



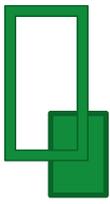
RAA48 Series Absolute Encoder



Changchun Rongde Optics Co., Ltd.

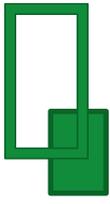


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Safety Precautions

When using this product, be sure to observe the following important precautions in order to prevent product failure and malfunction. Please use this product after fully understanding the following.

Precautions for storage, transportation, and installation

Do not store and set up in the following environments. •Places exposed to direct sunlight • Places with ambient temperature exceeding the storage and installation temperature conditions •Places with relative humidity exceeding storage and installation humidity conditions •Places with rapid temperature changes and easy condensation •Corrosive gases*1 (hydrogen sulfide, sulfurous acid, Places close to flammable gases such as chlorine, ammonia, etc. •If it is installed in other special gas environments, it needs to be inspected by the customer before use. This product is not guaranteed for use in special gas environments.

•A radiation environment or a place exposed to radiation •A place where there is a lot of dust, dust, salt, and metal dust

※1. Please note that in addition to the normal surrounding environment, corrosive gas may be generated due to the volatilization of components such as grease around the encoder.

Installation Precautions

•When installing, follow the instruction manual for assembly and adjustment.

•Please pay sufficient attention to the installation environment to prevent oil, foreign matter, etc. from entering the inside of the encoder.

•Please loosen the screws and bolts used for fixing the encoder.

•Please take measures against static electricity in the installation environment, etc., to prevent electrical parts from being subjected to overvoltage, etc.

•If the encoder is subjected to vibration or shock, it may malfunction or malfunction. Please check the installation environment carefully.

•Do not apply external force such as knocking to the encoder.

•For the encoder cable and the connection part between the cable and the cover, please fix it so that it will not be subjected to loads such as pulling and bending. Otherwise, the problem of falling off and pulling out the cable may occur.

•The interference received by the encoder may cause malfunction. Please pay attention to the installation environment such as the method of installing the encoder case and the method of connecting the motor cable.

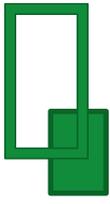
※1. Please use metal products that can shield electromagnetic and keep stable potential for the encoder housing. At this time, please ensure sufficient space distance from the electrical components in the circuit board. If the encoder will be affected by the magnetic field generated by the nearby motor and the welding current, please use soft magnetic material (such as soft iron, etc.) for the encoder housing.

※2. Do not place the motor power cable close to the encoder.

※3. Make sure to ground the FG wire of the motor and the FG of the mechanical device.

•After installing the encoder, the user is requested to conduct a sufficient system evaluation in advance.

•Do not perform withstand voltage test and insulation resistance test on the encoder.

**Wiring Precautions**

- Please perform wiring correctly and securely.
- When wiring, please turn off the power.
- Please use the specified power supply voltage. Also, pay attention to the drop in the power supply voltage due to the wiring length.
- Do not use the encoder wiring and other power lines in the same pipe or bundle them in parallel.
- Use twisted pair cables for encoder wiring for signal cables and power cables.
- Use braided shielded cables for encoder wiring. Also, make sure to ground the shielded wires at the encoder and the other side (controller side).

Operation Precautions

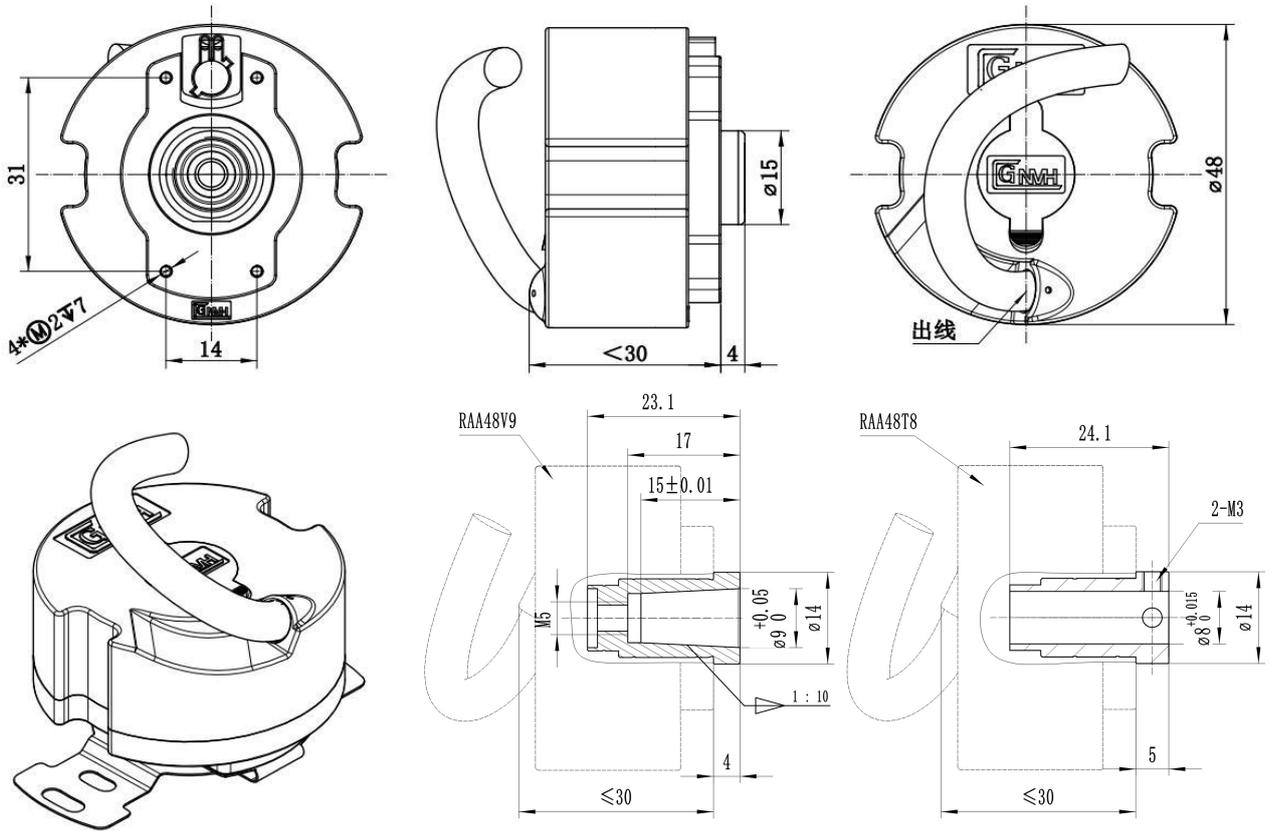
- Please fully study and confirm the safety design of the device against encoder failure and malfunction before using it.
- When an alarm occurs, remove the cause and ensure safety before resetting the alarm and restarting the operation.
- Do not apply excessive force to the cable, otherwise it may cause disconnection.
- Do not apply overvoltage or reverse voltage exceeding the absolute maximum ratings, otherwise the components may be damaged or even fire may occur.

General Notes

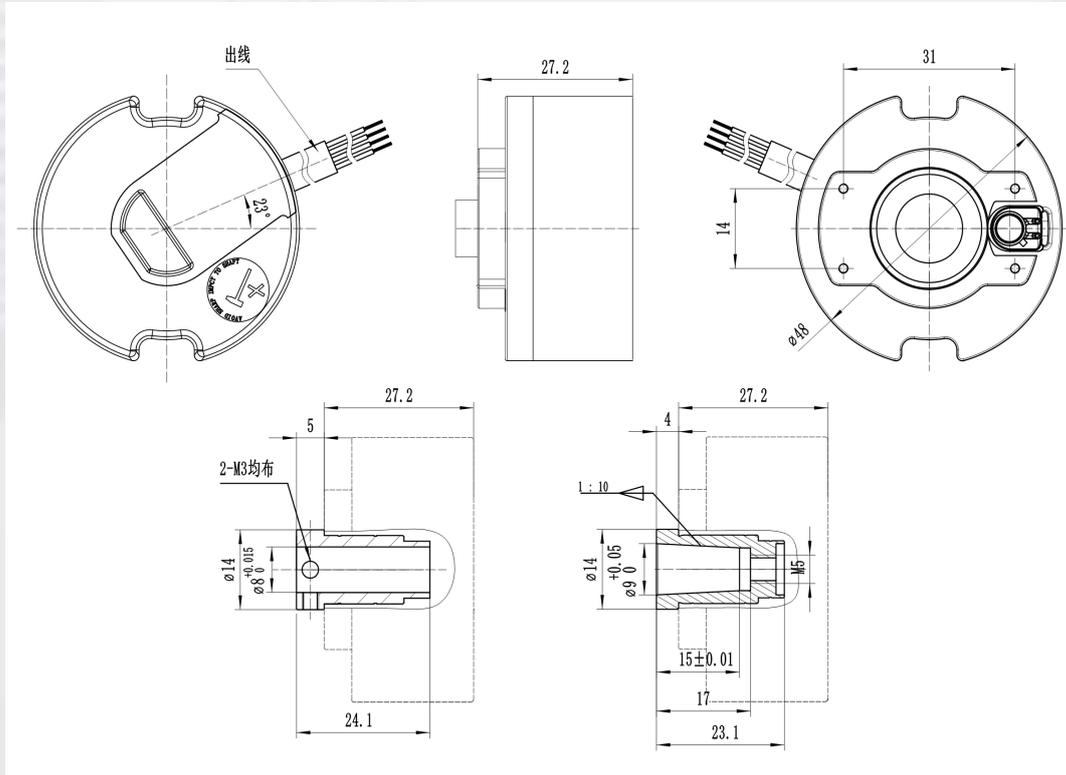
- These specifications are subject to change without prior notice due to product improvement and technological transformation. Please inquire about the latest specifications and confirm the application before actual use.
- Please note that this product is intended for use in a part of general electronic equipment (OA equipment, communication equipment, home appliances, entertainment equipment, measurement equipment, general industrial equipment, etc.). It is not intended for applications requiring extremely high reliability and safety (transportation equipment, aerospace equipment, atomic force control systems, medical equipment for life support, etc.).
- Our company strives to improve quality and reliability, but in general, malfunctions and failures of semiconductor products cannot be completely avoided. Therefore, when using this product, please take safety measures in order to avoid accidents by considering the possible influences such as malfunction of this product. When the life or property of others is damaged or adversely affected due to the malfunction, failure, or life of this product, or when the installation and use of this product results in failure of the equipment, facilities or machinery used, regardless of the degree How, the company is not responsible. Users are responsible for the system security design by themselves.
The company is responsible for free repair or replacement for the failure of the product due to manufacturing reasons within 18 months of leaving the factory.

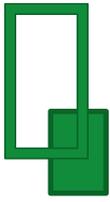
1. Mechanical Dimensions

1.1 G type outlet mechanical dimensions

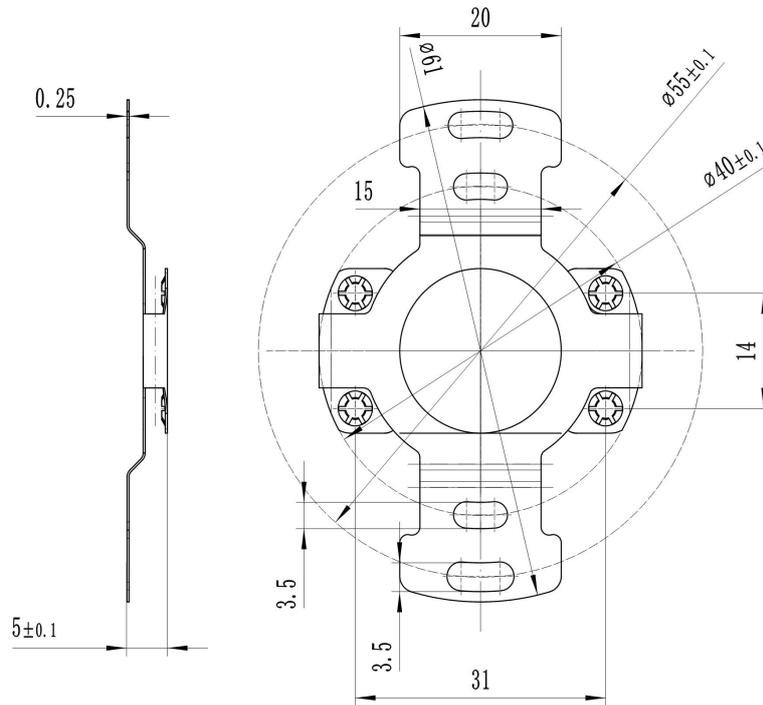


1.2 L-type outlet mechanical dimensions

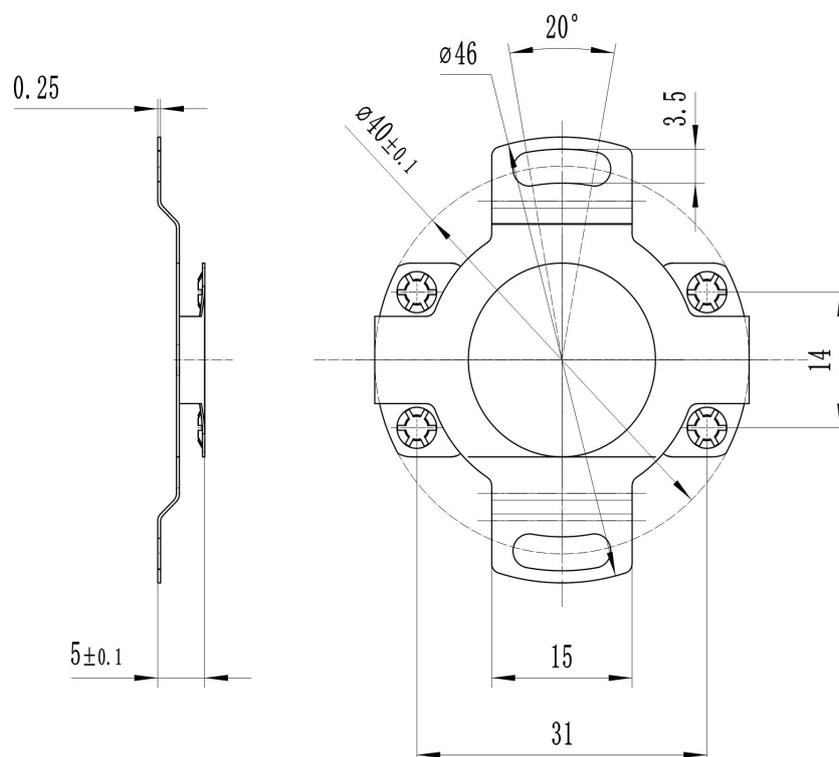




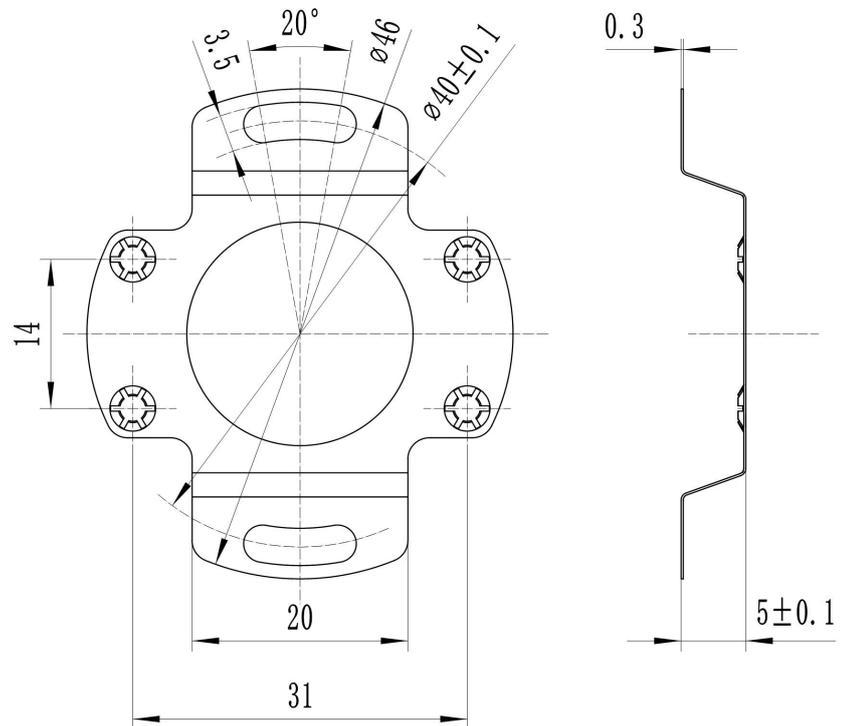
1.3 Accessory A



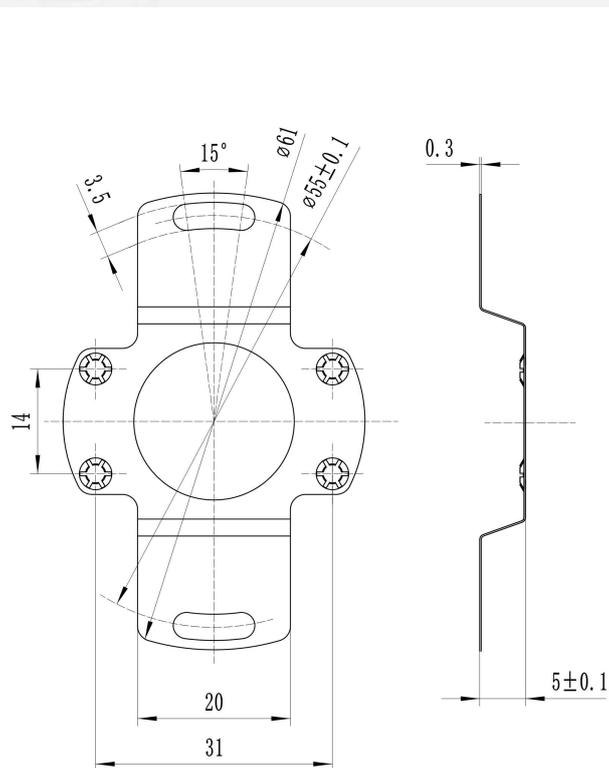
1.4 Accessory B



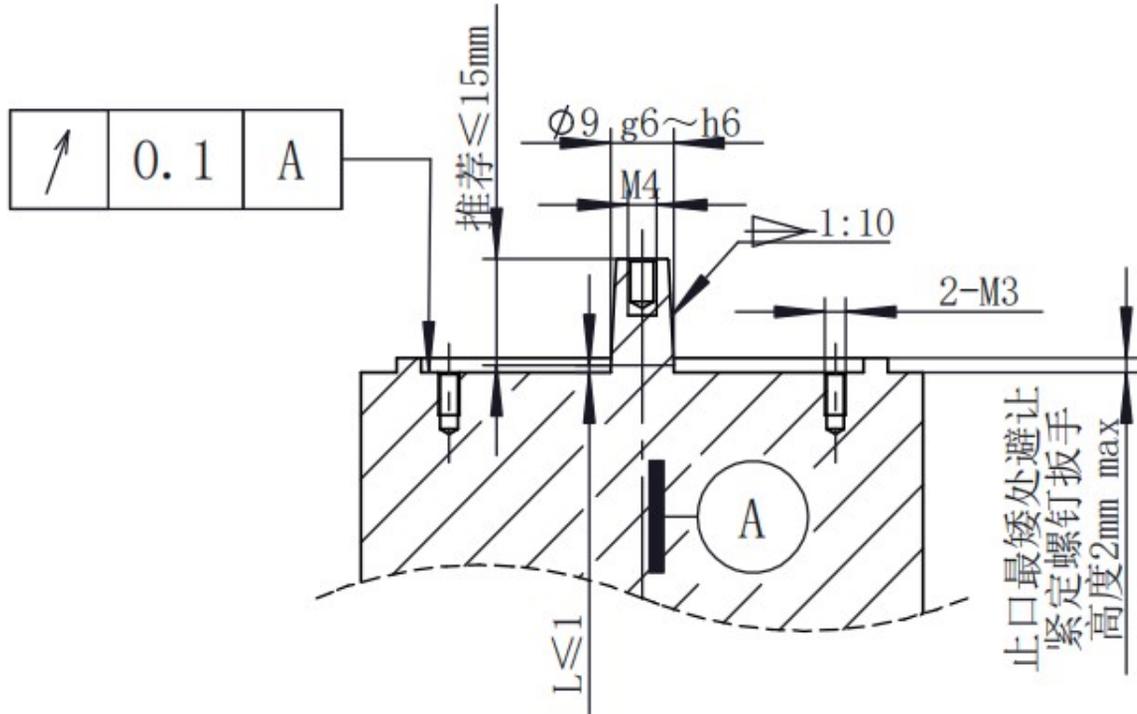
1.5 Accessory C2



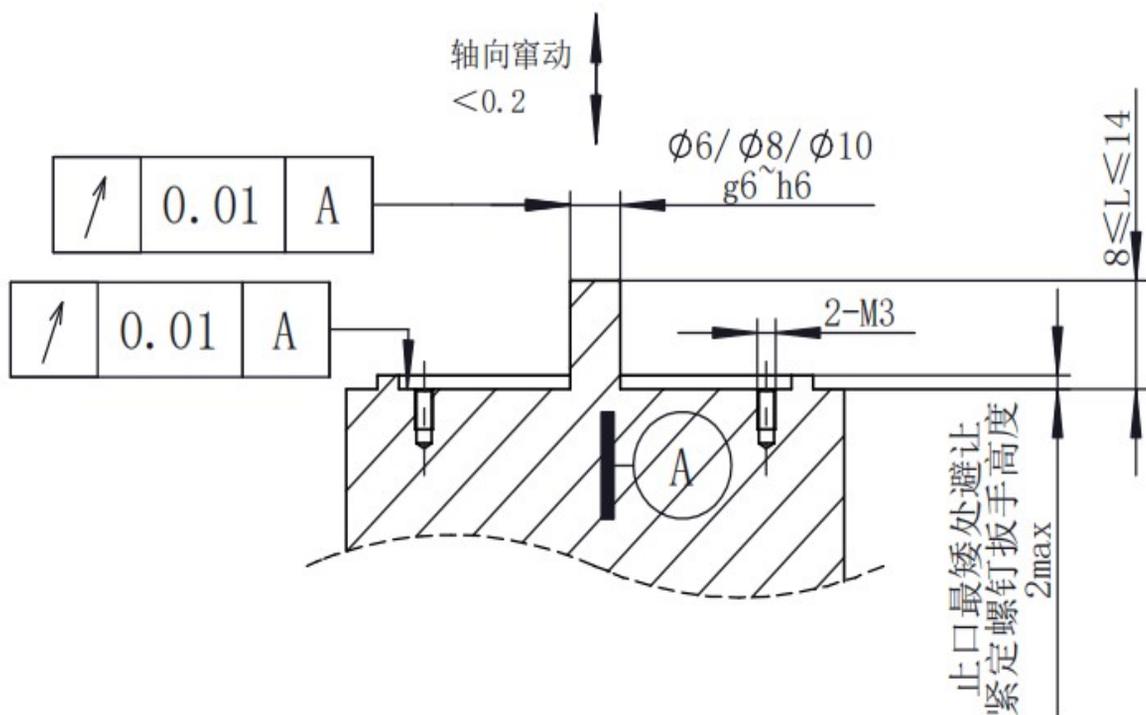
1.6 Accessory D2



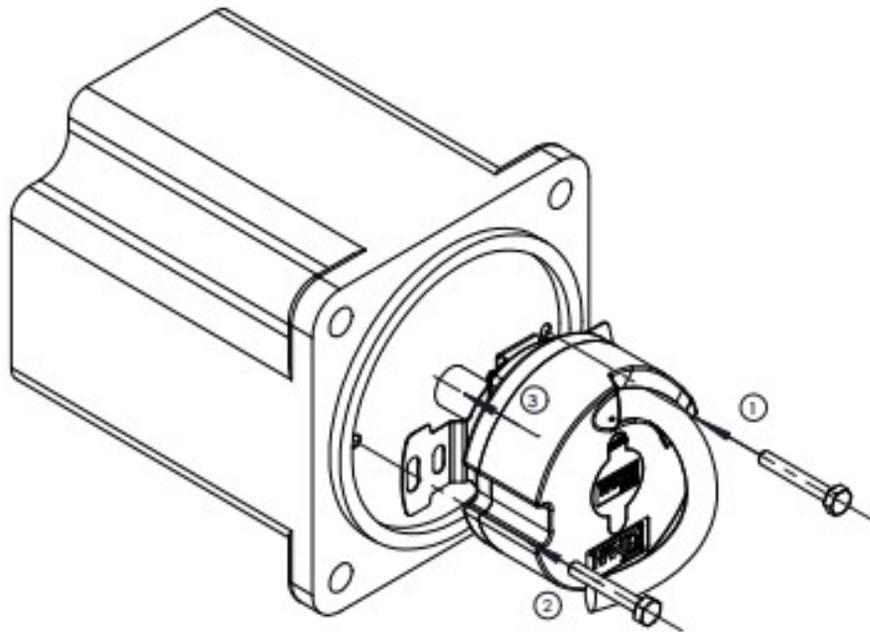
1.7 Recommended motor end design dimensions (V9 shaft)



1.8 Recommended motor end design dimensions (T shaft)



1.9 Installation



Installation accessories: Metric 1.5mm hexagon torque wrench
Metric 2.5mm hexagon torque wrench

2 Electrical Wiring

2.1 485 Protocol Cable Definition

Color	Definition	Wire configuration
RD	5V	Twisted Pair
BK	GND	
BU	485+	Twisted Pair
YL	485-	
BN	Battery positive	Twisted Pair
WH	Battery Negative	
Black heat shrink tubing	PE	

3. Technical Parameters

Part Number	Eg : RAA48V9-G0.2M1TLKT-23/16B-A
Single turn resolution	23bit, compatible 17bit, 25/26 bit can be customized
Multi turn resolution	16bit
Communication Interface	RS485
Supply voltage	5V±0.25
Battery voltage	3.6V
Battery error generating voltage	2.75V (±0.15v)
Battery alarm generating voltage	3.1V (±0.15V)
Baud rate	2.5MHz (customized if large quantity , like 5MHz)
Refresh rate	16K
Output code	Binary code
Fall time/Rise time	100ms
Operating Temp.	-10°C ~ 90°C
Operating Humidity	90%RH bellow (No condensation)
Storage Temp.	-20°C ~ 100°C
Storage humidity	95%RH bellow (No condensation)
Shock	980m/s ² ,11ms; 3 times for each direction, total 18 times
Vibration	10 to 55Hz , amplitude 1.5mm ; 55 to 2000Hz , 98m/s ² ; 2 hours for each axis, total 6 hours
Rotational speed	Blank: default speed(≤6000rpm) G:high speed(6000rpm≤speed≤12000rpm)
Protection class	IP54
Accuracy	Accuracy > 30

4. Communication Protocol (17bit-23bit) :

4.1 General Specifications (17-23bit)

Items	Specifications	Remarks
Communication code	Binary	
Transmission type	Differential line driver	RS485
Transmission data	Single turn data	17bit(Max23bit)
	Multi turn data	16bit
	Status Flags	(1)Over Speed (2)Full absolute status (3)Counting Error (4)Counter overflow (5)Over-heat (6)Multi-turn error (7)Battery alarm (8)Battery error
Communication rate	2.5Mbps	--

*The protocol contents involved in this encoder are all customized by customers. It is normal if some customers cannot fully match them. If there is a need for protocol customization or matching, we can jointly negotiate and develop.

4.2 EEPROM

Items	Description	Remarks
User parameter address range can be read and written	0 ~ 0x7E	This address field can be used to store user parameters
Page address	0x7F	0-5
Permissible times for writing	100000次	User parameter saves the number of times the write operation can be executed

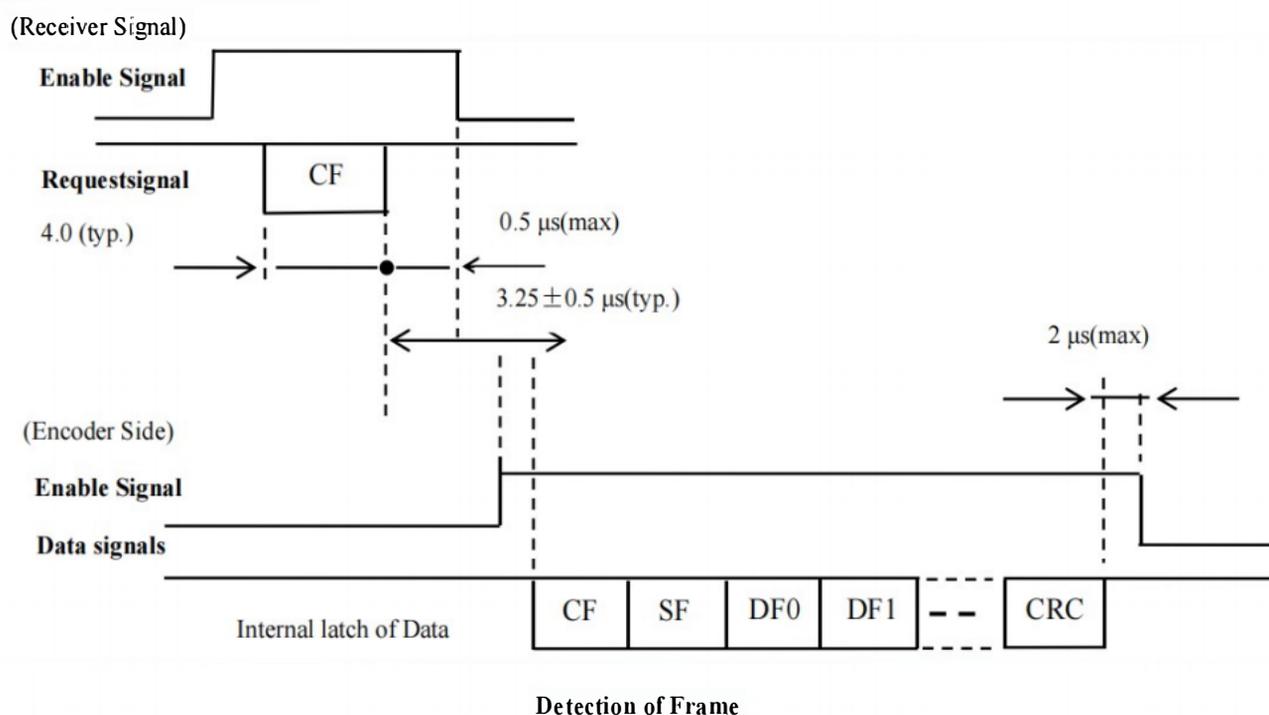
4.3 Frame Format

Items	Description	Remark
CF	Control Field	to identify different command types
SF	Status Field	Get the encoder status through this part
DF	Data Field	Encoder position data
ADF	Address Field	Accessible encoder addresses
EDF	E2PROM Field	the content of the address
CRC	CRC Field	Polynomial: x^8+1 (XOR all data except CRC)

※The name used in data frame transmission are shown in the table above

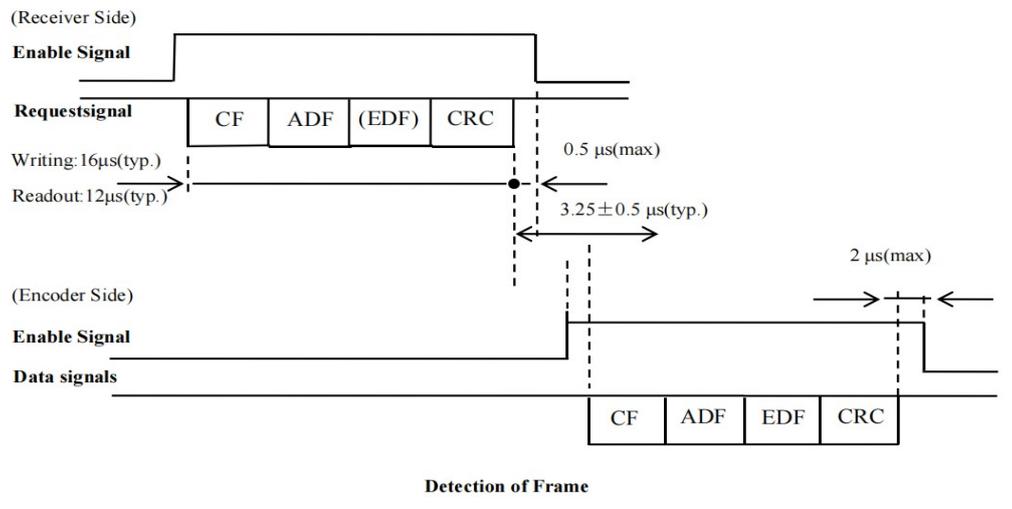
Each data frame is divided into several bytes, and the transmission and reception of each byte is realized by 1 start bit, 8 data bits and 1 stop bit, the low bit is in front and the high bit is behind.

4.3.1 Position data reading

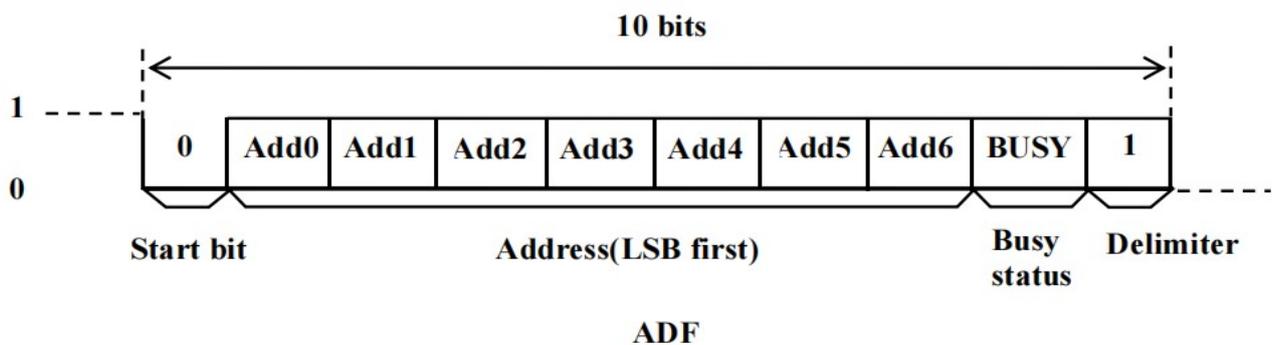


The number of data in DF depends on different CFs

4.3.2 Access (Writing) to E²PROM



4.3.3 ADF and EDF when operating EEPROM



- (1) Start bit: fixed
- (2) Address: eeprom Address range 0 ~ 127
- (3) Busy status: The access status to the eeprom can be checked through the busy status bit

	request	Encoder sends data			Description
	Busy	Busy	ADF	EDF	
eeprom Read	0	0	ADF	Eeprom Data	Normal read
		1	ADF	0x00	Encoder busy, request Read invalid
eeprom Write	0	0	ADF	EDF	Accepting Requests
		1	ADF	0x00	Encoder busy, request Read invalid

4.4 Details

4.4.1 Control Field (CF)		
Application	Data ID	Remark
Data readout	ID0(0x02)	Read absolute position information (CF+SF+ABS+CRC)
	ID1(0x8A)	Multi-turn data information reading (CF+ABM+CRC)
	ID2(0x92)	Encoder ID information read (CF+ID+CRC)
	ID3(0x1A)	Read all data (CF+SF+ABS+ID+ABM+ALMC+CRC)
	ID4(0x2B)	Read necessary data (SF+ABS+ABM0+ABM1+ALMC+CRC)
Writing to E2PROM	ID6(0x32)	The 8-bit "user data" can be written into the data corresponding to the specified address. Within 20 μ s after sending according to the command format, the encoder will send back data. Do not communicate with the encoder during this process.
Readout from E2PROM	IDD(0xEA)	8-bit "user data" can be read from the specified address. Within 20 μ s after sending according to the command format, the encoder will send back data. Do not communicate with the encoder during this process.
Reset	ID7(0xBA)	This reset command requires 10 consecutive commands to be sent at a time interval of not less than 62.5 μ s to reset all fault flags.
	ID8(0xC2)	This reset command requires 10 consecutive commands to be sent at a time interval of not less than 62.5 μ s to reset any single-turn position to zero. Even if the power is turned on again, the position still retains the position data after reset.
	IDC(0x62)	This reset command requires that the command be sent 10 times continuously at a time interval of not less than 62.5 μ s, and the multi-turn data will be reset to zero (single-turn data will not be affected). At the same time reset all fault flags.

4.4.2 Status Field (SF)		
Bit No	Description	Remark
Bit0	Rsvd	all are fixed to "0"
Bit1	Rsvd	
Bit2	Rsvd	
Bit3	Rsvd	
Bit4	Counting Error	Logic "1" is transmitted when any error occurs
Bit5	Output multi-turn error, battery error and battery alarm	confirm them in ALMC
Bit6	Rsvd	all are fixed to "0"
Bit7	Rsvd	

※CF consists of 1 byte, the category and content are shown in the table above

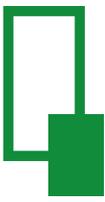
4.4.3 Data Field (DF0~DF7)

CF type	DF0	DF1	DF2	DF3	DF4	DF5	DF6	DF7
ID0 (0x02)	ABS0	ABS1	ABS2					
ID1 (0x8A)	ABM0	ABM1	ABM2					
ID2 (0x92)	ENID							
ID3 (0x1A)	ABS0	ABS1	ABS2	ENID	ABM0	ABM1	ABM2	ALMC
ID4 (0x2B)	ABS0	ABS1	ABS2	ABM0	ABM1	ALMC		
ID7 (0xBA)	ABS0	ABS1	ABS2					
ID8 (0xC2)	ABS0	ABS1	ABS2					
IDC (0x62)	ABS0	ABS1	ABS2					

※According to different CF types, there are different number of bytes in DF, as shown in the above table

Note:

1. ABS0~ABS2 are the low, middle and high bits of the absolute position of the encoder. Higher 7 bits of ABS2 are always logic "0", and then the valid data consists of total 17 bits (for a 23-bit encoder, the high 1 bit of ABS2 is 0, and the rest are valid bits).
2. ABM0~ABM2 are the low, middle and high bits of the multi-turn position of the encoder. ABM2 is always logic "0", and then the valid data consists of total 16 bits.
3. ENID: Encoder ID, =0x11 (17Bit) or 0x17 (23Bit).



4.4.4 Fault Description

ALMC Faults see the table below:

Bit	0	1	2	3	4	5	6	7
Fault name	Over Speed	Full absolute status	Counting error	Counter overflow	Over heat	Multi-turn error	Battery error	Battery alarm

Description of each fault flag

Fault name	Functional Description	Solution
Over Speed	Acceleration greater than 2000rad/s ² is detected with 5V battery off. This flag should be used only as it is intended, as it may not be detected in some cases.	Fault reset
Full absolute status	During the 5V power-on process, the encoder speed is detected to be greater than 100rpm (±20rpm)	Restart the power supply
Counting error	Single turn information solution failure	Restart the power supply
Over heat	Over temperature	Fault reset
Multi-turn error	Multi-turn data loss, multi-turn counting failure	Fault reset
Counter overflow	When the multi-turn counter overflows, a logic "1" is indicated	Fault reset
Battery error	The battery voltage is lower than 2.75V, set	Check the electromagnetic power supply circuit and replace the battery
Battery alarm	The battery voltage is lower than 2.75V, set	After replacing the battery with normal voltage, the fault disappears automatically

5. Communication Protocol (25bit/26bit) :

5.1 General Specifications(25bit)		
Items	Specifications	Remarks
Communication code	Binary	
Transmission type	Differential line driver	RS485
Transmission data	single turn data	25bits/26bit
	multi turn data	16bit
	Status Flags	(1)Over Speed (2)Full absolute status (3)Counting Error (4)Counter overflow (5)Over-heat (6)Multi-turn error (7)Battery alarm (8)Battery error
Communication rate	2.5Mbps	25bit
	10 Mbps	26bit

*The protocol contents involved in this encoder are all customized by customers. It is normal if some customers cannot fully match them. If there is a need for protocol customization or matching, we can jointly negotiate and develop.

5.2 EEPROM		
Items	Description	Remarks
Accessible address	0 ~ 0x7E	This address field can be used to store user data
Page address	0x7F	0-5
Permissible times for writing	100000 times	The number of times the operation can be performed

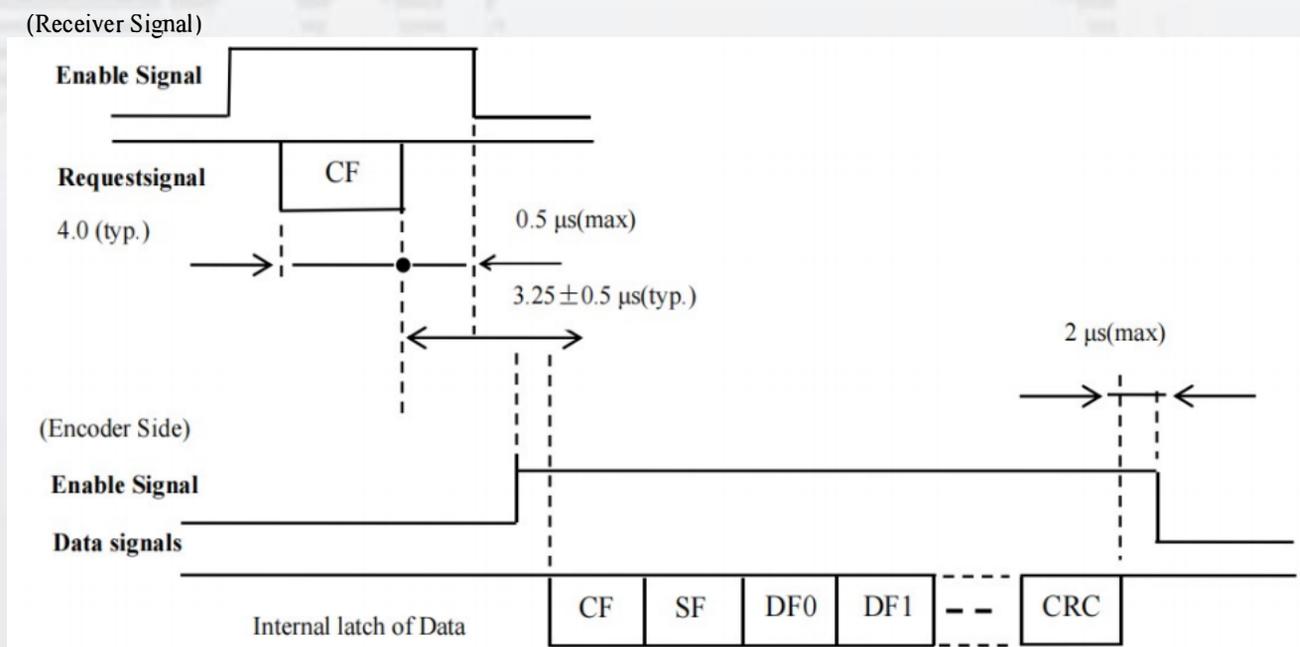
5.3 Frame Format

Items	Description	Remark
CF	Control Field	to identify different command types
SF	Status Field	Get the encoder status through this part
DF	Data Field	Encoder position data
ADF	Address Field	Accessible encoder addresses
EDF	E2PROM Field	the content of the address
CRC	CRC Field	Polynomial: x^8+1 (XOR all data except CRC)

✧The name used in data frame transmission are shown in the table above

Each data frame is divided into several bytes, and the transmission and reception of each byte is realized by 1 start bit, 8 data bits and 1 stop bit, the low bit is in front and the high bit is behind.

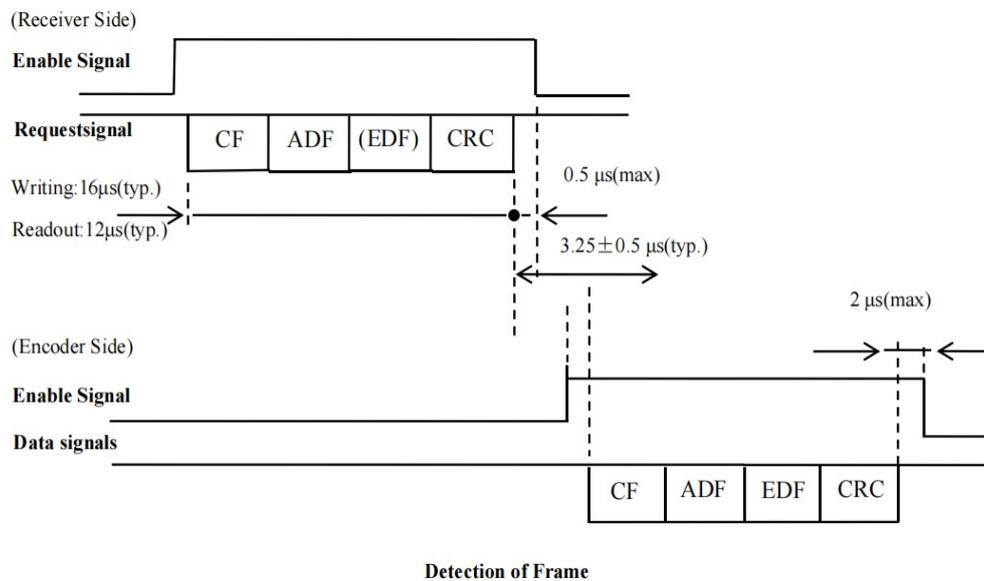
5.3.1 Data Readout



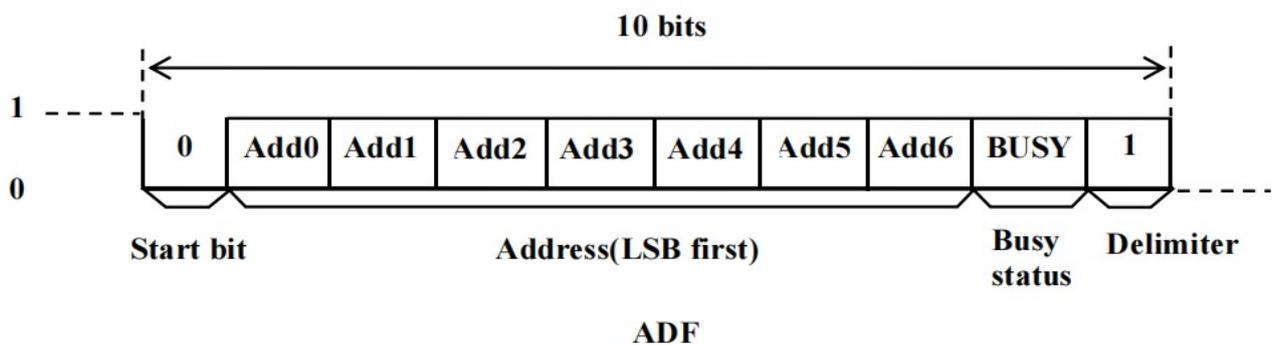
Detection of Frame

The number of data in DF depends on different CFs

5.3.2 Access (Writing) to E²PROM



5.3.3 ADF and EDF when operating EEPROM



- (1) Start bit: fixed
- (2) Address: eeprom address range 0 to 127
- (3) Busy status: The access status to eeprom can be checked through the busy status bit

	Request	Encoder sends data			Description
	Busy	Busy	ADF	EDF	
eeprom read	0	0	ADF	Eeprom data	Normal read
		1	ADF	0x00	Encoder busy, request Read invalid
eeprom write	0	0	ADF	EDF	Accepting Requests
		1	ADF	0x00	Encoder busy, request Read invalid

5.4 Details

5.4.1 Control Field (CF)

CF type	CF Content	Remark
Data readout	ID2(0x92)	25bit encoder ID information read (0x19)
	ID3(0x1A)	Read all data (single turn + multi-turn + fault flag + encoder ID)
	ID4(0xA2)	Reading single-turn position
	ID5(0x2A)	Read single-turn and multi-turn positions
Writing to E2PROM	ID6(0x32)	The 8-bit "user data" can be written into the data corresponding to the specified address. Within 20 μ s after sending according to the command format, the encoder will send back data. Do not communicate with the encoder during this process.
Readout from E2PROM	IDD(0xEA)	8-bit "user data" can be read from the specified address. Within 20 μ s after sending according to the command format, the encoder will send back data. Do not communicate with the encoder during this process.
Reset	ID7(0xBA)	This reset command requires 10 consecutive commands to be sent at a time interval of not less than 62.5 μ s to reset all fault flags.
	ID8(0xC2)	This reset command requires 10 consecutive commands to be sent at a time interval of not less than 62.5 μ s to reset any single-turn position to zero. Even if the power is turned on again, the position still retains the position data after reset.
	IDC(0x62)	This reset command requires that the command be sent 10 times continuously at a time interval of not less than 62.5 μ s, and the multi-turn data will be reset to zero (single-turn data will not be affected). At the same time reset all fault flags.

※CF consists of 1 byte, the category and content are shown in the table above

5.4.2 Status Field (SF)

Bit No	Description	Remark
Bit0	Rsvd	all are fixed to " 0 "
Bit1	Rsvd	
Bit2	Rsvd	
Bit3	Rsvd	
Bit4	Counting Error	Logic " 1 " is transmitted when any error occurs
Bit5	Output multi-turn error, battery error and battery	confirm them in ALMC
Bit6	Rsvd	all are fixed to " 0 "
Bit7	Rsvd	

CF consists of 1 byte, the category and content are shown in the table above

5.4.3 Data Field (DF0~DF7)

CFtype	DF0	DF1	DF2	DF3	DF4	DF5	DF6	DF7
ID2 (0x92)	ENID							
ID3 (0x1A)	ABS0	ABS1	ABS2	ENID	ABS3	ABM0	ABM1	ALMC
ID4 (0xA2)	ABS0	ABS1	ABS2	ABS3				
ID5 (0x2A)	ABS0	ABS1	ABS2	ABS3	ABM0	ABM1		
ID7 (0xBA)	ABS0	ABS1	ABS2					
ID8 (0xC2)	ABS0	ABS1	ABS2					
IDC (0x62)	ABS0	ABS1	ABS2					

Depending on the type of CF, there are different numbers of bytes in DF, as shown in the table above.

Note:

For the absolute position of a 25-bit encoder ABS0~ABS3, there are 32 bits of data in total. ABS0 is the lowest bit and ABS3 is the highest bit. The lower 7 bits of ABS0 are "0", and the remaining valid data constitutes 25 bits of single-turn position data;

For the absolute position of a 26-bit encoder ABS0~ABS3, there are 32 bits of data in total. ABS0 is the lowest bit and ABS3 is the highest bit. The lower 6 bits of ABS0 are "0", and the remaining valid data constitutes 26 bits of single-turn position data.

ABM0~ABM1 are the low and high bits of the encoder multi-turn position, and the two data constitute 16 bits of multi-turn information.

ENID is the ID of the encoder, the 25-bit value is 0x19, and the 26-bit value is 0x1A.

ALMC is the encoder fault flag



5.4.4 Fault Description

ALMC Faults see the table below:

Bit	0	1	2	3	4	5	6	7
Fault name	Over Speed	Full absolute status	Counting error	Counter overflow	Over heat	Multi-turn error	Battery error	Battery alarm

Description of each fault flag

Fault name	Functional Description	Solution
Over Speed	Acceleration greater than 2000rad/s ² is detected with 5V battery off. This flag should be used only as it is intended, as it may not be detected in some cases.	Fault reset
Full absolute status	During the 5V power-on process, the encoder speed is detected to be greater than 100rpm (± 20 rpm)	Restart the power supply
Counting error	Single turn information solution failure	Restart the power supply
Over heat	Over temperature	Fault reset
Multi-turn error	Multi-turn data loss, multi-turn counting failure	Fault reset
Counter overflow	When the multi-turn counter overflows, a logic "1" is indicated	Fault reset
Battery error	The battery voltage is lower than 2.75V, set	Check the electromagnetic power supply circuit and replace the battery
Battery alarm	The battery voltage is lower than 2.75V, set	After replacing the battery with normal voltage, the fault disappears automatically



6 Over temperature alarm setting and temperature measurement⁷.

6.1.1 To set the over-temperature alarm device and measure the temperature, you can use the EEPROM interface command on the encoder side.

6.1.2 To set the over-temperature alarm, use the EEPROM page 7 address "4", and to read the temperature, use the EEPROM page 7 address "5"

6.1.3 Over-temperature alarm setting table

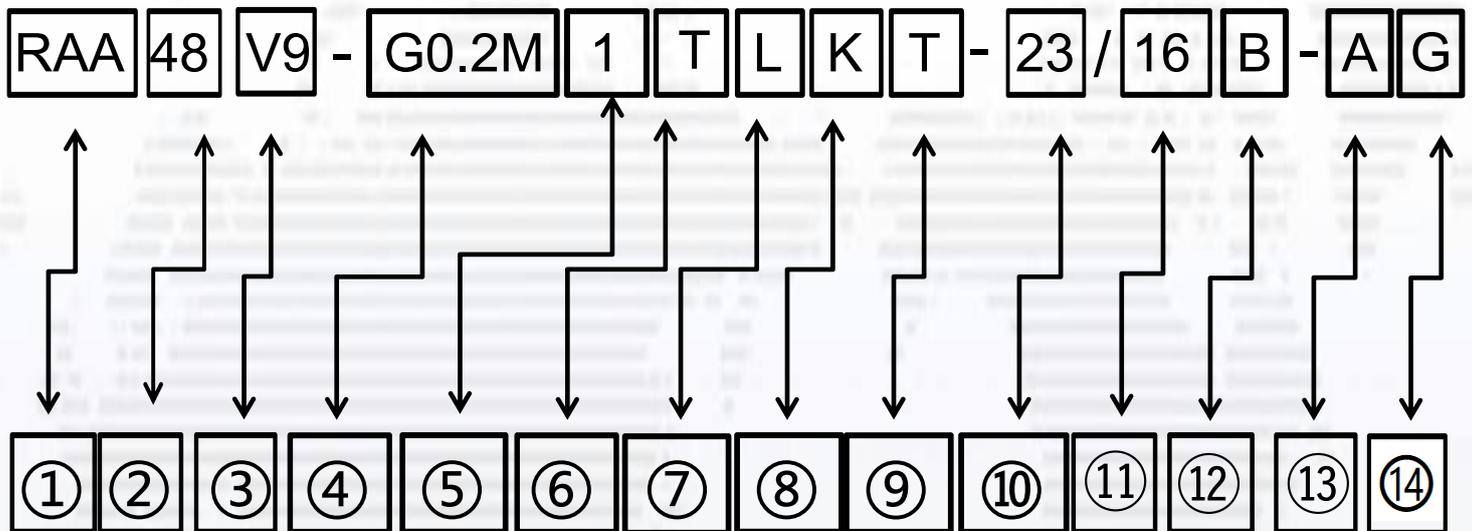
Address	EEPROM data		Over-heat detection Temperature
	edd7	edd6.....edd0	
	0	X X X X X X X	Not output
	1	0 0 0 0 0 0 1	+1
	1	0 0 0 0 0 1 0	+2
	1	0 0 0 0 0 1 1	+3

	1	1 1 1 1 1 1 0	+126
	1	1 1 1 1 1 1 1	+127

6.1.4 Reading Temperature

Address	EEPROM data		Over-heat detection Temperature
	Edd7	edd6.....edd0	
		1 0 0 0 0 0 0 0	-128
		1 0 0 0 0 0 0 1	-127
	
		1 1 1 1 1 1 1 1	-1
		0 0 0 0 0 0 0 0	± 0
		0 0 0 0 0 0 0 1	+1
	
		0 1 1 1 1 1 1 0	+126
		0 1 1 1 1 1 1 1	+127

7 Part Number Defination



序号	Defination
①	RAA:Main model RTA:with temperature sensor function
②	OD of mainbody
③	φ9 taper hollow shaft (1:10) φ8/φ6 straight hollow shaft (customized for large quantity)
④	G-type outlet or L-type outlet, cable length: 0.2m bare wire
⑤	Voltage 5V
⑥	RS485 interface
⑦	2.5MHz baud rate (cutomized if large quantity , like 5MHz)
⑧	16Krefresh rate
⑨	Timing transmission
⑩	23bit single turn resolution (17bit optional、 customized 25bit/26bit)
⑪	16bit multi turn resolution
⑫	Positive logic binary code
⑬	Accessory A bracket
⑭	Blank : default speed (6000rpm) G : high speed (6000rpm < speed 12000rpm)

※As shown in the figure above: outer diameter 48mm, 9 taper shaft, G-type outlet, cable length 0.2m bare wire, 5V working voltage, RS485 interface, baud rate 2.5MHz, update rate 16K, communication protocol is timing transmission, single turn 23 bits, multi-turn 16 bits, output code is positive logic binary code, A bracket, high speed.