

Ore wells logging   Coal and water wells logging   Open hole

# AKIPS apparatus and method complex for downhole smallsize geophysical logging

## SCOPE OF APPLICATION

oil and gas, coal, ore and hydrogeological wells a diameter of 60-200 mm, max. operating pressure up to 60 MPa, max. operating temperature 120°C

## FEATURES

- it has a basic module of relay + gamma log provides tying to depth for each method;
- program, power, design compatibility of modules;
- possibility of simultaneous registration of all parameters;
- software-controlled operating;
- the wireline digital system of registering and information transmission;
- high-passability of the complex because due to of controled centralizers, holding down devices and joint connector.

## ADVANTAGES

- combination of different geophysical methods according to the solving geological problem and customer demands;
- it can be used for research of directional and horizontal wells;
- informational, energetic and constructive combination;
- complex openness for system combination and addition of new transducers on a customer's demand.

## EQUIPMENT

digital transducers with a diameter of 36 and 48 mm, which realize the following methods:

- gamma-ray logging (GK);
- spectrometric gamma-ray logging (SGK);
- density gamma-gamma ray logging (GGK-P);
- selective gamma-gamma ray logging (GGK-S);
- litho-density gamma-gamma ray logging (GGK-L);
- neutron-gamma ray logging (NGK);
- neutron-neutron logging (NNK);
- spectral neutron gamma-ray logging (SNGK);
- spectrometric X-ray radiometrical logging (SPPK);
- lateral logging (BK);
- lateral scanning logging (BK-S);

The equipment AKIPS is compatible with any type of programmable stations.

The apparatus can be operated with any conventional wireline, as well as a stiff wireline or coiled tubing installation equipped with a logging cable.

### AKIPS complex can be delivered in two modifications:

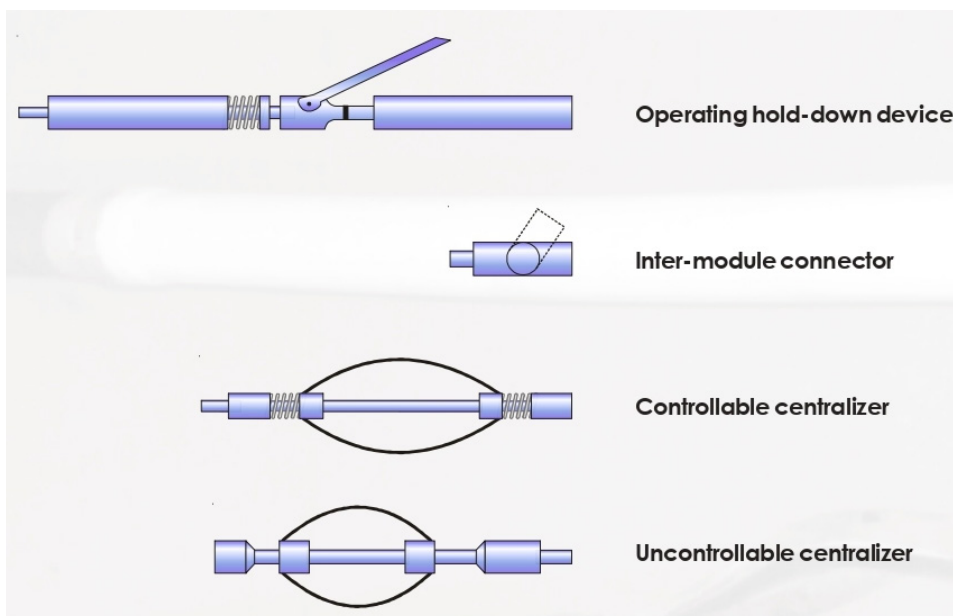
- telemetry connecting link module, combined with GK module, to which any of mentioned above modules can be attached from the underside;
- set of separate downhole tools, which constructively can not be attached.

### Delivery completeness:

•Downhole digital modules, controllable centralizers, operating hold-down devices, uncontrollable centralizers, inter-module connectors; facilities for tool calibration, devices for tool servicing, spare parts tools and accessories, certificates, operating manuals, calibration of a primary basic protocols.

•At customer's option supplied interface unit, IBM-compatible computer Notebook, soft-ware controlled powersupply source, technological software

## PROCESSING UNIT OF AKIPS-COMPLEX



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## GK digital gamma-ray logging and SGK digital spectrometric gamma-ray logging modules (as a part of AKIPS complex)

GK module is designed for power measurement the exposure dose of natural gamma radiation.  
 SGK module is designed for measurement mass fraction of natural radioactivity K, U, Th elements.  
 Measurement capabilities: it is compatible in operation to other modules as a part of AKIPS.

### SPECIFICATIONS



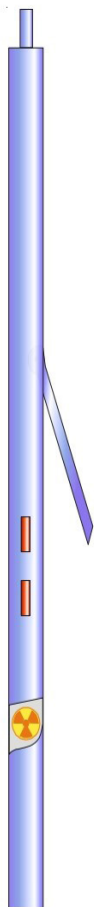
Maximum operating temperature, °C	70±120
Maximum hydrostatic pressure, MPa	25±60
Module dimensions, mm	
diametr	48
length	800
GK module	
Measurement range of exposure rate, µR/hr	0÷100
Measurement error, %	±15
SGK module	
Mass fraction of naturally radioactive elements, %r	
K	0,1÷20
Th, U	(10÷100)·10 <sup>-4</sup>
Measurement error, %	
K	±15÷10
Th, U	±25÷15

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## GGK-P Digital gamma-gamma density logging module (as a part of AKIPS complex)

Is designed for volume density measurement by scattered gamma radiation method.  
Potential for use as a part of AKIPS comparable with other modules.

### SPECIFICATIONS



Volume density measurement range, gr/sm<sup>3</sup>:

coal	1...2.7
ore	1.8...4.5
oil	1.8...4.5

Rock volume density measurement error, %, up to

2

Operating temperature range, °C

70÷120

Maximum hydrostatical pressure, MPa

25÷60

Module dimensions, mm:

diameter	48
length	1800

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## GGK-S Digital selective gamma-ray logging module (as a part of AKIPS complex)

Is designed for measurement effective rock atomic number.

Potential for use as a part of AKIPS comparable with other modules.

### SPECIFICATIONS

Effective atomic number measurement error, atomic unit:

coal	6÷13
ore	6÷22

Rock volume density measurement error, %

2

Operating temperature range, °C

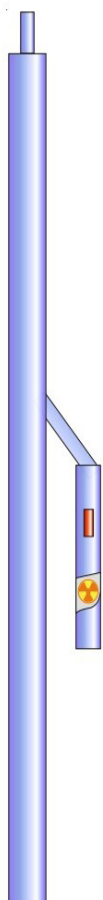
70

Maximum hydrostatical pressure, MPa

25

Module dimensions, mm:

diameter	48
length	1200



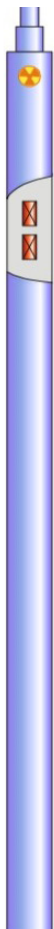
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## G GK-L Digital litho-density gamma-ray logging module (as part of AKIPS complex)

Is designed for measurement volume density and effective rock atomic number.  
Potential for use as a part of AKIPS comparable with other modules

### SPECIFICATIONS

Effective atomic number measurement error, atomic unit:	6÷13
Volume density measurement range, gr/sm <sup>3</sup>	1.8÷3.5
Effective atomic number measurement error, %	2
Rock volume density measurement error, %	2
Operating temperature range, °C	70÷120
Maximum hydrostatic pressure, MPa	25÷60
Module dimensions, mm:	
diametr	48
length	1200



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## NGK Digital neutron gamma-ray logging and NNK digital neutron-neutron logging modules (as part of AKIPS complex)



Is designed for measurement of equivalent water-filled formation porosity.  
 Potential for use as a part of AKIPS comparable with other modules

### SPECIFICATIONS

Maximum range of water-filled porosity measurement, %	1÷40
Rock volume density measurement error, %, up to	15
Operating temperature range, °C	70÷120
Maximum hydrostatic pressure, MPa	25÷60
Module dimensions, mm:	
diameter	48
length	800

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## BK digital lateral logging and BKS digital lateral scanning logging modules (as part of AKIPS complex)



BKS module is designed for measurement of rock apparent resistivity. Existence of several variable-depth probes provides an estimate of rock nonhomogeneity in radial axis.

BKS module is designed for measurement of azimuthal dependence of rock apparent resistivity. Sectionalized central electrode A0 of scanning lateral logging allows to estimate rock azimuth in homogeneity along six directions by means of scanning. Scanning lateral logging is used for determination layer spatial arrangement.

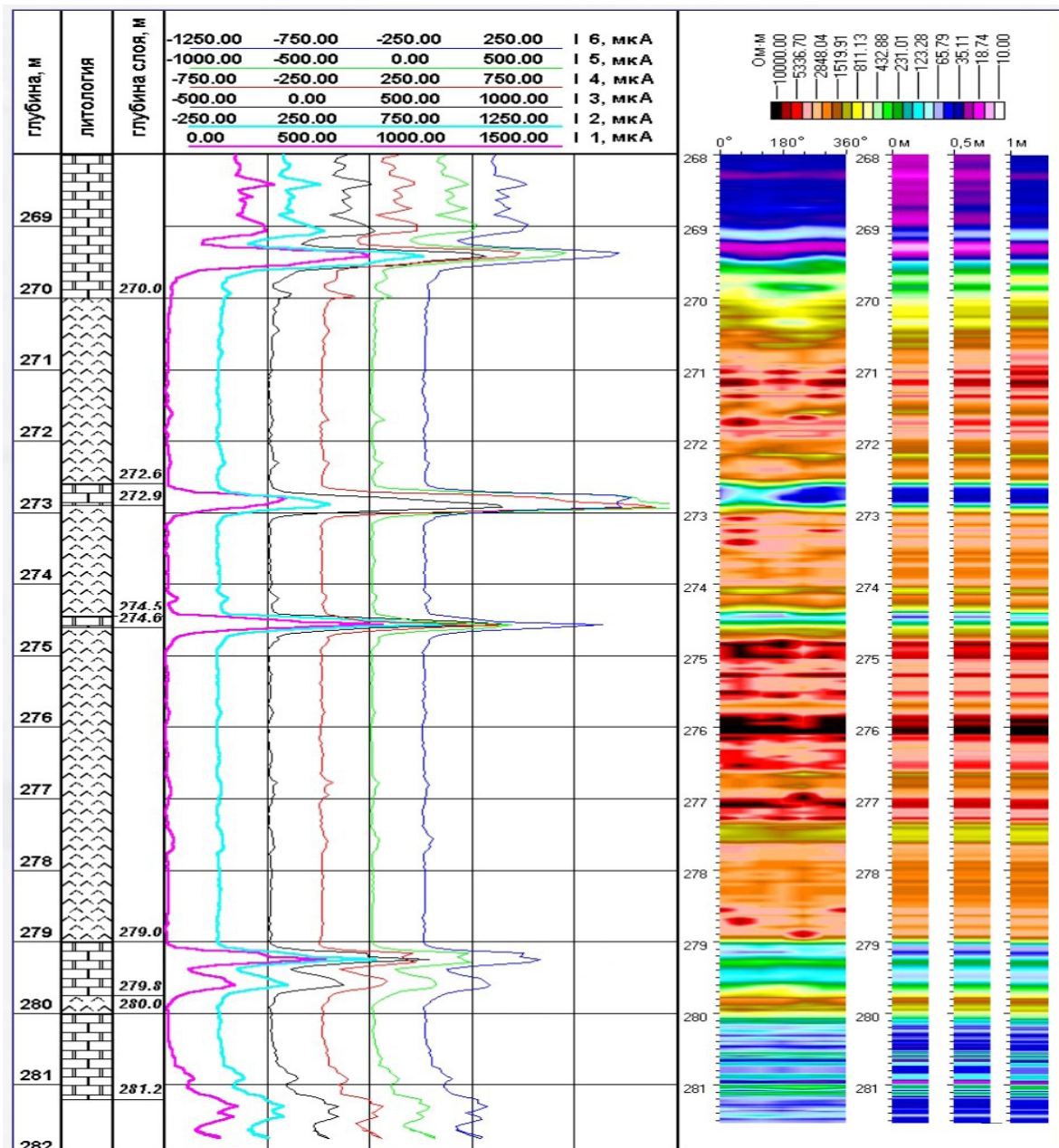
Potential for use as a part of AKIPS comparable with other modules.

Measured resistance range, Ohm·m	0,1.....10000
Relative measurement error, %, up to:	
in range 0,1....1 Ohm*m	10
in range 2...20000 Ohm*m	5
Operating temperature range, °C	70÷120
Maximum hydrostatic pressure, MPa	25÷60
Module dimensions, mm:	
diametr	48
length	3200



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## Example of application BK module for an assessment of azimuthal heterogeneity of the reservoir at different distances from the borehole wall



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## EMK Digital electromagnetic logging module (as part of AKIPS complex)



Is designed for magnetic and conducting rock characteristics measurement by register of real and imaginary component of induction electromagnetic field.

### CALCULATED PARAMETERS FOR EMK MODULE

The ratio of  $E_p$  real component of the complex amplitude magnetic induction of electromagnetic field which is excited by the module in researched environmental to  $E_0$  real component induction of this field in the air

$$\epsilon_p = E_p / E_0$$

The ration of  $E_a$  imaginary component of a complex amplitude magnetic induction of electromagnetic field which is excited by the module in researched environment to  $E_0$  real component induction of this field in the air

$$\epsilon_a = E_a / E_0$$

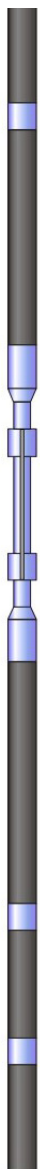
### POTENTIAL FOR USE AS A PART OF AKIPS COMPARABLE WITH OTHER MODULES

#### SPECIFICATIONS

Measurement range of $E_p$ , real component, relative unit	$10^{-4} - 1$
Measurement range of $E_a$ , imaginary component, relative unit	$5 \cdot 10^{-4} - 0.5$
Rock volume density measurement error	$\pm[5+0.05 \cdot (X_r/X-1)]$
Operating temperature range, °C	70÷120
Maximum hydrostatic pressure, MPA	25÷60
Module dimensions, mm:	
diameter	48
length	1330

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## VAK Digital wave acoustic logging module (as part of AKIPS complex)



Is designed for measurement full acoustic waves patterns.  
Potential for use as a part of AKIPS comparable with other modules

### SPECIFICATIONS

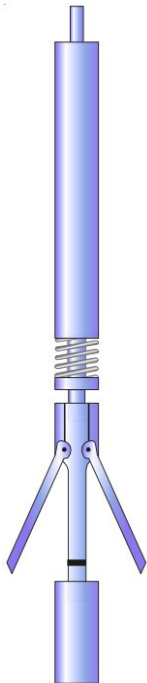
Measurement of wave patterns from two sound acoustic receiving devices along with equidistant 2 microseconds discretization, mks	32÷2048
Signal amplitude within one wave pattern, dB	96
Gain drift, dB	36
Rock volume density measurement error, %	$10^{-4}$
Operation temperature range, °C	70÷120
Maximum hydrostatic pressure, MPa	25÷60
Module dimensions, mm:	
diameter	50
length	3500

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## KV Digital caliper log module (as part of AKIPS complex)

Is designed for measurement of well mean-diameter. Opening and closing of caliper arms is realized with the help of a controlled electric motor.

Potential for use as a part of AKIPS comparable with other modules.



### SPECIFICATIONS

Well diameter measurement range, mm	200÷300
Well diameter measurement error, %, up to	1
Operating temperature range, °C	70÷120
Maximum hydrostatic pressure, MPa	25÷60
Module dimensions, mm:	
diametr	48
length	1330

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## TR Digital thermal log and continuous mud resistivity module (as part of AKIPS complex)



Is designed for measurement of electrical conductivity and temperature of borehole fluids. Potential for use as a part of AKIPS comparable with other modules.



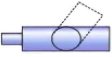










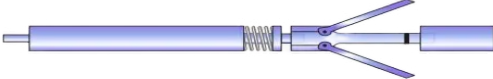
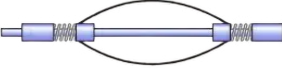
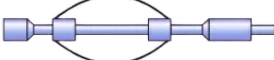
### SPECIFICATIONS

Electrical conductivity of borehole fluid measurement range, Sm/m	0.05÷20
Relative measurement error of electric conductivity, %, up to	±5
Operating temperature range, °C	70÷120
Maximum hydrostatic pressure, MPa	25÷60
Module dimensions, mm:	
diameter	48
length	810
Weight of module, kg, up to	4



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## AKIPS-oil complex element set

-  **GAMMA-RAY MODUL WITH RETRANSLATOR**
-  **OPERATED HOLD-DOWN DEVICE**
-  **JOINT CONNECTOR**
-  **TERMOMETRY AND RESISTIVITY MODULE (TR)**
-  **GAMMA-GAMMA DENSITY LOGGING MODULE (GGK-P)**
-  **LITHO-DENSITY GAMMA-GAMMA RAY LOGGING MODULE (GGK-L)**
-  **SPECTROMETRIC GAMMA-RAY LOGGING MODULE (SGK)**
-  **SPECTROMETRIC NEUTRON GAMMA-RAY LOGGING MODULE (SNGK)**
-  **NEUTRON GAMMA-RAY LOGGING MODULE (NGK)**
-  **NEUTRON-NEUTRON LOGGING MODULE (NNK)**
-  **LATERAL LOGGING MODULE (BK)**
-  **LATERAL SCANNING LOGGING MODULE (BKS)**
-  **FULL-WAVEFORM LOGGING MODULE (VAK)**
-  **CALIPER MODULE (KV)**
-  **CONTROLLABLE CENTRALIZER**
-  **UNCONTROLLABLE CENTRALIZER**

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## AKIPS-oil complex application example

