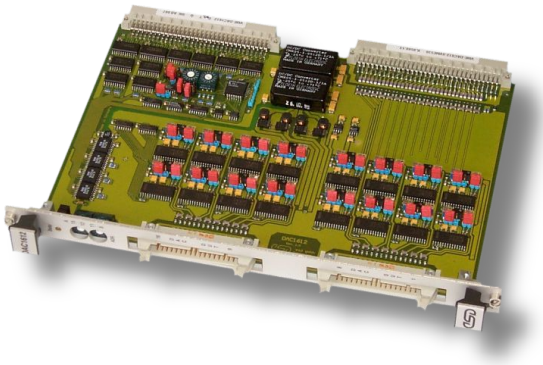
VME-DAC1612

16 Analog Outputs



Manual

to Product V.1706.08, V.1706.16

esd electronic system design gmbh
Vahrenwalder Str. 207 • 30165 Hannover • Germany
http://www.esd.eu
Phone: +49 (0) 511 3 72 98-0 • Fax: +49 (0) 511 3 72 98-68

N O T E

The information in this document has been carefully checked and is believed to be entirely reliable. **esd** makes no warranty of any kind with regard to the material in this document, and assumes no responsibility for any errors that may appear in this document. In particular descriptions and technical data specified in this document may not be constituted to be guaranteed product features in any legal sense.

esd reserves the right to make changes without notice to this, or any of its products, to improve reliability, performance or design.

esd electronic system design gmbh
Vahrenwalder Str. 207
30165 Hannover
Germany

Phone:	+49-511-372 98-0
Fax:	+49-511-372 98-68
E-Mail:	info@esd.eu
Internet:	www.esd.eu

This manual contains important information and instructions on safe and efficient handling of the VME-DAC1612. Carefully read this manual before commencing any work and follow the instructions.
The manual is a product component, please retain it for future use.

Trademark Notices

All trademarks, product names, company names or company logos used in this manual are reserved by their respective owners.

Document file:	I:\Texte\Doku\MANUALS\VME\DAC1612\Englisch\VME-DAC1612_Manual_en_12.odt
Date of print:	2016-05-23
Document type number:	DOC0800

Hardware version:	VME-DAC1612 Rev. 1.2

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
1.1	4.1.2.1	Default value of base address corrected.	2002-06-26
	4.1.4	Jumper unipolar/bipolar: Meaning of setting corrected.	
1.2	-	“Classification of Warning Messages and Safety Instructions” inserted, Safety Instructions inserted	2016-05-23
	1.1	Block circuit diagram changed, description of options inserted	
	1.2.	Chapter “Front Panel ” moved	
	2.2	New chapter: “VMEbus Interface”	
	4.1.4	D8 - table corrected, D9 - description inserted D10 - table corrected D11 - table inserted, D12-D15 - table corrected	
	5.2.1	Table corrected, notes inserted.	
	6.	New chapter “Hardware Installation”	
	8.	Chapter moved	
	8.2	Note on supply voltages changed	
	9.	Chapter moved	
	10.	Chapter moved and revised	

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-DAC1612 follow the instructions below and read the manual carefully to protect yourself from injury and the VME-DAC1612 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-DAC1612.
- 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 have to be sufficiently protected against hazardous voltage (SELV according to EN 60950-1).
- The VME-DAC1612 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 this conditions.

- The device has to be securely installed in the control cabinet before commissioning.
- Protect the VME-DAC1612 from dust, moisture and steam.
- Protect the VME-DAC1612 from shocks and vibrations.
- The VME-DAC1612 may become warm during normal use. Always allow adequate ventilation around the VME-DAC1612 and use care when handling.
- Do not operate the VME-DAC1612 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-DAC1612 is to be integrated.
→ Disconnect all hazardous voltages (mains voltage) before opening the system.
→ Ensure the absence of voltage before starting any electrical work

NOTICE
Electrostatic discharges may cause damage to electronic components.
To avoid this, perform the steps described on page 34 *before* you touch the VME-DAC1612, in order to discharge the static electricity from your body.

Qualified Personal

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

Conformity

The VME-DAC1612 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-DAC1612 is the operation as VMEbus board for the generation of up to 16 analog signals for process control purposes.
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-DAC1612 is intended for installation in VMEbus systems only.
- The operation of the VME-DAC1612 in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the VME-DAC1612 for medical purposes is prohibited.

Service Note

The VME-DAC1612 does not contain any parts that require maintenance by the user. The VME-DAC1612 does not require any manual configuration of the hardware but the configuration of the jumpers and the coding switches as described in this manual. 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 have to 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 prefix of 0x. For example, 42 is represented as 0x2A in hexadecimal.

Table of contents

1. Overview

1.1 Module Description

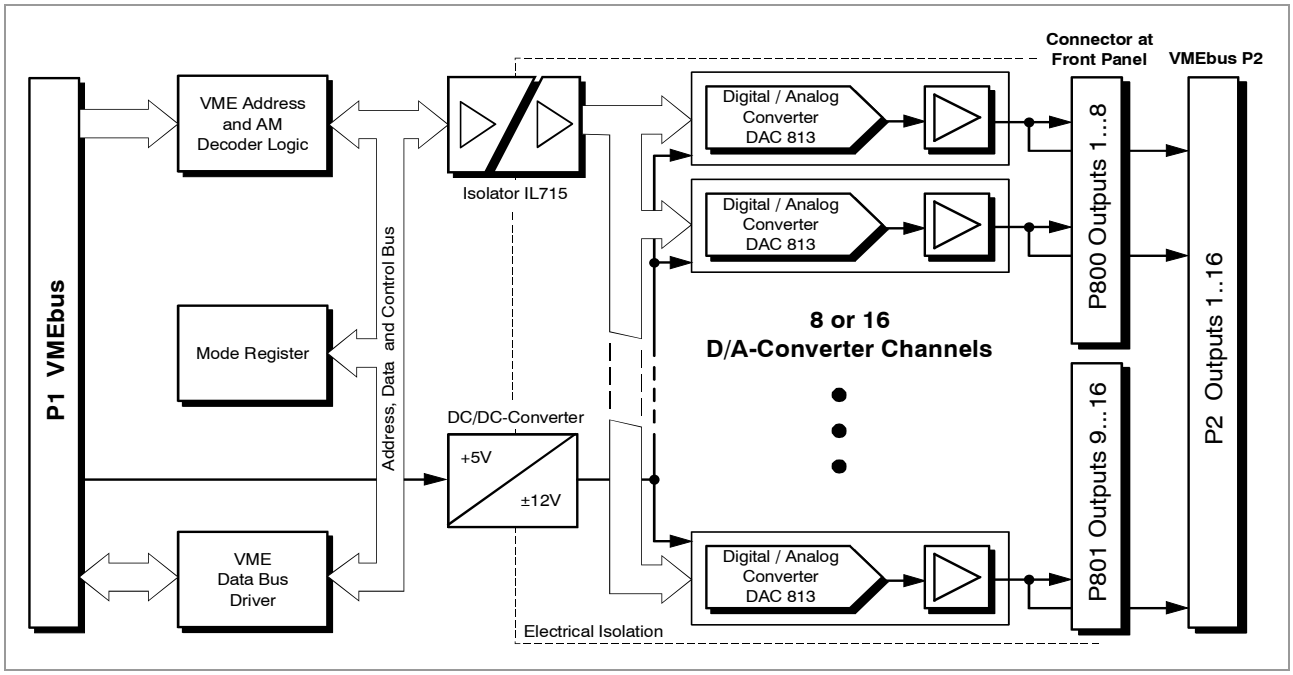


Figure 1: Block circuit diagram of the VME-DAC1612 module

The VME-DAC1612 is an interface board designed for the generation of 8 analog signals (VME-DAC1612-8) or 16 analog signals(VME-DAC1612-16) for process control purposes.
The output voltages can be selected as ±5 V, ±10 V or 0 ...+10 V, with a resolution of 12 bits.

A D/A-converter of DAC 813 type is used. The control and data signals between VMEbus and analog process are electrically insulated by means of fast digital couplers.

The power supply of the analog side (±15 V, +5 V) are generated by DC/DC-converters from the +5 VMEbus power supply.

The VME-DAC1612 is compatible to VMEbus Standard Rev. C. With a height of 4 HP it uses one slot on the VMEbus.

In the customized version VME-DAC1612-XVME530 the board comes with 5 outputs, 12 bits, adjusted for 0...+10 V. The front-I/O, I/O data access and power supply are compatible with XYCOM XVME530.

1.2 Front Panel

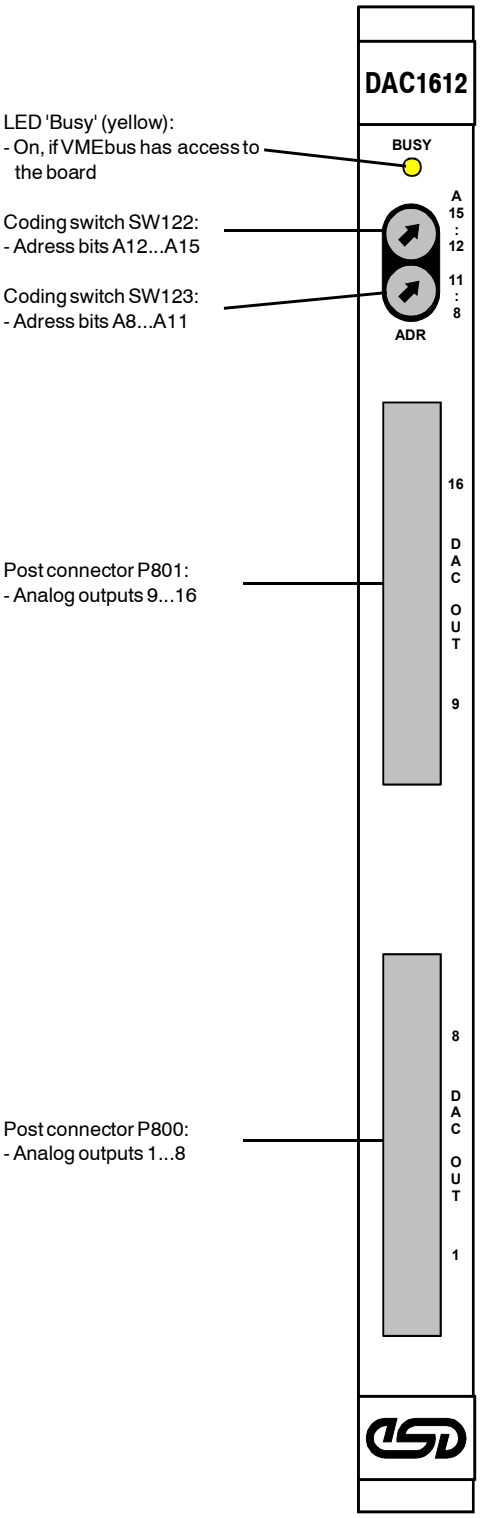


Figure 2: PCB top view

NOTICE
Read chapter “Hardware Installation” on page 34, before you start with the installation of the hardware!

2. Technical Data

2.1 General Technical Data

Temperature range	max. permissible ambient temperature: 0...70 °C
Humidity	max. 90%, non-condensing
Connectors	P1 - DIN 41612-C96 (VMEbus) P2 - DIN 41612-C64 (analog outputs 1-16) P800 - 34-pin post connector (analog outputs 1-8) P801 - 34-pin post connector (analog outputs 9-16) X140 - 8-pin socket strip (ISP-programming for testing)
Board dimensions	160 mm x 233 mm
Weight	ca. 320 g
Power supply	VMEbus P1: 5V ± 5% / 1.6 A (typical, at T = 20 °C, 16 channels)

Table 1: General module data

2.2 VMEbus Interface

VMEbus interface	IEEE 1014 / C.1
Data transfer mode	A16/D16, A24/D16
Interrupts	none
VME access time	< 150 ns (up to DTACK)
VMEbus installation	6 U high / 4 HP wide front panel with lever holds

Table 2: General module data

2.3 Technical Data of Analog Units

Number of D/A-channels	8 or 16
Resolution	12 bits
D/A-converter	DAC813
Output voltage	configurable via jumpers: 0-10 V, ±5 V, ±10 V
Output capacity	$R_L \geq 2$ kΩ
Resolution	± 1 LSB in adjusted status, i.e. *) at 0-10 V: ≤ ± 2.5 mV at ±5 V: ≤ ± 2.5 mV at ±10 V: ≤ ± 5.0 mV
	INFORMATION *) The board is default set and adjusted to bipolar operation (±10V). If the board is set to unipolar operation (0...10 V) via jumpers without being coordinated via the gain potentiometer afterwards, you have to consider an additional deviation of about ½ LSB (referred to maximum value).
Settling time of D/A-converter	max. 6 µs / channel (at voltage swing 20 V, final value achieved to 0.01%)

Table 3: Technical data of analog units

3. Address Assignment

The basis address of the board is configured via the coding switches SW120...SW124. The basis address can be set in steps of 32 bytes in the 16 Mbyte address range.

In addition to 'STANDARD' accesses (A24) there is the possibility to use the VME-addressing 'SHORT I/O' (jumper J120). In this addressing the address lines A16 to A23 are ignored and the basis address of the VME-DAC1612 board is set in the 'SHORT I/O' address range (64 KByte) of the VME-system.

The basis address of the VME-DAC1612 is default set to 0xXXE20000.

Each of the 16 D/A-converters of the VME-DAC1612 has got its own access address, which has to be addressed word-by-word. In addition a mode register can be read in which the setting of the operating mode and the number of equipped channels of the VME-DAC1612 is evaluated.

INFORMATION
If jumper J130/pin 1-2 is not set, the D/A-converters are selected by means of the data bits D15...D12 (see page 27).

Unit	Offset address	Access mode
D/A-converter: DAC16 DAC15 DAC14 DAC13 DAC12 DAC11 DAC10 DAC9	 + 0x1E + 0x1C + 0x1A + 0x18 + 0x16 + 0x14 + 0x12 + 0x10	word-by-word, only writing access
D/A-converter: DAC8 DAC7 DAC6 DAC5 DAC4 DAC3 DAC2 DAC1	 + 0xE + 0xC + 0xA + 0x8 + 0x6 + 0x4 + 0x2 + 0x0	word-by-word, only writing access
Mode register	+ 0x0	word-by-word, only reading access

Table 4: Address assignment of VME-DAC1612

4. Jumpers and Coding Switches

4.1 PCB-View

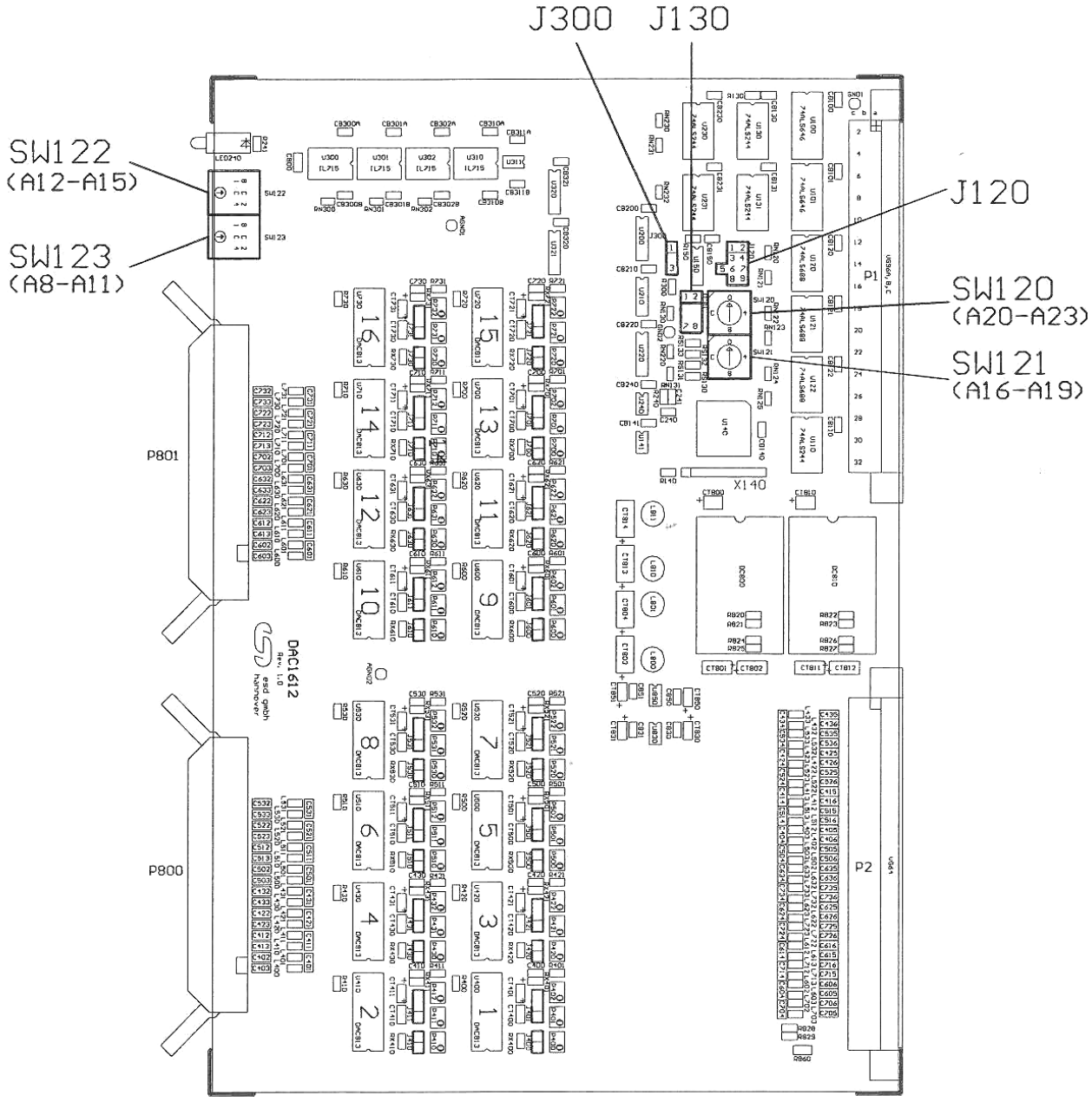


Figure 3: Position of coding switches and jumpers

4.1.1 Default Setting of Jumpers

The according default setting at board delivery is shown in the table below.
For the position of jumpers please refer to figure 3. The jumpers will be shown below as seen by users with the board in front of them and the VMEbus connectors on the right.

Default setting of the jumpers:

Jumper	Function	Default setting at board delivery
SW120... SW123	basis address of board	VME-DAC1612: 0xE20000
J120	address modifier decoding	short/standard supervisory and non-privileged accesses permitted
J130	mode register	depending on model and the output voltage range selected
J300	output level after RESET (negation of data bit D11 for the D/A-converters)	D11 is inverted, i.e. a bipolar operation has been selected
J400, J410, J420, J430, J500, J510, J520, J530, J600, J610, J620, J630, J700, J710, J720, J730	voltage swing of the D/A-converter assigned	U = 20 V -‣ voltage range = ±10 V
J401, J411, J421, J431, J501, J511, J521, J531, J601, J611, J621, J631, J701, J711, J721, J731	bipolar/unipolar conversion of the D/A-converter assigned	bipolar : ±5V, ±10V

Table 5: Default setting of jumpers

4.1.2 Setting Basis Address and Address Modifier Decoding

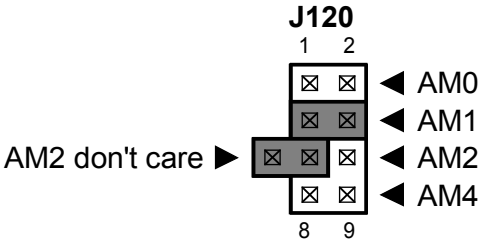
4.1.2.1 Basis Address (Coding Switch)

Address bits	Setting via coding switches	Default setting	Position
A23...A20	SW120	0xE	on board next to VMEbus connector P1
A19...A16	SW121	2	
A15...A12	SW122	0	in front panel (above)
A11...A8	SW123	0	in front panel (below)

Table 6: Setting of basis address

4.1.2.2 Address Modifier (J120)

The address modifiers AM0 to AM5 are completely evaluated on board. The signals AM3 and AM5 are always decoded as '1'. The other signals can be configured via the jumper field J120. A set jumper sets the according bit to '0'.



Example shown: standard setting of address modifiers:
standard supervisory data access and
standard non-privileged data access and
short supervisory I/O access and
short non-privileged I/O access permitted

The AM-configurations available to the VME-DAC1612 are listed in the table below. In addition to the AM-combinations listed, the bit AM2 can be ignored at decoding by setting jumper 'AM2 don't care'. Supervisor as well as non-privileged accesses are permitted (see also example shown).

CODE	AM5	AM4	AM3	AM2	AM1	AM0	Function
0x3E	1	1	1	1	1	0	standard supervisory program access
0x3D	1	1	1	1	0	1	standard supervisory data access
0x3A	1	1	1	0	1	0	standard non-privileged program access
0x39	1	1	1	0	0	1	standard non-privileged data access
0x2D	1	0	1	1	0	1	short supervisory I/O access
0x29	1	0	1	0	0	1	short non-privileged I/O access

Table 7: Selectable AM-combinations

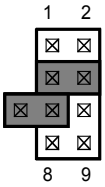
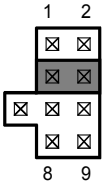
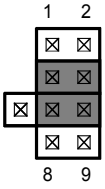
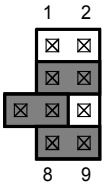
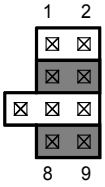
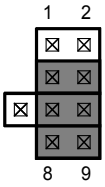
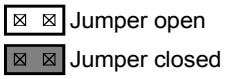
Jumper field J120	Permissible AM-codes							Addressing
	AM5	AM4	AM3	AM2	AM1	AM0	HEX	
	1 1	1 1	1 1	0 1	0 0	1 1	0x39 0x3D	standard non-privileged data access or standard supervisory data access
	1	1	1	1	0	1	0x3D	standard supervisory data access
	1	1	1	0	0	1	0x39	standard non-privileged data access
	1 1	0 0	1 1	0 1	0 0	1 1	0x29 0x2D	short non-privileged access or short supervisory access
	1	0	1	1	0	1	0x2D	short supervisory access
	1	0	1	0	0	1	0x29	short non-privileged access

Table 8: Recommended useful AM-combinations



4.1.3 Configuration of Analog Units

34 jumper fields have been designed for the configuration of the board (number of channels, unipolar or bipolar operation).

Via jumper field J130 the number of equipped channels and a global flag for unipolar or bipolar operation is set in the mode register.

Via jumper field J300 the data bit D11 can be inverted for all D/A-converters together. This can be used, for example, to reset the D/A-converters to 0 V in bipolar operation after a RESET.

Jumpers J400 to J731 switch the respective D/A-converter outputs to unipolar or bipolar operation and the desired voltage swing.

4.1.4 Mode Register (J130)

The mode register is a 'read-only' register to configure the board via software. It is read as WORD under the local address '0x00'. The LSB (D0-D7) is always read as 0x01. It is used to identify the board as VME-DAC1612 in the VMEbus system.

The MSB contains information about the number of D/A-converter channels equipped and the polarity of the output voltage. Depending on whether the output voltage is unipolar or bipolar, the D/A-data has to be specified in the format 'Unipolar Straight Binary' or 'Binary Two's Complement'.

Register bit	Assignment	
D15	Number of D/A-converter channels (set via the equipment of resistors)	
D14		
D13		
D12		
D11	Jumper J130, pin 7-8, available for user	
D10	Jumper J130, pin 5-6, switching between unipolar/bipolar	
D9	Jumper J130, pin 3-4, switching to Big_Endian_Mode	
D8	Jumper J130, pin 1-2, DAC-addresses D12-D15/A1-A4	
D7	0	These bits identify the board in the VMEbus system and cannot be changed.
D6	0	
D5	0	
D4	0	
D3	0	
D2	0	
D1	0	
D0	1	

Table 9: Jumper field J130 in mode register

A set jumper sets the according data bit to '0'.

D8: DAC-addresses D12-D15/A1-A4...

The D/A-converters of the VME-DAC1612 are usually selected via the four least significant address bits (A1...A4).
If the jumper J130/pin 1-2 has not been set, the D/A-converters are not selected via the addresses, but the most significant data bits (D11...D15). These bits are transmitted along with the 12-bit analog value. In this case the address bits A1 ...A4 can be freely set.
On the standard version of the board this jumper is default-set.

Jumper J130, pin 1-2	Bit D8	Selection of the D/A-converter channels
set	0	via the address bits A1...A4 **Default setting at delivery**
open	1	via data bits D12...D15 (address bits A1...A4 are not evaluated)

Table 10: Mode for selection of D/A converter channels

D9: Big Endian Mode...

D9 specifies whether Big Endian Mode is set instead of the standard format (LSB first).

Jumper J130, pin 5-6	Bit D9	Data format
set	0	Big Endian (MSB first)
open	1	Little Endian (standard format, LSB first)

Table 11: Selection of Big Endian Mode

D10: unipolar/bipolar...

D10 specifies whether the D/A-converters on board have been configured for unipolar or bipolar operation. The format of the transmitted D/A-data depends on the polarity selected.

Jumper J130, pin 5-6	Bit D10	Polarity	Data format
set	0	bipolar	BTC (Binary Two's Complement) **Default setting at delivery**
open	1	unipolar	USB (Unipolar Straight Binary)

Table 12: Coding for unipolar/bipolar operation

In principle it is possible to select unipolar operation for some channels and bipolar operation for others. However, this is not recommendable, because it does not only cause irregularities for this jumper, but also for jumper field J300. Especially the resetting of channels to 0 V after a RESET is not possible simultaneously for unipolar and bipolar operation.

D11: free for users...

This jumper can be freely set and evaluated by the user.

Jumper J130, pin 7-8	Bit D11
set	0
open	1

Table 13: Set register bit D11 via jumper J130

D12-D15: DAC-number...

By means of these four bits the number of equipped D/A-converter channels can be read.
The bits encode the channel number as follows:

Bit 3 (D15)	Bit 2 (D14)	Bit 1 (D13)	Bit 0 (D12)	Number of equipped D/A-converter channels
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15
0	0	0	0	16

Table 14: Encoding the number of equipped D/A-converter channels

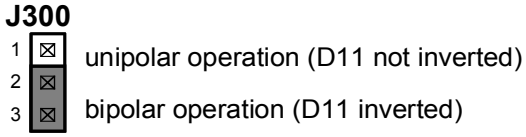
4.1.5 Negation of Data Bit D11 (J300)

Via jumper field J300 the data bit D11 can be inverted for all D/A-converters simultaneously. This is necessary, because depending on the mode of the output voltage, the D/A-converters expect the data in various formats:

In **unipolar** operation the data has to be transmitted in **USB (Unipolar Straight Binary)** format.

In **bipolar** operation the converter expects the data in **BTC (Binary Two's Complement)** format.

NOTICE
Please note, the negation is especially important, because the analog outputs will only be set to 0 V after a RESET, if bit D11 has got the level required for the operating mode!

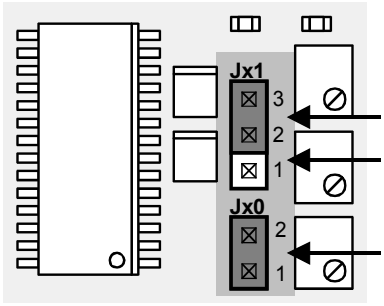


Example: D11 inverted for bipolar operation of D/A-converter outputs

4.1.6 Selecting the Output Voltage Range (J400-J731)

For each analog channel there are two jumper fields to configure the voltage range. As the jumpers are closely connected, they will be explained together.
The voltage swing of the A/D-converters is set via jumpers J400...J730. Unipolar and bipolar operations are selected by means of the three-pin jumper fields J401...J731. For the assignment of jumpers to the sixteen channels, please refer to the PCB view on page 13. There the channel units are designated by numbers.

Alternatively, the voltage swing can also be determined by equipping resistors. In that case the jumpers are not equipped.



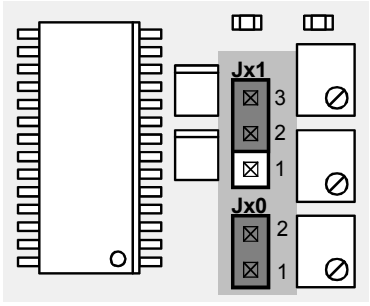
unipolar output voltage
bipolar output voltage

open: voltage swing = 20 V
closed: voltage swing = 10 V

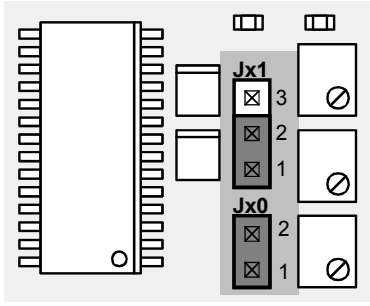
Example: Unipolar output voltage 0...+10V

Jumper settings for output voltage ranges

Output voltage range
0...+10V

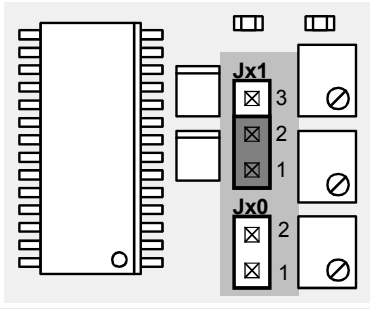


Output voltage range
±5V



Default setting at delivery ->>

Output voltage range
±10V



jumper open jumper closed

It is also important to make sure that the correct output configuration has been set in mode register via BR1 and that the correct polarity has been assigned to data bit D11 via BR7!

INFORMATION
Principally, unipolar and bipolar output configurations can be selected on a VME-DAC1612. However, this is not recommendable, because other settings (at J130) are made simultaneously for all channels of the board.

The jumpers are assigned to output channels as follows:

Jumper for voltage swing	Jumper for polarity	Output channel
J400	J401	1
J410	J411	2
J420	J421	3
J430	J431	4
J500	J501	5
J510	J511	6
J520	J521	7
J530	J531	8
J600	J601	9
J610	J611	10
J620	J621	11
J630	J631	12
J700	J701	13
J710	J711	14
J720	J721	15
J730	J731	16

Table 15: Assignment of jumpers BR8 to BR23 to output channels

NOTICE
For the assignment of jumpers to the sixteen channels, please refer to the PCB view on page 13. There the channel circuits are designated by numbers.

5. Analog Outputs

5.1 Output Circuit

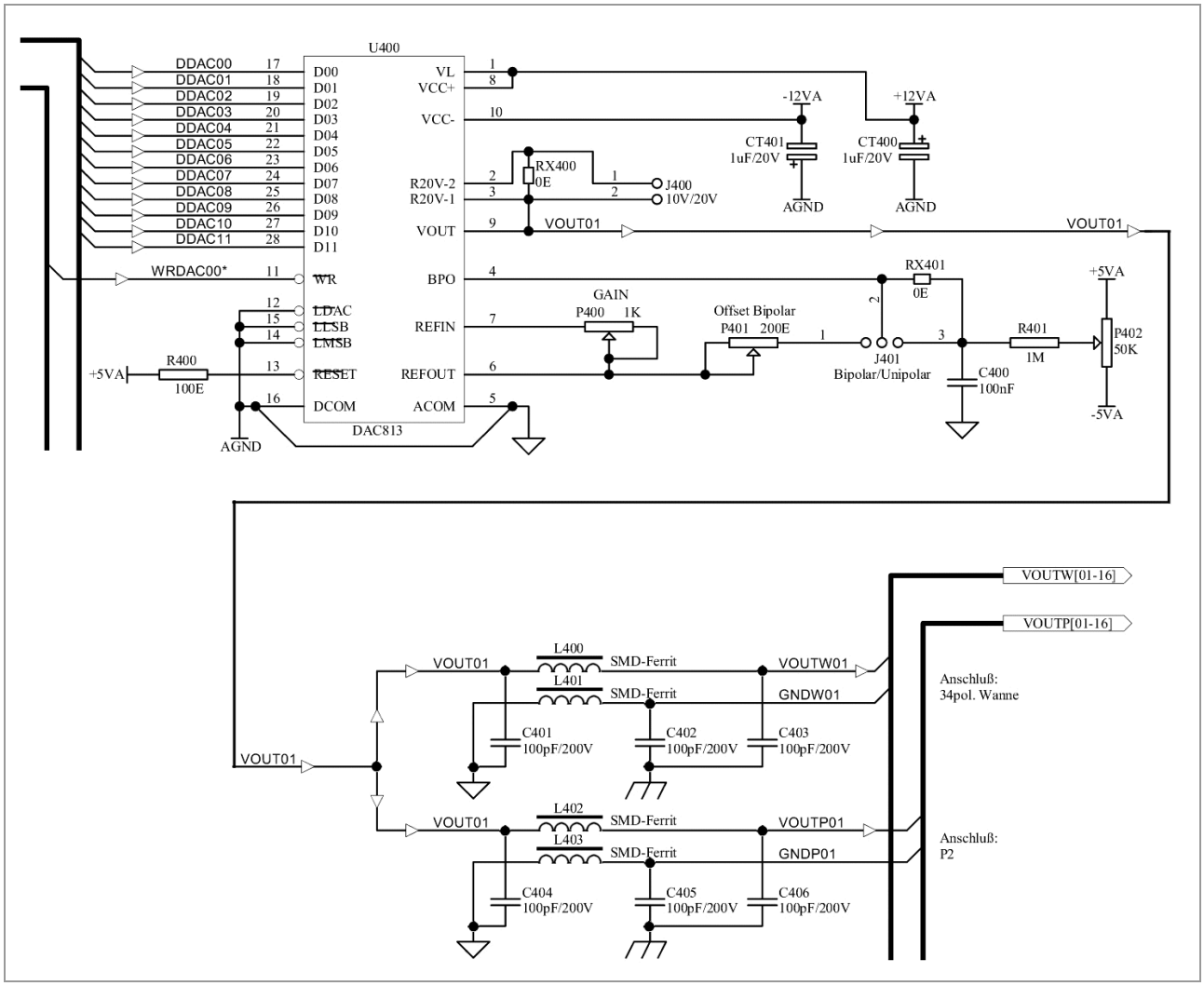


Figure 4: Output circuit of the VME-DAC1612 (example: channel 1)

5.2 Operating Modes of the D/A-Converters

5.2.1 Data Transfer

Each of the 16 D/A-converters of the VME-DAC1612 has got its own access address. Writing the data at this address sets the D/A-converters and starts the conversion. The data has to be transferred word by word, because the conversion is started immediately when the WRITE signal is cancelled!

Additionally, a mode register can be read in which the setting of the output polarity and the number of equipped channels can be evaluated. The mode register has already been described in the chapter ‘Mode Register (J130)’ on page 19.

The D/A-converters evaluate the received data word as follows:

Mode	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Little Endian	x	x	x	x	f MSB	f	f	f	f	f	f	f	f	f	f	f LSB
Big Endian	f MSB	f	f	f	f	f	f	f	f	f	f	f LSB	x	x	x	x

Meaning of bits:

D/A-converter data (f f f f .f f f f .f f f f)

Data bit D11 can be inverted for all D/A-converters simultaneously by means of jumper J300. This is necessary if the outputs are run in bipolar mode, because the D/A-converters expect the data in various formats, depending on the operating mode:

In **unipolar** operation the data have to be specified in
USB (Unipolar Straight Binary) format.

In **bipolar** operation the converter expects the data in
BTC (Binary Two's Complement) format.

NOTICE
The negation is especially important, because the analog outputs will only be set to 0 V following a RESET, if bit D11 has got the level required for this operating mode!

In mixed operation of bipolar and unipolar channels on the VME-DAC1612 it is up to the user to decide which channels are to be set to 0 V after a RESET*.

In the following chapters the voltage values corresponding to the binary data words of the respective operating mode will be shown.

Alternative channel selection (xxxx)

These bits (D15...D12) are not evaluated, unless jumper J130/pin 1-2 is not set (‘1’). In this case the desired D/A-converter is selected via these bits:

Value of bits				D/A-converter (output channel)
D15	D14	D13	D12	
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	5
0	1	0	1	6
0	1	1	0	7
0	1	1	1	8
1	0	0	0	9
1	0	0	1	10
1	0	1	0	11
1	0	1	1	12
1	1	0	0	13
1	1	0	1	14
1	1	1	0	15
1	1	1	1	16

Table 16: Selection of D/A-converter

If jumper J130/pin 1-2 is set (‘0’), the D/A-converters are selected via addresses A1...A4, as described on page 12.

INFORMATION
If the D/A-converter channels are selected via the data bits D15...D12, the lower address bits A1...A4 are not evaluated.
The write access can be done with any address setting, that lies in the local address range of the VME-DAC1612.

INFORMATION
At the hardware address decoding the data bits take over the function of the address bits (A1 <=> D12, A2 <=> D13, A3 <=> D14, A4 <=> D15) if the D/A-converter channels are selected via the data bits D15...D12.
The coding of the channels therefore differs from the channel coding, which is restored via the mode register and which is chosen different to provide compatibility with the VME-DAC812!

5.2.2 Unipolar Operation 0...10 V

Prerequisite for a unipolar operation with 0...10 V is the correct configuration of the board via the jumpers (J300 for all channels together and two of jumpers J400...J731 for the according channel)!

For the output voltage range 0...10V the converter components DAC813 require the data in format 'USB' (Unipolar Straight Binary). The following table shows the assignment of data to output voltages for this format by means of some basic data.

Input		Output	
D11 MSB ▾ D0 LSB ▾	HEX		
111111111111	0xFFF	+ maximum value	(+ 9.9976 V)
100000000000	0x800	+ ½ maximum value	(+ 5.0000 V)
011111111111	0x7FF	+ ½ maximum value-1 LSB	(+ 4.9976 V)
000000000000	0x000	null	(0.0000 V)

Table 17: Data format for output voltages of 0...10 V

5.2.3 Bipolar Operation ±5 V

Prerequisite for a bipolar operation with ±5 V is the correct configuration of the board via the jumpers (J300 for all channels together and two of jumpers J400...J731 for the according channel)!

For the output voltage range ±5 V the converter components DAC813 require the data in 'BTC' (Binary Two's Complement) format. The following table shows the assignment of data to output voltages for this format by means of some basic data.

Input		Output	
D11 MSB ▾ D0 LSB ▾	HEX		
011111111111	0x7FF	+ maximum value	(+ 4.9975 V)
000000000000	0x000	null	(0.0000 V)
111111111111	0xFFF	- 1 LSB	(- 0.0024 V)
100000000000	0x800	- maximum value	(- 5.000 V)

Table 18: Data format for output voltages of ±5 V

5.2.4 Bipolar Operation ±10 V

Prerequisite for a bipolar operation with ±10 V is the correct configuration of the board via the jumpers (J300 for all channels together and two of jumpers J300...J731 for the according channel)!

For the output voltage range ±10 V the converter components DAC813 require the data in 'BTC' (Binary Two's Complement) format. The following table shows the assignment of data to output voltages for this format by means of some basic data.

Input		Output	
D11 MSB ▾ D0 LSB ▾	HEX		
011111111111	0x7FF	+ maximum value	(+ 9.9951 V)
000000000000	0x000	null	(0.0000 V)
111111111111	0xFFF	- 1 LSB	(- 0.0049 V)
100000000000	0x800	- maximum value	(- 10.0000 V)

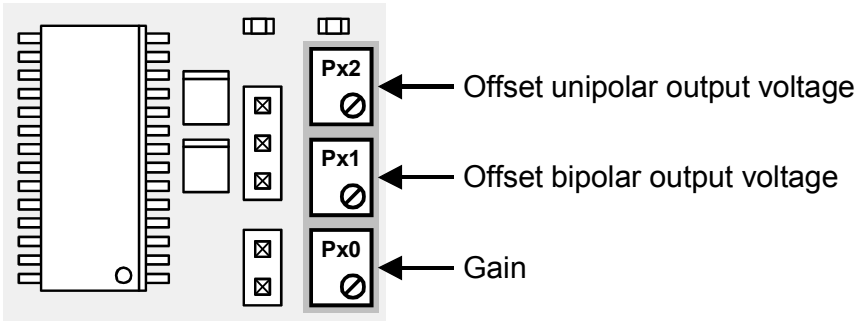
Table 19: Data format for output voltages of ±10 V

5.3 Adjusting the D/A-Converters

Offset and Gain have already been adjusted by the manufacturer. However, if another adjustment, for instance following a change in operating mode of a channel, was required, just follow the instructions given in the following chapters.

INFORMATION
For the assignment of potentiometers to the sixteen channels please refer to the PCB view on page 13. There the channel circuits are designated by numbers.

For each channel three potentiometers are available for adjustment:



The following table shows the potentiometers for Offset (unipolar and bipolar) and Gain for each D/A-channel.

D/A-converter channel	Potentiometer		
	Gain	Offset bipolar	Offset unipolar
1	P400	P401	P402
2	P410	P411	P412
3	P420	P421	P422
4	P430	P431	P432
5	P500	P501	P502
6	P510	P511	P512
7	P520	P521	P522
8	P530	P531	P532
9	P600	P601	P602
10	P610	P611	P612
11	P620	P621	P622
12	P630	P631	P632
13	P700	P701	P702
14	P710	P711	P712
15	P720	P721	P722
16	P730	P731	P732

Table 20: Assignment of adjusting potentiometers to channels

5.3.1 Offset Setting

The offset voltage is adjusted by means of a potentiometer (see table 20). Via this adjustment the offset voltage of the D/A-converter and the following operation amplifier is set.

In unipolar operation the value 0x0000 is applied to the D/A-converter which is to generate an output voltage of 0.0 V at the output of the according channel of the VME-DAC1612.

0x0000 -‣ 0.0 V

Via offset potentiometer ‘Px2’ the output of the respective channel is set to 0.0 V.

In bipolar operation (BTC) the value 0x0800 is applied to the D/A-converter which is to generate the maximum possible negative output voltage.

0x0800 -‣ -5.0 V or -10.0 V

Via offset potentiometer ‘Px1’ the output of the respective channel is set to the maximum possible negative output voltage (-5.0 V or -10.0 V).

5.3.2 Gain

For unipolar as well as for bipolar operation a digital value is applied to the D/A-converter which generates the maximum possible positive output voltage:

	0x0FFF = +9.9976 V	in unipolar operation
or	0x07FF = +4.9976 V or +9.9951 V	in bipolar operation

Via gain potentiometer ‘Px0’ the output of the respective channel is set to the maximum possible positive output voltage.

INFORMATION
The board is first configured and adjusted to the unipolar operation by the manufacturer. Then it is configured and adjusted to bipolar operation. The board is delivered with the bipolar setting (±10 V).

If the board is then changed to unipolar operation (0...10 V) via jumpers again and is then *not* adjusted via the gain potentiometer, you have to expect a further deviation of about ½ LSB (regarding to the maximum value) in unipolar operation.

6. Hardware Installation

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

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-DAC1612 is to be integrated.
→ Disconnect all hazardous voltages (mains voltage) before opening the system.
→ 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 by touching the metal case of the VMEbus system *before* you touch the VME-DAC1612.
→ Furthermore, you should prevent your clothes from touching the VME-DAC1612, 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.
3. Disconnect the system from the mains.

   DANGER
   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 (i.e. with caution label).
   → Ensure the absence of voltage before starting any electrical work.
4. Open the case if necessary.
5. If necessary, configure the coding switches as described in chapter “Jumpers and Coding Switches” from page 13.
6. Insert the VME-DAC1612 board into the selected VME slot. Carefully push the board until it snaps into place.
7. Close the system's case again.
8. Connect the system to mains again (mains connector or safety fuse).
9. Switch on the system and the peripheral devices. - End of hardware installation.

7. Software

7.1 Initialisation

The D/A-converter outputs generally do not have to be especially initialized after a RESET signal by the VMEbus, if the same operating mode was selected for all output channels. In this case a sequence control on board resets the output voltages to 0.0 V.

In mixed operation (unipolar and bipolar) the reset status for only one operating mode is met, however, so that the other channels should be reset by the user.

An output voltage at the D/A-converter channel can be generated by writing the data word word-by-word (depending on operating mode) at the corresponding address of the DAC channel.

The following page shows an example program for accesses to the VME-DAC1612 board in realtime-multitasking-standard language PEARL.

The MODE register can only be read (see chapter ‘Mode Register (J130)’, page 19), from which the user can take information about the configuration of the VME-DAC1612-board in the system.

7.2 PEARL-Example Program to Generate Lissajous-Figures on an Oscilloscope

```
MODULE DAC812;
SYSTEM;
   /* für 'xx' jeweils VMEbus Adresse einsetzen */
dac0   : BU(xxE20000,02)   ->; /* DA-Wandler Nr. 1 */
dac1   : BU(xxE20002,02)   ->; /* DA-Wandler Nr. 2 */
dac2   : BU(xxE20004,02)   ->; /* DA-Wandler Nr. 3 */
dac3   : BU(xxE20006,02)   ->; /* DA-Wandler Nr. 4 */
dac4   : BU(xxE20008,02)   ->; /* DA-Wandler Nr. 5 */
dac5   : BU(xxE2000A,02)   ->; /* DA-Wandler Nr. 6 */
dac6   : BU(xxE2000C,02)   ->; /* DA-Wandler Nr. 7 */
dac7   : BU(xxE2000E,02)   ->; /* DA-Wandler Nr. 8 */
dacmode: BU(xxE20000,02)  <- ; /* DAC-Revision, read only */
PROBLEM;
SPC (dac0,dac1,dac2,dac3,dac4,dac5,dac6,dac7)
           DATION OUT BASIC;
SPC dacmode DATION IN  BASIC;
SPC PI      FLOAT GLOBAL;
...
lissajous: TASK;
/* Lissajous-Figuren mit DAC_0=x und DAC_1=y auf einem
  Oszilloskope
  ! unipolar- oder bipolar-Mode beachten ! */;
DCL (a, r, b)       FLOAT;
DCL (sinus, cosin) FIXED;
DCL speed           FIXED INIT(5);
b=TOFIXED '0800'B4-0.5;
REPEAT;
  r=PI/speed;
  FOR i FROM  -speed TO speed REPEAT;
   sinus=ROUND((SIN(i*r)+1.0)*b);
   cosin=ROUND((COS(i*r)+1.0)*b);
   SEND sinus  TO dac0;
   SEND cosin  TO dac1;
  END;
END;
END;                          /* of Task "lissajous" */
...
MODEND;
```

8. Connector Assignment

8.1 VMEbus Connector P1

Pin	Row a	Row b	Row c
1	D00	-	D08
2	D01	-	D09
3	D02	-	D10
4	D02	BG0IN* ⎤	D11
5	D04	BG0OUT* ⎦	D12
6	D05	BG1IN* ⎤	D13
7	D06	BG1OUT* ⎦	D14
8	D07	BG2IN* ⎤	D15
9	GND	BG2OUT* ⎦	GND
10	-	BG3IN* ⎤	-
11	GND	BG3OUT* ⎦	-
12	DS1*	-	SYSRESET*
13	DS0*	-	LWORD*
14	WRITE*	-	AM5
15	GND	-	A23
16	DTACK*	AM0	A22
17	GND	AM1	A21
18	AS*	AM2	A20
19	GND	AM3	A19
20	IACK*	GND	A18
21	IACKIN* ⎤	-	A17
22	IACKOUT* ⎦	-	A16
23	AM4	GND	A15
24	-	-	A14
25	-	-	A13
26	-	-	A12
27	A04	-	A11
28	A03	-	A10
29	A02	-	A09
30	A01	-	A08
31	-	-	-
32	+5V	+5V	+5V

Spring contact strip according to DIN41612 design C96/a+b+c
I_{max} per pin : 1.0 A

⎤⎦ ... signals on board bridged
- ... signal not connected

8.2 I/O-Connector P2 and Transition Module

Assignment of a 64-pin transition module					
	Assignment of I/O-connector P2				
Pin	Row a	Signal		Row c	Pin
2	1	-	-	1	1
4	2	-	-	2	3
6	3	DAC4-GND	DAC4-OUT	3	5
8	4	-	-	4	7
10	5	DAC8-GND	DAC8-OUT	5	9
12	6	-	-	6	11
14	7	DAC3-GND	DAC3-OUT	7	13
16	8	-	-	8	15
18	9	DAC7-GND	DAC7-OUT	9	17
20	10	-	-	10	19
22	11	DAC2-GND	DAC2-OUT	11	21
24	12	-	-	12	23
26	13	DAC6-GND	DAC6-OUT	13	25
28	14	-	-	14	27
30	15	DAC1-GND	DAC1-OUT	15	29
32	16	-	-	16	31
34	17	DAC5-GND	DAC5-OUT	17	33
36	18	-	-	18	35
38	19	DAC12-GND	DAC12-OUT	19	37
40	20	DAC16-GND	DAC16-OUT	20	39
42	21	DAC11-GND	DAC11-OUT	21	41
44	22	DAC15-GND	DAC15-OUT	22	43
46	23	DAC10-GND	DAC10-OUT	23	45
48	24	DAC14-GND	DAC14-OUT	24	47
50	25	DAC09-GND	DAC9-OUT	25	49
52	26	DAC13-GND	DAC13-OUT	26	51
54	27	-	-	27	53
56	28	(+5 V_{analog})	(+5 V_{analog})	28	55
58	29	(-15 V_{analog})	(-15 V_{analog})	29	57
60	30	(+15 V_{analog})	(+15 V_{analog})	30	59
62	31	GND_{analog}	GND_{analog}	31	61
64	32	-	-	32	63

I/O-connector: spring contact strip according to DIN41612 design C64/a+c
I_{max} per pin : 1.0 A

See the following page for the description of signals.

Signal descriptions for `I/O-connector P2 and transition module':

-	...	These connector pins are not connected on board.
DACx-OUT	...	Output of A/D-converter channel 'x' (x = 1, 2, ...16)
DACx-GND	...	reference potential of A/D-converter output 'x'

($+5V_{analog}$), ($+15V_{analog}$), ($-15V_{analog}$)

NOTICE
In the standard version of the board the analog supply voltages are generated via DC/DC-converters from the +5V-power supply of the VMEbus.
The supply voltages ($+5V_{analog}$), ($+15V_{analog}$) and ($-15V_{analog}$) **are not** needed, therefore!

GND_{analog} ... The reference potential of the analog supply voltages is only required at P2, if the DAC812 adapter is used for the conversion of voltage outputs to current outputs.
The reference potential of the analog supply voltages is connected to the reference potentials of the analog outputs only on the VME-DAC1612 board and not on the adapter. Therefore the reference potential of the supply voltages of the VME-DAC1612 and the reference potential of the supply voltages of the adapter board (GND_{analog}) are connected via P2.

8.3 Post Connectors P800 and P801

Signal	Pin P801		Signal
DAC9-GND	1	2	DAC9-OUT
DAC9-GND	3	4	-
DAC10-GND	5	6	DAC10-OUT
DAC10-GND	7	8	-
DAC11-GND	9	10	DAC11-OUT
DAC11-GND	11	12	-
DAC12-GND	13	14	DAC12-OUT
DAC12-GND	15	16	-
DAC13-GND	17	18	DAC13-OUT
DAC13-GND	19	20	-
DAC14-GND	21	22	DAC14-OUT
DAC14-GND	23	24	-
DAC15-GND	25	26	DAC15-OUT
DAC15-GND	27	28	-
DAC16-GND	29	30	DAC16-OUT
DAC16-GND	31	32	-
Shield	33	34	Shield

Signal	Pin P800		Signal
DAC1-GND	1	2	DAC1-OUT
DAC1-GND	3	4	-
DAC2-GND	5	6	DAC2-OUT
DAC2-GND	7	8	-
DAC3-GND	9	10	DAC3-OUT
DAC3-GND	11	12	-
DAC4-GND	13	14	DAC4-OUT
DAC4-GND	15	16	-
DAC5-GND	17	18	DAC5-OUT
DAC5-GND	19	20	-
DAC6-GND	21	22	DAC6-OUT
DAC6-GND	23	24	-
DAC7-GND	25	26	DAC7-OUT
DAC7-GND	27	28	-
DAC8-GND	29	30	DAC8-OUT
DAC8-GND	31	32	-
Shield	33	34	Shield

34-pin post connector in front panel with locking.
Please refer to previous page for a description of signals.

9. DAC812-Adapter (DAC812-20mA)

9.1 Overview

The optional adapter DAC812-20mA is connected to I/O-connector P2. The adapter converts the output voltage of 0...10 V to a current of 0(4)...20 mA. You can select between 0...20 mA and 4...20 mA via a jumper. When using a precision load resistor at the current output, the voltage drop caused by the connected line can be compensated: if, for instance, a resistor of 500 Ω is connected to the output configured for 0...20 mA, the voltage drop over the resistor is always 0...10 V.

The conversion from voltage/current is made via converter component XTR110 by means of a transistor (BSS110), connected in series. Potentiometers for adjusting offset and gain are available for each of the at most 8 channels. The channels have already been adjusted by the manufacturer.

Each of the voltage/current converters has got three jumpers, by which the three different operating modes can be selected:

1. Voltage output (the output voltage of the VME-DAC1612 is directly fed to the terminals of the adapter. All voltage ranges of the VME-DAC1612 are permissible)
2. Current output 0...20 mA
3. Current output 4...20 mA (line break recognition)

9.2 PCB View with Jumpers

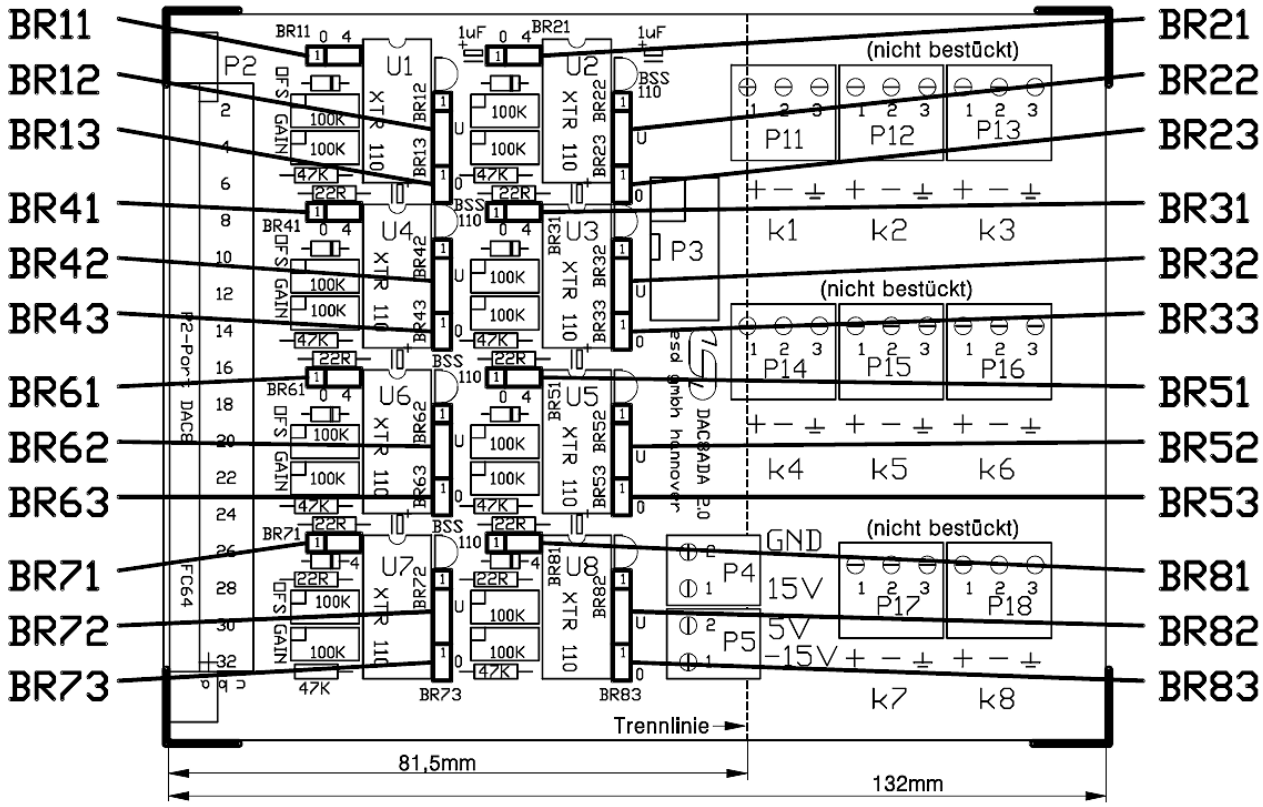


Figure 5: Position of jumpers on the DAC812-adapter

9.3 Default Settings of Jumpers

The respective default setting at the time of delivery of the board can be found in the table below.

The position of jumpers can be found in figure 5. The jumpers are shown below as seen by users with the board in front of them, transition connector P2 pointing to the left.

Jumper	Function	Default setting at the time of delivery
BR11, BR21,... ...BR81	Selection between 0...20 mA and 4...20 mA	all channels set to 0...20 mA
BR12, BR22,... ...BR82	Selection between current and voltage output	all channels set to current output
BR13, BR23,... ...BR83	Determining the reference input of the voltage/current converters for 0...20 mA or 4...20 mA	set to 0...20 mA for all channels

Table 21: Default setting of jumpers

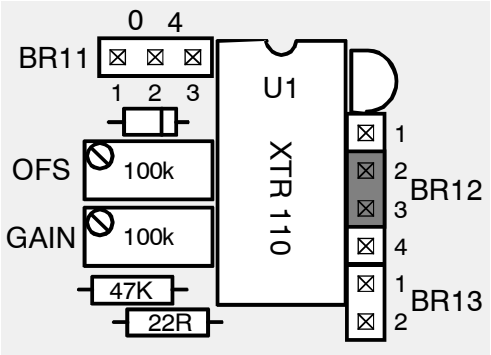
9.4 Description of Jumpers

Each channel of the DAC812-adapter has got three jumper fields. By means of bridges Brx1 and Brx3 (x= 1, 2,..., 8 for the channel number) 0...20 mA and 4...20 mA current outputs are distinguished. Jumper Brx2 distinguishes between voltage and current output.

Channel No.	Current or voltage output	0...20 mA or 4...20 mA output
1	BR12	BR11 and BR13
2	BR22	BR21 and BR23
3	BR32	BR31 and BR33
4	BR42	BR41 and BR43
5	BR52	BR51 and BR53
6	BR62	BR61 and BR63
7	BR72	BR71 and BR73
8	BR82	BR81 and BR83

Table 22: Assignment of jumpers to channels

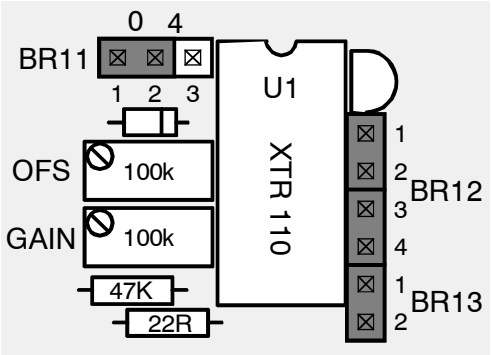
There are three combinations of jumper positions. They are shown in the following figures. The example in the diagrams always shows the first channel in the possible configurations. The position of the jumpers of the individual channels can be taken from the figure 5: 'Position of jumpers of the DAC812-adapter'.



Voltage outputs

If the output voltage of the VME-DAC1612 is to fed through for a channel, a jumper has to bridge pins 2-3 in jumper field Brx2. Jumper fields Brx1 and Brx2 are insignificant in this case.
(x = 1, 2,...,8 for the channel number).

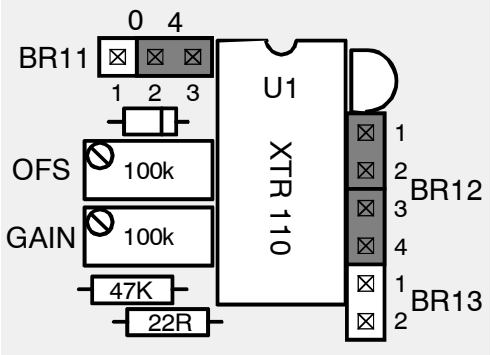
Figure 6: Jumper position for voltage outputs



0...20 mA current outputs

For current outputs pins 1-2 and 3-4 of jumper field BRx2 have to be bridged. For operation with 0...20 mA a jumper has to be set on pins 1-2 of jumper field Brx1 and jumper Brx3 has to be set additionally.
(x = 1, 2,...,8 for the channel number).

Figure 7: Jumper position for 0...20 mA current outputs.



4...20 mA current outputs

For current outputs pins 1-2 and 3-4 of jumper field BRx2 have to be bridged. For operation with 4...20 mA you also have to bridge pins 2-3 of jumper field Brx1. Jumper Brx3 remains open.
(x = 1, 2,...,8 for the channel number).

Figure 8: Jumper position for 4...20 mA current outputs

Description of jumper symbol:

9.5 Conversion of Voltages to Currents

The conversion of output voltage to current outputs is shown in the table below:

VME-DA1612-output voltage [V]	Output current of the DAC812-20mA adapter [mA]
+ 0.0 + 0.0 (4 mA option) + 9.9975	+ 0.0 + 4.0 + 20.0

Table 23: Voltage/current assignment

9.6 Adjusting the Channels

Offset and Gain have already been adjusted by the manufacturer. If you require another adjustment, for instance following a change in the operating mode of a channel, please refer to chapter 'Adjusting the D/A-Converters' on page 31. Instead of the voltage values cited there, you set the equivalent current values.

If you only feed through the output voltage of the VME-DAC1612, you do not have to adjust offset and gain.

9.7 Assignment of Connectors of the DAC812-Adapter

In addition to the 64-pin socket strip P2 the adapter has got a 10-pin post connector (P3) to connect the analog outputs via flat ribbon cable and it has got screw terminals to connect the analog supply voltages (P4, P5).

The analog outputs can also be connected via screw-type terminals (such as *PHOENIX* SMKDS1.2-3) (P11-P18). These connectors are not available in the standard version of the adapter. If required, they can be equipped afterwards by the user or the manufacturer, if desired.

If connectors P11 to P18 are not required, the adapter board can be sawn-off at the line especially marked. This is useful, if the space in the VMEbus system is limited. The length of the board is reduced from 132 mm to 81.5 mm. Please refer to figure 5 'Position of jumpers of the DAC812-adapter' on page 41 for the position of the line.

9.7.1 Transition Connector P2

Assignment of I/O-connector P2			
Row a	Signal		Row c
1	Signal-GND	-	1
2	.	-	2
3	.	DAC4-IN	3
4	.	-	4
5	.	DAC8-IN	5
6	.	-	6
7	.	DAC3-IN	7
8	.	-	8
9	.	DAC7-IN	9
10	.	-	10
11	.	DAC2-IN	11
12	.	-	12
13	.	DAC6-IN	13
14	.	-	14
15	.	DAC1-IN	15
16	.	-	16
17	Signal-GND	DAC5-IN	17
18	-	-	18
19	-	-	19
20	-	-	20
21	-	-	21
22	-	-	22
23	-	-	23
24	-	-	24
25	-	-	25
26	-	-	26
27	-	-	27
28	+5 V_{analog}	+5 V_{analog}	28
29	-15 V_{analog}	-15 V_{analog}	29
30	+15 V_{analog}	+15 V_{analog}	30
31	GND_{analog}	GND_{analog}	31
32	-	-	32

I/O-connector: Spring contact strip in accordance with DIN41612 design C64/a+c
I_{max} per pin: 1.0 A

For signal description turn to the following page.

Signal descriptions to `Transition Connector P2`:

- ...	these connector pins are not connected on board
DACx-IN ...	analog input signal of the DAC812-adapter board (= output of VME-DAC1612 with x = 1...8)
Signal-GND ...	reference potential of analog inputs of the adapter board
+5 V_{analog}, +15 V_{analog}, -15 V_{analog}, GND_{analog} ...	power supply of analog units

NOTICE
The analog supply voltages of the VME-DAC1612 are generated via DC/DC-converters from the +5 V supply voltage of the VMEbus. The DAC812-adapter requires its own analog power supply of 5 V and ±15 V, however!

INFORMATION
The potentials 'Signal-GND' and 'GND_{analog}' are connected to each other on the VME-DAC1612-board. On the adapter board these signals are not connected.

9.7.2 Analog Outputs at P3

Signal	Pin		Signal
OUT 1	1	2	OUT 2
OUT 3	3	4	OUT 4
OUT 5	5	6	OUT 6
OUT 7	7	8	OUT 8
GND_{analog}	9	10	Signal-GND

10-pin post connector

OUT x ... analog output signal of the DAC812-adapter:
voltage output of the VME-DAC1612 or
current output 0...20 mA or
current output 4...20 mA

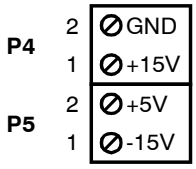
Signal-GND ... reference potential of analog outputs

GND_{analog}... reference potential of the power supply of analog units (used as shield)

INFORMATION
The potentials 'Signal-GND' and 'GND_{analog}' are connected to each other on the VME-DAC1612-board. On the adapter board these signals are not connected.

9.7.3 Supplying the Analog Units via Screw Terminals (P4, P5)

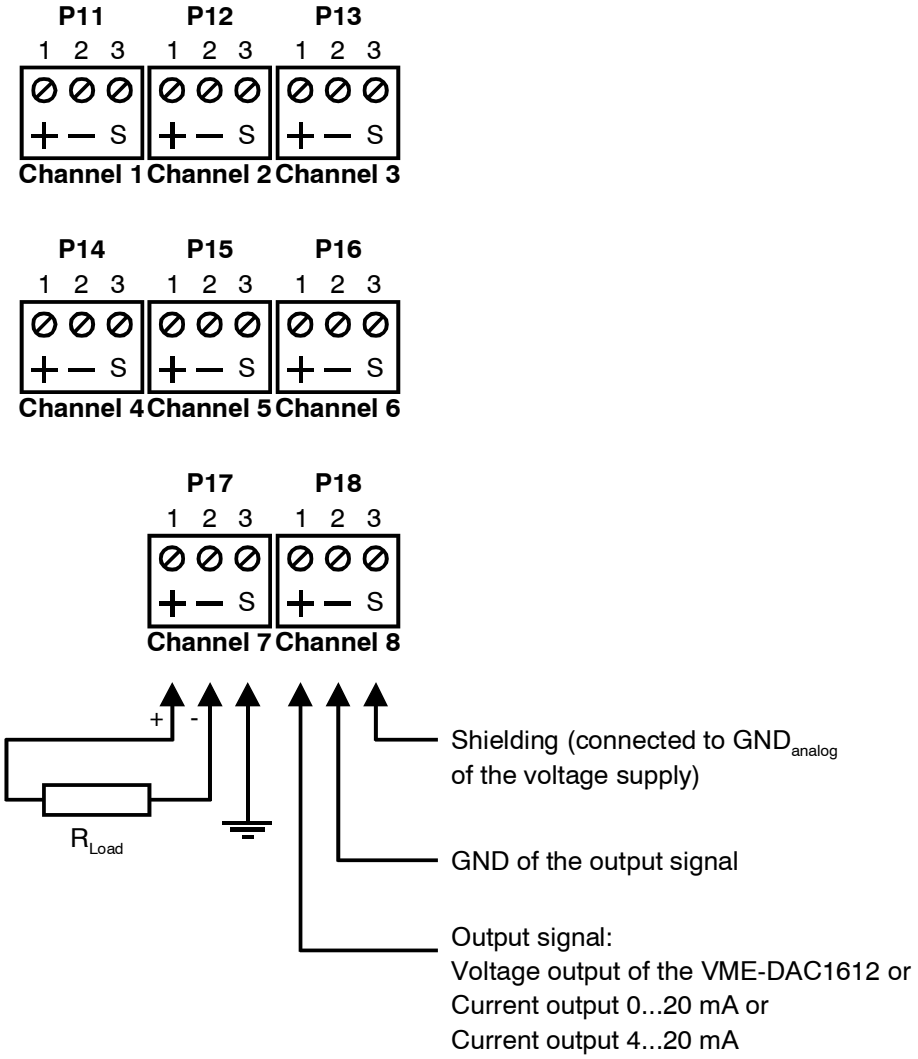
If the DAC812-adapter is not only to be used to feed through the output voltages of the VME-DAC1612, the power supply of the analog units of the adapter has to be supplied via P4 and P5.



P4 and P5 are 'SMKDS1.2' screw terminals and can be connected to lines with a cross-section of up to 1.5 mm^2.

9.7.4 Analog Outputs via Screw Terminals (P11-P18)

Screw terminals P11 to P18 can be equipped later, if required. They are not available on the standard board of the DAC812-adapter.



10. Order Information

Type	Features	Order no.
VME-DAC1612-08	8 analog outputs, 12 bits, adjusted for ±10V	V.1706.08
VME-DAC1612-16	16 analog outputs, 12 bits, adjusted for ±10V	V.1706.16
VME-DAC1612-IEEE/FRONT	IEEE front panel for VME-DAC1612-16, 6 U/ 4 HP with ejector handle	V.1706.31
VME-DAC1612-XVME530	5 outputs, 12 bits, adjusted for 0...+10 V, opto-isolated, front-I/O, I/O data access and power supply compatibel with XYCOM XVME530	K.0508.13
Accessories		
VME-DAC1612-ADAPT1	Adapter module with solderless lug connectors for connection to P2	V.1923.01
VME-DAC1612-ADAPT2	Adapter module with spring clip connectors for connection to P2	V.1923.02
DAC812-20mA-8	Adapter module for VME-DAC1612-08 to convert voltage outputs into current outputs 0(4)...20 mA for 8 channels	V.1702.28

Table 24: Order information

PDF Manuals
Manuals are available in English and usually in German as well. For availability of English manuals see table below.
Please download the manuals as PDF documents from our esd website www.esd.eu for free.

Manuals		Order No.
VME-DAC1612-ME	VME-DAC1612 manual in English	V.1706.21

Table 25: 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.