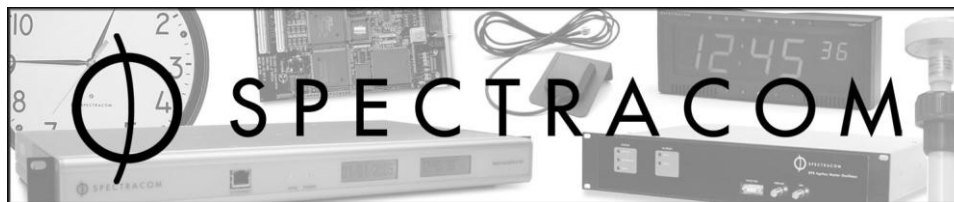


*EPSILON CLOCK  
MODELS EC2S, EC2S-RB & EC2T  
USER'S MANUAL*

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Ref. Number 4159-H1

Manual Revision H4

16 November 2010

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# SPECTRACOM LIMITED WARRANTY

## LIMITED WARRANTY

Spectracom warrants each new product manufactured and sold by it to be free from defects in software, material, workmanship, and construction, except for batteries, fuses, or other material normally consumed in operation that may be contained therein AND AS NOTED BELOW, for five years after shipment to the original purchaser (which period is referred to as the "warranty period"). This warranty shall not apply if the product is used contrary to the instructions in its manual or is otherwise subjected to misuse, abnormal operations, accident, lightning or transient surge, repairs or modifications not performed by Spectracom.

The GPS receiver is warranted for one year from date of shipment and subject to the exceptions listed above. The power adapter, if supplied, is warranted for one year from date of shipment and subject to the exceptions listed above.

THE TIMEVIEW ANALOG CLOCKS ARE WARRANTED FOR ONE YEAR FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

THE TIMECODE READER/GENERATORS ARE WARRANTED FOR ONE YEAR FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

THE WIRELESS CLOCK SYSTEM TRANSMITTERS AND/OR TRANSCEIVERS AND CLOCKS ARE WARRANTED FOR TWO YEARS FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

THE EPSILON CLOCKS, BOARDS, AND SYNCHRONIZATION UNITS ARE WARRANTED FOR TWO YEARS FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

The Rubidium oscillator, if supplied, is warranted for two years from date of shipment and subject to the exceptions listed above.

All other items and pieces of equipment not specified above, including the antenna unit, antenna surge suppressor and antenna pre-amplifier are warranted for 5 years, subject to the exceptions listed above.

## WARRANTY CLAIMS

Spectracom's obligation under this warranty is limited to in-factory service and repair, at Spectracom's option, of the product or the component thereof, which is found to be defective. If in Spectracom's judgment the defective condition in a Spectracom product is for a cause listed above for which Spectracom is not responsible, Spectracom will make the repairs or replacement of components and charge its then current price, which buyer agrees to pay.

Spectracom shall not have any warranty obligations if the procedure for warranty claims is not followed. Users must notify Spectracom of the claim with full information as to the claimed defect. Spectracom products shall not be returned unless a return authorization number is issued by Spectracom.

Spectracom products must be returned with the description of the claimed defect and identification of the individual to be contacted if additional information is needed. Spectracom products must be returned properly packed with transportation charges prepaid.

**Shipping expense:** Expenses incurred for shipping Spectracom products to and from Spectracom (including international customs fees) shall be paid for by the customer, with the following exception. For customers located within the United States, any product repaired by Spectracom under a "warranty repair" will be shipped back to the customer at Spectracom's expense unless special/faster delivery is requested by customer.

Spectracom highly recommends that prior to returning equipment for service work, our technical support department be contacted to provide trouble shooting assistance while the equipment is still installed. If equipment is returned without first contacting the support department and "no problems are found" during the repair work, an evaluation fee may be charged.

EXCEPT FOR THE LIMITED WARRANTY STATED ABOVE, SPECTRACOM DISCLAIMS ALL WARRANTIES OF ANY KIND WITH REGARD TO SPECTRACOM PRODUCTS OR OTHER MATERIALS PROVIDED BY SPECTRACOM, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Spectracom shall have no liability or responsibility to the original customer or any other party with respect to any liability, loss, or damage caused directly or indirectly by any Spectracom product, material, or software sold or provided by Spectracom, replacement parts or units, or services provided, including but not limited to any interruption of service, excess charges resulting from malfunctions of hardware or software, loss of business or anticipatory profits resulting from the use or operation of the Spectracom product or software, whatsoever or howsoever caused. In no event shall Spectracom be liable for any direct, indirect, special or consequential damages whether the claims are grounded in contract, tort (including negligence), or strict liability.

## EXTENDED WARRANTY COVERAGE

Extended warranties can be purchased for additional periods beyond the standard five-year warranty for those products covered under five-year warranty. Contact Spectracom no later than the last year of the standard five-year warranty for extended coverage.



## Table of Contents

|            |  |            |
|------------|--|------------|
| <b>1</b>   | <b>INTRODUCTION.....</b>   | <b>1-1</b> |
| <b>1.1</b> | <b>Inventory</b>   | <b>1-2</b> |
| <b>1.2</b> | <b>Inspection</b>  | <b>1-2</b> |
| <b>1.3</b> | <b>Dimensions and Weight</b>   | <b>1-2</b> |
| <b>1.4</b> | <b>Basic Configuration</b>   | <b>1-2</b> |
| <b>1.5</b> | <b>Terminology</b>   | <b>1-3</b> |
| <b>1.6</b> | <b>Front and Rear Panel</b>  | <b>1-4</b> |
| <b>2</b>   | <b>INSTALLATION.....</b>   | <b>2-1</b> |
| <b>2.1</b> | <b>Preliminary Connections</b>                                       | <b>2-1</b> |
| <b>2.2</b> | <b>Connections Quality</b>   | <b>2-2</b> |
| <b>2.3</b> | <b>Starting the Clock</b>  | <b>2-3</b> |
| <b>2.4</b> | <b>Turning Off the Clock</b>   | <b>2-4</b> |
| <b>3</b>   | <b>SPECIFICATIONS.....</b>   | <b>3-1</b> |
| <b>3.1</b> | <b>OCXO Oscillator Equipped</b>                                      | <b>3-1</b> |
| 3.1.1      | Series 2S Frequency output (10 MHz) and Time output (1PPS signal)    | 3-1        |
| 3.1.2      | Series 2T Frequency output (2.048 MHz) and Time output (1PPS signal) | 3-2        |
| <b>3.2</b> | <b>Rubidium Oscillator Equipped</b>                                  | <b>3-3</b> |
| 3.2.1      | Series 2S Frequency output (10 MHz)                                  | 3-3        |
| <b>4</b>   | <b>FEATURES.....</b>   | <b>4-1</b> |
| <b>4.1</b> | <b>Frequency Output</b>  | <b>4-1</b> |
| <b>4.2</b> | <b>1PPS Output</b>   | <b>4-1</b> |
| <b>4.3</b> | <b>Optional G.704 Output</b>   | <b>4-1</b> |
| <b>4.4</b> | <b>Optional 2MHZ - 2MBIT/S Outputs</b>                               | <b>4-2</b> |
| 4.4.1      | Features of 2.048 Mhz Outputs  | 4-2        |
| 4.4.2      | Features of 2048 Kbit/s Output                                       | 4-2        |
| <b>4.5</b> | <b>Optional STANAG 4430 (HAVEQUICK) Output</b>                       | <b>4-3</b> |
| <b>4.6</b> | <b>Optional IRIG-B Output</b>  | <b>4-4</b> |

|             |  |            |
|-------------|--|------------|
| <b>4.7</b>  | <b>Remote Control Interface (RS232C)</b>                               | <b>4-4</b> |
| <b>4.8</b>  | <b>TOD Output</b>  | <b>4-4</b> |
| <b>4.9</b>  | <b>Alarm</b>   | <b>4-5</b> |
| <b>4.10</b> | <b>Mains Power Supply</b>  | <b>4-5</b> |
| <b>4.11</b> | <b>DC Power Supply</b>   | <b>4-6</b> |
| <b>4.12</b> | <b>GPS Antenna Input</b>   | <b>4-6</b> |
| <b>5</b>    | <b>OPERATING ENVIRONMENT</b> .....                                     | <b>5-1</b> |
| <b>6</b>    | <b>REMOTE CONTROL INTERFACE</b> .....                                  | <b>6-1</b> |
| <b>6.1</b>  | <b>General</b>   | <b>6-1</b> |
| <b>6.2</b>  | <b>Protocol</b>  | <b>6-1</b> |
| <b>6.3</b>  | <b>Commands description</b>  | <b>6-2</b> |
| 6.3.1       | TOD output setup   | 6-2        |
| 6.3.2       | TOD output transmission period   | 6-2        |
| 6.3.3       | Clock reset  | 6-2        |
| 6.3.4       | GPS mode setup   | 6-2        |
| 6.3.5       | GPS Positioning init.  | 6-3        |
| 6.3.6       | Local hour   | 6-3        |
| 6.3.7       | Phase correction   | 6-3        |
| 6.3.8       | Leap second  | 6-3        |
| 6.3.9       | Holdover mode  | 6-4        |
| 6.3.10      | Display  | 6-4        |
| 6.3.11      | Alarms limits  | 6-4        |
| <b>6.4</b>  | <b>Time distribution on the remote control interface</b>               | <b>6-5</b> |
| <b>6.5</b>  | <b>Command and Request List</b>  | <b>6-6</b> |
| <b>7</b>    | <b>MAINTENANCE</b> .....   | <b>7-1</b> |
| <b>7.1</b>  | <b>Loading Profile and Flash</b>                                       | <b>7-1</b> |
| 7.1.1       | EPSILWIN32 Software  | 7-1        |
| 7.1.2       | How to Create a Profile with EPSILWIN32 Software ?                     | 7-1        |
| 7.1.3       | How to check and download a firmware version on an Epsilon Clock unit? | 7-4        |
| 7.1.4       | Download a new software version by selecting SETUP & LOAD FLASH menu?  | 7-5        |
| 7.1.5       | When Restarting Epsilwin32?  | 7-9        |

## 1 Introduction

The EPSILON CLOCK® family of products provides solutions to a wide variety of users for applications involving time, frequency, and synchronization. The Model EC2S and EC2T clocks are highly accurate, stable frequency sources operating from GPS input.

The relative accuracy of clock frequency is  $2.10^{-12}$  in relation to the international frequency definition. Time setting is accurate to less than 100 ns in relation to UTC (GPS) time.

The clock has autonomous control of GPS system integrity features (TRAIM) and rejects defective satellites.

The time reference thus obtained is processed by efficient algorithms that control the built-in oscillator, which generates inner frequency and time signals. The clock continues to distribute time and frequency signals even if the GPS input signal is lost. Furthermore, “learning” from its behavior in different situations (effects attributed to aging and to temperature variations) while the GPS reference signal is present, the frequency driver improves on the accuracy of time and frequency distribution when the GPS signal is lost.

Most of the EPSILON CLOCK's functions are software controlled. At start-up, the clock carries out a series of automatic tests, including hardware tests and verification of the built-in oscillator's stability, before making an initial coarse adjustment to the distributed frequency. After half an hour, the frequency accuracy approaches  $1.10^{-9}$  and the time setting is accurate to within  $1\mu\text{s}$  of UTC time.

**NOTE:** This document refers to EPSILON CLOCK® series 2S (P/N: 08738) version release E, 10MHz Rb (P/N: 09282) version release D and EPSILON CLOCK® series 2T (P/N: 35902) version O. For other releases, please contact Spectracom Customer Support.

The standard EPSILON CLOCK® Model EC2S and EC2T clocks are used to generate, maintain, and provide the following:

- A synchronized UTC (GPS) time reference. The clock distributes a 1PPS signal and a time code message corresponding to this signal.
- A frequency reference (four 10 MHz outputs for the Series 2S or four 2048 kHz outputs for the Series 2T).

The clock is powered by AC or DC power supplies. A remote control interface provides information on clock status and allows the user to send initialization and configuration commands. The working status of the clock is reported locally using the three LED indicators on the front panel of the machine.

The relay contact output of the machine is closed in the event of hardware failure (the closure on hardware or software failure is a factory setting).

The EPSILON CLOCK® is fully automatic. It requires no field service for a period of 10 years.

## 1.1 Inventory

Before installing your Spectracom product, please verify that all material ordered has been received. If there is a discrepancy, please contact Spectracom Customer Service. Customer service is available by telephone at +33 (0) 1.64.53.39.80 (France), or +1.585.321.5800 (United States). Updated contacts information are available on web site, see "Support" page.

**CAUTION:**

*Electronic equipment is sensitive to Electrostatic Discharge (ESD). Observe all applicable ESD precautions and safeguards when handling the Spectracom equipment.*

**NOTE:** If equipment is returned to Spectracom, it must be shipped in its original packing material. Save all packaging material for this purpose.

## 1.2 Inspection

Unpack the equipment and inspect it for damage. If any equipment has been damaged in transit, please contact Spectracom Customer Service. Customer service is available by telephone at +33 (0) 1.64.53.39.80 (France), or +1.585.321.5800 (United States). Updated contacts information are available on web site, see "Support" page.

## 1.3 Dimensions and Weight

**Height** 1 U \* 44 mm  
**Width** 19" \* 483 mm  
**Depth** \* 340 mm  
**Weight** < 5 kg

## 1.4 Basic Configuration

This document is applicable to the EPSILON CLOCK® Model EC2S and EC2T equipped with OCXO or Rubidium oscillators. In its basic configuration, the EPSILON CLOCK® Series 2S is equipped with:

- 1 GPS antenna input,
- 1 main power supply input (90 to 265V / 48 to 63 Hz),
- 1 DC power supply input (18 to 32 VDC),
- 4 x 10 MHz outputs (>10 dB / 50 Ω),
- 1 1PPS output (TTL / 50 Ω),
- 1 time code output (RS232C),
- 1 alarm output (relay contact),
- 1 remote control interface (RS 232C).



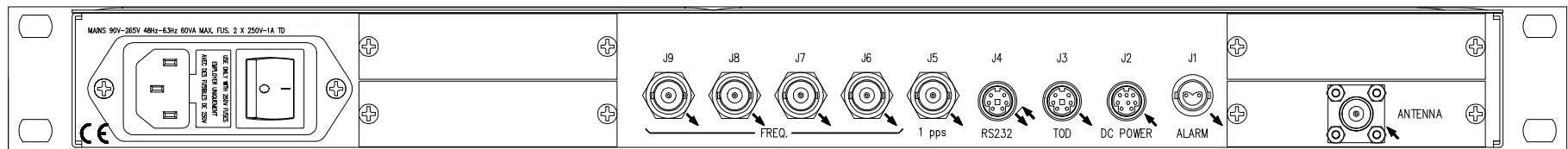
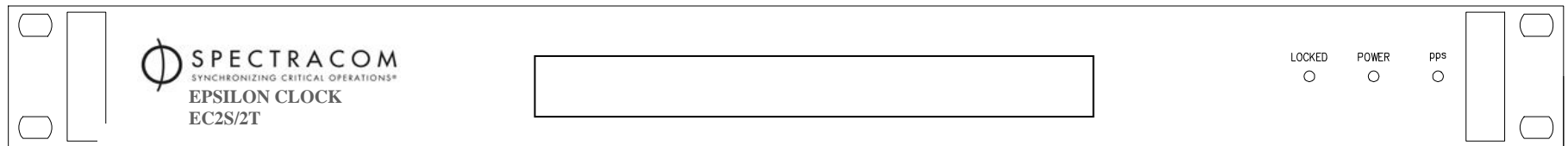
In its basic configuration, the EPSILON CLOCK® Series 2T is equipped with:

- 1 GPS antenna input,
- 1 main power supply input (90 to 265V / 48 to 63 Hz),
- 1 DC power supply input (36 to 72 VDC),
- 4 x 2048 kHz outputs ( G 703 § 13 / 75 Ω),
- 1 1PPS output (TTL / 50 Ω),
- 1 time code output (RS232C),
- 1 alarm output (relay contact),
- 1 remote control interface (RS 232C).

## ***1.5 Terminology***

|                         |  |
|-------------------------|--|
| <b>GPS</b>              | Global Positioning System  |
| <b>OCXO</b>             | Oven Controlled XTAL (Crystal) Oscillator  |
| <b>Rb</b>               | Rubidium oscillator  |
| <b>S/A</b>              | Selective Availability   |
| <b>TRAIM</b>            | Time Receiver Autonomous Integrity Monitoring  |
| <b>UTC</b>              | Universal Time Coordinated   |
| <b>1PPS</b>             | One Pulse Per Second   |
| <b>1 PPS driver</b>     | Pulse signal obtained through division of the frequency driver   |
| <b>Holdover</b>         | If the reference input signal is lost, the EPSILON CLOCK® maintains the generation of information and of time and frequency signals.   |
| <b>Reliability</b>      | Concerns the positioning mode of the antenna. In automatic mode, the EPSILON CLOCK® calculates the position of the antenna and, after testing the result, imposes the reliable position on the internal GPS receiver. The receiver therefore functions in GPS 0D reception mode. The EPSILON CLOCK® is synchronized by following at least one satellite. |
| <b>Frequency driver</b> | Frequency signal generated by the built-in oscillator.   |
| <b>Reference input</b>  | Time and frequency source used by the EPSILON CLOCK®.  |
| <b>IERS</b>             | International Earth Rotation Service.  |

### 1.6 Front and Rear Panel



## 2 Installation

### 2.1 Preliminary Connections

If installing the unit in a rack, install the rack-mount ears on the two sides of the front panel and mount the unit in a standard 19 inch rack cabinet. The unit is intended to be installed in one orientation only. The unit should be mounted so the front panel interface keys are to the left of the display area.

Before starting the EPSILON CLOCK®, perform the following tasks:

- Position the machine so that the upper and lower air vents are not obstructed.
- Position the GPS antenna outside with an unobstructed view of the sky over 360 degrees (on top of a mast, for example).

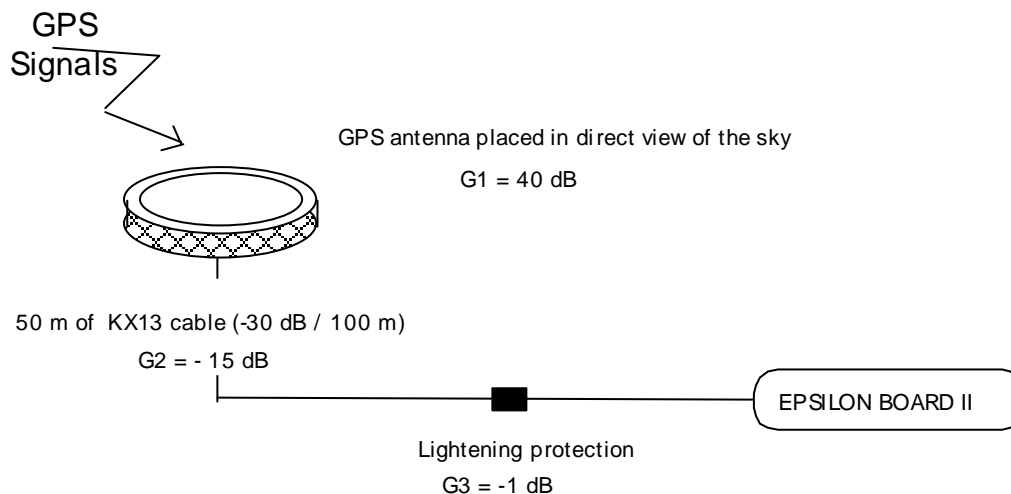
#### CAUTION:



*The EPSILON CLOCK® is designed to be used with the supplied GPS antenna ONLY. Using another antenna may cause significant damage to the unit and will void your Spectracom warranty.*

- Connect the antenna cable to the MCX GPS connector of the GPS receiver. To ensure the correct reception of the GPS signal, the overall system of antenna/cable/protection requires accurate gain matching.

Example:



$$G1 + G2 + G3 = 40 \text{ dB} - 15 \text{ dB} - 1 \text{ dB} = 24 \text{ dB}$$

$$\text{Thus: } X_{\min} \text{ dB} < G1 + G2 + G3 = 24 \text{ dB} < X_{\max} \text{ dB}$$

$X_{\min}$  and  $X_{\max}$  are defined in last updated revision of application note TF2.

- Connect the clock to the main power supply or connect the DC power supply (24V for the 2S, 48V for the 2T) to the "DC Power" connector (J2).
- The main outlet and every associated extension must provide a protective path to earth ground. The protection must not be defeated by an extension cord lacking an earth conductor.

**WARNING:**



*If the protective conductor's path to ground is broken or defeated, the danger of electrical shock to the operator may be present.*

*Before disconnecting the unit from the main power supply, always switch it off. Failure to do may cause damage that voids your Spectracom warranty.*

## 2.2 Connections Quality

Great care must be taken in setting up the GPS Antenna and its connections. Remember that your GPS antenna must have an unobstructed view of the sky.

The type of cable connecting the antenna to the clock and the length of the cable influence greatly the quality of the signal reception. Cable type and length must conform to the rules described herein.

Connections to the antenna, the accessories (surge protection, in-line amplifier) and the cable must be weatherproofed.

An improper installation could result in problems ranging from random, intermittent loss of signal to complete loss of GPS reference. The most common outcome is the inability to discipline the GPS reference correctly.

## 2.3 Starting the Clock

Verify that the preliminary connections have been made.

If the machine is connected to the main power supply, place the ON/OFF switch in the "1" position.

**NOTE:** The ON/OFF switch does not act on the DC power supply (J2).

About 10 seconds after the power is switched on, the "1PPS" indicator will start flashing once per second. This indicates the normal generation of the 1PPS signal by the built-in oscillator.

**CAUTION:**



*The POWER Led will indicate red until the end of the oscillator warm-up time (15 minutes for OCXO, 1 hour for Rb).*

*For 10 seconds after clock start-up, the TOD and the Remote Control cannot be used.*

The two other colored indicators, "Locked" and "Power", are used to report the status of the clock. During start-up procedures, the colors of these two indicators may be interpreted as follows:

|                                  | Locked | Power | Notes   |
|----------------------------------|--------|-------|---|
| Standard hardware automatic test | Red    | Red   | Checks the basic features of the clock            |
| Optional hardware test           | Green  | Red   | Checks optional features                          |
| Period of synchronization        | Red    | Green | Looking for signal emitted by GPS satellite       |
| Synchronization                  | Green  | Green | The distributed time is synchronized to UTC (GPS) |

In case of hardware failure (or software failure if the corresponding factory setting is active) the "Alarm" output (J1) is activated (closed relay contact).

The conditions for activating this output are as follows:

- Faulty GPS receiver
- Faulty frequency driver
- Faulty frequency divider loop
- Faulty distribution of frequency or synchronization signals
- Faulty frequency or synchronization performances\*

*\* This can be selected via the remote control interface.*

If the failure occurs after the start-up sequence, both the "Locked" and "Power" indicators will be red. In this state, the Time Of Day message is not distributed (Connector J3) and the clock will not be synchronized to the GPS source. If this happens, contact Spectracom technical support for more information.

If none of the indicators are lighted, the clock is not connected to the power supply.

Under normal operating conditions, the EPSILON CLOCK® will synchronize to GPS time about 20 minutes after start-up. When it is synchronized, both the "Locked" and "Power" indicators will be green and the "1PPS" indicator will flash once per second. In this state, the EPSILON CLOCK® continuously provides, with UTC(GPS) reference, the following outputs:

- The 1PPS output (J5) and the associated Time Of Day message output (J3)
- The four frequency outputs (J6 to J9)

The Power led turns red in the following cases:

- Faulty GPS receiver
- Faulty frequency driver
- Faulty frequency divider loop
- Faulty frequency or synchronization outputs or impedances not matched
- Faulty frequency or synchronization performances\*

\* This can be selected via the remote control interface.

**NOTE:** From software version V9R2, when the reference UTC is selected, the source reference "U" transmitted by the TOD and displayed on the front panel display screen will flash every second as long as the 10MHz frequency reference is not cycle locked to the 1pps. This means that there are not always 10,000,000 cycles between 1pps occurrences. This information is also available on the remote control interface.

## 2.4 Turning Off the Clock

To turn-off the EPSILON CLOCK®, place the main power switch to the 0 position and unplug the DC (J2) power supply.

## 3 Specifications

### 3.1 OCXO Oscillator Equipped

#### 3.1.1 Series 2S Frequency output (10 MHz) and Time output (1PPS signal)

| Frequency output (10 MHz)  | High Performance OCXO   | Double Oven OCXO  |
|--|---|---|
| Medium term stability after 24 hours minimum of working with GPS locked at constant temperature, average over 24 hours   | $< \pm 2 \times 10^{-12}$   | $< \pm 1 \times 10^{-12}$   |
| Medium term stability in holdover mode (without GPS) 24 hours after last GPS synchronization at constant temperature, following 48 hours of GPS lock and 2 weeks of continuous operation | $< \pm 2 \times 10^{-10}$ per day                                       | $< \pm 1 \times 10^{-10}$ per day                                       |
| Short term stability, Allan Variance at:<br>1 s<br>10 s<br>100 s   | $1 \times 10^{-11}$<br>$3 \times 10^{-11}$<br>$3 \times 10^{-11}$       | $5 \times 10^{-12}$<br>$1 \times 10^{-11}$<br>$1 \times 10^{-11}$       |
| Temperature stability (peak to peak)   | $1 \times 10^{-9}$<br>from 0 to 60°C                                    | $2 \times 10^{-10}$<br>from -5 to 70°C                                  |
| Phase noise (typical, static conditions)<br>10 Hz<br>100 Hz<br>1 kHz<br>10 kHz<br>100 kHz  | -120 dBc/Hz<br>-130 dBc/Hz<br>-140 dBc/Hz<br>-145 dBc/Hz<br>-145 dBc/Hz | -120 dBc/Hz<br>-130 dBc/Hz<br>-140 dBc/Hz<br>-145 dBc/Hz<br>-145 dBc/Hz |
| Time output (1 PPS)  |   |   |
| Accuracy to UTC: when GPS locked, without SA, $1\sigma$  | $\pm 100$ ns  | $\pm 100$ ns  |
| Holdover mode, at constant temperature, GPS lost following 24 hours of GPS lock:<br><br>after 4 hours<br>after 24 hours  | $< 0.8 \mu\text{s}$<br>$< 12 \mu\text{s}$                               | $< 0.6 \mu\text{s}$<br>$< 7 \mu\text{s}$                                |

**3.1.2 Series 2T Frequency output (2.048 MHz) and Time output (1PPS signal)**

|  |                                      |                                       |
|--|--------------------------------------|---------------------------------------|
| Frequency output (10 MHz)  | High Performance OCXO                | Double Oven OCXO                      |
| Medium term stability after 24 hours minimum of working with GPS locked at constant temperature, average over 24 hours   | $< \pm 2 \times 10^{-12}$            | $< \pm 1 \times 10^{-12}$             |
| medium term stability in holdover mode (without GPS) 24 hours after last GPS synchronization at constant temperature, following 48 hours of GPS lock and 2 weeks of continuous operation | $< \pm 2 \times 10^{-10}$ per day    | $< \pm 1 \times 10^{-10}$ per day     |
| Short term stability, Allan Variance at:   |                                      |                                       |
| 1 s  | $1 \times 10^{-11}$                  | $5 \times 10^{-12}$                   |
| 10 s   | $3 \times 10^{-11}$                  |                                       |
| 100 s  |                                      | $1.5 \times 10^{-11}$                 |
| Temperature stability (peak to peak)   | $1 \times 10^{-9}$<br>from 0 to 60°C | $7 \times 10^{-10}$<br>from 0 to 70°C |
| Time output (1 PPS)  |                                      |                                       |
| Accuracy to UTC: when GPS locked, without SA, $1\sigma$  | $\pm 120$ ns                         | $\pm 120$ ns                          |
| Holdover mode, at constant temperature, GPS lost following 24 hours of GPS lock  |                                      |                                       |
| after 4 hours  | $< 0.8 \mu\text{s}$                  | $< 0.6 \mu\text{s}$                   |
| after 24 hours   | $< 12 \mu\text{s}$                   | $< 7 \mu\text{s}$                     |



## 3.2 Rubidium Oscillator Equipped

### 3.2.1 Series 2S Frequency output (10 MHz)

|  |   |  |
|--|---|--|
| Frequency output (10 MHz)  |   | Hig performance<br>Rb  |
| Medium term stability after 24 hours minimum of working with GPS locked at constant temperature after 3 month of continuous operation, average over 24 hours                               |   | $< \pm 1 \times 10^{-12}$  |
| Medium term stability in holdover mode (without GPS) 24 hours after last GPS synchronization at constant temperature, following 48 hours of GPS lock and 3 months of continuous operation: | 24 hours<br>30 days                           | $< \pm 1 \times 10^{-11}$<br>$< \pm 5 \times 10^{-11}$                 |
| Short term stability, Allan Variance at:   | 10 s<br>100 s                                 | $1 \times 10^{-11}$<br>$3 \times 10^{-12}$                             |
| Temperature stability (peak to peak)   |   | $2 \times 10^{-10}$<br>from -5 to 70°C                                 |
| Phase noise (typical, static conditions)   | 10 Hz<br>100 Hz<br>1 kHz<br>10 kHz<br>100 kHz | -80 dBc/Hz<br>-115 dBc/Hz<br>-135 dBc/Hz<br>-140 dBc/Hz<br>-140 dBc/Hz |
| Time output (1 PPS)  |   |  |
| Accuracy to UTC: when GPS locked, without SA, $1\sigma$  |   | $\pm 100$ ns   |
| Holdover mode, in stable temperature, gravity, pressure and magnetic fields conditions, after 3 months of continuous operation, GPS lost following 24 hours of GPS lock:                   | after 4 hours<br>after 24 hours               | $< 0.3 \mu\text{s}$<br>$< 2 \mu\text{s}$                               |



## 4 Features

### 4.1 Frequency Output

Connectors: J6, J7, J8, J9 BNC Female

**Pin settings:**

Core: Sine-wave signal

**Series 2S**

Frequency: 10 MHz

Level: > 10 dBm load 50  $\Omega$  (typical 13 dBm)

**Series 2T**

Frequency: 2048 kHz

Level: G703 §13 75 $\Omega$  (120 $\Omega$  optional with BR2 connectors).

Ground: Electrical ground of the clock

### 4.2 1PPS Output

Connector J5: BNC Female

**Pin settings:**

Core: Periodic pulse

Period: 1s

Active edge: Rising

Pulse duration: 100 $\mu$ s  $\pm$  10 $\mu$ s

High-level: > 2.4 V load 50 $\Omega$

Low-level: < 0.8 V load 50 $\Omega$

Rising edge duration: < 20 ns load 50 $\Omega$

Ground: Electrical and mechanical ground of the clock

### 4.3 Optional G.704 Output

**EPSILON CLOCK<sup>®</sup> Series 2T only:**

Number of outputs: 2

Type: Synchronization frames at 2048 kbits/second in accordance with G.704.

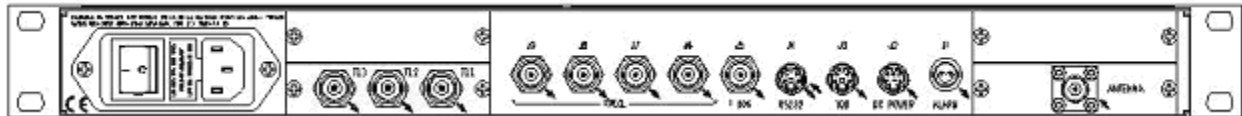
Electrical adaptation: 120  $\Omega$  output in accordance with G.703 §9  
(optional 75 $\Omega$  output with BNC connectors ).

Connectors: J<sub>1</sub> and J<sub>2</sub> of the "G.704" rear panel plate, BR2 Female.

## 4.4 Optional 2MHZ – 2MBIT/S Outputs

Number of Outputs: 3  
 Type: 2 x 2.048 Mhz and 1 x 2048 kbit/s

With this option, the Epsilon Clock outputs two 2.048 MHz on J11, J12 and one 2048 kbit/s on J13.



### 4.4.1 Features of 2.048 Mhz Outputs

Connectors: J11 and J12 of the obturator panel “FREQ”: BNC Female for 75 Ohms Output impedance. BR2 Female for 120 Ohms Output impedance.

Pin settings:

- Core : Sine-wave signal
  - o Frequency : 2048 kHz
  - o Level : G.703 § 13 / 75  $\Omega$  or 120  $\Omega$
- Ground: electrical ground of the clock.

### 4.4.2 Features of 2048 Kbit/s Output

Connector: J13 of the obturator panel “FREQ”: BNC Female for 75 Ohms Output impedance. BR2 Female for 120 Ohms Output impedance.

Type: Synchronization frames at 2048 kbits/s in conformance with ITU-T Recommendation G.703 § 9 and G.704.

Pin settings:

- Core : Synchronization frames
  - o Level : G.703 § 9, 75  $\Omega$  or 120  $\Omega$
- Ground: electrical ground of the clock.

## 4.5 Optional STANAG 4430 (HAVEQUICK) Output

This option provides one output port with the following information in accordance with STANAG 4430 edition 1 (NATO):

- Standard Time Message (STM) with synchronization
- Have Quick Message (XHQ) with synchronization.

The connector type is DB25:

- STM and XHQ messages in accordance with Apendice A, Ed 1 STANAG 4430. The XHQ message is available in RS485.
- Connectors: SUB-D 25 pin Female (HE501).

Pin settings:

| Pin Number | Signal                            |
|------------|-----------------------------------|
| 1          | Electrical and mechanical ground  |
| 2          | RS485 Time message high           |
| 3          | Reserved                          |
| 4          | XHQ RS485 high message            |
| 5          | Reserved                          |
| 6          | Electrical and mechanical ground  |
| 7          | Electrical and mechanical ground  |
| 8          | Reserved                          |
| 9          | 1PPS RS485 high                   |
| 10         | Reserved                          |
| 11         | Reserved                          |
| 12         | Electrical and mechanical ground  |
| 13         | 0-5V Have Quick message broadened |
| 14         | RS485 Time message low            |
| 15         | Reserved                          |
| 16         | Reserved                          |
| 17         | XHQ RS485 low message             |
| 18         | Reserved                          |
| 19         | Reserved                          |
| 20         | Reserved                          |
| 21         | 1PPS RS485 low                    |
| 22         | Reserved                          |
| 23         | Electrical and mechanic ground    |
| 24         | 1PPS Have Quick 0-5V              |
| 25         | Electrical and mechanic ground    |

N.B. The pin shown "Reserved" may be used by the constructor for validation or extension needs and should not be connected by the user.

## 4.6 Optional IRIG-B Output

The Epsilon Clock outputs time code signal in IRIG-B format when optional output board is installed.

This IRIG-B (Inter-Range Instrumentation Group-format B) option provides one output signal (GPS / UTC time information) in conformance with IRIG-B Recommendation (1 kHz carrier, 0 dBm / 600  $\Omega$ ) or with NFS 87 500 (variante A, annexe C).

Maximum output level of 1 kHz carrier: 2,2 Vpp / 600  $\Omega$  (typical)

The connector type is BNC.

## 4.7 Remote Control Interface (RS232C)

|   |  |
|---|--|
| Serial port parameters:                 | 9600 bps, 8 bits, 1 stop bit, odd parity |
| Protocol / syntax / format of messages: | Refer to the remote control interface    |
| Data:                                   | Binary (two's complement)                |
| Order of bytes emitted:                 | Most significant bytes first             |

Connector J4: Mini Din 8 pins female

### Pin settings:

| <u>Pin</u> | <u>Setting</u>                   |
|------------|----------------------------------|
| 1          | Reserved                         |
| 2          | Reserved                         |
| 3          | Message Output (RS 232C)         |
| 4          | Electrical and mechanical ground |
| 5          | Message Input (RS232C)           |
| 6          | NC                               |
| 7          | NC                               |
| 8          | Reserved                         |

## 4.8 TOD Output

### Time Of Day message output:

Output: ASCII, 9600 bps, 8 bits, 1 stop bit, odd parity.  
 Protocol: <Message> CR LF  
 Format\*: Day/Month/Year Hour: Minute: Second Source  
 e.g.: 20/03/1996\_21:02:05U

Format\*: Month/Day/Year Hour: Minute: Second Source  
 e.g.: 11/12/1996\_18:14:38L

Format\*: Day of Year/Year Hour: Minute: Second Source  
 e.g.: 317/1996\_18:16:20 L

Format\*: MJD\*\* - Integer part Hour: Minute: Second Source

e.g.: \_\_\_\_\_50399.18:20:50\_U

Format\*:    MJD\*\*                    Source  
e.g.:        \_\_\_\_\_50399.762130\_L

The "Source" byte holds one ASCII character which codes the reference of the time chosen

N    No reference  
U    UTC reference  
G    GPS reference  
L    Local time  
M    Manual  
-    Maximum output period\*:        1 message per second  
-    Output synchronization:        sent at 200 ms  $\pm$ 100 ms after the 1PPS signal.

**NOTE:** From software version V9R2, when the reference UTC is selected, the source reference "U" transmitted by the TOD and displayed on the front panel display screen will flash every second as long as the 10MHz frequency reference is not cycle locked to the 1pps. This means that there are not always 10,000,000 cycles between 1pps occurrences. This information is also available on the remote control interface.

\* Programmable through the remote control interface.

\*\* Modified Julian Day

Connectors: J3

Mini Din 6 pins Female

#### ***Pin settings:***

| <u>Pin</u> | <u>Setting</u>                   |
|------------|----------------------------------|
| 1          | Reserved                         |
| 2          | NC                               |
| 3          | Electrical and mechanical ground |
| 4          | Electrical and mechanical ground |
| 5          | Message Output (RS232C)          |
| 6          | NC                               |

## ***4.9 Alarm***

Connector:                    J1 BR2 Female  
Resistive Contact Rating:    30 VA / 250 V (DC Load)  
Ground:                      Mechanical ground of the clock

## ***4.10 Mains Power Supply***

### ***Mains power connector CCE22 with ON/OFF switch.***

Input voltage:                90 to 265 V / 48 to 63 Hz  
Fuses:                        2 x 250 V - 1A TD (Time Delay)  
Consumption:                OCXO type oscillator : < 25 W typical  
Rb type oscillator:         < 30 W typical (< 45W during warm-up)

## 4.11 DC Power Supply

### **Input power (VDC):**

Series 2S: 18 to 32V

Series 2T: 36 to 72V

Consumption: OCXO type oscillator: < 25 W typical

Rb type oscillator: < 40 W typical (< 60W during warm-up)

Protection against polarity inversion.

Protection against short-circuit: polyswitch ensures the isolation of the clock in relation to the DC power supply in the event of a short-circuit of the clock's power supply.

Connector J2: Min Din 7 pins Female

### **Pin settings:**

| <u>Pin</u> | <u>Setting</u>    |
|------------|-------------------|
| 1          | VDC               |
| 2          | VDC               |
| 3          | VDC               |
| 4          | VDC               |
| 5          | Electrical Ground |
| 6          | Electrical Ground |
| 7          | Electrical Ground |

## 4.12 GPS Antenna Input

Connector "Antenna": TNC Female 50Ω

Core: GPS Signal Input (L1)

### **Output power supply of the active antenna**

Voltage: 5V

Current: 75 mA max.

"Fold Back" protection: The power supply is cut in the event of a short-circuit in the antenna input.

Ground: Electrical and mechanical ground of the clock



## 5 *Operating Environment*

Operating temperature: -5 to +60°C  
Storage temperature: - 40°C to 85°C  
Relative humidity: 95 % without condensation, at + 40°C

### **EMC:**

Radiated and conducted Emissions: In accordance with EN 55022 class B  
Radiations immunity and conducted disturbances: In accordance with EN 50082-1  
Electrostatic discharges: In accordance with EN 50082-1 level B

Low-voltage security: In accordance with EN 60950



## 6 Remote Control Interface

### 6.1 General

The remote control interface allows remote configuration and remote status reporting of the clock. The RS232C connection operates at 9600 bps and is set to 8 bits, 1 stop bit, and odd parity.

### 6.2 Protocol

The protocol used is Master (Host) / Slave (EPSILON CLOCK<sup>®</sup>) with a systematic reply to all messages. The following exceptions apply (for which no reply is expected):

- The time code message sent periodically
- The reset clock command

All messages start with the "STX" character and end with the "ETX" character.  
e.g.: <STX> <Message> <ETX>

The characters " STX ", " ETX " or " DLE " to be sent within a message should be escaped (prefixed) by the "DLE" character.

Each message contains four distinct sections:

- The message "ID" (this identifies the type of message being sent):
- The count of the number of data bytes in the message (CNT),
- The data bytes (DATA<sup>(\*)</sup>) of the message,
- The checksum: calculated by performing an exclusive OR on all the consecutive characters in the message (ID + CNT + DATA)

e.g.: <Message> = <ID> <CNT > <DATA<sup>(\*)</sup>> <CS>  
Number of bytes 1 1 N 1

(\*): The encoding format of the DATA is based on "MOTOROLA big Endian" type (integer, long, float, and double data must be sent or received with the MSB first).

**NOTE:** The maximum length of the <DATA> section is 255 bytes.

Messages belong to one of three categories:

- Queries (requests for information from the EPSILON CLOCK<sup>®</sup>)
- Commands (functions that initialize or configure the EPSILON CLOCK<sup>®</sup>)
- Error Messages (returned by the clock if errors are detected in the Queries or Commands sent by the user)

When a user sends a message to the EPSILON CLOCK<sup>®</sup>, it replies within the current second. This reply, or acknowledgement, is formatted as follows:

- The format of the message is identical to the message sent by the user

- The contents of sections <ID> and <CNT> are identical to those sent by the user
- The content of the <DATA > section:
  - Is identical to that sent by the user if the message was a Command
  - Contains the information supplied by the clock, if the message was a Query

The acknowledgement to a Command is an exact copy of the message sent.

The reply to a Query is the copy of the Query message with the <DATA> section completed by the EPSILON CLOCK<sup>®</sup>. In a query, the <DATA> field is not taken into account by the EPSILON CLOCK<sup>®</sup> command interpreter.

An Error message is generated by the clock if one of the following errors occurs:

- The message contains an unknown ID
- The number of bytes in the <DATA> section does not correspond to the <CNT> value
- An overflow is detected in a parameter within the <DATA> section

## ***6.3 Commands description***

### ***6.3.1 TOD output setup***

This command allows the user to modify the contents of the periodical messages transmitted by the clock on the TOD output. In standard mode, the default message transmitted contains the current date and hour according to the codes provided herein. In diagnostic mode, the message transmitted contains information regarding the disciplining of the frequency driver to the GPS reference. This mode is used by the manufacturer during the “good” working verification phases.

### ***6.3.2 TOD output transmission period***

This command defines the transmission period to the TOD message on the corresponding special link. This period is quantified in seconds; the value 0 inhibits permanently the transmission of the message.

### ***6.3.3 Clock reset***

This command generates the re-initialization of the clock.

### ***6.3.4 GPS mode setup***

This command defines the clock functioning mode with regards to the GPS signals received. Three modes are available: Automatic, Manual, or Mobile.

The Automatic mode is the default mode during the clock initialization. In this mode, the clock averages during 1 hour the antenna position supplied by the receiver in order to make it reliable. After this period and providing that a minimum of 4 satellites were received at all times, the position is fixed and the clock requires only one satellite for time transfer. This 1 hour reliability procedure of the position is initialized every time the clock is switched on and is maintained as long as a minimum of 4 satellites are not received continuously.

The manual mode allows the user to instantaneously force the GPS receiver to function in one satellite mode. The user is required to enter the date and the geographic position of the antenna.

The Mobile mode is useful when the clock is moved while functioning. This command prevents the GPS receiver from switching to the 1 satellite mode. It is therefore necessary in this case to receive a minimum of 4 satellites continuously to ensure a good disciplining of the frequency source.

### **6.3.5 GPS Positioning init.**

This command allows the initialization of the antenna position. This is necessary in Manual mode. This command also allows the user to define which time reference is used. The two possibilities are as follows:

- The Universal Time Coordinated,
- The GPS Atomic Time.

The difference between these two time references is equal to a whole number of seconds, which changes with every leap second insertion in the UTC reference.

The GPS Atomic Time reference is recommended when the user's application requires a perfectly continuous time reference. In effect, the GPS Atomic Time is not subject to leap second insertion.

### **6.3.6 Local hour**

Using this command, the user may shift the hour transmitted by the GPS clock. This shift corresponds to a whole number of hours and minutes (such as a correction for DST).

### **6.3.7 Phase correction**

The cable between the antenna and the clock generates a propagation delay of the GPS signal. This delay corresponds to a time shift of the synchronizing signal. This time shift can be compensated for using this command. The correction is entered in nanoseconds, and the value corresponding to the delay is linked to the type of cable and its length. As a general rule of thumb, the value for the delay of a coaxial cable is 3 to 4 nanoseconds per meter.

### **6.3.8 Leap second**

The UTC time reference, maintained by the GPS clock, is subject to leap second corrections, the purpose of which is to maintain the difference between the atomic time represented by UTC and the astronomic time. These corrections decided by the IERS are published in Bulletin C and D.

If the time reference used by the clock is UTC, these corrections are automatically made in real time provided the GPS signal is received correctly. This command allows the clock to maintain a reliable time reference by programming in advance the leap second correction, ensuring it will be applied even in the case of loss of GPS signal input.

This command does not apply to the other time references.

### 6.3.9 Holdover mode

The initial functioning mode of the clock is always synchronized on the GPS reception. However, the user may configure the clock in the holdover mode, specifically, the disciplining of the driver frequency and if the 1 pps is stopped.

### 6.3.10 Display

This command defines the format of the hour transmitted by the TOD message and displayed on the front panel display screen if this option was chosen.

The five formats available are as follows:

- |                      |                       |
|----------------------|-----------------------|
| • Day / Month / Year | Hour: Minute: Second  |
| • Month / Day / Year | Hour: Minute: Second  |
| • Day of year / Year | Hour: Minute: Second  |
| • MJD                | (Modified Julian Day) |
| • MJD integer part   | Hour: Minute: Second  |

With this command, the user defines whether the output of the hour is issued from the UTC or GPS time reference, or from the local hour with the programmed shift.

### 6.3.11 Alarms limits

If the GPS input signal is lost, the clock's internal oscillator is no longer disciplined. The frequency accuracy and the distributed synchronization start to degrade slowly according to the ageing of the oscillator.

Using the alarms limits commands, the user may define the accuracy limits outside of which the output signals are deemed invalid. These limit values are in the form of a time difference for the 1 PPS and in the form of a relative frequency difference for the frequency outputs.

When these limit values are reached, a fault is generated and the contact relay is closed.

In addition, the user may activate the squelch of the frequency outputs. These outputs are disabled in the same way the alarm is activated.

**NOTE:** From software version V8R9, with OCXO oscillator inside, the user has the possibility to program the frequency limit with a step of  $1.10^{-10}$  in the range of  $1.10^{-10}$  to  $1.10^{-6}$  against  $1.10^{-9}$  in a range of  $1.10^{-9}$  to  $1.10^{-6}$  with previous version.

To know the step that the EPSILON CLOCK<sup>®</sup> is able to support, the user must send an alarm limits query with the MSB of the long integer, which encodes the frequency limit at one.

If, in the reply message, this bit is set at one, then both steps  $1.10^{-10}$  and  $1.10^{-9}$  are allowed. Otherwise, only step  $1.10^{-9}$  is supported.

When equipped with a Rubidium oscillator, the user can program the frequency limit with a step of  $1.10^{-12}$  in the range of  $1.10^{-12}$  to  $1.10^{-8}$ .

## 6.4 Time distribution on the remote control interface

The time message is transmitted to the remote control interface. The format and the output TOD are selected by the "display" function. The transmission is synchronous with the 1pps.

|           |  |
|-----------|--|
| Format 1: | ID: 193                                    |
|           | CNT: 8                                     |
|           | DATA: day/month/year/hour/min/sec/source   |
| Format 2: | ID: 194                                    |
|           | CNT: 8                                     |
|           | DATA: day/month/year/hour/min/sec/source   |
| Format 3: | ID: 195                                    |
|           | CNT: 8                                     |
|           | DATA: Day of Year/year/hour/min/sec/source |
| Format 4: | ID: 196                                    |
|           | CNT: 9                                     |
|           | DATA: MJD/source                           |
| Format 5: | ID: 197                                    |
|           | CNT: 8                                     |
|           | DATA: MJD integer part/hour/min/sec/source |

The "Source" byte holds an ASCII character, which codes the time reference:

|   |               |
|---|---------------|
| N | No reference  |
| U | UTC reference |
| G | GPS reference |
| L | Local time    |
| M | Manual        |

**NOTE:** From software version V9R2, when the reference UTC is selected, the source reference "U" transmitted by the TOD and displayed on the front panel display screen flashes every second as long as the 10MHz frequency reference is not cycle locked to the 1pps. This means that there are not always 10,000,000 cycles between 1pps occurrences. This information is also available on the remote control interface.

## 6.5 Command and Request List

| Designation  | Command ID | query ID | Number of bytes | Command validity conditions |
|--|------------|----------|-----------------|-----------------------------|
| Status   | ---        | 80       | 37              | (1)                         |
| TOD output setup   | 1          | 65       | 1               | (1)                         |
| Emission period of the time message on the TOD interface and on the remote control interface | 2          | 66       | 4               |                             |
| Reset clock  | 16         | ---      | 0               | (1)                         |
| GPS Positioning init   | 10         | 74       | 19              | (1) and (3)                 |
| Local Time   | 7          | 71       | 2               | (1) and (3)                 |
| Phase Correction   | 8          | 72       | 4               | (1) and (3)                 |
| Leap Second  | 9          | 73       | 6               | (1) and (4)                 |
| Display  | 13         | 77       | 2               | (1)                         |
| Alarm limits   | 14         | 78       | 10              | (1)                         |
| Version  | 3          | 67       | 10              | (1)                         |
| Forced holdover mode   | 15         | 79       | 1               | (1)                         |
| Manual time setting  | 17         | 81       | 7               | (1) and (5)                 |
| Manual correction $\pm 1$ s  | 21         | 85       | 1               | (1) and (5)                 |
| Manual 1pps correction   | 19         | 83       | 4               | (1) and (5)                 |
| Remote control mode  | 18         | 82       | 1               | (2)                         |

- (1): Command authorized if the clock is in remote control mode.  
(2): Command always authorized.  
(3): Command authorized if the clock is not in forced holdover mode.  
(4): Command authorized if the current time reference is UTC.  
(5): Command authorized if the clock is in forced holdover mode.

The tables that follow contain the format of the commands and the requests.



| Name                               | Identifier |         | Bytes | Byte No. | Encode Type | Settings                                       | Description  |
|------------------------------------|------------|---------|-------|----------|-------------|--|--|
|                                    | Query      | Command |       |          |             |  |  |
| Status                             | 80         | -       | 37    | 0 to 3   | 1 long      | b <sub>0</sub> = 1<br>b <sub>0</sub> = 0       | Clock is synchronized to the reference input (GPS)<br>Clock is not synchronized (the clock is in hold over mode after the loss of the reference input signal).   |
|                                    |            |         |       |          |             | b <sub>1</sub> to b <sub>7</sub>               | Reserved bits.   |
|                                    |            |         |       |          |             | b <sub>8</sub> = 1<br>b <sub>8</sub> = 0       | GPS 1pps failure.<br>GPS 1pps operational.   |
|                                    |            |         |       |          |             | b <sub>9</sub> = 1<br>b <sub>9</sub> = 0       | Frequency driver failure.<br>Frequency driver operational.   |
|                                    |            |         |       |          |             | b <sub>10</sub> = 1<br>b <sub>10</sub> = 0     | 1pps driver failure.<br>1pps driver operational.   |
|                                    |            |         |       |          |             | b <sub>11</sub> = 1<br>b <sub>11</sub> = 0     | Failure in at least one standard frequency output<br>All the standard frequency outputs are operational..  |
|                                    |            |         |       |          |             | b <sub>12</sub> = 1<br>b <sub>12</sub> = 0     | 1pps output failure.<br>1pps output operational.   |
|                                    |            |         |       |          |             | b <sub>13</sub> = 1<br>b <sub>13</sub> = 0     | Phase limit alarm: loss of synchronization, programmed phase-limit exceeded.<br>Phase limit not exceeded.  |
|                                    |            |         |       |          |             | b <sub>14</sub> = 1<br><br>b <sub>14</sub> = 0 | Frequency or limit alarm: loss of synchronization (if the programmed limit is set to 0) or loss of synchronization and limit exceeded or synchronization period too short to provide the programmed frequency limit.<br>Programmed frequency or limit not exceeded: the clock is synchronized during a period of time sufficient enough to provide the frequency inside the programmed limit or the loss of synchronization is not sufficiently long to exceed the programmed limit. |
|                                    |            |         |       |          |             | b <sub>15</sub> = 1<br>b <sub>15</sub> = 0     | Optional output board failure<br>Optional output board operational   |
|                                    |            |         |       |          |             | b <sub>16</sub> = 1<br>b <sub>16</sub> = 0     | EPSILON CLOCK <sup>®</sup> hardware failure.<br>EPSILON CLOCK <sup>®</sup> hardware operational.   |
|                                    |            |         |       |          |             | b <sub>17</sub>                                | Reserved   |
|                                    |            |         |       |          |             | b <sub>18</sub> = 1<br>b <sub>18</sub> = 0     | Antenna not connected.<br>Antenna connected.   |
|                                    |            |         |       |          |             | b <sub>19</sub> = 1<br>b <sub>19</sub> = 0     | Antenna short circuit alarm.<br>No antenna short circuit.  |
|                                    |            |         |       |          |             | b <sub>20</sub> to b <sub>23</sub>             | Reserved   |
|                                    |            |         |       |          |             | b <sub>24</sub> = 1<br>b <sub>24</sub> = 0     | 10MHz frequency reference is cycle locked to the 1pps (available onfy from software version V9r2)<br>10MHz frequency reference is not cycle locked to the 1pps (available onfy from software version V9r2)   |
| b <sub>25</sub> to b <sub>31</sub> | Reserved   |         |       |          |             |  |  |

| Name                           | Identifier |         | Bytes    | Byte No. | Encode Type | Settings   | Description  |
|--------------------------------|------------|---------|----------|----------|-------------|--|--|
|                                | Query      | Command |          |          |             |  |  |
|                                |            |         |          | 4        | 1 char      | Char value: 1 or 5                                   | GPS reception, mode 0D:<br>The EPSILON CLOCK <sup>®</sup> is synchronized using a single satellite.<br>Mode set to manual positioning of the GPS antenna or after reliability testing of the GPS antenna's coordinates in automatic positioning mode.                  |
|                                |            |         |          |          |             | Char value: 2 or 6                                   | GPS reception mode 2D:<br>The EPSILON CLOCK <sup>®</sup> is synchronized using 3 satellites.<br>This mode can only operate if the antenna positioning mode is set to mobile, or automatic (before reliability testing and only if 3 satellites are tracked).           |
|                                |            |         |          |          |             | Char value: 3 or 7                                   | GPS reception mode 3D:<br>The EPSILON CLOCK <sup>®</sup> is synchronized using 4 to 8 satellites and the antenna positioning mode is set to mobile, or automatic (before reliability testing).   |
|                                |            |         |          | 5 to 20  | 8 integers  | Odd bytes (5 to 19)                                  | For each byte, the number of the satellite being tracked is set on bits $b_0$ to $b_6$ . The locking to satellite indicator is given by bit $b_7$ ( $b_7=0$ ; locked).   |
|                                |            |         |          |          |             | Even bytes (6 to 20)                                 | SNR (0 to 255) of the followed satellites.<br>The even byte $O_i$ gives the SNR of the satellite indicated by the byte $O_{i-1}$<br>e.g.: $O_3 = 140$ (80 HEX + 12 decimal) $O_4 = 120$<br>Satellite 12 is locked and its SNR is 120.                                  |
|                                |            |         |          | 21 to 22 | 1 integer   | 0 ... 65535<br>(0 to 65535 ns)                       | Estimation of the standard deviation of the GPS 1PPS reference signal. This estimation required the locking of at least two satellites by the clock. If only a single satellite is locked this parameter is set to 65535, indicating that an estimation is impossible. |
|                                |            |         |          | 23 to 26 | 1 long      | -324,000,000 ... 324,000,000<br>(-90° S ... +90° N)  | Latitude of the GPS antenna (ms).  |
|                                |            |         |          | 27 to 30 | 1 long      | -648,000,000 ... 648,000,000<br>(-180° W .. +180° E) | Longitude of the GPS antenna (ms).   |
|                                |            |         |          | 31 to 34 | 1 long      | -100,000 ... 1,800,000<br>(-1,000 m to 18,000 m)     | Altitude of the GPS antenna (cm).  |
|                                |            |         |          | 35       | 1 char      | 1<br>0   | GPS receiver failure<br>GPS receiver operational.  |
| 36                             | 1 char     | ---     | Reserved |          |             |  |  |
| TOD output setup               | 65         | 1       | 1        | 0        | 1 char      | 1<br>0   | Clock diagnostic output.<br>TOD message output.  |
| TOD output transmission period | 66         | 2       | 4        | 0 to 3   | 1 long      | 0 ... 100,000<br>(0 ... 100,000 sec)                 | Period of the emission of the time message on the TOD interface and on the remote control interface.   |
| Clock reset                    | ---        | 16      | 0        |          | ---         | ---  | Stops and restarts the clock (warm-reboot).  |

| Name                 | Identifier |         | Bytes | Byte No. | Encode Type | Settings              | Description   |           |  |  |
|----------------------|------------|---------|-------|----------|-------------|-----------------------|---|-----------|--|--|
|                      | Query      | Command |       |          |             |                       |   |           |  |  |
| GPS positioning init | 74         | 10      | 19    | 0        | 1 char      | 1                     | Antenna positioning mode: Automatic<br>Antenna positioning mode: Manual<br>Antenna positioning mode: Mobile<br>NB: the position initialization is available only in the manual mode. Therefore, if a position is given with bit 1 or bit 3 equal to 1, this position will not be taken into account. The position will be automatically calculated by the receiver.<br>In the manual mode, (bit 2 = 1), the position given should be precise because any update will be recalculated by the GPS receiver. |           |  |  |
|                      |            |         |       |          |             | 2                     |   |           |  |  |
|                      |            |         |       |          |             | 3                     |   |           |  |  |
|                      |            |         |       |          |             | 1 to 4                |   | 1 long    | -324,000,000 ... 324,000,000<br>(-90° S ... +90° N)  | Latitude (ms).   |
|                      |            |         |       |          |             | 5 to 8                |   | 1 long    | -648,000,000 ... 648,000,000<br>(-180° W .. +180° E) | Longitude (ms).  |
|                      |            |         |       |          |             | 9 to 12               |   | 1 long    | -100,000 ... 1,800,000<br>(-1,000 m to 18,000 m)     | Altitude (cm).   |
| Local Time           | 71         | 7       | 2     | 0        | 1 char      | ---                   | Reserved  |           |  |  |
|                      |            |         |       |          |             | 18                    |   | 1 char    | 1<br>0   | UTC time reference.<br>GPS time reference.   |
| Phase Correction     | 72         | 8       | 4     | 0 to 3   | 1 char      | -23 ... +23 (hours)   | Difference, in hours and minutes, between local time and the clock's reference time.  |           |  |  |
|                      |            |         |       |          |             | -59 ... +59 (minutes) |   |           |  |  |
| Leap Second          | 73         | 9       | 6     | 0        | 1 char      | 0 ... 1,000 ns        | Programmed difference between the distributed 1pps signal and the built-in reference (to correct antenna cable delay).  |           |  |  |
|                      |            |         |       |          |             | 1                     |   | 1 char    | 1<br>2   | No leap second.<br>Use leap second.<br>Leap second addition.<br>Leap second subtraction. |
|                      |            |         |       |          |             | 2 to 3                |   | 1 integer | 1 ... 366 Days                                       | Day of the year to be used.  |
|                      |            |         |       |          |             | 4 to 5                |   | 1 integer | 1992 ... 2127  | Year to be used  |

| Name         | Identifier |         | Bytes | Byte No. | Encode Type | Settings            | Description                              |   |  |
|--------------|------------|---------|-------|----------|-------------|---------------------|--|---|--|
|              | Query      | Command |       |          |             |                     |  |   |  |
| Display      | 77         | 13      | 2     | 0        | 1 char      | 0                   | Day / Month / Year format                |   |  |
|              |            |         |       |          |             | 1                   | Month / Day / Year format                |   |  |
|              |            |         |       |          |             | 2                   | Day of year / Year format                |   |  |
|              |            |         |       |          |             | 3                   | MJD format                               |   |  |
|              |            |         |       |          |             | 4                   | MJD format integer part /hh/mn/sec       |   |  |
| Alarm limits | 78         | 14      | 10    | 0 to 3   | 1 long      | 0 ... 1,000 $\mu$ s | Phase alarm limit<br>0 = no phase alarm. |   |  |
|              |            |         |       |          |             | 4 to 7              | 1 long                                   | $b_{31} = 0$<br>$b_{31} = 1$  | Step of frequency alarm limit is $1.10^{-9}$ with all software version<br>Step of frequency alarm limit is $1.10^{-10}$ with software version from V8R9<br>Nota: to know the step allowed by the clock, the user must send a query with this bit at one.<br>if in the reply message, this bit is set at one then the clock supports both steps $1.10^{-10}$ and $1.10^{-9}$ else the clock support only the step $1.10^{-9}$ |
|              |            |         |       |          |             |                     |  | $b_{30}$ to $b_0 = 0 .. 1000 10^{-9}$<br>$b_{30}$ to $b_0 = 0 .. 10 000 10^{-10}$ | Frequency alarm limit with step of $1.10^{-9}$ in accordance with $b_{31}$<br>0 = alarm immediate if synchronization is lost.<br>Frequency alarm limit with step of $1.10^{-10}$ in accordance with $b_{31}$<br>0 = alarm immediate if synchronization is lost.  |
|              |            |         |       |          |             | 8                   | 1 char                                   | 1<br>0  | No squelch of frequency output.<br>Frequency output squelched if frequency limit is exceeded or in case of hardware failure.   |
|              |            |         |       |          |             |                     |  | 9   | 1 char   |

| Name  | Identifier   |         | Bytes | Byte No. | Encode Type | Settings  | Description   |   |
|---|--|---------|-------|----------|-------------|---|---|---|
|   | Query  | Command |       |          |             |   |   |   |
| Version                                       | 67   | 3       | 10    | 0 to 3   | 1 long      | ---   | Reserved  |   |
|   |  |         |       | 4        | 1 char      | 0 ... 255   | Software version.   |   |
|   |  |         |       | 5        | 1 char      | 0 ... 255   | Update version number.  |   |
|   |  |         |       | 6 to 7   | Integer     | ---   | Reserved.   |   |
|   |  |         |       | 8        | 1char       | $b_0$ to $b_1 = 1/2/3$  | Clock's series number   | 1: serie 1<br>2: serie 2<br>3: serie 3        |
|   |  |         |       |          |             | $b_2 = 1$<br>$b_2 = 0$  | 24V DC input voltage<br>48V DC input voltage  |   |
|   |  |         |       |          |             | $b_3 = 1$<br>$b_3 = 0$  | GPS Input<br>STANAG Input   |   |
|   |  |         |       |          |             | $b_4$ to $b_6 = 7$<br>$= 4/5/6$<br>$= 3$<br>$= 2$<br>$= 1$<br>$= 0$ | No output option.<br>Reserved.<br>STANAG 4430 Output<br>G.704 Output.<br>Pulse rate output.<br>IRIG.B. Output |   |
|   |  |         |       |          |             | $b_7 = 1$<br>$b_7 = 0$  | Multiple of 2048 kHz frequency .<br>Multiple of 1 MHz frequency .   |   |
|   |  |         |       |          |             | 9   | 1char   | $b_0$ to $b_1 = 3$<br>$= 2$<br>$= 1$<br>$= 0$ |
| $b_2$ to $b_3 = 3$<br>$= 2$<br>$= 1$<br>$= 0$ | Series 3 high performance Rubidium frequency driver<br>Series 2 standard performance Rubidium frequency driver<br>High-performance OCXO frequency driver<br>Standard performance OCXO frequency driver |         |       |          |             |   |   |   |
| $b_4 = 0$<br>$= 1$                            | Relay contact closed on hardware failure / phase limit / frequency limit.<br>Relay contact closed on hardware failure only.  |         |       |          |             |   |   |   |
| $b_5$ to $b_7$                                | Reserved   |         |       |          |             |   |   |   |
| Error<br>(ID = 64)                            |  |         | 2     | 0        | 1 char      | X   | Invalid message ID  |   |
|   |  |         |       | 1        | 1 char      | 0   | Incorrect number of useful bytes  |   |
|   |  |         |       |          |             | 1   | Unknown message ID  |   |
|   |  |         |       |          |             | 2   | Unauthorized parameter in <DATA> section.   |   |
|   |  |         |       |          |             | 3   | Command not valid   |   |
| 4   | Remote command not authorized  |         |       |          |             |   |   |   |
| Forced holdover mode                          | 79   | 15      | 1     | 0        | 1 char      | 1   | Functioning mode: disciplining authorized   |   |
|   |  |         |       |          |             | 0   | Functioning mode: holdover forced   |   |

| Name                   | Identifier |         | Bytes | Byte No. | Encode Type | Settings  | Description   |                       |
|------------------------|------------|---------|-------|----------|-------------|---|---|-----------------------|
|                        | Query      | Command |       |          |             |   |   |                       |
| Manual time setting    | 81         | 17      | 7     | 0        | 1 char      | 1 ... 31 (days)   | Manual setting of the clock (authorized only in forced keeping mode). |                       |
|                        |            |         |       |          | 1           | 1 char  |   | 1 ... 12 (months)     |
|                        |            |         |       |          | 2 to 3      | 1 integer   |   | 1992 ... 2127 (years) |
|                        |            |         |       |          | 4           | 1 char  |   | 0 ... 23 (hours)      |
|                        |            |         |       |          | 5           | 1 char  |   | 0 ... 59 (minutes)    |
|                        |            |         |       |          | 6           | 1 char  |   | 0 ... 59 (seconds)    |
| Manual correction ±1s  | 85         | 21      | 1     | 0        | 1 char      | 1: - 1 second<br>0: + 1 second  | Manual second correction (authorized only in forced keeping mode).    |                       |
| Manual 1pps correction | 83         | 19      | 4     | 1        | 1 integer   | -500,000 ... 500,000<br><br>(-5,000ns ... 5,000ns)                    | 1pps output phase offset setting                                      |                       |
| Remote control mode    | 82         | 18      | 1     | 0        | 1 char      | 0: remote control mode authorized<br>1: remote control not authorized | Authorization or not of new remote control commands.                  |                       |

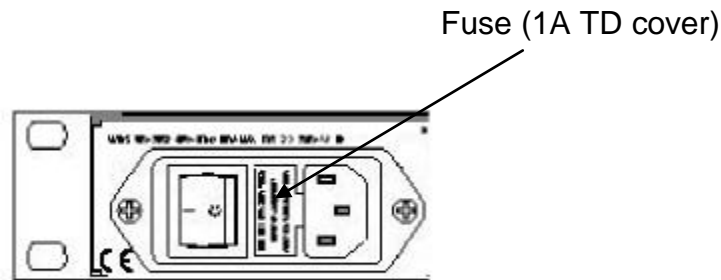
## 7 Maintenance

The EPSILON CLOCK<sup>®</sup> is fully automatic, is not field-serviceable and requires no preventive maintenance. After 10 years lifetime it is recommended to require a technical checkup from SPECTRACOM Service Organization.

The only potential maintenance operation, on the first level, is the main power fuse replacement.

Characteristics: Cartridge 2 x 1A TD, 5 x 20 mm.

There are two fuses in the EPSILON CLOCK<sup>®</sup>. It is mandatory to replace them both at the same time. This operation requires unplugging the power cords.



### 7.1 Loading Profile and Flash

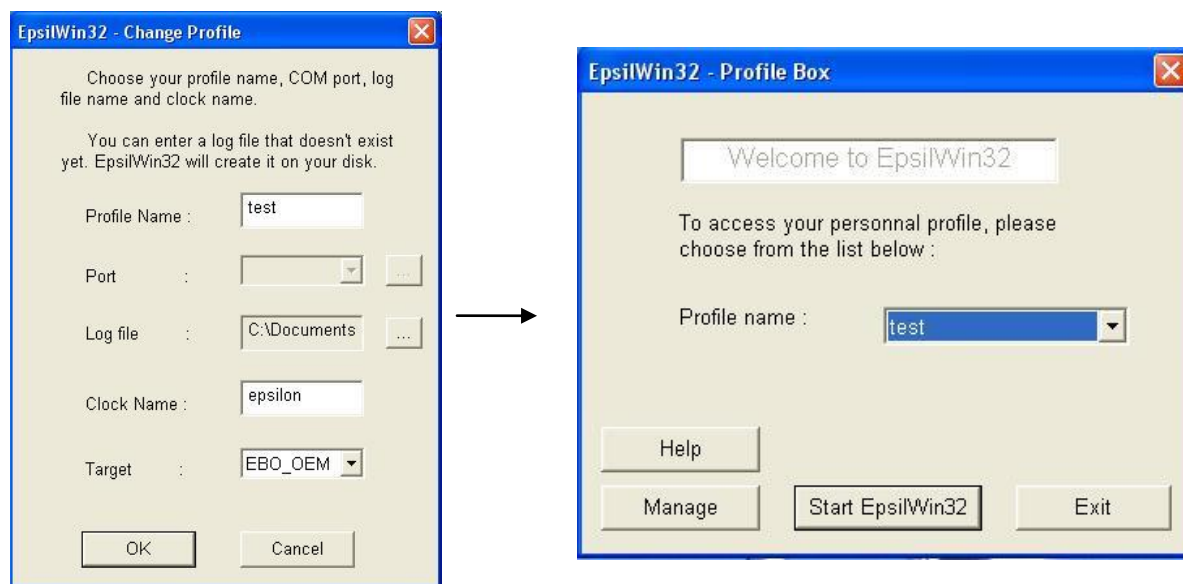
#### 7.1.1 EPSILWIN32 Software

As an option, the EPSILWIN32 software can be used on a standard computer to monitor and control EPSILON CLOCK<sup>®</sup>.

#### 7.1.2 How to Create a Profile with EPSILWIN32 Software ?

- After the first start of Epsilwin32 Software we get the « Profile Box » window.
- You have to create a profile specific to the type of your clock (NTP, EBO OEM EC2S ...). Select your choice by clicking « Manage » to obtain the profile configuration window: « Manage Profile ».
- Add a new profile with the « new » button; you get the window « new profil ».
- Write the information in the different fields:

- Profile name: take a free name,
- Port: com1 ou com2....RS232 port of your PC,
- Log file: you have to create a LOG file to record all the future incoming events on the unit. Choose a free file like « **clock.his** » for example. It is a text mode file so you will be able to read it with standard software like: wordpad, excel, word..... Get the browser to select a directory where Epsilwin32 will find this file: **push the [...] button.**
- Clock name: Choose a free name for the clock (this is for the text in the « clock.his » file – usefull if you have more than one clock) : for example **CLOCK Nb 1....**
- Target: Choose the type of the clock i.e. Epsilon Clock 2S.



- Return back by clicking on « OK » and « back » buttons to return to the « Profile Box » window.
- Choose the created profile with the scrolling menu.
- Start the software « Start Epsilwin32» button.... The front panel of the clock must appear with Time & Date data.



- NEW PROFILE = NEW PASSWORD: after creating a New PROFILE you will have to enter a New Password.



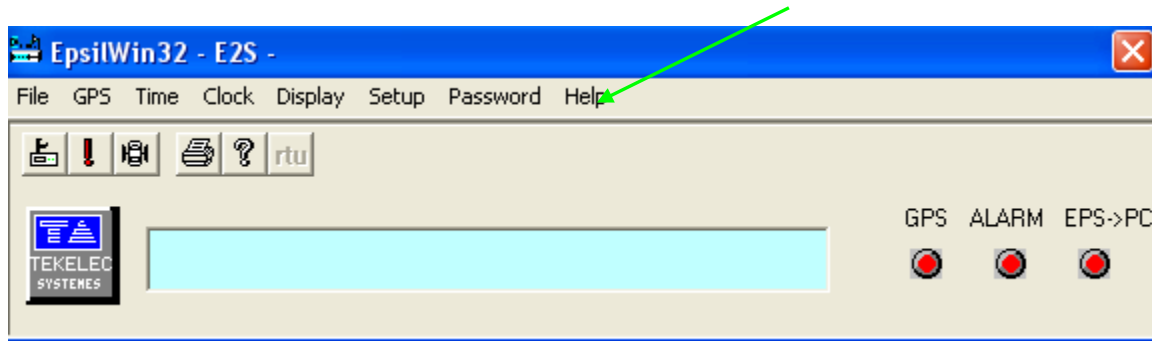
- For the first time , You will have to enter a password again



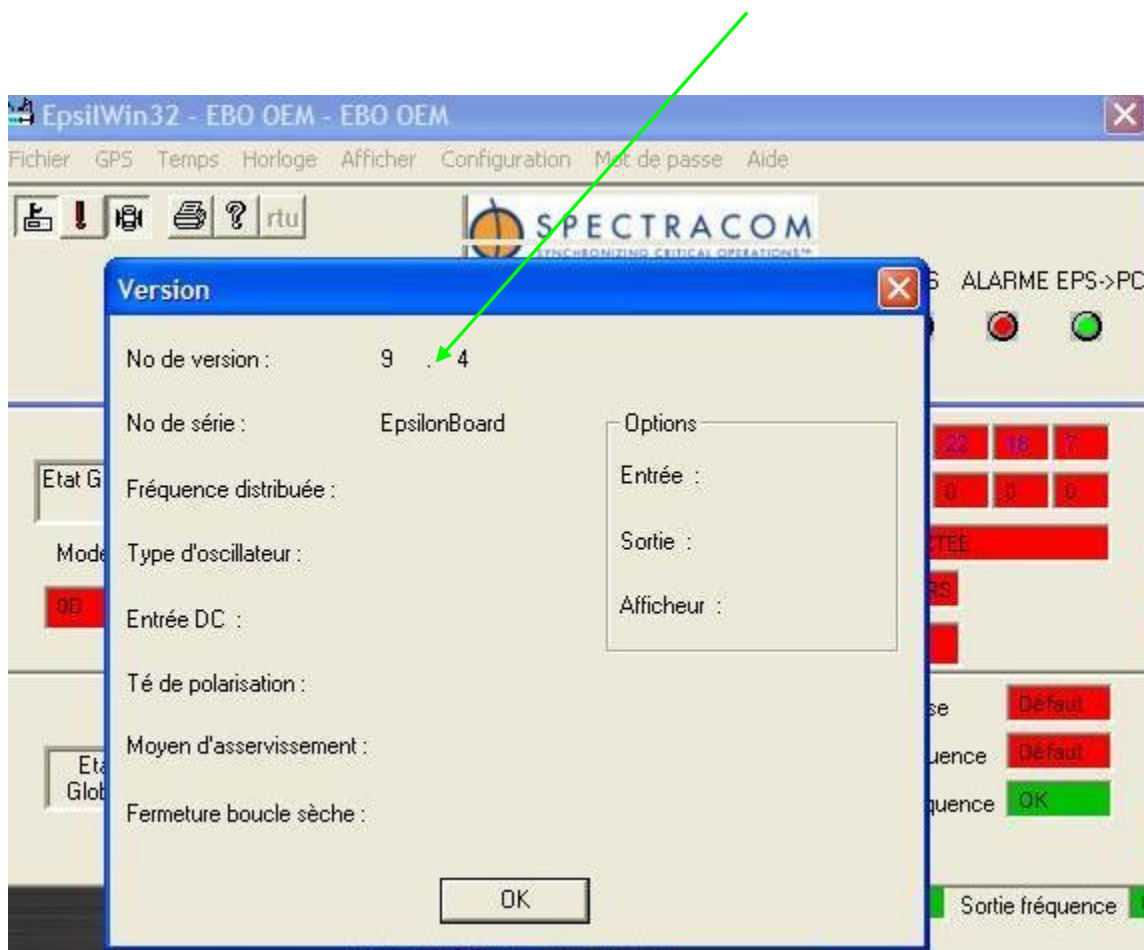
- After entering this password in this way, Epsilwin32 will never ask you again to write 2 times the password.
- If you have forgotten your password, you will have to create a NEW profile (repeat the actions described on chapter 1.). Then, you will be able to create a NEW password.

### 7.1.3 How to check and download a firmware version on an Epsilon Clock unit?

- 1) Go to Epsilwin32 software main window and select « Help » menu:



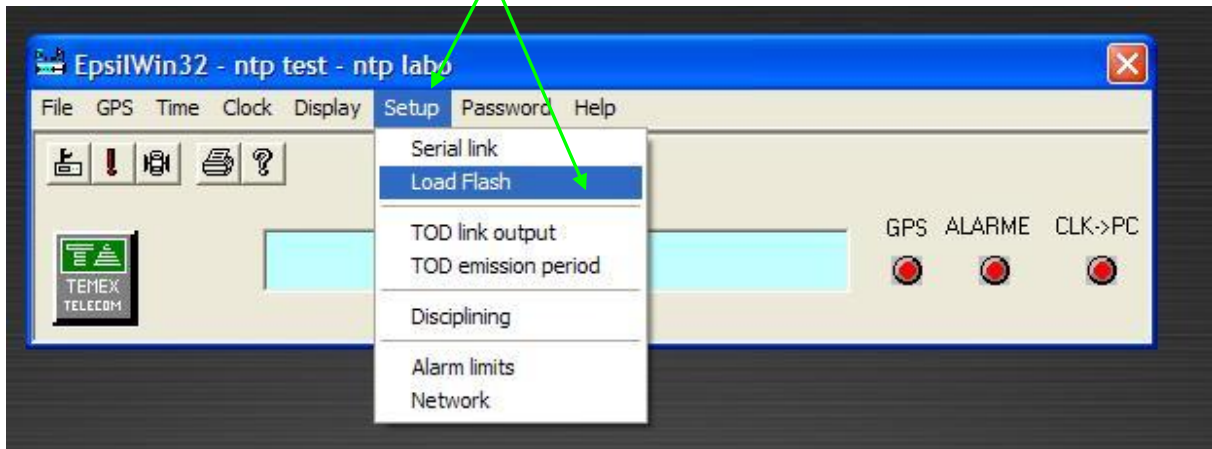
- 2) Read the Version number of the Epsilon internal firmware (“Clock Version” button):



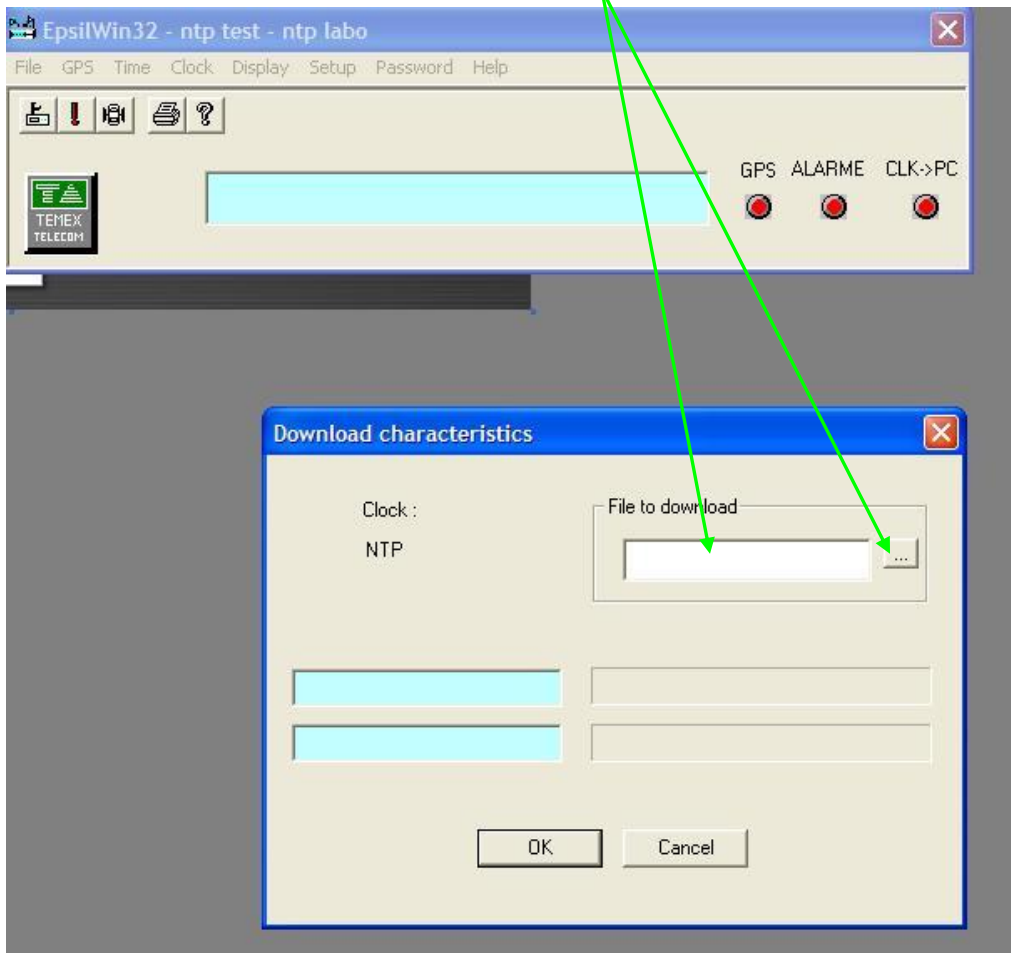
For example: for this EBO II unit, the version is V9.4

### 7.1.4 Download a new software version by selecting **SETUP & LOAD FLASH** menu?

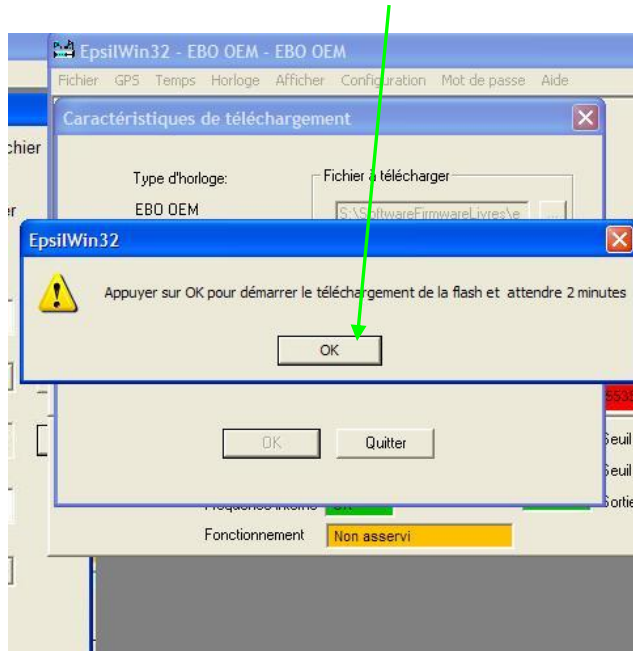
- Select STEUP / Load Flash menu



- Choose your binary files through the browser, click OK and follow the indication during the operation: for example : eblc0904\_v9r4.bin for EBO 2

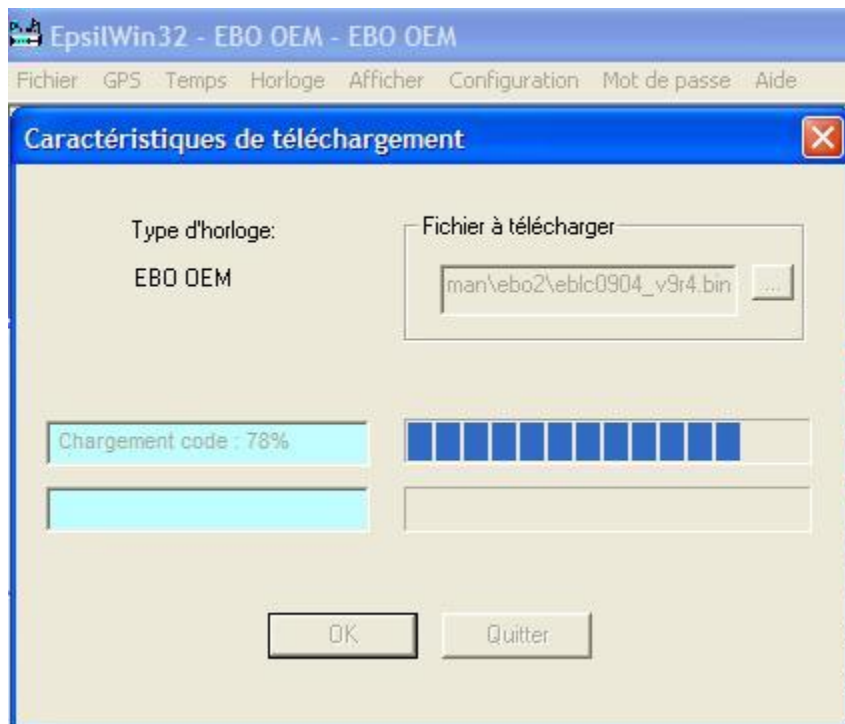


- Click "OK" to start the operation

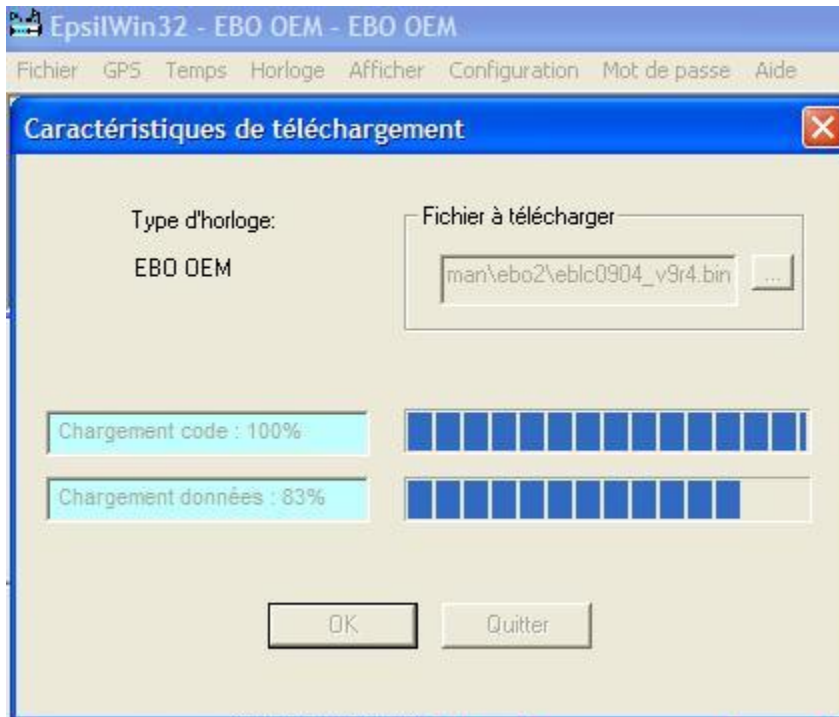


Following operations: The display must show the following screens during the operation:

- Code Loading:

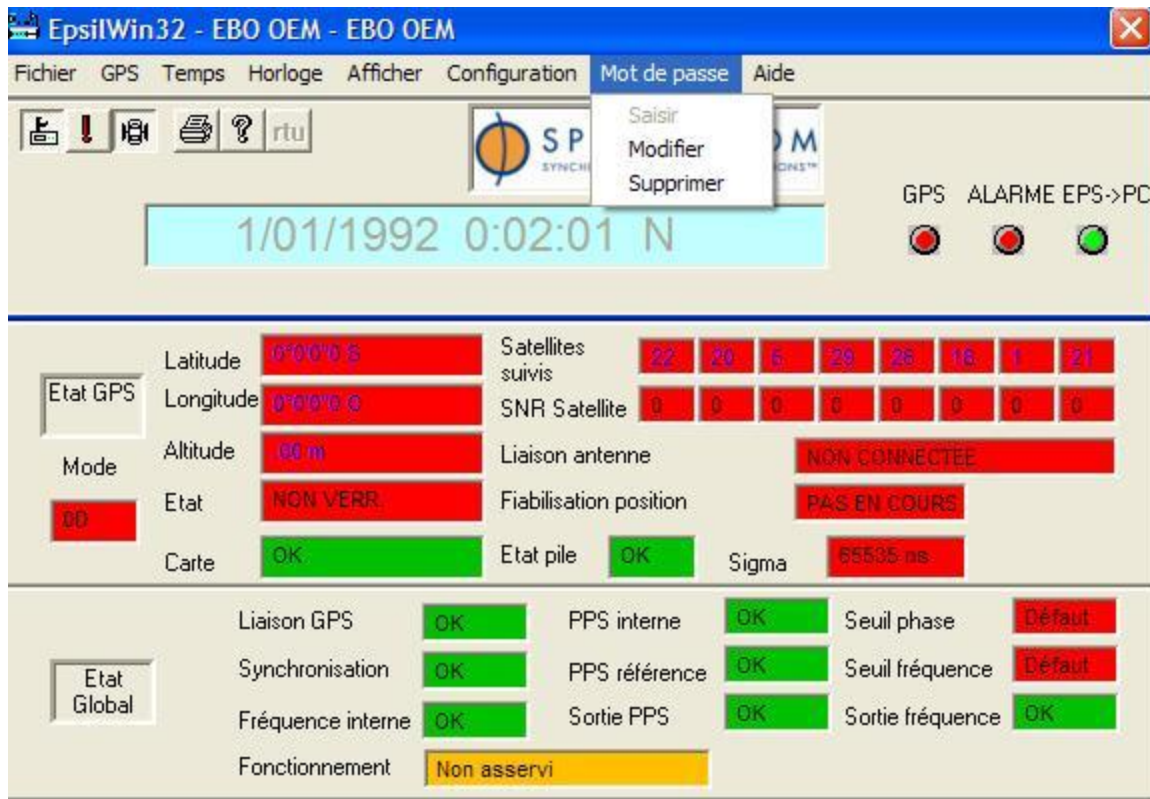


- Data loading:



- Final loading: the clock restart – Click “OK” to finalize.





At the end of the operation (1 or 2 minutes), the unit must automatically reset.

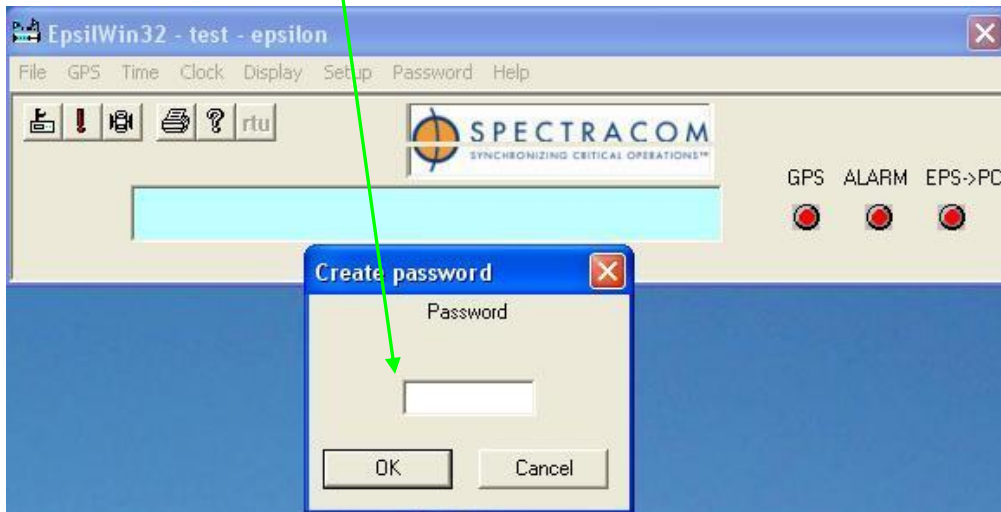
The Password is always active. You can continue to use the unit.

### 7.1.5 When Restarting Epsilwin32?

If you close Epsilwin32 and restart again, the software will ask you to choose your profile:



After starting Epsilwin32, if you want to make setup action, the software will ask you to enter a password, only one time.



## *REVISION HISTORY*

| <b><i>Revision Level</i></b> | <b><i>ECN Number</i></b> | <b><i>Description</i></b>  |
|------------------------------|--------------------------|--|
| A                            | 03/10/96                 | Creation   |
| B                            | 29/08/97                 | Update   |
| C                            | 17/10/97                 | Update   |
| D                            | 13/02/04                 | Rubidium type oscillator addition  |
| E                            | 12/01/05                 | GPS installation, OCXO specification improved, Command amended   |
| F                            | 06/07/06                 | Update, Command amended  |
| G                            | 12/12/06                 | Hardware release with Command amended  |
| H0                           | 09/06/08                 | First iteration of this Spectracom documentation, converted from previous documentation. Product name officially changed to EPSILON CLOCK MODELS EC2S, EC2S-RB & EC2T. |
| H1                           | 05/01/09                 | Update front & rear panel  |
| H2                           | 25/10/2010               | Update to add optional output features and some maintenance information  |
| H3                           | 15/11/2010               | Update to remove empty pages and put the warranty conditions within a single page.   |
| H4                           | 16/11/2010               | Add details in the Maintenance section.  |



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