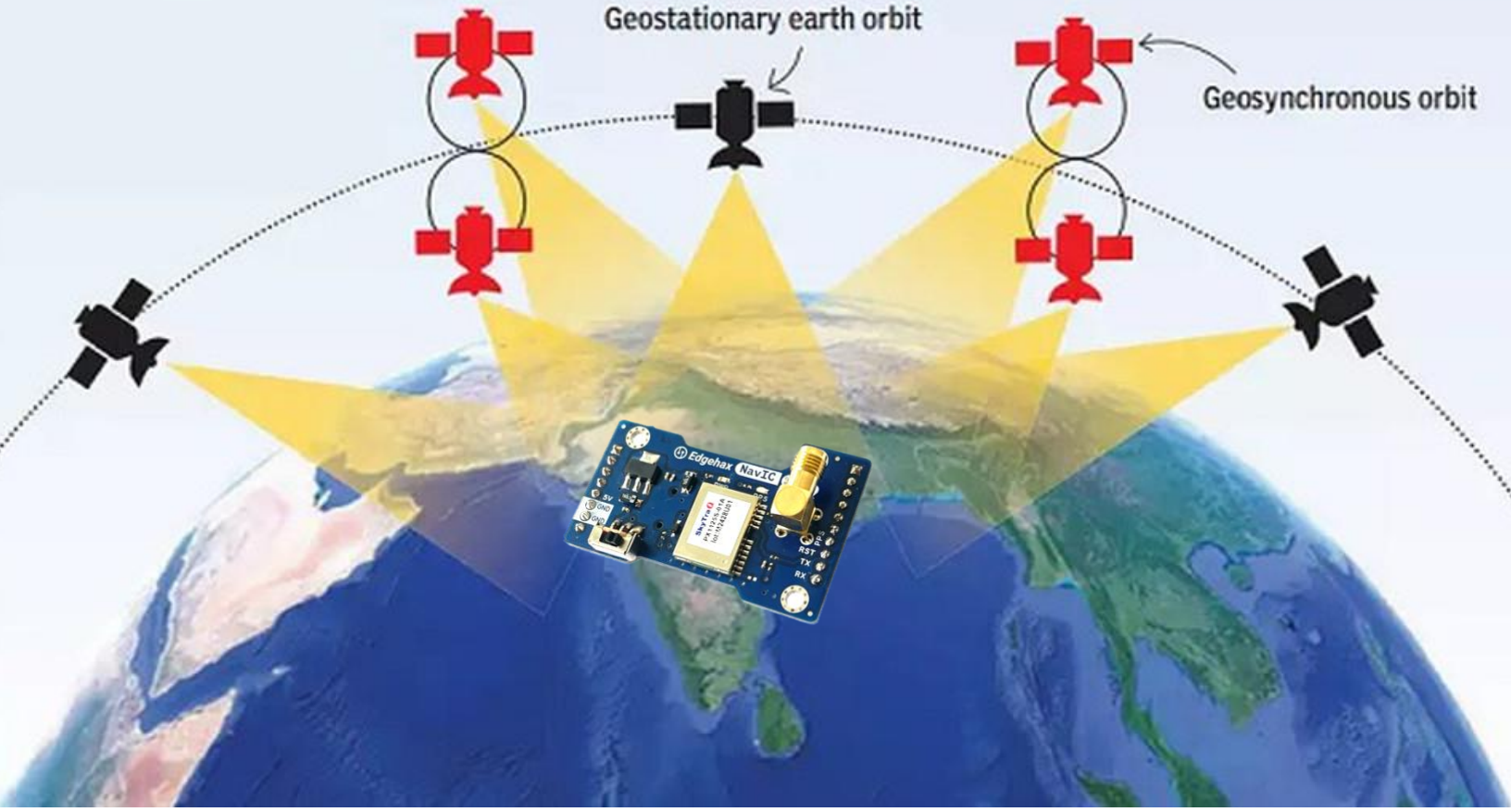
NavIC GPS

NAVIC LIVE LOCATION TRACKER

Edgehax
Edge AI Hardware Xeleration



Introduction

The Indian Regional Navigation Satellite System (IRNSS), with an operational name of NavIC (acronym for Navigation with Indian Constellation; also, nāvik 'sailor' or 'navigator' in Indian languages), is an autonomous regional satellite navigation system that provides accurate real-time positioning and timing services. It covers India and a region extending 1,500 km (930 mi) around it, with plans for further extension. The system currently consists of a constellation of eight satellites, with two additional satellites on ground as stand-by.

NavIC Module

Edgehax NavIC module is designed in a way to simplify development of live tracking/navigation devices and applications based on NavIC satellites. The module used is built for an India's AIS-140 market needs with 2m CEP accuracy.

The module is capable of using NavIC L5, GAGAN L1, and GPS L1 signal to provide 3D navigation in a single compact SMD module. It can track all in-view GPS, GAGAN and NavIC satellites. It is fully autonomous such that once power is applied, the receiver automatically searches, acquires, and tracks satellite signals. When enough satellites are tracked with valid measurements, the receiver produces 3D position and velocity outputs. NavIC + GPS dual-satellite capability enables using greater number of satellite signal than GPS-only receivers. The increased satellite number offers superior performance in challenging urban canyon and multipath environments. The module contains single-chip Phoenix positioning engine inside, featuring high sensitivity and fast TTFF (Time to First Fix). It can acquire, track, and get position fix autonomously in difficult weak signal environment. Its high tracking sensitivity allows continuous position coverage in nearly all outdoor application environments. The high-performance signal parameter search engine is capable of testing 16 million time-frequency hypotheses per second, offering superior signal acquisition and TTFF speed.

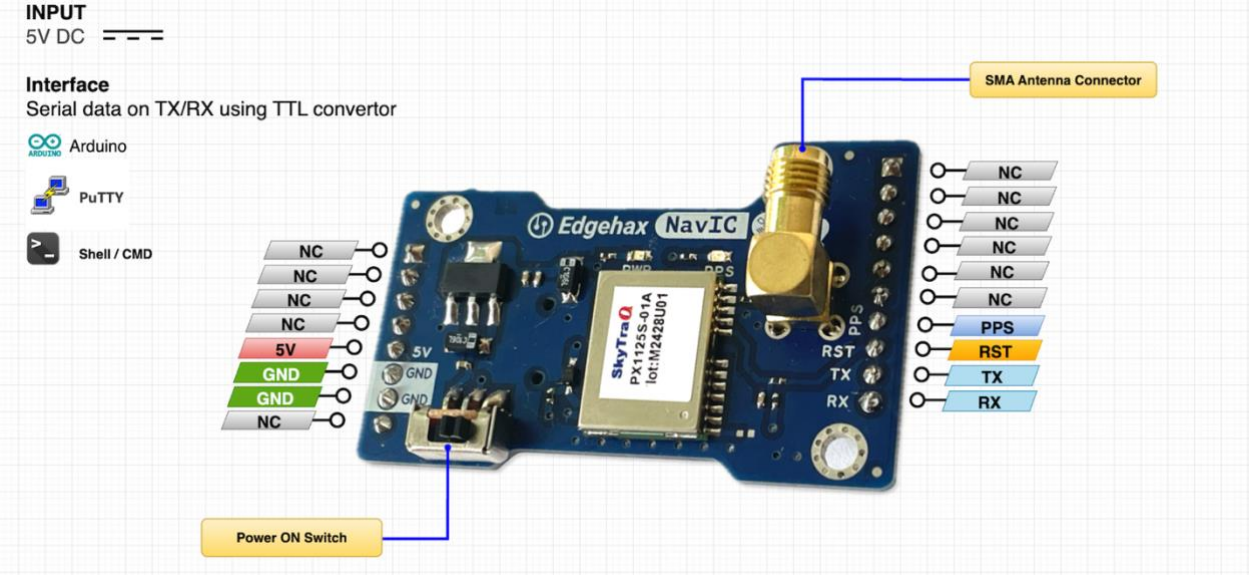
Key Features

- L1 / L5 signal reception
- Works with NavIC, GAGAN, GPS
- Less than 30 second cold start TTFF
- ~ 1 second hot start
- ~2.5m CEP accuracy
- Multipath detection and suppression
- Works with passive and active antenna
- Complete receiver in 12.2mm x 16.0mm size
- Operating temperature -40 ~ +85ºC
- Pb-free RoHS compliant

Technical Specifications

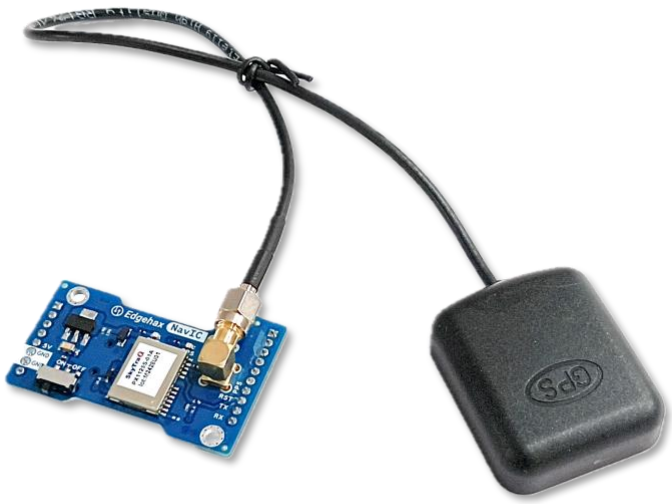
Receiver Type	NavIC L5, GAGAN/GPS L1 C/A code Phoenix engine
Accuracy	Position – 2.5m CEP Velocity – 0.1m/sec Time – 12nsec
Startup Time	~1sec hot start < 30sec cold start
Sensitivity	Better than -145 / -144dBm GPS / NavIC cold-start Better than -154 / -153dBm GPS / NavIC hot-start Better than -155 / -154dBm GPS / NavIC re-acquisition Better than -165 / -156dBm GPS / NavIC tracking
Multi-path Mitigation	Multi-path detection and suppression
A-GPS	7-day server-based AGPS Self-aided ephemeris estimation
Update Rate	1 / 2 / 4 / 5 / 8 / 10 Hz, default 1Hz
Dynamics	4G (39.2m/sec^2) acceleration
Operational Limits	Altitude < 80,000m and velocity < 515m/s, not exceeding both
Serial Interface	3.3V LVTTL level UART, selectable 4800 ~ 115200 baud rate
Protocol	NMEA-0183 V3.01, SkyTraq binary, 115200 baud, 8, N, 1
Datum	Default WGS-84, User definable
Input Voltage	3.3V DC +/-10%
Current Consumption	80mA acquisition, 60mA tracking
Dimension	12.2mm W x 16.0mm L x 2.9mm H
Operating Temperature	-40^{0}C ~ +85^{0}C
Storage Temperature	-55^{0}C ~ +100^{0}C
Humidity	5% ~ 95%

NavIC Pinout



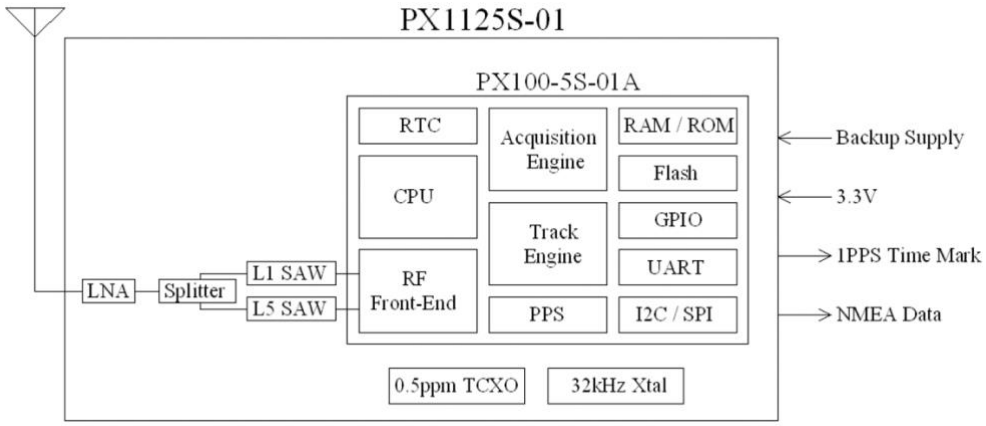
Edgehax NavIC Pinout Diagram

LED Indicator	Description
Power	Power ON status
PPS	One-pulse-per-second (1PPS) time mark output, 3.3V LVTTL. The rising edge synchronized to UTC second when getting 3D position fix. The pulse duration is about 100msec at rate of 1 Hz.



Edgehax NavIC Module Connected to L1/L5 IRNSS Antenna

Block Diagram



NavIC module block diagram

The PX1125S-01 is a L5 NavIC + L1 GAGAN/GPS satellite navigation receiver in a compact surface mount package. It is based on the latest single-chip Phoenix GNSS receiver technology, providing high performance signal acquisition and tracking. The simple UART serial interface and the standard NMEA-0183 protocol make usage of PX1125S-01 very easy and straightforward.

The PX1125S-01 module performs all the necessary system initialization, signal acquisition, signal tracking, data demodulation, and calculation of navigation solution autonomously.

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Parameter	Minimum	Maximum	Condition
Supply Voltage (VCC)	-0.5	3.6	Volt
Backup Battery Voltage (V_BCKP)	-0.5	3.6	Volt
Input Pin Voltage	-0.5	VCC+0.5	Volt
Input Power at RF_IN		+5	dBm
Storage Temperature	-40	+100	degC

OPERATING CONDITIONS

Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC)	3	3.3	3.6	Volt
Acquisition Current (exclude active antenna current)		80		mA
Tracking Current (exclude active antenna current)		60		mA
Backup Voltage (V_BCKP)	1.3		3.6	Volt
Backup Current (VCC voltage applied)		54		uA
Backup Current (VCC voltage off)		13		uA
Output Low Voltage			0.4	Volt
Output HIGH Voltage	2.4			Volt
Input LOW Voltage			0.8	Volt
Input HIGH Voltage	2			Volt
Input LOW Current	-10		10	uA
Input HIGH Current	-10		10	uA
RF Input Impedance (RFIN)		50		Ohm

ANTENNA CONSIDERATIONS

Antenna Type	Passive	Active
GAGAN/GPS Frequency (MHz)	1575.42 +/- 2	1575.42 +/- 2
NavIC Frequency (MHz)	1176.45 +/- 2	1176.45 +/- 2
VSWR	< 2 (typical)	< 2 (typical)
Polarization	RHCP	RHCP
Antenna Gain	> 0dBi	> -2dBi
LNA Gain		17dB (typical)
Noise Figure		< 1.5dB
Total Gain		> 15dB

NMEA Output Description

The output protocol supports NMEA-0183 standard. The implemented messages include GGA, GLL, GSA, GSV, VTG, RMC, and ZDA messages. The NMEA message output has the following sentence structure:

$aaccc,c–c*hh<CR><LF>

The detail of the sentence structure is explained in below Table 1.

Table 1: The NMEA sentence structure

character	HEX	Description
"$"	24	Start of sentence.
Aaccc		Address field. "aa" is the talker identifier. "ccc" identifies the sentence type.
","	2C	Field delimiter.
C–c		Data sentence block.
"*"	2A	Checksum delimiter.
Hh		Checksum field.
<CR><LF>	0D0A	Ending of sentence. (carriage return, line feed)

Table 2: Overview of SkyTraq receiver's NMEA messages

$GNGGA	Time, position, and fix related data of the receiver.
$GNGLL	Position, time and fix status.
$GNGSA **$GPGSA** **$GIGSA**	Used to represent the ID's of satellites which are used for position fix. When both GPS and NavIC satellites are used in position solution, a $GNGSA sentence is used for GPS satellites and another $GNGSA sentence is used for NavIC satellites. When only GPS satellites are used for position fix, a single $GPGSA sentence is output. When only NavIC satellites are used, a single $GIGSA sentence is output.
$GPGSV **$GIGSV**	Satellite information about elevation, azimuth and CNR, $GPGSV is used for GPS satellites, while $GIGSV is used for NavIC satellites
$GNRMC	Time, date, position, course and speed data.
$GNVTG	Course and speed relative to the ground.
$GNZDA	UTC, day, month and year and time zone.

The formats of the supported NMEA messages are described as follows:

GGA – Global Positioning System Fix Data
Time, position and fix related data for a GNSS receiver.

Structure:
$GNGGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13

Example:
$GNGGA,175258.000,2447.0870,N,12100.5221,E,2,15,0.7,95.2,M,19.6,M,,0000*72<CR><LF>

Field	Name	Example	Description
1	UTC Time	175258.000	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
2	Latitude	2447.0870	Latitude in ddmm.mmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
4	Longitude	12100.5221	Longitude in dddmm.mmmm format Leading zeros transmitted
5	E/W Indicator	E	Longitude hemisphere indicator, 'E' = East, 'W' = West
6	Quality Indicator	2	Quality Indicator 0: position fix unavailable 1: valid position fix, SPS mode 2: valid position fix, differential GPS mode 3: GPS PPS Mode, fix valid 6: Estimated (dead reckoning) Mode
7	Satellites Used	15	Number of satellites in use, (00 ~ 56)
8	HDOP	0.7	Horizontal dilution of precision, (0.0 ~ 99.9)
9	Altitude	95.2	mean sea level (geoid), (-9999.9 ~ 17999.9)
10	Geoidal Separation	19.6	Geoidal separation in meters
11	Age pf Differential GPS data		Age of Differential GPS data NULL when DGPS not used
12	DGPS Station ID	0000	Differential reference station ID, 0000 ~ 1023
13	Checksum	72	

GSA – GNSS DOP and Active Satellites

GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA sentence and DOP values.

Structure:

$GNGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,x*hh<CR><LF>

1 2 3 3 3 3 3 3 3 3 3 3 3 3 4 5 6 7 8

Example:

$GNGSA,A,3,21, 12,15,18,20,24,10,32,25,13,,,1.2,0.7,1.0,1*18<CR><LF>

$GNGSA,A,3,03,04,05,07,,,,,,,,1.2,0.7,1.0,4*34<CR><LF>

Field	Name	Example	Description
1	Mode	A	Mode 'M' = Manual, forced to operate in 2D or 3D mode 'A' = Automatic, allowed to automatically switch 2D/3D
2	Mode	3	Fix type 1 = Fix not available 2 = 2D 3 = 3D
3	Satellite used 1~12	21, 12, 15, 18, 20, 24, 10, 32, 25, 13	01 ~ 32 are for GPS; 33 ~ 64 are for SBAS (PRN minus 87); 01 ~ 07 are for NavIC. GPS and NavIC satellites are differentiated by the GNSS System ID. Maximally 12 satellites are included in each GSA sentence.
4	PDOP	1.2	Position dilution of precision (0.0 to 99.9)
5	HDOP	0.7	Horizontal dilution of precision (0.0 to 99.9)
6	VDOP	1.0	Vertical dilution of precision (0.0 to 99.9)
7	GNSS System ID	1	1 for GPS, 4 for NavIC
8	Checksum	18	

GSV – GNSS Satellites in View

Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value. Four satellites maximum per transmission.

Structure:

$GPGSV,x,x,xx,xx,xx,xxx,xx,...,xx,xx,xxx,xx,x *hh<CR><LF>

1 2 3 4 5 6 7 4 5 6 7 8 9

Example:

$GPGSV,4,1,13,02,72,109,43,24,69,035,48,18,52,330,42,21,49,246,43,1*69<CR><LF>
$GPGSV,4,2,13,20,47,118,42,15,39,046,44,41,39,242,41,12,28,129,42,1*68<CR><LF>
$GPGSV,4,3,13,10,25,321,38,25,15,170,35,32,14,278,36,13,06,063,35,1*64<CR><LF>
$GPGSV,4,4,13,05,04,126,36,1*57<CR><LF>
$GIGSV,2,1,07,07,63,158,46,05,61,202,44,04,57,199,44,03,39,243,42,4*7F<CR><LF>
$GIGSV,2,2,07,01,00,000,39,02,00,000,24,06,00,266,,4*44<CR><LF>

Field	Name	Example	Description
1	Number of message	4	Total number of GSV messages to be transmitted (1-5)
2	Sequence number	1	Sequence number of current GSV message
3	Satellites in view	13	Total number of satellites in view (00 ~ 20)
4	Satellite ID	02	01 ~ 32 are for GPS; 33 ~ 64 are for SBAS (PRN minus 87); 01 ~ 07 are for NavIC. GPS and NavIC satellites are differentiated by the GNSS System ID. Maximally 4 satellites are included in each GSV sentence.
5	Elevation	72	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	109	Satellite azimuth angle in degrees, (000 ~ 359)
7	SNR	43	C/No in dB (00 ~ 99) Null when not tracking
8	GNSS System ID	1	1 for GPS, 4 for NavIC
9	Checksum	69	

RMC – Recommended Minimum Specific GNSS Data

Time, date, position, course and speed data provided by a GNSS navigation receiver.

Structure:

$GNRMC,hhmmss.sss,A,dddmm.mmmm,a,dddmm.mmmm,a,x.x,x.x,ddmmyy,,,a*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11

Example:

$GNRMC,175258.000,A,2447.0870,N,12100.5221,E,000.0,000.0,220617,,,D*75<CR><LF>

Field	Name	Example	Description
1	UTC time	175258.000	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.0870	Latitude in dddmm.mmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.5221	Longitude in dddmm.mmmm format Leading zeros transmitted
6	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
7	Speed over ground	000.0	Speed over ground in knots (000.0 ~ 999.9)
8	Course over ground	000.0	Course over ground in degrees (000.0 ~ 359.9)
9	UTC Date	220617	UTC date of position fix, ddmmyy format
10	Mode indicator	D	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode
11	checksum	75	

VTG – Course Over Ground and Ground Speed

The actual course and speed relative to the ground.

Structure:

GNVTG,x.x,T,,M,x.x,N,x.x,K,a*hh<CR><LF>

1 2 3 4 5

Example:

$GNVTG,000.0,T,,M,000.0,N,000.0,K,D*16<CR><LF>

Field	Name	Example	Description
1	Course	000.0	True course over ground in degrees (000.0 ~ 359.9)
2	Speed	000.0	Speed over ground in knots (000.0 ~ 999.9)
3	Speed	000.0	Speed over ground in kilometers per hour (000.0 ~ 1800.0)
4	Mode	D	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode
5	Checksum	16	

ZDA – TIME AND DATE

UTC, day, month, year and local time zone

Structure:

$GNZDA,hhmmss.sss,xx,xx,xxxx,xx,xx*hh<CR><LF>

1 2 3 4 5 6 7

Example:

$GNZDA,175258.000,22,06,2017,00,00*46<CR><LF>

Field	Name	Example	Units	Description
1	UTC time	175258.000		UTC time in hhmmss.ss format (000000.00 ~ 235959.99)
2	UTC Day	22		UTC time: day (01 ~ 31)
3	UTC Month	06		UTC time: month (01 ~ 12)
4	UTC Year	2017		UTC time: year (4 digit format)
5	Local zone hour	00		Local zone hours (00 ~ +/- 13)
6	Local zone minutes	00		Local zone minutes (00 ~59)
7	Checksum	46		Checksum

IRNSF – NavIC Sub-Frame Data (Periodic)

Sub-frame data decoded after preamble. It begins with telemetry word (TLM) and ends with tail bits.

Structure:

$PIRNSF, x, x, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx,

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

xx, xx, xx, xx, xx, xx, xx, xx, xx, x *hh <CR> <LF>

30 31 32 33 34 35 36 37 38 39 40

Example:

$PIRNSF,3,1,8B,1F,AA,83,A2,17,54,18,09,9C,00,0B,D4,BF,40,05,E8,B8,F8,43,2D,E2,C5,7F,F4,00,0E,D8,B2,BB,CB,9A,00,B2

,12,D0,0*0C<CR><LF>

Field	Name	Example	Description
1	SVID	3	NAVIC Satellite PRN
2	SFID	1	Sub-frame ID (1-4)
3~38	SF_DATA	8B~D0	Decoded sub-frame data after preamble, begin with telemetry word (TLM).
39	SF_DATA	0	Decoded sub-frame data Tail bits.
40	Checksum	0C	

GAGAN SUBFRAME MESSAGE TYPE 63 – GAGAN subframe message type 63 data *

This is the information about the GAGAN subframe data bits currently collected in the receiver. The subframe data bits are 212 bits.

Structure:

```
$PGAMES ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx ,xx *hh
          1  2  3  4  5  6  7  8  9  10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
```

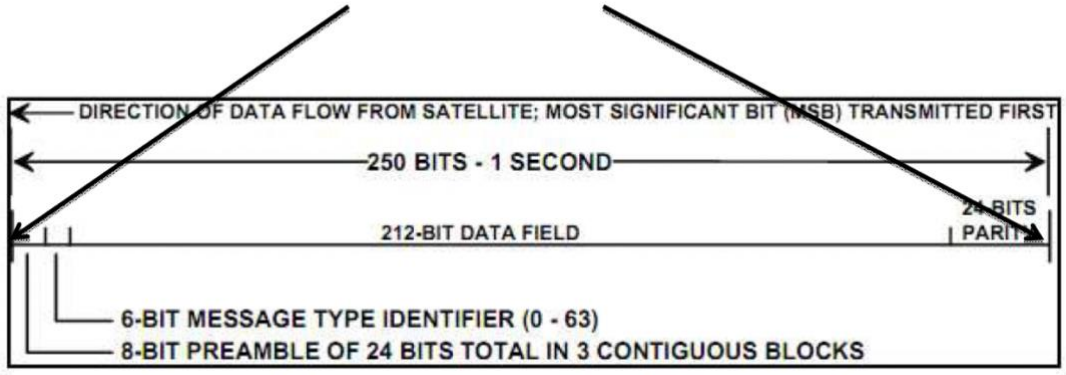
Example:

$PGAMES,41,02,00,00,03,51,BB,F0,FC,00,0A,01,0C,C0,10,11,E2,4B,39,48,BC,80,00,00,00,00,00,00*01<CR><LF>

Field	Name	Example	Description
1	SVID	41	GAGAN PRN
2	Subframe data[0]	02	Type 63 message data bit 0~ bit 7 in UINT8 mapped to Subframe data[0] bit 7~ bit 0, bit 0 is LSB
3~27	Subframe data[ndx]		Type 63 message data bit 8~ bit 207 in UINT8 ndx: 1~25 bit 8 ~ bit 15 mapped to Subframe data[1] bit 7~ bit 0, bit 0 is LSB bit 16 ~ bit 23 mapped to Subframe data[2] bit 7~ bit 0, bit 0 is LSB ..etc
28	Subframe data[26]	00	Type 63 message data bit 208~ bit 211 mapped to Subframe data[26] bits 7~4 of UINT8 Padding 4 bits of zero at bits 3~0 of UINT8 Bit 0 is LSB
29	Checksum	01	

* $PGAMES supported for PX1125S-01C module only

Type 63 message data bit 0 ~ bit 211



Data Type Definition

UINT8	8 bit unsigned integer
UINT16	16 bit unsigned integer
UINT32	32 bit unsigned integer
SINT8	8 bit signed integer
SINT16	16 bit signed integer
SINT32	32 bit signed integer
SPFP	32 bit single precision floating point number
DPFP	64 bit double precision floating point number

NavIC Applications

Edgehax NavIC module can be easily mounted on Edgehax 4G boards for building live location tracking applications like GPS trackers, Asset monitoring etc. Edgehax 4G board comes with SD card for offline data caching. Any operator 4G/2G or even M2M sim card from Airtel, Jio, Vodaphone, BSNL can be used for cloud sync and live location tracking.

Edgehax NavIC Module Mounted on 4G module and connected to L1/L5 IRNSS Antenna

Used for Live tracking and navigation applications using any 4G/2G or M2M based Sim card.

Contact Us

Email: support@edgehax.com
Phone: +91-87478 66999
Website: https://edgehax.com

Address:

Edgehax
Stavar Systems Pvt Ltd
#4 Yuvaka Sangha, 1st Floor (STPI)
31st Cross, 11th Main Rd,
Jayanagar 4th Block, **Bengaluru, 560011**