THE ALMANAC

Orbit Data and Resources on Active GNSS Satellites

GPS Constellation

SV #	PRN #	CLOCK	LAUNCHED	USABLE	PLANE/ SLOT	NOTES
TYPE: Block IIA						
23	32	Rb	11-26-90	2-26-08	E5	
24	24	Cs	7-4-91	8-30-91	D5	
25	25	Rb	2-23-92	3-24-92	A5	
26	26	Rb	7-7-92	7-23-92	F5	
27	27	Cs	9-9-92	9-30-92	A4	
32	01		11-22-92			A
37	01	Rb	5-13-93	6-12-93	C6	B
39	09	Cs	6-26-93	7-20-93	A1	
35	05	Rb	8-30-93	9-28-93	B5	
34	04	Rb	10-26-93	11-22-93	D4	
36	06	Rb	3-10-94	3-28-94	C5	
33	03	Cs	3-28-96	4-9-96	C2	
40	10	Cs	7-16-96	8-15-96	E3	
30	30	Cs	9-12-96	10-1-96	B2	
38	08	Cs	11-6-97	12-18-97	A3	
TYPE: Block IIR						
43	13	Rb	7-23-97	1-31-98	F3	
46	11	Rb	10-7-99	1-3-00	D2	
51	20	Rb	5-11-00	6-1-00	E1	
44	28	Rb	7-16-00	8-17-00	B3	
41	14	Rb	11-10-00	12-10-00	F1	
54	18	Rb	1-30-01	2-15-01	E4	
56	16	Rb	1-29-03	2-18-03	B1	
45	21	Rb	3-31-03	4-12-03	D3	
47	22	Rb	12-21-03	12-1-04	E2	
59	19	Rb	3-20-04	4-5-04	C3	
60	23	Rb	6-23-04	7-9-04	F4	
61	02	Rb	11-6-04	11-22-04	D1	
TYPE: Block IIR-M						
53	17	Rb	9-26-05	12-16-05	C4	
52	31	Rb	9-25-06	10-12-06	A2	
58	12	Rb	11-17-06	12-13-06	B4	
55	15	Rb	10-17-07	10-31-07	F2	
57	29	Rb	12-20-07	1-2-08	C1	
48	07	Rb	3-15-08	3-24-08	A6	

General Notes:

1. "SV Number" refers to space vehicle number. "PRN Number" refers to the satellite's unique pseudorandom noise code.
2. Clock: Rb = rubidium; Cs = cesium. Only clock changes made since this Almanac was last published in December are included in the performance notes.
3. "Launched" and "Usable" dates are based on Universal Time.
4. The current GPS constellation consists of 13 usable Block IIA satellites, 12 Block IIRs, and 6 Block IIR-Ms for a total of 31 satellites and is under FOC (Full Operational Capability).
5. SVN35 and 36 carry onboard corner-cube reflectors for satellite laser ranging (SLR). SLR tracking of the satellites permits analysts to differentiate between onboard clock errors and satellite ephemeris errors in GPS tracking.
6. Selective availability (SA) was set to zero on all satellites by presidential order on May 2, 2000 at approximately 4:00 UT. Previous Almanacs provide a history of SA status.
7. Antispoofing (AS) was activated on January 31, 1994, on all Block IIs. AS is occasionally off for testing and other purposes. Previous Almanacs provide a history of AS status.
8. The PRN number of SVN32 was changed from 32 to 01 on January 28, 1993.
9. The design life of Block II/IIA vehicles is 7.5 years with a mean mission-duration goal of 6 years. Block IIR satellites are designed for a mean-mission duration of 7.5 years and a design life of 10 years.
10. *GPS World* believes this information to be correct as of press time. However, because of the satellite constellation's evolving nature, readers should contact GPS information services listed on these pages for more current data.
11. Dr. Richard Langley of the University of New Brunswick provided the GPS satellite status information and compiled the notes.

Performance Notes:

A. SVN32, previously decommissioned, was recommissioned still as PRN01 on September 24, 2008. It was not set healthy and L-band transmissions were discontinued on October 16, 2008.

B. SVN37, previously decommissioned, was recommissioned as PRN01 on October 23, 2008. It is currently set unhealthy and not included in almanacs.

GPS Satellite & System Information

International GNSS Service: *http://igscb.jpl.nasa.gov/*
National Executive Committee for Space-Based Positioning, Navigation & Timing: *www.pnt.gov*
2nd Space Operations Squadron: *http://gps.afspc.af.mil/gps*
U.S. Coast Guard Navigation Center: *www.navcenter.org*
For a complete list of resources on GPS with hotlinks, visit *www.gpsworld.com/almanac.*

GNSS Internet Information

The Aerospace Corporation's GPS Primer *www.aero.org/education/primers/gps*

Beidou/Compass System Information *www.sinodefence.com/space/spacecraft/beidou1.asp*

Canadian Space Geodesy Forum *http://gauss.gge.unb.ca/CANSPACE.html*

Civil GPS Service Interface Committee *www.navcen.uscg.gov/cgsic/Default.htm*

Czech Technical University, Radio Engineering Dept. *http://radio.fel.cvut.cz/satnav/*

EC Directorate-General for Energy and Transport (Galileo) *europa.eu.int/comm/dgs/energy_transport/galileo/index_en.htm*

Educational Observatory Institute *www.edu-observatory.org/gps/gps.html*

European Space Agency (Galileo) *www.esa.int/esaNA/*

Federal Aviation Administration Navigation Services *http://gps.faa.gov/*

Federal Geographic Data Committee *www.fgdc.gov*

European GNSS Supervisory Authority (GSA) *www.gsa.europa.eu*

European Satellite Services Provider (EGNOS) *www.essp.be/*

Geoscience Australia *www.ga.gov.au*

GPS, Geodesy, and Application Program *www.gnss.umaine.edu/*

How GPS Receivers Work *www.howstuffworks.com/gps.htm*

The Institute of Navigation *www.ion.org*

International GNSS Service *http://igscb.jpl.nasa.gov/*

Japanese Quasi-Zenith Satellite System (QZSS) *www.jaxa.jp/projects/sat/qzss/index_e.html*

MTSAT Satellite-Based Augmentation System (MSAS) *www.kasc.go.jp/MSAS/index_e.html*

NASA's GPS Applications Exchange *http://gpshome.ssc.nasa.gov/default.aspx*

National Air and Space Museum, GPS — A New Constellation *www.nasm.si.edu/exhibitions/gps/*

National Executive Committee for Space-Based Positioning, Navigation & Timing *www.pnt.gov*

National Geodetic Survey *www.ngs.noaa.gov/*

National Geospatial-Intelligence Agency *http://earth-info.nga.mil/GandG/sathtml/*

National Institute of Standards and Technology (NIST), Time and Frequency Division *http://tf.nist.gov*

National Survey and Cadastre-Denmark *www.kms.dk*

Natural Resources Canada Geodetic Survey *www.geod.nrcan.gc.ca , www.cdgps.com*

Russian Space Agency Information–Analytical Cente *www.glonass-ianc.rsa.ru r*

Scripps Orbit and Permanent Array Center (SOPAC) *http://sopac.ucsd.edu*

2nd Space Operations Squadron *http://gps.afspc.af.mil/gps*

746 Test Squadron GPS Information Archive *https://gpstest.46tg.af.mil/webpub/general/bbstest.nsf*

USAF Global Positioning Systems Wing *http://gps.losangeles.af.mil/*

U.S. Coast Guard Navigation Center *www.navcenter.org*

U.S. Naval Observatory *http://tycho.usno.navy.mil/gps.html*

WAAS Test Team *www.nstb.tc.faa.gov*

Go online to *www.gpsworld.com/almanac* for details and links for these resources.

GLONASS Constellation

GLONASS NUMBER	KOSMOS NUMBER	LAUNCHED	USABLE	ALMANAC/ SLOT NUMBER	CHANNEL	ORBIT PLANE	NOTES
92 (701)	2404	12-10-03	12-9-04	6	1	1	
94 (795)	2403	12-10-03	1-30-04	4	6	1	
95 (712)	2413	12-26-04	6-10-05	7	5	1	
96 (797)	2412	12-26-04					A
97 (796)	2411	12-26-04					B
99 (713)	2418	12-25-05	8-31-06	24	2	3	
100 (714)	2419	12-25-05	8-31-06	23	3	3	
101 (715)	2424	12-25-06	4-3-07	14	4	2	
102 (716)	2425	12-25-06	10-12-07	15	0	2	
103 (717)	2426	12-25-06	4-3-07	10	4	2	
104 (718)	2431	10-26-07	12-4-07	17	-1	3	
105 (719)	2432	10-26-07	11-27-07	20	2	3	
106 (720)	2433	10-26-07	11-25-07	19	3	3	
107 (721)	2434	12-25-07	2-8-08	13	-2	2	
108 (722)	2435	12-25-07	1-25-08	9	-2	2	C
109 (723)	2436	12-25-07	1-22-08	11	0	2	
110 (724)	2442	9-25-08	10-26-08	18	-3	3	
111 (725)	2443	9-25-08	11-5-08	21	-1	3	
112 (726)	2444	9-25-08	11-13-08	22	-3	3	

General Notes:

1. The first GLONASS satellite was launched October 12, 1982.
2. The GLONASS numbering scheme used in this table includes the eight "dummy" satellites orbited as ballast along with "real" satellites on the first seven GLONASS launches. The second number (in parentheses) in the "GLONASS Number" column is that assigned by the Russian Space Forces.
3. The Russian Federation designated the "Kosmos Number."
4. GLONASS numbers 1–91 have been withdrawn from service.
5. GLONASS 88 is a development or prototype GLONASS-M satellite. All other operational satellites are GLONASS-M satellites except GLONASS 94.
6. All launch and usable dates are based on Moscow Time (Universal Time + 3 hours).
7. Channel number "k" indicates L1 and L2 carrier frequencies: L1 = 1,602 1 0.5625 k (MHz); L2 = 1,246 + 0.4375 k (MHz).
8. All GLONASS satellites use cesium atomic clocks.
9. Seventeen GLONASS satellites are healthy.
10. The latest triple GLONASS launch was on September 25, 2008. The next launch is scheduled for December 25, 2008.
11. New GLONASS channel allocations were introduced September 1993 to reduce interference to radio astronomy. Note the use of the same channel on pairs of antipodal satellites.
12. *GPS World* believes this information to be correct as of press time. However, because of the satellite constellation's evolving nature, we encourage readers to contact the GLONASS sources listed on these pages for more current information.
13. Information compiled by Richard Langley.

Performance Notes:

A. GLONASS 96 was set unusable on June 16, 2008 and decommissioned on October 16, 2008.

B. GLONASS 97 was set unusable on May 4, 2008 and decommissioned on October 18, 2008.

C. GLONASS 108 was set unusable on May 14, 2008. It was set healthy on August 6, 2008; however, it appears that its L2 signals are unusable.

Satellite-Based Augmentation Systems

SBAS	SATELLITE	ORBIT LONGITUDE	PRN NO.	NOTES
EGNOS	Inmarsat-3-F2/AOR-E	15.5° W	120	A
	Artemis	21.5° E	124	B
	Inmarsat-3-F5/IOR-W	25° E	126	A
GAGAN	Inmarsat-4-F1/IOR	64° E	127	C
MSAS	MTSAT-1R	140° E	129	D
	MTSAT-2	145° E	137	D
WAAS	Intelsat Galaxy XV	133° W	135	E, G
	TeleSat Anik F1R	107.3° W	138	F, G

Notes:

A. IOR-W (also known as IND-W) and AOR-E began EGNOS Initial Operations on June 3, 2006, and July 6, 2006, respectively, transmitting message type 0/2.

B. Industry test transmissions using message type 0/0.

C. Test transmissions using the Inmarsat satellite ceased on April 8, 2008, and will resume after the launch of India's GSAT-4 expected in 2009.

D. MSAS commissioned for aviation use on September 27, 2007. Either satellite can transmit both PRN signals if necessary.

E. Galaxy XV was switched from test mode to normal mode on November 9, 2006. Ranging supports non-precision approach.

F. Anik F1R was switched from test mode to normal mode on July 13, 2007. Ranging supports non-precision approach.

G. The Galaxy XV and Anik F1R WAAS payloads, operated by Lockheed Martin for the FAA, are known as LMRPS-1 and LMRPS-2, respectively.

Galileo System Information

Galileo is a joint initiative of the European Commission (EC) and the European Space Agency (ESA). Initially, they formed the Galileo Joint Undertaking (GJU) to manage Galileo's development phase. The European GNSS Supervisory Authority (GSA), headquartered in Brussels, Belgium, took over Galileo responsibility from GJU on January 1, 2007. The GSA's tasks include management of the first series of satellites to ensure the large-scale demonstration of the capabilities and reliability of the Galileo system. The first two Galileo satellites will secure the system's frequency allocation and validate key technologies for the full Galileo constellation.

Surrey Satellite Technology Ltd. (SSTL) in Guildford, United Kingdom, constructed the first test satellite. Formerly known as the Galileo System Test Bed (GSTB) V2/A satellite, it has been christened Galileo In-Orbit Validation Element-A (GIOVE-A) and was launched on December 28, 2005, on a Soyuz rocket from the Baikonur Cosmodrome in Kazakhstan. It continues to transmit test signals.

The second test satellite, GSTB V2/B or GIOVE-B, constructed by a team led by Astrium GmbH in Ottobrunn near Munich, Germany, was launched from Baikonur on April 26, 2008. Commissioning has been completed and the satellite entered full nominal operational mode on July 5, 2008. GIOVE-B entered safe mode on September 9, 2008, likely due to a radiation-triggered anomaly. The satellite returned to service on September 24, 2008.

For more information:

Astrium: *www.astrium.eads.net*

EC Directorate-General for Energy and Transport: *europa.eu.int/comm/dgs/energy_transport/galileo/index_en.htm*

ESA: *www.esa.int/esaNA/*

GSA: *www.gsa.europa.eu*

SSTL: *www.sstl.co.uk*

GLONASS Satellite Information

www.glonass-ianc.rsa.ru

The Information–Analytical Center (IAC) of the Russian Space Agency publishes official information about GLONASS status and plans as well as consultation, information, and scientific-method services to increase GLONASS applications efficiency. It provides current constellations, Earth maps of the current and daily navigation availabilities, results of GNSS navigation fields monitoring in the Moscow area in a real-time mode, and other data. **For more information:** e-mail glonass-ianc@mcc.rsa.ru.

Beidou/Compass System Information

China has developed a regional satellite-based navigation system known as Beidou (Chinese for the "Big Dipper" asterism). The initial constellation of three geostationary Earth orbit (GEO) satellites was completed in 2003. The first Beidou Navigation Test System 1 (BNTS-1) satellite, or Beidou 1A, was launched on October 30, 2000, into a geostationary orbit slot at 140° E. On December 20, 2000, Beidou 1B followed, going into a slot at 80.5° E. Beidou 1C, an in-orbit back-up satellite, was launched into an orbit at 110.5° E, on May 24, 2003. A fourth satellite, Beidou 1D, was launched on February 2, 2007 into the slot at 145° E. After some initial difficulties, the satellite was made operational. There are some reports that Beidou 1A is no longer operational.

The initial regional Beidou system is being expanded into a global system to be known as Beidou-2 or Compass. It will likely include five GEO satellites and additionally 30 or so medium Earth orbit (MEO) satellites. The first MEO satellite was launched on April 13, 2007 into a circular orbit with a radius of about 27900 kilometers.

For more information:

www.sinodefence.com/strategic/spacecraft/beidou1.asp

www.sinodefence.com/strategic/spacecraft/beidou2.asp

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