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Glossary of Terms

ASCII	A 7-bit wide serial code describing numbers, upper and lower case characters, special and non-printing characters. Typically used for textual data.
Acquisition	The process of locking onto a satellite's C/A code and P code. A receiver acquires all available satellites when it is first powered up, then acquires additional satellites as they become available and continues tracking them until they become unavailable.
Anti-Spoofing	Denial of the P-code by the Control Segment is called Anti-Spoofing. It is normally replaced by encrypted Y-code, [see *P-Code* and *Y-Code]*
Attenuation	Reduction of signal strength
Azimuth	The horizontal direction of a celestial point from a terrestrial point, expressed as the angular distance from 000° (reference) clockwise through 360°. The reference point is generally True North, but may be Magnetic North, or Relative (ship's head).
Bearing	The horizontal direction of one terrestrial point from another terrestrial point, expressed as the angular distance from a reference direction, usually measured from 000° at the reference direction clockwise through 360°. The reference point may be True North, Magnetic North, or Relative (ship's head).
Carrier	The steady transmitted RF signal whose amplitude, frequency, or phase may be modulated to carry information.
Carrier Phase Ambiguity	The number of integer carrier phase cycles between the user and the satellite at the start of tracking. (Sometimes ambiguity for short)
Carrier Phase Measurements	These are "accumulated doppler range" (ADR) measurements. They contain Measurements the instantaneous phase of the signal (modulo 1 cycle) plus some arbitrary number of integer cycles. Once the receiver is tracking the satellite, the integer number of cycles correctly accumulates the change in range seen by the receiver. When a "lock break" occurs, this accumulated value can jump an arbitrary integer number of cycles (this is called a cycle slip).
Checksum	By NMEA standard, a validity check performed on the data contained in the sentences, calculated by the talker, appended to the message, then recalculated by the listener for comparison to determine if the message was received correctly. Required for some sentences, optional for all others.
Circular Error Probable (CEP)	Circular error probable; the radius of a circle such that 50% of a set of events occur inside the boundary.
Coarse Acquisition (C/A) Code	A pseudorandom string of bits that is used primarily by commercial GPS receivers to determine the range to the transmitting GPS satellite. The 1023 chip C/A code repeats every 1 ms giving a code chip length of 300 m which, is very easy to lock onto.
Communication Protocol	A method established for message transfer between a talker and a listener which includes the message format and the sequence in which the messages are to be transferred. Also includes the signalling requirements such as bit rate, stop bits, parity, and bits per character.
Control Segment	The Master Control Station and the globally dispersed Reference Stations used to manage the GPS satellites, determine their precise orbital parameters, and synchronize their clocks.

Coordinated Universal Time (UTC)	This time system uses the second-defined true angular rotation of the Earth measured as if the Earth rotated about its Conventional Terrestrial Pole. However, UTC is adjusted only in increments of one second. The time zone of UTC is that of Greenwich Mean Time (GMT).
Course	The horizontal direction in which a vessel is to be steered or is being steered; the direction of travel through the air or water. Expressed as angular distance from reference North (either true, magnetic, compass, or grid), usually 000° (north), clockwise through 360°. Strictly, the term applies to direction through the air or water, not the direction intended to be made good over the ground. Differs from heading.
Course Made Good (CMG)	The single resultant direction from a given point of departure to a subsequent position; the direction of the net movement from one point to the other. This often varies from the track caused by inaccuracies in steering, currents, cross-winds, etc. This term is often considered to be synonymous with Track Made Good, however, Course Made Good is the more correct term.
Course Over Ground (COG)	The actual path of a vessel with respect to the Earth (a misnomer in that courses are directions steered or intended to be steered through the water with respect to a reference meridian); this will not be a straight line if the vessel's heading yaws back and forth across the course.
Cross Track Error (XTE)	The distance from the vessel's present position to the closest point on a great Circle line connecting the current waypoint coordinates. If a track offset has been specified in the GPSCard SETNAV command, the cross track error will be relative to the offset track great circle line.
Cycle Slip	When the carrier phase measurement jumps by an arbitrary number of integer cycles. It is generally caused by a break in the signal tracking due to shading or some similar occurrence.
Dead Reckoning (DR)	The process of determining a vessel's approximate position by applying from its last known position a vector or a series of consecutive vectors representing the run that has since been made, using only the courses being steered, and the distance run as determined by log, receiver rpm, or calculations from speed measurements.
Destination	The immediate geographic point of interest to which a vessel is navigating. It may be the next waypoint along a route of waypoints or the final destination of a voyage.
Differential GPS (DGPS)	A technique to improve GPS accuracy that uses pseudorange errors at a known location to improve the measurements made by other GPS receivers within the same general geographic area.
Dilution of Precision (DOP)	A numerical value expressing the confidence factor of the position solution based on current satellite geometry. The lower the value, the greater the confidence in the solution. DOP can be expressed in the following forms.
	GDOP -uncertainty of all parameters (latitude, longitude, height, clock offset)
	PDOP -uncertainty of 3D parameters (latitude, longitude, height)
	HTDOP -uncertainty of 2D and time parameters (latitude, longitude, time)
	HDOP -uncertainty of 2D parameters (latitude, longitude)
	VDOP -uncertainty of height parameter
	TDOP -uncertainty of clock offset parameter
Doppler	The change in frequency of sound, light or other wave caused by movement of its source relative to the observer.
Doppler Aiding	A signal processing strategy, which uses a measured Doppler shift to help a receiver smoothly track the GPS signal, to allow more precise velocity and position measurement.
Double-Difference	A mathematical technique comparing observations by differencing between receiver channels and then between the reference and rover receivers.

Double-Difference Carrier Phase Ambiguity	Carrier phase ambiguities which are differenced between receiver channels and between the reference and rover receivers. They are estimated when a double-difference mechanism is used for carrier phase positioning. (Sometimes double-difference ambiguity or ambiguity, for short)
Earth-Centred-Earth-Fixed (ECEF)	This is a coordinate-ordinate system which has the X-coordinate in the earth's equatorial plane pointing to the Greenwich prime meridian, the Z-axis pointing to the north pole, and the Y-axis in the equatorial plane 90° from the X-axis with an orientation which forms a right-handed XYZ system.
Elevation	The angle from the horizon to the observed position of a satellite.
Ellipsoid	A smooth mathematical surface which represents the earth's shape and very closely approximates the geoid. It is used as a reference surface for geodetic surveys, refer to the MATCHEDPOS log in user manual *Volume 2, Command and Log Reference.*
Ellipsoidal Height	Height above a defined ellipsoid approximating the surface of the earth.
Ephemeris	A set of satellite orbit parameters that are used by a GPS receiver to calculate precise GPS satellite positions and velocities. The ephemeris is used in the determination of the navigation solution and is updated periodically by the satellite to maintain the accuracy of GPS receivers.
Ephemeris Data	The data downlinked by a GPS satellite describing its own orbital position with respect to time.
Epoch	Strictly a specific point in time. Typically when an observation is made.
Field	A character or string of characters immediately preceded by a field delimiter.
Fixed Ambiguity Estimates	Carrier phase ambiguity estimates which are set to a given number and held constant. Usually they are set to integers or values derived from linear combinations of integers.
Fixed Discrete Ambiguity Estimates	Carrier phase ambiguities which are set to values which are members of a predetermined set of discrete possibilities, and then held constant.
Fixed Field	A field in which the number of characters is fixed. For data fields, such fields are shown in the sentence definitions with no decimal point. Other fields which fall into this category are the address field and the checksum field (if present).
Fixed Integer Ambiguity Estimates	Carrier phase ambiguities which are set to integer values and then held constant.
Flash ROM	Programmable read-only memory.
Floating Ambiguity Estimates	Ambiguity estimates which are not held to a constant value, but are allowed to gradually converge to the correct solution.
GAGAN	GPS aided Geo Augmented Navigation
Geometric Dilution of Precision (GDOP)	*[*See *DOP]*
Geoid	The shape of the earth if it were considered as a sea level surface extended continuously through the continents. The geoid is an equipotential surface coincident with mean sea level to which at every point the plumb line (direction in which gravity acts) is perpendicular. The geoid, affected by local gravity disturbances, has an irregular shape.
Geodetic Datum	The reference ellipsoid surface that defines the coordinate system.
Geostationary	A satellite orbit along the equator that results in a constant fixed position over a

	particular reference point on the earth's surface. (GPS satellites are not geostationary.)
Global Positioning System (GPS)	Full name is NAVSTAR Global Positioning System. A space-based radio Positioning system which provides suitably equipped users with accurate position, velocity and time data. GPS provides this data free of direct user charge worldwide, continuously, and under all weather conditions. The GPS constellation consists of 24 orbiting satellites, four equally spaced around each of six different orbital planes. The system is being developed by the Department of Defence under U.S. Air Force management.
Great Circle	The shortest distance between any two points along the surface of a sphere or ellipsoid, and therefore the shortest navigation distance between any two points on the Earth. Also called Geodesic Line.
Handshaking	Predetermined hardware or software activity designed to establish or maintain two machines or programs in synchronization. Handshaking concerns the exchange of messages or packets of data between two systems with limited buffers. Hardware handshaking uses voltage levels or pulses in wires to carry the handshaking signals. Software handshaking uses data units (e.g. ASCII characters) carried by some underlying communication medium.
Horizontal Dilution of Precision (HDOP)	[See *DOP*]
Horizontal and Time Dilution of Precision (HTDOP)	[See *DOP*]
Heading	The direction in which a vessel points or heads at any instant, expressed in degrees 000° clockwise through 360° and may be referenced to True North, Magnetic North, or Grid North. The heading of a vessel is also called the ship's head. Heading is a constantly changing value as the vessel oscillates or yaws across the course due to the effects of the air or sea, cross currents, and steering errors.
Integer Ambiguity Estimates	Carrier phase ambiguity estimates which are only allowed to take on integer values.
Iono-Free Carrier Phase Observation	A linear combination of L1 and L2 carrier phase measurements which provides an estimate of the carrier phase observation on one frequency with the effects of the ionosphere removed. It provides a different ambiguity value (non-integer) than a simple measurement on that frequency.
Kinematic	The user's GPS antenna is moving. In GPS, this term is typically used with precise carrier phase positioning, and the term dynamic is used with pseudorange positioning.
L1 Frequency	The 1575.42 MHz GPS carrier frequency which contains the course acquisition (C/A) code, as well as encrypted P-code, and navigation messages used by commercial GPS receivers.
L2 Frequency	The 1227.60 MHz. secondary GPS carrier frequency, containing only encrypted P-code, used primarily to calculate signal delays caused by the ionosphere.
Lane	A particular discrete ambiguity value on one carrier phase range measurement or double difference carrier phase observation. The type of measurement is not specified (L1, L2, L1-L2, iono-free)
L-Band	The range of radio frequencies that includes the GPS carrier frequencies L1 and L2 and the OmniSTAR satellite broadcast signal.
Local Observation Set	An observation set, as described below, taken by the receiver on which the software is operating as opposed to an observation taken at another receiver (the reference station) and transmitted through a radio link.
Local Tangent Plane	A coordinate system based on a plane tangent to the ellipsoid's surface at the user's location. The three coordinates are east, north and up. Latitude, longitude

	and height positions operate in this coordinate system.
Low-latency Solution	A position solution which is based on a prediction. A model (based on previous reference station observations) is used to estimate what the observations will be at a given time epoch. These estimated reference station observations are combined with actual measurements taken at the remote station to provide a position solution.
Magnetic Bearing	Bearing relative to magnetic north; compass bearing corrected for deviation.
Magnetic Heading	Heading relative to magnetic north.
Magnetic Variation	The angle between the magnetic and geographic meridians at any place, expressed in degrees and minutes east or west to indicate the direction of magnetic north from true north.
Mask Angle	The minimum GPS satellite elevation angle permitted by a particular receiver design. Satellites below this angle will not be used in position solution.
Matched Observation Set Pair	Observations from both the reference station and the local receiver which have been matched by time epoch, contain the same satellites, and are corrected for any known offsets.
Measurement Error Variance	The square of the standard deviation of a measurement quantity. The standard deviation is representative of the error typically expected in a measured value of that quantity.
Measurement Time Epoch	The point in time at which a GPSCard takes a measurement.
Multipath Errors	GPS positioning errors caused by the interaction of the GPS satellite signal and its reflections.
Non-Volatile Memory	A type of memory device that retains data in the absence of a power supply.
Null Field	By NMEA standard, indicates that data is not available for the field. Indicated by two ASCII commas, i.e., ",," (HEX 2C2C), or, for the last data field in a sentence, one comma followed by either the checksum delimiter "*" (HEX 2A) or the sentence delimiters <CR><LF> (HEX 0D0A). [Note: the ASCII Null character (HEX 00) is not to be used for null fields.]
Obscuration	Term used to describe periods of time when a GPS receiver's line-of-sight to GPS satellites is blocked by natural or man-made objects.
Observation	Any measurement. The two observations used in NovAtel's RTK algorithms are the pseudorange measurement and the carrier phase measurement.
Observation Set	A set of GPSCard measurements taken at a given time which includes one time for all measurements, and the following for each satellite tracked: PRN number, pseudorange or carrier phase or both, lock time count, signal strength, and tracking status. Either L1 only or L1 and L2 measurements are included in the set. The observation set is assumed to contain information indicating how many satellites it contains and which ones have L1-only and which ones have L1/L2 pairs.
OmniSTAR	A wide-area GPS correction service, using L-band satellite broadcast frequencies (1525 - 1560 MHz). Data from many widely-spaced Reference Stations is used in a proprietary multi-site solution. OmniSTAR Virtual Base Station (VBS) types acheive sub-meter positioning over most land areas worldwide while OmniSTAR High Performance (HP) types acheive 10 cm accuracy. Use of OmniSTAR service requires a subscription.
Origin Waypoint	The starting point of the present navigation leg, expressed in latitude and longitude.
Parallel Receiver	A receiver that monitors four or more satellites simultaneously with independent channels.
Parity	The even or odd quality of the number of ones or zeroes in a binary code. Parity

	is often used to determine the integrity of data especially after transmission.
Perigee	The point in a body's orbit at which it is nearest the earth.
P-Code	Precise code or protected code. A pseudorandom string of bits that is used by GPS receivers to determine the range to the transmitting GPS satellite. P-code is replaced by an encrypted Y-code when Anti-Spoofing is active. Y-code is intended to be available only to authorized (primarily military) users. [See *Anti-Spoofing*, *C/A Code* and *Y-Code*]
PDOP	Position Dilution of Precision [See *DOP*]
Precise Positioning Service (PPS)	The GPS positioning, velocity, and time service which is available on a continuous, worldwide basis to users authorized by the U.S. Department of Defence (typically using P-Code).
PRN Number	A number assigned by the GPS system designers to a given set of pseudorandom codes. Typically, a particular satellite will keep its PRN (and hence its code assignment) indefinitely, or at least for a long period of time. It is commonly used as a way to label a particular satellite.
Pseudolite	An Earth-based transmitter designed to mimic a satellite. May be used to transmit differential corrections.
Pseudorange	The calculated range from the GPS receiver to the satellite determined by taking the difference between the measured satellite transmit time and the receiver time of measurement, and multiplying by the speed of light. Contains several sources of error.
Pseudorange Measurements	Measurements made using one of the pseudorandom codes on the GPS signals. They provide an unambiguous measure of the range to the satellite including the effect of the satellite and user clock biases.
Receiver Channels	A GPS receiver specification which indicates the number of independent hardware signal processing channels included in the receiver design.
Reference Satellite	n a double difference implementation, measurements are differenced between different satellites on one receiver in order to cancel the correlated errors. Usually one satellite is chosen as the "reference, and all others are differenced with it.
Reference Station	The GPS receiver which is acting as the stationary reference. It has a known position and transmits messages for the rover receiver to use to calculate its position.
Relative Bearing	Bearing relative to heading or to the vessel.
Remote/ Rover Receiver	The GPS receiver which does not know its position and needs to receive measurements from a reference station to calculate differential GPS positions. (The terms remote and rover are interchangeable.)
Residual	In the context of measurement, the residual is the misclosure between the calculated measurements, using the position solution and actual measurements.
Root Mean Square (RMS)	A probability level of 68%.
Route	A planned course of travel, usually composed of more than one navigation leg.
RT-20	NovAtel's Double Differencing Technology for real-time kinematic (RTK) carrier phase floating ambiguity resolution.
Radio Technical Commission for Aeronautics (RTCA)	An organization which developed and defined a message format for differential positioning.
Radio	An organization which developed and defined the SC-104 message format for

Technical Commission for Maritime Services (RTCM)	differential positioning.
Real-Time Kinematic (RTK)	A type of differential positioning based on observations of carrier phase. In this document it is also used with reference to RT-2™ and RT-20.
Satellite-Based Augmentation System (SBAS)	A type of geo-stationary satellite system that improves the accuracy, integrity, and availability of the basic GPS signals. This includes WAAS, EGNOS, and MSAS.
Selected Waypoint	he waypoint currently selected to be the point toward which the vessel is travelling. Also called "to waypoint, destination or destination waypoint.
Selective Availability (SA)	The method used by the United States Department of Defence to control access to the full accuracy achievable by civilian GPS equipment (generally by introducing timing and ephemeris errors).
Sequential Receiver	A GPS receiver in which the number of satellite signals to be tracked exceeds the number of available hardware channels. Sequential receivers periodically reassign hardware channels to particular satellite signals in a predetermined sequence.
Spherical Error Probable (SEP)	The radius of a sphere, centred at the user's true location, that contains 50 percent of the individual three-dimensional position measurements made using a particular navigation system.
Spheroid	Sometimes known as ellipsoid; a perfect mathematical figure which very closely approximates the geoid. Used as a surface of reference for geodetic surveys.
Standard Positioning Service (SPS)	A positioning service made available by the United States Department of Defence which is available to all GPS civilian users on a continuous, worldwide basis (typically using C/A Code).
Space Vehicle ID (SV)	Sometimes used as SVID. A unique number assigned to each satellite for identification purposes. The 'space vehicle' is a GPS satellite.
TDOP	Time Dilution of Precision [See *DOP*]
Three-Dimensional Coverage	The number of hours-per-day when four or more satellites are available with acceptable positioning geometry. Four visible satellites are required to determine location and altitude.
Three-Dimensional (3D) Navigation	Navigation mode in which altitude and horizontal position are determined from satellite range measurements.
Time-To-First-Fix (TTFF)	The actual time required by a GPS receiver to achieve a position solution. This specification will vary with the operating state of the receiver, the length of time since the last position fix, the location of the last fix, and the specific receiver design.
Track	A planned or intended horizontal path of travel with respect to the Earth rather than the air or water. The track is expressed in degrees from 000° clockwise through 360° (true, magnetic, or grid).
Track Made Good	The single resultant direction from a point of departure to a point of arrival or subsequent position at any given time; may be considered synonymous with Course Made Good.
True Bearing	Bearing relative to true north; compass bearing corrected for compass error.
True Heading	Heading relative to true north.
Two-Dimensional Coverage	The number of hours-per-day with three or more satellites visible. Three visible satellites can be used to determine location if the GPS receiver is designed to accept an external altitude input.

Two-Dimensional (2D) Navigation	Navigation mode in which a fixed value of altitude is used for one or more position calculations while horizontal (2D) position can vary freely based on satellite range measurements.
Undulation	The distance of the geoid above (positive) or below (negative) the mathematical reference ellipsoid (spheroid). Also known as geoidal separation, geoidal undulation, geoidal height.
Update Rate	The GPS receiver specification which indicates the solution rate provided by the receiver when operating normally.
UTC	[See *Coordinated Universal Time*]
VDOP	Vertical Dilution of Precision [See *DOP*]
Variable Field	By NMEA standards, a data field which may or may not contain a decimal point and which may vary in precision following the decimal point depending on the requirements and the accuracy of the measuring device.
World Geodetic System 1984 (WGS84)	An ellipsoid designed to fit the shape of the entire Earth as well as possible with a single ellipsoid. It is often used as a reference on a worldwide basis, while other ellipsoids are used locally to provide a better fit to the Earth in a local region. GPS uses the centre of the WGS-84 ellipsoid as the centre of the GPS ECEF reference frame.
Waypoint	A reference point on a track.
Wide Lane	A particular integer ambiguity value on one carrier phase range measurement or double difference carrier phase observation when the difference of the L1 and L2 measurements is used. It is a carrier phase observable formed by subtracting L2 from L1 carrier phase data: $\Phi' = \Phi_1 - \Phi_2$. The corresponding wavelength is 86.2 cm
Y-Code	An encrypted form of P-Code. Satellites transmit Y-Code in replace of P-Code when Anti-Spoofing is in effect. [See *P-Code* and *Anti-Spoofing*]