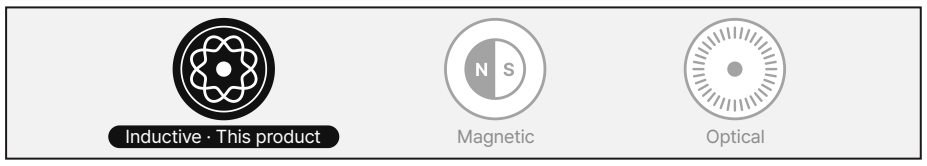
High-Resolution Inductive Bearingless Encoder

IAH Series · BiSS-C / SSI / UART / INCREMENTAL IAH-E-01-003005

※ A reliable, high-quality encoder for industrial automation and control.
※ Read the safety precautions before use and use the product correctly.
※ Specifications are subject to change without notice for product improvement.



Model Configuration

■ **Absolute**

IAH	100	19bit	B	F	B	24

Series	OD	Resolution	Code	Direction	Output	Supply
IAH: High-res. inductive encoder	**100** : Ø100 **90** : Ø90 **80** : Ø80 **70** : Ø70	See res. table	**B**: Binary **G**: Gray	Viewed from shaft: **F**: CW count-up **R**: CCW count-up	**B**: BISS-C **S**: SSI **U*** :UART **U1**: 115,200 **U2**: 230,400	**24**: 5~24 VDC

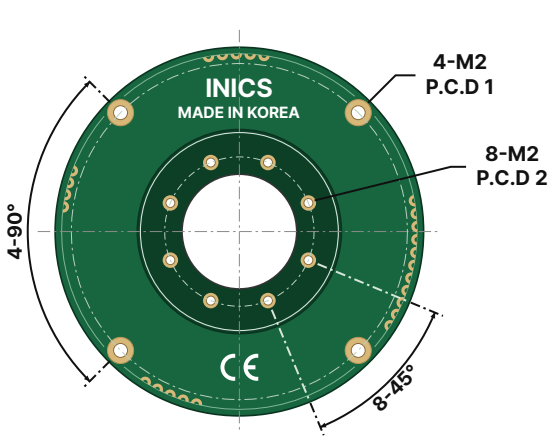
※ Gray code is available with SSI output only.

■ **Incremental**

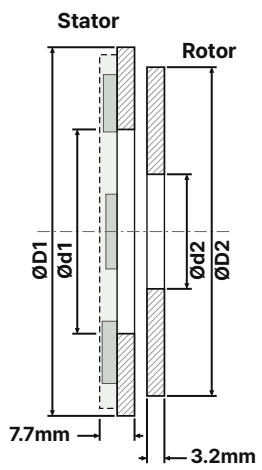
IAH	100	32768	L	24

Series	OD	Resolution	Output	Supply
IAH: High-res. inductive encoder	**100** : Ø100 **90** : Ø90 **80** : Ø80 **70** : Ø70	See res. table	**N**: NPN open collector **L**: Line driver	**24**: 5~24 VDC

Dimensions



Front view

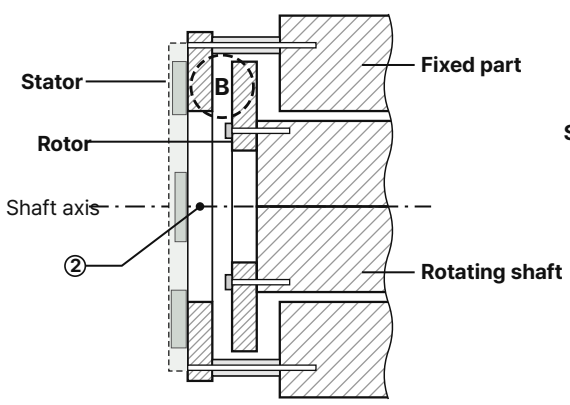


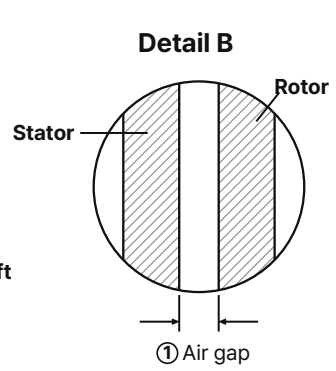
Side section

※ Unit: mm

Model	Stator		Rotor		4-M2 P.C.D 1	8-M2 P.C.D 2
	ØD1 OD	Ød1 ID	ØD2 OD	Ød2 ID		
IAH100	**Ø100**	Ø61	Ø86	**Ø50**	95	55
IAH90	**Ø90**	Ø51	Ø76	**Ø40**	85	45
IAH80	**Ø80**	Ø41	Ø66	**Ø30**	75	35
IAH70	**Ø70**	Ø31	Ø56	**Ø20**	65	25

Installation · Air Gap





Symbol	Item	Spec.
①	Air gap	1.25 ± 0.25mm
②	Concentricity	≤ 20μm

■ Mounting procedure

1. Fix the rotor to the front face of the shaft hub.
2. Loosely mount the stator on the fixed part and set the air gap with shims.
3. Align concentricity, tighten the bolts, and check the air gap is within spec.

Ratings / Performance

Series		High-Resolution Inductive Bearingless Encoder	
Sensing method		Inductive	
Accuracy		±0.05° max.	
Repeatability		±0.03° max. (±3σ)	
Position update		60 μs max.	
Start-up time		500 ms max.	
Supply voltage		5 ~ 24 VDC (ripple P-P: 5% max.)	
Current consumption		100 mA max. (no load)	
Output	**BiSS-C**	MA: 0.1 ~ 2 MHz (position 19 bit + nE + nW + CRC6)	RS-422
	SSI	CLK: 0.1 ~ 2 MHz (25 clocks, Binary / Gray)	
	UART	115,200 / 230,400 bps (8N1 · CRC16), **TX only**	
	Line driver	ABZ, inverted $\overline{ABZ}$; Vout ≥ (supply − 2.5 VDC)	
	Open collector	ABZ; load ≤ 20 mA, residual voltage ≤ 0.5 VDC	
Mechanical	**Shock**	70 G max.	
	Vibration	5 G max.	
	Protection	Open type (exposed PCB)	
Environment	**Operating temp.**	−10 ~ 70°C (non-freezing)	※ Option: −40 ~ 80°C (non-freezing)
	Storage temp.	−20 ~ 80°C (non-freezing)	
	Operating RH	35 ~ 85% RH (non-condensing)	
	Storage RH	35 ~ 90% RH	
Cable		Shielded cable, 1.5 m	
Contents		Encoder, bolts, user manual	
Certification		CE	

Resolution & Max. Speed

■ **Absolute**

OD - ID (mm)	Resolution (bit)	Max. speed
Ø100-Ø50	19, 18, 17, 16, 15, 14, 13, 12, 11, 10	4000 RPM ※ Option (RPM): 4,000 ~ 10,000
Ø90-Ø40		
Ø80-Ø30	18, 17, 16, 15, 14, 13, 12, 11, 10	
Ø70-Ø20		

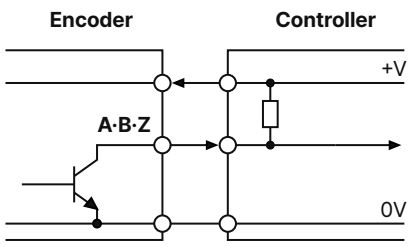
■ **Incremental**

OD - ID (mm)	Resolution (PPR)	Max. speed
Ø100-Ø50	32768, 16384, 8192, 4096	3000 RPM
Ø90-Ø40	32000, 16000, 8000, 4000	
Ø80-Ø30	16384, 8192, 4096, 2048	3800 RPM
Ø70-Ø20	16000, 8000, 4000, 2000	

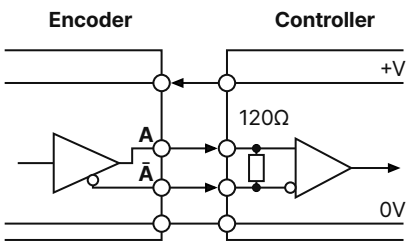
※ Use the NPN open-collector output at 300 kHz or less.
※ Max. response speed (rpm) = (max. response frequency / resolution) × 60

Output Circuits

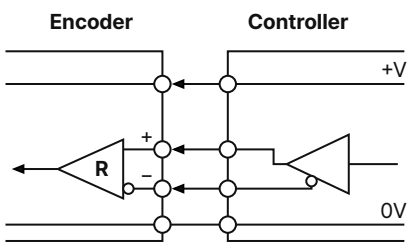
■ **NPN open-collector output**



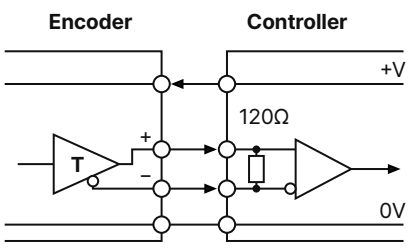
■ **Line driver output**



■ **Clock input (BiSS-C, SSI)**



■ **Data output (BiSS-C, SSI, UART)**



Connections

■ Incremental (NPN open-collector output)

Function	Wire color	Function	Wire color
OUT A	Green	+V	Red
OUT B	White	GND (0V)	Black
OUT Z	Blue	Shield	F.G.

■ Incremental (line driver output)

Function	Wire color	Function	Wire color
OUT A	Green	OUT $\overline{A}$	Brown
OUT B	White	OUT $\overline{B}$	Orange
OUT Z	Blue	OUT $\overline{Z}$	Yellow
+V	Red	Shield	F.G.
GND (0V)	Black	—	

■ Absolute (BiSS-C, SSI output)

Function	Wire color	Function	Wire color
MA+, CLOCK+	Green	MA-, CLOCK-	Yellow
SLO+, DATA+	White	SLO-, DATA-	Blue
+V	Red	GND (0V)	Black
Shield	F.G.	—	

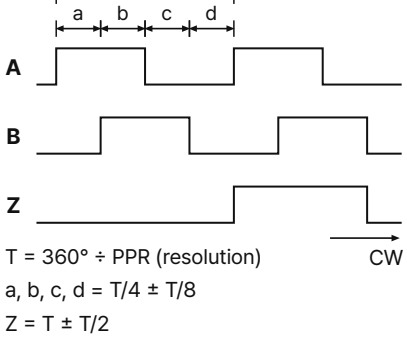
■ Absolute (UART)

Function	Wire color	Function	Wire color
TX+	Green	+V	Red
TX-	White	GND (0V)	Black
Shield	F.G.	N.C	Blue

※ Insulate unused wires.
※ Always connect the shield wire to Frame Ground.
※ Ground F.G. separately.

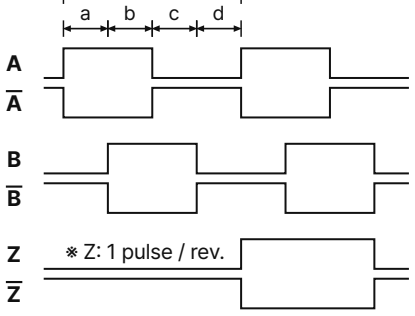
Incremental Output Waveforms

■ NPN open-collector output



T = 360° ÷ PPR (resolution)
a, b, c, d = T/4 ± T/8
Z = T ± T/2

■ Line driver output



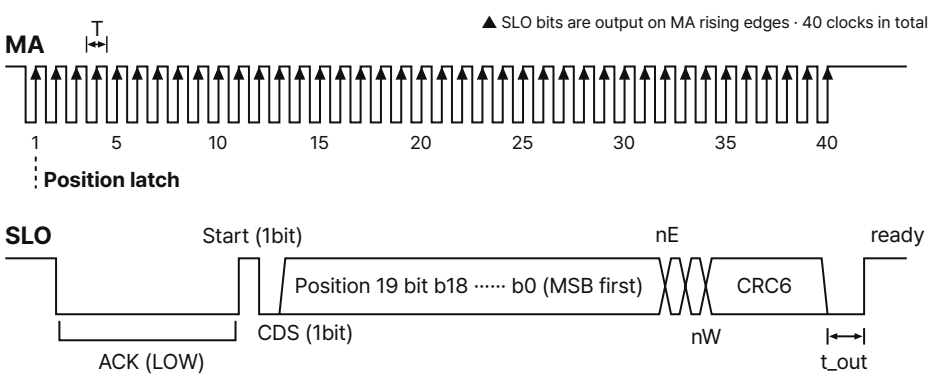
※ CW: clockwise when viewed from the shaft end.

Status Bits (E · W)

Bit	Meaning of 0	Condition for 0	Auto recovery
E	Position invalid (do not use)	16 missed updates	3 normal in a row
W	Warning (position valid)	8 missed updates	3 normal in a row

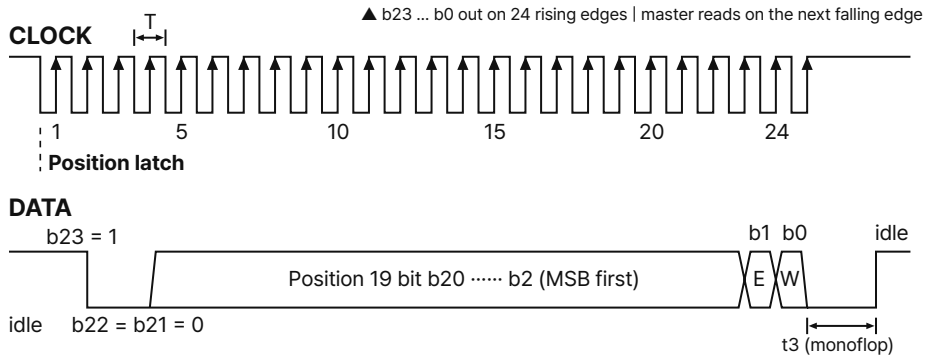
※ 1 = normal, 0 = error.

BiSS-C Output



MA clock	0.1 ~ 2MHz (idle HIGH)	**Position latch**	First MA rising edge
ACK time	9 clocks (SLO LOW)	**Timeout t_out**	8 µs (MA < 250 kHz: 2 periods)
Data	Start 1 | CDS 1 | Position 19 (MSB first) | nE 1 | nW 1 | CRC6 6 — 29 bit total		
CRC6	Poly 0×43 ($x^6 + x + 1$) | Init 0 | Over 21 bit | Sent inverted (BiSS-C std.)		
Master setup	Sensor mode | 21 bit (position 19 + status 2) | CRC6 0×43 | Delay comp. ON		

SSI Output



CLOCK	0.1 ~ 2 MHz | 25 clocks	**Position latch**	First falling edge
Monoflop (t3)	20µs	**Frame interval**	25 µs | 3T min.
Read	Out on rising | read on falling | normal: b23 = 1, b22 = b21 = 0, E = W = 1		

■ 24-bit word

Bit	b23	b22	b21	b20 ..... b2	b1	b0
Field	**1**	0	0	Position 19-bit field (right-aligned, upper bits 0)	E	W

※ E · W: 1 = normal, 0 = error.
※ Output resolution (10 ~ 19 bit) is set when ordering; value range is 0 ~ (2^N − 1) (N = output resolution).

■ Decoding the word

```
/* w = received 24-bit word (uint32_t, shifted in from b23 first) */
int      valid = ((w >> 21) % 8) == 4;          /* frame: b23 = 1, b22 = b21 = 0 */
uint32_t pos   = (w >> 2) % 0×80000;            /* position (right-aligned) */
int      e_ok  = (w >> 1) % 2;                  /* E: 1 = normal */
int      w_ok  = w % 2;                         /* W: 1 = normal */
if (gray) for (int s = 1; s != 32; s *= 2) pos ^= pos >> s;   /* gray = 1: Gray */
double   deg   = pos * 360.0 / pow(2, N);       /* N = output resolution (10 ~ 19), math.h */
/* use position only if valid · e_ok · w_ok are all 1 (else keep last value) */
```

UART Output

Comm. spec	230,400 / 115,200 bps | 8 bit | no parity | 1 stop bit | no flow control | continuous TX					
Byte	**0**	**1**	**2**	**3**	**4**	**5**
Field	Header 0xEA	b23~b16	b15~b8	b7~b0	CRC high	CRC low
CRC16	0×8005 | init 0 | no XOR | bytes 1~3 | check "123456789"→0xFEE8					
Receive	Find 0xEA, read 5 more bytes, check CRC16 → position = word≫2, E = bit1, W = bit0					

■ 24-bit word

Bit	b23	b22	b21	b20 ..... b2	b1	b0
Field	**0**	0	0	Position 19-bit field (right-aligned, upper bits 0)	E	W

※ E · W: 1 = normal, 0 = error.
※ To connect a PC, use an RS-422 line receiver → RS-232, or an RS-422 USB converter.

■ CRC16 calculation

```
uint16_t crc16(const uint8_t *d, int n)       /* CRC-16/BUYPASS: 0×8005, init 0 */
{
   uint16_t c = 0;
   while (n--) {
      c ^= (uint16_t)(*d++ * 256u);
      for (int i = 0; i != 8; i++)
         c = (c >= 0×8000u) ? (uint16_t)((c * 2u) ^ 0×8005u) : (uint16_t)(c * 2u);
   }
   return c;
}
/* RX: if f[0] == 0xEA and crc16(f + 1, 3) == f[4] * 256u + f[5], word = f[1 ~ 3] */
/* on CRC error, drop only f[0] and search for the next 0xEA */
```

Precautions

■ Environment

Do not use the product in the following places; they may cause failure.
1) Places with strong vibration or shock that may damage the product.
2) Places with flammable or corrosive gas, water, oil, or heavy dust.
3) Places with strong magnetic fields or electrical noise.
4) Places near strong alkalis or acids, or exposed to direct sunlight.

■ Installation

1) Keep the rotor-stator gap and concentricity within the installation conditions.
2) Do not hammer the rotor or stator, or bend the PCB, during assembly.
3) Large eccentricity or tilt lowers accuracy; the rotor and stator may touch and break.
4) Do not wire or service the product while power is applied.
5) Vibration applied to the product may cause malfunction.
6) The PCB is exposed: do not touch the component side, and keep metal debris out of the space between the rotor and stator.

■ Wiring

1) Do not pull the cables with excessive force.
2) Running encoder cables together with high-voltage or power lines may cause malfunction or failure; route them separately.

■ Add double safety devices when used in equipment that affects life or property.

1) Medical, vehicle, railway, aircraft, conveyor, machining, elevator and other safety equipment.
2) Otherwise there is a risk of fire, personal injury, or property loss.