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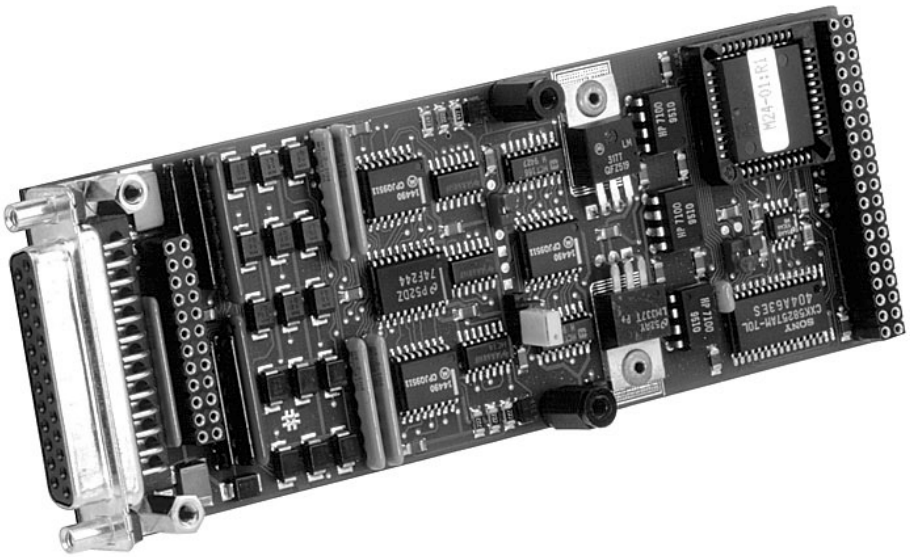
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Embedded Solutions

M24 – 8/16 Binary Inputs



User Manual

Board-Level Computers for Industrial Applications

men mikro elektronik gmbh • nürnberg

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M24 – 8/16 Binary Inputs

The M24 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, PXI, 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.

The M24 has voltage-sensitive inputs. Either 16 channels are available using a 25-pin D-Sub connector, or 8 channels using a screw terminal with LED display. The nominal switching threshold is half the supply voltage. Suppressor diodes protect all inputs against overvoltage.

Interrupt generation can be programmed for each individual channel on each transition.

The M24 is a high-end M-Module for process input. It is designed for use in critical applications.

Technical Data

Binary Inputs

- 16 binary inputs with 25-pin D-Sub connector
- 8 binary inputs with screw terminal and LED display
- Input load on ground or supply voltage
- Schmitt trigger characteristics with 2V hysteresis
- Input current 5mA @ 24V typ.
- Input voltage range 12..32V

Input Control

- BIOC (Binary Input/Output Controller)

Switching Voltage and Current

- U low = VBB / (2 - 0.5V)
- U high = VBB / (2 + 0.5V)
- I in = ±5mA (VBB = 24V)

Overload Protection

- Intelligent protection

Miscellaneous

- Debouncing circuit
- Interrupt generation for each channel on each signal edge

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Peripheral Connections

- Via front panel on a shielded 25-pin D-Sub connector (16 inputs) or
- Via screw terminal and LED display (8 inputs)
- Via carrier board (rear I/O)

M-Module Characteristics

- A08, D08, INTA, IDENT

Electrical Specifications

- Isolation voltage:
  - 500V DC between isolated side and digital side
  - Voltage between the connector shield and isolated ground is limited to 180V using a varistor; AC coupling between connector shield and isolated ground through 47nF capacitor
- Supply voltage/power consumption:
  - +5V (4.85V..5.25V), 120mA typ.
  - +24V (10V..32V), 50mA typ.
- MTBF: tbd.

Mechanical Specifications

- Dimensions: conforming to M-Module Standard
- Weight: 84g

Environmental Specifications

- Temperature range (operation):
  - 0..+60°C
  - Industrial temperature range on request
  - Airflow: min. 10m³/h
- Temperature range (storage): -40..+85°C
- Relative humidity range (operation): max. 95% without condensation
- Relative humidity range (storage): max. 95% without condensation
- Altitude: -300m to + 3,000m
- Shock: 15g/0.33ms, 6g/6ms
- Vibration: 1g/5..2,000Hz

Safety

- PCB manufactured with a flammability rating of 94V-0 by UL recognized manufacturers

EMC

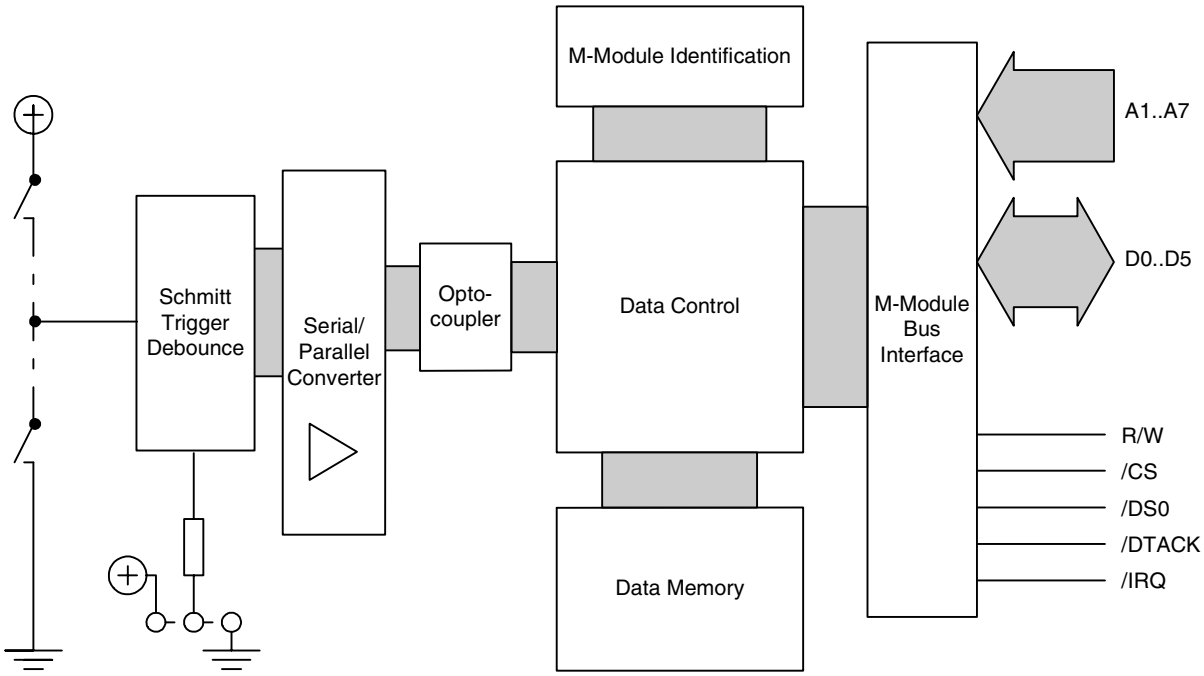
- Tested according to EN 55022 / 1999-05 (radio disturbance) and EN 55024 / 1999-05 (immunity) with regard to CE conformity

Software Support

- MEN Driver Interface System (MDIS)

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Block Diagram



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Product Safety



Electrostatic Discharge (ESD)

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should 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.
- Store the board only in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

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About this Document

This user manual describes the hardware functions of the board, connection of peripheral devices and integration into a system. It also provides additional information for special applications and configurations of the board.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Edition	Description	Technical Content	Date of Issue
E1	First edition	M. Schmitz	1992-12-15
E2	Second edition	M. Schmitz	1995-12-04
E3	Third edition	M. Schmitz	2004-03-18

Conventions



This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics — Folder and file names are printed in *italics*.

bold — **Bold** type is used for emphasis.

hyperlink — Hyperlinks are printed in blue color.



The globe will show you where hyperlinks lead directly to the Internet, so you can look for the latest information online.

0xFF — Hexadecimal numbers are preceded by "0x", which is the usual C-language convention, and are printed in a monospace type, e.g. 0x00FFFF.

IRQ# /IRQ — Signal names followed by "#" or preceded by a 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 "coming from it".

Vertical lines on the outer margin signal technical changes to the previous edition of the document.

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1 Getting Started

This chapter gives some hints for first installation of the M-Module in a system.

1.1 Installation Check List

You can use the following "check list" to install the M-Module on a carrier board for the first time and to test proper functioning of the board.



The M-Module is completely trimmed on delivery.

- ☑ Power-down the system.
- ☑ Install the M-Module carrier board in your system without the M-Module.
- ☑ Power-up the system.
- ☑ Test the carrier board.
- ☑ If O.K., power-down the system and remove the carrier board.
- ☑ Install the M-Module in slot 0 of the carrier board.
- ☑ Initially, do not change any jumpers.
- ☑ Insert the carrier board into the system again.
- ☑ Power-up the system.
- ☑ Load a suitable debugger.
- ☑ Access the base address as set, reading word by word.
- ☑ If a bus error is occurring now, the M-Module is not plugged properly or the carrier board is not set up correctly (e. g. D201 PLD must be loaded). Please refer to the carrier board's user manual for details.
- ☑ Write the word `0x0001` to the base address.
- ☑ Reading from the base address should yield the value `0xyyy9`.

1.2 Installing Driver Software

For a detailed description on how to install driver software please refer to the respective documentation.



You can find any driver software available for download on MEN's website.

1.3 Power Supply

Power supply to the logic part is done via the carrier board. The necessary voltage is +5V. The isolated supply voltages (nominal ±24V) must be taken from an external source. The M-Module cannot operate unless this voltage is connected.

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2 Connecting the M-Module

2.1 Peripheral Interfaces

There are two possibilities for connecting peripherals:

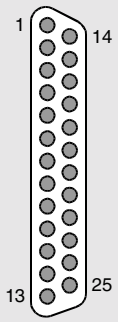
- Connection via 25-pin D-Sub connector.
- Connection via the carrier board.

Table 1. *Signal Mnemonics of Peripheral Connectors*

Signal	Direction	Function
D0..D15	in	Binary inputs 0 to 15
GND	-	Ground
VBB	-	Supply voltage

2.1.1 Connection via 25-pin D-Sub Connector

Table 2. *Pin Assignment of the 25-Pin D-Sub Receptacle Connector*



1	GND	14	GND
2	GND	15	D0
3	D8	16	D1
4	D9	17	D2
5	D10	18	D3
6	D11	19	D4
7	D12	20	D5
8	D13	21	D6
9	D14	22	D7
10	D15	23	VBB
11	VBB	24	VBB
12	VBB	25	VBB
13	VBB		

Connector types:

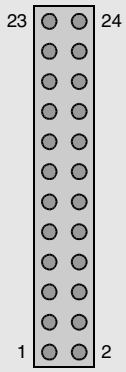
- 25-pin D-Sub receptacle according to DIN41652/MIL-C-24308, with thread bolt UNC 4-40
- Mating connector:
  25-pin D-Sub plug according to DIN41652/MIL-C-24308, available for ribbon cable (insulation piercing connection), hand-soldering connection or crimp connection

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2.1.2 Connection via Carrier Board/24-pin Connector

When a carrier board with a 96-pin DIN 41612 PCB connection is used for peripheral signals (for example a 6U VMEbus board), these are fed to the M-Module through the 24-pin receptacle connector. You can connect up to four 21-pin connectors to the 96-pin connector (cf. carrier board manual). When these connectors are used, for each M-Module three pins of the DIN 41612 PCB connector cannot be used. The pin numbers for the 96-pin connector shown below are valid for M-Module slot number 3. If other M-Module slots (2, 1 or 0) are used, the value 8, 16 or 24 must be added as appropriate.

Table 3. *Pin Assignment of the 24-Pin Receptacle Connector*

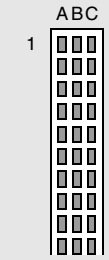


23	-	24	-
21	VBB	22	-
19	VBB	20	VBB
17	D7	18	D15
15	D6	16	D14
13	D5	14	D13
11	D4	12	D12
9	D3	10	D11
7	D2	8	D10
5	D1	6	D9
3	D0	4	D8
1	GND	2	GND

Connector types:

- Two 12-pin receptacles, high-precision, 2.54mm pitch, for square pins ∅ 0.635mm gold, 6.9mm height
- Mating connector:
  Two 12-pin plugs, 2.54mm pitch, square pins ∅ 0.635mm gold

Table 4. *Signal Correspondence between 24-Pin M-Module Connector and 96-pin Carrier Board Connector*

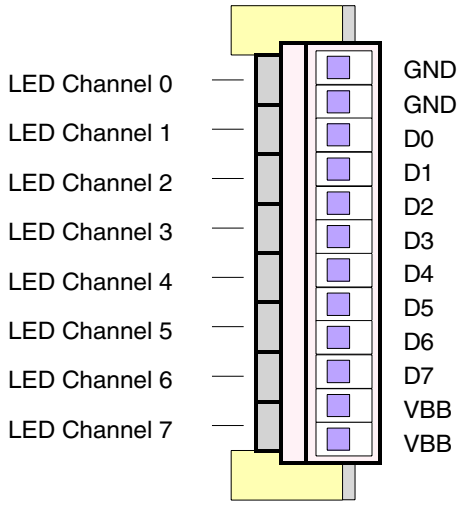


	A	B	C
1	GND	GND	D0
2	D8	D1	D9
3	D2	D10	D3
4	D11	D4	D12
5	D5	D13	D6
6	D14	D7	D15
7	VBB	VBB	VBB
8	-	VBB	VBB

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2.1.3 Connection via Screw Terminal

Figure 1. *Screw Terminal Connector*



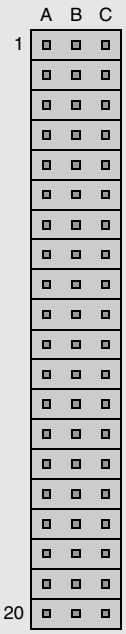
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2.2 Host Interface

The M-Module supports the following signals of a 60-pin carrier board interface plug connector:

Note: Only two rows—A and B—of the 60-pin connector are mounted on the M24!

Table 5. *Supported Pins of 60-Pin Plug Connector on Carrier Board*



	A	B	C
1	/CS	GND	-
2	A01	+5V	-
3	A02	-	-
4	A03	-	-
5	A04	GND	-
6	-	-	-
7	-	-	-
8	A07	-	-
9	-	D00	-
10	-	D01	-
11	-	D02	-
12	-	D03	-
13	-	D04	-
14	-	D05	-
15	-	-	-
16	-	-	-
17	-	/DS0	-
18	/DTACK	/WRITE	-
19	-	/IRQ	-
20	/RESET	SYSCLK	-

Connector types:

- Three 20-pin receptacles, high-precision, 2.54mm pitch, for square pins ∅ 0.635mm gold, 6.9mm height
- Mating connector:
  Three 20-pin plugs, 2.54mm pitch, square pins ∅ 0.635mm gold

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3 Address Organization

When using the driver software supplied, you do not need to be familiar with the hardware of the M-Module in detail. However, familiarity with the address organization of the board is essential if you wish to write your own software for the M-Module or do low-level development.

The 256-byte I/O area of the M-Module is hardware-mapped. The address at which individual functions can be addressed from the carrier board is computed from the base address of the M-Module plus the address in the following table.

Table 6. *Address Map*

Address	D15..D8	D7..D0
0x00	-	Input Register 0 (r/w)
0x02	-	Input Register 1 (r/w)
0x04	-	Input Register 2 (r/w)
0x06	-	Input Register 3 (r/w)
0x08	-	Input Register 4 (r/w)
0x0A	-	Input Register 5 (r/w)
0x0C	-	Input Register 6 (r/w)
0x0E	-	Input Register 7 (r/w)
0x10	-	Input Register 8 (r/w)
0x12	-	Input Register 9 (r/w)
0x14	-	Input Register 10 (r/w)
0x16	-	Input Register 11 (r/w)
0x18	-	Input Register 12 (r/w)
0x1A	-	Input Register 13 (r/w)
0x1C	-	Input Register 14 (r/w)
0x1E	-	Input Register 15 (r/w)
0xFE	-	Interrupt Register (r) M-Module Identification Register (r/w)

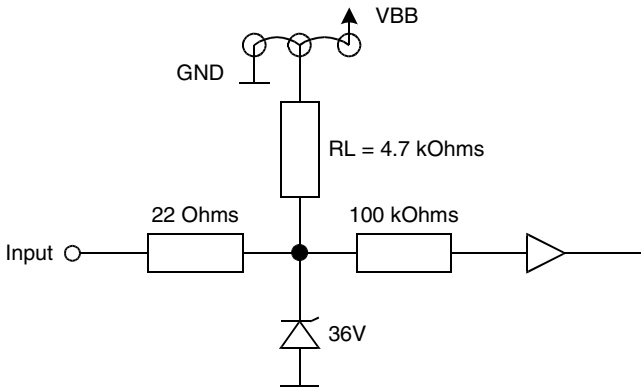
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4 Functional Description

4.1 Binary Input Circuit

The M24 M-Module can accept 16 binary inputs. The inputs constitute a load connected to ground or to the supply voltage. This is configurable through a jumper.

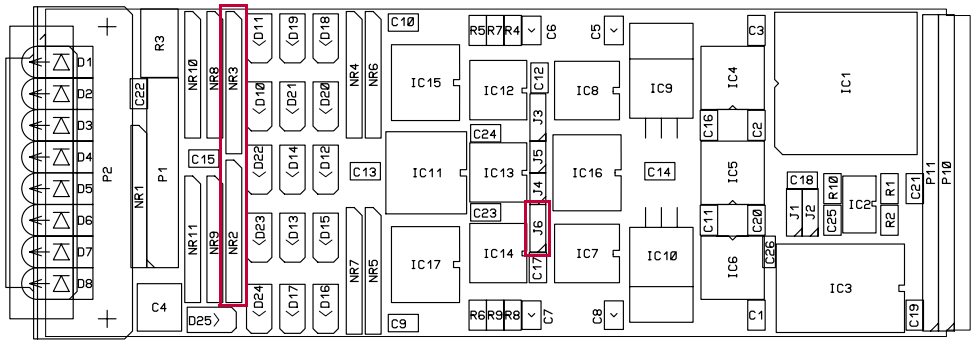
Figure 2. *Input Circuit*



4.1.1 Inputs

Since the input may take the form of a passive switch contact or be fed by open-collector outputs, the M24 M-Module must constitute a load connected either to the supply voltage (VBB) or to ground (GND). The selection of VBB or GND applies to all inputs and is made by means of jumper J6. The load resistances are made up of two resistor networks (NR2 and NR3). The standard resistance is 4.7kΩ. This means that with a supply voltage of 24V there is a current of approximately 5mA. If these resistors are removed completely, the input resistance of the circuit is approx. 100kΩ.

Figure 3. *Position of Jumper J6 and Resistor Networks NR2 and NR3*



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4.1.1.1 Load on Ground or Supply Voltage

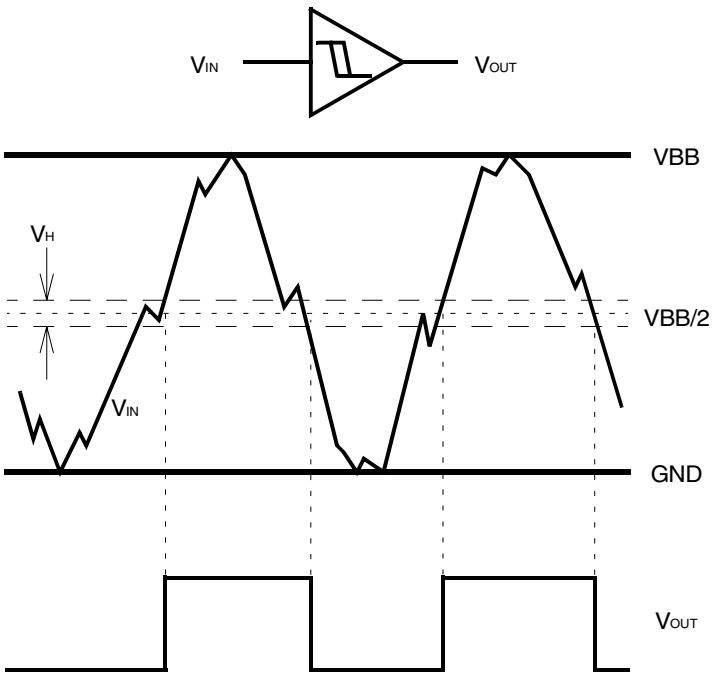
Table 7. *Configuring the Input for Load on GND or VBB*

Jumper Setting	Load on
J6 3 2 1	GND
J6 3 2 1	VBB

4.1.1.2 Signal Switching and Debouncing

Each input has a Schmitt trigger. This ensures proper switching even when the input signal is noisy. Hysteresis is typically 1V. The nominal switching voltage is always exactly half the supply voltage of the electrically isolated part of the circuit, that is 12V nominal with a 24V supply.

Figure 4. *Input Waveform*



For eliminating the "bounce", which typically occurs when switches are opened or closed, so-called bounce eliminators are included. These digital components monitor the stable input state of a signal for a certain time before passing this state to the output.

The debouncing time is 4.5 cycles of a reference frequency determined by capacitor C17, the frequency being approx.

$$\frac{1.5}{1000000 \cdot C17}$$

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The standard value for C17 is 1nF, which yields a frequency of 1500Hz, corresponding to a debouncing time of 3ms. The debouncing time can be altered by changing the capacitor. If this capacitor is removed completely, the debouncing time is approx. 50µs, which means that signals up to 20kHz can be registered.

Figure 5. *Position of Capacitor C17*

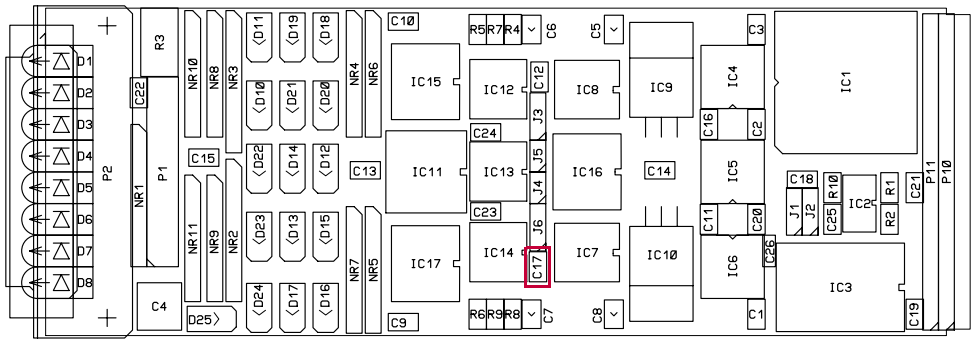
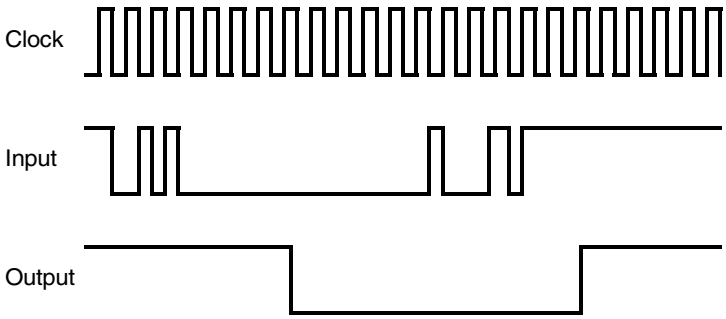


Figure 6. *Debounce Timing*



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4.1.2 ESD Protection

As ESD protection, a suppressor diode is switched in parallel with each input. This diode acts as a Zener diode for voltage spikes caused by discharge of electrostatic charges. It prevents negative input voltages in forward direction and excessive input voltages in reverse direction. The nominal breakdown voltage for the diodes is 36V in reverse direction. The diodes will tolerate very high power for a short time. For instance, the maximum current is up to 100A and the power is 600W for up to 1ms. The current through the diode is also limited by a 22Ω resistance connected in series.

4.1.3 Electrical Isolation

The input stages are isolated from the system by optocouplers. For operation, the module must be supplied with switching voltage VBB—nominal voltage 24V—on the isolated side. This is used by two voltage regulators to generate the necessary 5V for the electrically isolated logic part of the M-Module. This voltage "floats" directly in the middle of the 24V potential difference.

Data transfer between the two parts of the circuit is serial via optocouplers. The potential difference between the protective ground (the connector shell and thereby the front panel) and the electrically isolated part of the circuit is limited to approx. 200V by means of a varistor. In effect, this varistor limits the maximum potential difference across the optocouplers and protects them from being destroyed. In order to prevent interference caused by capacitive coupling across the optocouplers, the electrically isolated part is connected to protective ground through a capacitor (47nF/400V). This capacitor forms an AC short-circuit and thus limits transient interference.

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4.2 Binary Input Output Controller

The M24 Module has a Binary Input Output Controller (BIOC). This controls the inputs and outputs on a channel basis. For each channel there is one register byte, which stores the desired value and the actual value. Edge detection and interrupt masking are also handled by this 6-bit register; two bits remain unused. One such register is used for each channel.

4.2.1 Input Registers

The state of the input can be read from bit *IN* of the input register. If this bit is 0, then the input is at a potential less than half of VBB; if the bit is 1, the potential is higher. Two bits are used to indicate that the input has changed—from 0 to 1 or vice versa. If one of the bits is set, you can reset it by software so as to be able to detect a new edge. Each of these edges can trigger an interrupt if the corresponding interrupt-enable bit *IEF* or *IER* is set.

(See also Chapter 4.2.2 Interrupt Handling on page 22.)

Input Register 0..15 (`0x00..0x1E`) (read/write)

15..8	7..6	5	4	3	2	1	0
-	-	FE	RE	IN	IEF	IER	-

FE 1 = A falling edge has occurred on the input

RE 1 = A rising edge has occurred on the input

IN Value of the input (read only)

IEF Interrupt enable, falling edge
0 = Disable
1 = Enable

IER Interrupt enable, rising edge
0 = Disable
1 = Enable

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4.2.2 Interrupt Handling

If an interrupt occurs, the number of the channel (4 bits) which triggered the interrupt is stored in the Interrupt Register.

Interrupt Register (0xFE) (read only)

15..8	7..5	4..1	0
-		IRQ_CH	DATA

IRQ_CH Interrupt channel (read only)

DATA M-Module identification data (read/write)
See Chapter 4.3 M-Module Identification Register on page 23.

If an interrupt source is enabled by setting the interrupt-enable bit and if a corresponding edge occurs on the input channel so that the corresponding edge bit is set, then an interrupt is triggered by setting the IRQ pin to 0. This causes the corresponding interrupt-enable bit to be reset. Accessing the Interrupt Register causes the IRQ pin to be set back to 1, which acknowledges the interrupt. The register indicates the channel which caused the interrupt. Whether the trigger was a rising or falling edge can be ascertained from the respective Input Register.

If several edges capable of triggering an interrupt occur simultaneously, the first edge detected generates an interrupt. The corresponding edge bit is set for the appropriate edges; however, the interrupt enable bit is only reset in the Input Register of the channel whose input signal generated the interrupt.

This procedure means that the following situations can occur:

- While the BIOC is waiting for an interrupt to be handled, a falling and a rising edge occur on another channel. After the interrupt output has been reset, this channel triggers an interrupt. Now, the interrupt-enable bits for the rising edge and the falling edge are reset simultaneously, i.e. only one interrupt is triggered for the two edges.
- When reading from one register, one of the edge registers and also the corresponding interrupt-enable bit are set. At the same time, the IRQ output is already at 0, but the interrupt was triggered by another register and has not yet been processed.
- Since all bits of a register, with the exception of the *IN* bit, can be written to, an interrupt can also be triggered by software simultaneously setting an interrupt-enable bit and an edge bit.

Note: The IRQ output is reset by reading or **writing** the M-Module Identification (address 0xFE).

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4.3 M-Module Identification Register

The M24 M-Module is supplied with an identification EEPROM in accordance with the M-Module specification.

M-Module Identification Register (0xFE) (read/write)

15..8	7..3	2	1	0
-	-	CS	CLK	DATA

CS Chip-select
1 = Chip-select for EEPROM (write-only)

CLK Serial identification clock (write-only)

DATA Identification data (read/write)

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5 Appendix

5.1 Literature and Web Resources

- M-Module Standard:
  ANSI/VITA 12-1996, M-Module Specification;
  VMEbus International Trade Association
  www.vita.com

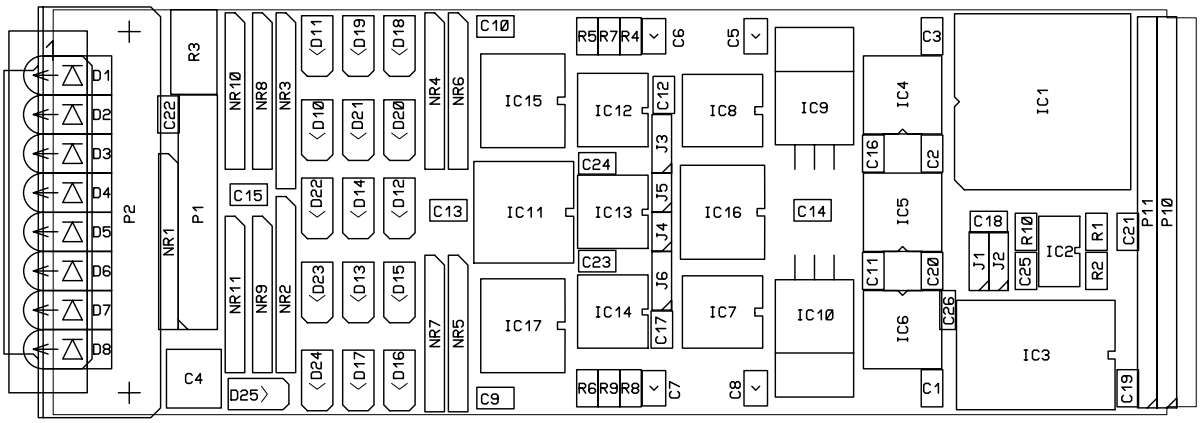
5.2 Board Revisions

Table 8. *Table of Hardware Revisions*

Revision	Comment	Restrictions
01.xx	First revision released	None known
02.xx	Second revision released	None known
03.xx	Third revision released	None known

5.3 Component Plan

Figure 7. *Component Plan of M24 Hardware Revision 03*



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You can request the circuit diagrams for the current revision of the product described in this manual by completely filling out and signing the following non-disclosure agreement.

Please send the agreement to MEN by mail. We will send you the circuit diagrams along with a copy of the completely signed agreement by return mail.

MEN reserves the right to refuse sending of confidential information for any reason that MEN may consider substantial.

mikro elektronik
gmbh · nürnberg

Non-Disclosure Agreement

for Circuit Diagrams provided by MEN Mikro Elektronik GmbH

between

MEN Mikro Elektronik GmbH
Neuwieder Straße 7
D-90411 Nürnberg

("**MEN**")

and

_____
_____
_____
_____

("**Recipient**")

We confirm the following Agreement:

MEN		**Recipient**	
Date:	_____	Date:	_____
Name:	_____	Name:	_____
Function:	_____	Function:	_____

Signature: Signature:

_____ _____

The following Agreement is valid as of the date of MEN's signature.

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This Agreement is only effective if signed by both parties.

Amendments to this Agreement can be adopted only in writing. There are no supplementary oral agreements.

This Agreement shall be governed by German Law.

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