Chapter 12 Absolute System

Introduction

Delta's absolute system includes an ASDA-A2 series servo drive, an ECMA series servo motor with an absolute encoder and a backup battery box for an absolute encoder. An ECMA series servo motor with an absolute encoder has an encoder which is able to rotate and tell the servo motor the actual position when the power is turned on. An absolute encoder in an ECMA series servo motor will constantly record the actual positions by its built-in coordinate system at any time. So the real position of the servo motor will be measured and recorded even if the motor shaft rotates after the power is turned off.

An ECMA series servo motor with an absolute encoder is essential and must be connected with an ASDA-A2 series servo drive for a Delta's absolute system. When an ECMA series servo motor with an incremental encoder is connected to an ASDA-A2 series servo drive, if the users enable the servo parameters for absolute system, a fault code, AL069 will be shown on the drive's LCD display to alert that an error occurs. When AL069 is displayed, please examine if the connected servo motor is a servo motor with an absolute encoder. While using absolute motor, as soon as it applies to the power, the motor speed cannot lower than 250rpm. When operating in battery mode, make sure the maximum speed does not exceed 200rpm. The model name of a servo motor with an absolute encoder is shown as below

One servo drive uses one single battery box. Two servo drives can share a dual battery box. We recommend the users to choose Delta's backup battery boxes and Delta's encoder connection cables for Delta's absolute systems for wiring and connection. Please perform the installation in order as specified in the quick start and user manual when connecting to an absolute system. Regarding the descriptions and specifications of battery boxes and corresponding accessories, please refer to the contents in the following sections.

12.1 Backup Battery Boxes

12.1.1 Specifications

Precautions

Please thoroughly understand and observe the following safety precautions. Failure to observe these precautions may void warranty! In order to prevent damage and danger, please use batteries in accordance with the specified specification.

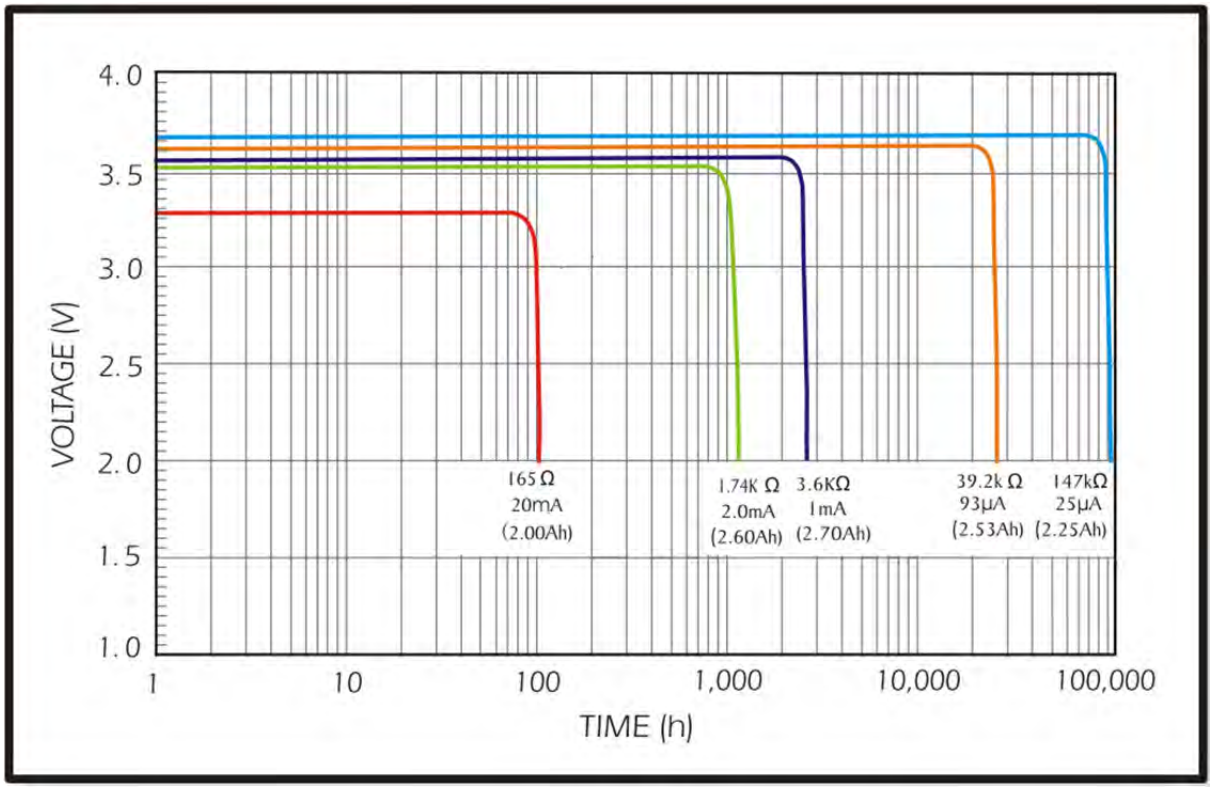
- Do not use the product in a potentially explosive environment. Install the product in a clean and dry location free from corrosive and inflammable gases or liquids.
- Do not place the battery dispersedly to prevent short circuiting and accidents.
- Do not short circuit the positive pole and the negative pole of the batteries or install batteries in reverse polarity.
- To prevent electric energy loss and lifetime reduction, it is recommended to use new batteries only.

- Do not store batteries within an ambient temperature above +100°C. Failure to observe this precaution may cause fire or explosion.
- The batteries are non-rechargeable. Do not charge the batteries or explosion may result.
- Do not directly solder the battery surface.

Battery Specifications

Items	Li/SOCl2 Cylindrical Battery
Type	ER14505
Delta Model Number	ASD-CLBT0100
International Standard Size	AA
Nominal Voltage	3.6 V
Nominal Capacity	2700 mAh
Maximum Continuous Operating Current	100 mA
Maximum Pulse Current	200 mA
Dimensions (D x H)	14.5 x 50.5 mm
Weight	Approx. 19 g
Operating Temperature	-40 ~ +85°C

Battery Life



Above figure comes from EVE Energy Co. ER14505 Discharge Characteristics

(1) The above figure illustrates the discharge current curve generated by constant current test. According to the testing result shown on the graph above, when the power consumption of an absolute encoder is 65uA or lower, if the voltage of the battery keeps 3V or higher, the expected battery life is about 21900hr, approximately 2.5 years (Note). Therefore, the lowest voltage level of battery for an absolute encoder is set to 3.1V.

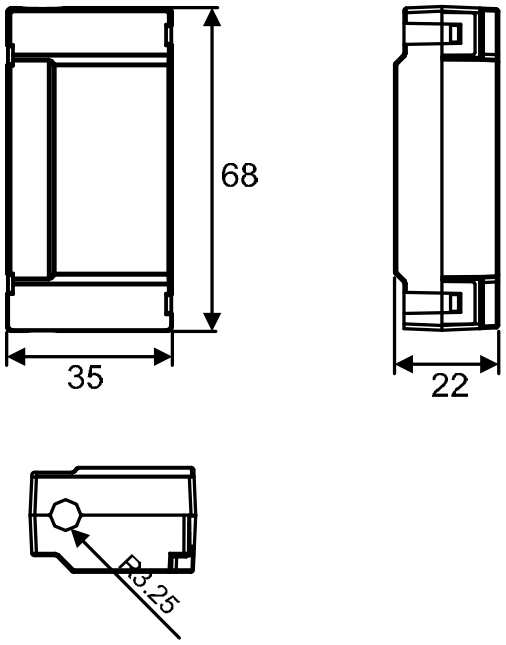
(2) The battery life expectancy is about 5 years and is able to provide 3.6V or higher voltage under normal temperature and humidity conditions.

NOTE The battery life was measured when one single battery box is connecting to one servo drive and one servo motor.

12.1.2 Battery Box Dimensions

Single Battery Box

Delta Model Number: ASD-MDBT0100

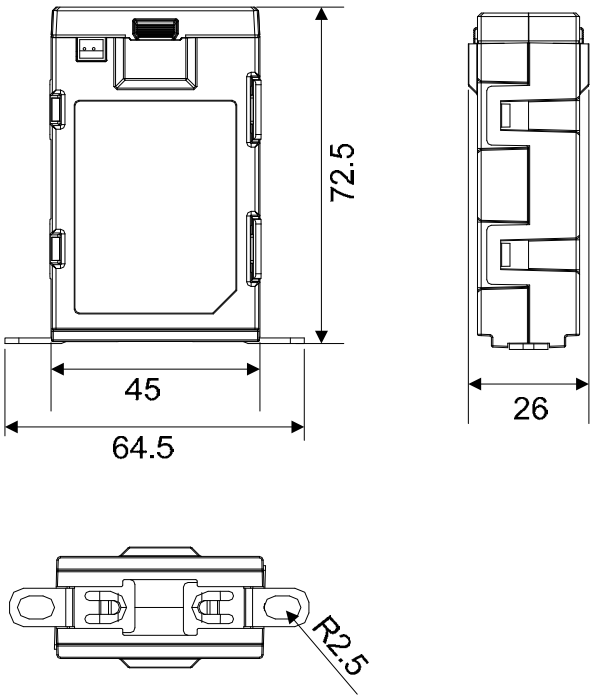


Weight
44 g

Units: mm

Dual Battery Box

Delta Model Number: ASD-MDBT0200



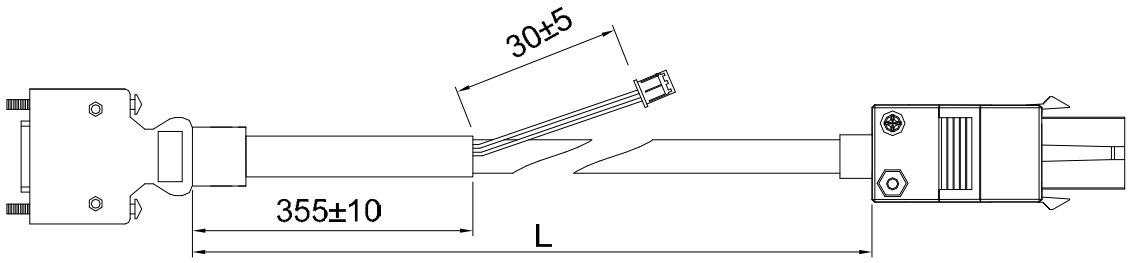
Weight
80 g

Units: mm

12.1.3 Connection Cables for Absolute Encoder

A. Quick Connector

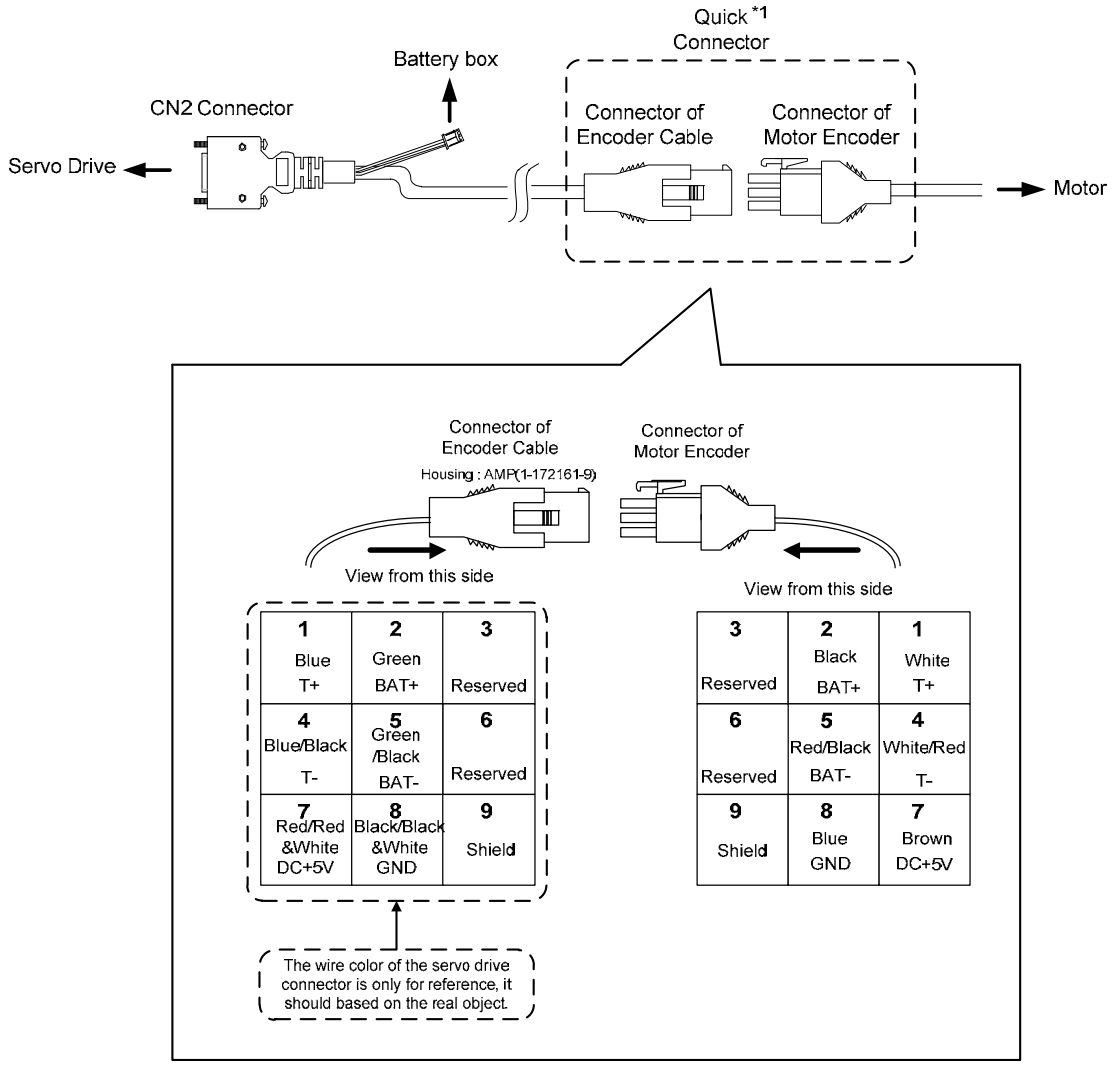
Delta part number: **ASD-A2EB0003, ASD-A2EB0005**



Title	Model Name	L	
		mm	inch
1	ASD-A2EB0003	3000 ± 100	118 ± 4
2	ASD-A2EB0005	5000 ± 100	197 ± 4

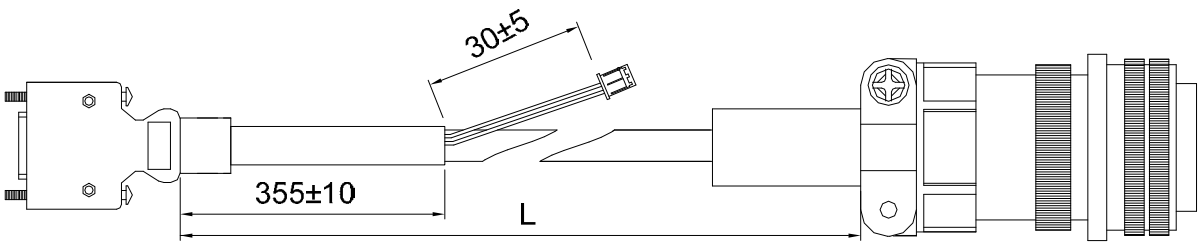
Connection method:

Please conduct the wiring according to the following instructions. Wrong wiring might cause battery explosion.



B. Military Connector

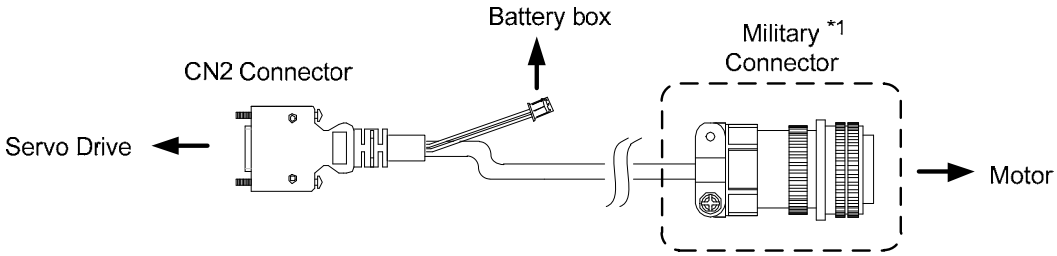
Delta part number: **ASD-A2EB1003, ASD-A2EB1005**

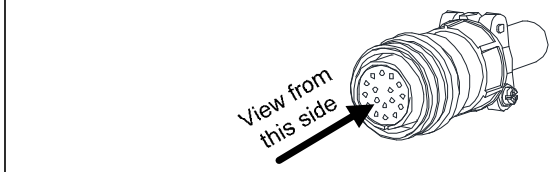


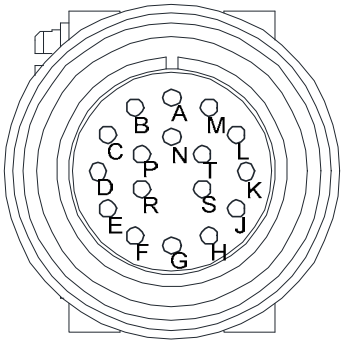
Title	Model Name	L	
		mm	inch
1	ASD-A2EB1003	3000 ± 100	118 ± 4
2	ASD-A2EB1005	5000 ± 100	197 ± 4

Connection method:

Please conduct the wiring according to the following instructions. Wrong wiring might cause battery explosion.







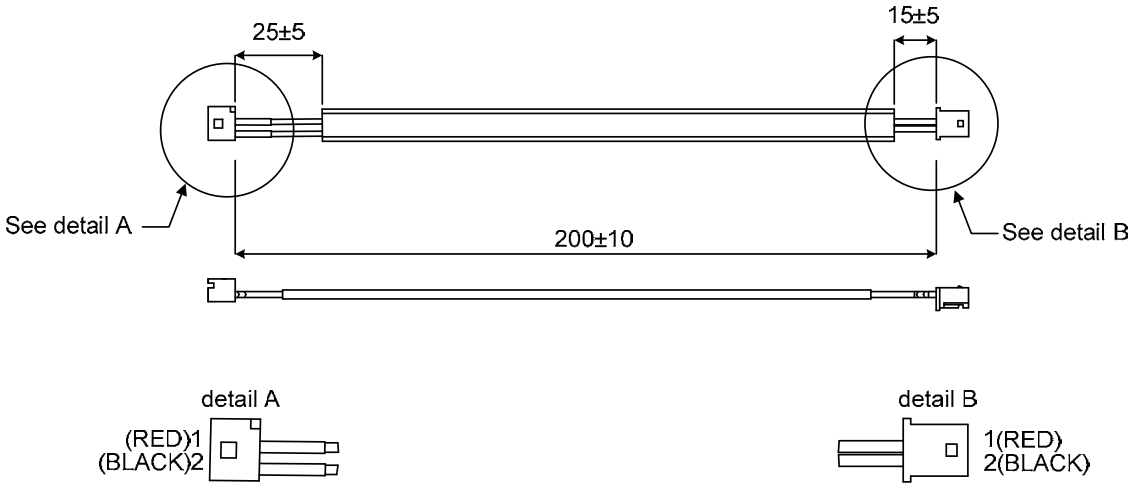
3106A-20-29S
Military Connector

Pin No.	Terminal	Color
A	T+	Blue
B	T-	Black
C	BAT+	Green
D	BAT-	Green/ Black
S	DC+5V	Red/Red & white
R	GND	Black/Black & white
L	BRAID SHIELD	-

12.1.4 Battery Box Cords

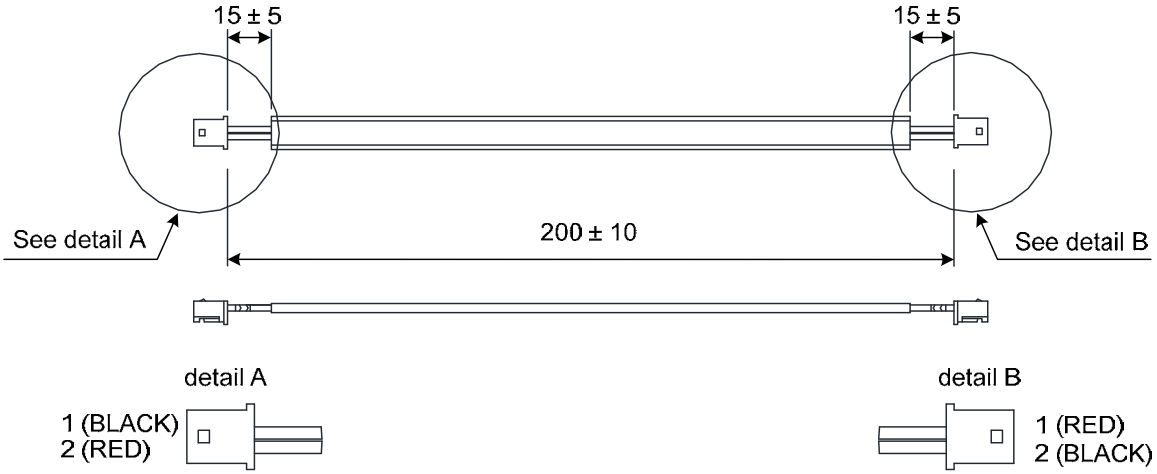
Battery Box Cord AW

Delta Part Number: 3864573700



Battery Box Cord IW

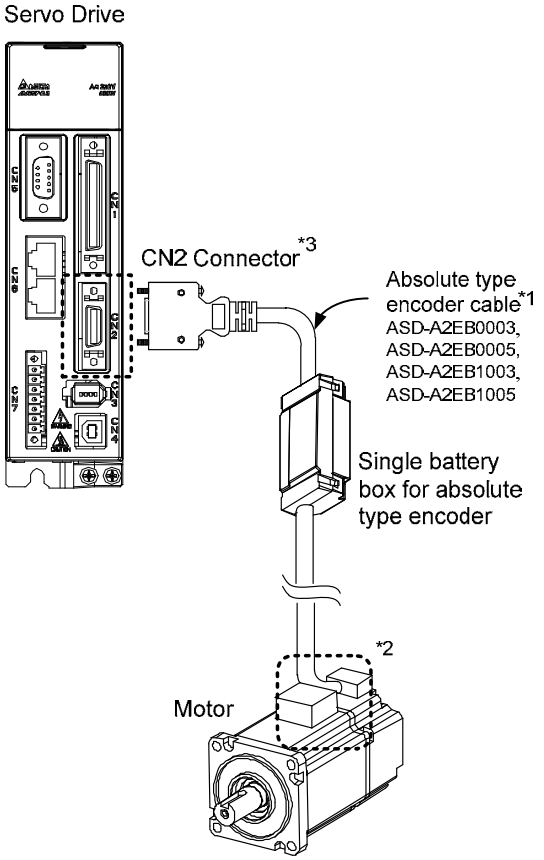
Delta Part Number: 3864811900



12.2 Installation

12.2.1 Connection Examples

Single Battery Box



NOTE This is the wiring diagram for connecting to a single battery box. The scale of the objects does not match the dimensions as shown in the drawing above. For different models of AC servo drives and motors, the connection cables may differ.

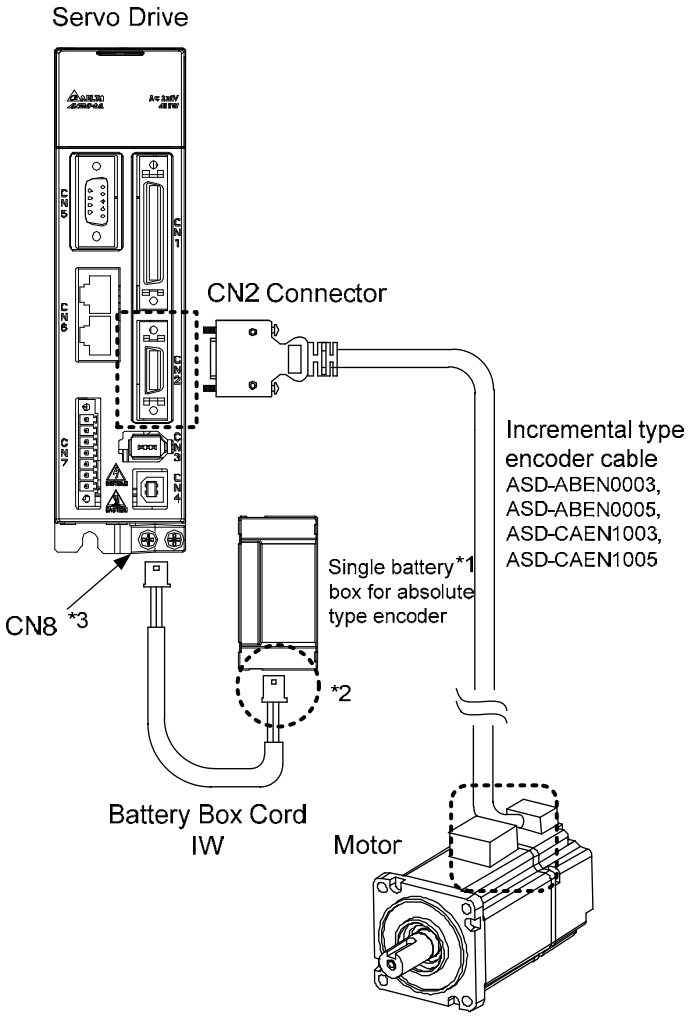
1* and 2* Please refer to section 12.1.3.

3* Definition of CN2 connector

Please conduct the wiring according to the following instructions. Wrong wiring might cause battery explosion.

CN2 Connector			Motor Connector	
Pin No	Terminal Symbol	Function and Description	Military Connector	Quick Connector
5	T+	Serial communication signal input/output (+)	A	1
4	T-	Serial communication signal input/output (-)	B	4
7	BAT+	Battery 3.6V	C	2
9	BAT-	Battery ground	D	5
14, 16	+5V	Power+5V	S	7
13, 15	GND	Power ground	R	8
-	Shield	Shield	L	9

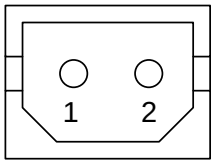
Single Battery Box (Connect to CN8)



NOTE This is the wiring diagram for connecting to a single battery box. The scale of the objects does not match the dimensions as shown in the drawing above. For different models of AC servo drives and motors, the connection cables may differ.

1* Make sure the battery box is firmly fixed with this connection method.

2* Connect to power base on single battery box, see the descriptions below:



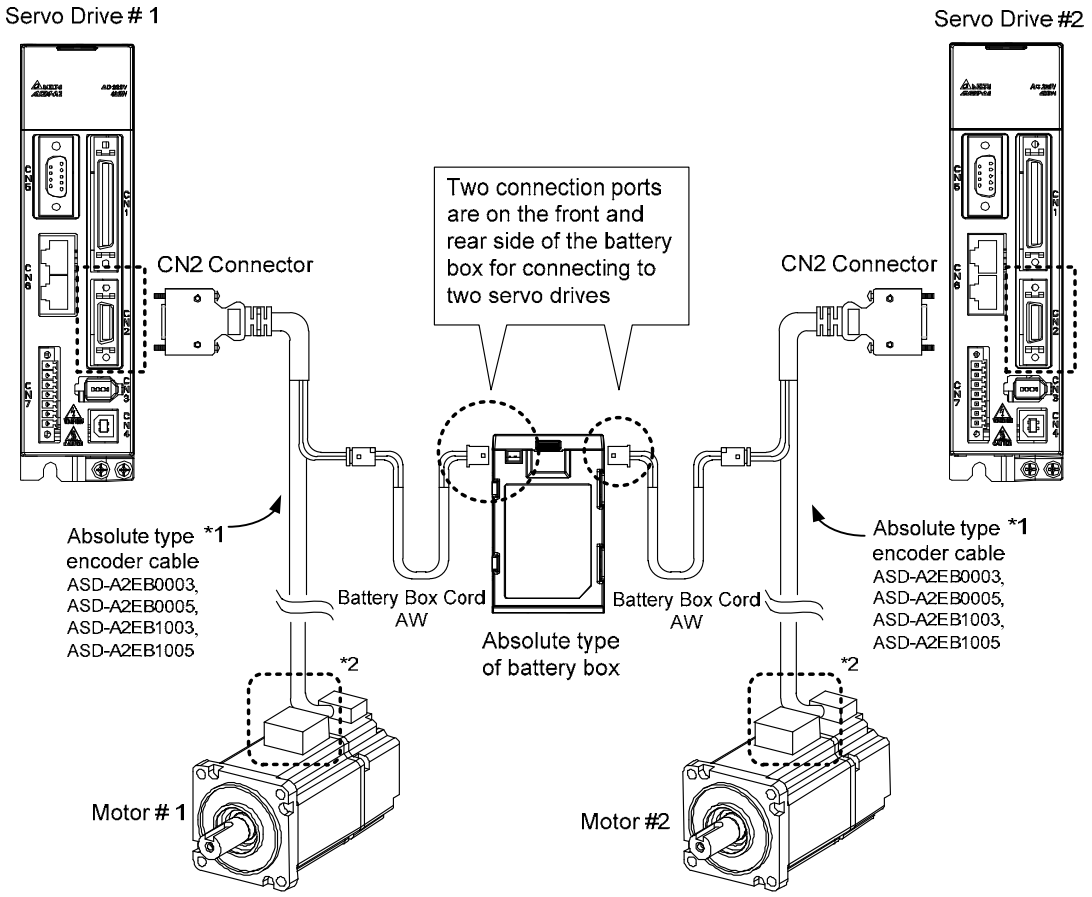
Pin No	Terminal Symbol	Connector Cable
1	BAT+	Red
2	BAT-	Black

3* Definition of CN8 Connector:

Please conduct the wiring according to the following instructions. Wrong wiring might cause battery explosion.

Pin No	Terminal Symbol
1	BAT+
2	BAT-

Dual Battery Box (Connect to CN2)



NOTE

This is the wiring diagram for connecting to a single battery box. The scale of the objects does not match the dimensions as shown in the drawing above. For different models of AC servo drives and motors, the connection cables may differ.

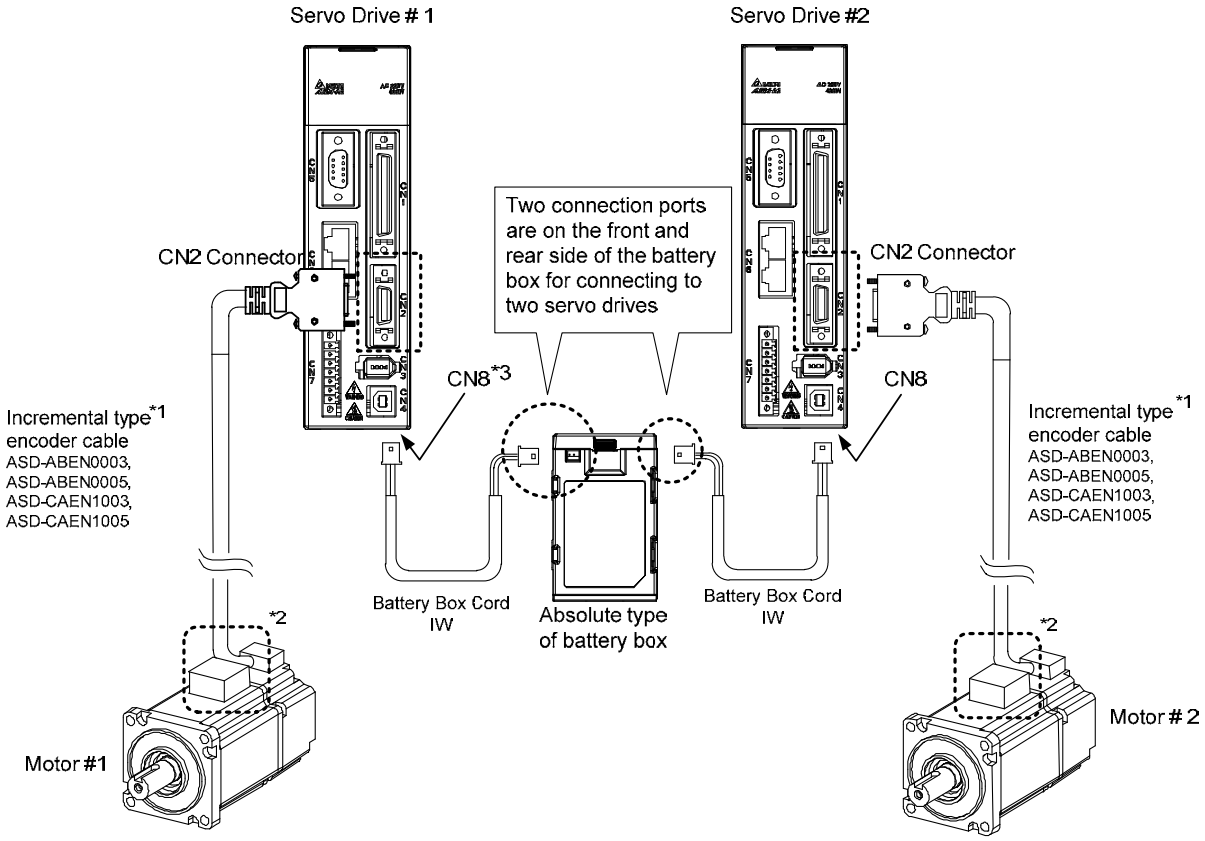
1* and 2* Please refer to section 12.1.3.

3* Definition of CN2 connector

Please conduct the wiring according to the following instructions. Wrong wiring might cause battery explosion.

CN2 Connector			Motor Connector	
Pin No	Terminal Symbol	Function and Description	Military Connector	Quick Connector
5	T+	Serial communication signal input/output (+)	A	1
4	T-	Serial communication signal input/output (-)	B	4
7	BAT+	Battery 3.6V	C	2
9	BAT-	Battery ground	D	5
14, 16	+5V	Power+5V	S	7
13, 15	GND	Power ground	R	8
-	Shield	Shield	L	9

Dual Battery Box (Connect to CN8)



NOTE

This is the wiring diagram for connecting to a single battery box. The scale of the objects does not match the dimensions as shown in the drawing above. For different models of AC servo drives and motors, the connection cables may differ.

1* and 2* Please refer to section 12.1.3.

3* Definition of CN8 connector

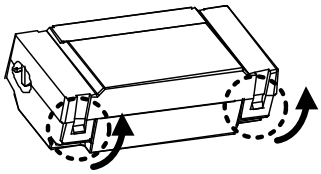
Please conduct the wiring according to the following instructions. Wrong wiring might cause battery explosion.

Pin No	Terminal Symbol
1	BAT+
2	BAT-

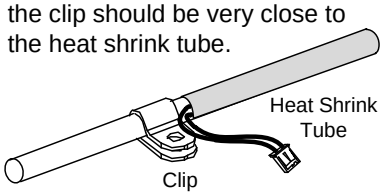
12.2.2 How to Install a Battery

Single Battery Box

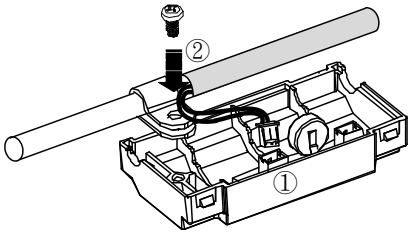
Loosen the latches of both sides to open the top cover.



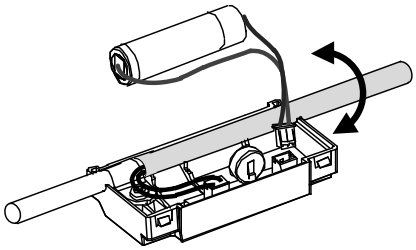
Put on the clip on the cable. Please note that the position of the clip should be very close to the heat shrink tube.



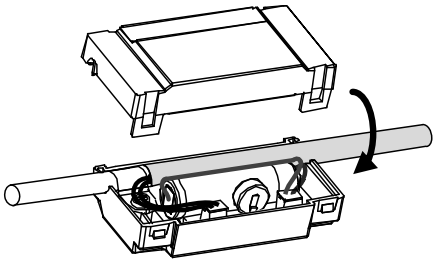
① Plug in the connection cable
② Turn the screw to tighten it.



Install a new battery.

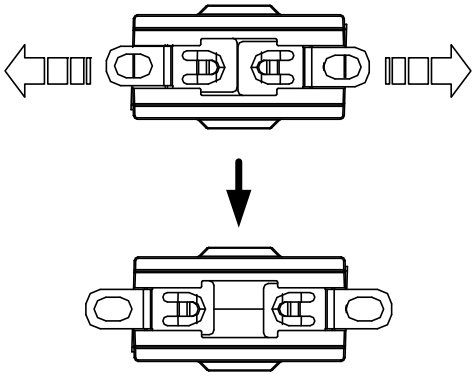


Place the cables into the box and put the cover on the box.

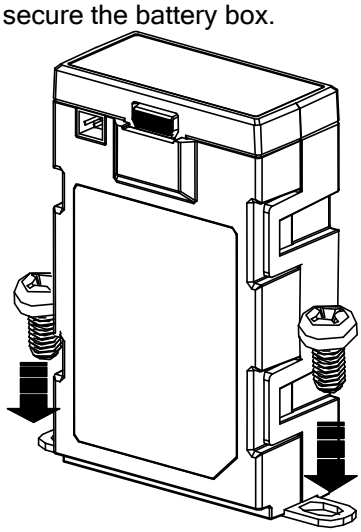


Dual Battery Box

Pull the latches located on the bottom side as shown in the figure below.



Tighten the mounting screws to secure the battery box.



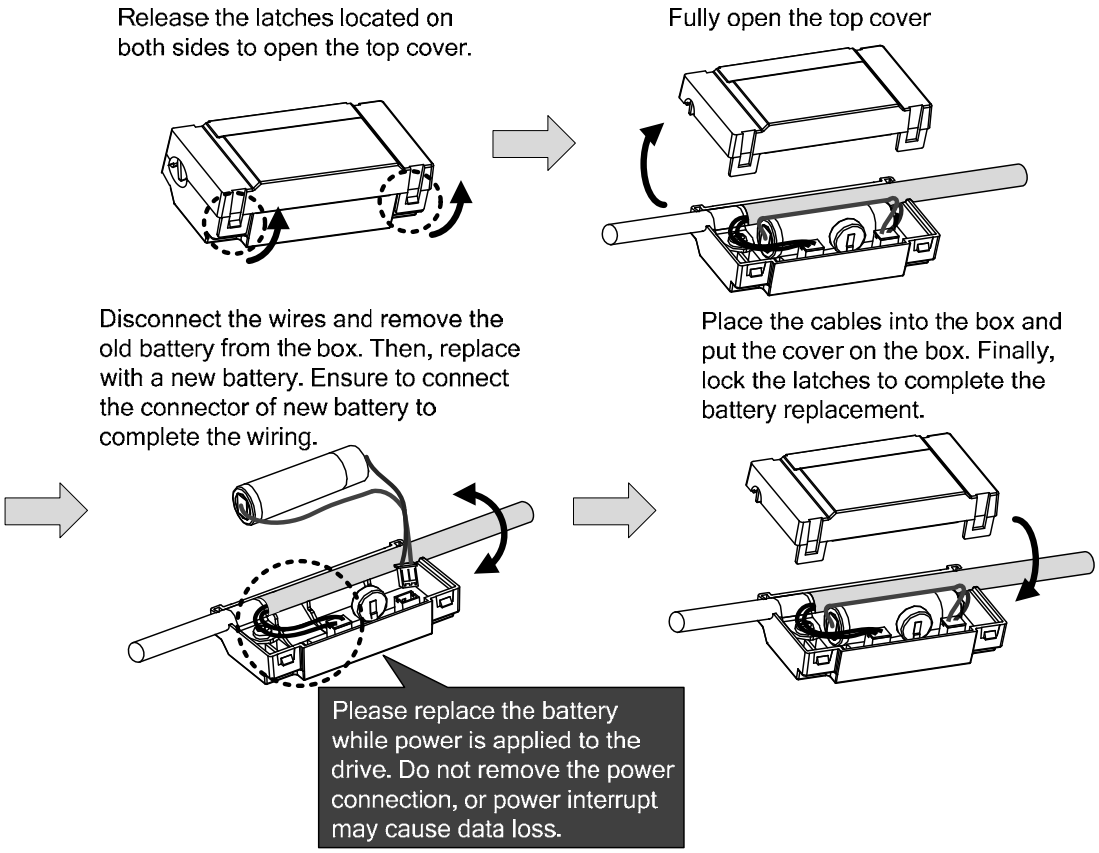
12.2.3 How to Replace a Battery

Please replace with a new battery if AL061 occurs, it means the battery is under voltage (Please refer to section 12.7.1 for detailed description). Or when accessing P0-02 for showing the battery power and it displays 31, which means the voltage is under 31V, so as to avoid data lost.

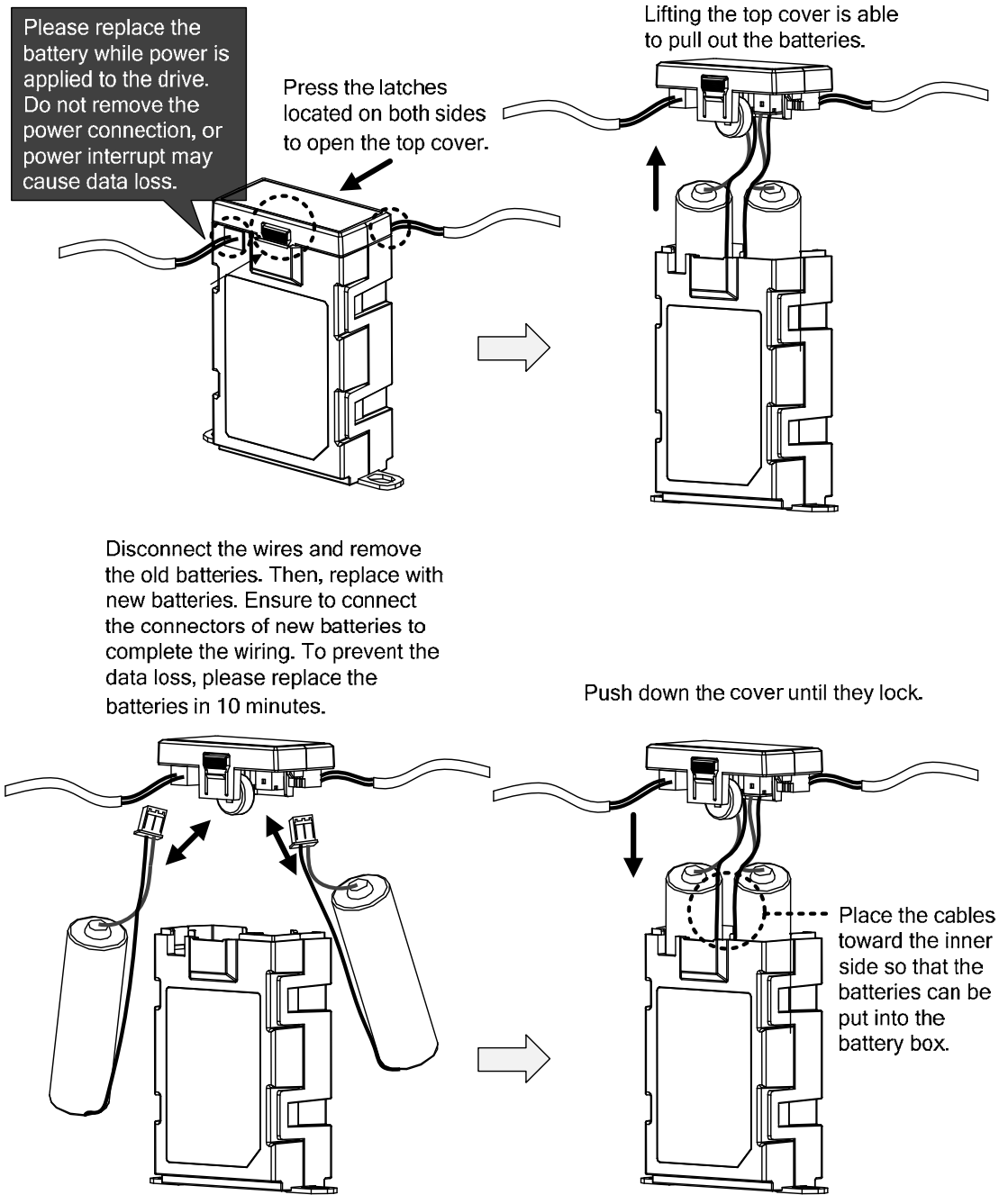
When the voltage is under 2.7V, it might lose the record of motor's position. Please conduct homing after replacing with a new battery. Please refer to 12.7.1 for detailed description

Please replace the battery while the power is applied to the servo drive in order to prevent the absolute position data lose.

Single Battery Box



Dual Battery Box



12.3 System Initialization Procedure and Operation

12.3.1 System Initialization Procedure

When the servo system is power on, the host controller can get the motor coordinate position via communication with RS-485 or DI/O. There are two data in different units can be read, and they are in PULSE and PUU.

At the very first time to operate absolute system, there will be a fault code, AL060 shown when power on because the initialization procedure still not yet be done. The fault will be kept until the initialization procedure is finished. Besides, the AL060 will be displayed when the power from the servo and battery is discontinued that will lead to the coordinate system lost. There is a fault code, AL062 which is used to indicate when the motor position is exceeding the design range where -32768 ~ 32767 for motor turns. But from the view of PUU, the coordinate value must fall into the range -2147483648 ~ 2147483647 to avoid triggering the fault AL289.

For some applications which will rotate motor in one direction, the fault AL062 for checking turns number within -32763~32768 and the fault AL289 for detecting PUU within -2147483648~2147483647 can be turned off by parameter P2-70.

Parameter Settings:

1. The AL060 will be cleared when the coordinate system has been initialized.

   PR mode: The absolute coordinate system will be reset after any homing operation under PR mode.

   Other modes: Two methods can be used to initialize the coordinated system. One is via digital inputs described in section 12.3.4, and another one is applying parameters in section 12.3.5.

2. For an initialized system when every time the power is turned on, the host controller can read the absolute coordinate data via digital inputs and digital outputs (see section 12.3.6) or parameters with communication (see section 12.2.6). Through the settings of parameter P2-70, the host controller can read the coordinated data in PUU (see section 12.3.3) or in number of turn plus the number of pulse within one turn (see section 12.3.2).

12.3.2 Pulse Counting

When the motor is running in clockwise direction, the counting number of turns will be minus where the counter clockwise rotating is plus. The number range for turns is from -32768 to 32767. The fault code, AL062 will appear when exceeding this counting range and it can be cleared by resetting the coordinate system. If parameter P2-70 has been set to ignore the over range alarming, the AL062 is disabled even exceeding the counting range. When the value reaches its largest number, it will rewind. For the counter clockwise counting, the sequence of the number is …32767, -32768, -32767, -32766 …. and the clockwise will have a sequence like …-32768, 23767, 32766 ….

In addition, there are 1280000 pulses (0~1279999) in one rotation. Please pay attention on its direction. The communication or digital inputs/digital outputs can be used to read it.

Pulse number for the distance = m (turn) × 1280000 + pulse number within one turn (0~1279999)

The conversion between Pulse and PUU:

When the rotating direction is CCW defined in P1-01.

$$\text{PUU number} = \text{pulse number} \times \frac{(P1-45)}{(P1-44)} + (\text{P6-01})$$

When the rotating direction is CW defined in P1-01.

$$\text{PUU number} = (-1) \times \text{pulse number} \times \frac{(P1-45)}{(P1-44)} + (\text{P6-01})$$

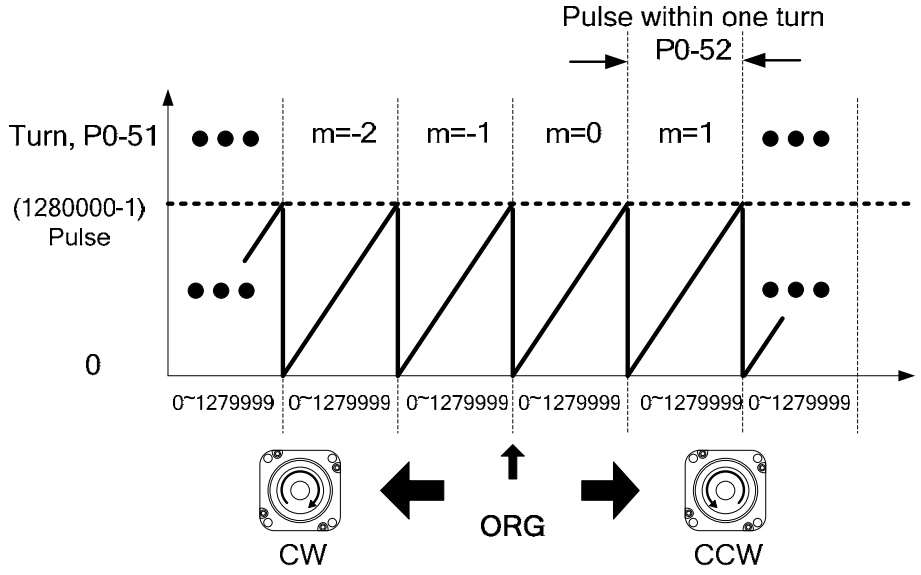


Figure 12.1 Pulse counting in absolute coordinate system

12.3.3 PUU Counting

A 32 bits number with sign is used to denote PUU number in an absolute system. The PUU number is increasing when motor is in positive rotating direction and decreasing for a negative running direction. The motor's rotating direction is defined in P1-01 Z setting.

In a word, the encoder feedback number is an easy way to distinguish the motor's rotating direction. Increasing number sequence is for positive direction and decreasing number sequence is for negative direction.

If the motor keeps rotating in one direction, the AL062 will be shown when exceeding the number range -32768 to 32767 for turns, and the AL289 is for PUU out of the range -2147483648 to 22147483647. Both of these fault codes can be cleared by homing.

And the parameter P2-70 can be used to take the range restrictions away in order to avoid occurring AL062 and AL289. When the counting number reaches the maximum number, the PUU pulse number sequence for forward rotation is … 2147483647, -2147483648, -2147483647…where the number sequence -2147483648, 2147483647, 2147483646… is for reverse rotation. Two examples for evaluating the timing of overflow are as below:

Example 1:

When P1-44=128 and P1-45=10, there are 100000 PUU for motor to rotate one turn. 2147483647 ÷ 100000 ≒ 21474.8. The limit to trigger the fault AL289 is 21474.8 (< 32767).

Example 2:

When P1-44=128 and P1-45=1, there are 10000 PUU for motor to rotate one turn. 2147483647 ÷ 10000 ≒ 214748.3. The limit to trigger the fault AL062 is 32767 (< 214748.3).

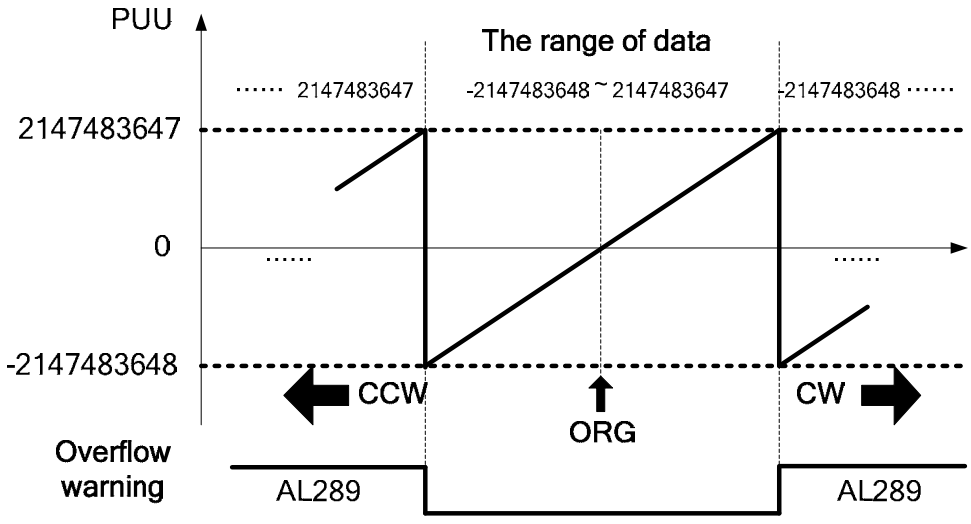
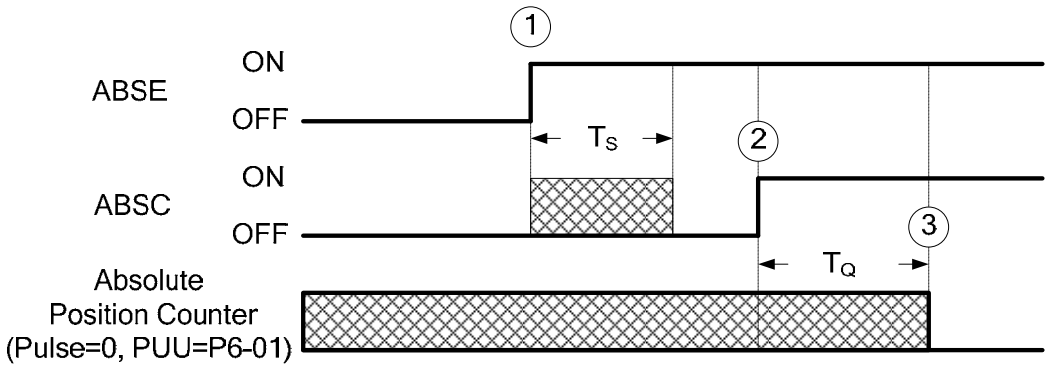


Figure 12.2 PUU counting in absolute coordinate system

NOTE When an absolute system has been initialized, if the parameter P1-01 Z setting, P1-44, and P1-45 be changed, the absolute coordinate system will be destroyed. A homing procedure is necessary at that moment.

12.3.4 Use Digital Inputs/Outputs to Initialize an Absolute System

Except PR mode, the digital inputs and outputs can be used for a driver to do homing when other modes are selected. Move the motor to home place, enable digital input, ABSE, then enable digital input, ABSC from OFF to ON, and the system will start to initialization. The pulse number will be set to zero and the number in P6-01 is for PUU to reference. Please refer to Figure 12.3 below for the signal controlling chart.



	$T_{S(ms)}$	$T_{Q(ms)}$
Min.	P2-09+2	
Max.	P2-09+10	

Figure 12.3 The controlling chart for initializing an absolute system via digital inputs/outputs

The descriptions for the timing:

1. When the host controller switches ABSE from OFF to ON, a period of time Ts have to be waited for the next step to process.

2. After waiting time Ts, the host controller now can enable the ABSC from OFF to ON and hold the signal for T_Q to reset the coordinate system where pulse number will be zero and PUU number is defined in P6-01.

12.3.5 Use Parameters to Initialize an Absolute System

When the parameter P2-71 is set to 1(one) via digital keypad or communication, the system starts to initialization. In order to protect from accidentally writing on P2-71 to reset an absolute system, the number 271 should be written to P2-08 to unlock the writing of 1(one) to P2-71. The procedure is P2-08=271 and then P2-71=1. This mode is only for the other modes except PR mode that already has its homing procedure to apply.

12.3.6 Use Digital Inputs/Outputs to Read the Absolute Coordinate Data

When Bit 0 is 0 in P2-70, the PUU number can be read by using digital inputs and outputs. The frame is as below.

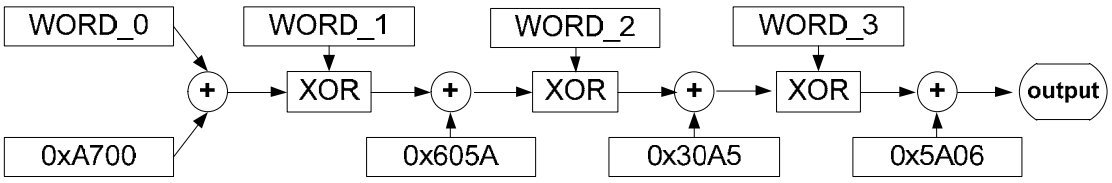
Bit 79 ~ Bit 64	Bit 63 ~ Bit 32	Bit 31 ~ Bit 16	Bit 15 ~ Bit 0
Check Sum	Encoder PUU -2147483648 - 2147483647	0	Encoder status, P0-50

When Bit 0 is 1 in P2-70, the PULSE number can be read by using digital inputs and outputs. The frame is as below.

Bit 79 ~ Bit 64	Bit 63 ~ Bit 32	Bit 31 ~ Bit 16	Bit 15 ~ Bit 0
Check Sum	Pulse within one turn 0 ~ 1279999 (= 1280000-1)	Encoder turn -32768 ~ +32767	Encoder status, P0-50

Explanation:

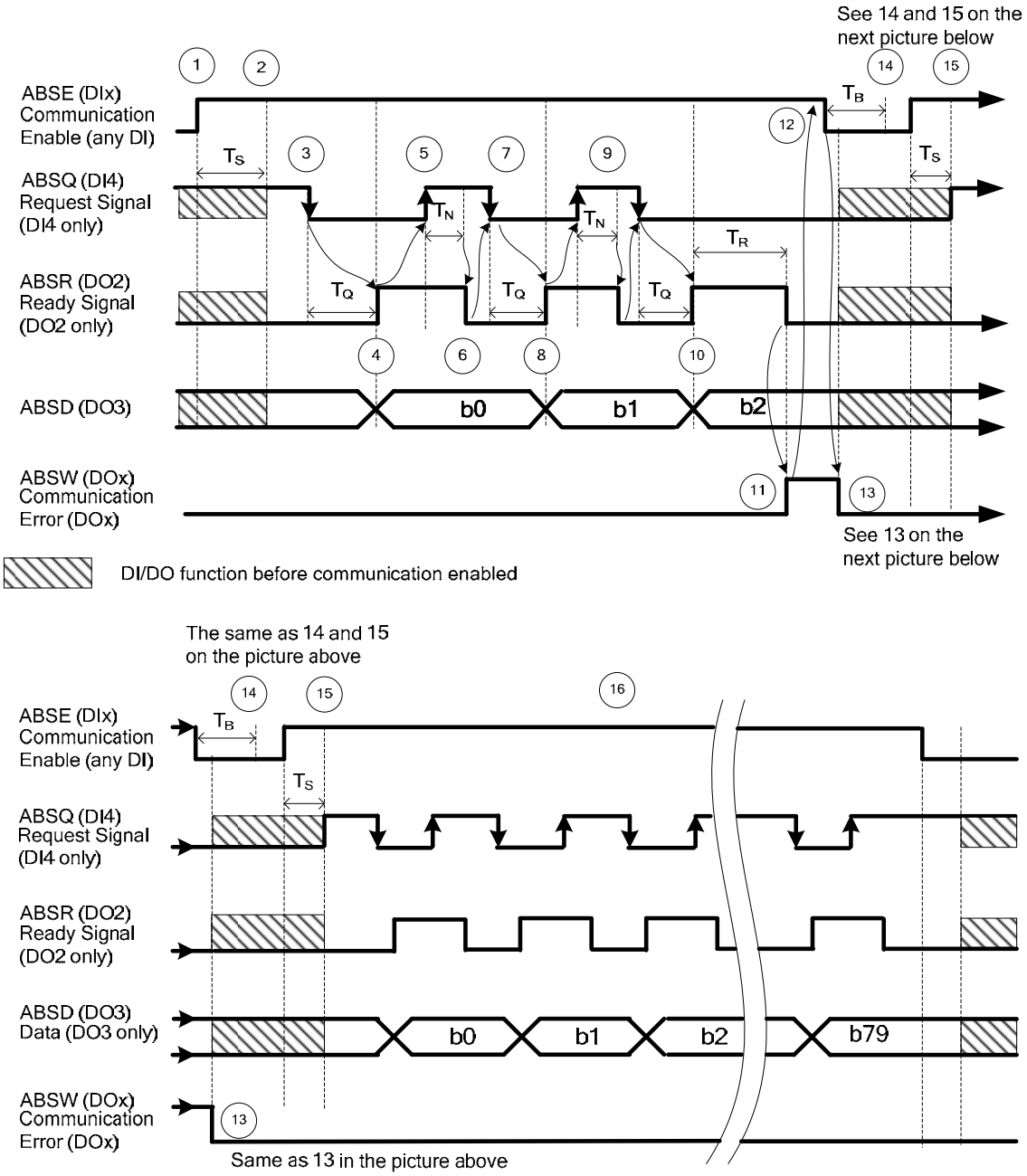
Check Sum = (((((((WORD_0+0xA700) XOR WORD_1)+0x605A) XOR WORD_2)+0x30A5) XOR WORD_3)+0x5A06)



Note:

1. This algorithm has no plus or minus sign.
2. 0xA700, 0x605A, 0x30A5 and 0x50A6 are the constans of hexadecimal.
3. WORD_0: encoder status (Bit 15~0)
   WORD_1: encoder turn (Bit 31~16)
   WORD_2: encoder pulse (Bit 47~32)
   WORD_3: encoder pulse (Bit 63~48)

The setting in P2-70 with digital inputs/outputs communication can be used to read PULSE number or PUU data with below signal communication sequence.



	$T_{R(ms)}$	$T_{S(ms)}$	$T_{Q(ms)}$	$T_{N(ms)}$	$T_{B(ms)}$
Min	-	P2-09+2			
Max	200	P2-09+10			

Figure 12.4 Timing of using digital inputs/outputs to read absolute data

The step explanation for the communication:

①. At the very beginning of communication, the host controller must enable ABSE and all the communication starts from here.

②. A threshold time Ts for confirming the signal ABSE is necessary. After the signal has been recognized, the DI4, DO2, and DO3 (no matter what their functions are), will be switched to the function of ABSQ, ABSR, and ABSD respectively. At the moment of the communication function enabled, if the signal of ABSQ is in high level, it will keep high level for its original function and also will be high level signal for ABSQ. DI4, DO2, and DO3 are multiple functions pins, please be noted especially at the moment of communication function switching on and off. For the purpose of simplifying the application, the functions of these three digital inputs and outputs could to set to 0 for communication use only.

③. When ABSE is at high level and retaining Ts long, the function of DI4 will be switched to ABSQ. If the host controller switch ABSQ to low after it is defined, the servo drive will recognize that host controller wants to read data from it.

④. After confirming time T_Q, the data for communication is already well prepared on ABSD and the signal ABSR is enabled for signaling the host controller to get data from the servo drive side. If the longest possible waiting time of T_Q (see Figure 12.4) expired, the host controller still cannot get the signal ABSR from low to high which could be a problem of wiring disconnection.

⑤. After the host controller detects that ABSR is high, the data is fetched. The ABSQ will be set to signal high to inform the drive after dada read.

⑥. After confirming time T_N for ABSQ kept high, the servo drive will maintain ABSR to low for signaling the host controller to be ready for accessing next bit.

⑦. The host will set ABSQ to low when it detects that ABSR is low for requesting the next bit from drive.

⑧. The servo drive will repeat the steps 3 to 4 to put its data at ABSD for next bit communication

⑨. By repeating steps 5 t o 7, the host controller will get the data, bit, and have an acknowledgement to the servo drive.

⑩. The third bit data is ready on the servo drive side.

⑪. After the data is ready and has been held for time T_R, the servo drive still does not see the signal ABSQ controlled by the host controller, and then the servo drive will have a communication error flag ABSW raise to terminate the communication procedure.

⑫. The host controller will set the ABSE to low for restart the communication cycle after getting the communication error message from the servo drive.

⑬. The communication error flag on servo drive side will be reset after detecting a low signal ABSE from the host controller.

⑭. A new communication cycle on host controller will be restarted after the buffering time T_B.

⑮. Repeat the step 1 for the host controller to start a new communication cycle.

⑯. If there doesn't have any error occurred during communication course for the host controller to finish bit 0 to bit 79 (80 bits data), the functions of DI4, DO2, DO3 will be changed back to their original functions before communication cycle started.

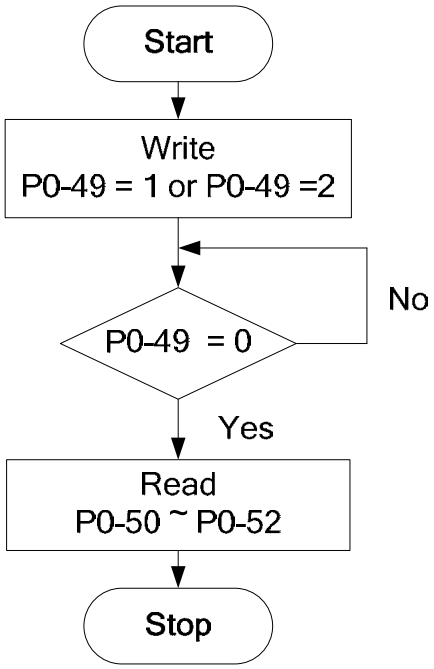
NOTE

If ABSW does not go back to high level signal after the changing of ABSE for signal low to high that is a sign of error occurring, there must be some other errors existing. Please check if the coordinate data still there, the voltage level of battery, or overflowing on the coordinate value.

A new communication cycle can be started only all of these errors been removed.

12.3.7 Use Parameter to Read the Absolute Coordinate Data

The servo drive will update its encoder status to P0-50 and encoder position to P0-51 and P0-52 when the parameter P0-49 is set. The Bit 1 of P2-70 is used to select which type of the data will be read, PULSE or PUU. While the servo motor is stalling, it is always maintaining its position with a very tiny forward and backward movement. At the moment the encoder data read, the coordinate data in servo drive side will be reset to the current position of motor if P0-49=2 where it is just read without changing any from the servo motor when P0-49=1. For example of P0-49=2, if the motor is positioning at the place of 20000, it will move around position from 19999 to 20001 normally. The command for reading the encoder data is put when the motor is at the place 20001, and the data 20001 will be read and the coordinate data in servo drive will be revised to 20001. There will avoid the error from the data at encoder side and the data at drive side. The P0-49 will be reset to 0 when all the encoder data put in P0-50 to P0-52 is ready, and it means that the host controller can get the data now. When the status already signals absolute coordinate data lost or overflow of number for turns in P0-50, the values in P0-51 to P0-52 are not correct. A homing or system reset procedure is necessary now.



12.4 Related Parameters for Absolute System

P2-69●	ABS	Absolute Encoder Setting		Address: 028AH 028BH
	Operational Interface：	Panel / Software	Communication	Related Section: N/A
	Default：	0x0		
	Control Mode：	ALL		
	Unit：	N/A		
	Range：	0x0 ~ 0x1		
	Data Size：	16-bit		
	Format：	Hexadecimal		

Settings： 0: Incremental mode. Servo motor with absolute encoder can be operated as incremental motor.

1: Absolute mode. (This setting is only available for the servo motor with absolute encoder. When an incremental servo motor is connected, if P2-69 is set to 1, AL.069 will occur.)

NOTE This parameter is effective only after the servo drive is re-powered on.

P2-70	MRS	Read Data Format Selection		Address: 028CH 028DH
	Operational Interface：	Panel / Software	Communication	Related Section: N/A
	Default：	0x0		
	Control Mode：	ALL		
	Unit：	N/A		
	Range：	0x00 ~ 0x07		
	Data Size：	16-bit		
	Format：	Hexadecimal		

Settings：

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8

Bit 0: Data unit setting of digital input/output (DI/DO);

1: Pulse, 0: PUU

Bit 1: Communication data unit setting; 1: Pulse, 0: PUU

Bit 2: Overflow warning; 1: No overflow warning, 0: Overflow warning,

AL.289 (PUU), AL.062 (pulse).

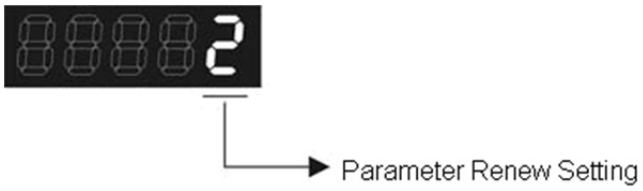
Bit 3 ~ Bit 15: Reserved. Must be set to 0.

P2-71■	CAP	Absolute Position Homing		Address: 028EH 028FH
	Operational Interface :	Panel / Software	Communication	Related Section: N/A
	Default :	0x0		
	Control Mode :	ALL		
	Unit :	N/A		
	Range :	0x0 ~ 0x1		
	Data Size :	16-bit		
	Format :	Hexadecimal		

Settings : When P2-71 is set to 1, the current position will be set as home position. This function is the same as the digital input, ABSC. This function can be enabled only when parameter P2-08 is set to 271.

P0-49■	UAP	Renew Encoder Absolute Position		Address: 0062H 0063H
	Operational Interface :	Panel / Software	Communication	Related Section: N/A
	Default :	0x0		
	Control Mode :	ALL		
	Unit :	N/A		
	Range :	0x00 ~ 0x02		
	Data Size :	16-bit		
	Format :	Hexadecimal		

Settings : This parameter is used to renew the absolute position data of the encoder.



Parameter Renew Setting:

1: Renew the encoder data to parameters P0-50~P0-52 only.

2: Renew the parameters P0-50~P0-52, and clear the position error as

well. While this setting is activated, the current position of the motor will be reset as the target position of position command (same function as CCLR).

P0-50★	APSTS	Absolute Coordinate System Status		Address: 0064H 0065H
	Operational Interface：	Panel / Software	Communication	Related Section: N/A
	Default：	0x0		
	Control Mode：	ALL		
	Unit：	N/A		
	Range：	0x00 ~ 0x1F		
	Data Size：	16-bit		
	Format：	Hexadecimal		

Settings：

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8

Bit0: Absolute position status

Bit0=0: Normal

Bit0=1: Absolute position is lost

Bit1: Voltage level of battery

Bit0=0: Normal

Bit0=1: Low battery

Bit2: Status of encoder multiturn

Bit0=0: Normal

Bit0=1: Overflow

Bit3: Status of PUU

Bit0=0: Normal

Bit0=1: Overflow

Bit4: Absolute coordinate system status

Bit0=0: Normal

Bit0=1: Absolute coordinate system has not been set

Bit5 ~ Bit15: Reserved. Must be set to 0.

P0-51★	APR	Encoder Absolute Position (Multiturn)	Address: 0066H 0067H
Operational Interface :	Panel / Software	Communication	Related Section: N/A
Default :	0x0		
Control Mode :	ALL		
Unit :	rev		
Range :	-32768 ~ +32767		
Data Size :	32-bit		
Format :	Decimal		

Settings : While the Bit 1 of P2-70 is set to read the encoder pulse number, this parameter represents the turns of encoder absolute position. While the Bit 1 of P2-70 is set to read the PUU number, this parameter becomes disabled and the setting value of this parameter is 0.

P0-52★	APP	Encoder Absolute Position (Pulse number within Singleturn or PUU)	Address: 0068H 0069H
Operational Interface :	Panel / Software	Communication	Related Section: N/A
Default :	0x0		
Control Mode :	ALL		
Unit :	Pulse or PUU		
Range :	0~1280000-1 (Pulse Number); -2147483648 ~ 2147483647 (PUU)		
Data Size :	32-bit		
Format :	Decimal		

Settings : While the Bit 1 of P2-70 is set to read the pulse number, this parameter represents the pulse number of encoder absolute position. While the Bit 1 of P2-70 is set to read the PUU number, this parameter represents PUU number of motor absolute position.

P0-02	STS	Drive Status	Address: 0004H 0005H
Operational Interface：	Panel / Software	Communication	Related Section: 7.2
Default：	00		
Control Mode：	ALL		
Unit：	-		
Range：	00 ~ 127		
Data Size：	16-bit		
Format：	Decimal		

Settings： 00：Motor feedback pulse number (after the scaling of electronic gear ratio) [PUU]

01：Input pulse number of pulse command (after the scaling of electronic gear ratio) [PUU]

02：Deviation between control command pulse and feedback pulse number[PUU]

03：The number of motor feedback pulse [Encoder unit, 1,280,000 Pulse/rev]

04：Distance to command terminal (Encoder unit) [Pulse]

05： Error pulse number (after the scaling of electronic gear ratio) (Encoder unit) [Pulse]

06：The frequency of pulse command input [Kpps]

07：Motor speed [r/min]

08：Speed command input [Volt]

09：Speed command input [r/min]

10：Torque command input [Volt]

11：Torque command input [%]

12：Average torque [%]

13：Peak torque [%]

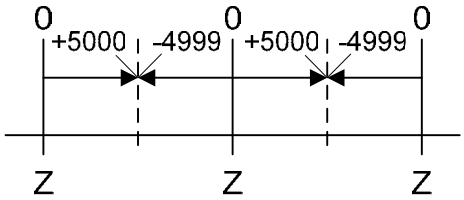
14：Main circuit voltage (BUS voltage) [Volt]

15：Load/motor inertia ratio [0.1times]

16：IGBT temperature

17：The frequency of resonance suppression

18：The distance from the current position to Z. The range of the value is between -5000 and +5000;



The interval of the two Z-phase pulse command if 10000 Pulse.

19：Mapping Parameter #1：P0 - 25

20：Mapping Parameter #2：P0 - 26

21：Mapping Parameter #3：P0 - 27

22：Mapping Parameter #4：P0 - 28

23：Monitor Variable #1：P0 - 09

24：Monitor Variable #2：P0 - 10

25：Monitor Variable #3：P0 - 11

26：Monitor Variable #4：P0 - 12

38：It display the battery voltage [0.1 Volt]. For example, if it displays 36, it means the battery voltage is 3.6 V.

72：Analog speed command [0.1 r/min] (This is supported by A2-M/-U/-L.)

12.5 Digital Input (DI) Function Definition (for Absolute System)

Setting Value: 0x1D			
DI Name	Function Description of Digital Input (DI)	Trigger Method	Control Mode
ABSE	When DI.ABSE is ON, it is in ABS mode. DI.ABSQ, DI.ABSC, DI.ABSR, DI.ABSD and DI.ABSC are enabled. When DI.ABSE is ON, the function of DI4, DO2, and DO3 will be disabled. Function of DI4 will be ASDQ, DO2 will be ABSR and DO3 will be ABSD.	Level Triggered	ALL

Setting Value: When DI.ABSE is ON, DI4 inputs ABSQ signal, function set by P2-13 is disabled.			
DI Name	Function Description of Digital Input (DI)	Trigger Method	Control Mode
ABSQ is always inputted by DI4	During I/O transmission, Handshaking signal will be sent to the servo drive by the controller. When DI.ABSQ is OFF, it means the controller issues Request ; DI.ABSQ is ON means the controller has already recdived ABSD signal. When DI.ABSE is ON, this DI is enabled. Please refer to diagram 13.4 for detailed description.	Rising / Falling-edged Triggered	ALL

Setting Value: 0x1F			
DI Name	Function Description of Digital Input (DI)	Trigger Method	Control Mode
ABSC	When DI.ABSC is ON, multi-turn data stored in absolute encoder will be cleared. When DI.ABSE is ON, this function is enabled.	Rising-edge Triggered	ALL

12.6 Digital Output (DO) Function Definition (for Absolute System)

Setting Value: When DI.ABSE is ON, DO2 outputs ABSR signal, function set by P2-19 is disabled.			
DO Name	Function Description of Digital Output (DO)	Trigger Method	Control Mode
ABSR is always outputted by DO2	DO.ABSR is OFF means the Request sent by ABSQ has been received. DO.ABSR is ON means the data that is outputted by ABSD is valid. When DI.ABSE is ON, this DO is enabled. Please refer to diagram 12.4 for detailed description.	Level Triggered	ALL

Setting Value: When DI.ABSE is ON, DO3 outputs ABSD signal, function set by P2-20 is disabled.			
DO Name	Function Description of Digital Output (DO)	Trigger Method	Control Mode
ABSD is always outputted by DO3	Position data of ABS is outputted. The data is valid when ABSR is ON. When DI.ABSE is ON, this DO is enabled. Please refer to diagram 13.4 for detailed description.	Level Triggered	ALL

Setting Value：0x0D			
DO Name	Function Description of Digital Output (DO)	Trigger Method	Control Mode
ABSW	Warning of absolute encoder.	Level Triggered	ALL

12.7 Alarms for Absolute System

Display	Alarm Name	Alarm Description
AL028	Encoder voltage error or the internal of the encoder is in error	Charging circuit of the servo drive is not removed and the battery voltage is higher than the specification (>3.8 V) or the encoder signal is in error.
AL029	Gray code error	Absolute position is in error.
AL060	The absolute position is lost	Due to battery under voltage or the failure of power supply, the encoder lost the internal record.
AL061	Encoder under voltage	The voltage of the absolute encoder is lower than the specification
AL062	The multi-turn of absolute encoder overflows	The multi-turn of absolute encoder exceeds the maximum range: -32768 ~ +32767
AL068	Absolute data transmitted via I/O is in error	The sequence is wrong when reading the absolute position via DIO.
AL069	Wrong motor type	Incremental motor is not allowed to activate the absolute function.
AL289	Feedback position counter overflows	Feedback position counter overflows.

12.7.1 Causes and Corrective Actions

AL028: Encoder voltage error or the internal of the encoder is in error

Causes	Checking Method	Corrective Actions
Battery voltage is too high	1. Check if the charging circuit exists in the servo drive. 2. Check if the battery is correctly installed	According to the procedure of Over voltage to check. When corrective actions are done, AL.028 will be cleared automatically.
The internal encoder is in error.	1. Check if it is the absolute type encoder. 2. Check if the servo is properly grounded. 3. Check if the encoder cable separates from the power supply or the high-current circuit to avoid the interference. 4. Check if the shielding cables are used in the wiring of the encoder.	1. If the situation is not improving, please send the drive back to the distributors or contact with Delta. 2. Please connect the UVW connector (color green) to the heat sink of the servo drive. 3. Please check if the encoder cable separates from the power supply or the high-current circuit. 4. Please use shielding mesh. If the situation is not improving, please send the drive back to the distributors or contact with Delta.

AL029: Gray code error

Causes	Checking Method	Corrective Actions
Absolute position is in error	Re-power on to operate the motor and check if the alarm will occur again.	If the alarm occurs again, please change the encoder.

AL060: Absolute Position Lost

Causes	Checking Method	Corrective Actions
Battery under voltage	Check if the voltage of the battery is lower than 2.8V.	After change the battery, conduct homing procedure again. Please refer to the description of absolute coordinate initialization in Chapter 12.
Change the battery when the power is OFF which is controlled by the servo drive	Do no change or remove the battery when the power is OFF which is controlled by the servo drive.	Conduct homing procedure again. Please refer to the description of absolute coordinate initialization in Chapter 12.
After activating the absolute function, the absolute coordinate initialization has not been completed.	1. Install the battery. 2. Check the wiring between the battery pack and the power cable of the servo drive. 3. Check the wiring of the encoder.	Conduct homing procedure. Please refer to the description of absolute coordinate initialization in Chapter 12.
Bad connection of the battery power circuit	1. Check the wiring of the encoder. 2. Check the wiring between the battery pack and the power cable of the servo drive.	Connect or repair the wiring of the battery so as to supply the power to the encoder. Conduct homing procedure again. Please refer to the description

Causes	Checking Method	Corrective Actions
		of absolute coordinate initialization in Chapter 12.

AL062: Encoder under voltage

Causes	Checking Method	Corrective Actions
Battery under voltage	1. Check if the voltage of the battery on the panel is lower than 3.1 V (tentative specification). 2. Measure if the voltage of the battery is lower than 3.1 V (tentative specification).	Do not change the battery when the power is ON which is controlled by the servo drive. After change the battery, AL061 will be cleared automatically.

AL062: The multi-turn of absolute encoder overflows

Potential Cause	Checking Method	Corrective Actions
The operation distance exceeds the range the absolute encoder is able to record	Check if the operation distance exceeds the range, -32768 ~ +32767, the absolute encoder is able to record.	Conduct homing procedure again. Please refer to the description of absolute coordinate initialization in Chapter 12.

AL068: Absolute data transmitted via I/O is in error

Causes	Checking Method	Corrective Actions
Sequence error	1. Switch OFF DI ABSQ should wait until DO ABSR is OFF. 2. Switch ON ABSQ should wait until DO ABSR is ON.	Correct the reading sequence of I/O
Reading time out	Check if the time between switching ON DO ABSR and switching ON ABSQ exceeds 200ms.	After switching ON DO ABSR (the absolute position data is ready), read DO ABSD and switch ON DI ABSQ within 200ms so that to inform the servo drive data reading is completed.

AL069: Wong motor type

Causes	Checking Method	Corrective Actions
Incremental motor is not allowed to activate the absolute function	1. Check if the motor is incremental or absolute encoder. 2. Check parameter P2-69.	If the user desires to use absolute function, please choose absolute motor. If not, please set parameter P2-69 to 0.

AL289: Feedback position counter overflows

Causes	Checking Method	Corrective Actions
Feedback position counter overflows	This alarm will not occur at the moment. If it does, please contact the distributors.	NMT: Reset node or 0x6040.Fault Reset

12.8 Related Monitoring Variables

Code	Monitoring Variables / Attribute	Explanation
038 (26h)	Voltage level of battery	The voltage level of battery for an absolute encoder.