Connecting a GNSS Receiver to the CEE ECHO

To minimize latency and provide a simplified connection to the acquisition PC, usually with a single LAN (Ethernet) cable, it is suggested that GNSS data are always routed to the CEE ECHO™ and not directly to the acquisition PC. Position and depth data are combined in the CEE ECHO and output simultaneously over the activated Real Time Output ports - Ethernet, RS232 cable, Bluetooth, or WiFi. This approach also allows the use of precise CEE "POS" time stamps applied to the dataset for ultimate precision, enables the position to be displayed on the CEE ECHO LCD screen, and allows the user to record the entire dataset inside the CEE ECHO.

NOTE: This guide refers exclusively to the CEE ECHO™ however this procedure applies equally to the CEESCOPE™, which may be used with an external GNSS instead of its built-in receiver.

When conducting hydrographic surveys, it is common for echo sounder data to be passed to an acquisition PC through one connection and GNSS data separately over a second connection. Sometimes these connection types may be different – for example Ethernet for echo sounder data and RS232 serial for GNSS data. The PC's management of the disparate incoming data streams may potentially introduce latency, software driver setup is complex, and the multiple cables and connections results in a cumbersome hardware setup. The CEE ECHO eliminates the need for a second PC connection for GNSS data as the position data may be routed directly to the CEE ECHO first and then to the PC through a single connection.

It is possible to connect the GNSS receiver to the CEE ECHO directly using Bluetooth. The method for achieving this connection is described in a separate SURVEY NOTES guide. The Bluetooth mode does not have baud rate or serial port settings however the remaining considerations below apply equally to Bluetooth or RS232 cable inputs.

To connect an external GNSS receiver to the CEE ECHO, the following steps must be completed:

1. The CEE ECHO GNSS menu selection must be "EXTERNAL" if using the RS232 cable input or "BTSERIAL / BLUETOOTH" if using Bluetooth input.
2. The appropriate NMEA 0183 output messages must be activated on the GNSS receiver on the appropriate output port at an appropriate / adequate frequency.
3. The baud rate and output parameters of the GNSS output port and CEE ECHO input must be set appropriately and MUST be identical.
4. The position (Lat / Long or UTM grid) MUST be visible on the CEE ECHO LCD home screen otherwise a valid position is not being received.

1. Select GNSS Mode

The CEE ECHO allows the user to select RS232 "EXTERNAL" or Bluetooth "BTSERIAL / BLUETOOTH" input modes or to "DISABLE" the GNSS input. In standard operation mode "EXTERNAL" should be selected, which selects incoming GNSS data from the LEMO 5 pin GNSS input port. The 5 pin LEMO to 9 pin DB9 male adapter cable is included in the CEE ECHO kit and should be used. This cable will mate with standard RS232 output cables from GNSS manufacturers, and this GNSS proprietary cable is not supplied by CEE HydroSystems.

2. Select GNSS Output Messages

In the appropriate proprietary GNSS configuration application, such a WiFi browser interface on a phone or laptop, or hand-held data collector such as the Leica CS15/16 or Trimble TSC3, the GNSS receiver RS232 serial NMEA output should be activated. NMEA messages are standardized message formats that are used by GNSS receivers – and other devices - to output position and supplemental related data. Note that GNSS data always should be output from the GNSS receiver and NOT any ancillary device such as a data collector. The ability to output NMEA data may be an additional feature that must be activated, particularly on some Leica GNSS receivers. Check this if unsure.

After selecting the appropriate output port representing the cable connected to the CEE ECHO, the following output messages must be selected:

GGA: Position and elevation - the principal data message
VTG: Course and speed
ZDA: Date and time

Other messages may be activated as required, with the consideration that a higher message count may require a higher baud rate to handle the additional characters. Other useful messages include GSA, GST, and GSV that output GNSS error statistics and specific data detailing satellites in view. For details on NMEA message fields, many reference sources are available on the Internet for "NMEA-0183 message formats".

The output frequency should be selected for each message, with the minimum output rate of 1-2Hz. Typically, 5Hz for GGA and VTG and all other messages set at no more than 1Hz offers good precision without excessive data volume. The ZDA message is output at no greater than 1Hz independent of user selection.

GNSS receivers will output messages with a Talker ID prefix "GP", "GL", or "GN", indicating GPS, GLONASS, or GNSS data respectively. The use of these prefixes varies with GNSS manufacturer. The CEE ECHO will read all prefix types so selection will not affect message reception.

3. Set Baud Rate and Serial Parameters

Each serial device (GNSS receiver and CEE ECHO) has a baud rate setting which is the maximum number of bits per second that can be communicated. Data rates are 4800bps - 115200bps. If the baud rate is too low, data will be lost or delayed resulting in significant lag in the position shown on the acquisition software. These data will not be recoverable, and a survey would be not usable if collected in this condition. If the baud rates of the two devices are not the same, no data will flow. It is recommended never to use 4800bps. It is safe to consider 38400 bps as the minimum baud rate to select, although simply selecting the maximum allowable data rate of 115200bps always is a good approach. **Baud rate mismatch is the most common cause of GNSS interface problems**.

It is critical that the other serial parameters on the GNSS output are also set appropriately. Pay close attention to these; incorrect settings will prevent the position data being recognized by the CEE ECHO:

Data Bits: 8
Parity: None
Stop Bits: 1   (8-N-1)
Flow Control: None

The various GNSS receiver software utilities will provide similar-looking menus allowing the user to select the NMEA messages and communication parameters. Some examples are shown below.
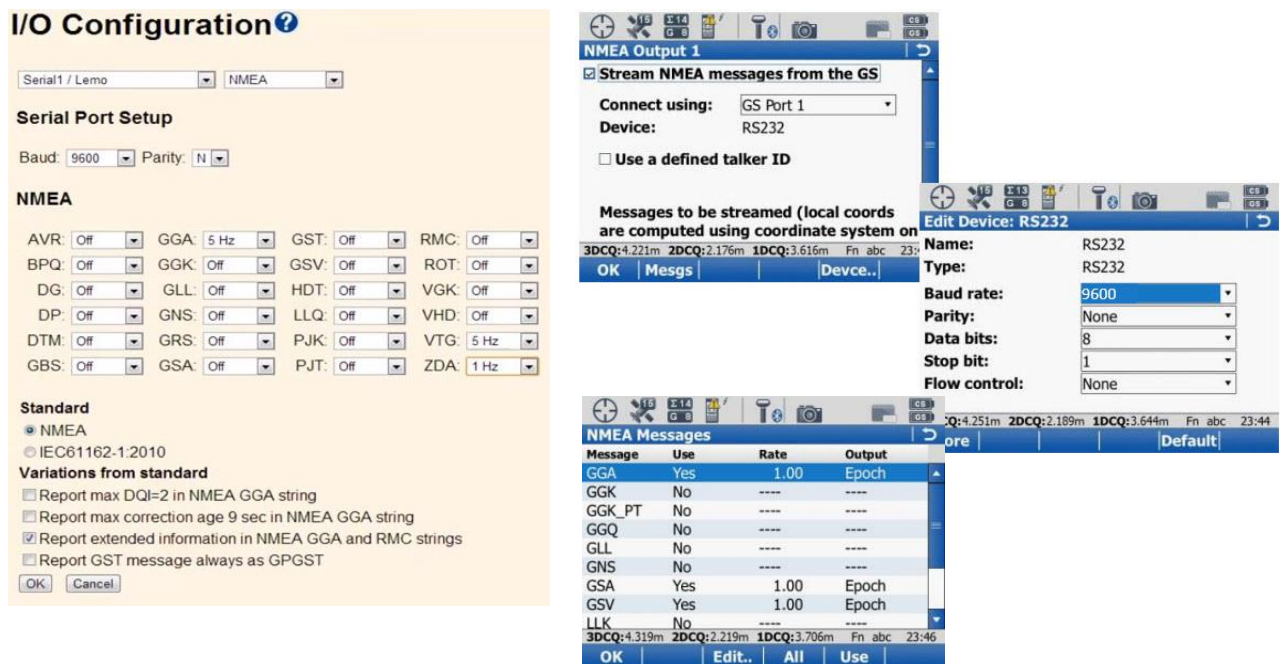

Figure 1. Example Trimble (left) and Leica (right) NMEA output configuration menus

4.   View Position Data on CEE ECHO LCD Home Screen

If the equipment setup is completed properly, the position data will appear on the CEE ECHO home screen. The quality code will be shown: (1) - Auto (2) - Diff (4) - Fix RTK (5) - Float RTK (9) - SBAS
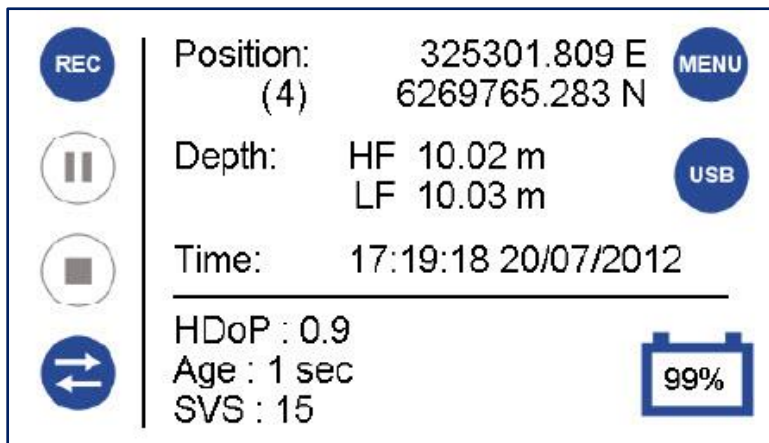

Figure 2. CEE ECHO home screen with valid RTK Fixed GNSS position

If no position data are seen, the GNSS data viewer can be used to verify what is being received from the GNSS receiver. The GNSS Menu Page 5 shows the data received by the CEE ECHO in real time. This is equivalent to a terminal program such as TeraTerm or Hyperterminal. If your echo sounder does not have the data viewer menu then contact CEE HydroSystems to obtain the firmware update to enable this. Without the data viewer feature, the GNSS output cable may be connected to the PC running a terminal program to allow further troubleshooting (TeraTerm is recommended).

If there are no streaming messages seen on the data viewer, then the communications parameters are incorrect or the GNSS receiver is not properly configured to output NMEA data. First check the baud rate; changing the input baud rate selection on the CEE ECHO GNSS menu then checking the GNSS terminal viewer is the easiest way to check for a baud rate mismatch. Unrecognizable "garbage" characters on the terminal viewer is a good indication the baud rate is mismatched. If coherent but incomplete (ie unfilled) NMEA messages are received, then there is simply no valid position being computed by the GNSS receiver but the configuration is otherwise correct, as shown below. If the GGA message is missing, but others are present, then there will be no position available.
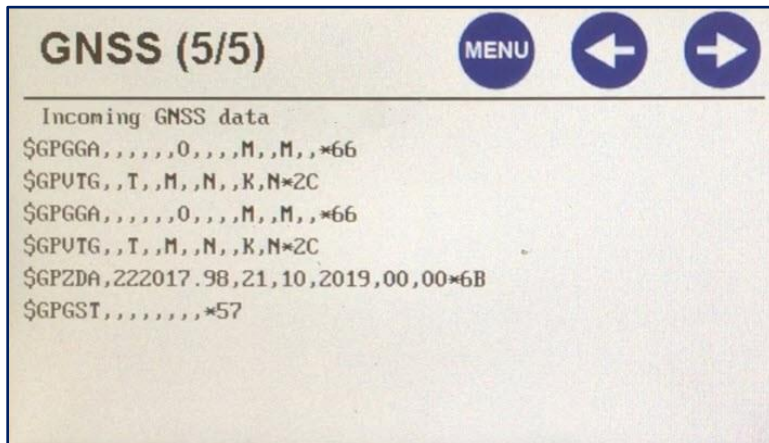

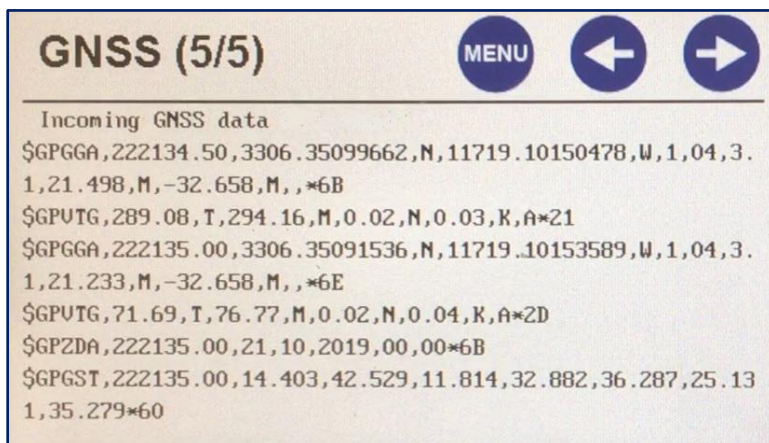*Figure 3. GNSS Data viewer – NMEA messages are being received with no position fix*

Figure 3. GNSS Data viewer – NMEA messaged received with position fix

Troubleshooting with a PC Terminal Program

If the boat position is not shown on the CEE ECHO home screen and the CEE ECHO data viewer menu is not available, and initial troubleshooting does not identify the problem, it is necessary to view the data output from the GNSS receiver by using a terminal program. First, download TeraTerm HERE. Then, connect the GNSS receiver output directly to the PC serial port or use a USB to Serial converter. In TeraTerm, select the appropriate serial port assigned to the connection and input the serial port parameters to match the GNSS receiver output. This terminal viewer can be used to determine what is being output from the GNSS receiver and monitor changes made in the GNSS setup. The goal is to achieve the data stream as shown in Figure 3, above shown on the terminal viewer display. When this is achieved, the serial cable can be reconnected to the CEE ECHO and a valid boat position should be displayed.

Timing Considerations: ZDA NMEA Message

The CEE ECHO proprietary Real Time data output format "+ CEE" that is used with the default Ethernet output mode has a time stamp applied to every packet or line of data. This time stamp is a prefix with the format "POS 123.456". On later firmware versions, the POS timestamp may be deactivated in the CEE ECHO GNSS menu, however this is only necessary for unusual configurations and it is recommended to keep the time stamp active to match the factory default condition. The time stamp is used to provide a highly precise dataset and is critical in USV applications to avoid latency from data telemetry. The hydrographic acquisition software setup determines whether this time stamp is used in place of the local PC time. It is important to remember that the POS time stamp originates from the CEE ECHO clock time. If the CEE ECHO is receiving a valid ZDA message from the GNSS receiver, the clock will be synchronized to GNSS time and the time stamp will be valid. If no ZDA message is being received, even though the CEE ECHO may still be showing a position from the GGA message, the time stamp will be applied based on the unsynchronized CEE ECHO internal clock. While the time stamp will still be included, it will not be related to GNSS time and under some circumstances this could introduce a problem in data processing.