



Automotive
Energy & Power Analysis
Aerospace & Defense
Transportation
General Test & Measurement

DEWE-CLOCK

Technical reference manual



Test & Measurement Solutions



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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
08:00 and 17:00 GST (GMT -5:00)

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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 or IRIG synchronized time base generator

Features:

- Absolute time accurate, wireless synchronisation between data acquisition systems
- **Clock output:**
 - Output clock rate of up to 10 MHz
 - Synchronization of DEWE-ORION-DSA systems
 - Continuous synchronization to absolute GPS or IRIG time
 - Absolute long time stable
 - High frequency accuracy without GPS or IRIG (A/B) signal
- **GPS engine**
 - PPS accuracy of 250 ns
 - 1 Hz update rate
 - Supports differential GPS (SBAS)
- **IRIG engine**
 - PPS accuracy of 250 ns
 - IRIG-A/B DC/AC as input signal
 - IRIG-B/DC as output signal



Specifications

DEWE-CLOCK			
IRIG input specifications			
Supported codes:	IRIG code A or B; AM or DC		
Compatibility (AM code):	0.5 V _{pp} to 10 V _{pp}		
Ratio (AM):	3:1 ±10 %		
Compatibility (DC code):	DC Level Shift TTL / CMOS compatible		
Impedance:	20 kΩ		
Isolation	150 V _{DC}		
Trigger accuracy	1 μs		
IRIG output specifications			
Supported codes	IRIG code B, DC		
Isolation	None		
Accuracy	< 1 μs (delay to GPS PPS)		
GPS specifications			
General	12 channel, L1 frequency receiver		
PPS accuracy	100 ns		
Refreshrate	1 Hz		
Position accuracy	Horizontal CEP		
Autonomous	3.0 m		
Differential	1.0 m		
Trigger accuracy	1 μs		
System specifications			
Clock accuracy locked	without drift		Vibration test: Shape: Frequency: Power spectral density: Duration:
Clock accuracy unlocked	< 10 ppm		
Input	SMA for GPS antenna, BNC for IRIG I/O		EN 600068-2-6 Sine 10 Hz to 150 Hz
Output:	Clock and Trigger for DAQ-systems on DB9 connector		1 m/s² / Hz from 10 – 200 Hz
Trigger:	PPS (pulse per second), rising edge on time, 75 ms high time, TTL level compatible		30 minutes per axis
Scan clock:	10 Hz to 10 MHz, rising edge synchronized, 50 % duty cycle, TTL level compatible		Vibration test: Shape Frequency range Power spectral density Duration
ORION-DSA-SYNC:	LVDS compatible on RJ45		EN 60721-3-2 Class 2M2 Random 10 - 200 Hz 1 m/s² / Hz from 10 – 200 Hz 30 minutes per axis
Power supply:	USB powered, max. current 500 mA		Shock: Shape: Acceleration amplitude: Duration:
Operation temperature:	-5 °C to +70 °C		EN 60068-2-27 Half-sine 15 g 11 ms
Storage temperature:	-20 °C to +85 °C		Test in 3 axis, 3 shocks in each axis and direction
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)		

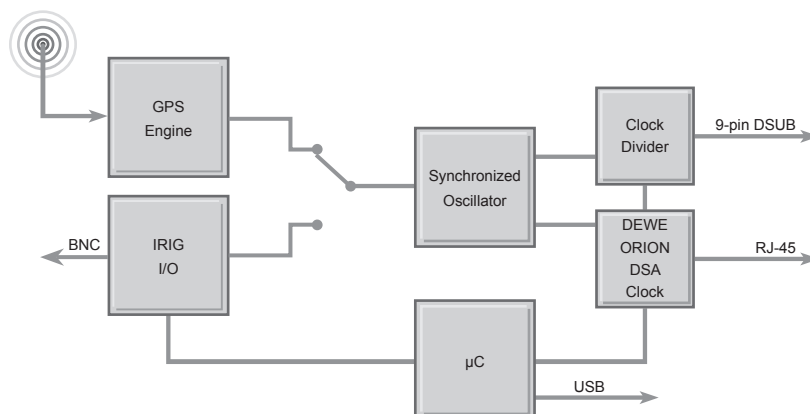
DEWE-CLOCK

Device overview

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

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

The diagram below outlines the basic functionality of the DEWE-CLOCK



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.

For A/D-boards with over-clocked delta sigma converters (e.g. DEWE-ORION-DSA series), a special output clock is required for synchronized sampling. This is available on a RJ45 connector.

The communication to the host is provided over USB interface.

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)

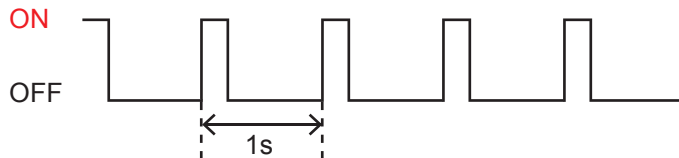
Functionality of the LEDs

Power (green)

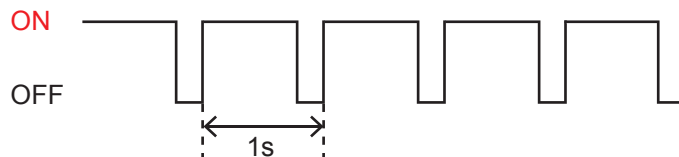
The power LED is solid green when the DEWE-CLOCK is in normal operation.

Status (red)

Indicates current status of device. At normal operation - when DEWE-CLOCK is locked to the selected time source - it shortly blinks once a second.



When the time source signal is missing (neither GPS or IRIG time code signal), the device automatically goes to flying-wheel operation. This is indicated by inverted blinking.



Mounting the aerial

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

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

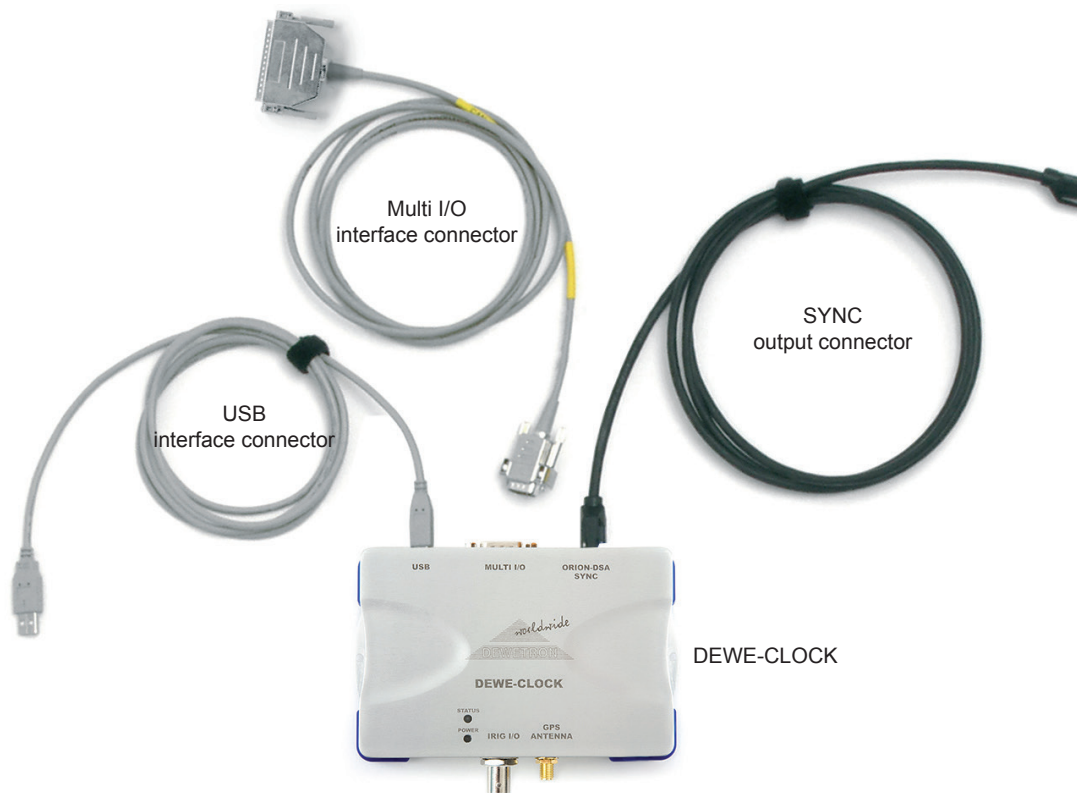
PC-GPS-CBL15 - 15 m
PC-GPS-CBL25 - 25 m

DEWE-CLOCK

Warm-Up time

When the DEWE-CLOCK is used as 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, 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



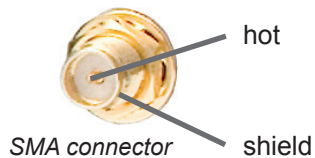
Connection

Connector overview:



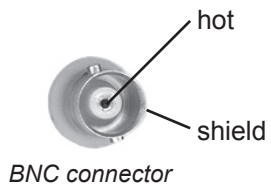
Aerial connector

Connect the GPS antenna to the SMA connector.



IRIG connector

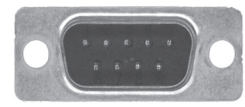
Connect the IRIG signal to the BNC connector.



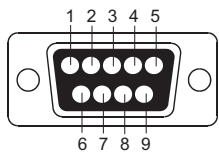
DEWE-CLOCK

Multi I/O connector

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



9-pin SUB-D
connector (male)



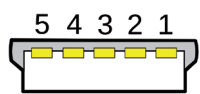
Schematic

Pin assignment

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

Mini USB connector

The mini-USB interface connectors meets standard USB pin assignment.



5-pin USB connector schematic

Pin assignment

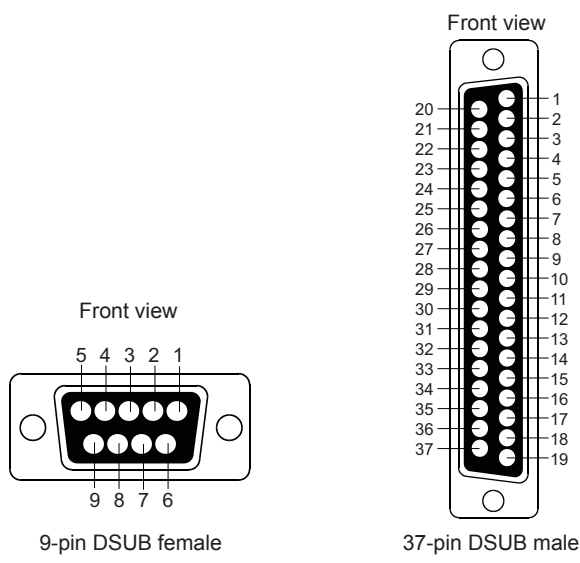
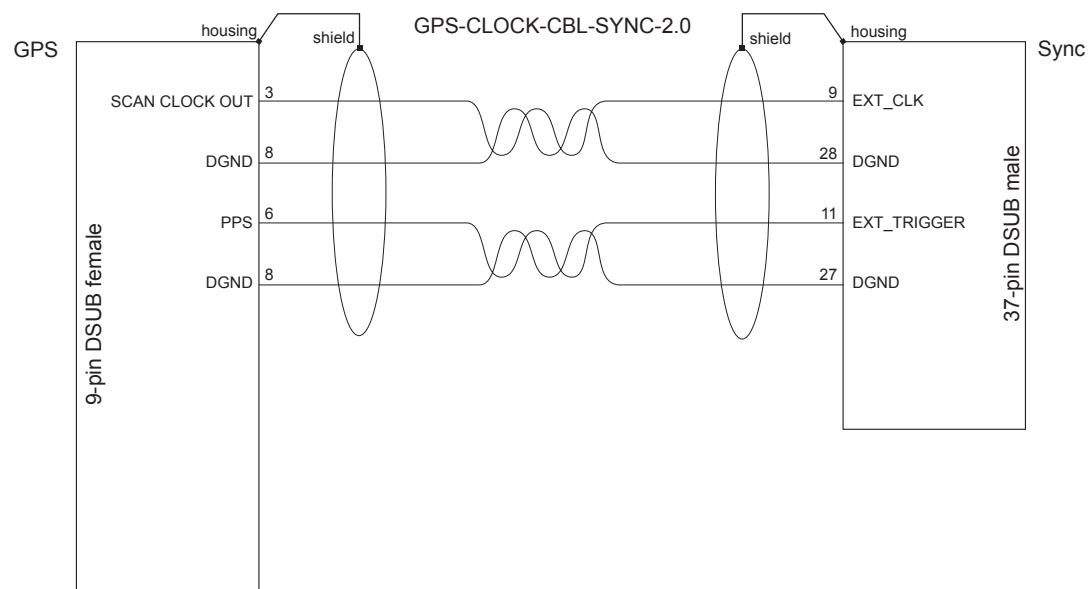
- 1: +5 V
- 2: D-
- 3: D+
- 4: ID
- 5: GND

ORION-DSA-SYNC connector

This connector is used for synchronizing any ORION-DSA data acquisition card to the DEWE-CLOCK. For this purpose the DEWE-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.

Multi I/O connector cable

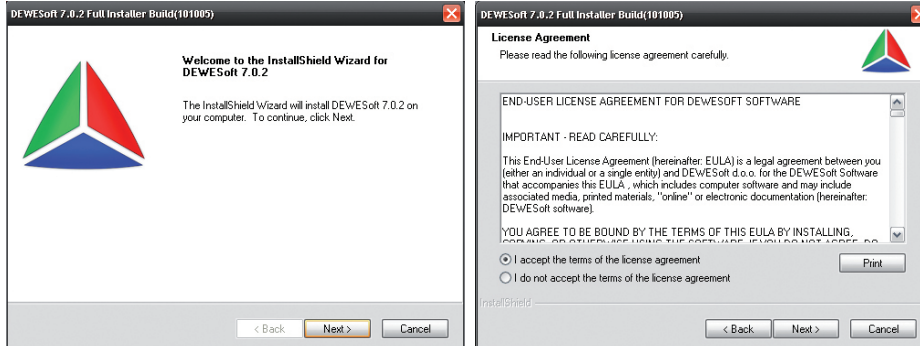
Type of cable: 2x2x0.25 shielded



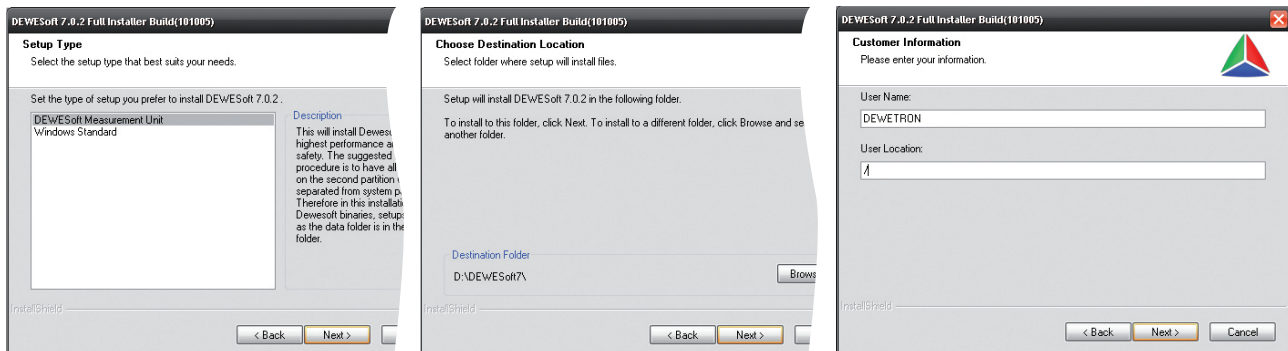
DEWE-CLOCK

Installation of the DEWESoft measurement software

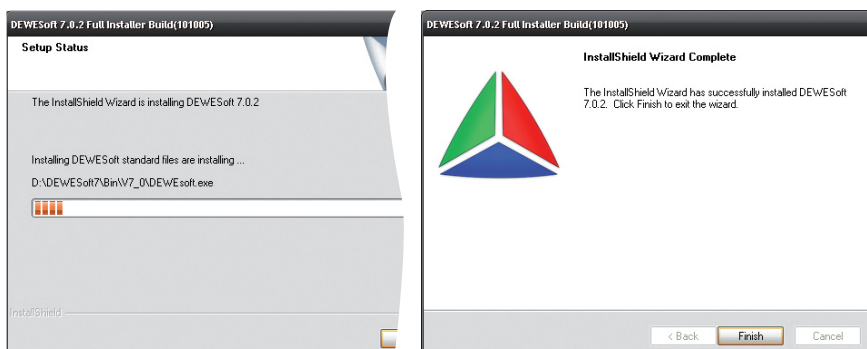
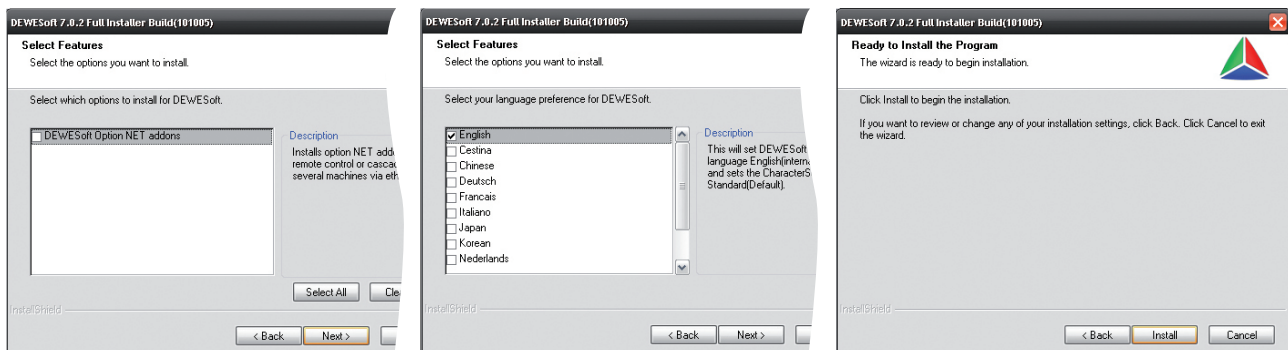
The install shield wizard will simplify the installing procedure.



Select the needed options you want to install and enter your information.



Select the features you want to install and start the installation.



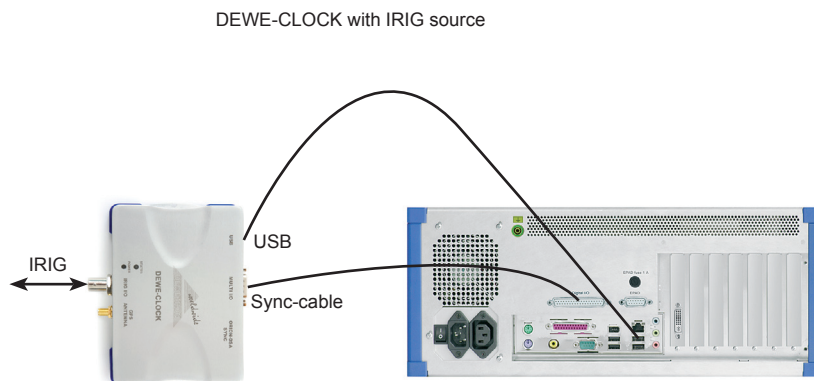
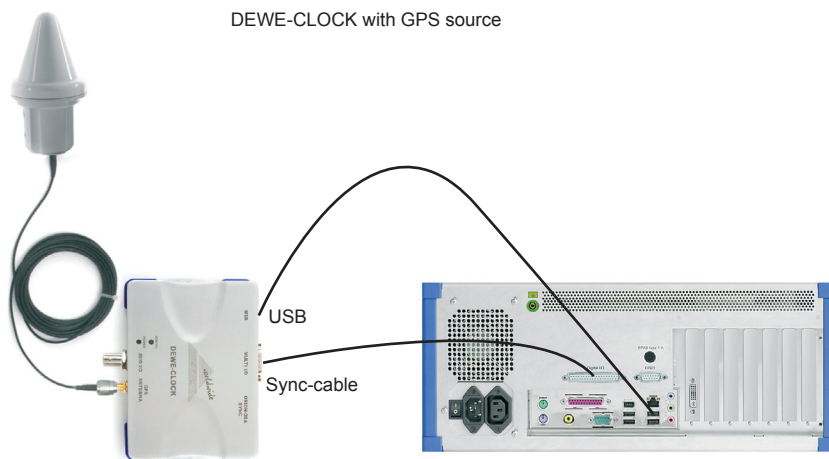
Now DEWESoft is installed on your computer. The software creates some directories on your harddisk.

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*.

Connecting the DEWE-CLOCK hardware to the DAQ-System

Synchronization to DEWE-ORION-DAQ series or 3rd party A/D boards

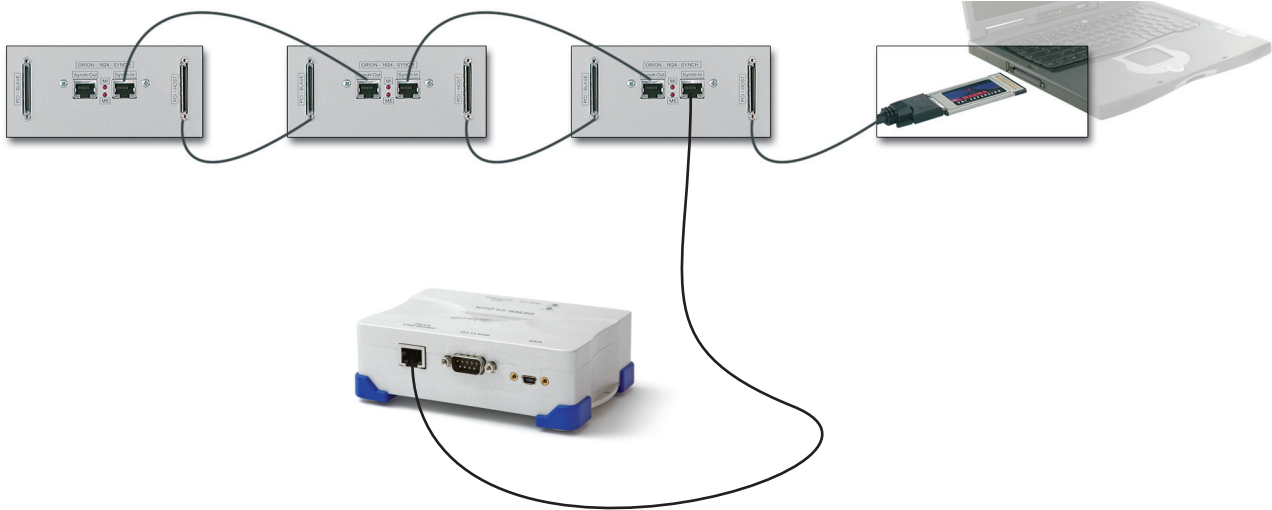
To synchronize standard data acquisition systems a start trigger and the possibility of external clocking is required. Usually DEWETRON data acquisition systems are equipped with a 37-pin DSUB connector. This digital multifunction connector contains the required clock and trigger input for easy connection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



DEWE-CLOCK

Synchronization to DEWE-ORION-DSA series

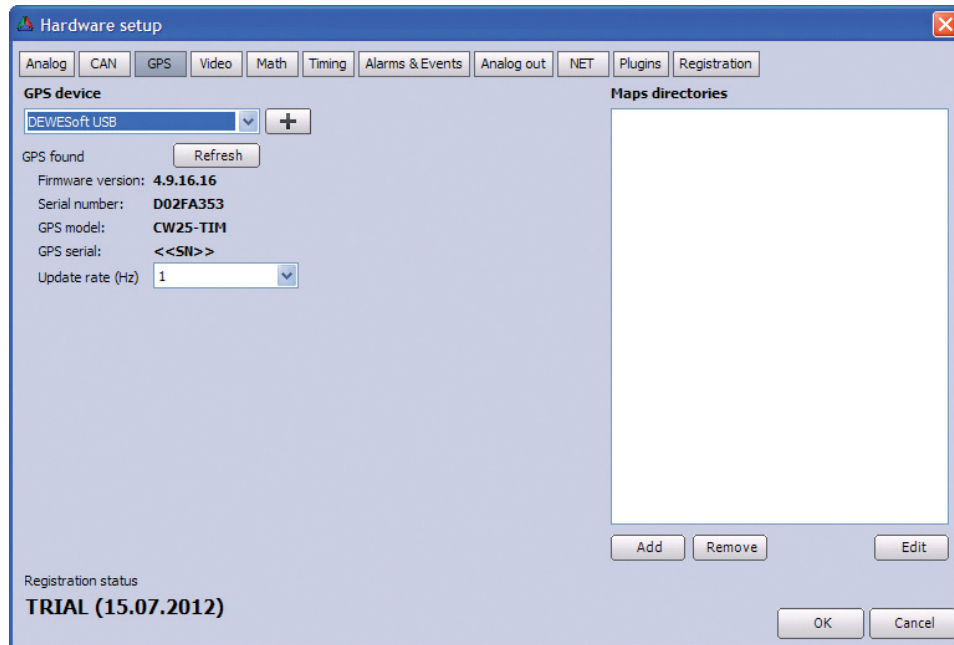
One of the unique features of the DEWE-CLOCK is the possibility to synchronize also data acquisition systems using delta sigma ADC technology like DEWE-ORION-DSA. The main challenge is to produce the up to 256 times over sample clock used for these types of analog to digital converters. For this purpose the DEWE-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-DSA-SYNC option for having access to the synch bus of the board.

Configuration of DEWESoft for the DEWE-CLOCK

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



Select DEWESoft USB from the GPS device dropdown menu. DEWESoft will automatically start searching for a connected device.

Update rate

The update rate is fixed at 1 Hz.

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.

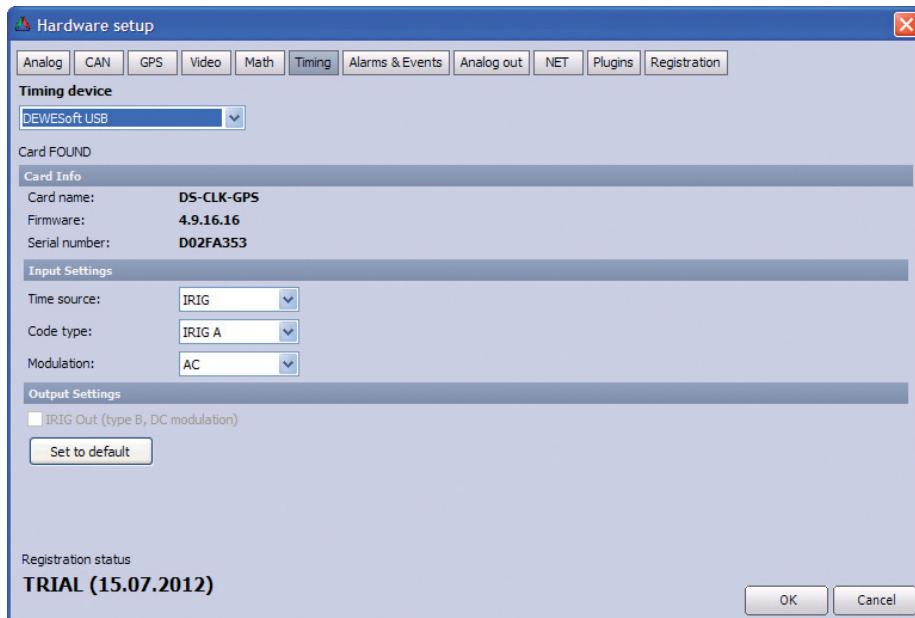
Timing settings

When you want to use the DEWE-CLOCK as high precision timing device for synchronized data acquisition, you need to enable this in the Timing section (System → Hardware Setup → Timing).

DEWE-CLOCK

Timing settings

If you want to use the DEWE-CLOCK as high precision timing device for synchronized data acquisition, you need to enable this in the Timing section (System → Hardware Setup → Timing).



Select DEWESoft USB from the Timing device dropdown menu. DEWESoft will automatically start searching for a connected device.

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 time source, this dropdown 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 checkbox "IRIG Out" enables the output of the internally generated IRIG signal on the BNC connector of the DEWE-CLOCK.

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

Set do default

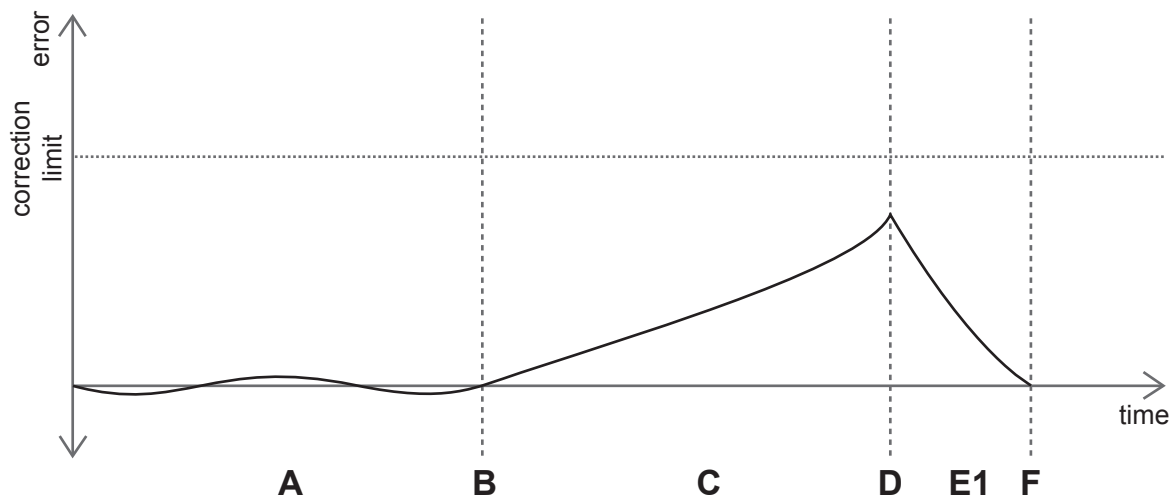
This button defines the current input- and output settings as power on default settings. This way the DEWE-CLOCK will always start up with the predefined settings.

What happens when the timing source is lost?

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 DEWE-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 anymore. However, as soon the GPS or IRIG signal is available again, the DEWE-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.

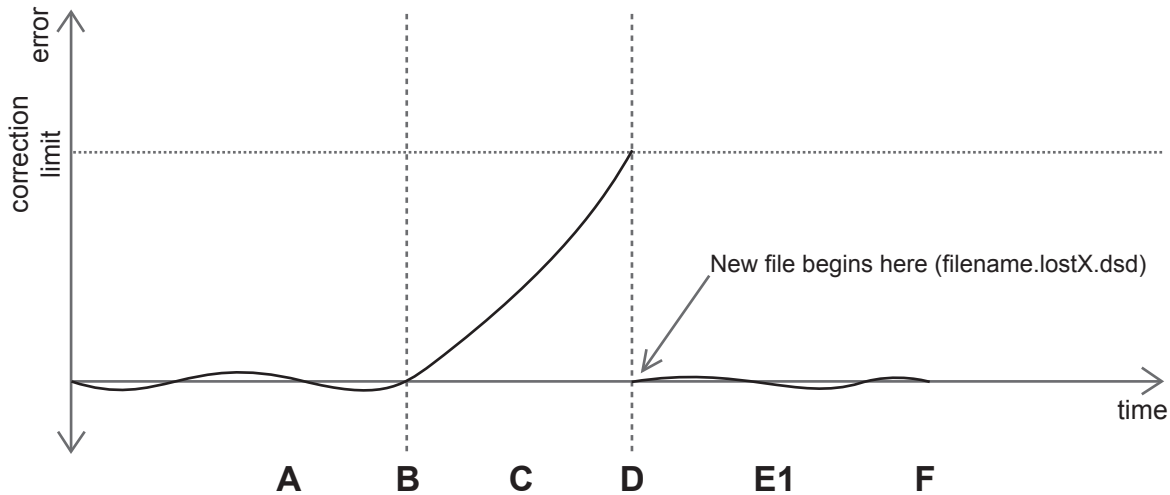
The graph below gives an idea how the DEWE-CLOCK behaves when the GPS or IRIG signal is lost during data acquisition. In this example the drift of the oscillator is smaller than the allowed 2 ms (fixed).

- 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 DEWE-CLOCK automatically corrects the drift for getting again time synchronized data. So the data acquisition is not interrupted although the time source signal was lost. The correction is done with the maximum rate of 5 $\mu\text{s}/\text{sec}$.



DEWE-CLOCK

However if the time source signal is lost for too long, the oscillator drift may be higher than 200 ms. 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 time source signal loss.



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-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.

Channel setup

The screenshot below shows the channel setup screen of the DEWE-CLOCK when it was selected as 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.

SLOT	ON/OFF	C	NAME	VALUE	SETUP
0	Used	Store	X absolute	15°30,32' E	Setup
1	Used	Store	Y absolute	47°1,159' N	Setup
2	Used	Store	Z	356,89 m	Setup
3	Used	Store	Velocity	0,006 km/h	Setup
4	Used	Store	Direction	30,93 deg.	Setup
5	Used	Store	Used satellites	5	Setup
6	Used	Store	Current sec	40929	Setup
7	Used	Store	NMEAlog	\$GPGSV,3,3,10,15,70,241,51,1	Setup

PPS sync: Not fixed

Satellite constellation diagram: 10 InView, 5 Used

Show NMEA log

- 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)
- Direction: True track over ground
- Used sat.: Numbers of satellites used for calculation of position and speed
- Current sec: Seconds since midnight (UTC + 15 seconds)
- NMEA log: 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 color 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 color from grey to green depending if the appropriate feature is available at the moment (green means available).

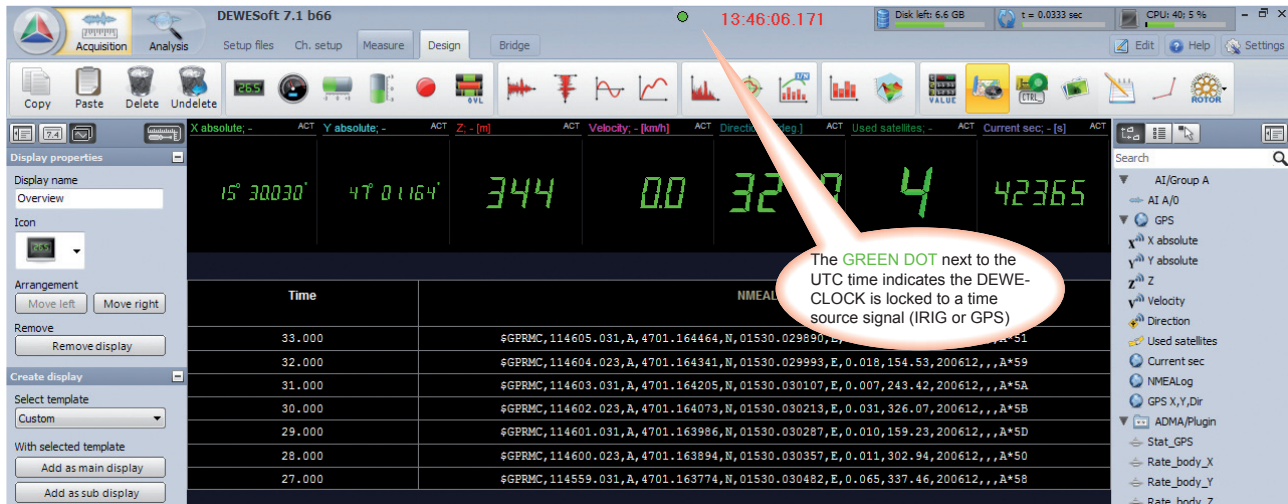
The PPS sync is used for hardware synchronisation to analog channels. This will eliminate the time shift caused due the calculation time of the GPS receiver and of the data transfer time of the USB interface.

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

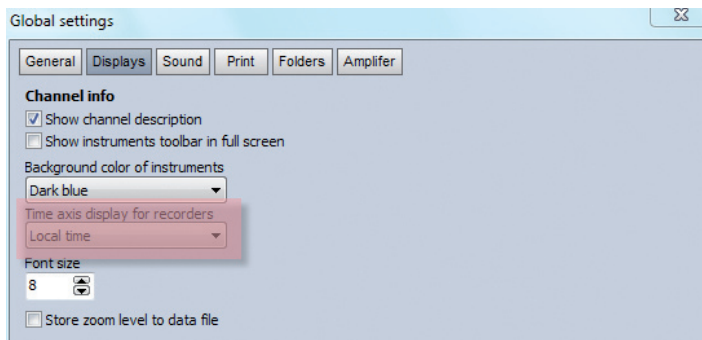
DEWE-CLOCK

Measurement setup

When the DEWE-CLOCK is used as timing device and you switch to the measurement screen you will see the actual time from the DEWE-CLOCK shown in the top right corner of the screen. A green dot next to this time indicates that the DEWE-CLOCK is locked to the GPS or IRIG time whereas a red dot indicates that the DEWE-CLOCK is in free-run mode.



As 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 analyzed it is recommended to set to UTC or GPS time. This can be done in the Global settings of DEWESoft (Settings → Global settings → Displays). Doing so, the data from all data acquisition systems are containing the same absolute time stamp.



CE-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-CLOCK

Kind of product:

GPS & IRIG module

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, April 28, 2010

Place / Date of the CE-marking

Dipl.-Ing. Roland Jeutter / Managing director

Notes
