PLC440L
Multichannel stepper motor driver

INSTRUCTION MANUAL

! Check www.purelogic.ru for more information.

01   General information

PLC440L is a modern and available microstepping multichannel driver of stepper motors.
The driver has inbuilt protection coils from coil short-circuit and back EMF effect protection, softstarter, dumper, STEP frequency generator.
The driver works with standard control protocol STEP/DIR/ENABLE .
All driver's control inputs are optoisolated and logic levels 2.5V, 3.3V, 5V compatible.
The module is AUTO-SLEEP mode supplied which is turned on when there is no STEP signal.
The multichannel driver supports control of frequency converter.
The device is optimal for control of bipolar and unipolar Purelogic R&D stepper motors PL42/PL57 series Work with other stepper motors is also possible.

02   Delivery set

• Multichannel driver PLC440L — 1 pcs.
• LPT-cable — 1 pcs.
• Instruction manual — 1 pcs.
• CD with software — 1 pcs.

Technical features   03

Control method	STEP/DIR/ENABLE from LPT port
Supply voltage	18...40V (bogey value 35V)
Operating current of each stepper motor	1A...4A
Step division (microstep)	1:2, 1:8, 1:10, 1:16, 1:20, 1:32, 1:40, 1:64
STEP Max signal frequency	280 kHz
Max shaft rotation frequency	100 cycles per second or 6000 cycles per minute (PL57H76, 40V, step division 1:8, 160 kHz)
Number of inputs	5 inputs, 1 E-STOP (opto-coupler, 1 kOhm, 30V MAX)
Number of power outputs, relays	3, changeover, relay 6A/250V
Timer parameters of lubricoolant control	Operation frequency – 2...80 sec Duration – 5...95% from frequency
PWN converter parameters>voltage	Uoutp. = 0...9.5V (when changing pulse Frequency converters control ratio Q=0...1) Power 10V from frequency convertor
Inbuilt generators	STEP signal generator - 2 kHz ±20% DIR signal generator – 0.5 kHz ±20%
Isolation resistance	500 MOhm
Operating temperature	0...60 °C
Net weight	0,6 kg
Overall dimensions (W x H x D)	215 x 130 x 56 mm

TURN OFF POWER DEVICE BEFORE MAKING ANY CONNECTIONS AND DRIVER OPERATION MODE CHANGINGS.
DO NOT MOUNT THE POWER SWITCH AFTER THE POWER SOURCE (ON THE DRIVER POWER LINE).
POWER SWITCH SHOULD BE INSTALLED BEFORE POWER SUPPLY, AT ~220V SIDE.
DO NOT CONNECT POWER SUPPLY'S «−» TO GROUND, MASS, HOUSING, ETC.
STRICTLY OBSERVE THE POLARITY OF POWER SUPPLY AND CONTROL SIGNALS CONNECTIONS.

04 Driver functional capabilities

• Optoisolation of module control signals STEP/DIR/ENABLE.
• Operation in STEP/DIR mode (MACH3, Linux, CNC via LPT or controller series PLCM USB/Ethernet).
• Inbuilt test generator of STEP signal (~2 kHz) and DIR (~0,5 kHz).
• AUTO-SLEEP mode, driver after 1 sec standstill (lack of STEP signal) automatically enters rotor hold mode (full/half operating current) for heating reduction.
• Coil short-circuit module protection, wrong stepper motor connection protection.
• Protection against back EMF effect.
• Protection against overheating (temperature sensor).
• Inbuilt dumper.
• Control of 3 high current relays 7A/220V for commutation of additional devices of a machine (spindle, coolant pump or electric fan).
• Operation support with Charge Pump signal.
• Relay modes option, indication of relay operation.
• Inbuilt regulated timer (time and relay operation duration are regulated) for a coolant pump commutation.
• Operation support of frequency converter (regulation of spindle rotation, PWN converter>voltage), from PWN signal from MACH3.
• Control of 5 external sensors state (limit switches) All the inputs are optoisolated, indication of sensors operation.
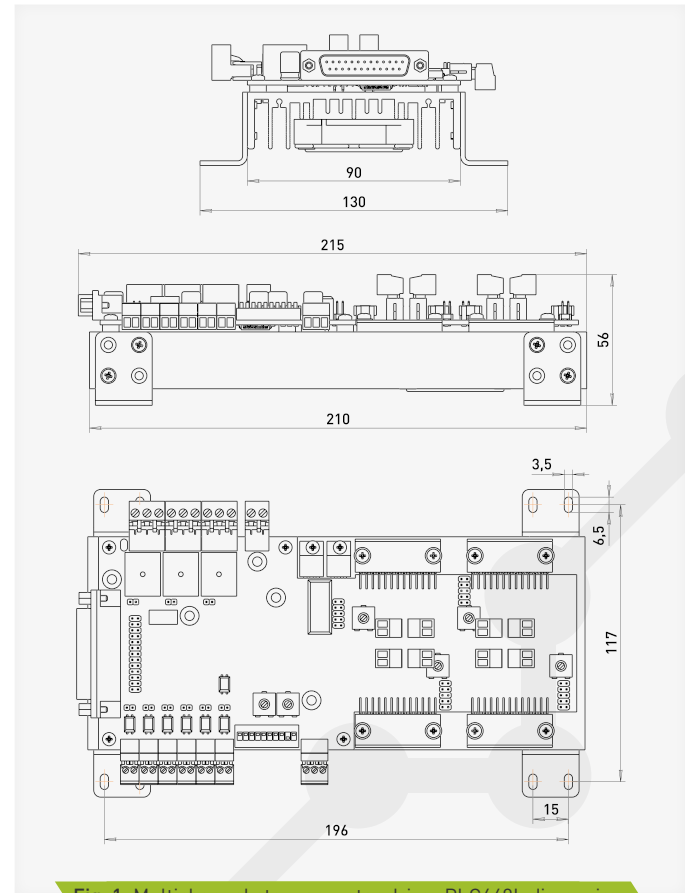

Fig. 1. Multichannel stepper motor driver PLC440L dimensions

• Convenient dismountable clip connectors to step motor, power source and relay loads.

LPT PC port connection is provided via standard adapter DB-25M and also male connector with use of a tail (if it is necessary to have the adapter on instrumentation panel when mounting the module in housing).

05 Connectors, switches and indication assignment

XP23 – clip connector of driver power supply.
XP20, XP21, XP22 – clip connectors of loads connection RELAY1, RELAY2, RELAY3.
XP3, XP4, XP5, XP6, XP7, XP8 – clip connectors of input signals connection.
XP24 – clip connector of frequency converter connection.
XP25, XP26; XP27, XP28; X29, XP30; X31, XP32 – clip connectors of stepper motor connection.
XP15, XP16 – connectors for fans connection.
JX1, JX2, JX3, JX4 – contacts of stepper motor operation mode switch-overs.

XP14 – external LED of activity input E-Stop.
XP13 – external LED of activity input IN1.
XP12 – external LED of activity input IN2.
XP11 – external LED of activity input IN3.
XP10 – external LED of activity input IN4.
XP9 – external LED of activity input IN5.
XP17 – external LED of RELAY1 operation .
XP18 – external LED of RELAY2 operation.
XP19 – external LED of RELAY3 operation.

LED6 – activity LED of input E-Stop.
LED5 – LED of activity input IN1.
LED4 – LED of activity input IN2.
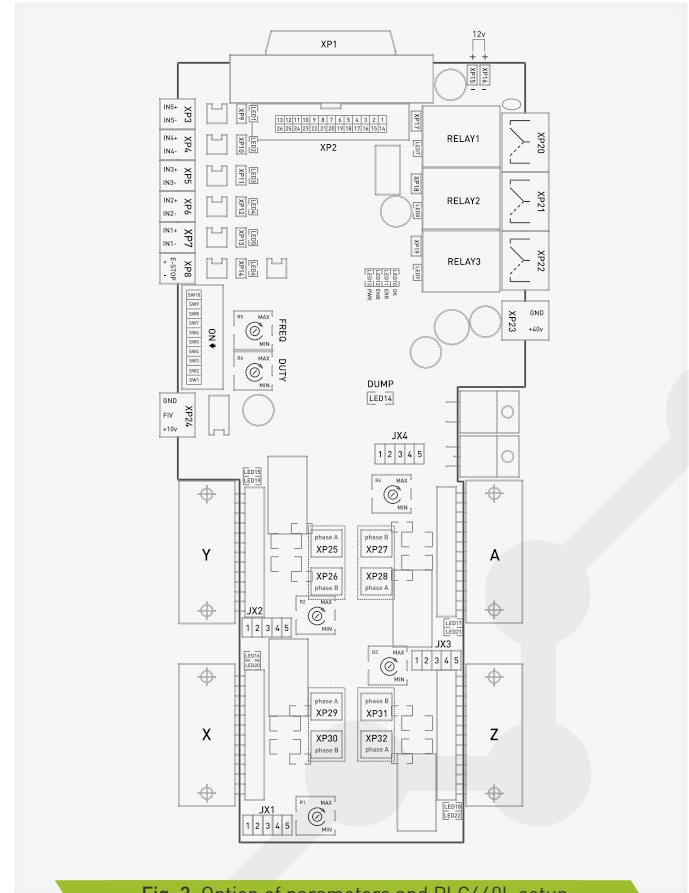LED3 – LED of activity input IN3.

Fig. 2. Option of parameters and PLC440L setup

LED2 – LED of activity input IN4.
LED1 – LED of activity input IN5.

LED7 – LED of operation RELAY1.
LED8 – LED of operation RELAY2.
LED9 – LED of operation RELAY3.
LED15, LED16, LED17, LED18 – indication LED of STEP signal of X, Y, Z and A axes.
LED19, LED20, LED21, LED22 – indication LED of DIR signal of X, Y, Z and A axes.
LED10 – indication LED of driver being ready for work.
LED11 – indication LED of an error.
LED12 – indication LED of ENABLE signal.
LED13 – indication LED of power.
LED14 – indication LED of dumper operation.

R1 – trimming resistor for stepper motor working current regulation of axis X.
R2 – trimming resistor for stepper motor working current regulation of axis Y.
R3 – trimming resistor for stepper motor working current regulation of axis Z.
R4 – trimming resistor for stepper motor working current regulation of axis A.
R5 – trimming resistor for operation frequency regulation of relay control of lubricoolant.
R6 – trimming resistor for regulation of relay operation delay of lubricoolant control.

SW1-SW10 – switch-overs for driver operation modes change.
SW1 – "ON" mode Charge Pump, "OFF" mode ENABLE.
SW2 – "ON" relay RELAY3 is controlled by a signal from contact 14(PWM)
LPT-port, "OFF" relay RELAY3 is controlled by coolant timer.
SW3 – "ON" relay RELAY1 is on, "OFF" relay RELAY1 is off.
SW4 – "ON" relay RELAY2 is on, "OFF" relay RELAY2 is off.
SW5 – "ON" relay RELAY3 is on, "OFF" relay RELAY3 is off.

SW6 – "ON" generator STEP on axis X, Y, Z and A is on, "OFF" generator STEP is off.
SW7 – "ON" generator DIR on axis X, Y, Z and A is on, "OFF" generator DIR is off.
SW8 – "ON" forcible ENABLE is on, "OFF" forcible ENABLE is off.
SW9 – "ON" signal E-STOP (input XP1) is transmitted to pin 10 LPT-port.
SW10 – is not used.

Contacts assignment in XP1

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	IN4	IN2	IN3	PWM	IN5	RL1	RL2	GND	GND	GND	GND	GND	GND	GND	GND	NC

Contacts assignment in XP2

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	IN4	IN2	IN3	PWM	IN5	RL1	RL2	GND	GND	GND	GND	GND	GND	GND	GND	

Connection   06

Control signals connection
Multichannel driver PLC440L controls 4 stepper motors using standard signals STEP/DIR/ENABLE (there is a possibility of connecting additional external 2 drivers).
The driver of every channel has its couple of signals STEP1/2/3/4 and DIR1/2/3/4 and signal ENABLE is mutual for all the channels.
Signals STEP/DIR/ENABLE are galvanically isolated from the controller and are buffered. All the signals are allocated to the connector DB-25M type (LPT port) XP1 and are doubled by male connectors XP2 (fig.2).

STEP signal characteristics are working voltage 3...5V, current consumption 0.1 mA, min signal duration is 10ms. The step is carried out on the signal back edge.

DIR signal characteristics are working voltage 3...5V, current consumption 0.1 mA, operation time 1 ms.
ENABLE signal characteristics are working voltage 3...5V, current consumption 0.1 mA, operation time 1 ms. When supplying logic '1', the module is turned on, '0', the module is switched off.

STEP/DIR/ENABLE are signaled by LEDS. STEP – LED15, LED16, LED17, LED18. DIR – LED19, LED20, LED21, LED22. ENABLE – LED12.

Limit switches connection
Multichannel driver PLC440L has 5 optoisolated inputs for connecting limit switches – IN1...IN5.
Physically, every input is an opto-coupler with built-in current-limiting resistor (1kOhm, depending on sensor type and sensor voltage supply, resistance increase will be needed). Such opto-inputs construction allows to connect any sensors to the driver and provides driver optoisolation coils of sensors.
Common contact limit switches (buttons) and non-contact sensors (inductive, capacitive) PLL01 type (inductive non-contact sensor) with signal output can be connected to the module. Connection is performed according to fig. 3.
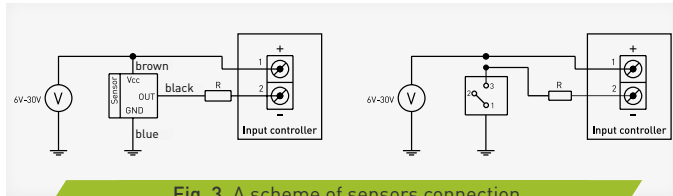

Fig. 3. A scheme of sensors connection

Relay loads connection RELAY1/2/3
Multichannel driver PLC440 supports control of 3 high current relays RELAY1/2/3 for commutation of additional machine devices. Relay loads connection is performed in fig. 4.
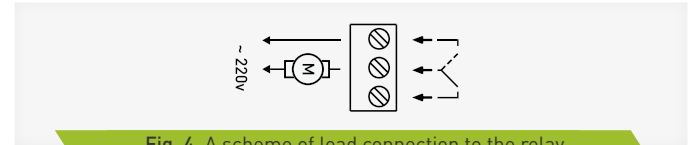

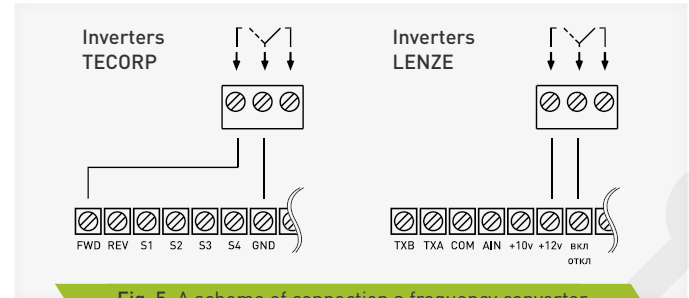**Fig. 4.** A scheme of load connection to the relay

Fig. 5. A scheme of connection a frequency converter to the relay for starting the spindle via MACH3

Frequency converter connection (inverter)
Multichannel driver PLC440L has a control scheme of frequency converter i.e. allows to change spindle rotations by command from CNC program MACH3.
The control scheme of requency converter is optoisolated from driver PLC440L and is supplied from FC. Normally FC has 3 contacts for control device connection – power 10V, ground and control voltage input is 0...9,5V (frequency of spindle rotation changes proportionally). Connection of frequency converter is performed according to fig. 7.

Power source connection
Power source connection is performed according to fig. 9.
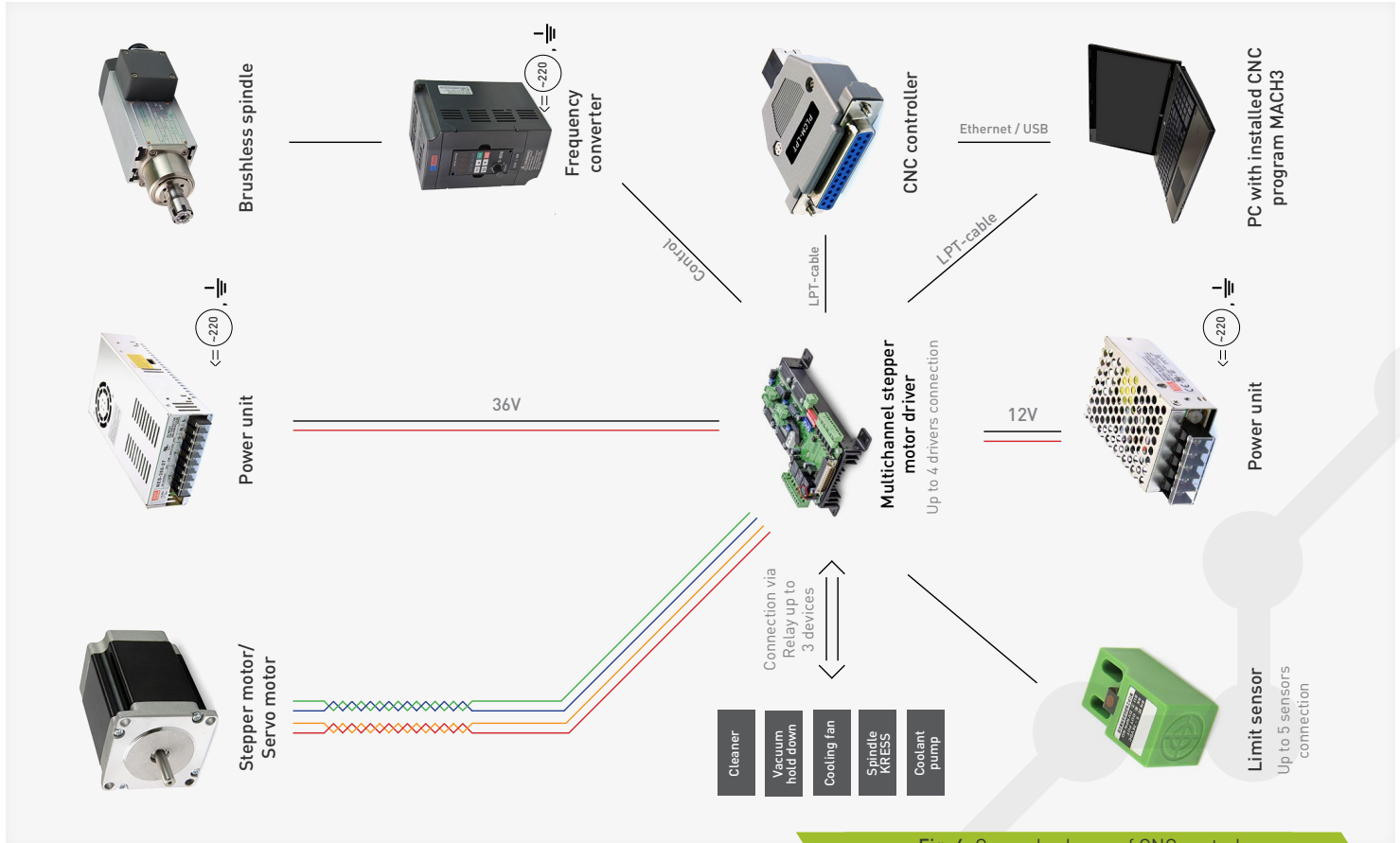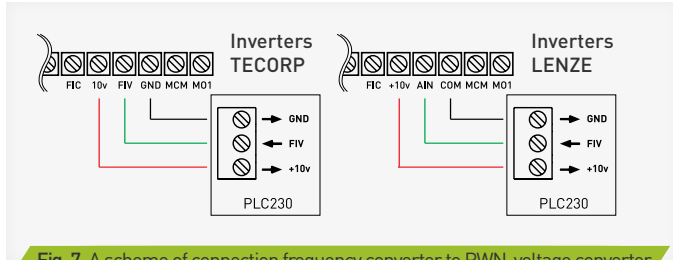Voltage supply is indicated by LED PWR (LED13).

Brushless spindle

~220

Frequency converter

Control

CNC controller

LPT-cable

Ethernet / USB

LPT-cable

PC with installed CNC program MACH3

~220

Power unit

36V

Multichannel stepper motor driver
Up to 4 drivers connection

12V

~220

Power unit

~220

Stepper motor/ Servo motor

Connection via Relay up to 3 devices

Cleaner | Vacuum hold down | Cooling fan | Spindle KRESS | Coolant pump

Limit sensor
Up to 5 sensors connection

Fig. 6. General scheme of CNC control

Fig. 7. A scheme of connection frequency converter to PWN-voltage converter

PH1.1 [+A]		Red (RED)
PH1.2 [-A]		Orange (ORG)
PH2.1 [+B]		Blue (BLU)
PH2.2 [-B]		Green (GRN)

Fig. 8. Purelogic R&D stepper motor connection

07 Stepper motor connection

Multichannel driver PLC440L is optimal for for control of bipolar and unipolar Purelogic R&D series PL42/PL57.

Purelogic R&D stepper motor connection to the driver is performed as it is shown in fig. 8.

(clips PH1.1[+A], PH1.2[-A] and PH2.1[+B], PH2.2[-B]). The driver has protection against wrong stepper motor coil connection and coils linked together / '+' power supply.

Please note that in case of couple (phase) interchange PH1.x<>PH2.x, the motor will start rotating in the opposite direction (inversion analogue of DIR signal).

The length of wires leading to the stepper motor from the driver must not exceed 10 meters. Longer wires can lead to driver's work failures. It is strongly recommended to interlace the stepper motor wires per phase, then put this braid to the screened metal sheathes. Sheathes and stepper motor frame must be grounded.

08 Current and voltage option

Maximal driver voltage power option depends on the applied stepper motor and desired maximum rotation speed.

Optimal supply voltage calculation for the stepper motor is carried out according to the formula U=32*v (stepper motor phase inductance mH), but not more than 40V.

Supply current must be chosen 50...70% from the claimed stepper motor coil current.

Operating current installation is performed according to fig. 2 by trimming resistors R1, R2, R3, R4.

When there is no STEP signal for more than 1 sec, each driver goes to sleep mode.
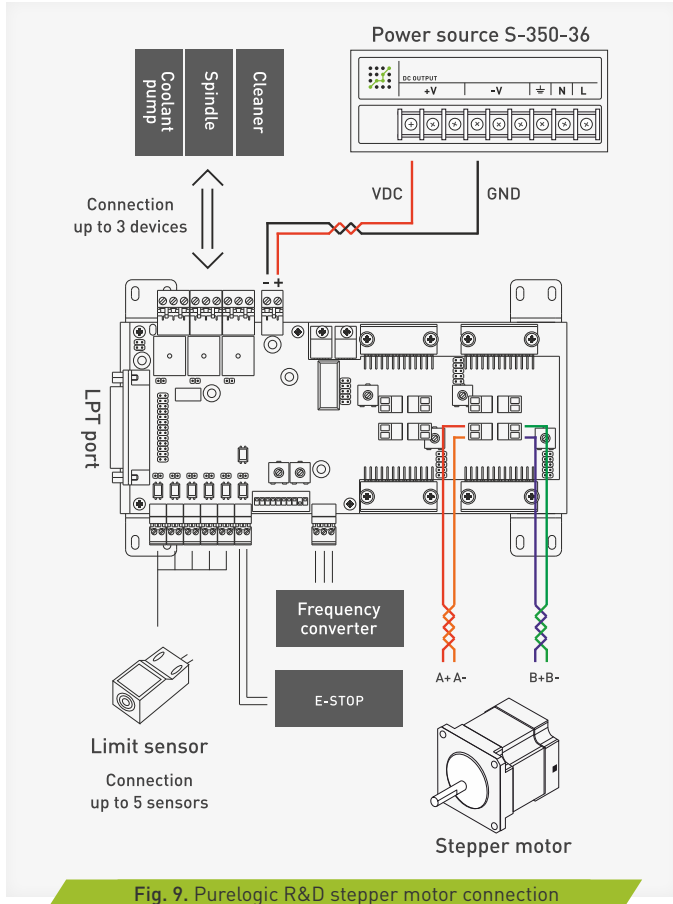
Fig. 9. Purelogic R&D stepper motor connection

(Diagram labels:) Coolant pump · Spindle · Cleaner · Power source S-350-36 · DC OUTPUT +V −V ⏚ N L · Connection up to 3 devices · VDC · GND · − + · LPT port · Frequency converter · E-STOP · A+ A− · B+ B− · Limit sensor · Connection up to 5 sensors · Stepper motor

E-STOP function   09

Input E-STOP is used for signals transmission in case of alarm situation for machine emergency stop.
When supplying signal to this input the module switches off, for restoring its work you need to remove alarm signal from E-STOP and off/on module power.
Mode operation option is performed by jumper SW9. When jumper SW9 is ON, alarm signal E-STOP will be transmitted through LPT port (10 contact) to control program (MACH3).
When turning SW9 to OFF position, only hardware module switching off will occur.
Also LED11 indicates driver alarm.

Commutation timer of a coolant pump   10

The driver is equipped with inbuilt commutation timer of a coolant pump. The timer controls on/off RELAY3.
Please note that timer operation is performed according to installation of DIP-switch SW2 (fig. 2).
Starting frequency RELAY3 is installed by trimming resistor R5 (frequency, 8...60 sec.),
 relay holding duration when being on is set by a preset resistor R6 (pulse ratio, 1...8 sec). Frequency and timer operation duration is set at the moment of module power switching on. Therefore after values changing of preset resistors it is necessary to turn on/off multichannel driver.

11 Stepper motor connection

The driver allows to divide electronically physical stepper motor step – 2, 8, 10, 16, 20, 32, 40 and 64. Thus positioning accuracy is higher. Step division mode is called microstep mode. This mode allows to reduce stepper motor resonances at low revs. But when using microstep a claimed moment is reduced on stepper motor shaft.
It is recommended to use the driver in step division 1:8 and higher. In these modes stepper motor rotates as smooth as possible, low-frequency vibrations are minimal.
Switching step division mode is carried out according to fig. 9. by the jumpers, jumper setting to corresponding adapter contacts JX1, JX2, JX3, JX4.
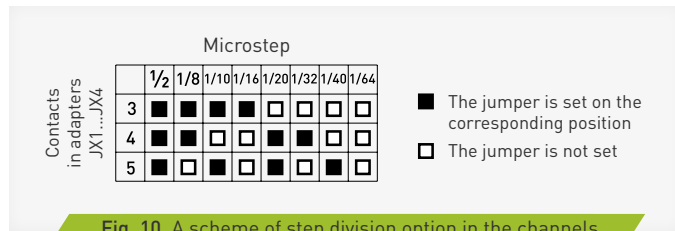

Fig. 10. A scheme of step division option in the channels

12 Protection functions, setup

Overheating protection – the driver has inbuilt temperature sensor which changes radiator temperature. When radiator temperature reaches ~60°C the driver turns off. It will be on as soon as the temperature drops to ~50°C.
Change of DIP-switches SW1-SW9 must be performed only when the power supply is OFF. Otherwise the driver will not react to changes.

When the power is switched on, red LED ERR (LED11) is on.
When there is no alarm red ERR LED goes out in 1 sec and green LED OK (LED10) is on.
LED DUMP (LED14) indicates operation of the dumper (back EMF compensation).
When the protection function operates, the driver switches off stepper motor coils, red signal ERR flashes on.
The driver restores its work after alarm cause removal and switching off/on power supply.
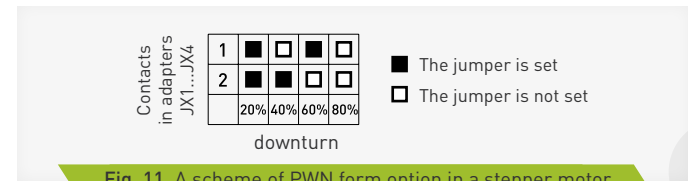

Fig. 11. A scheme of PWN form option in a stepper motor

PWN form in stepper motor channel coils is chosen by jumpers 1 and 2 in adapters JX1, JX2, JX3, JX4 (fig. 8). PWN form option influences the vibrations when rotating a stepper motor and is chosen experimentally. In some cases by interturn short-circuit of stepper motor coil, short-circuit protection may not work because there is no exceeding of permissible alarm current. This happens because under such coil short circuit resistance does not equal 0 and the driver maintains the specified current.

13 Inbuilt generator of STEP and DIR signals

PLC440L is equipped with inbuilt generator of STEP and DIR signals. (for testing and setting the machine).
When turning on the generators, signals STEP and DIR are transmitted to the corresponding channels X, Y, Z, A, corresponding LEDs signal about it (Fig. 2).

SW6 – "ON" generator STEP on axis X, Y, Z and A is on, "OFF" generator STEP is off.
SW7 – "ON" generator DIR on axis X, Y, Z A is on, "OFF" generator DIR is off.

14 Common problems

POWER		
Symptom	Possible reason	Possible solution
Green LED PWR (LED13) is off	Problem in power supply circuit	Check if the supply is connected correctly (polarity), wiring
CONTROLLER OPERATION		
Red LED ERR is on (LED11)	Driver error (E-STOP is active, Set E-stop button to "OFF" state. Overheating, current, voltage exceeding)	Check the commutation of E-STOP signal, a very low power supply, insufficient current) correspondence of power supply and current with recommended values; check if the driver is overheated (let it cool down)
Green LED ENB is off (LED12)	No ENB signal	Check PLC440L driver commutation with LPT-port of PC or supply the signal manually by switch SW8 in 'ON' state

Terms of Warranty 15

The warranty period is 12 months after purchasing and is valid only if all operational conditions and scheduled maintenance are strictly followed.

1. General terms
1.1. In case of product acquisition as separate components, Seller guarantees working ability of every component, but does not assume responsibility for the quality of their joint work (mismatch of components). If you have questions please consult our technical support team.
1.2. Seller does not guarantee compatibility of the purchased product with the one that Buyer already has or bought from third parties.
1.3. Product's component parts and configuration can be changed by manufacturer without notice due to the product consistent technical improvement.

2. Conditions for warranty acceptance
2.1. The product is accepted only in the same completeness of set as it was purchased.

3. Warranty service procedure
3.1. Warranty service is performed by testing the claimed product defect.
3.2. If the defect is proved, warranty repair is carried out.

4. We do not assume any responsibility for glass, electric lamps, starters and expendable materials as well as:
4.1. Damaged product caused by inappropriate transport and store conditions, wrong connection, operation in abnormal (off-design) mode, or in conditions which are not manufacturer-supplied (including temperature and humidity out of limits of recommended range), having damages due to third-party circumstances (voltage jumps, natural disasters, etc.), also having mechanical or thermal damages.

4.2. The product with traces of foreign objects or substances impact, including dust, liquids, insects, also objects having extraneous inscription.

4.3. The product with traces of unauthorized tampering and (or) repair process (traces of opening, home-made soldering, elements changing etc).

4.4. The product with self-diagnostic function that shows improper exploitation.

4.5. Technically complex product in respect of which assembly and integration and start-up works were not performed by Seller specialists or by recommended organizations, except in cases directly regulated under goods documentation.

4.6. In cases when the product exploitation was performed in conditions when power supply did not correspond with manufacturer's requirements, also when there is no electrical protection device .

4.7. The product which was resold by the initial buyer to the third party.

4.8. The product with defects which were caused by low-quality spare parts or fulfilled their service life spare parts,consumable materials, also using spare parts, consumable materials not corresponding with manufacturer's requirements.

Produced and accepted in accordance with obligatory requirements of valid technical documentation and is qualified for exploitation.

Lot number:

Technical Control Department

purelogic
research & development

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