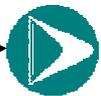




# TESTIME<sup>PLUS</sup><sup>®</sup> RUBISOURCE<sup>®</sup> T&M



## USER GUIDE

Manual P/N: 60500070  
Doc. No.: 001472AA  
Published: October 2001

... applicable for **RubiSource T&M** P/N 81710000



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## IN THIS CHAPTER . . .

- ◆ Purpose of this Document
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- ◆ Conventions
- ◆ Where to Find Answers to Product and Document Questions

## 1. How to Use This Manual

### 1.1. Purpose of this Document

This User Guide provides necessary information for installation, configuration and operation of the RubiSource T&M. Furthermore it contains maintenance procedures, troubleshooting instructions and procurement information.

### 1.2. Structure of this Document

This document contains the following sections and appendixes:

Chapter	Title of the Chapter	Description
1	How to Use This Manual	Contains a general overview of this document, the intended audience, the conventions used, and lists related documents available for the user.
2	Product Description and Function	Provides an overview of the product, describes the major functions, and lists the technical data including the EC-Declaration of Performance.
3	Unpacking and Inspection	Contains procedures for unpacking and inspecting the unit.
4	Installation	Contains instructions for installing and configuring the unit.
5	Operation	Describes the power-up sequence and provides procedures for operating the equipment.
6	Functional Check	Provides checklist-based functional tests that could be performed to check that the equipment is ready for normal operation.
7	Maintenance and Troubleshooting	Contains cleaning and maintenance procedures including troubleshooting instructions for fault isolation.
A	Procurement Information	Lists necessary procurement information to purchase equipment and parts associated to this product.

### 1.3. Who Should Read This Document

This publication is written for technical audiences. It describes instructions for installation, configuration, operation and maintenance as well as technical details primarily intended for qualified technical personnel.

The sections `Product Description` and `Typical Applications` are written for non-technical audiences who need information about the product.

### 1.4. Related Documentation

Further documents related to the product described herein which are published at time of issue of this document are listed below. See our web-site [www.datum.com](http://www.datum.com) for a complete list of actual documentation.

Part Number	Document Number	Title
60500010	000702xx	Manual for GPS FC
60500011	001463xx	GPS FC Installation Instructions

### 1.5. Conventions

#### 1.5.1. Acronyms and Abbreviations

Terms are spelled out the first time they appear in text. Thereafter, the acronym or abbreviation is used. In addition, the glossary defines the acronyms and abbreviations.

#### 1.5.2. Typographical Conventions

When text appears this way...	... it means:
<code>Installation</code>	The title of a document or the title of a chapter
<i>GPS FC Input</i>	The name of a signal, ...
<u>A GPS disciplined frequency standard ...</u>	A word or term being emphasized.
Datum <b>does not</b> recommend...	A word or term given special emphasis.

#### 1.5.3. Warnings, Cautions, Recommendations and Notes

Warnings, Cautions, Recommendations and Notes attract attention to essential or critical information in this document. The types of information in each are explained in the following:



**Warning**

To avoid serious personal injury or death, do not disregard warnings. All warnings use this symbol. Warnings are installation, operation, or maintenance procedures, practices, or statements, that if not strictly observed, may result in serious personal injury or even death.

---



**Caution**

To avoid personal injury, do not disregard cautions. All cautions use this symbol. Cautions are installation, operation, or maintenance procedures, practices, conditions, or statements, that if not strictly observed, may result in damage to, or destruction of, the equipment. Cautions are also used to indicate a long-term health hazard.

---



**ESD Caution**

To avoid personal injury and electrostatic discharge (ESD) damage to equipment, do not disregard ESD cautions. All ESD cautions use this symbol. ESD cautions are installation, operation, or maintenance procedures, practices, conditions, or statements that if not strictly observed, may result in possible personal injury, electrostatic discharge damage to, or destruction of, static sensitive components of the equipment.

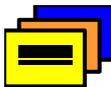
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**Electrical Shock Caution**

To avoid electrical shock and possible personal injury, do not disregard electrical shock cautions. All electrical shock cautions use this symbol. Electrical shock cautions are practices, procedures, or statements, that if not strictly observed, may result in possible personal injury, electrical shock damage to, or destruction of components of the equipment.

---



**Recommendation**

All recommendations use this symbol. Recommendations indicate manufacturer-tested methods or known functionality. Recommendations contain installation, operation, or maintenance procedures, practices, conditions, or statements, that provide important information for optimum performance results.

---



**Note**

All notes use this symbol. Notes contain installation, operation, or maintenance procedures, practices, conditions, or statements, that alert you to important information, which may make your task easier or increase your understanding.

---

## **1.6. Where to Find Answers to Product and Document Questions**

For additional information about the products described in this guide, please contact your Datum representative or our service office.

To get answers to questions regarding this publication you may also complete and return the Reader Comment Form located in the back of this guide. We appreciate your suggestions of ways to improve any part of this guide. Please make your suggestions on a copy of the concerned page and enclose it with the Reader Comment Form.

## IN THIS CHAPTER

- ◆ Product Description
- ◆ Product Views
- ◆ Product Functions
- ◆ Typical Applications
- ◆ Technical Data
- ◆ EC-Declaration of Conformity

## 2. Product Description and Functions

This chapter provides an overall description of the product including typical applications and the functional behavior. Illustrations of the front and back view of the unit and the section `Technical Data` serve as the main reference for other chapters with technical content (e.g. troubleshooting).

Additionally this chapter contains the `EC-Declaration of Conformity`.

### 2.1. Product Description

The RubiSource T&M is a portable timing reference based on Datum's well-known rubidium oscillator technology for universal usability in test and measurement applications. It provides a number of coherent standard frequencies

- ✓ sine wave 10 MHz, 5 MHz and 1 MHz
- ✓ square wave 10 MHz and 5 MHz

with excellent stability and aging performance specially designed for both stationary applications and mobile operations.

The two square wave output signals are user-configurable whereby a combination of two out of

- ✓ 10 MHz TTL signal (factory setting)
- ✓ 5 MHz TTL signal (factory setting)
- ✓ 1 MHz TTL signal
- ✓ 8 kHz TTL signal
- ✓ 100 Hz TTL signal
- ✓ 1 PPS signal

is selectable.

Furthermore the RubiSource T&M supplies a 1 PPS output signal in order to provide exact timing information. This output can be synchronized to an external 1 PPS input signal.

All reliable output signals are based on the highly accurate and stable rubidium oscillator inside. The rubidium's fast warm up eliminates the need of bulky backup batteries. The RubiSource T&M can be locked to an external primary source such as GPS receiver or Cesium for automatic frequency calibration of the rubidium oscillator and/or enhancing the intrinsic rubidium accuracy to near cesium quality.

## 2.2. Product Views

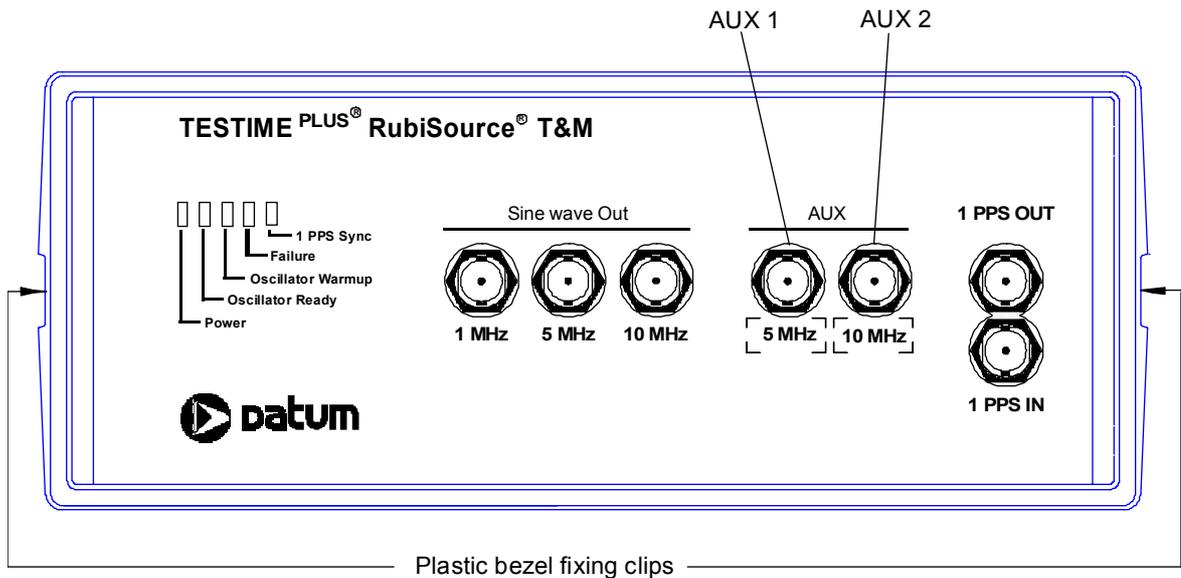


Figure 2-1 – Front Panel

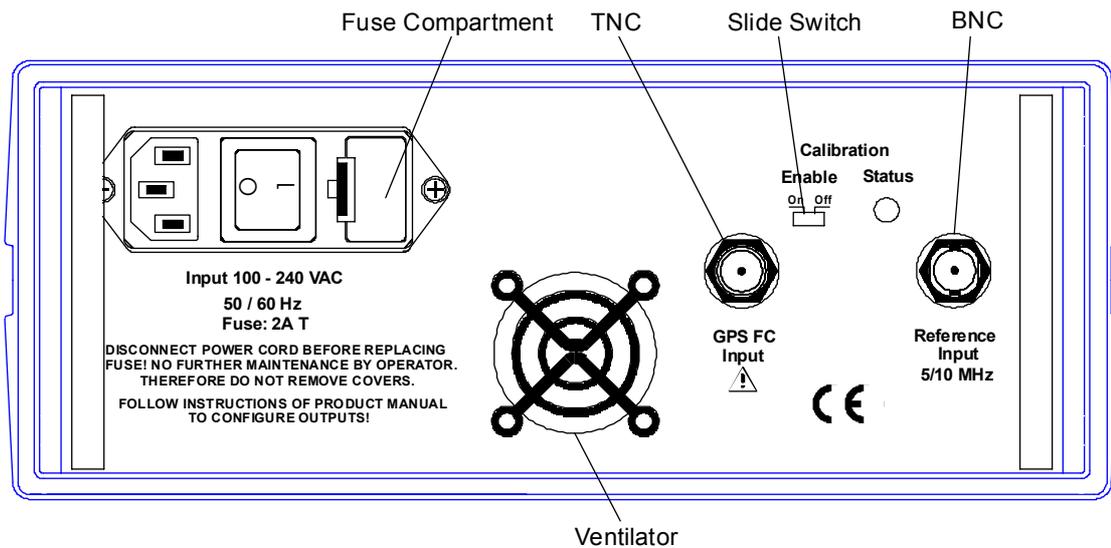


Figure 2-2 – Rear Panel

## 2.3. Product Functions

### Automatic Frequency Adjustment

Calibration of the RubiSource T&M has been made extremely simple. There is no need for external frequency difference meters or phase comparators. Just connect a 5 MHz or 10 MHz reference signal from a primary standard (cesium, GPS disciplined rubidium) to the rear panel input. The RubiSource T&M will automatically sense the signal, evaluate its stability and slowly (typically within 10 minutes) tune the output signals to a frequency accuracy of  $< 2 \times 10^{-11}$ . The unit will continue to operate with the excellent performance of the internal rubidium oscillator until a new calibration cycle is started. The calibration parameters will be retained in a non-volatile memory.

Alternatively, you can connect Datum's smart GPS antenna model GPS FC to the RubiSource T&M, turning it into a GPS disciplined frequency standard which exceeds a cesium's long term frequency accuracy.

Automatic frequency adjustment can be disabled with a recessed slide switch. Switch tampering can be prevented by placing a calibration sticker across its access opening.

### 1 PPS Input/Output Synchronization

The 1 PPS output can be synchronized to an external reference 1 PPS signal. The RubiSource integrity checks the signal at the 1 PPS input and synchronizes its output to better than 100ns. A front panel LED indicates successful synchronization. The LED turns off if synchronization is lost.

### Functional Monitoring / Built-in Test Equipment

Continuous extensive self tests monitor the critical functions of the RubiSource T&M to ensure its high accuracy. Failures of the equipment hardware compromising the frequency accuracy of the output signals will be detected.

When power is applied the unit enters into a warm-up phase for a few minutes until it reaches full accuracy.

Front panel LED indicators inform the user about the status of the unit.

## 2.4. Typical Applications

The sine wave and square wave outputs of the RubiSource T&M are typically provided for metrology and calibration laboratory equipment such as:

- Universal Counter
- Spectrum Analyzer
- Synthesized Signal Generator

## 2.5. Technical Data

Physical Data	
Maximum Size (WxHxD)	260 x 120 x 365 mm (without handle) 10.24 x 4.72 x 14.37 inches (without handle)
Maximum Weight	4.3 kg (9.3 pounds)
Environmental Conditions	
Meets or exceeds ETS 300 019 – 1-3 class 3.1	
Humidity	95 % non-condensing
Temperature	5° to 40°C Operating with specified accuracy -10° to 55°C Operating with de-rated accuracy -55° to 85°C Storage
Regulations and Standards	
EN 61326-1:1997	Electrical equipment for measurement, control and laboratory use – EMC requirements –
EN 61010-1:1993	Safety regulations for electrical measurement, control and laboratory apparatus
MTBF	
65,000 hours (prediction based on field experience)	
Power Supply	
Voltage	100 to 240 VAC, 50 to 60 Hz
Current Consumption	max. 1.0 A
Power Consumption	typically 30 VA at 230 VAC, 22 VA at 110 VAC
Internal Time Base - Datum's Rubidium oscillator	
Aging	< 5x10 <sup>-11</sup> / month < 1x10 <sup>-9</sup> over 10 years
Warm-Up	Time to Lock <5.4 min @ 25°C <8.7 min @ -10°C Time to < 1x10 <sup>-9</sup> <7.3 min @ 25°C <10.2 min @ -10°C Time to < 4x10 <sup>-10</sup> <10.6 min @ 25°C <12.7 min @ -10°C
Temperature Coefficient	Y <sub>(50°C)</sub> - Y <sub>(0°C)</sub>   < 3x10 <sup>-10</sup>
Input Signals	
1 x external reference signal	5 MHz or 10 MHz sine wave / square wave; 0.5 ... 5.0 Vpp into 50 Ohm/BNC; MTIE (200 s) < 1 ns signal levels: 1 V <sub>RMS</sub> ±10% or TTL min. 2.4 V/max. 5 V,
1 x GPS disciplined frequency signal	from Datum's GPS FC product; TNC connector / 50 Ohm Input Impedance
1 x 1 PPS signal	1 Hz ±1 x 10 <sup>-8</sup> square wave; 1.0...10.0 Vpp into 50 Ohm/BNC; pulse length minimum 150 ns, slope < 15 ns

Frequency Accuracy							
Factory Shipment	$< 5 \times 10^{-11}$ @ 25°C						
With GPS FC connected	Typically $< 1 \times 10^{-12}$ (ADEV $< 2.5 \times 10$ ) Specification $< 1 \times 10^{-12}$ (ADEV $< 1 \times 10^{-11}$ )						
Adjusted to a reference	$< 2 \times 10^{-11}$ relative to the reference @ 25°C						
Frequency Retrace	$< \pm 2.5 \times 10^{-11}$ (after 24 h power on @ 25°C and up to 48 h power off)						
Output Signals							
1 x 1 MHz sine wave	1 V <sub>RMS</sub> ±10% into 50 Ohm, BNC connector						
1 x 5 MHz sine wave	1 V <sub>RMS</sub> ±10% into 50 Ohm, BNC connector						
1 x 10 MHz sine wave	1 V <sub>RMS</sub> ±10% into 50 Ohm, BNC connector						
1 x AUX *)	minimum 2.4 V into 50 Ohm, BNC connector (factory setting: 10 MHz TTL)						
1 x AUX *)	minimum 2.4 V into 50 Ohm, BNC connector (factory setting: 5 MHz TTL)						
1 x 1 PPS square wave	minimum 2.4 V into 50 Ohm, BNC connector (pulse length typ. 10 us)						
*) user configurable to	<table border="0"> <tr> <td>10 MHz TTL</td> <td>8 kHz TTL</td> </tr> <tr> <td>5 MHz TTL</td> <td>100 Hz TTL</td> </tr> <tr> <td>1 MHz TTL</td> <td>1 PPS (pulse length typ. 10 us)</td> </tr> </table>	10 MHz TTL	8 kHz TTL	5 MHz TTL	100 Hz TTL	1 MHz TTL	1 PPS (pulse length typ. 10 us)
10 MHz TTL	8 kHz TTL						
5 MHz TTL	100 Hz TTL						
1 MHz TTL	1 PPS (pulse length typ. 10 us)						

### LED Indicators

Indication	Location	Status	Meaning
Power	Front Panel	Not active	Power OFF
		Active Green	Power ON
Oscillator Ready	Front Panel	Not active	Oscillator not ready; outputs not useable
		Active Green	Oscillator ready, outputs useable
Oscillator Warmup	Front Panel	Not active	Oscillator warm-up not in progress
		Active Yellow	Oscillator warm-up in progress
Failure	Front Panel	Not active	No failure detected
		Active Red	At least one failure actually detected
1 PPS Sync	Front Panel	Not active	Synchronization not successfully possible / Synchronization status lost by power interrupt
		Active	Synchronization already performed
Calibration Status	Rear Panel	Not active	Frequency reference signals * not available / No frequency adjustment
		Flashing Green	Frequency reference signal * determination or frequency output signal calibration in progress
		Active Red	Frequency reference signal * not accepted
		Active Green	Frequency adjustment completed

\* External frequency reference signal or GPS disciplined frequency signal

## 2.6. EC-Declaration of Conformity



**EC-Declaration of Conformity**

The Supplier

**Datum GmbH**  
Fichtenstrasse 25  
D – 85649 Hofolding

declares, that the product

**RubiSource T&M**  
Model Number 81710000

conforms to the standards of the following European Directives

<b>89/336/EWG</b>	<b>Electromagnetic Compatibility Directive</b>
<b>73/23/EWG</b>	<b>Low Voltage Directive</b>

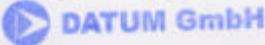
The conformity is evidenced by strictly meeting the following harmonized European Standards:

<b>EN 61326-1:1997</b>	<b>Electrical equipment for measurement, control and laboratory use – EMC requirements –</b>
<b>EN 61010-1:1993</b>	<b>Safety regulations for electrical measurement, control and laboratory apparatus</b>

**Place, Date** Hofolding, October 20, 2001

**Responsibility** Gerhard Hübner (General Manager)

**Stamp and Signature**

  
  
Fichtenstrasse 25, D-85649 Hofolding  
Phone: +49 (0)9104 / 6024-0, Fax: -28

This declaration includes no warranty of properties.  
The safety instruction specified in this publication delivered must be observed.

Doc.-No. 001635AA 10/2001

## IN THIS CHAPTER

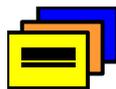
- ◆ Unpacking
- ◆ Inspection

### 3. Unpacking and Inspection

This chapter contains recommended procedures for unpacking the new equipment. It also lists instructions for inspection the delivered items for correct condition and completeness.

#### 3.1. Unpacking

- (1) Open the package on the top labeled with the unit identification.
- (2) Remove the upper protection material
- (3) Remove the equipment together with associated parts. Check the shipping container for loose parts.



#### Recommendation

Keep all packaging materials in the event the equipment or components must be returned or shipped to another location.

#### 3.2. Inspection

- (1) Check the equipment against packing list.
- (2) Inspect the unit for shipping damage, including bent or loose parts, broken connectors, or other visible defects.
- (3) Notify DATUM GmbH and the carrier who delivered the equipment if you suspect that it was damaged in transit.

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## IN THIS CHAPTER

- ◆ Configuration of AUX Outputs
- ◆ Installation Location
- ◆ Connecting Power
- ◆ Distributing of Outputs Signals
- ◆ Connecting a Reference Input Signal
- ◆ Connecting a 1 PPS Input Signal

## 4. Installation

This chapter provides procedures to be performed before first power up of the unit. It also contains instructions to configure the auxiliary outputs and to connect input and output signals. The illustrations outlined in the section *Product Views* may support you.

The chapters *Operation and Maintenance* and *Troubleshooting* require that the instructions outlined herein are correctly performed.

### 4.1. Configuration of AUX Outputs



#### Warning

To avoid personal injury do not operate the equipment when the housing must be opened. Switch off and disconnect power.

To configure the two auxiliary outputs follow the instruction below:

- (1) Remove the plastic bezel at the front side of the housing by carefully unclipping one side, followed by the other side.
- (2) Remove the four screws at the front panel.
- (3) Pull out the front panel carefully until the jumper fields S300 and S500 located on the attached CCA become accessible.
- (4) Jumper S300 will configure the output at connector AUX 1, while S500 is for AUX 2.
- (5) Set the jumper to the position which corresponds to the desired frequency.

- (6) Mark the configured frequencies for both outputs by placing the corresponding label to the front panel.



**Note**

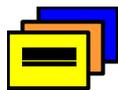
The labels are found at the inner side of the back cover of this document (alternatively inside a CD cover containing this publication).

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- (7) Slide back the front panel and reattach it using the four screws.
- (8) Place the plastic bezel over front panel on one side and clip it followed by pulling over the front panel on the other side. Check that it is fixed by the clips on both sides.

## 4.2. Installation Location

The unit shall be operated in an environment that meets the requirements of the section *Technical Data*.



**Recommendation**

To achieve highest precision do not subject the unit to adverse conditions such as:

- strong magnetic fields, e.g. mobile phones shocks
- temperature differences
- direct solar radiation

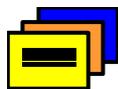
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## 4.3. Connecting Power

Connect the equipment to a 100 to 240 V, 50 to 60 Hz alternating current socket with ground lead. The power source shall be able to supply at least 1.0 Ampere.

## 4.4. Distributing of Outputs

If necessary, several outputs can be connected at the same time.

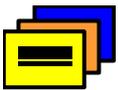


**Recommendation**

For lowest cross-talk avoid to use the 100 Hz and 8 kHz outputs simultaneously (if configured).

---

The outputs are capable to drive a load impedance of 50 Ohms.



**Recommendation**

Properly shielded cables must be used to maintain EMC/EMI performance. Be sure to terminated cables properly to maintain signal integrity.

---

## 4.5. Connecting a Reference Input Signal

Two input ports are located at the back of the equipment, one BNC connector labeled *Reference Input 5/10 MHz* to connect a reference source, and one TNC connector labeled *GPS FC Input* to connect a GPS FC.



### Note

If both input ports are connected and in use, the signal *Reference Input* will be preferred for frequency adjustment.

---

### 4.5.1. Connecting a Reference Source

Suitable as a source is an external primary reference source as, for example, a GPS-supported frequency standard or a cesium frequency standard. The output signal of such a reference source shall meet the specification provided in the `Technical Data` section.

Connect a reference source to the *Reference Input 5/10 MHz* port. Use a shielded cable with a BNC connector.



### Caution

To avoid damage to your reference source, do not connect a reference other than a GPS FC to the *GPS FC Input* port. This connector carries DC power.

---

### 4.5.2. Connecting a GPS FC

Connect a GPS FC to the *GPS FC Input* port using a RG58 interface cable with a maximum length of 250 m. The interface cable consists of TNC connectors at both ends.



### Note

To install the GPS FC refer to the `Installation Instructions` or the `Manual` of the GPS FC.

---

## 4.6. Connecting a 1 PPS Input

Connect a 1 PPS source to the *1 PPS IN* port using a shielded cable with a BNC connector.

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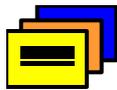
### IN THIS CHAPTER

- ◆ Power Up
- ◆ Frequency Adjustment to an external reference signal
- ◆ Use as a GPS disciplined frequency standard
- ◆ Operation as a stand alone frequency source
- ◆ Use as an 1 PPS source

## 5. Operation

This chapter describes all modes of operation of the product. Ensure that the unit is correctly installed as outlined in the [Installation](#) chapter.

If the equipment does not perform as described below follow the instructions in the [Maintenance and Troubleshooting](#) chapter.



### Recommendation

To achieve highest precision do not subject the unit to adverse conditions such as:

- strong magnetic fields, e.g. mobile phones
- shocks
- temperature differences
- direct solar radiation

---

For a reference of the signals and LED's refer to the illustrations outlined in the section [Product Views](#).

### 5.1. Acclimatization

In the case that water has condensed on the unit during transport, or storage, the equipment must be allowed to acclimatize for approximately two hours before operation.



### Caution

Condensed water may damage the unit.

---

## 5.2. Power Up



**Warning**

To avoid personal injury do not operate the equipment when the housing is opened.

---



**Warning**

To avoid personal injury do not operate the equipment while there is danger of explosion.

---



**Caution**

To avoid equipment damage caused by excessive heat, do not cover the ventilation slots at the bottom of the unit or the ventilator slot on the rear panel.

---



**Caution**

The equipment may not be operated while there are high atmospheric humidity, high dust level, and aggressive chemical influence.

---

- (1) Switch the equipment **ON** at the rear panel of the unit. The *Power* LED illuminates when power is applied.
- (2) Immediately after applying power the unit's internal micro-controller executes an LED test, followed by the warm-up phase of the internal rubidium oscillator starts (indicated by the *Oscillator Warmup* LED).
- (3) The warm-up will be completed typically within 10 minutes depending on the environmental temperature conditions.
- (4) The unit is ready for operation when the *Oscillator Warmup* LED is switched off and the *Oscillator Ready* LED lights.



**Note**

Malfunction of the equipment is indicated by the *Failure* LED.

---

### 5.3. Frequency Adjustment to an External Reference Signal

In order to enhance the stability and accuracy of the output signals, the unit can be adjusted by means of an external reference source.



**Note**

Automatic frequency adjustment can be disabled using a recessed slide switch labeled *Calibration Enable* located on the rear panel. Switch tampering can be prevented by placing a calibration sticker across its access opening.

---

- (1) Move the *Calibration Enable* slide switch to the **ON** position.
- (2) The adjustment starts automatically when a reference signal is connected and will be performed within 30 minutes (typically within 10 minutes). A flashing *Calibration Status* LED signals that the reference signal will be determined followed by the frequency calibration cycle.
- (3) After successful completing of the adjustment procedure the LED *Calibration Status* lights steady green and the output signals are available with an frequency accuracy of  $\leq 2 \times 10^{-11}$  (immediately after calibration) relative to the reference signal.
- (4) The calibration parameters will be retained in a non-volatile memory to be used after switching the unit off and on again.
- (5) The reference source can be disconnected.
- (6) A repetition of this procedure can be started by dis-connecting and re-connecting the source or by switching the slide switch to off and on again.

If during adjustment the reference signal fails or is disconnected the micro-controller will abort the procedure indicated by switching off the *Calibration Status* LED. In that case the unit will operate with the originally stored calibration parameters after switching the unit off and on again.

If the input signal is not suitable (e. g. the source is not stable enough) the *Calibration Status* LED turns to steady red.



**Note**

If the slide switch is positioned to **OFF**, the input signal will be ignored. Therefore an accidental re-adjustment will be impossible.

---

## 5.4. Use as a GPS Disciplined Frequency Standard

Unlike the *Reference Input 5/10 MHz*, the *GPS FC Input* is designed for permanent connection to a GPS disciplined frequency. This will turn the equipment into a GPS disciplined frequency standard that exceeds a cesium's long term frequency accuracy.



### Note

A GPS FC can also be used for a one-time frequency adjustment, but this will take much more time than with the method described in the section *Frequency Adjustment to an External Reference Signal*. Due to the fact that the GPS time signal is subject to short-term fluctuations notable longer observation of the reference is necessary (worst case 48 hours).

- (1) Move the *Calibration Enable* slide switch to the **ON** position.
- (2) The adjustment procedure starts automatically when a signal from the GPS FC is received and will take between a few hours (in case of small frequency divergence) and up to one day (at large frequency divergence conditions). A flashing *Calibration Status* LED signals that the GPS FC signal will be determined followed by the frequency calibration cycle.
- (3) If the frequency is disciplined to the GPS source the *Calibration Status* LED lights steady green and the output signals can be used.



### Note

If an adjustment was performed within the last 6 month the outputs will be available with an frequency accuracy of typically  $\leq 1 \times 10^{-12}$  within 24 hours. Otherwise wait 48 hours.

- (4) The control procedure will continue as long as the GPS FC is connected.
- (5) The micro-controller retain the calibration parameters in a non-volatile memory to be used after switching the unit off and on again.
- (6) A repetition of this procedure can be started by dis-connecting and re-connecting the source or switching the slide switch to off and on again.

If during adjustment the GPS FC signal fails or the GPS FC is disconnected the micro-controller will abort the procedure indicated by switching off the *Calibration Status* LED. In that case the unit will operate with the originally stored calibration parameters after switching it off and on again.

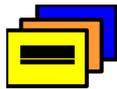


### Note

The GPS FC starts to transmit a signal after a warm-up phase of up to 1 hour. Therefore wait at least 1 hour before assuming a failure condition.

## 5.5. Operation as a Stand Alone Frequency Source

The unit's internal micro-controller controls the rubidium oscillator by using stored calibration parameters. Therefore the outputs are available with an accuracy as specified while subject to aging.



### Recommendation

For applications demanding very high accuracy the unit should be operated first for a longer time span (e. g. a few hours) after power up.

---

## 5.6. Operation as an 1 PPS Source

The equipment permanently provides a 1 PPS signal without any relation to a time base (e. g. UTC). The signal is available on the *1 PPS OUT* connector on the front panel.

You can synchronize the *1 PPS OUT* to another 1 PPS signal by connecting the synchronizing signal to the *1 PPS IN* port.

- (1) The synchronization starts automatically when a *1 PPS IN* signal is connected. The *1 PPS Sync* LED will be switched off if activated before. The determination of the input signal including the output synchronization will be performed within a few seconds.
- (2) After successfully completing of the synchronization procedure the *1 PPS Sync* LED indicates that the *1 PPS OUT* signal is synchronized to the *1 PPS IN* signal.
- (3) The control procedure will be continued as long as the input signal is connected.
- (4) A repetition of this procedure can be started by dis-connecting and re-connecting the source.



### Note

If the *1 PPS Sync* LED is off, it means that synchronization was not possible, or synchronization to a reference was lost by power interruption of the equipment.

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### IN THIS CHAPTER

- ◆ Required Equipment
- ◆ Test Procedures

## 6. Functional Check

This chapter provides equipment functional tests that are checklist-based. They can be performed to check that the equipment operates without malfunction.

### 6.1. Required Equipment

The following equipment or equivalent equipment is required to perform the functional check of the product.

Type of Equipment	Specification	Remarks
Oscilloscope	No special requirements	Standard
Connection Cable	RG58-cable, length 1 m with BNC-connectors	

## 6.2. Test Procedures

The following test shall be performed in a sequential order. If a test fails follow the instructions at the *Maintenance and Troubleshooting* chapter.

### 6.2.1. Checking the Power Up Sequence

- (1) Check that the *Power* LED lights when power is switched on.
- (2) Check that *Oscillator Ready* LED lights after maximum 10 minutes.
- (3) Check that the *Failure* LED does not light.

### 6.2.2. Checking the Frequency Output Circuitry

- (1) Connect an oscilloscope with an input impedance of 50 Ohm to each output connector.



#### Note

If the oscilloscope does not provide the correct input impedance the signal can be loaded by an impedance of 50 Ohm.

---

- (2) Check signal level of all sine wave outputs for minimum 2.6 Vpp.
- (3) Check signal level of the AUX and 1 PPS outputs for minimum 2.4 Vpp.

### 6.2.3. Checking the Reference Input Circuitry and Frequency Calibration

- (1) Connect the 10 MHz output directly to the *Reference Input 5/10 MHz* port and set the micro-switch on the rear panel to the ON position.
- (2) Check that the calibration cycle starts (indicated by flashing *Calibration Status* LED) and the *Calibration Status* LED lights green within approximately 10 minutes.



#### Caution

Do not connect an output signal to the *GPS FC Input* port. Doing this will damage the unit.

---

### 6.2.4. Checking the 1 PPS Input Circuitry and 1 PPS Synchronization

- (1) Connect the *1 PPS OUT* port directly to the *1 PPS IN* port.
- (2) Check that the *1 PPS Sync* LED lights after approximately 5 seconds.

## IN THIS CHAPTER

- ◆ Cleaning
- ◆ Preventive Maintenance
- ◆ Responding to Failures
- ◆ Troubleshooting and Fault Isolation
- ◆ Return Procedure

## 7. Maintenance and Troubleshooting

This chapter contains cleaning and maintenance procedures. Troubleshooting instructions allow fault isolation of the unit including associated equipment. These instructions refer to the *Technical Data* section as the main reference for the technical specification. Before starting with troubleshooting ensure that the unit is correctly installed.

### 7.1. Cleaning

Should it become necessary to clean the unit, wipe the housing with a cleaning cloth moistened with methylated spirits.



#### Caution

To avoid damage to the unit, always switch off and disconnect the power before cleaning the unit. Avoid exposing the unit to liquid.

### 7.2. Preventive Maintenance

The unit does not require any preventive maintenance.

Make sure that the equipment is not endangered by strong magnetic fields, hard shocks, extreme humidity and extreme temperature differences, which may be detrimental to frequency accuracy.

### 7.3. Troubleshooting and Fault Isolation



**Warning**

To avoid personal injury do not open the unit or replace the fuse with power connected. Always disconnect the power cord.

Problem Occurrence	Probable Cause	Corrective Action
<i>Power</i> LED does not light when switching on	Power of the unit not connected	Check power supply and connect if applicable
	Power cable faulty	Check power cable. Replace it if applicable.
	Fuse of the unit blown	Check fuse and replace it if applicable.
	Unit faulty	Return the equipment to the manufacturer.
<i>Oscillator Ready</i> LED does not light after warm up phase	Oscillator warm up still in progress	Wait at least 30 minutes.
	Rubidium oscillator faulty	Return the equipment to the manufacturer.
<i>Oscillator Warmup</i> LED does not light after power on	Oscillator already at working temperature	Operate if <i>Oscillator Ready</i> LED lights.
	Unit faulty	Return the equipment to the manufacturer.
<i>Failure</i> LED lights	Frequency of the reference signal does not meet specified values	Check reference signal and readjust if applicable. (see section Technical Data)
	Unit faulty	Return the equipment to the manufacturer.
<i>1 PPS Sync</i> LED does not light when <i>1 PPS IN</i> is connected	1 PPS synchronization still in progress	Wait at least 1 minute.
	1 PPS input signal not provided or does not meet specified values	Check 1 PPS input signal source. (see section Technical Data)
	1 PPS synchronization lost by power interruption	Start new synchronization.
	Unit faulty	Return the equipment to the manufacturer.

<b>Problem Occurrence</b>	<b>Probable Cause</b>	<b>Corrective Action</b>
<i>Calibration Status</i> LED does not start flashing green when a GPS FC is connected	Frequency adjustment disabled	Check micro-switch at the rear panel of the unit for correct position (ON).
	GPS FC not ready for operation	Check expiration of the start-up time of the GPS FC (typically within 30 minutes) Check location of the GPS FC regarding view to the satellites. (refer to the Manual of the GPS FC).
	Interface cable to the GPS FC not connected, too long or faulty	Check interface cable for connection, length and correct condition
<i>Calibration Status</i> LED does not start flashing green when a reference signal is connected	Frequency adjustment disabled	Check micro-switch at the back side of the unit for correct position (ON).
	Reference Source not available or not connected	Check reference source for availability of signal and correct connection to the unit
	Signal level of the reference source not sufficient	Check level of the reference signal
	Unit faulty	Return the equipment to the manufacturer.
<i>Calibration Status</i> LED lights red when a reference signal or a GPS FC is connected	GPS FC faulty	Replace GPS FC.
	Reference signal does not meet specified values	Check input signal for accuracy and stability (see section Technical Data)
	Unit faulty	Return the equipment to the manufacturer.
<i>Calibration Status</i> LED does not stop flashing green when a reference signal or a GPS FC is connected	Determination of input signals still in progress	If a GPS FC is connected wait worst case 72 hours. If a reference source is connected wait at least 30 minutes.
	Unit faulty	Return the equipment to the manufacturer.
Ventilator does not operate	Unit faulty	Return the equipment to the manufacturer.
Further problems.		Contact the manufacturer.

## 7.4. Return Procedure

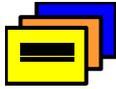
To return the unit to the manufacturer for repair, use the following instructions:

- (1) Contact the service department of DATUM GmbH (see back cover of this document) to announce the repair/service case before returning the product.
- (2) Follow the procedure provided by the service department.

## 7.5. Repacking

The unit is portable and may be carried unpacked at normal environmental conditions.

Use standard packing procedures to protect the unit during shipment. Custom foam packing material is preferred because it conforms to the shape of the instrument.



### Recommendation

Use transport case and original packing materials in the event the unit must be returned or shipped to another location.

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### IN THIS APPENDIX

Procurement Information for

- ◆ GPS FC
- ◆ Interface Cable to Connect a GPS FC
- ◆ Transport Case

## A. Procurement Information

This appendix provides information needed to procure Datum's GPS FC model including associated interface cable as well as a transport case.

For further information than outline herein and for ordering please contact Marketing/Sales of Datum GmbH.

**DATUM GmbH**  
Marketing/Sales  
Fichtenstrasse 25  
D-85649 Hofolding / Munich  
Germany

Phone: +49 – 8104-6624-29  
Fax: +49 – 8104-6624-28  
e-mail: [sales@datumgmbh.de](mailto:sales@datumgmbh.de)  
web: [www.datum.com](http://www.datum.com)

Please provide the parts name together with the part number when ordering.

Name of the Component	Part Number
GPS FC 10 MHz, 12-36 VDC	84000000
Interface Cable RubiSource – GPS FC, 25 m / RG 58	45400710
Interface Cable RubiSource – GPS FC, 50 m / RG 58	45400720
Transport Case for RubiSource products	81700001

### Brief Description of Datum's GPS FC model

The GPS FC is a GPS supported frequency source with an internal TCXO oscillator providing a frequency accuracy of better than  $1 \times 10^{-11}$  (over 24 h). The unit already consists of the GPS antenna and a corresponding receiver system assembled into a waterproof case. It is specially designed to be installed on a mounting mast withstanding extreme environmental conditions.

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## GLOSSARY

(ONLY NON-STANDARD ABBREVIATIONS ARE LISTED)

<b>ADEV</b>	<i>Allan Deviation</i> The square root of AVAR (Allan Variance). A measure of the expected fractional frequency variation of a signal as a function of integration time. ADEV can also provide information about the spectral content of the phase (or frequency) noise of a signal. ADEV is dimensionless.
<b>BNC</b>	<i>Bayonet Navy Connector</i> Coaxial connector with bayonet lock.
<b>CCA</b>	<i>Circuit Card Assembly</i>
<b>EC</b>	<i>European Council</i>
<b>EMI</b>	<i>Electro-Magnetic Interference</i> Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, inter-modulation products, and the like.
<b>EMC</b>	<i>Electro-Magnetic Compatibility</i> The ability of systems, equipment, and devices that utilize the electromagnetic spectrum to operate in their intended operational environments without suffering unacceptable degradation or causing unintentional degradation because of electromagnetic radiation or response.
<b>EN</b>	<i>Europäische Norm</i> Abbreviation for German expression of European Standard
<b>ESD</b>	<i>Electro Static Discharge</i> The rapid, spontaneous transfer of electrostatic charge induced by a high electrostatic field.
<b>GPS</b>	<i>Global Positioning System</i> (satellite navigation system) A satellite-based global navigation system that consists of (a) a constellation of 24 satellites in orbit 11,000 nmi above the Earth, (b) several on-station (i.e., in-orbit) spares, and (c) a ground-based control segment. The satellites transmit signals that are used for extremely accurate three-dimensional (latitude, longitude, and elevation) global navigation (position determination), and for the dissemination of precise time.
<b>Hz</b>	<i>Hertz</i> A unit of frequency equal to one per second (cps.). One kilohertz (kHz) equals 1000 cps; One megahertz (MHz) equals 1 million cps; One gigahertz (GHz) equals 1 billion cps.

<b>LED</b>	<i>Light Emitting Diode</i> A semiconductor device that emits incoherent light formed by the P-N junction. Light intensity is roughly proportional to electrical current flow. A principal light source for optical-fiber transmission used mainly with multi-mode fiber.
<b>MTBF</b>	<i>Mean Time Between Failures</i> An indicator of expected system reliability calculated on a statistical basis from the known failure rates of various components of the system. Note: MTBF is usually expressed in hours. 2. Of a system, over a long performance measurement period, the measurement period divided by the number of failures that have occurred during the measurement period. 3. For population of items, during a measurement period, the total functioning life of the population of items divided by the total number of failures within the population during the measurement period.
<b>MTIE</b>	<i>Maximum Time Interval Error</i> The maximum peak-to-peak delay variation of a given timing signal with respect to an ideal timing signal within an observation time ( $t = nt_0$ ) for all observation times of that length within the measurement period (T).
<b>PPS</b>	<i>Pulse Per Second</i>
<b>RMS</b>	<i>Root Mean Square</i>
<b>TCXO</b>	<i>Temperature Compensated Crystal Oscillator</i>
<b>TDEV</b>	<i>Time Deviation</i> A measure of the expected time variation of a signal as a function of integration time. TDEV can also provide information about the spectral content of the phase (or time) noise of a signal. TDEV is in units of time.
<b>TNC</b>	<i>Threaded Navy Connector</i> Coaxial connector with screw lock
<b>UTC</b>	<i>Universal Time Coordinated</i> Time scale based on the second (SI), as defined and recommended by the CCIR, and maintained by the Bureau International des Poids et Mesures (BIPM).
<b>VA</b>	<i>Voltage Ampere</i> The unit of electrical apparent power. In alternating-current power systems, the product of the rms voltage and amperage.
<b>VAC</b>	<i>Volts, Alternating Current</i> The unit of electromotive force
<b>VDC</b>	<i>Volts, Direct Current</i> The unit of electromotive force

**READER COMMENT FORM**

Company:

Name:

Title and Department:

Telephone:

email:

Job Responsibility:

Answer expected:

Yes

No

**Please indicate your evaluation of this manual. Attach additional sheets with comments as needed.**

How and when do you use this manual?

- Read entire manual before attempting task
- Read selected sections before attempting task
- Read while attempting task
- Attempt task first
- Read as last resort

How well is the manual's content *organized*?  
Please explain.

- Excellent** – parallels product's operation, very usable
- Good** – representative of the product's operation, usable
- Average** – usable but can be improved
- Fair** — not very usable, must be improved
- Poor** — not usable, must be improved
- No Opinion**

Understandable

Applicable

Is the manual's content *understandable* and *applicable* to the product's operation?  
Please explain.

- Excellent** – very easy to understand, very applicable
- Good** – easy to understand, applicable
- Average** – applicable but some sections not easy to understand
- Fair** – not very understandable or applicable, must be improved
- Poor** – not understandable or applicable, must be improved
- No Opinion**

How well do the manual's *illustrations* convey product information? Please explain on a separate sheet.

- Excellent** – very easy to understand, extremely usable
- Good** – easy to understand, very usable
- Average** – fairly easy to understand, usable
- Fair** – not easy to understand, should be improved, not very usable
- Poor** – cannot understand, must be improved, totally unusable
- No Opinion**

---

Describe the *amount* of usable information in this manual including tables.  
Please explain.

- Too much information** – not all required to perform task
- Proper amount provided** – not too much or too little
- Too little information** – needed additional information to perform task
- No Opinion**

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How well is information *cross-referenced* in the manual's individual section?  
Please explain.

- Excellent** – very easy to locate information, extremely usable
- Good** – easy to locate information, very usable
- Average** – fairly easy to locate information, usable
- Fair** – not easy to locate information, should be improved, not very usable
- Poor** – cannot locate information, must be improved, totally unusable
- Did Not Use**
- No Opinion**

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How *useful* is the Glossary?

- Useful**
- Useful but not complete or accurate**
- Not Useful**
- Did Not Use**
- No Opinion**

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What is your *overall impression* of this manual?  
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- Excellent** – met all needs, extremely usable
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  - Fair** – should be revised, not very usable
  - Poor** – must be revised, totally unusable
  - No Opinion**
- 

Questions/Further Comments:

Please fax or mail this form to:

**DATUM GmbH**  
Service/Support  
Fichtenstrasse 25  
D-85649 Hofolding / Munich  
Germany

Phone: +49 – 700DATUMHELP  
+49 – 700-32886435  
Fax: +49 – 8104-6624-33  
e-mail: [service@datumgmbh.de](mailto:service@datumgmbh.de)  
web: [www.datum.com](http://www.datum.com)



Service/Support

Phone: +49-700DATUMHELP  
+49-700-32886435  
Fax: +49-8104-6624-33  
E-mail: [service@datumgmbh.de](mailto:service@datumgmbh.de)

International Sales

Datum GmbH  
Fichtenstrasse 25  
D-85649 Hofolding / Munich  
Germany

Phone: +49-8104-6624-29  
Fax: +49-8104-6624-28  
E-mail: [sales@datumgmbh.de](mailto:sales@datumgmbh.de)

US Sales

Datum - Timing, Test & Measurement  
34 Tozer Road  
Beverly, MA 01915-5510  
USA

Phone: 978-927-8220  
Fax: 978-927-4099  
E-mail: [ttmsales@datum.com](mailto:ttmsales@datum.com)



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