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MODULbus
The Mezzanine Standard

VMOD-IO

MODULbus carrier board

(User's Manual)

Version 3.3

MODULbus series

refers to product revision no.
V 6.x

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Title:	VMOD-IO
File:	j:\as\entwicklung\projekte\hw\vme\vmod-io\doc\manual\vmod-io_v3.doc
Pattern:	j:\as\entwicklung\formulare\entwicklung (ew)\f_manual.dot
Created:	hr, 01.09.2006
Last Update:	Stefan Althöfer, 15.02.2010

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About this Manual

This is the User's Manual for the VMOD-IO VME MODULbus carrier board. It gives all necessary information to users and programmers. We have tried to keep it compact, so there are no special sections for users and programmers. i.e. everything that can be said about the serial port is said in one place (connector layout, signal levels and programming hints). Users that are not programmers might therefore only read the first sections (Introduction and Installation), and come back to the detailed sections when they need special information.

Conventions

If numbers are specified in this manual, they will be either decimal or hexadecimal. We use C-notation to identify hexadecimal numbers (the 0x prefix).

If we refer to low active signal names, they will suffixed by a "#" character.

Some parts of the text are really important. These are visually marked with the following signs:



Indicates information that, when not fully understood or followed, might cause permanent damage to the system. You should not start using the product before you have read this information.



Indicates information that we think you should have read to save your time by avoiding problems. Important suggestions that should be followed will also be marked with this sign.

Acronyms and Abbreviations

ESD	Electrostatic discharge.
MODULbus	Industry standard mezzanine bus system.
VME	Versa Module equipment.

Product Options

The VMOD-IO is available in different versions:

Ordering-no.	Type
BO-FVM-34001	VMOD-IO/S (without onboard ±15V analog power supply)
BO-FVM-34002	VMOD-IO/E (including onboard ±15V analog power supply)

table 1: VMOD-IO versions

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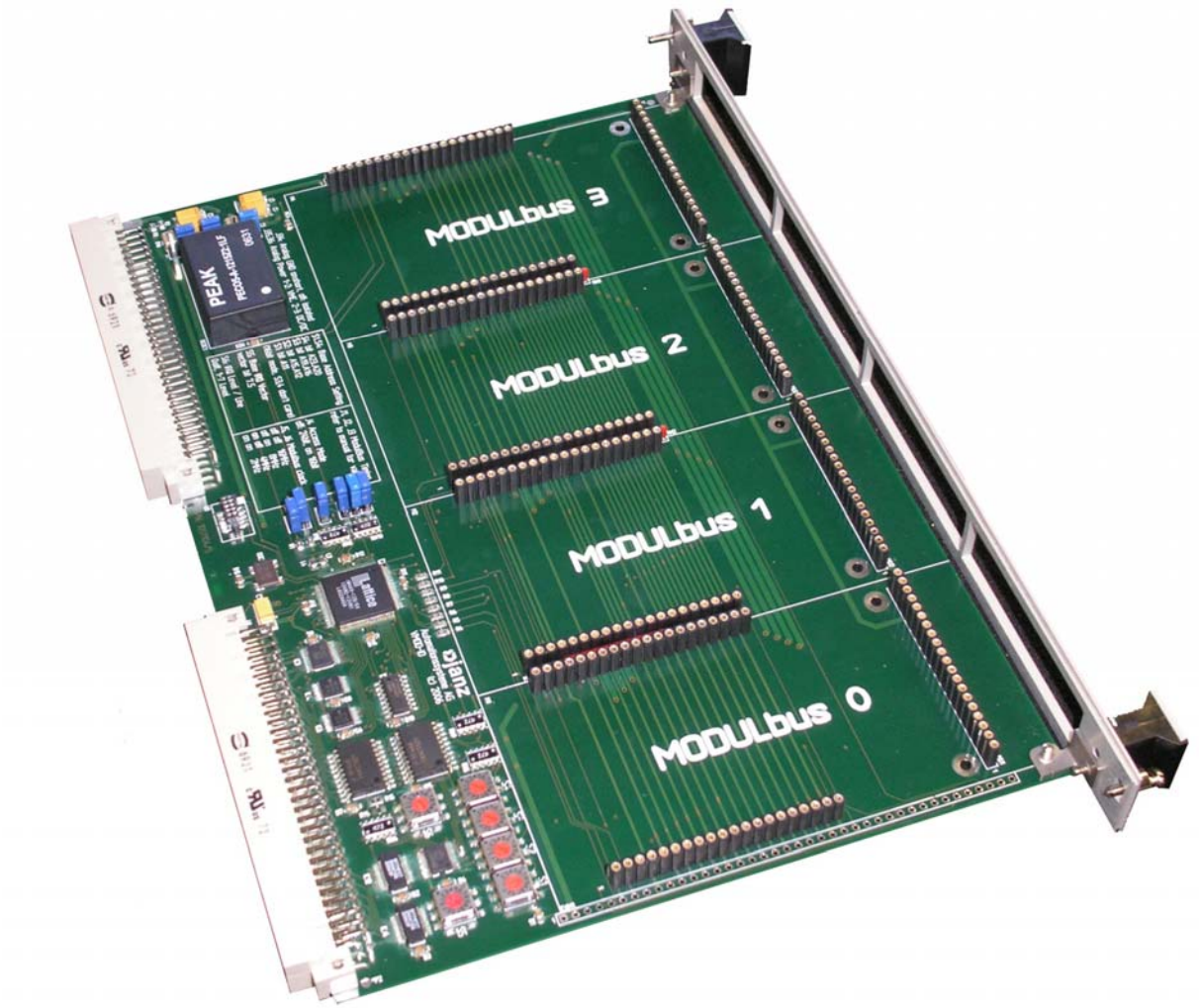


figure 1: VMOD-IO/E

1 Introduction

The VMOD-IO is a VMEbus-compatible carrier board for up to four plug-in modules with MODULbus-interface. Even if the mother board is equipped with four modules, only one slot in the VME-system is needed.
With use of the VMOD-IO the system integrator is able to build up VME-systems with flexible configurations for needs in industrial environment.

1.1 Features

- VMEbus nonintelligent carrier board for MODULbus
- double euro-card with A24/D16 VMEbus slave interface
- 4 plug-in sockets for MODULbus I/O
- different interrupt vector from each MODULbus socket
- user selectable interrupt level
- 2KByte short-I/O or standard-address range
- needs only one VME-Slot
- front panel and P2 connection of I/O lines
- optional on-board DC/DC converter to supply Analog-I/O modules

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1.2 Functional Overview

The VMOD-IO carrier board can be equipped with a maximum of 4 MODULbus I/O-modules. Every MODULbus socket has a 512byte address space and can be selected as byte-device or as word-device.
For integration in complex VMEbus-systems the VMOD-IO can be used within the Short-I/O address space or within the Standard memory address space.
The plug-in modules are able to generate a modified vectored interrupt to the VMEbus via the carrier board with selectable level and configurable vector. The vector holds information about the causing module in its 4 LSB's.

2 Installation

When opening the shipping package of the VMOD-IO, you should immediately check the contents of the package. In the package you will find information about the scope of delivery, as this depends on the options that you have ordered.

If not otherwise noted, the VMOD-IO is delivered in a properly configured state. That is, all jumpers and code-switches are set into a working state after factory testing. Please refer to figure 2 for details.
However, you need to check the following user options (The defaults that are mentioned here, might be replaced by the shipping information that is enclosed in the VMOD-IO delivery):

Item	Type	Description	Default	Reference
J1, J2, J3	Jumper	MODULbus access timing 300ns	on, on, on	Sec.
J4	Jumper	VME short access mode (16bit)	on	Sec.
J5, J6	Jumper	MODULbus clock 4MHz	on, off	Sec.
S4, S3, S2, S1	Code-Switch	VMOD-IO base address (0xAAA8xx)	0xA, 0xA, 0xA, 0x8	
S5	Code-Switch	IRQ vector (upper nibble) (0xAx)	0xA	
S6	Code-Switch	Interrupt priority level 3	0x3	
J34	Jumper	Analog GND shorted to VME GND	on	
J35, J36	Jumper	Analog power supply VMOD-IO/S: from VME VMOD-IO/E: from DC/DC converter	 1-2, 1-2 2-3, 2-3	

table 2: default settings

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Handling Instructions for VMEbus boards



When installing the VMOD-IO into a VMEbus rack or subrack, you need to obey some handling precautions to avoid damaging your board with electrostatic discharge.

When taking the board from the anti-static bag in which it is delivered, you should wear a grounded anti-static wrist strap. The strap should also be connected to your working environment. It is recommended to first touch the board at the front panel, as this has a defined resistive path of about 2MΩ to the sensitive board electronics. Thereby a controlled discharge will take place.

Before inserting the board to your VMEbus system, you should check that the power supply has enough strength to provide the extra load for the VMOD-IO and the additional MODULbus modules. Before inserting the VMOD-IO to the rack or subrack, you *must* turn the power off.

When you insert the VMOD-IO into the backplane, a second discharge defect could arise. This can be avoided by the ESD clips in the card guides of your rack or subrack. These clips make contact to the boards ESD strips, and discharge any electrostatic on the board board through a defined resistive path (2MΩ) *before* the board connectors mate with the backplane.

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2.1 Components and Jumper Locations

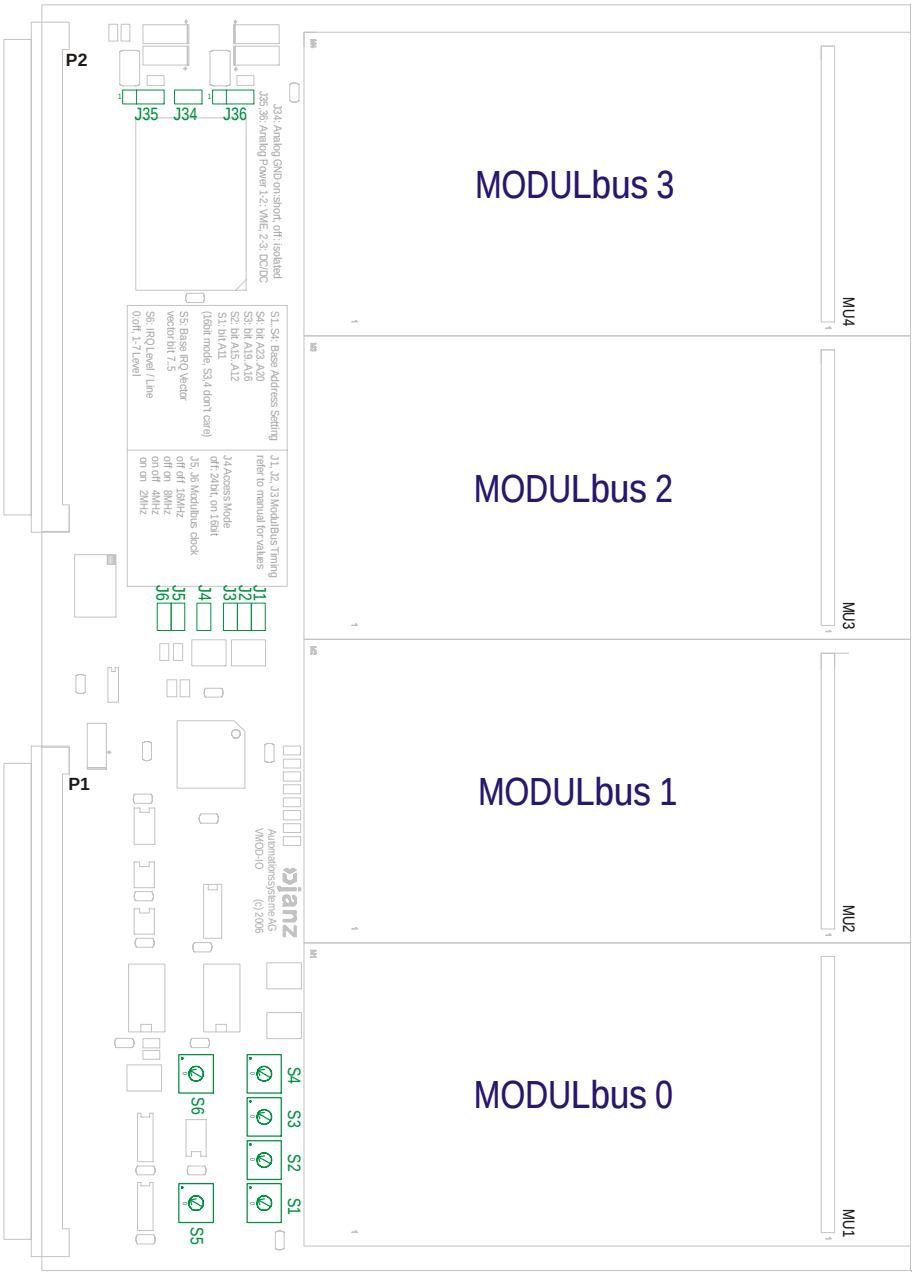


figure 2: VMOD-IO Layout and jumpers locations

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3 Addressing

The VMOD-IO uses 2048 bytes within the 64Kbyte wide Short-I/O or in the 16Mbyte wide Standard address range of the VMEbus.

3.1 Board-address

The basic address of the board can be set by using 2 code-switches in the SHORT (A16) address range and with 4 code-switches in the STANDARD (A24) address range. Switch S1 corresponds to the address line A11, switch S2 to address lines A12 - A15, switch S3 to address lines A16 - A19 and switch S4 accordingly to address lines A20 - A23. The selection of the address range can be ensured by jumper J4. If the SHORT address range is choosen, the address on the code-switches S3, S4 and on the corresponding address lines is irrelevant.

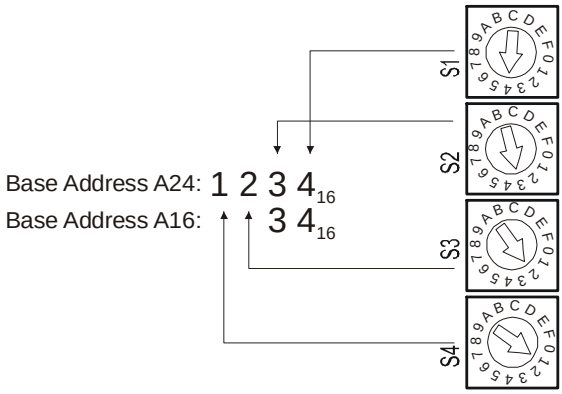


figure 3: base address selection

3.2 Address-modifiers

The VMOD-IO decodes the address modifiers which are specified by theVMEbus. This means that during an access on the AM-lines there must be a code which describes what type of an access it is, i.e. USERDATA, SYSTEM I/O etc. The VMOD-IO accepts User- and system- Short accesses with AM-codes 0x29 and 0x2D and User/System Standard accesses with AM-codes 0x39 and 0x3D.
Jumper J4 selects between Short and Standard accesses (*J4 on: Short A16 mode*).

3.3 MODULbus Address-ranges

To access a MODULbus socket, its address must be added to the VMOD-IO's base address. For example, if you have selected the base address 0xAAA8xx you have to add 0x400 if you want to access MODULbus socket 2 (= 0xAAAC00).
The addresses of the MODULbus-sockets are:

MODULbus socket	Address
socket 0	0x000 – 0x1FF
socket 1	0x200 – 0x3FF
socket 2	0x400 – 0x5FF
socket 3	0x600 – 0x7FF

table 3: MODULbus addresses

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3.4 Interrupt

The VMOD-IO is able to generate interrupts to the VMEbus by a "low"-signal on the signal-lines INT# or DMRQ# from the MODULbus-modules. The interrupt-level can be selected with code-switch S6:

S6 setting	IRQ level
0	interrupt disabled
1..7	level 1..7
8..F	reserved, don't use

table 4: interrupt level setting

After an interrupt has been occurred the VMOD-IO generates an interrupt vector which contains the information about causing module. The upper nibble (D7 – D4) of the vector is user selectable using code-switch S5. The lower nibble (D3 – D0) contains the information about the module which has generated the interrupt.

D3	D2	D1	D0	interrupt source
1	1	1	0	module 0
1	1	0	1	module 1
1	0	1	1	module 2
0	1	1	1	module 3

table 5: interrupt vector

3.5 MODULbus clock-selection

Some MODULbus modules use an external clock source which is provided by the carrier board. Before installing modules onto the VMOD-IO, please refer to the module's user manual whether your module needs the external clock or not or which frequency must be set.
The jumpers J5 and J6 select the MODULbus clock for all slots:

J5	J6	clock
off	off	16 MHz
off	on	8 MHz
on	off	4 MHz
on	on	2 MHz

table 6: MODULbus clock

3.6 MODULbus Access-time

For adapting to different response times of MODULbus mezzanine boards the access time of the VMOD-IO can be changed with the jumpers J1, J2 and J3.

J3	J2	J1	access time
on	on	on	300 ns
on	on	off	600 ns
on	off	on	830 ns
on	off	off	1050 ns
off	on	on	1550 ns

table 7: MODULbus access time settings

Since the VMOD-IO uses an internal clock of 16 MHz you have to calculate a jitter of about ½ clocks (31.25 ns) to the given values.

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Be sure not to set other configurations than described. Otherwise erratic behavior of the VMOD-IO may occur!

Moreover, the access time can be controlled by the signal “WAIT” independent of the chosen jumpers.

3.7 Analog power supply

The VMOD-IO/E version is fitted with a DC/DC converter for decoupling the 15V and -15V analog power supply from the logic devices. The DC/DC converter delivers a maximum current of 167mA at 15V. If a higher current is needed to supply the modules, the 12V rail of the VMEbus (pin A31 and C31) can be led to the modules by setting the jumpers J35 and J36 in position1-2.
To decouple the analog ground from the VME digital ground the jumper J34 must be opened.

J35, J36	power source
1 – 2	VME ±12V
2 – 3	DC/DC converter ±15V (VMOD-IO/E only)

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4 Appendices

4.1 Technical Data

VMEbus connector	DIN 41612C, 96 pins, P1 DIN 41612 ,64 pins P2

Expansion Capabilities

MODULbus	Accepts four MODULbus modules (without MODULbus+ capability)

Onboard power supply for modules (VMOD-IO/E only)

output voltage	±15V (±2%)
output current	max. 167mA (5W)
switching freq.	100..400kHz
output ripple	60mV p-p

Physical Dimensions

Board Size	VMEbus double eurocard form factor (6U)
Height	233mm
Width	160mm
Slot requirements	1 slot
Weight	~ 210g

Power Requirements

+5V (±5%)	160 mA (typ.) without modules
±12V (±5%)	not needed by VMOD-IO itself, but might be used on MODULbus

Environmental Specifications

Temperature range	0..+70°C (operating), -20..+75 (non operating)
Humidity	0%..80%, non condensing

4.2 References

These references direct you to manuals and specifications, that you might need to know when you attempt to program the VMOD-IO. Most of the documents can be downloaded from the Internet. Look for the WWW servers of the chip manufacturers.

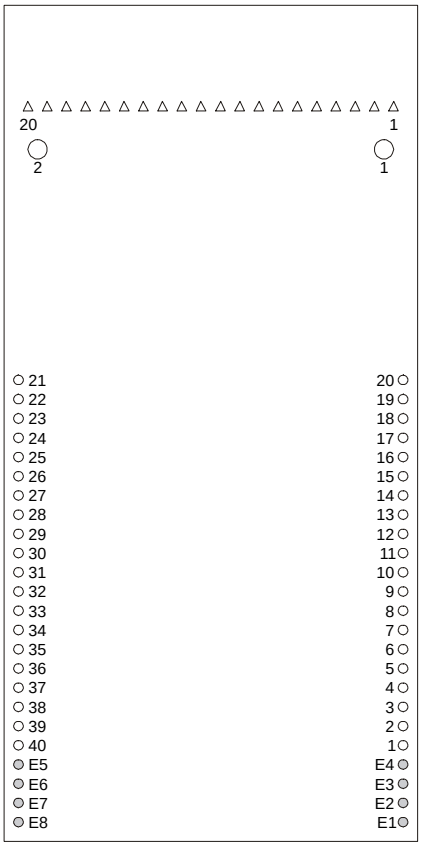
[1] **MODULbus Specification Manual**, Fördergemeinschaft MODULbus e.V., Version 2.3, 1997.
[1a] **MODULbus+ Specification**, JANZ Computer AG, Version 1.0, April 1999.
[2] MODULbus+ Specification, Janz Computer AG, Version 1.0, 1999.
[3] **VME bus specification**, VITA, VME64 Specification Revision 1.10, 1994.

WWW-References

Janz Automationssysteme AG:	www.janz.de
VITA	www.vita.com

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4.3 Pin Assignment MODULbus



Viewed to the component side of the carrier board

Legend

- MODULbus
- MODULbus+
- IO-Connector
- Mounting Bolt

Pin Designations

MODULbus				IO Connector	
1	EN0#	21	MA0	1	IO1
2	EN1#	22	MA1	2	IO2
3	CLK	23	MA2	3	IO3
4	RS#	24	MA3	4	IO4
5	D0	25	MA4	5	IO5
6	D1	26	MA5	6	IO6
7	D2	27	MA6	7	IO7
8	D3	28	MA7	8	IO8
9	D4	29	WRMOD#	9	IO9
10	D5	30	RDMOD#	10	IO10
11	D6	31	PFD	11	IO11
12	D7	32	+15V	12	IO12
13	D8	33	-15V	13	IO13
14	D9	34	AGND	14	IO14
15	D10	35	+5V	15	IO15
16	D11	36	DGND	16	IO16
17	D12	37	WAIT#	17	AGND
18	D13	38	INT#	18	-12V
19	D14	39	DMRQ#	19	AGND
20	D15	40	-	20	+12V

MODULbus+			
E1	USER0	E5	-
E2	USER1	E6	-
E3	-	E7	USER2
E4	DGND	E8	USER3

Mounting Bolt	
1	Shield
2	Shield

figure 4: MODULbus pin assignment

The signal lines on the modules IO-connector (MU1-MU4) are connected to the VME-P2 connector as described in section 4.4.

For mechanical and electrical details, refer to the MODULbus specification [1] and [1a].

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4.4 Pin assignment P2 connector

	Row A	Row C	
1	MU1.01	MU1.02	**Module 0**
2	MU1.03	MU1.04	
3	MU1.05	MU1.06	
4	MU1.07	MU1.08	
5	MU1.09	MU1.10	
6	MU1.11	MU1.12	
7	MU1.13	MU1.14	
8	MU1.15	MU1.16	
9	MU2.01	MU2.02	**Module 1**
10	MU2.03	MU2.04	
11	MU2.05	MU2.06	
12	MU2.07	MU2.08	
13	MU2.09	MU2.10	
14	MU2.11	MU2.12	
15	MU2.13	MU2.14	
16	MU2.15	MU2.16	
17	MU3.01	MU3.02	**Module 2**
18	MU3.03	MU3.04	
19	MU3.05	MU3.06	
20	MU3.07	MU3.08	
21	MU3.09	MU3.10	
22	MU3.11	MU3.12	
23	MU3.13	MU3.14	
24	MU3.15	MU3.16	
25	MU4.01	MU4.02	**Module 3**
26	MU4.03	MU4.04	
27	MU4.05	MU4.06	
28	MU4.07	MU4.08	
29	MU4.09	MU4.10	
30	MU4.11	MU4.12	
31	MU4.13	MU4.14	
32	MU4.15	MU4.16	

table 8: Pin assignment of VMEbus P2 connector (I/O signals)

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4.5 Product History

Note that changes in the major version number are related to a PCB redesign. Though, PCB redesign need not be related to functional changes, but might have been done for manufacturing purposes only.

Version	Release Date	Name	Changes
V1.0	??.??.????	??	• initial version
V4.0	12.12.1996	be	• new PCB with MACH210
V4.1	09.12.1997	be	• bugfixed IACK signal, int. vector latched
V5.0	04.09.2006	hr	• new PCB with Lattice M4A5, RoHS compliant
V5.1	14.02.2007	as	• fixed wrong polarity PFD signal • improved waveform of MODULbus clock signals
V5.2	23.05.2007	as	• fixed VME interrupt vector generation in systems with multiple interrupt requester boards
V6.0	17.04.2008	as	• PCB rework for improved signal integrity and improved BOM (F521 comparators replaced) • PCB Design allows partial implementation of MODULbus+. However, the 24pin connectors are no yet used to ensure mechanical compatibility with older boards (only 20pin connectors are mounted).

4.6 Manual History

Version	Release Date	Name	Changes
V1.0	19.01.1993	be	• initial version
V2.6	03.12.1997	be	• refers to V4.x
V3.0	04.09.2006	hr	• refers to new hardware version V5.0
V3.1	21.01.2008	hr	• corrected jumper setting for 600ns access time
V3.2	17.04.2008	hr	• Refers to new version V6.0 • Fixed wrong table header in access time jumper table • Updated product history.
V3.3	15.02.2010	As	• Reworked DC/DC converter specification in section Technical Data. Most important: Permissible output current was specified wrongly.

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