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DPT Magnetic Dual Encoder DataSheet v0.5

DPT Magnetic Dual Encoder

DPT dual magnetic encoder is specially used for the integrated joint of the robot. It uses the pattern magnetic technology of KingKong Technology, which can achieve the measurement of two axes in a limited volume and each of them infinitely approaching the resolution and accuracy of photoelectric encoder, and has a strong anti-environmental interference ability.

DPT is driven by magnetoelectric technology and has a unique interference shielding technology. There are multiple high-precision magnetic field sensors inside the encoder to measure the filed strength changes of the rotor magnetic ring, and it is formed by the precision calibration technology provided by KingKong Technology. Each product has unique magnetic field calibration data at the factory, providing the best measurement accuracy.

The unique tolerances fit installation method with rotor and stator simplifies the installation for users, but also guarantees the measurement accuracy.

The separated magnetoelectric solution can ensure that the encoder can avoid the interference of external environmental factors such as vibration, dust, oil pollution, even when it is running at ultra-high speed, without affecting the accuracy and service life.

Ultra-thin body with hollow shaft could easily suit with any application.

- Dual 24-bit absolute output
- Dual ±0.01° accuracy
- Ultra-compact (Ring width 7mm)
- Models for every 5mm on diameter
- Stator and rotor tolerance fit installation
- Magnetic interference shielding
- Hollow structure
- Permissible speed 8,000 rpm
- Unique data calibration
- Various output interfaces
- Resistance to various environmental disturbances

Models

DPT-10-15-25-A-24-24-R-N-A-M

Inner rotor ID

Refer to Size

xx — Thread type

xxB — Bonding type

Outer rotor ID

Refer to Size

xx — Thread type

xxB — Bonding type

Stator OD

Refer to Size

xx — Front install

xxH — Front/Back install

Output type

A — Absolute

Inner encoder output parameter

24 — 24 bits

Outer encoder output parameter

24 — 24 bits

Output interface

R — RS485

B — BISS-C

Input voltage

N — 5V

Operating temperature

A — -40 ~ 85 ℃

B — -40 ~ 105 ℃

C — -40 ~ 125 ℃

Addition

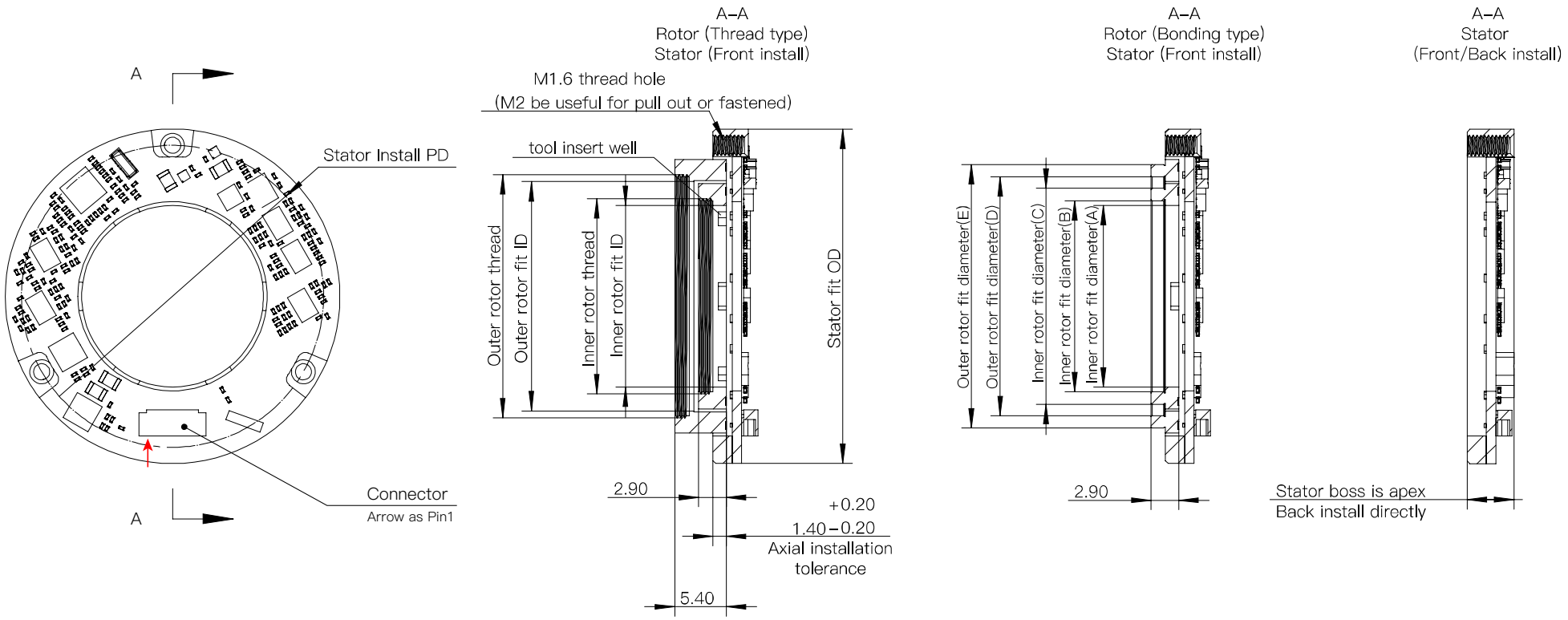
M — No addition

Size

Series	Size	Rotor type	Stator type	Inner rotor thread	Inner rotor height	Inner rotor ID (H7)[3]			Outer rotor thread	Outer rotor height	Outer rotor OD(H7)[3]		Stator mounting PD	Stator fit OD(h7)	Stator back install directly[2]
						A	B	C			D	E			
10–15–25	DPT–10–15–25	Thread	Front	M10x0.4mm	2.9		9		M15x0.4mm	5.4		14	21.6	25	–
	DPT–10B–15B–25	Bonding	Front	–	2.9	9	10	12.6	–	2.9	15	17.6	21.6	25	–
	DPT–10–15–25H	Thread	Front/Back	M10x0.4mm	2.9		9		M15x0.4mm	5.4		14	21.6	25	✓
	DPT–10B–15B–25H	Bonding	Front/Back	–	2.9	9	10	12.6	–	2.9	15	17.6	21.6	25	✓
15–20–30	DPT–15–20–30	Thread	Front	M15x0.4mm	2.9		14		M20x0.4mm	5.4		19	26.6	30	–
	DPT–15B–20B–30	Bonding	Front	–	2.9	14	15	17.6	–	2.9	20	22.6	26.6	30	–
	DPT–15–20–30H	Thread	Front/Back	M15x0.4mm	2.9		14		M20x0.4mm	5.4		19	26.6	30	✓
	DPT–15B–20B–30H	Bonding	Front/Back	–	2.9	14	15	17.6	–	2.9	20	22.6	26.6	30	✓
20–25–35	DPT–20–25–35	Thread	Front	M20x0.4mm	2.9		19		M25x0.4mm	5.4		24	31.6	35	–
	DPT–20B–25B–35	Bonding	Front	–	2.9	19	20	22.6	–	2.9	25	27.6	31.6	35	–
	DPT–20–25–35H	Thread	Front/Back	M20x0.4mm	2.9		19		M25x0.4mm	5.4		24	31.6	35	✓
	DPT–20B–25B–35H	Bonding	Front/Back	–	2.9	19	20	22.6	–	2.9	25	27.6	31.6	35	✓
25–30–40	DPT–25–30–40	Thread	Front	M25x0.4mm	2.9		24		M30x0.4mm	5.4		29	36.6	40	–
	DPT–25B–30B–40	Bonding	Front	–	2.9	24	25	27.6	–	2.9	30	32.6	36.6	40	–
	DPT–25–30–40H	Thread	Front/Back	M25x0.4mm	2.9		24		M30x0.4mm	5.4		29	36.6	40	✓
	DPT–25B–30B–40H	Bonding	Front/Back	–	2.9	24	25	27.6	–	2.9	30	32.6	36.6	40	✓
30–35–45	DPT–30–35–45	Thread	Front	M30x0.4mm	2.9		29		M35x0.4mm	5.4		34	41.6	45	–
	DPT–30B–35B–45	Bonding	Front	–	2.9	29	30	32.6	–	2.9	35	37.6	41.6	45	–
	DPT–30–35–45H	Thread	Front/Back	M30x0.4mm	2.9		29		M35x0.4mm	5.4		34	41.6	45	✓
	DPT–30B–35B–45H	Bonding	Front/Back	–	2.9	29	30	32.6	–	2.9	35	37.6	41.6	45	✓

1. Download 3D models: https://kingkong.tech/encoder/DPT
2. If front install needs to back install, must align boss to shield manually.
3. ID of bonding type, You can choose either one.

Drawings



When installing the stator, you can use M1.6 screws to pass through the M2 threaded holes, or you can fasten M2 threads by M2 screws.

When installing the rotor, use special tools to tighten it. For details, please refer to the “DPT Design and Installation Recommendations”.

Electrical connections

Connectors

	Wire-to-Board Connector
Model	SM06B-SURS-TF
Type	Wire to board
Wire	AWG32 Wires

Pin descriptions

Pin	Color	R	B
		RS485	BISS-C
1	Orange	–	SLO –
2	Yellow	–	SLO +
3	Green	B	MA –
4	Blue	A	MA +
5	Black	0V (GND)	
6	Red	+5V	

Specification

System

Installation	Axial hollow
Resolution	24bit
Accuracy	±0.01°

Electrical

Power supply	4.5 ~ 5.5 V
Startup time	15 ms
Connection	Wire-to-Board Connector
Current	≈ 130 mA
ESD resistance	HBM, max. ±2 kV CDM, max. ±1 kV

Mechanical

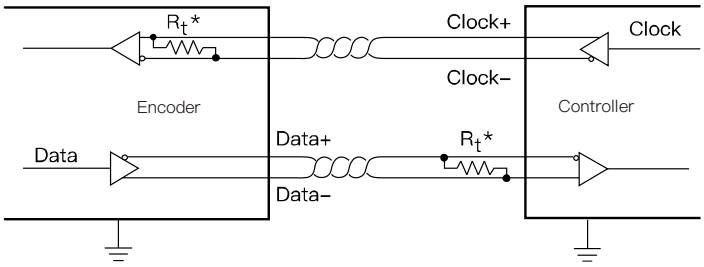
Rotor material	Stainless steel

Environmental

Operating temperature	-40 ~ 85 ℃ -40 ~ 105 ℃ -40 ~ 125 ℃

RS485 interface

RS485 Electrical connection diagram:



It is a differential two-wire interface, both wires need to be terminated with parallel termination resistors. The terminal resistors have been integrated into the encoder. The users only need to configure terminal resistors or choose other impedance matching schemes for the differential wires of the controller side.

The underlying protocol of both RS485 is UART. Since this protocol has no clock line, the encoder and controller must have the same transmission frequency and data format in order to ensure proper signal transmission.

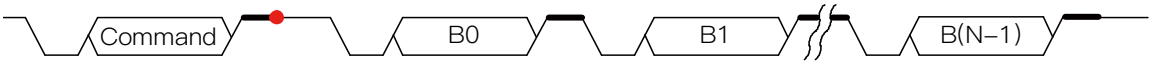
Protocol configuration:

Length	Parity check	Stop bit	Stream control	Byte order
8 bit	–	1	–	LSB first

Baud rate supported (if not noted in addition, B is default and recommended):

Code	B	C	D
Baud rate (Mbps)	2.5	5	7.75

Timing diagram:



(1) Angle will be latched at the red point

Commands and data:

Com-mand	Function		N	Data (N Bytes)							
				B0	B1	B2	B3	B4	B5	B6	B7
0x29	set	Inner Zero(1)	2	C	CRC						
0x30	set	Outer Zero(2)	2	C	CRC						
0x31	get	Inner Angle	4	A0	A1	A2	CRC				
0x32	get	Outer Angle	4	B0	B1	B2	CRC				
0x33	get	Inner Angle Outer Angle	7	A0	A1	A2	B0	B1	B2	CRC	
0x41	get	Inner Angle Status	5	A0	A1	A2	S	CRC			
0x42	get	Outer Angle Status	5	B0	B1	B2	S	CRC			
0x43	get	Inner Angle Outer Angle Status	8	A0	A1	A2	B0	B1	B2	S	CRC
0x74	get	Temperature	3	T0	T1	CRC					

Above letters in table represent:

A	B	C	S	T	CRC
Inner Angle	Outer Angle	Count for zero set	Status	Temperature	CRC

(1) Send the command “0x31” and then command ”0x29” one after another, and repeat the combines ten times to set the zero position. The return count value achieves to 10, the encoder will execute the set zero procedure.

(2) Send the command “0x32” and then command ”0x30” one after another, and repeat the combines ten times to set the zero position. The return count value achieves to 10, the encoder will execute the set zero procedure.

(3) The temperature is the junction temperature of the chip (value equal to ℃ * 10)

(4) Larger number in letter, the byte order higher.

(5) CRC byte (CRC polynomial is $x^8+x^7+x^4+x^2+x^1+1$, See Appendix for calculation method CRC-8 table ($x^8+x^7+x^4+x^2+x^1+1$))

Example code:

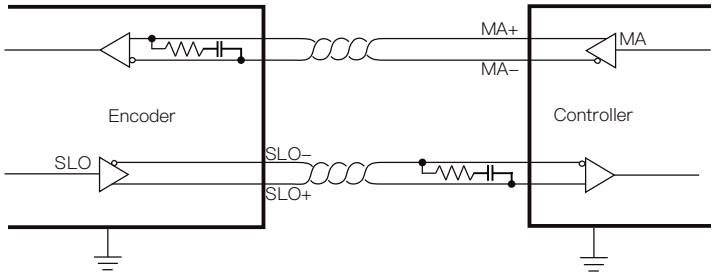
If used 0x33, get uint8_t Buffer[7];

In use:

```
uint32_t angleInner = Buffer[2] << 16 | buffer[1] << 8 | buffer[0];
uint32_t anngleOutter = Buffer[5] << 16 | buffer[4] << 8 | buffer[3];
float angleInnerFloat = angleInner / (float)(1 << 24) * 360;
float angleOutterFloat = angleOutter / (float)(1 << 24) *360;
```

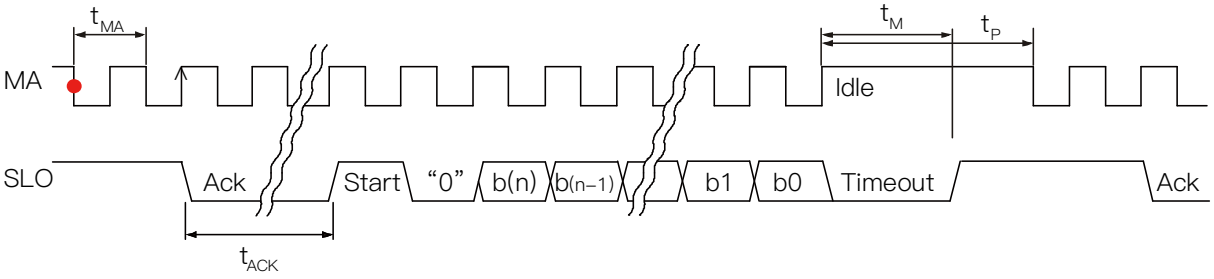
BISS-C interface

BiSS-C electrical connection diagram:



It is a four-wire interface, include the differential lines of MA and SLO. And the terminal resistors of the MA lines have been integrated into the encoder. The users only need to configure terminal resistors or choose other impedance matching schemes for SLO lines.

Timing diagram:



(1) Angle will be latched at the red point

The protocol uses MA as the synchronization clock, and the MA line is high when idle. When the first falling edge of the synchronous clock arrives, the system latches the current data. The communication will start on the first falling edge, encoder will configure SLO low on the second MA rising edge. After the "0", the MSB will be written to the SLO line on each rising edge of MA, and on controller side, the data on Data line is read on the falling edge of Clock, and so on until the LSB is read by the controller.

Timing parameters:

Parameters	Symbol	Min	Typical	Max
Clock period	tMA	400 ns		14 μs
Clock frequency	f	120 kHz		2.5 MHz
ACK length	tACK		5 bits	
Transmission timeout	tM		10 μs	
Pause time	tP	20 μs		

After the transfer is complete, when the t_M transfer time is over, the SLO line goes high and the MA signal must remain high until the next read is allowed, i.e. after t_P time. t_{CL} must be less than t_m, and the read can be terminated by making the time exceed t_m while any read operation is in progress.

Data format:

Bit	b55 : b32	b31 : b8	b7	b6	b5 : b0
Length	24 bits	24 bits	1bit	1bit	6 bits
Data	Inner Angle	Outer Angle	Error	Warning	CRC(3)

(1) The error bit is valid at a low level.

(2) The warn bit is valid at a low level.If the value is 1, no error or warning is triggered;If the value is 0,Indicates that at least one error or warning is triggered

(3) The CRC polynomial is x6 + x1 + 1 (i.e. 0x43), According to the BISS-C protocol requirements, the calculated CRC value will be inverted before send. Appendix CRC-6 calculations gives directly portable calculation codes for easy reference

For a detailed description of the status bit, see the Status section later.

Status Bits

In BISS-C/RS485 protocol, the usage of status bit is consistent, when a warning or error occurs, the warning bit or error bit will be set, and the user can specify the cause of the warning or error by viewing the status bit information.

The location of error/warning in protocols:

	Error bit	Warning bit
BISS-C	b13	b12
RS485	b7	b6

Status bits:

Bit	b3	b2	b1	b0
Description	Outer rotor is too far	Outer rotor is too close	Inner rotor is too far	Inner rotor is too close

In normal condition, the LED status light is green. When the warning bit is 1, the data is still valid, and the LED turns yellow, but some parameters of status bit are close to their limit values, which can be viewed through the status bit. When the error bit is 1, the data is no longer valid, and the LED turns red. And the status bit shows specific error message.

Appendix

CRC-8 table $(x^8+x^7+x^4+x^2+x^1+1)$

```
//poly = x^8+x^7+x^4+x^2+x^1+1
uint8_t crcTable [256] = {
    0x00, 0x97, 0xB9, 0x2E, 0xE5, 0x72, 0x5C, 0xCB, 0x5D, 0xCA, 0xE4, 0x73, 0xB8, 0x2F, 0x01, 0x96,0xBA, 0x2D, 0x03, 0x94,
0x5F, 0xC8, 0xE6, 0x71, 0xE7, 0x70, 0x5E, 0xC9, 0x02, 0x95, 0xBB, 0x2C,0xE3, 0x74, 0x5A, 0xCD, 0x06, 0x91, 0xBF, 0x28, 0xBE,
0x29, 0x07, 0x90, 0x5B, 0xCC, 0xE2, 0x75,0x59, 0xCE, 0xE0, 0x77, 0xBC, 0x2B, 0x05, 0x92, 0x04, 0x93, 0xBD, 0x2A, 0xE1, 0x76,
0x58, 0xCF,0x51, 0xC6, 0xE8, 0x7F, 0xB4, 0x23, 0x0D, 0x9A, 0x0C, 0x9B, 0xB5, 0x22, 0xE9, 0x7E, 0x50, 0xC7,0xEB, 0x7C, 0x52,
0xC5, 0x0E, 0x99, 0xB7, 0x20, 0xB6, 0x21, 0x0F, 0x98, 0x53, 0xC4, 0xEA, 0x7D,0xB2, 0x25, 0x0B, 0x9C, 0x57, 0xC0, 0xEE, 0x79,
0xEF, 0x78, 0x56, 0xC1, 0x0A, 0x9D, 0xB3, 0x24,0x08, 0x9F, 0xB1, 0x26, 0xED, 0x7A, 0x54, 0xC3, 0x55, 0xC2, 0xEC, 0x7B, 0xB0,
0x27, 0x09, 0x9E,0xA2, 0x35, 0x1B, 0x8C, 0x47, 0xD0, 0xFE, 0x69, 0xFF, 0x68, 0x46, 0xD1, 0x1A, 0x8D, 0xA3, 0x34,0x18, 0x8F,
0xA1, 0x36, 0xFD, 0x6A, 0x44, 0xD3, 0x45, 0xD2, 0xFC, 0x6B, 0xA0, 0x37, 0x19, 0x8E,0x41, 0xD6, 0xF8, 0x6F, 0xA4, 0x33, 0x1D,
0x8A, 0x1C, 0x8B, 0xA5, 0x32, 0xF9, 0x6E, 0x40, 0xD7,0xFB, 0x6C, 0x42, 0xD5, 0x1E, 0x89, 0xA7, 0x30, 0xA6, 0x31, 0x1F, 0x88,
0x43, 0xD4, 0xFA, 0x6D,0xF3, 0x64, 0x4A, 0xDD, 0x16, 0x81, 0xAF, 0x38, 0xAE, 0x39, 0x17, 0x80, 0x4B, 0xDC, 0xF2, 0x65,0x49,
0xDE, 0xF0, 0x67, 0xAC, 0x3B, 0x15, 0x82, 0x14, 0x83, 0xAD, 0x3A, 0xF1, 0x66, 0x48, 0xDF,0x10, 0x87, 0xA9, 0x3E, 0xF5, 0x62,
0x4C, 0xDB, 0x4D, 0xDA, 0xF4, 0x63, 0xA8, 0x3F, 0x11, 0x86, 0xAA, 0x3D, 0x13, 0x84, 0x4F, 0xD8, 0xF6, 0x61, 0xF7, 0x60, 0x4E,
0xD9, 0x12, 0x85, 0xAB, 0x3C
};

uint8_t calcCRC(uint8_t * buffer, uint8_t length){
    uint8_t temp = *buffer++;
    while(--length){
        temp = *buffer++ ^ crcTable[temp];
    }

    return crcTable[temp];
}
```

CRC-6 calculation

```
#define DATA_TOTAL_BIT_LENGTH 47


//poly = x^6+x^1+1
uint8_t tableCRC6[64] = {
0x00, 0x03, 0x06, 0x05, 0x0C, 0x0F, 0x0A, 0x09, 0x18, 0x1B, 0x1E, 0x1D, 0x14, 0x17, 0x12, 0x11, 0x30, 0x33, 0x36, 0x35, 0x3C, 0x3F, 0x3A, 0x39, 0x28, 0x2B, 0x2E, 0x2D, 0x24, 0x27, 0x22, 0x21, 0x23,
0x20, 0x25, 0x26, 0x2F, 0x2C, 0x29, 0x2A, 0x3B, 0x38, 0x3D, 0x3E, 0x37, 0x34, 0x31, 0x32, 0x13, 0x10, 0x15, 0x16, 0x1F, 0x1C, 0x19, 0x1A, 0x0B, 0x08, 0x0D, 0x0E, 0x07, 0x04, 0x01, 0x02
};

uint8_t calcBissCCRC(uint8_t buffer[]){
	#define CRC_BIT_LENGTH 6
	#define DATA_CRC_MASK ((1 << CRC_BIT_LENGTH) - 1)
	#define DATA_WITHOUT_CRC_BIT_LENGTH (DATA_TOTAL_BIT_LENGTH - CRC_BIT_LENGTH)
	#define TOP_BYTE_BITLENGTH (DATA_WITHOUT_CRC_BIT_LENGTH % CRC_BIT_LENGTH)
	#if TOP_BYTE_BITLENGTH == 0
		#undef TOP_BYTE_BITLENGTH
		#define TOP_BYTE_BITLENGTH CRC_BIT_LENGTH
	#endif

	uint32_t firstWord = __REV(*(uint32_t *) buffer);
	#if DATA_WITHOUT_CRC_BIT_LENGTH > 32
	uint32_t secondWord = __REV(*(uint32_t *) (buffer + 4));
	#endif

	uint8_t crc = tableCRC6[firstWord >> (32 - TOP_BYTE_BITLENGTH)];

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 1)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ (firstWord >> (32 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 2)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ (firstWord >> (32 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 3)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ (firstWord >> (32 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 4)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ (firstWord >> (32 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 5)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		#if 32 - CURRENT_CRC_BIT_LENGTH >= 0
			crc = tableCRC6[crc ^ (firstWord >> (32 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
		#elif 32 - CURRENT_CRC_BIT_LENGTH > -CRC_BIT_LENGTH
			crc = tableCRC6[crc ^ (((firstWord << -(32 - CURRENT_CRC_BIT_LENGTH)) & DATA_CRC_MASK) | (secondWord >> (64 - CURRENT_CRC_BIT_LENGTH)))];
		#else
			crc = tableCRC6[crc ^ (secondWord >> (64 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
		#endif
	#endif

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 6)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ (secondWord >> (64 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 7)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ (secondWord >> (64 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 8)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ (secondWord >> (64 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	#undef CURRENT_CRC_BIT_LENGTH
	#define CURRENT_CRC_BIT_LENGTH (TOP_BYTE_BITLENGTH + CRC_BIT_LENGTH * 9)
	#if DATA_WITHOUT_CRC_BIT_LENGTH - CURRENT_CRC_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ (secondWord >> (64 - CURRENT_CRC_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	#if 32 - DATA_TOTAL_BIT_LENGTH >= 0
		crc = tableCRC6[crc ^ DATA_CRC_MASK ^ (firstWord >> (32 - DATA_TOTAL_BIT_LENGTH) & DATA_CRC_MASK)];
	#elif 32 - CURRENT_CRC_BIT_LENGTH > -CRC_BIT_LENGTH
		crc = tableCRC6[crc ^ DATA_CRC_MASK ^ (((firstWord << -(32 - DATA_TOTAL_BIT_LENGTH)) & DATA_CRC_MASK) | (secondWord >> (64 - DATA_TOTAL_BIT_LENGTH)))];
	#else
		crc = tableCRC6[crc ^ DATA_CRC_MASK ^ (secondWord >> (64 - DATA_TOTAL_BIT_LENGTH) & DATA_CRC_MASK)];
	#endif

	return crc;
}
```

Instruction:

This program can be applied to ARM series MCU, and can generate the fastest CRC-6 check through the compiler, just modify DATA_TOTAL_BIT_LENGTH to the value of the corresponding model.

For example: 17M model to 47, 16 model to 30

Caution:

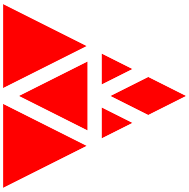
When called this function, a 32-bit read command is used for the buffer, requiring the buffer to be 4-byte aligned (some core versions don't support unaligned data read; Even with support for unaligned reads, the kernel consumes more concatenation time). For the reception of BISS-C, the first byte received will be a placeholder byte with ACK, and the position data starts from the second byte, to read data and calculate CRC quickly, it is necessary to calculate CRC from the address where the position data starts, and require the address to be 4-byte alignment data.

For example:

```
struct{
        uint8_t notUsedForAlignment[3];                 //Only align data
        uint8_t placeholder;                            //The first placeholder byte of BISS-C is 0x82
        uint8_t buffer[8] __attribute__ ((aligned(4)));    //Buffer of 4 bytes data align, for fast CRC
} receiveBuffer;

//Configure SPI and DMA
//Use  &receiveBuffer.placeholder  as the receiving address
//......

//CRC calculate
// Calculated using the  receiveBuffer.buffer  which is already 4-byte aligned
uint8_t crc = calcBissCCRC(receiveBuffer.buffer);

//The CRC result is equal to 0, indicating that the verification is passed
if ( crc != 0 ){
        //crc validation faile
}
```

Revision history

Date	Version	Description
2023/09/01	V0.1	Initial release
2024/03/18	V0.2	Update status bits Add BISS-C interface
2024/05/01	V0.3	Add standard drawing Add colors of wires
2024/12/08	V0.4	Add rotor type with bonding Add stator front/back install type Change pin1 to left of connector
2024/12/22	V0.5	Add latch point of angle



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