M325

Quad. Voltage/Current DAC

Hardware Manual

Revision 1.1

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AcQuisition Technology B.V.
P.O. Box 627, 5340 AP OSS, The Netherlands
Tel: +31 412 651055
Fax: +31 412 651050

Contents

1. Using the Manual

This manual serves as instruction for starting the module, for the connection of peripheral devices, and for the integration in a system. Furthermore it gives the user additional information for special applications and configuration possibilities of the assembly.

Detailed information concerning the individual assemblies (data sheets etc.) are no part of this manual. In the annex you will find a bibliography.

This manual describes the hardware of the assembly.

Notes concerning the nomenclature:

Hex numbers are marked with a leading dollar-sign, for example: $800000 or $BFFFFF.

1.1. Validity of this Manual

The contents of this manual are valid for M325 version 1.

1.2. Revision History

Revision 1 of the M325 module is the first release.

2. General Description

The M325 D/A module is designed as a plug-on module for the M-module interface. It is capable of handling up to four single-ended channels. The module features voltage or current output, in different ranges.

The 12-bits DAC can operate in either unipolar or bipolar mode. In the bipolar mode the range of the output voltage is -5 to +5 volt. In unipolar mode, two ranges are available: 0 to +5V and 0 to +10V.

In current-mode, the voltage generated by the DAC is converted by a voltage-to-current converter (UIC). In this mode, two ranges are available: 0 to 20mA and 4 to 20mA. For every single channel, the current-mode supports an alarm option. The alarm warns of an open loop-circuit or noncompliance of the output stage by generating an interrupt request. The alarms can be masked per channel so only unmasked alarms will interrupt a process. It is also possible to enable or disable the alarm option by a jumper (also per channel).

Conversions start when the module is accessed. It is possible to update one, two or all four channels by one access.

The identification readout feature is implemented on the M325. For details on this please refer to chapter 3.6.

M325 features:

- 4 analog output channels
- 3 voltage ranges
- 4 0-20mA and 4-20mA current outputs
- alarms on noncompliance of the output stages
- identification EEPROM

3. Detailed Description

3.1. Block Diagram

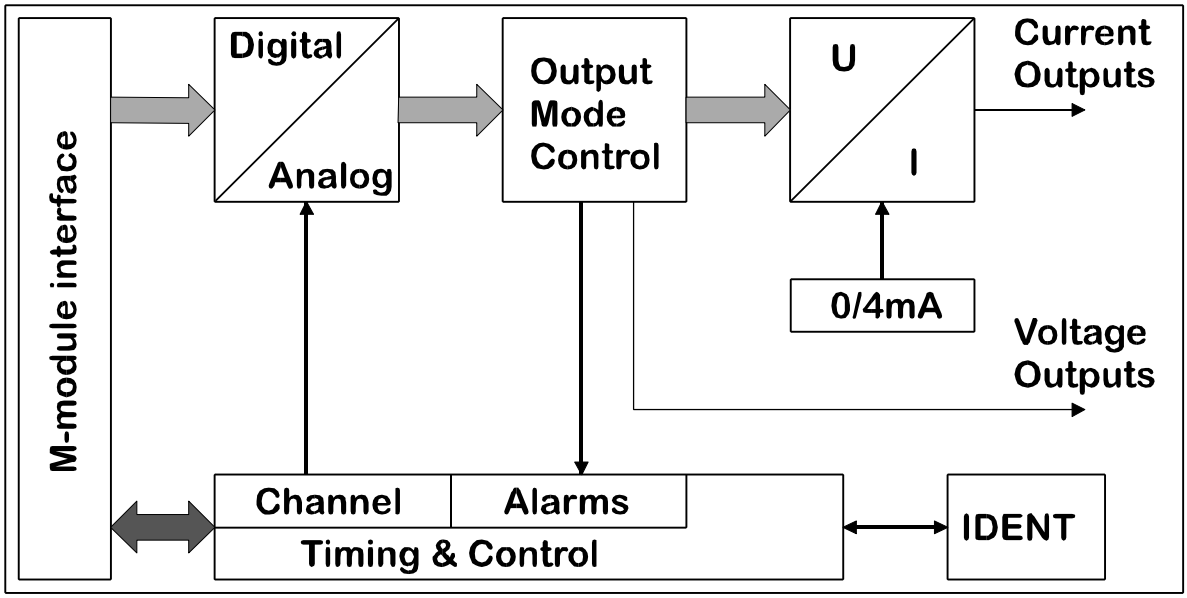


Figure 1 Blockdiagram M325 module.

3.2. M-module Interface

The databus is 16 bits wide and supports byte transfers from or to the VMEbus. The alarm status- and mask-register are byte-accessable.
Chip select signals, interrupt and signals needed for identification readout are derived from the M-module interface by PLD's. By writing words to the addresses shown in Table 1, the analog outputs are updated.

Offset	read	write
$00	-	Update DAC A
$02	-	Update DAC B
$04	-	Update DAC C
$06	-	Update DAC D
$08	-	Update DAC A+B
$0A	-	Update DAC C+D
$0C	-	Update DAC A+B+C+D
$0E	Alarms	Mask bits
$FF	ID EEPROM	IDEE EEPROM

Table 1: Register map M325 Word access

Offset	read	write
$0F	Alarms	Mask bits

Table 2 Register map M325 Byte access

Offset is the value which must be added to the (even) baseaddress of the module.

3.3. Data Register

The twelve most significant bits of the dataregister contains the conversion data. The four least significant bits are not used. Together they form a two bytes word.

For unipolar operation the data is in binary format. Some examples are given in table 3: code vs. output. In the 0 to 10 Volt mode, 1 LSB represents 2.44 mV. In unipolar mode, 1 LSB represents 1.22 mV.

E.g.

Module configured for unipolar mode, 0..+5V range.

When 2.5 Volt is needed, the data word written to the dataregister must be:

1000 0000 0000 0000 (2) = $8000

Note that table 3 does not include the 4 least significant bits.

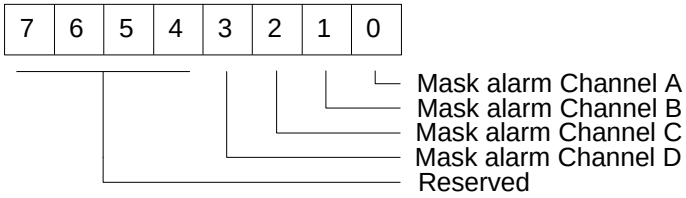
For the bipolar mode the data must be in 2's complement. In this case, code 1000 0000 0000 is equal to 0 Volt and 1 LSB is 2.44 mV.

The four least significant bits must be added to the code, forming a 2 bytes word. The value of these four unused bits is not important.

	Unipolar mode	Unipolar mode	Bipolar mode
MSB LSB	0..+5V range	0..+10V range	-5..+5V range
1111 1111 1111	5*(4095/4096)	10*(4095/4096)	5*(+2047/2048)
1111 1111 1110	5*(4094/4096)	10*(4094/4096)	5*(+2046/2048)
1000 0000 0001	5*(2049/4096)	10*(2049/4096)	5*(+1/2048)
1000 0000 0000	5*(2048/4096)	10*(2048/4096)	0
0111 1111 1111	5*(2047/4096)	10*(2047/4096)	5*(-1/2048)
0000 0000 0001	5*(1/4096)	10*(1/4096)	5*(-2047/2048)
0000 0000 0000	0	0	5*(-2048/2048)

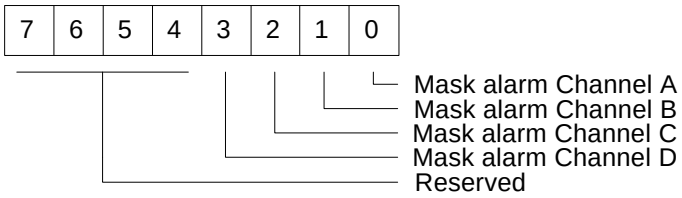
Table 3 Code vs. output

3.4. Alarm Status Register



This register contains the unmasked alarm status and is read only. An alarm warns of an open loop failure or non compiance of the output stage. Only when the corresponding mask bit in the Mask Register is set, an alarm will lead to an interrupt request.

3.5. Mask Register



Alarms from the four output stages can be masked by setting the corresponding bits in this register. When the bit is set, it will pass the alarm, resulting in an interrupt request. By power-up (reset) the mask register is automatically reset to $00; then alarms are not be passed.

3.6. Module Identification

The idea behind this feature is that a universal piece of software should be able to determine what module (and what revision etc.) is on a specific location. In order to do this an EEPROM type 93C06 (16x16 bits) is implemented.

The identification EEPROM contains the following information:

Word 0:	identification
Word 1:	module code
Word 2:	revision code
Word 3:	characteristics of the module
Word 4:	no intermodule port
Word 5..7:	reserved
Word 8..15:	manufacturer dependent information

The identification parameters can be read by a program called 'modident'. This program is supplied with the standard M325-driver software. For more details, please refer to the software documentation.

3.7. Output Considerations

Per channel are several configurations possible. The jumper-settings are described in chapter 4.
In **voltage mode** three ranges are selectable for each channel: 0..+5V, 0..+10V and -5..+5V. Alarms are only used in **current mode**. In this mode an external power supply is needed. Two ranges are selectable for each channel: 0..20mA and 4..20mA.

3.7.1. Voltage-mode Considerations

The output amplifier of the DAC is capable to of developing +10V across a 2kΩ resistor to GND resuling in a 5 mA load current. Do not exceed this value. Short-circuit current is typically 80mA. The outputs may be shorted to voltages in this range provided the power dissipation of the package is not exceeded.

3.7.2. Current-mode considerations

In current mode, be sure, the external power supply is connected correctly. Only the channel(s) operating in current-mode must be connected to the external powersupply. An example is given in the figure 4. The external power supply (VsX) should be in the range from 15 to 25V. The maximum load-impedance is related to the power supply:

$$R_{L\ (MAX)} = \frac{V_s - 2V}{20mA}$$

For example: if a 24V external power supply is connected to VsX, the maximum load R_L will be 1100 Ω. A correct combination of R_L and VsX is marked the graphic below.

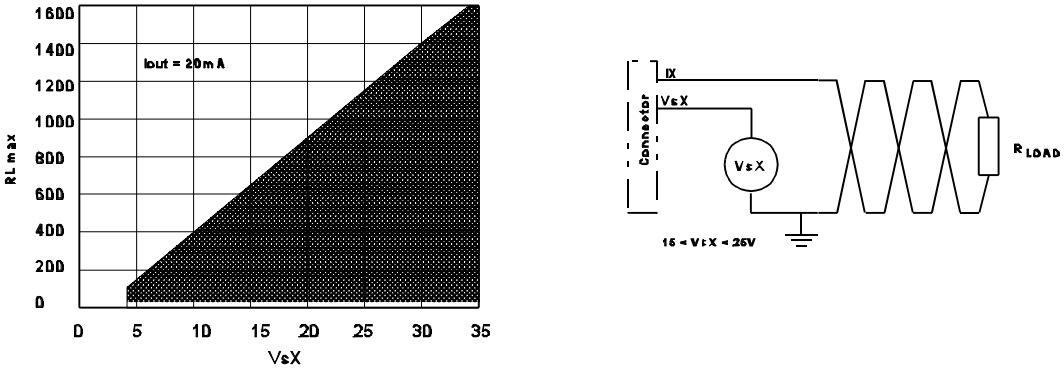


Figure 2 Connection external power supply.

3.8. Connector Lay-Out

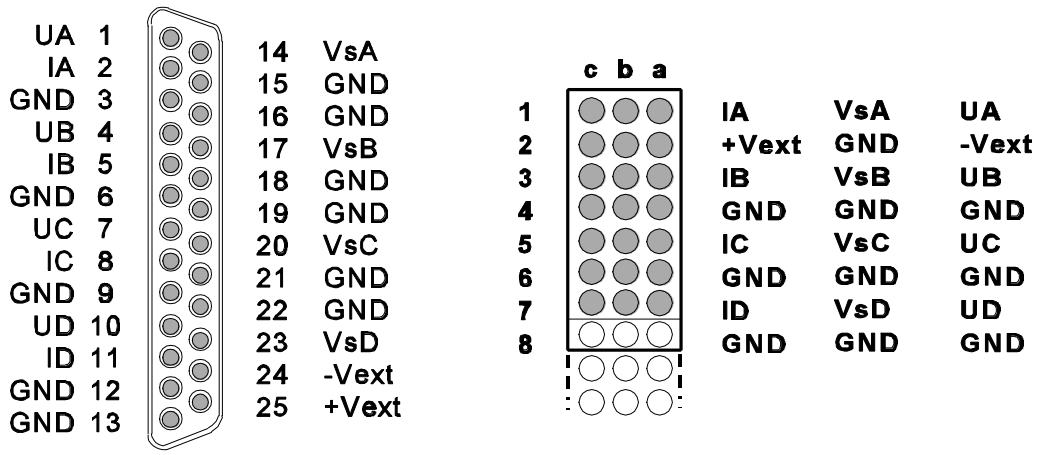


Figure 3 Connector lay-out M325 Analog Input Module.

4. Installation of the Module

4.1. Unpacking the Module

The M325 analog input module is shipped in an ESD protective container. Unpacking must take place in an ESD protected environment! Check the module for visual transportation damage.

4.2. Jumper Settings

To work properly, the M325 analog output module must be configured. The configuration of the hardware is controlled by placing and/or removing jumpers.

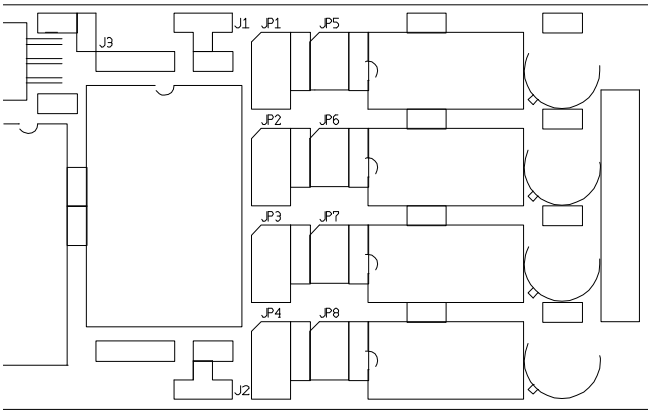


Figure 4 Jumpers JP1 to JP8.

Relation between channels and jumpers:

Channel A:	JP1 and JP5
Channel B:	JP2 and JP6
Channel C:	JP3 and JP7
Channel D:	JP4 and JP8

4.2.1. Voltage Mode

In the voltage mode, only the jumpers JP1 to JP4 are significant. All the channels may be configured differently. Figure 5 shows a configuration in which channel A is configurated for 0..+5V, channel B for 0..+10V and channel C for -5..+5V.

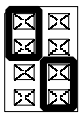
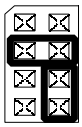
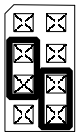
Voltage output range [JP1..JP4]		
0 to 5V	0 to 10V	-5 to +5V
		

Table 6 Voltage output configuration

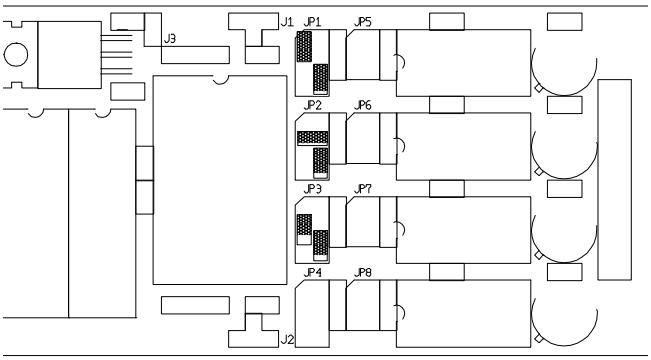


Figure 5 Jumpers JP1 to JP4.

Jumpers JP5..JP8 arenot used for this mode.

4.2.2. Current Mode

In current-mode all jumpers are significant. Use jumpers JP1 to JP4 (see figure 3) to select current-mode. In current-mode the alarm feature can optional be selected.
To select current-output range (0 to 20mA or 4 to 20mA) for channel A, B, C or D, configure jumpers JP5/JP9, JP6/JP10, JP7/JP11 and JP8/JP12. The configuration of the current range can also be made per channel.

Current-output [JP1..JP4]	
Alarm enabled	Alarm disabled

Table 7 Current-output configuration

Current-output range [JP5..JP8]	
0 to 20mA	4 to 20mA

Table 8 Current-output range configuration

In figure 6 the module has the following configuration:
Channel A 4..20mA, alarms enabled, Channel B 0..20mA, alarms enabled
Channel C 4..20mA, alarms disabled, Channel D 0..20mA, alarms disabled

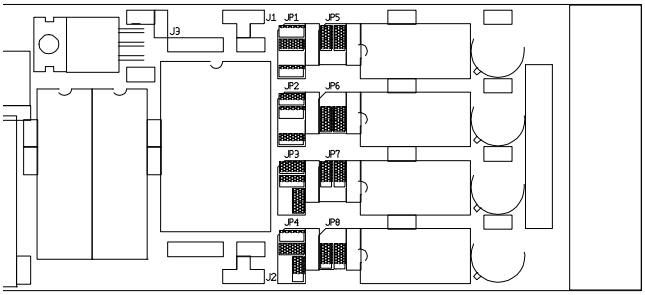


Figure 6 Jumpers JP1 to JP4.

4.2.3. Power Supply

There are three ways in which the two DAC's get their power. The first possibility is the DC/DC converter with which all ranges are supported. When the M325 is shipped without a DC/DC converter, an external power supply should be connected on ±Vx at the module front connector. +Vx is lead to a voltage regulator, decreasing it to +15V. Therefor +Vx should be at least 24V. -Vx can be connected to GND.
Another possibility is the ±12V from the M-module interface. Only the voltage ranges 0..5V and -5..5V are reliable.

Jumpers J1 and J2 set the source of the DAC's power.

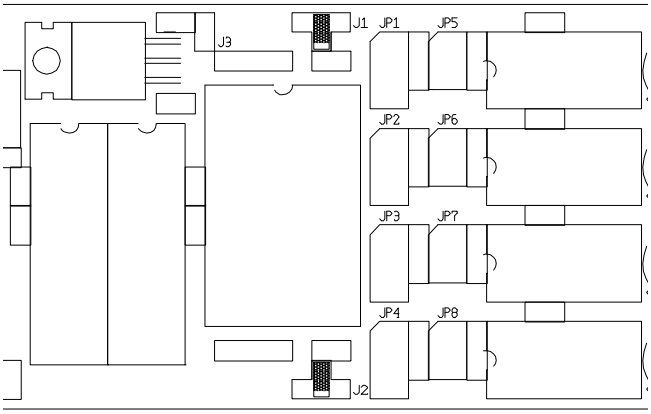


Figure 7 Power from DC/DC converter

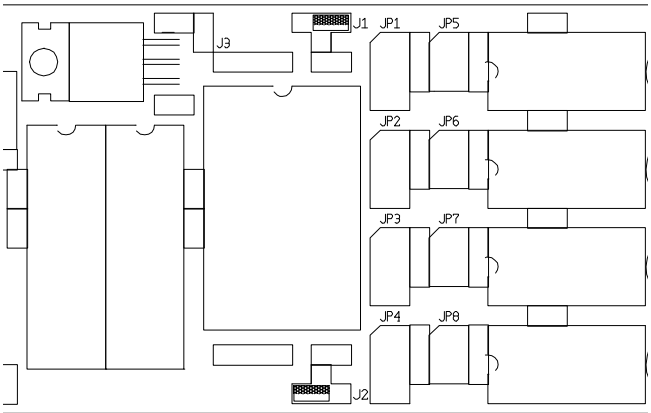


Figure 8 External power source

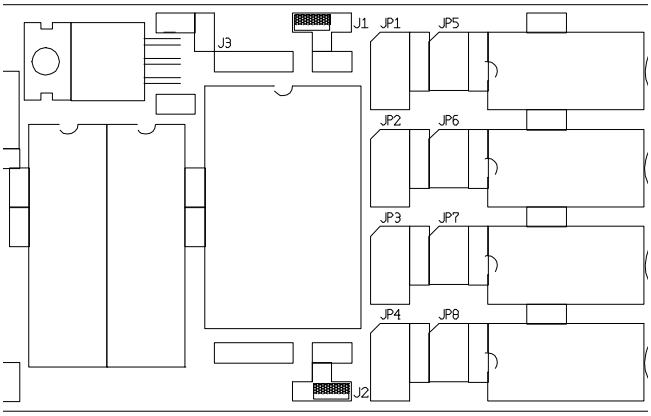


Figure 9 Power from VMEbus

4.3. Mounting the Module

CAUTION

Never attempt to install or remove any boards before turning off the power to the bus, and all related external power supplies.

Prior to installing a module, you should determine and verify all relevant jumper configuraions, and all connections to external devices or power supplies. (Please check the jumperconfiguration against the diagrams and lists in this manual).

To install a module, follows these steps:

- Make sure the module is configured properly.
- Mount the module on the M-module interface. Be careful not to misplace the module, because this can result in fatal hardware damage on the module, as on the base-board.
- Power up the system.
- Load an appropriate debugger and access the module. If a bus-error occurs, check the base-address of the M-module interface.
- To test all the functions implemented in the M325, standard software is shipped with the module. Please follow the instructions in the software manual to get this to work.

4.4. Caveats

The noise on the M325 output can be too high for some applications. It can be decreased by filtering the output with a capacitor. It must be placed parallel to the load. A value of about 4.7uF will filter most of the noise.

5. Annex

5.1. Bibliography

Specification for M-module interface and physical dimensions:
M-module specification manual, revision 2.2 by MUMM.

AD7247 *Dual D/A Converter:*
Data Conversion Reference Manual by Analog Devices. Page 2-347.

AD694 *4-20mA Transmitter:*
Linear Products Data Book by Analog Devices. Page 13-51.

5.2. Differences compared to former versions

Version 1 is the first release

5.3. Technical Data

Slots on the base-board:
Requires one 16-bit slot.

Interrupt:
Interrupt type A is supported; the interrupt will be released by software.

Connection:
To base-board via 40 pole M-module interface.
To peripheral on the front via 25 pole D-sub connector,
or via second VG-header.

Power supply:

+5VDC	±5%,	typical 400mA	(from VMEbus)
+12VDC	±5%,	typical 50mA	(from VMEbus)
-12VDC	±5%,	typical 50mA	(from VMEbus)

Temperature range:

Operating:	0..+60 °C
Storage:	-20..+70 °C

Humidity:
Class F, non-condensing.