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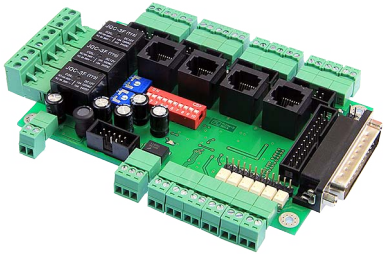
User manual



PLC4x-G2

LPT breakout board

CONTENTS:

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1. GENERAL INFORMATION

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

PLC4x-G2 module allows to control 1 ... 6 step/servo motor drivers with STEP/DIR/ENABLE interface.

All control signals from LPT-port of 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" 3.3-5 V. The module has 6 optoisolated inputs for connection limit switches and E-STOP buttons. Terminal sockets and RJ-45 type sockets for connection limit switches, load relays, supply voltage and step motor drivers are mounted in module.

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

2. DELIVERY SET

- PLC4x-G2 controller – 1 pcs
- PLC4x-G2 User manual – 1 pcs

3. TECHNICAL SPECIFICATIONS

Supply voltage	12V
Maximum consumption current	200 mA
Control interface	LPT, STEP/DIR/ENABLE signals translation, compatibility with CNC programs (for example MACH3)
Frequency of control signals	1 mHz MAX
Quantity of inputs	6, opto-inputs (optocouple, 1 Kohm, 30V MAX)
Quantity of power outputs, relay	3, toggle, 6A/250V relay
Frequency of ChargePump signal	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	Vout = 0 ... 9.5V (duty ratio Q = 0 ... 1) at 10v power supply
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

TURN OFF POWER DEVICE BEFORE MAKING ANY CONNECTIONS

CONNECTION NEGATIVE WIRE OF POWER SUPPLY WITH GROUND (GND), HOUSING AND ETC. IS FORBIDDEN

4. KEY FEATURES

• Device is compatible with 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 step/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 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" 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 operation relay duration.

• Control support of frequency converter (adjustment of spindle rotations, PWM voltage converter) by PWM signal of control program (Mach).

• Test built-in generator of STEP and DIR signals.

• Control of three high-current relays 6A/220V for commutation of supplementary CNC machine devices (spindles, coolant system pump or electro ventilator).

• Step/servo motor drivers can be connected to the module with terminal socket, IDC-10 or RJ-45 type sockets.

• PLC4x 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.

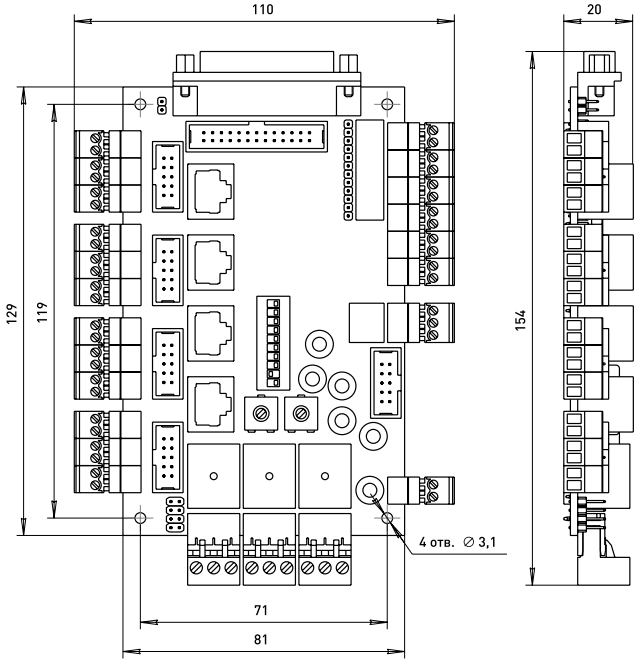

Fig. 1. PLC4x-G2 dimensions

5. CNC MACHINE CONTROL WITH LPT CONNECTION

PC LPT-port has 12 outputs and 5 inputs lines. Accordingly control program (type Mach3) 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 in personal computer additional LPT-port and additional module of PLC6x commutation.

For 1 step motor driver full-fledged control it is necessary to have 2 STEP/DIR lines + common ENABLE for all step motor drivers. Therefore 5 step 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 step motor drivers is required it is necessary to refuse ENABLE signal and relay signal. 12 lines are connected to STEP1...6/DIR...6.

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

6. 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) –** drivers connection of step motor and servo motor;
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) – frequency converter 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.

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, **SW10** are not used.

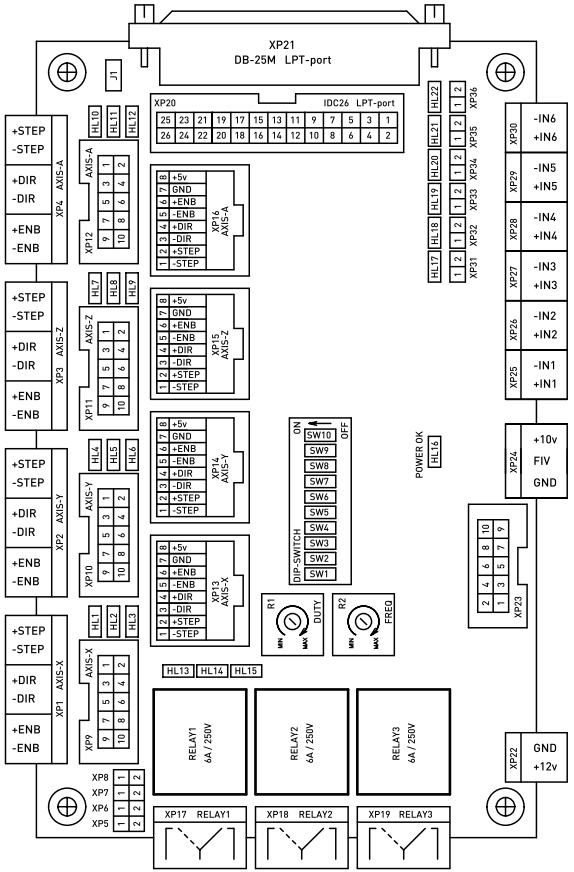

Fig.2. Module connection

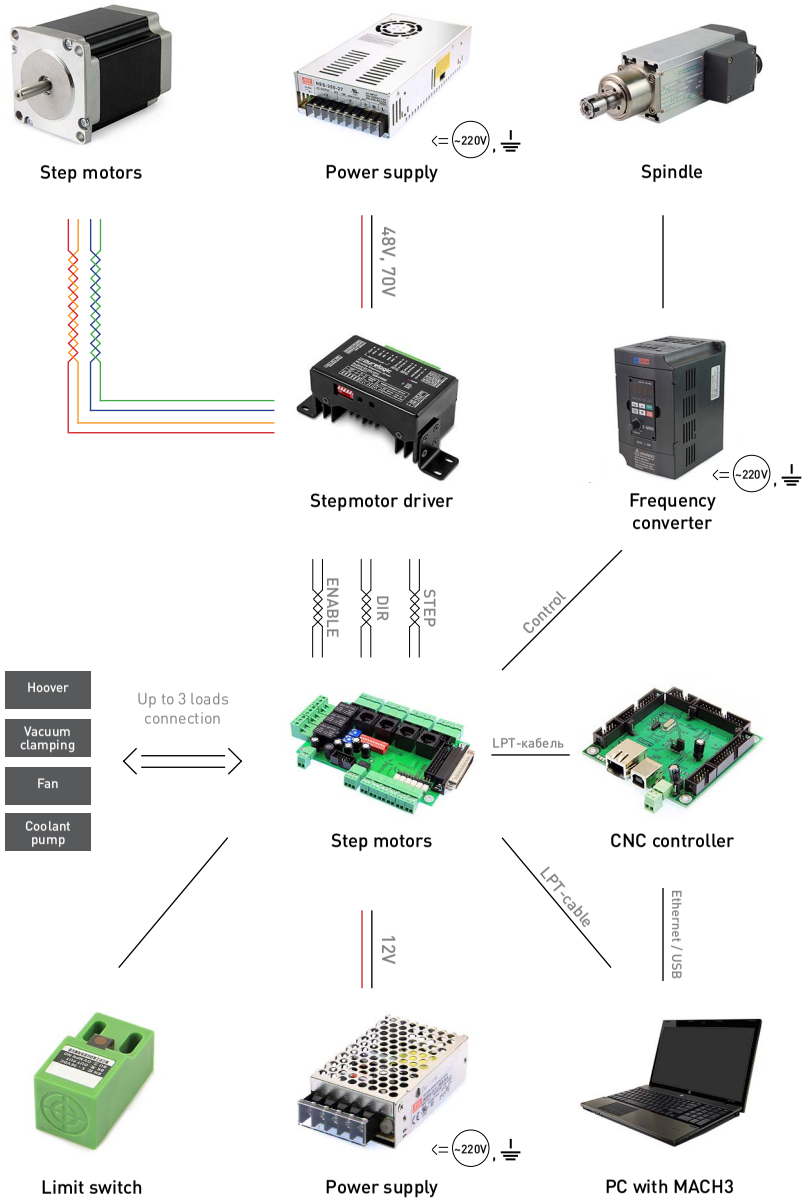

Fig. 3. General CNC control system diagram

7. CONNECTION

Control signals connection

Module PLC4x-G2 translates control signals 1...4 STEP/DIR/ENABLE step motor drivers from LPT-port of PC to step motor drivers. Any channel driver has own couple of STEP1/2/3/4 and DIR1/2/3/4 signals, ENABLE signal – common signal for all channels. 2 step motor drivers can be additionally connected through expansion socket XP23 if it is necessary. It is important to remember that LPT-port physically has 12 output lines and 5 input lines.

Operation mode selection of module with Charge Pump/ENABLE signals is accomplished by SW1 switch. Position OFF – driver operates in standard ENABLE signal mode (ENABLE = "1" turns on step motor drivers; if ENABLE = "0" step motor drivers are turned off).

Position ON – driver operates in Charge Pump signal/function mode (availability of frequency switches on step motor drivers; if frequency is absent, step 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 fig.2 for convenient connection to PC LPT-port or any other device, which generates STEP/DIR/ENABLE signals. Also LPT-port connection is provided through XP20 pin connector type IDC-26 using loop (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 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...5V, consumption current 0.1 мА.

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

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

Step motor drivers connection

Step 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 fig.2. Drivers are connected to module according to circuit with common "+". In this case it is +5V.

It is necessary to connect additionally 2 step motor drivers through expansion socket XP23.

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

Power supply connection

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

Limit switches connection

PLC4x-G2 has 5 inputs for limit switches connection – IN1/IN2/IN3/IN4/IN5 and forced turning off input IN6 (for forced turning off ENABLE). Physically each input is optocouple with built-in transition resistor (1 KOhm, depending on sensor type and sensor supply voltage the increase in resistance is probably required). Such creation of optoisolated inputs allows to connect any sensors to driver and provides driver optoisolated 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 fig.2).

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

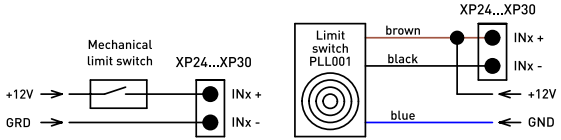

Fig.4. Limit sensors connection.

RELAY1/2/3 relay loads connection

PLC4x-G2 provides control 3 high-current relays RELAY1/2/3 for commutation of CNC additional devices (spindle, coolant pump or electro ventilator). States of relays are indicated by using HL13-HL15 according to fig.2. Relay loads are connected to 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.

Relays K1, K2, K3 is controlled by LPT-port signals according to 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 step 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).

8. 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 fig.2.

Physically, coolant system timer is independent timer, which can connect/disconnect 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) (on-off time ratio). Relay holding duration in turned on position is adjusted by using trimming resistor R1 (on-off time ratio).

9. E-STOP FUNCTION

E-STOP (XP4) input – optocouple with built-in transition resistor (1 KOhm, depending on type of the sensor and sensor supply voltage the increase of resistance is probably required). Forced setting signal ENABLE = "0" is happen in case injection to E-STOP (XP4) input. Step motor drivers and relays are turned off.

10. PWM → VOLTAGE CONVERTOR

PLC4x-G2 has built-in PWM → voltage convertor, which transforms control signal on-off time ratio to voltage – on-off time ratio Q=0...1 → voltage U=0...9V.

Convertor is used for frequency transformer control (FT, inverter), to which is connected spindle (it allows to change spindle rotations by CNC control program using electronic method).

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

PWM FT control signal is generated by using CNC control program (MACH3) and is supplied to compliant LPT socket pins (14 pin, PWM).

11. BUILT-IN GENERATOR OF STEP AND DIR SIGNALS

PLC4x-G2 has built-in generator of STEP and DIR signals (for CNC testing and CNC 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" – STEP generator at X, Y, Z and A axes is turned on, "OFF" – STEP generator is turned off.

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

Pay attention that documentation can be changed due
to constant technical upgrading of production.
You can download last versions from **www.purelogic.ru**

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