Navigation & Multimedia System & Architecture
STA8088 Firmware Configuration

1 Introduction

The STA8088 binary image supports the firmware configuration facility. It allows changing some application parameters in order to address most of the specific HW constraints and/or the final product functionality requirements.

The firmware configuration management supports the “Factory Setting”, embedded in the binary code, and the “Customized Setting”, stored in the GNSS backup memory (NVM). The “Factory Setting” can be changed directly on the binary image file using the FWConfig.exe tool before flashing (or upgrading) the device’s flash memory. The “Customized Setting” can be made and saved at run-time using specific NMEA commands (See the “Command Interface” sections for details).

Purpose of this document is to provide details about each supported parameter including procedures for changing and saving the firmware configuration.

The ST8088 Binary Image software is released with the ST defined default setting (Factory Setting). It is recommended to check if the default setting of all parameters is in line with the final product requirement. ST default setting may be changed on different releases.

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3.1 Revision History

Rev	Date	Author	Notes
1.0	06/02/2012	Andrea Di Girolamo	First revision.
1.1	06/04/2012	Giovanni De Angelis	Added USB related CDB-IDs
1.2	06/04/2012	Andrea Di Girolamo	Added new parameters for multiple NMEA message list settings.

Table 1: Revision history

3.2 Acronyms

Keyword	Definition
DGPS	Differential GPS (it is the RTCM SC-104)
GLONASS	GLObal NAvigation Satellite System (The Russian GNSS)
GNSS	Global Navigation Satellite System – It can include any combination of different satellite constellations like GPS, GLONASS, SBAS etc.
GPS	Global Positioning System (The US GNSS)
NVM	Non Volatile Memory (In the contest of this document it is referred to the GNSS backup memory)
PPS	Pulse Per Second
RTC	Real Time Clock
SBAS	Satellite Based Augmentation System
QZSS	Quasi-Zenith Satellite System
DTE	Data Terminal Equipment

Table 2. Acronyms

4 Configuration Data Block (CDB)

All configuration parameters are grouped in a data block. Each field is addressed by a unique ID. The IDs are made by three digits: the most significant one represent the parameter type and the others are used to identify different parameters of the same type.

The table below includes all parameters which can be changed to apply a different configuration to the STA8088 firmware.

The IDs not reported in the table should be considered as reserved and must be left untouched to avoid unexpected system behaviors.

ID	Parameter Name	Size Bytes	Allowed values	Default	Description
100	Debug Port Number	1	0 .. 2	0	Set debug port number
101	NMEA Port Number	1	0 .. 2	2	Set NMEA port number
102	NMEA Port Baudrate	1	0x0 = 300 baud 0x1 = 600 baud 0x2 = 1200 baud 0x3 = 2400 baud 0x4 = 4800 baud 0x5 = 9600 baud 0x6 = 14400 baud 0x7 = 19200 baud 0x8 = 38400 baud 0x9 = 57600 baud 0xA = 115200 baud 0xB = 230400 baud 0xC = 460800 baud 0xD = 921600 baud	0xA	Set NMEA Baudrate
103	GPS Debug Mode	1	0 = Debug Mode ON 1 = Debug Mode OFF	0	Debug Mode ON/OFF
104	GNSS Mask Angle	1	0 …. 45	0	Set the GNSS Mask Angle for low Satellite Elevation
105	GNSS Tracking Threshold [dB]	1	10..50	10	Set the satellites tracking threshold
120	Cold Start Type	1	0xF = clear Almanach,Ephem,Time &Position 0xE = clear Ephemeris, Time, Position	0xE	Set the cold start type with selective data erase
121	NMEA GSV Rate	1	0 …. 255	1	Set Message Rate in seconds
124	NMEA and Debug Output Redirection	1	0x11 = NMEA and Debug over UART 0x21 = NMEA over USB and Debug over UART 0x12 = NMEA over UART and Debug over USB 0x44 = NMEA and Debug over SD card	0x11	Configure the output method for NMEA and Debug messages (over UART, USB or SD card)
125	Notch Filter Setting	1	0x0..0xF	0x0	Enable or disable the Notch Filter usage
126	HW CONFIG	1	0..1	1	Select the HW configuration: 0: SOC 1: SAL
127	NMEA Decimal Digits	1	First nibble: 0x1..0x8 Second nibble: 0x1..0x8	0x55	Allow setting the number of decimal digits for the position data in the NMEA messages.

128	Differential Source Type	1	0..3	0x3	Allow selecting the differential mode source type.
129	GLONASS Satellite ID Type	1	0..1	0x1	Allow setting the GLONASS satellite ID type used in the GSV and GSA messages. 0x0 – the satellite ID is based on frequency 0x1 – the satellite ID is based on slot number.
130	CPU clock speed	1	0x00, 0x10, 0x20, 0x30, 0x02	0x02	Allow setting the CPU clock source and speed.
131	NMEA Talker ID	1	'P', 'L', 'N'	'P'	Allow setting the second character of the NMEA talker ID.
135	SBAS Default PRN	1	120 ... 138	124	Set the SBAS default PRN
138	RTCM Port Number	1	0 .. 2	0	Set the serial port number for the RTCM input.
139	RTCM Port Baud rate	1	0x0 = 300 baud 0x1 = 600 baud 0x2 = 1200 baud 0x3 = 2400 baud 0x4 = 4800 baud 0x5 = 9600 baud 0x6 = 14400 baud 0x7 = 19200 baud 0x8 = 38400 baud 0x9 = 57600 baud 0xA = 115200 baud 0xB = 230400 baud 0xC = 460800 baud 0xD = 921600 baud	0xA	Set the baudrate for the RTCM input serial port.
From 140 To 188 Even IDs	RF front-end address register and operation	1	b0..b5 = address (from 0 to 24) b6..b7= operation (00b or 01b or 10b)	0xFF = Don't Touch	Set the address and the operation to be performed on the corresponding RF front end register. The address is reported in the first 6 bits. The operation is reported in the last 2 bits. Any address from 0 to 24 is allowed. Supported operations are: b6..b7 = 00b : overwrite register with provided value b6..b7 = 01b: Perform OR operation between register and provided value b6..b7 = 11b: Perform AND operation between register and provided value. Provided value is the value reported in the next parameter (e.g. 140 reports the address and operation for the value reported on 141) NOTE: using 0xFF for this parameter means don't touch the front-end register. If the front-end registers configuration is not needed, all parameters from 140 to 188 (even IDs) should be set to 0xFF. This is the default value of standard ST image.
From 141 To 189 Odd IDs	RF front-end data register value	1	Any RF front-end supported values (see front-end reference manual)	0xFF	The value to be applied to the front-end register pointed by the previous address and operation parameter (e.g. 141 reports the value to be applied to the address reported on 140)
190	NMEA Msg-List 0 output rate scaling factor.	1	1..255	1	Message list output rate scaling factor referred to the fix rate. Examples: 1 = message list is sent out at the selected fix-rate 2 = message list is sent out every 2 fixes N = message list is sent out every N fixes

191	NMEA Msg-List 1 output rate scaling factor.	1	1..255	1	Message list output rate scaling factor referred to the fix rate. Examples: 1 = message list is sent out at the selected fix-rate 2 = message list is sent out every 2 fixes N = message list is sent out every N fixes
192	NMEA Msg-List 2 output rate scaling factor.	1	1..255	1	Message list output rate scaling factor referred to the fix rate. Examples: 1 = message list is sent out at the selected fix-rate 2 = message list is sent out every 2 fixes N = message list is sent out every N fixes
193	USB Detect feature	1	0..1	0	Enable or disable the USB detect feature
194	USB Detect GPIO pin configuration	1	b0..b5 = GPIO pin number (from 0 to 63) b6..b7= GPIO Alternate Function configuration (00b or 01b or 10b or 11b)	0	Configure GPIO pin used for USB detect feature
195	USB Data Terminal Equipment feature	1	0..1	1	Enable or disable the USB Data Terminal Equipment feature
200	Application ON/OFF	4	0x2 = GPS_2D_FIX_ENABLE 0x4 = SBAS_ENABLE 0x8 = SBAS_SAT_ON_GSV_MSG_ENABLE 0x200 = CONFIG_TXT_HEADER_EN. 0x400 = ST_HEADERS_ENABLE 0x800 = RTCM_ENABLE 0x1000 = FDE_ENABLE 0x4000 = WALKING_MODE_ENABLE 0x8000 = STOP_DETECTION_ENABLE 0x10000 = GPS_ENABLE 0x20000 = GLONASS_ENABLE 0x40000 = QZSS_ENABLE 0x80000 = NMEA_GNGSV_ENABLE 0x100000 = NMEA_GNGSA_ENABLE 0x200000 = GLONASS_USE_ENABLE 0x400000 = GPS_USE_ENABLE 0x800000 = QZSS_USE_ENABLE 0x1000000 = PPS_ENABLE 0x2000000 = PPS_POLARITY_INVERSION 0x4000000 = POSITION_HOLD_ENABLE	0x1639604	Activates/Deactivates GNSS application features
201	NMEA Port Msg-List 0	4	0x0000.0000 to 0xFFFF.FFFF	0x884356	Set NMEA Message List 0
202	NCO Range max.	4	-132000 to 132000	0xFFFF6F78 (-37000)	Set NCO range max. value in Hz
203	NCO Range min.	4	-132000 to 132000	0xFFFF2158 (-57000)	Set NCO range min. value in Hz
204	NCO Center	4	-132000 to 132000	0xFFFF4868 (-47000)	Set NCO centre frequency Offset in Hz
205	Position Data Time Delay [ms]	4	0..(fix rate time period)	0	Set the time delay between the measurements (on UTC second) and the position data delivery. "0" means auto configured according to the CPU speed setting: 50 ms when CPU @ 208MHz 500 ms when CPU @ 52MHz
206	GPIO Port0 CFG0	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFFFFFF	Config0 for GPIO Port0
207	GPIO Port0 CFG1	4	0x0000.0000 to 0xFFFF.FFFF	0x00000000	Config1 for GPIO Port0

208	GPIO Port1 CFG0	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFFFFFF	Config0 for GPIO Port1
209	GPIO Port1 CFG1	4	0x0000.0000 to 0xFFFF.FFFF	0x00000000	Config1 for GPIO Port1
210	NMEA Port Msg-List 1	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA Message List 1
211	NMEA Port Msg-List 2	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA Message List 2
301	PPS Pulse Duration	8	<= 1.0 seconds	0.5	PPS pulse width. It is the time distance (in seconds) from PPS rising edge and next PPS falling edge.
302	PPS Delay Correction	8	< 1.0 seconds	716E-7	PPS time delay correction n seconds. It allows to compensate any delay introduced on PPS signal by RF chain.
303	GNSS Fix Rate	8	> 0.1 seconds	1.0	Set the GNSS fix rate period in seconds. NOTE: high fix rates may require a different setting (e.g. 208MHz) of the CPU speed.
304	Position Hold Latitude [deg]	8	From -90.0 to 90.0	40.91747	Set the position hold latitude.
305	Position Hold Longitude [deg]	8	From -180.0 to 180.0	14.27586	Set the position hold longitude.
306	Position Hold Altitude [m]	8	From -1500 to 100000	88.43307	Set the position hold altitude.
400	2D DOPs Threshold	4	P = 0..99,V = 0..99, H = 0..99,G=0..99	P=15,V=12, H=12,G=18	Set default DOP values for 2D fixes
401	3D DOPs Threshold	4	P = 0..99,V = 0..99, H = 0..99,G=0..99	P=15,V=12, H=12,G=18	Set default DOP values for 3D fixes
402	2D DOPs Startup	4	P = 0..99,V = 0..99, H = 0..99,G=0..99	P=15,V=12, H=12,G=18	Set startup DOP values for 2D fixes
403	3D DOPs Startup	4	P = 0..99,V = 0..99, H = 0..99,G=0..99	P=15,V=12, H=12,G=18	Set startup DOP values for 3D fixes
500	Text Message	88	ASCII Characters	Default Configuration	Define Text message to be sent at startup

4.1 CDB-ID 100 – Debug port setting

Allow setting the debug port number.

A system reboot is needed to have new setting in use.

4.2 CDB-ID 101 – NMEA port setting

Allow setting the NMEA port number.

A system reboot is needed to have new setting in use.

4.3 CDB-ID 102 – NMEA port baudrate setting

Allow setting the baudrate for the NMEA port number. The translation table is reported below.

Parameter Value	Baudrate
0x0	300 baud
0x1	600 baud
0x2	1200 baud
0x3	2400 baud
0x4	4800 baud
0x5	9600 baud
0x 6	14400 baud
0x 7	19200 baud
0x 8	38400 baud
0x 9	57600 baud
0xA	115200 baud
0xB	230400 baud
0xC	460800 baud
0xD	921600 baud

A system reboot is needed to have new setting in use.

4.4 CDB-ID 103 – Debug mode setting

Allow enabling/disabling the GNSS debug messages.

A system reboot is needed to have new setting in use.

4.5 CDB-ID 104 – Mask angle setting

Allow setting the minimum elevation angle at which a satellite can be tracked. Satellite with elevation below the mask angle cannot be tracked.

A system reboot is needed to have new setting in use.

4.6 CDB-ID 105 – GNSS Tracking threshold

Allow setting the minimum CN0 [dB] at which a satellite can be tracked. Satellite with CN0 below the configured threshold cannot be tracked.

A GNSS engine reset (suspend/restart) is needed to have this setting in place.

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4.7 CDB-ID 120 – Cold start setting

Allow setting the data to be cleared during the COLD start command execution. This parameter is a bitmask where bit=1 indicates the data to be cleared.

Bit	Bitmask	Description
0	0x1	Clear almanacs
1	0x2	Clear ephemeris
2	0x4	Clear position
3	0x8	Clear time

Any bitmask combination can be used, the default one is 0xE.

This setting is in place as soon as the $PSTMSETPAR is performed.

4.8 CDB-ID 121 – NMEA GSV message rate

Allow setting the time period at which the GVS message is sent on the NMEA port.

A GNSS engine reset (suspend/restart) is needed to have this setting in place.

4.9 CDB-ID 124 – NMEA and Debug Output Redirection

Allow setting the output channel for NMEA and Debug messages. Supported channels are UART, USB and SD card. UART is the default channel. If the SD card is selected for NMEA and Debug output but the SD card is not present in the slot, the system switch automatically to the UART mode. NMEA and Debug output cannot be redirected to USB together.

This parameter is made by two bit masks (4 bits each one):

Bit	Bitmask	Description
From B0 to B3	0x01=enable/disable UART output 0x02=enable/disable USB output 0x04=enable/disable SD output	Bit mask for Debug output configuration (only one bit can be enabled at same time in the bitmask)
From B4 to B7	0x10=enable/disable UART output 0x20=enable/disable USB output 0x40=enable/disable SD output	Bit mask for NMEA output configuration (only one bit can be enabled at same time in the bitmask)

NOTE: If the USB is selected make sure that the PLL is enabled even if the CPU speed is set to 52MHz (see CDB-ID 130 for details on PLL enabling).

4.10 CDB-ID 125 – Notch Filter Setting

Allow setting the Notch filter usage on GPS RF path, GLONASS RF path or both GPS and GLONASS RF paths. The notch filter can be enabled and inserted in the RF path (normal mode – see b0, b1 below) or the notch filter can be enabled but inserted only if locked on a jammer (auto-insertion mode – see b2, b3 below).

Bitmask	Description
b0..b3 = 0x00	Notch Filter is disabled on both GPS and GLONASS paths
b0	Enable/disable notch filter on GPS path (normal mode).
b1	Enable/disable notch filter on GLONASS path (normal mode).
b2	Enable/disable notch filter on GPS path in auto-insertion mode.
b3	Enable/disable notch filter on GLONASS path in auto-insertion mode.

4.11 CDB-ID 126 – HW Config

Allow setting the HW configuration (SOC=0 or SAL=1). It is currently used for PPS signal configuration.

4.12 CDB-ID 127 – Number of decimal digits in NMEA position messages

Allow setting the number of decimal digits for the NMEA position messages.

It is possible to set a different number of decimal digits for GGA and for both RMC and GLL messages.

Bit	Values	Description
From B0 to B3	From 1 up to 5	Allow setting the number of decimal digits for the RMC and GLL massages
From B4 to B7	From 1 up to 5	Allow setting the number of decimal digits for the GGA massage.

4.13 CDB-ID 128 – Differential Source Type

Allow selecting the differential mode source type.

Value	Description
0x0 - NONE	No differential source.
0x1 - SBAS	SBAS is the source for differential correction.
0x2 - RTCM	RTCM is the source for differential corrections.
0x3 - AUTO	RTCM (if available) or SBAS (if available) is the source for differential corrections.

4.14 CDB-ID 129 – GLONASS Satellite ID Type

Allow selecting between two different ways to report the GLONASS satellites ID in the GSV and GSA messages.

Value	Description
0x0	GLONASS satellite ID based on the satellite frequency. If lowest frequency is marked with freq_ID = 1 and highest frequency is marked with freq_ID = 14, the satellite IDs are reported, starting from lowest frequency as 64+freq_ID. Satellites from 79 up to 92 are the antipodal of satellites from 65 up to 78 (they are received at the same frequency).

0x1	GLONASS satellite ID based on the satellite slot (reported in almanacs and ephemeris data). The satellite IDs are reported as 64+slot_number. The slot number is in the range from 1 up to 24.

4.15 CDB-ID 130 – CPU clock speed

Allow setting the CPU clock speed. By default the GNSS software starts with CPU clock at 52MHz, it is then configured during the system startup phase according to the configuration parameters.

Bit	Values	Description
From B0 to B3	0 = PLL is ON and it is the clock source. 2 = PLL is OFF. The clock source is the input frequency (26MHz) multiplied by 2.	Allow setting the CPU clock source
From B4 to B7	If PLL is ON: 0 = 52MHz 1 = 104MHz 2 = 156MHz 3 = 208MHz	Allow setting the CPU clock speed. If PLL is OFF the clock speed is set to 52MHz.

4.16 CDB-ID 131 – NMEA Talker ID

Allow setting the second character of the NMEA talker ID for the GGA, RMC, VTG, GLL NMEA sentences. The talked ID for GSV and GSA is managed in a different way (see CDB-ID 200, bits 19 and 20).

4.17 CDB-ID 135 – SBAS default PRN

Allow setting the default PRN for the SBAS library.

A system reboot is needed to have new setting in use.

4.18 CDB-ID 138 – RTCM port setting

Allow setting the RTCM port number.

NOTE: Pay attention to avoid conflicts with other serial ports used for debug and NMEA. The RTCM port can be shared with the debug data (debug data is only output and RTCM is only input) but not with the NMEA.

A system reboot is needed to have new setting in use.

4.19 CDB-ID 139 – RTCM port baudrate setting

Allow setting the baudrate for the RTCM port number. The translation table is reported below.

Parameter Value	Baudrate
0x0	300 baud
0x1	600 baud
0x2	1200 baud
0x3	2400 baud
0x4	4800 baud
0x5	9600 baud
0x 6	14400 baud
0x 7	19200 baud
0x 8	38400 baud
0x 9	57600 baud
0xA	115200 baud
0xB	230400 baud
0xC	460800 baud
0xD	921600 baud

A system reboot is needed to have new setting in use.

4.20 CDB-ID From 140 to 189 – GNSS RF Front-end configuration

Allow setting the GNSS RF front-end register. By default the front-end registers don't need to be configured. If a specific configuration is required (see RF front-end reference manual for details about registers) it can be achieved setting in the proper way the configuration parameters in the range from 140 to 189.

Even IDs (e.g. 140, 142, …, 188) are used to set the address at which the value (reported in the next odd ID parameter) is applied. Together with the address (first 6 bits of parameter) there is the operation to perform (last 2 bits).

Allowed addresses are from 0 to 24 (see front-end specs).

Supported operations are:

- 00b: overwrite the register with provided value.
- 01b: execute “OR” operation between register content and provided value.
- 10b: execute “AND” operation between register content and provided value.

Odd IDs (e.g. 141, 143, …, 189) are the value to be applied (according to the operation) to the address reported on previous even ID. For example the value in the parameter ID 141 is applied to the address in the parameter 140 etc.

Examples

Param 140=0x81 and Param 141=0x55: the front-end register at 0x1 address is updated with the result of bit-to-bit AND operation between the register content and 0x55 value.

Param 140=0x44 and Param 141=0x55: the front-end register at 0x4 address is updated with the result of bit-to-bit OR operation between the register content and 0x55 value.

Param 140=0x08 and Param 141=0x55: the front-end register at 0x8 address is overwritten with 0x55 value.

NOTE: 0xFF value in the address IDs is used to skip the parameter without apply any configuration to the front-end registers. The default setting in the ST binary image is all addresses parameters set to 0xFF.

4.21 CDB-ID 190 – NMEA Message list 0 output rate scaling factor.

Allow setting the message list output rate for the message list 0. It is a scaling factor referred to the selected fix rate. The default value is 1 and means that messages are sent out on every fix. Setting the scaling factor to “N” means that the corresponding message list is sent out every “N” fixes.

NOTE: The message list 0 is the standard message list. Only the message list 0 should be used if the NMEA multiple rate features is not required.

4.22 CDB-ID 191 - NMEA Message list 1 output rate scaling factor.

Allow setting the message list output rate for the message list 1. It is a scaling factor referred to the selected fix rate. The default value is 1 and means that messages are sent out on every fix. Setting the scaling factor to “N” means that the corresponding message list is sent out every “N” fixes.

4.23 CDB-ID 192 - NMEA Message list 2 output rate scaling factor.

Allow setting the message list output rate for the message list 2. It is a scaling factor referred to the selected fix rate. The default value is 1 and means that messages are sent out on every fix. Setting the scaling factor to “N” means that the corresponding message list is sent out every “N” fixes.

NOTE: The message list 2 is reserved for those messages which need to be sent at high rate (e.g. 10Hz) and/or require accurate message output timing (low jitter). If high rate messages or low jitter are not required, this message list should not be used.

4.24 CDB-ID 193 - USB Detect feature

Enable or disable the USB detect feature. When enabled the USB VCOM is open only if detect pin is high. Look at next CDB to see how to configure detect GPIO pin.

4.25 CDB-ID 194 - USB Detect GPIO pin configuration

Allow setting of USB detect GPIO pin.

Bit	Values	Description
From B0 to B5	From 0 to 63	GPIO pin number
From B6 to B7	0 = Default mode 1 = Alternate function mode A 2 = Alternate function mode B 3 = Alternate function mode C	GPIO pin alternate mode configuration

4.26 CDB-ID 195 - USB Data Terminal Equipment feature

Enable or disable the USB Data Terminal Equipment feature. When enabled, the data (NMEA or Debug depending on CDB-ID 124 configuration) are sent over USB VCOM only when DTE is present. This signal corresponds to RS-232 signal DTR. When this feature is enabled, the host must open the VCOM enabling DTR mode.

4.27 CDB-ID 200 - Application ON/OFF

Allow enabling/disabling different features in the GNSS library.

For each bit:

- 0 means feature disabled;
- 1 means feature enabled.

Bit[1]	Bitmask	Function
1	0x2	2D position fix (with large position shift algorithm)

[1] The Bit-Value indicates the bit position (starting from 0 as least significant bit), thus multiple choices are possible.

2	0x4	SBAS (WAAS / EGNOS) augmentation system
3	0x8	Enabling SBAS satellite reporting in the GSV messages
9	0x200	Send “config text” in the “Header Message” at start up
10	0x400	Send standard ST NMEA Headers
11	0x800	RTCM enable
12	0x1000	FDE Algorithm
14	0x4000	Walking Mode Algorithm
15	0x8000	Stop Detection Algorithm
16	0x10000	GPS constellation enable
17	0x20000	GLONASS constellation enable
18	0x40000	QZSS constellation enable
19	0x80000	NMEA GNGSV enable
20	0x100000	NMEA GNGSA enable
21	0x200000	GLONAS usage for positioning enable
22	0x400000	GPS usage for positioning enable
23	0x800000	QZSS usage for positioning enable
24	0x1000000	PPS enabling
25	0x2000000	PPS polarity inversion
26	0x4000000	Position Hold enable

4.27.1 Bit 1 – 2D position fix algorithm

Enable/disable the 2D fix algorithm. When this bit is enabled large position shift for 2D fix position are allowed in cold start conditions. This feature is OFF by default.

4.27.2 Bit 2 – SBAS (WAAS / EGNOS) augmentation system

Enable/disable the SBAS engine. When this bit is enabled, the SBAS engine starts searching for SBAS satellites at system startup.

4.27.3 Bit 3 – Enabling SBAS satellite reporting in the GSV messages

If enabled the SBAS satellite is reported in the GSV messages. The SBAS satellite ID, reported in the GSV messages, is in the range from 33 to 51 according to the NMEA specifications.

4.27.4 Bit 9 – Send Configured Text

Enable/disable sending the configured text on the NMEA port at startup.

4.27.5 Bit 10 – Send ST headers

Enable/disable sending the ST standard headers on the NMEA port at startup.

4.27.6 Bit 11 – RTCM enable

Enable/disable the RTCM data processing.

4.27.7 Bit 12 – FDE algorithm

Enable/disable the False Detection and Exclusion algorithm.

4.27.8 Bit 14 – Walking Mode algorithm

Enable/disable the Walking Mode algorithm.

4.27.9 Bit 15 – Stop Detection algorithm

Enable/disable the Stop Detection algorithm.

4.27.10 Bit 16 – GPS constellation

Enable/disable the GPS constellation. When this bit is enabled GPS satellites are enabled to be tracked and used for positioning.

This bit setting affect also the talker ID of GSV and GSA NMEA messages. If only the GPS constellation is enabled the NMEA talker ID for GSV and GSA is “GP”. If GLONASS constellation is also enabled “GP” is used for GPS related GSV messages while “GN” is used for the GSA messages.

Note: When GPS and GLONASS constellation are enabled, the GSV messages are sent in two separate sets: one with “GP” as talker ID and one with “GL”.

4.27.11 Bit 17 – GLONASS constellation

Enable/disable the GLONASS constellation. When this bit is enabled GLONASS satellites are enabled to be tracked. To be used for positioning also the Bit 21 should be enabled.

This bit setting affect also the talker ID of GSV and GSA NMEA messages. If only the GLONASS constellation is enabled the NMEA talker ID for GSV and GSA is “GL”. If GPS constellation is also enabled “GL” is used for GLONASS related GSV messages while “GN” is used for the GSA messages

Note: When GPS and GLONASS constellation are enabled, the GSV messages are sent in two separate sets: one with “GP” as talker ID and one with “GL”.

4.27.12 Bit 18 – QZSS constellation

Enable/disable the QZSS constellation. When this bit is enabled QZSS satellites are enabled to be tracked and used for positioning.

Note: Only "GN" is supported as talker ID for QZSS GSV and GSA messages.

4.27.13 Bit 19 – NMEA GNGSV enable

Enable/disable the "GN" talker ID for GSV messages reporting satellite for all constellations. When this bit is enabled, only the talker ID "GN" is used for GSV messages.

Note: In this case the GSV messages are sent in a single set reporting satellites for all enabled constellations.

4.27.14 Bit 20 – NMEA GNGSA enable

Enable/disable the "GN" talker ID for GSA messages reporting satellite for all constellations. When this bit is enabled, only the talker ID "GN" is used for GSA messages.

Note: In this case the GSA messages are sent in a single set reporting satellites for all enabled constellations.

4.27.15 Bit 21 – GLONASS usage

Enable/disable the usage of GLONASS satellite for the GNSS position fix. If this bit is disabled and GLONASS constellation is enabled, the GLONASS satellites are only tracked.

4.27.16 Bit 22 – GPS usage

Enable/disable the usage of GPS satellite for the GNSS position fix. If this bit is disabled and GPS constellation is enabled, the GPS satellites are only tracked.

4.27.17 Bit 23 – QZSS usage

Enable/disable the usage of QZSS satellites for the GNSS position fix. If this bit is disabled and QZSS constellation is enabled, the QZSS satellites are only tracked.

4.27.18 Bit 24 – PPS enabling

Enable/disable the PPS generation on the PPS pin.

4.27.19 Bit 25 – PPS signal polarity inversion.

Enable/disable the PPS signal polarity inversion. If polarity inversion is disabled (Bit25 = 0) the PPS signal has the rising edge on the PPS event. If polarity inversion is enabled (Bit25 = 1) the PPS signal has a falling edge on the PPS event.

4.27.20 Bit 26 – Position Hold enabling

Enable/disable the Position Hold functionality (timing applications).

4.28 CDB-ID 201 – NMEA Message List 0

Allow enabling/disabling each NMEA message in the message list 0.

For each bit:

- 0 means feature disabled;
- 1 means feature enabled.

Bit[2]	Bitmask	Function
0	0x1	$GPGGA Message
1	0x2	$GPGGA5 Message
2	0x4	$GPGSA Message
3	0x8	Not used anymore
4	0x10	$GPVTG Message
5	0x20	Not used anymore
6	0x40	$GPRMC Message
7	0x80	$PSTMRF Message
8	0x100	$PSTMTG Message
9	0x200	$PSTMTS Message
10	0x400	$PSTMPA Message
11	0x800	$PSTMSAT Message
12	0x1000	$PSTMRES Message
13	0x2000	$PSTMTIM Message
14	0x4000	$PSTMWAAS Message
15	0x8000	$PSTMDIFF Message
16	0x10000	$PSTMCORR Message
17	0x20000	$PSTMSBAS Message
18	0x40000	$PSTMTESTRF Message

[2] The Bit-Value indicates the bit position, thus multiple choices are possible.

19	0x80000	$GPGSV Message
20	0x100000	$GPGLL Message
21	0x200000	Not used
22	0x400000	Not used
23	0x800000	$PSTMCPU Message
24	0x1000000	Not used
25	0x2000000	Not used
26	0x4000000	$PSTMPOSHOLD Message
27	0x8000000	$PSTMKFCOV Message
28	0x10000000	$PSTMAGPS Message
29	0x20000000	Not used
30	0x40000000	Not used
31	0x80000000	Not used

NOTE: The message list 0 is the standard message list. Only the message list 0 should be used if the NMEA multiple rate features is not required.

4.29 CDB-ID 202 – NCO range max value

Allow setting the upper limit for the NCO search range.

A system reboot is needed to have new setting in use.

4.30 CDB-ID 203 – NCO range min value

Allow setting the lower limit for the NCO search range.

A system reboot is needed to have new setting in use.

4.31 CDB-ID 204 – NCO centre value

Allow setting the NCO centre frequency.

A system reboot is needed to have new setting in use.

4.32 CDB-ID 205 – Position Data Time Delay

Allow setting the time delay [ms] between the measurements (on the UTC second) and the GNSS position data delivery. This parameter should be never bigger than the time period of the configured fix rate.

If “0” is used, the time delay is set in accordance with the CPU speed:

- 50ms if CPU is running @ 208MHz
- 500ms if CPU is running @ 52MHz

A system reboot is needed to have new setting in use.

4.33 CDB-ID From 206 to 209 – GPIO High/Low Status Setting

Allow setting the High/Low status for each GPIO.

Parameters 206 and 207 refer to the GPIO port 0; parameters 208 and 209 refer to GPIO port 1. Each parameter is a 32-bit mask representing the 32 pins of the GPIO port (bit 0 corresponds to PIN0 and bit31 corresponds to PIN31).

For each pin three configurations are possible: DO_NOT_TOUCH, SET_HIGH and SET_LOW. Each configuration is achieved setting in the proper way the bits corresponding to the same pin in the two configurations bit mask of the same port.

Port CFG0 Bit	Port CFG1 Bit	Description
0	0	SET_LOW: GPIO pin is configured as output and set to LOW state.
1	1	SET_HIGH: GPIO pin is configured as output and set to HIGH state.
0	1	DO_NOT_TOUCH: the pin is left unchanged
1	0	DO_NOT_TOUCH: the pin is left unchanged

Examples:

Param 206=0xFFFFFFFE and Param 207=0x08000000 GPIO Port0 pin 0 is set to LOW and GPIO Port0 pin 27 is set to HIGH. All other GPIO Port0 pins are left unchanged.

Param 208=0x7FFFFFFF and Param 209=0x00000004 GPIO Port1 pin 2 is set to HIGH and GPIO Port1 pin 31 is set to LOW. All other GPIO Port1 pins are left unchanged.

4.34 CDB-ID 210 – NMEA Message List 1

Allow enabling/disabling each NMEA message in the message list 1. The message list configuration is done in the same way as for the message list 0 (see CDB-ID 201 for details).

If not used the message list must be set to “0”.

4.35 CDB-ID 211 – NMEA Message List 2

Allow enabling/disabling each NMEA message in the message list 2. Allow enabling/disabling each NMEA message in the message list 1. The message list configuration is done in the same way as for the message list 0 (see CDB-ID 201 for details).

If not used the message list must be set to “0”.

NOTE: The message list 2 is reserved for those messages which need to be sent at high rate (e.g. 10Hz) and/or require accurate message output timing (low jitter). If high rate messages or low jitter are not required, this message list should not be used.

4.36 CDB-ID 301 – PPS Pulse Duration

Allow setting the pulse duration of the PPS signal. The pulse duration is intended to be the time distance between the PPS rising edge and the next falling edge if polarity inversion is disabled or the time distance between falling and rising edge if polarity inversion is enabled.

4.37 CDB-ID 302 – PPS Delay Correction

Allow setting a time correction to compensate any delay introduced on the Pulse Per Second (PPS) signal by cables and/or RF chain.

4.38 CDB-ID 303 – GNSS fix rate

Allow setting the GNSS library fix rate. It is the time period between two consecutive position fix evaluations.

A system reboot is needed to have new setting in use.

4.39 CDB-ID 304 – Position Hold Latitude

Allow setting the latitude [degrees] for the position hold mode (NOTE: to be used the position hold functionality must be enabled, see CDB-ID 200 for details).

A system reboot is needed to have new setting in use.

4.40 CDB-ID 305 – Position Hold Longitude

Allow setting the longitude [degrees] for the position hold mode (NOTE: to be used the position hold functionality must be enabled, see CDB-ID 200 for details).

A system reboot is needed to have new setting in use.

4.41 CDB-ID 306 – Position Hold Altitude

Allow setting the altitude [m] for the position hold mode (NOTE: to be used the position hold functionality must be enabled, see CDB-ID 200 for details).

NOTE: the altitude to be configured in this parameter mustn't be compensated with the geoid correction. If the altitude value is retrieved by the $GPGGA NMEA message, it must be added to the geoid correction (reported in the same $GPGGA message) before setting it in the CDB-ID 306 parameter.

A system reboot is needed to have new setting in use.

4.42 CDB-ID 400 – Default 2D DOP

Allow setting the default value for the 2D DOP. This value is used at run-time, after the GNSS startup phase, as a threshold for the 2D fix validation. DOP below this threshold will be considered valid for position fixing.

A system reboot is needed to have new setting in use.

4.43 CDB-ID 401 – Default 3D DOP

Allow setting the default value for the 3D DOP. This value is used at run-time, after the GNSS startup phase, as a threshold for the 3D fix validation. DOP below this threshold will be considered valid for position fixing.

A system reboot is needed to have new setting in use.

4.44 CDB-ID 402 – Startup 2D DOP

Allow setting the startup value for the 2D DOP. This value is used during the GNSS startup phase as a threshold for the 2D fix validation. DOP below this threshold will be considered valid for position fixing.

A system reboot is needed to have new setting in use.

4.45 CDB-ID 403 – Startup 3D DOP

Allow setting the startup value for the 3D DOP. This value is used during the GNSS startup phase as a threshold for the 3D fix validation. DOP below this threshold will be considered valid for position fixing.

A system reboot is needed to have new setting in use.

4.46 CDB-ID 500 – Text message

Allow setting a text message which is sent (if enabled – see bit9 of CDB-ID 200 parameter) at startup over the NMEA port. The user is free to use this text as product name or as specific configuration marker.

A system reboot is needed to have new setting in use.

5 Changing the Factory Setting

Default setting of configuration data block is hard coded into the binary image file. Using a PC tool (FWConfig.exe), it is possible to change the software configuration without recompile the source code. FWConfig.exe allows reading and writing configuration block inside binary images.

5.1 Writing a new configuration

```
FWConfig.exe –f <input_image_file> -c <new_config.txt> -o
<output_image_file>
```

Arguments:

input_image_file	the software binary image.
new_config.txt	is the configuration file. It is a text file reporting the list of parameters ID together with new values to set. It is necessary to include only ID of parameters to be changed.
output_image_file	is the binary image which includes the new configuration.

Note: the input file is not modified by FWConfig.exe.

Example:

Example of config.txt file

```
122 -> 01
123 -> 17
203 -> 00002b83
403 -> 15,12,12
500 -> THIS IS MY CONFIGURATION
```

Config file above will change only the parameters ID 122, 123, 203, 403 and 500 writing respectively 0x01, 0x17, 0x00002B83,(15,12,12) and a new text message that can be used to mark the configuration (this configuration message can be also displayed in the NMEA header message).

5.2 Reading configuration in the binary image

```
FWConfig.exe –f <input_image_file> -r
```

Arguments:

input_image_file	the software binary image.

Example:

The command execution will display the complete parameter list with current values. Here is an example:

```
100 -> 00
101 -> 02
102 -> 0a
103 -> 00
104 -> 00
105 -> 0a
106 -> 05
107 -> 0a
108 -> 0e
109 -> 0d
110 -> 0c
111 -> 0b
112 -> 0a
113 -> 09
114 -> 09
115 -> 08
116 -> 07
117 -> 03
118 -> 01
119 -> 63
120 -> 0e
121 -> 00
122 -> 0c
123 -> 04
124 -> 11
125 -> 00
126 -> 01
127 -> 35
128 -> 03
129 -> 01
130 -> 02
131 -> 50
132 -> 0f
133 -> 00
134 -> 00
135 -> 7c
136 -> 07
137 -> 14
138 -> 00
139 -> 0a
140 -> ff
141 -> ff
142 -> ff
143 -> ff
144 -> ff
145 -> ff
146 -> ff
147 -> ff
```

```
148 -> ff
149 -> ff
150 -> ff
151 -> ff
152 -> ff
153 -> ff
154 -> ff
155 -> ff
156 -> ff
157 -> ff
158 -> ff
159 -> ff
160 -> ff
161 -> ff
162 -> ff
163 -> ff
164 -> ff
165 -> ff
166 -> ff
167 -> ff
168 -> ff
169 -> ff
170 -> ff
171 -> ff
172 -> ff
173 -> ff
174 -> ff
175 -> ff
176 -> ff
177 -> ff
178 -> ff
179 -> ff
180 -> ff
181 -> ff
182 -> ff
183 -> ff
184 -> ff
185 -> ff
186 -> ff
187 -> ff
188 -> ff
189 -> ff
190 -> 01
191 -> 01
192 -> 01
193 -> ff
194 -> ff
195 -> ff
```

```
200 -> 01639604
201 -> 00884356
202 -> ffff6f78
203 -> ffff2158
204 -> ffff4868
205 -> 00000001
206 -> ffffffff
207 -> 00000000
208 -> ffffffff
209 -> 00000000
210 -> 00000000
211 -> 00000000
212 -> ffffffff
213 -> ffffffff
300 -> 0.000000e+000
301 -> 5.000000e-001
302 -> 0.000000e+000
303 -> 1.000000e+000
304 -> 4.091747e+001
305 -> 1.427586e+001
306 -> 8.843307e+001
400 -> 15,12,12,18
401 -> 15,12,12,18
402 -> 15,12,12,18
403 -> 15,12,12,18
500 -> DEFAULT CONFIGURATION
```

Note: values of parameters ID 1xx and 2xx must be reported in hexadecimal format (without "0x" prefix); values for parameters ID 3xx, 4xx and 500 must be reported as decimal.

Note: ALL THE PARAMETERS NOT DOCUMENTED IN THIS MANUAL MUST BE CONSIDERED AS RESERVED AND MUST NOT BE MODIFIED

6 Run Time Configuration: “Customized Setting”

At run-time the configuration parameters can be read, changed and stored (in NVM) using the system configuration commands: `$PSTMSETPAR`, `$PSTMGETPAR` and `$PSTMSAVEPAR`. There is also a command to restore the factory setting parameters: `$PSTMRESTOREPAR`.

When the system is running, it could be possible to have up to three different configuration blocks:

- *Current configuration*: it is placed in RAM memory and it includes the current configuration of each parameter. This configuration block can be modified with the `$PSTMSETPAR` command. The `$PSTMSAVEPAR` command stores the current configuration data block into the NVM memory. At startup the current configuration block is loaded from NVM (if a stored data block is available) or it is loaded from default one embedded in the code (factory settings).

- *Default configuration*: it is generally placed in the flash/rom memory. It includes the factory setting for each parameter. This configuration is used at system startup if there is no configuration data into the NVM memory.

- *NVM stored configuration*: it is available in the NVM backup memory as soon as the `$PSTMSAVEPAR` command is executed. It includes all parameters modified and stored by the user. At system startup the SW configuration managements checks if a valid configuration block is available in the NVM backup memory. In case the stored configuration is available, it will be used for system configuration. If not available the default setting will be used.

6.1 $PSTMSETPAR

This command sets the defined parameter (indicated by "ID") to the value provided as "param_value" in the commands parameter.

Synopsis:

```
$PSTMSETPAR,<ConfigBlock><ID>,<param_value>[,<mode>]*<cr><lf>
```

Arguments:

Parameter	Format	Description
ConfigBlock	Decimal,1 digit	Indicates one of configuration blocks: 1=Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see, Configuration Data Block)
param_value	1 up to 80 bytes	Parameter to be set, see "Allowed values"
mode	Decimal, 1 digit	This parameter is optional. It allows to perform bit-to-bit "OR" or "AND" operations between the selected parameter in the configuration block and the param_value in input. It has the following meaning: 0: the parameter in the configuration block is overwritten by the param_value. This is the default action as in the case mode is omitted. 1: the parameter in the configuration block is the result of bit-to-bit "OR" between old value and the param_value.This is useful for bit mask setting. 2: the parameter in the configuration block is the result of bit-to-bit "AND" between old value and NOT(param_value). This is useful for bit mask resettimg.

Results:

- The parameter indicated by the ID value is set according to the parameters included in param_value. In case of no errors, the following message is returned

```
$PSTMSETPAROK ,<ConfigBlock><ID>*<checksum><cr><lf>
```

- In case of errors, the error message is returned

```
$PSTMSETPARERROR*<checksum><cr><lf>
```

Where:

Parameter	Format	Description
ConfigBlock	Decima1,1 digit	Indicates one of configuration blocks: 1=Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see, Configuration Data Block)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

Issuing the command:

```
$PSTMSETPAR,1121,10*
```

You could have this answer:

```
$PSTMSETPAROK,1121*
```

Note: The configuration block parameter is ignored by the "SET" command because only the current configuration, stored in the RAM memory, can be written. It is used only to keep same syntax as for the "GET" command. The configuration block stored in NVM will be overwritten by current configuration after the $PSTMSAVEPAR command.

Note: There is no comma and no space between ConfigBlock and ID parameters.

Note: The input param_value must be expressed in hexadecimal format without "0x" prefix for any integer value except DOP configuration. It must be decimal for any not integer value and DOP setting.

6.2 $PSTMGETPAR

This command reads the defined parameter (indicated by "ID") from the "Configuration Data Block" and returns it as a specific message.

Synopsis:

```
$PSTMGETPAR,<ConfigBlock><ID>*<cr><lf>
```

Arguments:

Parameter	Format	Description
ConfigBlock	Decima1,1 digit	Indicates one of configuration blocks: 1=Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see, Configuration Data Block)

Results:

- In case of no errors, the selected parameter ID value is returned in the following message

```
$PSTMSETPAR,<ConfigBlock><ID>,<value>*<checksum><cr><lf>
```

- In case of errors, the error message is returned

```
$PSTMGETPARERROR*<checksum><cr><lf>
```

Where:

Parameter	Format	Description
ConfigBlock	Decima1,1 digit	Indicates one of configuration blocks: 1=Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see, Configuration Data Block)
value	Hexadecimal or Decimal	The value of returned parameter. According to the parameter type it could be expressed in hexadecimal format (in case parameter is integer) or decimal format (in case the parameter is floating).

checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

Issuing the command:

```
$PSTMGETPAR,1403*
```

You could have this answer:

```
$PSTMSET,1403,15,12,12,18*<checksum><cr><lf>
```

Note: there is no comma and no space between `ConfigBlock` and `ID` parameters.

Note: In case of no errors the answer is deliberately `$PSTMSET` and not `$PSTMGET`.

Note: if the parameter ID is "000" all the configuration block is printed out using one message for each parameter. The message syntax is the same as reported above.

6.3 $PSTMSAVEPAR

Save current configuration data block into the backup memory.

Synopsis:

```
$PSTMSAVEPAR<cr><lf>
```

Arguments:

None.

Results:

- The current configuration data block, including changed parameters, will be stored into the backup memory (NVM).

Note: the factory setting parameters can be restored using the $PSTMRESTOREPAR command.

Example:

```
$PSTMSAVEPAR
```

6.4 $PSTMRESTOREPAR

Restore the factory setting parameters. The configuration data block stored in NVM, if present, will be invalidated. Any changed parameter will be lost.

Synopsis:

```
$PSTMRESTOREPAR<cr><lf>
```

Arguments:

None.

Results:

- The factory setting parameters will be restored and the configuration block in the backup memory will be lost. A system reboot is needed to complete the factory reset restoring ad to get system working with default setting.

Example:

```
$PSTMRESTOREPAR
```

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