



# Trimble Kestrel SeismoGeodetic System (Model SG160-09) SG160 Command Reference

P/N 97333-00-CR

Rev B

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This manual provides the command set descriptions used for the Trimble Kestrel System (P/N 97333-00) and its related family of products.

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### Release notice

This is the October 2016 release of the Trimble Kestrel System ***Command Reference Format Specification***. (97333-00-CR) It applies to version 20150923\_1648 of the SG160-09 firmware.

### Product warranty information

For applicable product warranty information, please refer to the Warranty Card included with this Trimble SG160 product.

## Notation Conventions

The following notation conventions are used throughout REF TEK documentation:

Notation	Description
ASCII	Indicates the entry conforms to the American Standard Code for Information Interchange definition of character (text) information.
Binary	Indicates the entry is a raw, numeric value.
Hex	Indicates hexadecimal notation. This is used with both ASCII characters (0 – 9, A – F) and numeric values.
BCD	Indicates the entry is a numeric value where each four bits represents a decimal digit.
FPn	Indicates the entry is the ASCII representation of a floating-point number with n places following the decimal point.
<n>	Indicates a single 8-bit byte. When the contents are numeric, it indicates a hexadecimal numeric value; i.e. <84> represents hexadecimal 84 (132 decimal). When the contents are capital letters, it represents a named ASCII control character; i.e. <SP> represents a space character, <CR> represents a carriage return character and <LF> represents a line feed character.
MSB	Most Significant Byte of a multi-byte value.
MSbit	Most Significant Bit of a binary number.
LSB	Least Significant Byte of a multi-byte value.
LSbit	Least Significant Bit (bit 0) of a binary number.
YYYY	Year as a 4-digit number
DDD	Day of year
HH	Hour of day in 24-hour format
MM	Minutes of hour
SS	Seconds of minute
TTT	Thousandths of a second (milliseconds)
IIII	Unit ID number

n, ns	nano, nanosecond; $10^{-9} = 0.000000001$
u, us	micro, microsecond; $10^{-6} = 0.000001$
m, ms	milli, millisecond; $10^{-3} = 0.001$
K, KHz	Kilo, KiloHertz; $10^3 = 1,000$
M, MHz	Mega, MegaHertz; $10^6 = 1,000,000$
G, GHz	Giga, GigaHertz; $10^9 = 1,000,000,000$
Kb, KB	Kilobit, KiloByte; $2^{10} = 1,024$
Mb, MB	Megabit, MegaByte; $2^{20} = 1,048,576$
Gb, GB	Gigabit, GigaByte; $2^{30} = 1,073,741,824$

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## Contents

<b>1</b>	<b>Command Overview</b> .....	<b>1</b>
1.1	Command List .....	2
<b>2</b>	<b>Command Detail</b> .....	<b>3</b>
2.1	(AQ) Acquisition Control.....	3
2.2	(BT) Boot Status .....	4
2.3	(DM) Data Monitor.....	5
2.4	(FM) File Maintenance .....	6
2.4.1	File Transfer Protocol Overview .....	7
2.4.2	(Command = DL) Delete Files.....	10
2.4.3	(Command = EV) Event Files .....	11
2.4.4	(Command = GT) Get Files.....	12
2.4.5	(Command = LS) List Files .....	13
2.4.6	(Command = PT) Put Files.....	14
2.4.7	(Command = RN) Rename Files.....	15
2.5	(ID) Identify Unit and Software.....	16
2.6	(MF) Media Format.....	16
2.7	(PD) Datastream Parameters.....	17
2.7.1	(Command = AN) Antenna Configuration .....	18
2.7.2	(Command = DR) Displacement Reference Configuration .....	20
2.7.3	(Command = DS) Recording Destinations .....	21
2.7.4	(Command = GR) Raw GNSS Data Rate .....	22
2.7.5	(Command = ST) Station Information Configuration.....	23
2.7.6	(Command = TR) Trigger Configuration .....	23
2.8	(PN) Network Parameters .....	25
2.8.1	(Command = CP) CPU Module Network Parameters.....	26
2.8.2	(Command = RT) RTP Network Parameters .....	26
2.8.3	(Command = GN) GNSS Module Network Parameters.....	27
2.9	(PR) Parameter Request .....	28
2.9.1	Parameter Request Response.....	29
2.10	(PT) NTRIP Parameters.....	30
2.11	(RS) Reset Trimble Kestrel System .....	31
2.12	(RV) Revert Parameters .....	32
2.13	(SS) Status Information .....	32
2.13.1	(Status Type = AQ) Acquisition Status Response .....	33
2.13.2	(Status type = CD) Displacement Conn. Response .....	34
2.13.3	(Status type = CG) GNSS Conn. Response .....	34
2.13.4	(Status type = CK) Reference Clock Response.....	35

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2.13.5	(Status type = DK) Disk Status Response .....	36
2.13.6	(Status type = EN) Ethernet Status Response .....	36
2.13.7	(Status type = GC) GNSS Configuration Response .....	37
2.13.8	(Status type = GV) GNSS Version Response .....	40
2.13.9	(Status type = LE) LED Status Response .....	41
2.13.10	(Status type = NT) NTRIP Server Response .....	42
2.13.11	(Status type = RT) RTP Status Response .....	43
2.13.12	(Status type = SV) Satellite Vehicle Status Response .....	44
2.13.13	(Status type = US) Unit Status Response .....	46
2.13.14	(Status type = VS) Version Status Response .....	47
2.13.15	(Status type = WI) Wi-Fi Status Response .....	48
2.14	(ST) Self-Test .....	49
<b>3</b>	<b>Index</b> .....	<b>50</b>



## 1 Command Overview

### Command Format

```
{CC, ID, p1, p2...` XX<CR><LF>
```

### Response Format

```
}CC, ID, p1, p2...` XX<CR><LF>
```

Field	Description
{	(Open curly bracket) Indicate start of command
}	(Close curly bracket) Indicates start of a response
CC	2-character ASCII Command Code
ID	Up to 8 ASCII hex characters for Unit ID, or 0 for any Unit
,	(Comma) Delimits parameters
Px	Command-specific set of ASCII parameters
`	(Grave accent) Optional, not required if Checksum omitted
XX	8bit Checksum in ASCII hex characters (optional)
<CR>	ASCII carriage return character
<LF>	ASCII line feed character

The entire sequence is composed of ASCII characters (with the exception of the DM response and YMODEM transfers). Every recognized command generates at least one response.

A Unit ID of 0 addresses any and all units that can receive the command. The Unit ID field is never 0 in a response, but always indicates which unit issued the response.

The parameters are specific to each command or response. Spaces are ignored. The total command length cannot exceed 1024 bytes.

The value range listed for a given input parameter is the range for which an 'invalid parameter' error is not produced. Using values outside of the specified range may produce an 'invalid parameter' error or may be erroneously interpreted as a valid value.

The value range listed for a given output parameter includes all possible outputs. Parameters listed as U32, I16, etc. are all decimal values representable by unsigned 32-bit integer, signed 16-bit integer, etc. These numbers are formatted without leading zeroes or spaces.

Parameter values shown as some number of hex digits "0 – FFFFFFFF" have certain considerations. No more than the maximum number of digits shown is allowed. Values with fewer than the maximum number of digits are considered LSbit-aligned, so F is 15 and FF is 255.

The Checksum field is calculated by XORing the character data between the '{' or '}' and the ''. The checksum is not required for the command. If no '' is included, no checks are made. The response always includes the checksum.

As a general rule, if a command requires a minimum number of parameters to operate but too few are specified, then the response returns "ERR ..." where the missing parameter field is specified.

Example 1: The command "{RS,A123<CR><LF>" is invalid because of the missing reset type, so a response of "}RS,A123,ERR COMMAND`XX<CR><LF>" is generated.

Example 2: The command "{FM,A123,RN,/myfile<CR><LF>" is missing the second parameter to the RN sub-command, so a response of "}FM,A123,RN,ERR FILENAME 2<CR><LF>" is generated.

The P-mode of a parameter indicates whether a particular parameter is:

- R = Required and non-empty
- E = Required but may be empty
- O = Not required and may be empty if used

As a general rule, if a parameter is P-mode E and is used to set a value in the unit, as opposed to selecting a response, leaving the parameter empty leaves the current value unchanged. This allows parameters to be changed piecewise which eliminates the need for a read-modify-write operation.

Example 3: In the command "{RV,,DEFAULT" the Command parameter of "DEFAULT" is P-mode R, and so is required and cannot be empty. If it is omitted or empty, a response of "}RV,,ERR COMMAND`XX<CR><LF>" is generated.

Example 4: In the command "{PN,,CP,0,10.8.122.114,," the Ethernet Net Mask and Ethernet Gateway parameters are P-mode E and are present but empty. If the command is instead "{PN,,CP,0,10.8.122.114," which omits the Ethernet Gateway, a response of "}PN, ,CP,0,ERR GATEWAY`XX<CR><LF>" is generated.

Example 5: In the command "{SS,,RT" the RTP Instance is P-mode O and is omitted. The response is as defined in the command details. If the command is instead "{SS,,RT," where the RTP Instance is present but empty, the same response is returned.

All characters are case insensitive (e.g., "{FM" is the same as "{fm").

## 1.1 Command List

Cmd Code	Command Name	Function
AQ	Acquisition Control	Perform acquisition start/stop
BT	Boot Status	Get status of last boot
DM	Data Monitor	Get most recent data
FM	File Maintenance	Access files on disk
ID	Identify Unit	Get Unit ID and firmware version
MF	Media Format	Perform media formats (RAM, Disk, etc.)
PD	Datastream Parameters	Set datastream parameters
PN	Network Parameters	Set network parameters
PR	Parameter Request	Get parameters
PT	NTRIP Parameters	Set NTRIP parameters
RS	Reset	Perform resets
SS	Status	Get statuses
ST	Self-test	Perform self-tests





## 2 Command Detail

### 2.1 (AQ) Acquisition Control

This command starts and stops data acquisition. The actual process of starting or stopping acquisition may take a few seconds. This command sets the desired acquisition state; the acquisition status command should be used to query the current acquisition state.

A delay is provided to allow a user to leave the area without causing a false trigger upon starting acquisition. Acquisition starts or stops once the delay has elapsed after sending this command. A newly commanded delay value overrides any existing delay and re-starts the delay with the new value.

#### Product Usage:

SG160-09
X

#### Command Code: AQ

Parameter	P-mode	Description	Type and Range
P1	R	Acquisition Request	Y or N
P2	R	Delay	Seconds of delay before starting/stopping acquisition U32

#### Response for AQ

Parameter	Description	Type and Range
P1	Status	String ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.2 (BT) Boot Status

The Boot Status command returns information about the last CPU boot.

### Product Usage:

SG160-09
X

### Command Code: BT

### Response for BT

The Reset Code is for diagnostic purposes. The External reset cause usually means the watchdog circuit outside the CPU forced a CPU reset using its reset line. The Power on reset usually means the CPU was reset because external power was applied to the unit, or a Hard Reset command was issued. The Software reset usually means that the CPU reset itself in response to a Soft or Orderly Reset command being issued. The CPU Reset Count indicates the number of times the CPU has reset since the last firmware update; its value is maintained through power cycles.

Parameter	Description	Type and Range
P1	Reset Code	Reset cause code Hex: 0 – 3F 0x00000020 Watchdog 1 reset 0x00000010 Software reset 0x00000008 Watchdog 0 reset 0x00000004 Brown-out reset 0x00000002 Power on reset 0x00000001 External reset
P2	CPU Reset Count	U32

## 2.3 (DM) Data Monitor

The data monitor command controls the output of simple monitor data. This data is intended for simple display purposes, not for precise data analysis. Each command gets an immediate response that contains the latest data acquired; the same data is returned until new data is created.

This command is only applicable for the MRF data format.

### Product Usage:

SG160-09
X

### Command Code: DM

Parameter	P-mode	Description	Type and Range
P1	R	Stream	Stream number 1 – 4

### Response

The latest data acquired. In contrast to the general command format, this response contains some **BINARY DATA**. This data is only intended for a direct connection via a serial port, so the ASCII-only specification is waived in favor of less transmitted data. All DM responses contain one second worth of data, with the Sequence Number updated each time a new response is created. Each stream has its own sequence number progression.

Parameter	Description	Type and Range
P1	Stream	Stream number 1 – 4
P2	Sequence Number	Stream DM response sequence number U8
P3	Channels	Bitmap of included channels, LSbit is Channel 1 Hex: 0 – 3F Zero if no data available
P4	Overscales	Bitmap of overscaled channels, LSbit is Channel 1 Hex: 0 – 3F
P5	Frames	Number of multiplexed frames Decimal: 0 – 50 Zero if no data available
P6	Binary Data	Binary multiplexed sample data Little Endian signed 32-bit samples Data Length = Number of Channels * Number of Frames * 4 Bytes per Sample

## 2.4 (FM) File Maintenance

This is a command that allows files to be put, listed, deleted, and retrieved from disk. Files are transferred to and from the unit using a modified YMODEM protocol. Firmware updates are performed by sending new firmware files using the `FM, ,PT, /firmware/` command for each file followed by a Trimble Kestrel System reset. All firmware updates are then executed during boot.

### Command Code: FM

Parameter	P-mode	Description	Type and Range
P1	R	Command	DL – delete a file EV – event file listing GT – retrieve a file from the disk LS – list all files PT – put a file on the disk RN – renames (moves) a file or directory

### Response

An acknowledgement response is returned immediately for each FM command. It may take some time to power on the disk to generate further responses, so this first response indicates that the command has been received and is in progress. A further response is generated within 30 seconds after this one.

Parameter	Description	Type and Range
P1	Command	The command issued
P2	Acknowledge	String "IN PROGRESS"

---

## 2.4.1 File Transfer Protocol Overview

The file transfer protocol used in the Trimble Kestrel System is based on the YMODEM protocol. Some customizations have been made to the protocol for use in the Trimble Kestrel System. Refer to the commonly available "XMODEM/YMODEM PROTOCOL REFERENCE" (<http://textfiles.com/programming/ymodem.txt>).

The Trimble Kestrel System protocol runs in one of two modes:

1. C Mode: All packets acknowledged (based on "normal YMODEM").
2. G Mode: Acknowledge every 64th packet and last packet of file (based on "YMODEM with g option").

Three following three scenarios are supported:

1. User as Sender, Trimble Kestrel System as Receiver, C Mode
2. User as Sender, Trimble Kestrel System as Receiver, G Mode
3. User as Receiver, Trimble Kestrel System as Sender, C Mode

The following are customizations to the YMODEM protocol:

- No retries are attempted or allowed for timeouts or CRC errors.
- All timeouts are 10 seconds.
- Only CRC packets are supported (only 'C' or 'G' as packet start character).

Retrieving files from the Trimble Kestrel System is not a typical use case. Because the Trimble Kestrel System uses the REN-style (non-sequential) RTP mode to send data to RTPD, and in order to keep the protocol simple, the Trimble Kestrel System as Sender only supports C Mode.

### 2.4.1.1 Scenario 1: User as Sender, Trimble Kestrel System as Receiver, C Mode

Example based on XMODEM/YMODEM PROTOCOL REFERENCE, Figure 3.

User as Sender	System as Receiver
{fm,C004,pt, or {fm,C004,pt,/,c	
	}fm,C004,pt,IN PROGRESS
	}fm,C004,pt,RECEIVING
	C
SOH 00 FF foo.c <length> NUL[123] CRC CRC	
	ACK
	C
SOH 01 FE Data[128] CRC CRC	
	ACK
STX 02 FD Data[1024] CRC CRC	
	ACK
SOH 03 FC Data[128] CRC CRC	
	ACK
SOH 04 FB Data[100] CPMEOF[28] CRC CRC	
	ACK
EOT	
	ACK
	C
SOH 00 FF NUL[128] CRC CRC	
	ACK
	}fm,C004,pt,OK

### 2.4.1.2 Scenario 2: User as Sender, Trimble Kestrel System as Receiver, G Mode

Example based on XMODEM/YMODEM PROTOCOL REFERENCE, Figure 6.

User as Sender	System as Receiver
{fm,C004,pt,/,g	
	}fm,C004,pt,IN PROGRESS
	}fm,C004,pt,RECEIVING
	G
SOH 00 FF foo.c <length> NUL[123] CRC CRC	
	G
SOH 01 FE Data[128] CRC CRC	
STX 02 FD Data[1024] CRC CRC	
...	
SOH 3F C0 Data[128] CRC CRC	
SOH 40 BF Data[128] CRC CRC	
	ACK
STX 41 BE Data[1024] CRC CRC	
SOH 42 BD Data[100] CPMEOF[28] CRC CRC	
	ACK
EOT	
	ACK
	G
SOH 00 FF NUL[128] CRC CRC	
	}fm,C004,pt,OK

### 2.4.1.3 Scenario 3: Trimble Kestrel System as Sender, User as Receiver, C Mode

Example based on XMODEM/YMODEM PROTOCOL REFERENCE, Figure 3.

Notes:

- A NAK of the first EOT is supported. A second EOT will be transmitted (not counted as a retry). Some YMODEM implementations (e.g., TeraTerm) always NAK the first EOT.
- Only 128 byte packets are transmitted by the Trimble Kestrel System. This guarantees that an entire YMODEM packet will fit within a single RTP packet. In REN-style (non-sequential) RTP mode, this is necessary to ensure the User as Receiver receives complete YMODEM packets.

TRIMBLE KESTREL SYSTEM as Sender	User as Receiver
	{fm,C004,gt,/afile.txt
}fm,C004,gt,IN PROGRESS	
}fm,C004,gt,SENDING	
	C
SOH 00 FF foo.c <length> NUL[123] CRC CRC	
	ACK
	C
SOH 01 FE Data[128] CRC CRC	
	ACK
SOH 02 FD Data[128] CRC CRC	
	ACK
SOH 03 FC Data[128] CRC CRC	
	ACK
SOH 04 FB Data[100] CPMEOF[28] CRC CRC	
	ACK
EOT	
	NAK
EOT	
	ACK
	C
SOH 00 FF NUL[128] CRC CRC	
	ACK
}fm,C004,gt,OK 1	

## 2.4.2 (Command = DL) Delete Files

A single file is deleted if a file is specified (e.g., /mydir/myfile).

A directory is deleted (including all sub-directories and files recursively) if a directory is specified (e.g., /mydir1/mydir2/).

Once the First Response indicates "RECEIVING", the unit enters YMODEM transmit mode waiting for the user to initiate a YMODEM transfer. The transfer either completes successfully, with error, or times out.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Command	DL
P2	R	File specification	Full path of file or directory, ≤ 80 chars

### Response

A response for each file/directory deleted is returned. The last response contains an empty string to indicate completion of the command response.

Parameter	Description	Type and Range
P1	Command	DL
P2	File specification	Full path of file or directory deleted, or empty to indicate end, ≤ 80 chars
P3	Result	String, (Omitted if end) "DELETED" if file/directory deleted "ERR" if error trying to delete file/directory



### 2.4.3 (Command = EV) Event Files

#### Product Usage:

SG160-09
X

#### Response

A response for each event file on all installed disks is returned.

Parameter	Description	Type and Range
P1	Command	EV
P2	File	Full path of file or directory
P3	Date	Y-M-D, i.e. 2005-03-22
P4	Time	H-M, i.e. 15:37
P5	File Size	Decimal bytes

Once a response for all files has been returned, a final response is returned as follows. The File is an empty string to indicate that it is the final response.

Parameter	Description	Type and Range
P1	Command	EV
P2	File	Empty
P3	Status	String ≤ 80 chars "OK" "ERR ..." (variable length)

## 2.4.4 (Command = GT) Get Files

A single file is transferred if a file is specified (e.g., /mydir/myfile).

All files in a directory (not recursive) are transferred if a directory is specified (e.g., /mydir1/mydir2/).

Once the First Response indicates "SENDING", the unit enters YMODEM transmit mode waiting for the user to initiate a YMODEM transfer. The transfer either completes successfully, with error, or times out.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Command	GT
P2	R	File specification	Full path of file or directory, ≤ 80 chars

### First Response

This response is given first.

Parameter	Description	Type and Range
P1	Command	GT
P2	Response	String, ≤ 100 chars "SENDING" "ERR ..." (variable length)

### Second Response

If there was no error in the first response, but there was an error retrieving a file, this response is given second.

Parameter	Description	Type and Range
P1	Command	GT
P2	Response	String "ERR FILE"

### Third Response

If the second response was given, this response is given third.

Parameter	Description	Type and Range
P1	Command	GT
P2	Result	String, ≤ 100 chars "OK #" "ERR TX # OK" (# is the number of files transmitted successfully, as U32)

## 2.4.5 (Command = LS) List Files

### Product Usage:

SG160-09
X

### Response

A response for each file on the disk is returned. The last response contains an empty string to indicate completion of the command response.

Parameter	Description	Type and Range
P1	Command	EV
P2	File	Full path of file or directory, or empty to indicate end, ≤ 80 chars
P3	Date	YYYY-MM-DD, e.g. 2005-03-22 (Omitted if end)
P4	Time	HH:MM, e.g. 15:37 (Omitted if end)
P5	File Size	File size in bytes (Omitted if end) U32

Once a response for all files has been returned, a final response is returned as follows. The File is an empty string to indicate that it is the final response.

Parameter	Description	Type and Range
P1	Command	EV
P2	File	Empty
P3	Status	String ≤ 80 chars "OK" "ERR ..." (variable length)

## 2.4.6 (Command = PT) Put Files

Once the First Response indicates "RECEIVING", the unit enters YMODEM receive mode trying to initiate a YMODEM transfer from the user. The transfer either completes successfully, with error, or times out.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Command	PT
P2	R	File specification	Full path of directory, ≤ 80 chars
P3	O	Transfer Mode	G or C (or omit field for C Mode)

### First Response

This response is given first.

Parameter	Description	Type and Range
P1	Command	PT
P2	Response	String, ≤ 100 chars "RECEIVING" "ERR ..." (variable length)

### Second Response

If there was no error in the first response, but there was an error retrieving the file, this response is given second.

Parameter	Description	Type and Range
P1	Command	PT
P2	Response	String, "OK" "ERR RECEIVE"

## 2.4.7 (Command = RN) Rename Files

A file is renamed or moved if a file is specified (e.g., /mydir/myfile).

A directory is renamed or moved if a directory is specified (e.g., /mydir1/mydir2/).

The new name must be the same type (file or directory) as the existing name.

### Product Usage:

<b>SG160-09</b>
X

Parameter	P-mode	Description	Type and Range
P1	R	Command	RN
P2	R	Existing file directory name	Full path of file or directory, ≤ 80 chars
P3	R	New file or directory name	Full path of file or directory, ≤ 80 chars

### Response for RN

Parameter	Description	Type and Range
P1	Command	RN
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.5 (ID) Identify Unit and Software

The Identify command returns information about the firmware installed in the unit.

### Product Usage:

SG160-09
X

### Command Code: ID

### Response for ID

Parameter	Description	Type and Range
P1	CPU Version	String, ≤ 50 chars

## 2.6 (MF) Media Format

### Product Usage:

SG160-09
X

### Command Code: MF

The media format command is used to format the RAM or Disk. Formatting may take some time, so a first response is issued to indicate the operation is starting (or cannot start due to an error). If the operation started successfully, a second response is issued once the operation is completed or cannot complete due to an error.

Formatting the RAM causes the unit to reset shortly after the second response is issued.

Parameter	P-mode	Description	Type and Range
P1	R	Command	String, "RAM" "DISK"

### First Response for MF

Parameter	Description	Type and Range
P1	Command	String, repeated from command
P2	Result	String, ≤ 100 chars "STARTING" "ERR ..." (variable length)

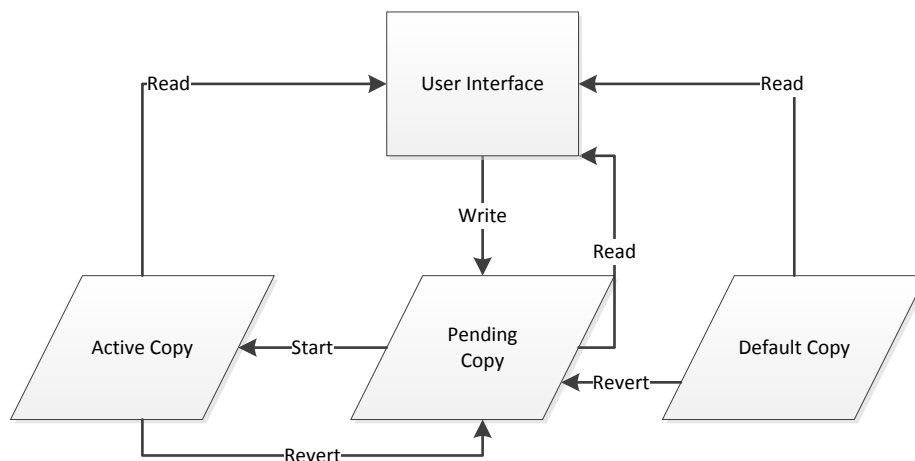
### Second Response for MF

Parameter	Description	Type and Range
P1	Command	String, repeated from command
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.7 (PD) Datastream Parameters

The datastream parameters set the conditions for data collection. Three copies of datastream parameters are stored in the unit, the Active Copy, the Pending Copy, and the Default Copy. The Active Copy is the set of parameters that is currently being used for acquisition if acquisition has been started. The Active Copy can only be read. The Pending Copy is the set of parameters that is moved to the Active Copy upon starting acquisition. The Pending Copy can be written, read, or reverted to the Active Copy or Default Copy.

This command is used to write the Pending Copy. Use the parameter request command to read the Active Copy or Pending Copy. Use the parameter revert command to copy the Active Copy or Default Copy to the Pending Copy. Use the acquisition control command to start acquisition, which automatically copies the Pending Copy to the Active Copy just prior to starting acquisition.



### Command Code: PD

Example:

```
PD, ,DS, 3, Y
```

sets the recording destination parameter in the Pending Copy to send data to RTP links 1 and 2 (indices 0 and 1) and to the disk.

When reading the datastream parameters using the PR command, fields beyond Type are not required.

Parameter	P-mode	Description	Type and Range
P1	R	Type	AN – Antenna DR – Displacement Reference DS – Recording destinations GR – Raw GNSS Data Rate ST – Station Information

---

### 2.7.1 (Command = AN) Antenna Configuration

This command sets the antenna configuration for use in the GNSS module. The Trimble antenna.ini file (installed with Trimble Configuration Utility) provides the codes and offsets that relate to these settings. All offsets in the **antenna.ini** file should be added to the measured height to calculate the true antenna height. In the **antenna.ini** file, the second number for each measurement method is the offset to use for calculating the displayed antenna height.

Example:

```
MeasMethod0=0.00000,0.08785,0.00000,"Bottom of antenna mount"
```

Here, the measurement method is code 0, the offset from phase center is 0.08785 meters, and the measurement method name is "Bottom of antenna mount".

The Antenna Height field is the true (phase center of the antenna) height of the antenna. The Antenna Type field is the code for the antenna as specified in the antenna.ini file. The Antenna Group should always be set to zero for the Trimble Kestrel System. The Measurement Method field is the code of the measurement method for a specific Antenna Type. This field is to be used by the UI along with the antenna.ini file to determine which height offset to apply before displaying the measured antenna height to the user. The Antenna Serial Number field is the serial number string of the antenna. The Radom Serial Number field is the serial number string of the radome.

Example, using "bottom of antenna mount" measurement method:

To generate and send this configuration:

- The user measures an antenna to be 1.1 meters from the ground by measuring the distance from the ground to the bottom of the antenna mount.
- The user inputs into the UI a height of 1.1 meters and a measurement method of "bottom of antenna mount".
- The UI, based on the currently selected antenna type, calculates the true height by adding the offset of the "bottom of antenna mount" measurement method. (If the offset is 0.1 meters, the true height is 1.2 meters).
- The UI sends the currently selected antenna type, "bottom of antenna mount" measurement method and calculated true height values to the Trimble Kestrel System.



To read and display this configuration:

- The UI reads the antenna type, measurement method and true height values from the Trimble Kestrel System.
- The UI, based on the received antenna type, calculates the measured height by subtracting the offset of the “bottom of antenna mount” measurement method. (If the offset is 0.1 meters and the true height reported 1.2 meters, the measured height is 1.1 meters.
- The UI displays the reported antenna type, measurement method and calculated measured height.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Type	AN
P2	E	Antenna Height	True antenna height, in micrometers 0 – 4000000
P3	E	Antenna Type	Antenna Type code from antenna.ini 0 – 65535
P4	E	Antenna Group	0
P5	E	Measurement Method	Antenna Measurement Method code from antenna.ini 0 – 255 A value of 255 is the code for true (phase center) height
P6	E	Antenna Serial Number	String, ≤ 31 chars
P7	E	Radome Serial Number	String, ≤ 31 chars

### Response

Parameter	Description	Type and Range
P1	Type	AN
P2	Result	String, ≤ 100 chars “OK” “ERR ...” (variable length)

## 2.7.2 (Command = DR) Displacement Reference Configuration

This command sets the reference position used to calculate the displacement stream values. The reference position is subtracted from each new position provided by the GNSS module. This difference is stored as a sample in the displacement stream of data. If the automatic reference is used, the first position acquired after acquisition is started is used as the reference position. The reference position remains the same until acquisition is stopped and started again.

The Automatic Reference field indicates whether to use the first position as a reference (Y) or the user configured position as a reference (N). The Reference Latitude/Longitude/Altitude fields are the user configured position to use as the reference position.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Type	DR
P2	E	Automatic Reference	Y or N
P3	E	Reference Latitude	In picodegrees -9000000000000000 – 9000000000000000
P4	E	Reference Longitude	In picodegrees -1800000000000000 – 1800000000000000
P5	E	Reference Altitude	In millimeters -2147483648 – 2147483647

### Response

Parameter	Description	Type and Range
P1	Type	DR
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

### 2.7.3 (Command = DS) Recording Destinations

#### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Type	DS
P2	E	Data RTP Link Mask	Bitmask RTP links for data. LSBit is RTP0. For each bit: 0 = Disabled 1 = Enabled Hex: 0 – 3
P3	E	Disk Enable	Y or N

#### Response

Parameter	Description	Type and Range
P1	Type	DS
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.7.4 (Command = GR) Raw GNSS Data Rate

## Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range																																						
P1	R	Type	GR																																						
P2	R	Data Rate Code	Data rate code where: <table border="1"> <thead> <tr> <th>Rate</th> <th>Code</th> </tr> </thead> <tbody> <tr> <td>Off</td> <td>0</td> </tr> <tr> <td>100 Hz</td> <td>16</td> </tr> <tr> <td>50 Hz</td> <td>15</td> </tr> <tr> <td>20 Hz</td> <td>13</td> </tr> <tr> <td>10 Hz</td> <td>1</td> </tr> <tr> <td>5 Hz</td> <td>2</td> </tr> <tr> <td>2 Hz</td> <td>11</td> </tr> <tr> <td>1 Hz</td> <td>3</td> </tr> <tr> <td>2 s</td> <td>4</td> </tr> <tr> <td>5 s</td> <td>5</td> </tr> <tr> <td>10 s</td> <td>6</td> </tr> <tr> <td>15 s</td> <td>12</td> </tr> <tr> <td>30 s</td> <td>7</td> </tr> <tr> <td>60 s</td> <td>8</td> </tr> <tr> <td>5 min</td> <td>9</td> </tr> <tr> <td>10 min</td> <td>10</td> </tr> <tr> <td>Triggered</td> <td>14</td> </tr> <tr> <td>Once</td> <td>255</td> </tr> </tbody> </table>	Rate	Code	Off	0	100 Hz	16	50 Hz	15	20 Hz	13	10 Hz	1	5 Hz	2	2 Hz	11	1 Hz	3	2 s	4	5 s	5	10 s	6	15 s	12	30 s	7	60 s	8	5 min	9	10 min	10	Triggered	14	Once	255
Rate	Code																																								
Off	0																																								
100 Hz	16																																								
50 Hz	15																																								
20 Hz	13																																								
10 Hz	1																																								
5 Hz	2																																								
2 Hz	11																																								
1 Hz	3																																								
2 s	4																																								
5 s	5																																								
10 s	6																																								
15 s	12																																								
30 s	7																																								
60 s	8																																								
5 min	9																																								
10 min	10																																								
Triggered	14																																								
Once	255																																								

## Response

Parameter	Description	Type and Range
P1	Type	GR
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.7.5 (Command = ST) Station Information Configuration

This command sets the station information.

The Station Name and Network Name fields are copied directly into the respective fields of the MRF MH header and MT trailer packets.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Type	ST
P2	E	Station Name	String, ≤ 6 chars Stored value truncated to first 6 characters, padded to the right with spaces if less than 6 characters. Must be at least 1 character.
P3	E	Network Name	String, ≤ 4 chars Stored value truncated to first 4 characters, padded to the right with spaces if less than 4 characters. Must be at least 1 character.

### Response

Parameter	Description	Type and Range
P1	Type	ST
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.7.6 (Command = TR) Trigger Configuration

This command sets the trigger parameters applied to the accelerometer stream to define the start of statistics calculation. Only certain trigger types and parameters apply. The format of the command depends on the trigger type selected.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Type	TR
P2	R	Trigger Type	EVT or LEV
P3, etc.	See below	Trigger Parameters	Parameters specific to the specified Trigger Type

### 2.7.6.1 (Trigger Type = EVT) Event Trigger Description

The Event trigger specifies that data will be recorded when the ratio between the Short Term Average (STA) and the Long Term Average (LTA) exceeds a specified ratio for a minimum number of trigger channels. Only channels that are included in the data stream may be used as trigger channels, but all included channels are recorded, even if they are not trigger channels. The length of the recording is always at least the length specified by the record length, but may be longer when a de-trigger ratio is specified. The post-trigger length is only used in conjunction with a de-trigger ratio.

Parameter	P-mode	Description	Type and Range
P1	R	Type	TR
P2	R	Trigger Type	EVT
P3	E	Trigger Channels	<empty>
P4	E	Minimum Channels	<empty>
P5	E	Trigger Window	<empty>
P6	E	Pre-trigger Length	<empty>
P7	E	Post-trigger Length	<empty>
P8	E	Record Length	<empty>
P9	E	STA Length	In seconds: FP3 ≥ 0.000
P10	E	LTA Length	In seconds: FP3 ≥ 0.000
P11	E	Trigger Ratio	FP2 ≥ 0.00
P12	E	De-trigger Ratio	<empty>
P13	E	LTA Hold	Y or N
P14	E	Low Pass Corner Freq.	String OFF or 12
P15	E	High Pass Corner Freq.	String OFF, 0.1, or 2

### 2.7.6.2 (Trigger Type = LEV) Level Trigger Description

The Level trigger specifies that data will be recorded when the amplitude of the data exceeds a specified threshold for any channel in the data stream.

The trigger level can be specified in several different ways. If the Unit field is 'G' then the Value field is interpreted as containing a level in G's. If the Unit field is 'M' then the Value field is interpreted as containing a level in milliG's. If the Unit field is '%' then the Value field is interpreted as containing a level as a percent of full scale. If the Unit field is 'C' then the Value field is interpreted as an integer number of digital counts.

Regardless of how the level is specified, it is converted to digital counts and compared against the absolute value of the data (after filtering, if filtering is enabled). If sensor sensitivity information is not available from the sensor itself, the unit assumes the presence of a 4G sensor for converting from a level in G's to digital counts.

Parameter	P-mode	Description	Type and Range
P1	R	Type	TR
P2	R	Trigger Type	LEV
P3	E	Unit	String G, M, %, or C
P4	E	Value	FP4 ≥ 0.0000
P5	E	Pre-trigger Length	<empty>
P6	E	Record Length	<empty>
P7	E	Low Pass Corner Freq.	String OFF or 12
P8	E	High Pass Corner Freq.	String OFF, 0.1, or 2

### Response

Parameter	Description	Type and Range
P1	Type	ST
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.8 (PN) Network Parameters

The network parameters set the TCP/IP configuration for the CPU. To ensure proper network operation, all processes that rely on the network functionality being changed should be restarted after changing the network parameters. Processes which would require a restart are ones such as RTP, FTP, any data streams that utilize TCP/IP, etc. The simplest solution is to restart the entire Trimble Kestrel System once all network parameters have been set to their desired values.

### Command Code: PN

Parameter	P-mode	Description	Type and Range
P1	R	Command	CP – CPU Module Network Parameters RT – RTP Network Parameters GN – GNSS Module Network Parameters

## 2.8.1 (Command = CP) CPU Module Network Parameters

The CPU and GNSS module are connected to an internal network switch which is also connected to the external Ethernet interface, so all three are nodes on the same physical network. If the CPU Ethernet IP Address is 0.0.0.0, the CPU attempts to acquire an IP address via DHCP. Otherwise, it uses the fixed IP address settings set by this command.

The entire Trimble Kestrel System needs to be restarted (e.g., orderly reset) after writing these parameters.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Command	CP
P2	R	Network Interface	0
P3	E	Ethernet IP Address	U8.U8.U8.U8
P4	E	Ethernet Net Mask	U8.U8.U8.U8
P5	E	Ethernet Gateway	U8.U8.U8.U8

### Response

Parameter	Description	Type and Range
P1	Command	CP
P2	Network Interface	0
P3	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.8.2 (Command = RT) RTP Network Parameters

The RTP instance being configured is automatically restarted after receiving this command.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Command	RT
P2	R	RTP Instance	0 – 1 RTP1 is 0, RTP2 is 1, etc.
P3	E	Server IP Address	IP address of RTPD server U8.U8.U8.U8
P4	E	Server UDP Port	U16



## Response

Parameter	Description	Type and Range
P1	Command	RT
P2	RTP Instance	0 – 1 RTP1 is 0, RTP2 is 1, etc.
P3	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

### 2.8.3 (Command = GN) GNSS Module Network Parameters

The CPU and GNSS module are connected to an internal network switch which is also connected to the external Ethernet interface, so all three are nodes on the same physical network. The GNSS module is configured to always use the static IP address set by this command.

The entire Trimble Kestrel System needs to be restarted (e.g., orderly reset) after writing these parameters.

#### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	R	Command	GN
P2	R	Network Interface	0
P3	E	GNSS IP Address	U8.U8.U8.U8
P4	E	GNSS Net Mask	U8.U8.U8.U8
P5	E	GNSS Gateway	U8.U8.U8.U8

## Response

Parameter	Description	Type and Range
P1	Command	GN
P2	Network Interface	0
P3	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.9 (PR) Parameter Request

The Parameter Request command causes the unit to report the parameters corresponding to the request. This is a generic parameter request that can be used with current and future parameter commands.

It is important to note that requesting the Active Copy is only valid for Datastream Parameters (PD). Reading Active Copy parameters for any other parameter may result in invalid values. Therefore, specify Pending Copy for non-Datastream Parameters.

Examples:

PR, , A, PD, DS

**retrieves the Active Copy Datastream Recording Destination Parameters.**

PR, , P, PD, DS

**retrieves the Pending Copy Datastream Recording Destination Parameters.**

PR, , D, PD, DS

**retrieves the Pending Copy Datastream Recording Destination Parameters.**

PR, , P, PN, CP, 0

**retrieves the Pending Copy CPU Module Network Parameters for the Ethernet0 interface. Even though "Pending Copy" is specified, this retrieves the actual network parameters being used.**

PR, , D, PN, CP, 0

**retrieves the Default Copy CPU Module Network Parameters for the Ethernet0 interface.**

**Product Usage:**

SG160-09
----------

X
---

**Command Code: PR**

Parameter	P-mode	Description	Type and Range
P1	R	Copy Code	A for Active Copy P for Pending Copy D for Default Copy
P2	R	Parameter Command Code	Parameter Command Code (PN, etc.)
P3	R	Parameter Command	Command field within Parameter Command Code (For PN: CP, RT, etc.)
P4, etc.	R	Command Arguments	Any necessary arguments to the specified Parameter Command (e.g., instance index, interface index, etc.)

## 2.9.1 Parameter Request Response

The Parameter Request response follows the same format as the specified Parameter Command Code and Parameter Command. An example, using the CPU Module Network Parameters:

### Request for PR,,P,PN,CP,0

Parameter	Description	Type and Range
P1	Copy Code	P for Pending Copy
P2	Parameter Command Code	PN
P3	Parameter Command	CP
P4	Network Interface (specific to PN,CP)	0

### Response for PR,,P,PN,CP,0

Parameter	Description	Type and Range
P1	Copy Code	P for Pending Copy
P2	Parameter Command Code	PN
P3	Parameter Command	CP
P4	Network Interface (specific to PN,CP)	0
P5	Ethernet IP Address	U8.U8.U8.U8
P6	Ethernet Net Mask	U8.U8.U8.U8
P7	Ethernet Gateway	U8.U8.U8.U8

## 2.10(PT) NTRIP Parameters

The NTRIP parameters set the conditions for the operation of the NTRIP server within the unit. The NTRIP server is a TCP link initiated by the GNSS module to the CPU module, which is tunneled through RTP as if it were a data stream. A change in these parameters takes effect immediately, forcing a reconnect of any existing NTRIP TCP connection.

Only one RTP link can be used for the NTRIP data. When set to Off, the NTRIP server is disabled.

The NTRIP RTP Link field selects which RTP link to tunnel NTRIP data through. The NTRIP Mount Point field is the mount point name to which the NTRIP Client will connect. The NTRIP Username and Password fields are the credentials used to connect to the NTRIP Caster.

The typical Mount Point is TGIP with the values of the Username and Password being ignored. This corresponds with TGIP Mode in other Trimble GNSS receivers, but the option of using other Mount Point, Username and Password values is available.

### Product Usage:

SG160-09
X

Parameter	P-mode	Description	Type and Range
P1	E	NTRIP RTP Link	0 for Off 1 for RTP1 2 for RTP2
P2	E	NTRIP Mount Point	String, ≤ 79 chars Typical: TGIP
P3	E	NTRIP Username	String, ≤ 32 chars Typical: <empty> (don't care)
P4	E	NTRIP Password	String, ≤ 32 chars Typical: <empty> (don't care)

### Response

Parameter	Description	Type and Range
P1	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.11(RS) Reset Trimble Kestrel System

The Trimble Kestrel System can be reset using one of three methods.

- The orderly reset performs an orderly shutdown followed by a CPU reset.
- The soft reset performs an immediate direct reset of the CPU.
- The hard reset performs an immediate direct power cycle of the entire unit.

Power cycles are implemented in dedicated hardware to perform the most thorough power cycle possible without physically disconnecting power from the unit. Any response is given prior to the reset sequence occurring, which begins a few seconds after receiving the command. The unit can be queried for status to determine when the reset is complete. Alternatively, the ID and BT responses are issued automatically once the reset is complete.

The GNSS module can be reset to factory defaults. This uses the internal serial port, so even if security is enabled on the module, the factory reset still works. An orderly Trimble Kestrel System reset should be issued after performing a GNSS factory reset so the GNSS module can then be re-configured by the CPU module during boot. Use the GNSS Configuration response to ensure that the factory Setup Action has completed before resetting the CPU module.

### Product Usage:

SG160-09
X

### Command Code: RS

Parameter	P-mode	Description	Type and Range
P1	R	Command	String, "ORDERLY" "SOFT" "HARD" "GNSS_FACTORY"

### Response for RS

Parameter	Description	Type and Range
P1	Command	String, repeated from command
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.12(RV) Revert Parameters

### Product Usage:

SG160-09
X

### Command Code: RV

This command causes the Pending Copy of the datastream parameters to revert to either the Active Copy or the Default Copy.

Parameter	P-mode	Description	Type and Range
P1	R	Command	String, "ACTIVE" "DEFAULT"

### Response for RV

Parameter	Description	Type and Range
P1	Command	String, repeated from command
P2	Result	String, ≤ 100 chars "OK" "ERR ..." (variable length)

## 2.13(SS) Status Information

The Status command causes the unit to report various kinds of status information. All status responses include the current time of the internal phase-locked clock.

### Command Code: SS

Parameter	P-mode	Description	Type and Range
P1	O	Status Type	See sub-command table. Omit or leave empty to get all sub-command responses.

### Sub-command Codes for SS

Function	Description	Return Information
AQ	Acquisition	Acquisition state, event count
CD	Displacement Conn.	Displacement data stream conn. status
CG	GNSS Conn.	GNSS data stream conn. status
CK	Reference Clock	Reference clock state
DK	Disk	Disk space total, used, available
EN	Ethernet Status	Physical Ethernet port connection status
GC	GNSS Configuration	GNSS module configuration status
GV	GNSS Version	GNSS module version
LE	LED Status	External LED display state
NT	NTRIP	NTRIP server state
RT	RTP	RTP status
SV	Satellite Vehicle	Satellite Vehicle Tracking status
US	Unit	Time, Temperature, Power
VS	Version	Code, FPGA versions
WI	Wi-Fi	Wi-Fi version and status

### 2.13.1 (Status Type = AQ) Acquisition Status Response

Acquisition takes some time to start and to stop. When starting, recording parameters are implemented and any ADCs are synchronized to the internal phase-locked clock. When stopping, all data packets waiting to be written to disk are flushed to disk. Therefore two states are presented, the Acquisition Request and Acquisition Active state.

#### Product Usage:

SG160-09
X

#### Response for SS,,AQ

Once acquisition has started Acquisition Active shows Y. Once acquisition has stopped Acquisition Active shows N. The Acquisition Requested state represents the last received request from the AQ command.

The Event in Progress field indicates whether any datastream that uses a non-continuous trigger has triggered and is presently recording data.

Parameter	Description	Type and Range
P1	Status Type	AQ
P2	Time	YYYY:DDD:HH:MM:SS
P3	Acquisition Requested	Y or N
P4	Acquisition Active	Y or N
P5	Event Count	Counter of MRF events: 1-9999
P6	Event in Progress	Y or N
P7	RAM Used	In Bytes: U32
P8	RAM Available	In Bytes: U32
P9	RAM Total	In Bytes: U32
P10	Acquisition Delay Left	In Seconds: U32

## 2.13.2(Status type = CD) Displacement Conn. Response

### Product Usage:

SG160-09
X

### Response for SS,,CD

The IP Address and Port fields are the values used when the CPU opens a TCP socket to the GNSS module to receive displacement data. The Connection Open field indicates if the connection is open or not. The Data Valid field indicates whether the last received epoch data was valid or not. The Reference Position fields indicate the reference position being used to calculate displacement values.

Parameter	Description	Type and Range
P1	Status Type	CD
P2	Time	YYYY:DDD:HH:MM:SS
P3	IP Address	U8.U8.U8.U8
P4	Port	U16
P5	Conn. Open	Y or N
P6	Data Valid	Y or N
P7	Reference Latitude	In picodegrees: -9000000000000000 – 9000000000000000
P8	Reference Longitude	In minutes: -1800000000000000 – 1800000000000000
P9	Reference Altitude	In millimeters: -6371000 – 2147483647

## 2.13.3(Status type = CG) GNSS Conn. Response

### Product Usage:

SG160-09
X

### Response for SS,,CG

The IP Address and Port fields are the values used when the CPU opens a TCP socket to the GNSS module to receive raw GNSS data (RT27). The Connection Open field indicates if the connection is open or not. The Buffer Overruns field indicates how many Bytestream packets were received via RTP but not delivered to the GNSS module due to the internal buffer being full.

Parameter	Description	Type and Range
P1	Status Type	CG
P2	Time	YYYY:DDD:HH:MM:SS
P3	IP Address	U8.U8.U8.U8
P4	Port	U16
P5	Conn. Open	Y or N
P6	Buffer Overruns	In packets: U32



### 2.13.4(Status type = CK) Reference Clock Response

The reference clock is the logic that handles aligning the internal phase-locked clock to the GNSS 1 PPS signal, as well as setting the time of the internal clock. The CPU receives GSOF messages from the internal GNSS module at 1 Hz along with the PPS signal.

#### Product Usage:

SG160-09
X

#### Response for SS,,CK

The IP Address and Port fields are the values used when the CPU opens a TCP socket to the GNSS module to receive 1 Hz time messages. The Connection Open field indicates if the connection is open or not. The Leap Second Valid field indicates whether the time includes a valid leap second value. The Last Status Flags field is the GSOF Time Position Flags 1 value in the last epoch received from the GNSS module. The Time Since Last Message field indicates the time passed since the last epoch was received from the GNSS module. The Position fields indicate the position from the GNSS module, averaged over the last 30 seconds of valid epochs.

The Position OK Time Series field shows a bitmap time series of the last 32 seconds worth of GSOF TIME messages that indicated a valid position (the 4 LSbits of GSOF Time Position Flag 2 are set). The Lock OK Time Series field shows the same as the Position OK Time Series bit-wise ANDed with a time series of valid PPS indicators. If the Position OK bit is 1 and a PPS pulse was not detected for that epoch, the Lock OK bit is 0. If the PPS pulse was detected, the Lock OK bit is 1.

Parameter	Description	Type and Range
P1	Status Type	CK
P2	Time	YYYY:DDD:HH:MM:SS
P3	IP Address	U8.U8.U8.U8
P4	Port	U16
P5	Connection Open	Y or N
P6	Leap Second Valid	Y or N
P7	Last Status Flags	Most recently received GSOF TIME Position Flags 1, as bitmask: Hex: 0 – FF Bit      Meaning 0      New position 0: No. 1: Yes. 1      Clock fix calculated for current position 0: No. 1: Yes. 2      Horizontal coordinates calculated this position 0: No. 1: Yes 3      Height calculated this position 0: No. 1: Yes. 4      Reserved. Always set. 5      Least squares position 0: No. 1: Yes. 6      Reserved. Always clear. 7      Position uses filtered L1 pseudoranges 0: No. 1: Yes.
P8	Time Since Last Msg.	In seconds: U32
P9	Position Valid	Y or N
P10	Position Latitude	In minutes: FP3: -5400.000 – 5400.000
P11	Position Longitude	In minutes: FP3: -10800.000 – 10800.000
P12	Position Altitude	In meters: -6371 – 2147483647
P13	Pos. OK Time Series	Hex: 0 – FFFFFFFF
P14	Lock OK Time Series	Hex: 0 – FFFFFFFF

### 2.13.5(Status type = DK) Disk Status Response

The disk status response reports the disk usage as of the last time the disk was powered on. If there was an error accessing the disk, as indicated by the SS,,LE response, then these values may be inaccurate.

#### Product Usage:

SG160-09
X

#### Response for SS,,DK

Parameter	Description	Type and Range
P1	Status Type	DK
P2	Time	YYYY:DDD:HH:MM:SS
P3	Disk 1 Total	In Mebibytes: Values < 1: FP3: 0.000 – 0.999 Values ≥ 1: U32
P4	Disk 1 Available	In Mebibytes: Values < 1: FP3: 0.000 – 0.999 Values ≥ 1: U32
P5	Disk 1 Used	In Mebibytes: Values < 1: FP3: 0.000 – 0.999 Values ≥ 1: U32

### 2.13.6(Status type = EN) Ethernet Status Response

The CPU and the internal Ethernet switch have physical link indicators. This response reflects the values of those indicators.

#### Product Usage:

SG160-09
X

#### Response for SS,,EN

The CPU Link Up field indicates whether the physical CPU Ethernet link is up or not. The switch fields indicate whether the respective links are up or not.

Parameter	Description	Type and Range
P1	Status Type	EN
P2	Time	YYYY:DDD:HH:MM:SS
P3	CPU Link Up	Y or N
P4	Switch CPU Link Up	Y or N
P5	Switch GNSS Link Up	Y or N
P6	Switch External Link Up	Y or N

### 2.13.7 (Status type = GC) GNSS Configuration Response

The CPU configures various GNSS module parameters and gathers GNSS module statuses at various times. The CPU also controls firmware updates of the GNSS module. To integrate this functionality into the CPU firmware architecture, three hierarchical state machines are used. This status command indicates the statuses of these state machines. The state machines are:

- The highest one manages a sequence of commands (Setup Action).
- The middle one manages which command is being performed (Configuration Action).
- The lowest one manages sending commands and receiving responses for a particular command (Configuration State).

All GNSS module parameters and statuses are communicated using a direct serial port connection. The firmware is updated over a TCP connection. A firmware update takes several minutes, so the FW fields of this status can be checked for the firmware update progress (percent complete).

The CPU firmware executes a single Setup Action, sequencing multiple Configuration Actions, at a time, but can queue up multiple Setup Actions for future execution.

For example, upon boot the SETUP\_FULL\_DELAYED Setup Action is initiated but takes around a minute to complete, during which time the SETUP\_GET\_SERIAL Setup Action is queued. Once the SETUP\_FULL\_DELAYED Setup Action completes, the SETUP\_GET\_SERIAL action is executed. Once all Setup Actions are completed, the Setup Action field of the SS,,GC response reports SETUP\_NONE.

Some commands, such as the SS,,SV command, initiate a Setup Action, queuing it if necessary. The SS,,GC response can be polled to see if an initiated Setup Action is complete.

#### Product Usage:

SG160-09
X

#### Response for SS,,GC

The IP Address, Net Mask, and Gateway fields are the actual IP values in use by the GNSS module. The IP Address is the one used for the firmware update TCP connection. The Setup Action field indicates which the sequence of commands currently executing (and their bit value in the Pending Setup field). The Setup Action Done field indicates the last completed sequence. The Configuration Action field indicates which specific command is being executed. The Configuration State field indicates which communication state a command is in. The Configuration Action Done field indicates the last completed Configuration Action. The Configuration Response field indicates the result of the last command. The Configuration Cancel field indicates whether or not a Configuration Action was canceled. The FW fields show the firmware update status messages provided by the GNSS module, truncated to 64 characters. The FW field messages are similar (or identical) to what is displayed in the GNSS module web UI when performing a firmware update. The Pending Setup field indicates which Setup Actions are pending and will be executed when the currently executing Setup Action is finished.

Parameter	Description	Type and Range
P1	Status Type	GC
P2	Time	YYYY:DDD:HH:MM:SS
P3	IP Address	U8.U8.U8.U8
P4	IP Net Mask	U8.U8.U8.U8
P5	IP Gateway	U8.U8.U8.U8
P6	Setup Action	String (bit value, Hex): SETUP_NONE (0) SETUP_FACTORY_RESET (1) SETUP_BOOT (2) SETUP_ACQ (4) SETUP_NTRIP (8) SETUP_GET_SERIAL (10) SETUP_GET_SVDATA (20)
P7	Setup Action Done	String: see Setup Action
P8	Configuration Action	String: GCA_NONE GCA_SETUP_RESET_APPFILES GCA_SETUP_RESET_RAM GCA_SETUP_RESET_FACTORY GCA_SETUP_GNSS GCA_SETUP_DISP GCA_SETUP_REF_CLK GCA_SETUP_PPS GCA_ENET_IP GCA_SETUP_NTRIP GCA_SETUP_NTRIP_EN GCA_SETUP_NTRIP_DIS GCA_SETUP_ANTENNA GCA_LOG_APPFILE GCA_LOG_SERIAL GCA_LOG_ENET GCA_LOG_APPFILE_ANTENNA GCA_FW_UPLOAD GCA_FW_REBOOT_DELAY GCA_SETUP_ENET_CFG GCA_REBOOT_DELAY GCA_LOG_SVDATA
P9	Configuration State	String: GCS_IDLE, GCS_REBOOT_DELAY_START GCS_REBOOT_DELAY GCS_SETUP_TX GCS_SETUP_RX GCS_ENET_TX GCS_ENET_RX GCS_ENET_REBOOT_DELAY_START GCS_ENET_REBOOT_DELAY GCS_LOG_TX GCS_LOG_RX GCS_FW_DOPEN GCS_FW_FOPEN GCS_FW_FSTAT GCS_FW_CON GCS_FW_CANCEL_TX GCS_FW_CANCEL_RX GCS_FW_STATUS_CANCEL_TX GCS_FW_STATUS_CANCEL_RX GCS_FW_UPLOAD_TX GCS_FW_UPLOAD_RX GCS_FW_STATUS_UPLOAD_TX GCS_FW_STATUS_UPLOAD_RX GCS_FW_STATUS_DONE_TX GCS_FW_STATUS_DONE_RX

Parameter	Description	Type and Range
		GCS_FW_REBOOT_DELAY_START GCS_FW_REBOOT_DELAY GCS_FW_REBOOT_CON GCS_FW_STATUS_REBOOT_TX GCS_FW_STATUS_REBOOT_RX
P10	Configuration Action Done	String: see Configuration Action
P11	Configuration Response	String: GCR_ACTION_INVALID GCR_REBOOT_DELAY_OK GCR_SETUP_OK GCR_SETUP_ERR_RECV GCR_ENET_OK GCR_ENET_ERR_RECV GCR_LOG_OK GCR_LOG_ERR_RECV GCR_FWU_OK GCR_FWU_ERR_DOPEN GCR_FWU_ERR_FOPEN GCR_FWU_ERR_FSTAT GCR_FWU_ERR_CONNECT GCR_FWU_ERR_CANCEL_TX GCR_FWU_ERR_CANCEL_RX GCR_FWU_ERR_STATUS_CANCEL_TX GCR_FWU_ERR_STATUS_CANCEL_RX GCR_FWU_ERR_FREAD GCR_FWU_ERR_UPLOAD_TX GCR_FWU_ERR_UPLOAD_RX GCR_FWU_ERR_STATUS_UPLOAD_TX GCR_FWU_ERR_STATUS_UPLOAD_RX GCR_FWU_ERR_STATUS_DONE_TX GCR_FWU_ERR_STATUS_DONE_RX GCR_FWU_ERR_REBOOT_CONNECT GCR_FWU_ERR_STATUS_REBOOT_TX GCR_FWU_ERR_STATUS_REBOOT_RX
P12	Reserved	N
P13	FW Active String	String, ≤ 64 chars, from GNSS module
P14	FW Status String	String, ≤ 64 chars, from GNSS module
P15	FW Detail String	String, ≤ 64 chars, from GNSS module
P16	Pending Setup	Bitmap of pending setup actions: Hex: 0 – FFFFFFFF

### 2.13.8(Status type = GV) GNSS Version Response

The CPU module gathers the R SERIAL DCOL response from the GNSS module asynchronously relative to the SS,,GV command. Therefore, the SS,,GV response returns only the latest gathered version data. Once the SS,,GV response is returned, the CPU then requests a new R SERIAL DCOL response from the GNSS module. The GNSS Configuration Response (SS,,GC) command can be used to check the status of the request.

#### Product Usage:

SG160-09
X

#### Response for SS,,GV

Refer to the Trimble DCOL documentation for expected values.

Parameter	Description	Type and Range
P1	Status Type	GV
P2	Time	YYYY:DDD:HH:MM:SS
P3	Receiver Serial #	String, ≤ 8 chars
P4	Receiver Type	String, ≤ 8 chars
P5	Nav Process Version	String, ≤ 5 chars Reports the version *100 with no decimal point. E.g., version 0.62 reports as 00062.
P6	Sig Process Version	String, ≤ 5 chars Reports the version *100 with no decimal point. E.g., version 0.62 reports as 00062.
P7	Boot Rom Version	String, ≤ 5 chars Reports the version *100 with no decimal point. E.g., version 0.62 reports as 00062.
P8	Antenna Serial #	String, ≤ 8 chars
P9	Antenna Type	String, ≤ 2 chars
P10	# Channels	String, ≤ 2 chars
P11	# Channels L1	String, ≤ 2 chars
P12	Long Serial Number	String, ≤ 10 chars
P13	Local Long Ant Serial	String, ≤ 31 chars
P14	Base Long Ant Serial	String, ≤ 31 chars
P15	Base NGS Ant Descriptor	String, ≤ 31 chars
P16	# Usable Channels	U16
P17	# Physical Channels	U16
P18	# Simultaneous Channels	U8
P19	Antenna INI Version	String, ≤ 5 chars

### 2.13.9 (Status type = LE) LED Status Response

The LED status reflects the state of the LEDs on the exterior of the unit. Generally, Off means off or not in use, Solid On means on or OK, Blinking means error or transient state.

#### Product Usage:

<b>SG160-09</b>
X

#### Response for SS,,LE

Parameter	Description	Type and Range
P1	Status Type	LE
P2	Time	YYYY:DDD:HH:MM:SS
P3	Time LED Status	0 if Off, 1 if Solid On, 2 if Blinking
P4	Acquisition LED Status	0 if Off, 1 if Solid On, 2 if Blinking
P5	Disk LED Status	0 if Off, 1 if Solid On, 2 if Blinking
P6	Wi-Fi LED Status	0 if Off, 1 if Solid On, 2 if Blinking
P7	Ethernet LED Status	0 if Off, 1 if Solid On, 2 if Blinking
P8	RTP Inst. 0 LED Status	0 if Off, 1 if Solid On, 2 if Blinking
P9	RTP Inst. 1 LED Status	0 if Off, 1 if Solid On, 2 if Blinking

### 2.13.10 (Status type = NT) NTRIP Server Response

The NTRIP server in the CPU listens for an incoming connection from the GNSS module. Then all data received from the GNSS module is passed on to the NTRIP server RTP link, and all data received from the NTRIP server RTP link is passed on to the GNSS module. If the NTRIP RTP Link is set to off, then no incoming connections are accepted. It is expected that almost all data through the connection is destined for the GNSS module and not sourced by it, so a Received Data Age field is included to indicate whether this data is flowing.

#### Product Usage:

SG160-09
X

#### Response for SS,,NT

The IP Address and Port fields are the values for the accepted connection from the GNSS module. The Connection Open field indicates if the connection is open or not. The Buffer Overruns field indicates how many Bytestream packets were received via RTP but not delivered to the GNSS module due to the internal buffer being full. The NTRIP RTP Link field indicates which RTP data is tunneled through. The Received Data Age field indicates the number of seconds since the last packet was received from the RTP link.

Parameter	Description	Type and Range
P1	Status Type	NT
P2	Time	YYYY:DDD:HH:MM:SS
P3	Conn. Open	Y or N
P4	IP Address	nnn.nnn.nnn.nnn
P5	Port	0 – 65535
P6	Buffer Overruns	0 – 4294967295
P7	NTRIP RTP Link	0 for Off 1 for RTP1 2 for RTP2
P8	Received Data Age	Seconds since last received NTRIP data. 0 – 4294967295



### 2.13.11 (Status type = RT) RTP Status Response

The RTP links maintain several pieces of state information. This information is provided here mostly for diagnostic purposes. The RTP State field is typically the most useful, indicating the connection state of the RTP link state machine (similar to TCP handshake).

#### Product Usage:

SG160-09
X

#### Command for SS,,RT

Parameter	P-mode	Description	Type and Range
P1	R	Status Type	RT
P2	O	RTP Instance	0 – 1 RTP1 is 0, RTP2 is 1, etc. Omit or leave empty to receive all instances

#### Response for SS,,RT

The RTP Instance field indicates which instance this response is for. The RTP State is the state of the RTP client link state machine. The Tx Queue Oldest Sequence is the sequence number of the oldest packet in the transmit queue (waiting to be acknowledged). The Tx Queue Count field is the number of physical packets in the transmit queue. The Rx Queue Oldest Sequence is the sequence number of the oldest packet in the receive queue (waiting to be reordered before consumption). The Rx Queue Count field is the number of physical packets in the receive queue. The Restart Count is the number of synchronization retries left before the connection attempt is restarted. The Server IP and Port fields are the UDP address and port number of the RTPD server. The Local Port is the port number is the port number used for receiving packets. The Uptime is the time the link has been open.

Parameter	Description	Type and Range
P1	Status Type	RT
P2	Time	YYYY:DDD:HH:MM:SS
P3	RTP Instance	0 – 1 RTP1 is 0, RTP2 is 1, etc.
P4	Network Interface	0
P5	RTP State	0 for Closed (Down) 1 for Discover (Down) 2 for Sync Sent (Sync) 3 for Ack Sent (Sync) 4 for Ack Received (Sync) 5 for Opened (Connected) 6 for Sync Delayed (Sync)
P6	Line Mode	B for backfill
P7	Tx Queue Oldest Sequence	Hex: 0 – FFFF
P8	Tx Queue Count	U32
P9	Rx Queue Oldest Sequence	Hex: 0 – FFFF
P10	Rx Queue Count	U32
P11	Restart Count	U8
P12	Server IP	U8.U8.U8.U8
P13	Server Port	U16
P14	Local Port	U16
P15	Uptime	In seconds:U32

### 2.13.12 (Status type = SV) Satellite Vehicle Status Response

This response provides the satellite tracking status of the GNSS module. The values reported by this response are those provided by DCOL response 17h SVDATA, from the "new" "Eclipse-GNSS" data format. **Refer to the Trimble DCOL documentation for conversions.**

The CPU module gathers the SVDATA DCOL response from the GNSS module asynchronously relative to the SS,,SV command. Therefore, the SS,,SV response returns only the latest gathered SV data. Once the SS,,SV response is returned, the CPU then requests a new SVDATA DCOL response from the GNSS module. It is intended that this command be issued periodically while monitoring the status of satellites, every few seconds, to both retrieve the latest SV data and initiate another request of the SV data. **The GNSS Configuration Response (SS,,GC) command can be used to check the status of the request.**

This command returns three types of responses. The Overall Response is always returned first, followed by a number of Satellite Responses as indicated by the **Number of Satellites** field in the Overall Response. A Final Response is always returned last.

#### Product Usage:

SG160-09
X

#### Overall Response for SS,,SV

This response is followed by satellite responses for each of the tracked satellites. The Number of Satellites field indicates how many satellite responses follow. The Data Time field indicates the time when the returned SV data was received from the GNSS module.

Parameter	Description	Type and Range
P1	Status Type	SV
P2	Time	YYYY:DDD:HH:MM:SS
P3	Number of Satellites	0 – 99
P4	Data Time	YYYY:DDD:HH:MM:SS If no SV data available yet, 2000:001:00:00:00

## Satellite Response for SS,,SV

The SV Number field is the satellite number. The system field is the satellite system (GPS, GLONASS, etc.). The GLONASS FDMA# is the FDMA number for GLONASS and whose value is only valid when the GLONASS system code is indicated. The Azimuth field indicates the azimuth of the satellite. The Elevation field indicates the elevation of the satellite. The Number of Sub-channels indicates how many sub-channels are included in the response. The Code Type, Frequency, and SNRx4 fields indicate the sub-channel details for each sub-channel present in the response.

Parameter	Description	Type and Range
P1	Status Type	SV
P2	Time	YYYY:DDD:HH:MM:SS
P3	SV Number	0 – 255
P4	System	0 – 255
P5	GLONASS FDMA#	Irrelevant when System does not indicate GLONASS -7 – 13
P6	Azimuth	In degrees 0 – 359
P7	Elevation	In degrees 0 – 90
P8	Number of Sub-channels (n)	0 – 255
P9-P11 repeated n times		
P9	Code Type	0 – 255
P10	Frequency	0 – 255
P11	SNRx4 (CNo)	0 – 255

## Final Response for SS,,SV

This response indicates that all SS,,SV responses have finished being sent. The Result field indicates whether all SV data was returned or if the SVDATA DCOL response is too large to fit in the internal CPU buffer.

Parameter	Description	Type and Range
P1	Status Type	SV
P2	Time	YYYY:DDD:HH:MM:SS
P3	Result	String "OK" "ERR DATA LENGTH"

## 2.13.13 (Status type = US) Unit Status Response

### Product Usage:

SG160-09
X

### Response for SS,,US

The External Voltage field indicates the voltage of the external voltage input. The External Current field indicates the current at the external voltage input. The Battery Voltage indicates the voltage at the battery voltage input. The Battery Current indicates the current at the battery voltage input. The RAM Backup field indicates the voltage of the battery that maintains SRAM through power cycles. The Temperature field indicates the temperature measured by the CPU. The CPU Reset Count indicates the number of times the CPU has reset since the last firmware update; its value is maintained through power cycles. The Firmware CRC OK indicates whether the firmware in internal CPU flash has passed a CRC check. The Rail Count indicates the number of power supply voltage rails in the system. The Rail Nominal and Rail Measured fields are repeated for as many rails as are in the system, indicating the nominal voltage and measured voltage for each rail.

Parameter	Description	Type and Range
P1	Status Type	US
P2	Time	YYYY:DDD:HH:MM:SS
P3	External Voltage	0.000 – 65.535 Volts
P4	External Current	0.000 – 65.535 Amps
P5	Battery Voltage	0.000 – 65.535 Volts
P6	Battery Current	0.000 – 65.535 Amps
P7	RAM Backup	0.000 – 65.535 Volts
P8	Temperature	In degrees Celsius: FP3: -2147483.648 – 2147483.648
P9	CPU Reset Count	U32
P10	Firmware CRC OK	Y or N
P11	Rail Count (n)	6
P12	Rail Nominal	-32.768 – 32.768 Volts
P13	Rail Measured	-32.768 – 32.768 Volts
P12-P13 repeated	Rails, continued	Repeat Rail Nominal and Rail Measured n times, one for each rail present.

### 2.13.14 (Status type = VS) Version Status Response

The unit is comprised of four internal modules linked by a bus interface. Each module contains a number of circuit boards. All modules and circuit boards contain certain identification information. This response returns those statuses. The CPU is capable of addressing 7 modules at a time, but not all modules slots are occupied by a physical module. This is a generic response that can report the status of any number of modules and boards that the CPU supports.

#### Product Usage:

SG160-09
X

#### Command for SS,,VS

The Module Number field indicates which modules to report on.

Parameter	P-mode	Description	Type and Range
P1	R	Status Type	VS
P2	O	Module Number	Module Number, 0 – 7 Omit or leave empty to receive overall and all modules responses 0 to receive just overall response 1 – 7 to receive individual module response

#### Overall Response for SS,,VS

This response is followed by module responses for the number of modules specified by Module Count if all module responses were requested. The CPU Version and LED version fields are the version strings of the CPU firmware and LED firmware respectively.

Parameter	Description	Type and Range
P1	Status Type	VS
P2	Time	YYYY:DDD:HH:MM:SS
P3	CPU Version	String, ≤ 50 chars
P4	LED Version	String, ≤ 50 chars
P5	Max Module Count	7

## Module Response for SS,,VS

Parameters P5 and beyond are omitted if no module is installed or the module is not defined. The Module Acronym is the 3 character type identifier of the module. The Board Count indicates how many Board ID fields are included in this response. The Board ID is the identification information stored in the EEPROM of that board (formatted similar to: REFTEK=RT0632D BOM=01 SN=7095 FPGA=1 TYPE=FPG). The Module Gate Array ID is the firmware version of the FPGA in the module (blank if not applicable).

Parameter	Description	Type and Range
P1	Status Type	VS
P2	Time	YYYY:DDD:HH:MM:SS
P3	Module Number	1 – 7
P4	Module Acronym	String, 3 chars CPU for CPU module PWR for power module ATD for analog-to-digital converter module GPS for GNSS module NON if no module installed UND if module not defined
P5	Board Count (n)	1 – 4
P6, repeated n times	Board ID	String, ≤ 64 chars
P7	Module Gate Array ID	String, ≤ 7 chars

### 2.13.15 (Status type = WI) Wi-Fi Status Response

The Wi-Fi module acts as a software access point. When powered on it attempts to create and join a network specific to the Unit ID of the unit. The Wi-Fi module is powered off 30 minutes from the last command sent via Wi-Fi. The Wi-Fi connection is available as long as the Joined field is Y and the Joined Time Left field is non-zero.

#### Product Usage:

SG160-09
X

#### Response for SS,,WI

The Wi-Fi Firmware Version field indicates the firmware version of the Wi-Fi module itself. The Joined field indicates whether or not the Wi-Fi module has successfully created and joined its access point. If the Wi-Fi module is joined, the Joined Time Left field indicates the time left before the Wi-Fi module is powered off.

Parameter	Description	Type and Range
P1	Status Type	WI
P2	Time	YYYY:DDD:HH:MM:SS
P3	Wi-Fi Firmware Version	String, ≤ 100 chars
P4	Joined	Y or N
P5	Joined Time Left	In milliseconds: 0 – 1800000

## 2.14 (ST) Self-Test

Request a self-test to be performed.

### Product Usage:

SG160-09
X

### Command Code: ST

Parameter	P-mode	Description	Type and Range
P1	R	Test Type	String "SENSOR"

The sensor self-test commands the accelerometer sensor to apply its self-test signal for two seconds.

### Response for ST

The self-test command takes some time to start, so two responses are given for the ST command. The first response acknowledges that the command was received and the test is starting. The second response indicates whether the test started successfully or not.

#### First Response

This response is given first to acknowledge the command.

Parameter	Description	Type and Range
P1	Response	String "STARTING"

#### Second Response

This response is given second to indicate whether the test was successfully started or not.

Parameter	Description	Type and Range
P1	Response	String, ≤ 100 chars "OK" "ERR ..." (variable length)



## 3 Index

<b>A</b>		<b>I</b>	
Active Copy		ID - Identify Unit .....	16
<b>PD</b> Command .....	17	<b>L</b>	
<b>PR</b> Command .....	28	LE – <b>SS</b> LED Status .....	41
<b>AN</b> Antenna Configuration .....	19	Level Trigger - LEV .....	25
<b>AQ</b> - Acquisition Control .....	3	LS - List Files .....	13
<b>AQ</b> – <b>SS</b> Acq Status .....	33	<b>M</b>	
<b>B</b>		MF - Media Format .....	16
<b>BT</b> - Boot Status .....	4	<b>N</b>	
<b>C</b>		NT – <b>SS</b> NTRIP Server Status .....	42
<b>CD</b> – <b>SS</b> Displacement Status .....	34	<b>P</b>	
<b>CG</b> – <b>SS</b> GNSS Conn Status .....	34	<b>PD</b> - Datastream Parameters .....	17
<b>CK</b> – <b>SS</b> Reference Clock Status .....	35	Pending Copy	
<b>CP</b> – CPU Module Network Parameter .....	26	<b>PD</b> Command .....	17
<b>D</b>		<b>PR</b> Command .....	28
<b>DE</b> – Delete Files .....	10	<b>PN</b> - Network Parameters .....	25
Default Copy		<b>PR</b> - Parameter Request .....	28
<b>PD</b> Command .....	17	<b>PT</b> - NTRIP .....	30
<b>PR</b> Command .....	28	<b>PT</b> - Put Files .....	14
<b>DK</b> – <b>SS</b> Disk Status .....	36	<b>R</b>	
<b>DM</b> - Data Monitor .....	5	<b>RN</b> - Rename Files .....	15
<b>DR</b> Displacement Reference Configuration .....	20	<b>RS</b> - Reset System .....	31
<b>DS</b> Recording Destination .....	21	<b>RT</b> - RTP Network Parameter .....	26
<b>E</b>		<b>RT</b> – <b>SS</b> RTP Status .....	43
<b>EN</b> – <b>SS</b> Ethernet Status .....	36	<b>RV</b>	
<b>EV</b> - Event Files .....	11	Revert Parameters .....	32
Event Trigger - EVT .....	24	<b>S</b>	
<b>F</b>		SS	
file transfer		<b>AQ</b> - Acquisition .....	33
supported .....	7	<b>CD</b> - Displacement Conn .....	34
YMODEM .....	7	<b>CG</b> – GNSS Conn .....	34
<b>FM</b> - File Maintenance .....	6	<b>CK</b> - Reference Clock .....	35
<b>G</b>		<b>DK</b> - Disk Status .....	36
<b>GC</b> – <b>SS</b> GNSS Config Status .....	38	<b>EN</b> – Ethernet .....	36
<b>GN</b> – GNSS Module Network Parameter .....	27	<b>GC</b> - GNSS Config .....	38
<b>GR</b> RAW GNSS Data Rate .....	22	<b>GV</b> - GNSS Version .....	40
<b>GT</b> - Get Files .....	12	<b>LE</b> – LED .....	41
<b>GV</b> – <b>SS</b> GNSS Version Status .....	40	<b>NT</b> - NTRIP Server .....	42
<b>H</b>		<b>RT</b> - RTP Status .....	43
<b>I</b>		<b>US</b> - Unit Status .....	46
<b>J</b>		<b>VS</b> - Version Status .....	47
<b>K</b>		<b>WI</b> - Wi-Fi Status .....	48
<b>L</b>			
<b>M</b>			
<b>N</b>			
<b>O</b>			
<b>P</b>			
<b>Q</b>			
<b>R</b>			
<b>S</b>			
<b>T</b>			
<b>U</b>			
<b>V</b>			
<b>W</b>			
<b>X</b>			
<b>Y</b>			
<b>Z</b>			



**ST** - Self-Test Command.....49  
**ST** Station Information Configuration.....23

**T**

**TR** Trigger Configuration .....23

**U**

**US – SS** Unit Status.....46

**V**

**VS – SS** Version Status .....47

**W**

**WI – SS** Wi-Fi Status Response.....48



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