Briterencoder Absolute Rotary Encoder

CANbus Single-turn Interface Communication Protocol

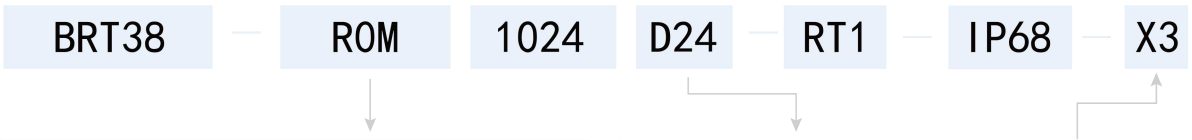
1. Product Model Description

BRT=BriterEncoder:
BRT25=OD.25mm,4mm shaft
BRT27=27*27mm,6mm shaft
BRT38=OD.39mm, 6mm shaft
BRT38B=OD.39mm, 8mm hoop blind hole
BRT38M=OD.39mm,8mm blind hole
BRT42=OD.42mm, 6mm shaft
BRT50=OD.50mm, 8mm shaft
BRT58=OD.58mm, 10mm shaft

Resolution:
1024=10bit
4096=12bit
16384=14bit
32768=15bit
16bit =65536
17bit =131072
.....
21bit=2097152

RT1=Side Outlet
AT1=Tail Outlet
(Default Cable Length 1~1.2M)

IP54:Normal
IP65:Waterproof
IP68:Waterproof and dustproof
(Usable 1m underwater)
EX:Explosion-proof



Communication Protocal:

R0M=RS485 (Modbus RTU)	A0M=4~20mA
R2M=RS232(Modbus RTU)	V5M=0~5V
R4M=RS422(Modbus RTU)	V10M=0~10V
T0M=TTL(Modbus RTU)	R0&A0M=RS485&4~20mA
C0M=CANbus	R0&V5M=RS48580~5V
C2M=CANopen	R0&V10M=RS485&0~10V
S0M=SPI	
S1M=SSI	
S2M=BISS-C	

Turns:
1, 16, 24, 32, 50, 64, 99, 100, 200, 400, 600, 800, 1800, 5400, 10800, 21600, 34891, 69782 turns (Customizable)
D1 = Single turn
D16 = 16 turns

Internal Identification Code

Note 1: For photoelectric types, add P before the communication interface, e.g., photoelectric RS485 = PROM.

Note 2: For high-speed RS485 communication interfaces compatible with Tamagawa models, add HS before the communication interface, e.g., high-speed RS485 = HSR0M.

Note 3: For analog speed models, note the maximum speed RPM after the model, e.g., BRT38 - A0M1024 - RT1 - IP68(1000RPM).

Model Description:
1.Model:e.g., BRT25 indicates an outer diameter of 25mm and an output shaft of 4mm.
2.Communication interface: e.g., R0M means the electrical interface is RS485 and the communication protocol is Modbus RTU.
3.Resolution: It refers to the single - turn resolution, which has nothing to do with the subsequent number of turns. e.g., with a 10 - bit resolution, 2 to the power of 10 equals 1024. That is, the 360° full circle is divided into 1024 parts, and the minimum angular resolution is 360°/1024 = 0.38°.
4.Turns:It represents the power-off memory range, rather than the mechanical rotation turns of the encoder. The power-off memory of a single-turn encoder is limited to one turn, while a multi-turn encoder can record and restore multi-turn position information. Both types of encoders can perform infinite mechanical rotations.
5.Blind holes are mainly used to provide space for fixed threaded connections, while hoop blind hole are mainly used to fix and connect components. In practical applications, it is more recommended to use hoop blind hole for encoders.
6.Inventory: Some randomly combined models may be out of stock. Please consult in advance to ensure that the selected model is available.

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2. Wiring Definition and connection

Red wire	Power Supply	DC 5V~24V
Black wire	0V (GND)	-
Green wire	CANH	-
White wire	CANL	-
Yellow wire	Function line	1. It serves for encoder zero position setting and factory settings restoration. 2. During normal encoder operation, keep the yellow wire suspended and disconnected.

3. Product Parameters

Multi-turns	16、25、32、50、64、100、400、1800、5400、10800、21600turns(Customizable)		
Resolution	10bit、12bit、13bit、14bit、15bit、16bit		
Supply Voltage	5~24V	Linearity	0.1%
Kernel Refresh Period	50uS	Electrical lifespan	> 100000 h
WorkingCurrent	100mA	Baud Rate	100k~1M(default 500k)
Shell/ Flange Material	Galvanized steel / Aluminum alloy IP68/EX Stainless Steel	Address	1-255(default 1)
Shaft Material	Stainless Steel(Customizable)	Maximum mechanical speed	8000PRM
Bearing material	Bearing Steel	Starting Torque	0.006Nm
Maximum load on the shaft	Axial 20 N, Radial 80 N	Weight	120 g-and-above
Working temperature	-40 ~ + 85 ℃	Humidity	98 % (No condensation)
Storage temperature	-40 ~ +85°C	Protection Level	IP54、IP68、EX

Three simple ways to set absolute encoder to zero position?

- ✧ Method 1. Connect yellow wire to ground (black wire) more than 100mS. After set zero, please separate the yellow and black wire.
- ✧ Method 2. After right connected the wires according to the wiring definition. send set zero position command according to the user manual.
- ✧ Method 3. Use the upper computer provided by our company (BriterEncoder).

How to restore the absolute encoder to factory settings?

- ✧ Step 1, After power off, connect the yellow wire to the black wire.
- ✧ Step 2, power on, and hold for two minutes.
- ✧ Step 3, power off, then separate the yellow wire from the black wire. now the rotary encoder had been restored to factory settings.

4. CANbus communication protocol

1) 6.1. Application CAN and encoder communication

Open the CAN device

Set the baud rate.
The host should be set to the same baud rate as the encoder;
The encoder factory default baud rate is 500kbps.
Note: To connect the CAN device to the encoder, at least one 120 Ω terminal resistor needs to be added, and a second resistor should be added according to the actual situation.

Frame information setting

(1) Select standard frames instead of extended frames;
(2) Select data frames instead of remote frames;
(3) Calculate the length of the data field, including all content in the data field, with a maximum value of "8".

Data transmission

According to the encoder's protocol, fill in the data field content. When the content of the data field is multi byte, the low byte comes first.
For example, the host sends command to encoder 1: "Read encoder value", data field length 4;
Data field: 0x04 (data length) + 0x01 (encoder address) + 0x01 (instruction code) + 0x00 (data 1)

Identifier ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0X01	0x04	0x01	0x01	0x00	——	——	——	——

Returned data: data field length 7;

Data field: 0X07 (data length) + 0X01 (encoder address) + 0X01 (instruction code) + 0x00012345 (data)Identifier ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0X01	0x07	0x01	0x01	0x45	0x23	0x01	0x00	——

2) BriterEncoder CAN instruction set. V2.3

CAN Protocol

(1) Adopting CAN2.0B standard frame communication protocol.
(2) Communication rate: 1Mbps、500kbps、250kbps、125kbps、100kbps are settable.
500kbps is the default baud rate.
Note: After modifying the communication rate of the encoder, the host should also be modified to the same communication rate.

Command structure

The composition of CAN2.0B instruction code:
[Length LEN] + [Device ID] + [Command FUNC] + [Data DATA]
• [Length LEN]: 1 byte, including [Length LEN] + [Device ID] + [Command FUNC] + [Data DATA]
• [Device ID]: 1 byte, range 0~255;
• [Command]: 1 byte, range 0~255;
• [data]: 0 ~4 bytes； 2 bytes consist16 bit data， The low byte comes first; 4 bytes make up 32-bit data, and the low byte comes first.

CAN command data list. V2.3

CAN Command	Function description	Example (encoder address ID defaults to 01). Standard frame ID (identifier) is also 01

0x01	Read the encoder value.(Power off memory) Return data: 32-bit unsigned integer. Numerical range: 0~N (N For single turn resolution-1) Encoder current angle= Encoder value*360/ single turn resolution. e.g. reading the encoder value is 1000, the single turn resolution is 1024 (10bit). then the encoder current angle= 1000*360/1024=351.5625°	Issue: [0x04][0x01][0x01][0x00] Return: [0x07][0x01][0x01][0x45][0x23][0x01][0x00] Encoder value: 0X00012345 (Decimal: 74565)
0x02	Set the encoder ID, Numerical range: 1~255 (8-bit unsigned integer) The default node address is 1(0x01) Send data: 8-bit unsigned integer. Return data: 8-bit unsigned integer. 0: Set successfully other: Error code Effective immediately after successful setting	Issue: [0x04][0x01][0x02][0x08] Return: [0x04][0x08][0x02][0x00] Set address: 0X08 After successful setup, the slave responds with a new address
0x22	Set the encoder ID to a value greater than 255 (0xFF). Value range: 0–1FFFFFFF (29-bit unsigned integer) Default node address: 1 (0x01) Downstream data: 32-bit unsigned integer. Return data: 32-bit unsigned integer. 0: Setting successful; other values: Error code Parameter settings take effect immediately.	Downstream: [0x07][0x01][0x22][0x18][0xFF][0xF2][0x25] Return: [0x07][0x25][0x22][0x00][0x00][0x00][0x00] Set Address: 0x18FFF225 After a successful setting, the slave responds using the new address.
0x03	Set CAN baud rate: Numerical range: 0~4 (8-bit unsigned integer) Send data: 8-bit unsigned integer. Return data: 8-bit unsigned integer. 0: Set successfully，other: Error code 0x00: 500K (default)；0x01:1M 0x02: 250K；0x03:125K; 0x04: 100K； Effective immediately after successful setting	Issue: [0x04][0x01][0x03][0x01] Return: [0x04][0x01][0x03][0x00] Set baud rate: 1M
0x04	Set the encoder mode: 0x00: query mode，(default) 0x01: Automatically return encoder angular velocity value, 0xAA: Automatically return encoder value, Effective immediately after successful setting	Issue: [0x04][0x01][0x04][0xAA] Return: [0x04][0x01][0x04][0x00] Setting mode: 0xAA (automatic return mode), After setting the automatic mode, the encoder position or angular velocity will be periodically and actively transmitted back. The transmission cycle is determined by the encoder's automatic transmission time.
0x05	Set the automatic return time of the encoder (microseconds), Numerical range: 50~65535 (16-bit unsigned integer) Effective immediately after successful setting	Issue: [0x05][0x01][0x05][0xE8][0x03] Return: [0x04][0x01][0x05][0x00] Set automatic return time: 0X03E8 (1000ms)
Note: Setting too short a return time and then setting other parameters through the encoder upper computer can easily fail. Use with caution!		
0x06	Set the current position value to zero, Send data: 8-bit unsigned integer. Return data: 8-bit unsigned integer. 0: Set successfully，other: Error code Effective immediately after successful setting	Issue: [0x04][0x01][0x06][0x00] Return: [0x04][0x01][0x06][0x00] Set the position value to zero, and after setting, the current encoder value is 0.
0x07	Set encoder value increment direction: 0x00: Clockwise, 0x01: Counterclockwise Effective immediately after successful setting	Issue: [0x04][0x01][0x07][0x01] Return: [0x04][0x01][0x07][0x00] Set direction: 0x01 (Counterclockwise)

0x08	Read encoder virtual multi-turns value (back to zero when power off). Return data: 32-bit unsigned integer. Data range: 0~2147483647 Encoder's current virtual multi turn angle=encoder virtual multi turn value*360/single turn resolution. E.g. if read encoder single turn value is 100000, the single turn resolution is 10bit (1024). then the encoder current angle= 100000*360/1024=35156.25°	Issue：[0x04][0x01][0x08][0x00] Return：[0x07][0x01][0x08][0x45][0x23][0x01][0x00] Encoder value: 0X00012345（Decimal：74565）
0x09	Read encoder virtual number of turns. (back to zero when power off). Return data: 32-bit unsigned integer.	Issue：[0x04][0x01][0x09][0x00] Return：[0x07][0x01][0x09][0x45][0x23][0x01][0x00] Encoder value: 0X00012345（Decimal: 74565）
0x0A	Read encoder angular velocity value. Return data: 32-bit signed integer. Numerical range: -2147483648~2147483647 Encoder rotation speed= Encoder angular velocity value/ single turn resolution/ Speed calculation time (Unit: rpm) e.g. The encoder angular velocity value is returned as 1000，single turn resolution is 32768 (15bit)， Speed calculation time is 100ms (0.1/60min) Encoder rotation speed= 1000/32768/(0.1/60) = 1000*0.0183 = 18.31rpm.	Issue: [0x04][0x01][0x0A][0x00] Return: [0x07][0x01][0x0A][0x45][0x23][0x01][0x00] The encoder angular velocity value: 0X00012345 (Decimal: 74565)
0x0B	Set encoder angular velocity calculation time (power off memory，unit: ms) Numerical range: 0~65535 (16-bit unsigned integer) Effective immediately after successful setting	Issue: [0x05][0x01][0x0B][0x03][0xE8] Return: [0x04][0x01][0x0B][0x00] Set encoder angular velocity calculation time: 0X03E8 (1000 ms)
0x0C	Set encoder midpoint, Send data: 8-bit unsigned integer. Return data: 8 -bit unsigned integer. 0: Set successfully，other: Error code Effective immediately after successful setting	Issue: [0x04][0x01][0x0C][0x01] Return: [0x04][0x01][0x0C][0x00] Set the encoder to use the current position value as the midpoint value. Set the current encoder value to M (M is single turn resolution*turns/2)
0x0D	Set the current position value of the encoder(back to zero when power off). Numerical range: 0~N (N is for the single turn resolution-1) Send data: 32 -bit unsigned integer. Return data: 8 -bit unsigned integer. 0: Set successfully，other: Error code Effective immediately after successful setting	Issue: [0x07][0x01][0x0D][0x00][0x01][0x23][0x45] Return: [0x04][0x01][0x0D][0x00] Set encoder value: 0X00012345 (Decimal: 74565)

5. Precautions and warranty

● Encoders belong to precision instruments. Please handle them with care and use them with care, especially do not knock, hit, or forcefully pull the encoder shaft.
● The encoder and mechanical connection should use flexible connectors or elastic brackets to avoid hard damage caused by non concentric rigid connections.
● Although the encoder itself does not lose the number of turns in interference environments, it can cause interference to the data during transmission. Therefore, when there is a motor or strong electromagnetic interference environment in the system, an isolated power supply should be used to power the encoder. And when there's external extended communication lines, it is best to use double shielded cables.

● The encoder casing and shielding wire should be well grounded to prevent damage to the encoder circuit caused by lightning strikes or high-voltage static electricity
● The product is guaranteed for one year free of charge when used correctly.
● When exceed the warranty period, or the product is damaged due to improper use, the product can be sent back to the original factory for repair (only raw material cost is required when repair).

6. Encoder Indicator Lights Description

1) The default state consists of 5 flashing statuses in the following sequence: “Blue -> Blue -> Blue -> Cyan -> Blue” with a slow flash every 1 second, indicating normal power supply to the encoder.

2) Other operational status indications
a. Query encoder data status: Green light flashing quickly every 0.5 seconds.
b. Setting the zero point for the yellow line: Orange light flashing quickly every 0.5 seconds.
c. Power-on reset status for the yellow line: Purple light flashing quickly every 0.5 seconds.
d. Encoder data automatic return status: Pause for 1 second, slow flash, interval of 0.5 seconds fast flash, blinking 5 times, defined with reference to the first item.
e. The red light indicates encoder malfunction.

3) When the encoder’s ID and baud rate are changed, the colors of the flashing lights will correspondingly change. Here is the color reference table for the status lights and their meanings:

Table 1 Color and Numerical Definition Relationship

Color	Blue	Cyan	Orange	Purple	Green	Red
Numerical Value	0	1	2	3	4	5

Table 2 CANbus Baud Rate and Numerical Definition Relationship

Baud Rate	500K	1M	250K	200K	100K
Numerical Value	0	1	2	3	4

(1) Upon power-on in normal operation:
a. There is a 4-second pause followed by 5 slow flashes with a 1-second interval.
b. The colors of the first 4 flashes form a quaternary (base-4) data that corresponds to the encoder ID number.
c. The color of the last flash defines the baud rate.

(2) For example: Orange -> Cyan -> Purple -> Orange -> Blue. Referring to Table 1 and Table 2, we can determine the corresponding numbers: 21320. The last digit is 0, according to Table 2, which corresponds to a baud rate of 9600. The first four digits form the quaternary number 2132, which converts to decimal ID: 2 * 4^3 + 1 * 4^2 + 3 * 4^1 + 2 * 4^0 = 158 (Encoder ID).

Table 3 Status LED Blinking Definitions and Examples

		Section 1 Encoder ID				Section 2 Baud Rate	
LED Status	OFF	ON	ON	ON	ON	ON	OFF
Hold Time	4s	1s	1s	1s	1s	1s	4s
Status Color	-	orange	blue-green	purple	orange	blue	-

Number	-	2	1	3	2	0	-
Status Analysis	-	2*4^3+ 1*4^2 + 3*4^1 + 2*4^0 = 158				Baud rate is 500K	-
Status Meaning	-	Encoder ID				Baud Rate	-

7. Contact us and technology support

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Technical documentation

Detailed version of the instruction manual;
PC software;
2D drawings and 3D model files;
Additional Video Tutorials;

For more details, please visit our website:
www.briterencoder.com.

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