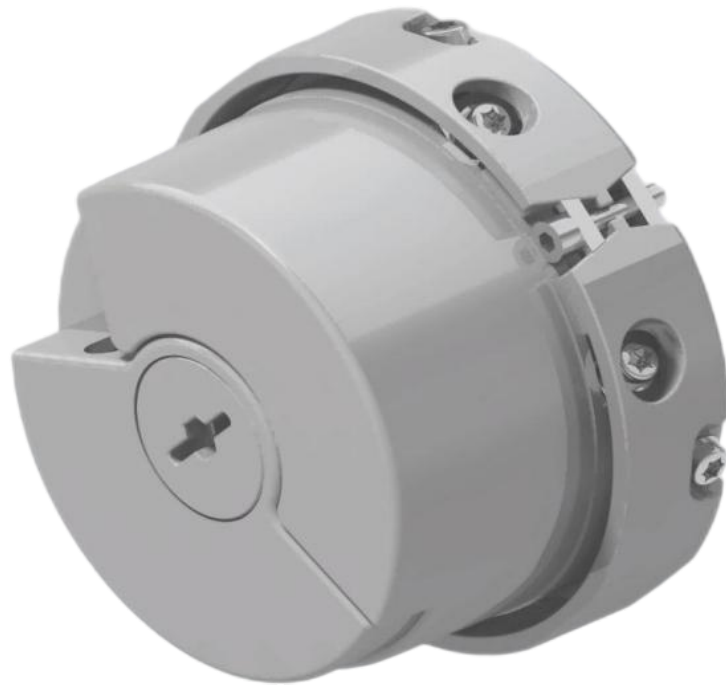




# RAA56U10 Series Encoder User Manual



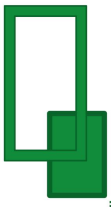
Changchun Rongde Optics Co., Ltd.(ROUNDSS)



[www.roundss.cc](http://www.roundss.cc)

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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.

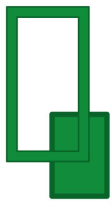
※1. Please use metal products that can shield electromagnetic and keep stable potential for the encoder housing. At this time, please ensure sufficient space distance from the electrical components in the circuit board. If the encoder will be affected by the magnetic field generated by the nearby motor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

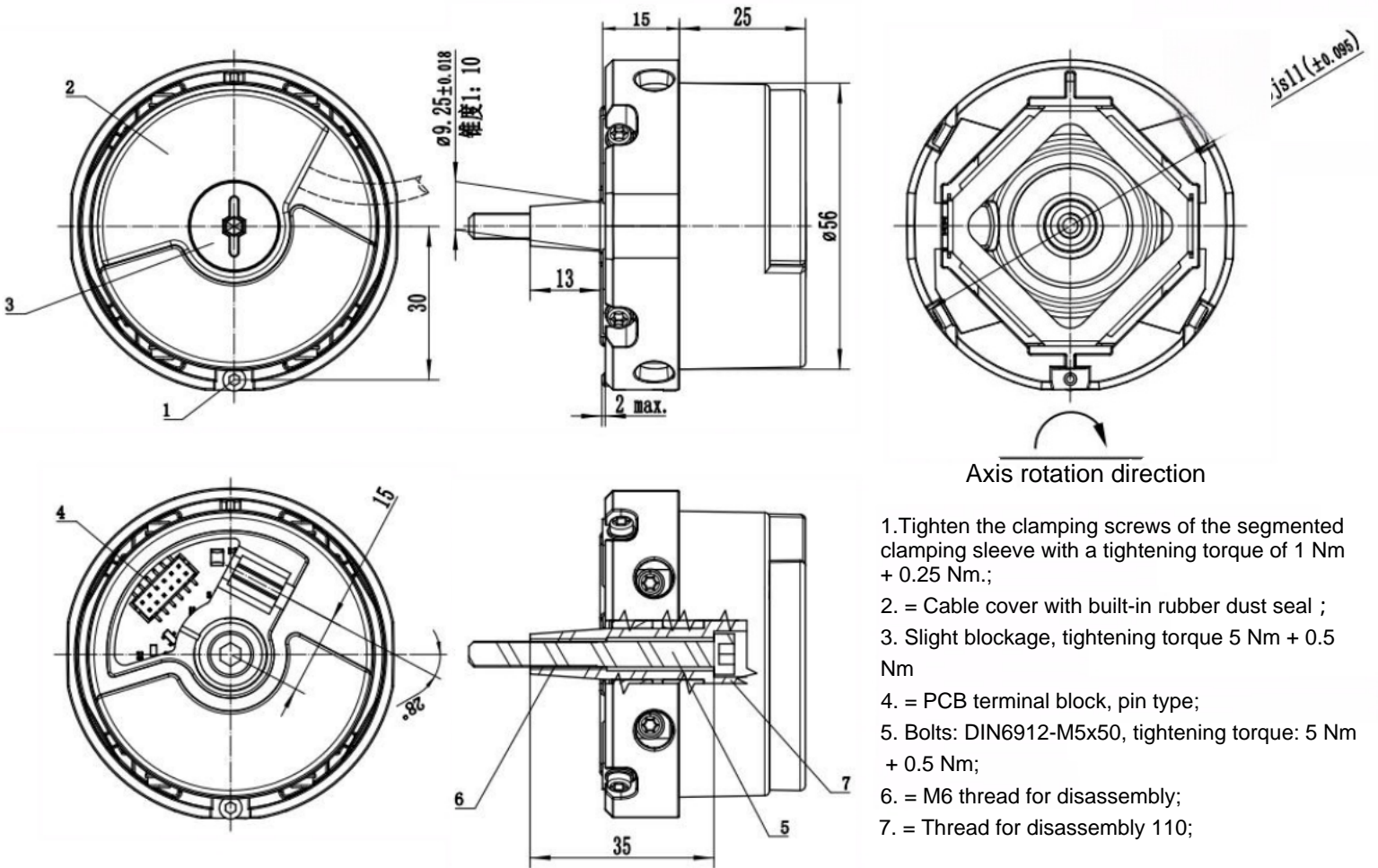
### **Operation Precautions**

- 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.

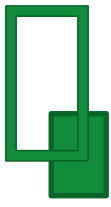
### **General Notes**

- 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 Dimensio



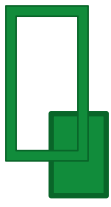
- 1.Tighten the clamping screws of the segmented clamping sleeve with a tightening torque of 1 Nm + 0.25 Nm.;
2. = Cable cover with built-in rubber dust seal ;
3. Slight blockage, tightening torque 5 Nm + 0.5 Nm
4. = PCB terminal block, pin type;
5. Bolts: DIN6912-M5x50, tightening torque: 5 Nm + 0.5 Nm;
6. = M6 thread for disassembly;
7. = Thread for disassembly 110;



## 2. Electrical Wiring

### 2.1 Wiring definition

Pigment	Definition
Black	Power supply <b>0V</b>
Red	Power supply <b>5V</b>
Green	Signal <b>D+</b>
Brown	Signal <b>D-</b>
White	Battery <b>3.6V</b>
Ash	Battery <b>0V</b>
Shield	Shell <b>G</b>

**3. Technical Parameter**

<b>Product model</b>	RAA56U10-12D1TLKT-23/16B
<b>Single loop resolution</b>	23-bit (17-bit, 25-bit, or 26-bit optional)
<b>Multi-turn resolution</b>	16bit
<b>CI</b>	RS485
<b>Service voltage</b>	5V ± 0.25
<b>Cell voltage</b>	3.6V
<b>Battery failure voltage</b>	2.75V ( ±0.15v )
<b>Battery warning voltage</b>	3.1V ( ±0.15V )
<b>Baud rate</b>	2.5MHz(available in bulk)
<b>Refresh rate</b>	16K
<b>Communication code</b>	Binary system
<b>Along the time of change</b>	100ms
<b>Working temperature</b>	-10 ~ 90
<b>Working humidity</b>	90%RH or below(no condensation)
<b>Storage temperature</b>	-20 ~ 100
<b>Storage humidity</b>	Below 95%RH (no condensation)
<b>Lash</b>	The impact acceleration was 980 m/s <sup>2</sup> , 11 ms; the impact was 3 times in each direction, a total of 18 times.
<b>Vibrate</b>	Between 10 and 55Hz, maintain an amplitude of 1.5mm; between 55 and 2000 Hz, apply an acceleration of 98m/s <sup>2</sup> ; XYZ each axis for 2 hours, totaling 6 hours.
<b>Working speed</b>	None: Default speed (6000 rpm) G: High speed (6000rpm <speed <12000 rpm)
<b>Levels of protection</b>	IP64

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

4.1 Overview (17bit-23bit)		
Cell	Description	Remarks
Communication code	Binary system	
Communication circuit	Differential drive	RS485
Data transfer content	Single-loop position information	<b>17 bits (maximum 23 bits)</b>
	Multi-loop position information	16bit
	Status flag	(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
Traffic rate	2.5Mbps	--

\*The protocol specifications for this encoder are all customized by clients. It is normal for some clients to have partial mismatches. For any protocol customization or alignment requirements, we can collaborate to develop solutions.

4.2 EEPROM communication specification		
Cell	Description	Remarks
Read and write user parameter address range	0 ~ 0x7E	This address field can store user parameters
Address	0x7F	0-5
Maximum number of write cycles	100,000 times	<b>The number of times the user can save and write parameters</b>



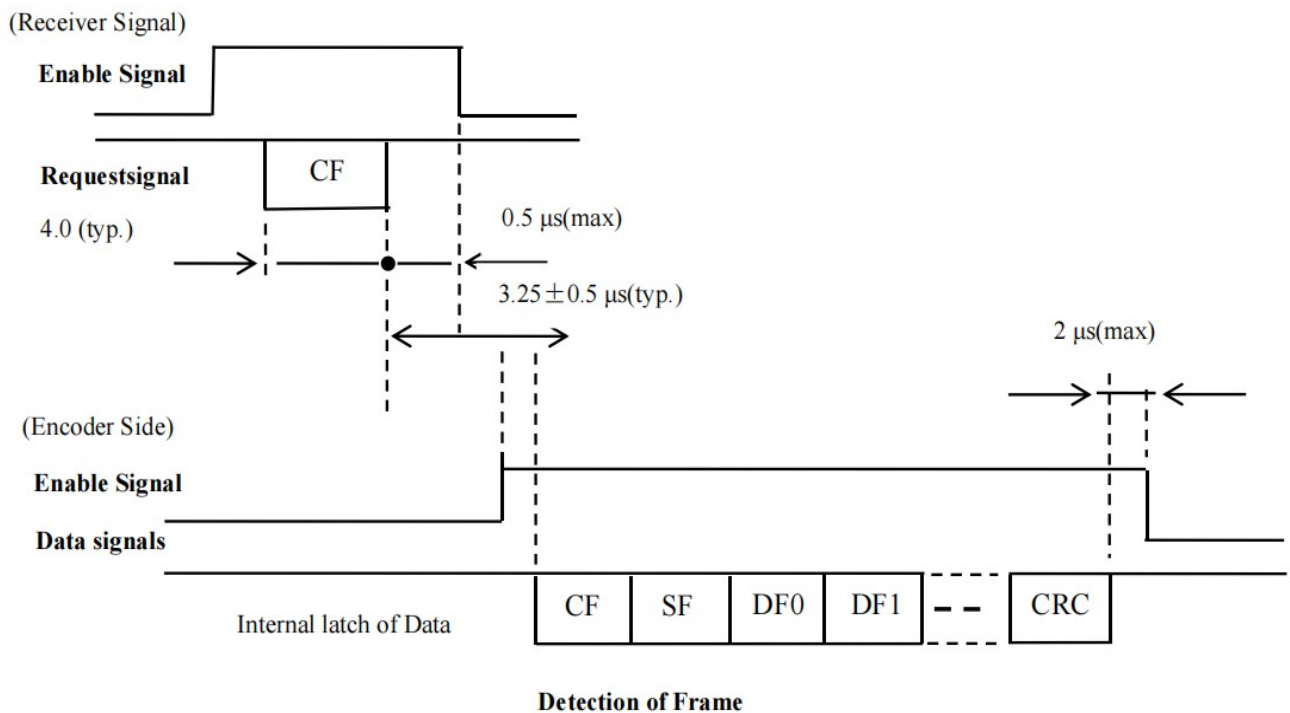
### 4.3 Frame Format

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

Terms used in data frame transmission:

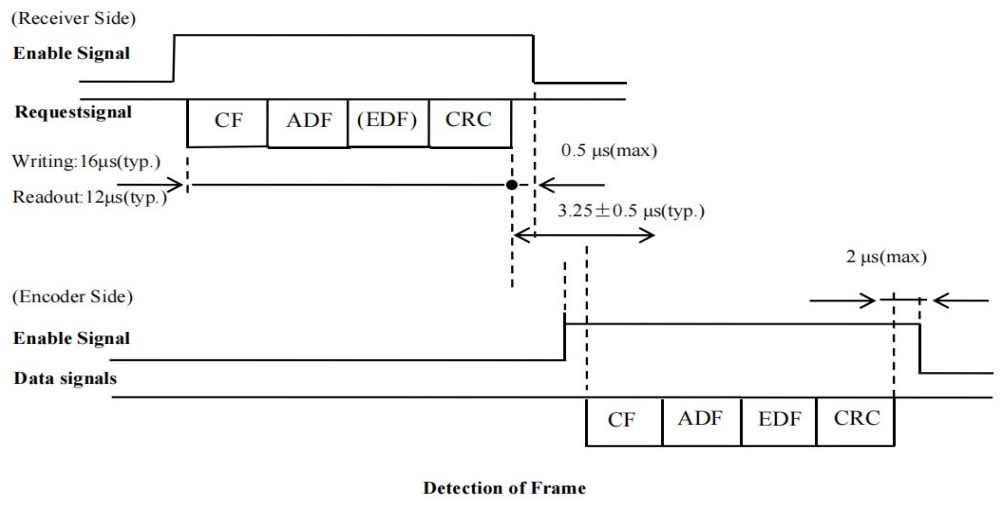
Cell	Description	Remarks
CF	Control Field	Use this to identify different command types
SF	Status Field	The encoder state is obtained through this section.
DF	Data Field	Encoder position data
ADF	Address Field	Accessible encoder address
EDF	E2PRM Field	Address content
CRC	CRC verification	Polynomial: $x^8 + 1$ (exclusive OR of all data except CRC)

#### 4.3.1 Location Data Reading

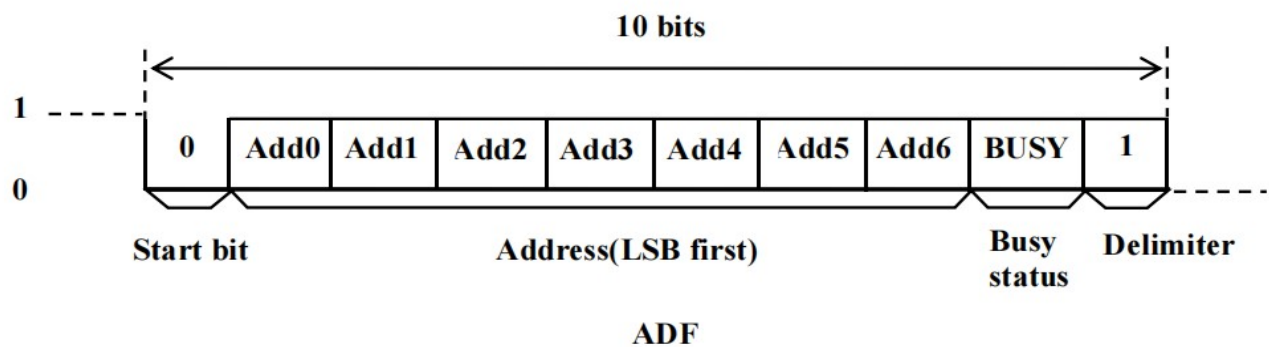


The number of data points in **DF** depends on the **CF**.

### 4.3.2 Read-Write EEPROM



### 4.3.3 ADF and EDF During EEPROM Operations



- (1) Start Bit: Fixed
- (2) Address: EEPROM Address Range 0 to 127
- (3) Busy Status: The Access Status of EEPROM Can Be Checked Through the Busy Status Bit.

	Ask	Encoder data transmission			Description
	Busy	Busy	ADF	EDF	
EEPROM read	0	0	ADF	Eeprom data	Normal read
		1	ADF	0x00	The encoder is busy. The read request is invalid.
EEPROM write	0	0	ADF	EDF	Accept request
		1	ADF	0x00	The encoder is busy. The read request is invalid.

## 4.4 Explain

### 4.4.1 Control Field (CF)

CF class	CF content	Remarks
Read data	ID0(0x02)	<b>Absolute Position Information Reading (CF+SF+ABS+CRC)</b>
	ID1(0x8A)	<b>Multi-loop data information reading (CF+ABM+CRC)</b>
	ID2(0x92)	<b>Encoder ID information reading (CF+ID+CRC)</b>
	ID3(0x1A)	<b>Read all data (CF+SF+ABS+ID+ABM+ALMC+CRC)</b>
	ID4(0x2B)	<b>Read the required data (SF+ABS+ABM0+ABM1+ALMC+CRC)</b>
<b>Write E2PROM</b>	ID6(0x32)	<b>8</b> The "user data" of the bit can be written into the data corresponding to the specified address. After the instruction format is sent, the encoder will return the data within <b>20μs</b> . Do not communicate with the encoder during this process.
<b>Read E2PROM</b>	IDD(0xEA)	<b>8</b> The "user data" of the bit can be read from the specified address. After the instruction format is sent, the encoder will send back the data within <b>20μs</b> . Do not communicate with the encoder during this process.
Reset	ID7(0xBA)	The reset instruction requires that the instruction be sent continuously 10 times with a time interval of not less than 62.5us, and all fault flag bits are reset.
	ID8(0xC2)	The reset command requires 10 consecutive transmissions at intervals of no less than 62.5 microseconds to reset any single cycle position to zero. Even after a power cycle, the position data remains unchanged from the reset state.
	IDC(0x62)	The reset instruction requires 10 consecutive instructions to be sent at intervals of no less than 62.5us to reset the multi-turn data (without affecting the single-turn data) and reset all fault flag bits.

Note:CF consists of 1 byte, with categories and contents as shown in the table above

### 4.4.2 Status Field (SF)

Item	Description	Remarks
Bit0	Rsvd	All for "0"
Bit1	Rsvd	
Bit2	Rsvd	
Bit3	Rsvd	
Bit4	Counting Error	Encoder position calculation failure, this bit will be set to "1"
Bit5	Multiplecircuiterrors,batt-eryerror,andbatteryalarm	View sub-faults through <b>ALMC</b>
Bit6	Rsvd	All for "0"
Bit7	Rsvd	

Note:CF consists of 1 byte, with categories and contents as 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					

※ Different CF types have different byte counts in DF, as shown in the table above

pour :

- 1、 **ABS0~ABS2** are the low, middle, and high bits of the encoder's absolute position, where the high 7 bit of **ABS2** is 0, and the remaining data form the **17bits** position information (for **23bit** encoders, the high 1 bit of **ABS2** is 0, and the rest are valid bits).
- 2、 **ABM0~ABM2** is the low, middle and high bits of the encoder multi-turn position, in which **ABM2** is 0, and the other data form the **16bits** multi-turn information.
- 3、 **ENID** is the ID of the encoder, with values of **0x11 (17-bit)** or **0x17 (23-bit)**.



4.4.4 Fault Description

See the table below for ALMC faults:

Bit	0	1	2	3	4	5	6	7
<b>Fault name</b>	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	Function declaration	Countermeasure
Over Speed	5 The 5V drop-out is detected when the acceleration is greater than 2000rad/s <sup>2</sup> in the battery state. This flag should only be used as its target, because it may not be detected in some cases.	Fault reset
Full absolute status	5 During the power-on process, the encoder speed was detected to be greater than 100rpm (±20 rpm)	Power on again
Counting error	Single loop information solution failure	Power on again
Over heat	Excess temperature	Fault reset
Multi-turn error	Multiple circuit data loss, multiple circuit counting failure	Fault reset
Counter overflow	When the multi-cycle counter overflows, the logic '1' is flagged.	Fault reset
Battery error	The battery voltage is below 2.75V. Set it.	Check the electromagnetic power supply line and replace the battery
Battery alarm	The battery voltage is below 2.75V. Set it.	The fault automatically disappears after replacing the battery with a properly voltageed one.

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

5.1 Overview		
Cell	Description	Remarks
Communication code	Binary system	
Communication circuit	Differential drive	RS485
Data transfer content	Single-loop position information	25bits/26bit
	Multi-loop position information	16bit
	Status flag	(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
Traffic rate	2.5Mbps	25bit
	10Mbps	26bit

\*The protocol specifications for this encoder are all customized by clients. It is normal for some clients to have partial mismatches. For any protocol customization or matching requirements, we can collaborate to develop solutions.

5.2 EEPROM communication specification		
Cell	Description	Remarks
Read and write user parameter address range	0 ~ 0x7E	This address field can store user parameters
Address	0x7F	0-5
Maximum number of write cycles	100,000 times	<b>The number of times the user can save and write parameters</b>



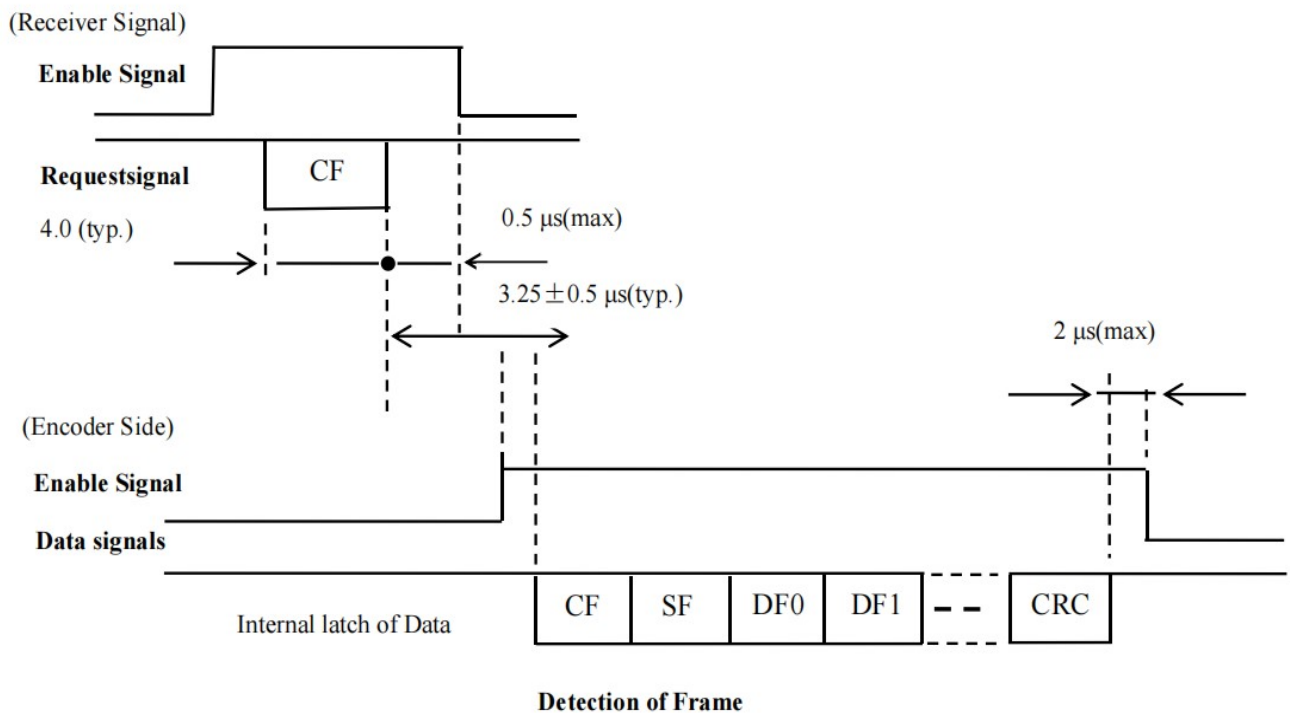
### 5.3 Frame Format

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

Terms used in data frame transmission:

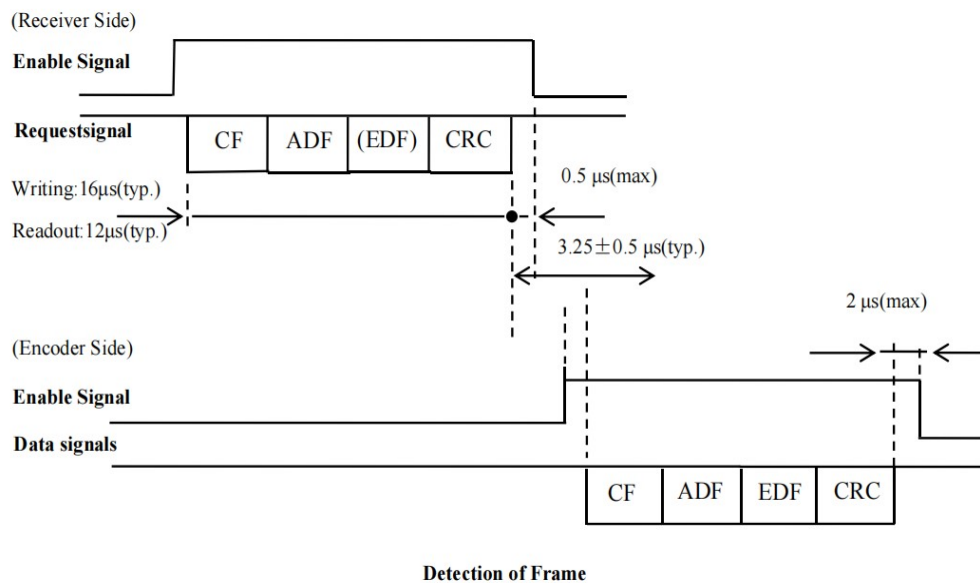
Cell	Description	Remarks
CF	Control Field	Use this to identify different command types
SF	Status Field	The encoder state is obtained through this section.
DF	Data Field	Encoder position data
ADF	Address Field	Accessible encoder address
EDF	E2PRM Field	Address content
CRC	CRC verification	Polynomial: $x^8 + 1$ (exclusive OR of all data except CRC)

#### 5.3.1 Location Data Reading

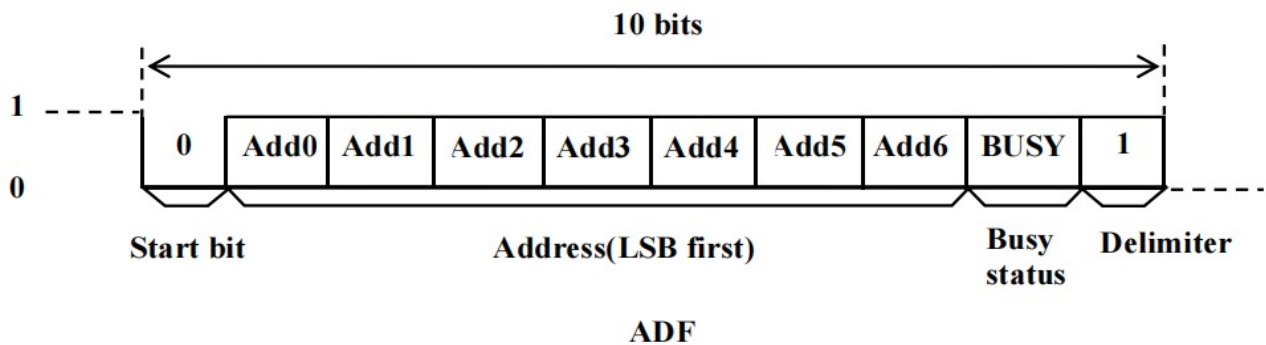


The number of data points in **DF** depends on the **CF**.

5.3.2 Read-Write EEPROM



5.3.3 ADF and EDF During EEPROM Operations



- (1) Start Bit: Fixed
- (2) Address: EEPROM Address Range 0 to 127
- (3) Busy Status: The Access Status of EEPROM Can Be Checked Through the Busy Status Bit.

	Ask	Encoder data transmission			Description
	Busy	Busy	ADF	EDF	
EEPROM read	0	0	ADF	Eeprom data	Normal read
		1	ADF	0x00	The encoder is busy. The read request is invalid.
EEPROM write	0	0	ADF	EDF	Accept request
		1	ADF	0x00	The encoder is busy. The read request is invalid.

## 5.4 Explain

### 5.4.1 Control Field (CF)

CF class	CF content	Remarks
Read data	ID2(0x92)	25-bit encoder ID information reading (0x19) 26-bit encoder ID information read (0x1A)
	ID3(0x1A)	Read all data (single cycle + multiple cycles + fault flag + encoder ID)
	ID4(0xA2)	Read single loop position
	ID5(0x2A)	Read single and multiple loop positions
Write EEPROM	ID6(0x32)	<b>8</b> The "user data" of the bit can be written into the data corresponding to the specified address. After the instruction format is sent, the encoder will return the data within <b>20μs</b> . Do not communicate with the encoder during this process.
A slight pause in reading EEPROM	IDD(0xEA)	<b>8</b> The "user data" of the bit can be read from the specified address. After the instruction format is sent, the encoder will send back the data within <b>20μs</b> . Do not communicate with the encoder during this process.
Reset	ID7(0xBA)	<b>The reset instruction requires that the instruction be sent continuously 10 times with a time interval of not less than 62.5us, and all fault flag bits are reset.</b>
	ID8(0xC2)	The reset instruction requires 10 consecutive instructions to be sent at intervals of no less than <b>62.5us</b> to reset any single loop position to zero. Even after power-on, the position data remains unchanged after reset.
	IDC(0x62)	The reset instruction requires 10 consecutive instructions to be sent at intervals of no less than <b>62.5us</b> to reset the multi-turn data (without affecting the single-turn data) and reset all fault flag bits.

Note: CF consists of 1 byte, with categories and contents as shown in the table above

### 5.4.2 Status Field (SF)

Item	Description	Remarks
Bit0	Rsvd	All for "0"
Bit1	Rsvd	
Bit2	Rsvd	
Bit3	Rsvd	
Bit4	CountingError	Encoder position calculation failure, this bit will be set to "1"
Bit5	Multiple circuit errors, battery error, and battery alarm	View sub-faults through <b>ALMC</b>
Bit6	Rsvd	All for "0"
Bit7	Rsvd	

Note: CF consists of 1 byte, with categories and contents as shown in the table above

### 5.4.3 Data Field (DF0~DF7)

CF type	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					

※ Different CF types have different byte counts in DF, as shown in the table above

pour :

The 25-bit encoder generates 32-bit absolute position data for each cycle (ABS0 to ABS3), where ABS0 is the least significant bit and ABS3 is the most significant bit. The lower 7 bits of ABS0 are set to "0", while the remaining valid bits form the 25-bit single-cycle position data.

The 26-bit encoder generates 32-bit absolute position data for each cycle (ABS0 to ABS3), where ABS0 is the least significant bit and ABS3 is the most significant bit. The lower 6 bits of ABS0 are set to '0', while the remaining valid bits form the complete 26-bit single-cycle position data.

ABM0 ~ ABM1 are the low and high bit of the encoder's multi-turn position, to get her forming a 16-bit multi-turn information. ENID is the encoder's ID, with the 25-bit value being 0x19 and the 26-bit value being 0x1A. ALMC bit encoding fault flag



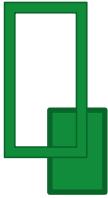
### 5.4.4 Fault Description

See the table below for ALMC faults:

Bit	0	1	2	3	4	5	6	7
<b>Fault name</b>	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	Function declaration	Countermeasure
Over Speed	5 V drop power detected acceleration greater than $2000\text{rad/s}^2$ in battery state, this flag should only be used as its target, because it may not be detected in some cases.	Fault reset
Full absolute status	During the 5V power-up process, the encoder speed was detected to exceed 100 rpm ( $\pm 20$ rpm).	Power on again
Counting error	Single loop information solution failure	Power on again
Over heat	Excess temperature	Fault reset
Multi-turn error	Multiple circuit data loss, multiple circuit counting failure	Fault reset
Counter overflow	When the multi-cycle counter overflows, the logic '1' is flagged.	Fault reset
Battery error	The battery voltage is below 2.75V. Set it.	Check the electromagnetic power supply line and replace the battery
Battery alarm	The battery voltage is below 2.75V. Set it.	The fault automatically disappears after replacing the battery with a properly voltageed one.



## 6 Over temperature Alarm Settings and Temperature Measurement

6.1.1 The Temperature Alarm Device and Measurement Can Be Configure at the Encoder End by Accessing the EEPROM Interface Command.

6.1.2 To configure the over - temperature alarm, use address '4' on page 7 of the EEPROM, and read the temperature value from address '5' on page 7 of the EEPROM.

6.1.3 Set Temperature Alarm 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 Read 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