CAN - DeviceNet BoX
Base-Module

Technical Documentation
CNX-21 and Sub-Modules
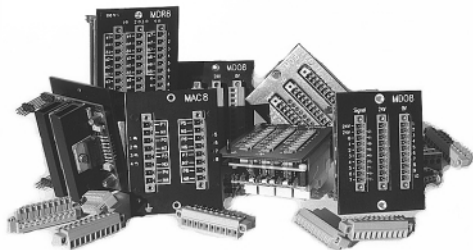
Sub-Modules

MDI 8	8 digital inputs 24 VDC
MDO 8	8 digital outputs 24 VDC/0.5A
MDM 8	8 digital DMOS outputs 24 VDC/2.0A
MAC 8	8 digital AC inputs 110 VAC/220 VAC
MDR 8	8 Relay outputs
MAI 4	4 analog inputs
MAO 4	4 analog outputs
MSSI 2	2 SSI-Absolute-Encoder-Interfaces
MINC 2	2 Incremental-Encoder-Interfaces
MDIO-16	16 digital inputs / outputs 24V/0.5A

Publisher

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Note

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Revision History

i *Note:*
The cover of this document shows the current revision status and the corresponding date. Since each individual page has its own revision status and date in the footer, there may be different revision statuses within the document.

Document created: 16.02.2000

Revision	Date

Table of contents

1 System Description

1.1 DeviceNet

DeviceNet is an open system based on the CAN principle which was developed a few years ago by the company R. Bosch. CAN was primarily intended for the transfer of data within automobiles, and millions of CAN chips have since been installed. The disadvantage of using CAN in automation technology is that it does not define an application layer, it specifies only the physical layer and data security layer.

DeviceNet specifies a uniform application layer which makes it possible to use the CAN protocol for industrial applications. The ODVA (Open DeviceNet Association) is an independent association which supports manufacturers and users of the DeviceNet system. The ODVA ensures that all devices which conform to the specification can operate together in one system regardless of their manufacture.
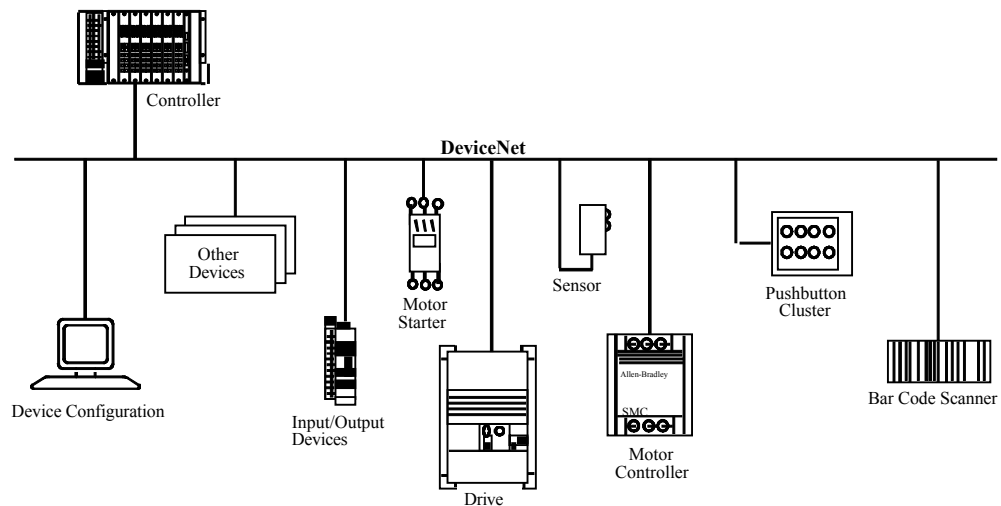
Sample for a DeviceNet network

CAN's bit arbitration procedure makes it theoretically possible to operate communication networks using master/slave and multimaster access methods. The CNX-21 supports master/slave operation (in polling mode). The module CNX-21 is working as slave.

The CNX-21 does not receive its operating power via the DeviceNet bus cable. The CNX-21 and the sub-modules must be wired up using the corresponding connections which enables you to isolate the bus electrically from the peripherals. If you wish, you can connect the power supply of the bus cable to the peripherals side and dispense with the decentralized power supply.

The bus cable consists of two pairs of shielded twisted-pair wiring, one for the data transfer and one for the power supply. The latter can carry currents of up to 8 amperes. The maximum possible length of a line depends essentially on the Baud rate. If you choose the highest Baud rate (500kBaud) you are restricted to lines of at most 100 m. With the lowest Baud rate (125kBaud) you will be able to use cable with an overall length 500m.
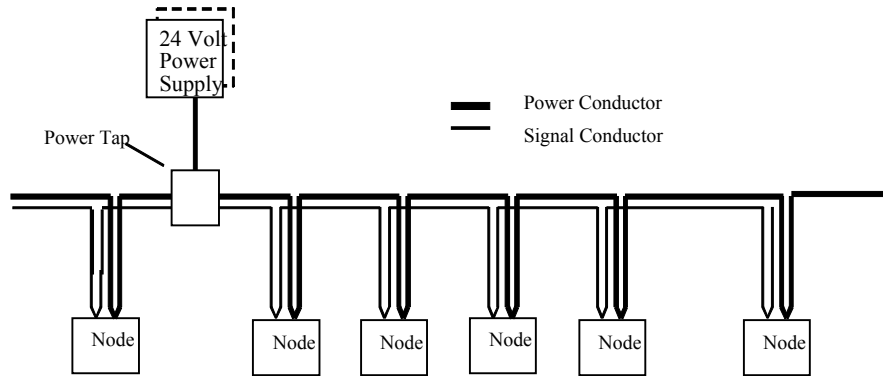
The bus cable may consist of a main line with branch lines up to 12m long. It is important that both ends of the main line should carry 121Ω terminating resistors. You can operate up to 64 subscribers on one line.

It is advisable to use a special software program to set up the system parameters, for example Allen Bradley's "DeviceNet Manager" which enables you to record the parameter data in the master. When it is first switched on, the master will compare its stored settings with the actual configurations of each of the stations. The exchange of user data between master and slave will not be set up unless all the parameters agree. Setting the parameters for the master is carried out directly via the DeviceNet connection. The DeviceNet system does not use a separate interface such is provided for other fieldbuses.

2 Functional description CNX-21 hardware

CNX-21 base module with 4 in-/output-modules
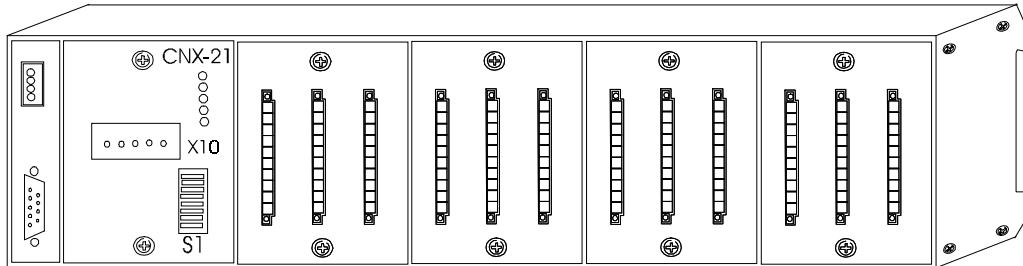
General
The base module CNX-21 represent the basis of all digital and analog sub-modules for the operating in the DeviceNet. Depending on application the four sub-modules are configurable with the most various modules as input or output.
The base module contains the DeviceNet connection, the power supply and four plug-in places for the sub-modules.

At present the following sub-modules are available:

- MDI8   8 digital inputs
- MDO8   8 digital outputs 24V/0.5A
- MDM8   8 digital power outputs 24V/2.2A
- MDR8   8 digital relay outputs, 220V/1A
- MAC8-110   8 AC inputs 110VAC
- MAC8-220   8 AC inputs 220VAC
- MAI4   4 analog inputs
- MAO4   4 analog outputs
- MSSI2   2 SSI interfaces
- MINC2   2 Incremental counter
- MDIO-16   16 digital inputs / outputs 24V,0.5A
              arbitrary useable as inputs or outputs

3 CNX-21 plug-in places can be equipped with arbitrary available analog and digital sub-modules. The first plug-in place can be equipped only with word-oriented I/O´s or 16 digital I/O´s (see following Table).

Following sub-modules can be used:

Sub-Modules		Slot 1	Slot 2	Slot 3	Slot 4
MDIO-16	16 digital inputs / outputs	YES	YES	YES	YES
MDI-8	8 digital inputs	NO	YES	YES	YES
MDO-8	8 digital outputs 24V/0.5 A	NO	YES	YES	YES
MDM-8	8 digital outputs 24V/2.0 A	NO	YES	YES	YES
MAC-8	8 digital inputs 110/220 VAC	NO	YES	YES	YES
MDR-8	8 Relays	NO	YES	YES	YES
MAI-4	4 analog inputs: 14/16 bit resolution	YES	YES	YES	YES
MAO-4	4 analog outputs: 16 bit resolution	YES	YES	YES	YES
MSSI-2	2 synchronous serial interface	YES	YES	YES	YES
MINC-2	2 incremental encoder	YES	YES	YES	YES

2.1 Technical data

Inputs / Outputs	max. 64 digital I/O´s or max. 16 analog I/O´s, or a mixture from both via galvanically decoupled submodules (max. 4 submodules). Divided into 4 slots that can be fitted byte-by-byte with input or output modules (MDI8,MDO8 a.s.o.). LED status indicator on all MD modules
Input Specifications	see input modules for CNX-21
Output Specifications	see output modules for CNX-21
Output Monitoring	Watchdog circuit
Data Connection	5 pole DeviceNet connector (Phönix Contact)
Supply Voltage	24 VDC (± 20%)
Current Consumption	Approx. 0,1 A (without submodules)
Housing Form	Closed, snap-in-mountable on mounting rail complying with DIN EN 50022, 50035
Dimensions (W * H * D)	CNX-21: 315 * 76 * 68 mm
Weight	Approx. 750 g
Operating Temperature	±0..+55 °C
Storage Temperature	-20..+70 °C

2.2 Installation notes

Assembly

You mount the CNX-21 in a decentralized position at the machine or in the switching cabinet by simply snap into place to a mounting rail complying with DIN EN 50022 or DIN EN 50035.

Voltage supply

The connection of the voltage supply for the control logic is carried out via the four-pole terminal X10.

2.3 Pin assignment

Connector X10:

Pin	Signal	Description
1	VCC-High	+24V Voltage supply, control logic
2	CAN-High	
3	Shield	Shielding line
4	CAN-Low	
5	GND	GND Voltage supply, control logic

2.4 Meaning of the light-emitting diodes

Four LEDs report the status:

2.4.1 MS-LED (Module - Status)

LED	Status	Cause
Off	Power off	Power supply is not connected
Green	Module is working	The device works normally
Red	Fault	Unknown sub-module

2.4.2 NS - LED (Network - Status)

Status	LED	Cause
Power off	off	Power supply is not connected
On-Line not connected	green flashes	The module is online but it exists no connection to a Master
On-Line connected	green	The module is online and it exists a connection to a Master
Timeout	red flashes	Timeout for IO-connection
Connection fault	red	Connection to a Master is failed (Duplicate MAC-ID or BUS-off)

2.4.3 5VCN

Status	LED	Cause
Power off	off	Power supply is not connected
Power on	yellow	Power supply for DeviceNet is ok

2.4.4 5V

Status	LED	Cause
Power off	off	Power supply is not connected
Power on	yellow	Power supply for module is ok

2.5 DIP-switches

Baud rate setting	1	2	3	4	5	6	7	8
125 kBd	off	off						
250 kBd	on	off						
500 kBd	off	on						
500 kBd	on	on						

With the DIP switches 3 to 8 the MAC-ID will be adjusted:
DIP switch 3 $= 2^0$
DIP switch 8   = bit 25
DIP switch   = ON, bit is set
MAC ID   = 0 to 63

2.6 Type key

```
CNX -21  -A - B - C - D
                    └─ Typ Slot 4 (on the right)
                   ─── Typ Slot 3
                  ──── Typ Slot 2
                 ───── Typ Slot 1
                ────── Typ base module ( on the left )
```
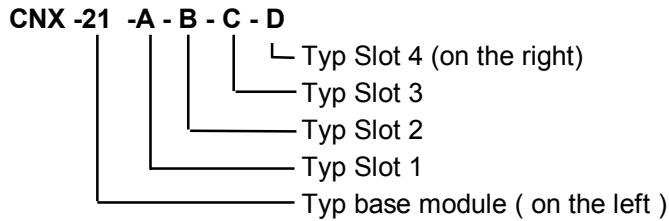
Type No.	Name	Description
	CNX-21	DeviceNet-Box-System, Base modue for max.4 Interface modules
		Sub-Modules:
-A	MAB	Dummy plate instead of a sub-module
-B	MDI8	Sub-Module 8 digital inputs 24VDC
-C	MDO8	Sub-Module 8 digital outputs 24VDC/0.5A
-D	MDIO-16	Sub-Module 16 digital inputs / outputs 24VDC/0.5A
-E	MDR8-001	Sub-Module 8 Relay, as „F", without protection allocation
-F	MDR8	Sub-Module 8 Relay outputs, max. 220VAC/2.0A
-G	MAC8-110	Sub-Module 8 digital AC-inputs 110VAC
-H	MAC8-220	Sub-Module 8 digital AC-inputs 220VAC
-K	MDM8	Sub-Module 8 digital DMOS power-outputs 24V/2.0A
-L	MAI4-12	Sub-Module 4 analog inputs
-N	MAI4-16	Sub-Module 4 analog inputs
-M	MAO4	Sub-Module 4 analog outputs
-O	MSSI-2	Sub-Module 2 SSI interfaces
-P	MINC-2	Sub-Module 2 Incremental counter
	Example:	Base module equipped with (of the left to the right): 4 analoge inputs, 16 bit 8 digital outputs 8 Relay oputputs 220V Unequipped reserve place
	Order-No. :	**CNX-21-NCFA**

3 Functional description DeviceNet interface
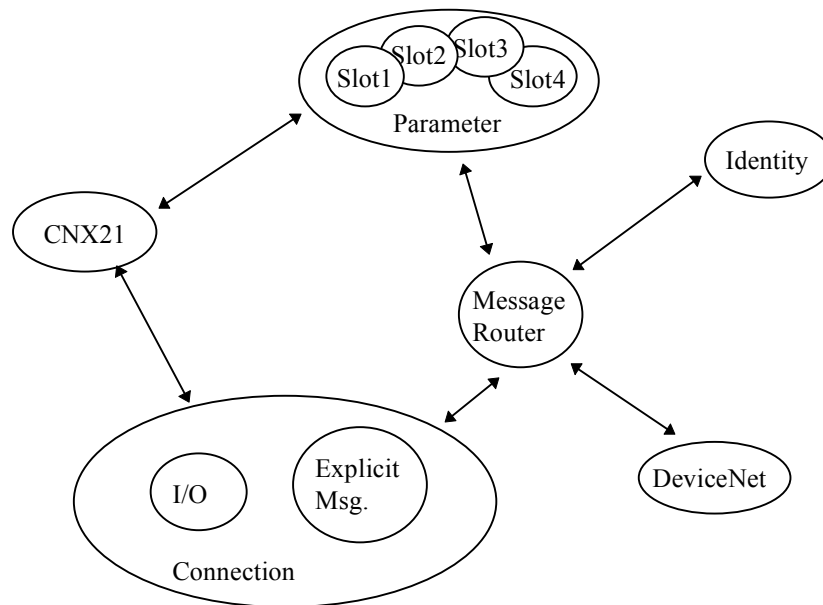
Object Class	# Instances
Identity	1
Message Router	1
DeviceNet	1
Connection	2
Parameter	4
CNX	1

3.1 I/O data interchange

I/O data between master and slave will be transferred in form of I/O-poll-messages. With the DeviceNet manager the allocation of the input/output bytes to definite memory areas is possible in the control. The CNX-21 uses a consistent algorithm to correlate the message data to the sub-modules. Various examples of correlations are in the appendix. A poll-message which is transferred from the DeviceNet master to the CNX-21 must begin with data for sub-module1, then sub-module2 and then sub-module3 and sub-module4. The number of the bytes to be transferred is determined by the plugged module. For example 1 byte must be sent for a MDO and 8 bytes for a MAO. Data must be sent only at output modules such as MDO, MAO or MDR. No data must be sent to input-modules such as MDI, MAI or MSSI.

A data-message which is transferred from the CNX-21 to the DeviceNet master begins also with data for sub-module1, then sub-module2 and then sub-module3 and sub-module4. Only the data of input-modules such as MDI, MAI or MSSI will be transferred.

i **Note**
An unequipped Slot is handled like a MDO

3.2 Programming

Some sub-modules can be programmed. The programming is carried out via the corresponding instance of the parameter-object.

For each sub-module variant an instance is available:

Sub-module 1 corresponds instance 1
Sub-module 2 corresponds instance 2
Sub-module 3 corresponds instance 3
Sub-module 4 corresponds instance 4

If a sub-module isn't programmable, the DeviceNet function "SetAttributeSingle" is acknowledged with an error report. The data necessary for the programming of the modules are integrated in the documentation of the individual sub-modules.

MDI-8

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3.3 MDI 8, digital input sub-module

8 bit 24V
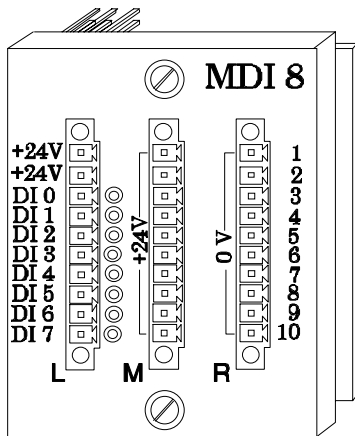
Figure: 8-Bit Digital Input Module

3.3.1 General

The MDI8 input module is a submodule, which is galvanically decoupled by means of opto-couplers, for the CNX-21 basic module. The submodule provides eight digital inputs. For operation in the DeviceNet system, you can install up to three MDI8 modules in the four slots of a CNX-21 basic module. This makes possible a maximum of 24 inputs per CNX-21. In addition, you can combine MDI8 modules with different modules, e.g. digital outputs.

3.3.2 I/O Data format

In the case of a MDI8 module the transferred I/O-message from the CNX-21 to the Device-Net master needs 1 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Data							

3.3.3 Technical data MDI8

Inputs	8 outputs, galvanically decoupled 8 LED output status indicators 1 LED voltage indicator
Input level	Power supply : 10V .. 32 V Standard: 24V Triggerpoint is 1/2 of power supply Input resistor: 15 KOhm Input current: 24 V < 2 mA
Input	Opto coupled
Filter	The inputs are a) digital filtered with 6 msec b) by hardware with 3 msec
Reverse-connect protection	Inputs are protected against reverse-connection.
Power supply	24 VDC (± 20%)
Current consumption	0,05 A (without load)
Housing	Module with front panel is mounted in the CNX-21 using two screws.
Dimensions (W * H * D)	58 * 72 * 50 mm
Weight	ca. 100 g
Operating temperature	±0..+55 $^{\circ}$C
Storage temperature	-20..+70 $^{\circ}$C

3.3.4 Signal description and example of MDI8 connection

Pin	Signal	I/O	Description
L-1	+ 24V	VCC	+ 24 VDC power supply (output driver)
L-2	+ 24V	VCC	+ 24 VDC power supply (output driver)
L-3	DI 0	In	Bit 0 of data byte
L-4	DI 1	In	Bit 1 of data byte
L-5	DI 2	In	Bit 2 of data byte
L-6	DI 3	In	Bit 3 of data byte
L-7	DI 4	In	Bit 4 of data byte
L-8	DI 5	In	Bit 5 of data byte
L-9	DI 6	In	Bit 6 of data byte
L-10	DI 7	In	Bit 7 of data byte
Pin	**Signal**	**I/O**	**Description**
M-1	+ 24V	VCC	+ 24 VDC power supply (sensors)
M-2	+ 24V	VCC	
M-3	+ 24V	VCC	
M-4	+ 24V	VCC	
M-5	+ 24V	VCC	
M-6	+ 24V	VCC	
M-7	+ 24V	VCC	
M-8	+ 24V	VCC	
M-9	+ 24V	VCC	
M-10	+ 24V	VCC	
Pin	**Signal**	**I/O**	**Description**
R-1	0V	GND	Ground, return of the outputs
R-2	0V	GND	
R-3	0V	GND	
R-4	0V	GND	
R-5	0V	GND	
R-6	0V	GND	
R-7	0V	GND	
R-8	0V	GND	
R-9	0V	GND	
R-10	0V	GND	

Pin marking: L : row (left)
M : row (middle)
R : row (right)

MDO‑8

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3.4 MDO 8, digital output sub-module

8 bit 24V/0.5A
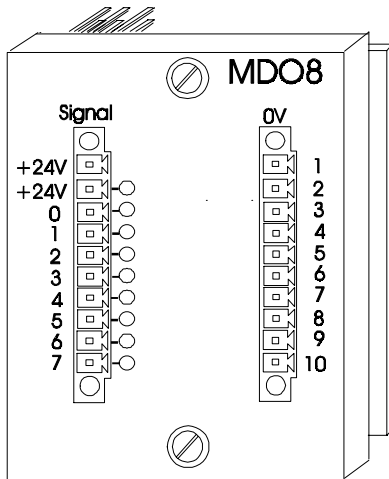
Figure: 8-Bit Digital Output Module

3.4.1 General

The MDO8 output module is a submodule, which is galvanically decoupled by means of optocouplers, for the CNX-21 basic module. The submodule provides eight digital outputs for 24V/0.5A. For operation in the DeviceNet system, you can install up to three MDO8s in the four slots of a CNX-21 basic module. This makes possible a maximum of 24 outputs per CNX-21. In addition, you can combine MDO8s with different modules, e.g. digital inputs.

3.4.2 I/O Data format

In the case of a MDO8 module the transferred I/O-message from the DeviceNet master to the CNX-21 needs 1 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Data							

3.4.3 Technical data MDO8

Outputs	8 outputs, galvanically decoupled 8 LED output status indicators 1 LED voltage indicator
Output Specifications	24 V/0.5 A, short-circuit-proof After getting rid of an existing short-circuit, the output resets itself to its logical status, i.e. if the output is set from the point of view of the message, it switches ON.
Output Monitoring	Watchdog circuit
Power supply	24 VDC (± 20%), 0,02 A (without load and input currents)
Housing	Module with front panel is mounted in the CNX-21 using two screws.
Dimensions (W x H x D)	58 * 72 * 50 mm
Weight	ca. 100 g
Temperature	Operation: ±0..+55 °C, Storage: -20..+70 °C

3.4.4 Signal description and example of MDO8 connection

Pin	Signal	I/O	Description
L-1	+ 24V	VCC	+ 24 VDC power supply (output driver)
L-2	+ 24V	VCC	+ 24 VDC power supply (output driver)
L-3	DO 0	Out	Bit 0 of data byte
L-4	DO 1	Out	Bit 1 of data byte
L-5	DO 2	Out	Bit 2 of data byte
L-6	DO 3	Out	Bit 3 of data byte
L-7	DO 4	Out	Bit 4 of data byte
L-8	DO 5	Out	Bit 5 of data byte
L-9	DO 6	Out	Bit 6 of data byte
L-10	DO 7	Out	Bit 7 of data byte
Pin	**Signal**	**I/O**	**Description**
R-1	0V	GND	Ground, return of the outputs
R-2 ...			Ground, return of the outputs
....			Ground, return of the outputs
R-9			
R-10	0V	GND	Ground, return of the outputs

Pin marking: L : row (left)
                      R : row (right)

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MDM-8

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## 3.5 MDM 8, digital power output sub-module

8 bit 24V/2.2A with DMOS-outputs and fault feedback
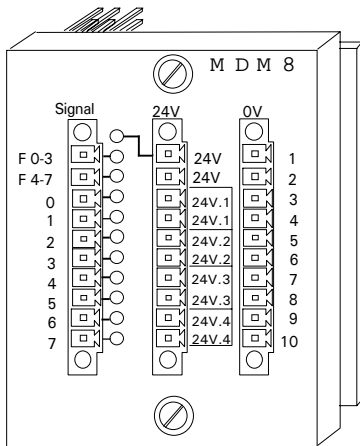
Figure: 8-Bit Digital Power Output Module

3.5.1 General

The MDM-8 component is a galvanically decoupled submodule for the CNX-21 basic module. It provides eight digital outputs for 24 V/2.2 A. For operation in the DeviceNet System, you can install up to three MDM8s in the four slots of a CNX-21 basic module. This makes possible a maximum of 24 outputs per CNX-21. You can mix MDM-8s with other submodules, e.g. digital input modules.

The outputs are short-circuit-proof and protected from thermal overloads. An avalanche diode rated at 72V/5A/100mJ protects the outputs from inductive loads. Due to the high avalanche voltage, the break time of an inductive load is very short (typically below 30 ms).

The module has one fault output for each of channels 0-3 and 4-8. The master can read back these fault outputs via an MDI 8, for example. They are activated in the case of an output short-circuit, or an output driver defect. To spare input channels, you can connect the two fault outputs to one common MDI 8 channel.

3.5.2 I/O Data format

In the case of a MDM8 module the transferred I/O-message from the DeviceNet master to the CNX-21 needs 1 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Data							

3.5.3 Technical data MDM 8

Outputs	8 switching outputs, galvanically decoupled 2 fault outputs 8 LED status indicators of the outputs 2 LED fault indicators 1 LED voltage indicator
Output Specifications	24V/2.2A (*1), short-circuit-proof, thermally protected suitable for inductive loads (*2), RDSon = 100 mW
Output Monitoring	Watchdog circuit 2 fault outputs, 24V/10mA, short-circuit-proof
Supply Voltage	24 VDC (± 20%)
Current Consumption System voltage Switching voltage	20 mA 80 mA (without load)
Housing	Module mounted with front panel by means of two screws in CNX-21
Dimensions (W x H x D)	58 * 72 * 50 mm
Weight	ca. 200 g
Temperature	Operation: ±0..+55 $^{\circ}$C , storage: -20..+70 $^{\circ}$C

(*1)   Since the power loss increases steeply at high currents, the maximum permissible switching current was limited to 2.2A. If you observe the total power loss, individual channels can be loaded at up to 3A.

The static power loss per activated channel is calculated according to the following formula:

$P = I^{2} * 0.1 \text{ Ohm}$ resulting in   100 mW at 1A
                                                              400 mW at 2A
                                                              900 mW at 3A

When inductive loads switch, the losses of the free-wheeling diode are added. The maximum permissible power loss per submodule is 3.8 W.

(*2)   With inductive loads, the maximum operating frequency reduces in dependence on the inductivity and the current (2-A solenoid valve, maximum of 2.5 Hz).

3.5.4 Signal description

Terminal strip (on left)

Pin	Signal	I/O	Description
L1	F 0-3	Out	Error output for channels 0-3
L2	F 4-7	Out	Error output for channels 4-7
L3	DO 0	Out	Bit 0 of data byte
L4	DO 1	Out	Bit 1 of data byte
L5	DO 2	Out	Bit 2 of data byte
L6	DO 3	Out	Bit 3 of data byte
L7	DO 4	Out	Bit 4 of data byte
L8	DO 5	Out	Bit 5 of data byte
L9	DO 6	Out	Bit 6 of data byte
L10	DO 7	Out	Bit 7 of data byte

Terminal strip (in middle)

Pin	Signal	I/O	Description
M1,2	24V	VCC	+24-V DC logic supply of output stage
M3,4	24V.1	VCC	+24-V DC supply of outputs bit 0 and bit 1
M5,6	24V.2	VCC	+24-V DC supply of outputs bit 2 and bit 3
M7,8	24V.3	VCC	+24-V DC supply of outputs bit 4 and bit 5
M9,10	24V.4	VCC	+24-V DC supply of outputs bit 6 and bit 7

Terminal strip (on right)

Pin	Signal	I/O	Description
R1-10	0V	GND	Ground, feedback of outputs

i *Note*

The maximum power loading of any connector pin is 8A. If loading is higher, this means that you may not loop the power supply on the middle terminal strip and GND on the terminal strip on the right.

```
┌─────────────────────┐
│                     │
│      MDR-8          │
│                     │
└─────────────────────┘
```

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3.6 MDR 8, digital output relay sub-module

8 Bit 110VAC, 220VAC, 24VDC

Figure: 8 Bit Digital Relay Output Module

3.6.1 General

The MDR8 output module is a submodule, which is galvanically decoupled by means of optocouplers, for the CNX-21 basic module. The submodule provides eight digital outputs. For operation in the DeviceNet system, you can install up to three MDR8s in the four slots of a CNX-21 basic module. This makes possible a maximum of 24 outputs per CNX-21. In addition, you can combine MDR8s with different modules, e.g. digital inputs.

Per output, there are available on the connectors a normally closed contact, a mid-position contact and a normally open contact.

To protect the relay contacts, the system short-circuits the voltage peaks, which occur at the NO or NC contact when inductive loads switch, via varistors to the front connectors designated N. The MDR8 is provided for a 220 V switching voltage. The breakdown voltage of the varistors mentioned above is matched to the switching voltage. For reasons of interference protection, it is, however, sensible to directly suppress the interference of inductive consumers.

If the MDR8 is used to switch 220 V, you must connect the protective earth to the appropriate connection.

The relays used have a rated test voltage of 3000 V AC and a surge withstand capability of 5000 V between the contact and the coil, i.e. between the load current circuit and the 24 V system voltage. If this dielectric strength is insufficient with 220 V applications, relays with greater dielectric strength are available on request.

i

Note:

Since the relay needs a coil voltage of at least 20 V to pick up, the CNX-21 operating voltage range is limited to 24 V -15%/+20% when the MDR 8 is used.

3.6.2 I/O Data format

In the case of a MDR8 module the transferred I/O-message from the DeviceNet master to the CNX-21 needs 1 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Data							

3.6.3 Technical data

MDR8 Outputs	8 relay outputs, galvanically decoupled 8 LED output status indicators 1 LED voltage indicator
Outputs	NC contact, mid-position contact, NO contact
Relay Data Detailed relay data sheet on request	Switching voltage: 0.1 - 220 V Switching current: 1 A Switching cycle: $1*10^5 ...5*10^7$ test voltage Contact/coil: 3000V AC impulse voltage Contact/coil: 5000V
Contact Protector	Varistor between NO or NC contact and corresponding N connections Varistor data: Wtm (10/1000 µs) 0.8 J Itm (8/20 µs) 100 A Um (ac) 110 V version 163 V 　　　　　 220 V version 253 V
Output Monitoring	Watchdog circuit
Supply Voltage	Internally via CNX-21
Current Consumption	5 V/0.02 A; 24 V / 140 mA (relay coil current)
Housing	Module with front panel is mounted in the CNX-21 using two screws.
Dimensions (W x H x D)	58 x 72 x 50 mm
Weight	approx. 300 g
Temperature	Operation: ±0..+55° C Storage: -20..+70° C

3.6.4 Signal description and example of MDR8 connection

Pin	Signal	I/O	Description
L-1	s1	Out	NO contact, relay 1
L-2	m1	Out	Mid-position contact, relay 1
L-3	ö1	Out	NC contact, relay 1
L-4	s1	Out	NO contact, relay 2
L-5	m2	Out	Mid-position contact, relay 2
L-6	ö2	Out	NC contact, relay 2
L-7	s2	Out	NO contact, relay 3
L-8	m1	Out	Mid-position contact, relay 3
L-9	ö1	Out	NC contact, relay 3

Pin	Signal	I/O	Description
M-1	s4	Out	NO contact, relay 4
M-2	m4	Out	Mid-position contact, relay 4
M-3	ö4	Out	NC contact, relay 4
M-4	s5	Out	NO contact, relay 5
M-5	m5	Out	Mid-position contact, relay 5
M-6	ö5	Out	NC contact, relay 5
M-7	s6	Out	NO contact, relay 6
M-8	m6	Out	Mid-position relay6
M-9	ö6	Out	NC contact, relay 6

Pin	Signal	I/O	Description
R-1	s7	Out	NO contact, relay 7
R-2	m7	Out	Mid-position contact, relay 7
R-3	ö7	Out	NC contact, relay 7
R-4	s8	Out	NO contact, relay 8
R-5	m8	Out	Mid-position contact, relay 8
R-6	ö8	Out	NC contact, relay 8
R-7	N	Inp	Conductor for contact protection, relays 1..3
R-8	N	Inp	Conductor for contact protection, relays 4..6
R-9	N	Inp	Conductor for contact protection, relays 7..8

Pin marking: L : row (left)
M : row (middle)
R : row (right)

MAC-8

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3.7 MAC 8, AC voltage input sub-module
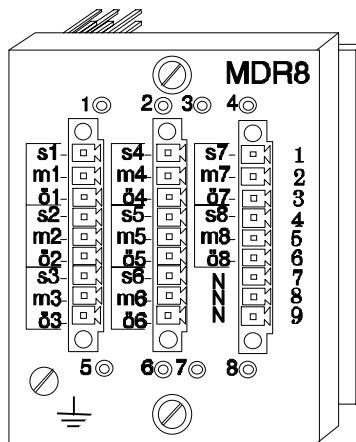
8 Bit, 110VAC or 220VAC
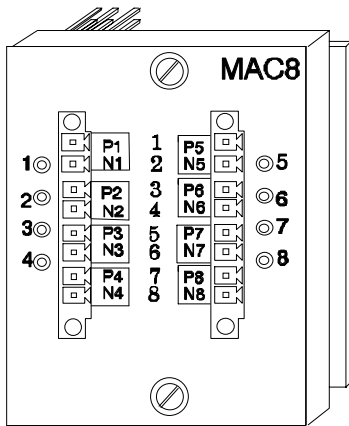
Figure: 8 Bit AC Voltage Input Module

3.7.1 General

The MAC-8 input module is a submodule, which is galvanically decoupled by means of op-tocouplers, for the CNX-21 basic module. It provides eight digital AC inputs for 110 V or 220 V. For operation in the DeviceNet system, you can install up to three MAC-8s in the four slots of a CNX-21 basic module. This makes possible a maximum of 24 inputs per CNX-21. In addition, you can combine MAC-8s with different modules, e.g. digital inputs.

Per input, there is one pin available on the connectors for P and one for N.

Two versions of the MAC-8 can be supplied:

− MAC-8/110   110 V AC
− MAC-8/220   220 V AC

3.7.2 I/O Data format

In the case of a MAC8 module the transferred I/O-message from the CNX-21 to the DeviceNet master needs 1 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Data							

3.7.3 Technical data MAC8

Inputs	8 AC voltage inputs 8 LED input status indicators
Input Specifications	MAC-8/110: 110 V AC MAV8/220: 220 V AC
Output Monitoring	Watchdog circuit
Voltage Supply	Not necessary
Switching Times	Since the positive half-wave is used for triggering, the times are always adapted to the positive half-wave. The make instant is the first detected peak value. The break instant is 40 ms after the last peak value was detected.
Housing	Module with front panel is mounted in the CNX-21 using two screws.
Dimensions (W x H x D), Weight	58 x 72 x 50 mm, approx. 300g
Temperature	Operation: ±0..+55° C Storage: -20..+70° C

3.7.4 Signal description of MAC8

Pin	Signal	I/O	Description
L-1	P1	In	AC input channel 1 P (phase)
L-2	N1	In	AC input channel 1 N (conductor)
L-3	P2	In	AC input channel 2 P
L-4	N2	In	AC input channel 2 N
L-5	P3	In	AC input channel 3 P
L-6	N3	In	AC input channel 3 N
L-7	P4	In	AC input channel 4 P
L-8	N4	In	AC input channel 4 N
Pin	**Signal**	**I/O**	**Description**
R-1	P5	In	AC input channel 5 P
R-2	N5	In	AC input channel 5 N
R-3	P6	In	AC input channel 6 P
R-4	N6	In	AC input channel 6 N
R-5	P7	In	AC input channel 7 P
R-6	N7	In	AC input channel 7 N
R-7	P8	In	AC input channel 8 P
R-8	N8	In	AC input channel 8 N

Pin marking: L : row (left)
                         R : row (right)

MAI-4

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3.8 MAI 4, Analog input sub-module

12 Bit or 16 Bit Resolution   -10..+10V, 0.. +10V, 0..20 mA
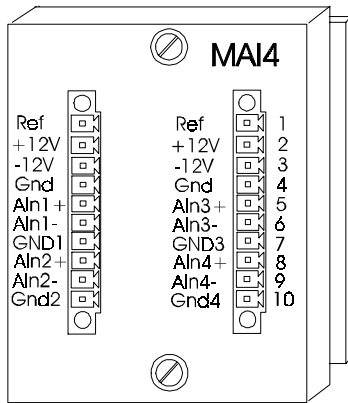
Figure: 4 Channel Analog Input Module

3.8.1 General

The MAI-4 input module is a submodule for the CNX-21 basic module. It provides four analog inputs which are separated galvanically.

For operation in the DeviceNet system, you can install up to four MAI-4s in the four slots of a CNX-21 basic module. This makes possible a maximum of 16 inputs per CNX-21. In addition, you can combine MAI-4s with different modules, e.g. digital outputs.

Two variants of the MAI-4 module can be supplied:
MAI-4-12   12-bit resolution
MAI-4-16   16-bit resolution

3.8.2 I/O Data format

In the case of a MAI4 module the transferred I/O-message from the CNX-21 to the Device-Net master needs 8 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Low Byte Channel 1							
1	High Byte Channel 1							
2	Low Byte Channel 2							
3	High Byte Channel 2							
4	Low Byte Channel 3							
5	High Byte Channel 3							
6	Low Byte Channel 4							
7	High Byte Channel 4							

i   *Note*

The analog input is a differential input. Therefore an unused input (**Ain- / Ain+)** must be connected to GND. **Notice desired polarity!**
+12V and -12V may not be used to supply external devices.

3.8.3 Adjusting possibilities:

1.)   Bipolar -10V...+10V (default)
         or unipolar   0V...+5V

2.)   Current measuring resistors (default, not equipped)
         Example 0..20mA: R = U/I = 5V / 20 mA = 250 Ohm
                                     range adjusting unipolar 0..5V:
                                     0 mA = 0000H, 20 mA = FFFFH

3.)   2 Potis for the setting of the gain and the offset (factory-tuned)
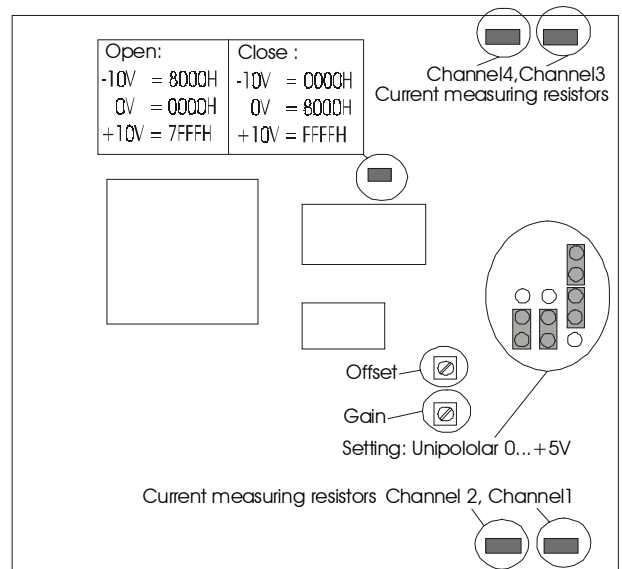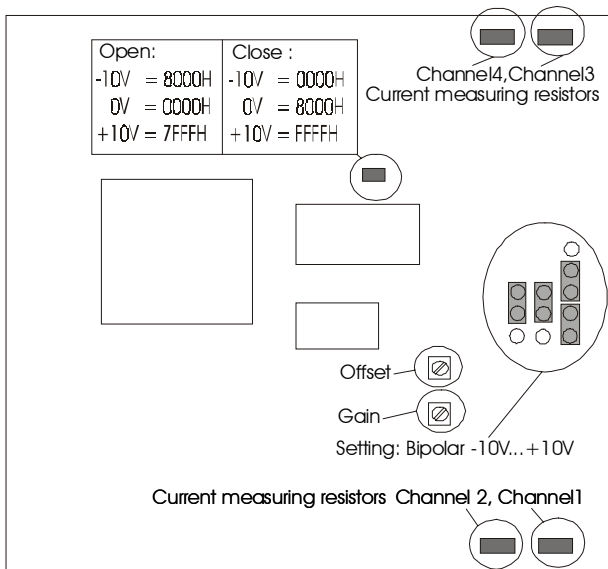
3.8.4 Technical data MAI4

Inputs	Four analog inputs, galvanically decoupled
Inputlevels	Input voltage - 10V ... +10V bipolar Input voltage 0..5V unipolar Input current 0 .. 20 mA Resistors: customer specific
Decoupling	Submodule is galvanically separated to the basic module by optocoupler
Resolution	MAI4-12: 12 bit, MAI4-16: 16 bit
Sampling Rate	max: 1000 Hz
Supply Voltage	24 VDC (± 20%)
Current Consumption	0,05 A (without load and input currents)
Housing	Module with front panel is mounted in the CNX-21 using two screws
Dimensions (W x H x D)	58 * 72 * 50 mm, weight 100g
Temperature	Operation: ±0..+55 $^\circ$C, Storage: -20..+70 $^\circ$C

3.8.5 Signal description and example of MAI4 connection

Pin	Signal	I/O	Description
L-1	Ref		Not available
L-2	+ 12 V	V Out	+ 12 VDC Power supply
L-3	- 12 V	V Out	- 12 VDC Power supply
L-4	Gnd	Gnd	Ground for pin L1 .. L3
L-5	AIn1+	In	Analog input channel 1 positive
L-6	AIn1-	In	Analog input channel 1 negative
L-7	Gnd1	In	Ground for channel 1
L-8	AIn2+	In	Analog input channel 2 positive
L-9	AIn2-	In	Analog input channel 2 negative
L-10	Gnd2	In	Ground for channel 2
Pin	**Signal**	**I/O**	**Description**
R-1	Ref		Not available
R-2	+ 12 V	V Out	+ 12 VDC Power supply
R-3	- 12 V	V Out	- 12 VDC Power supply
R-4	Gnd	Gnd	Ground for pin L1 .. L3
R-5	AIn3+	In	Analog input channel 3 positive
R-6	AIn3-	In	Analog input channel 3 negative
R-7	Gnd3	In	Ground for channel 3
R-8	AIn4+	In	Analog input channel 4 positive
R-9	AIn4	In	Analog input channel 4 negative
R-10	Gnd4	In	Ground for channel 4

Pin marking: L : row (left)
                          M : row (middle)
                          R : row (right)

MAO–4

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3.9 MAO 4, Analog output sub-module

16 Bit Resolution   -10..+10V, 0.. +10V
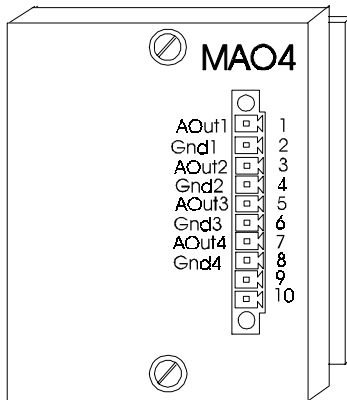
Figure: 4 Channel Analog Output Module

3.9.1 General

The MAO-4 output module is a submodule for the CNX-21 basic module. The submodule provides four digital outputs which are separated galvanically. For operation in the DeviceNet system, you can install up to four MAO-4s in the four slots of a CNX-21 basic module. This makes possible a maximum of 16 analog outputs per CNX-21. In addition, you can combine MAO-4s with different modules, e.g. digital outputs.
The four channels always have a 16-bit resolution.

3.9.2 I/O Data format

In the case of a MAO4 module the transferred I/O-message from the DeviceNet master to the CNX-21 needs 8 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Low Byte Channel 1				
1				High Byte Channel 1				
2				Low Byte Channel 2				
3				High Byte Channel 2				
4				Low Byte Channel 3				
5				High Byte Channel 3				
6				Low Byte Channel 4				
7				High Byte Channel 4				

16 bit resolution:	
-10V	= 8000H
0V	= 0000H
+10V	= 7FFFH

3.9.3 Technical data MAO-4

Outputs	Four analog outputs, galvanically decoupled
Outputslevel	-10V .. +10V , Imax = 10 mA
Decoupling	Submodule is galvanically separated by optocoupler to the basic module
Resolution	16-bit (1 digit = 305 µV)
Supply Voltage	24 V DC (±20%)
Current Consumption	0.05 A (without load and input currents)
Housing	Module with front panel is mounted in the CNX-21 using two screws.
Dimensions (W x H x T)	58 x 72 x 50 mm
Weight	Approx. 100 g
Operating Temperature	±0..+55° C
Storage Temperature	-20..+70° C

3.9.4 Signal description and example of MAO-4 connection

Pin	Signal	I/O	Description
R-1		AOut1	Analog output, channel 1
R-2	0V	GND1	Ground, channel 1
R-3		AOut2	Analog output, channel 2
R-4	0V	GND2	Ground, channel 2
R-5		AOut3	Analog output, channel 3
R-6	0V	GND3	Ground, channel 3
R-7		AOut4	Analog output, channel 4
R-8	0V	GND4	Ground, channel 4
R-9			Not assigned
R-10			Not assigned

Pin marking: R : row (right)

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MSSI-2
```

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3.10 MSSI 2, SSI sub-module (Synchronous Serial Interface)

16 Bit-, 24 Bit-, Option 25 Bit Resolution / 2 Channels
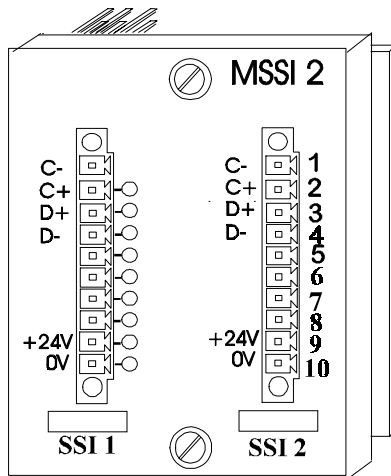
Figure: 2 Channel SSI-2 Module

3.10.1 General

The MSSI-2 input module is a submodule for use in a CNX-21 Basic Module. The submodule provides two synchronous serial inputs.
For operation in the DeviceNet system, you can install up to four MSSI-2s in the four slots of a CNX-21 basic module. This makes possible a maximum of 8 SSI inputs per CNX-21. In addition, you can combine MSSI-2s with different modules, e.g. digital outputs.

3.10.2 I/O Data format

In the case of a MSSI2 module the transferred I/O-message from the CNX-21 to the DeviceNet master needs 8 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte 0 SSI1				
1				Byte 1 SSI1				
2				Byte 2 SSI1				
3				Byte 3 SSI1				
4				Byte 0 SSI2				
5				Byte 1 SSI2				
6				Byte 2 SSI2				
7				Byte 3 SSI2				

3.10.3 Technical data MSSI-2

Inputs	Two synchronous serial inputs
Input Level	Input voltage RS-485
Resolution	16-bit/24-bit
Supply Voltage	24 V DC (±20%)
Current Consumption	0.05 A (without load and input currents)
Housing	Module with front panel is mounted in the CNX-21 using two screws.
Dimensions (WxHxD)	58 x 72 x 50 mm, weight 100 g
Temperature	Operation: ±0..+55° C Storage: -20..+70° C

3.10.4 Signal description and example of MSSI-2 connection

Pin	Signal	I/O	Description
L-1	C-	Clock-	Clock line for encoder 1
L-2	C+	Clock+	Clock line for encoder 1
L-3	D+	Data+	Data line for encoder 1
L-4	C-	Data-	Data line for encoder 1
L-5			
L-6			
L-7			
L-8			
L-9	+24 V	Supply.	Supply voltage for the encoder
L-10	0 V	Ground	
Pin	**Signal**	**I/O**	**Description**
R-1	C-	Clock-	Clock line for encoder 2
R-2	C+	Clock+	Clock line for encoder 2
R-3	D+	Data+	Data line for encoder 2
R-4	D-	Data-	Data line for encoder 2
R-5			
R-6			
R-7			
R-8			
R-9	+24V	Supply.	Supply voltage for the encoder
R-10	0 V	Ground	

Pin marking: L : row (left)
R : row (right)

MINC-2

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3.11 MINC 2, ISI sub-module (Incremental Counter Interface)

24-Bit Resolution
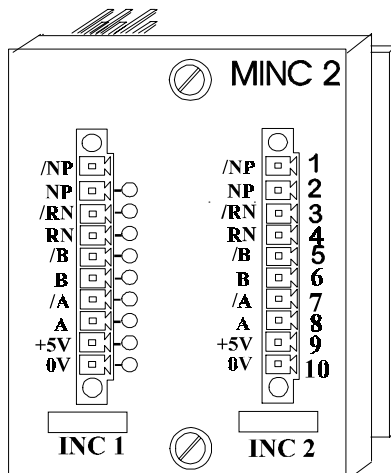
Figure: 2 Channel INC-2 Module

3.11.1 General

The MINC-2 input module is a submodule, which is galvanically decoupled by means of optocouplers, for the CNX-21 basic module. The submodule provides two incremental counters. For operation in the DeviceNet system, you can install up to four MINC-2s in the four slots of a CNX-21 basic module. This makes possible a maximum of 8 incremental inputs per CNX-21. In addition, you can combine MINC-2s with different modules, e.g. digital outputs.

3.11.2 I/O Data format

In the case of a MINC module the transferred I/O-message from the CNX-21 to the Device-Net master needs 8 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte 0 INC1				
1				Byte 1 INC1				
2				Byte 2 INC1				
3				Byte 3 INC1				
4				Byte 0 INC2				
5				Byte 1 INC2				
6				Byte 2 INC2				
7				Byte 3 INC2				

3.11.3 Technical data MINC-2

Inputs	Two incremental counter inputs Reference cams galvanically decoupled
Input Level	Input voltage RS-422
Resolution	24-bit counter (twos complement)
Encoder Feed	+5 V DC
Current Consumption	0.1 A (without encoder)
Housing	Module with front panel is mounted in the CNX-21 using two screws.
Dimensions (W x H x D)	58 x 72 x 50 mm, Weight 100 g
Temperature	Operation: ±0..+55° C, Storage: -20..+70° C

3.11.4 Signal description and example of MINC-2 connection

Pin	Signal	I/O	Description of Channel 1
L-1	/NP		Inv. zero pulse
L-2	NP		Zero pulse
L-3	RN-		Inv. reference cam
L-4	RN+		Reference cam
L-5	/B		Inv. channel B
L-6	B		Channel B
L-7	/A		Inv. channel A
L-8	A		Channel A
L-9	+5V	Supply	Supply voltage for the encoder
L-10	0 V	Ground	
Pin	**Signal**	**I/O**	**Description of Channel 2**
R-1	/NP		Inv. zero pulse
R-2	NP		Zero pulse
R-3	RN-		Inv. reference cam
R-4	RN+		Reference cam
R-5	/B		Inv. channel B
R-6	B		Channel B
R-7	/A		Inv. channel A
R-8	A		Channel A
R-9	+24V	Supply	Supply voltage for the encoder
R-10	0 V	Ground	

Pin marking: L : row (left)
                              R : row (right)

MDIO-16

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3.12 MDIO 16, digital input / output sub-module

8 Bit 24V   **input**
8 Bit 24V/0.5A   **output**
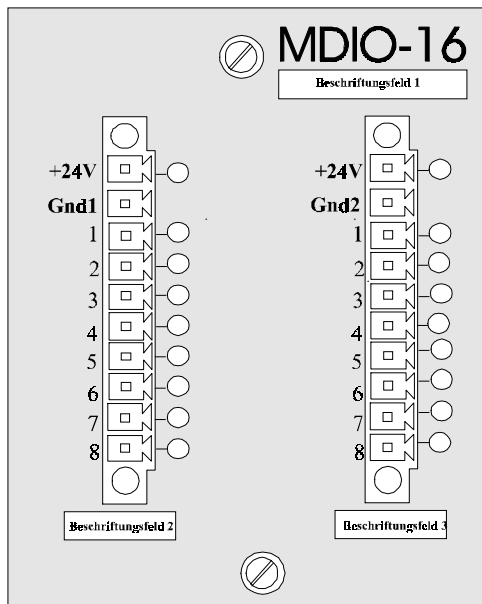
3.12.1 General

The MDIO16 input/output module is a submodule, which is galvanically decoupled by means of optocouplers, for the CNX-21 basic module. It has 16 digital inputs/outputs for 24V /0,5A. For operation in the DeviceNet system, you can install up to four MDIOs in the four slots of a CNX-21 basic module. Thus, 64 inputs/outpus per module are possible. A mixture with other digital or analog modules is also possible.

3.12.2 I/O Data format

Dependent of the configuration and programming the transferred I/O-message from the CNX-21 to the DeviceNet master or from the DeviceNet master to the CNX-21 needs 1 or 2 bytes.

MDIO16 – 16I/O

Without programming all 16 bits are used as output. In this case the transferred I/O-message from the DeviceNet master to the CNX-21 needs 2 bytes.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				
1				Byte Channel 2				

Programming:
      Channel 1 = output, 8 bits
      Channel 2 = input, 8 bits
I/O-Message in both directions = 1 byte

To Master :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 2				

To CNX21 :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				

Programming:
      Channel 1 = input, 8 bits
      Channel 2 = output, 8 bits
I/O-Message in both directions = 1 byte

To Master :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				

To CNX21 :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 2				

Programming:
      Channel 1 = input/output
      Channel 2 = input/output
I/O-Message in both directions = 2 byte

To Master :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				
1				Byte Channel 2				

To CNX21 :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				
1				Byte Channel 2				

MDIO16 – 8I / 8I/O

Channel 1 always = input, 8 bits
Without programming:
        Channel 2 = output, 8 bits
        I/O-Message in both directions = 1 byte

To Master :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				

To CNX21 :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 2				

Programming:
        Channel 2 = input, 8 bits
I/O-Message from CNX21 to Master = 2 bytes

To Master :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				
1				Byte Channel 2				

Programming:
        Channel 2 = input / output
I/O-Message in both directions = 2 byte

To Master :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				
1				Byte Channel 2				

To CNX21 :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 2				
1				Byte Channel 2				

MDIO16 – 16I

Channel 1/2 always = input, 8 bits
I/O-Message from CNX21 to Master = 2 bytes

To Master :

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0				Byte Channel 1				
1				Byte Channel 2				

3.12.3 Programming

MDIO16 – 16I/O and MDIO16 – 8I / 8I/O:

Individual programming of the bits to inputs or outputs

MDIO16 – 16I/O

Individual programming of the bits to inputs or outputs of Channel1 and Channel2

MDIO16 – 8I / 8I/O

Channel 1 always = input, 8 bits
Individual programming of the bits to inputs or outputs of Channel 2

The programming is carried out via the parameter object in the DeviceNet. Therefore the instance corresponding to the slot must be addressed. For example the MDIO16 is plugged in slot 3, the MDIO16 can be programmed via the parameter-object instance 3. To use a bit of a channel as output, the corresponding bit must be set to "1" in the attribute of the instance. To use a bit of a channel as input, the corresponding bit must be set to "0" in the attribute of the instance.

3.12.3.1 Data format for programming

MDIO16 – 16I/O

The attribute consists of 2 bytes.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Byte Channel 1							
1	Byte Channel 2							

MDIO16 – 8I / 8I/O

The attribute consists of 1 byte.

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Byte Channel 2							

4 Appendix

Example of the composition of a process map in the CNX-21

4.1 Example 1

CNX-21 format:

Slot 0	Slot 1	Slot 2	Slot 3	Slot 4
CNX21	MAO	MDO	MDI	leer

In an I/O-message from the DeviceNet-master 10 bytes must be sent to the CNX-21. The CNX-21 sends 1 byte to the DeviceNet master.

Data from the master to the CNX-21

Byte 1	Low Byte MAO Channel 1
Byte 2	High Byte MAO Channel 2
Byte 3	Low Byte MAO Channel 1
Byte 4	High Byte MAO Channel 2
Byte 5	Low Byte MAO Channel 1
Byte 6	High Byte MAO Channel 2
Byte 7	Low Byte MAO Channel 1
Byte 8	High Byte MAO Channel 2
Byte 9	MDO
Byte 10	unplugged slot

Data from the CNX-21 to the master

Byte 1	MDI

4.2 Example 2

CNX-21 format:

Slot 0	Slot 1	Slot 2	Slot 3	Slot 4
CNX21	MINC	MDO	MDI	MDO

In an I/O-message from the DeviceNet-master 2 bytes must be sent to the CNX-21. The CNX-21 sends 9 bytes to the DeviceNet master.

Data from the master to the CNX-21

Byte 1	MDO Slot 2
Byte 2	MDO Slot 4

Data from the CNX-21 to the master

Byte 1	MINC Channel 1
Byte 2	MINC Channel 1
Byte 3	MINC Channel 1
Byte 4	MINC Channel 1
Byte 5	MINC Channel 2
Byte 6	MINC Channel 2
Byte 7	MINC Channel 2
Byte 8	MINC Channel 2
Byte 9	MDI slot 3