Selecting the Appropriate Drivers for the CEESCOPE™ and CEE ECHO™ when using HYPACK Acquisition Software.

Configuring the CEESCOPE™ and CEE ECHO™ and HYPACK to function correctly together is critical for a successful survey. When using a CEESCOPE or CEE ECHO only this is a straightforward task, however when third-party equipment such as a side-scan sonar is also added complications can arise. This document explains the settings required for both situations, focusing on time synchronization between the various pieces of equipment.

Document conventions

In this document, unless otherwise specified, any reference to the CEESCOPE applies equally to the CEE ECHO. The term 'GPS' refers to all GNSS positioning systems.

Background

The CEESCOPE™ and CEE ECHO™ use the ZDA GPS message in combination with the 1PPS signal[1] to generate a precise GPS-derived timetag that is applied to every line of data and each binary echogram ping packet. This timetag, as it is applied upstream of the acquisition PC and associated interface ports represents a highly precise source of timing and minimizes latency for single beam surveys. This timing method becomes particularly beneficial when data are telemetered over a wireless connection such as when using a USV. Where possible this timetag is used in the following configurations.

How to use this document

1. Decide which of the three typical configurations (page 2) applies to your survey and make note of the corresponding CONFIG number.
2. Configure the CEESCOPE according to the CONFIG number. See page 4.
3. Configure your HYPACK project according to the CONFIG number. See page 6.

Additional background information can be found in the appendices.

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[1] The CEESCOPE includes an internal GNSS receiver so the 1PPS signal is always available. The CEE ECHO can only use the 1PPS signal if it is generated by the external GNSS receiver and if the cabling used to connect the receiver with the CEE ECHO supports this feature. When the 1PPS signal is not available then the ZDA GPS message will be used by itself to synchronise the internal clock. The 1PPS feature is not available when the Bluetooth interface is used for the CEESCOPE / CEE ECHO and receiver connection.

Typical configurations

There are three common ways to configure the CEESCOPE and HYPACK to work together. For the purposes of this document these three are numbered 1, 2A and 2B.

1. CEESCOPE only with HYPACK

In this simple configuration the survey is using HYPACK and a CEESCOPE only. The PC-time is not important, and HYPACK's CEE-GPS driver should be used to log the timetagged data from the CEESCOPE. The CEESCOPE's "POS NMEA prefix" setting must be set to ENABLE and the CEE-GPS Advanced "User Modified NMEA Messages" option must be set to "POS (CeeScope)".

2. CEESCOPE and other equipment (e.g. side-scan sonar) with HYPACK

a. CEE-GPS driver version prior to 19.2.0.0

In this configuration the CEESCOPE's timetag cannot be used, so PC-time is used to timetag all CEESCOPE data as well as third party data (e.g. side-scan data). Either the GPS NMEA-0183 driver or CEE-GPS may be used. In both cases the Advanced "User Modified NMEA Messages" option of the driver must be set to "None". For this to work the CEESCOPE real-time output must not timetag the position data, so the CEESCOPE's "POS NMEA prefix" setting must be set to DISABLE. The HYPACK project must specify the CEE-GPS driver (or GPS NMEA-0183 if used) as the device to synchronize the PC-time to, which is done using the "Select Device to Synchronize Clock" setting.

b. CEE-GPS driver version 19.2.0.0 or later

This is the preferred option. In this configuration the CEESCOPE's timetag can be used for the CEESCOPE data, meaning that the timetags of logged data stored in the CEESCOPE and those recorded in HYPACK will be identical. The CEE-GPS driver must be used, as well as the GPS Sync Only driver which is used to synchronize PC-time to CEE-time. The CEESCOPE's "POS NMEA prefix" setting must be set to ENABLE and the CEE-GPS Advanced "User Modified NMEA Messages" option must be set to "POS (CeeScope)".

There are other possible configurations such as synchronising PC-time with a GPS receiver separate from the CEESCOPE but these are beyond the scope of this document.
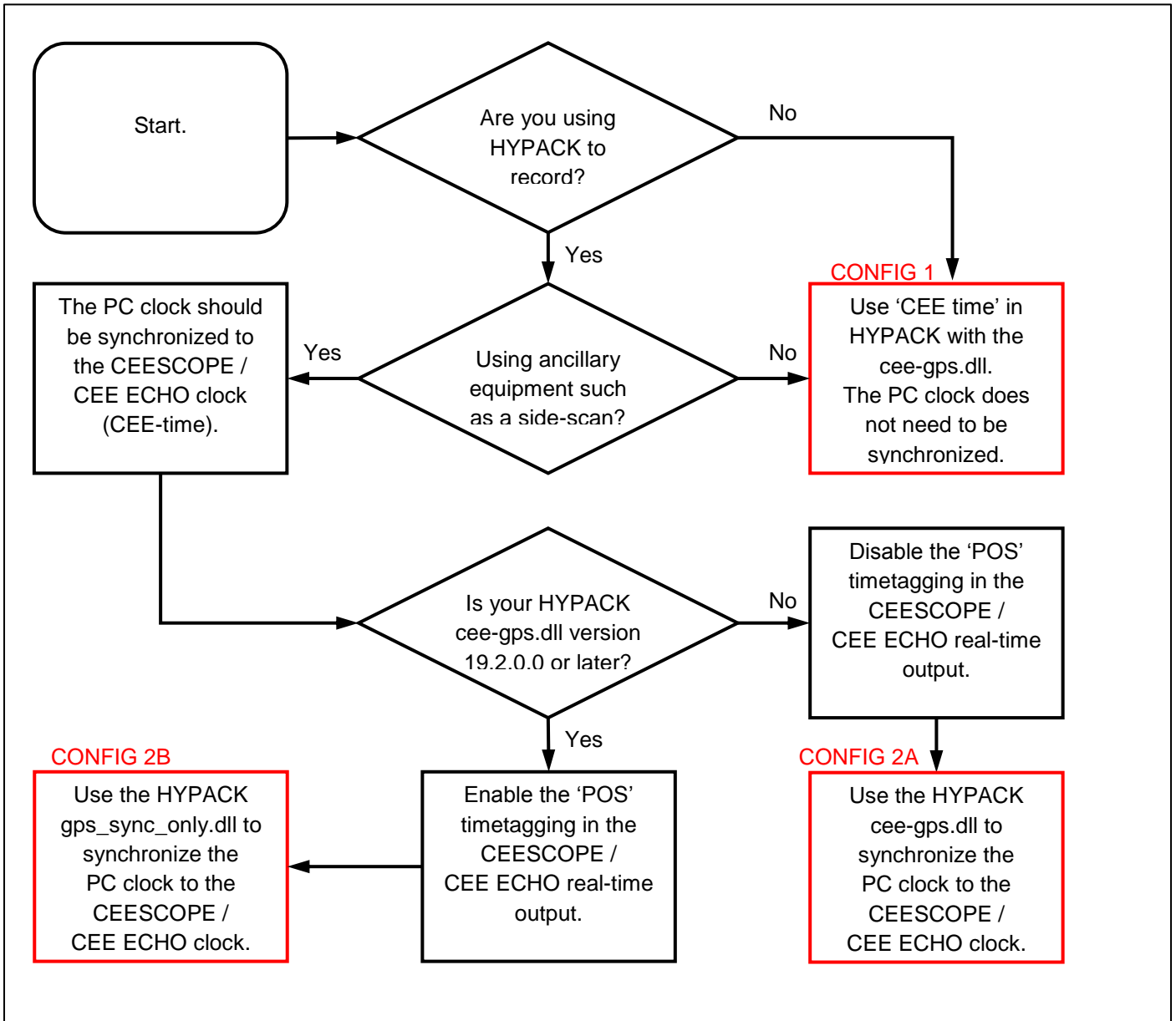
Figure 1 - HYPACK driver selection flowchart

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Configuring the CEESCOPE

Configure the CEESCOPE as follows:

Home screen settings

For all configurations ensure that real-time output is enabled. This is done by ensuring the real-time output button is active as shown below:

When real-time output is enabled the 'Data Out' LED on the CEESCOPE's front panel will blink.

Real-time output settings

The real-time output settings can be accessed from the main menu.

Setting	Function	Config #	Value
RT Format	Real-time output format	1,2A,2B	**GNSS+CEE** Other formats are supported by the CEESCOPE but aren't covered in this document.
POS NMEA prefix	Sets whether the GNSS NMEA output has the CEESCOPE 'POS' prefix	1,2B	**ENABLE**
		2A	**DISABLE**
Ethernet	Enables real-time output on the CEESCOPE's Ethernet port	1,2A,2B	**ENABLE**
Ethernet IP	Ethernet IP address	1,2A,2B	**192.168.2.1** This is the default setting, however this may need to be changed in some configurations.
Ethernet Port	The UDP port number of the position data (see Table 1).	1,2A,2B	**1234**

Note that if your CEESCOPE does not display the "POS NMEA prefix" option on the "R/T Output (1/2)" screen (see Figure 2) then your CEESCOPE is running an older software version. In this case the POS NMEA prefix will be enabled. Either request an updated version of CEESCOPE software from CEE HydroSystems, or ensure that your HYPACK CEE-GPS driver version is 19.2.0.0 or later.
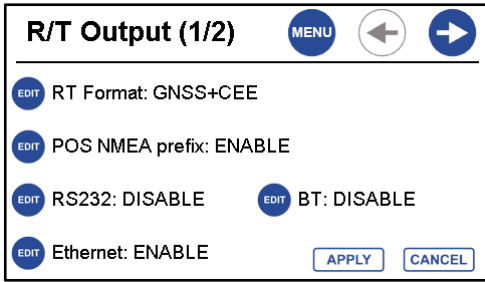
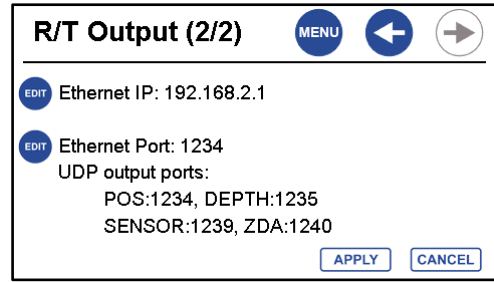*Figure 2 - CEESCOPE real-time output screen 1/2*

Figure 3 - CEESCOPE real-time output screen 2/2

CEESCOPE time and date settings

The CEESCOPE time and date settings can be accessed from the main menu then system screen 5.

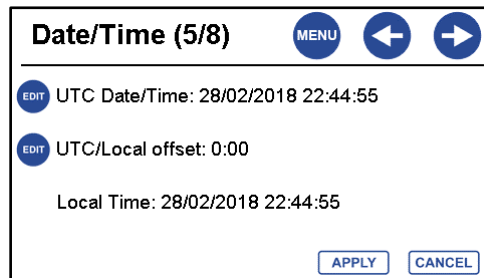| Setting	Function	Config #	Value
UTC/local offset	The CEECOPE time offset from UTC time	1,2A,2B	**0** For simplicity it is recommended that all survey equipment interfacing with HYPACK be set to UTC time with no local offset.



Figure 4 - CEESCOPE real-time output screen 1/2

Configuring HYPACK

Configure your HYPACK project as follows:

Clock synchronisation

The following are accessed through the System tab when the Hardware item is selected.
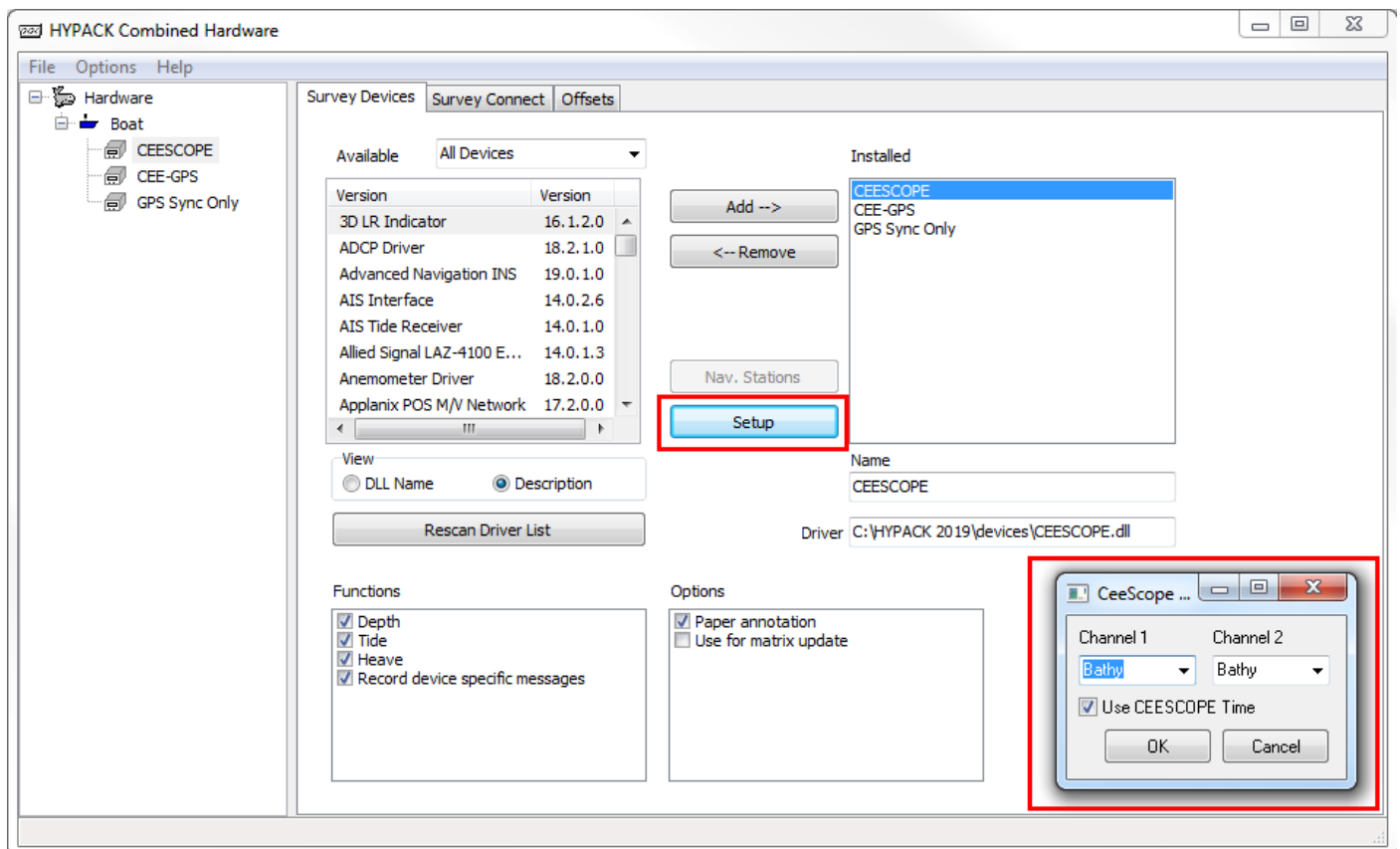
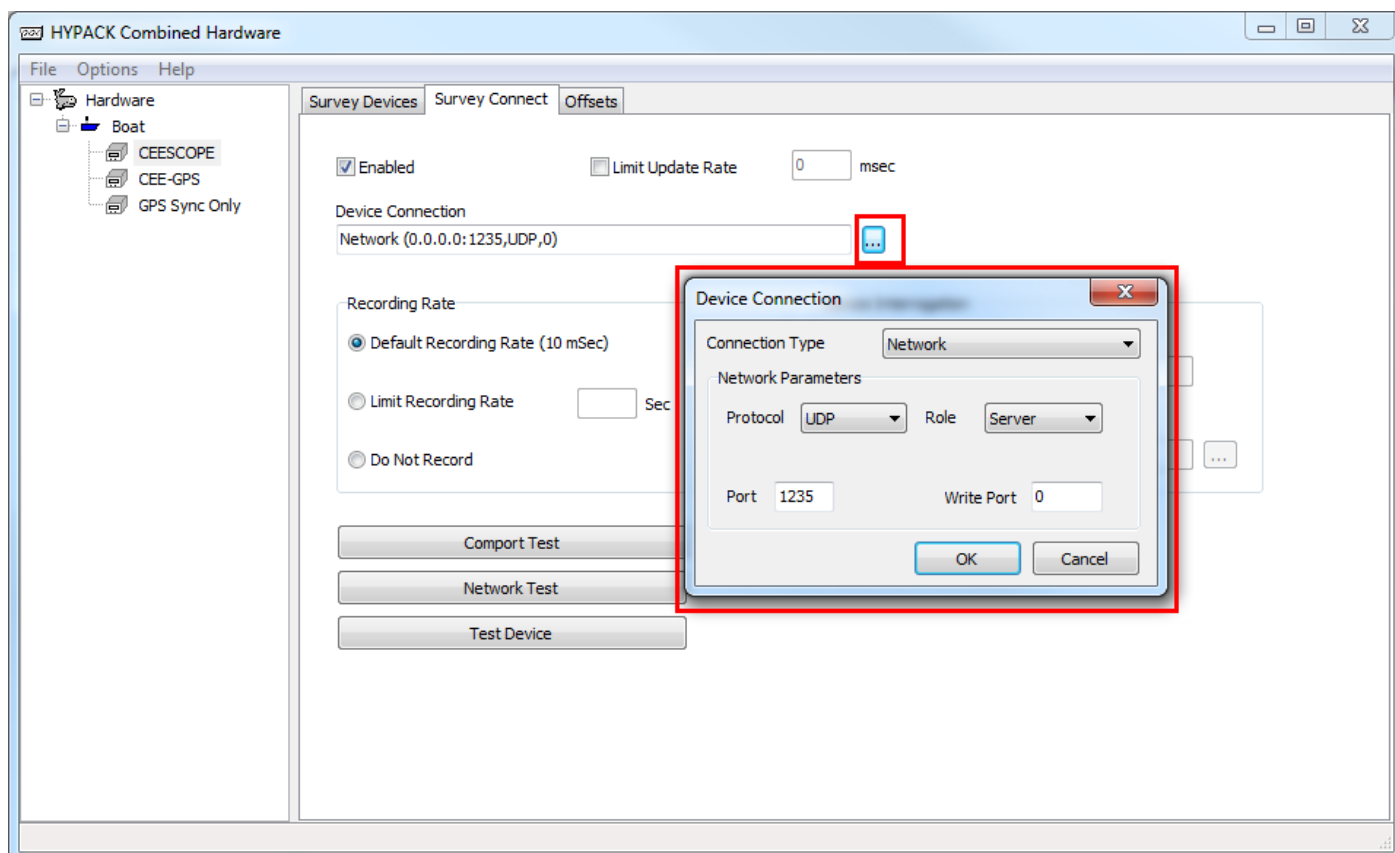| Setting	Function	Config #	Value
Synchronise Computer Clock	Selects the device that HYPACK uses to synchronize PC-time	1	None (no synch)
		2A	CEE-GPS
		2B	GPS Sync Only
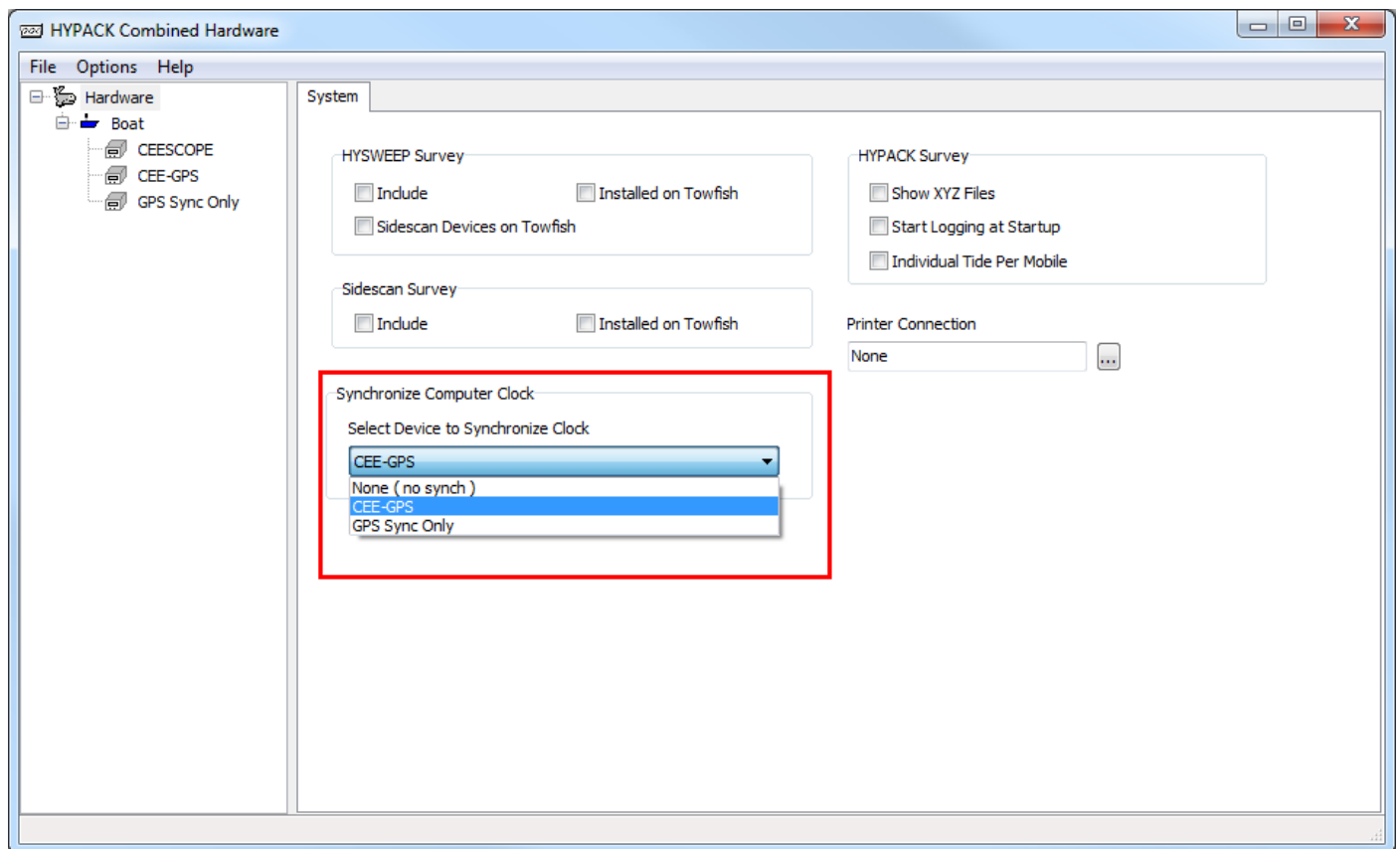
CEESCOPE driver configuration

The following are accessed through the Setup button on the Survey Devices tab of the CEESCOPE driver.

Setting	Function	Config #	Value
Use CEESCOPE Time	Selects whether HYPACK records sounder data with CEE-time (checked) or PC-time (unchecked)	1,2B	Checked
		2A	Unchecked

The following are accessed through the Survey Connect tab of the CEESCOPE driver.

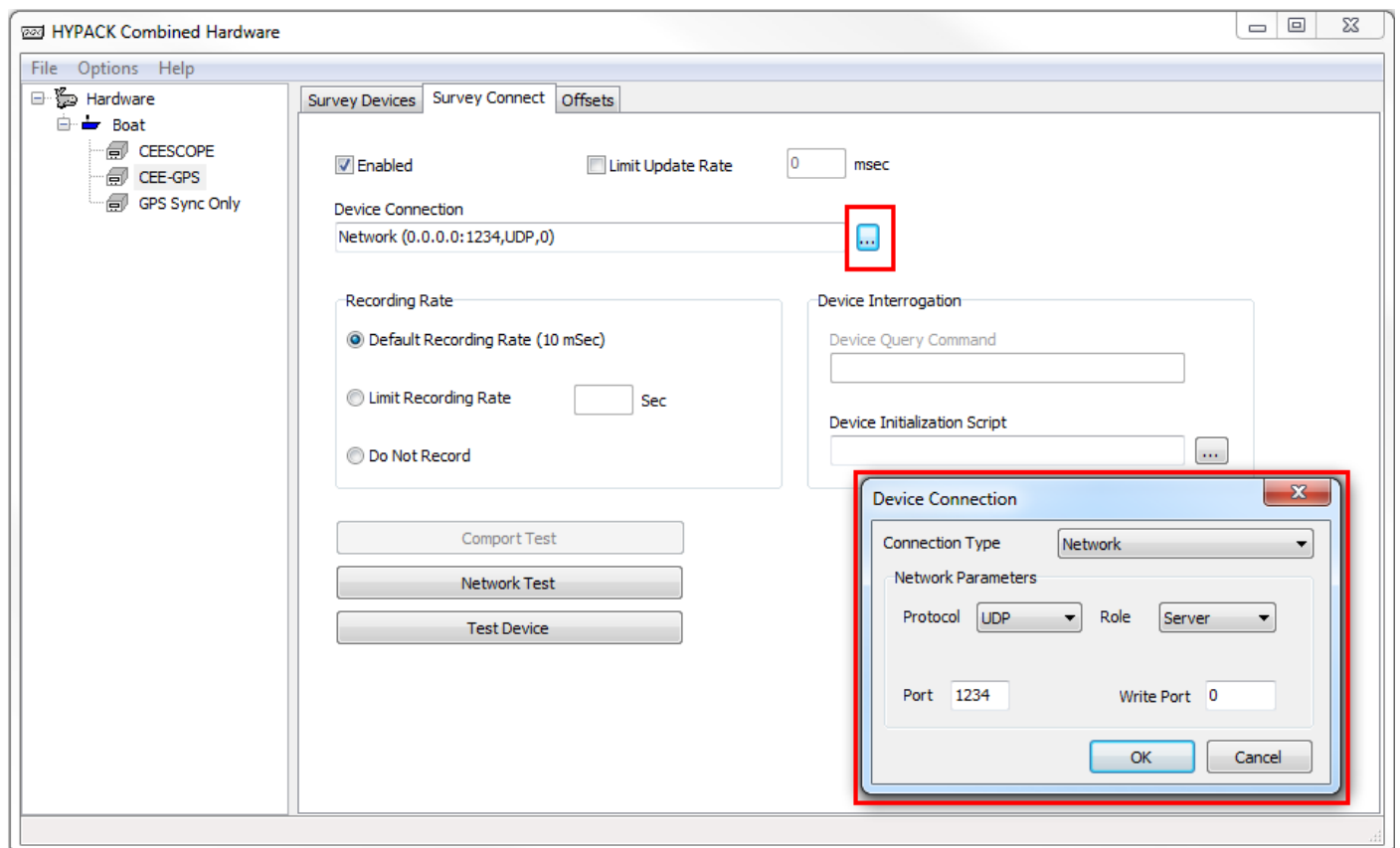| Setting	Function	Config #	Value
Enabled	Enables the driver.	1,2A,2B	Checked
Device connection	Connectivity settings	1,2A,2B	Connection type: network Protocol: UDP Role: Server Port: **1235** Write Port: 0

CEE-GPS driver configuration

The following are accessed through the Advanced Tab of the Setup button on the Survey Devices tab of the CEE-GPS driver.

Setting	Function	Config #	Value
User Modified NMEA Messages	Tells HYPACK whether to expect non-standard NMEA data.	1,2B	POS (CeeScope)
		2A	None
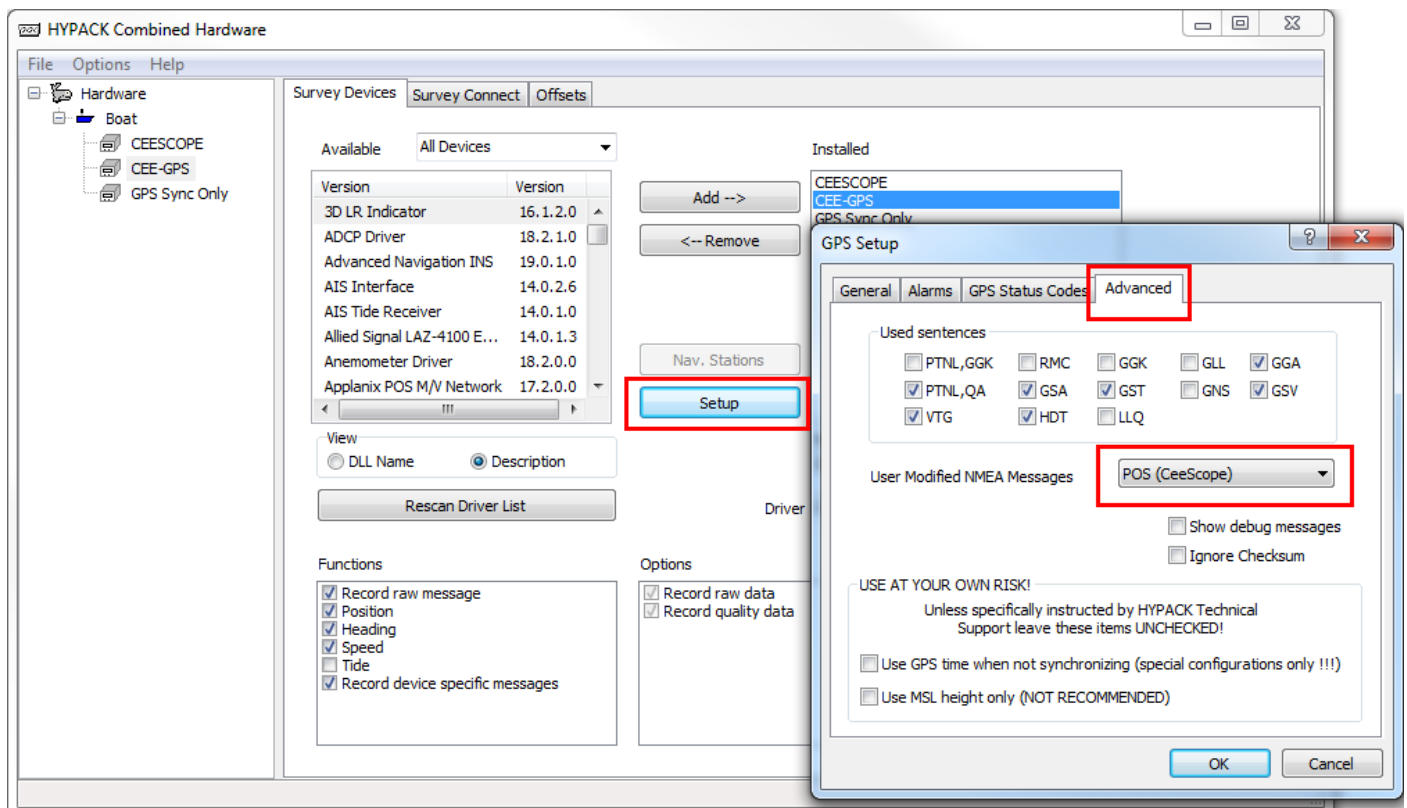
The following are accessed through the Survey Connect tab of the CEE-GPS driver.

Setting	Function	Config #	Value
Enabled	Enables the driver.	1,2A,2B	Checked
Device connection	Connectivity settings	1,2A,2B	Connection type: network Protocol: UDP Role: Server Port: **1234** Write Port: 0

GPS Sync Only driver configuration

The following are accessed through the Survey Connect tab of the GPS Sync Only driver.

Setting	Function	Config #	Value
Enabled	Enables the driver.	1,2A	Unchecked
		2B	Checked
Device connection	Connectivity settings	1,2A	N/A
		2B	Connection type: network Protocol: UDP Role: Server Port: **1240** Write Port: 0
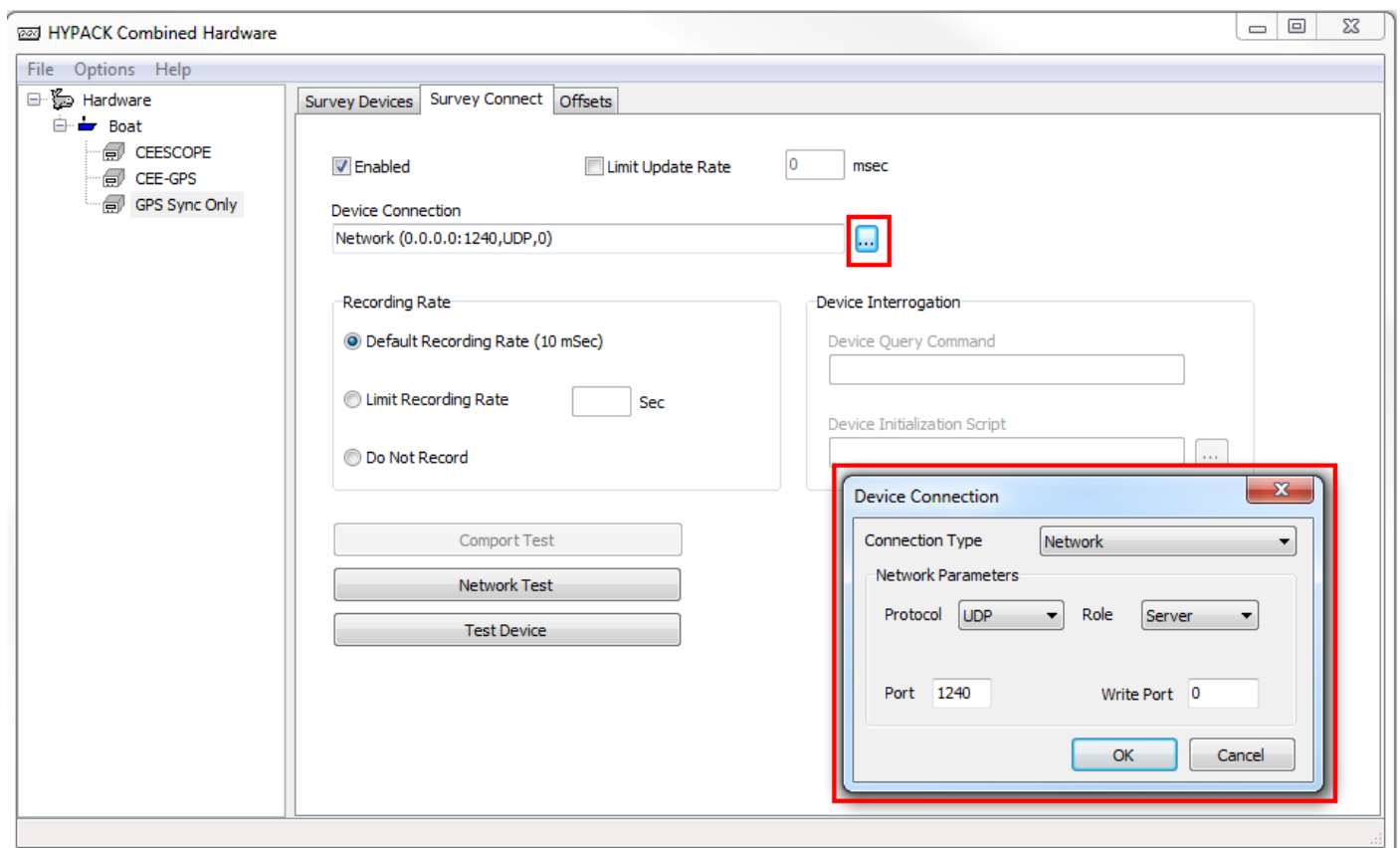
Appendix A – Important concepts

NMEA-0183: the NMEA-0183 specification is a protocol used to communicate between marine equipment such as GPS receivers, echosounders, compasses, etc. The protocol's data units are referred to as "sentences". A variety of standard communications interfaces are used to carry NMEA-0183 such as RS-232 and Ethernet. Here is an example of four NMEA-0183 sentences:

> $GPZDA,015055.00,24,02,2012,,*67
>
> $GPGGA,015055.00,3338.9114522,S, 15109.8404898, E,4,14,0.8,2.074,M,23.20,M,02,0006*45
>
> $GNGST,015055.00,4.76,0.01,0.01,-17.5827,0.01,0.01,0.01*6A
>
> $GNVTG,344.989,T,344.989,M,3.752,N,6.948,K,D*38

CEE-time: CEE-time is the CEESCOPE's time. If the CEESCOPE has a valid position then CEE-time will be synchronized by the CEESCOPE to UTC time. The CEECOPE uses CEE-time for its internal logging and for its real-time output.

PC-time: PC-time is the time of your PC running HYPACK disregarding your regional time offset. HYPACK can synchronize PC-time to a time source such as the CEESCOPE or a separate GPS receiver. HYPACK will use PC-time to log any non-timetagged data it receives.

ZDA message: the ZDA message is a NMEA-0183 sentence used to report the time and date and is typically produced once per second (1Hz). The time field in a ZDA message has a 10 millisecond precision. Both HYPACK and the CEESCOPE use ZDA messages to synchronize their respective clocks.

1PPS signal: the pulse-per-second signal is a 1Hz electrical pulse generated by a GPS receiver in order to improve the time precision beyond that permitted by the ZDA message. The GPS receiver within the CEESCOPE (but not the CEE ECHO) generates this signal and is used by the CEESCOPE to better synchronize CEE-time. Without this signal a device trying to synchronize with a stream of ZDA messages depends on the arrival time of the message, so communications latency and jitter must be low for the synchronization to be accurate.

Communications latency and jitter: latency is the time delay between the generation / transmission of data from a real-time device such the CEESCOPE and its reception / processing by a destination device such as a PC running HYPACK. The moment to moment variation in this latency is called the jitter. In some situations, wireless communications interfaces such as Wi-Fi or Bluetooth can suffer from these delays more than wired interfaces such as Ethernet or RS-232.

POS NMEA prefix: to timetag the NMEA data, the CEESCOPE adds the 'POS' prefix to the data before transmission. The timetag is the number of milliseconds since midnight CEE-time. Here is an example of timetagged data with the POS prefixes in red:

> **POS 42649023** $GPZDA,015055.00,24,02,2012,,*67
>
> **POS 42649023** $GPGGA,015055.00,3338.9114522,S, 15109.8404898, E,4,14,0.8,2.074,M,23.20,M,02,0006*45
>
> **POS 42649040** $GNGST,015055.00,4.76,0.01,0.01,-17.5827,0.01,0.01,0.01*6A
>
> **POS 42649040** $GNVTG,344.989,T,344.989,M,3.752,N,6.948,K,D*38

Appendix B – Default CEESCOPE UDP port numbers

Data stream	Default UDP port number	Port number offset	Purpose
Position data (GPS data)	1234	0	ASCII position, heave and compass data is broadcast on this port. If the "POS NMEA prefix" option is enabled in the CEESCOPE then this data will be prefixed by the CEESCOPE's 'CEE time' timetag.
Sounder data	1235	1	The CEESCOPE's echosounder data.
Sensor data	1239	5	Heave (TSS1) or compass (HDG or HDT) data. This data stream is not prefixed with the CEESCOPE timetag.
NMEA ZDA data	1240	6	ZDA-only port. This data stream is not prefixed with the CEESCOPE timetag (POS NMEA prefix).

Table 1 – CEESCOPE UDP port functions

Appendix C - HYPACK drivers

Each of the relevant HYPACK drivers are listed in Table 2.

HYPACK driver	Driver filename	Purpose
CEE-GPS	cee-gps.dll	The custom CEE Hydrosystems GPS driver. This is used by HYPACK to receiver the position data form the CEESCOPE.
GPS CEE	gps-cee.dll	Except for their filenames, these two drivers are identical and can be used interchangeably. Future versions of HYPACK will no longer include gps-cee.dll so we recommended this one be ignored.
CEESCOPE	ceescope.dll	The custom CEE Hydrosystems echosounder driver. This is used by HYPACK to receive the depth data from the CEESCOPE.
GPS NMEA-0183	gps.dll	The standard HYPACK GPS driver.
GPS Sync Only	gps_sync_only.dll	This driver is used by HYPACK to synchronize the PC clock to a source that is generating NMEA 0183 ZDA messages. This driver will reject ZDA messages prefixed by the 'CEE time' time-stamp.

Table 2 - HYPACK drivers list