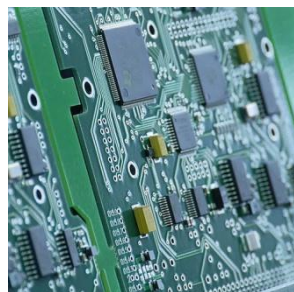
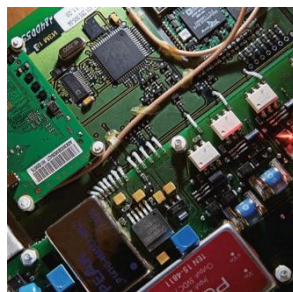
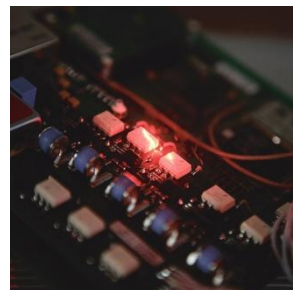
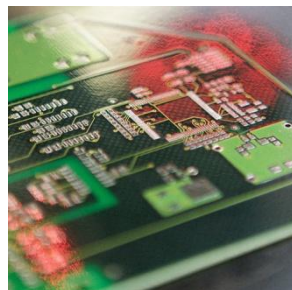




en.irz.ru

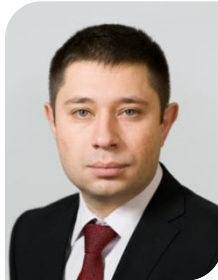




|  |   |
|--|---|
| <b>Izhevskiy Radiozavod (IRZ)</b>      | Russian group of companies producing electronics  |
| <b>Date of foundation</b>              | March 6, 1958   |
| <b>Total number of employees</b>       | 5 500   |
| <b>Engineering department</b>          | 810   |
| <b>Parts testing center</b>            | procurement, tests, supply of electronic components   |
| <b>Customer representative offices</b> | Ministry of Defense, Russian Railways   |
| <b>Company is certified to</b>         | GOSTR EN 9100-2011 standard by International Aerospace Quality Group (IAQG) for aerospace and military products |



**Aleksandr Maier**  
CEO



**Rustam Shikhiev**  
First Deputy CEO —  
Chief Financial Officer



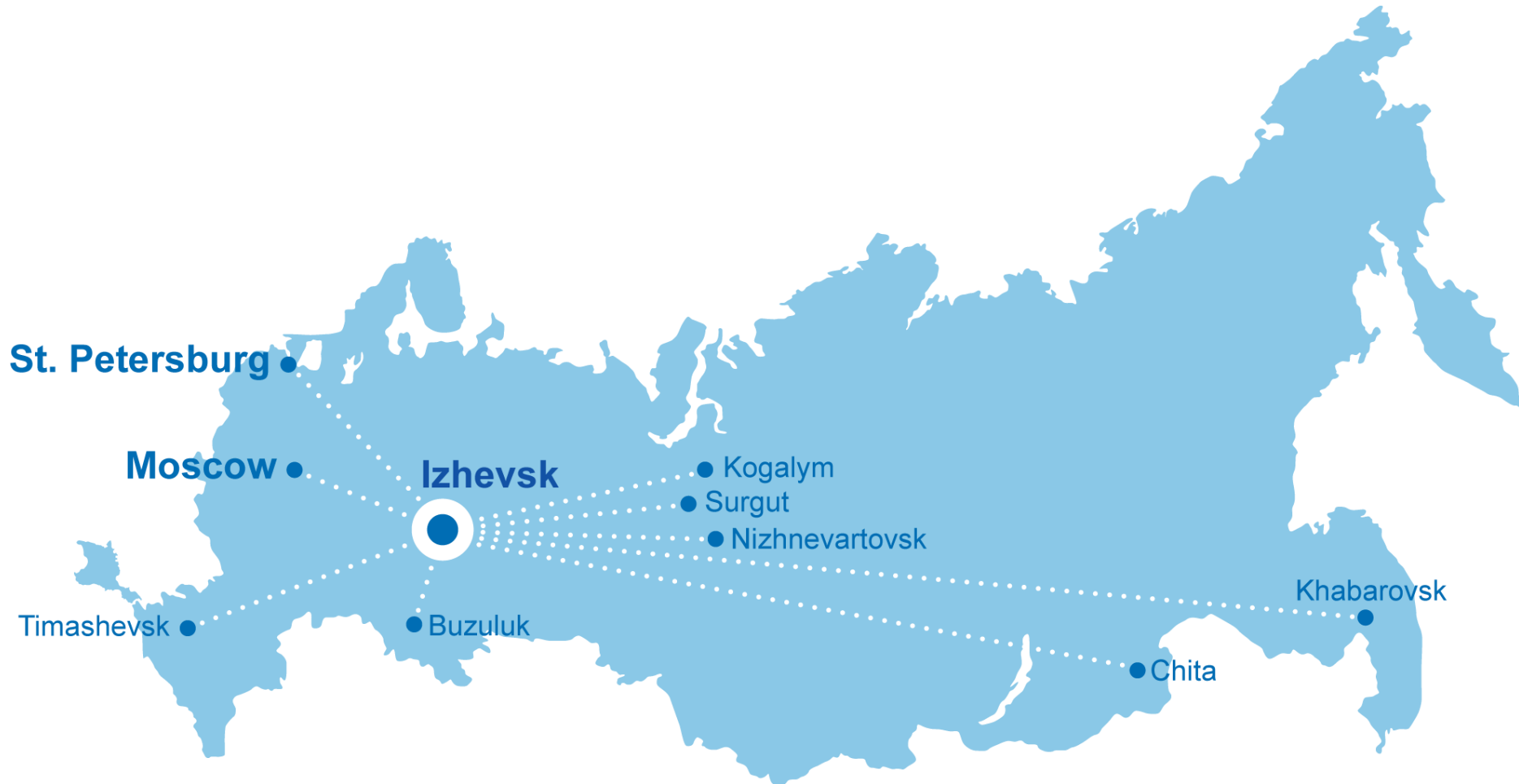
**Sergey Nevyantsev**  
Deputy CEO – Business  
Development Director



**Elena Mityagina**  
Deputy CEO –  
International Business



**Alexander Semdyanov**  
Chief Technical Officer



## Producing companies

- 000 "IRZ"
- 000 "IRZ-Lokomotiv"
- 000 "IRZ TEK"
- 000 "IRZ-Svyaz"
- 000 "IRZ TEST"
- 000 "IRZ-Foton"
- 000 "IRZ-Rinkos"



|                                   |   |  |
|-----------------------------------|---|--|
| <b>GOSTR EN 9100-2011</b>         | • | compliance of the quality management system to requirements of the international standard for aerospace and military industry  |
| <b>GOST RV0015-002-2012</b>       | • | compliance of the quality management system to requirements of the national military standard  |
| <b>GOST R ISO 9001-2015</b>       | • | compliance of the quality management system to requirements of the international standard  |
| <b>OST 134-1028-2012 (rev. 1)</b> | • | compliance of the quality management system to requirements of the industry standard for companies involved in the development, production and operation of rocket and space equipment |
| <b>ISO 9001:2015</b>              | • | compliance of the quality management system to requirements of the international standard  |
| <b>OHSAS 18001:2007</b>           | • | compliance of the quality management system to requirements of the international occupational health and safety standard   |
| <b>ISO 14001:2015</b>             | • | compliance of the quality management system to requirements of the international environmental management standard   |



Space-related electronics for on-board and ground segments



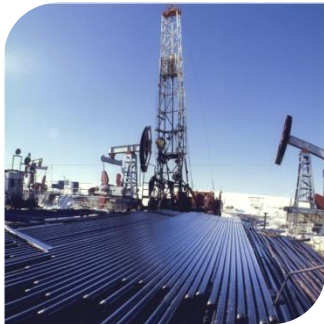
Railway automatics and safety systems



User navigation equipment



Telecommunication systems



Oilfield electronic equipment



Video systems



Control and measuring equipment



Mobile robotic systems

## For spacecraft, launchers, upper-stages, space stations, ground segment

Telemetry subsystems, on-board data-gathering subsystems

ODGS



Satellite on-board computers

OBC



Equipment for TCR systems

TCR transceivers



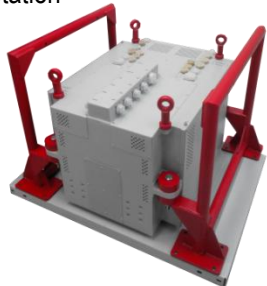
Equipment for central control and telemetry system

APAA-M



Equipment for automatic docking of spacecraft to the International Space Station

KURS-NA



On-board communication payload subsystems



Satellite thrusters orientation mechanism control unit

TOM CU



Battery charge monitors

Battery monitor





## Realized projects

### Equipment for spacecraft

Meteor, Meteor-M, Gorizont, Gals, Glonass, Glonass-K, Glonass-M, Loutch, Express, Express-AM, Express-AM5, Express-AM6, Express-MD1, Express-MD2, Loutch-5A, Loutch-5B, Loutch-5V, Spektr-R, Spektr-UF, Electro-L, Bion-M, Foton, Foton-M, Koronas-Foton, Resurs-DK, Yamal-300K, Yamal-401, SESAT, AMOS-5, TELKOM-3, KazSat-3, Lybid

### Equipment for launchers and upper-stages

Molniya, Zenit, Energia, Rokot, Proton, Soyuz, Angara, Fregat, Briz, DM, Volga

### Equipment for cargo / manned spacecraft and orbital space stations

Vostok, Soyuz, Progress, ATV, Salyut, Mir, ISS

### Equipment for ground segment

Ground terminals of the GONETS satellite communication system



IRZ equipment is applied in major Russian space projects



## On-board, track and station systems

Safety systems for rolling stock



Safety systems for rail-track  
vehicles



Interval control signaling  
systems



ABTC-M

Integrated safety systems for locomotives



Systems for control and record of motion  
parameters



Control and monitoring  
equipment

Workbench  
UPR--ALSMP



## Realized projects

### Automatics and safety systems for rolling stock

Railways of Russia, CIS and the Baltics.

On locomotives of international manufacturers: Siemens ("Sapsan" train), General Electric, Alstom ("Allegro" train), Skoda, PESA, Talgo, Hyundai, Stadler, Zhuzhou Electric Lokomotive, Datong Electric Lokomotive Co., Dalian Lokomotive Co., Plasser.

Moscow Metro, St. Petersburg Metro

### Interval control signaling systems

Railways of Russia, CIS countries

### Data processing systems

Railways of Russia, Kazakhstan



Major part of rolling stock of Russian Railways is equipped with IRZ safety systems



## Radio communication and data transmission systems

VHF radio modems

PP-3U

MOST



DMR portable radios

RN-311



Mobile DMR radios

RM-211



Dispatcher consoles

PS7, PS12



TETRA, GSM-R and DMR versatile locomotive / fixed HF and VHF radios

Terminal stations

DMR base stations / repeaters

Fixed HF and VHF radios for railways

RVS-1



SR-C-03



RVS-1-40



RS46-MC



## Realized projects

### For railways

Railways of Russia, CIS and Baltic States

Governmental railways of Russia

On locomotives of international manufacturers: Siemens ("Sapsan", "Desiro" train), General Electric, Alstom ("Allegro" train), Skoda, PESA, Talgo, Stadler, Zhuzhou Electric Lokomotive, Datong Electric Lokomotive Co., Dalian Lokomotive Co., Plasser, etc.

Moscow Metro, Saint-Petersburg Metro, Yekaterinburg Metro

Major part of locomotives of Russian Railways is equipped with IRZ communication systems



### For ministries

Russian Ministry of Internal Affairs, Russian Public Health Ministry, Russian Ministry of Education and Science

### For fuel and energy companies

Oil producing and oilfield service companies  
Energy sector companies

### For governmental customers

Radio link for aerostat



## oDAS RADIUS

oDAS RADIUS is designed to provide mobile coverage along railways, roads and rural areas. The system provides the increase of network capacity efficiency.

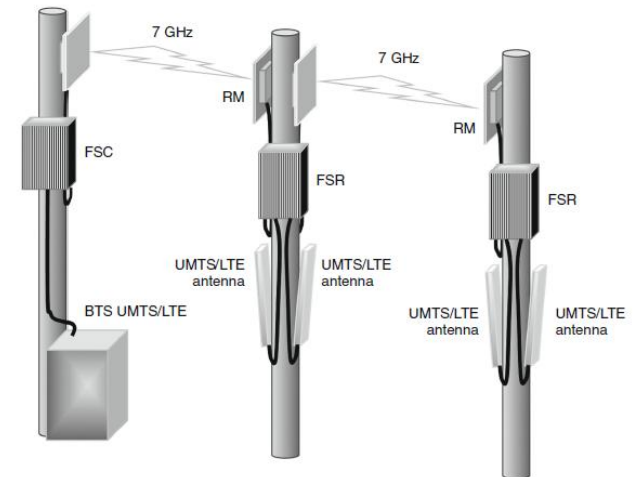
oDAS RADIUS modules:

- FSC is designed to convert several (from one to four) LTE, UMTS or GSM (GSM-R) carriers from BTS into oDAS system signals.
- FSR is designed to receive and convert two (or four) carriers from MWL or fiber optic to cellular signals providing remote sectors similar to BTS.

oDAS RADIUS is designed for the use in LTE FDD, UMTS and GSM (GSM-R) networks and provides sequential retransmission of up to 4 carriers from a base station (BTS) over distances up to 60 km reducing CAPEX and OPEX on building and maintenance of cellular infrastructure.



FSR unit



## Satellite navigation systems

OEM navigation receivers

GLONASS/GPS/SBAS /QZSS/Galileo/BeiDou

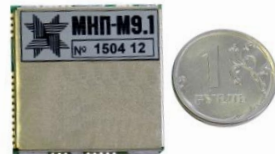
MNP-M7

Single-frequency receiver  
L1 band



MNP-M9.1

Double-frequency receiver  
L1, L2 bands



Antenna amplifying units

AUU-1N

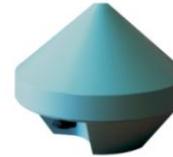


AUU-1MT



GPS / GLONASS time synchronization modules

BSN



IRIG-B



Satellite navigation equipment for high-speed objects

ASN



## Realized projects

### For governmental customers

Fregat upper stage, Angara-1.2 launcher, LitSat-1 satellite (Lithuania)

Navigation systems for manned and unmanned air vehicles

Mobile objects monitoring systems for governmental transport - Russian Railways, Russian Ministry of Internal Affairs, EMERCOM

### For commercial customers

Time synchronization equipment for LTE networks and energy infrastructure objects

Equipment for technical universities classrooms – Korolev SSAU, Kalashnikov ISTU

Mobile objects monitoring systems

On-board equipment for ERA-GLONASS automated emergency response system

Over 100 000 units  
delivered to various  
customers





## Oil production equipment and control systems



ESP control stations  
IRZ-500



Sucker-rod pump control stations  
IRZ-410

Downhole sensors

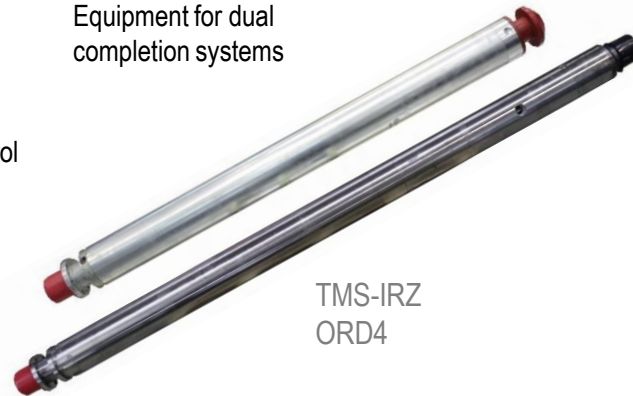


BP

Downhole  
anti-scaling  
system

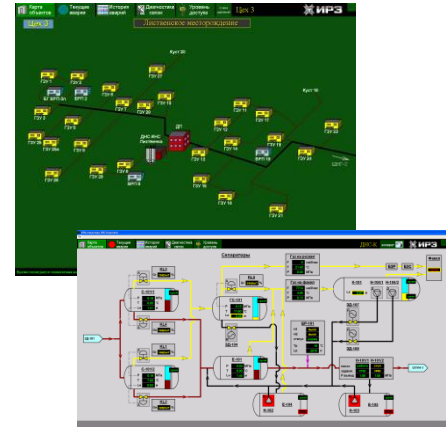
Pilot-1

Equipment for dual  
completion systems



TMS-IRZ  
ORD4

Dispatch control systems for  
monitoring oilfield equipment  
through wire communication and  
radio link



## Realized projects

### Control stations and downhole sensors

Lukoil, TNK-BP, Surgutneftegaz, Rosneft, Slavneft, Tatneft, Bashneft, Gazpromneft, etc.

Foreign customers – Azerbaidjan, Kazakhstan

### Equipment for dual completion systems

Lukoil, Juganskneftegaz, Surgutneftegaz

### Resonant undular systems

Lukoil

### Dispatch control systems

Udmurtneft, RN-Severnaya Neft, Belkamneft, Absheron Operating Company (Azerbaidjan), RTRS, Russian Railways

40% of Russian market for ESP telemetry systems



## HD cameras and video monitoring systems

HD cameras



Video cameras as a part of control systems  
and motion-parameters record systems



On-board video monitoring system



## Realized projects

### Aerospace industry

BSVK for launchers (Soyuz-2.1a, Vostochny launch site)

Flight simulators

Sheremetyevo airport (runways monitoring systems)

### General purpose

Entities of Federal Penitentiary Service of Udmurt Republic

Industrial companies of Udmurt Republic

Russian oil and energy companies

### Transport infrastructure

Moscow Metro, St. Petersburg Metro

Sea transport



РОСКОСМОС



Designed and produced  
in Russia



## Robotic systems, optical surveillance systems and subsystems

Mobile robotic systems



Mobile robotic system

Optical surveillance systems



Visual monitoring

Rotary supports



Antenna rotator

Servo-drive controllers



Controller

Additional equipment

Portable console



Joystick



Rotary base junctions



Stereoscopic camera



- Supply of standard measuring equipment
- Design and manufacture of customized test systems

## Test systems for digital equipment

interfaces, digital logic, controllers, filters, functional elements, analyzers, codecs, decoders, comparators

## Test systems for analog equipment

receivers, transmitters, amplifiers, converters, measuring devices, analyzers

## Test systems for high-frequency equipment

transceivers, generators, LNA, filters and systems based on such parts within the range up to 40 GHz

## Customized test systems for microelectronic components

microcircuits, FPGA, processors, operational amplifiers, RF parts, memories

## Simulation and test systems for multichannel radar equipment

radars, APAA, PAA, antennas

## Service test benches

cable products, light-emitting-diode products, passive EEE parts, windings



## Realized projects

### Aerospace

Automated data-handling system for testing spacecraft on-board computers

Control and measuring system for debug and control of operational performance of spacecraft on-board programmable network router

Laboratory experimental test system for spacecraft on-board computers

Check-out system for on-board spacecraft equipment

### Transport

Mobile test systems

Test workbenches for ALSN equipment in repair depots and maintenance points

### Oil & Gas

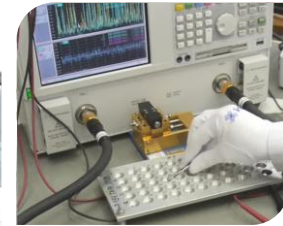
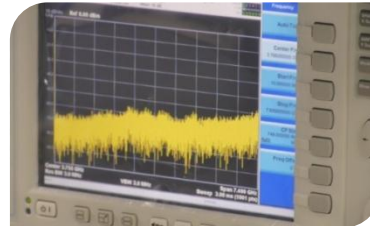
Diagnostic systems for downhole equipment

Testing systems for ESP downhole sensors

### Video systems

Test systems for control of lens optical characteristics and testing video camera functionality

State-of-the-art  
hardware and  
software



РОСКОСМОС



ЛУКОЙЛ



ГАЗПРОМ



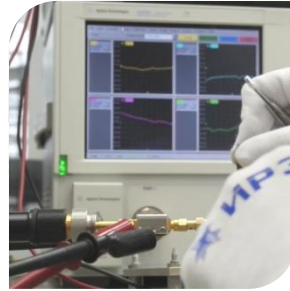
РОСНЕФТЬ



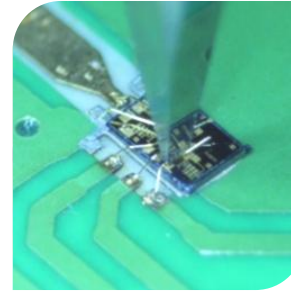
БАШНЕФТЬ



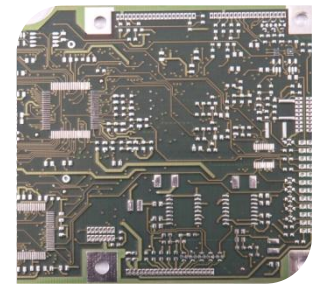
Design and development



Procurement and tests of electronic components



Hybrids production



PCB production



Surface mounting of components



Mechanical processing



Assembly and integration

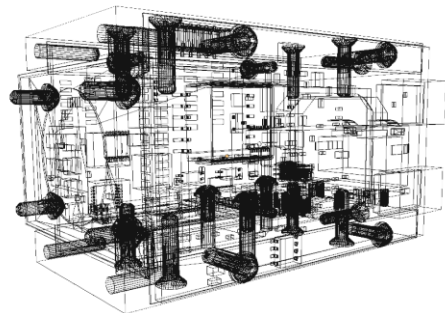


Products testing



## SKILLS

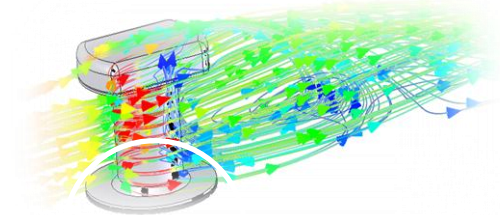
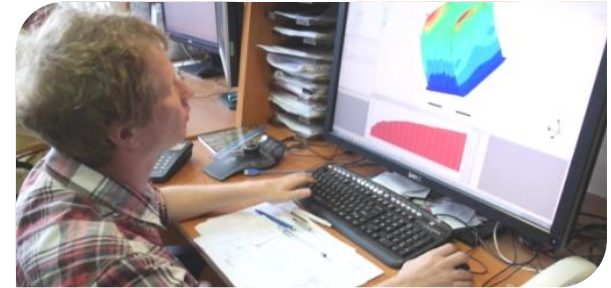
- Control systems
- Navigation systems
- Computing systems
- Telemetry systems
- Telecommunication and data transmission systems
- Control and diagnostic systems
- Video monitoring and control systems
- Control and measurement systems



## CAPABILITIES

**Development according to customer technical specifications**

- Reliability analyses
- Thermal analyses
- Vibration analyses
- Mechanical analyses
- Aero/gas dynamic analyses
- Radiation analyses

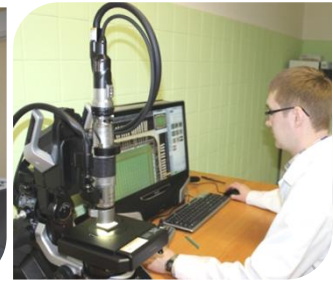


### Advanced CAD tools

- Mentor Graphics
- Solid Works
- Cosmos
- MicroWave Office
- Pro Engineer

- Altium Designer
- Quartus
- Kompas 3D
- P-Cad
- AutoCAD
- ANSYS





## SKILLS

Accredited testing center

Qualified supplier

Design documents and software development,  
production of tooling for tests

Documentation: development and approval of testing  
procedures, analysis and optimization of parts lists

## CAPABILITIES

### Procurement of electronic components

Procurement of EEE parts of Russian and foreign origin

Efficient transport logistics

Continuously replenished stock (over 15,000 types of components)

Customer-oriented services

### Tests of electronic components

Incoming inspection

Additional tests

Certification tests

Total radiation dose tests

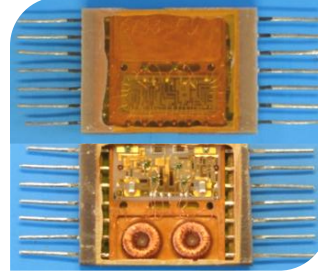
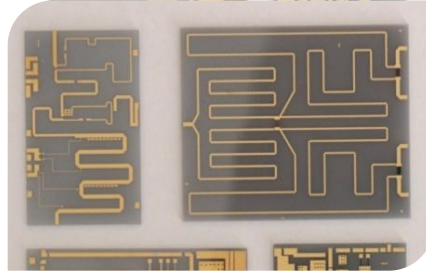
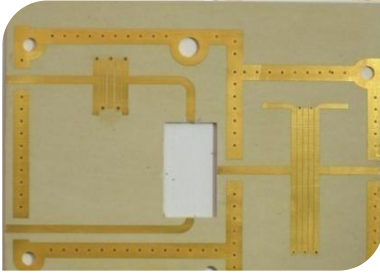
Information security tests

### Parts failure analysis

### Certification according to FSS KT



Full cycle tests



## PRODUCTS

### Microstrip boards

- on the substrates of alumina, glass-ceramic, ceramic, ferrite and barium titanate
- on the substrates of alumina with three-, four- and five-side metal plating vias

### Discrete passive elements:

- thin-film resistors
- leucosapphire capacitors
- inductors on alumina substrates

### Microstrip boards on RT/Duroid metalized dielectric

### Metalized phototools (iron oxide, chromium)

### Hybrids

- on alumina, glass-ceramic and ceramic substrates
- packaged hybrids

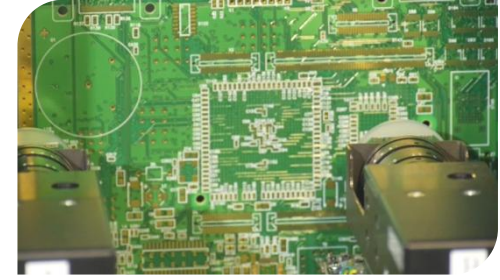
### Semiconductor electronic assembly units, chip transistors

## CAPABILITIES

### Dimensions:

- Microstrip boards - from 2x2 mm up to 60x48 mm, RT/Duroid
  - substrate microstrip boards - up to 60x120 mm
  - Film conductors from 1 up to 23  $\mu\text{m}$ , 25  $\mu\text{m}$  min width
  - Discrete passive components - from 2x2 mm
  - Hybrids - from 2x5 mm up to 60x48 mm
  - Electronic assemblies – chip sizes from 1x1 mm, pin diameter - from 40  $\mu\text{m}$
  - Phototool elements - from 3  $\mu\text{m}$
- Protective electroplating:** gold, tin-bismuth

up to  
**40** GHz  
frequency range



## PRODUCTS

**Single-side, double-sided, multilayer PCBs**

**Multilayer PCBs with blind and hidden holes**

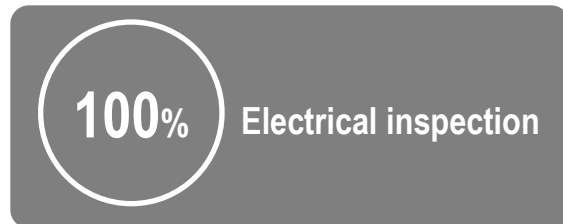
**Semi-flexible boards**

**HF and microwave printed circuit boards** including:

- multilayer boards with metal-plated holes
- multilayer boards made of RT/Duroid 6002 by Rogers

**Flexible printed circuit boards and flexible printed cables** with metal-plated holes

**Printed transformers**



## CAPABILITIES

**Accuracy class:** 6

**Number of layers:** from 2 to 24

**Maximum PCB sizes:** 420x380 mm

**Board thickness:** 0.1-10 mm

**Min wire width:** 0.1 mm

**Min distance between pattern elements:** 0.1 mm

**Min diameter of vias:** 0.2 mm

**Through-hole diameter to depth ratio:** up to 1/10

**Min diameter of blind holes:** 0.1 mm

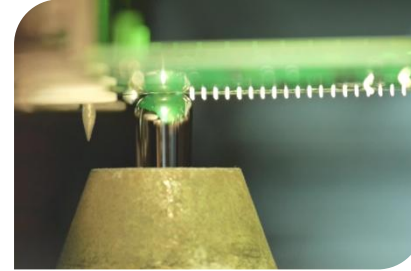
**Blind hole diameter to depth ratio:** up to 1/8

**Final coatings:** POS (SnPb), HALS, galvanic Au, immersion gold

**Foil thickness:** 18, 35, 50, 105, 200, 300  $\mu\text{m}$

**Dielectrics:** SF, STF, FR-4, FR-4 HiTg FAF-4D, FLAN, Rogers,

Taconic, ELIFOM-PF, DUPONT



## SKILLS

### **High-precision installation of electronic components**

with all types of packages (including BGA, CGA, LGA, CCGA, QFN)

**Convection furnace for solder reflow** (nine-zone system: seven-zone heating, two-zone cooling)

**Selective soldering** – mounting of pins in holes

**PCB ultrasonic cleaning**

**100% automatic optical inspection** of soldering and mount quality

**X-ray inspection with a topographic scanner function**

for inspection of electronic units and components in real time with sub-micron accuracy

## CAPABILITIES

**Sizes of chips:** from 01005 up to 2225

**Simultaneous assembly:** 320 part types

**Maximum sizes of components:** 45x100 mm, height up to 35 mm

**Distance between BGA leads:** 0.5 mm

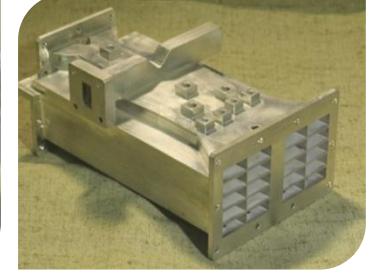
**Maximum PCB sizes:** 420x380 mm

**Mounting of Pb and Pb-free components**

**Capacity:** 50 thousand components per hour



X-ray quality control



## SKILLS

**Processing of materials by cutting** with accuracy up to 6-7 quality classes with machined surface flatness tolerance of 0.01 / 100 mm

**Sheet working:** chipping-out, stamping, bending, shaping

**Welding, all kinds of welding of nonferrous and ferrous metals:**

- argon arc welding in shielding gases
- laser welding
- structural soldering in molten salts (800x600x650 mm), including for complex three-dimensional structures made of Al alloys
- electro-erosion processing of Al, Mg, Ti and other alloys

**Die casting of Al alloys** with sizes of casting 200x200 mm, wall thickness up to 0.5 mm, weight up to 3 kg

**Injection molding and processing of press materials, pressing**

**Tools production:** design and manufacture of tooling including molds, dies, fixtures, jig-devices, probes

**Electroplating and application of paint coatings:**

Zinc coating

Nickel chemical plating

Anodic oxide and chemical oxide coating

Tin-bismuth coating

Chemical oxidation and multi-layer coating of magnesium

Covering of parts with precious metals (silver, gold, gold-nickel, palladium)

Application of conductive coatings

Enameling, powder coatings



**Design and  
production of  
tooling**



## SKILLS

**Varnish impregnation in vacuum**

**Application of compounds on surfaces**

**Moulding of products with compounds**

**Varnish coating**

**Mounting of connectors** with soldering and crimping

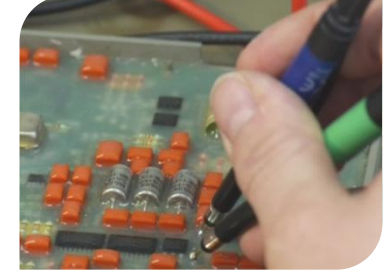
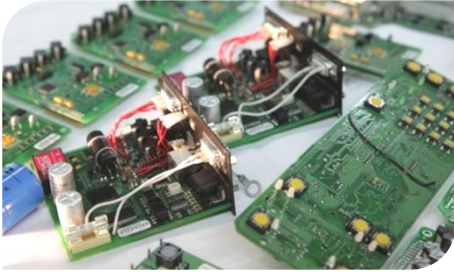
**Marking** of connectors by engraving with a marking printer,  
marking of cables with self-adhesive labels

## PRODUCTS

- bundles and cables for civil and military application, including products accepted by the MOD representative office
- cables of various design and complexity, with Russian or foreign connectors, using common and heat-shrinking materials
- cable assemblies with length up to 30 m
- coils, transformers with various types of cores:
  - SW-cores, E-type, dumbell, shell, rod, ring, transfluxor, etc.
  - in-house cores made of electrical and alloy steels

100%

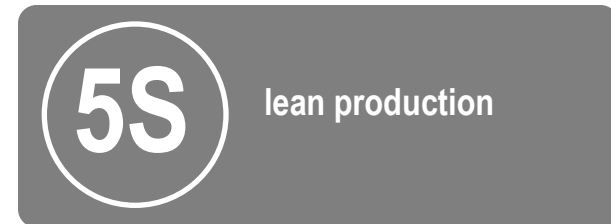
Parameters  
control



## SKILLS

**60%** of operators, tuning engineers and mechanical fitters working with electronic products have the highest level of qualification (4-6 grades)

Workplaces of tuning engineers are equipped with High-End equipment from leading manufacturers



## CAPABILITIES

**Component mounting**, including:

- mounting of components in plated-through holes
- micro mounting
- surface mounting
- mounting pin connections

**Electric wiring, shaping of leads of EEE parts of Russian and foreign origin**, assembly electronic units of different designs

**Sealing and seal testing**

**Electric wiring moisture protection**

**Moulding with compounds**

**Micro welding**

**Micro soldering**





## CAPABILITIES

**Vibration tests:** 5-2000 Hz, 40g

**Shock tests:** 5-500g , 0.1-15 msec

**Single shock tests:** 3-800g ; 0.1-15 msec; 350 kg

**Linear acceleration tests:** up to 150g , 18 kg

**High temperature tests:** up to +300 °C; up to 8 m<sup>3</sup>

**Low temperature tests:** up to minus 75 °C, up to 8 m<sup>3</sup>

**Frost and dew tests:** minus 20 °C

**Humidity tests:** 20-80 °C; up to 100%

**High pressure tests:** up to 3 atm

**Hard vacuum tests:** 10<sup>-6</sup> mm Hg

**Low pressure test:** up to 1x10<sup>-6</sup> mm Hg

**Dynamic dust tests:** 4-19 m/sec, 30-70 °C

**Dust (sand) static tests:** 0.5-1 m/sec, 30-70 °C

**Salt mist tests:** 1-10 µm, 25-55 °C



RF test site for  
APAAs and  
spacecraft  
payload

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