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The Global Leader in Resilient PNT

GNSSource-1000

Smart, Low-Cost & High Performance GNSS OCXO Reference Source

User Manual

Document Part No: GNSSource-1000_Manual

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Contents

1. Introduction

The GNSSource-1000 has been specifically designed for cross industry applications, including telecom and calibration, requiring extremely stable and precise timing or frequency source.

The GNSSource-1000 integrates a GPS receiver, a smart GPS-disciplined OCXO clock, and distributes multiple output signals, either phase or frequency aligned depending on the operating modes.

Definitions

This is a list of words and related definitions used in this manual to help the user understand the content:

Words	Definitions
GNSSource-1000	Unit or product
Unit	GNSSource-1000
System	GNSSource-1000 and its integrated modules
GXClock-500	GNSS OCXO disciplined module
Track mode	Frequency alignment between a reference and an output signal, regardless of the relative phase position of the two signals. Also known as "syntonization"
Sync mode	Phase alignment between a reference and an output signal. Also know as synchronization"
Free-run mode	Rubidium clock not locked to any reference, including GPS
Holdover mode	Rubidium clock that was previously locked to a GPS reference but lost it or is no longer present

2. Before Getting Started

2.1 Unpacking

Unpack and carefully inspect the unit. Check for physical damage. If physical damage is observed, please immediately contact us.

Unit Supplies

- 1x GNSSource-1000 unit
- 1x GPS patch antenna with 5 meters (16.4') cable with standard option
  Note: For optional Rooftop GPS Antenna (Ordering code: RA)

  This kit contains the following items:
  - 1x roof antenna
  - 1x cable of 15 meter (49')
  - 1x cable of 5 meter (16.4')
  - 1x lightning arrestor

- Cables SUB-D male/female for PC serial COM
- 1x Power cable
- 2x 19" rack mountable ears or tabletop feet
- 1x Operating Manual + Specifications

2.2 Safety!

- Use proper ESD precautions

- Ensure that all cables are properly connected
- For pluggable equipment, the socket-outlet shall be installed near the equipment and shall be easily accessible.
- The integrity of the protective earth must be ensured.

- Handling the product in a reasonably foreseeable conditions do not cause any risk for human health, exposure to the SVHC (substances of very high concern) would require grinding the component up.

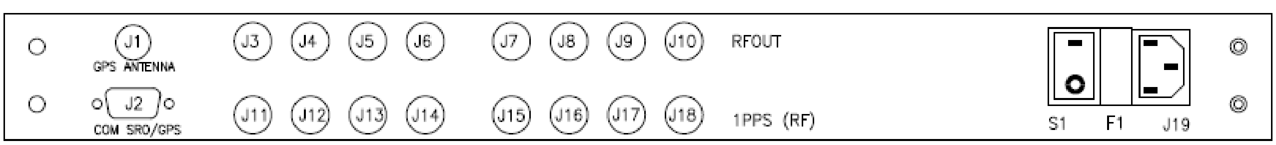
Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to CE Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

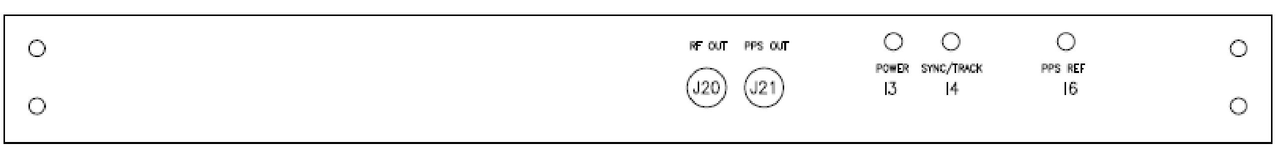
2.3 Environmental Responsibility

- The equipment contains materials, which can be either re-used or recycled.
- Do not deposit the equipment as unsorted municipal waste. Leave it at an authorized local WEEE collection point or return to Orolia Switzerland SA to ensure proper disposal.
- To return the appliance :
  a. Download and fill up the RMA form (from orolia.com) and send it to clocksupport@orolia.com
  b. Once the RMA is approved, we will contact you with shipment process details.

2.4 Installation Procedure

2.4.1 Connections





2) Connect GPS antenna to J1 GPS antenna. Install the included patch antenna close to a window

Notes:

a) If the installed antenna is in a region susceptible to lightning, a surge arrestor must be installed. For the installation, please refer to section "Safe GPS Antenna installation".
b) Customize GPS Antenna. The customer can install their own desired Antenna. In such case, the antenna connector of the device supplies 5V/30 mA for the amplifier.
c) GNSSource-1000 is CE tested only for an antenna cable less than 30 meters (98').

3) Connect a COM cable between J2 and one COM available of your computer for RS232 commands and monitoring (if required).
4) Place S2 in position "Free run".
5) Switch On the system S1.

2.4.2 Software Monitoring

2.4.2.1 iSyncMgr Application

GNSSource-1000 operates independently. However, the smart integrated GXClock-500 module can be monitored through GxClock-500 manager application. The latest version of this software can be downloaded from https://www.orolia.com/documents/isyncmgr-gxclock-software/attachment

To start the application, please follow procedure below:

- Start the application with File Explorer

  By default, the serial port is COM1. If a warning window pops up before the application GXClock manager starts, the COM1 is not free and another port has to be selected. How? Go to "Serial Port \ PortNo"menu, then select another available port.

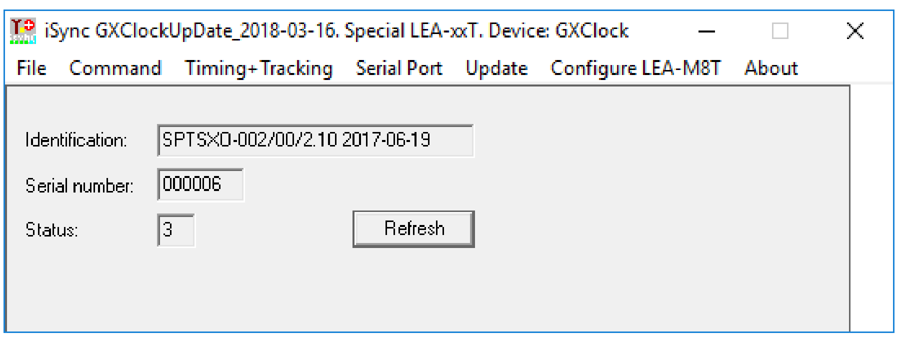


Figure 1 – GXClock Manager.exe

- Once the serial port number is properly working, click on the "Refresh" button. The Identification, Serial Number and Status of the smart Gxclock inside the GNSSource-1000 should be displayed .
  Notes: a) GXClockmanager gives full monitoring access to the smart GXClok-500
  b) Changes through these commands should be avoided as the dvice was factory optimized

2.4.2.2 Monitoring Through RS232 Terminal Communication Interface

The user can also use a serial communication RS232 to monitor the parameters of rubidium clock or to send specific commands. For example, a hyper terminal communication can be used as follows:

RS232 protocol is:
9600 bits/s
8 data bits
No parity
1 stop bit
No handshake

Notes:

1) See chapter 6 for the list of commands

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3. System Operations

3.1 Operating Modes

The GNSSource-1000 integrates a smart GXClock-500 module integrating a GNSS receiver. It provides 4 basic modes of operation as follows:

1. Free Run: When the GXClock is not locked to a GNSS reference and, thus, is free running
2. Track: When the GNSS reference is used to perform frequency alignment applications. It uses the PPS_GNSS as a reference (PPSREF) to align the frequency of the OCXO clock, but the phase is not aligned.
3. Sync: When the GNSS reference is used to perform phase alignment applications. The PPSOUT of the GNSSource-1000 is aligned in phase with the GPS PPSREF input through the internal PPSINT reference signal, which uses the SmarTiming+™ algorithm to 1) compare the PPSOUT against the PPSREF signal at 1ns resolution within a +/-500ns dynamic range and 2) auto-adaptively align them.
4. Holdover: When the GNSS signal is not present (NO PPSREF). The last averaged frequency value is used for performance enhancement by the SmarTiming+™ algorithm

Note:

a) At power ON, the GXClock is factory configured to go in Sync after the Warm up delay.

3.2 Operating Mode Setup

The user can set up the operating mode only by software:

- Select desired operation mode through the GXClock manager application or send RS-232 commands. Example:
  - Free Run: Send *TR0*
  - Track: Send *TR0, SY0, TR1*
  - Sync: Send *TR0, SY1, TR1*
  - Holdover Disconnect GNSS antenna. Or with MAv parameter 0x04:1

Note:

a) See Chapter 6 for a list of supported RS-232 commands

3.3 Normal Power / On sequence

Sequence	Status	Duration	LED status			Comment / Possible trouble
			Power LED	Green LED	Red LED	
Warm up	0	6 minutes	√	-	√	Duration too short or too long: Check MAv parameter 0x0E
Going in tracking	1	1 minute	√	√	√	If duration longer than 5 minutes or Status:5 or 6, check GNSS antenna. Then send *TR0, TR1*
Tracking GNSS	3		√	√	-	Normal Sync situation
Holdover	6		√	√	√	Antenna issue

4. System Description

4.1 Block diagram

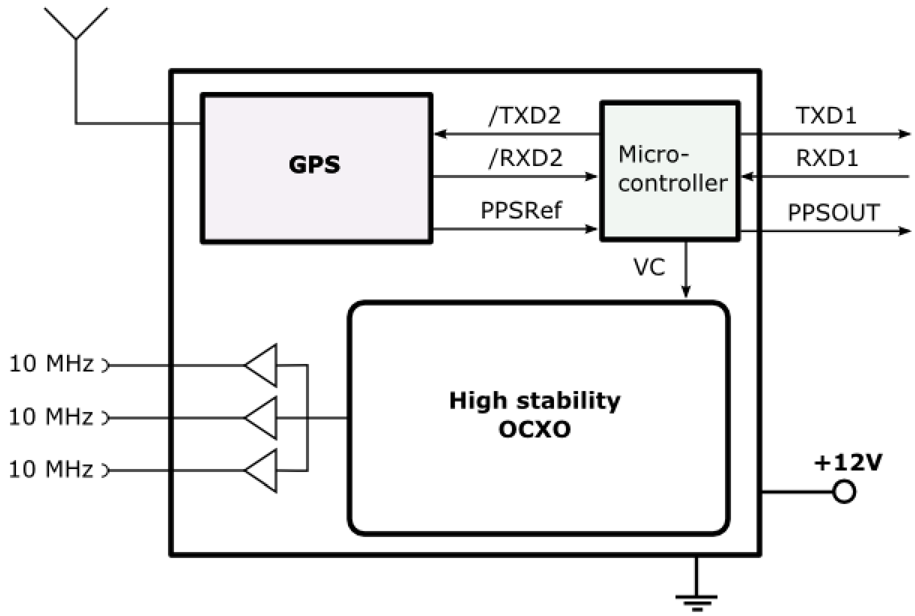


Figure 3-1 Building block of the GXClock-500 module inside the GNSSource-1000

4.2 THE TIMING AND TRACKING SYSTEM OF THE GXCLOCK

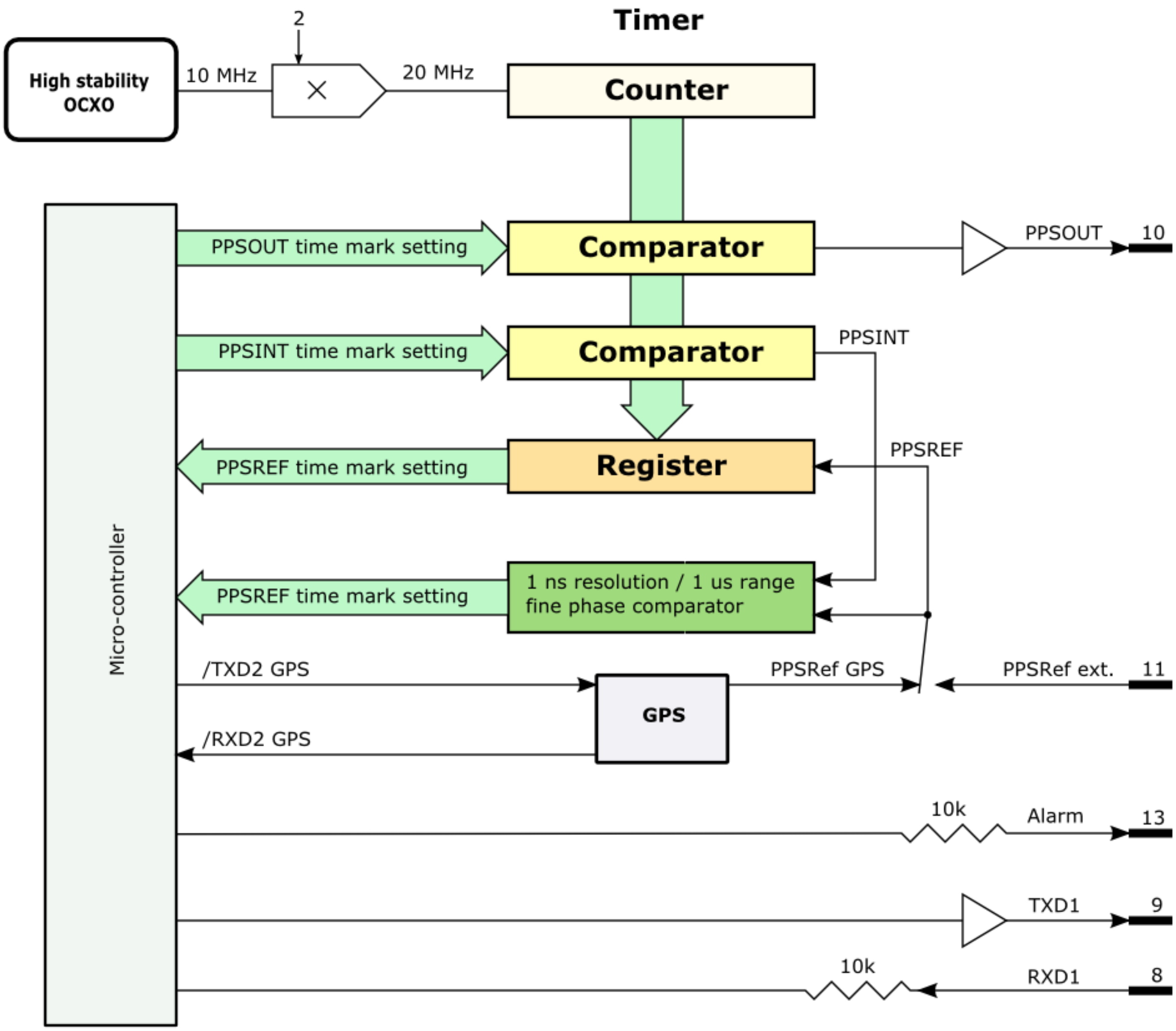


Figure 3-2 Timing system.

This iSync includes extended PPS (Pulse Per Second) facility. The hardware of this facility consists of two modules. The first module is a timer clocked at 20 MHz. This timer tags the PPSREF coming from the internal GPS or from the outside, pin 11, and generates two other PPS. The first one is called PPSINT and is used internally. The second one is called PPSOUT and appears on pin 10 of the connector.

The second module is a phase comparator with 1 ns resolution and 1 μs range. This module compares the phase between PPSREF and PPSINT. The phase information is used for the perfect tracking of a low noise PPSREF and for calculating the noise of this PPSREF. The calculation is used to adjust the time constant of the tracking loop. This way, a noisy PPSREF can be directly connected to the device without adjustments by hard or software.

4.2.1 THE "TRACK" MODE AND THE "SYNC" MODE.

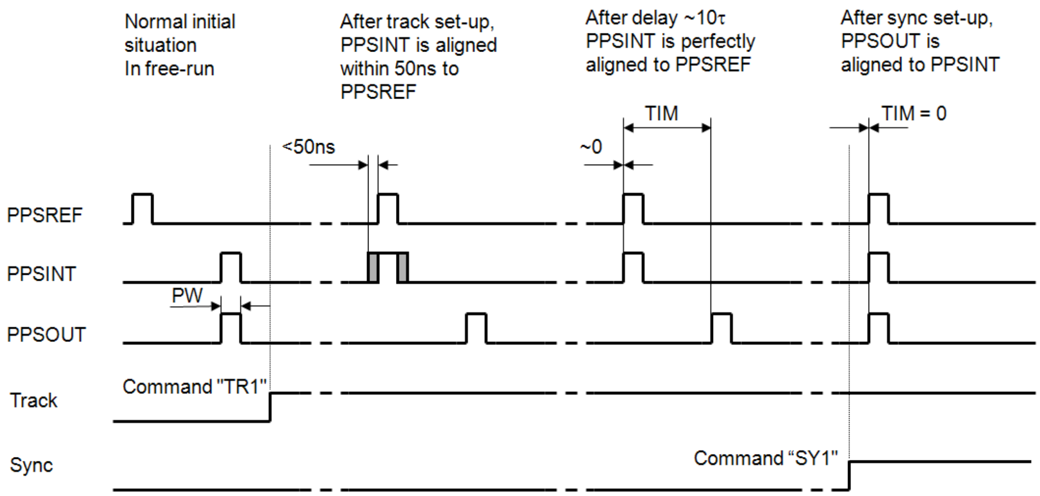


Figure 3-3 "Track" mode and "Sync" mode.

When "track" mode is set-up, the PPSINT is aligned to the PPSREF within 50 ns and the device start to track it. At the beginning the loop time constant is set to an arbitrary low value. Then the phase comparator starts the long-term frequency stability analysis of the PPSREF and the loop time constant is set accordingly.

If "sync" mode is not active, the PPSOUT is let in the place where it was before going in tracking.

If "sync" mode is active, the PPSOUT is aligned to PPSINT, just after going in tracking if it was set already or just after it is set elsewhere.

Remark: Just after the beginning of tracking, PPSINT is not perfectly aligned to PPSREF. The error can be as big as 50 ns. Of course, the tracking loop will cancel this error after some time.

4.2.2 THE FREQUENCY LEARNING

When the GXClock is tracking the PPSREF of the GPS, in reality, it aligns its frequency to the one of the GPS system. The learning process is simply the memorization of this frequency from time to time to use it after a reset or Power-On. By default, when the device is continuously and successfully tracking a PPSREF, the average value of the frequency is saved in EEPROM every 24 hours.

With the command FSx, it is possible to cancel the learning or to make an immediate save.

4.2.3 THE FREQUENCY IN USE

With the PPSREF facilities, a different frequency can be in use in different situations. Let know first, that the frequency just currently in use is located in a single register, and that this register can ever be read by the user. The command to read this register is: FC??????.

On a device connected through the serial interface to a terminal, it is possible to follow the evolution of the tracking by this way.

The frequency in use in different situations is as follows:

- After a Reset or Power-On, the value is copied from the EEPROM to the RAM and is used.
- When not in tracking, the command FCsddddd or the command Cxxxx, change the value in use and store it in the EEPROM.
- At the beginning of a tracking, the value in use is the one of the EEPROM.

- During a tracking, the value in use changes continuously to align as well as possible the PPSINT to the PPSREF. A holdover frequency is also estimated continuously. By default, the holdover frequency is saved in EEPROM every 24 hours.
- When the tracking is stopped intentionally, the device goes in FREE RUN and the value in EEPROM becomes in use.
- If a tracking is stopped because of a degraded or a missing PPSREF, the iSync goes in HOLDOVER with the holdover frequency previously estimated.

4.2.4 THE PPS TRACKING LOOP

The iSync is equipped with a numerical PI regulation loop to track the PPSREF. The time constant of the tracking loop is either set automatically, or forced by the user with the command TCdddddd.

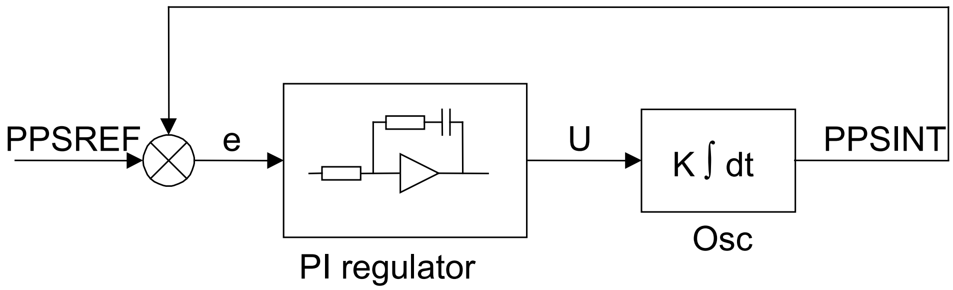


Figure 3-4 Schematic of the PPSREF regulation loop.

By default the time constant is set automatically. In such situation, the optimum loop time constant is computed from information's like PPSREF noise and temperature fluctuations. If this information is missing, the time constant is slowly forced to 1000 second in the GXClock.

4.2.5 TRACKING LIMITS AND ALARMS

If the frequency between the iSync and the master to track is too large, after some time, the phase time error between PPSINT and PPSREF can become too big for some applications.

There are two limits. If the phase time error becomes bigger than the first limit, an alarm is raised up, but the tracking continues. If the phase time error comes bigger than the second limit, then the tracking stops. The first limit is called (no) alarm window and the second window tracking window. The value of the half (no) alarm window can be changed by the user with the command AWddd. For the GXClock, the default value is ± 20µs. The value of the half tracking window can be changed by the user with the command TWddd. For the GXClock, the default value is ± 60µs. For more details, see the Chapter "TIMING AND TRACKING COMMANDS".

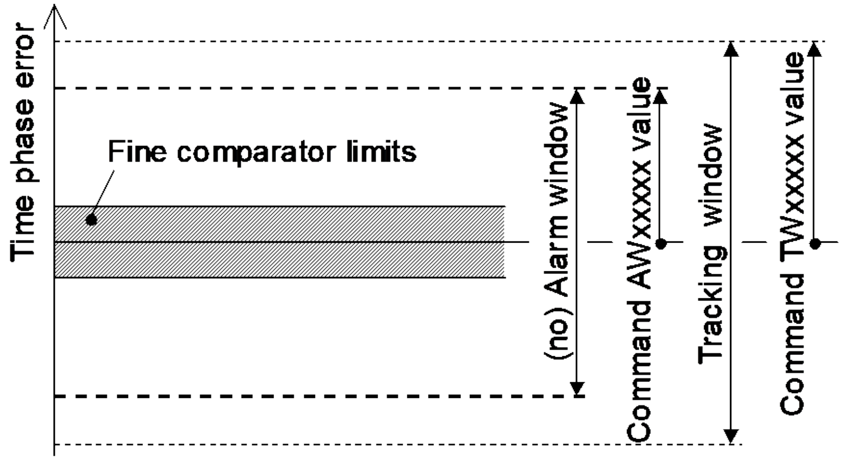


Figure 3-5 Tracking limits.

4.2.6 FREQUENCY FLUCTUATIONS DURING THE TRACKING

By default, during a tracking, the GXClock is able to tune it's frequency on the nearly full range given by a 16

bit number. In reality from FC-32765 to FC+32765. Or in relative frequency: > ±4e-7.

In case the frequency limit is reached during a tracking, no error will be raised up as long the phase time error is staying in the (no) alarm window.

So high frequency variations are may be not acceptable in some applications. In such case it is possible to lower the limit by software tuning, See MAv.. parameters, Frequency limit.

4.2.7 FINE PHASE COMPARATOR OFFSET

This fine offset adjustment can be used in case of precise phase calibration. The range of the offset is +127/ - 128 steps of the fine phase comparator. As the fine comparator works analogue, a step corresponds to approx. 1 ns. The command to put the offset is COsddd

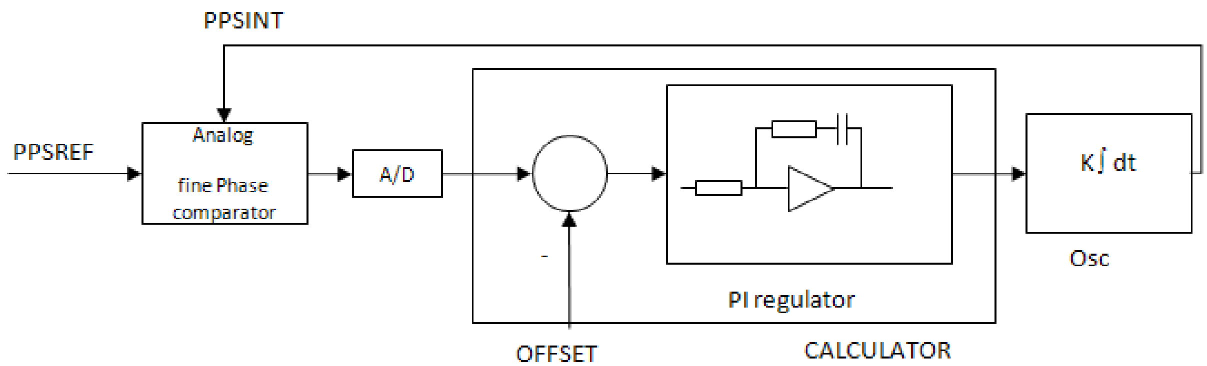


Figure 3-6 schematic of the analog fine phase comparator regulation loop

4.2.8 THE AUTOMatical RESTART OF THE TRACKING

In a situation where just a frequency disciplining is asked, like in a laboratory, it is recommended to allow the automatically restart of the tracking by setting MAv parameter 0x06, bit 2 to 1.

In other situations, like synchronization of a base station to the GPS constellation, it is recommended to not allow this automatically restart by setting MAv parameter 0x06, bit 2 to 0. This way GPS receiver anomaly may be cancelled. But this induce stacking in Status=5 problem. To fix up this, it is recommended to restart the tracking (local controller).

4.3 SIMPLE SERIAL INTERFACE OPERATION

4.3.1 INTRODUCTION

The GXClock is equipped with a micro-controller which supervises the normal working of the device. All the working parameters are stored in a built-in EEPROM memory.

The built-in serial interface allows an automatic parameter adjustment during the manufacturing.

The serial interface serves also for the monitoring and tuning of the internal parameters and the PPS facilities.

4.3.2 SERIAL INTERFACE CONNECTION

The data transfer from the GXClock can be made by direct connection to a PC or standard terminal.

The data transfer parameters are the following:

bit rate: 9600 bits/s.
parity: none
start bit: 1
data bits: 8
stop bit: 1

IMPORTANT NOTE:

In most cases, the serial PC interface accepts the 0 to 5V level and a direct connection can be made. In case this 0 to 5V standard is not working, please refer to the small adaptation circuit called 'RS 232 adapter circuit' described in annex I.

4.3.3 GXClock INTERNAL PARAMETERS MONITORING

The internal parameters monitoring is made via the serial interface and with the use of single command "M" followed by a carriage return character.

M<CR>[<LF>]
The GXClock will respond to this single character command with an eight ASCII / HEX coded string which looks like:

HH GG FF EE DD CC BB AA <CR><LF>
Where each returned byte is an ASCII coded hexadecimal value separated by a <Space> character.

The values are indicative and not scaled.

HH: reserved
GG: PCB temperature
FF: reserved
EE: reserved
DD: OCXO Voltage Control
CC: reserved
BB: reserved
AA: reserved

PCB temperature [Celsius] = 0xGG * 0.5859 - 10.0

4.3.4 CENTRE FREQUENCY ADJUSTMENT WITH THE SERIAL INTERFACE

A single character command is available to the user for center frequency adjustment.

Cxxxx <CR>[<LF>] : output frequency correction through the synthesizer, by steps of approx. $6{\cdot}10^{-12}$, where xxxx is a signed 16 bits integer in hexadecimal string representation.

This value is stored in an EEPROM as last frequency correction which is applied after RESET or power-ON operation.

* Warning : This command can act into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated). See MAv06: 4 parameter to cancel the eeprom writing. (Since Version 2013-12-02)

- The argument of this command can vary from 0x8000 to 0x7FFF (-32768 to 32767).
- In track state, the frequency is changed internally by the software for optimum alignment and this command is no more active.
- The basic command FCsddddd does the same.
- Even if MAv06:4 parameter is settled to cancel the writing in eeprom of FC, a writing in eeprom is anyway possible if the command FCsddddd is followed by the command FS3

Examples:

C0000<CR>: return to the nominal value (factory setting).
C0010<CR>: the actual frequency is increased of 16 steps.
CFFF0<CR>: the actual frequency is decreased of 16 steps.

4.3.5 CENTER FREQUENCY READ-BACK

R05<CR>[LF]: read-back high byte of user frequency correction actually in use.
R06<CR>[LF]: read-back low byte of user frequency correction actually in use.
L05<CR>[LF]: read-back high byte of user frequency correction in use after RESET or power-ON.
L06<CR>[LF]: read-back low byte of user frequency correction in use after RESET or power-ON.

- In track state, the value of these registers is subject to be changed by the software for optimum alignment.

4.4 Status & Alarms

Status	Device ok		Alarm			
			Track Mode		Sync Mode	
	Pin 7	LED Green	Pin 13	LED red	Pin 13	LED red
S=0 warming up	(Low)[4]	(OFF)[4]	High	ON	High	ON
S=1 tracking set-up	High	ON	High	ON	High	ON
S=2 track to GPS (PPSREF)	High	ON	Low	OFF	N/A	N/A
S=3 Sync to GPS (PPSREF)	High	ON	N/A	N/A	Low	OFF
S=4 FreeRun. Track OFF	High	ON	High	ON	High	ON
S=5 HO[1] PPSREF unstable	High	ON	High	ON	High	ON
S=6[3] HO[2] No PPSREF	High	ON	High	ON	High	ON
S=7 Factory used	High	ON	High	ON	High	ON

(1) HO means Hold Over. Device still in Free Run if PPSREF unstable during tracking set-up
(2) HO means Hold Over : Device still in Free Run if No PPSREF during tracking set-up
(3) Status =6 also if GPS message activated (MAv22: Bit0:1) AND missing or defective GPS messages
Remarks: It is possible to deactivate “Device OK” and “Alarm” by SW, (MAv04:Bit6:1) In such case, pins 7,13 are Low and LED’s OFF

5. Timing & Locking Control Functions extended list

Extended commands beginning with 2 characters are implemented in the device for efficient managing, setting, tuning, reading back and surveying. Like the 1 character commands, this commands use the serial port 1.

5.1 INFORMATION COMMANDS

ID	Identification.
SN	Serial number.
ST	General Status.
BTx	Beat a message (every second) on the serial port.
VS	View PPSRef Sigma.
VT	View Time constant.

5.2 TRACKING COMMANDS

TRx	Tracking start and stop.
SYx	PPSOUT synchronization.
AWddd	Set the no alarm window during a tracking.
TWddd	Set the tracking window during a tracking.
TCdddddd	Set tracking loop time constant.
FSx	Set frequency saving.
COsddd	Set phase comparator Offset.
RAsddd	Raw phase adjust.

5.3 PPSOUT COMMANDS

PWddddddddd	Set the PPSOUT pulse width.
DEddddddddd	PPSOUT delay.
PPdddeee	Set PPSOUT cadence and initial phase.

5.4 DATE / TIME COMMANDS

DT	Send out the date.
DTyyyy-mm-dd	Set the date.
TD	Send out the time of day.
TDhh:mm:ss	Set the time of day.

5.5 SETTING COMMANDS

FCsddddd	Change frequency.
MAvxx..	Module adjust. Set and read internal parameters.

5.6 OTHER COMMANDS

FREEZEx	Freeze frequency.
RESET	Hot Reset.

INFORMATION COMMAND: ID Identification.

ID<CR><LF>	Identification.	
Answer:	SPTSXO-002/rr/s.ss<CR><LF>	
	rr:	revision number
	s.ss:	software version
Factory setting:	-	
EEPROM modification :	No	
Data in :	FLASH	
MAv access :	Yes	
Reset value:	-	

Example

Command	Answer	Comment
ID<CR>	SPTSXO-002/00/2.10<CR><LF>	-

INFORMATION COMMAND: SN Serial number.

SN<CR><LF>	Serial number.	
Answer:	aaaaaa<CR><LF>	
	aaaaaa:	6 characters serial number
Factory setting:	-	
EEPROM modification :	No	
MAv access:	No	
Reset value:	-	

Example

Command	Answer	Comment
SN<CR>	G00098<CR><LF>	–

INFORMATION COMMAND: **ST** General Status.

ST<CR><LF>	General Status.	
Answer:	s<CR><LF>	
	s:	Status.
	0: warming up	
	1: tracking set-up	
	2: track to PPSREF	
	3: sync to PPSREF	
	4: Free Run. Track OFF	
	5: PSREF unstable (Holdover)	
	6: No PPSREF (Holdover)	
	7: frequency frozen	
	8: factory used	
	9: fault	
Factory setting:	-	
EEPROM modification :	No	
Data in :	RAM	
MAv access :	No	
Reset value:	(0)	

Notes

- The Status is also transmitted every second with BT5, BT7.
- The Status is also included in the NMEA messages $PTNTA, $PTNTS,B.

Example

Command	Answer	Comment
`ST<CR>`	`4<CR><LF>`	Status=4, free run.

INFORMATION COMMAND: **BTx** Beat a message (every second) on the serial port.

BTx<CR><LF>	Beat a message (every second) on the serial port.	
	x:	message to beat.
	0:	no beat.
BT1<CR><LF>	Beat effective time interval PPSOUT vs PPSREF.	
Answer:	ddddddddd<CR><LF>	
	ddddddddd:	delay in ns.
BT2<CR><LF>	Beat fine phase comparator value.	
Answer:	sppp<CR><LF>	
	sppp:	s: +/- ppp: value in approx. ns.
BT3<CR><LF>	Beat effective time interval PPSOUT vs PPSREF + fine phase comparator value.	
Answer:	ddddddddd sppp<CR><LF>	
	ddddddddd:	delay in ns.
	sppp:	s: +/- ppp: value in approx. ns.
BT4<CR><LF>	Beat time of day.	
Answer:	hh:mm:ss<CR><LF>	
	hh:mm:ss	hh: hour mm: minute ss: second
BT5<CR><LF>	Beat general status.	
Answer:	x<CR><LF>	
	x: general status. See STx command	
BT6<CR><LF>	Beat <CR><LF>.	
Answer:	<CR><LF>	
	just <CR><LF>	
BT7<CR><LF>	Beat Date, Time, Status.	
Answer:	yyyy-mm-dd hh:mm:ss x<CR><LF>	
	yyyy-mm-dd	yyyy: year mm: month dd: day
	hh:mm:ss	hh: hour mm: minute ss: second
	x: general status. See STx command	
BT8<CR><LF>	Time tagging of PPSREF vs PPSINT as soon as PPSREF is arrived.	
Answer:	ssssssssss.nnnnnnnnn<CR><LF>	
	ssssssssss:	Seconds elapsed since 2000-01-01 00:00:00.
	nnnnnnnnn:	Residual in ns. Rounded to: 50ns. (GXClock)
BT9<CR><LF>	Send GPS receiver message status as soon GPS messages are arrived	
Answer:	x<CR><LF>	
	x:	See BT9 Note
BTA<CR><LF>	Beat NMEA message $PTNTA	

BTB<CR><LF>	Beat NMEA message $PTNTS,B
BTR<CR><LF>	Beat NMEA message $GPRMC
BTZ<CR><LF>	Beat NMEA message $GPZDA
Factory setting:	0
EEPROM modification :	No
Data in :	RAM
MAv access :	No
Reset value:	0

Notes

- BT8 can work as time tagging for PPSREF.
- BT1 BT3 output ????????? if there is no PPSREF .
- Regarding the phase comparator, no precision or linearity can be expected. This comparator just increases the resolution of the phase used by the tracking algorithm.
- This command is just for debugging. To store a beat behavior in EEPROM, one should use MAv parameters 0x0B and 0x0C.

Example

Command	Answer	Comment
BT5<CR>	..3<CR><LF>..3<CR><LF>..	Status=3, sync, in tracking.

INFORMATION COMMAND: **VS** View PPSRef Sigma.

VS<CR><LF>	view the Sigma of PPSRef.In tracking Status 2 or 3.	
Answer:	ddd.d<CR><LF>	
	ddd.d:	ddd.d: Sigma in ns
Factory setting:	-	
EEPROM modification :	No	
Data in :	RAM	
MAv access :	No	
Reset value:	000.0	

Note

- Measurement time interval: 1 second.

Example

Command	Answer	Comment
`VS<CR>`	`005.3<CR><LF>`	Means Time Variance @1s of 5.3 10^{-9}

INFORMATION COMMAND: VT View Time constant.

VT<CR><LF>	view the time constant of the tracking loop just in use	
Answer:	dddddd<CR><LF>	
	dddddd:	dddddd: Time constant in s
Factory setting:	-	
EEPROM modification :	No	
Data in :	RAM	
MAv access :	No	
Reset value:	000100 in automatic mode, settled time constant otherwise	

Example

Command	Answer	Comment
`VT<CR>`	`001000<CR><LF>`	Time constant of 1000 second

TRACKING COMMAND: **TRx** Tracking start and stop.

TRx<CR><LF>	Set tracking state of PPSINT - PPSREF . Interrogation of tracking state.	
TRx<CR><LF>	x:	Tracking state.
	0:	Set tracking state to OFF.
	1:	Set tracking state to ON.
	?:	Interrogation.
Answer:	x<CR><LF>	
	x = 0	Tracking state OFF.
	x = 1	Tracking state ON.
TRE<CR><LF>	eeprom tracking state interrogation	
Answer:	y<CR><LF>	
	y = 0	eeprom tracking state off
	y = 1	eeprom tracking state on
Factory setting:	1	
EEPROM modification :	No	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	Last value stored in EEPROM	

Notes

- When the tracking state is ON, the tracking starts.
- Every TR1 command induces a new tracking start.
- The value stored in EEPROM can only be changed with the MAv system.

Example

Command	Answer	Comment
TR1<CR>	1<CR><LF>	Tracking start.

TRACKING COMMAND: **SYx** PPSOUT synchronization.

SYx<CR><LF>	Set synchronization state of PPSOUT - PPSINT. Interrogation of sync. state.	
SYx<CR><LF>	x:	Synchronization state.
	0:	Set sync. state to OFF.
	1:	Set sync. state to ON.
	?:	Interrogation.
Answer:	x<CR><LF>	
	x = 0	Sync. state OFF.
	x = 1	Sync. state ON.
SYE<CR><LF>	eeprom sync state interrogation	
Answer:	y<CR><LF>	
	y = 0	eeprom sync. state off
	y = 1	eeprom sync. state on
Factory setting:	1	
EEPROM modification :	No	
Data in :	RAM, EEPROM	
MAv access:	Yes	
Reset value:	Last value stored in EEPROM	

Notes

- When the sync. state is ON, a synchronization is done at the end of the tracking setup.
- Every SY1 command induce a new synchronization.
- The commands SY1 and DE000000000 are equivalent in tracking.
- The value stored in EEPROM can only be changed with the MAv system.

Example

Command	Answer	Comment
`SY1<CR>`	`1<CR><LF>`	Synchronization PPSOUT - PPSINT.

TRACKING COMMAND: **AWddd** Set the no alarm window during a tracking.

AWddd<CR><LF>*	Set the no alarm window during a tracking. An alarm is raised up if the time interval ppsint vs ppsref become bigger than the ddd value, but the tracking continues as long this time interval is lower than the Tracking Window.	
	ddd:	half no alarm window in µs. From 001 to 255.
	000:	no checking.
	???:	interrogation.
Answer:	ddd<CR><LF>	
	ddd:	half no alarm window in µs. From 001 to 255.
Factory setting:	040	
EEPROM modification :	Yes * Warning : This command is acting into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated).	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	Last value stored in EEPROM.	

Notes

- When an alarm is raised up, Status=5, the pin 13 of the output connector is driven to high and the red LED lights up.
- A value of 000 means no checking. In such situation, an alarm is raised up in case of a calculation overflow (approx +/-500 µs).

Example

Command	Answer	Comment
AW???<CR>	040<CR><LF>	-

TRACKING COMMAND: **TWddd** Set the tracking window during a tracking.

TWddd<CR><LF>*	Set the tracking window during a tracking. Set the window in which the interval ppsint vs ppsref should stay during a tracking. If not, the tracking is stopped.	
	ddd:	half tracking window in µs. From 001 to 255.
	000:	no checking.
	???:	interrogation.
Answer:	ddd<CR><LF>	
	ddd:	half tracking window in µs. From 001 to 255.
Factory setting:	120	
EEPROM modification :	Yes * Warning : This command is acting into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated).	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	Last value stored in EEPROM.	

Notes

- When the tracking is stopped, Status=5, the pin 5 of the output connector is driven to high and the red LED lights up. The iSync goes in holdover and the holdover frequency comes in use.
- A value of 000 means no checking. In such situation, the tracking is stopped in case of a calculation overflow (approx +/-500 µs.

Example

Command	Answer	Comment
`TW???<CR>`	`120<CR><LF>`	-

TRACKING COMMAND: **TCdddddd** Set tracking loop time constant.

TCdddddd<CR><LF>*	Set tracking loop time constant.	
	dddddd:	time constant in seconds.
	000000:	change to automatic mode.
	000100:	minimum value, 100 s.
	010000:	maximum value, 10000 s.
	??????:	interrogation.
Answer:	dddddd<CR><LF>	
	dddddd:	time constant in seconds.
Factory setting:	000000	
EEPROM modification :	Yes * Warning : This command is acting into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated).	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	Last value stored in EEPROM.	

Notes

- In automatic mode, the time constant is automatically adapted to the PPSREF noise. The starting value is 100 s and the maximum value is 10000 s.
- In automatic mode, if the time interval PPSREF vs PPSINT go out of the fine phase comparator range, approx. +/-500 ns, the time constant goes slowly to 1000 s.

Example

Command	Answer	Comment
`TC??????<CR>`	`000000<CR><LF>`	automatic mode

TRACKING COMMAND: FSx Set frequency saving..

FSx<CR><LF>*	Set frequency save mode.	
	x:	mode.
	0:	no saving every 24 hours.
	1:	save holdover frequency in EEPROM every 24 hours.
	2:	save holdover frequency in EEPROM now.
	3:	save actual frequency in EEPROM now.
	?:	interrogation.
Answer:	y<CR><LF>	
	y:	frequency save mode.
	y = 1	no saving every 24 hours.
	y = 0	save holdover frequency in EEPROM every 24 hours.
Factory setting:	1	
EEPROM modification :	Yes * Warning : This command is acting into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated).	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	last value stored in EEPROM.	

Notes

- In frequency save mode 1, the saving is only done if the GXClock is in track state. (General Status 2 or 3).
- If PPSREF are missing or rejected, the 24 hours period is increased.

Example

Command	Answer	Comment
`FS?<CR>`	`1<CR><LF>`	In tracking, frequency saved every 24 hours.

TRACKING COMMAND: **COsddd** Set phase comparator Offset.

COsddd<CR><LF>*	fine phase comparator offset.	
	sddd:	fine phase offset in approx. 1 ns steps
	+000:	no offset
	+127:	highest offset
	-128:	lowest offset
	????:	interrogation
Answer:	sddd<CR><LF>	
	sddd:	phase offset actually in use.
Factory setting:	+000	
EEPROM modification :	Yes * Warning : This command is acting into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated).	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	last value stored in EEPROM.	

Note

- Usefull for precise phase calibration.

Example

Command	Answer	Comment
`CO????<CR>`	`+000<CR><LF>`	In tracking, no fine phase offset.

TRACKING COMMAND: **RAsddd** Raw phase adjust.

RAsddd<CR><LF>	raw phase adjust in 50 ns steps.	
	sddd:	raw phase adjust
	+000:	no jump
	+127:	highest ahead jump
	-128:	highest behind jump
	????:	interrogation (response always +000)
Answer:	sddd<CR><LF>	
	sddd:	just asked jump in 50 ns steps
Factory setting:	-	
Store in EEPROM:	no.	
MAv access:	no.	
Reset value:	-	

Notes

- This command moves the PPSINT by itself.
- This command can be useful for some timing applications to bring the fine phase comparator into an area where it works.
- This command doesn't move the PPSOUT pulse and don't modify the reading of BT1 or BT3.
- This command has an influence on the delay value, command DEddddddd, as the delay is in fact referenced to PPSINT.

Example

Command	Answer	Comment
`RA+001<CR>`	`+001<CR><LF>`	50 ns ahead jump of PPSINT.

PPSOUT COMMAND: **PWddddddddd** Set the PPSOUT pulse width.

PWddddddddd<CR><LF>*	Set the pulse width of PPSOUT.	
	ddddddddd:	Pulse width in ns, rounded to 50 ns.
	000000000:	No PPSOUT.
	000000050:	minimum pulse width
	999999950:	maximum pulse width
	?????????:	interrogation
Answer:	ddddddddd<CR><LF>	
	ddddddddd:	Pulse in ns, rounded to 50 ns.
Factory setting:	000100000	
EEPROM modification :	Yes * Warning : This command is acting into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated).	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	last value stored in EEPROM	

Example

Command	Answer	Comment
`PW100000000<CR>`	`100000000<CR><LF>`	Setting a PPSOUT pulse width of 1/10 second

PPSOUT COMMAND: **DEddddddddd** PPSOUT delay.

DEddddddddd<CR><LF>	Set the delay of PPSOUT pulse vs PPSINT. Read the effective measured delay PPSOUT vs PPSINT.	
	ddddddddd:	Delay in ns, rounded to 50 ns.
	000000000:	sync. to PPSINT, the same as SY1.
	000000050:	minimum delay.
	999999950:	maximum delay.
	?????????:	interrogation.
Answer:	ddddddddd<CR><LF>	
	ddddddddd:	Delay in ns, rounded to 50 ns.
Factory setting:	(000000000)	
EEPROM modification :	No	
Data in :	RAM	
MAv access :	No	
Reset value:	000000000	

Notes

- When going in tracking, Status=1, the delay vary continuously, as PPSINT is aligned on PPSREF.
- After a command SY1, PPSOUT is aligned to PPSINT and DE=000000000.
- Setting command: the answer is the just entered value.
- Interrogation command: the answer is the measured value.

Example

Command	Answer	Comment
`DE?????????<CR>`	`000000000<CR><LF>`	-

PPSOUT COMMAND: **PPdddeee** Set PPSOUT cadence and initial phase.

PPdddeee<CR><LF>*	Set PPSOUT cadence and initial phase.	
	ddd:	cadence. PPSOUT active every ddd second. From 001 to 255.
	eee:	offset to GPS epoch (1980-01-06 00:00:00) in second. From 000 to 255.
	000000:	no PPSOUT.
	??????:	interrogation.
Answer:	dddeee<CR><LF>	
	ddd:	cadence. PPSOUT active every ddd second. From 001 to 255.
	eee:	offset to GPS epoch (1980-01-06 00:00:00) in second. From 000 to 255.
Factory setting:	001000	
EEPROM modification :	Yes * Warning : This command is acting into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated).	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	Last value stored in EEPROM.	

Notes

- Synchronization to local GPS time if delay between ppsout and ppsint is lower than +/- 1ms. From DE999000000 to DE001000000.
- Outside of this +/-1 ms delay, the pulse is emitted at a fixed interval, with no relationship to GPS time.
- This mean if the iSync is in sync mode with Status=3, the output pulse will be for sure synchronized to GPS time, if available.

Examples

Command	Answer	Comment
`PP??????<CR>`	`001000<CR><LF>`	normal pulse per second
`PP002000<CR>`	`002000<CR><LF>`	pulse every 2 seconds. Synchronized to even GPS second.
`PP002001<CR>`	`002001<CR><LF>`	pulse every 2 seconds. Synchronized to odd GPS second.
`PP060000<CR>`	`060000<CR><LF>`	pulse every minute. Synchronized to minute since GPS epoch.

DATE / TIME COMMAND: **DT** Send out the date.

DT<CR><LF>	Send out the date.	
Answer:	yyyy-mm-dd<CR><LF>	
	yyyy-mm-dd:	year - month - day
Factory setting:	2000-01-01	
EEPROM modification :	No	
Data in :	RAM	
MAv access :	No	
Reset value:	2000-01-01	

Notes

- After reception of this command, the device responds following the rules of the command BTx. This means the answer is not immediate, but can be delayed up to 1 s.
- The calendar works from 2000-01-01 to 2099-12-31.

Example

Command	Answer	Comment
`DT<CR>`	`2008-04-28<CR><LF>`	-

DATE / TIME COMMAND: **DTyyyy-mm-dd** Set the date.

DTyyyy-mm-dd<CR><LF>	Set the date.	
	yyyy-mm-dd:	year - month - day
Answer:	yyyy-mm-dd<CR><LF>	
	yyyy-mm-dd:	year - month - day
Factory setting:	2000-01-01	
EEPROM modification :	No	
Data in :	RAM	
MAv access :	No	
Reset value:	2000-01-01	

Notes

- After reception of this command, the device responds following the rules of the command BTx. This means the answer is not immediate, but can be delayed up to 1 s.
- The calendar works from 2000-01-01 to 2099-12-31.

Example

Command	Answer	Comment
`DT2008-04-29<CR>`	`2008-04-29<CR><LF>`	-

DATE / TIME COMMAND: **TD** Send out the time of day.

TD<CR><LF>	Send out the time of day.	
Answer:	hh:mm:ss<CR><LF>	
	hh:mm:ss:	hours : minutes : seconds
Factory setting:	00:00:00	
EEPROM modification :	No	
Data in :	RAM	
MAv access :	No	
Reset value:	00:00:00	

Notes

- After reception of this command, the device responds following the rules of the command BTx. This means the answer is not immediate, but can be delayed up to 1 s.

Example

Command	Answer	Comment
`TD<CR>`	`15:08:38<CR><LF>`	-

DATE / TIME COMMAND: **TDhh:mm:ss** Set the time of day.

TDhh:mm:ss<CR><LF>	Set the time of day.	
	hh:mm:ss:	hours : minutes - seconds
Answer:	hh:mm:ss(+1)<CR><LF>	
	hh:mm:ss:	hours : minutes - seconds(+1)
Factory setting:	00:00:00	
EEPROM modification :	No	
Data in :	RAM	
MAv access :	No	
Reset value:	00:00:00	

Notes

- After reception of this command, the device responds following the rules of the command BTx. This means the answer is not immediate, but can be delayed up to 1 s.
- It is a pulse - message system. That mean the time information is referenced to the PPSINT just before the command arrival.
  As the answer is coming after the next PPSINT, it is 1 second ahead.

Example

Command	Answer	Comment
`TD08:25:37<CR>`	`08:25:38<CR><LF>`	The difference from 37 to 38 seconds is due to the pulse - message system.

SETTING COMMAND: **FCsddddd** Change frequency.

FCsddddd<CR><LF>*	set new frequency	
	sddddd:	new frequency in approx. 6e-12 / step
	+00000:	back to factory setting
	+32767:	highest pull-up
	-32768:	lowest pull-down
	??????:	interrogation
Answer:	sddddd<CR><LF>	
	sddddd:	frequency in use
Factory setting:	+00000	
EEPROM modification :	(Yes) * Warning : This command can act into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated). See MAv06: 4 parameters to cancel the writing in eeprom. (Since Version 2013-12-02)	
Data in :	RAM, EEPROM	
MAv access :	No	
Reset value:	Last value stored in EEPROM.	

Notes

- In track state the frequency is changed internally by the software for optimum alignment.
- This command should never be used in track state. (Except FC??????).
- Even if MAv06:4 parameter is settled to cancel the writing in eeprom of FC, a writing in eeprom is anyway possible if the command FCsddddd is followed by the command FS3
- The command FC?????? is useful to know the frequency actually in use. But the command BTB gives the 3 frequencies: actual, holdover, eeprom

Example

Command	Answer	Comment
`FC+00100<CR>`	`+00100<CR><LF>`	10'000'000.000 Hz becomes approx.10'000'000.025Hz.

SETTING COMMAND: **MAvxx..** Module adjusts. Set and read internal parameters

MAvxx..<CR><LF>*	Module adjusts. Set and read internal parameters.	
	v:	action verb.
	xx:	parameter number. From 00 to FF.
MARxx<CR><LF>	Read the ram value of the parameter number xx.	
MALxx<CR><LF>	Read the eeprom value of the parameter number xx.	
MAFxx<CR><LF>	Read the flash value of the parameter number xx.	
Answer:	yy<CR><LF> parameter value, or yyyy<CR><LF> or yyyyyyyy<CR><LF> or yyyyyyyyyyyyyyyy<CR><LF> or aaaaaa..<CR><LF> or bbbbbb..	
hexa coded ascii	yy:	unsigned 1 byte, type=y0 signed 1 byte, type=y1
	yyyy:	unsigned 2 byte, type=y2 signed 2 byte, type=y3
	yyyyyyyy:	unsigned 4 byte, type=y4 signed 4 byte, type=y5
	yyyyyyyyyyyyyyyy:	unsigned 8 byte, type=Y6 signed 8 byte, type=y7
	aaaaaa..:	string ascii, type=y8
	bbbbbb..:	string binary, type=y9
MAWxx(z)<CR><LF>	Change the ram value of the parameter number xx.	
MASxx(z)<CR><LF>*	Change the eeprom value of the parameter number xx.	
Parameter (z): hexa coded ascii	yy:	unsigned 1 byte, type=y0 signed 1 byte, type=y1
	yyyy:	unsigned 2 byte, type=y2 signed 2 byte, type=y3
	yyyyyyyy:	unsigned 4 byte, type=y4 signed 4 byte, type=y5
	yyyyyyyyyyyyyyyy:	unsigned 8 byte, type=y6 signed 8 byte, type=y7
Parameter (z):	aaaaaa..:	string ascii, type=y8 up to 24 characters
Answer:	<CR><LF>	
MATxx<CR><LF>	Read data type of the parameter number xx.	
Answer:	xy<CR><LF>	

	x= 4	memorized in ram
	x= 2	memorized in eeprom
	x= 1	memorized in flash
	y= 0	unsigned, 1 byte
	y= 1	signed, 1 byte
	y= 2	unsigned, 2 byte
	y= 3	signed, 2 byte
	y= 4	unsigned, 4 byte
	y= 5	signed, 4 byte
	y= 6	unsigned, 8 byte
	y= 7	signed, 8 byte
	y= 8	string ascii
	y= 9	string binary
MABxx<CR><LF>	Behaviour of the sending of the string parameters 0x00, 0x01, <0x30 at power on / reset.	
Answer:	x<CR><LF> x=1 : activated, x=0 : cancelled	
MAAxx<CR><LF>*	Activation of the sending of the string parameters 0x00, 0x01, <0x30 at power on / reset.	
Answer:	<CR><LF>	
MACxx<CR><LF>*	Cancellation of the sending of the string parameters 0x00, 0x01, <0x30 at power on / reset.	
Answer:	<CR><LF>	
MAHxx<CR><LF>	Read help message related to parameter number xx.	
Answer:	blabla..<CR><LF>	
MAHxxy<CR><LF>	Read help message related to parameter number xx, bit y=0 to y=7. 1 byte data type used as flags.	
Answer:	blabla..<CR><LF>	

Note:

* Warning: This command can acting into non volatile memory. Numbers of commands sent during the whole unit life time limited to 100'000 in total (all commands cumulated).

Example

Command	Answer	Comment
`MAH05<CR>`	`Timing / Frequency<CR><LF>`	Timing/frequency flags.

OTHER COMMAND: **FREEZEx** Freeze frequency.

FREEZEx<CR><LF>	Freeze the varactor voltage that drive the crystal frequency.	
	x:	freeze state 1: frozen 0:no.
	?:	interrogation.
Answer:	x<CR><LF>	
	x:	freeze state 1: frozen 0:no.
Factory setting:	0	
EEPROM modification :	No	
Data in :	RAM, EEPROM	
MAv access :	Yes	
Reset value:	Last value stored in EEPROM.	

Notes

- No tracking possible.
- Status=7 is issued in this state.

Example

Command	Answer	Comment
FREEZE?<CR>	0<CR><LF>	-

OTHER COMMAND: **RESET** Hot Reset.

RESET<CR><LF>	Hot Reset the micro-controller.
Answer:	(Normal messages after Power-on, Reset)
Factory setting:	-
EEPROM modification :	-
Data in :	-
MAv access :	-
Reset value:	-

Notes

- If a PPSREF is present during a RESET command, the PPSINT is aligned to this PPSREF.
- The RESET command is a substitute to the former "RAQUIK" command.
- All parameters will be loaded with their EEPROM default value.
- During a Hot Reset, a partial hardware initialization is done. It is to avoid when a long term stability test is underway.

Example

Command	Answer	Comment
`RESET<CR>`	`SPTSXO-002/00/2.10<CR><LF>`	-

5.7 DEVICE STATUS

5.7.1 STATUS BROADCASTED BY MESSAGES

0	warming up	The device was just powered on, or warming up delay.
1	tracking set-up	The device is going in tracking after this one was initiated.
2	track to PPSREF	Frequency tracking of PPSREF.
3	sync to PPSREF	PPSINT, PPSOUT and PPSREF are aligned.
4	Free Run. Track OFF.	
5	PPSREF unstable(holdover)	The stability of the PPSREF is too low to be tracked.
6	No PPSREF(holdover)	No PPSREF was detected.
7	Frequency frozen	Frequency is frozen.
8	factory used	
9	Fault	

5.8 THE MAvxx.. SYSTEM

5.8.1 INTRODUCTION

The MAvxx.. command is a computer and human oriented command to tune quickly.

- Manage parameters:
  - Read, MARxx, and write, MAWxx.., parameters in ram (working parameters).
  - Load, MALxx, and store, MASxx.., parameters in eeprom (non volatile memory).
  - Load parameters in flash, MAFxx, (permanent memory).

- Load the parameter localization and data type, MATxx :
  The answer is: yz, 2 hexa
  - y = 4, in ram
  - y = 2, in eeprom
  - y = 1, in flash

  A combination is possible. Example: y = 7, means the parameter is in ram, eeprom and flash.

  - z = 0, unsigned, 1 byte, also used for bit field
  - z = 1, signed, 1 byte
  - z = 2, unsigned, 2 byte
  - z = 3, signed, 2 byte
  - z = 4, unsigned, 4 byte
  - z = 5, signed, 4 byte
  - z = 6, unsigned, 8 byte
  - z = 7, signed, 8 byte
  - z = 8, string ascii
  - z = 9, string binary
- There is a help for each parameter, a textual description of the parameter, MAHxx
- The help is also available for each bit in a bit field, MAHxxy
- A flag in eeprom is associated with each parameter :
  - MABxx : load the flag　　Answer: 0[CR][LF] or 1[CR][LF]
  - MAAxx : flag activated　　Answer: [CR][LF] if success
  - MACxx : flag cancelled　　Answer: [CR][LF] if success

  The actual function of this flag is to transmit or not a message, data type y = 8,9, at power-on, Reset. Currently, only MAv00, Factory welcome message and MAv01, User welcome message, are concerned.

5.9 MAVxx.. PARAMETERS DESCRIPTION FOR THE GXClock

Numerical values are in hexa coded ascii.

5.9.1 Clock main parameters

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x00	-	-	x	ascii	SPTSXO-002/00/2.10	Factory welcome message
0x01	-	x	x	ascii	Free for user message	User welcome message
0x02	-	x	x	u 1byte	0x05	GPS configuration delay (s)
0x03	-	x	x	u 1byte	0x03	GPS configuration interval (s)
0x04	x	x	x	u 1byte	0x13	Timing / Frequency
0x05	x	x	x	u 1byte	0x10	Tracking
0x06	x	x	x	u 1byte	0x02	Tracking start
0x07	-	x	x	u 1byte	0x01	Communication control
0x08	-	x	x	u 1byte	0x00	Holdover. Don't touch.
0x09	-	x	x	u 1byte	0x20	Aging. Under dev. Don't touch.
0x0A	-	x	x	u 1byte	0x01	Environment.
0x0B	x	x	x	u 1byte	0x00	Messages at T=0ms, T=250ms
0x0C	x	x	x	u 1byte	0x00	Messages at T=500ms, T=750ms
0x0D	x	x	x	u 1byte	0x18	[A] validity life(hours).
0x0E	x	x	x	u 1byte	0x00	Warmup in 32s time interval
0x12	x	x	x	u 4byte	0x000186A0	Pulse width.
0x13	x	x	x	u 1byte	0x78	Tracking window.
0x14	x	x	x	u 1byte	0x28	Alarm window.
0x15	x	x	x	u 4byte	0x00000000	Tracking loop time constant
0x16	x	x	x	s 1byte	0x00	Fine comparator offset
0x17	x	x	x	u 1byte	0x01	Pulse every d second
0x18	x	x	x	u 1byte	0x00	Pulse origin
0x19	x	x	x	u 2bytes	0x7FFD	Frequency limit

u: unsigned, s:signed

5.9.2 GPS main parameters

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x20	x	x	x	u 1byte	0x00	GPS type
0x21	x	x	x	u 1byte	0x00	GPS language
0x22	x	x	x	u 1byte	0x00	GPS resource utilization
0x24	x	x	x	s 4byte	0x00000000	GPS longitude
0x25	x	x	x	s 4byte	0x00000000	GPS latitude
0x26	x	x	x	s 4byte	0x00000000	GPS altitude
0x27	x	x	x	s 2byte	0x0010	Time GPS-UTC offset

u: unsigned, s:signed

0x00 Factory welcome message

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x00	-	-	x	ascii	SPTSXO-002/00/2.10	Factory welcome message

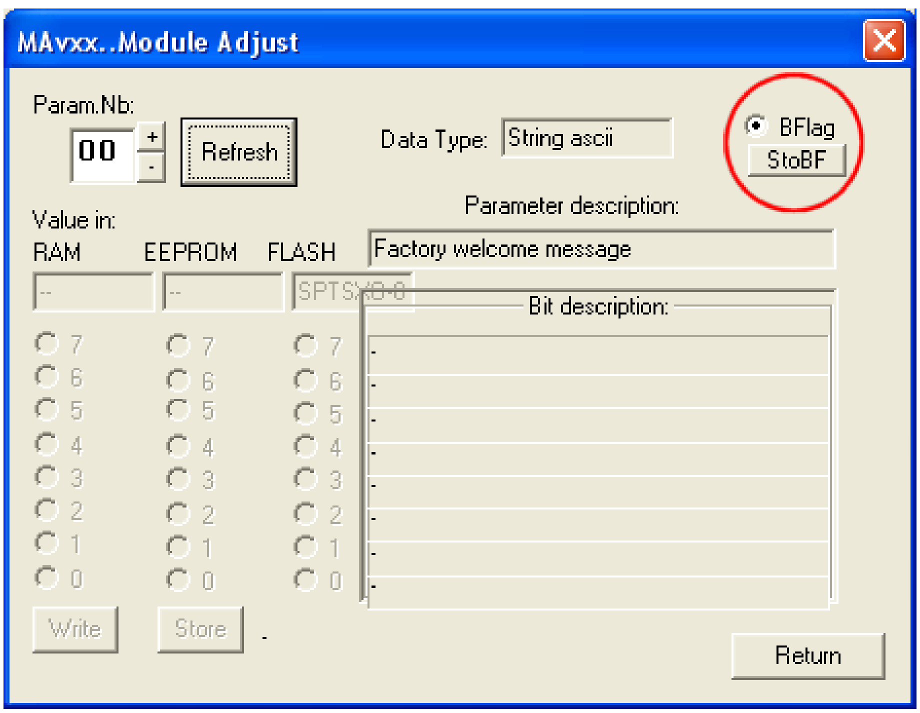
Message description

This message is transmitted on pin 9 (TXD1) some delay after Power on /Reset.
As it is stored in flash only, it cannot be modified.

Message behavior control

- To read the behavior : MAB00<CR> Answer : 0 : cancelled; 1 : activated
- To cancel the message : MAC00<CR>
- To activate the message : MAA00<CR>

Changing the message behavior with the Monitoring program:



0x01 User welcome message

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x01	-	x	x	ascii	Free for user message	User welcome message

Message description

This message is transmitted on pin 9 (TXD1) some delay after Power on /Reset.
As it is stored in eeprom, it can be modified.

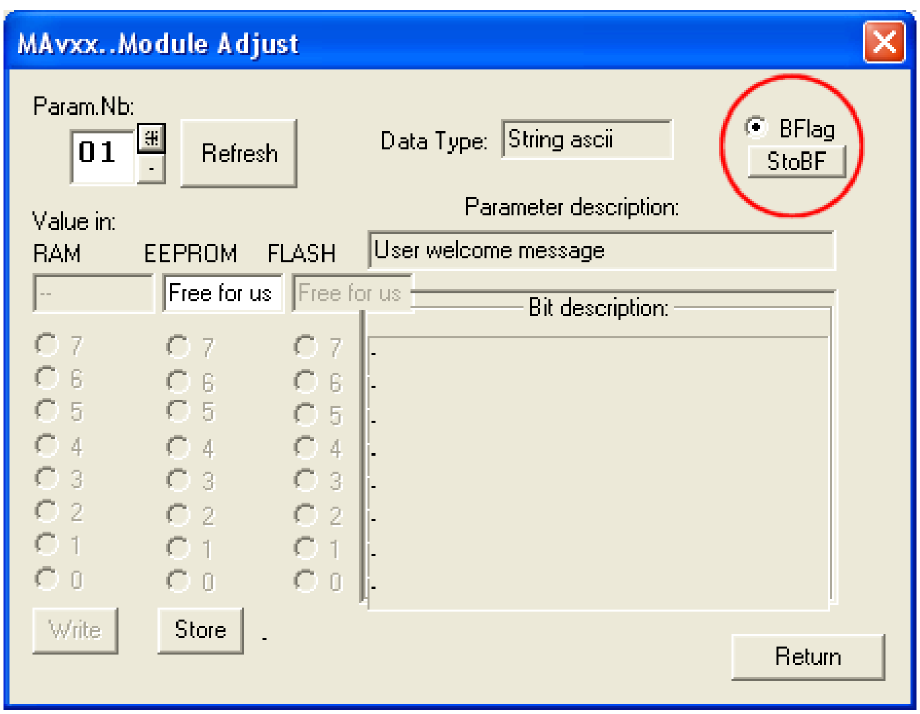
Message modification

MAS01Rubidium and Crystal<CR> (message length is limited to 24 characters.)

Message behavior control

- To read the behavior : MAB00<CR>   Answer : 0 : cancelled; 1 : activated
- To cancel the message : MAC01<CR>
- To activate the message : MAA01<CR>

Changing the message behavior with the Monitoring program:



0x02 GPS configuration delay

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x02	-	x	x	u 1byte	0x05	GPS configuration delay (s)

Description

This value is the delay in seconds before the first activated message is transmitted on pin 9 (TXD1) after Power on /Reset.
If activated, the messages are sent in following order: 0x00, 0x01, 0x30, etc..
As it is stored in eeprom, it can be modified.

Currently this parameter did not apply to GXClok.

0x03 GPS configuration interval

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x03	-	x	x	u 1byte	0x03	GPS configuration interval (s)

Description

This value is the interval in seconds between messages that are transmitted on pin 9 (TXD1) after Power on /Reset.
If activated, the messages are transmitted in following order : 0x00, 0x01, 0x30, etc..
As it is stored in eeprom, it can be modified.

Currently this parameter did not apply to GXClok.

0x04 Timing and frequency flags

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x04	x	x	x	u 1byte	0x0B	Timing / Frequency

Bit description

bit	State	Default value	Help	Comment
6	1: LED disabled 0: LED enabled	0	LED Off	Increased holdover performance
5	1:PPSREF is coming from pin 11 of the external connector 0:PPSREF not coming from pin 11	0	PPS Ext.	PPS Source choice
4	1:PPSRef is coming from the internal GPS 0:PPSRef not coming from the internal GPS	1	PPS GPS	PPS Source choice
3	1: thermal compensation active 0: no thermal compensation	1	Therm. comp.	Useful for noise reduction
2	1: driving voltage frozen (GXClock)	0	Freeze	Useful for phase noise measurement
1	1: PPSREF active 0: behave like no PPSREF	1	PPSREF	Useful for holdover simulation
0	1:PPSOUT active 0: PPSOUT inactive	1	PPSOUT	Useful in low noise application

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information about some bit

bit 2, freeze

It is recommended to not use commands that change the frequency when freeze is active.

1. Freeze activation.
2. No commands like TR1,..
3. Freeze not active.

The "Freeze" value can also be changed with the command FREEZEx.

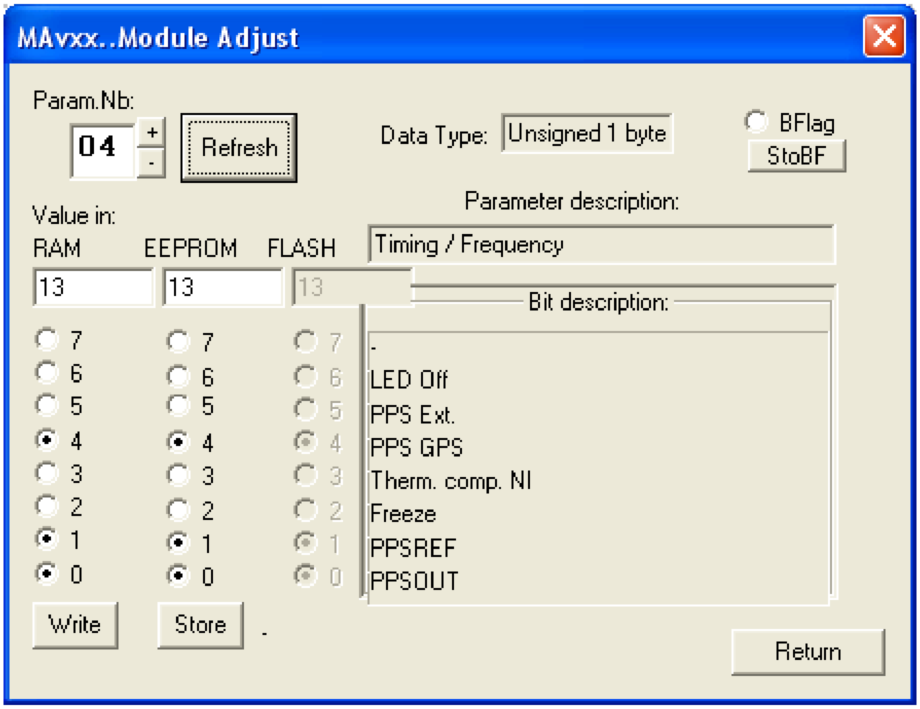
bit 0, PPSOUT

- There are 3 possibilities to stop PPSOUT:
    1. bit0 of parameter 0x04 (this one), to low.
    2. Pulse width to 0, command PW000000000.
    3. PPSOUT cadence to null, command PP000000.

Bit 5

- Bit5 is active only if Bit4 is not active

Changing timing and frequency flags with the Monitoring program :



0x05 Tracking flags

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x05	x	x	x	u 1byte	0x10	Tracking

Bit description

bit	State	Default value	Help	Comment
5	1: select 24 hours true average 0: select 24 hours exponential average	0	24h exp/true average	True average is useful for base stations
4	1: save frequency every 24 hours 0: no frequency saving	1	24h save	Average frequency is saved in eeprom every 24 hours
3	1: Tracking message on 0: Tracking message off	0	Track NMEA	Track a $GPRMC message on Port RXD1, pin 8
2	-	0	-	-
1	1: align PPSOUT to PPSINT 0: no alignment	0	Sync	Useful to be in Sync to GPS time
0	1: track the PPSREF 0: no tracking	0	Track	Align PPSINT to PPSREF during tracking setup

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information about some bit

bit 5, 24h exp. / 24h true average

It is possible to choose between 2 kinds of average regarding the 24 hours frequency saving:

- The traditional exponential average with a time constant of 24 hours.
- A real mathematical average based on exactly 24 hours.

bit 4, 24h save

In case of successful tracking, the average frequency value is saved in eeprom.
The "24h save" value can also be changed with the command FSx.

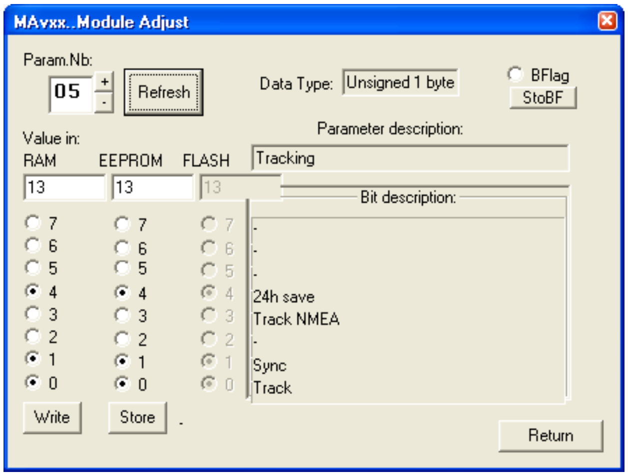
bit 1, Sync

The "Sync" value can also be changed with the command SYx.

bit 0, Track

The "Track" value can also be changed with the command TRx.

Changing tracking start flags with the Monitoring program:



0x06 Tracking start flags

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x06	x	x	x	u 1byte	0x02	Tracking start

Bit description

bit	State	Default value	Help	Comment
4	1: cancel FC writing in eeprom 0: FC is writing in eeprom	0	FC not in eeprom	Custom tracking made with the command FCsddddd
3	1: keep frequency 0: optimize frequency	0	Keep frequency	To simplify frequency behavior
2	1: tracking re-start allowed 0: no tracking re-start	0	Restart tracking	Useful in lab conditions.
1	1: align to PPSREF frequency 0: no alignment	1	Frequency align	Fast frequency alignment
0	1: test active 0: no test	0	Frequency test	Test frequency of PPSREF during tracking setup

Changing the value in ram: the new parameter is taken into account immediately.
Changing the value in eeprom: the new parameter is taken into account after power on / reset.

More information about some bit

bit 4, control of the writing in eeprom of the command FCsddddd

From the sw Version 2.10 dated 2013-12-02, it is possible to avoid the writing in eeprom of the command

FCsddddd and Cxxxx

If this bit is settled, the command FCsddddd and Cxxxx will just write in RAM. To force the transfert of the frequency

value from RAM to eeprom, send the command FS3.

bit 3, keep frequency

When this flag is set, the last frequency is always kept. Exceptions:

- During free run, with the command FCsddddd.
- During a tracking.

bit 2, restart tracking

After 254 seconds with a PPSREF out of tracking window, but stable, a new tracking is initiated if this flag is set.

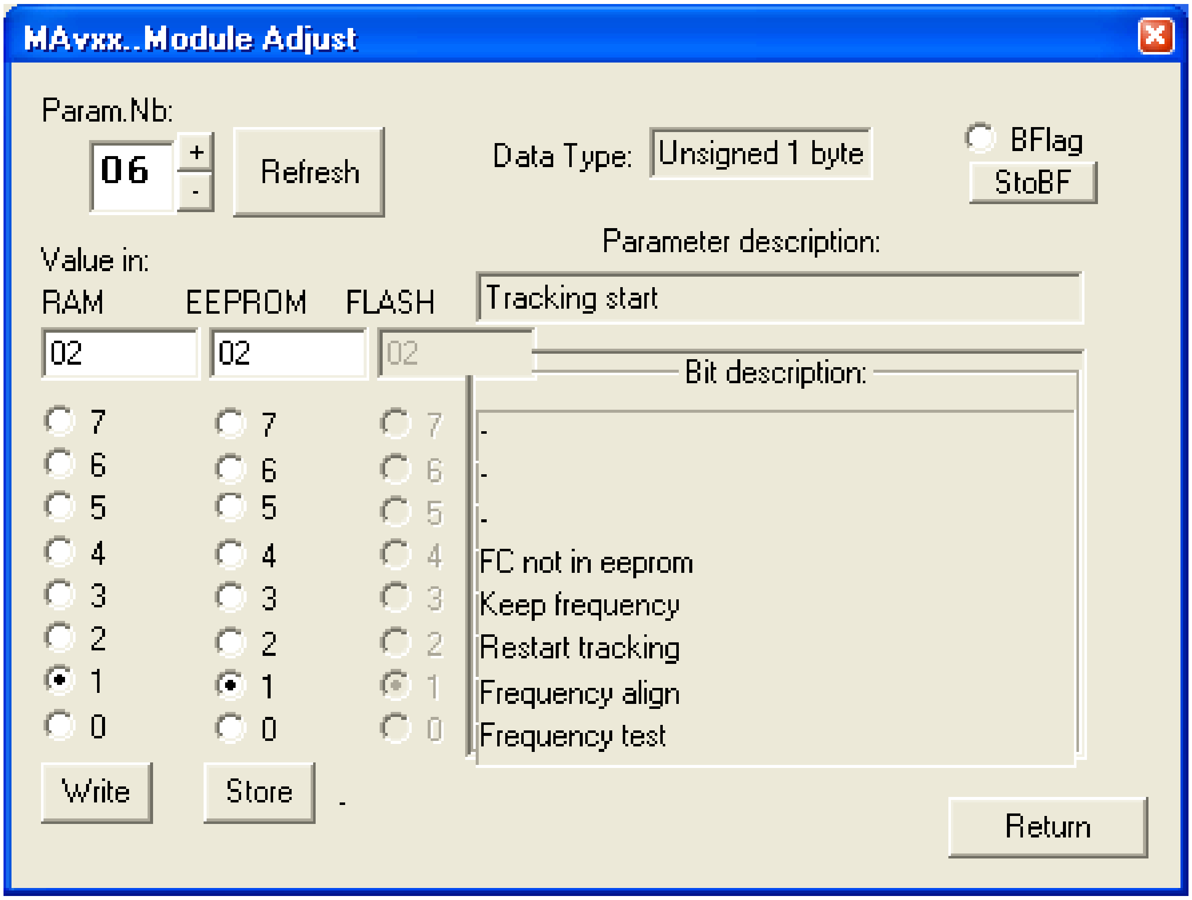
bit 1, Frequency align

A frequency determination of PPSREF is done during tracking setup. After that, a sudden frequency alignment is done just before tracking start. Status=5 is issued if the new frequency is out of ± 25'000 range. (FC)

bit 0, Frequency test

A frequency determination of PPSREF is done during tracking setup. If during 25 seconds the time tagging of the PPSRef changes more than ± 2 comparator steps, Status = 5 is issued. For the GXClock that means a frequency offset of ± 4e-9.

Changing tracking start flags with the Monitoring program:



0x07 Communication flags

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x07	-	x	x	u 1byte	0x01	Communication control

Bit description

bit	State	Default value	Help	Comment
2	1: transparent communication to a GPS 0: normal	0	Normal/Transparent GPS	For GPS receiver debugging
1	1: incoming messages are not decoded 0: normal behavior	0	XON/XOF	Useful in multiple devices systems
0	1: send "?" by unknown command 0: send nothing by unknown command	1	? by unknown command	Behavior in test equipment

Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information about some bit

bit 2, Normal / Transparent GPS

Direct communication to a GPS receiver connected to the iSync.
Related to command @@@@GPS. See special_commands for more information.

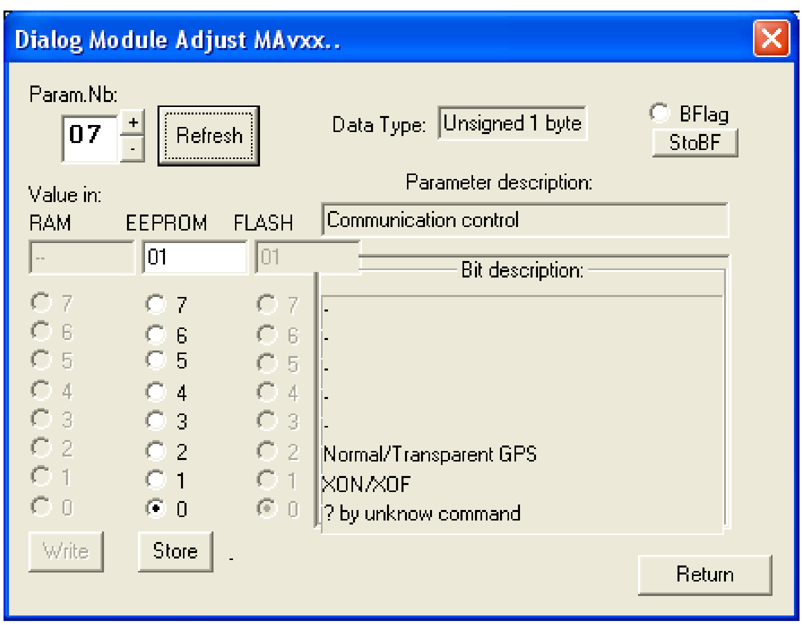
bit 1, XON / XOF

Incoming messages are stopped.
Related to command @@@@XOF. See special_commands for more information.

bit 0, ? by unknown command

Although the new value is stored in eeprom, the new behavior is active immediately.

Changing communication flags with the Monitoring program :



0x08 Holdover

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x08	-	x	x	u 1byte	0x00	Holdover. Don't touch.

Description

GXClock, sw 2.10: in development

0x09 Aging

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
09	-	x	x	u 1byte	20	Aging. Under dev. Don't touch.

Description

GXClock, sw 2.10: in development

0x0A Environment flag

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x0A	-	x	x	u 1byte	0x01	Environment.

Bit description

bit	Help
4	Boat
3	Vehicle
2	Submarine/diving
1	Labs(frequency)
0	Base station

Changing the value in eeprom: the new parameter is taken account after power on / reset.

. Warning

This parameter is not taken account in the GXClock, sw 2.10. It is supposed the device is always stationary.

0x0B, 0x0C Messages coming out every second

MAv parameters 0x0B and 0x0C.

The iSync is able to send one message every second at 4 time slot positions: ~3ms, ~250ms, ~500ms, ~750ms. At each time slot, 1 of 4 messages is possible.

At	~3ms	~250ms	~500ms	~750ms
Activation commands	`MAWØBØx`	`MAWØBxØ`	`MAWØCØx`	`MAWØCxØ`
Activation after power on	`MASØBØx`	`MASØBxØ`	`MASØCØx`	`MASØCxØ`

Ø : zero.

Signification of x:

0: nothings

1: NMEA $GPRMC

2: NMEA $ZDA

3: -

4: -

5: -

6: -

7: -

8: -

9: -

A: $PTNTA

B: $PTNTS,B

C: -

D: -

E: -

F: -

Example:

Commands:

1. `MAWØBBA<CR><LF>`
2. `MAWØC21<CR><LF>`

The iSync will send at:

1. t=~3ms, the NMEA message $PTNTA.
2. t=~250ms, the NMEA message $PTNTS,B.
3. t=~500ms, the NMEA message $GPRMC.
4. t=~750ms, the NMEA message $GPZDA.

Notes

- The reference for time slot is PPSINT.
- Position information of message $GPRMC is updated as soon as new information from the GPS receiver are available. This mean if this message is activated 4 times, position information may vary.
- For quick debugging command BTx can also be used.

0x0D Validity duration of the A / V flag, message $GPRMC

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x0D	X	x	x	u 1byte	Rb:0xF0 Crystal:0x18	[A] validity life(hours).

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

In the message $GPRMC, the flag A / V is the quality indicator for the GPS date/time transfer. After a successfully date/time transfer due to a correct GPS message, the flag is A. If the GPS antenna is disconnected during more than the number of hours of this parameter, the flag become V.

Value :

- 0 : The flag become immediately V after a GPS failure.
- 1 to 254 : delay in hours before the flag become V after a GPS failure.
- 255 : The flag always A after a GPS successfully date/time transfer. Only a failure of the clock can make it become V.

In the message $PTNTA, this parameter determine the duration before the quality indicator of the time transfer goes from 3 to 2.

0x0E Warm-up delay

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x0E	X	x	x	u 1byte	0x0A	Warmup in 32s time interval

Changing the value in ram: the new parameter is taken into account immediately.
Changing the value in eeprom: the new parameter is taken into account after power on / reset.

More information

After power ON / Reset in a crystal based clock and after the Rb lock in a Rubidium based clock, a delay is added in the Status determination system in order to cancel a too fast going in tracking.
This delay is mainly intended for situations where the tracking state is permanently settled by software or by hardware.
The unit of the delay is 32 seconds.

0x12 Pulse width

Parameter description

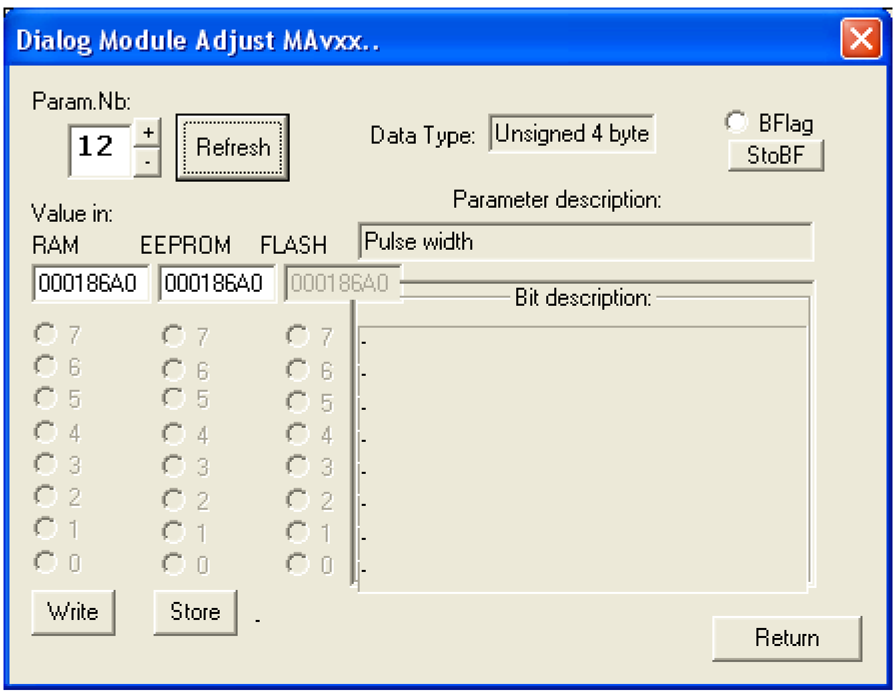
Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x12	X	x	x	u 4byte	0x000186A0	Pulse width.

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- Pulse width of the PPSOUT in ns.
- The pulse width is rounded to 50 ns in the GXClock.
- See also command PWddddddddd.
- 0x000186A0 equal 100'000 ns.

Changing the pulse width with the Monitoring program :



0x13 Tracking window

Parameter description

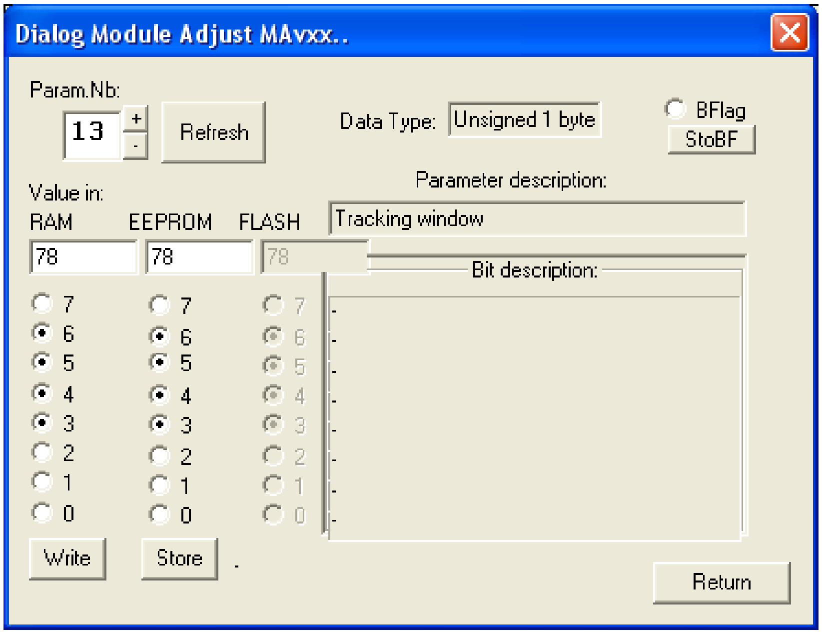
Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x13	x	x	x	u 1byte	GXClock: 0x78	Tracking window.

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- Tracking window in use.
- In tracking, no error as long | ppsint - ppsref | < Tracking window.
- See also command TWddd.

Changing the tracking window with the Monitoring program :



0x14 Alarm window

Parameter description

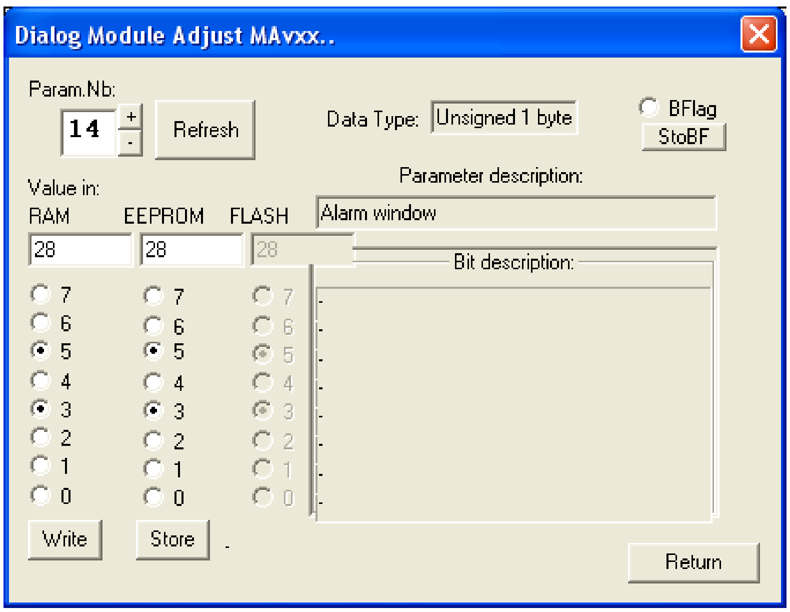
Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x14	x	x	x	u 1byte	GXClock: 0x28	Alarm window.

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- Alarm window in use.
- In tracking, no alarm as long | ppsint - ppsref | < Alarm window.
- See also command AWddd.

Changing the alarm window with the Monitoring program :



0x15 Tracking loop time constant

Parameter description

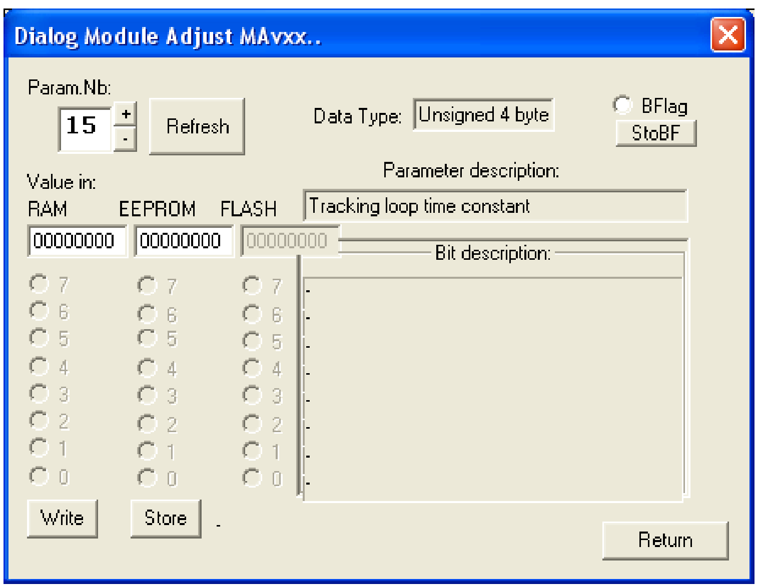
Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x15	x	x	x	u 4byte	0x00000000	Tracking loop time constant

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- Time constant of the tracking loop in second.
- For the GXClock, from 100 seconds to 10'000 seconds.
- See also command TCdddddd.

Changing the tracking loop time constant with the Monitoring program :



0x16 Fine comparator offset

Parameter description

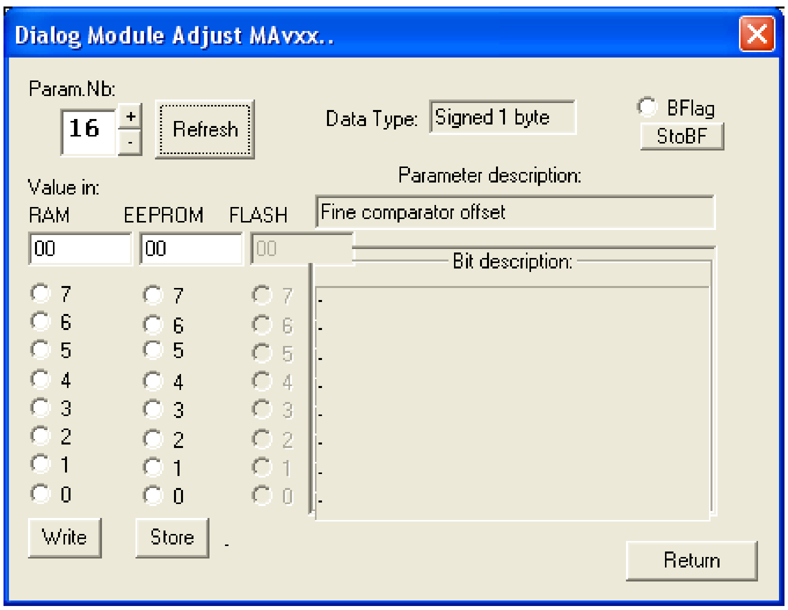
Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x16	x	x	x	s 1byte	0x00	Fine comparator offset

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- Fine comparator offset in approx. ns.
- + 127 / -128 range.
- See also command COsddd.

Changing the fine comparator offset with the Monitoring program :



0x17 Pulse every d second

Parameter description

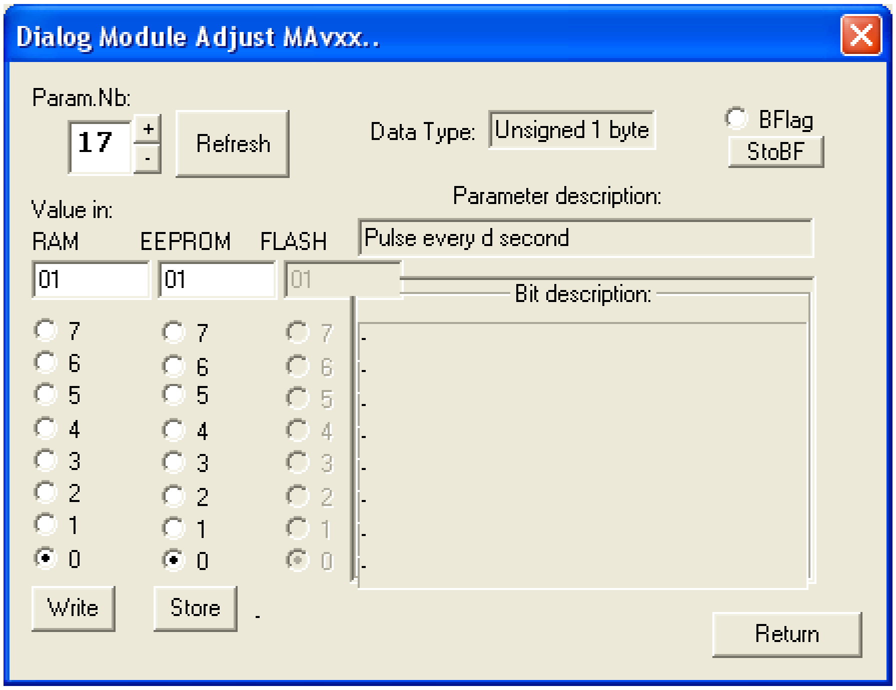
Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x17	x	x	x	u 1byte	0x01	Pulse every d second

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- PPSOUT cadence .
- 1 pulse every 1 to 255 second.
- See also command PPdddeee.

Changing the PPSOUT cadence with the Monitoring program :



0x18 Pulse origin

Parameter description

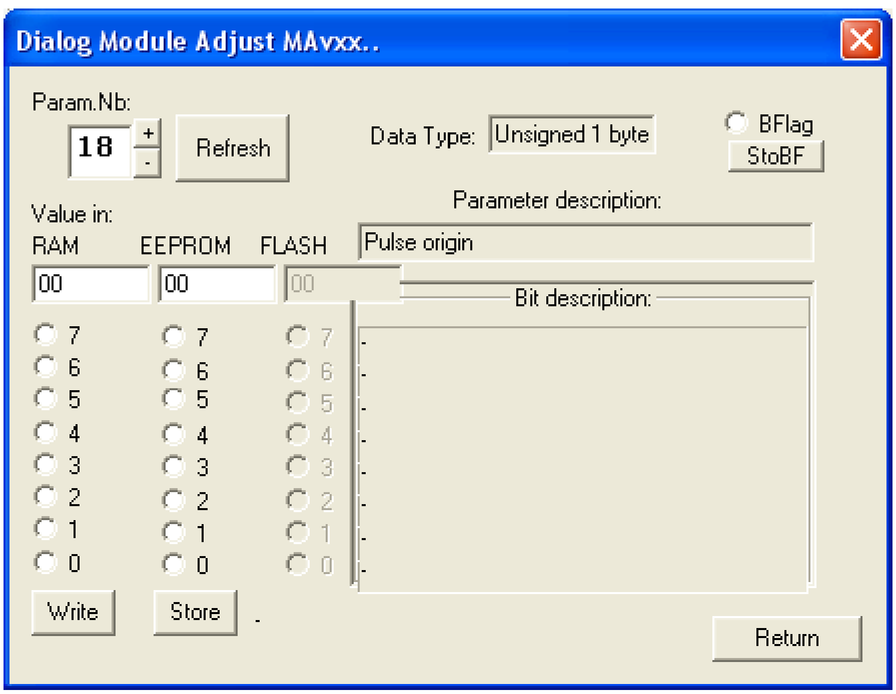
Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x18	x	x	x	u 1byte	0x00	Pulse origin

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- Offset in second to GPS origin that is 1980-01-06 00:00:00.
- In fact useful in pp2s situation to choose in between odd or even pulse.
- See also command PPdddeee.

Changing the PPSOUT origin with the Monitoring program :



0x19 Frequency limit

Parameter description

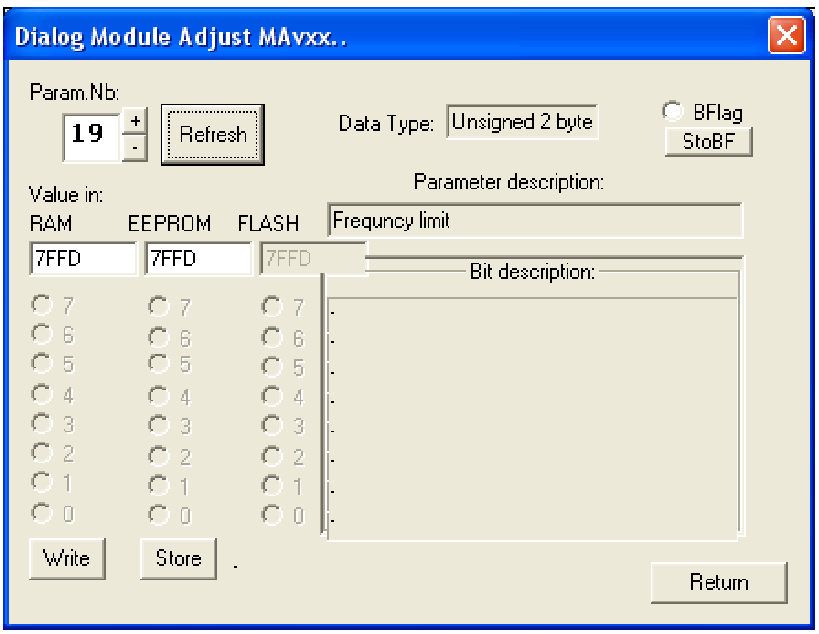
Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x19	x	x	x	u 2byte	0x7FFD	Frequency limit

Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- The tracking of the PPSREF is only possible is this +/- frequency range.

Changing the frequency limit with the Monitoring program :



0x20 GPS type

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x20	x	x	x	u 1byte	0x00	GPS type

Description

GXClock, sw 2.10: This parameter is just indicative. Only the GPS language, Parameter 0x21 is considered.

0x21 GPS language selection

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x21	x	x	x	u 1byte	0x00	GPS language

Possible values

Value	Help
08	NMEA $GPRMC
07	Furuno NMEA
06	Trimble TSIP
05	Novatel SSII
04	UBlox LEA-xT
03	Motorola @@A2
02	Motorola @@A1
01	Zodiac binary
00	No selection

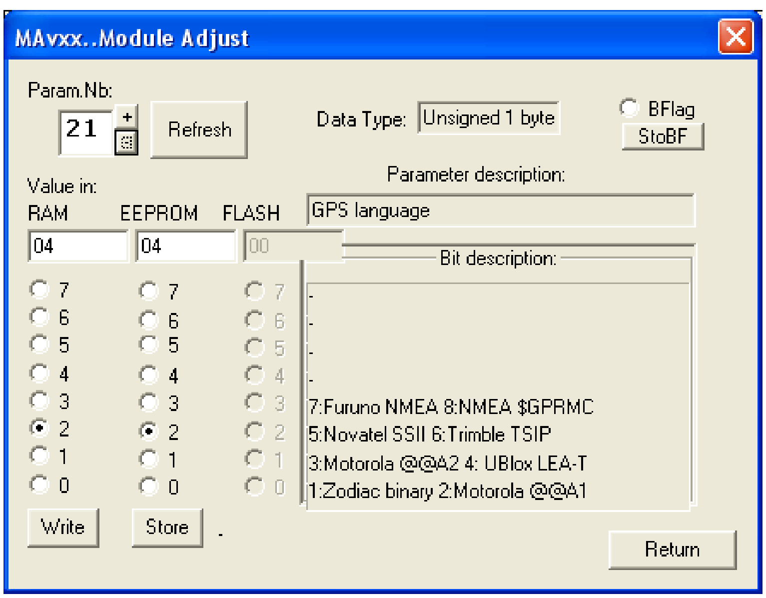
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- Situation in October 2012, sw2.10 : It is recommended to work with 2 languages:
  - 0x04 UBlox LEA-xT.
  - 0x08 NMEA $GPRMC.

Other languages are possible, but it is recommended to inform SpectraTime before to work with them.

Typical configuration for LEA-xT:



0x22 GPS resource utilization

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x22	x	x	x	u 1byte	0x00	GPS resource utilisation

Bit description

bit	State	Default value	Help	Comment
4	1: Position transfer from GPS to the iSync 0: no Position transfer from GPS	0	GPS Position transfer	Pick the Position GPS information for the NMEA messages
3	1: Date/Time transfer from GPS to the iSync 0: no Date/Time transfer from GPS	0	GPS Date/Time transfer	Pick the date/time GPS information to use it in the iSync
2	1: consider the granularity message 0: do not consider the granularity message	0	Consider granularity mess.	To cancel the noise due to the GPS ppsref granularity
1	1: the iSync must configure the GPS 0: GPS receiver already configured	0	Configure GPS	-
0	1: consider GPS messages 0: do not consider GPS messages	0	Consider GPS messages to track	Main bit to consider or not a GPS receiver

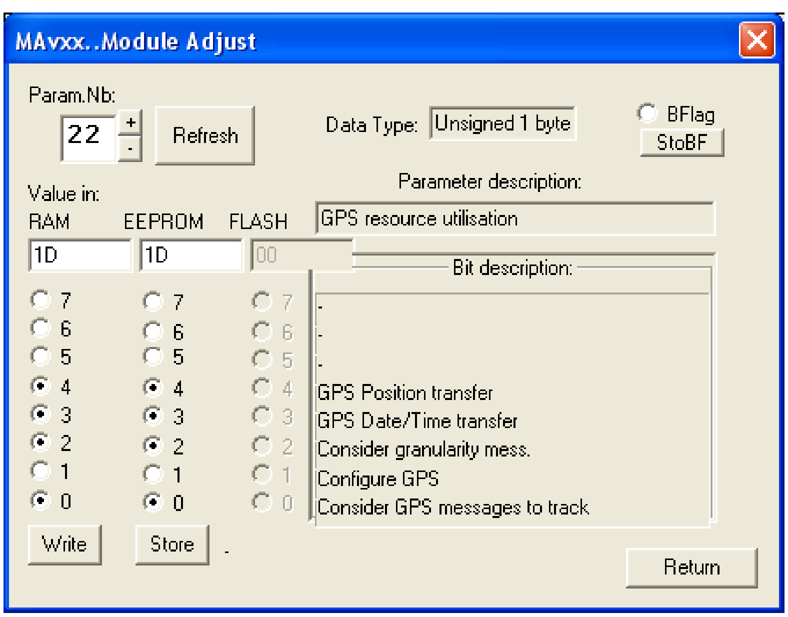
Changing the value in ram: the new parameter is taken account immediately.
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information about some bit

bit 0, Consider GPS messages to track

If this bit is settled and the expected GPS messages are not present, it will be Status=6 in tracking.

Typical configuration for LEA-xT:



0x24 GPS longitude

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x24	x	x	x	s 4byte	0x00000000	GPS longitude

Description

Units : tbd (e-7deg)

GXClock, sw 2.10: This parameter is not active.

0x25 GPS latitude

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x25	x	x	x	s 4byte	0x00000000	GPS latitude

Description

Units : tbd (e-7deg)

GXClock, sw 2.10: This parameter is not active.

0x26 GPS altitude

Parameter description

Parameter Nb	ram	eeprom	flash	Data type	Value(default)	Help
0x26	x	x	x	s 4byte	0x00000000	GPS altitude

Description

Units : tbd (mm)

GXClock, sw 2.10: This parameter is not active.

5.10 SERIAL COMMUNICATION INTERFACE 2

In the iSync, the Micro-Controller has a second serial port dedicated to the communication with a GPS.
In the GXClock the GPS is embedded and there is no external connection to this port.

5.11 The NMEA messages

Up to 4 messages can be transmitted by the device every second at 4 time slots. By the exception of the communication speed, the messages follow the NMEA 0183 standard.

5.11.1 Conditions :

Communication port: TXD1. For GXClock pin 9.

Configuration: 9600,n,8,1

5.11.2 Messages activation:

For debugging, with the command BTx. Possibilities: BTA, BTB, BTR, BTZ.

Temporary or permanently after Power ON / Reset, with MAv parameters 0x0B and 0x0C.

5.11.3 Messages cancellation:

Messages activated with BTx can be cancelled with the command BT0.

Messages activated with the MAv parameters 0x0B and 0x0C can be temporary cancelled with the commands MAW0B00 and MAW0C00. And permanently cancelled after power-on / Reset with the commands MAS0B00 and MAS0C00.

5.11.4 The NMEA messages list:

$PTNTA $PTNTS,B $GPRMC $GPZDA

5.11.5 Message NMEA $PTNTA

Proprietary SpectraTime general iSync indicator.

At	~3ms	~250ms	~500ms	~750ms
Activation commands	BTA, MAWØBØA	MAWØBAØ	MAWØCØA	MAWØCAØ
Activation after power on	MASØBØA	MASØBAØ	MASØCØA	MASØCAØ

Ø : zero.

Example:

$PTNTA,20000101001558,1,T4,663542250,-511,4,1,0*1F<CR><LF>

$PTNTA:	message header that never change.
20000101001558:	date/time in format year, month, day, hour, minute, second. In GPS time or manual setting.
1:	oscillator quality 0:warming up, 1:freerun, 2:disciplined.
T4:	always T4. Format indicator.
663542250:	interval ppsref-ppsout in [ns]. Blank if no ppsref.
-511:	fine phase comparator in approx. [ns]. Always close to -500 or +500 if not disciplined. Blank if no ppsref.
4:	iSync Status. See documentation.
1:	GPS messages indicator. 0:do not take account, 1:take account, but no message, 2:take account, partially ok, 3:take account, totally ok.
0:	transfer quality of date/time. 0:no, 1:manual, 2:GPS, older than x hours, 3:GPS, recent.
*1F:	xor checksum in between $ and *.

Note

- Regarding the parameter x, age of the last GPS date/time transfer, this one can be modified. The default value is 240 hours (10 days) for a Rb based clock, and 24 hours for a crystal based clock.See MAv parameter 0x0D.

5.11.6 Message NMEA $PTNTS,B

Proprietary SpectraTime details iSync indicator.

At	~3ms	~250ms	~500ms	~750ms
Activation commands	BTB, MAWØBØB	MAWØBBØ	MAWØCØB	MAWØCBØ
Activation after power on	MASØBØB	MASØBBØ	MASØCØB	MASØCBØ

Ø : zero.

Exemple:

$PTNTS,B,2,F6B6,F688,F644,,,1,001500,001.50,,*16<CR><LF>

$PTNTS,B:	message header that never change.
2:	iSync Status. Status=2 means in tracking. See documentation.
F6B6:	actual frequency, signed hexa, steps of approx. 6e-12.
F688:	holdover frequency, signed hexa, steps of approx. 6e-12.
F644:	eeprom frequency, signed hexa, steps of approx. 6e-12.
1:	loop time constant mode 0: fixed value, 1: automatic.
001500:	loop time constant in use, from 000100 to 999999 seconds.
,001.50:	sigma (1s) of PPSRef in approx. ns.
*16:	xor checksum in between $ and *.

5.11.7 Message NMEA $GPRMC

Legacy NMEA minimum message.

At	~3ms	~250ms	~500ms	~750ms
Activation commands	BTR, MAWØBØ1	MAWØB1Ø	MAWØCØ1	MAWØC1Ø
Activation after power on	MASØBØ1	MASØB1Ø	MASØCØ1	MASØC1Ø

Ø : zero.

Example:

$GPRMC,134550.00,A,4659.3554,N,00654.4072,E,,,090507,,,E*58<CR><LF>

$GPRMC : message header that never change.

134550.00 : hour, minute, second in UTC. .00: always this value.

A : message (Time / Date) is Available. If V: message is not valid (Void).

4659.3554 : 46: latitude in degree. 59.3554: latitude residual in minute.

N : north hemisphere. If S: south hemisphere.

00654.4072 : 006: longitude in degree. 54.4072: longitude residual in minute.

E : eastern of Greenwich. If W: western of Greenwich.

090507 : 09: day. 05: month. 07: year.

E : mode indicator. Always E.

*58 : xor checksum in between $ and *.

Notes

- As the iSync device is timing oriented, the meaning the validity flag "A/V" is somewhat different. Meaning of the flag:
  "V" :
  - The device is not synchronized to the GPS yet.
  - The device doesn't receive time indication from GPS for longer than x hours.

  "A" :
  - The device is date/time synchronized to GPS with information more recent than x hours.
- The parameter x can be modified. For a Rb based clock it is by default 240 hours (10 days). For a crystal based clock it is by default 24 hours. See MAv parameter 0x0D.
- The time/date information is always present.
- The position information are present in the $GPRMC message only if :
  - A correct message from a GPS device is present.
  - The position information of the GPS message is correct.
- In the standard configuration the GXClock is able to manage a leap second correction during a holdover.

5.11.8 Message NMEA $GPZDA

Legacy NMEA timing message.

At	~3ms	~250ms	~500ms	~750ms
Activation commands	BTZ, MAWØBØ2	MAWØB2Ø	MAWØCØ2	MAWØC2Ø
Activation after power on	MASØBØ2	MASØB2Ø	MASØCØ2	MASØC2Ø

Ø : zero.

Exemple:

$GPZDA,133358,09,05,2007,,*4E<CR><LF>

$GPZDA : message header that never change.

133358 : hour, minute, second in UTC.

09 : day.

05 : month.

2007 : year.

*4E : xor checksum in between $ and *.

5.12 THE NMEA $GPRMC mode

The iSync device can track a PPSRef and update its internal GPS time system with information coming from a NMEA message $GPRMC.

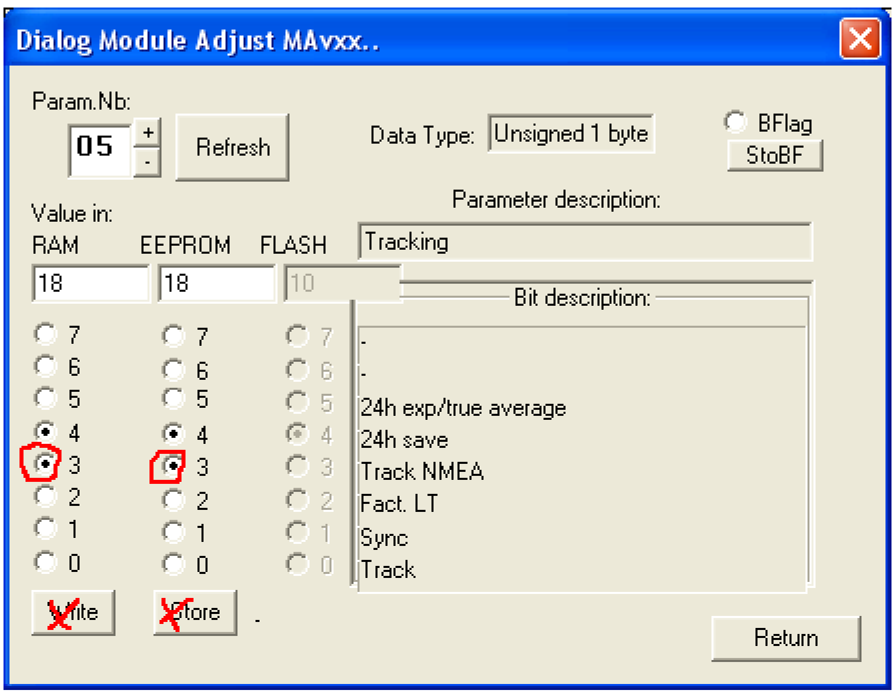
Conditions:
Communication port: TXD1. For GXClock pin 9.

Configuration: 9600,n,8,1

Message : $GPRMC,
See Message $GPRMC
It is a pulse - message system. See Time of Day Command Synchronization.

Setting:
The bit 3 of parameter 0x05 must be settled, so the incoming $GPRMC messages will be accepted.
This can be done with Hyperterminal : p.ex. : MAW0518 in ram. To store this behavior permanently in eeprom : MAS0518.

With the Monitoring program :



5.13 Special commands

These special commands are for debugging. It is not recommended to include them in a standard development.

Command `@@@@GPS<CR>[<LF>]`

Use Open a transparent serial communication way between a terminal and a GPS receiver connected to the iSync device.
Setting: 9600,n,8,1
```
Terminal -> pin19:RxD1 -> iSync -> pin16:/TxD2 -> GPS
Terminal <- pin18:TxD1 <- iSync <- pin12:/RxD2 <- GPS
```

Remark Messages transmitted normally by the iSync on TXD1 and to TXD2 are not stopped. To stop them: `BT0, MAW0B00, MAW0C00 and MAW2100`.

Command `@@@@`

Use Cancellation of `@@@@GPS` command.

Command `@@@@XOF<CR>[<LF>]`

Use Stop decoding incoming messages from terminal to iSync.
Outgoing messages are not stopped.

Remark Messages transmitted normally by the iSync on TXD1 and to TXD2 are not stopped. To stop them: `BT0, MAW0B00, MAW0C00 and MAW2100`.

Command `@@@@XON<CR>[<LF>]`

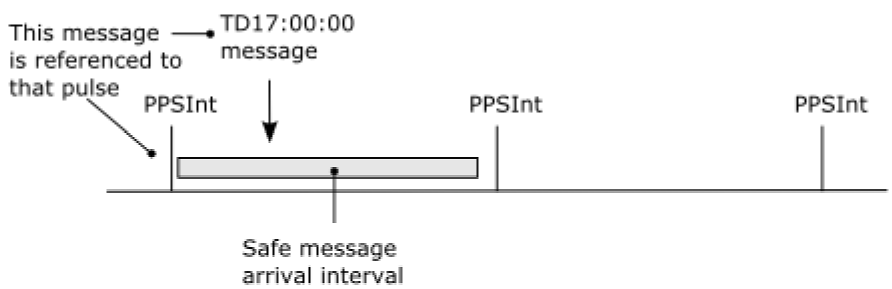
Use Cancellation of `@@@@XOF` command.

5.14 Time of Day Command Synchronization

Important

In the iSync there is a pulse - message system. That means the pulse arrives first, then the information related to it.

- The reference for timing is PPSINT.
- The time information is referenced to the PPSINT just before the command arrival.
- **TD17:00:00** means it was 17:00:00 at the last ppsint.
- The safe message arrival interval is approx. 3 ms after reference PPSINT and 50 ms before next PPSINT.
- Remark: with **SY1** PPSINT and PPSOUT are aligned.



5.15 Time tagging on the PPSREF input and the BT8 command

It is possible to make time tagging on the PPSREF input.

- Activation command : BT8.
- Origin of time stamp : 2000-01-01 00:00:00.
- Referenced to PPSINT.
- Fine phase comparator not activated.
- Tagging of an independent signal not possible during a tracking.
- A stamp message is transmitted on the serial TXD1, up to 10 ms after the pulse arrival. See BTx command.

5.16 Signification of the BT9 message

Every second, the GPS send data to the iSync.This data contains information about timing and navigation parameters. A bit is settled for each parameter when the iSync found pertinent data about it and BT9 send a message as soon the information is arrived. This way, several messages may follow if the information is scattered over several GPS messages. Note: Only the information "Validation" is followed by a <CR> <LF>. It is therefore possible that BT9 sends long messages without any <CR>< LF> if the GPS doesn't make fixes.

Signification of each bit :

Bit	Comment
7	Leap second
6	UTC offset
5	ND
4	Position
3	Date / Time
2	Granularity
1	ND
0	Validation

Typical BT9 messages for some GPS :

GPS type	Param. 0x21	Param. 0x22	Good working message
LEA-xT	0x04	0x1D	10400C01
NMEA $GPRMC	0x08	0x19	19

5.17 Time and date in use in the iSync clock

Topic related to MAv parameter 0x27

- The internal time of the iSync clock is the GPS time. Message with GPS time: $PTNTA. Commands that gives out GPS time: DT, TD, BT4, BT7, BT8, BTA. See also MAv 0x0B, 0x0C.
- UTC time is used in messages: $GPRMC, $GPZDA. Commands that gives out UTC time: BTR, BTZ. See also MAv 0x0B, 0x0C.
- UTC time = GPS time - Offset.
- Offset is retrieved from GPS receiver messages if available.
- Offset is stored in eeprom. The storage is not automatic. It is possible to modify the offset value with the MAv.. system, parameter 0x27. Exemple: Command that store an offset of 16 second in eeprom : MAS270010 <CR><LF>
- Offset value at 2012-08-22: 16 seconds.
- At Power ON, Offset is a copy of the value stored in the iSync eeprom.
- It can take up to 20 minutes after Power ON before an Offset value from the GPS becomes available.
- At Power ON, as long the Offset value from the GPS is not available, the flag "A/V" of the message $GPRMC is staying "V" (Void).
- When the iSync is tracking with information from an external message $GPRMC, the offset is always coming from the value stored in eeprom. This means the internal GPS time of the iSync is perhaps not correct.

5.18 The time constant of the PI loop, GXClock

In automatic mode (TC000000 <CR><LF>)

- At the beginning of a tracking the time constant is settled to 100 second. After that this value can climb up to 10'000 second, depending on the |ppsref - ppsint| noise.
- The noise determination can only be done in the range |ppsref - ppsint| < 500 ns.
- Over this range, there is no noise information. In such situation, the time constant goes gently to 1000 second, whatever the initial value.
- In really noisy environment, with ppsref jumps larger than 500 ns, it is recommended to not work in automatic time constant mode because the time constant will never go over 1000 seconds.

The following relationship is available:

```
(ppsref noise)[ns] x 100.0 -> (time constant)[s]
```

5.19 GXClock simplified state machine and Status indication

```
Situation                                                          Status

|warming up flag|---------------------------------------------(0)


|iddle|-------------------------------------------------------(4)


|tracking setup|-----------|ppsref|---|ppsref stable|---------(1)
                       |
                       ---/|ppsref|---------------------------(6)
                       |
                       ---/|ppsref stable|--------------------(5)
                       |
                       --|consider GPS|--/|GPS message|-------(6)


|holdover|----------------------------------------------------(5)


|tracking|--------|ppsref|---|ppsref in alarm window|---------(2)
            |
            --|sync|--|(ppsout - ppsref) in alarm window|-----(3)
            |
            -----/|ppsref|------------------------(holdover)--(6)
            |
            -----/|ppsref in alarm window|--------(tracking)--(5)
            |
            -----/|ppsref in tracking window|-----(holdover)--(5)
            |
            ---|consider GPS|--/|GPS message|-----(holdover)--(6)


|whatever|--------|FREEZE=1|-------(Uvaractor=cst)------------(7)
```

Notes:

- This is a simplified representation. The conditions that make the transitions between |warming up|, |tracking setup|, |holdover|, |tracking| possible are not showed here.
- The transition from |tracking setup| to |tracking| goes for a short time through |holdover|. That is why Status=5 can appear for a short time in such situation.

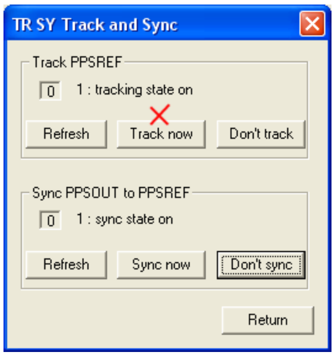
6. Annexes

6.1 Typical tunings

6.1.1 Start of a tracking

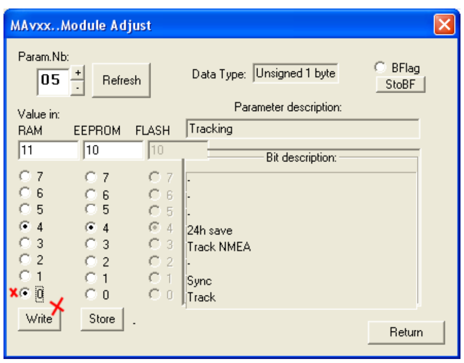
There are 3 possibilities:

1. With iSync Manager, Timing+Tracking/TRx



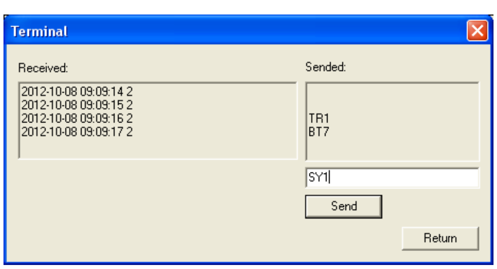
Click on "Track now". If the PPSOUT must be aligned to the PPSREF, click also on "Sync now".

2. With iSync Manager, Timing+Tracking/MAvxx..,parameter 0x05



Activate bit 0 on RAM Then "Write". If the PPSOUT must be aligned to the PPSREF, activate also bit 1.

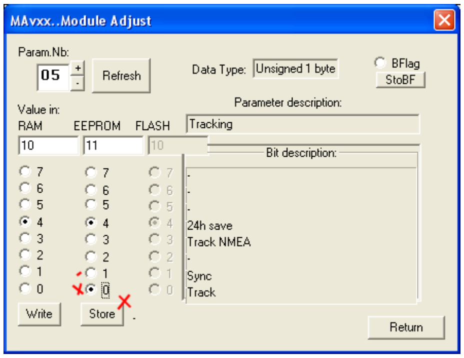
3. With iSync Manager, Command/Terminal



Send "TR1". To see if the going in tracking works fine, send "BT7", Date / Time, Status. First the Status is 1. After a while the Status becomes 2. Sometime later, the Date / Time will be aligned to the GPS, if available.
To align the PPSOUT to the PPSREF, send "SY1". Remark: "SY1" can also be sent whenever before. When the Sync mode is active, the final Status becomes 3.
To cancel BT7, send "BT0".

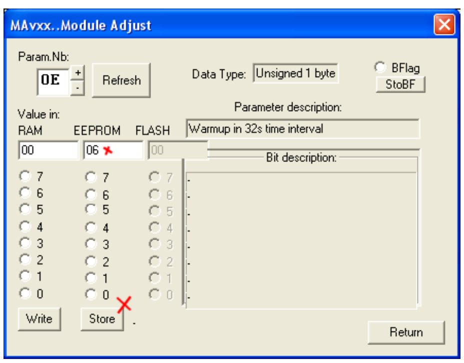
6.1.2 Automatic start of the tracking.

This is only possible with iSync Manager, Timing+Tracking/MAvxx.., parameter 0x05.



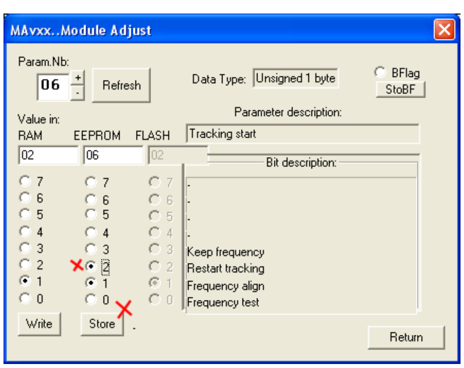
Activate bit 0 on EEPROM. Then "Store". After Power ON / Reset, the GXClock will automatically initiate a tracking. If the PPSOUT must be aligned to the PPSREF, activate also bit 1.

Remark: Although the GXClock frequency is quickly stable, it is recommended to delay somewhat the going in tracking after Power ON. This can be done with MAv parameter 0x0E:



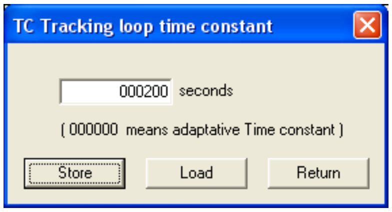
Here the GXClock waits 6•32 seconds = 192 seconds after Power ON / Reset before initiating a tracking.

Just after Power ON, the GPS can generate a bad PPSREF. It is therefore recommended to allow the restart of tracking if the PPSREF changes its position. This can be made with the bit 2 of the MAv parameter 0x06:

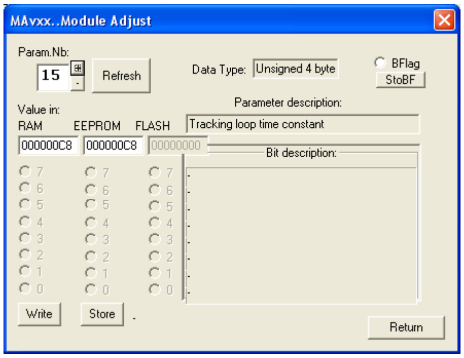


6.1.3 Low Time Interval Error with the PPSRef from the GPS

There are situations where a low Time Interval Error between the PPSREF from the GPS and the PPSOUT of the GXClock-500 is more important than a low phase noise or very good short term frequency stability.
This can be achieved by forcing the tracking loop time constant to a low value:

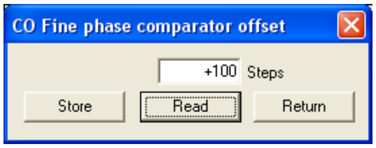


or

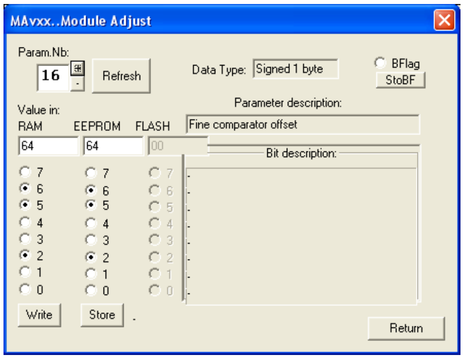


Here the time constant is forced to 200 seconds. This can be done with the iSync Manager Timing+Tracking / TCdddddd, in EEPROM or with the MAv parameter 0x15, in RAM and in EEPROM.

Due to a non-linearity nearly zero of the fine phase comparator, it is recommended to add an offset when the time constant is low. The value can be changed with the command COsddd or with the MAv parameter 0x16.



or



Here an offset of 100 ns is added to the fine phase comparator. This make it works outside of the zero area.

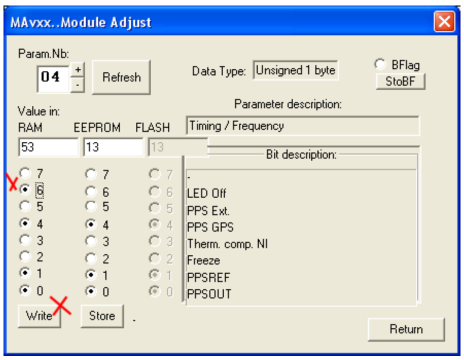
6.1.4 Very good short term frequency stability

Very good short stability or Allen Variances could be achieved in following conditions:

- Tracking loop time constant forced to 2000 seconds and above.
- Avoiding air flows around the GXClock-500.

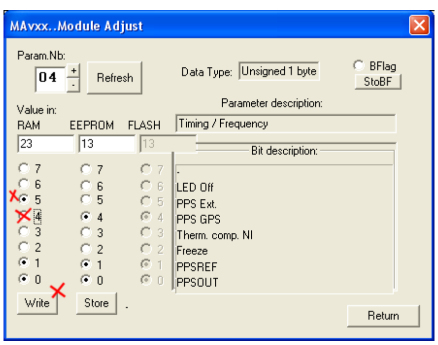
6.1.5 Improved holdover performance

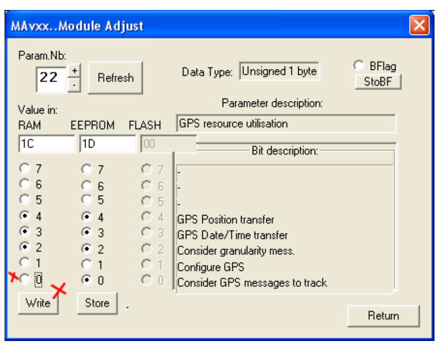
It was observed that the holdover performance is slightly improved if the LEDs, especially the "ALARM" LED were disconnected. For high performance applications, when LED lamps are not a must, they can by cancelled as following with the MAv parameter 0x04, Bit 6:

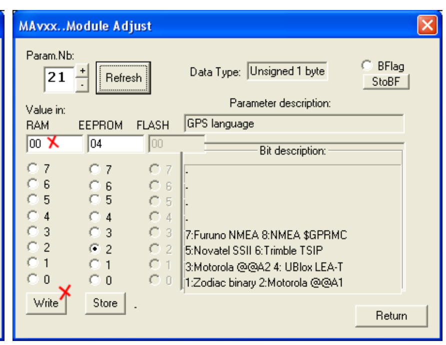


6.1.6 Tracking an external PPSREF

It is possible to track an external PPSREF connected to the pin 11 of the Interface. There is an internal circuitry to choose the PPSREF source. The switching is made with the MAv parameters 0x04 and 0x05:



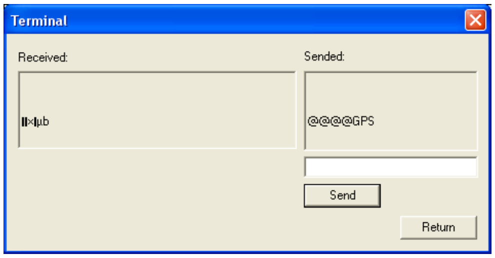




MAv parameter 0x04, bit 4 must be put to 0 and bit 5 must be put to1. MAv parameter 0x22, the bit 0 must be put to 0. And to avoid any interference of the still messaging GPS, MAv parameter 0x21, can be settled to 0x00.

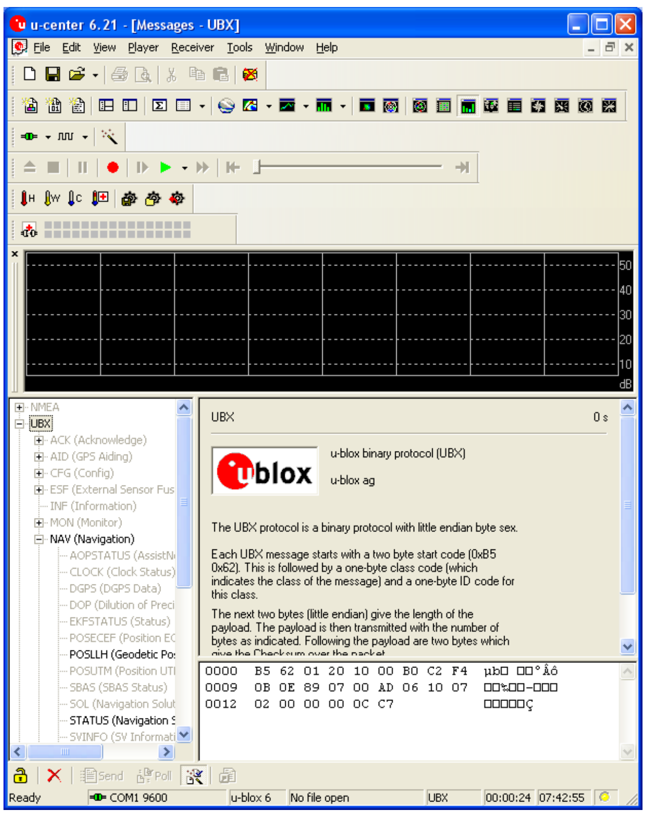
6.1.7 Direct communication with the GPS receiver

The GXClock has a reduced set of standard NMEA messages limited to $GPZDA and $GPRMC. It is possible to take profit of the rich messaging system of the LEA-xT by sending them out through the Micro-Controller.



To initiate the link between the internal GPS port and the external serial port, send the debug command "@@@@GPS" from the "Terminal" window of the iSync Manager program. Immediately after the setting of the link, strange characters are displayed in the "Received" box. It is binary from the GPS. To continue, close the "Terminal" window as well the iSync Manager program.

With the u-center program from U-Blox it is now possible to control the GPS receiver LEA-xT.



First, connect the right serial port with the corresponding icon or from the menu Receiver/Port. Then open the Message window with the short key F9 and make it big. The messages needed by the iSync for stationary timing are highlighted. With the help of the U-Blox documentation, it is now possible to cancel messages, make other messages active or fully change the LEA-xT configuration.

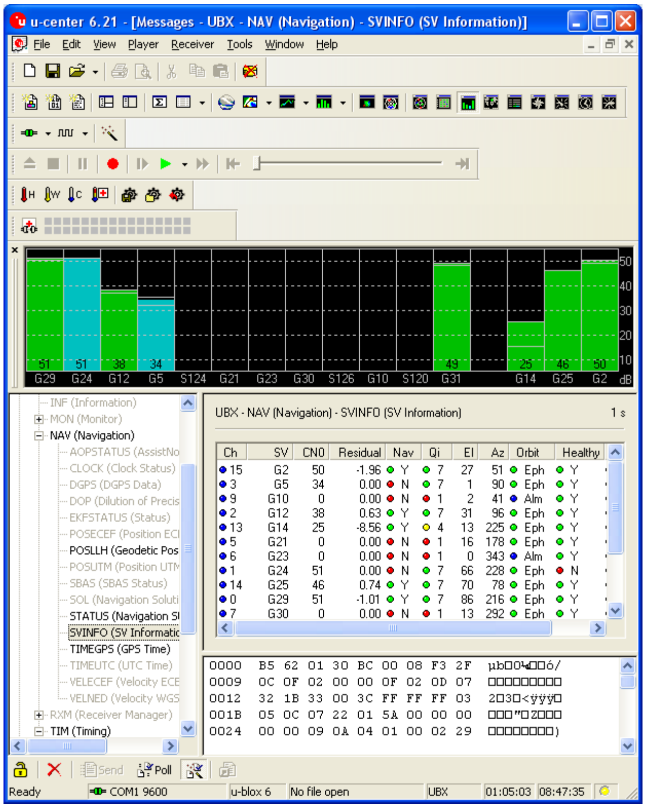
Important note:

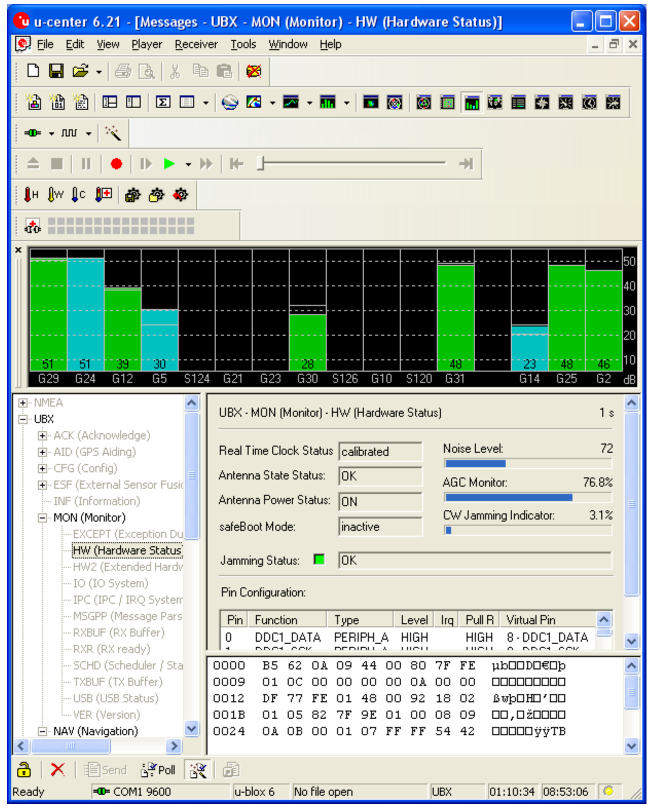
- The changes made "on the fly" are not saved in eeprom. By power down / Power ON the iSync, the old configuration comes back. But there is a way to save the actual configuration in eeprom. (CFG/CFG). SpectraTime is not responsible of malfunction due to changes in the GPS configuration.
- With the standard configuration, the iSync will go in holdover, if it was in tracking, after the setting of the direct link to the GPS. In fact the messages are no more decoded by the iSync in such situation. But it is possible to consider the GPS just as a "PPSREF generator" and to configure the iSync accordingly, see the Chapter: Tracking an external PPSREF

To break the direct link to the GPS, run the iSync Manager, window "Terminal" and send "@@@@".

6.1.8 Testing the GPS jamming

If the GXClock is placed near RF emitting devices, it can be helpful to see how the embedded GPS receiver is jammed. The LEA-xT has useful tools to make some tests. First initiate a direct link to the GPS, see the Chapter "Direct communication with the GPS receiver" and run the u-center program.





- From UBX / NAV / SVINFO, activate the SV level indication. Right click / Enable message.
- From UBX / MON / HW, activate the jamming indication. Right click / Enable message

In SpectraTime we have 3 criteria to evaluate the jamming:

1) Regarding the level, it must be said that our GPS antenna is not well located. Therefore we estimate that 1 SV with a signal level over 50 dB•Hz and 3 SV over 48 dB•Hz are good.
2) The "Jamming Status" is the most important criteria. It must be "Green, OK".
3) The "CW Jamming Indicator" is always under 4% in a not jamming situation. Values up to 10% are acceptable as long the "Jamming Status" is staying "Green, OK".

- End of document -