

AksIM™ off-axis rotary absolute encoder



AksIM™ is a non-contact high performance off-axis absolute rotary encoder designed for integration into space-constrained applications. A hollow ring, true absolute functionality and high speed operation make this encoder suitable for many applications.

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

The encoders come with SSI, SPI, PWM, asynchronous serial RS422 and USB communication interfaces and offer a range of binary resolutions to 18 bits per revolution.

The encoder operates from -40 °C to +85 °C and is resistant to shock and vibrations.

The AksIM™ encoder has a built-in advanced self-monitoring function, continually checking several internal parameters. Error reporting, warnings and other status signals are available on all digital interfaces and are visualised with the on-board LED.

The AksIM™ encoder system is suitable for use in industrial and medical applications.

A typical application is a robotic arm joint with a cable feed running through the ring or a precision gearbox where the ring is attached onto the main transmission shaft.

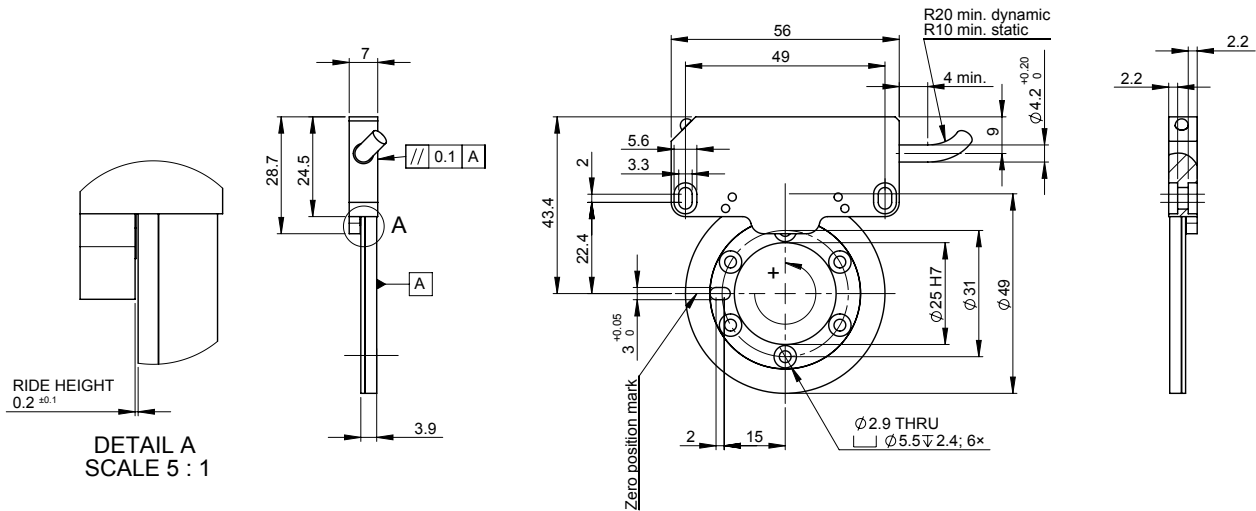
Custom design service for OEM integration is also available.

- True absolute system
- Single track
- Custom magnetic sensor ASIC
- No hysteresis
- Resolution to 18 bits
- High speed operation
- Low profile, non-contact
- Built-in self-monitoring
- Integrated status LED
- SSI, SPI, PWM, asynchronous serial RS422 or USB communication interface
- Corrosion resistant magnetic ring

AksIM™ dimensions

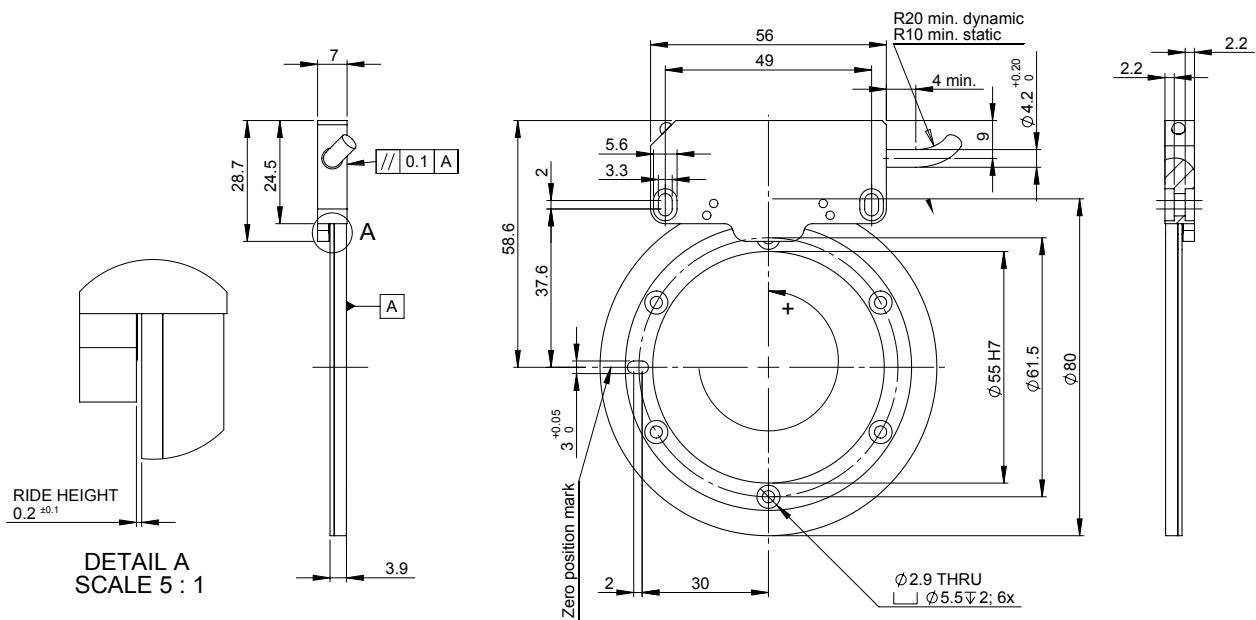
Dimensions and tolerances in mm.

Ring MRA7



NOTE:
CCW positive measuring direction.

Ring MRA8



NOTE:
CCW positive measuring direction.

AksIM™ technical specifications

System data	
Reading type	Axial reading
Resolution	From 15 to 18 bit (see chapter Available resolutions)
Maximum speed	> 10,000 rpm
Encoder accuracy	±0.025° (before installation - errors caused by mounting inaccuracy of the readhead, ring and drive shaft are not included)
Final system accuracy	Typ. ±0.1° (including installation tolerances - see chapter Installation instructions)
Hysteresis	Less than unit of resolution
Repeatability	Better than unit of resolution
Electrical data	
Supply voltage	4 V to 6 V – voltage on readhead *
Set-up time	10 ms (first data ready after switch-on)
Power consumption	Typ. 115 mA, max. 150 mA
Voltage drop over cable	~ 55 mV/m – without load
Mechanical data	
Available ring sizes (outer diameter)	49 mm (ring MRA7)
	80 mm (ring MRA8)
Material type	Ring EN 1.4005 / AISI416 or EN 1.4104 / AISI430F with glued NBR rubber filled with ferrite particles
Mass	Readhead (with 1 m cable, no connector) 45 g Ring MRA7 32 g Ring MRA8 45 g
Cable	Ø4.2 ± 0.2 mm, PUR highly flexible cable, drag-chain compatible, double-shielded; 8 × 0.05 mm ² ; durability: 20 million cycles at 20 mm bend radius; power supply lines resistance: 0.48 Ω/m
Environmental data	
Temperature	Operating -40 °C to +85 °C with static cable -10 °C to +80 °C with cable under dynamic conditions
	Storage -40 °C to +85 °C
Humidity	0 to 100% (condensation permitted)
Environmental protection	IP64 (protected against dust and splashing water)
External magnetic field	Max ±6 mT (DC or AC) on top side of readhead

* Note: Consider voltage drop over cable.

Status indicator LED

The LED provides visual feedback of signal strength, error condition and for set-up and diagnostic use.

LED	Status
Green	Normal operation; position data is valid
Orange	Warning; position is valid, but the resolution and/or accuracy might be out of specification. Some operating conditions are outside limits.
Red	Error; position data is not valid
No light	No power supply

Installation instructions

Axial position adjustment (air gap)

The nominal gap between the sensor on the readhead and the rubber band on the ring is 0.2 ± 0.1 mm. To achieve this, the base of the ring should be in the same level as the bottom of the readhead. See "Detail A" section of the drawing on the previous page.

Any nonmagnetic tool with 0.2 mm thickness can be used to check the correct air gap setting mechanically.

The integrated LED can be used as a coarse indicator. When the correct air gap is achieved, the LED glows green and does not change colour when the ring rotates.

Radial position adjustment

The four small holes ($\varnothing 2$ mm) in the housing of the readhead should be used for correct radial positioning of the readhead to the ring.

The two holes farther apart are for adjusting the readhead to the MRA7 ring (see Installation drawing on the next page).

The two holes closer together are for adjusting the readhead to the MRA8 ring (see Installation drawing on the next page).



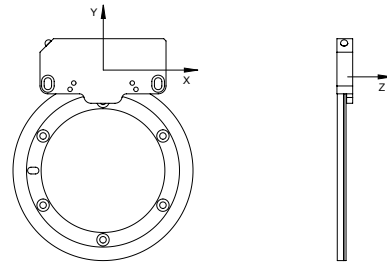
WARNING!

ESD protection

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

Installation tolerances (readhead to ring)

Axial (Z) displacement (ride height)	0.2 mm nominal ± 0.1 mm
Radial (Y) displacement	± 0.3 mm
Off center (X) displacement	± 0.5 mm
Nonparallell mounting	± 0.05 mm



Installation tolerances (ring to shaft)

Ring/shaft fit on MRA7	Guaranteed accuracy
H7/g6	$\pm 0.07^\circ$
H7/h7*	$\pm 0.08^\circ$
H7/f7	$\pm 0.09^\circ$

Ring/shaft fit on MRA8	Guaranteed accuracy
H7/g6	$\pm 0.06^\circ$
H7/h7*	$\pm 0.07^\circ$
H7/f7	$\pm 0.08^\circ$

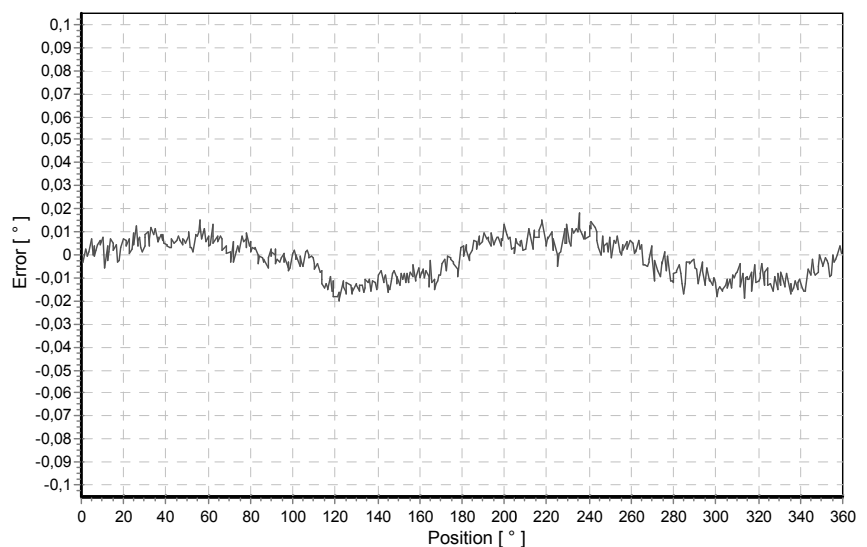
* Note: Fit with possible zero gap is not recommended.

Accuracy of the encoder system

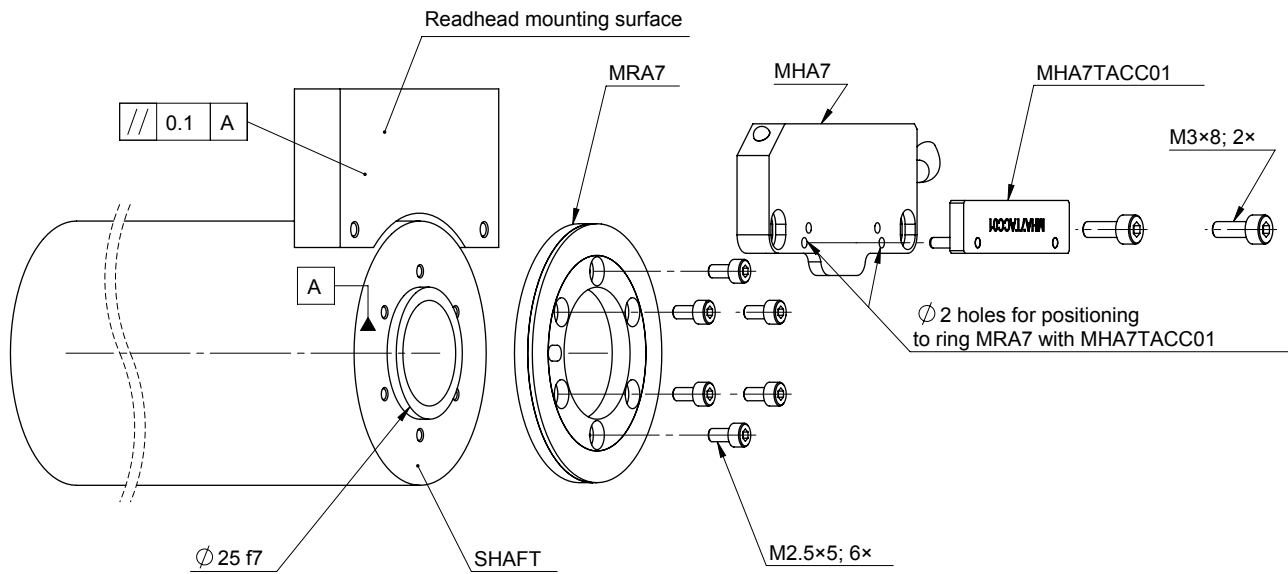
Precise centering of the ring is key to achieving good overall accuracy.

By minimising the eccentricity of the ring installation (using a gauge) and using a drive shaft with precision bearings, the error can be reduced typically to $\pm 0.025^\circ$.

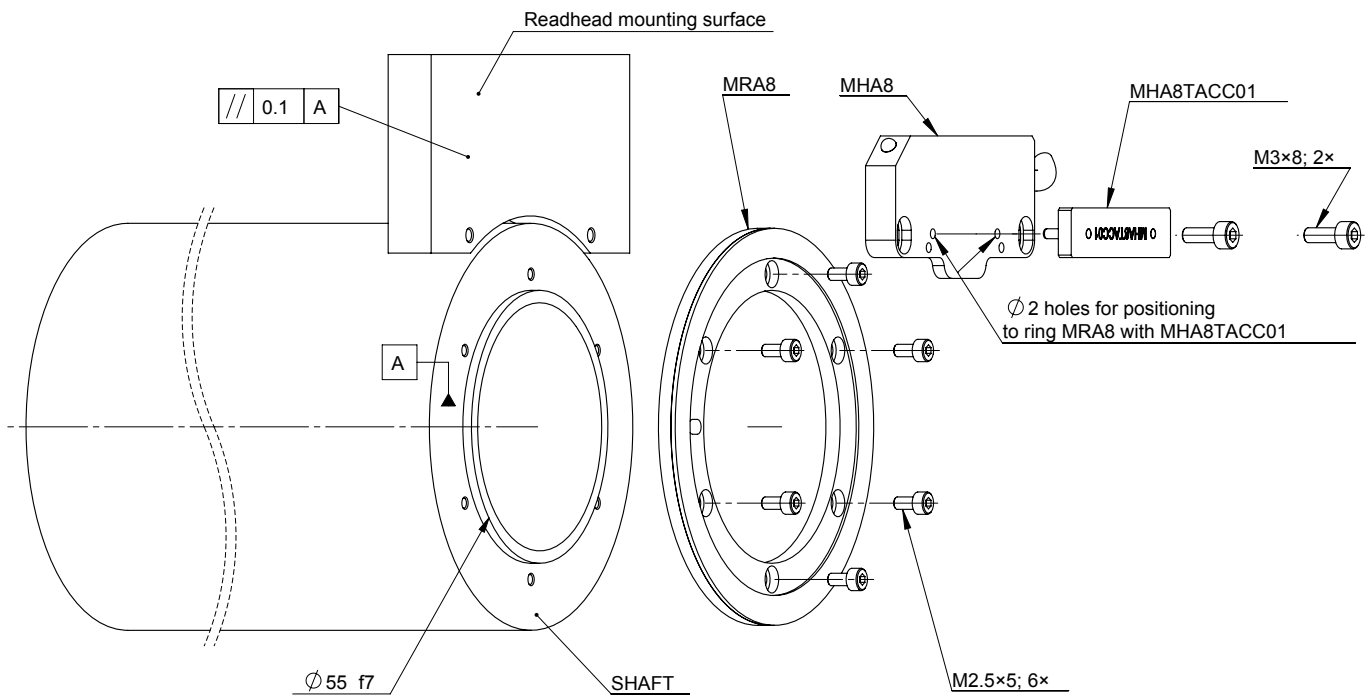
A typical accuracy plot after good installation is shown in the graph on the right.



Installation drawing for MHA7 and MRA7



Installation drawing for MHA8 and MRA8



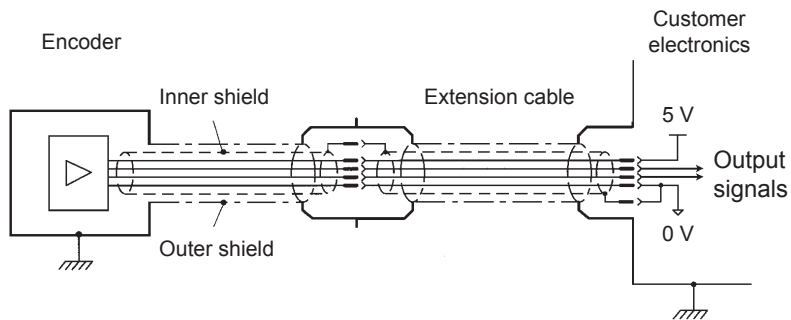
Adjustment procedure

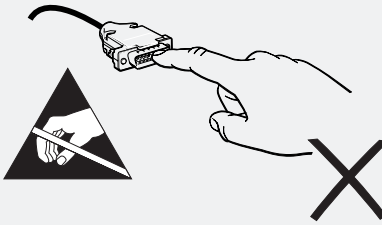
Loosen mounting screws (M3) for readhead. Pull readhead away from center of ring. Insert adjustment tool (MHA7ACC01 or MHA8ACC01) or two screws (M2x8 mm) into assisting holes. Push readhead towards ring so that assisting pins or screws touch outer side of ring. Tighten mounting screws. Remove adjustment tool or assisting screws. Check operation of encoder.

Electrical connections

Pin	Wire Colour	Asynchronous serial RS422	PWM	SSI	SPI slave
Case	Outer shield	Encoder/machine case (Earth connection)	Encoder/machine case (Earth connection)	Encoder/machine case (Earth connection)	Encoder/machine case (Earth connection)
1	Inner shield	0 V (GND)	0 V (GND)	0 V (GND)	0 V (GND)
2	Red	RX data in +	-	Clock +	SCK (Clock in)
3	Blue	RX data in -	-	Clock -	$\overline{\text{CS}}$ (Chip Select)
4	Grey	-	Status	-	Status
5	Brown	5 V supply	5 V supply	5 V supply	5 V supply
6	Green	TX data out +	-	Data +	MISO (Data out)
7	Yellow	TX data out -	-	Data -	-
8	Pink	-	PWM Out	-	-
9	White	0 V (GND)	0 V (GND)	0 V (GND)	0 V (GND)

For USB interface, the encoder is provided with a certified USB cable and type A connector.





WARNING!

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

AksIM™ communication interfaces

Asynchronous serial RS422	
Baud rate	115.2 kbps, 128 kbps, 230.4 kbps, 256 kbps, 500 kbps, 1 Mbps
Data format	8 bits, no parity, 1 stop bit
Update rate	On demand or continuous
Resolution	See table below
Latency	250 µs
PWM	
Base frequency	122.07 Hz
Step duration	0.125 µs
Update rate	122.07 Hz
Resolution	16 bits
Latency	250 µs
SSI*	
Maximum clock frequency	500 kHz
Update rate	4 kHz
Resolution	See table below
Latency	250 µs to 500 µs
Timeout (monoflop time)	20 µs
SPI slave*	
Maximum clock frequency	3 MHz at 1.5 m cable length
Update rate	4 kHz
Resolution	16 bits fixed (option S) or up to 18 bits (option A) - see table below
Latency	250 µs to 500 µs
USB	
Standard	USB 1.1
Update rate	4 kHz
Resolution	17 bits fixed on MHA7; 18 bits fixed on MHA8
Latency	Dependent on the software configuration

* Note: Slave type interfaces might not be suitable for high-speed closed control loops because of the variable latency time.

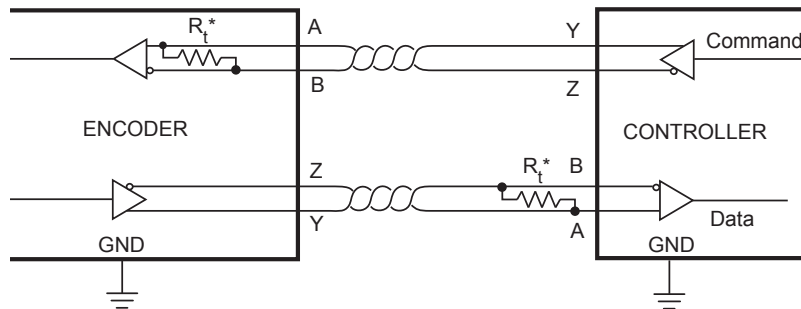
Available resolutions

Resolution	Ring MRA7	Ring MRA8
Binary	15 bits per revolution 16 bits per revolution 17 bits per revolution	16 bits per revolution 17 bits per revolution 18 bits per revolution

Asynchronous serial communication over RS422

Encoder identification, position data and temperature are available over the request-response type of communication over the asynchronous serial link. There are two unidirectional communication channels, forming a full-duplex bidirectional data link. Every channel consists of a two wire differential twisted-pair connection conforming to the RS422 signalling standard.

Electrical connection



Line signals	
A	Receiver, + input
B	Receiver, - input
Y	Transmitter, + output
Z	Transmitter, - output

* The Command and Data lines are 5 V RS422 compatible differential pairs. The termination resistor on the Command line is integrated inside the encoder. The termination on the end of the Data line at the controller end is required if the total cable length is longer than 5 m. The nominal impedance of the cable is 120 Ω .

Communication parameters

Character length	8 bits
Parity	None
Stop bits	1
Repetition rate	4 kHz max
Position latency	Fixed 250 μ s between the position acquisition and first start bit sent out

Link speed is selectable by the *Output type variant* in the part number:

Output type variant	A	B	C	D	E	F
Value	115.2 kbps	128 kbps	230.4 kbps	256 kbps	500 kbps	1 Mbps

Command set

Command "v" (small character "v")

Response - version info and serial number
 5 bytes ASCII identification string ("AksIM")
 1 byte ASCII space character
 8 bytes ASCII serial number
 1 byte binary firmware version
 1 byte binary communication interface version (3)
 1 byte binary ASIC revision
 1 byte binary code identification (7 or 8)
 1 byte binary Resolution

Command "1" (ASCII one)

Response - position and status, transmitted once
 1 byte header 0xEA
 3 bytes binary absolute position, big-endian, left aligned
 2 bytes encoder status – see below
 1 byte constant footer 0xEF

The next request should not be sent sooner than 250 μ s after the end of the previous response from the readhead to allow refreshing of the position data. If request is sent sooner, data will arrive at the end of the refresh cycle.

Command "2" (ASCII two)

Response - position and status, transmitted continuously
 1 byte constant header 0xEA
 3 bytes binary absolute position, big-endian, left aligned
 2 bytes encoder status – see below
 1 byte constant footer 0xEF

Command "0" (ASCII zero)

Stop continuous transmission

Command "t" (small character "t")

Response - temperature of the encoder
 1 byte signed binary number - temperature of the sensor in °C
 1 byte signed binary number - temperature of the processor in °C

Accuracy of the readings is ± 3 °C

This function is available with firmware version 30 and later (see command "v" for firmware version).

Structure of the data packet

Encoder status (two bytes):

b15 : b10 Reserved, always zero

General status

b9 Error. If bit is set, position is not valid.

b8 Warning. If bit is set, encoder is near operation limits. Position is valid. Resolution and / or accuracy might be lower than specified.

Error and Warning bits can be set at the same time; in this case Error bit has priority.

Those two bits are synchronized to the LED indicator on the housing of the encoder:

Red = Error, Orange = Warning, Green = Normal operation, No light = no power supply.

The warning or error status is more closely defined by the Detailed status bits.

Detailed status

b7 Warning - Signal amplitude too high. The readhead is too close to the ring or an external magnetic field is present.

b6 Warning - Signal amplitude low. The distance between the readhead and the ring is too high.

b5 Error - Signal lost. The readhead is out of alignment with the ring or the ring is damaged.

b4 Warning - Temperature. The readhead temperature is out of range.

b3 Error - Power supply error. The readhead power supply voltage is out of specified range.

b2 Error - System error. Malfunction detected inside the circuitry or inconsistent calibration data is detected. To reset the System error bit try to cycle the power supply while the rise time is shorter than 20 ms.

b1 Not used

b0 Error - Acceleration error. The position data changed too fast. A stray magnetic field is present or metal particles are present between the readhead and the ring.

PWM - Pulse width modulation output

The PWM interface consists of two digital signals: the Status signal and the PWM Out signal. It is 3.3 V TTL compatible.

Electrical connection

The Status and PWM Out signals are 3.3 V TTL compatible. These signals have weak ESD protection. Handle with care.

Status signal

The Status signal indicates the current status of the encoder. The Status signal is high for normal operation and valid position information. The low state of the Status signal indicates an error state of the encoder which can be caused by:

- Operation outside the installation tolerances
- Invalid or corrupted magnetic pattern of the ring
- Sensor malfunction
- System error
- No power supply

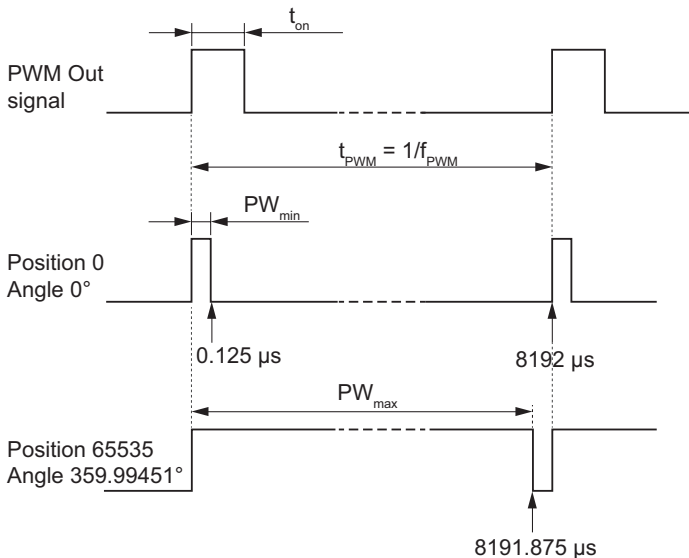
When the Status signal is low, the PWM Out signal is low and no pulses are output.

The encoder position is latched on the rising edge of the PWM Out signal. The Status signal should also be checked at the rising edge of the PWM Out signal. If the Status signal changes during the PWM period, it does not affect the currently transmitted position information.

PWM Out signal

The PWM Out is a pulse width modulated output with 16-bit resolution whose duty cycle is proportional to the measured position. The change of the pulse width by $0.125 \mu\text{s}$ corresponds to a change in position by one count (change in angle for $360^\circ / 65536 \approx 0.00549^\circ$). At 16 bit encoder resolution the base PWM frequency is 122.07 Hz.

PWM Out signal timing diagram



Communication parameters

Output type variant in the part number defines the PWM frequency and all other dependent parameters.

Output type variant	Parameter	Symbol	Value	Note
A	Signal period	t_{PWM}	8192 μs	
	PWM frequency	f_{PWM}	122.07 Hz	
	Minimum pulse width	PW_{min}	0.125 μs	Position 0 (Angle 0°)
	Maximum pulse width	PW_{max}	8191.875 μs	Positions 65534 and 65535 * (Angle 359.98901° and 359.99451°)
	Resolution		16 Bit	Fixed; resolution in part number must be set as "16B"

* Note that positions 65534 and 65535 result in the same pulse width PW_{max} .

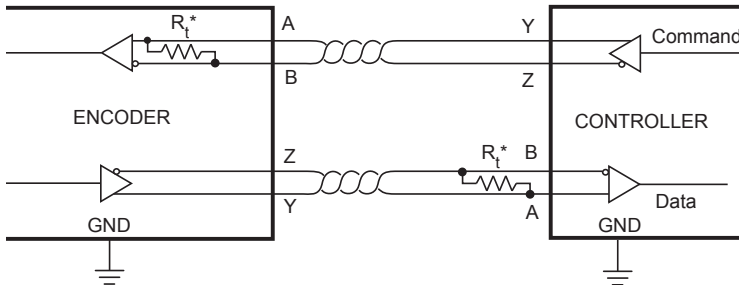
$$Position [\text{counts}] = \frac{t_{on} \times 65536}{t_{PWM}} - 1$$

$$Position [^\circ] = \frac{(t_{on} - 0.125 \mu\text{s}) \times 360^\circ}{t_{PWM}}$$

SSI - Synchronous serial interface

The encoder position, in up to 18 bit natural binary code, and the encoder status are available through the SSI protocol. The position data is left aligned. After the position data there are two general status bits followed by the detailed status information.

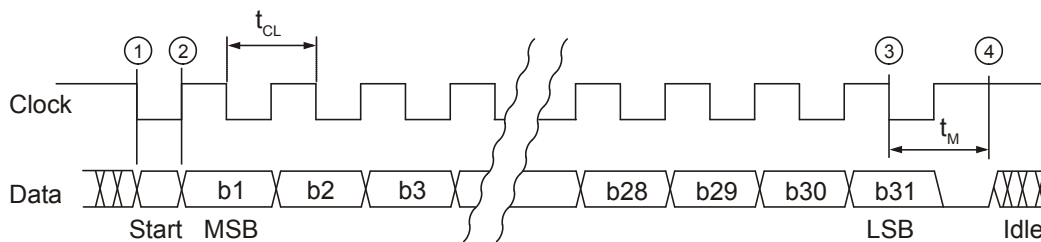
Electrical connection



Line signals	
A	Receiver, + input
B	Receiver, - input
Y	Transmitter, + output
Z	Transmitter, - output

* The Command and Data lines are 5 V RS422 compatible differential pairs. The termination resistor on the Command line is integrated inside the encoder. The termination on the end of the Data line at the controller end is required if the total cable length is longer than 5 m. The nominal impedance of the cable is 120 Ω .

SSI timing diagram

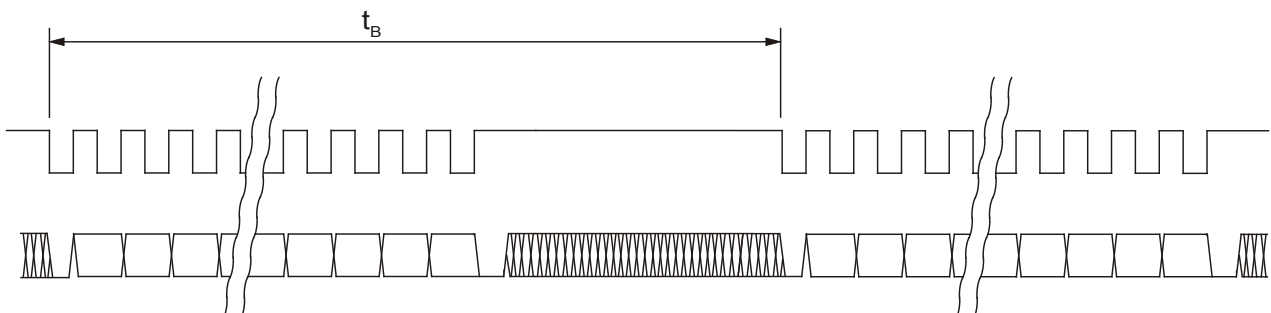


The controller interrogates the readhead for its position and status data by sending a pulse train to the Clock input. The Clock signal always starts from high. The first falling edge ① latches the last position data available and on the first rising edge ② the most significant bit (MSB) of the position is transmitted to the Data output. The Data output should then be latched on the following falling edge. On subsequent rising edges of the Clock signal the next bits are transmitted.

After the transmission of the last bit ③ the Data output goes to low. When the t_M time expires, the Data output is undefined ④. The Clock signal must remain high for at least t_M before the next reading can take place.

While reading the data, the period t_{CL} must always be less than t_M . However, reading the encoder position can be terminated at any time by setting the Clock signal to high for the duration of t_M .

To allow updating of the position data at least t_B should pass between two subsequent readings. If the reading request arrives earlier than t_B after the previous reading, the encoder position will not be updated.



The power supply must be applied at least 10 ms before the clock sequence is being sent to the encoder.

Data sheet
MHAD01_02

Communication parameters

Parameter	Symbol	Min	Typ	Max
Clock period	t_{CL}	2 μ s		20 μ s
Clock frequency	f_{CL}	50 kHz		500 kHz
Monoflop time	t_M		20 μ s	
Update time	t_B	250 μ s		

Start bit and idle line value are defined by the *Output type variant*.

Output type variant	Line state selection
A	Start bit = 0; idle line = 0
B	Start bit = 1; idle line = 1

Structure of the data packet

Bit	b30 : b13	b12 : b21	b10 : b9	b8 : b1	b0
Data length	18 bits	2 bits	2 bits	8 bits	1 bit
Meaning	Encoder position	Reserved	General status	Detailed status	Reserved

Encoder position	
b30 : b13	Encoder position – Left aligned, MSB (b1) first, LSB (b18) last. If the encoder resolution is lower than 18 bits, the last few bits of the encoder position, which are not used, are set to zero.
b12 : b11	Reserved, always zero
General status	
b10	Error bit. If set, the position is not valid.
b9	Warning bit. If set, the encoder operation is close to its limits. The position is still valid, but the resolution and/or accuracy might be out of specification.
<p>The Error and Warning bits can be set at the same time, in this case the Error bit has priority. The colour of the LED on the readhead housing indicates the value of the General status bits: Red = Error, Orange = Warning, Green = Normal operation, No light = No power supply. The warning or error status is more closely defined by the Detailed status bits.</p>	
Detailed status	
b8	Warning - Signal amplitude too high. The readhead is too close to the ring or an external magnetic field is present.
b7	Warning - Signal amplitude low. The distance between the readhead and the ring is too high.
b6	Error - Signal lost. The readhead is out of alignment with the ring or the ring is damaged.
b5	Warning - Temperature. The readhead temperature is out of range.
b4	Error - Power supply error. The readhead power supply voltage is out of specified range.
b3	Error - System error. Malfunction detected inside the circuitry or inconsistent calibration data is detected. To reset the System error bit try to cycle the power supply while the rise time is shorter than 20 ms.
b2	Not used
b1	Error - Acceleration error. The position data changed too fast. A stray magnetic field is present or metal particles are present between the readhead and the ring.
b0	Reserved, always zero.

SPI - Serial peripheral interface – slave mode

The SPI interface is designed for communication with nearby devices.

Electrical connection

All data signals are 3.3 V LVTTTL. Inputs are 5 V tolerant.

Signal	Description
\overline{CS}	Active low. \overline{CS} line is used for synchronisation between master and slave devices. During communication it must be held low. Idle is high. Rising edge on \overline{CS} signal resets the SPI interface.
SCK	Clocks out the data on rising edge. Max frequency 3 MHz at 1.5 m cable length.
MISO	Data is output on rising edge on SCK after \overline{CS} low. Data is valid on the falling edge of SCK signal. During $\overline{CS}=1$ MISO line is in high-Z mode.
Status	Indicates normal operation (only available with S option).

Communication parameters

Output type variant in the part number defines the SPI interface type and all dependent parameters.

Output type variant	Description	Parameter	Value
S	SPI slave - simple mode	Resolution	Fixed - resolution in part number must be set as "16B"
		Status	Error status available on a separate wire
		Data length	16 bit data packet - position only
A	SPI slave - advanced mode	Resolution	Selectable (see part numbering)
		Status	All status bits are available through the SPI
		Data length	40 bit data packet - position, status, CRC

Parameter	Symbol	Min	Typ	Max	Note
Clock frequency	f_{CLK}	1 Hz		3 MHz	Max frequency with 1.5 m cable
Time after \overline{CS} low to first CLK rising edge	t_s	1 μ s			
Time after last CLK falling edge to \overline{CS} high	t_h	1 μ s			
\overline{CS} high time	t_r	8 μ s			Time to complete SPI reset
Read repetition rate	f_{REP}			4 kHz	If higher, the same position data might be transmitted twice

SPI slave - simple mode (option S)

Structure of the data packet

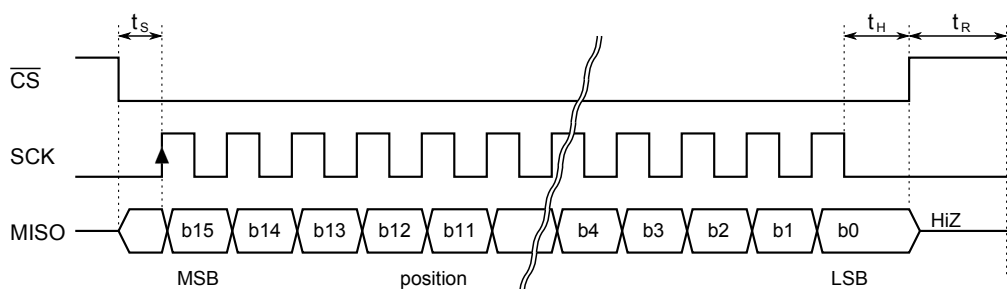
Data packet is 16 bits long. MSB first. Left aligned. Position only, no status bits. Only 16-bit resolution available. Repetition of reading max 4000 times per second. If higher, it is possible to read the same position data twice.

Status signal

The Status signal indicates the current status of the encoder. The Status signal is high for normal operation and valid position information. The low state of the Status signal indicates an error state of the encoder which can be caused by: Operation outside the installation tolerances, invalid or corrupt magnetic pattern of the ring, sensor malfunction, system error or no power supply.

When the Status signal is low, the data read through the SPI interface is invalid. The Status signal should be checked at the first rising edge of the SCK signal. If the Status signal changes during the data transmission, it does not affect the currently transmitted position information.

SPI slave timing diagram (option S)



Data sheet
MHAD01_02

SPI slave - advanced mode (option A)

Structure of the data packet

Data packet is 40 bits long. MSB first. Position data is left aligned.

Repetition of reading max 4000 times per second. If higher, it is possible to read the same position data twice.

Bit	b31 : b14	b13 : b12	b11 : b10	b9 : b2	b1 : b0	c7 : c0
Data length	18 bits	2 bits	2 bits	8 bits	2 bits	8 bits
Meaning	Encoder position	Reserved always 0	General status	Detailed status	Reserved always 1	CRC

Encoder position

b31 : b14 Encoder position, left aligned, MSB first. If the encoder resolution is lower than 18 bits, the last few bits of the encoder position, which are not used, are set to zero.

General status

b11 Error. If bit is set, position is not valid.

b10 Warning. If bit is set, encoder is near operation limits. Position is valid. Resolution and / or accuracy might be lower than specified.

Error and Warning bits can be set at the same time; in this case Error bit has priority.
 Those two bits are synchronized to the LED indicator on the housing of the encoder:
Red = Error, **Orange** = Warning, **Green** = Normal operation, No light = no power supply.
 The warning or error status is more closely defined by the Detailed status bits.

Detailed status

b9 Warning - Signal amplitude too high. The readhead is too close to the ring or an external magnetic field is present.

b8 Warning - Signal amplitude low. The distance between the readhead and the ring is too high.

b7 Error - Signal lost. The readhead is out of alignment with the ring or the ring is damaged.

b6 Warning - Temperature. The readhead temperature is out of range.

b5 Error - Power supply error. The readhead power supply voltage is out of specified range.

b4 Error - System error. Malfunction detected inside the circuitry or inconsistent calibration data is detected. To reset the System error bit try to cycle the power supply while the rise time is shorter than 20 ms.

b3 Not used

b2 Error - Acceleration error. The position data changed too fast. A stray magnetic field is present or metal particles are present between the readhead and the ring.

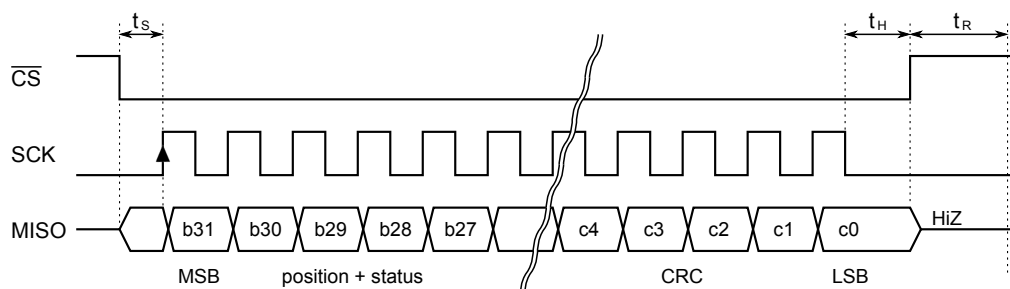
CRC

c7 : c0 CRC check with polynomial 0x97 - see Application Note on the website: www.rls.si/AksIM

Status signal

The Status signal is not available in Advanced mode.

SPI slave timing diagram (option A)



USB - Universal serial bus

Encoder identification, position data and temperature are available over the request-response type of communication over the Universal Serial Bus (USB). The encoder is recognised by a computer as a virtual COM port. This type of communication can be used for direct connection to a measuring station powered by an (industrial) PC. Drivers are available for Windows XP and Windows 7 operating systems. Both 32-bit and 64-bit versions are supported. The encoder may not be correctly recognised if plugged into a USB 3.0 port. Please use USB 2.0 port or USB hub. The encoder can be accessed from any software that supports connection to a virtual COM port (for example C++, Delphi, Labview, etc.).

Electrical connection

USB cable with A type USB connector is provided. Cable length is 1.8 meter. It can be extended to 5 meters with certified USB extension cords capable of carrying higher supply currents (200 mA minimum).

USB drivers

USB drivers for the virtual COM port are available on the RLS website: www.rls.si/AksIM

Communication parameters

Settings of baud rate, character length and parity bits do not affect the communication. Any value can be used.

Output type variant does not affect the USB interface. Use default value "B".

Command set

Command "v" (small character "v")

Response - version info and serial number
 5 bytes ASCII identification string ("AksIM")
 1 byte ASCII space character
 8 bytes ASCII serial number
 1 byte binary firmware version
 1 byte binary communication interface version (3)
 1 byte binary ASIC revision
 1 byte binary code identification (7 or 8)
 1 byte binary Resolution

Command "1" (ASCII one)

Response - position and status, transmitted once
 1 byte header 0xEA
 3 bytes binary absolute position, big-endian, left aligned
 2 bytes encoder status – see below
 1 byte constant footer 0xEF

The next request should not be sent sooner than 250 µs after the end of the previous response from the readhead to allow refreshing of the position data. If request is sent sooner, data will arrive at the end of the refresh cycle.

Command "2" (ASCII two)

Response - position and status, transmitted continuously
 1 byte constant header 0xEA
 3 bytes binary absolute position, big-endian, left aligned
 2 bytes encoder status – see below
 1 byte constant footer 0xEF

Command "0" (ASCII zero)

Stop continuous transmission

Command "t" (small character "t")

Response - temperature of the encoder
 1 byte signed binary number - temperature of the sensor in °C
 1 byte signed binary number - temperature of the processor in °C

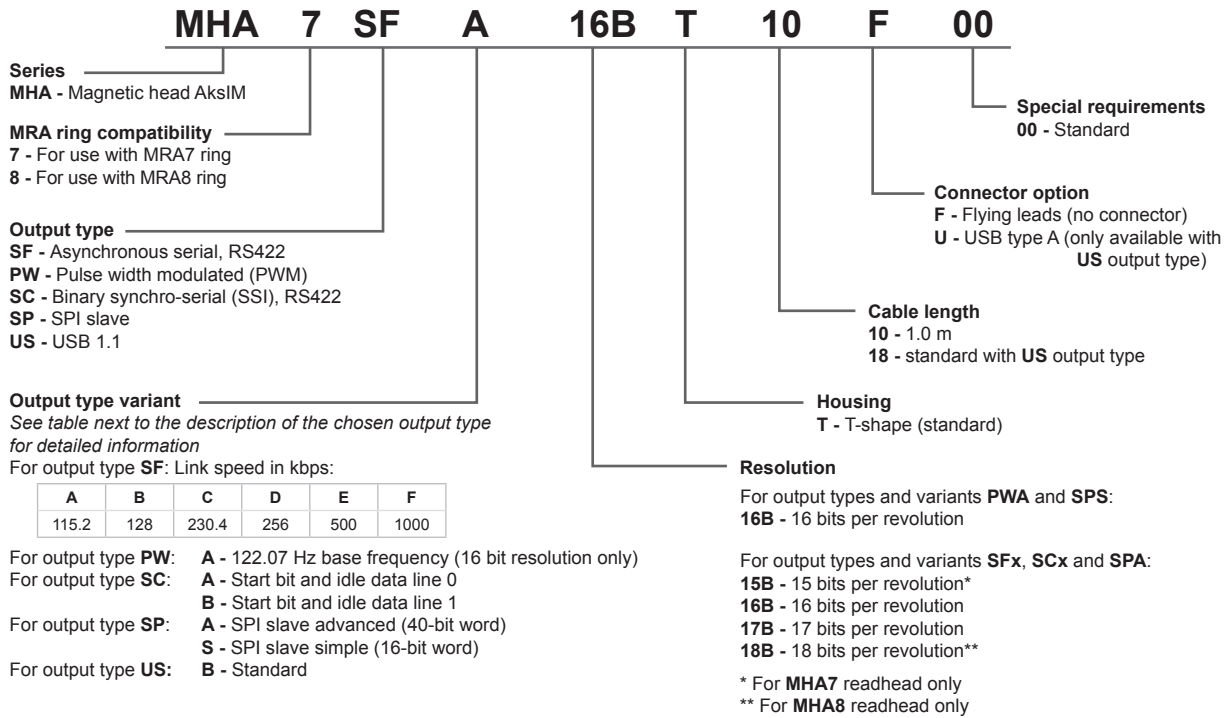
Accuracy of the readings is ±3 °C

This function is available with firmware revision 30 and later.

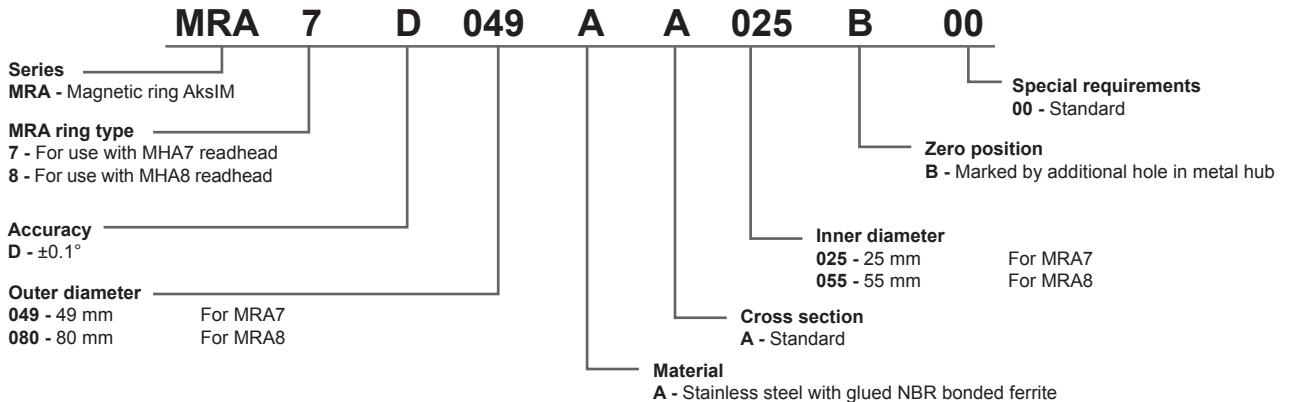
Structure of the data packet

Encoder status (two bytes):	
b15 : b10	Reserved; always zero
General status	
b9	Error. If bit is set, position is not valid.
b8	Warning. If bit is set, encoder is near operation limits. Position is valid. Resolution and/or accuracy might be lower than specified.
Error and Warning bits can be set at the same time; in this case Error bit has priority. Those two bits are synchronized to the LED indicator on the housing of the encoder: Red = Error, Orange = Warning, Green = Normal operation, No light = no power supply. The warning or error status is more closely defined by the Detailed status bits.	
Detailed status	
b7	Warning - Signal amplitude too high. The readhead is too close to the ring or an external magnetic field is present.
b6	Warning - Signal amplitude low. The distance between the readhead and the ring is too high.
b5	Error - Signal lost. The readhead is out of alignment with the ring or the ring is damaged.
b4	Warning - Temperature. The readhead temperature is out of range.
b3	Error - Power supply error. The readhead power supply voltage is out of specified range.
b2	Error - System error. Malfunction detected inside the circuitry or inconsistent calibration data is detected. To reset the System error bit try to cycle the power supply while the rise time is shorter than 20 ms.
b1	Not used
b0	Error - Acceleration error. The position data changed too fast. A stray magnetic field is present or metal particles are present between the readhead and the ring.

AksIM readhead part numbering



AksIM ring part numbering



Currently available ring options:

MRA7D049AA025B00
MRA8D080AA055B00

Accessories

MHA7TACC01 Alignment tool for MHA7 readhead / MRA7 ring radial positioning
MHA8TACC01 Alignment tool for MHA8 readhead / MRA8 ring radial positioning

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Document issues

Issue	Date	Page	Corrections made
1	7. 1. 2013	-	New document
2	24. 4. 2013		Power supply range, voltage drop on cable, IP protection, installation tolerances, accuracy, SPI-S, SPI-A, USB, part numbering

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