

# DS-GPS-CLOCK

## TECHNICAL REFERENCE MANUAL

DS-GPS-CLOCK V23-1



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## 2. About this document

### 2.1. Legend

The following symbols and formats will be used throughout the document.



#### **Important**

It gives you important information about the subject.  
Please read carefully!



#### **Hint**

It gives you a hint or provides additional information about a subject.



#### **Example**

Gives you an example of a specific subject.

## 3. Specifications

IRIG Input Specifications		
Supported codes	IRIG code A or B / AM or DC	
Compatibility (AM code)	0.5 Vpp to 10 Vpp	
Ratio (AM)	3:1 ±10 %	
Compatibility (DC code)	DC Level Shift TTL / CMOS compatible	
Impedance	20 kΩ	
Isolation	150 VDC	
Trigger accuracy	1 μsec	
IRIG output specifications		
Supported codes	IRIG code B, DC	
Isolation	None	
Accuracy	< 1 μsec (delay to GPS PPS)	
GPS specifications		
General	12 channel, L1 frequency receiver	
PPS accuracy	100 ns	
Refresh rate	1 Hz	
Position accuracy	Horizontal CEP	
	Autonomous	3.0 m
	Differential	1.0 m
Trigger accuracy	1 μsec	
System specifications		
Clock accuracy locked	without drift	
Clock accuracy unlocked	< 10 ppm	
Input	SMA for GPS antenna, BNC for IRIG I/O	
Output: Trigger:	Clock and Trigger for DAQ-systems on DB9 connector PPS (pulse per second), rising edge on time, 75 msec high time, TTL level compatible 10 Hz to 10 MHz, rising edge synchronized, 50 % duty cycle, TTL level compatible.	
Power supply	USB powered, max. current 500 mA	
Environmental specifications		

Operation temperature	-5 °C to +70 °C
Storage temperature	-20 °C to +85 °C
Humidity	10 % to 80 %; non condensing
Dimensions (W x D x H)	133 x 104 x 43 mm (5.23 x 4.1 x 1.7 in.)
Weight	approx. 330 g (0.72 lb)

### 3.1. Shock & Vibration

Property	Vibration Test		Shock Test
European Standard	EN 600068-2-6	EN 60721-3-2 Class 2M2	EN 60068-2-27
Shape	Sine	Random	Half-sine
Frequency	0 Hz to 150 Hz	10 - 200 Hz	
Power spectral density	1 m/s <sup>2</sup> / Hz from 10 – 200 Hz	1 m/s <sup>2</sup> / Hz from 10 – 200 Hz	
Acceleration amplitude			15 g
Duration	30 Minutes per axis	30 Minutes per axis	11 ms
Test in 3 axis, 3 shocks in each axis and direction			

## 4. Device overview

The DS-GPS-CLOCK is a synchronized time base generator capable of using either GPS or IRIG as a time source. This allows completely synchronized data acquisition of multiple systems whether they are mobile or stationary. Additionally, the DS-GPS-CLOCK can also be used as an IRIG time code generator (output IRIG B/DC) synchronized to the GPS time.

The diagram below outlines the basic functionality of the DS-GPS-CLOCK:

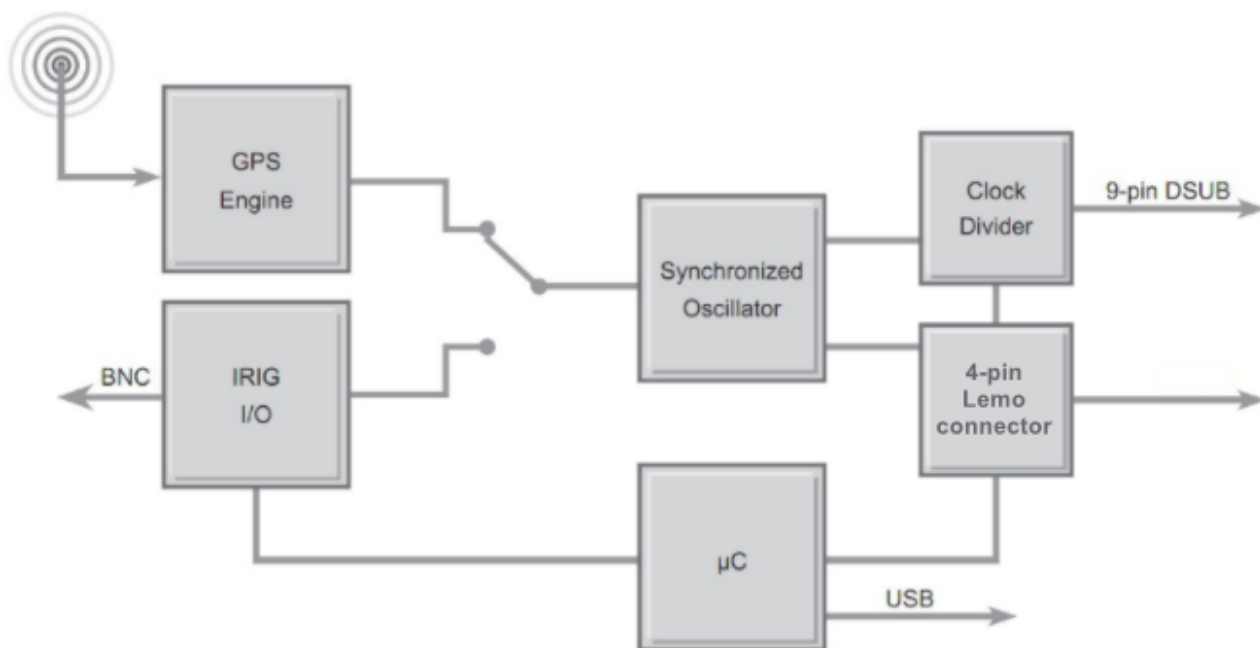


Image 1: Block Diagram

## 4.1. GPS based operation

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 standard data acquisition system which is being output on the 9-pin DSUB connector or 4-pin Lemo connector.

## 4.2. IRIG based operation

The IRIG signal contains the binary-coded time (year, day of year, hours, minutes, seconds, fractions of a second) modulated on a sine wave carrier. This signal is decoded to the PPS and the drift-free 40 MHz clock.

The following IRIG time codes are supported:

- IRIG-A (10 Hz)
- IRIG-B (1 Hz)

## 4.3. LED Description

### 4.3.1. Power

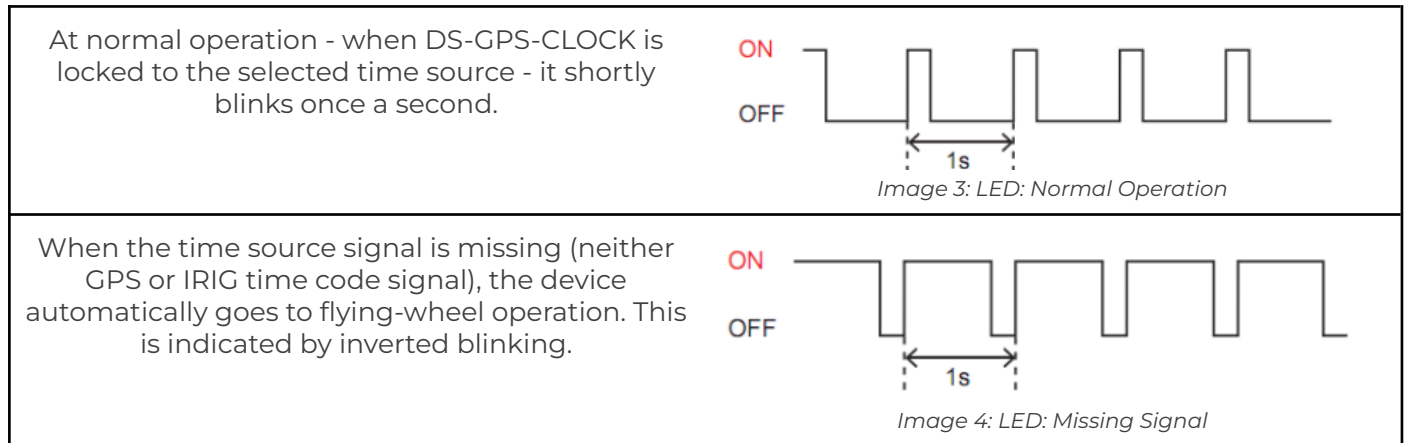
The power LED is solid green when the DS-GPS-CLOCK is in normal operation.



*Image 2: LED lights*

### 4.3.2. Status

The status LED indicates the current status of the device:



### 4.4. Mounting the aerial

The aerial supplied with the DS-GPS-CLOCK is designed to be mounted magnetically on any metallic surface. The cable length is 5 m.

Please contact your sales manager if your application requires a different aerial.

### 4.5. Warm-Up time

When the DS-GPS-CLOCK is used as a GPS based time code generator 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 so that 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.

## 4.6. Scope of supply

When ordering the DS-GPS-CLOCK the following supply is also included in the package:

- 0.5m 4-pin sync cable, for the synchronization of the system (*LEMO SYNC-CBL FGG00050.0500N2 2xFGG.00.304.CLAD35ZN 0,5m*)
- USB-mini cable for connecting the device to the SBOX or PC (*CABLE-USBAmiini-USBBS-1.8m*)
- CABLE-GLONASS-RG174-ANTENNA-5m (*GLONASS,5M RG174 2J7501MP ANTENA*)

## 4.7. Connection

### 4.7.1. Front Connectors



Image 5: Front connectors

#### 4.7.1.1. LEDs

See chapter [LED Description](#)

4.7.1.2 Aerial connector

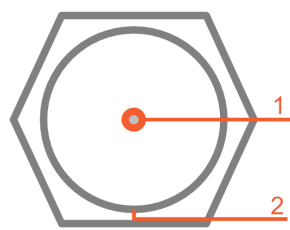


Image 6: SMA connector

Pin	Description
1	Hot
2	shield

4.7.1.3 IRIG connector

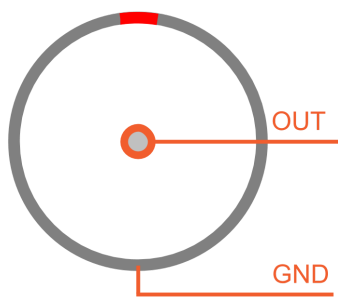


Image 7 : BNC connector

Pin	Description
1	out
2	GND

## 4.7.2. Rear Connectors



*Image 8: Rear Connectors*

4.7.2.1. Multi I/O Connector

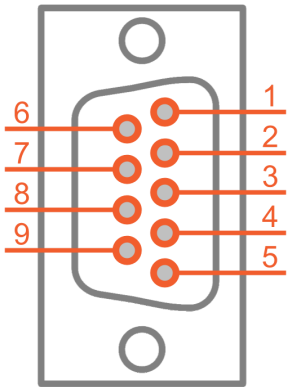


Image 9: DSUB-9 male connector

Pin	Name	Description
1	n.c.	Not Connected
2	n.c.	Not Connected
3	CLK OUT	Scan clock output
4	n.c.	Not Connected
5	n.c.	Not Connected
6	PPS	Pulse Per Second
7	n.c.	Not Connected
8	DGND	Ground
9	n.c.	Not Connected

Multi I/O Cable

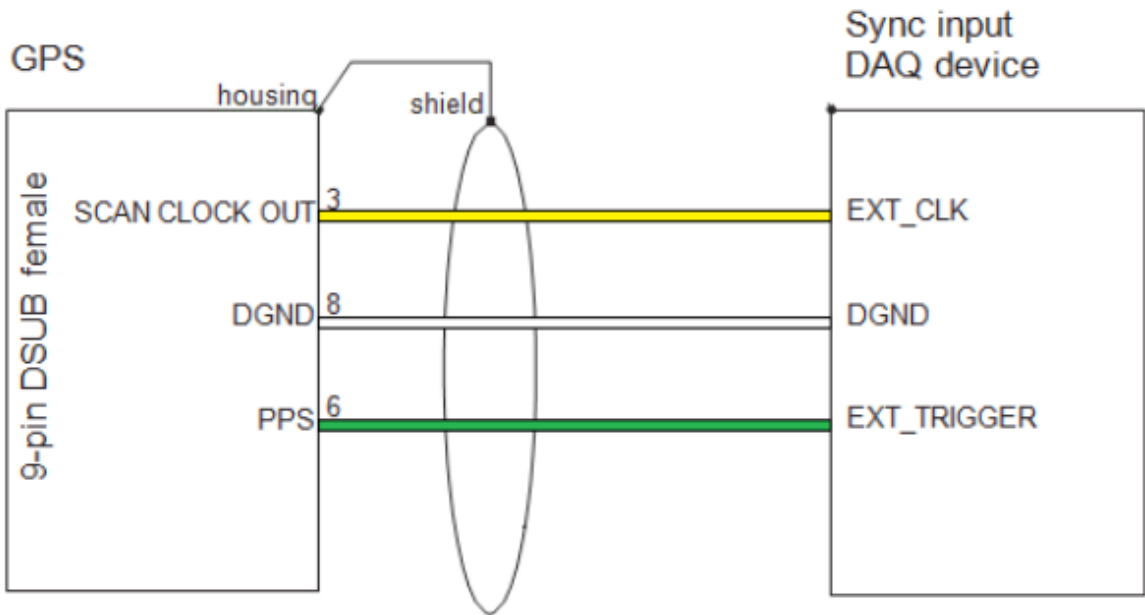
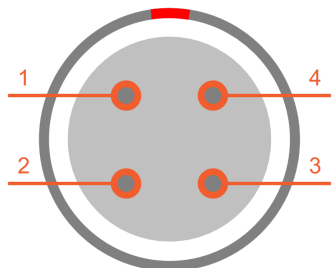


Image 10: MULTI I/O cable

#### 4.7.2.2. SYNC connector



*Image 11: Sync connector: pin-out (4-pin LEMO female)*

Pin	Name	Description
1	CLK	Clock
2	Trigg	Trigger
3	GPS-PPS	GPS - PPS
4	DGND	Digital Ground

Interface connector: EEG.00.304.CLL

Mating connector: FGG.00.304.CLAD27Z

## 4.8. Installation

The hardware drivers for the DS-GPS-CLOCK are automatically installed together with DewesoftX®. There is no additional SW needed. You can start the software in the Windows start menu or use the icon created on your desktop. For more information about the DewesoftX® installation please refer to the DewesoftX® Software User's Manual.

## 4.9. Connecting the DS-GPS-CLOCK to the DAQ-System

### 4.9.1. Synchronization to system with Clock and Trigger

To synchronize standard data acquisition systems a start trigger and the possibility of external clocking is required. This input needs to be connected to the output of the DS-GPS-CLOCK sync signals of the 9-pin DSUB female (signal Scan Clock Output and PPS).

## 4.10. Configuration of DewesoftX® for the DS-GPS-CLOCK

When the DS-GPS-CLOCK is connected it will be automatically recognized in DewesoftX® Device settings menu:

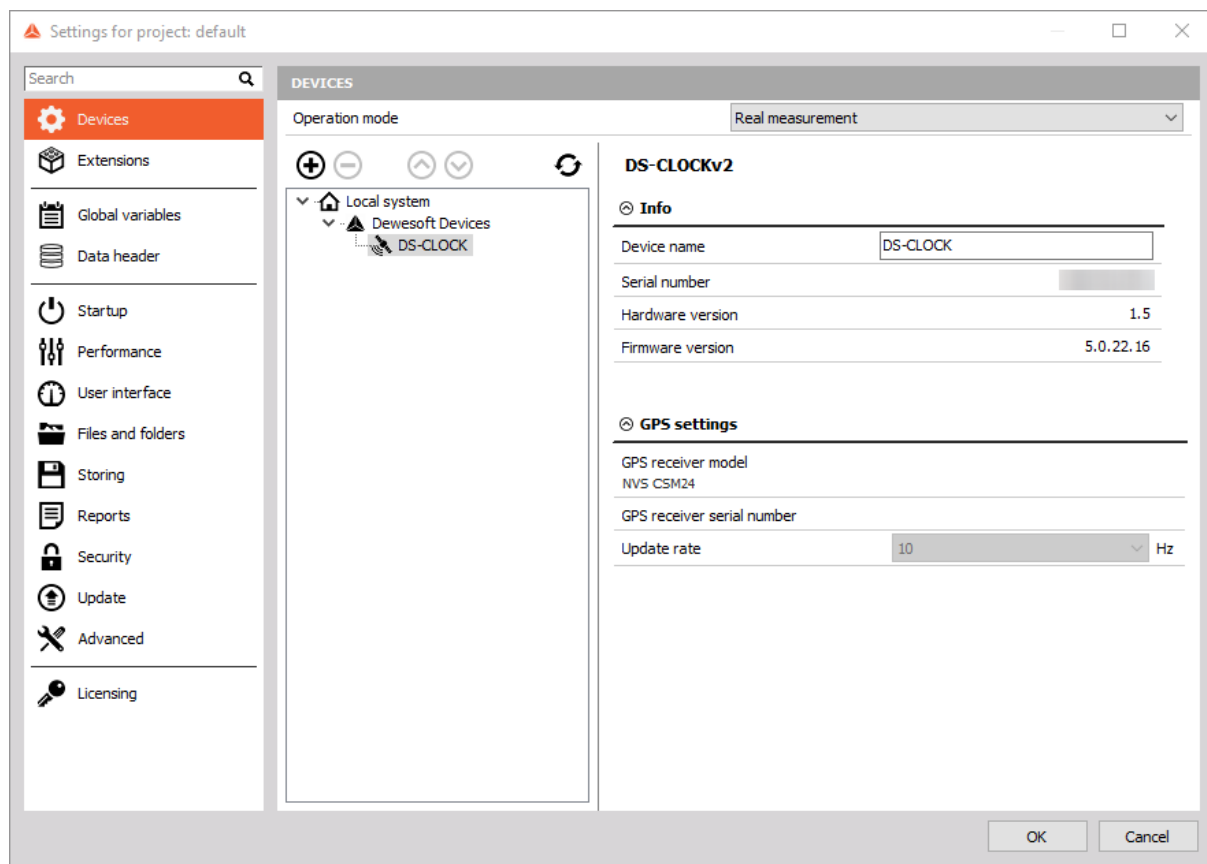


Image 12: DewesoftX® device settings

### 4.10.1. Update rate

The update rate is fixed at 1 Hz.

### 4.10.2. Maps directories

Select the directories, where you stored your 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.

### 4.10.3. Timing settings

When you want to use the DS-GPS-CLOCK as a high precision timing device for synchronized data acquisition, you need set the Time source as External.

a.) IRIG input

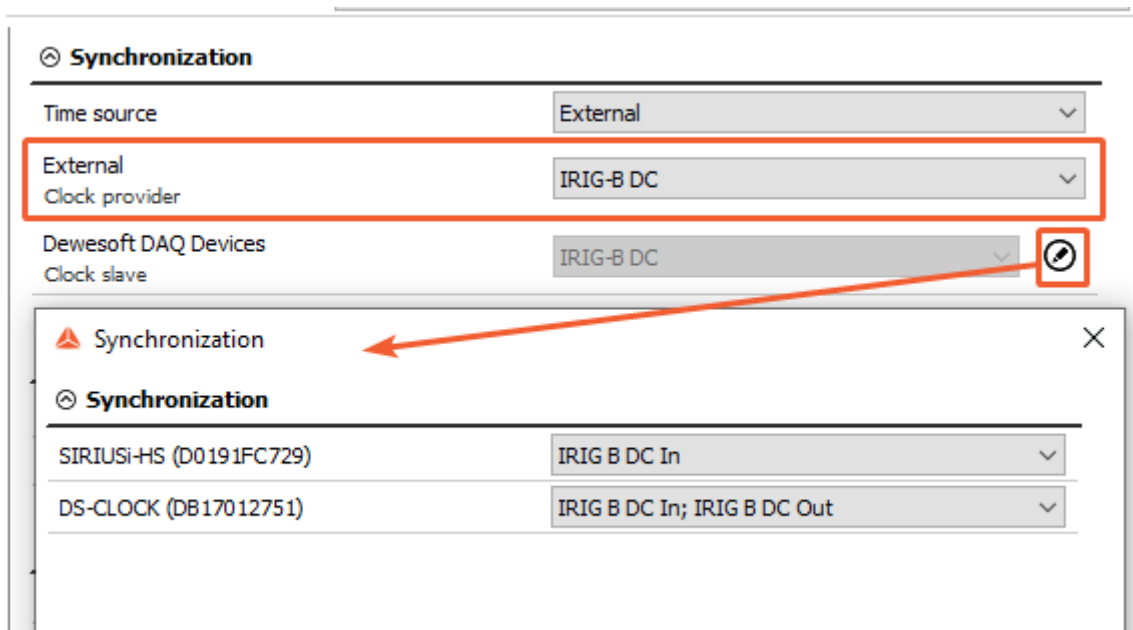


Image 13: IRIG as external source

b.) GPS input

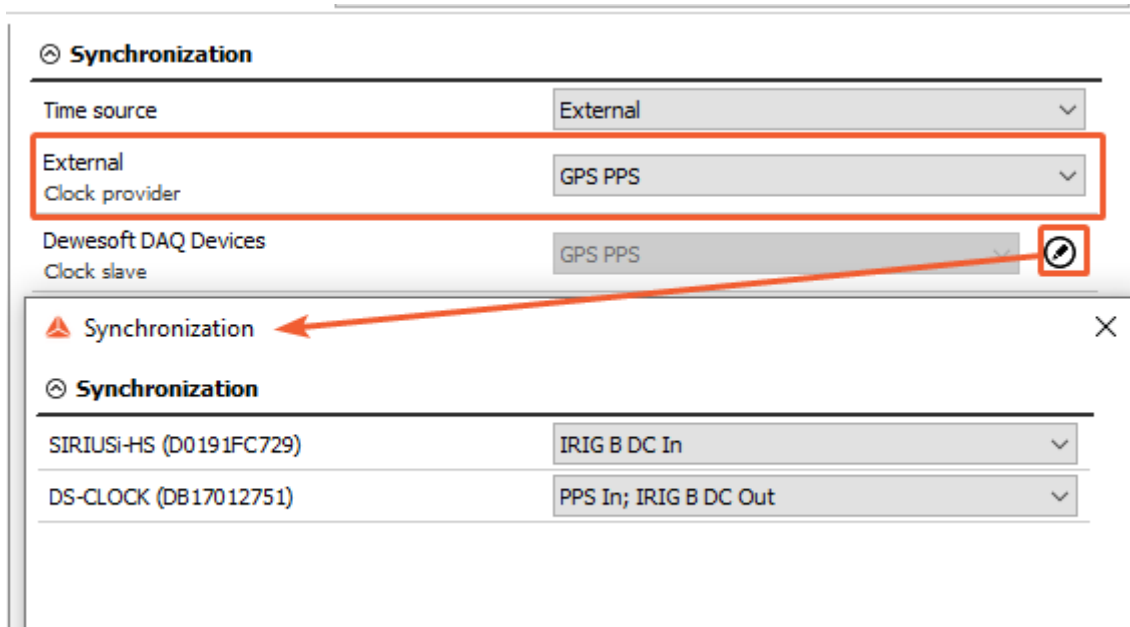


Image 14: GPS as external source

#### 4.10.3.1. Input settings

##### **Time source**

Here you can select which input signal (GPS or IRIG) is used for the time source.

##### **Code type**

If IRIG mode is selected as a time source, this drop-down menu defines the used code type (IRIG-A, IRIG-B or IRIG-G).

##### **Modulation**

This selects the modulation type (AC or DC) of the IRIG input signal.

##### **Output settings**

The check-box "IRIG Out" enables the output of the internally generated IRIG signal on the BNC connector of the DSCLOCK.

Please note that only IRIG-B with DC modulation is supported as output signal.

Set to default Button

This button defines the current input- and output settings as power on default settings. This way the DS-GPS-CLOCK will always start up with the predefined settings. The 'power on default' function is available only in Dewesoft7.

## 4.11. Channel setup

The screenshot below shows the channel setup screen of the DS-GPS-CLOCK when it was selected as a GPS device. 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.

ID	Used	C	Name	Description	Value	Unit	Setup
1	Unused		Longitude	-	15°3,312' E	'	Setup
2	Unused		Latitude	-	46°10,297' N	'	Setup
3	Unused		Z	-	340,26	m	Setup
4	Unused		Velocity	-	0	km/h	Setup
5	Unused		Direction	-	0	deg.	Setup
6	Unused		Distance	-	0,0	m	Setup
7	Unused		Used satellites	-	9	-	Setup
8	Unused		Current sec	-	11:13:32,2	-	Setup
9	Unused		GPS fix quality	-	Standalone	-	Setup
10	Unused		NMEALog	-	\$GPGGA,11133...		Setup

Image 15: Channel Setup

- Longitude component of position in degrees, minutes and fraction of minutes
- 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)
- 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
- Current sec: Seconds since midnight (UTC)
- GPS fix quality: To recognize in which mode the receiver is (Standalone, DGPS, RTK)
- NMEA: The raw NMEA string from the GPS receiver

The circle on the right gives an overview of the satellites in view of the GPS receiver and which of them are used from the receiver. The colour of the shown satellites indicates the signal strength of them. From grey to dark green which is the strongest signal. 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 <Not fixed> change their colour from grey to green depending if the appropriate feature is available at the moment (green means available).

The PPS sync is used for hardware synchronisation to analogue channels. This will eliminate the time shift caused due the calculation time of the GPS receiver and of the data transfer time of the USB interface.

The button “NMEA log” shows/hides the raw NMEA data stream from the GPS receiver.

## 4.12. Measurement setup

When the DS-GPS-CLOCK is used as a timing device and you switch to the measurement screen you will see the actual time from the DS-GPS-CLOCK shown in the top right corner of the screen. A green clock next to this time indicates that the DS-GPS-CLOCK is locked to the GPS or IRIG time whereas a red clock with additional Sync Lost warning indicates that the DS-GPS-CLOCK does not have any real input.

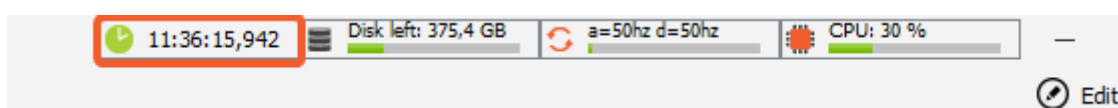


Image 16: sync OK

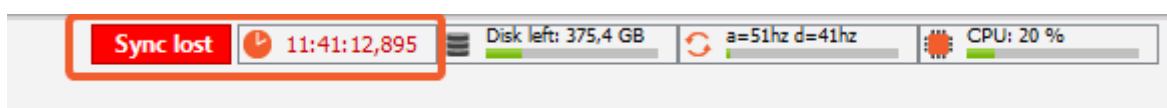


Image 17: sync lost

By default the local time is stored inside the data file, but if the measurement results from multiple systems located in different time zones should be analysed it is recommended to set to UTC or GPS time (Local time in settings). This can be done in the Global settings of DewesoftX® (Settings Global settings Displays). Doing so, the data from all data acquisition systems are containing the same absolute time stamp.

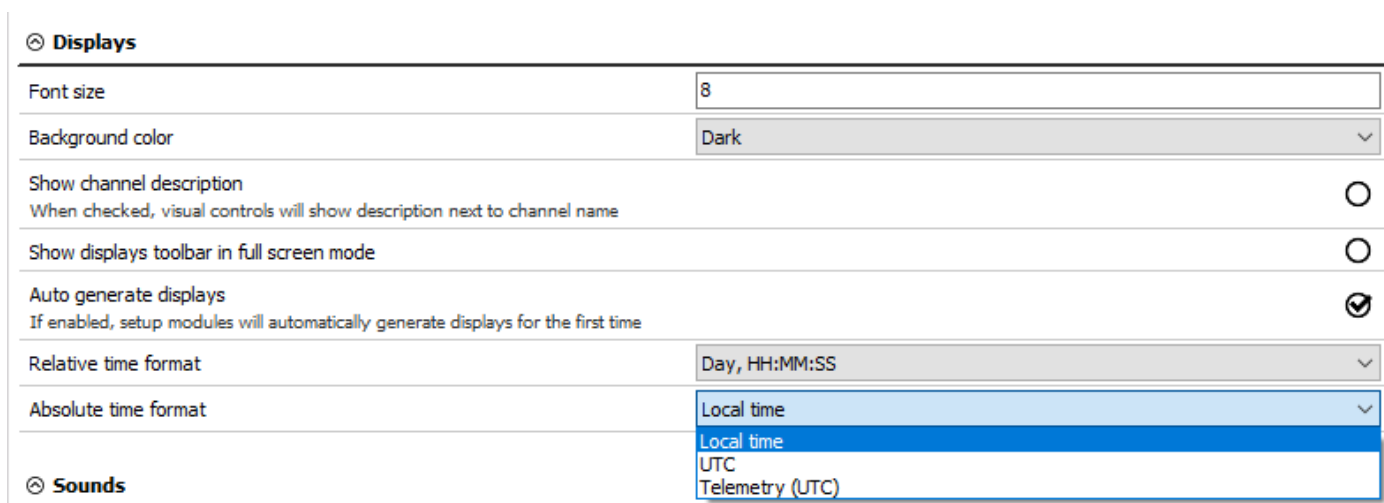


Image 18: Global Time Settings

## 4.13. Time code restore

For synchronizing the internal oscillator with the PPS signal at least 4 satellites are required. If the GPS or IRIG signal is lost during acquisition the DS-GPS-CLOCK continues sourcing the data acquisition system with a precision clock source. Without synchronising to the GPS or IRIG signal, the oscillator may drift. Therefore the absolute time synchronisation cannot be guaranteed any more. However, as soon as the GPS or IRIG signal is available again, the DS-GPS-CLOCK recognizes a possible drift and tries to correct this inaccuracy. If the drift during the free-run time is higher than 200 ms, a new data file is automatically generated with exact time stamping.

The graph below gives an idea how the DS-GPS-CLOCK behaves when the GPS or IRIG signal is lost during data acquisition. In this example the drift of the oscillator is smaller than the allowed 2 ms (fixed).

A) This state shows the normal operation. The internal clock is synchronized to the GPS/IRIG once per second.

B) At this point the time source signal is lost.

C) In the free-run operation the oscillator drift is obvious.

D) After the time source signal is received again, the error during the free run cycle is calculated.

E1) Because the oscillator drift is smaller than 200 ms, the DS-GPS-CLOCK automatically corrects the drift to get time synchronized data again. The data acquisition is not interrupted even though the time source signal was lost. The correction is done with the maximum rate of 5  $\mu\text{s}/\text{sec}$ .

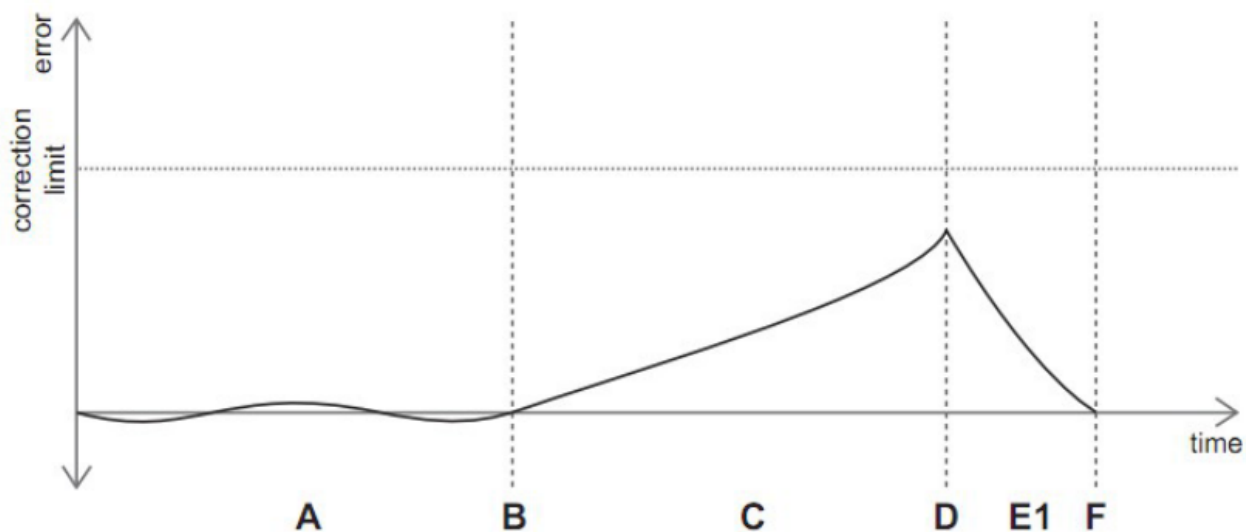
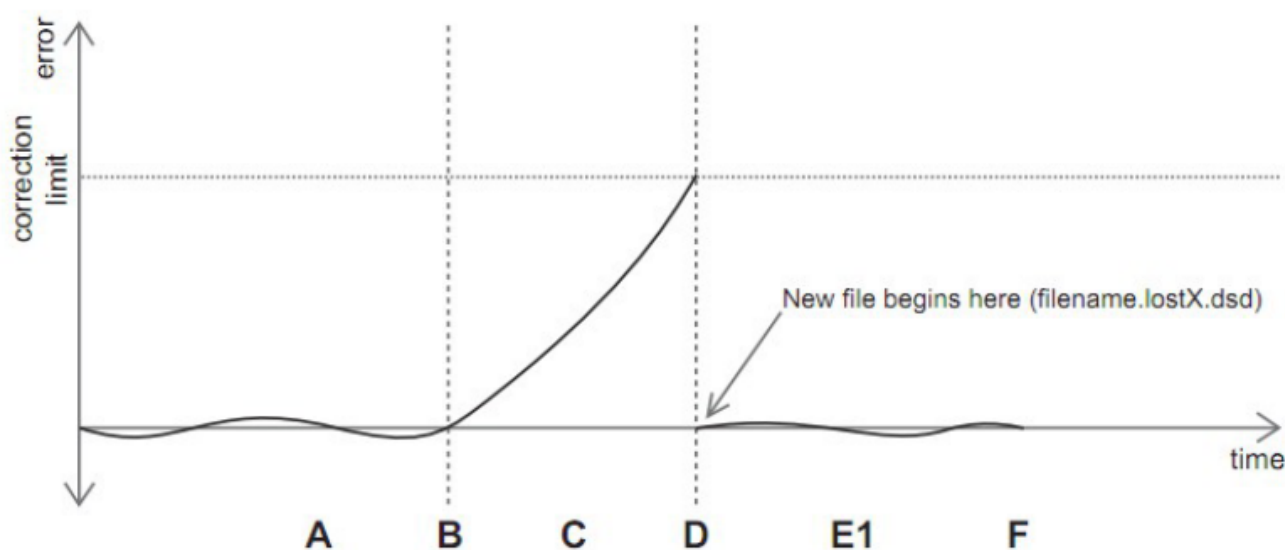


Image 19: Timing Correction

However if the time source signal is lost for too long, the oscillator drift may be higher than 200 ms. In this case, the existing data file is automatically closed and a new file is created. The word "Lost" and the running count of time source signal losses are appended to the new data file name.



*Image 20: Timing Correction Long*

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

## 5. Warranty information

### Notice

The information contained in this document is subject to change without notice.

### Note:

Dewesoft d.o.o. shall not be liable for any errors contained in this document. Dewesoft MAKES NO WARRANTIES OF ANY KIND WITH REGARD TO THIS DOCUMENT, WHETHER EXPRESS OR IMPLIED. DEWESOFT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Dewesoft shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory, in connection with the furnishing of this document or the use of the information in this document.

The copy of the specific warranty terms applicable to your Dewesoft product and replacement parts can be obtained from your local sales and service office. To find a local dealer for your country, please visit <https://dewesoft.com/support/distributors>.

### 5.1. Calibration

Every instrument needs to be calibrated at regular intervals. The standard norm across nearly every industry is annual calibration. Before your Dewesoft data acquisition system is delivered, it is calibrated. Detailed calibration reports for your Dewesoft system can be requested. We retain them for at least one year, after system delivery.

### 5.2. Support

Dewesoft has a team of people ready to assist you if you have any questions or any technical difficulties regarding the system. For any support please contact your local distributor first or Dewesoft directly.

Dewesoft d.o.o.  
Gabrsko 11a  
1420 Trbovlje Slovenia

Europe Tel.: +386 356 25 300

Web: <http://www.dewesoft.com>

The telephone hotline is available Monday to Friday from 07:00 to 16:00 CET (GMT +1:00)

### 5.3. Service/repair

The team of Dewesoft also performs any kinds of repairs to your system to assure a safe and proper operation in the future. For information regarding service and repairs please contact your local distributor first or Dewesoft directly on <https://dewesoft.com/support/rma-service>.

### 5.4. Restricted Rights

Use Slovenian law for duplication or disclosure. Dewesoft d.o.o. Gabrsko 11a, 1420 Trbovlje, Slovenia / Europe.

### 5.5. Printing History

Version 2.0.0, Revision 217 Released 2015 Last changed: 23. July 2018 at 16:54.

## 5.6. Copyright

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## 5.7. Trademarks

We take pride in our products and we take care that all key products and technologies are registered as trademarks all over the world. The Dewesoft name is a registered trademark. Product families (KRYPTON, SIRIUS, DSI, DS-NET) and technologies (DualCoreADC, SuperCounter, GrandView) are registered trademarks as well. When used as the logo or as part of any graphic material, the registered trademark sign is used as a part of the logo. When used in text representing the company, product or technology name, the ® sign is not used. The Dewesoft triangle logo is a registered trademark but the ® sign is not used in the visual representation of the triangle logo.

# 6. Safety instructions

Your safety is our primary concern! Please be safe!

## 6.1. Safety symbols in the manual



### Warning

Calls attention to a procedure, practice, or condition that could cause the body injury or death



### Caution

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

## 6.2. General Safety Instructions



### Warning

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. Dewesoft d.o.o. assumes no liability for the customer's failure to comply with these requirements.

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

### 6.2.1. Environmental Considerations

Information about the environmental impact of the product.

### 6.2.2. Product End-of-Life Handling

Observe the following guidelines when recycling a Dewesoft system:

### 6.2.3. System and Components Recycling

Production of these 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 its end of life! Please recycle this product in an appropriate way to avoid 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 information about recycling on the Dewesoft web site [www.dewesoft.com](http://www.dewesoft.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. However, we take care of our environment and the product is lead-free.

### 6.2.4. General safety and hazard warnings for all Dewesoft systems

Safety of the operator and the unit depend on following these rules.

- Use this system under the terms of the specifications only to avoid any possible danger.
- Read your manual before operating the system.
- Observe local laws when using the instrument.
- DO NOT touch internal wiring!
- DO NOT use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- You may not connect higher voltages than rated to any connectors.
- The power cable and connector serve as Power-Breaker. The cable must not exceed 3 meters, the disconnect function must be possible without tools.
- Maintenance must be executed by qualified staff only.
- During the use of the system, it might be possible to access other parts of a more comprehensive system. Please read and follow the safety instructions provided in the manuals of all other components regarding warning and security advice for using the system.
- With this product, only use the power cable delivered or defined for the host country.
- DO NOT connect or disconnect sensors, probes or test leads, as these parts are connected to a voltage supply unit.
- 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.
- Please note the characteristics and indicators on the system to avoid fire or electric shocks. Before connecting the system, please read the corresponding specifications in the product manual carefully.

- The inputs must not, unless otherwise noted (CATx identification), be connected to the main circuit of category II, III and IV.
- The power cord separates the system from the power supply. Do not block the power cord, since it has to be accessible for the users.
- DO NOT use the system if equipment covers or shields are removed.
- If you assume the system is damaged, get it examined by authorized personnel only.
- Adverse environmental conditions are Moisture or high humidity Dust, flammable gases, fumes or dissolver Thunderstorm or thunderstorm conditions (except assembly PNA) Electrostatic fields, etc.
- The measurement category can be adjusted depending on module configuration.
- Any other use than described above may damage your system and is attended with dangers like short-circuiting, fire or electric shocks.
- The whole system must not be changed, rebuilt or opened.
- 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 the safe operation can be verified by service-trained personnel. If necessary, return the product to Dewesoft sales and service office for service and repair to ensure that safety features are maintained.
- If you assume a more riskless use is not provided anymore, the system has to be rendered inoperative and should be protected against inadvertent operation. It is assumed that a more riskless operation is not possible anymore if the system is damaged obviously or causes strange noises. the system does not work anymore. The system has been exposed to long storage in adverse environments. the system has been exposed to heavy shipment strain.
- Warranty void if damages caused by disregarding this manual. For consequential damages, NO liability will be assumed!
- Warranty void if damage to property or persons caused by improper use or disregarding the safety instructions.
- Unauthorized changing or rebuilding the system is prohibited due to safety and permission reasons (CE).
- Be careful with voltages >25 VAC or >35 VDC! These voltages are already high enough in order to get a perilous electric shock by touching the wiring.
- The product heats during operation. Make sure there is adequate ventilation. Ventilation slots must not be covered!
- Only fuses of the specified type and nominal current may be used. The use of patched fuses is prohibited.
- Prevent using metal bare wires! Risk of short circuit and fire hazard!
- DO NOT use the system before, during or shortly after a thunderstorm (risk of lightning and high energy over-voltage). An advanced range of application under certain conditions is allowed with therefore designed products only. For details please refer to the specifications.
- Make sure that your hands, shoes, clothes, the floor, the system or measuring leads, integrated circuits and so on, are dry.
- DO NOT use the system in rooms with flammable gases, fumes or dust or in adverse environmental conditions.
- Avoid operation in the immediate vicinity of high magnetic or electromagnetic fields, transmitting antennas or high-frequency generators, for exact values please refer to enclosed specifications.
- Use measurement leads or measurement accessories aligned with the specification of the system only. Fire hazard in case of overload!

- Do not switch on the system after transporting it from a cold into a warm room and vice versa. The thereby created condensation may damage your system. Acclimatise the system unpowered to room temperature.
- Do not disassemble the system! There is a high risk of getting a perilous electric shock. Capacitors still might be charged, even if the system has been removed from the power supply.
- The electrical installations and equipment in industrial facilities must be observed by the security regulations and insurance institutions.
- The use of the measuring system in schools and other training facilities must be observed by skilled personnel.
- The measuring systems are not designed for use in humans and animals.
- Please contact a professional if you have doubts about the method of operation, safety or the connection of the system.
- Please be careful with the product. Shocks, hits and dropping it from already- lower level may damage your system.
- Please also consider the detailed technical reference manual as well as the security advice of the connected systems.
- This product has left the factory in safety-related flawlessness and in proper condition. In order to maintain this condition and guarantee safety use, the user has to consider the security advice and warnings in this manual.

#### EN 61326-3-1:2008

IEC 61326-1 applies to this part of IEC 61326 but is limited to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3.

The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1.

Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard, IEC 61326-3-1.

Devices and systems according to IEC 61508 or IEC 61511 which are considered as “operationally well-tried”, are excluded from the scope of IEC 61326-3-1.

Fire-alarm and safety-alarm systems, intended for the protection of buildings, are excluded from the scope of IEC 61326-3-1.

## 7. Document Version History

Revision number: 57

Last modified: Wed 04 Sep 2013, 11:02

Version	Date	Notes
1.0.0	04-09-2013	Initial version
V21-1	23-02-2021	Updated template
V23-1	29-05-2023	Power on default function