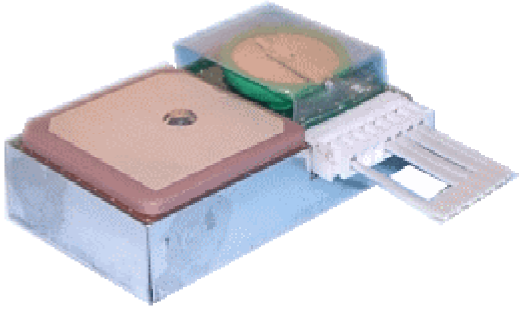
S A N J O S E N A V I G A T I O N , I N C .

Professional in Navigation & Communication

OEM GPS Receiver/Antenna Module

FV-18BK



User Manual

Preliminary Version

Please read this manual before operating the unit

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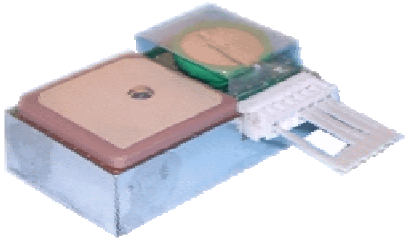
ISO 9001
NO. T2000-351

Content

Chapter 1 Overview

Congratulations on the purchase of **FV-18BK**, a new member of our successful GPS receiver / antenna module family. You will find the device an ***accurate***, ***reliable*** and ***useful*** aid to your positioning pursuits.



1.1 Introduction of FV-18BK

Coming up with an "**active antenna on board**" feature, **FV-18BK** set users free from the hassle of mounting any other GPS active antenna. Owing to its state-of-the-art design, the compactness of **FV-18BK** allows users to enjoy "**all-in-one**" applications without compromising the device's excellent performance. Essentially, **FV-18BK** is a single-board 12 parallel-channel Global Positioning System (GPS) receiver module that can be integrated into a wide variety of OEM GPS products. The receiver tracks up to 12 satellites, providing users with 3D accuracy. Thanks to these features, **FV-18BK** is particularly ideal for embedded applications, such as for hand-held or mobile products; one of our high performance receivers, **FV-18BK** is also designed with maximum flexibility in today's various OEM modules used in-vehicle automotive products.

Other features of **FV-18BK** include: a built-in real-time clock and PPS timing output.

1.2 What is GPS?

GPS (Global Positioning System) is a satellite-based global navigation system created and operated by the United States Department of Defense (DOD). Originally intended solely to enhance military defense capabilities, GPS capabilities have expanded to provide highly accurate position and timing information for many civilian applications.

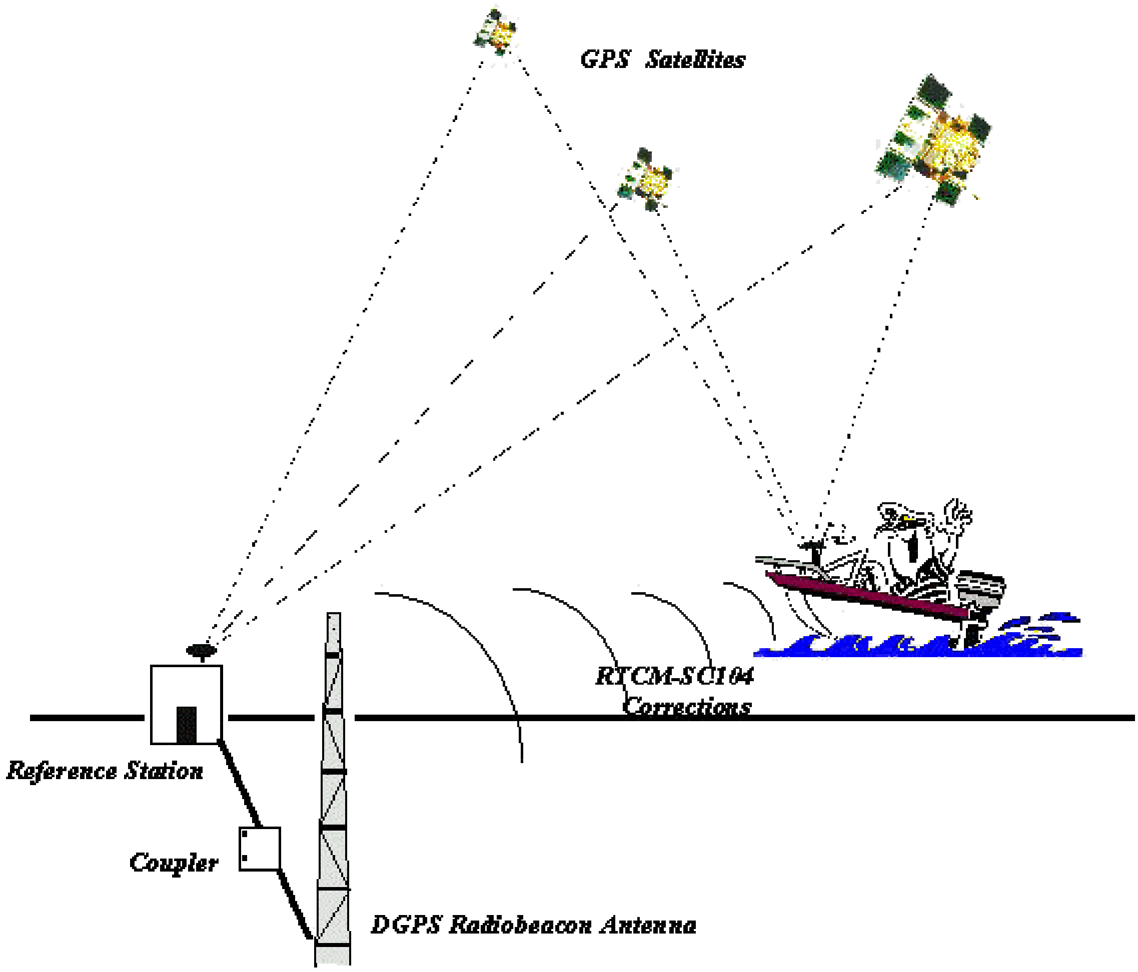
An in-depth study of GPS is required to fully understand how it works, but simply stated: Twenty four satellites in six orbital paths circle the earth twice each day at an inclination angle of approximately 55 degrees to the equator. This constellation of satellites continuously transmit coded positional and timing information at high frequencies in the 1500 Megahertz range. GPS receivers with antennas located in a position to clearly view the satellites, pick up these signals and use the coded information to calculate a position in an earth coordinate system.

GPS is the navigation system of choice for today and many years to come. While GPS is clearly the most accurate worldwide all-weather navigation system yet developed, it still can exhibit significant errors. GPS receivers determine position by calculating the time it takes for the radio signals transmitted from each satellite to reach earth. It's that old "Distance = Rate x Time" equation. Radio waves travel at the speed of light (Rate). Time is determined using an ingenious code matching technique within the GPS receiver. With time determined, and the fact that the satellite's position is reported in each coded navigation message, by using a little trigonometry the receiver can determine its location on earth.

Position accuracy depends on the receiver's ability to accurately calculate the time it takes for each satellite signal to travel to earth. This is where the problem lies. There are primarily five sources of errors which can affect the receiver's calculation. These errors consist of (1) ionosphere and troposphere delays on the radio signal, (2) signal multi-path, (3) receiver clock biases, (4) orbital errors, also known as ephemeris errors of the satellite's exact location, and (5) the intentional degradation of the satellite signal by the DOD. This intentional degradation of the signal is known as "Selective Availability (SA)" and is intended to prevent adversaries from exploiting highly accurate GPS signals and using them against the United States or its allies. However, on May 1, 2000, U.S. President Bill Clinton ordered Selective Availability (SA) turned off at midnight (Coordinated Universal Time). Now, civilian GPS users around the world will no longer experience the up to 100 meter (approximate 300 feet) random errors that SA added to keep GPS a more powerful tool for the military. Today, GPS units are accurate to within 20 meters (approximately 60 feet); although in good conditions, units should display an error of less than 10 meters. The combination of these errors in conjunction with poor satellite geometry can limit GPS accuracy to 100 meters 95% of the time and up to 300 meters 5% of the time. Fortunately, many of these errors can be reduced or eliminated through a technique known as "Differential."

1.3 What is DGPS?

DGPS works by placing a high-performance GPS receiver (reference station) at a known location. Since the receiver knows its exact location, it can determine the errors in the satellite signals. It does this by measuring the ranges to each satellite using the signals received and comparing these measured ranges to the actual ranges calculated from its known position. The difference between the measured and calculated range is the total error. The error data for each tracked satellite is formatted into a correction message and transmitted to GPS users. The correction message format follows the standard established by the Radio Technical Commission for Maritime Services, Special Committee 104 (RTCM-SC104) These differential corrections are then applied to the GPS calculations, thus removing most of the satellite signal error and improving accuracy. The level of accuracy obtained is a function of the GPS receiver.



Differential GPS Broadcast Site

Chapter 2 Specification

2.1 Receiver Specification

PERFORMANCE
Architecture: 12 channels (All-in-views)
Receiver Frequency: 1575.42 MHz
C/A code: 1.023 MHz chip rate

TIME TO FIRST FIX
Cold start average: <95sec
Warm start average: <12sec

RECEIVER ACCURACY
Position: 15meter or 50 feet
Velocity: 0.1 km/h
UTC-Sync Pulse: +/-1 µs to UTC

DGPS ACCURACY
Position Accuracy: 1 to 2 meters, with DOP<3
DGPS input baud rate: 4,800bps
DGPS: RTCM SC-104, version 2.1

DYNAMIC CONDITION
Velocity: 515 m/sec. (1000 knots) max.
Acceleration: >49m/s^2 (sustained tracking)

ENVIRONMENTAL CONDITIONS
Temperature
Operating range: -40℃ to + 85℃
Datum WGS-84 plus 250 + user selectable
Storage range: -50℃ to + 95℃

ELECTRICAL CHARACTERISTICS
Input Voltage: +5Vdc +/-5%
Power Consumption (typical): 0.65 W typically
Backup: +2.5Vdc to +5.5Vdc

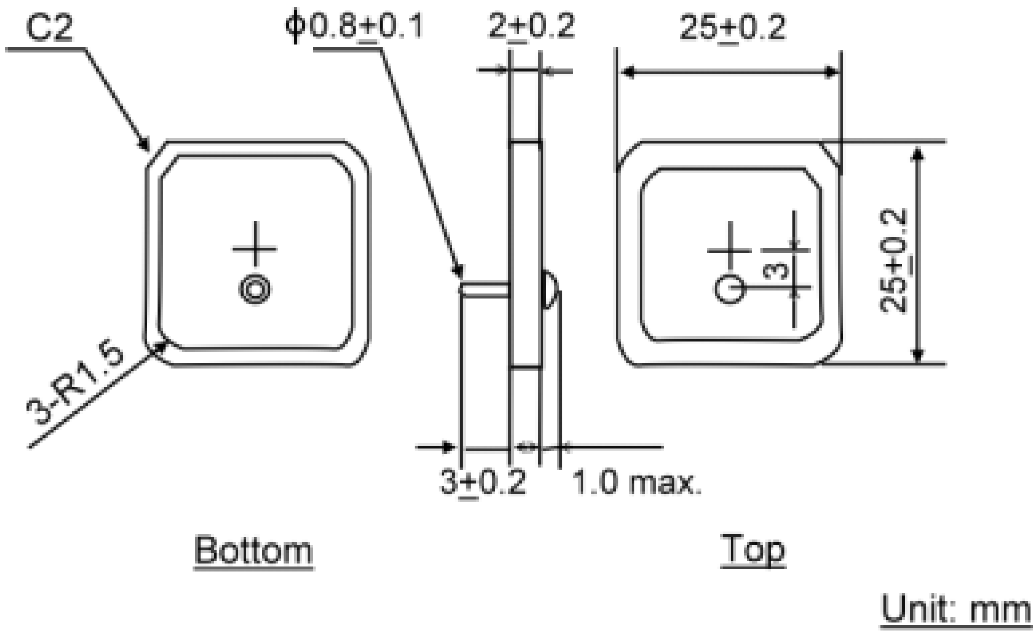
INTERFACE I/O
Compatibility: One full duplex serial
Data Rate: 4800bps
Format: NMEA-0183, version 2.3
Standard Output Sentences:
GGA,GLL,GSA,GSV,RMC & VTG
Default Sentences:
GGA,ZDA,DTM,GSV & VTG
San Jose Navigation, Inc. may add other NMEA sentences to the standard output to maximize interfacing capabilities

Time-1PPS Pulse
Level: TTL
Velocity: 0.05 m/sec. (typically)
Pulse duration: 1sec
Time reference: At the pulse negative edge
Altitude: 18,000 meters (60,000 feet) max
Measurements: Aligned to GPS second, +/- 1 microsecond

COMMUNICATION
Output Protocol: NMEA 0183 at 4800bps
Signal Level: TTL
Interface Connector: 7-pin Molex connector, shipped with its mating connector

2.2 Antenna Specification

2.2.1 Dimensions



2.2.2 Electrical Characteristics

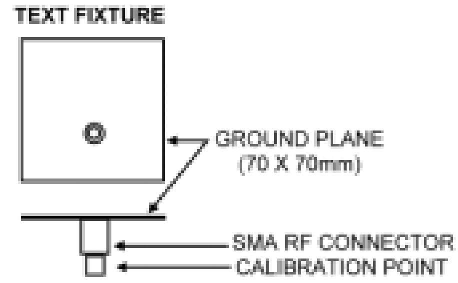
CHARACTERISTICS	SPECIFICATION	UNIT	CONDITIONS
Center Frequency	1582 +/- 3	MHz	70x70 mm GND (w/o Tape)
Bandwidth	12 min.	MHz	Return Loss ≧ -10 dB
VSWR	1.8 max.		
Gain @ Zenith	+2 Typ.	dBi	At 1582 MHz
Gain @ 10^{o} Elevation	-5 Typ.	dBi	At 1582 MHz
Temp. Coefficient	0 +/- 20℃	ppm/℃	-40℃ to +80℃, 25℃ Ref.

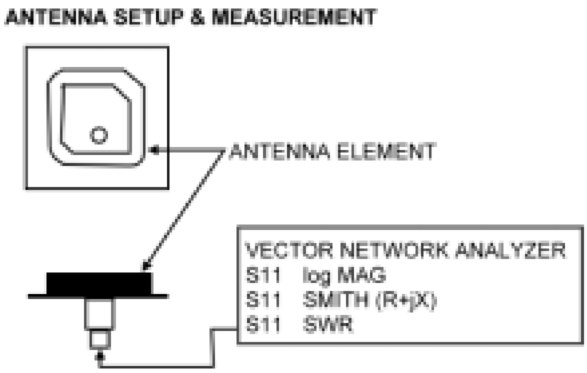
2.2.3 Mechanical Characteristics

CHARACTERISTICS	SPECIFICATION	CONDITIONS
Electrode Plating	Silver	
Terminal Pin	Brass with silver coating	
Electrode Plating Adhesion (Peel Strength)	3 Kg	$10mm^2$ at the corner

2.2.4 Notes

1. Measured with 70cm x 70cm ground plane, without radome cover.
2. Center frequency is generally shifted down about 5MHz, when a radome cover is used.
3. Right hand circular polarized

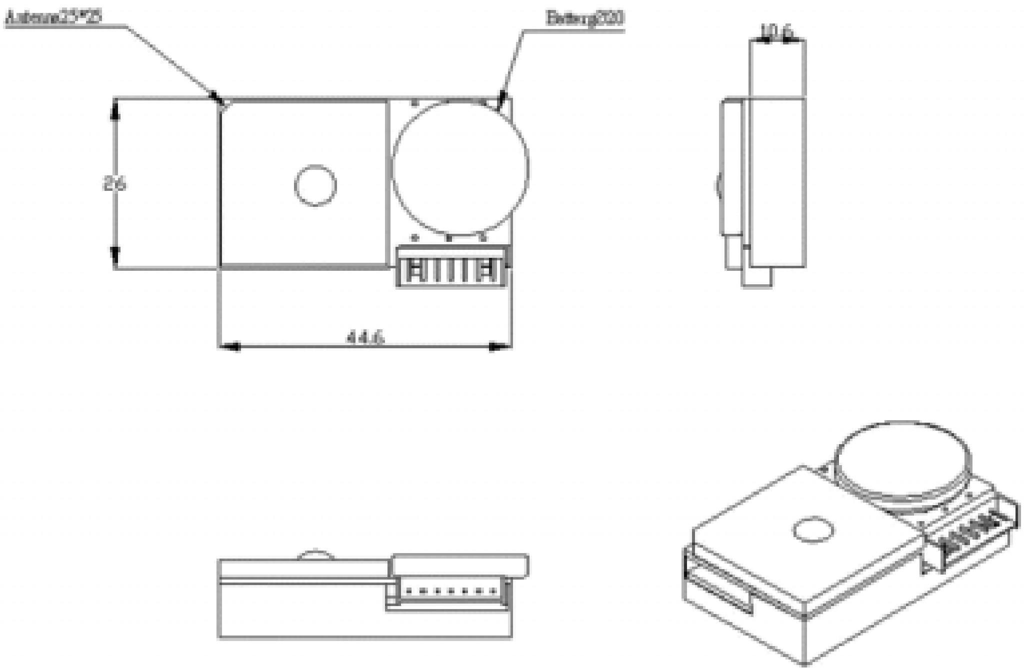




2.3 Overall Characteristics

DIMENSION: 44.2mm (L) x 27.9mm (W) x 12.85mm (H)
WEIGHT: 26 grams (w/o cable)
RADOME: Made of Tinplate
POWER CONSUMPTION: 96mA + / - 10% @ 5V

2.4 System Layout



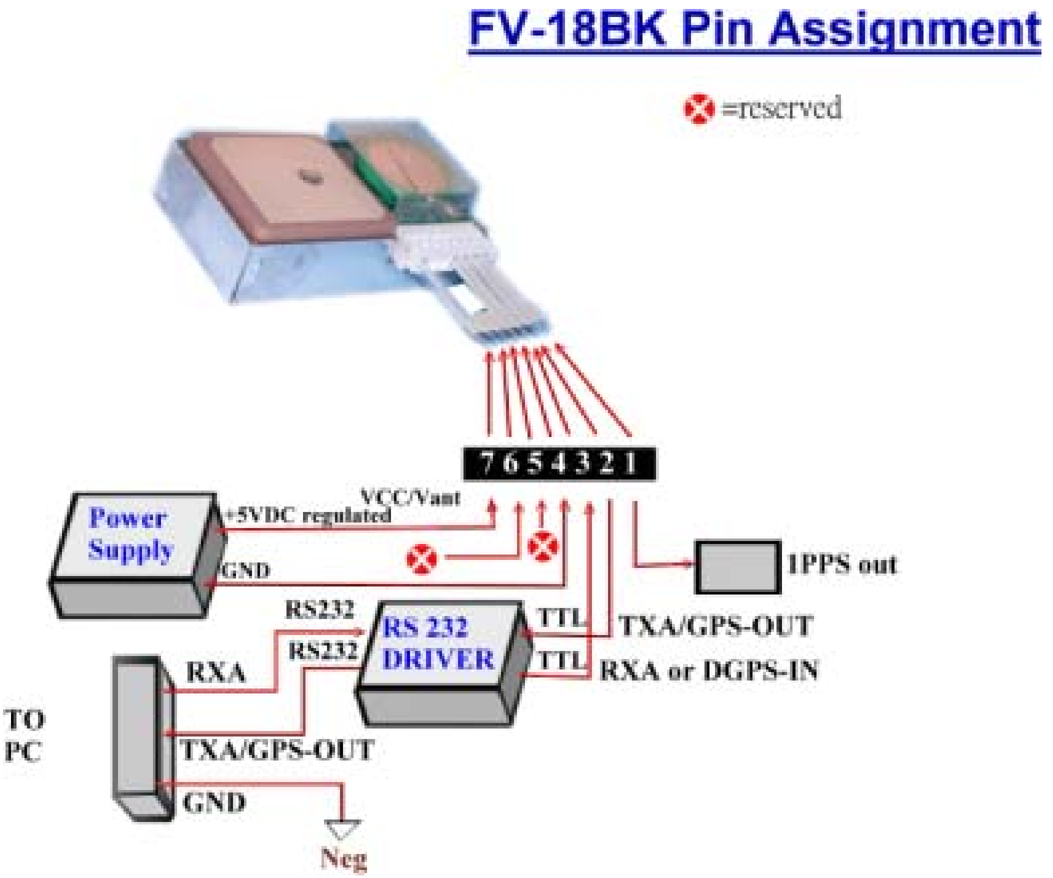
2.4.1 Pin Assignment

1. 1 PPS Output
2. GPS Data Output (TTL)
3. Data Input (TTL)
4. GND
5. Ext. Back-up (3.0-5.0V)
6. Reserved
7. Power Supply (DC 5V)

2.4.2 GPS Module FV-18BK

Signal	Function
1PPS	1 pulse/sec out
TX	GPS data out/TTL
RX	Data In/DGPS-in 9.6K
GND	System ground
Vbak	SRAM Back-up
Vcc	System supply

2.5 Module System Layout



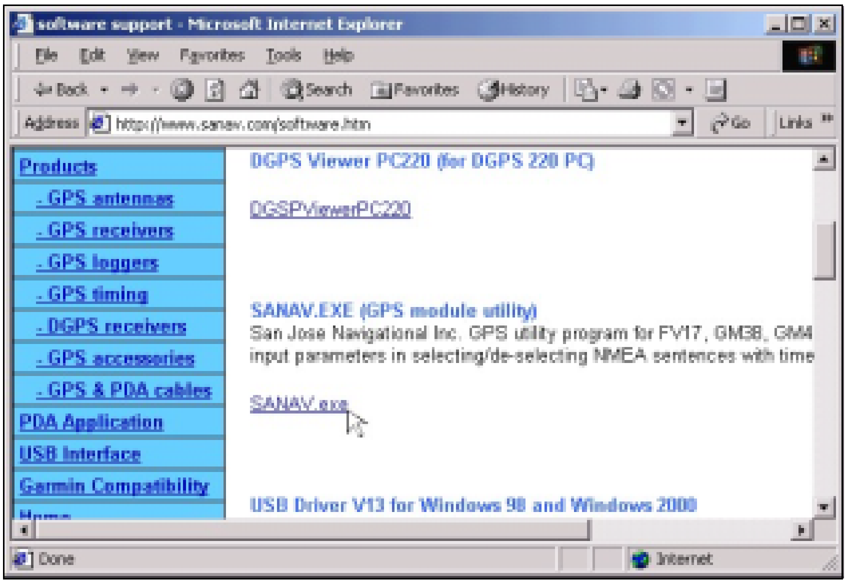
Chapter 3 Software Installation & Operation

3.1 Install SANAV.EXE

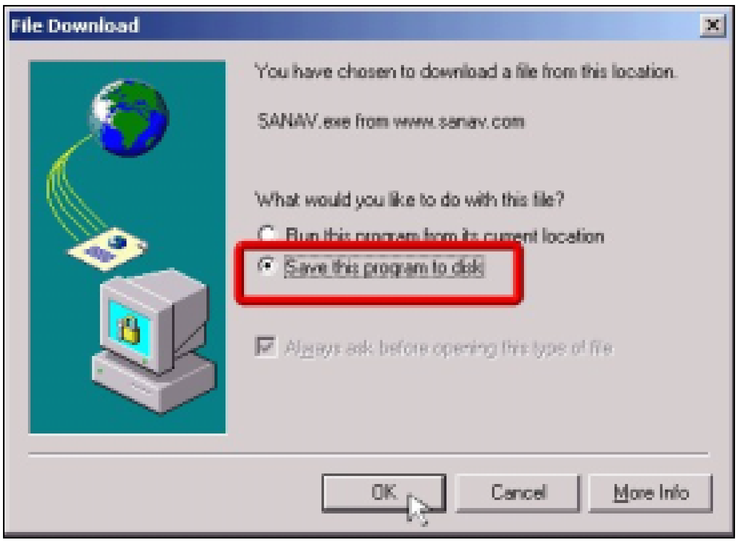
Sanav.exe is a utility program that works in conjunction with **FV-18BK**. You have to install this program to your computing device first before operating **FV-18BK**.

3.1.1 Procedures:

1. Download **Sanav.exe** from our website at http://www.sanav.com/software.htm:

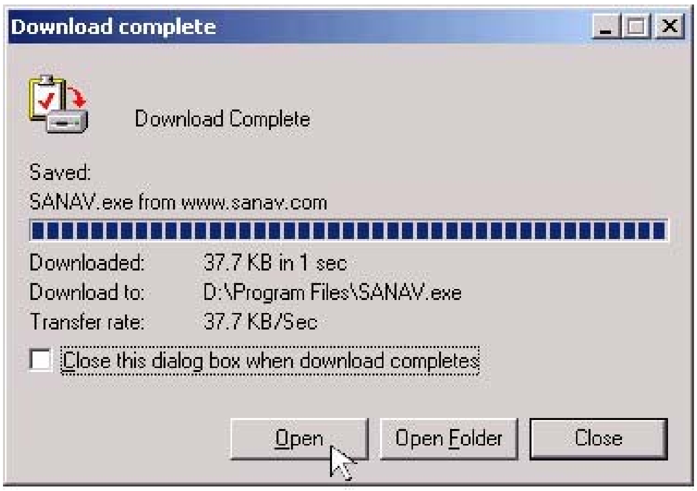


2. The **File Download** window appears. Select "**Save this program to disk**" and then click **OK**:



3. In the following **Save As** window, save the **Savav.exe** in your system by clicking the "**Save in**" dropdown list. In our example, we choose to save the program in **Program Files**:

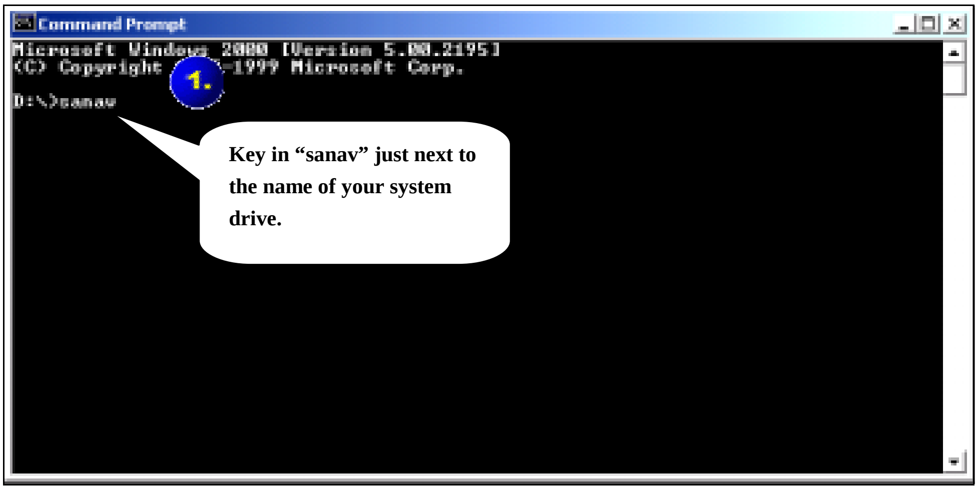
4. When the **Download complete** window appears, click **Open**: (**Note**: You must leave the "**Close this dialog box when download completes**" unchecked.)



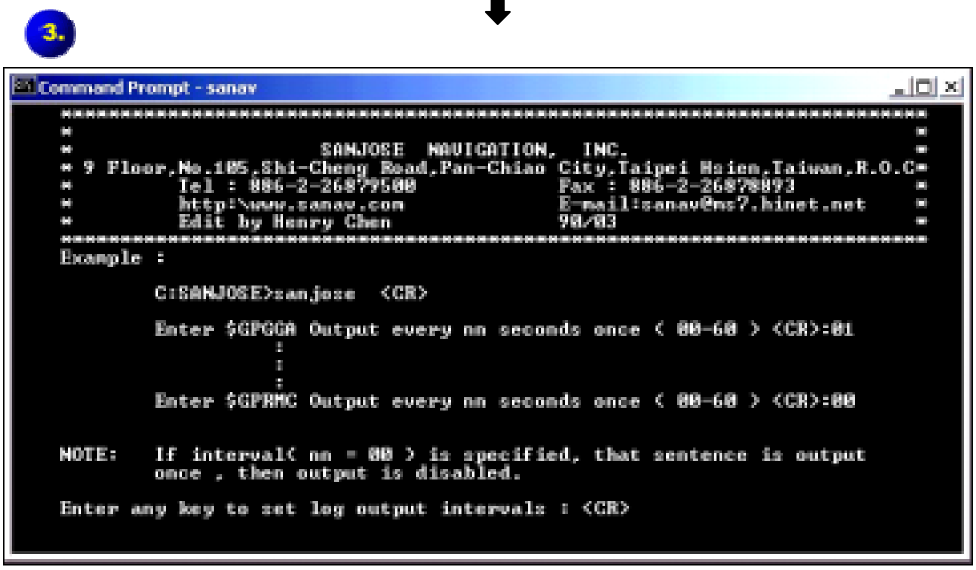
5. A black window flashes for one or two seconds and then disappears. Please ignore this. The **Sanav.exe** has already been saved to your system by now.

3.1.2 Setting Up Log Output Intervals:

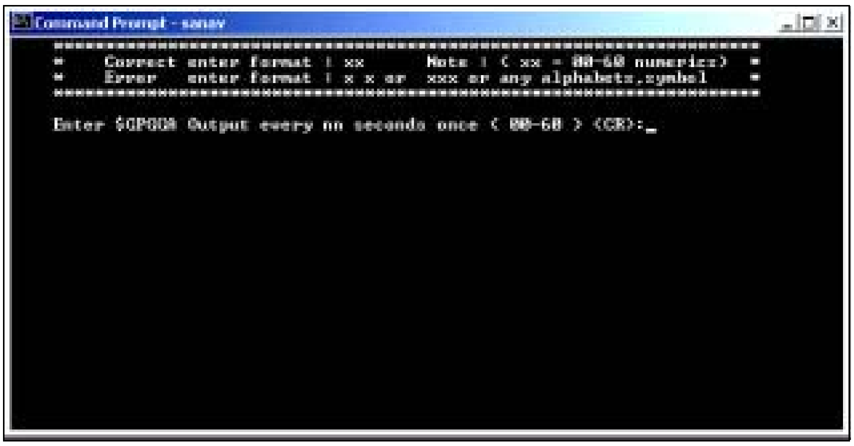
1. Click **Start → Programs → Command Prompt** for Windows 95/98/Me; Click **Start → Programs → Accessories → Command Prompt** for Windows 2000 Professional/Server
2. Key in **sanav** and press **Enter** to run **SANAV.exe**, which is supposed to have saved in your system. In our example the drive is **D**, as shown below:



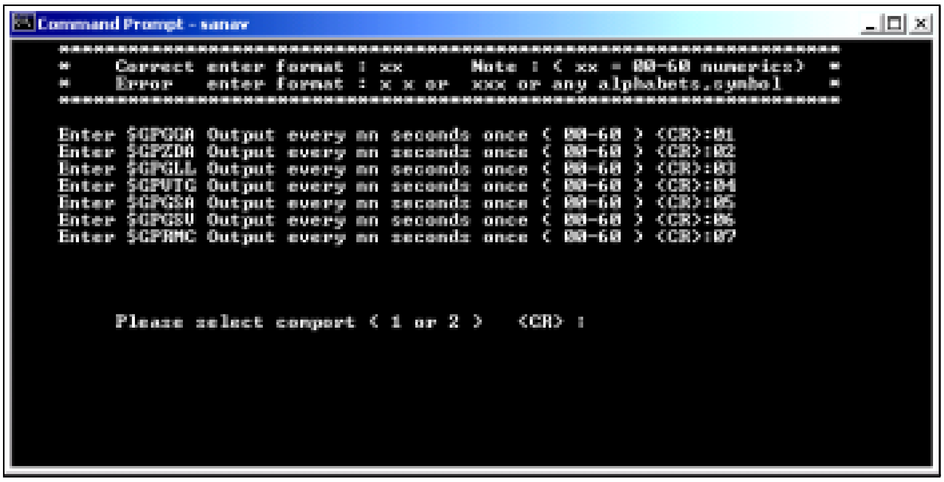
2. Press **Enter**



3. Press **Enter** to enter a setup screen, as shown below, to configure various **NMEA 0183 Protocol** intervals for **FV-18BK**:

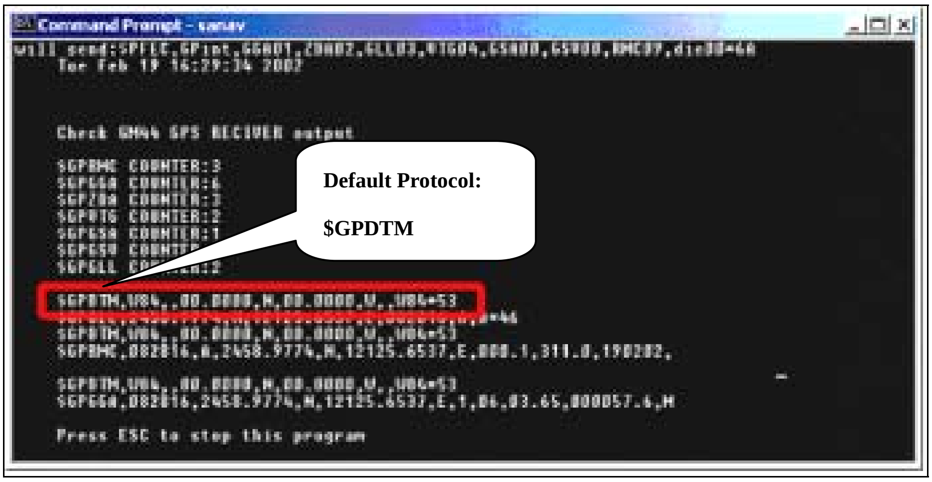


4. Key in any number ranging from **00-60** and then press **Enter** for each protocol interval, as shown below:



Note: To disable an interval, key in **00**.

5. At the middle of the screen there is a sentence asking you to tell the program which **Com Port** you are using to connect **FV-18BK**. In our example, it is **Com 1** and thus we key in **1** here and then press **Enter**. By now we have successfully interval configuration, and a screen will then appear to show that **FV-18BK** is receiving GPS signals, in the form of **NMEA 0183 protocol**, according to the intervals you have just configured.



Note: There is a default protocol of the program, $GPDTM, as surrounded by a red rectangular frame in the diagram above. This protocol is automatically generated by the program itself, and thus you can just ignore it.

6. To leave the program, press **ESC** and then either key in **exit** or click the ☒ button at the screen's top right side.
7. You are now ready to evaluate your new 12 channels GPS module according to

your new input.

Note: For a prompt TTF during warm start, a battery backup must be in place to power up the RAM and keep it alive.

Chapter 4 Software Specification

4.1 Communication Specification

System: Full Duplex Asynchronous
Speed: 4800 bps
Start Bit: 1 bit
Data Length: 8 bits (MSB=0)
Stop Bit: 1 bit
Parity Bit: None

Start Bit	B0	B1	B2	B3	B4	B5	B6	B7	Stop Bit

Flow Control: None
Signal Lines used: TD1 and RD1 only (TD2 and RD2 not used)
Data Output Interval: 0 to 2 seconds

Character Codes used
NMEA-0183 Sentences: ASCII (HEX 0D, 0A, 20 to 7E)
Different GPS Data: Binary (“6-of-8” format)
(B7=0, B6=1, Only B5 to B0 are used.)

Electrical specification similar to RS-232C

Protocol:
NMEA-0183 Sentences: NMEA-0183 Ver 2.30 dated March 1, 1998 (Approved / Proprietary sentences)
Differential GPS Data: RTCM SC-104 Ver 2.1 dated January 3, 1994 (Input only)

Note: NMEA-0183 sentence and differential GPS data inputs may coexist because the GN79 can distinguish them automatically.

4.2 About NMEA-0183 Protocol

4.2.1 Approved Sentences

Approved sentences are those of which formats are defined and fixed within the NMEA-0183 standard. Any portion within an approved sentence format is NOT user-definable. An approved sentence generally takes the following form:

$<address field>,<data field>…【*<checksum field>】<CR><LF> Where:

Field	Description
$	Start-of-Sentence marker
<address field>	5-byte fixed length. First 2 bytes represent a talker ID, and the rest 3 bytes do a sentence formatter. All sentences transmitted by FV-18BK bear talker ID "GP" meaning a GPS receiver. For the sentences received from external equipment, the FV-18BK accepts any talker ID. Talker ID "XX" found on the succeeding pages is a wildcard meaning "any valid talker ID."
,<data field>…	Variable or fixed-length fields preceded by delimiter "," (comma). Commas are required even when valid field data are not available, i.e., null fields. Ex. ",,,,," In a numeric field with fixed field length, fill unused leading digits with zeroes. (Do not support leading zeroes.)
*<checksum field>	8-bit data between "$" and "＊" (excluding "$" and "＊") are XORed, and the resultant value is converted to 2 bytes of hexadecimal letters. Note that two hexadecimal letters must be preceded by "＊", and delimiter "," is not required before *<checksum>. For input sentences, *<checksum> is ignored.
<CR><LF>	End-of-Sentence marker

Maximum length from "$" to <CR><LF> is limited to 82 bytes including "$" and <CR><LF>. Every input sentence in and over 83 bytes is ignored. Be careful with entering GPset and GPint sentences. Suggest to verify if the input is done correctly by issuing GPsrq, GPirq, GPdrq sentences.

- Examples of Approved Sentences:
  $GPGLL, 3444.000,N, 13521.00,E, E<CR><LF>
  $XXGLL, 3444.000,N, 13521.00,E, E<CR><LF>

"XX" may be any valid talker ID, such as "LC" (Loran C).

4.2.2 Proprietary Sentences

The NMEA-0183 standard allows nav-aid makers to send proprietary sentences if the minimum rules defined by the NMEA are obeyed. Proprietary sentences must take the following form, but it is free to makers what kind of fields are included and in what order they are transmitted out.

$P<maker ID>, <data field>…<＊check sum field><CR><LF> where:

Field	Description
$	Start-of-Sentence marker
P	Proprietary sentence identifier
<maker ID>	3-byte fixed length FV-18BK's maker ID is "FEC' meaning Furuno Electric Company.
, <data field>	Variable or fixed-length fields preceded by delimiter "," (comma). (Layout is maker-definable.)
<check sum field>	8-bit data between "$" and "＊" (excluding "$" and "＊") are XORed, and the resultant value is converted to 2 bytes of hexadecimal letters. Note that two hexadecimal letters must be preceded by "＊", and delimiter "," is not required before *<checksum>. For input sentences, *<checksum> is ignored.
<CR><LF>	End-of-Sentence marker

4.3 List of NMEA-0183 Sentences

The following NMEA-0183 sentences are supported by FV-18BK.

	Input Sentence		Output Sentence		
High			GPDTM	Datum	
	XXGGA	Set initial position	GPGGA	Position, time, etc.	OO
	XXZDA	Set time, etc.	GPZDA	Time, etc.	OO
	XXGLL	Set initial position	GPGLL	Position, time, etc.	O
			GPGSA	Status, DOP	O
			GPGSV	Satellite details	OO
			GPVTG	Speed, Course.	OO
	XXRMC	Set initial position, time	GPRMC	Position, time, speed, course	O
			GPalt	No. of satellites expected in coming 24 hours	O
			GPanc	Date of existing almanac	O
Priorit			GPacc	SV accuracy	O
			GPast	GPS fix (position, local time)	O
			GPtst	Selftest result	O
	GPsrq	Send GPS receiver parameters	GPssd	Answer to GPsrq	A
	Gpirq	Send data output interval	GPisd	Answer to GPirq	A
	GPdrq	Send DGPS parameters	GPdsd	Answer to GPdrq	A
			Gpdie	DGPS status	O
	GPclr	Restart			
	GPset	Set rx parameters			
	GPint	Set sentence output interval			
Low	GPdif	Set DGPS parameters			

Note 1: Higher priority data is output first, from top to bottom. (Highest priority: GGA for example).

GPDTM is always output in front of each of GGA, GLL, RMC, GPast sentence.

O Sentence output interval is adjustable but if the back up is lost, the sentence will not be output.

OO	Sentence output interval is adjustable and if the back up is lost, it goes back to the default value, which is one second interval.
A	Sentence is output as an answer.
XX	Any talker ID

4.4 List of Parameters & Backed-up Data

	Data	**Backed -up**	Default	Range
GPS Data	Estimated position Lat. & Long.	Yes	N34deg. 44.0000 min. E135deg.21.0000 min.	S90deg. to N90deg. W180deg. to E180deg.
	Time	Yes	1997 Jan. 1 0h. 0m. 12s	1997 Jan. 1 through 2040 Dec. 31
	Altitude	Yes	0 m	-999.9m to 17999.9m
	Almanac data	Yes	---	---
	Almanac date	Yes	1980 Jan. 6 0h. 0m. 0s	---
	Ephemeris	Yes	---	---
Parameters	Local Zone Time	Yes	+0h	-13h0m to +13h0m
	PDOP value	Yes	6	0 to 10
	Elevation Angle Mask	Yes	5 deg.	5 to 90 deg.
	Geodetic ID	Yes	1 (WGS84)	1 to 171
	Mask by Elevation Angle for Receivalbe Satellites Prediction	Yes	5 deg.	5 to 90 deg.
	Mask by Signal Strength	No	1 dBHz (No mask)	1 to 99 dBHz
	1PPS Correction	Yes	0μsec	-999.9μsec to +999.9μsec
	Delete Satellites	No	00000000	00000000 to FFFFFFFF
	Smoothing Index	No	2	1 to 3
	Dynamic Index	No	2	1 to 3
	Data Output Interval	Yes	DTM, GGA, ZDA, GSV, VTG (Every second)	0-60 seconds (Only for those sentences that are adjustable.)
	DGPS parameter	Yes	1 (LSB first)	1 (LSB first) 2 (MSB first)

4.5 NMEA-0183 Input Sentences

4.5.1 $XXGLL(in)

Set initial position

This sentence sets the initial latitude/longitude. The position data will be updated when position fixing begins.

Example

$XXGLL	,3444.123,N	,03521.5,E	, , ,	✱ 4D	CR LF
Field#	1 2	3 4	5 6 7	8	

#.	Description	Range	【Bytes】
1-2.	Latitude		
	“34”: degree	00-90	【2】
	“44”: minute (integer)	00-59	【2】
	“123”: minute (fraction)	0-9999	【variable】 see **Note**.
	“N”: North/South	N or S	【1】
3-4.	Longitude		
	“035”: degree	000-180	【3】
	“21”: minute (integer)	00-59	【2】
	“5”: minute (fraction)	0-9999	[variable] see **Note**.
	“E”: East/West	E or W	【1】
	Note: Digits below 1/10000 are ignored.		
5-7.	Null Fields	Any entry is ignored.	
8.	Checksum		【2】

Interpreting Example:

34 deg 44.123 min N

35 deg 21.5 min E

4.5.2 $XXGGA(in)

Set initial position

This sentence sets the initial latitude/longitude. The position data will be updated when position fixing begins.

Example

$XXGGA	,	,3444.123,N	,03521.5,E	, , , , , , , , ,	＊79	CR LF

Field# 1 2 3 4 5 6-14 15

#.	Description	Range	【Bytes】
2-3.	Latitude		
	"34": degree	00-90	【2】
	"44": minute (integer)	00-59	【2】
	"123": minute (fraction)	0-9999	【variable】 see **Note**.
	"N": North/South	N or S	【1】
4-5.	Longitude		
	"035": degree	000-180	【3】
	"21": minute (integer)	00-59	【2】
	"5": minute (fraction)	0-9999	【variable】 see **Note**.
	"E": East/West	E or W	【1】
	Note: Digits below 1/10000 are ignored.		
6-14.	Null Fields	Any entry is ignored.	
15.	Checksum		【2】

Interpreting Example:

34 deg 44.123 min N

35 deg 21.5 min E

4.5.3 $XXZDA(in)

Set date/time

Example

$XXZDA	,123456	,01	,02	,1997	,-09	,00	✱79	CR LF
Field#	1	2	3	4	5	6	7	

#.	Description	Range	【Bytes】
1.	UTC: Time		
	"12": hh	00-23	【2】
	"34":mm	00-59	【2】
	"56": ss	00-59	【2】
2.	UTC: Date		
	"01": DD	01-31	【2】
3.	UTC: Month		
	"02": MM	01-12	【2】
4.	UTC: Year		
	"1997": YYYY	1997-2040	【4】
5.	Local Zone Time (Hour)		
	"-09": hh	-13…+00…+13 (-/+: East/West of date line)	【3】
6.	Local Zone Time (Minute)		
	"00": mm	00 to 59	【2】

Note: Local zone time setting is used for calculating local time when outputting GPS fix ($PFEC,GPast):
(Local Time)=(UTC) – (Local Zone Time)

7.	Checksum		【2】

Interpreting Example:

February 1, 1997
12:34:56
Local Zone Time: -09:00

4.5.4 $XXRMC(in)

Set initial position/UTC

Example

$XXRMC	,123456	,	,3444.123,N	,13521.456,E	, ,	,020197	…
Field#	1	2	3 4	5 6	7 8	9	10 11 12

✱ 69	CR LF
13	

#.	Description	Range	【Bytes】
1.	UTC: Time		
	"12": hh	00-23	【2】
	"34":mm	00-59	【2】
	"56": ss	00-59	【2】
2.	Null Field	Any entry is ignored.	
3-4.	Latitude		
	"34": degree	00-90	【2】
	"44": minute (integer)	00-59	【2】
	"123": minute (fraction)	0-9999	【 variable 】 See **Note**
	"N": North/South	N or S	【1】
5-6.	Longitude		
	"135": degree	000-180	【3】
	"21": minute (integer)	00-59	【2】
	"456": minute (fraction)	0-9999	【 variable] 】 See **Note**
	"E": East/West	E or W	【1】
	Note: Digits below 1/10000 are ignored.		
7-8.	Null Fields	Any entry is ignored.	
9.	UTC: Date		
	"02": DD	01-31	【2】
	"01": MM	01-12	【2】
	"97": YY	97-40 (1997-2040)	【2】
10-12.	Null Fields	Any entry is ignored.	
13.	Checksum		【2】

Interpreting Example:

January 2, 1997

12:34:56

34 deg. 44.123 min. N

deg. 21.456 min. E

4.5.5 $PFEC,GPclr(in)

Restart

Example

$PFEC	,GPclr	,1	＊4B	CR LF
Field#	1	2	3	

This sentence clears the data in the GPS receiver and restarts the receiver. The restart works in the same way as the power is first on.

#.	Description	Range	【Bytes】
1.	Command Name		【5】
2.	Mode	1-3 "1": Clear mode 1 "2": Clear mode 2 "3": Clear mode 3	【1】
3.	Checksum		【2】

Receiver Data	Clear Mode		
	1	2	3
Latitude/Longitude	Returned to default	Backed-up value used	Backed-up value used
Time	Backed-up value used	Backed-up value used	Backed-up value used
Almanac Data	Deleted	Backed-up value used, if valid	Deleted
Ephemeris Data	Deleted	Backed-up value used, if valid	Deleted
Receiver Parameters (**Note 1**)	All parameters returned to default	Backed-up value used	Backed-up value used

Note 1: Receiver parameters are those set by "$PFEC, GPset" sentence. Refer to the "**3.4. List of Parameters & Backed-up data**" to see whether the value set by the sentence is backed up or not.

Interpreting Example:

Clear mode 1

4.5.6 $PFEC,GPset(in)

Setup receiver parameters

Example

$PFEC	,GPset	,D05	,U00200000	……	＊hh	CR LF

Field# 1 2 3 4……

#.	Description	Range	【Bytes】(Unit) {Default}
1.	Command Name		【5】 120
2.			
3.			
4…….			

Up to eight parameters in any order preceded by delimiter "," (comma). See parameter syntax below:

Note: Do not send same parameters twice within the same sentence.

"Dnn":	PDOP Threshold	D00-D10	【3】 (n/a) {D06}

In 3D positioning mode, 2D positioning is forced when PDOP is higher than this threshold. If D00 is set, 3D positioning is not performed. In 2D positioning, the altitude is not updated and the same altitude is continuously output as set at the first 2D positioning.

"Enn":	Elevation Angle Mask for Receivable Satellite Prediction	E05-E90	【3】 (deg.) {E05}

As the function of "**Receivable Satellite Prediction**" is deleted in this model, this parameter setting is neglected.

"Gnn":	Geodetic ID	G001-G171	【4】 (n/a) {G001}
"Hnnnnnn.n":	Altitude for 2D positioning	**H-00999.9 to H017999.9**	【9】 **(meter) {H000000.0}**

Note: When 3D positioning is performed, this data is updated.

"Mnn":	Mask by Elevation Angle	M05-M90	【3】 (degree) {M05}

Any satellites below this angle are ignored when positioning.

"Snn":	Mask by Signal Strength	S01-S99	【3】 (dBHz) {S01}

Any satellites weaker than this level are ignored when positioning. The maximum level is practically limited by the lowest tracking signal level (38 dBHz).

"Tnnnn":	1PPS Correction	T-9999 to T+9999	【6】 (x0.1 μs) {T+0000}

0.1μs corresponds 30-meter antenna length. Note that negative setting advances 1PPS pulses.

“Uhhhhhhhh”: Delete satellites. **U00000000 – UFFFFFFF** 【9】(n/a) {n/a}

hhhhhhhh means eight hexadecimal letters, representing a bit map of 32 bits. Each bit within the bit map represents one satellite; 0000001 and 8000000, for example, indicate satellite SV#1 and SV#32, respectively.

Example: “PFEC,GPset,U0000000F” <CR><LF> declares unhealthy satellites SV#1 to SV#4.

Satellites declared by this sentence are ignored when positioning. It should be noted that satellites with their bits cleared are declared as “healthy”. In the above example, satellites SV#5 to SV#32 are implicitly declared as “healthy”.

In the following example, the first sentence declares satellite SV#5 as “unhealthy”, and it is restored later by the second sentence.

Example: “PFEC,GPset,U00000010” <CR><LF>
“PFEC,GPset,U00000000” <CR><LF>

“Wn”: Smoothing Index W1-W3 【2】(n/a) {W2}

Index	Characteristics	Remarks
1	Quick responsive	Quicker response but relatively more zigzag tracking record.
2	Averaged	Averaged tuning (Initial setting)
3	Smoother tracking record	Less responsive (large inertia) but smoother tracking record

“Xn”: Dynamic Index X1-X3 【2】(n/a) {X2}

Index	Characteristics	Remarks
1	More accurate positioning	Higher accuracy but less frequent positioning
2	Averaged	Averaged tuning (Initial setting)
3	More frequent positioning	More frequent positioning but less accuracy.

4.5.7 $PFEC,GPsrq(in)

Get receiver parameters

Issue this sentence when you need receiver parameters set by $PFEC,GPset. The answer will be output as $PFEC,GPssd sentence.

$PFEC	,GPsrq	＊5B	CR LF
	1	2	

#.	Description	Range	【Bytes】
1.	Command Name		【5】
2.	Checksum		【2】

4.5.8 $PFEC,GPint(in)

Request output/Set log output intervals

Example

$PFEC	,GPint	,GGA01	,GLL00	……	＊hh	CR LF
Field#	1	2	3	4……	n+1	

#.	**Description**	**Range**	**【Bytes】(Unit) {Default}**
1.	Command Name		【5】
2-n.	Sentence name & Interval	(00-60)	【5】
n+1.	Checksum		

Up to 11 (eleven) parameters in any order preceded by delimiter "," (comma). See parameter syntax below:

"Param":
Log Output Sentence
<Log Output Sentence Length in bytes>

"GGAnn":	$GPGGA<82 max>	GGA00-GGA60	【 5 】 (sec) {GGA01}
"ZDAnn":	$GPZDA<36>	ZDA00-ZDA60	【 5 】 (sec) {ZDA01}
"GLLnn":	$GPGLL<47>	GLL00-GLL60	【 5 】 (sec) {GLL00}
"GSAnn":	$GPGSA<69 max>	GSA00-GSA60	【 5 】 (sec) {GSA00}
"GSVnn":	$GPGSV<70 max>	GSV00-GSV60	【 5 】 (sec) {GSV01}
"VTGnn":	$GPVTG<46 max>	VTG00-VTG60	【 5 】 (sec) {VTG01}
"RMCnn":	$GPRMC<77 max>	RMC00-RMC60	【 5 】 (sec) {RMC00}
"ancnn":	$PFEC,GPanc<62>	anc00-anc60	【 5 】 (sec) {anc00}
"accnn":	$PFEC,GPacc<49>	acc00-acc60	【 5 】 (sec) {acc00}

“astnn”:	$PFEC,GPast<85>	ast00-ast60	【 5 】 (sec) {ast00}
“tstnn”:	$PFEC,GPtst<33>	tst00-tst60	【 5 】 (sec) {tst00}
“dienn”:	$PFEC,GPdie<27>	die00-die60	【 5 】 (sec) {die00}

Note: If zero interval (nn=00) is specified that sentence is output once when $PFEC,GPint is executed, then output is disabled.

GN-79L can output 480 bytes or so per second. Do not set the log sentence output intervals too short; otherwise, this capacity will be exceeded. When estimating the output volume, refer to byte count of each sentence enclosed within [] in the above list.

Example:

$PFEC,GPint,tst00<CR><LF>……Output self-test result once.

$PFEC,GPint,RMC05<CR><LF>……Output $GPRMC sentence every five seconds.

4.5.9 $PFEC,GPirq(in)

Get log sentence output intervals

Issue this sentence when you need the log sentence output intervals set by $PFEC,GPint.
The answer will be output as $PFEC,GPisd sentence.

$PFEC	,GPirq	＊41	CR LF
	1	2	

#.	**Description**	**Range**	**【Bytes】**
1.	Command Name		【5】
2.	Checksum		【2】

4.5.10 $PFEC,GPdif(in)

Set DGPS parameters

Example

$PFEC	,GPdif	,D0	✱ 18	CR LF
	1	2	3	

#.	Description	Range	【Bytes】
1.	Command Name		【5】
2.	Bit Stream Direction of RTCM SC-104 DGPS data	D0-D1 "D0": MSB first "D1": LSB first	【2】
3.	Checksum		【2】

Interpreting Example:

DGPS data will be transmitted from MSB.

4.5.11 $PFEC,GPdrq(in)

Get DGPS parameters

Issue this sentence when you need the DGPS parameter set by $PFEC,GPdif. The answer will be output as $PFEC,GPdsd sentence.

$PFEC	,GPdrq	* 4C	CR LF
	1	2	

#.	Description	Range	[Bytes]
1.	Command Name		[5]
2.	Checksum		[2]

4.6 NMEA-0183 Output Sentences

4.6.1 $GPGGA (out)

Position, Altitude, UTC, etc.

Example

$GPGGA	,123456	,3444.0000,N	,13521.0000,E

Field# 1 2 3 4 5

,1	,04	,02.00	,000123.0	,M	,0036.0

6 7 8 9 10 11

,M	,13	,0001	* 76	CR LF

12 13 14 15

#.	Description	Range	【Bytes】
1.	UTC		
	"12": hh	00-23	【2】
	"34": mm	00-59	【2】
	"56": ss	00-59	【2】
2-3	Latitude		
.	"34": degree	0-90	【2】
	"44": minute (integer)	0-59	【2】
	"0000": minute (fraction)	0000-9999	【4】
	"N": North/South	N or S	【1】
4-5	Longitude		
.	"135": degree	000-180	【3】
	"21": minute (integer)	00-59	【2】
	"0000": minute (fraction)	0000-9999	【4】
	"E": East/West	E or W	【1】
6.	GPS Quality Indication	0-2 "0": Fix not available or invalid "1": GPS. SPS fix valid "2": GPS. SPS fix valid	【1】
7.	No. of satellites used for positioning	00-12	【2】
8.	DOP (2D: HDOP; 3D: PDOP)	n/a	【5】

Note: "00.00" is output while positioning is interrupted.

#.	Description	Range	【Bytes】
9.	Altitude	-00999.9 to 017999.9	【8】
10.	Unit for Altitude	M	【1】

11. Geoide Altitude	-999.9 to 9999.9	【6】
12. Unit for Geoide Altitude	M	【1】
13. DGPS Data Time	00-99	【2】
14. DGPS Station ID	0000-1023	【4】
Unless DGPS mode is selected, a null field is output.		
15. Checksum		【2】

Interpreting Example:

UTC 12:34:56

34 deg 44.0000 min N

135 deg 21.0000 min E

Status: Stand-alone GPS

No. of satellites: 4 satellites

DOP: 2.00

Altitude: 123.0 meters high

Geoide Altitude: 36.0 meters high

DGPS Data Time: 13

DGPS Station ID: 1

4.6.2 $GPZDA (out)

Date / Time

Example

$GPZDA	,123456	,01	,02	,1997	,+09	,00	＊6B	CR LF
Field#	1	2	3	4	5	6	7	

#.	Description	Range	【Bytes】
1.	UTC: Time		
	"12": hh	00-23	【2】
	"34": mm	00-59	【2】
	"56": ss	00-59	【2】
2.	UTC: Day of Month		
	"01": DD	01-31	【2】
3.	UTC: Month		
	"02": MM	01-12	【2】
4.	UTC: Year		
	"1997": YYYY	1997-2040	【4】
5.	Local Zone Time (Hour)		
	"+09": hh	-13…+00…+13 (-/+: East/West of date line)	【3】
6.	Local Zone Time (Minute)		
	"00": mm	00-59	【2】

Note: Local zone time setting is used for calculating local time when outputting $PFEC,GPast:

(Local Time) = (UTC) – (Local Zone Time)

7. Checksum 【2】

Interpreting Example:

February 1, 1997

12:34:56

Local Zone Time: +09:00

4.6.3 $GPGLL (out)

Position, UTC, etc.

Example

$GPGLL	,3444.1234,N	,03521.0000,E	,123456	,A	,A	* 43	CR LF

Field# 1 2 3 4 5 6 7 8

#.	Description	Range	【Bytes】
1-2.	Latitude		
	"34": degree	00-90	【2】
	"44": minute (integer)	00-59	【2】
	"1234": minute (fraction)	0000-9999	【4】
	"N": North/South	N or S	【1】
3-4.	Longitude		
	"035": degree	000-180	【3】
	"21": minute (integer)	00-59	【2】
	"0000": minute (fraction)	0000-9999	【4】
	"E": East/West	E or W	【1】
5.	UTC		
	"12": hh	00-23	【2】
	"34": mm	00-59	【2】
	"56": ss	00-59	【2】
6.	Status	A or V "A": Data Valid (Stand-alone or DGPS) "V": Navigation Receiver Warning	【1】
7.	Position System Mode Indication	A: Autonomous mode D: Differential Mode N: Data not valid	【1】
8.	Checksum		【2】

Interpreting Example:

34 degree 44.1234 min N

35 degree 21.0000 min E

UTC: 12:34:56

Status: Positioning

4.6.4 $GPGSA (out)

Positioning Status

Example

$GPGSA	,A	,3	,01	,02	,03	……	,02.00	,03.00	,04.00	* hh	CR LF
Field#	1	2	3	4	5	6…	15	16	17	18	

#.	Description	Range	【Bytes】
1.	Operation Mode	M or A "M": 2D-only Mode "A": 2D/3D Auto-switching Mode	【1】
2.	Positioning Status	1-3 "1": Fix not available "2": 2D-positioning "3": 3D-positioning	【1】
3-14.	Satellite Numbers Used for Positioning	01-32	【2】 or 【0】
	Note: A null field is output unless a satellite is available.		
15.	PDOP	n/a	【5】
	Note: "00.00" is output unless 3D positioning is performed.		
16.	HDOP	n/a	【5】
	Note: "00.00" is output while positioning is interrupted.		
17.	VDOP	n/a	【5】
	Note: "00.00" is output unless 3D positioning is performed.		
18.	Checksum		【2】

Interpreting Example:

2D/3D Auto-switching Mode

3D Positioning

Satellites used: 01, 02, 03…

PDOP: 2.00

HDOP: 3.00

VDOP: 4.00

4.6.5 $GPGSV (out)

Satellite Details

Example

$GPGSV	,2	,1	,06	,01	,05	,234	,56
Field#	1	2	3	4	5	6	7

,04	,11	,223	,44
8	9	10	11

,01	,75	,088	,32
12	13	14	15

,01	,42	,234	,48	*75	CR LF
16	17	18	19	20	

#.	Description	Range	【Bytes】 (unit)
1.	Total No. of Messages	1-3	【1】 (n/a)
2.	No. of Message	1-3	【1】 (n/a)
3.	No. of satellites in line-of-site (with elevation angle higher than 5 degrees only)	00-12	【2】 (n/a)
4.	1st Sat. SV#	01-32	【2】
5.	1st Sat. Elevation Angle	05-90	【2】 (degree)
6.	1st Sat. Bearing Angle	000-359	【3】 (degree)
7.	1st Sat. SNR (Signal/Noise Ratio) (C/No)	00-99	【2】 (dBHz)
8-11.	2nd Sat. Details		【9】
12-15.	3rd Sat. Details		【9】
16-19.	4th Sat. Details		【9】
20.	Checksum		【2】

In this sentence, a maximum of four satellite details is indicated per each output. Five or more satellite details are output in the 2nd or 3rd messages. When there is only one to three satellite details, the checksum <CR><LF> is issued immediately after Sat. SV#, Sat. Elevation Angle, Sat. Bearing Angle and SNR.

4.6.6 $GPVTG (out)

Course & Speed

Example

$GPVTG	,012.3,T	,001.1,M	,001.2,N	,0002.2,K	,A	✱ 10	CR LF

Field# 1 2 3 4 5 6 7 8 9 10

#.	Description	Range	【Bytes】(unit)
1-2	True Course		
	"012.3"	000.0-359.9	【5】(degree)
	"T" means "**True**"	T	【1】(n/a)
	Note: A null field is output unless true course information is available.		
3-4.	Magnetic Course		
	"001.1"	000.0-359.9	【5】(degree)
	"M" means "**Magnetic**"	M	【1】(n/a)
	Note: A null field is output unless magnetic course information is available.		
5-6.	Speed (kts)		
	"001.2"	000.0-999.9	【5】(kts)
	"N" means "**kNot**"	N	【1】(n/a)
	Note: A null field is output unless speed information is available.		
7-8.	Speed (km/h)		
	"0002.2"	0000.0-9999.9	【6】(km/h)
	"K" means "**Km/h**"	K	【1】(n/a)
	Note: A null field is output unless speed information is available.		
9.	Position System Mode Indicator	A: Autonomous Mode D: Differential Mode N: Data not valid	【1】
10.	Checksum		【2】

4.6.7 $GPRMC (out)

UTC, Position, Course, Speed, etc.

Example

$GPRMC	,123456	,A	,3444.1234,N	,13521.4567,E

Field# 1 2 3 4 5 6

,005.6	,123.5	,020195	,001.0,W	,A

7 8 9 10 11

* 07	CR LF

13

#.	Description	Range	【Bytes】
1.	UTC: Time		
	"12": hh	00-23	【2】
	"34": mm	00-59	【2】
	"56": ss	00-59	【2】
2.	Status	A or V	【1】
		"A": Data valid (Stand-alone or DGPS)	
		"V": Navigation receiver warning	
3-4.	Latitude		
	"34": degree	0-90	【2】
	"44": minute (integer)	0-59	【2】
	"1234": minute (fraction)	0000-9999	【4】
	"N": North/South	N or S	【1】
5-6.	Longitude		
	"135": degree	000-180	【3】
	"21": minute (integer)	00-59	【2】
	"4567": minute (fraction)	0000-9999	【4】
	"E": East/West	E or W	【1】
7.	Speed (kts)		
	"005.6": speed (kts)	000.0-999.9	【5】
	Note: A null field is output unless speed information is available.		
8.	True Course (degree)		
	"123.5"	000.0-359.9	【5】
	Note: A null field is output unless true course information is available.		
9.	UTC: Date		
	"02": DD	01-31	【2】
	"01": MM	01-12	【2】

	"97": YY	97-40 (1997-2040)	【2】
10.	Magnetic Deviation (degree)		
	"001.0"	000.0-180.0	【5】
	"W"	W or E "W": West (MAG=TRUE-DEV) "E": East (MAG=TRUE+DEV)	【1】
12.	Positioning System Mode Indication	A: Autonomous Mode D: Differential Mode N: Data not valid	
13.	Checksum		【2】

8 bits data between "$" and "*" (excluding "$" & "*") are XORed, and the result is converted to 2 bytes of hexadecimal letters. Only RMC sentences are transmitted with checksum. All other output sentences do not include checksum fields.

Interpreting Example:

UTC Time 12:34:56

Positioning

34 deg. 41.1234 min. N

135 deg. 21.4567 min. E

Speed: 5.6 kts

True Course: 123.5 degrees

UTC date: Jan. 2, 1995

Magnetic Deviation: 1.0 degree, West

4.6.8 $GPDTM (out)

Datum

Example

$GPRMC	,TOY	,M	,00.1697	,S	,00.1234	,E	,,W84	* 05	CR LF
Field#	1	2	3	4	5	6	7 8	9	

#.	Description	Range	【Bytes】
1.	Local datum code		【3】
2.	Local datum sub code		【1】
3.	Latitude offset (minute)		【7】
4.	Latitude offset mark (N: +, S: -)		【1】
5.	Longitude offset (minute)		【7】
6.	Longitude offset mark (E: +, W: -)		【1】
7.	Altitude offset (m)	Always null	
8.	Datum	Always "W84"	【3】
9.	Checksum		【2】

Interpreting Example:

Datum 172

4.6.9 $PFEC,GPanc (out)

Almanac data and satellite's health condition

Example

Column 1 ... 32

$PFEC	**,GPanc**	**,970102030405**	**,22222200222222222222000000222221**	* 4B	**CR LF**
Field# 1		2	3	4	

#.	Description	Range	【Bytes】
1.	Command name		【5】
2.	Almanac Date/Time (Local Date/Time)		
	"970102030405": YYMMDDhhmmss		【12】
3.	Health conditions for 32 satellites	0-2	【32】
		"0": Almanac not collected yet, or that satellite is not launched yet.	
		"1": Unhealthy (Not used for positioning).	
		"2": Healthy (Usable for positioning)	
	Each column represents each satellite		
4.	Checksum		【2】

Interpreting Example:

Almanac is obtained on Jan.2, 1997 at 03h:04m:05s

SV#1	healthy
SV#2	healthy
SV#3	healthy
SV#4	healthy
SV#5	healthy
SV#6	healthy
SV#7	unhealthy
SV#8	unhealthy
SV#9	healthy

4.6.10 $PFEC,GPacc (out)

SV(satellite) Accuracy

Example

Column 1 32

$PFEC	,GPanc	,222222XXXXXXXXX77777XXXXXXXXXXXB	*0D	CR LF

Field# 1 2 3

#.	Description	Range	【Bytes】
1.	Command name		【5】
2.	SV accuracies for 32 satellites		【32】
		F: SV Accuracy in hexadecimal notation	
		X: SV Accuracy not available	
	Each column represents each satellite.		
3.	Checksum		【2】

Interpreting Example:

SV#1	2
SV#2	2
SV#3	2
SV#4	2
SV#5	2
SV#6	2
SV#7	Data not available
SV#8	Data not available
SV#9	Data not available

4.6.11 $PFEC,GPast (out)

Position, Altitude, Speed, Course, Local Time, etc.

Example

$PFEC	,GPast	,4	,6	,1	,0356
Field#	1	2	3	4	5

,N34431234	,E135211234	,0012347
6	7	8

,970123123456	,01235	,1234	,1345	* 65	CR LF
9	10	11	12	13	

#.	Description	Range	【Bytes】
1.	Command name		【5】
2.	Status	0,3-6	【1】
		"0": Positioning not performed yet	
		"3": Stand-alone GPS, 2D	
		"4": Stand-alone GPS, 3D	
		"5": DGPS 2D	
		"6": DGPS 3D	
3.	No. of satellites used for positioning (0-9, A-C)		
	"6"	0-9	【1】
		A: 10	
		B: 11	
		C: 12	
4.	Seed/course calculation status		
	"1"	0-1	【1】
		"0": Data invalid (can't be calculated)	
		"1": Data valid	
5.	DOP x 100 (2D: HDOP; 3D: PDOP)		
	"0356"	0000-9999	【4】
	Note: For actual DOP, divide the above value by 100.		
	"0000" is output while positioning is interrupted.		
6.	Latitude		
	"N": North/South	N or S	【1】
	"34": degree	00-99	【2】
	"43": minute (integer)	00-59	【2】
	"1234": minute (fraction)	0000-9999	【4】
7.	Longitude		

"E": East/West	E or W	【1】
"135": degree	000-179	【3】
"21": minute (integer)	00-59	【2】
"1234": minute (fraction)	0000-9999	【4】

8. Altitude (x10m)

"0012347"	-009999 to 0179999	【7】

Note: For actual altitude, divide the above value by 10.

9. Local Date/Time

"940123123456": YYMMDDhhmmss	n/a	【12】

Note: (Local date/time) = (UTC) – (Local Zone Time)

Unless local zone time information is available, UTC is output.

10. Speed (x10 km/h)

"01235"	00000-18519	【5】

Note: For actual speed, divide the above value by 10.

If speed/course calculation status (field#4) is "0" (invalid), output value is held.

11. True Course (x10 degrees)

"1234"	0000-3599	【4】

Note: For actual course, divide the above value by 10.

If speed/course calculation status (field#4) is "0" (invalid), output value is held.

11. Magnetic Course (x10 degrees)

"1345"	0000-3599	【4】

Note: For actual course, divide the above value by 10.

If speed/course calculation status (field#4) is "0" (invalid), output value is held.

12. Checksum 【2】

4.6.12 $PFEC,GPtst (out)

Self-test results

Example

$PFEC	,GPtst	,0	,4850280001	,08	＊19	CR LF

Field# 1 2 3 4 5 6

#.	Description	Range	【Bytes】(unit)
1.	Command name 【5】		【5】
2.	Status	0-1	【1】
		"0": Testing now	
		"1": Completed	
3.	Program and Version Numbers		
	"4850280": Program No.	n/a	【7】
	"001": Version No.	n/a	【3】
4-5.	Self-test Results		
	"0": Result of Test 1	0-1	【1】
		"0": Normal	
		"1": GPS data backup error (Including RTC back-up error)	
	"8": Result of Test 2	0-F	【1】

Code	Rx Param Backup	Antenna Error	RAM	ROM
"1"	OK	OK	OK	Error
"2"	OK	OK	Error	OK
"3"	OK	OK	Error	Error
"4"	OK	Error	OK	OK
"5"	OK	Error	OK	Error
"6"	OK	Error	Error	OK
"7"	OK	Error	Error	Error
"8"	Error	OK	OK	OK
"9"	Error	OK	OK	OK
"A"	Error	OK	OK	Error
"B"	Error	OK	Error	Error
"C"	Error	Error	OK	OK
"D"	Error	Error	OK	OK
"E"	Error	Error	Error	OK
"F"	Error	Error	Error	Error

6. Checksum 【2】

4.6.13 $PFEC,GPssd (Answer to $PFEC,GPsrq)

Receiver parameters set by $PFEC,GPset

Example

$PFEC	,GPssd	,G001	……	＊ hh	CR LF
Field#	1	2	3……		

$PFEC	,GPssd	,D08	……	＊ hh	CR LF
Field#	1	2	3……	n+1	

#.	Description	Range	【Bytes】
1.	Command name		【5】
2-n.	Receiver parameters set by $PFEC,GPset are output in two sentences. Each parameter is preceded by delimiter "," (comma).		
n+1.	Checksum		【2】

4.6.14 $PFEC,GPisd (Answer to $PFEC,GPirq)

Log output intervals set by $PFEC,GPint

Example

$PFEC	,GPisd	,GGA01	……	＊ hh	CR LF
Field#	1	2	3……	n+1	

$PFEC	,GPisd	,tst01	……	＊ hh	CR LF
Field#	1	2	3……	n+1	

#.	Description	Range	【Bytes】
1.	Command name		【5】
2-n.	Log output intervals set by $PFEC,GPint are output in two sentences. Each parameter is preceded by delimiter "," (comma).		
n+1.	Checksum		【2】

4.6.15 $PFEC,GPdsd (Answer to $PFEC,GPdrq)

DGPS parameters set by $PFEC,GPdif

DGPS parameters set by $PFEC,GPdif are output.

Example

$PFEC	,GPdsd	,D0	* 02	CR LF
Field#	1	2	3	

#.	Description	Range	【Bytes】
1.	Command name		【5】
2.	DGPS parameters set by $PFEC,GPdif are output.		
3.	Checksum		【2】

4.6.16 $PFEC,GPdie (out)

Receiver status

Example

$PFEC	,GPdie	,1	,08	,0	,0	,0	*66	CR LF
Field#	1	2	3	4	5	6	7	

#.	Description	Range	【Bytes】
1.	Command name		【5】
2.	DGPS status	0-1 "0": DGPS data not received yet "1": Receiving DGPS data	【1】

Note: This flag will be set a few seconds after DGPS data entry.

#.	Description	Range	【Bytes】
3.	No. of DGPS Satellites		
	"08"	n/a	【2】
4.	DGPS Base Station's Health Condition		
	"0"	0-1 "0": Healthy "1": Unhealthy	【1】

Note: If DGPS station is unhealthy, stand-alone GPS function rather than DGPS is performed.

#.	Description	Range	【Bytes】
5.	DGPS Data Status		
	"0"	0-1 "0": Normal "1": Abnormal	【1】

Note: If DGPS station is invalid, stand-alone GPS function rather than DGPS is performed.

#.	Description	Range	【Bytes】
6.	DGPS Error Code		
	"0"	0-F	【1】

Error Code	Meaning
0	No error
1	In Type 1, Type 3 or Type 9 messages, the base station's health field indicates "unhealthy".
2	In Type 1 message, UDRE field indicates "3" meaning not usable due to big error.
3	3 or less satellites are available for differential data input.
4 to F	Reserved

7. Checksum 【2】

Common Errors:

If DGPS status (fields# 2) cannot be set to "1" (Receiving DGPS data), or if DGPS fix is not obtainable, suspect:

- ✧ Invalid format of incoming DGPS data
- ✧ Insufficient number of satellites in DGPS data
- ✧ DGPS station is faulty
- ✧ DGPS data is too old to correct positioning

4.6.17 $PFEC,GPspe,ANCOUT (in)

Download Almanac

Issue this sentence when you need the almanac data from **FV-18BK**.

$PFEC,GPspe,ANCOUT	* 63	**CR LF**

As an answer to the above sentence, **FV-18BK** outputs internal almanac data (about 6.0K bytes of ASCII characters) in the following format.

Note: After this sentence is received, the **FV-18BK** stops positioning, receiving data and outputting the other data than almanac data. After outputting the almanac data, the **FV-18BK** will restart automatically (Restart clear mode 2).

Example

#GP,TYP=GP77	**90A927FDE……980FE3**	**#GP,END**	**CR LF**

You may save the downloaded almanac for future uploading.

4.6.18 $PFEC,GPspe,ANCINP (in)

Upload Almanac

Issue this sentence when you to send almanac data to **FV-18BK**. This function enables quicker Time-To-First-Fix.

$PFEC,GPspe,ANCINP	* 7A	**CR LF**

Following the above sentence, send almanac data which you saved by $PFEC,GPspe,ANCOUT before:

#GP,TYP = GP79	**90A927FDE……980FE3**	**#GP,END**	**CR LF**

If uploading is completed successfully, **FV-18BK** outputs the following acknowledgment and restarts by itself (Restart clear mode 2).

$ANC,OK	**CR LF**

If uploading is failed, **FV-18BK** will request you to send the entire almanac sentence again by outputting the following error message:

$ANC,NG	CR LF

"NG" means "**No Good**".

4.7 Geodetic ID

There are many geodetic systems in the world. Enter a right geodetic system datum in accordance with your chart or map in use. If the geodetic system in which you are situated differs from the geodetic system employed in your chart or map, GPS fixes may be deviated from the actual position on the chart or map.

➢ International Geodetic Datum

001 W84: WGS-84	
002 W72: WGS-72	
003 TOY-M: TOKYO (Go to 172)*	:Mean Value (Japan, Korea & Okinawa)
004 NAS-C: NORTH AMERICAN 1927	:Mean Value (CONUS)
005 EUR-M: EUROPEAN 1950	:Mean Value
006 AUG: AUSTRALIAN GEODETIC 1984	:Australia and Tasmania Island
007 ADI-M: ADIADAN	:Mean Value (Ethiopia & Sudan)
008 ADI-A:	:Ethiopia
009 ADI-C:	:Mali
010 ADI-D:	:Senegal
011 ADI-B:	:Sudan
012 AGF: AGF	:Somalia
013 AIN-A: AIN EL ABD 1970 (Go to 173)*	:Bahrain Island
014 ANO: ANNA 1 ASTRO 1965	:Cocos Island
015 ARF-M: ARC 1950	:Mean Value
016 ARF-A:	:Botswana
017 ARF-B:	:Lesotho
018 ARF-C:	:Malawi
019 ARF-D:	:Swaziland
020 ARF-E:	:Zaire
021 ARF-F:	:Zambia
022 ARF-G:	:Zimbabwe
023 ARS-M: ARC 1960* (Go to 174)*	:Mean Value (Kenya & Tanzania)
024 ARS-A: (Go to 175)*	:Kenya
025 ARS-B: (Go to 176)*	:Tanzania
026 ASC: ASCENSION ISLAND 1958 (Go to 177)*	:Ascension Island
027 ATF: ASTRO BECON "E"	:Iwo Jima Island
028 TRN: ASTRO B4 SOR. ATOLL	:Tern Island
029 SHB: ASTRO POS 71/4	:St. Helena Island

030 ASQ: ASTRONOMIC STATION 1952	:Marcus Island
031 AUA: AUSTRALIAN GEODETIC 1966	:Australia and Tasmania Island
032 IBE: BELLEVUE (IGN)	:Efate and Erromango Islands
033 BER: BERMUDA 1957	:Bermuda Islands
034 BOO: BOGOTA OBSERVATORY	:Columbia
035 CAI: CAMPO INCHAUPE	:Argentina
036 CAO: CANTON ISLAND 1966	:Phoenix Islands
037 CAP: CAPE	:South Africa
038 CAC: CAPE CANAVERAL (Go to 178)*	:Mean Value (Florida & Bahama Islands)
039 CGE: CARTHAGE	:Tunisia
040 CHI: CHATHAM 1971	:Chatham Island (New Zealand)
041 CHU: CHUA ASTRO	:Paraguay
042 COA: CORREGO ALEGRE	:Brazil
043 BAT: DJAKARTA (BARAVIA)	:Sumatra Island (Indonesia)
044 GIZ: DOS 1968	:Gizo Island (New Georgia Islands)
045 EAS: EASTER ISLAND 1967 (Go to 179)*	:Easter Island
046 EUR-A: EUROPEAN 1950	:Western Europe
047 EUR-E:	:Cyprus
048 EUR-F:	:Egypt
049 EUR-G:	:England, Scotland, Channel & Shetland Islands
050 EUR-K:	:England, Scotland, Channel & Shetland Islands
051 EUR-B:	:Greece
052 EUR-H:	:Iran
053 EUR-I:	:Italy-Sardinia
054 EUR-J:	:Italy-Sicily
055 EUR-C:	:Norway and Finland
056 EUR-D: (Go to 180)*	:Portugal and Spain
057 EUS: EUROPEAN 1979	:Mean Value
058 GAA: GANDAJIKA BASE	:Republic of Maldives
059 GEO: GEODETIC DATUM 1949	:New Zealand
060 GUA: GUAM 1963	:Guam Island
061 DOB: GUX 1 ASTRO	:Guadalcanal Island
062 HJO: HJORSEY 1955	:Iceland
063 HKD: HONG KONG 1963	:Hong Kong
064 INF-A: INDIAN	:Thailand and Vietnam

065 IND-B:	:Bangladesh, India and Nepal
066 IRL: IRELAND 1965	:Ireland
067 IST: ISTS 073 ASTRO 1969	:Diego Garcia
068 JOH: JHONSTON ISLAND 1961 (Go to 181)*	:Jhonston Island
069 KAN: KANDAWALA	:Sri Lanka
070 KEG: KERGUELEN ISLAND	:Kerguelen Island
071 KEA: KERTAU 1948	:West Malaysia and Singapore
072 REU: LA REUNION	:Mascarene Island
073 LCF: L.C. 5 ASTRO	:Cayman Brac Island
074 LIB: LIBERIA 1964	:Liberia
075 LUZ-A: LUZON	:Philippines (Excluding Mindanao Island)
076 LUZ-B:	:Mindanao Island
077 MIK: MAHE 1971	:Mahe Island
078 SGM: MARCO ASTRO	:Salvage Islands
079 MAS: MASSAWA	:Eritrea (Ethiopia)
080 MER: MERCHICH	:Morocco
081 MID: MIDWAY ASTRO 1961	:Midway Island
082 MIN-B: MINNA	:Nigeria
083 NAH-A: NAHRWAN	:Masirah Island (Oman)
084 NAH-B:	:United Arab Emirates
085 NAH-C: (Go to 182)*	:Saudi Arabia
086 SCK: NAMIBIA	:Namibia
087 NAP: MAPARIMA, BWI (Go to 183)*	:Trinidad and Tobago
088 NAS-B: NORTH AMERICAN 1927	:Western United States
089 NAS-A:	:Eastern United States
090 NAS-D:	:Alaska
091 NAS-Q:	:Bahamas (Excluding San Salvador Island)
092 NAS-R:	:Bahamas-San Salvador Island
093 NAS-E:	:Canada (Including Newfoundland Island)
094 NAS-F:	:Alberta and British Columbia
095 NAS-G:	:East Canada
096 NAS-H:	:Manitoba and Ontario
097 NAS-I:	:Northwest Territories and Saskatchewan
098 NAS-J:	:Yukon
099 NAS-O:	:Canal Zone
100 NAS-P (Go to 184)*	:Caribbean
101 NAS-N:	:Central America

102 NAS-T:	:Cuba
103 NAS-U:	:Greenland
104 NAS-L:	:Mexico
105 NAR-A: NORTH AMERICAN 1983	:Alaska
106 NAR-B:	:Canada
107 NAR-C:	:CONUS
108 NAR-D:	:Mexico, Central America
109 FLO: OBSERVATORIO 1966	:Corvo and Flores Islands (Azores)
110 OEG: OLD EGYPTIAN 1930	:Egypt
111 OHA-M: OLD HAWAIIAN	:Mean Value
112 OHA-A:	:Hawaii
113 OHA-B:	:Kauai
114 OHA-C:	:Maui
115 OHA-D: (Go to 185)*	:Oahu
116 FAH: OMAN	:Oman
117 OGB-M: Ordnance Survey of Great Britain 1936	:Mean Value
118 OGB-A:	:England
119 OGB-B:	:England, Isles of Man and Wales
120 OGB-C:	:Scotland and Shetland Islands
121 OGB-D:	:Wales
122 PLN: PICO DE LAS NIVIES	:Canary Islands
123 PIT: PITACAIRN ASTRO 1967	:Pitacaim Island
124 HIT: PROVISIONAL SOUTH CHILEAN 1963	:South Chile (near 53^{o}S)
125 PRP-M: Provisional South American 1956	:Mean Value
126 PRP-A:	:Bolivia
127 PRP-B:	:Chile – Northern Chile (near 19^{o}S)
128 PRP-C:	:Chile – Southern Chile (near 43^{o}S)
129 PRP-D:	:Colombia
130 PRP-E:	:Ecuador
131 PRP-F:	:Guyana
132 PRP-G:	:Peru
133 PRP-H:	:Venezuela
134 PUR: PUERTO RICO	:Puerto Rico and Virgin Islands
135 QAT: QATAR NATIONAL	:Qatar
136 QUO: QORNOQ	:South Greenland
137 MOD: ROME 1940	:Sardinia Islands
138 SAO: SANTA BRAZ	:Sao Miguel, Santa Maria Islands (Azores)

139 SAE: SANTO (DOS)	:Espirito Santo Island
140 SAP: SAPPER HILL 1943 (Go to 186)*	:East Falkland Island
141 SAN-M: SOUTH AMERICAN 1969	:Mean Value
142 SAN-A:	:Argentina
143 SAN-B:	:Bolivia
144 SAN-C:	:Brazil
145 SAN-D:	:Chile
146 SAN-E:	:Columbia
147 SAN-F:	:Ecuador
148 SAN-G:	:Guyana
149 SAN-H:	:Paraguay
150 SAN-I:	:Peru
151 SAN-K:	:Trinidad and Tobago
152 SAN-L:	:Venezuela
153 SOA: SOUTH ASIA	:Singapore
154 POS: SOUTHEAST BASE	:Porto Santo and Madeira Islands
155 GRA: SOUTHWEST BASE	:Faial, Graciosa, Pico, Sao Jorge and Terceira Island
156 TIMBALAI 1948 (Go to 187)*	:Brunei and East Malaysia (Sarawak & Sabah)
157 TOY-A: TOKYO (Go to 188)*	:Japan
158 TOY-B: (Go to 189)*	:Korea
159 TOY-C: (Go to 190)*	:Okinawa
160 TDC: TRISTAN ASTRO 1968	:Tristan da Cunha
161 MVS: VITI LEVU 1916	:Viti Levu Island (Fiji Islands)
162 ENW: WAKE-ENISETOK 1960 (Go to 191)*	:Marshall Islands
163 ZAN: ZANDERIJ	:Suriname
164 BUR: BUKIT RIMPAH	:Bangka and Belitung Islands (Indonesia)
165 CAZ: CAMP AREA ASTRO	:Camp Memurdo Area, Antarctica
166 GSE: G.. SEGARA	:Kalimantan Islands (Indonesia)
167 HEN: HEART NORTH	:Afghanistan
168 HTN: HU-TZU-SHAN (Go to 192)*	:Taiwan
169 TAN: Tananarive Observatory 1925	:Madagascar
170 YAC: YUCARE	:Uruguay
171 999: RT90	:Sweden
172 TOY-M: TOKYO	:Mean Value (Japan, Korea, and Okinawa)
173 AIN-A: AIN EL ABD 1970	:Bahrain Island
174 ARS-M: ARC 1960	:Mean Value (Kenya, Tanzania)

175 ARS-A:	:Kenya
176 ARS-B:	:Tanzania
177 ASC: ASCENSION ISLAND 1958	:Ascension Island
178 CAC: CAPE CANAVERAL	:Ascension Island (Florida and Bahama Islands)
179 EAS: EASTER ISLANDS 1967	:Easter Island
180 EUR-D: EUROPEAN 1950 (Cont'd)	:Portugal and Spain
181 JOH: JOHNSTON ISLAND 1961	:Johnston Island
182 NAH-C: NAHRWAN	:Saudi Arabia
183 NAP: NAPARIMA, BWI	:Trinidad and Tobago
184 NAS-P: NORTH AMERIAN 1927 (Cont'd)	:Caribbean
185 OHA-D: OLD HAWAIIAN	:Oahu
186 SAP: SAPPER HILL 1943	:East Falkland Island
187 TIL: TIMBALAI 1948	:Brunei and East Malaysia (Sarawak and Sabah)
188 TOY-A: TOKYO	:Japan
189 TOY-B: TOKYO	:South Korea
190 TOY-C: TOKYO	:Okinawa
191 ENW: WAKE-ENIWETOK 1960	:Marshall Islands
192 HTN: HU-TZU-SHAN	:Taiwan
*193 through 200 are reserved	
201. ADI-E: ADINDAN	:Burkina Faso
202. ADI-F: ADINDAN	:Cameroon
203. ARF-H: ARC 1950	:Burundi
204. PHA: AYABELLE LIGHTHOUSE	:Djibouti
205. BID: BISSAU	:Guinea-Bissau
206. DAL: DABOLA	:Guinea
207. EUR-T: EUROPEAN 1950	:Tunisia
208. LEH: LEIGON	:Ghana
209. MIN-A: MINNA	:Cameroon
210. MPO: M'PORALOKO	:Gabon
211. NSD: NORTH SAHARA 1959	:Algeria
212. PTB: POINT58	:Mean Solution (Burkina Faso and Niger)
213. PTN: POINTE NOIRE 1948	:Congo
214. SRL: SIERRA LEONE 1960	:Sierra Leone
215. VOR: VOIROL 1960	:Algeria
216. AIN-B: AIN EL ABD 1970	:Saudi Arabia

217. IND-B: INDIAN	:Bangladesh
218. IND-I: INDIAN	:India and Nepal
219. INF-A: INDIAN 1954	:Thailand
220. ING-A: INDIAN 1960	:Vietnam (near 16N)
221. ING-B: INDIAN 1960	:Con Son Island (Vietnam)
222. INH-A: INDIAN 1975	:Thailand
223. IDN: INDONSIAN 1974	:Indonesia
224. EST: CO-ORDINATE SYSTEM 1937 OF ESTONIA	:Estonia
225. EUR-L: EUROPEAN 1950 (Cont'd)	:Malta
226. EUR-T: EUROPEAN 1950 (Cont'd)	:Tunisia
227. SPK-A: S-42 (PULKOVO 1942)	:Hungary
228. SPK-B: S-42 (PULKOVO 1942)	:Poland
229. SPK-C: S-42 (PULKOVO 1942) (Cont'd)	:Czechoslovakia
230. SPK-D: S-42 (PULKOVO 1942) (Cont'd)	:Latvia
231. SPK-E: S-42 (PULKOVO 1942) (Cont'd)	:Kazakhstan
232. SPK-F: S-42 (PULKOVO 1942) (Cont'd)	:Albania
233. SPK-G: S-42 (PULKOVO 1942) (Cont'd)	:Romania
234. CCD: S-JTSK	:Czechoslovakia
235. NAS-V: NORTH AMERICAN 1927 (Cont'd)	:East of 180W
236. NAS-W: NORTH AMERICAN 1927 (Cont'd)	:West of 180W
237. NAR-E: NORTH AMERICAN 1983	:Aleutian Island
238. NAR-H: NORTH AMERICAN 1983	:Hawaii
239. SAN-J: SOUTH AMERICAN 1969 (Cont'd)	:Baltra, Galapagos Island
240. AIA: ANTIGUA ISLAND	:Antigua, Leeward Island
241. DID: DECEPTION ISLAND	:Deception Island, Antarctica
242. FOT: FORT THOMAS 1955	:Nevis, St.Kitts, Leeward Island
243. ISG: ISTS 061 ASTRO 1968	:South Georgia Island
244. ASM: MONTSERRAT ISLAND ASTRO 1958	:Montserrat, Leeward Island
245. REU: REUNION	:Mascarene Island
246. AMA: AMERICAN SAMOA 1962	:American Samoa Island
247. IDN: INDONESIAN 1974	:Indonesia
248. KUS: Kusaie ASTRO 1951	:Caroline Island, Fed. States of Micronesia
249. WAK: Wake Island ASTRO 1952	:Wake Atoll
250. EUR-S: EUROPEAN 1950	:Iraq, Israel, Jordan, Kuwait, Lebanon, Saudi Arabia and Syria
251. HER: HERMANNSKOGEL	:Yugoslavia (Prior to 1990) Slovenia, Croatia,

	Bosnia and Herzegovian Serbia
252. IND-P: INDIAN	:Pakistan
253. PUK: PULKOVO 1942	:Russia
254. VOI: VOIROL 1874	:Tunisia/Algeria

Chapter 5 Glossary

- Almanac (GPS Data)

  Almanac is constellation data for all GPS satellites. Each GPS satellite transmits almanac. The unit receives GPS satellites referring to almanac. (Unlike ephemeris, almanac indicates rough constellation only, and is not directly used for position/time fixing.) Unless almanac is available, the unit must try to acquire satellites sequentially until it successfully acquires one.

- Almanac Data (Output Data)

  Almanac is a very stable data like your calendar. So, once the unit receives almanac, it is preserved for a considerable long term. Almanac date output indicates when the unit received the existing almanac.

- RTCM SC-104 Differential GPS

  Error correcting data based on the standard released by the Radio Technical Commission for Maritime Services, Washington D.C. This unit supports the following three data:

  - Type 1 Message: Differential GPS Correction Data (Basic Data)
  - Type 3 Message: Locations of Base Stations
  - Type 9 Message: High-rate Differential GPS Correction Data

  When these correction data are entered, DGPS mode is invoked automatically, resulting in high-precision position fixing. When DGPS mode is invoked, the position fixing status changes to DGPS automatically.

  * FV-18BK ignores messages other than TYPE 1, 3, and 9.

- 3D Position Fixing

  In 3D position fixing, altitude is obtained in addition to L/L. For 3D fixing the following conditions should be met:

  - More than four satellites can be acquired/tracked.
  - PDOP, which is determined by relative allocations of satellites in the sphere, must be smaller than the preset threshold:
    PDOP < PDOP Threshold (Default=6, Setting may be altered.)

- Number of Satellites for DGPS

  Satellite correction number involved in DGPS input data.

- DGPS Station ID

  DGPS station ID number ranging from 0 to 1023 as defined by RTCM SC-104 specifications.

- 2D Positioning

  Assuming the altitude at 0 meter, the unit fixes L/L. If a reliable altitude had been obtained by 3D positioning, that altitude is assumed instead of 0 meter.

2D positioning is performed when the following two conditions are met:

At least one satellite is available for acquisition and tracking.

HDOP, which is determined by satellite allocations in the sphere, is smaller than 10.
HDOP < 10

The unit does its best to perform 3D positioning, but switches to 2D positioning only when either condition can't be met.

- PDOP Threshold

  When PDOP degrades exceeding this parameter, the unit switches from 3D to 2D positioning automatically. Bear in mind that the altitude is updated by 3D positioning only.

- PDOP, HDOP, VDOP

  In GPS positioning, position fixing accuracy depends on satellite allocating positions in the sphere. Parameters PDOP, HDOP, and VDOP indicate this type of degrading indexes for GPS position fixing; the smaller the values are, the higher the position fixing accuracy gets. HDOP means horizontal dilution of position fixing and affects 2D positioning; VDOP does vertical dilution; PDOP contains these two components as expressed below, and can be used for 3D positioning.

  PDOP = SQRT (HDOP x HDOP + VDOP x VDOP)

- UTC Time

  This is Coordinated Universal Time. Depending on earth's rotating speed, leap second of one second or so may be inserted per year. The UTC output by the unit is based on both almanac data and satellite tracking. Therefore, the UTC output directly after power-on may not be accurate. Japanese local time is obtainable by adding 9 hours to UTC. The UTC which you enter is used for the first time search of a satellite directly after power-on. If UTC you enter is deviated much from the actual UTC, first fix will delay accordingly. UTC entry with 10 minutes' accuracy is desirable. When FV-18BK internal UTC is incorrect due to discharge of the backup battery, etc., enter UTC as correctly as possible. FV-18BK internal UTC is automatically adjusted to a correct value once a satellite is tracked.

5.1 Common Terms:

1. PC: Personal Computer
2. Comm Communications
3. LED: Light Emitting Diode
4. GPS: Global Positioning System
5. MOB: Man Over Board

6. INT: Interval
7. GGA: Global Positioning System Fixed Data
8. GLL: Geographic Positioning –latitude / longitude
9. GSA: GNSS DOP and active satellites
10. GSV: GNSS Satellites in View
11. RMC: Recommended Minimum Specific GNSS Data
12. VTG: Course Over Ground and Ground Speed
13. DC: Direct Current
14. TTL: Time-To-Live
15. TTFF: Time To First Fix

Chapter 6 Troubleshooting

1. Module has no output
   A. Power is at pin7 & pin6
   B. Improper ComPort (either 1 or 2) is selected
   C. Baud rate is FIXED at 4800bps
2. Module has long COLD START
   A. Under the cold start mode, the module will be automatically initialized for about 4~6 min.

   Note: During cold start, the module must accumulate GPS data from each satellite without interruptions or Sky-view blockages, resulting in longer TTFF.
3. Module does not store last position & RTC for quick warm start
   A. Battery must be VANT input for SRAM backup power to keep the component alive.

   Note: All user parameter input changes must be backed up by an external battery; otherwise, module default value will make every power on.
4. DGPS does not work
   A. An RTCM must be input at pin3 for the DGPS RTCM to operate.

   Note: The module pin3 has 2 functions designed for PC RXA RS232 input and RTCM input firmware auto detect circuit for RTCM 9.6K input data.

Chapter 7 WARRANTY

LIMITED WARRANTY

SANJOSE NAVIGATION, INC. expressly warrants that for a period of one (1) year from the date of purchase. Our accessories will be free of defects in material (parts) and workmanship (labor). Within the warranty period, a unit will be tested, repaired, or replaced at our option at no charge.

If your unit is out warranty, we will quote repair charges necessary to bring your unit up to factory standards.

THIS WARRANTY APPLIES ONLY TO ORIGINAL PURCHASE

Any unit under warranty should be shipped prepaid to our factory. Warranty replacements will take approximately ninety (90) days.

WARRANTY EXCLUSION

THE FOREGOING EXPRESS WARRANTY IS MADE IN LIEU OF ALL OTHER PRODUCT WARRANTIES, EXPRESSED AND IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH ARE SPECIFICALLY DISCLAIMED. The express warranty will not apply to defects or damage due to accidents, neglect, misuse, alternations, operator error, or failure to properly maintain, clean or repair products.

LIMIT OF LIABILITY

In no event will San Jose Navigation, Inc. or any seller will be responsible or liable for any injury, loss or damage, direct or consequential, arising out of the use or the inability to use the product. Before using, users shall determine in the suitability of the product for their intended use, and users assume all risk and liability whatsoever in connection therewith.

PURCHASER'S DUTIES

The purchaser must return the unit postpaid, with proof of the date of original purchase with the return address to:

SANJOSE NAVIGATION,INC.
9F NO. 105 SHI-CHENG ROAD, PAN-CHIAO CITY
TAIPEI HSIEN, TAIWAN, R.O.C.
TEL: 886-2-26879500
FAX: 886-2-26878893
WWW.SANAV.COM

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