

RbSource-1500 & GNSSource-2500

Smart PPS/ GPS Clock Reference Source



User Manual

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1. Introduction

The RBSource-1500 / GNSSource-2500 has been specifically designed for cross industry applications, including telecom and calibration, requiring extremely stable and precise timing or frequency source.

The GNSSource-2500 integrates a GPS receiver, a smart GPS-disciplined Rubidium clock, and distributes multiple output signals, either phase or frequency aligned depending on the operating modes. The RBSource-1500 does not integrate GPS receiver but just equipped with 1 PPS reference input.

2. Definitions

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

| <u>Words</u> | <u>Definitions</u> |
|----------------|---|
| RBSource-1500 | Unit or product |
| GNSSource-2500 | Unit or product |
| Unit | RBSource-1500 or GNSSource-2500 |
| System | RBSource-1500 or GNSSource-2500 and its integrated modules |
| Rb | Rubidium |
| Rubidium clock | Refers to the smart GRCllok-1500 models |
| Rubidium | Rubidium clock |
| GRCllok | Rubidium clock, model GRCllok-1500 |
| 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 called "synchronization" |
| Free-run mode | Rubidium clock not locked to any reference, including GPS |
| Holdover mode | Rubidium clock previously locked to a GPS reference but lost it or is no longer present |

3. Before Getting Started

3.1 Unpacking

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

Unit Supplies

- 1x RBSource-1500 or GNSSource-2500 unit
- 1x GPS patch antenna with 5 meters (16.4') cable with standard option, (GNSSource-2500 ONLY)
- 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

3.2 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 ground must be ensured.

- The equipment contains small quantities of rubidium metal hermetically sealed inside the glass lamp and cell assemblies, hence, any dangers arising from ionizing radiation are caused for human health (exemption set in article 3 to Council directive 96/29/Euratom).
- For further information, ask for the «rubidium product data sheet».
- 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.

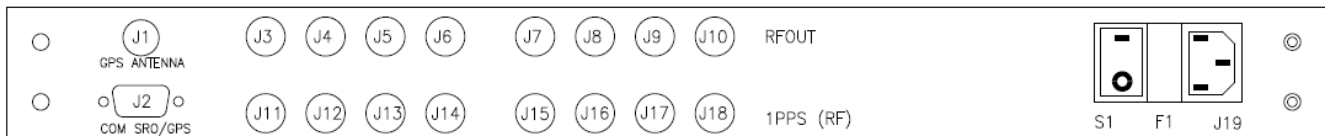
Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment 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.

3.3 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.

3.4 Installation Procedure

3.4.1 Connections



1. Connect power 100-240V 50-60Hz to J19.
2. Connect GPS antenna to J1 GPS antenna. Install the included patch antenna close to a window. (GNSSource-2500 Only. For RBSource-1500, the 1 PPS reference is to be connected in place of the antenna to J1)

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-2500 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.

3.4.2 Software Monitoring

3.4.2.1 iSyncMgr Application

RBSource-1500 / GNSSource-2500 operates independently. However, the smart integrated rubidium clock can be monitored through the iSyncMgr Application. The latest version can be downloaded from orolia.com.

To start the application, please follow procedure below:

- Start the application with Internet Explorer. By default, the serial port is COM1. If a warning window pops up before the application iSyncMgr 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.
- Once the serial port number is properly working, click on the "Refresh" button. The Identification, Serial Number and Status of the smart rubidium clock inside the RBSource-1500 / GNSSource-2500 should be displayed as Figure 1 below:



Figure 1 - iSyncMgr.exe

Notes:

- a. iSyncMgr gives full monitoring access to the smart GXClock-1500 or GRClock-1500-1500 rubidium clock
- b. Changes through these commands should be avoided: TCddddd or MCsxx...

3.4.2.2 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: -9600 bits/s, 8 data bits, No parity, 1 stop bit, and no handshake.

See chapter 5 for the list of commands

4. System Operations

4.1 Operating Modes

The RbSource-1500 / GNSSource-2500 integrates a smart rubidium clock and a GPS receiver. It provides 4 basic modes of operation as follows:

1. **Free Run:** When the Rubidium clock is not locked to a GPS reference and, thus, is free running
2. **Track:** When the GPS reference is used to perform frequency alignment applications. It uses the PPS_GPS as a reference (PPSREF) to align the frequency of the Rubidium clock, but the phase is not aligned.
3. **Sync:** When the GPS reference is used to perform phase alignment applications. The PPSOUT of the RbSource-1500 / GNSSource-2500 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 GPS signal is not present (NO PPSREF). The last averaged frequency value is used for performance enhancement by the SmarTiming+™ algorithm

Note:

- a) See Chapter 4.4.1 for more detailed description

4.2 Operating Mode Setup

The user can set up the operating mode in 2 ways:

- **Hardware:** Select desired operation mode through the Switch 2 (see user interface location in Section 6). This mode overrides any software setup. Example: if the Switch 2 is set in Track mode, the unit will work in tracking mode, even though the user sets up the Free-Run or Sync mode through the iSyncMgr application or send a RS-232 command to the unit.
- **Software:** Select desired operation mode through the iSyncMgr 101 application or send RS-232 commands.

Note:

- a) See Chapter 5 for a list of supported RS-232 commands

4.3 Alarm Indicators Description

| Operation modes | LED status | | | | Switch 2 positions | | | Troubleshooting Actions |
|-----------------|------------|------------|---------------|----------|--------------------|------|-------|---|
| | Power | Sync/Track | Rb Lock (red) | GPS Mark | free run | Sync | Track | |
| Free Run | - | - | - | - | - | - | - | Check power supply |
| | ✓ | - | ✓ | - | ✓ | - | - | Wait for 15 minutes, if I5 is still red then send back the RBSource-1500 / GNSSource-2500 to factory |
| | ✓ | - | - | - | ✓ | - | - | Bad installation of GPS antenna |
| | ✓ | - | - | Blinking | ✓ | - | - | Normal free run situation |
| | | | | | | | | |
| Track/Sync | ✓ | - | - | ✓ | | ✓ | - | Wait 10 minutes, if I4 still not green, maybe a bad configuration, please contact us |
| | ✓ | - | - | ✓ | | | ✓ | Wait 10 minutes, if I4 still not green, maybe a bad configuration, please contact us |
| | ✓ | green | - | | | ✓ | (✓) | Normal Sync/Track situation |
| Holdover | ✓ | - | - | - | | ✓ | | In holdover mode. No GPS signal detected. If the signal comes back, I6 should blink again and I4 will become green. It doesn't mean that the holdover time was too long. In such case, set the Switch S2 in Free-Run and then back in Sync or Track |
| | ✓ | - | - | - | | | ✓ | |

5. System Description

The RbSource-1500 / GNSSource-2500 unit consists of a GPS receiver disciplined to a smart rubidium clock (model GRCLK-1500 as standard option or GRCLK-1500 / LN for low phase noise option).

5.1 Principle of Operation

The GRCLK-1500 essentially consists of a voltage-controlled crystal oscillator (VCXO) which is locked to a highly stable atomic transition in the ground state of the Rb87 isotope. While the VCXO is oscillating at a convenient frequency of 60 MHz, the Rb clock frequency is at 6.834...GHz in the microwave range. The link between the two frequencies is done through a phase-stabilized frequency multiplication scheme whereby a synthesized frequency is admixed to enable exact matching.

The Rb atoms are confined in a high temperature vapor cell. The cell is put in a microwave resonator to which the microwave power derived from the VCXO is coupled. The Rb87 atoms in the cell occur with equal probability in the two hyperfine energy levels of the ground state ($F=1$ and $F=2$).

In order to detect the clock transition between these two levels, the atoms need to be manipulated in such a way that most of them occur in only one level. This is done by optical pumping via a higher lying state (P). Figure 2 visualizes the atomic energy levels and transitions involved in the optical pumping process.

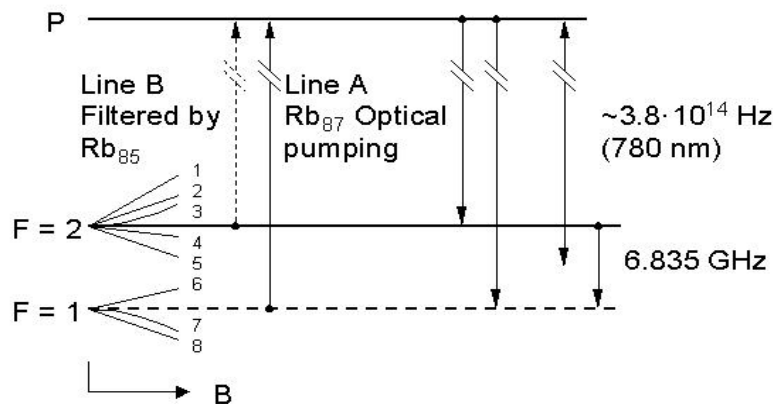


Figure 2 Energy levels and transitions in Rb87 atoms during GRCLK-1500 operation.

The pump light comes from a Rb resonance lamp which emits the light of Rb87 atoms. This light, which intersects the absorption cell, is filtered in such a way that mainly one optical frequency, which corresponds to a transition out of one of the two ground state levels (line A), enters the principal absorption region.

The pump light excites Rb87 atoms which are in the lower hyperfine level ($F=1$) to the short-lived excited state P from which they decay to the two ground state levels ($F=1,2$) with equal probability. Since pumping occurs continuously out of the $F=1$ level, after some time, almost all atoms are found in the $F=2$ level and no further absorption occurs.

The transmitted light level is detected by a photodiode after the cell. If now a microwave field resonant with clock transition $F=2$ to $F=1$ is coupled to the interaction region, the level $F=1$ is repopulated and light absorption is enhanced. A sweep of the microwave field over the resonance is detected as a small dip in the transmitted light level after the cell.

This signal is fed into a synchronous detector whose output generates an error signal which corrects the frequency of the VCXO when its multiplied frequency drifts off the atomic resonance maximum.

The absorption cell is filled with metallic vapor which contains Rb85 and Rb87 isotopes and a buffer gas. Filtering of the pump light is achieved in the entrance region of the cell by absorption with Rb85 atoms which have an accidental overlap with one of the Rb87 resonance transitions (line B): integrated filter cell.

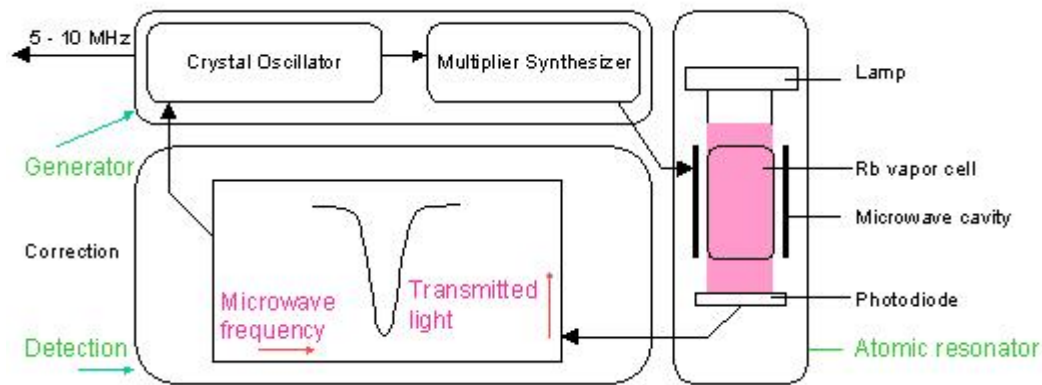


Figure 3 Rubidium atomic clock principal block diagram.

The principal function of the buffer gas is to keep the Rb atoms away from the cell walls and restrict their movements. As a result, they are practically "frozen in place" for the interaction time with the microwave field. In this way the Doppler-effect is virtually removed, resulting in a narrow line width.

The cell region is also surrounded by a so-called C-field coil which generates a small axial static magnetic field to resolve the Zeeman sub-transitions of the hyperfine line and select the clock transition, i.e. the one with the least magnetic sensitivity. To further reduce the magnetic sensitivity, the complete device is placed into a magnetic shield.

Figure gives a basic overview of the different function blocks of the Rubidium atomic clock. The GRCllok-1500 consists of three different packages. The optical elements, which include the Rb absorption cell and microwave cavity, form the atomic resonator, while the electronics package is constituted of the generator and the detection circuitry.

5.2 Physics Package

The main design characteristics of the physics package are its low power consumption, small size and mass, along with minimal environmental sensitivities and mechanical ruggedness.

Other design features contributing to the compact design are:

- Use of the integrated filter technique (IFT)
- Use of a magnetron-type microwave resonator

The integrated filter technique combining the optical filtering and pumping in one cell contributes also to the reliability, the configuration is simplified and the number of components is reduced. The thermal capacitance of the cell assembly is relatively low. Thus, the necessary power during warm-up is greatly reduced.

The magnetron resonator is a cylindrical cavity loaded with a concentric capacitive-inductive structure (annular metal electrodes). It allows smaller cavity dimensions and concentrates the microwave field at the right region of the cell.

The Rb lamp is an electrode-less RF-discharge lamp, a heated glass bulb, containing Rb and a starter gas surrounded by an RF-coil.

5.3 Electronics Package

The clock transition of a Rubidium (Rb) resonator is a microwave transition at 6.834 GHz. The microwave resonance occurs as a dip in the optical signal - i.e. in the Rb lamp light which, after transiting the cell, is detected by a photodiode.

The basic purpose of the electronics package is to synchronize the entering microwave frequency, derived from a quartz crystal oscillator, to this absorption dip. This is achieved by tuning the microwave frequency to maximum optical absorption.

The clock microwave frequency of the Rb atoms in the vapor cell has a nominal value of 6834.684 MHz. This frequency is generated from a voltage controlled quartz oscillator (VCXO) oscillating at 60 MHz.

A serial interface connection, monitoring and tuning the internal parameters and the PPS facilities, is provided.

The correct operation of the unit can be checked by an output signal called “lock monitor”. This lock monitor information is generated by the micro-controller and is a function of the following parameters: light level intensity, Rb signal level (detected signal) and heaters supply voltages.

The different alarm threshold levels, corresponding to the different internal electronics and physics parameters, are programmed during the automatic adjustment procedure at the factory.

5.4 The Timing and Tracking system

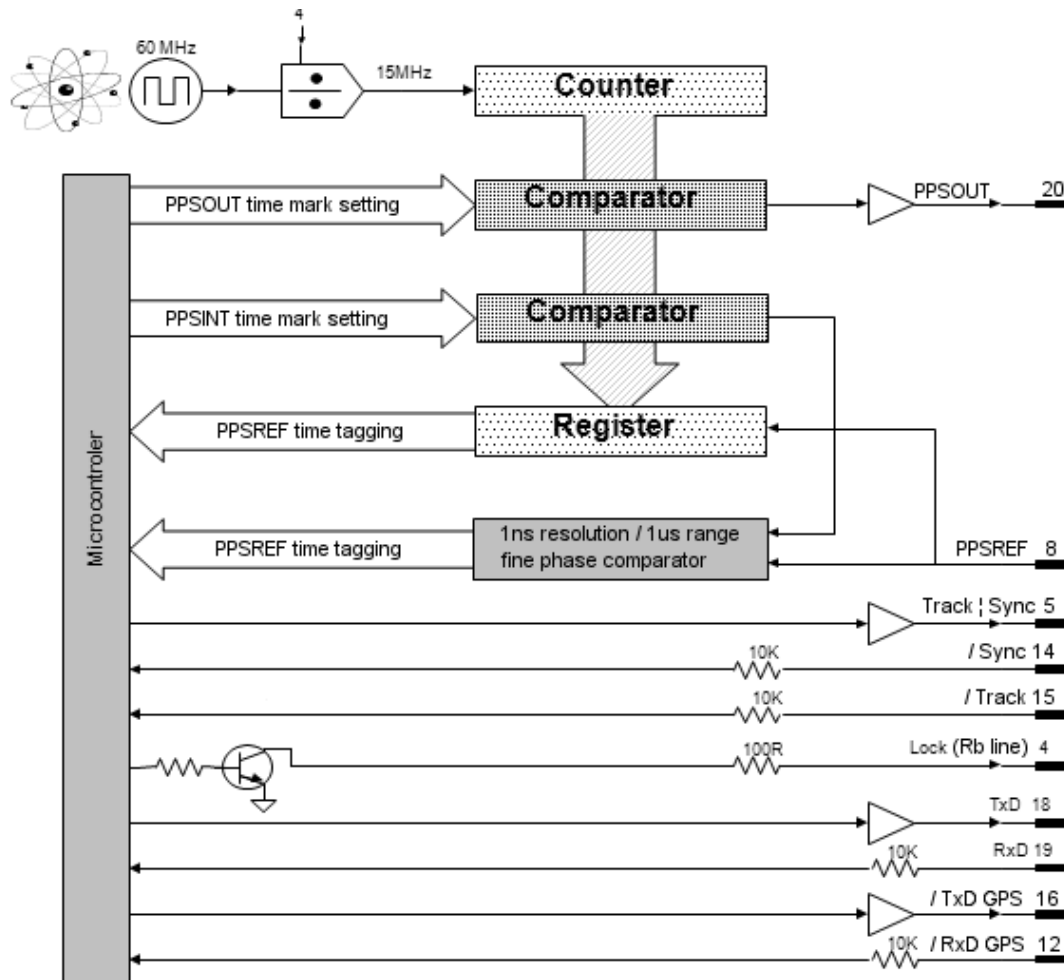


Figure 4 Timing system.

The GRClock-1500 models includes extended PPS (Pulse Per Second) facility. The hardware of this facility consists of two modules. The first module is a timer clocked at 15 MHz. This timer tag the PPSREF connected to the GRClock and generates two other PPS. The first one is called PPSINT and is used internally. The second one is called PPSOUT and appear on pin 20 of the connector.

The second module is a fine 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 GRCLK without adjustments by hard or software.

A tracking can be initiated by grounding pin 15 "/Track" and if the tracking is successful, the pin 5 "Track/Sync" will be set in low TTL level. By grounding pin 14 "/Sync", the PPSOUT will be aligned to PPSINT. But all of the tracking and PPS functions can also be controlled via the serial interface port RS232.

5.4.1 THE "TRACK" MODE AND THE "SYNC" MODE.

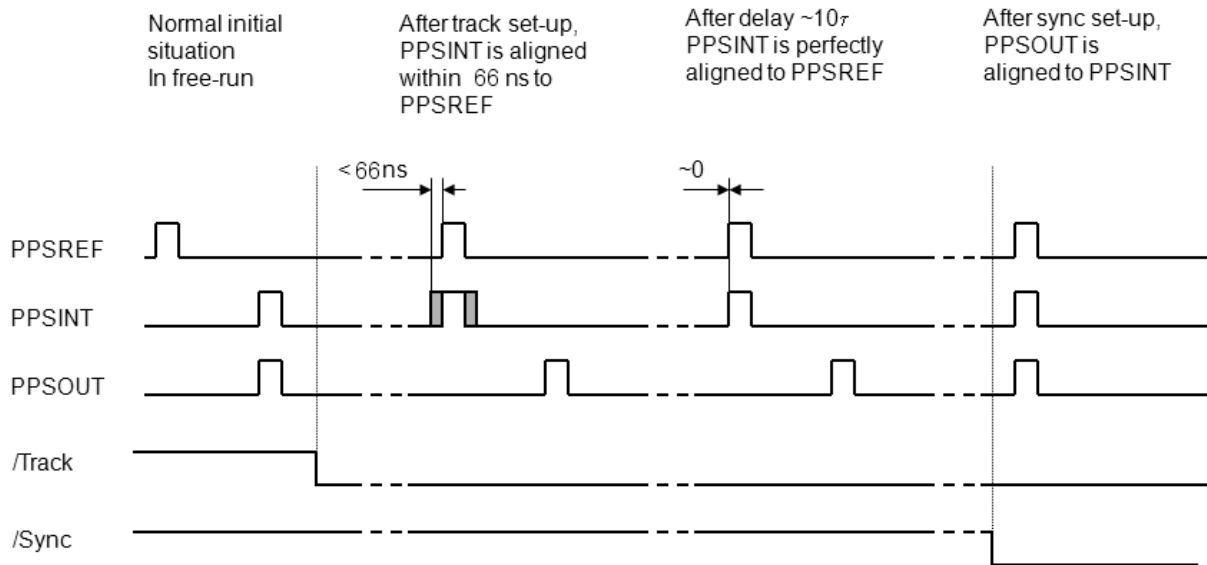


Figure 5 "Track" mode and "Sync" mode.

PPSOUT behaves differently, depending on if SYNC is active or not.

- If SYNC is not active, the position of PPSOUT will never change, it will therefore not make a jump at the beginning of the tracking. It is in fact a frequency tracking.
- If SYNC is active, PPSOUT will make a jump to be aligned to PPSINT. This jump will happen just after the beginning of the tracking. PPSREF, PPSINT and PPSOUT are synchronized.

At the beginning, the phase-time difference between PPSINT and PPSREF can be as big as 66 ns. After some time, this difference will become more and more little and finally PPSINT and PPSREF will be aligned.

SYNC can be made active before a tracking, during a tracking, by hardware, grounding the pin 15, "/Sync" or by software, it is quiet flexible. SYNC can also be made active permanently.

5.4.2 THE FREQUENCY LEARNING

When the GRCLK-1500 is tracking the PPSREF of a master oscillator, it aligns its frequency to the master. The learning process is the memorization of this frequency from time to time to use it after a reset or Power-On.

By default, when the GRCLK-1500 is continuously and successfully tracking a PPSREF, the average value of the frequency is saved in EEPROM every 24 hours. With the command FSx<CR>, it is possible to cancel the learning or to make an immediate save.

5.4.3 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 always be read by the user. The command to read this register is: FC?????<CR>.

On a GRCLK-1500 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 a tracking is stopped intentionally, the GRCLOCK-1500 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 GRCLOCK-1500 goes in HOLDOVER with the holdover frequency previously estimated.

USER FREQUENCY CORRECTION

This correction is made with the command [FCsddddd](#) (Free Run mode only). The command has 2 effects: memorization of the asked frequency in EEPROM, and immediate use of the new frequency.

5.4.4 THE PPS TRACKING LOOP

The GRCLOCK-1500 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 [TCddddd](#).

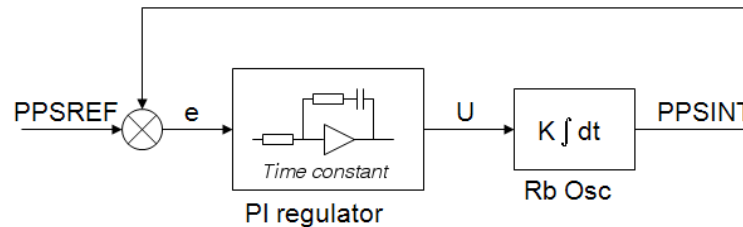


Figure 6 Schematic of the PPSREF regulation loop.

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.

5.4.5 TRACKING LIMITS AND ALARMS

If the frequency between the GRCLOCK-1500 and the master to track is too large, after some time, the phase time error between PPSINT and PPSREF continuously increases. To avoid large values, the device has a limitation system.

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](#). By default its value is $\pm 4\mu s$. The value of the half tracking window can be changed by the user with the command [TWddd](#). By default its value is $\pm 4\mu s$. For more details, see the Chapter "[TIMING AND TRACKING COMMANDS](#)".

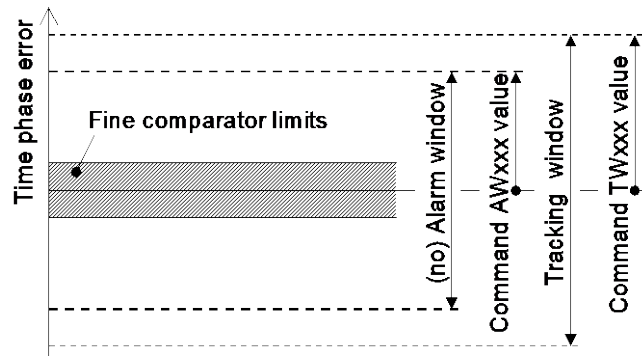


Figure 7 Tracking limits.

5.4.6 FREQUENCY FLUCTUATIONS DURING THE TRACKING

By default, during a tracking, the GRCLOCK-1500 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 : $\pm 1.6e-8$.

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](#).

5.4.7 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 <CR>`

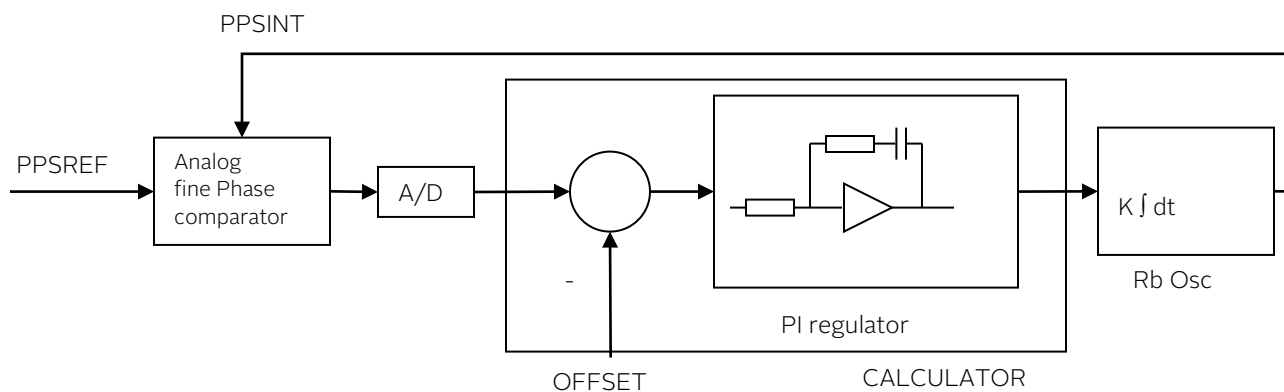


Figure 8 Schematic of the analog fine phase comparator regulation loop.

5.4.8 STARTING THE TRACKING, PRECAUTIONS

In a situation where just a frequency disciplining is asked, like in a laboratory, it is recommended to allow the restart of the tracking by setting MAV parameter O6, bit 2 to 1.

In other situations, like synchronization of a base station to the GPS constellation, it is recommended to not allow the restart of tracking by setting MAV parameter O6, bit 2 to 0. This way GPS receiver anomalies may be cancelled. This induces stacking in Status=5 problems. To fix up Status=5 problems, it is recommended to restart the tracking.

6. System Communication

User can monitor the internal parameters of the GRClok-1500 or LNRClock-1500 such as identification, status and parameters by sending a command followed by a carriage return character through the serial interface.

6.1 INTRODUCTION

The GRCLOCK-1500 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.

6.2 SERIAL INTERFACE CONNECTION

The data transfer from the GRCLOCK-1500 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
 output "mark" voltage : 0 V
 output "space" voltage : 5 V
 input "mark" voltage : 0 to 2.5 V (CMOS)
 input "space" voltage : 2.5 to 5 V (CMOS)

IMPORTANT NOTE

This voltage is uncommon, but 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..

6.2.1 SIMPLE 1 CHARACTER COMMANDS

GRCLOCK-1500 INTERNAL VOLTAGES 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 GRCLOCK-1500 will respond to this single character command with an eight ASCII / HEX coded string which look 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. All parameters are coded at full scale.

HH: Read-back of the user provided frequency adjustment voltage on pin 6 (0 to 5V)
GG: reserved
FF: peak voltage of Rb-signal (0 to 5V)
EE: DC-Voltage of the photocell (5V to 0)
DD: varactor control voltage (0 to 5V)

- CC: Rb-lamp heating current (Imax to 0)
- BB: Rb-cell heating current (Imax to 0)
- AA: reserved

- **DC-Frequency adjustment voltage.**
HH: o/p frequency adj. voltage (0 to 5V for \$00 to \$FF)

This parameter corresponds to the frequency adjustment voltage provided by the user. This information can be used for a read-back of the actual voltage applied to pin 6 of the GRCLOK-1500 connector.

- **Reserved**
GG:
- **Rb signal level.**
FF: Peak voltage of Rb signal level (0 to 5V for \$00 to \$FF)

This signal monitors the rectified value of the AC signal produced by the interrogation process of the Rb dip absorption. During warm-up time this signal is approximately 0V and after it stabilizes to a nominal value of 1 to 5V. As long as this signal is too low the internal GRCLOK-1500 control unit sweeps the Xtal frequency in order to find the Rb absorption dip.

- **DC-Voltage of the photocell.**
EE: DC-Voltage of the photocell (5V to 0 for \$FF to \$00)

This signal corresponds to the transmitted Rb light level. This is the light of the Rb lamp which is partly absorbed by the Rb cell. The nominal photocell voltage is in the range 2.0 to 3.5 V but must stay stable after the warm-up time. The photocell voltage is related to the internal reference 5 V voltage. The full scale corresponds to the coded value \$00 and the zero (no light) corresponds to the coded value \$FF

- **Frequency adjustment voltage.**
DD: VCXO control voltage (0 to 5V for \$00 to \$FF)

This parameter corresponds to the voltage applied to the varicap of the internal VCXO.

In normal operation this voltage is mainly temperature dependent in the range 2 to 3V in order to compensate the frequency versus temperature characteristic of the crystal resonator.

During warm-up the control unit generates a ramp of this parameter from 0.3 to 5V and from 5V to 0.3V until the Rb dip absorption is found.

- **Rb lamp heating limiting current.**
CC: Rb lamp heating limiting current (Imax to 0 for \$00 to \$FF)

This parameter corresponds to heating limiting current applied to the lamp heating resistive element. In normal operation, this current depends on the ambient temperature but should stay between \$1A and \$E6. During warm-up, this current is set to its maximal value \$00 (no current limiting).

- **Rb cell heating limiting current.**
BB: Rb cell heating limiting current (Imax to 0 for \$00 to \$FF)

This parameter corresponds to heating limiting current applied to the cell heating resistive element. In normal operation, this current depends on the ambient temperature but should stay between \$1A and \$E6. During warm-up, this current is set to its maximal value \$00 (no current limiting).

- **Reserved**
AA:

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 $5.12 \cdot 10^{-13}$, where xxxx is a signed 16 bits.

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

- In track state, the user frequency correction is changed internally by the software for optimum alignment.
- The basic command FCsdddd do the same. See chapter 4.7.

Note :

* 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).

Examples:

C0000<CR>: return to the nominal value (factory setting)
C7FFF<CR>: the actual frequency is increased of 16.7 ppb. 10'000'000.000 Hz become 10'000'000.167 Hz.
C8000<CR>: the actual frequency is decreased of 16.7 ppb. 10'000'000.000 Hz become 9'999'999.833 Hz.

READING BACK TUNING PARAMETERS IN RAM OR EEPROM

It is possible to read back some internal parameters.

Rxx <CR>[<LF>]: read value at RAM position xx, in ASCII / HEX coded.

Response : **YY <CR>[<LF>]** Where YY is a byte, in ASCII coded hexadecimal.

Lxx <CR>[<LF>]: load value at EEPROM position xx, in ASCII / HEX coded.

Response : **YY <CR>[<LF>]** Where YY is a byte, in ASCII coded hexadecimal.

Parameters location can vary, depending on hardware and software version. This 2 commands are maintained for compatibility with former versions.

6.3 BASIC 2 CHARACTERS COMMANDS

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.

6.4 Timing & Locking Control Functions shortlist

| Command Name | Syntax Command | Data field (if any) | Response Syntax | Response data (if any) |
|---|--------------------|---|----------------------------|--|
| Identification | ID<CR><LF> | - | SPTLNR-aaa/rr/s.ss<CR><LF> | aaa: 001. rr: revision number s.ss: software version |
| Serial Number | SN<CR><LF> | - | xxxxxx<CR><LF> | xxxxxx : 6 digits serial nbr |
| Status | ST<CR><LF> | - | s<CR><LF> | s: Status s=0: warming up or no light s=1: tracking set-up s=2: track to PPSREF s=3: synch to PPSREF s=4: Free Run. Track OFF s=5: FR. PPSREF unstable s=6: FR. No PPSREF s=7: FREEZE s=8: factory used s=9: searching Rb line |
| Beat a message on the serial port once per second. Except BT8, BT9. | BTx<CR><LF> | x=0 : Stop beat x=1 : Effective Time interval PPSOUT vs PPSREF x=2 : Phase comparator x=3 : Both x=1 & x=2 x=4 : Beat Time of day x=5 : Beat status x=6 : Beat <CR><LF> x=7 : Beat Date, Time, Status x=8 : Spec. PPSREF tagging x=9 : Special GPS message x=A : Beat NMEA \$PTNTA, x=B : Beat NMEA \$PTNTS,B, x=R : Beat NMEA \$GPRMC,... x=Z : Beat NMEA \$GPZDA,... | | |
| View PPSRef Sigma | VS<CR><LF> | | ddd.d<CR><LF> | ddd.d : Sigma of PPSRef in ns. In tracking, Status 2, 3. |
| View Time constant | VT<CR><LF> | | dddddd<CR><LF> | dddddd : Loop time constant now in use, in second. |
| Set Tracking PPSINT-PPSREF | TRx<CR><LF> | x=0 : set tracking state : OFF x=1 : set tracking state : ON x=? : interrogation | x<CR><LF> | x= tracking state x=0: set tracking state : OFF x=1: set tracking state : ON |
| Set Synch PPSOUT-PPSINT | SYx<CR><LF> | x=0 : set synch. state : OFF x=1 : set synch. state : ON x=? : interrogation | x<CR><LF> | x=synchronization state x=0 : set synch. state : OFF x=1 : set synch. state : ON |
| Set no Alarm Window | AWddd<CR><LF> * | ddd = Half no Alarm Window in μ s. From 1 to 255 AW000 : no checking AW??? : interrogation | ddd<CR><LF> | ddd : half no Alarm Window in μ s. |
| Set Tracking Window (in μ s) | TWddd<CR><LF> * | ddd = half Tracking Window in μ s. From 001 to 255 TW000 : no checking TW??? : interrogation | ddd<CR><LF> | ddd : half Tracking Window in μ s. |
| Set tracking phase loop time constant | TCdddddd<CR><LF> * | dddddd = Time constant in seconds (000100 to 999999) TC000000 : change to auto. TC?????? : interrogation | dddddd<CR><LF> | dddddd : time constant in seconds |
| Set frequency save. Average value, when Status = 2, 3 | FSx<CR><LF> * | x=0 : save not evr. 24 hours x=1 : save hold. evr. 24 hours x=2 : save hold. Now x=3: save actual freq. now x=? : interrogation | x<CR><LF> | x=0 : save not evr. 24 hours x=1 : save holdover frequency every 24 hours |

| | | | | |
|--|-------------------------------|---|-------------------|---|
| Set fine phase comparator Offset | CO sddd<CR><LF> * | s : +/- sign ddd : limited with range + 127 / - 128 CO???? : interrogation | sddd<CR><LF> | s : +/- sign ddd : offset in approx 1 ns steps |
| Raw phase adjust | RA sddd<CR><LF> | s : +/- sign ddd : limited with range + 127 / - 128 | sddd <CR><LF> | s : +/- sign ddd : raw phase just asked in 66 ns steps |
| Set PPSOUT Pulse Width (rounded to 66ns) | PW ddddddddd<CR><LF> * | ddddddddd=pulse width (ns) Max : 999999933 PW000000000 : no pulse PW???????? : interrogation | ddddddddd<CR><LF> | ddddddddd=pulse width in ns |
| Set PPSOUT delay (rounded to 66ns) | DE ddddddddd<CR><LF> > | ddddddddd=delay in ns Max : 999999933 DE000000000 : synch. to PPSREF DE???????? : interrogation | ddddddddd<CR><LF> | ddddddddd= delay in ns |
| Set Pulse Per d second | PP dddeeee<CR><LF> * | ddd: 1 pulse every ddd second eee: offset to GPS epoch in second PP000000 : no pulse PP?????? : interrogation | dddeeee<CR><LF> | ddd second epoch in second |
| Date | DT <CR><LF> | | yyyy-mm-dd | yyyy : year mm : month dd : day |
| Set date | DT yyyy-mm-dd <CR><LF> | yyyy : year mm : month dd : day | yyyy-mm-dd | yyyy : year mm : month dd : day |
| Time of day | TD <CR><LF> | - | hh:mm:ss<CR><LF> | hh:hours mm:minutes ss:seconds |
| Set time of day | TD hh:mm:ss<CR><LF> | hh:Hours mm:Minutes ss:seconds | hh:mm:ss<CR><LF> | hh:hours mm:minutes ss:seconds |
| Set frequency correction | FC sdddd<CR><LF> * | s= +/- signe dddd = limited within range : +32767/-32768 FC?????? : interrogation | sdddd<CR><LF> | s : +/- signe dddd : frequency in 5.12 x 10 ⁻¹³ step |
| Set module adjust | MA vxx.<CR><LF> * | v : action verb xx: 00..FF: parameter number v=R : Read from ram v=W : Write to ram v=L : Load from eeprom v=S : Store to eeprom * v=F : Flash value v=B : Behavior at start v=A : Activate msg at start * v=C : Cancel msg at start * v=H : Help v=T : Type of data | | |
| FREEZE frequency | FREEZE x<CR><LF> | x= 1:freeze frequency x= 0:no | x<CR><LF> | x: 1:frequency frozen x: 0:no |
| Reset micro controller | RESET <CR><LF> | | | (Identification & welcome message, GPS binary) |

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

6.5 Timing & Locking Control Functions extended list

6.5.1 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. |

| | | |
|-------------------------------|---|------------------|
| ID<CR><LF> | Identification. | |
| Answer: | SPTLNR-001/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> | SPTLNR-001/00/3.10<CR><LF> | - |

| | | |
|-------------------------------|-----------------------------------|----------------------------|
| 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> | 000098<CR><LF> | - |

| | |
|-------------------------------|------------------------------|
| ST<CR><LF> | General Status. |
| Answer: | s<CR><LF> |
| | s: Status. |
| | 0: warming up or no light |
| | 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: searching Rb line |
| 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. |

| | |
|--------------------------------|--|
| 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. |
| | nnnnnnnnnn: | Residual in ns. Rounded to GRCLOCK-1500 : 66ns. |
| BT9<CR><LF> | Send GPS receiver message status as soon GPS messages are complete. | |
| 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 OB and OC](#).

Example

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

| | |
|-------------------------------|---|
| 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 $5.3 \cdot 10^{-9}$ |

| | |
|-------------------------------|---|
| VT<CR><LF> | view the time constant of the tracking loop just in use |
| Answer: | dddddd<CR><LF> |
| | dddddd: ddddddd: Time constant in s |
| Factory setting: | - |
| EEPROM modification : | No |
| Data in : | RAM |
| MAv access : | No |
| Reset value: | 001000 in automatic mode, set led time constant otherwise |

Example

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

6.5.2 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. |
| TCddddd | Set tracking loop time constant. |
| FSx | Set frequency saving. |
| COsddd | Set phase comparator Offset. |
| RASddd | Raw phase adjust. |

| | | |
|--------------------------------|---|----------------------------|
| 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: | 0 | |
| EEPROM modification : | No | |
| Data in : | RAM, EEPROM | |
| MAv access : | Yes | |
| Reset value: | Pin 15 potential Last value stored in EEPROM | |

Notes

- When the tracking state is ON, the tracking starts.
- When the device is heating, the tracking start is delayed.
- Every TR1 command induce a new tracking start.
- The tracking state can also be settled to ON by grounding the pin 15. TRO answering "1" means the pin 15 is grounded.
- The value stored in EEPROM can only be changed with the MAV system.

Example

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

| | | |
|--------------------------------|---|-------------------------|
| 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: | 0 | |
| EEPROM modification : | No | |
| Data in : | RAM, EEPROM | |
| MAv access: | Yes | |
| Reset value: | Pin 14 potential 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 sync. state can also be set to ON by grounding the pin 14. SY0 answering "1" means the pin 14 is grounded.
- 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. |

| | | |
|-----------------------------------|--|---|
| 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 μ s. From 001 to 255. |
| | 000: | no checking. |
| | ???: | interrogation. |
| Answer: | ddd<CR><LF> | |
| | ddd: | half no alarm window in μ s. From 001 to 255. |
| Factory setting: | 004 | |
| 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 and the pin 5 of the output connector is driven to high.
- A value of 000 means no checking. In such situation, an alarm is raised up in case of a calculation overflow (approx +/-500 μ s).

Example

| Command | Answer | Comment |
|-----------|-------------|---------|
| AW???<CR> | 004<CR><LF> | - |

| | | |
|-----------------------------------|--|---|
| 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 μ s. From 001 to 255. |
| | 000: | no checking. |
| | ???: | interrogation. |
| Answer: | ddd<CR><LF> | |
| | ddd: | half tracking window in μ s. From 001 to 255. |
| Factory setting: | 004 | |
| 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, and the pin 5 of the output connector is driven to high. The iSync goes in holdover and the frequency in use is an average value of former frequencies.
- A value of 000 means no checking. In such situation, the tracking is stopped in case of a calculation overflow (approx +/-500 μ s).

Example

| Command | Answer | Comment |
|-----------|-------------|---------|
| TW???<CR> | 004<CR><LF> | - |

| | | |
|-----------------------|--|----------------------------------|
| TCdddddd<CR><LF>* | | Set tracking loop time constant. |
| | dddddd: | time constant in seconds. |
| | 000000: | change to automatic mode. |
| | 000100: | minimum value, 100 s. |
| | 999999: | maximum value, 999999 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 1000 s and the maximum value is 30000 s.
- In automatic mode, if the time interval PPSREF vs PPSINT goes 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 |

| | | |
|---------------------------------|--|---|
| 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 GRCLOCK-1500 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 save every 24 hours. |

| | | |
|------------------------------------|--|---|
| 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. |

| | | |
|------------------------------------|----------------------------------|--------------------------------------|
| RA sddd<CR><LF> | raw phase adjust in 66 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 66 ns steps |
| Factory setting: | - | |
| Store in EEPROM: | no. | |
| MAv access: | no. | |
| Reset value: | - | |

Notes

- This command move 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 don'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 DE d d d d d d d d, as the delay is in fact referenced to PPSINT.

Example

| Command | Answer | Comment |
|------------|--------------|-----------------------------|
| RA+001<CR> | +001<CR><LF> | 66 ns ahead jump of PPSINT. |

6.5.3 PPSOUT COMMANDS

| | |
|-----------------------------|---------------------------------------|
| PWddddddddd | Set the PPSOUT pulse width. |
| DEddddddddd | PPSOUT delay. |
| PPddeeee | Set PPSOUT cadence and initial phase. |

| | | |
|---|--|--------------------------------------|
| PWddddddddd<CR><LF>* | Set the pulse width of PPSOUT. | |
| | ddddddddd: | Pulse width in ns, rounded to 66 ns. |
| | 000000000: | No PPSOUT. |
| | 000000066: | minimum pulse width |
| | 999999933: | maximum pulse width |
| | ?????????: | interrogation |
| Answer: | ddddddddd<CR><LF> | |
| | ddddddddd: | Pulse in ns, rounded to 66 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 |

| | | |
|--|---|-----------------------------------|
| 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 66 ns. |
| | 000000000: | sync. to PPSINT, the same as SY1. |
| | 000000066: | minimum delay. |
| | 999999933: | maximum delay. |
| | ?????????: | interrogation. |
| Answer: | ddddddddd<CR><LF> | |
| | ddddddddd: | Delay in ns, rounded to 66 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> | - |

| | | |
|--------------------------------------|---|---|
| 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 lifetime 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. |

6.5.4 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. |

| | |
|-------------------------------|---------------------------------------|
| 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> | - |

| | |
|---|---------------------------------------|
| 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> | - |

| | |
|-------------------------------|--|
| 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> | - |

| | |
|---------------------------------------|--|
| 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. |

6.5.5 SETTING COMMANDS

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

| | | |
|--------------------------------------|--|--|
| FCsddddd<CR><LF>* | set new frequency | |
| | sddddd: | new frequency in 5.12·10 ⁻¹³ step |
| | +00000: | back to factory setting |
| | +32767: | highest pull-up, +16.7 ppb |
| | -32768: | lowest pull-down, -16.7 ppb |
| | ??????: | interrogation |
| Answer: | sddddd<CR><LF> | |
| | sddddd: | frequency in use |
| Factory setting: | +00000 | |
| 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 : | 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. (Exept FC??????).

Example

| Command | Answer | Comment |
|--------------|----------------|---|
| FC+01000<CR> | +01000<CR><LF> | 10.000000000000MHz becomes 10.00000000512MHz. |

| | | |
|-------------------------------------|--|----------------------------------|
| MAvxx..<CR><LF>* | Module adjust. 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> | Read a flag related to parameter number xx. Behavior at power on /reset. For GDK-1. |
| Answer: | x<CR><LF> x=1 : activated, x=0 : cancelled |
| MAAxx<CR><LF>* | Active a flag related to parameter number xx. Behavior at power on /reset. For GDK-1. |
| Answer: | <CR><LF> |
| MACxx<CR><LF>* | Cancel a flag related to parameter number xx. Behavior at power on /reset. For GDK-1. |
| 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. |

6.5.6 OTHER COMMANDS

| | |
|--------------------------|-------------------|
| FREEZE x | Freeze frequency. |
| RESET | Hot Reset. |

| | | |
|-------------------------|---|------------------------------|
| FREEZE x<CR><LF> | GRCLOCK-1500 : Freeze DDS gear between 10MHz and Rb line. | |
| | 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> | - |

| | |
|----------------------------------|--|
| 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> | SPTGRCLOCK-1500-1/00/3.10<CR><LF> | - |

6.6 DEVICE STATUS

6.6.1 STATUS BROADCASTED BY MESSAGES

| | | |
|---|---------------------------|---|
| 0 | warming up or no light | The device was just powered on. |
| 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 | FREEZE | Frequency is frozen. |
| 8 | factory used | |
| 9 | searching Rb line | Scanning the frequency to find the Rb line. |

6.6.2 PIN #4 AND #5 STATUS LEVELS

| Status | Pin # 4 Xtal not locked to Rb line | Pin # 5 Track/Synch alarm | |
|----------------------------------|---------------------------------------|------------------------------|-------------------------|
| | Rb lock (open collector) | In Track Mode (TTL + 1K) | In Sync Mode (TTL + 1K) |
| s=0 : warming up or no light | Low (<.2 V / 5 mA) | High | High |
| s=1 : tracking set-up | High | High | High |
| s=2 : track to PPSREF | High | Low | High |
| s=3 : sync to PPSREF | High | High | Low |
| s=4 : Free Run. Track OFF. | High | High | High |
| s=5 : PPSREF unstable (holdover) | High | High | High |
| s=6 : No PPSREF(holdover) | High | High | High |
| s=7 : FREEZE | High | High | High |
| s=8 : factory used | High | High | High |
| s=9 : searching Rb line | Low (<.2 V / 5 mA) | High | High |

6.7 THE MAVxx.. SYSTEM

6.7.1 INTRODUCTION

In order to make the tuning easy, there is a computer interface oriented command, the MAVxx.. command.

- Managing parameters on a clear and easy way :
 - Reading, MARxx., and writing, MAWxx., parameters in ram (working parameters).
 - Loading, MALxx., and storing, MASxx., parameters in eeprom (non volatile memory).
 - Loading parameters in flash, MAFxx., (permanent memory).
- Loading the parameter localization and data type, MATxy :
 - x = 4, in ram
 - x = 2, in eeprom
 - x = 1, in flash

A combination is possible. Example : x = 7, in ram, in eeprom and in flash.

- y = 0, unsigned, 1 byte, also used for bit field
- 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
- 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
- For compatibility with former version, a flag in eeprom is associated with each parameter :
 - MABxx : load the flag
 - MAAXx : flag activated
 - MACxx : flag cancelled

The actual function of this flag is to transmit or not a message, data type y = 8,9, at power-on, Reset.

6.8 MAVxx.. PARAMETERS DESCRIPTION FOR THE GRCLOCK-1500

Numerical values are in hexa coded ascii.

6.8.1 Clock main parameters

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------------|-----|-------|-------|-----------|---------------------------|--------------------------------|
| 00 | - | - | x | ascii | SPTGRCLOCK-1500-1/00/3.10 | Factory welcome message |
| 01 | - | x | x | ascii | Free for user message | User welcome message |
| 02 | - | x | x | u 1byte | 05 | GPS configuration delay (s) |
| 03 | - | x | x | u 1byte | 03 | GPS configuration interval (s) |
| 04 | x | x | x | u 1byte | 0B | Timing / Frequency |
| 05 | x | x | x | u 1byte | 10 | Tracking |
| 06 | x | x | x | u 1byte | 02 | Tracking start |
| 07 | - | x | x | u 1byte | 01 | Communication control |
| 08 | - | x | x | u 1byte | 00 | Holdover. Don't touch. |
| 09 | - | x | x | u 1byte | 20 | Aging. Under dev. Don't touch. |
| 0A | - | x | x | u 1byte | 01 | Environment. |
| 0B | x | x | x | u 1byte | 00 | Messages at T=0ms, T=250ms |
| 0C | x | x | x | u 1byte | 00 | Messages at T=500ms, T=750ms |
| 0D | x | x | x | u 1byte | F0 | [A] validity life(hours). |
| 0E | x | x | x | u 1byte | 00 | Warmup in 32s time interval |
| 12 | x | x | x | u 4byte | 000186A0 | Pulse width. |
| 13 | x | x | x | u 1byte | 04 | Tracking window. |
| 14 | x | x | x | u 1byte | 04 | Alarm window. |
| 15 | x | x | x | u 4byte | 00000000 | Tracking loop time constant |
| 16 | x | x | x | s 1byte | 00 | Fine comparator offset |
| 17 | x | x | x | u 1byte | 01 | Pulse every d second |
| 18 | x | x | x | u 1byte | 00 | Pulse origin |
| 19 | x | x | x | u 2bytes | 7FFD | Frequency limit |

u: unsigned, s:signed

6.8.2 GPS main parameters

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------------|-----|-------|-------|-----------|----------------|--------------------------|
| 20 | x | x | x | u 1byte | 00 | GPS type |
| 21 | x | x | x | u 1byte | 00 | GPS language |
| 22 | x | x | x | u 1byte | 00 | GPS resource utilization |

| | | | | | | |
|--------------------|---|---|---|---------|----------|---------------------|
| 24 | x | x | x | s 4byte | 00000000 | GPS longitude |
| 25 | x | x | x | s 4byte | 00000000 | GPS latitude |
| 26 | x | x | x | s 4byte | 00000000 | GPS altitude |
| 27 | x | x | x | s 2byte | 0010 | Time GPS-UTC offset |

u: unsigned, s:signed

GPS GDK-1. Motorola OnCore legacy

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------------|-----|-------|-------|---------------|----------------|--------------------------------|
| 30 | | | x | String binary | -- | @En Time RAIM setup |
| 31 | | | x | String binary | -- | @At Position hold, site survey |

GPS GDK-1. Motorola M12 legacy

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------------|-----|-------|-------|---------------|----------------|------------------------------|
| 34 | | | x | String binary | -- | @Gd Position control message |
| 35 | | | x | String binary | -- | @Gc PPS control message |
| 36 | | | x | String binary | -- | @Ge Time RAIM algorithm |
| 37 | | | x | String binary | -- | @Gc Time RAIM alarm message |

GPS GDK-1. Zodiac binary

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------------|-----|-------|-------|---------------|----------------|---------------------|
| 38 | | | x | String binary | -- | Zodiac binary quiet |

GPS GDK-1. Novatel SSII

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------------|-----|-------|-------|---------------|----------------|-----------------------------|
| 3A | | | x | String binary | -- | Novatel SSII InitLink |
| 3B | | | x | String binary | -- | Novatel SSII set Rover |
| 3C | | | x | String binary | -- | Novatel SSII mask 5 deg. |
| 3D | | | x | String binary | -- | Novatel SSII set tim. para. |
| 3E | | | x | String binary | -- | Novatel SSII set survey 24h |

6.9 Factory welcome message

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|--------------------|-------------------------|
| 00 | - | - | x | ascii | SPTLNR-001/00/3.10 | Factory welcome message |

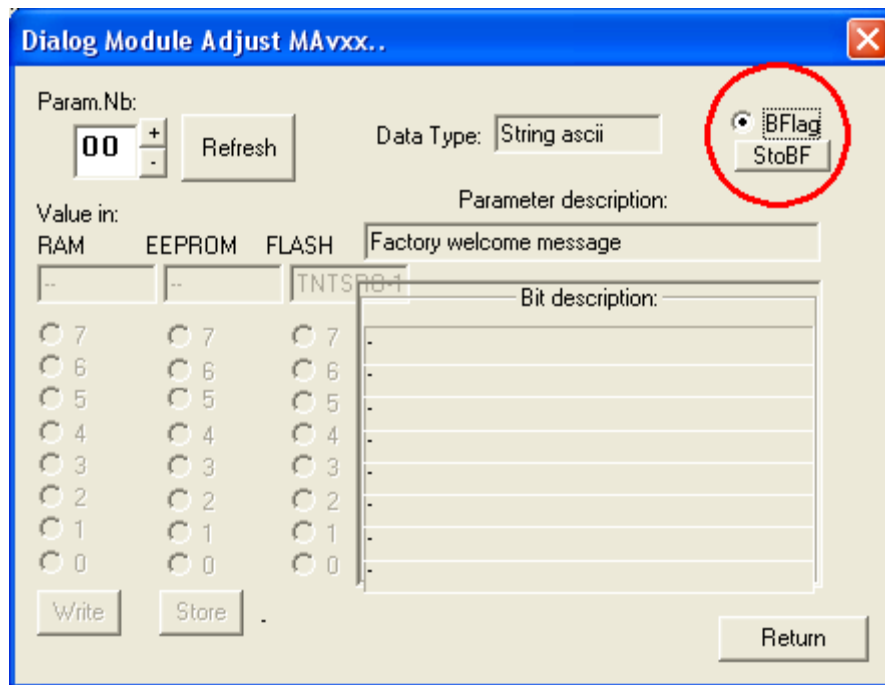
Message description

This message is transmitted on pin 18 (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:



6.10 User welcome message

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|-----------------------|----------------------|
| 01 | - | x | x | ascii | Free for user message | User welcome message |

Message description

This message is transmitted on pin 18 (TxD1) some delay after Power on /Reset.
As it is stored in eeprom, it can be modified.

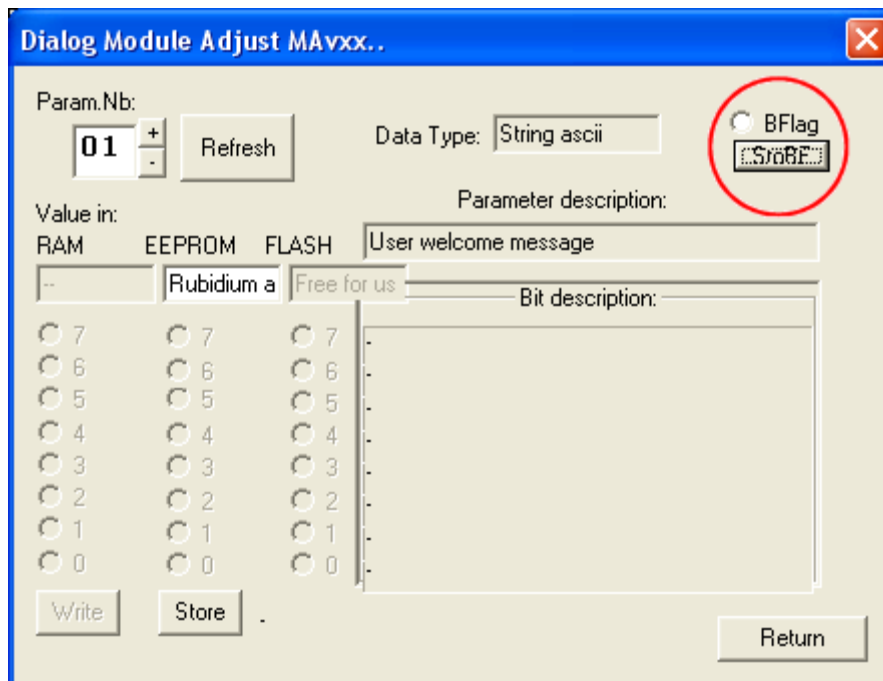
Message modification

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:



6.11 GPS configuration delay

Parameter description

| Parameter Nb | ram | eeeprom | flash | Data type | Value(default) | Help |
|--------------|-----|---------|-------|-----------|----------------|-----------------------------|
| 02 | - | x | x | u 1byte | 05 | GPS configuration delay (s) |

Description

This value is the delay in seconds before the first activated message is transmitted on pin 18 (TxD1) after Power on /Reset.

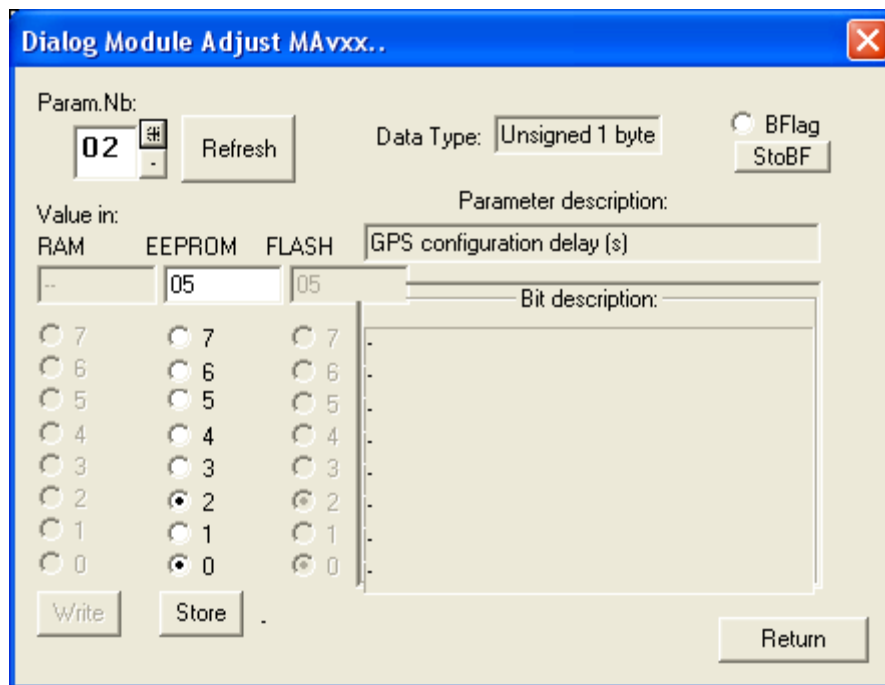
If activated, the messages are sent in following order : 0x00, 0x01, 0x30, etc..

As it is stored in eeprom, it can be modified.

GPS configuration delay modification

MAS020A<CR> put a delay of 10 seconds.

GPS configuration delay modification with the Monitoring program:



6.12 GPS configuration interval

Parameter description

| Parameter Nb | ram | eeeprom | flash | Data type | Value(default) | Help |
|--------------|-----|---------|-------|-----------|----------------|--------------------------------|
| 03 | - | x | x | u 1byte | 03 | GPS configuration interval (s) |

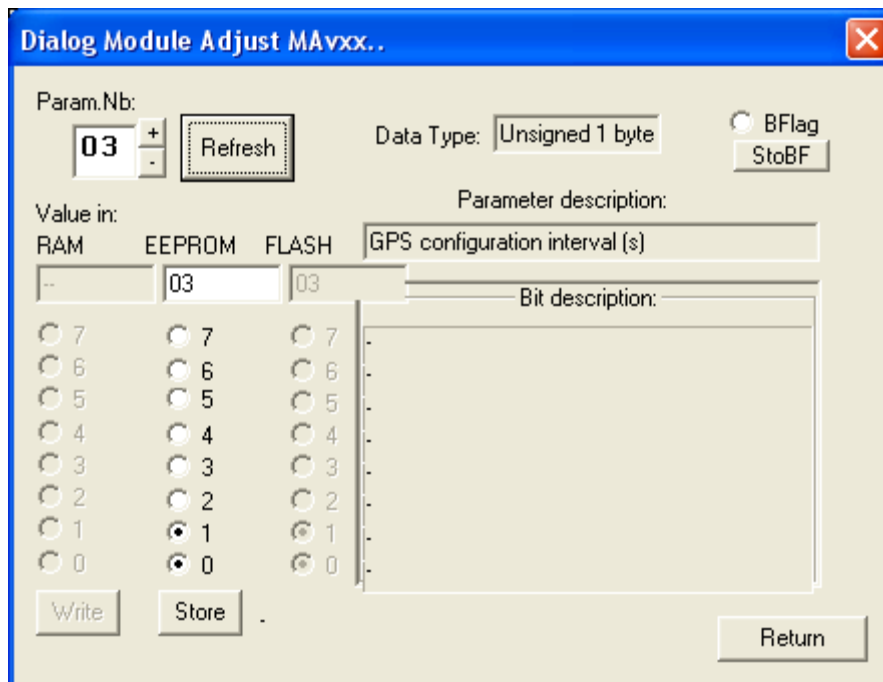
Description

This value is the interval in seconds between messages that are transmitted on pin 18 (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.

GPS configuration interval modification

MAS0305<CR> put an interval of 5 seconds.

GPS configuration interval modification with the Monitoring program :



6.13 Timing and frequency flags

Parameter description

| Parameter Nb | ram | eeprom | flash | Data type | Value(default) | Help |
|--------------|-----|--------|-------|-----------|----------------|--------------------|
| 04 | x | x | x | u 1byte | 0B | Timing / Frequency |

Bit description

| bit | State | Default value | Help | Comment |
|-----|--|---------------|--------------|------------------------------------|
| 3 | 1: thermal compensation active 0: no thermal compensation | 1 | Therm. comp. | Useful for noise reduction |
| 2 | 1: DDS value (GRCLOCK-1500) | 0 | Freeze | Useful for phase noise measurement |
| 1 | 1: PPSREF active 0: behave like no PPSREF | 1 | PPSREF | Useful for holdover simulation |
| 0 | 1: pin 20, PPSOUT active 0: pin 20, 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

6.13.1 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 [FREEZE](#)x.

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 PP0000000.

Changing timing and frequency flags with the Monitoring program :

Dialog Module Adjust MAVxx..

Param.No:

Data Type: ☐ BFlag

Value in: RAM EEPROM FLASH

Parameter description:

Bit description:

| Bit | RAM | EEPROM | FLASH | Description |
|-----|----------------------------------|----------------------------------|----------------------------------|--------------|
| 7 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 6 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 5 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 4 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 3 | <input checked="" type="radio"/> | <input checked="" type="radio"/> | <input checked="" type="radio"/> | Therm. comp. |
| 2 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Freeze |
| 1 | <input checked="" type="radio"/> | <input checked="" type="radio"/> | <input checked="" type="radio"/> | PPSREF |
| 0 | <input checked="" type="radio"/> | <input checked="" type="radio"/> | <input checked="" type="radio"/> | PPSOUT |

6.14 Tracking flags

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|----------|
| 05 | x | x | x | u 1byte | 10 | 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 19 |
| 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 :

The screenshot shows a software window titled "Dialog Module Adjust MAVxx..". It contains several input fields and buttons for configuring tracking parameters.

- Param.Nb:** A numeric input field set to "05", with "+" and "-" buttons and a "Refresh" button.
- Data Type:** A dropdown menu set to "Unsigned 1 byte".
- BFlag / StoBF:** Two radio buttons, with "StoBF" selected.
- Value in:** Three input fields for "RAM", "EEPROM", and "FLASH", all set to "10".
- Parameter description:** A text box containing the word "Tracking".
- Bit description:** A list of 8 bits (0-7) with radio buttons and descriptions:
 - Bit 7: -
 - Bit 6: -
 - Bit 5: 24h exp/true average
 - Bit 4: 24h save (selected)
 - Bit 3: Track NMEA
 - Bit 2: -
 - Bit 1: Sync
 - Bit 0: Track
- Buttons:** "Write", "Store", and "Return" buttons are located at the bottom.

6.15 Tracking start flags

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|----------------|
| 06 | x | x | x | u 1byte | 02 | Tracking start |

Bit description

| bit | State | Default value | Help | Comment |
|-----|---|---------------|------------------|--|
| 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 account immediately.

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

More information about some bit

bit 3, keep frequency

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

- During free run, with the command [FCsddd](#).
- 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 the frequency offset is larger than 5'328 e-12 for the GRCLOK-1500, Status=5 is issued.

Changing tracking start flags with the Monitoring program :

Dialog Module Adjust MAVxx..

Param.Nb:

Data Type: ☐ BFlag

Value in:

Parameter description:

Bit description:

| RAM | EEPROM | FLASH | Bit description: |
|------------------------------------|------------------------------------|------------------------------------|------------------|
| <input type="radio"/> 7 | <input type="radio"/> 7 | <input type="radio"/> 7 | - |
| <input type="radio"/> 6 | <input type="radio"/> 6 | <input type="radio"/> 6 | - |
| <input type="radio"/> 5 | <input type="radio"/> 5 | <input type="radio"/> 5 | - |
| <input type="radio"/> 4 | <input type="radio"/> 4 | <input type="radio"/> 4 | - |
| <input type="radio"/> 3 | <input type="radio"/> 3 | <input type="radio"/> 3 | Keep frequency |
| <input type="radio"/> 2 | <input type="radio"/> 2 | <input type="radio"/> 2 | Restart tracking |
| <input checked="" type="radio"/> 1 | <input checked="" type="radio"/> 1 | <input checked="" type="radio"/> 1 | Frequency align |
| <input type="radio"/> 0 | <input type="radio"/> 0 | <input type="radio"/> 0 | Frequency test |

6.16 Communication flags

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|-----------------------|
| 07 | - | x | x | u 1byte | 01 | 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 :

Dialog Module Adjust MAVxx..

Param.Nb: Data Type: ☐ BFlag

Value in: Parameter description:

Bit description:

| RAM | EEPROM | FLASH | Bit description: |
|-------------------------|------------------------------------|------------------------------------|------------------------|
| <input type="radio"/> 7 | <input type="radio"/> 7 | <input type="radio"/> 7 | . |
| <input type="radio"/> 6 | <input type="radio"/> 6 | <input type="radio"/> 6 | . |
| <input type="radio"/> 5 | <input type="radio"/> 5 | <input type="radio"/> 5 | . |
| <input type="radio"/> 4 | <input type="radio"/> 4 | <input type="radio"/> 4 | . |
| <input type="radio"/> 3 | <input type="radio"/> 3 | <input type="radio"/> 3 | . |
| <input type="radio"/> 2 | <input type="radio"/> 2 | <input type="radio"/> 2 | Normal/Transparent GPS |
| <input type="radio"/> 1 | <input type="radio"/> 1 | <input type="radio"/> 1 | XON/XOF |
| <input type="radio"/> 0 | <input checked="" type="radio"/> 0 | <input checked="" type="radio"/> 0 | ? by unknow command |

6.17 Holdover

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|------------------------|
| 08 | - | x | x | u 1byte | 00 | Holdover. Don't touch. |

Description

GRCLOCK-1500, sw 3.10 : under development, please don't touch.

6.18 Aging

Parameter description

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

Description

SRO, sw 3.10 : under development

6.19 Environment flag

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|--------------|
| 0A | - | x | x | u 1byte | 01 | Environment. |

Bit description

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

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

More information

- Only one bit should be selected.
- In case of multiple selection, only the lowest bit is taken account.
- **GRCLOCK-1500, sw 3.10** : In fact only 2 situations are taken account:
 - Bit1 or lower selected, GPS not in movement.
 - Bit2 or higher selected, GPS in move.

Changing environment flag with the Monitoring program :

Dialog Module Adjust MAVxx..

Param.Nb: Data Type: ☐ BFlag

Value in: RAM EEPROM FLASH Parameter description:

Bit description:

| | | | |
|-------------------------|------------------------------------|------------------------------------|------------------|
| <input type="radio"/> 7 | <input type="radio"/> 7 | <input type="radio"/> 7 | |
| <input type="radio"/> 6 | <input type="radio"/> 6 | <input type="radio"/> 6 | |
| <input type="radio"/> 5 | <input type="radio"/> 5 | <input type="radio"/> 5 | |
| <input type="radio"/> 4 | <input type="radio"/> 4 | <input type="radio"/> 4 | Boat |
| <input type="radio"/> 3 | <input type="radio"/> 3 | <input type="radio"/> 3 | Vehicle |
| <input type="radio"/> 2 | <input type="radio"/> 2 | <input type="radio"/> 2 | Submarine/diving |
| <input type="radio"/> 1 | <input type="radio"/> 1 | <input type="radio"/> 1 | Labs(frequency) |
| <input type="radio"/> 0 | <input checked="" type="radio"/> 0 | <input checked="" type="radio"/> 0 | Base station |

6.20 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: -

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.

6.21 Validity duration of the A / V flag, message \$GPRMC

Parameter description

| Parameter Nb | ram | eeprom | flash | Data type | Value(default) | Help |
|--------------|-----|--------|-------|-----------|------------------|---------------------------|
| OD | X | x | x | u 1byte | Rb:FO Crystal:18 | [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 go from 3 to 2.

Warm-up delay

Parameter description

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

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

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.

6.22 Pulse width

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|--------------|
| 12 | X | x | x | u 4byte | 000186A0 | Pulse width. |

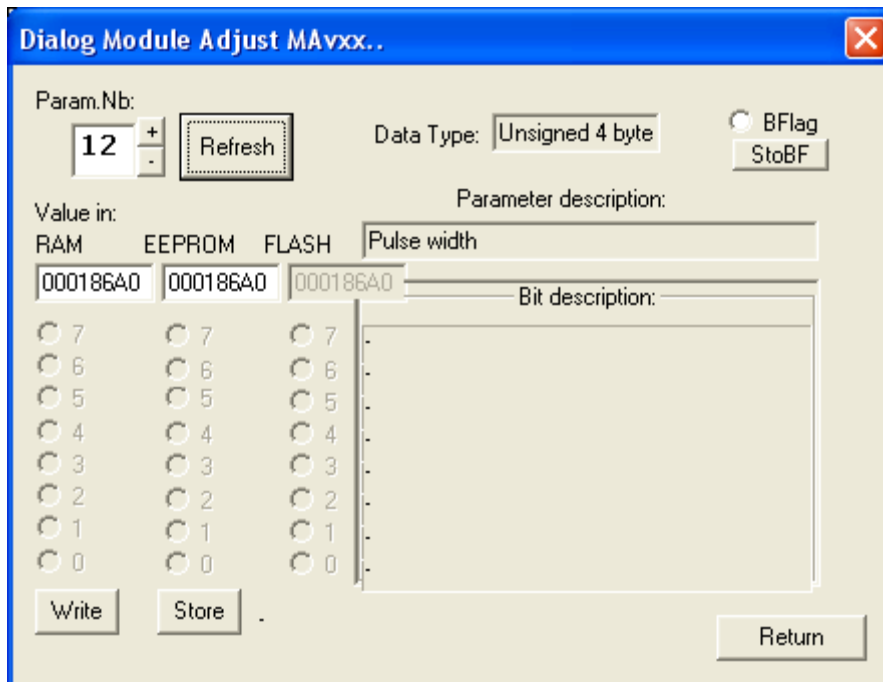
Changing the value in ram: the new parameter is taken account immediately.

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 66 ns for the GRCLOCK-1500.
- See also command [PWddddddddd](#).
- 0x000186A0 equal 100'000 ns.

Changing the pulse width with the Monitoring program :



6.23 Tracking window

Parameter description

| Parameter Nb | ram | eeeprom | flash | Data type | Value(default) | Help |
|--------------|-----|---------|-------|-----------|------------------|------------------|
| 13 | x | x | x | u 1byte | GRCLOCK-1500 : 4 | Tracking window. |

Changing the value in ram: the new parameter is taken account immediately.

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

More information

- Tracking window in use.
- In tracking, no error as long $|ppsint - ppsref| < \text{Tracking window}$.
- See also command [TWddd](#).

Changing the tracking window with the Monitoring program :

6.24 Alarm window

Parameter description

| Parameter Nb | ram | eeeprom | flash | Data type | Value(default) | Help |
|--------------|-----|---------|-------|-----------|-------------------|---------------|
| 14 | x | x | x | u 1byte | GRCLOCK-1500 : 04 | Alarm window. |

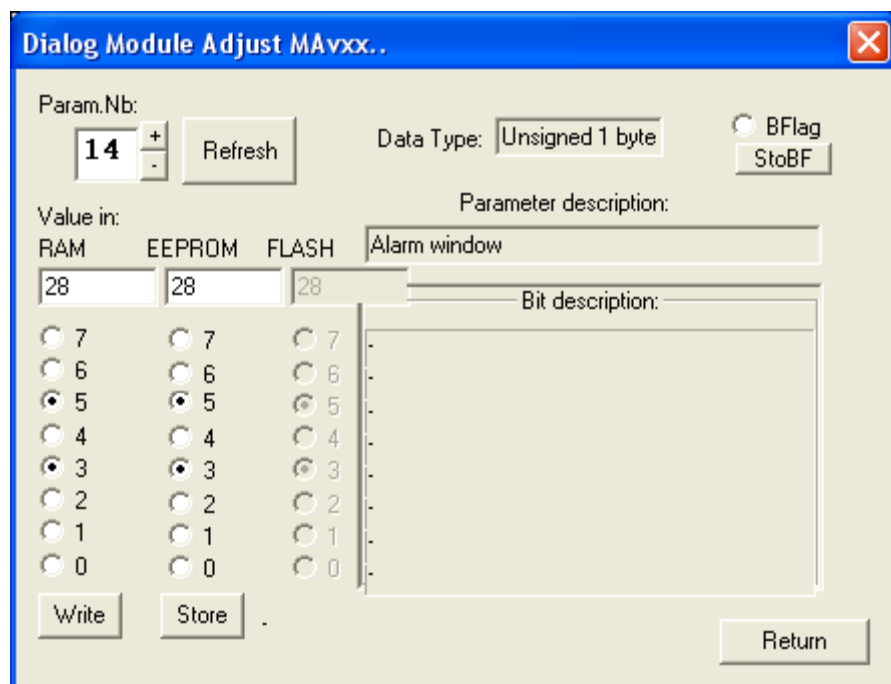
Changing the value in ram: the new parameter is taken account immediately.

Changing the value in eeeprom: 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 :



6.25 Tracking loop time constant

Parameter description

| Parameter Nb | ram | eeeprom | flash | Data type | Value(default) | Help |
|--------------|-----|---------|-------|-----------|----------------|-----------------------------|
| 15 | x | x | x | u 4byte | 00000000 | Tracking loop time constant |

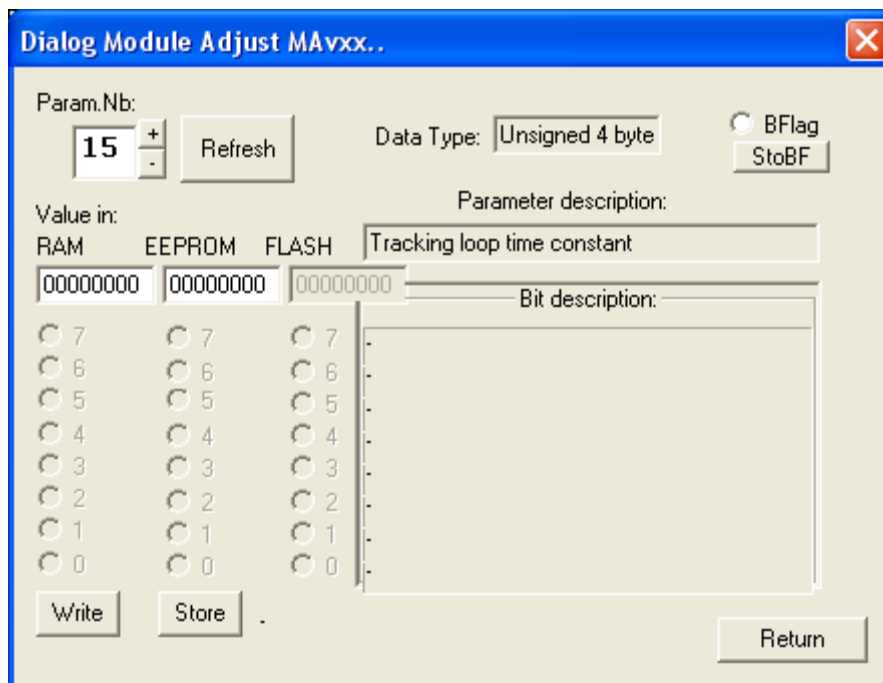
Changing the value in ram: the new parameter is taken account immediately.

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 GRCLK-1500, from 100 second to 999999 second.
- See also command [TCddddd](#).

Changing the tracking loop time constant with the Monitoring program :



6.26 Fine comparator offset

Parameter description

| Parameter Nb | ram | eeprom | flash | Data type | Value(default) | Help |
|--------------|-----|--------|-------|-----------|----------------|------------------------|
| 16 | x | x | x | s 1byte | 00 | Fine comparator offset |

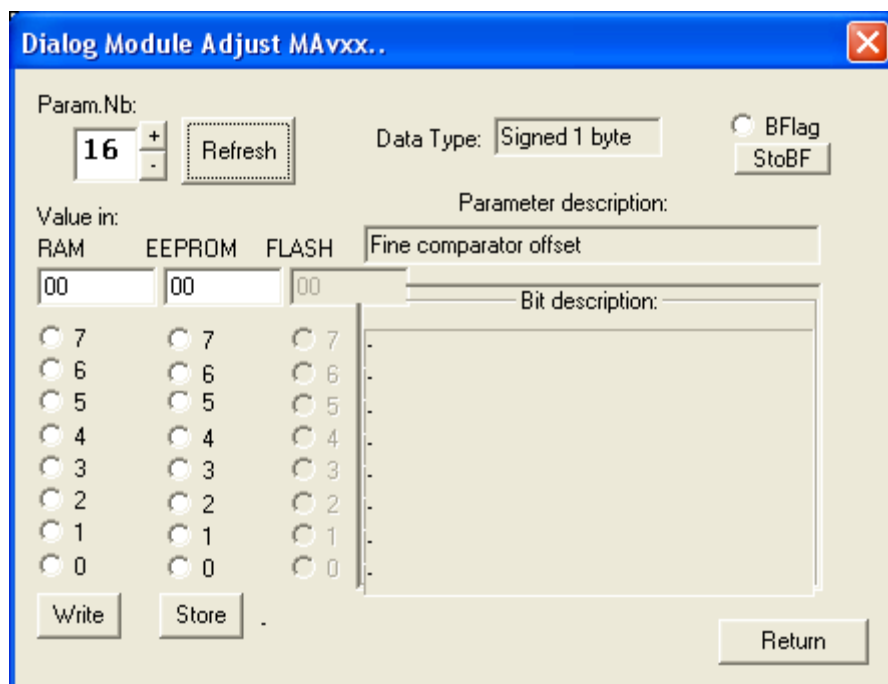
Changing the value in ram: the new parameter is taken account immediately.

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 :



Dialog Module Adjust MAVxx..

Param.Nb: 16 + - Refresh

Data Type: Signed 1 byte

☐ BFlag ☐ StoBF

Value in:

RAM EEPROM FLASH

00 00 00

Parameter description: Fine comparator offset

Bit description:

7 6 5 4 3 2 1 0

7 6 5 4 3 2 1 0

7 6 5 4 3 2 1 0

Write Store . Return

6.27 Pulse every d second

Parameter description

| Parameter Nb | ram | eeprom | flash | Data type | Value(default) | Help |
|--------------|-----|--------|-------|-----------|----------------|----------------------|
| 17 | x | x | x | u 1byte | 01 | Pulse every d second |

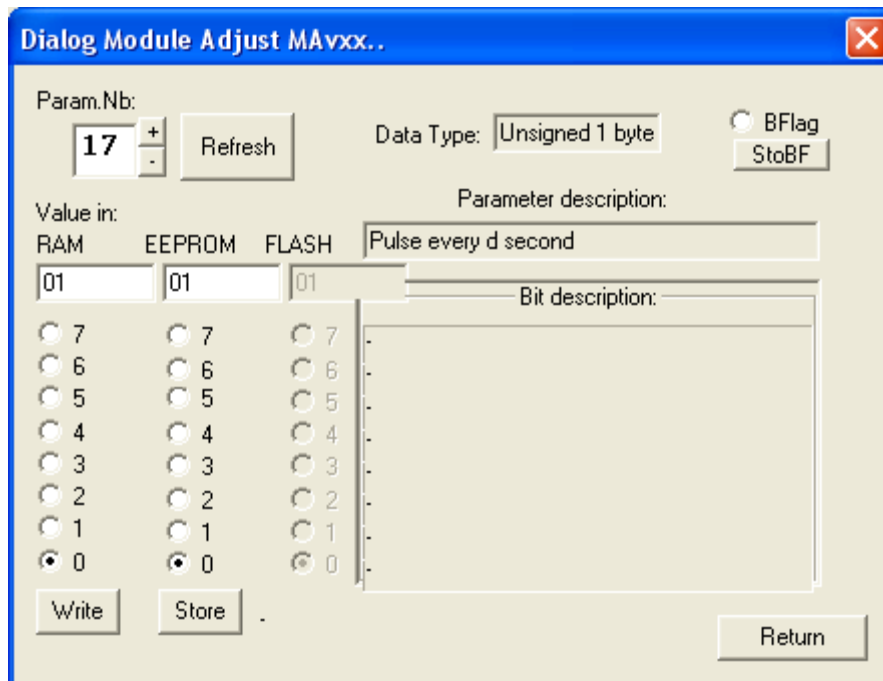
Changing the value in ram: the new parameter is taken account immediately.

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 :



Dialog Module Adjust MAVxx..

Param.Nb: 17 Refresh Data Type: Unsigned 1 byte BFlag StoBF

Value in: RAM 01 EEPROM 01 FLASH 01 Parameter description: Pulse every d second

Bit description:

Write Store Return

6.28 Pulse origin

Parameter description

| Parameter Nb | ram | eeprom | flash | Data type | Value(default) | Help |
|--------------|-----|--------|-------|-----------|----------------|--------------|
| 18 | x | x | x | u 1byte | 00 | Pulse origin |

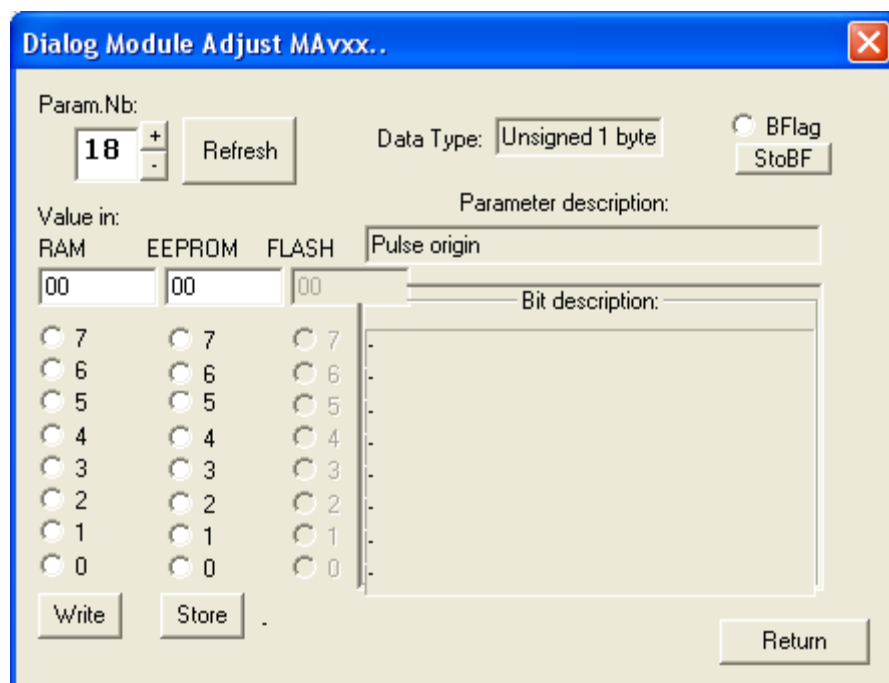
Changing the value in ram: the new parameter is taken account immediately.

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 :



Dialog Module Adjust MAVxx..

Param.Nb: 18 Refresh Data Type: Unsigned 1 byte BFlag StoBF

Value in: RAM EEPROM FLASH Parameter description: Pulse origin

00 00 00 Bit description:

Write Store Return

6.29 Frequency limit

Parameter description

| Parameter Nb | ram | eeprom | flash | Data type | Value(default) | Help |
|--------------|-----|--------|-------|-----------|----------------|-----------------|
| 19 | x | x | x | u 2byte | 7FFD | 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 :

The screenshot shows a software window titled "Dialog Module Adjust MAVxx..". It contains the following elements:

- Param.Nb:** A text box containing "19" with "+" and "-" buttons and a "Refresh" button.
- Data Type:** A text box containing "Unsigned 2 byte".
- BFlag:** A radio button labeled "BFlag" and a button labeled "StoBF".
- Value in:** Three tabs labeled "RAM", "EEPROM", and "FLASH", each with a text box containing "7FFD".
- Parameter description:** A text box containing "Frequency limit".
- Bit description:** A large empty text box.
- Buttons:** "Write", "Store", and "Return" buttons at the bottom.

6.30 GPS type

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|----------|
| 20 | x | x | x | u 1byte | 00 | GPS type |

Description

GRCLOK-1500, sw 3.10 : the software don't take account this parameter.

6.31 GPS language selection

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|--------------|
| 21 | x | x | x | u 1byte | 00 | GPS language |

Possible values

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

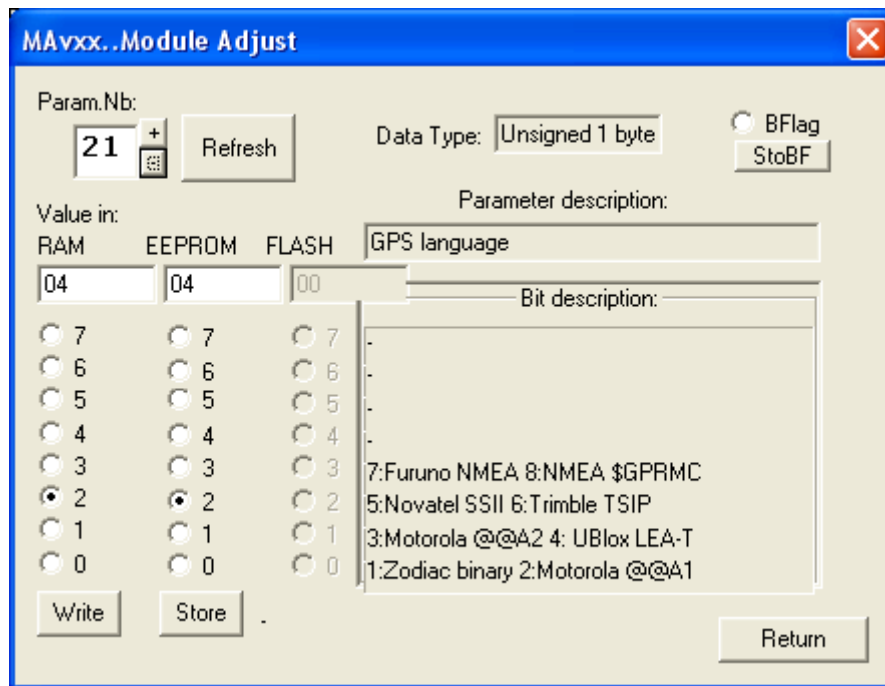
Changing the value in eeprom: the new parameter is taken account after power on / reset.

More information

- **Situation in October 2012, sw 3.10** : It is recommended to work with 2 languages:
 - 04 UBX LEA-xT.
 - 08 NMEA \$GPRMC.

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

Changing GPS language with the Monitoring program:



The screenshot shows the 'MAVxx..Module Adjust' dialog box. The 'Param.Nb:' field is set to 21, and the 'Data Type' is 'Unsigned 1 byte'. The 'Value in:' section shows 'RAM' selected with a value of 04, 'EEPROM' with a value of 04, and 'FLASH' with a value of 00. The 'Parameter description:' field is 'GPS language'. The 'Bit description:' section lists the following options:

- 7: Furuno NMEA 8: NMEA \$GPRMC
- 5: Novatel SSII 6: Trimble TSIP
- 3: Motorola @@A2 4: UBlox LEA-T
- 1: Zodiac binary 2: Motorola @@A1

The 'Write' and 'Store' buttons are visible at the bottom left, and the 'Return' button is at the bottom right.

6.32 GPS resource utilization

Parameter description

| Parameter Nb | ram | eeeprom | flash | Data type | Value(default) | Help |
|--------------|-----|---------|-------|-----------|----------------|--------------------------|
| 22 | x | x | x | u 1byte | 00 | 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.

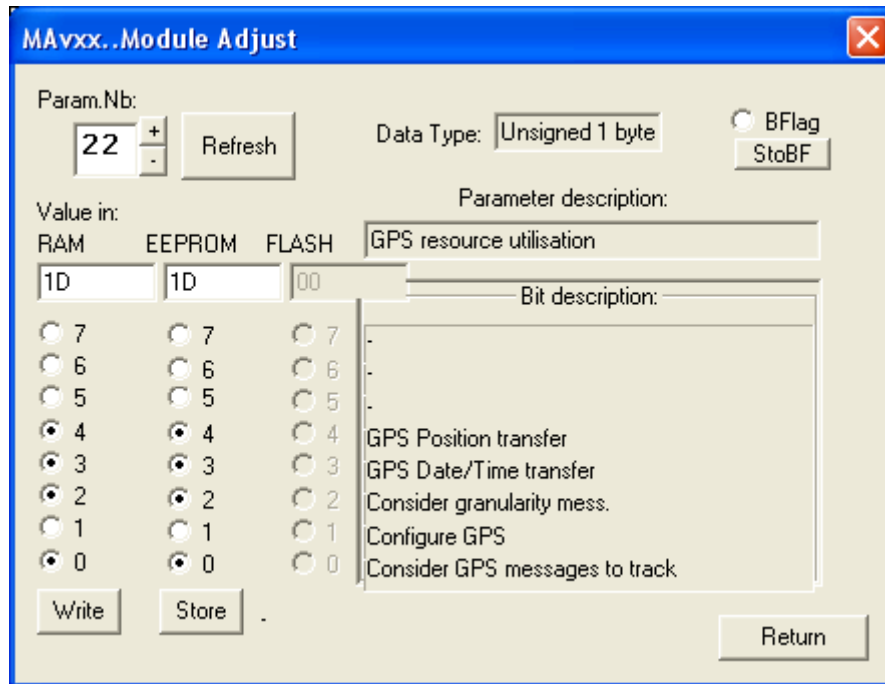
Changing the value in eeprom: the new parameter is taken account after power on / reset.

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:



The screenshot shows the 'MAVxx..Module Adjust' dialog box. The 'Param.Nb' is set to 22. The 'Data Type' is 'Unsigned 1 byte'. The 'Value in:' section shows 'RAM' as 1D, 'EEPROM' as 1D, and 'FLASH' as 00. The 'Parameter description' is 'GPS resource utilisation'. The 'Bit description' section shows a list of bits with their descriptions:

| Bit | Description |
|-----|--------------------------------|
| 7 | |
| 6 | |
| 5 | |
| 4 | GPS Position transfer |
| 3 | GPS Date/Time transfer |
| 2 | Consider granularity mess. |
| 1 | Configure GPS |
| 0 | Consider GPS messages to track |

Buttons at the bottom include 'Write', 'Store', and 'Return'.

6.33 GPS longitude

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|---------------|
| 24 | x | x | x | s 4byte | 00000000 | GPS longitude |

Description

Units : tbd (e-7deg)

GRCLOK-1500, sw 3.10 : nothings is done with this parameter.

6.34 GPS latitude

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|--------------|
| 25 | x | x | x | s 4byte | 00000000 | GPS latitude |

Description

Units : tbd (e-7deg)

SRO, sw 3.10 : nothings is done with this parameter.

6.35 GPS altitude

Parameter description

| Parameter Nb | ram | eprom | flash | Data type | Value(default) | Help |
|--------------|-----|-------|-------|-----------|----------------|--------------|
| 26 | x | x | x | s 4byte | 00000000 | GPS altitude |

Description

Units : tbd (mm)

SRO, sw 3.10 : nothings is done with this parameter.

6.36 GPS GDK-1 configuration message

Parameter description

Each message is related to a GPS type.

Note : This GPS messages are only useful in GDK-1 configuration. This configuration is not recommended for new developments.

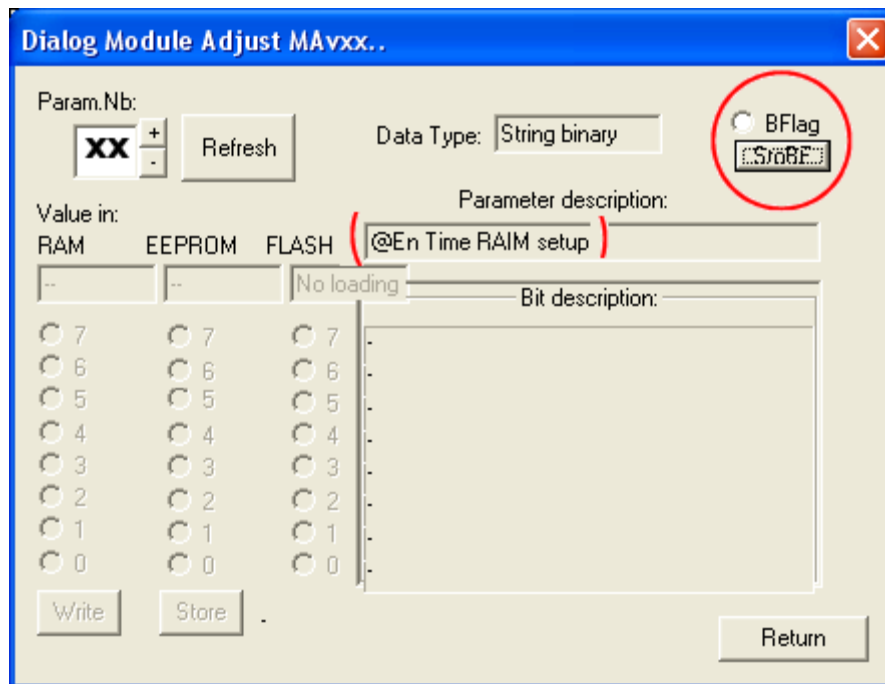
Message description

This message is sent on pin 18 (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 : [MABxx](#)<CR> Answer : 0 : cancelled; 1 : activated
- To cancel the message : [MACxx](#)<CR>
- To activate the message : [MAAxx](#)<CR>

Changing the message behavior with the Monitoring program :



6.37 SERIAL COMMUNICATION INTERFACE 2

6.37.1 INTRODUCTION

The device has a second serial port to communicate on a transparent way with a GPS receiver. Important information like GPS time and position can be transmitted. The GPS receiver is also monitored and a PPSREF tracking can be stopped in case of dysfunction.

6.37.2 SERIAL 2 INTERFACE CONNECTION

Following parameters are standard :

bit rate : 9600 bits/s

parity : none

start bit : 1

data bits : 8

stop bit : 1

output "mark" voltage : 5 V

output "space" voltage : 0 V

input "mark" voltage : 2.5 to 5 V (CMOS)

input "space" voltage : 0 to 2.5 V (CMOS)

- Depending on GPS receiver type, this parameters may be changed internally.
- The serial interface port of almost GPS receivers accept this voltage level directly.

6.38 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.

6.38.1 Conditions :

Communication port : Tx D1. Pin 18. Configuration : 9600,n,8,1

See [THE REFERENCE DESIGN FOR THE GRCLOCK-1500](#)

6.38.2 Messages activation :

For debugging, with the command BTx. Possibilities : [BTA](#), [BTB](#), [BTR](#), [BTZ](#).

Temporary or permanently after power-on / Reset, with MAV parameters [Ox0B and Ox0C](#).

6.38.3 Messages cancellation :

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

Messages activated with the MAV parameters Ox0B and Ox0C can be temporary cancelled with the commands MAWOBOO and MAWOC00. And permanently cancelled after power-on / Reset with the commands MASOB00 and MASOC00.

6.38.4 The NMEA messages list :

[\\$PTNTA](#)

[\\$PTNTS,B](#)

[\\$GPRMC](#)

[\\$GPZDA](#)

6.39 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, fresh.

*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.

6.40 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.

Example:

\$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 5.12e-13.

F688: holdover frequency, signed hexa, steps of 5.12e-13.

F644: eeprom frequency, signed hexa, steps of 5.12e-13.

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 *.

6.41 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 valid. If V: message is not valid.

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" is somewhat different. Exact meaning of the flag "A" : - The device was in tracking and the time/date was settled by a correct GPS timing message during the last 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.
- The time/date information are 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 are correct.

6.42 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.

Example:

\$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 *.

6.43 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 : Rx D1. Pin 19. Configuration : 9600,n,8,1

PPSREF : Pin 8.

See [THE REFERENCE DESIGN FOR THE GRCLOCK-1500](#)

Message : \$GPRMC,

See [Message \\$GPRMC](#)

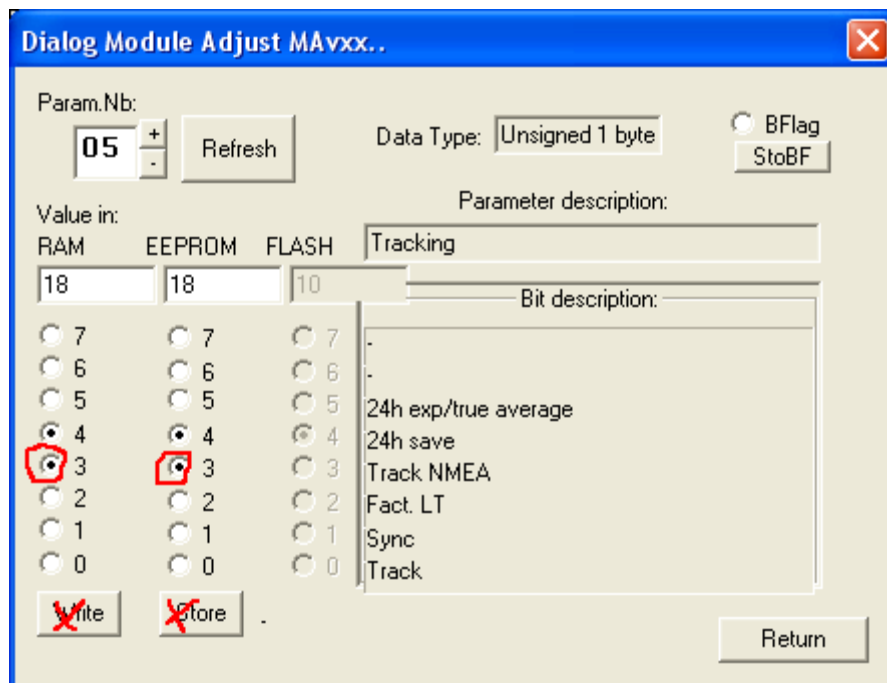
It is a pulse - message system. See [Time of Day Command Synchronization](#).

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 :



6.44 Special commands

This 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 to pin18:TxD1 and to pin16:/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 to pin18:TxD1 and to pin16:/TxD2 are not stopped. To stop them:

BT0, MAW0B00, MAW0C00 and MAW2100.

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

Use Cancellation of @@@@XOF command.

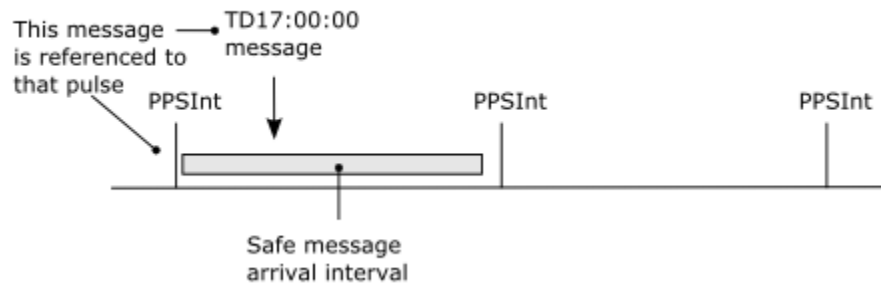
6.45 Time of Day Command Synchronization

Important

Rb GRCLK-1500 sw 3.10 : has a different behavior than former sw version.
(Crystal SXO sw 2.10 : has a different behavior than former sw version.)

There is now a pulse - message system.

- 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.
- Rem.: with **SY1** ppsint and ppsout are aligned.



7. System I/O Interfaces

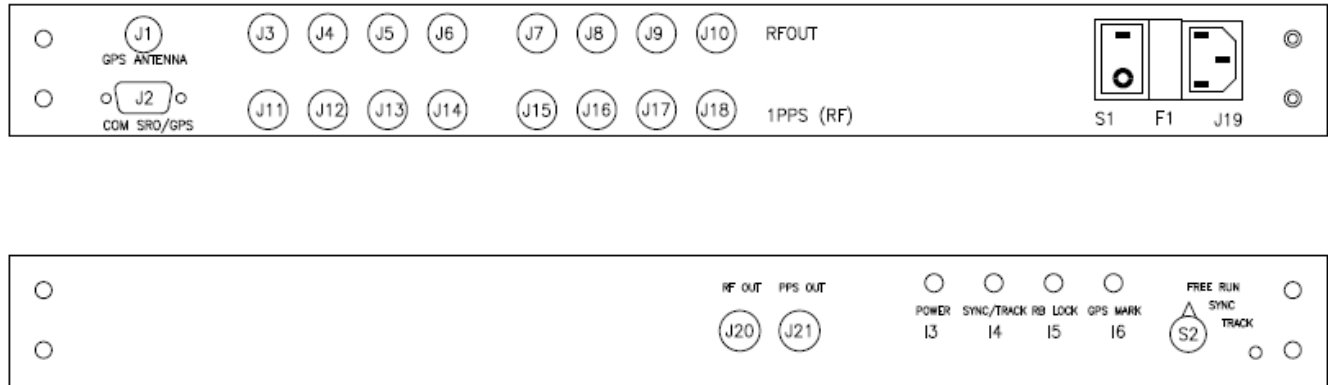


Figure 9 - RbSource-1500 / GNSSource-2500 Interfaces

7.1 Back plate

| N° | Type | Definition | I/O |
|---------|----------|---|-----|
| J1 | SMA | GPS antenna connection for GNSSource-2500 (1PPS in for RbSource-1500) | I |
| J2 | SUB-D9-F | Serial communication RS232 | I/O |
| J3-J10 | SMA | 8x 10MHz sine reference outputs | O |
| J11-J18 | SMA | 8x 1PPS outputs (8x 10 MHz sine reference outputs with option code 8RF) | O |
| J19 | IEC PLUG | Power connection | I |
| S1 | SWITCH | On/Off switch | - |
| F1 | FUSE | Primary Power Supply Fuse T3.15A | - |

7.2 Face plate

| N° | Type | Definition | I/O |
|-----|-----------|--|-----|
| J20 | BNC | 10MHz sine reference output | O |
| J21 | BNC | 1PPS output | O |
| I3 | Green LED | Power indicator | - |
| I4 | Green LED | Sync or Track mode enabled | - |
| I5 | Red LED | Rubidium clock locked alarm | - |
| I6 | Green LED | 1PPS GPS applied | - |
| S2 | SWITCH | Free run, Sync or track selection switch | - |

See the separate RbSource-1500 / GNSSource-2500 datasheet for characteristic of the outputs.

8. System GPS Antenna Kit

A GPS patch antenna with 5 meters (16.4') of cable is included in the normal package. This antenna can be installed close to a window. If installed in a region susceptible to lightning, a surge arrestor must be installed. For the installation, please refer to our GNSSource-2500 user manual, section "Safe GPS Antenna installation".

8.1 Optional Rooftop GPS Antenna

The kits contain the following items:

Ordering code: RA :

- a roof antenna
- a lightning arrestor

Ordering code: CA :

- a cable of 15 meter (49')
- a cable of 5 meter (16.4')

8.2 Custom GPS Antenna

The customer can install another antenna. In such case, the antenna connector of the device supplies 5V/30 mA for the amplifier. Please note that the device is CE tested only for an antenna cable less than 30 meters (98').

For the installation, please refer to our AN "Custom GPS Antenna Installation".

9. Safe GPS Antenna Installation

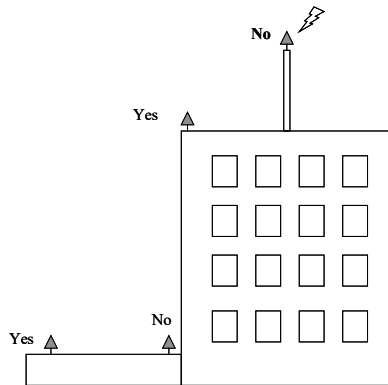
Below is described where and how to install safely a GPS antenna.

Where to install the GPS Antenna

The antenna must be located on a place with a direct view to the sky.

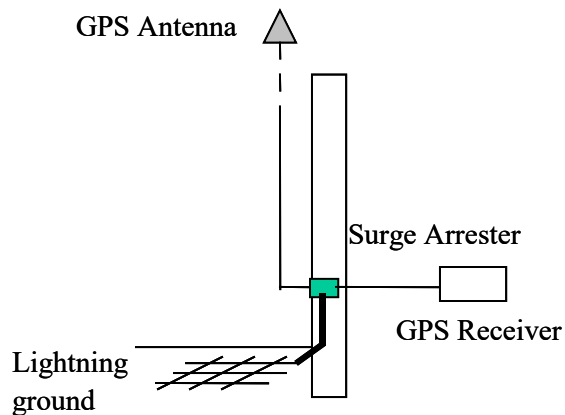
Usually the best place is on the roof with no important masks due to other buildings for instance.

However ,to avoid lightning, it is important that the antenna is not the highest point in the surroundings.



Lightning protection

A lightning surge arrester must be installed at the entrance of the building. It must be grounded to a lightning ground, that is separated to the instrument ground. Please ask for your local regulation about this question. The surge arrester will not protect the GPS receiver against high voltage destruction, it is for human safety.



10. GLOSSARY

Adobe Acrobat Reader A software program that enables people to read and print files saved in the PDF format.

Allan Deviation Square root of Allan Variance: It indicates the typical deviation from one measurement to the next.

DDS Direct Digital Synthesizer

DUT Device Under Test

FSMS Frequency Stability Measurement System

IF Intermediate Frequency

BP Band Pass filter

LP Low Pass filter

GRCllok-1500 Synchronized Rubidium Oscillator

XTAL Quartz crystal

.PDF Portable Document Format, file extension to be used by Adobe Acrobat Reader

- End of document -