Cruiser. It is recommended that you construct the pick-up tube and bulkhead pass-though from 3/32" or 1/8" OD brass or aluminum tube. All other plumbing may be made with any convenient combination of rigid and flexible tubing. The vertical run of the pick-up tube should be installed as close to the bow of your submarine as you can practically achieve, although any location forward of the center of gravity will provide acceptable results. (You may also create the vertical run by wrapping the tube around the outside of your WTC from top center to bottom center.)

Depth Cruiser Setup

Setup mode is used to teach the DC what servo end-points to use, as well as what direction to drive the pitch servo to command it to dive and rise. Because of this you must have the required end-points set in your transmitter to prevent the pitch servo from binding before you begin the setup procedure. It should also be noted that the user interface for the DC was designed assuming that it will be controlled from a spring-return to center control input (transmitter stick), not a dial. While successful operation from a dial is possible it is not recommended.

To enter setup mode turn on your transmitter, press and hold the setup button on the Depth Cruiser, then turn on your receiver. The status LED will flash to indicate the power on self test result and will then show a solid green to indicate that you've entered Setup mode. (You may now release the Setup button.)

1. The status LED will now flash with a 2-blink pattern. Ensure your pitch stick is in the neutral position. Press and hold the setup button to save the neutral command input and servo position until the green LED is lit (nolonger flashing) then release the button.
2. The status LED will now flash a 3-blink pattern. Command full-rise on the bow-planes from your transmitter. While holding full-rise press and hold the setup button until the green LED is lit (nolonger flashing) then release the button.
3. The status LED will now flash a 4- blink pattern. Command full-dive on the bow-planes from your transmitter. While holding full-dive press and hold the setup button until the green LED is lit (nolonger flashing) then release the button. This completes the DC setup, the DC will now automatically return to normal operation.

Setting the Depth Cruiser Sensitivity

During normal operation mode, press and hold the set button for at least 1 seconds, then release. When the button is released the sensitivity setting will change to the next setting and the LED will flash the new value. There are three sensitivity settings: 3 being the most sensitive and 1 being the least sensitive. The default speed setting is 2 (mid).

Depth Cruiser Operation

After completing the power-on test the DC will begin operation in a standby condition. When it is in the standby condition the DC will pass the command signal directly to the bow-planes without any modification. To bring the DC out of the standby condition to an active condition you quickly jab the control stick from neutral to full dive. From an active condition you can return the DC to a standby condition by jabbing from neutral to full-rise. (Standby/active transitions *must* begin from a neutral command setting, if the control stick is off-neutral before going to full-dive or full-rise the transition will be ignored.) When in the active condition the DC will operate in depth-update mode (LED on solid) or depth maintenance mode (LED quickly flashing). Depth update mode happens when the command stick is off the neutral position, either up or down. The plane position will be as commanded by the control stick, and the DC will continuously update the current depth as the desired depth. Depth maintenance mode occurs when the command stick is allowed to return to the neutral position, and at this time the DC will continuously compare the current depth to the desired depth and drive the bow-planes in the appropriate direction to minimize the depth error.

General Notes

- The precision with which the DC will "hold" depth is affected by many things, one of these being speed. At high speed the bow-planes are most effective at controlling your depth, at slow speeds they are least effective. Because of this the DC will have a better ability to hold depth at higher speeds, but if the sensitivity is set too high the boat will begin to oscillate up and down as the DC "chases" the right depth. Finding the "correct" sensitivity setting is all about compromise. The best sensitivity setting is the one which does not cause too much oscillation at the highest speed you wish to cruise at periscope depth.
- The point at which depth is sensed is within the vertical pressure pick-up tube. You will achieve the greatest depth maintaining accuracy by installing the vertical portion of the pickp-up as far forward as possible in your submarine.
- The importance of a well trimmed boat cannot be understated. To be able to maintain good depth control your boat must be able to hold itself with a aero-bubble attitude in submerged trim when running fast and slow. If the boat adopts a bow-up or bow down attitude the DC will not be able to prevent it from changing depth.
- In theory the DC should be able to help maintain depth when connected to either bow- or stern-planes, but at the time of writing only bow-plane and sail-plane control have been exhaustively tested. For depth-keeping purposes control of the bow-planes will provide better results than control by stern-planes so this is the recommended configuration.

Questions?

- If you have questions or concerns about your DC please contact Kevin McLeod by email at KevinMc.Electronics@gmail.com