

# PRESSURE MEASUREMENT FOR THE UNK-1 VACUUM SYSTEM

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The required vacuum  $10^{-9}$  Torr at the UNK-1 will be produced by 3900 ion pumps. For pressure measurement in the  $10^{-5}$  —  $10^{-9}$  Torr range the system based on continuous monitoring of all ion pumps currents is being developed as a part of vacuum instrumentation. To cover such a range Current - to - Frequency Converters are used as current monitors. Their outputs pass to the acquisition electronics packaged into Eurocard style. Crates are distributed over 14 surface buildings. This presentation focuses on the measurement principle and the major electronics components.

## I. INTRODUCTION

In the UNK-1 ring vacuum chamber of 20, 7 km length the required working pressure has to be of the order of  $10^{-9}$  Torr. Such a vacuum will be produced by 3900 Ion Pumps (IP) located at distances of about 6 m from each other [?]. IP Power Supplies ( 16 IPs are fed by 1 HV Power Supply) and vacuum controls are distributed over 14 surface buildings. As a part of vacuum instrumentation the pressure monitoring within the  $10^{-5}$  —  $10^{-9}$  Torr range is being developed. It will be based on the IPs current measurement to simplify the hardware and to get adequate spatial resolution. This paper describes the principle of the measurement and the major hardware components.

## II. GENERAL DESCRIPTION

A layout of the measuring electronics belonging to one of the surface buildings is given in the Fig.1. The measured currents which vary from a few hundreds of nanoamperes to tens of microamperes are picked-up by current sensors (CS) and processed by Current-to-Frequency-Converters (CFC). The latter are directly connected to the HV circuitry and are fed by floating Power Supplies. The CFC output pulses are decoupled from the high voltage platform by means of Diode Optoelectric Couple (DOC).

Each group of 32 CFC outputs are multiplexed to one channel of 16-channel 16-bit Scaler. Gating time is 0.1 s, so scanning period is 3.2 s. Such a time resolution allows to monitor dynamic pressure effects, f.e. "pressure bumps" created by circulating proton beam. In addition, certain segmentation of the input channels is foreseen for sophisticated investigations. The electronics is under control of the Single Board Microcomputer (SBC) integrated in the UNK Control System [?].

The pressure at a monitored point of the vacuum chamber can be calculated as:

$$P = \frac{10KN}{S} [Torr]$$

where :

$N$  — count of scaler for the gating time

$K$  — factor of the corresponding IP determined by effective pumping speed ( $Torr \cdot Hz/A$ )

$S$  — CFC conversion sensitivity ( $Hz/A$ )

Factor 10 accounts for 0.1 s gating time. CFCs are installed in the IP Power Supply racks, the rest of the electronics are Eurocard modules.

## III. COMPONENTS

Current Sensor is a resistor current divider with a transfer coefficient of 0.1. While pumping down and when bad vacuum occurs the IP current can increase abruptly. To protect the measuring circuitry the bypassing Zener diodes, having sufficient power consumption and low leakage current, are incorporated. The diodes allow also to keep normal operating the IPs in these cases.

The current - to - frequency conversion is based on the well-known principle described in [?]. In this case the output frequency is expressed as

$$F_o = I_{in} \frac{F_c}{I_s}$$

where :

$I_{in}$  — input current

$F_c/I_s$  — conversion sensitivity  $S$

$F_c$  — clock frequency

$I_s$  — compensating standard current.

Realization of such a principle ensures the high stability of the conversion sensitivity. As a result the CFC routine calibration can be avoided. In addition, common clock gives opportunity to get low spread in values of conversion sensitivity. The CFC parameters are:

– conversion sensitivity	$10^{11}$	Hz/A
– temperature coefficient		
of the conversion sensitivity	0.001	$1/^\circ C$
– additive error	10	pA
– clock frequency	1.2	MHz

The output pulses are transmitted via 40 m twisted pairs to Pulse Shapers, whose TTL outputs are connected to inputs of multiplexer (MUX) and counted by the scaler. For  $F_c = 1.2$  MHz  $F_o$  doesn't exceed 600 KHz, so maximum count is 60, 000.

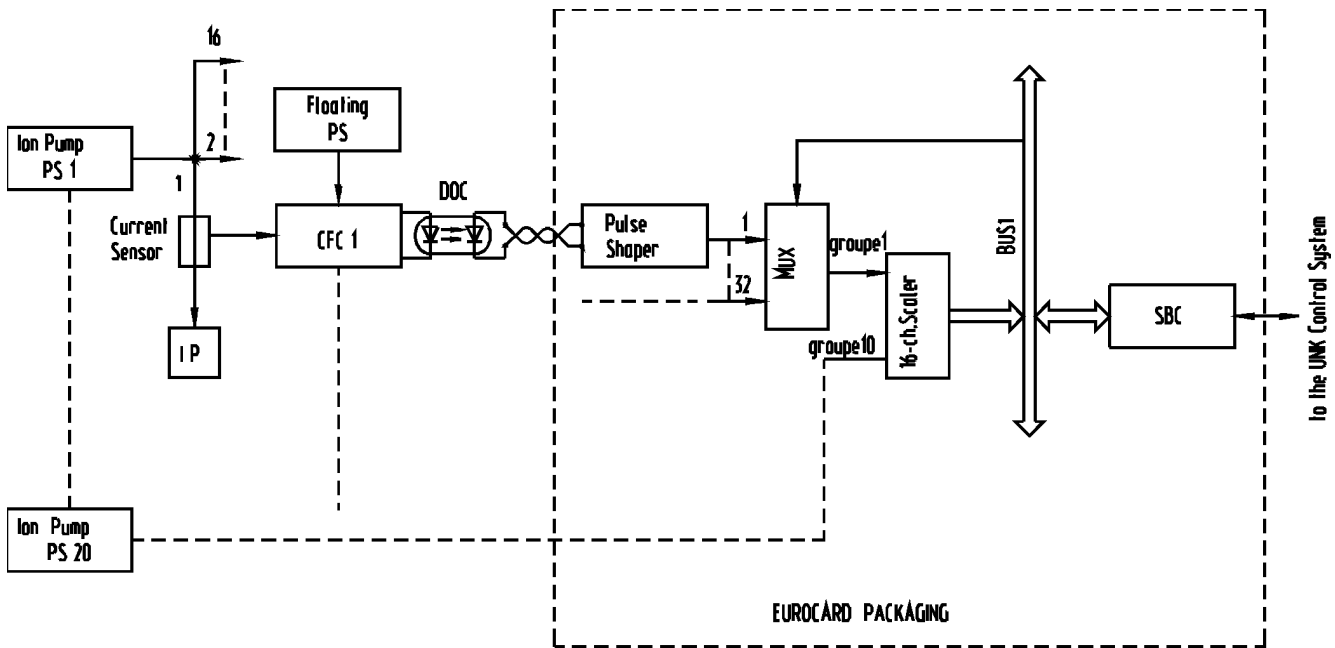


Fig. 1 Block Diagram of the Ion Pump Currents Instrumentation of the UNK-1 Vacuum System.

#### IV. REFERENCES

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