VME-DIO32-C
VME-DIO32-F

Digital IO VMEbus Board

Hardware Manual

to Products   V.1607.06
                 K.0508.68

Notes

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⚠️	This manual contains important information and instructions on safe and efficient handling of the VME-DIO32. Carefully read this manual before commencing any work and follow the instructions. The manual is a product component, please retain it for future use.

Document Information

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Document History

The changes in the document listed below affect changes in the hardware as well as changes in the description of the facts, only.

Rev.	Chapter	Changes versus previous version	Date
1.0	-	First English manual for VME-DIO32-C and VME-DIO32-F	2021-08-03

Technical details are subject to change without further notice.

Classification of Warning Messages and Safety Instructions

This manual contains noticeable descriptions, warning messages and safety instructions, which you must follow to avoid personal injuries or death and property damage.

This is the safety alert symbol.
It is used to alert you to potential personal injury hazards. Obey all safety messages and instructions that follow this symbol to avoid possible injury or death.

DANGER, WARNING, CAUTION

Depending on the hazard level the signal words DANGER, WARNING or CAUTION are used to highlight safety instructions and warning messages. These messages may also include a warning relating to property damage.

> **DANGER**
> Danger statements indicate a hazardous situation which, if not avoided, will result in death or serious injury.

> **WARNING**.
> Warning statements indicate a hazardous situation that, if not avoided, could result in death or serious injury.

> **CAUTION**
> Caution statements indicate a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

Notice statements are used to notify people on hazards that could result in things other than personal injury, like property damage.

> **NOTICE**
> This NOTICE statement indicates that the device contains components sensitive to electrostatic discharge.

> **NOTICE**
> This NOTICE statement contains the general mandatory sign and gives information that must be heeded and complied with for a safe use.

INFORMATION

> **INFORMATION**
> Notes to point out something important or useful.

⚠ Safety Instructions

- When working with the VME-DIO32 follow the instructions below and read the manual carefully to protect yourself from injury and the VME-DIO32 from damage.
- The device is a built-in component. It is essential to ensure that the device is mounted in a way that cannot lead to endangering or injury of persons or damage to objects.
- Do not use damaged or defective cables to connect the VME-DIO32 and follow the CAN wiring hints in chapter: "Correct Wiring of Electrically Isolated CAN Networks".
- In case of damages to the device, which might affect safety, appropriate and immediate measures must be taken, that exclude an endangerment of persons and domestic animals and property.
- Current circuits which are connected to the device must be sufficiently protected against hazardous voltage (SELV according to EN 60950-1).
- The VME-DIO32 may only be driven by power supply current circuits, that are contact protected. A power supply, that provides a safety extra-low voltage (SELV) according to EN 60950-1, complies with these conditions.

- The device must be securely installed in the control cabinet before commissioning.
- Protect the VME-DIO32 from dust, moisture, and steam.
- Protect the VME-DIO32 from shocks and vibrations.
- The VME-DIO32 may become warm during normal use. Always allow adequate ventilation around the VME-DIO32 and use care when handling.
- Do not operate the VME-DIO32 adjacent to heat sources and do not expose it to unnecessary thermal radiation. Ensure an ambient temperature as specified in the technical data.

⚠ **DANGER**
Hazardous Voltage - Risk of electric shock due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the VME-DIO32 is to be integrated.
→ Disconnect all hazardous voltages (mains voltage) before opening the system.
→ Ensure the absence of voltage before starting any electrical work

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NOTICE
Electrostatic discharges may cause damage to electronic components.
To avoid this, perform the steps described on page 16 before you touch the VME-DIO32, in order to discharge the static electricity from your body

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Qualified Personnel
This documentation is directed exclusively towards personnel qualified in control and automation engineering. The installation and commissioning of the product may only be carried out by qualified personnel, which is authorized to put devices, systems, and electric circuits into operation according to the applicable national standards of safety engineering.

Conformity
The VME-DIO32 is a sub-assembly intended for incorporation into an apparatus by a manufacturer and NOT by the end user. The manufacturer of the final system must decide whether additional EMC or EMI protection requirements are necessary.

Intended Use

The intended use of the VME-DIO32 is the operation as VME board with digital I/Os.

The guarantee given by esd does not cover damages which result from improper use, usage not in accordance with regulations or disregard of safety instructions and warnings.

- The VME-DIO32 is intended for installation in VMEbus systems only.
- The operation of the VME-DIO32 in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the VME-DIO32 for medical purposes is prohibited.

Service Note

The VME-DIO32 does not contain any parts that require maintenance by the user. The VME-DIO32 does not require any manual configuration of the hardware except of the configuration of the dip switches and the rotary switch. Unauthorized intervention in the device voids warranty claims.

Disposal

Devices which have become defective in the long run have to be disposed in an appropriate way or must be returned to the manufacturer for proper disposal. Please, make a contribution to environmental protection.

Typographical Conventions

Throughout this manual the following typographical conventions are used to distinguish technical terms.

Convention	Example
File and path names	`/dev/null` or `<stdio.h>`
Function names	*open()*
Programming constants	`NULL`
Programming data types	`uint32_t`
Variable names	*Count*

Number Representation

All numbers in this document are base 10 unless designated otherwise. Hexadecimal numbers have a $_h$ appended. For example, 42 is represented as $2A_h$ in hexadecimal format.

Table of Contents

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1 Overview

1.1   About this Manual

In this manual the VME-DIO32-C and the VME-DIO32-F are described together as VME-DIO32. The descriptions given in this manual apply to both versions, any differences are noted in the text where they appear.

1.2   Description of VME-DIO32-C
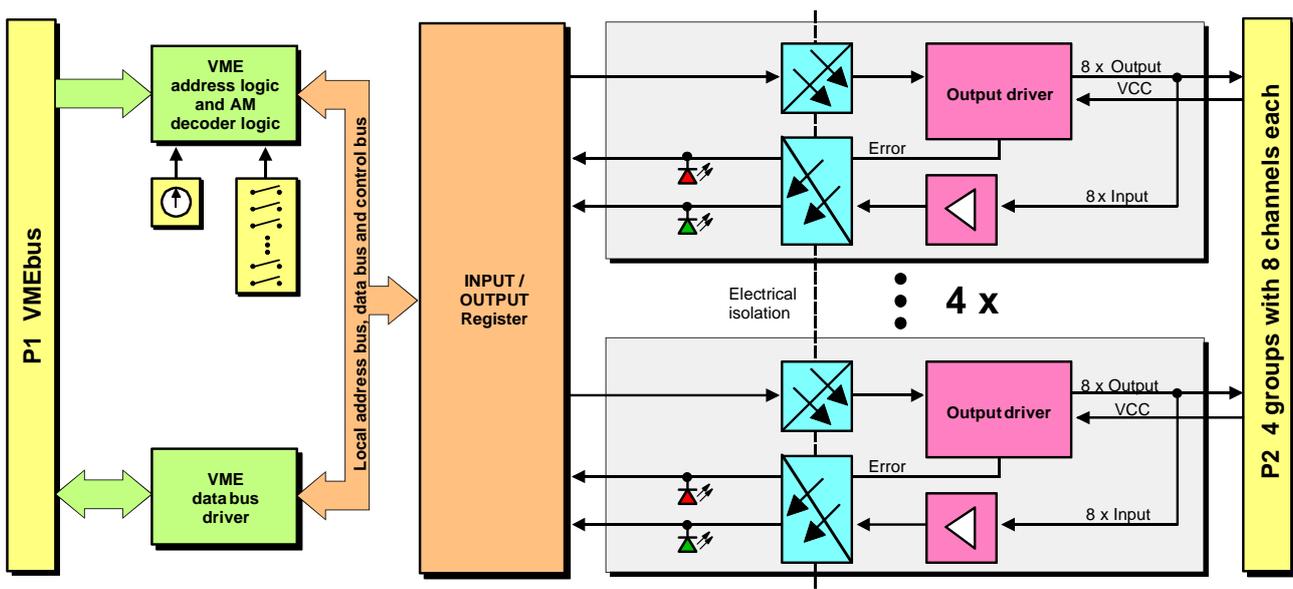
Figure 1: Block circuit diagram of VME-DIO32-C

The VME-DIO32-C offers a digital process interface containing 32 opto-isolated digital process I/O channels. It includes all necessary components on a VMEbus 6U board and needs one slot.

The 32 digital I/O channels are programmable in 4 groups of 8 channels as inputs or outputs. The 4 groups are electrically isolated against the system and each other. An external voltage must be fed individually for each group. The 32 input/outputs and the external voltages are connected to the 64-pin connector P2.

The digital output channels use a quad channel smart high-side power switch ITS4130Q and accept an operating voltage range of 12 VDC to 34 VDC (24 VDC nominal voltage) with a nominal current of 0.5 A.
The current of each channel is limited. Overvoltage and undervoltage protection functions are integrated in the power switch.

The VME-DIO32-C comes with a green and a red LED in the front panel for each of the 32 I/O-channels. The green LEDs indicate the input status, and the red LEDs indicate the output short-circuit.

1.3 Description of VME-DIO32-F
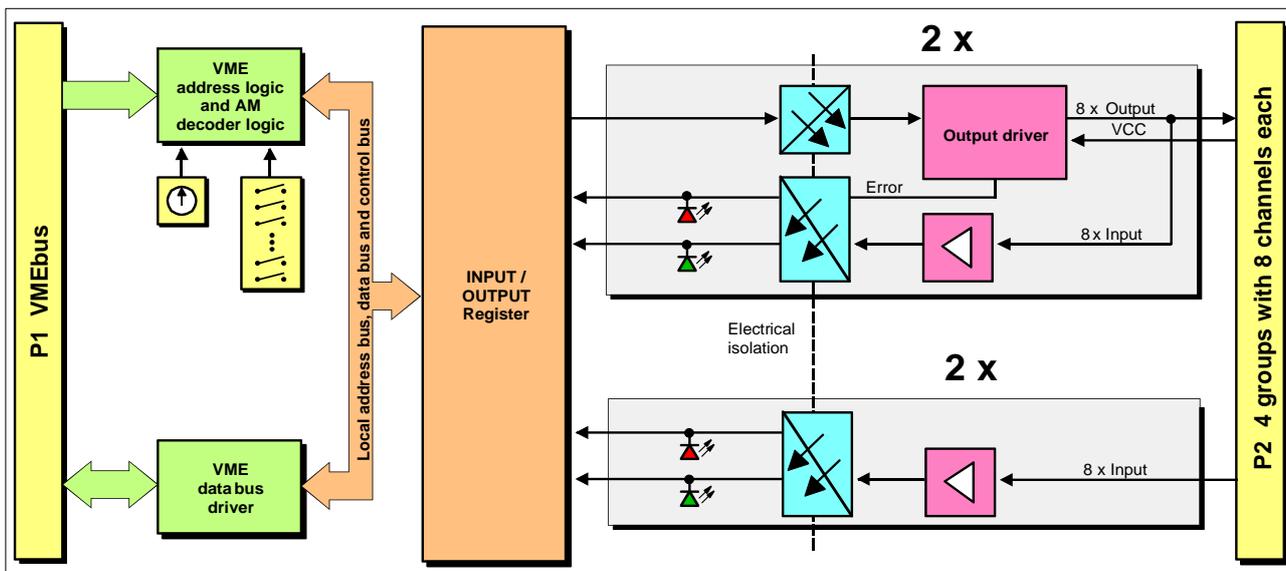
Figure 2: Block circuit diagram of VME-DIO32-F

The VME-DIO32-F is designed as the VME-DIO32-C but only 16 output drivers are equipped.

1.4 Abbreviations

Abbreviation	Term
CPU	Central Processing Unit
HW	Hardware
I/O	Input/Output
LSB	Least Significant Bit
MSB	Most Significant Bit
n.a.	not applicable
OS	Operating System
SDK	Software Development Kit

2 Hardware

2.1 PCB View VME-DIO32-C

Figure 3: PCB top view of VME-DIO32-C

> **NOTICE**
> Read chapter "Hardware Installation" on page 16, before you start with the installation of the hardware!

2.2   PCB View VME-DIO32-F
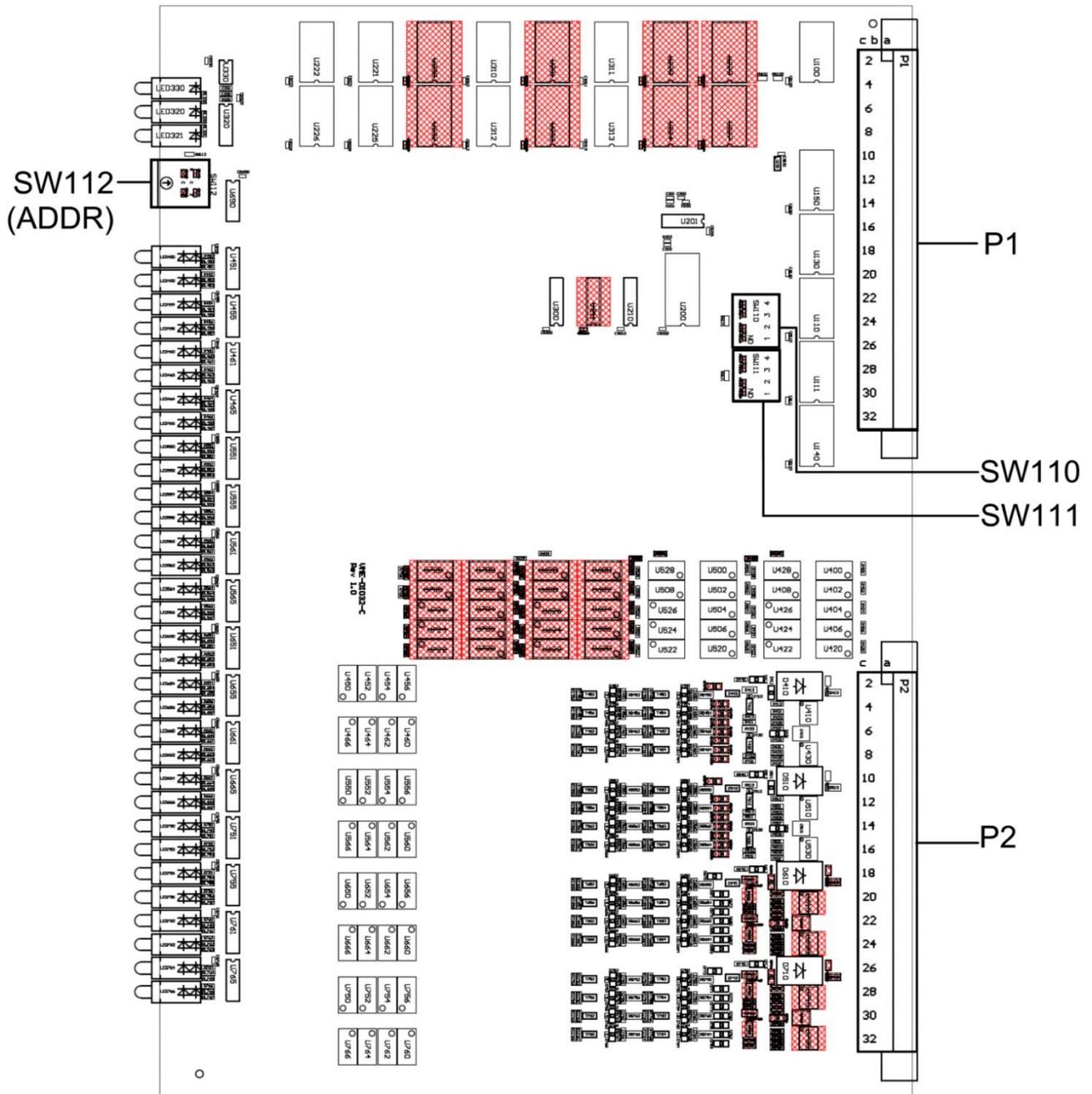
Figure 4: PCB top view of VME-DIO32-F

> ⓘ **NOTICE**
> Read chapter "Hardware Installation" on page 16, before you start with the installation of the hardware!

2.3 LEDs

The VME-DIO32 comes with 3 general LEDs (BSY, OOK, OER) and 2 LEDs for each I/O-channel (STAT0- STAT 31 and I/O0 -I/O31)
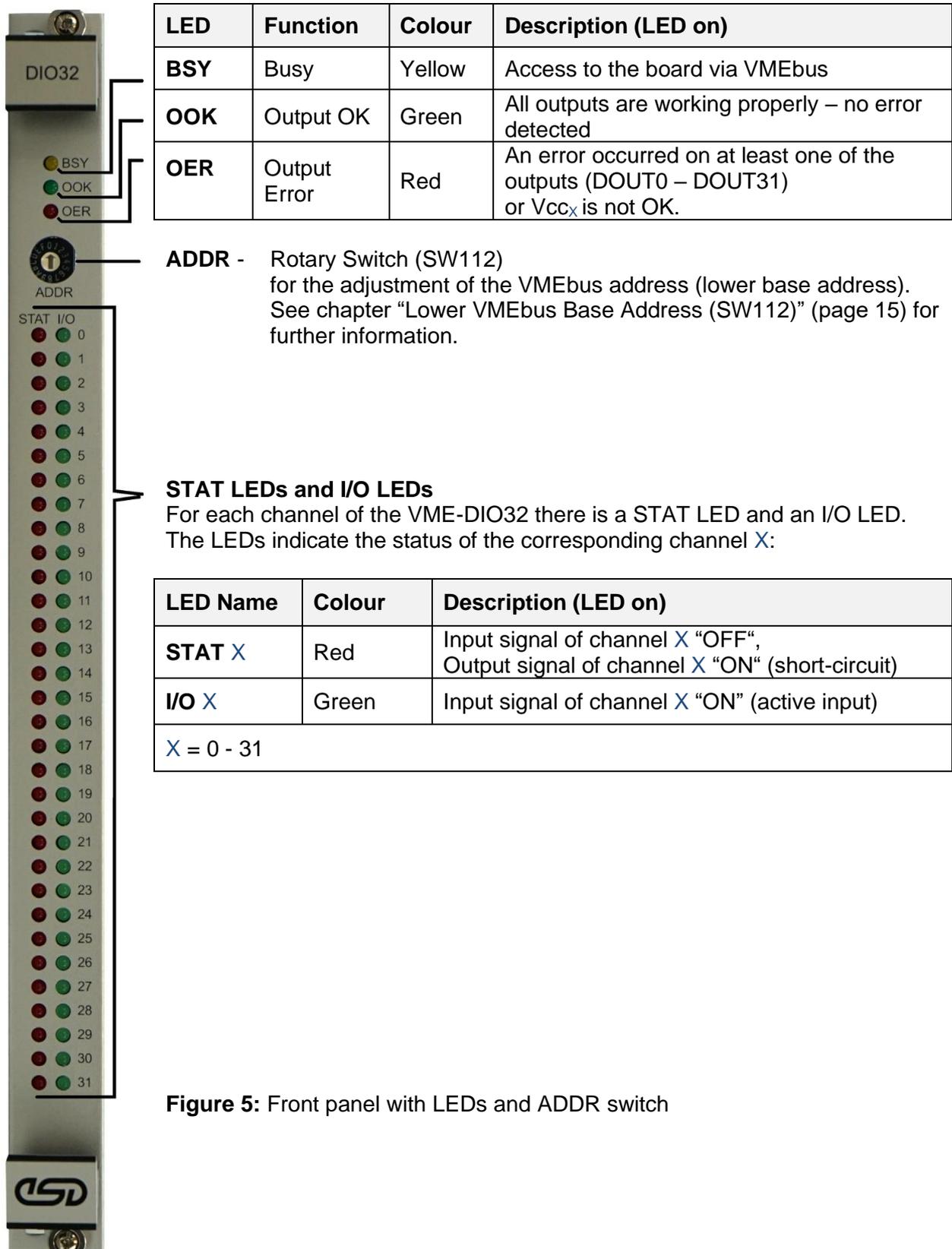
LED	Function	Colour	Description (LED on)
BSY	Busy	Yellow	Access to the board via VMEbus
OOK	Output OK	Green	All outputs are working properly – no error detected
OER	Output Error	Red	An error occurred on at least one of the outputs (DOUT0 – DOUT31) or Vcc_X is not OK.

ADDR - Rotary Switch (SW112)
for the adjustment of the VMEbus address (lower base address).
See chapter "Lower VMEbus Base Address (SW112)" (page 15) for further information.

STAT LEDs and I/O LEDs
For each channel of the VME-DIO32 there is a STAT LED and an I/O LED.
The LEDs indicate the status of the corresponding channel X:

LED Name	Colour	Description (LED on)
STAT X	Red	Input signal of channel X "OFF", Output signal of channel X "ON" (short-circuit)
I/O X	Green	Input signal of channel X "ON" (active input)
X = 0 - 31		

Figure 5: Front panel with LEDs and ADDR switch

2.4 Coding Switches

The VME-DIO32 comes with two DIP switches and a rotary switch for the adjustment of the VMEbus address. Furthermore, the digital inputs DIN18 and DIN19 can be inverted via the INV_IN signal on switch SW110.

2.4.1 Higher VMEbus Base Address (SW110, SW111)

The DIP-switches (SW110, SW111) are equipped on the board next to VMEbus connector P1 as described in Figure 3 page 11.

Example:

SW111   SW110

DIP switches (as seen from P1)
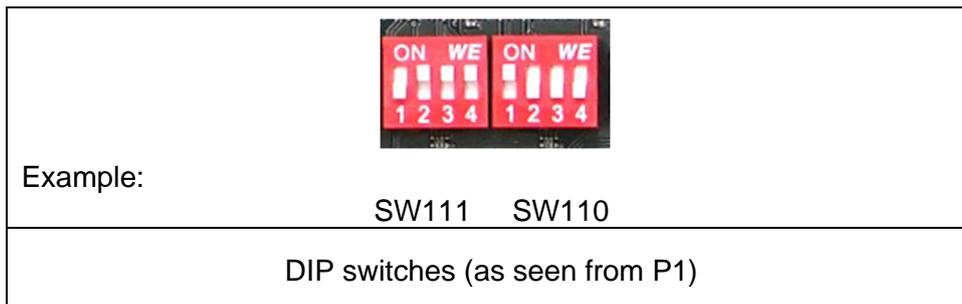
Switch	SW111				SW110			
Position	1	2	3	4	1	2	3	4
Address bit	A15	A14	A13	A12	A11	A10	A09	INV_IN
ON	0	0	0	0	0	0	0	0
OFF	1	1	1	1	1	1	1	1
Description	Higher VMEbus base address							See **Table 2** below
Example:								
Adress bit:	1	0	0	0	0	1	1	1
Meaning	Higher VMEbus base address: $86yy_h$							Inverted

Table 1: Description of the switches

Signal	INV_IN			
Switch	SW110			
Position	4			
Description of the signal	Position	Setting	Value	Meaning
	4	ON	0	Non-inverted => Digital Inputs DIN18 and DIN19 are **not** inverted
		OFF	1	Inverted => Digital inputs DIN18 and DIN19 are inverted

Table 2: Description of INV_IN

2.4.2 Lower VMEbus Base Address (SW112)

The rotary switch (SW112) can be easily accessed via the front panel (see Figure 5, page 13). The lower VMEbus address can be adjusted from $0 - 15$ (0_h - F_h).

SW112
Rotary switch
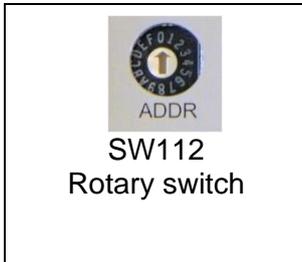
Switch	ADDR
Position	0_h 1_h : : F_h
	Lower VMEbus base address

Table 3: Description of the switches

3 Hardware Installation

> **NOTICE**
> **Read the safety instructions at the beginning of this document carefully before you start with the hardware installation!**

> **WARNING**
> Hazardous Voltage - **Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the VME-DIO32 is to be integrated.
>
> → Disconnect all hazardous voltages (mains voltage) before opening the system. Never carry out work while power supply voltage is switched on!
> → Ensure the absence of voltage before starting any electrical work.

> **NOTICE**
> **Electrostatic discharges may cause damage to electronic components.**
>
> → To avoid this, please discharge the static electricity from your body *before* you touch the VME-DIO32.
> → Furthermore, you should prevent your clothes from touching the VME-DIO32, because your clothes might be electrostatically charged as well.

Procedure:

1. Switch off your system and all connected peripheral devices (monitor, printer, etc.).

2. Discharge your body as described above.

   If necessary, configure the VMEbus address via the rotary switch and the DIP switches as described in chapter "Coding Switches" from page 14. The lower VMEbus address can also be easily set later via the rotary switch in the front panel.

3. Disconnect the VME system from the mains.
   Make sure that no risk arises from the system into which the VME-DIO32 shall be inserted.

   > **WARNING**
   > Hazardous Voltage
   > Risk of electric shock due to unintentional contact with uninsulated live parts with high voltages.
   >
   > → Disconnect all hazardous voltages (mains voltage) before opening the system.
   > → If the system does not have a flexible mains cable, but is directly connected to mains, disconnect the power supply via the safety fuse and make sure that the fuse cannot switch on again unintentionally (e.g. with caution label).
   > → Ensure the absence of voltage before starting any electrical work.
   > → Cover or block off adjacent live parts.

4. Insert the VME-DIO32 board into the selected slot.
   Carefully push the board into the slot until it snaps into place.

5. Fix the module.

6. Connect the system to mains again (mains connector or safety fuse).

7. Switch on the system and the peripheral devices. - End of hardware installation.

4 Technical Data

4.1 General Technical Data

Power supply voltage	4.85 V … 5.25V DC
	
	nominal current: I_{OFF} = ca. 250 mA (all Inputs/Outputs OFF),
	                            I_{ON} = ca. 625 mA (all Inputs/Outputs ON)
	                            $I_{Typical}$ = ca. 440 mA

Power consumption	typical: P_{OFF} = 1.25 W (all Inputs/Outputs OFF) maximum: P_{MAX} = 3.25 W
Temperature range	Operation: 0 °C ... +70 °C ambient temperature Storage: -20 °C ... +70 °C ambient temperature Transport: -20 °C ... +70 °C
Humidity	Operation: max. 90%, non-condensing Storage: max. 90%, non-condensing
Protection class	IP20 (mounted in VMEbus system)
Electrical isolation of inputs and outputs	Pollution degree: maximum permissible according to DIN EN 61131-2: Pollution degree 2 Over voltage category: II (acc. to DIN EN 61131-2) Electrical isolation: functional isolation between I/O circuits and VMEbus, dimensioning of air and creepage distances: max. isolation working voltage U_e = 600 V AC/DC (acc. to. DIN EN 61131-2, pollution degree 2, over voltage category II) max. isolation voltage of optocouplers U_{rms} = 2500 V_{rms} for 1 minute
Form factor / Dimensions	Eurocard Double-height (6U), 1 slot width /160 mm x 233,35 mm x 20,1 mm (length, width, hight)
Weight	Ca. 470 g

Table 4: General Data of the module

4.2   VME Interface

VME interface	IEEE 1014 / D
Addressing	A16 Slave
Transfer mode	D8O
Base address	Adjustable by DIP-switches and rotary switch Bit 15 - 9 The higher part of the base address can be adjusted with 2 DIP-switches (SW110, SW111) Bit 8 - 5 the lower base address can be adjusted via the rotary switch (ADDR) in the front panel
Interrupter	none

Table 5: Microprocessor and Memory

4.3   Connectors accessible from Outside

Name	Function, Interfaces	Type
P1	VMEbus	DIN41612, type C, 96-pin., Harting: 09033966921
P2	Inputs/Outputs	DIN41612, type C, 64-pin.,Harting: 09033646921

Table 6: Connectors, accessible from outside

4.4 Digital Inputs/Outputs

Number of outputs	VME-DIO32-C: 32, arranged in 4 groups with 8 channels; VME-DIO32-F: 16, arranged in 2 groups with 8 channels
I/O-configuration	Ports are configurable as inputs or outputs, digital outputs, VME-DIO32-C only: The status of the outputs (DERR) can be read.
Type of the outputs	Plus switching (High Side Driver)
Power supply	
External power supply	18 V ... 32 V Arranged in 4 groups, no reverse polarity protection maximum current per group: 6A
Protective circuits of the power supply	Safety fuse 6.3 A for each group of 8 channels, after activation of the fuse, the VME-DIO32 has to be returned to esd for an expert repair. Transient protection from 39 V
Digital Inputs	
Input voltage range	-3 V ... 32 V (but maximum external power supply) Note that the maximum reachable voltage value results from the external power supply.
Input threshold	$U_{ON} \geq 12$ V $U_{OFF} \leq 3$ V
Input current at 24V	Minimum 4 mA, maximum 6 mA
Digital outputs	
Driver module	ITS4130
Output current	Typical: 0.50 A maximal: 0.75 A max. overcurrent-limit: 1.5 A
Electrical isolation	Isolation voltage: 5000 V_{rms} (1 minute)
Connector	See chapter 6.2 "I/O-Connector P2" page 23

Table 7: Digital inputs/outputs

5 Description of the Hardware Registers

The following registers are supported:
"Status Register"
"Transparent Input-Data", 32-Bit, read_only
"Output-Data-Register", 32-Bit, VME-DIO32-C: read/write, VME-DIO32-F: write only
On read access to the other addresses, '1' will be returned.
A write access will be ignored.

5.1 VME-DIO32-C

5.1.1 INPUT-Register (read only)

Local Address	D7	D6	D5	D4	D3	D2	D1	D0	
01$_h$	1	0	0	0	DERR1215	DERR0811	DERR0407	DERR0003	
03$_h$	DIN15	DIN14	DIN13	DIN12	DIN11	DIN10	DIN09	DIN08	
05$_h$	DIN07	DIN06	DIN05	DIN04	DIN03	DIN02	DIN01	DIN00	
07$_h$	0	0	0	0	0	0	0	0	(CIO Status)
09$_h$	1	0	0	0	DERR2831	DERR2427	DERR2023	DERR1619	
0B$_h$	DIN31	DIN30	DIN29	DIN28	DIN27	DIN26	DIN25	DIN24	
0D$_h$	DIN23	DIN22	DIN21	DIN20	DIN19	DIN18	DIN17	DIN16	
0F$_h$	0	0	0	0	0	0	0	0	(CIO Status)

Table 8: Input Register VME-DIO32-C

5.1.2 OUTPUT-Register (read/ write)

Local Address	D7	D6	D5	D4	D3	D2	D1	D0
11$_h$	DOUT07	DOUT06	DOUT05	DOUT04	DOUT03	DOUT02	DOUT01	DOUT00
13$_h$	DOUT15	DOUT14	DOUT13	DOUT12	DOUT11	DOUT10	DOUT09	DOUT08
15$_h$	DOUT23	DOUT22	DOUT21	DOUT20	DOUT19	DOUT18	DOUT17	DOUT16
17$_h$	DOUT31	DOUT30	DOUT29	DOUT28	DOUT27	DOUT26	DOUT25	DOUT24

Table 9: Output Register VME-DIO32-C

5.2 VME-DIO32-F

5.2.1 INPUT-Register (read only)

Local Address	D7	D6	D5	D4	D3	D2	D1	D0
03h	DIN15	DIN14	DIN13	DIN12	DIN11	DIN10	DIN09	DIN08
05h	DIN07	DIN06	DIN05	DIN04	DIN03	DIN02	DIN01	DIN00
0Bh	DIN31	DIN30	DIN29	DIN28	DIN27	DIN26	DIN25	DIN24
0Dh	DIN23	DIN22	DIN21	DIN20	DIN19	DIN18	DIN17	DIN16

Table 10: Input Register VME-DIO32-F

5.2.2 OUTPUT-Register (write only)

Local Address	D7	D6	D5	D4	D3	D2	D1	D0
11h	DOUT07	DOUT06	DOUT05	DOUT04	DOUT03	DOUT02	DOUT01	DOUT00
13h	DOUT15	DOUT14	DOUT13	DOUT12	DOUT11	DOUT10	DOUT09	DOUT08

Table 11: Output Register VME-DIO32-F

6 Connector Assignments

6.1 VMEbus P1

Device connector: DIN41612, type C, 96-pin, Harting: 09033966921

pin	row a	row b	row c
1	DATA 0	-	-
2	DATA 1	-	-
3	DATA 2	-	-
4	DATA 3	BG0 IN*	-
5	DATA 4	BG0 OUT*	-
6	DATA 5	BG1 IN*	-
7	DATA 6	BG1 OUT*	-
8	DATA 7	BG2 IN*	-
9	GND	BG2 OUT*	GND
10	-	BG3 IN*	-
11	GND	BG3 OUT*	-
12	DS1*	-	SYSRESET*
13	DS0*	-	LWORD*
14	R/W*	-	AM5
15	GND	-	-
16	DTACK*	AM0	-
17	GND	AM1	-
18	AS*	-	-
19	GND	AM3	-
20	IACK*	GND	-
21	IACKIN*	-	-
22	IACKOUT*	-	-
23	AM4	GND	ADDR 15
24	ADDR 7	-	ADDR 14
25	ADDR 6	-	ADDR 13
26	ADDR 5	-	ADDR 12
27	ADDR 4	-	ADDR 11
28	ADDR 3	-	ADDR 10
29	ADDR 2	-	ADDR 9
30	ADDR 1	-	ADDR 8
31	-	-	-
32	+ 5V	+ 5V	+ 5V

P1 connector according to DIN 41 612-C 96 / a+b+c

Signals with * :   active low
Current rating: max 1.0 A per pin

- .... pin is not connected on the PCB

] .... signals are connected on the PCB

6.2 I/O-Connector P2

Device connector: DIN41612, type C, 64-pin, Harting: 09033646921

pin	row a	row c
1	VCC1	VCC1
2	VCC1	VCC1
3	I/O0	I/O1
4	I/O2	I/O3
5	I/O4	I/O5
6	I/O6	I/O7
7	GND1	GND1
8	GND1	GND1
9	VCC2	VCC2
10	VCC2	VCC2
11	I/O8	I/O9
12	I/O10	I/O11
13	I/O12	I/O13
14	I/O15	I/O15
15	GND2	GND2
16	GND2	GND2
17	VCC3	VCC3
18	VCC3	VCC3
19	I/O16	I/O17
20	I/O18	I/O19
21	I/O20	I/O21
22	I/O22	I/O23
23	GND3	GND3
24	GND3	GND3
25	VCC4	VCC4
26	VCC4	VCC4
27	I/O24	I/O25
28	I/O26	I/O27
29	I/O28	I/O29
30	I/O30	I/O31
31	GND4	GND4
32	GND4	GND4

P1 connector according to DIN 41 612-C 96 / a+c

Signal Description

GNDy, VCCy …   power supply (U_{vcc}) for the digital I/O circuits to be fed externally. Each 4 channels are locally connected to the same power supply (y = 1, 2, ..., 4)

I/Ox ...   I/O channels of VME-DIO32
(x = 0, 1, 2, ..., 31)

7 Order Information

7.1 Hardware

Type	Properties	Order No.
VME-DIO32-C	32 digital input/output, P2 and VMEbus comply with VDOT32	V.1607.06
VME-DIO32-F	16 digital inputs and 16 digital outputs, P2 and VMEbus comply with VDOT32	K.0508.68

Table 12: Order information hardware

7.2 Manuals

PDF Manuals
For the availability of the manuals see table below.
Please download the manuals as PDF documents from our esd website https://www.esd.eu for free.

Manuals		Order No.
VME-DIO32-C/F-ME	Hardware manual in English for VME-DIO32-C and VME-DIO32-F	M.1607.26

Table 13: Available Manuals

Printed Manuals
If you need a printout of the manual additionally, please contact our sales team (sales@esd.eu) for a quotation. Printed manuals may be ordered for a fee.