

PULSED POWER LABORATORY MICROWAVE DIVISION



RESEARCH DIRECTIONS

VHF-systems and components

- high quality resonance systems
- oscillators
- transceiver systems
- equipment for researches in VHF-range

Interaction of electromagnetic waves and biological objects

- presowing biophysical treatment of agricultural seeds
- microwave sterilization and drying of foodstuff and materials

Electrodynamics of heterogeneous mediums

- new types of high quality resonance VHF systems
- research of electrodynamic characteristics of nanomaterials

Promising Directions

- Research of presowing biophysical treatment of flax seeds
- Research of presowing biophysical seed treatment of forestry seeds
- Practical applications of nanomaterials in VHF-ranges
- Production of technological VHF equipment for drying and sterilization according to customer's requirements

MICROWAVES COMPONENTS, SYSTEMS, TECHNOLOGIES

WE SUGGESTED OUR SERVICES IN DESIGNING AND MANUFACTURING MICROWAVE COMPONENTS, SYSTEMS AND DEVICES IN DIFFERENT FREQUENCY RANGES FROM 1 TO 405 GHZ:

- microwave oscillators
- high Q resonators
- microwave components (modulators, mixers, detectors, attenuators, switches, directional couplers, matched load)
- resonance system frequency tuning units
- communication transceiver systems
- amplitude and phase noise measurement systems
- equipment sets for microwave training and research laboratories

THE MICROWAVE STERILIZATION AND DRYING TECHNOLOGY

The microwave sterilization and drying technology is based on the volume dielectric heating. It is characterized by high efficiency of sterilization and high efficiency of the microwave energy conversion into heat energy.

TECHNOLOGY OF PRESOWING TREATMENT FOR VEGETABLE CROP SEEDS

Technology is based on low-level microwave energy effect on biological objects. High applicability (tomato, cucumber, cabbage, etc.). Using this technology perfect the sowing quality of seeds, raises stability of the plants to disease, raises the productivity on 10-12%

- Ecological safety
- Low power consumption

MICROWAVE OSCILLATORS

The microwave oscillators are used as receiver local oscillators and transmitter exciters in the digital and analog communication systems, the radio-relay station, satellite television systems and various measuring apparatus.



GUNN OSCILLATORS

| Parameter | Model of oscillators | | |
|----------------------|----------------------|-------------|-----------|
| | U-GO-1827 | U-GO-2737 | U-GO-3753 |
| Frequency range, GHz | 18...27,5 | 27,5...37,5 | 37,5...53 |
| Output power, mW | 20...200 | 20...100 | 20...100 |

GUNN OSCILLATORS (with stabilization)

| Parameter | Model of oscillators | | | | |
|----------------------|----------------------|-------------|-------------|-------------|-------------|
| | U-GO-S-1416 | U-GO-S-1720 | U-GO-S-1824 | U-GO-S-3234 | U-GO-S-3437 |
| Frequency range, GHz | 14,1...16,7 | 17,5...20,5 | 18,0...24,5 | 32,0...34,0 | 34,0...37,0 |
| Output power, mW | 30...60 | 30...60 | 100...200 | 20...100 | 20...150 |

| Parameter | Model of oscillators | | | | |
|----------------------|----------------------|-------------|-------------|-------------|-------------|
| | U-GO-S-3739 | U-GO-S-4548 | U-GO-S-4849 | U-GO-S-4951 | U-GO-S-5153 |
| Frequency range, GHz | 37,0...39,0 | 45,0...48,0 | 48,0...49,0 | 49,0...51,0 | 51,0...53,0 |
| Output power, mW | 20...150 | 20...100 | 20...100 | 20...100 | 20...50 |

GUNN OSCILLATORS (with frequency tuning by means of varactor)

| Parameter | Model of oscillators | | |
|--------------------------------|----------------------|-----------------|-----------------|
| | U-GO-VCO-3038-1 | U-GO-VCO-3038-2 | U-GO-VCO-3037-4 |
| Frequency range, GHz | 30...38 | 30...38 | 30...37 |
| Range of frequency tuning, MHz | 1000 | 2000 | 4000 |
| Output power, mW | 30...80 | 30...80 | 10...60 |

MICROWAVE OSCILLATORS

GUNN OSCILLATORS (second harmonica)

| Parameter | Model of oscillators | | | |
|----------------------|----------------------|--------------|--------------|--------------|
| | U-GO-SH-5265 | U-GO-SH-6578 | U-GO-SH-7890 | U-GO-SH-9098 |
| Frequency range, GHz | 52...65 | 65...78 | 78...90 | 90...98 |
| Output power, mW | 10...30 | 10...30 | 10...15 | 5...10 |

GUNN OSCILLATORS (high stability, with multiplying of the frequency)

| Parameter | Model of oscillators | | | |
|----------------------|----------------------|--------------|--------------|---------------|
| | U-GO-FM-6076 | U-GO-FM-7690 | U-GO-FM-9010 | U-GO-FM-10012 |
| Frequency range, GHz | 60...76 | 76...90 | 90...100 | 100...120 |
| Output power, mW | 10...20 | 10...20 | 10...20 | 5...8 |

FET OSCILLATORS (with dielectric resonators stabilization)

| Parameter | Model of oscillators | | | | |
|----------------------|----------------------|-------------|-------------|-------------|-------------|
| | U-TO-S-2032 | U-TO-S-3250 | U-TO-S-5065 | U-TO-S-6575 | U-TO-S-7590 |
| Frequency range, GHz | 2,0...3,2 | 3,2...5,0 | 5...6,5 | 6,5...7,5 | 7,5...9 |
| Output power, mW | 10...25 | 10...25 | 10...25 | 10...20 | 10...20 |

FET OSCILLATORS (with dielectric resonators stabilization)

| Parameter | Model of oscillators | | | | |
|----------------------|----------------------|-------------|-------------|-------------|-------------|
| | U-TO-S-9012 | U-TO-S-1215 | U-TO-S-1518 | U-TO-S-1827 | U-TO-S-2730 |
| Frequency range, GHz | 9...12 | 12...15 | 15...18 | 18...27 | 27...30 |
| Output power, mW | 10...20 | 8...20 | 8...15 | 8...15 | 8...12 |

FET OSCILLATORS (with frequency multiplication)

| Parameter | Model of oscillators | | | |
|----------------------|----------------------|--------------|--------------|--------------|
| | U-TO-FM-1620 | U-TO-FM-2024 | U-TO-FM-2430 | U-TO-FM-3040 |
| Frequency range, GHz | 16...20 | 20...24 | 24...30 | 30...40 |
| Output power, mW | 10...20 | 10...20 | 10...20 | 10...16 |

MICROWAVE OSCILLATORS

BIPOLAR TRANSISTOR OSCILLATORS (with dielectric resonators stabilization)

| Parameter | Model of oscillators | | | |
|----------------------|----------------------|---------------|---------------|----------------|
| | U-TO-S-3-74-7 | U-TO-S-6-06-7 | U-TO-S-7-58-5 | U-TO-S-9-51-05 |
| Frequency range, GHz | 3,7...4,7 | 6,0...6,7 | 7,5...8,5 | 9,5...10,5 |
| Output power, mW | 20...60 | 20...50 | 20...40 | 10...15 |

VOLTAGE CONTROLLED TRANSISTOR OSCILLATORS

| Parameter | Model of oscillators | | | |
|--------------------------------|----------------------|-----------------|-----------------|-----------------|
| | U-TO-VCO-1-22-0 | U-TO-VCO-2-04-0 | U-TO-VCO-4-08-0 | U-TO-VCO-8-0-12 |
| Frequency range, GHz | 1,2...2,0 | 2...4 | 4...8 | 8...12 |
| Range of frequency tuning, MHz | 300...600 | 300 | 600 | 1000 |

OSCILLATORS WITH AMPLITUDE MODULATION

| Parameter | Model of oscillators |
|----------------------|----------------------|
| | U-O-AM-0315 |
| Frequency range, GHz | 3...15 |
| Output power, mW | 10...120 |

OSCILLATORS WITH PHASE LOCKING

| Parameter | Model of oscillators | | |
|--------------------------|----------------------|----------|----------|
| | U-OPL-03 | U-OPL-11 | U-OPL-15 |
| Operating frequency, GHz | 3 | 11 | 15 |
| Output power, mW | 10...500 | 10...500 | 10...500 |

We propose the microwave oscillators with amplitude or frequency modulation, the microwave oscillators with dielectric resonator stabilization, the voltage controlled microwave oscillators, the frequency multipliers microwave oscillators in various frequency range. The microwave oscillators are reliable in operation and stable to the mechanical and climatic effects. They have small weight and dimensions.



HIGH Q-FACTOR MICROWAVE RESONATORS WITH RARIFIED SPECTRUM OF EIGEN OSCILLATION IN FREQUENCY RANGE FROM 0,6 TO 405 GHz



The high Q-factor resonators are used to make the high-quality generators of the radar and navigation systems, to carry out the the spectrum and frequency measurements, to measure the material parameters, to carry out the physical investigations.

The microwave resonators are applied at the microwave electronic: the resonance and stabilization generator systems; at the measurement technique: wavemeters, filters, signal spectrum measurement systems, frequency discriminators; at the experimental physics: spectroscopy, material parameter measurement systems; as well at the elementary particles accelerators, golography, radioastronomy, etc.

The resonators are made of thermostable material, the inside surface - silver or gold. They have small weight and dimensions. There is the electronic tuning of frequency.

MAIN TECHNICAL CHARACTERISTICS OF RESONATORS

| Model | Frequency range, GHz | Type of resonator | Type of channel | Q-factor | VSWR |
|--------|----------------------|---------------------|-----------------|----------|------|
| PBC241 | 0,60-1,20 | cylindrical | coaxial | 10000 | 1,2 |
| PBC251 | 1,07-2,14 | | | 10000 | 1,6 |
| PBC311 | 2,0-3,0 | | | 18000 | 1,6 |
| PBC321 | 3,0-4,0 | | | 24000 | 1,6 |
| PBC331 | 4,0-5,2 | | | 51000 | 1,6 |
| PBC371 | 4,9-5,64 | | | 57000 | 1,6 |
| PBC401 | 5,64-7,2 | | | 42000 | 1,6 |
| PBC411 | 6,93-8,15 | | | 42000 | 1,6 |
| PBC421 | 7,6-9,8 | | | 45000 | 1,5 |
| PBC451 | 9,4-12,05 | | | 45000 | 1,8 |
| PBC061 | 8,15-12,05 | | | 42000 | 1,6 |
| PBC461 | 12,05-15,4 | | | 42000 | 1,95 |
| PBC481 | 15,4-17,44 | | | 42000 | 1,95 |
| PBC071 | 12,05-17,44 | | | 42000 | 1,8 |
| PBC501 | 17,44-21,6 | cylindrical | waveguide | 42000 | 1,80 |
| PBC511 | 21,6-25,95 | | | 48000 | 1,90 |
| PBC521 | 25,95-32,0 | | | 45000 | 2,0 |
| PBC531 | 32,0-37,5 | | | 45000 | 2,0 |
| PBG531 | 32,0-37,5 | corrugated | waveguide | 60000 | 1,65 |
| PBG541 | 37,5-47,0 | | | 60000 | 1,65 |
| PBG551 | 47,0-53,57 | | | 60000 | 1,6 |
| PBO101 | 32,0-53,57 | opened quasioptical | waveguide | 60000 | 1,65 |
| PBO111 | 53,57-78,33 | | | 66000 | 1,70 |
| PBO121 | 78,33-118,1 | | | 75000 | 1,70 |
| PBO131 | 118,1-178,4 | | | 75000 | 1,90 |

The quality of the radar and communication systems is mainly determined by the noise characteristics of their components - oscillators, local oscillators, amplifiers, mixers.

We propose the noise measurement systems to make high sensitivity measurement of the amplitude and phase noise of the radar and communication systems components - oscillators, amplifiers, mixers. The amplitude noise measurement is realized in the circuitry of the microwave amplitude detector with the input power - 100 mW. The phase noise measurement is realized in the circuitry of the two-channel frequency discriminator with the input power - 1 mW.



SPECTRUM GENERATORS

| Parameter | Model of generetors |
|-----------------------|---------------------|
| | SG-001-8/100 |
| Frequency range, GHz | 0,1...8 |
| Subrange A | 0,1...3 |
| Subrange B | 3...8 |
| Step of spectrum, MHz | 100 |
| Output power, mW | 50...100 |

FREQUENCY SYNTHESIZERS WITH FAST SWITCHING OF FREQUENCIES

| Parameter | Model of sinthesizers |
|------------------------------------|-----------------------|
| | FFS-0118 |
| Band of operating frequencies, Ghz | 1...4 |
| | 3,6...8 |
| | 8...15 |
| | 10...18 |
| | 4...12 |
| | 4...18 |
| Amount of operating frequencies | 2, 4, 8, 10, 12, 16 |
| Output power, mW | 50...100 |

MICROWAVE SYSTEMS

FREQUENCY SYNTHESIZERS

| Parameter | Model of synthesizers | | |
|------------------------------------|-----------------------|----------------|----------------|
| | FS-00102 | FS-0208 | FS-0816 |
| Frequency range, GHz | 0,1...2 | 2...8 | 8...16 |
| Band of operating frequencies, GHz | 0,01...0,4 | 0,1...0,8 | 0,1...1,2 |
| Step of spectrum, MHz | 0,1...20 | 0,1...20 | 0,1...60 |
| Output power, mW | 10...50 | 10...50 | 10...50 |

FREQUENCY SYNTHESIZERS

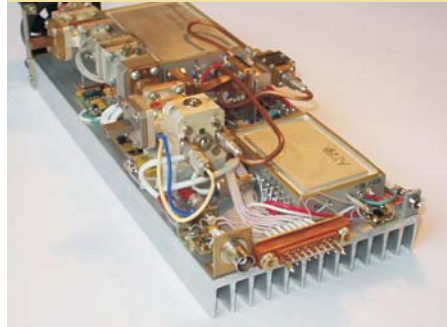
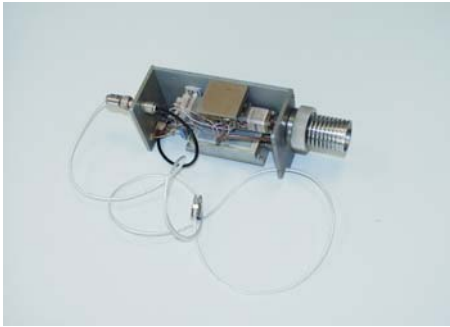
| Parameter | Model of synthesizers | | |
|------------------------------------|-----------------------|----------------|----------------|
| | FS-1624 | FS-2729 | FS-3239 |
| Frequency range, GHz | 16...24 | 27...29 | 32...39 |
| Band of operating frequencies, GHz | 0,1...1,2 | 0,1...1,2 | 0,1...1,2 |
| Step of spectrum, MHz | 0,5...100 | 0,5...100 | 0,5...100 |
| Output power, mW | 10...50 | 10...50 | 10...50 |

FREQUENCY SYNTHESIZERS

| Parameter | Model of synthesizers | |
|------------------------------------|-----------------------|-------------------|
| | FS-1824 | FS-3040 |
| Frequency range, GHz | 18...24 | 30...40 |
| Band of operating frequencies, GHz | 0,2...2000 | 0,2...2000...4000 |
| Step of spectrum, MHz | 0,2...200 | 0,5...200 |
| Output power, mW | 10...50 | 10...50 |

MM WAVE FREQUENCY SYNTHESIZERS

| Parameter | Model of synthesizers |
|------------------------------------|-----------------------|
| | FS-7080 |
| Frequency range, Ghz | 70...80 |
| Band of operating frequencies, Ghz | 1000...1200 |
| Step of spectrum, MHz | 10...100 |
| Output power, mW | 5...10 |



MM WAVE CONVERTERS OF FREQUENCY

| Parameter | Model of converters | | | | | |
|---------------------------------------|---------------------------------------|---------|---------|---------|-----------|-----------|
| | FC-1828 | FC-2840 | FC-4052 | FC-5375 | FC-751000 | FC-10012 |
| Frequency range of input signal, GHz | 18...28 | 28...40 | 40...52 | 53...75 | 75...100 | 100...120 |
| Frequency range of output signal, Ghz | 0.1...1; 1...2; 2...4; 0,1...4; 4...8 | | | | | |
| Conversion loss, dB | 5...7 | 6...8 | 6...8 | 6...8 | 7...9 | 8...10 |

MM WAVE AMPLIFIERS-CONVERTERS OF FREQUENCY

| Parameter | Model of amplifier-converters | | | | |
|--------------------------------------|-------------------------------|----------|----------|-----------|-----------|
| | FCA-3038 | FCA-4353 | FCA-5375 | FCA-75100 | FCA-10012 |
| Frequency range of input signal, Ghz | 30...38 | 43...53 | 53...75 | 75...100 | 100...120 |
| Operating frequency band, GHz | 4 | 4 | 4 | 4 | 4 |
| Coefficient of amplification, dB | 13...30 | 13...30 | 13...30 | 13...30 | 13...30 |

MICROWAVE COMPONENTS



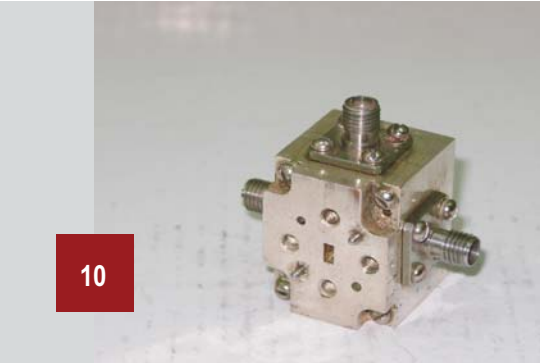
Microwave components (modulators, mixers, detectors, attenuators, switches, directional couplers, matched load) are used for signal processing and transforming in various microwave systems. These components can be produced in various construction (microstrip, coaxial, waveguide). The Customer defines microwave component technical parameters (frequency range, modulation parameters, losses, VSWR)

MICROWAVE MIXERS

| Parameter | Model of mixers | | | | | |
|---------------------------------------|-----------------|-----------|-----------|-----------|------------|------------|
| | U-LM-1828 | U-LM-2840 | U-LM-4052 | U-LM-5275 | U-LM-75100 | U-LM-10012 |
| Frequency range of input signal, GHz | 18...28 | 28...40 | 40...52 | 52...75 | 75...100 | 100...120 |
| Frequency range of output signal, GHz | 0.1...8 | 0.1...8 | 0.1...8 | 0.1...8 | 0.1...8 | 0.1...8 |
| Conversion loss, dB | 5...7 | 6...8 | 6...8 | 6...8 | 7...9 | 8...10 |

CONVERTERS OF FREQUENCY

| Parameter | Model of converters | | | |
|---------------------------------------|---------------------|-----------|-----------|-----------|
| | F0-4552 | F0-5260 | F0-6075 | F0-9096 |
| Frequency range of input signal, GHz | 45...52 | 52...60 | 60...75 | 90...96 |
| Operating frequency band, GHz | ±1 | ±1 | ±1 | ±1 |
| Frequency range of output signal, MHz | 10...1000 | 10...1000 | 10...1000 | 10...1000 |



MICROWAVE COMPONENTS



SWITCHES (microstrip)

| Parameter | Model of switches | | | | |
|-------------------------|---------------------|--------|---------|---------|---------|
| | SW-0104S | W-0410 | SW-1018 | SW-0110 | SW-0218 |
| Frequency range, Ghz | 1...4 | 4...10 | 10...18 | 1...10 | 2...18 |
| Initial attenuation, dB | 1.8 | 2 | 2.5 | 3.5 | 3.5 |
| Amount of channels | 2 → 1, 4 → 1, 8 → 1 | | | | |

ATTENUATORS (microstrip, electrically controlled)

| Parameter | Model of attenuators | | | | |
|-------------------------|----------------------|----------|----------|----------|----------|
| | AEC-0104 | AEC-0410 | AEC-1018 | AEC-0110 | AEC-0218 |
| Frequency range, Ghz | 1...4 | 4...10 | 10...18 | 1...10 | 2...18 |
| Initial attenuation, dB | 1.8 | 2 | 2.5 | 3.5 | 3.5 |
| Max attenuation, dB | 40...60 | | | | |

PHASE «0» MODULATORS (microstrip)

| Parameter | Model of modulators | | | | |
|-------------------------|---------------------|----------|----------|----------|----------|
| | MPh-0104 | MPh-0410 | MPh-1018 | MPh-0110 | MPh-0218 |
| Frequency range, Ghz | 1...4 | 4...10 | 10...18 | 1...10 | 2...18 |
| Initial attenuation, dB | 1.8 | 2 | 2.5 | 3.5 | 3.5 |

AMPLITUDE MODULATORS (microstrip)

| Parameter | Model of modulators | | | | |
|-------------------------------------|---------------------|---------|---------|---------|---------|
| | MA-0104 | MA-0410 | MA-1018 | MA-0110 | MA-0218 |
| Band of modulating frequencies, MHz | 0.01...20 | | | | |
| Form of modulating signal | meander, sin | | | | |

MICROWAVE COMPONENTS



WIDEBAND MICROWAVE TRANSISTOR AMPLIFIERS

| Parameter | Model of amplifiers | | | | |
|----------------------------------|---------------------|---------|---------|---------|---------|
| | AT-0102 | AT-0204 | AT-0408 | AT-0812 | AT-1218 |
| Frequency range, Ghz | 0,1...18 | | | | |
| Coefficient of amplification, dB | 20...55 | | | | |

GUNN AMPLIFIERS

| Parameter | Model of amplifiers | |
|---|---------------------|-----------|
| | U-GA-1825 | U-GA-3038 |
| Frequency range, Ghz | 18...25 | 30...38 |
| Band of operating frequencies (3 dB), MHz | 1000 | 1200 |
| Coefficient of amplification, dB | 16...20 | 16...20 |

MICROWAVE TECHNOLOGIES

MICROWAVE STERILIZATION TECHNOLOGY

The microwave sterilization technology is based on the volume dielectric heating. It is characterized by high efficiency of sterilization and high efficiency of the microwave energy conversion into heat energy.



MICROWAVE STERILIZATION TECHNOLOGY OF PRESOWING TREATMENT FOR SEEDS

Technology is based on low-level microwave energy effect on biological objects. High applicability (tomato, cucumber, cabbage, etc.). Ecological safety. Low power consumption. Using this technology perfects the sowing quality семян, raises stability of the plants to disease, raises the productivity on 10-12%.



EQUIPMENT FOR MICROWAVE DRYING OF WOOD

Using of technology for microwave drying of wood makes it possible:

- reduce the period of the drying of wood in 1,5 - 2 times
- reduce the cost of the drying of wood in 1,5 - 1,8 times (especially for hard wood - oak, ash, beech)
- get high quality of dried wood

