

Computerized Numerical Control Unit NC-210

Hardware. Operating Instruction



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INTRODUCTION

This Hardware Operating Instruction V1.0 (HOI) contains information on the design, setup and technical specifications of the NC-210 computerized numerical control unit (further below referred to as the CNC Unit) and its component parts. This HOI is designed for use by CNC operating personnel in order to be able to master the setup and functions of the CNC module and also to be able to operate it properly and safely during its entire service life.

This HOI covers all the modifications of the NC-210 CNC module. In addition to the HOI the operating personnel members must acquaint themselves with those papers that are part of the operation documentation set which is delivered together with the CNC Unit and that are referred to in Section 3 here.

The following designations and abbreviations are adopted in this HOI:

- AC alternating current;
- A/N alphanumeric keyboard;
- CNC computerized numerical control unit;
- COM serial data transmission channel;
- CPU central processor;
- CU control unit;
- DAC digital-analog converter;
- DC direct current;
- DOC Disk-On-Chip – memory unit of the Flash Disk type;
- DOM Disk-On-Module – memory unit of the Flash Disk type;
- DOS disk operation system;
- DRAM dynamic RAM;
- FBT feed-back transducers;
- FDD floppy disk drive;
- Flash disk solid-state disk;
- FS feedback sensor;
- HDD hard disk drive;
- HW Hand Wheel;
- In./out. input/outputs;
- LCD liquid crystal display;
- MU memory unit;
- NCC normally closed contact;
- NMI unmasked interruption – a hardware error that blocks the CNC operation;
- NOC normally-opened contact;
- OCP operator's control panel;
- Panel display flat screen display;
- PC personal computer;
- PL machine-tool program logic;
- PLC programmable logical controller;
- PP part program;
- PSU power supply unit;
- RAM random-access memory;
- SPEPN signal/relay of the CNC readiness;
- SW software;

- SWE an error blocking the operation of the CNC and that can be discovered by software;
- TFT thin-film transistor monitor;
- TO TIME OUT;
- TS tactile sensor;
- VGA video graphic adaptor;
- WD WATCH DOG.

1 GENERAL INDICATIONS

1.1 The NC-210 numerical control unit is used in the machine-building, the machine-tools industry, in the metal-processing industry, also in wood processing and in the other branches of industry.

The CNC Unit is used as a completing part to make complete equipment sets, comprising «a CNC unit + a controlled object», such sets as, e.g., production process complexes, installations, highly-automated machine-tools and processing centers, including such groups of equipment as milling-drilling-boring machine aggregates, turning-vertical lathe-turret lathe machine-tool groups, gas flame machines, laser machine-tools, woodworking machine-tools, etc.

1.2 The CNC Unit must be operated in roofed premises, meeting the following requirements regarding their operation conditions:

1) operation conditions:

- ambient air temperature from +5 to +40 °C;
- relative air humidity from 40 to 80% at +25 °C;

2) storage conditions:

- ambient air temperature from +5 to +50 °C;
- relative air humidity not more than 80% at +25 °C;

Remarks

1 The air temperature inside the CNC cabinet shall not be more than 20°C above the temperature of ambient air supplied for cooling, while the temperature inside the CNC cabinet must not exceed +60°C.

2 The upper value of the ambient air temperature for CNC modules that are designed to be built into other equipment items containing sources of heat shall be selected from the following sequence of figures: 5, 10, 15, 20.

3 For those CNC units that are designed for operation in unheated rooms higher relative air humidity level values are fixed: Rh= 98% at +25°C.

1.3 In the operation zone of the said CNC Unit efforts must be undertaken in order to prevent dust, moisture, oil, metal chips, cooling liquids, vapors and steam from getting onto the outer surfaces and into the interior compartments of the CNC module in concentrations that could be damaging to its metal and insulation parts, including also periods of technical maintenance.

1.4 Vibration levels in the working area of production rooms, acting along the longitudinal axis of the CNC Unit, shall not exceed a frequency of 25Hz and an amplitude of movement of over 0.1 mm.

1.5 The electric power supply of the CNC Unit shall be carried with a single-phase AC voltage of 220 +22/-33V and a frequency of 50+/-1 Hz.

1.6 The CNC Unit may be connected to the factory power supply systems only via an isolating transformer with a capacity of not less than 300 VA.

1.7 Power supply conductors to the CNC Unit shall be laid, fulfilling the requirements of the IEC 550-77 standard, regarding the protection degree against electromagnetic interference, power outages and voltage drops.

It is not advisable to connect to the power supply system of the CNC Unit any other power systems, whose operation might cause disruptions in this system, affecting the levels of feed voltage, the level and spectrum of interference, the duration of power supply interruptions and feed voltage drops.

2 TECHNICAL SPECIFICATIONS OF THE CNC UNIT

2.1	Number of channels of controlled axes	- 5 (with a spindle)
2.2	Number of channels of position transmitters	- 4
2.3	Number of channels of DAC (14 digits)	- 5
2.4	Number of channels of the electronic hand wheel	- 1
2.5	Number of channels of the tactile sensor	- 1
2.6	Number of discrete input/output channels	- 32/24 or 64/48
2.7	Memory capacity:	
	- RAM	- SDRAM: 64/128MB
	- memory	- Flash Disk: DOM: 32/64/128MB
2.8	Display:	
	- a color flat LCD screen	- TFT 10.4"
	- resolution	- 640x480
	- video memory	- SDRAM 2MB
	- interface	- LCD 24 bit
2.9	Alpha-numeric keyboard	- 79 key, interface EXKB
2.10	Interfaces of external I/O devices:	
	- FDD interface	- 1 channel for 2 FDDs: 3.5" (1.44MB)
	- serial interface	- COM1: RS232
	- VGA CRT interface	- CRT screen
	- LAN interface (optional)	- Ethernet: 10/100 Mbit/s
	- USB interface	- specification rev. 1.0
2.11	Rated feed voltage	- ~220 V, 50 Hz
2.12	Power consumption (without periphery devices)	- 60 VA, max.
2.13	Current consumption (without periphery devices)	- 250 mA, max.
2.14	Protection degree of the casing:	
	- front panel	- IP54
	- body	- IP20
2.15	Overall dimensions	- 439x340x140 mm
2.16	Weight	- 9.7 kg, max.
2.17	The software characteristics are shown in the «Programmer's Manual MS/TS»	

3 CNC UNIT SETUP

3.1 The Structural Diagram of the CNC Unit

3.1.1 The CNC Unit is a software-controlled device that incorporates both hardware and software (**SW**) elements. The CNC Unit block diagram is represented in Figure 3.1. The CNC structure incorporates a control unit (**CU**), operator's control panel (**OCP**) and a power supply unit (**PSU**). Connections between the component parts of the CNC Unit and its structural elements, also a brief description of the component parts is presented in Table 3.1.

3.1.2 The **CU** governs the CNC operation and that of its externally connected equipment. The heart of the **CU** is its CPU card. The interaction of the **CU** modules is secured by signals coming from the external local bus of the **ISA BAS** 16 bit processor.

The bus module is represented by the CNC Unit interface, whose basis is formed by signals coming from the **ISA BAS** 16 bit processor. The bus module structurally and electrically combines both the **CPU ECDA** and **I/O** modules, through which the **CU** communicates with its controlled object.

Control of the following peripheral equipment is carried out through the **ECDA** module channels:

- the electric servo drive of feed and the main motion, with feedback (control at the input of the analog voltage of ± 10 V);
- the photoelectric traverse converters (encoders) as feedback (supply voltage plus 5V, the output signal – rectangular pulses);
- the machine-tool spindle;
- the photoelectric electronic hand wheel (its supply voltage is plus 5V, its output signal is shaped like rectangular pulses);
- a tactile sensor.

Through input/output channels the **I/O** module provides bi-directional communication (polling/controlling action) between the CNC Unit and the electrical units of an object to be controlled. Information exchanges are carried out under software control.

Control of additional input/output devices is carried out by the **CPU** card through the following interfaces of external devices: **RS-232, FDD, VGA, LAN, USB1, USB2**.

3.1.3 The **OCP** element secures the execution of all the control and monitoring functions within the "OPERATOR-CNC-CONTROLLED OBJECT" system. The **OCP** structure includes a display unit and a keyboard.

Control signals originating from the CPU reach the display unit via an internal cable through an **LCD 24 bit** interface. The connection between the keyboard and the CPU card is secured by means of signals from the **EXKB** keyboard interface via the bus module and the **ECDA** card.

Keys, push buttons and selector switches are used for controlling the software, while a display screen and light-emission diodes are used as elements of monitoring. All the said components make it possible for the operator to control the system operation, to maintain an active dialogue with it and obtain the required information about the process of governing an object to be controlled.

3.1.4 The **PSU** supplies the CNC Unit with the necessary variety of feed voltages. Power from the **PSU** is supplied to the component parts of the CNC Unit via the CNC bus unit.

3.1.5 The CNC Unit is connected to the object under control and the external input/output devices via external connectors. The list of external CNC Unit connectors, their positions, designations and purpose of use are shown in Table 3.2.

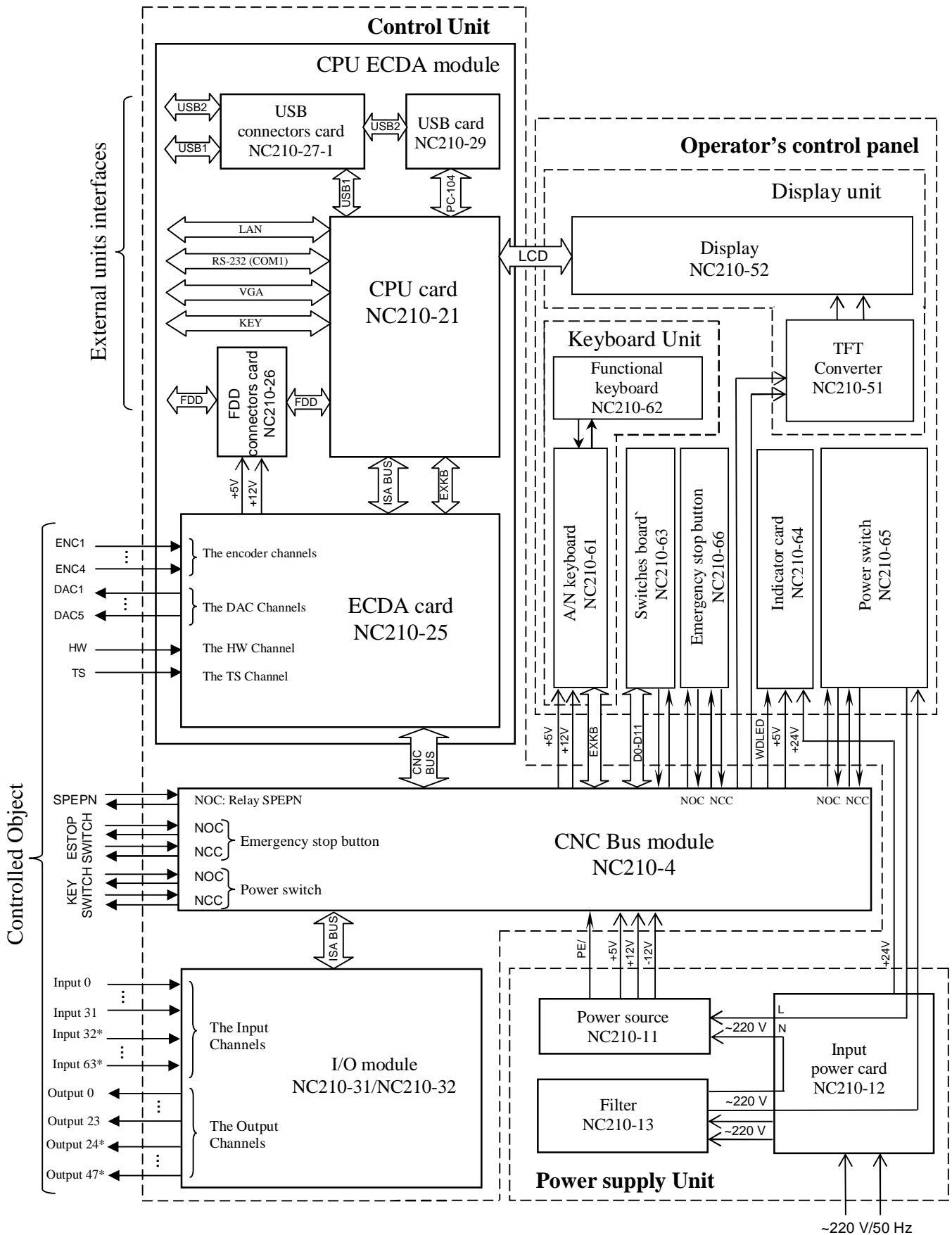


Figure 3.1 – The Structural Diagram of the NC-210 Unit

Table 3.1 The NC-210 CNC Unit Set Up

CNC unit component part	Component units, modules, cards		
	Denomination	Designation	A Brief Description
Power unit (PU)	Power source	NC210-11	Output voltage: +5V, 12A (adjustable $\pm 0,25$ V); +12V, 2A (not adjustable); -12V, 1A (not adjustable).
	Input power card	NC210-12	Input voltage: ~220V/50Hz, safety fuse – 3A, connector: power supply input ~220V.
	Filter	NC210-13	~250V/3A, 50/60 Hz
Control unit (CU)	<u>CPU ECDA module</u> CPU card	<u>CPU ECDA</u> NC210-21	CPU: Intel Pentium MMX CPU 266; ISA BUS 16 bit; Video 2MB; interfaces: RS-232, Keyboard, LCD, FDD, VGA, Ethernet (optional). Connectors: "VGA", "KEY", "RS23", "LAN".
	Memory unit Operation memory ECDA card	NC210-23 NC210-24 NC210-25	DOM: 32/64/128 MB. SDRAM: 32/64/128 MB.
	FDD connectors card USB connectors card USB card ISA BUS card	NC210-26 NC210-27-1 NC210-29 NC110 ISA BUS	Encoder channel – 4; hand wheel channel – 1, DAC channel 14 bits – 5; TS channel – 1. Connectors: encoders – "1" – "4"; DAC and TS – "5"; the hand wheel – "6". Connector: "FDD". Connectors: "USB1", "USB2". Interface USB2. Interaction between the CPU and peripheral modules.
	<u>I/O module</u>	<u>I/O</u> NC210-31/32	Input channels 12mA/24V – 32/64; output channels 50mA/24V – 24/48. Connectors: inputs – "1", "2"; outputs – "3", "4".
	Bus module	NC210-4	All CU exchange signals. CNC readiness relays "SPEPN". Connectors: "KEY SWITCH" contacts, emergency stop button pins "ESP SWITCH", CNC readiness relay contacts "SPEPN".
	Operator's control panel (OCP)	<u>Display unit</u> TFT converter	- NC210-51
Display		NC210-52	Color TFT LCD flat panel display: 10.4", 640x480.
<u>Keyboard unit</u>		-	A hermetically sealed keyboard with tactile effect with 79 keys.
Alphanumeric keyboard		NC210-61	36 alphanumeric, 8 functional, 25 special keys. Keyboard controller.
Functional keyboard		NC210-62	8 functional keys, 2 special keys
Switches board		NC210-63	Selector switches: "F", "S", "JOG", "MDI, ..., RESET"; START button; STOP button.
Indicator card		NC210-64	Power supply "AC" indicators and CNC PSU switch-on "DC" indicators, an "ER" stop indicator.
Power switch		NC210-65	A CNC power switch (lock and key): ~240V/3A.
Key	NC210-651	Used as a complete set part with the power switch.	
Emergency stop button	NC210-66	A mushroom-shaped button of red color: ~240V/3A	
Case	-	NC210-7	Overall dimensions: 439 x 340 x 140 mm

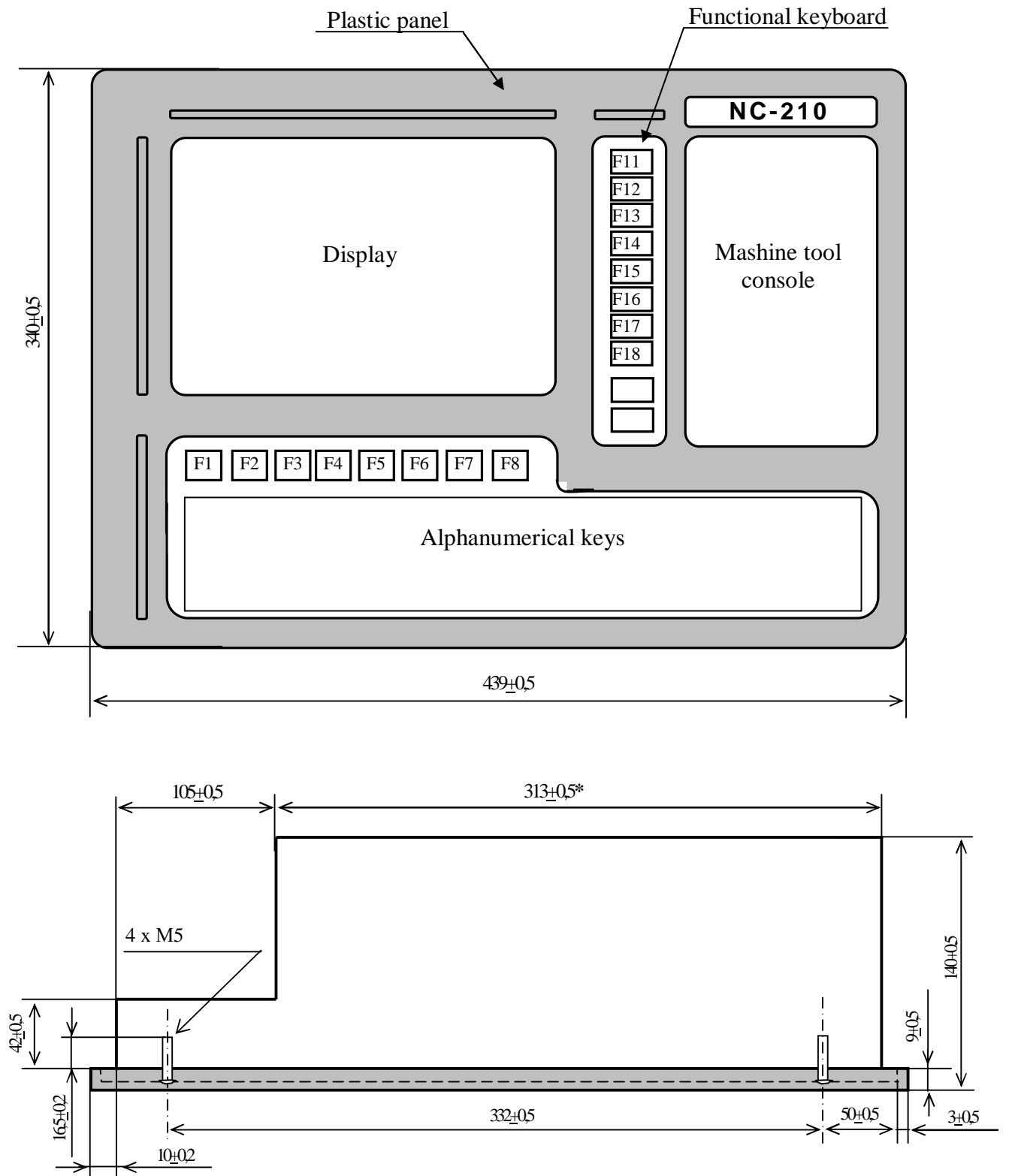


Figure 3.2 – Basic dimensions of the NC-210 CNC Unit

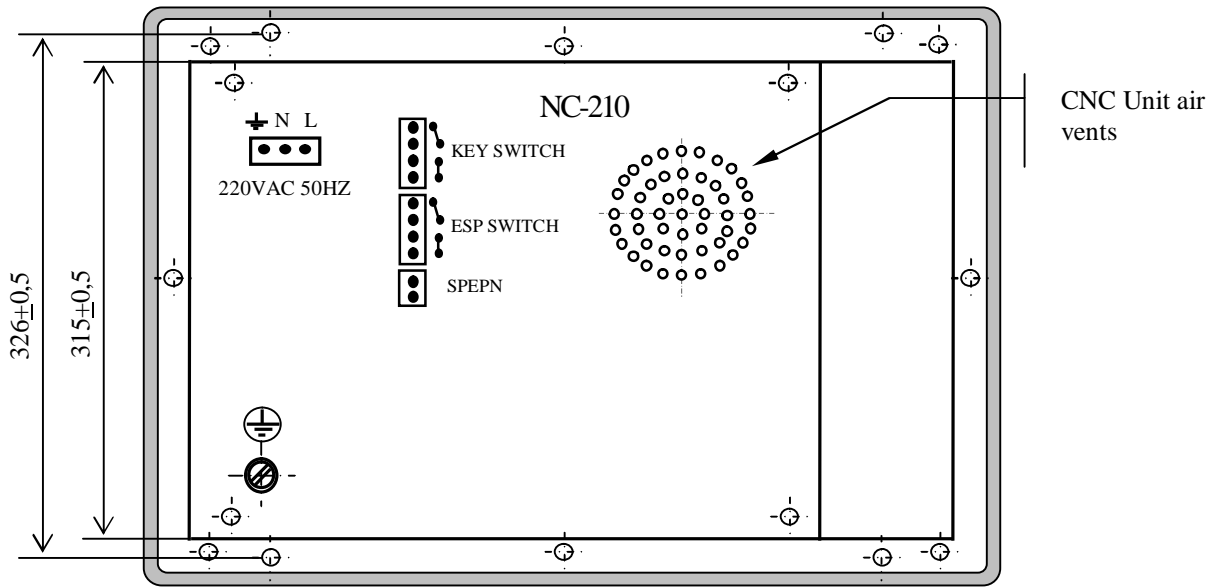


Figure 3.3 – View of the rear panel of the NC-210 CNC Unit

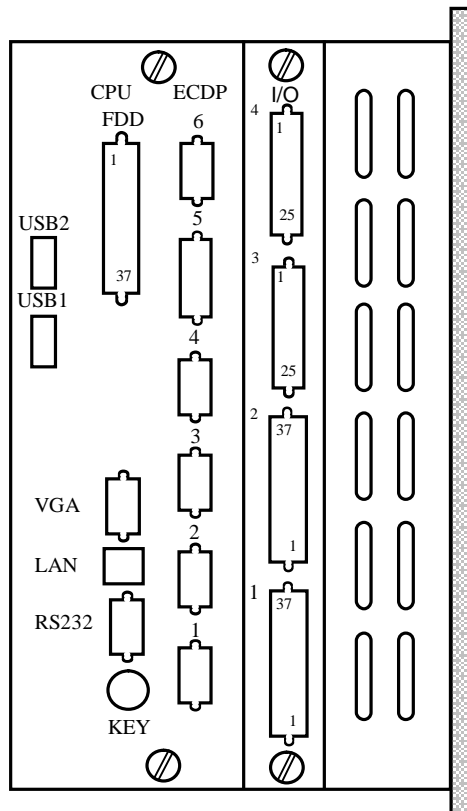


Figure 3.4 - NC-210 CNC Unit connector's panel

Table 3.2 – External connectors of the NC-210 CNC Unit

Module	Connector			
	Designation and type	Number of pins	Number of connectors	Purpose
CPU ECDA	RS232 DBR 9-M plug	9	1	RS-232 channel
	FDD DBR 37-F socket	37	1	Communication with FDD
	VGA DBRH 15-F socket	15	1	An external CRT monitor
	KEY MDR 6-F socket	6	1	An external keyboard
	USB1 USBA-4G socket	4	1	USB channel (MS DOS)
	USB2 USBA-4G socket	4	1	USB channel (CNC)
	LAN RJ-45 socket	8	1	A local area network (optional)
	1,2,3,4 DBR 9-F socket	9	4	Encoder inputs
	5 DBR 15-F socket	15	1	DAC outputs, a TS input
	6 DBR 9-F socket	9	1	A hand wheel input
I/O	1,2 DBR 37-M plug	37	1/2	Discrete inputs
	3,4 DBR 25-F socket	25	1/2	Discrete outputs
NC210-12	Phoenix Contact plug MSTB 2,5/3-STF	3	1	Power supply
NC210-4	KEY SWITCH Phoenix Contact plug MSTB 2,5/4-ST	4	1	Power switch contacts
	ESP SWITCH Phoenix Contact plug MSTB 2,5/4-ST	4	1	Emergency stop button contacts
	SPEPN Phoenix Contact plug MSTB 2,5/2-ST	2	1	NC relay contact SPEPN of the NC readiness

3.2 The CNC Unit Design

3.2.1 In terms of its design, the CNC Unit represents a mono-block, for built-in mounting and it incorporates a control unit (CU), an operator's panel (OCP) and a power supply unit (PSU). The main overall and mounting dimensions of the CNC Unit are given in Figure 3.2. The rear panel view of the CNC Unit is given in Figure 3.3.

3.2.2 The mono-block's base is made up of a metal frame with two compartments. The PSU is placed in one of them, while the other one houses the CU. The metal walls of the frame perform the functions of a protective shielding. Parts containing the OCP are mounted on the front panel of the CNC Unit. This panel is fixed with screws to the frame. There are guiding grooves in it, fixed along its perimeter, to allow for putting the mono-block into a cabinet or into controlled object equipment.

3.2.3 The CNC unit bus module is mounted on the metal partition between the CU and PU sections. The **CPU ECDA** and the **I/O** modules are structurally complete, having front panels with connectors for connecting cables from equipment to be controlled. These modules are to be installed into the CU section on the left side of the CNC Unit by pushing them over its guiding grooves, to

enable their mating with the bus module connectors, following that, they can be fastened in the frame with screws mounted on the front module panels. The front panels of the modules form the CNC Unit connector's panel, as it is shown in Figure 3.4.

3.2.4 The operator's control panel, which serves as the front CNC panel, is divided into 4 sections, upon which its elements are located, as follows:

- a display section;
- an alphanumeric keys section;
- a functional keyboard section ("F11"- "F18");
- a machine-tool console section on which indication elements, a selector switch module, a power switch and an emergency stop button are mounted.

3.2.5 A removable casing encloses the whole construction, except for the front panel. The casing is fastened to the frame with screws. A fan is installed inside the casing at the control unit level. There are slits for ventilation on the sidewalls of the casing.

A grounding screw is mounted in the lower part of the outside surface of the casing, which forms the rear panel of the CNC Unit. The casing has slits to secure access to the connectors that open onto the CNC rear panel, as shown in Figure 3.3.

3.3 The CNC Unit Software

3.3.1 Control over the system equipment is provided by a Part Program. The rules and methods of drawing up the part program are laid out either in the "Programming and Operator's Manual (TC)" for turning machinery (lathes) or in the "Programming and Operator's Manual (MC)" for milling machine-tools. The "Programming and Operator's Manual" version is to be agreed upon with the manufacturer when issuing an order.

3.3.2 The CNC Unit can be made compatible for running in company with some concrete system equipment by way of system characterization. The said characterization process consists in developing and writing files containing the parameters and characteristics of hardware and software modules, that completely determine the CNC configuration for a particular user. These files contain information necessary for the functioning of software, controlling this equipment operation. The ways of developing these characterization files are described in the document entitled "Software Characterization".

3.3.3 The final stage of making the CNC Unit ready for operation is the development a PL, which is a program for controlling the auxiliary mechanisms of some concrete equipment.

Any PL compilation means that it is necessary to be familiar with the basic PLC program interface and its language. The basic PLC interface is a program interface and it ensures the execution of the basic CNC software communication protocol and it is specific for any controlled object.

The PLC language is part of the basic CNC software. The PLC interface is designed for the following:

- 1) to initialize the switch-on/switch-off signals of controlled equipment;
- 2) to implement the exchange protocols as it is shown below:

THE BASIC SOFTWARE \hat{U} PL \hat{U} CONTROLLED EQUIPMENT

- 3) to process protocol signals that determine the application of the various CNC operating modes;
- 4) to secure the operation of controlled equipment safety devices;
- 5) to implement certain auxiliary functions.

PL is developed with the help of the PLC language. The description of the PLC interface, its language, its development methods, ways of debugging, compilation and activation of PL are given in the document called "The PLC Interface Programming".

PL development is not the obligation of the CNC Unit design company. The CNC Unit user is given the opportunity to develop the said PL on his own, in accordance with the document referred to.

3.3.4 The CNC software has several versions. Any software version is to be agreed upon with the manufacturer when placing a purchasing order.

The CNC software versions up to Version 3.60.E are essentially based on MS DOS. The software version 3.60.E and all subsequent versions are based on the RTOS-32 operation system, which enables to expand the software capacities, for example, it allows to use visual programming for part program compilation and editing.

When the basic software has been installed into this CNC Unit its program is to be registered. A reliable operation of the CNC hardware in company with its software is only possible, applying a software version approved by the supplier, at the time of placing an order, and which is supplied together with equipment.

IT IS FORBIDDEN TO INSTALL ANY UNLICENSED SOFTWARE, AS WELL AS ANY SOFTWARE NOT RELATED TO THE CNC UNIT.

3.3.5 The CNC Software set up includes two editors: the main editor and an editor for visual programming. Rules concerning the CNC SW running are given in the document «An Operator's Manual». This document consists of two parts and each part is published as a separate book. The first part explains rules of work with the main editor of the CNC Unit, the second part contains rules of working with the visual editor, which is used for creating and editing part programs of the CNC Unit.

3.4 The CNC Unit Delivery Set

3.4.1 The scope of the CNC Unit delivery set corresponds to Section 4 of the Form sheet. The obligatory set of delivery shall comprise the CNC Unit with its installed software version, with a set of working documentation and a mounting parts kit and tree 3.5" (1.44 MB) diskettes with a duplicate of software version:

- No.0 – "COPYFLASH";
- No.1 – "FLASH.RAR";
- No.2 – "FLASH.R00".

3.4.2 The set of the working documentation shall include the following:

- Hardware. Operating Instruction;
- Form sheet;
- Programming and Operator's manual (MC/TC);
- Software characterization (MC-TC);
- PLC Interface Programming.

3.4.3 The mounting parts kit includes mating parts for the CNC Unit output connectors, as shown in Table 3.2. These connectors are used to make cables for communication with controlled objects. A list of connectors to be supplied is given in Table 3.3.

The obligatory delivery set includes ready-made cables:

- an FDD cable, 0,6 m;
- an USB cable, 1,0 m.

Table 3.3

Denomination	Number	Intended use
DB 9-F socket, H9	1	An RS-232 cable
DB 9-M plug, H9	1	The flywheel cable
DB 9-M plug, H9	4	A FS cable
DB 15-M plug, H15	1	A DAC cable
DB25-M plug, H25	1/2	An output cable
DB37-F socket, H37	1/2	An input cable
MSTB socket 2.5/2-ST-5.08	1	A cable for the "SPEPN" connector
MSTB socket 2.5/3-STF-5.08	1	A cable for the power connector of the CNC Unit
MSTB socket 2.5/4-ST-5.08	1	A cable for the connector "ESP SWITCH"
MSTB socket 2.5/4-ST-5.08	1	A cable for the connector "KEY SWITCH"

When an order is placed for cables for communication with the control object by the CNC manufacturer, connectors will be removed from the set of mounting parts and they will be mounted onto the cables.

3.4.4 Spare diskettes serve for software rebooting in the event of a system files loss. The software restoration procedure is presented in the "Software Characterization".

3.4.5 On request, the CNC Unit may be supplied with extra equipment items, their list is given in Table 3.4.

Table 3.4 – Additional equipment (optional)

Module designation	Module description	Quantity
	<u>External input/output modules</u>	
NC210-401	Input module with relay commutation and indication (24): Output channels -24	1-2
NC210-402	Input indication module (32): Input channels -32	1-2
	<u>Additional modules</u>	
NC110-75	An electronic hand wheel LGF-12-003-100	1/2
NC310-75	An electronic hand wheel ZBG-5-003-100	1/2
NC110-78	A detachable machine-tool panel	1

4 POWER SUPPLY UNIT

4.1 The Purpose of the Power Supply Unit

4.1.1 The PU provides the CNC unit with a set of feed voltages of: +5V, +12V, -12V.

4.1.2 The supply voltage is delivered from the PU (the NC210-11 power source) to the CU (the NC210-4 bus module), from where it is distributed among all the component parts. Power supply of +5V, +12V, -12V comes into the **CPU card** through the NC210-25 card and the NC110 **ISA BUS**.

The +12V supply voltage for the fan is delivered from the NC210-26 **FDD** card. Voltages of +5V, +12V are delivered to the display unit, while the keyboard unit receives a voltage of +5V, +12V.

In addition, power voltage is also used to feed external equipment items. Voltages of +5V, +12V are sent to the "**FDD**" connector of the NC210-26 card, to supply power to the **FDD**. Through connectors "**1**"-"**4**" of the **CPU ECDA** module the +5B voltage is delivered to encoders, while through connector "**6**" it is fed to the hand wheel and through the "**USB1**", "**USB2**" connectors it is supplied to the external **I/O** equipment connected to it.

4.2 Technical Specifications of the Power Supply Unit

4.2.1 Input characteristics:

- input voltage range: ~ (187-242) V
- input voltage frequency: 49-51 Hz

4.2.2 Output characteristics:

- Output voltages:
 - adjustable +5.00±0.25 V/12A
 - not adjustable +12.00 V/2A
 - not adjustable -12.00 V/1A
- Output power: 100 W, max.

4.3 Power Supply Unit Setup

4.3.1 The PU composition is presented in Table 3.1.

4.3.2 The NC210-12 input power supply card.

4.3.2.1 Connector **J1** of the CNC Unit power supply is mounted on the NC210-12 card. Against overloads and short-circuits the primary circuit of the CNC is protected with a safety fuse. A fuse with a rating of 3A is mounted into the circuit of Phase wire **L** of the primary circuit.

4.3.2.2 The circuit of Phase wire **L** of the primary circuit contains a power switch NC210-66, which is mounted on the OCP. The switch pins are wired to the **J13** connector in the NC210-4 bus module, which is designated as the "**KEY SWITCH**" on the rear wall of the CNC Unit.

4.3.2.3 A stabilizer unit converts the input voltage of ~220V into a D.C. voltage of 24V and transfers it through the **J6** connector to indicator "**AC**" of the NC210-64 indication card and into the OCP. The green color "**AC**" indicator determines, if the power supply is in a good condition.

4.3.3 The NC210-13 filter of the primary circuit serves to suppress power system interference at the CNC input.

4.3.4 The currents and voltages generated by the NC210-11 power source are indicated in Item 4.2.

4.3.5 Power supply monitoring unit.

4.3.5.1 The power monitoring unit is located in the NC210-4 bus module. It provides for the monitoring of output voltages of the power supply source. The +5V voltage and signal **PE/** are used to generate a "**Power OK**" signal. If this signal does not get through into the CU, the CNC Unit cannot be started. Furthermore, the +5V voltage is used to indicate, if the secondary power supply is in a good condition. The +5V voltage together with the "**WATCH DOG LED**" signal comes through the **J14** connector to connector **J2**, into the NC210-64 card to the "**DC**" and "**ER**" indicators. The green color "**DC**" indicator announces, if the secondary power source is in a good condition, while the red color "**ER**" indicator informs the operator on the presence of an error detected by the "**WATCH DOG**" system.

4.3.5.2 The CNC readiness relay **RL1** ("**SPEPN**") is mounted on the NC210-4 card. The connectors and jumpers positions, their designation and function on the NC210-4 card are given in Appendix A.

The **SPEPN** relay has two NO contacts. The NOC of the **SPEPN** relay fix the CNC Unit readiness to switch the machine tool control voltage. When the relay contacts are open, this is the sign of the CNC Unit not being ready. If the relay contacts are closed, the CNC Unit is ready. The NOC of the relay must be enabled in the circuit switching on/off the control voltage of the machine tool. The control voltage of the machine tool can be switched on both in a standard way and in an emergency situation.

Signals from the PLC interface take part in the procedure of switching on /off the **SPEPN** relay. Contacts can be switched over by:

- the **U10K20** (**ASPEPN**) signal from PL;
- if there is a fault in the axes shown in word **W06K3**;
- if blocking errors **SWE** and **NMI** are present.

The causes of the absence of the CNC readiness signal "**SPEPN**" are shown in Table 5.1. The work sequence and the PLC interface signals are shown in the document "**PLC Interface Programming**".

The NO contacts of the **RL1** relay are wired to the **J8** connector marked as "**SPEPN**" on the rear wall of the CNC Unit.

ATTENTION! – IT IS RECOMMENDED TO USE THE "SPEPN" RELAY PINS IN THE 24V POWER SUPPLY CIRCUIT FROM THE ELECTRICAL EQUIPMENT OF THE CONTROLLED OBJECT IN THE CNC UNIT.

5 CPU ECDA Module

5.1 The CPU Card NC210-21

5.1.1 The **CPU** NC210-21 card is the core element of the control unit. The **CPU** card features the following characteristics:

- CPU: Intel Pentium MMX 266 MHz
- SDRAM: 64/128 MB
- Flash Disk: DOM: 32/64/128 MB
- FDD interface: 1 channel for 2 FDD: 3.5" (1.44 MB)
- EIDE HDD interface: 1 channel for 2 devices: HDD/Flash Disk: DOM
- PCI SVGA interface:
 - a) video memory: DRAM: 2 MB
 - b) VGA CRT channel:
 - display type: CRT monitor
 - resolution: 1024 x 768 (256 colors)
 - c) VGA LCD channel:
 - display type: color TFT LCD Panel
 - resolution: 640x480
- EXKB Interface: CNC keyboard: 79 keys
- Serial port: COM1: RS-232, COM2: RS-232/422/485
- LAN interface (optional): Ethernet: 10/100 Mbit/s
- USB Interface: specification rev. 1.0
- Local bus: ISA BUS 16 bit
- Local bus: PC-104 16 bit

5.1.2 The **CPU** card setup is shown in Table 3.1. The **CPU** card is a **PCA-6751** type built-in processor card. The connectors and jumpers positions, their designation and function on the **CPU** board are given in Appendix A.

5.1.3 A **Flash Disk** type memory unit is installed in the **CPU** card as a storage device: **DOM** NC210-23. The **Flash Disk** provides 100% compatibility with hard disk (the EIDE bus). The time of storing data in the Flash Disk is essentially unlimited. The **DOM** part is installed into connector "**IDE**". When standard software is used, the memory capacity makes 32 MB. When a special software product is ordered, the memory capacity increases up to 128 MB.

5.1.4 Two 144-pin **SODIMM RAM** sockets support **SDRAM** memory module from 8 to 256 MB. The NC210-24 memory (RAM) is installed in sockets "**SODIMM1**", "**SODIMM2**". Each socket accepts 8/16/32/64/128 MB. If only one **SODIMM** module is installed, it may be installed in either **SODIMM** socket on the solder side of the PCA-6751 card. The standard capacity of the working memory is 64 MB.

5.1.5 The initial configuration of the computer equipment and software installation are made by the manufacturer of the CNC Unit. The CNC Unit uses a **BIOS** made by the **AWARD** Company. The **BIOS** capabilities and the list of parameters set by the CNC Unit manufacturer are shown in Appendix B.

5.1.6 The basic software of the CNC Unit is installed in the **Flash Disk**. The operation of the basic software is under the control of the "**WATCH DOG**" circuit. An error detected by the "**WATCH DOG**" is then indicated by the red color "**ER**" LED located in the OCP, with the simultaneous reset of the CNC readiness signal. The causes of the absence of the CNC readiness signal are listed in Table 5.1.

Table 5.1

Error	OCP indicator	Indication on display screen (second line)
Temporary errors in the bus. The module installed in the bus is either missing or it does not respond.	ER	TIME-OUT
WATCH DOG. An error occurs as a consequence of software errors, also because of NC-210 module malfunctions.	ER	WAITING ERROR
Power failure.	-	Power failure
An emergency stop. An error emerges, if the " EMERGENCY STOP " button is processed by the software, in this case this button must be released before turning the CNC Unit on.	-	An Emergency stop
A malfunction of the CNC Unit. An error occurs, if the cause of the CNC malfunction cannot be determined due to the reasons listed in this table.	-	NMI -> A CNC error
Not enough memory in the operating storage device (UMB)	-	no free memory
A servo cycle error (ticking rate must be increased in the TIM instruction of the AXCFIL file)	-	A servo cycle error
Encoder initialization error.	-	An encoder initialization error
File reading error svdold , when the " OLD " instruction is installed in the PGCFIL file (check the disk with the scandisk.exe program). The CNC Unit must always be switched off after the machine-tool has been turned down.	-	"OLD" reading error

5.1.7 Communication of the **CPU** card with the **TFT 10.4"** screen is accomplished directly via a cable through the "**LCD 24 bit**" connector (CN5).

Communication of the **CPU** card with the OCP keyboard is secured through the "**EXKB**" connector (CN17). Via a cable keyboard interface signals are channeled into the **ECDA** card, from where they get through connector **J8** into the NC210-4 bus module and then through the **J1** connector via a cable, then they follow into the keyboard of the NC210-61 unit.

5.1.8 The **CPU** card has external "**VGA**", "**KEY**", "**RS232**", "**LAN**" connectors on the front panel of the **CPU ECDA** module. The connector's types are shown in Table 3.2.

5.1.8.1 The "**VGA**" connector (CN11) is designed for connecting an external **CRT** graphic monitor to the CNC Unit. The connector signals are shown in Table 5.2.

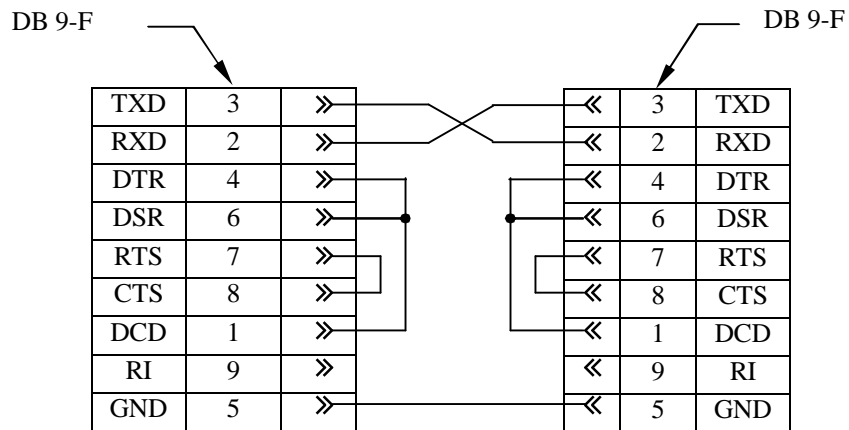
Table 5.2

Pin	Signal	Pin	Signal
1	RED	9	NC
2	GREEN	10	GND
3	BLUE	11	NC
4	NC	12	NC
5	GND	13	H SYNC
6	GND R	14	V SYNC
7	GND G	15	NC
8	GND B	-	-

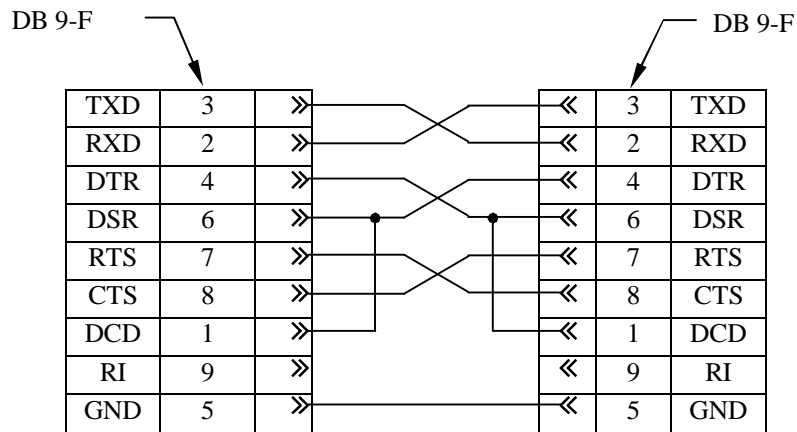
5.1.8.2 Signals from the **RS-232** serial interface (port **COM1**) are wired to connector "**RS232**" (CN16). The "**RS232**" connector signals are shown in Table 5.3. Diagrams for connecting the CNC Unit with an external PC through the **RS-232** channel are shown in Figure 5.1.

Table 5.3

Pin	Signal	Pin	Signal
1	DCD	6	DSR
2	RXD	7	RTS
3	TXD	8	CTS
4	DTR	9	RI
5	GND	-	-



a) A minimum-size cable



b) A full cable

Figure 5.1

The **RS-232** serial channel port must be declared as a **COM1** port, while the **RS-422/485** must be declared as channel port **COM2** - the address and interruption level setting for the **UART** microcircuit in the option "**INTEGRATED PERIPHERALS**" **SETUP**. An example of this setting is as follows:

On board UART 1: 3F8/IRQ4
 On board UART 2: 2F8/IRQ3

5.1.8.3 Signals from the Ethernet interface are wired to connector "**LAN**". The "**LAN**" connector signals are shown in Table 5.4.

Table 5.4

Pin	Signal	Pin	Signal
1	TX+	5	COMM
2	TX-	6	RX-
3	RX+	7	COMM
4	COMM	8	COMM

5.1.8.4 The "**KEY**" connector makes it possible to connect to the CNC Unit an external keyboard instead of the operator panel keyboard. The "**KEY**" connector signals are shown in Table 5.5.

Table 5.5

Pin	Signal	Pin	Signal
1	KB data	4	VCC
2	NC	5	KB clock
3	GND	6	NC

5.1.9 The **FDD** interface signals from the **CPU** (CN1) are wired to the front panel of the **CPU ECDA** module, to its connector "**FDD**" through the **FDD NC210-26** transition card. Besides the above-mentioned connectors, the **FDD** interface signals protection elements and the fan power supply connector are also located on this panel.

The "**FDD**" connector type is indicated in Table 3.2. The signals of the "**FDD**" connector and their communication with the external magnetic floppy disk memory connectors are indicated in Table 5.6. Power is fed to the **FDD** from the CNC Unit through its interface channel. Three pins: 18, 19 and 37 in the "**FDD**" connector are assigned for this purpose.

The **FDD** responds to the name **B:**, if the CNC unit is connected with the **FDD** by a cable made in accordance with Table 5.6.

To be able to carry out the software restoration procedure from reserve diskettes, the **FDD** must respond to its name **A:**. To make the **FDD** respond to this name **A:**, it is necessary to introduce the following settings into the **SETUP** menu:

- 1) In the **STANDARD CMOS SETUP** menu option make two devices as present:

drive A: 1.44M, 3.5 in;
drive B: 1.44M, 3.5 in.

- 2) In the **BIOS FEATURES SETUP** menu option enter the following:

Boot Sequence	:A,C
Swap Floppy Driver	:Enabled

5.1.10 The **PCA-6751** board provides two USB interfaces, which give complete plug and play and also hot attach/detach for up to 127 external devices. The USB interfaces comply with USB specification rev. 1.0 and are fuse protected.

The **USB** interface signals from the **CPU** (CN4) are wired to the front panel of the **CPU ECDA** module, to its connector "**USB2**" through the **USB NC210-27-1** transition card. The connector type is indicated in table 3.2. The signals of the "**USB2**" connector are indicated in Table 5.7.

Table 5.6

CNC connector		FDD connector	
"FDD"		34 pins	Power connector
pin	signal	pin	pin
1	GND	1	
2	GND	3	
3	GND	5	
4	GND	7	
5	GND	9	
6	GND	11	
7	GND	13	
8	GND	15	
9	GND	17	
10	GND	19	
11	GND	21	
12	GND	23	
13	GND	25	
14	GND	27	
15	GND	29	
16	GND	31	
17	GND	33	
18	+5V	-	1
19	+12V	-	4
20	High Density	2	
21	No connect	4	
22	No connect	6	
23	INDEX	8	
24	Motor Enable A	10	
25	Drive Select A	12	
26	Drive Select B	14	
27	Motor Enable B	16	
28	Direction	18	
29	Step Pulse	20	
30	WRITE DATA	22	
31	Write Enable	24	
32	TRACK 0	26	
33	Write Protect	28	
34	Read Data	30	
35	Select Head	32	
36	Disk Change	34	
37	GND	-	2, 3

Table 5.7

Pin	Signal	Pin	Signal
1	+5B	3	DATA+
2	DATA-	4	GND

5.2 The USB card NC210-29

5.2.1 The **USB** channel is provided for on the **USB NC210-29** card. The **USB** channel enables the CNC Unit to operate with peripheral devices in the **Plug & Play** mode. It makes it possible to connect external devices to the CNC Unit when it is running, to automatically identify them immediately after their connection and the installation of appropriate drivers that follows it. A +5V power supply is provided for low-capacity external devices in the channel

5.2.2 Technical characteristics of the **USB** channel:

- | | |
|---|-----------------|
| 1) data exchange rate: | 1.6 Mbit/s, max |
| 2) number of devices to be connected: | 1 |
| 3) supply voltage for external devices to be connected: | +5 V |
| 4) consumption current per device: | 250 mA, max |
| 5) length of the cable to be connected: | 1.5 m, max |

5.2.3 The **USB** channel is organized on the basis of signals of the **PC-104** processor bus. The channel converts the parallel 8-digit code **D0-D7** received from the **CPU** via the **PC-104** bus into a sequence of symbols with service bits and it brings out this sequence into the **USB** communication channel and also carries out a reverse conversion – it converts a serial flow of symbols received from an external device through the **USB** channel into the parallel 8-digit code **DO-D7** coming via the **PC-104** bus into the **CPU**.

The arrangement of the **USB NC210-29** card elements is indicated in Appendix A. The **USB** channel signals are sent from the **J3** connector through a cable and via the **USB** connector card NC210-27-1 to the "**USB1**" connector of the connector card of the CNC Unit, as this is shown in Figure 3.4.

The arrangement and purpose of the **USB** card connectors NC210-27-1 are indicated in Appendix A. The "**USB1**" connector type is indicated in Table 3.2, the channel signals are presented in Table 5.7.

5.3 The ECDA Card NC210-25

5.3.1 The Purpose and Set Up of the ECDA Card

5.3.1.1 The NC210-25 **ECDA** card (An encoder-DAC converter card) is a module for controlling the following peripheral equipment:

- electric tracking drives having feedback sensors;
- photoelectric angular movement transmitters (encoders) performing the functions of feedback sensors;
- a machine-tool spindle;
- an electronic hand wheel;
- a tactile sensor.

5.3.1.2 The set up of the **ECDA** card is given in Table 3.1. The **ECDA** card is equipped with:

- a **DAC** channel - 5;
- an encoder channel - 4;
- an electronic hand wheel channel - 1;
- a tactile sensor channel - 1.

5.3.1.3 The **ECDA** card can service between 1 to 4 electric tracking drives with feedback. The encoder channel, to which the feedback sensor is connected, must conform to each **DAC** channel connected to the electric drive. This link is established by applying the **NTC** instruction in the **AXCFIL** file in accordance with the "Software characterization".

5.3.1.4 One **DAC** channel is used for spindle control without a feedback sensor. The spindle control parameters are set in accordance with the "Software characterization".

5.3.1.5 The electronic hand wheel is used for manual axes travel. One electronic hand wheel, which does not require any characterization, can be connected to the CNC Unit via the hand wheel channel.

The hand wheel is not included into the obligatory CNC delivery set. The CNC Unit can be provided with the electronic hand wheel on the basis of a special order. Appendix C provides information about the hand wheel, also on another method of connecting the hand wheel to the CNC Unit and about its operation with two hand wheels.

5.3.1.6 The tactile sensor performs the function of an electronic measuring feeler which performs the following functions:

- measuring the coordinates of a point in space;
- measurements of circumference center points and radii in a plane;
- measurements of displacement values from theory-based points.

The tactile sensor channel allows to connect one tactile sensor to the CNC Unit. One can connect a tactile sensor to the CNC Unit in different ways: through a **PLC** signal (the discrete input of the **I/O** module).

5.3.1.7 The **ECDA** card is equipped with external connectors for connecting equipment that is controlled, and these are linked to the front panel of the **CPU ECDA** module, as it is shown in Figure 3.4. The designation, names and purpose of connectors are given in Table 3.2.

The connectors and jumpers positions, their designation and function on the **ECDA** card are given in Appendix A.

5.3.2 The Encoder channel

5.3.2.1 The CNC Unit can operate with four photoelectric angular or linear travel transmitters with an rectangular impulse output signal (TTL). Power is fed from the CNC Unit to the encoders through their connection channels.

5.3.2.2 The encoder channel features the following characteristics:

1) encoder feed voltage:	5.00±0.25 V
2) encoder consumed current:	160 mA, not more
3) channel input:	differential
4) range of input signals:	
- main	(A+, A-)
- displaced	(B+, B-)
- zero-mark	(Z+, Z-)
5) type of input signals:	rectangular pulses
6) frequency of input signals before quadrupling:	200 kHz, not more
7) the discreteness of input signal step:	1/(4xN), where N is the number of pulses per one sensor revolution
8) input signal levels:	
- the logic "0"	0.50 V, not more
- the logic "1"	2.50 V, not less
9) connecting cable length:	50 m, not more

5.3.2.3 The encoder channel input is differential: direct signals **A+**, **B+**, **Z+** and inverse **A-**, **B-**, **Z-** signals must come to it from the sensor. The **A**, **B**, **Z** signals polarity can be altered within any of the channels. This makes it possible to:

- change the direction of the encoder pulse count;
- coordinate the **A**, **B**, **Z** signals in time; the **Z** signal must be on a high level when the **A** and **B** signals are also on a high level.

An example of correct direct signal phasing is shown in Figure 5.2 (the inverse signals **A-**, **B-**, **Z-** are not shown).

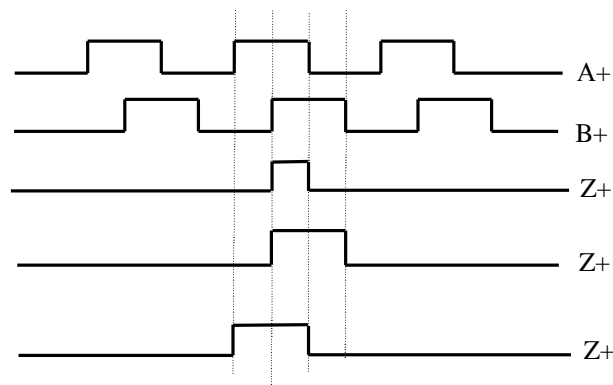


Figure 5.2

An example of encoder signals, when it is required to alter the polarity of one of the signals, is shown in Figure 5.3.

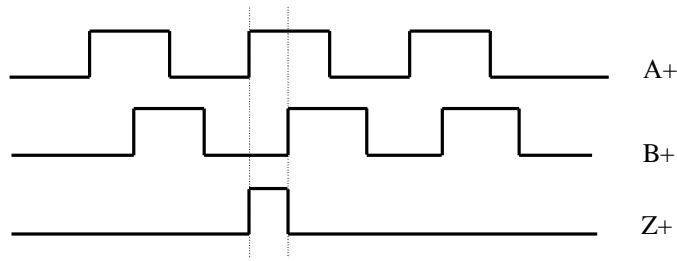


Figure 5.3

5.3.2.4 The polarity of the **A**, **B**, **Z** signals inside the NC210-25 card channel for encoders "1"-**4**" is selected by using jumpers **S11**, **S12**, **S9**. The positive polarity of direct encoder signals **A**, **B**, **Z** is set by default, as it is shown in Figure 5.4.

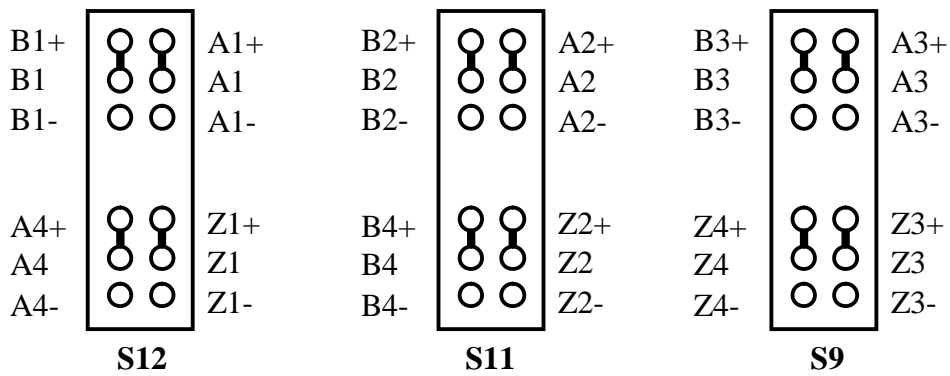


Figure 5.4

In order to change the polarity of the signals, it is necessary to change the jumper positions, as it is shown in Figure 5.5.

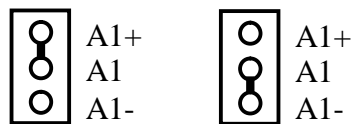


Figure 5.5

5.3.2.5 This channel performs a hardware-based check of the encoder signal interruption or of its power supply. Its operation mode is set by placing Jumper **S7** in accordance with Figure 5.6. The encoder signal break hardware checks are enabled by default.

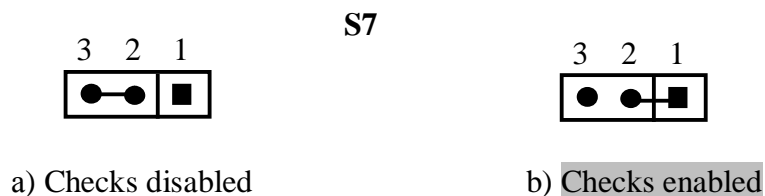


Figure 5.6 – Selection of the Mode of Encoder Signal Hardware-Based Interruption Checks

5.3.2.6 The encoder channels are wired to connectors "1"-**4**" on the front panel of the **CPU ECDA** module. Connector types are shown in Table 3.2. Connector pins arrangement is shown in Figure 5.7. The channel signals are presented in Table 5.8.

Table 5.8

Pin	Signal
1	A+
2	B+
3	Z+
4	+5V
5	GND
6	A-
7	B-
8	Z-
9	+5V

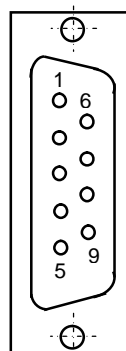


Figure 5.7

5.2.2.7 Encoders are connected to the CNC Unit according to the diagram presented in Figure 5.8.

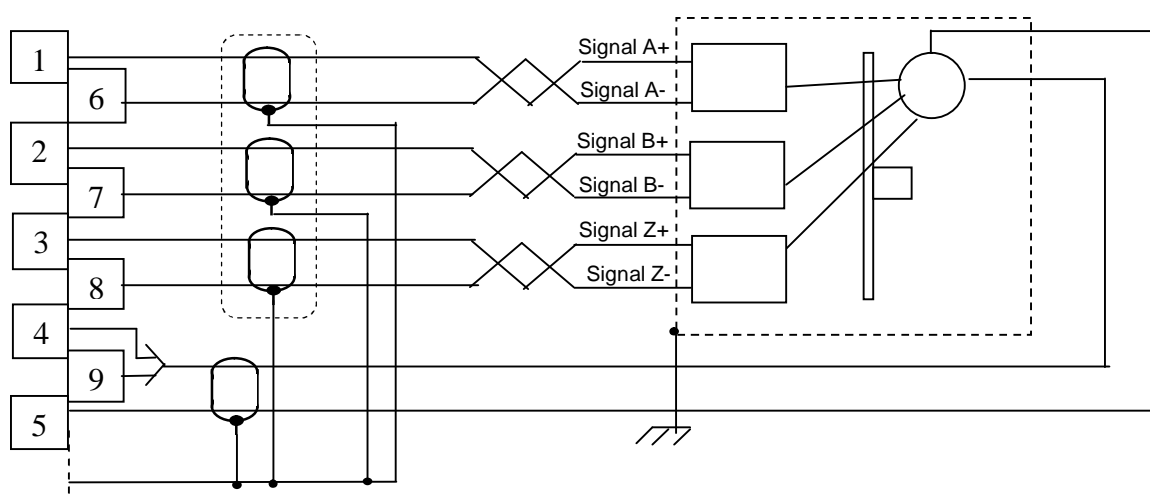


Figure 5.8

5.3.3 The Digital-to-Analog Converter

5.3.3.1 The DAC characteristics:

- | | |
|---|------------------------------------|
| 1) number of channels: | 5 |
| 2) basic microcircuit chip | AD7545 |
| 3) output resistance: | 0.2 Ohm |
| 4) output current: | 5 mA |
| 5) output signal range: | ± 10.0 V |
| 6) linear section: | ± 8.5 V |
| 7) resolution: | 14 digits (13 digits+ 1 character) |
| 8) nominal discreteness in the range: | |
| - from minus 10 to minus 5 V | 2.440 mV |
| - from minus 5 to plus 5 V | 1.220 mV |
| - from plus 5 to plus 10 V | 2.440 mV |
| 9) main conversion error: | |
| - in the range of ± 0.15 V | ± 25 mV, not more |
| - in the rest of the range | $\pm 1\%$ |
| 10) additional conversion error per 10^0 C: | does not exceed the main error |

Table 5.9 – Correspondence of Codes with the DAC Output Voltage

Hexadecimal code (Hex)	DAC output voltage, mV
9FFF	-10000.00
9CCF	- 9000.24
9B35	- 8500.00
999B	- 8000.48
9802	- 7500.00
9668	- 7000.73
9336	- 6000.97
8FFF	- 5000.00
8CCF	- 4000.24
8998	- 3000.48
8801	- 2500.00
8667	- 2000.73
8334	- 1000.93
8194	- 500.48
80A4	- 200.18
8052	- 100.09
8040	- 78.12
8020	- 39.06
8010	- 19.53
8008	- 9.76
8004	- 4.88
8002	- 2.44
8001	- 1.22
0000	0.00
0001	+ 1.22
0002	+ 2.44
0003	+ 3.66
0005	+ 6.10
0009	+ 10.98
0011	+ 20.75
0020	+ 39.06
0041	+ 79.34
0052	+ 100.97
00A4	+ 200.19
019A	+ 500.19
0334	+ 1000.95
0667	+ 2000.73
0801	+ 2500.00
0998	+ 3000.00
0CCF	+ 4000.24
0FFF	+ 5000.00
1336	+ 6000.97
1668	+ 7000.73
1802	+ 7500.00
199B	+ 8000.48
1B35	+ 8500.00
1CCF	+ 9000.24
1FFF	+ 9998.77

5.3.3.2 The DA converter can operate both under a supply voltage of $\pm 12V$ from the power source of the CNC Unit and at a voltage of $\pm 15V$ obtained from the $\pm 12V$ voltage through a **DC/DC** converter. The choice of the DAC supply voltage is made with the help of jumpers **S5**, **S6** in accordance with Figure 5.9. The $\pm 12V$ voltage is a default setting.



Figure 5.9

5.3.3.3 The **DAC** device converts the influencing factors, originating from the **CPU** and arriving in a 14-digit code, into an analog voltage. Then this voltage is sent to the drives of equipment to be controlled. This correspondence between the coding and the analog voltage at the **DAC** output is shown in Table 5.9. The graph of the **DAC** output voltage is presented in Figure 5.10.

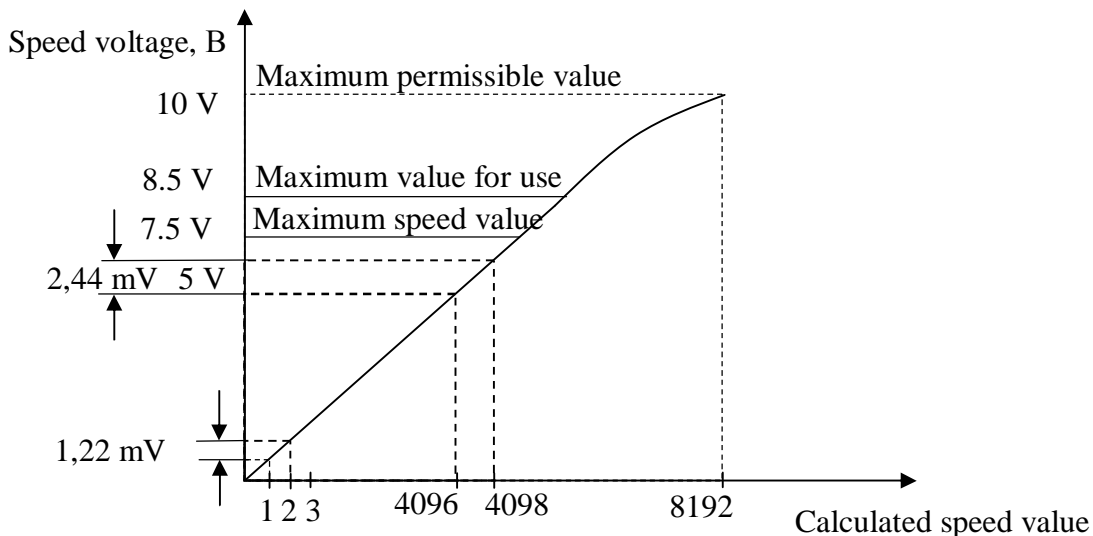


Figure 5.10

5.3.3.4 The DAC device channels are wired to connector "5" on the front panel of the **CPU ECDA** module. The connector types are given in Table 3.2. The arrangement of connector pins is shown in Figure 5.11. The **DAC** channel signals are presented in Table 5.10.

Table 5.10

Pin	Signal	Pin	Signal
1	DAC1 channel	9	GNDA DAC1
2	DAC2 channel	10	GNDA DAC2
3	DAC3 channel	11	GNDA DAC3
4	DAC4 channel	12	GNDA DAC4
5	DAC 5 channel	13	GNDA DAC5
6	Not used	14	TS- (TS output)
7	TS+ (TS input)	15	TS- (TS output)
8	TS+ (TS input)	-	-

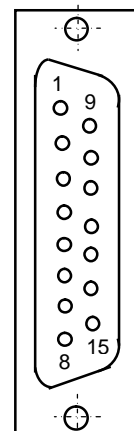


Figure 5.11

5.3.4 The Electronic Hand Wheel Channel

5.3.4.1 The CNC Unit has one electronic hand wheel channel. Power is fed to the hand wheel from the CNC Unit through its channel.

5.3.4.2 Characteristics of the electronic hand wheel channel:

- | | |
|---|---|
| 1) hand wheel supply voltage: | 5.00±0.25 V; |
| 2) hand wheel consumption current: | 160 mA, not more; |
| 3) input type: | differential/single (direct) |
| 4) range of input signals: | |
| - main | (A+, A-/A+); |
| - displaced | (B+, B-/B+); |
| 5) type of input signals: | rectangular pulses; |
| 6) input signal frequency before quadrupling: | 200 kHz, not more; |
| 7) discreteness of input signal step: | 1/(4xN), where N is the number of pulses per one sensor revolution; |
| 8) input signal levels: | |
| - the logic "0" | 0.50 V, not more; |
| - the logic "1" | 2.50 V, not less; |
| 9) connection cable length: | 50 m, not more. |

5.3.4.3 The hand wheel channel allows to operate this unit both with hand wheels having direct and inverse signals **A+**, **A-** and **B+**, **B-** and with hand wheels having direct signals **A+** and **B+** only. The type of the hand wheel input can be selected by means of the **S1-S4** jumpers on the NC210-25 card according to Table 5.11. The differential input type is set by default.

Table 5.11

Input type	S1	S2	S3	S4
differential	open	open	closed	closed
single	closed	closed	open	open

5.3.4.4 The hand wheel channel is linked to connector "6" on the front panel of the **CPU ECDA** module. The connector type is shown in Table 3.2. The arrangement of connector pins is shown in Figure 5.12. The channel signals are given in Table 5.12.

Table 5.12

Pin	Signal
1	A+
2	B+
3	Not used
4	+5 V
5	GND
6	A-
7	B-
8	Not used
9	+5 V

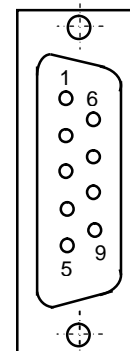


Figure 5.12

ATTENTION! POWER IS SUPPLIED TO THE HAND WHEEL FROM THE CNC UNIT THROUGH ITS CHANNEL. CONNECTION OF THE COMMUNICATION CABLE COMING FROM THE CNC UNIT TO THE HAND WHEEL REQUIRES SPECIAL ATTENTION. THE FEED WIRES "+5V" AND "GND" AT THE SIDE OF THE HAND WHEEL MUST BE CLEARLY

DEFINED (WITH A CLEAR MARKING OR COLOR). IT IS NOT ALLOWED TO REVERSE THE FEED WIRES "+5V" AND "GND". NON-COMPLIANCE WITH THIS REQUIREMENT LEADS TO A FAILURE OF THE PHOTOCCELL AND THE HAND WHEEL MICROCIRCUIT CHIP.

5.3.5 The Tactile Sensor Channel

5.3.5.1 Characteristics of the tactile sensor channel (an electronic feeler) are as follows:

1) input signal:	D.C. voltage
2) input signal levels:	
the logic "0"	0.0 – 0.8 V
the logic "1"	2.4 – 4.5 V

5.3.5.2 An illustration showing the tactile sensor operation is given in Figure 5.13.

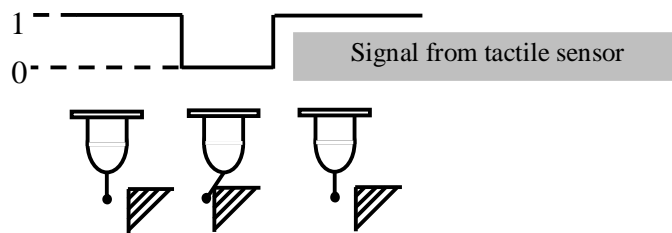


Figure 5.13

5.3.5.3 To connect the feeler to the CNC Unit through the tactile sensor channel, it is necessary to allocate a discrete I/O module input (an "A" package signal). The discrete I/O module input is designed to ensure the mechanical safety of the feeler. The address of the I/O module input channel, to which the tactile sensor is connected, should be declared in the **TAS** instruction of the **PGCFIL** characterization file for cycles **G72** and/or **G73**, or in the **INU** instruction of the **PGCFIL** characterization file for cycle **G74**. Issues pertaining to the feeler characterization are presented in the "Software characterization".

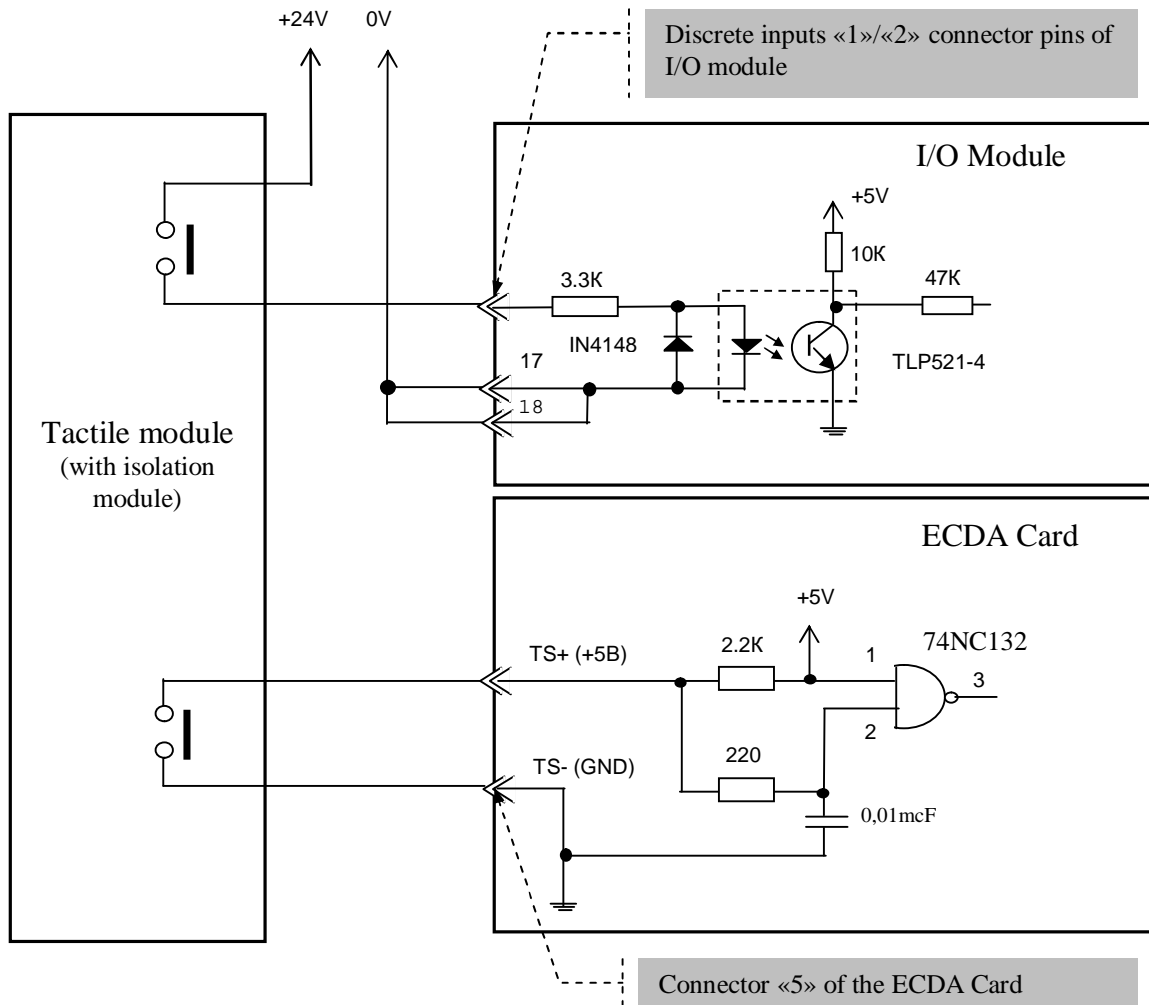
5.3.5.4 The tactile sensor channel signals are wired to connector "5" on the front panel of the **CPU ECDA** module. The connector types are presented in Table 3.2. The arrangement of connector pins is shown in Figure 5.11. The distribution of tactile sensor channel signals "TS+" and "TS-" between the pins of connector "5" is indicated in Table 5.10.

5.3.5.5 The tactile sensor should be connected through an optronic isolation module. Connection of the tactile sensor to the CNC Unit in a general form is shown in Figure 5.14. Concrete (specific) examples of connecting tactile sensors to the CNC Unit through a tactile sensor channel are presented in Figures 5.15-5.17.

5.3.5.6 Another method of connecting tactile sensors to the CNC Unit is through the discrete I/O module input (an "A" package signal). In this case the discrete I/O module input signal is a logic signal, used for measuring the coordinates of a point.

In this case, the tactile sensor should also be connected to the CNC Unit through the optronic isolation module. Examples of connecting the tactile sensor to the CNC Unit through the discrete I/O module input are similar to the examples given in Figures 5.14-5.17, in which only the communication of the tactile sensor with the I/O module is used.

The address of the I/O module input channel, to which the tactile sensor is connected, must be declared in the **TAS** instruction of the **PGCFIL** characterization file for cycles **G72** and/or **G73**. The feeler characterization in this case is indicated in "Software characterization".



Supply voltage range of the isolation module $U_{pow.} = (15-40)V$.
 Nominal supply voltage of the isolation module +24V, nominal current $I_{nom.} = 13mA/24V$.

Figure 5.14 – General case of connecting a tactile sensor to the CNC Unit

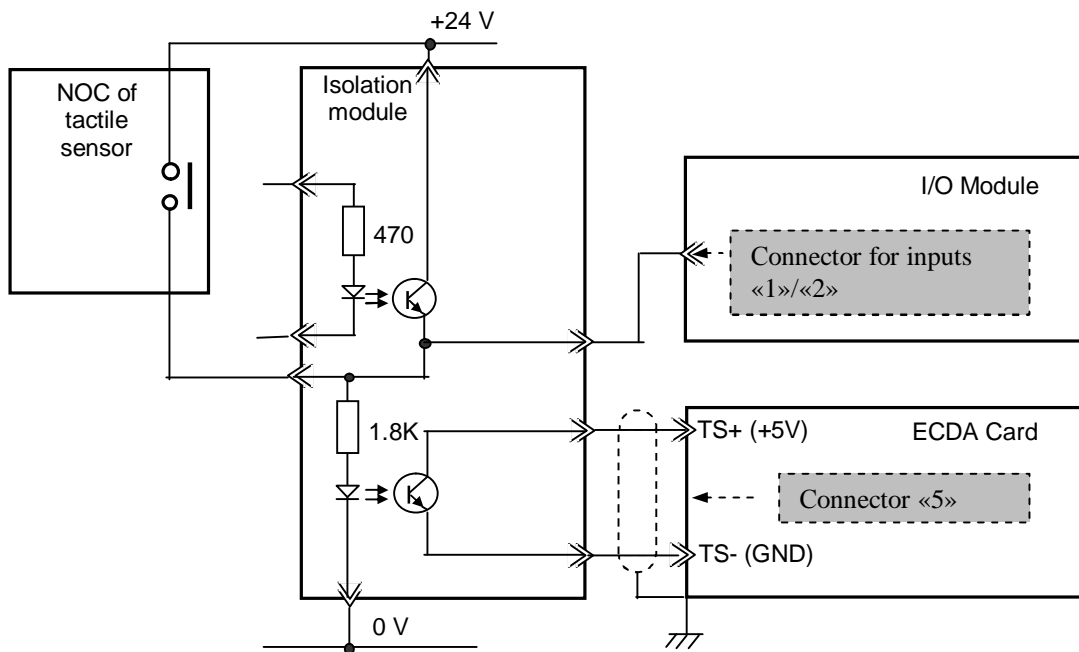


Figure 5.15 – Connections of a TS with Normally Open Contacts (NOC) to the CNC Unit

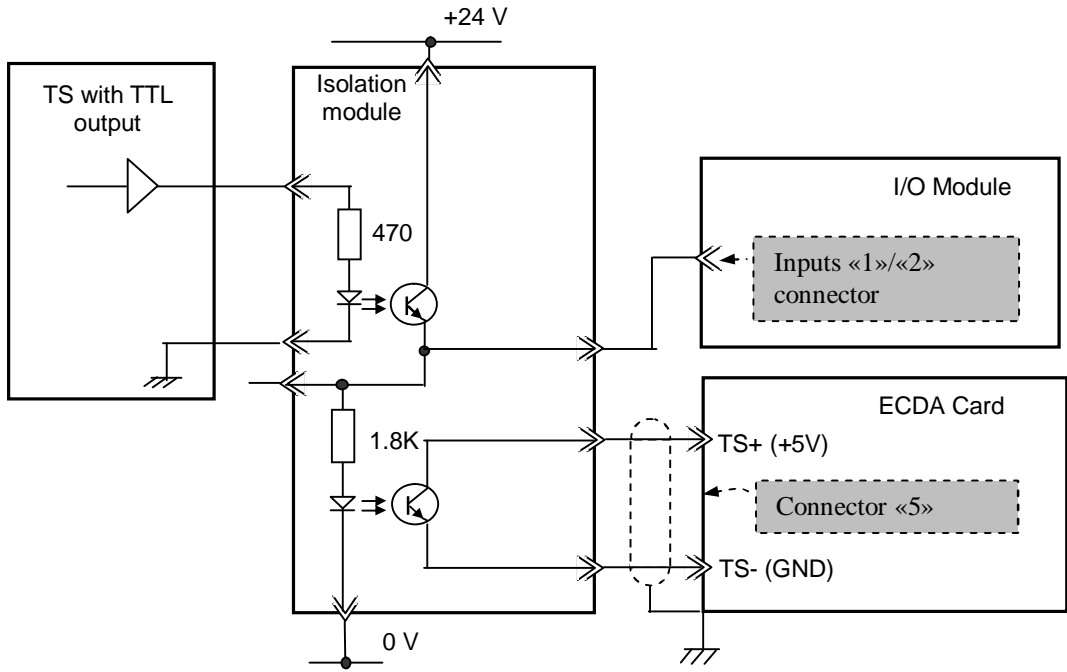


Figure 5.16 – Connections to the CNC Unit of a TS with a TTL Output

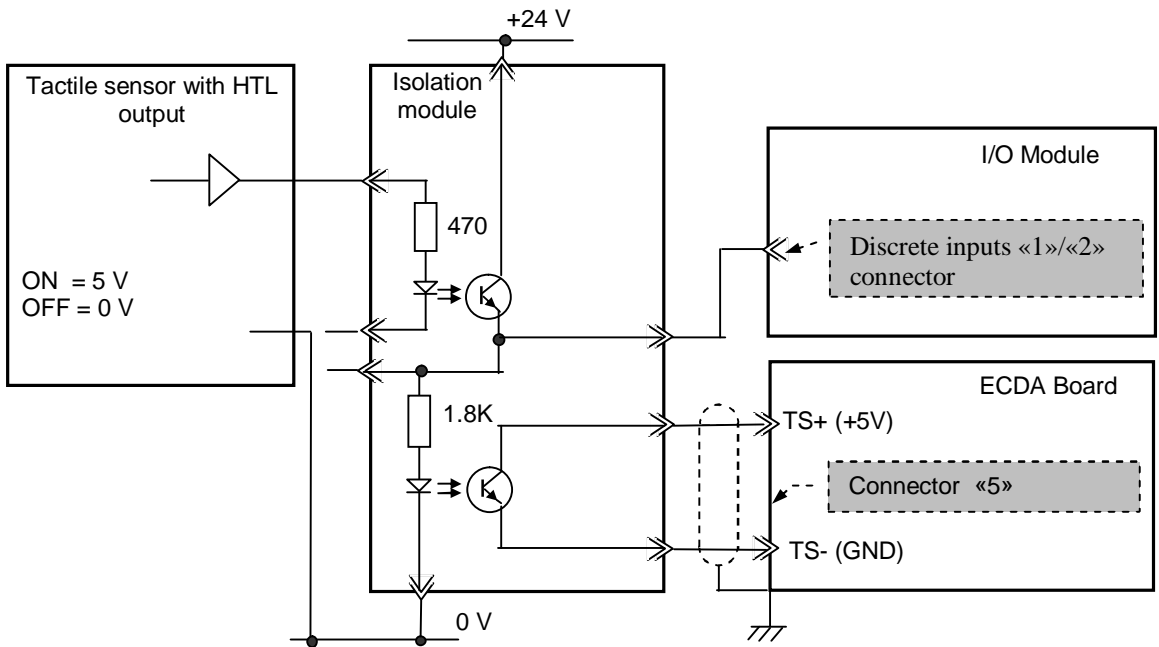


Figure 5.17 – Connection to the CNC Unit of a Tactile Sensor with an HTL Output

6 The I/O Module

6.1 The Purpose and Setup of the I/O Module

6.1.1 Via the input/output channels the **I/O** module provides bi-directional communication (a polling/controlling action) between the CNC Unit and the electrical equipment of an object to be controlled. Information exchange is carried out under software control. A part program ensures information transfer both from the controlled equipment to the PL and in the opposite direction via a **PLC** interface.

The setup of the **I/O** module is given in Table 3.2. The connectors and jumpers positions, their designation and function on the **I/O** module are given in Appendix A.

6.2 Discrete Input/Output Channels

6.2.1 The input/output channels provide for the physical connection of the CNC Unit and the controlling, monitoring and protection elements, etc., in the electric circuits of controlled objects.

The input/output channel signals are discrete (digital) signals and they can assume the values of either of the logic "1" or the logic "0". Input signals inform the CNC Unit on the status of an element being polled (log. "1"/log. "0") in the control circuits. Output signals come through the output channels from the CNC Unit into controlled equipment, to switch on/off certain elements in the control circuits.

6.2.2 Technical input characteristics:

- | | |
|--|---------------|
| 1) number of input channels: | |
| - NC210-31: | 32 |
| - NC210-32: | 64 |
| 2) form of input signal: | DC voltage |
| 3) input signal level: | |
| - the Logic «0» | 0-7 V |
| - the Logic «1» | 15-30 V |
| 4) nominal input current: | 12 mA at 24 V |
| 5) time constant of the input filter: | 5 ms |
| 6) electric strength of optoisolation: | 1500 V, min. |

6.2.3 Output characteristics:

- | | |
|-------------------------------|-------------------|
| 1) number of output channels: | |
| - NC210-31: | 24 |
| - NC210-32: | 48 |
| 2) output type: | an open collector |
| 3) commutated voltage: | 15-30 V |
| 4) nominal output current: | 50 mA at 24 V |

6.2.4 The input/output channel signals are physical package- "A" signals of the PLC interface. Information about the "A"-package signals is contained in the "Programming and Operator's Manual" and "PLC Interface Programming".

Connectors **00-03** and **08-11** are assigned to the input signals in the "A" package by the CNC software, while connectors **04, 05, 12, 13** are assigned to output signals. Determination of input/output

channel parameters, when characterizing the controlled equipment logic, is given in the "Software Characterization".

6.2.5 The input/output channels are wired to connectors of the front panel of the **I/O** module, which is presented in Figure 3.4. The input channels are wired to connectors “1”, “2”, while the output channels are linked to connectors “3”, “4”. The type of connectors is indicated in Table 3.2.

An example of distribution of the “A”-package signals of the **PLC** interface between the **I/O** module connectors is given in Table 6.1.

Table 6.1

The No. of the I/O module	PLC signals(«A» package)			
	№ I/O module connector			
	Inputs		Outputs	
	1	2	3	4
0	I00A00-I00A31	I01A00-I01A31	U04A00-U04A23	U04A24-U04A31 U05A00-U05A15

6.2.6 The input channel signals for connectors «1», «2» of the **I/O** module are given in Table 6.2.

Table 6.2

Connector “1”		Connector “2”	
Signal	Pin	Signal	Pin
Input0 (I00A00)	1	Input 32 (I01A00)	1
Input1 (I00A01)	2	Input 33 (I01A01)	2
Input2 (I00A02)	3	Input 34 (I01A02)	3
Input3 (I00A03)	4	Input 35 (I01A03)	4
Input4 (I00A04)	5	Input 36 (I01A04)	5
Input5 (I00A05)	6	Input 37 (I01A05)	6
Input6 (I00A06)	7	Input 38 (I01A06)	7
Input7 (I00A07)	8	Input 39 (I01A07)	8
Input8 (I00A08)	9	Input 40 (I01A08)	9
Input9 (I00A09)	10	Input 41 (I01A09)	10
Input10 (I00A10)	11	Input 42 (I01A10)	11
Input11 (I00A11)	12	Input 43 (I01A11)	12
Input12 (I00A12)	13	Input 44 (I01A12)	13
Input13 (I00A13)	14	Input 45 (I01A13)	14
Input14 (I00A14)	15	Input 46 (I01A14)	15
Input15 (I00A15)	16	Input 47 (I01A15)	16
0V	17	0V	17
0V	18	0V	18
0V	19	0V	19
Input16 (I00A16)	20	Input 48 (I01A16)	20
Input17 (I00A17)	21	Input 49 (I01A17)	21
Input18 (I00A18)	22	Input 50 (I01A18)	22
Input19 (I00A19)	23	Input 51 (I01A19)	23
Input20 (I00A20)	24	Input 52 (I01A20)	24
Input21 (I00A21)	25	Input 53 (I01A21)	25
Input22 (I00A22)	26	Input 54 (I01A22)	26
Input 23 (I00A23)	27	Input 55 (I01A23)	27
Input 24 (I00A24)	28	Input 56 (I01A24)	28
Input 25 (I00A25)	29	Input 57 (I01A25)	29
Input 26 (I00A26)	30	Input 58 (I01A26)	30
Input 27 (I00A27)	31	Input 59 (I01A27)	31

Table 6.2 (continued)

Connector "1"		Connector "2"	
Signal	Pin	Signal	Pin
Input 28 (I00A28)	32	Input 60 (I01A28)	32
Input 29 (I00A29)	33	Input 61 (I01A29)	33
Input 30 (I00A30)	34	Input 62 (I01A30)	34
Input 31 (I00A31)	35	Input 63 (I01A31)	35
0V	36	0V	36
0V	37	0V	37

6.2.7 The output channel signals for connectors «3», «4» of the I/O module are given in Table 6.3.

Table 6.3

Connector "3"		Connector "4"	
Signal	Pin	Signal	Pin
Output0 (U04A00)	1	Output 24 (U04A24)	1
Output 1 (U04A01)	2	Output 25 (U04A25)	2
Output 2 (U04A02)	3	Output 26 (U04A26)	3
Output 3 (U04A03)	4	Output 27 (U04A27)	4
Output 4 (U04A04)	5	Output 28 (U04A28)	5
Output 5 (U04A05)	6	Output 29 (U04A29)	6
Output 6 (U04A06)	7	Output 30 (U04A30)	7
Output 7 (U04A07)	8	Output 31 (U04A31)	8
Output 8 (U04A08)	9	Output 32 (U05A00)	9
Output 9 (U04A09)	10	Output 33 (U05A01)	10
Output 10 (U04A10)	11	Output 34 (U05A02)	11
Output 11 (U04A11)	12	Output 35 (U05A03)	12
Output 23 (U04A23)	13	Output 47 (U05A15)	13
Output 12 (U04A12)	14	Output 36 (U05A04)	14
Output 13 (U04A13)	15	Output 37 (U05A05)	15
Output 14 (U04A14)	16	Output 38 (U05A06)	16
Output 15 (U04A15)	17	Output 39 (U05A07)	17
Output 16 (U04A16)	18	Output 40 (U05A08)	18
Output 17 (U04A17)	19	Output 41 (U05A09)	19
Output 18 (U04A18)	20	Output 42 (U05A10)	20
Output 19 (U04A19)	21	Output 43 (U05A11)	21
Output 20 (U04A20)	22	Output 44 (U05A12)	22
Output 21 (U04A21)	23	Output 45 (U05A13)	23
Output 22 (U04A22)	24	Output 46 (U05A14)	24
+24 V	25	+24 V	25



6.2.8 It is recommended to implement the connection of the discrete input/output channels of the CNC Unit to the electric automation devices of controlled equipment (for their mutual adjustment) through external input/output modules. The list of external input/output modules developed for the CNC Unit, their characteristics, and their diagram of connection to the CNC Unit and the table of soldered connections for communication cables are contained in Appendix D.

ATTENTION! POWER SUPPLY TO EXTERNAL INPUT/OUTPUT MODULES FROM THE CONTROL OBJECT SHALL BE PROVIDED VIA THE «SPEPN» RELAY CONTACTS, SINCE THE MOMENT OF ENABLING/REMOVING POWER SUPPLY IS PROGRAMME-CONTROLLED.

7 OPERATOR'S CONTROL PANEL

7.1 The Set Up of the Operator's Control Panel

7.1.1 The operator's control panel (OCP) comprises a display unit and a keyboard unit. The set up of these units is presented in Table 3.1. The front panel of the OCP, its overall and mounting dimensions are shown in Figure 3.2. The following elements are located on the front surface of the OCP:

- a color liquid-crystal display panel TFT 10.4", 640x480;
- an alphanumeric keyboard module:
 - § 36 alphanumeric keys;
 - § 25 special-purpose keys;
 - § 8 functional keys: "F1"- "F8";
- a functional keyboard module:
 - § 8 functional keys: "F11"- "F18";
 - § 2 special-purpose keys:  and  ;
- a console:
 - § the CNC power switch (a lock with a key for switching on/off the CNC power supply);
 - § light-emission diodes (LED):
 - "AC" – a power supply indicator;
 - "DC" – an indicator of the healthy status of the secondary power supply
 - "ER" – the CNC operation error indicator;
 - § one START key "1" (processed by the basic software);
 - § one STOP key "0" (processed by the basic software);
 - § one EMERGENCY STOP button (a red color, mushroom-shaped button);
 - § corrector of manual feeds "F";
 - § corrector of the "JOG" feed;
 - § corrector of spindle rotation speed "S";
 - § a mode selector switch "MDI, AUTO, STEP ... RESET".

7.1.2 The description of the purpose of the OCP control elements is presented in the "Programming and Operator's Manual".

7.1.3 The display and the keyboard are controlled from the CPU card. Control signals come onto the NC210-52 display from CPU via an internal cable through the LCD 24 bit interface.

Communication between the keyboard unit and the CPU card is secured through a bus module and the ECDA card with EXKB interface signals.

7.1.4 The "ESP SWITCH" connector, to which the NC210-66 EMERGENCY STOP button pins – (both normally open and normally closed ones) are linked, is placed on the rear wall of the CNC Unit, as it is shown in Figure 3.

The contact of the power switch is wired to the "KEY SWITCH" connector of the CNC Unit connector card.

8 SAFETY INDICATIONS

8.1 Personnel members admitted to the operation of the CNC Unit must be attested in terms of safety regulations.

8.2 Before connecting the CNC Unit to the power supply system of ~220 V, 50 Hz, the outer body of the CNC Unit and that of the controlled object must be grounded.

8.2.1 The value of resistance between any grounding element (a bolt, a screw, or a pin) and any non-conducting metal part of the CNC Unit that might happen to be accessible to human contacts and that might bear a voltage, must not exceed 0.1 Ohm.

8.2.2 The grounding resistance value must not be more than 4 Ohms.

8.3 Connection of the CNC Unit to the factory power system is allowed through an isolation transformer only, with a capacity of not less than 300 VA.

8.4 Operation of the CNC Unit, when its power supply is turned on, shall be carried out with its cabinet doors closed.

8.5 Any repair works, or replacement of the CNC modules, installation of selector switches into the modules and **connection/disconnection of external cables must be carried out with power supply turned off**, since voltage jumps may damage electronic components or the entire CNC Unit. It is necessary to wait during 10 seconds after disconnecting the power supply from the CNC Unit, for the device to return to its static condition.

8.6 **ATTENTION!** INTEGRATED CIRCUITS OF THE MOS, CMOS FAMILY, ETC. ARE SENSITIVE TO STATIC ELECTRICITY. THEREFORE, BEFORE TOUCHING ANY PARTS INSIDE THE CNC UNIT OR BEFORE WORKING WITH ANY MODULES OUTSIDE THE DEVICE, IT IS NECESSARY TO CONTACT THE GROUNDED METAL BODY OF THE CNC UNIT IN ORDER TO REMOVE ANY STATIC VOLTAGE FROM YOUR BODY.

8.7 It is necessary to keep to the following sequence of actions, when taking CNC modules out of its casing:

- switch off the CNC Unit;
- disconnect the controlled equipment from power supply;
- disconnect the CNC Unit from power supply;
- disconnect the external module connectors;
- unscrew evenly the external mounting screws and remove the housing;
- remove any electrostatic voltage from your body;
- carefully take out the module from its case.

8.8 Any installation works inside the CNC Unit and modules should be done with a soldering iron designed for an operation voltage of 36 V. The soldering iron must have well-insulated conductive parts in relation to its own body. The soldering iron body must be grounded.

9 SPECIFIC FEATURES OF CABLE LAYING

9.1 A reliable operation of this equipment complex which is made up of the CNC Unit and a controlled object directly depends on the way cables between the component parts of the equipment set are laid out. The remote location of the CNC Unit, in relation to its feedback sensors and drives, predetermines the laying out of a great number of data transfer cables, which will be located near electric power cables.

9.2 Cables classification.

9.2.1 The following cables should be referred to as information cables:

- cables for communication with a digital-to-analog converter (DAC);
- cables for communication with feedback transducers (FBT);
- a RS-232 interface cable; cables for communication with the FDD; an USB interface cable, a LAN interface cable.

9.2.2 The following cables should be referred to as power cables:

- cables of D.C. voltage sources, $U = \pm 24$ V;
- power cables with a voltage of ~ 220 V, ~ 380 V;
- supply cables for contactors.

9.3 When laying cables, it is necessary to adhere to the requirements of the IEC 550 Standard, taking into account the following recommendations:

1) the distance between data transfer and power cables laid inside the cabinet must be as big as possible; while the shortest possible spacing between them, if they are laid in parallel, must be not less than 20 cm; in case it is impossible to meet this requirement, it is necessary to ensure that cables are laid in a shielding, in grounded cable ducts or to use shielded metal boxes or partitions;

2) external cables connecting the component parts of this equipment set must be laid close to the cabinet walls, metal structural elements or metal buses; all cable brackets must be grounded;

3) information and power cables must not:

- run next to devices emitting a strong external electromagnetic radiation;
- run next to cables relaying impulse signals;

4) information cables must be shielded and have special connectors ensuring connection of the shielding with the body (casing) at both cable ends; yet, cables for analog DAC signals of ± 10 V are an exception, when connection of the shielding with the body is made only at the side of the CNC Unit, which increases resistance against interference;

5) in case of any information cable rupture the point of damage must be shielded and cable shielding sections must be reconnected;

6) conductors of cables for discrete input/output signals (D.C. voltage) may be arranged close to one another;

7) The chosen cable lengths must be justified from the technological point of view; in order to increase resistance to the influence of inductive and capacitive factors, cables must not be excessively long, nor may they be tensioned at their connection and bend points;

8) It is necessary to ensure that electrical potentials are equalized with an extra wire in the data communication cables, for example, in the cable connecting the CNC Unit with the remote PC; it is also necessary to ensure a reliable sort of grounding for these devices.

10 INSTALLATION PROCEDURES, PREPARATION FOR OPERATION, THE CNC UNIT OPERATION PROCEDURE

10.1 Compliance must be ensured with requirements related to operating conditions with regard to mechanical and environmental factors, as well as concerning requirements set to the power supply system in accordance with the requirements of Section 1.

10.2 Measures shall be undertaken to suppress any interference from the inductive loads of electric automation devices, in accordance with IEC 550.

10.3 The CNC Units must be installed in a cabinet (housing) with a protection degree according to IP54. The overall dimensions of the CNC Units are indicated in Figures 3.2-3.3.

10.3.1 The CNC Unit must be fixed vertically or at an angle in relation to the operator.

10.3.2 Any equipment parts with a high level of heat emission shall be placed above the CNC Unit.

10.3.3 Any heat emitted by the CNC Unit shall be evacuated by applying inner cabinet or housing ventilation systems, taking into account the requirements set in Section 1 (See the Note).

10.4 This device must be grounded in accordance with the recommended diagram of Appendix F, taking into account the requirements of Clause 8.2. The grounding conductor cross-section shall be as follows:

- for flexible wires – 0.75-1.00 mm²;
- for other wires – 1.00-2.50 mm².

10.5 Prepare cables to connect the CNC Unit with the controlled equipment. Use connectors included into the CNC delivery set to make the cables. Tables with data on how output connectors of the CNC modules are soldered are given in this manual.

10.6 Connect the CNC Unit and the controlled equipment with cables, using Table 3.3 and Figures 3.3-3.4 for that. When laying connector cables take into account the requirements set forth in Section 9.

10.7 Connect the «**SPEPN**» connector to the switch-on circuit of the controlled equipment. Ensure the supply of +24 V from the controlled equipment power source through the «**SPEPN**» connector to the external relay modules.

10.8 Connect the «**EMERGENCY STOP**» button (the red-color mushroom-shaped button) to the machine emergency disconnection circuit.

10.9 Study the CNC switch-on/off sequence and the control guidelines for the CNC Unit with an OCP, which are contained in the "Operator's Manual".

10.10 Deliver the power supply line voltage to the power connector. When power supply is connected, the «**AC**» LED will light up on the front panel of the CNC Unit.

10.11 Switch on the CNC power supply by setting the key in the lock on the OCP into the «**ON**» position, in which case the «**DC**» indicator lights up, the fan starts on, the CNC self-diagnostics systems are started and the operating system will be loaded.

It is further advised to select out from the menu the **DEBUG/CNC** operating mode within two-three seconds. The CNC Unit automatically loads by default the **CNC**, and video-page #1 appears on the monitor screen.

10.12 During its subsequent operation of the CNC Unit the «Operator's Manual» should be used.

11 APPENDIX A

(obligatory)

CONNECTORS AND JUMPERS OF THE CONTROL UNIT

11.1 Connectors and Jumpers of the CPU ECDA Module

11.1.1 PCA-6751 CPU Card (NC210-21)

11.1.1.1 The arrangement of connectors, jumpers and electronic components of the **CPU card** NC210-21 type **PCA-6751** is presented in Figure A.1. The marking given on the card is: «**JP**» – a jumper.

Note – The jumper consists of two or three metal contacts on a plastic basis mounted on the board and a small plastic "cap" with a metal contact inside it for closing the contacts. Therefore, it is convenient to use jumpers for setting the CPU configuration by opening or closing the jumper contacts.

11.1.1.2 Designation and purpose of jumpers of the PCA-6751 type CPU card is indicated in Table A.1.

Table A.1 – Designation and purpose of jumpers

Jumper	Purpose
JP1	COM2 setting for RS-232/422/485
JP2	LCD panel select
JP3	CMOS backup select
JP4	Watchdog timer configuration
JP5	Closed 2-3

11.1.1.3 Designation and purpose of connectors of the PCA-6751 type CPU card is indicated in Table A.2.

Table A.2 – Designation and purpose of connectors

Обозначение	Назначение	Обозначение	Назначение
CN1	FDD connector	CN15	COM2 RS-232 connector
CN2	Parallel port connector	CN16	COM1 RS-232 connector
CN3	Keyboard lock, LED connector	CN17	External keyboard connector (EXKB)
CN4	USB connector	CN18	ATX power connector
CN5	24 bit LCD display connector	CN19	Reserved
CN6	36 bit LCD display connector	CN20	AT power connector
CN7	LCD inverter connector	CN21	Keyboard and PS/2 Mouse connector
CN8	IR connector	CN22	ISA gold finger connector
CN9	External speaker connector	CN23	ISA gold finger connector
CN10	Reserved	CN24	CompactFlash card connector
CN11	VGA connector	CN25	HDD LED connector
CN12	PC-104 connector	CN26	System reset switch connector
CN13	Ethernet connector	CN27	ATX power button
CN14	COM2 RS-422/485 connector	CN28	Enhanced IDE connector

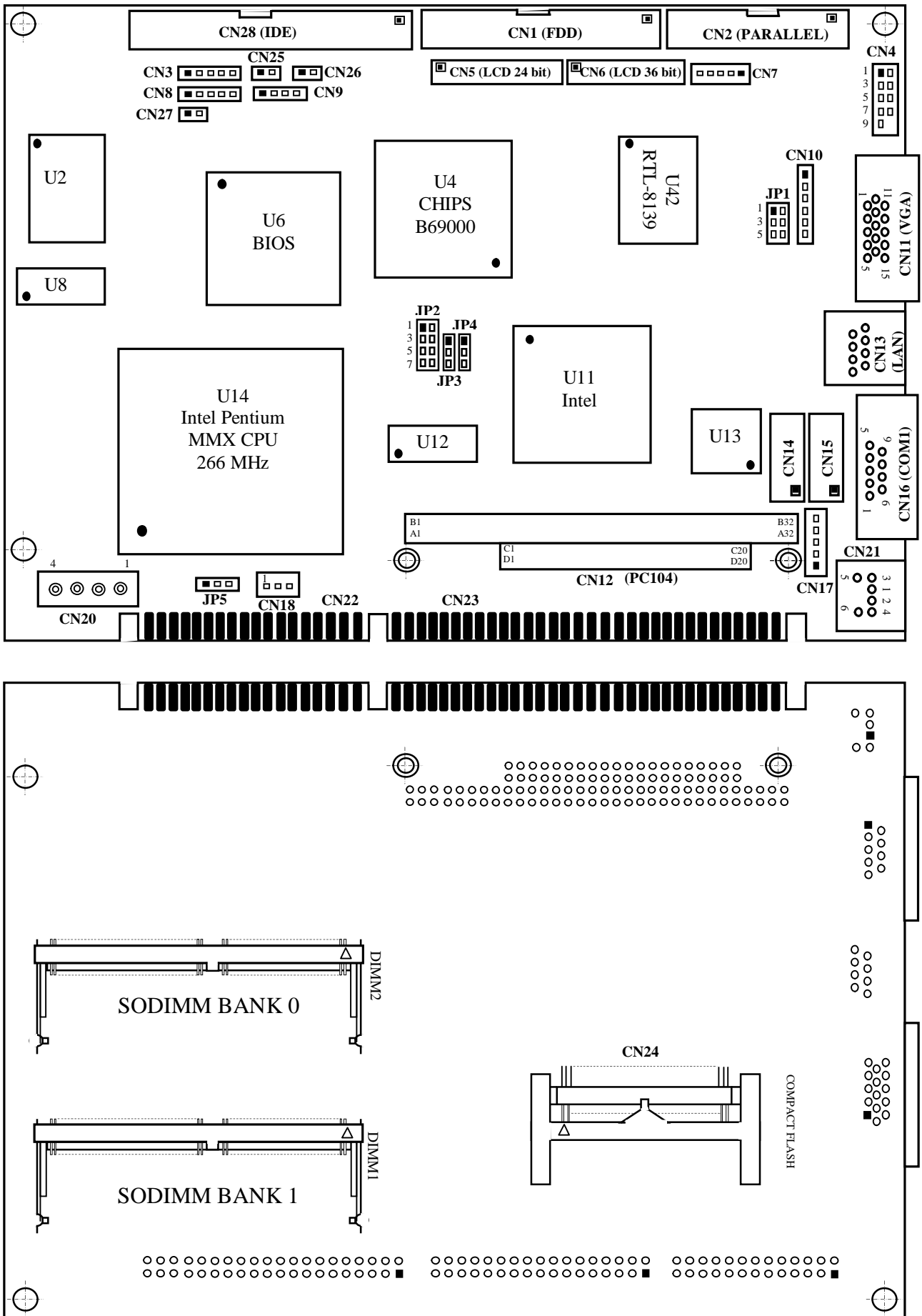


Figure A.1 – Arrangement of Connectors and Jumpers of the PCA-6751 CPU Board

11.1.1.4 Tables A.3–A.29 indicate information necessary to select **CPU** interfaces, the on-line memory configuration and they also present the interfaces used in the CNC Unit.

Table A.3 – **COM2** interface selection RS232/422/485 (**JP1**)

COM2	JP1
RS-232	Closed 5-6
RS-422	Closed 3-4
RS-485	Closed 1-2

Table A.4 –LCD panel select (**JP2**)

LCD type	JP2
1024x600 TFT 48K	All contacts are opened
800x600 DSTN2 48K	Closed 5-6
1280x1024 DSTN 48K	Closed 3-4
800x600 TFT2 48K	Closed 3-4, 5-6
1024x600 DSTN	Closed 1-2
800x600 DSTN 48K	Closed 1-2, 5-6
1024x768 DSTN 48K	Closed 1-2, 3-4
800x600 TFT1 48K	Closed 1-2, 3-4, 5-6
800x600 DSTN	Closed 7-8
800x600 DSTN	Closed 5-6, 7-8
640x480 TFT 18 bit	Closed 3-4, 7-8
1280x1024 TFT	Closed 3-4, 5-6, 7-8
1024x768 TFT	Closed 1-2, 7-8
640x480 DSTN	Closed 1-2, 5-6, 7-8
640x480 Sharp TFT	Closed 1-2, 3-4, 7-8
1024x768 DSTN	Closed 1-2, 3-4, 5-6, 7-8

Table A.5 – CMOS backup select (**JP3**)

Режим	JP3
Normal	Closed 1-2
CMOS data clear	Closed 2-3

Table A.6 - Watchdog timer configuration (JP4)

Режим	JP4
System reset	Closed 2-3
IRQ11 interrupt	Closed 1-2

Table A.7 –FDD connector (**CN1**)

Pin	Signal	Pin	Signal
1	GND	2	Densiti selecн
3	GND	4	No connect
5	GND	6	No connect
7	GND	8	Index
9	GND	10	Motor 0
11	GND	12	Drive select 1
13	GND	14	Drive select 0
15	GND	16	Motor 1
17	GND	18	Direction
19	GND	20	Step
21	GND	22	Write data
23	GND	24	Write gate
25	GND	26	Track 0
27	GND	28	Write protect
29	GND	30	Read data
31	GND	32	Head select
33	GND	34	Disk change

Table A.8 –USB connector (CN4)

Pin	USB1: Signal	Pin	USB2: Signal
1	+5V	2	+5V
3	UV-	4	UV-
5	UV+	6	UV+
7	GND	8	GND
9	GND	10	No connect

Table A.9 – 24-bit LCD display connector (CN5)

Pin	Signal	Pin	Signal
1	VDDSAFE5	2	VDDSAFE5
3	GND	4	GND
5	VDDSAFE3	6	VDDSAFE3
7	V _{CON}	8	GND
9	P0	10	P1
11	P2	12	P3
13	P4	14	P5
15	P6	16	P7
17	P8	18	P9
19	P10	20	P11
21	P12	22	P13
23	P14	24	P15
25	P16	26	P17
27	P18	28	P19
29	P20	30	P21
31	P22	32	P23
33	GND	34	GND
35	SHIFT CLOCK	36	FILM
37	M	38	LP
39	No connect	20	ENAVEE

Table A.10 – 36-bit LCD display connector (CN6)

Pin	Signal	Pin	Signal
1	GND	2	GND
3	P24	4	P25
5	P26	6	P27
7	P28	8	P29
9	P30	10	P31
11	P32	12	P33
13	P34	14	P35
15	GND	16	GND
17	No connect	18	No connect
19	No connect	40	No connect

Table A.11 –LCD inverter connector (CN7)

Pin	Signal
1	+12V
2	GND
3	ENABKL
4	VBR
5	+5V

Table A.12 –IR connector (CN8)

Pin	Signal
1	+5V
2	No connect
3	IR_RX
4	GND
5	IR_TX

Table A.13 – External speaker connector (CN9)

Pin	Signal
1	+5V
2	No connect
3	Internal speaker
4	External speaker

Table A.14 – VGA display connector (CN11)

Pin	Signal	Pin	Signal	Pin	Signal
1	Red	6	GND	11	No connect
2	Green	7	GND	12	No connect
3	Blue	8	GND	13	H-Sync
4	No connect	9	No connect	14	V-Sync
5	GND	10	GND	15	No connect

Table A.15 – PC/104 connector (CN12)

CN12				CN12			
Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1	IOCHK	B1	GND	C1	GND	D1	GND
A2	D7	B2	REST	C2	SBHE	D2	MEMCS16
A3	D6	B3	+5V	C3	LA23	D3	IOCS16
A4	D5	B4	IRQ9	C4	LA22	D4	IRQ10
A5	D4	B5	-5V	C5	LA21	D5	IRQ11
A6	D3	B6	DRQ2	C6	LA20	D6	IRQ12
A7	D2	B7	-12V	C7	LA19	D7	IRQ15
A8	D1	B8	0WS	C8	LA18	D8	IRQ14
A9	D0	B9	+12V	C9	LA17	D9	DACK0
A10	IOCHRDY	B10	GND	C10	MEMR	D10	DRQ0
A11	AEN	B11	SMEMW	C11	MEMW	D11	DACK5
A12	A19	B12	SMEMR	C12	D8	D12	DRQ5
A13	A18	B13	IOW	C13	D9	D13	DACK6
A14	A17	B14	IOR	C14	D10	D14	DRQ6
A15	A16	B15	DACK3	C15	D11	D15	DACK7
A16	A15	B16	DRQ3	C16	D12	D16	DRQ7
A17	A14	B17	DACK1	C17	D13	D17	+5V
A18	A13	B18	DRQ1	C18	D14	D18	MASTER
A19	A12	B19	REFRESH	C19	D15	D19	GND
A20	A11	B20	CLK	C20	KEYPIN	D20	GND
A21	A10	B21	IRQ7	-		-	
A22	A9	B22	IRQ6	-		-	
A23	A8	B23	IRQ5	-		-	
A24	A7	B24	IRQ4	-		-	
A25	A6	B25	IRQ3	-		-	
A26	A5	B26	DACK2	-		-	
A27	A4	B27	TC	-		-	
A28	A3	B28	BALE	-		-	
A29	A2	B29	+5V	-		-	
A30	A1	B30	OSC	-		-	
A31	A0	B31	GND	-		-	
A32	GND	B32	GND	-		-	

Table A.16 – Ethernet connector RJ-45A (CN13)

Pin	Signal	Pin	Signal
1	+5V	2	ACTLED-
3	RX+	4	RX-
5	LILED-	6	GND
7	No connect	8	GND
9	TX+	10	TX-

Table A.17 – Serial port COM2: RS-232/422/485 (CN14)

Pin	Signal		
	RS-232	RS-422	RS-485
1	Data Carrier Detect (DCD)	TX-	DATA-
2	Data Set Ready (DSR)	No connect	No connect
3	Receive Data (RXD)	TX+	DATA+
4	Request to Send (RTS)	No connect	No connect
5	Transmit Data (TXD)	RX+	No connect
6	Clear to Send (CTS)	No connect	No connect
7	Data Terminal Ready (DTR)	RX-	No connect
8	Ring Indicator (RI)	No connect	No connect
9	GND	GND	GND
10	No connect	No connect	No connect

Table A.18 – Serial port COM2: RS-232 (CN15)

Pin	Signal	Pin	Signal
1	DCD	2	DSR
3	RxD	4	RTS
5	TxD	6	CTS
7	DTR	8	RI
9	GND	10	No connect

Table A.19 – Serial port COM1: RS-232 (CN16)

Pin	Signal	Pin	Signal
1	DCD	6	DSR
2	RxD	7	RTS
3	TxD	8	CTS
4	DTR	9	RI
5	GND	-	-

Table A.20 – External keyboard connector (CN17)

Pin	Signal	Pin	Signal
1	Clock	2	Data
3	No connect	4	GND
5	+5V	-	-

Table A.21 – ATX power connector (CN18)

Pin	Signal
1	+5VSB
2	No connect
3	PS_ON

Table A.22 – AT power connector (CN20)

Pin	Signal
1	+12V
2	GND
3	GND
4	+5V

Table A.23 – Keyboard & PS/2 Mouse connector (CN21)

Pin	Signal	Pin	Signal	Pin	Signal
1	KB DATA	2	MS DATA	3	GND
4	+5V	5	KB CLCK	6	MS CLCK

Table A.24 –ISA gold fingers (CN22, CN23)

CN23				CN22			
A		B		C		D	
Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1	-IOCHCHK	B1	GND	C1	SBHE	D1	-MEMCS16
A2	SD07	B2	RESET	C2	LA23	D2	+HOCs16
A3	SD06	B3	+5V	C3	LA22	D3	IRQ10
A4	SD05	B4	IRQ9	C4	LA21	D4	IRQ11
A5	SD04	B5	-5V	C5	LA20	D5	IRQ12
A6	SD03	B6	DRQ2	C6	LA19	D6	IRQ15
A7	SD02	B7	-12V	C7	LA18	D7	IRQ14
A8	SD01	B8	OWS	C8	LA17	D8	-DACK0
A9	SD00	B9	+12V	C9	-MEMR	D9	DRQ0
A10	-IOCHRDY	B10	GND	C10	-MEMW	D10	-DACK5
A11	AEN	B11	-SMEMW	C11	SD08	D11	DRQ5
A12	SA19	B12	-SMEMR	C12	SD09	D12	-DACK6
A13	SA18	B13	-IOW	C13	SD10	D13	DRQ6
A14	SA17	B14	-IOR	C14	SD11	D14	-DACK7
A15	SA16	B15	-DACK3	C15	SD12	D15	DRQ7
A16	SA15	B16	-DRQ3	C16	SD13	D16	+5V
A17	SA14	B17	-DACK1	C17	SD14	D17	-MASTER
A18	SA13	B18	-DRQ1	C18	SD15	D18	GND
A19	SA12	B19	-REFRESH	-	-	-	-
A20	SA11	B20	BCLK	-	-	-	-
A21	SA10	B21	IRQ7	-	-	-	-
A22	SA09	B22	IRQ6	-	-	-	-
A23	SA08	B23	IRQ5	-	-	-	-
A24	SA07	B24	IRQ4	-	-	-	-
A25	SA06	B25	IRQ3	-	-	-	-
A26	SA05	B26	-DACK2	-	-	-	-
A27	SA04	B27	T/C	-	-	-	-
A28	SA03	B28	BALE	-	-	-	-
A29	SA02	B29	+5V	-	-	-	-
A30	SA01	B30	OSC	-	-	-	-
A31	SA00	B31	GND	-	-	-	-

Table A.25 – HDD LED (CN25)

Pin	Signal
1	IDE LED+
2	IDE LED-

Table A.26 – Reset switch (CN26)

Pin	Signal
1	MR_RESET
2	GND

Table A.27 – ATX power button (CN27)

Pin	Signal
1	Standby 5V
2	Power ON

Table A.28 – CompactFlash disk (CN24)

Pin	Signal	Pin	Signal
1	GND	2	D03
3	D04	4	D05
5	D06	6	D07
7	CS0	8	A10
9	ATA SEL	10	A09
11	A08	12	A07
13	+5V	14	A06
15	A05	16	A04
17	A03	18	A02
19	A01	20	A00
21	D00	22	D01
23	D02	24	-IOCS16
25	CD2	26	-CD1
27	D11	28	D12
29	D13	30	D14
31	D15	32	-CS1
33	VS1	34	-IORD
35	IOWR	36	-WE
37	INTRQ	38	+5V
39	CSEL	40	-VS2
41	RESER	42	IORDY
43	INPACK	44	-REG
45	DASP	46	-PDIAG
47	D08	48	D09
49	D10	50	GND

Table A.29 – EIDE connector (CN28)

Pin	Signal	Pin	Signal
1	IDE RESET	2	GND
3	DATA7	4	DATA8
5	DATA6	6	DATA9
7	DATA5	8	DATA10
9	DATA4	10	DATA11
11	DATA3	12	DATA12
13	DATA2	14	DATA13
15	DATA1	16	DATA14
17	DATA0	18	DATA15
19	SIGNAL GND	20	N/C
21	N/C	22	GND
23	IO WRITE	24	GND
25	IO READ	26	GND
27	IO CHANNEL READY	28	N/C
29	HDACKO	30	GND
31	IRQ14	32	IOCS16
33	ADDR1	34	N/C
35	ADDR0	36	ADDR2
37	HARD DISK SELECT 0	38	HARD DISK SELECT 1
39	IDE ACTIVE	40	GND

11.1.2 ECDA Card (NC210-25)

11.1.2.1 The arrangement of connectors and jumpers of the **ECDA** card (NC210-25 V1.12) is shown in Figure A.2.

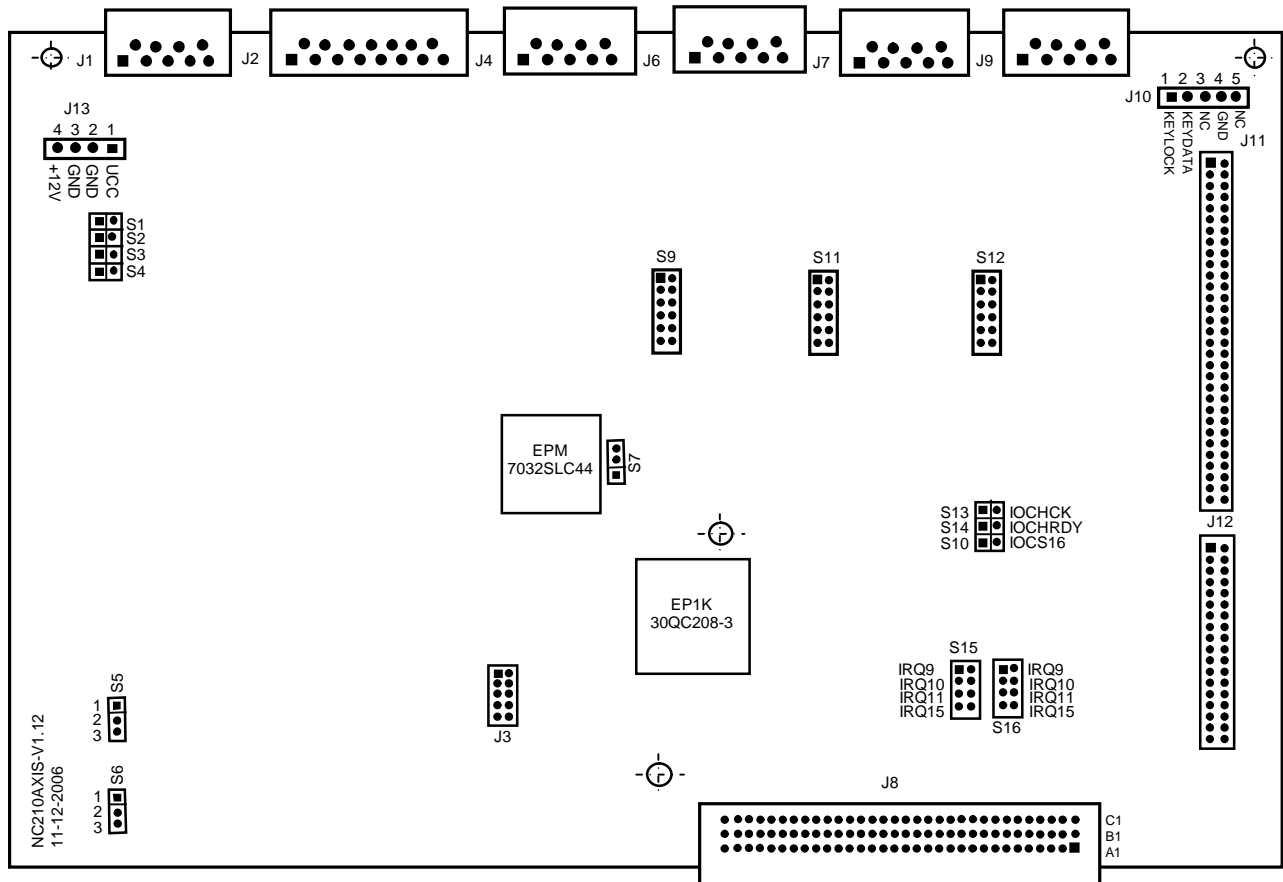


Figure A.2 – Arrangement of Connectors and Jumpers of the NC210-25 Card

11.1.2.2 Purpose of connectors and jumpers of the NC210-25 card:

- **J1** - the output connector of the electronic hand wheel channel; it has the marking «6» on the front panel of the **CPU ECDA** module; the connector type is indicated in Table 3.2, the hand wheel signals are presented in Table 5.12;
- **J2** - the output connector of the DAC channels and the tactile sensor channel; it has the marking «5» on the front panel of the **CPU ECDA** module; the connector type is indicated in Table 3.2, the DAC channel signals and the tactile sensor channel signals are presented in Table 5.10;
- **J3** - technological jumpers for testing the system; they must be opened during the operation of the CNC Unit;
- **J4,J6,J7,J9** - the output connectors of the encoder channels; they have the marking «1» - «4» on the front panel of the **CPU ECDA** module; the connector type is indicated in Table 3.2, the encoder channel signals are presented in Table 5.8;
- **J5** - this connector is absent;

- **J8** - the CNC Unit interface connector (plug CM96abcR), it secures communication with the CNC bus module NC210-4 (J2);
- **J10** - this is a connector (plug PW 10-5-M) for connecting with the keyboard interface **EXKB**; it is connected via the internal cable with the CPU board NC210-21 (CN17);
- **J11, J12** - metal-clad holes for the installation of pin strips PLDR 62-G and PLDR 36-G of the bus board ISA BUS, which secures communication between the CPU NC210-21 (CN22, CN23) board and the **ECDA** NC210-25 board;
- **J13** - an adapter power connector (plug PW 10-4-M); supply voltage (+5 V and +12 V) goes from it by cable to the NC210-26 (J3) connector card;
- **S1-S4** - jumpers used to determine the electronic hand wheel input type:
 - a differential input (for direct and inverse signals):
 - closed **S1, S2**;
 - open **S3, S4**;
 - a unitary input (for the direct signal):
 - open **S1, S2**;
 - closed **S3, S4**;
- **S5, S6** - for selecting the supply voltage of **DAC**:
 - ± 15 V: **S5, S6** closed 1-2,
 - ± 12 V: **S5, S6** closed 2-3;
- **S7** - by installing this jumper the mode of firmware monitoring over encoder signals disruptions will be selected:
 - monitoring is allowed - **S7**: 2-3 closed;
 - monitoring forbidden - **S7**: 1-2 closed;
- **S8** - this jumper is absent;
- **S9, S11, S12** - for changing the polarity of input signals of the encoder; the jumpers settings are shown in Section 5.3.2;
- **S10, S13, S14** - technological jumpers for testing the system; they must be closed during the operation of the CNC Unit:
 - S10** – IOCS16;
 - S13** – IOCHCK;
 - S14** – IOCYRDY;
- **S15** - this jumper sets the interrupt IRQ10: **IRQ10** is closed;
- **S16** - this jumper sets the interrupt IRQ11 from the timer 8254: **IRQ11** is closed.

11.1.3 Connector Card FDD (NC210-26)

11.1.3.1 The arrangement of connectors of the **FDD** connector card NC210-26 is shown in Figure A.3.

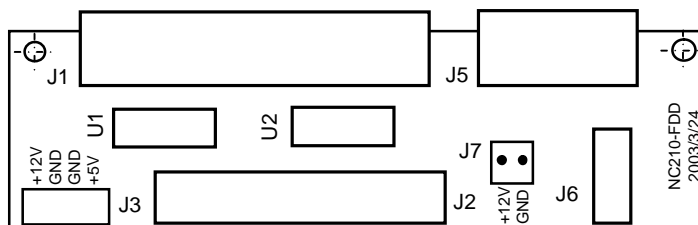


Figure A.3 – Arrangement of the Elements of the NC210-26 Card

11.1.3.2 Purpose of the Elements of the **FDD** NC210-26 Connector Card:

- **J1** - the output connector of the **FDD** channel; it has the marking «**FDD**» on the front panel of the **CPU ECDA** module; the «**FDD**» connector type is indicated in Table 3.2, the channel signals are presented in Table 5.6;
- **J2** - the adapter connector of the **FDD** channel (plug BHR 34-G); it ensures the reception of **FDD** channel signals from the CPU NC210-21 card (CN1) via a cable;
- **J3** - a power connector (plug PW 10-4-M); the supply voltage +5 V and +12 V from the NC210-25 (J13) comes to it by cable. The supply voltage is used to supply power to the NC210-26, **FDD** and the **FAN**;
- **J4** - this connector is absent;
- **J5** - the output connector of the **RS-232/485** channel (port COM2); it do not use with the **CPU PCA-6751**;
- **J6** - the adapter connector of the **RS-232/485** channel (port COM2); it do not use with the **CPU PCA-6751**;
- **J7** - the **FAN** power-supply connector (a plug with 2 pins: +12V, GND);
- **U1, U2** - **SN74HCT244N** chips; they ensure protection of **FDD** channel signals.

11.1.4 Connectors Card USB (NC210-27-1)

11.1.4.1 The arrangement of connectors of the **USB** connectors card NC210-27-1 is shown in Figure A.4.

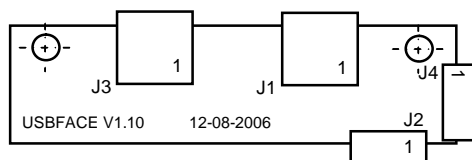


Figure A.4 – Arrangement of the Elements of the NC210-27-1 Card

11.1.4.2 Purpose of the Elements of the **USB** NC210-27-1 Connectors Card:

- **J1** - the output adapter of the **USB2** channel; it has the marking «**USB1**» on the front panel of the **CPU ECDA** module; the «**USB1**» connector type is indicated in Table 3.2, the channel signals are presented in Table 5.7;
- **J2** - the adapter connector of the **USB2** channel (plug PW 10-4-M-R); it ensures reception of **USB2** channel signals from the NC210-29 (J3) module to the NC210-27-1 card via a cable;
- **J3** - the output adapter of the **USB1** channel; it has the marking «**USB2**» on the front panel of the **CPU ECDA** module; the «**USB2**» connector type is indicated in Table 3.2, the channel signals are presented in Table 5.7;
- **J4** - the adapter connector of the **USB1** channel (plug PW 10-4-M-R); it ensures reception of **USB1** channel signals from the NC210-21 module (CN4: pins 1-5) to the NC210-27-1 card via a cable.

11.1.5 USB Card (NC210-29)

11.1.5.1 Arrangement of the elements of the **USB** card (NC210-29) is shown in Figure A.5.

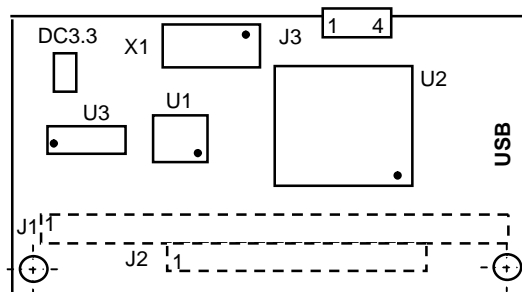


Figure A.5 – Arrangement of USB Card Elements

11.1.5.2 Purpose of the **USB Card** connectors:

- **J1, J2** - these the connectors of the **PC104** board (plugs PLD 64-G and PLD 40-G), they ensure the reception of signals of the PC104 bus from the CPU card (CN12); they are located on the reverse side of the card;
- **J3** - the adapter connector of the USB2 channel (plug PW 10-4-M), ensures the channel signal transmission by cable to the USB NC210-27-1 (J2) channel connector card. The channel signals are presented in Table A.30.

Table A.30

Pin	Signal	Pin	Signal
1	+5V	3	DATA+
2	DATA-	4	GND

11.2 Connectors of the I/O Module

11.2.1 The I/O Module NC210-31

11.2.1.1 The positioning of connectors of the **I/O** module NC210-31 and their designations are shown in Figure A.6

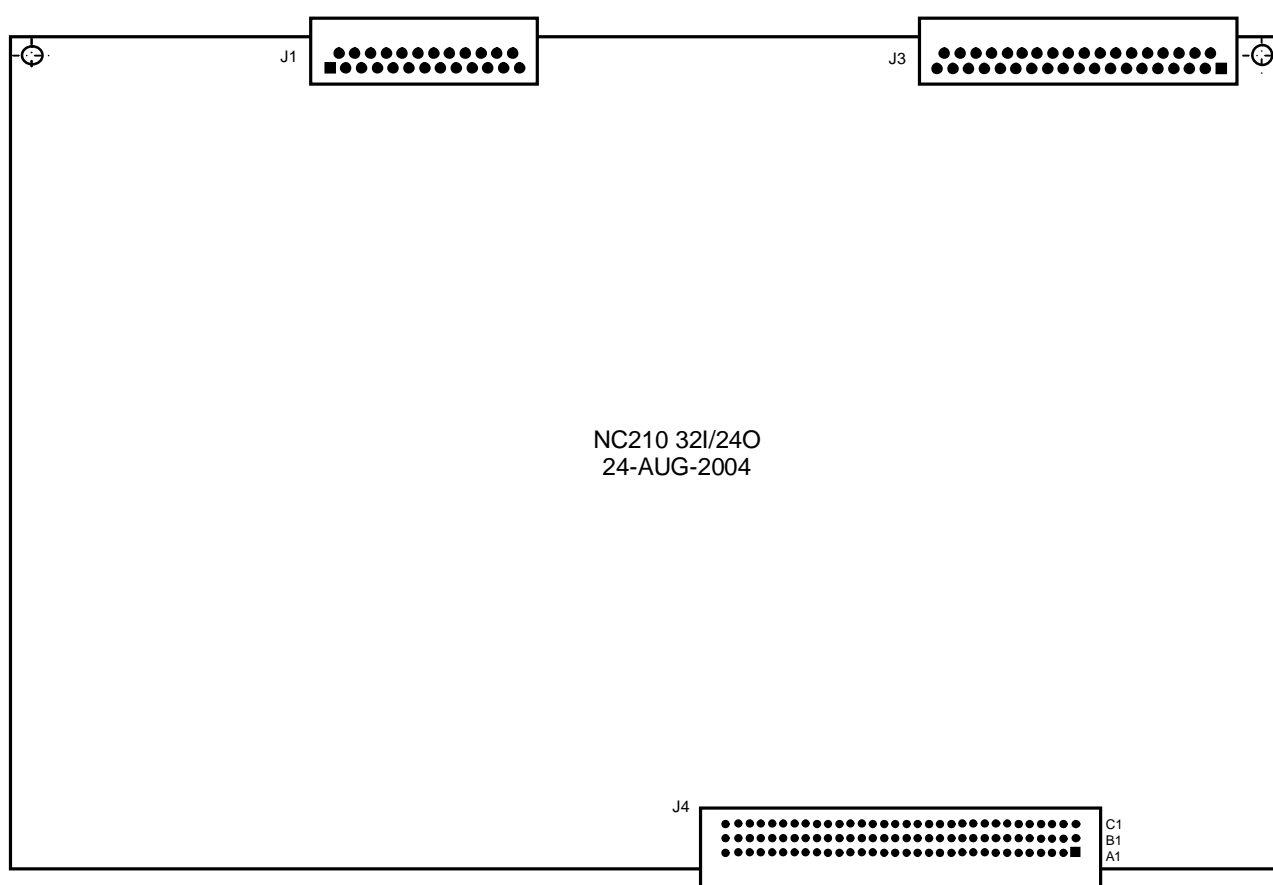


Figure A.6 – Positions of the NC210-31 Connectors

11.2.1.2 The designations and function of connectors of the I/O NC210-31 board:

- **J1** - external connector of discrete output channels, it is marked as «3» on the front panel of the **I/O** module; the type of this connector is given in Table 3.2, the signals of output channels are given Table 6.3;
- **J3** - external connector of discrete input channels, it is marked with figure «1» on the front panel of the **I/O** module; the type of this connector is given in Table 3.2, the signals of input channels are listed in Table 6.2;
- **J4** - a CNC Unit interface connector (plug CM96abcR), it provides for communication with the CNC Unit bus module NC210-4 (J3);

11.2.2 The I/O Module NC210-32

11.2.2.1 The positioning of connectors of the **I/O** module NC210-32 and their designations are shown in Figure A.7.

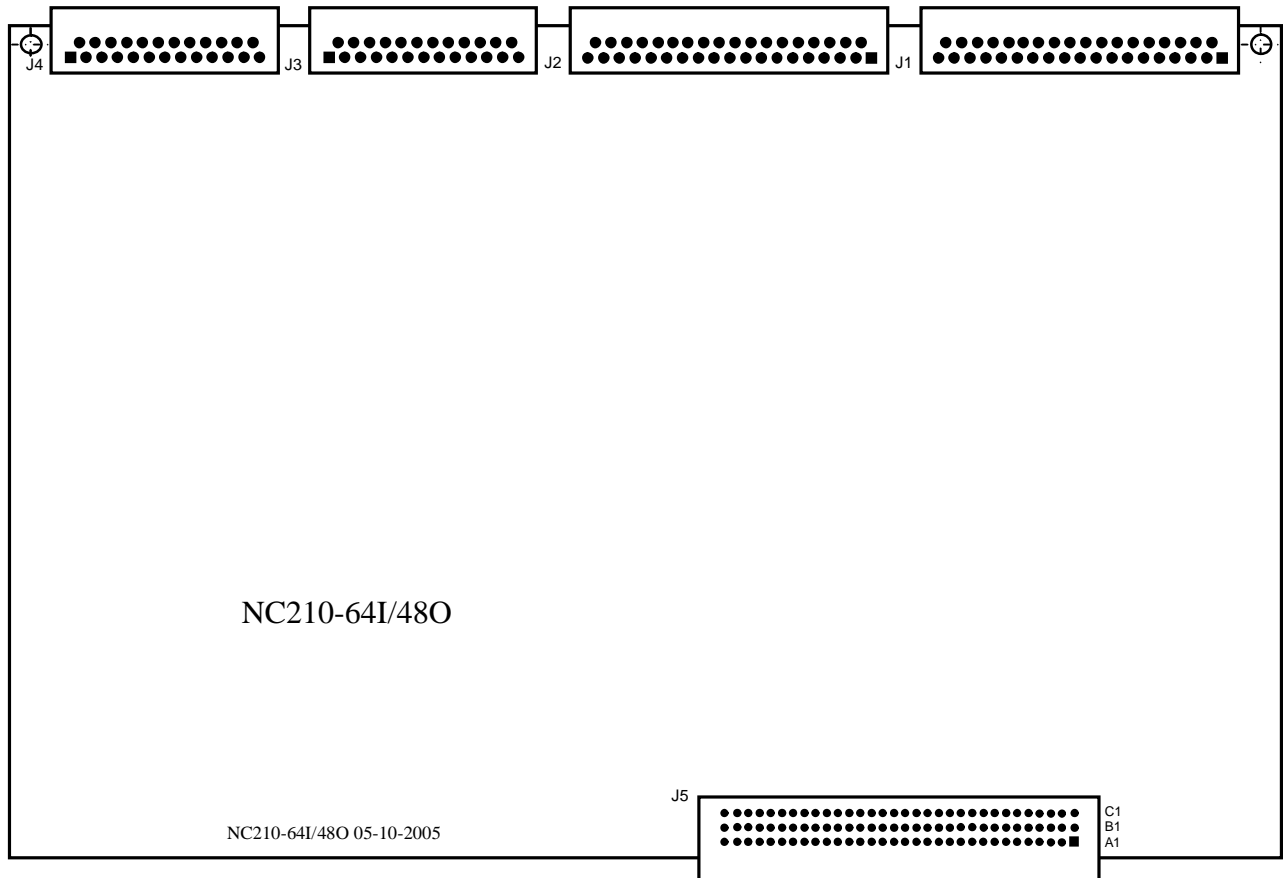


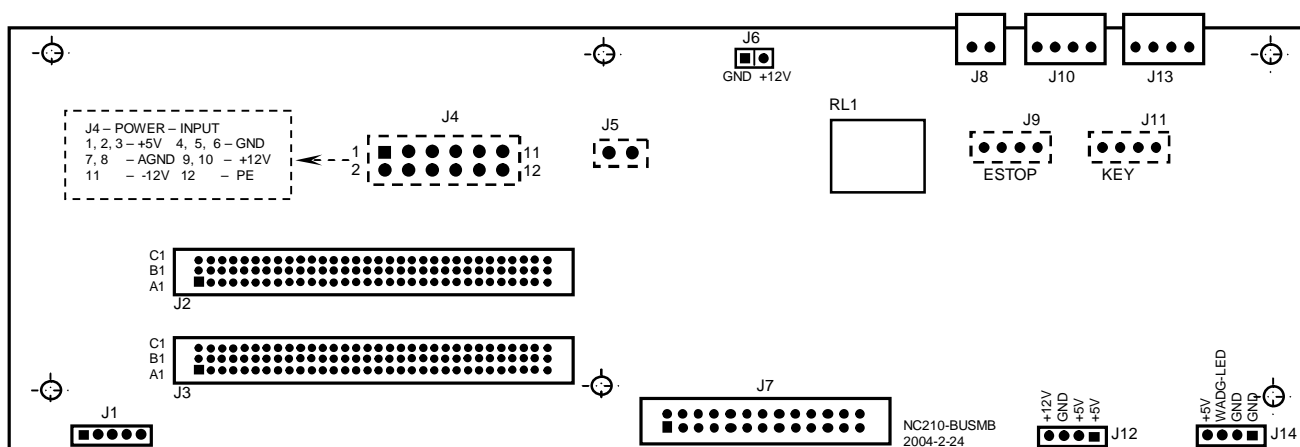
Figure A.7 – Positions of the NC210-32 Connectors

11.2.2.2 The designations and function of connectors of the I/O NC210-32 board:

- **J1, J2** - external connectors of discrete input channels, they are marked with figures «1» and «2» on the front panel of the **I/O** module; the type of these connectors is given in Table 3.2, the signals of input channels are listed in Table 6.2;
- **J3, J4** - external connectors of discrete output channels, they are marked as «3» and «4» on the front panel of the **I/O** module; the type of these connectors is given in Table 3.2, the signals of output channels are given Table 6.3;
- **J5** - a CNC Unit interface connector (plug CM96abcR), it provides for communication with the CNC Unit bus module NC210-4 (J3).

11.3 CNC Bus Module NC210-4

11.3.1 The positioning of connectors of the CNC Bus Module NC210-4 and their designations are shown in Figure A.8.



Connectors marked with a dotted line are mounted on reverse side of the board

Figure A.8 – Positions of the CNC Bus Module NC210-4 Connectors

11.3.2 The designations and function of connectors of the NC210-4 board:

- **J1** - this is **EXKB** interface connector (plug **PW 10-5-M**); it is connected via the cable with the Alphanumeric keyboard board NC210-61 (**J1**);
- **J2** - the CNC Unit interface connector (socket **CF96abcT**); it secures communication with the **ECDA** NC210-25 card (**J8**);
- **J3** - the CNC Unit interface connector (socket **CF96abcT**); it secures communication with the **I/O** NC210-31 or NC210-32 card;
- **J4** - a power connector (plug **MF 12-M**); it receives power voltage from the NC210-11 power-supply source for all the component parts of the CNC Unit;
- **J5, J6** - these jumpers are absent;
- **J7** - this is the transition connector (plug **LBH 26-G**); it is connected by an internal cable with connector **J1** on the Switches board NC210-61;
- **J8** - the output connector of contacts of the **RL1** relay (plug **MSTB 2,5/2-G-5,08**); it has the marking «**SPEPN**» on the rear wall of the CNC Unit;
- **J9** - this is the transition connector (plug for 4 pins); it is connected by an internal cable with the Emergency Stop button NC210-66;
- **J10** - the output connector of contacts of the Emergency Stop button (plug **MSTB 2,5/4-G-5,08**); it has the marking «**ESP SWITCH**» on the rear wall of the CNC Unit;
- **J11** - this is the transition connector (plug for 4 pins); it is connected by an internal cable with the Power Switch NC210-65;
- **J12** - an adapter power connector (plug **PW 10-4-M**); supply voltage goes from it by cable to the TFT NC210-51 converter card (**CN1**);
- **J13** - the output connector of contacts of the Power Switch (plug **MSTB 2,5/4-G-5,08**); it has the marking «**KEY SWITCH**» on the rear wall of the CNC Unit;
- **J14** - this is the transition connector (plug **PW 10-4-M**); it is connected by an internal cable with connector **J2** on the Indication board NC210-64;
- **RL1** - the CNC readiness relay «**SPEPN**» (**NT73C10DC12**); it has two NO contacts.

12 APPENDIX B *(for reference)* **BIOS**

12.1 BIOS configuration

BIOS is the basic input/output system, the main software stored in the CPU module. The initial BIOS Setup configuration (hereinafter referred to as "Setup") is installed by the CNC manufacturer, with the possibility left for its later modification, when installing any additional equipment. When the CNC Unit is turned on, the program that is stored in BIOS will be launched.

Structurally, BIOS is a ROM microcircuit. When the CNC Unit is started, BIOS will carry out its minimum testing, a memory check, and computation of all check sums and only after that it programs the microchips and issues a command to start DOS. The results of BIOS operation are presented on the screen: there appears a static picture on it, the size of the operating memory and its test are indicated. Then a check on Plug and Play devices is carried out and the start of the system itself is made.

All the necessary settings are contained in BIOS. However, there exists some information about the device, which may change (for example, information about HDD, about the initial memory testing method, response to errors, etc.). All the parameters that change are in the CMOS microcircuit. This microcircuit also stores all settings, when the power is off.

To change the main device settings, one should use the BIOS Setup utility. To call it up, the "Del" key should be pressed and held pressed. The CNC Unit uses the BIOS of the Award Company. After loading Setup the main menu appears (figure B.1).

ROM PCI/ISA BIOS ()
CMOS SETUP UTILITY
AWARD SOFTWARE, INC.

STANDARD CMOS SETUP BIOS FEATURES SETUP CHIPSET FEATURES SETUP POWER MANAGEMENT SETUP PNP/PCI CONFIGURATION LOAD BIOS DEFAULTS LOAD SETUP DEFAULTS	INTEGRATED PERIPHERALS PASSWORD SETTING IDE HDD AUTODETECTION HDD LOW LEVEL FORMAT SAVE & EXIT SETUP EXIT WITHOUT SAVING
Esc: Quit F10: Save & Exit Setup Time, Date, Hard Disk Type...	: Select Item (Shift)F2 : Change Color

Figure B.1 – Main Menu of the BIOS SETUP Utility

12.2 Control keys in the SETUP medium

The required SECTION is chosen by shifting the cursor control keys "MOVE THE LINE BACK OR FORWARD" to a given point followed by pressing the "Enter" key. When the choice is made, the chosen point menu appears, which will enable you to modify the configuration parameters with the «+» («Pg Up») or «*» («Pg Dn») keys. To return to the previous menu uses the "Esc" key. In

the upper menu the "Esc" key can be used to exit SETUP without saving changes in CMOS.



– Save all CMOS changes.

12.3 Section "Standard CMOS Setup"

The very first point is STANDARD CMOS SETUP. On pressing the "Enter" key, there appears at this point the menu shown in Figure B.2.

In this menu as in all the others shifting is carried out by means of the cursor control keys, while parameter values are changed by the "Page Up" and "Page Down" keys.

```

ROM PCI/ISA BIOS ()
STANDARD CMOS SETUP
AWARD SOFTWARE, INC.

```

Date (mm:dd:yy) : Sun, Jun, 1 1997

Time (hh:mm:ss) : 10 : 42 : 40

HARD DISKS	CYLS	HEADS	PRECOMP	LANDZONE	SECTORS	MODE
Primary Master:	0	0	0	0	0	----
Primary Slave :	0	0	0	0	0	----
Drive A :	None					
Drive B :	None					
Video :	EGA/VGA					
Halt On :	All Errors					
ESC: Quit	↑ ↓ → ←		: Select Item		PU/PD/+/- : Modify	
F1 : Help	(Shift) F2		: Change Color			

Figure B.2 – Menu of the Section "STANDARD CMOS SETUP"

The "STANDARD CMOS SETUP" SECTION contains minimum information about the device configuration. This information includes its memory size, the number and type of hard disks, the presence of disk drives in the system. A reservation should be made here right now that we will not dwell on all the menu items. The very first settings are "Date" and "Time".

They are needed to enable the device to "know" both the current time and date. Then follow the hard disk parameters. There are four types of them: Primary, Master and Slave as well as Secondary. The following parameters are indicated for each disk: size in Mb, the number of cylinders (Cyls), the number heads on the disk and the number of sectors on the track.

All these parameters are indicated on the hard disk outer body. To enable the system to work with hard disks, it is absolutely necessary to indicate their parameters on these lines. Below you will find information on how to preset hard disk parameters (see the SECTION "IDE HDD AUTO DETECTION").

NOTE – AN UNASSISTED INSTALLATION OF THE HARD DISK BY THE HARD DISK USER:

- SUBSTITUTION OF HDD FOR FLASH REQUIRES ITS REGISTRATION BY THE CNC MANUFACTURER.
- UNDER THE NAME «D» IT DOES NOT REQUIRE REGISTRATION BY THE CNC MANUFACTURER.

The main problem consists in the hard disk parameter determination mode. The thing is that DOS cannot work with disks having more than 1024 cylinders. The disk capacity for DOS is not more than 540 MB, even if you have a disk with a volume of 1 GB. However, a solution was found: the LBA-mode began to be used in computers. When it is installed, DOS can sense disks with a volume of more than 540 MB. One can see this mode setting in the Mode column. The "Normal" indication can be shown there in it for disks with a volume of less than 540 MB, and the "LBA" Indication for disks of more than 540 MB and finally "Auto" for automatic mode determination. It is strongly recommended not to experiment with this column. If your disk is set in the LBA mode and it has been shifted to Normal, then almost all information on the disk may be lost! No should one experiment with other columns.

Pay attention to the "Type" column determining the installed disk type. The number of these types is sufficiently large, but only the three basic ones are important to us: "None", "User" and "Auto".

The "None" mode is an indication for the device that there is no hard disk in the system. If the hard disk is physically unavailable and the "None" mode is set in the Setup, the device will not sense it and will require a loading diskette for loading (since the system can be loaded not only from the Winchester disk, but also from an ordinary diskette). And, vice versa, if the hard disk is absent or disconnected and its type is indicated in the Setup (that is, it exists), then it will wait a little during switching on the device and signal an error "Hard Disk Fail".

The "User" mode means a fixed setting of the hard disk type. The parameters indicated on this line influence its volume. The volume is calculated this way: **Cyls x Head x Sector x 512**.

We receive an answer in bytes. If for some reason one hard disk (even a similar one) was substituted for another, these parameters must be set again. Read below how it is done (Cf. the SECTION "IDE HDD AUTO DETECTION").

The "Auto" mode implies an automatic determination of the hard disk parameters. It is a very convenient parameter. When it is set, then in case of the hard disk change one doesn't have to install its parameters every time in the Setup. The device will determine them by itself. But one must be careful: make sure that the "Auto" mode is also put into the "Mode" column!

This is to be followed by setting the floppy disk parameters in the system. There can be two of them in general. The system supports different types of floppy disks - from 360 KB to 2.88 MB.

The "Halt On" Item makes it possible to define the types of errors that will cause the device stopping during its loading, if they should occur. For example, if you try to switch on the device without connecting the keyboard, the "Keyboard error" message will appear, and the system will stop. If you intend for some reason to switch on the device without connecting the keyboard, you should indicate: "All But Keyboard".

In the right-hand lower corner it is written how much and what memory the device has. Exit from this section and return to the main menu can be made by pressing the "Esc" key.

12.4 Section "BIOS Features SETUP"

Now, the following item: "BIOS FEATURES SETUP" should be examined. After entering it, the menu presented in Figure B.3 can be seen.

The "Virus Warning" feature gives out a warning on the screen, if any program should attempt to write something into the Boot Sector or to format the disk. Such events, as a rule, may occur as a consequence of a computer virus working or due to careless handling of some programs. If any loading program manager is installed in your computer, or you have decided to install another operation system, then this point should better be disabled. But during the normal work in DOS it is desirable to enable it, since it gives some guarantee against any infection with boot viruses.

The "CPU Internal Cache, External Cache" features, i.e. the switching on/off of the internal and external cache devices – for getting a maximum productivity, these features must always be enabled.

BIOS Configuration
ROM PCI/ISA BIOS ()
BIOS FEATURES SETUP
AWARD SOFTWARE, INC.

Virus Warning	:Disabled	Vide BIOS Shadow	:Enabled
CPU Internal Cache	:Enabled	C8000-CBFFF Shadow	:Disabled
External Cache	:Enabled	CC000-CFFFF Shadow	:Disabled
Quick Power On Self Test	:Enabled	D0000-D3FFF Shadow	:Disabled
Boot Sequence	:C,A	D4000-D7FFF Shadow	:Disabled
Swap Floppy Driver	:Disabled	D8000-DBFFF Shadow	:Disabled
Boot Up Floppy Seek	:Disabled	DC000-DFFFF Shadow	:Disabled
Boot Up Num Lock Status	:Off	Cyrix 6x86/MII CPUID	:Enabled
Boot Up System Speed	:High		
Gate A20 Option	:Fast		
Typematic Rate Setting	:Enabled		
Typematic Rate (Chars/sec)	:30	Esc: Quit	↑↓→← : Select Item
Typematic Delay (ms)	:500	F1 : Help	PU/PD/+/- : Modify
Security Option	:Setup	F5 : Old Values (Shift)	F2 : Color
PCI/VGA Palette Snoop	:Disabled	F6 : Load BIOS Defaults	
OS Select For DRAM > 64 MB	Non-OS2	F7 : Load Setup Defaults	

Figure B.3 – The Menu of the SECTION "BIOS FEATURES SETUP"

The "Boot Sequence" feature will signal to the device on which carrier to search for the system in the first place. If "A"; "C:" stand there, then during loading first disk drive A: is interrogated and only after that hard disk C:. In this case, if the system diskette is inserted into disk drive A:, the system will be loaded from it. If you rarely use the system diskette, then the symbols "C:", "A": should be inserted, to speed up the loading.

The "Swap Floppy Driver" feature reverses the disk drives A: and B:. If you have two disk drives "A:" (5.25") and "B:" (3.5") and the system diskette is only of 3.5" (for disk drive "B"), this setting may be enabled (We remind you that it is possible to carry the loading from a diskette only from disk drive "A:"). In this case the loading diskette may be inserted into the 3.5" disk drive, since it will become a disk with the letter "A:".

The "Boot Up Floppy Seek" feature – if there stands the word "Enabled", then each time the device is switched on, the disk drive will be interrogated. It should better be disabled to speed up the loading.

The "Boot Up Num Lock Status" command – if there stands "ON" in it, then the keys on the additional keyboard will be used as numeric ones, if "OFF" is chosen, then they will used as the cursor control keys.

The command "Typematic Rate Setting, Typematic Rate" refers to keyboard adjustments. If the key is held pressed for a long time, the symbol begins to recur. This parameter shows the frequency of such recurrences.

The "Typematic Delay" feature means the delay time before the beginning of a symbol recurrence.

The "Video BIOS Shadow, ..., Shadow" feature means the copying of the BIOS adapter areas into the operation memory. These parameters should better be not touched at all, or they should be disabled, except for Video BIOS.

The "Cyrix 6x86/MII CPUID" feature – by setting the "enable/disable" of the identification of the Cyrix 6x86/MII CPUID processor BIOS can be forced to automatically display this processor's parameters on the screen. This processor is not used in our device. Therefore one can set for it the: "disabled" parameter.

12.5 Section "CHIPSET Features SETUP"

The "CHIPSET FEATURES SETUP" feature: the operating modes of the memory and the bus are shown here. The menu of this section is presented in Figure B.4.

ROM PCI/ISA BIOS ()			
CHIPSET FEATURES SETUP			
AWARD SOFTWARE, INC.			
Auto Configuration	:Enabled	Memory Parity / ECC Check	:Auto
DRAM Read Timing	:70ns	Single Bit Error Report	:Enabled
DRAM RAS# Precharge Time	:4	L2 Cache Cacheable Size	:64MB
DRAM R/W Leadoff Timing	:7/6	Chipset NA# Asserted	:Enabled
Fast RAS# To CAS# Delay	:3	Pipeline Cache Timing	:Faster
DRAM Read Burst(EDO/FPM)	:x333/x444	Passive Release	:Enabled
DRAM Write Burst Timing	:x333	Delayed Transaction	:Disabled
Turbo Read Leadoff	:Disabled		
DRAM Speculative Leadoff	:Enabled		
Turn-Around Insertion	:Disabled		
ISA Clock	:PCICLK/4		
System BIOS Cacheable	:Disabled		
Video BIOS Cacheable	:Disabled		
8 Bit I/O Recovery Time	:1		
16 Bit I/O Recovery Time	:1	Esc: Quit	↑ ↓ → ← : Select Item
Memory Hole At 15M-16M	:Disabled	F1 : Help	PU/PD/+/- : Modify
Peer Concurrency	:Enabled	Old Values (Shift) F2	: Color
Chipset Special Features	:Enabled	F6 : Load BIOS Defaults	
DRAM ECC/RARITY Select	:Parity	F7 : Load Setup Defaults	

Figure B.4 – Menu of the Section "CHIPSET FEATURES SETUP"

Do not alter the settings here, to increase the device productivity. It should be better not done, since you won't make the CNC Unit run much faster, but this will increase the load on its internal components instead, which will lead to unstable operation. It is best to trust the manufacturing plant settings.

12.6 Integrated Peripherals

The menu of the Section «INTEGRATED PERIPHERALS» is shown in Figure B.5.

The "IDE HDD Block" Mode will speed up the process of addressing the hard disk. It must always be "Enabled".

The "IDE Primary Master PIO" mode sets the speed modes of the hard disk function. They can be set manually (Mode 0 — Mode 4). The fastest mode is Mode 4. But your hard disk may not always support such a mode. Therefore, let the device determine the capacity of your hard disk by itself (Auto). The next three settings are related to additional hard disks.

The "IDE Primary Slave PIO" setting fixes speed values for the hard disk function. They can be set manually (Mode 0 — Mode 4). The fastest mode is Mode 4. But your hard disk may not always support such a mode. Therefore let the device determine the capacity of your hard disk by itself (Auto). The next three settings are related to additional hard disks.

The "On-Chip Primary PCI IDE" setting enables or disables the operation of the main hard disk controller.

The "Onboard FDD Controller" setting enables or disables the operation of the floppy disk controller.

The "Onboard Parallel Port" is a port configuration for the printer. Its address and interruption alternatives are set here. It can use interruptions IRQ7 or IRQ5.

ROM PCI/ISA BIOS
INTEGRATED PERIPHERALS
AWARD SOWTWARE, INC

IDE HDD Block Mode	: Enabled	
PCI Slot IDE 2nd Channel	: Enabled	
On-Chip primary PCI IDE	: Enabled	
IDE Primary Master PIO	: AUTO	
IDE Primary Slave PIO	: AUTO	
Onboard FDD Controller	: Enabled	
Onboard UART 1	: 3F8/IRQ4	
Onboard UART 2	: 2F8/IRQ3	
Onboard Parallel Port	: 378/IRQ7	
Parallel Port Mode	: Normal	
Esc: Quit	↑ ↓ → ←	: Select Item
F1 : Help	PU/PD/+/-	: Modify
F5 : Old Values	(Shift) F2	: Color
F6 : Load BIOS Defaults		
F7 : Load Setup Defaults		

Figure B.5 – Menu of the Section "INTEGRATED PERIPHERALS"

12.7 Section "Password Setting"

This Section of the main menu "PASSWORD SETTING" enables a password to be set into the CNC Unit. It is best not experiment with it, since, as a rule, it ends in a failure: the user makes an accidental mistake and, not knowing the password, cannot enter the Setup mode any more or, what is even worse, he cannot load the CNC Unit. And an expert can break up the password in any case.

12.8 Section "Power Management Setup"

The next Section of the main menu is "POWER MANAGEMENT SETUP". It was made up with the aim to reduce the CNC Unit power consumption. The idea was to enable the device to "pass into the sleeping mode", if it has not been used for a certain period of time, in other words, to switch it off, but to make it "alive" again on pressing any key. However, it is not recommended to use this function, for its performance is not quite correct as a rule.

12.9 Section "PCI/PNP Configuration Setup"

The SECTION "PCI/PNP CONFIGURATION SETUP" is meant only for specialists. The settings in it are used to distribute hardware interruptions between the devices located on the ISA and PCI buses, as well as for Plug and Play devices.

12.10 Sections "Load BIOS Defaults", "Load SETUP Defaults"

The utilities "LOAD BIOS DEFAULTS" load all settings by default. We recommend you not to touch them, since while making adjustments the Setup content in your device is arranged in such a way that so that no conflicts should emerge between all its internal devices. And the use of Setup by default may upset these settings. But, in the extreme case, if you have seriously distorted all the

settings with your actions and have become confused about them, these points will help you restore everything anew.

12.11 Section "IDE HDD Auto Detection"

"IDE HDD AUTO DETECTION" – this means an automatic determination of the hard disk type. When installing a new hard disk, it wouldn't be a bad thing to consult this SECTION. If automatic detection is not set in your STANDARD CMOS SETUP, then it is necessary to determine the disk parameters. Press "Enter". After a short pause the hard disk parameters will be highlighted on the screen. As a rule, "Y" and "Enter" should be pressed. However, as many as three parameter versions may be highlighted. At this point one must look attentively: if your disk is more than 540 MB, then LBA should be chosen, if less, the "Normal" mode is to be taken..

It should be noted that the device will try to define the hard disk type four times. The first time it will define it as the Primary Master, then as the Primary Slave, next as the Secondary Master and finally as the Secondary Slave. The main hard disk is the Primary Master, and it must be definable the first time. If, however, it should be defined as the Secondary Master, it means that the stub from it was connected to an additional controller, and it is necessary to shift it to the main one.

12.12 Section "HDD Low Level Format"

"HDD LOW LEVEL FORMAT" – you please never start this utility! The provision is, of course, made in it for your accidental interference, and before formatting begins at a low level you will be asked a number of questions with the request to confirm the actions being carried out, but if you safely come to the end, always answering with a "Y", then you will lose forever all the data stored on the hard disk.

12.13 Items "SAVE & EXIT SETUP" and "EXIT WITHOUT SAVING"

"SAVE & EXIT SETUP" – this is a command for the device to store all the new changes made by you. You should answer the question by "Y", if you agree to exit Setup, saving data.

"EXIT WITHOUT SAVING" this means exit from Setup without saving data. If you are not sure of your new settings or are confused, then select this point, in order not to save the changes.

ATTENTION!

DO NOT TOUCH SETUP WITHOUT A SPECIAL NEED TO DO SO. IF THE CNC UNIT IS WORKING WELL, LET IT CONTINUE TO WORK THAT WAY.

WHEN INSTALLING NEW HARD DISKS MAKE SURE THAT THEIR DETERMINATION MODE (THE MODE COLUMN IN THE INITIAL FIRST MENU POINT "STANDARD CMOS SETUP") CORRESPONDS TO THEIR CAPACITY. IF IT IS LESS THAN 540 MB, SET NORMAL, IF IT IS MORE, SET LBA.

The list of the parameters set by the manufacturer of CNC Units is presented in figures B.6 and B.7.

NOTE – IN THESE DIRECTIONS FOR USE SETTINGS ARE GIVEN FOR ONLY ONE BIOS VERSION, AS AN EXAMPLE. THEREFORE, FOR OTHER BIOS VERSIONS THE CITED SETTINGS CAN BE USED AS A REFERENCE MATERIAL.

ROM PCI/ISA BIOS ()
STANDARD CMOS SETUP
AWARD SOFTWARE, INC.

Date (mm:dd:yy) : Sun, Jun, 1 1997
Time (hh:mm:ss) : 10 : 42 : 40

HARD DISKS	CYLS	HEAD	PRECOMP	LANDZONE	SECTORS	MODE
Primary Master : (0Mb)	0	0	0	0	0	----
Primary Slave : (0Mb)	0	0	0	0	0	----
Drive A	: 1.44, 3.5 in*					
Drive B	: 1.44, 3.5 in*					
Video	: EGA/VGA					
Halt On	: All, But Disk/Key					
ESC: Quit	↑ ↓ → ←	: Select Item			PU/PD/+/-	: Modify
F1 : Help	(Shift)F2	: Change Color				

Figure B.6 – Menu of the Section “STANDARD CMOS SETUP”

BIOS CONFIGURATION
ROM PCI/ISA BIOS ()
BIOS FEATURES SETUP
AWARD SOFTWARE, INC.

Virus Warning	:Enabled	Vide BIOS Shadow	:Enabled
CPU Internal Cache	:Enabled	C8000-CBFFF Shadow	:Disabled
External Cache	:Enabled	CC000-CFFFF Shadow	:Disabled
Quick Power On Self Test	:Enabled	D0000-D3FFF Shadow	:Disabled
Boot Sequence	:C,A	D4000-D7FFF Shadow	:Disabled
Swap Floppy Driver	:Enabled *	D8000-DBFFF Shadow	:Disabled
Boot Up Floppy Seek	:Disabled	DC000-DFFFF Shadow	:Disabled
Boot Up Num Lock Status	:off	Cyrix 6x86/MII CPUID	:Enabled
Boot Up System Speed	:High		
Gate A20 Option	:Fast		
Typematic Rate Setting	:Enabled		
Typematic Rate (Chars/Sec)	:30	Esc: Quit	↑ ↓ → ← : Select Item
Typematic Delay (msec)	:500	F1 : Help	PU/PD/+/- : Modify
Security Option	:Setup	F5 : Old Values (Shift) F2	: Color
PCI/VGA Palette Snoop	:Disabled	F6 : Load BIOS Defaults	
OS Select For DRAM > 64 MB	Non-OS2	F7 : Load Setup Defaults	

Figure B.7 – Menu of the Section “BIOS FEATURES SETUP”

12.14 Restoration of SETUP Settings

To restore any changed settings, it is necessary to carry out the menu option "LOAD SETUP DEFAULTS" and then to enter data for options in the menu "STANDARD CMOS SETUP" and "BIOS FEATURES".

NOTE – THE SETTINGS MARKED WITH AN ASTERISK (*) ARE VALID ONLY FOR FDD, WHOSE CABLE PIN SOLDERING IS ACCORDING TO THE TABLE IN SECTION 5.

13 APPENDIX C *(obligatory)* **ELECTRONIC HAND WHEEL**

13.1 The Purpose of the Electronic Hand Wheel

13.1.1 This electronic hand wheel (hereunder referred to as the «hand wheel») is an angular motion transducer. This hand wheel is used as part of the CNC Unit to process work pieces in the manual mode «**MANU**» or «**MANJ**». By means of this hand wheel the axes can be moved manually (set in either «+» or «-» direction and the length of the travel).

13.2 The NC110-75B Electronic Hand Wheel

13.2.1 The NC110-75B Hand Wheel Characteristics

13.2.1.1 The basic technical characteristics of hand wheel NC110-75B, type LGF-12-003B-100 are:

- | | |
|--|-----------------------------------|
| 1) Supply voltage: | 5.00±0.25 V |
| 2) Current consumption: | 160 mA, max. |
| 3) Output type: | differential |
| 4) Range of output signals: | |
| - main | A+, A- |
| - offset | B+, B- |
| 5) Output signal type: | rectangular pulses |
| 6) Output signal frequency: | 5 kHz, max. |
| 7) Duration of the leading and trailing output signal edges: | 0.1 µs, max. |
| 8) Output signal levels: | |
| - logic «0» | 0.50 V, max. |
| - logic «1» | 2.50 V, max. |
| 9) Number of output signal periods | 100 periods/rev. |
| 10) Speed of shaft rotation: | 600 rpm, max. |
| 11) Nominal speed of shaft rotation | 200 rpm, max. |
| 12) Mean-time-between-failures: | 3x10 ⁵ rpm at ≤200 rpm |
| 13) Weight | 270 g |
| 14) Operation temperature range | 0 up to +60°C |

13.2.1.2 Hand wheel LGF-12-003B-100 has rectangular pulse output signals (100 pulses per one rotation). The supply voltage of the hand wheel is +5V. This hand wheel has two output channels **A** and **B**. Each of these channels emits differential signals **A+**, **A-**, **B+**, **B-**, as shown in Figure C.1.

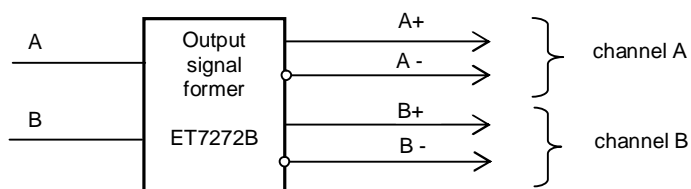


Figure C.1 - LGF-12-003B-100 Hand Wheel Output Channels

The time operation diagram of the hand wheel is shown in Figure C.2 (the inverse signals are not shown).

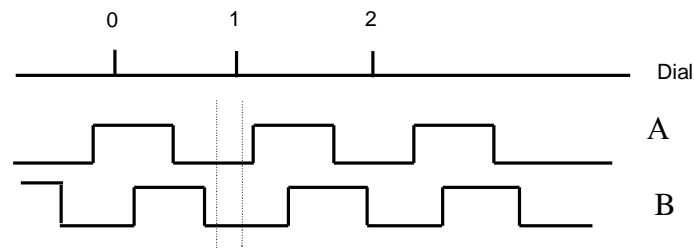


Figure C.2 – The Time Graph of Hand Wheel Operation

13.2.2 The Overall Dimensions of Hand Wheel NC110-75B

13.2.2.1 The overall dimensions of the hand wheel LGF-12-003B-100 are shown in Figure C.3. Mechanically, the hand wheel is of a round shape. There is a movable metal small-size wheel on the front side of this hand wheel, which has a calibrated scale of 100 divisions. The small wheel has a handle which makes it possible to rotate it both in the clockwise direction (+), and in the anti-clockwise direction (-). The stationary metal disc has a black hairline signifying the beginning of readings. There is a round label with the logo of the company **Balt-System** in the centre of the hand wheel.

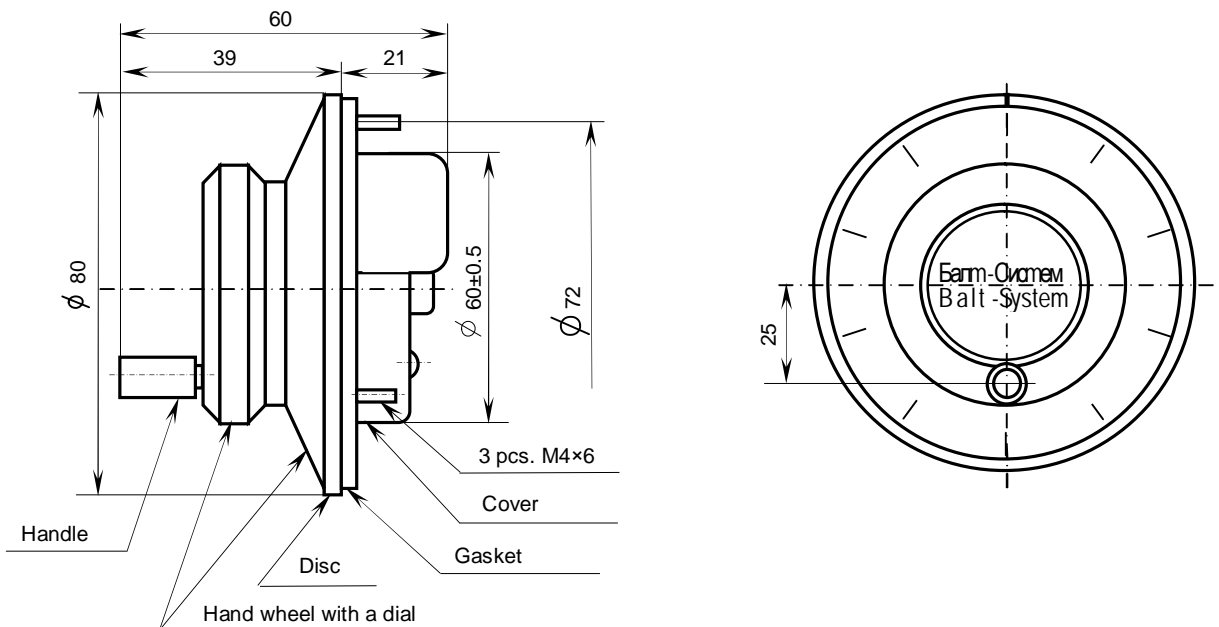


Figure C.3 – The Overall Dimensions of LGF-12-003B-100 Hand Wheel

A ring-shaped rubber seal is glued onto the back side of the disc and three M4x6 screws are for fixing the hand wheel. The delivery set of hand wheel LGF-12-003B-100 includes fixing parts, as follows:

- M4 nuts - 3 pcs.;
- flat washers - 3 pcs.;
- spring washers - 3 pcs.

A round plastic cover of black color covers the hand wheel at its back. This cover is fixed in place with two screws. There is a slit in the cover, through which a terminal socket for M3 screws for six positions goes through, and it is installed on the PCB to connect the communication cable with the

CNC Unit. There is a label glued onto the cover. The label has pin numbers and signal designations according to Table C.1.

Table C.1

Pin	1	2	3	4	5	6
Signal	5V	0V	A+	A-	B+	B-

13.2.2.2 The holes positions for mounting the hand wheel LGF-12-003B-100 is given in Figure C.4.

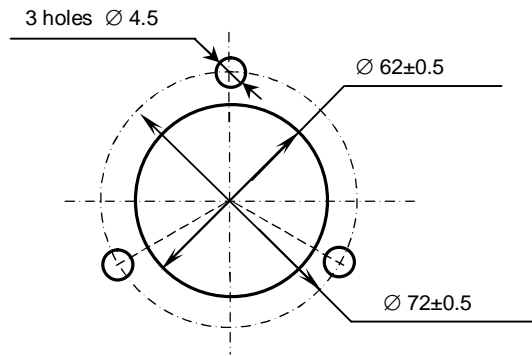


Figure C.4 – The LGF-12-003B-100 Hand Wheel Mounting Dimensions

13.3 The Electronic Hand Wheel NC310-75A

13.3.1 The NC310-75A Hand Wheel Characteristics

13.3.1.1 The basic technical characteristics of hand wheel NC310-75A, type ZBG-5-003-100:

- | | |
|---|---|
| 1) supply voltage: | 5.00±0.25 V |
| 2) consumed current: | 120 mA, max. |
| 3) output type: | differential |
| 4) output signals range: | |
| - the basic one | A+, A- |
| - the displaced one | B+, B- |
| 5) output signals type: | rectangular pulses |
| 6) output signals frequency: | 5 kHz, max. |
| 7) duration of the front and back fronts of output signals: | 0.1 µs, max. |
| 8) output signals levels: | |
| - the logical «0» | 0.50 V, max. |
| - the logical «1» | 2.50 V, max. |
| 9) the number of periods of output signals: | 100 per./rev. |
| 10) the rotation speed of the shaft: | 600 rev./min., max. |
| 11) the rated rotation speed of the shaft: | 200 rev./min., max. |
| 12) MTBF: | 3x10 ⁵ rev./min. at ≤200 rev./min. |
| 13) weight: | 90 g |
| 14) working temperature range: | 10to + 60°C |

13.3.1.2 Hand wheel ZBG-5-003-100 generates rectangular output pulse signals (100 pulses per revolution). The hand wheel is supplied with a voltage of +5V. The hand wheel has two output channels **A** and **B**. Each channel generates differential signals **A+**, **A-**, **B+**, **B-**, as shown in Figure C.5.

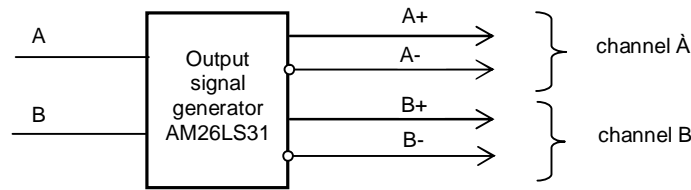


Figure C.5 – Output Channels of the ZBG-5-003-100 Hand Wheel

The time graph of hand wheel ZBG-5-003-100 operation corresponds to the working graph of hand wheel LGF-12-003B-100 and it is given in Figure C.2.

13.3.2 The Design of Hand Wheel NC310-75A

13.3.2.1 The overall dimensions of hand wheel ZBG-5-003-100 are shown in Figure C.6. The design version is 5. The hand wheel has a round shape, the degree of protection with an envelope is **IP50**.

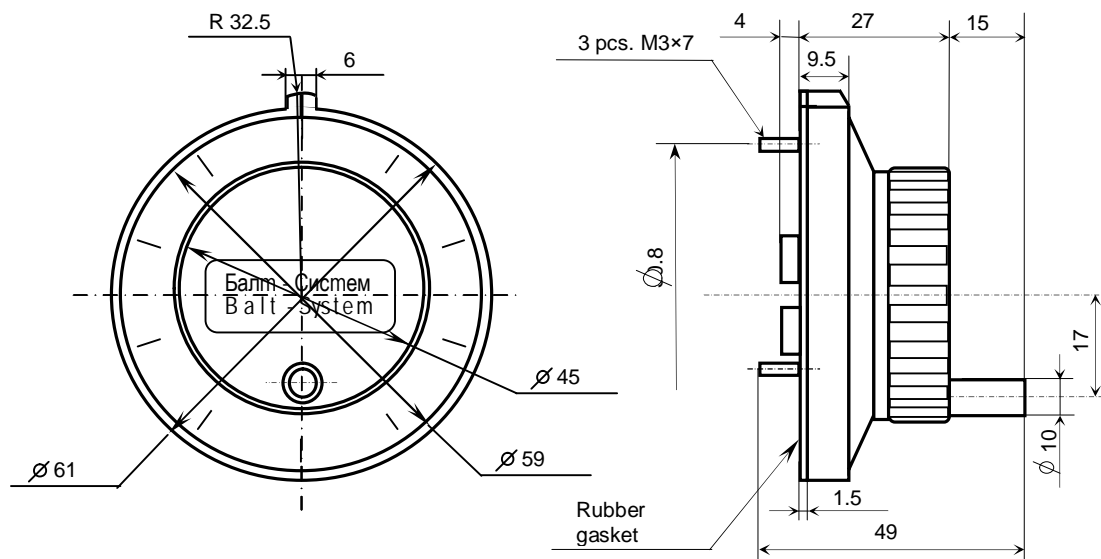


Figure C.6 – The Overall Dimensions of the ZBG-5-003-100 Hand Wheel

There is a small-size rotary metal wheel on the front side of this hand wheel, which has a calibrated scale of 100 divisions. This wheel has a handle which allows to rotate it both in the clockwise direction (+), and in the anti-clockwise direction (-). The stationary plastic body has a black hairline signifying the beginning of readings. There is a round label with the logo of the company **Balt-System** in the centre of the wheel.

A ring-shaped rubber seal is glued onto its circumference and three M3x7 screws are placed to fix the hand wheel. The delivery set of the hand wheel includes fixing parts, as follows:

- M3 nuts - 3 pcs.;
- flat washers - 3 pcs.;
- spring washers - 3 pcs.

There is a cut out hole, Ø 41 mm, in the back part of the plastic case, which opens the PCB. There are two lead sockets on the PCB, for M3 screws, with 2 and 4 pins for connecting a communication cable for communication with the CNC Unit. The marking of the pins is shown on the PCB. The positions of the hand wheel output contacts are given in Figure C.7.

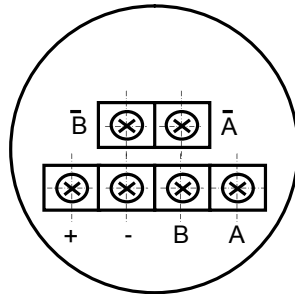


Figure C.7 – Positions of the ZBG-5-003-100 Hand Wheel Output terminals

13.3.2.2 The holes positions for installing the ZBG-5-003-100 hand wheel is given in Figure C.8.

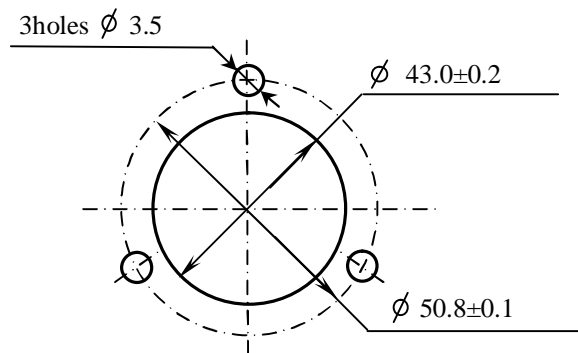


Figure C.8 – Mounting Dimensions of the ZBG-5-003-100 Hand Wheel

13.4 Connection of the Hand Wheel to the CNC Unit

13.4.1 The hand wheel can be connected to the CNC Unit in the following way:

- via the CNC hand wheel channel;
- via the CNC encoder channel.

Make sure that attention is paid to the characteristics of the chosen connection channel input, i.e., what input signals (differential/single) the connection channel can process. The inputs characteristics are explained in this document in its part where a description of channels is given.

In all cases power supply of +5V to the hand wheel must be delivered from the CNC Unit via the channel connected. The CNC Unit can operate both with one and two hand wheels.

13.4.2 For connecting the hand wheel via the CNC hand wheel channel its characterization is not necessary. The method of operating the hand wheel for such a case is given in the document «Programming and Operator's Manual».

Hand wheel connection via any of the encoder channels makes it necessary to define the hand wheel as an axis in the characterization files **AXCFIL** and **IOCFIL**.

In case the hand wheel is connected via an electronic hand wheel channel or via an encoder channel, the hand wheel will be controlled internally by the SW.

13.4.3 The CNC SW allows operation with two hand wheels over two independent channels. Operation with two hand wheels requires characterization in file **AXCFIL** (the **CAS** instruction) and **IOCFIL** (the **ADV** instruction).

When operation is made with two hand wheels, the hand wheels will be controlled externally. This external operation is performed by the SW and PL will be activated in any operation mode.

13.4.4 Issues pertaining to the characterization of the hand wheel/hand wheels are examined in the document «Software Characterization ». External control signals controlling the hand wheels are listed in the document «PLC Interface Programming».

14 APPENDIX D *(obligatory)* **EXTERNAL OUTPUT/INPUT MODULES**

14.1 The Purpose of External Input/Output Modules

14.1.1 External input/output modules ensure adjustment between the discrete CNC input/output channels and the electric automation channels of equipment to be controlled. The following external modules have been developed for use with the CNC Unit:

- NC210-401 – an output module with relay commutation and indication (24);
- NC210-402 – an input indication module (32).

14.1.2 The input indication module translates signals coming from the electrical equipment of this system to the CNC discrete channels without transforming them. All the channels of this module have light-emission diodes, which indicate that the information being transferred is on a high level.

The outputs module with relay-based commutation and indication is designed to expand the capacity of CNC discrete output channels. All module channels have light-emission diodes and relays controlled by the CNC output channel signals. The contacts of this relay allow to commutate both DC and AC voltages, which is accompanied by a considerable increase in the commuted current.

14.1.3 The rated supply voltage of the modules is as follows: +24V DC. Supply voltage range of the modules: + (15-30)V DC.

The supply voltage of external input/output modules must be applied from the control object through the «SPEPN» relay of the CNC Unit.

14.2 Technical Characteristics of External Input/Output Modules

14.2.1 Characteristics of input module NC210-402:

- | | |
|----------------------------------|--------------|
| 1) Number of indicated channels: | 32 |
| 2) Rated input current: | 12 mA/24V DC |

14.2.2 Characteristics of output module NC210-401:

- | | |
|--|--|
| 3) Number of commuted output channels: | 24 |
| 4) Commuted voltage: | DC/AC |
| 5) Rated commuted current value: | 3A/28V DC;
3A/110V AC; 1.5A/220V AC |

14.3 Input Indication Module (32) NC210-402

14.3.1 The appearance of the NC210-402 module is presented in Figure D.1. The module height is 66 mm max. The module can be mounted onto a DIN-strip.

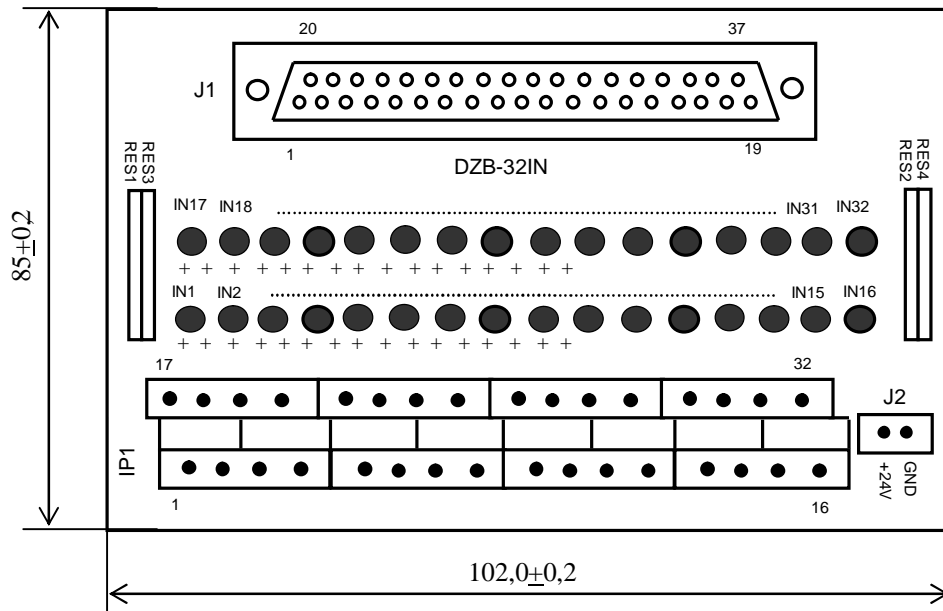


Figure D.1

14.3.2 Designation and purpose of the NC210-402 module elements:

- **IN1-IN32** - light-emission diodes to indicate the input status;
- **IP1** - it is a two-row, two-level connector for screw mounting with 32 pins for connecting 32 input channels from the controlled equipment (10 connectors MDSTBV 2,5/2-G-5,08).
This module delivery set includes the mating part of the IP1 connector: 10 sockets, type MVSTBR 2,5/4-ST-5,08 with 4 pins and a fixing screw;
- **J1** - it is a connector (socket DPS 37-F) for connecting the communication cable of the I/O module inputs (connector «1»/«2») with the NC210-402 module;
- **J2** - it is a connector with 2 pins for screw mounting (MSTBV 2,5/2-G-5,08) for connecting DC voltage from an external power source +24V.
This module delivery set includes the mating part of the J2 connector: 1 socket, type MSTBR 2,5/2-ST-5,08 or MSTB 2,5/2-ST-5,08 with 2 pins and a fixing screw;
- **RES1-RES4** - resistors limiting the LED circuit currents (4 resistor assemblies **A472G**: 8 resistors of 4.7 KOhm).

14.3.3 The assignment of discrete input signals to connector pins «**J1**» and «**IP1**» of the NC210-402 module, as well as to connector pins «1» and «2» of the **CNC I/O** module is presented in Table D.1. The data of this table should be used when making up an input cable.

14.3.4 The diagram showing the connection of the NC210-402 module to the CNC Unit is given in Figure D.2.

Table D.1

Signal	Module I/O (CNC Unit)		NC210-402		
	Connector		Item number	Connector	
	1	2		J1	IP1
	Pin		Pin		
Inp0 (I00A00)	01	-	1	1	1
Inp1 (I00A01)	02	-		2	2
Inp2 (I00A02)	03	-		3	3
Inp3 (I00A03)	04	-		4	4
Inp4 (I00A04)	05	-		5	5
Inp5 (I00A05)	06	-		6	6
Inp6 (I00A06)	07	-		7	7
Inp7 (I00A07)	08	-		8	8
Inp8 (I00A08)	09	-		9	9
Inp9 (I00A09)	10	-		10	10
Inp10 (I00A10)	11	-		11	11
Inp11 (I00A11)	12	-		12	12
Inp12 (I00A12)	13	-		13	13
Inp13 (I00A13)	14	-		14	14
Inp14 (I00A14)	15	-		15	15
Inp15 (I00A15)	16	-		16	16
0V	17	-		17	-
0V	18	-		18	-
0V	19	-		19	-
Inp16 (I00A16)	20	-		20	17
Inp17 (I00A17)	21	-		21	18
Inp18 (I00A18)	22	-		22	19
Inp19 (I00A19)	23	-		23	20
Inp20 (I00A20)	24	-		24	21
Inp21 (I00A21)	25	-		25	22
Inp22 (I00A22)	26	-		26	23
Inp23 (I00A23)	27	-		27	24
Inp24 (I00A24)	28	-		28	25
Inp25 (I00A25)	29	-		29	26
Inp26 (I00A26)	30	-		30	27
Inp27 (I00A27)	31	-		31	28
Inp28 (I00A28)	32	-		32	29
Inp29 (I00A29)	33	-		33	30
Inp30 (I00A30)	34	-		34	31
Inp31 (I00A31)	35	-		35	32
0V	36	-		36	-
0V	37	-		37	-

Table D.1 (continued)

Signal	Module I/O (CNC Unit)		NC210-402		
	connector		Item number	connector	
	1	2		J1	IP1
	Pin			Pin	
Inp32 (I01A00)	-	1	2	1	1
Inp33 (I01A01)	-	2		2	2
Inp34 (I01A02)	-	3		3	3
Inp35 (I01A03)	-	4		4	4
Inp36 (I01A04)	-	5		5	5
Inp37 (I01A05)	-	6		6	6
Inp38 (I01A06)	-	7		7	7
Inp39 (I01A07)	-	8		8	8
Inp40 (I01A08)	-	9		9	9
Inp41 (I01A09)	-	10		10	10
Inp42 (I01A10)	-	11		11	11
Inp43 (I01A11)	-	12		12	12
Inp44 (I01A12)	-	13		13	13
Inp45 (I01A13)	-	14		14	14
Inp46 (I01A14)	-	15		15	15
Inp47 (I01A15)	-	16		16	16
0V	-	17		17	-
0V	-	18		18	-
0V	-	19		19	-
Inp48 (I01A16)	-	20		20	17
Inp49 (I01A17)	-	21		21	18
Inp50 (I01A18)	-	22		22	19
Inp51 (I01A19)	-	23		23	20
Inp52 (I01A20)	-	24		24	21
Inp53 (I01A21)	-	25		25	22
Inp54 (I01A22)	-	26		26	23
Inp55 (I01A23)	-	27		27	24
Inp56 (I01A24)	-	28		28	25
Inp57 (I01A25)	-	29		29	26
Inp58 (I01A26)	-	30		30	27
Inp59 (I01A27)	-	31		31	28
Inp60 (I01A28)	-	32		32	29
Inp61 (I01A29)	-	33		33	30
Inp62 (I01A30)	-	34		34	31
Inp63 (I01A31)	-	35		35	32
0V	-	36		36	-
0V	-	37		37	-

Supply voltage must be delivered through SPEPN relay contacts

0V +24V

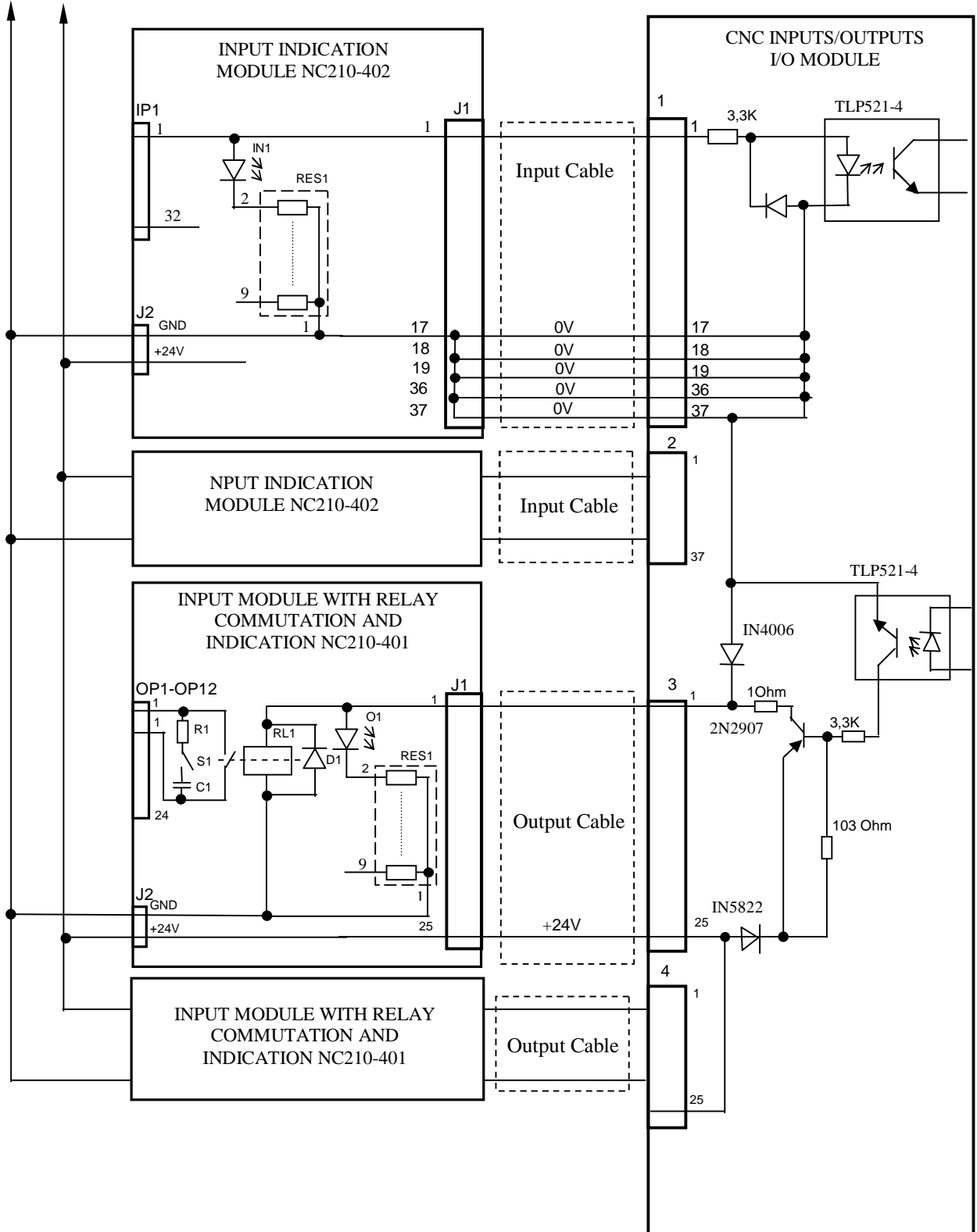


Figure D.2 – Diagram of Connections of the NC210-401 and NC210-402 Modules to the CNC Unit

14.4 Output Module with Relay Commutation and Indication (24) NC210-401

14.4.1 The external view of the NC210-401 module is presented in Figure D.3. The module height is 56 mm max. The module can be mounted onto a DIN-strip.

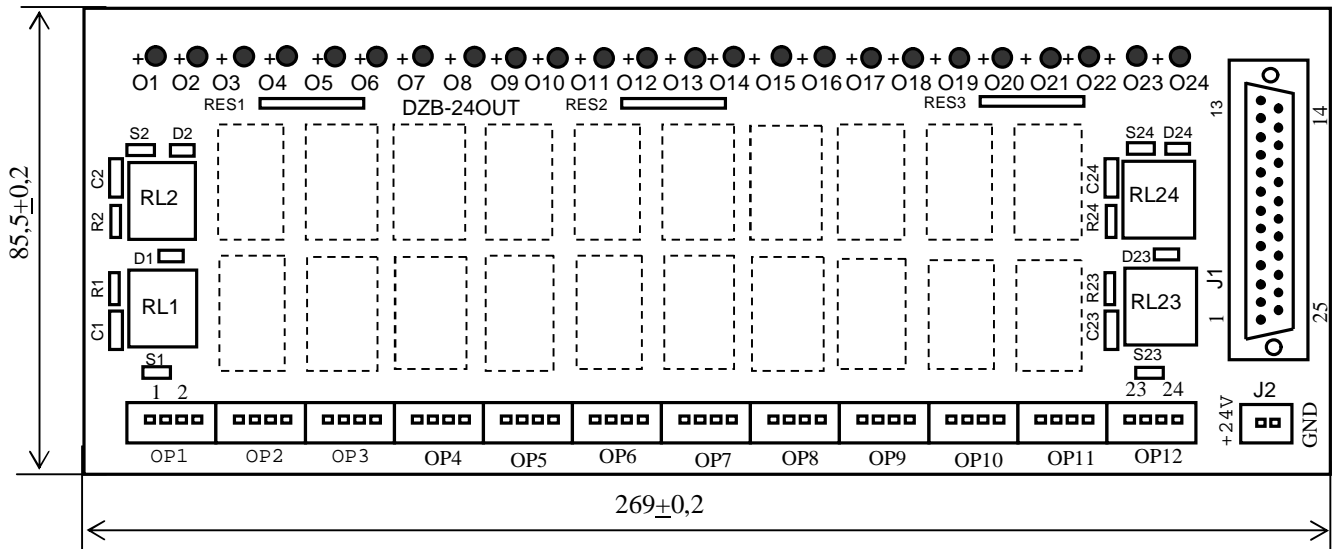


Figure D.3

14.4.2 The designation and purpose of the NC210-401 module elements are as follows:

- **J1** - a connector (a DPS 25-M plug) for connecting the communication cable of the I/O module outputs (connector «3»/«4») with the NC210-401 module;
- **J2** - it is a connector with 2 pins (a plug, type MSTBV 2,5/2-G-5,08) for connecting DC voltage from an external +24V DC power source.
This module delivery set includes the mating part of the J2 connector: 1 socket, type MSTBR 2,5/2-ST-5,08 with 2 pins and a fixing screw;
- **O1–O24** - light-emission diodes to indicate the status of the outputs;
- **OP1-OP12** - 12 connectors (a plug, type MSTBV 2,5/4-G-5,08) for 2 commuted signals each: 2 pins per signal; the normally-open contacts of the **RL1-RL24** relay are wired to 48 pins for the commutation of 24 equipment controlling signals.
The delivery set of this module includes mating parts for the **OP1-OP12** connectors: 12 sockets, type MVSTBR 2,5/4-ST-5,08 with 4 pins with a fixing screw;
- **R1C1-R24C24** – **RC** - chains (24 pcs.) are installed parallel to relay commutating contacts;
- **RES1-RES3** - resistors limiting the **LED** circuit currents (3 resistor assemblies **A472G**: 8 resistors of 4.7 KOhm).

Table D.2

Signal	Module I/O (CNC Unit)		NC210-401		
	connector		Item number	connector	
	3	4		J1	OPI-OP12
	pin		pin		
Out0 (U04A00)	01	-	1	1	1-1
Out1 (U04A01)	02	-		2	2-2
Out2 (U04A02)	03	-		3	3-3
Out3 (U04A03)	04	-		4	4-4
Out4 (U04A04)	05	-		5	5-5
Out5 (U04A05)	06	-		6	6-6
Out6 (U04A06)	07	-		7	7-7
Out7 (U04A07)	08	-		8	8-8
Out8 (U04A08)	09	-		9	9-9
Out9 (U04A09)	10	-		10	10-10
Out10 (U04A10)	11	-		11	11-11
Out11 (U04A11)	12	-		12	12-12
Out23 (U04A23)	13	-		13	13-13
Out12 (U04A12)	14	-		14	14-14
Out13 (U04A13)	15	-		15	15-15
Out14 (U04A14)	16	-		16	16-16
Out15 (U04A15)	17	-		17	17-17
Out16 (U04A16)	18	-		18	18-18
Out17 (U04A17)	19	-		19	19-19
Out18 (U04A18)	20	-		20	20-20
Out19 (U04A19)	21	-		21	21-21
Out20 (U04A20)	22	-		22	22-22
Out21 (U04A21)	23	-		23	23-23
Out22 (U04A22)	24	-		24	24-24
+24V	25	-		25	-
Out24 (U04A24)	-	01	2	1	1-1
Out25 (U04A25)	-	02		2	2-2
Out26 (U04A26)	-	03		3	3-3
Out27 (U04A27)	-	04		4	4-4
Out28 (U04A28)	-	05		5	5-5
Out29 (U04A29)	-	06		6	6-6
Out30 (U04A30)	-	07		7	7-7
Out31 (U04A31)	-	08		8	8-8
Out32 (U05A00)	-	09		9	9-9
Out33 (U05A01)	-	10		10	10-10
Out34 (U05A02)	-	11		11	11-11
Out35 (U05A03)	-	12		12	12-12
Out36 (U05A15)	-	13		13	13-13
Out37 (U05A04)	-	14		14	14-14
Out38 (U05A05)	-	15		15	15-15
Out39 (U05A06)	-	16		16	16-16
Out40 (U05A07)	-	17		17	17-17
Out41 (U05A08)	-	18		18	18-18
Out42 (U05A09)	-	19		19	19-19
Out43 (U05A10)	-	20		20	20-20
Out44 (U05A11)	-	21		21	21-21
Out45 (U05A12)	-	22		22	22-22
Out46 (U05A13)	-	23		23	23-23
Out47 (U05A14)	-	24		24	24-24
+24V	-	25		25	-

- **RL1-RL24** - 24 relays, type **NT73CS10DC24** commuting 24 equipment control signals; it is allowed to apply the following voltages: 3A/28V DC; 3A/110V AC or 1.5A/220V AC to the relay contacts;
- **S1-S24** - 24 jumpers for switching on/off **RC** - chains.

14.4.3 The allocation of discrete output signals to connector pins «**J1**» and «**OP1**»-«**OP12**» of the NC210-401 module as well as to connector pins «**3**», «**4**» of the **I/O** module is presented in Table D.2. The data of said table should be used for making a cable for outputs.

14.4.4 The diagram for the connection of the NC210-401 module to the CNC Unit is shown in Figure D.2.

15 APPENDIX E *(obligatory)* **HAND HELD PROGRAMMABLE STATION**

15.1 The Hand-Held Programmable Station Function

15.1.1 The hand-held programmable station is designed for adjusting the tool position, for controlling the axes movements and for the automatic machine-tool control.

15.1.2 The said **HHPS** is a programmable device. The operation of the **HHPS** is controlled by the CNC Unit. To provide for the joint operation of the **HHPS** with the CNC Unit **PL** must be developed. The CNC Unit user must on his own develop this **PL**, with due account of the specific nature of his system, in which the **HHPS** is used. The principles of developing and debugging the **PL** are explained in «PLC Interface Programming».

The **HHPS** elements functions (its buttons, keys, selector switches) and the sequence of their operations shall be determined by the **PL** engineer, proceeding from the requirements dependent on the control equipment in question. In order to establish a link between the **HHPS** and the CNC Unit, the CNC **I/O** discrete channels, also the electronic hand wheel/encoder channel and the external power source of +24V are used.

15.1.3 The abbreviations adopted here are as follows:

HHPS	- a hand-held programmable station;
HW	- hand wheel.

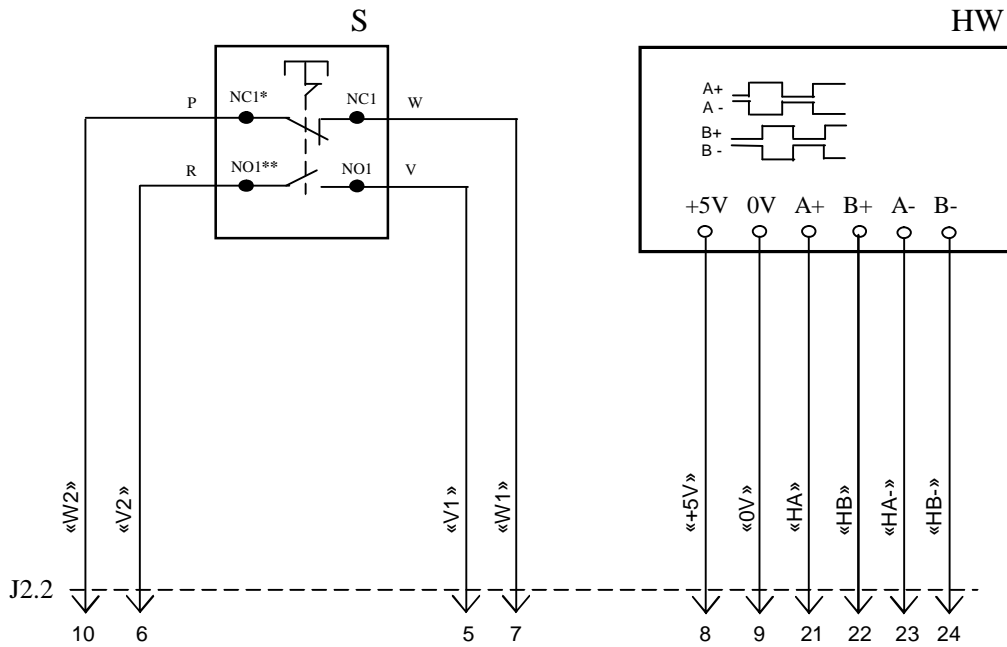
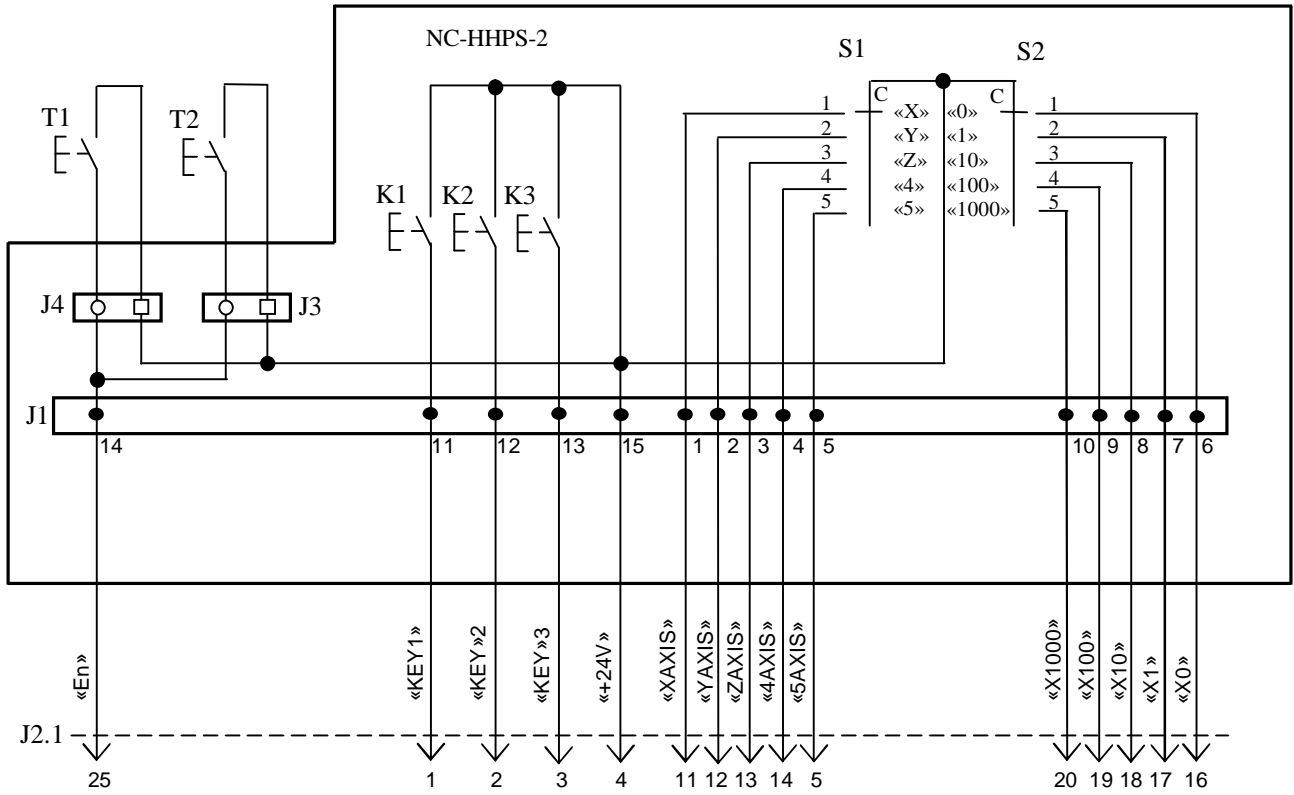
15.2 The Hand-Held Programmable Station NC110-78B

15.2.1 The Electric Diagram of NC110-78B

15.2.1.1 The electric diagram of the **HHPS-2** NC110-78B is shown in Figure E.1. The following designations of its component parts are adopted here:

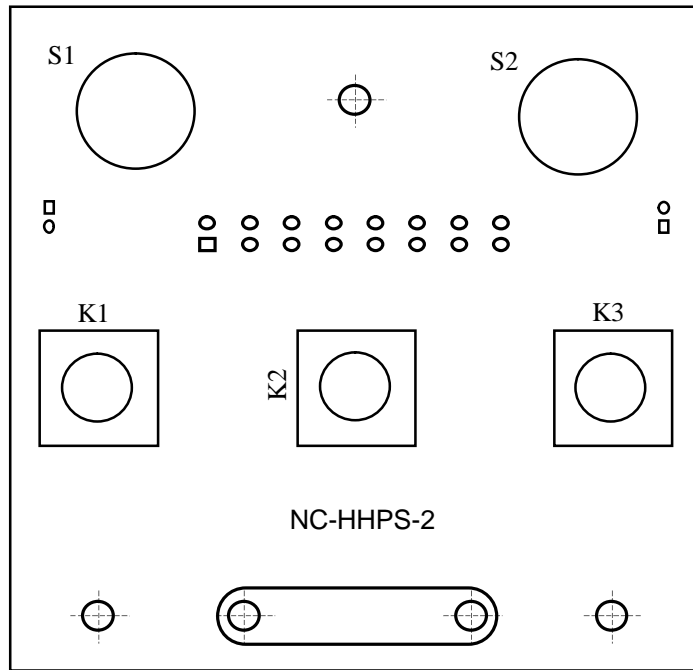
A	– the PCB of the hand-held programmable station NC-HHPS-2 ;
J1	- 16 pads for communication between the wires of the HHPS external cable and selectors S1, S2 , keys K1-K3 and buttons T1, T2 ;
J2	- a 26-pin connector (cable plug) in the external cable of the HHPS for its communication with the CNC Unit;
J3	- a connector for communication Button T2 on the right side of the HHPS (plug PW 10-2-M);
J4	- a connector for communication Button T1 on the left side of the HHPS (plug PW 10-2-M);
K1-K3	- programmable functional keys;
S1	- a programmable selector switch with 5 positions: X, Y, Z, 4, 5 ;
S2	- a programmable selector switch with 5 positions: 0, 1, 10, 100, 1000 ;
HW	- the ZBG-003-100 electronic hand wheel;
S	- an emergency stop button (mushroom-shaped, of red color);
T1, T2	– two in parallel-connected programmable buttons, duplicating one another; they are programmed as a single button.

A

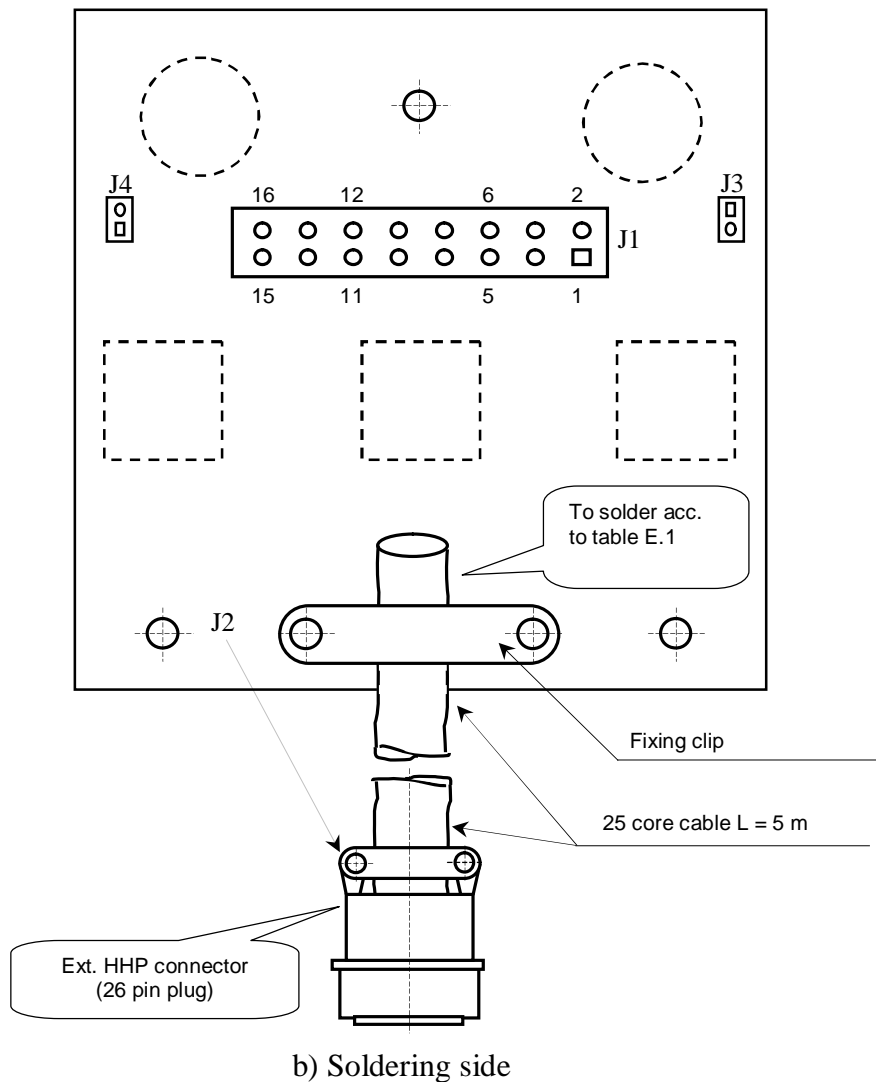


NC* - Normally Closed (NCC)
 NO** - Normally Open (NOC)

Figure E.1 – Electric Circuit Diagram of HHPS NC110-78B



a) Component side



b) Soldering side

Figure E.2 – The NC110-78B Board of the NC-HHPS-2

15.2.1.2 On board **A (NC-HHPS-2)** selector switches **S1, S2**, keys **K1-K3** and connectors **J1, J3, J4** are installed. The lay out of board **A** components is presented in Figure E.2. An external cable is led to this board. All the individual wires of this cable are marked with colors. Cable ends are fixed with a metal buckle. The contact pads of connector **J1**, board **A**, are used for soldering on the wires of a cable that which provides for communication with selectors **S1, S2**, keys **K1-K3** and buttons **T1, T2**. The wires of the cable that secures a link with the hand wheel **HW** and the emergency stop button **S** are led directly to the elements referred to.

The cable wires are soldered in accordance with Table E.1.

Table E.1 – Signals of the HHPS NC110-78B cable (HHPS-2)

J2 connector pin	Wire color		Connecting pin for HHPS	Signal		Connection to external objects
	Basic	Additional		Designation	Function	
25	white	black	A:J1-14	En	Buttons T1, T2	CNC Unit discrete inputs
1	white	-	A:J1-11	KEY1	Keys K1-K3	
2	brown	-	A:J1-12	KEY2		
3	green	-	A:J1-13	KEY3		
4	yellow	-	A:J1-15	+24V	Power supply	External source +24V
11	grey	rose	A:J1-1	XAXIS	selector S1	CNCU discrete inputs
12	red	blue	A:J1-2	YAXIS		
13	white	green	A:J1-3	ZAXIS		
14	brown	green	A:J1-4	4AXIS		
15	white	yellow	A:J1-5	5AXIS		
20	rose	brown	A:J1-10	X1000	selector S2	
19	white	rose	A:J1-9	X100		
18	grey	brown	A:J1-8	X10		
17	white	grey	A:J1-7	X1		
16	yellow	brown	A:J1-6	X0		
10	violet	-	S:P(NC1)	W2	Emergency stop button	Emergency cut off circuit of control object (30V, max.)
5	grey	-	S:V(NO1)	V1		
6	rose	-	S:R(NO1)	V2		
7	blue	-	S:W(NC1)	W1		
8	red	-	HW:+5V	+5V	electronic hand wheel	CNC electronic Hand wheel/encoder
9	black	-	HW: 0V	0V		
21	white	blue	HW:A+	HA+		
22	brown	blue	HW:B+	HB+		
23	white	red	HW:A-	HA-		
24	brown	red	HW:B-	HB-		
26	-	-	-	-	-	-

Connector **J2** is installed on the other end of this cable, providing for communication between the HHPS and the CNC Unit. The pins lay out of connector **J2** is given in Figure E.3.

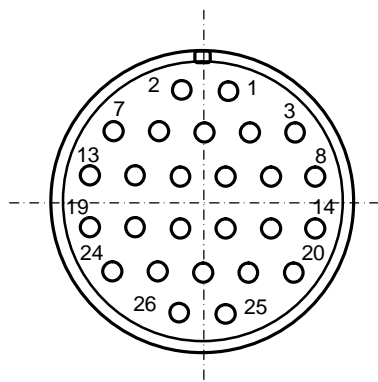


Figure E.3 – The HHPS Connector Pins Positions

15.2.2 The NC110-78B HHPS Design

15.2.2.1 The basic dimensions and positions of the HHPS NC110-78B elements are given in Figure E.4. The NC110-78B HHPS has a plastic outer case. This case consists of a base and a cover, which are joined together with six M3x15 screws. The cover mechanically serves as the front panel of the HHP Station.

The external spring-shaped cable of the HHPS is 2 meters long when it is contracted, when stretched, its length will increase up to 5 m. The weight of the HHPS NC110-78B, considering the weight of the cable, is 1.2 kg, max.

A magnet is mounted in the upper part of the case base, allowing HHPS attachment to any metal surface. Besides, the delivery set of the HHPS contains a stand for the panel and 3 fixing screws M4x20. The overall stand dimensions are given in Figure E.5, its mounting dimensions are according to Figure E.6.

The front panel is divided into upper and lower sections. The upper area has Board A (NC-HHPS-2), the lower section has a hand wheel on it (**HW**). The emergency stop button **S** is installed on the upper surface of the case, buttons **T1** and **T2** are installed on its side surfaces. A cable inlet with a safety sleeve is put into a hole in the lower butt end of the case. It serves to lead in the external cable into the HHPS case.

Selector switch knobs through the openings in the cover are led out into the upper row of the HHPS front panel - **S1**, **S2** (from left to right), the buttons of keys **K1-K3** (from left to right) are in the second row. The upper section of the HHPS has a film coating which hermetically seals off the keys. The switching positions are indicated near all the switches; in the lower section the starting point of readings and the directions of rotation are indicated for the electronic hand wheel: «+» is its rotation clockwise, «-» - anti-clockwise.

15.2.2.2 The electronic hand wheel **HW** controls the motion of the machine-tool axes in the manual mode **MANU** or **MANJ** (it sets the motion direction «+»/«-» and travel length). A **ZBG-003-100** type hand wheel is installed in HHPS NC110-78B. Both the case and the hand wheel rotary part are of black plastic. The hand wheel scale (100 divisions) is calibrated with a white paint. The case has a white hairline as a star line for readings. Hand wheel **ZBG-003-100** has differential output signals: **A+**, **A-**, **B+**, **B-**. The power supply voltage of the hand wheel is 5 ± 0.25 V. Its consumed current is no more than 120 mA. The connection methods of the hand wheel are described in Appendix C.

15.2.2.3 The emergency stop button **S** has two groups of contacts with fixation: NC contacts (**NC1**) and NO contacts (**NO1**). The current value that can be commutated is 2A/30V, max. The button initial position is when it is released. The emergency stop button must be linked to the emergency switch off circuit of the control object (30 V, max.). If this button is pressed, the CNC Unit will receive an emergency stop signal. This emergency stop status of the CNC Unit can be removed by the operator by turning the mushroom-shaped button in the clockwise direction, as this is shown with arrows on the button.

15.2.2.4 Buttons T1 (the left one) and T2 (the right one) have one NO contact each without fixation. The current value that can be commutated is 200mA/24V, max. The button contacts are connected in parallel. The contacts of each button are connected with wires which are 10 cm long with socket PWC 10-2-F, which secures connection with connector J4/J3 of Board A.

15.2.2.5 An external spring-shaped cable (25x0.14) is led into the HHPS case via a cable inlet. This cable input allows to fix the cable position in the HHPS case. The outside end of this cable has a connector (**J2**). The lay out of connector pins of the HHPS is shown in Figure E.3, the connector signals are shown in Table E.1. The delivery set of the HHPS includes the mating part of this connector: a unity socket with 26 pins.

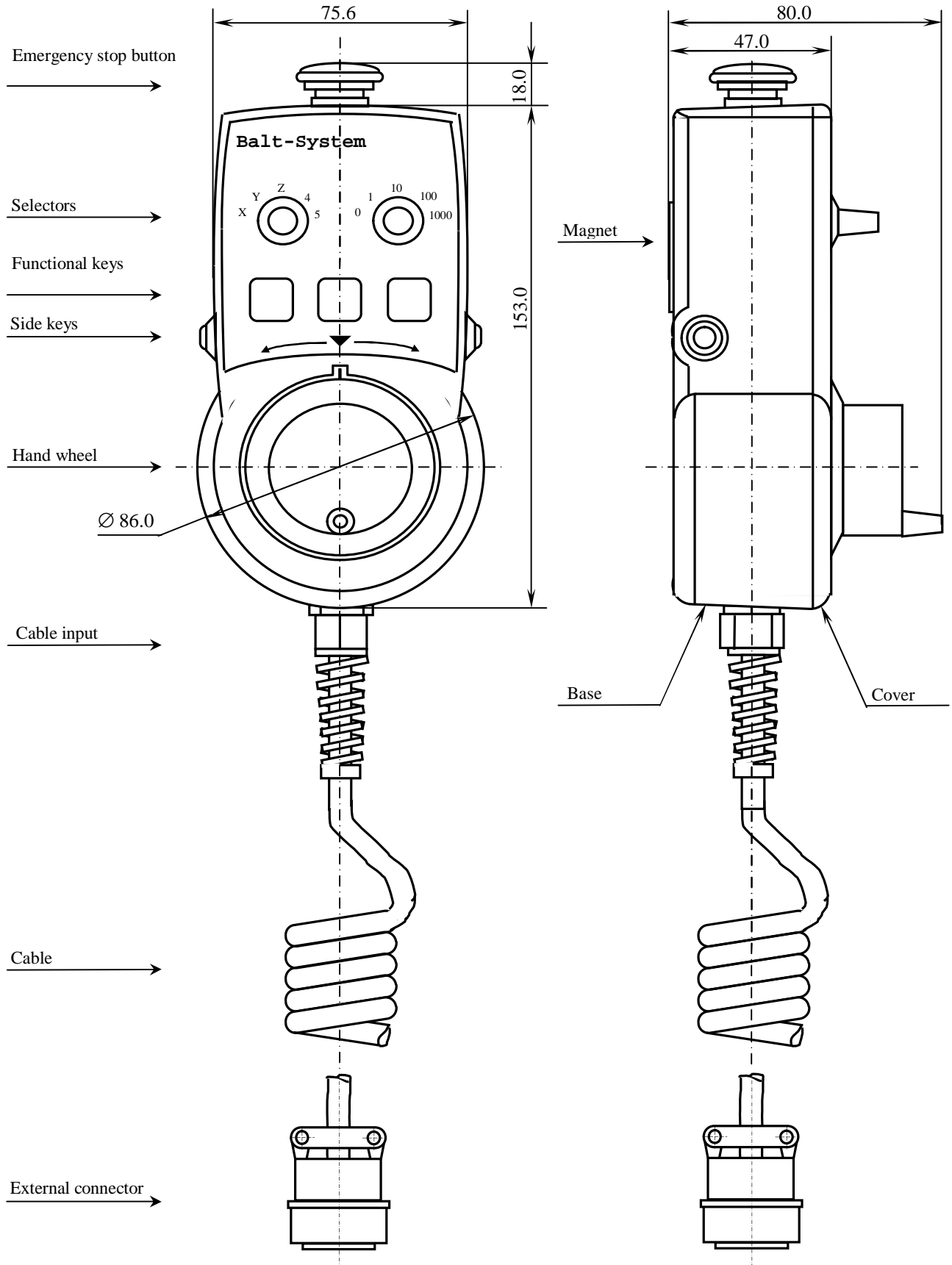


Figure E.4 – Basic Dimensions and Position of NC110-78B elements

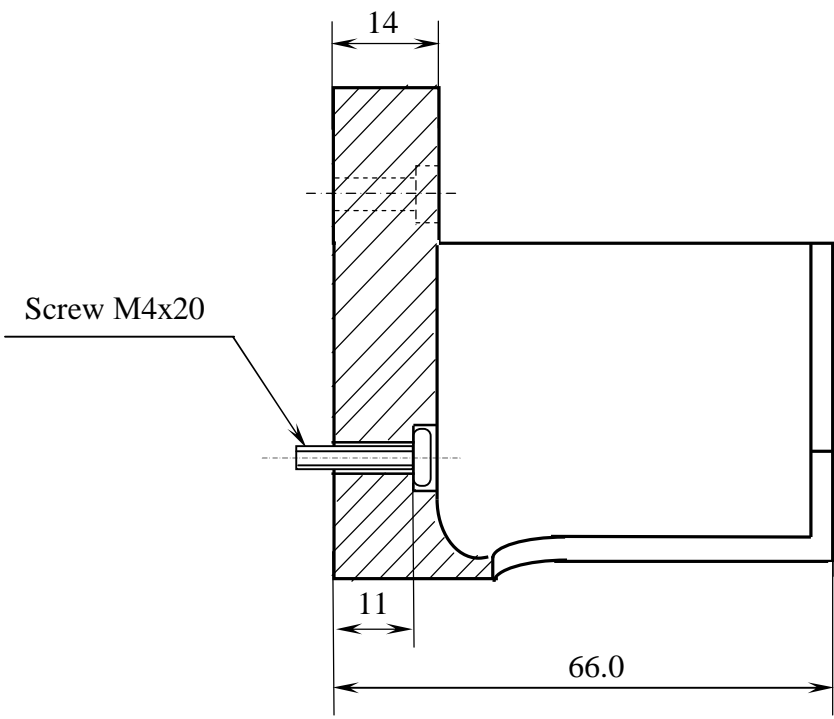
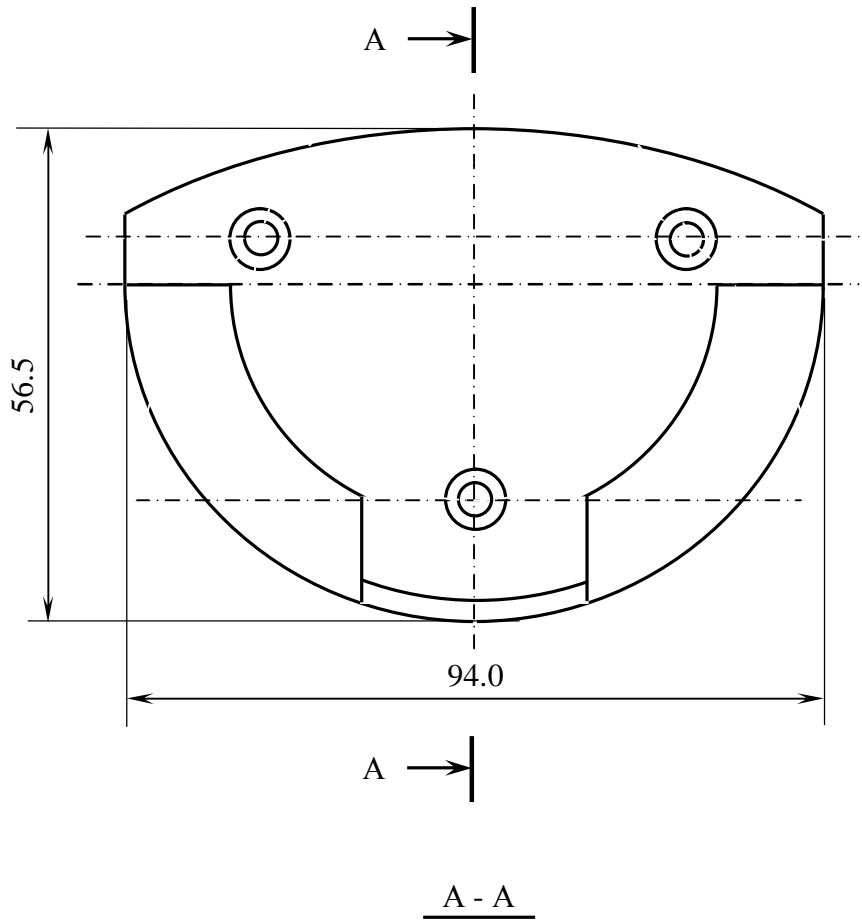


Figure E.5 – The Overall Dimensions of the HHPS NC110-78B Stand

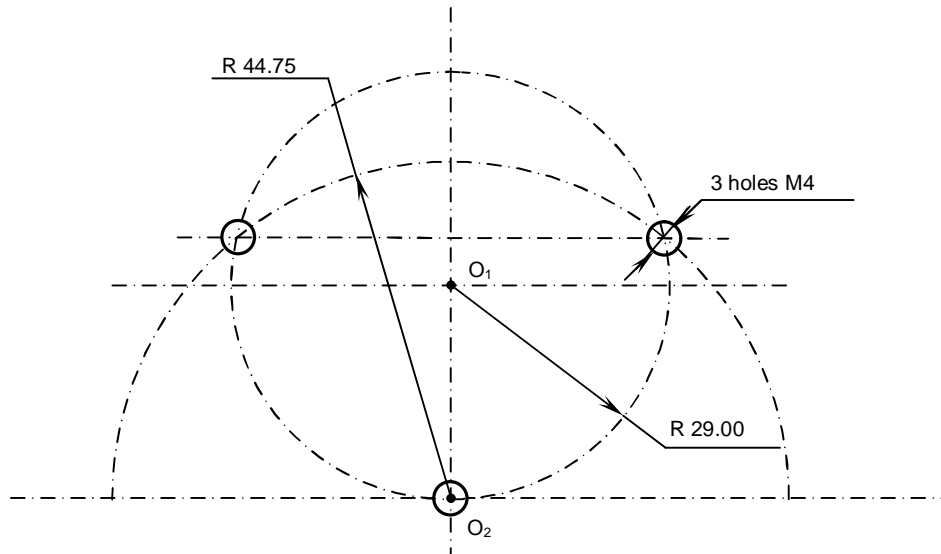


Figure E.6 – The Mounting Dimensions of the HHPS NC110-78B Stand

16 APPENDIX F (for reference) CNC UNIT CONNECTION DIAGRAM

16.1 The diagram for the connection of the CNC Unit to the machine is shown in Figure F.1.

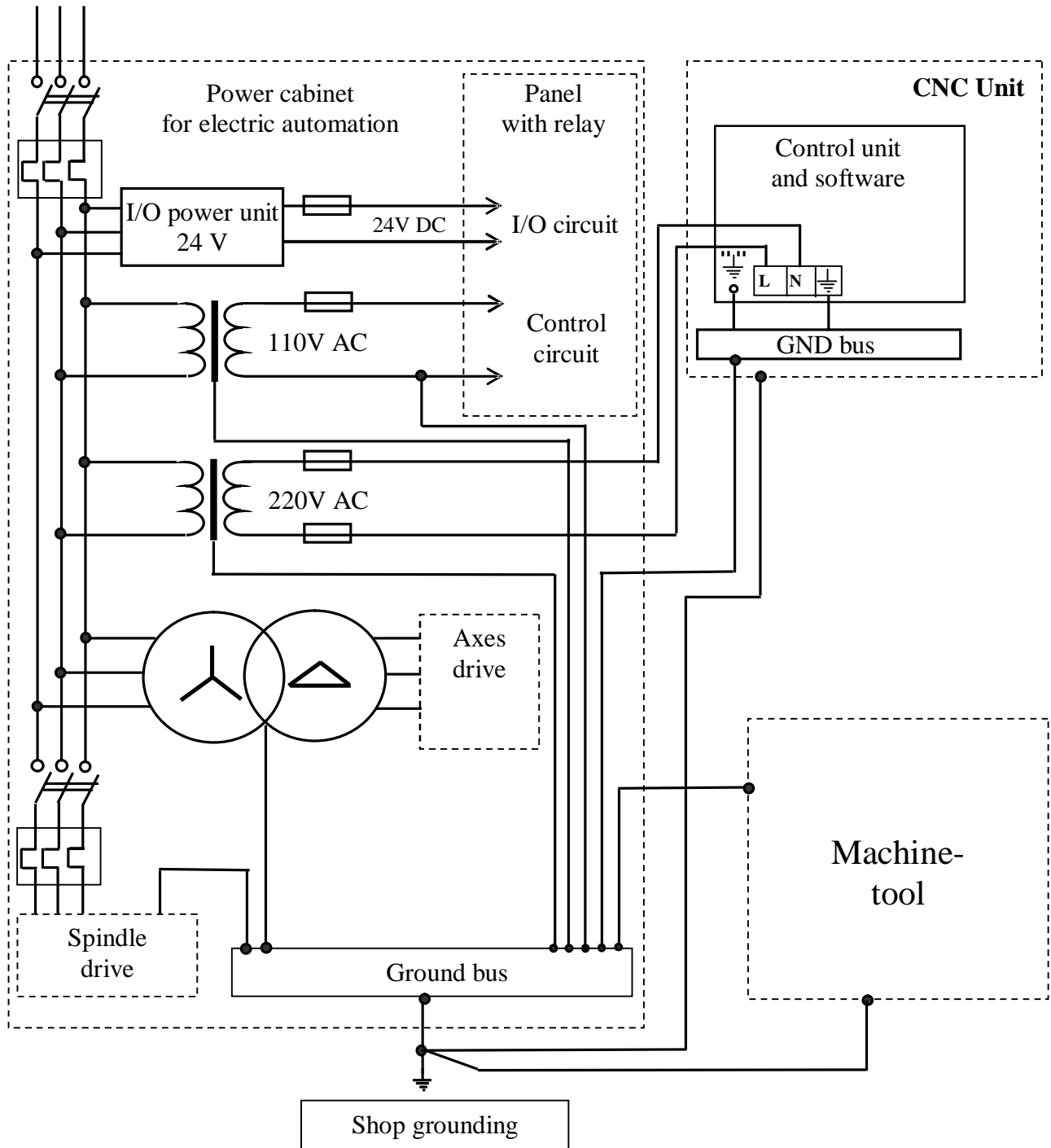


Figure F.1

