

COMMUNICATIONS PROTOCOL OF PERSONAL COMPUTER AND MKS-05 “TERRA” OR
RKS-01 “STORA”
(for devices with the installed Bluetooth module)

This document contains the following abbreviations and symbols:

Photon-ionizing radiation – gamma and X-ray radiation;

DE – ambient dose equivalent of photon-ionizing radiation;

DER – ambient dose equivalent rate of photon-ionizing radiation;

PC – personal computer.

Data communications between the PC and the devices MKS-05 “TERRA” or RKS-01 “STORA” (hereinafter called the devices) is done via the Bluetooth interface with the use of the Serial Port Profile (SPP). Exchange rate: 115200 bit/s; data word format: 8N1.

As soon as data communications of the device and the PC is activated (see the Operating Manual of the device), the device automatically connects the Bluetooth with the PC and starts sending the “Exchange start” frame. Until that moment the PC is passive and waits for the “Exchange start” frame. When the PC receives the “Exchange start” frame, it sends the “Exchange start confirmation” frame to the device and becomes active – starts sending request frames to the device and waits for the data frames in response.

Note – Each next request frame can be sent only after the response to the current request frame. It is impossible to send several request frames at a time.

Right after the beginning of communications the device is ready to transmit measurement results that have been saved in the nonvolatile memory, or current real-time measurement results, in other words, to work as an intelligent detecting unit (hereinafter referred to as IDU). After the information is sent from the nonvolatile memory, but prior to sending the “Exchange completion” frame, the device can also proceed to the IDU operating mode. The “Measurement result request” frame acceptance switches the device to the IDU operating mode. As soon as the device enters the IDU operating mode, contents of the nonvolatile memory becomes unavailable. Only by sending the “Operating mode selection” frame with the parameter “off” you can finish the IDU operating mode.

While working with the nonvolatile memory contents of the device, the PC should transmit frames with the interval not exceeding 2000 ms. Greater interval will be considered as connection break (interframe timeout). In the IDU operating mode the time interval between the frames should not exceed 20 s.

In each operating mode the time interval between the bytes of one frame should not exceed 5 ms.

Frames formats are given below.

FRAMES FOR DATA COMMUNICATION ESTABLISHMENT

“Exchange start” frame format – device to PC

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h – start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
0	0	1	0	0	0	0	0	D7...D0 – “Exchange start” frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» – device type=7; for RKS-01 «STORA» – device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
byte								Data frames quantity that will be sent during operation with the contents of the device nonvolatile memory
control								arithmetical checksum with a carry

“Exchange start confirmation” frame format – PC to device

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character Byte AAh
1	0	1	0	1	0	1	0	
0	0	1	0	0	0	0	0	D7...D0 - "Exchange start confirmation" frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
control								arithmetical checksum with a carry

FRAMES FOR OPERATION WITH NONVOLATILE MEMORY CONTENTS

“Dummy” frame format – PC to device

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
X	0	1	0	0	1	0	1	D6...D0 - "Dummy" frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
control								arithmetical checksum with a carry

“Dummy frame confirmation” frame format – device to PC

Dummy frame confirmation frame format - device type=7								
7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
X	0	1	0	0	1	0	1	D6...D0 - "Dummy frame confirmation" frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
control								arithmetical checksum with a carry

“Data request from nonvolatile memory” frame format – PC to device

Data request from nonvolatile memory - frame format - PC to device								
7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
1/0	0	1	0	0	0	0	1	D6...D0 - "Data request from nonvolatile memory" frame code
								D7=0 - new data frame request
								D7=1 - repeat request of the last data frame
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
control								arithmetical checksum with a carry

“Data from nonvolatile memory” frame format – device to PC

Data from nonvolatile memory - frame format - device to PC								
7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
1/0	0	1	0	0	0	0	1	D6...D0 - "Data from nonvolatile memory" frame code D7=0 - new data D7=1 - repeat
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
0	0	0	0	0	0	D1	D0	D0 - low/high half of segment D1=1 - character: data frame
byte								Frame counter, Increases only when new data frames are transmitted
byte 0								$\frac{1}{2}$ of data segment from nonvolatile memory (256 bytes)
byte 1								
. . .								
byte 2								
byte 255								
control								arithmetical checksum with a carry

“Data from nonvolatile memory” frame format – device to PC

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
1/0	0	1	0	0	0	0	1	D6...D0 - "Data from nonvolatile memory" frame code D7=0 - new data D7=1 - repeat
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
0	0	0	0	0	0	D1	D0	D1=0, D0=0 - character: no data to be transmitted
byte								frame counter
control								arithmetical checksum with a carry

“DE request from nonvolatile memory” frame format – PC to device (only for MKS-05 “TERRA”)

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
0	0	1	0	0	0	1	1	D6...D0 - "DE request from nonvolatile memory" frame code
digit 2				low-order digit (1)				Device serial number, bcd code
digit 4				digit 3				
digit 6				digit 5				
device type = 7				high-order digit (7)				
control								arithmetical checksum with a carry

“DE from nonvolatile memory” frame format – device to PC
(only for MKS-05 “TERRA”)

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
0	0	1	0	0	0	1	1	D6...D0 - "DE from nonvolatile memory" frame code
digit 2				low-order digit (1)				Device serial number, bcd code
digit 4				digit 3				
digit 6				digit 5				
device type = 7				high-order digit (7)				
mantissa high byte								DE accumulated value *, (float MSP430)
exponent								
mantissa low byte								
mantissa middle byte								
tens of hours				hours				DE accumulation time * bcd code
thousands of hours				hundreds of hours				
tens of seconds				seconds				
tens if minutes				minutes				
control								arithmetical checksum with a carry

* DE is accumulated in all operating modes of the device, but for beta-particles flux density measurement; DE accumulated value and DE accumulation time are updated in the transmission buffer of the device with 2 s interval;

“Clear data from nonvolatile memory” frame format – PC to device

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
X	0	1	0	0	1	1	0	D6...D0 - "Clear data from nonvolatile memory" frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
X	X	X	X	X	X	D1	D0	D0=1 - clear measurement results of DER and beta-particles flux density D1=1 - clear DE accumulated value and DE accumulation time only for MKS-05 «TERRA»)
seconds								PC current time, bcd code (is set in the device when measurement results of DER and beta-particles flux density are cleared)
minutes								
hours								
date								
month								
day of week								
year - 2000								
control								arithmetical checksum with a carry

“Clear data confirmation” frame format – device to PC

Clear data confirmation frame format - device to PC								
7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
0	0	1	0	0	1	1	0	D6...D0 - "Clear data confirmation" frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
control								arithmetical checksum with a carry

“Exchange completion” frame format –PC to device
(only for operation with nonvolatile memory contents)

(only for operation with non-volatile memory contents)								
7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
X	0	1	0	0	1	0	0	D6...D0 - "Exchange completion" frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
control								arithmetical checksum with a carry

“Exchange completion confirmation” frame format – device to PC
(only for operation with nonvolatile memory contents)

(only for operation with non-volatile memory contents)								
7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
0	0	1	0	0	1	0	0	D6...D0 - "Exchange completion confirmation" frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
control								arithmetical checksum with a carry

FRAMES FOR OPERATION WITH CURRENT MEASUREMENT RESULTS

“Measurement result request” frame format – PC to device

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character Byte AAh
1	0	1	0	1	0	1	0	
X	X	0	0	0	0	0	0	D5...D0- "Measurement result request" frame code
byte 0								reserve
byte 1								
byte 2								
byte 3								
0								reserve
control								arithmetical checksum with a carry

“Current measurement result” frame format - device to PC

Current measurement result frame format - device to PC								
7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
X	X	0	0	0	0	0	0	D5...D0-"Current measurement result" frame code
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
mantissa high byte								Measurement result *, (float MSP430)
exponent								
mantissa low byte								
mantissa middle byte								
mantissa high byte								Statistical error of measurement, (float MSP430)
exponent								
mantissa low byte								
mantissa middle byte								
reserve				physical quantity				D3...D0- measured physical quantity 0 - DER (measurement result is transmitted in µSv/h); 1 - beta-particles flux density (measurement result is transmitted in kiloparticles/(cm² · min));
D7	D6	D5	0	0	0	D1	D0	Self-testing results of the device D0=1 - battery discharged D1=1 - detectors failure D0 D5 D6 - battery status: 0 0 0 - charge 100% 0 1 0 - charge 75% 0 0 1 - charge 50% 0 1 1 - charge 25% 1 X X - charge 0% Reliable measurement result character D7=0 - reliable result D7=1 - unreliable result **
mantissa high byte								Battery power supply (Volt),

exponent	(float MSP430)
mantissa low byte	
mantissa middle byte	
control	arithmetical checksum with a carry

* - measurement results are updated in transmission buffer of the device with 2 s interval. The order of update is stopped and starts from the beginning if measurement restart takes place.

** - see the Operating manual of the device.

“Operating mode selection” frame format – PC to device

Operating mode selection - frame format - PC to device								
7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
X	X	0	0	0	0	0	1	D5...D0- "Operating mode selection" frame code
low byte								PC current time, transmitted as a number of seconds passed from 00:00:00 1 Jan 2002 to the current time (binary digit) (is set only if the nonvolatile memory contains no measurement results of DER and flux density)
middle byte								
middle byte								
high byte								
byte								Mode number the device should be switched to: 0 - no change («dummy» frame) 1 - off; 2 - DER measurement; 3 - beta-particles flux density measurement; 255 - measurement restart
control								arithmetical checksum with a carry

“Confirmation” frame format – device to PC

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
D7	D6	0	0	0	0	0	1	D5...D0- "Confirmation" frame code D7 = 0 - regular switching D7 = 1 - error
digit 2				low-order digit (1)				Device serial number, bcd code (for MKS-05 «TERRA» - device type=7; for RKS-01 «STORA» - device type=8)
digit 4				digit 3				
digit 6				digit 5				
device type				high-order digit (7)				
control								arithmetical checksum with a carry

“DE request” frame format – PC to device
(only for MKS-05 “TERRA”)

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
X	X	0	0	0	1	0	0	D5...D0-"DE request" frame code
byte 0								reserve
byte 1								
byte 2								
byte 3								
0								reserve
control								arithmetical checksum with a carry

“DE” frame format – device to PC
(only for MKS-05 “TERRA”)

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character Byte AAh
1	0	1	0	1	0	1	0	
X	X	0	0	0	1	0	0	D5...D0-"DE" frame code
digit 2				low-order digit (1)				Device serial number, bcd code
digit 4				digit 3				
digit 6				digit 5				
device type = 7				high-order digit (7)				
mantissa high byte								DE accumulated value *, (float MSP430)
exponent								
mantissa low byte								
mantissa middle byte								
Tens of hours, hours								DE accumulation time * bcd code
thousands of hours, hundreds of hours								
Tens of seconds, seconds								
Tens of minutes, minutes								
control								arithmetical checksum with a carry

* DE is accumulated in all operating modes of the device, but for beta-particles flux density measurement; DE accumulated value and DE accumulation time are updated in the transmission buffer of the device with 2 s interval;

“DE deletion” frame format – PC to device
(only for MKS-05 “TERRA”)

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character
1	0	1	0	1	0	1	0	Byte AAh
X	X	0	0	0	1	0	1	D5...D0-"DE deletion" frame code
byte 0								reserve
byte 1								
byte 2								
byte 3								
0								reserve
control								arithmetical checksum with a carry

“Confirmation” frame format – device to PC
(only for MKS-05 “TERRA”)

7	6	5	4	3	2	1	0	
0	1	0	1	0	1	0	1	Byte 55h - start-of-frame character Byte AAh
1	0	1	0	1	0	1	0	
D7	D6	0	0	0	0	0	1	D5...D0- "Confirmation" frame code D7 = 0 - regular switching D7 = 1 - error
digit 2				low-order digit (1)				Device serial number, bcd code
digit 4				digit 3				
digit 6				digit 5				
device type = 7				high-order digit (7)				
control								arithmetical checksum with a carry

Checksum is calculated according to Figure 1.

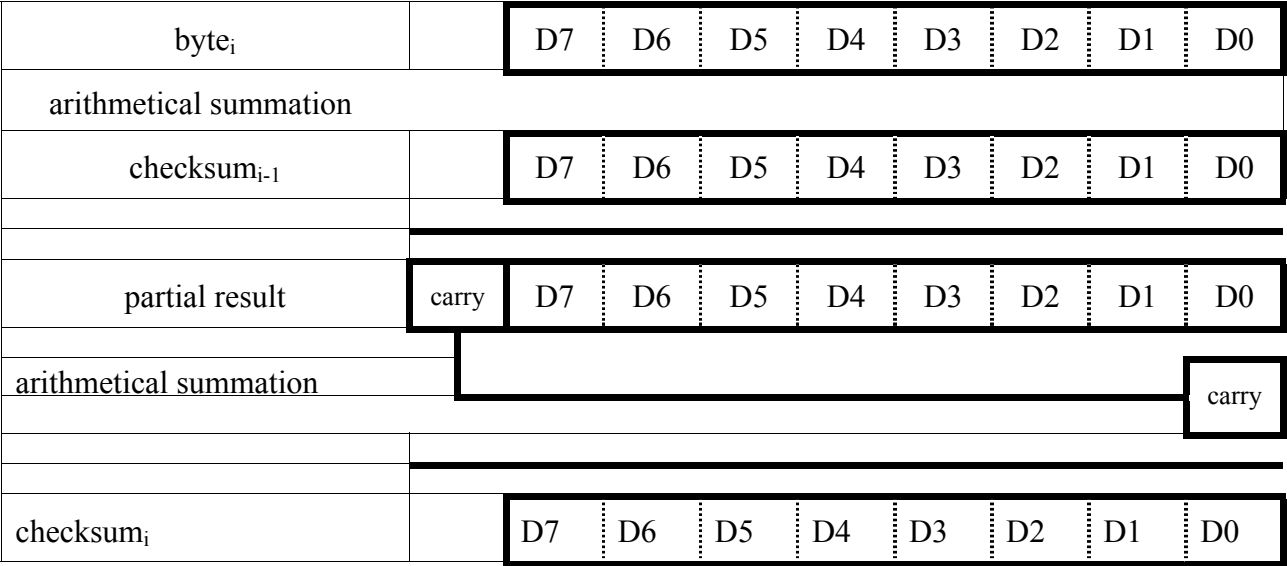


Figure 1 - Checksum calculation algorithm

Nonvolatile memory information is saved in the records of the following format.

“Blank” record – 1 byte length

Heading	01
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“DER measurement result” record – 13 bytes length

Heading	02						
low byte	Measurement time, transmitted as a number of seconds passed from 00:00:00 1 Jan 2002 (binary digit)						
middle byte							
middle byte							
high byte							
low byte	Point No. bcd code						
high byte							
mantissa high byte	DER, $\mu\text{Sv/h}$ (float MSP430)						
exponent							
mantissa low byte							
mantissa middle byte							
byte							Statistical error of measurement Binary code
X	X	X	X	X	D2	D1	D0
							D0=0 reliable information D1=1 dose threshold exceeding D2=1 DER threshold exceeding

“Beta-particles flux density measurement result” record – 13 bytes length

Heading	03						
low byte	Measurement time, transmitted as a number of seconds passed from 00:00:00 1 Jan 2002 (binary digit)						
middle byte							
middle byte							
high byte							
low byte	Point No. bcd code						
high byte							
mantissa high byte	Beta-particles flux density, $10^3 \cdot \text{part./}(\text{cm}^2 \cdot \text{min})$ (float MSP430)						
exponent							
mantissa low byte							
mantissa middle byte							
byte							Statistical error of measurement Binary code
X	X	X	X	X	D2	D1	D0
							D0=0 reliable information D1=1 dose threshold exceeding D2=1 beta-particles flux density threshold exceeding

The nonvolatile memory of the device is organized in segments 512 bytes long. The segment length is indivisible by the records length “DER measurement result” and “Beta-particles flux density measurement result”, thus 507 bytes of each segment are occupied by records with measurement results, and the rest 5 bytes are occupied by “blank” records.

To work with fractional numbers the device uses 32-bit format with floating point (referred to as float MSP430).

```

;=====
;  MSB.31          .23                               LSB.0
;  |-----|
;  | e.7 ... e.0 | sign | m.22 ..... m.0 |
;  |-----|.-----|
;
;=====

```

In this format mantissa is presented by 23 low bits. The 24th bit of mantissa in number presentation is absent. This bit always equals 1 by definition (normalized number).

The exponent is presented by 8 high bits. The order is “shifted” by 0x7F.

Examples of floating point numbers presentation:

```

0      = 00 00 00 00
+0.5   = 7F 00 00 00
+1      = 80 00 00 00
-1      = 80 80 00 00
+2      = 81 00 00 00
+3      = 81 40 00 00
-3      = 81 C0 00 00

```

To demonstrate operation with current measurement results from MKS-05 “TERRA” or RKS-01 “STORA” according to the abovementioned protocol, use Terra_Demo.exe program. The PC should be equipped with Bluetooth-interface adapter, and special Bluetooth-interface software (SW) should be properly installed and set to enable operation with the program. For example, see the operation procedure of the Bluetooth-USB adapter BlueWalker and setup of IVT Blue Soleil SW that is provided with the adapter.

- Connect the Bluetooth-USB adapter to one of the PC’s USB-ports and install the IVT Blue Soleil SW in accordance with the guide enclosed in this SW.
- Launch the IVT Blue Soleil SW.
- Select **My Bluetooth->Device properties**. Enter the name of the device in the **General** bookmark of the **Device Name** component. First 10 symbols of the name should be set in **CHECKPOINT** – other symbols are optional and can be set at the operator’s discretion. In the **Accessibility** bookmark in the **Connecting Mode** component select the **Connectable** radio button, in the **Discovery Mode** component select **General Discoverable**, and in the **Bonding Mode (Pairing Mode)** select the **Accepts Bonding** radio button.
- Select **My Bluetooth->Security**. Set the **Low** radio button in the **Security Level** component of the **General** bookmark. This means that the devices will access the Bluetooth service of the PC without entering an access code. If the need in controlling devices access to the Bluetooth service of the computer arises, select the **Medium** radio button in the **General** bookmark of the **Security Level** component. The **Authentication** indicator should be set in the **Services** bookmark for the **Serial port A** service. In such a case each time the device is connected to the Bluetooth interface of the PC, the authentication code (PIN): 0000 should be entered.
- Select **Tools->My Bluetooth device**. Set the **USB** radio button in the **Bluetooth Device** bookmark.
- Select **My services->Properties**. Set the **Auto-start this service when My Bluetooth starts** indicator in the **Serial port A** bookmark. Record the value of the **Serial port service** component for further use (COM-port, to which the device will be connected). Clear the **Auto-start this service when My Bluetooth starts** indicator in the **Serial port B**.
- Close the main window of the IVT BlueSoleil SW.

Other adapters of Bluetooth interface can be used as well to work with Terra_Demo.exe program. In such a case, make sure settings of the corresponding Bluetooth interface SW, supplied along with such adapter, coincide in meaning with the above given settings for IVT BlueSoleil.

Terra_Demo.exe program (hereinafter referred to as the program) does not need to be installed. As soon as it is started a window appears and the **Setup** bookmark becomes active (Figure 2).

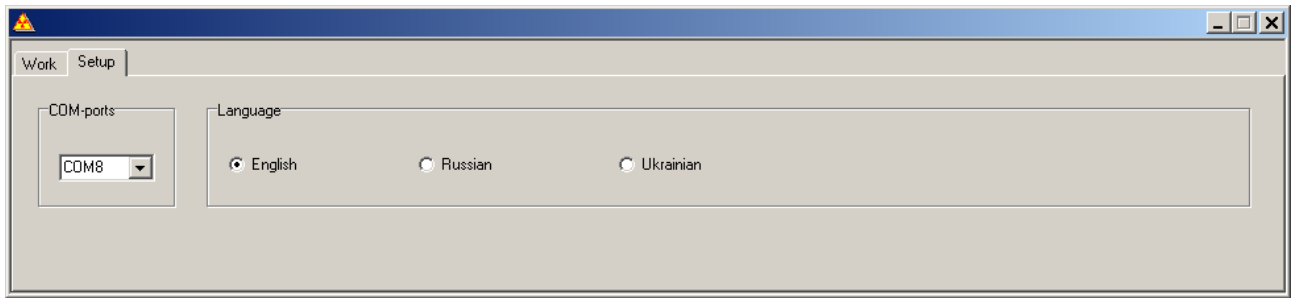


Figure 2 – Program window with the activated **Setup** bookmark.

Select the interface language among English, Russian, or Ukrainian. Then select a COM-port to which the device will be connected via Bluetooth interface (this Com-port is displayed in the “Serial port service” component of the Bluetooth adapter software).

Then select the **Work** bookmark and click the **Start** button (Figure 3).

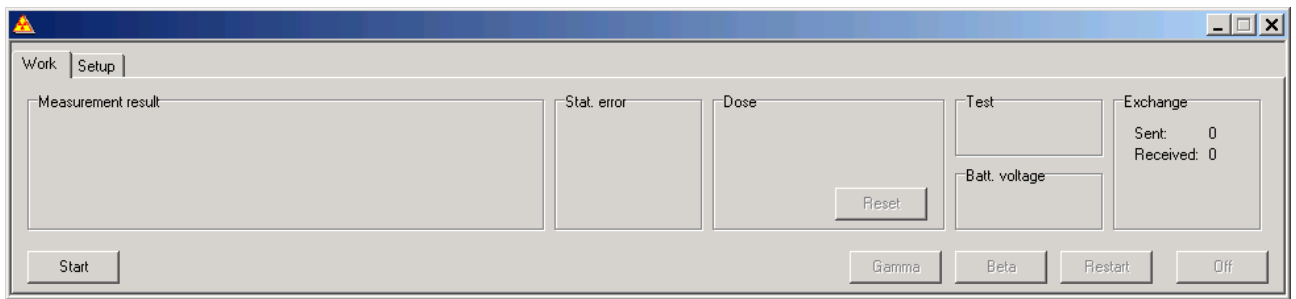


Figure 3 – Program window with the activated **Work** bookmark. The PC is waiting for connection with the device.

The PC is now waiting for connection with the device (accepts the “Exchange start” frame from the device and sends “Exchange start confirmation” frame in response). As soon as the connection is established, the PC starts working with measurement results of the device.

When the RKS-01 “STORA” is being connected, operation with measurement results is done in the following way. The PC transmits “Measurement result request” frame with 1 s interval, accepts “Current measurement result” frame in response and displays its information in the program’s window. The “DE request” frame is not transmitted because RKS-01 “STORA” does not measure DE.

Operation with measurement results from MKS-05 “TERRA” slightly differs from operation with measurement results from RKS-01 “STORA”. When MKS-05 “TERRA” is being connected, the PC transmits “Measurement result request” frame with 1 s interval, accepts “Current measurement result” frame in response and displays its information in the program’s window. But instead of every tens frame “Measurement result request”, the PC sends “DE request” frame and, correspondingly, accepts “DE” frame in response and displays its information in the program’s window.

Program window view with information received from MKS-05 “TERRA” is given in Figure 4.

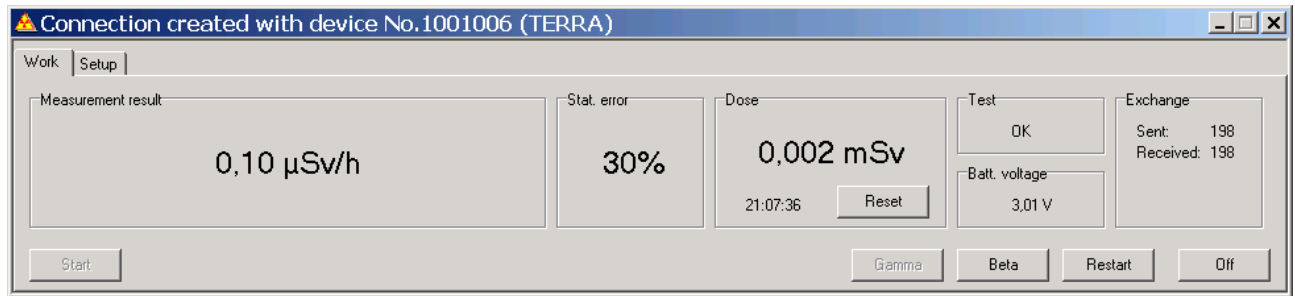


Figure 4 – Program window with activated **Work** bookmark after connection with the device was established.

The following grouped data is displayed:

- **MEASUREMENT RESULT** – measurement result of photon-ionizing radiation DER or beta-particles flux density is displayed here. Unreliable measurement result is grey, reliable – black (concerning information reliability, see the operating manual of the device).
- **Stat. error** – statistical error of measurement result is displayed here.
- **Test** – indicates a self-testing result of the device. **OK** message is indicated when the device functions properly. **Counters** message is indicated at failure of Geiger-Muller counters of the device, and **Battery** at failure of the batteries. Failure messages appear in red color.
- **Battery voltage** – battery voltage is displayed here.
- **Dose** (active only for MKS-05 “TERRA”) – indicates DE accumulated value, DE accumulation time and **Reset** button to reset the values. If this button is clicked, the PC stops working with measurement results of the device (stops sending request frames “Measurement result request”, “DE request”) and sends request frame “Clear DE”. The PC resumes operation with measurement results of the device as soon as the “Confirmation” frame is received.
- **Exchange** – indicates the quantity of data frames that have been sent to the device and received from it.

In the bottom of the **Work** bookmark there are **Start**, **Gamma**, **Beta**, **Restart** and **Off** buttons. Buttons function in the following way:

- **Start** – starts the program via Bluetooth interface – the PC waits for connection with the device (waits for “Exchange start” frame acceptance from the device and sends it “Exchange start confirmation” frame), and after connection establishment – starts working with measurement results of the device (sends request frames “Measurement result request” or “DE request” with 1 s interval and displays received information).
- **Gamma** – Switches the operating mode of the device. Click this button to make PC stop working with measurement results of the device and send the request frame “Operating mode selection” with the mode number 2 (DER measurement). On receipt of the “Confirmation” frame, the PC resumes working with measurement results of the device.
- **Beta** – Switches the operating mode of the device. Click this button to make PC stop working with measurement results of the device and send the request frame “Operating mode selection” with the mode number 3 (measurement of beta-particles flux density). On receipt of the “Confirmation” frame, the PC resumes working with measurement results of the device.
- **Restart** – Restarts measurement process of the device. Click this button to make PC stop working with measurement results of the device and send the request frame “Operating mode selection” with the mode number 255 (measurement restart). On receipt of the “Confirmation” frame, the PC resumes working with measurement results of the device.

- **Off** – Switches off the device. Click this button to make PC stop working with measurement results of the device and send the request frame “Operating mode selection” with the mode number 1 (switching off). On receipt of the “Confirmation” frame, the PC displays information about switching the device off in the program window heading. The program is ready to work with a different device.