AU9290 Stepping Motor Driver

Users Manual

MNL000718W00 rev200

Contents

1. Introduction

AU9290 is a high functional and quite a compact stepping motor driver of latest design.

AU9290 drives a stepping motor with micro-step method, and minimize motor vibration. Only 1 rpm operation can be performed without bothering limitation of self-starting frequency of stepping motor.

AU9290 also has a profile generation function, and can operate stepping motor without getting pulse signal inputs.

Parallel I/O signals are available to set operation commands in AU9290.

No pulse generator is necessary to operate stepping motor with expected velocity by using parallel I/O signals.

RS485 serial communication is also available to transmit operation commands to AU9290.

Multi-axis motor control can be realized with only 2 wires connection by RS485 serial communication.

Parameters settings for AU9290 are easily executed with USB port connecting to PC.

AU9290 will contribute to improvement in performance and downsizing for all industrial equipments.

1.1. Power supply for AU9290

AU9290 has two types of power supply range. A standard model is of range from 15V to 36V D.C. Another model is of range from 30V to 50V D.C.

1.2. Applicable stepping motors

All 2 phase stepping motors may be operated by AU9290 with setting the motor parameters correctly in AU9290.

AU9290 has 2 types of drive method, unipolar drive type and bipolar drive type.

AU9290 of unipolar drive type is designed only for unipolar wiring stepping motor, and AU9290 of bipolar drive type is for bipolar wiring stepping motor. They are distinguished by the part number.

Please pay attention to the part number of AU9290 correctly adapted to your stepping motor.

Note: Although AU9290 of bipolar drive type is designed for bipolar motor, it also can drive unipolar motor. Please see article 4.2 'Connection with motor'.

1.3. Setting and storing of parameters

AU9290 is necessary to be set parameters correctly to drive a motor.

Our set-up software will help you to do it easily, by connecting AU9290 with PC by USB cable.

After setting parameters, please save them in non-volatile memory on AU9290 by clicking Parameter Save button.

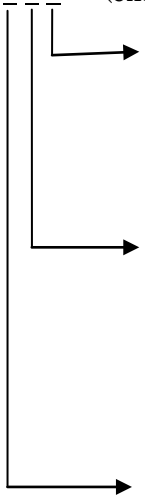
You can also try to drive a motor by the set-up software.

1.4. Optional functions

AU9290 can get drive commands from Parallel I/Os (In: 4 point, Out: 1 point) or RS232 serial communication as well as Pulse command signal inputs. You can choose them by designating the part number like following article 1.5.

1.5. Part number for ordering

AU9290 N * * * (except for AU9290 N103 throgh N106)



Interface voltage for input signals
- 0: 5V for both of pulse command signals and digital inputs
- 1: 5V for pulse command signals, and 24V for digital inputs.
- 2: 24V for pulse command signals and digital inputs

Optional function
- 0: nothing (CN4 is not mounted)
- 1: Parallel I/O
- 2: RS485 Serial communication
- 3: RS232C Serial communication

Power supply and motor wiring type
- 1: DC24V, Unipolar motor
- 2: DC24V, Bipolar step motor
- 4: DC48V, Bipola step motor

Value type: AU9290N103, N104, N105, N106

Type number	Power and Motor	Input and Output signals
AU9290N103	DC24V Power source Unipola wiring Motor	4 digital Inputs, Enable Input (5V I/F)
AU9290N104		4 digital Inputs, Enable Input (24V I/F)
AU9290N105		RS485 and Enable Input (5V I/F)
AU9290N106		RS485 and Enable Input (24V I/F)

Note: 2 Digital Inputs of AU9290N103 and N104 may be used as command pulse signals as well as PIO input signals.

Note: AU9290N103 and N104 do not have PIO digital output.

Note: AU9290N105 and N106 do not have command pulse signal inputs.

2. Selection of Power supply

Select a power supply with the range of DC15 to 36V for N1xx and N2xx, and rage of DC30 to 50V for N4xx.

Capacity of the power supply is dependent on stepping motor. It should be able to supply the rating current of stepping motor.

Power voltage is a fundamental factor to drive a stepping motor. Higher rotation speed needs higher power voltage. If you need not to rotate a motor so high speed, you may select a lower voltage power supply.

It is necessary to confirm that power voltage is high enough for your motor to be driven at a required speed without step-out.

When a stepping motor is decelerated, some electric current may flow back to power source temporarily. In this case, power voltage goes up and it may cause power supply shut-down by over voltage protection. Accordingly, the power source that does not have enough capacity against over voltage is not suitable to use for motor driving.

We recommend installing enough capacitance (470 uF or more) to power supply line.

On the other hand, since AU9290 has a function of over voltage protection, AU9290 may go alarm status and stop the operation if power voltage goes over the alarm level, so that power voltage does not increase.

3. Installation of AU9290

AU9290 has a structure of open-board type. Please secure AU9290 with screw hole in each corner.

Since AU9290 will heat during operation, please consider the installation location where lets air through and has enough distance from heat generating element.

4. Connection

4.1. Connection to CN1

CN1 shall be connected drive power source, pulse command signals and drive enable signal as shown in Table 4.1. Table4.1-2 and Table 4.1-3 shall be refered for Value type; AU99290N103, N104, N105, N106.

Table 4.1 CN1 Connection

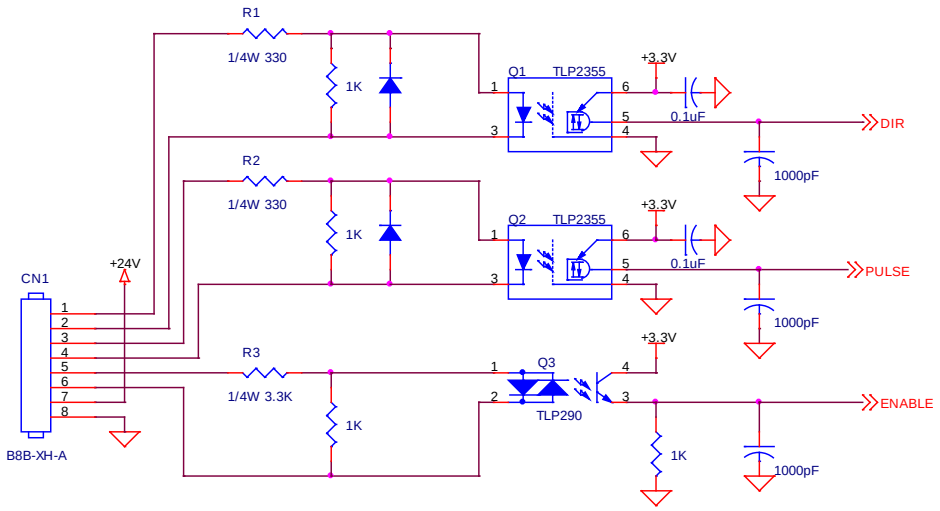
Pin	Signal name	Description	I/O
1	Command Pulse_1+	R-Pulse signal at F-Pulse/R-Pulse mode.	IN
2	Command Pulse_1−	Direction signal at Pulse/Dir mode.	IN
3	Command Pulse_2+	F-Pulse signal at F-Pulse/R-Pulse mode.	IN
4	Command Pulse_2−	Pulse signal at Pulse/Dir mode.	IN
5	Enable+	Drive enable signal	IN
6	Enable−		IN
7	VDD	Connect + side of power supply (DC15 to 36V)	IN
8	VSS	Connect − side of power supply	IN

Differential line drivers are recommended to use for pulse command signals source.

Open collector output is commonly used for Enable signal.

The receiving circuits are shown in Diagram 4.1..

Diagram 4.1 Receiving circuits of command pulses and drive enable signal.



※ The value of R1 and R2 are 3.3 k ohms in case of AU9290Nxx2.

※ The value of R3 is 330 ohms in case of AU9290Nxx0.

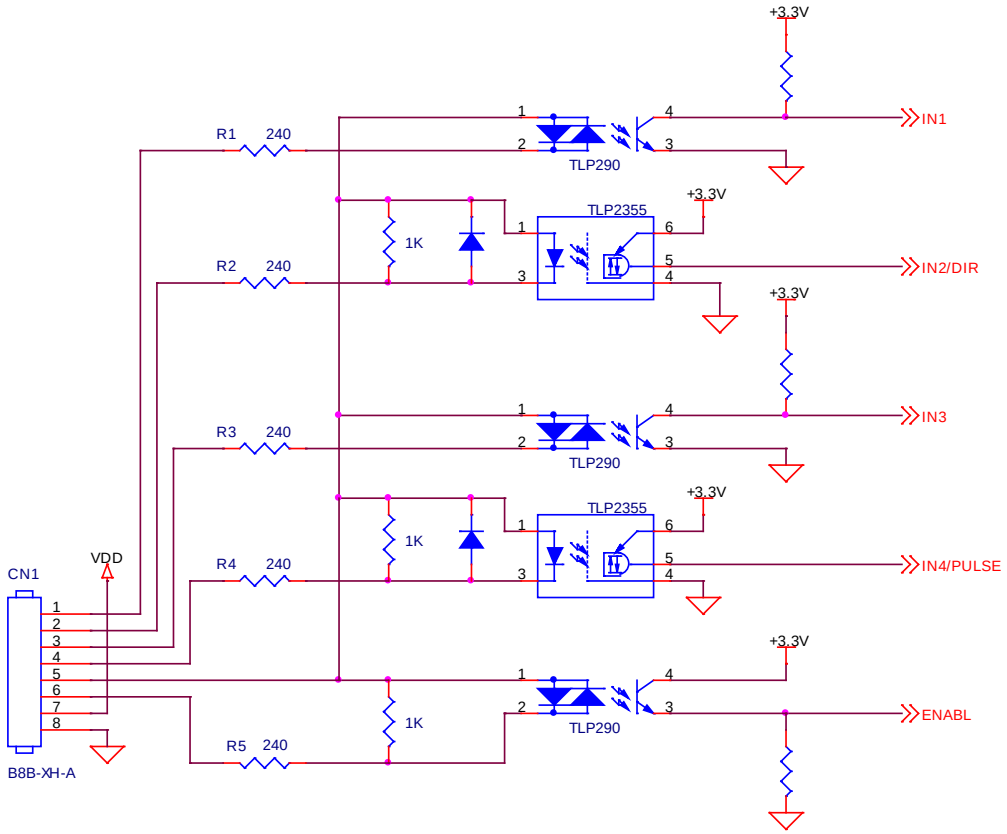
Table 4.1-2　CN1 Connection for AU9290N103 and N104

Pin	Signal name	Description	I/O
1	IN1	Digital Input-1.	IN
2	IN2	Digital Input-2 / Command Pulse-1	IN
3	IN3	Digital Input-3	IN
4	IN4	Digital Input-4 / Command Pulse-2	IN
5	Input Common	Common Input for DIN1 – DIN4 and Enable signals.	IN
6	Enable	Drive enable signal	IN
7	VDD	Connect + side of power supply (DC15 to 36V)	IN
8	VSS	Connect − side of power supply	IN

AU9290N103 and N104 have 5 digital inputs and 2 of them are shared with command pulse inputs. Open collector output is commonly used for them.

Diagram 4.1-2 is indicating the receiving circuits.

Diagram 4.1-2　Receiving circuits for AU9290N103 and N104.



※ The value of R1 through R5 are 4.4 k ohms in case of AU9290N104.

※ AU9290N103 and N104 do not have digital output.

Table 4.1-3　CN1 Connection for AU9290N105 and N106

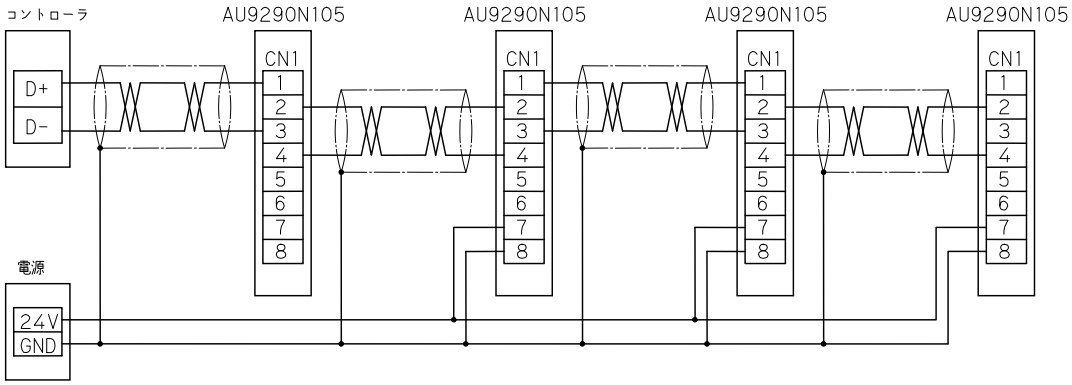
Pin	Signal name	Description	I/O
1	D+	Positive side of RS485 differencial signal	IN
2	D+		IN
3	D-	Negative side of RS485 differencial signal	IN
4	D-		IN
5	Enable+	Drive enable signal	IN
6	Enable-		IN
7	VDD	Connect + side of power supply (DC15 to 36V)	IN
8	VSS	Connect − side of power supply	IN

In case of AU9290N105 and N106, RS485 differencial signals are connected to pin1 thorough pin4, so that daisy chain connection is easily realized.

A terminal resister should be mounted on the final terminal point of RS485 bus line. AU9290N105 and N106 have a jumper socket on the print board. When the socket is inserted, the terminal resister is connected to RS485 bus line. Please remove the socket to remove the terminal resister.

Please refer the previous paragraph for the receiving circuits of Enable signal

Diagram 4.1-3　Connection example for RS485 differencial bus line.



※ Jumper socket should be removed for all AU9290N105 other than one of right edge on the above connection.

4.2. Connection with motor

Stepping motor shall be connected to CN2.

In case of unipolar type driver (AU9290N1xx), CN2 is 6 pins connector, and 4 pins connector for bipolar type driver (AU9290N2xx and AU9290N4xx).

Unipolar type driver can drive only unipolar motors. On the other hand, bipolar type driver can drive both of bipolar motor and unipolar motor.

Connect a stepping motor as follows.

Table 4.2 Connection of motor for unipolar type driver (CN2)

Pin	Signal	Description	I/O
1	COM1	A phase common	OUT
2	COM2	B phase common	OUT
3	A	A phase	OUT
4	$\overline{A}$	$\overline{A}$ phase	OUT
5	B	B phase	OUT
6	$\overline{B}$	$\overline{B}$ phase	OUT

Table 4.3 Connection of motor for bipoplar type driver (CN2)

Pin	Signal	Description	I/O
1	A	A phase of bipolar motor and unipolar motor	OUT
2	$\overline{A}$	$\overline{A}$ phase of bipolar motor / A phase common of unipolar motor	OUT
3	B	B phase of bipolar motor and unipolar motor	OUT
4	$\overline{B}$	$\overline{B}$ phase of bipolar motor / B phase common of unipolar motor	OUT

4.3. Connection with PC

CN3 on AU9290 is USB Min-B connector, and can be connected with PC using USB Min-B cable on the market.

It is necessary to install USB Driver into PC in advance to launch our set-up software.

Please refer to installation manual for AU9290 set-up software.

4.4. Connection for Parallel I/O signals

Parallel I/O signals, 4 inputs and 1 output, are available on AU9290Nx1x as optional function.

Please connect with CN4 as follows.

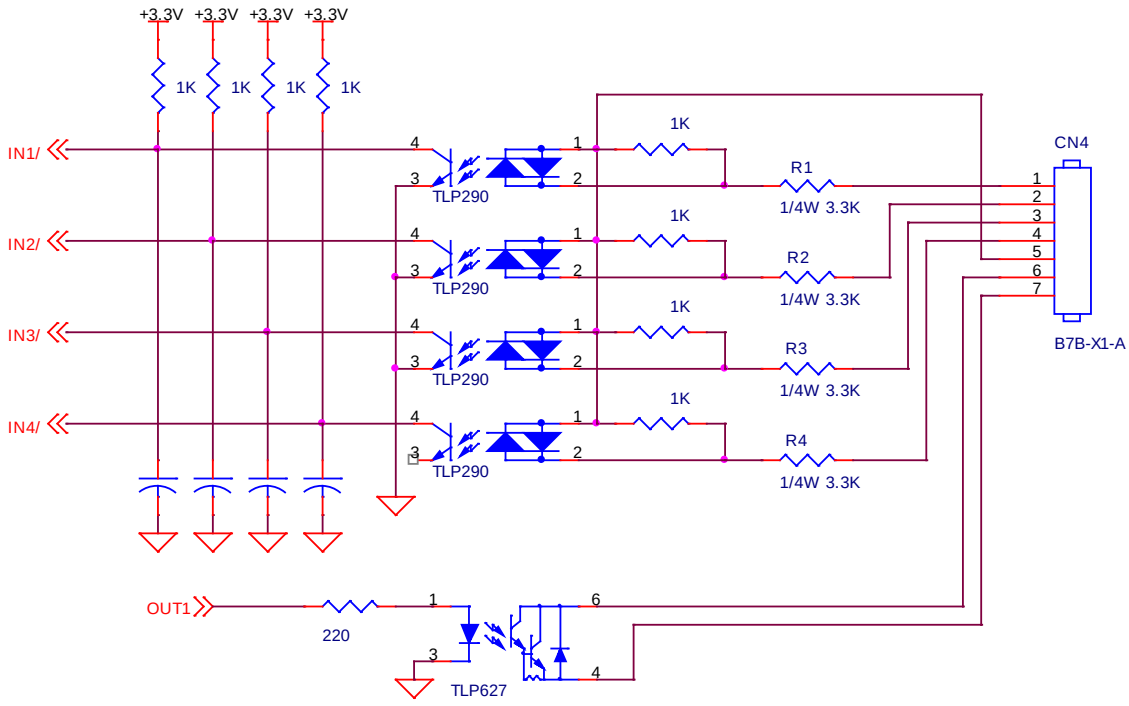
Table 4.4 PIO signals connection (CN4)

Pin	Signal	Description	I/O
1	IN1	Digital input-1	IN
2	IN2	Digital input-2	IN
3	IN3	Digital input-3	IN
4	IN4	Digital input-4	IN
5	InputCom	Digital input common signal	IN
6	OUT1+	Digital output (Collector side)	OUT
7	OUT1-	Digital output (Emitter side)	OUT

Diagram 4.2 indicates inputs/output circuits of Parallel I/O signals.

Interface voltage shall be 5V for AU9290Nx10 and 12V to 24V for AU9290Nx11 and AU9290Nx12.

Diagram 4.2 Inputs/output circuits of Parallel I/O signals.



※Value of R1,R2,R3 and R4 is 330 ohms in case of AU9290Nxx0,

4.5. Connection for RS485 Serial communication signals

AU9290Nx2x is provided with RS485 serial communication function.

Please connect to CN4 as follows.

Table4.5 RS485 serial communication signals connection (CN4)

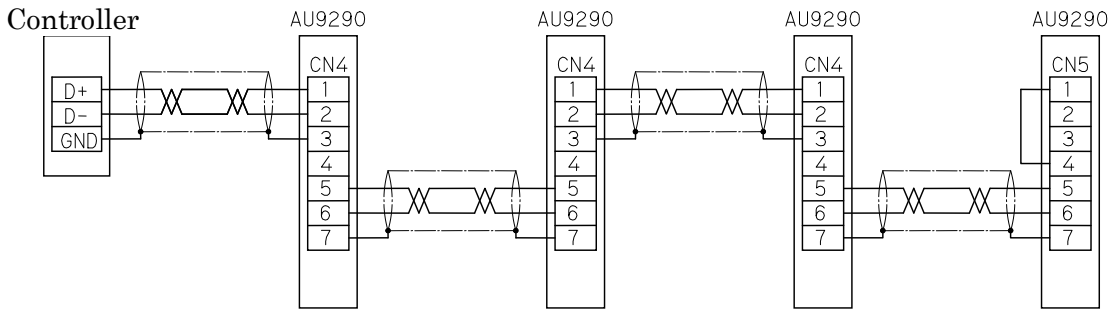
Pin	Signal	Description	I/O
1	D+	RS485 differential signal +	IN
2	D−	RS485 differential signal −	IN
3	GND	Circuit ground	IN
4	R	At the end of RS485 serial bus connection, connect this pin with pin-1/pin-5 to connect terminal resistor.	IN
5	D+	RS485 differential signal +	OUT
6	D−	RS485 differential signal −	OUT
7	GND	Circuit ground	OUT

See Diagram 4.3 for example of RS485 serial bus connection.

Daisy chain connection is applicable.

A terminal resistor (120 ohms) can be connected at the end of RS485 serial bus by connecting pin-4 with pin-1.

Diagram 4.3 RS485 serial bus connection examples.



4.6. Connection for RS232C Serial communication signals

AU9290Nx3x has RS232C serial communication function.

Please connect RS232C signals to CN4 in according to the following table.

表 4.6 RS232C Serial communication connection（CN4）

Pin	Signal	Description	I/O
1	TXD	RS232C signal output from Driver	IN
2	RXD	RS232C signal input to Driver	IN
3	GND	Circuit ground	IN
4	NC		IN
5	NC		IN
6	NC		OUT
7	GND	Circuit frond	OUT

5. Status indication

AU9290 operating status is indicated by LEDs on PCB.

(1) Alarm status:

Red LED repeats blinking in a manner that LED blinks to a number of times as same as alarm code and makes a bit long turning off.

(2) Drive off status:

Green LED turns on.

(3) Drive ON status:

Green LED repeats blinking.

6. Trial operation (Please execute in advance of real operation.)

(1) Connect with PC

Please install both USB driver and Set-up software in advance of connecting power source to AU9290.

Connect power source and turned it on.

Connect AU9290 with PC by USB cable, and launch our set-up software.

Click COM START button for PC to start connection with AU9290.

(2) Set motor parameters

First of all, set motor parameters.

Click 'Trial Operation' tab to open motor setting window.

Set Data-ID #40 to #44 in according to the value specified in your motor data-sheet.

Data-ID	ID name	Description
40	Motor rate current	Set motor rate current in unit of 0.01A.
41	Winding resistance	Set motor winding resistance in unit of 0.01 ohms
42	Winding inductance	Ser motor winding inductance in unit of 0.01 mH.
44	Basic Number of Steps	360 ÷ Basic step angle (degree)

※Example for Data-ID #44: Set 200 when basic step angle is 1.8 degree.

(3) Drive your motor

After setting motor parameters, connect the motor with AU9290.

Click 'Enable' button on upper window, then you may confirm motor shaft being locked, while AU9290 makes current flow into the motor.

Set 100 [rpm] to 'Target Velocity' and set 1 [rev.] to 'Number of revolution'.

Click 'Position control set' button, then you can see motor makes 1 rotation.

Set −1 [rev] to 'Number of revolution' and click 'Position control set' button again.

You can see motor makes 1 rotation in the opposite direction and comes back to original position.

(4) Save parameters.

If the trial operation is finished successfully, you need to store motor parameters in non-volatile memory not to be lost by turning off the power supply.

Please click 'Parameter Save' button.

7. Operation by pulse command signals

Pulse command signals are commonly used to drive a stepping motor.

[Parameters for pulse command signals control]

ID	Name	Description
0	Control mode	Please set 1 for pulse command signals operation.
1	Pulse command mode	0：F-Pulse and R-Pulse 1：Pulse and Direction 2：F-Pulse and R-Pulse　(opposite direction) 3：Pulse and Direction　(opposite direction)
2	Micro-step magnification	This value determines the positioning resolution. The resolution is calculated by： (Basic Number of Steps)×(Micro-step magnification)

In case of pulse command signals operation, motor rotates by an increment of the number of input pulses.

Data-ID #0 shall be set to 1.

Data-ID #1 shall be select in according to pulse signals style of your pulse generator

(1) Forward Pulse／Reverse Pulse:　set 0 to Data-ID #1

(2) Pulse／Direction:　set 1 to Data-ID #1

If you want to change the definition of rotation direction, you may set 2 or 3, so that motor rotates in opposite direction by pulse command signals.

Data-ID #2 defines the positioning resolution.

If you set X to Data-ID #2, the positioning resolution is calculated by N x X, where N is basic number of steps (Data-ID #44), that is, motor rotates 1 revolution with N x X pulses.

You can determine positioning resolution regardless of micro-step resolution for AU9290 to drive a stepping motor.

Even if you set 1 to Data-ID #2, AU9290 will drive stepping motor with micro-step method and the motor will rotate smoothly with low noise and finally gets to the designated position correctly.

[How to operate by pulse command signals]

Connect pulse command signals and Enable signal in according to article 4.1.

Turn on Enable signal. Output command pulses to AU9290, then, motor rotates to the angle corresponding to the number of command pulses.

8. Operation by Parallel I/O signals

If you use AU9290 with parallel I/O option, you can operate a stepping motor without a pulse generator.

Both of position control and speed control can be realized by parallel I/O signals.

The function of parallel I/O signals is available for AU9290Nx1x.

AU9290 N103 and N104 are also provided with parallel I/O function but no output signal.

[Parameters for parallel I/O control]

Parameter necessary to operate by Parallel I/O is as following.

Data-ID	Name	Description
0	Control mode	Set 1 for position control. Set 2 for speed control.
1	Pulse Mode	Only for N103 and N104, 'Pulse Mode' must be set to 4 to make pulse signal invalid.
2	Micro-step magnification	This value determines the positioning resolution.
10	Minimum speed	Set Minimum travel speed in the unit of rpm.
12	Acceleration	Set acceleration in the unit of 10rpm/sec
13	Deceleration	Set deceleration in the unit of 10rpm/sec.
14	Travel speed-0	Set rotation speed-0 in the unit of rpm
15	Travel speed-1	Set rotation speed-1 in the unit of rpm
16	Travel speed-2	Set rotation speed-2 in the unit of rpm
17	Travel speed-3	Set rotation speed-3 in the unit of rpm
20	Travel command-0	Set travel distance-0
21	Travel command-1	Set travel distance-1
22	Travel command-2	Set travel distance-2
23	Travel command-3	Set travel distance-3
24	Travel command-4	Set travel distance-4
25	Travel command-5	Set travel distance-5
26	Travel command-6	Set travel distance-6
27	Travel command-7	Set travel distance-7
28	Travel magnification	Travel distance is given by each Travel command multiplied by this value.

[Position control mode] (Data-ID #0 = 1)

When Data-ID #0 is set to 1, parallel I/O signals are acquired as position control commands.

After turning on Enable signal, change parallel I/O signals (IN1 to IN4) to set position control command for AU9290.

When IN4 is changed to ON from OFF, AU9290 takes in data of travel distance and travel speed in according to the table below, and rotates motor by an increment of designated distance with designated speed.

IN3	IN2	IN1	Travel distance	Travel speed
OFF	OFF	OFF	Value of Data-ID #20	Value of Data-ID #14
OFF	OFF	ON	Value of Data-ID #21	Value of Data-ID #15
OFF	ON	OFF	Value of Data-ID #22	Value of Data-ID #16
OFF	ON	ON	Value of Data-ID #23	Value of Data-ID #17
ON	OFF	OFF	Value of Data-ID #24	Value of Data-ID #14
ON	OFF	ON	Value of Data-ID #25	Value of Data-ID #15
ON	ON	OFF	Value of Data-ID #26	Value of Data-ID #16
ON	ON	ON	Value of Data-ID #27	Value of Data-ID #17

The range of value for Data-ID #20 to ID #27 is from -32767 to +32767. Negative value is accepted.

If you need to set the value beyond +/−32767, you can set Data-ID #28 to set the magnification for travel distance.

AU9290 takes in travel distance and travel speed whenever IN4 changed to ON even if motor does not reach the target position. In this case, target position is summed up with last travel command and target speed is changed to the last travel speed.

[OUT1 signal output at position control mode]

At position control mode, OUT1 signal turns ON when driver is “ready” and motor position is on target position. That is, you can confirm by this signal if directed travel operation is finished or not.

※ ”Ready” means that CPU finished initial setting, AU9290 is not in alarm status and power voltage is over the low voltage level.

※ AU9290N103 and N104 do not have OUT1 signal output.

[Speed control mode] (Control mode= 2)

When Data-ID #0 is set to 2, parallel I/O signals are acquired as speed control command.

After turning on Enable signal, change parallel I/O signals (IN1 to IN4) to set speed control command for AU9290.

When IN1 to IN4 are changed, AU9290 takes in data of rotation speed in according to the table below, and rotates motor with designated speed.

IN4	IN3	IN2	IN1	Rotation speed
OFF	－	－	－	0 rpm（Stop）
ON	OFF	OFF	OFF	Value of Data-ID #14
ON	OFF	OFF	ON	Value of Data-ID #15
ON	OFF	ON	OFF	Value of Data-ID #16
ON	OFF	ON	ON	Value of Data-ID #17
ON	ON	OFF	OFF	Negative Value of Data-ID #14
ON	ON	OFF	ON	Negative Value of Data-ID #15
ON	ON	ON	OFF	Negative Value of Data-ID #16
ON	ON	ON	ON	Negative Value of Data-ID #17

[OUT1 signal output at speed control mode]

In case of Speed control mode, OUT1 signal turns ON as long as AU9290 is "ready".

※ "Ready" means that CPU finished initial setting, AU9290 is not in alarm status and power voltage is not under the low voltage level.

※ AU9290N103 and N104 do not have OUT1 signal output.

9. Operation by serial communication

AU9290 can accept the motor control commands from serial communication of UART. No pulse generator is necessary to operate a motor by serial communication as same as parallel I/O control.

RS485 serial communication function is available for AU9290Nx2x N105 and N106.

RS232C serial communication function is available for AU9290Nx3x.

The serial communication protocol is same for both of RS485 and RS232C.

[Parameters for serial communication control]

All data in AU9290 can be monitored, and all control data necessary to drive stepping motor can be changed by serial communication.

Following table shows primary control data for serial communication control.

Data-ID	Name	Description
0	Control mode	Set 1 for position control mode. Set 2 for speed control mode.
2	Micro-step magnification	Positioning resolution is determined by this value. Please see article 7.
10	Minimum Speed	Set minimum travel speed in rpm.
12	Acceleration	Set acceleration in 10rpm/sec.
13	Deceleration	Set deceleration in 10rpm/sec.
60	Drive Command	Drive ON/OFF and alarm clear can be executed by this data.
61	Travel command	Set travel distance.
62	Travel speed	Set target speed.

AS all data with ID less than 60 can be saved in non-volatile memory, it is not necessary each time to set them as long as you do not want to change them.

When Data-ID #0 is set to 1 (position control mode), you can rotate a motor to designated distance as you want.

Set Data-ID #60 to 1 to start excitation for a motor.

Set target speed to Data-ID #62.

Set travel distance to Data-ID #61.

Your stepping motor will rotate by an increment of designated distance with designated speed.

When Data-ID #0 is set to 2 (speed control mode), you can rotate motor with designated rotation speed.

Set Data-ID #60 to 1 to start excitation for a motor.

Set target speed to Data-ID #62.

Your stepping motor will rotate with designated speed.

Bit7 through Bit10 of Drive Command (Data ID #60) are equivalent to PIO inputs DIN1 through DIN4. By using of this parameter, PIO operation is realized in serial communication control.

Set Bit2 of Drive Command (Data ID #60), you can reset Present Position (Data ID #1000).

9.1. Protocol of serial communication

Asynchronous serial communication is provided on AU9290.

The communication protocol can be selected from TSC-Standard, Modbus-ASCII and Modbus-RTU.

In any protocol choosen, your controller is Master server, while AU9290 works as a slave server.

UART parameters are also possible to be changed.

Data-ID	Name	Description
30	Device ID	Slave number for communicaion：1～15
31	Baud Rate	Baud Rate of communication　Unit: 0.1kHz]
32	UARTsettings	0：STOP=1, Parity= non, Length=8 1：STOP=2, Parity= non, Length=8 10：STOP=1, Parity=even, Length=9 11：STOP=2, Parity=even, Length=9 20：STOP=1, Parity=odd, Length=9 21：STOP=2, Parity=odd, Length=9
33	Communication Protocol	0：TSC-Standard 1：Modbus-ASCII, 2：Modbus-RTU

Next paragraph describes TSC-Standard protocol.

“AU9290 Modbus Communication Specification” shall be refered for Modbus protocol.

9.2. Protocol of TSC-Standard serial communication

[Configuration for Asynchronous communication]

Baud rate: 19.2 kbps,　Parity: none、　Data length: 8bits

Stop bit: 1,　Start bit: 1,　Character code: ASCII

Note: Baud rate can be changed.

[Read request Sequence]

(1) Master sends Read request to AU9290.

(2) AU9290 sends ACK and subsequently sends requested data to Master.

(3) Master sends ACK to AU9290.

[Write request Sequence]

(1) Master sends Write request to AU9290.

(2) AU9290 sends ACK with updating the value of requested ID.

Note: If there is any error in message from Master, AU9290 sends NAK.

［Format for Read request］

STX	1	Data-ID	;	Check SUM	ETX

［Format for Write request and Read request response］

STX	2	Data-ID	,	Data	;	Checksum	ETX

Length of 'Data-ID' and 'Checksum' is 4 characters.

Length of 'Data' is 4 characters for 2 bites data, and 8 characters for 4 bites data.

'Checksum' is lower 16 bits of summing result from 'STX' to ';'.

'Data ID', 'Data' and 'Checksum' are transferred in order from upper 4 bits to lower 4 bits.

【Slave designation】

Master can designate Slave by setting 'Slave-ID' in upper 4bits of 'Data-ID'.

'Slave-ID' must be 1 to 15 (F hex).

Slave will ignore received data if upper 4 bits of 'Data-ID' is neither 0 nor his ID number. That is, if upper 4 bits of 'Data-ID' is 0, the message is for everyone, so that all Slaves will make response.

10. Various functions of AU9290

10.1. Control mode

AU9290 operates a motor with position control mode or speed control mode.

At position control mode, AU9290 rotates a motor by an increment of designated distance. At speed control mode AU9290 rotates a motor with designated speed.

Set control mode to Data-ID #0.

Data-ID	name	Description
0	Control mode	1 : Position control mode 2 : Speed control mode

10.2. Pulse command mode

AU9290 accepts 2 types of pulse commands as below.

(1) Forward Pulse/Reverse Pulse:

AU9290 rotates a motor in the forward direction by an increment of number of forward pulses, and in the reverse direction by an increment of number of reverse pulses.

(2) Pulse/Direction:

AU9290 rotate a motor by an increment of number of Pulses in the direction of Direction signal.

Data-ID	Name	Description
1	Pulse command mode	0: F-Pulse and R-Pulse 1: Pulse and Direction 2: F-Pulse and R-Pulse (opposite direction) 3: Pulse and Direction (opposite direction) 4: Pulse signals are ignored (only for N103 and N104)

10.3. Positioning resolution

If you set X to Data-ID #2, the positioning resolution is N x X, where N is basic number of steps (Data-ID #44).

This value is applied to pulse command signals and travel commands data (Data-ID #61 and Data-ID #20 thorough #27).

Please take account of the matter that this resolution does not affect micro-step resolution with that AU9290 makes micro-step driving.

ID	Name	Description
2	Micro-step magnification	This value determines the positioning resolution. The resolution is calculated by : (Basic Number of Steps)×(Micro-step magnification)
44	Basic Number of Steps	360 ÷ Basic step angle (degree)

10.4. Rotating motor current

Motor current at rotating can be changed by Data-ID #3.

Please set to Data-ID #3 with the value of the percentage (%) to motor rate current.

Data-ID	Name	Description
3	Rotating motor current	Set in the unit of % / motor rate current

10.5. Stopping motor current

Motor current at stopping can be changed by Data-ID #4.

Please set to Data-ID #3 with the value of the percentage (%) to motor rate current.

Stopping status is detected when no more rotation command is accepted for the time set in Data-ID #5.

Data-ID	Name	Description
4	Stopping motor current	Set in the unit of % / motor rate current
5	Stop detection time	Set in the unit of m sec

10.6. PIO input filter

To prevent error fetch of PIO signals, AU9290 takes in PIO signals after PIO signals get stable over the time set in Data-ID #6.

Data-ID	name	Description
6	PIO input filter	Filtering time for PIO input signals. Unit: m sec

10.7. Origin search operation and Enable signal porarity

AU9290 is provided with origin search operation.

Origin search operation becomes valid by setting PIO Select (Data ID #7).

AU9290 makes the origin search operation as follows:

(1) Start rotation of motor with the velocity of Travel speed-3 (Data ID #17) by turning ON of origin search start signal.

(2) Stop rotation by turning ON of origin sensor and keep stopping for a designated perid of 'Origin Stop Time' (Data ID #18) and then start reverse rotation with 'Minimum Speed' (Data ID #10).

(3) Stop reverse rotation by turning OFF of origin sensor.

OUT1 signal keeps OFF during origin search operation, and comes ON after the end of operation.

Motor position (Data ID #1000) is reset at the end of origin search operation.

'PIO Select' (Data ID #7) selct input port of origin sensor and origin search start signal.

Porarity of origin sensor and rotation direction can be changed also by this parameter.

If origin serach signal turns ON again in the process of origin search operation, AU9290 stops origin search operation making origin serach fault.

Bit6 of Drive Command (Data ID #60) is also works as origin search start signal.

Bit6 of Drive Status (Data ID #100) comes to 1 at the end of origin search opearation.

Bit15 of Drive Status (Data ID #100) comes to 1 at the origin search fault.

These data are useful for AU9290 of serial communication option to make origin search.

'PIO Select' (Data ID #7) also changes Enable signal polarity. (Please see Table 10.1)

Data-ID	Name	Description
7	PIO Select	This parameter selects origin serch opearion and enable-signal polarity as shown on next table.
10	Minimum Speed	Creep speed in origin search operation: Unit [rpm]
17	Travel speed-3	Start origin search with this speed: Unit [rpm]
18	Origin Stop Time	Stop time at origin in origin search operation: [msec]
60	Drive Command	Bit0=1: enable motor drive Bit6=1: start origin search
100	Drive Status	Bit6=1: end of origin search Bit15=1: origin search fault

Table 10.1 Setting of Origin search operation and Enable signal porarity

Value Of PIO Select	Origin serach operation				Enable signal
	Origin signal	Start signal	Origin signal porarity	Rotation direction	Porarity
0	Origin search invalid				Enable at ON
1					Enable at OFF
1000	DIN1 signal Input	when DIN3 signal turned to ON	ON at origin	Negative direction	Enable at ON
1001					Enable at OFF
1010				Positive direction	Enable at ON
1011					Enable at OFF
1100			OFF at origin	Negative direction	Enable at ON
1101					Enable at OFF
1110				Positive direction	Enable at ON
1111					Enable at OFF
2000	DIR signal Input	When Pulse signal turned to ON	ON at origin	Negative direction	Enable at ON
2001					Enable at OFF
2010				Positive direction	Enable at ON
2011					Enable at OFF
2100			OFF at origin	Negative direction	Enable at ON
2101					Enable at OFF
2110				Positive direction	Enable at ON
2111					Enable at OFF
3000	Enable signal input	when DIN4 signal turned to ON under condition that DIN1 - DIN3 are all ON.	ON at origin	Negative direction	(Note 1)
3001					Enable normally
3010				Positive direction	(Note 1)
3011					Enable normally
3100			OFF at origin	Negative direction	(Note 1)
3101					Enable normally
3110				Positive direction	(Note 1)
3111					Enable normally

(Note 1) Enable only when Bit0 of DriveCommand (Data ID #60) is 1. This setting is effevtive only for AU9290 of serial communication option.

(Note 2) When PIO Select is set to 2000 through 2111, pulse command signal is ignored.

10.8. Smoothing parameters

When AU9290 gets a travel command from PIO or serial communication, AU9290 makes movement profile in according to Data-ID #10, #12 and #13 to make motor rotate smoothly.

Set required acceleration value in Data-ID #12 and deceleration value in Data-ID #13.

You may also set the minimum speed at acceleration and deceleration in Data-ID #10.

The target speed set by PIO or serial communication must not exceed the value in Data-ID #11.

Data-ID	Name	Description
10	Minimum speed	Set minimum speed at accel. and decel. Unit: [rpm]
11	Speed limit	Target speed is limited by this value. Unit: [rpm]
12	Acceleration	Set in the unit of 10rpm/sec
13	Deceleration	Set in the unit of 10rpm/sec

10.9. Serial communication parameters

The baud rate of serial communication can be changed with Data-ID #31.

You can also change UART settings with Data ID #32.

Setting of Data-ID #30 realizes multi-axis control by RS485 serial communication.

After changing parameters above, save them in non-volatile memory. Changes will be valid at the next power-ON.

Data-ID	name	Description
30	Device ID	Device ID for serial communication: 1 to 15
31	Baud rate	Set baud rate in the unit of 0.1kHz.
32	UART settings	0 : STOP=1, Parity= non, Length=8 1 : STOP=2, Parity= non, Length=8 10 : STOP=1, Parity=even, Length=9 11 : STOP=2, Parity=even, Length=9 20 : STOP=1, Parity=odd, Length=9 21 : STOP=2, Parity=odd, Length=9
33	Communication Protocol	0 : TSC-standard 1 : Modbus-ASCII, 2 : Modbus-RTU

10.10. Motor parameters

Please set correctly motor parameters, Data-ID #40 through Data-ID #44, so that AU9290 makes motor current flow normally

ID	Name	Description
40	Motor rate current	Set motor rate current　Unit : [0.01A]
41	Winding resistance	Set motor winding resistance　Unit : [0.01Ω]
42	Winding inductance	Set motor winding inductance　Unit : [0.01mH]
44	Basic Number of Steps	Set the value calculated by 360÷Basic Step Angle

10.11. Parameters handling

Every data in AU9290 has Data-ID. Most of the data with ID less than 100 can be changed and the data with ID less than 60 are called Parameters and they can be stored in non-volatile memory.

Please set 1 in Data-ID #71, and then all parameters are stored in non-volatile memory.

If you need to change all parameters to default values, set 1 in Data-ID #70.

Please pay attention that the default values are not always same as factory settings.

Data-ID	name	Description
70	Parameters Init	Set 1 to initialize all parameters to default value.
71	Parameters Save	Se1 to store all parameters in non-volatile memory.

10.12. Status monitor

The operation status of AU9290 can be monitored with Data-ID #100.

Data-ID	Name	Description
100	Drive Status	Bit0: '1' at drive ON Bit1: '1' at drive ready Bit2: '1' when motor is at targeted position. Bit3: '1' at alarm Bit6: '1' when origin search is completed. Bit8: '1' when step-out is detected. Bit9: '1' when power voltage is at over voltage level Bit10: '1' when power voltage is at low voltage level Bit11: '1' at overheat Bit12: '1' at over-load Bit14: '1' at current control error. Bit15: '1' at origin search fault
111	Power voltage	Power voltage can be monitored. Unit: [0.1V]
112	Drive temperature	Temperature around power deviceis can be monitored. Unit: [0.1℃]
120	Motor current	Motor current can be monitored. Unit: [0.01A]
121	Motor current (averaged)	Motor current averaged for 0.1 sec can be monitored. Unit: [0.01A]

10.13. Alarm histories

AU9290 remembers last 32 errors and they are monitored with Data-ID #102 through #109.

Data-ID #102 – Data-ID #109 consists of 4 alarm codes with a size of 4 bits.

Data-ID	Name	Content
102	Alarm History-1	Alarm codes from last to 3 times before (4bit x 4)
103	Alarm History-2	Alarm codes from 4 to 7 times before (4bit x 4)
104	Alarm History-3	Alarm codes from 8 to 11 times before (4bit x 4)
105	Alarm History-4	Alarm codes from 12 to 15 times before (4bit x 4)
106	Alarm History-5	Alarm codes from 16 to 19 times before (4bit x 4)
107	Alarm History-6	Alarm codes from 20 to 23 times before (4bit x 4)
108	Alarm History-6	Alarm codes from 24 to 27 times before (4bit x 4)
109	Alarm History-7	Alarm codes from 28 to 31 times before (4bit x 4)

10.14. Step-out detection

AU9290 is provided with a function of step-out detection.

AU9290 detect step-out by change of motor current at high speed control situation.

Although step-out cannot be detected always for the above reason, this detection is still effective because step-out occurs due to torque decay at high speed rotation.

When step-out is detected, Bit8 of Drive Status (Data ID #100) turns to 1 and status-LED indication changes to orange blinking from green blinking.

When motor stops, step-out detection turns to off.

If Bit0 of Alarm-Mask (Data ID #35) is set to 0, AU9290 generate an alarm status at step-out detection. Alarm code of step-out is '2' same to over-load. Status-LED repeates 2 times red blinking.

Number of step-out detections can be monitored by the value of Data ID #210.

11. Protection for abnormal status

AU9290 is continuously checking the status and stop driving the motor when error is detected.

Red LED repeats blinking indicating alarm code number (see article 5).

You can also confirm the alarm code in Data-ID #101.

Table 10.1 Alarms and the solutions

Code	Alarm name and the detail, the cause and the handling
1	[Over current] Detect over current by shunt resistor. 1. Short of motor winding ⇒ Replace the motor 2. Short of motor cable ⇒ Replace the cable 3. Breakdown in motor drive circuits ⇒ Replace AU9290.
2	[Over load] Average current of motor exceeded rated current of driver. 1. Motor rated current is too large ⇒ Review parameters (#3, #4, #40). 2. Abnormal control of motor current ⇒ Review parameters (#41, #42). 3. Breakdown of drive circuit ⇒ Replace AU9290. [Step-out] Step-out is detected 1. Load torque is too large ⇒ Review the load and motor selction. 2. Velocity command is too large ⇒ Review the command velocity Review the motor selection.
3	[Current control error] Average deviation of current control is too large. 1. Breakdown of motor ⇒ Replace the motor 2. Disconnection of motor cable ⇒ Replace the cable 3. Abnormal control of motor current ⇒ Review parameters (#41, #42).
4	[Current offset error] Offset in current sensing is too large. 1. Breakdown in current sensing circuits ⇒ Replace AU9290.
5	[Overheat] Temperature exceeded overheat detection level (#38). 1. Motor current is too large ⇒ Review parameter (#3, #4, #40). 2. Abnormal control of motor current ⇒ Review parameters (#41, #42). 3. Breakdown in motor drive circuits ⇒ Replace AU9290.
6	[Over voltage] Power voltage exceeded over voltage detection level (#36). 1. Voltage increased by regeneration. ⇒ Review operation pattern. 2. Breakdown in voltage sensing circuits ⇒ Replace AU9290.

Code	Alarm name and the detail, the cause and the handling
7	[Voltage drop] Power voltage decreased under the value (#37). 1. Shutdown of Power supply ⇒ Research regeneration effect. 2. Disconnection of power cable ⇒ Replace power cable. 3. Voltage drop caused by power cable ⇒ Change the cable shorter. 4. Breakdown of drive circuit ⇒ Replace AU9290.
8	[Parameters error] Value of a Parameter is wrong. (This alarm is detected at parameter saving.) 1. Zero or negative value in a parameter where only positive value is allowed. 2. Negative value in a parameter where zero or positive value is allowed. ⇒ Change the value of wrong parameter that Data-ID #189 shows.
9	[Memory read failure] (This alarm happens at power-ON.) 1. Malfunction by noise ⇒ Power OFF and Power ON. 2. Memory data is destroyed. ⇒ Initialize and save parameters. 3. Breakdown of non-volatile memory ⇒ Replace AU9290. [Memory save failure] (This alarm happens at parameter saving) 1. Malfunction by noise ⇒ Try parameter save again. 2. Breakdown of non-volatile memory ⇒ Replace AU9290.

12. Data list

All the data in AU9290 has Data-ID, and each value can be monitored.

Most of the data with ID less than 100 can be changed.

The data with ID less than 60 are called Parameters and can be saved in nonvolatile memory.

The data size with ID larger than 999 is 32 bits long and 16 bits long for others.

Parameter #0～#9, Basic operation parameters

ID	Name	Content
0	Control mode	1：Position control mode 2：Speed control mode
1	Pulse command mode	0：F-Pulse/R-Pulse 1：Pulse/Direction 2：F-Pulse/R-Pulse (opposite direction). 3：Pulse/Direction (opposite direction). Note: This parameter shall be set to 4 to enable PIO function in case of AU9290N103 and N104
2	Micro-step magnification	This value determines the positioning resolution. The positioning resolution is calculated by： (Basic Number of Steps)×(Micro-step magnification)
3	Rotating Motor current	Set motor current at rotating Unit：[%／Rate current]
4	Stopping Motor current	Set motor current at stopping Unit：[%／Rate current]
5	Stop detection time	Confirmation time to detect stop status Unit：[m sec]
6	PIO input filter	Set filtering time for PIO input signals. Unit: m sec
7	PIO select	Set origin search method and enable signal porarity in according to Table 10.1 in paragraph 10.7.

Parameter #10～#13, Parameters for movement profile calculation

ID	Name	Content
10	Minimum travel speed	Minimum speed at Acc./Dec. Unit : [rpm]
11	Speed limit	Set Maximum speed. Unit : [rpm]
12	Acceleration	Set acceleration. Unit : [10rpm/sec]
13	Deceleration	Set deceleration. Unit : [10rpm/sec]

Parameter #14～#29, Parameter for PIO control.

ID	Name	Content
14	Travel speed -0	Target speed when PIO inputs are 0 and 4 Unit : [rpm]
15	Travel speed -1	Target speed when PIO inputs are 1 and 5 Unit : [rpm]
16	Travel speed -2	Target speed when PIO inputs are 2 and 6 Unit : [rpm]
17	Travel speed-3	Target speed when PIO inputs are 3 and 7 Unit : [rpm]
20	Travel command -0	Travel distance when PIO inputs are 0 Unit : [Pulse]
21	Travel command -1	Travel distance when PIO inputs are 1 Unit : [Pulse]
22	Travel command -2	Travel distance when PIO inputs are 2 Unit : [Pulse]
23	Travel command -3	Travel distance when PIO inputs are 3 Unit : [Pulse]
24	Travel command -4	Travel distance when PIO inputs are 4 Unit : [Pulse]
25	Travel command -5	Travel distance when PIO inputs are 5 Unit : [Pulse]
26	Travel command -6	Travel distance when PIO inputs are 6 Unit : [Pulse]
27	Travel command-7	Travel distance when PIO inputs are 7 Unit : [Pulse]
28	Travel command magnification	Travel distance is given by each Travel command multiplied by this value.

Parameter #30～#39, Parameters for Serial communication control

ID	Name	Content
30	Device ID	Device ID for serial communication : 1～15
31	Baud rate	Set serial communication frequency : Unit : [0.1kHz]
32	UART setting	0 : STOP=1, Parity= non, Length=8 1 : STOP=2, Parity= non, Length=8 10 : STOP=1, Parity=even, Length=9 11 : STOP=2, Parity=even, Length=9 20 : STOP=1, Parity=odd, Length=9 21 : STOP=2, Parity=odd, Length=9
33	Communication protocol	0: TSC-standard 1: Modbus-ASCII 2: Modbus-RTU

Parameter #30～#39, Parameters for Alarm detection

ID	Name	Content
35	Alarm Mask	Bit0 = 1: Step-out alarm is masked and ignored. Bit2 = 1: Over load alarm is masked and ignored. Bit3 = 1: Current control error is masked and ignored. Bit5 = 1: Over-heat alarm is masked and ignored. Bit7 = 1: Voltage drop alarm is masked and ignored.
36	Over voltage detection value	Unit : [0.1V]
37	Voltage drop detection value	Unit : [0.1V]
38	Over-heat detection value	Unit : [0.1℃]
39	Current control error detection value	Set by percentage against motor rate current [%／rate current]

Parameter #40～#45, Motor Parameters.

ID	Name	Contents
40	Motor rate current	Set motor rate current Unit : [0.01A]
41	Winding resistance	Set motor winding resistance Unit : [0.01Ω]
42	Winding inductance	Set motor winding inductance Unit : [0.01mH]
43	Motor inertia	(Reserved)
44	Basic Number of Steps	Set the value calculated by 360÷Basic Step Angle
45	Motor type	(Reserved)

Parameter #48～#59, Driver Parameters

ID	Name	Content
48	Kcp	Current control loop proportional gain Unit : [rad/sec]
49	Kci	Current control loop integral gain Unit : [rad/sec]
50	Current scale	(System parameter) Unit : [0.01A]
51	Drive rate current	(System parameter) Unit : [0.01A]
52	Drive maximum current	(System parameter) Unit : [0.01A]
53	Voltage scale	(System parameter) Unit : [0.1V]
54	Driver type	(System parameter)
-	-	-
56	Product Code	(System parameter)
57	Software Code	(System parameter)
58	Revision	(System parameter)

Data #60～#69, Control data for serial communication control

ID	Name	Content
60	Drive command	Bit0 = 1: Drive on Bit2 = 1: Reset present position (DataID #1000) Bit3 = 1: Alarm clear Bit6 = 1: Start origin search Bit7 – Bit10: Equivallent to PIO inputs DIN1 – DIN4
61	Travel command	Set travel distance Unit : [Pulse]
62	Travel speed	Set target speed Unit : [rpm]
63	Voltage command	Set target voltage at voltage control mode. Unit : [0.1V]

Data #70～#79, Non-volatile memory handling data

ID	Name	Content
70	Parameters-Init	Set 1 to initialize all parameters to default value.
71	Parameters-Save	Se1 to store all parameters in non-volatile memory.
72	History-Save	Set 1 to store alarm histories to non-volatile memory. Set 9 to clear alarm histories.
73	Parameters-Read	Set 1 to read all parameters from non-volatile memory.
74	History-Read	Set 1 to read alarm history from non-volatile memory.
189	Error-Parameter-ID	Error ID is stored here when alarm-8 is occurred.

Data #100～#119, Status

ID	Name	Content
100	Drive Status	Bit0: '1' at drive ON Bit1: '1' at drive ready Bit2: '1' when motor is at targeted position. Bit3: '1' at alarm Bit6: '1' when origin search operation is completed. Bit8: '1' when step-out is detected. Bit9: '1' when power voltage is at over voltage level Bit10: '1' when power voltage is at low voltage level Bit11: '1' at overheat Bit12: '1' at over-load Bit14: '1' at current control error. Bit15: '1' at origin search operation fault
101	Alarm Code	Current alarm code
102	AlarmHistory-1	Alarm codes from last to 3 time before.(4bit x 4)
103	AlarmHistory-2	Alarm codes from 4 to 7 times before (4bit x 4)
104	AlarmHistory-3	Alarm codes from 8 to 11 times before (4bit x 4)
105	AlarmHistory-4	Alarm codes from 12 to 15 times before (4bit x 4)
106	AlarmHistory-5	Alarm codes from 16 to 19 times before (4bit x 4)
107	AlarmHistory-6	Alarm codes from 20 to 23 times before (4bit x 4)
108	AlarmHistory-7	Alarm codes from 24 to 27 times before (4bit x 4)
109	AlarmHistory-8	Alarm codes from 28 to 31 times before (4bit x 4)

Data #110～#112, Monitor for I/O status, power voltage and temperature

ID	Name	Content
110	I/O Status	Bit0 : indicates status of Enable signal Bit1～Bit4 : indicate status of IN1～IN4 input signals Bit8 : indicates status of OUT1 output signal
111	Power voltage	Voltage applied to power circuits Unit : [0.1V]
112	Motor temperature	Temperature around power devices Unit : [0.1℃]

Data #120～#121 Motor current

ID	Name	Content
120	Motor current（instant）	Instantaneous motor current Unit : [0.01A]
121	Motor current（average）	Motor current averaged for 0.1sec Unit : [0.01A]

Data #1000～#1002, Position data (32 bits)

ID	Name	Content
1000	Actual position	Present motor position Unit : [Pulse]
1001	Position deviation	Difference between Actual position and target position Unit : [Pulse]
1002	Target position	Position directed to move Unit : [Pulse]

13. Specifications

Basic specifications

PN	AU9290N1xx	AU9290N2xx	AU9290N4xx
Power voltage	DC15V～DC28V	DC15V～DC36V	DC30V～DC50V
Applicable stepping motor	2 phase-unipolar winding	2 phase- Bipolar winding 2 phase-Unipolar winding	
Drive method	Micro-step current control drive Micro-step angle : Motor basic step angle ÷ 64		
Rating Output	1.8 Arms	2.4 Arms	2.0 Arms
Installation Environment	Operation temperature : 0～50℃ (note1) Humidity : Less than 90%RH (No condensation)		

Note1: This value does not ensure a continuous operation with driver rating output without detecting over-heat alarm.

Functions and Performances

PN	Nx0x	Nx1x	Nx2x	Nx3x	N103,N104	N105,N106
Pulse inputs	2 inputs (note2)				2 (note5)	Non
Digital input	1 (note3)	5 (note3)	1 (note3)		5 (note5)	1 (note6)
Digital output	non	1 (note4)	Non		Non	
Communication	Non				RS485	RS232C
I/F for PC	USB2.0 (Full speed)					
Functions	Please refer to paragraph 10					
Protections	Please refer to paragraph 11					
Parameters	All Parameters are saved in EEPROM					
Indication	2-color LED					

Note2: Isolated with photo-couplers. Pulse signals up to 500 kHz are accepted in case output circuits are differencial line driver.

Note3: Isolated with photo-couplers.
Interface voltage is 5V for Nxx0 and Nxx1 and 12-24V for Nxx2.

Note4: Isolated with photo-coupler. Maximum output current is 40 mA.

Note5: Pulse input circuits are shared with Digital inputs circuits.
Receiving circuits are isolated with photo-couplers.
Interface voltage is 5V for N103 and 12-24V for N104.

Note6: Isolated with photo-coupler.
Interface voltage is 5V for N105 and 12-24V for N106.

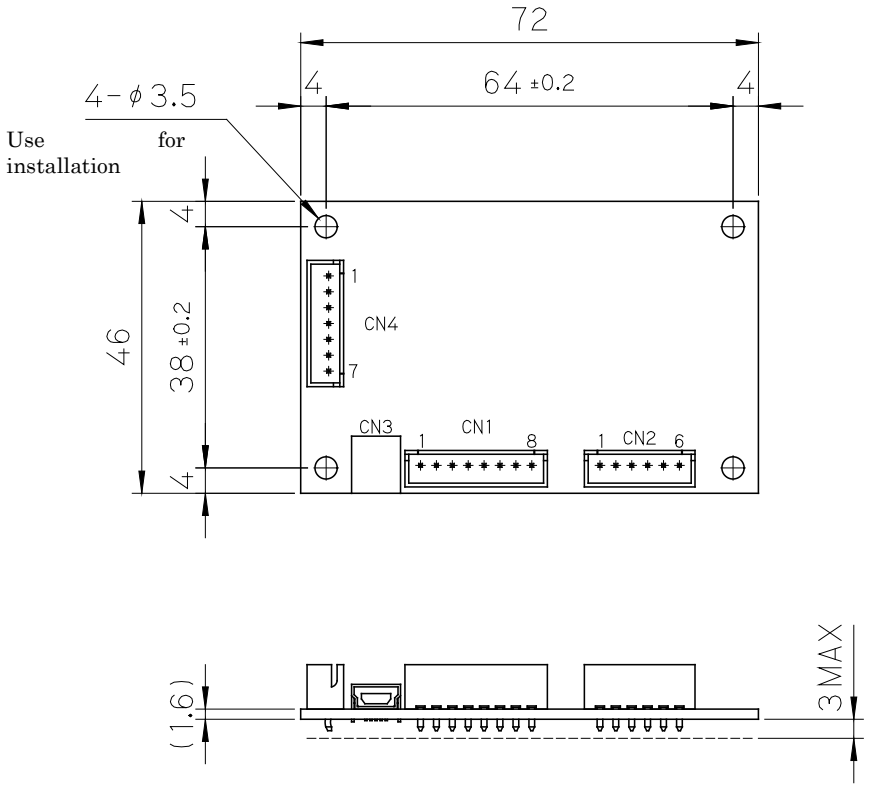
Connectors

No.	Model of Connector	Mating connector	
		Housing	Socket Contact
CN1	B8B-X1-A(LF)(SN) (JST)	XHP-8	SXH-001T-P0.6
CN2 for N1xx	B6B-X1-A(LF)(SN) (JST)	XHP-6	SXH-001T-P0.6
CN2 for N2xx, N4xx	B4B-X1-A(LF)(SN) (JST)	XHP-4	SXH-001T-P0.6
CN3	USB-Min B	-	
CN4 (note7)	B7B-X1-A(LF)(SN) (JST)	XHP-7	SXH-001T-P0.6

Note7: CN4 is not provided for AU9290Nx0x.

14. Outline drawing

Diagram 14.1 AU9290 outline drawing 図



Revision history

Date	Change content	Note
2016.03.21	First edition	
2017.07.18	Reviewed all pages Additions: (1) Description of N103-N06 (2) Origin search function (3) Step-out detection function (4) Description of Modbus-ASCII and Modbus-RTU for serial communication protocol.	2nd Edition