

ABSOLUTE ENCODER



Multi-turn absolute encoder general brochure

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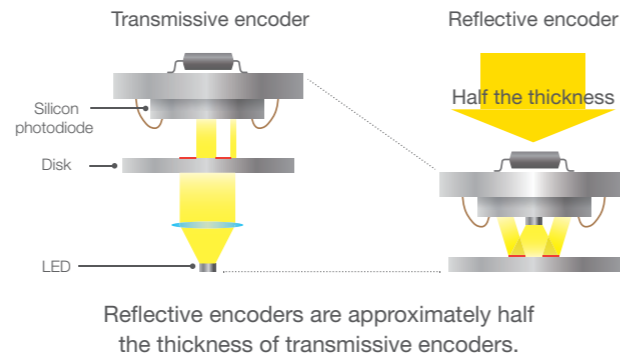
Absolute Encoders featuring reliability recognized by Robot

Offering refined accuracy and reliability, Nikon's absolute encoders serve as the eyes of servo motors and machine tools. Boasting the No.1 share in Japan with over 12 million units shipped, Nikon's Nikon developed the compact, high-performance M-sequence one-track absolute pattern in the 1990s, the world's first reflective optical absolute encoder. Nikon seeks to provide encoders that robot

High-accuracy and compact design based on reflective optics

High-accuracy position detection with 27 bit high resolution using optical system

Nikon drew on its proprietary light utilization technology and precision technology cultivated through cameras and semiconductor exposure equipment to develop a reflective optical type and M-sequence one-track absolute pattern as an alternative to conventional transmissive encoders. In addition to a thin, compact design, Nikon's absolute encoders offer precise position detection with maximum 27 bit (single-turn) and maximum 16 bit (multi-turn) high resolution. In response to changes in relative position between the motor and encoder while the motor is operating, the encoders will flexibly accommodate variations in the gap between the LED, photodetector, and disk to allow continuously accurate position detection. Nikon's absolute encoders are also less susceptible to magnetic fields and electromagnetic noise, providing high reliability and durability.

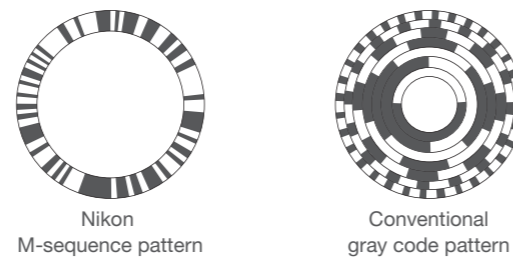


M-sequence one-track absolute pattern

In response to market demand for both compact dimensions and reliability, Nikon adopted an M-sequence pattern for the absolute encoder's track pattern.

With the M-sequence, a single one-track pattern creates absolute value data. This is a unique proprietary technique that has reduced size and increased reliability, improvements not possible with the gray code pattern commonly used in conventional absolute encoders.

The Nikon M-sequence pattern can also output full absolute data immediately after the main power is turned on.



Nikon M-sequence Pattern is Capable of Detecting Absolute Position with One Track

Combining High Resolution with Response Speed that meets High-Speed Rotation

Nikon's absolute encoder support high-speed rotation up to 8,000 min⁻¹. Encoders compatible with high-speed rotation are essential for speeding up production lines and improving equipment performance. Reliable position detection is achieved in the field, where speed is essential.

Hassle-free, Maintenance-free

Maintenance-free operation without an external battery

Requires no external battery; reflective optics allow multi-turn detection for accurate retention of position information, even when the power is turned off. The internal power supply uses all-solid-state batteries with outstanding safety and stability, and automatic recharging during normal operation enables long-term stable performance.

Angle Accuracy Self-Correction Function

The MAR-M700 Series features automated precision adjustment after motor assembly, allowing adjustment to be completed in approximately 10 seconds while maintaining high accuracy. Two sets of Silicon photodiode and LEDs are used to correct angular errors automatically during motor assembly.

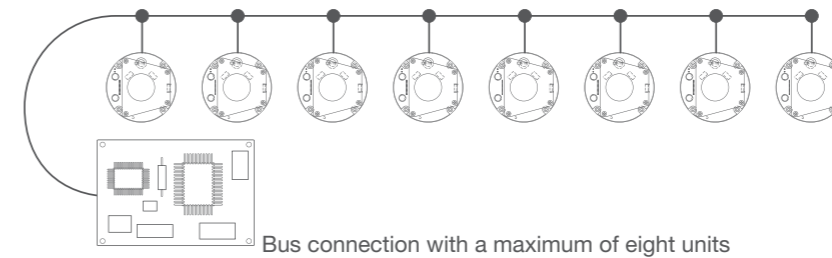
Manufacturers

in wide-ranging fields, including industrial robots, semiconductor manufacturing equipment, absolute encoders help support advancements at manufacturing sites. drawing on technology and expertise cultivated since the 1970s. In the 2000s, Nikon developed manufacturers demand.

Reliable High Quality Supporting Manufacturing

Smart Control Using Proprietary "A-format" Communication

The A-format[®] communication protocol used between the servo driver and encoder allows high-accuracy, high-speed control with reduced wiring. Up to eight units can be connected using a bus connection, reducing cabling and equipment dimensions and improving design flexibility. Moreover, high-speed communication up to 16 Mbps allows smooth and accurate robot motion control, making it ideal for precision machining and high-speed production.



Predictive Maintenance for Reduced Risk of Sudden Shutdown

The MAR-M700 Series features redundant design with two sets of light-emitting and receiving elements to prevent system shutdown if one should fail. The predictive maintenance function issues alarms for potential failure signs, allowing maintenance to be performed at the optimal timing.

Reliable High Quality

Minimizes product quality variations through consistent in-house production at automated domestic factories. Ensures a consistent supply of high-quality products. Products are subjected to diverse tests (temperature environment, noise, shock, limit tests, etc.) based on Nikon's own rigorous evaluation standards in the pursuit of even higher reliability and quality.

Application



General automation process applications



Wafer handling in semiconductor manufacturing equipment



Automotive manufacturing process



Medical robot manipulator drive

Product Map

Modular type		
M700 Series	M60 Series	M50 Series
φ35mm Thickness 12.5mm (M700MFA) Max. Resolution 27 bit Max. Operating Temperature 105°C	φ35mm Thickness 13.7mm (MX60MFA) Max. Resolution 27 bit Max. Operating Temperature 85°C	φ35mm Thickness 13.4mm (M50A) Max. Resolution 24 bit Max. Operating Temperature 95°C

Compact dimensions

Multi-turn model

Battery-free model

MAR-M700MFA MAR-MX60MFA

MAR-M50A

MAR-M700A MAR-MX60A

Single-turn model

SAR-ML700A SAR-ML60A SAR-ML50A

Shaft type	
H700 Series	H60 Series
Max. Resolution 27 bit Max. Operating Temperature 95°C (H700MFA)	Max. Resolution 27 bit Max. Operating Temperature 95°C (HX60A)

Compact dimensions

Multi-turn model

Battery-free model

MAR-H700MFA Straight shaft

MAR-HX60MFA Ø 79 Oldham coupling

MAR-HX60MFA □40 Oldham coupling

MAR-H700MFA Ø 79 Oldham coupling

MAR-H700MFA □40 Oldham coupling

MAR-H700A Straight shaft

MAR-HX60A Ø 79 Oldham coupling

MAR-HX60A □40 Oldham coupling

Modular type	
MC52 Series	MCX63 Series
Disk hollow shaft inner diameter φ 24 mm Max. Resolution 24 bit Max. Operating Temperature 95°C	Disk hollow shaft inner diameter φ 63 mm Max. Resolution 27 bit Max. Operating Temperature 105°C

Hollow-shaft model

Multi-turn model

MAR-MC52A MAR-MCX63A

Modular type
ML51 Series
□14 mm Max. Resolution 20 bit Max. Operating Temperature 95°C

Ultra-compact dimensions

Single-turn model

SAR-ML51A

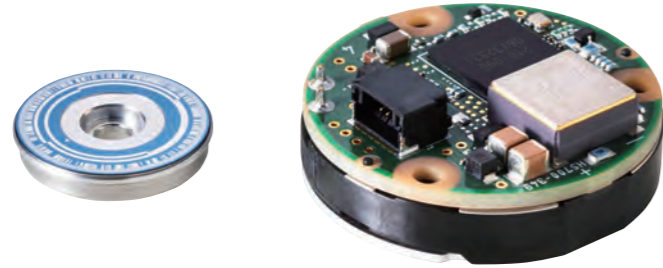
Model number configuration

MAR - M 700 MF A

Symbol	Special specifications
MF	Maintenance-free (external battery-free model)
Symbol	Rotation detection method
	Magnetic multi-turn (M700series : Optical multi-turn)
X	Optical multi-turn
L	Single-turn
Symbol	Mounting method
M	Modular type
H	Shaft type

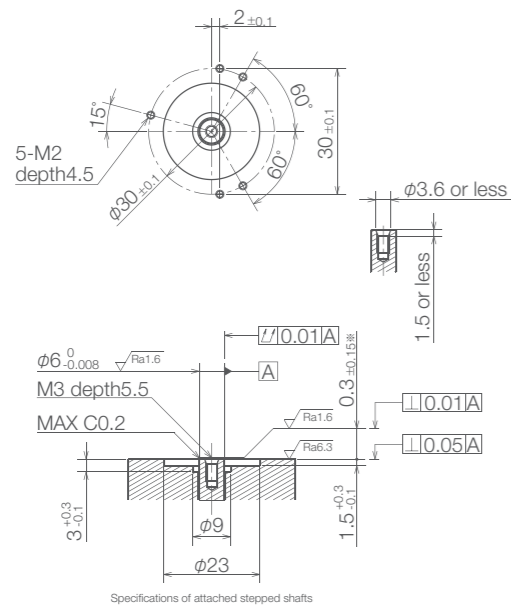
MAR-M700MFA

Multi-turn battery-free Absolute Encoder mounted with All-Solid-State Battery

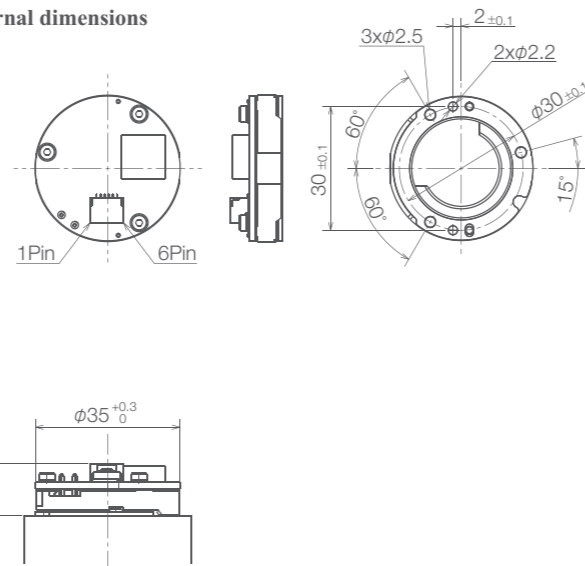


Multi-Turn Absolute Encoder MAR-M700MFA

• Installation dimensions



• External dimensions



Applications

Ideal for small AC servo motors used in compact industrial robots, service robots, pick-and-place machine, and other equipment.

External battery-free

World-first all-solid-state battery model retains multi-turn information without an external power supply. Provides protection against the risk of sudden power loss.

High resolution

Provides up to 27 bit resolution.

Angle accuracy self-correction function

Features an error correction function for self-correction without using a reference encoder.

Battery-free design is thinner than conventional encoder (M50A)

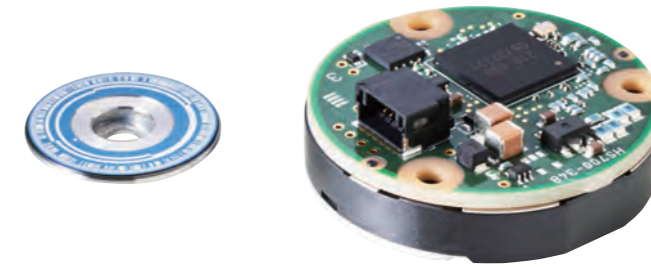
- Utilizing our unique light utilization and precision technology, Nikon have adopted a reflective optical system.
- Achieves high-precision position detection by achieving a compact, low-profile design and high resolution of up to 27 bits without requiring an external battery.

Guaranteed temperature range up to 105°C

- By using a temperature-resistant internal power supply, the operating temperature range has been extended to -20°C to +105°C.
- Resistant to magnetic fields and electromagnetic noise, ensuring stable operation even in harsh environments.

MAR-M700A/SAR-ML700A

Predictive maintenance function is available to minimize the risk of sudden failure-induced shutdowns. Compatible design with the conventional M50 and M60 series and can be installed without modifying mounting parts.



Multi-Turn /Single-Turn Absolute Encoder MAR-M700A/SAR-ML700A

MAR-H700MFA

World-First Multi-Turn External Battery-Free Absolute Encoder with All-Solid-State Battery
Both external battery-less type and standard type are available for the shaft models.



Multi-Turn Absolute Encoder
MAR-H700MFA
φ79 Oldham coupling



Multi-Turn Absolute Encoder
MAR-H700MFA
Straight shaft



Multi-Turn Absolute Encoder
MAR-H700MFA
□40 Oldham coupling

Reduce the risk of sudden equipment stoppage due to failure with equipped predictive maintenance function

- Equipped with redundant design and predictive maintenance function using two light-emitting/receiving elements.
- Prevents system downtime even in the event of a malfunction, and enables optimal maintenance with predictive alarms, reducing user effort and anxiety.

Equipped with a unique angular accuracy self-correction function that contributes to enhance the motion accuracy

- By utilizing two light receiving sensors and LEDs, motor assembly work time is significantly reduced.
- Automatic correction of angle errors during assembly, allowing adjustment work to be completed in approximately 10 seconds.

MAR-MX60A

Super Mid-Range series to suit a wide range of applications.



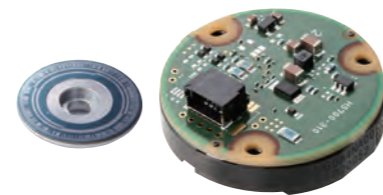
Multi-Turn Absolute Encoder MAR-MX60MFA

Applications

Ideal for small AC servo motors used in compact industrial robots, service robots, pick-and-place machine, and other equipment.

Battery-free configuration achieves the same thin profile as conventional products.

The MAR-MX60MFA is an innovative absolute encoder that incorporates a proprietary Nikon battery-free design to achieve the same thin profile as conventional products. Eliminates the need for major design changes when developing new equipment or replacing existing devices or encoders.



Multi-Turn/Single-Turn Absolute Encoder MAR-MX60A/SAR-ML60A

High resolution

Provides up to 27 bit resolution.

High operating temperatures

The MAR-MX60A features a guaranteed operating temperature of 105°C. Improved resistance to various environment parameters increases flexibility in motor and equipment design.

MAR-HX60A

Mid-range MX60 Series model with Oldham coupling.



Multi-Turn Absolute Encoder MAR-HX60MFA φ79 Oldham coupling

Applications

Ideal for small AC servo motors used in compact industrial robots, service robots, pick-and-place machine, and other equipment.

High resolution

Provides up to 27 bit resolution.



Multi-Turn Absolute Encoder MAR-HX60A □40 Oldham coupling

External battery-free

The MAR-HX60MFA uses Nikon's unique battery-free design. It retains multi-turn information without an external power source, protecting against the risk of sudden power loss.

MAR-M50A

Standard model M50 Series Absolute Encoder.



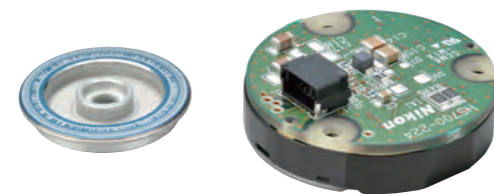
Multi-Turn Absolute Encoder MAR-M50A

Applications

Ideal for small AC servo motors used in compact industrial robots, service robots, pick-and-place machine, and other equipment.

Ultra-thin construction based on reflective optics

Uses proprietary Nikon optical design to achieve a thickness in the range of 12 mm. The thickness is less than half that of conventional transmissive encoders.



Single-Turn Absolute Encoder SAR-ML50A

High resolution

Provides up to 24 bit resolution.

High operating temperatures

Guaranteed operating temperatures up to 95°C. Outstanding heat resistance and improved heat dissipation characteristics

MAR-MCX63A

Large inner diameter hollow-shaft absolute encoder.



Multi-Turn Absolute Encoder MAR-MCX63A

Applications

Ideal for hollow actuators used in multi-joint robots. The lineup now includes a hollow-shaft model with large internal diameter. Disk hollow shaft inner diameter: $\varnothing 63$ mm. Outer diameter: $\varnothing 113$ mm. Thickness: approx. 12 mm.

High resolution

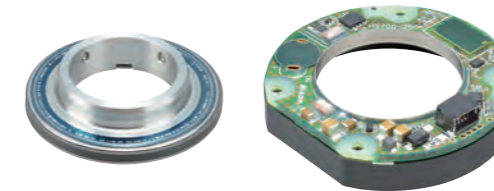
Provides up to 27 bit resolution.

High operating temperatures

The MAR-MCX63A features a guaranteed operating temperature of 105°C. Improved resistance to various environment parameters increases flexibility in motor and equipment design.

MAR-MC52A

Hollow-shaft turn absolute encoder.



Multi-Turn Absolute Encoder MAR-MC52A

Applications

Ideal for hollow actuators used in multi-joint robots.

Two different inner diameter models requiring no signal adjustments

Proprietary Nikon optics help achieve a reliable design that allows for gap and thrust variations. Two models are available with disk hollow shaft inner diameters of $\varnothing 15$ mm and $\varnothing 24$ mm (maximum shaft diameter $\varnothing 25$ mm), providing functionality without signal adjustments.

High resolution

Provides up to 24 bit resolution.

High operating temperatures

The MAR-MC52A features a guaranteed operating temperature of 95°C. Improved resistance to various environment parameters increases flexibility in motor and equipment design.

SAR-ML51A

Ultra-compact model capable of all types of precision positioning.



Single-Turn Absolute Encoder SAR-ML51A

Applications

Ideal for applications requiring compact dimensions, such as precision hands, medical syringe pumps, and optical adjustments.

High resolution

Provides up to 20 bit high resolution despite its ultra-compact dimensions.

Ultra-compact dimensions

World-leading ultra-compact 14 mm square size, making it ideal for drive units requiring minimal space.

M700/H700 Series

Model		MAR-M700MFA	MAR-H700MFA	MAR-M700A	SAR-ML700A
Resolution	Single-turn	MAX 27bit (134,217,728 positions/rev.)		MAX 27bit (134,217,728 positions/rev.)	MAX 27bit (134,217,728 positions/rev.)
	Multi-turn signal	MAX 16 bit (65,536 revolutions)		MAX 16 bit (65,536 revolutions)	—
Response rotation speed	With main power on	8,000 min ⁻¹		8,000 min ⁻¹	8,000 min ⁻¹
	With backup battery	8,000 min ⁻¹		8,000 min ⁻¹	—
Power supply voltage	With main power on	DC 5 V		DC 5 V	DC 5 V
	With backup battery	—		DC 3.6 V	—
Current consumption	Normal operation	105 mA (TYP)		105 mA (TYP)	105 mA (TYP)
	Using external battery	—		55 μA (TYP)	—
Operating temperature range		-20°C~ +105°C	-20°C~ +95°C	-20°C~ +105°C	-20°C~ +105°C
Mechanical specifications	Axial moment of inertia(kg·m ²)	1.2 × 10 ⁻⁷		3.9 × 10 ⁻⁸	3.9 × 10 ⁻⁸
	Permitted rotational angular velocity(rad/sec ²)	1.0 × 10 ⁵		1.0 × 10 ⁵	1.0 × 10 ⁵
Communication specifications		A-format® Supports various communication formats			
Transmission standard		EIA standard RS-485 compliant			
Transmission method		NRZ code half-duplex serial communications			
Baud rate(Option)		2.5 Mbps (Option : 4 Mbps~16 Mbps)			
Number of signal wires(Option)		4	4 (Option : 6)		4
Functions		3.75k bit (240×16bit) (expandable)			
Memory access development space		3.75k bit (240×16bit) (expandable)			
Temperature sensor		○	○	○	○
Bus connectivity(Option)		○	○	○	○

M60/H60 Series

Model		MAR-MX60MFA	MAR-MX60A	MAR-HX60MFA (\varnothing 79 Oldham coupling)	MAR-HX60A (\square 40 Oldham coupling)	SAR-ML60A
Resolution	Single-turn	MAX 27bit (134,217,728 positions/rev.)	MAX 27bit (134,217,728 positions/rev.)	MAX 27bit (134,217,728 positions/rev.)	MAX 27bit (134,217,728 positions/rev.)	MAX 27bit (134,217,728 positions/rev.)
	Multi-turn signal	MAX 16 bit (65,536 revolutions)	MAX 16 bit (65,536 revolutions)	MAX 16 bit (65,536 revolutions)	MAX 16 bit (65,536 revolutions)	—
Response rotation speed	With main power on	8,000 min ⁻¹	8,000 min ⁻¹	6,000 min ⁻¹	6,000 min ⁻¹	8,000 min ⁻¹
	With backup battery	8,000 min ⁻¹	8,000 min ⁻¹	6,000 min ⁻¹	6,000 min ⁻¹	—
Power supply voltage	With main power on	DC 5 V	DC 5 V	DC 5 V	DC 5 V	DC 5 V
	With backup battery	—	DC 3.6 V	—	DC 3.6 V	—
Current consumption	Normal operation	80 mA (TYP)	80 mA (TYP)	80 mA (TYP)	80 mA (TYP)	80 mA (TYP)
	Using external battery	—	55 μA (TYP)	—	55 μA (TYP)	—
Operating temperature range		-20°C~ +85°C	-20°C~ +105°C	-20°C~ +85°C	-20°C~ +95°C	-20°C~ +105°C
Mechanical specifications	Axial moment of inertia (kg·m ²)	1.2 × 10 ⁻⁷	3.9 × 10 ⁻⁸	22.2 × 10 ⁻⁷	21.5 × 10 ⁻⁷	3.9 × 10 ⁻⁸
	Permitted rotational angular velocity (rad/sec ²)	1.0 × 10 ⁵	1.0 × 10 ⁵	1.0 × 10 ⁵	1.0 × 10 ⁵	1.0 × 10 ⁵
Communication specifications		A-format® Supports various communication formats				
Transmission standard		EIA standard RS-485 compliant				
Transmission method		NRZ code half-duplex serial communications				
Baud rate (Option)		2.5 Mbps (Option : 4 Mbps~16 Mbps)				
Number of signal wires (Option)		4	4 (Option: 6)	4	4 (Option : 6)	4
Functions		3.75k bit (240×16bit)				
Memory access development space		3.75k bit (240×16bit)				
Temperature sensor		○	○	○	○	○
Bus connectivity (Option)		○	○	○	○	○

Hollow-shaft model/Ultra-compact dimensions Series

Model		MAR-MC52A	MAR-MCX63A	SAR-ML51A
Resolution	Single-turn	MAX 24bit (16,777,216 positions/rev.)	MAX 27bit (134,217,728 positions/rev.)	MAX 20bit (1,048,576 positions/rev.)
	Multi-turn signal	MAX 16 bit (65,536 revolutions)	MAX 16 bit (65,536 revolutions)	—
Response rotation speed	With main power on	6,000 min ⁻¹	6,000 min ⁻¹	6,000 min ⁻¹
	With backup battery	6,000 min ⁻¹	6,000 min ⁻¹	—
Power supply voltage	With main power on	DC 5 V	DC 5 V	DC 5 V
	With backup battery	DC 3.6 V	DC 3.6 V	—
Current consumption	Normal operation	65 mA (TYP)	75 mA (TYP)	65 mA (TYP)
	Using external battery	30 μA (TYP)	55 μA (TYP)	—
Operating temperature range		-20°C~ +95°C	-20°C~ +105°C	-20°C~ +95°C
Mechanical specifications	Axial moment of inertia (kg·m ²)	6.03 × 10 ⁻⁶	3.59 × 10 ⁻⁵	0.02 × 10 ⁻⁷
	Permitted rotational angular velocity (rad/sec ²)	1.0 × 10 ⁵	1.0 × 10 ⁵	1.0 × 10 ⁵
Communication specifications		A-format® Supports various communication formats		
Transmission standard		EIA standard RS-485 compliant		
Transmission method		NRZ code half-duplex serial communications		
Baud rate (Option)		2.5 Mbps (Option : 4 Mbps~16 Mbps)		
Number of signal wires (Option)		4 (Option: 6)		
Functions		3.75k bit (240×16bit)		
Memory access development space		3.75k bit (240×16bit)		
Temperature sensor		○	○	○
Bus connectivity (Option)		○	○	○

M50 Series

Model		MAR-M50A	SAR-ML50A
Resolution	Single-turn	MAX 24bit (16,777,216 positions/rev.)	MAX 24bit (16,777,216 positions/rev.)
	Multi-turn signal	MAX 16 bit (65,536 revolutions)	—
Response rotation speed	With main power on	6,000 min ⁻¹	6,000 min ⁻¹
	With backup battery	10,000 min ⁻¹	—
Power supply voltage	With main power on	DC 5 V	DC 5 V
	With backup battery	DC 3.6 V	—
Current consumption	Normal operation	65 mA (TYP)	65 mA (TYP)
	Using external battery	30 μA (TYP)	—
Operating temperature range		-20°C~ +95°C	-20°C~ +95°C
Mechanical specifications	Axial moment of inertia (kg·m ²)	3.25 × 10 ⁻⁷	3.25 × 10 ⁻⁷
	Permitted rotational angular velocity (rad/sec ²)	1.0 × 10 ⁵	1.0 × 10 ⁵
Communication specifications		A-format® Supports various communication formats	
Transmission standard		EIA standard RS-485 compliant	
Transmission method		NRZ code half-duplex serial communications	
Baud rate (Option)		2.5 Mbps (Option : 4 Mbps~16 Mbps)	
Number of signal wires (Option)		4 (Option: 6)	4
Functions		3.75k bit (240×16bit)	
Memory access development space		3.75k bit (240×16bit)	
Temperature sensor		○	○
Bus connectivity (Option)		○	○



Safety Precautions

Please read the Delivery Specifications before use to ensure correct use of the product.

- Company names and product names mentioned in this brochure are the trademarks or registered trademarks of their respective companies.
- A-format® is a registered trademark of Nikon Corporation.
- The product free warranty period is one year after delivery. Note that the warranty is void if the product is used in ways outside the product specifications (as stated in the specifications) or if the quality has deteriorated due to deliberate action or negligence on the part of the customer. Note that analysis after the free warranty period will be charged in principle.
- This brochure is current as of October 2025. Specifications and products are subject to change without notice, with no liabilities on the part of the manufacturer or retailer.



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