MSH SERIES — OPEN-TYPE MAGNETIC GRATING DISPLACEMENT SENSOR

Industrial-grade magnetic encoding built for demanding environments.

The MSH Series magnetic grating displacement sensor delivers high-accuracy linear position measurement in conditions where optical systems may be compromised by dust, oil mist, or moisture. With IP67 protection, seamless measurement up to 50 metres, and bidirectional repeatability of ±2 µm, it is engineered for robust, long-service-life performance on the factory floor. Both incremental and absolute output variants are available.

KEY FEATURES

- Non-contact open magnetic system
- Ultra-compact read head
- Cyclic zero and single zero reference selectable
- RS-422 differential digital output and 1Vpp output selectable
- Incremental and absolute output selectable
- Ultra-high precision — bidirectional repeatability ±2 µm; absolute error <0.02 mm/m
- Seamless measurement up to 50 m

part number structure & ordering information

MSH 20 X - 3.0 - DB9

Magnetic grating read head series

Matching Scale Pitch
10: 1mm+1mm pitch; **20:** 2mm+2mm pitch;
50: 5mm+5mm pitch

Resolution
Z: 0.5 µm **E:** 10 µm
X: 1 µm* **F:** 20 µm
C: 2 µm **G:** 25 µm
D: 5 µm **K:** 50 µm

**recommended for direct-drive linear motor applications*

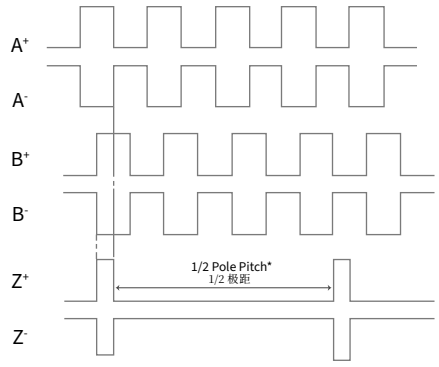
Connector
Blank: Bare wire
D09: 9-pin D-sub
D15: 2-row 15-pin D-sub

Cable Length
0.3: 0.3m **3.0:** 3.0m
0.5: 0.5m **5.0:** 5.0m
1.0: 1.0m **10.0:** 10m
1.5: 1.5m *Other cable lengths available on request

OUTPUT SIGNAL

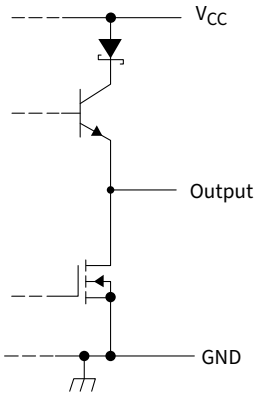
Output Signal	Industrial RS-422 differential output — A+, A−, B+, B−, Z+, Z−
Output Circuit	Differential line driver; max output current 100 mA
AB Signal Relationship	AB signal phase angle is 90° (used to determine direction during reading)
Max Output Frequency	6 MHz (after ×4 interpolation)
Z Signal Output	Cyclic zero reference output
Z Signal Interval	2 mm (MS100), 4 mm (MS200), 10 mm (MS500); Z pulse width = 1/4 of A signal
Max Speed by Resolution	2 µm (at 0.5 µm res.) / 4 µm (at 1 µm res.) for 2, 5, 10, 20, 25, 50 µm: ±1 subdivision
Repeatability	6 MHz (after ×4 interpolation)
Note	Repeatability tested with MS200A at 0.3mm gap without protective tape. Accuracy may vary with increased read head-to-scale gap.
LED Indicator	Red = Alarm Green = Normal Operation

OUTPUT SIGNAL WAVEFORM

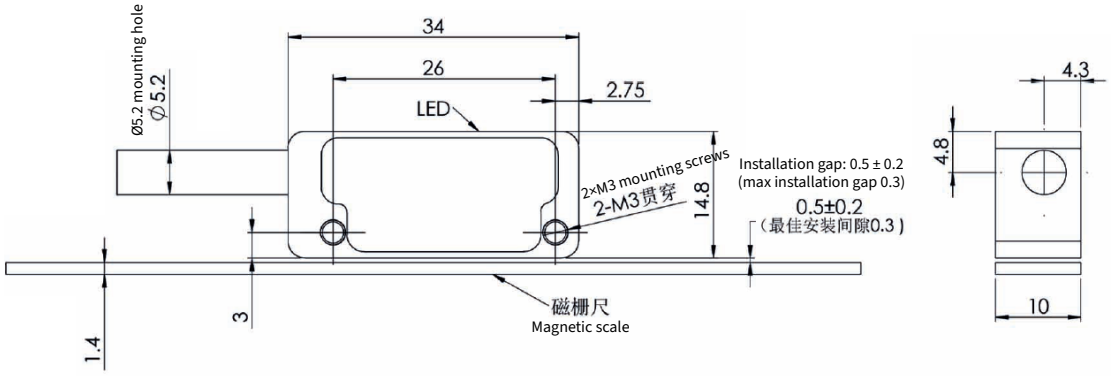


*Z Signal pulse width spans half the magnetic pole pitch of the scale.

ABZ SIGNAL OUTPUT CIRCUIT



MSH Installation Dimension

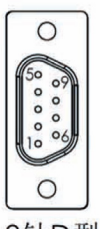


ANALOG OUTPUT PIN ASSIGNMENT

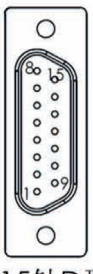
Function	Signal	Colour	9-pin D (Male)	15-pin D (Male)
Power	5V	Red	5	7
	0V	Black	9	2
Incremental Signal	A+	White	4	14
	A-	Grey	8	6
	B+	Blue	3	13
	B-	Purple	7	5
Reference Zero Switch	Z+	Brown	2	12
	Z-	Orange	6	4
Shield	Outer	Silver	Housing	Housing

OPERATING & ELECTRICAL PARAMETERS

Supply Voltage	5V ±5%
No-load Current	<30 mA
Operating Current	<110 mA
Operating Temperature	−10°C to 70°C (wide-temp custom available)
Storage Temperature	−20°C to 80°C
Protection Class	IP67
Cable	ϕ5.2mm, AWG26, 8-core shielded PUR ultra-flexible cable, 12.5Ω/100m; finer 8-core variants available in ϕ4.5mm and ϕ3.8mm

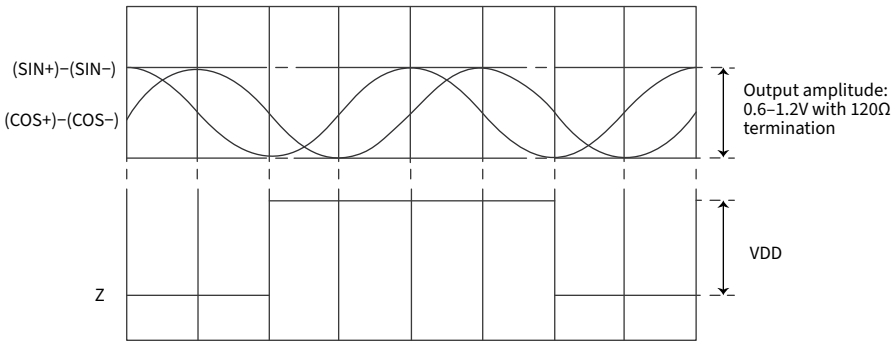


9针D型
9-Pin D-sub



15针D型
15-Pin D-sub

ANALOG OUTPUT SIGNAL WAVEFORM



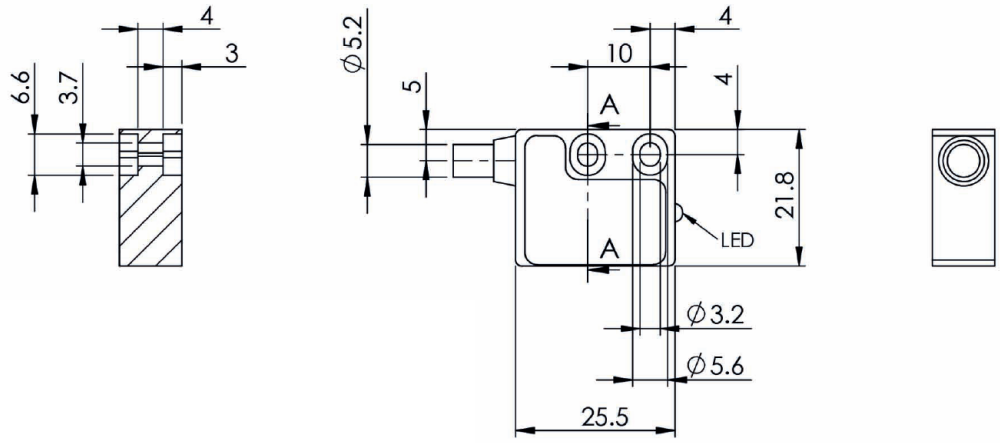
Analog Output Models

- MRHS10-1Vpp
- MRHS20-1Vpp
- MRHS50-1Vpp

ANALOG OUTPUT PIN ASSIGNMENT

Colour	Red	Black	White	Grey	Blue	Purple	Brown	Orange	Silver	Inner Shield
Function	5V	GND	SIN+	SIN-	COS+	COS-	Z+	Z-	Housing	GND

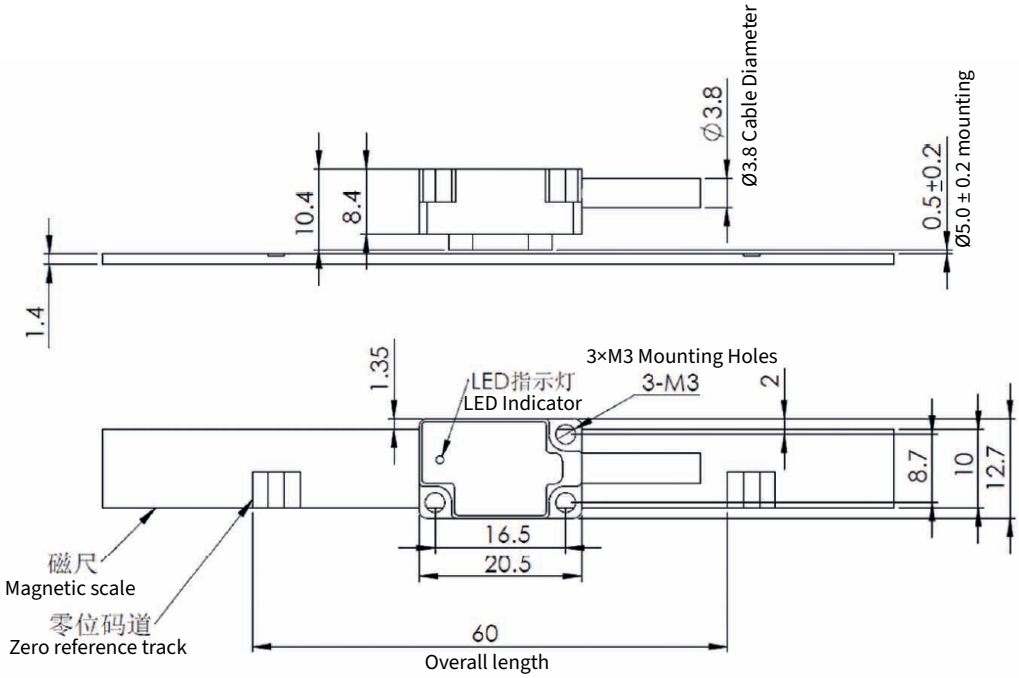
MRH20 Installation Dimension



TECHNICAL SPECIFICATIONS (MRH20)

Performance	Same as MSH20X
Imperial Output	This model includes imperial resolution variants: MRHP20C-150DPI, MRHP20D-180DPI, MRHP20E-300DPI, MRHP20F-360DPI, MRHP20G-600DPI, MRHP20H-720DPI — primarily for UV printing machines
Matching Scale Model	MS200A
Supply Voltage	5V ± 5%

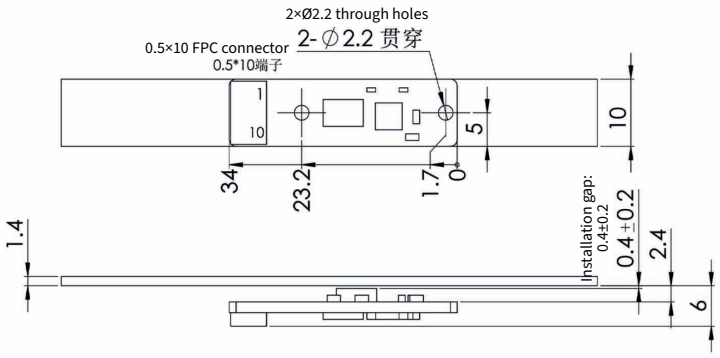
MILLET-M2 Installation Dimension



TECHNICAL SPECIFICATIONS (MILLET-20)

Zero Reference	One zero reference signal every 60mm
Matching Scale Model	MDS200, 50m per roll
LED Indicator	● Red = Alarm ● Green = Normal Operation; zero reference flash
Supply Voltage	5V ± 5%

PCB-Mount Magnetic Encoder Installation Diagram



Pin No.	Definition
1	/
2	/
3	Z-
4	Z+
5	B-
6	B+
7	A-
8	A+
9	+5V
10	GND

TECHNICAL SPECIFICATIONS (PCB-MOUNT)

PCB Magnetic Read Head Model	MRHM20X (**X:** 1µm, **Z:** 0.5µm)
Magnetic Scale Model	MS200
Zero Reference	Cyclic zero; one Z signal every 2mm
Supply Voltage	5V ± 5%

ABSOLUTE ROTARY ENCODER SELECTION GUIDE — MRH20A22B-3.0

part number structure & ordering information

MRH 20A 22 B - 3.0

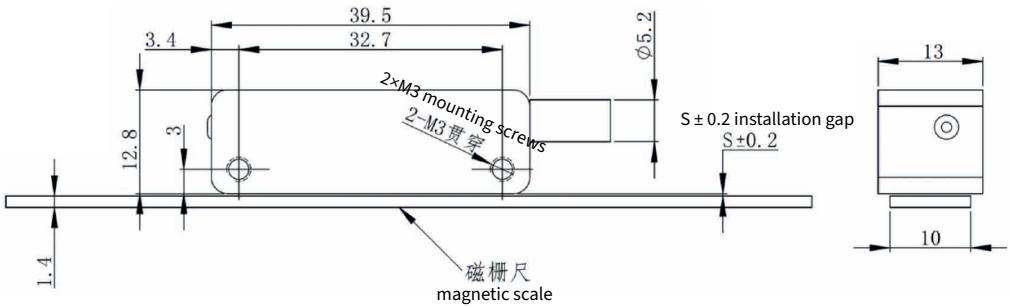
- **MRH** — Magnetic Read Head
- **20A** — Scale Pitch
  15A: 1.5mm+1.5mm absolute scale
  20A: 2mm+2mm absolute scale
- **22** — Resolution
  20: 20-bit | **22:** 22-bit | **23:** 23-bit
- **B** — Output protocol
  B: BiSS C | **S:** SSI
- **3.0** — Cable Length
  0.3: 0.3m | **3.0:** 3.0m | **5.0:** 5.0m
  *Other cable lengths available on request

ENCODER MODELS

Model	Max Speed	Matching Scale	Length	Resolution
MRH15A22B / MRH15A22S	5 m/s	MRA1522-768L	768 mm	0.1831µm
MRH20A20B / MRH20A20S	8 m/s	MRA2020-256L	256 mm	0.2441µm
MRH20A22B / MRH20A22S	8 m/s	MRA2022-1024L	1024 mm	0.2441µm
MRH20A23B / MRH20A23S	8 m/s	MRA2023-2048L	2048 mm	0.2441µm

MRH15A/MRH20A Installation Dimensions (mm)

	MRH15A	MRH20A
Gap (S)	0.4	0.5



OUTPUT PIN ASSIGNMENT (ABSOLUTE ENCODER)

Function	BiSS C Signal	SSI Signal	Colour	9-pin D (Male)	15-pin D (Male)
Power	5V	5V	Red	5	7
	0V	0V	Black	9	2
Signal	MA+ (clock)	CLK+ (clock)	White	4	14
	MA− (clock)	CLK− (clock)	Grey	8	6
	SL+ (data)	DAT+ (data)	Blue	3	13
	SL− (data)	DAT− (data)	Purple	7	5
Shield	Shield	Shield	Silver	Housing	Housing

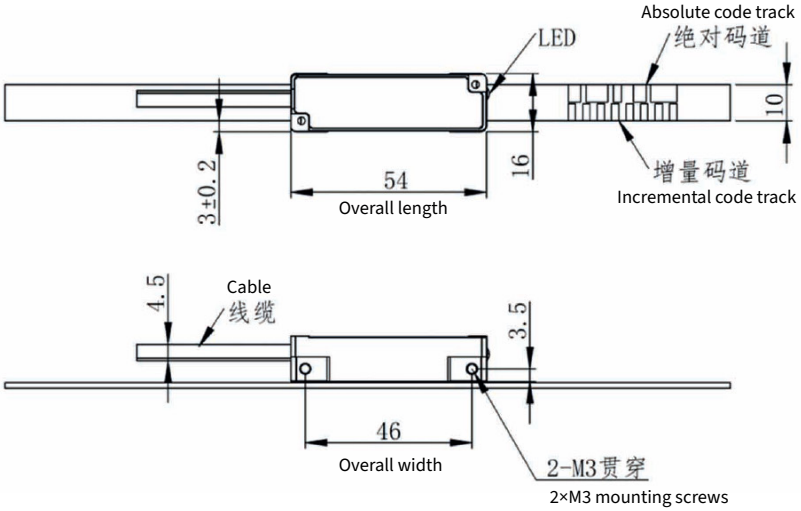
**Note:* *Absolute encoders are available with Millet read head and PCB-mount absolute encoder options.*

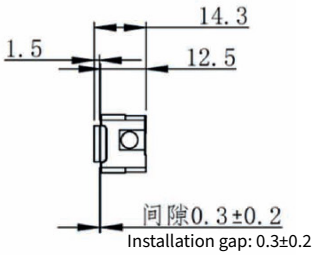
PSEUDORANDOM CODE ABSOLUTE ENCODER — MRHA20

Model	Resolution	Max Speed
MRHA20X	1 µm	5 m/s
MRHA20Z	0.5 µm	3 m/s

Matching magnet: MRA2-1000L (1000mm magnetic scale length)

MRHA20 INSTALLATION DIMENSIONS (MM)





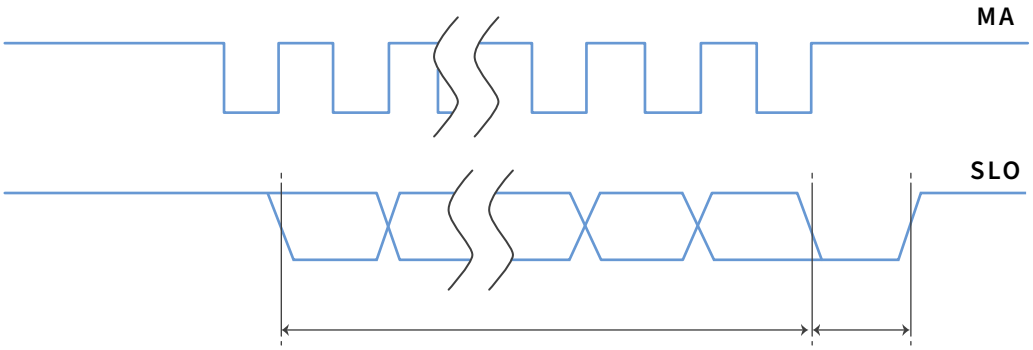
TECHNICAL SPECIFICATIONS

LED Status	🔵 Blue = Normal Operation 🔴 Red = Alarm 🟣 Purple = Calibration mode; alternating red/purple flash during calibration
Output Signal	BiSS C
Supply Voltage	5V ± 5%
Fault Causes	Speed too high, temperature too high, magnetic scale demagnetised or broken, read head and scale directions opposite, or excessive twist, gap out of range
Note	To clear fault, power cycle the device

OUTPUT PIN ASSIGNMENT

Function	Signal	9-pin D (Male)	Wire Colour
Power	+5V	5	Red
	0V	1	Grey
Signal	SLO+	2	White
	SLO-	6	Green
	MA+	4	Brown
	MA-	8	Yellow
Outer Shield	Shield	Housing	Silver

BiSS COMMUNICATION INTERFACE



- The read head saves the position value 500ns after the falling edge of the MA signal, then responds to the controller command
- MA idles high; communication begins on the first falling edge
- The read head sets SLO to low response on the second rising edge of MA
- Ack is the time period for the read head to calculate the absolute position
- When the read head is ready for the next request cycle, it signals the host by setting SLO high
- CRC is in binary format; MSB is sent first. Absolute position is in binary format, left-aligned; unused low bits are set to zero. CDS bit is always zero.

BISS-C COMMUNICATION PARAMETERS

Parameter	Min	Recommended	Max
Clock Frequency	100 kHz	2.5MHz	8 MHz
Timeout	—	—	20 µs

READ HEAD RESOLUTION VS. ENCODER DATA WORD LENGTH

Read Head Resolution	1 µm	0.5 µm
Encoder Data Word Length	23 bit	24 bit

STATUS BITS

Type	Value = 0	Value = 1	Description
Error Bit	Position data invalid	Position data valid	If low, position is invalid. Possible causes: read head and magnetic scale not aligned; scale demagnetised; read head and scale directions incorrect; distance between read head and scale too large; travel speed too high.
Warning Bit	Position data valid	Position data normal	Warning is active if low — read head is approaching its operational limit (>80% of max temperature). Position data remains valid.

RADIAL RING MAGNETIC SCALE DIMENSION TABLE & TECHNICAL SPECIFICATIONS

Reference Zero	Single reference zero (dual-track: incremental track and zero track)
Pitch	2mm + 2mm
Signal Output	AB signal phase angle is 90° (used to determine direction during reading)
Installation Gap	0.3 – 0.5mm
LED Indicator	Red = Alarm Green = Normal Operation; zero reference flash

Model	Poles	Ring OD (mm)	Ring ID (mm)	Max Speed (rpm) 4000 subdivision
MR82	128	81.8	77	1600
MR90	142	90	70	1500
MR125	196	125	105	1080
MR191	300	190	160	700
MR229	360	229.2	209	660