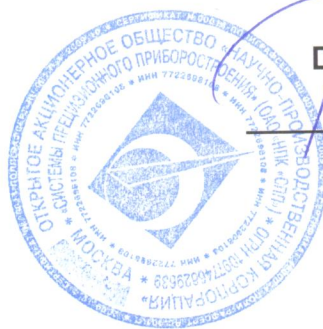


Open Joint-stock Company
“Research-and-Production Corporation
“Precision Systems and Instruments” (OJC “RPC “PSI”)

APPROVED

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The User Manual
for LRR array S3-LRR

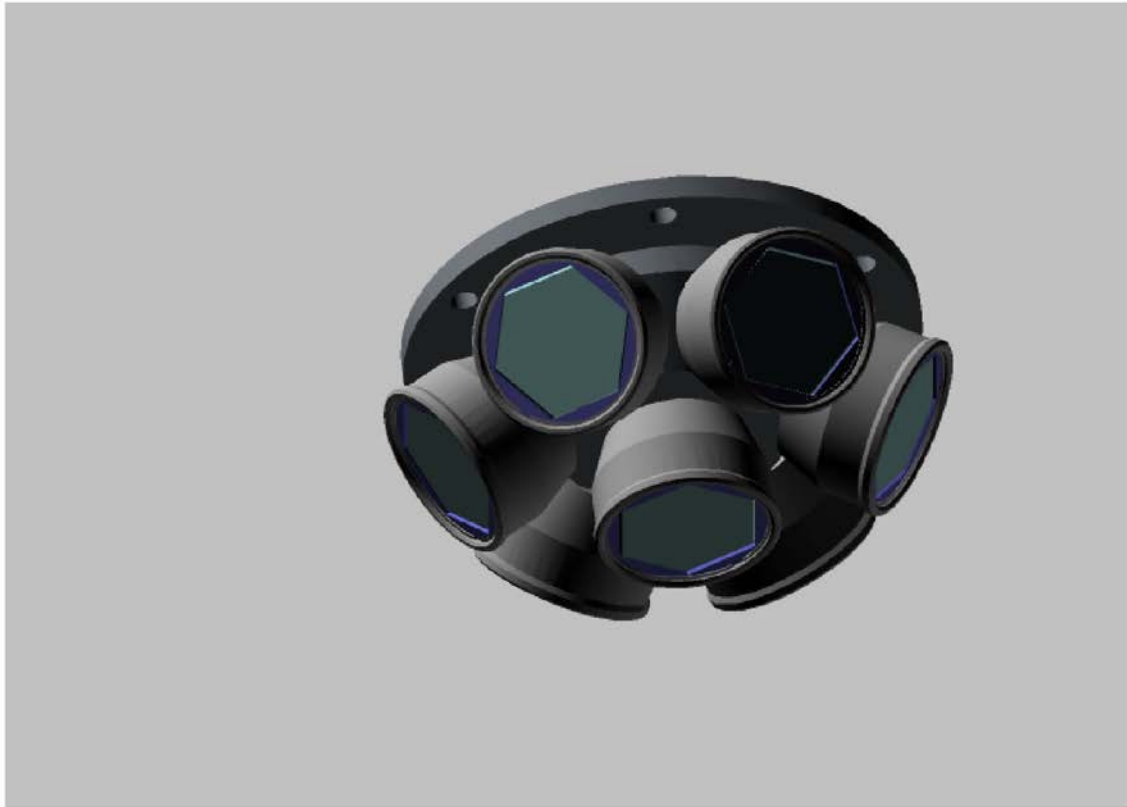
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Manual Instruction for the S3-LRR array contains the data necessary for studying and correct operation with the item.
To work with the S3-LRR array are allowed a persons studied this User Manual.



1 DISCRIPTION AND OPERATION

1.1 Description and operation of the item

1.1.1 Purpose

1.1.1.1 The S3-LRR array is a passive system and its purpose to provide measurement of distances from SLR (Satellite Laser Ranging) ground stations to the spacecraft for precision determination of satellite orbit.

1.1.2 Technical parameters

1.1.2.1 The S3-LRR array provides efficient return of laser radiation for SLR at a wavelength of 532 nm.

1.1.2.2 The S3-LRR array provides distance measurements (ranging) at elevations more than 20 deg above horizon, at any azimuth

1.1.2.3 The value of RMS target error of the S3-LRR array for operational elevations is less than 2.0 mm.

1.1.2.4 The systematic correction value ($H_{orbit}=814.5$ km) for laser ranging relative to the center of the LRR baseplane C (Fig.5) varies between 23.13 mm and 16.25 mm depending on the zenith angle and the culmination (see Table). The systematic correction value is added to the range measurement.

Table

Zenith angle at culmination deg.	Zenith angle, deg.	Systematic correction, mm
0	0	19.62
	10	17.68
	20	16.51
	30	16.48
	40	17.54
	50	19.09
	60	20.41
	70	21.09
10	10	17.69
	20	16.37
	30	16.30
	40	17.54
	50	19.26
	60	20.57
	70	21.19
20	20	16.37
	30	16.28
	40	17.51
	50	19.48
	60	21.02
	70	21.50
30	30	16.25
	40	17.53
	50	19.60
	60	21.46
	70	22.05

40	40	17.51
	50	19.38
	60	21.70
	70	22.66
50	50	19.60
	60	21.09
	70	23.12
60	60	21.70
	70	22.28
70	70	23.13

1.1.2.5 Error of the equivalent reflection plane position of the S3-LRR array relative to baseplane center is less 2mm.

1.1.2.6 The S3-LRR array 1 provides maintaining of its stated parameters in spaceflight conditions.

1.1.2.7 The S3-LRR array provides normal operation after shocks and vibrations during the Spacecraft (SC) launching.

1.1.2.8 The S3-LRR array provides maintaining of its parameters in accordance with the thermal and climatic requirements of GMES Sentinel-3 LRR SOW & RS.

1.1.2.9 The S3-LRR array mass is $(0,32 \pm 0,01)$ kg.

1.1.2.10 The S3-LRR array overall dimensions are $\varnothing 114 \times 51$ mm.

1.1.2.11 The total guaranteed lifetime of the S3-LRR array is no less than 17.5 years including not less than 7.5 years on-orbit life.

1.1.3 Set of the S3-LRR array Deliverable

1.1.3.1 The set of deliverables includes the following:

- | | | |
|--|-------------------|------------|
| - S3-LRR array | KO1-Э391-00-00 | - 1 set.; |
| - User Manual | KO1-Э391-00-00 PЭ | - 1 copy.; |
| - Passport-Certificate | KO1-Э391-00-00 ПС | - 1 copy.; |
| - Dimensional drawing | KO1-Э391-00-00 ГЧ | - 1 copy.; |
| - Container for transportation and storage | | - 1 set. |

1.1.4 Structure and operation of the S3-LRR array

1.1.4.1 The S3-LRR array consists of 7 CCRs, which are installed on the baseplate.

.Photo of the S3-LRR array without protective cover are shown in Figure 1-3.

Photo of the S3-LRR array with protective cover are shown in Figure 4.

The S3-LRR array overall view and dimensions are shown in Figure 5.

The array baseplate is truncated cone with flange in base of cone. The baseplate and CCR housings are made of a non-magnetic aluminum alloy. For the S3-LRR array fastening on the SC, 6 holes are made with a diameter of 5,5 mm on the flange of cone.

At the top of the truncated cone is an arrow (\uparrow) showing the flight direction (see Figure 3). After installation of the S3-LRR array on the SC, align the arrow in the flight direction of the spacecraft.

One CCR is installed on the top of truncated cone, 6 CCRs - on the side face. All CCRs are fastened to the baseplate surface by special screws with nuts, M2 and M2, 5.

The screws are stopped by the mastic protecting them from self-unscrewing.

Each of the 7 CCRs includes a mechanism normalizing the mechanical load applied to the CCR, thus preventing significant thermal distortions of the CCR reflection pattern caused by different thermal expansion of the CCR and holder materials.

The CCRs are made of fused silica with aluminum coating on the reflecting surfaces. The equivalent free aperture diameter is 28.2 mm; the distance from the prism input surface to the prism apex is 19.1 mm.

The baseplate and CCRs housing are made of aluminum alloy with an oxide coating: infrared emissivity $\varepsilon = 0,75$, solar absorption $\alpha = 0,24$. CCRs are made of fused silica KY-1: infrared emissivity $\varepsilon = 0,93$ and solar absorption $\varepsilon = 0,1$.

During transportation, storage and integration on SC all CCRs should be covered by red protective covers to prevent damages and contamination of optical surfaces.

1.1.5 Marking and sealing of the container; packing

1.1.5.1 On baseplate of S3-LRR array is engraved its name, serial number and flight direction (see Figures 1,2,3).

After completion of the testing, each from seven CCRs are closed by red protective cover (see Figure 4), than S3-LRR array is placed in a protective boot, is soldered and then packed in the container with dehumidifier. In the container are placed Conformity Certificate, User Manual, Dimension Drawing, and squirrel brush, cotton wool, cambric napkin, gloves. The packaging must be dense, if necessary, use additional polyurethane gasket. The container is closed and sealed. At the external side of the container are warning notices:

“GLASS!”, “Not to be tipped!”

ATTENTION: Work with the S3-LRR array should be made in cotton gloves!



Figure 1 Name of the LRR array



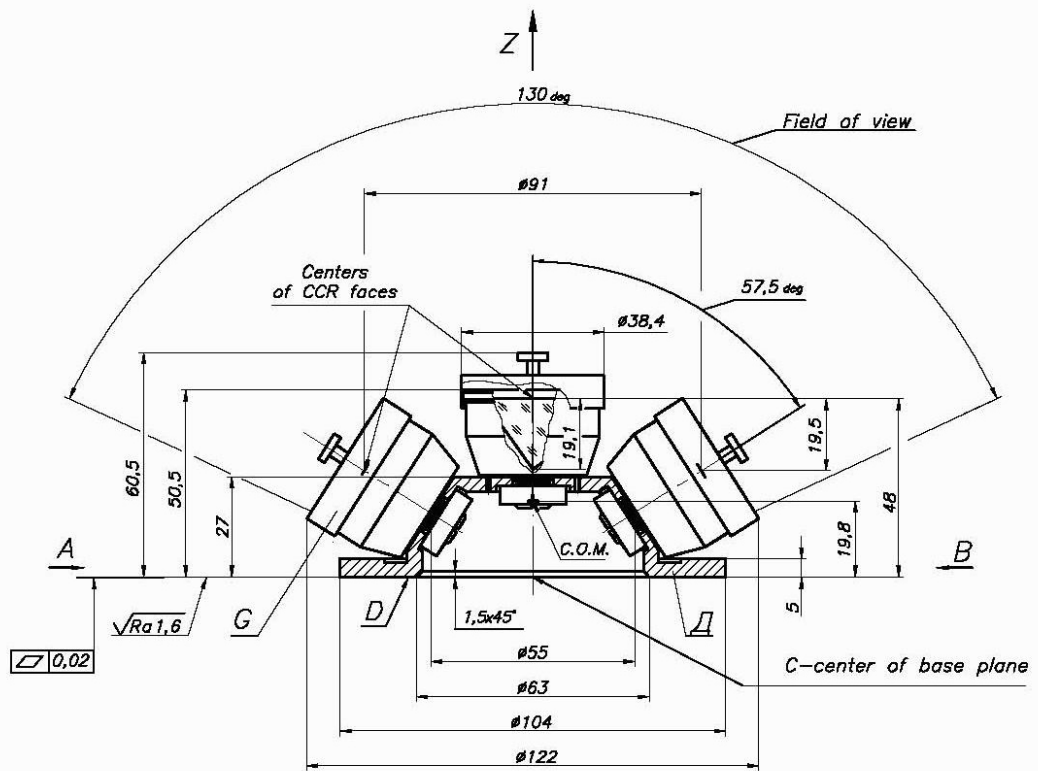
Figure 2 Serial number of the LRR array



Figure 3 The flight direction



Figure 4 The protective covers



Protective covers G are not showed

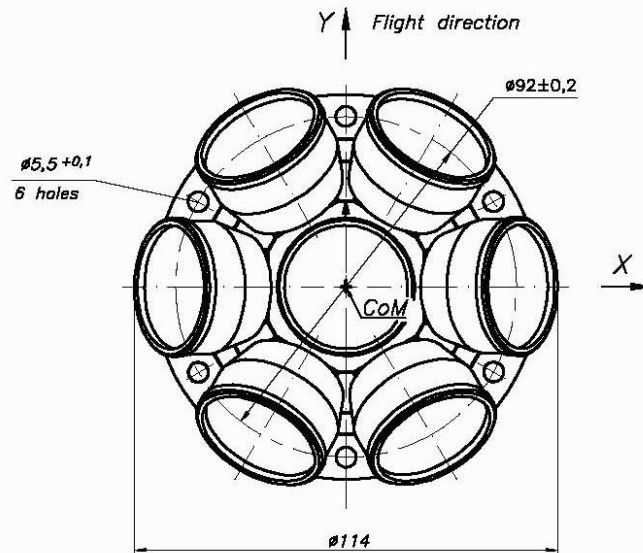


Figure 5 The S3-LRR array overall view and dimensions

2 NOTES FOR USE

2.1 Operational restrictions

2.1.1 Work with the item should be made in cotton gloves. It is required to be **careful** in work with the S3-LRR array.

2.2 Preparation of the item for use.

2.2.1 Safety measures during preparation of the item.

2.2.1.1 S3-LRR array is delivered by manufacturer in the container. The container is intended for transportation and storage of S3-LRR array.

2.2.1.2 The S3-LRR array mounting and maintenance should be made only by persons who have studied the KO1-Э391-00-00 PЭ.

2.2.2 Content and sequence of the item visual inspection

2.2.2.1 Prior to working with the S3-LRR, the user should make a visual inspection of the array.

The room where the S3-LRR inspection is made should be protected from ambient factors; the relative humidity in the room should not exceed 70% at temperatures +17°C to +27°C.

2.2.2.2 For visual inspection, take the S3-LRR array from the container, remove the boot and the red protective covers. All works with the S3-LRR array should be made in cotton gloves.

2.2.2.3 The tightly mounted red protective covers should be carefully removed, using cotton gloves, holding the S3-LRR array by the body base.

2.2.2.4 During the visual inspection of the S3-LRR array it is necessary to check the following:

- 1) absence of cracks on the optical elements;
- 2) absence of mechanical damage;
- 3) absence of corrosion signs on metal surfaces;
- 4) absence of dust, dirt, and grease spots.

2.2.2.5 If dust, dirt, or grease spots will be found on the optical surfaces, cleaning should be made in accordance with the Annex A.

2.2.2.6 On completion of work with the S3-LRR array, the CCRs should be covered by the red protective covers; the item should be placed in boot and in container.

2.2.2.7 When working with S3-LRR array must fulfill the following rules:

- Do not knock the item
- Do not touch the optical surfaces of hands without gloves
- Carefully install the item on testing table and on the spacecraft without damaging of interface surface of item.

3. TECHNICAL MAINTENANCE

3.1 Technical maintenance of the item

3.1.1 General Instructions

3.1.1.2 The user should not made instrumental control of the S3-LRR array.

After the visual inspection of the S3-LRR array (p.2.2.2), the item is ready for installation on the spacecraft.

Attention!

After the S3-LRR array is mounted on the SC, prior to the SC cone push-on, the red protective covers should be carefully removed. The tightly mounted red protective covers should be carefully removed, using cotton gloves, holding the S3-LRR array by the body base.

4. STORAGE

4.1 When the S3-LRR array is stored in storage rooms, it should be in the manufacturer's container. The room temperature should be +5°C to +35°C with a relative humidity less than 80%. No vapors of acids, alkali, or harmful substances are allowed in the storage room.

5. TRANSPORTATION

5.1 The S3-LRR array should be transported in the manufacturer's container protecting it against mechanical damage, as well as against moisture and dust.

Transportation is allowed by any kinds of transportation means, on any distance, with speed values typical for the transportation means, when the ambient temperatures are within the range -50°C to +50°C. Time during which the means are in transport vehicle should not exceed one month.

Attention!

During freight handling, do not toss or tip the container with the S3-LRR array.

Recommendations for cleaning of the optical surfaces

The external surfaces of the optical elements should be cleaned to remove grease spots, moisture, dust, or any other kind of dirt from the optical surfaces.

Before cleaning, wash your hands with soap and wipe them dry.

The cleaning should be made in cotton gloves, in the following order:

- dust and other easy-removable dirt should be removed with a squirrel-fur brush or dry air;
- grease or moisture should be removed with cambric cloth or cotton pad wrapped on the brush handle. To wrap the brush handle, first wet in distilled alcohol, then put it in the cotton and rotate around handle axis. Take care the handle is not uncovered – not to damage the optical surfaces. Then put the cotton pad into the alcohol;
- the cleaning should be made with gentle circular movements from the center to the edge, to prevent damage. The cotton pads should be changed; do not use dirty pads;
- during the cleaning of optical surfaces, extra clean distilled ethyl alcohol should be used. Do not use hydrolytic alcohol: after its use, oily traces may be left on the optical surfaces.