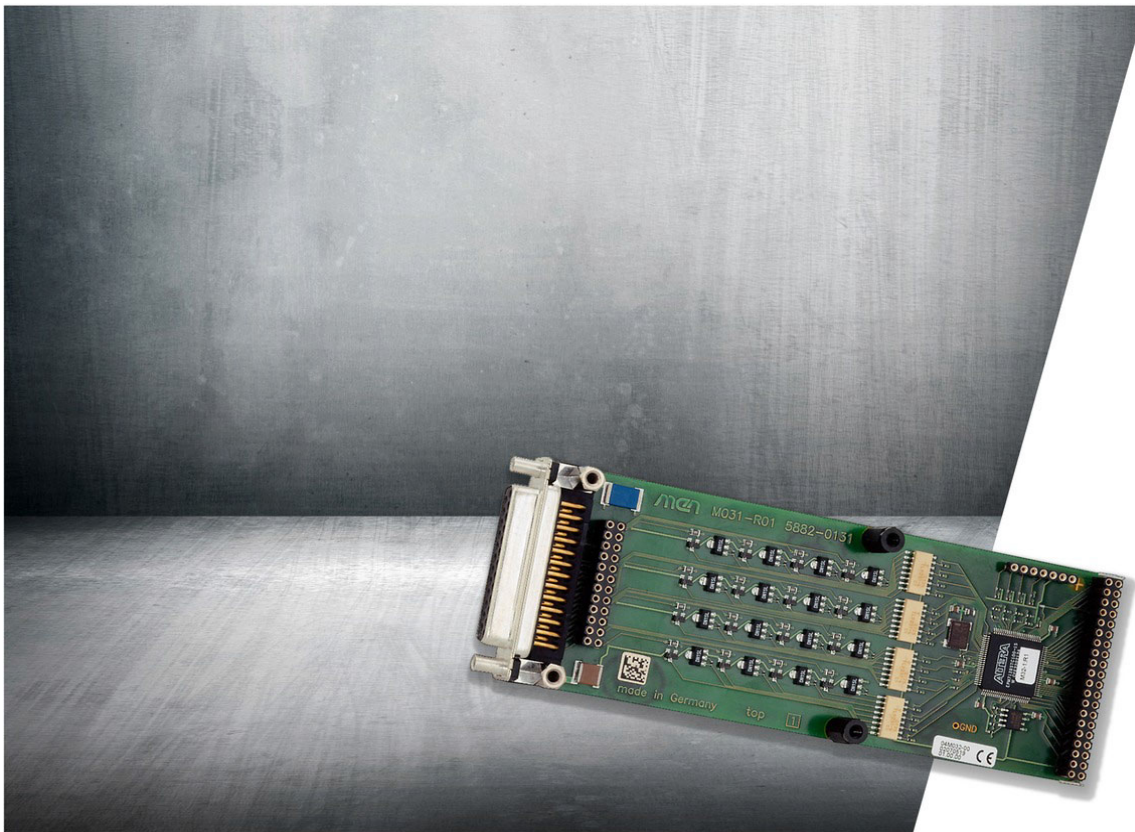


# M31

**Mezzanine Card with 16 Digital Inputs, High-Side Switching**

**M-Module**



**User Manual**



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## About this Document

This document is intended only for system developers and integrators.

It describes the design, functions and connection of the product. The manual does not include detailed information on individual components (data sheets etc.).



M31 product page with up-to-date information and downloads:  
[www.men.de/products/m31/](http://www.men.de/products/m31/)

### History

Issue	Comments	Date
E1	First edition	1993-06-28
E2	Second edition	1994-03-08
E3	Third edition	1995-12-04
E4	Fourth edition, for hardware revision 01.xx or higher	2002-11-21
E5	General update, minor errors corrected	2019-04-01

## Conventions



Indicates important information or warnings concerning situations which could result in personal injury, or damage or destruction of the component.



Indicates important information concerning electrostatic discharge which could result in damage or destruction of the component.



Indicates important information or warnings concerning proper functionality of the product described in this document.



The globe icon indicates a **hyperlink** that links directly to the Internet. When no globe icon is present, the hyperlink links to specific information within this document.

*Italics* Folder, file and function names are printed in *italics*.

*Comment* Comments embedded into coding examples are shown in green text.

IRQ#  
/IRQ Signal names followed by a hashtag "#" or preceded by a forward slash "/" indicate that this signal is either active low or that it becomes active at a falling edge.

In/Out Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "from the board or component".

0xFF Hexadecimal numbers are preceded by "0x".

0b1111 Binary numbers are preceded by "0b".

## Product Safety

Read the user manual carefully before using the product. Keep the user manual for later reference.

### **Conditions for Use, Field of Application**

The product is designed to function correctly in the market, application area and environmental conditions specified in the applicable standards which are listed in the Technical Data.

Use cases in environments exceeding the specifications in the applicable standards and the Technical Data have to be agreed upon between MEN and the customer.

The product is not suitable for use in areas where children might be present.

### **Electrostatic Discharge (ESD)**



Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the PCB and other components against damage from static electricity, follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Only store the product in its original ESD-protected packaging. Retain the original packaging in case you need to return the product to MEN for repair.

### **Qualified Personnel**

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

## Product Compliance

MEN products are no ready-made products for end users. They are tested according to the standards given in the Technical Data and thus enable you to achieve certification of the product according to the standards applicable in your field of application.

If the product delivered was certified by MEN and is modified by the customer, e.g., by installing an additional hardware component, the certification achieved by MEN becomes invalid and has to be repeated for the new product configuration.

### RoHS

MEN is committed to develop and produce environmentally compatible products according to the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU (formerly 2002/95/EC) of the European Union.

Since July 1, 2006 all MEN standard products comply with RoHS legislation.

### REACH

MEN is a manufacturer of electronic products and thus a so-called "downstream user" in terms of REACH. The products MEN supplies are solely non-chemical goods. Moreover and under normal and reasonably foreseeable circumstances of application, the goods supplied shall not release any substance.

Beyond that, according to REACH – Art.33, MEN will inform the customer immediately should a substance contained in an MEN product (with a content of > 0.1%) be classified alarming by the European Chemicals Agency (ECHA).

### WEEE Application



The WEEE directive does not apply to fixed industrial plants and tools. The compliance is the responsibility of the company which puts the product on the market, as defined in the directive; components and sub-assemblies are not subject to product compliance.

Since MEN does not deliver ready-made products to end users, the WEEE directive is not applicable for MEN. Users are nevertheless recommended to properly recycle all electronic boards which have passed their life cycle.

Nevertheless, MEN is registered as a manufacturer in Germany. The registration number can be provided on request.

## Disclaimer

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# 1 Product Overview

## 1.1 Product Description

### **16-Bit Digital Input M-Module**

The mezzanine card M31 is a 16-bit digital input M-Module with latching capabilities for industrial applications. The inputs are optically isolated with a high isolation voltage of 500 V DC.

A current limit for each input guarantees a wide input voltage range of 0 V to 155 V.

Each input signal edge generates a maskable interrupt for each channel.

The signals of mechanical switches are debounced by a digital circuit with the precision debouncing time of 300 ns to 14 ms.

### **High-Side Switching**

The M31 has its input load on ground which means that switching an input to supply voltage activates the respective optocoupler.

### **Based on ANSI Standard**

The M31 is based on the M-Module ANSI mezzanine standard. It can be used as an I/O extension in any type of bus system, i.e. CPCI, VME or on any type of stand-alone SBC. Appropriate M-Module carrier cards in 3U, 6U and other formats are available from MEN or other manufacturers.

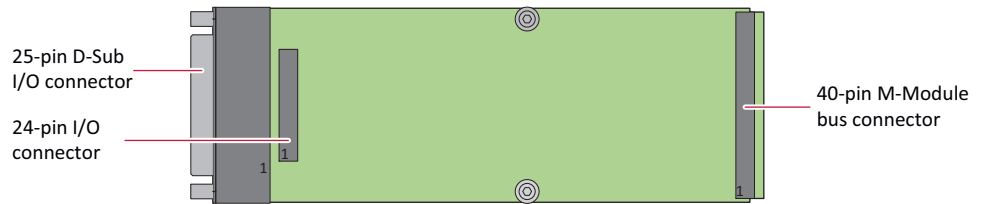
### **Reliable and Robust**

The M31 can operate in a -40 °C to +85 °C temperature range. The board withstands shock and vibration for reliable operation.

## 1.2 Product Architecture

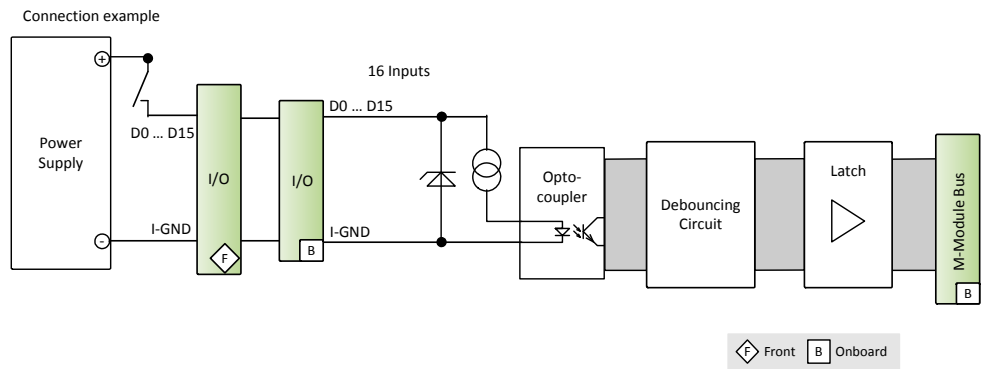
### 1.2.1 Interfaces

Figure 1. Board layout – top view



### 1.2.2 Functions

Figure 2. Functional diagram



## 1.3 Technical Data

### Digital Inputs

- Input load on ground
- FET constant current source inputs
- Input voltage: Logical low max. 1 V
- Input voltage: Logical low min. 0 V
- Input current: Logical low max. 0.2 mA
- Input current: Logical low min. 0 mA
- Input voltage: Logical high max. 40 V
- Input voltage: Logical high max. 155 V (M-Module version for extended temperature range)
- Input voltage: Logical high min. 5 V
- Input current: Logical high max. 3.5 mA
- Input current: Logical high min. 2.5 mA
- Switching time for input change: 3  $\mu$ s typ.
- Debouncing time: 14 ms (defined by PLD programming)

### Interfaces

- Digital I/O
  - 16x digital input, isolated, D-Sub, 25-pin, receptacle
  - 16x digital input, isolated, board to board
- M-Module
  - 1x A08/D16/INTA/INTB/IDENT, board to board

### Product Standard

- M-Module: ANSI/VITA 12-1997 (S2012)

### Electrical Specifications

- Supply voltage
  - +5 V (-3 % / +5 %)
- Power consumption
  - 0.25 W typ.
- Isolation voltage
  - 500 V DC between isolated side and digital side
  - Voltage between the connector shield and isolated ground is limited to 180 V using a varistor; AC coupling between connector shield and isolated ground through 47 nF capacitor

### Mechanical Specifications

- Dimensions standard: M-Module: (W) 149 mm, (D) 53 mm
- Weight: 67.5 g

### **Environmental Specifications**

- Operating temperature
  - 0 °C to +60 °C, or
  - -40 °C to +85 °C
  - Airflow: min. 10 m³/h
- Storage temperature: -40 °C to +85 °C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300 m to +3000 m
- Shock: 15 g / 11 ms
- Bump: 10 g / 16 ms
- Vibration (sinusoidal): 2 g / 10 Hz to 150 Hz

### **Reliability**

- MTBF: 2 496 550 h predicted @ 40 °C according to IEC/TR 62380 (RDF 2000)

### **Safety**

- Flammability (PCBs)
  - UL 94 V-0

### **EMC**

- EN 55022 (radio disturbance)
- IEC 61000-4-2 (ESD)
- IEC 61000-4-4 (burst)

### **Software Support**

- Linux
- Windows
- VxWorks
- QNX
- OS-9



See the MEN website for supported operating system versions, available software and more details on supported functions:

[www.men.de/products/m31/#downl](http://www.men.de/products/m31/#downl)

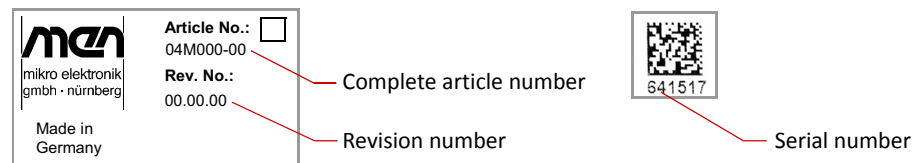
## 1.4 Product Identification

MEN documentation may describe several different models and design revisions of the M31. You can find the article number, design revision and serial number affixed to the M31.

- **Article number:** Indicates the product family and model. This is also MEN's main ordering number. To be complete it must have 9 characters.
- **Revision number:** Indicates the design revision of the product.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

*Figure 3. Product labels*



## 2 Getting Started

### 2.1 Connecting and Starting

You can use the following check list when installing the board in a system for the first time and with minimum configuration.

- » Power down the system.
- » Remove the carrier board from the system.
- » Install the M31 on the carrier board, making sure that the connectors are properly aligned.



For details regarding the installation of the M31 on the carrier board please refer to the user manual of the carrier board.

- » Insert the carrier board into the system.
- » Power up the system.
- » If an error occurs during start-up, check if the M31 is plugged correctly on the carrier board.
- » Now you can install driver software for the M31.

#### 2.1.1 Connecting a Digital Input

- » Connect the GND of a 24 V supply (12 V is also possible) to pin 25 on the 25-pin D-Sub connector.
- » Connect one of the digital inputs, e.g., pin 1 (bit 0) to the +-connection of this supply.
  - Now you should read the value `0x0001` at the base address.

## 2.2 *Installing Driver Software*

For a detailed description on how to install driver software, please refer to the respective documentation of the software package to be installed.



See the MEN website for all available software:  
[www.men.de/products/m31/#downl](http://www.men.de/products/m31/#downl)

### 2.2.1 *MDIS System Package*

The M31 is supported by the MDIS framework.

MDIS stands for MEN Driver Interface System and is a framework for device drivers for almost any kind of I/O hardware. It greatly simplifies system configuration, also in combination with specialized board BSPs.



See the [MEN website](#) for more information on MDIS.



## 3 Functional Description

### 3.1 Power Supply

The M31 is supplied via the carrier board.

Note: The I/O voltage is supplied via the front connector.

See [Figure 2, Functional diagram on page 11](#).

### 3.2 Digital Inputs

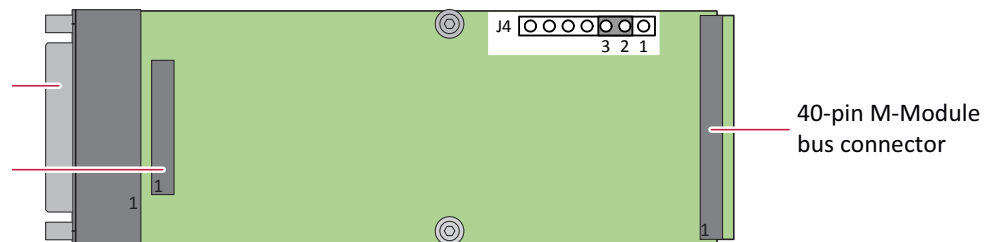
#### 3.2.1 Operating Principle

Referred to ground, an input signal is 1 (logical high) if a current of 3.5 mA (typical value) is flowing. All open inputs with no current flowing are considered 0 (logical low).

A debouncing circuit takes care that signals are acknowledged only with a changed level, if they are present safely for an adequate time. This time is programmed in a PLD. This guarantees a debouncing time of 14 ms.

It is possible to disable the debouncing circuit. To do this, connect pins 2 and 3 at receptacle connector J4 of the M-Module.

*Figure 4. Disabling the debouncing circuit through connector J4*



### 3.2.2 Front Connection

Table 1. Connector types - 25-pin D-Sub receptacle


Connector	Type
On M31	25-pin D-Sub receptacle according to DIN41652/MIL-C-24308, with thread bolt UNC 4-40
Mating	25-pin D-Sub plug according to DIN41652/MIL-C-24308, available for ribbon cable (insulation piercing connection), hand-soldering connection or crimp connection

Table 2. Pin assignment - digital inputs (25-pin D-Sub)

	1	D00	14	D01
	2	D02	15	D03
	3	D04	16	D05
	4	D06	17	D07
	5	D08	18	D09
	6	D10	19	D11
	7	D12	20	D13
	8	D14	21	D15
	9	I-GND	22	I-GND
	10	I-GND	23	I-GND
	11	I-GND	24	I-GND
	12	I-GND	25	I-GND
	13	I-GND		

### 3.2.3 Onboard Connection

6U M-Module carrier boards can implement the 24-pin board-to-board connection to lead the I/O signals also to a rear connector, i.e. the CompactPCI or VMEbus backplane.

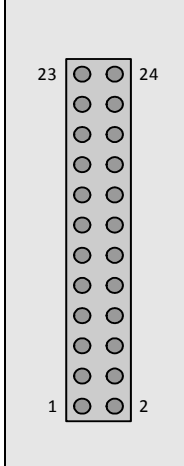


For details regarding the onboard connection on the carrier board please refer to the user manual of the carrier board.

*Table 3. Connector types – 24-pin receptacle*

Connector	Type
On M31	Two 12-pin receptacles, high-precision, 2.54 mm pitch, for square pins $\varnothing$ 0.635 mm gold, 6.9 mm height
Mating	Two 12-pin plugs, 2.54 mm pitch, square pins $\varnothing$ 0.635 mm gold

*Table 4. Pin assignment – digital inputs (24-pin onboard connector)*

	23	I-GND	24	I-GND
	21	I-GND	22	I-GND
	19	I-GND	20	I-GND
	17	I-GND	18	I-GND
	15	D14	16	D15
	13	D12	14	D13
	11	D10	12	D11
	9	D08	10	D09
	7	D06	8	D07
	5	D04	6	D05
	3	D02	4	D03
	1	D00	2	D01

### 3.2.4 Signal Mnemonics

*Table 5. Signal mnemonics – digital inputs*

Signal	Direction	Function
D[00:15]	in	Data input lines
I-GND	-	Isolated ground

### 3.3 M-Module Bus Host Interface

Table 6. Connector types – 40-pin receptacle

Connector	Type
On M31	Two 20-pin receptacles, high-precision, 2.54 mm pitch, for square pins $\varnothing$ 0.635 mm gold, 6.9 mm height
Mating	Two 20-pin plugs, 2.54 mm pitch, square pins $\varnothing$ 0.635 mm gold

Table 7. Pin assignment – M-Module bus connector (40-pin onboard connector)

		A	B
	20	RESET#	-
	19	IACK#	IRQ#
	18	DTACK#	WRITE#
	17	DS1#	DS0#
	16	D15	D07
	15	D14	D06
	14	D13	D05
	13	D12	D04
	12	D11	D03
	11	D10	D02
	10	D09	D01
	9	D08	D00
	8	A07	GND
	7	A06	-
	6	A05	-
	5	A04	GND
	4	A03	-
	3	A02	-
	2	A01	+5V
	1	CS#	GND

*Table 8. Signal mnemonics – M-Module bus connector*

<b>Signal</b>	<b>Direction</b>	<b>Function</b>
+5V	in	Supply voltage
Axx	out	Address bus
CS#	out	M-Module chip select
DS0#	out	Data bus select signal
DTACK#	in	Data acknowledge
Dxx	in/out	Multiplexed data bus
GND	-	Ground (logical reference signal)
IACK#	in	Interrupt acknowledge
IRQ#	out	M-Module interrupt
RESET#	out	M-Module reset
WRITE#	out	Read/write enable

## 4 Hardware/Software Interface

This chapter is intended for software developers or board integrators who need deeper knowledge of the implementation details of the M31 interfaces and its internal connections.

### 4.1 M-Module Registers

To access individual functions from the carrier board, compute the necessary address from the base address of the M-Module and the offset address from the following table:

Table 9. Address map

Offset Address	D[15:8]	D[7:0]
0x00	Data Register (read)	
0x02	Interrupt Mask Register (read/write)	
0x80	Interrupt Clear Register (read/write)	
0xFE	-	M-Module Identification Register (read/write)

### 4.2 Reading Data

You can access the M-Module at the respective M-Module base address. Read access to the 16 input bits can be word by word, byte by byte, or bit by bit. D0 in the word corresponds to line D00 of the connector (pin 1 of the 25-pin D-Sub connector). Write accesses to the M-Module are not acknowledged through DTACK#, which usually leads to a bus error.

#### Data Register (0x00) (read)

Bit	15	14	13	12	11	10	9	8
Name	D15	D14	D13	D12	D11	D10	D9	D8
Access	R	R	R	R	R	R	R	R
Reset								
Bit	7	6	5	4	3	2	1	0
Name	D7	D6	D5	D4	D3	D2	D1	D0
Access	R	R	R	R	R	R	R	R
Reset								
Bit Field		Description						
[15:0]	D[15:0]	Data input bit						

## 4.3 Interrupt Generation

### 4.3.1 General

When level changes occur on one or more inputs, the interrupt request line of the M-Module becomes active. The carrier board can be prompted to enable a (vector) interrupt on the bus. The IACK# signal on the M-Module interface resets the interrupt request on the M-Module (hardware end of interrupt). Another possibility is to access the Interrupt Clear Register (0x80). Reading from or writing to this register will also clear the interrupt (software end of interrupt).

An interrupt only indicates a change of the input data, but not which data has changed.

### 4.3.2 Enabling and Disabling Interrupts

By default, a change of one of the input lines generates an interrupt. The Interrupt Mask Register allows you to disable each individual channel for interrupts.

You can also read back this interrupt mask.

#### Interrupt Mask Register (0x02) (read/write)

Bit	15	14	13	12	11	10	9	8
Name	I15	I14	I13	I12	I11	I10	I9	I8
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	1	1	1	1	1	1	1	1
Bit	7	6	5	4	3	2	1	0
Name	I7	I6	I5	I4	I3	I2	I1	I0
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	1	1	1	1	1	1	1	1
Bit Field		Description						
[15:0]	I[15:0]	Interrupt mask for channel 15 to 0 <ul style="list-style-type: none"> <li>▪ 0: Interrupt disabled</li> <li>▪ 1: Interrupt enabled (default)</li> </ul>						

### 4.3.3 M-Module Identification Register

The M31 has an identification EEPROM in accordance with the M-Module specification.

*Table 10. M-Module Identification Register (0xFE)*

Bit	7	6	5	4	3	2	1	0
<b>Name</b>	-	-	-	-	-	CS	CLK	DATA
<b>Access</b>	-	-	-	-	-	W	W	R/W
<b>Reset</b>	0	0	0	0	0	0	0	0
Bit Field		Description						
<b>2</b>	CS	Chip select <ul style="list-style-type: none"> <li>▪ 1: Chip select for EEPROM</li> </ul>						
<b>1</b>	CLK	Serial identification clock						
<b>0</b>	DATA	Identification data						