

GPS CONSTELLATION

SVN	PRN	CLOCK	LAUNCHED	USABLE	PLANE/SLOT	NOTES
TYPE: Block IIR						
43	13	Rb	7-23-97	1-31-98	F6	A
46	11	Rb	10-7-99	1-3-00	D2-F	
51	20	Rb	5-11-00	6-1-00	E7	B
44	28	Rb	7-16-00	8-17-00	B3	
41	14	Rb	11-10-00	12-10-00	F2-F	C
54	18	Rb	1-30-01	2-15-01	E4	
56	16	Rb	1-29-03	2-18-03	B1-A	
45	21	Rb	3-31-03	4-12-03	D3	
47	22	Rb	12-21-03	1-12-04	E6	
59	19	Rb	3-20-04	4-5-04	C5	
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-A	
57	29	Rb	12-20-07	1-2-08	C1	
48	07	Rb	3-15-08	3-24-08	A4	
50	05	Rb	8-17-09	8-27-09	E3	
TYPE: Block IIF						
62	25	Rb	5-28-10	8-27-10	B2	
63	01	Rb	7-16-11	10-14-11	D2-A	
65	24	Cs	10-4-12	11-14-12	A1	
66	27	Rb	5-15-13	6-21-13	C2	
64	30	Rb	2-21-14	5-30-14	A3	
67	06	Rb	5-17-14	6-10-14	D4	
68	09	Rb	8-2-14	9-17-14	F3	
69	03	Rb	10-29-14	12-12-14	E1	
71	26	Rb	3-25-15	4-20-15	B1-F	
72	08	Cs	7-15-15	8-12-15	C3	
73	10	Rb	10-31-15	12-9-15	E2	
70	32	Rb	2-5-16	3-9-16	F1	D

GPS NOTES

Websites:

- GPS.gov
- National Executive Committee for Space-Based Positioning, Navigation & Timing: www.gps.gov/governance/excom/
- DoD GPS Operations Center and 250PS Constellation Status: <https://gps.afspc.af.mil/gpsoc/>; <https://gps.afspc.af.mil/gps/>
- U.S. Coast Guard Navigation Center Navigation Information Service (NIS): www.navcen.uscg.gov

“SVN” refers to space vehicle number. “PRN” refers to the satellite’s unique pseudorandom noise code; Clock: Rb = rubidium; Cs = cesium. “Launched” and “Usable” dates are

based on Universal Time.

- SVN43/PRN13’s slot designation has been changed from F2-F to F6 in GPSOC daily Operational Advisories and on the NavCen website.
- Due to limitations in official GPS orbit nomenclature, slot E7 is currently also referred to as slot B6.
- SVN41/PRN14’s slot designation has been changed from F1 to F2-F in GPSOC daily Operational Advisories and on the NavCen website.
- SVN70/PRN32’s slot designation has been changed from F5 to F1 in GPSOC daily Operational Advisories and on the NavCen website.

IRNSS CONSTELLATION

SATELLITE	NORAD ID	LAUNCHED	ORBIT
IRNSS-1A	39199	7-1-13	IGSO 55° E
IRNSS-1B	39635	4-4-14	IGSO 55° E
IRNSS-1C	40269	10-15-14	GEO 83° E
IRNSS-1D	40547	3-28-15	IGSO 111.75° E
IRNSS-1E	41241	1-20-16	IGSO 111.75° E
IRNSS-1F	41384	3-10-16	GEO 32.5° E
IRNSS-1G	41469	4-28-16	GEO 129.5° E

IRNSS NOTES

Website: www.isro.gov.in/irNSS-programme

All three rubidium atomic clocks on IRNSS-1A have failed. A replacement satellite, IRNSS-1H, was launched on Aug. 31, 2017, but was not successfully deployed. A further replacement satellite will be launched early in 2018.

ABOUT THESE TABLES

- GPS World believes this information to be correct as of press time. However, because of the evolving nature of satellite constellations, readers should refer to the online version of this Almanac for more current data.
- Dr. Richard Langley of the University of New Brunswick provided the satellite status information and compiled the notes.
- For supplemental notes on the constellations, additional satellite and system information and other GNSS resources, see the online GNSS Almanac at gpsworld.com/the-almanac/.

For more information, see the online GNSS Almanac at gpsworld.com/the-almanac/.

SATELLITE-BASED AUGMENTATION SYSTEMS

SBAS	SATELLITE	ORBIT LONGITUDE	PRN	SIGNALS	NOTES
EGNOS	Inmarsat-3-F2/AOR-E	15.5° W	120	L1	A
	Astra 5B	31.5° E	123	L1/L5	B
	Artemis				C
	Inmarsat-4-F2				D
	SES-5	5° E	136	L1/L5	E
GAGAN	GSAT-8	55° E	127	L1/L5	F, I
	GSAT-10	83° E	128	L1/L5	G, I
	GSAT-15	93.5° E	132	L1/L5	H, I
GATBP	Inmarsat 4F1/PAC-W	143.5° E	122	L1/L5	J
MSAS	MTSAT-1R				K
	MTSAT-2	145° E	129/137	L1	K
NSAS	NigComSat-1R	42.5° E	147	L1/L5	L
	QZSS	135° E	183	L1	M
QZSS	QZS-1	135° E	184/196	L1/L5	M
	QZS-2	136° E		L1/L5	M
	QZS-3	127° E		L1/L5	M
	QZS-4	136° E		L1/L5	M
SDCM	Luch-5A	167° E°	140	L1	N
	Luch-5B	16° W	125	L1	O
	Luch-5V	95° E	141	L1	P
WAAS	Intelsat Galaxy 15 (CRW)	133° W	135	L1/L5	Q, S
	TeleSat Anik FIR (CRE)	107.3° W	138	L1/L5	R, S
	Inmarsat-4-F3 (AMR)	98° W	133	L1/L5	T
	Eutelsat 117W B	117° W	131	L1/L5	U

SBAS NOTES

- Inmarsat 3-F2 began Safety-of-Life Service on March 2, 2011, and is transmitting message type 2.
- Astra 5B was launched on March 22, 2014. On March 20, 2017, it became an operational satellite and is transmitting message type 2.
- Decommissioned for EGNOS use. Satellite sold to Britain’s Avanti Communications.
- Inmarsat-4-F2 began Safety-of-Life Service on March 22, 2012. It has been retired.
- SES-5 (also known as Sirius 5 and Astra 4B) was launched on July 9, 2012 and was an operational satellite transmitting message type 2. On March 21, 2017, SES-5 became a test satellite.
- GSAT-8 was launched on May 20, 2011.
- GSAT-10 was launched on Sept. 28, 2012.
- GSAT-15 was launched on Nov. 10, 2015. Its SBAS transponder is in reserve.
- GAGAN was certified for enroute navigation and non-precision approaches on Dec. 30, 2013, and for precision approaches on April 21, 2015.
- Geoscience Australia Test-Bed Project. Transmitting message type 0; not for safety-of-life use. L1 transmissions began on May 31, 2017.
- MSAS commissioned for aviation use on Sept. 27, 2007. MTSAT-1R has been decommissioned. MTSAT-2 began transmitting both PRN signals on Dec. 10, 2015.
- Nigerian Satellite Augmentation System. L1 tests.
- QZS-1 (nicknamed Michibiki) transmits an L1 augmentation signal using PRN code 183. That signal is in test mode. QZS-2 transmits L1 and L5 augmentation signals using PRNs 184 and 196. Central longitudes of satellites can vary by ± 5° or more from nominal value. QZS-3 (geostationary) and QZS-4 in commissioning.
- Luch-5A was launched on Dec. 11, 2011. Initially positioned at 58.5° E, it was shifted to 95° E between about May 30 and June 28, 2012, then shifted to 167° E between about Nov. 30 and Dec. 22, 2012. Transmissions as PRN 140 began on July 12, 2012. Transmitted occasional, non-coherent code/carrier test signals.
- Luch-5B was launched on Nov. 2, 2012, and started transmitting test signals on Jan. 17, 2013.
- Luch-5V was launched on April 28, 2014. Testing may have started using PRN 140, not 141.
- Galaxy 15 ranging supports enroute through precision approach modes. Switched to backup satellite oscillator on Jan. 6, 2012.
- Anik FIR ranging supports enroute through precision approach modes.
- The Galaxy 15 and Anik FIR payloads, operated by Lockheed Martin for the FAA, are known as LMPRS-1 and LMPRS-2, respectively.
- As of July 18, 2015, Inmarsat-4-F3 indefinitely discontinued non-precision approach ranging service. The satellite transponder was retired in November 2017.
- Has begun test transmissions.

GLONASS CONSTELLATION

GLONASS NUMBER	KOSMOS NUMBER	LAUNCHED	USABLE	ALMANAC/ SLOT	CHANNEL	ORBIT PLANE	NOTES
100 (714)	2419	12-25-05					A
101 (715)	2424	12-25-06					B
102 (716)	2425	12-25-06	10-12-07	15	0	2	
103 (717)	2426	12-25-06	4-3-07	10	-7	2	
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	
109 (723)	2436	12-25-07	1-22-08	12	-1	2	C
116 (730)	2456	12-14-09	1-30-10	1	1	1	
117 (733)	2457	12-14-09	1-24-10	6	-4	1	
118 (734)	2458	12-14-09	1-10-10	5	1	1	
119 (731)	2459	3-1-10	3-28-10	22	-3	3	
120 (732)	2460	3-1-10	3-28-10	23	3	3	
121 (735)	2461	3-1-10	3-28-10	24	2	3	
122 (736)	2464	9-2-10	10-4-10	16	-1	2	
123 (737)	2465	9-2-10	10-12-10				D
125 (701)	2471	2-26-11		(20)	-5	3	E
126 (742)	2474	10-2-11	10-25-11	4	6	1	
127 (743)	2475	11-4-11	3-5-13	8	6	1	
128 (744)	2476	11-4-11	12-8-11	3	5	1	
129 (745)	2477	11-4-11	12-23-11	7	5	1	
131 (747)	2485	4-26-13	7-4-13	2	-4	1	
132 (754)	2492	3-24-14	4-13-14	18	-3	3	F
133 (755)	2500	6-14-14	8-3-14	21	4	3	
134 (702)	2501	11-30-14	2-15-16	9	-2	2	
135 (751)	2514	2-7-16	2-28-16	17	4	3	
136 (753)	2516	5-19-16	6-27-16	11	0	2	
137 (752)	2522	9-22-17	10-16-17	14	-7	2	

GLONASS NOTES

Website: www.glonass-iac.ru/en/

- A. GLONASS 100 was withdrawn from the constellation on Aug. 24, 2017.
- B. GLONASS 101 was withdrawn from the constellation on Oct. 6, 2017.
- C. L2 transmissions appear to be impaired.
- D. GLONASS 123 was withdrawn from the constellation on Aug. 25, 2017.
- E. GLONASS 125, the first GLONASS-K1 satellite, is currently in flight test mode near physical orbital slot 20. When not in the active constellation, the satellite typically identifies itself as satellite 26 in its broadcast ephemeris.
- F. The Kosmos number for GLONASS 132 has been changed from 2491 to 2492.

BEIDOU CONSTELLATION

SATELLITE	NORAD ID	PRN	LAUNCHED	ORBIT	NOTES
TYPE: BeiDou-2					
BeiDou M1	31115	C30	4-13-07	MEO period 12.89 hours	A
BeiDou G2	34779	N/A	4-14-09	GEO drifting	B
BeiDou G1	36287	C01	1-16-10	GEO 140° E	C
BeiDou G3	36590	C03	6-2-10	GEO 110.5° E	D
BeiDou IGSO1	36828	C06	7-31-10	IGSO 118° E, 55° incl.	
BeiDou G4	37210	C04	10-31-10	GEO 160° E	
BeiDou IGSO2	37256	C07	12-17-10	IGSO 118° E, 55° incl.	
BeiDou IGSO3	37384	C08	4-9-11	IGSO 118° E, 55° incl.	
BeiDou IGSO4	37763	C09	7-26-11	IGSO 95° E, 55° incl.	
BeiDou IGSO5	37948	C10	12-1-11	IGSO 95° E, 55° incl.	
BeiDou G5	38091	C05	2-24-12	GEO 58.75° E	
BeiDou M3	38250	C11	4-29-12	MEO slot 1-7	E
BeiDou M4	38251	C12	4-29-12	MEO slot 1-8	E
BeiDou M5	38774	C13	9-18-12	MEO slot 2-3	E, F
BeiDou M6	38775	C14	9-18-12	MEO slot 2-4	E
BeiDou G6	38953	C02	10-25-12	GEO 80° E	
BeiDou IGSO6	41434	C13	3-29-16	IGSO 95° E, 55° incl.	G
BeiDou G7	41586	C17	6-12-16	GEO 144.5° E	H
TYPE: BeiDou-3					
BeiDou I1-S	40549	C31	3-30-15	IGSO 95° E, 55° incl.	
BeiDou M1-S	40749	C33	7-25-15	MEO slot 1-1	E, I
BeiDou M2-S	40748	C34	7-25-15	MEO slot 1-6	E, I
BeiDou I2-S	40938	C32	9-29-15	IGSO 95° E, 55° incl.	
BeiDou M3-S	41315	C35	2-1-16	MEO slot 2-1	E
BeiDou-3 M1	43001	C19	11-5-17	MEO slot 2-7	E, J
BeiDou-3 M2	43002	C20	11-5-17	MEO	E, J, K

BEIDOU NOTES

Website: <http://en.beidou.gov.cn/>

IGSO node longitudes are nominal values. Nodes are allowed to drift ±3 degrees or so.

- A. Inactive.
- B. Initially achieved geostationary orbit at a longitude of about 84.5° E, but appears to have become uncontrollable shortly thereafter. Librating about the 75° E libration point.
- C. GEO, formerly at 144.5° E, shifted to 140° E between about June 30 and July 9, 2011.
- D. GEO, formerly at 84° E, shifted to 110.5° E between about Nov. 7 and Nov. 23, 2012.
- E. The MEO satellites are in a 24-satellite three-orbit-plane Walker constellation with orbit planes spaced by 120° with 55° inclination and orbital period of 12.89 hours.
- F. Satellite is not currently transmitting standard signals.
- G. Satellite switched PRN from C15 to C13 on Oct. 11, 2016.
- H. Not operational yet.
- I. NORAD IDs and slot numbers corrected.
- J. Operational BeiDou-3 satellite.
- K. Satellite still drifting to final orbit.

GALILEO CONSTELLATION

SATELLITE	NORAD ID	LAUNCHED	L-BAND ACTIVE	OPERATIONAL	SLOT	PRN	CLOCK	NICKNAME	NOTES
GIOVE-A	28922	12-28-05							A
GIOVE-B	32781	4-26-08							B
PFM (GSATO101)	37846	10-21-11	12-10-11	12-10-11	B5	E11	Rb	Thijs	
FM2 (GSATO102)	37847	10-21-11	1-9-12	1-16-12	B6	E12	H	Natalia	C
FM3 (GSATO103)	38857	10-12-12	12-1-12	12-1-12	C4	E19	H	David	
FM4 (GSATO104)	38858	10-12-12	12-12-12	12-12-12	C5	E20	Rb	Sif	D
FOC-FM1 (0201)	40128	8-22-14	11-29-14		Ext 1	E18	H	Doresa	E,G
FOC-FM2 (0202)	40129	8-22-14	3-17-15		Ext 2	E14	H	Milena	F,G
FOC-FM3 (0203)	40544	3-27-15	5-24-15	12-3-15	B8	E26	H	Adam	
FOC-FM4 (0204)	40545	3-27-15	5-21-15	12-4-15	B3	E22	Rb	Anastasia	H
FOC-FM5 (0205)	40889	9-11-15	11-9-15	1-28-16	A8	E24	H	Alba	
FOC-FM6 (0206)	40890	9-11-15	11-9-15	1-28-16	A5	E30	H	Oriana	
FOC-FM7 (0207)	41859	11-17-16	3-2-17	5-29-17	C6	E07	H	Antoniana	
FOC-FM8 (0208)	41174	12-17-15	2-16-16	4-22-16	C7	E08	H	Andriana	
FOC-FM9 (0209)	41175	12-17-15	2-18-16	4-22-16	C2	E09	H	Liene	
FOC-FM10 (0210)	41550	5-24-16	8-17-16	12-1-16	A2	E01	H	Danièle	
FOC-FM11 (0211)	41549	5-24-16	8-20-16	12-1-16	A6	E02	H	Alizée	
FOC-FM12 (0212)	41860	11-17-16	4-22-17	8-1-17	C8	E03	H	Lisa	
FOC-FM13 (0213)	41861	11-17-16	4-22-17	8-9-17	C3	E04	H	Kimberley	
FOC-FM14 (0214)	41862	11-17-16	3-3-17	5-29-17	C1	E05	H	Tijmen	

GALILEO NOTES

Websites:

- European GNSS Agency, www.gsa.europa.eu
- European Space Agency, www.esa.int

- A. Navigation signals from GIOVE-A were switched off on June 30, 2012, and the satellite decommissioned for ESA use.
- B. Navigation signals from GIOVE-B were switched off on July 23, 2012, and the satellite decommissioned for ESA use.
- C. Active clock switched from Rb to H and satellite available again on or about Oct. 22, 2016.
- D. Payload power problem beginning May 27, 2014. Now only transmits an E1 signal.
- E. Orbit perigee raised by about 3500 kilometers in November 2014. Active clock switched from Rb to H on or about Mar. 10, 2017.
- F. Orbit perigee raised by about 3500 kilometers in January–February 2015. Active clock switched from Rb to H on or about July 2, 2016.
- G. Satellites launched into wrong orbits. Testing underway.
- H. Active clock switched from H to Rb and satellite available again on or about Dec. 21, 2016.