AksIM-4™ HIPERFACE DSL®
Absolute Rotary Magnetic Encoder

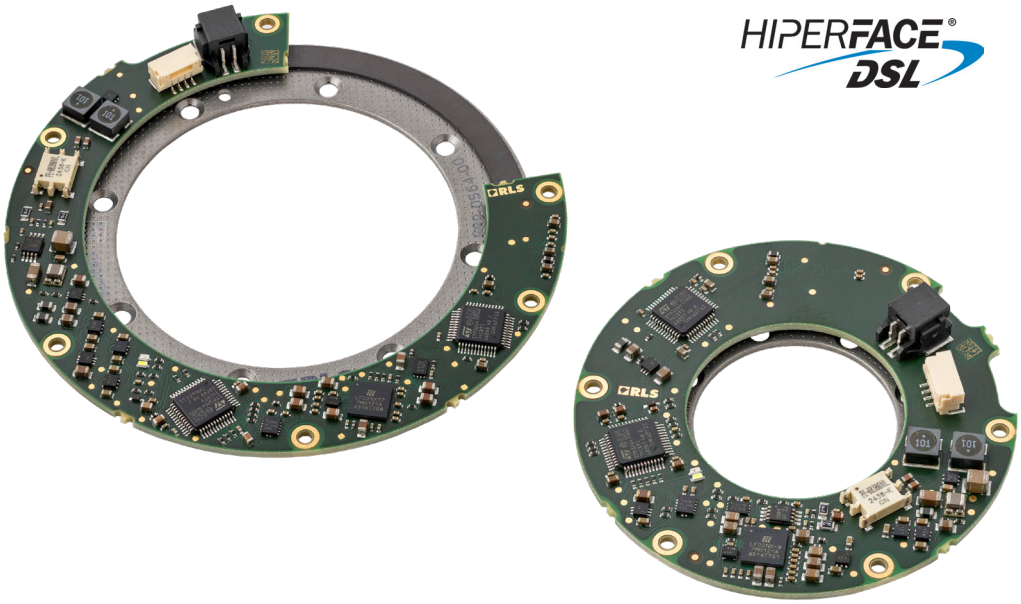
COMPACT & LIGHTWEIGHT

ONE CABLE TECHNOLOGY

INDUSTRY 4.0

The AksIM-4™ with HIPERFACE DSL® is a non-contact, high performance off-axis absolute rotary encoder. It is designed for integration into applications with limited space. A hollow ring, true absolute functionality and HIPERFACE DSL® protocol make this encoder suitable for compact servo motor applications.

The AksIM-4 encoder system consists of an axially magnetised ring and a readhead.



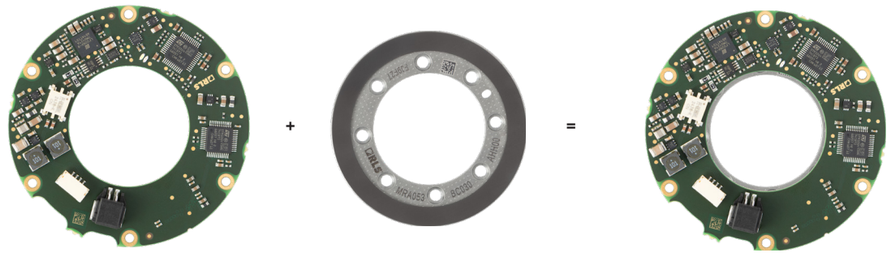
Features and benefits

- True absolute system
- Custom magnetic sensor ASIC
- Self-calibration option
- Low profile, non contact
- Reduced wiring complexity
- High speed data transmission
- Cost efficient
- Possibility for more compact motor design
- Wide axial installation tolerances

MOTOR FEEDBACK | ASSEMBLY LINES | INDUSTRIAL AUTOMATION | SPINDLES | INDUSTRY 4.0

General information

The AksIM-4 HIPERFACE DSL® encoder operates in a temperature range between -40 °C and +115 °C and is highly resistant to shock and vibration. The encoder has a digital motor feedback protocol that requires a minimum of connecting cables. Together with the AksIM encoder, this results in a very compact, low profile encoder that minimises costs, saves space and enables efficient installation.



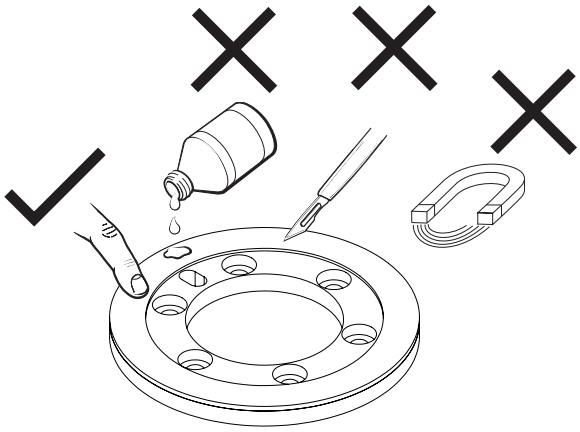
MC readhead + MRA axial magnetic ring = AksIM-4 HIPERFACE DSL®

Selection guide	Magnetic ring					Readhead					
Part number	**Inner diameter**	**Circle for fasteners**	**Outer diameter**	**Thickness**	**Inertia (kg × mm²)**	**Inner diameter**	**Circle for fasteners**	**Outer diameter**	**Arc length**	**System thickness (Typ.)**	**Mass (g)**
MC053 assembly											
MC053						32	60	65	360°	11.15	11
MRA053BC030AHH00	30	36	53	2	7.4						15
MC080 assembly											
MC080						64.4	85	90	280°	11.15	11
MRA080BC055AHH00	55	61.5	80	2	32						27
MRA080BG064AHN00	64	none	80	2	12.8						20

All dimensions in mm.

Storage and handling

Storage temperature	Operating temperature	Humidity
–40 °C to +105 °C	Readhead: –40 °C to +115 °C Ring: –40 °C to +125 °C	Up to 70 % non-condensing



HANDLE WITH CARE. This encoder system is a high performance metrology product and should be treated with the same care as any other precision instrument. Use of heavy duty industrial tools or exposure to strong magnets, such as a magnetic base, is unacceptable and risks irreparable damage to the product.

The magnetic ring should not be exposed to magnetic field densities higher than 50 mT on its surface, as this can damage the ring.

Please see **Chemical resistance** or **contact RLS**.



Readhead is ESD sensitive - handle with care.
Do not touch electronic circuit, wires or sensor area without proper ESD protection or outside of ESD controlled environment.

Technical specifications

System data

Reading type	Axial reading
Resolution	20 bits, 22 bits
Maximum speed	10,000 rpm
Hysteresis	Less than unit of resolution
Repeatability	Within the range of position noise
Communication interface	HIPERFACE DSL®
Thermal drift	None (accuracy does not change with temperature)

Accuracy	**MC053**	**MC080**
System accuracy*	±0.006°	±0.004°
Typical installed accuracy - Calibrated	±0.012°	±0.009°
Typical installed accuracy - Uncalibrated	±0.040°	±0.029°

Total installed accuracy without calibration is influenced by mounting precision (e.g. eccentricity and bearing wander).
* System accuracy = Max. achievable accuracy when using self-calibration
Accurate centering of the ring is key to good overall accuracy. Minimising the eccentricity of the ring assembly (using a gauge) and using a drive shaft with precision bearings can usually reduce the error. To improve accuracy after installation, we recommend performing **self-calibration**.

Electrical data

Supply voltage (V_{DD})	7 V to 12 V at the connector
Set-up time	< 250 ms (first data ready after supply voltage is in range), worst case: < 450 ms
Current consumption	Typ. 85 mA at 12 V - at the connector, max 1.4 W
Connection	4-pin low-profile connector
ESD protection	HBM, Class 2, ±2 kV (do not touch other components)

Mechanical data

Ring material type	EN 1.4016 / AISI 430 with glued rubber filled with ferrite particles

Environmental and operational conditions

Environmental data

Operating and storage temperature	**Readhead**	–40 °C to +115 °C
	Ring	–40 °C to +125 °C
Humidity		Up to 70 % non-condensing (for higher with conformal coating **contact RLS**)
Shock		100 g (6 ms, half-sine, EN 60068-2-27:2009)
Vibration		80 g (55 Hz - 2000 Hz, EN 60068-2-6:2008)
Environmental compliance		RoHS, REACH

Chemical resistance

RLS products are commonly used in industrial applications and are exposed to chemicals that can affect their internal and external components. Although our products are designed to withstand many harsh chemicals and environments, long-term resistance depends on exposure, temperature and concentration. Most chemical exposures are brief, rather than continuous. A material that cannot withstand prolonged immersion may still perform indefinitely when exposed to it occasionally and for short periods of time.

External magnetic field

The operating principle of any magnetic encoder is to detect changes in the magnetic field of the magnetised ring. External magnetic fields generated by permanent magnets, electric motors, coils, magnetic brakes, etc. can affect the operation of the encoder. If external magnetic field is greater than 15 mT, it will temporarily cause the encoder to malfunction. Fields stronger than 50 mT may cause permanent damage to the ring.

Unwanted magnetic fields must be blocked at the source. If this is not possible, the encoder can be shielded with a ferromagnetic metal sheet. The ring can also be used for partial shielding. It is recommended that the bottom of the ring is mounted with the readhead facing away from the source of the escaping magnetic field.

External isolated temperature sensor

Encoders provide two pin connector for connecting an external temperature sensor in an application. These can be any low voltage analogue or digital sensors with resistivity in the 0 - 5 kOhm range, such as PT1000, LPTC600, KTY84-130, etc. The signals are isolated from the encoder circuitry. Final user connects external temperature sensor to 2-pin temperature connector and can access raw values through RDB (see table **Supported resources**) .

The purpose of this is to provide temperature monitoring in applications such as electric motors, gearboxes, etc. where precise monitoring is required in the vicinity of the encoder.

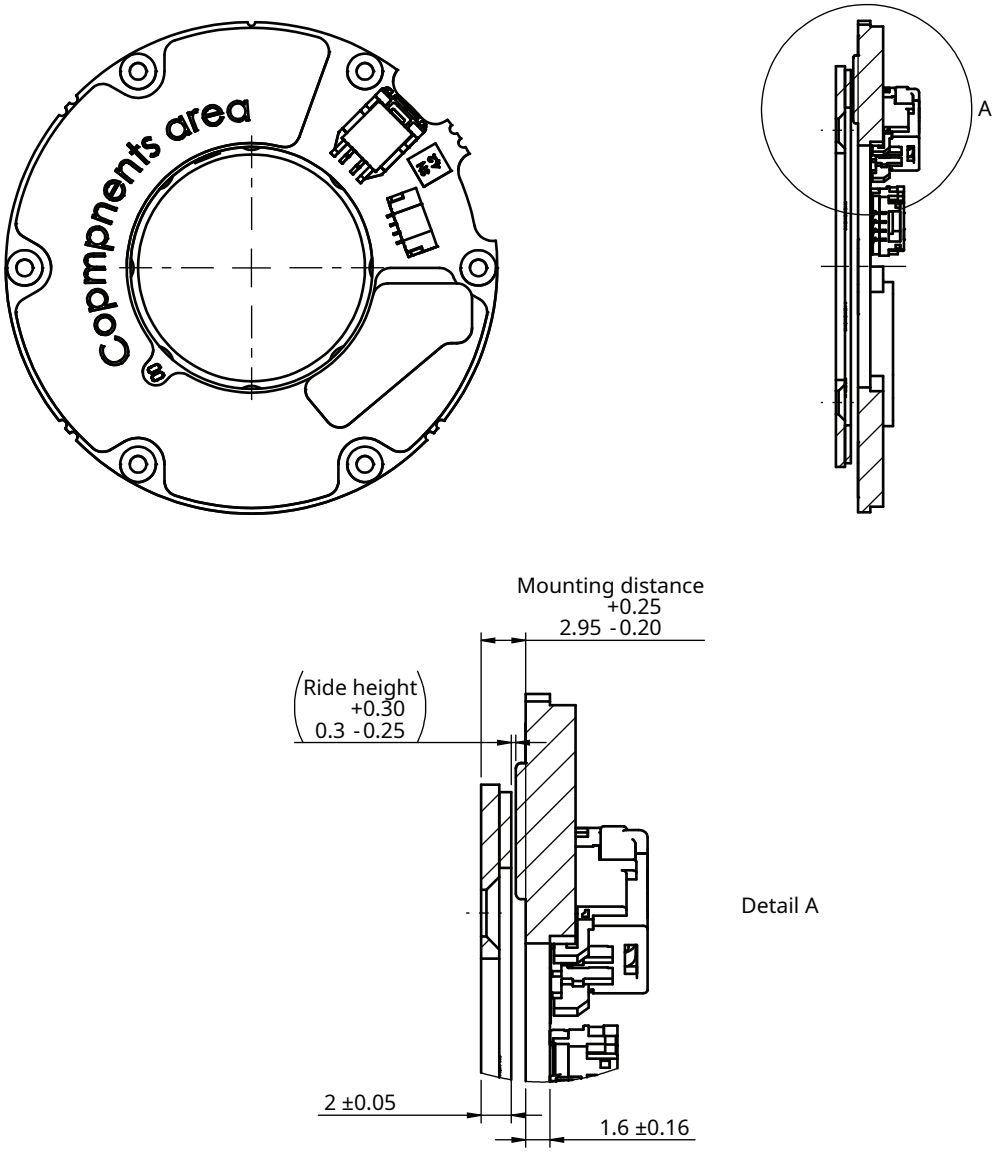
The position of solder pads for the temperature sensor for each readhead size is shown in the chapter **Dimensions and installation drawings.**

For additional details, please **contact RLS.**

Dimension and installation drawings

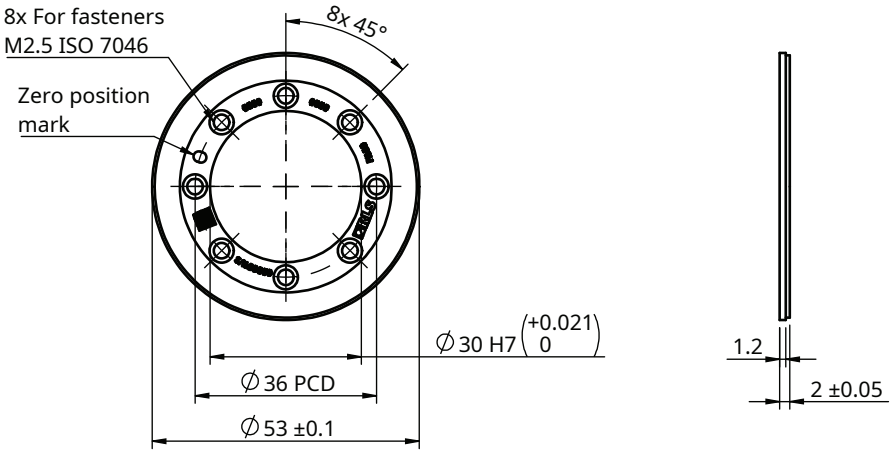
Dimensions and tolerances are in mm. Dimensions without tolerance values are in accordance with ISO 2768-m.

Encoder assembly MC053 readhead with MRA053BC030AHH00 magnetic ring

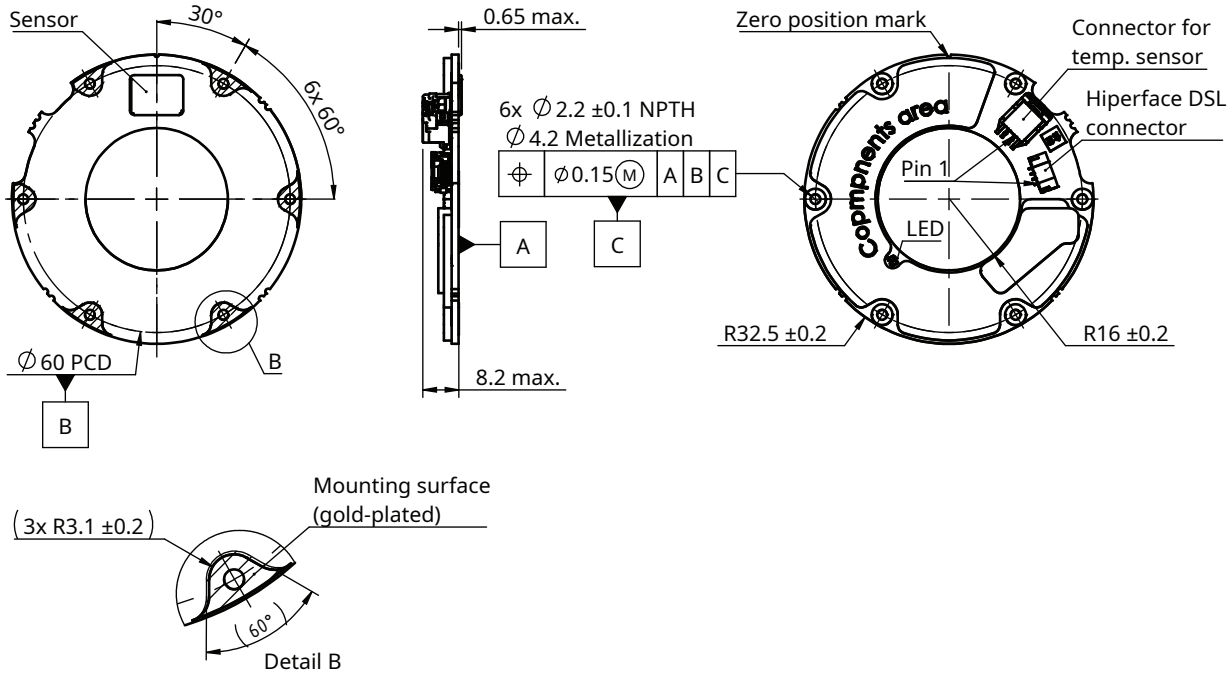


Ride height influences noise on the output. See chapter **Installation instructions** for details.

MRA053 magnetic ring

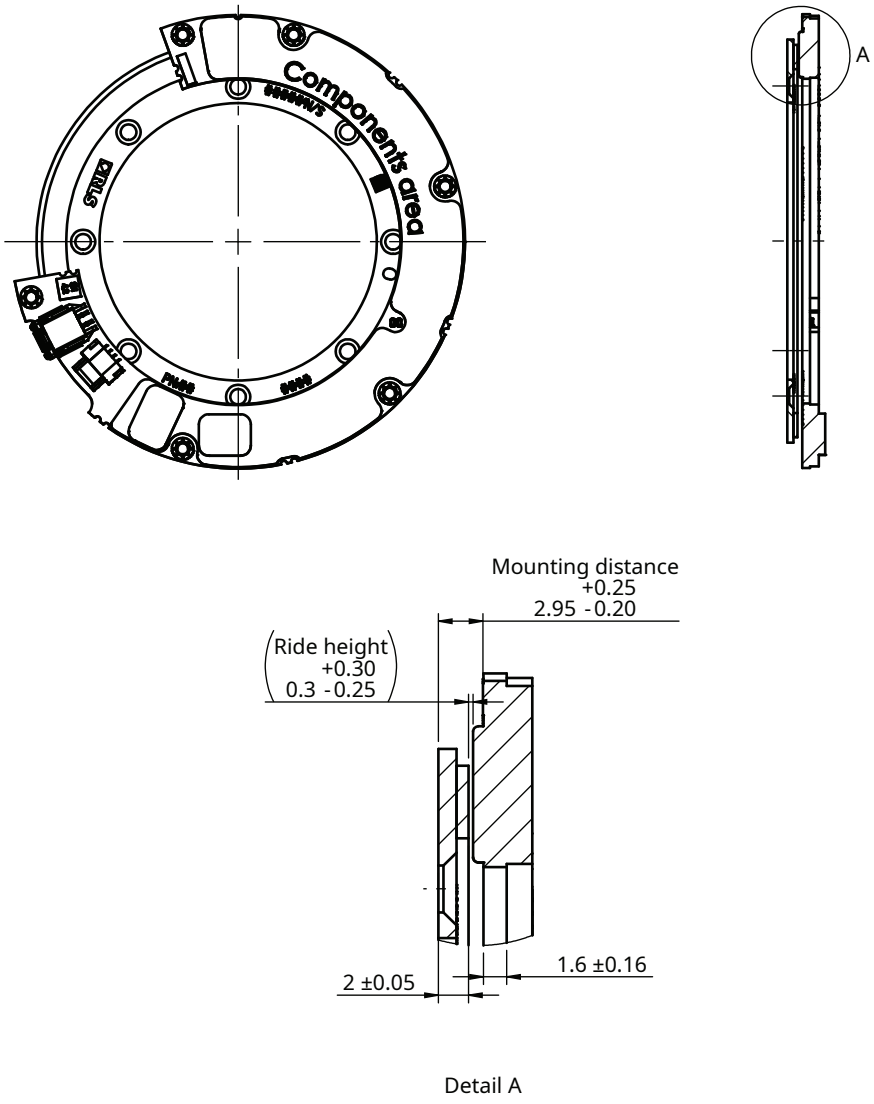


MC053 readhead



Dimensions and installation drawings continued

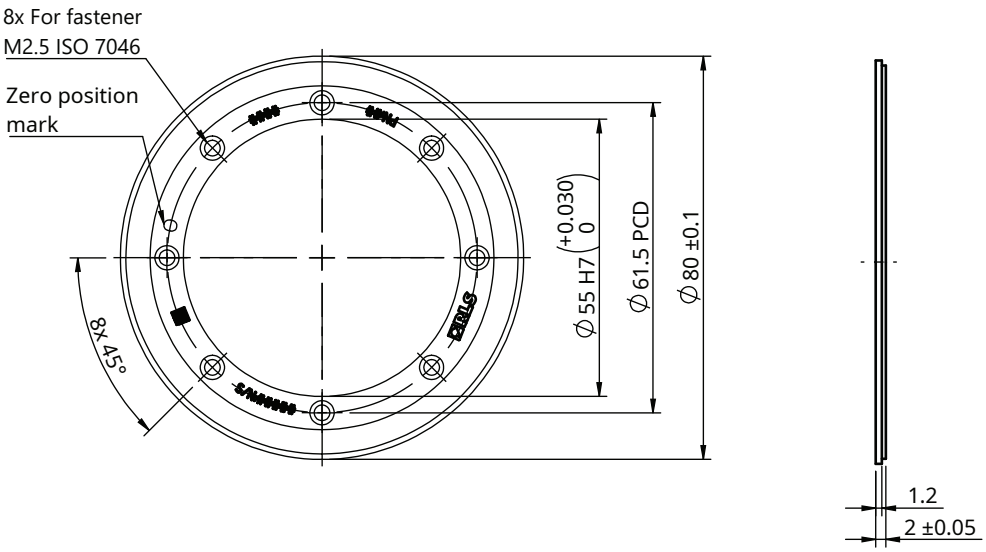
Encoder assembly MC080 readhead with MRA080BC055AHH00 magnetic ring



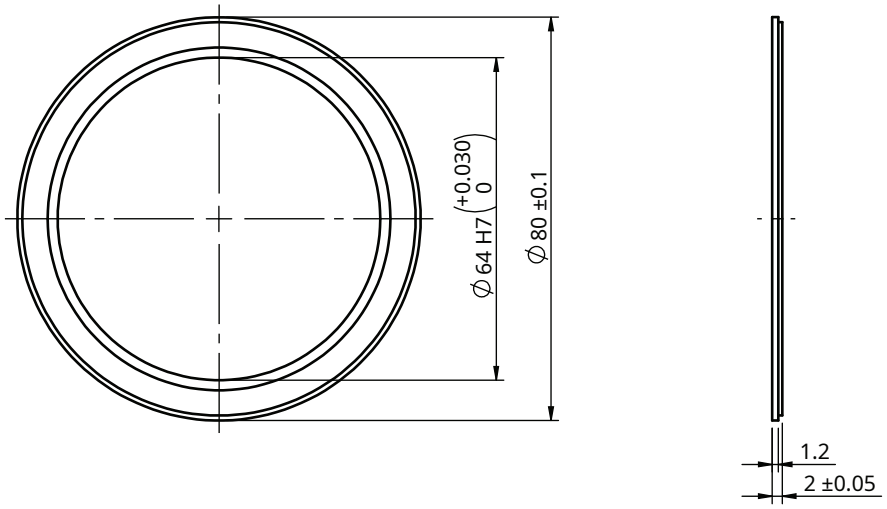
Detail A

Ride height influences noise on the output. See chapter **Installation instructions** for details.

MRA080BC055AHH00 magnetic ring

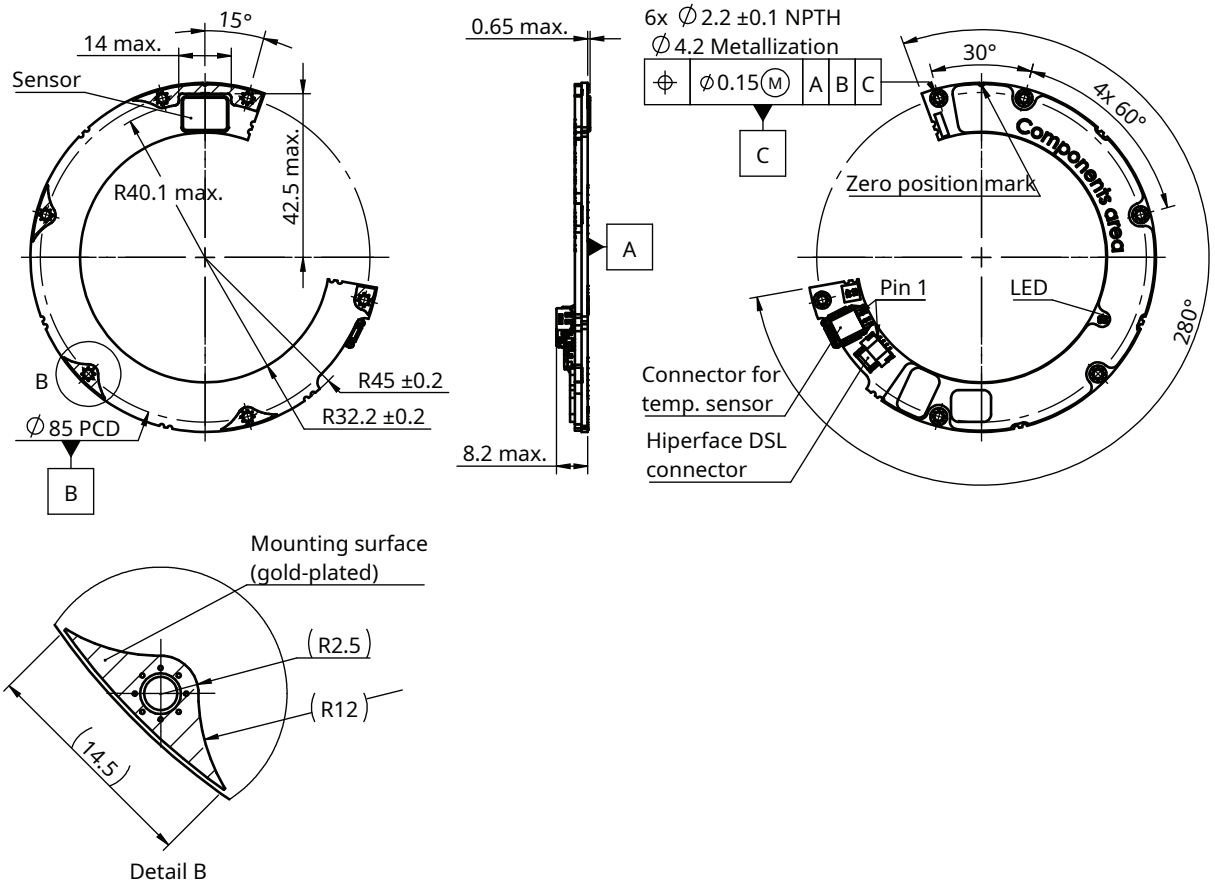


MRA080BG064AHN00 magnetic ring



Dimensions and installation drawings continued

MC080 readhead



Installation instructions

Axial position adjustment (mounting distance)

The distance between the sensor and the ring should be as shown on the dimension drawings of encoder assemblies. Using the gold-plated surface on the bottom as a reference surface for mounting the readhead is recommended. If the top side of the readhead is used as a reference surface, note that the thickness tolerance of the readhead must be taken into account. Also make sure that the signal traces and components are not in contact with mechanical assembly.

The integrated LED can be used as an indicator. If the ride height is within the installation tolerances, the indicator LED will be green and will not change when the ring rotates. The center of the ring and the center of the readhead arc must be coaxial. The permissible eccentricity tolerances are given in the table below. Precise centering of the ring is essential, as the eccentricity of the ring mounting plays a major role in the overall accuracy. Once the ring is centered within the prescribed tolerance the remaining eccentricity of the ring may be compensated by using the auto-calibration function. See chapter **Self-calibration after installation.**

Current ride height distance can be accessed through RDB. For more information refer to the table **Supported resources**.

Installation tolerances (readhead to ring)

Mounting distance	See detail A on dimension drawings of encoder assemblies. Tight ride height is recommended. Increasing the ride height exponentially increases encoder noise even when within installation tolerances. See chapter **Resolutions**.	
Tangential displacement of the sensor	±0.5 mm	
Radial displacement of the readhead	±0.5 mm	
Non-parallel mounting	Tilt angle <0.2°	

AksIM installation video

Installation tolerances (ring to shaft)

Recommended shaft tolerance is g6. See table of recommended tightening torques for RLS products (document TTD01) available at **RLS media center**.

Self-calibration after installation

The self-calibration function eliminates the error caused by eccentricity, which is a dominant contributor to the accuracy of the encoder and is caused by the eccentric mounting of the ring. It cannot compensate for the magnetisation error between different rings. The Subdivisional Error (SDE) is negligible with AksIM. This function removes the error from one sine wave per revolution. Communication with encoder during self-calibration procedure is not permitted. The self-calibration function can be initiated by the user through the resource database, using the appropriate HDSL master device. Refer to the table of **Supported resources** for SELFCAL resource ID.

Requirements:

- Free mechanical rotation of 360°
- Good signal over the entire calibration angle (no warnings or errors).
- Default time available is 10 seconds. Desired time (up to 40 seconds) can be set via the communication interface.
- Variation of direction and speed are not important. Minimum speed is 6 RPM.
- Suitable communication interface or adapter that enables the function to be triggered.

The remaining minimum accuracy of encoder system is influenced by magnetisation variations and noise of the readhead.

For typical accuracy values see chapter **Accuracy.**

When the self-calibration process is complete, fast-flashing LED indicates whether the process was successful.

LED		Self-calibration status
	Green flashing fast	Self-calibration succesfully performed.
	Orange flashing fast	Ring positioning is already perfect - correction was not performed.
	Red flashing fast	Self-calibration not performed. Possible reasons: • Eccentricity or radial offset is very high. • Timeout. Ring is rotating too slowly (<6 rpm). • Any error present during self-calibration procedure.

Explainer video: AksIM-4 self-calibration feature

Electrical connections

Pinout

Supply / HDSL communication connector

4-pin low profile connector: JST SM04B-GHS-TB(LF)(SN)
Mating connector: JST (GHR-04V-S)

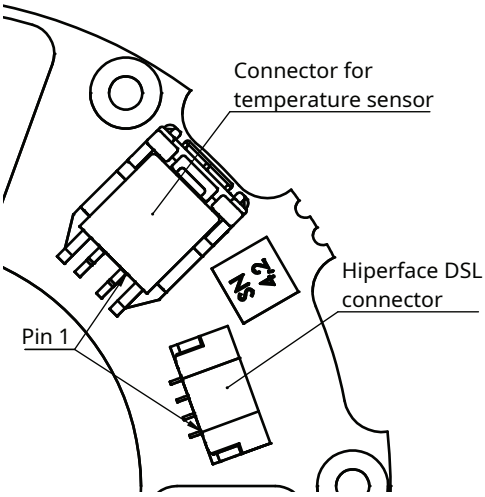
Pin	Function
1	Not connected
2	+Us/DSL+ Power Supply / DSL-Data
3	GND/DSL- Ground connection / DSL-Data
4	Not connected

Connector for temperature sensor

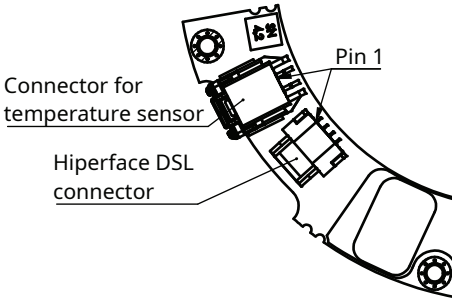
2-pin locking connector: Molex 5023520201

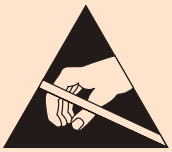
Pin	Function
1	Temperature sensor pin 1
2	Temperature sensor pin 2

MC053



MC080





Readhead is ESD sensitive - handle with care.
Do not touch electronic circuit, wires or sensor area without proper ESD protection or outside of ESD controlled environment.

Status indicator LED

The LED provides visual feedback on signal strength, error status, and is used for setup and diagnostics.
A flashing LED indicates that power is being supplied to the encoder, but the communication link has not been established. Otherwise, the LED remains constantly lit.

LED signal		Status
	Green	Normal operation; position data is valid
	Orange	Warning; position is valid, but resolution and/or accuracy might be out of specification. Some operating conditions are outside of limits.
	Red	Error; position data is not valid.
	Constantly lit	HDSL link established.
	Slow flashing	Communication has not been established - 450 ms boot time or HDSL link down.
	No light	No power supply or high temperature - see below
	Continuously fast flashing red	System error during start-up or operation.
	3 sec. fast flashing	Self-calibration result - see chapter **Self-calibration after installation.**

The LED switches off automatically when the ambient temperature reaches 85 °C to extend its lifespan. It switches on again when the temperature drops to 80 °C.

Multiturn counter

The multiturn option is selected with the resolution in the **Part numbering**. The multiturn counter is 16 bits (0 to 65535 counts). Counting is only available when the encoder is powered, but the counter state is stored in a non-volatile memory at power-down and is restored at power-up. Maximum permissible rotation during power-down is ±90°. If the rotation is greater than this, the encoder reports an error to indicate an invalid multiturn counter value. To reset this condition, it is necessary to apply a new multiturn counter value via the communication interface or cycle power to the encoder. If encoder is rotated for ±360° or for multiple rotations, this movement is not registered and no multiturn error is set. If any other error is set during a rotation of 90° or more, the multiturn counter value may become inconsistent with the mechanical position.

The user must implement the multiturn counter validation method by either:

- Activating the mechanical brake before the encoder goes into the power-down state and releasing the brake after the encoder is powered-up.
- Presetting a new multiturn counter value each time the encoder is powered-up.
- Other user-implemented multiturn counter validation methods.

Multiturn - shaft turn counter limitations

Counter may have invalid value in following circumstances:

Possible reasons for failure	Solution
If encoder is rotated for ±360° or multiple rotations during off state.	Use mechanical brake.
If Error flag (red LED) is present for 90° rotation or more.	Read and evaluate Error bit.
When the encoder moves for 90° or more, or rotates 300 rpm or more when the encoder performs blocking operations (storing information in non-volatile memory, factory reset, write protect, self-calibration).	Stop rotation before performing these operations.
If user changes single-turn position offset for 90° or more.	Set new multiturn counter value right after setting zero position offset.
If any function for storing information to non-volatile memory (save configuration, factory reset, write protect, self-calibration) is active when power-down happens.	Keep power supply stable when performing those operations.

Multiturn error flag

Error flag is set in one of the following conditions:

- Detected movement of >90° and <270° when powered off,
- Detected speed of more than 300 rpm during blocking operation,
- High, unexpected positional difference detected (acceleration error)

Multiturn error bit can be cleared by writing new value by ovewriting the multiturn value via the resource database (refer to the table **Supported resources**) or by power cycle.

HIPERFACE DSL® protocol

HIPERFACE DSL® is a fast digital protocol for motor feedback (MFB) systems for the connection between servo drive and motor feedback system. This is a digital interface communication with RS-485 standard with a transfer rate of 9.375 MBaud. Power supply and communication with the encoder can be carried out using the same dual cable. All products listed in this data sheet have been successfully tested and fully comply with SICK's conformity requirements.

Overview of warning and fault indications

Error type (ENC_STx)	Error Register	Error bit	Description
Position (incremental) (ENC_ST0)	40h	0	A Protocol reset was executed.
	40h	1	Acceleration overflow, invalid position.
	40h	2	Test running.
	40h	3	Not used (always 0).
	40h	4	Not used (always 0).
	40h	5	Not used (always 0).
	40h	6	Not used (always 0).
	40h	7	Not used (always 0).
Position (absolute) (ENC_ST1)	41h	0	Not used (always 0).
	41h	1	Not used (always 0).
	41h	2	Not used (always 0).
	41h	3	Multiturn counter mismatch. Encoder was rotated for more than ±90° during power-down.
	41h	4	Not used (always 0).
	41h	5	Not used (always 0).
	41h	6	Not used (always 0).
	41h	7	Not used (always 0).
Initialization (ENC_ST2)	42h	0	Not used (always 0).
	42h	1	Not used (always 0).
	42h	2	Not used (always 0).
	42h	3	Not used (always 0).
	42h	4	Internal SPI communication error.
	42h	5	Not used (always 0).
	42h	6	Internal system error.
	42h	7	Not used (always 0).
Checking (ENC_ST3)	43h	0	The readhead temperature is out of range.
	43h	1	Not used (always 0).
	43h	2	Power supply voltage is out of range.
	43h	3	High speed warning. Speed is above threshold.
	43h	4	Not used (always 0).
	43h	5	Position decoding error.
	43h	6	SFE Internal Error / Incosistent Calibration table.
	43h	7	Not used (always 0).
Access to resources (ENC_ST4)	44h	0	Invalid argument given during resource access procedure.
	44h	1	Resource access refused due to incorrect access level.
	44h	2	Internal error during resoure access.
	44h	3	Error when accessing a user file.

Supported resources

RID	Name	Time overrun [ms]	Description
0x000	ROOT	25	Top/root node of resource tree.
0x001	IDENT	25	Node for accessing all identification resources.
0x002	MONITOR	25	Node for accessing all monitoring resources.
0x003	ADMIN	25	Node for accessing all administration resources.
0x005	DATA	25	Node for accessing file system.
0x006	SENSHUB	25	Node for accessing MFB I/O.
0x007	PRODUCTN	25	Node for accessing production dependent resources.
0x080	ENCTYPE	25	Basic properties of encoder.
0x081	RESOLUTN	25	Encoder's singleturn resolution.
0x082	RANGE	25	Encoder multiturn range.
0x083	TYPECODE	25	Type code name of the MFB.
0x084	SERIALNO	25	Serial number of HDSL slave product.
0x085	FWREVNO	25	firmware and hardware revision number of HDSL slave product.
0x086	FWDATE	25	Firmware date of HDSL slave product.
0x087	EESIZE	25	Size of non-volatile memory for storing user files.
0x0C0	TEMPRNG	25	Min and max temperature value for HDSL slave product.
0x0C1	TEMPRTUR	25	Current temeprature at the sensor.
0x0C4	SUPRANGE	25	Minimum and maximum permitted values of supply voltage.
0x0C5	SUPVOLT	25	Measured supply voltage of DSL MFB.
0x0C6	SPEEDRNG	25	Maximum permitted rotation speed of encoder.
0x0C7	SPEED	25	Measured velocity in RPM.
0x0CB	LIFETIME	50	Counts lifetime of encoder in minutes.
0x0CC	ERRORLOG	50	System errors logging.
0x0D5	ERRORLOGFI	50	Selective disabling of error logging.
0x0D6	SIGLVL	25	Signal level, k&n factors and calculated ride height
0x0D7	DETSTAT	25	Detailed status
0x0D8	MINDIST	25	Minimal distance of decoding point from decoding warning threshold.
0x100	RESET	25	MFB processor processing reset or shut down.
0x101	SETPOS	75	Setting position offset.
0x104	SETACCES	25	RDB access levels that governs which resources are available.
0x105	CHNGEKEY	150	Used to change access keys (password) required to set appropriate access level.
0x108	FACTRST	2000	Resets mfb mcu, file system or encoder configuration to factory settings.
0x109	ENCIDENT	60	User defined MFB index.
0x113	MT_INFO	25	Multiturn specific data and functionality.
0x114	SELFCAL	2000	Self calibration specific data and functionality.
0x115	CFGBLOCK	25	Encoder's configuration block.
0x130	LOADFILE	2000	Resource allows loading existing file before accessing it.
0x131	RWFILE	2000	Resource allows reading/writing to an existing file.
0x132	FILESTAT	2000	Resource shall indicate status of the loaded file.
0x133	MAKEFILE	2000	Resource shall create new file, change status of a file or delete existing file.
0x134	DIR	2000	Resource indicates number of files, free and user memory and user file names.
0x180	EOLT	25	Reserved for internal use during production
0x200	ACCESSIO	25	Resource containing external temperature sensor measurement in ohms

Access levels

Access level	User	Standard access key
0	Execute (default setting)	- (no key required)
1	Operator	1111 (31 31 31 31h)
2	Maintenance	2222 (32 32 32 32h)
3	Authorized client	3333 (33 33 33 33h)
4	User service	4444 (34 34 34 34h)

Part numbering

Readhead

MC 053 HL A 22M V J H 00

Series
MC - AksIM-4 board-level readhead

MRA ring compatibility
053 - For use with MRA053 ring
080 - For use with MRA080 ring

Communication interface
HL - HIPERFACE DSL® protocol

Communication interface variant
A - Mandatory resources + AksIM-4 features

Resolution
20B - 20 bits per revolution
22B - 22 bits per revolution

Multiturn counter options
20M - 20 bits per revolution + 16 bits multiturn counter
22M - 22 bits per revolution +16 bits multiturn counter

Shape and connector orientation
V - Full circle, radial connector exit, Extended RH (MC053)
T - Partial arc, radial connector exit, Extended RH (MC080)

Connector option
J - JST SM04B-GHS-TB(LF)(SN)

Option
H - Temperature range -40 °C to +115 °C

Special requirements
00 - No special requirements (standard)

Not all part number combinations are valid. Refer to the table of available combinations below.

For more dimensions and configurations please **contact RLS.**

Table of available combinations

Series	Ring compatibility	Communication interface	Communication interface variant	Resolution	Shape & connector orientation	Connector option	Option	Special requirements
MC	053	HL	A	20B / 22B / 20M / 22M	V	J	H	00
	080				T			

Magnetic ring

MRA 053 B C 030 A H H 00

Series
MRA - AksIM magnetic ring

Outer diameter and readhead compatibility
053 - 53 mm
080 - 80 mm

Thickness
B - 2.0 mm

Installation type
C - Countersunk holes Use flat-head countersunk fasteners ISO 7046 / DIN 965
G - Glue

Inner diameter
030 - 30 mm
055 - 55 mm
064 - 64 mm

Accuracy grade
A - AksIM-4, Extended rideheight

Material
H - Stamped metal plate with glued rubber

Zero marking
H - Hole
N - None

Special requirements
00 - No special requirements (standard)

Not all part number combinations are valid. Refer to the table of available combinations below.

Table of available combinations

Series	Outer diameter and readhead compatibility	Thickness	Installation type	Inner diameter	Accuracy grade	Material	Zero marking	Special requirements
MRA	053	B	C	030	A	H	H	00
	080			055				
			G	064			N	

Available ring part numbers:

MRA053BC030AHH00
MRA080BC055AHH00
MRA080BG064AHN00

Packaging

There are two packaging options. Less than 20 products are packed individually in an antistatic box. If more than 20 systems are ordered, the parts are packed in antistatic plastic trays.

Bulk packaging:

Readheads		
Part	**Tray size**	**Box size**
053	NA	1 piece per box
080	NA	

Magnetic rings		
Part	**Tray size**	**Box size**
053	10 units per tray	12 trays per box
080	5 units per tray	

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Document issues

Issue	Date	Page	Description
1	14. 10. 2026	-	New document
2	19. 10. 2026	6 - 10	Drawings amended
		12	Self-calibration chapter amended

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