

QZS-2 SATELLITE INFORMATION

Cabinet Office, Government of Japan

National Space Policy Secretariat

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1. Introduction

This documentation describes the information about QZS-2 satellite properties which need to be known in order to properly implement advanced processing algorithms for precise orbit determination (POD) and precise point positioning (PPP) etc.

2. Reference Frame

The QZS-2 satellite coordinate system is aligned with the main body axes and originates at the center of the launch adapter plane. The individual axes of QZS-2 satellite coordinate system are aligned in the following way: (see Figure 1)

- origin : Center of the launch adapter plane
- The +Z-axis is oriented to the bore sight direction of the L-ANT antenna.
- The +Y-axis is parallel to the rotation axis of the solar panels.
- The +X-axis is constituted by a right handed system with +Y/+Z axis.

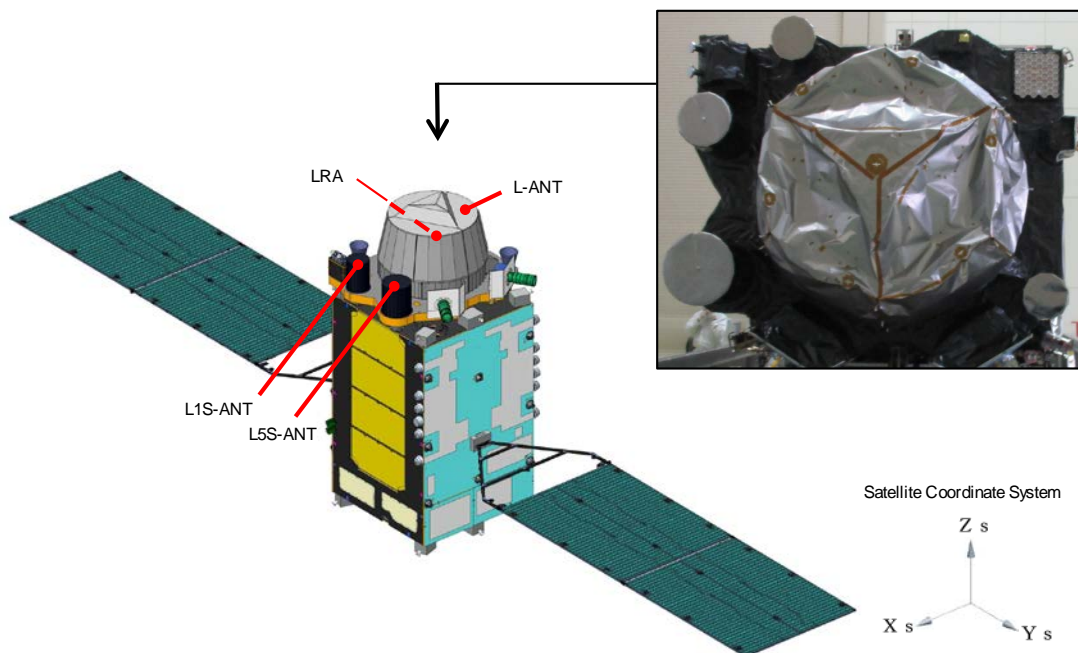


Figure 1 Reference Frame

3. Attitude Law

QZS-2 takes always attitude of the yaw steering mode except the period that the orbit control maneuver is conducted.

① Yaw steering mode (see Figure 2)

The +z-axis is pointing to the Earth.

The y-axis is oriented perpendicular to the plane made up by the Sun, Earth and satellite.

The x-axis is oriented within the plane made up by the Sun, Earth and satellite. The Sun is located in the *negative* hemisphere.

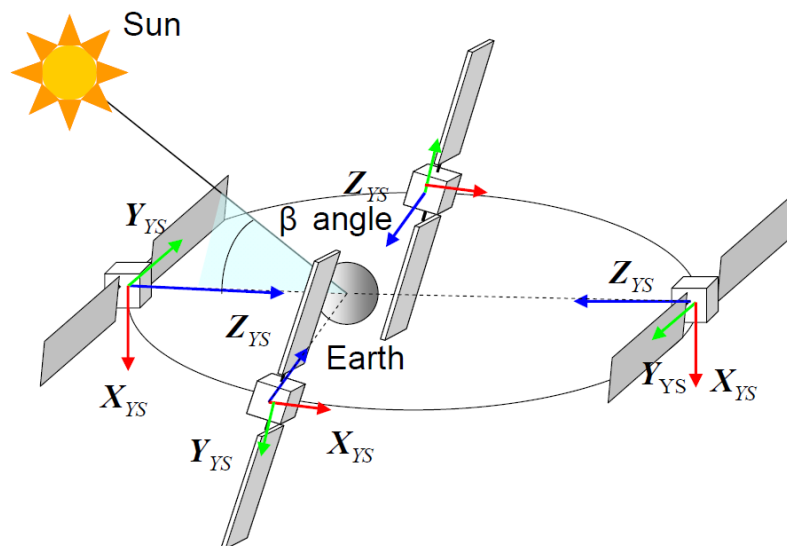


Figure 2 Yaw Steering mode

In the case of nominal yaw steering rate over 0.055deg/s, yaw motion is planned to keep the maximum rate and cross the nearest +/-90deg at the neighboring midnight or noon point. This motion can occur while the sun elevation angle from the orbital plane is within 5deg.

② Orbit normal mode

When QZS-2 conducts the orbit control, the attitude mode takes orbit normal mode.

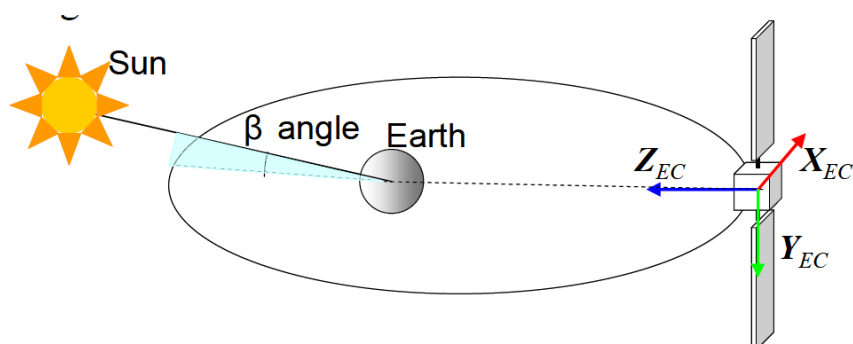


Figure 3 Orbit normal mode

4. Mass and Center Of Mass

The spacecraft mass and the center of mass with respect to the satellite reference frame are provided in Table 1.

Table 1 Mass and center of mass

	Mass [kg]	CoM (w.r.t. origin) [mm]		
		Xs	Ys	Zs
BOL	2234	3	-2	1787
MOL	2065	3	-2	1813
EOL	1896	4	-2	1849

5. Navigation Antenna Phase Center Corrections

The phase center offsets of the navigation antenna are provided in Table 2.

Table 2 Phase center location

Signal	Coordinates (w.r.t. origin) [mm]		
	X	Y	Z
L1	0	0	5025.49
L2	0	0	4820.49
L5	0	0	4905.49
L6	0	0	4975.49

The phase center variations of the navigation antenna are provided in Table 3, where θ and ϕ denote off-nadir and azimuth angles, respectively. The phase center origin corresponds to $\theta = 0$.

Table 3 Phase center variations (1/2)

(Unit: mm)

(a) L1

θ	ϕ	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.5	0.026	0.049	0.072	0.095	0.111	0.127	0.143	0.129	0.115	0.101	0.074	0.048	0.021	-0.018	-0.056	-0.095	-0.134	-0.173	-0.212	-0.247	-0.282	-0.317	-0.321	-0.324	-0.328	-0.310	-0.293	-0.275	-0.252	-0.229	-0.206	-0.171	-0.136	-0.101	-0.058	-0.016	0.026		
1	-0.159	-0.104	-0.049	0.005	0.032	0.058	0.085	0.062	0.039	0.016	-0.035	-0.086	-0.138	-0.219	-0.300	-0.381	-0.458	-0.536	-0.614	-0.672	-0.730	-0.788	-0.795	-0.802	-0.809	-0.793	-0.778	-0.762	-0.702	-0.642	-0.582	-0.513	-0.444	-0.376	-0.303	-0.231	-0.159		
2	-1.005	-0.906	-0.808	-0.709	-0.656	-0.603	-0.550	-0.598	-0.645	-0.693	-0.788	-0.883	-0.979	-1.113	-1.247	-1.381	-1.520	-1.659	-1.798	-1.917	-2.035	-2.153	-2.170	-2.188	-2.206	-2.176	-2.146	-2.116	-1.994	-1.873	-1.751	-1.642	-1.532	-1.423	-1.284	-1.144	-1.005		
2.5	-1.555	-1.446	-1.337	-1.227	-1.190	-1.153	-1.116	-1.169	-1.222	-1.275	-1.388	-1.500	-1.613	-1.774	-1.934	-2.095	-2.248	-2.401	-2.555	-2.678	-2.802	-2.925	-2.946	-2.967	-2.989	-2.950	-2.911	-2.872	-2.749	-2.625	-2.502	-2.343	-2.185	-2.026	-1.869	-1.712	-1.555		
3	-2.200	-2.079	-1.957	-1.835	-1.795	-1.754	-1.714	-1.772	-1.830	-1.888	-2.031	-2.174	-2.317	-2.488	-2.659	-2.830	-2.997	-3.165	-3.332	-3.451	-3.569	-3.687	-3.715	-3.743	-3.771	-3.726	-3.680	-3.634	-3.482	-3.331	-3.179	-3.052	-2.925	-2.798	-2.599	-2.400	-2.200		
3.5	-2.867	-2.728	-2.588	-2.449	-2.430	-2.410	-2.391	-2.477	-2.564	-2.650	-2.765	-2.879	-2.994	-3.181	-3.368	-3.555	-3.740	-3.925	-4.110	-4.242	-4.374	-4.507	-4.530	-4.553	-4.575	-4.514	-4.452	-4.390	-4.242	-4.094	-3.946	-3.794	-3.643	-3.491	-3.283	-3.075	-2.867		
4	-3.449	-3.320	-3.191	-3.063	-3.052	-3.042	-3.031	-3.119	-3.207	-3.295	-3.421	-3.546	-3.671	-3.853	-4.034	-4.216	-4.420	-4.625	-4.829	-4.992	-5.094	-5.196	-5.193	-5.249	-5.305	-5.217	-5.129	-5.041	-4.900	-4.759	-4.618	-4.450	-4.283	-4.115	-3.893	-3.671	-3.449		
4.5	-4.004	-3.891	-3.779	-3.666	-3.646	-3.630	-3.613	-3.722	-3.831	-3.941	-4.059	-4.177	-4.295	-4.484	-4.672	-4.861	-5.036	-5.210	-5.385	-5.614	-5.642	-5.771	-5.794	-5.817	-5.840	-5.759	-5.677	-5.596	-5.455	-5.314	-5.173	-5.004	-4.835	-4.665	-4.445	-4.223	-4.004		
5	-4.554	-4.348	-4.242	-4.136	-4.159	-4.182	-4.205	-4.300	-4.396	-4.491	-4.609	-4.727	-4.845	-5.007	-5.170	-5.332	-5.519	-5.706	-5.893	-6.007	-6.122	-6.236	-6.252	-6.268	-6.284	-6.212	-6.139	-6.067	-5.905	-5.743	-5.581	-5.417	-5.253	-5.089	-4.877	-4.665	-4.454		
5.5	-4.718	-4.650	-4.581	-4.512	-4.540	-4.568	-4.597	-4.717	-4.836	-4.956	-5.059	-5.161	-5.263	-5.406	-5.549	-5.692	-5.871	-6.051	-6.231	-6.348	-6.464	-6.590	-6.587	-6.594	-6.601	-6.511	-6.422	-6.332	-6.175	-6.018	-5.861	-5.699	-5.536	-5.374	-5.156	-4.937	-4.718		
6	-4.882	-4.835	-4.787	-4.739	-4.780	-4.821	-4.861	-4.983	-5.104	-5.226	-5.318	-5.409	-5.501	-5.628	-5.755	-5.882	-6.048	-6.214	-6.379	-6.499	-6.619	-6.739	-6.728	-6.718	-6.707	-6.605	-6.503	-6.400	-6.247	-6.094	-5.940	-5.794	-5.648	-5.501	-5.295	-5.089	-4.882		
6.5	-4.856	-4.828	-4.799	-4.771	-4.831	-4.891	-4.951	-5.074	-5.198	-5.321	-5.397	-5.473	-5.549	-5.662	-5.774	-5.887	-6.053	-6.219	-6.385	-6.496	-6.607	-6.718	-6.686	-6.654	-6.623	-6.510	-6.397	-6.284	-6.139	-5.995	-5.850	-5.711	-5.572	-5.432	-5.240	-5.048	-4.856		
7	-4.660	-4.651	-4.643	-4.634	-4.710	-4.785	-4.861	-4.990	-5.119	-5.247	-5.307	-5.367	-5.427	-5.521	-5.614	-5.707	-5.863	-6.018	-6.173	-6.279	-6.385	-6.490	-6.439	-6.388	-6.337	-6.219	-6.101	-5.983	-5.827	-5.672	-5.517	-5.404	-5.291	-5.179	-5.066	-4.833	-4.660		
7.5	-4.274	-4.295	-4.316	-4.337	-4.406	-4.475	-4.544	-4.672	-4.801	-4.930	-4.985	-5.039	-5.094	-5.179	-5.263	-5.348	-5.496	-5.644	-5.792	-5.899	-5.996	-6.093	-6.009	-5.935	-5.861	-5.716	-5.572	-5.427	-5.304	-5.180	-5.057	-4.951	-4.845	-4.739	-4.584	-4.429	-4.274		
8	-3.671	-3.720	-3.770	-3.819	-3.898	-3.978	-4.057	-4.186	-4.315	-4.443	-4.482	-4.521	-4.560	-4.635	-4.711	-4.787	-4.930	-5.073	-5.216	-5.318	-5.420	-5.522	-5.515	-5.507	-5.500	-5.036	-4.872	-4.708	-4.595	-4.482	-4.369	-4.256	-4.200	-4.115	-3.987	-3.819	-3.671		
8.5	-2.936	-2.989	-3.042	-3.094	-3.190	-3.285	-3.380	-3.503	-3.627	-3.750	-3.763	-3.775	-3.787	-3.856	-3.925	-3.994	-4.156	-4.318	-4.480	-4.538	-4.597	-4.655	-4.542	-4.429	-4.316	-4.159	-4.002	-3.846	-3.727	-3.609	-3.491	-3.408	-3.325	-3.243	-3.140	-3.038	-2.936		
9	-1.873	-1.964	-2.056	-2.148	-2.245	-2.342	-2.439	-2.532	-2.625	-2.719	-2.763	-2.807	-2.851	-2.893	-2.936	-2.978	-3.161	-3.345	-3.528	-3.570	-3.613	-3.655	-3.495	-3.334	-3.174	-2.997	-2.821	-2.645	-2.565	-2.486	-2.407	-2.352	-2.297	-2.243	-2.119	-1.996	-1.873		
9.5	-0.730	-0.848	-0.966	-1.084	-1.178	-1.261	-1.349	-1.426	-1.504	-1.582	-1.608	-1.599	-1.608	-1.677	-1.746	-1.814	-1.985	-2.156	-2.327	-2.384	-2.440	-2.497	-2.294	-2.091	-1.888	-1.668	-1.448	-1.227	-1.187	-1.146	-1.077	-1.049	-1.021	-0.924	-0.827	-0.730			
10	0.688	0.552	0.416	0.280	0.171	0.062	-0.048	-0.111	-0.175	-0.238	-0.238	-0.235	-0.233	-0.305	-0.377	-0.450	-0.594	-0.739	-0.883	-0.957	-1.031	-1.106	-0.866	-0.626	-0.386	-0.155	0.076	0.307	0.569	0.430	0.492	0.490	0.488	0.487	0.554	0.621	0.688		

(b) L2

θ	ϕ	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.5	0.034	0.036	0.038	0.041	0.043	0.045	0.048	0.045	0.043	0.041	0.041	0.041	0.041	0.041	0.038	0.036	0.034	0.041	0.048	0.054	0.048	0.041	0.034	0.038	0.043	0.048	0.050	0.052	0.054	0.057	0.059	0.061	0.063	0.066	0.068	0.071	0.074	
1	0.129	0.122	0.115	0.108	0.115	0.122	0.129	0.118	0.106	0.095	0.085	0.095	0.095	0.095	0.095	0.097	0.100	0.102	0.100	0.097	0.095	0.095	0.106	0.118	0.129	0.138	0.147	0.156	0.156	0.148	0.143	0.136	0.134	0.131	0.129			
1.5	0.234	0.226	0.229	0.231	0.231	0.231	0.231	0.217	0.204	0.190	0.183	0.176	0.170	0.167	0.165	0.163	0.179	0.195	0.210	0.204	0.197	0.190	0.206	0.222	0.238	0.247	0.256	0.265	0.267	0.269	0.272	0.265	0.258	0.251	0.242	0.233	0.224	
2	0.367	0.358	0.348	0.339	0.344	0.348	0.353	0.335	0.317	0.299	0.299	0.299	0.299	0.292	0.285	0.278	0.287	0.296	0.305	0.305	0.305	0.305	0.326	0.351	0.373	0.387	0.401	0.414	0.421	0.428	0.434	0.416	0.398	0.380	0.376	0.371	0.367	
2.5	0.529	0.511	0.493	0.475	0.486	0.498	0.509	0.484	0.459	0.434	0.430	0.425	0.421	0.410	0.398	0.387	0.410	0.432	0.455	0.448	0.441	0.434	0.466	0.498	0.529	0.543	0.557	0.570	0.582	0.593	0.604	0.586	0.568	0.550	0.543	0.536	0.529	
3	0.706	0.688	0.670	0.652	0.658	0.665	0.672	0.645	0.618	0.591	0.591	0.591	0.591	0.581	0.579	0.568	0.557	0.570	0.584	0.597	0.595	0.593	0.591	0.620	0.649	0.679	0.701	0.724	0.747	0.763	0.778	0.794	0.767	0.740	0.713	0.711	0.708	0.706
3.5	0.882	0.862	0.842	0.821	0.826	0.830	0.835	0.799	0.763	0.728	0.733	0.740	0.747	0.731	0.715	0.699	0.720	0.740	0.760	0.780	0.765	0.768	0.774	0.810	0.846	0.882	0.901	0.919	0.937	0.948	0.959	0.971	0.948	0.925	0.903	0.886	0.889	0.882
4	1.073	1.045	1.018	0.991	0.993	0.996	0.998	0.973	0.948	0.923	0.919	0.914	0.910	0.896	0.882	0.869	0.877	0.905	0.923	0.923	0.925	0.928	0.930	0.975	1.021	1.066	1.086	1.106	1.127	1.138	1.149	1.161	1.134	1.106	1.079	1		

Table 3 Phase center variations (2/2)

(Unit: mm)

(c) L5

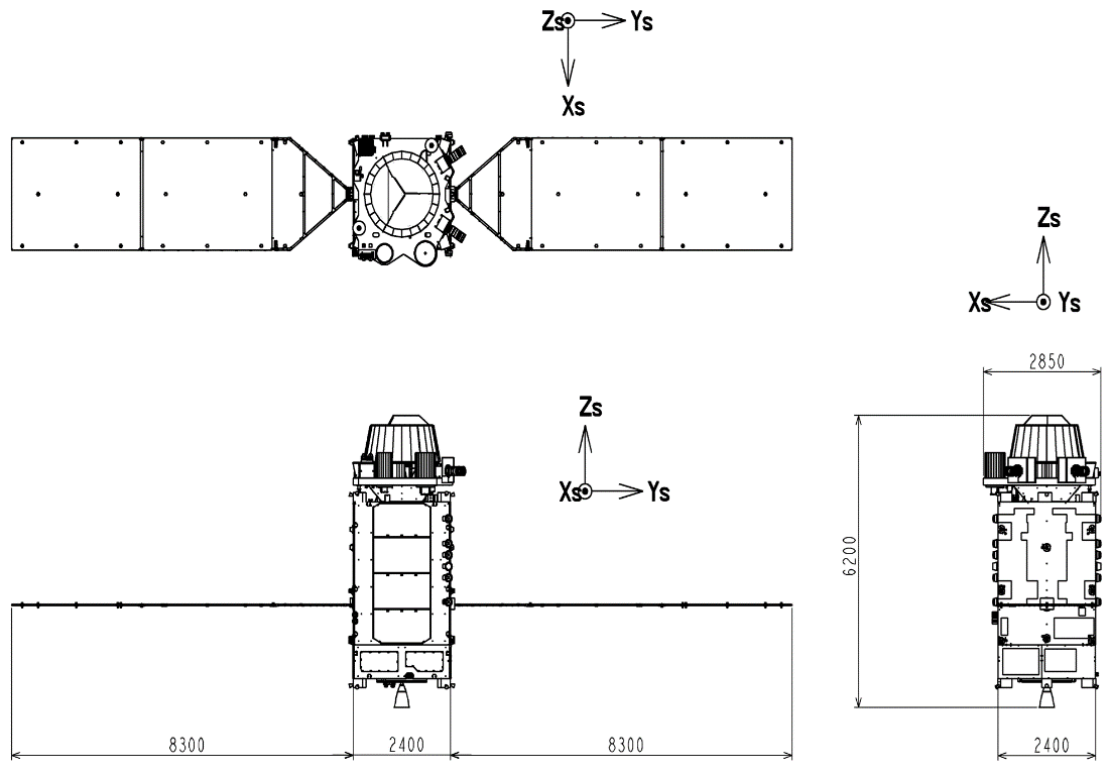
θ	ϕ	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.5	0.071	0.073	0.076	0.078	0.068	0.059	0.050	0.047	0.045	0.043	0.031	0.019	0.007	0.007	0.007	0.007	0.014	0.021	0.028	0.028	0.028	0.028	0.028	0.033	0.038	0.043	0.050	0.057	0.064	0.071	0.078	0.085	0.090	0.078	0.076	0.073	0.071		
1	0.135	0.139	0.144	0.149	0.123	0.097	0.071	0.068	0.066	0.064	0.045	0.026	0.007	0.014	0.021	0.028	0.035	0.043	0.050	0.057	0.064	0.071	0.076	0.080	0.085	0.094	0.104	0.113	0.125	0.137	0.149	0.156	0.163	0.170	0.158	0.146	0.135		
1.5	0.198	0.198	0.198	0.198	0.168	0.137	0.106	0.102	0.097	0.092	0.066	0.040	0.014	0.028	0.043	0.057	0.064	0.071	0.078	0.080	0.090	0.102	0.113	0.118	0.123	0.128	0.151	0.175	0.198	0.215	0.231	0.248	0.248	0.248	0.248	0.231	0.215	0.198	
2	0.269	0.267	0.264	0.262	0.227	0.191	0.156	0.144	0.132	0.120	0.090	0.059	0.028	0.043	0.057	0.071	0.078	0.085	0.092	0.109	0.125	0.142	0.153	0.165	0.177	0.205	0.234	0.262	0.288	0.314	0.340	0.340	0.340	0.316	0.293	0.269			
2.5	0.340	0.335	0.331	0.326	0.283	0.241	0.198	0.189	0.179	0.170	0.132	0.094	0.057	0.066	0.076	0.085	0.099	0.113	0.128	0.139	0.151	0.163	0.179	0.196	0.213	0.250	0.288	0.326	0.354	0.383	0.411	0.411	0.411	0.387	0.364	0.340			
3	0.397	0.392	0.387	0.383	0.328	0.274	0.220	0.215	0.210	0.205	0.161	0.116	0.071	0.087	0.104	0.120	0.135	0.149	0.163	0.177	0.191	0.205	0.224	0.243	0.262	0.309	0.357	0.404	0.439	0.475	0.510	0.510	0.510	0.472	0.434	0.397			
3.5	0.482	0.470	0.458	0.446	0.392	0.338	0.283	0.282	0.241	0.220	0.179	0.139	0.099	0.113	0.128	0.142	0.151	0.161	0.170	0.184	0.194	0.217	0.241	0.269	0.298	0.326	0.373	0.420	0.468	0.515	0.562	0.609	0.607	0.604	0.602	0.562	0.522	0.482	
4	0.560	0.541	0.522	0.503	0.442	0.380	0.319	0.307	0.295	0.283	0.241	0.198	0.156	0.161	0.165	0.170	0.182	0.194	0.205	0.224	0.243	0.262	0.295	0.328	0.361	0.423	0.484	0.545	0.593	0.640	0.687	0.687	0.687	0.687	0.645	0.602	0.560		
4.5	0.652	0.621	0.590	0.560	0.496	0.437	0.375	0.357	0.338	0.318	0.278	0.238	0.198	0.203	0.208	0.213	0.224	0.236	0.248	0.267	0.286	0.305	0.342	0.380	0.418	0.489	0.560	0.630	0.692	0.734	0.786	0.784	0.782	0.779	0.737	0.694	0.652		
5	0.730	0.689	0.649	0.609	0.545	0.482	0.418	0.394	0.371	0.347	0.308	0.272	0.234	0.243	0.253	0.262	0.269	0.278	0.283	0.305	0.326	0.347	0.384	0.423	0.460	0.538	0.616	0.694	0.760	0.826	0.893	0.888	0.883	0.878	0.829	0.779	0.730		
5.5	0.815	0.767	0.720	0.673	0.604	0.536	0.468	0.444	0.420	0.397	0.364	0.331	0.298	0.293	0.288	0.283	0.295	0.307	0.313	0.335	0.352	0.368	0.420	0.472	0.524	0.604	0.685	0.765	0.836	0.907	0.978	0.980	0.982	0.985	0.928	0.871	0.815		
6	0.921	0.859	0.798	0.737	0.661	0.586	0.510	0.486	0.463	0.439	0.404	0.368	0.333	0.333	0.333	0.333	0.345	0.357	0.368	0.380	0.392	0.404	0.460	0.517	0.574	0.666	0.758	0.850	0.921	0.992	1.063	1.060	1.058	1.055	1.011	0.966	0.921		
6.5	0.999	0.928	0.857	0.786	0.708	0.630	0.553	0.522	0.491	0.460	0.434	0.408	0.383	0.378	0.373	0.368	0.380	0.392	0.404	0.418	0.432	0.446	0.508	0.569	0.630	0.725	0.819	0.914	0.994	1.074	1.155	1.155	1.155	1.103	1.051	0.999			
7	1.091	1.006	0.921	0.836	0.753	0.671	0.588	0.560	0.531	0.503	0.477	0.451	0.425	0.418	0.411	0.404	0.416	0.427	0.439	0.451	0.463	0.475	0.538	0.602	0.666	0.774	0.883	0.992	1.074	1.157	1.240	1.244	1.249	1.254	1.199	1.145	1.091		
7.5	1.162	1.067	0.973	0.878	0.782	0.685	0.588	0.569	0.550	0.531	0.505	0.479	0.453	0.451	0.449	0.446	0.458	0.470	0.482	0.494	0.486	0.489	0.569	0.649	0.730	0.841	0.952	1.063	1.148	1.233	1.318	1.320	1.322	1.325	1.270	1.216	1.162		
8	1.240	1.138	1.037	0.935	0.831	0.727	0.623	0.600	0.576	0.553	0.527	0.501	0.475	0.472	0.470	0.468	0.477	0.486	0.496	0.498	0.501	0.503	0.590	0.678	0.765	0.881	0.996	1.112	1.202	1.292	1.381	1.388	1.395	1.403	1.348	1.294	1.240		
8.5	1.296	1.185	1.074	0.963	0.855	0.746	0.638	0.612	0.586	0.560	0.536	0.512	0.489	0.489	0.489	0.489	0.501	0.512	0.524	0.529	0.534	0.538	0.630	0.723	0.815	0.940	1.065	1.190	1.273	1.355	1.438	1.450	1.462	1.473	1.414	1.355	1.296		
9	1.353	1.235	1.117	0.999	0.878	0.758	0.638	0.616	0.595	0.574	0.548	0.522	0.496	0.498	0.501	0.503	0.519	0.536	0.553	0.548	0.543	0.539	0.638	0.737	0.836	0.978	1.119	1.261	1.404	1.516	1.523	1.530	1.537	1.476	1.414	1.353			
9.5	1.424	1.294	1.164	1.034	0.911	0.789	0.666	0.635	0.604	0.574	0.550	0.527	0.503	0.505	0.508	0.510	0.529	0.548	0.567	0.567	0.567	0.567	0.668	0.770	0.871	1.018	1.164	1.310	1.458	1.573	1.584	1.586	1.608	1.547	1.485	1.424			
10	1.466	1.332	1.197	1.063	0.933	0.803	0.673	0.647	0.621	0.595	0.569	0.543	0.517	0.517	0.517	0.517	0.543	0.569	0.595	0.590	0.586	0.581	0.687	0.793	0.900	1.065	1.230	1.395	1.480	1.565	1.650	1.653	1.655	1.658	1.594	1.530	1.466		

(d) L6

θ	ϕ	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.5	0.013	0.022	0.030	0.039	0.043	0.045	0.052	0.070	0.087	0.104	0.109	0.113	0.117	0.124	0.130	0.137	0.140	0.144	0.147	0.151	0.157	0.162	0.169	0.176	0.182	0.188	0.194	0.200	0.206	0.212	0.218	0.224	0.230	0.236	0.242	0.248	0.254	0.260
1	0.033	0.046	0.059	0.072	0.087	0.102	0.117	0.143	0.169	0.198	0.217	0.236	0.261	0.287	0.274	0.280	0.280	0.280	0.280	0.276	0.272	0.267	0.259	0.251	0.243	0.235	0.227	0.220	0.214	0.208	0.202	0.196	0.190	0.184	0.178	0.172	0.166	0.160
1.5	0.072	0.091	0.111	0.130	0.152	0.174	0.196	0.237	0.278	0.319	0.352	0.384	0.417	0.432	0.447	0.463	0.456	0.450	0.443	0.432	0.421	0.411	0.374	0.337	0.300	0.263	0.226	0.189	0.161	0.133	0.104	0.089	0.074	0.059	0.063	0.067	0.072	
2	0.124	0.148	0.172	0.196	0.241	0.287	0.332	0.380	0.428	0.476	0.519	0.563	0.606	0.619	0.632	0.645	0.641	0.636	0.632	0.608	0.584	0.560	0.517	0.474	0.430	0.382	0.335	0.287	0.252	0.217	0.182	0.163	0.143	0.124	0.124	0.124	0.124	
2.5	0.209	0.239	0.269	0.300	0.348	0.395	0.443	0.506	0.569	0.632	0.684	0.736	0.789	0.808	0.828	0.847	0.847	0.847	0.847	0.812	0.778	0.743	0.691	0.639	0.587	0.524	0.461	0.398	0.358	0.319	0.280	0.256	0.232	0.209	0.209	0.209	0.209	
3	0.280	0.313	0.345	0.378	0.447	0.517	0.587	0.656	0.726	0.795	0.858	0.921	0.984	0.999	1.014	1.030	1.032	1.034	1.036	0.993	0.949	0.906	0.862	0.819	0.775	0.695	0.615	0.534	0.489	0.443	0.398	0.369	0.341	0.313	0.302	0.291	0.280	
3.5	0.391	0.424	0.456	0.488	0.573	0.658	0.743	0.817	0.891	0.964	1.038	1.112	1.186	1.201	1.216	1.232	1.236	1.240	1.245	1.186	1.127	1.069	1.025	0.982	0.938	0.838	0.739	0.639	0.595	0.552	0.508	0.471	0.434	0.398	0.395	0.393	0.391	
4	0.489	0.526	0.563	0.600	0.691	0.782	0.873	0.951	1.030	1.108	1.203	1.299	1.395	1.408	1.421	1.434	1.434	1.434	1.434	1																		

6. Geometry

The spacecraft dimensions are described in Figure 4.



(Unit: mm)

Figure 4 Satellite dimensions

Optical properties are currently in preparation. They will be provided in Table 4.

Table 4 Optical properties

Surface	Material	Area	Absorption	Specular	Diffuse
-	-	-	-	-	-

7. Laser Retro Reflector Location

The location of the optical center of the laser retro-reflector array (LRA) with respect to the satellite reference frame is provided in Table 5.

Table 5 Location of LRA optical center

	Coordinates (w.r.t. origin) [mm]		
	X	Y	Z
Optical Center	-988.2	-860.8	+4373.3

8. Satellite Group Delay

8.1 Satellite Group Delay

The satellite group delay of each navigation signal is provided in Table 6.

Table 6 Group delay

Signal	Group delay [ns]
L1	135.76
L2	133.43
L5	133.81

8.2 Differential Code Bias

The differential code bias (DCB) between L1, L2, and L5 signals are provided in Table 7.

Table 7 Differential code bias

Signal	DCB [ns]
L1-L2	2.68
L1-L5	2.28

9. GNSS Bibliography

[1] Quasi-Zenith Satellite System Interface Specification Satellite Positioning, Navigation and Timing Service, the Cabinet Office, Government of Japan, 2017.

[2] ILRS SLR Mission Support Request Form