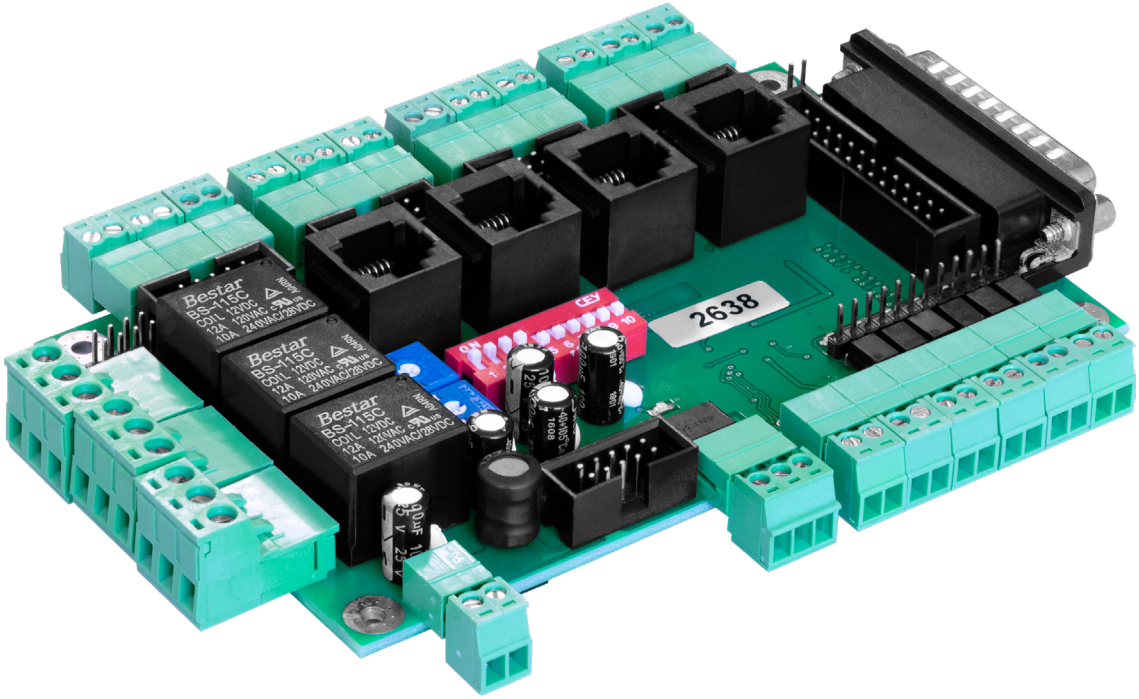
PUMOTIX

OPERATIONAL MANUAL

LPT BREAKOUT BOARD

PLC4X-G2



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1 General Information

PLC4x-G2 is a breakout board, which allows to convert a personal computer (PC) into a full-fledged control system of a CNC machine. The board is connected to LPT-port of a PC and translates control signals from LPT-port to stepper motor drivers.

PLC4x-G2 module allows to control 1…6 stepper/servo motor drivers with STEP/DIR/ENABLE interface. All control signals from LPT-port of a PC pass through buffered current amplifier element (current of each contact is reinforced to level 10 mA). Buffering of all LPT-port signals (inputs and output) completely prevents port failure, the module can be connected to any port with logical “1” of 3.3-5 V. The module has 6 optoisolated inputs for connection limit switches and E-STOP buttons.

The module supports operating with all stepper motor drivers and servo motor drivers of Purelogic R&D production, drivers of other manufactures.

Key features:

- device is compatible with PUMOTIX/MACH3/TurboCNC and similar CNC software;
- single power supply can be used for power supply of entire circuit, seamless start system;
- simultaneous control up to 6 stepper/servo motors drivers. 4 drivers are connected with help of special sockets (XP1, XP2, XP3, XP4 or XP9, XP10, XP11, XP12 or XP13, XP14, XP15, XP16), 2 drivers can be connected with help of expansion socket XP23;
- buffering control signals. All control signals from LPT-port of a PC pass through buffered current amplifier element (current of each contact is reinforced to level 10 mA). Buffering of all LPT-port signals (inputs and outputs) completely prevents port failure, the module can be connected to any port with logical “1” of 3.3-5 V;
- 6 optoisolated inputs for connection limit switches and E-STOP button;
- 5 signals are translated to LPT-port, 1 signal is used for forced turning off ENABLE;
- operating support with Charge Pump signal;
- built-in adjustable timer for coolant system pump commutation. Timer adjusts time and relay operation duration;
- control support of Variable Frequency Drive (VFD) (adjustment of spindle rotations, PWM voltage converter) by PWM signal of control program (PUMOTIX, Mach);
- built-in test generator of STEP and DIR signals;
- control of three high-current relays 6 A/250 V for commutation of supplementary CNC machine devices (spindles, coolant system pump or fan);
- stepper/servo motor drivers can be connected to the module with terminal socket, IDC-10 or RJ-45 type sockets;
- PLC4x-G2 can be connected to LPT-port with DB-25M or IDC-26 type standard socket;
- external duplication LEDs connection of relay operation and optoisolated is available;
- constant signals' transaction of inputs IN1-IN5 to the controlling program (PUMOTIX, MACH3/4) regardless the breakout board operation mode (functioning/failure) and the position of the hardware buttons E-STOP (IN6). Possibility to invert the ENB output signal and the E-STOP input signal (IN6).

2 Set of Delivery:

PLC4x-G2 breakout board – 1 pc.

3 Product Features and Specifications

Power supply voltage	12 V
Rated consumption current	200 mA
Control interface	LPT, STEP/DIR/ENABLE signals translation, compatibility with CNC programs (PUMOTIX, MACH3/4, etc.)
Frequency of control signals	1 MHz MAX
Quantity of inputs	6, opto-inputs (optocoupler, 1 KOhm, 30 V MAX)
Quantity of power outputs, relay	3, toggle, 6 A/250 V relay
ChargePump signal frequency	2-15 kHz
Built-in generators	STEP signal generator: 2 kHz ±20% DIR signal generator – 0.5 Hz ±20%
Parameters of coolant system pump timer	Operation frequency – 8...60 seconds Duration – 1...8 seconds
PWM -> voltage converter parameters	Uout = 0.5...9.5 V ± 5% (duty ratio Q = 0...1), at 10 V power supply of Variable Frequency Drive
Isolation resistance	500 MOhm
Operating temperature	0...50°C
Net weight	0.3 kg
Overall dimensions (Width x Height x Depth)	119 x 30 x 71 mm

ATTENTION!
Turn off power device before making any connections.
Power supply negative wire connection with ground (GND), housing and etc. is forbidden.

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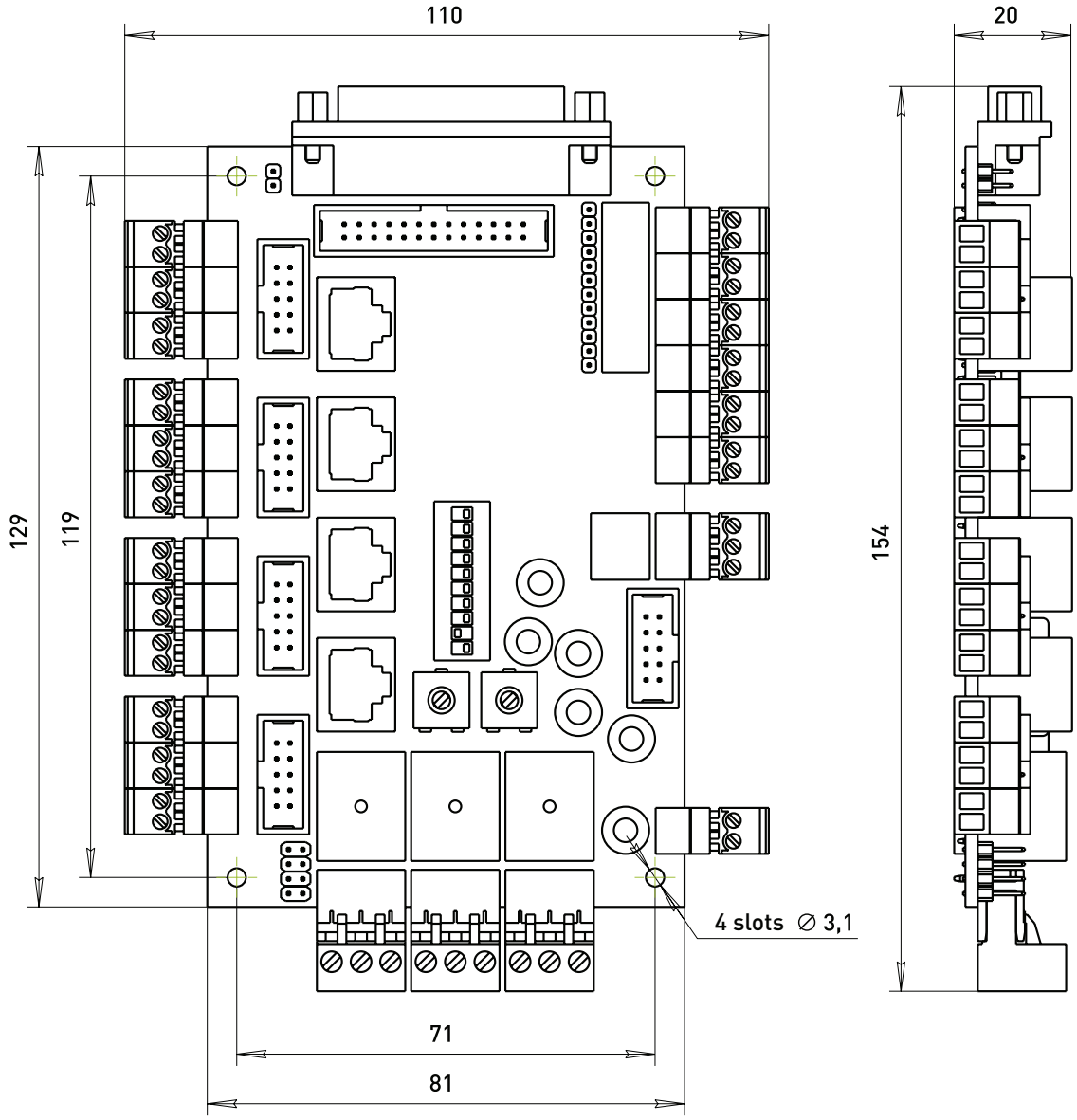

Fig. 1. PLC4x-G2 dimensions

4 CNC machine control with LPT connection

PC LPT-port has 12 outputs and 5 inputs lines. Accordingly control program (PUMOTIX/Mach3 type) can use only 12 lines for external devices control and 5 lines for receiving information by external sensors. For lines quantity increase it is necessary to mount on a personal computer additional LPT-port and additional module of PLC4x-G2 commutation.

For 1 stepper motor driver full-fledged control it is necessary to have 2 lines: STEP/DIR + common ENABLE for all stepper motor drivers. Therefore 5 stepper motor drivers (11 lines for STEP1...5/ DIR1...5 + common ENABLE) can be connected to LPT-port. 1 remained line is for external relay control.

If connection of 6 stepper motor drivers is required it is necessary to refuse ENABLE signal and relay signal. 12 lines are connected to STEP1...6/DIR...6.

If it's necessary to use 3 external relays, there will be 9 lines for stepper motor drivers control – it will be able to connect only 4 stepper motor drivers (STEP1...4/DIR1...4 + common ENABLE). Other combinations with 12 output lines are possible.

5 Purpose of the sockets, switches and indication

- **XP1**, **XP2**, **XP3**, **XP4** (terminal sockets) or **XP9**, **XP10**, **XP11**, **XP12** (IDC-10 type) or **XP13**, **XP14**, **XP15**, **XP16** (RG-45) – connection of stepper / servo motor drivers.
- **XP17**, **XP18**, **XP19** (terminal socket) – load relay connection RELAY1, RELAY2, RELAY3.
- **XP20** (IDC-26 type), **XP21** (DB-25M type) – control signals connection from LPT-port of PC.
- **XP22** (terminal socket) – connection of module supply voltage.
- **XP23** (IDC-10 type) – additional socket, on which signals are translated.
- **XP24** (terminal socket) – Variable Frequency Drive connection.
- **XP25**, **XP26**, **XP27**, **XP28**, **XP29**, **XP30** (terminal socket) – connection of external sensors and E-STOP button, optoisolated inputs.
- **XP5** – external LED of operation relay RELAY1, 1 "anode, +", 2 "cathode,-".
- **XP6** – external LED of operation relay RELAY2, 1 "anode, +", 2 "cathode,-".
- **XP7** – external LED of operation relay RELAY3, 1 "anode, +", 2 "cathode,-".
- **XP8** – external LED of ENABLE signal, 1 "anode, +", 2 "cathode,-".
- **XP31** – external LED of input activity IN1, 1 "anode, +", 2 "cathode,-".
- **XP32** – external LED of input activity IN2, 1 "anode, +", 2 "cathode,-".
- **XP33** – external LED of input activity IN3, 1 "anode, +", 2 "cathode,-".
- **XP34** – external LED of input activity IN4, 1 "anode, +", 2 "cathode,-".
- **XP35** – external LED of input activity IN5, 1 "anode, +", 2 "cathode,-".
- **XP36** – external LED of input activity IN6, 1 "anode, +", 2 "cathode,-".
- **HL1**, **HL4**, **HL7**, **HL10** – indication LEDs of STEP signal for X,Y, Z and A axes.
- **HL2**, **HL5**, **HL8**, **HL11** – indication LEDs of DIR signal for X,Y, Z and A axes.
- **HL3**, **HL6**, **HL9**, **HL112** – indication LEDs of ENABLE signal.
- **HL13**, **HL14**, **HL15** – indication LEDs of relay operation RELAY1, RELAY2, RELAY3.
- **HL17**, **HL18**, **HL19**, **HL20**, **HL21**, **HL22** – indication LEDs of inputs IN1, IN2, IN3, IN4, IN5 and IN6.

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PINS PURPOSE IN XP9, XP10, XP11, XP12:									
1	2	3	4	5	6	7	8	9	10
-STEP	+STEP	-DIR	+DIR	-ENB	+ENB	GND	+5V	GND	+5V

PINS PURPOSE IN XP20																									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
ENABLE	PWM	STEP1	IN5	STEP2	RL1	STEP3	RL2	STEP4	GND	DIR1	GND	DIR2	GND	DIR3	GND	DIR4	GND	IN1	GND	IN2	GND	IN3	GND	IN4	+5V

PINS PURPOSE IN XP21																									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
ENABLE	STEP1	STEP2	STEP3	STEP4	DIR1	DIR2	DIR3	DIR4	IN1	IN2	IN3	IN4	PWM	IN5	RL1	RL2	GND	GND	GND	GND	GND	GND	GND	GND	

PINS PURPOSE IN XP23:									
1	2	3	4	5	6	7	8	9	10
+12V	GND	+5V	GND	XP21 pin 1	IN6	XP21 pin 17	ENABLE	XP21 pin 14	XP21 pin 16

J1 – in case of closing operation, 26-th pin of XP20 socket is connected with +5V power line (it is used for external devices supply).

Timer adjustment of coolant system – R1 potentiometer sets operation duration, R2 potentiometer sets operation frequency.

Operating modes selection (all changes of switches positions require turned off power supply).

SW1 – “ON”: Charge Pump mode, “OFF”: ENABLE mode.

SW2 – “ON”: RELAY3 is controlled by signal of LPT-port pin 14 (PWM), “OFF”: RELAY3 is controlled by coolant system timer.

SW3 – “ON”: RELAY1 is turned on, RELAY1: is turned off.

SW4 – “ON”: RELAY2 is turned on, RELAY2: is turned off.

SW5 – “ON”: RELAY3 is turned on, RELAY3: is turned off.

SW6 – “ON”: STEP generator of X, Y, Z and A axes is turned on, “OFF”: STEP generator is turned off.

SW7 – “ON”: DIR generator of X, Y, Z and A axes is turned on, “OFF”: DIR generator is turned off.

SW8 – “ON”: forced ENABLE of X, Y, Z and A axes is turned on, “OFF”: forced ENABLE is turned off.

SW9 – “ON”: E-STOP (IN6) input signal is inverted, “OFF”: E-STOP (IN6) input signal is not inverted.

SW10 – “ON”: ENB output signal is inverted, “OFF”: ENB output signal is not inverted.

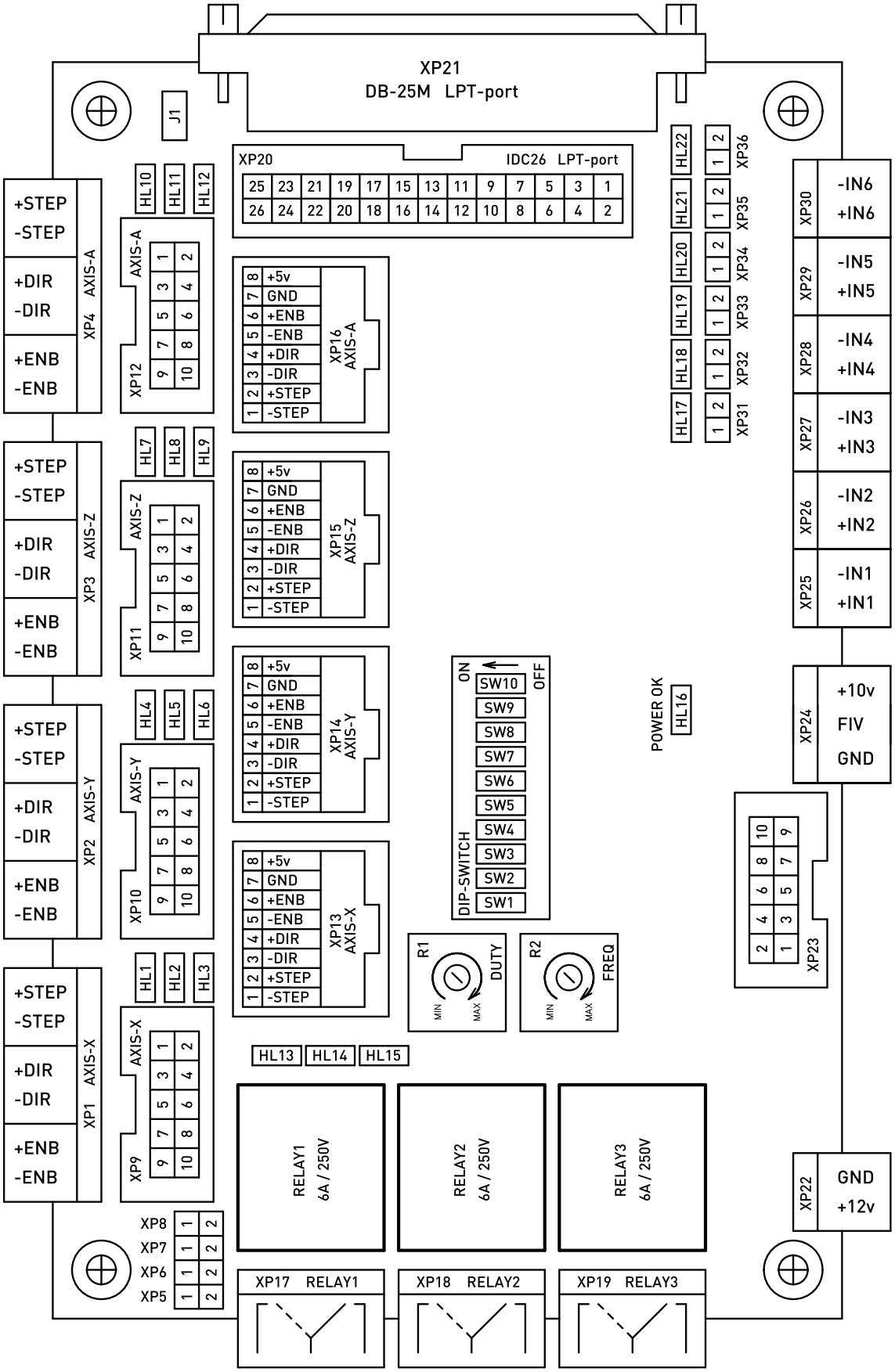

Fig. 2. Module connection

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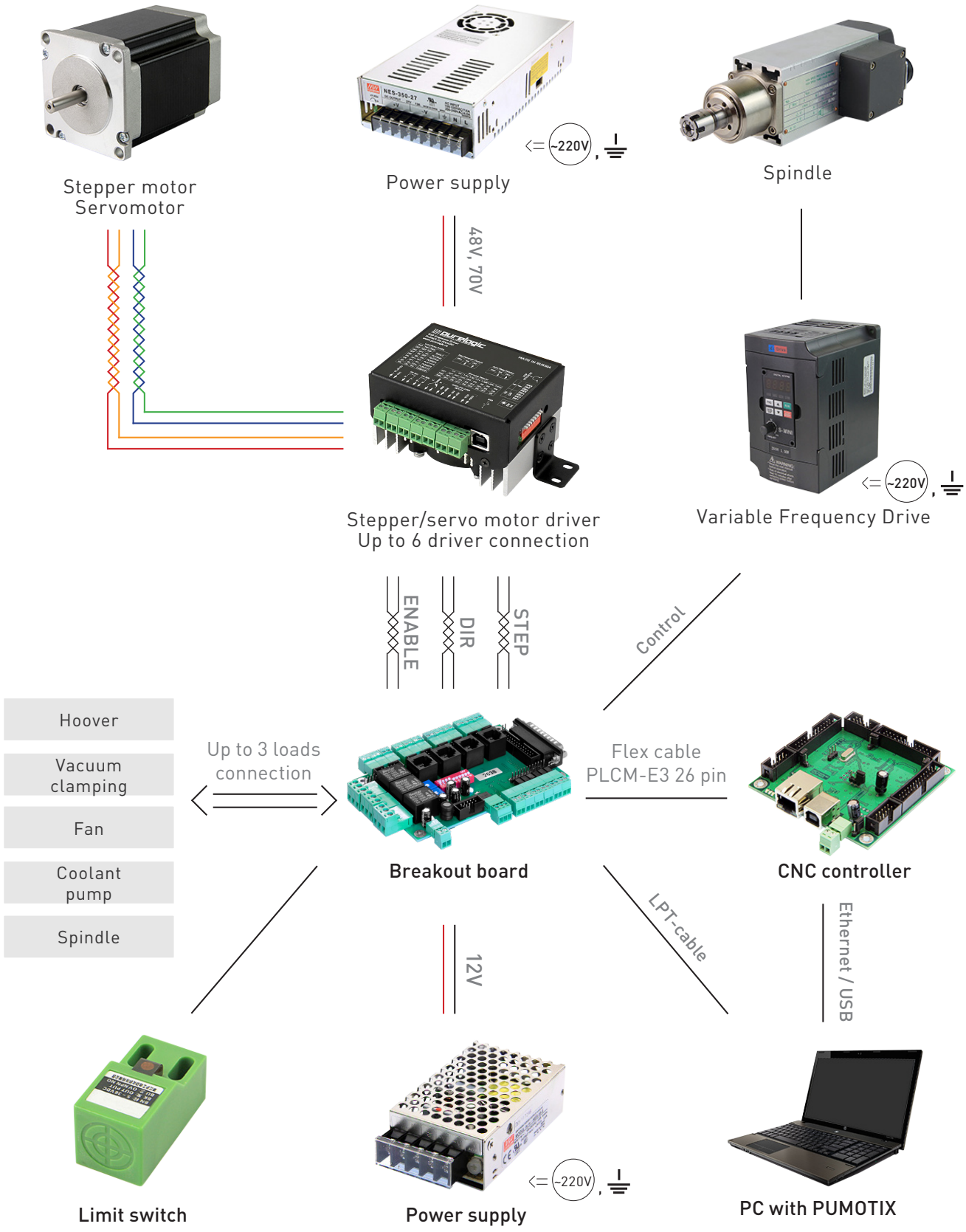

Fig. 5. General CNC control system diagram

6 Connection

Control signals connection

Module PLC4x-G2 translates control signals 1...4 STEP/DIR/ENABLE from LPT-port of a PC to stepper motor drivers. Every driver channel has own couple of STEP1/2/3/4 and DIR1/2/3/4 signals, ENABLE signal is common signal for all channels.

Switch SW10 allows to invert the ENB output signal. If SW10 is in the “ON” position (ENB is inverted), the green LEDs HL3, HL6, HL9, HL12 glow corresponds to the disabled stepper motor drivers. (Change the position of any dip-switches only when the power is off.) 2 stepper motor drivers can be additionally connected via expansion socket XP23 if it is necessary.

It is important to remember that LPT-port physically has 12 output lines and 5 input lines.

Charge Pump/ENABLE signals operation mode selection is accomplished by SW1 switch. Position OFF – driver operates in standard ENABLE signal mode (ENABLE = “1” turns on stepper motor drivers; if ENABLE = “0” stepper motor drivers are turned off).

Position ON – driver operates in Charge Pump signal/function mode (availability of frequency switches on stepper motor drivers; if frequency is absent, stepper motor drivers are switched off).

STEP/DIR/ENABLE signals are buffered. STEP/DIR/ENABLE signals are removed to DB-25M type socket XP21 (PC LPT-port) according to the fig. 2 for convenient connection to a PC LPT-port or any other device, which generates STEP/DIR/ENABLE signals. Also LPT-port connection is provided via XP20 pin connector type IDC-26 using flex cable (if it is necessary to remove socket at gauge board in module mounting process in the housing).

States of STEP/DIR/ENABLE signals are indicated by HL1-HL12 according to the fig. 2. External ENABLE LED connection is provided through XP8.

Forced injection ENABLE (for testing) mode is provided. Forced ENABLED signal is controlled by SW8 switch. “ON” – forced ENABLE signal is turned on, “OFF” – forced ENABLE signal is turned off.

STEP signal parameters – operating voltage 3...5 V, consumption current 0.1 мA.

DIR signal parameters – operating voltage 3...5 V, consumption current 0.1 мA.

ENABLE signal parameters – operating voltage 3...5 V, consumption current 0.1 мA.

Stepper motor drivers connection

Stepper motor drivers are connected to the module by using XP1, XP2, XP3, XP4 sockets (terminal sockets) or XP9, XP10, XP11, XP12 sockets (IDC-10 type) or XP13, XP14, XP15, XP16 sockets (type RG-45) according to the fig. 2. Drivers are connected to module according to the circuit with common “+”. In this case it is +5V. If it is necessary, you can additionally connect 2 stepper motor drivers through expansion socket XP23. It is important to remember that LPT-port physically has 12 output lines and 5 input lines.

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Power supply connection

PLC4x-G2 needs to be supplied by separate power supply 12 V voltage (DC, for example, S-15-12 or power line of 12 V PC power supply). Power supply is connected to the socket XP22 (according to the fig. 2). Connection polarity is important.

Limit switches connection

PLC4x-G2 has 5 inputs for limit switches connection – IN1/IN2/IN3/IN4/IN5 and ENABLE forced turning off input IN6. Physically each input is an optocoupler with built-in transition resistor (1 KOhm, depending on sensor type and sensor supply voltage, resistance increase is probably required). Such formation of optoisolated inputs allows to connect any sensors to a driver and provides a driver with isolation from sensors.

States of all optic inputs (IN1/IN2/IN3/IN4/IN5) are translated to LPT-port and are indicated by HL17-HL21 LEDs (according to the fig. 2). External LEDs can be connected via XP31-XP36.

Simple contact limit switches (buttons) and noncontact sensors (inductive, capacitive) of PLL01 type (inductive noncontact sensor) with alarm signal output can be connected to the PLC4x-G2 module. Connection is accomplished according to the fig. 3. Separate power supply unit with necessary voltage is strongly recommended to be used for sensors supply. 12 V module supply can be used in an extreme case (in this case optic isolation will not take place.

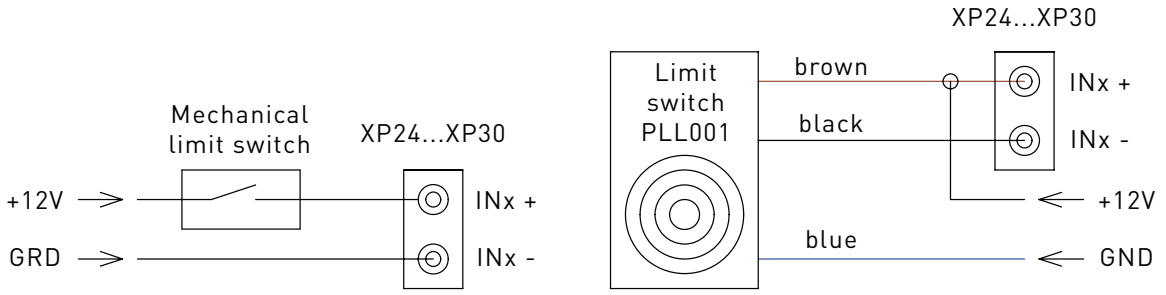

Fig. 4. Limit sensors connection

RELAY1/2/3 relay loads connection

PLC4x-G2 controls 3 high-current relays RELAY1/2/3 for commutation of CNC additional devices (spindle, coolant pump or fan). States of relays are indicated by using HL13-HL15 according to the fig. 2. Relay loads are connected to the XP17...XP19 pins. Connection of external indication LEDs for relay operation through XP5-XP7 is available.

ENABLE = “1” signal turns on RELAY1/2/3 relay control. If ENABLE = “0” relay control is disabled and relays are established in initial position according to fig. 2.

Relays1/2/3 are controlled by LPT-port signals according to the fig. 2. Logic “1” is supplied to compliant LPT-port pins – relay is enabled (LEDs HL13...HL15 are switched on). Logic “0” is supplied to compliant LPT-port pins – relays are turned off (LEDs HL1...HL3 are switched off).

As control pins of LPT-port have dual purpose (pins don’t only control relay, but pins can also control stepper motor driver control), therefore there are control signals physical disconnecting from each relay. Disconnecting is accomplished by using the jumpers SW3, SW4, SW5. We recommend to disconnect relay control if you are not going to use it.

RELAY3 can be controlled by signal from pin 14 (PWM) of LPT-port or coolant system timer. Mode selection is accomplished by switch SW2 (“ON” RELAY3 is controlled by signal from pin 14 (PWM) of LPT-port, “OFF” RELAY3 is controlled by coolant system timer).

7 Commutation timer of coolant system pump

PLC4x-G2 has built-in commutation timer of coolant system pump. Timer controls turning on/turning off RELAY3. Timer is adjusted by using R1, R2 potentiometers according to the fig. 2. Physically, coolant system timer is (an) independent timer, which can be connected/disconnected to RELAY3 relay control by using SW2 switch. “ON – RELAY3 is controlled by using the signal of LPT-port pin 14 (PWM), “OFF” – RELAY3 is controlled by using the coolant system timer.

Frequency of RELAY3 relay turning on is adjusted by using trimming resistor R2 (frequency). Relay holding duration in turned on position is adjusted by using trimming resistor R1 (on-off time ratio).

8 E-STOP function

E-STOP input IN6 (XP30) is an optocoupler with a built-in transition resistor (1 KOhm, depending on sensor type and sensor supply voltage the increase in resistance is probably required). When a signal is applied to this input, the ENABLE = "0" signal is forcibly set, stepper motor drivers and relays are disabled. Switch SW9 allows you to invert the signal from the E-STOP input (IN6). If SW9 is in the “ON” position (the signal of the E-STOP input is inverted), the red LED HL22 illuminates in normal operation.

9 PWM → voltage converter

PLC4x-G2 has built-in PWM → voltage converter, which transforms control signal on-off time ratio to voltage – duty ratio Q=0...1 → voltage U=0.5..9.5 V. Converter is used for Variable Frequency Drive (VFD), to which spindle is connected (it allows to change spindle rotations by CNC control program using electronic method).

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The converter is optoisolated from module and is supplied from VFD. Standardly VFD has 3 pins of converter connection – 10 V supply voltage, GROUND and voltage 0...10 V input VFD (proportionally to which spindle rotation frequency is changing).

PWM VFD control signal is generated by using a CNC control program (PUMOTIX, MACH3/4) and is supplied to compliant LPT socket pins (14 pin, PWM).

10 Built-in generator of STEP and DIR signals

PLC4x-G2 has built-in generator of STEP and DIR signals (for CNC testing and adjustment).

STEP and DIR signals are supplied in process of turning on generators to compliant pins of XP1, XP2, XP3, XP4 sockets (terminal sockets), XP9, XP10, XP11, XP12 sockets (type IDC-10), XP13, XP14, XP15, XP16 (type RG-45) according to fig. 2. Generators are controlled by using SW6 and SW7 switches.

SW6: “ON” – X, Y, Z and A axes STEP generator is turned on, “OFF” – STEP generator is turned off.

SW7: “ON” – X, Y, Z and A axes DIR generator is turned on, “OFF” – DIR generator is turned off.

11 Warranty

Warranty service period is 12 months from purchase date. The warranty is valid only in case of observance of operational and preventive maintenance conditions.

1. General provisions

1.1. If Goods are purchased as components Seller guarantees operability of each component but is not responsible for quality of their joint operation (improper selection of components). If you have any questions, contact our technical specialists for technical assistance.

1.2. Seller is not guarantee compatibility of purchased Goods with Buyer components or Goods purchased from the third parties.

1.3. Article parameters and scope of delivery are subject to change by Manufacturer without notice due to constant technical improvement of products.

2. Warranty service acceptance criteria

2.1. Goods are accepted for Warranty service in the same configuration as they have been purchased.

3. Warranty service procedure

3.1. Warranty service is provided by testing (checking) of Goods declared defects.

3.2. Warranty repair is performed after defect confirmation.

4. Warranty does not cover glass, electric lamps, starters and consumables and also:

4.1. Goods with damages due to improper transportation and storage conditions, misconnection, off-design operation or conditions that are not specified by Manufacturer (including excess temperature and humidity), damages due other conditions (power supply voltage surges, natural disasters etc) and having mechanical and thermal damages.

4.2. Goods with effects of impact and/or entry of foreign matters, objects (including dust), liquids, insects and having foreign signs.

4.3. Goods with signs of unauthorized access and/or repair (signs of opening, crude soldering, element replacement etc.)

4.4. Goods with self-diagnostics indicating improper operation conditions.

4.5. Technically complex Goods which erection, assembling and commissioning works are performed by other specialists but not specialists of Seller or companies recommended by Seller except cases directly specified by Goods documentation.

4.6. Goods that operation is performed under conditions when electric power supply does not correspond to Manufacturer requirements and in absence of equipment and network electric protection devices.

4.7. Goods that have been resold by initial Purchaser to the third persons.

4.8. Goods with defects occurred as a result of use of poor quality or exhausted spare parts, consumables, accessories and in case of use of spare parts, consumables, accessories that are not recommended by Manufacturer.

It was manufactured and accepted in accordance with mandatory requirements of the applicable technical documentation and deemed ready for operations.

Batch No.: QCD:

We draw your attention to the fact that there can be some changes in this instruction due to the product consistent technical improvement. You can always download our latest versions at pumotix.com

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