Orion B17

RTK Heading + Pitch/Roll GNSS Receiver Module for Low Earth Orbit Applications

Features

- Dual antenna input satellite compass
- Moving-base RTK
- Heading + pitch/roll output
- Multi-band, quad-GNSS
- 17mm x 22mm size
- NMEA-0183 and RTCM 3.x protocol
- Easy to integrate
- Operating temperature -40 ~ +85ºC
- RoHS compliant

Applications

- Attitude determination

The ORION B17 offers precise heading + pitch/roll based on carrier phase RTK technique and can be used for attitude determination applications. Its 17mm x 22mm stamp size makes it ideal for application requiring compact form factor.

Dual antenna input satellite-based precision heading + pitch/roll determination is unaffected by magnetic surrounding, requires no calibration, and offers unmatched performance in both static and dynamic conditions.

The ORION B17 receiver is based on SkyTraq's high-performance Phoenix GNSS chipset, featuring fast signal acquisition search engine and high-sensitivity track engine. Search engine performs 16 million time-frequency hypothesis testing per second, offering industry-leading signal acquisition performance.

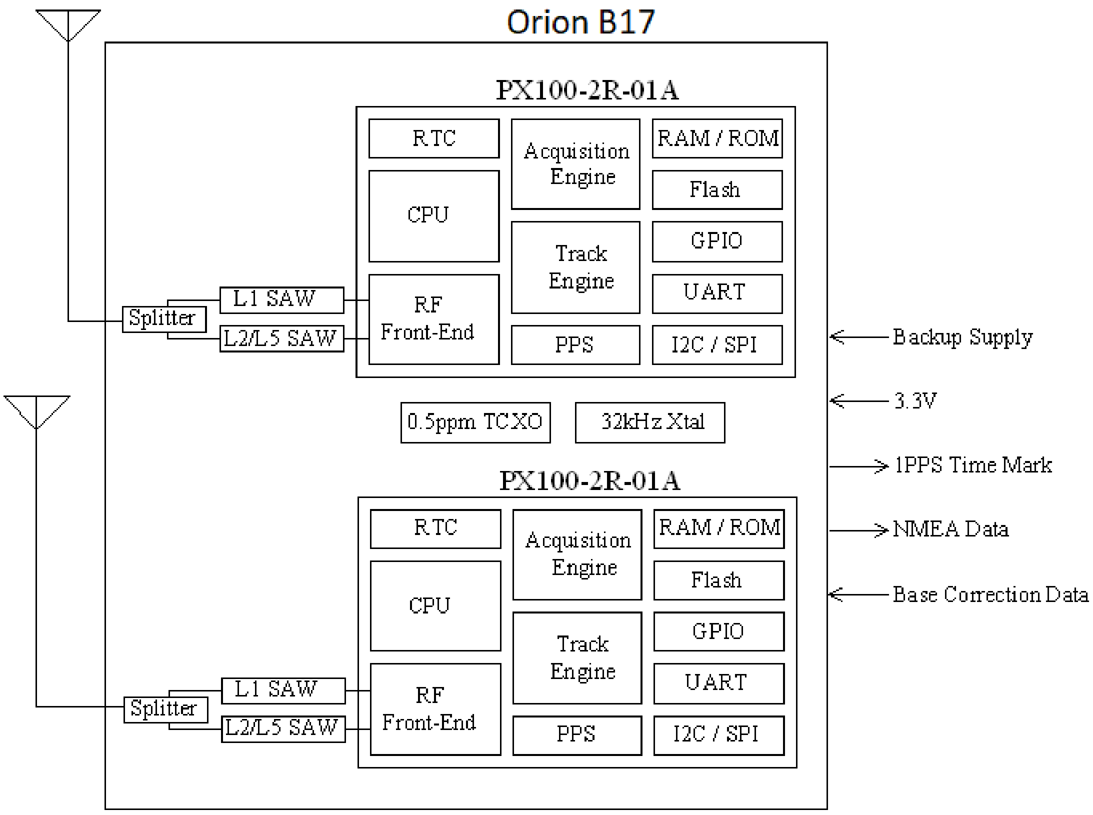
The moving-base RTK receiver is optimized for low earth orbit applications requiring high-accuracy heading + pitch/roll data.

TECHNICAL SPECIFICATIONS

Receiver Type	230 channel Phoenix GNSS engine GPS/QZSS L1/L2C, BeiDou B1I/B2I, Galileo E1/E5b, GLONASS L1OF/L2OF
Accuracy	Position 1.5m CEP Velocity 0.05m/sec*[1] Time 12ns Moving Base Heading 0.13 degree*[2]
Time to First Fix	~ 50 second cold-start under open sky (average)
RTK Convergence	< 10sec
Reacquisition	1s
Update Rate	1 / 2 / 4 / 5 / 8 Hz
Operational Limits	Velocity up to 10Km/sec
Serial Interface	3.3V LVTTL level
Protocol	NMEA-0183 V4.1 GGA, GLL, GSA, GSV, RMC, VTG, ZDA, THS 115200 baud, 8, N, 1
Datum	Default WGS-84 and user definable in stand-alone mode
Input Voltage	3.3V DC +/-10%
Current Consumption	250mA
Dimension	17mm L x 22mm W x 2.9mm H
Weight:	1.7g
Operating Temperature	-40°C ~ +85°C
Storage Temperature	-40 °C ~ +85°C
Humidity	5% ~ 95% non-condensing

*[1] 50% @ 30 m/s for dynamic operation
*[2] (1-sigma) heading accuracy using 1 meter baseline

FUNCTIONAL DESCRIPTION



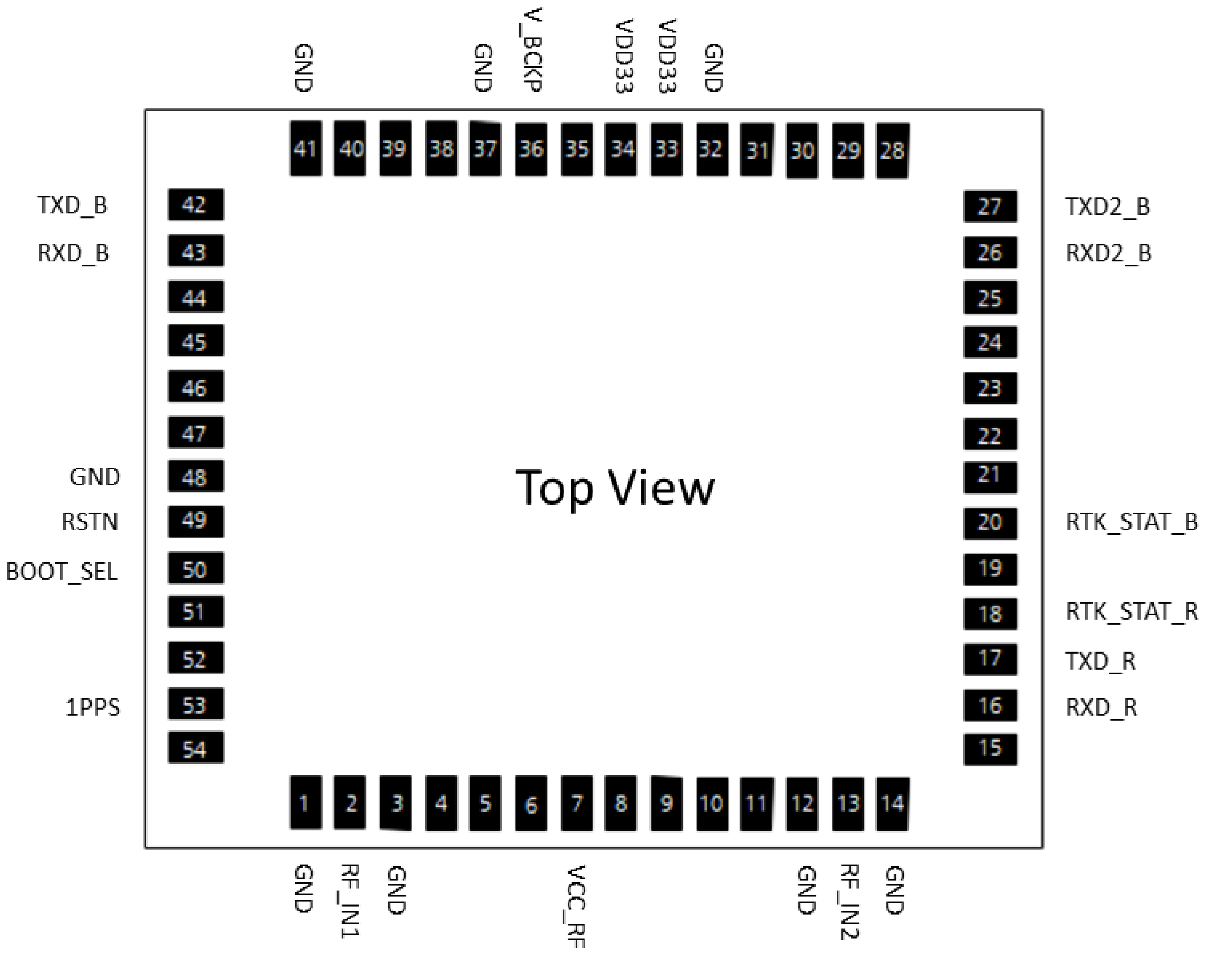
Active antenna is required to use with ORION B17. The received signal goes through a signal splitter, to individual L1 and L2/L5 SAW filters to remove out-band interference, then to the PX100 GNSS receiver chip for RTK signal processing. By using two antennas, ORION B17 can provide accurate heading + pitch/roll formed by directional vector of the two antennas. It has below measured 1-sigma heading accuracy.

2 meter Baseline: 0.07 Degree Accuracy
1 meter Baseline: 0.13 Degree Accuracy
50 cm Baseline: 0.27 Degree Accuracy

The rule of thumb 1-sigma accuracy is:

Heading: 0.2/B degree
Pitch or Roll: 0.4/B degree
B: dual antenna separation in meter

PINOUT



PINOUT DESCRIPTION

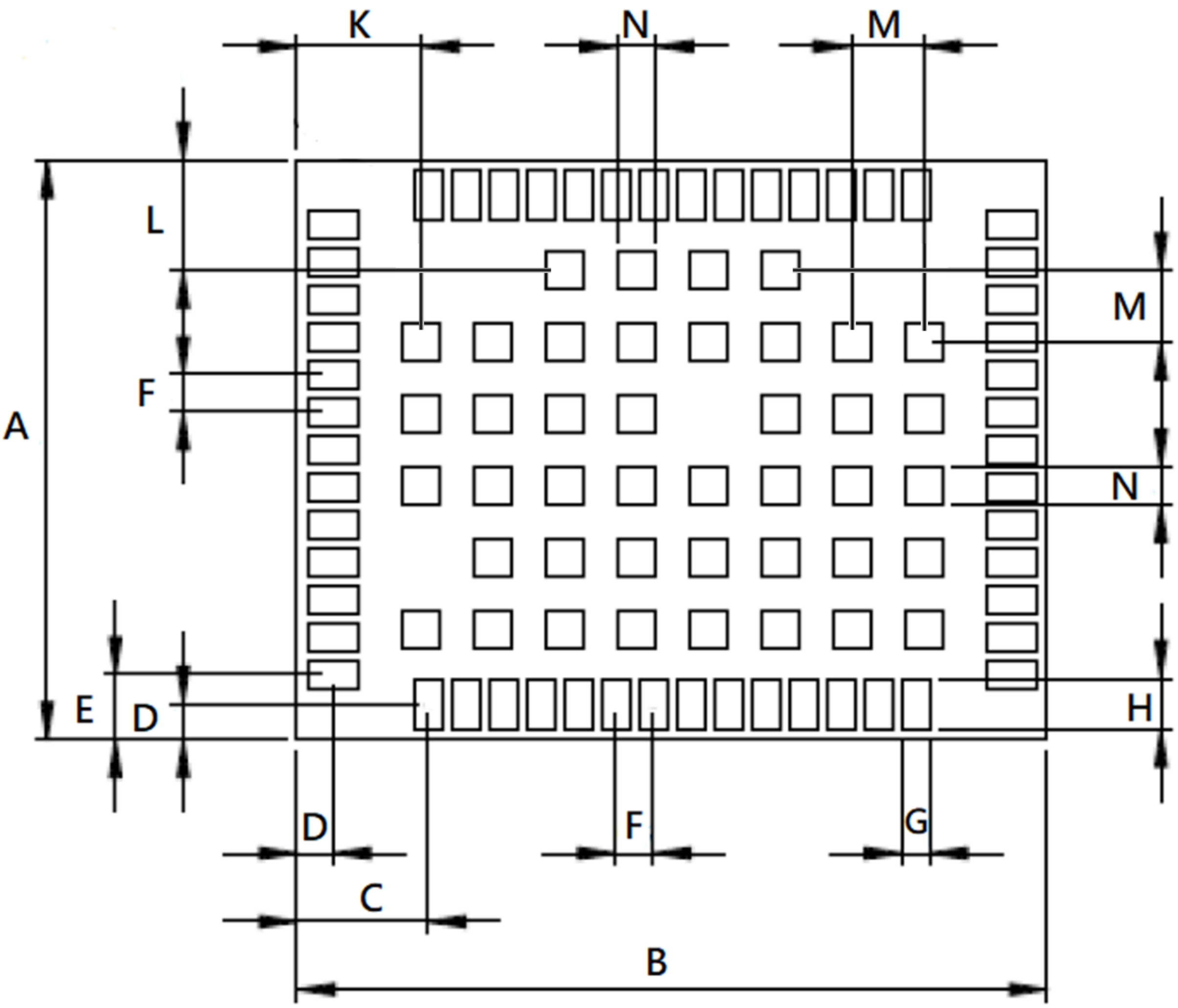
Pin No.	Name	Description
1	GND	Ground
2	RF_IN1	RF input #1 RTK Heading: directional vector from RF_IN1 antenna to RF_IN2 antenna Position: RF_IN1 antenna position
3	GND	Ground
4,5,6	NC	No connection, empty pin
7	VCC_RF	Voltage for external LNA
8,9,10,11	NC	No connection, empty pin
12	GND	Ground
13	RF_IN2	RF input #2
14	GND	Ground
15	NC	No connection, empty pin
16	RXD_R	UART serial data input, 3.3V LVTTL. UART port for firmware updating of R-chip. Default baud rate 460800.

17	TXD_R	UART serial data input, 3.3V LVTTL. UART port for firmware updating of R-chip. Default baud rate 460800.
18	RTK_STAT_R	Status signal 0 : RTK Fix for Heading Blink : RTK Float for Heading 1 : otherwise
19	NC	No connection, empty pin
20	RTK_STAT_B	Not used
21,22,23,24, 25	NC	No connection, empty pin
26	RXD2_B	UART serial data input, 3.3V LVTTL. Not used
27	TXD2_B	UART serial data output, 3.3V LVTTL. Not used.
28,29,30,31	NC	No connection, empty pin
32	GND	Ground
33,34	VDD33	Power supply, 3.3V DC
35	NC	No connection, empty pin
36	V_BCKP	Backup supply voltage for internal RTC and backup SRAM, 1.3V ~ 3.6V. VBAT must be applied whenever VCC is applied. This pin should be powered continuously to minimize the startup time. If VCC and V_BCKP are both removed, the receiver will be in factory default mode upon power up, all user configuration set is lost. For applications the does not care cold starting every time, this pin can be connect to VCC.
37	GND	Ground
38,39,40	NC	No connection, empty pin
41	GND	Ground
42	TXD_B	UART serial data output, 3.3V LVTTL. One full-duplex asynchronous serial UART port is implemented. This UART output is normally used for sending position, time and velocity information from the receiver in NMEA-0183 format at 115200 default baud rate. When idle, this pin output HIGH.
43	RXD_B	UART serial data input, 3.3V LVTTL. One full-duplex asynchronous serial UART port is implemented. This UART input is normally for sending commands or information to the receiver in SkyTraq binary protocol at 115200 default baud rate. In the idle condition, this pin should be driven HIGH. If the driving circuitry is powered independently of ORION B17, ensure that this pin is not driven to HIGH when ORION B17 is put to sleep, or a 10K-ohm series resistor can be added to minimize leakage current.
44	SDA	Not used, leave unconnected
45	SCL	Not used, leave unconnected
46,47	NC	No connection, empty pin
48	GND	Ground
49	RSTN	External active-low reset input to the baseband. Only needed when power supply rise time is very slow or software controlled reset is desired.
50	BOOT_SEL	No connection for normal use. Pull-low for loading firmware into empty or corrupted Flash memory from ROM mode.
51	NC	No connection, empty pin
52	NC	No connection, empty pin

53	1PPS	One-pulse-per-second (1PPS) time mark output, 3.3V LV-TTL. The rising edge synchronized to UTC second when getting 3D position fix. The pulse duration is about 100msec at rate of 1 Hz.
54	NC	No connection, empty pin

The unshown inner grids on the bottom side of the module are GND pads.

MECHANICAL DIMENSION



Symbol	Dimension (mm)
A	17.00
B	22.00
C	3.85
D	1.05
E	1.90
F	1.10
G	0.80
H	1.50
K	3.65
L	3.25
M	2.10
N	1.10

ELECTRICAL SPECIFICATIONS

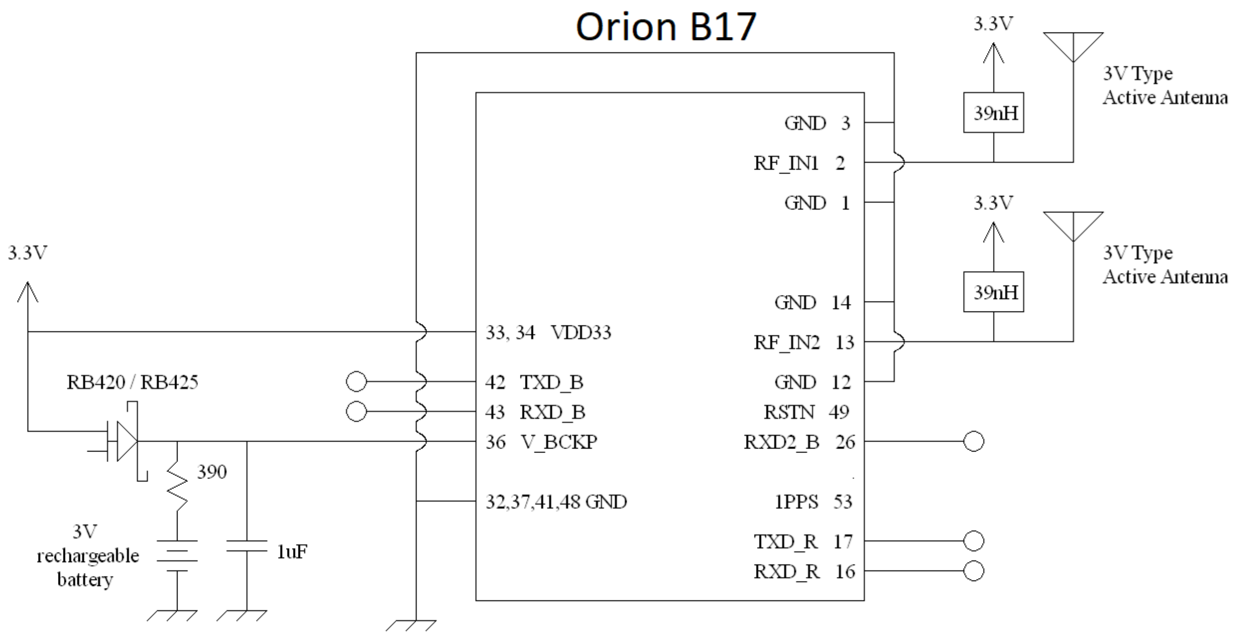
ABSOLUTE MAXIMUM RATINGS

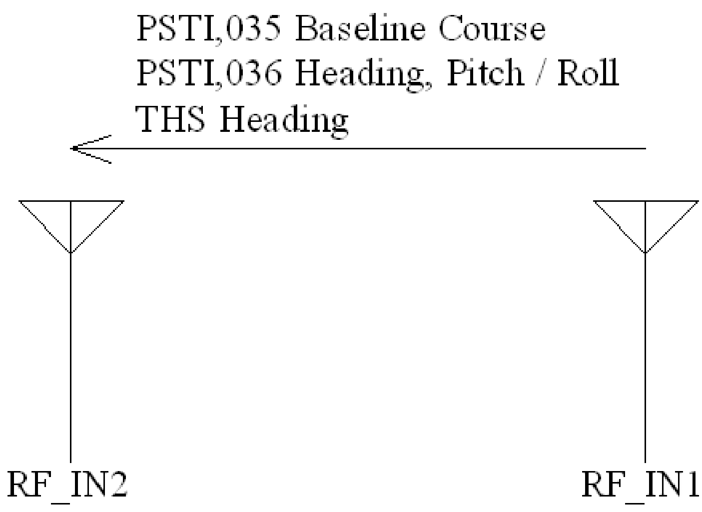
Parameter	Minimum	Maximum	Condition
Supply Voltage (VCC)	-0.5	3.6	Volt
Backup Battery Voltage (V_BCKP)	-0.5	3.6	Volt
Input Pin Voltage	-0.5	VCC+0.5	Volt
Input Power at RF_IN		+5	dBm
Storage Temperature	-40	+85	degC

OPERATING CONDITIONS

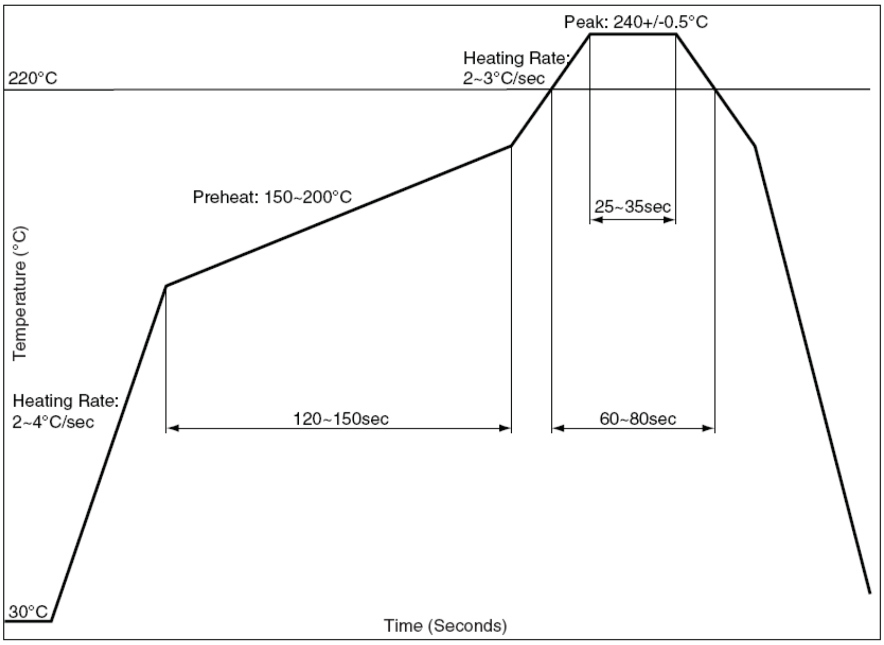
Parameter	Min	Typ	Max	Unit
Supply Voltage (VDD33)	3	3.3	3.6	Volt
Acquisition Current (exclude active antenna current)		250		mA
Tracking Current (exclude active antenna current)		250		mA
Backup Voltage (V_BCKP)	1.3		3.6	Volt
Backup Current (VDD33 voltage applied)		54		uA
Backup Current (VDD33 voltage 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 (RF_IN1, RFIN2)		50		Ohm

APPLICATION CIRCUIT





RECOMMANDED REFLOW PROFILE



The reflow profile shown above should not be exceeded, since excessive temperatures or transport times during reflow can damage the module. Cooling temperature fall rate: max 3°C / sec

ANTENNA CONSIDERATIONS

The ORION B17 is designed to be used with GPS L1/L2C, GLONASS L1/L2, Beidou B1I/B2I, Galileo E1/E5b multi-frequency active antenna. Antenna with gain up to 40dB and noise figure less than 2dB can be used. It is important to select a high-performance antenna to achieve optimal RTK performance.

POWER SUPPLY REQUIREMENT

ORION B17 requires a stable power supply, avoid ripple on VCC pin (<50mVpp). Power supply noise can affect the receiver's sensitivity. Bypass capacitors should be placed close to the module VCC pin, with values adjusted depending on the amount and type of noise present on the supply line.

BACKUP SUPPLY

The purpose of backup supply voltage pin (V_BCKP) is to keep the SRAM memory and the RTC powered when the module is powered down. This enables the module to have a faster time-to-first-fix when the module is powered on again. The backup current drain is less than 55µA. In normal powered on state, the internal processor access the SRAM and current drain is higher in active mode

1PPS OUTPUT

A 1 pulse per second signal (100msec HIGH duration) is generated on 1PPS pin when the receiver has 3D position fix using 4 or more satellites. The rising edge of the pulse is aligned with UTC second, with accuracy of about 10nsec. It outputs constant LOW when no position fix is available initially.

LAYOUT GUIDELINES

Separate RF and digital circuits into different PCB regions.

It is necessary to maintain 50-ohm impedance throughout the entire RF signal path. Try keeping the RF signal path as short as possible.

Do not route the RF signal line near noisy sources such as digital signals, oscillators, switching power supplies, or other RF transmitting circuit. Do not route the RF signal under or over any other components (including ORION B17), or other signal traces. Do not route the RF signal path on an inner layer of a multi-layer PCB to minimize signal loss.

Avoid sharp bends for RF signal path. Make two 45-deg bends or a circular bend instead of a single 90-degree bend if needed.

Avoid vias with RF signal path whenever possible. Every via adds inductive impedance. Vias are acceptable for connecting the RF grounds between different layers. Each of the module's ground pins should have short trace tying immediately to the ground plane below through a via.

The bypass capacitors should be low ESR ceramic types and located directly adjacent to the pin they are for.

HANDLING GUIDELINE

The ORION B17 modules are rated MSL4, must be used for SMT reflow mounting within 72 hours after taken out from the vacuumed ESD-protective moisture barrier bag in factory condition < 30degC / 60% RH. If this floor life time is exceeded, or if the received ESD-protective moisture barrier bag is not in vacuumed state, then the device need to be pre-baked before SMT reflow process. Baking is to be done at 85degC for 8 to 12 hours. Once baked, floor life counting begins from 0, and has 72 hours of floor life at factory condition < 30degC / 60% RH.

ORION B17 module is ESD sensitive device and should be handled with care.

RTK Usage Guideline

Below conditions are required for getting RTK fix solution. If the conditions are not met, ORION B17 will not be able to have RTK heading + pitch/roll output.

* Open sky environment without interference
* Signal over 37dB/Hz
* 8 or more satellites above 15 degree elevation angle with good satellite geometry or low DOP value; generally more satellites will have faster RTK fix

NMEA Output Description

The output protocol supports NMEA-0183 standard. The implemented messages include GGA, GLL, GSA, GSV, VTG, RMC, ZDA and THS 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 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

$GPGGA	Time, position, and fix related data of the receiver.
$GNGLL	Position, time and fix status.
$GNGSA	Used to represent the ID’s of satellites which are used for position fix. When GPS satellites are used for position fix, $GNGSA sentence is output with system ID 1. When GLONASS satellites are used for position fix, $GNGSA sentence is output with system ID 2. When Galileo satellites are used for position fix, $GNGSA sentence is output with system ID 3. When BDS satellites are used for position fix, $GNGSA sentence is output with system ID 4.
$GPGSV **$GLGSV** **$GAGSV** **$GBGSV**	Satellite information about elevation, azimuth and CNR, $GPGSV is used for GPS satellites, $GLGSV is used for GLONASS satellites, $GAGSV is used for GALILEO satellites, while $GBGSV is used for BDS 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.
$GNTHS	True Heading and Status.

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 GPS receiver.

Structure:

```
$GPGGA,hhmmss.ssssss,ddmm.mmmmmmm,a,dddmm.mmmmmmm,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
```

Example:

```
$GPGGA,032058.000116,2447.0912036,N,12100.5204899,E,1,28,0.6,115.194,M,19.600,M,,0000*6E<CR><LF>
```

Field	Name	Example	Description
1	UTC Time	032058.000116	UTC of position in hhmmss.ssssss format, (000000.000000 ~ 235959.999999)
2	Latitude	2447.0912036	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, ‘N’ = North, ‘S’ = South
4	Longitude	12100.5204899	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
5	E/W Indicator	E	Longitude hemisphere indicator, ‘E’ = East, ‘W’ = West
6	GPS quality indicator	1	GPS 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 4: Real Time Kinematic. System used in RTK mode with fixed integers 5: Float RTK. Satellite system used in RTK mode., floating integers 6: Estimated (dead reckoning) Mode 7: Manual Input Mode 8: Simulator Mode
7	Satellites Used	28	Number of satellites in use, (00 ~ 12)
8	HDOP	0.6	Horizontal dilution of precision, (0.0 ~ 99.9)
9	Altitude	115.194	mean sea level (geoid), (-9999.9 ~ 17999.9)
10	Geoidal Separation	19.600	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	6E	

GLL – Latitude/Longitude

Latitude and longitude of current position, time, and status.

Structure:

```
$GNGLL,ddmm.mmmmmmm,a,dddmm.mmmmmmm,a,hhmmss.ssssss,A,a*hh<CR><LF>
              1           2       3            4       5      6 7  8
```

Example:

$GNGLL,2447.0912036,N,12100.5204899,E,032058.000116,A,A*7E<CR><LF>

Field	Name	Example	Description
1	Latitude	2447.0912036	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
2	N/S Indicator	N	Latitude hemisphere indicator ‘N’ = North ‘S’ = South
3	Longitude	12100.5204899	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere indicator ‘E’ = East ‘W’ = West
5	UTC Time	032058.000116	UTC time in hhmmss.ssssss format (000000.000000 ~ 235959.999999)
6	Status	A	Status, ‘A’ = Data valid, ‘V’ = Data not valid
7	Mode Indicator	A	Mode indicator ‘A’ = Autonomous mode ‘D’ = Differential mode ‘E’ = Estimated (dead reckoning) mode ‘M’ = Manual input mode ‘S’ = Simulator mode ‘N’ = Data not valid
8	Checksum	7E	

GSA – GNSS DOP and Active Satellites

GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA or GNS 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,3,05,06,11,15,20,29,30,194,195,196,199,,1.0,0.6,0.8,1*3D<CR><LF>
$GNGSA,A,3,65,66,72,87,88,,,,,,,,1.0,0.6,0.8,2*34<CR><LF>
$GNGSA,A,3,07,08,13,15,26,33,,,,,,,1.0,0.6,0.8,3*31<CR><LF>
$GNGSA,A,3,06,08,11,13,14,16,,,,,,,1.0,0.6,0.8,4*35<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	05,06,11,15,20,29,30,194,195,196,199	01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 199 are for QZSS; 65 ~ 88 are for GLONASS (GL PRN) ; 01 ~ 36 are for GALILEO (GA PRN); 01 ~ 37 are for BDS (BD PRN). GPS, GLONASS, GALILEO and BDS satellites are differentiated by the GNSS system ID in table 3. Maximally 12 satellites are included in each GSA sentence.
4	PDOP	1.0	Position dilution of precision (0.0 to 99.9)
5	HDOP	0.6	Horizontal dilution of precision (0.0 to 99.9)
6	VDOP	0.8	Vertical dilution of precision (0.0 to 99.9)
7	GNSS System ID	1	GNSS system ID* 1 = GPS 2 = GLONASS 3 = GALILEO 4 = BDS 5 = IRNSS
8	Checksum	3D	

*GNSS System ID identifies the GNSS system ID according to Table 3.

*GNSS Signal ID identifies the GNSS signal name according to Table 3.

Table 3: GNSS Identification Table for GSA, GSV

System	System ID (Talker)	Signal ID	Signal Name
GPS	1 (GP)	0	All signals
		1	L1 C/A
		2	L1 P(Y)
		3	L1C
		4	L2 P(Y)
		5	L2C-M
		6	L2C-L
		7	L5-I
		8	L5-Q
GLONASS	2 (GL)	0	All signals
		1	G1 C/A
		2	G1P
		3	G2 C/A
		4	GLONASS (M) G2P
GALILEO	3 (GA)	0	All signals
		1	E5a
		2	E5b
		3	E5 a+b
		4	E6-A
		5	E6-BC
		6	L1-A
		7	L1-BC
BDS	4 (BD)	0	All signals
		1	B1
		5	B2A
		B	B2
		8	B3
		3	B1C
IRNSS	5 (GI)	0	All signals
		4	L5

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,3,1,11,196,74,045,45,195,63,152,45,199,60,166,39,05,51,345,45,1*5A<CR><LF>
$GPGSV,3,2,11,11,51,103,45,15,50,236,46,20,42,045,43,29,38,297,43,1*6F<CR><LF>
$GPGSV,3,3,11,30,22,071,40,06,21,123,39,194,12,159,37,1*6C<CR><LF>
$GPGSV,3,1,09,196,74,045,46,195,63,152,48,199,60,166,47,05,51,345,42,6*54<CR><LF>
$GPGSV,3,2,09,15,50,236,43,29,38,297,41,30,22,071,40,06,21,123,41,6*62<CR><LF>
$GPGSV,3,3,09,194,12,159,40,6*6C<CR><LF>
$GLGSV,2,1,07,87,81,134,46,65,57,313,43,88,46,334,47,72,31,021,43,1*7F<CR><LF>
$GLGSV,2,2,07,66,22,246,44,74,01,080,,75,00,127,,1*43<CR><LF>
$GLGSV,1,1,04,65,57,313,38,88,46,334,42,72,31,021,39,66,22,246,38,3*70<CR><LF>
$GAGSV,2,1,07,07,82,346,44,13,61,110,44,26,54,336,43,08,30,038,40,7*7E<CR><LF>
$GAGSV,2,2,07,15,12,131,33,33,08,320,35,27,07,167,,7*4D<CR><LF>
$GAGSV,2,1,06,07,82,346,45,13,61,110,45,26,54,336,43,08,30,038,40,2*7A<CR><LF>
$GAGSV,2,2,06,15,12,131,36,33,08,320,34,2*7F<CR><LF>
$GBGSV,3,1,10,11,68,182,47,03,60,205,,14,59,315,46,08,50,356,42,1*76<CR><LF>
$GBGSV,3,2,10,16,47,180,45,13,45,337,43,06,41,186,39,02,41,242,,1*7C<CR><LF>
$GBGSV,3,3,10,04,38,117,,09,27,193,,1*78<CR><LF>
$GBGSV,2,1,06,11,68,182,49,14,59,315,49,08,50,356,44,16,47,180,45,B*0A<CR><LF>
$GBGSV,2,2,06,13,45,337,42,06,41,186,43,B*0A<CR><LF>

Field	Name	Example	Description
1	Number of message	3	Total number of GSV messages to be transmitted (1-5)
2	Sequence number	1	Sequence number of current GSV message
3	Satellites in view	11	Total number of satellites in view (00 ~ 20)
4	Satellite ID	196	01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 199 are for QZSS; 65 ~ 88 are for GLONASS (GL PRN) ; 01 ~ 36 are for GALILEO (GA PRN); 01 ~ 37 are for BDS (BD PRN). GPS, GLONASS, GALILEO and BDS satellites are differentiated by the GNSS system ID in table 3. Maximally 4 satellites are included in each GSV sentence.
5	Elevation	74	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	045	Satellite azimuth angle in degrees, (000 ~ 359)
7	SNR	45	C/No in dB (00 ~ 99) Null when not tracking
8	Signal ID	1	Signal ID*
9	Checksum	5A	

RMC – Recommended Minimum Specific GNSS Data
Time, date, position, course and speed data provided by a GNSS navigation receiver.

Structure:
$GPRMC,hhmmss.ssssss,A,dddmm.mmmmmmm,a,dddmm.mmmmmmm,a,x.x,x.x,ddmmyy,,,a,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12
Example:
$GNRMC,032058.000116,A,2447.0912036,N,12100.5204899,E,000.0,000.0,160922,,,A,V*3D<CR><LF>

Field	Name	Example	Description
1	UTC time	032058.000116	UTC time in hhmmss.ssssss format (000000.000000 ~ 235959.999999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.0912036	Latitude in dddmm.mmmmmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.5204899	Longitude in dddmm.mmmmmmm 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	160922	UTC date of position fix, ddmmyy format
10	Mode indicator	A	Mode indicator 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'F' = Float RTK. Satellite system used in RTK mode, floating integers 'M' = Manual Input Mode 'N' = Data not valid 'P' = Precise 'R' = Real Time Kinematic. System used in RTK mode with fixed integers 'S' = Simulator Mode
11	Navigation status	V	Navigation status indicator according to IEC61108 requirement on 'Navigational (or Failure) warnings and status indicators'. 'S' = Safe 'C' = Caution 'U' = Unsafe 'V' = Navigation status not valid, equipment is not providing navigation status indicator.
12	checksum	3D	

VTG – Course Over Ground and Ground Speed
The actual course and speed relative to the ground.

Structure:
GPVTG,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,A*13<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	A	Mode indicator ‘A’ = Autonomous mode ‘D’ = Differential mode ‘E’ = Estimated (dead reckoning) mode ‘M’ = Manual input mode ‘N’ = Data not valid ‘P’ = Precise ‘S’ = Simulator mode
5	Checksum	13	

ZDA – TIME AND DATE
UTC, day, month, year and local time zone

Structure:
$GPZDA,hhmmss.ssssss,xx,xx,xxxx,xx,xx*hh<CR><LF>
1 2 3 4 5 6 7

Example:
$GNZDA,032058.000116,16,09,2022,00,00*7E<CR><LF>

Field	Name	Example	Description
1	UTC time	032058.000116	UTC time in hhmmss.ssssss format (000000.000000 ~ 235959.999999)
2	UTC Day	16	UTC time: day (01 ~ 31)
3	UTC Month	19	UTC time: month (01 ~ 12)
4	UTC Year	2022	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	7E	Checksum

THS – True Heading and Status

Actual vessel heading in degrees True produced by any device or system producing true heading. This sentence includes a “Mode indicator” field providing critical safety related information about the heading data, and replaces the HDT sentence.

Structure:

$GPTHS, x.x,a*hh<CR><LF>

1 2 3

Example:

$GNTHS, 11.73.A*0F<CR><LF>

Field	Name	Example	Description
1	Heading	11.73	Heading, degrees True
2	Mode	A	Mode indicator ‘A’ = Autonomous ‘E’ = Estimated (dead reckoning) ‘M’ = Manual input ‘S’ = Simulator ‘V’ = Data not valid
3	Checksum	0F	Checksum

STI,035 – RTK Baseline Data of Rover Moving Base Receiver

Time, date, status and baseline related data of GNSS rover moving base receiver provided by GNSS precisely kinematic base receiver.

Structure:

$PSTI,035,hhmmss.ssssss,ddmmyy,A,R,x.xxx,x.xxx,x.xxx,x.xxx,x.xx,,,,,*hh<CR><LF>

1 2 3 4 5 6 7 8 9

Example:

$PSTI,035,032058.000116,160922,A,R,0.692,3.334,0.980,3.544,11.73,0.07,,,,*03

Field	Name	Example	Description
1	UTC time	032058.000116	UTC time in hhmmss.ssssss format (000000.000000~235959.999999)
2	UTC Date	160922	UTC date of position fix, ddmmyy format
3	Status	A	Status 'V' = Void 'A' = Active
4	Mode indicator	R	Mode indicator 'F' = Float RTK. System used in RTK mode with float ambiguity 'R' = Real Time Kinematic. System used in RTK mode with fixed ambiguity
5	East-projection of baseline	0.692	East-projection of baseline, meters
6	North-projection of baseline	3.334	North-projection of baseline, meters
7	Up-projection of baseline	0.980	Up-projection of baseline, meters
8	Baseline length	3.544	Baseline length, meters
9	Baseline course	11.73	Baseline course (angle between baseline vector and north direction), degrees
10	Baseline course standard deviation	0.07	Baseline course standard deviation in degree
11	Reserve		Reserve
12	Reserve		Reserve
13	Reserve		Reserve
14	Reserve		Reserve
15	Checksum	03	

PSTI,036 – Heading, Pitch and Roll Messages of Vehicle

Heading, Pitch and Roll messages provided by GNSS RTK rover moving base receiver. This message will also be shown in RTK precisely kinematic base mode GNSS receiver.

Structure:

$PSTI,036,hhmmss.ssssss,ddmmyy,x.xx,x.xx,x.xx,R*hh<CR><LF>

1 2 3 4 5 6 7

Example:

$PSTI,036,032058.000116,160922,11.73,16.05,0.00,R*67

Field	Name	Example	Description
1	UTC time	032058.000116	UTC time in hhmmss.sss format (000000.000000~235959.999999)
2	UTC Date	160922	UTC date of position fix, ddmmyy format
3	Heading	11.73	Heading, 0~359.99 when mode indicator is ‘R’
4	Pitch	16.05	Pitch: -90~90 degree when mode indicator is ‘R’, else null 0: when absolute value of “heading offset” > 45 && < 135; i.e. antenna baseline toward perpendicular to vehicle centerline. Heading offset is the angle between the baseline course from north and vehicle centerline.
5	Roll	0.00	Roll: -90~90 degree when mode indicator is ‘R’, else null 0: when absolute value of “heading offset” <= 45 or >= 135; i.e. antenna baseline toward parallel to vehicle centerline. Heading offset is the angle between the baseline course from north and vehicle centerline.
6	Mode indicator	R	Mode indicator ‘N’ = Data not valid ‘A’ = Autonomous mode ‘D’ = Differential mode ‘E’ = Estimated (dead reckoning) mode ‘M’ = Manual input mode ‘S’ = Simulator mode ‘F’ = Float RTK. Satellite system used in RTK mode, floating integers ‘R’ = Real Time Kinematic. System used in RTK mode with fixed integers
7	Checksum	67	

STI,008 – ECEF Coordinate Position and Velocity

ECEF coordinate position and velocity of a GNSS navigation receiver.

Structure:

$PSTI,008,hhmmss.ssssss,A, x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>

1 2 3 4 5 6 7 8 9

Example:

$PSTI,008,032058.000116,A,-2984968.95,4966119.28,2657512.92,0.00,0.01,-0.00*67 <CR><LF>

Field	Name	Example	Description
1	UTC time	032058.000116	UTC time in hhmmss.sssssss format (000000.0000000 ~ 235959.9999999)
2	Status	A	Status ‘V’ = Navigation receiver warning ‘A’ = Data Valid
3	ECEF-X	-2984968.95	ECEF X coordinate Unit in meter
4	ECEF-Y	4966119.28	ECEF X coordinate Unit in meter
5	ECEF-Z	2657512.92	ECEF X coordinate Unit in meter
6	ECEF-VX	0.00	ECEF X Veolcity Unit in m/s
7	ECEF-VY	0.01	ECEF Y Veolcity Unit in m/s
8	ECEF-VZ	-0.00	‘ECEF Z Veolcity Unit in m/s
9	Checksum	67	

ORDERING INFORMATION

Model Name	Description
ORION B17	Multi-Band Multi-GNSS Receiver With RTK Heading + Pitch/Roll for LEO Application

Revision History

Revision	Date	Description
1	Sep. 16, 2022	Initial release
2	May 23, 2023	Updated pin-51 description. Removed PSTI,005 description.
3	June 11, 2024	Updated storage temperature

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