EPSILON CLOCK

MODEL EC3S

USER'S MANUAL

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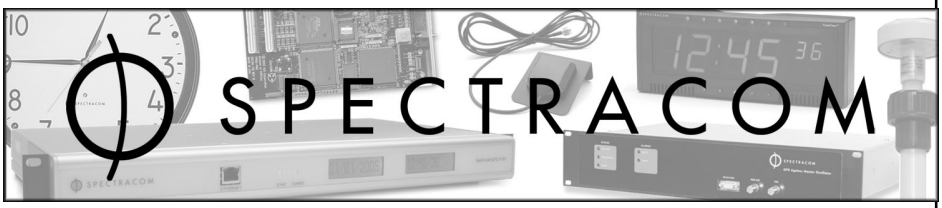

www.spectracomcorp.com

www.spectracom.fr
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20 June 2008

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

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 EC3S clock is highly accurate, stable frequency sources operating from GPS input.

The relative accuracy of clock frequency is 1.10-12 in relation to the international frequency definition. Time setting is accurate to less than 100 ns in relation to UTC (GPS) time.

The initial configuration may be changed by the user through the local user interface or through the remote control interface (described herein).

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 5.10-11 and the time setting is accurate to within 1µs of UTC time.

The standard EPSILON CLOCK® MODEL EC3S clock is 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.

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 2 U * 89 mm
Width 19’’ * 483 mm
Depth * 340 mm
Weight < 7 kg

1.4 Basic Configuration

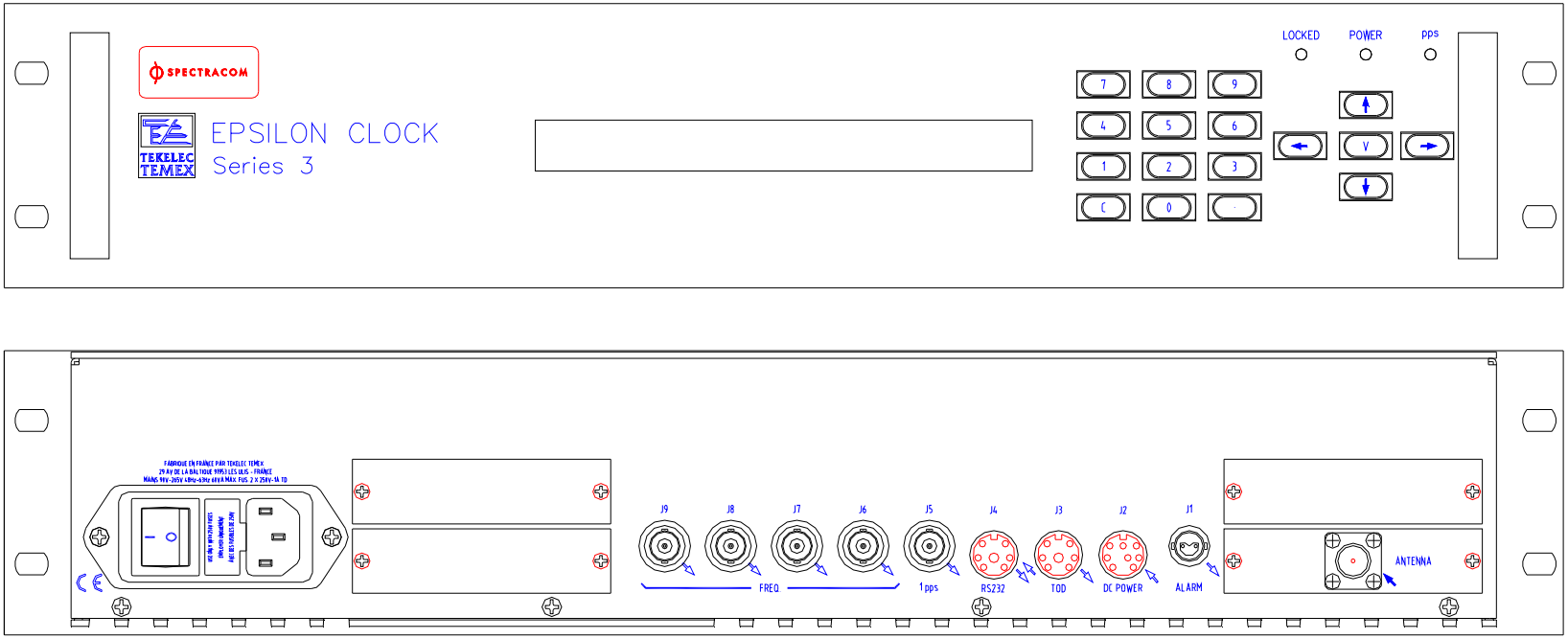
This document is applicable to the EPSILON CLOCK® Model EC3S equipped with OCXO or Rubidium oscillators. In its basic configuration, the EPSILON CLOCK® Series 3S is equipped with:

- 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).

1.5 Terminology

GPS	Global Positioning System
OCXO	Oven Controlled XTAL (Crystal) Oscillator
Rb	Rubidium oscillator
S/A	Selective Availability
TRAIM	Time Receiver Autonomous Integrity Monitoring
UTC	Universal Time Coordinated
1PPS	One Pulse Per Second
1 PPS driver	Pulse signal obtained through division of the frequency driver
TOD	Time Of Day
Holdover	If the reference input signal is lost, the EPSILON CLOCK® maintains the generation of information and of time and frequency signals.
Autonomy	On user request, the EPSILON CLOCK® maintains the generation of time and frequency signals without using the reference input.
Reliability	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.
Frequency driver	Frequency signal generated by the built-in oscillator.
Reference input	Time and frequency source used by the EPSILON CLOCK®.
IERS	International Earth Rotation Service.

1.6 Front and Rear Panel



2 Installation

2.1 Preliminary Connections

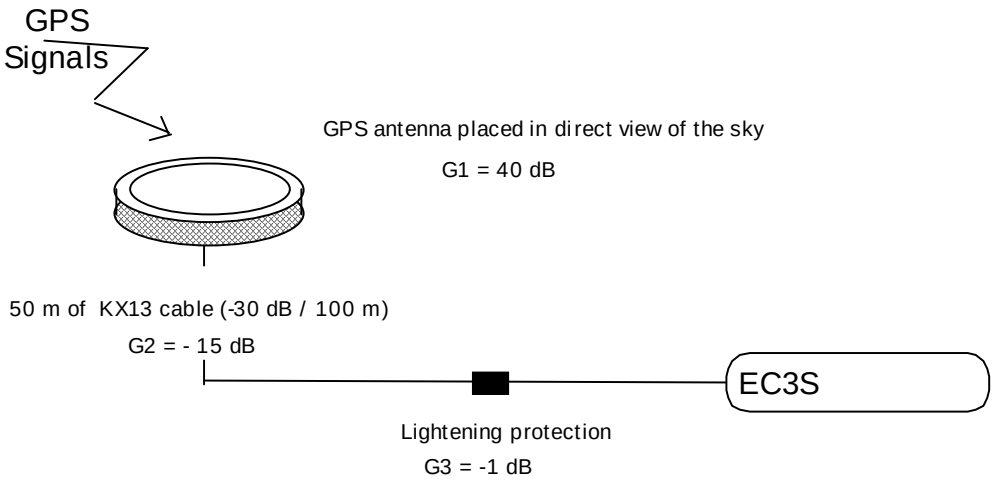
Before starting the EPSILON CLOCK®, perform the following tasks:

- 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:



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

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

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 3S) 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 3 minutes after start-up. When it is synchronized, both the "Locked" indicator will be green and the "1PPS" indicator will flash once per second. The “Power” indicator will be red until the Rubidium oscillator has warmed up (approximately 1 hour). 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.*

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

Frequency output (10 MHz):

	Rubidium	OCXO
Accuracy (1)	< ±1 x 10^{-12} / day (typical)	< ±1 x 10^{-12} / day (typical)
Medium Term stability (2)	< ±3 x 10^{-11} / month (typical)	< ±1 x 10^{-10} / day (typical)

Time output (1PPS):

	Rubidium	OCXO
Accuracy	< ±100 ns (1σ)	< ±100 ns (1σ)
Holdover Mode after 1 day (2)	< 2 µs	< 7 µs

(1): Average over 24 hours when GPS locked after 3 months of continuous operation
(2): Without GPS, constant temperature after 3 months of continuous operation

4 Features

4.1 Frequency Output

Connectors: J6, J7, J8, J9 BNC Female

Pin settings:

Core: Sine-wave signal

Frequency: 10 MHz
Level: > 10 dBm load 50 Ω (typical 13 dBm)

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: 100µs ± 10µs
High-level: > 2.4 V load 50Ω
Low-level: < 0.8 V load 50Ω
Rising edge duration: < 20 ns load 50Ω

Ground: Electrical and mechanical ground of the clock

4.3 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:

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

4.4 TOD Output

Time Of Day message output:

Output: ASCII, 9600 bps, 8 bits, 1 stop bit, odd parity.
Protocole: <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 ±100 ms after the 1PPS signal.

* Programmable through the remote control interface.

** Modified Julian Day

Connectors: J3

Mini Din 6 pins Female

Pin settings:

Pin	Setting
1	Reserved
2	NC
3	Electrical and mechanical ground
4	Electrical and mechanical ground
5	Message Output (RS232C)
6	NC

4.5 Alarm

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

4.6 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:	< 60 W typical

4.7 DC Power Supply

Input power (VDC):

Series 3S: 18 to 32V
Consumption: < 60 W typical

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:

Pin	Setting
1	VDC
2	VDC
3	VDC
4	VDC
5	Electrical Ground
6	Electrical Ground
7	Electrical Ground

4.8 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

4.9 Operating Environment

Operating temperature:	0 to +50℃
Storage temperature:	- 40℃ to 85℃
Relative humidity:	90 % without condensation
EMC:	In accordance with EN50081 and EN50082

5 Commands Description

5.1 GPS 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 24 hours 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 24 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.

5.2 GPS position

This command allows the initialization of the antenna position. This is necessary in Manual mode.

5.3 Date setup

This command initializes the date of the clock's GPS receiver. This, associated with the initialization of position, when possible, accelerates the tracking procedure of the GPS satellites.

5.4 Time Reference

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.

5.5 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).

5.6 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.

5.7 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.

5.8 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.

5.9 Alarms

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.

5.10 Antenna Delay 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 5 to 6 nanoseconds per meter.

5.11 Functioning mode

The initial functioning mode of the clock is always synchronized on the GPS reception. However, the user could configure the clock in off-line mode. This stops the disciplining of the driver frequency and of the 1PPS. In the off-line mode, the user has the manual setup function available.
I

5.12 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.

5.13 Clock reset

This command generates the re-initialization of the clock.

6 The Local Graphic User Interface

6.1 Functionalities

The UI manages the keyboard and the screen of the clock. It allows the following choices:

- Sequenced menu,
- Data consulting,
- Data capture,
- Controlling selection to execute ,
- Permanent display of some states of the system.

6.2 Keyboard

The UI keyboard consists of:

- A keypad including the "C" and "." keys,
- A set of 5 keys to move the cursor or to validate.

6.2.1 Keypad

The **0** to **9** keys are reserved for the capture of the digital fields.

The key **C** is used to select the data among a multiple choice.

The key '**.**' is not used in this application.

6.2.2 Function keys

The key functions are as follows:

→	Set the cursor on the next capture field, or display the next page
←	Set the cursor on the previous capture field, or display the previous page
↑	Go back to the previous menu. The current capture is not confirmed
↓	Go to the next menu
V	Confirmed the capture of the current menu

6.3 Menus

Three kind of menus are provided:

- Connecting menus
- Consulting menus
- Capture menus

6.3.1 Connecting Menus

The connecting menus are access menus. To select one of these menus, use the ← → keys. The key ↓ validates the choice. The key ↑ allows the user to go back to the previous menu.

6.3.2 Consulting Menus

These menus may have many pages. You may use the "scrolling" mode page per page with the ← → keys. The key ↑ allows the user to go back to the previous menu. There is no circle cycle at the end of it.

6.3.3 Capture Menus

The user indicates a functioning parameter of the clock: digital length or other proposed option.

The digital values are captured with the **0** to **9** keys.

The choice is done with the **C** key to select the character **[ ]** around the chosen option.

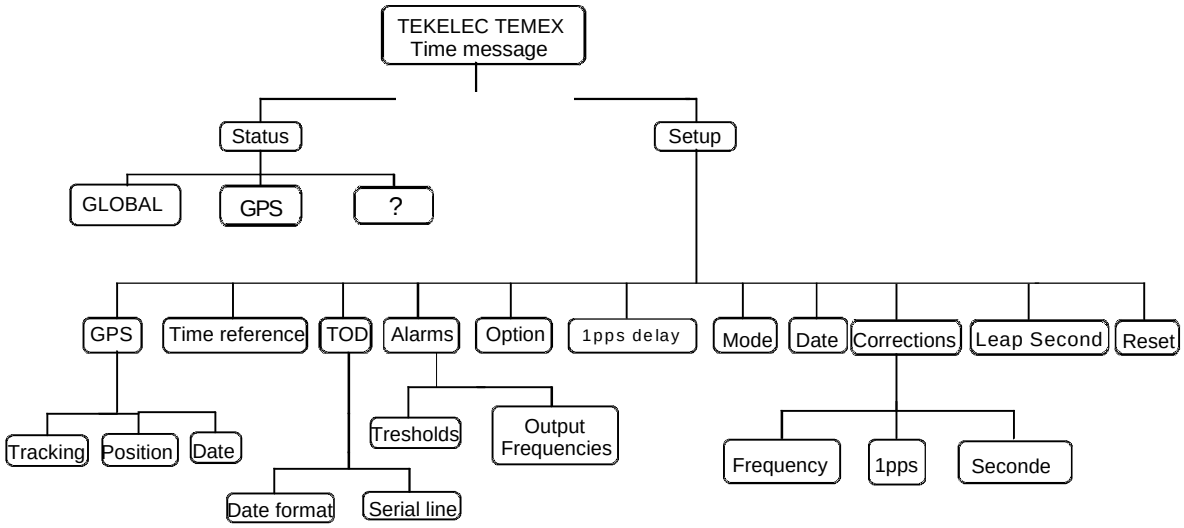
6.3.4 Capture confirmation

The capture is validated by using the V key, if there were some modifications. The user receives the following indications:

- OK The capture is successful
- ERR The capture is not successful
- REM The UI is inactive. The clock runs in remote control mode (REMOTE)

To exit the menu, press the key offered.

6.3.5 Menus Organization



6.4 Status Menu

This allows access to the states consultation menu of the clock.

STATUS		
.Global	.GPS	.?

Active keys : ←, →, ↑, ↓.

To select the menu, use the keys : ←, →.

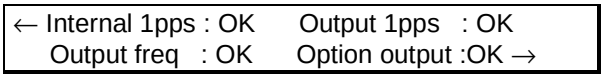
The ↓ key allows the user to select the under menu.

The ↑ key allows the user to go back to the upper menu.

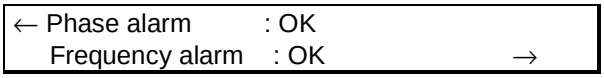
6.4.1 Global Menu

This menu gives global information about the functioning of the clock. The sub-menus are the following :

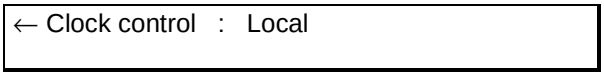
Reference input (GPS) of the material, of the synchronization, and of the internal frequency state.



Internal 1pps, frequency outputs and option output state.



Display of the phase alarms and frequency alarm.



Functioning mode of the UI
Local : keyboard Remote : Remote control

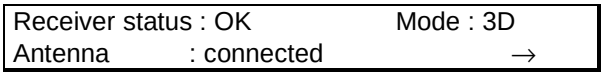
Active keys : ←, →, ↑.

To select the menu, use the keys : ←, →.

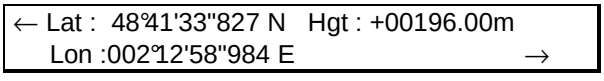
The ↑ key allows the user to go back to the upper menu.

6.4.2 GPS Menu

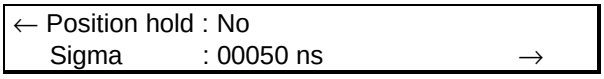
This menu gives information about the GPS reception. The sub-menus are the following :



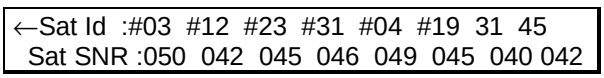
GPS receiver status of the clock.



Calculated Position by the GPS antenna.



Reliability state of the position hold
Estimated error on the GPS 1 PPS precision .



N° of the GPS satellites followed.
Reception level for each satellite.

Active keys : ←, →, ↑.

To select the menu, use the keys : ←, →.

The ↑ key allows the user to go back to the upper menu.

6.4.3 Menu ?

This menu gives information about the based configuration of the clock:

Software version : 07.01 Series :3 Input opt : GPS Output option : STANAG →	Software Version . Synchronization on GPS / Output option.
←Frequencies : 5MHz DC input : 24V →	Given Frequencies . External DC power supply
←Pilot : Rubidium high perf. Alarm output : Hardware or Software →	Kind of frequency pilot. Alarm in case of Hardware or Software default

Active keys : ←, →, ↑.

To select the menu, use the keys : ←, →.

The ↑ key allows the user to go back to the upper menu.

6.5 Setup Menu

This menu allows the user to access sub-menu to configure the clock.

SETUP .GPS .Time reference .TOD .Alarms →
← .Option .1pps delay .Mode Date →
← .Correction Leap second .Reset

Active keys : ←, →, ↑, ↓.

To select the menu, use the keys : ←, →.

The ↓ key allows the user to select the under menu.

The ↑ key allows the user to go back to the upper menu.

For each menu, the default configuration is the one written in different characters in the following chapter.

The Option menu may be selected if the G704 option is in the clock.

6.5.1 GPS Menu

This menu may be chosen if the SLAVED mode is selected

This allows the user to set up the GPS receiver mode :

```
        GPS receiver setup
.Tracking       .Position       .Date
```

Select the sub-menu with the keys → ← et ↓.

Tracking :

```
Tracking mode  : [Auto]  Fix  Mobile
```

GPS tracking mode : Automatic, Manual or Mobile.

Select the tracking mode Automatic, Manual, or mobile with the keys C and V to confirm the choices

Position :

```
Lat :  48°41'33"827 N   Hgt : +00196.00m
Lon :002°12'58"984 E
```

Setup of the GPS Antenna Position.

The digital keys are used to set this with the key C and the keys ← and →. The position setup is necessary only in Fix mode.

Date :

```
Date : 10/24/1997  (mm/dd/yyyy)
Time : 12 :33 :46      (hh :mm :ss)
```

Date & time setup.

The digital keys are used to set this with the key C and the keys ← and →. The date setup is necessary only in Fix mode.

6.5.2 Time reference Menu

This menu may be chosen if the SLAVED mode is selected

This allows the user to select the time reference :

Time reference : GPS **[UTC]** Local time offset from UTC : **+00h00mn**	Time reference GPS or UTC Time offset from UTC.

The offset time is active if the UTC reference is selected. This function allows the user to select local time.

Active keys : ←, →, ↑, C, keypad and V.

The selection is done with the C key.

The offset time is selected with the keypad.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the upper menu.

6.5.3 TOD Menu

This menu allows the user to set up the time format of the TOD output.

TOD SETUP	
.Date format	.Serial line

Select the under menu with the keys → ← and ↓.

Date format :

Date format : **[Day/Month/Year]**	Distribution & display format of the time message .

Serial line:

TOD output period : 000001s Output message : **[TOD]** Factory message	TOD output period. The Factory message may be used only by Spectracom in Debug mode .

Active keys: ←, →, ↑, C, keypad and V.

The selection is done with the C key.

The TOD output period is selected with the keypad.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the upper menu.

6.5.4 Alarms Menu

This allows the user to setup activating values of the phase and frequency alarms.

ALARM SETUP	
.Thresholds	.Output frequencies

Select the under menu with the keys → ← and ↓.

Thresholds :

Phase alarm limit	: **0000001µs**	Phase alarm threshold
Frequency alarm limit	: **00100e-9**	Frequency alarm threshold

Phase alarm at 0 let it in active.

The frequency alarm at 0 let it active just after the GPS reception loss.

Output frequencies :

Out. freq. squelch on alarm : Yes **[No]**	The user may cut off the frequency outputs in case of alarms squelch .

Active keys : ←, →, ↑, C, keypad and V.

The selection is done with the C key.

The alarm threshold is selected with the keypad.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the upper menu.

6.5.5 1pps delay Menu

This menu may be chosen if the SLAVED mode is selected

The 1PPS delay is the delay due to the GPS antenna cable.

1PPS delay: **000000** ns

Active keys : ←, →, ↑, C, keypad and V.

The delay is selected with the keypad.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the upper menu.

6.5.6 Mode Menu

The user may select the functioning mode of the clock: slaved on GPS or off-line (non-slaved).

Slaving on GPS input : **[yes]** no

Active keys: C, V and ↑.

If the [Yes] is selected with the C key and followed by the V key, the slaving on GPS is validated.

If the [No] is selected and followed by the V key, the slaving is in off line mode.

The ↑ key allows the user to go back to the upper menu.

6.5.7 Date Menu

This menu may be chosen if the OFF LINE mode is selected

This allows the manual time setup of the clock. The time capture format is the same as the time given.

Date : 11/09/1997 (dd/mm/yyyy) Time : 16 :23 :00 (hh :mm :ss)

Active keys : ←, →, C, V, ↑, ↓, and keypad.

The selection is done with the C key.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the upper menu.

6.5.8 Corrections Menu

This menu is optional and may be chosen if the OFF-LINE mode is selected. Frequency and 1PPS corrections are optional

This allows the user to access to the correction sub-menu .

CORRECTIONS .Frequency .1PPS .second

Active keys : ←, →, ↑, ↓.

To select the menu, use the keys: ←, →.

The ↓ key allows the user to select the under menu.

The ↑ key allows the user to go back to the SETUP menu.

Frequency :

The frequency correction of the pilot. The capture corresponds to Δf/f and is independent from the pilot frequency.

Frequency correction : ±00000e-12

Active keys: V, ↑ and keypad.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the CORRECTIONS menu.

1 PPS:

Phase correction of the 1pps.

1pps correction : ±000000.0 µs

Active keys: C, V, ↑ and keypad.

The selection is done with the C key.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the CORRECTIONS menu.

Second :

Displays the current time and allows the user to correct it ± 1 second.

11/01/1997 10 :30 : 00 UTC
second correction : [+1 sec.] -1 sec.

Active keys: C, V and ↑.

The C key selects +1 second or -1 second.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the CORRECTIONS menu.

6.5.9 Second Leap Menu

This function allows the user to program a positive or negative leap second when the time reference is UTC.

```
Leap second : [Positive]  Negative  No
Day of year  : 001   Year : 1992
```

Active keys : ←, →, ↑, ↓, C, V and keypad.

The C key selects the application way of the leap second.

The keypad allows the capture of the date.

The V key allows the user to validate the capture.

The ↑ key allows the user to go back to the SETUP menu.

6.5.10 Menu Reset

This allows the user to reset the clock.

```
Do you want to reset the clock now ?
                  Yes  [No]
```

Active keys: C and V.

7 Remote Control Interface

7.1 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.

7.2 Protocol

The protocol used is Master (Host) / Slave (EPSILON CLOCK®) 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(*)) 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(*)> <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®)
- Commands (functions that initialize or configure the EPSILON CLOCK®)
- 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®, 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®. In a query, the <DATA> field is not taken into account by the EPSILON CLOCK® 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

7.3 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

7.4 Command and Request List

Designation	Command ID	Request ID	Useful bytes n°
Status	---	80	37
Version	---	67	10
Date setup	4	68	7
GPS setup	10	74	19
Local Time	7	71	2
Display	13	77	2
Emission Time of the TOD	2	66	4
Serial Line Configuration	1	65	1
Antenna delay Correction	8	72	4
Leap Second	9	73	6
Alarms limits	14	78	10
Mode (slaved or off line)	15	79	1
Manual time setting	17	81	7
Frequency correction	20	84	4
1pps correction	19	83	4
correction ± 1 second	21	85	1
Local/Remote control	18	82	1
Reset	16	---	0

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

Name	Identifier		Bytes	Byte No.	Settings	Description
	Query	Command				
Status	80	-	37	0	$b_0 = 1$ $b_0 = 0$	Clock is synchronized to the reference input (GPS) Clock is not synchronized (the clock is in hold over mode after the loss of the reference input signal).
					b_1 to b_7	Reserved bits.
				1	$b_0 = 1$ $b_0 = 0$	Reference input 1 PPS failure. Reference input 1 PPS operational.
					$b_1 = 1$ $b_1 = 0$	Frequency driver failure. Frequency driver operational.
					$b_2 = 1$ $b_2 = 0$	1PPS driver failure. 1PPS driver operational.
					$b_3 = 1$ $b_3 = 0$	Failure in at least one standard frequency output. All the standard frequency outputs are operational.
					$b_4 = 1$ $b_4 = 0$	1PPS output failure. 1PPS output operational.
					$b_5 = 1$ $b_5 = 0$	Phase limit alarm : loss of synchronization, programmed phase-limit exceeded. Phase limit not exceeded.
Status	80	-	37	1	$b_6 = 1$ $b_6 = 0$	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. 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.
					$b_7 = 1$ $b_7 = 0$	Optional output board failure. Optional output board operational.
				2	$b_0 = 1$ $b_0 = 0$	EPSILON CLOCK® hardware failure. EPSILON CLOCK® hardware operational.
					$b_1 = 1$ $b_1 = 0$	Reserved
					$b_2 = 1$ $b_2 = 0$	Antenna not connected. Antenna connected.
					$b_3 = 1$ $b_3 = 0$	Antenna short circuit alarm. No antenna short circuit.
				3		Reserved

Name	Identifier		Bytes	Byte No.	Settings	Description
	Query	Command				
				4	1 or 5	GPS reception, mode 0D : The clock is synchronized using a single satellite. Mode set to manual positioning of the GPS antenna or after reliability testing of the GPS antenna's coordinates in automatic positioning mode.
Status	80	-	37	4	2 or 6	GPS reception mode 2D : The clock is synchronized using 3 satellites. 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).
		-			3 or 7	GPS reception mode 3D : The clock is synchronized using 4 to 8 satellites and the antenna positioning mode is set to mobile, or automatic (before reliability testing).
				5 to 20	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. The even byte O_i gives the SNR of the satellite indicated by the byte O_{i-1} e.g. : O_3 = 140 (80 HEX + 12 decimal) O_4 = 120 Satellite 12 is locked and its SNR is 120.
				21 to 22	0 ... 65535 (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	-324,000,000 ... 324,000,000 (-90°S ... +90°N)	Latitude of the GPS antenna (ms).
				27 to 30	-648,000,000 ... 648,000,000 (-180°W .. +180°E)	Longitude of the GPS antenna (ms).
				31 to 34	-100,000 ... 1,800,000 (-1,000 m to 1,800 m)	Altitude of the GPS antenna (cm).
Status	80	-	37	35	1 0	GPS receiver failure GPS receiver operational.
				36	---	Reserved
Serial port TOD link configuration	65	1	1	0	1 0	Clock diagnostic output. TOD message output.
Period of TOD message emission	66	2	4	0 to 3	0 ... 100,000 (0 ... 100,000 sec)	Period of the emission of the TOD message in seconds.
Reset clock	---	16	0	---	---	Stops and restarts the clock (warm-reboot).
Version	67		10	0 to 3	---	Reserved
				4	0 ... 255	Software version.
				5	0 ... 255	Update version number.
				6	b0 to b1 (1, 2 or 3)	Clock settings 1 : serie 1 2 : serie 2 Series number 3 : serie 3

Name	Identifier		Bytes	Byte No.	Settings	Description
	Query	Command				
Version	67		10	6	b2= 1 b2= 0	24V DC input voltage 48V DC input voltage
					b3 = 1 b3= 0	GPS Input STANAG Input
					b4 to b6 = 7 = 4/5/6 = 3 = 2 = 1 = 0	No output option. Reserved. STANAG 4430 Output G.704 Output. Pulse rate output. IRIG.B. Output
					b7 = 1 b7= 0	Multiple of 2048 kHz frequency . Multiple of 1 MHz frequency .
				7	b_0 to b_1 = 3 = 2 = 1 = 0	1 MHz or 2048 kHz. (according to byte 6 / b_7) 5 MHz or 4096 kHz. 10 MHz or 8192 kHz. Reserved.
Version	67		10	7	b_2 to b_3 = 3 = 2 = 1 = 0	High performance Rubidium frequency driver Standard performance Rubidium frequency driver High-performance OCXO frequency driver Standard performance OCXO frequency driver
					b4 = 0 =1	Relay contact closed on hardware failure / phase limit / frequency limit. Relay contact closed on hardware failure only.
Version	67		10	8 to 9	---	Reserved.
Set date	68	4	7	0	1 ... 31 (Days)	Sets the GPS receiver date and time.
				1	1 to 12 (Months)	
				2 to 3	1992 ... 2016 (Years)	
				4	0 ...23 (hours)	
				5	0 ... 59 (minutes)	
				6	0 ... 59 (seconds)	
Local time	71	7	2	0 1	-23 ... +23 (hours) -59 ... +59 (minutes)	Difference, in hours and minutes, between local time and the clock's reference time.
Correct antenna cable delay	72	8	4	0 to 3	0 ... 1,000 ns	Programmed difference between the distributed 1PPS signal and the built-in reference.
Leap second	73	9	6	0	1 0	No leap second. Use leap second.
				1	1 2	Leap second addition. Leap second subtraction.
				2 to 3	1 ... 366 Days	Day of the year to be used.
Leap second	73	9	6	4 to 5	1992 ... 2127	Year to be used
Set GPS	74	10	19	0	1 2 3	Antenna positioning mode : Automatic Antenna positioning mode : Manual Antenna positioning mode : Mobile

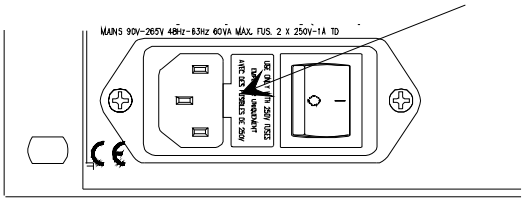
Name	Identifier		Bytes	Byte No.	Settings	Description
	Query	Command				
Set GPS	74	10	19	1 to 4	-324,000,000 ... 324,000,000 (-90°S ... +90°N)	Latitude (ms).
				5 to 8	-648,000,000 ... 648,000,000 (-180°W .. +180°E)	Longitude (ms).
				9 to 12	-100,000 ... 1,800,000 (-1,000 m to 1,800 m)	Altitude (cm).
				13 to 17		Reserved
				18	1 0	UTC time reference. GPS time reference.
Display	77	13	2	0	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
				1	---	Reserved
Alarm limits	78	14	10	0 to 3	0 ... 1,000 µs	Phase alarm limit 0 = no phase alarm.
				4 to 7	0 ... 1,000 10^{-9}	Frequency alarm limit 0 = alarm immediate if synchronization is lost.
				8	1 0	No interruption of frequency output. Frequency output interrupted if frequency limit is exceeded or in case of hardware failure.
				9	---	Reserved
Time keeping	79	15	1	0	1 0	Functioning mode : disciplining authorised Functioning mode : off line
Manual time setting	81	17	7	0	1 ... 31 (days)	Manual setting of the clock (authorised only in forced keeping mode).
				1	1 ... 12 (month)	
				2 à 3	1992 ... 2127 (year)	
				4	0 ...23 (hours)	
				5	0 ... 59 (minutes)	
				6	0 ... 59 (seconds)	
Remote Control	82	18	1	0	1 0	Remote control not active / Front panel user interface active Remote control active / Front panel user interface not active

Name	Identifier		Bytes	Byte No.	Settings	Description
	Query	Command				
Remote Control	82	18	1	0	1 0	Remote control not active / Front panel user interface active Remote control active / Front panel user interface not active
1pps correction	83	19	4	0 to 3	-2500000...2500000	Phase correction of the 1pps from -250 to +250 (active function on off line mode)
Frequency correction	84	20	4	0 to 3	- 50000 ... 50000 (10^{-12})	Frequency correction from -5 to +5.10^{-8} (active function on off line mode)
+1s correction	85	21	1	0	1 0	Correction +1s Correction -1s
Error (ID = 64)			2	0	X	Invalid message ID
				1	0	Incorrect number of useful bytes
					1	Unknown message ID
					2	Unauthorized parameter in <DATA> section.

8 Maintenance

The EPSILON CLOCK® is fully automatic and is not field-serviceable. It requires no maintenance for a period of 10 years. The only potential maintenance operation, on the first level, is the main power fuse replacement.

Fuse



REVISION HISTORY

Revision Level	***ECN Number***	***Description***
A	22/06/98	*Creation*
B	04/08	*First iteration of this Spectracom documentation, converted from Temex Sync documentation.*
C	26/05/08	*Suppression of all references to EC3T correction of OCXO performances*
D0	20/06/08	*Modification of Front and Rear Panel (sheet 1-5)*

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