GLOBAL NAVIGATION SATELLITE SYSTEM

GLONASS

INTERFACE CONTROL DOCUMENT

Code Division Multiple Access Open Service Navigation Signal in L2 frequency band

Edition 1.0

MOSCOW
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Definitions and acronyms

CDMA – Code Division Multiple Access

CSI – Channel for Service Information

d – symbol in signal name, indicating attribution to a data component

f_b – Base frequency

FDMA – Frequency Division Multiple Access

GLONASS – Global Navigation Satellite System

ICD – Interface Control Document

IS – Initial State

L2 CSI – CDMA Signal for Service Information in L2 frequency band

L2OCp – CDMA Open Service Navigation Signal in L2 frequency band (pilot signal)

L2q – signal formed by L2 CSI and L2OCp multiplexing

L2SC – Code Division Multiple Access Secured Signal in L2

MS – Meander sequence

OC – Overlay code

p – symbol in signal name, indicating attribution to a pilot component

PRN – Pseudorandom Noise sequence (ranging code)

S – Sequence

SC – Synchronous Counter

SV – Space Vehicle

TDM – chip by chip Time-Division Multiplexing

UE – User Equipment

1 Scope

1.1 This Interface Control Document (ICD) defines the parameters between the space segment, represented by Glonass-K2 space vehicles (SV), and the navigation user equipment (UE) of GLONASS for L2 Code Division Multiple Access (CDMA) navigation.

Information common to all GLONASS CDMA signals is given in the document "GLONASS. Interface Control Document. General Description of Code Division Multiple Access Signal System" (hereinafter General Description ICD) which consists of the following sections:

- purpose, composition and concept of GLONASS-based positioning;
- time scales used in GLONASS;
- GLONASS geodetic reference;
- general characteristics of GLONASS signals;
- monitoring GLONASS signal-in-space;
- recommendations and algorithms for processing of data transmitted in GLONASS signals.

1.2 Russian Rocket and Space Engineering and Information Systems Corporation, Joint Stock Company (Russian Space Systems, JSC) – the designer of the GLONASS mission payload – is assigned as a developer of ICD and is responsible for its drafting, coordination, revision and maintenance.

The current Document comes into force provided that it is signed by the following persons/entities:

- GLONASS Chief Designer;
- Russian Rocket and Space Engineering and Information Systems Corporation, Joint Stock Company (Russian Space Systems, JSC) of ROSCOSMOS State Space Corporation which is the leading organization on the GLONASS payload, service radiofrequency and telemetry systems, ground control and command facilities, and a set of user equipment for different user groups;
- Academician M.F. Reshetnev Information Satellite Systems (ISS, JSC) of ROSCOSMOS State Space Corporation – prime for development and integration of GLONASS satellites, including system integration of space, launch, and ground control complexes, on-board mission software used to generate navigation message and SV control data;

- Research and Development Center (Korolev) of the Central Research Institute of the Russian Federation Space Forces – leading research and development organization of the Russian Ministry of Defense on the GLONASS system;
- Russian Institute of Radionavigation and Time (RIRT, OJSC) of Ministry of Industry and Trade of Russian Federation responsible for developing timing facilities of special and dual use, facilities for generating space segment time scale; synchronization of GLONASS timing facilities and developing user equipment for different user groups;
- Central Research Institute of Machine Building, Federal State Unitary Enterprise (TSNIIMASH, FSUE) – the head research institute of the ROSCOSMOS State Space Corporation.

ICD is approved by the authorized representatives of ROSCOMOS State Space Corporation and Space Forces. ICD comes into force on approval by the Commanding General of the Space Forces and the Director General of the ROSCOSMOS State Space Corporation.

In the course of GLONASS system evolution, its individual parameters may change. The developer of ICD bears responsibility for coordination of the suggested modifications with all responsible parties and, if necessary, for drafting new edition of the Document containing such modifications.

Modifications and new editions of ICD come into force on approval by the Commanding General of the Space Forces and the Director General of the ROSCOSMOS State Space Corporation.

The Russian Space Systems, JSC is responsible for official distribution of GLONASS ICD.

2 L2OCp signal structure

2.1 General scheme of L2OCp signal generation

L2OCp signal is transmitted on carrier frequency (nominal value)

$$f_{L2} = 1220 \cdot f_b = 244 \cdot 5.115\ \text{MHz} = 1248.06\ \text{MHz}$$

and is multiplexed with L2 CSI signal by chip by chip time-division multiplexing (TDM) of their pseudorandom noise sequences (PRNs).

L2q signal is in phase quadrature with L2SC signal, which is delayed by 90º (Figure 1).

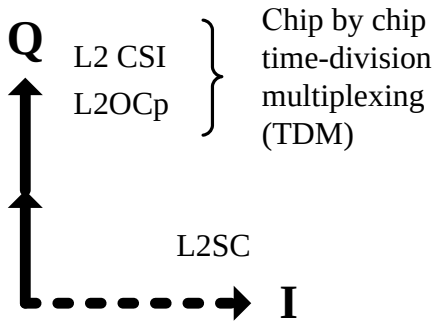

Figure 1 – L2 CSI signal structure

Figure 2 shows L2 signal generation scheme.

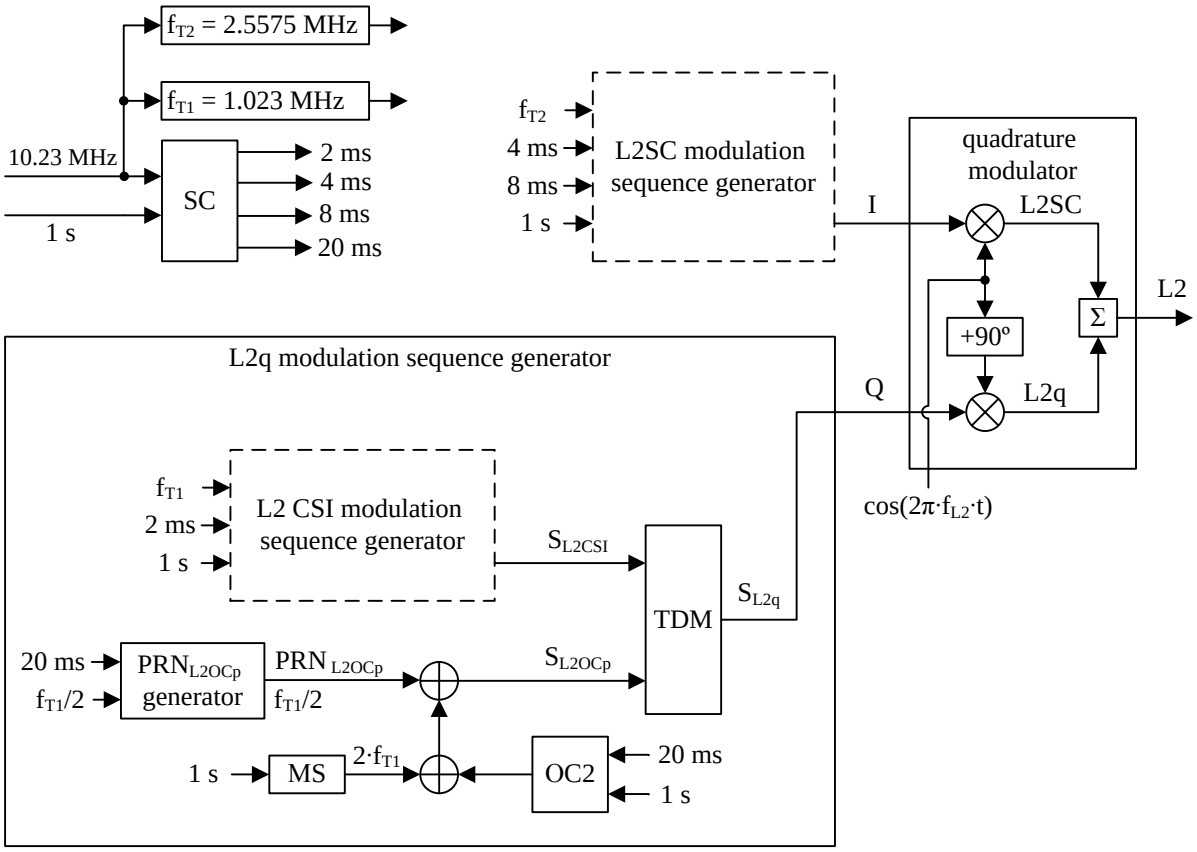

Figure 2 – L2 CSI signal generation scheme

2.2 L2OCp signal generation

Modulation sequence of symbols of L2OCp signal (S_{L2OCp}) is the modulo-2 sum of PRN_{L2OCp} chip stream clocked at $f_{T1}/2$ = 0.5115 MHz (see. 2.4), overlay code OC2 symbol stream clocked at 50 sps (see 2.5), and meander sequence (MS) clocked at $2 \cdot f_{T1}$ = 2.046 MHz as shown in Figure 2.

MS is a 0101 periodic sequence, synchronized with PRN_{L2OCp} chips and transmitted with most significant bits first (the first symbol of MS for a PRN_{L2OCp} chip duration is 0). MS is intended to form BOC(1,1) spectrum for L2OCp component.

2.3 L2 CSI and L2OCp multiplexing

The modulation sequence of symbols for L2q signal (S_{L2q}) is formed at the TDM output. Figure 3 shows the TDM principle of operation. It also shows the second mark position

corresponding to PRN chips end/start. The second mark also corresponds to PRN periods' end/start.

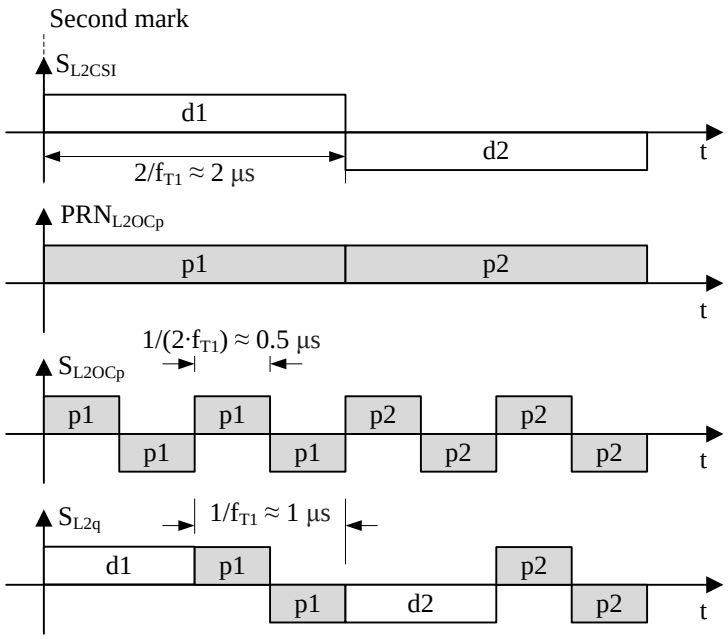

Figure 3 – Timing relationship between components of L2q modulation sequence

Sequence S_{L2q} is used to phase-shift key Q-component of carrier frequency in L2 by 180°.

2.4 Structure of L2OCp PRN generator

Figure 4 shows the structure of L2OCp PRN generator.

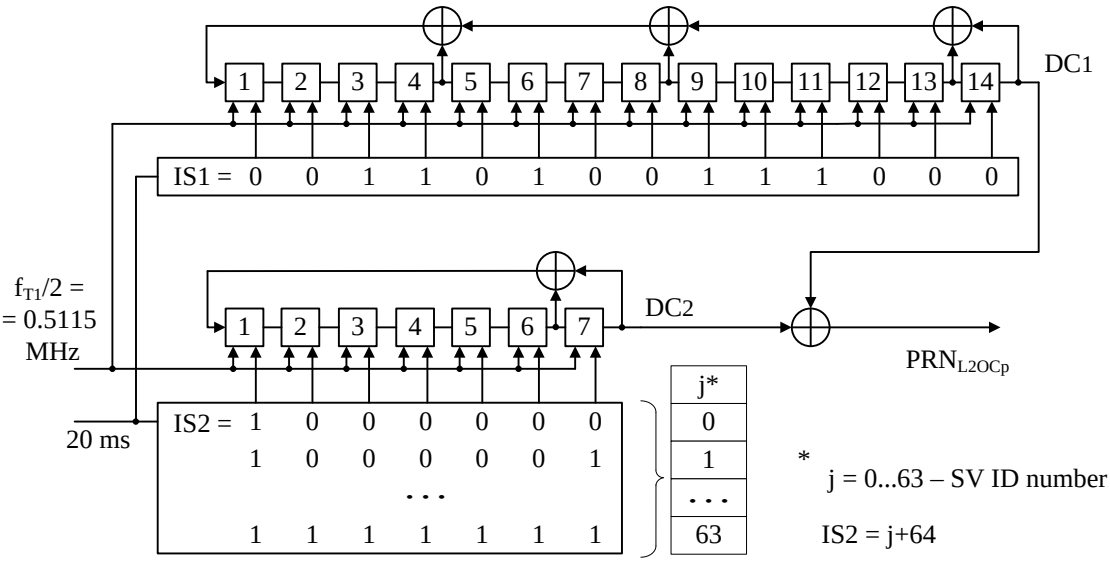

Figure 4 – L2OCp PRN generator structure

Zero SV ID number is the reserved one, which can only be enabled upon termination of GLONASS CDMA and FDMA signals combined use.

L2OCp PRNs are Gold sequences of length N = 10230 and period T = 20 ms. These sequences are generated by the modulo-2 addition of binary digits (1 and 0) incoming at clock rate $f_{T1}/2 = 0.5115$ MHz from digital circuits DC1 and DC2 shown in Figure 4.

The shift register of DC1 has 14 triggers and feedback from triggers number 4, 8, 13 and 14. The shift register of DC2 has 7 triggers and feedback from triggers 6 and 7. The shift direction in all registers is from lower to higher trigger number.

The following initial state (IS) codes are set into DC registers at 20 ms intervals:

- IS1 = 00110100111000 into DC1;
- IS2 = j + 64 = 1000000, 1000001…1111111 into DC2, where j is an SV ID number.

IS1 and IS2 (binary numbers) are registered into DC1 and DC2 in such a way that the least significant bit enters the last trigger of register.

Short pulses at 20 ms intervals determine moments of IS codes registering into DCs. They are formed in synchronous counter (SC) shown on Figure 2 based on 10.23 MHz signal and 1 s pulses.

Table 1 shows first and last 32 chips of L2OCp PRNs in HEX. For example, 1EBF3DE2 means 00011110101111110011110111100010. The record of sequences means that the left-most chip is generated first.

2.5 OC2 overlay code

OC2 is a periodic 50-symbol code

00101101011111000110000100011010000001011000100010,

which is transmitted with most significant bits first (the leftmost symbol is generated first) and synchronized with second marks (the leading edge of the first symbol coincides with the second mark). Period of OC2 is 1 s. Duration of each OC2 symbol is 20 ms.

Table 1 – First and last 32 chips of L2OCp PRNs

j	IS2 (Figure 4)	PRN_{L2OCp}		j	IS2 (Figure 4)	PRN_{L2OCp}	
		First 32 chips	Last 32 chips			First 32 chips	Last 32 chips
0	1000000	1EBF3DE2	1BA445DE	32	1100000	1AA76C06	6E9AC2CC
1	1000001	9FB9299B	86EBE41A	33	1100001	9BA1787F	F3D56308
2	1000010	5F3A23A7	484C34F8	34	1100010	5B227243	3D72B3EA
3	1000011	DE3C37DE	D503953C	35	1100011	DA24663A	A03D122E
4	1000100	3E7DB2C0	B2507D4D	36	1100100	3A65E324	C76EFA5F
5	1000101	BF7BA6B9	2F1FDC89	37	1100101	BB63F75D	5A215B9B
6	1000110	7FF8AC85	E1B80C6B	38	1100110	7BE0FD61	94868B79
7	1000111	FEFEB8FC	7CF7ADAF	39	1100111	FAE6E918	09C92ABD
8	1001000	0EDE7A73	CF5E5997	40	1101000	0AC62B97	BA60DE85
9	1001001	8FD86E0A	5211F853	41	1101001	8BC03FEE	272F7F41
10	1001010	4F5B6436	9CB628B1	42	1101010	4B4335D2	E988AFA3
11	1001011	CE5D704F	01F98975	43	1101011	CA4521AB	74C70E67
12	1001100	2E1CF551	66AA6104	44	1101100	2A04A4B5	1394E616
13	1001101	AF1AE128	FBE5C0C0	45	1101101	AB02B0CC	8EDB47D2
14	1001110	6F99EB14	35421022	46	1101110	6B81BAF0	407C9730
15	1001111	EE9FFF6D	A80DB1E6	47	1101111	EA87AE89	DD3336F4
16	1010000	168F9E2A	F1D94BFA	48	1110000	1297CFCE	84E7CCE8
17	1010001	97898A53	6C96EA3E	49	1110001	9391DBB7	19A86D2C
18	1010010	570A806F	A2313ADC	50	1110010	5312D18B	D70FBDCE
19	1010011	D60C9416	3F7E9B18	51	1110011	D214C5F2	4A401C0A
20	1010100	364D1108	582D7369	52	1110100	325540EC	2D13F47B
21	1010101	B74B0571	C562D2AD	53	1110101	B3535495	B05C55BF
22	1010110	77C80F4D	0BC5024F	54	1110110	73D05EA9	7EFB855D
23	1010111	F6CE1B34	968AA38B	55	1110111	F2D64AD0	E3B42499
24	1011000	06EED9BB	252357B3	56	1111000	02F6885F	501DD0A1
25	1011001	87E8CDC2	B86CF677	57	1111001	83F09C26	CD527165
26	1011010	476BC7FE	76CB2695	58	1111010	4373961A	03F5A187
27	1011011	C66DD387	EB848751	59	1111011	C2758263	9EBA0043
28	1011100	262C5699	8CD76F20	60	1111100	2234077D	F9E9E832
29	1011101	A72A42E0	1198CEE4	61	1111101	A3321304	64A649F6
30	1011110	67A948DC	DF3F1E06	62	1111110	63B11938	AA019914
31	1011111	E6AF5CA5	4270BFC2	63	1111111	E2B70D41	374E38D0

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