



EuroPak-15ab Receiver

USER MANUAL

EuroPak-15ab Receiver User Manual

Publication Number:	OM-20000121	
Revision Level:	1	
Revision Date:	2008/03/25	
Associated Firmware Version:	L1/E5a	5.200 or higher
	E5a/E5b	6.200 or higher

NovAtel® and Narrow Correlator® tracking technology are registered trademarks of NovAtel Inc.
All other brand names are trademarks of their respective holders.

© Copyright NovAtel Inc. (2008). All rights reserved.
Unpublished rights reserved under International copyright laws.
Printed in Canada on recycled paper. Recyclable.



Table of Contents

Notices	9
Terms and Conditions	12
Software License	14
Warranty Policy	16
Customer Service	17
Foreword	18
1 Introduction	19
1.1 Overview of the EuroPak-15ab.....	19
1.2 SBAS Overview	19
1.3 Galileo Overview.....	20
1.3.1 Open Service	21
1.3.2 Commercial Service	21
1.3.3 Safety-of-Life Service	22
1.3.4 Public Regulated Service	22
1.3.5 Search and Rescue Service.....	22
1.4 EuroPak-15ab Enclosure	22
1.5 EuroPak-15ab Features.....	23
1.5.1 GEO Signal Processing	24
1.5.2 Digital Pulse Blanking	24
1.6 Functional Overview	24
1.7 Internal Euro-L1E5a and E5a/E5b Cards	24
1.7.1 Radio Frequency Section	24
1.7.2 Digital Electronics Section.....	25
1.8 Antenna or Signal Generator	25
1.9 Principal Power Supply	25
1.10 Data Communications Equipment	25
1.11 External Oscillator.....	25
2 Installation	26
2.1 Additional Equipment Required	26
2.1.1 Selecting an Antenna or Signal Generator.....	26
2.1.2 Choosing a Coaxial Cable.....	26
2.1.3 10 MHz External Oscillator.....	27
2.1.4 Power Supply Requirements.....	27
2.2 Installation Overview.....	27
2.2.1 Mounting the Antenna or Signal Generator.....	28
2.2.2 Connecting the Antenna or Signal Generator to the Receiver	29
2.2.3 Applying Power to the Receiver	29
2.2.4 Connecting the Oscillator	29
2.2.5 Connecting Data Communications Equipment	29
2.3 Additional Features and Information.....	29
2.3.1 Strobes	29
2.3.2 Status Indicators	30
2.3.3 Mounting Bracket	30
3 Operation	31
3.1 Pre-Start Check List.....	31
3.2 Start-Up	31

3.3	Communicating with the EuroPak-15ab	32
3.4	Getting Started.....	32
3.4.1	Starting the Receiver.....	32
3.4.2	Communicating with the Receiver Using GPSolution (Aviation)	32
4	Using Commands and Logs	34
4.1	Entering Commands	34
4.1.1	Command Settings on Power-Up.....	34
4.1.2	Determining the Current Command Settings	35
4.1.3	Response Formats	35
4.1.4	Response Messages.....	35
4.2	Logging Data	37
4.2.1	Log Types.....	37
4.2.2	Log Triggers	37
4.2.3	Specifying Log Formats.....	38
4.3	Log Formats.....	38
4.3.1	ASCII.....	38
4.3.2	Binary	39
4.4	Fields	41
4.4.1	Field Types.....	41
4.4.2	Commonly-Used Fields	42
5	Commands	46
5.1	Functional Listing of Commands	46
5.2	Command Summary.....	47
5.3	Command Reference.....	48
5.3.1	AGCMODE Control Automatic Gain Control	48
5.3.2	ANTENNAPOWER.....	50
5.3.3	ASSIGN Assign Individual Satellite Channels	51
5.3.4	CHANCONFIG	53
5.3.5	COM Serial Port Configuration Control.....	54
5.3.6	ECUTOFF Set Satellite Elevation Cut-off	56
5.3.7	EXTERNALCLOCK	57
5.3.8	FIX Constrain to Fixed Position	59
5.3.9	FRESET Clear Data in NVM.....	61
5.3.10	LOG Request Logs from Receiver.....	62
5.3.11	POSITIONTYPE Set the Position Solution	64
5.3.12	PULSEBLANKING Enable/Disable Pulse Blanking.....	65
5.3.13	RESET Hardware Reset.....	66
5.3.14	SDLLBW Configure DLL Filter Bandwidth	67
5.3.15	SPLLBW Configure Phase-Lock-Loop Bandwidth.....	68
5.3.16	STHRESHOLD Control Signal Thresholds.....	69
5.3.17	UNLOG Remove Log from Logging Control.....	70
5.3.18	UNLOGALL Remove All Logs from Logging Control.....	71
6	Data Logs	72
6.1	Functional Listing of Logs	72
6.2	Log Summary	73
6.3	Log Reference	73
6.3.1	AGCSTATS Automatic Gain Control Status	74
6.3.2	ALMANAC Decoded Almanac.....	77
6.3.3	CLOCKMODEL Current Clock Model Status.....	79
6.3.4	PSRPOS Pseudorange Position.....	82
6.3.5	RANGE Satellite Range Information.....	84

6.3.6 RAWEPHEM Raw Ephemeris	88
6.3.7 RAWFRAME Raw Subframes	89
6.3.8 RXCOMMANDS Receiver Configuration.....	90
6.3.9 RXSECSTATUS Receiver Section Status.....	93
6.3.10 SATVIS Satellite Visibility	96
6.3.11 SYSTEMLEVELS System Hardware Levels	98
6.3.12 TIME Time Data	99
6.3.13 TRACKSTAT Tracking Status	100
6.3.14 VERSION Version Information	102
7 Firmware Updates	104
7.1 Contacting the NovAtel Aviation Department	104
7.2 Downloading the Files	105
7.3 Decompressing the Files	105
7.4 Running the Utility.....	106
7.4.1 Open a File to Download.....	106
7.4.2 Communications Settings	107
7.4.3 Downloading Firmware	107
8 Built-In Status Test	109
8.1 Overview.....	109
8.2 Receiver Status Word.....	109
8.3 Error Strobe Signal	109
8.4 Receiver Status Log	109
8.4.1 Overview	109
8.4.2 Error Word.....	110
8.4.3 Status Code Arrays	111
8.4.4 Receiver Status Code	111
8.4.5 Auxiliary Status Codes	111

Appendices

A Technical Specifications	112
B Electrostatic Discharge Control (ESD) Practices	126
C Standards/References	128
D Replacement Parts	129

Figures

1	The SBAS Concept	20
2	EuroPak-15ab Enclosure	23
3	Typical Receiver Installation.....	28
4	The WGS84 ECEF Coordinate System	60
5	Serial Number and Version Label	104
6	Main Screen of WinLoad	106
7	WinLoad's Open Dialog.....	106
8	Open File in WinLoad.....	107
9	COM Port Setup	107
10	Authorization Code Dialog.....	108
11	Update Process Complete	108
12	Location of Receiver Status Word.....	110
13	Reading the Bits in the Receiver Status Word	110
14	Location of Receiver Error Word	110
15	Reading the Bits in the Receiver Error Word	110
16	EuroPak-15ab Power Cable.....	117
17	EuroPak-15ab Null Modem Cable.....	118
18	EuroPak-15ab Straight Through Serial Cable	119
19	EuroPak-15ab I/O Strobe Port Cable	120

Tables

1	Default Serial Port Configurations	29
2	Available Strobe Signals on the EuroPak-15ab	30
3	EuroPak-15ab Status Indicators	30
4	Response Messages	36
5	Log Triggers for Each Log Type	37
6	ASCII Message Header Structure	39
7	Binary Message Header Structure	40
8	Field Types	41
9	Byte Arrangements	42
10	Serial Port Identifier Values	42
11	Message Type Byte Format	42
12	GPS Time Status	43
13	Commands By Function	46
14	Command Summary	47
15	Frequency Values for AGCMODE Command	48
16	AGC Mode Values	48
17	Channel State Values	52
18	Configuration Values	53
19	Parity Values	55
20	Handshaking Values	55
21	Echo Values	55
22	Break Values	55
23	Clock Type	58
24	Pre-Defined Values for Oscillators	58
25	Fix Type Values	59
26	Log Trigger Values	63
27	Log Hold Values	63
28	Position Frequency Switch	64
29	Frequency Switch	65
30	Pulse Blanking Switch	65
31	Logs By Function	72
32	Log Summary	73
33	AGC Status Word	75
34	Antispoofing Flag Values	78
35	Clock Model Status Values	81
36	Constellation Change Flag Values	81
37	Solution Status Values	83
38	Position Type Values	83
39	Channel Tracking Status	86
40	Tracking State Bit Values	87
41	Correlator Spacing Bit Values	87
42	Command Type Values	92
43	Component Type	93
44	Receiver Error	94
45	Receiver Status	95
46	Satellite Visibility Values	97
47	Complete Almanac Flag Values	97
48	Reject Code Values	101
49	Version Log Field Formats	103
50	Target Card Identification	107
51	Performance Specifications	112

52	EuroPak-15ab Serial Port Pin-Out Descriptions	115
53	EuroPak-15ab I/O Port Pin-Out Descriptions	116
54	10GALILEO6GPS Channel Configuration	122
55	16GPSL1L5 Channel Configuration	122
56	16GALILEOL1E5a Channel Configuration	123
57	12GPS4GEO1L5 Channel Configuration	123
58	8GPS8GEO Channel Configuration	124
59	24GALILEO8GPS Channel Configuration	125
60	Static-Accumulating Materials	127

Notices

The following notices apply to the EuroPak-15ab.

FCC NOTICE

This equipment has been tested and found to comply with the radiated and conducted emission limits for a Class B digital device, for both CISPR 22 and Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

IMPORTANT: In order to maintain compliance with the limits of a Class B digital device, it is required to use properly shielded interface cables (such as Belden #9539 or equivalent) when using the serial data ports, and double-shielded cables (such as Belden #9945 or equivalent) when using the I/O strobe port.



WARNING: Changes or modifications to this equipment not expressly approved by NovAtel Inc. could result in violation of Part 15 of the FCC rules.

CE NOTICE

The enclosure carries the CE mark.



WARNING: This is a Class B product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

"Hereby, NovAtel Inc. declares that this EuroPak-15ab is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC."

Electromagnetic Compatibility (EMC)

The EuroPak-15ab has passed the following EMC regulatory tests:

Emissions Testing of the EUROPAK-15ab

- EN 55022 1998 (CISPR 22 (2006)) - Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
- FCC, Part 15 Subpart B (2004)

Immunity Testing of the EUROPAK-15ab

- EN 55024 1998 - Information technology equipment - Immunity characteristics - Limits and methods of measurement

Safety of Information Technology Equipment

- EN 60950-1 2001 - Information technology equipment - Safety - Part 1: generic requirements

Lightning Protection Notice

What is the Hazard?

A lightning strike into the ground causes an increase in the earth's potential causing a high voltage potential between the centre conductor and the shield of the coaxial cable. Voltages directly applied onto the centre conductor "roll off" and arrive after the shield pulse producing a high voltage potential between the centre conductor and shield of the coaxial cable.

Hazard Impact

A lightning strike causes the ground potential in the area to rise to dangerous levels resulting in harm to personnel or destruction of electronic equipment in an unprotected environment. It also conducts a portion of the strike energy down the inner conductor of the coaxial cable to the connected equipment.

Actions to Mitigate Lightning Hazards

See also *Figure 1* on *Page 13*:

1. Do not install the external antenna lines extra-building during a lightning storm.
2. Use a lightning protection device to shunt a large portion of the transient energy to the building ground reducing an over voltage condition as quickly as possible although it is not possible to avoid over voltages caused by lightning.
3. Provide primary lightning protection via the operator/customer according to local building codes as part of the extra-building installation.
4. Use a secondary lightning protection device in building equipment installations with external antennas to ensure compliance with Clause 7, Connection to Cable Distribution Systems of EN 60950-1, Safety for Information Technology Equipment. The following PolyPhaser Corporation devices have been approved for use and are available from NovAtel's Sales Department:
DJXZ+24NFNF-A
5. Connect the shield of the coaxial cable entering the building to protective ground through the primary and secondary lightning protection.

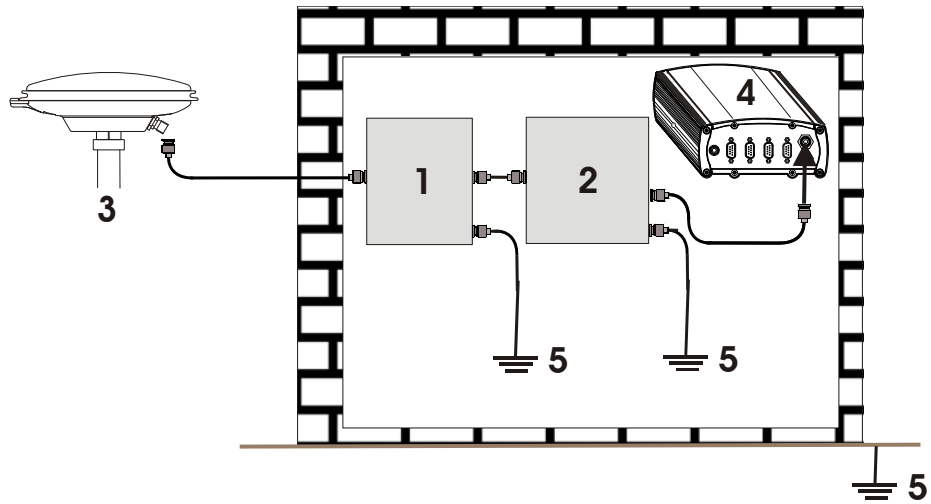


Figure 1: Primary and Secondary Lightning Protection

Reference	Description	Reference	Description
1	Primary Lightning Protection Device	4	EuroPak-15ab Receiver
2	Secondary Lightning Protection Device	5	To Earth Ground
3	External Antenna		

Terms and Conditions

Standard Terms and Conditions of Sales

1. PRICES: All prices are Firm Fixed Price, EX WORKS 1120 - 68th Avenue N.E., Calgary, Alberta. All prices include standard commercial packing for domestic shipment. All transportation, insurance, special packing costs and expenses, and all Federal, provincial and local excise, duties, sales, and other similar taxes are the responsibility of the Purchaser

2. PAYMENT: Terms are prepayment unless otherwise agreed in writing. Interest shall be charged on overdue accounts at the rate of 18% per annum (1.5% per month) from due date. To expedite payment by wire transfer to NovAtel Inc.: Bank - HSBC Bank of Canada

407 - 8 Avenue S.W.	US Account #	788889-002
Calgary, AB, Canada T2P 1E5	Transit #	10029-016
	Swift	HKBCCATTCAL

3. DELIVERY: Purchaser shall supply shipping instructions with each order. (Ship to and bill to address, NovAtel Quotation #, Preferred carrier and account #, Custom broker/freight forwarder including name and contact #) In the absence of specific instructions, NovAtel may select a carrier and insure Products in transit and charge Purchaser accordingly. NovAtel shall not be responsible for any failure to perform due to unforeseen circumstances or causes beyond its ability to reasonably control. Title shall pass to Purchaser when Purchaser has paid NovAtel all amounts due. Risk of loss, damage or destruction shall pass to Purchaser upon delivery to carrier. Goods are provided solely for incorporation into the Purchaser's end product and shall not be onward delivered except as incorporated in the Purchaser's end product.

4. COPYRIGHT AND CONFIDENTIALITY: Copyright in any specification, drawing, computer software, technical description and other document supplied by NovAtel under or in connection with the Order and all intellectual property rights in the design of any part of the Equipment or provision of services, whether such design be registered or not, shall vest in NovAtel absolutely. The Buyer shall keep confidential any information expressed or confirmed by NovAtel in writing to be confidential and shall not disclose it without NovAtel's prior consent in writing to any third party or use it other than for the operation and maintenance of any Equipment provided.

5. GENERAL PROVISIONS: All Purchase Orders are subject to approval and acceptance by NovAtel. Any Purchase Order or other form from the Purchaser, which purports to expand, alter or amend these terms and conditions, is expressly rejected and is and shall not become a part of any agreement between NovAtel and the Purchaser. This agreement shall be interpreted under the laws of the Province of Alberta.

6. LIMITED WARRANTY AND LIABILITY: Warranty Period: Products - 1 year; Accessories - 90 days (in each case from the date of invoice). NovAtel warrants that during the Warranty Period that (a) the Product will be free from defects in material and workmanship and conform to NovAtel specifications; (b) the software will be free from error which materially affect performance; and (c) if applicable as defined in the User's Manual, be eligible for access to post contract support and software updates when

available. **THESE WARRANTIES ARE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NOVATEL SHALL IN NO EVENT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND OR NATURE DUE TO ANY CAUSE.**

Purchaser's exclusive remedy for a claim under this warranty shall be limited to the repair or replacement at NovAtel's option and at NovAtel's facility, of defective or nonconforming materials, parts or components or in the case of software, provision of a software revision for implementation by the Buyer. All material returned under warranty shall be returned to NovAtel prepaid by the Buyer and returned to the Buyer, prepaid by NovAtel. The foregoing warranties do not extend to (i) nonconformities, defects or errors in the Products due to accident, abuse, misuse or negligent use of the Products or use in other than a normal and customary manner, environmental conditions not conforming to NovAtel's specifications, or failure to follow prescribed installation, operating and maintenance procedures, (ii) defects, errors or nonconformities in the Products due to modifications, alterations, additions or changes not made in accordance with NovAtel's specifications or authorized by NovAtel, (iii) normal wear and tear, (iv) damage caused by force of nature or act of any third person, (v) shipping damage, (vi) service or repair of Product by the Purchaser without prior written consent from NovAtel, (vii) Products designated by NovAtel as beta site test samples, experimental, developmental, preproduction, sample, incomplete or out of specification Products, (viii) returned Products if the original identification marks have been removed or altered or (ix) Services or research activities.

7. EXCLUSION OF LIABILITY: If a Party would, but for this paragraph (7), have concurrent claims in contract and tort (including negligence) such claims in tort (including negligence) shall to the extent permitted by law be wholly barred, unenforceable and excluded.

NovAtel shall not be liable to the Buyer by way of indemnity or by reason of any breach of the Order or of statutory duty or by reason of tort (including but not limited to negligence) for any loss of profit, loss of use, loss of production, loss of contracts or for any financing costs or for any indirect or consequential damage whatsoever that may be suffered by the Buyer.

In the event and to the extent that NovAtel shall have any liability to Buyer pursuant to the terms of the Order, NovAtel shall be liable to Buyer only for those damages which have been foreseen or might have reasonably been foreseen on the date of effectivity of the Order and which are solely an immediate and direct result of any act or omission of NovAtel in performing the work or any portion thereof under the Order and which are not in the aggregate in excess of ten (10%) percent of the total Order price.

Software License

BY INSTALLING, COPYING, OR OTHERWISE USING THE SOFTWARE PRODUCT, YOU AGREE TO BE BOUND BY THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, DO NOT INSTALL, COPY OR USE THE SOFTWARE PRODUCT.

1. License: NovAtel Inc. ("NovAtel") grants you a non-exclusive, non-transferable license (not a sale) to use one copy of the enclosed NovAtel software on a single computer, and only with the product it was supplied with. You agree not to use the software for any purpose other than the due exercise of the rights and licences hereby agreed to be granted to you.
2. Copyright: NovAtel owns, or has the right to sublicense, all copyright, trade secret, patent and other proprietary rights in the software and the software is protected by national copyright laws, international treaty provisions and all other applicable national laws. You must treat the software like any other copyrighted material except that you may either (a) make one copy of the software solely for backup or archival purposes, the media of said copy shall bear labels showing all trademark and copyright notices that appear on the original copy, or (b) transfer the software to a single hard disk provided you keep the original solely for backup or archival purposes. You may not copy the product manual or written materials accompanying the software. No right is conveyed by this Agreement for the use, directly, indirectly, by implication or otherwise by Licensee of the name of NovAtel, or of any trade names or nomenclature used by NovAtel, or any other words or combinations of words proprietary to NovAtel, in connection with this Agreement, without the prior written consent of NovAtel.
3. Patent Infringement: NovAtel shall not be liable to indemnify the Licensee against any loss sustained by it as the result of any claim made or action brought by any third party for infringement of any letters patent, registered design or like instrument of privilege by reason of the use or application of the software by the Licensee or any other information supplied or to be supplied to the Licensee pursuant to the terms of this Agreement. NovAtel shall not be bound to take legal proceedings against any third party in respect of any infringement of letters patent, registered design or like instrument of privilege which may now or at any future time be owned by it. However, should NovAtel elect to take such legal proceedings, at NovAtel's request, Licensee shall co-operate reasonably with NovAtel in all legal actions concerning this license of the software under this Agreement taken against any third party by NovAtel to protect its rights in the software. NovAtel shall bear all reasonable costs and expenses incurred by Licensee in the course of co-operating with NovAtel in such legal action.
4. Restrictions: You may not: (1) copy (other than as provided for in paragraph 2), distribute, transfer, rent, lease, lend, sell or sublicense all or any portion of the software; (2) modify or prepare derivative works of the software; (3) use the software in connection with computer-based services business or publicly display visual output of the software; (4) transmit the software over a network, by telephone or electronically using any means; or (5) reverse engineer, decompile or disassemble the software. You agree to keep confidential and use your best efforts to prevent and protect the contents of the software from unauthorized disclosure or use.
5. Term and Termination: This Agreement and the rights and licences hereby granted shall continue in force in perpetuity unless terminated by NovAtel or Licensee in accordance herewith. In the event that the Licensee shall at any time during the term of this Agreement: i) be in breach of its obligations hereunder where such breach is irremediable or if capable of remedy is not remedied within 30 days of notice from NovAtel requiring its remedy; or ii) be or become bankrupt or insolvent or make any composition with its creditors or have a receiver or manager appointed of the whole or any part of its undertaking or assets or (otherwise

as a solvent company for the purpose of and followed by an amalgamation or reconstruction hereunder its successor shall be bound by its obligations hereunder) commence to be wound up; or iii) be acquired or otherwise come under the direct or indirect control of a person or persons other than those controlling it, then and in any event NovAtel may forthwith by notice in writing terminate this Agreement together with the rights and licences hereby granted by NovAtel. Licensee may terminate this Agreement by providing 30 days prior written notice to NovAtel. Upon termination, for any reasons, the Licensee shall promptly, on NovAtel's request, return to NovAtel or at the election of NovAtel destroy all copies of any documents and extracts comprising or containing the software. The Licensee shall also erase any copies of the software residing on Licensee's computer equipment. Termination shall be without prejudice to the accrued rights of either party, including payments due to NovAtel. This provision shall survive termination of this Agreement howsoever arising.

6. **Warranty:** For 90 days from the date of shipment, NovAtel warrants that the media (for example, compact disk) on which the software is contained will be free from defects in materials and workmanship. This warranty does not cover damage caused by improper use or neglect. NovAtel does not warrant the contents of the software or that it will be error free. The software is furnished "AS IS" and without warranty as to the performance or results you may obtain by using the software. The entire risk as to the results and performance of the software is assumed by you.
7. **Indemnification:** NovAtel shall be under no obligation or liability of any kind (in contract, tort or otherwise and whether directly or indirectly or by way of indemnity contribution or otherwise howsoever) to the Licensee and the Licensee will indemnify and hold NovAtel harmless against all or any loss, damage, actions, costs, claims, demands and other liabilities or any kind whatsoever (direct, consequential, special or otherwise) arising directly or indirectly out of or by reason of the use by the Licensee of the software whether the same shall arise in consequence of any such infringement, deficiency, inaccuracy, error or other defect therein and whether or not involving negligence on the part of any person.
8. For software UPDATES and UPGRADES, and regular customer support, contact the NovAtel GPS Hotline at 1-800-NOVATEL (U.S. or Canada only), or 403-295-4900, or fax 403-295-4901, e-mail to support@novatel.ca, visit our website <http://www.novatel.com> or write to:

NOVATEL INC.
CUSTOMER SERVICE DEPT.
1120 - 68 AVENUE NE,
CALGARY, ALBERTA, CANADA T2E 8S5

9. **Disclaimer of Warranty and Limitation of Liability:**
 - a. THE WARRANTIES IN THIS AGREEMENT REPLACE ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. NovAtel DISCLAIMS AND EXCLUDES ALL OTHER WARRANTIES. IN NO EVENT WILL NovAtel's LIABILITY OF ANY KIND INCLUDE ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, EVEN IF NovAtel HAS KNOWLEDGE OF THE POTENTIAL LOSS OR DAMAGE.
 - b. NovAtel will not be liable for any loss or damage caused by delay in furnishing the software or any other performance under this Agreement.
 - c. NovAtel's entire liability and your exclusive remedies for our liability of any kind (including liability for negligence) for the software covered by this Agreement and all other performance or non-performance by NovAtel under or related to this Agreement are to the remedies specified by this Agreement.

This Agreement is governed by the laws of the Province of Alberta, Canada. Each of the parties hereto irrevocably attorns to the jurisdiction of the courts of the Province of Alberta.

Warranty Policy

NovAtel Inc. warrants that its Global Positioning System (GPS) products are free from defects in materials and workmanship, subject to the conditions set forth below, for the following periods of time:

EuroPak-15ab Receivers	One (1) Year from date of sale
NovAtel Antennas	One (1) Year from date of sale
Cables and Accessories	Ninety (90) Days from date of sale
Software Support	One (1) Year from date of sale

Date of sale shall mean the date of the invoice to the original customer for the product. NovAtel's responsibility respecting this warranty is solely to product replacement or product repair at an authorized NovAtel location.

Determination of replacement or repair will be made by NovAtel personnel or by technical personnel expressly authorized by NovAtel for this purpose.

THE FOREGOING WARRANTIES DO NOT EXTEND TO (I) NONCONFORMITIES, DEFECTS OR ERRORS IN THE PRODUCTS DUE TO ACCIDENT, ABUSE, MISUSE OR NEGLIGENT USE OF THE PRODUCTS OR USE IN OTHER THAN A NORMAL AND CUSTOMARY MANNER, ENVIRONMENTAL CONDITIONS NOT CONFORMING TO NOVATEL'S SPECIFICATIONS, OR FAILURE TO FOLLOW PRESCRIBED INSTALLATION, OPERATING AND MAINTENANCE PROCEDURES, (II) DEFECTS, ERRORS OR NONCONFORMITIES IN THE PRODUCTS DUE TO MODIFICATIONS, ALTERATIONS, ADDITIONS OR CHANGES NOT MADE IN ACCORDANCE WITH NOVATEL'S SPECIFICATIONS OR AUTHORIZED BY NOVATEL, (III) NORMAL WEAR AND TEAR, (IV) DAMAGE CAUSED BY FORCE OF NATURE OR ACT OF ANY THIRD PERSON, (V) SHIPPING DAMAGE; OR (VI) SERVICE OR REPAIR OF PRODUCT BY THE DEALER WITHOUT PRIOR WRITTEN CONSENT FROM NOVATEL. IN ADDITION, THE FOREGOING WARRANTIES SHALL NOT APPLY TO PRODUCTS DESIGNATED BY NOVATEL AS BETA SITE TEST SAMPLES, EXPERIMENTAL, DEVELOPMENTAL, PREPRODUCTION, SAMPLE, INCOMPLETE OR OUT OF SPECIFICATION PRODUCTS OR TO RETURNED PRODUCTS IF THE ORIGINAL IDENTIFICATION MARKS HAVE BEEN REMOVED OR ALTERED. THE WARRANTIES AND REMEDIES ARE EXCLUSIVE AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WRITTEN OR ORAL, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE ARE EXCLUDED. NOVATEL SHALL NOT BE LIABLE FOR ANY LOSS, DAMAGE, EXPENSE, OR INJURY ARISING DIRECTLY OR INDIRECTLY OUT OF THE PURCHASE, INSTALLATION, OPERATION, USE OR LICENSING OR PRODUCTS OR SERVICES. IN NO EVENT SHALL NOVATEL BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR NATURE DUE TO ANY CAUSE.

There are no user serviceable parts in the GPS receiver and no maintenance is required. When the status code indicates that a unit is faulty, replace with another unit and return the faulty unit to NovAtel Inc.

Before shipping any material to NovAtel or Dealer, please obtain a Return Material Authorization (RMA) number from the point of purchase. You may also visit our website at <http://www.novatel.com> and select *Support / Repair Request* from the side menu.

Once you have obtained an RMA number, you will be advised of proper shipping procedures to return any defective product. When returning any product to NovAtel, please return the defective product in the original packaging to avoid ESD and shipping damage.

Customer Service

Contact Information

If you have any questions or concerns regarding your EuroPak-15ab receiver, please contact the NovAtel Aviation Group using any one of the following methods:

NovAtel GPS Hotline:	1-800-NOVATEL (U.S. and Canada) 403-295-4900 (International)
Fax:	403-295-4999
E-mail:	support@novatel.ca
Website:	www.novatel.com
Write:	NovAtel Inc. Aviation Group 1120 - 68 Avenue NE Calgary, Alberta, Canada T2E 8S5

Firmware Updates

Firmware updates are firmware revisions to an existing model, which improve basic functionality of the GPS receiver.

The process for obtaining firmware updates is discussed in *Chapter 7, Firmware Updates* starting on *Page 104*. If you need further information, please contact NovAtel using one of the methods given above.

Foreword

Scope

This manual contains sufficient information on the installation and operation of the EuroPak-15ab receiver to allow you to effectively integrate and fully operate it. After the addition of accessories, user-supplied data communications equipment and a power supply, the receiver is ready to go.

These receivers utilize a comprehensive user-interface command structure, which requires communications through its communications (COM) ports. This manual also lists and describes the various receiver commands and logs.

For an overview of GPS, a glossary of terms, units of conversion and acronyms, refer to the *GPS+ Reference Manual* available on our website at <http://www.novatel.com/Downloads/docupdates.html>.

It is beyond the scope of this manual to provide details on service or repair. Please contact your local NovAtel dealer for any customer-service related inquiries, see *Customer Service* on Page 17.

Prerequisites

The installation chapters of this document provide information concerning the installation requirements and considerations for the EuroPak-15ab receiver.

Conventions

The conventions used throughout this document are:

H The letter H in the *Binary Bytes* or *Binary Offset* columns represents the header length for that command or log. The binary header is described in *Section 4.3.2* on *Page 39*.

0x A number following 0x is a hexadecimal number.

field

 Text surrounded by a box indicates a variable parameter to be entered as part of the command string.

[] Parameters surrounded by [and] are optional in a command or are required for only some instances of the command depending on the values of other parameters.

< > Text displayed between < and > indicates the entry of a keystroke in the case of the command or an automatic entry in the case of carriage return <CR> and line feed <LF> in data output.

In tables where no values are given, such fields should be assumed to be reserved for future use.

Compliance with GPS Week Rollover

The GPS week rollover issue refers to the way GPS receivers store information regarding the current GPS week. According to the official GPS system specifications document (*ICD-GPS-200*, paragraph 20.3.3.3.1.1), "... 10 bits shall represent the number of the current GPS week...". This means the GPS week is represented by an integer number between 0 and 1023. As GPS time started on Sunday January 6, 1980 at 0:00 hours, week 1023 ended on Saturday August 21, 1999 at 23:59:59.

As per the GPS system specifications document, NovAtel firmware resets the receiver's GPS week number back to zero. Users should be aware of this issue and keep in mind that there may be a compatibility issue when purchasing and using different makes of GPS receivers.

This chapter provides information on the features and functionality of the EuroPak-15ab and how it operates in the context of an SBAS system.

1.1 Overview of the EuroPak-15ab

The EuroPak-15ab is a high-performance GPS, Galileo and GEO receiver capable of receiving and tracking 32 GPS L1, GPS L5, Galileo L1, Galileo E5a and Galileo E5b signals. Alternatively, it can track GPS L5, SBAS GEO L1 and SBAS GEO L5 signals. The EuroPak-15ab also decodes the navigation signals.

There is flexibility in areas such as configuration and specification of output data and control signals. Multiple software models are available, allowing you to better fit the receiver to the application while maintaining the option for a compatible upgrade path.

The EuroPak-15ab enclosure offers a complete solution, a protective enclosure that provides an interface to the receiver card's power, data, and status signals.

1.2 SBAS Overview

A Satellite-Based Augmentation System (SBAS) is a safety-critical system designed to augment the Department of Defense Global Positioning System (GPS) Standard Positioning Service (SPS). SBAS enhances GPS service by providing:

- a ranging function to the SBAS satellites, which improves signal availability and reliability
- GPS signal corrections, which improve accuracy
- integrity monitoring, which improves safety

The primary mission of the SBAS system is to provide a means for air navigation for all phases of flight in the National Airspace System (NAS) from departure, through en route, and approach. The principal functions of SBAS include:

- determining ionospheric corrections
- determining satellite orbits
- determining satellite clock corrections
- determining satellite integrity
- independent data verification
- SBAS message broadcast and ranging
- system operations & maintenance

As shown in *Figure 1* on *Page 20*, the SBAS system consists of a series of *Reference Stations* and *Master Stations*, a *Ground Uplink Subsystem*, and *Geostationary Satellites (GEOs)*. The *Reference Stations*, which are strategically located to provide adequate coverage, pick up GPS satellite data and route it to the *Master Stations*. The *Master Stations* then process the data to determine the signal integrity, signal corrections, and residual errors for each monitored satellite. This information is sent to the *Ground Uplink Subsystem* for transmission to the *GEOs*, which then re-transmits the data on the GPS L1 and L5 (not yet available) frequency. In the future, the system will support L5 signal frequency broadcasts.

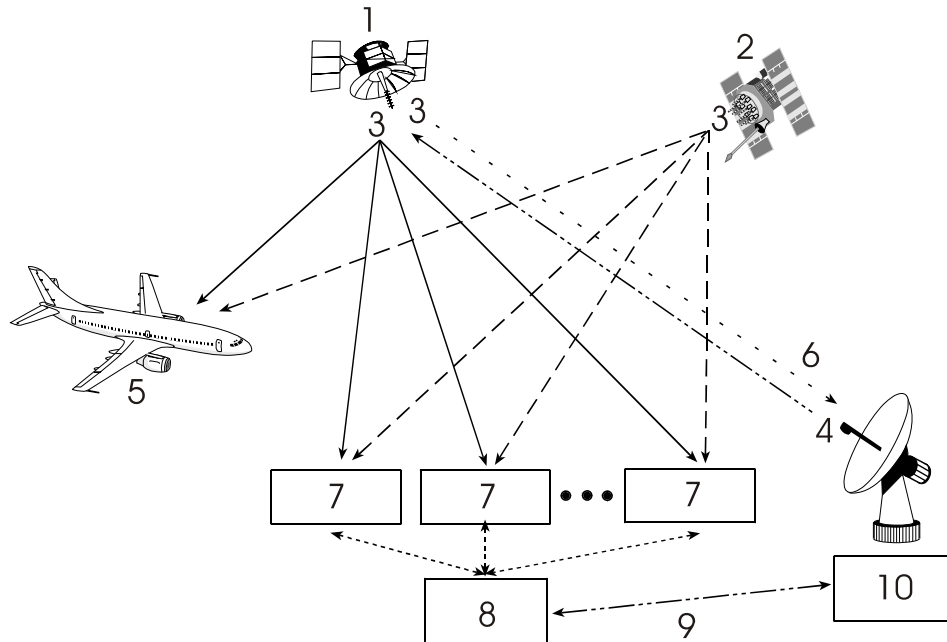


Figure 1: The SBAS Concept

Reference	Description
1	Geo satellite
2	GPS satellite constellation
3	L1 and L5
4	C1 and C5
5	GPS user
6	Integrity data, differential corrections and ranging control
7	Reference station
8	Master station
9	Integrity data, differential corrections, time control and status
10	Ground uplink subsystem

1.3 Galileo Overview

Galileo will be Europe's own global navigation satellite system, providing a highly accurate, guaranteed global positioning service under civilian control. It will be inter-operable with GPS and GLONASS, the two other global satellite navigation systems.

A user will be able to take a position with the same receiver from any of the satellites in any combination. By offering dual frequencies as standard, however, Galileo will deliver real-time positioning accuracy down to the metre range, which is unprecedented for a publicly available system.

It will guarantee availability of the service under all but the most extreme circumstances and will inform users within seconds of a failure of any satellite. This will make it suitable for applications where safety is crucial, such as running trains, guiding cars and landing aircraft.

The first experimental satellite, part of the so-called Galileo System Test Bed (GSTB) was launched in December 2005. The objective of this experimental satellite is to characterize the critical technologies, which are already in development under European Space Agency (ESA) contracts. Thereafter up to four operational satellites will be launched in the 2009-2010 time frame to validate the basic Galileo space and related ground segment. Once this In-Orbit Validation (IOV) phase has been completed, the remaining satellites will be installed to reach the Full Operational Capability (FOC) in 2013.

The fully deployed Galileo system consists of 30 satellites (27 operational + 3 active spares), positioned in three circular Medium Earth Orbit (MEO) planes in 23616 km altitude above the Earth, and at an inclination of the orbital planes of 56 degrees with reference to the equatorial plane. Once this is achieved, the Galileo navigation signals will provide a good coverage even at latitudes up to 75 degrees north, which corresponds to the North Cape, and beyond. The large number of satellites together with the optimization of the constellation, and the availability of the three active spare satellites, will ensure that the loss of one satellite has no discernible effect on the user.

Two Galileo Control Centres (GCC) will be implemented on European ground to provide for the control of the satellites and to perform the navigation mission management. The data provided by a global network of twenty Galileo Sensor Stations (GSS) will be sent to the Galileo Control Centres through a redundant communications network. The GCC's will use the data of the Sensor Stations to compute the integrity information and to synchronize the time signal of all satellites and of the ground station clocks. The exchange of the data between the Control Centres and the satellites will be performed through so-called up-link stations. Five S-band up-link stations and 10 C-band up-link stations will be installed around the globe for this purpose.

As a further feature, Galileo will provide a global Search and Rescue (SAR) function, based on the operational search and rescue satellite aided tracking Cospas-Sarsat system. To do so, each satellite will be equipped with a transponder, which is able to transfer the distress signals from the user transmitters to the Rescue Co-ordination Centre (RCC), which will then initiate the rescue operation. At the same time, the system will provide a signal to the user, informing them that their situation has been detected and that help is under way. This latter feature is new and is considered a major upgrade compared to the existing system, which does not provide a feedback to the user.

Five categories of services have been defined:

1. A free Open Service (OS)
2. A highly reliable Commercial Service (CS)
3. A Safety-of-Life Service (SOL)
4. A government encrypted Public Regulated Service (PRS)
5. A Search and Rescue Service (SAR)

1.3.1 Open Service

This single-frequency service will involve the provision of a positioning, navigation and precise timing service. It will be available for use by any person in possession of a Galileo receiver. No authorization will be required to access this service. Galileo is expected to be similar to GPS in this respect.

The principal applications will be general navigation and positioning, network timing, traffic information systems, systems including information on alternative routes in the event of congestion, and wireless location, for example, with mobile telephones.

Studies clearly show that the availability of these services will be significantly enhanced by the existence of a greater number of satellites, as is the case when both GPS and Galileo are in operation. This is particularly important for land-based services, such as private car navigation, where service is mostly required in downtown cores and where satellite shadowing is minimized by the combination of the systems.

The Open Service will be transmitted in the E5a frequency band at 1176.45 MHz.

1.3.2 Commercial Service

Service providers using the multi-frequency commercial services will have the opportunity to give added value to their range of products for which they can charge the end customer and will, in turn, pay a fee to the Galileo operator. The signal will contain data relating to the additional commercial services being offered. In return for the fee, the Galileo operator will be able to offer certain service guarantees. This aspect of service guarantee and the commensurate liabilities is one area where Galileo is significantly differentiated from GPS. A key component in achieving this is an independent system within Galileo for monitoring the satisfactory working of

the system and informing the end user of this by an integrity signal incorporated in the data stream.

The main applications for this service concern professional users who are ready to pay for a service guaranteed by the Galileo operator, notably in the areas of technical surveys, in activities involving customs and excise operations, network synchronization, sea fleet management, vehicle fleet management, and road tolls.

Controlled access to this service for end-users and the providers of value-added services will be based on protected access keys in the receivers. This will also enable revenue to be collected from users.

The commercial service will be transmitted in the E6 frequency band at 1278.75 MHz.

1.3.3 Safety-of-Life Service

The safety-of-life service will be offered to users who are highly dependant on precision, signal quality and signal transmission reliability. It will offer a high level of integrity, and consequently, provide the user with a very rapid warning of any possible malfunctions. It will need to be certified in accordance with the regulations applicable to the various modes of transport (the International Civil Aviation Organization (ICAO) regulations in the case of air transport; the International Maritime Organization (IMO) regulations in the case of sea transport). This service will require specialized receivers providing access to this enhanced-quality signal.

The safety-of-life service will be transmitted in two frequency bands – L1 at 1575.42 MHz, and E5b at 1207.14 MHz. Users may receive signals from the two frequency bands independently.

1.3.4 Public Regulated Service

The PRS will be a restricted access service, offered to government agencies that require a high availability navigation signal. The PRS service will utilize ranging codes that are encrypted with a highly secure government encryption scheme. To enhance availability, the PRS service is intended to have anti-jamming and anti-spoofing capabilities.

The PRS will be transmitted in two frequency bands – L1 at 1575.42 MHz, and E6 at 1278.75 MHz. Users may receive signals from the two frequency bands independently.

1.3.5 Search and Rescue Service

A specific public service designed to assist in search and rescue operations will make it possible to locate person and vehicles in distress. The vehicles will be fitted with beacons, which having been activated in the event of an emergency will send an alerting signal to the rescue centre.

The Galileo Program provides this search and rescue service for users based on humanitarian and public service principles of the international COSPAS-SARSAT system while at the same time making search and rescue operations more effective.

1.4 EuroPak-15ab Enclosure

The EuroPak-15ab provides a hardware interface between your equipment and the NovAtel Euro-L1E5a and E5a/E5b cards. Each is a rugged, sealed enclosure that provides protection against adverse environments. It has DB-9 connectors to access data and status signals.

The EuroPak-15ab offers the following features:

- A mounting enclosure with a PCB interconnect back plane
- Two serial ports provided on two DB-9P connectors (see the note below):
 - COM1
 - COM3 (the port is labelled COM2 on the enclosure but is COM3 in the software)
- Auxiliary status and synchronization signals

- Antenna or signal generator Radio Frequency (RF) ports
- Input power port
- Indicators to provide power and communication status
- An external oscillator port (input only)

The following accessories are included with the EuroPak-15ab:

- 1 12V power adapter cable
- 1 I/O cable
- 1 null modem serial cable
- 1 straight through serial cable
- A CD containing NovAtel's PC utilities and product documentation

For technical specifications on the EuroPak-15ab, please see *Appendix A, Technical Specifications* starting on *Page 112*.

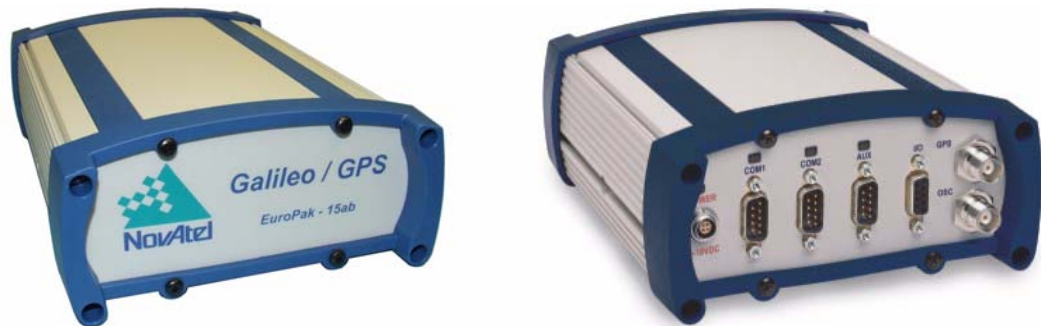


Figure 2: EuroPak-15ab Enclosure

-
- ☒ The port labelled COM2 on the back of the receiver, see *Figure 2* above, connects to COM3 of the internal Euro-L1E5a card.
-

1.5 EuroPak-15ab Features

The EuroPak-15ab has been designed with the following features:

- 32 channel parallel tracking
- Fully field-upgradeable firmware
- Low power consumption
- 1 Hz raw data and position output rates

At a minimum, the following channel configuration is available:

- 8 GPS L1 (for L1L5GPS model)
- 8 GPS L5 (for L1L5GPS model)
- 8 Galileo L1 (for L1E5aGALT model)
- 8 Galileo E5a (for L1E5aGALT model)
- 8 Galileo E5b (for L1E5aGALT model)
- 8 GPS L1 (for L1E5aGALT model)

Additional features for the receiver card include:

- GEO signal processing
- GPS signal processing
- Galileo signal processing
- Digital pulse blanking for the GPS L1 signal
- Digital pulse blanking for the GPS L5 signal
- Digital pulse blanking for the Galileo L1 signal
- Digital pulse blanking for the Galileo E5a signal
- Digital pulse blanking for the Galileo E5b signal

☒ Galileo signal processing will only be available on activated models.

Some of these features are discussed further in the following sections.

1.5.1 GEO Signal Processing

Specific channels have the capability to receive and process the SBAS signal provided by GEOs. These signals are in-band at L1 and L5. They are identified through the use of SBAS-specific PRN numbers. The SBAS message is decoded and separated into its various components. The SBAS message and associated pseudorange are provided as an output.

1.5.2 Digital Pulse Blanking

Digital pulse blanking involves removing or attenuating pulses in the RF signal that exceed a specified level. The EuroPak-15ab provides digital pulse blanking for the GPS L1, GPS L5, Galileo L1, Galileo E5a and Galileo E5b signal paths. Digital pulse blanking reduces the negative effects of pulsed interference.

Use the PULSEBLANKING command to enable/disable pulse blanking or control its sensitivity, see *Page 65*.

1.6 Functional Overview

In addition to the EuroPak-15ab, an GNSS receiver system typically contains three other major components:

- An antenna (and optional LNA power supply) or signal generator
- A power supply
- Data communications equipment

1.7 Internal Euro-L1E5a and E5a/E5b Cards

The internal Euro-L1E5a card consists of a radio frequency and a digital electronics section. The EuroL1E5a card communicates with the E5A/E5B card over the receiver backplane using USB.

1.7.1 Radio Frequency Section

The receiver obtains a filtered and amplified L1, L5, E5a or E5b signal from the antenna or signal generator via the coaxial cable. The RF section performs the translation from the incoming RF signal to an IF signal usable by the digital section. It also supplies power to the active antenna's LNA through the coaxial cable while maintaining isolation between the DC and RF paths. The RF section can reject a high level of potential interference (for example, MSAT, Inmarsat, cellular phone, and TV sub-harmonic signals).

1.7.2 Digital Electronics Section

The digital section of the receiver receives a down-converted, amplified GNSS signal which it digitizes and processes to obtain a navigation solution (position, velocity and time). The digital section consists of an analog-to-digital converter, a 32-bit system processor, memory, control and configuration logic, signal processing circuitry, serial peripheral devices, and supporting circuitry.

The digital section performs the translations and calculations necessary to convert the IF analog signals into usable position and status information. It also handles all I/O functions, including the auxiliary strobe signals, which are described in detail in *Section 2.3.1 on Page 29*. For input and output levels please see *Appendix A, Technical Specifications on Page 112*.

1.8 Antenna or Signal Generator

The purpose of the antenna is to convert the electromagnetic waves transmitted by the satellites into RF signals. An active antenna or a signal generator is required for the receiver to function properly.

Power for an antenna LNA is supplied by the receiver.

1.9 Principal Power Supply

A single external power supply capable of delivering 20 W is necessary to operate the receiver. See *Appendix A, Technical Specifications* starting on *Page 112* for details.



WARNING: If the voltage supplied is below the minimum specification, the receiver will suspend operation. If the voltage supplied is above the maximum specification, the receiver may be permanently damaged, voiding your warranty.

1.10 Data Communications Equipment

A PC or other data communications equipment is necessary to communicate with the receiver and, if desired, to store data generated by the receiver.

1.11 External Oscillator

The receiver requires an external 10 MHz oscillator connection in order to operate correctly. See also *Figure 3, Typical Receiver Installation on Page 28*.

This chapter contains instructions and tips to set up your NovAtel receiver to create a GNSS receiver system.

At the time of publication, it is recommended that the L5 signal for the receiver be generated by a signal generator as there are no L5 signals in space.

2.1 Additional Equipment Required

In order for the receiver to perform optimally, the following additional equipment is required:

- An interface for power, communications, and other signals
- An antenna or signal generator
- A 10 MHz external oscillator and connector cable
- A quality coaxial cable (and interconnect adapter cable as necessary)
- Data communications equipment capable of serial communications
- A serial cable (if not included with the receiver)
- A power supply
- A power cable (if not included with the receiver)



CAUTION: When the EuroPak-15ab receiver is installed in a permanent location, such as in a building, it should be protected by a lightning protection device according to local building codes. See also the *Notices on Page 10* and *Warranty Policy on Page 16*.

2.1.1 Selecting an Antenna or Signal Generator

An L5 Signal Generator is available from NovAtel, see the Aviation Group's contact information on *Page 17* to learn more.

The GPS-704-X antenna is a wide band passive antenna available from NovAtel. It is designed to operate in the frequency range 1150-1650 MHz. An external LNA is required.

NovAtel offers a variety of antenna models. Each offer exceptional phase-center stability, a significant measure of immunity against multipath interference and has an environmentally-sealed radome.

Connection at the time of publication is directly to a signal generator. There are no L5 signals in space at the present time.

2.1.2 Choosing a Coaxial Cable

An appropriate coaxial cable is one that is matched to the impedance of the antenna or signal generator and receiver being used (50 ohms), and whose line loss does not exceed 10.0 dB. If the limit is exceeded, excessive signal degradation will occur and the receiver may not be able to meet its performance specifications. NovAtel offers a variety of coaxial cables to meet your interconnection requirements, including:

- 5, 15, or 30 m RF cables with TNC male connectors on both ends (NovAtel part numbers C006, C016 and C032 respectively)

Your local NovAtel dealer can advise you about your specific configuration. Should your application require the use of cable longer than 30 m you will find the application note *RF Equipment Selection and Installation* at our website, www.novatel.com, or you may obtain it from NovAtel Customer Service directly.

High-quality coaxial cables should be used because a mismatch in impedance, possible with lower quality cable, produces reflections in the cable that increase signal loss. Though it is possible to use other high-quality

RF cables, the performance specifications of the EuroPak-15ab receivers are warranted only when used with NovAtel-supplied accessories.

2.1.3 10 MHz External Oscillator

The EuroPak-15ab receiver requires the use of a 10 MHz external oscillator. Choose an external 10 MHz reference oscillator with a signal power level of +3 to +13 dBm.

Installation consists of connecting a cable from the external oscillator to the EuroPak-15ab's external oscillator input connector.

The BNC external oscillator port, labelled OSC, is used for input signals on the EuroPak-15ab. See *Figure 2* on *Page 23*.

2.1.4 Power Supply Requirements

This section contains information on the requirements for the input power to the receiver. See *Appendix A, Technical Specifications* starting on *Page 112* for more power supply specifications.



WARNING: If the voltage supplied is below the minimum specification, the receiver will suspend operation. If the voltage supplied is above the maximum specification, the receiver may be permanently damaged, voiding your warranty.

The receiver is designed to prevent internal damage when subjected to a reverse polarity power connection. It also provides protection from short over voltage events. It is recommended that appropriate fuses or current limiting be incorporated as a safety precaution on all power lines used. Use a sufficient gauge of wire to ensure that the voltage at the connector is within the receiver's requirements.

2.1.4.1 EuroPak-15ab Enclosure

The EuroPak-15ab is supplied with a 12 V power adapter with a built-in slow-blow fuse for use with a standard 12 VDC power outlet.

If a different supply is desired, the input range required is +9 to +18 VDC. The type of connector required to mate with the receiver's power connector is a 4-pin LEMO socket connector labelled *PWR*. The supply should be capable of 25 W. See *Appendix D, Replacement Parts* starting on *Page 129* for the LEMO connector part number.

2.2 Installation Overview

Once you have selected the appropriate equipment, complete the following steps to set up and begin using your NovAtel receiver.

1. Mount the antenna or signal generator to a secure, stable structure, see *Section 2.1.1* on *Page 26* and *Section 2.2.1* on *Page 28*.
2. Connect the antenna or signal generator to the receiver with an RF cable, using the information given in *Section 2.2.2* on *Page 29*.
3. Apply power to the receiver, as described in *Section 2.2.3* on *Page 29*.
4. Connect the 10 MHz external oscillator, as described in *Section 2.1.3* above and *Section 2.2.4* on *Page 29*.
5. Connect the receiver to a PC or other data communications equipment by following the information given in *Section* on *Page 29*.

Figure 3 below shows a typical setup for an enclosed receiver.

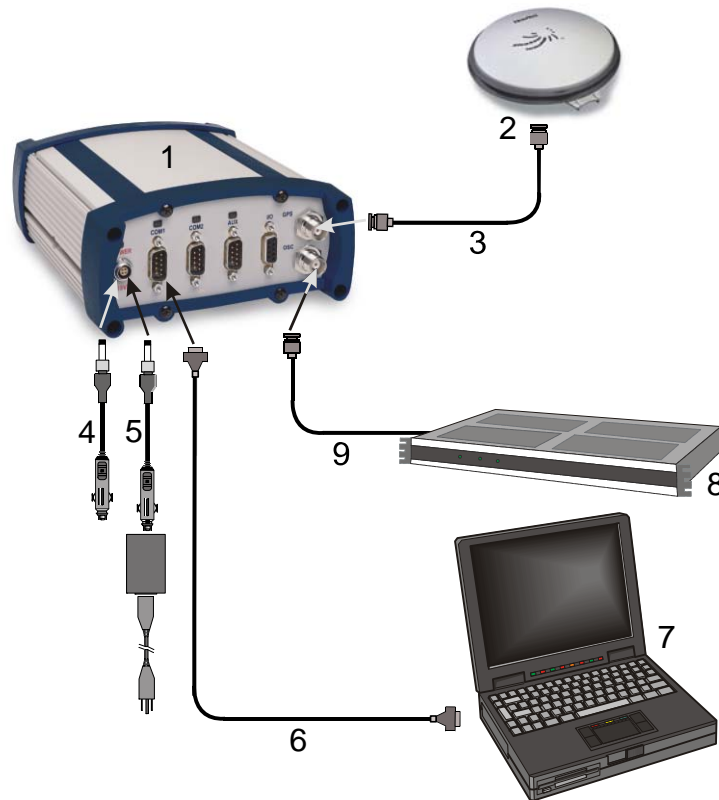


Figure 3: Typical Receiver Installation

Reference	Description
1	Receiver
2	Antenna or Signal Generator
3	RF Cable
4	12V Power Cable
5	12V Power Cable with Optional AC Adapter or Aircraft Power Conditioner
6	Null Modem Data Cable
7	Data Communications Equipment
8	10 MHz External Oscillator
9	External Oscillator Cable

2.2.1 Mounting the Antenna or Signal Generator

When installing an antenna or signal generator system:

- Mount the antenna on a secure, stable structure capable of safe operation in the specific environment

Also, if mounting an antenna:

- Choose an antenna location that has a clear view of the sky so that each satellite above the horizon can be tracked without obstruction

2.2.2 Connecting the Antenna or Signal Generator to the Receiver

Connect the antenna or signal generator to the receiver using high-quality coaxial cable, as discussed in *Section 2.1.2 on Page 26*.

The EuroPak-15ab provides a TNC female connector, which can be connected to the antenna or signal generator directly with any of NovAtel’s coaxial cables.

2.2.3 Applying Power to the Receiver

Connect the power supply to the *PWR* port of the EuroPak-15ab receiver.

2.2.4 Connecting the Oscillator

Connect the 10 MHz external oscillator to the *OSC* port of the EuroPak-15ab receiver.

2.2.5 Connecting Data Communications Equipment

In order to communicate with the receiver by sending commands and obtaining logs, a connection to some form of data communications equipment is required. The default configuration available for each of the receiver types is given in the table below. Consult NovAtel Customer Service for more details on factory configuration. See *Appendix A, Technical Specifications* starting on *Page 112* for data connection details.

Table 1: Default Serial Port Configurations

Receiver	COM1	COM2
EuroPak-15ab	RS-232	RS-232

Each port supports some, or all, of the following signals:

- Clear To Send (CTS)
- Transmitted Data (TXD)
- Request To Send (RTS)
- Received Data (RXD)

The EuroPak-15ab enclosure is Data Terminal Equipment (DTE) so that TXD and RTS are outputs while RXD and CTS are inputs. A null modem cable is required to connect to another DTE like a terminal or a PC.

2.3 Additional Features and Information

This section contains information on the additional features of the EuroPak-15ab receivers, which may affect the overall design of your receiver system.

2.3.1 Strobes

A set of inputs and outputs that provide status and synchronization signals are given on the EuroPak-15ab. These signals are referred to as strobes. As shown in *Table 2 on Page 30*, not all strobe signals are provided on all receivers. However, for those products for which strobes are available, you may want to design your installation to include support for these signals.

The EuroPak-15ab enclosure provides strobe signals at its I/O port, as described in *Table 53 on Page 116*.

Strobe signals include an input and several outputs as described below:

- Mark Input (Event1) A pulse on this input triggers certain logs to be generated. (see *Section 4.2.2, Log Triggers on Page 37*).
- Measure Output (MSR) Falling edge is synchronized with internal GPS

- Pulse Per Second Output (PPS) measurements.
A pulse for which the falling edge is synchronized with GPS time.
- Position Valid Output (PV) High when good GPS position and time solution.
- Error Output (ERROR) High when a receiver hardware failure is detected.

See *Appendix A, Technical Specifications* starting on *Page 112*, for further information on the strobe signal characteristics.

Table 2: Available Strobe Signals on the EuroPak-15ab

Signal	EVENT1	MSR	PPS	PV	ERROR	STATUS _RED	STATUS _GREEN
EuroPak-15ab	I/O port, pin 4	I/O port, pin 3	I/O port, pin 2	I/O port, pin 5	I/O port, pin 8	Not available	Not available

☒ The ground return pin for these signals is Pin 9.

2.3.2 Status Indicators

The EuroPak-15ab receivers have LED indicators that provide the status of the receiver. The EuroPak-15ab provides the status indicators shown in *Table 3*.

Table 3: EuroPak-15ab Status Indicators

Indicator	Indicator Color	Status
COM1	Green	Data is being transmitted from COM1
	Red	Data is being received on COM1
COM2	Green	Data is being transmitted from COM3
	Red	Data is being received on COM3
PWR	Red	The receiver is powered

2.3.3 Mounting Bracket

Along with the EuroPak-15ab enclosure, mounting kits have been provided to facilitate mounting the receivers to a surface. To install the mounting bracket provided with the EuroPak-15ab, refer to the instructions provided with the mounting kit. *Page 121* provides the dimension information for the bracket.

☒ The mounting kits are not designed for use in high-dynamics/vibration environments. Contact NovAtel, see *Page 17*, if your application requires the EuroPak-15ab to be mounted in these types of environments.

Before operating the EuroPak-15ab for the first time, ensure that you have followed the installation instructions in *Chapter 2*. From here on, it will be assumed that testing and operation of the EuroPak-15ab will be performed while using a personal computer (PC), which allows the greatest ease and versatility.

3.1 Pre-Start Check List

Before turning on power to the EuroPak-15ab, ensure that all of the following conditions have been met:

- The antenna or signal generator is properly installed, powered, and connected
- The 10 MHz external oscillator is properly installed, powered and connected
- The PC is properly connected using a serial cable, and its communications protocol has been configured to match that of the EuroPak-15ab

Supply power to the EuroPak-15ab only after all of the above checks have been made. Note that the warm-up process may take several minutes, depending on ambient temperature.

3.2 Start-Up

The EuroPak-15ab's firmware resides in non-volatile memory. After supplying power to the unit, wait a moment for self-boot, and the EuroPak-15ab will be ready for command input.

The initial start-up indicator to let you know that the EuroPak-15ab's main serial port is ready to communicate:

- Your PC will display the following prompt, indicating you are connected through the *COM1* port:
[COM1]

The receiver has 4 modes of operation including power-up mode:

- Power-Up
- Operational
- Fault
- Maintenance

The EuroPak-15ab is in power-up mode after receiving a reset signal. While in this mode, everything is disabled except for the clock generators and microprocessor interface. During this mode, Firmware (FW) is transferred from Flash to RAM, the 32-bit CRC is verified on the FW load and the Initiated Built In Test (IBIT) is exercised to determine whether the receiver is usable. This mode ends when the functional blocks of the receiver have been enabled, initialized and the IBIT has been successfully executed.

The EuroPak-15ab is in operational mode following power-up mode and before a fault is discovered by the Continuous Built In Test (CBIT) and goes into fault mode when the device outputs are affected by one or more faults preventing its use.

The EuroPak-15ab is in maintenance mode when it is loading firmware. Maintenance mode can only be entered via the Power-up mode.

Once you are connected, commands can be entered as explained in *Section 3.3, Communicating with the EuroPak-15ab* on *Page 32*.

3.3 Communicating with the EuroPak-15ab

Communication with the receiver consists of issuing commands through the communication ports from an external serial communications device. This could be either a PC or laptop that is directly connected to the receiver serial port using a null modem cable.

The commands and logs used by the EuroPak-15ab, as well as the fields within them, follow specific formats, which are discussed in *Chapter 4*. The valid commands, which are used to control the operation and data logging of the EuroPak-15ab, are specified in *Chapter 5*. *Chapter 6* provides details on the data logs that can be requested from the EuroPak-15ab. It is to your advantage to become thoroughly familiar with *Chapters 4* through *6* of this manual to ensure maximum utilization of the EuroPak-15ab's capabilities.

3.4 Getting Started

Included with your receiver are NovAtel's *GPSolution (Aviation)* and *Convert* programs. *GPSolution (Aviation)* is a Microsoft Windows-based GUI which allows you to access the receiver's many features without the need for communications protocol or to write special software. The *Convert* utility is a Windows-based utility that allows you to convert between file formats, and strips unwanted records for data file compilation. See the *EuroPak-15ab Quick Start Guide* for more information on their installation.

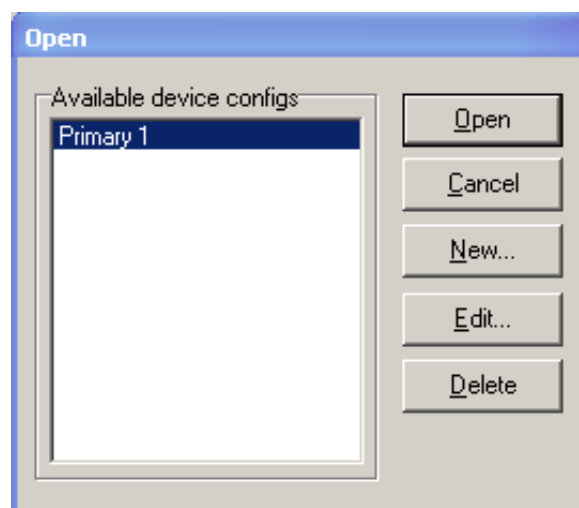
-
- ☒ You must install the *Aviation* version of the PC Utilities provided on your CD. It is only this version, *GPSolution (Aviation)*, of *GPSolution* that works with the EuroPak-15ab receiver.
-

3.4.1 Starting the Receiver

The receiver's software resides in read-only memory. When first powered, it undergoes a complete self-test. If an error condition is detected during a self-test, the self-test status word changes. This self-test status word can be viewed in the header of any data output log. See also *Chapter 8, Built-In Status Test* starting on *Page 109*.

3.4.2 Communicating with the Receiver Using *GPSolution (Aviation)*

Launch the *GPSolution (Aviation)* program and select *Device / Open* from its main menu. The *Open* dialog appears. The example below shows an *Open* dialog with a possible configurations already set up. Your configurations may be different or you may have none at all. In that case, the *Available device configs* window would be empty.



Refer to *GPSolution (Aviation)*'s Help file by selecting *Help / Contents* from the main menu to see Help for windows and their descriptions. Ensure you can see the *Console* and *ASCII Messages* windows by selecting them under *View* in the main menu.

When the receiver is first turned on, no data is transmitted from the COM ports except for the port prompt. The *Console* window displays a port name:

[COM1] *if connected to COM1 port,*

or

[COM3] *if connected to COM3 port*

Any of the above prompts indicate that the receiver is ready and waiting for command input.

-
- If you find that *GPSolution (Aviation)* is unable to locate your EuroPak-15ab receiver, it may be that you have previously used the SAVECONFIG command. In this case, try using a different COM port to communicate to the receiver. Once communication has been established, issue a FRESET STANDARD command. You should now be able to use your original communication port again.
-

WARNING!: Ensure all other windows are closed in *GPSolution (Aviation)* when entering the SAVECONFIG command in the Console window.

Commands are typed at the interfacing computing device's keypad or keyboard, and executed after issuing a carriage return command which is usually the same as pressing the <Enter> key.

An example of a response to an input command is the FIX POSITION command. It can be entered like this:

```
[COM1] fix position 51.11635 -114.0383 1048.2 [carriage return]
```

```
<OK
```

where [COM1] is the port prompt, the bolded type is the command you enter from you keypad or keyboard and [carriage return] indicates that you should press the <Enter> key.

The above example illustrates command input to the base receiver's COM1 port which sets the position of the base station receiver for differential operation. Confirmation that the command was actually accepted is the appearance of <OK>.

If a command is entered incorrectly, the receiver responds with:

```
<INVALID MESSAGE ID (or a more detailed message)
```

WARNING!: Ensure the Control Panel's Power Settings on your PC are not set to go into Hibernation or Standby modes. Data will be lost if one of these modes occurs during a logging session.

Chapter 5 and *Chapter 6* provide the details of the commands and logs used to communicate with the EuroPak-15ab. The sections below give information on using these messages, including the formats they can take and the responses they may provide.

4.1 Entering Commands

The EuroPak-15ab is capable of responding to many different input commands. The commands offer a wide range of flexibility and can be used to control the following:

- The overall status of the EuroPak-15ab
- Input and output functions
- Configuration of a specific channel of the EuroPak-15ab

The following rules apply when entering commands and logs:

1. You must enter commands in *Abbreviated ASCII* format. The name of the command and its parameters are entered.
2. The commands are not case sensitive. For example:

```
FIX POSITION or fix position
```
3. At the end of a command or command string, press <ENTER>.

4.1.1 Command Settings on Power-Up

When the receiver is first powered up, or after an *FRESET* command, all commands revert to the factory default settings.

The *FRESET* command causes all previously stored information saved to non-volatile memory to be erased. This command is detailed in *Section 5.3.9 on Page 61*.

4.1.1.1 Factory Defaults

The factory defaults for the EuroPak-15ab are:

ANTENNAPOWER ON

COM COM1 9600 N 8 1 N OFF ON

COM COM3 115200 N 8 1 N OFF ON

POSITIONTYPE GPSSL1

SDLLBW *n* 0.2

where n is for channel numbers 0 to 31 inclusive

SPLLBW *n* 3.0

where n is for channel numbers 0 to 31 inclusive

EXTERNALCLOCK OCXO 10 MHZ

4.1.1.2 Default Thresholds

For all signal channels, the acquisition threshold is 36 dB-Hz, the tracking threshold is 20 dB-Hz and the cross-correlation threshold is 36 dB-Hz.

4.1.1.3 Default AGC Modes

The AGC modes are set to AUTO by default for all frequencies.

4.1.2 Determining the Current Command Settings

To determine the current command settings of a receiver, request an *RXCOMMANDS* log, which is described in *Section 6.3.8 on Page 90*. This will provide a listing of all commands and their parameter settings. This log provides the most complete information on receiver configuration.

For some commands, including *COM* and *LOG*, multiple parameter sets can exist. For example, the *LOG* command can be entered with one set of parameters to enable logging of the *PSRPOS* log. It can then be entered again with a second set of parameters to configure the EuroPak-15ab to capture the *RANGE* log. When the *LOG* command is entered the second time, the new parameter set does not overwrite the first, it exists in addition to the first set.

4.1.3 Response Formats

The format of the response is dependent on the format of the input command. If the command is input as *Abbreviated ASCII*, the output will be *Abbreviated ASCII*.

The *Abbreviated ASCII* response consists of a leading < followed by the response string, like the example below:

```
<OK
```

4.1.4 Response Messages

The receiver is capable of outputting several responses for various conditions. Most of these responses are error messages to indicate when something is not correct. *Table 4 on Page 36* outlines the various response strings and message IDs.

Table 4: Response Messages

String	ID	Meaning
OK	1	Command was received correctly
NOT ENOUGH RESOURCES IN SYSTEM	3	The request has exceeded a limit (for example, the maximum number of logs are being generated)
DATA PACKET DOESN'T VERIFY	4	Data packet is not verified
COMMAND FAILED ON RECEIVER	5	Command did not succeed in accomplishing requested task
INVALID MESSAGE ID	6	The input message ID is not valid
INVALID MESSAGE FIELD = X	7	Field <i>x</i> of the input message is not correct
MESSAGE MISSING FIELD	9	A field is missing from the input message
ARRAY SIZE FOR FIELD X EXCEEDS MAX	10	Field <i>x</i> contains more array elements than allowed
PARAMETER X IS OUT OF RANGE	11	Field <i>x</i> of the input message is outside the acceptable limits
TRIGGER X NOT VALID FOR THIS LOG	14	Input trigger <i>x</i> is not valid for this type of log
NO VALID AUTH CODE FOR THAT MODEL	19	The model attached to the authcode is not valid
CHANNEL IS INVALID	20	The channel number is not correct
REQUESTED RATE IS INVALID	21	The requested rate is invalid
CHANNELS LOCKED DUE TO ERROR	23	Channels are locked due to error
INJECTED TIME INVALID	24	Injected time is invalid
COM PORT NOT SUPPORTED	25	The COM port is not supported
MESSAGE IS INCORRECT	26	The message is invalid
INVALID PRN	27	The PRN is invalid
MESSAGE TIMED OUT	31	The message has timed out
UNKNOWN COM PORT REQUESTED	33	Unknown COM port requested
HEX STRING NOT FORMATTED CORRECTLY	34	Hex string not formatted correctly
INVALID BAUD RATE	35	The baud rate is invalid
MESSAGE IS INVALID FOR THIS MODEL	36	This message is invalid for this model of receiver
COMMAND ONLY VALID IF IN NVM FAIL MODE	40	Command is only valid if NVM is in fail mode
INVALID OFFSET	41	The offset is invalid
MAX NUMBER OF USER MESSAGES REACHED	78	The maximum number of user messages allowed has been reached
GPS PRECISE TIME IS ALREADY KNOWN	84	GPS precise time is already known

4.2 Logging Data

You can control how the EuroPak-15ab logs data by using the *LOG* command given on *Page 62*. A field within this command allows you to specify which data log from *Chapter 6* to capture. Note the following however:

1. The EuroPak-15ab can handle 20 logs at a time. If you attempt to log more than 20 logs at a time, the receiver will respond with the error message:

```
Not enough resources in system
```
2. Maximum flexibility for logging data is provided to you by these logs. You are cautioned, however, to recognize that each log requested requires additional CPU time and memory buffer space. Too many logs may result in lost data and degraded CPU performance. Receiver overload can be monitored using the *idle-time* field and the *buffer overrun* bits of the *Receiver Status* field, which are both found in any log header.

When a log is generated, it is sent to the serial port specified by the `port` parameter in the entered *LOG* command.

4.2.1 Log Types

The receiver is capable of generating many different logs. These logs are divided into the following three types:

- Synchronous The data contained in *synchronous* logs is generated on a regular schedule.
- Asynchronous The data in *asynchronous* logs is generated at irregular intervals. If these logs were collected on a regular schedule, there would be a delay in capturing the new data. The result is that changes to the data are not captured the moment they were available.
- Polled The data in *polled* logs is generated only when requested. Typically the data in these logs, such as configuration settings, does not change.

4.2.2 Log Triggers

Each log can be configured for output when a certain condition, or *trigger*, is met. The possible triggers are:

- ONNEW Output a new log whenever the message is updated (not necessarily changed).
- ONCHANGED Output a new log whenever the message has changed.
- ONTIME Output a new log at a specified interval (in seconds).
- ONCE Output the current, existing message. Only a single log will be generated.

For each log type described in *Section 4.2.1, Log Types* only certain triggers are valid. For example, the *VERSION* log is a *polled* log because it does not change. Therefore, it would not make sense to log this kind of data using the *ONCHANGED* or *ONNEW* triggers. *Table 5* outlines the valid triggers for each log type:

Table 5: Log Triggers for Each Log Type

Type	Recommended Triggers	Illegal Triggers
Synchronous	ONTIME	ONNEW ONCHANGED
Asynchronous	ONCHANGED	-
Polled	ONCE	ONNEW ONCHANGED

4.2.3 Specifying Log Formats

Logs can be requested in two formats, *ASCII* or *Binary*, described in *Section 4.3* on *Page 38*.

When entering the *LOG* command using *ASCII* format, the default format for the output log is *ASCII*. To generate logs in a different format, a suffix is added to the name of the message being requested. To request a log in *ASCII* format, add *A* to the end of the log as shown below.

```
LOG ALMANACA
```

To request a log in *Binary* format, *B* is added to the end of the log name.

```
LOG RANGEB ONTIME 30
```

When issuing *Binary* logs, the output message type is set in the *Message Type* field in the command header, as described in *Table 7* on *Page 40*.

4.3 Log Formats

The receiver handles all incoming and outgoing NovAtel logs using two different formats:

- *ASCII*
- *Binary*

This allows for some versatility in the way the EuroPak-15ab can be used.

4.3.1 ASCII

The *ASCII* format is readable by both you and a computer. The structures of all *ASCII* messages follow the general conventions as noted here:

1. Basic format:

```
#HEADER_PARAMS ; PARAM_1 , PARAM_2 , . . . , PARAM_N* XXXXXXXX [ CR ] [ LF ]
```
2. The lead code identifier for each record is '#'. This identifier is followed by the header parameters, as described in *Table 6* on *Page 39*.
3. Each log is of variable length depending on the amount of data and field formats.
4. All data fields are delimited by a comma ',' with two exceptions. The first exception is the last header field which is followed by a ';' to denote the start of the data message. The other exception is the last data field, which is followed by a '*' to indicate end of message data.
5. Each log ends with a hexadecimal number preceded by an asterisk and followed by a line termination using the carriage return and line feed characters, for example, *1234ABCD [CR] [LF]. This value is a 32-bit cyclic redundancy check (CRC) of all bytes in the message, excluding the '#' identifier and the asterisk preceding the checksum digits. See *Section 4.4.2.5* on *Page 44* for the algorithm used to generate the CRC.
6. An *ASCII* string is one field and is surrounded by double quotation marks, for example, "ASCII string". If separators are surrounded by quotation marks then the string is still one field and the separator will be ignored, for example, "xxx , xxx" is one field. Double quotation marks within a string are not allowed.
7. If the receiver detects an error parsing an input message, it will return an error response message. Please see *Section 4.1.4* on *Page 35* for a list of response messages from the receiver.

The *ASCII* message header is formatted as follows:

Table 6: ASCII Message Header Structure

Field	Field Name	Field Type	Description	Ignored on Input
1	sync	Char	Sync character. The <i>ASCII</i> message is always preceded by a single '#' symbol.	N
2	message	Char	The <i>ASCII</i> name of the message. The names of logs are given in <i>Table 32 on Page 73</i> .	N
3	port	Char	The name of the port from which the log was generated. See <i>Table 10 on Page 42</i> .	Y
4	Reserved	ULong	Reserved for internal use	N
5	idle time	Float	The minimum percentage of time that the processor is idle	Y
6	time status	Enum	The quality of the GPS time, as described in <i>Section 4.4.2.4 on Page 43</i> .	Y
7	week	ULong	GPS week number	Y
8	seconds	GPSTime	Seconds from the beginning of the GPS week accurate to the millisecond level	Y
9	receiver status	ULong	An eight digit hexadecimal number representing the status of various hardware and firmware components of the receiver. This number is described in <i>Table 45 on Page 95</i> .	Y
10	Reserved	ULong	Reserved for internal use	Y
11		ULong		Y
12	;	Char	The ';' character indicates the end of the header	N

Example ASCII Format Log:

```
#PSRPOSA,COM1,0,43.0,FINESTEERING,265,320943.000,00840000,
0000,33331;SOL_COMPUTED,SINGLE,51.11638529847,-114.03825624352,
1045.2359,0.0000,WGS84,1.5908,1.4096,2.3924,"",0.000,0.000,10,8,
0,0,0,0,0,0*84ea7b68[CR][LF]
```

4.3.2 Binary

Binary messages are meant strictly as a machine readable format. They are also ideal for applications where the amount of data being transmitted is fairly high. Because of the inherent compactness of binary as opposed to *ASCII* data, the messages are much smaller. This allows a larger amount of data to be transmitted and received by the receiver's communication ports. The structure of all *Binary* format messages follows the general conventions as noted here:

1. Basic format:

Header	3 sync bytes plus 25 bytes of header information. The header length is variable as fields may be appended in the future. Always check the header length.
Parameters	Variable length binary data
CRC	4 bytes

2. The 3 Sync bytes are always:

Byte	Hex	Decimal
First	AA	170
Second	44	68
Third	12	18

- The CRC is a 32-bit cyclic redundancy check performed on all data including the header. See *Section 4.4.2.5 on Page 44* for the CRC algorithm.
- The header is in the format shown in *Table 7 on Page 40*.

Table 7: Binary Message Header Structure

Field	Field Name	Field Type	Description	Binary Bytes	Binary Offset	Ignored on Input
1	sync	Char	Hexadecimal 0xAA	1	0	N
2	sync	Char	Hexadecimal 0x44	1	1	N
3	sync	Char	Hexadecimal 0x12	1	2	N
4	header length	UChar	Length of the header	1	3	N
5	message ID	UShort	Message ID. The message IDs for logs are given in <i>Table 32 on Page 73</i> .	2	4	N
6	message type	Char	Message type indicator, as explained in <i>Section 4.2.1 on Page 37</i> .	1	6	N
7	port address	Char	The port from which the log was generated. See <i>Table 10 on Page 42</i> .	1	7	N
8	message length	UShort	The length in bytes of the body of the message. This does not include the header nor the CRC.	2	8	N
9	sequence	UShort	For multiple related logs. A number that counts down from N-1 to 0 where N is the number of related logs and 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0.	2	10	N
10	idle time	Char	The percentage of time that the processor is idle in the last second. Take the time (0-200) and divide by two to give the percentage of time (0-100%).	1	12	Y
11	time status	Enum	The quality of the GPS time, as described in <i>Section 4.4.2.4 on Page 43</i>	1 ^a	13	N ^b
12	week	UShort	GPS week number	2	14	N ^b
13	milli-seconds	GPSTime	Milliseconds from the beginning of the GPS week	4	16	N ^b
14	receiver status	ULong	32 bits representing the status of various hardware and firmware components of the receiver. This number is described in <i>Table 45 on Page 95</i> .	4	20	Y
15	Reserved	UShort	Reserved for internal use	2	24	Y
16		UShort		2	26	Y

a. This ENUM is not 4 bytes long but, as indicated in the table, is only 1 byte.

b. These time fields are ignored if Field #11, Time Status, is invalid. In this case the current receiver time is used. The recommended values for the three time fields are 0, 0, 0.

4.4 Fields

The commands and logs for the EuroPak-15ab use a variety of field types to convey data. The following sections provide information on the types of fields used and some of the more commonly-used fields.

4.4.1 Field Types

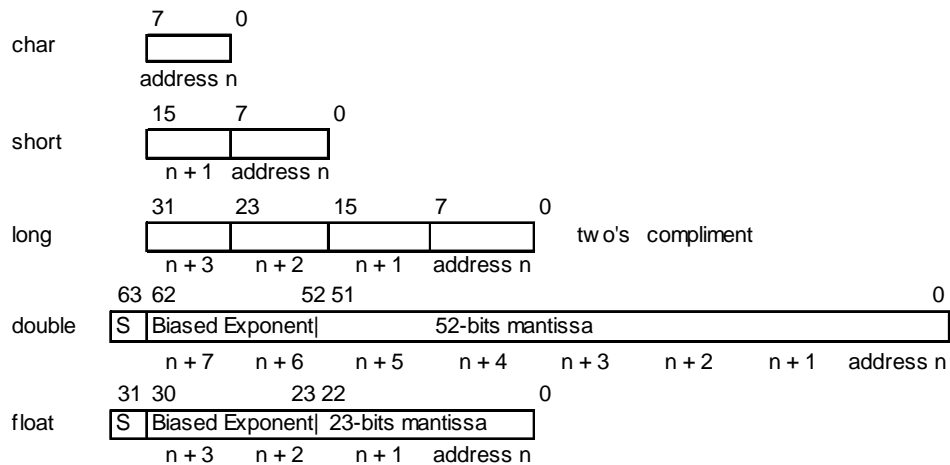
The following table describes the field types used in the commands and logs.

Table 8: Field Types

Type	Binary Size (Bytes)	Description
Char	1	An 8-bit signed integer in the range -128 to +127. This integer value may be the ASCII code corresponding to the specified character. In <i>ASCII</i> or <i>Abbreviated ASCII</i> this comes out as an actual character.
UChar	1	An 8-bit unsigned integer. Values are in the range from +0 to +255. In <i>ASCII</i> or <i>Abbreviated ASCII</i> this comes out as a number.
Short	2	A 16-bit signed integer in the range -32768 to +32767.
UShort	2	A 16-bit unsigned integer in the range +0 to +65535.
Long	4	A 32-bit signed integer in the range -2147483648 to +2147483647.
ULong	4	A 32-bit unsigned integer in the range +0 to +4294967295.
Double	8	64 bits, with 1 for the sign, 11 for the exponent, and 52 for the mantissa. Its range is $\pm 1.7E308$ with at least 15 digits of precision. This is IEEE 754.
Float	4	32 bits, with 1 for the sign, 8 for the exponent, and 23 for the mantissa. Its range is $\pm 3.4E38$ with at least 7 digits of precision. This is IEEE 754.
Enum	4	A 4-byte enumerated type beginning at zero (an unsigned long). In <i>Binary</i> , the enumerated value is output. In <i>ASCII</i> or <i>Abbreviated ASCII</i> , the enumeration label is spelled out.
GPSSec	4	Two separate formats that depend on whether the output is requested in <i>Binary</i> or an <i>ASCII</i> format. For <i>Binary</i> the output is in milliseconds and is a long type. For <i>ASCII</i> the output is in seconds and is a float type.
Hex	n	A packed, fixed length (n) array of bytes in <i>Binary</i> but in <i>ASCII</i> or <i>Abbreviated ASCII</i> is converted into 2 character hexadecimal pairs.
String	n	A variable length array of bytes that is null-terminated in the <i>Binary</i> case. The maximum byte length for the field is shown in the row in the log or command table.

Section 9 on Page 42 shows the arrangement of bytes within each field type when used by IBM PC computers. All data sent to or from the receiver, however, is read Least Significant Bit (LSB) first, opposite to what is shown in Table 9. Data is then stored in the receiver LSB first. For example, in *char* type data, the LSB is bit 0 and the Most Significant Bit (MSB) is bit 7.

Table 9: Byte Arrangements



4.4.2 Commonly-Used Fields

Some of the more commonly-used fields are discussed in this section.

4.4.2.1 Serial Port Identifiers

The values used to indicate serial ports are given below.

Table 10: Serial Port Identifier Values

ASCII	Binary
COM1	32
COM3	96

4.4.2.2 Message Type Indicator

The *Message Type Indicator* is a byte given in numerous binary format messages and all binary headers. It follows the format in *Table 11* below.

Table 11: Message Type Byte Format

Bit	Description
0-4	Reserved
5-6	Message format, where 00 = <i>Binary</i> 01 = <i>ASCII</i> 10 = <i>Abbreviated ASCII</i> , NMEA 11 = Reserved
7	Response indicator, where 0 = original message 1 = response message. (See <i>Section 4.2 on Page 37</i> for more information on logging data.)

4.4.2.3 Message Time Stamps

All NovAtel format messages generated by the receiver have a GPS time stamp in their header. GPS time is referenced to UTC with zero point defined as midnight on the night of January 6, 1980 at 0:00 hours. The time stamp consists of the number of weeks since that zero point, the EuroPak-15ab rolls over, (0 to 1023) and the number of seconds since the last week number change (0 to 603,799). GPS time differs from UTC time since leap seconds are occasionally inserted into UTC but GPS time is continuous. In addition a small error (less than 1 microsecond) can exist in synchronization between UTC and GPS time. The *TIME* log reports both GPS and UTC time and the offset between the two.

The data in synchronous logs, like the *RANGE* log, are based on a periodic measurement of satellite pseudoranges. The time stamp on these logs is the receiver estimate of GPS time at the time of the measurement. When setting time in external equipment, a small synchronous log with a high baud rate will be accurate to a fraction of a second. A synchronous log with trigger *ONTIME 1* can be used in conjunction with the 1 PPS signal to provide relative accuracy better than 250 ns.

Other log types (asynchronous and polled) are triggered by an external event and the time in the header may not be synchronized to the current GPS time. Logs that contain satellite broadcast data have the transmit time of their last subframe in the header. In the header of differential time matched logs, the time of the matched reference and local observation that they are based on is given. Logs triggered by a mark event have the estimated GPS time of the mark event in their header. The header of a polled log, like *VERSION*, gives the approximate GPS time when its data was generated.

4.4.2.4 GPS Time Status

All reported receiver times are subject to a qualifying time status. This status gives you an indication of how well a time is known, see *Table 12*:

Table 12: GPS Time Status

GPS Time Status (Decimal)	GPS Time Status (ASCII)	Description
20	UNKNOWN	Time validity is unknown.
60	APPROXIMATE	Time is set approximately.
100	COARSE	This time is valid to coarse precision.
130	FREEWHEELING	Position is lost, and the range bias cannot be calculated.
160	FINE	Time has fine precision.
200	SATTIME	Time from satellite. This is only used in logs containing satellite data such as ephemeris and almanac.

There are several distinct states that the receiver will go through:

- UNKNOWN
- COARSE
- FREEWHEELING
- FINE

On start up, and before any satellites are being tracked, the receiver can not possibly know the current time. As such, the receiver time starts counting at GPS week 0 and second 0.0. The time status flag is set to UNKNOWN.

After the first ephemeris is decoded, the receiver time is set to a resolution of ± 10 milliseconds. This state is qualified by the COARSE time status flag.

Once a position is known and range biases are being calculated, the internal clock model begins modelling the position range biases and the receiver clock offset.

Modelling continues until the model is a good estimation of the actual receiver clock behavior. At this time, the receiver time is adjusted again, this time to an accuracy of ± 1 microsecond. This state is qualified by the FINE time status flag.

The final logical time status flag never improves on FINE. The time is only adjusted again to within ± 1 microsecond if the range bias gets larger than ± 250 milliseconds.

If for some reason position is lost and the range bias cannot be calculated, the time status is degraded to FREEWHEELING.

4.4.2.5 32-Bit CRC

The *ASCII* and *Binary* message formats all contain a 32-bit Cyclic Redundancy Check (CRC) for data verification. This allows you to ensure that the data received (or transmitted) is valid with a high level of certainty. This CRC can be generated using the C algorithm shown on *Page 45*.

```

#define CRC32_POLYNOMIAL    0xEDB88320L

/* -----
Calculate a CRC value to be used by CRC calculation functions.
----- */
unsigned long CRC32Value(int i)
{
    int j;
    unsigned long ulCRC;

    ulCRC = i;
    for ( j = 8 ; j > 0; j-- )
    {
        if ( ulCRC & 1 )
            ulCRC = ( ulCRC >> 1 ) ^ CRC32_POLYNOMIAL;
        else
            ulCRC >>= 1;
    }
    return ulCRC;
}

/* -----
Calculates the CRC-32 of a block of data all at once
----- */
unsigned long CalculateBlockCRC32(
    unsigned long ulCount,      /* Number of bytes in the data block */
    unsigned char *ucBuffer ) /* Data block */
{
    unsigned long ulTemp1;
    unsigned long ulTemp2;
    unsigned long ulCRC = 0;

    while ( ulCount-- != 0 )
    {
        ulTemp1 = ( ulCRC >> 8 ) & 0x00FFFFFFL;
        ulTemp2 = CRC32Value( ((int) ulCRC ^ *ucBuffer++ ) & 0xff );
        ulCRC = ulTemp1 ^ ulTemp2;
    }
    return( ulCRC );
}

```

5.1 Functional Listing of Commands

Table 13 lists the commands by function. Please see Section 5.3 on Page 48 for a more detailed description of each individual command.

Table 13: Commands By Function

Command	Description
COMMUNICATIONS, CONTROL AND STATUS	
ANTENNAPOWER	Control power to low-noise amplifier (LNA) of an active antenna
COM	Set serial port configuration
LOG	Request a log
UNLOG	Remove a specified log from logging control
UNLOGALL	Remove all logs from logging control
GENERAL RECEIVER CONTROL	
AGCMODE	Control Automatic Gain Control (AGC) functionality
RESET	Perform a hardware reset
FRESET	Reset receiver to factory default
POSITION CONTROL	
FIX	Constrain receiver position
POSITIONTYPE	Control the position solution on GPS L1 or L5 signals
SATELLITE TRACKING AND CHANNEL CONTROL	
ASSIGN	Assign individual satellite channel
CHANCONFIG	Set receiver channel tracking configuration
ECUTOFF	Set satellite elevation cut-off angle
PULSEBLANKING	Enable/disable digital pulse blanking for L1 Galileo or E5a/E5b signals
SDLLBW	Configure channel's DLL filter bandwidth
SPLLBW	Configure channel's phase-lock-loop bandwidths
STHRESHOLD	Control signal channel thresholds for acquisition, tracking and cross correlation
CLOCK INFORMATION, STATUS, AND TIME	
EXTERNALCLOCK	Set the parameters for an external clock

5.2 Command Summary

Table 14: Command Summary

Command Name	Message ID	Description	Syntax
AGCMODE	229	Control Automatic Gain Control (AGC)	agcmode <i>frequency mode [pulsewidth loadvalue]</i>
ANTENNAPOWER	98	Control power to low-noise amplifier of an active antenna	antennapower <i>flag</i>
ASSIGN	27	Assign individual satellite channel to a PRN	assign <i>channel [state] [prn [Doppler window]]</i>
CHANCONFIG	501	Set receiver channel tracking configuration	chanconfig <i>config</i>
COM	4	Serial port configuration control	com <i>[port] bps [parity [databits [stopbits [handshake [echo [break]]]]]]</i>
ECUTOFF	50	Set satellite elevation cutoffs	ecutoff <i>angle</i>
EXTERNALCLOCK	230	Set external clock parameters	externalclock <i>clocktype [freq] [h0 [h1 [h2]]]</i>
FIX	44	Fix height, position or velocity	fix <i>type [lat lon height]</i>
FRESET	20	Clear data stored in non-volatile memory. Followed by a receiver reset.	freset
LOG	1	Request logs from receiver	log <i>[port] message [trigger] [period [offset] [hold]]</i>
POSITIONTYPE	836	Set position filter to GPS L1 or L5 frequency	positiontype <i>frequency</i>
PULSEBLANKING	519	Enables or disables digital pulse blanking for L1 or E5a/E5b signals.	pulseblanking <i>frequency switch</i>
RESET	18	Perform a hardware reset	reset <i>[delay]</i>
SDLLBW	800	Configure channel's DLL filter bandwidth	sdllbw <i>dsigchan bw</i>
SPLLBW	801	Configure channel's phase-lock-loop bw	spllbw <i>psigchan bw</i>
STHRESHOLD	803	Control signal channel thresholds for acquisition, tracking and cross correlation	sthreshold <i>sigchan acqui lock crosscorr</i>
UNLOG	36	Remove log from logging control	unlog <i>[port] datatype</i>
UNLOGALL	38	Remove all logs from logging control	unlogall <i>[port]</i>

5.3 Command Reference

All syntax strings and command examples given in this section are in the *Abbreviated ASCII* format, unless otherwise indicated. The tables provided show the fields necessary for all formats unless otherwise noted.

☒ As mentioned in *Section 4.1 on Page 34*, all command strings must be followed by <Enter>.

5.3.1 AGCMODE Control Automatic Gain Control

-
- ☒ 1. This command can fundamentally change the way that the receiver operates. Do not alter the default settings unless you are confident that you understand the consequences.
2. When the AGC mode is disabled, the *Receiver Status* word in the message header, discussed in *Table 45, Receiver Status on Page 95*, reports the AGC as *GOOD* as long as the control metric used in the feedback loop is within 7.5% of the set point.
-

This command controls the EuroPak-15ab's Automatic Gain Control (AGC) mechanism, which has two primary functions:

- To perform the analog-to-digital conversions in the receiver's front end.
- Mitigate jamming.

Table 15: Frequency Values for AGCMODE Command

ASCII	Description
L1	L1 GPS and Galileo channels ^a
L5	L5 GPS and E5a Galileo channels ^a
E5b	E5b Galileo channels

a. Changing GPS L1 affects Galileo L1 and changing GPS L5 affects Galileo E5a

Table 16: AGC Mode Values

ASCII	Description
AUTO	Specifies that the default pulse width and load values should be used.
MANUAL	Specifies that the values specified in the <i>pulsewidth</i> and <i>loadvalue</i> fields should be used.

Syntax:

Message ID: 229

AGCMODE [FREQUENCY MODE [PULSEWIDTH LOADVALUE]]

Field	Field Name	Valid Values		Description	Format	Binary Bytes	Binary Offset
		ASCII	Binary				
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .				H	0
2	frequency	See <i>Table 15</i> on <i>Page 48</i> .		Specifies which signal type to apply the command to.	Enum	4	H
3	mode	See <i>Table 16</i> on <i>Page 48</i> .		Specifies whether to use the default or custom values for the pulse width and load value.	Enum	4	H+4
4	pulsewidth	35 to 262144		Pulse width. A value is only required when the <i>mode</i> field is set to MANUAL.	Float	4	H+8
5	loadvalue	35 to 262144		Modulus load value. A value is only required when the <i>mode</i> field is set to MANUAL.	Float	4	H+12

Example:

AGCMODE L1 MANUAL 40 50

5.3.2 ANTENNAPOWER

This command enables or disables the supply of electrical power from the internal (see *Section 2.2.3 on Page 29* for information on supplying power to the antenna) power source of the receiver to the low-noise amplifier (LNA) of an active antenna.

There are several bits in the Receiver Status (see *Table 45, Receiver Status on Page 95*) that pertain to the antenna. These bits indicate whether the antenna is powered (internally or externally) and whether it is open circuited or short circuited.

On startup, the ANTENNAPOWER command is set to ON and the L1/E5a card powers the antenna. If the receiver identifies a short circuit (5 seconds over 0.125 A), antenna power is turned OFF, the receiver status word, see the RXSECSTATUS log on *Page 93*, shows the antenna power as off and shows the antenna as shorted. Antenna current and voltage details are output in the SYSTEMLEVELS log, see *Page 98*. If the EuroPak-15ab receives another ANTENNAPOWER ON command, the L1/E5a card tries to power the antenna again. If it finds the same shorted condition, the above consequences repeat. If there is not another shorted condition, the receiver continues to power the antenna and the receiver clears the status word bits. After a shorted condition, the receiver does not try to power the antenna unless you issue an ANTENNAPOWER command. If you issue an ANTENNAPOWER OFF command, after the shorted condition, the receiver clears the shorted bit.

Abbreviated ASCII Syntax:

Message ID: 98

ANTENNAPOWER FLAG

ANTENNAPOWER flag

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1 on Page 34</i> .				H	0
2	flag	OFF	0	Disables internal powering of antenna.	Enum	4	H
		ON	1	Enables internal powering of antenna.			

ASCII Example:

ANTENNAPOWER ON

5.3.3 **ASSIGN** Assign Individual Satellite Channels

☒ The *ASSIGN* command should only be used by advanced users.

This command may be used to aid in the initial acquisition of a satellite by allowing you to override the automatic satellite/channel assignment and reacquisition processes with manual instructions. The command specifies that the selected tracking channel should search for a specified satellite at a specified Doppler frequency within a specified Doppler window.

The instruction remains in effect for the specified SV channel and PRN, even if the assigned satellite subsequently sets. If the satellite Doppler offset of the assigned SV channel exceeds that specified by the *window* parameter of the *ASSIGN* command, the satellite may never be acquired or re-acquired. If a PRN has been assigned to a channel and the channel is currently tracking that satellite, when the channel is set to *AUTO* tracking, the channel will immediately idle and return to automatic mode.

To cancel the effects of *ASSIGN*, you must issue the following:

- The *ASSIGN* command with the *state* set to *AUTO*

This returns SV channel control to the automatic search engine immediately.

-
- ☒ 1. Assigning a PRN to an SV channel does not remove the PRN from the search space of the automatic searcher; only the SV channel is removed (i.e. the searcher may search and lock onto this PRN on another channel). The automatic searcher only searches for PRNs 1 to 32 for GPS channels and 1 to 32 for Galileo channels.
2. Assigning an SV channel will set the *Channel Assignment* bit to 1 for forced assignment in the *Channel Tracking Status* field of the *RANGE* log. The *RANGE* log is specified in *Section 6.3.5* on *Page 84*.
-

Syntax:**Message ID: 27**

```
ASSIGN CHANNEL [ STATE ] [ PRN [ DOPPLER WINDOW ] ]
```

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .			H	0
2	channel	0 to 31	SV channel number to apply the command to. 0 is the first SV channel and 31 is the last: 24GALILEO8GPS: 0-7 for GPSL1 8-15 for GALL1 16-23 for GALE5A 24-31 for GALE5B See also <i>Section 5.3.4, CHANCONFIG</i> starting on <i>Page 53</i> and <i>Table 55</i> on <i>Page 122</i> .	ULong	4	H
3	state	See <i>Table 17</i> below.	Optional desired SV channel state. If a value is not given, the default of <i>ACTIVE</i> is used.	Enum	4	H+4
4	prn	0 to 37 for GPS 120 to 138 for GEO 0 to 51 for GAL	Optional satellite PRN code. A value is required only when the <i>state</i> field is set to <i>ACTIVE</i> .	Long	4	H+8
5	doppler	-100 000 to 100 000	Optional current Doppler offset of the satellite specified in the <i>prn</i> field in Hz. NOTE:Satellite motion, receiver antenna motion, and receiver clock frequency error must be included in the calculation of Doppler frequency.	Long	4	H+12
6	window	0 to 10 000	Error or uncertainty in the Doppler estimate given in the <i>doppler</i> field, in Hz. NOTE:This is a \pm value. For example, enter 500 for \pm 500 Hz.	ULong	4	H+16

Examples:

```
ASSIGN 0 ACTIVE 37 0 2000
```

```
ASSIGN 15 120 -250 0
```

```
ASSIGN 11 28 -250 0
```

The first example sets the first SV channel to acquire satellite PRN 37 in a range from -2000 Hz to +2000 Hz until the satellite signal has been detected. SV channel 11 is set to acquire satellite PRN 28 at an offset of -250 Hz only in the third example.

Table 17: Channel State Values

ASCII	Description
IDLE	Set the SV channel to not track any satellites.
ACTIVE	Set the SV channel active.
AUTO	Tell the receiver to automatically assign PRN codes to channels.

5.3.4 CHANCONFIG

This command changes the channel configuration of the receiver. This will effect the number of channels tracking GPS signals, Galileo signals, and GEO signals. Entering this command will reset the receiver, causing the receiver to initiate a cold-start bootup and reset all data stored in NVM to factory default values (except for the channel configuration).

The default configuration of the EuroPak-15ab receiver is 24GALILEO8GPS.

Syntax:

Message ID: 501

```
CHANCONFIG CONFIG
```

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1 on Page 34</i> .			H	0
2	config	See <i>Table 18</i> below.	Specifies the channel configuration for the receiver to use.	Enum	4	H

Example:

```
CHANCONFIG 16GPSL1L5
```

Table 18: Configuration Values

ASCII	Description
16GPSL1L5	8 GPS L1 + 8 GPS L5 channels
10GALILEO6GPS	5 Galileo L1 + 5 Galileo E5a + 6 GPS L1 channels
16GALILEOL1E5a	8 Galileo L1 + 8 Galileo E5a channels
8GPS8GEO	8 GPS L1 + 4 GEO L1 + 4 GEO L5 channels
12GPS4GEOL1L5	6 GPS L1 + 6 GPS L5 + 2 GEO L1 + 2 GEO L5 channels
24GALILEO8GPS ^a	8 GPS L1 + 8 GAL L1 + 8 GAL E5A + 8 GAL E5B channels

a. There are channels in the 24GALILEO8GPS configuration that can track the GIOVE-A test satellite, see *Table 59 on Page 125*.

Table 19: Parity Values

ASCII	Description
N	No parity
E	Even parity
O	Odd parity

Table 20: Handshaking Values

ASCII	Description
N	No handshaking
XON	XON/XOFF software handshaking
CTS	CTS/RTS hardware handshaking

Table 21: Echo Values

ASCII	Description
OFF	No echo
ON	Transmit any input characters as they are received.

Table 22: Break Values

ASCII	Description
OFF	Disable break detection
ON	Enable break detection

5.3.6 ECUTOFF Set Satellite Elevation Cut-off

This command sets the elevation cut-off angle for tracked satellites. The receiver will not track a satellite until it rises above the cut-off angle. Tracked satellites that fall below the cut-off angle will no longer be tracked unless they were manually assigned using the *ASSIGN* command.

In either case, satellites below the *ECUTOFF* angle will be eliminated from the internal position and clock offset solution computations.

If the receiver has not yet received an almanac, satellites below the cut-off angle may be tracked.

This command permits a negative cut-off angle, which could be used in these situations:

- the antenna is at a high altitude, and thus can look below the local horizon
- satellites are visible below the horizon due to atmospheric refraction

-
- ☒ 1. This command only affects GPS satellites. GEO and Galileo satellites maintain their lock.
2. Care must be taken when using *ECUTOFF* because the signals from lower elevation satellites are travelling through more atmosphere and are therefore degraded.
-

Syntax:

Message ID: 50

ECUTOFF

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1 on Page 34</i> .			H	0
2	angle	-90.0 to +90.0	Elevation cut-off angle relative to horizon in degrees.	Float	4	H

Example:

ECUTOFF 10.0

5.3.7 EXTERNALCLOCK

Overview

The EXTERNALCLOCK command allows the EuroPak-15ab to operate with an optional external oscillator. You are able to optimally adjust the clock model parameters of the receiver for various types of external clocks.

-
- ☒ 1. The EXTERNALCLOCK command is permanently enabled for the EuroPak-15ab and cannot be disabled.
 - 2. This command will affect the interpretation of the CLOCKMODEL log, see *Page 79*.
-

There are two steps involved in using an external oscillator:

1. Follow the procedure outlined in *Chapter 2, Installation* starting on *Page 26* of this manual to connect an external oscillator to your EuroPak-15ab enclosure.
2. Using the EXTERNALCLOCK command, select a standard oscillator and its operating frequency.

Theory

An unsteered oscillator can be approximated by a three-state clock model, with two states representing the range bias and range bias rate, and a third state assumed to be a Gauss-Markov (GM) process representing the range bias error generated from satellite clock dither. The third state is included because the Kalman filter assumes an (unmodeled) white input error. The significant correlated errors produced by satellite clock dither are obviously not white and the Markov process is an attempt to handle this kind of short-term variation.

The internal units of the new clock model’s three states (offset, drift and GM state) are meters, meters per second, and meters. When scaled to time units for the output log, these become seconds, seconds per second, and seconds, respectively. Note that the old units of the third clock state (drift rate) were meters per second per second.

The user has control over 3 process noise elements of the linear portion of the clock model. Namely, the h_0 , h_1 , and h_2 elements of the power law spectral density model used to describe the frequency noise characteristics of oscillators:

$$S_y(f) = \frac{h_{-2}}{f^2} + \frac{h_{-1}}{f} + h_0 + h_1f + h_2f^2$$

where f is the sampling frequency and $S_y(f)$ is the clock’s power spectrum. Typically only h_0 , h_{-1} , and h_{-2} affect the clock’s Allan variance and the clock model’s process noise elements.

Usage

Before using an optional external oscillator, several clock model parameters must be set. There are default settings for a voltage-controlled temperature-compensated crystal oscillator (VCTCXO), ovenized crystal oscillator (OCXO), Rubidium and Cesium standard, which are given in *Table 24* on *Page 58*. Or, the user may choose to supply customized settings.

Abbreviated ASCII Syntax:

Message ID: 230

EXTERNALCLOCK CLOCKTYPE [FREQ] [h0] [h1] [h2]

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1 on Page 34</i> .				H	0
2	clocktype	See <i>Table 23 on Page 58</i>		Clock type	Enum	4	H
3	freq	10MHz	2	Frequency. The default is 10 MHz.	Enum	4	H+4
4	h0	1.0 e-31 to 1.0 e-18		Optional timing standards. These fields are only valid when the USER clocktype is selected.	Double	8	H+8
5	h1	1.0 e-31 to 1.0 e-18			Double	8	H+16
6	h2	1.0 e-31 to 1.0 e-18			Double	8	H+24

ASCII Example:

```
EXTERNALCLOCK USER 10MHZ 1.0167E-23 6.87621E-25 8.1762E-26
```

or

```
EXTERNALCLOCK TCXO 5MHZ
```

Table 23: Clock Type

ASCII	Binary	Description
TCXO	1	Sets the pre-defined values for a VCTCXO
OCXO	2	Sets the pre-defined values for an OCXO
RUBIDIUM	3	Sets the pre-defined values for a rubidium oscillator
CESIUM	4	Sets the pre-defined values for a cesium oscillator
USER	5	Defines custom process noise elements

Table 24: Pre-Defined Values for Oscillators

Clock Type	h ₀	h ₁	h ₂
VCTCXO	1.0 e-21	1.0 e-20	1.0 e-20
OCXO	2.51 e-26	2.51 e-23	2.51 e-22
Rubidium	1.0 e-23	1.0 e-22	1.3 e-26
Cesium	2.0 e-20	7.0 e-23	4.0 e-29

5.3.8 FIX Constrain to Fixed Position

This command fixes position parameters for the EuroPak-15ab. For various applications, fixing this value can assist in improving acquisition times and accuracy of position or corrections.

Syntax:

Message ID: 44

```
FIX TYPE [ LAT LONG HEIGHT ]
```

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .			H	0
2	type	See <i>Table 25</i> below.	Fix type	Enum	4	H
3	lat	-90 to +90	Latitude parameter for a fixed position in degrees. Only entered when the fix type is set to <i>POSITION</i> .	Double	8	H+4
4	long	-360 to +360	Longitude parameter for a fixed position in degrees. Only entered when the fix type is set to <i>POSITION</i> .	Double	8	H+12
5	height	-1000 to +20000000	Ellipsoidal height parameter for a fixed position in metres. Only entered when the fix type is set to <i>POSITION</i> .	Double	8	H+20

Example:

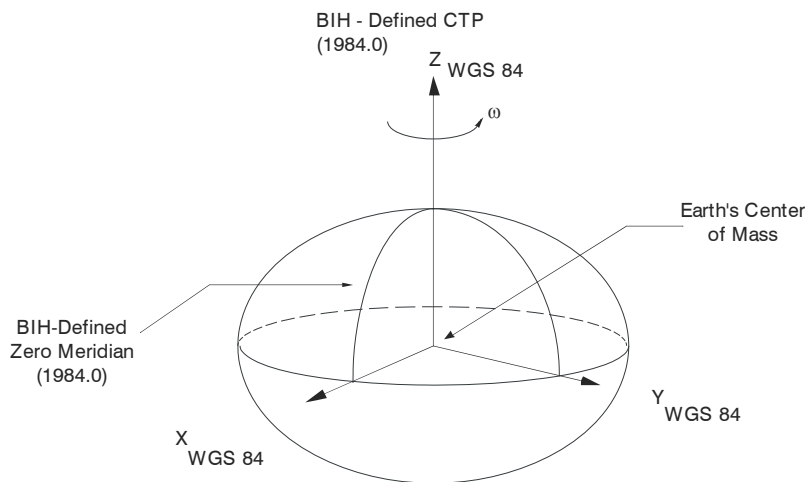
```
FIX POSITION 51.116381983333 -114.03829231944 1048.215
```

Table 25: Fix Type Values

ASCII	Description
NONE	Unfix or none. Clears any previous FIX commands.
POSITION	Configures the receiver with its position fixed. The receiver performs all computations based on WGS84, which is illustrated in <i>Figure 4</i> on <i>Page 60</i> .

- Definitions - *

- Origin = Earth's center of mass
- Z-Axis = Parallel to the direction of the Conventional Terrestrial Pole (CTP) for polar motion, as defined by the Bureau International de l'Heure (BIH) on the basis of the coordinates adopted for the BIH stations.
- X-Axis = Intersection of the WGS 84 Reference Meridian Plane and the plane of the CTP's Equator, the Reference Meridian being parallel to the Zero Meridian defined by the BIH on the basis of the coordinates adopted for the BIH stations.
- Y-Axis = Completes a right-handed, earth-centered, earth-fixed (ECEF) orthogonal coordinate system, measured in the plane of the CTP Equator, 90° East of the X-Axis.



* Analogous to the BIH Defined Conventional Terrestrial System (CTS), or BTS, 1984.0.

Figure 4: The WGS84 ECEF Coordinate System

5.3.9 FRESET Clear Data in NVM

This command clears data which is stored in the receiver’s non-volatile memory and restores the receiver to factory default settings. The receiver is forced to hardware reset.

Syntax:

Message ID: 20

FRESET

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .			H	0
2	Reserved field required for <i>Binary</i> format only. Set to 0 when entering the command in <i>Binary</i> .			Enum	4	H

Example:

FRESET

5.3.10 LOG Request Logs from Receiver

Many different types of data can be logged using several different methods of triggering the log events. See *Chapter 6, Data Logs* starting on *Page 72* for further information and a complete list of data log structures.

The *hold* parameter, which is only valid when the *ONTIME* trigger is being used, will prevent a log from being removed when the *UNLOGALL* command is issued. To remove a log which was invoked using the *hold* parameter requires the specific use of the *UNLOG* command.

The *period* and *offset* parameters are only valid when the *ONTIME* trigger is being used as well. For example, to log data at 1 second after every minute you would set the *period* to 60 and the *offset* to 1.

-
- ☒ Maximum flexibility for logging data is provided to you by these logs. You are cautioned, however, to recognize that each log requested requires additional CPU time and memory buffer space. Too many logs may result in lost data and degraded CPU performance. Receiver overload can be monitored using the *Buffer Over-run* bits of the *Receiver Status* word in any log header.
-

Syntax:

Message ID: 1

```
LOG [ [ PORT ] ] [ MESSAGE ] [ [ TRIGGER ] ] [ [ PERIOD ] [ [ OFFSET ] ] [ [ HOLD ] ] ]
```

Field	Field Name	Valid Values		Description	Format	Binary Bytes	Binary Offset
		ASCII	Binary				
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .				H	0
2	port	See <i>Table 10</i> on <i>Page 42</i> .		Serial port at which to output the log data.	Enum	4	H
3	message	Any valid message name, with a suffix to specify the output format as explained in <i>Section 4.2.3</i> on <i>Page 38</i> .	Any valid message ID	Log to output	UShort	2	H+4
4	message type	This field is only present in <i>Binary</i> format. See <i>Section 10</i> on <i>Page 42</i> .		Message type of log.	Char	1	H+6
5	Reserved field required for <i>Binary</i> format only. Set to 0 when entering the command in <i>Binary</i> .				Char	1	H+7
6	trigger	See <i>Table 26</i> on <i>Page 63</i> .		Trigger, or condition, to generate log on.	Enum	4	H+8
7	period	Any positive double value.		Log period for <i>ONTIME</i> trigger in seconds	Double	8	H+12
8	offset	Any positive double value smaller than the value specified in the <i>period</i> field.		Offset for <i>ONTIME</i> trigger in seconds.	Double	8	H+20
9	hold	See <i>Table 27</i> on <i>Page 63</i> .		Flag for whether or not the log is removed by the <i>UNLOGALL</i> command. Valid for <i>ONTIME</i> trigger only.	Enum	4	H+28

Examples:

```
LOG COM1 PSRPOSA ONTIME 7 2.5 HOLD
```

```
LOG COM3 PRSPOSA ONCE
```

The first example configures the EuroPak-15ab to output the *PSRPOS* log in *ASCII* format to COM1 at 7 second intervals offset by 2.5 seconds (output at 2.5 seconds then 9.5 seconds and so on). The second example outputs the log only once on COM3.

Table 26: Log Trigger Values

ASCII	Binary	Description
ONNEW	0	Output when the message is updated (not necessarily changed).
ONCHANGED	1	Output when the message is changed.
ONTIME	2	Output on a time interval.
ONNEXT	3	Output only the next message.
ONCE	4	Output only the current message.

Table 27: Log Hold Values

ASCII	Binary	Description
NOHOLD	0	Allow log to be removed by the <i>UNLOGALL</i> command.
HOLD	1	Prevent log from being removed by the <i>UNLOGALL</i> command.

5.3.11 POSITIONTYPE Set the Position Solution

This command sets the position filter to compute the position on either the GPS L1 or GPS L5 frequencies. You can also obtain data from a specific frequency. Both position and navigation data are available on GPS L1 or GPS L5. The ephemeris and almanac are decoded on the selected frequency.

When using simulated signals, if the L1 and L5 constellations are different, the receiver may drop signals that are not in view based on the almanac. For example, if the receiver is tracking PRN 15 on L5, the position type is set to GPSL1 and the L1 almanac indicates that PRN 15 is not in view, then the receiver stops tracking PRN 15.

To prevent this:

- Use the ASSIGN command, see *Page 50*, to force lock on the satellites
- Change the position type frequency with the POSITIONTYPE command, or
- Ensure the constellations in the simulations agree with what you expect to track

☒ This command only affects GPS satellites. Galileo satellites maintain their lock.

Syntax:

Message ID: 836

POSITIONTYPE FREQUENCY

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1 on Page 34</i> .			H	0
2	frequency	GPSL1 or GPSL5	Position frequency, see <i>Table 28</i>	Enum	4	H

Example:

POSITIONTYPE GPSL1

Table 28: Position Frequency Switch

ASCII	Description
GPSL1	GPS L1 frequency
GPSL5	GPS L5 frequency

5.3.12 PULSEBLANKING Enable/Disable Pulse Blanking

☒ The PULSEBLANKING command should only be used by advanced users.

This command enables or disables digital pulse blanking. By default, the digital pulse blanking is disabled. The sensitivity of the digital pulse blanking may be adjusted using the switch field.

Syntax:

Message ID: 519

PULSEBLANKING FREQUENCY SWITCH

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1 on Page 34</i> .			H	0
2	frequency	L1, L5 or E5b	Pulse blanking frequency. See <i>Table 29</i> below.	Enum	4	H
3	switch	0-127	Pulse blanking switch using thresholds. See <i>Table 30</i> below.	Ulong	4	H+4

Examples:

PULSEBLANKING L1 5

Table 29: Frequency Switch

ASCII	Description
L1	GPS L1 and Galileo L1 frequency
L5	GPS L5 and Galileo E5a frequency
E5B	Galileo E5b frequency

Table 30: Pulse Blanking Switch

ASCII	Description
0	Disable pulse blanking
1-127	Enable pulse blanking

5.3.13 *RESET* Hardware Reset

This command performs a hardware reset. Following a *RESET* command, the receiver will initiate a cold-start bootup and will retain the most recent receiver configuration (that is, channel configuration).

The optional delay field is used to set the number of seconds the receiver is to wait before resetting.

Syntax:

Message ID: 18

```
RESET [ DELAY ]
```

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .			H	0
2	delay	Any ulong value.	Seconds to wait before resetting. If no value is provided, the default of 0 seconds is assumed.	ULong	4	H

Example:

```
RESET 5
```

See also the *FRESET* command.

5.3.14 SDLLBW Configure DLL Filter Bandwidth

This is the noise equivalent bandwidth command for the signal channel DLL filter bandwidth.

- ☒ 1. The SDLLBW command should only be used by advanced users. It may not be suitable for every application. When using SDLLBW in a differential mode, the same setting should be used at both the monitor and remote station.
- 2. When you issue the SDLLBW command, all channels lose lock and the locktime for all tracking satellites is reset to zero.
- 3. The measurement becomes noisier as the DLL bandwidth increases.

Syntax:

Message ID: 800

```
SDLLBW DSIGCHAN BW
```

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1 on Page 34</i> .			H	0
2	dsigchan	0-31	The parameters should be applied to this signal channel.	Ulong	4	H
3	bw	0.001-0.5	Noise equivalent bandwidth of DLL filter in Hz.	Float	4	H+4

Example:

```
SDLLBW 0 0.01
```

5.3.15 SPLLBW Configure Phase-Lock-Loop Bandwidth

-
- ☒ 1. This command can fundamentally change the way that the receiver operates. Do not alter the default settings unless you are confident that you understand the consequences.
 - 2. When you change this command, the selected channel loses lock and the locktime for its tracking satellite is reset to zero.
 - 3. The PLL is 3rd order.
-

This command sets the PLL low-pass filter bandwidth for one signal channel.

A time filtered square of the signal carrier phase tracking loop error signal is used to track the performance of this tracking loop. This value is used as the variance of signal carrier phase measurements. The threshold specified by this command is compared with the loop variance to determine when the signal tracking lock time is reset. The resetting of the signal lock time is used to indicate that conditions exist in which a cycle slip might occur.

The time filtering that is performed on the loop variance determination is controlled using the third argument of this command. This value is used to compute the first order time constant that provides a noise equivalent bandwidth for the specified bandwidth. The filtering equation used is:

$$\text{new value} = e^{-\Delta T \omega} \times (\text{old data}) + (1 - e^{-\Delta T \omega}) \times (\text{new data})$$

where

ΔT = the PLL sampling rate, and

ω = $4 \times$ filter constant

Syntax:

Message ID: 801

SPLLBW

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .			H	0
2	psigchan	0-31	The parameters should be applied to this signal channel.	Ulong	4	H
3	bw	0.5-15	PLL low-pass filter bandwidth in Hz.	Float	4	H+4

Example:

SPLLBW 0 1.0

5.3.16 STHRESHOLD Control Signal Thresholds

This command controls signal acquisition and steady-state-lock signal thresholds. The *sigchan*, *acqui*, *lock* and *crosscorr* fields must have values. They set the thresholds for the specified signal channel.

See also *Table 55* on *Page 122* for the mapping of signal channels.

- When you change this command, the selected channel loses lock and the locktime for its tracking satellite is reset to zero.

Syntax:

Message ID: 803

```
STHRESHOLD [SIGCHAN] [ACQUI] [LOCK] [CROSSCORR]
```

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .		H		0
2	sigchan	0-31	The parameters should be applied to this signal channel.	Ulong	4	H+20
3	acqui	25-80	Acquisition power threshold in dBHz.	Ulong	4	H
4	lock	10-80	Steady-state tracking lock threshold in dBHz.	Ulong	4	H+4
5	crosscorr ^a	10-80	Specifies the cross-correlation power threshold in dBHz, at which point, the checks are performed.	Ulong	4	H+8

- a. The receiver does not have cross-correlation functionality at this point even though the command requires a value.

Example:

```
STHRESHOLD 0 35 20 35
```

5.3.17 UNLOG Remove Log from Logging Control

This command permits you to remove a specific log request from the system.

Syntax:

Message ID: 36

```
UNLOG [ PORT ] DATATYPE
```

Field	Field Name	Valid Values		Description	Format	Binary Bytes	Binary Offset
		ASCII	Binary				
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.1</i> on <i>Page 34</i> .				H	0
2	port	See <i>Section 10</i> on <i>Page 42</i> .		Serial port at which log is being output. If a value is not provided, <i>COM1</i> is assumed.	Enum	4	H
3	datatype	Message name	Message ID	Log to be disabled.	ULong	4	H+4

Example:

```
UNLOG COM3 PSRPOSA
```

5.3.18 UNLOGALL Remove All Logs from Logging Control

This command disables all logs on the specified port only. All other ports are unaffected.

- ☒ This command does not disable logs that have the *HOLD* attribute set. (See the *LOG* command in Section 5.3.10 on Page 62 for more information on this attribute). To disable logs with the *HOLD* attribute, use the *UNLOG* command.

Syntax:

Message ID: 38

```
UNLOGALL [ PORT ]
```

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See Section 4.1 on Page 34.			H	0
2	port	See Table 10 on Page 42.	Serial port at which logging is to disabled. If a value is not provided, <i>COM1</i> is assumed.	Enum	4	H
3	Reserved (always 0).			Enum	4	H+4

Example:

```
UNLOGALL
```

6.1 Functional Listing of Logs

Table 31 lists the logs by function and provides the type of each log. The valid types are discussed in Section 4.2.1 on Page 37.

Table 31: Logs By Function

Log	Description	Type
GENERAL RECEIVER CONTROL AND STATUS		
AGCSTATS	Automatic gain control status	Synch
RXCOMMANDS	Receiver configuration information	Polled
RXSECSTATUS	Receiver section status	Synch
SYSTEMLEVELS	System hardware levels	Synch
VERSION	Receiver hardware and software version numbers	Polled
POSITION, PARAMETERS, AND SOLUTION FILTERING CONTROL		
PSRPOS	Position data	Synch
CLOCK INFORMATION, STATUS, AND TIME		
CLOCKMODEL	Range bias information	Synch
TIME	Receiver time information	Synch
POST PROCESSING DATA		
RANGE	Satellite range information	Synch
SATELLITE TRACKING AND CHANNEL CONTROL		
ALMANAC	Current decoded almanac data	Asynch
RANGE	Satellite range information	Synch
RAWEPHEM	Raw ephemeris	Asynch
RAWFRAME	Raw subframes	Asynch
SATVIS	Satellite azimuth and elevation angle data	Synch
TRACKSTAT	Channel tracking information	Synch

6.2 Log Summary

The available logs are listed alphabetically in *Table 32*.

Table 32: Log Summary

Log Name	Message ID	Description
AGCSTATS	630	Automatic gain control status
ALMANAC	73	Current decoded almanac data
CLOCKMODEL	16	Current clock model matrices
PSRPOS	47	Position data
RANGE	43	Satellite range information
RAWEPHEM	41	Raw ephemeris
RAWFRAME	804	Raw subframes
RXCOMMANDS	579	Receiver configuration information
RXSECSTATUS	638	Receiver section status
SATVIS	48	Satellite azimuth and elevation angle data
SYSTEMLEVELS	653	System hardware levels
TIME	101	Receiver time information
TRACKSTAT	83	Channel tracking information
VERSION	37	Receiver hardware and software version numbers

6.3 Log Reference

For each log, the recommended input command for generating the log is provided. The recommended command is shown in *ASCII* format, unless otherwise specified. An example of the log output, in *ASCII* format, is provided for each recommended input.

-
- ☒ All logs are followed by a carriage return and line feed. However, in some of the examples, carriage returns have been inserted in the middle of the log to clearly indicate different data sets.
-

6.3.1 AGCSTATS Automatic Gain Control Status

This log provides status information for the automatic gain control mechanism and details of the parameters it is currently using.

Log Type: Synch

Message ID: 630

Field	Field Name	Data Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3 on Page 38</i> .		H	0
2	# RF decks	Number of RF decks reported in this message.	Ulong	4	H
3	AGCword	AGC status word (see <i>Table 33 on Page 75</i>)	Ulong	4	H+4
4	gain	AGC gain (0 to 99999)	Ulong	4	H+8
5	pulse width	VARF pulse width	Ulong	4	H+12
6	modulus	VARF modulus	Ulong	4	H+16
7	bin1	A/D bin 1 (decimal percentage)	Double	8	H+20
8	bin2	A/D bin 2 (decimal percentage)	Double	8	H+28
9	bin3	A/D bin 3 (decimal percentage)	Double	8	H+36
10	bin4	A/D bin 4 (decimal percentage)	Double	8	H+44
11	bin5	A/D bin 5 (decimal percentage)	Double	8	H+52
12	bin6	A/D bin 6 (decimal percentage)	Double	8	H+60
13	noise floor	Calculated noise floor	Double	8	H+68
14	Reserved		Double	8	H+76
15			Double	8	H+84
16...	Next RF deck, offset = H+ 4 + (#RF *88) Bytes				
	32-bit CRC (ASCII and Binary only)		Hex	4	H+ 4 (#RF*88)

Table 33: AGC Status Word

Bit	Description	Bit = 0	Bit = 1
0	Reserved		
1	AGC Calibrated	Coarse Calibration = 0 Fine Calibration = 1	
2			
3	RF Type	1 = L1 2 = L2 3 = L5/E5a 4 = E5b	
4			
5			
6	ADC Range indicates which 3 bits of the 8-bit ADC output are currently being used by the receiver.	0 = Bits 7, 6, 5 1 = Bits 7, 5, 4 2 = Bits 7, 4, 3 3 = Bits 7, 3, 2 4 = Bits 7, 2, 1 5 = Bits 7, 1, 0	
7			
8			
9	Method of Noise Floor Calculation	1 = AGC 2 = Post Correlation 3 = ...	
10			
11			
12	Receiver Card	0 = L1E5a 1 = E5aE5b	
13			
14	Reserved		
15	Reserved		
16	Reserved		
17	Reserved		
18	Reserved		
19	Reserved		
20	Reserved		
21	Reserved		
22	Reserved		
23	Reserved		
24	Reserved		
25	Reserved		
26	Reserved		
27	Reserved		
28	Reserved		
29	Reserved		
30	Reserved		
31	Reserved		

Recommended Input:

```
LOG AGCSTATSA ONTIME 10
```

Example Output:

```
#AGCSTATSA,COM1,0,82.5,FINE,439,232443.949,00A41000,0000,33331;  
3,  
28A,8758,4158,8000,0.0269,0.0839,0.2039,0.2856,0.2419,0.1578,  
1212377.500000,0.000000,0.000000,  
125A,4612,2312,8000,0.0660,0.1435,0.2310,0.2505,0.1867,0.1223,  
1216996.500000,0.000000,0.000000,  
1262,5976,3676,8000,0.0776,0.1589,0.2528,0.2585,0.1665,0.0857,  
1294032.875000,0.000000,0.000000*9D9A651B
```

6.3.2 ALMANAC Decoded Almanac

This log contains the decoded almanac parameters for the frequency specified in the POSITIONTYPE command, see *Page 64*. Multiple messages are transmitted, one for each SV almanac collected. For more information on Almanac data, refer to the GPS SPS Signal Specification. A list of standards and references with contact information can be found in the *GPS+ Reference Manual* available on our website at <http://www.novatel.com/support/docupdates.htm>.

Log Type: Asynch

Message ID: 73

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	#msg	The number of satellite PRN almanac data sets to follow.	Long	4	H
3	PRN	Satellite PRN number for current message, dimensionless	ULong	4	H+4
4	week	Almanac reference week (GPS week number)	ULong	4	H+8
5	seconds	Almanac reference time, seconds into the week	Double	8	H+12
6	ecc	Eccentricity, dimensionless	Double	8	H+20
7	$\dot{\omega}$	Rate of right ascension, radians/second	Double	8	H+28
8	ω_0	Right ascension, radians	Double	8	H+36
9	ω	Argument of perigee, radians	Double	8	H+44
10	M_0	Mean anomaly of reference time, radians	Double	8	H+52
11	a_{f0}	Clock aging parameter, seconds	Double	8	H+60
12	a_{f1}	Clock aging parameter, seconds/second	Double	8	H+68
13	N	Corrected mean motion, radians/second	Double	8	H+76
14	A	Semi-major axis, meters	Double	8	H+84
15	incl-angle	Angle of inclination relative to 0.3π , radians	Double	8	H+92
16	SV config	Satellite configuration	ULong	4	H+100
17	health-prn	SV health from subframe 4 or 5	ULong	4	H+104
18	health-alm	SV health from almanac	ULong	4	H+108
19	antispoof	Anti-spoofing flag, see <i>Table 34</i> on <i>Page 78</i>	Enum	4	H+112
20...	Next almanac data set, offset = H + 4 + (# previous msg x 112)				
21	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H + 4 + (112 x #msg)

Table 34: Antispoofing Flag Values

ASCII	Description
FALSE	Antispoofing is disabled.
TRUE	Antispoofing is enabled.

Recommended Input:

LOG ALMANACA ONCHANGED

ASCII Example:

```
#ALMANACA,COM1,0,78.0,SATTIME,338,320004.000,00A00000,0000,33331;
29,
1,338,503808.0,6.318092E-03,-7.60031658E-09,-1.96827599E+00,
-1.70715209E+00,-1.27284116E+00,3.71932983E-05,3.63797881E-12,
1.45856914E-04,2.65599916E+07,4.42098057E-02,1,0,0,TRUE,
2,338,503808.0,9.141445E-03,-8.26320134E-09,2.18251798E+00,
1.97852363E+00,1.88691247E-01,-1.81198120E-05,0.00000000E+000,
1.45860977E-04,2.65594983E+07,8.63463404E-03,1,0,0,FALSE,
3,338,503808.0,7.876873E-03,-8.11462372E-09,1.04690369E+00,
6.62592815E-01,-6.81532759E-01,7.53402710E-05,3.63797881E-12,
1.45858780E-04,2.65597651E+07,-1.61187825E-02,1,0,0,TRUE,
4,338,503808.0,7.454395E-03,-8.27463039E-09,2.20228558E+00,
1.45160422E-01,2.49410670E+00,1.52587891E-04,1.09139364E-11,
1.45848996E-04,2.65609528E+07,8.20919406E-03,1,0,0,FALSE,
...
27,338,503808.0,1.979542E-02,-8.16033991E-09,-1.01833966E+00,
-1.95538209E+00,2.34013039E+00,3.62396240E-05,0.00000000E+000,
1.45857411E-04,2.65599312E+07,1.44709516E-02,1,0,0,FALSE,
28,338,503808.0,1.103687E-02,-7.84032658E-09,1.06756599E-01,
-2.28547146E+00,1.17978552E+00,3.33786011E-05,0.00000000E+000,
1.45859194E-04,2.65597148E+07,1.80602269E-02,1,0,0,TRUE,
29,338,503808.0,9.426594E-03,-7.60031658E-09,-2.01631026E+00,
-9.70531593E-01,7.15315540E-01,5.36918640E-04,1.09139364E-11,
1.45855712E-04,2.65601375E+07,4.33289651E-02,1,0,0,TRUE,
30,338,503808.0,8.715153E-03,-8.02319134E-09,5.43083877E-02,
1.29254172E+00,1.52598431E+00,2.57492065E-05,3.63797881E-12,
1.45865786E-04,2.65589145E+07,2.19311316E-03,1,0,0,FALSE
*2E0D3E7A
```

6.3.3 CLOCKMODEL Current Clock Model Status

The *CLOCKMODEL* log contains the current clock-model status of the receiver.

Monitoring the *CLOCKMODEL* log will allow you to determine the error in your receiver reference oscillator as compared to the GPS satellite reference.

All logs report GPS time not corrected for local receiver clock error. To derive the closest GPS time, subtract the clock offset from the GPS time reported. The clock offset can be calculated by dividing the value of the range bias given in field 6 of the *CLOCKMODEL* log by the speed of light (c).

The following symbols are used throughout this section:

- B = Range bias (m)
- BR = Range bias rate (m/s)
- SAB = Gauss-Markov process representing range bias error due to SA clock dither (m)

The standard clock model now used is as follows:

clock parameters array = [B BR SAB]

covariance matrix =

$$\begin{bmatrix} \sigma_B^2 & \sigma_B \sigma_{BR} & \sigma_B \sigma_{SAB} \\ \sigma_{BR} \sigma_B & \sigma_{BR}^2 & \sigma_{BR} \sigma_{SAB} \\ \sigma_{SAB} \sigma_B & \sigma_{SAB} \sigma_{BR} & \sigma_{SAB}^2 \end{bmatrix}$$

Log Type: Synch

Message ID: 16

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	clock status	Clock model status as computed from current measurement data. See <i>Table 35</i> on <i>Page 81</i> .	Enum	4	H
3	reject	Number of rejected range bias measurements	ULong	4	H+4
4	noise time	GPS time of last noise addition	GPSTime	4	H+8
5	update time	GPS time of last update	GPSTime	4	H+12
6	parameters	Clock correction parameters (a 1x3 array of length 3), listed left-to-right	Double	8	H+16
7				8	H+24
8				8	H+32
9	cov data	Covariance of the straight line fit (a 3x3 array of length 9), listed left-to-right by rows	Double	8	H+40
10				8	H+48
11				8	H+56
12				8	H+64
13				8	H+72
14				8	H+80
15				8	H+88
16				8	H+96
17				8	H+104
18	range bias	Last instantaneous measurement of the range bias (meters)	Double	8	H+112
19	range bias rate	Last instantaneous measurement of the range bias rate (m/s)	Double	8	H+120
20	change	Indicates whether or not there is a change in the constellation. See <i>Table 36</i> on <i>Page 81</i> .	Enum	4	H+128
21	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+132

Recommended Input:

LOG CLOCKMODELA ONTIME 1

Example Output:

```
#CLOCKMODELA,COM1,0,55.0,FINE,1048,497224.500,
00000128,879E,0;VALID,0,497224.500,497224.500,6.59596736E-01,-
9.29232987E-02,-3.40165918E+00,4.63006778E+02,1.19966616E+00,-
4.50054493E+02,1.19966616E+00,2.15673338E-01,-7.90256149E-01,-
4.50054493E+02,-7.90256149E-01,4.76057122E+02,-2.902,-1.03659974E-
01,FALSE*f33b4465
```

Table 35: Clock Model Status Values

ASCII	Binary	Description
VALID	0	The clock model is valid
CONVERGING	1	The clock model is near validity
ITERATING	2	The clock model is iterating towards validity
INVALID	3	The clock model is not valid
ERROR	4	Clock model error

Table 36: Constellation Change Flag Values

ASCII	Binary	Description
FALSE	0	There has not been a change in the constellation
TRUE	1	The constellation has changed

6.3.4 PSRPOS Pseudorange Position

This log contains the pseudorange position computed by the receiver, along with three status flags.

Log Type: Synch

Message ID: 47

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	sol status	Solution status. See <i>Table 37</i> on <i>Page 83</i> .	Enum	4	H
3	pos type	Position type. See <i>Table 38</i> on <i>Page 83</i> .	Enum	4	H+4
4	lat	Latitude (percentage degrees)	Double	8	H+8
5	lon	Longitude (percentage degrees)	Double	8	H+16
6	hgt	Height above ellipsoid (m)	Double	8	H+24
7	Reserved		Float	4	H+32
8	datum id#	Datum ID number. This will always be 61 for the WGS84 coordinate system.	Enum	4	H+36
9	lat σ	Latitude standard deviation (m)	Float	4	H+40
10	lon σ	Longitude standard deviation (m)	Float	4	H+44
11	hgt σ	Height standard deviation (m)	Float	4	H+48
12	Reserved		Char[4]	4	H+52
13			Float	4	H+56
14			Float	4	H+60
15	#obs	Number of observations tracked for signal type being used in position solution.	UChar	1	H+64
16	#obs in pos	Number of observations used in position	UChar	1	H+65
17	Reserved		UChar	1	H+66
18			UChar	1	H+67
19			UChar	1	H+68
20			UChar	1	H+69
21			UChar	1	H+70
22			UChar	1	H+71
23	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+72

Recommended Input:

```
LOG PSRPOSA ONTIME 1
```

Example Output:

```
#PSRPOSA,COM1,0,58.0,FINE,1027,324231.000,00000000,FC91,0;
SOL_COMPUTED,SINGLE,51.11615533807,-114.03850611829,1010.452,-
16.271,61,19.50677306162,14.52973740177,39.584,"0",0.0,60.000,9,8,
8,1,0,0,0,0*de152df7
```

Table 37: Solution Status Values

ASCII	Binary	Description
SOL_COMPUTED	0	Solution computed
INSUFFICIENT_OBS	1	Insufficient observations
NO_CONVERGENCE	2	No convergence
SINGULARITY	3	Singularity at parameters matrix
CONV_TRACE	4	Covariance trace exceeds maximum (trace > 1000 m)
TEST_DIST	5	Test distance exceeded (maximum of 3 rejections if distance > 10 km)
COLD_START	6	Not yet converged from cold start
V_H_LIMIT	7	Height or velocity limits exceeded (in accordance with COCOM export licensing restrictions)
VARIANCE	8	Variance exceeds limits
RESIDUALS	9	Residuals are too large
DELTA_POS	10	Delta position is too large
NEGATIVE_VAR	11	Negative variance

Table 38: Position Type Values

ASCII	Binary	Description
NONE	0	No solution
FIXEDPOS	1	Position has been fixed by the <i>FIX POSITION</i> command or by position averaging
SINGLE	16	Single point position

6.3.5 RANGE Satellite Range Information

RANGE contains the channel measurements for the currently tracked satellites. When using this log, please keep in mind the constraints noted along with the description.

It is important to ensure that the receiver clock model is valid. This can be monitored by the bits in the *Receiver Status* field of the log header. Large jumps in pseudorange as well as accumulated Doppler range (ADR) will occur as the clock is being adjusted. If the ADR measurement is being used in precise phase processing, it is important not to use the ADR if the *parity known* flag in the *ch-tr-status* field is not set as there may exist a half (1/2) cycle ambiguity on the measurement. The tracking error estimate of the pseudorange and carrier phase (ADR) is the thermal noise of the receiver tracking loops only. It does not account for possible multipath errors or atmospheric delays.

If a PRN is being tracked on more than one signal (GPS L1, GPS L5, Galileo L1, Galileo E5a or Galileo E5b) multiple entries with the same PRN will appear in the range logs. As shown in *Table 39* on *Page 86*, these entries can be differentiated by bits 21-22 of the *ch-tr-status* field, which denote whether the observation is for GPS L1, GPS L5, Galileo L1, Galileo E5a or Galileo E5b. This is to aid in parsing data.

Log Type: Synch

Message ID: 43

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	# obs	Number of data sets to follow.	Long	4	H
3	PRN	Satellite PRN number of range measurement.	UShort	2	H+4
4	Reserved		UShort	2	H+6
5	psr	Pseudorange measurement (m).	Double	8	H+8
6	psr std	Pseudorange measurement standard deviation (m).	Float	4	H+16
7	adr	Carrier phase, in cycles (accumulated Doppler range).	Double	8	H+20
8	adr std	Estimated carrier phase standard deviation (cycles).	Float	4	H+28
9	dopp	Instantaneous carrier Doppler frequency (Hz).	Float	4	H+32
10	C/N ₀	Carrier to noise density ratio $C/N_0 = 10[\log_{10}(S/N_0)]$ (dB-Hz)	Float	4	H+36
11	locktime	Number of seconds of continuous tracking (no cycle slipping).	Float	4	H+40
12	ch-tr-status	Tracking status. See <i>Table 39</i> on <i>Page 86</i> .	ULong	4	H+44
13...	Next data set, offset = H + 4 + (# previous obs x 44)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+4+ (#obs x 44)

Recommended Input:

```
LOG RANGEA ONTIME 30
```

Example Output:

```
#RANGEA,COM1,0,78.5,FINE,439,232536.000,00A41000,0000,33331;  
20,  
2,0,21285571.261,0.188,-111856430.792,0.004,2443.143,46.9,  
287.940,00005C04,  
5,0,21942915.921,0.356,-115310802.925,0.007,2820.671,41.3,  
290.620,00005C44,  
4,0,20519317.770,0.171,-107829743.850,0.004,-324.364,  
47.7,347.110,00005C64,  
12,0,21413159.503,0.236,-112526914.356,0.006,2002.298,44.9,  
278.540,00005C84,  
17,0,22939598.687,0.291,-120548403.778,0.007,-2982.162,43.1,  
81.340,00005CA4,  
17,0,22871146.176,1.612,-120188682.163,0.084,275.355,44.1,  
5.384,04035D24,  
20,0,25273209.399,0.259,-132811609.020,0.005,-3106.407,44.1,  
312.136,04035D64,  
1,0,36294000.299,0.025,1504943106.108,0.003,-13.099,49.8,  
340.910,05433E04,  
2,0,25327160.711,0.025,-110900154.247,0.003,-1901.979,49.8,  
320.930,05433E24,  
16,0,23368818.345,0.025,-91704264.191,0.004,1899.531,49.8,  
180.340,05433E64,  
20,0,25273198.853,0.026,-99177458.786,0.005,-2319.704,49.8,  
98.710,05433E84,  
9,0,21350912.281,0.025,-83785566.201,0.004,641.320,49.8,  
263.440,05433EA4,  
18,0,24974945.368,0.025,-98007049.791,0.003,-1503.489,49.8,  
122.530,05433EC4,  
8,0,24305771.038,0.025,-106851973.842,0.004,1778.620,49.8,  
316.650,05433EE4,  
17,0,22871131.098,0.027,-101857649.337,0.004,210.996,49.2,  
263.064,05E33F04,  
2,0,25327159.878,0.027,-118490178.649,0.003,-1951.599,49.3,  
323.276,05E33F24,  
27,0,24473949.145,0.027,-98546449.449,0.004,401.691,49.2,  
71.876,05E33F84,  
16,0,23368817.647,0.027,-103823675.484,0.004,1949.090,49.2,  
261.780,05E33FA4,  
15,0,26124772.027,0.027,-105193640.720,0.004,2502.083,49.2,  
240.412,05E33FC4,  
18,0,24974944.621,0.027,-100563751.872,0.003,-1542.714,49.2,  
224.796,06033FE4*149ADDC1
```

Table 39: Channel Tracking Status

Nibble #	Bit #	Mask	Description	Range Value		
N0	0	0x00000001	Tracking state	0 to 22 See Table 40 on Page 87		
	1	0x00000002				
	2	0x00000004				
	3	0x00000008				
N1	4	0x00000010	SV channel number	0-n (0 = first, n = last) n depends on the receiver		
	5	0x00000020				
	6	0x00000040				
	7	0x00000080				
N2	8	0x00000100	Phase lock flag	0 = Not locked, 1 = Locked		
	9	0x00000200				
	10	0x00000400				
	11	0x00000800				
N3	12	0x00001000	Code locked flag	0 = Not locked, 1 = Locked		
	13	0x00002000	Correlator spacing	See Table 41 on Page 87		
	14	0x00004000				
	15	0x00008000				
N4	16	0x00010000	Satellite system	0 = GPS 1, 4-7 = Reserved 2 = GEO 3 = Galileo		
	17	0x00020000				
	18	0x00040000				
	19	Reserved (always 0)				
N5	20	Reserved (always 0)				
	21	0x00200000	Signal Type (depends on satellite system)	If GPS/GEO: If Galileo: 0 = L1 C/A 0 = L1 dataless 5 = L2 P 1 = L1 data 9 = L2 P codeless 10 = E5a dataless 14 = L5 C5 dataless 11 = E5a data 26 = L5 C5 data 15 = E5b dataless 30 = L5 C5 combined 16 = E5b data		
	22	0x00400000				
	23	0x00800000				
24	0x01000000					
N6	25	0x02000000	Forward Error Correction (FEC)	0 = Not FEC, 1 = FEC		
	26	0x04000000				
	27	Reserved (always 0)				

Continued on Page 87

Nibble #	Bit #	Mask	Description	Range Value
N7	28	0x10000000	Reserved for future use	
	29	0x20000000		
	30	Reserved (always 0)		
	31	0x80000000	Channel assignment	0 = Automatic, 1 = Forced

Table 40: Tracking State Bit Values

Bit Value	Description
0	Idle
1	Sky search
2	Wide frequency band pull-in
3	Narrow frequency band pull-in
4	PLL
5	Reacquisition
6	Steering
7	Frequency-lock loop
8-14	Reserved
15	Neumann-Hoffman alignment

Table 41: Correlator Spacing Bit Values

Bit Value	Description
0	Reserved
1	Standard correlator: spacing > 0.1 chip
2	Narrow correlator: spacing = 0.1 chip
3	Reserved
4	Reserved

6.3.6 RAWEPHEM Raw Ephemeris

This log contains the raw binary information for subframes one, two and three from a satellite with the parity information removed. Each subframe is 240 bits long (10 words - 24 bits each) and the log contains a total 720 bits (90 bytes) of information (240 bits x 3 subframes). This information is preceded by the PRN number of the satellite from which it originated. This message is not generated unless all 10 words from all 3 frames have passed parity.

Ephemeris data whose Time Of Ephemeris (TOE) is older than six hours is not shown.

Log Type: Asynch

Message ID: 41

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	prn	Satellite PRN number	Ulong	4	H
3	ref week	Ephemeris reference week number	Ulong	4	H+4
4	ref secs	Ephemeris reference time (seconds.)	Ulong	4	H+8
5	subframe1	Subframe 1 data.	Hex	30	H+12
6	subframe2	Subframe 2 data.	Hex	30	H+42
7	subframe3	Subframe 3 data.	Hex	32	H+72
8	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+104

Recommended Input:

LOG RAWEPHEMA ONCHANGED

Example Output:

```
#RAWEPHEMA,COM1,7,76.5,SATTIME,338,338430.000,00A00000,0000,33331;
29,338,345600,8B05486E2B255490003CD3E8731DDB8A24F57C45F225546000006
946137A00000000000,8B05486E2BA8250A4E2BB771090CD2097204D3A7FB1250A10
D95B354607D000000B2EA,8B05486E2C2F0072ADE5E6AE005C2829DA2F1B93D8620
667FFA AFC250D9A00000000000*D413845E
```

...

```
#RAWEPHEMA,COM1,4,76.5,SATTIME,338,338430.000,00A00000,0000,33331;
10,338,345584,8B05486E2B255490003CD3E8731DDB8A24F57C45FB94545F00000
50A52E700000000000,8B05486E2BA894FC2A2D01670FCEA8FCC0039DF4691822A10
C7F8E545F2B000000B2EA,8B05486E2C2FFFBA8488C0FDFFD127BDA71614E90FD78
438FFABE494F11E00000000000*6854985A
```

...

```
#RAWEPHEMA,COM1,0,76.5,SATTIME,338,338430.000,00A00000,0000,33331;
15,338,345600,8B05486E2B255492012CD3E8731DDB8A24F57C45FB56546000003
44A404600000000000,8B05486E2BA856FD4936E4E87361D4FD2F04D0F1270900A10
DA76554607C000000B2EA,8B05486E2C2FFFFD5C183A3FFFBE27061AC724B767F70
A30FFA2F056FDD400000000000*71B1AC43
```


6.3.7 RAWFRAME Raw Subframes

This log contains raw subframes. GPS subframes are output even when there are parity failures. Galileo subframes are not output if there are parity failures.

Log Type: Asynch

Message ID: 804

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	sigchan	The parameters should be applied to this signal channel.	ULong	4	H
3	PRN	Satellite PRN number	ULong	4	H+4
4	#parity failures	Number of words that had parity failures	Ulong	4	H+12
5	#bits in frame	Number of bits in subframe	ULong	4	H+8
6	#bytes	Number of bytes to follow	Ulong	4	H+16
7	data	Raw subframe data	Hex[variable]	40 ^a	H+20
8	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+60

a. In the *Binary* log case, the data field will only output the number of bits in the subframe. This is 120 for L1 and E5b and 244 for E5a.

Recommended Input:

```
LOG RAWFRAMEA ONNEW
```

Example Output:

```
#RAWFRAMEA,COM1,0,80.5,FINE,439,232656.119,00A41000,0000,33331;
27,30,0,120,15,
0E3F26ABBAEBF56C0449C0DBDE1800*4B618D4C
```

6.3.8 RXCOMMANDS Receiver Configuration

This log outputs all of the current receiver configuration parameters set using the commands in *Chapter 5*. When requested, one RXCOMMANDS log is output for each command type. The embedded message is the most-recent command string entered by you for that command type. If you have not yet entered a command string for that command type, the default configuration values from start-up are provided.

Log Type: Polled

Message ID: 579

Field	Field Name	Data Description	Format	Bytes	Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	command type	Indicates which command the embedded message represents, see <i>Table 42</i> on <i>Page 92</i> .	Int	4	H
3	e msg	Embedded message of the most-recent command string you entered. If a command string has not been entered yet, the default values from start-up will be provided.	Uchar [variable]	variable	H+4
4	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	variable

Recommended Input:

```
LOG RXCOMMANDSA ONCE
```

Example Output:

```
#RXCOMMANDSA,COM1,44,80.0,FINE,439,232702.670,00A41000,0000,33331;
4,COM COM1 230400 N 8 1 N OFF ON*0AEE4B3F
#RXCOMMANDSA,COM1,43,80.0,FINE,439,232702.672,00A41000,0000,33331;
20,CHANCONFIG24GALILEO8GPS*21083552
#RXCOMMANDSA,COM1,42,80.0,FINE,439,232702.674,00A41000,0000,33331;
5,ECUTOFF 10.0*F1DBFE25
#RXCOMMANDSA,COM1,41,80.0,FINE,439,232702.675,00A41000,0000,33331;
7,FIX NONE*D28AC210
#RXCOMMANDSA,COM1,40,80.0,FINE,439,232702.675,00A41000,0000,33331;
21,PULSEBLANKING L1 127*D372D5DC
#RXCOMMANDSA,COM1,39,80.0,FINE,439,232702.679,00A41000,0000,33331;
21,PULSEBLANKING L5 127*4D256AE3
#RXCOMMANDSA,COM1,38,80.0,FINE,439,232702.680,00A41000,0000,33331;
21,PULSEBLANKING E5B 127*B567DC0E
#RXCOMMANDSA,COM1,37,80.0,FINE,439,232702.680,00A41000,0000,33331;
39,DLLORDER GPS 1*597D0670
#RXCOMMANDSA,COM1,36,80.0,FINE,439,232702.682,00A41000,0000,33331;
2,ANTENNAPOWER ON*7977E4D8
#RXCOMMANDSA,COM1,35,80.0,FINE,439,232702.682,00A41000,0000,33331;
3,CLOCKADJUSTDISABLE*0169268B
#RXCOMMANDSA,COM1,34,80.0,FINE,439,232702.685,00A41000,0000,33331;
4,COM COM3 115200 N 8 1 N OFF ON*10FD1D32
#RXCOMMANDSA,COM1,33,80.0,FINE,439,232702.687,00A41000,0000,33331;
47,POSITIONTYPE GPSL1*5A4C0818
#RXCOMMANDSA,COM1,32,80.0,FINE,439,232702.688,00A41000,0000,33331;
45,SDLLBW 0 0.2000*3D836CFF
```

```
#RXCOMMANDSA,COM1,31,80.0,FINE,439,232702.688,00A41000,0000,33331;
45,SDLLBW 1 0.2000*AB669D0A
#RXCOMMANDSA,COM1,30,80.0,FINE,439,232702.690,00A41000,0000,33331;
45,SDLLBW 2 0.2000*3767D951
#RXCOMMANDSA,COM1,29,80.0,FINE,439,232702.690,00A41000,0000,33331;
45,SDLLBW 3 0.2000*EEBAA480
#RXCOMMANDSA,COM1,28,80.0,FINE,439,232702.693,00A41000,0000,33331;
45,SDLLBW 4 0.2000*4E294FF7
#RXCOMMANDSA,COM1,27,80.0,FINE,439,232702.695,00A41000,0000,33331;
45,SDLLBW 5 0.2000*3FFB1CFF
#RXCOMMANDSA,COM1,26,80.0,FINE,439,232702.695,00A41000,0000,33331;
45,SDLLBW 6 0.2000*319E49FA
#RXCOMMANDSA,COM1,25,80.0,FINE,439,232702.697,00A41000,0000,33331;
45,SDLLBW 7 0.2000*22839AC0
#RXCOMMANDSA,COM1,24,80.0,FINE,439,232702.697,00A41000,0000,33331;
45,SDLLBW 8 0.2000*7B49DA8A
#RXCOMMANDSA,COM1,23,80.0,FINE,439,232702.698,00A41000,0000,33331;
45,SDLLBW 9 0.2000*03D8188C
#RXCOMMANDSA,COM1,22,80.0,FINE,439,232702.698,00A41000,0000,33331;
45,SDLLBW 10 0.2000*1D4554BE
#RXCOMMANDSA,COM1,21,80.0,FINE,439,232702.700,00A41000,0000,33331;
45,SDLLBW 11 0.2000*C91C79AF
#RXCOMMANDSA,COM1,20,80.0,FINE,439,232702.703,00A41000,0000,33331;
45,SDLLBW 12 0.2000*ED3364F1
#RXCOMMANDSA,COM1,19,80.0,FINE,439,232702.703,00A41000,0000,33331;
45,SDLLBW 13 0.2000*061D81E2
#RXCOMMANDSA,COM1,18,80.0,FINE,439,232702.705,00A41000,0000,33331;
45,SDLLBW 14 0.2000*58D34CE1
#RXCOMMANDSA,COM1,17,80.0,FINE,439,232702.705,00A41000,0000,33331;
45,SDLLBW 15 0.2000*904A6B58
#RXCOMMANDSA,COM1,16,80.0,FINE,439,232702.706,00A41000,0000,33331;
46,SPLLBW 0 3.0000*6338DD41
#RXCOMMANDSA,COM1,15,80.0,FINE,439,232702.706,00A41000,0000,33331;
46,SPLLBW 1 3.0000*F5DD2CB4
#RXCOMMANDSA,COM1,14,80.0,FINE,439,232702.708,00A41000,0000,33331;
46,SPLLBW 2 3.0000*D4B2995E
#RXCOMMANDSA,COM1,13,80.0,FINE,439,232702.708,00A41000,0000,33331;
46,SPLLBW 3 3.0000*2C6D29F0
#RXCOMMANDSA,COM1,12,80.0,FINE,439,232702.710,00A41000,0000,33331;
46,SPLLBW 4 3.0000*34266351
#RXCOMMANDSA,COM1,11,80.0,FINE,439,232702.710,00A41000,0000,33331;
46,SPLLBW 5 3.0000*A2C392A4
#RXCOMMANDSA,COM1,10,80.0,FINE,439,232702.713,00A41000,0000,33331;
46,SPLLBW 6 3.0000*861A7729
#RXCOMMANDSA,COM1,9,80.0,FINE,439,232702.715,00A41000,0000,33331;
46,SPLLBW 7 3.0000*741A7F55
#RXCOMMANDSA,COM1,8,80.0,FINE,439,232702.715,00A41000,0000,33331;
46,SPLLBW 8 3.0000*2DD03F1F
#RXCOMMANDSA,COM1,7,80.0,FINE,439,232702.716,00A41000,0000,33331;
46,SPLLBW 9 3.0000*23C7BD8F
#RXCOMMANDSA,COM1,6,80.0,FINE,439,232702.716,00A41000,0000,33331;
46,SPLLBW 10 3.0000*E3D9E979
#RXCOMMANDSA,COM1,5,80.0,FINE,439,232702.718,00A41000,0000,33331;
46,SPLLBW 11 3.0000*C5D3EBCF
```

```
#RXCOMMANDSA,COM1,4,80.0,FINE,439,232702.718,00A41000,0000,33331;
46,SPLLBW 12 3.0000*02B54133
#RXCOMMANDSA,COM1,3,80.0,FINE,439,232702.720,00A41000,0000,33331;
46,SPLLBW 13 3.0000*FDB113CE
#RXCOMMANDSA,COM1,2,80.0,FINE,439,232702.720,00A41000,0000,33331;
46,SPLLBW 14 3.0000*BE9DB7C8
#RXCOMMANDSA,COM1,1,80.0,FINE,439,232702.723,00A41000,0000,33331;
46,SPLLBW 15 3.0000*4B44F7D5
#RXCOMMANDSA,COM1,0,80.0,FINE,439,232702.724,00A41000,0000,33331;
6,EXTERNALCLOCK OCXO 10MHZ 0.000000 0.000000 0.000000*6732E03E
```

Table 42: Command Type Values

ASCII	BINARY	Command
0	0	ASSIGN
1-3	1-3	Reserved
4	4	COM
5	5	ECUTOFF
6	6	EXTERNALCLOCK
7	7	FIX
8	8	FRESET
9	9	LOG
10	10	RESET
11-18	11-18	Reserved
19	19	AGCMODE
20	20	CHANCONFIG
21	21	PULSEBLANKING
22	22	UNLOG
23-24	23-24	Reserved
25	25	UNLOGALL
26	26	UNASSIGN
27-42	27-42	Reserved
43	43	STHRESHOLD
44	44	Reserved
45	45	SDLLBW
46	46	SPLLBW
47	47	POSITIONTYPE

6.3.9 RXSECSTATUS Receiver Section Status

This log is used to output the version and status information for each receiver card in the receiver section.

Log Type: Synchronous

Message ID: 638

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	# comp	Number of components (cards, and so on)	Ulong	4	H
3	type	Component type. See <i>Table 43</i> below.	Enum	4	H+4
4	Reserved		Enum	4	H+8
5	model	Model	Char[16]	16	H+12
6	psn	Product serial number	Char[16]	16	H+28
7	sw version	Firmware software version	Char[16]	16	H+44
8	status word	Receiver status word. See <i>Table 45</i> on <i>Page 95</i> .	Ulong	4	H+60
9	error word	Receiver error word. A value of zero indicates no errors. See <i>Table 44</i> on <i>Page 94</i> .	Ulong	4	H+64
10	Reserved		Ulong	4	H+68
11...	Next component offset = H + 4 + (#comp x 68)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+4+ (#comp x 68)

Recommended Input:

```
LOG RXSECSTATUSA ONNEW
```

Example Output:

```
#RXSECSTATUSA,COM1,0,72.5,FINE,439,233415.000,00A01000,0000,33331;
2,L1E5A,PM,"L1E5AGALT","DZN06300002","5.200D5",00A01000,00000000,00
401000,E5AB,PS1,"","DDG06389009","6.200D6",00EC0000,00000000,000000
00*F9BE622E
```

Table 43: Component Type

ASCII	Binary	Description
UNKNOWN	0	Unknown component
FPGA	5	Field Programmable Gate Array
CPLD	8	Complex programmable logic device
L1E5A	9	Receiver component
E5AB	11	Receiver component

Table 44: Receiver Error

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Dynamic Random Access Memory (DRAM) status	OK	Error
	1	0x00000002	Reserved	OK	Error
	2	0x00000004		OK	Error
	3	0x00000008		OK	Error
N1	4	0x00000010		Electronic Serial Number (ESN) access status	OK
	5	0x00000020	Authorization code status	OK	Error
	6	0x00000040	Reserved	OK	Error
	7	0x00000080	Supply voltage status	OK	Error
N2	8	0x00000100	Reserved	OK	Error
	9	0x00000200	Temperature status (as compared against acceptable limits)	OK	Error
	10	0x00000400	MINOS4 status (FPGA)	OK	Error
	11	0x00000800	PLL RF1 hardware status	OK	Error
N3	12	0x00001000	PLL RF2 hardware status	OK	Error
	13	0x00002000	Reserved	OK	Error
	14	0x00004000		OK	Error
	15	0x00008000	NVM status	OK	Error
N4	16	0x00010000	Stack usage status	OK	Error
	17	0x00020000	Memory usage status	OK	Error
	18	0x00040000	Message queue usage status	OK	Error
	19	0x00080000	Message usage status	OK	Error

Table 45: Receiver Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1			
N0	0	0x00000001	Error flag, see <i>Table 44, Receiver Error on Page 94</i>	No error	Error			
	1	0x00000002	Temperature status	Within specifications	Warning			
	2	0x00000004	Voltage supply status	OK	Warning			
	3	0x00000008	Antenna power status	Powered	Not powered			
N1	4	0x00000010	LNA status	OK	Failure			
	5	0x00000020	Antenna open flag	OK	Open			
	6	0x00000040	Antenna shorted flag	OK	Shorted			
	7	0x00000080	CPU overload flag	No overload	Overload			
N2	8	0x00000100	COM1 buffer overrun flag	No overrun	Overrun			
	9	0x00000200	Reserved					
	10	0x00000400	COM3 buffer overrun flag	No overrun	Overrun			
	11	0x00000800	Reserved					
N3	12	0x00001000						
	13	0x00002000						
	14	0x00004000						
	15	0x00008000						
N4	16	0x00010000						
	17	0x00020000						
	18	0x00040000				Almanac flag	Valid	Invalid
	19	0x00080000				Position solution flag	Valid	Invalid
N5	20	0x00100000	Position fixed flag, see <i>FIX on Page 59</i>	Not fixed	Fixed			
	21	0x00200000	Clock steering status	Enabled	Disabled			
	22	0x00400000	Clock model flag	Valid	Invalid			
	23	0x00800000	External oscillator flag	PLL not locked	PLL locked			
N6	24	0x01000000	Stack warning	OK	Warning			
	25	0x02000000	Memory warning	OK	Warning			
	26	0x04000000	Message queue warning	OK	Warning			
	27	0x08000000	Message block usage warning	OK	Warning			
N7	28	0x10000000	Reserved					
	29	0x20000000						
	30	0x40000000						
	31	0x80000000	AUX1 status event flag	No event	Event			

6.3.10 SATVISA Satellite Visibility

This log outputs satellite visibility data and additional satellite information based on the specified position type. See also the POSITIONTYPE command on *Page 64*.

Log Type: Synch

Message ID: 48

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	sat vis	Indicates if the satellite visibility is valid. See <i>Table 46</i> on <i>Page 97</i> .	Enum	4	H
3	comp alm	Indicates if the complete almanac was used. See <i>Table 47</i> on <i>Page 97</i> .	Enum	4	H+4
4	#sat	Number of satellite data sets to follow	ULong	4	H+8
5	PRN	GPS satellite PRN number of range measurement (GPS only).	Short	2	H+12
6	Reserved		Short	2	H+14
7	health	Satellite health ^a	ULong	4	H+16
8	elev	Elevation (degrees)	Double	8	H+20
9	az	Azimuth (degrees)	Double	8	H+28
10	true dop	Theoretical Doppler of satellite (Hz)	Double	8	H+36
11	app dop	Apparent Doppler for this receiver (Hz)	Double	8	H+44
12	Next satellite data set, offset = H + 12 + (# previous sat x 40)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+12+ (#sat x 40)

a. Satellite health values may be found in ICD-GPS-200. To obtain copies of ICD-GPS-200, refer to ARINC. A list of standards and references with contact information can be found in the *GPS+ Reference Manual* available on our website at <http://www.novatel.com/support/docupdates.htm>.

Recommended Input:

```
LOG SATVISA ONTIME 60
```

ASCII Example:

```
#SATVISA,COM1,0,44.0,FINE,1039,490308.000,00000028,6002,0;
TRUE,TRUE,27,
14,0,0,74.5,267.4,458.2,458.926672761,
25,0,0,61.3,73.7,-1252.6,-1251.902056196,
1,0,0,55.9,277.4,1799.2,1799.897879028,
16,0,0,33.6,305.9,2874.8,2875.534296744,
...
26,0,0,-82.0,114.8,-188.9,-188.237459086*bf8c9522
```


Table 46: Satellite Visibility Values

ASCII	Binary	Description
FALSE	0	Satellite visibility is invalid
TRUE	1	Satellite visibility is valid

Table 47: Complete Almanac Flag Values

ASCII	Binary	Description
FALSE	0	Complete almanac was not used
TRUE	1	Complete almanac was used

6.3.11 SYSTEMLEVELS System Hardware Levels

This log contains environmental and voltage parameters for the receiver card.

Log Type: Synchronous

Message ID: 653

Field	Field Name	Data Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	# comp	Number of components	Ulong	4	H
3	type	Component type, see <i>Table 43</i> on <i>Page 93</i>	Enum	4	H + 4
4	Reserved		Enum	4	H + 8
5	temp	Board temperature (°C)	Float	4	H + 12
6	ant current	Approximate internal antenna current (A)	Float	4	H + 16
7	core volt	1V CPU core voltage (V)	Float	4	H + 20
8	supply volt	12V supply voltage (V)	Float	4	H + 24
9	RF volt	5V RF supply voltage (V)	Float	4	H+28
10	LNA volt	Internal LNA voltage (V)	Float	4	H+32
11	3.3 V supply	3.3 V supply voltage	Float	4	H+36
12	TCXO control volt	Control voltage for TCXO	Float	4	H+40
13	idle time	Idle time (%)	Float	4	H+44
14	LNA output volt	LNA output voltage (V)	Float	4	H+48
15...	Next component offset = H + 4 + (# comp x 48)				
variable	32-bit CRC (ASCII and Binary only)		Hex	4	H + 4 + (# comp x 48)

Recommended Input:

```
LOG SYSTEMLEVELSA ONTIME 1
```

Example Output:

```
#SYSTEMLEVELSA, COM1, 0, 72.0, FINE, 439, 233399.000, 00A01000, 0000, 33331;
2,
L1E5A, PM, 57.000, 0.105, 1.204, 11.543, 5.007, 3.462, 3.289, 1.554, 72.137,
4.551,
E5AB, PS1, 55.000, 0.084, 1.496, 11.402, 4.845, 0.000, 3.300, 1.430, 5.343,
4.551*238BE4F0
```

6.3.12 TIME Time Data

This log is output at the *Time* port at a maximum rate of 1 Hz and provides the GPS time of the receiver's 1 PPS signal. It also includes the information on the receiver clock offset and the clock model status.

Log Type: Sync

Message ID: 101

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3 on Page 38</i> .		H	0
2	clock status	Clock model status (not including current measurement data). See <i>Table 35 on Page 81</i> .	Enum	4	H
3	offset	Receiver clock offset, in seconds from GPS time. A positive offset implies that the receiver clock is ahead of GPS time. To derive GPS time, use the following formula: GPS time = receiver time - offset	Double	8	H+4
4	offset std	Receiver clock offset standard deviation (s)	Double	8	H+12
5-12	Reserved			24	H+20
13	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+44

Recommended Input:

```
LOG TIMEA ONTIME 1
```

Example Output:

```
#TIMEA,COM1,0,58.0,FINE,1049,248050.000,00000128,5C46,0;
VALID,-0.000000002,0.000001901,-13.00000000294,2000,2,15,20,53,
57011,VALID*d6f14d5d
```

6.3.13 TRACKSTAT Tracking Status

These logs provide channel tracking status information for each of the receiver's channels.

Log Type: Synch

Message ID: 83

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	sol status	Solution status. See <i>Table 37</i> on <i>Page 83</i> .	Enum	4	H
3	pos type	Position type. See <i>Table 38</i> on <i>Page 83</i> .	Enum	4	H+4
4	cutoff	Primary antenna low elevation cut-off angle	Float	4	H+8
5	# chans	Number of hardware channel data sets to follow	Long	4	H+12
6	PRN	Satellite PRN number of range measurement	Short	2	H+16
7	Reserved		Short	2	H+18
8	ch-tr-status	Channel tracking status. See <i>Table 39</i> on <i>Page 86</i> .	ULong	4	H+20
9	psr	Pseudorange (m)	Double	8	H+24
10	Doppler	Doppler frequency (Hz)	Float	4	H+32
11	C/No	Carrier to noise density ratio (dB-Hz)	Float	4	H+38
12	locktime	Number of seconds of continuous tracking (no cycle slips)	Float	4	H+42
13	psr res	Pseudorange residual from pseudorange filter (m)	Float	4	H+46
14	reject	Range reject code from pseudorange filter. See <i>Table 48</i> on <i>Page 101</i> .	Enum	4	H+50
15	psr weight	Pseudorange filter weighting	Float	4	H+54
16...	Next hardware channel data set, offset = H+16 + (# previous chans x 40)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+16 + (#chans x 40)

Recommended Input:

```
LOG TRACKSTATA ONTIME 1
```

Example Output:

```
#TRACKSTATA,COM1,0,66.5,FINE,439,233441.000,00A01000,0000,33331;
SOL_COMPUTED,SINGLE,0.000,32,
2,0,00005C04,20903339.983,1987.446,46.227,1192.950,-0.581,GOOD
...
0.000,27,0,05433E44,24422742.231,51.671,49.365,532.270,0.000,
GALE5A,
...
0.000,18,0,06033fe4,25348965.667,-1779.239,49.364,1129.792,0.000,
GALE5B,0.000*d100c7e8
```

Table 48: Reject Code Values

ASCII	Binary	Description
GOOD	0	Observations are good
BADHEALTH	1	Bad satellite health is indicated by ephemeris data
OLDEPHEMERIS	2	Old ephemeris due to date not being updated during the last 3 hours
ECCENTRICANOMALY	3	Eccentric anomaly error during computation of the satellite's position
TRUEANOMALY	4	True anomaly error during computation of the satellite's position
SATCOORDINATEERROR	5	Satellite coordinate error during computation of the satellite's position
ELEVATIONERROR	6	Elevation error due to the satellite being below the cut-off angle
MISCLOSURE	7	Misclosure too large due to excessive gap between estimated and actual positions
NOEPHEMERIS	9	Ephemeris data for this satellite has not yet been received
INVALIDIODE	10	Invalid IODE (Issue Of Data Ephemeris) due to mismatch between differential stations
LOWPOWER	12	Low power meaning that the satellite is rejected due to low carrier/noise ratio
NOIONOCORR	16	No compatible ionospheric correction is available for this particular satellite
BAD_INTEGRITY	17	Bad integrity indicating a large variation between the measured range to the satellite and the theoretical range computed from the ephemeris
OBSL5	18	Tracking a GPS or SBAS L5 signal that is not used in a position solution
GALL1	19	Tracking a Galileo L1 signal
GALE5A	20	Tracking a Galileo E5a signal
GALE5B	21	Tracking a Galileo E5b signal
OBSL1	23	Tracking a GPS or SBAS L1 signal that is not used in a position solution
NA	99	No observation (a reject code is not applicable)

6.3.14 VERSION Version Information

This log contains the version information for all components of a system. When using a standard receiver, there will only be one component in the log.

Log Type: Polled

Message ID: 37

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 38</i> .		H	0
2	# comp	Number of components (cards, etc.)	Long	4	H
3	type	Component type. See <i>Table 43</i> on <i>Page 93</i> .	Enum	4	H+4
4	model	Model	Char[16]	16	H+8
5	psn	Product serial number	Char[16]	16	H+24
6	hw version	Hardware version. See <i>Table 49</i> on <i>Page 103</i> .	Char[16]	16	H+40
7	sw version	Firmware software version. See <i>Table 49</i> on <i>Page 103</i> .	Char[16]	16	H+56
8	boot version	Boot code version. See <i>Table 49</i> on <i>Page 103</i> .	Char[16]	16	H+72
9	comp date	Firmware compile date. See <i>Table 49</i> on <i>Page 103</i> .	Char[12]	12	H+88
10	comp time	Firmware compile time. See <i>Table 49</i> on <i>Page 103</i> .	Char[12]	12	H+100
11...	Next component, offset = H + 4 + (# previous comp x 108)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+4+ (#comp x 108)

Recommended Input:

```
LOG VERSIONA ONCE
```

Example Output:

```
#VERSIONA,COM1,0,72.0,FINE,439,233456.487,00A01000,0000,33331;
5,
L1E5A,"L1E5AGALT","DZN06300002","L1E5A-2.00-2X2","5.200D5",
"5.002D2DB","2008/JAN/18","16:26:08",
FPGA,"ALTERA","","1.6.45056","GALILEO","","2008/JAN/07","12:25:02",
E5AB","","DDG06389009","E5AB-1.04-2XX","6.200D6","6.000D5",
"2008/JAN/18","11:35:42",
FPGA","","","3.6.40966","","","","",
CPLD","","","CPLD-1","","","","*0154113F
```

Table 49: Version Log Field Formats

Field Name	Field Format	Description
hw version	P-RS-CCC	P= hardware platform (e.g. OEMV) R = hardware revision (e.g. 3.40) S = processor revision (e.g. A) CCC = COM port configuration (e.g. 22T) ^a
sw version, boot version	VV.RRR[Xxxx]	VV = major revision number RRR = minor revision number X = Special (S), Beta (B), Internal Development (D, A) xxx = number
comp date	YYYY/MM/DD	YYYY = year MM= month DD = day (1 - 31)
comp time	HH:MM:SS	HH = hour MM = minutes SS = seconds

- a. One character for each of the COM ports 1, 2, and 3. Characters are: 2 for RS-232, 4 for RS-422, and T for LV-TTL. Therefore, the example is for a receiver that uses RS-232 for COM 1 and COM 2 and LV-TTL for COM 3.

The receiver firmware is stored in on-board, non-volatile memory, which allows it to be updated in the field. Therefore, updating firmware takes only a few minutes instead of several days, which would be required if the receiver had to be sent to a service depot.

When updating to a higher revision level, you will need to transfer the new firmware to the appropriate card using one of NovAtel's firmware loading utilities. *WinLoader* is designed for use with Window-based systems and was developed for use with Unix-based systems.

Below is shown an outline of the procedure for updating your receiver's firmware:

1. Contact the NovAtel Aviation Group.
2. Download update files.
3. Decompress files.
4. Run the firmware loading utility.

7.1 Contacting the NovAtel Aviation Department

The first step in updating the receiver is to contact the NovAtel Aviation Group via any of the methods described in *Customer Service* on Page 17.

When you call, be sure to have the receiver's serial number and program revision level available. This information is printed on the bottom surface of a EuroPak-15ab, as shown in *Figure 5*.

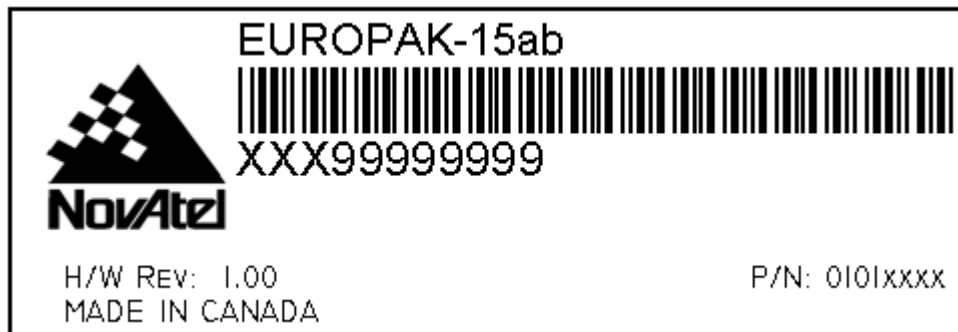


Figure 5: Serial Number and Version Label

You can also verify the information by powering up the receiver and requesting the *VERSION* log.

After conferring with the Aviation Group to establish the required revision level, as well as the terms and conditions of your firmware update, the Aviation Group will issue you an authorization code or *auth-code*. The *auth-code* is required to unlock the receiver features according to your authorized model type.

If it is determined that you will be updating to a higher revision level with the use of the firmware loading utility, the Aviation Group will confirm with you as to the procedures, files, and methods required for using this utility. As the main utility and other necessary files are generally provided in a compressed file format, you will also be given a file decompression password. The utility and update files are available from the Aviation Group by FTP, e-mail, or diskette.

7.2 Downloading the Files

Typically, there are two files required when performing firmware updates on a particular receiver card:

- WINLOAD.EXE (the firmware loading utility program)
- XXXX.HEX (the firmware update file)

Typical Euro-L1E5a card firmware files might be named 5200.HEX, for example.

To proceed with your update, you will first need to download the appropriate files from NovAtel's FTP site at <ftp.novatel.ca>, or via e-mail at support@novatel.com. If downloading is not possible, the files can be mailed to you on diskette.

The files are available in compressed, password-protected file format. The compressed form of the files may have different names than the names discussed above; the Aviation Group will advise you as to the exact names of the files you need. As well, the Aviation Group will provide you with a file de-compression password.

7.3 Decompressing the Files

After copying the compressed files to an appropriate directory on your computer, each file must be decompressed. The syntax for decompression is as follows:

Syntax:

[filename][password]

where filename is the name of the compressed file (but not including the .EXE extension) and password is the password required to allow decompression.

A window-based dialog is provided for password entry.

The self-extracting archive then generates the following files:

WinLoad.exe	WinLoad utility program
HowTo.txt	Instructions on how to use the WinLoad utility
WhatsNew.txt	Information on the changes made in the firmware since the last revision
XXXX.hex	Firmware version update file where XXXX = program version level (for example 2000.hex)

7.4 Running the Utility

WinLoad is a windows based program used to download firmware to receiver cards. The main screen is shown in *Figure 6*.

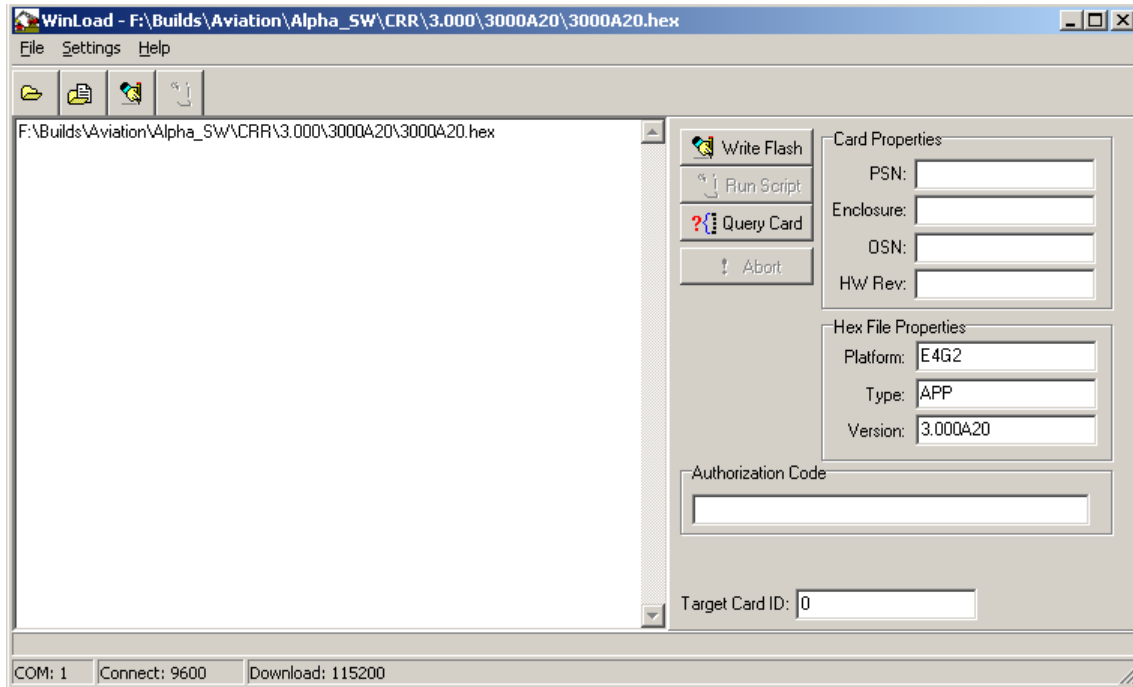


Figure 6: Main Screen of WinLoad

If you are running WinLoad for the first time you will need to make sure the file and communications settings are correct.

7.4.1 Open a File to Download

From the file menu choose Open. Use the Open dialog to browse for your file, see *Figure 7*.

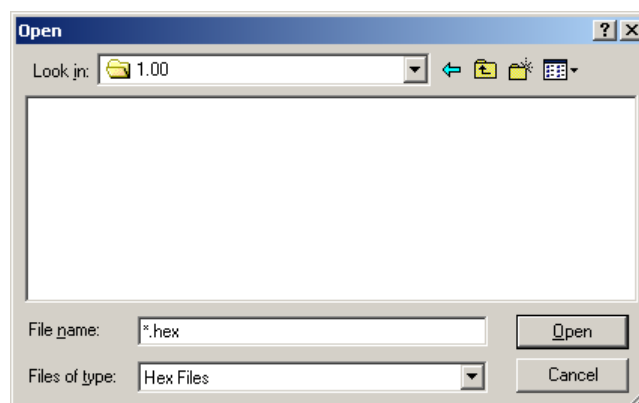


Figure 7: WinLoad's Open Dialog

Once you have selected your file, the name should appear in the main display area and in the title bar, see

Figure 8.

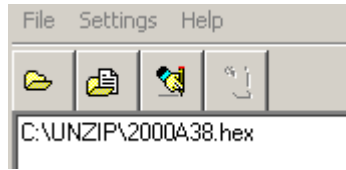


Figure 8: Open File in WinLoad

The *Target Card ID* field should remain at 0. WinLoad will put the firmware on the right card.

Table 50: Target Card Identification

Entry	Description
0	Euro-L1E5a card or Euro-E5ab card

7.4.2 Communications Settings

To set the communications port and baud rate, select COM Settings from the Settings menu, see *Figure 9* on *Page 107*. Choose the port on your PC from the Com Port drop down list and the baud rate from the Download Baudrate drop down list. The baud rate should be as high as possible (the default of 115200 is preferred).

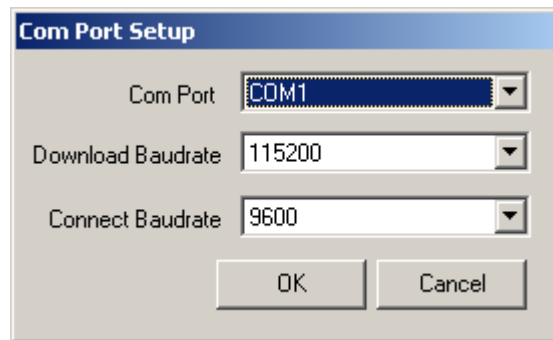


Figure 9: COM Port Setup

7.4.3 Downloading Firmware

To download firmware follow these steps:

1. Set up the communications port as described in *Section 7.4.2, Communications Settings* above.
2. Select the file to download, see *Open a File to Download* on *Page 106*.
3. Make sure the file path and file name are displayed in main display area, see *Figure 8*.
4. Click on the Write Flash button to download the firmware:



5. While WinLoad searches for the card, power cycle the receiver (turn it off and then on again).

You will only be able to access information from the card and download new firmware during the first few seconds after power initiation.

6. WinLoad should be able to locate the card and the hex file should start downloading. When the

Authorization Code dialog opens, see *Figure 10*, enter the auth code and select OK.

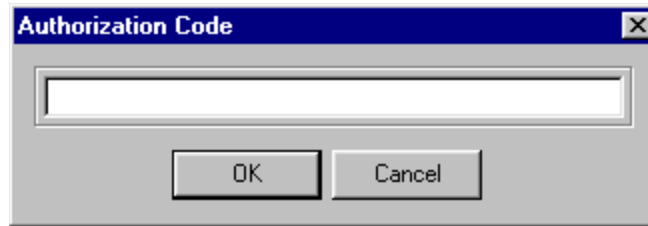


Figure 10: Authorization Code Dialog

7. The receiver should finish downloading and reset. The process is complete when "Done." is displayed in the main display area, see *Figure 11* on *Page 108*.

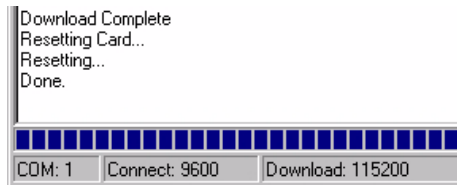


Figure 11: Update Process Complete

8. Close WinLoad.

This completes the procedure required to update a EuroPak-15ab receiver.

8.1 Overview

The built-in test monitors system performance and status to ensure the receiver is operating within its specifications. If an exceptional condition is detected, the user is informed through one or more indicators. The receiver status system is used to configure and monitor these indicators:

1. Receiver status word
2. Error strobe line
3. RXSECSTATUS log

In normal operation the error strobe is driven low. When an unusual and non-fatal event occurs (for example, there is no valid position solution), a bit is set in the receiver status word. Receiver operation continues normally and the error strobe remains off. When the event ends (for example, when there is a valid position solution), the bit in the receiver status word is cleared.

When a fatal event occurs (that is, in the event of a receiver hardware failure), a bit is set in the receiver error word to indicate the cause of the problem. Bit 0 is set in the receiver status word to show that an error occurred and the error strobe is driven high. Receiver tracking is disabled at this point but command and log processing continues to allow you to diagnose the error. Even if the source of the error is corrected at this point, the receiver must be reset to resume normal operation.

8.2 Receiver Status Word

The receiver status word indicates the current status of the receiver. This word is found in the header of all logs. See also *Section 4.3, Log Formats on Page 38*.

8.3 Error Strobe Signal

The error strobe line is one of the I/O strobes and is driven low when the receiver is operating normally. When the receiver is in the error state and tracking is disabled, the error strobe is driven high. This can be caused by a fatal error or by an unusual receiver status indication that the user has promoted to be treated like a fatal error. Once on, the error status will remain high until the cause of the error is corrected and the receiver is reset.

8.4 Receiver Status Log

8.4.1 Overview

The Receiver Status log (RXSECSTATUS) provides information on the current system status and configuration in a series of hexadecimal words.

The status word is the third last field in the RXSECSTATUS log as shown in *Figure 12 on Page 110*. It is also the third last field in the header of every log.

```
<RXSECSTATUSA COM1 0 78.0 FINE 338 320380.000 00a00000 0000 33331
< 1
< L1E5A PM "L1E5AGALT" "DZN05140006"
< "5.000D24" 00CC0000 00000000 00401000
```

Receiver
Status
Word

Figure 12: Location of Receiver Status Word

Each bit in the status word indicates the status of a specific condition or function of the receiver. If the status word is 00000000, the receiver is operating normally. The numbering of the bits is shown in *Figure 13* below.

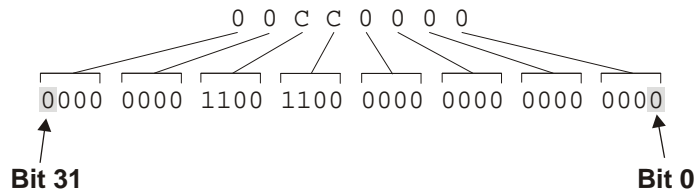


Figure 13: Reading the Bits in the Receiver Status Word

The format of the log is described in *Chapter 4* of this manual. If the receiver status word indicates a problem, please also see *Section 8.2, Receiver Status Word on Page 109*.

8.4.2 Error Word

The error field contains a 32 bit word. Each bit in the word is used to indicate an error condition. Error conditions may result in damage to the hardware or erroneous data, so the receiver is put into an error state. If any bit in the error word is set, the receiver will set the error strobe line, idle all channels, turn off the antenna, and disable the RF hardware. The only way to get out of the error state is to reset the receiver.

The error word is the second last field in the RXSECSTATUS log, as shown in the example below.

```
<RXSECSTATUSA COM1 0 78.0 FINE 338 320380.000 00a00000 0000 33331
< 1
< L1E5A PM "L1E5AGALT" "DZN05140006"
< "5.000D24" 00A00000 00000000 00401000
```

Receiver
Error
Word

Figure 14: Location of Receiver Error Word

The numbering of the bits is shown in *Figure 15*.

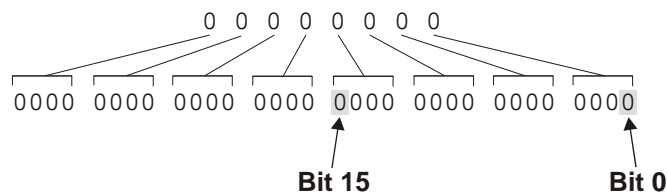


Figure 15: Reading the Bits in the Receiver Error Word

See the RXSECSTATUS log on *Page 93* for more detailed descriptions of this log. If the error word is 00000000, the receiver is not experiencing an error condition. If the receiver error word indicates an error, please also see *Section 8.2, Receiver Status Word on Page 109*.

8.4.3 Status Code Arrays

There are 3 status code arrays – the receiver status word, the auxiliary 1 status and the auxiliary 2 status. The status word is similar to the error word, with each of its 32 bits indicating a condition.

8.4.4 Receiver Status Code

The receiver status word is included in the header of all logs. It has 32 bits, which indicate certain receiver conditions. If any of these conditions occur, a bit in the status word is set.

8.4.5 Auxiliary Status Codes

The auxiliary status codes are only seen in the RXSECSTATUS log. The two bits representing the auxiliary status codes give indication about the receiver state for information only. The bits typically do not cause degradation of the receiver performance. Bit 31 and bit 32 of the receiver status word corresponds to the auxiliary 1 and auxiliary 2 status words respectively.

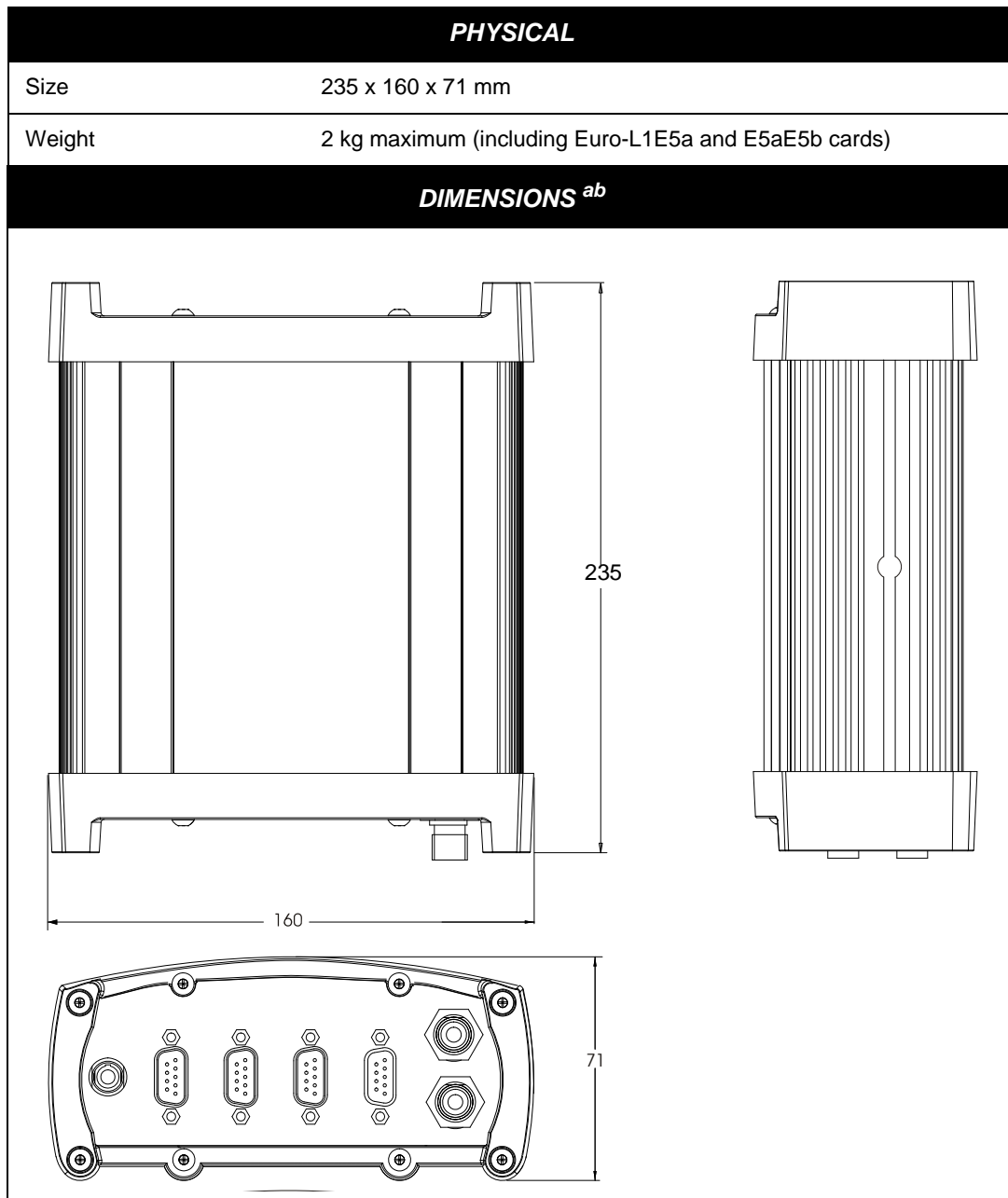
See the RXSECSTATUS log on *Page 93* for a more detailed descriptions of this log.

Table 51: Performance Specifications

PERFORMANCE	
<i>All values subject to GPS system characteristics</i>	
Frequency GPS Galileo	L1(1575.42 MHz), L5 (1176.45 MHz) L1 (1575.42 MHz), E5a (1176.45 MHz), E5b (1207.14 MHz)
Codes Tracked	GPS L1-C/A Code GPS L5 Code Galileo L1 Code Galileo E5a Code Galileo E5b Code GPS SVN (PRN 0-37) GEO SVN (PRN 120-138) Galileo SVN (PRN 0-51)
Satellite Tracking Channels	Up to 32 channels depending on the channel configuration, see <i>Table 18, Configuration Values on Page 53.</i>
Position Accuracy (stand-alone)	1.5 m CEP
Pseudorange Measurement Accuracy L1 C/A Narrow L1 C/A Wide L5 BOC L1 E5a E5b	10 cm RMS, C/No > 44 dB-Hz, DLL BW = 0.05 Hz 1 m RMS, C/No > 44 dB-Hz, DLL BW = 0.05 Hz 4 cm RMS, C/No > 44 dB-Hz, DLL BW = 0.05 Hz 7 cm RMS, C/No > 44 dB-Hz, DLL BW = 0.05 Hz 4 cm RMS, C/No > 44 dB-Hz, DLL BW = 0.05 Hz 4 cm RMS, C/No > 44 dB-Hz, DLL BW = 0.05 Hz
Single Channel Phase Accuracy L1 C/A L5 BOC L1 E5a E5b	3 mm RMS, C/No > 44 dB-Hz, Loop PLL = 3 Hz 3 mm RMS, C/No > 44 dB-Hz, Loop PLL = 3 Hz 3 mm RMS, C/No > 44 dB-Hz, Loop PLL = 3 Hz 3 mm RMS, C/No > 44 dB-Hz, Loop PLL = 3 Hz 3 mm RMS, C/No > 44 dB-Hz, Loop PLL = 3 Hz
C/No Accuracy L1C/A/L5/E5a/E5b/BOCL1	±2.5 dB, 30-65 dB-Hz
Raw Data Availability Rate L1SQM/L5/BOCL1/E5a/E5b Time Almanac Data	One phase and code measurement per second/per satellite One message per second < 15 minutes after reset
Time to First Fix	100 seconds (95%) with stabilized internal and external oscillators and initial time, almanac and position.
Re-acquisition L1 C/A L5 BOC L1 E5a E5b	5 seconds C/No = 44 dB-Hz 1σ 30 seconds C/No = 44 dB-Hz 1σ 60 seconds C/No = 44 dB-Hz 1σ 60 seconds C/No = 44 dB-Hz 1σ 60 seconds C/No = 44 dB-Hz 1σ
Height Measurements	Up to 18,288 metres (60,000 feet) maximum ^a

a. In accordance with export licensing.

A.1 EuroPak-15ab Enclosure



- a. All dimension are in millimeters, please use the *Unit Conversion* section of the *GPS+ Reference Manual* available on our website at <http://www.novatel.com/Downloads/docupdates.html> for conversion to imperial measurements.
- b. *Page 121* provides the dimension information for the mounting bracket.

INPUT/OUTPUT DATA INTERFACE	
COM1 AND COM2	
Electrical format	RS232
Bit rate^a	9600 (default), 19200, 38400, 57600, 115200, 230400 bps
Signals supported	TX, RX, RTS, CTS, DTR, DCD

a. Baud rates higher than 115,200 bps are not supported by standard PC hardware. Special PC hardware is required for higher rates, including 230,400 bps.

INPUT/OUTPUT STROBES	
MSR (Measure Output)	Normally high, active low where the pulse width is 1 ms. The falling edge is the receiver measurement strobe.
MKI (Mark Input)	An input mark (negative pulse > 55 ns), time tags output log data to the time of the falling edge of the mark input pulse.
PV (Position Valid)	Output indicates a 'good solution' or a valid GPS solution when high.
ERROR	Output that Indicates fatal error warning when high.
PPS (Pulse Per Second)	Normally high, active low pulse is 1 ms wide @ 1 Hz. Falling edge is used as the reference.
RESETOUT	Reset TTL signal output to external system; active high.
STROBE ELECTRICAL SPECIFICATIONS	
Output	Voltage: LVTTTL levels Low: minimum 0 VDC and maximum 0.55 VDC @ 24 mA High: minimum 2.4 VDC and maximum 3.6 VDC @ 8 mA
Input	Voltage: LVTTTL levels Low: minimum 0 VDC and maximum 0.8 VDC High: minimum 2.0 VDC and maximum 5.5 VDC

INPUT/OUTPUT CONNECTORS	
Antenna Input	TNC female jack, 50 Ω nominal impedance +5 VDC, 100 mA max (output from EuroPak-15ab to antenna/LNA)
PWR	4-pin LEMO connector EuroPak-15ab Input Voltage: +9 to +18 VDC Power Consumption: <20 W
COM1 COM2 AUX I/O OSC	DB9P connector DB9P connector DB9P connector (Reserved) DB9S connector BNC connector Oscillator input on the EuroPak-15ab Input Frequency 5 or 10 MHz ± 0.5 ppm Signal Level 0 to +13 dBm
ENVIRONMENTAL	
Operating Temperature	0°C to +40°C
Storage Temperature	-45°C to +95°C
Humidity	Not to exceed 95% non-condensing

A.1.1 Port Pin-Outs

Table 52: EuroPak-15ab Serial Port Pin-Out Descriptions

Connector Pin No.	COM1	COM2 ^a
1	Reserved	N/C
2	RXD1	RXD2
3	TXD1	TXD2
4	N/C	Reserved
5	GND	GND
6	Reserved	N/C
7	RTS1	RTS2
8	CTS1	CTS2
9	Reserved	N/C

a. The internal COM3 port is labelled COM2 on the EuroPak-15ab.

Table 53: EuroPak-15ab I/O Port Pin-Out Descriptions

Connector Pin No.	Signal Name	Signal Descriptions
1	Reserved	
2	PPS	Pulse per second
3	MSR	Measure output
4	MKI	Mark input
5	PV	Valid position available
6	Reserved	
7	RESETOUT	Reset output to an external system, active high
8	ERROR	Indicates a fatal error when high
9	GND	Digital ground

☒ For strobe signal descriptions, please see *Section 2.3.1, Strokes* on Page 29.

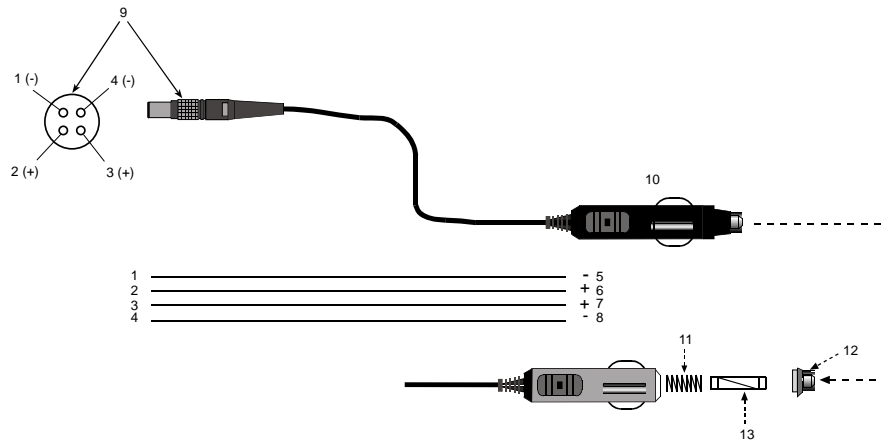
A.1.2 Cables

A.1.2.1 12V Power Adapter Cable (NovAtel part number 01017023)

The power adapter cable supplied with the EuroPak-15ab, see *Figure 16*, provides a convenient means for supplying +12 VDC while operating in the field.

Input is provided through the standard 12V power outlet. The output from the power adapter utilizes a 4-pin LEMO connector (LEMO part number FGG.0B.304.CLAD52Z) and plugs directly into the *PWR* input located on the back panel of the EuroPak-15ab.

For alternate power sources please see *Section 2.2.3 on Page 29*.



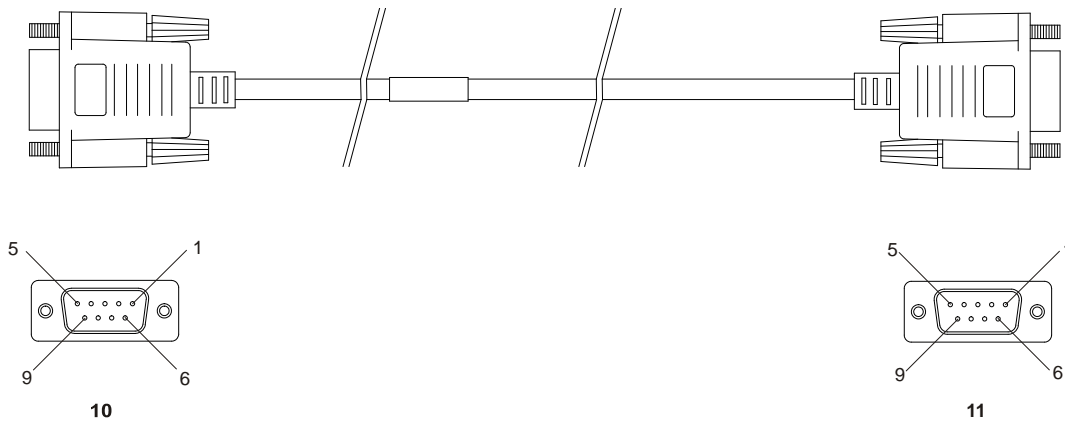
Reference	Description	Reference	Description
1	Black	5	Ground
2	Red	6	+9 to +18 VDC
3	Orange	7	+9 to +18 VDC
4	Brown	8	Ground
9	Connector key marking	12	Universal tip
10	12V adapter	13	6 Amp slow-blow fuse
11	Spring		



Figure 16: EuroPak-15ab Power Cable

A.1.2.2 Null-Modem Cable (NovAtel part number 60323062)

This cable supplied with the EuroPak-15ab, see *Figure 17*, provides an easy means of communications with a PC. The cable is equipped with a 9-pin connector at the receiver end which can be plugged into the *COM1*, *COM2*, or *AUX* port. At the PC end, a 9-pin connector is provided to accommodate a PC serial (RS232) communication port.



Wiring Table:

Connector	Pin Number						
To DB9S (10)	2	3	8	7	4	5	1 & 6
To DB9S (11)	3	2	7	8	1 & 6	5	4

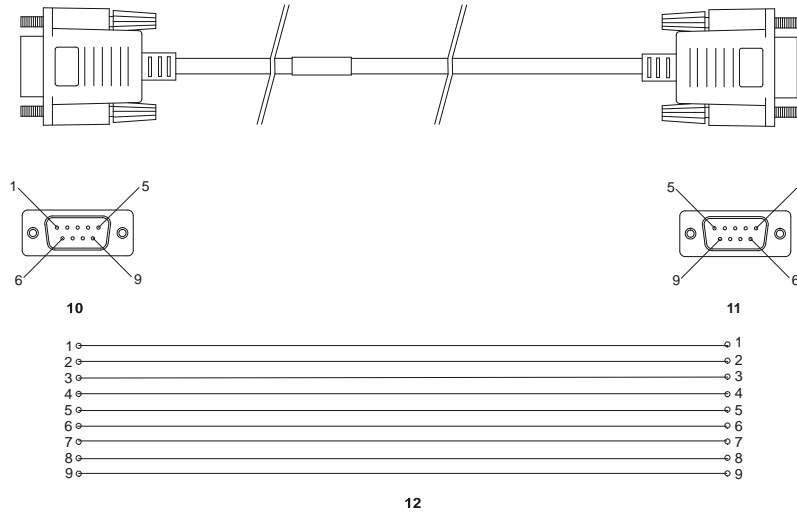
Reference	Description
10	DB9S (Female)
11	DB9S (Female)



Figure 17: EuroPak-15ab Null Modem Cable

A.1.2.3 Straight Through Serial Cable (NovAtel part number 60723066)

This cable can be used to connect the EuroPak-15ab to a modem or radio transmitter to propagate differential corrections. The cable is equipped with a female DB9 connector at the receiver end. The male DB9 connector at the other end is provided to plug into your user-supplied equipment (please refer to your modem or radio transmitter user guide for more information on its connectors). The cable is approximately 2 m in length. See *Figure 18*.



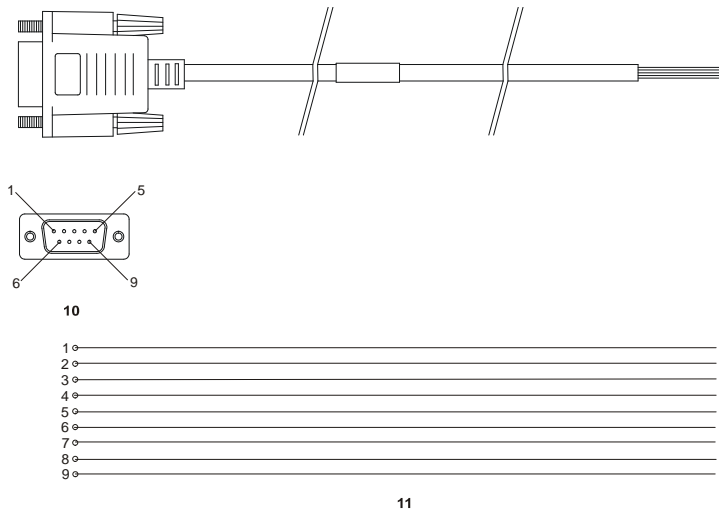
Reference	Description	Reference	Description
10	DB9P (male) connector	12	9-conductor cable
11	DB9S (female) connector		



Figure 18: EuroPak-15ab Straight Through Serial Cable

A.1.2.4 I/O Strobe Port Cable (NovAtel part number 60723065)

The strobe lines on the EuroPak-15ab can be accessed by inserting the male DB9 connector of the I/O strobe port cable into the I/O port. The other end of this cable is provided without a connector to provide flexibility. The jacket insulation is cut away slightly from the end but the insulation on each wire is intact. The cable is approximately 2 m in length. See *Figure 19*.



Wiring Table:

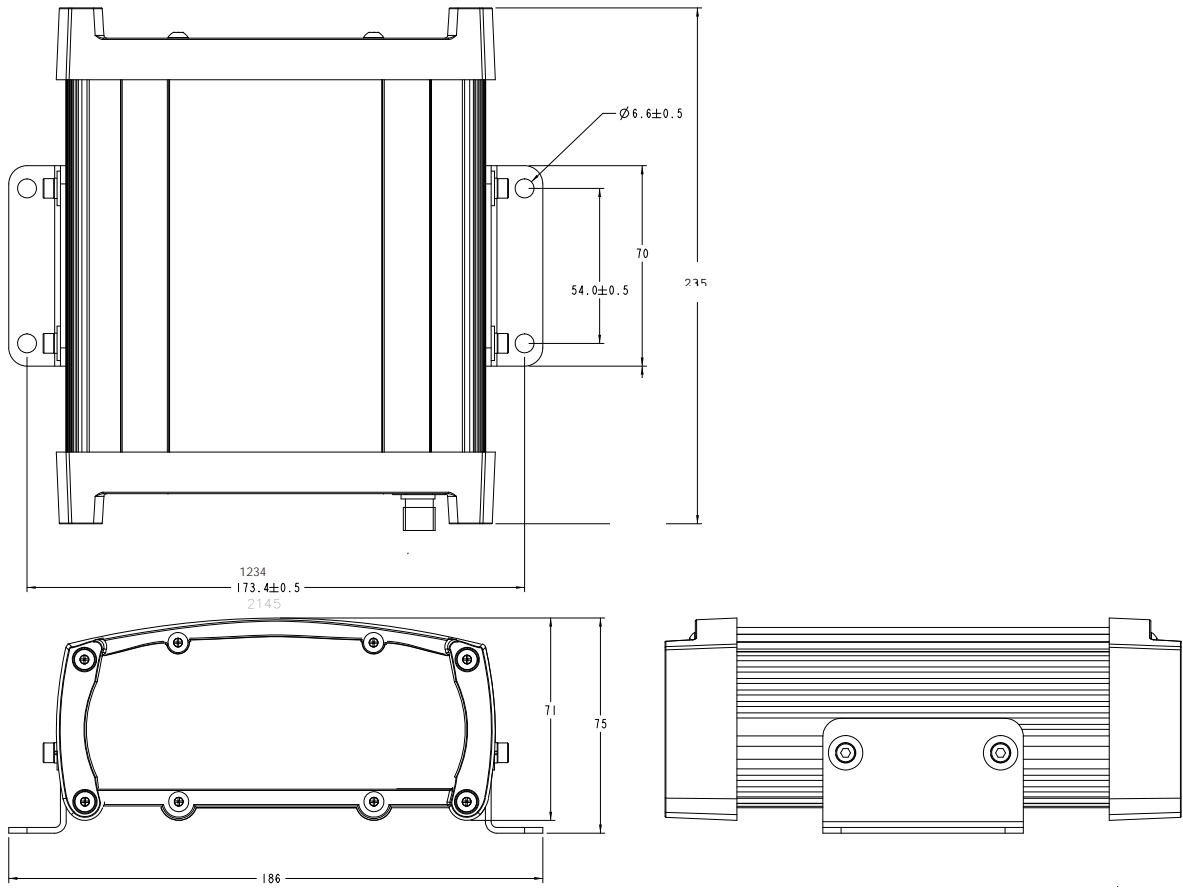
I/O Port Pin	I/O Port Signal	I/O Port Cable Wire Color	I/O Port Pin	I/O Port Signal	I/O Port Cable Wire Color
1	Reserved	Black	6	Reserved	Green
2	PPS	Brown	7	RESETOUT	Blue
3	MSR	Red	8	Error	Violet
4	MKI	Orange	9	GND	White/Grey
5	PV	Yellow			

Reference	Description	Reference	Description
10	DB9P (male) connector	11	9-conductor cable



Figure 19: EuroPak-15ab I/O Strobe Port Cable

A.1.3 Mounting Bracket Dimensions



A.2 Channel Assignments

Tables 55 through 59 show the mapping of signal channels for the different channel configurations.

Table 54: 10GALILEO6GPS Channel Configuration

Signal Channel	SV Channel	SV Type	Code	DLL Type	Frame	Nav Type	Symbol Rate	FEC	Sky Search
0	0	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
1	1	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
2	2	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
3	3	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
4	4	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
5	5	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
6	6	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
7	7	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
8	8	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
9	9	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
10	10	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
11	11	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
12	12	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
13	13	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
14	14	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
15	15	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto

Table 55: 16GPSL1L5 Channel Configuration

Signal Channel	SV Channel	SV Type	Code	DLL Type	Frame	Nav Type	Symbol Rate	FEC	Sky Search
0	0	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
1	1	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
2	2	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
3	3	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
4	4	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
5	5	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
6	6	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
7	7	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
8	8	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
9	9	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
10	10	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
11	11	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
12	12	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
13	13	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
14	14	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
15	15	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto

Table 56: 16GALILEOL1E5a Channel Configuration

Signal Channel	SV Channel	SV Type	Code	DLL Type	Frame	Nav Type	Symbol Rate	FEC	Sky Search
0	0	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
1	1	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
2	2	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
3	3	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
4	4	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
5	5	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
6	6	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
7	7	Galileo	L1	Narrow	GPS	Galileo	250	Yes	Auto
8	8	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
9	9	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
10	10	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
11	11	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
12	12	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
13	13	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
14	14	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto
15	15	Galileo	E5a	Narrow	GPS	Galileo	50	Yes	Auto

Table 57: 12GPS4GEO1L5 Channel Configuration

Signal Channel	SV Channel	SV Type	Code	DLL Type	Frame	Nav Type	Symbol Rate	FEC	Sky Search
0	0	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
1	1	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
2	2	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
3	3	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
4	4	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
5	5	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
6	6	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
7	7	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
8	8	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
9	9	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
10	10	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
11	11	GPS	L5 C5	Narrow	GPS	GPS	100	Yes	Auto
12	12	GEO	L1 C/A	Standard	WAAS	WAAS	500	Yes	Idle
13	13	GEO	L1 C/A	Narrow	WAAS	WAAS	500	Yes	Idle
14	14	GEO	L5 C5	Narrow	WAAS	WAAS	500	Yes	Idle
15	15	GEO	L5 C5	Narrow	WAAS	WAAS	500	Yes	Idle

Table 58: 8GPS8GEO Channel Configuration

Signal Channel	SV Channel	SV Type	Code	DLL Type	Frame	Nav Type	Symbol Rate	FEC	Sky Search
0	0	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
1	1	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
2	2	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
3	3	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
4	4	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
5	5	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
6	6	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
7	7	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
8	8	GEO	L1 C/A	Standard	WAAS	WAAS	500	Yes	Idle
9	9	GEO	L1 C/A	Standard	WAAS	WAAS	500	Yes	Idle
10	10	GEO	L1 C/A	Narrow	WAAS	WAAS	500	Yes	Idle
11	11	GEO	L1 C/A	Narrow	WAAS	WAAS	500	Yes	Idle
12	12	GEO	L5 C5	Narrow	WAAS	WAAS	500	Yes	Idle
13	13	GEO	L5 C5	Narrow	WAAS	WAAS	500	Yes	Idle
14	14	GEO	L5 C5	Narrow	WAAS	WAAS	500	Yes	Idle
15	15	GEO	L5 C5	Narrow	WAAS	WAAS	500	Yes	Idle

Table 59: 24GALILEO8GPS Channel Configuration

Signal Channel	SV Channel	SV Type	Code	DLL Type	Frame	Nav Type	Symbol Rate	FEC	Sky Search
0	0	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
1	1	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
2	2	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
3	3	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
4	4	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
5	5	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
6	6	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
7	7	GPS	L1 C/A	Narrow	GPS	GPS	50	No	Auto
8	8	Galileo	L1	Narrow	Galileo	Galileo	250	Yes	Auto
9	9	Galileo	L1	Narrow	Galileo	Galileo	250	Yes	Auto
10	10	Galileo	L1	Narrow	Galileo	Galileo	250	Yes	Auto
11	11	Galileo	L1	Narrow	Galileo	Galileo	250	Yes	Auto
12	12	Galileo	L1	Narrow	Galileo	Galileo	250	Yes	Auto
13	13	Galileo	L1	Narrow	Galileo	Galileo	250	Yes	Auto
14	14	Galileo	L1	Narrow	Galileo	Galileo	250	Yes	Auto
15	15 ^a	Galileo	L1	Narrow	Galileo	Galileo	250	Yes	Auto
16	16 ^a	Galileo	E5a	Narrow	Galileo	Galileo	50	Yes	Auto
17	17 ^a	Galileo	E5a	Narrow	Galileo	Galileo	50	Yes	Auto
18	18 ^a	Galileo	E5a	Narrow	Galileo	Galileo	50	Yes	Auto
19	19 ^a	Galileo	E5a	Narrow	Galileo	Galileo	50	Yes	Auto
20	20 ^a	Galileo	E5a	Narrow	Galileo	Galileo	50	Yes	Auto
21	21 ^a	Galileo	E5a	Narrow	Galileo	Galileo	50	Yes	Auto
22	22 ^a	Galileo	E5a	Narrow	Galileo	Galileo	50	Yes	Auto
23	23 ^a	Galileo	E5a	Narrow	Galileo	Galileo	50	Yes	Auto
24	24	Galileo	E5b	Narrow	Galileo	Galileo	250	Yes	Auto
25	25	Galileo	E5b	Narrow	Galileo	Galileo	250	Yes	Auto
26	26	Galileo	E5b	Narrow	Galileo	Galileo	250	Yes	Auto
27	27	Galileo	E5b	Narrow	Galileo	Galileo	250	Yes	Auto
28	28	Galileo	E5b	Narrow	Galileo	Galileo	250	Yes	Auto
29	29	Galileo	E5b	Narrow	Galileo	Galileo	250	Yes	Auto
30	30	Galileo	E5b	Narrow	Galileo	Galileo	250	Yes	Auto
31	31 ^a	Galileo	E5b	Narrow	Galileo	Galileo	250	Yes	Auto

a. You can use these signal channels to track the GIOVE-A test satellite.

B.1 Overview

Static electricity is electrical charge stored in an electromagnetic field or on an insulating body. This charge can flow as soon as a low-impedance path to ground is established. Static-sensitive units can be permanently damaged by static discharge potentials of as little as 40 volts. Charges carried by the human body, which can be thousands of times higher than this 40 V threshold, can accumulate through as simple a mechanism as walking across non-conducting floor coverings such as carpet or tile. These charges may be stored on clothing, especially when the ambient air is dry, through friction between the body and/or various clothing layers. Synthetic materials accumulate higher charges than natural fibers. Electrostatic voltage levels on insulators may be very high, in the order of thousands of volts.

Various electrical and electronic components are vulnerable to electrostatic discharge (ESD). These include discrete components, hybrid devices, integrated circuits (ICs), and printed circuit boards (PCBs) assembled with these devices.

B.2 Handling ESD-Sensitive Devices

ESD-sensitive devices must only be handled in static-controlled locations. Some recommendations for such handling practices follow:

- Handling areas must be equipped with a grounded table, floor mats, and wrist strap.
- A relative humidity level must be maintained between 20% and 80% non-condensing.
- No ESD-sensitive board or component should be removed from its protective package, except in a static-controlled location.
- A static-controlled environment and correct static-control procedures are required at both repair stations and maintenance areas.
- ESD-sensitive devices must be handled only after personnel have grounded themselves via wrist straps and mats.
- Boards or components should never come in contact with clothing, because normal grounding cannot dissipate static charges on fabrics.
- A circuit board must be placed into an anti-static plastic clamshell before being removed from the work location and must remain in the clamshell until it arrives at a static-controlled repair/test center.
- Circuit boards must not be changed or moved needlessly. Handles may be provided on circuit boards for use in their removal and replacement; care should be taken to avoid contact with the connectors and components.
- On-site repair of ESD-sensitive equipment should not be undertaken except to restore service in an emergency where spare boards are not available. Under these circumstances repair station techniques must be observed. Under normal circumstances a faulty or suspect circuit board must be sent to a repair center having complete facilities, or to the manufacturer for exchange or repair.
- Where protective measures have not been installed, a suitable alternative would be the use of a Portable Field Service Grounding Kit (for example, 3M Kit #8501 or #8507). This consists of a portable mat and wrist strap which must be attached to a suitable ground.
- A circuit board in a static-shielding bag or clamshell may be shipped or stored in a cardboard carton, but the carton must not enter a static-controlled area such as a grounded or dissipative bench top or repair zone. Do not place anything else inside the bag (for example, repair tags).
- Treat all PCBs and components as ESD sensitive. Assume that you will damage the PCB or component if you are not ESD conscious.
- Do not use torn or punctured static-shielding bags. A wire tag protruding through the bag could act as a "lightning rod", funneling the entire charge into the components inside the bag.
- Do not allow chargeable plastics, such as binders, within 0.6 m of unshielded PCBs.
- Do not allow a PCB to come within 0.3 m of a computer monitor.

B.3 Prime Static Accumulators

Table 60 provides some background information on static-accumulating materials.

Table 60: Static-Accumulating Materials

Work Surfaces	<ul style="list-style-type: none"> • formica (waxed or highly resistive) • finished wood • synthetic mats • writing materials, note pads, and so on
Floors	<ul style="list-style-type: none"> • wax-finished • vinyl
Clothes	<ul style="list-style-type: none"> • common cleanroom smocks • personal garments (all textiles) • non-conductive shoes
Chairs	<ul style="list-style-type: none"> • finished wood • vinyl • fiberglass
Packing and handling	<ul style="list-style-type: none"> • common polyethylene bags, wraps, envelopes, and bubble pack • pack foam • common plastic trays and tote boxes
Assembly, cleaning, and repair areas	<ul style="list-style-type: none"> • spray cleaners • common solder sucker • common soldering irons • common solvent brushes (synthetic bristles) • cleaning, drying and temperature chambers

B.4 Handling Printed Circuit Boards

ESD damage to unprotected sensitive devices may occur at any time. ESD events can occur far below the threshold of human sensitivity. Follow this sequence when it becomes necessary to install or remove a circuit board:

1. After you are connected to the grounded wrist strap, remove the circuit board from the frame and place it on a static-controlled surface (grounded floor or table mat).
2. Remove the replacement circuit board from the static-shielding bag or clamshell and insert it into the equipment.
3. Place the original board into the shielding bag or clamshell and seal it with a label.
4. Do not put repair tags inside the shielding bag or clamshell.
5. Disconnect the wrist strap.

GPS L5 SIGNAL SPECIFICATION REFERENCE

For copies of the Interface Control Document (ICD)-GPS-705, contact:

ARINC Research Corporation

Address: 2551 Riva Road
Annapolis, MD, USA
21401-7465

Telephone: 410-266-4000

Fax: 410-266-4049

Website: www.arinc.com

GEODETTIC SURVEY OF CANADA

Geodetic Survey of Canada

Address: 615 Boothe Street
Ottawa, ON, Canada
K1A 0E9

Telephone: (613) 995-4410

Fax: (613) 995-3215

Website: www.geod.emr.ca

U.S. NATIONAL GEODETTIC SURVEY

NGS Information Services

Address: 1315 East-West Highway
Station 9244
Silver Springs, MD, USA
20910-3282

Telephone: (301) 713-2692

Fax: (301) 713-4172

Website: www.ngs.noaa.gov

☒ Contact information may be subject to change however they are accurate at the time of publication.

Appendix D

Replacement Parts

The following are a list of the replacement parts available for your NovAtel GPS receiver. Should you require assistance or need to order additional components, please contact your local NovAtel dealer or Customer Service representative.

D.1 EuroPak-15ab

Part Description	NovAtel Part
I/O strobe cable (<i>Figure 19 on Page 120</i>)	60723065
Straight through serial data cable (<i>Figure 18 on Page 119</i>)	60723066
Null modem serial data cable (<i>Figure 17 on Page 118</i>)	60715062
Power cable: LEMO 4-pin socket to 12V power outlet plug (<i>Figure 16 on Page 117</i>)	01017023

D.2 Accessories

Part Description	NovAtel Part
Aviation Compact Disc with PC utilities	01017679
Optional RF Antenna Cables:	
5 meters	C006
15 meters	C016
30 meters.	C032
22 cm interconnect adapter cable	GPS-C002

D.3 Manufacturer's Part Numbers

The following original manufacturer's part numbers, for the EuroPak-15ab cables, are provided for information only and are not available from NovAtel as separate parts:

Part Description	LEMO Part
4-pin socket connector on power cable (<i>Figure 16 on Page 117</i>)	FGG.0B.304.CLAD52Z

Index

A

accumulated Doppler range (ADR), 84
accuracy
 corrections, 59
 position, 59
 time, 44
acquisition
 assignment, 51
 satellite, 51
 signal, 69
 times, 59
ADR, *see* accumulated Doppler range
AGCMODE command, 48
AGCSTATS log, 74
almanac
 log, 77
 reset, 61, 64
 time status, 43
ALMANAC log, 77
ambiguity, half cycle, 84
anomaly, 77, 101
antenna
 active, 24, 50
 altitude, 56
 cable, 26
 cable considerations, 26
 cables, 129
 card status, 110
 input, 115
 single-frequency, 26
anti-spoofing (AS), 77
anti-static, 126–127
ARINC, 128
array, clock model, 79
AS, *see* anti-spoofing
ASCII, 39
ASSIGN command, 51
asterisk, 38
asynchronous logs, 37
atmosphere, 56, 84
automatic channel assignment, 51
auxiliary status, 111
azimuth, 96

B

baseline, 33
Binary, 39–40, 88
bit rate, *see* bps
blinking, 24, 49
boot code, version, 102

bps, 54
break detection, 54
buffer, 37, 62
byte arrangements, 42

C

C/N0, *see* carrier to noise density ratio
cables
 antenna, 129
 coaxial, 24, 26
 extended cable lengths, 26
 warranty, 16
carrier phase, 84
carrier to noise density ratio (C/N0), 84, 100
CHANCONFIG command, 53
channel
 assigning, 51
 configuration, setting, 53
 control, 46, 72
 idle, 110
 range measurements, 84
 tracking status, 100
checksum, *see* cyclic redundancy check
circuit board, 127
clock
 aging parameter, 77
 dither, 57, 79
 error, 79
 internal, 44
 model, 79–80
 parameters, 57
 receiver, 99
 status, 72, 79
CLOCKMODEL log, 79
coaxial, 24, 26
COM command, 53–54
commands
 entering, 34
 formats, 38
 functional list, 46
 input, 33
 settings, 90
 summary, 47
communication, 46, 118
configuration
 additional equipment, 26
 antenna, 26
 channel, 53
 logging, 62
 overview, 19

- phase-lock-loop, 68
- receiver, 90
- reset, 61, 64, 66
- serial ports, 54
- status, 109
- connectors, 115, 117
- constellation, 80
- control
 - channel, 46
 - commands, 46
 - logs, 72
 - signals, 19
- conventions, document, 18
- corrected mean motion, 77
- corrections, accuracy, 59
- correlator technology, 86
- CPU, 37, 62
- CRC, *see* cyclic redundancy check
- Customer Service, 17
- cut-off angle, setting, 56
- cyclic redundancy check (CRC), 38–39, 44

D

- data, 54, 89
- DC, 24, 115
- defaults, 34, 114
- differential corrections, 101
- digital pulse blanking, 24
- DIMENSIONS, 113
- distance, 83
- dither, 79
- Doppler
 - assign, 51
 - instantaneous, 84
 - satellite visibility, 96
 - tracking status, 100

E

- eccentricity, 77
- echo, 54
- ECUTOFF command, 56
- electrostatic discharge (ESD), 126–127
- elevation
 - cut-off angle, 56
 - error, 101
 - satellite visibility, 96
 - tracking status, 100
- entering commands, 34
- ephemeris
 - health, 101
 - raw data, 88–89
 - reset, 61, 64

- time status, 43–44
- errors
 - card status, 110
 - clock, 57, 79
 - multipath, 84
 - range reject codes, 101
 - response messages, 35
 - tracking, 84
- ESD, *see* electrostatic discharge
- extended cable lengths, 26
- external oscillator, 25–29, 57, 95
- EXTERNALCLOCK, 57

F

- factory defaults, 34
- features, 24, 32
- fields, 18, 41
- filter, pseudorange, 100
- fine time, 44
- firmware, 102
- FIX command, 59
- flag, 50, 84
- formats, 38–39
- FRESET command, 61, 64
- functional overview, 24

G

- Galileo, 21, 89
- GEO processing, 24
- Geodetic Survey of Canada, 128
- GIOVE-A test satellite, 53, 125
- GPS
 - overview, 44
 - standards and references, 128
 - time, 39

H

- handshaking, 54
- hardware
 - interface, 22
 - reset, 61, 66
 - version, 102
- header, 18, 39–40, 111
- health, satellite, 77, 96, 101
- height, 59, 82–83
- hexadecimal, 18, 109
- hold, logs, 62

I

- I/O, 116
- identifier, ASCII, 38

impedance, 115
inclination angle, 77
INPUT, 114
input, 33, 115–116

L

latitude, 59, 82
LOADER utility, 106
local horizon, 56
lock, 69, 100
LOG command, 62
logs
 cancelling, 70–71
 configuring, 62
 formats, 38
 functional list, 72
 hold, 62
 summary, 73
 triggers, 37, 62
 types, 37
longitude, 59, 82
low noise amplifier (LNA), 50
LSB, 41
LVTTTL, 114

M

mark input (MKI), 114
memory, 34, 37, 61–62
message, 38, 77
MKI, *see* mark input
model
 clock, 79–80
 reset, 61, 64
 version, 102
month, 103
motion, mean, 77
MSB, 41
multipath, 26, 84

N

noise, 57, 80, 84
non-volatile memory (NVM), 34, 61
notices, 9
NovAtel Inc., 16

O

offset
 clock, 57, 79, 99
 Doppler, 51
ONCE trigger, 37
ONCHANGED trigger, 37
one pulse per second (1 PPS), time, 99

ONNEW trigger, 37
ONTIME trigger, 37
oscillator, 57, 79
output, 19, 115
overload, 37, 62
overview
 functional, 24
 SBAS, 19–20

P

parity, 54, 84, 88
performance specifications, 112
perigee, 77
period, 62
phase-lock-loop (PLL), 68, 94
polled logs, 37
ports
 COM, 33
 TIME, 99
 unlog, 71
position
 accuracy, 59
 base station, 33
 commands, 46
 fix, 59
 logs, 72
 pseudorange, 82
power, 26, 50, 101, 117
prerequisites, 18
processing, 25, 72
prompts, 31
pseudorange, 82, 84, 100
PULSEBLANKING command, 65

Q

quotation marks, 38

R

radio frequency (RF), 24–25, 110
range, 44, 79–80, 100
RANGE log, 84
RAWFRAME log, 88
receiver
 configuration, 90
 status, 37, 109
 version, 102
replacement parts, 129
reset, 34, 61, 64, 66, 110, 114
RESET command, 66, 68
residual, 100
response messages, 35
RF, *see* radio frequency

right ascension, 77
 rollover, GPS week, 18
 RXCOMMANDS log, 90
 RXSECSTATUS log, 93

S

Satellite-Based Augmentation System, *see*

SBAS

satellites

- acquisition, 51
- clock dither, 57
- commands, 46
- elevation cut-off, 56
- errors, 101
- PRN, 96
- raw, 88–89
- tracking, 72, 84
- transmit, 25
- visibility, 96

SATVIS log, 96

SBAS, 19–20

scope, 18

SDLLBW command, 67

self-test, 32

serial port, configuring, 54

setting, 48–49, 56

signals, 19, 69

specifications, 112

SPLLBW command, 67–68

standards, 128

start up, 34

static, 126–127

status

- channel tracking, 84, 100
- commands, 46
- receiver, 37, 39, 72

STHRESHOLD command, 69

stop bits, 54

subframe, 88–89

support, 16

synchronous logs, 37

SYSTEMLEVELS log, 98

T

test satellite, 53, 125

tests (built-in), 109, 111

threshold, 69

time

- acquisition, 59
- anomaly, 77
- CPU, 37, 62
- fine, 44

GPS, 79, 99

logs, 72

of ephemeris, 88

status, 39, 43–44

validity, 43

TIME log, 99

tracking

- assignment, 51
- channel, 84, 100
- commands, 46
- continuous, 84, 100
- cut-off angle, 56
- logs, 72
- loops, 84
- status, 100

TRACKSTAT log, 100

triggers, 37, 62

types, 37, 41

U

U.S. National Geodetic Survey, 128

UNASSIGN command, 69

UNLOG command, 70

UNLOGALL command, 71

V

VCTCXO, *see* oscillator

velocity, 83

VERSION log, 101–102

visibility, satellite, 96

voltage, 114

W

warnings, 9, 25–27

warranty, 16, 25

week

- almanac reference, 77

- ephemeris reference, 88

- GPS, 39–40

- rollover, 18

- time stamp, 43–44

weighting, pseudorange filter, 100

WGS84, 59

wide-area reference station, 19

word, 88

Y

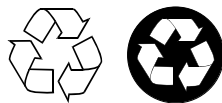
year, 103

Z

zero, 18, 41, 43, 67–69, 93



Recyclable



Printed in Canada on recycled paper