SwiftNav Binary Protocol

Protocol Specification v0.15

Contents

The Swift Navigation Binary Protocol (SBP) is a fast, simple, and minimal binary protocol for communicating with Swift devices. It is the native binary protocol used by the Piksi GPS receiver to transmit solutions, observations, status and debugging messages, as well as receive messages from the host operating system, such as differential corrections and the almanac. As such, it is an important piece of interfacing with your Piksi receiver and integrating it with other systems.

This document provides language-agnostic specification and documentation for messages used with SBP, as well as a detailed description of some of Piksi's configuration settings accessible via SBP and the Piksi console. SBP client libraries in a variety of programming languages are available online.

1 Message Structure

SBP consists of two pieces: (i) an over-the-wire message framing format and (ii) structured payload definitions. As of Version 1.0, the packet consists of a 6-byte binary header section, a variable-sized payload field, and a 16-bit CRC value. SBP uses the CCITT CRC16 (XMODEM implementation) for error detection.

Name	Size	Description
Preamble	1	Denotes the start of frame transmission. Always 0x55.
Message Type	2	Identifies the payload contents.
Sender	2	A unique identifier of the sending hardware. Set to the 2 least significant bytes of the Piksi serial number.
Length	1	Length in bytes of the Payload field.
Payload	N	Binary data of the message.
CRC	2	Cyclic Redundancy Check of the packet's binary data from the Message Type up to the end of Payload (does not include the Preamble).
	$N+8$	

Table 1.0.1: Swift Binary Protocol message structure

2 Basic Formats and Payload Structure

The binary payload field of an SBP message can be decoded into structured data based on the message type defined in the SBP header. SBP uses several primitive numerical and collection types for defining the contents of messages:

Name	Size	Description
s8	1	Signed 8-bit integer
s16	2	Signed 16-bit integer
s32	4	Signed 32-bit integer
s64	8	Signed 64-bit integer
u8	1	Unsigned 8-bit integer
u16	2	Unsigned 16-bit integer
u32	4	Unsigned 32-bit integer
u64	8	Unsigned 64-bit integer
bool	—	Boolean
float	4	Single-precision float
double	8	Double-precision float
array	—	Fixed or variable length array of any fill type
bytes	—	Fixed or variable length array of bytes
string	—	Fixed or variable length string (NULL terminated)
bitfield	—	A primitive type, such as a u8, can encode boolean status flags.

Table 2.0.2: SBP primitive types

As an example, the following cryptic bytestring is an example of a complete SBP message read from a serial port:

`U\x02\x02\xcc\x04\x14p=\xd0\x18\xcf\xef\xff\xff\xef\xe8\xff\xff\xf0\x18\x00\x00\x00\x00\x05\x00C\x94.`

Believe it or not, this mystery decodes into a `MSG_BASELINE_ECEF`, which reports the baseline position solution of the rover receiver relative to the base station receiver in Earth Centered Earth Fixed (ECEF) coordinates. The segments of this this message breakdown as follows:

Field Name	Type	Value	Bytestring Segment
Preamble	u8	0x55	`U`
Message Type	u16	0x0202	`\x02\x02`
Sender	u16	0x4cc	`\xcc\x04`
Length	u8	20	`\x14`
Payload		—	`p=\xd0\x18\xcf\xef\xff\xff\xef\xe8\xff\xff` `p=\xd0\x18\xcf\xef\xff\xff\xef\xe8\xff\xff`
`.MSG_BASELINE_ECEF`			
.tow	u32	416300400 sec	`p=\xd0\x18`
.x	s32	−4145 mm	`\xcf\xef\xff\xff`
.y	s32	−5905 mm	`\xef\xe8\xff\xff`
.z	s32	6384 mm	`\xf0\x18\x00\x00`
.accuracy	u16	0	`\x00\x00`
.nsats	u8	5	`\x05`
.flags	u8	0	`\x00`
CRC	u16	0x9443	`C\x94`

Table 2.0.3: SBP breakdown for `MSG_BASELINE_ECEF`

3 Message Types

Packages define a logical collection of SBP messages. By convention, the contents and layout of messages in packages marked "stable" are unlikely to change in the future, whereas "unstable" messages may change with future development. Some collections of unstable message definitions, such as the bootloader package, are intended for internal development.

Package	Message	Name	Size	Description
Stable				
Navigation	0x0100	MSG_GPS_TIME	11	GPS Time
	0x0206	MSG_DOPS	14	Dilution of Precision
	0x0200	MSG_POS_ECEF	32	Single-point position in ECEF
	0x0201	MSG_POS_LLH	34	Geodetic Position
	0x0202	MSG_BASELINE_ECEF	20	Baseline Position in ECEF
	0x0203	MSG_BASELINE_NED	22	Baseline in NED
	0x0204	MSG_VEL_ECEF	20	Velocity in ECEF
	0x0205	MSG_VEL_NED	22	Velocity in NED
System	0xFF00	MSG_STARTUP	4	System start-up message
	0xFFFF	MSG_HEARTBEAT	4	System heartbeat message
Unstable				
Acquisition	0x0015	MSG_ACQ_RESULT	13	Satellite acquisition result
Bootload	0x00B0	MSG_BOOTLOADER_HANDSHAKE	1	Bootloading handshake
	0x00B1	MSG_BOOTLOADER_JUMP_TO_APP	1	Bootloader jump to application
	0x00DD	MSG_NAP_DEVICE_DNA	8	Send FPGA device DNA over UART
File Io	0x00A8	MSG_FILEIO_READ	25	Read file from the file system
	0x00A9	MSG_FILEIO_READ_DIR	24	List files in a directory
	0x00AC	MSG_FILEIO_REMOVE	20	Delete a file from the file system
	0x00AD	MSG_FILEIO_WRITE	24	Write to file
Flash	0x00E0	MSG_FLASH_PROGRAM	5	Program addresses of the STM or M25 flash
	0x00E0	MSG_FLASH_DONE	1	Flash response message
	0x00E1	MSG_FLASH_READ	5	Read STM or M25 flash address
	0x00E2	MSG_FLASH_ERASE	2	Erase sector of Piksi flash memory
	0x00E3	MSG_STM_FLASH_LOCK_SECTOR	1	Lock sector of STM flash memory
	0x00E4	MSG_STM_FLASH_UNLOCK_SECTOR	1	Unlock sector of STM flash memory
	0x00E5	MSG_STM_UNIQUE_ID	12	Read STM32F4's hardcoded unique ID
	0x00F3	MSG_M25_FLASH_WRITE_STATUS	1	Write M25 flash status register
Logging	0x0010	MSG_PRINT	1	Plaintext logging messages
Observation	0x0045	MSG_OBS	$13N+20$	GPS satellite observations
	0x0044	MSG_BASE_POS	24	Base station position
Piksi	0x00B2	MSG_RESET	0	Reset the device
	0x0023	MSG_INIT_BASE	0	Initialize IAR from known baseline
	0x0017	MSG_THREAD_STATE	26	State of a CPU/RTOS thread
	0x0018	MSG_UART_STATE	58	State of the UART channels
Settings	0x00A1	MSG_SETTINGS_SAVE	0	Save settings to flash
Tracking	0x0016	MSG_TRACKING_STATE	$6N+6$	Satellite tracking channel states
	0x001A	MSG_EPHEMERIS	175	WGS84 satellite orbit ephemeris parameters

4 Stable Message Definitions

4.1 Navigation

Geodetic navigation messages reporting GPS time, single-point position, and RTK baseline position solutions.

MSG_GPS_TIME — 0x0100

This message reports the GPS time, an integer time scale beginning at January 6, 1980 midnight. GPS time counts the weeks and seconds of the week. The weeks begin at the Saturday/Sunday transition. GPS week 0 began at the beginning of the GPS time scale. Within each week number, the GPS time of the week is between between 0 and 604800 seconds (=60*60*24*7).

Offset	Size	Format	Units	Name	Description
0	2	u16	weeks	`wn`	GPS week number
2	4	u32	ms	`tow`	GPS time of week rounded to the nearest ms
6	4	s32	ns	`ns`	Nanosecond remainder of rounded tow
10	1	u8		`flags`	Status flags (reserved)
	11				

Table 4.1.1: MSG_GPS_TIME 0x0100 message structure

MSG_DOPS — 0x0206

This dilution of precision (DOP) message describes the effect of navigation satellite geometry on positional measurement precision.

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`tow`	GPS Time of Week
4	2	u16	0.01	`gdop`	Geometric Dilution of Precision
6	2	u16	0.01	`pdop`	Position Dilution of Precision
8	2	u16	0.01	`tdop`	Time Dilution of Precision
10	2	u16	0.01	`hdop`	Horizontal Dilution of Precision
12	2	u16	0.01	`vdop`	Vertical Dilution of Precision
	14				

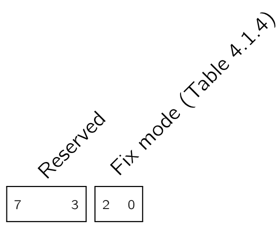
Table 4.1.2: MSG_DOPS 0x0206 message structure

MSG_POS_ECEF — 0x0200

The single-point position solution message reports absolute Earth Centered Earth Fixed (ECEF) coordinates and the status (single point absolute vs RTK) of the position solution. If the rover receiver knows surveyed position of the base station and has an RTK solution, this reports a pseudo-absolute position solution using the base station position and the rover's RTK baseline vector.

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`tow`	GPS Time of Week
4	8	double	m	`x`	ECEF X coordinate
12	8	double	m	`y`	ECEF Y coordinate
20	8	double	m	`z`	ECEF Z coordinate
28	2	u16	mm	`accuracy`	Position accuracy estimate
30	1	u8		`n_sats`	Number of satellites used in solution
31	1	u8		`flags`	Status flags
	32				

Table 4.1.3: MSG_POS_ECEF 0x0200 message structure



Field 4.1.1: Status flags (`flags`)

Value	Description
0	Single Point Positioning (SPP)

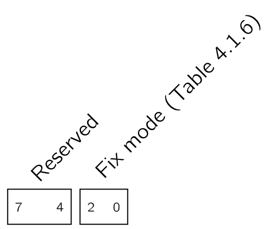
Table 4.1.4: Fix mode values (`flags[0:2]`)

MSG_POS_LLH — 0x0201

This single-point position solution message reports the absolute geodetic coordinates and the status (single point absolute vs RTK) of the position solution. If the rover receiver knows the surveyed position of the base station and has an RTK solution, this reports a pseudo-absolute position solution using the base station position and the rover's RTK baseline vector.

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`tow`	GPS Time of Week
4	8	double	deg	`lat`	Latitude
12	8	double	deg	`lon`	Longitude
20	8	double	m	`height`	Height
28	2	u16	mm	`h_accuracy`	Horizontal position accuracy estimate
30	2	u16	mm	`v_accuracy`	Vertical position accuracy estimate
32	1	u8		`n_sats`	Number of satellites used in solution
33	1	u8		`flags`	Status flags
	34				

Table 4.1.5: MSG_POS_LLH 0x0201 message structure



Field 4.1.2: Status flags (`flags`)

Value	Description
0	Single Point Positioning (SPP)

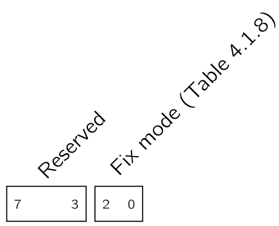
Table 4.1.6: Fix mode values (`flags[0:2]`)

MSG_BASELINE_ECEF — 0x0202

This message reports the baseline position solution in Earth Centered Earth Fixed (ECEF) coordinates.

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`tow`	GPS Time of Week
4	4	s32	mm	`x`	Baseline ECEF X coordinate
8	4	s32	mm	`y`	Baseline ECEF Y coordinate
12	4	s32	mm	`z`	Baseline ECEF Z coordinate
16	2	u16	mm	`accuracy`	Position accuracy estimate
18	1	u8		`n_sats`	Number of satellites used in solution
19	1	u8		`flags`	Status flags
	20				

Table 4.1.7: MSG_BASELINE_ECEF 0x0202 message structure



Field 4.1.3: Status flags (`flags`)

Value	Description
0	Float RTK

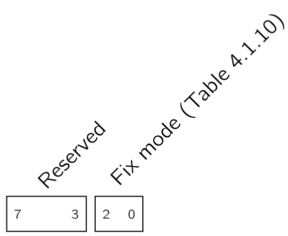
Table 4.1.8: Fix mode values (`flags[0:2]`)

MSG_BASELINE_NED — 0x0203

This message reports the baseline position solution in North East Down (NED) coordinates.

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`tow`	GPS Time of Week
4	4	s32	mm	`n`	Baseline North coordinate
8	4	s32	mm	`e`	Baseline East coordinate
12	4	s32	mm	`d`	Baseline Down coordinate
16	2	u16	mm	`h_accuracy`	Horizontal position accuracy estimate
18	2	u16	mm	`v_accuracy`	Vertical position accuracy estimate
20	1	u8		`n_sats`	Number of satellites used in solution
21	1	u8		`flags`	Status flags
	22				

Table 4.1.9: MSG_BASELINE_NED 0x0203 message structure



Field 4.1.4: Status flags (`flags`)

Value	Description
0	Float RTK

Table 4.1.10: Fix mode values (`flags[0:2]`)

MSG_VEL_ECEF — 0x0204

This message reports the velocity in Earth Centered Earth Fixed (ECEF) coordinates.

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`tow`	GPS Time of Week
4	4	s32	mm/s	`x`	Velocity ECEF X coordinate
8	4	s32	mm/s	`y`	Velocity ECEF Y coordinate
12	4	s32	mm/s	`z`	Velocity ECEF Z coordinate
16	2	u16	mm/s	`accuracy`	Velocity accuracy estimate
18	1	u8		`n_sats`	Number of satellites used in solution
19	1	u8		`flags`	Status flags (reserved)
	20				

Table 4.1.11: MSG_VEL_ECEF 0x0204 message structure

MSG_VEL_NED — 0x0205

This message reports the velocity in local North East Down (NED) coordinates.

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`tow`	GPS Time of Week
4	4	s32	mm/s	`n`	Velocity North coordinate
8	4	s32	mm/s	`e`	Velocity East coordinate
12	4	s32	mm/s	`d`	Velocity Down coordinate
16	2	u16	mm/s	`h_accuracy`	Horizontal velocity accuracy estimate
18	2	u16	mm/s	`v_accuracy`	Vertical velocity accuracy estimate
20	1	u8		`n_sats`	Number of satellites used in solution
21	1	u8		`flags`	Status flags (reserved)
	22				

Table 4.1.12: MSG_VEL_NED 0x0205 message structure

4.2 System

Standardized system messages from Swift Navigation devices.

MSG_STARTUP — 0xFF00

The system start-up message is sent once on system start-up. It is intended to be used to notify the host or other attached devices that the system has started and is now ready to respond to commands or configuration requests.

Offset	Size	Format	Units	Name	Description
0	4	u32		`reserved`	Reserved
	4				

Table 4.2.1: MSG_STARTUP 0xFF00 message structure

MSG_HEARTBEAT — 0xFFFF

The heartbeat message is sent periodically to inform the host or other attached devices that the system is running. It is intended to be used to monitor for system malfunctions and also contains status flags that indicate to the host the status of the system and if it is operating correctly.

The system error flag is used to indicate that an error has occurred in the system. To determine the source of the error the remaining error flags should be inspected.

Offset	Size	Format	Units	Name	Description
0	4	u32		`flags`	Status flags
	4				

Table 4.2.2: MSG_HEARTBEAT 0xFFFF message structure

Field 4.2.1: Status flags (`flags`)

5 Unstable Message Definitions

5.1 Acquisition

Satellite acquisition messages from the Piksi.

MSG_ACQ_RESULT — 0x0015

This message describes the results from an attempted GPS signal acquisition search for a satellite PRN over a code phase/carrier frequency range. It contains the parameters of the point in the acquisition search space with the best signal-to-noise (SNR) ratio.

Offset	Size	Format	Units	Name	Description
0	4	float		`snr`	SNR of best point.
4	4	float	chips	`cp`	Code phase of best point.
8	4	float	hz	`cf`	Carrier frequency of best point.
12	1	u8		`prn`	PRN identifier of the satellite signal for which acquisition was attempted.
	13				

Table 5.1.1: MSG_ACQ_RESULT 0x0015 message structure

5.2 Bootload

Messages for the bootloading configuration on the Piksi. These are in the implementation-defined range (0x0000-0x00FF), and intended for internal-use only. Note that some of these messages taking a request from a host and a response from the Piksi share the same message type ID.

MSG_BOOTLOADER_HANDSHAKE — 0x00B0

The bootloader continually sends a handshake message to the host for a short period of time, and then jumps to the firmware if it doesn't receive a handshake from the host. If the host replies with a handshake the bootloader doesn't jump to the firmware and nwaits for flash programming messages, and the host has to send a MSG_BOOTLOADER_JUMP_TO_APP when it's done programming. On old versions of the bootloader (¡=v0.1), hardcoded u8=0. On new versions, return the git describe string for the bootloader build.

Offset	Size	Format	Units	Name	Description
0	1	u8		`handshake`	Handshake value
	1				

Table 5.2.1: MSG_BOOTLOADER_HANDSHAKE 0x00B0 message structure

MSG_BOOTLOADER_JUMP_TO_APP — 0x00B1

The host initiates the bootloader to jump to the application.

Offset	Size	Format	Units	Name	Description
0	1	u8		`jump`	Ignored by the Piksi.
	1				

Table 5.2.2: MSG_BOOTLOADER_JUMP_TO_APP 0x00B1 message structure

MSG_NAP_DEVICE_DNA — 0x00DD

The device DNA message from the host reads the unique device DNA from the Swift Navigation Acceleration Peripheral (SwiftNAP), a Spartan 6 FPGA. By convention, the host message buffer is empty; the Piksi returns the device DNA in a MSG_NAP_DEVICE_DNA message.

Offset	Size	Format	Units	Name	Description
0	8	u8[8]		`dna`	57-bit SwiftNAP FPGA Device DNA
	8				

Table 5.2.3: MSG_NAP_DEVICE_DNA 0x00DD message structure

5.3 File Io

Messges for using Piksi's onboard flash filesystem functionality from the Contiki project. This allows data to be stored persistently in the microcontroller's program flash with wear-levelling using a simple filesystem interface. The Contiki file system interface (CFS) defines an abstract API for reading directories and for reading and writing files. These are in the implementation-defined range (0x0000-0x00FF), and intended for internal-use only. Note that some of these messages taking a request from a host and a response from the Piksi share the same message type ID.

MSG_FILEIO_READ — 0x00A8

The file read message reads a certain length (up to 255 bytes) from a given offset into a file, and returns the data in a MSG_FILEIO_READ message where the message length field indicates how many bytes were succesfully read. If the message is invalid, a followup MsgPrint message will print "Invalid fileio read message".

Offset	Size	Format	Units	Name	Description
0	4	u32	bytes	`offset`	File offset.
4	1	u8	bytes	`chunk_size`	Chunk size to read.
5	20	string		`filename`	Name of the file to read from (NULL terminated).
	25				

Table 5.3.1: MSG_FILEIO_READ 0x00A8 message structure

MSG_FILEIO_READ_DIR — 0x00A9

The read directory message lists the files in a directory on the Piksi's onboard flash file system. The offset parameter can be used to skip the first n elements of the file list. Returns a MSG_FILEIO_READ_DIR message containing the directory listings as a NULL delimited list. The listing is chunked over multiple SBP packets and the end of the list is identified by an entry containing just the character 0xFF. If message is invalid, a followup MsgPrint message will print "Invalid fileio read message".

Offset	Size	Format	Units	Name	Description
0	4	u32		`offset`	The offset to skip the first n elements of the file list.
4	20	string		`dirname`	Name of the directory to list.
	24				

Table 5.3.2: MSG_FILEIO_READ_DIR 0x00A9 message structure

MSG_FILEIO_REMOVE — 0x00AC

The file remove message deletes a file from the file system. If message is invalid, a followup MsgPrint message will print "Invalid fileio remove message".

Offset	Size	Format	Units	Name	Description
0	20	string		`filename`	Name of the file to delete (NULL terminated)
	20				

Table 5.3.3: MSG_FILEIO_REMOVE 0x00AC message structure

MSG_FILEIO_WRITE — 0x00AD

The file write message writes a certain length (up to 255 bytes) of data to a file at a given offset. Returns a copy of the original MSG_FILEIO_WRITE message to check integrity of the write. If message is invalid, a followup MsgPrint message will print "Invalid fileio write message".

Offset	Size	Format	Units	Name	Description
0	20	string		`filename`	Name of the file to write to (NULL terminated)
20	4	u32	bytes	`offset`	Offset into the file at which to start writing in bytes
	24				

Table 5.3.4: MSG_FILEIO_WRITE 0x00AD message structure

5.4 Flash

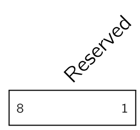
Messages for reading/writing the Piksi's onboard flash memory. These are in the implementation-defined range (0x0000-0x00FF), and largely intended for internal-use only.

MSG_FLASH_PROGRAM — 0x00E0

The flash program message programs a set of addresses of either the STM or M25 flash. The Piksi replies with either a MSG_FLASH_DONE message containing the return code FLASH_OK (0) on success, or FLASH_INVALID_LEN (2) if the maximum write size is exceeded. Note that the sector-containing addresses must be erased before addresses can be programmed.

Offset	Size	Format	Units	Name	Description
0	1	u8		`target`	Target flags
1	3	u8[3]	bytes	`addr_start`	Starting address offset to program
4	1	u8	bytes	`addr_len`	Length of set of addresses to program, counting up from starting address.
	5				

Table 5.4.1: MSG_FLASH_PROGRAM 0x00E0 message structure



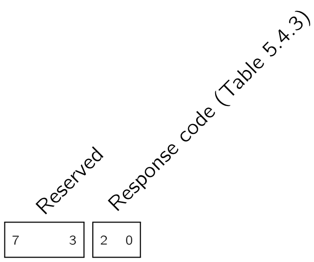
Field 5.4.1: Target flags (`target`)

MSG_FLASH_DONE — 0x00E0

This message defines success or failure codes for a variety of flash memory requests from the host to the Piksi. Flash read and write messages, such as MSG_FLASH_READ or MSG_FLASH_WRITE, may return this message on failure.

Offset	Size	Format	Units	Name	Description
0	1	u8		`response`	Response flags
	1				

Table 5.4.2: MSG_FLASH_DONE 0x00E0 message structure



Field 5.4.2: Response flags (`response`)

Value	Description
0	FLASH_OK

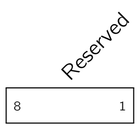
Table 5.4.3: Response code values (`response[0:2]`)

MSG_FLASH_READ — 0x00E1

The flash read message reads a set of addresses of either the STM or M25 onboard flash. The Piksi replies with a MSG_FLASH_READ message containing either the read data on success or a MSG_FLASH_DONE message containing the return code FLASH_INVALID_LEN (2) if the maximum read size is exceeded or FLASH_INVALID_ADDR (3) if the address is outside of the allowed range.

Offset	Size	Format	Units	Name	Description
0	1	u8		`target`	Target flags
1	3	u8[3]	bytes	`addr_start`	Starting address offset to read from
4	1	u8	bytes	`addr_len`	Length of set of addresses to read, counting up from starting address.
	5				

Table 5.4.4: MSG_FLASH_READ 0x00E1 message structure



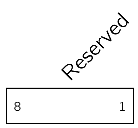
Field 5.4.3: Target flags (`target`)

MSG_FLASH_ERASE — 0x00E2

The flash erase message from the host erases a sector of either the STM or M25 onboard flash memory. The Piksi will reply with a MSG_FLASH_DONE message containing the return code - FLASH_OK (0) on success or FLASH_INVALID_FLASH (1) if the flash specified is invalid.

Offset	Size	Format	Units	Name	Description
0	1	u8		`target`	Target flags
1	1	u8		`sector_num`	Flash sector number to erase (0-11 for the STM, 0-15 for the M25).
	2				

Table 5.4.5: MSG_FLASH_ERASE 0x00E2 message structure



Field 5.4.4: Target flags (`target`)

MSG_STM_FLASH_LOCK_SECTOR — 0x00E3

The flash lock message locks a sector of the STM flash memory. The Piksi replies with a MSG_FLASH_DONE message.

Offset	Size	Format	Units	Name	Description
0	1	u8[1]		`sector`	Flash sector number to lock.
	1				

Table 5.4.6: MSG_STM_FLASH_LOCK_SECTOR 0x00E3 message structure

MSG_STM_FLASH_UNLOCK_SECTOR — 0x00E4

The flash unlock message unlocks a sector of the STM flash memory. The Piksi replies with a MSG_FLASH_DONE message.

Offset	Size	Format	Units	Name	Description
0	1	u8[1]		`sector`	Flash sector number to unlock.
	1				

Table 5.4.7: MSG_STM_FLASH_UNLOCK_SECTOR 0x00E4 message structure

MSG_STM_UNIQUE_ID — 0x00E5

This message reads the STM32F4's hardcoded unique ID. The Piksi returns STM32F4 unique ID (12 bytes) back to host.

Offset	Size	Format	Units	Name	Description
0	12	string		`stm_id`	STM32F4 unique ID.
	12				

Table 5.4.8: MSG_STM_UNIQUE_ID 0x00E5 message structure

MSG_M25_FLASH_WRITE_STATUS — 0x00F3

The flash status message writes to the 8-bit M25 flash status register. The Piksi replies with a MSG_FLASH_DONE message.

Offset	Size	Format	Units	Name	Description
0	1	u8[1]		`status`	Byte to write to the M25 flash status register.
	1				

Table 5.4.9: MSG_M25_FLASH_WRITE_STATUS 0x00F3 message structure

5.5 Logging

Logging and debugging messages from the Piksi. These are in the implementation-defined range (0x0000-0x00FF).

MSG_PRINT — 0x0010

This message contains a human-reabable payload string from the Piksi containing errors, warnings and informational messages at ERROR, WARNING, DEBUG, INFO logging levels. These message may also contain information tagged by filename, as well as debug info on function entry/exit when enabled within the firmware.

Offset	Size	Format	Units	Name	Description
0	1	string		`text`	Informative, human-readable string.
	1				

Table 5.5.1: MSG_PRINT 0x0010 message structure

5.6 Observation

Satellite observation messages from the Piksi.

MSG_OBS — 0x0045

The GPS observations message reports all the pseudo range and carrier phase observations for the satellites being tracked by the Piksi.

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`header.t.tow`	Milliseconds since start of GPS week
4	2	u16	week	`header.t.wn`	GPS week number
6	1	u8		`header.n_obs`	Total number of observations. First nibble is the size of the sequence (n), second nibble is the zero-indexed counter (ith packet of n)
$13N + 7$	4	u32	cm	`obs[*N*].P`	Pseudorange observation.
$13N + 11$	4	s32	cycles	`obs[*N*].L.i`	Carrier phase whole cycles.
$13N + 15$	1	u8	cycles / 255	`obs[*N*].L.f`	Carrier phase fractional part.
$13N + 16$	1	u8	dB Hz	`obs[*N*].cn0`	Carrier-to-Noise density
$13N + 17$	2	u16		`obs[*N*].lock`	Lock indicator. This value changes whenever a satellite signal has lost and regained lock, indicating that the carrier phase ambiguity may have changed. There is no significance to the value of the lock indicator.
$13N + 19$	1	u8		`obs[*N*].prn`	PRN identifier of the satellite signal
	$13N + 20$				

Table 5.6.1: MSG_OBS 0x0045 message structure

MSG_BASE_POS — 0x0044

This may be the position as reported by the base station itself or the position obtained from doing a single point solution using the base station observations.

Offset	Size	Format	Units	Name	Description
0	8	double	deg	`lat`	Latitude
8	8	double	deg	`lon`	Longitude
16	8	double	m	`height`	Height
	24				

Table 5.6.2: MSG_BASE_POS 0x0044 message structure

5.7 Piksi

System health, configuration, and diagnostic messages specific to the Piksi L1 receiver, including a variety of legacy messages that may no longer be used. These messages are in the implementation-defined range (0x0000-0x00FF), and largely intended for internal-use only.

MSG_RESET — 0x00B2

This message from the host resets the Piksi back into the bootloader. It ensures that all outstanding memory accesses including buffered writes are completed before reset begins.

Offset	Size	Format	Units	Name	Description
	0				

Table 5.7.1: MSG_RESET 0x00B2 message structure

MSG_INIT_BASE — 0x0023

This message initializes the Integer Ambiguity Resolution (IAR) process on the Piksi to use an assumed baseline position between the base station and rover receivers. Warns via MsgPrint if there aren't a shared minimum number (4) of satellite observations between the two.

Offset	Size	Format	Units	Name	Description
	0				

Table 5.7.2: MSG_INIT_BASE 0x0023 message structure

MSG_THREAD_STATE — 0x0017

The thread usage message from the Piksi reports RTOS thread usage statistics for the named thread. The reported values require renormalization.

Offset	Size	Format	Units	Name	Description
0	20	string		`name`	Thread name (NULL terminated)
20	2	u16	Utilization percentage /1000.	`cpu`	Percentage cpu use for this thread. Ranges from 0 - 1000 and needs to be renormalized to 100.
22	4	u32	kB	`stack_free`	Free stack space for this thread.
	26				

Table 5.7.3: MSG_THREAD_STATE 0x0017 message structure

MSG_UART_STATE — 0x0018

The UART message reports data latency and throughput of the UART channels providing SBP I/O. On the default Piksi configuration, UARTs A and B are used for telemetry radios, but can also be be host access ports for embedded hosts, or other interfaces in future.

Offset	Size	Format	Units	Name	Description
0	4	float	kB/s	`uart_a.tx_throughput`	UART transmit throughput.
4	4	float	kB/s	`uart_a.rx_throughput`	UART receive throughput.
8	2	u16		`uart_a.crc_error_count`	UART CRC error count.
10	2	u16		`uart_a.io_error_count`	UART IO error count.
12	1	u8	Utilization /255	`uart_a.tx_buffer_level`	UART transmit buffer percentage utilization. Ranges from 0 - 255 and needs to be renormalized to 100.
13	1	u8	Utilization /255	`uart_a.rx_buffer_level`	UART receive buffer percentage utilization. Ranges from 0 - 255 and needs to be renormalized to 100.
14	4	float	kB/s	`uart_b.tx_throughput`	UART transmit throughput.
18	4	float	kB/s	`uart_b.rx_throughput`	UART receive throughput.
22	2	u16		`uart_b.crc_error_count`	UART CRC error count.
24	2	u16		`uart_b.io_error_count`	UART IO error count.
26	1	u8	Utilization /255	`uart_b.tx_buffer_level`	UART transmit buffer percentage utilization. Ranges from 0 - 255 and needs to be renormalized to 100.
27	1	u8	Utilization /255	`uart_b.rx_buffer_level`	UART receive buffer percentage utilization. Ranges from 0 - 255 and needs to be renormalized to 100.
28	4	float	kB/s	`uart_ftdi.tx_throughput`	UART transmit throughput.
32	4	float	kB/s	`uart_ftdi.rx_throughput`	UART receive throughput.
36	2	u16		`uart_ftdi.crc_error_count`	UART CRC error count.
38	2	u16		`uart_ftdi.io_error_count`	UART IO error count.
40	1	u8	Utilization /255	`uart_ftdi.tx_buffer_level`	UART transmit buffer percentage utilization. Ranges from 0 - 255 and needs to be renormalized to 100.
41	1	u8	Utilization /255	`uart_ftdi.rx_buffer_level`	UART receive buffer percentage utilization. Ranges from 0 - 255 and needs to be renormalized to 100.
42	4	s32	ms	`latency.avg`	Average latency.
46	4	s32	ms	`latency.lmin`	Minimum latency.
50	4	s32	ms	`latency.lmax`	Maximum latency.
54	4	s32	ms	`latency.current`	Smoothed estimate of the current latency.
	58				

Table 5.7.4: MSG_UART_STATE 0x0018 message structure

5.8 Settings

Messages for reading and writing the Piksi's device settings. These are in the implementation-defined range (0x0000-0x00FF), and intended for internal-use only. Please see the accompanying description of settings configurations for more details. Note that some of these messages taking a request from a host and a response from the Piksi share the same message type ID.

MSG_SETTINGS_SAVE — 0x00A1

The save settings message persists the Piksi's current settings configuration to its onboard flash memory file system.

Offset	Size	Format	Units	Name	Description
	0				

Table 5.8.1: MSG_SETTINGS_SAVE 0x00A1 message structure

5.9 Tracking

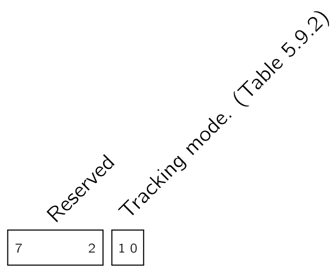
Satellite code and carrier-phase tracking messages from the Piksi.

MSG_TRACKING_STATE — 0x0016

The tracking message returns a variable-length array of tracking channel states. It reports status and code/carrier phase signal power measurements for all tracked satellites.

Offset	Size	Format	Units	Name	Description
$6N + 0$	1	u8		`states[*N*].state`	Status of tracking channel.
$6N + 1$	1	u8		`states[*N*].prn`	PRN being tracked.
$6N + 2$	4	float	dB Hz	`states[*N*].cn0`	Carrier-to-noise density
	$6N + 6$				

Table 5.9.1: MSG_TRACKING_STATE 0x0016 message structure



Field 5.9.1: Status of tracking channel. (`states[*N*].state`)

Value	Description
0	Disabled

Table 5.9.2: Tracking mode. values (`states[*N*].state[0:1]`)

MSG_EPHEMERIS — 0x001A

The ephemeris message returns a set of satellite orbit parameters that is used to calculate GPS satellite position, velocity, and clock offset (WGS84). Please see the Navstar GPS Space Segment/Navigation user interfaces (ICD-GPS-200, Table 20-III) for more details (http://www.navcen.uscg.gov/pubs/gps/icd200/icd2

Offset	Size	Format	Units	Name	Description
0	8	double	s	`tgd`	Group delay differential between L1 and L2 (?)
8	8	double	m	`crs`	Amplitude of the sine harmonic correction term to the orbit radius
16	8	double	m	`crc`	Amplitude of the cosine harmonic correction term to the orbit radius
24	8	double	rad	`cuc`	Amplitude of the cosine harmonic correction term to the argument of latitude
32	8	double	rad	`cus`	Amplitude of the sine harmonic correction term to the argument of latitude
40	8	double	rad	`cic`	Amplitude of the cosine harmonic correction term to the angle of inclination
48	8	double	rad	`cis`	Amplitude of the sine harmonic correction term to the angle of inclination
56	8	double	rad/s	`dn`	Mean motion difference
64	8	double	radians	`m0`	Mean anomaly at reference time
72	8	double		`ecc`	Eccentricity of satellite orbit
80	8	double	m^(1/2)	`sqrta`	Square root of the semi-major axis of orbit
88	8	double	rad	`omega0`	Longitude of ascending node of orbit plane at weekly epoch
96	8	double	rad/s	`omegadot`	Rate of right ascension
104	8	double	rad	`w`	Argument of perigee
112	8	double	rad	`inc`	Inclination
120	8	double	rad/s	`inc_dot`	Inclination first derivative
128	8	double	s	`af0`	Polynomial clock correction coefficient (clock bias)
136	8	double	s/s	`af1`	Polynomial clock correction coefficient (clock drift)
144	8	double	s/s^2	`af2`	Polynomial clock correction coefficient (rate of clock drift)
152	8	double	s	`toe_tow`	Time of week
160	2	u16	week	`toe_wn`	Week number
162	8	double	s	`toc_tow`	Clock reference time of week
170	2	u16	week	`toc_wn`	Clock reference week number
172	1	u8		`valid`	Is valid?
173	1	u8		`healthy`	Satellite is healthy?
174	1	u8		`prn`	PRN being tracked
	175				

Table 5.9.3: MSG_EPHEMERIS 0x001A message structure

6 Piksi Settings Summary

Piksi's firmware settings can be controlled by th eend user via the provided Piksi Console or through SBP. The following enumerates these settings with an explanation and any relevant notes.

Grouping	Name	Description
float_kf	phase_var	Assumed variance of a satellite's phase measurement
	code_var	Assumed variance of a satellite's pseudorange measurement
	amb_init_var	Initial integer ambiguity variance at filter initialization
	new_amb_var	Variance for new ambiguity measurements
frontend	antenna_selection	Determines which antenna to use.
iar	phase_var	Determines the measured carrier phase variance for use in the integer ambiguity resolution test loop.
	code_var	Determines the pseudocode variance for the integer ambiguity resolution subroutine.
sbp	obs_msg_max_size	Determines the maximum message length for raw observation sbp messages.
simulator	radius	Radius of the circle around which the simulated Piksi will move
	speed	Simulated tangential speed of Piksi
	phase_sigma	Standard deviation of noise added to the simulated carrier phase
	pseudorange_sigma	Standard deviation of noise added to the simulated pseudorange
	cn0_sigma	Standard deviation of noise added to the simulated signal to noise ratio.
	speed_sigma	Standard deviation of noise addition to simulated tangential speed.
	pos_sigma	Standard deviation of simulated single point position
	num_sats	The number of satellites for the simulator.
	mode_mask	Determines the types of position outputs for the simulator.
	base_ecef_x	Simulated base station position
	base_ecef_y	Simulated base station position
	base_ecef_z	Simulated base station position
	enabled	Toggles the Piksi internal simulator on and off
solution	soln_freq	The rate at which a solution is generated internally to the Piksi.
	known_baseline_d	Determines the baseline vector for the "init known baseline" feature.
	known_baseline_e	Determines the baseline vector for the "init known baseline" feature.
	known_baseline_n	Determines the baseline vector for the "init known baseline" feature.
	dgnss_solution_mode	Determines the type of RTK solution which will be output.

	dgnss_filter	Determines the type of carrier phase ambiguity resolution that the Piksi will attempt to achieve.
	output_every_n_obs	Integer divisor of solution frequency for which the observations will be output.
surveyed_position	broadcast	Broadcast surveyed base station location
	surveyed_alt	Surveyed altitude of the Piksi's antenna
	surveyed_lat	Surveyed latitude of the Piksi's antenna
	surveyed_lon	Surveyed longitude of the Piksi's antenna
system_info	firmware_built	Date of firmware build
	nap_fft_index_bits	Number of bits to represent the result of fast fourier transform in SwiftNAP firmware
	nap_channels	Number of tracking channels in the SwiftNAP firmware
	nap_version	Version of the SwiftNAP FPGA firmware.
	hw_revision	hardware revision for Piksi
	firmware_version	Indicates the firmware version for the Local Piksi
	serial_number	The serial number of the Piksi
system_monitor	heartbeat_period_milliseconds	Period for sending the SBP HEARTBEAT messages
telemetry_radio	configuration_string	Configuration string to send radio modem over UART when detected
uart_ftdi	mode	Configure mode for USB serial port on Piksi
	baudrate	The baudrate for the UART for the USB port on Piksi
	sbp_message_mask	Configure the message mask for SBP messages on the UART for the USB port on Piksi.
uart_uarta uart_uarta	mode	Configure mode for UART
	sbp_message_mask	Configure the message mask for SBP messages on UART
	configure_telemetry_radio_on_boot	Determines whether this UART will attempt to configure a telemetry radio upon boot
	baudrate	The baudrate for the UART
uart_uartb	mode	Configure mode for UART
	baudrate	The baudrate for the uart
	sbp_message_mask	Configure the message mask for SBP messages on UART
	configure_telemetry_radio_on_boot	Determines whether this UART will attempt to configure a telemetry radio upon boot

7 Settings Detail

7.1 Float Kf

phase_var

Assumed variance of a satellite's phase measurement

This setting adjusts variance estimates in the Swift Kalman filter which aids in integer ambiguity resolution (IAR). Increasing this value can reduce the occurrence of false carrier phase locks but can also increase the time required to achieve an IAR fixed solution. This setting should not be adjusted by end users.

Label	Value
group	*float_kf*
enumerated possible values	*None*
name	*phase_var*
units	$cycles^2$
default value	0.0144
type	*Double*

code_var

Assumed variance of a satellite's pseudorange measurement

This setting adjusts variance estimates in the Swift Kalman filter which aids in integer ambiguity resolution (IAR). Increasing this value can reduce the occurrence of false carrier phase locks but can also increase the time required to achieve an IAR fixed solution. This setting should not be adjusted by end users.

Label	Value
group	*float_kf*
enumerated possible values	*None*
name	*code_var*
units	$meters^2$
default value	40000
type	*Double*

amb_init_var

Initial integer ambiguity variance at filter initialization

This setting adjusts variance estimates in the Swift Kalman filter which aids in integer ambiguity resolution (IAR). Increasing this value can reduce the occurrence of false carrier phase locks but can also increase the time required to achieve an IAR fixed solution. This setting should not be adjusted by end users.

Label	Value
group	*float_kf*
enumerated	*None*
possible values	
name	*amb_init_var*
units	*nondimensional*
default value	$1.00E+08$
type	*Double*

new_amb_var

Variance for new ambiguity measurements

This setting adjusts variance estimates in the Swift Kalman filter which aids in integer ambiguity resolution (IAR). Increasing this value can reduce the occurrence of false carrier phase locks but can also increase the time required to achieve an IAR fixed solution. This setting should not be adjusted by end users.

Label	Value
group	*float_kf*
enumerated	*None*
possible values	
name	*new_amb_var*
units	*nondimensional*
default value	$1.00E+10$
type	*Double*

7.2 Frontend

antenna_selection

Determines which antenna to use.

This setting selects the antenna input that should be used by the Piksi. When set to "Auto", if the unit senses an external antenna attached to the Piksi from a load placed on the antenna output DC bias, it will use the external antenna. If no external antenna is attached (or a passive antenna is attached), it will use the integrated patch antenna. Selecting "Patch" or "External" for this setting can override the automatic antenna selection and force the external or patch antenna to be used.

Label	Value
group	*frontend*
enumerated possible values	*Auto*, *Patch*, *External*
name	*antenna_selection*
units	*None*
default value	*Auto*
type	*enum*

7.3 Iar

phase_var

Determines the measured carrier phase variance for use in the integer ambiguity resolution test loop.

This setting adjusts variance estimates in the integer ambiguity resolution (IAR) subroutine. Increasing this value can reduce the occurrence of false carrier phase locks but can also increase the time required to achieve an IAR fixed solution. This setting should not be adjusted by end users.

Label	Value
group	*iar*
enumerated possible values	*None*
name	*phase_var*
units	$cycles^2$
default value	0.0144
type	*double*

code_var

Determines the pseudocode variance for the integer ambiguity resolution subroutine.

This setting adjusts variance estimates in the integer ambiguity resolution (IAR) subroutine. Increasing this value can reduce the occurrence of false carrier phase locks but can also increase the time required to achieve an IAR fixed solution. This setting should not be adjusted by end users.

Label	Value
group	*iar*
enumerated possible values	*None*
name	*code_var*
units	$meters^2$
default value	40000
type	*double*

7.4 Sbp

obs_msg_max_size

Determines the maximum message length for raw observation sbp messages.

This parameter is useful for tuning observation messages for compatibility with radio modems. Some serial modems will internally split serial packets for their protocol and this parameter allows the size of the message to be reduced as to prevent the modem from sending multiple packets. If the parameter exceeds 255 bytes (the maximum size of an SBP message), the Piksi firmware will ignore the parameter and use 255 bytes. If the parameter is set smaller than the size of one observation, the Piksi firmware will ignore the parameter and use the size of one observation as the maximum message size.

Label	Value
group	*sbp*
enumerated possible values	*None*
name	*obs_msg_max_size*
units	*bytes*
default value	104
type	*integer*

7.5 Simulator

radius

Radius of the circle around which the simulated Piksi will move

Label	Value
group	*simulator*
enumerated	*None*
possible values	
name	*radius*
units	*meters*
default value	100
type	*double*

speed

Simulated tangential speed of Piksi

Label	Value
group	*simulator*
enumerated	*None*
possible values	
name	*speed*
units	*meters/s*
default value	4
type	*double*

phase_sigma

Standard deviation of noise added to the simulated carrier phase

Label	Value
group	*simulator*
enumerated	*None*
possible values	
name	*phase_sigma*
units	*cycles*
default value	0.0009
type	*double*

pseudorange_sigma

Standard deviation of noise added to the simulated pseudorange

Label	Value
group	*simulator*
enumerated	*None*
possible values	
name	*pseudorange_sigma*
units	*meters*
default value	16
type	*double*

cn0_sigma

Standard deviation of noise added to the simulated signal to noise ratio.

Label	Value
group	*simulator*
enumerated	*None*
possible values	
name	*cn0_sigma*
units	*dbmhz*
default value	0.1
type	*double*

speed_sigma

Standard deviation of noise addition to simulated tangential speed.

Label	Value
group	*simulator*
enumerated	*None*
possible values	
name	*speed_sigma*
units	$meters^2/s^2$
default value	0.02
type	*double*

pos_sigma

Standard deviation of simulated single point position

Label	Value
group	*simulator*
enumerated possible values	*None*
name	*pos_sigma*
units	$meters^2$
default value	2
type	*double*

num_sats

The number of satellites for the simulator.

Label	Value
group	*simulator*
enumerated possible values	*None*
name	*num_sats*
units	*None*
default value	9
type	*integer*

mode_mask

Determines the types of position outputs for the simulator.

bit 0 (decimal value 1) turns on single point position PVT simulated outputs bit 1 (decimal value 2) turns on the satellite tracking simulated outputs bit 2 (decimal value 4) turns on Float IAR simulated RTK outputs bit 3 (decimal value 8) turns on Fixed IAR simulated RTK outputs

Label	Value
group	*simulator*
enumerated possible values	*None*
name	*mode_mask*
units	*None*
default value	$15(decimal), 0xF(hexadecimal)$
type	*packedbitfield*

base_ecef_x

Simulated base station position

Earth centered earth fixed (ECEF) x position of the simulated base station.

Label	Value
group	*simulator*
enumerated possible values	*None*
name	*base_ecef_x*
units	*meters*
default value	*None*
type	*double*

base_ecef_y

Simulated base station position

Earth centered earth fixed (ECEF) y position of the simulated base station.

Label	Value
group	*simulator*
enumerated possible values	*None*
name	*base_ecef_y*
units	*meters*
default value	*None*
type	*double*

base_ecef_z

Simulated base station position

Earth centered earth fixed (ECEF) z position of the simulated base station.

Label	Value
group	*simulator*
enumerated possible values	*None*
name	*base_ecef_z*
units	*meters*
default value	*None*
type	*double*

enabled

Toggles the Piksi internal simulator on and off

The Piksi simulator will provide simulated outputs of a stationary base station and the Local Piksi moving in a circle around the base station The simulator is intended to aid in system integration by providing realistic looking outputs but does not faithfully simulate every aspect of device operation.

Label	Value
group	*simulator*
enumerated possible values	*true, false*
name	*enabled*
units	*None*
default value	*false*
type	*boolean*

7.6 Solution

soln_freq

The rate at which a solution is generated internally to the Piksi.

Label	Value
group	*solution*
enumerated possible values	*None*
name	*soln_freq*
units	*hz*
default value	10
type	*integer*

known_baseline_d

Determines the baseline vector for the "init known baseline" feature.

This sets the number of meters that the rover is Down from the base station when the "init known baseline" feature is used.

Label	Value
group	*solution*
enumerated possible values	*None*
name	*known_baseline_d*
units	*meters(down)*
default value	0
type	*double*

known_baseline_e

Determines the baseline vector for the "init known baseline" feature.

This sets the number of meters that the rover is East from the base station when the "init known baseline" feature is used.

Label	Value
group	*solution*
enumerated possible values	*None*
name	*known_baseline_e*
units	*meters(east)*
default value	0
type	*double*

known_baseline_n

Determines the baseline vector for the "init known baseline" feature.

This sets the number of meters that the rover is North from the base station when the "init known baseline" feature is used.

Label	Value
group	*solution*
enumerated possible values	*None*
name	*known_baseline_n*
units	*meters(north)*
default value	0
type	*double*

dgnss_solution_mode

Determines the type of RTK solution which will be output.

A "Low Latency" solution uses an internal model of anticipated satellite observations to provide RTK output with minimal latency but slightly reduced accuracy. "Low Latency" mode assumes that the base station is stationary. For applications where accuracy is desired over timelieness or when both Piksi's are moving, "Time matched" mode can be chosen. This means that the RTK output will require a corresponding set of correction observations for each timestamp.

Label	Value
group	*solution*
enumerated possible values	*LowLatency, TimeMatched*
name	*dgnss_solution_mode*
units	*None*
default value	*None*
type	*enum*

dgnss_filter

Determines the type of carrier phase ambiguity resolution that the Piksi will attempt to achieve.

If "fixed", the Piksi will output a integer fixed ambiguity estimate. If no fixed solution is available, it will revert to the float solution. If "float", the device will only output the float ambiguity estimate.

Label	Value
group	*solution*
enumerated possible values	*Fixed, Float*
name	*dgnss_filter*
units	*None*
default value	*Fixed*
type	*enum*

output_every_n_obs

Integer divisor of solution frequency for which the observations will be output.

For instance, if the solution frequency is 10 hz, and the "output every n obs" parameter is 2, it means that the observation output will occur at a rate of 5hz. Since the observations are the information used by the Piksi receiving corrections from the connected Piksi, this determines the rate of information sharing for RTK solution output. This parameter is designed to tune the rate at which correction information is passed from one Piksi to the other as to efficiently use radio modem bandwidth and fit with user applications.

Label	Value
group	*solution*
enumerated possible values	*None*
name	*output_every_n_obs*
units	*None*
default value	2
type	*integer*

7.7 Surveyed Position

broadcast

Broadcast surveyed base station location

This flag ultimately determines whether the SBP message with identifier MSG_BASE_POS will be calculated and sent. Logically, setting this attribute to "true" sets the Local Piksi as a base station and configures the unit to send its surveyed location coordinates to the other Piksi(s) with which the base station is communicating. If "true", the remote Piksi that receives the surveyed position will calculate and communicate a pseudo absolute RTK position based upon the received position.

Label	Value
group	*surveyed_position*
enumerated possible values	*true*, *false*
name	*broadcast*
units	*None*
default value	*false*
type	*boolean*

surveyed_alt

Surveyed altitude of the Piksi's antenna

This setting represents the altitude of the Piksi's antenna above the WGS84 ellipsoid. If surveyed position "broadcast" is set to "true", this coordinate will be communicated to remote Piksi's against which to calculate a pseudo-absolute position. This value should be precise to 1 cm. Any errors in the surveyed position will directly affect the pseudo-absolute RTK position measurement reported by the Rover.

Label	Value
group	*surveyed_position*
enumerated possible values	*None*
name	*surveyed_alt*
units	*meters*
default value	0
type	*Double*

surveyed_lat

Surveyed latitude of the Piksi's antenna

This setting represents the latitude of the local Piksi's antenna. If surveyed position "broadcast" is set to "true", the coordinate will be communicated to remote Piksis with which to calculate their pseudo-absolute RTK position. The value should be as accurate as possible and should have precision to at least 7 digits following the decimal point. For reference, 1e-7 degrees of latitude is about 1.1cm on the surface of the earth. Any errors in the surveyed position will directly affect the pseudo-absolute RTK position measurement reported by the remote Piksi.

Label	Value
group	*surveyed_position*
enumerated possible values	*None*
name	*surveyed_lat*
units	*degrees*
default value	0
type	*Double*

surveyed_lon

Surveyed longitude of the Piksi's antenna

This setting represents the longitude of the local Piksi's antenna. If surveyed position "broadcast" is set to "true", the coordinate will be communicated to remote Piksis with which to calculate their pseudo-absolute RTK position. The value should be as accurate as possible and should have precision to at least 7 digits following the decimal point. For reference, 1e-7 degrees of longitude at 35 degree latitude is about 1 cm. Any errors in the surveyed position will directly affect the pseudo-absolute RTK position measurement reported by the remote Piksi.

Label	Value
group	*surveyed_position*
enumerated possible values	*None*
name	*surveyed_lon*
units	*degrees*
default value	0
type	*Double*

7.8 System Info

firmware_built

Date of firmware build

Label	Value
group	*system_info*
enumerated possible values	*None*
name	*firmware_built*
units	*None*
default value	*None*
type	*string*

nap_fft_index_bits

Number of bits to represent the result of fast fourier transform in SwiftNAP firmware

Label	Value
group	*system_info*
enumerated possible values	*None*
name	*nap_fft_index_bits*
units	*None*
default value	*None*
type	*None*

nap_channels

Number of tracking channels in the SwiftNAP firmware

Label	Value
group	*system_info*
enumerated possible values	*None*
name	*nap_channels*
units	*None*
default value	*None*
type	*integer*

nap_version

Version of the SwiftNAP FPGA firmware.

Label	Value
group	*system_info*
enumerated possible values	*None*
name	*nap_version*
units	*None*
default value	*None*
type	*integer*

hw_revision

hardware revision for Piksi

Label	Value
group	*system_info*
enumerated possible values	*None*
name	*hw_revision*
units	*None*
default value	*None*
type	*string*

firmware_version

Indicates the firmware version for the Local Piksi

For user generated firmware, this information will appear the same as the git command: "git describe –dirty"

Label	Value
group	*system_info*
enumerated possible values	*None*
name	*firmware_version*
units	*None*
default value	*None*
type	*string*

serial_number

The serial number of the Piksi

This number should match the number on the barcode and cannot be modified

Label	Value
group	*system_info*
enumerated possible values	*None*
name	*serial_number*
units	*None*
default value	*None*
type	*integer*

7.9 System Monitor

heartbeat_period_milliseconds

Period for sending the SBP_HEARTBEAT messages

Label	Value
group	*system_monitor*
enumerated	*None*
possible values	
name	*heartbeat_period_milliseconds*
units	*None*
default value	*None*
type	*integer*

7.10 Telemetry Radio

configuration_string

Configuration string to send radio modem over UART when detected

This configuration string is intended for radios that use AT style commands

Label	Value
group	*telemetry_radio*
enumerated	*None*
possible values	
name	*configuration_string*
units	*None*
default value	*None*
type	*string*

7.11 Uart Ftdi

mode

Configure mode for USB serial port on Piksi

Label	Value
group	*uart_ftdi*
enumerated possible values	*SBP, NMEA, RTCM*
name	*mode*
units	*None*
default value	*SBP*
type	*enum*

baudrate

The baudrate for the UART for the USB port on Piksi

Label	Value
group	*uart_ftdi*
enumerated possible values	*None*
name	*baudrate*
units	*baud*
default value	1000000
type	*integer*

sbp_message_mask

Configure the message mask for SBP messages on the UART for the USB port on Piksi.

'The message mask is bitwise anded to the message identifier for a particular message. If the result is non-zero, the message will be sent over this UART. For example, consider the Piksi firmware sending an SBP message with ID 0x0041. If UART A has mask "64" (0x0040), The SBP subsystem bitwise-ands the message id with the UART A mask giving the result of 0x0040. Since the result is non-zero, the message is valid for UART A and is sent. Practically, the UART with mask 64 (0x0040) transmits only RTK observation data and the USART with mask 65280 (0xFF00) transmits most messages of interest to the host system (such as position and velocity). A mask of 0xFFFF will transmit all messages at the expense of bandwidth.'

Label	Value
group	$uart\_ftdi$
enumerated possible values	$None$
name	$sbp\_message\_mask$
units	$None$
default value	$65535(decimal), 0xFFFF(hex)$
type	$integer$

7.12 Uart Uarta

mode

Configure mode for UART

Label	Value
group	$uart\_uarta$
enumerated possible values	$SBP, NMEA, RTCM$
name	$mode$
units	$None$
default value	SBP
type	$enum$

sbp_message_mask

Configure the message mask for SBP messages on UART

The default message mask on this UART (0x0040) is appropriate for a radio to communicate observation messages to another Piksi. The out-of-the box configuration uses UART A for Piksi to Piksi communication.

Label	Value
group	*uart_uarta*
enumerated possible values	*None*
name	*sbp_message_mask*
units	*None*
default value	64(*decimal*), 0x0040(*hex*)
type	*integer*

configure_telemetry_radio_on_boot

Determines whether this UART will attempt to configure a telemetry radio upon boot

If a telemetry radio is connected to this UART, this should be set to true in order to send the configuration string to the radio.

Label	Value
group	*uart_uarta*
enumerated possible values	*true, false*
name	*configure_telemetry_radio_on_boot*
units	*None*
default value	*TRUE*
type	*boolean*

baudrate

The baudrate for the UART

The radio baudrate may be constrained by the particular RF equipment used for the telemetry radio.

Label	Value
group	*uart_uarta*
enumerated possible values	*None*
name	*baudrate*
units	*baud*
default value	115200
type	*integer*

7.13 Uart Uartb

mode

Configure mode for UART

Label	Value
group	*uart_uartb*
enumerated possible values	*SBP, NMEA, RTCM*
name	*mode*
units	*None*
default value	*SBP*
type	*enum*

baudrate

The baudrate for the uart

Label	Value
group	*uart_uartb*
enumerated possible values	*None*
name	*baudrate*
units	*baud*
default value	115200
type	*integer*

sbp_message_mask

Configure the message mask for SBP messages on UART

The default message mask on this uart (0xFF00) is appropriate for a general purpose interface to the Piksi.

Label	Value
group	*uart_uartb*
enumerated possible values	*None*
name	*sbp_message_mask*
units	*None*
default value	655280(*decimal*), 0x*FF*00(*hex*)
type	*integer*

configure_telemetry_radio_on_boot

Determines whether this UART will attempt to configure a telemetry radio upon boot

If a telemetry radio is connected to this UART, this should be set to true in order to send the configuration string to the radio.

Label	Value
group	*uart_uartb*
enumerated possible values	*true*, *false*
name	*configure_telemetry_radio_on_boot*
units	*None*
default value	*TRUE*
type	*boolean*