Embedded device set for control systems.
Implementation and application.

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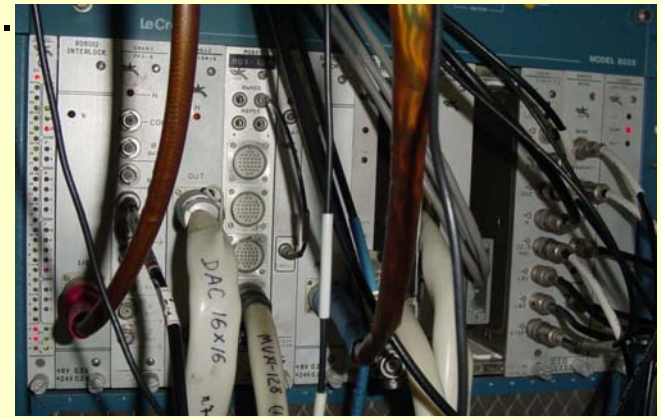
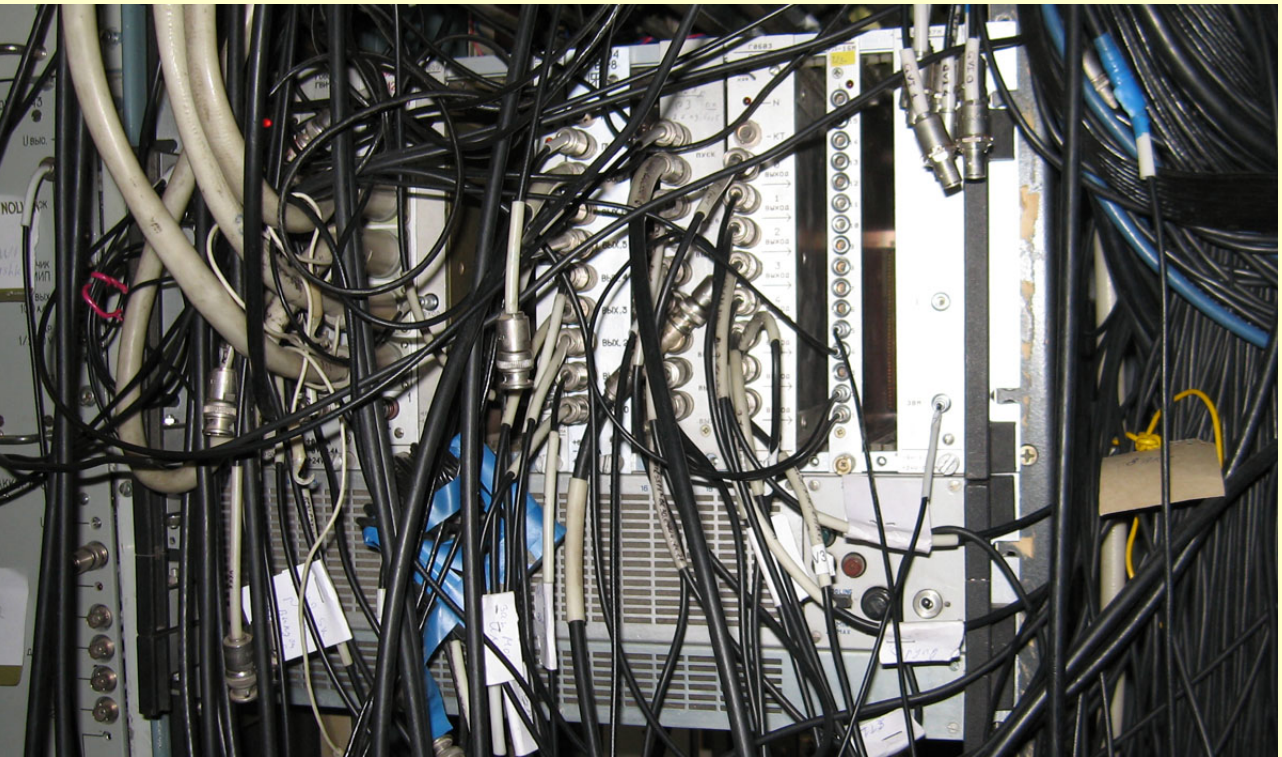
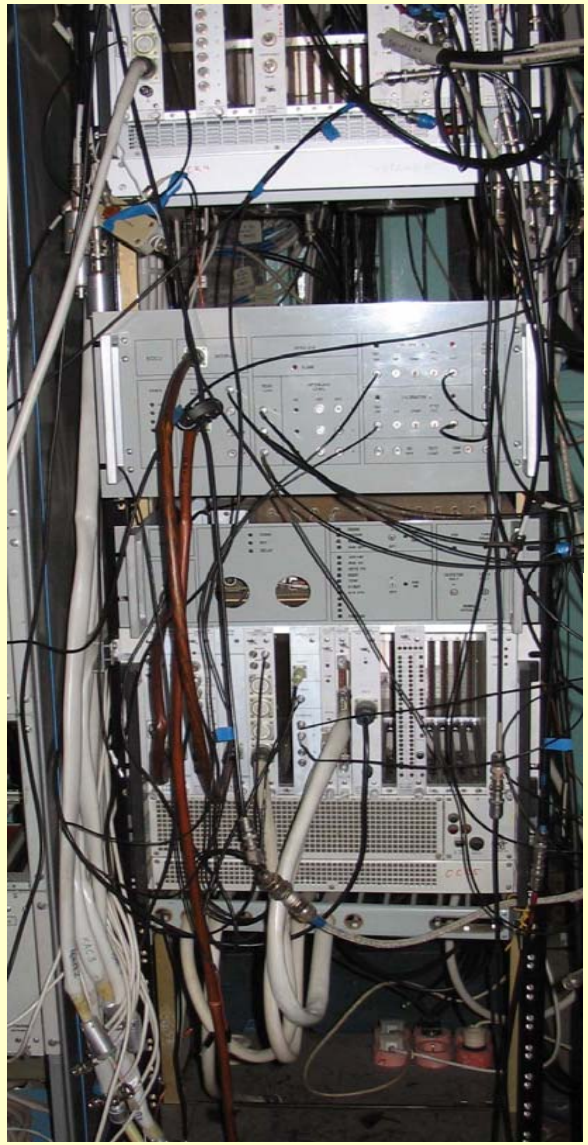
Introduction

70th - 90th - VEPP-2M, VEPP-3/4, Siberia (Moscow) etc. Control systems were based on CAMAC.





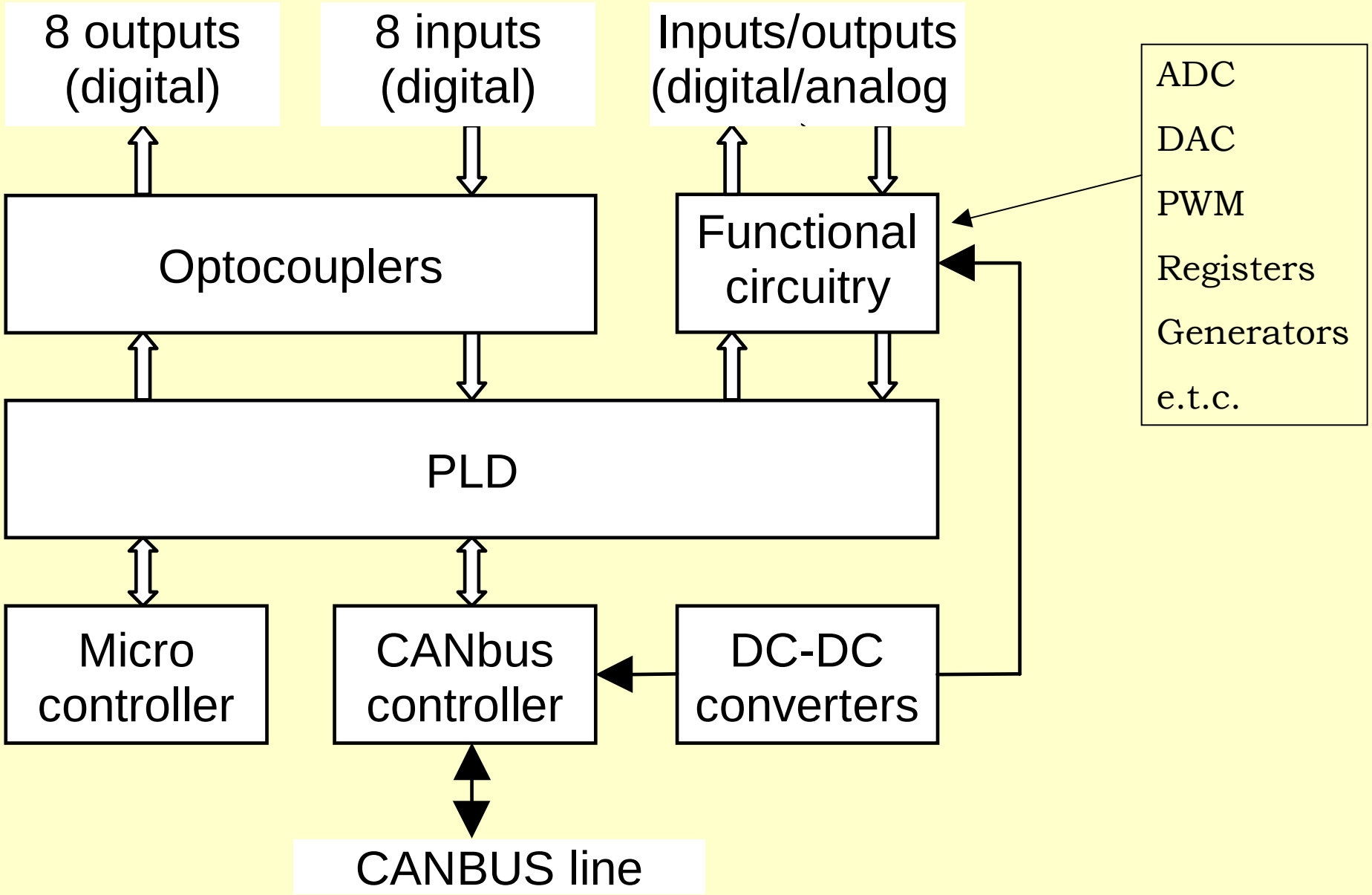


Now BINP builds new installations (VEPP-5, FEL, FEL-KAERI) and upgrades VEPP-2000. Growing requirements to functions, parameters and reliability of automation components initialize creating a new generation of automation devices. An activity on creating new automation components, new structural and architectural decisions was begun in 2000 year.

Requirements to new device set

- All devices must be embedded in terminal equipment.
- All devices must be based on micro-controller or microprocessor.
- All devices should use CANbus for interaction with control computer or with other devices.
- Devices should combine a number typical function (many devices in single).
- Devices should be maximally unified by functions, command set, connectors for external connections.

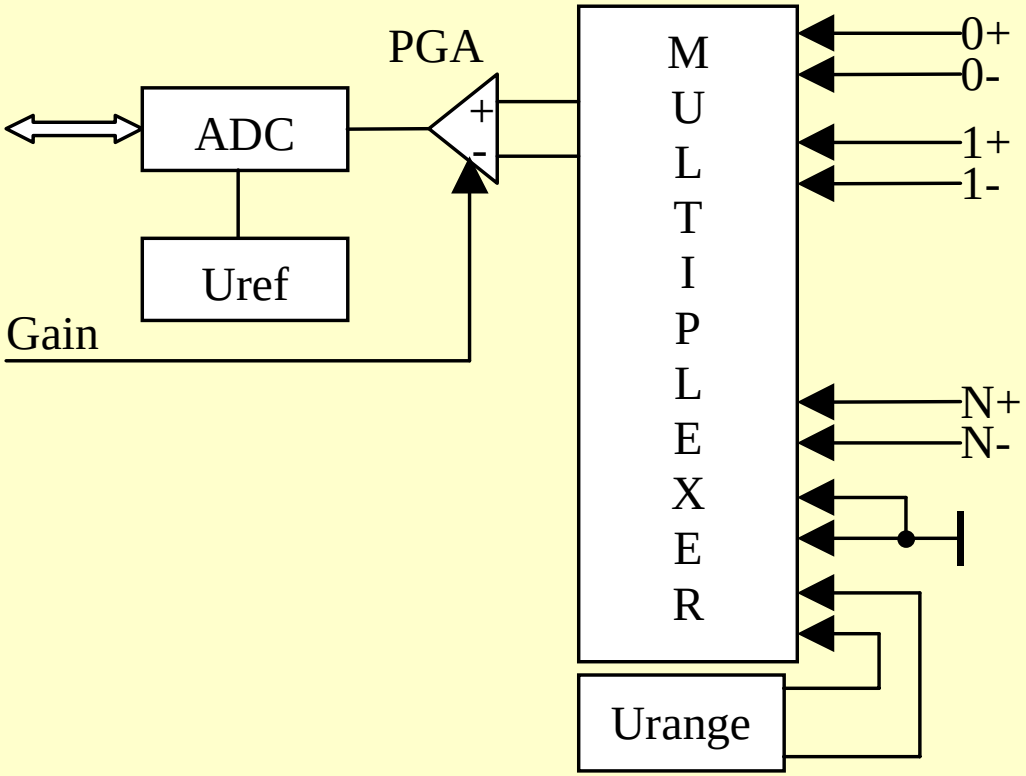
Unified structure of all devices



Embedded device set

Designation	Functional description
CANDAC16	16 channel 16 bit DAC
CANADC40	40 channel 24 bit ADC
CDAC20	6 channel 24 bit ADC, 21 bit DAC
CEDAC20	6 channel 24 bit ADC, 21 bit DAC, euromechanics
CAC208	20 channel 24 bit ADC, 8 channel 16 bit DAC
CGVI8	8 channel delayed pulse generator
CPKS8	8 channel pulse-width generator
CURVV	Multiport input/output register
SLIO24	24-bit bi-directional register
CKVCH	Reconfigurable RF multiplexer

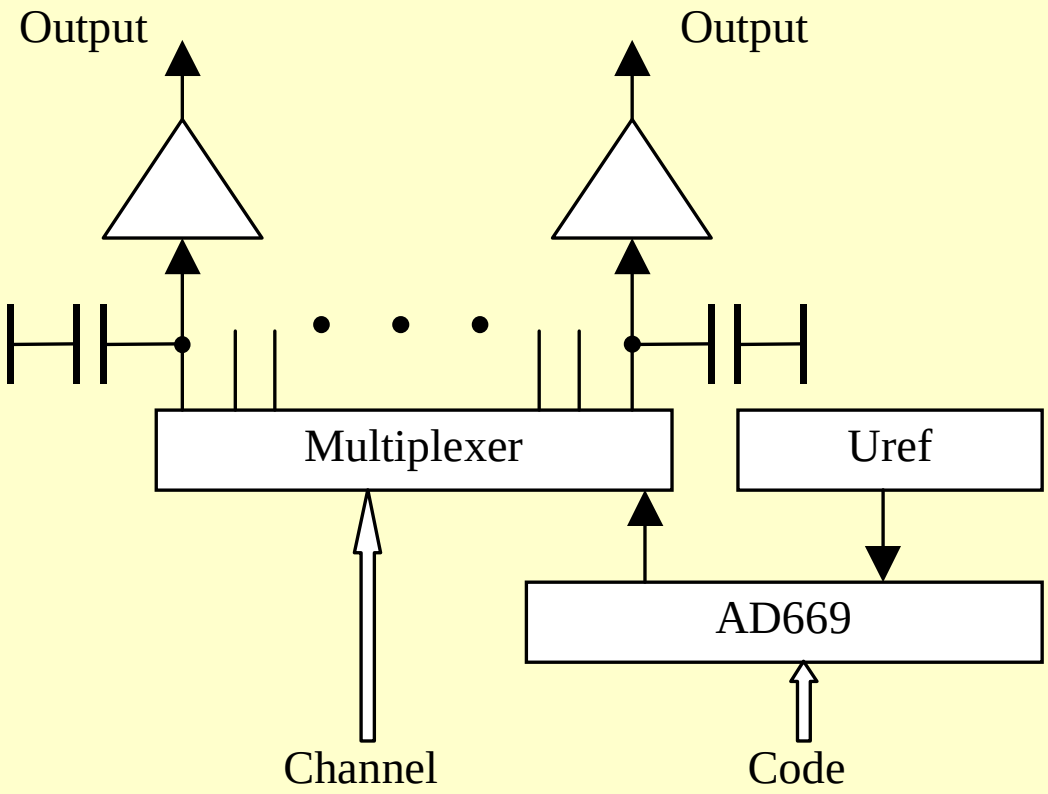
Analog-to-digital structure



- Differential multiplexer
- High precision reference
- Programmable gain amplifier or instrumentation amplifier
- ADC chip

Inputs:
- External
- Internal (calibration, temperature, power supply voltage)

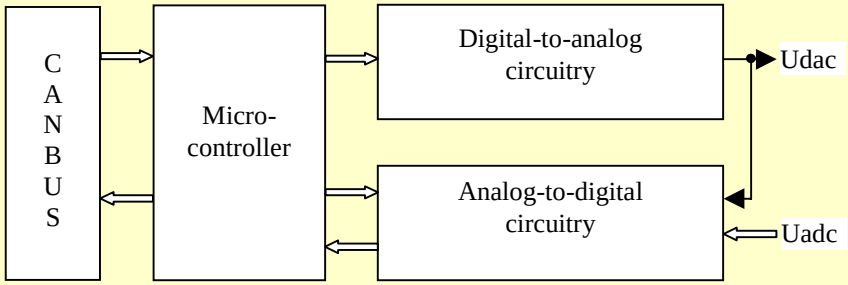
Multichannel digital-to-analog structure (CANDAC16, CAC208)

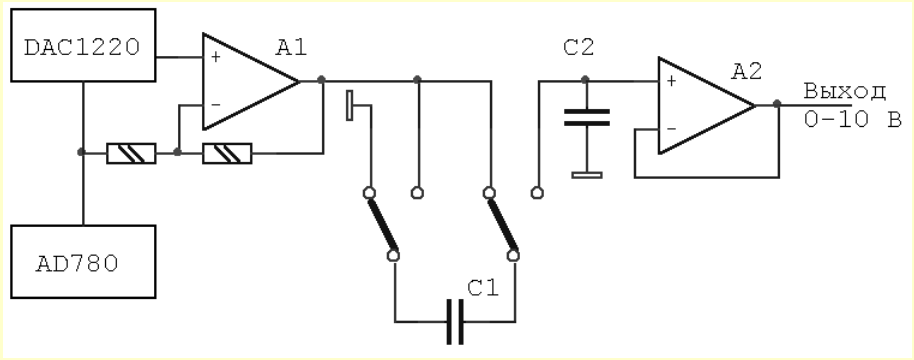


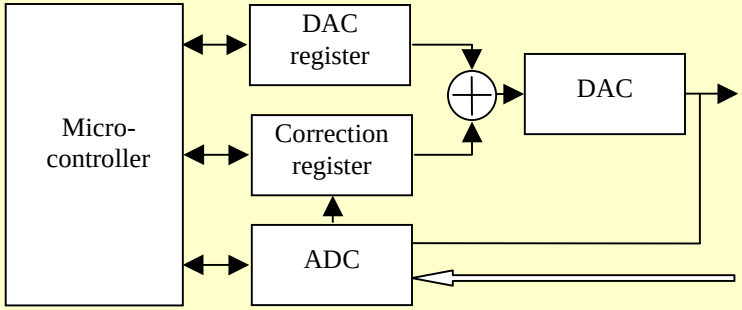
Parameters of CAC208

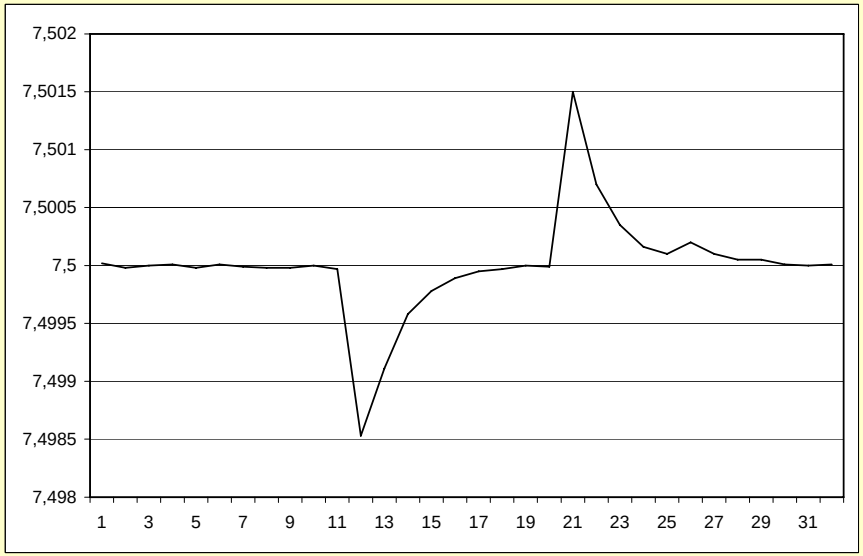
Parameter of CAC208	Value
External ADC inputs	20
ADC bits	24
Range, V	±10
Effective resolution, bits rms	22
Scale drift, ppm/°C	1,5
Accuracy, %	0,003
DAC outputs	8
DAC resolution, bits	16
Range, V	±10
Accuracy, %	0,05
Input digital channels	8
Output digital channels	8

Structure of precise DAC









Output voltage of DAC

Parameters of CDAC20

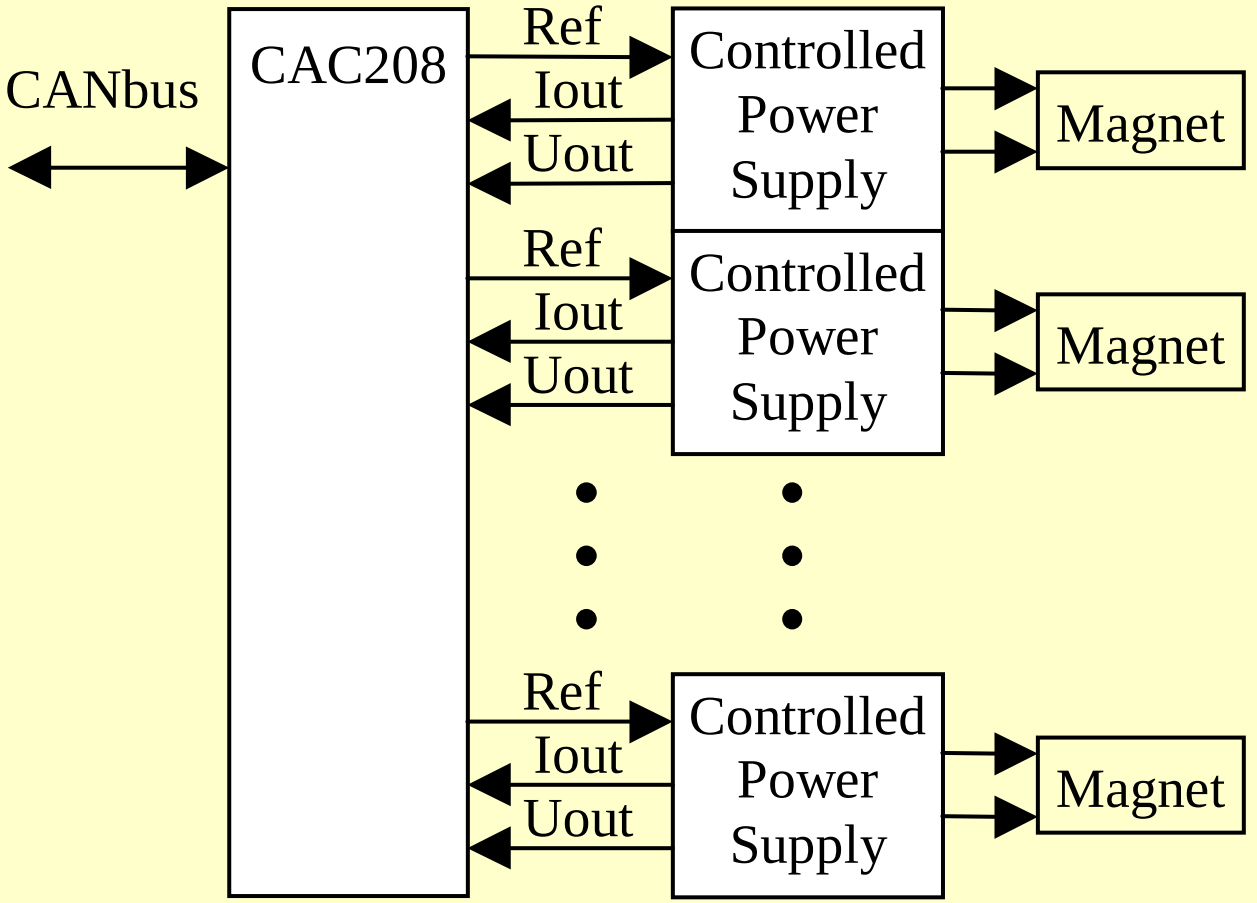
Parameter	Value
External ADC inputs	5
ADC bits	24
Range, V	±10
Effective resolution, bits rms	22
Scale drift, ppm/°C	1,5
Accuracy, %	0,002
DAC outputs	1
DAC resolution, bits	21
Range, V	±10
Accuracy (digital correction off), %	0,01
Scale drift (digital correction off), ppm/°C	5
Accuracy (digital correction on), %	0,002
Scale drift (digital correction on), ppm/°C	1
Input digital channels	8
Output digital channels	8

Digital devices

- CGVI8- 8-channel delayed pulse generator. It provides delayed pulses with jitter 10ns and with delay from 100 nS to 214 Sec.
- CPKS8- 8-channel pulse-width converter;
- CURVV- multi-port input/output register;
- CKVCH- reconfigurable multiplexer for high frequency signals;
- SLIO24- multiport bi-directional register for interfacing old equipment to CANBUS.

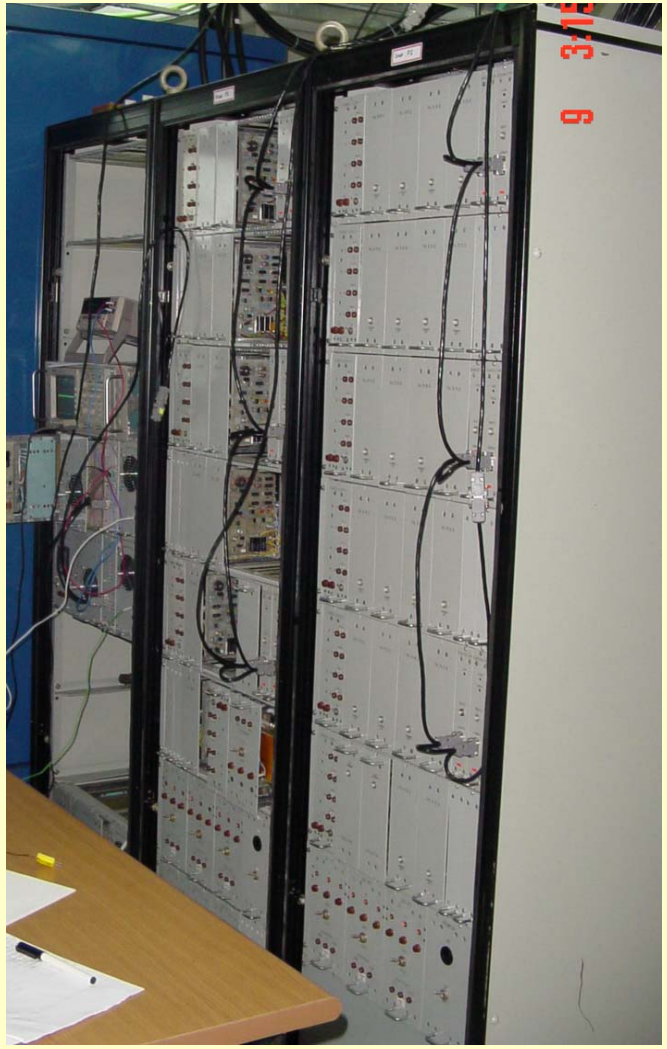
Today these devices are using in VEPP-2000 control system for replacing old CAMAC modules in different subsystems.

Typical application: multichannel power supply



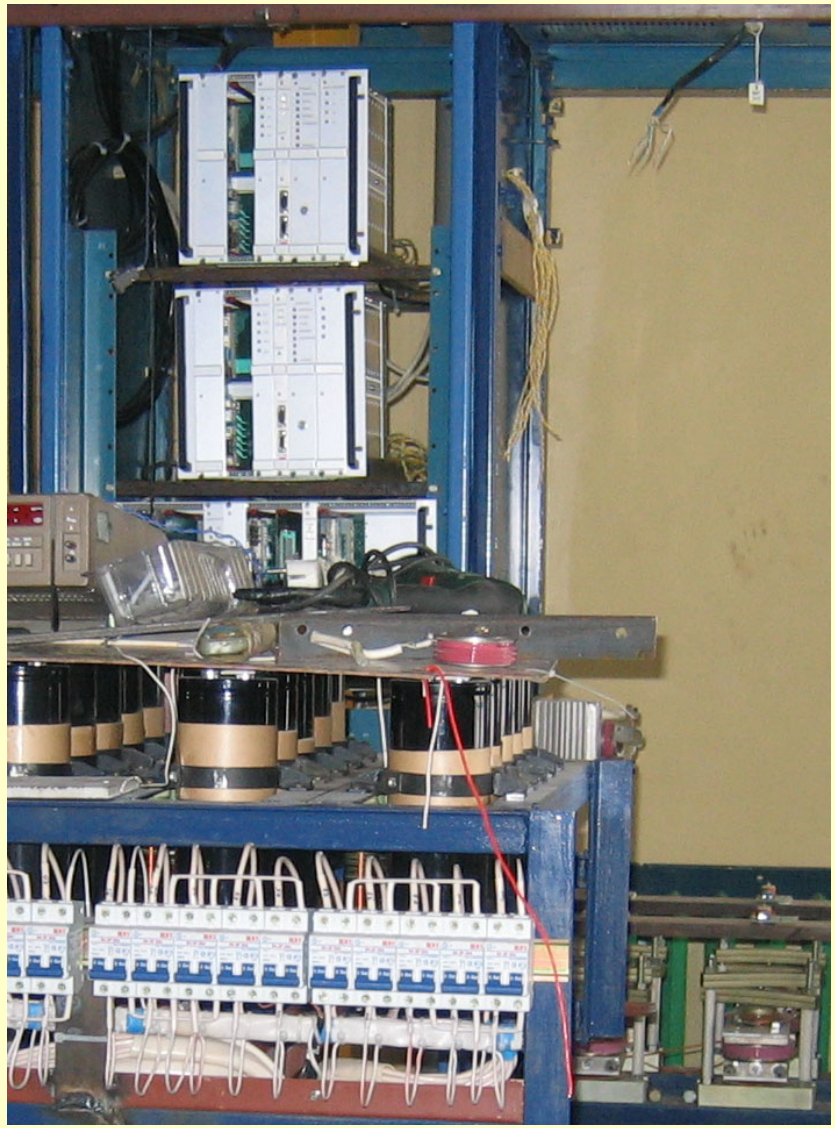
Typical application: FEL (2002), KAERI (2003)

Multichannel controlled power supplies for lenses and correctors (total 192 channels)

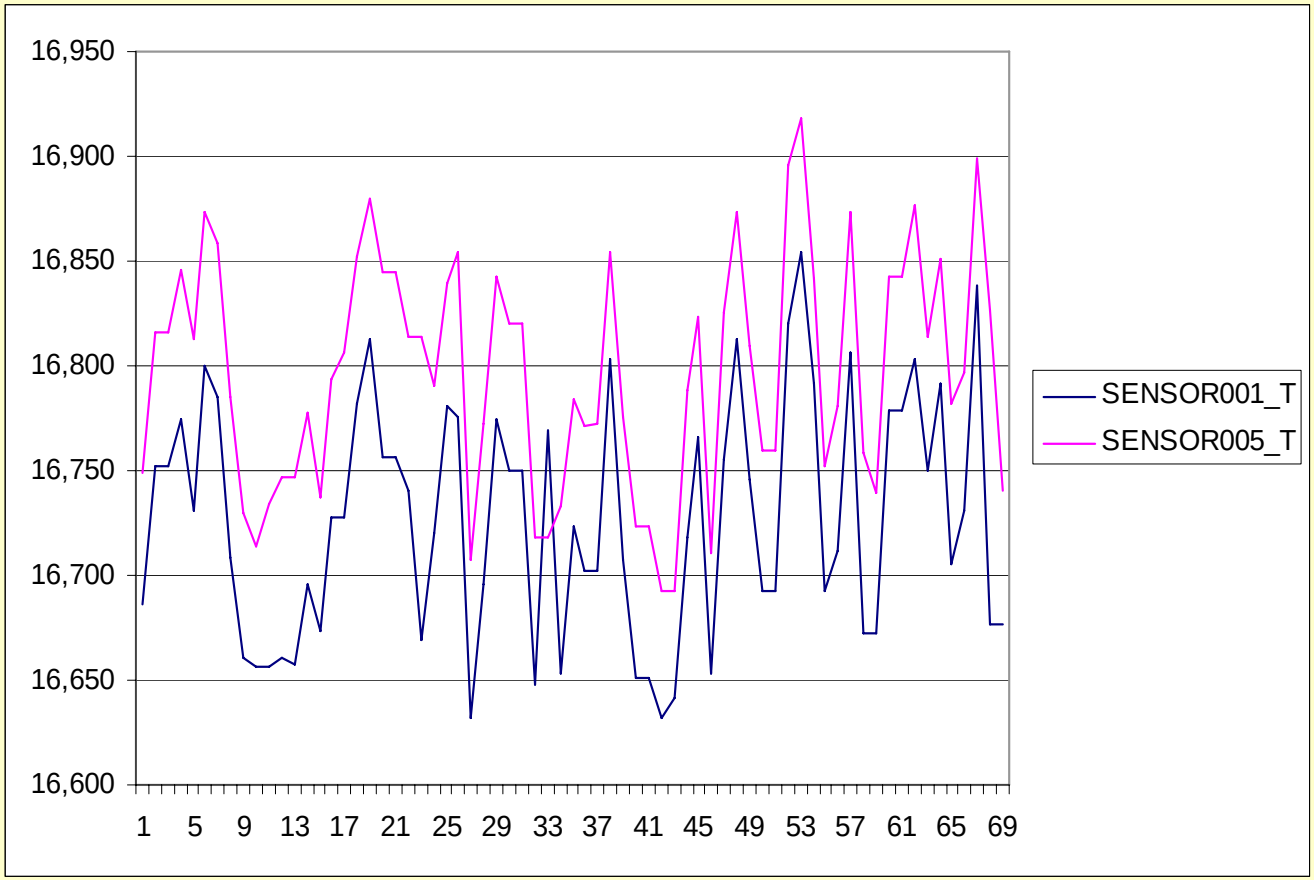


Controlled power supplies for lenses and correctors (total 98 channels)

Typical application, VEPP-2000 (2006)



Typical application (FEL-KAERI, 2003)



Temperature measurements, 40-channel module.
Total 160 channels in FEL-BINP control system.

Device set for automation

- Hardware compatibility - connectors, pin-outs, ranges for ADCs, DACs.
- Software compatibility - ADCs, DACs, registers.
- Additional on-board resources - microsystems, based on single controlled device.
- Embedded software evolution - function generator, DAC digital correction, etc.
- Custom software - special function implementation (Karnaval).
- Autonomous working - function generator for accelerator, thermostabilization and so on.

Conclusion

- Installations: VEPP-5, VEPP-2000, FEL-BINP, FEL-KAERI, KEDR, wigglers, coolers, etc.
- Geography: Russia (Novosibirsk, Moscow, Dubna), Korea, China.
- Control computers: PC, VME-Motorola, CAMAC-Motorola, Odrenok.
- OS: Windows, Linux, VxWorks, ODOS.

Additional information

http://www.inp.nsk.su/~kozak/designs/designs.htm

or

http://www.inp.nsk.su/~kozak/