

# SF-3040

## GNSS Receiver Product User Guide



### NavCom Technology, Inc.

20780 Madrona Avenue  
Torrance, California 90503 USA

Tel: +1 310.381.2000

Fax: +1 310.381.2001

[sales@navcomtech.com](mailto:sales@navcomtech.com)

[www.navcomtech.com](http://www.navcomtech.com)

PN: 96-310036-3001

# NAVCOM

A John Deere Company

This page is left blank intentionally.

---

## Table of Contents

<b>Table of Contents.....</b>	<b>i</b>
<b>List of Figures .....</b>	<b>vi</b>
<b>List of Tables.....</b>	<b>viii</b>
Notices.....	x
Copyright .....	x
Trademarks .....	x
FCC Notice .....	xi
User Notice .....	xi
Limited Warranty .....	xii
StarFire™ Licensing .....	xii
Software License Agreement .....	xii
USG FAR.....	xiii
Global Navigation Satellite System .....	xiii
<b>Revision History.....</b>	<b>xiv</b>
<b>Use of This Document .....</b>	<b>xviii</b>
Related Documents .....	xviii
SF-3040 Quick Start Guide PN 96-310035-3001.....	xviii
StarUtil 3000 User Guide PN 96-310008-3001 .....	xviii
Sapphire Technical Reference Manual PN 96-3120001-3001 .....	xix
RINEXUtil User Guide PN 96-310021-2101 .....	xix
NavCom Release Notes .....	xix
Related Standards .....	xix
ICD-GPS-200 .....	xix
GLONASS ICD, Version 5.0, 2002.....	xx
RTCM-SC-104.....	xx
NTRIP .....	xx
CMR, CMR+ .....	xx
RINEX.....	xx
QZSS.....	xx
NMEA-0183 .....	xxi
Publicly Operated SBAS Signals.....	xxi
<b>Chapter 1     Getting Started .....</b>	<b>23</b>
SF-3040 Product Overview.....	25
Product Configuration Files .....	25
Connect the Equipment .....	26
Save Folder/Files to PC.....	29
Establish Communications .....	30
Determine Current Firmware Versions .....	34

---

Upload Firmware Files .....	36
Upload Software Options.....	40
Confirm Software Options Are Uploaded to the Receiver .....	43
Upload Software Options via the Input Terminal.....	44
Upload the StarFire License .....	44
Confirm StarFire Navigation .....	48
Factory Default User Profile.....	49
Upload a User Profile (optional) .....	49
Enable or Disable Receiver Tracking and/or Use of Select Signals and Frequencies .....	50
Enable or Disable Receiver Use of Signals and Frequencies for Navigation.....	51
<b>Chapter 2 Introduction/Features.....</b>	<b>53</b>
GNSS Receiver .....	53
Performance Upgrade Path.....	60
Accuracy .....	61
Features.....	62
Output Data Rate .....	62
Sapphire GNSS Binary Proprietary Data .....	62
Software Options .....	64
Bluetooth .....	65
SF-3040 Antenna.....	65
Controller .....	66
Antenna Phase Center Offsets.....	67
Applications .....	68
Land Survey and GIS .....	68
<b>Chapter 3 Interfacing.....</b>	<b>69</b>
Battery Power .....	69
Electrical Power .....	70
Proper Shutdown of the SF-3040.....	71
Power Cables .....	72
Communication Ports .....	75
Supplied USB Device Cable.....	76
Bluetooth Communications Setup .....	78
Logging Data to the Removable SD Card.....	83
Installing the Battery Packs in the SF-3040.....	88
SF-3040 Indicator Panel LEDs .....	88
<b>Chapter 4 Installation .....</b>	<b>94</b>
GNSS Receiver .....	94
Batteries .....	95
Integrated Antenna .....	95

---

Communication Port Connectivity .....	97
Auxiliary Communication Module (Internal UHF radio) .....	98
Basics of RTK Surveying .....	98
<b>Chapter 5 Configuration .....</b>	<b>100</b>
Factory Default Output Messages .....	102
Message Descriptions .....	103
Factory Default Settings .....	105
User Profiles .....	106
Profile NONE .....	107
Avoiding User Profile Loading Errors .....	108
Third-Party Controller Configuration Settings .....	108
Over the Air StarFire Licensing .....	108
Over the Air Broadcast .....	109
Verify License Is Saved .....	109
Setting Up a StarFire Priority Network .....	110
RapidRecovery .....	111
Failed Search .....	112
StarFire Network List .....	112
Enable or Disable Receiver Tracking and/or Use of	
Select Signals and Frequencies .....	113
Enable or Disable Receiver Use of Signals and	
Frequencies for Navigation .....	113
3 <sup>rd</sup> Party Controller Configuration Settings .....	114
<b>Chapter 6 Batteries .....</b>	<b>115</b>
Charging the Battery Packs .....	115
Battery Charger LEDs .....	116
Installing the Battery Packs in the SF-3040 .....	117
Removing the Battery Packs .....	119
Battery Usage and Storage Precautions .....	119
<b>Chapter 7 UHF Radio Modem .....</b>	<b>123</b>
Licensing Requirements .....	123
Radio Overview .....	123
Technical Specifications .....	125
RF Interface .....	126
Channel Spacing .....	127
Data Speed .....	127
Transmitter .....	127
Radio Modem Receiver .....	128
Priority RX/TX .....	129
Forward Error Correction (FEC) and Error	
Checking .....	129
Installing the Radio Modem .....	129

---

External Antenna .....	131
Removing the Radio Modem .....	132
<b>Chapter 8 Safety Instructions .....</b>	<b>133</b>
Safety First.....	133
Transport .....	134
Maintenance .....	134
External Power Source .....	134
Battery Disposal.....	135
<b>A GNSS Receiver Specifications.....</b>	<b>137</b>
Features.....	137
Time-to-First-Fix (TTFF) Specifications .....	139
Dynamics .....	139
Measurement Performance .....	139
Pull-in Times.....	142
StarFire Rapid Recovery.....	142
User-Programmable Output Rates.....	143
Data Latency .....	143
Bluetooth .....	143
Connector Assignments .....	143
Input/Output Data Messages.....	144
Satellite Based Augmentation System Signals .....	144
Physical and Environmental .....	145
Battery Packs .....	145
<b>B Antenna Specifications .....</b>	<b>148</b>
Radiation Pattern.....	150
<b>C StarFire™ .....</b>	<b>152</b>
Description.....	152
Infrastructure .....	153
Reliability .....	155
StarFire Satellites .....	157
How to Access the StarFire™ Service .....	158
<b>D Networked Transport of RTCM Internet Protocol (NTRIP) Setup.....</b>	<b>161</b>
Configure the SF-3040 for Wireless Connection .....	161
Configure the NTRIP Server .....	162
Configure the NTRIP Client.....	162
<b>E Software License Agreement.....</b>	<b>165</b>
GNSS receiver Embedded Software License Agreement .....	165
Open Source Software License Appendix.....	173
<b>F RoHS Certification.....</b>	<b>187</b>
Description.....	187

---

RoHS 认证 .....	196
<b>Glossary .....</b>	<b>205</b>

## List of Figures

Figure 1: SF-3040, Bottom View.....	26
Figure 2: SF-3040 Connectors, Detail.....	27
Figure 3: SF-3040, Rear View .....	28
Figure 4: Indicator Panel .....	29
Figure 5: NavCom Sub-Folders on PC .....	30
Figure 6: StarUtil 3000, Connections Button .....	31
Figure 7: Port Configuration.....	32
Figure 8: StarUtil 3000 Communication Window.....	33
Figure 9: Connection at Incorrect Baud Rate .....	33
Figure 10: Receiver Options Tab .....	34
Figure 11: Example of Installed Firmware.....	35
Figure 12: Firmware Folder .....	35
Figure 13: Receiver Options Tab .....	37
Figure 14: File Upload – Unified File Loader, Selected UFL File .....	37
Figure 15: Firmware Folder .....	38
Figure 16: Ready to Downline Load File .....	38
Figure 17: Finished With All Downline Loads.....	39
Figure 18: Software Options .....	40
Figure 19: Software Options File .....	40
Figure 20: Software Options File to Upload .....	41
Figure 21: Successful Software Options Upload .....	41
Figure 22: Software Options Window .....	42
Figure 23: StarFire Licenses Window .....	42
Figure 24: Position, Velocity, Time Menu Item.....	45
Figure 25: Navigation Status Window .....	45
Figure 26: Navigation Modes Menu Item .....	46
Figure 27: StarFire Navigation Mode ON.....	46
Figure 28: StarFire License .....	47
Figure 29: Successful StarFire License Upload .....	48
Figure 30: StarFire Menu Item .....	48
Figure 31: Nav Mode: StarFire .....	49
Figure 32: SF-3040 Top View .....	66
Figure 33: Indicator Panel On/Off Button .....	71
Figure 34: Proper External Power Source Setup ....	72
Figure 35: DC Power Cable (Optional) .....	72



Figure 36: SF-3040 Bottom View .....	73
Figure 37: Automotive DC Power Cable with Cigarette Lighter Adapter (Optional) .....	74
Figure 38: Universal AC-DC Power Adapter Cable (Optional) .....	74
Figure 39: AC Two-Prong Power Cord (optional, with AC/DC adapter cable) .....	74
Figure 40: COM2 Serial Cable (Standard).....	75
Figure 41: USB Device Cable (Supplied) .....	76
Figure 42: Search for Bluetooth Devices in Range..	79
Figure 43: Bluetooth Serial Port .....	80
Figure 44: Bluetooth Properties.....	81
Figure 45: Bluetooth Port Configuration .....	82
Figure 46: Input Terminal – PING Command and Response .....	83
Figure 47: SD Card Chamber Release Button.....	84
Figure 48: SD Card Slot.....	84
Figure 49: SF-3040 Indicator Panel.....	88
Figure 50: SF-3040 Indicator Panel, Detail.....	89
Figure 51: Communication Port Connections .....	97
Figure 52: Battery Pack Dual-Bay Charger .....	115
Figure 53: Battery Chamber Release Button.....	117
Figure 54: SF-3040 Battery Packs Installed in Battery Chamber .....	118
Figure 55: Radio Modem.....	125
Figure 56: Radio Modem Chamber Release Button .....	130
Figure 57: Radio Modem Installation.....	130
Figure 58: Radio Modem Installed in SF-3040 .....	131
Figure 59: SF-3040 Antenna Polar Plot (Radiation Pattern) .....	150
Figure 60: StarFire™ Network.....	159
Figure 61: DTE to DCE RS-232 Pin Assignments .	208

## List of Tables

Table 1: Supplied Equipment.....	23
Table 2: Optional Equipment .....	24
Table 3: External Power Cable Pin-Out .....	70
Table 4: Optional Power Cables .....	72
Table 5: Pin Assignments – All Power Cables .....	72
Table 6: Pin Assignments – USB & COM1 .....	75
Table 7: Pin Assignments – COM2.....	76
Table 8: Pin Assignments – USB Device Cable Pin Assignments (Supplied) .....	77
Table 9: Bluetooth Connectivity LED Indication .....	83
Table 10: Data Logging Input Commands .....	85
Table 11: RTK LED Indicator.....	89
Table 12: Power/GNSS LED Indicator .....	89
Table 13: Data Link LED Indicator .....	90
Table 14: StarFire LED Indicator .....	90
Table 15: Battery Pack LED Indicator.....	91
Table 16: Factory Default NCT Messages/Responses .....	102
Table 17: StarFire Satellites v.2.0.15.0 and Later .	112
Table 18: StarFire Satellites v.3.0.12.0 and Later .	113
Table 19: Battery Charger LED Indicators .....	116
Table 20: UHF Radio Modem Kit, PN 92-210206- 3001LF .....	124
Table 21: Antenna Selection.....	124
Table 22: UHF Radio Modem Specifications .....	125
Table 23: Transmission Output Power Values, Watts vs. dBm .....	127
Table 24: Receiver Sensitivity .....	128
Table 25: Battery Maximum Charging Time.....	146
Table 26: Battery Charger Specifications.....	146
Table 27: SF-3040 Integrated Antenna.....	148
Table 28: StarFire Satellites v. 1.0.1.5 and Earlier	157
Table 29: StarFire Satellites v. 2.0.15.0 and Later	157
Table 30: StarFire Satellites v.3.0.12.0 and Later .	157
Table 31: Toxic or Hazardous Substances or Elements Disclosure by Part Number .....	187

表32：按部件号列出的有毒或危险物质或原件.....197

## Notices

SF-3040 GNSS Receiver Product User Guide

PN 96-310036-3001

Revision F

August, 2014

Serial Number: \_\_\_\_\_

Date Delivered: \_\_\_\_\_

Purchased From: \_\_\_\_\_

## Copyright

© 2014 by NavCom Technology, Inc.

All rights reserved. No part of this work or the computer program(s) described herein may be reproduced, stored, or transmitted by any means without the expressed written consent of the copyright holders. Translation in any language is prohibited without the expressed written consent of the copyright holders.

## Trademarks

'find your way', 'NavCom Globe' and 'NAVCOM TECHNOLOGY' logos are trademarks of NavCom Technology, Inc. StarFire™ is a registered trademark of Deere & Company. All other product and brand names are trademarks or registered trademarks of their respective holders.

## FCC Notice

This device complies with Part 15 Subpart B Class B of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

The GNSS receiver has been tested in accordance with FCC regulations for electromagnetic interference. This does not guarantee non-interference with other equipment. Additionally, the GNSS receiver may be adversely affected by nearby sources of electromagnetic radiation.

The Global Positioning System (GPS) is under the control of the United States Air Force. Operation of the GPS satellites may change at any time without warning.

## User Notice

NavCom Technology, Inc. shall not be responsible for any inaccuracies, errors, or omissions in information contained herein, including, but not limited to, information obtained from third party sources, such as publications of other companies, the press, or competitive data organizations.

This publication is made available on an “as is” basis, and NavCom Technology, Inc. specifically disclaims all associated warranties, whether express or implied. In no event will NavCom Technology, Inc. be liable for direct, indirect, special, incidental, or consequential damages in connection with the use of or reliance on the material contained in this publication, even if advised of the possibility of such damages. NavCom

Technology, Inc. reserves the right to make improvements or changes to this publication and the products and services herein described at any time, without notice or obligation.

## Limited Warranty

NavCom warrants that its products will be free from defects in material and workmanship at the time of delivery. A full description of the warranty policy is provided in NavCom's *Standard Terms & Conditions of Sale For NavCom Products* in force at the time of sale. Please contact your NavCom dealer or NavCom [Sales](#) for a copy of the warranty policy for your specific product. Please include your model and serial number, approximate date of purchase, and the dealer name where the unit was purchased through so that we may better service this request.

## StarFire™ Licensing

The StarFire signal requires a subscription and software option that must be purchased in order to access the service. Licenses are non-transferable, and are subject to the terms of the StarFire Signal License agreement. For further details on the StarFire Signal Network, its capabilities, terms and conditions visit [www.navcomtech.com](http://www.navcomtech.com) or send an email inquiry to [sales@navcomtech.com](mailto:sales@navcomtech.com)

## Software License Agreement

By powering on and using this GNSS StarFire™ Receiver, you agree to the terms and conditions of the NavCom Technology, Inc. GNSS Receiver Software License and Open Source Software Licenses. The complete terms and conditions of these software licenses may be found in the *SF-3040 GNSS Receiver Product User Guide*, Appendix E.

## USG FAR

### Technical Data Declaration (Jan 1997)

The Contractor, NavCom Technology, Inc., hereby declares that, to the best of its knowledge and belief, the technical data delivered herewith under Government contract (and subcontracts, if appropriate) are complete and accurate and comply with the requirements of the contract concerning such technical data.

### Global Navigation Satellite System

Global Navigation Satellite Systems (i.e., GPS and GLONASS) are under the control of the respective Governmental agencies, and the operation of these satellites may be changed at any time without warning.

GPS Selective availability (S/A code) was disabled on 02 May 2000 at 04:05 UTC. The United States government has stated that present GPS users use the available signals at their own risk.

The U.S. State Department International Traffic in Arms Regulations (ITAR) regulations limit the performance of commercial GNSS products. As a result, access to satellite measurements and navigation results will be limited from display and recordable output when predetermined values of velocity and altitude are exceeded. These threshold values are far in excess of the normal and expected operational parameters of the SF-3040 GNSS receiver.

## Revision History

Rev. G (Aug 2016)	<p>Appendix A: Updated Rapid Recovery specification</p> <p>Chapter 2: Updated Rapid Recovery specification</p> <p>Chapter 3: Update to battery power</p> <p>Remove RTG from Glossary</p>
Rev. F (Aug 2014)	<p>Chapter 1: Changed Figures 27 and 31 to eliminate StarFire RTG</p> <p>Chapter 2: Changed StarFire Over IP to one server/caster.</p> <p>Added RapidRecovery with QuickStart feature.</p> <p>Updated battery pack specs.</p> <p>Chapter 3: Added part numbers for cables.</p> <p>Chapters 4 &amp; 7: Deleted reference to 10W UHF radio.</p> <p>Appendix A: Corrected StarFire Single specs, changed RTK Extend operating time to 15 minutes for non-NavCom bases.</p> <p>Added note regarding RTK Extend maximum performance.</p> <p>Added specs and note for RTK-WL mode</p> <p>Deleted StarFire Single specs.</p> <p>Appendix B: Updated phase center information in Table 27</p> <p>Appendix C: Added StarFire ITRF-2008 transition information.</p>
Rev. E (Apr 2013)	<p>Corrected the LEMO 7-Pin USB Device Cable and LEMO 6-Pin COM2 Serial Cable part numbers.</p>



	<p>Added Appendix E: RoHS certification (both English and Chinese).</p> <p>Added Table 31: Toxic or Hazardous Substances or Elements Disclosure by Part Number (both English and Chinese)</p> <p>Chapter 2: Added RapidRecovery feature</p> <p>Chapter 4 and 7: Added 1W radio range considerations</p> <p>Chapter 5: Added RapidRecovery feature</p> <p>Chapter 6: Added two notes regarding charging batteries 12 hours prior to use.</p> <p>Appendix A: Added RapidRecovery specs</p> <p>Added note regarding 16GB SD card.</p> <p>Added note disclaiming UHF range from baseline lengths</p>
Rev. D (Nov 2012)	<p>Chapter 2: Added definition for DTM in Standard and Proprietary sections under NMEA-0183. Added description of StarFire Over IP.</p> <p>Added reference to ITRF-2008 datum.</p> <p>Chapter 5: Added note under NMEA messages that in software version 3.2.7 and greater, the NMEADTM will change at the same rate as the fastest NMEA message scheduled by user.</p> <p>Appendix A: Added DTM to the list of standard NMEA-0183 data strings. Added note regarding message scheduling. Added note on hardware altitude restriction. Added correction to</p>

	<p>frequency operation under Measurement Performance. Added StarFire Over IP in features.</p> <p>Removed all references to Galileo, E1 and E5A.</p> <p>Updated StarFire Satellite list and graphic.</p>
Rev. C (Dec 2011)	<p>Chapter 2, SF-3040 Antennae, added a new link for the antennae calibration values</p> <p>Corrected the LEMO 7-Pin USB Device Cable and LEMO 6-Pin COM2 Serial Cable part numbers</p> <p>Chapter 2, 3, and Appendix A: added Bluetooth operation information</p> <p>Chapter 7: Added a note regarding antenna selection</p> <p>Table 19: updated with new antenna part numbers</p> <p>Table 21: Added notes regarding UHF radio bandwidths and modulation schemes</p> <p>Table 24: updated sensitivity</p> <p>Added a note to External Antenna</p> <p>Appendix A: updated <i>Measurement Performance</i> with StarFire GNSS</p>
Rev. B (May 2011)	<p>Chapter 2: corrected Bluetooth operational range</p> <p>Chapter 3: added a Note regarding missing cable pins</p> <p>Chapter 3: corrected unterminated power cable rating</p> <p>Corrected battery operating time from 5hrs to 2.5hrs each (Chapter 3, Appendix A)</p>

	Chapter 8: corrected cleaning agent statement Appendix D: added REFSTNPOS command to Server setup sequence
Rev. A (Apr 2011)	Initial release

---

## Use of This Document

This User Guide is intended to be used by someone familiar with the concepts of GPS and satellite surveying equipment.



This symbol designates a Note that provides additional information to make better use of the product.



This symbol means Reader Be Careful, and indicates a caution, care, and/or safety situation. The user might do something that could result in equipment damage or loss of data.

Revisions to this User Guide can be obtained in digital format from

<http://www.navcomtech.com/Support/>

## Related Documents

### SF-3040 Quick Start Guide PN 96-310035-3001

Provides instructions to quickly set up the standard configuration of the SF-3040

### StarUtil 3000 User Guide PN 96-310008-3001

Describes the operation and use of NavCom's Windows-based control program (included on USB drive)

## Sapphire Technical Reference Manual PN 96-3120001-3001

Describes the control and output data message formats utilized by this instrument (for customer programming purposes; included on USB drive)

## RINEXUtil User Guide PN 96-310021-2101

Describes the conversion program used on NavCom proprietary output data message formats, to RINEX ver 2.10 observation and navigation files (for customer programming purposes; included on USB drive)

## NavCom Release Notes

Describes software updates for NavCom products. Current and archived Release Notes are available on the NavCom web site:

<http://www.navcomtech.com/Support/DownloadCenter.cfm?category=releasenotes>.

NavCom Customer Support provides software updates described in the Release Notes. Submit a request for software updates via the Request Support web page.

## Related Standards

### ICD-GPS-200

NAVSTAR GPS Space Segment /Navigation User Interfaces Standard. ARINC Research Corporation; 2250 E. Imperial Highway; El Segundo, California 90245

---

## GLONASS ICD, Version 5.0, 2002

Russian Space Agency, Information Analytical Center  
Internet: <http://www.glonass-ianc.rsa.ru/>

## RTCM-SC-104

Recommended Standards for Differential GNSS  
Service. Radio Technical Commission for Maritime  
Services; 1800 N. Kent St, Suite 1060; Arlington,  
Virginia 22209

## NTRIP

Radio Technical Commission for Maritime Services  
(RTCM) Standard 10410.0 (RTCM Paper 200-  
2004/SC104-STD, Version 1.0 for Networked  
Transport of RTCM via Internet Protocol (Ntrip)

Radio Technical Commission for Maritime Services  
(RTCM) Standard 10410.1 (RTCM Paper 111-2009-  
SC104-STD, Version 2.0 for Networked Transport of  
RTCM via Internet Protocol (Ntrip)

## CMR, CMR+

Compact Measurement Record; Trimble Navigation  
Limited; 935 Stewart Drive; Sunnyvale, CA 94085

## RINEX

Receiver Independent Exchange Format;  
Astronomical Institute of the University of Berne

## QZSS

Quasi Zenith Satellite System. Japan Aerospace  
Exploration Agency (JAXA). 7-44-1 Jindaiji Higashi-  
machi, Chofu-shi, Tokyo 182-8522.

## NMEA-0183

National Marine Electronics Association Standard for Interfacing Marine Electronic Devices. NMEA National Office; 7 Riggs Avenue; Severna Park, Maryland 21146

## Publicly Operated SBAS Signals

### RTCA/DO-229D

The Radio Technical Commission for Aeronautics (RTCA) develops consensus-based recommendations regarding communications, navigation, surveillance, and air traffic management (CNS/ATM) system issues.

RTCA. 1828 L Street, NW, Suite 805, Washington, DC 20036. RTCA. 1828 L Street, NW, Suite 805, Washington, DC 20036.

These organizations implement the RTCA/DO-229D standard set by RTCA:

### WAAS (Wide Area Augmentation System)

U.S. Department of Transportation. Federal Aviation Administration. 800 Independence Ave, SW, Washington, DC 20591

### EGNOS (European Geostationary Navigation Overlay Service)

European Space Agency. 8, 10 rue Mario-Nikis, F-75738 Paris Cedex 15, France

### MSAS (MTSAT Satellite-based Augmentation System)

Japan Civil Aviation Bureau. Ministry of Transport. Kasumigaseki 2-1-3, Chiyoda-ku, Tokyo 100, Japan

---

## GAGAN (GPS Aided Geo Augmented Navigation)

Indian Space Research Organization. Antariksh  
Bhavan, New Bel Road, Bangalore - 560 094, India



## Chapter 1 ..... Getting Started

This chapter provides instructions on enabling the robust functionality of the SF-3040.

- ✓ Confirm that all ordered equipment is delivered.  
Refer to these tables for detailed lists:

- *Supplied Equipment:* See Table 1.
- *Optional Equipment:* See Table 2.

*Table 1: Supplied Equipment*

1	SF-3040 Pole-Mount GNSS Receiver (PN 90-209549-01)
2	LEMO 7-Pin USB Device Cable Coiled 6 ft (PN 96-212169-01)
3	LEMO 6-Pin COM2 Serial Cable with hardware handshake 6 ft (PN 96-212238-01)
4	Two Li-Ion Batteries, 7.4V, 2600 mAh (PN 98-214946)
5	Battery Charger Kit (PN 98-214401) Kit includes: Dual-Bay Battery Charger Charger Power Supply w/ cord, 100 – 240 VAC; 50/60 Hz Car Adapter w/ cord
6	SD Memory Card, 2 GB (PN 25-212850)
7	SF-3040 Software Documentation USB thumb drive (PN 82-043000-0001)
8	SF-3040 Quick-Start Guide (PN 96-310035-3001 – hard copy)

*Table 2: Optional Equipment*

1	LEMO 2-Pin Universal AC/DC Adapter 100 V-240VAC, 12 VDC, 6 ft (North American 2-prong) (PN 96-212171-01)
2	Power Cord for AC/DC Adapter (North American 2-prong)
3	LEMO 2-Pin DC Power Cable, unterminated, 10 ft (PN 96-212172-01)
4	LEMO 2-Pin Automotive DC Power Cable, with cigarette lighter adapter (PN 96-212178-01)
5	LEMO 7-Pin USB Cable, 6 ft (PN 96-212177-01)
6	LEMO 7-Pin COM 1 Serial Cable, 6 ft (PN 96-212170-01)
7	UHF Radio Module Kit (PN 92-210206-3001LF)

See Chapter 3 for detailed information on the power cables.



If any items are missing or damaged, immediately contact NavCom Customer Support:

Telephone: +1 (310) 381-2000

Web:

<http://www.navcomtech.com/Contact/ContactSupport.cfm>



Consult your dealer to determine if the SF-3040 is already fully configured. If it is configured, the SF-3040 is ready to use. To get started, refer only to the sections below to connect equipment and operate the receiver.



If the SF-3040 is not dealer-configured, the receiver is not operational until the steps in this chapter are performed.

## SF-3040 Product Overview

The robust, lightweight, versatile SF-3040 is NavCom's latest addition to its family of GPS/GLONASS/StarFire Network-capable satellite receivers.

A basic SF-3040 software package, plus three distinct software option offerings, provide today's surveyor with everything needed:

- ✓ *Basic Software:* L1/L2, G1 (G2 or L5), StarFire Ready
- ✓ *Option:* L1/L2, G1 (G2 or L5), StarFire Ready plus RTK, including Network RTK
- ✓ *Option:* L1/L2, G1 (G2 or L5), StarFire Ready plus RTK, including Network RTK, and RTK Extend
- ✓ *Option:* Upgrade from 5Hz to 10Hz measurements and position

## Product Configuration Files

All of the files needed to set up the ordered configuration of the SF-3040 are included on the SF-3040 Product Configuration USB Thumb Drive (PN 82-043000-0001). The main product configuration files are as follows:

- ✓ *Firmware (\*.s19):* the most current firmware
- ✓ *Software Options (\*.opt):* The options enable the functionality of the SF-3040. Software Options may be purchased individually.
- ✓ *StarFire License (\*.lic):* The SF-3040 is hardware-ready for StarFire. The StarFire License *and* the StarFire Software Option are required to enable the StarFire Subscription Service.



The StarFire License is optional and not included in the price of the SF-3040.

- ✓ StarUtil 3000 (Starutil 3000\_v1,1,x.exe): NavCom's Windows-based control program is used to upload the product configuration files.
- ✓ USB Driver (navcomx1c45x3040.inf)
- ✓ User Profiles (\*.npt): The SF-3040 is already configured with a factory default user profile. If desired, replace the factory default user profile with a predefined profile, or create a profile. Predefined user profiles are available on the USB flash drive or by email.



Refer to Chapter 5 of the *StarUtil 3000 User Guide* for detailed information about user profiles.

## Connect the Equipment



*Figure 1: SF-3040, Bottom View*



POWER    USB/COM1    COM2

*Figure 2: SF-3040 Connectors, Detail*

*Refer to Figure 1 and Figure 2 for the steps below.*

1. Connect one of the two supplied communications cables:

- ✓ USB Device Cable (PN 96-212169-01): Connect the 7-pin LEMO connector end to the USB-COM1 port on the bottom of the SF-3040. Plug the USB end into the PC.

*Or*

- ✓ COM2 Serial Cable (PN 96-212238-01): Connect the 6-pin LEMO connector end to COM2 port on the bottom of the SF-3040. Connect the DB9S end to the PC.



*Figure 3: SF-3040, Rear View*



Refer to Chapter 3 for details on the communication ports. Refer to the Bluetooth Communications Setup section for details on setting up the Bluetooth™ connection.



Refer to Appendix A for additional considerations and restrictions.

Perform these steps to set up power:

1. Fully charge the battery pack for 12-hours after each use (refer to Charging the Battery Packs in this guide, if necessary).
2. Insert the batteries into the battery slot (refer to Figure 54, if necessary).
3. Optional: Plug the optional AC power cord into the optional Universal AC/DC power adapter.

Connect the male LEMO connector end of the Power Adapter cable into the female connector (labeled PWR) on the bottom of the SF-3040. Plug the AC power cord into an AC receptacle.



The purchase of a separate appliance cable may be necessary if the VAC plug configuration needed is not the standard 2-prong American connector.

4. Press the front panel On/Off switch to turn on the SF-3040. All front panel LEDs illuminate for a period of 3 to 5 seconds during power-up. The Power/GNSS Status LEDs change from **red** (starting up) to **green** (power is on). (Refer to Figure 4).



All indicator panel LEDs change from **red** to **green** when power is ON.

*Figure 4: Indicator Panel*

## Save Folder/Files to PC

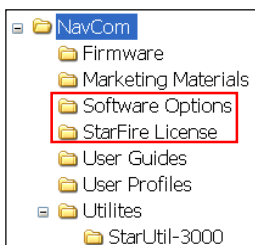


The SF-3040 Product Configuration USB flash drive includes the following:

- Root Directory: Software Options File and StarFire License (if purchased)
- NavCom Folder: Includes these sub-folders: Firmware, Marketing Materials, Utilities, User Guides, and User Profiles

1. Plug the SF-3040 Product Configuration USB flash drive into the PC.

2. Browse to the USB Flash Drive.
3. Save the Software Options File, StarFire License (if purchased), and NavCom folder to the PC.
4. On the PC, create two folders in the NavCom folder for the Software Options file and the StarFire License file (refer to Figure 5) and place each file in its appropriate folder.



*Figure 5: NavCom Sub-Folders on PC*



Only Software Options and StarFire License files are sent via email. All other files are available either on NavCom's website or via Customer Support.

## Establish Communications

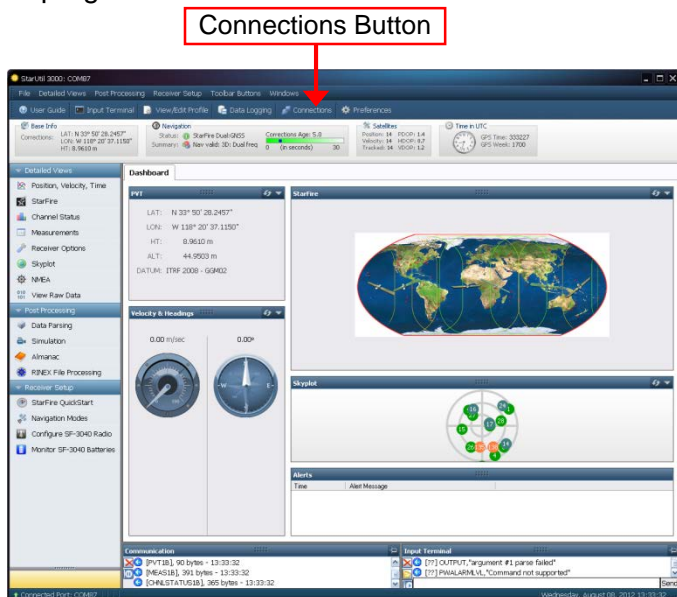
1. Browse to the folder Navcom\Utilities\StarUtil 3000 on the PC.
2. Ensure that these files are in the StarUtil 3000 folder: "StarUtil3000\_v1,1,x.exe" (program executable file), "navcomx1c45x3040.inf" (USB driver), 96-312007-3001Revx\_Sapphire TRM.pdf, and 96-310029-3001Revx\_StarUtil3000.pdf.



The USB driver must be in the same folder as StarUtil 3000 for the USB port to auto-recognize the SF-3040.



- Double-click “Starutil3000\_v1,1,x.exe” to open the program.

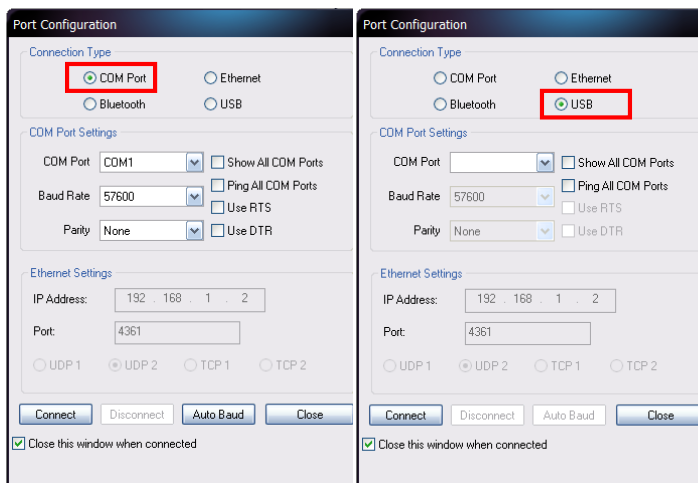


*Figure 6: StarUtil 3000, Connections Button*

- Click the **Connections** button to establish communications between the PC and the SF-3040 (refer to Figure 6). The **Port Configuration** dialog box opens.

*Refer to Figure 7 for the steps below:*

- Depending on the current connection type, select **COM Port** or **USB**.




COM Port Settings


USB Settings

*Figure 7: Port Configuration*

6. Set the appropriate options according to the *Connection Type*:

- COM Port (on the PC):
  - COM2 (on the SF-3040)
  - Baud Rate: 57600 (keep the default)
  - Parity: None (keep the default)
- Click  to connect.

Or

- USB (on the PC)
  - USB-COM1 (on the SF-3040)
  - Baud Rate: 57600 (keep the default)
  - Parity: None (keep the default)
- Click  to connect.

- Verify that the SF-3040 is connected to the PC:  
Scrolling messages in the *Communication* window indicate that a valid connection is established at the required baud rate (refer to Figure 8).

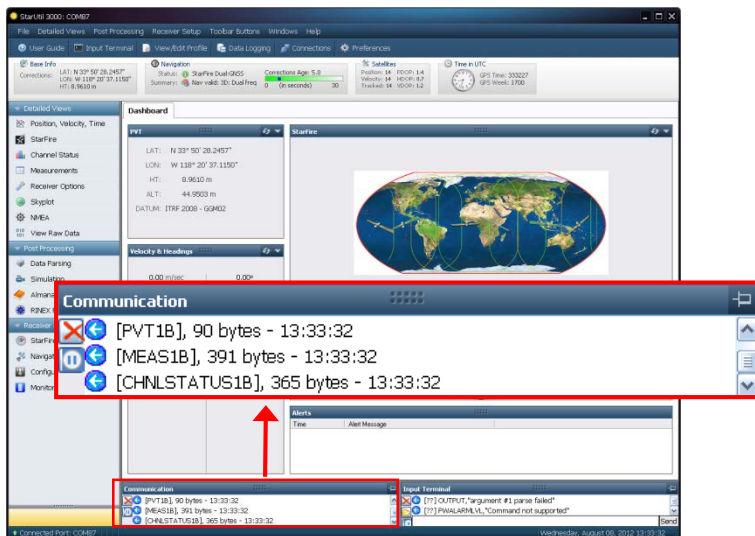


Figure 8: StarUtil 3000 Communication Window



A blue arrow indicates messages received by the GUI. A green arrow indicates messages sent by the GUI.



**COM Port Connection:** Scrolling lines designated as “DATA” indicate a connection is established but the baud rate is not correct (refer to Figure 9). Reopen the *Port Configuration* dialog box. Click  or  to connect.

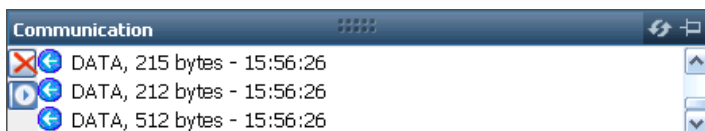


Figure 9: Connection at Incorrect Baud Rate

## Determine Current Firmware Versions

The user determines if the most current firmware is installed in the SF-3040. The version of the installed firmware is important to ensure the proper operation of the receiver.

In StarUtil 3000, checking the contents of the *Firmware Info* window (refer to Figure 10) on the *Receiver Options* tab is the easiest way to determine if the installed firmware is the most current.

1. Click *Receiver Options* on the *Detailed Views* menu to open the *Receiver Options* tab (refer to Figure 10).

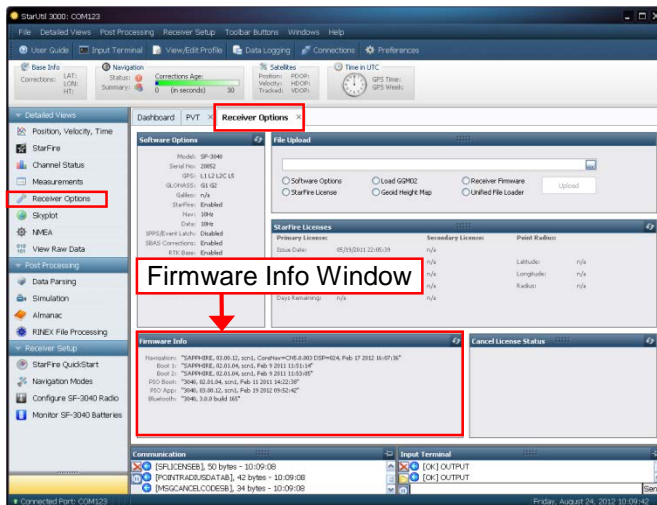



Figure 10: Receiver Options Tab

2. Click  (refresh) on the *Firmware Info* window to view the current output data (refer to Figure 11).



The firmware is identified by version number. For example, the NAV firmware in the example below is version 02.01.01.006.

NAV Firmware Version

Click the Refresh Button

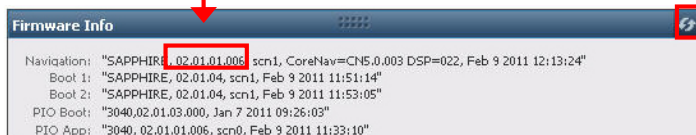


Figure 11: Example of Installed Firmware

3. Browse to the NavCom\Firmware folder on the PC (refer to Figure 5). The Firmware folder is copied from the SF-3040 Product Configuration USB Flash Drive. It contains the *most current firmware* (refer to Figure 12). The firmware file extension is \*.s19.

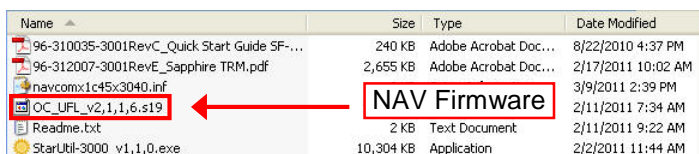


Figure 12: Firmware Folder



Open the Readme.txt file for additional information.

4. Compare the current NAV Firmware version in the Firmware folder with the installed version displayed in the *Firmware Info* window (refer to Figure 11 and Figure 12).

5. If the NAV firmware installed in the receiver is *not* the most current version:
  - Check the versions of the other firmware.
  - Write down all of the firmware that must be updated.
  - Go to the section below, [Upload Firmware](#).

## Upload Firmware Files



The required PC Baud rate to upload firmware via the supplied DB9S cable (RS-232) on COM2 is 57600 (default). This requirement does not apply to the supplied USB 2.0 Device cable.

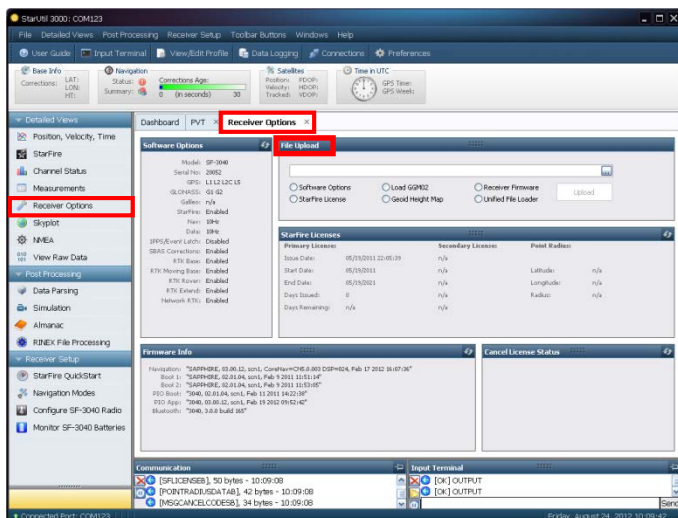


The receiver must be navigating at the time of the firmware upload. While the firmware will be accepted and applied properly, option and license files require date and timestamp verification.



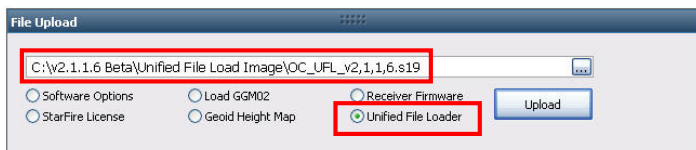
Typically, if any firmware needs to be updated, it is NAV and PIOAPP.

1. Click *Receiver Options* on the *Detailed Views* menu to open the *Receiver Options* tab (refer to Figure 13).




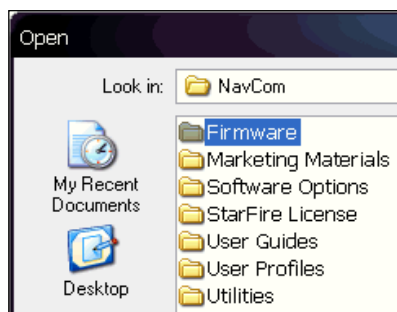
*Figure 13: Receiver Options Tab*

2. Select *Unified File Loader* on the *File Upload* window (refer to Figure 14).




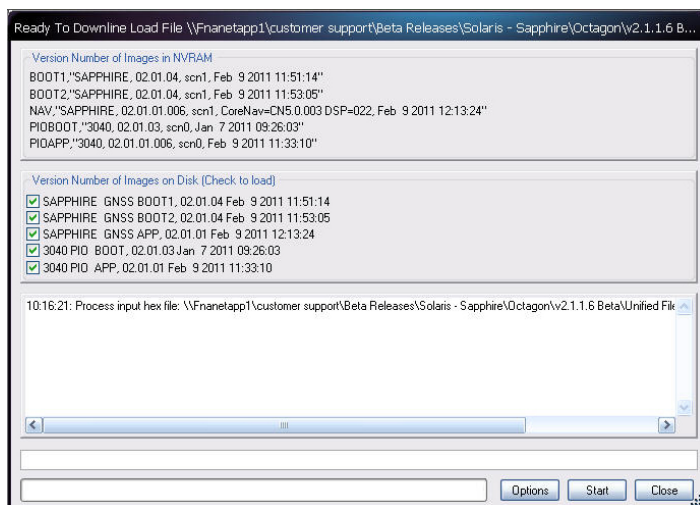
*Figure 14: File Upload – Unified File Loader, Selected UFL File*

3. Click .
4. Browse to the NavCom\Firmware folder on the PC (refer to Figure 15).



*Figure 15: Firmware Folder*

5. Select the unified file (UFL) to upload and click  (refer to Figure 14 to view the selected UFL file).
6. The files to be uploaded are displayed on the *Ready to Downline Load File* dialog box with their corresponding check boxes selected (refer to Figure 16). Select and deselect files as necessary.

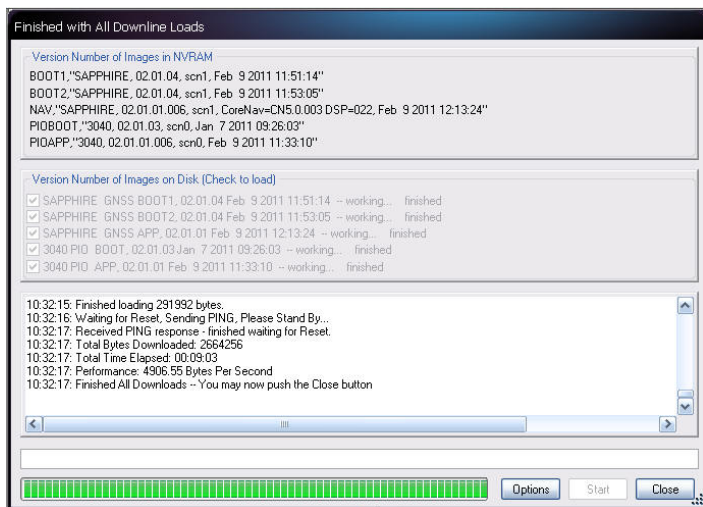


*Figure 16: Ready to Downline Load File*


7. Click .



8. Once the firmware files have been uploaded, the *Finished with All Downline Loads* dialog box showing all the files that were uploaded is displayed (refer to Figure 17).



*Figure 17: Finished With All Downline Loads*

9. Click .
10. Check the *Firmware Info* window (refer to Figure 11) to view the current versions of all uploaded firmware.

## Upload Software Options

Software options may be purchased individually.



Software Options must be uploaded before uploading the StarFire License, if purchased.




The receiver must be navigating at the time of the software options upload.

1. Select *Software Options* on the *File Upload* window (refer to Figure 18).



*Figure 18: Software Options*

2. Click .
3. Browse to the Software Options file on the PC. The Software Options file extension is \*.opt (refer to Figure 19 for an example .opt file).


Name	Size	Type	Date Modified
NavCom		File Folder	3/21/2011 11:20 AM
SN12345-PCS577.lic	1 KB	LIC File	3/21/2011 11:21 AM
SN12345-PCS1149.opt	1 KB	OPT File	3/21/2011 11:20 AM

*Figure 19: Software Options File*

4. Select the Software Options file. The path to the file appears in the upload field (refer to Figure 20).

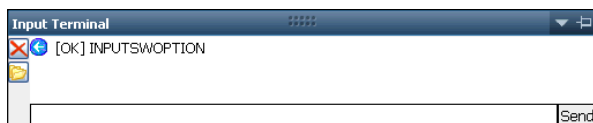


*Figure 20: Software Options File to Upload*


5. Click . At the end of the upload, a confirmation box is displayed. Click *OK* on the confirmation box.

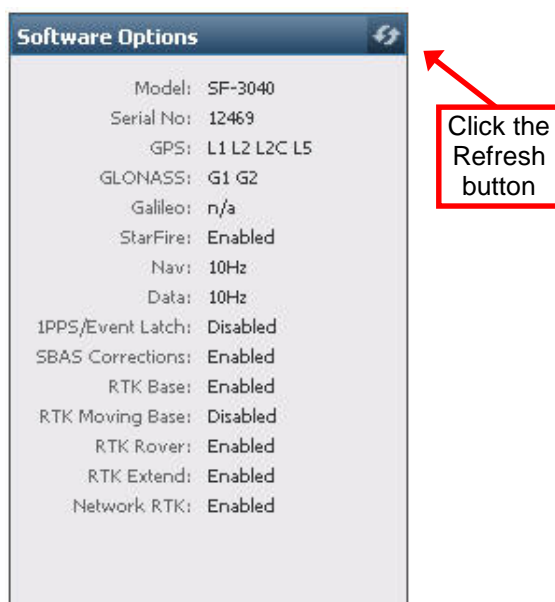


The *Input Terminal* window also displays the outcome of the upload (refer to Figure 21). In the example below, the upload is successful. Refer to the *Sapphire Technical Reference Manual* for detailed information on the INPUTSWOPTION command (see *Related Documents* in the fore-matter).



*Figure 21: Successful Software Options Upload*

6. Click  (refresh) on the *Software Options* window (refer to Figure 22), and check to ensure that all uploaded software options are displayed.



*Figure 22: Software Options Window*



“StarFire: Enabled” indicates that the StarFire Software Option is loaded. It does not indicate that a StarFire License is installed. The StarFire license information is displayed in the “StarFire Licenses” window of the Receiver Options tab (refer to Figure 23).

StarFire Licenses			
Primary Licenses:		Secondary Licenses:	Point Radius:
Issue Date:	01/12/2011 21:53:35	n/a	
Start Date:	01/12/2011	n/a	Latitude: n/a
End Date:	01/12/2012	n/a	Longitude: n/a
Days Issued:	0	n/a	Radius: n/a
Days Remaining:	n/a	n/a	

*Figure 23: StarFire Licenses Window*

7. Do not close StarUtil 3000. Perform one of these steps:
  - If a StarFire License is purchased, go to the *Upload the StarFire License* section.
  - If a StarFire License is not purchased, go to the *Factory Default User Profile* section.

## Confirm Software Options Are Uploaded to the Receiver



The SF-3040 returns the entire list of loaded software options. However, StarUtil 3000 may not display the entire list in the *Software Options* window. Follow the below steps to confirm that all software options successfully uploaded to the receiver:

1. Type the command [INPUTSWOPTION] on the *Input Terminal* window.
2. Click *Send*.
3. Highlight and copy the entire output.
4. Open any text editor (e.g., Microsoft Notepad) and paste the output there to verify that all software options have been uploaded to the receiver.



If the above method fails to upload any of the purchased software options, refer to the next section.

## Upload Software Options via the Input Terminal

Perform steps 1 through 5 under Upload Software Options

Open the software option file in any text editing program (e.g., Microsoft Notepad).

1. Locate the option code at the bottom of the file (e.g., 74C91E91 789FA173 8E70296A 3259B2E6).
2. Highlight and copy the option code.
3. Enter the command [INPUTSWOPTION] on the Input Terminal window and then paste the option code: 74C91E91 789FA173 8E70296A 3259B2E6.
4. Click Send on the Input Terminal window. If the software options loaded successfully, the *Input Terminal* window displays a confirmation message (refer to Figure 21).

## Upload the StarFire License



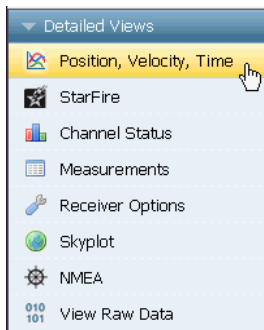
For the initial configuration, the StarFire license must be installed via data cable. Subsequent renewals of the license are typically transmitted to the receiver via radio broadcast. Refer to *Chapter 5* for details.




The receiver must be Tracking GPS satellites and providing a valid position solution at the time of the StarFire license upload to accept the license.

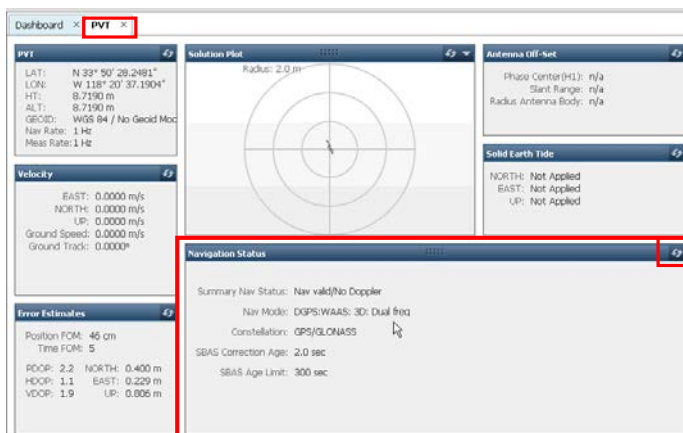
1. To confirm a valid position solution on the *PVT* tab/*Navigation Status* window, click *Position*,

*Velocity, Time* (refer to Figure 24) on the *Detailed Views* menu to open the PVT tab (refer to Figure 25).

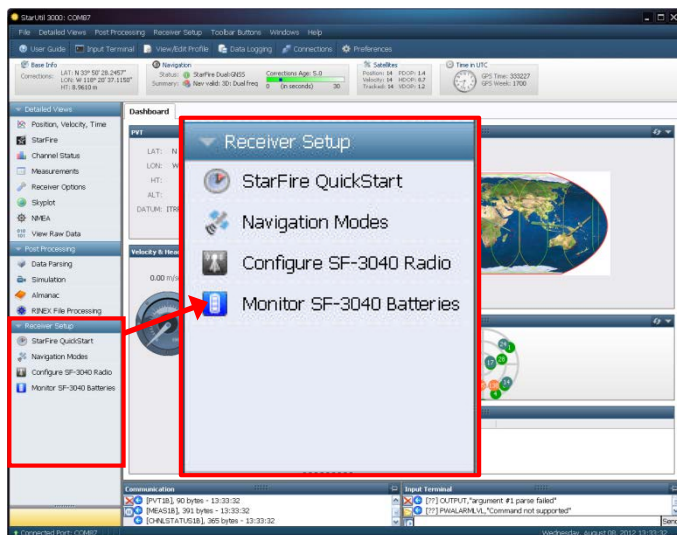


*Figure 24: Position, Velocity, Time Menu Item*

- Click  (refresh) on the *Navigation Status* window to ensure that the current position solution is displayed (refer to Figure 25).

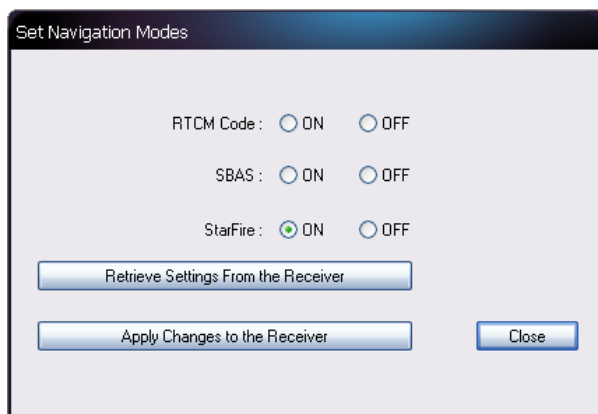


*Figure 25: Navigation Status Window*



*Figure 26: Navigation Modes Menu Item*

2. Click *Navigation Modes* on the *Receiver Setup* menu to open the *Set Navigation Modes* dialog box (refer to Figure 27).



*Figure 27: StarFire Navigation Mode ON*

*Refer to Figure 27 for the steps below:*



3. Click the *Retrieve Settings From the Receiver* button to retrieve the currently set navigation modes from the receiver.
4. Select the ON radio button next to StarFire if StarFire is not enabled.
5. Click the *Apply Changes to the Receiver* button to enable StarFire navigation. Then click *Close*.
6. Select *StarFire License* in the *File Upload* window on the *Receiver Options* tab (refer to Figure 28).

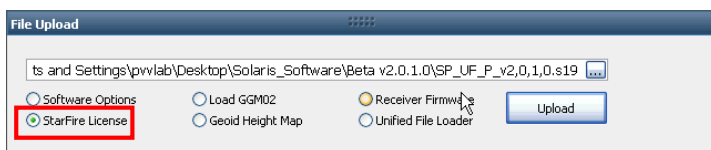



Figure 28: StarFire License

7. Click .
8. Browse to NavCom\StarFire License on the PC. The StarFire License file extension is \*.lic.
9. Select the StarFire License file. The path to the file appears in the upload field (see Figure 28).
10. Click the *Upload* button. At the end of the upload, a confirmation box opens. Click *OK*.



The *Input Terminal* window displays the outcome of the upload (refer to Figure 29). In the example below, the upload is successful. Refer to the *Sapphire Technical Reference Manual* for detailed information on the INPUTSFLICENSE command (see *Related Documents* in the fore-matter).

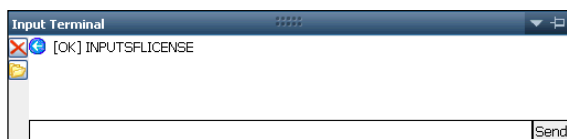


Figure 29: Successful StarFire License Upload

11. Ensure that the purchased StarFire License is loaded. These tabs provide license information:

- *Receiver Options* tab: *StarFire Licenses* and *License Status* windows
- *StarFire* tab: *License Info* window



To open the *StarFire* tab, click *StarFire* in the *Detailed Views* menu (refer to Figure 30).

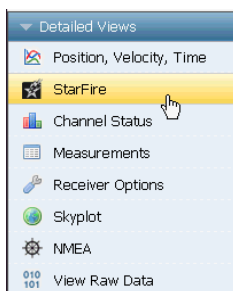


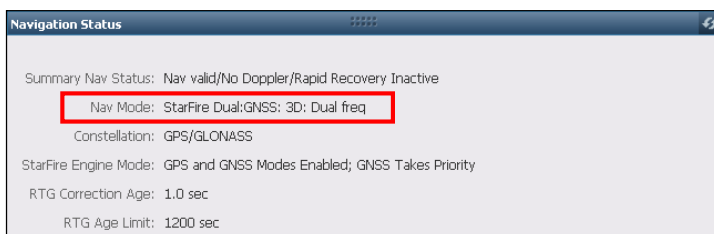
Figure 30: StarFire Menu Item

## Confirm StarFire Navigation

Click *Position, Velocity & Time* on the *Detailed Views* menu (see Figure 24) to determine if the receiver is navigating in *StarFire* mode. The *PVT* tab opens (refer to Figure 31).



The receiver enters *StarFire* mode approximately 3 minutes after it is first turned on; then the convergence period starts.



*Figure 31: Nav Mode: StarFire*



The Nav Mode: *StarFire Dual:GNSS: 3D: Dual freq* in Figure 31 indicates that the receiver is navigating in StarFire dual frequency with a 3D position fix, which is very accurate.

## Factory Default User Profile

Further configuration is not necessary for this initial use of the SF-3040. The receiver is preconfigured with a factory default user profile that includes settings for the various port assignments/parameters, navigation parameters, and output message lists.



If the SF-3040 does not function properly, refer to these online tools:

- [Troubleshooting Guides](#)
- [User Manuals](#)

Contact the authorized dealer or NavCom Customer Support (refer to the beginning of this chapter for contact information).

## Upload a User Profile (optional)

If desired, replace the factory default user profile with a predefined profile, or create a new profile. Refer to the *StarUtil 3000 User Guide* for detailed instructions.



Predefined user profiles are available in the Navcom\User Profiles folder saved on the PC from the SF-3040 Product Configuration USB Flash Drive.

## Enable or Disable Receiver Tracking and/or Use of Select Signals and Frequencies

Receiver tracking of various signals and frequencies can be enabled or disabled.

Refer to the [TRACKINGMODE] and [NAVMEASURE] commands in the *Sapphire Technical Reference Manual* for detailed instructions on enabling and disabling the tracking of and receiver use of various signals and frequencies. Also refer to the *StarUtil 3000 User Guide*.



These commands are used primarily for engineering experiments or receiver testing. They are not recommended for use in other applications.

## Enable or Disable Receiver Use of Signals and Frequencies for Navigation

Receiver use of various signals and frequencies for navigation can be enabled or disabled.

Refer to the [NAVMEASUSE] command in the *Sapphire Technical Reference Manual* for detailed instructions on enabling and disabling navigation signals and frequencies. Also refer to the *StarUtil 3000 User Guide*.

This command is used primarily for engineering experiments or receiver testing. It is not recommended for use in other applications.

This page is left blank intentionally.

## Chapter 2.....Introduction/Features

### GNSS Receiver



(rear view)

The lightweight SF-3040 GNSS receiver delivers unmatched accuracy to the precise positioning community. This unique unit is designed to use NavCom's StarFire™<sup>1</sup> network, a worldwide Satellite Based Augmentation System (SBAS) for decimeter-level position accuracy (post-convergence period). The receiver is also capable of RTK, RTCM (code and phase), and CMR/CMR+ DGPS operating methods. The operating software supports an optional internal UHF radio modem. Refer to Chapter 7 for details on the removable radio modem.

The ability to receive NavCom's unique StarFire correction service is fully integrated within each unit. A single set of corrections can be used globally enabling a user to achieve decimeter level positioning accuracy without the need to deploy a separate base station, thus saving time and capital expenditure.



The StarFire license is not included in the price of the SF-3040.

StarFire position outputs are referenced to the ITRF2008 datum and to the GRS80 ellipsoid.

The SF-3040 pole-mounted GNSS receiver with integrated antenna is suitable for use in multiple outdoor applications where it will be subjected to continuous operation in dust, water-splash, and rain (but not complete immersion), temperature variations, and sunlight/UV radiation (refer to Environmental Specifications in Appendix A).

Applications include the following:

- pole-mounted static and dynamic land survey
- pole-mounted offshore/marine survey
- pole-mounted GNSS base station

The SF-3040 consists of the following:

- ✓ All-in-one housing incorporates the compact GNSS antenna
- ✓ 66-channel, multi-frequency, precision GNSS/SBAS receiver
- ✓ StarFire™ L-Band receiver<sup>1</sup>

The SF-3040 Global Navigation Satellite Systems (GNSS) receiver delivers superior accuracy to the precise positioning community. This unique receiver is designed with a robust and long-term performance upgrade path to meet changing needs via software upgrades. Increased functionality does not typically require the costly purchase of additional hardware.

The SF-3040 software-enabled features, purchased individually, cover a wide variety of applications.



Software option and subscription not included in the price of the SF-3040.

The SF-3040 is uniquely suited for real-time applications in areas such as surveying, precise positioning, and construction. The receiver delivers the required millimeter measurement precision and fast update rates at low data latency. The SF-3040 provides the flexibility to be configured as a base station or as a rover.

Superior interference suppression (both in-band & out-band), multipath mitigation, and measurement accuracy are only a few of the receiver's technological advances. The SF-3040 GNSS engine incorporates several patented innovations advancing



the existing GNSS technology to the next generation. The receiver provides near optimal GPS P-code recovery, providing a significant signal-to-noise ratio advantage over competing technologies, among other benefits.

With appropriate software options, the receiver is capable of the following:

- ✓ **NavCom's StarFire Network:** A worldwide Satellite Based Augmentation System (SBAS) for decimeter level position accuracy (post-convergence period). Refer to Chapter 5 for detailed information.
- ✓ **RTK:** This unique receiver is designed to integrate easily into real-time kinematic (RTK<sup>1</sup>), field data verification, topographical surveys, and a wide variety of surveying applications. The system resolves ambiguities at startup or on satellite reacquisition typically within 2 seconds. The SF-3040 delivers centimeter level position accuracy via external RTK<sup>1</sup> correction formats. The receiver is capable of Sapphire GNSS RTK/UltraRTK™, RTCM 2.3 and 3.0 (code and phase), RTCM 3.1, types 1001-1012, 1019, 1020, and 1033 (Network RTK<sup>1</sup>), and CMR/CMR+ DGPS operating methods.



*<sup>1</sup>Dependent on the bundle:* A separate software option is required. The Network RTK software option allows the receiver to generate and receive RTCM 1000-series messages. The navigation algorithms are designed to support single-base correction configurations. Network adjusted RTK formats are not currently supported.

- ✓ **Internal and External UHF Radio:** The operating software is also capable of supporting an internal

radio modem and an external radio modem. Refer to Chapter 7 for detailed information.

- ✓ **Signal Reception:** The SF-3040 GNSS engine includes a digital ASIC to handle high speed signal processing.
- ✓ **StarFire Over IP:** The StarFire network is available over the internet. When a data collection device with internet access is connected to the SF-3040 with supporting software (i.e. FieldGenius or SurvCE), an independent StarFire server/caster can be accessed through four mount points. A choice of three data delivery rates ensures maximum reliability.
- ✓ **RapidRecovery:** Rapid Recovery is a feature designed for NavCom's Sapphire GNSS engine generation of products, which includes the SF-3040 and SF-3050 GNSS receivers. Rapid Recovery is to StarFire operation as RTK-Extend is to RTK operation. Rapid Recovery is a StarFire operating feature to improve navigation capability after a brief StarFire outage.

*Background:* While StarFire satellite delivered augmentation signals for precision positioning has been available since the year 2000, interruption of the GNSS navigation signal from navigation satellites by natural or man-made structures causes full re-convergence of StarFire navigation without Rapid Recovery to the final precision capability. The timeframe required to re-converge after such a shading event made StarFire undesirable for many operational applications. Hence, the develop need and opportunity for Rapid Recovery.

Rapid Recovery seeks to mitigate the full re-convergence time associated with brief

interruptions in satellite navigation caused by bridges, short tunnels, entry and exit from tree-lines and other similar operational environments. The technology takes advantage of lessons learned from introducing moving base RTK which produces highly accurate relative positioning between two moving platforms, whether moving in the same direction at similar speeds or moving in different directions at different speeds.

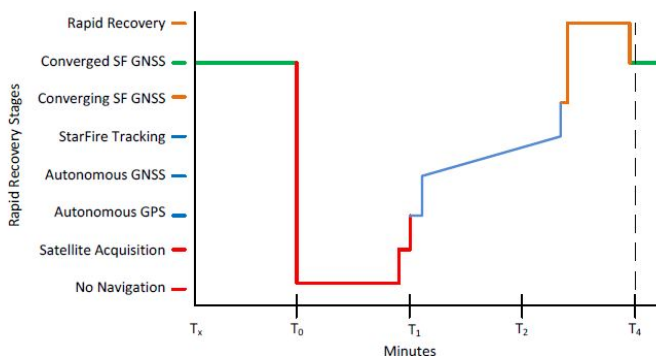
### **Rapid Recovery Process**

Rapid Recovery is successful more than 90% of the time under certain operating conditions. Generally speaking, Rapid Recovery is successful under the following conditions:

- ✓ The StarFire receiver is fully converged (final accuracy attained; i.e. 5-7cm horizontal)
  - This normally occurs after approximately 45-minutes of normal operation
- ✓ The navigation outage or shading event duration is less than 55-seconds
  - Navigation satellite reacquisition and navigation resumption occurs quickly
- ✓ The entire outage event and Rapid Recovery process is completed in less than 4-minutes

Rapid Recovery works best for short outages such as passing under bridge. The recovery interval is also determined by the duration and distance separation of the event origin and reacquisition point.

*The illustration below depicts the stages of Rapid Recovery.*



**T<sub>x</sub>** – the receiver has been operating normally and is fully converged for some period of time before the outage event.

**T<sub>0</sub>** – the receiver encounters an obstruction of navigation satellites. This also likely interrupts the StarFire correction signal as well.

If the StarFire signal is not lost during the obstruction event (i.e. a receiver in the northern hemisphere is travelling along a tree line to the north obstructing a significant portion of the navigation satellites, but not the StarFire satellite to the south), then the recovery time is improved.

**T<sub>1</sub>** – the receiver exits the shading event (duration must be 55-seconds or less) and begins reacquiring navigation satellites.

After a number of seconds, it begins autonomous (un-aided) satellite navigation (accuracy in the meters range); beginning with GPS first followed by GLONASS (GNSS combined navigation). Once navigation is restarted, the receiver begins looking for the StarFire satellite if that satellite was also dropped.

**T2+** – the receiver reacquires the StarFire satellite.

After processing a certain amount of data from visible satellites, the receiver begins the Rapid Recovery process by first applying a moving base RTK-like correction to initiate the StarFire process. The duration of this process is dependent on

- The duration of the event up until the initialization of the Rapid Recovery process
- The distance traveled from T0
- The quality of the positioning data at the initialization of the Rapid Recovery process

**T4** – if the receiver completes the Rapid Recover process successfully within the 4-minute window between T0 and T4, it will set a valid flag in the PVT1B data record for 10-seconds indicating success. Until this point, the receiver will demonstrate normal re-convergence; thereafter, it will indicate at or very near the same convergence as prior to the event. Variances from the pre-event condition are normal based on differences in number of satellites tracked and satellite geometry. If the receiver fails Rapid Recovery, no indication is given and the receiver will continue to demonstrate normal re-convergence.

- ✓ NavCom recommends using a FOM value in the range of 5-10.
- ✓ This feature is available only on the GPS portion of the StarFire correction, which constitutes the larger weighted component of the correction.

**RapidRecovery with QuickStart:** is used to initialize StarFire navigation. This is typically a position previously surveyed and converted to ITRF08 prior to initialization.

- ✓ This feature is available for StarFire GNSS only.
- ✓ The receiver must have a StarFire Dual Frequency solution prior to initiating QuickStart
- ✓ RapidRecovery is available only on the GPS portion of the StarFire correction, which constitutes the larger weighted component of the correction
- ✓ RapidRecovery is not available for the first 5 minutes after a successful quick start is completed
- ✓ When a lower FOM\_limit value is input, the receiver is more constrained in completing a Rapid Recovery process
- ✓ In order for RapidRecovery to function, the outages must not exceed 55 seconds.
- ✓ Requires up to three minutes to complete after navigation restarts
- ✓ Option to manually enter coordinates to initiate feature

## Performance Upgrade Path

The SF-3040 is designed with a robust and long-term performance upgrade path to meet changing needs via software upgrades.

Sixty-six signal channels provide the ability to track multiple frequencies of satellites in several constellations simultaneously. This allows for extended navigation in otherwise adverse conditions

for a single constellation. An additional channel is dedicated to tracking StarFire signals.

## Accuracy

When WAAS, EGNOS, MSAS, or GAGAN (RTCA/DO-229D compliant) SBAS correction signals are used, the system provides <50cm position accuracy.



System accuracy with WAAS, EGNOS, MSAS, or GAGAN signals is subject to the quality and update rate of these publicly-operated signals. Refer to *Related Standards\Publicly-Operated SBAS Signals* for contact information regarding the organizations that implement the RTCA/DO-229D standard.

The system provides <5cm position accuracy (post-convergence period – refer to “convergence” in the Glossary) when StarFire™ GNSS correction signals are used.

The system provides instant <1.0cm position accuracy when Ultra-RTK correction signals are used (base-line, <40km, 1cm +0.5ppm).



Dependent on software options



After RTK correction signals are received, the baseline length determines how long it takes to enter RTK mode. A rover close to the base enters RTK mode almost immediately. For longer baselines, it may take a minute or two.

---

## Features

### Output Data Rate

The SF-3040 can output proprietary raw data at a programmable rate up to 10Hz (5Hz standard; 10Hz requires option).

### Sapphire GNSS Binary Proprietary Data

The receiver outputs proprietary raw data containing information including, but not limited to, the following:

- ✓ Satellite Ephemeris (EPHEM1B)
- ✓ Satellite Almanac (ALM1B)
- ✓ Raw Pseudorange Measurements (MEAS1B)
- ✓ Position, Height, & Time (PVT1B)
- ✓ Velocity & Heading (PVT1B)
- ✓ Signal to Noise (CHNLSTATUS1B)
- ✓ Channel Status (CHNLSTATUS1B)
- ✓ Correction Data (mirror data; RTKSTATUS1B)
- ✓ Measurement Quality (PVT1B and PSEUDORANGESTATSB)

These data can be integrated in real-time positioning applications or post-processed against any number of software applications designed to handle Sapphire GNSS or RINEX raw data. A Technical Reference Manual is available on NavCom's web site, which describes the attributes of each of the input/output records (see *Related Documents* in the fore matter).

### NMEA-0183 Data

The SF-3040 is capable of outputting several standard NMEA-0183 data strings (see *Related Standards* in the fore-matter) and one proprietary data sting. Each data is headed with GP. The



proprietary data string is denoted with a \$PNCT header.

#### ■ Standard

- ✓ ALM – GPS Almanac Data
- ✓ DTM – Datum Reference
- ✓ GBS – GPS Satellite Fault Detection
- ✓ GFA– GNSS Fix Accuracy and Integrity (v.3.0.14 or later)
- ✓ GGA – GPS Fix Data
- ✓ GLL – Geographic Position – Lat /Lon
- ✓ GNS– GNSS Fix Data (v.3.0.14 or later)
- ✓ GRS – GPS Range Residuals
- ✓ GSA – GNSS DOP & Active Satellites
- ✓ GST – GNSS Pseudorange Error Statistics
- ✓ GSV – GNSS Satellites In View
- ✓ MLA – GLONASS Almanac Data
- ✓ RMC – Recommended Min. Specific GNSS Data
- ✓ RRE – Range Residual Errors  
(This command is not defined in NMEA 0183 Standard, version 3.0.)
- ✓ VTG – Course Over Ground & Ground Speed
- ✓ ZDA – Time & Date

Proprietary (header \$PNCT):

- ✓ DTM– Datum Reference for user-selected reference frame
- ✓ GGA – GPS Fix with Field 14
- ✓ SET – Solid Earth Tide  
Described in the *Technical Reference Manual* (see *Related Documents* in the fore-matter)

## Software Options

Software Options may be purchased individually.

The Software Options File contains all the purchased Software Options. The initial Software Options File must be uploaded to the receiver to enable the functionality of the SF-3040. Software upgrades purchased later are also provided in a Software Options File for upload.



Upgrades to the default values are available in electronic form and upgradeable via the Software Options Utility provided by Sapphire.

The SF-3040 receiver meets the needs of a large number of applications including, but not limited to, the following:

- ✓ Nautical Stationkeeping
- ✓ Dynamic Positioning
- ✓ Dredging and Offshore Construction
- ✓ Deep Water Survey
- ✓ Topographical Surveys in Rough Terrain
- ✓ High-Accuracy Data Collection for Post-Processing
- ✓ Real-time Positioning Applications

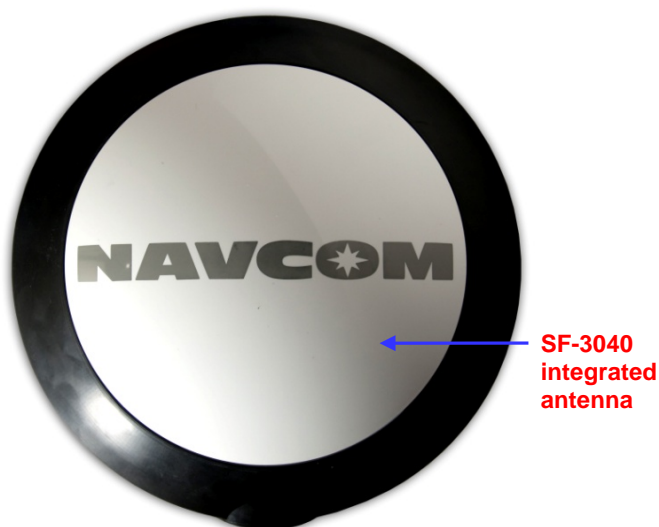
## Bluetooth

The SF-3040 GNSS receiver is Bluetooth-capable. The Bluetooth module permits cable-less operation between the receiver and a Class 2 Bluetooth-equipped controller, with less than 0.2% data loss. Wireless connectivity is provided within a range of 5 m (16 ft) once a connection is established, and a data rate of 230.4 Kbps is supported, 10 Hz maximum. The initial paring sequence must be conducted within 2m (6ft) of the SF-3040. The Bluetooth interface allows interleaved RTK data from a data collector GSM radio modem and SF-3040 data positioning (i.e., two communication links on one port). Refer to the [PACKB] command in the *Sapphire Technical Reference Manual*. The Bluetooth module contains Bluetooth-certified components and is FCC and CE certified. Communications performance is dependent on the user-supplied Bluetooth device.

Refer to Bluetooth Communications Setup for setup instructions via the supplied NavCom software utility, StarUtil 3000.

## SF-3040 Antenna

The SF-3040 all-in-one housing incorporates NavCom's compact GNSS antenna (refer to Figure 32), with excellent tracking performance and a stable phase center. The integrated antenna tracks L1, L2, L2C, L5, G1, G2, and StarFire™ signals. The [Antenna Calibration Values](#) for this product are available from the National Geodetic Survey (NGS) calibration table hyperlinked to this text.



*Figure 32: SF-3040 Top View*

See [http://www.ngs.noaa.gov/cgi-bin/query\\_cal\\_antennae.prl?Model=NAV](http://www.ngs.noaa.gov/cgi-bin/query_cal_antennae.prl?Model=NAV) for specifications.

The robust housing assembly features a standard 5/8-inch BSW thread on the bottom of the receiver for mounting the unit directly on a surveyor's pole, tripod, mast, or other industry-standard survey accessory, and is certified to 70K feet (see Appendix B Antenna Specifications, for restrictions).



Although rated to 70K feet, this antenna is not designed for aircraft installations. Contact [sales@navcomtech.com](mailto:sales@navcomtech.com) for aircraft solutions.

## Controller

The SF-3040 GNSS receiver is designed for use with an external controller solution connected via one of two serial COM ports or the Bluetooth port.

This may be accomplished using a PC, Tablet PC, or Personal Digital Assistant (PDA) and a software program that implements the rich control language defined for NavCom GNSS products. Refer to the user guide of your controller solution for further information. NavCom lists several application software solutions on our website:

<http://www.navcomtech.com/Support/ApplicationSoftware.cfm>

In addition, NavCom provides with the SF-3040 a Windows™ based software utility, StarUtil 3000.

The *StarUtil 3000 User Guide*, PN 96-310008-3001, is available online at

<http://www.navcomtech.com/Support/DownloadCenter.cfm?category=manuals>.

## Antenna Phase Center Offsets

- ✓ L2 – L1  
Vertical: -10.4 mm  
Horizontal: 2.4 mm
- ✓ L5 – L1  
Vertical: -6.0 mm  
Horizontal: 1.8 mm
- ✓ G1 – L1  
Vertical: 5.0 mm  
Horizontal: 1.0 mm
- ✓ G2 – L1  
Vertical: -9.6 mm  
Horizontal: 3.0 mm
- ✓ E6 – L1  
Vertical: -10.7 mm  
Horizontal: 3.0 mm

Absolute phase location in mm  
Reference plane at unit mounting nut

L1: x=0.1, y=1.2, z=79.2

L2: x=-0.2, y=-1.1, z=89.6

L5:  $x=-0.2$ ,  $y=-0.5$ ,  $z=85.3$

G1:  $x=-1.0$ ,  $y=0.8$ ,  $z=74.2$

G2:  $x=0.1$ ,  $y=-1.5$ ,  $z=88.8$

## Applications

The SF-3040 GNSS receiver meets the needs of the following applications:

### Land Survey and GIS

- ✓ Boundary Survey
- ✓ Topographical Surveys in Rough Terrain
- ✓ Construction Site Stake-out
- ✓ High-Accuracy Data Collection for Post-Processing
- ✓ Hydrographic Survey

NavCom lists several application software solutions on our website:

<http://www.navcomtech.com/Support/ApplicationSoftware.cfm>

## Chapter 3..... Interfacing

This chapter details the SF-3040 GNSS receiver connectors, LED display, appropriate sources of electrical power, and how to interface to the communication ports.

### Battery Power

Two supplied removable Lithium-Ion battery packs (PN 98-214946) provide power. Each of the two battery packs is designed to last 2.5 hours, 5 hours with both batteries, on a single charge with all GNSS channels turned on (discharge time varies based on environmental conditions and mode of operation). With only L1, L2 and StarFire channels turned on, each battery will last 3 hours, 6 hours with both batteries. The smart battery interface allows the batteries to be hot-swapped on the fly.

When battery 1 voltage is low, the receiver automatically switches to battery 2 to provide continuous power. For more information on the battery packs, refer to the following:

- ✓ Chapter 6, Batteries
- ✓ Chapter 8, Safety Instructions



As long as the input voltage on the external power connector is  $>9.0\text{ V}$ , the power input will be from that connector and the internal batteries will be in standby mode. This is automatically selected in the power input output (PIO) hardware. If the unit does not have an external power source and is running on batteries, if an external power source is connected, the PIO hardware automatically switches to the external

power source and the battery switches to standby mode.

If the voltage on the external power connector drops below 9.0 V, the PIO begins to draw some power from the selected battery and the power draw from that battery increases until the external voltage decreases to about 8.3 V. At this point, the selected battery will be supplying all of the power to the PIO.

The selected battery is the one with the lowest measured voltage when the PIO is powered up or reset. This assures that the one in standby mode is the one with the most charge remaining so that if the selected battery falls below the threshold and the PIO switches to the other battery, the user will have the most time to replace or recharge the discharged battery.

## Electrical Power

A 2-pin LEMO female connector provides electrical power to the SF-3040. It is located on the bottom of the SF-3040 (refer to Figure 36). Pin assignments are given in Table 3.

*Table 3: External Power Cable Pin-Out*

Pin	Description
1	Return, <b>black</b>
2	Power Input 9, 9 to 30 VDC, 8W, <b>red</b>



## Proper Shutdown of the SF-3040

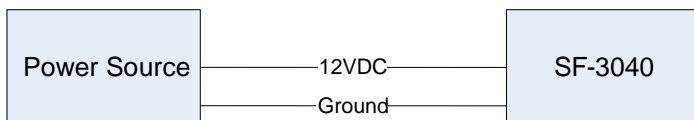
Do either of the following to perform a proper shutdown of the SF-3040:

- ✓ Press and hold the On/Off button in the center of the indicator panel (refer to Figure 33) for at least two seconds. (There may be a delay of approximately two seconds before the unit turns off.)
- ✓ Type [SHUTDOWN]HALT on the StarUtil 3000 (or other) *Input Terminal*.



Figure 33: Indicator Panel On/Off Button

⚠ Do not unplug the LEMO end of the optional unterminated power cable, if one is being used, before switching off power from the front panel. The receiver may not shutdown properly.



*Figure 34: Proper External Power Source Setup*

## Power Cables

The SF-3040 can be powered by any of three optional power cable types. Refer to Table 4 for details. Refer to Table 5 for the pin assignments for all power cables.

*Table 4: Optional Power Cables*

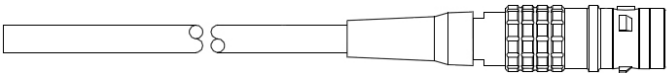
Part Number	Description
96-212172-01	DC power cable, unterminated, 10 ft
96-212178-01	Automotive DC power cable, with cigarette lighter adapter
96-212171-01	Power AC/DC Adapter cable, 12 V, 18 W, 1.5 A

*Table 5: Pin Assignments – All Power Cables*

Color	Signal	Pin No
<b>Black</b>	Ground – Return <sup>1</sup>	1
<b>Red</b>	Power – Input	2



<sup>1</sup>Wire size: AWG20 minimum  
Current rating: < 2A



*Figure 35: DC Power Cable P/N 96-212172-01 (Optional)*



The SF-3040 receiver is protected from reverse polarity with an inline diode. It will operate on any DC voltage between 9 and 30 VDC, 6 W typical. The recommended voltage is 12 Vdc.

⚠ Voltages in excess of 30VDC will damage the unit. The power supply must be well-conditioned with surge protection. Vehicular electrical systems that create voltage spikes in excess of 30VDC will benefit from providing power protection during vehicle engine power-up. This can be accomplished through a relay power-on sequence and/or power conditioning (such as a DC to DC converter). Do not connect equipment directly to the vehicle's battery without in-line protection (such as a DC to DC converter).

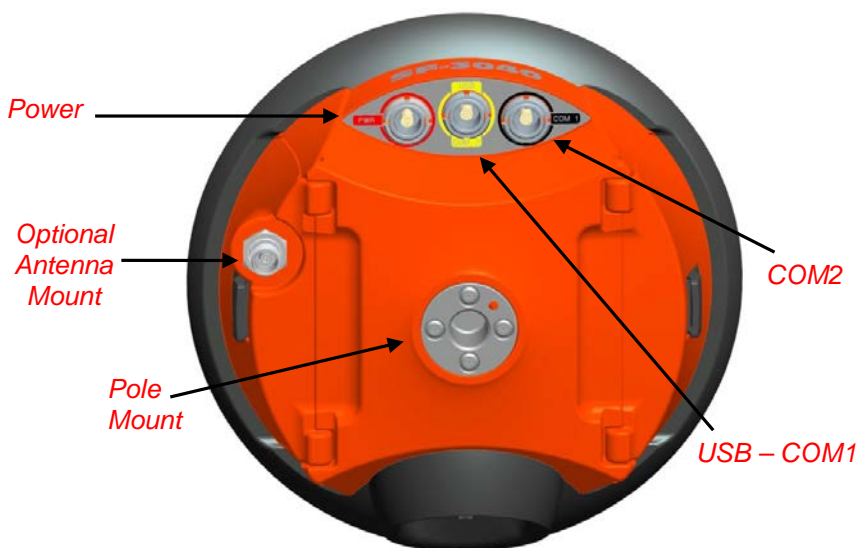
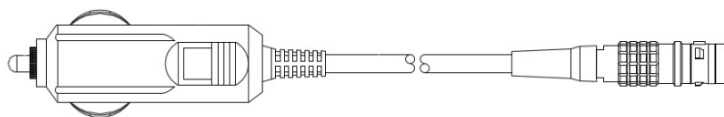
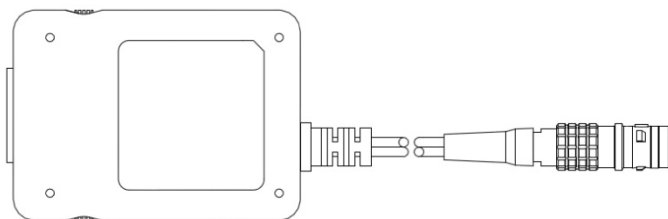


Figure 36: SF-3040 Bottom View



*Figure 37: Automotive DC Power Cable with  
Cigarette Lighter Adapter P/N 96-212179-01  
(Optional)*



*Figure 38: Universal AC-DC Power Adapter Cable  
P/N 96-212171-01 (Optional)*



Plug a standard American 2-prong power cord into the power cable adapter. AC power cords are available through small appliance retailers (Radio Shack, Walmart, Best Buy, etc.). AC power cords for non-110VAC locales must be purchased locally.



*Figure 39: AC Two-Prong Power Cord (optional, with  
AC/DC adapter cable)*

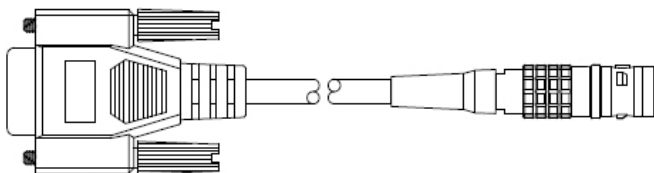
## Communication Ports

The SF-3040 provides two communication ports – one labeled USB and COM1 and the other COM2.

Table 6, Table 7, and Table 8 list the pin assignments for these ports.

*Table 6: Pin Assignments – USB & COM1*

DB9 Pin #	LEMO Pin #	Pin Name	Pin Function
2	1	COM TDX	Serial port data from GNSS board
3	2	COM1 RDX	Serial port data to GNSS board
5	3	GROUND	Ground
NC	4	USB D-	USB data - PIOB
NC	5	USB D+	USB data + PIOB
NC	6	USB ID	USB ID PIOB
NC	7	USB POWER	USB 5V power PIOB



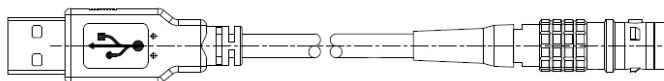
*Figure 40: COM2 Serial Cable P/N 96-212238-01  
(Standard)*

*Table 7: Pin Assignments – COM2*

DB9 Pin #	LEMO Pin #	Pin Name	Pin Function
2	1	COM2 TDX	RS-232 Serial port data from PIOB
3	2	COM2 RDX	RS-232 Serial port data to PIOB
5	3	GROUND	Ground
8	4	COM2 RTS	RS-232 Serial port flow control from PIOB
7	5	COM2 CTS	RS-232 Serial port flow control to PIOB
9	6	COM2 RING	RS-232 Ring signal to PIOB


## Supplied USB Device Cable

The USB Device Cable P/N 96-212169-01 is the supplied 6ft (1.83m) data cable fitted with a LEMO plug type and a USB A plug type, used to connect as Device directly to a USB 2.0 connector. The pin assignments are provided below.



*Figure 41: USB Device Cable P/N 96-212169-01  
(Supplied)*

The COM 1 Serial cable P/N 96-212170-01 is an optional 6ft (1.83 m) data cable that can be plugged directly into the COM1 port and used as an adjunct to the USB Device Cable.

 **COM1 - USB is the only USB-compliant port.**

*Table 8: Pin Assignments – USB Device Cable Pin Assignments (Supplied)*

USB Pin #	LEMO Pin #	Pin Name	Pin Function
4	3	Ground/Shield	Ground
2	4	USB D-	USB data -
3	5	USB D+	USB data +
NC	6	USB ID	USB ID
1	7	USB POWER	USB 5V power



To turn the unit on, power must be in the 9 to 30 VDC range. Press and hold in the I/O button for more than 3 seconds (see Figure 33).



Voltages in excess of 30 VDC will damage the unit. The power supply must be well-conditioned with surge protection. Vehicular electrical systems that create voltage spikes in excess of 30 VDC will benefit from providing power protection during vehicle engine power-up. This can be accomplished through a relay power-on sequence and/or power conditioning (such as a DC to DC converter). Do not connect equipment directly to the vehicles battery without in-line protection (such as a DC to DC converter).



Unused pins are commonly missing from cables. This is a typical cost-saving practice of cable manufacturers.

## Bluetooth Communications Setup

This section provides instructions to determine Bluetooth Virtual COM port on a PC and to connect to the SF-3040 via Bluetooth. Wireless connectivity is provided within a range of 5 m (16 ft) once a connection is established. The initial pairing sequence must be conducted within 2m (6ft) of the SF-3040.

1. Write down the SF-3040 serial number (from the label on the receiver).
2. Turn on the SF-3040.
3. Plug the Bluetooth dongle (if one is being used<sup>1</sup>) into the proper port on the PC.



<sup>1</sup>Many laptops incorporate Bluetooth, but not all will work; a dongle is an option.

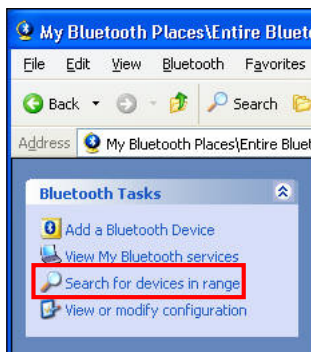


Right-click the Bluetooth icon on the Windows taskbar and select *Explore My Bluetooth Places* from the pop-up menu to open the *My Bluetooth Places* dialog box (refer to Figure 42).



Double-click *Search for devices in range* on the *My Bluetooth Places* dialog box to display a list of the Bluetooth devices in range (refer to Figure 42).





*Figure 42: Search for Bluetooth Devices in Range*



The naming convention for the SF-3040 is as follows:  
product type, serial\_num, rev\_num.  
Example: SF-3040,10280,2

4. Double-click SF-3040 in the Bluetooth device list. A Bluetooth serial port icon for the selected receiver is displayed (see Figure 48).
5. Double-click the Bluetooth serial port icon. A graphic with green arrows indicates a connection is established between the Bluetooth Virtual COM port on the PC and the Bluetooth dongle.



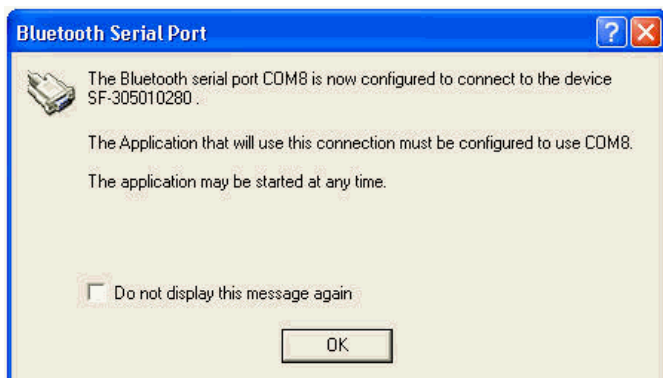
If the PC requests a Bluetooth passcode, click OK. There is no passcode for the SF-3040 Bluetooth device; use the BTSET command on the *Input Terminal* to create or delete a passcode in the receiver. Refer to the BTSET command in the *Sapphire Technical Reference Manual*.



Not all Bluetooth devices are compatible with the SF-3040. Refer to NavCom's [Support/Troubleshooting Guides](#) Web page for additional information.

6. Double-click the Bluetooth serial port icon to display the *Bluetooth Serial Port* dialog box (see Figure 44), which confirms the configured COM port.
7. Click OK.
8. To verify the assigned COM port, right-click the Bluetooth serial port icon and select *Properties* on the pop-up menu (the *Bluetooth Properties* dialog box opens).

The *Bluetooth Properties* dialog box (refer to Figure 43) displays the Bluetooth virtual COM port assigned to the Bluetooth dongle. (Notate the COM port number.)



*Figure 43: Bluetooth Serial Port*

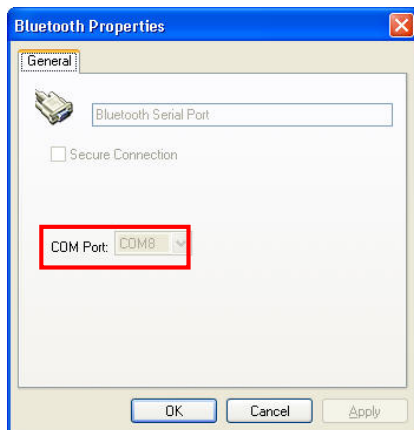


Figure 44: Bluetooth Properties

9. Click OK on the *Bluetooth Properties* dialog box.
10. Open StarUtil 3000 on the PC.
11. Click the *Connections* button on the Shortcut bar to open the *Port Configuration* dialog box (refer to Figure 45).

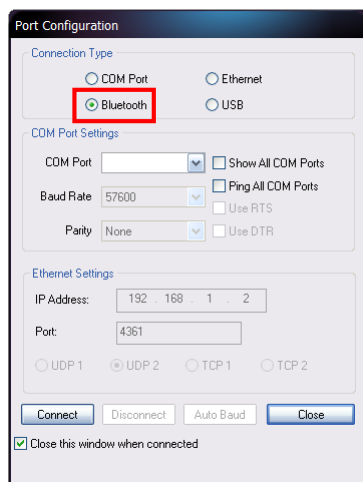


The Bluetooth module can be in two modes: Command Mode and Data Mode. When in Data Mode, the module has an active data connection with a connected device; it does not receive commands because commands would be interpreted as data that need to be passed to the connecting device.



Turning on Bluetooth is associated with a software reset of the Bluetooth firmware, so the system returns the same output as when the [SHUTDOWN]REBOOT command is issued (see details on the use of the [SHUTDOWN] command in the *Sapphire Technical Reference Manual*). When Bluetooth is ON, another in-range

Bluetooth electronic device should be able to detect the existence of the system.




*Figure 45: Bluetooth Port Configuration*

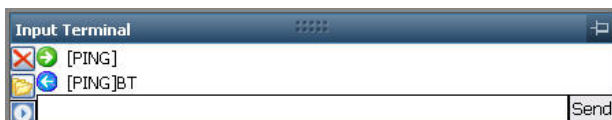
*Refer to Figure 45 for the steps below:*

12. Select *Bluetooth* as the *Connection Type*.
13. Select the appropriate COM Port (refer to Figure 49).
14. Click the *Connect* button to connect to the SF-3040.
15. Verify Bluetooth connectivity:  
View the Bluetooth LED on the SF-3040 front panel (refer to Table 9).

*Table 9: Bluetooth Connectivity LED Indication*

Icon	Indicator	Status	Description
	<b>Bluetooth</b>	<b>Off</b>	Bluetooth off
		<b>Blue Blinking</b>	Bluetooth on, no connection
		<b>Blue</b>	Bluetooth connected

- Type [PING] in the *Input Terminal* and click the *Send* button. If properly connected, the response is [PING]BT1 (refer to Figure 46).



*Figure 46: Input Terminal – PING Command and Response*



To use an input terminal to determine the Bluetooth Virtual COM port on a PC and connect to the SF-3040 via Bluetooth, refer to the BTSET message in the *Sapphire Technical Reference Manual* and to the section “Establish Bluetooth via the Input Terminal” in the *StarUtil 3000 User Guide*.

## Logging Data to the Removable SD Card

### Installing the SD Card

The SD card is located above the batteries in the SF-3040 battery bay.

Follow these steps to set up the SD card:

1. To open the side chamber where the SD card slot is located, hold the SF-3040 upright facing you

and press downward on the lower half (protruding part) of the black release button on the left-hand side of the SF-3040 (refer to Figure 47).



*Figure 47: SD Card Chamber Release Button*

2. Holding the SF-3040 upright, align the SD card with the SD slot (refer to Figure 48), with the lettering on the SD card facing downward.



*Figure 48: SD Card Slot*

3. Gently push the card into the slot.

4. Close the chamber door and press until it is securely closed (as verified by the latch click).



The receiver will support a SD card with a maximum of 16GB (not included).

### Logging Data to the Removable SD Card

Schedule the desired messages to log using the [OUTPUT] command, with a port designation of “FH1”. Refer to the *Sapphire Technical Reference Manual* for detailed instructions.

On the Input Terminal, type the appropriate commands (refer to Table 10).

When using the logging functions, allow a few seconds between actions for the processor to execute and the SD card to respond.

*Table 10: Data Logging Input Commands*

Command	Operation
[LOGFILE]A:	Displays the current logging status of drive A (SD card): ready, running <sup>1</sup> , stopped, or paused
[LOGFILE]A:, START <sup>2</sup>	Starts file logging on drive A (SD card), if logging has not been started
[LOGFILE]A:, FORCSTART	Forces file logging on drive A (SD card) and ignores previous CHKDSK.SD file state; overwrites CHKDSK.SD file
[LOGFILE]A:, PAUSE	Pauses file logging on drive A (SD card)
[LOGFILE]A:, STOP	Stops file logging on drive A (SD card) if file logging is running or paused
[LOGFILE]A:, RESUME	Resumes file logging on drive A (SD card) if file logging is paused



<sup>1</sup> When the status is RUNNING or PAUSED, the logged bytes are displayed:

*[LOGFILE]A: RUNNING 5245989  
BYTES LOGGED*



<sup>2</sup> When the receiver is first turned on, or when the USB mode is changed from Mass Storage device mode to COM port mode, the SD removable card is reconfigured. If the user sends the command [LOGFILE]A:;START before the reconfiguration is finished, the following message is output:

*[LOGFILE]A: SD CARD IS BEING  
MOUNTED, PLEASE WAIT*

If the SDCARD message is turned on for this port, the following [SDCARD] message is output:

*[SDCARD] MOUNTING... 5*

*[SDCARD] MOUNTING... 6*

*[SDCARD] MOUNTING... 7*

*[SDCARD] MOUNTING...8*

The numeral represents the SD card mounting time in seconds. Upon successful completion of mounting, data logging starts.

If mounting fails, the following message is output:

*[LOGFILE]A: ERROR ON  
MOUNTING SD CARD*

If the SD card is not present and the user sends the command



[LOGFILE]A:;START, the following message is output:

*[LOGFILE]A: SD CARD IS NOT PRESENT*

If the SD card is present and locked and the user sends the command

[LOGFILE]A:;START, the following message is output:

*[LOGFILE]A: SD CARD IS LOCKED*



Refer to the *Sapphire Technical Reference Manual* [LOGFILE] command for further essential notes regarding this command.

### Removing the SD Card

Follow these steps to remove the SD card from the SF-3040:

1. Close any “open” files or the data will be lost.
2. Turn off power to the unit.
3. To open the battery chamber where the SD card slot is located, hold the SF-3040 upright and press downward (toward the ground) on the lower half (protruding part) of the black button on the battery chamber (refer to Figure 53).
4. Remove the battery packs (refer to Removing the Battery Packs
5. Press in on the SD card and it will pop out enough to grab it with the thumb and forefinger.
6. Gently pull out the SD card.
7. Reinstall the battery packs in the SF-3040 (refer to All new batteries must be charged for a minimum of 12 hours prior to use, regardless of the LED indicator on the charger.

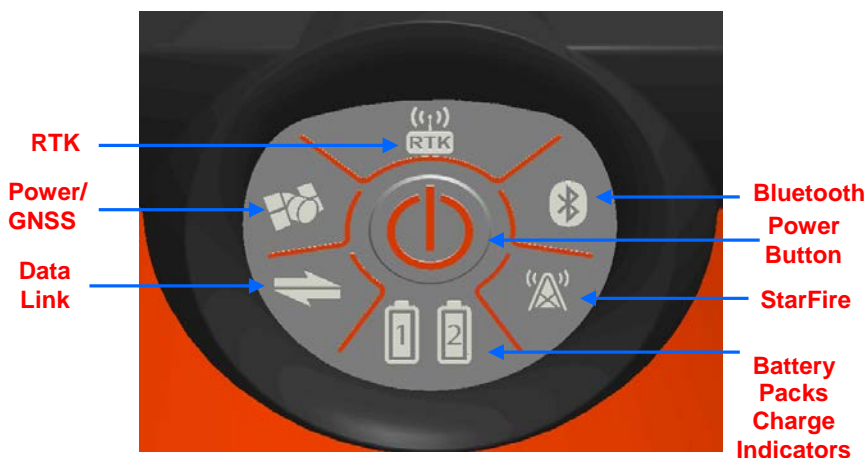
## Installing the Battery Packs in the SF-3040

8. Close the battery chamber door and press until it clicks shut.

## SF-3040 Indicator Panel LEDs



*Figure 49: SF-3040 Indicator Panel*




*Figure 50: SF-3040 Indicator Panel, Detail*

To power the unit on or off, depress the Power button for more than 2 seconds. All LEDs illuminate for a period of 3 to 5 seconds during power-up of the GNSS receiver. Refer to Table 11 through Table 15 for detailed information on the Indicator Panel LEDs.


#### ■ RTK LED


*Table 11: RTK LED Indicator*

Icon	Indicator	Status	Description
	<b>RTK</b>	<b>Off</b>	Radio power off or RTK corrections not being received (other ports)
		<b>Green Blinking</b>	RTK corrections being received (no position fix)
		<b>Green</b>	RTK corrections being applied (position fixed)
		<b>Red Blinking</b>	No RTK license

#### ■ Power/GNSS LED


*Table 12: Power/GNSS LED Indicator*

Icon	Indicator	Status	Description
	<b>Power/GNSS</b>	<b>Off</b>	Power off
		<b>Red</b>	Power on, but not tracking
		<b>Green Blinking</b>	Acquiring or tracking GNSS satellites (no position fix yet)
		<b>Green<sup>1</sup></b>	Position fixed

 <sup>1</sup>The GNSS LED blinks at the PVT positioning rate (1, 5, or 10 Hz).

■ **Data Link LED**

*Table 13: Data Link LED Indicator*


Icon	Indicator	Status	Description
	<b>Data Link</b>	<b>Off</b>	Power off or No data output
		<b>Green Blinking</b>	Data I/O activity
		<b>Green</b>	Data logging to internal SD card
		<b>Red Blinking</b>	Data logging – memory low
		<b>Red</b>	Data logging – data loss

■ **Bluetooth LED**

Refer to Table 9.

■ **StarFire LED**

*Table 14: StarFire LED Indicator*

Icon	Indicator	Status	Description
	<b>StarFire Link</b>	<b>Off</b>	Power off
		<b>Red</b>	No StarFire signal
		<b>Red Blinking</b>	No (or expired) StarFire license <sup>1</sup>
		<b>Green Blinking</b>	Acquiring StarFire signal
		<b>Green</b>	Tracking StarFire signal




<sup>1</sup> This LED blinks red until the receiver navigates and can verify the license.

## ■ Battery Pack LED

An LED associated with each battery pack shows that battery pack's status.

*Table 15: Battery Pack LED Indicator*

Icon	Indicator	Status	Description
	<b>Battery Packs</b>	<b>Off</b>	Power off or batteries not installed
		<b>Green</b>	Battery pack has sufficient charge
		<b>Red<sup>1</sup></b>	Battery pack is low
		<b>Red<sup>2</sup> Blinking</b>	Both battery packs are low



<sup>1</sup> When the battery pack indicator changes from green to red, the unit emits a 1-second warning beep.



<sup>2</sup> When both battery packs are low or not installed, the unit enters a power-down warning period. During this period, both battery LEDs blink red, and the unit emits a series of 3 warning beeps of 1 second each followed by 10 seconds of silence. This sequence is repeated 4 times. If either battery is replaced during the warning period with a charged battery pack, the new battery pack's status changes to green and the power-down warning ceases. The power-down warning also ceases if an external power source is connected at this time.



Batteries are *not* charged in the unit. If external power is applied, the battery LEDs indicate the status of the batteries, not the status of the external power source.



*Over-temperature Shutdown:* The SF-3040 emits a 5-second warning beep, and all LEDs turn red to indicate over- temperature condition and eminent shutdown. This may be caused by installed batteries and an internal temperature exceeding 80°C (typically, 65°C ambient) for 5 seconds or longer. This action is only to protect the batteries and will not occur if batteries are not installed.


This page is left blank intentionally.


## Chapter 4..... Installation


This chapter provides guidance on SF-3040 hardware installation for optimum performance.

### GNSS Receiver

The SF-3040 housing has a female 5/8-inch BSW threaded mount (5/8-11 UNC) with a depth of 16 mm (0.63 inch). Mount the SF-3040 on a surveyor's pole, tripod, mast, or any apparatus that accepts the thread size.

 Do not place the receiver in a space where it may be exposed to excessive heat, moisture, or humidity.

 There are no user-serviceable parts inside the SF-3040 GNSS receiver. Opening the unit compromises the environmental seal and voids the equipment warranty.

 The SF-3040 is not designed for use on a moving vehicle. If damage is sustained due to shock or vibration while mounted on a moving vehicle or if damage is sustained due to shear, the SF-3040 warranty is invalidated. The SF-3050 is recommended for use on a moving vehicle and provides comparable performance as it is based on the same GNSS receiver technology.



## Batteries

Refer to Chapter 6 for detailed information on charging, installing, and maintaining the SF-3040 GNSS battery packs.

## Integrated Antenna



Refer to Appendix B for detailed specifications on the integrated antenna.

- ✓ Antenna placement is critical to good system performance. Avoid antenna shading by buildings, rooftop structures, foliage, hills/mountains, etc.
  - ✓ Choose a mounting location with obstructions as low as possible (preferably below the horizon), where the antenna has a clear view of the sky, to an elevation angle of  $7^{\circ}$  if possible. Obstructions below  $15^{\circ}$  elevation generally are not a problem, though this is dependent on satellite availability for the local region.
  - ✓ Avoid placing the antenna where more than  $90^{\circ}$  azimuth of the sky is obstructed. When more than  $90^{\circ}$  of azimuth is shaded, it is often still possible for the receiver to navigate, however, poor satellite geometry (due to satellite shading) will provide poor positioning results. Even  $10^{\circ}$  of shading can have a negative effect on performance, though this generally is not the case.
  - ✓ Avoid placing the antenna on or near metal or other electrically reflective surfaces.
  - ✓ Do not paint the antenna enclosure with a metallic-based paint.
  - ✓ Avoid placing the antenna near electrical motors (elevator, air conditioner, compressor, etc.)
  - ✓ Do not place the antenna too close to other active
-

antennae. The wavelength of L2 is 0.244m and L1 is 0.19m. The minimum acceptable separation between antennae is 1m (39 in), which provides 6dB of isolation. For 10dB of isolation, separate the GNSS antennae by 2.5m, and for 13dB of isolation (recommended) separate the antennae by 5m.

- ✓ Active antennae (those with LNA's or amplifiers) create an electrical field around the antenna. These radiated emissions can interfere with other nearby antennae. Multiple GNSS antennae in close proximity to each other can create multipath and oscillations between the antennae. These add to position error or the inability to process the satellite signals.
- ✓ Most antennae have better gain when the satellite is high in elevation. Expect tracking performance to fade as the satellite lowers in elevation. It is not unusual to see 10dB difference in antenna gain (which translates into signal strength) throughout the entire elevation tracking path.
- ✓ Map obstructions above the horizon using a compass and inclinometer. Use satellite prediction software with a recent satellite almanac to assess the impact on satellite visibility at that location (available on NavCom's web site).
- ✓ A clear line of sight between the antenna and the local INMARSAT satellite is required to track the StarFire™ signal. INMARSAT satellites are geo-synchronized 35,768kms above the Equator, currently at Longitudes 15.5° West, 098° West, 142° West, 025° East, 109° East, and 143.5° East. An inclination and bearing estimation tool is available on NavCom's website to aid in determining potential obstructions to the StarFire™ signal.

## Communication Port Connectivity

Connect the supplied LEMO 6-Pin connector of the serial cable (PN 96-212169-01) COM 2 of the SF-3040. Connect the DB9S end to the control device.

In the Rover, the NMEA port is an output logical port and may share the data physical port with RTCM, CMR, or Sapphire GNSS RTK input corrections. In the Base Station, the NMEA port should not share the data port with any RTCM, CMR, or Sapphire GNSS RTK output corrections as many NMEA-compatible devices are likely to have parsing issues with the non-NMEA data.

Refer to the *Sapphire Technical Reference Manual* for the available port configuration settings.

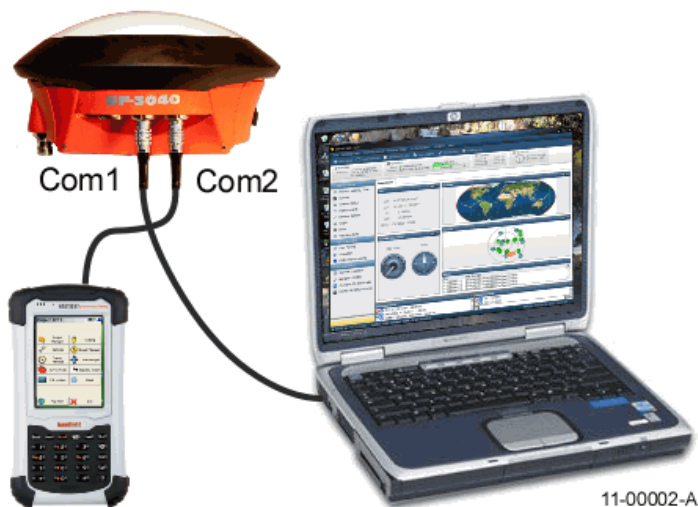


Figure 51: Communication Port Connections

## Auxiliary Communication Module (Internal UHF radio)

An optional 1-Watt internal, removable UHF radio is available with the SF-3040. (Refer to Chapter 7 for detailed information). The operational range of the 1W radio varies with the undulation of the topography, the density of foliage and man-made materials (i.e. buildings), the type of antenna employed (NavCom offers a half-wave antenna), and the height of the base antenna. A broadcast range of 2km is not uncommon, but will vary greatly based on the operating environment. If a longer range is desired, NavCom offers a 35W radio option.

## Basics of RTK Surveying

RTK (Real-Time Kinematic) is a GNSS system that yields very accurate 3D position fixes immediately in real-time.



The Network RTK software option allows the receiver to generate and receive RTCM 1000-series messages. The navigation algorithms are designed to support single-base correction configurations. Network adjusted RTK formats are not currently supported.

A reference station (base station) transmits its GNSS position to roving receivers as the base receiver generates them. The roving receivers use the reference station readings to differentially correct their own positions. Accuracies of a few centimeters in all three dimensions are possible. RTK requires multi-frequency GNSS receivers and high-speed radio modems.

Proper setup of a reference station minimizes GNSS errors in the rover. The reference GNSS receiver is set up at a known surveyed location. With this position locked in, it transmits its code, clock, and reference station coordinates information to the roving receiver(s). The roving receiver(s) use this information to correct each GNSS measurement received.

If the receiver will be used or transported above 40,000 ft (12.2 km), it must be located in a pressurized compartment.

The SF-3040, when configured as a reference station, can transmit corrections to any number of roving receivers capable of picking up the radio signal and decoding one of these correction formats: NavCom proprietary, RTCM 2.3/3.1 for Network RTK, CMR, or CMR+. The signal can be received in less than ideal environments, though some data loss may occur.

Setup of the reference station receiver above the roving receivers is recommended to enable transmission to all rovers in all directions with minimal obstruction. High- frequency radio signals generally travel a shorter distance than lower-frequency signals and do not penetrate obstructions as well over distance.

Refer to Chapter 8, RTK Setup, in the *StarUtil 3000 User Guide* for detailed instructions.

---

## Chapter 5..... Configuration

The SF-3040 has a rich interface and detailed control language, allowing each unit to be individually programmed to a specific application.

There are essentially 3 methods available to configure and control the SF-3040:

1. **StarUtil 3000** – This program is a NavCom-developed utility designed to configure and view many (but not all) of the SF-3040 functions. In addition to its setup capabilities, StarUtil 3000 can capture and log data, upload new software and licenses to the internal processor, and query and display various receiver performance functions. Though it is developed as an Engineering tool, it has its own place in the commercial market as well. The program is provided on the SF-3040 Product USB Flash Drive.
2. **3<sup>rd</sup> party controller** – Some manufacturers have already integrated NavCom's control features in their bundled hardware and software solution kits in a variety of applications including GIS, Machine Control, Aerial Photogrammetry, Land & Oceanographic Survey, Agriculture, and Military products. Information on these applications is available from the NavCom web site and customer service.
3. **User Program** – Users may develop unique operating programs to control the SF-3040 (potentially in conjunction with other devices or utilities). To facilitate this effort, NavCom provides the Sapphire Technical Reference Manual (TRM). Information on this tool is available from the NavCom Web site and customer service.

## ■ USB – COM1

- ✓ Configuration – Control or Data Port
- ✓ Default Baud Rates:
  - 57600 bps (RS-232)
  - 2 Mbps (USB)

This 7-pin port is normally used to output data to other devices or machines that can make immediate use of the precise positioning data available from the SF-3040. The data port outputs Sapphire GNSS Binary Messages and NMEA Messages and when applying external dGNSS corrections, also serves as the dGNSS correction input port.

## ■ COM2 – Serial Communication Port (RS-232)

- ✓ Configuration – Control or Data Port
- ✓ Default Baud Rate: 57600 bps

This 6-pin port is normally used to input and output proprietary messages used for navigation and receiver setup. Table 16 describes the default messages needed to best initiate surveying with minimal effort.

The user has full control over the utilized message types and their associated rates via either StarUtil 3000 or a 3<sup>rd</sup> party software/utility.

## ■ Bluetooth Virtual COM Port

- ✓ Configuration – Control Port
- ✓ Baud Rate – 230.4kbps

The PC's virtual COM port is used to input and output proprietary messages used for navigation and receiver setup. Table 16 describes the default messages needed to best initiate surveying with minimal effort. RTK correction data may be interleaved with control data via the [PACKB]

command. Refer to the *Sapphire Technical Reference Manual*.



The user has full control over the utilized message types and their associated rates via either StarUtil 3000 or a third-party software/utility.

## Factory Default Output Messages

### ■ NCT Messages

*Table 16: Factory Default NCT Messages/Responses*

Output on Ports COM1 and USB		
Message	Rate	Description
ALM1B	On Change	Satellite Almanac
CHNLSTATUS1B	On Time 1Hz	ASIC & StarFire Channel Status
EPHEM1B	On Change	Satellite Ephemeris
MEAS1B	On Time 1Hz	Raw Satellite Measurement Data
MSGPRODUCTINFO	On Time 600 Sec	Product Type, Digital Serial Number, and System Revision Number
MSGVERSION	On Time 600 Sec	Firmware Identification Block
PVT1B	On Time 1Hz	Position, Velocity, and Time (PVT) Solution
OK (mnemonic)	On Change	Ack ("Acknowledged"). Ack indicates a successful input message operation.
?? (mnemonic) {argument error}	On Change	Nak ("Not Acknowledged"). NAK indicates a failure in executing a command.
PANICA	On Change	Factory Use

Table continued on next page...



Output on All Ports		
Message	Rate	Description
OK (mnemonic)	On Change	Ack ("Acknowledged"). Ack indicates a successful input message operation.
?? (mnemonic) {argument error}	On Change	Nak ("Not Acknowledged"). NAK indicates a failure in executing a command.
PANICA	On Change	Factory Use



These settings indicate the following:

- **On Change:** The receiver outputs the specified message at the highest rate the system can output. The rate must be purchased. For example, if the receiver has a purchased rate of 10 Hz, the messages set at On Change are output at 10 Hz. (This rate applies only to MEAS1B and PVT1B.) Some messages, like satellite almanac, are output after an update is received over the air.
- **On Time:** The receiver outputs the specified message at a rate  $\leq$  the purchased rate. For example, if the receiver has a purchased rate of 10 Hz, a message may be set at a lower output rate, such as On Time, 5 Hz, or 0.2 seconds.

## Message Descriptions

The following message descriptions are fully defined in the *Sapphire Technical Reference Manual* (see *Related Documents* in the fore-matter).

- ✓ ALM1B Packed Almanac:

Data corresponding to each satellite in the GPS constellation, including: GPS Week number of collected almanac, GPS Time of week [in seconds] of collected almanac, almanac reference week, almanac reference time, almanac source, almanac health, pages 1-25, and sub-frames 4 and 5. Packed almanac data for 32 GPS or 24 GLONASS satellites.

- ✓ **CHNLSTATUS1B Channel Status:**  
Receiver channel status information containing: Sapphire engine status, number of satellites viewed/tracked, PDOP, tracked satellite identity, satellite elevation and azimuth, C/No for the track signals, and correction age for each satellite.
- ✓ **EPHEM1B Packed Ephemeris:**  
Individual satellite tracking information including: GPS Week number of collected ephemeris, GPS Time of week [in seconds] of collected ephemeris, IODC, and sub-frame 1, 2, and 3 data. Packed ephemeris data for 32 GPS or 24 GLONASS satellites.
- ✓ **MEAS1B Raw Measurement Data:**  
Raw Measurement Data Block containing: Raw measurements from satellites so measurements can be post-processed to achieve precise point positions, the GPS Week, GPS Time of Week, Time Slew Indicator, Status, Channel Status, CA Pseudorange, L1 Phase, P1-CA Pseudorange, P2-CA Pseudorange, L2 Phase, GPS L5, GLONASS G1 and G1 Code and Phase, and SBAS Code and Phase. This data stream is repeated for each individual tracked satellite.
- ✓ **MSGPRODUCTINFO Product Information:**  
Product type, digital serial number, and system revision number (incremented at every hardware change).
- ✓ **MSGVERSION Firmware Version:**

Version number, date and time stamp for the requested firmware component.

- ✓ PVT1B (Position, Velocity, and Time):  
Provides: GPS Week number, GNSS satellites used, latitude, longitude, navigation mode, and DOP information.
- ✓ PANICA Alert Text Message:  
Details message receipt and processing.

## Factory Default Settings

The COM1 Default Baud Rate = 57600 bps. The output default messages on COM1 are as follows:

OK – OnChange

?? – OnChange

PANICA – OnChange

ALM1B – OnChange

EPHEM1B – OnChange

CHNLSTATUS1B – 1 Hz

PVT1B – 1 Hz

MEAS1B – 1 Hz

Version – every 600 seconds

PRODUCTINFO – every 600 seconds

## ■ NMEA Messages

The SF-3040 provides support both for selected standard NMEA messages and for nonstandard proprietary NMEA-type messages. These messages must be scheduled by the user.

## ■ Base and Rover Navigation Setup

NavCom's StarUtil 3000 provides Base and Rover setup capabilities. Refer to the *StarUtil 3000 User Guide* for details. The guide is included on the supplied SF-3040 Product Configuration USB flash drive and is also available on the NavCom web site.

## User Profiles

The SF-3040 utilizes commands or groups of commands, known as User Profiles, to set the various port assignments/parameters, navigation parameters, and output message lists. A file with commonly used user profiles is included on the supplied USB flash drive.

- ✓ The SF-3040 provides for storage of up to 20 user profiles. Profiles may also be stored on a PC. Each user profile is stored with a name. The user profile extension is \*.npt.
- ✓ StarUtil 3000, or another controller solution, is used to upload a user profile by its name.
- ✓ The SF-3040 may be initially configured with the factory default user profile or with a profile customized for the user by an authorized dealer.
- ✓ Predefined, commonly used profiles are included on the supplied SF-3040 Product Configuration USB flash drive or are available by email.
- ✓ To save the current configuration settings in the receiver for future use, the user creates a profile and assigns it a name.



If the current settings are not saved to a profile and then made the active settings, the current settings will be overwritten by the last activated profile at the next power cycle or processor reset.



The user may reset all of the user-controlled configuration parameters to the factory default values (see the next section, *Profile NONE*).



A new profile sent to the receiver replaces the currently used profile, but it does not necessarily replace all of the current parameter settings. The new profile replaces only those parameter settings that it specifies.

For example:

The default navigation elevation mask is 7°.

The user changes the elevation mask to 12° in a profile named “Test”. The user subsequently sends profile “RTK” to the receiver. It replaces “Test” and changes navigation mode settings and port assignments.

But profile “RTK” does not specify a setting for the navigation elevation mask. So, the elevation mask remains at 12°, as previously set by the “Test” profile.



Refer to the *Sapphire Technical Reference Manual* for detailed information on the [PROFILE] and [USEPROFILE] commands (see *Related Documents* in the fore-matter).

## Profile NONE

The command [USEPROFILE] NONE resets all of the user-controlled configuration parameters to the factory default values. The receiver’s profile remains set to NONE until another profile is successfully input.



The profile NONE is subject to change.

## Avoiding User Profile Loading Errors

StarUtil 3000 v.1.0.0 and later scans user profiles before loading them to adjust port settings and reduce the likelihood of communication errors. Communication errors still occur, and this section aids in resolving common issues.

As a user profile is loaded into the receiver, each command line is acted upon as it is received. A profile loading error occurs if the communication link between the PC and the receiver is broken before all command lines are received. To avoid this loading error, the best practice is to preview the control port baud rate in a user profile before loading the profile. Refer to the *StarUtil 3000 User Guide* for detailed instructions.

## Third-Party Controller Configuration Settings

Refer to the third-party controller solution manual/user guide if your SF-3040 GNSS receiver is part of an integrated solution.

## Over the Air StarFire Licensing

Over the Air (OTA) StarFire Licensing is the easiest way to install a StarFire license. The installation of a purchased license is accomplished via radio broadcast. Over the Air StarFire Licensing is especially convenient for receivers in remote locations in the field.

These are the requirements for obtaining a StarFire license:

- ✓ Valid Purchase Order

- ✓ Signed License Agreement
- ✓ Appropriate Credit Terms with NavCom Technology or an Authorized Dealer, including a valid purchase order.

NavCom recommends that customers process new StarFire license requests through an authorized dealer or NavCom Sales 15 to 30 days before the expiration of the current license.

The customer selects the date and time in GMT for the Over the Air broadcast of the StarFire License.

- ✓ The scheduled broadcast must occur at least 3 business days after a valid P.O. is received by NavCom Sales.
- ✓ Specify broadcast date and time in GMT on the P.O.
- ✓ NavCom confirms the date & time of broadcast via email.

## Over the Air Broadcast

The StarFire license is broadcast at the scheduled time and 5 minutes later as a backup.



To ensure reception, turn on the receiver before the specified broadcast time. Do not turn off the receiver until verifying that the license is saved.



The receiver must be tracking StarFire satellites at the broadcast times, though the receiver is not required to be operating in StarFire mode during the broadcasts.

## Verify License Is Saved

There are two ways to view StarFire license data to verify that the license is saved:

- ✓ StarUtil 3000
- ✓ Sapphire Message SFLICENSEB (described in the Sapphire Technical Reference Manual)

(Refer to *Related Documents* in the fore-matter.)

Verify this StarFire license data:

- ✓ The StarFire license is saved as one of these license types:
  - Primary StarFire License: Currently active license  
OR
  - Secondary (Backup) StarFire License:  
Inactive license that becomes active at the expiration of the Primary StarFire license
- ✓ Duration of the saved license and the valid areas of operation

For special-case scenarios, customers may request to receive the StarFire license via email to manually upload via StarUtil 3000. The request must be specified in the purchase order.



The broadcast procedure for Over the Air StarFire Licensing is subject to change.

## Setting Up a StarFire Priority Network

The SF-3040 defaults to using the highest available satellite between both networks. If multiple receivers are used on one platform, the user may force one to use Net1 and the other to use Net2.

1. On the *Input Terminal*, type [SFNETPRIORITY] to view the current priority net settings.
2. Perform one of the following:
  - Type [SFNETPRIORITY]DEFAULT to command the system to automatically select



the StarFire satellite with the highest elevation angle, regardless of Net1 or Net2, but subject to authorized nets.

- Type [SFNETPRIORITY]NET1<sup>1</sup> to set Net1 as the priority net, which commands the receiver to select the Net1 StarFire satellite with the highest elevation angle.
- Type [SFNETPRIORITY]NET2<sup>2</sup> to set Net1 as the priority net, which commands the receiver to select the Net2 StarFire satellite with the highest elevation angle.



<sup>1</sup> If there are no visible Net1 satellites, or if the receiver is licensed as Net2 only, the receiver will select the Net2 StarFire satellite with the highest elevation angle.



<sup>2</sup> If there are no visible Net2 satellites, or if the receiver is licensed as Net1 only, the receiver will select the Net1 satellite with the highest elevation angle.



Refer to the *Sapphire Technical Reference Manual* for detailed information on the [SFNETPRIORITY] command.

## RapidRecovery

The receiver starts using these corrections when the link to the navigation satellites has either been lost or degraded to a specified quality value called Figure of Merit (FOM) which represents the best-guess accuracy of the horizontal position.

- ✓ NavCom recommends using a FOM value in the range of 5-10.



Refer to the Sapphire Technical Reference Manual for detailed information on the [RAPIDRECOVERY] command.

## Failed Search

Whether from loss of reception or lack of initial acquisition, after a 5-minute failed search for a StarFire satellite, the receiver automatically searches for another available StarFire satellite.

This functionality only applies to:

- ✓ Receivers licensed for both StarFire Net 1 and Net 2
- ✓ Receivers only licensed for StarFire Net 1 in areas where signals from 2 StarFire satellites overlap and may be available.

## StarFire Network List

Table 17 describes the current StarFire satellite orbit positions, network assignments, and uplink sites for v.2.0.15.0 and later.

*Table 17: StarFire Satellites v.2.0.15.0 and Later*

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	97.65W	PAC-E	Laurentides
	643	143.5E	PAC-W	Perth
	525	25E	IND-W	Burum
Net 2	358	142W	PAC-C	Santa Paula
	609	109E	IND-E	Auckland
	484	15.5W	AOR-E	Southbury

Table 18 describes the current StarFire satellite orbit positions, network assignments, and uplink sites for v.3.0.12.0 and later.

*Table 18: StarFire Satellites v.3.0.12.0 and Later*

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	97.65W	PAC-E	Laurentides
	643	143.5E	PAC-W	Auckland
	525	25E	IND-W	Burum
Net 2	678	178E	POR	Santa Paula
	564	64E	IND-E	Perth
	446	54W	AOR-W	Southbury
	484	15.W	AOR-E	Southbury

## Enable or Disable Receiver Tracking and/or Use of Select Signals and Frequencies

Receiver tracking of various signals and frequencies can be enabled or disabled.

Refer to the [TRACKINGMODE] and [NAVMEASURE] commands in the *Sapphire Technical Reference Manual* for detailed instructions on enabling and disabling the tracking of and receiver use of various signals and frequencies. Also refer to the *StarUtil 3000 User Guide*.



These commands are used primarily for engineering experiments or receiver testing. They are not recommended for use in other applications.

## Enable or Disable Receiver Use of Signals and Frequencies for Navigation

Receiver use of various signals and frequencies for navigation can be enabled or disabled.

Refer to the [NAVMEASUSE] command in the *Sapphire Technical Reference Manual* for detailed instructions on enabling and disabling navigation signals and frequencies. Also refer to the *StarUtil 3000 User Guide*.

This command is used primarily for engineering experiments or receiver testing. It is not recommended for use in other applications.

### 3<sup>rd</sup> Party Controller Configuration Settings




Refer to the 3<sup>rd</sup> party controller solution manual/user guide if your SF-3040 GNSS receiver is part of an integrated solution

## Chapter 6..... Batteries

The SF-3040 GNSS receiver is supplied with two Lithium-ion rechargeable battery packs that can be plugged into the unit simultaneously.

When operating in GPS mode, one battery can be hot-swapped for another without interruption in operation as long as the second battery has sufficient charge for 5 minutes of operation.

 The user must complete the battery swap within four minutes.

### Charging the Battery Packs

The SF-3040 GNSS receiver is supplied with two Lithium-ion rechargeable battery packs. The battery charger has two charging bays (refer to Figure 52).



*Figure 52: Battery Pack Dual-Bay Charger*

Follow these steps to charge the SF-3040 batteries:

1. Plug the supplied battery pack charger AC power adapter into a wall outlet.
2. Connect the AC power adapter to the DC in-jack on the supplied battery pack charger.

3. Place the battery packs in the charger (refer to Figure 54).
4. Charge the batteries for 12-hours after each use to ensure longest possible usage each day.
5. Once the battery packs are fully charged, slide them out and unplug the power.



The temperature range over which the battery can be charged is 0°C to 45°C. Charging the battery at temperatures outside of this range may cause the battery to become hot or to break. It may also harm the performance of the battery or reduce the battery's life expectancy.

## Battery Charger LEDs

The battery charger has two LEDs, one for each charger bay. The LED is green when no battery is in the charger. Once a battery is placed in the charger, the light turns red. When the battery is almost fully charged, the light turns yellow. Continue charging the battery. The light stays green when the battery packs are fully charged. Refer to the below table:

*Table 19: Battery Charger LED Indicators*

<b>Off</b>	Not charging
<b>Red</b>	Batteries charging
<b>Yellow</b>	Battery near full charge; continue charging
<b>Green</b>	No battery in charger <b>or</b> batteries are fully charged (Charge for 12hrs, regardless of LED color)



Batteries are *not* charged in the unit. If external power is applied, the SF-3040 battery

LEDs indicate the status of the batteries, not the status of the external power source.

⚠ All new batteries *must* be charged for a minimum of 12 hours prior to use, regardless of the LED indicator on the charger.

## Installing the Battery Packs in the SF-3040

The battery chambers are located on the side of the SF-3040. There are two locking clips on the outside edge of each battery chamber to hold the battery packs in place.

Follow these steps to install the battery packs in the SF-3040:

1. Open the battery pack chamber (located on the left-hand side of the SF-3040 as you hold the receiver with the front facing toward you) by pressing downward on the black button (refer to Figure 53).



Figure 53: Battery Chamber Release Button

2. Align the battery pack with the chamber.

3. Slide a battery pack into the right or left chamber, holding the locking clip to the side while inserting the battery pack.
4. Push the locking clip back into place.
5. Repeat steps 2 through 4 with the second battery pack.
6. Close the battery chamber door and press until it clicks shut.

⚠ If both locking clips are not locked in place, the battery packs can disengage.



*Figure 54: SF-3040 Battery Packs Installed in Battery Chamber*



## Removing the Battery Packs

Remove the battery packs individually.


If the receiver is turned on, remove the weakest battery first and exchange it for a fully charged battery.


Follow these steps to remove the battery packs:

1. To open the battery chamber, hold the SF-3040 upright and press downward on the lower half (protruding part) of the black button on the battery chamber (refer to Figure 53).
2. With the thumb of one hand, gently push to the locking clip to the outside on the battery chamber; the battery pack should pop out enough to be free of the chamber.
3. Remove the battery pack.








## Battery Usage and Storage Precautions





Adhere to the following precautions when using the battery packs and charger:

 Charge the battery packs only with the supplied battery charger (PN 98-214401) otherwise, damage to the battery packs could occur.

 Do not disassemble or modify the battery packs; there are no user-serviceable parts inside. The batteries contain safety and protection devices, which, if damaged, may cause the battery to generate heat, explode, or ignite.

- 
- ⚠ Do not short-circuit the battery contacts. A short circuit of the battery contacts could result in an explosion and a release of toxic fumes.
  - ⚠ Adhere to the following battery-pack storage temperature ranges:
    - Storage for 1 month: -20°C (-4°F) to 60°C (140°F)
    - Storage for 3 months: -20°C (-4°F) to 45°C (113°F)
    - Storage for 1 year: -20°C (-4°F) to 25°C (77°F)
  - ⚠ Do not store the battery packs in an environment in which the humidity exceeds 75%.
  - ⚠ In the event a battery leaks and battery fluid gets in the eye, do not rub the eye. Rinse well with water and immediately seek medical care. If left untreated, the eye could be damaged by the battery fluid.
  - ⚠ Remove the battery packs from the SF-3040 if the receiver will be inoperative for more than a week.
  - ⚠ Do not install the battery backwards so that the polarity is reversed.
  - ⚠ Do not connect the positive terminal and the negative terminal of the battery to each other with any metal object (such as wire).

-  Do not carry or store the batteries together with metal objects that may come in contact with the battery terminals.
-  Do not pierce the battery with nails, strike the battery with a hammer, step on the battery, or otherwise subject it to strong impacts or shocks.
-  Do not solder directly onto the battery.
-  Do not expose the battery to water, salt water, or moisture of any kind.
-  Do not expose the battery packs to fire; this could result in an explosion and the release of toxic fumes.
-  Do not place the battery on or near fires or stoves, or in other high-temperature locations. Do not use or store the battery in any areas with excessive heat; for example, the interior of a car or truck in hot weather. Doing so may cause the battery to generate heat, explode, or ignite. Using the battery in this manner may also result in a loss of performance and shortened life expectancy.
-  The battery packs and chargers are not to be used by small children.

-  Immediately discontinue use of the battery if, while using, charging, or storing the battery, the battery emits an unusual smell, feels hot, changes color, changes shape, or appears abnormal in any other way.
-  Do not place the batteries in microwave ovens, high-pressure containers, or on induction cookware.
-  Do not attach the batteries to a power supply plug or directly to a car's cigarette lighter.
-  Do not continue charging the battery if it does not accept a charge within the full charge cycle of 8 to 10 hours. Doing so may cause the battery to become hot, explode, or ignite.



Refer to Chapter 8 for instructions regarding safe battery disposal.

## Chapter 7 ..... UHF Radio Modem

An optional 1-Watt internal, removable, user-configurable UHF radio modem (PN 90-213034-01) is available for use with the SF-3040. Table 20 lists the items in the UHF Radio Modem Kit and their respective part numbers.

### Licensing Requirements

This radio device requires an FCC license prior to operation in the United States. Other countries may have similar requirements. It is the purchaser's responsibility to acquire all applicable operator licenses.

### Radio Overview

The operational range of the 1W radio varies with the undulation of the topography, the density of foliage and man-made materials (i.e. buildings), the type of antenna employed (NavCom offers a half-wave antenna), and the height of the base antenna. A broadcast range of 2km is not uncommon, but will vary greatly based on the operating environment. If a longer range is desired, NavCom offers a 35W radio option.

The user configures the radio via software running on a hand-held controller or a PC. Specifically, this radio is controlled via the [RADIO] command on the Input Terminal. This command controls turning power on and off to the radio as well as setting the carrier frequency, the transmit power, the signal threshold, and the network ID. A user can also schedule [RADIOSTAT] messages to report the current status of the radio. Refer to the *Sapphire Technical*




*Reference Manual* for detailed information about the [RADIO] and [RADIOSTAT] commands.

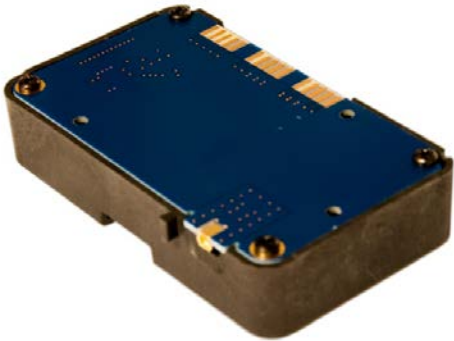
*Table 20: UHF Radio Modem Kit,  
PN 92-210206-3001LF*

Part Number	Description
90-213034-01	UHF Radio Modem Module
96-210183-3001	Installation Guide, UHF Radio Module

*Table 21: Antenna Selection*

98-213686	Half Watt Antenna – 400 to 435MHz
98-213687	Half Watt Antenna – 435 to 470MHz

-  Order the UHF radio with the appropriate upper (435 to 470MHz) or lower (400 to 435MHz) band antenna for proper operation.
-  Users in North America should be aware that, due to the allocation of the frequency band 406.0 – 406.1 MHz is for government use only, the use of the radio modem on this frequency band is strictly forbidden.
-  Use only the radio modem supplied by NavCom in the SF-3040.



*Figure 55: Radio Modem*

## Technical Specifications

*Table 22: UHF Radio Modem Specifications*

Item	Receiver	Transmitter	Notes
Operating Voltage	+3 V – +9 V		Supplied voltage: 3.8 V
Frequency Range	403 – 473 MHz		
Channel Spacing	12.5/20/25 KHz		<sup>1</sup> Programmable to 12.5 or 25 KHz
Tuning Range	70 MHz		
Sensitivity (BER <10 <sup>-3</sup> )	-110 dBm @ 12.5 KHz -112 @ 20 KHz -112 dBm @ 25 KHz		<sup>2</sup> FEC OFF



1. Software v2.1.7 is limited to 25KHz; Software v3.0 and later allows 12.5 or 25 KHz.
2. Due to design, the radio receiver is about 6 – 15 dB less sensitive on the following frequencies: 403.000, 416.000, 429.000, 442.000, 455.000, 468.000, and 469.200 MHz

Table continued on next page...

Item	Receiver	Transmitter	Notes
Power Consumption	<1.2 W	<3 W @ 0.5 W output power <7 W @ 1 W output power	
Power Consumption, Save Modes	Sleep: 0.24 W typical DTR: 5 mW		
Transmit Power		100, 200, 500, 1000 mW	
Communication Mode	Half-Duplex		
Carrier Power Stability		< $\pm 1.5$ dB	
Data Speed of Serial Interface	300 – 38400 bps		Programmed to 38400 bps
<sup>3</sup> Modulation	4FSK (Satel), GMSK (PacificCrest, TrimTalk)		
Antenna Connector	TNC		
Interface	LVTTTL UART		
Temperature Ranges	-30°C – +65°C		Functional
	-25°C – +55°C		Complies with standards
	-40°C – +80°C		Storage
Weight	50 g		



3. Software v2.1.7 is limited to Satel;  
Software v3.0 and later allows Satel,  
PacificCrest, and TrimTalk.

## RF Interface

The radio modem has a single antenna connector with an impedance of 50 ohm.



## Channel Spacing

The data speed of the radio interface depends on the chosen radio channel spacing. Channel spacing is fixed at 25 KHz in software v2.1.7. Software v3.0 and later allows 12.5 or 25 KHz.

## Data Speed

A channel spacing of 25 KHz enables a data speed of 19200 bps. Channel spacing of 12.5 KHz enable a data speed of 9600 bps. The TrimTalk protocol limits the data rate to 4800bps. However, these rates are not programmable in the SF-3040. The data speed of the radio interface is always fixed (19200 bps), regardless of the data speed of the serial interface.




If the data speeds of the radio interface and the serial interface differ, the radio modem temporarily buffers data being transferred, so no data loss occurs.


## Transmitter


The transmitter output power is adjustable: It can be set at 100, 200, 500, or 1000 mW (1 W). To conserve battery life, the transmitter output power should be set to the lowest possible level that ensures error-free connections under variable conditions.


*Table 23: Transmission Output Power Values,  
Watts vs. dBm*

Output Power	dBm
100 mW	+20
200 mW	+23
500 mW	+27
1 W	+30

 High output power levels using short connection distances can, in the worst case, disturb the overall operation of the system.

 The greatest allowable power depends on the limits set by local authorities, which limits must not be exceeded under any circumstance.

 When using the radio as a base station, use an external power supply to power the unit instead of the internal batteries.


 When using the radio as a base station and more than 1 W of power is required, use a compatible external radio unit. Contact NavCom for further information.

## Radio Modem Receiver

The sensitivity of the receiver depends on the channel spacing of the radio mode (data speed of the radio interface) and on the mode of the forward error correction (FEC), which is OFF on the SF-3040. Refer to Table 24.

*Table 24: Receiver Sensitivity*

Bandwidth, KHz	FEC OFF (Default)
25	-110 dBm
12.5	-112 dBm

 The signal threshold level setting of the receiver determines the level above

which the search for the actual data transfer signal is active.



Do not install the radio modem on a strongly vibrating surface. Suitable dampening and /or isolation materials should be used in cases where the installation surface will be subjected to vibration.

## Priority RX/TX

The radio priority is set to TX.

## Forward Error Correction (FEC) and Error Checking

FEC is disabled and unavailable in the SF-3040.

## Installing the Radio Modem

Follow these steps to install the radio modem in the SF-3040 radio modem chamber:

4. To open the radio modem chamber (located on the right-hand side of the SF-3040 as you hold the receiver with the front facing toward you), press downward on the protruding part of the black button (refer to Figure 56).



*Figure 56: Radio Modem Chamber Release Button*

5. With the multi-pin connector on top, fully insert the radio modem into the module opening on the side of the SF-3040 until you hear the radio click into place (refer to Figure 57).



*Figure 57: Radio Modem Installation*

6. Carefully plug the antenna plug into the MCX connector on the module. Be sure to align the center pin and press the connector on straight. A bent connector probably indicates a damaged

center pin and the connector will need to be replaced.



*Figure 58: Radio Modem Installed in SF-3040*

7. Align the antenna cable so that it is out of the way of the closed door.
8. Ensure that the door is in the locked position.
9. Connect the radio antenna.

## External Antenna

The radio modem requires an external antenna, which is included in the radio modem kit.

⚠ To prevent damage, the radio modem should be switched OFF prior to connecting or disconnecting the antenna.

⚠ Do not expose the radio modem to water or direct sunlight.




Radio performance is contingent upon the proper antenna selection for the band of operation (refer to Table 21).

---


## Removing the Radio Modem

Follow these steps to remove the radio modem from the SF-3040 radio modem chamber:

1. Turn the SF-3040 off.
2. Open the radio modem chamber, press downward on the black button (refer to Figure 56).
3. Carefully pull the antenna connector plug from the radio antenna port.

 The connector fits snugly. Do not use a prying device (i.e. screwdriver) to remove the connector. Instead, needle-nose pliers may be used on the connector body only; do not use the pliers at the coaxial cable connection.

4. Slide the radio modem out.
5. Use a small tie-wrap to secure the antenna connector to the coaxial cable on the door.

 Failure to perform Step 5 above may allow the MCX connector to momentarily touch the radio modem interface power port and short the SF-3040 power supply out.

## Chapter 8..... Safety Instructions



The SF-3040 GNSS receiver is designed for precise navigation and positioning using various GNSS. Users must be familiar with the use of portable GNSS equipment, the limitations thereof, and these safety instructions prior to using the receiver.

### Safety First

The owner of this equipment must ensure that all users are properly trained prior to using the equipment and are aware of the potential hazards and how to avoid them.

Other manufacturer's equipment must be used in accordance with the safety instructions issued by that manufacturer. This includes other manufacturer's equipment that may be attached to NavCom Technology, Inc. manufactured equipment.

Always use the equipment in accordance with local regulatory practices for safety and health at work.

-  There are no user-serviceable parts inside the SF-3040 GNSS receiver. Accessing the inside of the equipment will void the equipment warranty.
-  Take care to ensure that the SF-3040 does not come into contact with electrical power installations, the unit is securely fastened, and there is protection against electromagnetic discharge in accordance with local regulations.

## Transport

Utilize all original packaging when transporting via rail, ship, or air.

## Maintenance

The NavCom equipment may be cleaned using a new lint free cloth moistened with mild soap. Do not use pure alcohol on stenciled areas of the case as this will remove the stenciled labels.

Connectors must be inspected, and if necessary, cleaned before use. Always use the provided connector protective caps to minimize moisture and dirt ingress.

Inspect cables regularly for kinks and cuts as these may cause interference and equipment failure.


Damp equipment must be dried at a temperature less than +40°C (104°F), but greater than 5°C (41°F) at the earliest opportunity.


## External Power Source

An external power cable (optional) may be used to connect the SF-3040. The power cable must be connected to the chosen external power solution in accordance with the instructions in Chapter 3, Electrical Power. It is important that the external power source allow sufficient current draw for proper operation. Insufficient supplied current will cause damage to your external power source.


If your chosen external power source is a disposable battery, dispose of the battery in accordance with your local regulations.



 If the SF-3040 receiver is used with the optional DC power cable (PN 96-212172-01), the receiver must be connected to the chosen external power solution in accordance with the instructions in Chapter 3, Interfacing/Electrical Power

 It is important that the external power source allow sufficient current draw for proper operation. Insufficient supplied current will cause damage the external power source.

## Battery Disposal

 Dispose of battery packs properly; cover the contacts with a non-conductive material and recycle.





The Lithium-Ion battery packs are classified by the United States Federal Government as non-hazardous waste and are safe for disposal in the normal municipal waste stream per your local regulations. These batteries, however, do contain recyclable materials and are accepted for recycling by the Rechargeable Battery Recycling Corporation's (RBRC) Battery Recycling Program. For additional information, go to the RBRC website at <http://www.rbrc.org/call2recycle/index.html>

## ■ Battery Charging

Follow the rules listed in Chapter 6 regarding proper battery charging, use, and storage. Failure to do so may cause the battery to become hot, explode, or ignite and cause serious injury.

## ■ Battery Discharging

 The temperature range over which the battery can be discharged is -20°C to 60°C. Use of the battery outside of this temperature range may damage the performance of the battery or may reduce its life expectancy.

 Do not discharge the battery using any device other than the device it is designed to operate with (i.e., the receiver or radio modem). Doing so may damage the performance of the battery or reduce its life expectancy and may cause the battery to become hot, explode, or ignite and cause serious injury.

Remove the battery packs from the SF-3040 if the receiver will not be used for more than 1 week.

## A ..... GNSS Receiver Specifications

The technical specifications of this unit are detailed below. NavCom Technology, Inc. is constantly improving and updating its technology. For the latest technical specifications for all products, go to <http://www.navcomtech.com/Support/>

### Features

- ✓ Fully integrated receiver in robust housing
- ✓ Built-in StarFire receiver and demodulator
- ✓ Rugged and lightweight package for mobile applications
- ✓ Full constellation coverage with up to 66 signals tracked simultaneously, plus the StarFire channel
- ✓ SBAS (WAAS, EGNOS, MSAS, GAGAN) tracking
- ✓ L1/L2, L2C, G1, G2, L5, E1, E5A (GPS/GLONASS) code and full wavelength carrier phase tracking
- ✓ Fully automatic acquisition of satellite broadcast corrections
- ✓ High sensitivity/low signal level tracking
- ✓ Fast acquisition/re-acquisition
- ✓ SD internal memory card (2 GB memory).
- ✓ NavCom Ultra Compact RTK format, RTCM 2.3 and 3.1 (code & carrier), and CMR/CMR+
- ✓ Output NMEA 0183, NavCom Binary, NavCom ASCII formats
- ✓ Configurable as RTK base or rover

- 
- ✓ RTK Extend
  - ✓ Programmable output rates
  - ✓ C/A, L2C, L5, P1/P2, G1C/G2C code tracking
  - ✓ Two “hot-swappable”, rechargeable, lightweight battery packs
  - ✓ Minimal data latency
  - ✓ Superior interference suppression (both in-band and out of band)
  - ✓ Patented multipath rejection
  - ✓ Self-survey mode (position averaging)
  - ✓ Bluetooth®
  - ✓ Communication Ports: RS-232, USB 2.0, UHF radio option
  - ✓ StarFire Over IP corrections via the Internet.

## Time-to-First-Fix (TTFF) Specifications

Cold Start	< 60 seconds	No valid Almanac or Ephemeris data available
Warm Start	< 50 seconds	Valid Almanac available (less than one year old)
Hot Start	< 20 seconds	Valid Ephemeris available (less than 4 hours old)



Typical values measured per ION-STD 101

## Dynamics

Acceleration	up to 6g
Speed	< 515 m/s <sup>1</sup> (1,000 knots)
Altitude	< 18.3km <sup>1,2</sup> (60,000 ft)

<sup>1</sup>Restricted by export laws

<sup>2</sup>Supported in software. From a hardware perspective, receiver should be placed in a pressurized environment >12.2km (40,000 ft.)

## Measurement Performance

Measurement Precision (RMS)	
Raw C/A code:	7.50cm
Raw Carrier Phase	L1: 0.7mm
Noise:	L2: 0.9mm
RTK Positioning – Multi-Frequency <40kms <sup>1</sup> (RMS)	
Position (H):	± 1cm +0.5ppm
Position (V):	± 2cm +1ppm

<sup>1</sup>Does not represent UHF radio modem range

Table continued on next page...

RTK WL Positioning – Multi-Frequency <40kms (RMS) (see note below)	
Position (H):	$\pm 5\text{cm} +2\text{ppm}$
Position (V):	$\pm 10\text{cm} +2\text{ppm}$
RTK Extend (see note below)	
Position (H):	$\pm 3\text{cm} +1\text{ppm}$
Position (V):	$\pm 6\text{cm} +2\text{ppm}$
RTK Float	
Position (H):	$\pm 20\text{cm} +3\text{ppm}$
Position (V):	$\pm 40\text{cm} +3\text{ppm}$
StarFire (dual)	
Position (H):	$\pm 5\text{cm}$ , GNSS; $\pm 10\text{cm}$ , GPS
Position (V):	$\pm 10\text{cm}$ , GNSS; $\pm 15\text{cm}$ , GPS
Code Differential GPS <200kms <sup>1</sup> (RMS)	
Position (H):	$\pm 45\text{cm} +3\text{ppm}$
Position (V):	$\pm 90\text{cm} +3\text{ppm}$
Velocity (for all DGPS described above)	
Velocity:	0.01m/s
Enhanced SBAS (WAAS/EGNOS/MSAS/GAGAN) Position Accuracy (RMS)	
Position (H):	$\pm 30\text{cm}$
Position (V):	$\pm 60\text{cm}$

<sup>1</sup>Does not represent UHF radio modem range



The specifications herein are based on the following: PDOP <4, 1-sigma (65%), 24-hour averaged set of data. Further, performance is dependent on, but not limited to, location, satellite geometry, atmospheric conditions (i.e., solar storm activity), local interference, DoD signal degradation (i.e., Selective Availability or similar techniques), satellite messaging or timing errors, and augmentation correction messages. Equipment operated on a single frequency is more susceptible to atmospheric and solar

storm activity than is multi-frequency operated equipment.



The Network RTK software option allows the receiver to generate and receive RTCM 1000-series messages. The navigation algorithms are designed to support single-base correction configurations. Network adjusted RTK formats are not currently supported.



RTK WL is a positioning mode that is necessary for phase ambiguity resolution. However when this navigation mode is indicated, it is likely that the receiver is in a corner case navigation condition. As such, it is likely that the end user will not wish to use it as a valid navigation mode.

If the above conditions are met, then the receiver will not need to be put into RTK-WL mode.



RTK Extend is a purchased software option that uses StarFire to provide continuous RTK positioning during non-reception of RTK corrections. When a StarFire-enabled receiver with RTK Extend falls out of RTK mode, the system automatically transitions to RTK Extend mode. Positioning is maintained because of the close correlation in phase measurement corrections between RTK and StarFire.

Depending on how long the RTK base station has been running and is StarFire-fixed, the duration of RTK Extend is limited to:

- 2 to 15 minutes for an NCT base station
- 2 to 15 minutes for a non-NCT base station

For RTK Extend to achieve maximum performance, the rover must be fully converged, which typically requires one (1) hour of operation.

The correlation between RTK and StarFire phase measurement corrections decreases over time, until the system automatically transitions out of RTK Extend mode to the next available dGPS mode.

This option is only required on the Rover receiver. If a Base receiver may be used as a Rover at a future date, it should be optioned for RTK Extend as well. Refer to the *StarUtil 3000 User Guide*, Chapter 5, for more information on RTK Extend.

## Pull-in Times

StarFire GPS	45 minutes, typical
StarFire GNSS	45 minutes, typical

## StarFire Rapid Recovery

Outage duration	Up to 55 seconds
Maximum outage distance	10km
PDOP Limit	<4
HDOP Limit	<3
Recovery time	<3 minutes after re-entering StarFire navigation mode



## User-Programmable Output Rates

PVT	1, 2, 5Hz (Standard) 10 Hz max. (Optional)
Raw data	1, 2, 5Hz (Standard) 10 Hz max. (Optional)

## Data Latency

PVT	< 10 ms at all nav rates
Raw data	< 10 ms at all rates
Internal Memory	2 GB – SD card

## Bluetooth

Connectivity: Initial Paring: Once Connected:	2 meters (6 feet) Up to 5 meters (16 feet)
Data Rate	230.4 Kbps, 10 Hz max.
Data Loss	< 0.2%
Baud Rate	Fixed at 230400

## Connector Assignments

Data Interfaces	
2 serial ports	1200 bps to 115.2 kbps
USB port	2.0 Mbps

## Input/Output Data Messages

Control Commands (Input Only)	NavCom proprietary commands (refer to the <i>Sapphire Technical Reference Manual</i> )
Differential Correction (I/O)	RTCM 2.3 and 3.1, RTCM types 1, 3, and 9, SBAS (WAAS/EGNOS/ MSAS/ GAGAN), and StarFire
RTK Correction Data (I/O)	CMR/CMR+, RTCM types 3, 18-22, and 1001-1012, 1019-1020, 1033; NCT types 0x5B, 0x5C, and 0x5E (hex)
NMEA-0183 Messages (Output Only)	ALM, DTM, GFA, GNS, MLA, GBS, GGA, GLL, GRS, GSA, GST, GSV, RMC, RRE, VTG, ZDA



See *Related Standards* at the front of this manual for information on the various data formats.



In the most current version of the software, the DTM message will automatically display before the most frequently scheduled NAV message.

In older versions of the software (v3.0.13 and earlier), the DTM message must be manually scheduled to display at the same rate as the most frequent NAV message to meet IMO and MED certification requirements. v.3.0.14 and later software support NMEA-0183 v4.1. See *Sapphire Technical Reference Manual* for details.

## Satellite Based Augmentation System Signals

RTCA/DO-229D Standard (WAAS/EGNOS/MSAS/GAGAN)
StarFire™

## Physical and Environmental

Size	
Diameter	8 in. (203 mm)
Height (from mounting base to top of antenna housing)	4.36 in. (111 mm)
Weight	< 3.5 lb (1.59 kg)
External Power	
Input Voltage	9 VDC to 16 VDC
Consumption	< 6 W (without the radio) >7 W (with the radio)
Connectors	
I/O Ports	1 x 7 pin Lemo (COM1/USB) 1 x 6 pin Lemo (COM2)
DC Power	1 x 2 pin Lemo
Temperature (ambient)	
<i>Operating</i>	
External Power Supply:	-20° C to +65° C
Battery-Powered or with	
UHF Radio installed:	-20° C to +45° C
SD Card installed:	-20° C to +45° C
<i>Storage</i>	-40° C to +85° C
Humidity	95% non-condensing
Environment	IP-6 rating: TBD
Operating Shock	2 two-meter pole drops
Transport and Storage	
Vibration	MIL-STD-810 FIG. 514.5C

## Battery Packs

Type:	Lithium-Ion, Rechargeable
Size (L x W x H):	3.45" x 2.75" x 1.70"
Weight:	11 oz (0.312 kg)

Performance	
Without UHF Radio:	> 3 hr each battery > 6 hr with 2 batteries
With UHF Radio:	> 2.5 hr each battery > 5 hr with 2 batteries
Temperature (ambient)	
Storage/Discharge:	-20° C to +60° C
Charger Operating:	0° C to +40° C
Full Charge Cycle:	8 to 10 hr
Interface:	Hot-swappable
Operating Power Status:	Indicator Panel LEDs

*Table 25: Battery Maximum Charging Time*

Volt/VDC	Capacity/mAh	Time/Hr
7.4	2600	>4 hr

*Table 26: Battery Charger Specifications*

AC Input Voltage:	90-250 VAC
AC Current:	1.2 A max at 90VAC input
DC Output Voltage:	3.0 A max at 15VDC output
Display:	LED Indications: Power On, Charging, Charging Complete
Size (L x W x H):	11" x 4.33" x 2.95"
Weight (Battery Charger, Power Supply and Cables):	2.5 lbs (1.2 kg)

This page is left blank intentionally.

## B.....Antenna Specifications

The SF-3040 multi-constellation, multi-frequency GNSS integrated antenna tracks the following signals from satellite vehicles:

- ✓ GNSS:
  - GPS: L1, L2, L2C, L5
  - GLONASS: G1, G2
- ✓ SBAS: WAAS, EGNOS, MSAS, GAGAN
- ✓ StarFire (L-Band differential corrections)

*Table 27: SF-3040 Integrated Antenna*

Supported Signal Bands	GPS: L1, L2, L2C, L5 GLONASS: G1, G2 SBAS: WAAS, EGNOS, MSAS, GAGAN StarFire (L-Band differential corrections)
L1 Phase Center	90.55mm (3.56in)
L2 Phase Center	104.35mm (4.116in)
L2C Phase Center	TBD
L5 Phase Center	TBD
Polarization	Right Hand Circular (RHCP)
<b>Frequency</b>	
Band	MHz
GPS L1; Glonass G1;StarFire	1525 – 1610
GPS L2, L5; Glonass G2	1160 – 1252

Table continued on next page...

<b>Amplifier</b>	
Frequency (Frequency is dependent on software bundle options.)	GPS L1: 1575.42MHz, $\pm 16$ MHz GPS L2: 1227.60MHz, $\pm 16$ MHz GPS L2C: 1227.60MHz, $\pm 16$ MHz GPS L5: 1176.45MHz, $\pm 16$ MHz StarFire L-Band: 1525 -1585 MHz GLONASS G1: 1603.00MHz, $\pm 6.5$ MHz GLONASS G2: 1247.00MHz, $\pm 5$ MHz
Phase Center	TBD
Pre-amplifier	39dB gain (+/-2dB)
Vibration*	RTCA D0-160 E, Section 8, Curve D
Noise Figure	2.2 dB (L2 GPS)
	2.85 dB L-Band
	2.15 dB (L1, GPS)
Impedance	50 Ohms
VSWR	$\leq 2.0:1$
RF Power Handling	1 W
Band Rejection	20 db @ 250 mHz
Operating Temp	-55°C – +85°C
Altitude	70,000 ft; 21,366 m
Finish	UV-resistant white radome w/ black aluminum base

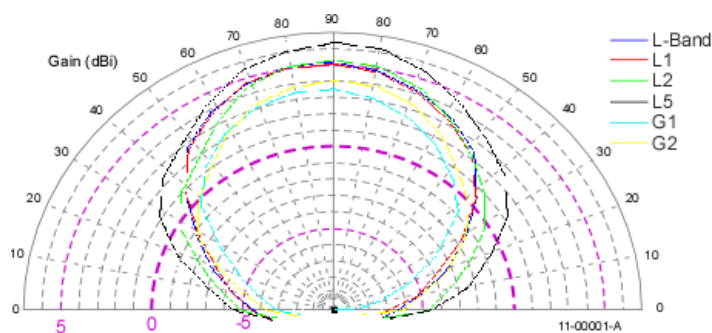
\*Does not apply to the Base antenna



To achieve the greatest level of accuracy, the absolute phase center values must be incorporated into your processing. Phase center information on this antenna is found on our web site:

<http://www.navcomtech.com/Support/DownloadCenter.cfm?category=antenna>

## Radiation Pattern



*Figure 59: SF-3040 Antenna Polar Plot  
(Radiation Pattern)*

Optimal antenna performance is realized at elevations greater than 30°.



There is a 10dB variation between 0° and 90° elevation (factor 10x); therefore, lower elevation satellites are always more difficult to track.

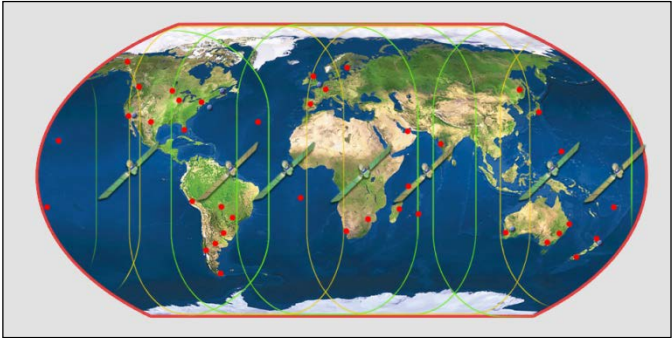


There is a 5dB variation between ~35° and 0° elevation (factor >3x)



This page is left blank intentionally.

C..... StarFire™



Description

The StarFire™ Network is a global system for the distribution of SBAS corrections, giving the user the ability to measure his position anywhere in the world with exceptional reliability and unprecedented accuracy of better than 5cm (2 inches). Because the SBAS corrections are broadcast via INMARSAT geo-stationary satellites, the user needs no local reference stations or post-processing to get this exceptional accuracy. Furthermore, the same accuracy is available virtually anywhere on the Earth's surface on land or sea down to a 10-degree look angle, due to the worldwide coverage of these geo-stationary satellites.

## Infrastructure

The system utilizes the GPS satellite system, L-Band communication satellites, and a worldwide network of reference stations to deliver real-time high-precision positioning.

To provide this unique service, NavCom has built a global network of dual-frequency reference stations, which constantly receive signals from the GPS satellites as they orbit the earth. Data from these reference stations is fed to two USA processing centers in Torrance, California and Moline, Illinois where they are processed to generate the differential corrections.

From the two processing centers, the correction data is fed via redundant and independent communication links to satellite uplink stations at Laurentides, Canada; Perth, Australia; Burum, The Netherlands; Santa Paula, California; Auckland, New Zealand; and Southbury, Connecticut for rebroadcast via the geostationary satellites.

The key to the accuracy and convenience of the StarFire™ system is the source of SBAS corrections. GPS satellites transmit navigation data on two L-Band frequencies. The StarFire™ reference stations are all equipped with geodetic-quality, dual-frequency receivers. These reference receivers decode GPS signals and send precise, high quality, dual-frequency pseudorange and carrier phase measurements back to the processing centers together with the data messages, which all GPS satellites broadcast.

At the processing centers, NavCom's proprietary differential processing techniques used to generate real time precise orbits and clock correction data for each satellite in the GPS constellation. This proprietary Wide Area DGPS (WADGPS) algorithm is

optimized for a dual-frequency system such as StarFire™ in which dual-frequency ionospheric measurements are available at both the reference receivers and the user receivers. It is the use of dual-frequency receivers at both the reference stations and the user equipment together with the advanced processing algorithms, which makes the exceptional accuracy of the StarFire™ system possible.

Creating the corrections is just the first part. From our two processing centers, the differential corrections are then sent to the Land Earth Station (LES) for uplink to L-Band communications satellites. The uplink sites for the network are equipped with NavCom-built modulation equipment, which interfaces to the satellite system transmitter and uplinks the correction data stream to the satellite that broadcasts it over the coverage area. Each L-Band satellite covers more than a third of the earth.

Users equipped with a StarFire™ precision GPS receiver actually have two receivers in a single package, a GPS receiver and an L-Band communications receiver, both designed by NavCom for this system. The GPS receiver tracks all the satellites in view and makes pseudorange measurements to the GPS satellites. Simultaneously, the L-Band receiver receives the correction messages broadcast via the L-Band satellite. When the corrections are applied to the GPS measurements, a position measurement of unprecedented real time accuracy is produced.

## Reliability

The entire system meets or exceeds a target availability of 99.99%. To achieve this, every part of the infrastructure has a built-in back-up system.

All the reference stations are built with duplicate receivers, processors and communication interfaces, which switch automatically or in response to a remote control signal from the processing centers. The data links from the reference stations use the Internet as the primary data link and are backed up by dedicated communications lines, but in fact the network is sufficiently dense that the reference stations effectively act as back up for each other. If one or several fail, the net effect on the correction accuracy is not impaired.

There are two continuously running processing centers, each receiving all of the reference site inputs and each with redundant communications links to the uplink LES. The LESs are equipped with two complete and continuously operating sets of uplink equipment arbitrated by an automatic fail over switch. Finally, a comprehensive team of support engineers maintains round the clock monitoring and control of the system.

The network is a fully automated self-monitoring system. To ensure overall system integrity, an independent integrity monitor receiver, similar to a standard StarFire™ user receiver, is installed at every reference station to monitor service quality. Data from these integrity monitors is sent to the two independent processing hubs in Torrance, California and Moline, Illinois. Through these integrity monitors the network is continuously checked for overall SBAS positioning accuracy, L-Band signal strength, data integrity and other essential operational parameters.

The StarFire network ground reference frame transitioned from the ITRF-2005 to the ITRF-2008 system on January 21, 2014 at 0900 hours UTC. The back-up systems provide fully redundant transition as of January 27, 2014 at 00:00 hours UTC. For information on this transition, please consult the Troubleshooting Guide *StarFire GPS Transition to ITRF2008 Ground Reference Network* located on the NavCom website.

## StarFire Satellites

*Table 28: StarFire Satellites v. 1.0.1.5 and Earlier*

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	97.65W	PAC-E	Laurentides
	609	109E	IND-E	Auckland
	525	25E	IND-W	Burum
Net 2	358	142W	PAC-C	Santa Paula
	643	143.5E	PAC-W	Perth
	484	15.5W	AOR-E	Southbury

*Table 29: StarFire Satellites v. 2.0.15.0 and Later*

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	97.65W	PAC-E	Laurentides
	643	143.5E	PAC-W	Perth
	525	25E	IND-W	Burum
Net 2	358	142W	PAC-C	Santa Paula
	609	109E	IND-E	Auckland
	484	15.5W	AOR-E	Southbury



Satellites 609 and 643 have been reassigned to provide improved reception. Satellite 609, which was in Net1, is now in Net2, and satellite 643, which was in Net2, is now in Net1.

*Table 30: StarFire Satellites v.3.0.12.0 and Later*

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	97.65W	PAC-E	Laurentides
	643	143.5E	PAC-W	Auckland
	525	25E	IND-W	Burum
Net 2	678	178E	POR	Santa Paula
	564	64E	IND-E	Perth
	446	54W	AOR-W	Southbury
	484	15.5W	AOR-E	Southbury

---

## How to Access the StarFire™ Service

StarFire™ is a subscription service. The user pays a subscription, which licenses the use of the service for a predetermined period of time.

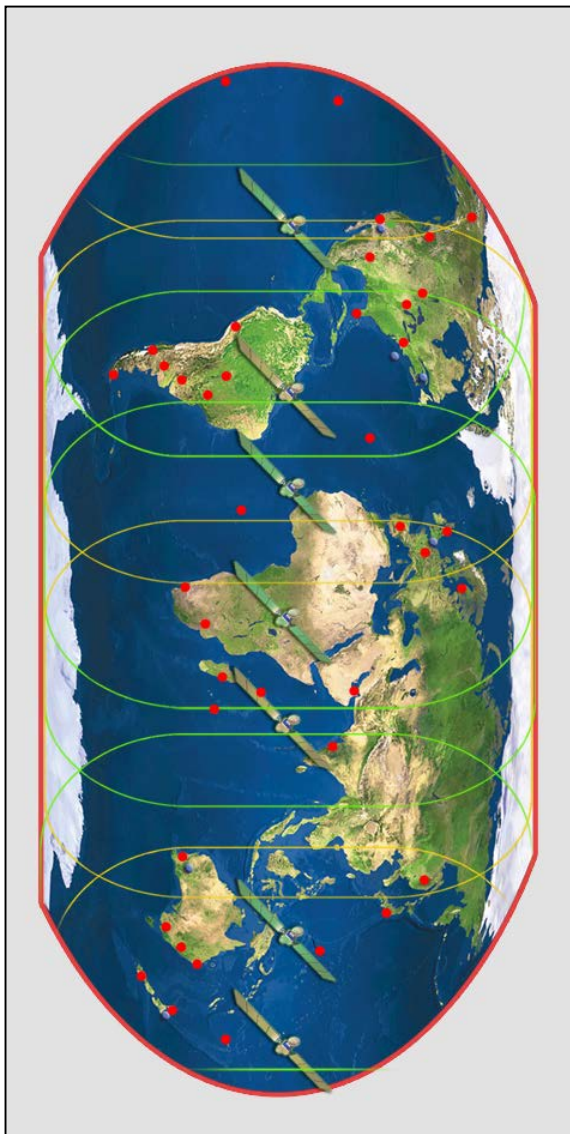
Subscriptions can be purchased for quarterly, biannual or annual periods and are available via a NavCom authorized representative, or by contacting [NavCom Sales Department](#).

An authorized subscription will provide an encrypted keyword, which is specific to the Serial Number of the NavCom receiver to be authorized. This is entered into the receiver using the provided controller solution. Typically the initial license is preinstalled at the factory, and subsequent licenses will be installed by the user.

The only piece of equipment needed to use the StarFire™ system is a StarFire™ receiver. NavCom offers a variety of receivers configured for different applications. Details of all the StarFire™ receivers are available from the NavCom authorized local representative or the NavCom website at: [www.NavComtech.com](http://www.NavComtech.com)

StarFire™ receivers include a dual-frequency GPS receiver and an L-Band receiver integrated into a single unit to provide the exceptional precise positioning capability of the StarFire™ Network, anywhere, anytime.





*Figure 60: StarFire™ Network*

This page is left blank intentionally.

## D..... Networked Transport of RTCM Internet Protocol (NTRIP) Setup

### Configure the SF-3040 for Wireless Connection

Perform these steps:

1. Connect the SF-3040 to the computer either on the USB port or the COM1 port.
2. Start StarUtil 3000 or another application that provides an *Input Terminal*.
3. Configure the SF-3040 as a rover:  
[RTKMODE]ROVER, RTCM, 1

4. Schedule the following messages (example below uses port USB1):

```
[OUTPUT]PVT1B,ONTIME,1,USB1
[OUTPUT]ECHODGPSB,ONCHANGE,,USB1
[OUTPUT]RTKSTATUS1B,ONTIME,1,USB1
```

5. Configure the modem control parameters; for example, assuming T-Mobile as service provider, enter the following command on the Input Terminal

```
[MODEMCONFIG] """, """, "1, 'IP',
'internet2.voicestream.com'''
```



For providers other than T-Mobile, the APN 'internet2.voicestream.com' should be changed to the appropriate APN. If in doubt, sometimes a blank APN works.

## Configure the NTRIP Server

Perform these steps:

1. Configure the SF-3040 to send corrections to the caster via the modem.

2. Connect to the caster:

```
[NTRIPSERVER]CONNECT
```

3. Set the base position (use the surveyed coordinates):

```
[REFSTNPOS] 33,30,22.649,-118,20,33.123, 65.89
```

4. Set RTKMODE to use the NTRIP virtual port as the port for sending the corrections:

```
[RTKMODE]BASERTCM1004,,1,NTRIP,STATIC,AUTO
```



BASERTCM1004 indicates the type of corrections to send.

5. Enter the following command to disconnect from the caster:

```
[NTRIPSERVER]DISCONNECT
```

Refer to the *Sapphire Technical Reference Manual* for detailed instructions on the [ECHODGPSB], [MODEMCONFIG], [NTRIPSERVER], [NTRIPCLIENT], [OUTPUT], and [RTKMODE] commands.

## Configure the NTRIP Client

Perform these steps:

1. Configure the SF-3040 to receive corrections from the caster via the modem.

2. Connect to the caster:

```
[NTRIPCLIENT]CONNECT
```

3. Verify that the ECHODGPSB message indicates that RTCM 3.0 corrections are being received.
4. Verify that both the PVT1B and RTKSTATUS1B screens indicate that the navigation status achieves “RTK Dual Fixed: RTCM3-Dual Full”. This may take several seconds.
5. Enter the following command to disconnect from the caster:

[NTRIPCLIENT]DISCONNECT

Refer to the *Sapphire Technical Reference Manual* for detailed instructions on the [ECHODGPSB], [MODEMCONFIG], [NTRIPCLIENT], [NTRIPSERVER], [OUTPUT], and [RTKMODE] commands.



The NTRIP client and server cannot both be active at the same time. An error message will be displayed if any keyword other than a status request or DISCONNECT is issued to one while the other is active.

This page is left blank intentionally.

## E .....Software License Agreement

### GNSS receiver Embedded Software License Agreement

PLEASE READ THE TERMS AND CONDITIONS OF THIS LICENSE AGREEMENT CAREFULLY BEFORE OPENING THE PACKAGE CONTAINING THE OPERATOR'S MANUALS FOR THE GNSS RECEIVER (THE "GNSS RECEIVER" OR "GNSS"). BY OPENING THE PACKAGE CONTAINING THE OPERATORS' MANUALS, OR BY POWERING ON OR BY USING THE GNSS RECEIVER, YOU ARE ACCEPTING AND AGREEING TO THE TERMS OF THIS LICENSE AGREEMENT WITH RESPECT TO THE SOFTWARE (THE "SOFTWARE") THAT HAS BEEN PRE-INSTALLED ON YOUR GNSS RECEIVER AND/OR THE USB MEMORY DEVICE PACKAGED WITH THE RECEIVER. IF YOU ARE NOT WILLING TO BE BOUND BY THE TERMS OF THIS LICENSE AGREEMENT, YOU SHOULD PROMPTLY RETURN THE GNSS RECEIVER TO THE PLACE OF PURCHASE, AND YOU WILL RECEIVE A REFUND OF YOUR MONEY. THIS LICENSE AGREEMENT REPRESENTS THE ENTIRE AGREEMENT CONCERNING THE SOFTWARE BETWEEN YOU AND THE LICENSOR IDENTIFIED BELOW IN THIS AGREEMENT (REFERRED TO AS "LICENSOR"), AND IT REPLACES ANY PRIOR PROPOSAL, REPRESENTATION, OR UNDERSTANDING BETWEEN YOU AND THE LICENSOR. EXCEPT IN THE CASE WHERE THE PARTIES ALREADY HAVE A COMMERCIAL AGREEMENT IN PLACE. IN THE EVENT OF ANY INCONSISTENCIES BETWEEN THIS LICENSE AGREEMENT AND THIS COMMERCIAL AGREEMENT, THE TERMS OF THE

---

## COMMERCIAL AGREEMENT SUPERCEDE THE TERMS OF THIS LICENSE AGREEMENT.

1. **License.** The Licensor, ("NAVCOM") hereby grants to you, and you hereby accept, a nonexclusive license to install and use the Software on the GNSS Receiver in machine-readable, object code form for your internal business purposes, solely as authorized in this License Agreement. Following acceptance of this Agreement, you may also copy the Software to one hard disk or other storage device for one computer for archive and retrieval purposes only. If you are a private business rather than an individual, you may authorize the personnel associated with your business to archive or retrieve the Software.

2. **Restrictions on License.** You acknowledge and agree that the Software is proprietary to NAVCOM and is protected under copyright law. You further acknowledge and agree that all right, title, and interest in and to the Software, including associated intellectual property rights, belong to and shall remain with NAVCOM. This License Agreement does not convey to you any title or interest in or to the Software, but only a limited right of use revocable in accordance with the terms of this License Agreement. You agree that you will not assign, sublicense, transfer, pledge, lease, rent, or share your rights under this License Agreement, except that you may permanently transfer all of your rights to use the Software granted under this License Agreement to another party, provided that you retain no copies of the Software, and provided that the transferee agrees to assume each of your duties and obligations under this License Agreement. You may not use the Software as part of a facility management, timesharing, service provider, or service bureau arrangement. Except as specifically authorized in this License Agreement, no copies of the Software or any portions thereof may be made by you or by any person acting under your authority or control. You agree that you will not reverse assemble, reverse compile, translate or make any attempt to discover the source code of the Software (which is a valuable trade secret of NAVCOM), or create derivative works of the Software, except and only to the extent that such activity is



expressly permitted by applicable law notwithstanding this limitation. You also agree that you may not attempt to defeat the copyright protection and application enabling mechanisms of the Software, or remove or obliterate any copyright, trademark or other proprietary rights notices from the Software. You agree not to permit any third party acting under your control to engage in any of the activities that are prohibited to you under this Section.

3. **License Fees.** The license fees paid by you are paid in consideration of the licenses granted under this License Agreement.

4. **Limited Warranty.** NAVCOM warrants, for your benefit alone and not for the benefit of any other party, that the media on which the Software is distributed will be free from defects for a period of twelve (12) months from the date of delivery of the Software to you. Your sole remedy in the event of a breach of this warranty will be that NAVCOM will, at its option, replace any defective media returned to NAVCOM within the warranty period.

5. **DISCLAIMER OF WARRANTIES.** YOU HEREBY AGREE THAT THE LIMITED WARRANTY PROVIDED ABOVE (THE "***LIMITED WARRANTY***") CONSTITUTES YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY PROBLEM WHATSOEVER WITH THE SOFTWARE. EXCEPT AS PROVIDED IN THE LIMITED WARRANTY, THE SOFTWARE IS LICENSED "AS IS," AND NAVCOM, ITS AFFILIATES AND THIRD PARTY SUPPLIERS EXPRESSLY DISCLAIM AND YOU EXPRESSLY WAIVE, RELEASE AND RENOUNCE ALL WARRANTIES ARISING BY LAW OR OTHERWISE WITH RESPECT TO THE SOFTWARE, INCLUDING, BUT NOT LIMITED TO: ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE; ANY IMPLIED WARRANTY ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE; ANY WARRANTY OF TITLE OR NON-INFRINGEMENT; AND, ANY OTHER WARRANTY ARISING UNDER ANY THEORY OF LAW, INCLUDING TORT, NEGLIGENCE, STRICT LIABILITY, CONTRACT

OR OTHER LEGAL OR EQUITABLE THEORY. NO REPRESENTATION OR OTHER AFFIRMATION OF FACT INCLUDING, BUT NOT LIMITED TO, STATEMENTS REGARDING SUITABILITY FOR USE, SHALL BE DEEMED TO BE A WARRANTY BY NAVCOM OR ANY OF ITS AFFILIATES OR THIRD PARTY SUPPLIERS. NAVCOM DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR WILL OPERATE WITHOUT INTERRUPTION.

6. **LIMITATION OF LIABILITY.** EXCEPT AS SET FORTH IN THE LIMITED WARRANTY, UNDER NO CIRCUMSTANCES SHALL NAVCOM, ITS AFFILIATES OR ITS THIRD PARTY SUPPLIERS BE LIABLE TO YOU OR TO ANY THIRD PARTIES FOR DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND, INCLUDING ANY LOSS OR DAMAGE CAUSED BY THE SOFTWARE; ANY PARTIAL OR TOTAL FAILURE OF THE SOFTWARE; PERFORMANCE, NONPERFORMANCE OR DELAYS IN CONNECTION WITH ANY INSTALLATION, MAINTENANCE, WARRANTY OR REPAIRS OF THE SOFTWARE, DAMAGES FOR, LOST PROFITS, LOSS OF BUSINESS OR LOSS OF GOODWILL, LOSS OF USE OF EQUIPMENT OR SERVICES OR DAMAGES TO BUSINESS OR REPUTATION ARISING FROM THE PERFORMANCE OR NON-PERFORMANCE OF ANY ASPECT OF THIS AGREEMENT, WHETHER IN CONTRACT, TORT OR OTHERWISE, AND WHETHER OR NOT NAVCOM, ITS AFFILIATES OR ITS THIRD PARTY SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL NAVCOM'S CUMULATIVE LIABILITY TO YOU OR TO ANY OTHER PARTY FOR ANY LOSSES OR DAMAGES RESULTING FROM ANY CLAIMS, LAWSUITS, DEMANDS, OR ACTIONS ARISING FROM OR RELATING TO USE OF THE SOFTWARE EXCEED THE LICENSE FEES YOU HAVE PAID FOR THE LICENSE GRANTED TO YOU IN THIS LICENSE AGREEMENT.

7. **Software Maintenance.** NAVCOM may, at its sole option, offer you maintenance of the Software. Such

maintenance may include providing modifications, corrections or updates ("**Enhancements**") to the Software. NAVCOM reserves the right, in its sole discretion, to charge you for maintenance. Your acceptance of this License Agreement constitutes your agreement that any Enhancements will be deemed included in the Software as defined in this License Agreement and that they shall be governed by the terms and conditions applicable to the Software under this License Agreement.

8. **Product Installation.** There are technological measures in the Software that are designed to prevent unlicensed or illegal use of the Software. You agree that NAVCOM may use these measures to protect NAVCOM against software piracy. This Software may contain enforcement technology that limits the ability to install and uninstall the Software on a the GNSS Receiver for which it is licensed.

9. **Termination of License.** NAVCOM may terminate the license granted under this Agreement upon written notice of termination provided to you if you violate any material term of this Agreement pertaining to your use of the Software or the rights of NAVCOM, including, without limitation, the provisions of Sections 1 and 2 above and Section 10 below.

10. **Compliance with Law.** Certain NAVCOM products are subject to export controls by the U.S. Department of Commerce ("**DOC**"), under the Export Administration Regulations ("**EAR**") (see [www.bxa.doc.gov](http://www.bxa.doc.gov)). You agree to comply with the requirements of the EAR and all applicable international, national, state, regional and local laws, and regulations, including any applicable import and use restrictions. NAVCOM products are currently prohibited for export or re-export to any country subject to applicable trade sanctions. You agree not to export, or re-export, directly or indirectly, any product to any country outlined in the EAR, nor to any person or entity on the DOC Denied Persons, Entities and Unverified Lists, the U.S. Department of State's Debarred List, or on the U.S. Department of Treasury's lists of

Specially Designated Nationals, Specially Designated Narcotics Traffickers, or Specially Designated Terrorists. Furthermore, you agree not to export, or re-export, NAVCOM products to any military entity not approved under the EAR, or to any other entity for any military purpose, nor will you sell any NAVCOM product for use in connection with chemical, biological, or nuclear weapons or missiles capable of delivering such weapons.

11. **Indemnification.** You agree to defend, indemnify and hold NAVCOM, its affiliates and third party suppliers and their officers, directors, employees, agents and representatives (each an ***"Indemnified Party"***), harmless from and against all claims, demands proceedings, injuries, liabilities, losses, or costs and expenses (including reasonable legal fees) brought by any third party against any such persons arising from or in connection with your use of the Software, regardless of whether such losses are caused, wholly or partially, by any negligence, breach of contract or other fault of an Indemnified Party.

12. **Costs of Litigation.** If any claim or action is brought by either party to this License Agreement against the other party regarding the subject matter hereof, the prevailing party shall be entitled to recover, in addition to any other relief granted, reasonable attorney fees and expenses of litigation.

13. **Severability and Waiver.** Should any term of this License Agreement be declared void or unenforceable by any court of competent jurisdiction, such declaration shall have no effect on the remaining terms hereof. The failure of either party to enforce any rights granted hereunder or to take action against the other party in the event of any breach hereunder shall not be deemed a waiver by that party as to subsequent enforcement of rights of subsequent actions in the event of future breaches.

14. **Language Clause.** If you are a resident of Canada at the time you accept this License Agreement, then the parties hereby acknowledge that they have required this License Agreement, and all other documents relating hereto, be drawn up in the English language only. Les

parties reconnaissent avoir demandé que le présent contrat ainsi que toute autre entente ou avis requis ou permis à être conclu ou donné en vertu des stipulations du présent contrat, soient rédigés en langue anglaise seulement. If you are a resident of any country other than the United States, Canada Great Britain, Australia or New Zealand then you agree as follows: there may be a translated version of this License Agreement. If there is an inconsistency or contradiction between the translated version and the English version of this License Agreement, the English version of this License Agreement shall control.

15. **Assignment by NAVCOM.** NAVCOM may assign this Agreement without your prior consent to any company or entity affiliated with NAVCOM, or by an assignment associated with a corporate restructuring, merger or acquisition.

16. **Governing Law and Forum.** This Agreement will be governed by and construed in accordance with the substantive laws in force: (a) in the State of Illinois, if this License Agreement is accepted when you are in the United States, Australia, Canada, New Zealand or any other country not described in (b) or (c); (b) in England, if this License Agreement is accepted when you are in any member country of the European Union; and, (c) in the Federal Republic of Brazil, if this License Agreement is accepted when you are in Brazil. The respective courts of Rock Island County, Illinois when Illinois law applies, the competent courts of England, when the law of England applies, and the competent Courts of Brazil, when the law of the Federal Republic of Brazil applies, shall each have non-exclusive jurisdiction over all disputes relating to this Agreement. This Agreement will not be governed by the conflict of law rules of any jurisdiction or the United Nations Convention on Contracts for the International Sale of Goods, the application of which is expressly excluded.

17. **Specific Exceptions.**

**17.1 Limited Warranty for Users Residing in Germany or Austria.** If you obtained the Software in Germany or Austria, and you usually reside in such

country, then Section 5 does not apply, instead, NAVCOM warrants that the Software will provide the functionalities set forth in the Documentation (the "**agreed upon functionalities**") for a period of sixty (60) days after you have accepted this License Agreement. Non-substantial variation from the agreed upon functionalities shall not be considered and does not establish any warranty rights. THIS LIMITED WARRANTY DOES NOT APPLY TO SOFTWARE PROVIDED TO YOU FREE OF CHARGE, FOR EXAMPLE, ENHANCEMENTS, CONTENT UPDATES, OR SOFTWARE THAT HAS BEEN ALTERED BY YOU, TO THE EXTENT SUCH ALTERATIONS CAUSED A DEFECT. To make a warranty claim, you must return, at the expense of end user, the Software and proof of purchase to the location where you obtained it. If the functionalities of the Software vary substantially from the agreed upon functionalities, NAVCOM is entitled -- by way of re-performance and at its own discretion -- to repair or replace the Software. If this fails, you are entitled to a reduction of the purchase price (reduction) or to cancel the purchase agreement (rescission). For further warranty information, please contact NAVCOM at the address listed in Section 19.

**17.2 Limitation of Liability for Users Residing in Germany and Austria.** (a) If you obtained the Software in Germany or Austria, and you usually reside in such country, then Sections 6 and 11 do not apply. Instead, subject to the provisions in Section 17.2(b), NAVCOM's statutory liability for damages shall be limited as follows: NAVCOM shall be liable only up to the amount of damages as typically foreseeable at the time of entering into this License Agreement in respect of damages caused by a slightly negligent breach of a material contractual obligation and (b) NAVCOM shall not be liable for damages caused by a slightly negligent breach of a non-material contractual obligation. (b) The aforesaid limitation of liability shall not apply to any mandatory statutory liability, in particular, to liability under the German Product Liability Act, liability for assuming a specific guarantee or liability for culpably caused personal injuries. (c) You are required to take all

reasonable measures to avoid and reduce damages, in particular to make back-up copies of the Software and your computer data subject to the provisions of this Agreement.

18. **Representations of Licensee.** BY ACCEPTING THIS AGREEMENT, YOU: (A) ACKNOWLEDGE THAT YOU HAVE READ AND UNDERSTAND THIS AGREEMENT; (B) REPRESENT THAT YOU HAVE THE AUTHORITY TO ENTER INTO THIS AGREEMENT; (C) AGREE THAT THIS AGREEMENT IS ENFORCEABLE AGAINST YOU AND ANY LEGAL ENTITY THAT OBTAINED THE SOFTWARE AND ON WHOSE BEHALF IT IS USED; AND, (D) AGREE TO PERFORM THE OBLIGATIONS OF THIS AGREEMENT.

19. **Notices.** All Your correspondence, including warranty claims, must be sent certified or registered mail as follows: Navcom Technology, Inc., ATTN: Contracts Administration, 20780 Madrona Avenue, Torrance, California 90503, USA. All notices to NAVCOM shall be effective upon receipt.

## Open Source Software License

Listing of modules/components not licensed under the Deere proprietary license

- **freeRTOS v4.7.2**
  - **lwIP v1.2.0**
- 
- **Module/Component: freeRTOS**
  - **Version: 4.7.2**
  - **License Text**

[See the end of this page for a special exception to the GPL]

---

GNU GENERAL PUBLIC LICENSE  
Version 2, June 1991

Copyright (C) 1989, 1991 Free Software Foundation,  
Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307  
USA

Everyone is permitted to copy and distribute verbatim  
copies of this license document, but changing it is not  
allowed.

Preamble

The licenses for most software are designed to take away  
your freedom to share and change it. By contrast, the  
GNU General Public License is intended to guarantee your  
freedom to share and change free software--to make sure  
the software is free for all its users. This General Public  
License applies to most of the Free Software Foundation's  
software and to any other program whose authors commit  
to using it. Some other Free Software Foundation software  
is covered by the GNU Library General Public License  
instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to  
freedom, not price. Our General Public Licenses are  
designed to make sure that you have the freedom to  
distribute copies of free software (and charge for this  
service if you wish), that you receive source code or can  
get it if you want it, that you can change the software or  
use pieces of it in new free programs; and that you know  
you can do these things.

To protect your rights, we need to make restrictions that  
forbid anyone to deny you these rights or to ask you to  
surrender the rights. These restrictions translate to certain  
responsibilities for you if you distribute copies of the  
software, or if you modify it.

For example, if you distribute copies of such a program,  
whether gratis or for a fee, you must give the recipients all  
the rights that you have. You must make sure that they,



too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

### GNU GENERAL PUBLIC LICENSE TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

- a) You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.

- b) You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.

- c) If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and

that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

a) Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

b) Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more

than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.

6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

7. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole

purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

9. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we

sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

## NO WARRANTY

11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

## END OF TERMS AND CONDITIONS

## How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the program's name and a brief idea of what it does.> Copyright (C) <year> <name of author>

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307 USA

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright (C) year name of author  
Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'. This is free



software, and you are welcome to redistribute it under certain conditions; type ``show c'` for details.

The hypothetical commands ``show w'` and ``show c'` should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than ``show w'` and ``show c'`; they could even be mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the program ``Gnomovision'` (which makes passes at compilers) written by James Hacker.

<signature of Ty Coon>, 1 April 1989  
Ty Coon, President of Vice

This General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Library General Public License instead of this License.

-----  
I have included the following exception to the GPL. The exception should only be used should you wish to combine FreeRTOS with a proprietary product. If you opt to use this exception you are encouraged to make a donation to the FreeRTOS project. The link on the [www.FreeRTOS.org](http://www.FreeRTOS.org) can be used for this purpose. Any such donation is entirely voluntary and does not result in any enhanced support or any warranty rights.

This exception can only be used if you use FreeRTOS solely through the API published on the

www.FreeRTOS.org WEB site, and on condition that the combined work is not itself an RTOS.

---

-----  
**EXCEPTION TEXT:**

Linking FreeRTOS statically or dynamically with other modules is making a combined work based on FreeRTOS. Thus, the terms and conditions of the GNU General Public License cover the whole combination.

As a special exception, the copyright holder of FreeRTOS gives you permission to link FreeRTOS with independent modules that communicate with FreeRTOS solely through the FreeRTOS API interface, regardless of the license terms of these independent modules, and to copy and distribute the resulting combined work under terms of your choice, provided that every copy of the combined work is accompanied by a written statement that details to the recipient the version of FreeRTOS used and an offer by yourself to provide the FreeRTOS source code should the recipient request it. Any FreeRTOS source code, whether modified or in its original release form, or whether in whole or in part, can only be distributed by you under the terms of the GNU General Public License plus this exception. An independent module is a module which is not derived from or based on FreeRTOS.

Note that people who make modified versions of FreeRTOS are not obligated to grant this special exception for their modified versions; it is their choice whether to do so. The GNU General Public License gives permission to release a modified version without this exception; this exception also makes it possible to release a modified version which carries forward this exception.

**Notice / Acknowledgement Obligations**

FreeRTOS.org V4.7.2 - Copyright (C) 2003-2008  
Richard Barry.

FreeRTOS v4.7.2 source code is available through email request to [customerservice@navcomtech.com](mailto:customerservice@navcomtech.com)

- 
- **Module/Component: lwIP**
  - **Version: 1.2.0**
  - **License Text**

Open Source package license

/\*

\* Copyright (c) 2001, 2002 Swedish Institute of Computer Science.

\* All rights reserved.

\*

\* Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

\*

\* 1. Redistributions of source code must retain the above copyright notice,

\* this list of conditions and the following disclaimer.

\* 2. Redistributions in binary form must reproduce the above copyright notice,

\* this list of conditions and the following disclaimer in the documentation

\* and/or other materials provided with the distribution.

\* 3. The name of the author may not be used to endorse or promote products

\* derived from this software without specific prior written permission.

\*

\* THIS SOFTWARE IS PROVIDED BY THE AUTHOR  
 ``AS IS" AND ANY EXPRESS OR IMPLIED

\* WARRANTIES, INCLUDING, BUT NOT LIMITED TO,  
 THE IMPLIED WARRANTIES OF

\* MERCHANTABILITY AND FITNESS FOR A  
 PARTICULAR PURPOSE ARE DISCLAIMED. IN NO  
 EVENT

\* SHALL THE AUTHOR BE LIABLE FOR ANY DIRECT,  
 INDIRECT, INCIDENTAL, SPECIAL,

\* EXEMPLARY, OR CONSEQUENTIAL DAMAGES

(INCLUDING, BUT NOT LIMITED TO, PROCUREMENT

\* OF SUBSTITUTE GOODS OR SERVICES; LOSS OF  
 USE, DATA, OR PROFITS; OR BUSINESS

\* INTERRUPTION) HOWEVER CAUSED AND ON ANY  
THEORY OF LIABILITY, WHETHER IN  
\* CONTRACT, STRICT LIABILITY, OR TORT  
(INCLUDING NEGLIGENCE OR OTHERWISE) ARISING  
\* IN ANY WAY OUT OF THE USE OF THIS SOFTWARE,  
EVEN IF ADVISED OF THE POSSIBILITY  
\* OF SUCH DAMAGE.

\*

\* This file is part of the lwIP TCP/IP stack.

\*

\* Author: Adam Dunkels <[adam@sics.se](mailto:adam@sics.se)>

\*

\*/

### **Notice / Acknowledgement Obligations**

Copyright (c) 2001-2004 Swedish Institute of  
Computer Science.

All rights reserved.

THIS SOFTWARE IS PROVIDED BY THE AUTHOR ``AS  
IS" AND ANY EXPRESS OR IMPLIED WARRANTIES,  
INCLUDING, BUT NOT LIMITED TO, THE IMPLIED  
WARRANTIES OF MERCHANTABILITY AND FITNESS  
FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN  
NO EVENT SHALL THE AUTHOR BE LIABLE FOR ANY  
DIRECT, INDIRECT, INCIDENTAL,  
SPECIAL, EXEMPLARY, OR CONSEQUENTIAL  
DAMAGES (INCLUDING, BUT NOT LIMITED TO,  
PROCUREMENT OF SUBSTITUTE GOODS OR  
SERVICES; LOSS OF USE, DATA, OR PROFITS; OR  
BUSINESS INTERRUPTION) HOWEVER CAUSED AND  
ON ANY THEORY OF LIABILITY, WHETHER IN  
CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING  
NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY  
OUT OF THE USE OF THIS SOFTWARE, EVEN IF  
ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

## F ..... RoHS Certification

### Description

RoHS (Restriction of Use of Hazardous Substances) regulations limit or ban specific substances – lead, cadmium, polybrominated biphenyl (PBB), mercury, hexavalent chromium, and polybrominated diphenyl ether (PBDE) flame retardants – in new electronic and electric equipment.

For Cadmium and Hexavalent chromium, there must be less than 0.01% of the substance by weight at raw homogeneous materials level. For Lead, PBB, and PBDE, there must be no more than 0.1% of the material, when calculated by weight at raw homogeneous materials. Any RoHS compliant component must have 100 ppm or less of mercury and the mercury must not have been intentionally added to the component.

The following components are RoHS compliant. They have been tested for RoHS controlled substances and found to be in accordance with RoHS regulations.

*Table 31: Toxic or Hazardous Substances or Elements Disclosure by Part Number*

92-310501-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBA	X	O	O	O	O	O
USB Flash Drive	O	O	O	O	O	O

---

Antenn a	X	O	O	O	O	O
Labels	O	O	O	O	O	O

### 92-310503-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBA	X	O	O	O	O	O
USB Flash Drive	O	O	O	O	O	O
Antenna	O	O	O	O	O	O
Labels	O	O	O	O	O	O

### 92-310411-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBA	X	O	O	O	O	O
Labels	O	O	O	O	O	O

### 92-210206-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBA	X	O	O	O	O	O
Radio	O	O	O	O	O	O
Spacer	O	O	O	O	O	O
Pad	O	O	O	O	O	O
Housing	O	O	O	O	O	O
Labels	O	O	O	O	O	O
Shim	O	O	O	O	O	O
Cable	O	O	O	O	O	O
Hardware	O	O	O	O	O	O

## 92-310459-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Memory Card	O	O	O	O	O	O
PCBAs	X	O	O	O	O	O
Switch	O	O	O	O	O	O
Shield	O	O	O	O	O	O
Housings	O	O	O	O	O	O
Labels	O	O	O	O	O	O
Tripod/ Poles	O	O	O	O	O	O
Measuring Instruments	O	O	O	O	O	O
Carrying Cases	O	O	O	O	O	O
PDA	O	O	O	O	O	O
Bumper	O	O	O	O	O	O
Antenna	X	O	O	O	O	O
Cables	X	O	O	O	O	O
Hardware	O	O	O	X	O	O
Gaskets	O	O	O	O	O	O
Battery	X	O	O	O	O	O
Battery Charger	O	O	O	O	O	O
USB Flash Drive	O	O	O	O	O	O

## 92-310520-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBAs	X	O	O	O	O	O
Switch	O	O	O	O	O	O
Shield	O	O	O	O	O	O
Housings	O	O	O	O	O	O
Labels	O	O	O	O	O	O
Bumper	O	O	O	O	O	O
Antenna	X	O	O	O	O	O
Cables	X	O	O	O	O	O



Hardware	O	O	O	X	O	O
Gaskets	O	O	O	O	O	O

## 92-310458-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Memory Card	O	O	O	O	O	O
PCBAs	X	O	O	O	O	O
Switch	O	O	O	O	O	O
Shield	O	O	O	O	O	O
Housings	O	O	O	O	O	O
Labels	O	O	O	O	O	O
Tripod/ Poles	O	O	O	O	O	O
Measuring Instruments	O	O	O	O	O	O
Carrying Cases	O	O	O	O	O	O
PDA	O	O	O	O	O	O
Bumper	O	O	O	O	O	O
Antenna	X	O	O	O	O	O
Cables	X	O	O	O	O	O
Hardware	O	O	O	X	O	O
Gaskets	O	O	O	O	O	O
Battery	X	O	O	O	O	O
Battery Charger	O	O	O	O	O	O
USB Flash Drive	O	O	O	O	O	O

## 92-310441-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Memory Card	O	O	O	O	O	O
PCBAs	X	O	O	O	O	O
Switch	O	O	O	O	O	O
Shield	O	O	O	O	O	O
Housings	O	O	O	O	O	O
Labels	O	O	O	O	O	O
Bumper	O	O	O	O	O	O
Antenna	X	O	O	O	O	O
Cables	X	O	O	O	O	O

Hardware	O	O	O	X	O	O
Gaskets	O	O	O	O	O	O
Battery	X	O	O	O	O	O
Battery Charger	O	O	O	O	O	O

**92-310413-3002LF**

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBAs	X	O	O	O	O	O
Switch	O	O	O	O	O	O
Clamp	O	O	O	O	O	O
Housing	O	O	O	O	O	O
Labels	O	O	O	O	O	O
End Plate	O	O	O	O	O	O
End Cover	O	O	O	O	O	O
Cable	O	O	O	O	O	O
Hardware	O	O	O	X	O	O
Gaskets	O	O	O	O	O	O
Brackets	O	O	O	O	O	O

**92-310416-3001LF**

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Antenna	O	O	O	O	O	O
PCBAs	X	O	O	O	O	O
Switch	O	O	O	O	O	O
Clamp	O	O	O	O	O	O
Housing	O	O	O	O	O	O
Labels	O	O	O	O	O	O
End Plate	O	O	O	O	O	O
End Cover	O	O	O	O	O	O
Power Cord	O	O	O	O	O	O
Cables	O	O	O	O	O	O
Hardware	O	O	O	X	O	O
Gaskets	O	O	O	O	O	O
Brackets	O	O	O	O	O	O

## 92-310418-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBAs	X	O	O	O	O	O
Switch	O	O	O	O	O	O
Clamp	O	O	O	O	O	O
Housing	O	O	O	O	O	O
Labels	O	O	O	O	O	O
End Plate	O	O	O	O	O	O
End Cover	O	O	O	O	O	O
Cables	O	O	O	O	O	O
Hardware	O	O	O	O	O	O
Gaskets	O	O	O	O	O	O
USB Flash Drive	O	O	O	O	O	O
Brackets	O	O	O	O	O	O

## 92-310413-3003LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBAs	X	O	O	O	O	O
Switch	O	O	O	O	O	O
Clamp	O	O	O	O	O	O
Housing	O	O	O	O	O	O
Labels	O	O	O	O	O	O
End Plate	O	O	O	O	O	O
End Cover	O	O	O	O	O	O
Cables	O	O	O	O	O	O
Hardware	O	O	O	O	O	O
Gaskets	O	O	O	O	O	O
Brackets	O	O	O	O	O	O

## 92-310415-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Power Adapter	0	0	0	0	0	0
PCBAs	X	0	0	0	0	0
USB Flash Drive	0	0	0	0	0	0
Switch	0	0	0	0	0	0
Clamp	0	0	0	0	0	0
Housing	0	0	0	0	0	0
Labels	0	0	0	0	0	0
End Cover	0	0	0	0	0	0
Spacer	0	0	0	0	0	0
Cable	X	0	0	0	0	0
Hardware	0	0	0	X	0	0
Gaskets	0	0	0	0	0	0
Brackets	0	0	0	0	0	0

## 92-310413-3001LF

Part Name	Toxic or hazardous substances and elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Clamp	0	0	0	0	0	0
PCBAs	X	0	0	0	0	0
Housing	0	0	0	0	0	0
Switch	0	0	0	0	0	0
Labels	0	0	0	0	0	0
End Cover	0	0	0	0	0	0
Spacer	0	0	0	0	0	0
Cable	X	0	0	0	0	0
Hardware	0	0	0	X	0	0
Gaskets	0	0	0	0	0	0
Bracket	0	0	0	0	0	0



“O” indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006 (Standard of the Electronics Industry of the People’s Republic of China).

“X” indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement in SJ/T11363-2006 (Standard of the Electronics Industry of the People's Republic of China).

## RoHS 认证

### 说明

RoHS ( 危险物质的使用限制 ) 法规限制或禁止在新的电气和电子设备中使用特定物质，这些物质包括铅、镉、多溴二苯醚 (PBB)、汞、六价铬和多溴代二苯醚 (PBDE) 阻燃剂。

对于镉和六价铬，在原材料均匀级别下按重量计算物质含量必须低于 0.01%。对于铅、PBB 和 PBDE，在均匀的原材料水平下，按材料重量计算时的不能超过 0.1%。任何符合 RoHS 的部件汞含量必须小于等于 100 ppm，并且不能将汞故意添加到部件中。

下列部件符合 RoHS 技术规格。 这些物质的测试结果显示它们是 RoHS 受控物质，并且符合 RoHS 法规的要求。

**表32：按部件号列出的有毒或危险物质或原件**

92-310501-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯 醚 (PBB)	多溴代二 苯醚 (PBDE)
PCBA	X	O	O	O	O	O
USB 闪存驱动器	O	O	O	O	O	O
天线	X	O	O	O	O	O
标签	O	O	O	O	O	O

92-310503-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯 醚 (PBB)	多溴代二 苯醚 (PBDE)
PCBA	X	O	O	O	O	O
USB 闪存驱动器	O	O	O	O	O	O
天线	O	O	O	O	O	O
标签	O	O	O	O	O	O

92-310411-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯 醚 (PBB)	多溴代二 苯醚 (PBDE)
PCBA	X	O	O	O	O	O
标签	O	O	O	O	O	O

92-210206-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯 醚 (PBB)	多溴代二 苯醚 (PBDE)
PCBA	X	O	O	O	O	O
收音机	O	O	O	O	O	O
隔片	O	O	O	O	O	O
衬垫	O	O	O	O	O	O
外壳	O	O	O	O	O	O
标签	O	O	O	O	O	O
垫片	O	O	O	O	O	O
线缆	O	O	O	O	O	O
固定件	O	O	O	O	O	O

92-310459-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯 醚 (PBB)	多溴代二 苯醚 (PBDE)
存储卡	O	O	O	O	O	O
PCBA	X	O	O	O	O	O
开关	O	O	O	O	O	O
屏蔽板	O	O	O	O	O	O
外壳	O	O	O	O	O	O
标签	O	O	O	O	O	O
三脚架/ 柱杆	O	O	O	O	O	O
测量仪表	O	O	O	O	O	O
便携包	O	O	O	O	O	O
PDA	O	O	O	O	O	O
减震台	O	O	O	O	O	O
天线	X	O	O	O	O	O



线缆	X	O	O	O	O	O
固定件	O	O	O	X	O	O
衬垫	O	O	O	O	O	O
电池	X	O	O	O	O	O
电池充电器	O	O	O	O	O	O
USB 闪存驱动器	O	O	O	O	O	O

## 92-310520-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯 醚 (PBB)	多溴代二 苯醚 (PBDE)
PCBA	X	O	O	O	O	O
开关	O	O	O	O	O	O
屏蔽板	O	O	O	O	O	O
外壳	O	O	O	O	O	O
标签	O	O	O	O	O	O
减震台	O	O	O	O	O	O
天线	X	O	O	O	O	O
线缆	X	O	O	O	O	O
固定件	O	O	O	X	O	O
衬垫	O	O	O	O	O	O

## 92-310458-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯 醚 (PBB)	多溴代二 苯醚 (PBDE)
存储卡	O	O	O	O	O	O
PCBA	X	O	O	O	O	O
开关	O	O	O	O	O	O

屏蔽板	○	○	○	○	○	○
外壳	○	○	○	○	○	○
标签	○	○	○	○	○	○
三脚架/ 柱杆	○	○	○	○	○	○
测量仪表	○	○	○	○	○	○
便携包	○	○	○	○	○	○
PDA	○	○	○	○	○	○
减震台	○	○	○	○	○	○
天线	X	○	○	○	○	○
线缆	X	○	○	○	○	○
固定件	○	○	○	X	○	○
衬垫	○	○	○	○	○	○
电池	X	○	○	○	○	○
电池充电器	○	○	○	○	○	○
USB 闪存驱动器	○	○	○	○	○	○

## 92-310441-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯醚 (PBB)	多溴代二 苯醚 (PBDE)
存储卡	○	○	○	○	○	○
PCBA	X	○	○	○	○	○
开关	○	○	○	○	○	○
屏蔽板	○	○	○	○	○	○
外壳	○	○	○	○	○	○
标签	○	○	○	○	○	○
减震台	○	○	○	○	○	○
天线	X	○	○	○	○	○
线缆	X	○	○	○	○	○
固定件	○	○	○	X	○	○

衬垫	O	O	O	O	O	O
电池	X	O	O	O	O	O
电池充电器						

## 92-310413-3002LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯醚 (PBB)	多溴代二苯醚 (PBDE)
PCBA	X	O	O	O	O	O
开关	O	O	O	O	O	O
线箍	O	O	O	O	O	O
外壳	O	O	O	O	O	O
标签	O	O	O	O	O	O
端板	O	O	O	O	O	O
端盖	O	O	O	O	O	O
线缆	O	O	O	O	O	O
固定件	O	O	O	X	O	O
衬垫	O	O	O	O	O	O
支架	O	O	O	O	O	O

## 92-310416-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯醚 (PBB)	多溴代二苯醚 (PBDE)
天线	O	O	O	O	O	O
PCBA	X	O	O	O	O	O
开关	O	O	O	O	O	O
线箍	O	O	O	O	O	O
外壳	O	O	O	O	O	O
标签	O	O	O	O	O	O
端板	O	O	O	O	O	O
端盖	O	O	O	O	O	O

电源线	○	○	○	○	○	○
线缆	○	○	○	○	○	○
固定件	○	○	○	X	○	○
衬垫	○	○	○	○	○	○
支架	○	○	○	○	○	○

## 92-310418-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯醚 (PBB)	多溴代二 苯醚 (PBDE)
PCBA	X	○	○	○	○	○
开关	○	○	○	○	○	○
线箍	○	○	○	○	○	○
外壳	○	○	○	○	○	○
标签	○	○	○	○	○	○
端板	○	○	○	○	○	○
端盖	○	○	○	○	○	○
线缆	○	○	○	○	○	○
固定件	○	○	○	○	○	○
衬垫	○	○	○	○	○	○
USB 闪存驱动器	○	○	○	○	○	○
支架	○	○	○	○	○	○

## 92-310413-3003LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯醚 (PBB)	多溴代二 苯醚 (PBDE)
PCBA	X	○	○	○	○	○
开关	○	○	○	○	○	○
线箍	○	○	○	○	○	○

外壳	0	0	0	0	0	0
标签	0	0	0	0	0	0
端板	0	0	0	0	0	0
端盖	0	0	0	0	0	0
线缆	0	0	0	0	0	0
固定件	0	0	0	0	0	0
衬垫	0	0	0	0	0	0
支架	0	0	0	0	0	0

92-310415-3001LF

部件号	有毒或危险物质和元件					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯醚 (PBB)	多溴代二 苯醚 (PBDE)
电源适 配器	0	0	0	0	0	0
PCBA	X	0	0	0	0	0
USB 闪 存驱动 器	0	0	0	0	0	0
开关	0	0	0	0	0	0
线箍	0	0	0	0	0	0
外壳	0	0	0	0	0	0
标签	0	0	0	0	0	0
端盖	0	0	0	0	0	0
隔片	0	0	0	0	0	0
线缆	X	0	0	0	0	0
固定件	0	0	0	X	0	0
衬垫	0	0	0	0	0	0
支架	0	0	0	0	0	0

92-310413-3001LF

部件号	有毒或危险物质和元件
-----	------------

	铅 (Pb) )	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴二苯醚 (PBB)	多溴代二苯 醚 (PBDE)
线箍	0	0	0	0	0	0
PCBA	X	0	0	0	0	0
外壳	0	0	0	0	0	0
开关	0	0	0	0	0	0
标签	0	0	0	0	0	0
端盖	0	0	0	0	0	0
隔片	0	0	0	0	0	0
线缆	X	0	0	0	0	0
固定件	0	0	0	X	0	0
衬垫	0	0	0	0	0	0
支架	0	0	0	0	0	0



“O”表示本部件中所有均匀物质中的有毒物质或危险物质含量均低于 SJ/T11363-2006（中华人民共和国电子工业标准）的限制要求。

“X”表示本部件中至少有一项均匀物质中的有毒物质或危险物质含量均超过了 SJ/T11363-2006（中华人民共和国电子工业标准）的限制要求。

## Glossary

**.yym files** see meteorological files (where yy = two digit year data was collected).

**.yyn files** see navigation files (where yy = two digit year data was collected).

**.yyo files** see observation files (where yy = two digit year data was collected).

**almanac files** an almanac file contains orbit information, clock corrections, and atmospheric delay parameters for all satellites tracked. It is transmitted to a receiver from a satellite and is used by mission planning software.

**alt** see *altitude*.

**altitude** vertical distance above the *ellipsoid* or *geoid*. It is always stored as height above *ellipsoid* in the GPS receiver, but can be displayed as height above *ellipsoid* (HAE) or height above *mean sea level* (MSL).

**Antenna Phase Center (APC)** the point in an antenna where the *GPS* signal from the satellites is received. The height above ground of the APC must be measured accurately to ensure accurate *GPS* readings. The APC height can be calculated by adding the height to an easily measured point, such as the base of the antenna mount, to the known distance between this point and the APC.

**APC** see *antenna phase center* or *phase center*.

**Autonomous positioning (GPS)** a mode of operation in which a GPS receiver computes *position* fixes in real time from satellite data alone, without reference to data supplied by a *reference station* or orbital clock corrections. Autonomous positioning is typically the least precise positioning procedure a

GPS receiver can perform, yielding *position* fixes that are precise to 100 meters with Selective Availability (S/A) on and 30 meters with S/A off.

**azimuth** the *azimuth* of a line is its direction as given by the angle between the *meridian* and the line measured in a clockwise direction from the north branch of the meridian.

**base station** see *reference station*.

**baud rate (*bits per second*)** the number of bits sent or received each second. For example, a *baud rate* of 9600 means there is a data flow of 9600 bits each second. One character roughly equals 10 bits.

**bits per second** see *baud rate*.

**bps** see *baud rate*.

**BSW (British Standard Whitworth)** a type of coarse screw thread. A 5/8" diameter *BSW* is the standard mount for survey instruments.

**C/A code** see *Coarse Acquisition code*.

**CAN BUS** a balanced (differential) 2-wire interface that uses an asynchronous transmission scheme. Often used for communications in vehicular applications.

**channel** the circuitry of a GPS receiver necessary to receive the signal for a single GPS satellite.

**civilian code** see *Coarse Acquisition code*.

**Coarse Acquisition code (C/A or Civilian code)** the pseudo-random code generated by *GPS* satellites. It is intended for civilian use, and the accuracy of readings using this code can be degraded if *Selective Availability (S/A)* is introduced by the U.S. Department of Defense.



**COM#** is the abbreviation for *communications port number*. It indicates a data communications port to/from the GNSS receiver to a controller or data collection device.

**Compact Measurement Record (CMR)** is a standard format for DGPS corrections used to transmit corrections from a *reference station* to *rover* receivers. See *Related Standards* in *Notices*.

**controller** is a device consisting of hardware and software used to communicate and manipulate the I/O functions of the GNSS receiver.

**convergence period** (StarFire™) is the time necessary for the received StarFire™ signal corrections to be applied and the position filtered to optimal performance. The convergence period is typically 30 to 45 minutes to achieve <decimeter accuracy. This period may be overcome using the Quick Start method.

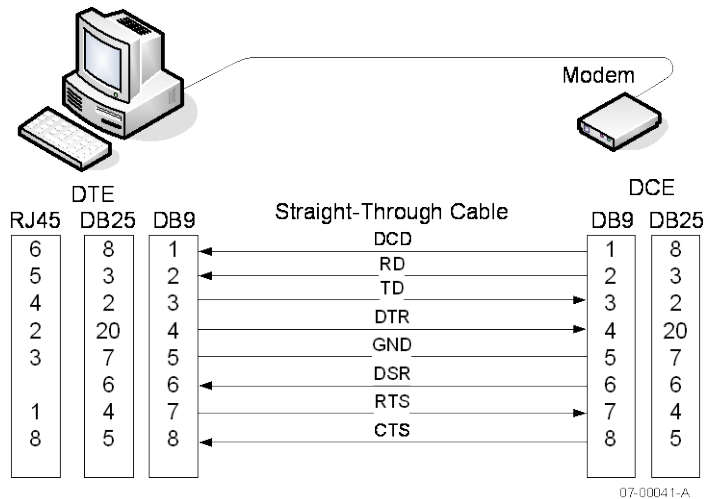
**data files** are those files that contain Proprietary, GNSS, NMEA, RTCM, or any type of data logged from a GNSS receiver.

**datum** is a known and constant reference surface that can be used to describe the location of unknown points. Geodetic datums define the size and shape of the earth and the origin and orientation of the coordinate systems used to map the earth.

**DB9P** is a type of electrical connector containing 9 contacts. The P indicates a plug pin (male).

**DB9S** is a type of electrical connector containing 9 contacts. The S indicates a slot pin (female).

**DCE** (Data Communications Equipment); the defined pin assignments are based on the IEEE RS-232 signaling standard. See Figure 61.



*Figure 61: DTE to DCE RS-232 Pin Assignments*

**DGPS** see *Differential GPS*.

**Differential GPS (DGPS)** is a positioning procedure that uses two receivers, a rover at an unknown location, and a reference station at a known, fixed location. The reference station computes corrections based on the actual and observed ranges of the satellites being tracked. The coordinates of the unknown location can be computed with sub-meter level precision by applying these corrections to the satellite data received by the rover.

**Dilution of Precision (DOP)** a class of measures of the magnitude of error in GNSS *position* fixes due to the orientation of the GNSS satellites with respect to the GNSS receiver. There are several DOPs to measure different components of the error. Note: This is a unit-less value. see also PDOP.

**DOP** see *Dilution of Precision*.

**DTE** Data Terminal Equipment. See *DCE*.

**dual-frequency** is a type of GNSS receiver that uses both L1 and L2 signals from GNSS satellites. A dual-frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions because it compensates for ionospheric delays. The SF-3040 is a dual-frequency receiver.

**dynamic mode** when a GNSS receiver operates in dynamic mode, it assumes that it is in motion and certain algorithms for GNSS position fixing are enabled in order to calculate a tighter position fix.

**EGNOS (European Geostationary Navigation Overlay Service)** a European satellite system used to augment the two military satellite navigation systems now operating: the U.S. GPS and the Russian GLONASS.

**elevation** is the distance above or below the Local Vertical Datum.

**elevation mask** is the lowest elevation, in degrees, at which a receiver can track a satellite; it is measured from the horizon to zenith, 0° to 90°.

**ellipsoid** is a mathematical figure approximating the earth's surface, generated by rotating an ellipse on its minor axis. GNSS positions are computed relative to the WGS-84 ellipsoid. An ellipsoid has a smooth surface, which does not match the earth's geoidal surface closely, so GNSS altitude measurements can contain a large vertical error component. Conventionally surveyed positions usually reference a geoid, which has an undulating surface and approximates the earth's surface more closely to minimize altitude errors.

**epoch** is literally a period of time. This period of time is defined by the length of the period.

**GAGAN (GPS Aided Geo Augmented Navigation)**

is an Indian satellite system that provides a set of corrections for the GPS satellites, which are valid for the Indian region. They incorporate satellite orbit and clock corrections.

**geoid** is the gravity-equipotential surface that best approximates mean sea level over the entire surface of the earth. The surface of a geoid is too irregular to use for GNSS readings, which are measured relative to an ellipsoid. Conventionally surveyed positions reference a geoid. More accurate GNSS readings can be obtained by calculating the distance between the geoid and ellipsoid at each position and subtracting this from the GNSS altitude measurement.

**GIS (Geographical Information Systems)** is a computer system capable of assembling, storing, manipulating, updating, analyzing, and displaying geographically referenced information, i.e., data identified according to their locations. GIS technology can be used for scientific investigations, resource management, and development planning. GIS software is used to display, edit, query, and analyze all of the graphical objects and their associated information.

**Global Navigation Satellite System (GNSS)** is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage.

**Global Positioning System (GPS)** geometrically, there can only be one point in space, which is the correct distance from each of four known points. *GPS* measures the distance from a point to at least four satellites from a constellation of 24 NAVSTAR satellites orbiting the earth at a very high *altitude*. These distances are used to calculate the point's position.

**GMT** see *Greenwich Mean Time*.

**GNSS** (Global Navigation Satellite System)

**GPS** see *Global Positioning System*.

**GPS time** is a measure of time. GPS time is based on UTC, but does not add periodic “leap seconds” to correct for changes in the earth’s period of rotation. As of September 2002, *GPS* time is 13 seconds ahead of UTC.

**Greenwich Mean Time (GMT)** is the local time of the 0° meridian passing through Greenwich, England.

**HAE** see *altitude* and *ellipsoid*.

**IODC** (Issue of Data, Clock) indicates the issue number of the data set and thereby provides the user with a convenient means of detecting any change in the correction parameters. The transmitted IODC will be different from any value transmitted by the satellite during the preceding seven days.

**JPL** Jet Propulsion Laboratory.

**Kbps** is the abbreviation for *kilobits per second*.

**L-Band** is the group of radio frequencies extending from approximately 400MHz to approximately 1600MHz. The GPS carrier frequencies L1 (1575.4MHz) and L2 (1227.6 MHz) are in the L-Band range.

**L1 carrier frequency** is the primary L-Band carrier used by GPS satellites to transmit satellite data. The frequency is 1575.42MHz. It is modulated by C/A code, P-code, or Y-code, and a 50 bit/second navigation message. The bandwidth of this signal is 1.023MHz.

**L2 carrier frequency** the secondary L-Band carrier used by GPS satellites to transmit satellite data. The frequency is 1227.6MHz. It is modulated by P-code,

or Y-code, and a 50 bit/second navigation message. The bandwidth of this signal is 10.23MHz.

**lat** see latitude.

**latitude (lat)** the north/south component of the coordinate of a point on the surface on the earth; expressed in angular measurement from the plane of the equator to a line from the center of the earth to the point of interest. Often abbreviated as Lat.

**LED** acronym for Light Emitting Diode.

**LEMO** a type of data or power connector.

**LES Land Earth Station** the point on the earth's surface where data is up linked to a satellite.

**logging interval** the frequency at which positions generated by the receiver are logged to data files.

**lon** see *longitude*.

**longitude (long)** the east/west component of the coordinate of a point on the surface of the earth; expressed as an angular measurement from the plane that passes through the earth's axis of rotation and the 0° meridian and the plane that passes through the axis of rotation and the point of interest. Often abbreviated as Long.

**Mean Sea Level (MSL)** a vertical surface that represents sea level.

**meridian** one of the lines joining the north and south poles at right angles to the equator, designated by degrees of longitude, from 0° at Greenwich to 180°.

**meteorological (.YYm) files** one of the three file types that make up the *RINEX* file format. Where YY indicates the last two digits of the year the data was collected. A meteorological file contains atmospheric information.

**MSAS (MTSAT Satellite-based Augmentation System)** a Japanese satellite system that provides a set of corrections for the GPS satellites, which are valid for the Japanese region. They incorporate satellite orbit and clock corrections.

**MSL** see *Mean Sea Level*.

**multipath error** a positioning error resulting from interference between radio waves that has traveled between the transmitter and the receiver by two paths of different electrical lengths.

**navigation (.YYn) files** one of the three file types that make up the *RINEX* file format. Where YY indicates the last two digits of the year the data was collected. A navigation file contains satellite position and time information.

**observation (.YYo) files** one of the three file types that make up the *RINEX* file format. Where YY indicates the last two digits of the year the data was collected. An observation file contains raw GPS position information.

**PN** Part Number.

**P-code** the extremely long pseudo-random code generated by a *GPS* satellite. It is intended for use only by the U.S. military, so it can be encrypted to Y-code deny unauthorized users access.

**parity** a method of detecting communication errors by adding an extra parity bit to a group of bits. The parity bit can be a 0 or 1 value so that every byte will add up to an odd or even number (depending on whether odd or even parity is chosen).

**PDA** Personal Digital Assistant.

**PDOP** see *Position Dilution of Precision*.

**PDOP mask** the highest PDOP value at which a receiver computes positions.

**phase center** the point in an antenna where the GPS signal from the satellites is received. The height above ground of the phase center must be measured accurately to ensure accurate GPS readings. The phase center height can be calculated by adding the height to an easily measured point, such as the base of the antenna mount, to the known distance between this point and the phase center.

**Position** the latitude, longitude, and *altitude* of a point. An estimate of error is often associated with a position.

**Position Dilution of Precision (PDOP)** a measure of the magnitude of Dilution of Position (DOP) errors in the x, y, and z coordinates.

**Post-processing** a method of differential data correction, which compares data logged from a known reference point to data logged by a roving receiver over the same period of time. Variations in the position reported by the reference station can be used to correct the positions logged by the roving receiver. Post-processing is performed after you have collected the data and returned to the office, rather than in real time as you log the data, so it can use complex, calculations to achieve greater accuracy.

**Precise code** see *P-code*.

**PRN (Uppercase)** typically indicates a GPS satellite number sequence from 1 – 32.

**prn (Lower Case)** see Pseudorandom Noise.

**Protected code** see *P-code*.

**Proprietary commands** those messages sent to and received from GPS equipment produced by NavCom Technology, Inc. own copyrighted binary language.



**pseudo-random noise (*prn*)** a sequence of data that appears to be randomly distributed but can be exactly reproduced. Each GPS satellite transmits a unique PRN in its signals. GPS receivers use PRNs to identify and lock onto satellites and to compute their pseudoranges.

**Pseudorange** the apparent distance from the reference station's antenna to a satellite, calculated by multiplying the time the signal takes to reach the antenna by the speed of light (radio waves travel at the speed of light). The actual distance, or range, is not exactly the same because various factors cause errors in the measurement.

**PVT** GPS information depicting Position, Velocity, Time in the Sapphire GNSS proprietary message format.

**Quick Start** (StarFire™) a startup mode that allows instant <decimeter accuracy with received StarFire™ signals, allowing the convergence period to be waived. The Quick Start (user input) position should have an accuracy of better <decimeter to achieve maximum results. Any error in the user input position will bias the StarFire™ position error accordingly, until convergence can correct the bias. In this scenario, convergence may take longer than the typical startup convergence period.

**Radio Technical Commission for Maritime Services** see *RTCM*.

**range** the distance between a satellite and a GPS receiver's antenna. The *range* is approximately equal to the pseudorange. However, errors can be introduced by atmospheric conditions which slow down the radio waves, clock errors, irregularities in the satellite's orbit, and other factors. A GPS receiver's location can be determined if you know the

ranges from the receiver to at least four GPS satellites. Geometrically, there can only be one point in space, which is the correct distance from each of four known points.

**RCP** a NavCom Technology, Inc. proprietary processing technique in which carrier phase measurements, free of Ionospheric and Troposphere effects are used for navigation.

**Real-Time Kinematic (RTK)** a GPS system that yields very accurate 3D *position* fixes immediately in real-time. The base station transmits its GPS position to roving receivers as the receiver generates them, and the roving receivers use the *base station* readings to differentially correct their own positions. Accuracies of a few centimeters in all three dimensions are possible. RTK requires dual frequency GPS receivers and high speed radio modems.

**reference station** a reference station collects GPS data for a fixed, known location. Some of the errors in the GPS positions for this location can be applied to positions recorded at the same time by roving receivers which are relatively close to the reference station. A reference station is used to improve the quality and accuracy of GPS data collected by roving receivers.

**RHCP Right Hand Circular Polarization** used to discriminate satellite signals. GPS signals are RHCP.

**RINEX (Receiver Independent Exchange)** is a file set of standard definitions and formats designed to be receiver or software manufacturer independent and to promote the free exchange of GPS data. The *RINEX* file format consists of separate files, the three most commonly used are:

the observation (.YYo) file,

the navigation (.YYn) file,  
 meteorological (.YYm) files; where YY indicates  
 the last two digits of the year the data was  
 collected.

**rover** any mobile GPS receiver and field computer  
 collecting data in the field. A roving receiver's position  
 can be differentially corrected relative to a stationary  
 reference GPS receiver or by using GPS orbit and  
 clock corrections from a SBAS such as StarFire™.

**roving receiver** see *rover*.

**RTCM** (Radio Technical Commission for Maritime  
 Services) a standard format for Differential GPS  
 corrections used to transmit corrections from a base  
 station to rovers. RTCM allows both real-time  
 kinematic (RTK) data collection and post-processed  
 differential data collection. RTCM SC-104 (RTCM  
 Special Committee 104) is the most commonly used  
 version of RTCM message.

**RTK** see *Real-time kinematic*.

**S/A** see *Selective Availability*.

**SBAS (Satellite Based Augmentation System)** this  
 is a more general term, which encompasses  
 StarFire™, WAAS, EGNOS, MSAS, and GAGAN  
 type corrections.

**Selective Availability (S/A)** is the deliberate  
 degradation of the GPS signal by encrypting the P-  
 code and dithering the satellite clock. When the US  
 Department of Defense uses S/A, the signal contains  
 errors, which can cause positions to be inaccurate by  
 as much as 100 meters.

**Signal-to-Noise Ratio (SNR)** is a measure of a  
 satellite's signal strength.

**single-frequency** is a type of receiver that only uses the L1 GPS signal. There is no compensation for ionospheric effects.

**SNR** see *signal-to-noise Ratio*.

**StarFire™** a set of real-time global orbit and clock corrections for GPS satellites. StarFire™ equipped receivers are capable of real-time decimeter positioning

(see Appendix C).

**Spread Spectrum Radio (SSR)** a radio that uses wide band, noise like (pseudo-noise) signals that are hard to detect, intercept, jam, or demodulate making any data transmitted secure. Because spread spectrum signals are so wide, they can be transmitted at much lower spectral power density (Watts per Hertz), than narrow band signals.

**SV (Space Vehicle)** a GPS satellite.

**Universal Time Coordinated (UTC)** a time standard maintained by the US Naval Observatory, based on local solar mean time at the Greenwich meridian. GPS time is based on UTC.

**UTC** see *Universal Time Coordinated*.

**WAAS (Wide Area Augmentation System)** a US satellite system that provides a set of corrections for the GPS satellites, which are valid for the North American region. They incorporate satellite orbit and clock corrections.

**WADGPS (Wide Area Differential GPS)** a set of corrections for the GPS satellites, which are valid for a wide geographic area.

**WGS-84 (World Geodetic System 1984)** the current standard datum for global positioning and surveying. The WGS-84 is based on the GRS-80 ellipsoid.

**Y-code** the name given to encrypted P-code when the U.S. Department of Defense uses selective availability