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Digital Reactivity Meter
NFA-09.03

Contents

1. Digital Reactivity Meter

Features:

- Detector: fixed position compensated ionisation chamber
- Neutron flux and period time and reactivity measurement
- Typical measuring range: 10^4 to $5*10^{10}$ nv (compensated ionisation chamber)
- Period time range: -3 s ∞ +3 s
- Trip signals: power level, period time
- Self testing capability
- % Power, Current range logarithmic power, period time, reactivity outputs.

2. Operation

Main components of the NFA-09.03 Digital Reactivity Meter:

1. Compensated ion chamber probe with max. 200m long cable.
2. RNL-03.02 Compensated Ion Chamber Analogue Module.
3. Max. 200 m cables to interconnect the analog modules and processing compartment.
4. NFA-05.06 Current Range Neutron Flux Data Processor(CR-NFDP).
5. DCL 02 Keyboards & Display.

2.1.1. Compensated Ionisation Chamber Probe

The detector KNK-53M is a ^{10}B lined, gamma compensated ionisation chamber for detection of thermal neutrons in a flux range of 10^4 to $5*10^{10}$ nv. During out-of-core measurement neutrons are to be detected in the presence of a strong gamma field, and as a consequence the ionisation current caused by gamma radiation exceeds the current originating from neutrons. In a compensated ionisation chamber a second ionisation chamber detecting only gamma is placed as well. The signal from the gamma chamber (gamma sensitivity is $1,5*10^{-12}$ A/r/H) may be used to cancel the gamma contributions to the neutron chamber signal (neutron sensitivity $4*10^{-14}$ A/nv). The probe is design and constructed from materials that minimise the effects of activation.

2.1.2. Compensated Ionisation Chamber Analogue Module RNL-03.02

- Measuring range: 10^{-11} to 10^{-3} A (in 8 ranges)
- Neutron flux measurement in intermediate and power ranges
- High voltage generators: included (positive and negative)
- Computer interfacing:
  - Multiline: analogue and digital signals without intelligence.
  - RS 485 serial I/O
- Powered from single power supply

The Compensated Ionisation Chamber Analogue Module RNL-03.02 receives the signal of compensated ion chamber probe.
The module is located in a double-shielded box near to the detector (max. 25-m) but out of the reactor vessel. It is built in massive brass housing to protect from electro-magnetic interference waves and cross coupling. This unit is installed isolated into additional die-cast aluminium housing. This insulated installation provides an additional protective screen. Maximum 200-m long cable ensures the electrical connection between the analogue module and CR-NFDP.

The current from an ionization chamber, with the values of 10^{-11} to 10^{-3} A, is fed to the equipment through a coaxial cable. A linear DC amplifier with 8 switch able ranges converts detector signal into a measurement current of 0/4…20 mA. The range switching is accomplished by automatic or manual manner, depending on the state of AUT/MAN signal. In manual state the range is controlled by RANGE UP or RANGE DOWN binary signals controlled electronic stepping-switch system. The TEST GEN. is controlled from TEST ON input. If this level is high, a 5 μA current is switched to the amplifier.
The positive and negative HV power supplies are built up of encapsulated circuits surrounded by current-loop driven isolated set-value controls and HV-monitoring isolation amplifiers. Both set-value control signals (HV+CNTR and HV-CNTR), and monitoring signals (HV+MON and HV-MON) are connected to RS 485 serial I/O lines.
The primary supply of power enters the board. Transient protection from the outside world is done by fuse diode. It saves the inputs of a four-member group of isolated DC-DC converters from damages. The unit also contains an isolation amplifier-current loop function to get the primary power monitoring signal (MON POWER S) output.

2.1.3. *Current Range- Neutron Flux Data Processor (CR-NFDP) -NFA-05.06*

The signals from fission chamber analogue module and from compensated ion chamber module are further processed in the Current Range-Neutron Flux Data Processor (CR-NFDP) NFA-05.06.
Components of the CR-NFDP:

1. RNL-03.02 module interface;
2. Main processor modules;
3. Interfacing;
4. Low voltage power supply;
5. DCL 02 keyboard & display board.

The modules are situated in a 19" rack. On the front panel the operator interface is accomplished via DCL-02 keyboard & display board. The power switch, SERVICE lock switch, mains connector and fuse are on the back panel. ANALOG MODULE, with corresponded SAFETY and CONTROL DESK connectors are situated on the interface units. An RS 485 connector and other organs that are important from the point of view of usage are placed on the back panel. In addition, there are still several terminals on the back panel, which are mainly important on servicing.
Analogue and digital lines carry out the signal exchange between analogue modules and CR-NFDP. For analogue signal exchange 0/4…20 mA decoupled current loop signals are used because nearly interference free transmission. For digital signal exchange potential free relay contacts ensures the decoupling. The frequency and serial interface signals are transmitted and decoupled according to RS485A standard.

<u>RNL-03.02 module interface</u>

The conditioned detector signals (CURRENT, RANGE) are led to the RNL-03.02 module interface. The signals are led by the way of 0/4…20 mA decoupled current loop. Software controlled AD converters receive the conditioned detector signals.

The following values are calculated from the DC power signal:

1. Linear level from 10^4 to $5*10^{10}$ nv is measured. In this multirange function the equipment converts the DC power signal into linear power ranges. This feature provides more precise reading of linear power level. The multirange function is either auto range or slaved to an operator’s switch. This function is scoped to accurate measurement of power in intermediate and power ranges.
2. On the logarithmic power output the power signal in logarithmic scale is presented. This function provides for the reading of eight-decade power magnitude (10^4 to $5*10^{10}$ nv) in a single range.
3. Period time and reactivity calculation. The measure for the relative rate of change in neutron flux density is derived from the DC power signal.
4. Limit value (trip) monitoring. The signals of the measuring channels are supervised by the limit value monitor system. The level excess monitoring (trip) operates on the base of the 1, 3 signals. The module provides isolated digital output signals for the safety logic through SAFETY connector. ALARM or WARNING lamps on the front panel of DCL-02 lights if any of the alarm or warning situations have occurred. In the following the most important safety functions are listed:
   - Power Alarm: if the power level exceeds the PWR120% value the alarm signalisation is activated;
   - Power Warning: if the power level exceeds the PWR110% value or decreases under the PWR10% value the warning signalisation is activated;
   - Period Alarm: if the period time is less than the PER10s value the alarm signalisation is activated;

- Period Warning: if the period time is less than the PER20s value the warning signalisation is activated;

The 1-3 signals are led to REMOTE connector as isolated 0/4…20 mA outputs.
The A/D converter receives current and range signals and power supply signal of RNL-03.02 module.
Digital outputs control the 5 μA test generator, the range of the DC amplifiers and the operating mode.
Watchdog unit supervises the proper operation of the whole digital processing hardware. An operating status signal (WORK) shows if the program goes to a wrong path or the self-monitoring system shows malfunction situation. The WORK lamp shows the state of the watchdog unit.

<u>NFL-05.06 main processor module</u>

An internal communication line ensures data exchange to interface modules and control panel.

The following values are calculated from the extended Current range power signal:

1. Linear level from 10^4 to $5*10^{10}$ nv is measured of linear power level over the entire range of reactor power. The multirange function is either auto range or slaved to an operator's switch. Automatic range selection is performed in the NFL-05.06 module. This function is scoped to accurate measurement of power in source and intermediate ranges.
2. On the logarithmic power output the power signal in logarithmic scale is presented. This function provides for the reading of 6.5-decade power magnitude in a single range.
3. Period time and reactivity calculation. The measure for the relative rate of change in neutron flux density is derived from the power signal.
4. Limit value (trip) monitoring. The signals of the measuring channels are supervised by the limit value monitor system. The level excess monitoring (trip) operates on the base of the 1, 3 signals. The module provides isolated digital output signals for the safety logic through SAFETY connector. ALARM or WARNING lamps on the front panel of DCL-02 lights if any of the alarm or warning situations have occurred. In the following the most important safety functions are listed:
    - Power Alarm: if the power level exceeds the PWR120% value the alarm signalisation is activated;
    - Power Warning: if the power level exceeds the PWR110% value or decreases under the PWR10% value the warning signalisation is activated;
    - Period Alarm: if the period time is less than the PER10s value the alarm signalisation is activated;
    - Period Warning: if the period time is less than the PER20s value the warning signalisation is activated;

The 1-3 signals are led to REMOTE connector as isolated 0/4…20 mA outputs.
Watchdog unit supervises the proper operation of the whole digital processing hardware. An operating status signal (WORK) shows if the program goes to a wrong path or the self-monitoring system shows malfunction situation. The WORK lamp shows the state of the watchdog unit.

Interfacing
Primary function of the module, in addition to the mentioned level excess monitoring, is to establish man-machine connection, and to produce accessibility of the measured data via a serial interface.
In remote mode the trip reset and range control can be realised through REMOTE rear panel connectors.
By means of a key lock the operator can determine the operating mode. In OPER mode the equipment provides alarms (trips) when period and/or neutron flux level exceeds the set point value(s).
During testing cycle the power level outputs are automatic calibrated. The power trip outputs are checked also automatically. Detection of unacceptable situation causes "electronic fault" alarm.
Functional capabilities are testing during reactor operation and during outages because the entire system is self-monitored. All adjustable parameters of the neutron monitoring assembly like discriminator threshold, high voltage value, power factor, etc. are testing periodically. Failures or deviations from reselected values are indicated immediately.

DCL 02 keyboard & display board.
Operator interface is accomplished via a 4x20 character Current vacuum fluorescent display and a keyboard of 23 push buttons. In LOCAL mode by means of the keyboard one can control the operation of the whole channel, set measuring range, changing display picture, controlling test, power etc.

3. Reactivity Computing

The reactivity meter method for measuring a reactivity worth of control rod is easy and simple, and the full curve showing the relation of reactivity to rod position can be obtained in a few minutes. Furthermore, from the point of view of reactor safety, the reactivity meter should be applicable as a tool in reactor instrumentation.
Changing its reactivity by moving control rods, by modifying the boron acid concentration, etc, controls the reactor. The change in the reactivity brought about in this way is measured by the time variations of the neutron.
Instead of reactivity it has been a general practice the measurement of the reactor period, that is, the time derivative of the logarithmic power. It might be considered a rough measure of reactivity provided that the reactor is near critical and the transient phenomena due to delayed neutrons have already decayed. In order to eliminate this ambiguity reactivity meters are generally used.

3.1. Theoretical Principles

The condition of a nuclear reactor is monitored - among others - by measuring the neutron flux. This parameter permits the calculation of the reactor's most important time dependent parameter, the reactivity. Continuous information on its value is highly useful.
The multiplication factor k can be assimilated to the term "reactivity" (ρ):

$$\rho = \frac{k-1}{k}$$

Fundamentally ρ is a non-dimensional number.

Several measures of reactivity:
1 pcm = 10^{-5}
1 % = 10^{-2}
1 $ = β
Where β is the delayed neutron fraction in the fission process.

The measurement of reactivity can be only made in an indirect way. It must be deduced from the evaluation of the neutron density.
The time dependent behavior of neutron density in a thermal reactor can be described by the reactor kinetic equations assuming no space dependency.
A mathematical model of a reactor is given by the point kinetic equation system, which employs the following assumptions:
1/ The reactor is treated in a point-like manner, i.e. homogeneous spatial distribution of the neutron flux is assumed.
2/ In addition to the prompt neutrons from nuclear fission, the influence of the delayed neutrons appearing later is also taken into consideration.
3/ Delayed neutrons are divided into a finite number of groups of different decay constants (most frequently one or six per isotope).
4/ The combined effect of two or more isotopes (e.g. 235U and 238U) in the fission process can also be traced by means of the point kinetic equation system.
The point kinetic equation system is formulated as follows:

$$\frac{dn}{dt} = \frac{\rho \bullet n}{l^*} - \sum_{i,j} \frac{dC_{ij}}{dt} + S$$

$$\frac{dC_{ij}}{dt} = \beta_{ij} \bullet \frac{n}{l^*} \bullet \alpha_j - \lambda_{ij} \bullet C_{ij}$$

$$\alpha_j = \frac{f_j \bullet \nu_j}{\sum_j f_j \bullet \nu_j}$$

Where:
n - neutron density
ρ - absolute value of the reactivity;
l* - mean lifetime between neutron generation and collision
C_{ij}- concentration of the precursors of i-th delayed neutron group deriving from a j-type fuel element,
S - neutron density from an external neutron source,
β_{ij}- fraction of i-th delayed neutron group from j-type fuel element (related to all generated neutrons from j-type fuel element) ,
λ_{ij}- decay constant of the precursor of i-th delayed neutron group from j-type fuel element,
f_j- percentage of fissions in a j-type fuel element (related to all fissions) ,
v_j- number of neutrons emitted by a single fission of an atom in the j-type fuel element.

3.2. Description of Operation

After calculating the actual power level of the reactor, subtracting it from the previous power levels the instrument computes the reactivity output signal with the special algorithm. The computed reactivity value appears on the display in digital form.
The reactor physical parameters (β_i, Λ_i, C_i, l) can be set through keyboard.

4. Quality Assurance

QUALITY ASSURANCE (QA) and TEST & INSPECTION PROCEDURES

For the nuclear instrumentation RegTron has established quality system documented by a quality manual covering the requirements of the International Standard ISO 9001:2000 today.

RegTron accepts the requirements, criteria and standards promulgated by IEC that must be incorporated into design and manufacture of any nuclear instrumentation system designed by them. The management of RegTron ensures that these standards are upheld throughout the procurement and manufacturing cycles by establishing appropriate controls at critical points such as receiving inspection of components and subassemblies, in-process inspection and subassembly testing, final system's test, shipping inspection and customer installation.

After the orders QA Organizations will be established for each project. The QA Organization will be led by a manager having a long practice in engineering and management and has been qualified in QA management by TÜV Akademie Rheinland (Certificate No.: TRA-97-614), too.

RegTron will define and document it's responsibility, authority and the interrelation of personnel who manage, perform and verify work affecting quality, particularly for some persons in QA Organization who need organizational freedom and authority to identify and record any problems relating to the design, production process, testing, product and quality system.

The whole process (project preparations, system and specified design, technical documentation, production, inspection, testing, control of technical and QA documents, packaging, delivery, putting in action, servicing) have to be followed by the QA activities.

Project preparations are executed and organized by the RegTron's project management. The management – after having reviewed the statements of requirements - defines and documents the specifications, the technical tasks for the measuring system and subsystems, the organizing duties during the whole process, the main requirements in conformity with the international standards and recommendations related to nuclear instrumentation. The management defines with executive responsibility defines and documents the QA requirements and it's quality policy which shall be implemented and maintained at all levels of the process organization. The QA activities are executed by the mentioned QA organization existing parallel with the Project Organization.

Preparing the **Development Plan** and linked **Quality Assurance (QA) and Quality Control (QC) Plans** and **Verification & Validation Plan** is the very important part of the project preparation.

RegTron prepares plans for each **design and development** activity. The plans describe or reference these activities and define responsibilities of persons or groups for their implementation. The design has to be assigned to qualified experts and organizations equipped with adequate resources. Organizational and technical interfaces between groups, companies of the design process have to be defined, documented and regularly reviewed.
Even in the design phase RegTron has to define the safety classification, providing the safety level to ensure the appropriate reliability, performance, environmental durability, with regard to the prescriptions, recommendations and normative references of the International Standard IEC 1226 and the IAEA Safety Guides.

Design outputs have to be documented in terms that can be verified and validated on the basis of the input requirements. Design output documents shall be reviewed before release.

In the cause of ensuring the suitability of the purchased products to the specified requirements, RegTron accepts only the materials, components having required certifications, purchasing documents.

Documented procedures shall be established and maintained to **control, approval, review, issue** all **documents and data** including the respecting standards and other documents of external origin such as customer drawings. The project management and it's participants have a similar documentation system procedure ensuring the registration of all documents, identifying the current revision status of documents and eliminating the use of invalid or obsolete documents, automatically. The documents and data and their changes are always reviewed, undersigned and approved for adequacy by authorized persons.

RegTron identifies and plans the **production, corrective action and installation process**es which directly affect quality and ensures that these processes are carried out under controlled conditions. There is a documented procedure for identifying the products i.e. materials, parts, components of the measuring system further the subsystems. The materials, relating to the system, are handled, stored separately and have grouped marking. Each assembly part, equipment are labelled. The components, assembled units, parts have this marking during production and testing process.

Documented procedure is available for **inspection and testing activities** in order to verify that the specified requirements for the products are met. The required inspection and testing are detailed partly in the V&V and QA plans partly in documented procedures. In-process and final inspection and testing are carried out in accordance with the V&V and QA plans to complete the evidence of conformance of the product to the specified requirements during the manufactoring process and after finishing.

In-process and final testing the actual system and its parts means the inspection of their functionality and environmental durability executed by calibrated measuring instruments. The functional tests verify that the equipment is suitable to the technical specification. Testing the environmental tolerance ensures that ageing effects and environmental conditions, that exist at the time the equipment is required to operate, do not degrade it's performance below that required. The effects of changing temperature (IEC 60068-2), electromagnetic compability (IEC 61000-4, EN 50092) for control electronics and seismic vibration (IEC 60068-3) for some sensitive parts are tested.
The environmental measurements will be executed partly by KFKI-RegTron Co., Ltd., partly by Vibration Diagnostic Laboratory in Space Research Department of the Institute for Nuclear Physics, Budapest and Inspecting Institute for Electrotechnics, Budapest.

The inspection and test records, prepared by RegTron, provide evidence that the product has been inspected and tested. These records have to show clearly whether the product has passed or failed the tests according to defined acceptance criteria. Where the product fails to pass any test, the procedures for control of nonconforming product must be applied.

The records identify the inspection authority responsible for the release of product.

The completed Test Results Package shall be submitted as a part of the final documentation.

5. Technical data

5.1. Compensated Ion Chamber Probe

	Detector Type	KNK-53M
	Measuring range	10^{3} to 5×10^{10} nv
	Manufacturer	Russia
	Detector/compensation voltage	+ 500 V/ - 500 V adjustable
	Neutron sensitivity	4×10^{-14} A/nv
	Gamma sensitivity	$1{,}5 \times 10^{-12}$ A/R/h
	Length	472 mm
	Diameter	70 mm
	Operating temperature	- 40 to + 400 ^{o}C

5.2. RNL-03.02 Compensated Ion Chamber Analog Module

1. Picoamper meter

Isolated input	Isolation voltage: 500V max.
Offset voltage	5 mV max. at 25 C^{o}
	0,05 mV/ C^{o} max.
Bias current	10^{-12} A max. at 25 C^{o}
Input resistance	10 kΩ

Input ranges

Range [A]	Accuracy (RTM) [%]	Temperature coefficient [/C^{o}]	Settling Time Filtered output [ms]	Settling Time Direct output [ms]
10^{-10}	±1	0,05 %	1000	< 5 ms
10^{-9}	±0,5	0,05 %	200	< 5 ms
10^{-8}	±0,3	0,03 %	80	< 5 ms
10^{-7}	±0,2	0,02 %	15	< 5 ms
10^{-6}	±0,2	0,02 %	7	< 5 ms
10^{-5}	±0,2	0,02 %	7	< 5 ms
10^{-4}	±0,2	0,02 %	6	< 5 ms
10^{-3}	±0,2	0,02 %	6	< 5 ms

Range control input	
-Number	3 (RANGE UP, RANGE DOWN, AUT/MAN)
- Levels	-33 to 8 V logic 0
	13 to 72 V logic 1
- Isolation	500VDC, 230VAC(between input and internal ground)
Range overlapping failure	< 1 % (RTM)
- Dead time after switching range	10 ms
Analog output	
- Output range	0/4 to 20 mA
- Accuracy	± 1 % (T=25°C, related to end value)
- Voltage test	500 V AC (between output and housing)
- Nonlinearity	< 2×10^{-3} (related to end value)
- Temperature coefficient	Max. 10^{-4} / K
Output select input	
- Levels	-33 to 8 V logic 0 (direct output)
	13 to 72 V logic 1 (filtered output)
- Isolation	500VDC, 230VAC(between input and internal ground)

	- Dead time after selecting output	20 ms
2.	**Test Generator**	
	Input test current	5 µA
	Test control input	
	- Levels	-33 to 8 V logic 0 (no test) 13 to 72 V logic 1 (test)
	- Isolation	500VDC, 230VAC(between input and internal ground)
	External detector-current-test input	
	-Conversation factor	5.5 x 10^{-5} A/10 V
	-Input resistance	181.818 kΩ
3.	**High voltage Power Supply**	
	High voltage setting range (detector)	0 to + 500 V / max. 1 mA
	High voltage setting range (Gamma compensation)	0 to - 500 V / max. 1 mA
	Ripple	Max. 100 mV_{pp}
	Power supply effect	Max. 10^{-4} / V
	Temperature effect	Max. 2 x 10^{-4} / K
	Load effect	Max. 10^{-4} / 0.3 mA
	HV settling	Through RS485 serial interface
	HV monitoring	Through RS485 serial interface
4.	**Communication**	
	Interface	Isolated RS485A
	Rate	57.6 kbaud
	Protocol	ANSI-0
	Length	Max. 100 m..
	Address setting	2 micro switch
5.	**Further Data**	
	External power	
	- Nominal value	24 V DC
	- Deviation	18 to 33 VDC
	- Ripple	Max. 3.6 V_{pp} (on + 24 V)
	- Power consumption	15 W
	Monitoring output of ext. power	
	- Range	0/4 to 20 mA
	- Conversion factor	10 mA / 24 V
	- Loading resistance	Max. 500 Ω
	Operating conditions	
	-Ambient temperature	10 to + 55 ^{o}C
	-Relative humidity	Max. 90 %

5.3. Neutron Flux Data Processor

5.3.1. Analog modules interfacing

1.	**Analog Inputs**	
	- Signals	RNL-03.02 Ion Chamber Module Interface Current Signal Current Range Signal 24 V Power Supply Monitor
	- Range	0/4 to 20 mA
	- Resistance	75 Ω
	-Isolation	500VDC, 230VAC
	- Accuracy	± 1 % (T=25°C)
2.	**Digital Outputs**	
	-Signals	RNL-03.02 Ion Chamber Module Interface Test-on Range-up Range-down Aut/Man
	-Characteristics	Isolated relay contact pairs Contact rate: 50 V/100 mA Isolation: 300 V
3.	**Safety connectors**	
	- Functions	RNL-03.02 Ion Chamber Module Interface ≥ 110 % power: power trip warning ≥ 120 % power: power trip alarm ≤10 % power: power trip warning ≤ 20 s per time: period time warning ≤ 10 s per time: period time alarm WORK SIGNAL
	- Characteristics	Isolated relay contact pairs Contact rate: 50 V/100 mA Isolation: 300 V

4. Remote connector

4.1 Digital Inputs

- Functions	RANGE UP: range up control RANGE DOWN: range down control AUT/MAN: range control mode RESET: TRIP reset OPERATION MODE: automatic, manual, pulsed, square wave
- Characteristics	Optoisolated Voltage / current: 5 V/20 mA Isolation voltage: 300 V dc

4.2 Analog outputs

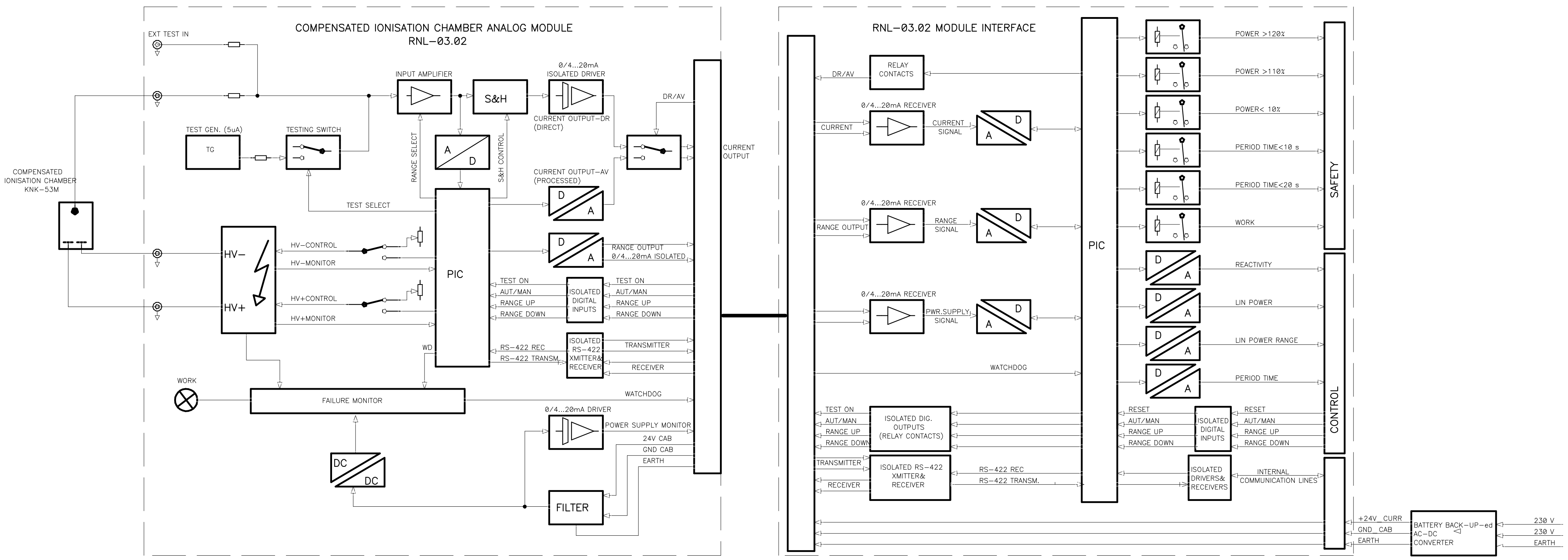
- Functions	REACTIVITYOUT: reactivity analogue signal PEROUT: period time analog signal LIN POWER: multirange analog signal LIN POWER RANGE: range signalisation LOG. POWER: logarithmical analog signal
- Characteristics	Isolation: 300 V dc Current range: 4…20 mA Load resistance: max 500 Ω Accuracy: ± 1 %

5.4. DCL-02 Keyboard & Display

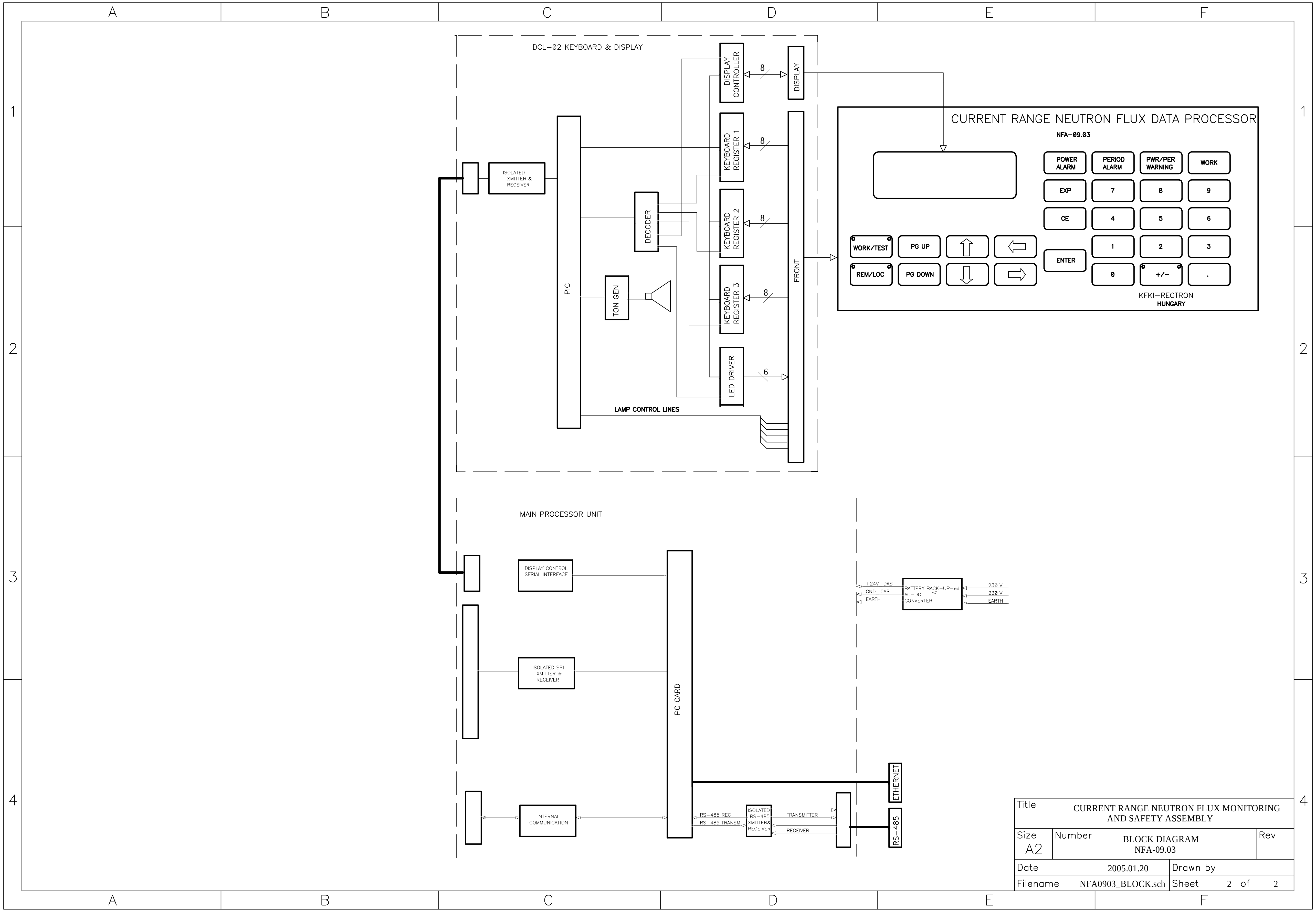
1.	**Display** Displayed values	4x20 characters VFD DC channel range & current level Period time Reactivity Power (W) High voltage levels: HV+, HV- Thresholds of trip monitoring stages Trip signals: • Period time alarm • Period time warning • Power high alarm • Power high warning • Power low warning Operating status: measuring, test Range control mode: automatic, manual. Channel control mode: remote, local.
2.	**Keyboard**	23 push buttons • Numeric characters: 0…9, ±, .,exp • ENTER • Clear enter (CE) • Select (→, ←) • Increase (↑) • Decrease (↓) • Display select (PAGE UP, PAGE DOWN) • REMOTE/LOCAL • WORK/TEST
3.	**Indicator lamps**	• POWER ALARM, • PERIOD ALARM, • POWER/PERIOD WARNING, • WORK
4.	**Switch**	LOCAL RESET

5.5. General

Mains	220 V +10 % - 15 %, 50 Hz, max. 100 VA.
Dimensions	Width: 19" (481 mm). Height: 3U (177mm). Depth: 440 mm.
Ambient temperature	10.to.40 °C
Relative humidity	max 90 %
Mass	10 kg



Title	CURRENT RANGE NEUTRON FLUX MONITORING AND SAFETY ASSEMBLY	
Size A2	Number BLOCK DIAGRAM NFA-09.05	Rev
Date 2005.01.20		Drawn by
Filename NFA0903_BLOCK.sch		Sheet 1 of 2



A B C D E F
1 2 3 4
DCL-02 KEYBOARD & DISPLAY
DISPLAY CONTROLLER
DISPLAY
KEYBOARD REGISTER 1
KEYBOARD REGISTER 2
KEYBOARD REGISTER 3
LED DRIVER
DECODER
TON GEN
PIC
FRONT
ISOLATED XMITTER & RECEIVER
LAMP CONTROL LINES
8
6
CURRENT RANGE NEUTRON FLUX DATA PROCESSOR
NFA-09.03
POWER ALARM
PERIOD ALARM
PWR/PER WARNING
WORK
EXP
7
8
9
CE
4
5
6
WORK/TEST
PG UP
ENTER
1
2
3
REM/LOC
PG DOWN
0
+/-
.
KFKI-REGTRON
HUNGARY
MAIN PROCESSOR UNIT
DISPLAY CONTROL SERIAL INTERFACE
ISOLATED SPI XMITTER & RECEIVER
INTERNAL COMMUNICATION
PC CARD
+24V_DAS
GND_CAB
EARTH
BATTERY BACK-UP-ed AC-DC CONVERTER
230 V
230 V
EARTH
ETHERNET
RS-485 REC
RS-485 TRANSM.
ISOLATED RS-485 XMITTER& RECEIVER
TRANSMITTER
RECEIVER
RS-485
Title
CURRENT RANGE NEUTRON FLUX MONITORING AND SAFETY ASSEMBLY
Size
A2
Number
BLOCK DIAGRAM
NFA-09.03
Rev
Date
2005.01.20
Drawn by
Filename
NFA0903_BLOCK.sch
Sheet 2 of 2