

POSITAL

FRABA

DATA SHEET

ABSOLUTE MAGNETIC ROTARY ENCODER

ANALOG



High-resolution absolute rotary encoder with analog output based on contactless magnetic Hall Effect technology. The Multi Turn rotary encoder can measure up to 65536 revolutions (16Bit). The Voltage or Current output of this rotary encoder is programmable, thus it can be scaled to fit perfect in any kind of application, particularly as a replace-

ment for potentiometers. The PushButton and visible LED feedback makes the programming very easy. This rotary encoder can be used as a replacement for less reliable Multi Turn potentiometers. The sensor can be also used as an economical Multi Turn feedback sensor for low cost control systems with analog inputs.

Main Features

- Compact Industrial Design
- Interface: Analog – Current, Voltage
- Housing: \varnothing 36,5 mm
- Shaft: \varnothing 6 mm
- Blind Hollow / Hub Shaft: \varnothing 6 mm
- 12 Bit Total Resolution
- Factory Default Turns: 16 (0 To 5760°)
- Inputs for User Defined Measuring Range
- Over Range and Under Range Deadband
- EMC: EN 61000-6-2, EN 61000-6-4

Mechanical Structure

- Aluminum Flange
- Coated Steel Housing
- Stainless Steel Shaft
- Precision Ball Bearings

Suitable for Applications Requiring

- Packaging machines
- Material Handling
- Buses and Trucks
- Solar Tracking
- Wind Turbines
- Construction Machines
- Defense Equipment

Electrical Features

- Reverse Voltage Protection
- Over-Voltage Protection
- Programmable Measurement Range
- Short Circuit Protection of Output

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Technical Data

Electrical Data

| | | |
|-----------------------------------|---------------------------------------|---------------|
| Current Options | 4–20 mA | 0–20 mA |
| Max Load Resistance ¹⁾ | 500 Ω | |
| Supply Voltage ²⁾ | 15–30 V DC (absolute maximum ratings) | |
| Linearity | 0.15 % | |
| Analog Accuracy | At 4mA = ±10µA; at 20mA = ± 50 µA | |
| Supply Voltage Cutoff/ Output | 14.8 V / 3.6 mA | 14.8 V / 0 mA |
| Settling Time | 80 ms | |
| Current Consumption | Typical 40 mA | |

1) Max value for supply voltage 15V. For higher supply voltage higher load resistances can be used.

2) Supply voltage according to EN 50 178 (safety extra-low voltage)

| | | | | |
|-----------------------------------|---------------------------------------|---------------|------------|---------------|
| Voltage Options | 0–5 V | 0.5–4.5V | 0–10 V | 0.5–9.5V |
| Min Load Resistance ¹⁾ | 10 kΩ | | | |
| Supply Voltage ²⁾ | 12-30 V DC (absolute maximum ratings) | | | |
| Linearity | 0.15% | | | |
| Analog Accuracy | at 5V = ±15mV; at 10V = ± 25mV | | | |
| Supply Voltage Cutoff/ Output | 11.8 / 0 V | 11.8 / 0.25 V | 11.8 / 0 V | 11.8 / 0.25 V |
| Settling Time | 80 ms | | | |
| Current Consumption | Typical 15 mA | | | |

1) Min value for supply voltage 12V. For higher supply voltage lower load resistances can be used-

2) Supply voltage according to EN 50 178 (safety extra-low voltage)

General Data

| | |
|---------------------|---|
| Turn On Time | < 1 s |
| Electrical Lifetime | > 10 ⁵ h |
| EMC | Emitted interference: EN 61000-6-4 Noise immunity: EN 61000-6-2 (500 V surge test) |
| Connection | Cable exit or M12 Connector |

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Sensor Data

| | |
|------------------------------------|---|
| Single Turn Technology | Magnetic 2 axis Hall sensor |
| Resolution of Output ¹⁾ | Max 12 bits over entire measuring range |
| Minimum Measurement Range | 0 to 22.5° |
| Single Turn Accuracy | Calibrated $\pm 0.35^\circ$ |
| Multi Turn Technology | Self supplied magnetic pulse counter |
| Multi Turn Range | 16 turns (default setting) User can use the scaling functionality to measure up to 65,536 turns |
| Signal Sense (Default) | Counterclockwise shaft movement (front view on shaft) means increasing output value |

1) Fractional Turns - Resolution decreases less than 12 bits when measurement range is less than 90 degrees

Mechanical Data

| | |
|----------------------------|---|
| Housing | Zinc Nickel Coated Steel Housing |
| Flange | Aluminum |
| Shaft | Stainless Steel |
| Lifetime | Dependent on shaft version and shaft loading – refer to table |
| Max. Shaft Load | Axial 20 N (4.5 lbs), radial 80 N (18 lbs) |
| Inertia of Rotor | $\leq 20 \text{ gcm}^2$ (0.11 oz-in ²) |
| Friction Torque at +25°C | $\leq 2 \text{ Ncm}$, (0,11 oz-in) |
| RPM (continuous operation) | Max. 12.000 RPM |
| Shock | EN 60068-2-27 $\leq 100 \text{ g}$ (half sine, 6 ms XYZ) |
| | MIL-STD-810C $\leq 200 \text{ g}$ (half sine, 3 ms XYZ) |
| Permanent Shock | EN 60028-2-29 $\leq 10 \text{ g}$ (half sine, 16 ms XYZ) |
| | MIL-STD-810C $\leq 30 \text{ g}$ (half sine, 11 ms XYZ) |
| Vibration | EN 60068-2-6 $\leq 10 \text{ g}$ (10 Hz – 1,000 Hz, XYZ) |
| | MIL-STD-810 $\leq 4.2 \text{ g}$ (5 Hz – 500 Hz XYZ) |
| Weight (Standard Version) | $\approx 150 \text{ g}$ (0.33 lbs), including cable |

| | | |
|----------------|---------------------|------------------|
| Flange | Synchro (S) | Hub shaft (B) |
| Shaft Diameter | 6 mm (~0.236 in) | 6 mm (~0.236 in) |
| Shaft Length | 11,5 mm (~0.453 in) | - ¹⁾ |

1) Mating Shaft: min: 8 mm (~0.315 in) / max: 18 mm (~0.709 in)

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Minimum (mechanical) Lifetime

| Flange | Lifetime in 10 ⁸ revolutions with (F _a /F _r) | | |
|---|--|-----------|------------|
| | 20 N/20 N | 20 N/40 N | 20 N/80 N |
| S6 Synchro Flange (MCD-...-S060-...) | 224 | 28 | 3 |
| | 40 N/600 N | 40 N/80 N | 40 N/110 N |
| C100 Clamp Flange (MCD-...-C100-...) | 247 | 104 | 40 |

Environmental Conditions

| | |
|--|--|
| Operating Temperature Sensor ¹⁾ | -40 – +85° (-40 – +185°F) |
| Storage Temperature | -40 – +85° (-42 – +185°F) |
| Humidity | 98 % Non-condensing |
| Protection Class (EN 60529) ²⁾ Casing Side | IP 54 (molded: MCD-...-CAW and MCD-...-CRW) IP 65 (other types: MCD-...-PAM and MCD-...-GAW) |
| Protection Class (EN 60529) ²⁾ Shaft Side | IP 65 (clamp flange: MCD-...-C100-...) IP 54 (other types: MCD-...-S060-... and MCD-...-B060-...) |

1) Higher temperatures [up to 125°C (257°F) for Singleturn] possible on request. See Operating Temperature: Cables

2) Higher IP ratings (up to 69K) on request

Cable¹⁾

| | |
|-----------------------------|--|
| Operating Temperature Cable | Flexing -5°C to +70°C (+23 – +158°F) Static -30°C to +70°C (-22 – +158°F) |
| Minimum Bend Radius | Flexing 10 x cable diameter/Static 5x cable diameter |
| Cable | Approx Ø 6 mm (~0.236 in)/Type : LIYCY 4x2x0.14 (~AWG 26) |

1) Valid for types: MCD-...-CAW, MCD-...-GAW, MCD-...-CRW

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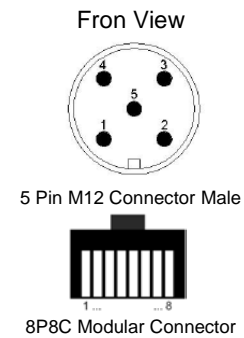
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Interface

Electrical Connection

| Pin M12 | Pin 8P8C | Wire End | Function |
|---------|----------|-----------|-------------------------|
| 1 | 3 | Green | Current/Voltage |
| 2 | 8 | Red | + V _S Supply |
| 3 | 4 | Yellow | GND (Supply) |
| 4 | 1 | White | Set 2 |
| 5 | 2 | Brown | Set 1 |
| Housing | – | Shielding | Shielding |



Scaling Functionality For Non-PushButton Versions (*MCD-AX0XX-..*)

Using the Set 1 and Set 2 Input Signals the measuring range (min range of 22.5°) with the analog output range can be scaled

- Turn the shaft to the min position (One end of the measuring range).
- Connect Set 1 signal to high level for 1 second.
- Turn the encoder shaft to the max position (Other end of the measuring range).
- Connect Set 2 signal to high level for 1 second.
- Analog Output is scaled to the new measuring range.

| Set 2 (White) | Set 1 (Brown) | Function |
|---|---|---|
| 0 (Input = N.C. or GND) | 0 (Input = N.C. or GND) | Normal Operation |
| 0 (Input = N.C. or GND) | 1 (Input ≥ 12V / Input ≤ V _S) | Preset Zero Point |
| 1 (Input ≥ 12V / Input ≤ V _S) | 0 (Input = N.C. or GND) | Preset Max Point |
| 1 (Input ≥ 12V / Input ≤ V _S) | 1 (Input ≥ 12V / Input ≤ V _S) | Reset Midpoint of Default Scale ¹⁾ |

1) See table on page 7 for exact values

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Scaling Functionality For PushButton Versions (MCD-AXPXX-..)

Using the Lim 1 and Lim 2 PushButtons on the housing the measuring range (min range of 22.5°) or the analog output range can be scaled

- Press Lim 1 and Lim 2 together for 15 sec to enter programming mode
- Turn the shaft to the min position (One end of the measuring range)
- Press Lim 1 for 1 sec
- Turn the encoder shaft to the max position (Other end of the measuring range)
- Press Lim 2 for 1 sec
- Analog Output is scaled to the new measuring range.

Timing Value: Operation Mode

| Action | Time (Sec) | Device State |
|---------------|------------|-------------------------|
| Both Buttons | 15.0 | Enter programming mode |
| Both Buttons | 30.0 | Reset to Mid of default |
| Single Button | – | Normal operation |



Timing Value: Programming Mode

| Action | Lim 1 pressed | Device State |
|---------------|---------------|------------------------|
| Both buttons | – | Abort programming mode |
| Lim 1 pressed | 1.0 | Set position 1 |
| Lim 2 pressed | 1.0 | Set position 2 |

LED States

| Yellow LED | Green LED | Description |
|------------|-----------|---|
| On | Off | Operation with default scale ("factory mode") |
| Off | On | Operation with user scale |
| On | On | Entering programming mode (temporary state) |
| Flashing | Flashing | Programming mode |
| On | Flashing | Position 2 set, waiting for position 1 |
| Flashing | On | Position 1 set, waiting for position 2 |

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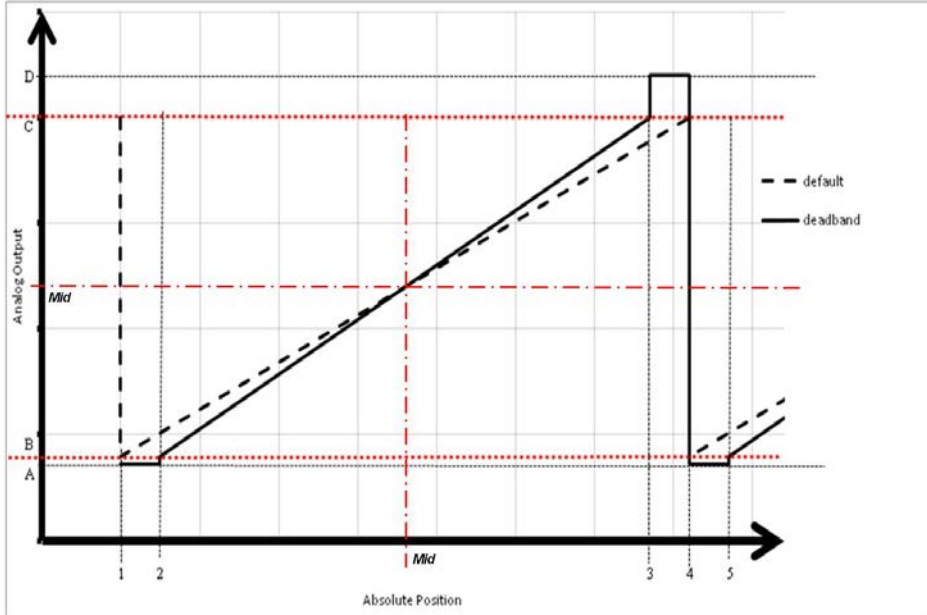
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Output Characteristics



| Encoder Type ¹⁾ | Absolute Position in Degrees | | | | | |
|--|------------------------------|-------------|----------------------|------------|----------------------------|-------------|
| | 1 | 2 | Mid | 3 | 4 | 5 |
| MCD-AXX0X-0012-... | 0 | – | 180° | – | 360° or 0° | – |
| User Scaled ...-0012-... | 0 | Preset Zero | – | Preset Max | 360° or 0° | Preset Zero |
| MCD-AXX0X-0412-... | 0 | – | 2 ² *360° | – | 2 ⁴ *360° or 0° | – |
| User Scaled ²⁾ ...-0412-... | 0 | Preset Zero | – | Preset Max | 2 ⁿ *360° or 0° | Preset Zero |

n is any integer between 0 and 16,

1) Refer to "Models / Ordering Description" for detailed information

2) Rollover occurs at 360, 720, 1440, 2880, 5760, ... when user scale is less than these values.

| Encoder Output Type | Analog Output Value in mA or V | | | | |
|-------------------------|--------------------------------|-----|-----|-----|------|
| | A | B | Mid | C | D |
| 0–5 V (...-AVX01-.) | – | 0 | 2.5 | 5 | – |
| 0.5–4.5 V (...-AVX03-.) | 0.25 | 0.5 | 2.5 | 4.5 | 4.75 |
| 0–10 V (...-AVX02-.) | – | 0 | 5 | 10 | – |
| 0.5–9.5 V (...-AVX04-.) | 0.25 | 0.5 | 5 | 9.5 | 9.75 |
| 4–20 mA (...-ACX05-.) | 3.6 | 4 | 12 | 20 | 22 |
| 0–20 mA (...-ACX06-.) | – | 0 | 10 | 20 | – |

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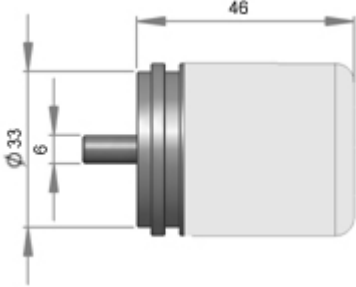

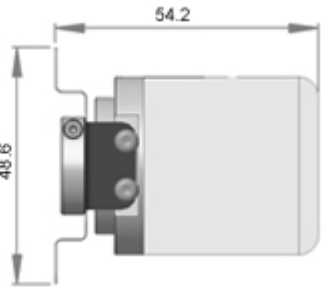
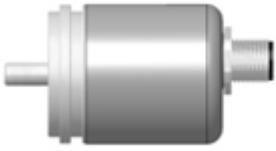
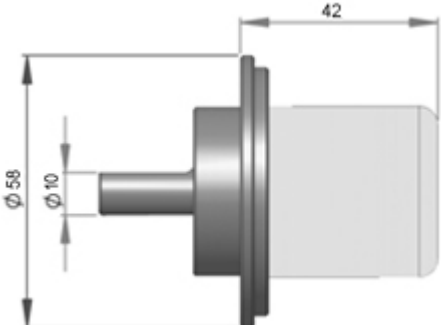


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Mechanical Models

For detailed drawings please refer our [website](#) or directly contact us. Also available as IGES Drawing and STEP 3D Model.

| Flange Type | Housing and Connector Type |
|--|--|
| <p>Synchro Flange. MCD-XXXX-XXXX-S060-XXX</p>  | <p>Axial Cable Exit MCD-XXXX-XXXX-XXXX-CAW</p>  |
| <p>Blind Hollow Shaft / Hub Shaft MCD-XXXX-XXXX-B060-XXX</p>  | <p>M12 Connector MCD-XXXX-XXXX-XXXX-PAM</p>  |
| <p>Clamp Flange MCD-XXXX-XXXX-C100-XXX</p>  | <p>Axial Cable Exit with Gland MCD-XXXX-XXXX-XXXX-GAW</p>  |
| | <p>Radial Cable Exit MCD-XXXX-XXXX-XXXX-CRW</p>  |

All units measured in mm

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Models / Ordering Description

| Description | Type key | | | | | | | | |
|--|--|-----------|-----------|---|----|-----------|---|----------|------------|
| Magnetocode | MCD - | -- | 00 | - | -- | -- | - | -- | -- |
| Interface ¹⁾ | Current | AC | | | | | | | |
| | Voltage | AV | | | | | | | |
| Version | Standard | | 00 | | | | | | |
| | PushButton ²⁾ | | P0 | | | | | | CRW |
| Code | AV = 0–5V | | 1 | | | | | | |
| | AV = 0–10 V | | 2 | | | | | | |
| | AV = 0.5–4.5 V | | 3 | | | | | | |
| | AV = 0.5–9.5 V | | 4 | | | | | | |
| | AC = 4–20 mA | | 5 | | | | | | |
| | AC = 0–20 mA | | 6 | | | | | | |
| Bits Corresponding to Number of Turns | 16 turns | | 04 | | | | | | |
| | 1 turns | | 00 | | | | | | |
| Bits for Max Single Turn Resolution of ³⁾ | 4096 | | | | | 12 | | | |
| Flange | Synchro Flange | | | | | S | | 06 | |
| | Blind Hollow Shaft with flexible mount | | | | | B | | 06 | |
| | Clamp Flange | | | | | C | | 10 | |
| Shaft Diameter | | | | | | | | | |
| Mechanical Options | Without | | | | | | | 0 | |
| Connection | Cable exit, axial 1m molded | | | | | | | | CAW |
| | Cable exit, radial 1m molded | | | | | | | | CRW |
| | Cable exit, axial 1m, with cable gland | | | | | | | | GAW |
| | 1x 5 pin M12 connector male | | | | | | | | PAM |

Standard = bold, further models on request

1) PWM interface available on Request

2) Radial cable exit housing with 2 PushButtons for user defined scaling.

3) Would be less for a multiturn encoder. The total resolution of 12 bits shall be spread over the entire measuring range.

Ordering Example

MCD-AC005-0412-S060-CAW

MCD-AVP03-0412-C100-CRW

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Check Out Some of the Other POSITAL Products



Absolute Magnetic Encoders for Industrial Environment

To measure rotary movements or rotary displacements, an absolute magnetic rotary encoder can be used. The contact-free measuring sensor stage of the MCD Sensor does not have any abrasion. The Sensor can be connected directly to digital control units via SSI, CANopen or Analog Interface.

[More Information](#)



Heavy Duty Stainless steel Magnetic Encoders for the Toughest Environments

Its stainless steel housing and high protection class of IP69K makes the MCD Heavy Duty rotary encoder resistant against active chemical cleaning and corrosion. Combined with the sturdy ball bearings this sensor is an ideal choice for reliable measurement under extreme environmental conditions and outdoor applications.

[More Information](#)



Tilt Sensors to Measure Inclinations up to 360°

ACS is developed on advanced MEMS technology based capacitance measurement. The sensor is a pre-calibrated device which can be put into immediate operation, upon simple and easy installation with a three point mount and setting of preset. Its compact design, installation "anywhere" and other versatile features makes it an ideal choice for very accurate measurement.

[More Information](#)

Disclaimer

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DATA SHEET

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List of types:

MCD-ACP05-0012-S060-CRW
MCD-ACP05-0012-B060-CRW
MCD-ACP05-0012-C100-CRW
MCD-ACP05-0412-S060-CRW
MCD-ACP05-0412-B060-CRW
MCD-ACP05-0412-C100-CRW
MCD-ACP06-0012-S060-CRW
MCD-ACP06-0012-B060-CRW
MCD-ACP06-0012-C100-CRW
MCD-ACP06-0412-S060-CRW
MCD-ACP06-0412-B060-CRW
MCD-ACP06-0412-C100-CRW
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MCD-AC005-0012-S060-CAW
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MCD-AC005-0012-B060-PAM
MCD-AC005-0012-B060-GAW
MCD-AC005-0012-B060-CAW
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MCD-AC005-0012-C100-PAM
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MCD-AC005-0012-C100-CAW
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MCD-AC006-0012-S060-GAW
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MCD-AC006-0012-B060-PAM
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MCD-AC006-0012-B060-CAW
MCD-AC006-0012-C100-CRW
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MCD-AC006-0412-C100-CAW
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MCD-AV001-0012-C100-GAW
MCD-AV001-0012-C100-CAW
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MCD-AV001-0412-S060-CAW
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MCD-AV001-0412-B060-GAW
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MCD-AV002-0412-C100-CAW
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MCD-AV003-0012-S060-GAW
MCD-AV003-0012-S060-CAW
MCD-AV003-0012-B060-CRW
MCD-AV003-0012-B060-PAM
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MCD-AV004-0012-S060-CAW
MCD-AV004-0012-B060-CRW
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MCD-AV004-0012-B060-GAW
MCD-AV004-0012-B060-CAW
MCD-AV004-0012-C100-CRW
MCD-AV004-0012-C100-PAM
MCD-AV004-0012-C100-GAW
MCD-AV004-0012-C100-CAW
MCD-AV004-0412-S060-CRW
MCD-AV004-0412-S060-PAM
MCD-AV004-0412-S060-GAW
MCD-AV004-0412-S060-CAW
MCD-AV004-0412-B060-CRW
MCD-AV004-0412-B060-PAM
MCD-AV004-0412-B060-GAW
MCD-AV004-0412-B060-CAW
MCD-AV004-0412-C100-CRW
MCD-AV004-0412-C100-PAM