

Automotive
Energy & Power Analysis
Field Service
Environmental
Research & Development

DEWE-GPS-CLOCK

Technical reference manual



ISO9001

... the precision signal conditioning company



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Technical Reference

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Warranty Information

A copy of the specific warranty terms applicable to your DEWETRON product and replacement parts can be obtained from your local sales and service office.

Support

For any support please contact your local distributor first or DEWETRON directly.

For Asia and Europe, please contact:

DEWETRON Ges.m.b.H.
Parking 4
A-8074 Graz-Grambach
AUSTRIA
Tel.: +43 316 3070
Fax: +43 316 307090
Email: support@dewetron.com
Web: <http://www.dewetron.com>

The telephone hotline is available
Monday to Friday between
08:00 and 17:00 CET (GMT +1:00)

For the Americas, please contact:

DEWETRON, Inc.
10 High Street, Suite K
Wakefield, RI 02879
U.S.A.
Tel.: +1 401 284 3750
Toll-free: +1 877 431 5166
Fax: +1 401 284 3755
Email: support@dewamerica.com
Web: <http://www.dewamerica.com>

The telephone hotline is available
Monday to Friday between
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DEWETRON GesmbH
Parking 4
A-8074 Graz-Grambach / Austria

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Safety instructions

Safety symbols in the manual



Indicates hazardous voltages.

WARNING *Calls attention to a procedure, practice, or condition that could cause bodily injury or death.*

CAUTION *Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.*

WARNINGS

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. DEWETRON Elektronische Messgeraete Ges.m.b.H. assumes no liability for the customer's failure to comply with these requirements.

All accessories shown in this document are available as option and will not be shipped as standard parts.

Safety instructions for all DEWETRON systems

- The DEWETRON data acquisition systems may only be installed by experts.
- Read your manual before operating the system.
- Observe local laws when using the instrument.
- Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), a non interruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.
- DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a DEWETRON sales and service office for service and repair to ensure that safety features are maintained.
- Keep away from live circuits: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.
- No modifications are allowed at the instrument. The fuse in the power module has to be replaced by the same type. For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type. DO NOT use repaired fuses or short-circuited fuse holder labels and print on the power module may not be removed.
- DO NOT service or adjust alone. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.
- DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a DEWETRON sales and service office for service and repair to ensure that safety features are maintained.
- Before opening the instrument (experts only) or exchanging the fuse in the power module disconnect power!
- Don't touch internal wiring!
- Don't use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- Install filler-panels in unused slots.
- The power-cable and -connector serve as Power-Breaker. The cable must not exceed 10 feet, disconnect function must be possible without tools.
- Safety of the operator and the unit depend on following these rules.

General System Information

Environmental Considerations

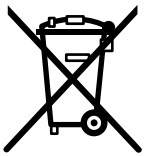
Information about the environmental impact of the product.

Product End-of-Life Handling

Observe the following guidelines when recycling a DEWETRON system:

System and Components Recycling

Production of this components required the extraction and use of natural resources. The substances contained in the system could be harmful to your health and to the environment if the system is improperly handled at it's end of life! Please recycle this product in an appropriate way to avoid an unnecessary pollution of the environment and to keep natural resources.



This symbol indicates that this system complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). Please find further informations about recycling on the DEWETRON web site www.dewetron.com



Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive. This product is known to contain lead.

GPS synchronized time base generator

Features:

- Absolute time accurate, wireless synchronisation between date acquisition systems
- **Clock output:**
 - Output clock rate of up to 10 MHz
 - Synchronization of DEWE-ORION-1624 systems
 - Continuous synchronization to absolute GPS time
 - Absolute long time stable
 - High frequency accuracy without GPS signal
- **GPS engine clock output:**
 - PPS accuracy of 250 ns
 - 1 Hz update rate
 - Supports differential GPS (SBAS)



Specifications

DEWE-GPS-CLOCK GPS synchronized time base generator		
Timing specifications		
Trigger accuracy	250 ns	
Clock acc. GPS locked	without drift	
Clock acc. GPS unlocked	< 1 ppm	
Clock/Trigger signal level	TTL (LVDS for ORION-1624)	
GPS specifications		
General	12 channel, L1 frequency receiver	
PPS accuracy	250 ns	
Refreshrate	1 Hz	
Position accuracy	Horizontal CEP	Horizontal 95 %
Autonomous	3.0 m	5.0 m
Differential	1.0 m	3.0 m
System specifications		
Input	TNC connector for GPS antenna, event mark input	
Output	Speed, displacement, RS-232, USB, Timebase generator	
Power Supply	8 to 18 V _{DC}	
Dimensions	165 x 115 x 50 mm (6.5 x 4.5 x 2 in.)	
Weight	740 g (1.63 lbs)	
Operating temperature	-30 °C to +80 °C	
Storage temperature	-40 °C to +85 °C	
Humidity	95 % RH non condensing @ +60 °C	
Vibration	0.008 a ² / Hz	5 to 20 Hz
	0.05 a ² / Hz	20 to 100 Hz
	3 dB/octave	100 to 900 Hz

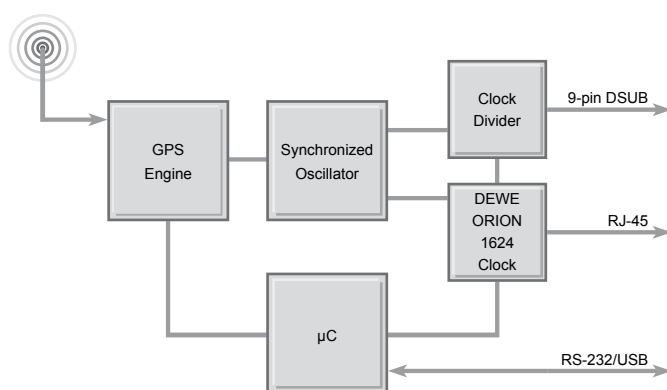
DEWE-GPS-CLOCK

Device overview

With the DEWE-GPS-CLOCK DEWETRON offers a GPS synchronized time base generator. This allows completely synchronized data acquisition of multiple systems located inside and outside of moving vehicles.

The time synchronization is supported for the whole DEWE-ORION series and also for many 3rd party A/D-boards.

The diagram below gives a basic idea about the DEWE-GPS-CLOCK functionality.



The base of any GPS receiver is precise time measurement. In addition to the position information a precise PPS (pulse per second) is generated by the GPS engine. This pulse is used to synchronize a 40 MHz oscillator with software PLL (phase locked loop). The result is an ultra stable 40 MHz clock source which is completely free of drift over time.

Out of this 40 MHz base clock, the programmable clock divider generates the clock frequency for the data acquisition system. Due to the over-clocking of delta sigma converters, a special output clock is required for synchronized sampling. This is available on a RJ45 connector for clocking the DEWE-ORION-1624.

The communication to the host is provided over USB or standard RS-232 interface.

Functionality of the LEDs

Power

Indicates the power and hardware status. At power-on this LED flashes for approx. 7 seconds until the receiver is recognized which is indicated by a solid LED. If it blinks three times in a row, there is a hardware failure (e.g. no receiver found, ...).

Sat.

Flashes according to the number of used satellites. A short flash means that it has locked onto a satellite but that satellite is not yet being used for the calculation of the position. A long flash means that the satellite is fully locked and used for the calculations.

Status

When the Status LED flashes alone (no flashing Satellite LED), the GPS is not locked to a satellite.



Mounting the aerial

The aerial supplied with the VGPS is designed to be mounted with the included mounting kit. The positioning of the aerial is critical to the correct operation of the VGPS.

The aerial picks up the signals from up to 12 satellites which are all in different places in the sky. These satellites are not necessarily directly overhead, and can often be close to the horizon. Therefore it is best to mount the aerial in a way, that the least amount of metal obscures the view of the sky. On a domed roof, place the aerial on the top of the dome. On an open car with a roll-over bar, place the aerial horizontally on the highest point of the roll-over hoop and tape the wire securely to the frame. Although the VGPS can work with at least three satellites, its precision increases the more satellites it finds. If one satellite disappears over the horizon, or behind an object, there are other satellites still in view.



In order to fix your antenna on a tube, use the provided universal mounting adaptor. The image on the left shows you, how you have to fix the tube with the screws (①, ②).

Please note:

The maximum diameter is limited to 43 mm (1.7 Inch). Otherwise the universal mounting adaptor will not fit on the tube.

The DEWE-GPS-CLOCK is shipped with a 6 m antenna cable (standard). 15 m or 25 m antenna cables are available optionally.

PC-GPS-CBL08 - 15 m

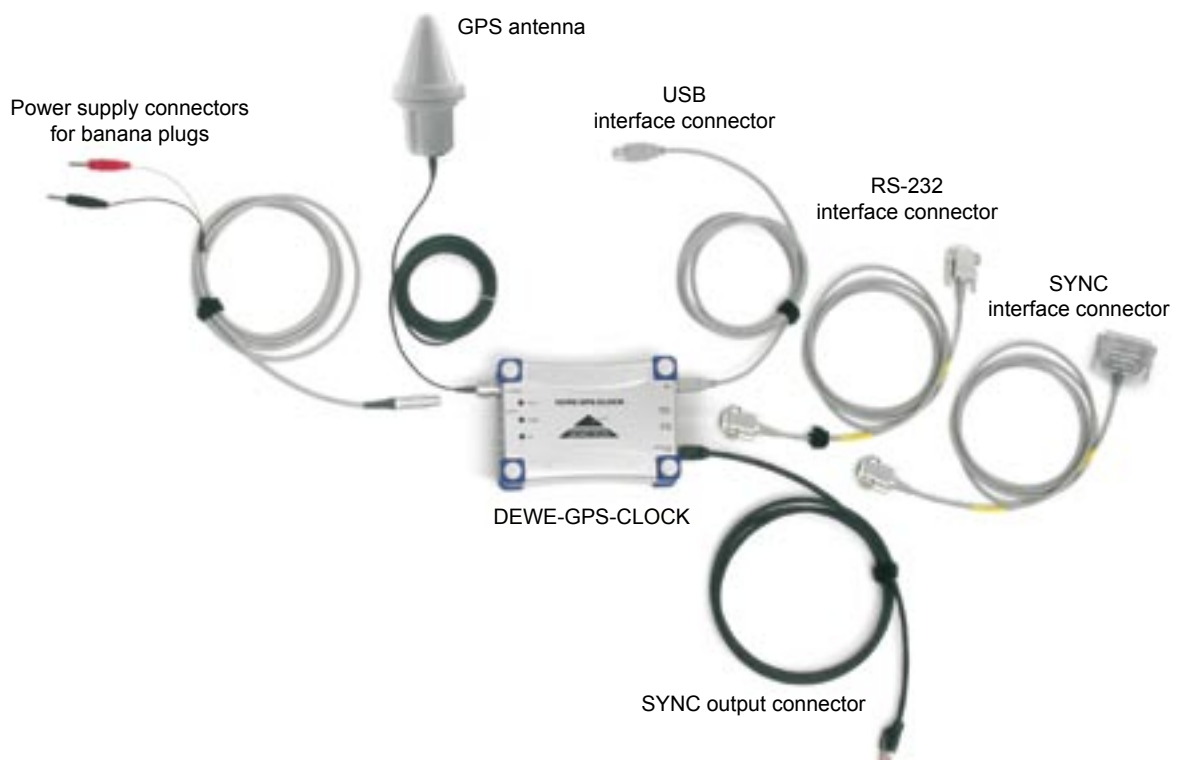
PC-GPS-CBL08 - 25 m

DEWE-GPS-CLOCK

Warm-Up time

When the VGPS is used for the first time, has been moved more than 200 km or not used for 10 hours (since last usage), it is recommended to perform a 'cold start'. To get the best performance from your GPS in the future, perform this cold start in an open place with a good all round view to the sky. Allow the GPS to map the satellites for at least 20 to 30 minutes. The GPS builds up the 'Ephemeris' data on each satellite which is stored in a non-volatile memory, and means future satellite tracking is swift and stable. Once the GPS has carried out a successful cold start, future satellite lock from power up will take between 15 seconds and 1 minute. Before going to test in a shady environment with tall objects or near to trees, allow the GPS to settle in an open space for 5 to 10 minutes.

Scope of supply



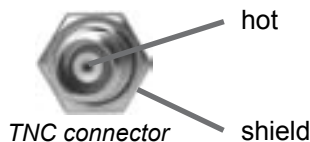
Connection

Connector overview:



Aerial connector

Connect the GPS antenna to the TNC connector.

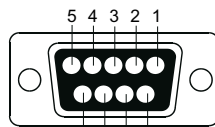


RS-232 interface

The RS-232 interface connector (female) is configured as standard RS-232 interface. Standard 9-pin RS-232 cable is allowed to connect.



9-pin SUB-D
connector (female)



Schematic

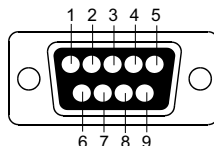
- Pin assignment
- 1: Free run operation
 - 2: TXD (Transmitted Data)
 - 3: RXD (Received Data)
 - 4: Not connected
 - 5: GND (Ground)
 - 6: PPS (pulse per second)
 - 7: Not connected
 - 8: Not connected
 - 9: Not connected

Signal out connector

The 9-pin DSUB 9 (male) connector is configured as output connector for following signals:



9-pin SUB-D
connector (male)



Schematic

- Pin assignment
- 1: PPS (pulse per second)
 - 2: Scan clock output
 - 3: Second clock output
 - 4: Not connected
 - 5: Not connected
 - 6: GND (Ground)
 - 7: GND (Ground)
 - 8: GND (Ground)
 - 9: GND (Ground)

USB connector

The USB interface connectors meets standard USB pin assignment.

DEWE-GPS-CLOCK



4-pin USB connector



Schematic

Pin assignment
1: +5 V
2: D-
3: D+
4: GND

Power supply connector

Connects the DEWE-GPS-CLOCK system to an external DC power supply.



2-pin Lemo
connector (male)
EGJ.1B.302.CLA



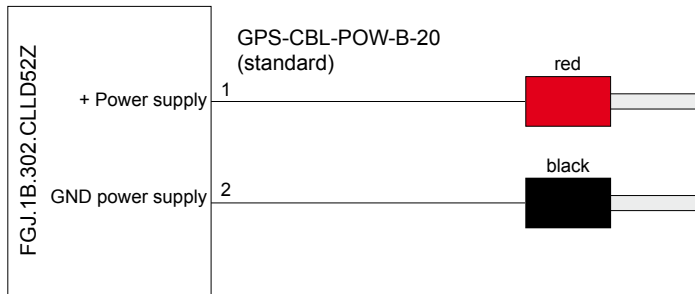
Schematic

Pin assignment
1: +8 to 18 V_{DC} power supply
2: GND power supply

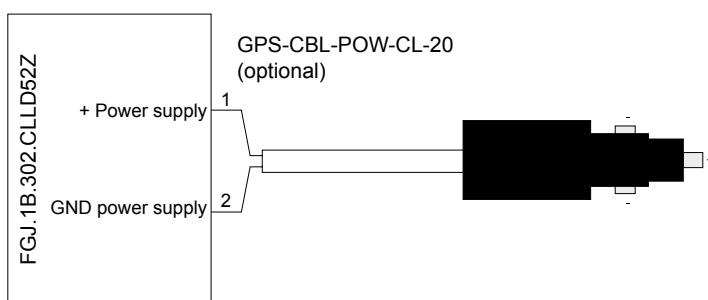
Cable for external power supply

Type of cable: LIYY 2x0.75, length: 2 m

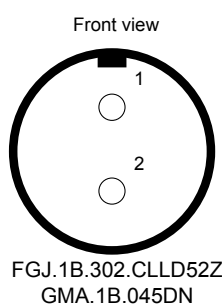
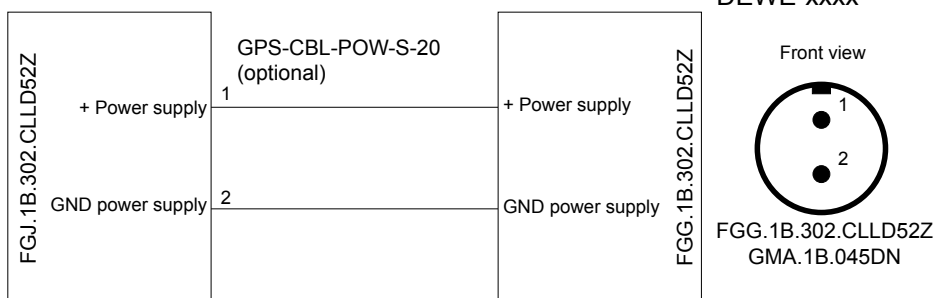
GPS



GPS



GPS



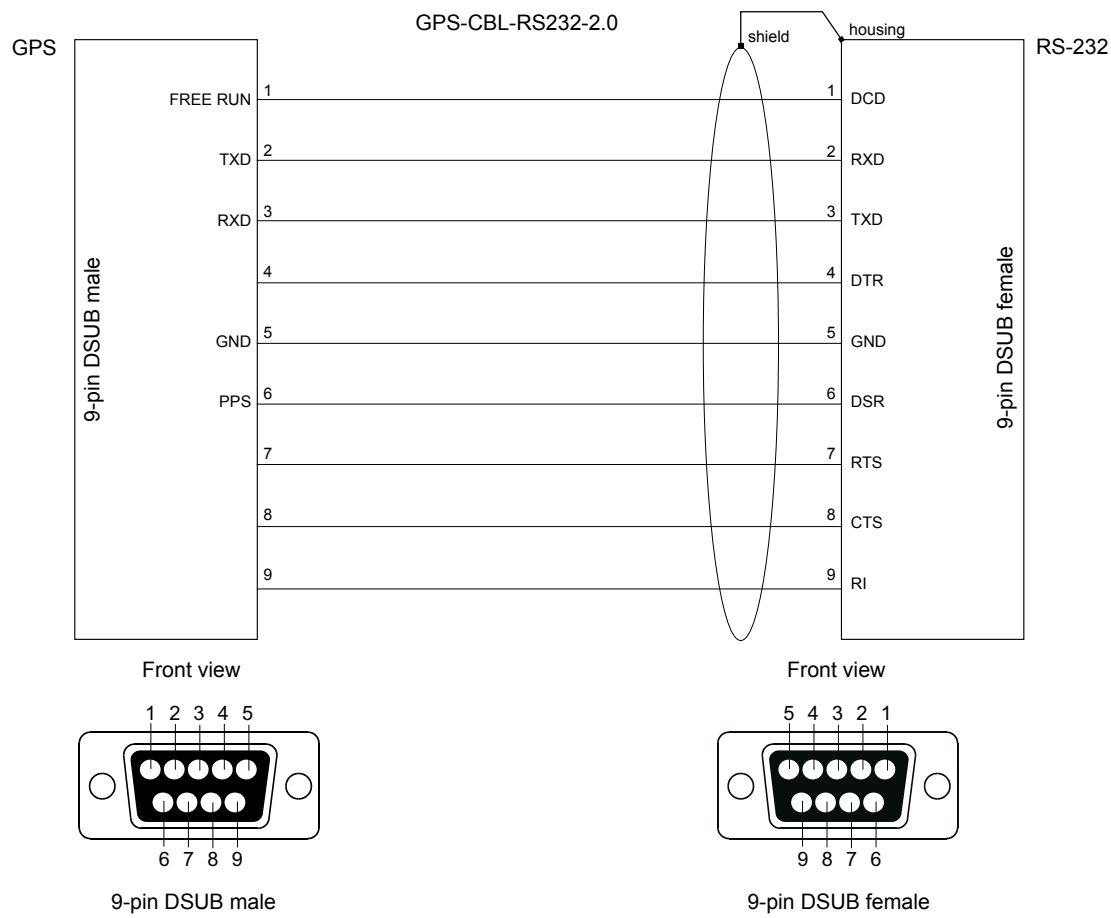
Power supply unit
(optional)



DEWE-GPS-CLOCK

RS-232 interface cable

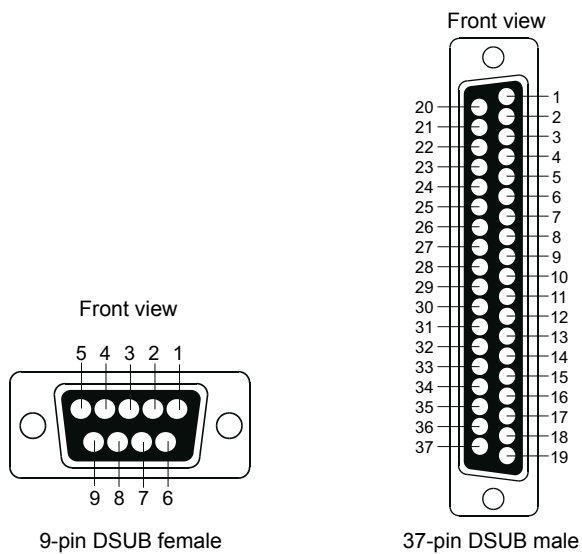
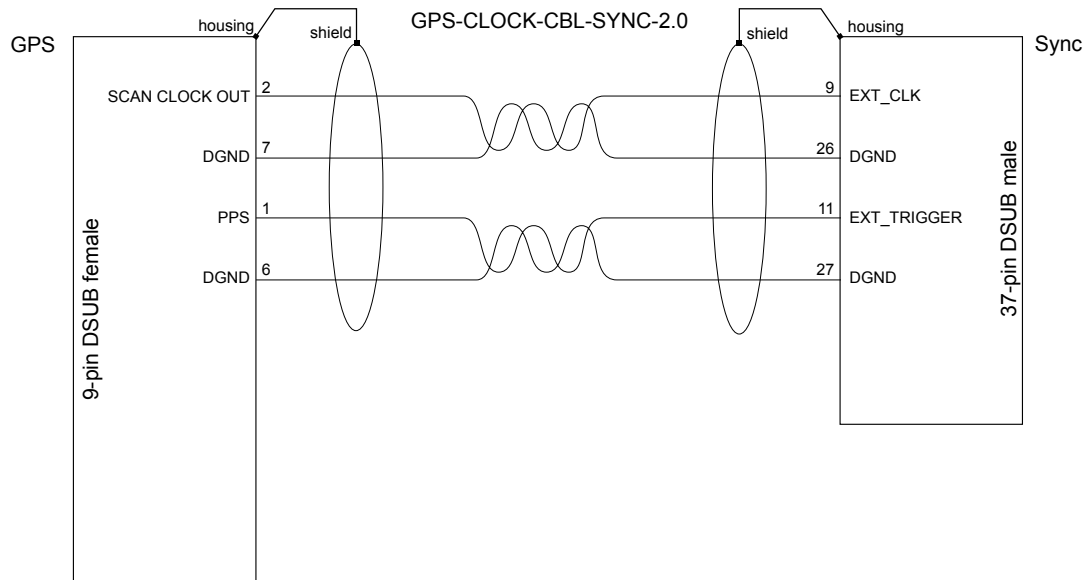
Type of cable: 10x0.14 shielded, length: 2 m



DEWE-GPS-CLOCK

Sync output

Type of cable: 2x2x0.25 shielded

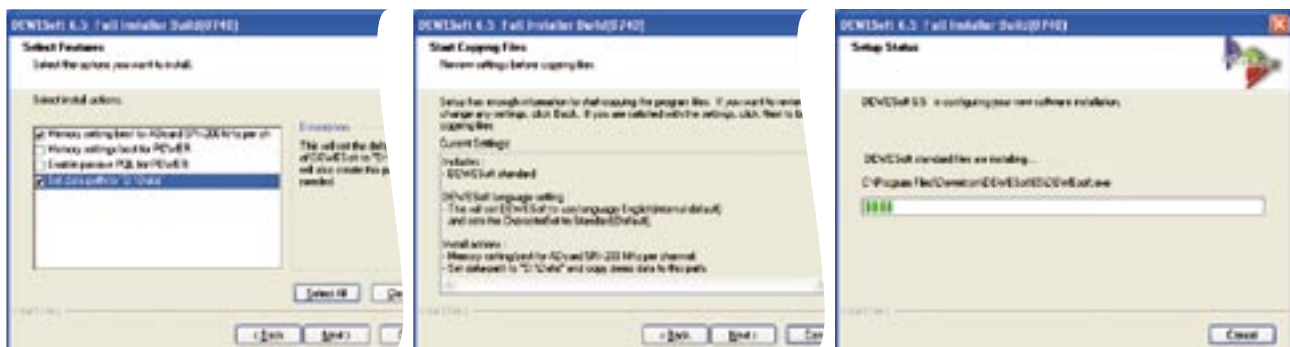
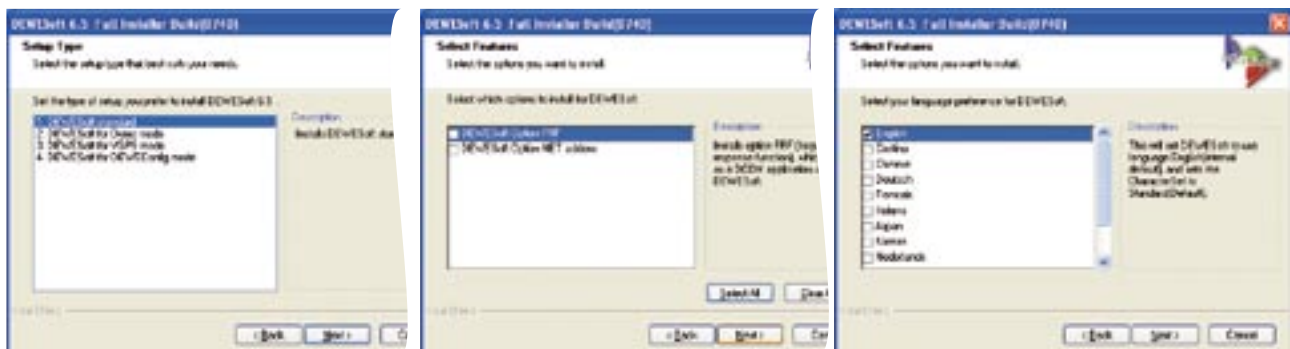
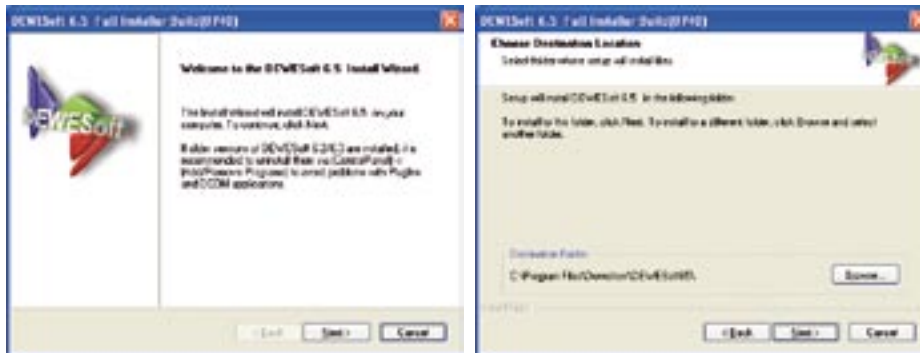


DEWE-GPS-CLOCK

Installation of the DEWESoft measurement software

Start the installation software on the System DVD, shipped with the system.

Follow the instructions of the install program according to your license.



DEWE-GPS-CLOCK

Now DEWESoft is installed on your computer. The software creates some directories on your harddisk.



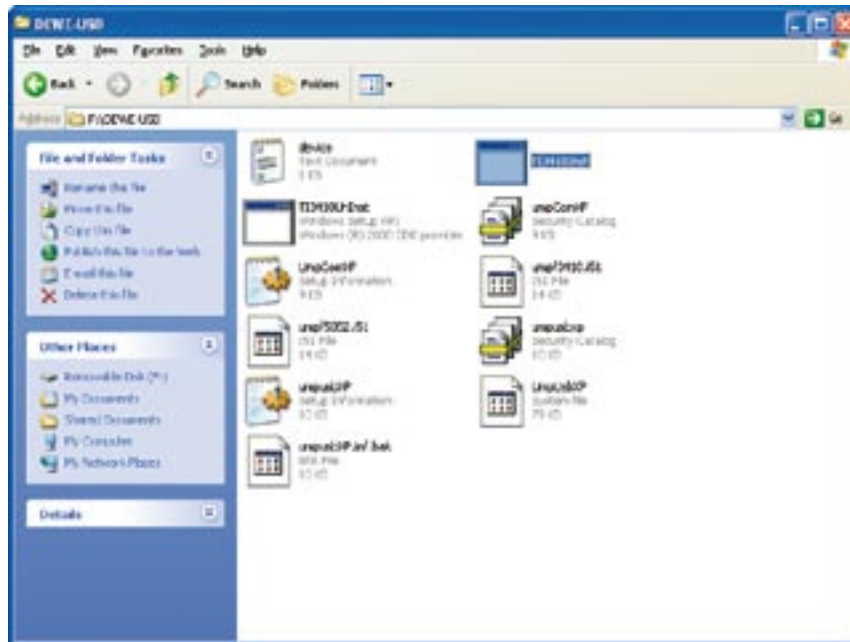
You can start the software in the Windows start menu or use the icon created on your desktop. For more information about the DEWESoft installation please refer to the *DEWESoft Software Users Manual*.

DEWE-GPS-CLOCK

Installation of the DEWE-GPS-CLOCK drivers

Execute the file „TI3410Inst.exe“ from the System-DVD

(usually D:\Install\Drivers\7_Communication\DEWE-USB where D is the units DVD-Drive letter).



Click on “Continue Anyway” to accept the software installation.

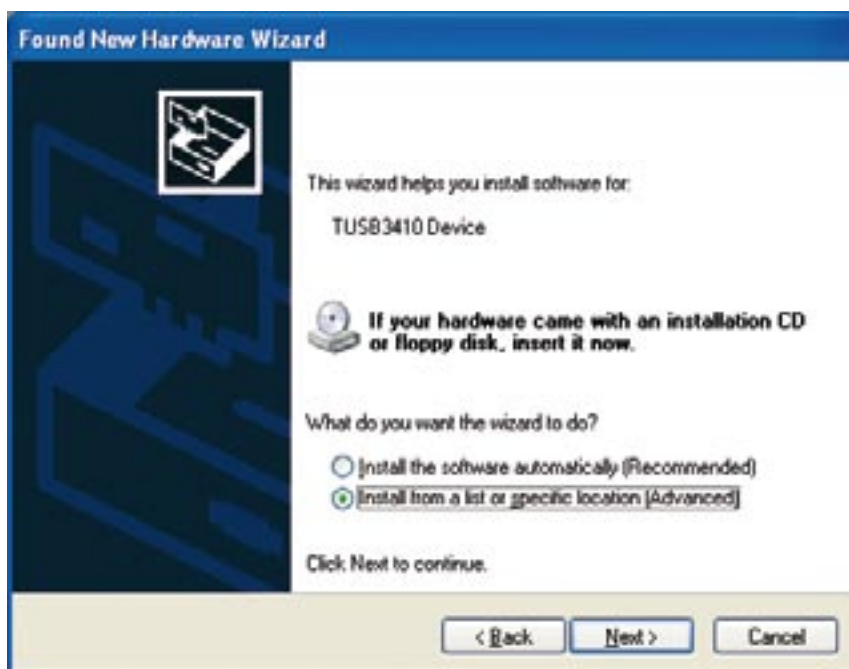


DEWE-GPS-CLOCK

Power the DEWE-GPS-CLOCK and connect it to the DAQ-System via USB.
When the hardware screen appears, select “No, not this time”

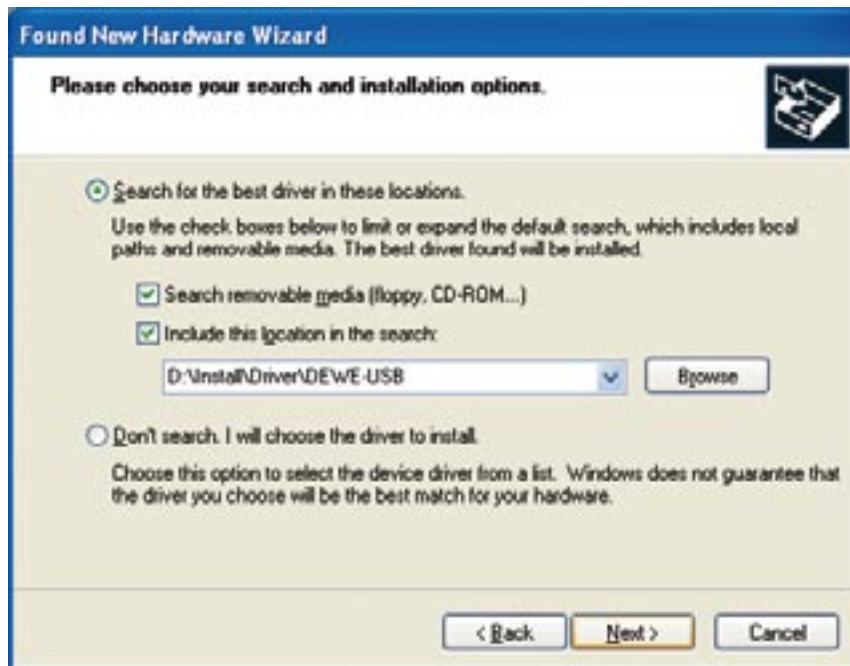


Select “Install from a list or a specific location”



DEWE-GPS-CLOCK

Choose the DEWE-USB folder from the DEWETRON-System-DVD
(D:\Install\Drivers\7_Communication\DEWE-USB)



When prompted for the driver installation, select "Continue Anyway"

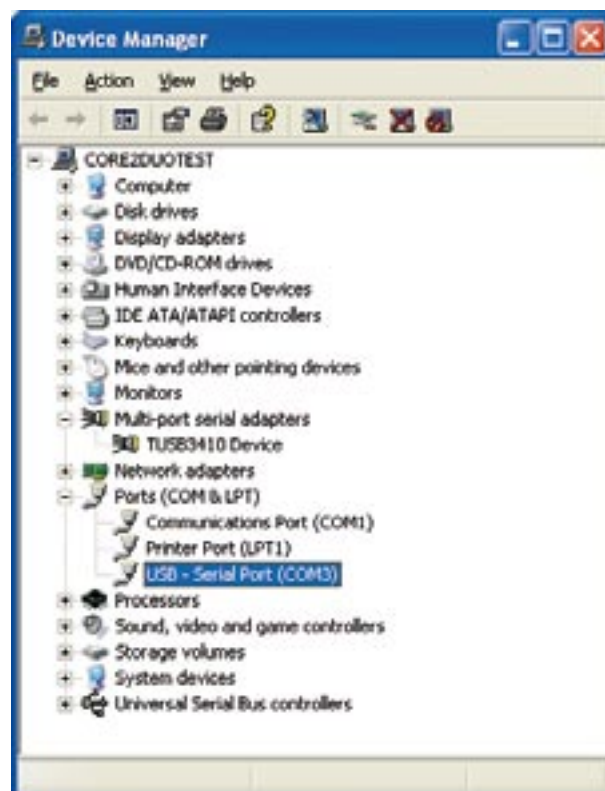


DEWE-GPS-CLOCK

To complete the driver installation click “Finish”



The Windows-Device-Manager should now show 2 new entries: (TUSB3410 Device and USB-Serial Port). Please note the COM port listed next to the “USB-Serial port” entry. This COM port is used for communicating with the DEWE-GPS-CLOCK when connected via USB.



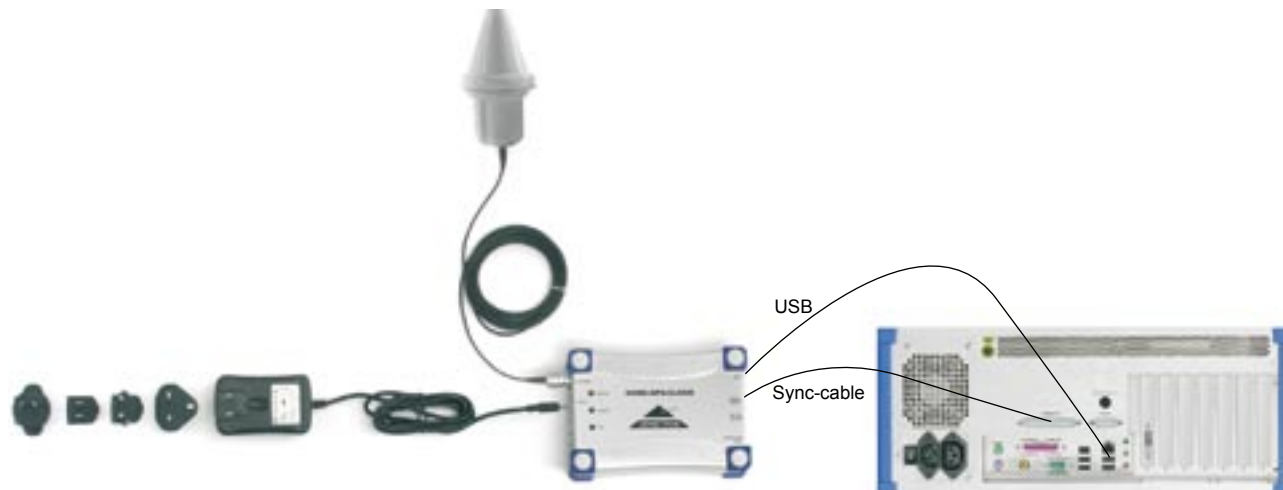
The driver has been successfully installed.

DEWE-GPS-CLOCK

Connecting the DEWE-GPS-CLOCK hardware to the DAQ-System

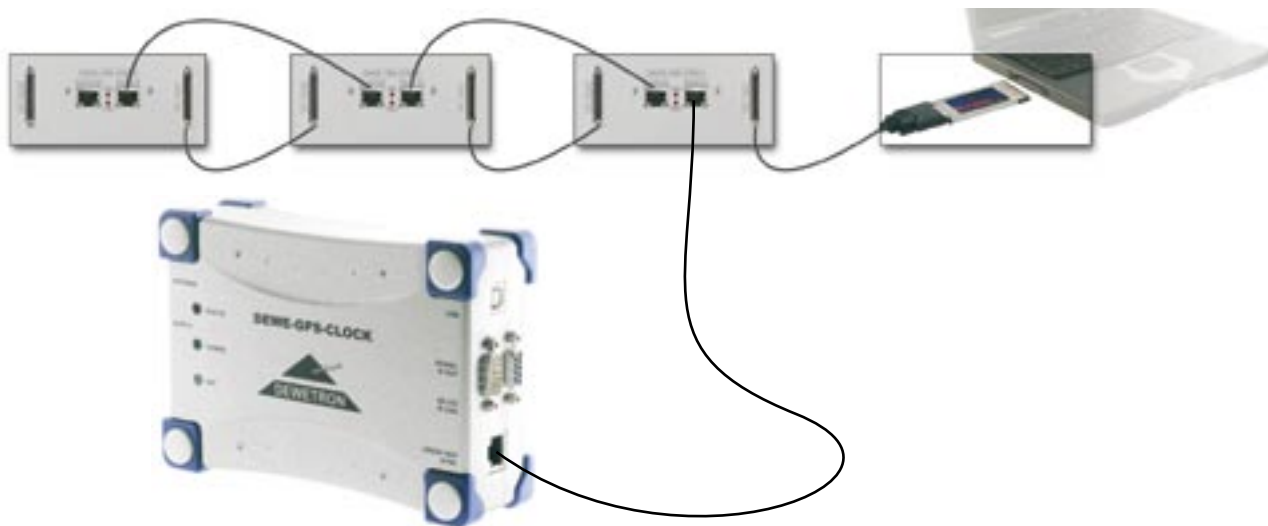
Synchronization to standard A/D-boards

To synchronize standard data acquisition systems a start trigger and the possibility of external clocking is required. Usually DEWETRON data acquisition systems are equipped with a 37-pin DSUB connector. This digital multi function connector contains the required clock and trigger input for easy connection to the clocking unit.



Synchronization to DEWE-ORION-1624

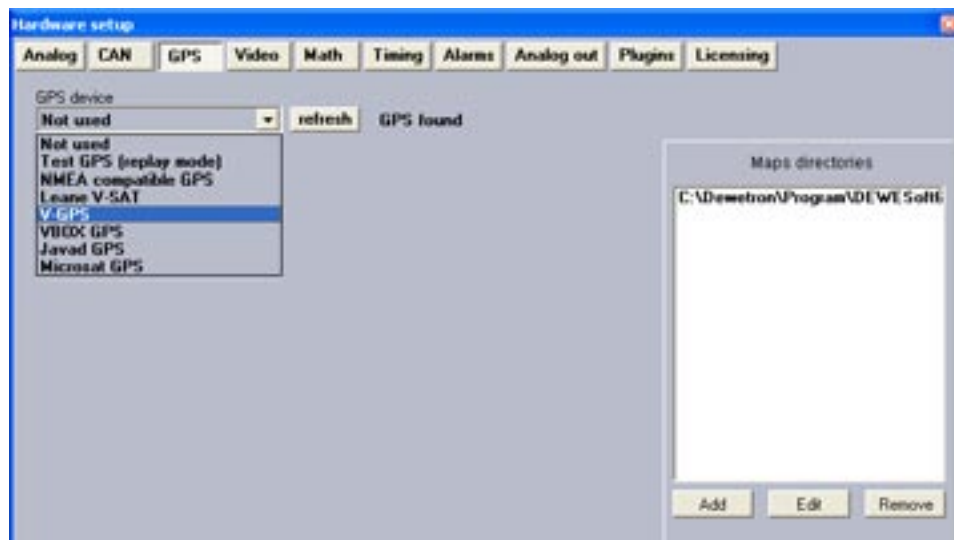
One of the unique features of the DEWE-GPS-CLOCK is the possibility to synchronize also data acquisition systems using delta sigma ADC technology like DEWE-ORION-1624. The main challenge is to produce the up to 256 times over sample clock used for these types of analog to digital converters. For this purpose the DEWE-GPS-CLOCK is equipped with a RJ45 connector for connection to the DEWETRON data acquisition system. A standard CAT5e or CAT6 Ethernet cable with up to 30 m can be used for connection.



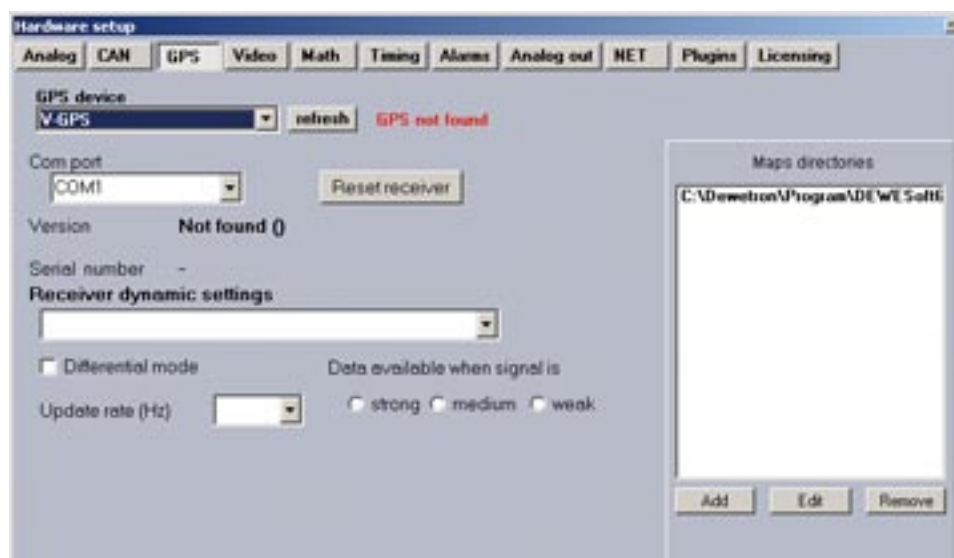
Please note: also the data acquisition has to be provided ORION-1624-SYNC option for having access to the synch bus of the board.

Configuration of DEWESoft for the DEWE-GPS-CLOCK

To unlock the GPS functionality in DEWESoft the GPS has to be configured in the Hardware Setup screen (System → Hardware Setup → GPS):

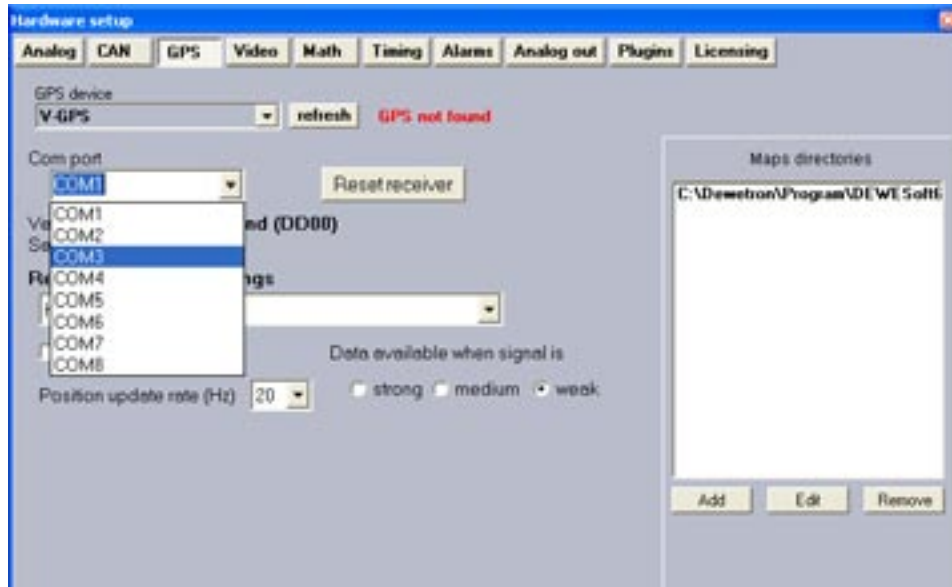


Select V-GPS from the GPS device dropdown menu. DEWESoft will automatically try to find a GPS on the standard COM port.



DEWE-GPS-CLOCK

If the GPS can not be found select the port where the GPS is connected from the COM port dropdown menu and hit the Refresh button. If the DEWE-GPS-CLOCK is connected to the DAQ-System via RS232 interface, select the onboard COM port (usually COM1 or COM2). If it is not connected via USB interface, select the COM port which is listed next to the entry "USB Serial port" in the Windows device manager (for further information please refer to the section: "Installation of the DEWE-GPS-CLOCK drivers").



DEWE-GPS-CLOCK

GPS device

A list of the supported GPS systems. Select the GPS device.

Com port

Communication port selection COM1 (standard setting) to COM8.

Version

Hardware version of the GPS system.

Serial number

Serial number of the connected GPS sensor. Serial number is recorded to reconstruct the measurement conditions.

Receiver setup

The “Reset receiver” button will reset the internally used receiver. This function has no influence on all settings below.

Maps directories

Select the directories, where you stored your maps. The standard setting is C:\Dewetron\Program\DEWESoft6\Maps. You can copy your maps into this directory, add individual directories or remove unused directories from the box. Convert the maps to .jpg or .bmp format before selecting them.

Timing settings

Hardware setup

In addition to a high precision speed sensor the DEWE-GPS-CLOCK is also a high precision timing source for synchronized data acquisition. In this operation mode the DEWE-GPS-CLOCK generates the clock for the data acquisition system. Beside of generating a clock from of up to 10 MHz for data acquisition systems a clock engine for synchronized acquisition using DEWE-ORION-1624 is included also.

This operation mode needs to be enabled in the Hardware setup of DEWESoft: (System → Hardware Setup → Timing):

- Select DEWE-GPS-CLOCK from the Timing device dropdown menu.



DEWE-GPS-CLOCK

Max. frequency

The maximum output frequency of the DEWE-GPS-CLOCK is 10 MHz for standard clock output and 200 kHz for DEWE-ORION-1624 operation.

Number of clocks

If a DEWE-ORION-1624 is installed one synchronized clock source is available for clocking the A/D board. In the standard operation mode a second clock source is available (reserved for future use).

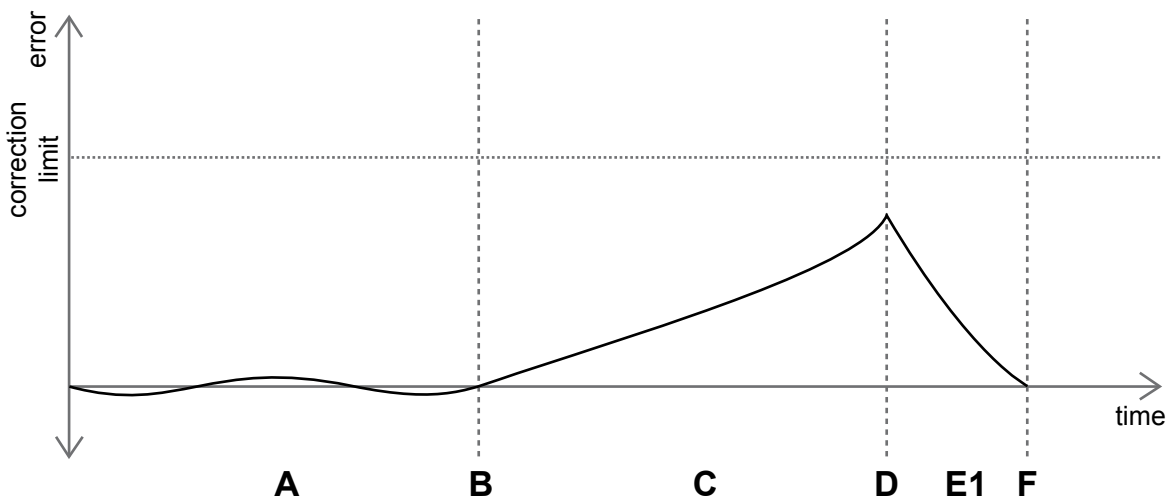
Correction limit

For synchronizing the internal oscillator with the PPS signal at least 4 satellites are required. If the GPS signal is lost during acquisition the DEWE-GPS-CLOCK continues sourcing the data acquisition system with a precision clock source. Without synchronising to the GPS signal, the oscillator may drift. Therefore the absolute time synchronisation can not be guaranteed anymore. However, as soon the GPS signal is available again, the GPS-CLOCK recognizes a possible drift and tries to correct this inaccuracy. If the drift during the free-run time is higher than the defined "Correction limit", a new data file is automatically generated with exact time stamping.

The maximum allowed correction limit is 500 ms.

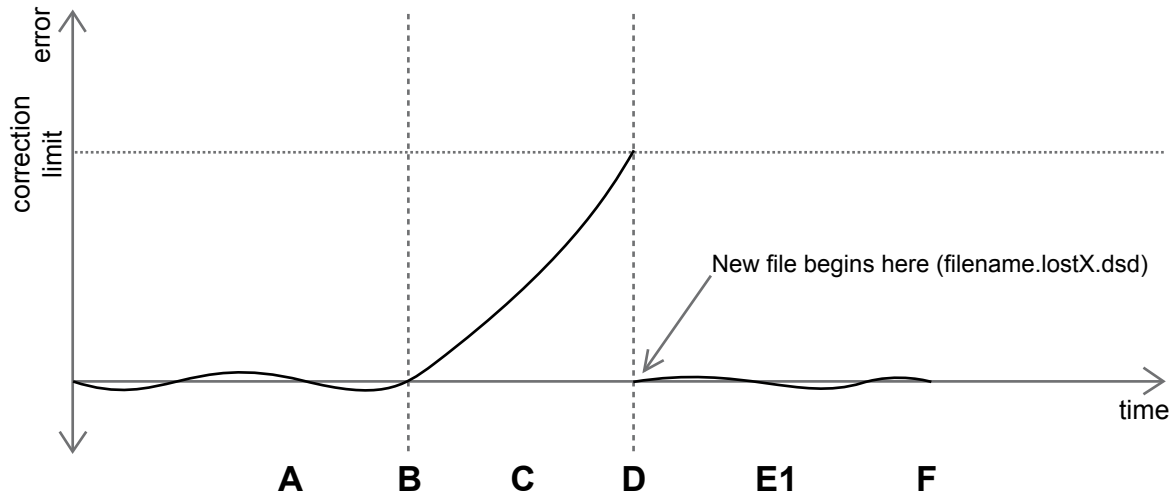
The graph below gives an idea how the DEWE-GPS-CLOCK behaves when the GPS signal is lost during data acquisition. In this example the drift of the oscillator is smaller than the allowed correction limit.

- A) This state shows the normal operation. The internal clock is synchronized to the GPS once per second.
- B) At this point the number of acquired satellites is lower than 4. The unit stops automatically locking for the GPS time.
- C) In the free-run operation the oscillator drift is obvious.
- D) After receiving again the GPS signal the error during the free run cycle is calculated.
- E1) Because the oscillator drift is smaller than the defined correction limit the DEWE-GPS-CLOCK automatically corrects the drift for getting again time synchronized data. So the data acquisition is not interrupted although the GPS signal was lost. The correction is done with the maximum rate of 5 $\mu\text{s}/\text{sec}$.



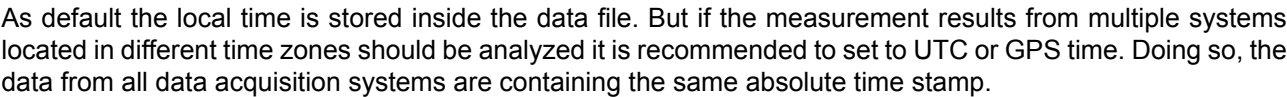
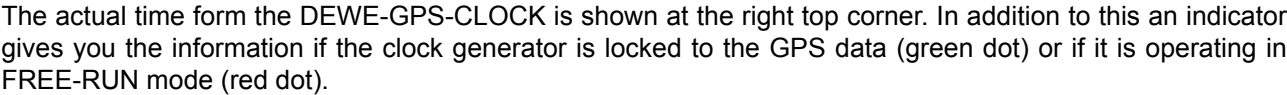
DEWE-GPS-CLOCK

But if the interrupt is too long the oscillator drift may be higher than the defined correction limit. In this case automatically the existing data file is closed and a new file is generated with adding "Lost" of the current filename: "DataFilenameLostX" where X is a running number for each GPS signal lost.

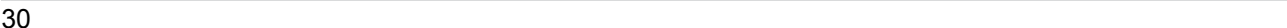


As soon the timing device is selected DEWESoft automatically sets the data acquisition hardware to external clocking for receiving the sample frequency out of the DEWE-GPS-CLOCK. In addition to this each measurement starts synchronized with the PPS signal. The time information of the data file is taken out of the GPS-time and not anymore from the local PC time.

When you finished the hardware settings, click on the “Setup” button.



General settings



Channel Setup

The screenshot below shows the channel setup screen of the DEWE-GPS-CLOCK. In the column *ON/OFF* you can select the channels for storing during the measurement. The default channel names are displayed in the column *NAME*. You can change them with a double click on it. Beside the channel names the actual value is displayed.



- X absolute: Longitude component of position in degrees, minutes and fraction of minutes
- Y absolute: Latitude component of position in degrees, minutes and fraction of minutes
- Z: Altitude in meters above sea level
- Velocity: Speed over ground (vector of all 3 dimensions)
- Velocity Z: Vertical component of the speed vector
- Direction: True track over ground
- Distance: Integration of speed for getting the displacement. Only speed levels above 0.5 km/h are used to calculate the distance
- Used sat.: Numbers of satellites used for calculation of position and speed

The circle at the left bottom corner gives an overview of the satellites in view of the GPS receiver and which of them are used from the receiver. The color of the shown satellites indicates the signal strength of them. From grey to dark green which is the strongest density. Satellites shown in the centre of the circle are directly above the GPS-aerial. Satellites shown at the border of the circle are near the horizon.

The field <PPS sync> and <Differential mode> change their color from grey to green depending if the appropriate feature is available at the moment (green means available).

The PPS synch is used for hardware synchronisation to analog channels. This will eliminate the time shift caused due to the calculation time of the GPS receiver and of the data transfer time of the RS-232 port.

DEWE-GPS-CLOCK

Notes

EC-Certificate of conformity

EC-Certificate of conformity

Manufacturer: **DEWETRON Elektronische Messgeraete Ges.m.b.H.**

Address: **Parkring 4
A-8074 Graz-Grambach Austria**

Tel.: +43 316 3070 0

Fax: +43 316 3070 90

e-mail: sales@dewetron.com

<http://www.dewetron.com>

Name of product:

DEWE-GPS-CLOCK

Kind of product:

GPS synchronized time base generator

The product meets the regulations of the following EC-directives:

73/23/EEC

"Directive on the approximation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits amended by the directive 93/68/EEC"

89/336/EEC

"Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility amended by the directives 91/263/EEC, 92/31/EEC, 93/68/EEC and 93/97/EEC"

The accordance is proved by the observance of the following standards:

L V E M C	Safety	IEC/EN 61010-1:1992/93 IEC/EN 61010-2-031	IEC 61010-1:1992/300 V CATIII Pol. D. 2 IEC 1010-2-031
	Emissions	EN 61000-6-4	EN 55011 Class B
	Immunity	EN 61000-6-2	Group standard

Graz, October 14, 2008

Place / Date of the CE-marking


Dipl.-Ing. Roland Jeutter / Managing director

Notes
