M0007966C

SANMOTION

MOTION CONTROLLER

C

# MM240/A

## Encoder Interface Module

## Project engineering manual

SANYO DENKI

## Notes on This Manual

At various points in this manual you will see notes and precautionary warnings regarding possible hazards. The meaning of the symbols used is explained below.

**⚠ DANGER**

- **DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

**⚠ WARNING**

- **WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

**⚠ CAUTION**

- **CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**

**CAUTION**

- **CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property injury.**



**This symbol reminds you of the possible consequences of touching electrostatically sensitive components.**

***Note***

*Notes on use of equipment and useful practical tips are identified by the "Notice" symbol. Notices do not contain any information that draws attention to potentially dangerous or harmful functions.*

## History

| Modification from / to | Date | Modified pages | Description | Author |
|---|---|---|---|---|
| V1.0 | 201006 | | New | meis |
| V1.0 / V1.1 | 221106 | | Various changes | meis |
| V1.1 / V1.2 | 220207 | 23 | Changes to chapter "Connection diagram" | meis |
| V1.2A | Jul. 2007 | | | Okamura |
| V1.2B | Mar. 2008 | P10 | Change from [DI:0] to [DI:1] | |
| | | P13 | Change a table of pin assignment | |
| | | P18,19 | Add to [B] in figure | |
| | | P22 | Change a figure of latch input | |
| | | P23 | Add a figure | |
| | | P25 | | |
| V1.2C | Oct. 2012 | P26 | Delete [counter overflow] from diagnosis possibilities | satou |

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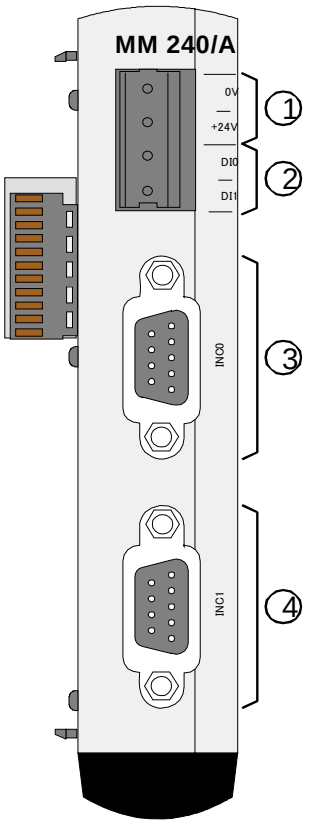
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# 1 Brief description

The MM 240/A is an incremental encoder interface module for the SANMOTION C control system with 2 incremental encoder inputs. It has two latch inputs for recording events.




① Voltage supply
② 2 Latch inputs
③ Encoder input 0
④ Encoder input 1

MM 240/A front view

# 2 General safety instructions

| CAUTION |
| --- |
| • **Turn off the power supply before inserting or removing the module. Otherwise, the module can be destroyed or undefined signal states can lead to damage of the control system.** |

# 3 Configuration

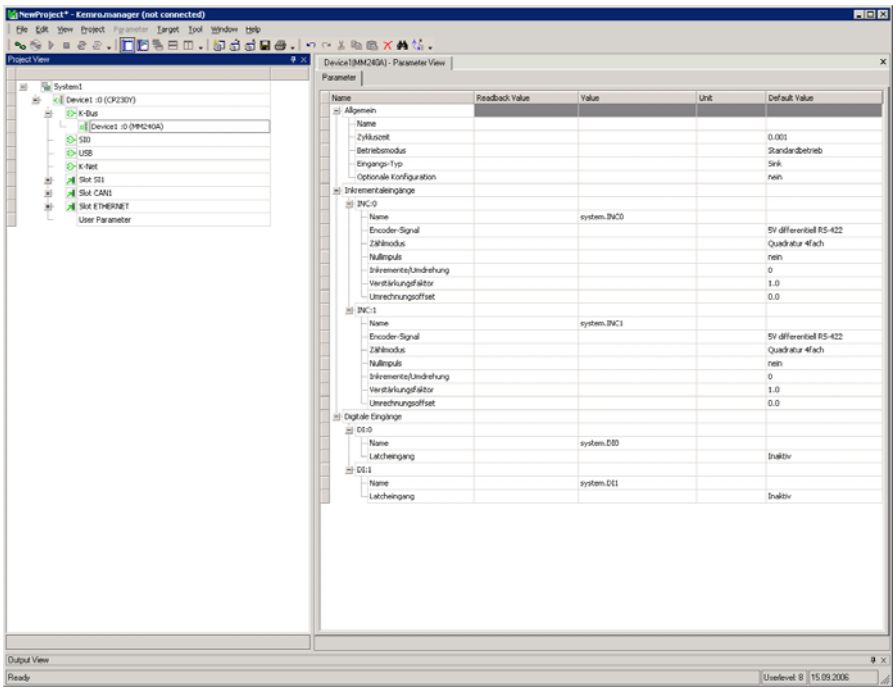
## General information

For configuration, the SANMOTION C system requires data that are read out from the configuration data (*.cfg) during the start-up of a master module.
There are 2 possibilities for configuring the MM 240/A:

- Via SANMOTION C manager
- Through creation of cfg-files

## Configuration via SANMOTION C manager

All modules of a system can be configured with the help of the SANMOTION C manager.
The example configuration has a MM 240/A added on to a CP 230/Y.
The right side lists the details of the respective parameter, which in this case are the details of the MM 240/A. The name of the module, the cycle time and the details of the encoder inputs can be specified here.




Screenshot SANMOTION C manager with an example configuration

Once all modules have been specified in the system and after all parameters have been adjusted the SANMOTION C manager creates the necessary cfg-files.

## Creation of cfg-files

All .cfg-files must be located in the directory “\\application\control\config" and are read-in during the start-up of the control-CPU.

**Example:**

Configuration of the K-Bus:

```
[IO.ONBOARD.KBUS:0]
name="KBUS"
cycleTime=0.001
```

Configuration of the MM 240/A:

```
[IO.ONBOARD.KBUS:0.MM240A:0]
name="MM240A"
cycleTime=0.001
simulate=0              // Operating mode:
                        // 0 ... Standard mode
                        // 1 ... Simulation mode
latchInputType=0        // Input type:
                        // 0 ... Sink
                        // 1 ... Source
```

Configuration of the individual incremental encoder inputs:

```
[IO.ONBOARD.KBUS:0.MM240A:0.INC:0]
name="system.INC0"
encoderType=1           // Encoder signal:
                        // 0 ... 24V-single ended
                        // 1 ... 5V differential
edgeCount=1             // Counter pulse:
                        // 1 ... Quadrature once
                        // 2 ... Quadrature twice
                        // 3 ... Quadrature 4 times
                        // 4 ... Counter track A
                        // 5 ... Counter track A / Direction track B
zeroLatchMode=0         // Zero pulse:
                        // 0 ... no
                        // 1 ... yes
incrementsPerRev=0
gain=1.0
offset=0.0
[IO.ONBOARD.KBUS:0.MM240A:0.INC:1]
name="system.INC1"
encoderType=1
edgeCount=1
zeroLatchMode=0
incrementsPerRev
gain=1.0
offset=0.0
```

Configuration of the latch inputs:

```
[IO.ONBOARD.KBUS:0.MM240A:0.DI:0]
name="system.DI0"
latchEdge=1             // Latch input:
                        // 0 ... Inactive
                        // 1 ... Latch input rising edge
                        // 2 ... Latch input falling edge
[IO.ONBOARD.KBUS:0.MM240A:0.DI:1]
name="system.DI1"
latchEdge=0
```

The following configuration options are available for users with a higher user level:

```
[IO.ONBOARD.KBUS:0.MM240A:0]
optional=0            // optional configuration:
                      // 0 ... if the module does not exist,
                      // an "Error" is output
                      // 1 ... if the module does not exist,
                      // a "Warning" is output
```

Hardware end points created through the configuration of the incremental inputs:

- `INC0 [KHW_Inc_Data] // Position value`
- `INC0_vel [KHW_Inc_Data] // Velocity value`
- `INC0_stat [BOOL] // Status: // (TRUE … Error)`
- `INC0_zeroData [KHW_Inc_Zero_Data] // Latch counter for // Zero pulse`
- `INC0_param [KHW_Inc_Param] // Parameterization`

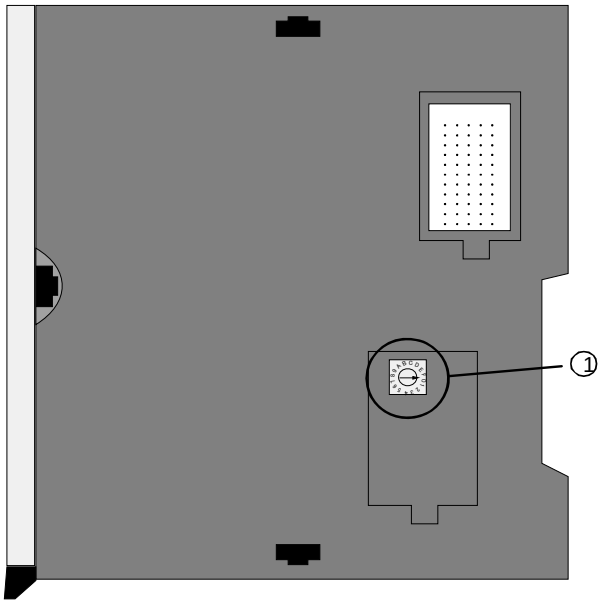
Hardware end points created through the configuration of the digital inputs:

- `DI0 [BOOL] // Digital input value`
- `DI0_stat [BOOL] // Status: // (TRUE … Error)`
- `DI0_latchData [KHW_Inc_Latch_Data] // Latch function via // edge change`

## Setting the address

The modules are addressed via the address switch. A maximum of 8 modules of the same type can be distinguished on one line. (Permitted address switch positions: 0 – 7)

The address switch is located on the right side underneath the lower cover. The K-Bus plug is located underneath the upper cover.




① Address switch

Position of the address switch

On leaving the factory all modules are set to address 0 and both covers are closed.

***Note**:*
*Modules of the same type that are installed within the same line must have different address switch positions. Different modules (e.g. MM 240 and DM 260) may have the same address switch positions.*

The lids for the K-Bus plug and the address switch must remain locked at the last module in the line. (to protect it against dirt and damage through electrostatic discharge on contact)

# 4 Connections, wiring

## Power input

The module is supplied by the CPU via K-Bus.

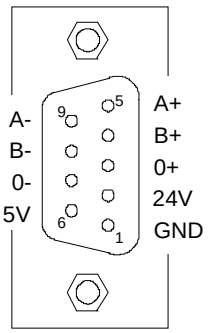
## Supply for connected transducers

The MM 240/A provides a 24V and 5V supply voltage for the connected incremental encoders.

Power supply is via the 24V terminal at the front.
The 24V are looped through secured, the 5V are generated internally in addition from the 24V that are fed in.
The 5V transducer supply can carry loads of up to 100mA each.

## Pin assignment Encoder input

The module is connected to the encoder via a 9-pole DSUB socket of the module.




Assignment Encoder interface, 9-pole DSUB socket connection, seen from front

| | Signal designation 5 V diff. | | Pin | Signal designation 24 V | | Pin |
|---|---|---|---|---|---|---|
| Signals | A+ | Track A+ | 5 | A+ | Track A+ | 5 |
| | A- | Track A- | 9 | A- | Do not connect | 9 |
| | B+ | Track B+ | 4 | B+ | Track B+ | 4 |
| | B- | Track B- | 8 | B- | Do not connect | 8 |
| | 0+ | Zero track+ | 3 | 0+ | Zero track+ | 3 |
| | 0- | Zero track- | 7 | 0- | Do not connect | 7 |
| Supply | 24 V | Transducer supply | 2 | 24 V | Transducer supply | 2 |
| | 5 V | Transducer supply | 6 | 5 V | Transducer supply | 6 |
| | GND | Ground | 1 | GND | Ground | 1 |

For further information, see chapter "Connection diagram"

## Encoder input

The encoder inputs can be operated in 2 operating modes:

- 5 V differential
- 24 V single ended.

Configuration is via software, see also chapter configuration (Parameter `encoderType`)

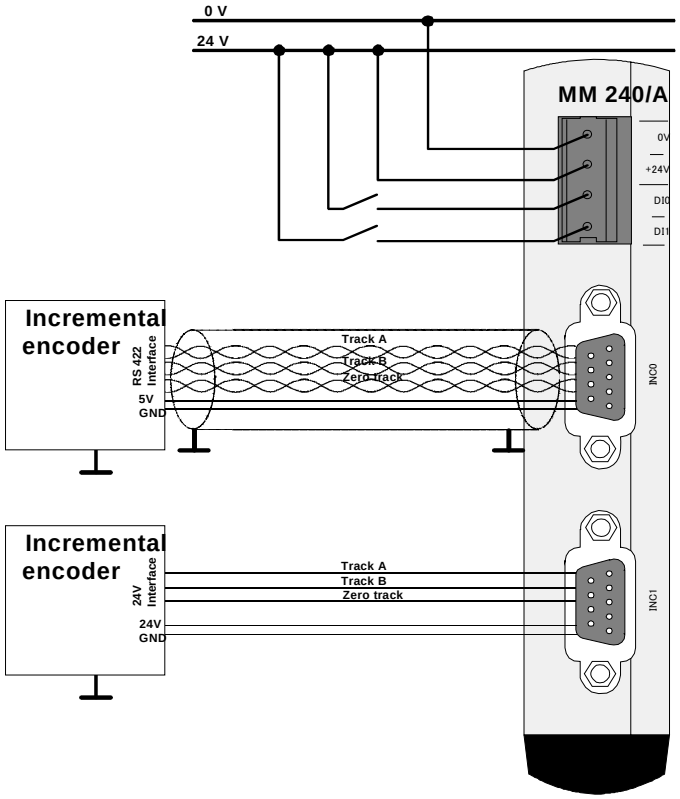
### Mode: 5 V differential

Specifications for the "Project engineering manual SANMOTION C Automation system" Chapter "EMC- and wiring guidelines, interfaces, RS485/422" to be complied with.

### Mode: 24 V single ended

- Wiring can be unshielded.
- Lines of an encoder input not to be laid out in separately.
- Ground (collar of shield of DSUB socket or Pin 1 of DSUB socket) must be laid out together with other lines, routed to the respective encoder and used as reference voltage of the encoder signal there.

## Example for wiring of the MM 240/A




Connection example, encoder inputs with transducer supply and latch

- INC0 is connected to a transducer via a 5V differential interface. The transducer is supplied with 5V operating voltage via the MM 240/A.
- INC1 is connected to a transducer with 24V interface. The transducer is also supplied by the MM 240/A.
- The latch function is used for both transducers. The latch inputs are configured to Sink.

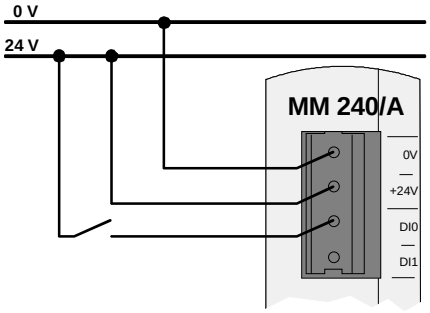
## Latch input

The latch inputs can be operated in 2 operating modes:

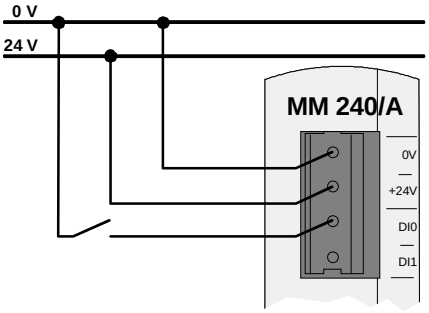
- as SINK input
- as SOURCE input

Configuration is via software, see also chapter configuration (Parameter `latchInputType`)

**SINK input:**




**SOURCE input:**




The feed and return conductor of an input must not be laid out in separately.

## Front panel connectors

For Power supply / latch input signals:
Standard male connectors with a grid of 5.08 mm

The following female connectors are required for the MM 240/A:

COMBICON Plugs made by Phoenix Contact
MSTB 2,5/2-ST-5,08 (2 block)
or Omnimate Raster made by Weidmuller
BLZ5.08/2 (2 block)

The following optional peripheral equipment is available for SANMOTION C.

| Model number | Contents |
|---|---|
| AL-00591171-03 | MSTB 2,5/2-ST-5,08 (2 block) |

For encoder signals: 9-pole DSUB plug connector

The following 9-pole DSUB plug connector is recommended for the MM 240/A:

made by J.S.T. Mfg. Co.,Ltd
plug: JEZ-9P-3(LF)(SN)
J cover set: J-C9-1C

Please select the inch screw thread of No.4-40UNC as screw rock.

# 5 Functional description

## Overview of functions

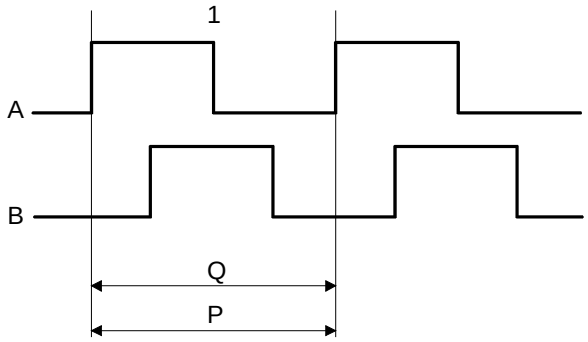
The MM 240/A provides the following functions:

- Position measurement: Up/down counter of increments (position measurement) with quadrature input (A/B, 90°), 32 Bit resolution
- Pulse counter on track A, 32 Bit resolution
- Pulse counter on track A with direction evaluation track B, 32 Bit resolution
- Velocity measurement through sampling with internal time basis
- Rotary encoder monitoring via zero track information
- Latch function of counter status via an external latch input 24V (Sink and Source)
- Latch function of counter status via zero pulse
- Sensor failure monitor of tracks A, B and zero (in 5 V diff. mode)
- Simulation mode for testing the application when incremental encoder is not connected

## Position counter

Position counters are taken from the evaluation of an incremental pulse position transducer with 2 pulse signals (A, B), which are phase-shifted by 90°. All edges can be evaluated. In an ideal case the possible resolution would be 1/4 of the period's duration (position measurement 4-fold).
The type of evaluation is determined by the configuration.

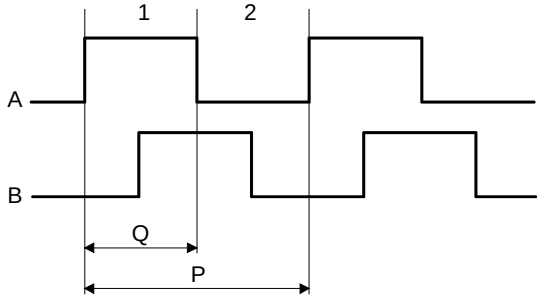
### Position measurement performed once:




*A, B* *Pulse signals of transducer*
*P* *Period duration*
*Q* *Single resolution*

Pulse signals of transducer, single resolution and period duration

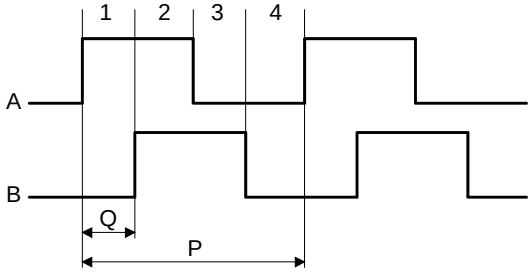
### Position measurement performed twice:




*A, B* *Pulse signals of transducer*
*P* *Period duration*
*Q* *Double resolution*

Pulse signals of transducer, double resolution and period duration

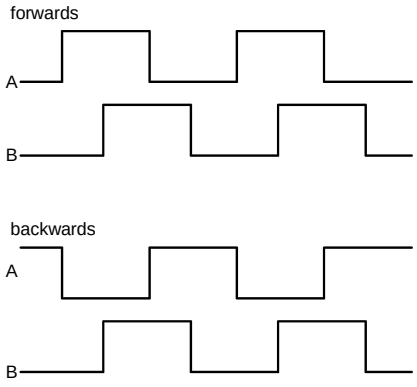
### Position measurement performed 4 times:




*A, B* *Pulse signals of transducer*
*P* *Period duration*
*Q* *Quadruple resolution*

Pulse signals of transducer, quadruple resolution and period duration

The movement direction is recognized through the evaluation of the phase position of the pulse signals A and B (see following image):




Pulse signals of transducer, recognition of movement direction

## Speed measurement

The velocity measurement function can be used to obtain a good accuracy of the evaluation when using a rotary encoder with a low resolution.
This is done by measuring the period duration between two incremental encoder pulses by means of an internal time basis.

The velocity measurement can be made in both direction.
The velocity value is measured four times for each period duration.

If the direction is changed during an ongoing measurement, the measurement is started anew.
Once the measurement is completed the value is marked as new.

The input pulses are scanned with an internal tact of 50 MHz. At a maximum input frequency of 250 kHz this will result in a resolution of at least 8 Bit.

Frequencies that are smaller than 3 pulses per second are evaluated as zero velocity.

## Pulse counter without direction evaluation

This function provides a pulse counter at track A.
Direction information will not be taken into consideration. Track B and Zero are not evaluated.

## Pulse counter with direction evaluation

This function provides a pulse counter at track A.
Track B is used as a static direction signal.

- Track B = 0 -> forward
- Track B = 1 -> backward

Track Zero is not evaluated.

## Zero pulse monitoring

When a rotary encoder with zero pulse is used, the configuration of the number of pulses per rotation will activate the monitoring, which compares the number of counted pulses with the number of configured pulses. If the numbers of pulses differs, an error message will be triggered.

This allows monitoring the correct function of the connected transducer.

## Latch function digital input

A latch function is available to record the counter status when an edge occurs at one of the latch inputs (DI0, DI1) of the MM 240/A.

The current counter status is recorded at the first edge. When the counter status is read out at the next update cycle the trigger will be activated again. If another latch event (edge change) occurs before the next update, the information of the first event will be retained.

A time stamp on each latch event is recorded within the update cycle. The time stamp has a resolution of 1µs. This time stamp is unique up to a update cycle of 65ms. The possibility of an overflow exists for longer cycle times of the application program, so that update cycles of the incremental encoder inputs of >65ms should be avoided.

The latch inputs are firmly assigned to the incremental encoder inputs: INC0 – DI0, INC1 – DI1.

To avoid faulty triggering of the latch inputs, attention should be given that the wiring is done appropriately.

## Latch function Zero pulse

Another latch function is available to record the counter status when a Zero pulse occurs at an incremental encoder.

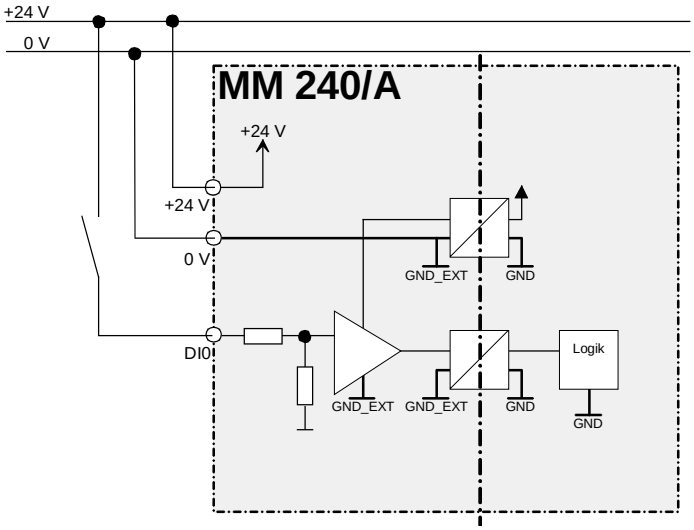
The current counter status is recorded when the zero pulse occurs. When the counter status is read out at the next update cycle the trigger will be activated again.

## Simulation mode

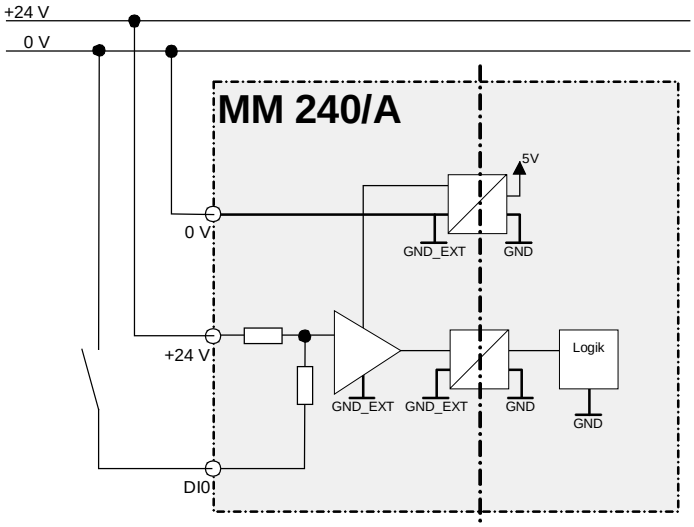
During simulation mode, internal software test signals are evaluated instead of the position transducer signals, the position transducer signals are evaluated. The simulation mode can be selected through the configuration. The application has to provide the actual values, which can be read out via the standard interface.

This way application tests can be conducted without the incremental encoder being connected.

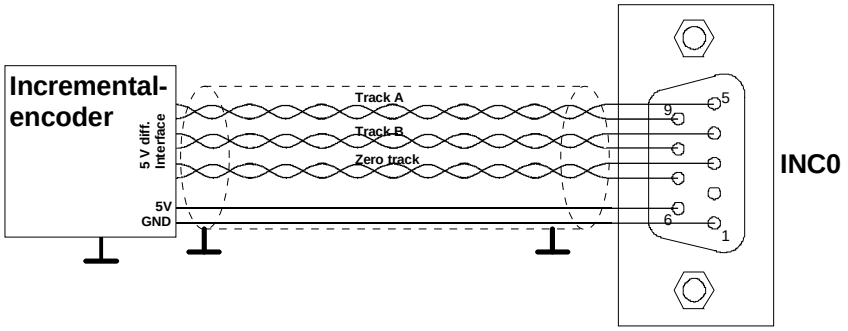
# 6 Connection diagram



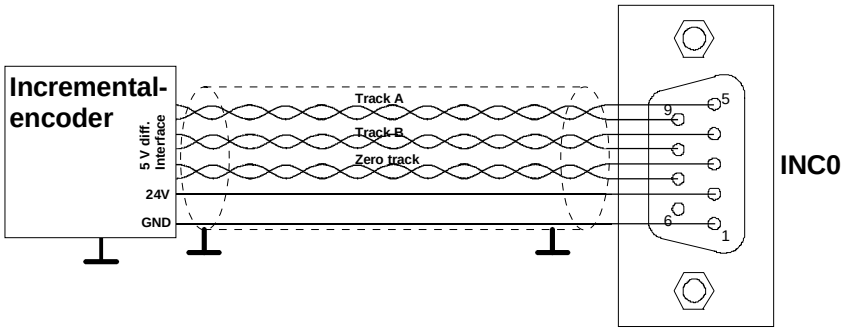

Input diagram latch input (SINK configuration)



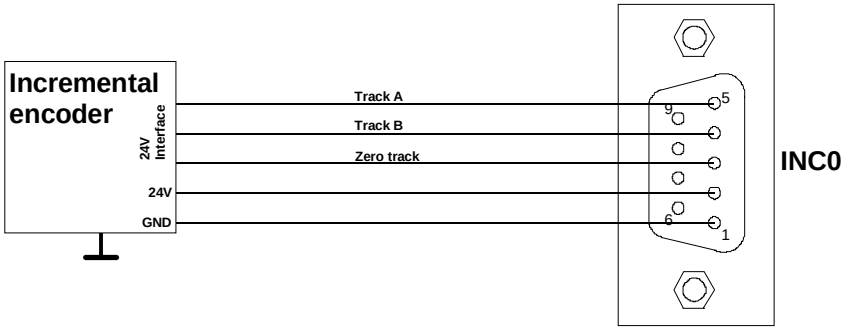

Input diagram latch input (SOURCE configuration)




Connection diagram incremental encoder 5 V diff. with 5 V signal voltage




Connection diagram incremental encoder 24 V supply voltage, differential operation, with 5 V signal voltage




Connection diagram incremental encoder 24 V single ended with 24 V signal voltage

# 7 Module response

## Response to sensor failure

This monitor checks the signal level of transducers with 5 V diff. interface. Both, the open signal lines as well as the short-circuited transducer lines are identified.

## Behavior at transducer error

If the zero pulse monitor is activated through configuration of the number of increments per rotation, the MM 240/A will internally monitor the number of pulses between two Zero pulses. If the number deviates, an error will be triggered.

## Behavior at short circuit of transducer supply

Both outputs for the transducer supply are sustained short-circuit proof and protected against overload.

## Monitoring track errors

If the maximum input frequency is exceeded, or if the edges of the incremental encoders are too close to one another (e.g. if there is no 90° phase difference between the tracks), this will be identified as error and output as such.

# 8 Technical data

## General information

| | |
|---|---|
| Power supply voltage: | +5 V DC from K Bus |
| Addressing at K-Bus: | Via 16-digit address switch, on the side |
| Connection terminals: | Open terminals, grid dimensions 5.08 mm |
| Power consumption at K-Bus: | max. 0.6 W |

## Incremental encoder inputs

| | |
|---|---|
| Number of inputs | 2 |
| Input range | Configurable 5V differential and 24V |
| Maximum input frequency | 250kHz |
| Evaluation | Single, double and quadruple evaluation configurable |
| | Counter function with and without direction evaluation |
| Resolution | 32 Bit |
| Galvanic isolation | no |

## Speed measurement

| | |
|---|---|
| Measurement process: | Dead time measurement with internal 50MHz tact |
| Counter depth: | 24 Bit |
| Minimum recordable velocity: | Pulse duration over 0.33s = velocity 0 |

## Position counter

| | |
|---|---|
| Counter depth: | 32 Bit |

## Transducer supply

| | |
|---|---|
| Supply 24V | Looped through from 24V input terminal |
| Load capacity | 500mA overall |
| Secured against | overload and short circuit |
| Supply 5V | Generated by 24V input terminal |
| Nominal voltage | 5.05V +/- 4% |
| Load capacity | 100mA per transducer |

## Latch inputs

| | |
|---|---|
| Number of inputs | 2 |
| Response time latch input | 20µs |
| Input type | Sink input in accordance with IEC61131 or source input configurable |
| Galvanic isolation | no |

## Time stamp for latch event

| | |
|---|---|
| Resolution | 1µs |
| Max. cycle time | 16 Bit counter -> unique up to 65ms cycle time |

## System interface

| | |
|---|---|
| K Bus: | Parallel Bus-interfaces, plug-in on side |

## Diagnosis possibilities

| |
|---|
| Sensor failure and sensor short circuit at 5V differential input configuration |
| Zero pulse monitoring |
| Track error: Signal frequence at inputs outside specifications (max. 250 kHz) |

## Dimensions:

| | |
|---|---|
| Footprint: | |
| Module height: | 120 mm |
| Mounting depth: | 100 mm |
| Front panel width: | 22.5 mm |
| Module width (incl. K-Bus plug): | 32.5 mm |
| Weight | 135 g |

## Standards:

The module conforms to the norms:

| | |
|---|---|
| General information | |
| UL 508 | In preparation |

| | |
|---|---|
| Product standard for programmable controllers: | |
| IEC 61131-1:2003 | General information |
| IEC 61131-2:2003 | Hardware |

| Release | |
|---|---|
| Revision A | Jul. 2007 |
| Revision B | Mar. 2008 |
| Revision C | Oct. 2012 |

**Precautions For Adoption**

## ⚠Cautions

The possibility of moderate or minor injury
and the occurrence of physical damage are assumed
when the precautions at right column are not observed.
Depending on the situation,
this may cause serious consequences.
Be sure to follow all listed precautions.

## ⚠Cautions

- Be sure to read the instruction manual before using this product.
- Take sufficient safety measures and contact us before applying this product to medical equipment that may involve human lives.
- Contact us before adapting this product for use with equipment that could cause serious social or public effects.
- The use of this product in high motion environments where vibration is present, such as in vehicles or shipping vessels, is prohibited.
- Do not convert or modify any equipment components.

* Please contact our Business Division for questions and consultations regarding the above.


**http://www.sanyodenki.com**

**SANYO DENKI CO., LTD.**
1-15-1, Kita-Otsuka, Toshima-ku, Tokyo 170-8451, Japan
Phone: +81 3 3917 5157

**SANYO DENKI *AMERICA, INC.***
468 Amapola Avenue Torrance, CA 90501 U.S.A.
Phone: +1 310 783 5400

**SANYO DENKI *EUROPE SA.***
P.A. Paris Nord Ⅱ, 48 Allée des Erables-VILLEPINTE, BP.57286, F-95958 ROISSY CDG Cedex, France
Phone: +33 1 48 63 26 61

**SANYO DENKI *GERMANY GmbH***
Frankfurter Strasse 92, 65760 Eschborn, Germany
Phone: +49 6196 76113 0

**SANYO DENKI *KOREA CO., LTD.***
9F 5-2, Sunwha-dong Jung-gu Seoul, 100-130, Korea
Phone: +82 2 773 5623

**SANYO DENKI *SHANGHAI CO., LTD.***
Rm2107-2109, Bldg A, Far East International Plaza, No.319, Xianxia Rd., Shanghai, 200051, China
Phone: +86 21 6235 1107

**SANYO DENKI *TAIWAN CO., LTD.***
Room 1208, 12F, No.96 Chung Shan N, Rd., Sec.2, Taipei 104, Taiwan, R.O.C.
Phone: +886 2 2511 3938

**SANYO DENKI *(H.K.)CO., LIMITED***
Room 2305, 23/F, South Tower, Concordia Plaza, 1 Science Museum Rd., TST East, Kowloon, Hong Kong
Phone: +852 2312 6250

**SANYO DENKI *SINGAPORE PTE. LTD.***
10, Hoe Chiang Road, #14-03A/04, Keppel Towers, Singapore 089315
Phone: +65 6223 1071



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