

The Dosimetry Protection of the MPD Electronic Equipment at the new NICA Collider – the prototype system



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Schedule

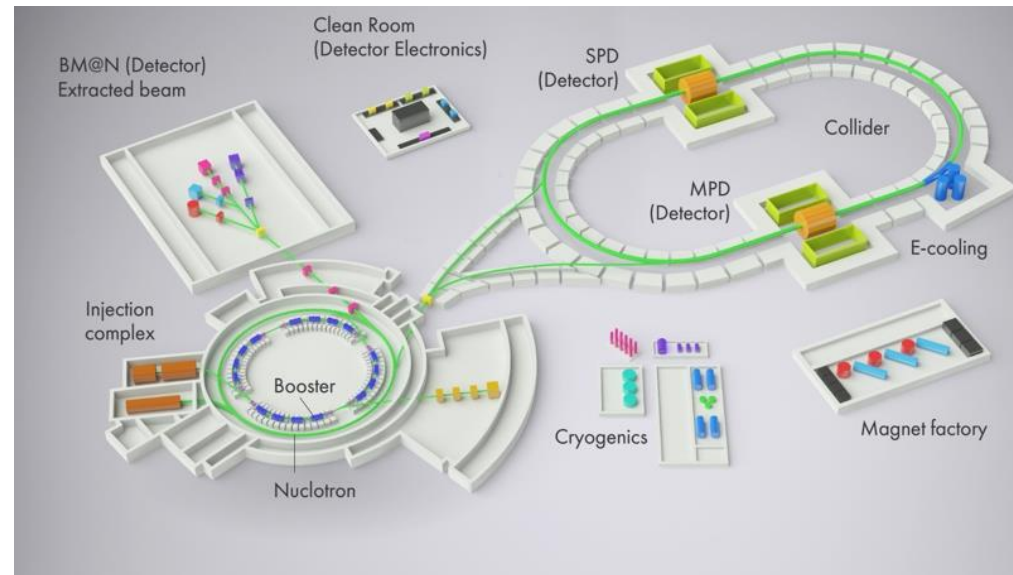


- NICA Complex and MPD
- Motivation
- Dosimeters
- Dosimetry software and data file structure
- Test stand and results
- Plans for year 2020



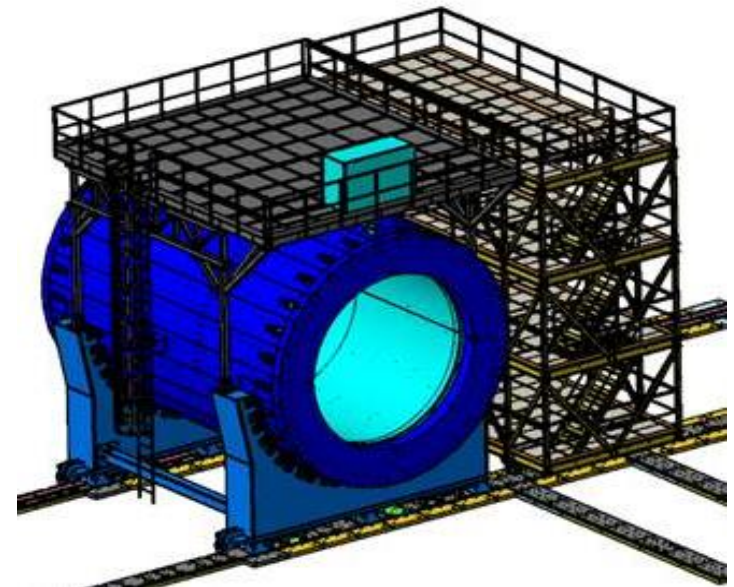
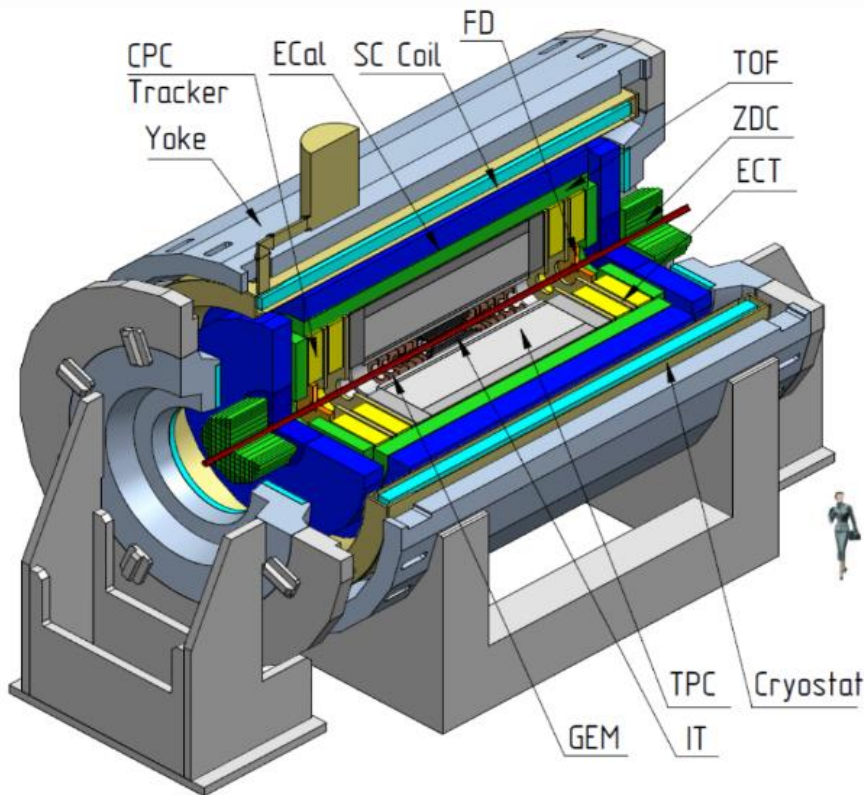
NICA Complex and MPD

- The New Experimental NICA Complex
 - ✓ Heavy and Light Ion Source
 - ✓ Linacs Accelerators
 - ✓ 1st Accelerator Ring (BOOSTER)
 - ✓ 2nd Accelerator Ring (NUCLOTRON)
 - ✓ Experimental Stand (BM@N)
 - ✓ Collider Ring (NICA)
 - ✓ Detector Sets (SPD and MPD)



• The MPD Detector Set

- ✓ TPC, TOF, eCAL and other subdetectors
- ✓ Magnets and Cryogenics system
- ✓ Support for Slow Control Electronic Equipment



• The MPD Slow Control System

- ✓ Power Supply System
- ✓ Gas Distribution System
- ✓ Temperature Control System
- ✓ Fire Protection System
- ✓ Dosimetry System



Motivation

- Continuous monitoring of radiation level
- Measurements in fixed time intervals
- Slow Control electronic equipment protection against too high radiation doses
- Automatic alarming in case of crossing respective safety radiation levels
- The reviewing of historical data in case of finding the radiation leakage source



Utilized dosimeters

Type	EKO-C	EGM-104
Measuring range	10 nSv/h – 1 mSv/h	10 nSv/h – 10 Sv/h
Number of GM tubes	1	3
Gamma energy range	50 keV – 1500 keV	40 keV – 3000 keV
Interfaces	RS-485	RS-485, RS-232, USB
Manufacturer	POLON-EKOLAB	NuviaTech Instruments
Country	Poland	Czech Republic

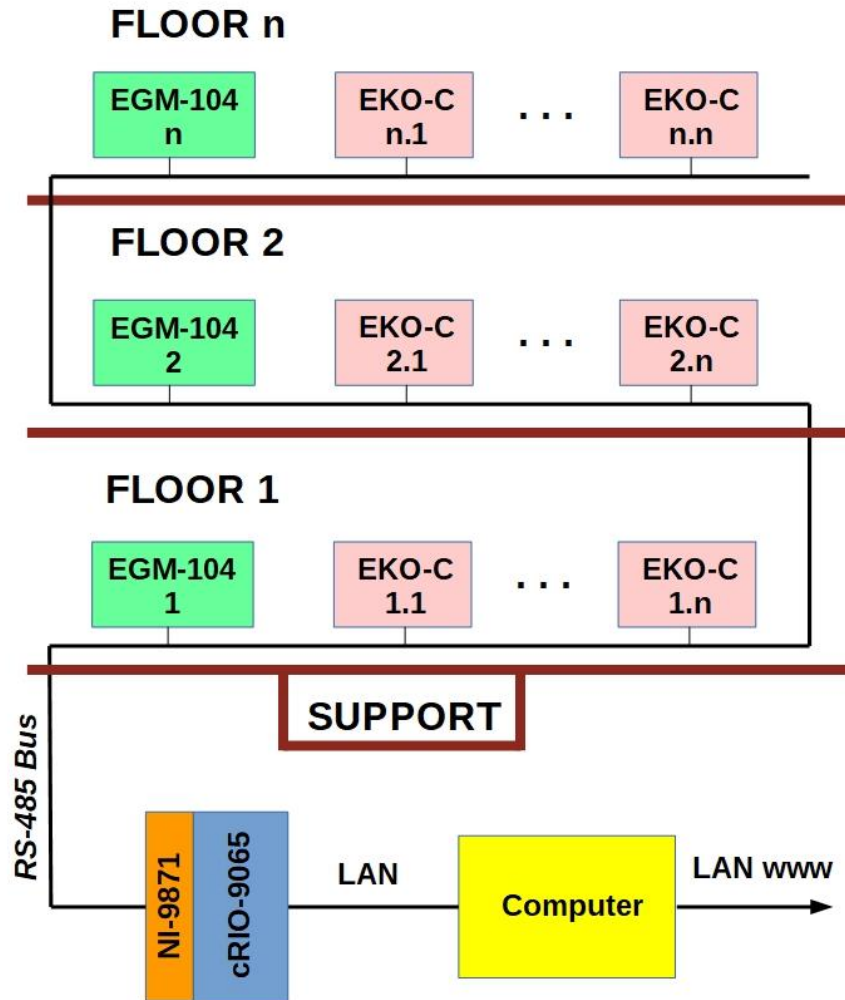


EKO-C



EGM-104

Dosimetry bus and dosimeters placement



Racks for Slow Control electronic equipment

Dosimetry software

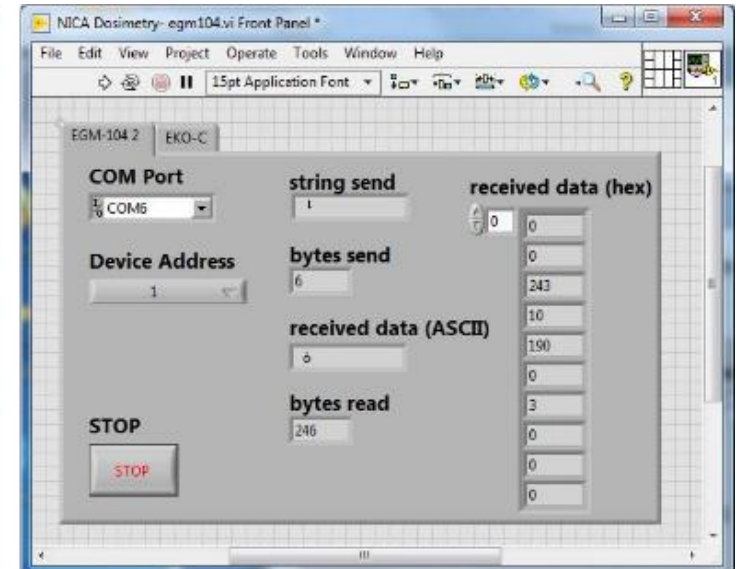
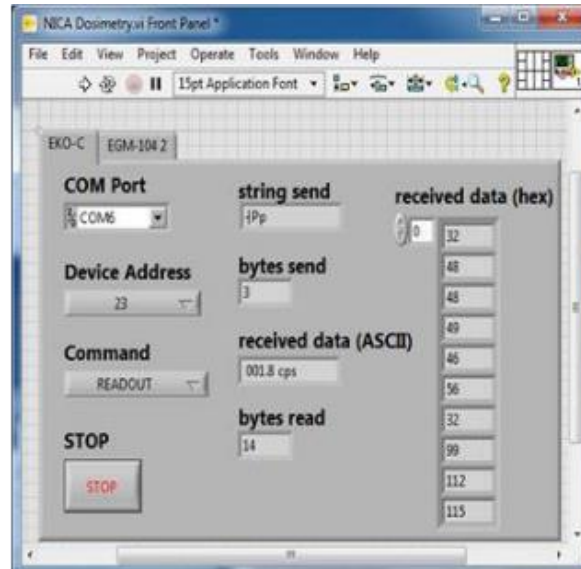
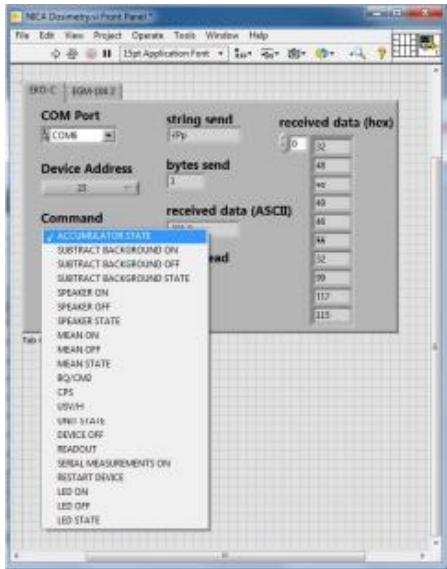
- Control software
 - ❖ written in National Instruments graphical language LabVIEW
 - ❖ user Interface for setting, monitoring and control the dosimetry system
 - ❖ PC computer and Compact RIO versions
 - ❖ visual data presentation (diagrams, charts etc.)
 - ❖ few alarming levels
 - ❖ archiving utility



cRIO-9065

• Software access levels

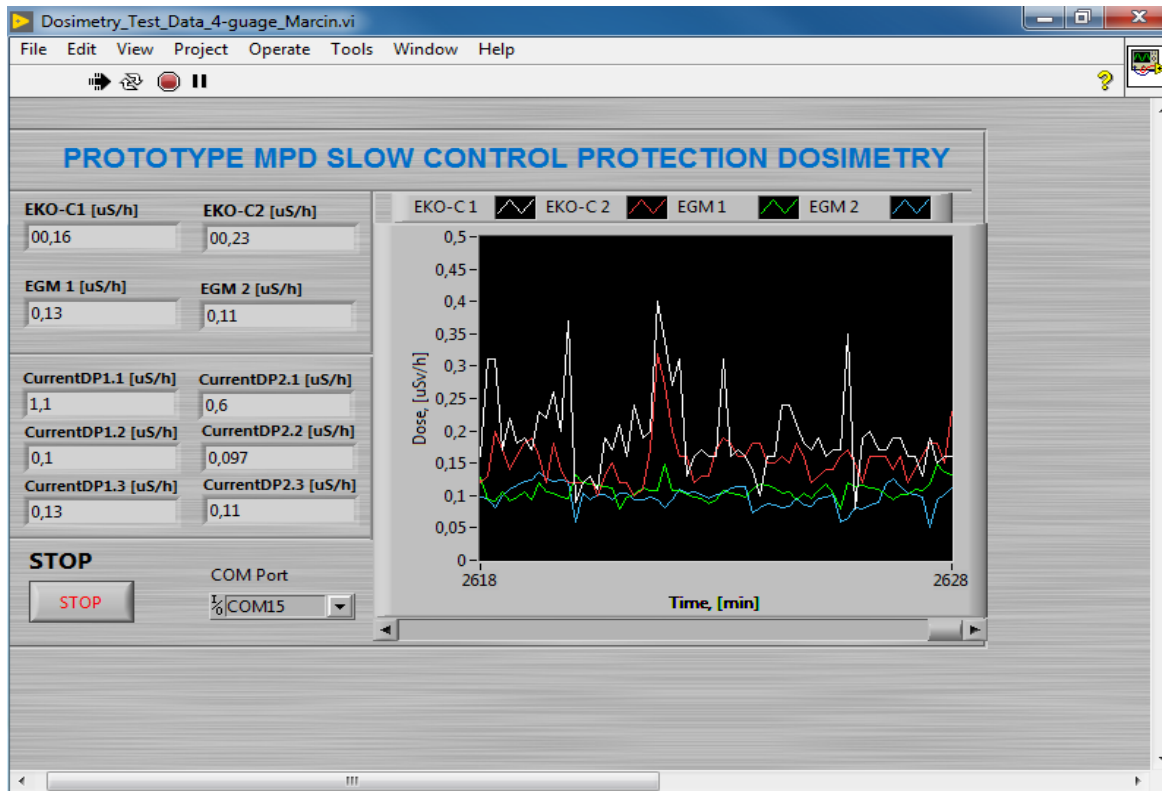
- ❖ **Run Panel** – for reviewing data only, no rights to change anything
- ❖ **Test Panel** – reviewing data, changing the system settings in limited range
- ❖ **Service Panel** – full access granted for data reviewing, archiving and changing the settings of the dosimetry system



Screenshots of Service Panel GUI

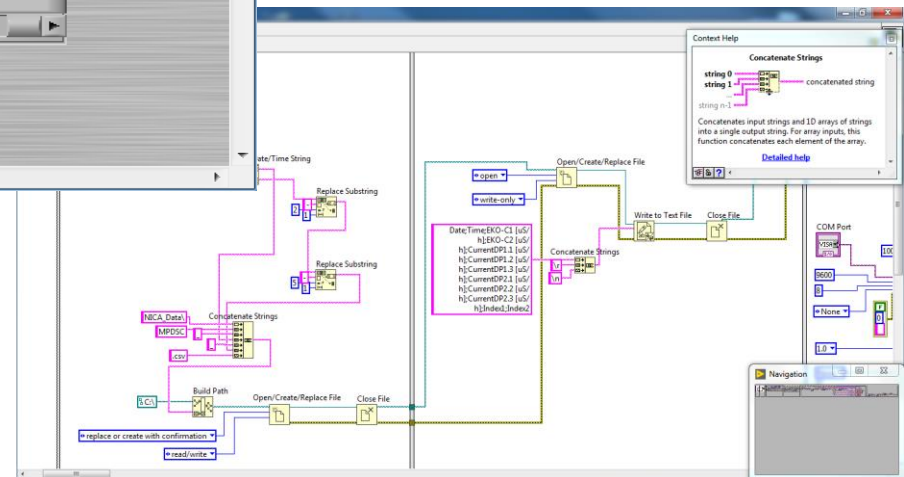


• Software access levels



Run Panel GUI

LabVIEW program example





Data file structure

- Comma Separated Values (CSV) file (possible charts viewing in Excel)
- First record is header
- Rest lines are data
- Each line ends with <CR><LF>

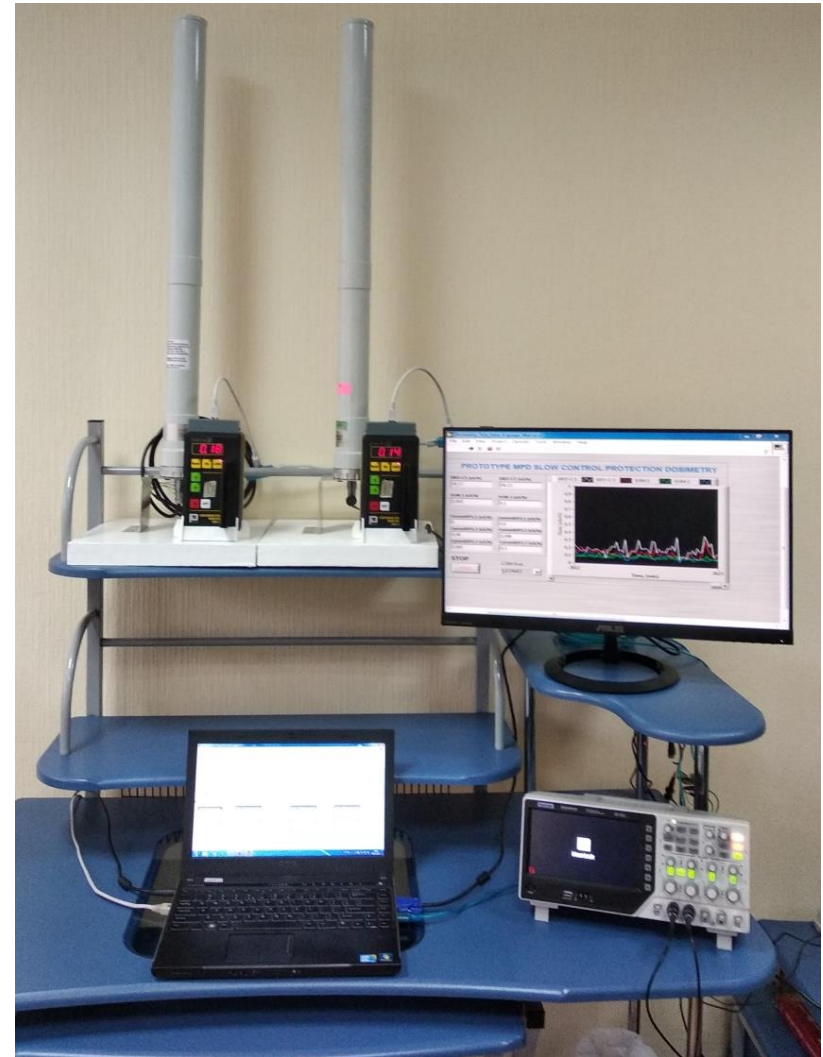
Date	Time	EKO-C1 [uS/h]	EKO-C2 [uS/h]	CurrentDP1.1 [uS/h]	CurrentDP1.2 [uS/h]	CurrentDP1.3 [uS/h]	CurrentDP2.1 [uS/h]	CurrentDP2.2 [uS/h]	CurrentDP2.3 [uS/h]	Index1	Index2
04.10.2019	11:05:07	0,1	0	0	0,423576	0	0	0	0,129262	0	0
04.10.2019	11:05:17	0,21	0,18	0	0,12547	0,08278	0	0,077575	0,097612	0	0
04.10.2019	11:05:27	0,16	0,1	0	0,133448	0,096163	0	0,132755	0,11779	0	0
04.10.2019	11:05:37	0,2	0,15	0	0,136317	0,110398	0	0,102153	0,123187	0	0
04.10.2019	11:05:47	0,16	0,14	0	0,137659	0,109052	0	0,099034	0,110193	0	0
04.10.2019	11:05:57	0,11	0,19	0	0,148868	0,102568	0	0,086948	0,106939	0	0
04.10.2019	11:06:07	0,12	0,22	0	0	0,041078	0	0,078804	0,125602	0	0
04.10.2019	11:06:17	0,13	0,23	0	0,07809	0,072013	0	0,065554	0,107654	0	0
04.10.2019	11:06:27	0,15	0,19	0	0,083558	0,082134	0	0,08148	0,123085	0	0
04.10.2019	11:06:37	0,09	0,16	0	0,068648	0,080118	0	0,08815	0,111769	0	0
04.10.2019	11:06:47	0,07	0,11	0	0,060971	0,084789	0	0,098703	0,110193	0	0
04.10.2019	11:06:57	0,12	0,13	0	0,066579	0,107165	0	0,107361	0,106941	0	0
04.10.2019	11:07:07	0,14	0,16	33,025238	0	0,08868	0	0,105905	0	0	0
04.10.2019	11:07:17	0,14	0,12	3,632849	0,031196	0,113918	0	0,112696	0,081709	0	0
04.10.2019	11:07:27	0,23	0,16	1,922145	0,058742	0,115382	0	0,114797	0,078956	0	0
04.10.2019	11:07:37	0,12	0,14	1,306782	0,085522	0,114032	0	0,116621	0,081719	0	0

Data file structure



Test stand and results

- All dosimeters connected to half-duplex RS-485 bus
- Special connectors made based on RJ-50 connector
- RS-485 Bus connected to PC with USB-RS485 converter
- The RS-485 Bus is expandable
- The Run Panel GUI displayed on additional monitor
- Testing RS-485 signals on Oscilloscope



Test stand in JINR

- **RS-485 Bus and its components**



Dosimeters with RS-485 Bus



RS-485 Bus components



EKO-C Bus connector



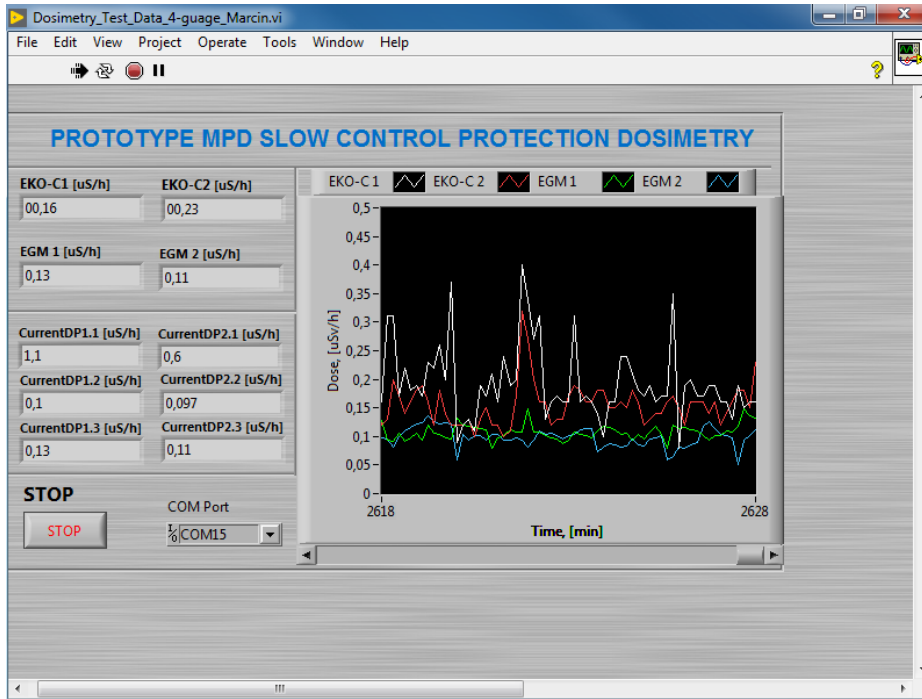
RS-485 Bus splitter



RS-485 Bus signals and power (+12V)



• Test results



The last collected data values and charts shown on a monitor

Date	Time	EKO-C1 [uS/h]	EKO-C2 [uS/h]	CurrentDP1.1 [uS/h]	CurrentDP1.2 [uS/h]	CurrentDP1.3 [uS/h]	CurrentDP2.1 [uS/h]	CurrentDP2.2 [uS/h]	CurrentDP2.3 [uS/h]
07.10.2019	15:15:27	0,08	0	0	0	0,189803	0	0	0,219836
07.10.2019	15:15:37	0,18	0,17	0	0,031347	0,11956	0	0	0,097612
07.10.2019	15:15:47	0,19	0,32	0	0,083732	0,1156	0	0	0,087393
07.10.2019	15:15:57	0,15	0,12	0	0,085639	0,114171	0	0,001132	0,0931
07.10.2019	15:16:07	0,15	0,16	0	0,086623	0,114867	0	0,022575	0,088924
07.10.2019	15:16:17	0,15	0,17	0	0,066635	0,116438	0	0,045929	0,092108
07.10.2019	15:16:27	0,16	0,21	0	0,423942	0	0	0,078859	0,129262
07.10.2019	15:16:37	0,16	0,17	0	0,031351	0,124827	0	0,095163	0,087205
07.10.2019	15:16:47	0,22	0,19	0	0,058868	0,101714	0	0,088007	0,103969
07.10.2019	15:16:57	0,24	0,15	0	0,085643	0,08654	0	0,082419	0,115665
07.10.2019	15:17:07	0,23	0,1	0	0,137793	0,100583	0	0,072732	0,110295
07.10.2019	15:17:17	0,22	0,13	0	0,138692	0,100348	0	0,083726	0,104728
07.10.2019	15:17:27	0,16	0,11	0	0	0,189803	0	0,088562	0,038735
07.10.2019	15:17:37	0,17	0,13	0	0,219604	0,088042	0,625537	0,08062	0,071576
07.10.2019	15:17:47	0,2	0,1	0	0,133455	0,104496	0,625268	0,073804	0,070818
07.10.2019	15:17:57	0,22	0,1	0	0,102535	0,106629	0,621501	0,07137	0,083703
07.10.2019	15:18:07	0,2	0,11	0	0,099418	0,106299	0,618315	0,073773	0,066075
07.10.2019	15:18:17	0,19	0,11	0	0,07693	0,107245	0,615448	0,079642	0,084079
07.10.2019	15:18:27	0,24	0,09	0	0	0,091618	0,656595	0,080216	0,03877
07.10.2019	15:18:37	0,26	0,12	0	0,12547	0,124827	0,652026	0,083466	0,08199
07.10.2019	15:18:47	0,21	0,12	0	0,083732	0,110048	0,647912	0,083775	0,081867
07.10.2019	15:18:57	0,2	0,11	0	0,102535	0,106629	0,644187	0,084055	0,093103
07.10.2019	15:19:07	0,31	0,12	0	0,086626	0,103442	0,640798	0,089073	0,091774
07.10.2019	15:19:17	0,24	0,11	0	0,087225	0,102649	0,637703	0,086821	0,093257
07.10.2019	15:19:27	0,22	0,09	0	0	0,034863	0,638063	0,091306	0,038831
07.10.2019	15:19:37	0,2	0,13	0	0,125482	0,093306	0,632251	0,091244	0,097612
07.10.2019	15:19:47	0,21	0,17	0	0,108593	0,110048	0,629838	0,093201	0,112258
07.10.2019	15:19:57	0,13	0,17	0	0,119428	0,114175	0,627602	0,095014	0,117546
07.10.2019	15:20:07	0,1	0,14	0	0,099418	0,116298	0,625525	0,096697	0,110286
07.10.2019	15:20:17	0,17	0,2	0	0,087225	0,119891	0,623593	0,101886	0,10817
07.10.2019	15:20:27	0,33	0,16	0	0,189967	0,621786	0,699728	0,099728	0,08337
07.10.2019	15:20:37	0,08	0,13	0	0,172551	0,14585	0,620998	0,099409	0,123653
07.10.2019	15:20:47	0,27	0,12	0	0,108999	0,115066	0,618514	0,097467	0,106732
07.10.2019	15:20:57	0,18	0,14	0	0,102535	0,110402	0,617025	0,100414	0,098743
07.10.2019	15:21:07	0,23	0,13	0	0,125003	0,100585	0,615624	0,103188	0,103173
07.10.2019	15:21:17	0,13	0,13	0	0,107815	0,10035	0,614303	0,105804	0,102434
07.10.2019	15:21:27	0,19	0,13	0	0	0,613054	0,108276	0,129366	0,129366

The data file loaded into MS Excel

Plans for year 2020

- Investigation of ionizing radiation influence on the different types of electronic devices
- Definition of the exact level of radiation dose from which an alarm should be sent to supervisor
- Addition of other probe type(s) (detection of short gamma irradiation pulses and **neutron monitoring**)
- The LabVIEW control software development and integration with other Slow Control systems



Thank you for your attention!

