Operation Manual

AC Servo Driver GPX2 Series

GPX2 - 80	GPX2 - 40	GPX2 - 16	GPX2 - 8
GPX2 - 60	GPX2 - 24	GPX2 - 12	

Sincerely we appreciate your purchasing our product.
This operation manual explains about function and connection methods of a servo driver GPX2 series. To use at the optimum situation, please be sure to read this before using.


WACOGIKEN

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< REVISION HISTORY >

DATE	NUMBER	CONTENTS
2019.02.21	D0502008	FIRST EDITION

1 Before use

Followings are general notes which should be read before using our servo driver.
Please make sure to read them and use it correctly.
Please keep this manual so that it can be used by an operator of this equipment.

Safety precautions

Please use the equipment after knowing well about an equipment, all safety note.
This operation manual dividing safety precaution ranking by 『Dangerous』 and 『Caution』 .

| ◇! Dangerous | In case of miss handling, dangerous situation may happen and death and or serious injuries can be considered. |

| ⚠ Caution | In case of miss handling, dangerous situation may happen and moderate injury and or minor injury possibility and physical disorders can be considered. |

Even an accident happened at Caution case, depending on situation it may cause big accident.
Please keep precaution written here as it contains important notes.

Following symbols are used here, depending upon necessity.

Symbols	Meaning		Symbols	Meaning
🚫	General prohibition notice		✋	Don't touch
🚫	Disassemble		⚠🔥	Caution of ignition
❗	Compulsion (be sure to do)		◇⚡	Caution of electric shock
⏚	Be sure to ground earth terminals		⚠💥	Caution of explosion

1) Transportation・Installation

⚠ Caution

⚠	Servo controller, servo driver and servo motor are precision equipment's. Please pay attention not drop and give a strong impact.
⚠	Please pay attention about over loading of the products as it may cause a load collapse.
⚠	Please do not step on the products and do not load any heavy articles on the top of the product.
⚠	At time of transporting servo motors, please do not hold motor cable and motor axis. There is a danger of causing injury and destruction of the products.
🔥	Please make sure to follow an installation instruction. Please follow heat sink instruction. Otherwise it may cause fire or malfunction.
🔥	Please make sure not to close an exhaust port or prevent exhausting. Please do not insert any foreign articles into exhausting port. It may cause a fire.
❗	Please keep an instructed distance between a servo controller, a servo driver and inside of control panel and other equipment's. Otherwise there is a danger of a malfunction.
🔥	At a servo driver which has a regenerative absorption circuit, in case you use an external regenerative resistor, please switch off the power by an abnormal signal. There is a danger regenerative resistor may be over heated and cause a fire, by regenerative transistor's malfunction.
🚫	Please do not install at the place where there is corrosive gas, oil, dust, water vapor and metal powder. It may cause a malfunction.
🚫	Please do not connect to bad quality power supply. (Variation ±more than 10%, pulse noise more than 1kV). It may cause a malfunction.
🚫	Please do not install at the place with heavy vibration and or a hermetically sealed. It may cause a malfunction.

❗	Please keep an operation environment temperature.
	    Servo controller, Servo driver : 0～50 [℃]
	    Servomotor : 0～40 [℃]

❗	Please keep an operation environment humidity.
	    Servo controller, Servo driver : less than 85 [%RH]
	    Servo motor : less than 80 [%RH] (both no condensation)

❗	Please fix firmly servo motor onto a machine. If fixation is not enough, it may come out during operation. There is a danger of injury and malfunction.
✋	During operation, please be absolutely sure not to touch moving portion of servo motor, by setting a cover to an axis. There is a danger of an injury.
🚫	At the time of coupling combining to axis end of servo motor, please do not give any impact like beating by hammer. There is a danger a detector and bearing may cause a malfunction.
🚫	Please do not give a load more than permitted on a servo motor axis. It may destroy the bearing, break the axis.
🚫	Please strictly never process on main frame and or axis of servo motor. It may cause a malfunction.

2) Wiring

 Danger

⚡	Wiring operation and an inspection should be done by professional specialist. Wiring should be done correctly and firmly. Otherwise a runaway of servo motor and electric shock may happen.
🔥	Wiring material should be used according to an instructed capacity. Otherwise there is a danger of firing by over heating.
⚡	Please be sure to ground the earth terminal of a servo driver (PE or FG terminal). There is a danger of electric shock.
⏚	Please be sure to ground for improvement of noise tolerance dose and reduction of radiation noise. We recommend ground method of D contact ground (less than 100Ω, more than $\phi 1.6$mm)
⚡	Please do not harm, put unreasonable stress, load heavy articles, and sandwiched. There is a danger of electric shock.
💥	Please do not mix up terminal connection wrongly. Please keep permitted voltage. Otherwise there is a danger of bursting and damage.
🔥	In the case of malfunction of servo driver, please switch off at power supply side of servo driver. It may cause a fire if big current keeps running.

3) Operation

⚠ Caution

⚠	Please make confirmation adjustment of each setting value before operation. Some machine may make unexpected action.
⚠	Please never change adjustment by extreme way as such cause unstable action. Please pay attention not to cause electrical short circuit on an inspection terminal (monitor). It may cause some injury.
❗	Please set an external emergency stop circuit so that operation can be immediately stop and power supply can be cut.
⚠	Trial operation should be done under circumstances of the motor is firmly set and separated from the machine. In case machine is operated without confirmation and adjustment, it might cause malfunction or injury of operator.
⚠	In the case of an alarm is generated, please get rid of the cause of an alarm, confirm safety and reset an alarm then start operation again. Otherwise it may cause some injury.
⚠	Please use a servo motor and a servo driver by an appointed combination. Otherwise it may be damaged.
⚠	A retention brake is not a stopping equipment to confirm a security of machine. Please set a stopping equipment on the machine side to keep a security. Otherwise there is a danger of injury of an operator.
⚠	Please be very careful the machine starts an operation suddenly after a recovery of power cut. (Please set a machine so that it will confirm a security of an operator after re starting an operation) There is a danger of injury.
⚠	Please try to minimize an influence of electro magnetic interference by something like noise filter. There is a danger it may give an electromagnetic interference to an electronic equipment's used nearby the servo driver.
🖐	Please do not touch to a radiator of servo driver, regenerative register and frame of servo motor carelessly as those can be very hot. There is a danger of a burn.

4) Maintenance, Inspection and Components

⬦ Danger

⚡	Inspection should be done more than 5 minutes after an input power supply is switched off. There is a danger of an electric shock.
⚡	Please do not make an inspection while a power is on. There is a danger of an electric shock.

△ Caution

△	A condenser at power supply line lower a capacity by deterioration. We recommend to change each about 5 years to prevent secondary disaster by Malfunction. In that opportunity, please contact us.

⬭ Prohibition

⬭	About driver and sensor portion of motor, please do not make Mega Testers・Pressure test. It may damage a control circuit.
⬭	Please never dismantle, modify and repair. We do not take any responsibility to an accident caused by a repair done without any permission.

5) Disposal

△ Caution

△	Please process as a general industrial waste.

6) Others

△ Caution

△	Although we are paying our maximum possible efforts to keep quality of this product、 by unexpected external noise, static electrode, if anything should happen on components, terminal wiring, it may act unspecified. Please pay your maximum attention on security of your machine and surroundings. There is a danger of an injury.

7) Warranty

< Gratis warranty period >

Whichever comes earlier, less than 12 months after start of use at your company or your customer's place by proper use range, or 18 months after our shipment.

< Range of warranty >

It is understood following 4 items are chargeable and others are free of charge.

・By you and at your customers place, inappropriate storage, handling, carelessness, accident and malfunction caused by your design.

・Malfunction caused by repair and dismantle done by you without our permission.

・Malfunction caused by use of our product out of specification range.

・All other malfunction which you recognize as out of our responsibility.

In principle, a repair can be done in Japan only.
Any repair out of warranty period and repair at oversea, the cost, postage should be paid by you.
It is understood any damage to an equipment except for ours, and any other treatment is understood excluded from compensation.

1.1 Confirmation of combined motor

Our driver has a matching information to combined motor.
If operation is done by different combination, there is a danger of a damage may happen on motor and driver.
Please use them after confirming your using motor model matches to the one sealed on a driver.
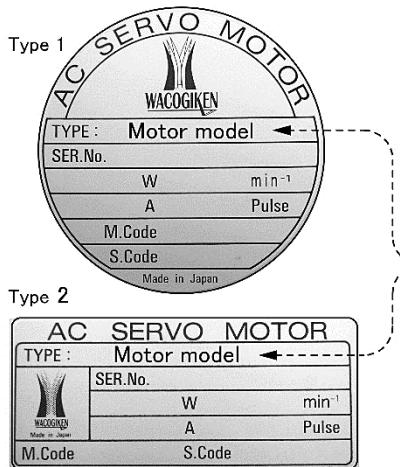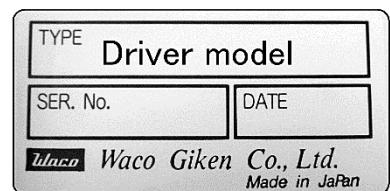
1.2 Optional goods

We have prepared following connection cables between motors and tool soft ware for setting as optional goods.
Please select if necessary and order to us in addition to main products.

Application	Name	Model	Remarks
Parameter setting	Tool soft ware	TelGPX2	
	Communication cable 3m	GP2-RS3	
Wiring components	CN1.connection connector ※1	GP2-CN1C	
	CN2.connection connector	GP2-CN2C	
	CN3.connection connector	GP2-CN3C	
	TB1.connection terminal ※2	GP2-TB1C	
	TB2.connection terminal ※2	GP2-TB2C	
Motor connection	Motor power cable 3m	GP2-MC3	～750 [W]
	Motor power cable 5m	GP2-MC5	～750 [W]
	Motor power cable 8m	GP2-MC8	～750 [W]
	Encoder cable 3m	GP2-EC3	
	Encoder cable 5m	GP2-EC5	
	Encoder cable 8m	GP2-EC8	
	Resolver cable 3m	GP2-RC3	
	Resolver cable 5m	GP2-RC5	
	Resolver cable 8m	GP2-RC8	

　※1 : Accessory common to all models.
　※2 : Accessory specially for GPX2‐16～8 (small capacity type).

　◎We can do some special modification like cable length. Please contact to our sales
　　department.

1.3 Name of each part

GPX2‐80, GPX2‐60

GPX2 - 40, GPX2 - 24

- Dip-SW 1〜4 (Upper side)
- VR1, 2 Gain volume
- LED1〜3 Condition display
- TP1, 2, GND Test terminal
- CN3 Communication connector 1
- CN4 Communication connector 2
- CN2 Sensor connector
- CN1 Input and output connector
- TB1 Power supply/motor terminal stand

TB1 POWER

L1C	1	～
L2C	2	
PE	3	⏚
L1	4	≋
L2	5	
L3	6	
RB1	7	
RB2	8	
U	9	MOTOR
V	10	
W	11	
FG	12	

WACOGIKEN

Ac Hi servo
GPX2-

VR1
VR2
TP1
TP2
GND
CN3 COM1
CN4 COM2
CN2 SEN
CN1 I/O

CAUTION
WARNING

1.4 Installation Method

GPX2 - 80, GPX2 - 60

unit : [mm]
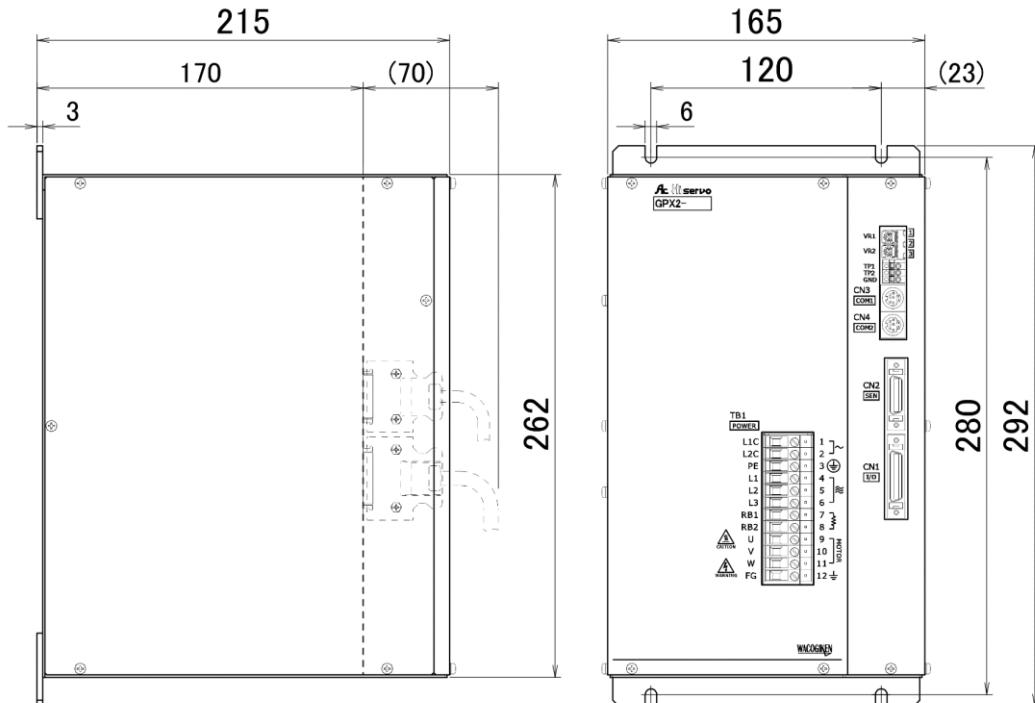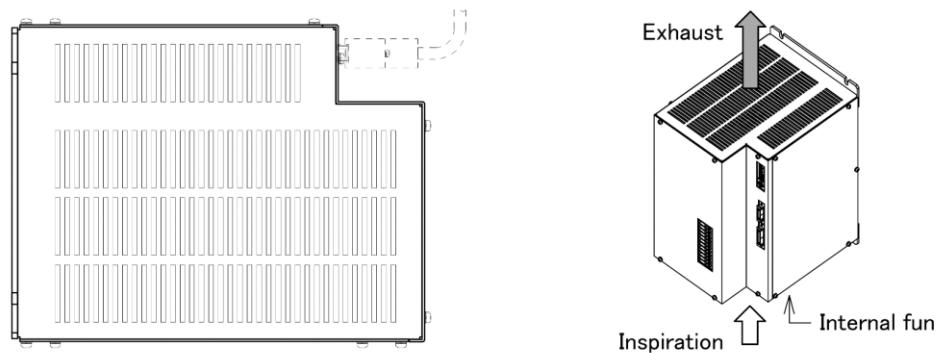
GPX2‑40, GPX2‑24

unit : [mm]
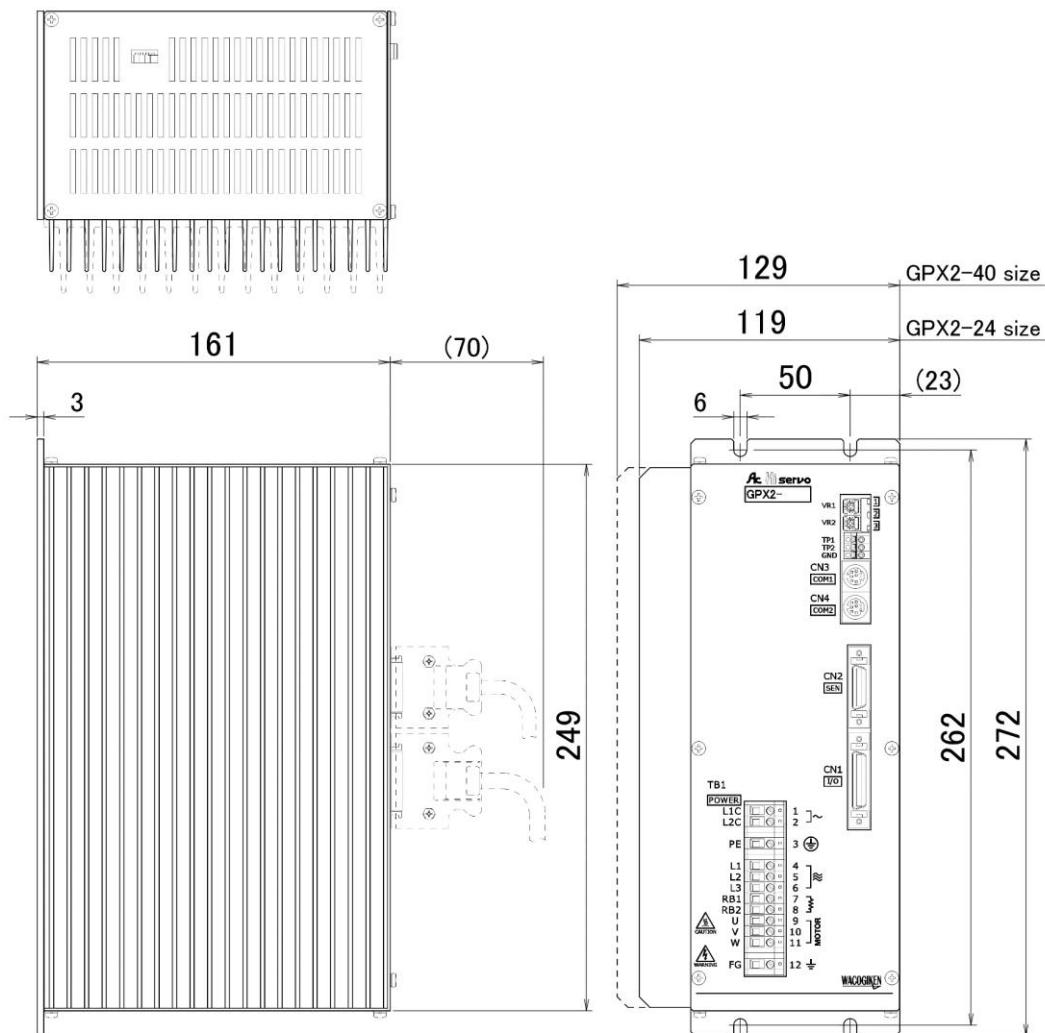
Before use

GPX2 - 16, GPX2 - 12, GPX2 - 8

unit : [mm]

- 18 -
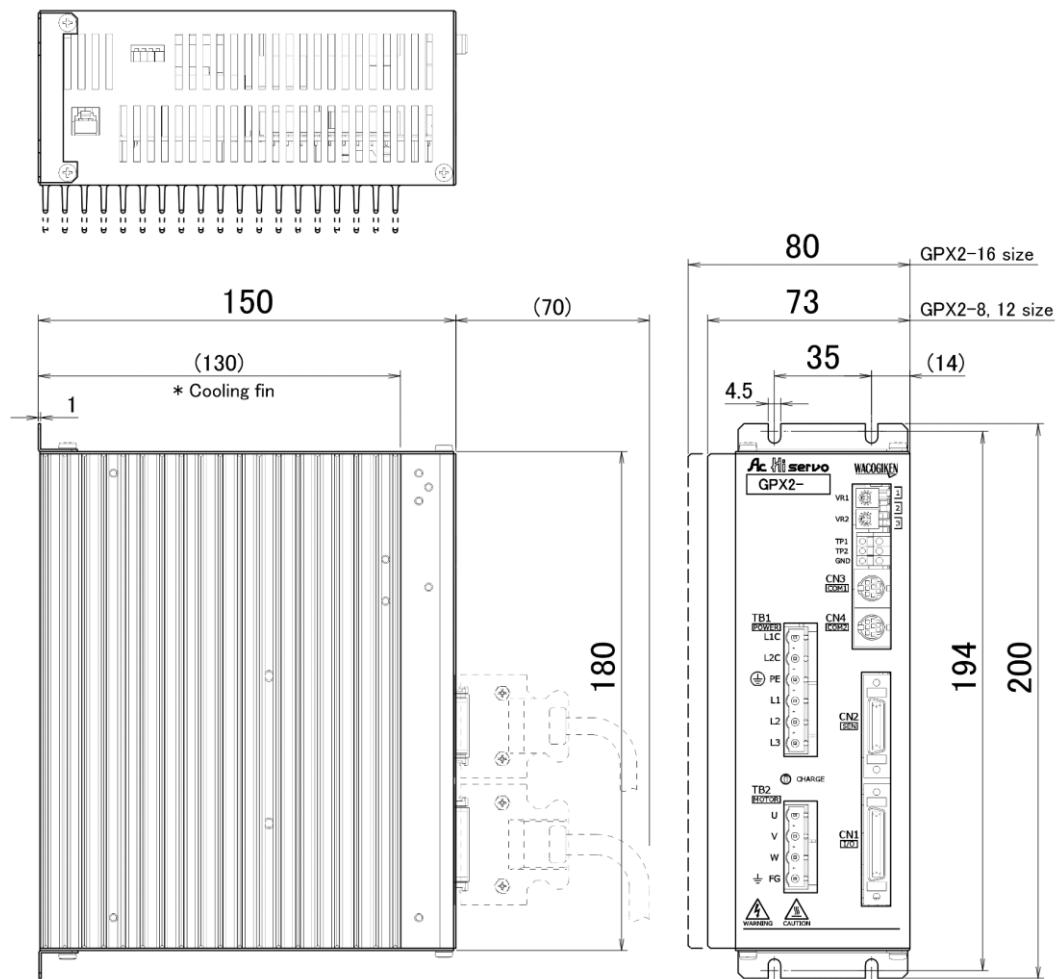
1.5 Installation

Please install a driver correctly to prevent any malfunction and accident.
A capability of the driver changes largely depending on heat radiation. Please take care the following points.

◎Please be sure to install vertically so that words can be seen in front as it is shown on drawing. If you install it up side down and or lay down, there is a possibility of partial over heating and causing troubles.
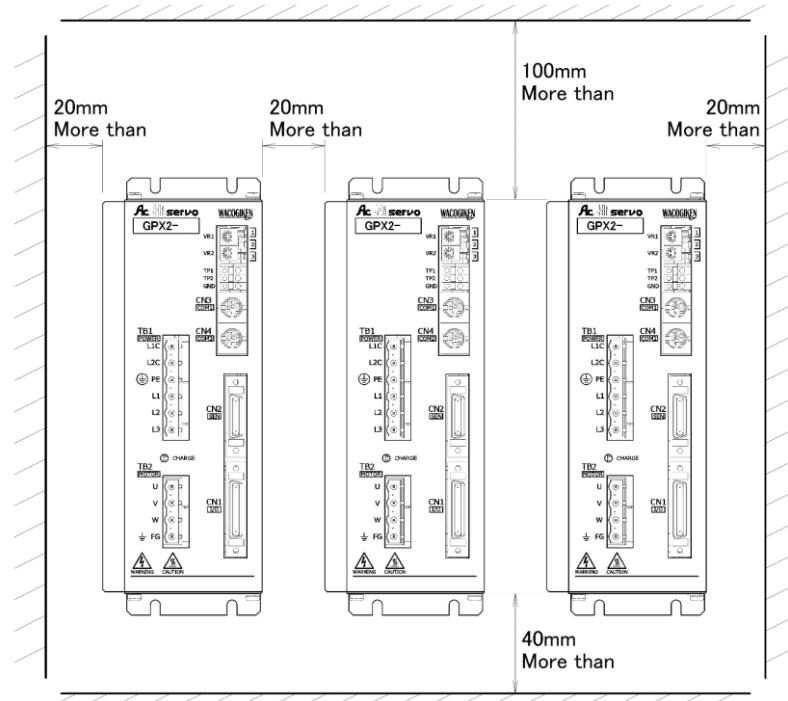
◎To avoid a heat interference, please keep a distance with other equipment or wall as it is shown on the drawing.

◎It is effective if you install it at the place where a heat does not muffled and make forced air circulation by fun.
In the case of forced air circulation is affected, you may set an installation distance less than 20 [mm], with in a range of a ventilation is not prevented.

◎GPX2 - 80, GPX2 - 60 : Cooling fun is installed at lower side of driver.

＜ Place of installation ＞

・Where rain and direct sunshine do not exist. （the equipment is not water proof）

・Where a corrosive gas, sprayed oil, dust and metal powder do not exist.

・Where less dust, no condensation and no frozen.

・Where there is no vibration.

＜ Environmental condition ＞

・Storage temperature　−10 [℃] ～ 80 [℃]　（no frozen）

・Storage humidity　less than 90 [%RH]　（no condensation）

・Operation temperature　0 [℃] ～ 50 [℃]　（no frozen）

・Operation humidity　less than 85 [%RH]　（no condensation）

＜ Installation ＞

・Please fix firmly by 4 pieces of M4 screw (GPX2 - 16~8), 4 pieces of M5 screw (GPX2 - 80~24).

・If there is any paintings on the surface of installation, it is effective for antinomies' measures to install after pealing off the painting.

2 Wiring

About wiring, please make sure it is done by a specialist of electric construction work and be careful about following points, please.

◎To prevent an electric shock, please do not switch on until wiring work is completed. Once switched on, please keep 5 minutes interval to start a work again, after switched OFF.

◎While main power supply charge lamp at front panel of GPX2‐8～16 is ON, charge remains in driver. Please be careful.

◎To prevent Electric shock and malfunction of driver by foreign noises, please make sure to ground the earth terminal PE.
Please connect motor ground FG(E) to driver special terminal FG. You can connect to the earth through above mentioned ground terminal PE.

◎For power supply wiring, please do not use not appointed terminal.
Please do not use poor quality power supply. (Variation more than ±10%, pulse noise more than 1kV)

◎Please take care a motor power and a power supply wiring should not give noise influence to other equipment's.
In order to prevent noise influence as much as possible, a wiring of position sensor and a wiring of control signal should be another system from motor power and power supply wiring.

◎A connection cable length between driver and motor differs according to a motor position sensor specification. Please contact to our sales department in case of using cable length more than below.
　　　・Encoder specification　　：10 [m]
　　　・Resolver specification　　：20 [m]

◎In this manual, to connect our motor, we describe counter clock wise (CCW) rotation as forward at the time of shipment.

Wiring

3 phase AC200[V]

Wiring circuit breaker

No fuse built in driver main power supply.
Please design externally
shut down possibility.

Tool software
TelGPX2

Noise filter

Please insert noise filter.
It prevent external noise from
power supply line to driver.

Please design an external switch
can cut driver main power supply
in case of emergency.

Electro magnetic contactor

RS-232C
D-Sub 9pi nfemale

Communication cable
GP2-RS3

Main power source

Control power supply

Please refer
「2.4 Communication
connection」

CN3

Ac servo

L1C
L2C
PE
L1
L2
L3

TB1

CHARGE

Please refer position sensor
「2.2 Motor connection」

CN2

Please refer
「2.1 Wiring of power supply」

Protective earth

Control I/O

CN1

U
V
W
FG

TB2

Please refer
「2.3 Wiring of control signal」

Please refer power line
「2.2 Motor connection」

Earth

Motor power cable
GP2-MC□

Resolver cable
GP2-RC□

Encoder cable
GP2-EC□

Brake line
(motor option)

Please refer holding brake
「2.2 Motor connection」

＊Option cable
GP2-MC□
GP2-RC□
GP2-EC□

Cable length
3: 3m, 5: 5m, 8: 8m

Other cable length, please contact to our sales department.

BNRII series
(Resolver)

LNE,LNEII series
(Encoder)

2.1 Wiring of power supply

We need a control power supply to start a driver and main power supply to drive a motor.
Both power supplies are insulated internally in driver.

GPX2‑80, GPX2‑60
・TB1：Power supply/motor terminal plate 〔POWER〕

Pin‑No.	Name		Abbreviation
1	Control power supply input	Single phase	L1C
2	Control power supply input	AC200〜240[V]	L2C
3	Protective earth		PE
4	Main power supply input		L1
5	Main power supply input	Three phases	L2
6	Main power supply input	AC200〜240[V]	L3
7	External regenerate resistor（optional）		RB1
8	External regenerate resistor（optional）		RB2
9〜12	（Item 2.2）Written on motor connection.		—

＜Parts＞

Driver： FRONT4‑H‑6.35 （Made by phoenix contact）	※Wire insert type

◎In case you use single or stranded wire, please set stripped wire 14 [mm].
In case you use insulated sleeve bar terminal (made by phoenix contact), please refer below.

Wire material	Wire diameter	Terminal	Stripped wire	Remarks
AWG10 (UL1015)	About 4.7 [mm]	AI6‑12YE	More than 13 [mm]	Please cut protruded material after pressing bar terminal.
AWG12 (UL1015)	About 4.1 [mm]	AI4‑12GY		
AWG14 (UL1015)	About 3.6 [mm]	AI2,5‑12BU		

GPX2‑40, GPX2‑24
・TB1：Power supply/motor terminal plate 〔POWER〕

Pin‑No.	Name		Abbreviation
1	Control power supply input	Single phase	L1C
2	Control power supply input	AC200〜240[V]	L2C
3	Protective earth		PE
4	Main power supply input		L1
5	Main power supply input	Three phases	L2
6	Main power supply input	AC200〜240[V]	L3
7	External regenerate resistor（optional）		RB1
8	External regenerate resistor（optional）		RB2
9〜12	（Item 2.2）Written on motor connection.		—

＜Parts＞

Driver： FRONT 2,5‑H/SA 5 （Made by phoenix contact）	※Wire insert type

◎In case you use single or stranded wire, please set stripped wire 9 [mm].
In case you use insulated sleeve bar terminal (made by phoenix contact), please refer below.

Wire material	Wire diameter	Terminal	Stripped wire	Remarks
AWG14 (UL1015)	About 3.6 [mm]	AI2,5‑10BU	More than 11 [mm]	Please cut protruded material after pressing bar terminal.
AWG16 (UL1015)	About 3.2 [mm]	AI1,5‑10BK		
AWG18 (UL1015)	About 2.9 [mm]	AI1‑10RD		

GPX2 - 16, GPX2 - 12, GPX2 - 8

・TB1：Power supply terminal plate   [POWER]

Pin-No.	Name		Abbreviation
1	Control power supply input	Single phase AC100~240[V]	L1C
2	Control power supply input		L2C
3	Protective earth		PE
4	Main power supply input	Three phases AC200~240[V]	L1
5	Main power supply input		L2
6	Main power supply input		L3

＜Parts＞

Driver：	GMSTB 2,5/6-G-7,62 (Made by phoenix contact)	
Wiring side：	GMSTB 2,5/6-ST-7,62 (Made by phoenix contact)	※Accessory

◎In case you use single or stranded wire, please set stripped wire 7 [mm].
　In case you use insulated sleeve bar terminal (made by phoenix contact), please refer below.

Wire material	Wire diameter	Terminal	Stripped wire	Remarks
AWG14 (UL1015)	About 3.6 [mm]	AI2,5 - 8BU	More than 9 [mm]	Please cut protruded material after pressing bar terminal.
AWG16 (UL1015)	About 3.2 [mm]	AI1,5 - 8BK		
AWG18 (UL1015)	About 2.9 [mm]	AI1 - 8RD		

◎Please design circuit you can cut a main power supply in case of emergency.
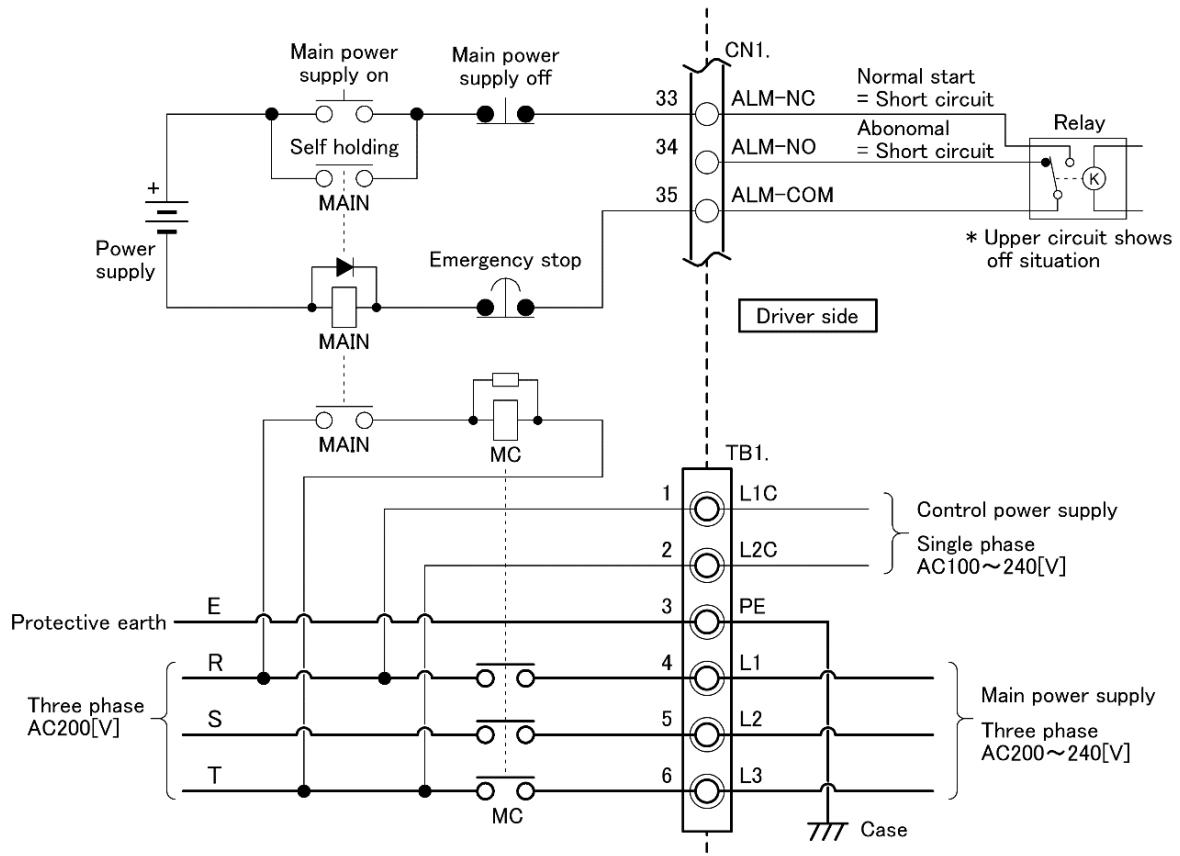
2.1.1 Control power supply

An input voltage range of control power supply differs depending on driver models.
  ・GPX2 - 80, 60   : Single phase AC200～240 [V]
  ・GPX2 - 40, 24   : Single phase AC200～240 [V]
  ・GPX2 - 16, 12, 8   : Single phase AC100～240 [V]
Please use a wire bigger than AWG18 for power supply wiring.

2.1.2 Protective earth

Please be sure to make ground in order to   prevent any wrong action of driver made by electric shock and external noise. For wiring, please use same level of wire as main power supply wiring.
Please do no make transition wiring but to each equipment, please make individual ground wiring.
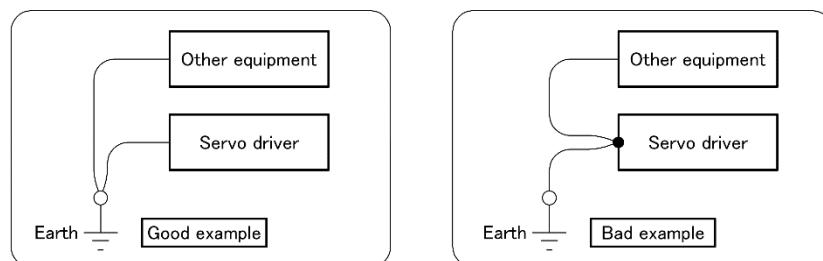
2.1.3 Main power supply

A range of input voltage of main power supply is three phase AC200~240 [V] and a single phase input is also possible depending on a combination of low capacity motor.
Power supply wiring also defers depending on a capacity of motor. Please refer below.

Motor capacity	Input	Wiring	Remarks
3.0～2.2 [kW]	Three phases	More than AWG12	
1.5～1.0 [kW]	Three phases	More than AWG14	
750～400 [W]	Three phases	More than AWG16	
400 [W]	Single phase ※1		Please wire to any two.
200～60 [W]	Three phases	More than AWG18	
200～60 [W]	Single phase		Please wire to any two.

※1 : There is a limitation of usage at motor instant area. For details please contact our sales department.

There is a possibility that main power supply usage changes depending on motor load.
Please make an individual wiring to each equipment, not transition wiring.
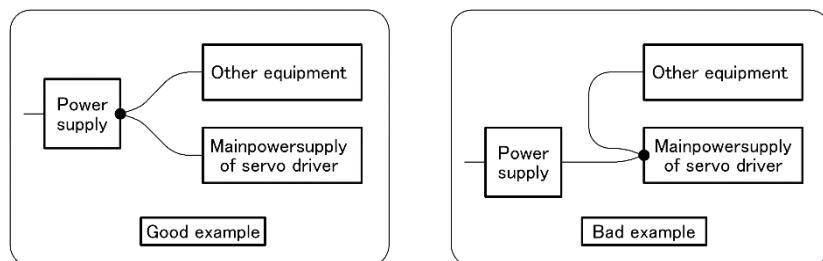
2.2 Motor connection

In order to drive a motor, power line is to be connected to position sensor. In case a holding brake is equipped, brake release circuit would be necessary.
As a wiring connection varies by motor model, please refer below.

Motor model	Power line	Position sensor	Holding brake
LNEⅡ300	GPX2‐80 TB1 wiring AWG12	Encoder CN2 connect ※2	No
LNEⅡ300B			Wiring needed
BNRⅡ300		Resolver CN2 connect ※3	No
BNRⅡ300B			Wiring needed
LNEⅡ220	GPX2‐60 TB1 wiring AWG14	Encoder CN2 connect ※2	No
LNEⅡ220B			Wiring needed
BNRⅡ220		Resolver CN2 connect ※3	No
BNRⅡ220B			Wiring needed
LNEⅡ150,　LNEⅡ100	GPX2‐40 TB1 wiring AWG16	Encoder CN2 connect ※2	No
LNEⅡ150B,　LNEⅡ100B			Wiring needed
BNRⅡ150,　BNRⅡ100-A		Resolver CN2 connect ※3	No
BNRⅡ150B,　BNRⅡ100B-A			Wiring needed
BNRⅡ100C	GPX2‐24 TB1 wiring ※1 AWG18		No
LNEⅡ075C,　LNE075C		Encoder CN2 connect ※2	No
LNEⅡ075BC,　LNE075BC			Wiring needed
BNRⅡ075C	GPX2‐16 TB2 wiring ※1 AWG18	Resolver CN2 connect ※3	No
BNRⅡ075BC			Wiring needed
LNE060C		Encoder CN2 connect ※2	No
LNE060BC			Wiring needed
LNEⅡ040C,　LNEⅡ020C	GPX2‐12 TB2 wiring ※1 AWG18	Encoder CN2 connect ※2	No
LNEⅡ040BC,　LNEⅡ020BC			Wiring needed
LNE040C,　LNE020C		Encoder CN2 connect ※2	No
LNE040BC,　LNE020BC			Wiring needed
BNRⅡ040C,　BNRⅡ020C		Resolver CN2 connect ※3	No
BNRⅡ040BC,　BNRⅡ020BC			Wiring needed
LNEⅡ012C,　LNEⅡ006C	GPX2‐8 TB2 wiring ※1 AWG18	Encoder CN2 connect ※2	No
LNEⅡ012BC,　LNEⅡ006BC			Wiring needed
LNE012C,　LNE006C		Encoder CN2 connect ※2	No
LNE012BC,　LNE006BC			Wiring needed
BNRⅡ012C,　BNRⅡ006C		Resolver CN2 connect ※3	No
BNRⅡ012BC,　BNRⅡ006BC			Wiring needed

※1 : A power line at motor side has been processed with connector. You may use an optional motor power cable (GP2-MC□).

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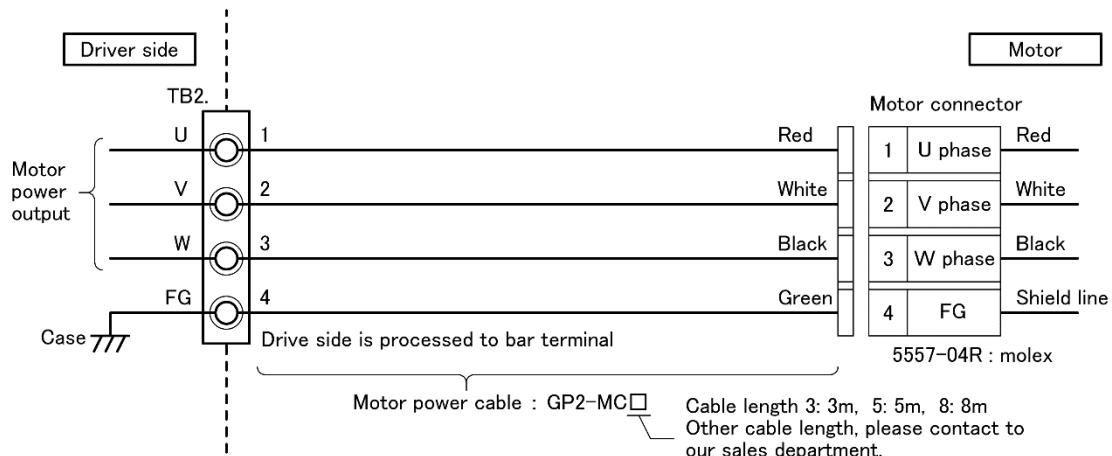
※2 : An encoder sensor at motor side has been processed to connector. You may use an optional encoder cable (GP2-EC□).

Driver side

Motor

CN2.

Encoder connector

CN2	No	Signal		Encoder connector		
A+	1	Grey		1	A	Grey
A−	2	White/grey		9	*A	White/grey
B+	3	Green		2	B	Green
B−	4	White/green		10	*B	White/green
Z+	5	Yellow		3	Z	Yellow
Z−	6	White/yellow		11	*Z	White/yellow
U+	7	White/brown		4	U	White/brown
U−	8	Brown		12	*U	Brown
V+	9	White/orange		5	V	White/orange
V−	10	Orange		13	*V	Orange
W+	11	White/blue		6	W	White/blue
W−	12	Blue		14	*W	Blue
+5VE	14	Red		7	+5V	Red
GNDE	16	Black		15	GND	Black, White/black
+5VE	15			8	ETH	White/red
GNDE	17	Drain wire		16	SD	Drain wire
FG	13					

Feedback signal

Sensor power supply

Each pair

Case

Total shield

5557-16R : molex

* 2 pair of power supply line to be used in case of cable length more than 10m.

Encoder cable : GP2-EC□

Cable length 3: 3m, 5: 5m, 8: 8m
Other cable length, please contact to our sales department.

※3 : A resolver sensor at motor side has been equipped with a connector. You may use an optional resolver cable (GP2-RC□).

Driver side

Motor

CN2.

Resolver connector

CN2	No	Signal		Resolver connector		
R1	18	Green		1	R1	Green
R2	19	Blue		2	R2	Blue
FG	20	Drain wire		3	FG	Drain wire
S1	21	Black		7	S1	Black
S3	22	Yellow		8	S3	Yellow
FG	23	Drain wire		9	FG	Drain wire
S2	24	White		4	S2	White
S4	25	Red		5	S4	Red
FG	26	Drain wire		6	FG	Drain wire

Excitation signal

Feedback signal

Each pair braided shield

Case

Resolver cable : GP2-RC□

50-57-9409 : molex

Cable length 3: 3m, 5: 5m, 8: 8m
Other cable length, please contact to our sales department.

2.2.1 Power line

If you connect a power line wrongly, there is a danger motor may be locked or become uncontrollable.
Please be very careful about cable connection as there are danger of a short circuit and a ground circuit which damages a driver.
As for terminal processing, please refer 「2.1 Wiring of power supply」.

GPX2 - 80, GPX2 - 60
・TB1 : Power supply/motor terminal plate 〔POWER〕

Pin-No.	Name	Abbreviation
1～8	(Item 2.1) Written on wiring of power supply.	—
9	Motor U phase output	U
10	Motor V phase output	V
11	Motor W phase output	W
12	Motor FG connection	FG

＜Parts＞

Driver :	FRONT4-H-6.35 (Made by phoenix contact)	※Wire insert type

GPX2 - 40, GPX2 - 24
・TB1 : Power supply/motor terminal plate 〔POWER〕

Pin-No.	Name	Abbreviation
1～8	(Item 2.1) Written on wiring of power supply.	—
9	Motor U phase output	U
10	Motor V phase output	V
11	Motor W phase output	W
12	Motor FG connection	FG

＜Parts＞

Driver :	FRONT 2,5-H/SA 5 (Made by phoenix contact)	※Wire insert type

GPX2 - 16, GPX2 - 12, GPX2 - 8
・TB2 : Motor terminal plate 〔MOTOR〕

Pin-No.	Name	Abbreviation
1	Motor U phase output	U
2	Motor V phase output	V
3	Motor W phase output	W
4	Motor FG connection	FG

＜Parts＞

Driver :	GMSTB 2,5/4-G-7,62 (Made by phoenix contact)	
Wiring side :	GMSTB 2,5/4-ST-7,62 (Made by phoenix contact)	※Accessory

2.2.2 Position sensor

A connectable position sensor is "Optical Incremental Encoder" or "Brushless Resolver".
Please take note if setting contents and sensor feedback signal does not match, it happens
motor position sensor abnormality.

・CN2：Sensor connector　［SEN］

Pin-No.	Name		Abbreviation
1		A phase feedback＋	A＋
2		A phase feedback－	A－
3		B phase feedback＋	B＋
4		B phase feedback－	B－
5		Z phase feedback＋	Z＋
6		Z phase feedback－	Z－
7		U phase feedback＋	U＋
8		U phase feedback－	U－
9	Encoder connection	V phase feedback＋	V＋
10		V phase feedback－	V－
11		W phase feedback＋	W＋
12		W phase feedback－	W－
13		Frame ground ※1 （connect to cable shield）	FG
14		Sensor power supply 5V ※2	＋5VE
15		Sensor power supply 5V ※2	＋5VE
16		Sensor power supply common ※2	GNDE
17		Sensor power supply common ※2	GNDE
18		Excitation signal R1	R1
19		Excitation signal R2	R2
20		Frame ground ※1 （R1/R2 shield connection）	FG
21	Resolver connection	Feedback signal S1	S1
22		Feedback signal S3	S3
23		Frame ground ※1 （S1/S2 shield connection）	FG
24		Feedback signal S2	S2
25		Feedback signal S4	S4
26		Frame ground ※1 （S2/S4 shield connection）	FG

※1：Pin-No.13, 20, 23, 26, FG terminals are connected internally.
※2：Pin-No.14, 15 (＋5VE) terminal and 16, 17 (GNDE) terminals：each same abbreviations
　　 are connected internally.

＜Parts＞

| Driver： | 10226-52A2PL (Made by Sumitomo 3M) |
| Wiring side： | 10126-3000PE　solder 10326-52A0-008　shell (Made by Sumitomo 3M) |
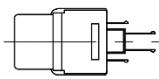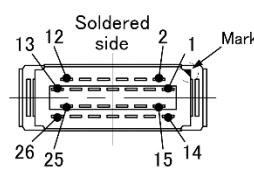
2.2.3 **Holding brake**

In case a motor (motor option) with a brake is selected, it is necessary to open and close a brake coordinating with a motor drive.
If it drives while braking, or if you use a brake to control a movement, there is a danger of malfunction of shorter the life span. Please be careful.

◎Below is a circuit diagram of utilizing a brake output (while brake is open) coordinating with Servo ON. You cannot connect directly to a motor brake to output signal (OUT3) of input and output (CN1). Please create relay circuit.
Please create multiple failsafe function like, a braking can be done by an external operation.
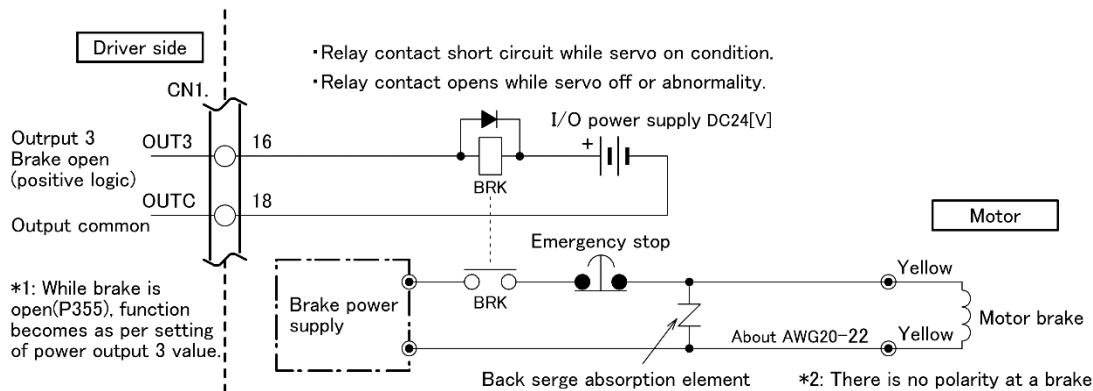
◎Below is a brake specification of our standard motor. Please refer at time of selecting a brake power supply.

Motor model	Rating voltage	Consumption current
BNRⅡ300B,　LNEⅡ300B	DC24 [V]	0.70 [A]
BNRⅡ220B,　LNEⅡ220B		
BNRⅡ150B,　LNEⅡ150B	DC24 [V]	0.65 [A]
BNRⅡ100B-A,　LNEⅡ100B		
BNRⅡ075BC,　LNEⅡ075BC,　LNE075BC	DC24 [V]	0.45 [A]
BNRⅡ040BC,　LNEⅡ040BC,　LNE040BC		
BNRⅡ020BC,　LNEⅡ020BC,　LNE020BC		
BNRⅡ012BC,　LNEⅡ012BC,　LNE012BC	DC24 [V]	0.36 [A]
BNRⅡ006BC,　LNEⅡ006BC,　LNE006BC		

※Measuring condition Ta=20 [℃]

2.3 Wiring of control signal

It is necessary to connect an input and output signal in order to do a servo control.
Please refer below as available function differs depending to control mode.

・CN1 : Input and output connector　[I／O]

Pin-No.	Name		Abbreviation
1	Analog speed	＋　　(Speed command)	VC＋
2	input	－　　(Speed command)	VC－
3	Analog torque	＋　　(Torque control)	TC＋
4	input	－　　(Torque control)	TC－
5		Input common	INC
6		1　　(Servo ON)	IN1
7		2　　(Reset + Deviation counter clear)	IN2
8		3　　(Forward start)	IN3
9	Control input	4　　(Reversal start)	IN4
10		5　　(Forward JOG)	IN5
11		6　　(Reversal JOG)	IN6
12		7　　(Forward force stop)	IN7
13		8　　(Reversal force stop)	IN8
14		1　　(Positioning complete)	OUT1
15		2　　(Zero speed)	OUT2
16	Control output	3　　(Brake open)	OUT3
17		4　　(Abnormal happen)	OUT4
18		Output common	OUTC
19		1　　(Speed feedback)	TP1
20	Analog monitor output	Signal ground ※1	GND
21		2　　(Torque feedback)	TP2
22		Signal ground ※1	GND
23		A phase＋	EA＋
24		A phase－	EA－
25	Feedback pulse output	B phase＋	EB＋
26		B phase－	EB－
27		Z phase＋	EZ＋
28		Z phase－	EZ－
29		A phase＋　(2 pulse method)	PA＋
30	Position command pulse input	A phase－　(2 pulse method)	PA－
31		B phase＋　(2 pulse method)	PB＋
32		B phase－　(2 pulse method)	PB－
33		Open at abnormality	ALM-NC
34	Alarm output	Short circuit at abnormality	ALM-NO
35		Alarm common	ALM-COM
36	Frame ground		FG

※1 : Pin-No. 20, 22, GND terminals are connected internally.
※2 : Names with in ( ) are parameters set at the time of shipment.

＜Parts＞

Driver：	10236-52A2PL (Made by Sumitomo 3M)	
Wiring side：	10136-3000PE　solder 10336-52A0-008　shell (Made by Sumitomo 3M) ※Accessory	
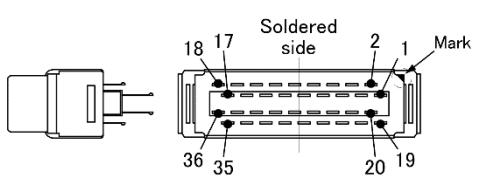
2.3.1 Connection of position control

Following is a connection example using position control mode.
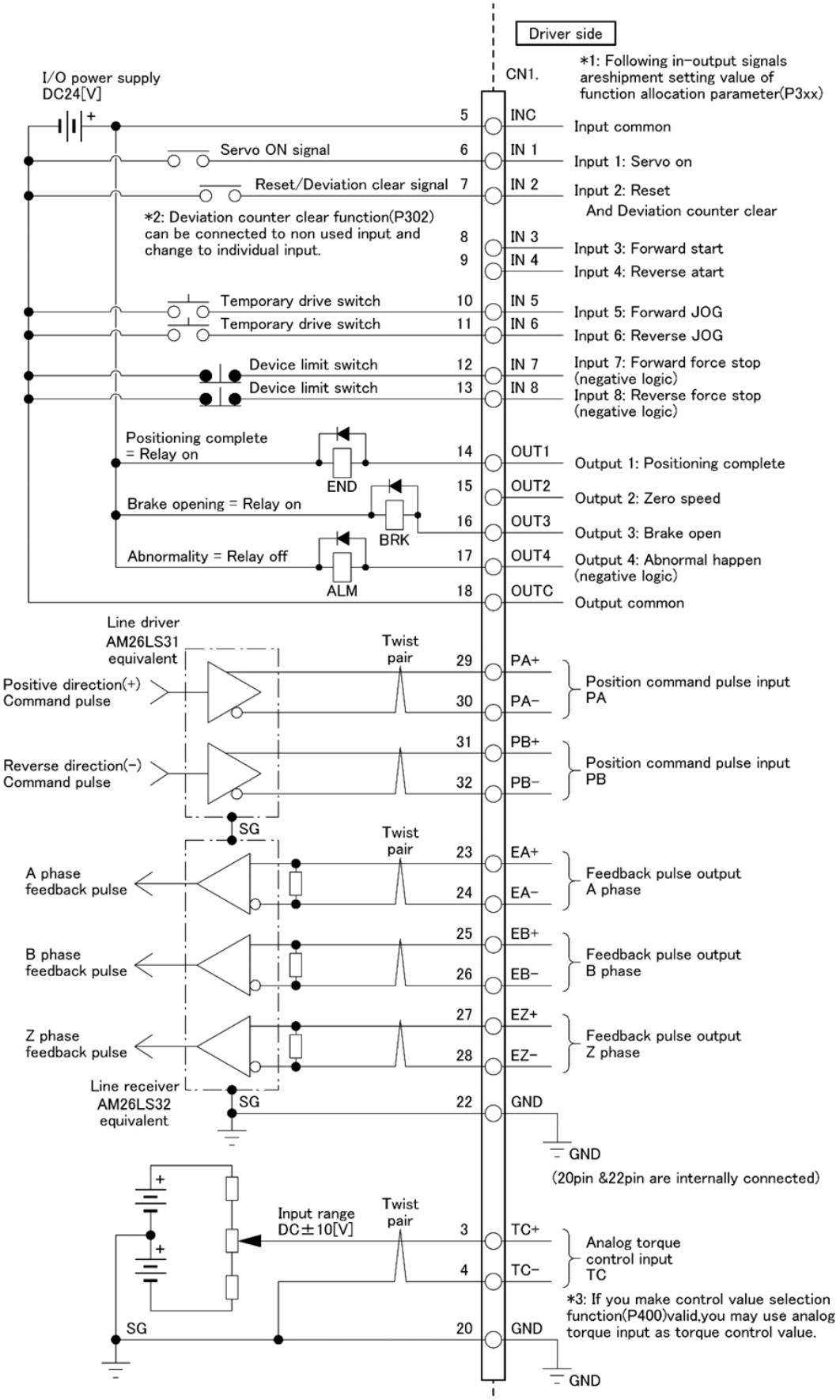
2.3.2 Connection of speed control

Following is a connection example using speed control mode.
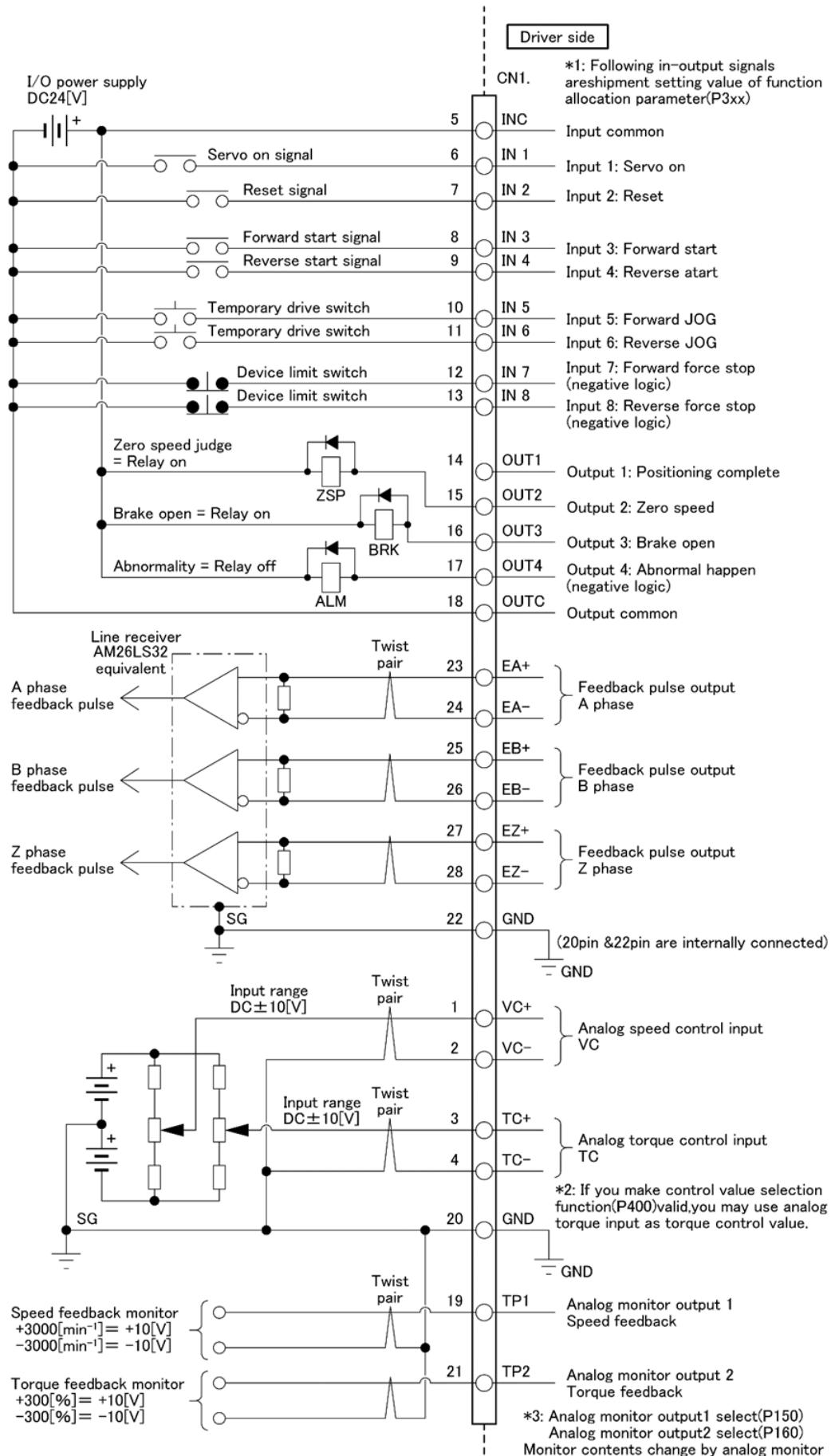
2.3.3 Connection of torque control

Following is a connection example using torque control mode.
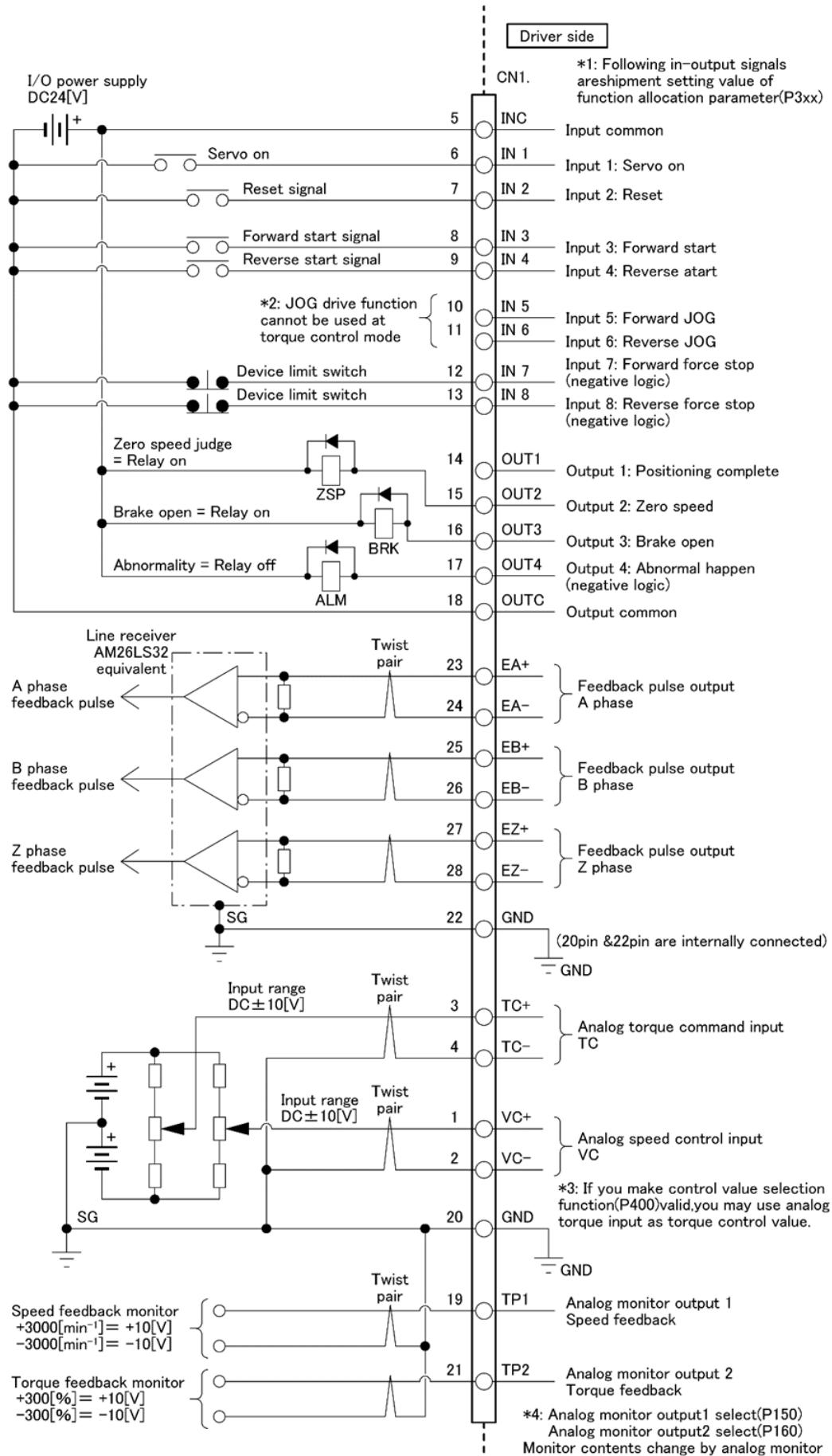
2.3.4 Details of each control signal

◎Position command pulse input

You may use 2 systems of pulse line inputs as position command. You may set command system of pulse line input by parameter. Maximum input frequency of line driver usage is 1 [Mpps].
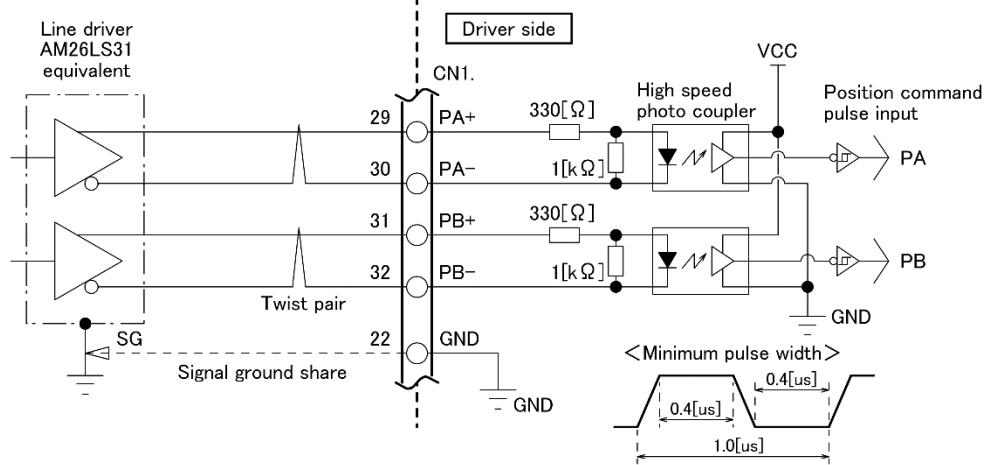
We recommended to use line driver which can prevent noise influence but you may connect open collector too. Please use anti noise countermeasure if you do it.
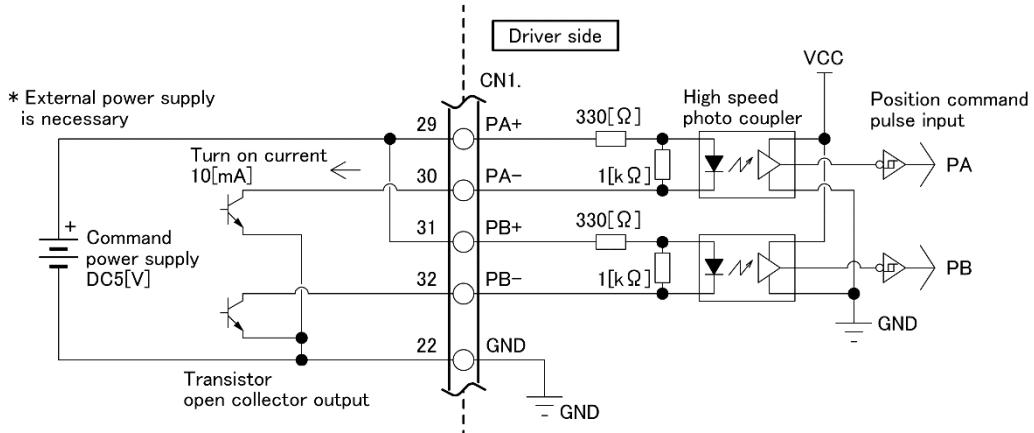
◎Feedback pulse output

Position sensor signals after frequency division processing will be output at each line driver.
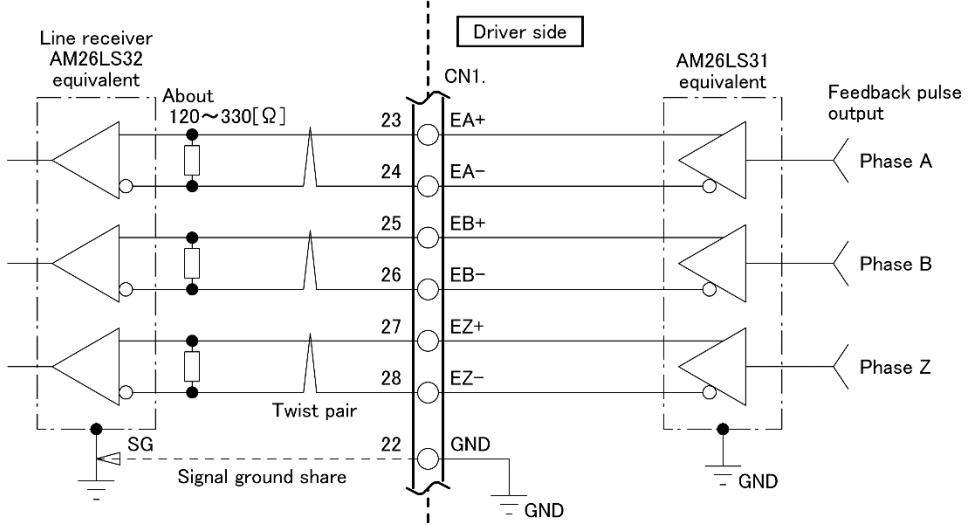
◎Analog (command/control) input
    There are two systems of speed and torque, you may set as command and control value
    by parameter.
    Each input usage voltage range is ±10[V] (Maximum allowable input ±12[V]).

Example single end connection

Rating input range
DC10[V]～ −10[V]

Driver side

CN1.

| 1 | VC+ |
| 2 | VC− |

12[kΩ]
12[kΩ]

4.7[kΩ]
+15[V]
−15[V]
4.7[kΩ]

Analog speed input
ADC 12Bit
GND

Twist pair

SG

Example differential connection

3	TC+
4	TC−
20	GND

Analog torque input
ADC 12Bit
GND

SG

Signal ground share

GND
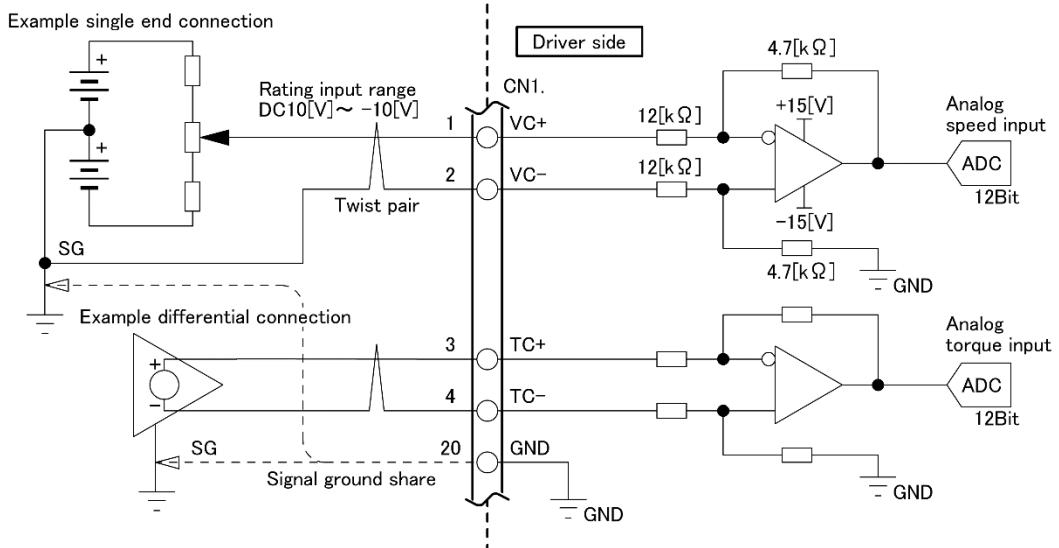
◎Analog monitor output
    It analog out puts the two system of monitor contents selected by parameter.
    Each output's applying voltage range is ±10[V] (Max allowable output ±12[V]).
    Connecting devices, please select the one which does not be broken by applied voltage
    max 15[V].
    The same monitor contents are out put at panel face test terminal (TP1,2).

Rating ourput range
DC10[V]～ −10[V]

CN1.

+15[V]

Analog
voltage
monitor

19	TP1
20	GND
21	TP2

1[kΩ]
−15[V]

Analog monitor output 1
DAC 12Bit
GND

Twist pair

Please use a device
which cannot be injured
by max ±15[V]

GND

1[kΩ]

Analog monitor output 2
DAC 12Bit
GND

Driver side
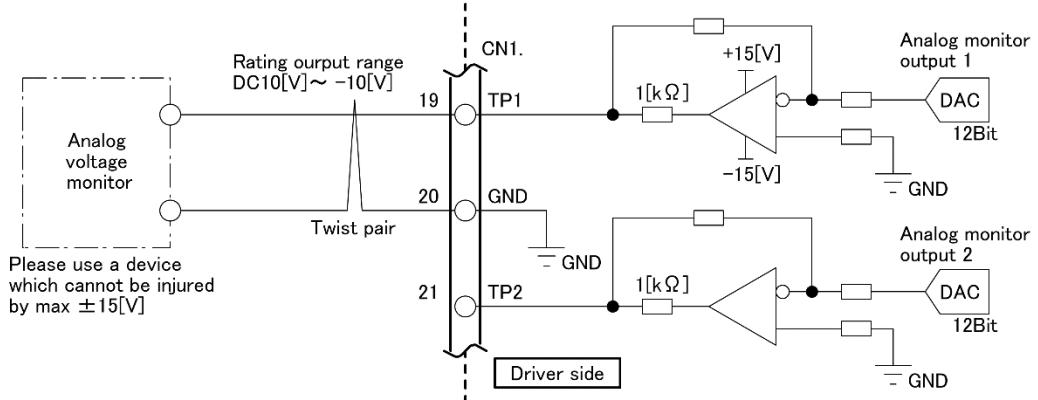
◎Control input

Maximum 8 points of control signal can be input and usable by function allocation by parameter. External power supply of DC24 [V] is necessary to operate input circuit.

* External power supply is necessary

CN1.

5	INC
6	IN 1
7	IN 2
8	IN 3
9	IN 4
10	IN 5
11	IN 6
12	IN 7
13	IN 8

4.7[kΩ]

Turn on current 6[mA]

Input 1

I/O power supply DC24[V]

Input 8

Transistor open collector output

Bidirectional photo coupler

Driver side | Source model

* External power supply is necessary

CN1.

5	INC
6	IN 1
7	IN 2
8	IN 3
9	IN 4
10	IN 5
11	IN 6
12	IN 7
13	IN 8

4.7[kΩ]

Turn on current 6[mA]

Input 1

I/O power supply DC24[V]

Input 8

Transistor open collector output

Bidirectional photo coupler

Driver side | Sink model

◎Control output

It is possible to output maximum 4 control signals which have been functional allocated by parameter. Alarm output is relay output of function fixation.

Current control resistor

CN1.

DC24[V] 50[mA]max.

Output 1

Photo coupler

14	OUT1
15	OUT2
16	OUT3
17	OUT4
18	OUTC

Output 4

Output common

Photo mos

Alarm output

DC24[V] 0.5[A]max.

Normal start on
ALM−NC : Connection close
ALM−NO : Connection open

33	ALM−NC
34	ALM−NO
35	ALM−COM

Alarm output common

Relay

Driver side | Sink model
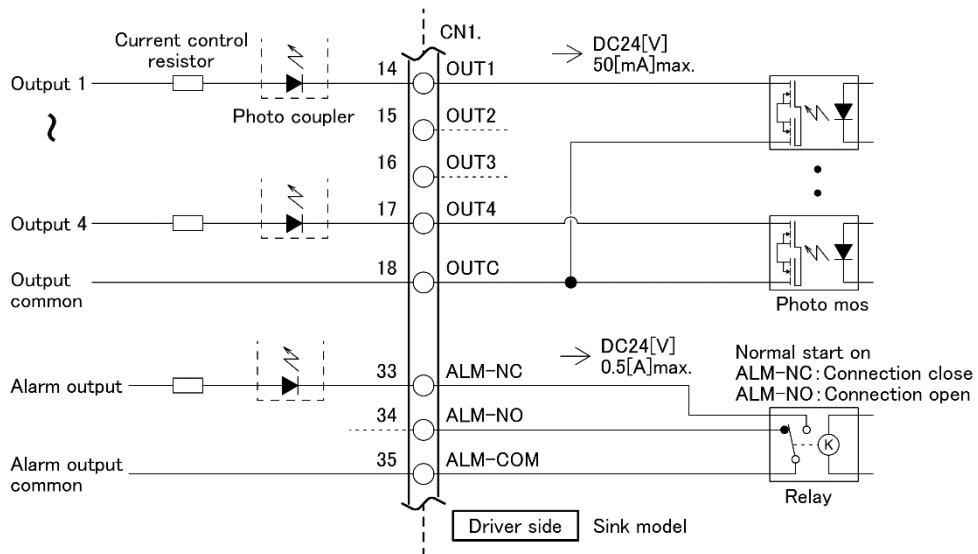
2.4 Connection of communication

It is necessary to connect at time of using tool software. You may select by parameter from communication function of RS-232C or RS-485.

・CN3 : Communication connector 1 〔COM1〕

Pin-No.	Name	Abbreviation
1	RS-232C-1 transmission	TxD1
2	RS-232C-1 reception	RxD1
3	Signal ground ※1	GND
4	RS-485 transmit and receive ＋ ※1	TD＋
5	RS-485 transmit and receive － ※1	TD－
6	Not used	—
7	Not used	—
8	Power supply specially for display ※1 ※2	+5V

・CN4 : Communication connector 2 〔COM2〕

Pin-No.	Name	Abbreviation
1	RS-232C-2 transmission	TxD2
2	RS-232C-2 reception	RxD2
3	Signal ground ※1	GND
4	RS-485 transmit and receive ＋ ※1	TD＋
5	RS-485 transmit and receive － ※1	TD－
6	Not used	—
7	Not used	—
8	Power supply specially for display ※1 ※2	+5V

※1 : Pin-No.3～8 is internally connected with same abbreviation terminal of CN3 and CN4.
※2 : Pin-No.8 is an exclusive terminal. Please do not connect externally as there is a possibility of damage.
※3 : Metal shell joint portion of connector is connected to frame ground (FG).

＜Parts＞

Driver :	MD-S8100-90 (made by JST connector)	
Wiring side :	Mini-DIN compliant 8pin straight connector soldering type	
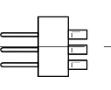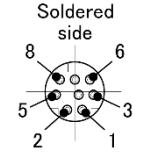
◎PC and RS-232C communication connects one either CN3 or CN4.
　Please use optional communication cable (GP2-RS3).
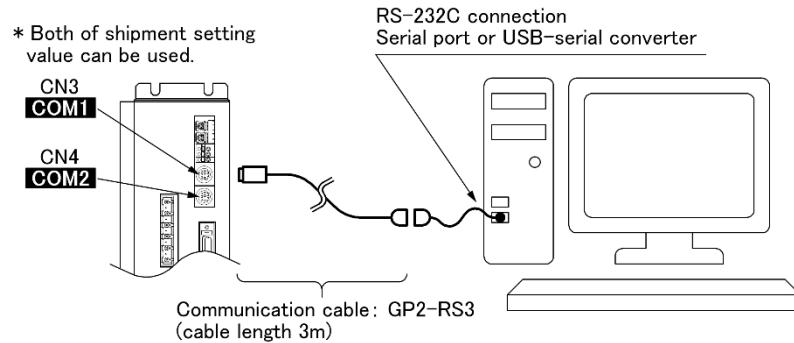
◎By setting communication setting parameter (item P520~), it becomes possible
　to connect by using RS-232C and RS-485 on the same time.
　Details please contact our sales department.
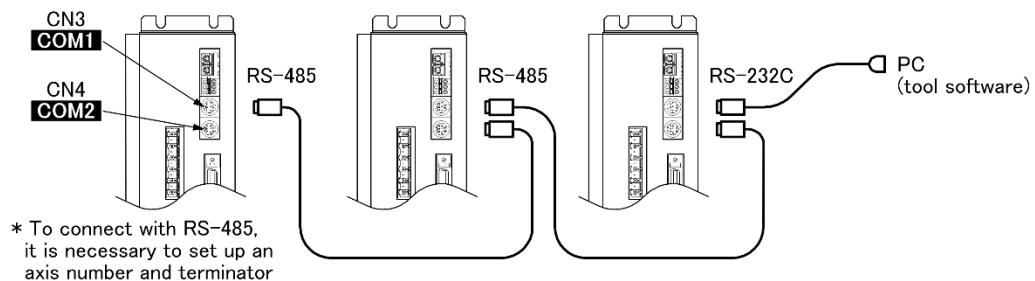
2.5 Test terminal

An analog monitor output contents at in and output (CN1) is outputs at a test terminal.
Please use it for test run and gain adjustment. Each terminal has two holes at right and left.
Left hand side hole is to confirm by a tester. Right hand side hole can be used by inserting wire
and fixed by a spring pressure.

・Test terminal

Position	Name	Abbreviation
Upper	Analog monitor output1	TP1
Middle	Analog monitor output2	TP2
lower	Signal ground	GND

＜Parts＞

Driver：	OCN-022-3P (Made by Osada Corporation)
Wiring side：	AWG20～24 wire to be inserted. (strip wire length 8 [mm])
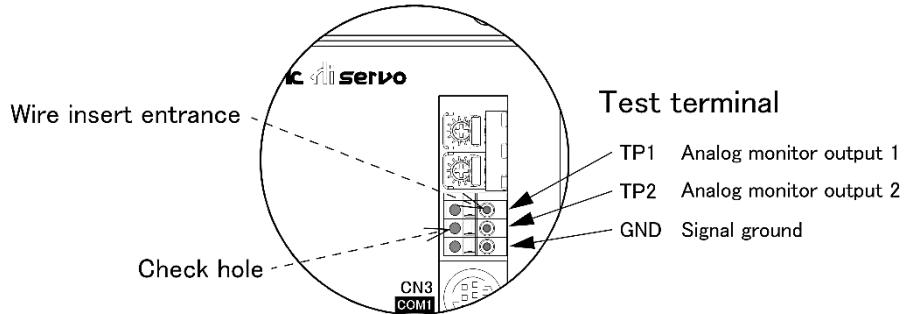
3 Parameter

Driver has various parameters to set servo characteristics and in and output signals.
In this paragraph, we explain about function contents of each parameters.
Please understand well and set for you optimal situation of your driving condition.

A modification of parameter contents can be done on tool software (TelGPX2) connected by communication to PC.
Please refer (2.4 Communication of connection) for details.

Parameter No.	Parameter analysis	Contents
Item P100～	Fundamental setting	Parameter about control mode, command style and fundamental setting.
Item P200～	Servo adjustment	Parameter about gain and filter of servo adjustment.
Item P300～	Function allotment	Parameter to allocate function status against in and out signal.
Item P400～	Extension setting	Parameter about extension setting of internal command and alarm output.
Item P500～	Communication setting	Parameter about baudrate and axis number for communication setting.

＜Tool software display image＞
Japanese version

3.1 Shipment setting list

Below is a parameter setting value at time of driver shipment.

P1xx : Fundamental setting parameter

No.	Parameter name	Setting value at shipment	Applicable control mode		
			Position	Speed	Torque
P100	Control mode	Speed	●	●	●
P101	Forward direction	CCW	●	●	●
	Position command pulse				
P110	Pulse line input format	2 Pulse	●	×	×
P111	Electronics gear numerator	1	●	×	×
P112	Electronics gear dominator	1	●	×	×
	Analog speed command				
P120	Command factor ※2	3000 [min⁻¹] (2000 [min⁻¹])	×	●	※1
P121	Command dead zone	0.0 [min⁻¹]	×	●	※1
P122	Input voltage offset	0.00 [V]	×	●	※1
P123	Acceleration time	0 [ms]	×	●	×
P124	Deceleration time	0 [ms]	×	●	×
P125	S shaped acc/dec time	0 [ms]	×	●	×
	Analog torque command				
P130	Command factor	300 [%]	※1	※1	●
P131	Command dead zone	0.0 [%]	※1	※1	●
P132	Input voltage offset	0.00 [V]	※1	※1	●
	Feedback pulse output				
P140	Pulse division numerator	1	●	●	●
P141	Pulse division dominator	1	●	●	●
	Analog monitor output 1				
P150	Output selection	Speed : Feedback [min⁻¹]	●	●	●
P151	Output factor ※2	3000 [min⁻¹] (2000 [min⁻¹])	●	●	●
P152	Output standard	0 [min⁻¹]	●	●	●
P153	Output voltage offset	0.00 [V]	●	●	●
P154	Averaging process function	16 [step]	●	●	●
	Analog monitor output 2				
P160	Output selection	Torque : Feedback [%]	●	●	●
P161	Output factor	300 [%]	●	●	●
P162	Output standard	0 [%]	●	●	●
P163	Output voltage offset	0.00 [V]	●	●	●
P164	Averaging process function	16 [step]	●	●	●
P170	Position deviation excessive judgement value	10000 [pulse]	●	×	×
P171	Speed control value ※2	3500 [min⁻¹] (2500 [min⁻¹])	●	●	●
P172	Torque control value	300 [%]	●	●	●
P180	Mechanical lock judgement function	Invalid	●	●	●
P181	Position keep function	Invalid	×	●	×
P182	Position complete judgement value	10 [pulse]	●	×	×
P183	Speed reaching judgement value ※2	3000 [min⁻¹] (2000 [min⁻¹])	●	●	●
P184	Zero speed judgement value	10 [min⁻¹]	●	●	●

※1 : It is used when control value selection function (item P400) is valid. When position control and speed control is on, torque (command) input becomes torque control. When torque control is on, speed (command) input will be speed control.
※2 : A combined motor excluding BNR II 100C more than 1 [kW], shipment setting value in ( ) will be applied.

P2xx : Servo adjustment parameter

No.	Parameter name	Setting value at shipment	Applicable control mode		
			Position	Speed	Torque
P200	Tuning system	Automatic	●	●	×
	Gain volume				
P210	Adjustment function 1	Valid	●	●	×
P211	Adjustment function 2	Valid	●	●	×
	Automatic tuning				
P220	Inertia estimation	Invalid	●	●	×
	Gain 1				
P221	Tuning level	1.0	●	●	×
P222	Response level	0.0	●	●	×
P223	Inertia ratio	0.2 [ratio]	●	●	×
	Gain2				
P224	Tuning level	1.0	※1	※1	×
P225	Response level	0.0	※1	※1	×
P226	Inertia ratio	0.2 [ratio]	※1	※1	×
	Manual tuning				
	Gain 1				
P242	Position feed forward	0 [%]	●	×	×
P243	Position proportion	30	●	※2	×
P244	Speed proportion	300	●	●	×
P245	Speed integral	150	●	●	×
	Gain 2				
P248	Position feed forward	0 [%]	※1	×	×
P249	Position proportion	30	※1	※1, ※2	×
P250	Speed proportion	300	※1	※1	×
P251	Speed integral	150	※1	※1	×
	Current command notch filter				
P260	Function	Invalid	●	●	●
P261	Frequency	1000.0 [Hz]	●	●	●
P262	Q value	0.7	●	●	●
	Current command low pass filter				
P263	Function	Invalid	●	●	●
P264	Frequency	1000.0 [Hz]	●	●	●
	Speed command low pass filter				
P270	Function	Invalid	●	●	×
P271	Frequency	1000.0 [Hz]	●	●	×

※1 : Normal motor control is "Gain 1" contents are selected. A content of "Gain 2" can be selected only
      after gain selection (item P303) function status switches ON.
※2 : It is to be used when position keep function (item P181).

P3xx : Function allocation parameter

No.	Parameter name	Setting value at shipment	Applicable control mode		
			Position	Speed	Torque
	Input allocation				
P300	Servo ON	Input 1 positive logic	●	●	●
P301	Reset	Input 2 positive logic	●	●	●
P302	Deviation counter clear	Input 2 positive logic	●	✕	✕
P303	Gain selection	Always OFF	●	●	✕
P304	Forward start	Input 3 positive logic	✕	●	●
P305	Reverse start	Input 4 positive logic	✕	●	●
P306	Forward force stop	Input 7 negative logic	●	●	●
P307	Reverse force stop	Input 8 negative logic	●	●	●
	Extended input allocation				
P320	Forward JOG	Input 5 positive logic	●	●	✕
P321	Reverse JOG	Input 6 positive logic	●	●	✕
P322	Command selection 1	Always OFF	✕	●	●
P323	Command selection 2	Always OFF	✕	●	●
P324	Control value selection 1	Always OFF	※1	※1	※1
P325	Control value selection 2	Always OFF	※1	※1	※1
P326	Control mode selection	Always OFF	※2	※2	※2
	Output allocation				
P350	Ready	No allocation	●	●	●
P351	Servo being ON	No allocation	●	●	●
P352	Positioning completed	Output 1 positive logic	●	✕	✕
P353	Speed reached	No allocation	●	●	●
P354	Zero speed	Output 2 positive logic	●	●	●
P355	Brake open	Output 3 positive logic	●	●	●
P356	Control ON	No allocation	●	●	●
P357	Abnormal happen	Output 4 negative logic	●	●	●
P360	Reverse ON	No allocation	●	●	●
	Extended output allocation				
P370	Specified item abnormal	No allocation	●	●	●
P371	Specified item warning	No allocation	●	●	●

※1 : It is used when control value selection function (item P400) is valid.
※2 : It is used when extend control mode (item P401) is selected.

P4xx : Extension setting parameter

No.	Parameter name	Setting value at shipment	Applicable control mode		
			Position	Speed	Torque
P400	Control value selection function	Invalid	●	●	●
P401	Extension control mode	None	●	●	●
P402	Specified abnormality function	None	●	●	●
P403	Specified warning function	None	●	●	●
	Warning judgement value				
P410	Main power supply bus voltage rise	380 [V]	●	●	●
P411	Main power supply bus voltage decline	220 [V]	●	●	●
P412	Transistor temperature	70 [℃]	●	●	●
P413	Regenerate resistance temperature	30 [K]	●	●	●
P414	Position deviation	9000 [pulse]	●	×	×
P415	Over speed ※2	3200 [min^{-1}] (2200 [min^{-1}])	●	●	●
P416	Effective torque	80 [%]	●	●	●
	JOG				
P420	Speed	100 [min^{-1}]	●	●	×
P421	Accelerating & Decelerating time	500 [ms]	●	●	×
P422	Inching travel value	Infinite [pulse]	●	×	×
	Internal speed 1				
P430	Speed	1000 [min^{-1}]	×	●	※1
P431	Accelerating time	100 [ms]	×	●	×
P432	Decelerating time	100 [ms]	×	●	×
P433	S shaped acc/dec time	100 [ms]	×	●	×
	Internal speed 2				
P434	Speed	2000 [min^{-1}]	×	●	※1
P435	Accelerating time	100 [ms]	×	●	×
P436	Decelerating time	100 [ms]	×	●	×
P437	S shaped acc/dec time	100 [ms]	×	●	×
	Internal speed 3				
P438	Speed ※2	3000 [min^{-1}] (2000 [min^{-1}])	×	●	※1
P439	Accelerating time	100 [ms]	×	●	×
P440	Decelerating time	100 [ms]	×	●	×
P441	S shaped acc/dec time	100 [ms]	×	●	×
P450	Internal torque 1	50 [%]	※1	※1	●
P451	Internal torque 2	100 [%]	※1	※1	●
P452	Internal torque 3	150 [%]	※1	※1	●
P472	Force stop processing	Torque zero	●	●	●

※1 : It is used as internal control value by input combination of Control value selection function (item P400) and Control value selection 1,2 (item P312,313). At the time of position control and speed control, internal torque becomes torque control value, and at the time of torque control, internal speed becomes speed control value.

※2 : In case of combination of motors more that 1 [kW] motor, excluding BNRⅡ100C, shipment setting value shown in ( ) is applied.

※3 : GPX2‐80～24 cannot be used.

P5xx : Communication setting parameter

No.	Parameter name	Setting value at shipment	Applicable control mode		
			Position	Speed	Torque
P500	RS-232C-1 (COM1) Baud rate	38400 [bps]	●	●	●
P510	RS-232C-2 (COM2) Baud rate	38400 [bps]	●	●	●
P520	RS-485 Axis number	0	●	●	●
P521	Baud rate	38400 [bps]	●	●	●
P525	Terminator	Invalid	●	●	●
P526	Response waiting time	1 [ms]	●	●	●

3.2 Details of fundamental setting parameter

The fundamental setting parameter is a group of an initial conditions assembled parameters like control mode and command systems.

3.2.1 Selection of control mode

Set a control mode which becomes a fundamental.

- ・Position control :   An action to control a motor angle (position) by pulse line input.
- ・Speed control :   An action to control a motor speed by analog input or internal speed setting value.
- ・Torque control :   An action to control motor's generated torque by analog input or internal torque setting value.

No.	Name & Setting function	Value	Setting range
P100	**Control mode** Set a fundamental control mode.	Speed	Select from position, speed and torque.

◎There is a function of control mode force exchange at driver (GPX‐8~40) upper side Dip-SW. A control mode can be set without using tool soft ware by Dip-SW1,2 change to ON.

Dip-SW condition

1	2	Applicable control mode
OFF	OFF	A contents of parameter control mode (item P100) becomes valid.
O N	OFF	Fixed to position control.
OFF	O N	Fixed to speed control.
O N	O N	Fixed to torque control.

※A force change of control mode by Dip-SW becomes valid, same like parameter setting,
  by power supply re-input.

＜Warning＞
Please pay attention as setting contents of parameter (item P100) does not reflect on motor control while Dip-SW is ON.

3.2.2 Selection of forwarding direction

Setting a rotation direction of motor axis versus driver control forward direction.
You may use when rotation direction changes by mechanical system like decelerator.

No.	Name & Setting function	Value	Setting range
P101	**Forward direction** To set a rotation direction of motor axis.	CCW	Select from CCW, CW

＜Related items＞	Forward direction (item P101)	
Contents	CCW setting	CW setting
Position command and pulse addition (+) direction like feedback pulse output.	CCW	CW
Speed/torque command and analog positive terminal (+) voltage at monitor output.	CCW	CW
Forward direction of start, force stop and JOG function status.	CCW	CW
Adding (+) direction of on tool software and driving condition monitoring.	CCW	CW
Rolling direction of motor axis.	CCW	CW

CCW
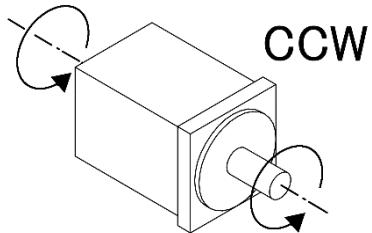
3.2.3 Position command pulse

Setting a position command pulse which is given from upper device to driver. As for wiring specification of input signal, please refer 「2.3.4 Details of each control signal」.

Input format	PA	PB	Remarks
2 pulse method	Adding (+) command pulse	Subtraction (−) command pulse	
1 pulse method	Command pulse	Rotation direction	Adding (+) by PB=OFF
2 phase pulse method	A phase command pulse	B phase command pulse	Adding (+) progress PA=90 [°]
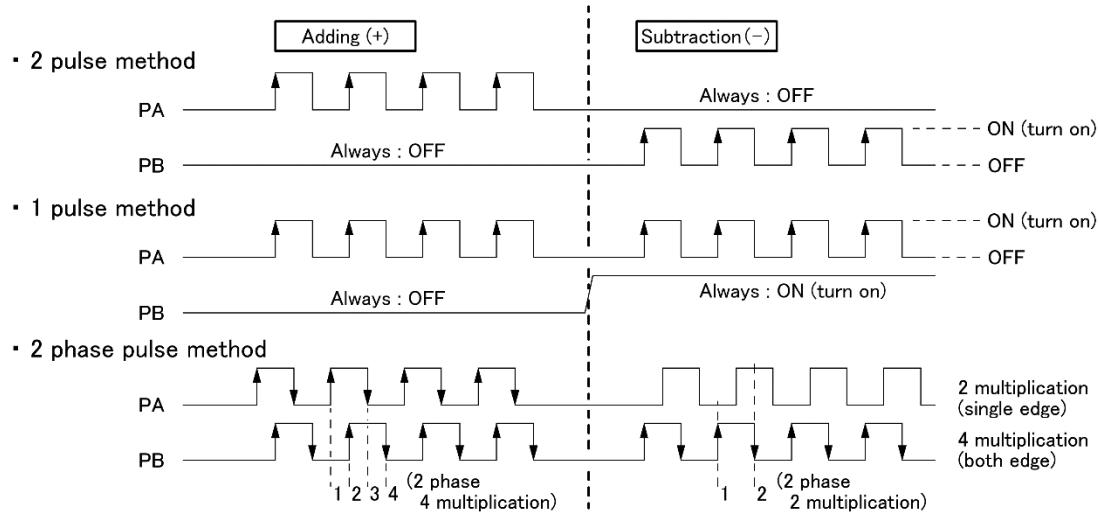
▷ Position command pulse

No.	Name & Setting function	Value	Setting range
P110	**Pulse line input format** To set a command format of pulse line input.	2 pulse	Select from 2 pulse, 1 pulse, 2 phase pulse.
P111 P112	**Electronics gear numerator** **Electronics gear dominator** To set motor moving volume per pulse line input unit. To set an electronics gear (conversion factor) by numerator and dominator.	1 1	Value input: 1～10000

※Motor moving volume ＝ Pulse line input × Electronics gear (numerator／dominator)

＜Related items＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	By setting at position, it accepts pulse line input as command.
	P101	Forward direction	To set motor rotation direction versus adding (+) command. At shipment setting, CCW has been selected.
Function allocation	P300	Servo ON	Servo becomes ON by function status becomes ON. At shipment setting, it functions by turning on the input signal (IN1).
	P302	Deviation counter clear	You can clear the position deviation counter value by changing function status ON. At shipment setting, it functions by input signal (IN2) turning ON.
	P306 P307	Forward force stop Reverse force stop	While function status is ON, fail safe works and normal processing cannot be done. Please use by input signal (IN7,8) turning ON, as it is allocated to negative logic input.

3.2.4 Analog speed command

Setting analog speed command to give to driver from upper device. As for analog signal wiring, please refer to 「2.3.4 Details of each control signal」.

・Analog speed command

・Used as analog speed control
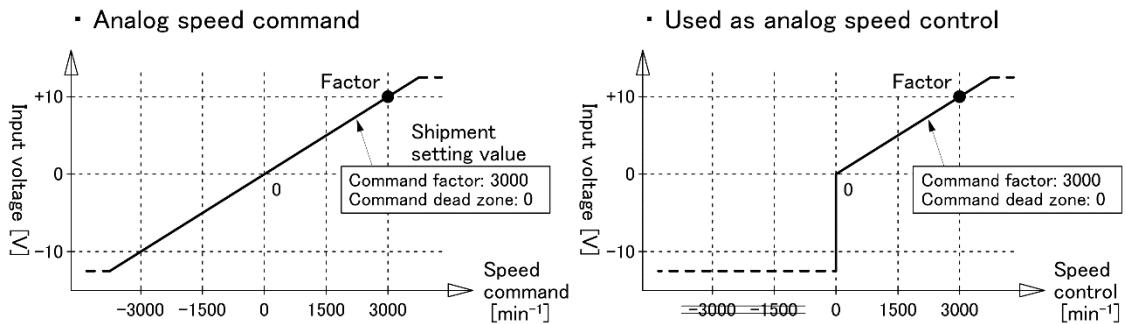
▷ Analog speed command

No.	Name & Setting function	Value	Setting range
P120	**Command factor** ※1 Setting motor rolling speed versus speed command voltage 10 [V].	3000 [min⁻¹] (2000 [min⁻¹])	Value input: 1～99999
P121	**Command dead zone** Setting dead zone (non-action area) versus speed command.	0.0 [min⁻¹]	Value input: 0.0～999.9
P122	**Input voltage offset** Adding as an offset adjustment value of analog speed command (VC) including upper device.	0.00 [V]	Value input:－1.00～1.00
P123 P124	**Acceleration time** **Deceleration time** Adding as acceleration and deceleration slope to speed command (VC) of analog input. Setting value till the time reaches command factor (item P120).	0 [ms] 0 [ms]	Value input: 0～99999
P125	**S shaped acc/dec time** Adding S shaped acceleration and deceleration to straight slope of acceleration time and deceleration time. It is used if shock happens by acceleration speed modification caused at start and stop timing.	0 [ms]	Value input: 0～99999 Please set by smaller value than (item P123) and (item P124).

※1 : A combined motor excluding BNRⅡ 100C more than 1 [kW], shipment setting value in ( ) will be applied.

＜Related items＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	By setting on speed, analog input is accepted as a command.
	P101	Forward direction	A motor rolling direction versus positive polarity (+) voltage is set. At shipment setting, CCW is selected.
Function allocation	P300	Servo ON	Servo becomes ON by function status becomes ON. At shipment setting, it functions by turning ON the input signal (IN1).
	P304 P305	Forward start Reverse start	By function status turns ON, rolling direction facing to command will be selected. At setting, either input signals (IN3,4) should be kept turning ON.
	P306 P307	Forward force stop Reverse force stop	While function status is ON, fail safe works and normal processing cannot be done. Please use by input signal (IN7,8) turning ON, as it is allocated to negative logic input.

◎Following is a related drawings showing at time of modifying command factor (item P120) and command dead zone (item P121).

・In case command factor is changed.

Input voltage [V]

Factor

+10

0

0

-10

Command factor: 3000→1500
Command dead zone: 0

-3000 -1500 0 1500 3000

Speed command [min⁻¹]

・In case dead zone is changed.

Input voltage[V]

Factor

+10

Dead zone

0

0

-10

Command factor: 3000
Command dead zone: 0→750

-3000 -1500 0 1500 3000
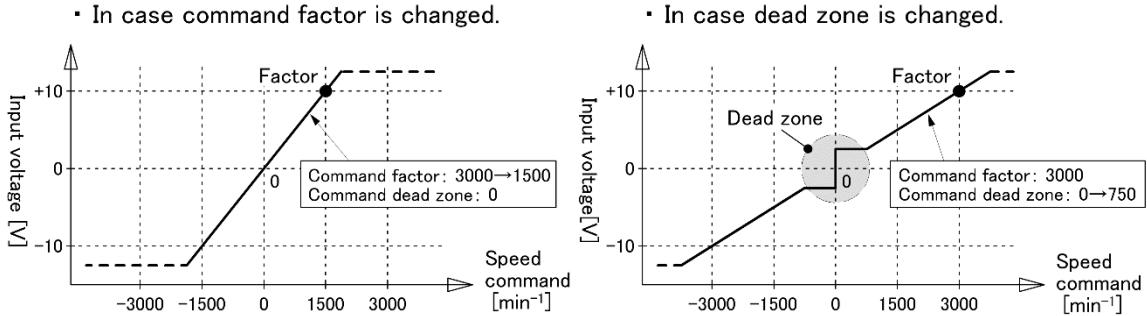
Speed command [min⁻¹]

◎When you set an acceleration time (item P123), deceleration time(item P124) and S shaped Acc/dec time (item P125), acceleration and deceleration will be added to analog speed command pattern as per shown below.

Acceleration time | S shaped acceleration and deceleration time | Deceleration time | S shaped acceleration and deceleration time

Analog speed command factor [min⁻¹]

・Acceleration time: 150 [ms]

・Deceleration time: 200 [ms]

・S shaped acceleration and deceleration time: 50 [ms]

S shape

S shape

0 100 200 300

0 100 200 300

Time [ms]

▲ Forward or reverse start ON

△ Forward/reverse start both OFF

3.2.5 Analog torque command

Setting an analog torque command which is given to a driver from upper device. As for wiring specification of input signal, please refer 「2.3.4 Details of each control signal」.

・Analog torque command   ・Used as an analog torque control
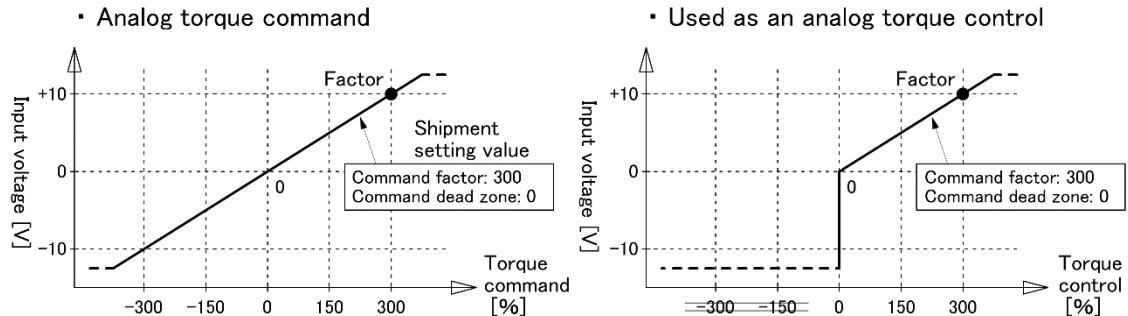
▷ Analog torque command

No.	Name & Setting function	Value	Setting range
P130	**Command factor** Setting generated torque of motor to torque command voltage 10 [V].	300 [%]	Value input: 1～999
P131	**Command dead zone** Setting dead zone (non-action area) versus torque command.	0.0 [%]	Value input: 0.0～999.9
P132	**Input voltage offset** Adding as an offset adjustment value of analog torque command, (TC) including upper device.	0.00 [V]	Value input:－1.00～1.00

＜Related items＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	By setting to torque, it accepts analog input as a command.
	P101	Forward direction	Setting generated torque direction to positive polarity (+) voltage. At shipment setting, CCW is selected.
Function allocation	P300	Servo ON	Servo becomes ON by function status becomes ON. At shipment setting, it functions by turning ON the input signal (IN1).
	P304 P305	Forward start Reverse start	By function status turns ON, rolling direction facing to command will be selected. At setting, either input signals (IN3,4) should be kept turning ON.
	P306 P307	Forward force stop Reverse force stop	While function status is ON, fail safe works and normal processing cannot be done. Please use by input signal (IN7,8) turning ON, as it is allocated to negative logic input.

3.2.6 Feedback pulse output

This is to set a position feedback pulse (number of pulse generated by one cycle of motor) output to upper device.

A phase and B phase signal output is 2 phase pulse system (4 multiplication). Phase relationship is, position information is output by adding (+) direction, phase A advances 90[°] versus phase B. Phase Z signal is output phase A 1 pulse width to one cycle of motor. As for wiring specification of output signal, please refer 「2.3.4 Details of each control signal」.
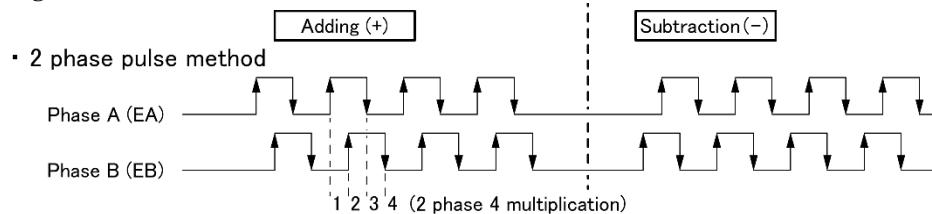
▷ Feedback pulse output

No.	Name & Setting function	Value	Setting range
P140 P141	**Pulse division molecule** **Pulse division denominator** Setting pulse output number per motor one rotation. Setting pulse division (conversion factor) by numerator and dominator.	1 1	Value input: 1～10000

※Feedback pulse output (2 phase pulse 4 multiplication)
= Driver resolution × Pulse division (molecule／denominator)
Please do not set a feedback pulse output number more than driver division.
Please set a division ratio by divisible value of feedback pulse output number.

◎Following is a feedback pulse output in case of changing pulse division (Molecule/Dominator).
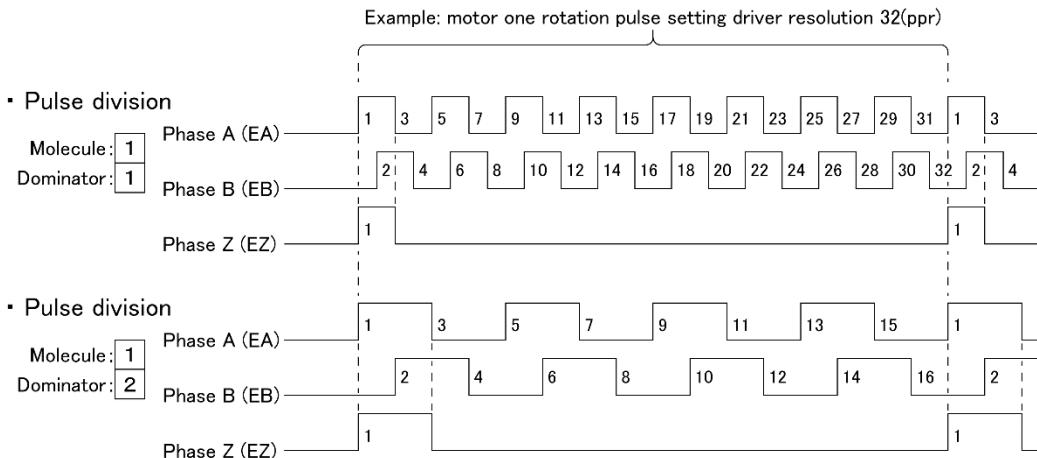
◎Following is a driver resolution and pulse output number at time of combination with our standard motors.

Motor series	Position sensor	Driver resolution	Phase A pulse output	Phase B pulse output
BNRⅡ	Resolver 1x	4096 [ppr]	1024 [ppr]	1024 [ppr]
LNEⅡ ※1	Encoder 2000 [ppr]	8000 [ppr]	2000 [ppr]	2000 [ppr]
LNE ※1	Encoder 1000 [ppr]	4000 [ppr]	1000 [ppr]	1000 [ppr]

※1 : A driver resolution at time of encoder sensor using, it is used 4 times multiplication by internal processing.

3.2.7 Analog monitor output

Setting a contents of analog monitor which outputs to test terminals (TP1, TP2).
As for wiring specification of output signal, please refer 「2.3.4 Details of each control signal」.

▷ Analog monitor output 1

No.	Name & Setting function	Value	Setting range
P150	**Output selection** Setting a monitor contents which outputs to test terminal (TP1).	Speed : Feedback [min⁻¹]	Select from monitor selection group [2]
P151	**Output factor** [1] Setting a conversion factor of monitor contents to output voltage 10 [V].	3000 (2000)	Value input: no limit
P152	**Output standard** Setting a standard value of monitor contents to output voltage 0 [V].	0	Value input: no limit
P153	**Output voltage offset** Adding as an offset adjustment value of analog system monitor output (TP1), including connection devices.	0.00 [V]	Value input:−1.00～1.00
P154	**Averaging processing function** To a contents of output selection (item P150) which is renewed by 0.1 [ms], setting whether presence or absence and number of steps of averaging processing function. A process is a moving average.	16 [step]	Invalid or select from, 16, 32, 64, 128, 256 steps.

▷ Analog monitor output 2

No.	Name & Setting function	Value	Setting range
P160	**Output selection** Setting a monitor contents which outputs to test terminal (TP2).	Torque : Feedback [%]	Select from monitor selection group [2]
P161	**Output factor** Setting a conversion factor of monitor contents to output voltage 10 [V].	300	Value input: no limit
P162	**Output standard** Setting a standard value of monitor contents to output voltage 0 [V].	0	Value input: no limit
P163	**Output voltage offset** Adding as an offset adjustment value of analog system monitor output (TP2), including connection devices.	0.00 [V]	Value input:−1.00～1.00
P164	**Averaging processing function** To a contents of output selection (item P160) which is renewed by 0.1 [ms], setting whether presence or absence and number of steps of averaging processing function. A process is a moving average.	16 [step]	Invalid or select from, 16, 32, 64, 128, 256 steps.

※1 : A combined motor excluding BNRⅡ100C more than 1 [kW], shipment setting value in ( ) will be applied.
※2 : Monitor selection group.

・Position : Feedback [pulse], Command [pulse], Deviation [pulse], Command speed [pps]
・Speed : Feedback [min⁻¹], Command [min⁻¹], Analog input [V]
・Torque : Feedback [%], Command [%], Analog input [V]
・Effective torque [%]　　　・Main power supply voltage [V]（GPX2‐16～8 only）
・Estimated inertia ratio [ratio]
・Monitor offset adjustment output : −10 [V], 0 [V], ＋10 [V]

◎Analog monitor's output voltage value is to be set by 2 points, output factor and output standard. Following is a relative drawing of shipment setting.

・Analog monitor output 1 (Speed feedback)

Output voltage[V]

Factor

+10

Standard

0

−10

Shipment setting value

Output factor: 3000
Output standard: 0

−3000 −1500 0 1500 3000

Speed feedback [min⁻¹]

・Analog monitor output 2 (Torque feedback)

Output voltage[V]

Factor

+10

Standard

0

−10

Shipment setting value

Output factor: 300
Output standard: 0

−300 −150 0 150 300

Torque feedback [%]
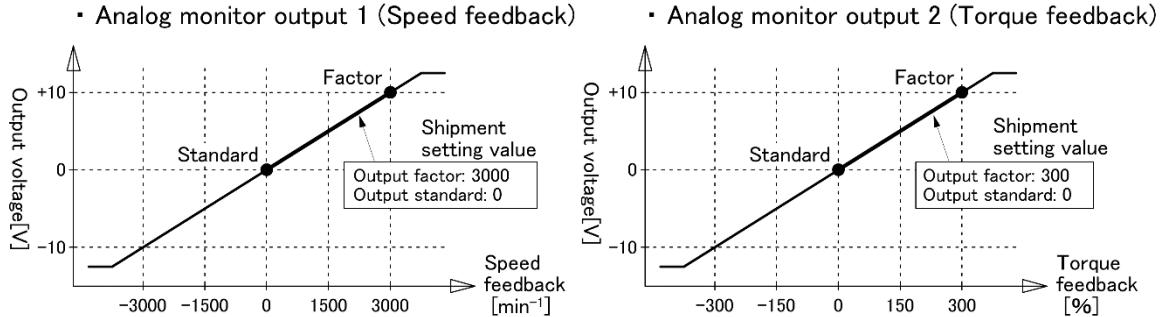
◎Output factor and Output standard can be set an input by negative polarity (−). Please refer below relative drawings.

・Analog monitor output 1 (Speed feedback)

Output voltage [V]

Output factor: −3000
Output standard: 0

+10

0

−10

Output factor: 3000
Output standard: 1500

−3000 −1500 0 1500 3000

Speed feedback [min⁻¹]

・Analog monitor output 2 (Torque feedback)

Output voltage [V]

Output factor: −150
Output standard: 150

+10

0

−10

Output factor: 300
Output standard: −150

−300 −150 0 150 300

Torque feedback [%]
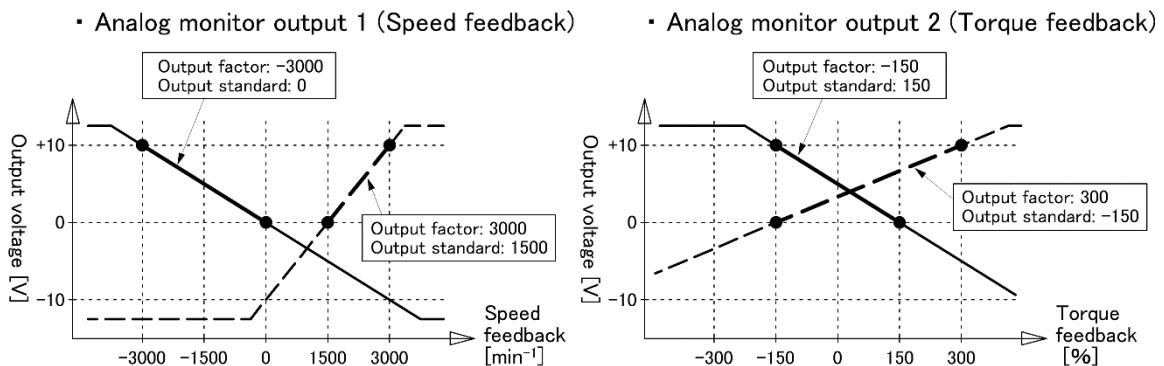
3.2.8 Control status

Setting fundamental control function and threshold of output signal.

No.	Name & Setting function	Value	Setting range
P170	**Position deviation excessive judgement value** Setting an abnormal determination value of excessive position deviation. If position deviation excess a determination value, position deviation excess (light failure) happens.	10000 [pulse]	Value input: 0～100000
P171	**Speed control value** ※1 Setting a control value (upper limit) of motor rolling speed. It controls that speed should not exceed more than control value.	3500 [min⁻¹] (2500 [min⁻¹])	Value input: 0～99999 Please set lower value than combined motor's maximum rolling speed.
P172	**Torque control value** Setting a control value (upper limit) of motor generation torque. It controls so that a torque should not be generated more than control value.	300 [%]	Value input: 0～1000 Please set lower value than the maximum instantaneous torque (rating current ratio) of combined motor.
P180	**Mechanical lock judgement function** Setting a present or absent determination function of mechanical lock. Mechanical lock determination means if the lowest torque control situation within zero speed determination value (item P184) continues more than 0.2 [sec], it causes a mechanical lock (light failure).	Invalid	Select from valid, invalid.
P181	**Position keep function** Setting a present or absent of position keep function. Position keep is a function to stop a motor at present position of motor axis without drift (motor rolls slowly) at the time of motor stopping of speed control. It works when motor rolling speed is within zero speed determination value (item P184) and function status of forward start (item P304) and reverse start (item P305) are both OFF.	Invalid	Select from valid, invalid.
P182	**Positioning complete judgement value** Setting a deviation counter's positioning complete judgement value. When a position deviation enters within setting value, a function status of positioning complete (item P352) turns ON.	10 [pulse]	Value input: 0～10000
P183	**Speed reaching judgement value** ※1 Setting motor rolling speed's speed reaching judgement value. Regardless a rolling direction, if speed feedback exceeds a setting value, function status of speed reach (item P353) turns ON.	3000 [min⁻¹] (2000 [min⁻¹])	Value input: 0～99999
P184	**Zero speed judgement value** Setting zero speed judgement value of motor rolling speed. Regardless a rolling direction, when speed feedback becomes lower than a setting value, function status of zero speed (item P354).	10 [min⁻¹]	Value input: 0～10000

※1 : A combined motor excluding BNRⅡ100C more than 1 [kW], shipment setting value in ( ) will be applied.

3.3 Details of servo adjustment parameter

Servo adjustment parameter is a group of parameters which adjusts gain and filter during actual driving. A parameter contents, excepts for tuning system (item P200) can be immediately reflected to control by changing a setting value. Please change taking care of motor and mechanical movements. Please refer 「5 Gain adjustment」 about adjustment method.

3.3.1 Selection of adjustment method

Setting a method of servo adjustment.

・Automatic tuning :   Generating a fundamental gain which is according to
an inertia ratio automatically.
・Manual tuning :   Setting a position and speed loop gain individually.

No.	Name & Setting function	Value	Setting range
P200	**Tuning system** Selecting a servo adjustment system from automatic tuning or manual tuning.	Automatic	Select from automatic or manual.

※To change a setting of tuning system, it is necessary to start a power supply again.

3.3.2 Adjustment by volume

Setting a present or absent of gain volume application to servo adjustment.

▷ Gain volume

No.	Name & Setting function	Value	Setting range
P210	**Adjustment function 1** Setting to use a panel surface volume (VR1, VR2) to servo adjustment of gain 1.	Valid	Select from valid, invalid.
P211	**Adjustment function 2** Setting to use a panel surface volume (VR1, VR2) to servo adjustment of gain 2.	Valid	Select from valid, invalid.

◎By using gain volume adjustment function, you can operate servo adjustment by panel surface volume (VR1, VR2). Please refer and confirm below as operation items are different by tuning system.

	Parameter No. : Name	Adjustment function1 (item P210) Valid	Adjustment function1 (item P210) Invalid	Adjustment function2 (item P211) Valid	Adjustment function2 (item P211) Invalid
Automatic tuning	P221 : Tuning level	Adjust by VR1	Figure input	—	—
	P222 : Response level	Adjust byVR2	Figure input	—	—
	P224 : Tuning level	—	—	Adjust by VR1	Figure input
	P225 : Response level	—	—	Adjust by VR2	Figure input
Manual tuning	P242 : Position feed forward	Figure input	Figure input	—	—
	P243 : Position proportion	Figure input	Figure input	—	—
	P244 : Speed proportion	Adjust by VR1	Figure input	—	—
	P245 : Speed integral	Adjust by VR2	Figure input	—	—
	P248 : Position feed forward	—	—	Figure input	Figure input
	P249 : Position proportion	—	—	Figure input	Figure input
	P250 : Speed proportion	—	—	Adjust by VR1	Figure input
	P251 : Speed integral	—	—	Adjust by VR2	Figure input

※When you change adjusting function from valid to invalid, please write down a servo adjustment value onto a parameter.

3.3.3 Automatic tuning

Automatic tuning generates fundamental gain according to inertia ratio automatically.
By adjusting one item of tuning level, total servo adjustment is possible. Each gain can
be set by two patterns. You can use by changing to a function allocation input (item P303).

No.	Name & Setting function	Value	Setting range
P220	**Inertia estimation** Setting present or absent of inertia estimate function. Valid setting generates a gain from real time calculating estimate inertia ratio within actual machine driving. An invalid setting generates a gain from each gain's inertia ratio (item P223, P226).	Invalid	Select from valid, invalid.

▷ Gain 1

No.	Name & Setting function	Value	Setting range
P221	**Tuning level** Setting a tuning strength by level at gain 1. The bigger the setting figure, gain becomes higher.	1.0	Value input: 1.0～10.0
P222	**Response level** Setting adjustment value of response time at gain 1. A fine tuning of response characteristics can be done individually.	0.0	Value input:－10.0～10.0
P223	**Inertia ratio** Setting an inertia ratio at gain 1. By a load inertia ratio to rotation inertia, it becomes no load =0.0 [ratio].	0.2 [ratio]	Value input: 0.0～30.0

▷ Gain 2

No.	Name & Setting function	Value	Setting range
P224	**Tuning level** Setting tuning strength by level at gain 2.	1.0	Value input: 1.0～10.0
P225	**Response level** Setting adjustment value of a response time at gain 2.	0.0	Value input:－10.0～10.0
P226	**Inertia ratio** Setting a n inertia value at gain 2.	0.2 [ratio]	Value input: 0.0～30.0

＜Related items＞

Parameter	No.	Name	Condition
Servo adjustment	P200	Tuning system	Please select automatic.
	P210	Adjustment function 1	A valid setting can be operated by a volume at tuning level (item P221) at gain 1 and response level (item P222).
	P211	Adjustment function 2	A valid setting can be operated by a volume at tuning level (item P224) at gain 2 and response level (item P225).
Function allocation	P303	Gain selection	Gain 1 is selected at time of shipment, you may use by changing to gain 2 by turning ON a function status.

3.3.4 Manual tuning

A manual tuning can set a position and speed loop gain individually. Various gain can set 2 patterns. You may use by changing by function allocation input (item P303).

▷ Gain 1

No.	Name & Setting function	Value	Setting range
P242	**Position feed forward** Setting a position loop's feed forward gain at gain 1. If you increase this gain, operating position deviation becomes less and follow up to command increases. But if you increase too much, it react too much to command and over shooting may happen.	0 [%]	Value input: 0～100
P243	**Position proportion** Setting a proportion gain of position loop at gain 1. If you increase this gain, position deviation becomes less and accuracy of position setting increases. However, if you increase too much, there is a possibility it may vibrate when stopping.	30	Value input: 0～1000
P244	**Speed proportion** Setting a proportion gain of speed loop at Gain 1. If you increase this gain, servo rigidity becomes higher and speed variation to load fluctuation becomes less. But if you increase too much, servo system becomes not stable and possible to oscillate.	300	Value input: 0～5000
P245	**Speed integral** Setting an integral gain of speed loop at Gain 1. If you increase this gain, responsiveness to speed command increase. But if you increase too much, it may easily cause a over shooting and hunting may happen. Please be careful if you decrease extremely, speed variation remains without fading away.	150	Value input: 0～5000

▷ Gain 2

No.	Name & Setting function	Value	Setting range
P248	**Position feed forward** Setting a feed forward gain of position loop at Gain 2.	0 [%]	Value input: 0～100
P249	**Position proportion** Setting a proportion gain of position loop at Gain 2.	30	Value input: 0～1000
P250	**Speed proportion** Setting a proportion gain of speed loop at Gain 2.	300	Value input: 0～5000
P251	**Speed integral** Setting an integral gain of speed loop at Gain 2.	150	Value input: 0～5000

＜Related items＞

| Parameter	No.	Name	Condition
Servo adjustment	P200	Tuning system	Please select a manual.
	P210	Adjustment function 1	A valid setting can be operated by a volume at speed proportion (item P244) at gain 1 and speed integral (item P245).
	P211	Adjustment function 2	A valid setting can be operated by a volume at speed proportion (item P250) at gain 2 and speed integral (item P251).
Function allocation	P303	Gain selection	Gain 1 is selected at time of shipment, you may use by changing to gain 2 by turning ON a function status.

3.3.5 Filter function

It adds a filter function to current command and speed command.

▷ Current command notch filter

No.	Name & Setting function	Value	Setting range
P260	**Function** Setting present and absent of notch filter insert to current command.	Invalid	Select from valid, invalid.
P261	**Frequency** Setting frequency of notch filter.	1000.0 [Hz]	Value input:10.0～1500.0
P262	**Q value** Setting a Q value (sharpness) of notch filter. If a setting figure is bigger, a zone is narrow, notch filter becomes deeper.	0.7	Value input: 0.5～5.0

◎By using notch filter, you can suppress motor vibration at mechanical resonance point.
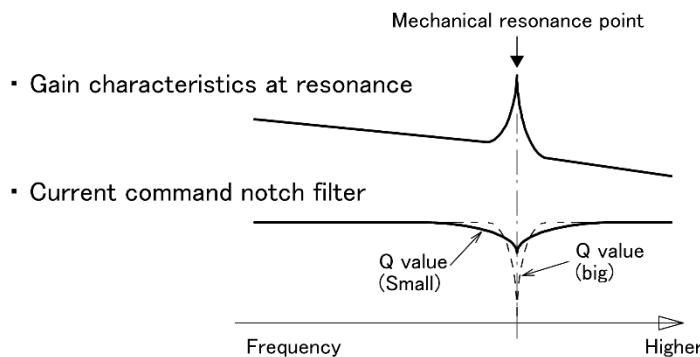
▷ Current command low pass filter

No.	Name & Setting function	Value	Setting range
P263	**Function** Setting a present and absent of low pass filter insert to current command.	Invalid	Select from valid, invalid.
P264	**Frequency** Setting a frequency of low pass filter.	1000.0 [Hz]	Value input:10.0～3000.0

▷ Speed command low pass filter

No.	Name & Setting function	Value	Setting range
P270	**Function** Setting a present and absent of low pass filter insert to speed command.	Invalid	Select from valid, invalid.
P271	**Frequency** Setting a frequency of low pass filter.	1000.0 [Hz]	Value input:10.0～3000.0

3.4 Details of function allocation parameter

Each function can be used by function status turning ON in driver.
Function allocation parameter can be a parameter group which allocates its function status
to in output (CN1) signal.

3.4.1 Function allocation of control input

Allocating a function status to input signal to control a driver from upper equipment.
Input numbers are maximum 8, you may set a multiple function status to same input
signal. Please refer 「2.3.4 Details of each control signal」about wiring specification
of input signal.

Input signal condition	Setting value logic	Function status
Energization	Positive logic	O N
Non-energization		OFF
Energization	Negative logic	OFF
Non-energization		O N

▷ Input allocation

No.	Name & Contents of function status	Value	Setting range
P300	**Servo ON** Motor can drive only after this function status turns ON. You can interlock to a driver from upper device so that motor should not move at the time of system starts.	Input 1 (positive logic)	Select from input 1～8 (positive logic, negative logic), always ON, always OFF. Possible to set multiple function allocation to the same input.
P301	**Reset** At turning ON, any abnormality which can be cancelled will be re set. (More than 30[ms])	Input 2 (positive logic)	
P302	**Deviation counter clear** After turning ON, position deviation counter value becomes clear "0". (more than 30[ms])	Input 2 (positive logic)	
P303	**Gain selection** Changing the two patterns of gain setting. If turning OFF, each Gain 1 will be selected.	Always OFF	
P304 P305	**Forward start** **Reverse start** Selecting a rolling direction of motor to speed and torque command.	Input 3 Input 4 (positive logic)	
P306 P307	**Forward force stop** **Reverse force stop** Once this function status turns ON, towards rotation direction, fail safe works and motor stops by force. For details please refer 「3.5.9 Process at the time of force stop」. It is necessary to keep function status OFF at time of normal operation.	Input 7 Input 8 (negative logic)	

▷ Extended input allocation

No.	Name & Contents of function status	Value	Setting range
P320 P321	**Forward JOG** **Reverse JOG** A function status for trial run. At the time of servo ON, Forward start (item P304) and reverse start (item P305) can be used while both are OFF situation timing. Details, please refer 「trial run from 4.2 control signal」.	Input 5 Input 6 (positive logic)	

No.	Name & Contents of function status	Value	Setting range
P322 P323	**Command selection 1** **Command selection 2** At the time of speed and torque control, you can select a command applied to this function status. At time of speed control <table></table> At time of torque control <table></table>	Always OFF Always OFF	Select from input 1～8 (positive logic, negative logic), always ON, always OFF. Possible to set multiple function allocation to the same input.
P324 P325	**Control value selection 1** **Control value selection 2** When control value selection function (item P400) is valid, it selects a control value which applies with this function status. <u>In case it is lower than speed control value (item P171), torque control value (item P172) it is controlled by this value.</u> At time of torque control <table></table> At time of position, speed control <table></table>	Always OFF Always OFF	
P326	**Control mode selection** When extension control mode (item P401) is selected, by this function status, control mode can be changed during driving. <table></table>	Always OFF	

P322/P323 — At time of speed control

1	2	Selected command
OFF	OFF	Analog speed input (VC)
O N	OFF	Internal speed 1 (item P430)
OFF	O N	Internal speed 2 (item P434)
O N	O N	Internal speed 3 (item P438)

P322/P323 — At time of torque control

1	2	Selected command
OFF	OFF	Analog torque input (TC)
O N	OFF	Internal torque 1 (item P450)
OFF	O N	Internal torque 2 (item P451)
O N	O N	Internal torque 3 (item P452)

P324/P325 — At time of torque control

1	2	Selected control value
OFF	OFF	Analog speed input (VC)
O N	OFF	Internal speed 1 (item P430)
OFF	O N	Internal speed 2 (item P434)
O N	O N	Internal speed 3 (itemP438)

P324/P325 — At time of position, speed control

1	2	Selected control value
OFF	OFF	Analog torque input (TC)
O N	OFF	Internal torque 1 (item P450)
OFF	O N	Internal torque 2 (item P451)
O N	O N	Internal torque 3 (item P452)

P326

―	Selected control mode
OFF	Control mode (item P100) setting
O N	Extension control mode (item P401) setting

3.4.2 Function allocation of control output

It allocates function status to an output signal from driver.
Output numbers are maximum 4. As for wiring specification of output signal, please refer 「2.3.4 Details of each control signal」.

Function status	Setting value logic	Output signal condition
O N	Positive logic	Short circuit
OFF		open
O N	Negative logic	open
OFF		Short circuit

※At time of control power supply turn ON, output signal condition till normal start will be all open.

▷ Output allocation

No.	Name & Contents of function status	Value	Setting range
P350	**Ready** After control power supply turned ON, function status turns ON by normal start. It is used as a reception permittance signal to upper devices.	No allocation	Select from output 1〜4 (positive logic, negative logic), no allocation. You cannot set multiple function allocation to a same output.
P351	**Servo being ON** While servo turned ON, function status also turns ON.	No allocation	
P352	**Positioning completed** When position deviation enters positioning completed determination value (item P182) function states turns ON.	Output 1 (positive logic)	
P353	**Speed reached** Regardless rotation direction, when speed feedback becomes bigger than speed reach determination value (item P183), function status turns ON.	No allocation	
P354	**Zero speed** Regardless rotation direction, when speed feedback becomes lower than zero speed determination value (item P184), function status turns ON.	Output 2 (positive logic)	
P355	**Brake open** This is a function to make brake control to a motor equipped with retention brake. Function status turns ON in connection with servo ON. Please refer 「2.2.3 Holding brake」.	Output 3 (positive logic)	
P356	**Control ON** Like speed control or torque control, while action is controlled during motor operation, function status turns ON.	No allocation	
P357	**Abnormal happen** When abnormality happens, function status turns ON. As for contents of abnormality, please refer 「6.1 Abnormality」.	Output 4 (negative logic)	
P360	**Reverse ON** When motor axis reverses against driver control forward direction (item P101) and exceeds zero speed determination value (item P184), function status turns ON.	No allocation	

▷ Extended output allocation

No.	Name & Contents of function status	Value	Setting range
P370	**Specified item abnormality** While a specified item abnormality selection (item P402) occurs, function status turns ON.	No allocation	Select from output 1〜4（positive logic, negative logic）, no allocation. You cannot set multiple function allocation to a same output.
P371	**Specified item warning** When a specified warning is happening during specified item warning selection (item P404), function status turns ON.	No allocation	

3.5 Details of extension setting parameter

Extension setting parameter is a group of parameters assembled by additional function like, internal command and warning output.

3.5.1 Selection of control value

It can be used to set a control value, except for speed control value (item P171) and torque control value (item P172) of fundamental setting parameter.
If you use this item, torque control will be added at position control and speed control time, and speed control will be added at torque control value. Motor drive would be restricted at the lowest control value.

No.	Name & Setting function	Value	Setting range
P400	**Control value selection function** Setting present or absent of control value selection function. Added contents of control value can be selected by function status of control value selection 1,2 (item P324, P325).	Invalid	Select from valid, invalid.

＜Related items＞

Parameter	No.	Name	Condition
Function allocation	P324 P325	Control value selection 1 Control value selection 2	When you turn above selection (item P400) into valid by using function status, you can select adding control value. When the function status is OFF, extension setting value will be added as control value by external analog input and other selection. Please use by allocating to input signal.
Fundamental setting	P120 P121 P122	Command factor Command dead zone Input voltage offset	At time of torque control, you can use analog speed input (VC) as control value. Regarding voltage input of negative polarity ($-$), it will be processed as speed 0 [min^{-1}].
Extension setting	P430 P434 P438	Internal speed 1 Internal speed 2 Internal speed 3	At time of torque control, you can use internal speed 1~3 as control value. As for figure input of negative polarity ($-$), it will be processed as speed 0 [min^{-1}].
Fundamental setting	P130 P131 P132	Command factor Command dead zone Input voltage offset	At time of position and speed control, you can use analog torque input (TC) as control value. Regarding voltage input of negative polarity ($-$) it will be processed as torque 0 [%].
Extension setting	P450 P451 P452	Internal torque 1 Internal torque 2 Internal torque 3	At time of position and speed control, you can use internal torque 1~3 as a control value. Regarding figure input of negative polarity ($-$), it will be processed as torque 0 [%].

3.5.2 Selection of extension control mode

Except for the case of control mode (item P100) of fundamental setting parameter,
it can be used to set a compound control.
By selection signals allocated input, control mode can be switched to real time, if you
change while driving, it may influence to change an action of motor.
Please be sure to use under the condition of without input command (rotation stop).

No.	Name & Setting function	Value	Setting range
P401	**Extension control mode** Setting an extension control mode. A switching over to control mode should be done by function status of control mode selection (item P326).	None	Select from none, position, speed, torque.

＜Related items＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	Please select fundamental control mode.
Function allocation	P326	Control mode selection	You can exchange control mode by function status. Please use by allocation to input signal.

3.5.3 Selection of specified abnormality function

It can set an output of abnormality like separation of abnormality and a light failure,
detecting a specified abnormality.
Please use specified item abnormality (item P370) of function allocation parameter by
allocating to output signal.
Regarding a contents of abnormality of a target, please refer 「6.1 Abnormality」.

No.	Name & Setting function	Value	Setting range
P402	**Specified abnormality function** You can select a desired abnormality items as you wish. When a selected items abnormality happens, a function status in specified item abnormality (item P370) will be turned ON.	None	Select from none, abnormality selection group[※1]

※1 : Abnormality selection group.

> ・Light failure : Software charging not completed, Main power supply shortage voltage (only GPX2‐16〜8), Position feedback too much, Over speed, Over load, Mechanical lock,　Communication input time out.
> ・Temperature : Transistor over heat, Generate register over heat, Cooling fun action (only GPX2‐80, 60), Over heat detection circuit (only GPX2‐16〜8), Regeneration absorption circuit (only GPX2‐16〜8).
> ・Control power supply shortage voltage.　　・Motor position sensor.
> ・Main power supply over voltage.　　・Over current.
> ・Systems abnormality

＜Related items＞

Parameter	No.	Name	Condition
Function allocation	P357	Abnormal happen	When all kind of abnormality happens, function status turns ON.
	P370	Specified item abnormal	When a specified abnormality, selected by a specified item abnormality selection (item P402) happens, function status turns ON.

3.5.4 Selection of specified warning function

You can set a symptom of abnormality like overload or overheat as warning output.
Please use by allocating a function allocation parameter's specified item warning
(item P371) to output signal.
As for subjected contents of warning, please refer 「6.2 Warning」.

No.	Name & Setting function	Value	Setting range
P403	**Specified warning function** You can select your output desired warning item as you like. When your selected item reaches to warning value, function status of a specified item warning (item P371) will be turned ON.	None	Select from none, warning selection group[※1]

※1 : Warning selection group.

- ・Main power supply bus voltage rise (only GPX2 - 16～8)
- ・Main power supply bus voltage decline (only GPX2 - 16～8)
- ・Transistor temperature (only GPX2 - 16～8)
- ・Regenerate resistor temperature (only GPX2 - 16～8)
- ・Position deviation　　　　　　・Over speed
- ・Effective torque　　　　　　　・Forced stop
- ・Output overlapping

＜Related items＞

Parameter	No.	Name	Condition
Function allocation	P371	Specified item warning	By specified warning contents which is selected at a specified item warning selection (item P403) function status turns ON.

3.5.5 Designate a warning determination value

Setting a determination value to do a warning output. Please set it by a figure less than abnormality designation value.

▷ Warning judgement value

No.	Name & Setting function	Value	Setting range
P410	**Main power supply bus voltage rise** ※2 Setting a voltage which outputs a warning at time of driver main power supply (internal bus voltage) rising. ・Abnormal determination value of main power supply over voltage: DC430 [V]	380 [V]	Value input: 1～999
P411	**Main power supply bus voltage decline** ※2 Setting a voltage which outputs a warning when a driver main voltage (internal bus voltage) declines. ・Abnormal determination value of main power supply voltage shortage: DC180 [V]	220 [V]	Value input: 1～999
P412	**Transistor temperature** ※2 When a cooling heat sink temperature of power element increases, it sets warning output temperature. ・Abnormal determination value of transistor over heat: 80 [℃]	70 [℃]	Value input: 1～999
P413	**Regenerate resistor temperature** ※2 When a resistor temperature of regenerate voltage protection function rises、it sets a temperature rising value to out put a warning. ・Abnormal determination value of regenerate resistor over heat: 35 [K]	30 [K]	Value input: 1～999
P414	**Position deviation** When a position deviation rises, it sets a warning output deviation pulse value. ・Abnormality determination value of excessive position deviation (item P170) contents.	9000 [pulse]	Value input: 1～99999
P415	**Over speed** ※1 It sets a speed to out put a warning when a motor rolling speed rises. ・Abnormality determination value of over speed (item P171) contents.	3200 [min^{-1}] (2200 [min^{-1}])	Value input: 1～99999
P416	**Effective torque** When a work volume rises, it sets an effective torque value to out put a warning. Effective torque is set a motor rating torque (rating current) continuous work volume 100 [%]. If over 100 [%] situation continues, there is a possibility over load abnormality may happen.	80 [%]	Value input: 1～999

※1 : In case of combination of motors more that 1 [kW] motor, excluding BNRⅡ100C, shipment setting value shown in ( ) is applied.
※2 : GPX2‐80～24 cannot be used.

＜Related items＞

Parameter	No.	Name	Condition
Function allocation	P371	specified item warning	Function status turns ON following a specified warning contents selected by a specified item warning selection (item P403). Please use by allocating to output signal.
Function Extension	P403	Specified warning function	You can select warning contents to output.

3.5.6 JOG Drive

This is used for trial run when there is no upper command. Please refer 「4.2 Trial run from control signal」 for details.

▷ JOG

No.	Name & Setting function	Value	Setting range
P420	**Speed** Setting a motor rotation speed used by trial run.	100 [min^{-1}]	Value input: 1～99999
P421	**Acceleration and deceleration time** Adding an acceleration and deceleration slope for trial run. Value is set by the time it reaches the speed (item P420).	500 [ms]	Value input: 0～99999
P422	**Inching amount of movement** Only at time of position control, inching (standard size) feed is possible. Setting a motor amount of movement per one pulse line input unit. In the case of setting value is finite, by using forward JOG (item P320) and reverse JOG (item P321)'s function status, we can make a position determination action of relative value drive. When an action is completed, by function status ON's re-start, next relative drive can be started.	∞ [pulse]	Value input: 1～∞ (infinite feed)

＜Related items＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	Please select a position or speed.
Function allocation	P300	Servo ON	Servo becomes ON by function status becomes ON. At shipment setting, it functions by turning ON the input signal (IN1).
	P304 P305	Forward start Reverse start	Please switch OFF a function status. At shipment setting, please switch OFF input signal (IN3,4).
	P306 P307	Forward force stop Reverse force stop	While function status is ON, fail safe works and normal processing cannot be done. Please use by input signal (IN7,8) turning ON, as it is allocated to negative logic input.
	P320 P321	Forward JOG Reverse JOG	By switching function status ON, motor rolls to the targeted direction at shipment setting, it functions by turning ON one of input signals (IN5 or 6).

◎Following is a command pattern of JOG speed when an acceleration and deceleration time (item P421) is set.
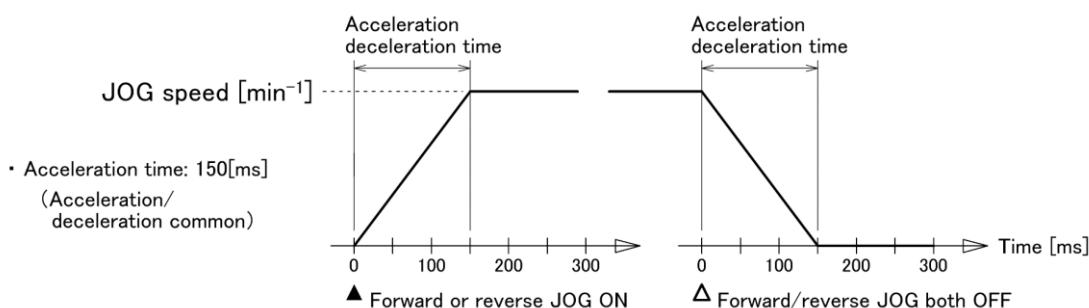
3.5.7 Internal speed

You can set a speed command or speed control value by three patterns without using
an analog input. Because it sets parameter values as speed command (control value),
you do not need to worry about noise like analog input. When you input a value of speed
setting. Torque setting by negative polarity (−), it is processed as reverse rolling torque
at the time of command, Torque 0 [%] at the time of torque control.

▷ Internal speed 1

No.	Name & Setting function	Value	Setting range
P430	**Speed** You can set as a speed command or control value.	1000 [min⁻¹]	Value input: −99999～99999
P431 P432 P433	**Acceleration time** **Deceleration time** **S shaped acc/dec time** As far as you use as a speed command value, acceleration and deceleration slope will be add to a speed (item P430).	100 [ms] 100 [ms] 100 [ms]	Value input: 0～99999 Please set P433 by smaller value than (item P431) and (item P432).

▷ Internal speed 2

| No.	Name & Setting function	Value	Setting range
P434	**Speed** You can set as a speed command or control value.	2000 [min⁻¹]	Value input: −99999～99999
P435 P436 P437	**Acceleration time** **Deceleration time** **S shaped acc/dec time** As far as you use as a speed command value, acceleration and deceleration slope will be add to a speed (item P434).	100 [ms] 100 [ms] 100 [ms]	Value input: 0～99999 Please set P437 by smaller value than (item P435) and (item P436).

▷ Internal speed 3

No.	Name & Setting function	Value	Setting range
P438	**Speed** ※1 You can set as a speed command or control value.	3000 [min⁻¹] (2000 [min⁻¹])	Value input: −99999～99999
P439 P440 P441	**Acceleration time** **Deceleration time** **S shaped acc/dec time** As far as you use as a speed command value, acceleration and deceleration slope will be add to a speed (item P438).	100 [ms] 100 [ms] 100 [ms]	Value input: 0～99999 Please set P441 by smaller value than (item P439) and (item P440).

※1 : In case of combination of motors more that 1 [kW] motor, excluding BNRⅡ100C, shipment
　　　setting value shown in ( ) is applied.

◎In internal speed (1~3) there are settings of an acceleration time, deceleration time and S
　shaped accelerating and decelerating time. If you use those, acceleration and deceleration
　will be added by the following contents, to a command pattern of internal speed.

・Function status

・Motor action
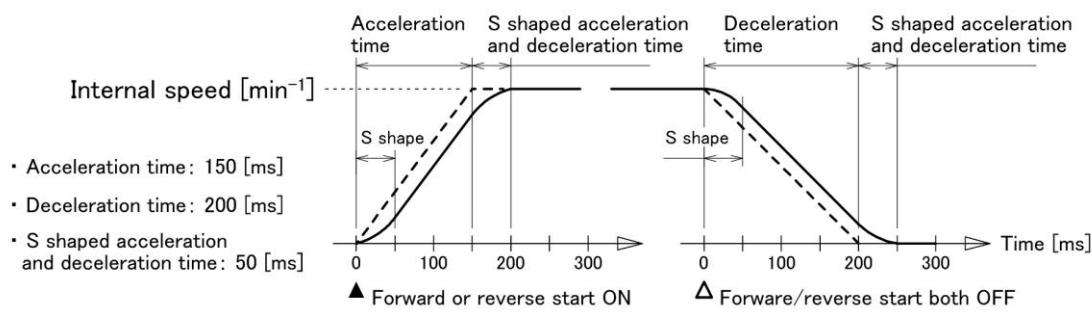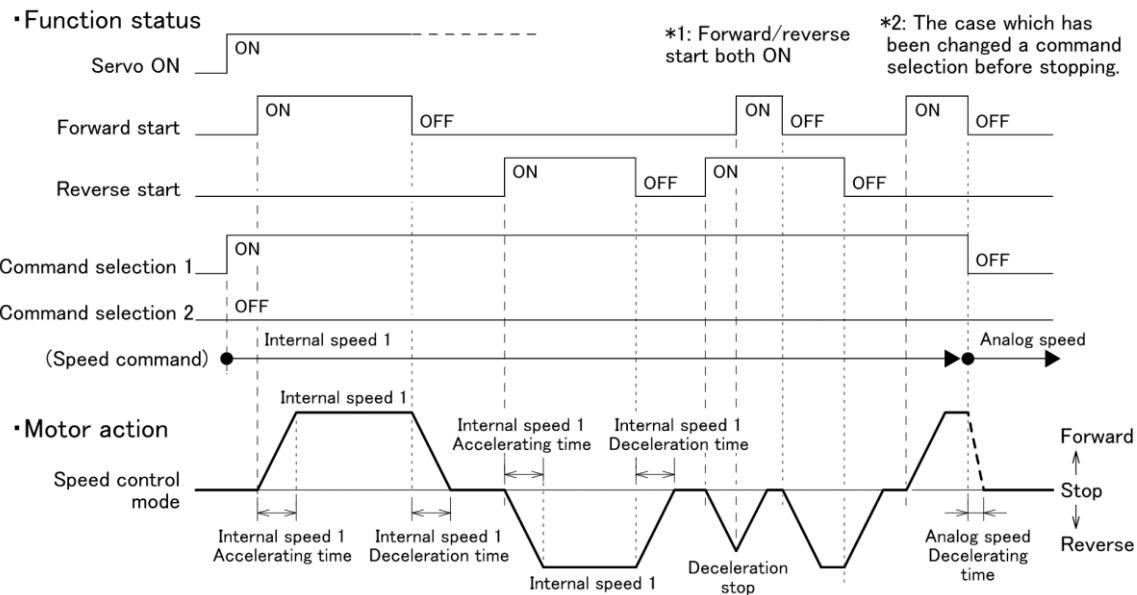
＜Items related to internal speed command＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	When you use an internal speed as a "command", please select a speed.
	P101	Forward direction	Setting a motor rolling direction to figure input of positive polarity (+). CCW is selected at a shipment selection.
Function allocation	P300	Servo ON	Servo becomes ON by function status becomes ON. At shipment setting, it functions by turning ON the input signal (IN1).
	P304 P305	Forward start Reverse start	By function status turns ON, rolling direction facing to command will be selected. At setting, either input signals (IN3,4) should be kept turning ON.
	P306 P307	Forward force stop Reverse force stop	While function status is ON, fail safe works and normal processing cannot be done. Please use by input signal (IN7,8) turning ON, as it is allocated to negative logic input.
	P322 P323	Command selection 1 Command selection 2	By function status, you can select an objected speed command. Please use it by allocating to an input signal.

＜Items related to an internal speed control＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	In case you use an internal speed as a "control value", please select a torque.
	P171	Speed control value	It is controlled by a lower value.
Function allocation	P324 P325	Control value selection 1 Control value selection 2	You can select an adding speed control value by a function status. Please use it by allocation input signal.
Extension setting	P400	Control value selection function	In case you use internal speed as "control value", please select a valid.

3.5.8 Internal torque

You can set a torque command or torque control value by three patterns without using analog input. Because we use a parameter value as torque command (control value), it is not necessary to worry noise like analog input.
If you figure input a torque setting by negative polarity (－), it is processed as reverse torque at the time of command, torque 0 [%] at the time of torque control.

No.	Name & Setting function	Value	Setting range
P450 P451 P452	**Internal torque 1** **Internal torque 2** **Internal torque 3** You can set as a torque command or a control value.	50 [%] 100 [%] 150 [%]	Value input: －99999～99999

＜Items related to an internal torque command＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	In case you use an internal torque as a "command", please select a torque.
	P101	Forward direction	Setting a generating torque direction to a figure input of positive polarity (+). At shipment setting, CCW is selected.
Function allocation	P300	Servo ON	A servo turns ON by a function status turns ON. At shipment setting, it functions by turning ON an input signal (IN1).
	P304 P305	Forward start Reverse start	When a function status turns ON, it generates a torque (motor rotation) by selected torque command. At a shipment setting, please turn either input signal (IN3,4) ON.
	P306 P307	Forward force stop Reverse force stop	When a function status turns ON, a fail-safe works and normal drive cannot be done. At shipment setting, it is allocated to negative logic input. Please use it by turning input signal ON (IN 7,8).
	P322 P323	Command selection 1 Command selection 2	You can select an objected torque command by function setting. Please use it by allocating to input signal.

＜Items related to an internal torque control＞

Parameter	No.	Name	Condition
Fundamental setting	P100	Control mode	In case you use an internal torque as a "control value", please select a position or a speed.
	P172	Torque control value	It is controlled by a lower value.
Function allocation	P324 P325	Control value selection 1 Control value selection 2	You can select an adding torque control value by a function status. Please use by allocating to an input signal.
Extension setting	P400	Control value selection function	In case you use an internal torque as a "control value", please select a valid.

3.5.9 Process at the time of force stop

While forward or reverse force stop function status turned ON, it will process a force stop to an objected rolling direction. This item set a process method at the time of stop.

- ・Torque zero :　　　Setting a torque command zero to an object rolling direction. (No loading a torque)

- ・Speed/torque zero :　　　An instant stop by setting a speed command zero. After that, facing to the rolling direction of the object, we turn a torque command to zero.

- ・Speed zero :　　　An instant stop turning a speed command zero to the objects rolling direction. (As a torque command is generated, it is valid as limiting switch of the direction of gravity or an inter lock of single direction rolling.)

No.	Name & Setting function	Value	Setting range
P472	**Force stop process** Setting a process method at the time of force stop of a forward force stop (item P306) or reverse force stop (item P307) function status turns ON.	Torque zero	Select from a torque zero, speed/torque zero or speed zero.

＜Related items＞

Parameter	No.	Name	Condition
Function allocation	P306 P307	Forward force stop Reverse force stop	When a function status turns ON, a process (item P472) at the time of force stop works and a normal drive cannot be done. At the time of shipment setting, it is allocated to a negative logic input, please use it by turning ON an input signals (IN 7 and 8).

3.6 Details of communication setting parameter

A communication setting parameter is an assembled parameter group of communication specification to connect tool software.

3.6.1 RS-232C Communication

You can set 2 systems of RS-232C communication baudrate. By using tool software, multiple situation display can be done and by using tool, in case of communication load happens, or it can be used when a communication time out happens frequently.
Please refer 「2.4 Connection of communication」 about wiring specification.

▷ RS-232C-1 (COM1)

No.	Name & Setting function	Value	Setting range
P500	**Baudrate** You can set COM 1 communication baudrate.	38400 [bps]	Select from 9600, 19200, 38400, 57600, 115200

▷ RS-232C-2 (COM2)

No.	Name & Setting function	Value	Setting range
P510	**Baudrate** You can set COM 2 communication baudrate.	38400 [bps]	Select from 9600, 19200, 38400, 57600, 115200

◎There is a fundamental communication change function at upper side of Driver (GPX‐40~8) Dip-SW. By turning ON Dip-SW3, a communication specification of connector CN3 and CN4 of RS-232C communication specification can be fixed per below contents.
Please use it after changing parameter setting, when it cannot be connected to tool software.

RS-232C communication specification

Baudrate	38400
Parity	nothing
Data bit length	8
Stop bit	1

※A function of changing fundamental communication by Dip-SW becomes.
Valid by power supply re-closing.

3.6.2 RS-485 Communication

When you connect a driver multi axis to daisy chain, you can set an internal axis communication.

▷ RS-485

No.	Name & Setting function	Value	Setting range
P520	**Axis number** ※1 You can set an axis number.	0	Value input: 0～7
P521	**Baudrate** You can set a communication baudrate number between axis's.	38400 [bps]	Select from 9600, 19200, 38400, 57600, 115200
P525	**Terminator** ※2 You can set a presence and absence of a terminator.	Invalid	Select from valid, invalid.
P526	**Response waiting time** You can set a time from receipt of single till start (delay) of sending signal.	1 [ms]	Value input: 0～999

※1 : Please set an axis number so that it should not double with other numbers.
※2 : Please set a terminator at the end of driver (both side) which are the most far.

4 Trial run

To adjust an equipment (mechanical) and to prevent an accident during driving, please be sure to perform a trial run.
Following is a peripheral configuration necessary at time of a trial run.
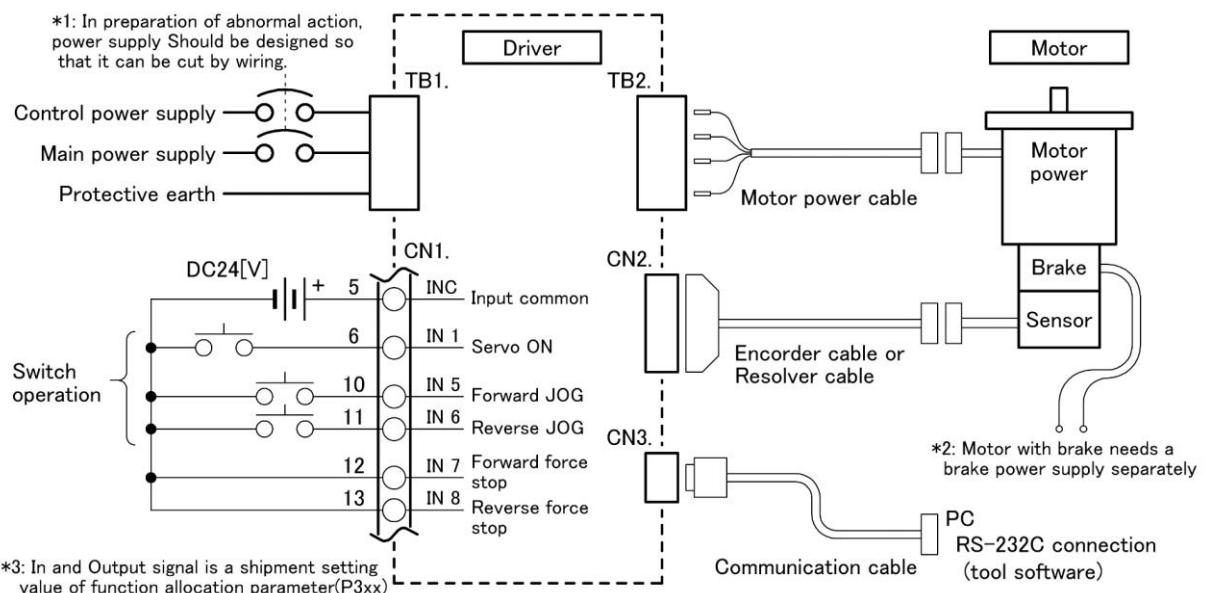

4.1 LED Display

To confirm driver's situation, two color LED has been allocated at 3 places on front panel.
Please confirm when you switch ON control power supply.

Front panel	Color	Abbreviation	Condition
LED 1	Green	RDY	After switch ON control power supply, a driver lights up by normal start.
	Red	AC1	It lights up when abnormal happens by alarm code. ※1 ※2
LED 2	Green	SRV	It lights up while servo ON.
	Red	AC2	It lights up when abnormal happens by alarm code. ※1 ※2
LED 3	Green	ATN	It flashes while inertia estimating and light out at estimation complete.
	Red	AC3	It lights up when abnormal happens by alarm code. ※1 ※2

※1 : At the time of control power supply switches ON (CPU starts) all LED lights up Red.
※2 : About abnormal classification (alarm code) while it is happening. Please refer 「6.1 Abnormality」.
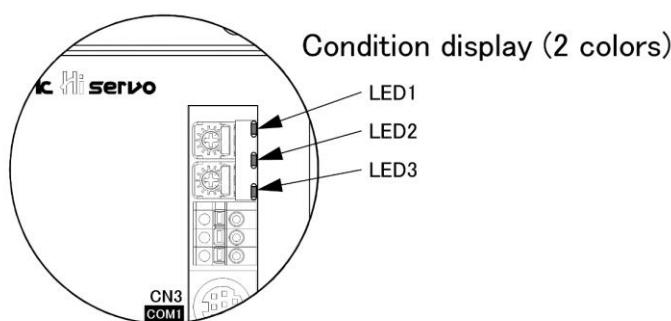
4.2 Trial run from control signal

By utilizing JOG drive function which is allocated to in output (CN1), we do motor trial run by three points switch operation.
Please start and proceed by undermentioned contents.

1) Please confirm wiring of TB1,2 and CN1~3.

2) By switching ON a control power supply (1φAC200V), please confirm it starts normal operation by LED 1 display (green).

3) Please confirm a communication connection of tool software.

4) Please switch ON a power supply (DC24V) to a control signal.

5) Please switch ON a main power supply (3φAC200V).

6) Please switch ON a servo ON signal.
In this case a motor does not become servo condition if a forward force stop (IN7) and a reverse force stop (IN8) have been wired as switching ON condition. Please pay attention.

7) Please confirm a servo ON situation by LED 2 display (green). In this case if motor axis vibrates, please decrease a gain a little. As for a gain adjusting method, please refer 「5 Gain adjustment」.

8) Please switch ON a forward and a reverse JOG signal by a switch ON operation. Motor rolls to a designated direction by a JOG speed and stops by a switch OFF operation. Please do a trial run of motor by using a JOG drive function.

9) In case you need to increase a rolling speed, please change a JOG speed (item P420).

10) If you change a control mode (item P100) a shipment setting value from "speed" to "position", you can use an inching (feed sizing). To change a control mode, a control power supply must be switched ON again.

11) When you finish work, please switch OFF a power supply after switching OFF a forward JOG/reverse JOG/servo signal switch OFF.

＜Warning＞
At the time of trial run, please be always prepared to shut down a power supply any time you feel an abnormality or danger.

◎ Switch operation

Servo ON ⌐ ON

Forward/reverse JOG both ON

Forward JOG ___ ON   OFF   ON   OFF   ON   OFF

Reverse JOG ___   ON   OFF   ON   OFF

◎ Motor action

Speed control mode

JOG speed

Acceleration deceleration time

Acceleration deceleration time

JOG speed

Deceleration stop

Forward ↑ Stop ↓ Reverse

Position control mode

JOG speed

Inching amount of movement

Acceleration deceleration time

Acceleration deceleration time

Inching amount of movement

JOG speed

Deceleration stop

Forward ↑ Stop ↓ Reverse

＊ It cannot be used in torque control mode.

4.3 Trial run from a tool software

Please start a trial run by operating a tool software, without using a wiring of in output (CN1). Please start and proceed by undermentioned contents.

1) Please confirm a wiring of TB1,2 and CN2,3.

2) Please switch ON a control power supply (1φAC200V) and confirm a normal start by LED 1 display (green).

3) Please confirm a communication connection of a tool software

4) Please switch ON a main power supply (3φAC200V).

5) Please select a「trial run tool」from menu bar of tool soft ware「tool」.

6) Please switch ON a servo following to a operation guide on screen.

7) Please confirm a servo ON situation by LED 2 display (green). In this case if motor axis vibrates, please decrease a gain a little. As for a gain control method, please refer 「5 Gain adjustment」.

8) Following to an operation guide on screen, please start a trial run by JOG button.

9) When finished, please shut down a power supply after servo OFF operation.

＜Warning＞
At the time of trial run, please be always prepared to shut down a power supply any time you feel an abnormality or danger.

5 Gain adjustment

In order to facilitate a motor servo control and use a machine by the maximum ability, a gain adjustment is necessary.
Please select from an automatic tuning which automatically generates a gain in compliance with inertia ratio, a manual tuning which sets a gain individually.
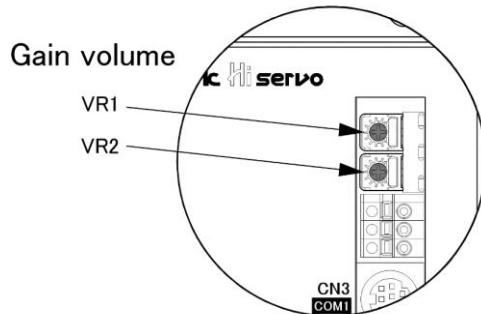
5.1 Automatic tuning

An automatic tuning generates automatically a fundamental gain in compliance with an inertia ratio. If you use a gain volume on display panel surface, you can adjust a tuning level and a response level. A gain adjustment is mainly done by tuning level only.
Please use a response level only to fine tune a command response ability.

・Normal use item

No.	Parameter of a gain 1	Gain volume adjustment function 1 (item P210)	
		Valid	Invalid
P221	Tuning level	Adjust by VR1	Set by tool software
P222	Response level	Adjust by VR2	Set by tool software
P223	Inertia ratio	Set by tool software	

・Items while a gain selection (item P303) ON

No.	Parameter of gain 2	Gain volume adjustment function 2 (item P211)	
		Valid	Invalid
P224	Tuning level	Adjust by VR1	Set by tool software
P225	Response level	Adjust by VR2	Set by tool software
P226	Inertia ratio	Set by tool software	

◎Tuning level
You can adjust by a tuning level, matching to a gain which is generated from inertia ratio to a mechanical system.
Please seta level 5.0 as a standard value, and you can modify within a level 1.0~10.0.

Low （level 1.0） ←	Tuning level	→ High （level 10.0）
Small ←	Resilience to disturbance	→ Big
Slow ←	Response to a command	→ Quick
Big machine, low rigility and big inertia ratio.	Applied mechanical system	Small machine, high rigid and inertia ratio low.

◎Response level
When you want to control by increasing a responsibility speed and restrict an over shooting without changing a fundamental tuning level, you can adjust by a response level. You should set a level 0.0 as a standard value, and change a level within ±10.0 range.

Low （level －10.0） ←	Response level	→ High （level ＋10.0）
No change ←	Resilience to disturbance	→ No change
Slow ←	Response to a command	→ Quick
Small ←	Over shooting	→ Big

※an adjustment range by a gain volume (VR2) is 0.0～10.0. as for a setting lower than 0 Please use a tool software.

◎Estimation of inertia
When a function (item P220) is valid, without using each gain's inertia ratio (item P223, P226) contents, you can generate a gain from estimation inertia ratio which calculates real time in actual machine drive.

A calculation of estimated inertia ratio takes some time till estimation completion because at each control power supply switch ON, it starts from no loading situation (inertia ratio = 0.0 [ratio]).

We recommend you to use by making this function invalid, in case a loading inertia is stable, input an estimated inertia ratio (item M143) value which is displayed on driving situation monitor of tool software (TelGPX2) to a servo adjustment parameter of an inertia ratio of (item P223, P226).

5.2 Manual tuning

Manual tuning method sets a gain of position and speed loop individually. If you use a gain volume on paned surface, you can adjust a speed loop gain.
We recommend to adjust a gain either by connecting an oscilloscope to an inspection terminal (TP1,2) or on wave display at tool software, while monitoring a feedback speed.

・Normal use item

No.	Parameter of a gain 1	Gain volume adjustment function 1 (item P210)	
		Valid	Invalid
P242	Position feed forward	Set by tool software	
P243	Position proportion	Set by tool software	
P244	Speed proportion	Adjust by VR1	Set by tool software
P245	Speed integral	Adjust by VR2	Set by tool software

・Items while a gain selection (item P303) ON

No.	Parameter of a gain 2	Gain volume adjustment function 2 (item P211)	
		Valid	Invalid
P248	Position feed forward	Set by tool software	
P249	Position proportion	Set by tool software	
P250	Speed proportion	Adjust by VR1	Set by tool software
P251	Speed integral	Adjust by VR2	Set by tool software

◎Adjustment of speed loop gain
A gain adjustment is mainly done by a speed proportion gain and a speed integral gain.
A speed proportion gain changes at all frequency zone, its responsiveness. When you increase a gain, totally recovery power increases and servo rigidity become high and a speed variation to a load becomes less.
A speed integral gain varies its responsiveness at low frequency zone, if you increase a gain, servo lock and low rotation area's recovery power. Increases and it becomes persistent.
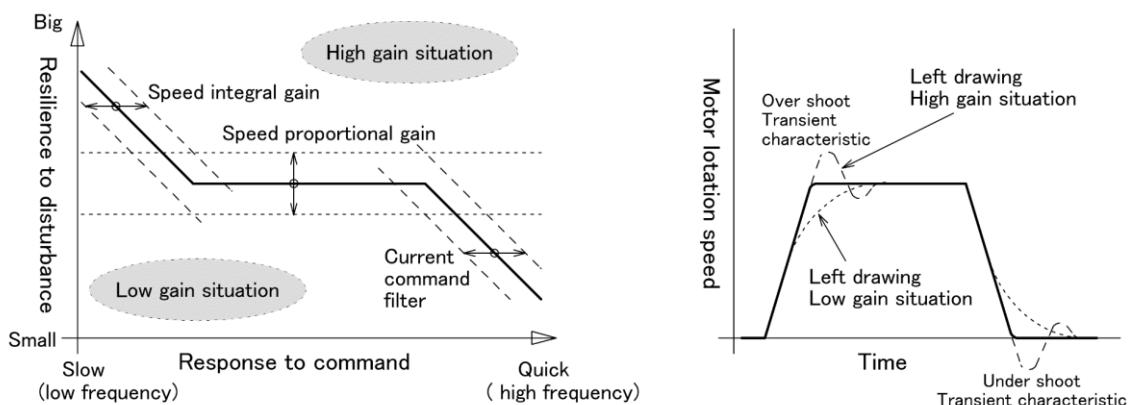

At first adjusting a speed proportional gain.
If there is any vibration at servo lock situation, decrease a little, otherwise. Increase within a range which a vibration does not occur. After that fine tune a transient characteristics by a speed integral gain.
But depends upon a combined mechanical system, a motor may vibrate at high frequency area. In such case, please also use a currency command filter (item P260〜264) and adjust.

＜An example of speed loop adjustment at the time motor vibrates＞
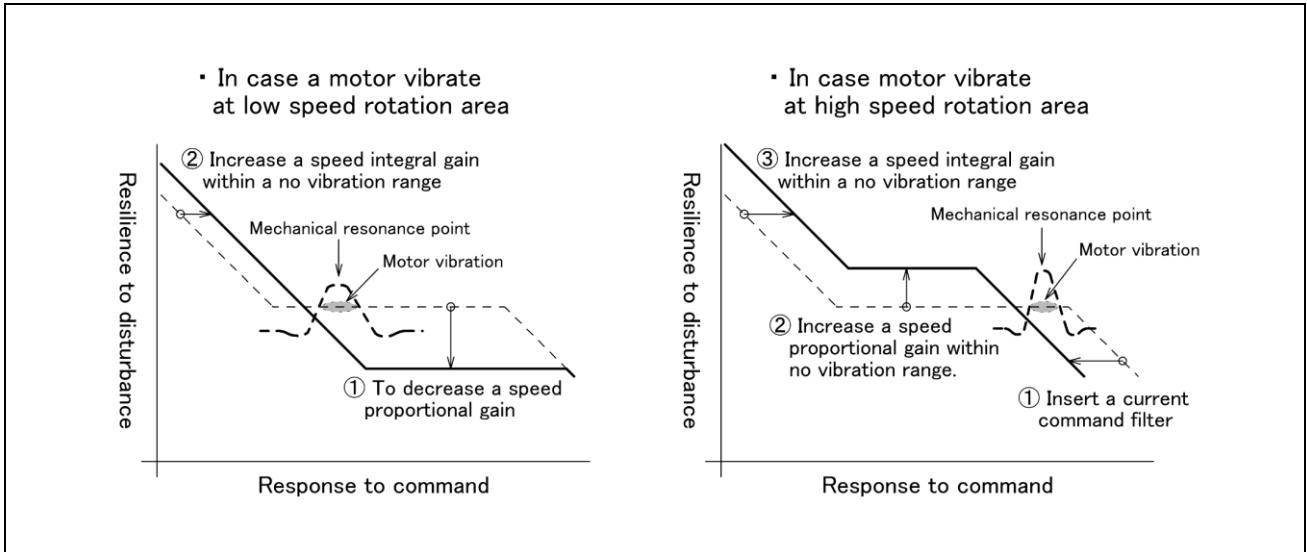
◎Adjustment of position loop gain
   Generally, please do this after adjusting a speed loop gain.
   A gain adjustment will be done by a position proportion gain and a position feed forward gain. A position proportion gain controls a stored volume of a position deviation. If you increase a gain, position deviation becomes less and position setting accuracy becomes higher.
   A position forward gain changes a responsiveness to a command. If you increase a gain, operating position deviation becomes less but transient characteristics appears evidently.
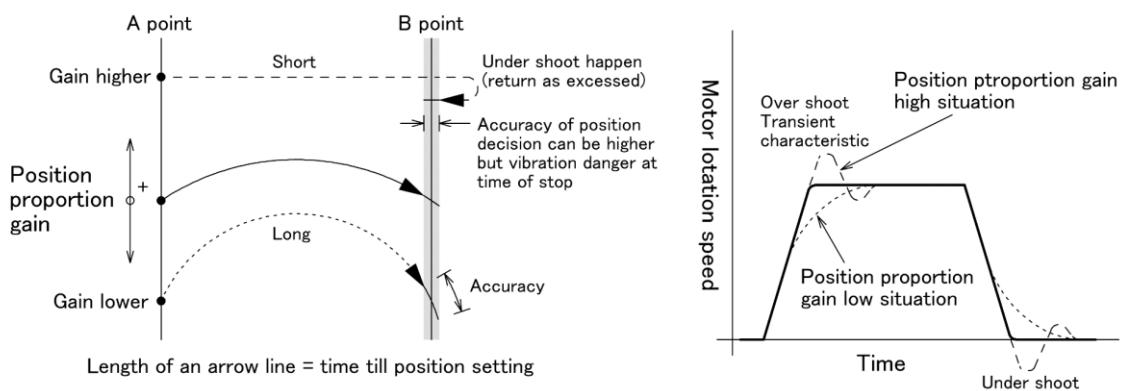
At first position setting drive should be done repeatedly and a position proportion gain should be increased within a range of no vibration at time of stop.
If a combined mechanical system 's rigidity is low, a vibration may easily happen and there is a possibility a position proportion gain cannot be increased.
In that case a position feed forward gain should be increased little by little and adjust allowable position deviation value.

6 Protection function

A driver has many protection functions and consisted by an abnormality and a warning.

6.1 Abnormality

When an abnormality happens, servo should be OFF, a motor should be a free condition and following action should be taken.

・Front panel :	LED displays (3points) lights ON by red color as abnormality classification.
・Control signal : (CN1)	A relay contacts at alarm output (ALM-NC) opens. An output signal which is set a function allocation coordinates. At shipment setting, FET contact between a brake opens (OUT3) and abnormality happens (OUT4) opens.
・Others :	An abnormality contents will be history preserved in a flash memory. Dynamic brake function works.

An abnormal situation cannot be released until an input operation by reset function (item P301) or re-input of a control current. After removing an abnormal factor, please keep a security and release.

No.	Abnormal class (Reset function)	LED display	Abnormal contents	Cause
1	**Minor fault** (Reset: Possible)	● ○ ○	Soft charge not completed	Input a servo signal at no main power supply situation.
			Main power supply voltage shortage	Driver main power supply (internal bus voltage) fall less than DC180 [V] during motor drive.
			Position deviation excess	A position deviation excesses a position deviation excess determination value (item P170).
			Excess speed	A situation which a feedback speed excesses a speed control value (item P171) continues more than 1 [sec].
			Excess load	Detects an excess load situation by electronics thermal system. Miss wiring by power line (TB1, 2) or sensor (CN2).
			Mechanical lock	In the zero-speed determination value (item P184) of feedback speed, the lowest torque control situation continues more than 0.2 [sec].
			Communication input time out	while motor trial run is done, from tool software by communication, an abnormal communication continues more than 2.5 [sec].
2	**Temperature** (Reset: Possible)	○ ● ○	Transistor over heat	A cooling heat sink temperature excesses 80 [℃]. Detect an internal protection of power element.
			Over heat detection circuit	Detecting an abnormality at over heat detecting electric circuit.

No.	Abnormal class (Reset function)	LED display	Abnormal contents	Cause
2	**Temperature** (Reset: Possible)	○ ● ○	Cooling fan action	Detect an abnormality of a fan. (only GPX2‐60～80)
			Regenerate resistor over heat	To detect an over heat of internal regenerate resistor by thermal signal or resistor temperature rise 35 [K].
			Regenerate absorption circuit	To detect an abnormality of electric circuit which does a regenerate absorption.
3	**Control power supply voltage shortage** (Reset: Possible)	● ● ○	Control power supply voltage shortage	Input voltage of a driver control power supply falls less than AC80 [V]. (increasing a case of instant power break down)
4	**Motor position sensor** (Reset: Not possible)	○ ○ ●	Motor position sensor	Wiring abnormality like sensor (CN2) disconnection and short circuit. Sensor system of a combined motors does not match. A logic of sensor signals and frequency abnormal situation
5	**Main power supply excess voltage** (Reset: Not possible)	● ○ ●	Main power supply excess voltage	By regenerate energy, a driver main power supply (internal bus) rises more than DC430 [V]. A shortage of regenerate absorption capacity.
6	**Excess current** (Reset: Not possible)	○ ● ●	Excess current	To detect an excess current of driver output stage by short circuit of motor power and ground fault.
7	**System abnormal** (Reset: Not possible)	● ● ●	System abnormal	To detect an abnormality at parameter zone (data contents) of memory. To detect a CPU mal function and an abnormality of control circuit by excess noise.

※LED display shows from up side AC1・AC2・AC3.　☀(light on) and ○ (light off) shows a situation.

◎Excess load abnormality

A driver detects excess load by electronics thermal system and make it as an abnormality. Motor current and detection time is shown characteristics drawing. Regarding an excess load detection level of a characteristics drawing, there is a variation of ±10 [%]. Please take note.

- 83 -
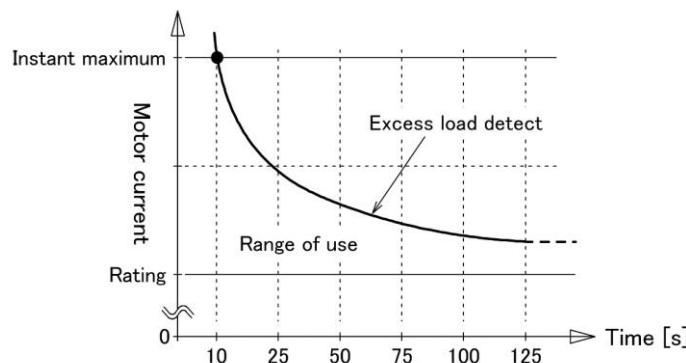
6.2 Warning

Unlike to an abnormality, motor does not stop even a warning is issued. Only a flag situation of a warning status changes.
Please use it when an upper device receives abnormality omen like an excess load and over heat as a warning signal and to avoid an abnormality by driver control.

Contents of warning	Cause
Main power supply bus voltage rise [※1]	When a driver main power supply (internal bus voltage) increases, reach to a warning determination value (item P410), a warning statue will be turned ON.
Main power supply bus voltage decline [※1]	When a driver main power supply (internal bus voltage) fall sand lowers a warning determination value (item P411), a warning status will be turned ON.
Transistor temperature [※1]	When a cooling heat sink temperature of power elements rises and reaches to a warning determination value, (item P412) a warning status will be switched ON.
Regenerate resistance temperature [※1]	When an internal regeneration resistor temperature rises and reaches to a warning determination value (item P413), a warning status will be switched ON.
Position deviation	When a position deviation increases and reaches to a warning determination value (item P414), a warning status will be switched ON.
Over speed	When a motor rolling speed rises and reaches to a warning determination value (item P415), a warning status will be switched ON.
Effective torque	When a motor continuous working volume increases and reaches to a warning determination value (item P416), a warning status will be switched ON.
Force stop	A forward force stop (item P306) and reverse force stop (item P307) works only when both function status OFF because of fail safe. By this reason a warning status switches ON when drive (Servo ON) does not switch ON.
Output overlapping	You cannot allocate multiple functions to an output signal 1~4. It switches ON a warning status when a setting is overlapped by mistake. Output signal in this situation, by smaller number of function status of output allocation (item P350～) it becomes valid.

※1 : GPX2 - 80～24 cannot be used.

6.3 Troubles shooting

Trouble factors happen at a driver starting time and its solution is written below.

◎Case 1 : An abnormality happens at time of control power supply switches ON

Factor	Solution
Minor failure (Soft charge not completed) abnormality happens.	・At the situation of main power supply is not switched ON, if Servo ON (item P300) function status is ON, an abnormality happens. Please confirm at a function monitor of tool software.
Temperature (Transistor over heat, Regenerate resistor over heat) abnormality happens.	・Internally driver is over heated. Please wait some moments and try again.
Control power supply voltage short abnormality happens.	・Please confirm if a specified voltage is applied to terminal table. (L1C, L2C)
Monitor position abnormality happens.	・Please confirm a combined motor model number. ・Please confirm CN2 sensor connector's connection. ・If you produce a sensor cable by yourself, please confirm a wiring of position sensor signal.

◎Case 2 : Servo ON (Thrust is generated on motor axis) does not work

Factor	Solution
Main power supply is not switched ON.	・Please confirm a specified voltage has been applied to a terminal table. (L1, L2, L3)
A motor power cable is not connected.	・Please confirm a motor power cable is connected to a terminal table. (U, V, W, FG)
There is no servo ON input.	・Please confirm a servo ON (item P300) function status is ON by function monitor of tool software. At shipment setting, it works by an input signal (IN1) turns ON.
There is no forward and reverse force stop input.	・Please confirm at tool software 's function monitor, forward force stop (item P306) and reverse force stop (item P307) function status is OFF. At shipment setting, function is released by turning input signal (IN 7,8) ON.

◎Case 3 : Monitor axis does not follow even a command is input

Factor	Solution
Control mode is not appropriate.	・By tool software driving condition monitor, please check current control mode's contents and set a control mode (item P100) correctly.
Position command pulse is not appropriate. (position control)	・By tool software's driving situation monitor, please confirm a contents of position command [pulse], please set a pulse line input format (item P110) correctly. In case driver does not recognize even a setting value and to connector CN1 correctly connected, there is a case that situation improves if you change a line driver connection polarity to upper device or if you reverse a logic.
Analog speed command is not appropriate. (speed control)	・Please confirm a speed analog input [V] contents by tool software driving situation monitor, and please set a speed command factor (item P120) correctly.
Analog torque command is not appropriate. (torque control)	・Please confirm a contents of torque analog input [V] by tool software driving situation monitor, and please set a torque command factor (item P130) correctly.
There is no input of forward or reverse start. (speed control, torque control)	・By a function monitor of tool software, please confirm either forward start (item P304) or a reverse start (item P305) function status is ON. At shipment setting, please switch ON either one of input signals (IN 3 or 4).
By motor axis's lock, runaway or abnormal it stops.	・Please confirm a motor power cable is wired sequent correctly to a terminal table. (U, V, W)
Motor's rolling speed does not rise.	・Please adjust a gain. ・A Load is heavy and motor capacity shortage is a possibility. Please separate a mechanism and lighter the load and try again. There is a possibility a retention brake is not open. ・Please confirm a specified voltage is applied to a brake wire. (only brake option product)
A motor vibrates.	・Please make an gain adjustment. ・Please confirm a voltage variation of main power supply is not more than ±10 [%]. ・Please confirm aground wiring of terminal table. (PE, FG) ・In case you produce a sensor cable by yourself, please confirm position sensor each pair signal combination. By a twist pair, noise reception influence varies. ・Please check there is no looseness of mechanism.

7　Other functions

7.1　Dynamic brake function

A Driver involves a dynamic brake internally and this system works when servo is OFF.
A dynamic brake is to control a motor at the time of black out and an abnormality happens.
A rating is for short time only and if you use continuous control or repeating control there
is a possibility a driver breakage.
Please be careful to the following points.

　◎If a dynamic brake works at time of high speed rolling, please keep about 3 minutes
　　pause.

　◎Please do not start or stop of rolling activity by servo ON signal while a command is
　　input.

　◎If you use a direction of gravity load, a dynamic brake may become a continuous control.
　　By using retention brake, please fix within 3 second mechanically.

　◎In case if you use in combination with decelerator (high decelerator), if you drive a main
　　axis by external power motor axis will be accelerated and may become a continuous
　　control.
　　Please exclude motor power cable (TB1 or TB2) and process your job.

7.2　Inrush current reduction function

A driver uses a rectifier circuit of condenser input system. A control current controls an
inrush current by series resistor, a main power supply built in an inrush current reduction
function because a condenser capacity is big.
An inrush current reduction function of a main power supply charges a smoothing capacitor
gently by 0.5 seconds.
Please be careful as it does not accept a servo ON within a charging time after turn ON a
main power supply. Please do not repeat an action power supply turn ON and OFF within a
short time.

GPX2‐80,　GPX2‐60
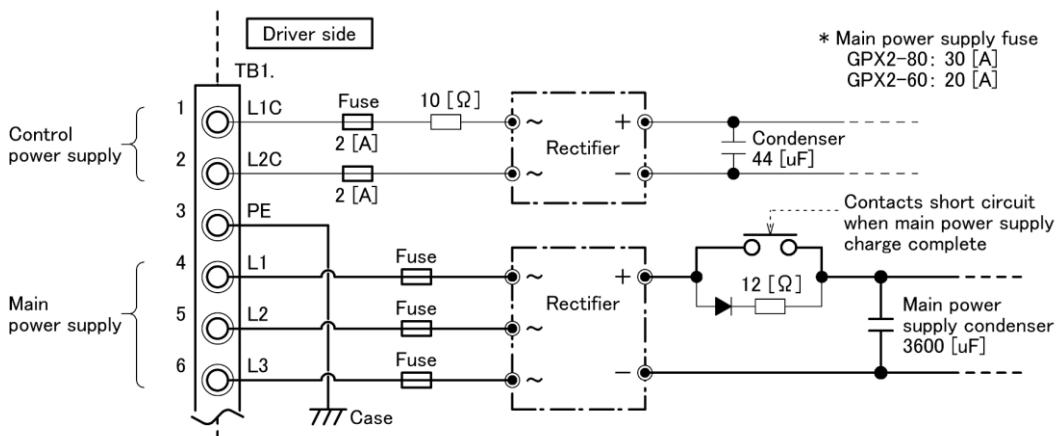
GPX2 - 40, GPX2 - 24
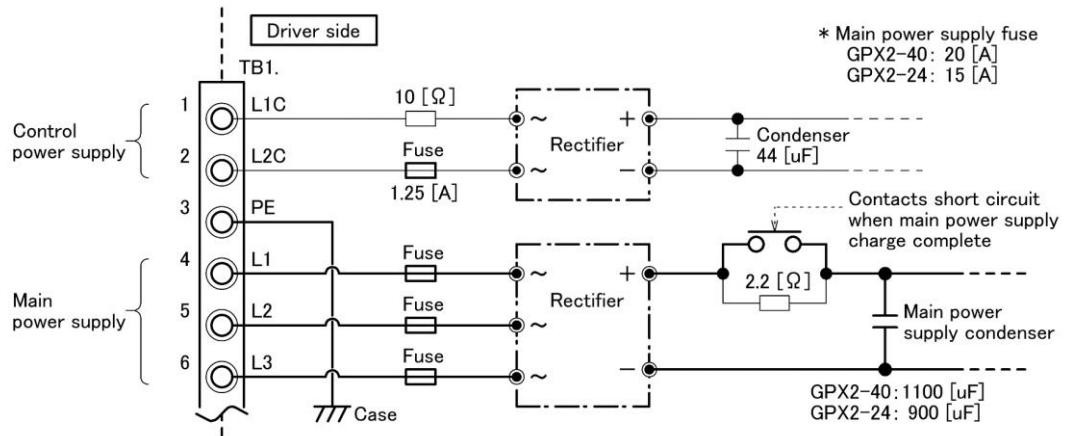

GPX2 - 16, GPX2 - 12, GPX2 - 8
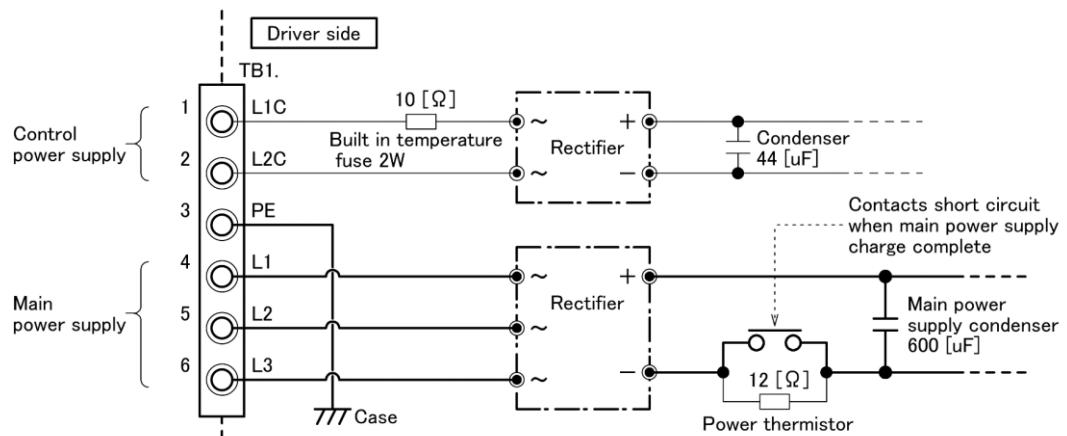
7.3 Regenerate voltage protection function

When a servo motor becomes a regenerate situation, an occurred regenerate energy charges
a smooth capacitor of a main circuit and absorbed.
In this moment, as main power supply voltage rises in accordance with a smooth capacitor capacity
and regenerate energy volume, in order not to exceed an inner circuit breakdown voltage by an
abnormal determination voltage, detecting an excess voltage abnormal stops a regenerating action.

A driver built in a regenerate voltage protection function, it suppresses a charging of main power
supply voltage by a regenerate energy, using a consumption of a regenerate resistance.

◎As a standard of a continuous operation, following is a graph of relation between total
inertia (including rotor inertia) and cycle time. A driver built in a regeneration resistance
but its regenerate absorption capability is limited.
In case a direction of gravity load's operation, sudden start of excess load inertia and stop,
please refer its operation cycle.
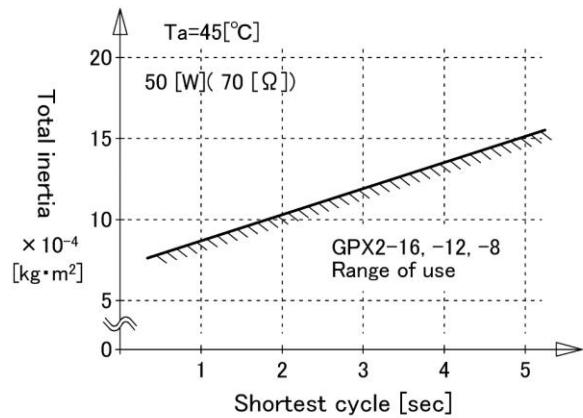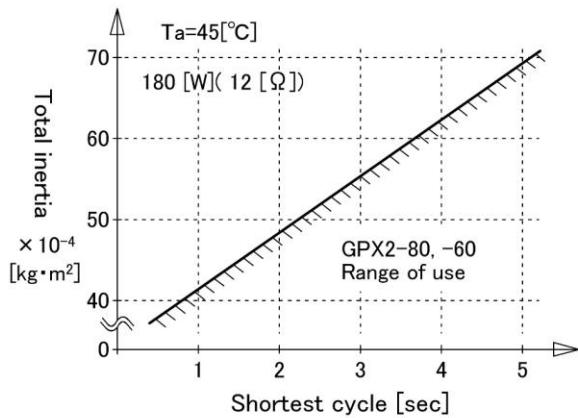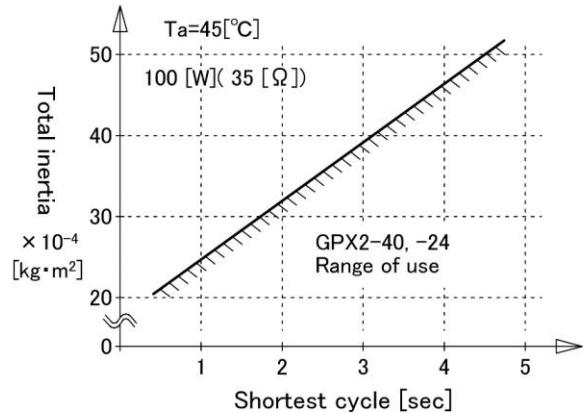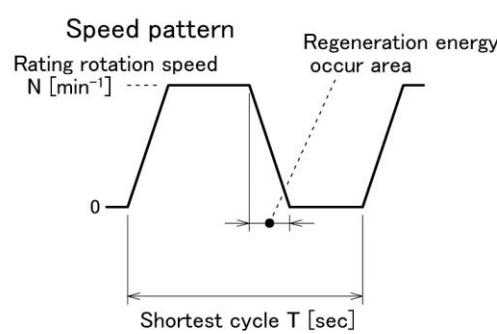
8 Specification

Series standard

Driver model	GPX2 - 80	GPX2 - 60	GPX2 - 40	GPX2 - 24
Max peak current	80.0 [A]	60.0 [A]	40.0 [A]	24.0 [A]
Continuous rated current	18.8 [A(rms)]	14.1 [A(rms)]	9.4 [A(rms)]	5.6 [A(rms)]
Control power supply	Single phase AC200～240 [V] ±10[%] (50/60Hz)			
Main power supply	Three phases AC200～240 [V] ±10[%] (50/60Hz)			
Combined motor	Our AC Servo motor, capacity 0.75～3.0 [kW]			
Motor control	Three phases PWM control			
Carrier frequency	10 [kHz]			
Combined sensor	Shipment by encored specification or resolver specification.			
Encoder specification	Optical incremental encoder With UVW line driver model, resolution depends on a combined motor.			

Resolver specification	BRX model brushless resolver
	  Amplitude and a phase cable length automatic adjust circuit and
	  synchronous detection method.
	  Resolution 4096 [ppr], Carrier frequency 10 [kHz]			

Control mode	Position control, Speed control, Torque control			
Position command	Pulse line input 1 [Mpps] Max. (high speed coupler DC5V) pulse form 2 pulse, 1 pulse, select by parameter from 2 phase systems.			
Speed command/control	Analog speed input ±10 [V] (resolution 25V/12bit) Or select from internal parameter setting value (3 points)			
Torque command/control	Analog torque input ±10 [V] (resolution 25V/12bit) Or select from internal parameter setting value (3 points)			
Encoder pulse output	Line driver output phase A, B and Z (26LS31 equivalent)			
Monitor output	Analog voltage output ±10 [V] (resolution 25V/12bit) Monitor 2ch contents to be selected by a parameter.			
Control input	Max. 8 points (common, bi directional photo coupler input DC24V) Select an allocation of input function by a parameter.			
Control output	Max. 4 points (common, photo MOSFET output 50mA) Select an allocation of output function by a parameter.			
Alarm output	1 point (relay C contact output 0.5A), fix a function to an abnormal output.			
Communication function	Possible to change parameter setting value on tool software and total display of abnormal record. Communication system is RS-232C (2ch), select from RS-485 by a parameter.			
Situation display	LED 3points Displays a start, a servo situation and an alarm code by two color LED switch.			
Gain setting	Select an automatic tuning system or manual tuning system by a parameter. Possible to adjust by 2 points of panel surface volume.			
Protection function	Consisted by abnormality 14 points and warning 5 points.		Consisted by abnormality 13 points and warning 5 points.	
Abnormality record	Store an abnormality record to flash memory. (1024 times from the latest information)			
Other function	Dynamic brake function, Inrush current reduction function, Regenerate voltage protection function			
External dimension (excluding connector and protrusion)	H: 292 [mm] D: 215 [mm] W: 165 [mm]	H: 292 [mm] D: 215 [mm] W: 165 [mm]	H: 272 [mm] D: 161 [mm] W: 129 [mm]	H: 272 [mm] D: 161 [mm] W: 119 [mm]
Mounting dimension	H: 280 [mm] W: 120 [mm]	H: 280 [mm] W: 120 [mm]	H: 262 [mm] W: 50 [mm]	H: 262 [mm] W: 50 [mm]
Weight (approximately)	7.0 [kg]	7.0 [kg]	3.6 [kg]	3.0 [kg]
Operation environment	0～50 [℃], less than 85 [%RH] (no condensation, dust)			

Driver model	GPX2 - 16	GPX2 - 12	GPX2 - 8
Max peak current	16.0 [A]	12.0 [A]	8.0 [A]
Continuous rated current	3.8 [A(rms)]	2.4 [A(rms)]	1.5 [A(rms)]
Control power supply	Single phase AC100～240 [V] ±10[%]　(50/60Hz)		
Main power supply	Three phases AC200～240 [V] ±10[%]　(50/60Hz)		
Combined motor	Our AC Servo motor, capacity 60～750 [W]		
Motor control	Three phases PWM control		
Carrier frequency	10 [kHz]		
Combined sensor	Shipment by encoder specification or resolver specification.		
Encoder specification	Optical incremental encoder With UVW line driver model, resolution depends on a combined motor.		

Resolver specification	BRX model brushless resolver
	  Amplitude and a phase cable length automatic adjust circuit and
	  synchronous detection method.
	  Resolution 4096 [ppr], Carrier frequency 10 [kHz]		

Control mode	Position control, Speed control, Torque control		
Position command	Pulse line input 1 [Mpps] Max. (high speed coupler DC5V) pulse form 2 pulse, 1 pulse, select by parameter from 2 phase systems.		
Speed command/control	Analog speed input ±10 [V] (resolution 25V/12bit) Or select from internal parameter setting value (3 points)		
Torque command/control	Analog torque input ±10 [V] (resolution 25V/12bit) Or select from internal parameter setting value (3 points)		
Encoder pulse output	Line driver output phase A, B and Z (26LS31 equivalent)		
Monitor output	Analog voltage output ±10 [V] (resolution 25V/12bit) Monitor 2ch contents to be selected by a parameter.		
Control input	Max. 8 points (common, bi directional photo coupler input DC24V) Select an allocation of input function by a parameter.		
Control output	Max. 4 points (common, photo MOSFET output 50mA) Select an allocation of output function by a parameter.		
Alarm output	1 point (relay C contact output 0.5A), fix a function to an abnormal output.		
Communication function	Possible to change parameter setting value on tool software and total display of abnormal record. Communication system is RS-232C (2ch), select from RS-485 by a parameter.		
Situation display	LED 3points Displays a start, a servo situation and an alarm code by two color LED switch.		
Gain setting	Select an automatic tuning system or manual tuning system by a parameter. Possible to adjust by 2 points of panel surface volume.		
Protection function	Consisted by abnormality 16 points and warning 9 points.		
Abnormality record	Store an abnormality record to flash memory. （1024 times from the latest information）		
Other function	Dynamic brake function, Inrush current reduction function, Regenerate voltage protection function		
External dimension (excluding connector and protrusion)	H: 200 [mm] D: 150 [mm] W:　80 [mm]	H: 200 [mm] D: 150 [mm] W:　73 [mm]	H: 200 [mm] D: 150 [mm] W:　73 [mm]
Mounting dimension	H: 194 [mm] W: 35 [mm]	H: 194 [mm] W: 35 [mm]	H: 194 [mm] W: 35 [mm]
Weight (approximately)	1.7 [kg]	1.6 [kg]	1.6 [kg]
Operation environment	0～50 [℃], less than 85 [%RH] (no condensation, dust)		

After service

This driver has been shipped after a strict inspection.
As for initial stage troubles, please check again by reading this manual again
if there is any mistake of wiring or usage method.

In case of contacting us, please inform following contents.
We are sorry for bothering you but it is needed to make an appropriate response.

    ①   Driver model (TYPE)

    ②   Serial number (SER. No.)

    ③   Production year and month (DATE)

    ④   Motor model

    ⑤   Contents of control, simply

    ⑥   Driving system combined to a motor

    ⑦   Contents of trouble

       (Above ①～③ are written on a name plate of driver side sheet metal.)

Contact from telephone and facsimile

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Contact from WEBSITE

     URL http://www.wacogiken.co.jp/

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ALL SPECIFICATION IS SUBJECT TO CHANGE FOR IMPROVEMENT WITHOUT
PRIOR INFORMATION.

D0502008