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CM-DO-40 Board User's Manual

64 Channel Discrete
Output Module.

CM-DO-40

64 Channel Discrete Output Module

User's Manual

CM Computer
Updated Documentation

Ref : CM-DO-40 MAP/I
Version: 5.2
Board PCB: 1.0
Date : January 1999

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Chapter 1.- Introduction.

1.1.- Board Description.

The **CM-DO-40** is a 64 channel discrete output module. It is designed for 6U VMEbus applications.

This board is high performance slave unit fitted with low heat dissipation CMOS technology. As a direct result of its improved design and functionality it can be successfully used in many of today's engineering applications.

The **CM-DO-40** offers the user the following basic features:

a) Wide range of discrete output DC & AC voltages.

This module is provided with a complete and flexible output stage which can be configured on a per channel basis to support a wide range of output voltage levels up to 400 Volts and 1 Amp in either AC or DC.

The channel output stage is extremely versatile given that it can be factory fitted to support a choice of 11 different output device configurations. The module supports essentially all configurations and voltage ranges commonly required in the industrial and military fields. The available options are:

- 64 DPDT Relays. 32 SPDT 3-pin contacts plus 32 SPST 2-pin contacts. 300 $V_{AC/DC}$ @ 1 Amp.
- 64 Optocouplers with 50 V_{DC} @ 100 mA NPN phototransistors. Optional up to 300 V_{DC} & 150 mA.
- 64 PhotoMOS. AC/DC voltages up to 300 Volts @ 150 mA. Optional up to 600 mA @ 60V_{DC}.
- 64 Solid State Relays (SSR) rated for 10 to 280 V_{RMS} AC @ 1 Amp.
- 64 Open-Drain power MOSFET transistors up to 400 V_{DC} @1 Amp.
- 64 Triacs up to 400 V_{RMS} AC @ 1 Amp.
- 64 Thyristors up to 400 V_{RMS} @ 1 Amp.
- 64 totem-pole FAST standard TTL gates (direct and inverted output configurations).
- 64 open-collector TTL outputs up to 30 V_{DC} @ 50 mA (direct and inverted configurations).
- 64 open-collector TTL outputs with 1K pull-up resistors @ +5V_{DC} (direct & inverted configurations).
- 64 open-collector TTL outputs with 2K2 pull-up resistors @+12V_{DC} (direct & inverted configurations).

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f) 5 row VME64x DIN connectors on both Front Panel and P2.

The 64 output channels are wired through two new generation 160 pin VME64x DIN connectors located on the front panel and the VMEbus P2. These two connectors offer identical pin-outs. As a result, the user can exchange the application wires from P2 to the board front panel and vice versa.

g) Extremely simple programming.

Programming of the **CM-DO-40** board is very simple:

- The board implements a 64 bit write-only latch which stores the status of all output channels. This register latches VMEbus data during write cycles and directly drives the channel output devices. The user can program the "ON-OFF" status of the 64 output channels by writing four consecutive Words on the module. Each Word programs 16 output channels simultaneously (one bit per channel).

- The board also incorporates a Channel Status Register. This register is a 64 bit read-only latch which senses the output status of the 64 on-board channels. The Channel Status Register usually needs to be read only for Built-In-Test purposes.

h) Military and Industrial versions. Two mechanical formats.

The **CM-DO-40** is available in 3 different temperature ranges, all 100% compatible. Additionally the module PCB is manufactured in two different mechanical versions:

- **CM-DO-40/A:** Module designed according to the VMEbus IEC-297 Standard. This classic version is provided with a front panel. It simultaneously wires all discrete output signals through both the front panel connector and on the VMEbus P2.

- **CM-DO-40/B:** Module designed according to the Military VMEbus P1101.2 specification for Conduction Cooled Eurocards. This military version, intended for avionics-type ATR enclosures, is provided with wedge-locks. It has a dummy front panel with no I/O capability, therefore it can only wire its output signals through the 160 pin VME64x connector located on the VMEbus P2.

Both mechanical versions are available with conduction cooled PCB provided with thermal overlay.

All **CM Computer** products are originally designed for military environments and therefore accept full military grade components and implement conduction cooled PCB. Industrial versions are available at a lower cost since these are populated with industrial grade components.

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1.4.- CM-DO-40 Ordering Information.

This section describes the **CM-DO-40** standard configurations and options:

CM-DO-40 **/V** **/T** **/M**

Module Name

PCB Mechanical Version

A = IEC 297 Standard Mechanics with front panel. J2 and front panel I/O connectors.

B = IEEE P1101.2 Military Mechanics with wedgelocks and no front panel. J2 I/O connector.

Board Temperature Range

I = Industrial range (-20 to +70 ºC). Only available with fiberglass PCB.

R+ = Military Rugged+ range (-40 to +85 ºC). Only available with conduction cooled PCB.

883 = Military 883 range (-55 to +90ºC). Only available with conduction cooled PCB.

Board Version

1 = 64 Relays with 32 SPDT plus 32 SPST contacts.

2 = 64 Optocouplers with 50 VDC @ 100 mA open-collector phototransistors.

3 = 64 Photo-MOSFETs up to 400 Volts AC/DC @ 150 mA.

4 = 64 Solid State Relays (SSR) from 10 to 280 VAC @ 1 Amp.

5 = 64 Open-Drain power MOSFETs up to 400 VDC @ 1 Amp.

6 = 64 Triacs up to 400 VAC @ 1 Amp.

7 = 64 Thyristors (SCR) up to 400 VAC @ 1Amp.

8 = 64 Totem-pole FAST TTL outputs.

9 = 64 Open-Collector TTL gates up to 30 VDC @ 50 mA.

10 = 64 Open-Collector TTL gates with on-board 1K pull-up resistors to +5VDC.

11 = 64 Open-Collector TTL gates with on-board 2K2 pull-up resistors to +12VDC.

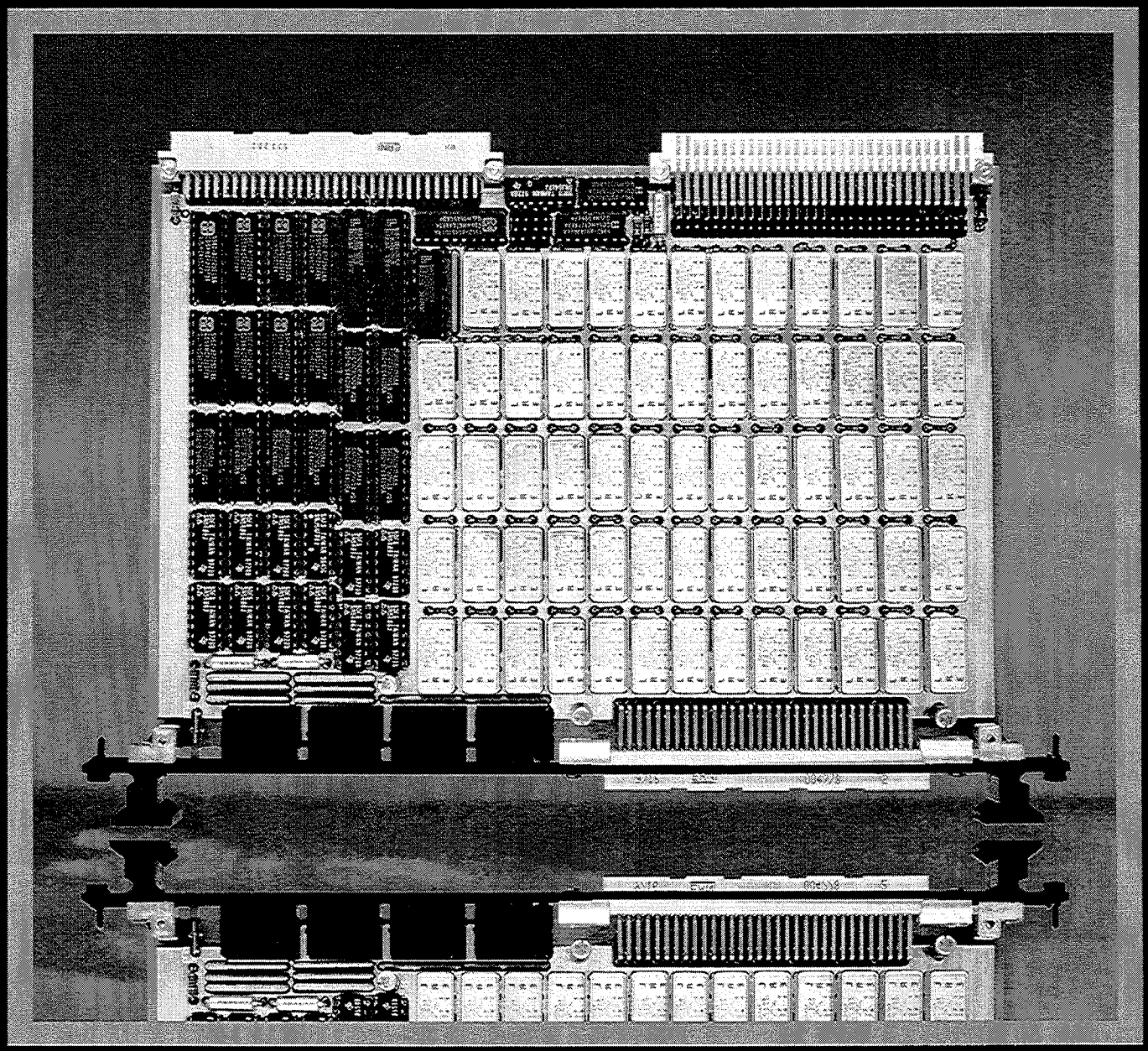
Note: Versions 8,9,10 & 11 are available with direct or inverted output polarity.

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Computer

6U VMEbus Series

CM-DO-40



64 Channel Discrete Output Module

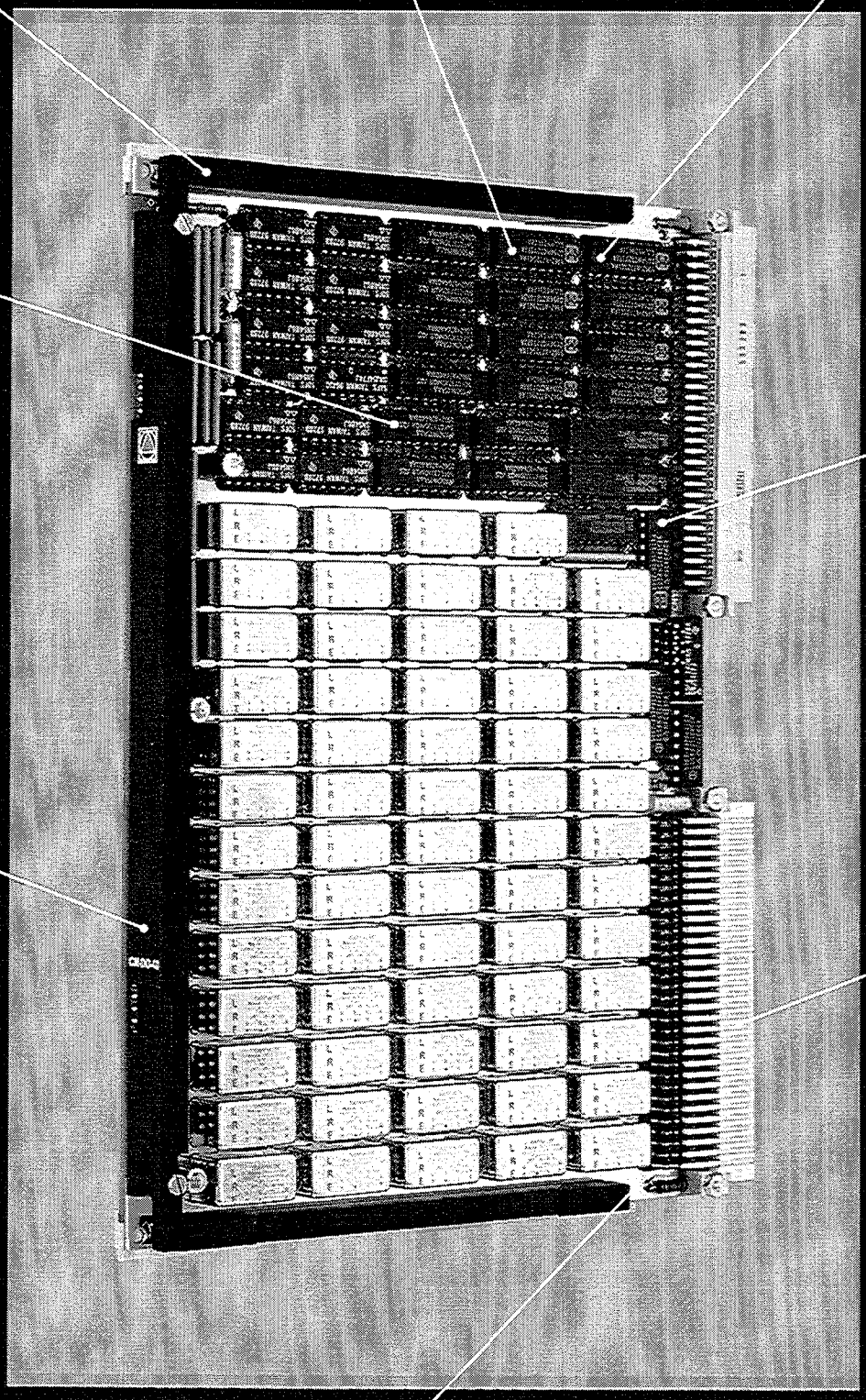
Industrial, MIL-Rugged & MIL-STD-883 Versions

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P1101.2 6U MECHANICS
fitted with wedge-locks for
insertion in ATR enclosures

LOW POWER CMOS IC's
improve power consumption
and increases module MTBF

QUALIFIED MIL-STD-883 ICs
in ceramic package and -55 to
+125 °C range



BUILT-IN-TEST
Registers allow testing
e module circuitry

THERMAL PASTE
behind ICs improves
heat dissipation with
the thermal overlay

FRONT PANEL with
xtraction handlers
nproves mechanical
performance

P2 CONNECTOR
wires all application
discrete output signals

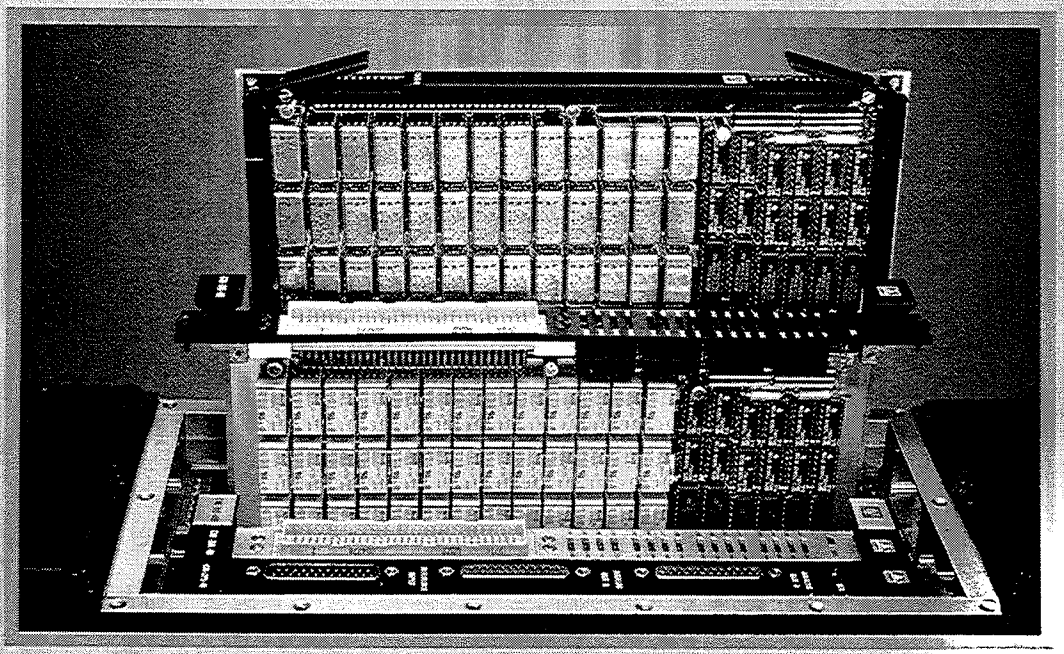
CONDUCTION COOLED
thermal overlay PCB

CM-DO-40/883/B MILITARY 883 VERSION

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FEATURES

- 64 discrete output channels per board.
- AC/DC output levels up to 400 V @ 1 Amp.
- Supports 11 different output devices: Relays, Optocouplers, Photo-MOS, SSRs, Power MOSFET, Triacs, Thyristors, TTL, etc.
- Four output device versions are galvanically isolated.
- Discrete output signals via 160 pin VME64x connectors on front panel and P2.
- 64 LED indicators on front panel show all output channels ON-OFF status.
- Low power CMOS design.
- On board Built-In-Test capability allows testing all the module TTL chips.
- Industrial, MIL-Rugged & MIL-883 versions.
- Available in IEC-297 mechanics with I/O via front panel and military P1101.2 mechanics with wedge-locks.
- Conduction cooled PCB with thermal overlay in MIL-Rugged and MIL-883 versions.
- Extensive software support.
- Extremely simple programming.
- Excellent price/performance ratio.
- Two year guarantee.



MILITARY DESIGN

- -55 to +125 °C ceramic military ICs.
- MIL-STD-883 TTL chips.
- MIL-C-55302 Class I Connectors.
- MIL-R-39016 Relays in MIL-883 version.
- No PCB tracks in external layers.
- MIL-E-5400 for avionics equipment class 1B (Temperature and Altitude).
- MIL-STD-810 D Temperature (Methods 501.2 & 502.2).
- MIL-STD-810 D Shock and Vibrations (Methods 514 & 516).
- MIL-STD-810 D Saline Fog and Dust (Methods 507 & 509).
- Military Class V Printed Circuit Board.

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Chapter 2.- General Considerations.

This section contains information concerning the terminology and conventions used in this manual, safety rules, complementary and recommended documentation as well as legal restrictions concerning the described product.

2.1.- Manual Terminology.

The terminology used in this manual is intended to be generally compatible with similar product manuals and common VMEbus literature terminology.

A signal is defined as "asserted" at logic '0' if the function associated with the signal line is valid or initiated by either a low level or falling edge on the signal line. The mnemonics of active low signals are marked with the suffix "*". For example, the BERR* signal is asserted (active or true) at logic '0' since when this signal is at '0' level it provokes a system Bus Error.

Most of the VMEbus signals are in asserted state when they are at logic '0' and this is noted by an asterisk. Those signals asserted at logic '1' are named without an asterisk. Note that a signal asserted at logic '0' is "negated" (inactive or false) at logic '1'.

IMPORTANT

The information in this manual has been carefully checked and supervised. However, no responsibilities are assumed for any inaccuracies that may be detected. **CM Computer** would appreciate any comments, suggestions or questions concerning this module and its manual.

2.2.- Other Documentation of Interest.

It is highly recommended that the user read all possible complementary information on the VMEbus specifications. The following manual is recommended:

- **" The VMEbus Specification Rev C & D ".** Edited by the VMEbus International Trade Association.

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2.5.- Guarantee.

All the VMEbus modules manufactured by **CM Computer** include a 2 year guarantee that covers free replacement in case of malfunction or design failure.

Guarantee does not cover failures provoked by boards incorrectly used, short circuits, overloading, or any operational conditions exceeding the limits specified in the present manual.

If you come across any problems or have any questions using this product please contact your authorized distributor.

To preserve all rights included in this guarantee, general recommendations, specifications and operating procedures described in the present manual must be followed.

2.6.- Safety Rules.

This VMEbus module can be implemented in many different projects and applications. The following recommendations and safety precautions are of vital importance for all users and system integrators.

IMPORTANT

This module implements integrated circuits sensitive to electrostatic discharges. The user should avoid touching the module with his hands and should observe the basic precautions when dealing with this kind of technology.

The user must avoid touching or removing the module from the backplane while functioning. Do not replace components with the power cable connected. Do not touch the output channel signals.

IMPORTANT

This module can provoke extremely dangerous electrical discharges. To minimize shock hazard it is the user's responsibility to create a safe working environment, avoiding all types of risks to human life and to the equipment. The cabinet, rack, chassis and other metallic parts involved in any application must be safety grounded.

IMPORTANT

This module radiates electromagnetic energy and if not installed and used properly, may occasionally cause interference to radio communications. The amount of energy radiated is in compliance with FCC rules class A 15J electronic equipment. If the use or application of this equipment causes any interference all necessary measures required to correct it must be supplied by the user.

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Chapter 3.- Functional Description.

This chapter describes the submodules and functional blocks that comprise the **CM-DO-40** board. The objective is to introduce and familiarize the user with the board contents and technical features. More detailed information on each functional block can be found in later chapters of this manual.

3.1.- Functional Blocks.

- Output channels.

The **CM-DO-40** board implements 64 independent output channels, each one incorporating an universal output stage capable of accepting one of 11 different discrete devices.

- Flexible output voltage range.

This board can be easily adapted to manage a wide range of DC and AC output voltages. The customization of the board to any desired output range (within the options specified in this manual) is performed by **CM Computer** during the manufacturing process. Customization requires factory fitting of the proper output device per channel (i.e. relay, optocoupler, TTL buffer, etc.)

- Galvanic isolation.

Four **CM-DO-40** options provide galvanically isolated outputs. These are the Relay, Optocoupler, Photo-MOS and Solid State Relay versions. With these options each channel is a floating output galvanically isolated from the VMEbus signals and power lines. All output voltages also remain floating with respect to the other channels. The isolation barrier is better than 1000V in continuous DC mode and up to 1500V peak.

The isolation barrier provides full protection to those loads connected to different voltage sources or wired to different grounds, etc. It also protects the VMEbus equipment against output overloadings, manipulation errors, etc.

Non isolated versions of the **CM-DO-40** are fitted with direct output stages which manage output voltages referenced to the VMEbus power supply ground (GND). Typical examples of direct, non-isolated output version are TTLs , power MOSFETs, open collectors, Triacs, etc.

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- VMEbus RESET monitoring.

The **CM-DO-40** monitors the VMEbus backplane SYSRES* signal. The Channel Control Register latch is reset to logic '0' when this signal is asserted on the bus. Therefore all output channels are cleared to "OFF" status after reset.

- Front panel LED indicators.

There are 64 red LED indicators implemented on the board's front panel. These LEDs monitor the status of all output channels (channel 1 thru 64). A LED is illuminated if its associated channel is driven to "ON" status. In the case of "OFF" status, the channel's LED is not illuminated.

A LED labeled "SEL" indicates master accesses to the board (board SELected). It is a green LED driven by the Location Monitor which is illuminated when the master accesses the **CM-DO-40** module.

- 160 pin Front panel application connector.

The **CM-DO-40** board implements a 160 pin VME 64x standard DIN connector on its front panel. This 5 row connector provides the 160 output pins needed to wire the board to the external application. The front panel connector is only available on the **CM-DO-40/A** mechanical version.

- 160 pin VMEbus P2 application connector.

All output signals available at the module front panel are simultaneously wired to the 160 pin VME64x DIN connector located at the VMEbus P2.

The use of the P2 connector is optional in row b, since a block of jumpers allow connection or removal of the 32 I/O signals assigned to this row. This set of jumpers is useful when the extended VMEbus data-address signals are present at P2. In this case the jumpers allow isolation of the **CM-DO-40** outputs with respect to the VMEbus P2 address and data TTL signals. Additional PCB micro-jumpers allow isolating output signals to-from a selected set of P2 pins at rows z and d.

OBSERVATION

Only the **CM-DO-40/1** relay version uses the row b of P2 connector.

P2 is available in all mechanical versions. It is mandatory for I/O purposes in the wedge-lock version.

- CM-DO-40 PCB jumpers.

The on-board PCB jumpers perform two main functions:

Two jumper blocks allow mapping of the **CM-DO-40** module within the VMEbus A24/D16 address range. Each **CM-DO-40** module takes up one 8 Byte block (4 Words).

A large block of 32 jumpers allow connection or removal of specified output signals to/from the VMEbus P2 application connector.

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- Open drain power MOSFET version (CM-DO-40/5).

The **CM-DO-40/5** incorporates 64 open-drain power MOSFET transistors. This non isolated device is supplied without pull-up resistors. Each MOSFET requires two pins per channel in the application connector (Source and Drain). The Source terminals are connected to the VMEbus ground.

The installed power MOSFETs are rated for 400 V_{DC} maximum of V_{DS} and 1 Amp of I_D current. This **CM-DO-40** version is well suited for driving DC loads which will require high voltage operation, DC current up to 1 Amp, fast switching response or a long life medium power solid state device.

- Triac version (CM-DO-40/6).

The **CM-DO-40/6** incorporates 64 Triacs. This device is intended for driving industrial type AC loads up to 400 V_{AC} @ 1 Amp. Each Triac offers a 2 pin switching circuit in the application connector. One of the Triac power terminals is connected, on all channels, to the VMEbus ground.

Triacs are suited for inductive or difficult to drive AC loads such as heaters, electric motors, etc.

This is a non-isolated version and therefore special caution must be observed in the application to avoid damage to the board circuitry. In particular, the VMEbus power supply mains AC should not be connected to external loads. Additionally, this version is not recommended for those applications using AC generators which are not isolated with regard the VMEbus ground, or when different loads are powered with not-isolated AC generators, etc.

- Thyristor version (CM-DO-40/7).

The **CM-DO-40/7** incorporates 64 Thyristors (SCRs). This P-gate non-isolated device is intended for rectifying AC voltages up to 400 V_{AC} @ 1 Amp. Each Thyristor uses two load pins in the application connector.

The Thyristor version can be used to rectify and regulate inductive or difficult loads (i.e. heaters, electric motors, battery charges, power supplies, etc).

Due to being a non-isolated device, one of the Thyristors power terminals is connected on all channels to the VMEbus ground. This is required for triggering the device.

Special caution must be observed in the application to avoid damage to the board circuitry. This version is not recommended for those applications using AC generators which are not isolated with regard the VMEbus ground, or when different loads are powered with not-isolated AC generators, etc.

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3.3.- CM-DO-40 Block Diagram.

Figure 3.1 illustrates the **CM-DO-40** block diagram.

This output module is easy to use in real time applications. ***Figure 3.1*** shows how the **CM-DO-40** board implements 64 identical output stages. Each output stage can be populated with the desired output device according the customer selected version.

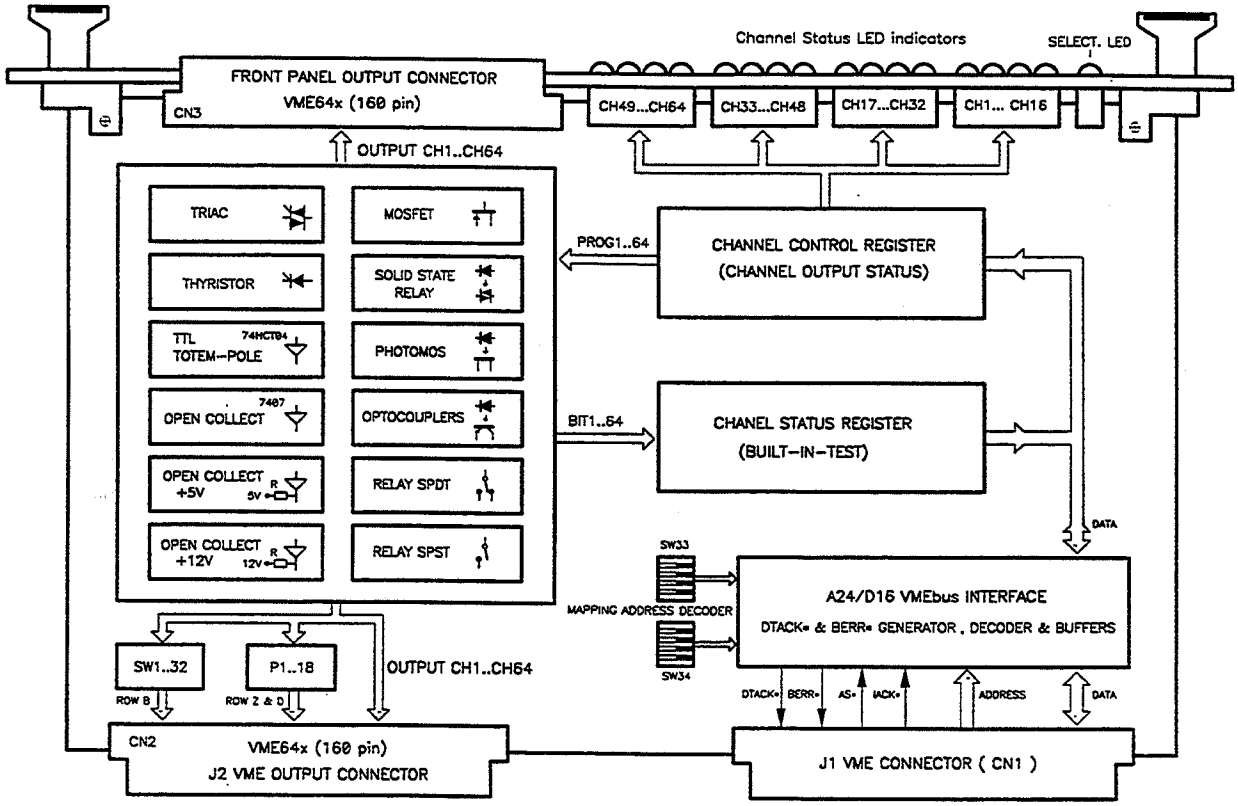


Figure 3.1.- CM-DO-40 general block diagram.

Other functional units are the VMEbus interface, Address Decoder, DTACK* and BERR* generators, Channel Control Register, Channel Status Register, Front Panel LEDs, etc. Each one of these blocks will be extensively explained in the following chapters.

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Chapter 4.- Technical Specifications.

This chapter defines the mechanical, electrical and functional specifications of the **CM-DO-40** board. Additionally, complementary sections are dedicated to explanation of temperature versions, jumper configuration, application connectors pin-out, etc.

4.1.- Mechanical Specifications.

The **CM-DO-40** is fully compliant with standard, double height, Euroboard size (233x160 mm).

Figure 4.1 shows the **CM-DO-40/A** silk screen and component layout. The external dimensions and tolerances are fully compatible with the VMEbus specs. IEC-297 and IEC-603.

Figure 4.2 details the **CM-DO-40/A** front panel, offering a description of the panel's mechanical dimensions and drill holes. This module front panel, when inserted in a 19" rack, occupies one slot size (4 hp).

Figure 4.3 shows the **CM-DO-40/B** board silk screen and component layout. ***Figure 4.4*** shows the **CM-D0-40/B** front panel. This version has no I/O signals through its front panel and is provided with wedge-locks for insertion in a military avionics-type enclosure. The mechanical dimensions and wedge-lock location of the **CM-DO-40/B** is compatible with the VMEbus P1101.2 Conduction Cooling for Eurocards specification.

OBSERVATION

All module versions incorporate a P1 96 pin DIN 41612 connector, intended for connection to any standard VMEbus J1 backplane on the market.

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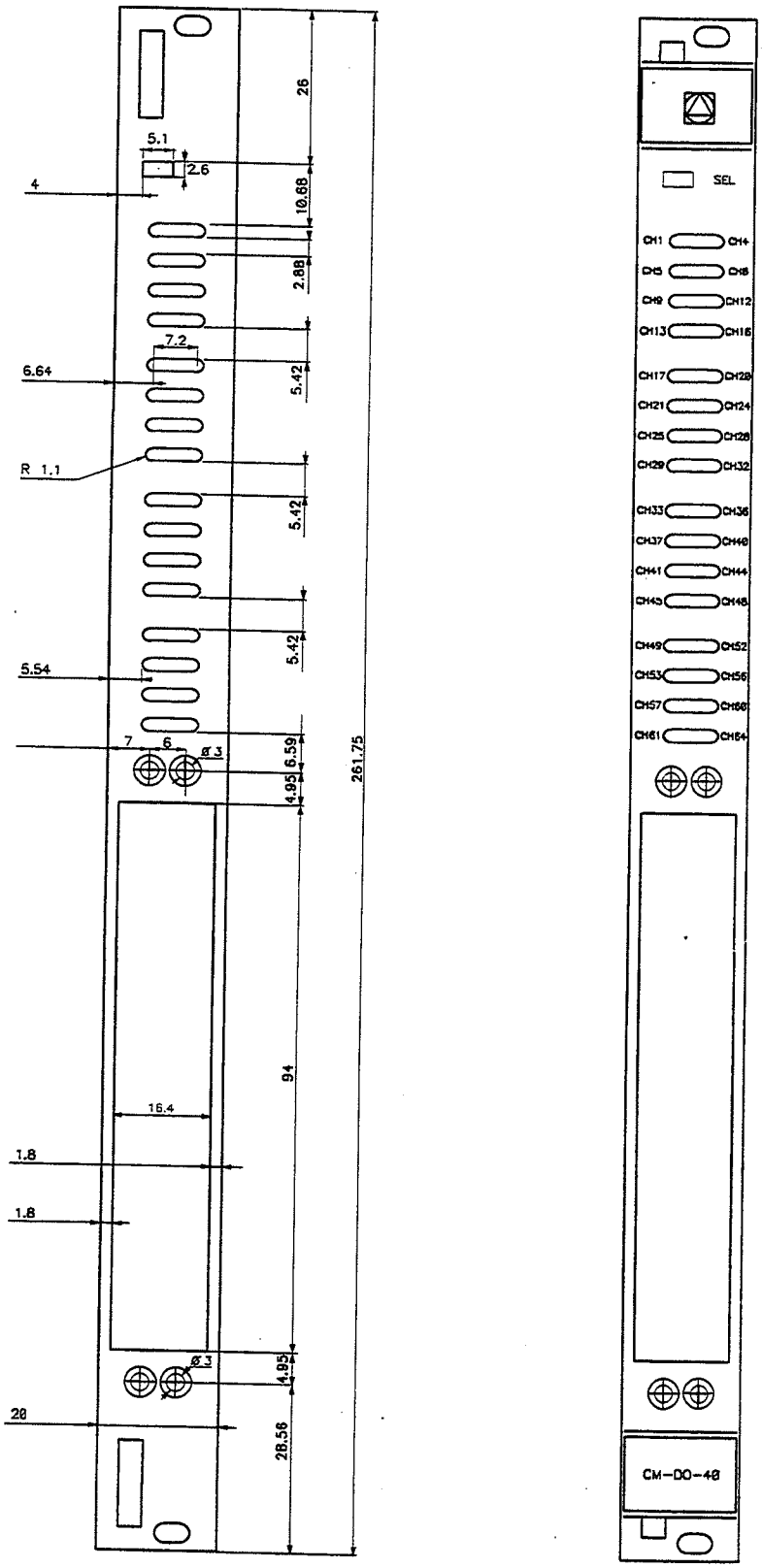


Figure 4.2.- CM-DO-40/A front panel.

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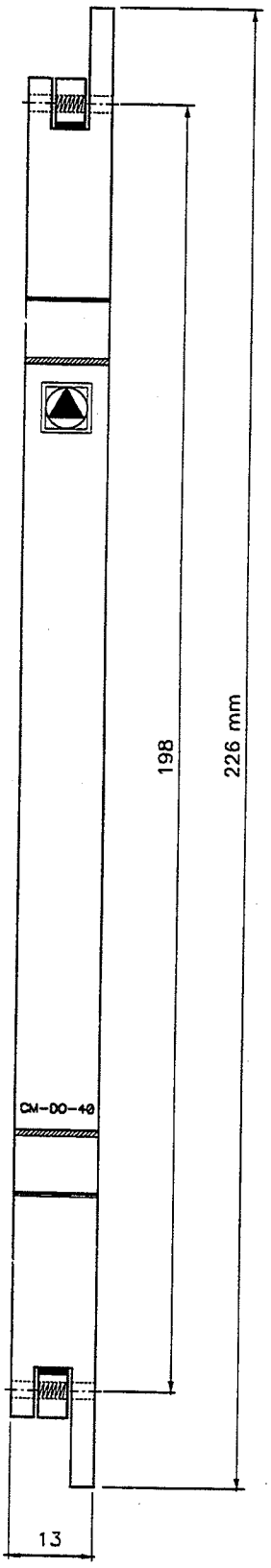


Figure 4.4.- CM-DO-40/B front panel.

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4.3.- General Electrical Specifications.

The **CM-DO-40** board incorporates the most advanced technology by using low power & high speed HCT, ACT and FCT CMOS chips, featuring an operation speed up to 120 MHz. It implements glue logic integration by using 15 nsec CMOS GALs.

Since this board is a TTL digital unit, the main power supply voltage is +5 V_{CC}. Several output options such as relays, MOS-FETs etc. need the auxiliary +12 V_{DC} power supply voltage.

The **CM-DO-40** is a low heat product. When all output devices are switched-off the power consumption is only about 2 Watts. All required supply voltages are available in any standard J1 VMEbus backplane, and are applied to the board through the P1 DIN 41612 connector.

The module maximum power consumption is a function of the selected output device. Therefore this information is provided in detail in those chapters dedicated to each output version.

IMPORTANT

Operation exceeding the maximum specified supply voltage in this manual may cause permanent damage to the module circuitry, which is not covered by the guarantee.

4.4.- Temperature Ranges.

The **CM-DO-40/A & CM-DO-40/B** boards have been designed to operate in 3 different temperature ranges: Industrial, Militarized-Rugged and full Military-883. All temperature range modules are 100% compatible at the functional and programming levels meaning that all software developed for any board range will run on the others.

IMPORTANT

Commercial versions of this module (**CM-DO-40 C**) are not available. **CM-DO-40 I** Industrial versions are supplied instead of Commercial versions due their higher performance and minimal cost difference.

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IMPORTANT

CM Computer recommends that the module not be operated during extended periods of time near the maximum specified temperature limits since this will result in premature degradation of components and a reduction in the useful life of the board circuitry.

In those projects in which the environmental conditions are very severe or when the module is frequently required for operation near the maximum temperature limits, the purchase of a superior temperature range module (i.e. Military-Rugged rather than Industrial) is recommended.

OBSERVATION

Since all temperature versions are software compatible, when developing military projects it is possible to use a low cost Industrial **CM-DO-40 I** for prototypes or software development and implement the **CM-DO-40 R+** or **CM-DO-40 883** in the final application.

OBSERVATION

Certain reliability considerations should be kept in mind for the on-board jumper blocks which will be customized by the user. In those modules destined for military applications the original plastic jumpers supplied with the board should be removed and the pins bound with wire wrapped cable or by soldering.

4.5.- CM-DO-40 Output Stage Configurations.

The **CM-DO-40** module is provided with a complete and flexible output stage per channel which can be configured to supply a wide range of output voltage levels.

IMPORTANT

The user must specify the output type when ordering any **CM-DO-40** module. The **CM-DO-40** output stage components are selected, dimensioned, and factory fitted according to the ordered output type. The customer must carefully study the different options supported by the board prior ordering the type of output required by the application.

OBSERVATION

If your application requires an output configuration similar to a standard option, but different of those listed in this manual, please contact CM or your authorized CM distributor.

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- Select isolated devices for driving AC loads.

CM Computer always recommends the use of galvanically isolated AC devices such as Relays, Solid State Relays, Optocouplers or Photo-MOS, due their extremely high reliability and low risk for the VMEbus system components.

The **CM-DO-40/6** and **CM-DO-40/7** can install Thyristors and Triacs which are frequently used for driving AC loads. These non-isolated devices, although fully supported by this board, are not usually recommended for many applications due to the high risk they represent to the module circuitry.

4.7.- Output Device Limits. Recommendations.

It is highly recommended that output voltages and current consumption of each **CM-DO-40** output channel be measured once the module is wired to the voltage sources in the customer application.

An output voltage or current consumption equal to or higher than the maximum specified for the output device overloads the channel and therefore may damage the module.

Another important recommendation is to switch-off main power, remove the module from the backplane, and check component temperature after applying the nominal output voltage for ten minutes.

Revise and ensure that the wiring and welding of the application connectors are correct. This cautionary rule allows detection of possible shortcircuits between output signals or wiring mistakes that may damage the **CM-DO-40** connector pins or its output stage components.

IMPORTANT

The lack of observance of the above rules and notes of caution may result in damage to the **CM-DO-40** board. Damage caused in this manner is not covered by the guarantee.

4.8.- Calibration.

The **CM-DO-40** module does not need to be adjusted. The user need only configure the VMEbus mapping address jumper blocks and optionally the J2 connector jumpers.

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c) VME64x P2 output signal wiring. SMD Jumpers P1 to P18.

The block of SMD microjumpers P1 to P18 allow connection or removal of **CM-DO-40/1** output signal to 18 non-free pins of rows d & z of the P2 VME64x connector. Due to the lack of space in the board, these microjumpers are installed in the PCB soldering side. The microjumpers P1 to P18 are supplied soldered from factory (ON). To open these microjumpers (OFF), it is necessary to disolder the jumper welded bridge. Opening these jumpers may be required when the module is inserted in a VME64 J1 + J2 standard backplane. These microjumpers will not affect when inserting the module in a backplane fitted with 3 row DIN-41612 P2 connectors (96 pin). This set of microjumpers is labeled as follows:

PIN	Row z	Row d
2	OUT 34 (P1 ON)	
4	OUT 36 (P2 ON)	
6	OUT 38 (P3 ON)	
8	OUT 40 (P4 ON)	
10	OUT 42 (P5 ON)	
12	OUT 44 (P6 ON)	
14	OUT 46 (P7 ON)	
16	OUT 48 (P8 ON)	
18	OUT 50 (P9 ON)	
20	OUT 52 (P10 ON)	
22	OUT 54 (P11 ON)	
24	OUT 56 (P12 ON)	
26	OUT 58 (P13 ON)	
28	OUT 60 (P14 ON)	
30	OUT 62 (P15 ON)	
31		COM63 (P17 ON)
32	OUT 64 (P16 ON)	COM64 (P18 ON)

- When all of these jumpers are disoldered, the VMEbus P2 rows d and z specified terminals are fully isolated with respect to the **CM-DO-40** internal circuitry.
- When all of these jumpers are soldered (factory default), the specified application outputs connected to rows d and z pins of P2 are wired to the **CM-DO-40.**

IMPORTANT

Notice that the set of P2 microjumpers are intended for isolating the **CM-DO-40** output signals with respect to P2 rows "z" and "d" (conflict signals assigned to VCC or GND in the VME64 specs).

- Remove all type of P2 jumpers in those applications using input signals only through the front panel.
- Remove all type of P2 jumpers when the module operates in a J1+J2 VME64 backplane.

IMPORTANT

The user must be careful when changing the **CM-DO-40** board jumper configuration. Before changing any jumper the user should study each associated section in this manual in order to be sure of its function within the module. If an incorrect configuration is performed the board may not work properly.

It is also recommended that a copy of the original factory default jumper configuration be made before making any changes.

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4.10.- Application Connector Information.

The **CM-DO-40** module offers very flexible I/O signal wiring since it incorporates a single type of application connector. All I/O signals are available both on the front panel and on P2.

The board can implement one or two 5 row VME64x connectors depending on the mechanical version.

The connectors soldered on the **CM-DO-40** board are the models manufactured by ERNI for the front panel, and the model manufactured by HARTING GERMANY for P2 of the VMEbus. Both connectors are 5 row, male, 160 contact, angled solder pins for PCB mounting with row separation of 2.54 mm.

- The front panel connector is Type E 160 compatible. This connector class II reference is ERNI P/N=004778. The same connector in Class I is ERNI P/N=004777.
- The VMEbus P2 connector is Type C compatible. This connector class II reference is HARTING P/N=02011602101. The same connector in Class I is HARTING P/N=02011601101.

OBSERVATION

Both connectors installed on the **CM-DO-40** are standard, and therefore the female model needed for wiring the application signals can be found by the user in several vendor catalogues. For example, the Harting female unit for VMEbus backplane is: P/N=02021602301, and the ERNI female unit for crimp snap-in is: P/N=024070.

Figure 4.6 show the two **CM-DI-42** PCB connectors datasheet. ***Figure 4.7*** focus on the front panel connector wiring. Two mating part options are shown: With or without cable housing. The adaptor part accessory needed for fitting the cable housing on the front panel is supplied by CM with the module.

Figure 4.8 shows the "application-board-backplane-application" connector arrangement. This figure illustrates the I/O signal compatibility between the front panel and P2 connectors. ***Figure 4.8*** must be carefully studied by the user before purchasing the connectors and wiring signals to the application.

Both the front panel and J2 application connector pin-out are detailed in those chapters dedicated to each specific board version.

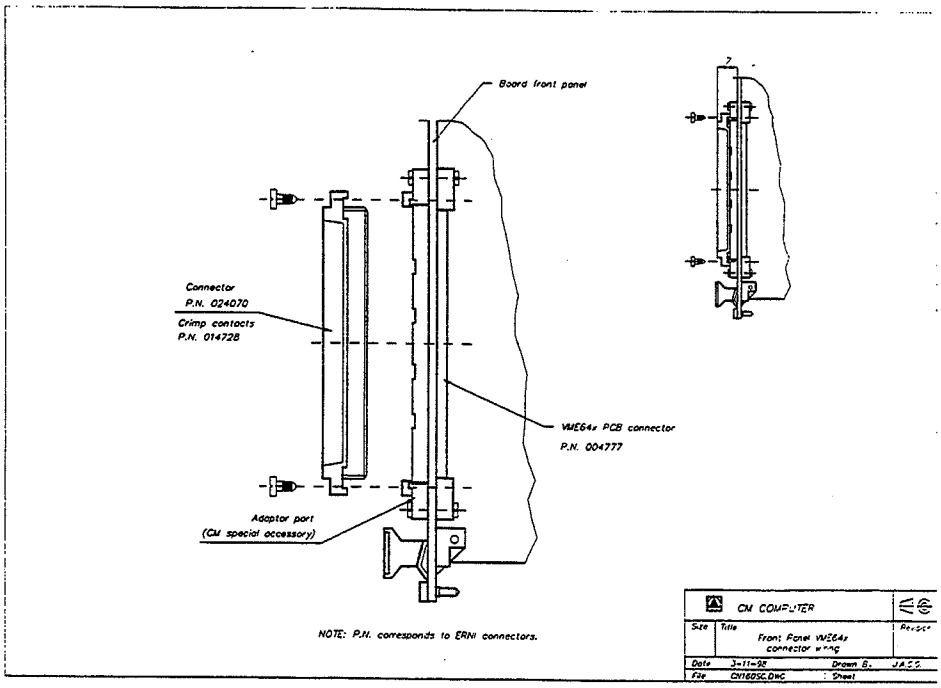
OBSERVATION

Notice that the P2 connector is intended to be inserted in a VME 64x backplane which serves as mid plane or transition card. On the rear side of the backplane, the user must install a rear I/O shroud which makes the connection compatible with the **CM-DO-40** front panel connector. Therefore a single user application connector type ERNI P/N=024070 is externally required in order to wire all input signals. This user connector can be inserted on either the front panel or on P2.

OBSERVATION

Those customers using the **CM-DO-30** must fit new connectors and signal wiring when replacing this board by the new **CM-DO-40**. The VME 64x connectors are not compatible with the **CM-DO-30**.

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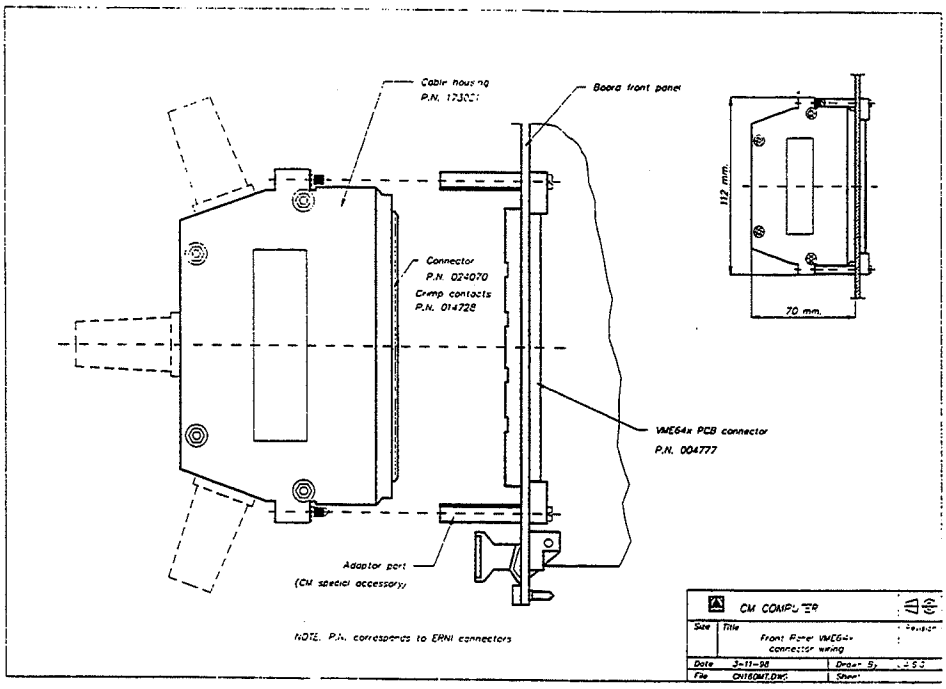


Figure 4.7.- Front panel mating connector options.

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4.11.- Technical Characteristics Summary.

SPECIFICATIONS		BOARD RANGE			
		COMMERCIAL	INDUSTRIAL	MIL-RUGGED +	MIL-883
Weight		N/A	Relays: 690 gr Other: 530 gr	Relays: 800 gr Other: 620 gr	Relays: 1020 gr Other: 650 gr
Physical Dimensions	*Height*	N/A	233.4 mm	233.4 mm	233.4 mm
	Depth	N/A	160 mm	160 mm	160 mm
	Thickness	N/A	15.0 mm	15.0 mm	15.0 mm
Temperature Methods 501&502	*Operating*	N/A	-20ºC to +70ºC	-40ºC to +85ºC	-55ºC to +90ºC
	Storage	N/A	-50ºC to +90ºC	-55ºC to +125ºC	-55ºC to +125ºC
Power Consumption (all channels OFF)		N/A	2 Watts	2 Watts	2 Watts
Vibration Method 514	*Sine*	N/A	2g from 5 to 2,000Hz	5g from 5 to 2,000Hz	5g from 5 to 2,000Hz
	Random	N/A	0,002 g^2/Hz from 10 to 2,000Hz	0,1 g^2/Hz from 10 to 2,000Hz	0,1 g^2/Hz from 10 to 2,000Hz
Shock Method 516		N/A	20g peak sawtooth 11 ms	40g peak sawtooth 11 ms	40g peak sawtooth 11 ms
Altitude Method 500		N/A	50,000 ft	50,000 ft	50,000 ft
Humidity Method 507	*Operating*	N/A	0 to 95% non-condensing	0 to 95% non-condensing	0 to 95% non-condensing
	Non-Operating	N/A	0 to 100% condensing	0 to 100% condensing	0 to 100% condensing
Acceleration Method 513		N/A	Up to 10g	Up to 15g	Up to 15g
Salt Fog Method 509		N/A	5% ClNa, 48 hours	5% ClNa, 48 hours	5% ClNa, 48 hours
IC Package		N/A	Plastic	Ceramic	Ceramic
IC Temperature		N/A	-25ºC to +85ºC -40ºC to +85ºC	-55ºC to +125ºC	-55ºC to +125ºC
IC Screening		N/A	N/A	883 in some parts	MIL-STD 883
Conduction Cooled PCB		N/A	N/A	YES	YES
Air Flow (max. Tª)		N/A	100 ft/min	150 ft/min	150 ft/min
Board MTBF (25 ºC) (Optocouplers)		N/A	160,000 Hours	220,000 Hours	240,000 Hours
Other		MIL-883 & MIL-Rugged+ boards are in compliance with MIL-STD-810E.			

Figure 4.9.- CM-DO-40 Technical Specification Summary.

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Chapter 5.- Programming the CM-DO-40.

5.1.- Programming the Output Channels.

Once the board address in the VMEbus address range has been selected by configuring SW33 & SW34 (see details in chapter 6), each module occupies 4 consecutive Word memory positions (8 bytes) as is shown in ***Figure 5.1.***

The data written by the master is stored in the Channel Control Register (CCR). This 64 bit latch can be accessed by the VMEbus master at any time to program the current output channel state. The CCR bits are properly buffered prior to driving the installed output devices (relays, optocouplers, TTL drivers, etc).

The **CM-DO-40** associates one bit of information per output channel. In other words, each bit of the 64 bits occupied by the board is assigned to one of the 64 output channels.

- To program a channel to the "OFF" status, its associated bit must be written with a logic '0'.
- To program a channel to the "ON" status, its associated bit must be written with a logic '1'.

OBSERVATION

The above channel programming polarity is valid for direct output polarity boards. This is the standard case.

Module versions /8, /9, /10 & /11 are optionally available with inverted output polarity. These modules require writing a logic '0' to program a channel to the "ON" state and writing a logic '1' for the "OFF" state.

OBSERVATION

Each Word written by the master to the **CM-DO-40** module programs the state of 16 channels simultaneously.

OBSERVATION

When multiple **CM-DO-40** modules are inserted in a backplane these can be mapped to consecutive addresses via SW34, stacking all system available channels in memory one after the other.

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Table 5.3 shows channel allocation in the CSR as a function of the read Word and the VMEbus D00-D15 lines.

MSB	CSR Channels versus VMEbus D00-D15 data lines														LSB	Word
D15	D14	D13	D12	D11	D10	D09	D08	D07	D06	D05	D04	D03	D02	D01	D00	
CH16	CH15	CH14	CH13	CH12	CH11	CH10	CH9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	Word 0
CH32	CH31	CH30	CH29	CH28	CH27	CH26	CH25	CH24	CH23	CH22	CH21	CH20	CH19	CH18	CH17	Word 1
CH48	CH47	CH46	CH45	CH44	CH43	CH42	CH41	CH40	CH39	CH38	CH37	CH36	CH35	CH34	CH33	Word 2
CH64	CH63	CH62	CH61	CH60	CH59	CH58	CH57	CH56	CH55	CH54	CH53	CH52	CH51	CH50	CH49	Word 3

Table 5.3.- CSR channels versus VMEbus D00-D15 lines.

This board has been designed with channel coherency. This means that the same bit used to program a channel through the CCR is used to interrogate its status through the CSR. Additionally, there is coherency in the channel logic level, so that those channels programmed with a logic "0" will be read back as logic "0" in the CSR. Similarly, those channels programmed to logic "1" will produce logic "1" when interrogated through the CSR.

OBSERVATION

In spite of the above explanation, the CSR must not be confused with a simple "memory". Note that the output device's settling time will affect the CSR status just after programming a channel. For this reason, during transitory periods, the programmed value for a channel may not match the channel status returned by the CSR.

5.3.- Built-In-Test.

The **CM-DO-40** features on-board Built-In-Test capability through its Channel Status Register. Each output channel incorporates a readback device which senses the current channel status at the latest possible test point.

The information supplied by the readback devices is latched in the Channel Status Register each time the VMEbus master CPU reads from the module. This feature creates a per channel wrap-around loop that allow checking the channel's output device as well as all TTL chips available on its signal network up to the VMEbus data buffers.

A typical BIT cycle would consist of programming the output channels with a test word, waiting for the output device settling time, then reading the Channel Status Register and finally, comparing the value initially written with the value read back.

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5.5- Front Panel LED Indicators.

The **CM-DO-40** has 64 red LED indicators on its front panel. There is a single green LED labeled "SEL" which is illuminated when the VMEbus master accesses the **CM-DO-40** board.

The red LEDs are distributed in four arrays of 16 LEDs each. Each array constitutes a group of 16 channels *(see **Figure 5.4**)*. Each LED is associated with an output channel and is independent of the other LEDs. The LEDs show the associated output channel ON-OFF status.

- The LEDs are illuminated when the output channels are activated (ON).
- The LEDs are switched-off when the output channels are deactivated (OFF).

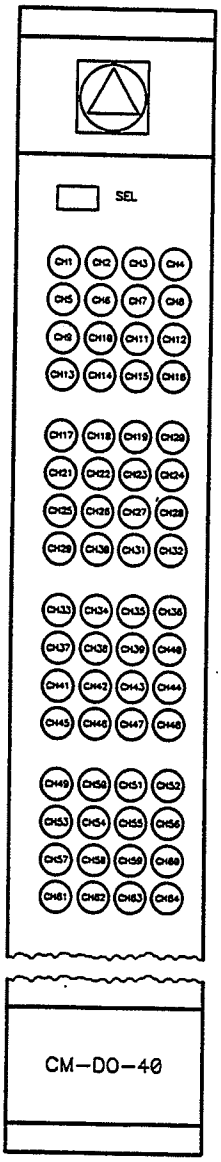


Figure 5.4.- CM-DO-40 Front panel LED indicators lay-out.

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Chapter 6.- VME Address Map.

This chapter contains details on the memory range occupied by the **CM-DO-40** module when connected to a VMEbus backplane.

6.1.- CM-DO-40 Address Decoder.

The address decoder is a functional block intended for mapping, in a flexible manner, one or more **CM-DO-40** modules within the VMEbus standard addressing range *(see **Figure 6.1**).*

Each board occupies a 4 Word address block (8 Bytes). Two jumper blocks SW33 & SW34, provide up to 256 mapping possibilities. This module is a slave unit with a generic address type " $Z0 90YX", where "Z", "Y" & "X" are defined by the user through the on-board jumpers.

SW33 (V0, V1, V2 & V3) is a 4x2 jumper block which defines the module x1MB mapping base address (Z selector). The user can select among 16 possibilities, each one associated with 1 of the 16 MB available in the standard VMEbus range *(see **Figure 6.1**).*

V3	V2	V1	V0	x 1 MB	Board Address
OFF	OFF	OFF	OFF	F	$F0 90YX
OFF	OFF	OFF	ON	E	$E0 90YX
OFF	OFF	ON	OFF	D	$D0 90YX
OFF	OFF	ON	ON	C	$C0 90YX
OFF	ON	OFF	OFF	B	$B0 90YX
OFF	ON	OFF	ON	A	$A0 90YX
OFF	ON	ON	OFF	9	$90 90YX
OFF	ON	ON	ON	8	$80 90YX
ON	OFF	OFF	OFF	7	$70 90YX
ON	OFF	OFF	ON	6	$60 90YX
ON	OFF	ON	OFF	5	$50 90YX
ON	OFF	ON	ON	4	$40 90YX
ON	ON	OFF	OFF	3	$30 90YX
ON	ON	OFF	ON	2	$20 90YX
ON	ON	ON	OFF	1	$10 90YX
ON	ON	ON	ON	0	$00 90YX
SW33 (Z selector)				YX = According to SW34	

Figure 6.1.- Board 1MByte boundary mapping versus SW33.

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Chapter 7.- VMEbus Interface.

The **CM-DO-40** has been designed for total compatibility with all VMEbus equipment or modules existent on the market.

Therefore this board can be connected to any standard VMEbus backplane together with other 3U and 6U modules manufactured by other suppliers.

7.1.- P1 VMEbus Connector.

The P1 connector is essential for correct board operation. The pull-up resistors on the VMEbus backplane provide logic '1' to various signals. These signals are monitored by the logic circuitry implemented on the board, and are indispensable for proper operation.

As mentioned in earlier chapters, the **CM-DO-40** board only supports the standard A24/D16 addressing mode. The implemented interface complies with IEEE 1014, IEC 821/297 rev. C specifications for VMEbus compatible products. This module only supports Word aligned access format.

The board includes only 16 bit read and write registers. Byte or Long Word accesses are illegal because the board is not capable of handling 8 or 32 bit data.

All P1 pins, which are driven or monitored by the **CM-DO-40**, are located according to the VMEbus IEEE 1014 and IEC 821 specs pin-out assignment. The board monitors the following P1 pins:

A01/A23 address bus.
AM0/AM5 address modifier codes.
D00/D15 data bus.
AS*, DS0*, DS1* address and data strobe lines.
SYSCLK, IACK*, LWORD*, and WRITE* lines.
BERR* and DTACK* lines.
SYSRES* line.
GND, +12 VDC and +5VDC supply lines.

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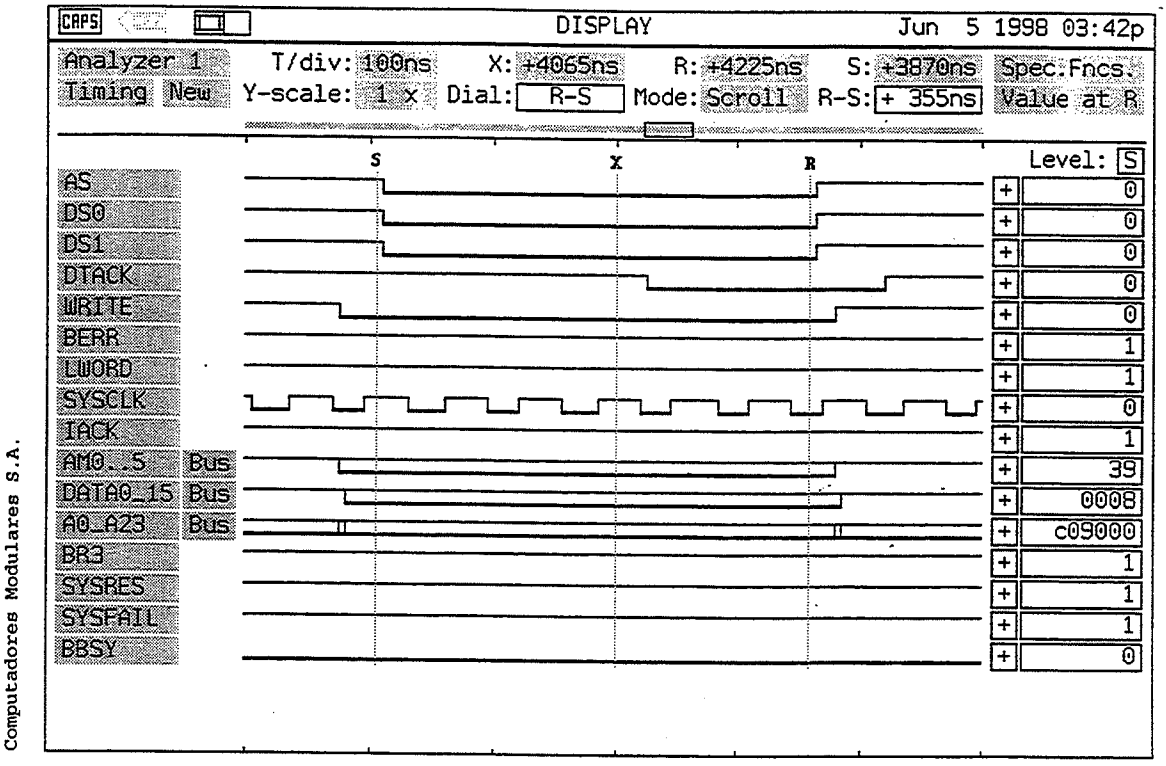


Figure 7.1.- VMEbus Write cycle timing diagram.

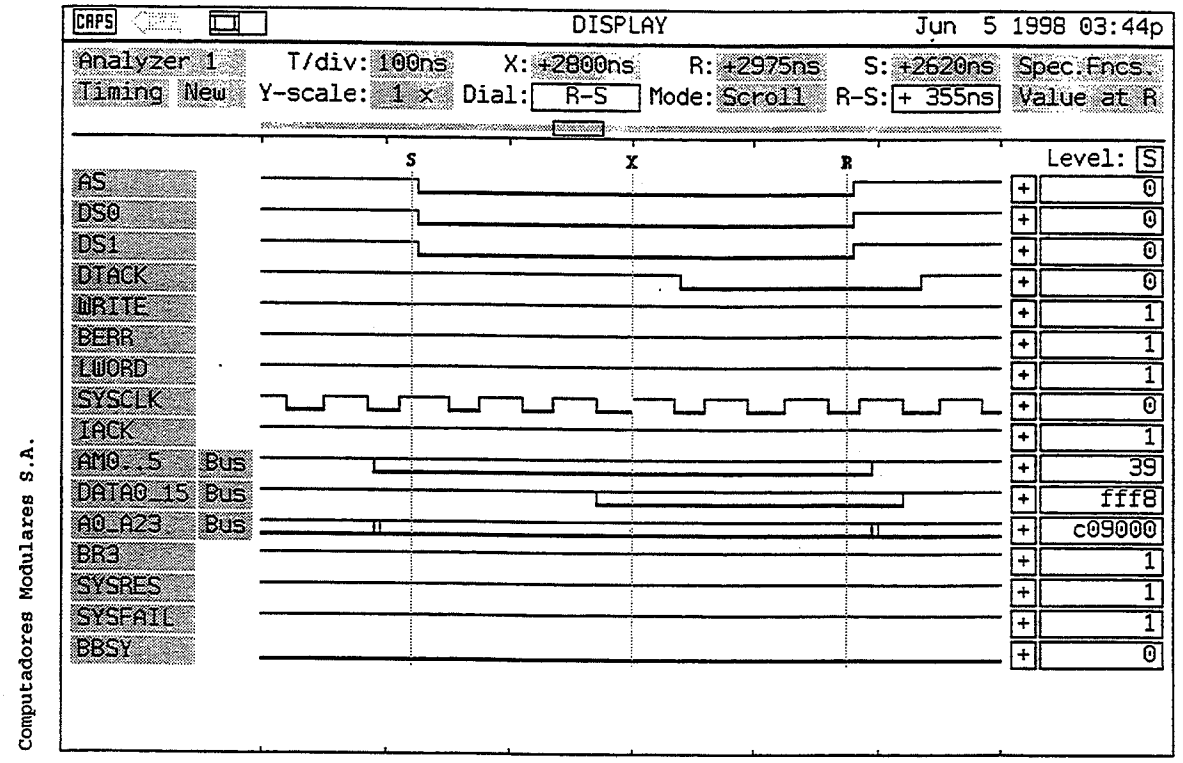


Figure 7.2.- VMEbus Read cycle timing diagram.

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Chapter 8.- CM-DO-40 Board Support Package.

This chapter describes the **CM-DO-40** Software Package. The objective of this section is to provide the user with an introduction to the main functions and their use.

8.1.- CM-DO-40 Software Package.

The **CM-DO-40** Software Package (**CM-DO-40/SFP**) is written in C language. There are two independent source code files tested under the VxWorks 5.3 Operating System and the Microtec Research MCC68K PC-Cross Compiler. If required, the code can be easily adapted or recompiled to any other standard ANSI C compiler existing on the market.

The package is comprised of a floppy-disk and an explanatory manual. The VxWorks code is supplied in Sun-4 format. The MCC68K code is supplied in PC format.

This package can be purchased from **CM Computer** at low cost. Once the user acquires a license the software does not require any further royalties for its use.

8.2.- Software Package Description.

This program has been developed to program the status of the output channels corresponding to up to 16 **CM-DO-40** boards that can be simultaneously connected to a VMEbus backplane. Specific software functions to perform Built-In-Test cycles and read the channels status are also included.

Main parameters for the program are the VMEbus base address of the first **CM-DO-40** module, the number of **CM-DO-40** boards inserted on the backplane, and the speed of the CPU used as VMEbus master. These parameters must be indicated in the header file (d040vxw.h/do40mcc.h) in order to properly initialize and dimension the software's internal variables. This can be done using the directives "#define DO40_BADDRS", "#define DO_NBOARDS", and "#define MASTER_SPEED".

By default, the DO40_BADDRS parameter is defined as address $C09000 (this address can be changed by SW33 & SW34 on-board switches); DO_NBOARDS is defined as 1 (the range of this parameter is from 1 to 16 inclusive); MASTER_SPEED is defined as 5 (see do40.h file for details). These parameters assume that there is only one **CM-DO-40** installed, its VMEbus base address is $C0 9000, and the CPU board used as master is the **CM-CPU-40** @ 33MHz.

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8.3.- Main Function Description.

The program consists of four main functions:

1.- "inido40 (board_id, board_version)"

This function configures all internal variables associated to the selected board with initial default values and programs the output channels to a deactivated status (OFF).

In order to ensure a proper program execution, this function must be executed before calling any other BSP function, and always after a **CM-DO-40** reset.

Input arguments:

"board_id".- Index number of the board. It can be any integer value from 1 to 16 Inclusive.
"board_version".- Version of the selected board. It can be any integer value from 1 to 11 inclusive. This parameter informs the driver about the switching delay time required by the installed output devices.

Return values:

0: Initialization successfully completed.
1: Initialization failed.
-1: Input parameters out of range.

Example of use:

Initializes a Relay version board (**CM-DO-40/1**) located on the second addressing position in the VMEbus:

```
inido40 (2,1);
```

2.- "do40Bit (board_id)"

This function performs a Built-In-Test cycle on the selected module. The BIT cycle will read the Channel Status Register and compare that value with the last value written to the Channel Control Register. If both values are equal, the BIT successfully passes. Otherwise, the BIT fails.

If the BIT fails, the user can investigate which channels have failure by scanning the channel BIT report array "do40[board_id-1].BITStatus[]". The array contains 64 Words (a word per channel), which stores 0 if channel PASSes or 1 if channel FAILs.

This BIT function does not modify the current outputs. Therefore, there is no risk to the application and the BIT can be invoked at any time.

Input argument:

"board_id".- Index number of the board. It can be any integer value from 1 to 16 inclusive.

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4.- "getdoChannel (board_id, ch_init, ch_end)"

This function reads the Channel Status Register of the selected board, and obtains the status of the selected channels.
The status of the channels is stored in the "do40[board_id-1].channelStatus[]" global array.

The function internally inserts a delay time according the board version before reading the Channel Status Register. This ensures a stable read-out.

OBSERVATION

The do40[].channelStatus[] global array is defined as a 64-Word array used to store the status of up to 64 channels. When getdoChannel() is called, the do40[].channelStatus[] global array is filled with '1' or '0' values depending on the status of the channels (ON or OFF respectively).

Although do40[].channelStatus[] is dimensioned to store up to 64 Words, getdoChannel() will only use so many Words as channels to test. Remainder Words up to 64 total array dimension are filled with 0xffff value.

- The channel status corresponding to "ch_init" input parameter is stored in the first Word of the global array (do40[board_id-1].channelStatus[0]).
- The channel status corresponding to "ch_end" input parameter is stored in the ("ch_end"-"ch_init") Word of the global array (do40[board_id-1].channelStatus["ch_end"-"ch_init"]).

Input arguments:

"board_id".- Index number of the board. It can be any integer value from 1 to 16 inclusive.
"ch_init".- Initial channel to read. It can be any integer number from 1 to "ch_end" inclusive.
"ch_end".- Last channel to read. It can be any integer number from "ch_init" to 64 inclusive.

8

Return values:

OK (0): Function successfully completed.
ERROR (-1): Input parameters out of range.

Example of use:

Get the status of channels from 41 to 62 inclusive on the **CM-DO-40** located on the second addressing position in the VMEbus:

```
getdoChannel (2,41,62);
```

Comments:
In this case, only 22 Words of do40[].channelStatus[] will be used (channels to test = 22).
- The user can read the status of channel 41 in do40[1].channelStatus[0]
- The user can read the status of channel 42 in do40[1].channelStatus[1]

. . . . . .
. . . . . .

- The user can read the status of channel 61 in do40[1].channelStatus[20]
- The user can read the status of channel 62 in do40[1].channelStatus[21]
- The user will read 0xffff in do40[1].channelStatus[22] thru do40[1].channelStatus[63].

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Chapter 9.- Application Example.

This chapter contains a brief and practical introduction to the use of the **CM-DO-40** board. It is intended to help the user when using the module for the first time.

The user need only write to the Channel Control Register in order to activate or deactivate the output channels. The following example considers the module to be address at its factory default VMEbus address:

EXAMPLE:

```
#define DO40_BADDR ((short *) 0xC09000)   /* pointer to CM-DO-40 VMEbus base address */

progChannel()
{
u_short *pCCR;                  /*pointer to Channel Control Register */
pCCR = DO40_BADDR;

*pCCR = 0x0002;        /* activates only the channel nº 2 */
*pCCR = 0xffff;        /* activates the first 16 channels */
*pCCR = 0xaaaa;        /* alternates the activation of the first 16 channels */
*pCCR = 0x0000;        /* deactivates the first 16 channels */
*(pCCR+1) = 0xffff;    /* activates the channels 17 trhu 32 */
*(pCCR+2) = 0xXX01;  /* activates channel 33; XX = don't care */
}
```

9

OBSERVATION

The **CM-DO-40** channel programming latches should not be considered R/W transparent registers.

For example, changing the status of a relay will not be properly reflected in the CSR until the device has switched to its final stable state.

Therefore it is highly recommended that the user define 4 software variables, one word size each, which will contain the current **CM-DO-40** 64 bit latch status. These variables can be considered as "latch-copy" variables.

When the current **CM-DO-40** channel state must be updated, the software should first process and update the contents of the copy of the Channel Control Register in RAM. Finally, the values of these variables can be written to the on-board **CM-DO-40** CCR. This procedure allows for keeping track of the module configuration without regard for the device settling time. Additionally, it allows management of individual output channels correctly (i. e. switching only output channel Nº23 without affecting the other channels).

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Chapter 10.- CM-DO-40/1 Relay Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/1** relay version. This version provides both SPST and SPDT relay outputs.

10.1.- CM-DO-40/1 Relays Technical Specifications.

The **CM-DO-40/1** incorporates 64 pre-magnetized hermetically sealed relays. The relays installed on the module are type DPDT Form C (double pole with change over contacts).

The module supports the 8 pin 20x10x10 mm industry standard relay case for PCB mounting. These relays are used extensively in military and industrial applications. The design allows for selection of parts from more than 7 different leading manufacturers who offer compatible pin-out relays with similar specifications.

One of the two relay poles is used as a conventional 2 or 3 pin output contact. The second contact is used for Built-In-Test purposes and its status is routed back into the Channel Status Register.

Table 10.1 shows the main characteristics of the **CM-DO-40/1** relays.

Parameter	Description
Relay type	64 DPDT relays
AC Voltage range	100 mV thru 250 VAC RMS
DC Voltage range	100 mV thru 300 VDC
AC Current range	1 Amp @ < 30 VAC (0.3 Amps @ >30 VAC)
DC Current range	1 Amp @ < 30 VDC (0.5 Amps @ >30 VDC)
Switching-ON Time	< 10 ms (3 ms typical)
Switching-OFF Time	< 10 ms (4 ms typical)
Switching frequency	100 Hz max (should not be used in continuous operation)
Contact impedance (ON)	< 0.2 Ω with contact closed (0.1 Ω typical)
Contact impedance (OFF)	>10 MΩ (contact open)
Galvanic isolation	1000 V peak maximum
Load type	AC or DC loads
Output terminals	2 or 3 terminals per relay in both VME64x output connectors.

Table 10.1.- CM-DO-40/1 general output characteristics.

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The first 32 on-board relays output a SPDT floating contact. This requires three pins per channel in the application connector labeled as *Common, Out A,* and *Out B.*

This configuration is shown in ***Figure 10.3.***

The 32 *Out B* pins are optionally wired to connector P2. In order to wire these pins to P2 a battery of 32 jumpers (SW1 thru SW32) must be inserted. *See also Section 4.9.c concerning SMD jumpers P1 thru P18.*

Notice that relays 33 thru 64 are ONLY capable of offering SPST contacts as described in ***Figure 10.2.***

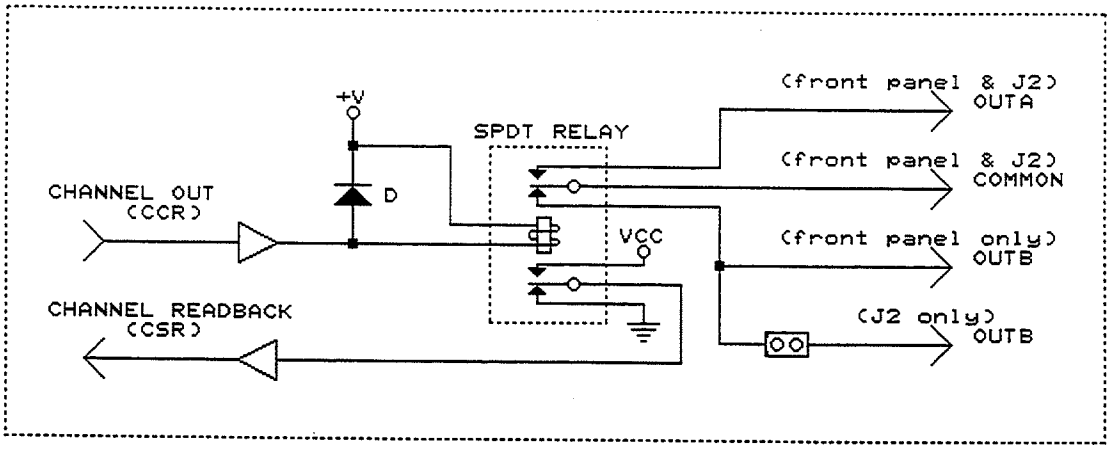


Figure 10.3.- CM-DO-40/1 SPDT channel output stage (32x).

As shown in the attached figures, testing the **CM-DO-40/1** outputs is very simple and can be done if necessary, by measuring with a conventional polimeter in ohms range.

OBSERVATION

Each relay output is galvanically isolated from the VMEbus TTL signals and power supply voltages, as well as from the other channels. The application output pins of each relay are left "floating", and must be externally wired by the user.

OBSERVATION

The board is supplied by default with relays with normally-open contacts between the *Common* and *Out A* terminals. Therefore, SPDT contacts will have normally-closed contacts between terminals *Common* and *Out B.*

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PIN	Row a	Row b	Row c	Row d	Row e
1	OUT A33	OUT A1	OUT B1	COM1	COM33
2	OUT A34	OUT A2	OUT B2	COM2	COM34
3	OUT A35	OUT A3	OUT B3	COM3	COM35
4	OUT A36	OUT A4	OUT B4	COM4	COM36
5	OUT A37	OUT A5	OUT B5	COM5	COM37
6	OUT A38	OUT A6	OUT B6	COM6	COM38
7	OUT A39	OUT A7	OUT B7	COM7	COM39
8	OUT A40	OUT A8	OUT B8	COM8	COM40
9	OUT A41	OUT A9	OUT B9	COM9	COM41
10	OUT A42	OUT A10	OUT B10	COM10	COM42
11	OUT A43	OUT A11	OUT B11	COM11	COM43
12	OUT A44	OUT A12	OUT B12	COM12	COM44
13	OUT A45	OUT A13	OUT B13	COM13	COM45
14	OUT A46	OUT A14	OUT B14	COM14	COM46
15	OUT A47	OUT A15	OUT B15	COM15	COM47
16	OUT A48	OUT A16	OUT B16	COM16	COM48
17	OUT A49	OUT A17	OUT B17	COM17	COM49
18	OUT A50	OUT A18	OUT B18	COM18	COM50
19	OUT A51	OUT A19	OUT B19	COM19	COM51
20	OUT A52	OUT A20	OUT B20	COM20	COM52
21	OUT A53	OUT A21	OUT B21	COM21	COM53
22	OUT A54	OUT A22	OUT B22	COM22	COM54
23	OUT A55	OUT A23	OUT B23	COM23	COM55
24	OUT A56	OUT A24	OUT B24	COM24	COM56
25	OUT A57	OUT A25	OUT B25	COM25	COM57
26	OUT A58	OUT A26	OUT B26	COM26	COM58
27	OUT A59	OUT A27	OUT B27	COM27	COM59
28	OUT A60	OUT A28	OUT B28	COM28	COM60
29	OUT A61	OUT A29	OUT B29	COM29	COM61
30	OUT A62	OUT A30	OUT B30	COM30	COM62
31	OUT A63	OUT A31	OUT B31	COM31	COM63
32	OUT A64	OUT A32	OUT B32	COM32	COM64

Table 10.5.- CM-DO-40/1 VME64x front panel application connector pin-out.

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Chapter 11.- CM-DO-40/2 Optocoupler Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/2** optocoupler version.

11.1.- CM-DO-40/2 Optocoupler Technical Specifications.

The **CM-DO-40/2** incorporates 64 general purpose optocouplers. The installed devices are NPN phototransistors or photodarlingtons.

The board supports the industry standard 6 pin DIL packages for PCB mounting. This allows selection parts from more than 15 different leading manufacturers who offer compatible pin-out opto-isolators with similar specifications. There is a wide range of optocouplers with Collector-Emitter Voltages ranging from 40 to 300 Volts, and Collector continuos current from 60 to 150 mA.

The factory default devices are rated for 50 Volts and 100 mA. These parameters are well suited for most applications. Other devices can be installed upon customer request.

The optocoupler phototransistor constitutes a 2 pin output. The input photodiode voltage is used for Built-In-Test purposes with its switching status routed back into the Channel Status Register.

Table 11.1 shows the principle characteristics of the **CM-DO-40/2** optocouplers.

Parameter	Description
Optocoupler type	NPN bipolar phototransistor
AC Voltage range	Not supported.
DC Voltage range	50 VDC standard (up to 300 VDC optional)
AC Current range	Not supported
DC Current range	100 mA standard (up to 150 mA optional)
Switching-ON Time	40 µS typical
Switching-OFF Time	40 µS typical
Switching frequency	20 KHz typical (50 KHz max)
Internal impedance (ON)	< 20 Ω (saturated transistor)
Internal impedance (OFF)	>10 MΩ (transistor in cut-off)
Galvanic isolation	1000 V peak maximum
Load type	DC loads in open-collector (pull-up resistors)
Output terminals	2 terminals per optocoupler in both VME64x output connectors.

Table 11.1.- CM-DO-40/2 general output characteristics.

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OBSERVATION

The optocoupler terminals are polarity sensitive. The output NPN phototransistor Emitter is the negative terminal (Common) and must be connected to GND or a negative supply. The Collector is the positive terminal (Out A) and must be wired to a positive DC voltage through a resistor load.

IMPORTANT

Use care with device polarity, since if not properly wired, the optocoupler may be damaged. Optocoupler output terminals need an external pull-up resistor in order to limit the I_{CE} current to a maximum of 100 mA during the "ON" state.

OBSERVATION

As shown in the attached figures, testing the **CM-DO-40/2** outputs is very simple and can be done if necessary, by measuring the phototransistors with a conventional polimeter in Ohms range.

OBSERVATION

Each optocoupler is galvanically isolated from the VMEbus signals as well as from the other channels. The application output pins of each optocoupler are left "floating", and must be externally wired by the user.

OBSERVATION

The board is supplied by default with optocouplers whose phototransistors are normally in cut-off state to the output terminals. Therefore the phototransistors will be in a high-impedance state after a VMEbus SYSRES* has been asserted.

11.3.- CM-DO-40/2 Electrical Specifications.

Table 11.3 shows the **CM-DO-40/2** optocoupler version voltage and current requirements. Voltage tolerances are also specified.

VMEbus Power	CM-DO-40/2 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC}, @ 400 mA, plus 13 mA per activated optocoupler (1.25 Amp max).	+4.85 to +5.25 V_{DC}

Table 11.3.- CM-DO-40/2 Optocoupler version power requirements.

Table 11.3 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

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PIN	Row z	Row a	Row b	Row c	Row d
1	COLL 33	COLL 1	N.C.	EMITT 1	EMITT 33
2	COLL 34 (P1=ON)	COLL 2	N.C.	EMITT 2	EMITT 34
3	COLL 35	COLL 3	N.C.	EMITT 3	EMITT 35
4	COLL 36 (P2=ON)	COLL 4	N.C.	EMITT 4	EMITT 36
5	COLL 37	COLL 5	N.C.	EMITT 5	EMITT 37
6	COLL 38 (P3=ON)	COLL 6	N.C.	EMITT 6	EMITT 38
7	COLL 39	COLL 7	N.C.	EMITT 7	EMITT 39
8	COLL 40 (P4=ON)	COLL 8	N.C.	EMITT 8	EMITT 40
9	COLL 41	COLL 9	N.C.	EMITT 9	EMITT 41
10	COLL 42 (P5=ON)	COLL 10	N.C.	EMITT 10	EMITT 42
11	COLL 43	COLL 11	N.C.	EMITT 11	EMITT 43
12	COLL 44 (P6=ON)	COLL 12	N.C.	EMITT 12	EMITT 44
13	COLL 45	COLL 13	N.C.	EMITT 13	EMITT 45
14	COLL 46 (P7=ON)	COLL 14	N.C.	EMITT 14	EMITT 46
15	COLL 47	COLL 15	N.C.	EMITT 15	EMITT 47
16	COLL 48 (P8=ON)	COLL 16	N.C.	EMITT 16	EMITT 48
17	COLL 49	COLL 17	N.C.	EMITT 17	EMITT 49
18	COLL 50 (P9=ON)	COLL 18	N.C.	EMITT 18	EMITT 50
19	COLL 51	COLL 19	N.C.	EMITT 19	EMITT 51
20	COLL 52 (P10=ON)	COLL 20	N.C.	EMITT 20	EMITT 52
21	COLL 53	COLL 21	N.C.	EMITT 21	EMITT 53
22	COLL 54 (P11=ON)	COLL 22	N.C.	EMITT 22	EMITT 54
23	COLL 55	COLL 23	N.C.	EMITT 23	EMITT 55
24	COLL 56 (P12=ON)	COLL 24	N.C.	EMITT 24	EMITT 56
25	COLL 57	COLL 25	N.C.	EMITT 25	EMITT 57
26	COLL 58 (P13=ON)	COLL 26	N.C.	EMITT 26	EMITT 58
27	COLL 59	COLL 27	N.C.	EMITT 27	EMITT 59
28	COLL 60 (P14=ON)	COLL 28	N.C.	EMITT 28	EMITT 60
29	COLL 61	COLL 29	N.C.	EMITT 29	EMITT 61
30	COLL 62 (P15=ON)	COLL 30	N.C.	EMITT 30	EMITT 62
31	COLL 63	COLL 31	N.C.	EMITT 31	EMITT 63 (P17=ON)
32	COLL 64 (P16=ON)	COLL 32	N.C.	EMITT 32	EMITT 64 (P18=ON)

Table 11.5.- CM-DO-40/2 VME64x P2 application connector pin-out.

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Chapter 12.- CM-DO-40/3 Photo-MOS Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/3** Photo-MOS Relay version (photo-MOS FET).

12.1- CM-DO-40/3 Photo-MOS Technical Specifications.

The **CM-DO-40/3** incorporates 64 photo-MOS FETs. Each device incorporates a bidirectional switch that can replace mechanical relays in many applications.

The board installs photo-MOS devices in industry standard 6 pin DIL packages for PCB mounting. This allows selection of parts from more than 3 different leading manufacturers who offer compatible pin-out products with similar specifications. There are several supported photo-MOS chips with operating voltages from 60 to 400 Volts and on-state continuos current from 150 mA to 1 Amp.

The factory default devices are rated for 400 Volts and 150 mA AC/DC. These parameters are well suited for most applications. Other devices within the voltage and current ranges described in the above paragraph can be installed upon customer request.

Table 12.1 shows the principle characteristics of the **CM-DO-40/3** photo-MOS devices.

Parameter	Description
Photo-MOS type	Two bidirectional MOS FET switches
AC Voltage range	400 VAC maximum
DC Voltage range	400 VDC maximum
AC Current range	150 mA AC standard (up to 1 Amp optional)
DC Current range	150 mA DC standard (up to 1 Amp optional)
Switching-ON Time	50 µS typical
Switching-OFF Time	50 µS typical
Switching frequency	4 KHz typical (5 KHz max)
Internal impedance (ON)	< 4 Ω typical (saturated MOS FET transistor)
Internal impedance (OFF)	> 20 MΩ typical (MOS FET transistor in cut-off)
Galvanic isolation	1500 V peak maximum
Load type	AC/DC analog signals up to 2MHz
Output terminals	2 terminals per photo-MOS in both VME64x connectors

Table 12.1.- CM-DO-40/3 general output characteristics.

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OBSERVATION

The photo-MOS terminals are not polarity sensitive. The two Drains are the output terminals (Out A and Out B) and must be wired to either a DC or AC voltage through an external load.

IMPORTANT

The device output terminals need an external load or limiting resistor in order to limit the current to 150 mA maximum during the "ON" state.

OBSERVATION

As shown in the attached figures, testing the **CM-DO-40/3** outputs is very simple and can be done if necessary, by measuring the channel terminals with a conventional polimeter in Ohms range.

OBSERVATION

Each photo-MOS is galvanically isolated from the VMEbus signals as well as from the other channels. The application output pins of each pho-MOS are left "floating" and must be externally wired by the user.

OBSERVATION

The board is supplied by default with photo-MOS relays normally in cut-off state to the output terminals. Therefore the MOS FET will be in a high-impedance state after a VMEbus SYSRES* has been asserted.

12.3.- CM-DO-40/3 Electrical Specifications.

Table 12.3 shows the **CM-DO-40/3** photo-MOS version voltage and current requirements. Voltage tolerances are also specified.

VMEbus Power	CM-DO-40/3 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC}, @ 400 mA, plus 20 mA per activated Photo-MOS (1.7 Amp max).	+4.85 to +5.25 V_{DC}

Table 12.3.- CM-DO-40/3 photo-MOS version power requirements.

Table 12.3 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

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PIN	Row z	Row a	Row b	Row c	Row d
1	DRAIN A33	DRAIN A1	N.C.	DRAIN B1	DRAIN B33
2	DRAIN A34 (P1=ON)	DRAIN A2	N.C.	DRAIN B2	DRAIN B34
3	DRAIN A35	DRAIN A3	N.C.	DRAIN B3	DRAIN B35
4	DRAIN A36 (P2=ON)	DRAIN A4	N.C.	DRAIN B4	DRAIN B36
5	DRAIN A37	DRAIN A5	N.C.	DRAIN B5	DRAIN B37
6	DRAIN A38 (P3=ON)	DRAIN A6	N.C.	DRAIN B6	DRAIN B38
7	DRAIN A39	DRAIN A7	N.C.	DRAIN B7	DRAIN B39
8	DRAIN A40 (P4=ON)	DRAIN A8	N.C.	DRAIN B8	DRAIN B40
9	DRAIN A41	DRAIN A9	N.C.	DRAIN B9	DRAIN B41
10	DRAIN A42 (P5=ON)	DRAIN A10	N.C.	DRAIN B10	DRAIN B42
11	DRAIN A43	DRAIN A11	N.C.	DRAIN B11	DRAIN B43
12	DRAIN A44 (P6=ON)	DRAIN A12	N.C.	DRAIN B12	DRAIN B44
13	DRAIN A45	DRAIN A13	N.C.	DRAIN B13	DRAIN B45
14	DRAIN A46 (P7=ON)	DRAIN A14	N.C.	DRAIN B14	DRAIN B46
15	DRAIN A47	DRAIN A15	N.C.	DRAIN B15	DRAIN B47
16	DRAIN A48 (P8=ON)	DRAIN A16	N.C.	DRAIN B16	DRAIN B48
17	DRAIN A49	DRAIN A17	N.C.	DRAIN B17	DRAIN B49
18	DRAIN A50 (P9=ON)	DRAIN A18	N.C.	DRAIN B18	DRAIN B50
19	DRAIN A51	DRAIN A19	N.C.	DRAIN B19	DRAIN B51
20	DRAIN A52 (P10=ON)	DRAIN A20	N.C.	DRAIN B20	DRAIN B52
21	DRAIN A53	DRAIN A21	N.C.	DRAIN B21	DRAIN B53
22	DRAIN A54 (P11=ON)	DRAIN A22	N.C.	DRAIN B22	DRAIN B54
23	DRAIN A55	DRAIN A23	N.C.	DRAIN B23	DRAIN B55
24	DRAIN A56 (P12=ON)	DRAIN A24	N.C.	DRAIN B24	DRAIN B56
25	DRAIN A57	DRAIN A25	N.C.	DRAIN B25	DRAIN B57
26	DRAIN A58 (P13=ON)	DRAIN A26	N.C.	DRAIN B26	DRAIN B58
27	DRAIN A59	DRAIN A27	N.C.	DRAIN B27	DRAIN B59
28	DRAIN A60 (P14=ON)	DRAIN A28	N.C.	DRAIN B28	DRAIN B60
29	DRAIN A61	DRAIN A29	N.C.	DRAIN B29	DRAIN B61
30	DRAIN A62 (P15=ON)	DRAIN A30	N.C.	DRAIN B30	DRAIN B62
31	DRAIN A63	DRAIN A31	N.C.	DRAIN B31	DRAIN B63 (P17=ON)
32	DRAIN A64 (P16=ON)	DRAIN A32	N.C.	DRAIN B32	DRAIN B64 (P18=ON)

Table 12.5.- CM-DO-40/3 VME64x P2 application connector pin-out.

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Chapter 13.- CM-DO-40/4 Solid State Relays.

This chapter is dedicated to describe all technical details which are exclusive of the **CM-DO-40/4** Solid State Relays version. This version provides AC contact circuit outputs.

13.1.- CM-DO-40/4 Solid State Relays Technical Specifications.

The **CM-DO-40/4** incorporates 64 Solid State Relays (SSR). The SSR installed on the module conform a 2 pin AC switched output.

SSR relays offer a sealed construction and no moving parts, which makes the device well suited for AC switching applications requiring long life and high reliability. Other features are a silent switching with causes no arcing and optically isolation. In case of operating with inductive loads an additional snubber network may be required.

The input photodiode driving voltage is used for Built-In-Test purposes and its switching status is routed back into the Channel Status Register.

Table 13.1 shows the main characteristics of the **CM-DO-40/4** Solid State Relays.

Parameter	Description
Relay type	64 Solid State Relays (normally open circuit)
AC Voltage range	10 thru 280 VAC RMS
DC Voltage range	Not available.
AC Current range	0.5 Amp nominal (1 Amp maximum)
DC Current range	Not available
Switching-ON Time	1/2 cycle maximum
Switching-OFF Time	1/2 cycle maximum
Switching frequency	100 Hz max
Internal impedance (ON)	8 Ω @ 100mA; 2 Ω @ 1 Amp
Internal impedance (OFF)	10 MΩ typical; < 5 mA maximum (circuit open)
Galvanic isolation	1000 V peak minimum
Load type	AC loads
Output terminals	2 terminals per SSR in both VME64x output connectors.

Table 13.1.- CM-DO-40/4 general output characteristics.

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13.3.- CM-DO-40/4 Electrical Specifications.

The **CM-DO-40/4** board requires only a +5 V_{DC} power supply. ***Table 13.4*** below shows the board power voltage and current requirements.

VMEbus Power	CM-DO-40/4 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC}, @ 400 mA, plus 15 mA per activated SSR (1.4 Amp max).	+4.85 to +5.25 V_{DC}

Table 13.4.- CM-DO-40/4 SSR version power requirements.

Table 13.4 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

IMPORTANT

Operation exceeding the maximum specified supply voltage may cause permanent damage to the module circuitry, which is not covered by the guarantee.

13.4.- CM-DO-40/4 Application Connector Pin-out.

Tables 13.5 & 13.6 show the Solid State Relay version application connectors pin-out.

See Section 4.10 in order to find out details concerning the connectors row arrangement.

OBSERVATION

Note that the signal distribution and pin-out is identical for both connectors. Therefore, only a single external user application connector which wires all output signals is required. This user connector can be inserted into either the front panel or P2.

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PIN	Row z	Row a	Row b	Row c	Row d
1	OUT A33	OUT A1	OUT B1	OUT B1	OUT B33
2	OUT A34 (P1=ON)	OUT A2	OUT B2	OUT B2	OUT B34
3	OUT A35	OUT A3	OUT B3	OUT B3	OUT B35
4	OUT A36 (P2=ON)	OUT A4	OUT B4	OUT B4	OUT B36
5	OUT A37	OUT A5	OUT B5	OUT B5	OUT B37
6	OUT A38 (P3=ON)	OUT A6	OUT B6	OUT B6	OUT B38
7	OUT A39	OUT A7	OUT B7	OUT B7	OUT B39
8	OUT A40 (P4=ON)	OUT A8	OUT B8	OUT B8	OUT B40
9	OUT A41	OUT A9	OUT B9	OUT B9	OUT B41
10	OUT A42 (P5=ON)	OUT A10	OUT B10	OUT B10	OUT B42
11	OUT A43	OUT A11	OUT B11	OUT B11	OUT B43
12	OUT A44 (P6=ON)	OUT A12	OUT B12	OUT B12	OUT B44
13	OUT A45	OUT A13	OUT B13	OUT B13	OUT B45
14	OUT A46 (P7=ON)	OUT A14	OUT B14	OUT B14	OUT B46
15	OUT A47	OUT A15	OUT B15	OUT B15	OUT B47
16	OUT A48 (P8=ON)	OUT A16	OUT B16	OUT B16	OUT B48
17	OUT A49	OUT A17	OUT B17	OUT B17	OUT B49
18	OUT A50 (P9=ON)	OUT A18	OUT B18	OUT B18	OUT B50
19	OUT A51	OUT A19	OUT B19	OUT B19	OUT B51
20	OUT A52 (P10=ON)	OUT A20	OUT B20	OUT B20	OUT B52
21	OUT A53	OUT A21	OUT B21	OUT B21	OUT B53
22	OUT A54 (P11=ON)	OUT A22	OUT B22	OUT B22	OUT B54
23	OUT A55	OUT A23	OUT B23	OUT B23	OUT B55
24	OUT A56 (P12=ON)	OUT A24	OUT B24	OUT B24	OUT B56
25	OUT A57	OUT A25	OUT B25	OUT B25	OUT B57
26	OUT A58 (P13=ON)	OUT A26	OUT B26	OUT B26	OUT B58
27	OUT A59	OUT A27	OUT B27	OUT B27	OUT B59
28	OUT A60 (P14=ON)	OUT A28	OUT B28	OUT B28	OUT B60
29	OUT A61	OUT A29	OUT B29	OUT B29	OUT B61
30	OUT A62 (P15=ON)	OUT A30	OUT B30	OUT B30	OUT B62
31	OUT A63	OUT A31	OUT B31	OUT B31	OUT B63 (P17=ON)
32	OUT A64 (P16=ON)	OUT A32	OUT B32	OUT B32	OUT B64 (P18=ON)

Table 13.6.- CM-DO-40/4 VME64x P2 application connector pin-out.

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Chapter 14.- CM-DO-40/5 Open Drain Power MOSFET Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/5** Open drain power MOSFET version.

14.1- CM-DO-40/5 Power MOSFET Technical Specifications.

The **CM-DO-40/5** incorporates 64 power MOSFET transistors. The installed N channel devices are not isolated and offer an Open-Drain output without pull-up resistors.

The board supports the industry standard TO-220 transistor package for PCB mounting. This allow selection of parts from more than 3 different leading manufacturers who offer compatible pin-out MOSFETs with similar specifications. There are a wide range of power MOSFET supported devices with Source-to-Drain Voltages from 40 to 400 Volts and 1 Amp of Drain continuos current (ID). The factory default MOSFETs are rated for 400 Volts and 1 Amp. These parameters are well suited for most applications. Other devices can be installed upon customer request.

Table 14.1 shows the principle characteristics of the **CM-DO-40/5** MOSFETs.

Parameter	Description
Transistor type	N channel power MOSFET
AC Voltage range	Not supported
DC Voltage range	up to 400 VDC
AC Current range	Not supported
DC Current range	Up to 1 Amp
Switching-ON Time	4 µS typical
Switching-OFF Time	4 µS typical
Switching frequency	20 KHz typical (50 KHz max)
Internal impedance (ON)	< 5 Ω (saturated transistor)
Internal impedance (OFF)	>10 MΩ (transistor in cut-off)
Galvanic isolation	Not isolated (FET source connected to board ground)
Load type	DC loads in open-collector (pull-ups)
Output terminals	2 terminals per transistor in both VME64x output connectors

Table 14.1.- CM-DO-40/5 general output characteristics.

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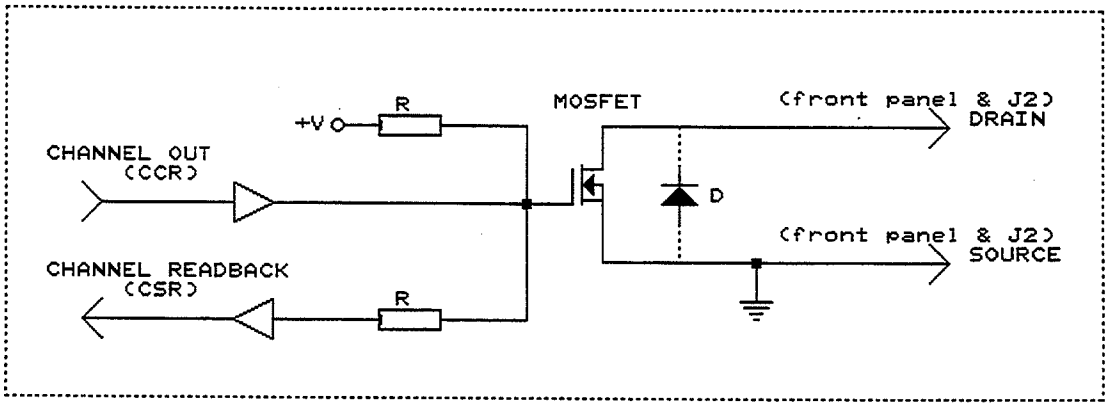


Figure 14.2.- CM-DO-40/2 power MOSFET output stage.

OBSERVATION

The MOSFET device terminals are polarity sensitive. The output transistor Source is the negative terminal (Common) and must be connected to a negative supply. The Drain terminal is positive (Out A) and must be wired to a positive DC voltage through a load.

IMPORTANT

Use care with device polarity, since if not properly wired, the power MOSFET or the external power supply may be damaged. Keep in mind that many MOSFET transistors incorporate a built-in reverse Diode. MOSFETs output terminals need an external pull-up resistor in order to limit the I_D current to a maximum of 1 Amp during the "ON" state.

OBSERVATION

As shown in the attached figures, testing the **CM-DO-40/5** outputs is very simple and can be done, if necessary, by measuring the transistor terminals with a conventional polimeter in Ohms range.

IMPORTANT

Each MOSFET Source terminal is connected to the VMEbus backplane ground (board ground). Therefore there is no galvanic isolation in the **CM-DO-40** version. Since the application output pins of each MOSFET must be externally wired by the user, special caution must be observed to avoid generating shortcircuits through the common ground, or provoking damage to the board circuitry or the VMEbus system. Use a single application DC power supply for all channels. If different external DC power supplies are required, be sure to confirm relative isolation and correct load wiring, etc.

Damage caused due to incorrect design or wiring of external DC power supplies or loads is not covered by the module guarantee.

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PIN	Row a	Row b	Row c	Row d	Row e
1	DRAIN 33	DRAIN 1	N.C.	SOURCE 1	SOURCE 33
2	DRAIN 34	DRAIN 2	N.C.	SOURCE 2	SOURCE 34
3	DRAIN 35	DRAIN 3	N.C.	SOURCE 3	SOURCE 35
4	DRAIN 36	DRAIN 4	N.C.	SOURCE 4	SOURCE 36
5	DRAIN 37	DRAIN 5	N.C.	SOURCE 5	SOURCE 37
6	DRAIN 38	DRAIN 6	N.C.	SOURCE 6	SOURCE 38
7	DRAIN 39	DRAIN 7	N.C.	SOURCE 7	SOURCE 39
8	DRAIN 40	DRAIN 8	N.C.	SOURCE 8	SOURCE 40
9	DRAIN 41	DRAIN 9	N.C.	SOURCE 9	SOURCE 41
10	DRAIN 42	DRAIN 10	N.C.	SOURCE 10	SOURCE 42
11	DRAIN 43	DRAIN 11	N.C.	SOURCE 11	SOURCE 43
12	DRAIN 44	DRAIN 12	N.C.	SOURCE 12	SOURCE 44
13	DRAIN 45	DRAIN 13	N.C.	SOURCE 13	SOURCE 45
14	DRAIN 46	DRAIN 14	N.C.	SOURCE 14	SOURCE 46
15	DRAIN 47	DRAIN 15	N.C.	SOURCE 15	SOURCE 47
16	DRAIN 48	DRAIN 16	N.C.	SOURCE 16	SOURCE 48
17	DRAIN 49	DRAIN 17	N.C.	SOURCE 17	SOURCE 49
18	DRAIN 50	DRAIN 18	N.C.	SOURCE 18	SOURCE 50
19	DRAIN 51	DRAIN 19	N.C.	SOURCE 19	SOURCE 51
20	DRAIN 52	DRAIN 20	N.C.	SOURCE 20	SOURCE 52
21	DRAIN 53	DRAIN 21	N.C.	SOURCE 21	SOURCE 53
22	DRAIN 54	DRAIN 22	N.C.	SOURCE 22	SOURCE 54
23	DRAIN 55	DRAIN 23	N.C.	SOURCE 23	SOURCE 55
24	DRAIN 56	DRAIN 24	N.C.	SOURCE 24	SOURCE 56
25	DRAIN 57	DRAIN 25	N.C.	SOURCE 25	SOURCE 57
26	DRAIN 58	DRAIN 26	N.C.	SOURCE 26	SOURCE 58
27	DRAIN 59	DRAIN 27	N.C.	SOURCE 27	SOURCE 59
28	DRAIN 60	DRAIN 28	N.C.	SOURCE 28	SOURCE 60
29	DRAIN 61	DRAIN 29	N.C.	SOURCE 29	SOURCE 61
30	DRAIN 62	DRAIN 30	N.C.	SOURCE 30	SOURCE 62
31	DRAIN 63	DRAIN 31	N.C.	SOURCE 31	SOURCE 63
32	DRAIN 64	DRAIN 32	N.C.	SOURCE 32	SOURCE 64

Table 14.4.- CM-DO-40/5 VME64x front panel application connector pin-out.

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Chapter 15.- CM-DO-40/6 Triacs Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/6** Triac version. This version provides bidirectional solid state AC switching outputs.

15.1.- CM-DO-40/6 Triacs Technical Specifications.

The **CM-DO-40/6** incorporates 64 Triacs. These devices are intended for driving industrial loads requiring AC voltages, such as heaters, lighting, motor control, etc.

Triacs are not-isolated devices. The 64 Triacs MT1 terminals (Common outputs), are connected to the board ground (VMEbus GND). The Gates of the devices are driven with TTL logic for triggering purposes. This limitation makes this version critical with respect to externally wiring loads and AC power sources. Therefore, the **CM-DO-40/6** version is a high risk option when compared with other versions populated with isolated devices.

Each Triac offers a 2 pin AC switching circuit. The Gate triggering TTL signal is additionally used for Built-In-Test purposes and its switching status is routed back into the Channel Status Register.

Table 15.1 shows the principle characteristics of the **CM-DO-40/6** Triacs.

Parameter	Description
Triac type	64 General Purpose Triacs (normally circuit open)
AC Voltage range	Up to 400 VAC RMS
DC Voltage range	Not Available
AC Current range	1 Amp maximum
DC Current range	Not available
Switching-ON Time	< 10 µS (5 µS typical)
Switching-OFF Time	< 100 µS (50 µS typical)
Switching frequency	20 KHz maximum
Internal impedance (ON)	< 2 Ω (circuit closed)
Internal impedance (OFF)	>10 MΩ (circuit open)
Galvanic isolation	Not isolated (MT1 connected to board ground)
Load type	AC loads
Output terminals	2 terminals per Triac in both VME64x output connectors.

Table 15.1.- CM-DO-40/6 general output characteristics.

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Most applications will require the use of a single AC generator and the same type of load for all channels. This is correct and accepted by the **CM-DO-40/6** Triac arrangement.

Use AC generators galvanically isolated with respect to the VMEbus power supply mains AC. If several AC generators are used to power different channels, these generators must be galvanic isolated.

IMPORTANT

Damage caused to the board circuitry or VMEbus system due to incorrect use or wiring of Triac devices is not cover by the CM Computer guarantee.

OBSERVATION

Due to the above mentioned limitations, CM recommends using, whenever possible, galvanic isolated devices with capacity for handling AC loads. In many if not most applications, Triacs can be replaced by Relays, photo-MOS or Solid State Relays (SSR).

15.3.- CM-DO-40/6 Electrical Specifications.

The **CM-DO-40/6** board only requires +5 V_{DC} voltage in order to power the on-board Triacs gate. ***Table 15.3*** below shows the **CM-DO-40/6** voltage and current requirements.

VMEbus Power	CM-DO-40/6 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC}, @ 400 mA, plus 10 mA per activated Triac (1.1 Amp max).	+4.85 to +5.25 V_{DC}

Table 15.3.- CM-DO-40/6 Triac version power requirements.

Table 15.3 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

IMPORTANT

Operation exceeding the maximum specified supply voltage may cause permanent damage to the module circuitry, which is not covered by the guarantee.

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PIN	Row z	Row a	Row b	Row c	Row d
1	MT2 33 (OUT A33)	MT2 1 (OUT A1)	N.C.	MT1 1 (GND)	MT1 33 (GND)
2	MT2 34 (OUT A34) (P1=ON)	MT2 2 (OUT A2)	N.C.	MT1 2 (GND)	MT1 34 (GND)
3	MT2 35 (OUT A35)	MT2 3 (OUT A3)	N.C.	MT1 3 (GND)	MT1 35 (GND)
4	MT2 36 (OUT A36) (P2=ON)	MT2 4 (OUT A4)	N.C.	MT1 4 (GND)	MT1 36 (GND)
5	MT2 37 (OUT A37)	MT2 5 (OUT A5)	N.C.	MT1 5 (GND)	MT1 37 (GND)
6	MT2 38 (OUT A38) (P3=ON)	MT2 6 (OUT A6)	N.C.	MT1 6 (GND)	MT1 38 (GND)
7	MT2 39 (OUT A39)	MT2 7 (OUT A7)	N.C.	MT1 7 (GND)	MT1 39 (GND)
8	MT2 40 (OUT A40) (P4=ON)	MT2 8 (OUT A8)	N.C.	MT1 8 (GND)	MT1 40 (GND)
9	MT2 41 (OUT A41)	MT2 9 (OUT A9)	N.C.	MT1 9 (GND)	MT1 41 (GND)
10	MT2 42 (OUT A42) (P5=ON)	MT2 10 (OUT A10)	N.C.	MT1 10 (GND)	MT1 42 (GND)
11	MT2 43 (OUT A43)	MT2 11 (OUT A11)	N.C.	MT1 11 (GND)	MT1 43 (GND)
12	MT2 44 (OUT A44) (P6=ON)	MT2 12 (OUT A12)	N.C.	MT1 12 (GND)	MT1 44 (GND)
13	MT2 45 (OUT A45)	MT2 13 (OUT A13)	N.C.	MT1 13 (GND)	MT1 45 (GND)
14	MT2 46 (OUT A46) (P7=ON)	MT2 14 (OUT A14)	N.C.	MT1 14 (GND)	MT1 46 (GND)
15	MT2 47 (OUT A47)	MT2 15 (OUT A15)	N.C.	MT1 15 (GND)	MT1 47 (GND)
16	MT2 48 (OUT A48) (P8=ON)	MT2 16 (OUT A16)	N.C.	MT1 16 (GND)	MT1 48 (GND)
17	MT2 49 (OUT A49)	MT2 17 (OUT A17)	N.C.	MT1 17 (GND)	MT1 49 (GND)
18	MT2 50 (OUT A50) (P9=ON)	MT2 18 (OUT A18)	N.C.	MT1 18 (GND)	MT1 50 (GND)
19	MT2 51 (OUT A51)	MT2 19 (OUT A19)	N.C.	MT1 19 (GND)	MT1 51 (GND)
20	MT2 52 (OUT A52) (P10=ON)	MT2 20 (OUT A20)	N.C.	MT1 20 (GND)	MT1 52 (GND)
21	MT2 53 (OUT A53)	MT2 21 (OUT A21)	N.C.	MT1 21 (GND)	MT1 53 (GND)
22	MT2 54 (OUT A54) (P11=ON)	MT2 22 (OUT A22)	N.C.	MT1 22 (GND)	MT1 54 (GND)
23	MT2 55 (OUT A55)	MT2 23 (OUT A23)	N.C.	MT1 23 (GND)	MT1 55 (GND)
24	MT2 56 (OUT A56) (P12=ON)	MT2 24 (OUT A24)	N.C.	MT1 24 (GND)	MT1 56 (GND)
25	MT2 57 (OUT A57)	MT2 25 (OUT A25)	N.C.	MT1 25 (GND)	MT1 57 (GND)
26	MT2 58 (OUT A58) (P13=ON)	MT2 26 (OUT A26)	N.C.	MT1 26 (GND)	MT1 58 (GND)
27	MT2 59 (OUT A59)	MT2 27 (OUT A27)	N.C.	MT1 27 (GND)	MT1 59 (GND)
28	MT2 60 (OUT A60) (P14=ON)	MT2 28 (OUT A28)	N.C.	MT1 28 (GND)	MT1 60 (GND)
29	MT2 61 (OUT A61)	MT2 29 (OUT A29)	N.C.	MT1 29 (GND)	MT1 61 (GND)
30	MT2 62 (OUT A62) (P15=ON)	MT2 30 (OUT A30)	N.C.	MT1 30 (GND)	MT1 62 (GND)
31	MT2 63 (OUT A63)	MT2 31 (OUT A31)	N.C.	MT1 31 (GND)	MT1 63 (GND) (P17=ON)
32	MT2 64 (OUT A64) (P16=ON)	MT2 32 (OUT A32)	N.C.	MT1 32 (GND)	MT1 64 (GND) (P18=ON)

Table 15.5.- CM-DO-40/6 VME64x J2 application connector pin-out.

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Chapter 16.- CM-DO-40/7 Thyristors Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/7** Thyristor version. This version provides unidirectional solid state AC switching outputs.

16.1.- CM-DO-40/7 Thyristor Technical Specifications.

The **CM-DO-40/7** incorporates 64 P-gate Thyristors (SCRs). These devices are intended for driving industrial loads requiring rectified AC voltages such as heaters, lighting dimming, DC motor control, battery charges, AC regulators, etc.

Thyristors are not-isolated devices. The 64 Thyristors cathode terminals are connected to the board ground (VMEbus GND). The gates of the devices are driven with TTL logic for triggering purposes. This represents a limitation that must be considered when externally wiring loads and AC power sources. The **CM-DO-40/7** is a higher risk option when compared with other **CM-DO-40** versions populated with isolated devices.

Each Thyristor offers a 2 pin diode AC switching circuit. The gate triggering TTL signal is additionally used for Built-In-Test purposes and its switching status is routed back into the Channel Status Register. ***Table 16.1*** shows the principle characteristics of the **CM-DO-40/7** Thyristors.

Parameter	Description
Thyristor type	64 General Purpose Thyristors (normally circuit open)
AC Voltage range	Up to 400 VAC RMS
DC Voltage range	Not Available
AC Current range	1 Amp maximum
DC Current range	Not available
Switching-ON Time	< 4 µS (2 µS typical)
Switching-OFF Time	< 50 µS (30 µS typical)
Switching frequency	10 KHz maximum
Internal impedance (ON)	< 4 Ω (circuit closed)
Internal impedance (OFF)	> 10 MΩ (circuit open)
Galvanic isolation	Not Isolated (Cathodes to ground)
Load type	Rectified AC loads
Output terminals	2 terminals per Thyristor in both VME64x output connectors

Table 16.1.- CM-DO-40/7 general output characteristics.

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Most applications will require the use of a single AC generator and the same type of load for all channels. This is supported by the **CM-DO-40/7** module.

Use AC generators galvanically isolated with regard the VMEbus power supply mains AC. If several AC generators are used to power different channels, these generators must be galvanic isolated.

IMPORTANT

Damage caused on the board circuitry or VMEbus system due to incorrect use or wiring of the Thyristor devices is not cover by the CM Computer guarantee.

OBSERVATION

Due to the above mentioned limitations, CM recommends using, whenever possible, galvanically isolated devices with capacity for handling AC loads. In many if not most applications, Thyristors can be replaced by Relays, photo-MOS or Solid State Relays (SSR).

16.3.- CM-DO-40/7 Electrical Specifications.

The **CM-DO-40/7** board only requires +5 V_{DC} voltage in order to power the on-board Thyristors. ***Table 16.3*** below shows the **CM-DO-40/7** voltage and current requirements.

VMEbus Power	CM-DO-40/7 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC}, @ 400 mA, plus 10 mA per activated Thyristor (1.1 Amp max).	+4.85 to +5.25 V_{DC}

Table 16.3.- CM-DO-40/7 Thyristor version power requirements.

Table 16.3 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

IMPORTANT

Operation exceeding the maximum specified supply voltage may cause permanent damage to the module circuitry which is not covered by the guarantee.

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PIN	Row z	Row a	Row b	Row c	Row d
1	ANODE 33	ANODE 1	N.C.	CATHODE 1	CATHODE 33
2	ANODE 34 (P1=ON)	ANODE 2	N.C.	CATHODE 2	CATHODE 34
3	ANODE 35	ANODE 3	N.C.	CATHODE 3	CATHODE 35
4	ANODE 36 (P2=ON)	ANODE 4	N.C.	CATHODE 4	CATHODE 36
5	ANODE 37	ANODE 5	N.C.	CATHODE 5	CATHODE 37
6	ANODE 38 (P3=ON)	ANODE 6	N.C.	CATHODE 6	CATHODE 38
7	ANODE 39	ANODE 7	N.C.	CATHODE 7	CATHODE 39
8	ANODE 40 (P4=ON)	ANODE 8	N.C.	CATHODE 8	CATHODE 40
9	ANODE 41	ANODE 9	N.C.	CATHODE 9	CATHODE 41
10	ANODE 42 (P5=ON)	ANODE 10	N.C.	CATHODE 10	CATHODE 42
11	ANODE 43	ANODE 11	N.C.	CATHODE 11	CATHODE 43
12	ANODE 44 (P6=ON)	ANODE 12	N.C.	CATHODE 12	CATHODE 44
13	ANODE 45	ANODE 13	N.C.	CATHODE 13	CATHODE 45
14	ANODE 46 (P7=ON)	ANODE 14	N.C.	CATHODE 14	CATHODE 46
15	ANODE 47	ANODE 15	N.C.	CATHODE 15	CATHODE 47
16	ANODE 48 (P8=ON)	ANODE 16	N.C.	CATHODE 16	CATHODE 48
17	ANODE 49	ANODE 17	N.C.	CATHODE 17	CATHODE 49
18	ANODE 50 (P9=ON)	ANODE 18	N.C.	CATHODE 18	CATHODE 50
19	ANODE 51	ANODE 19	N.C.	CATHODE 19	CATHODE 51
20	ANODE 52 (P10=ON)	ANODE 20	N.C.	CATHODE 20	CATHODE 52
21	ANODE 53	ANODE 21	N.C.	CATHODE 21	CATHODE 53
22	ANODE 54 (P11=ON)	ANODE 22	N.C.	CATHODE 22	CATHODE 54
23	ANODE 55	ANODE 23	N.C.	CATHODE 23	CATHODE 55
24	ANODE 56 (P12=ON)	ANODE 24	N.C.	CATHODE 24	CATHODE 56
25	ANODE 57	ANODE 25	N.C.	CATHODE 25	CATHODE 57
26	ANODE 58 (P13=ON)	ANODE 26	N.C.	CATHODE 26	CATHODE 58
27	ANODE 59	ANODE 27	N.C.	CATHODE 27	CATHODE 59
28	ANODE 60 (P14=ON)	ANODE 28	N.C.	CATHODE 28	CATHODE 60
29	ANODE 61	ANODE 29	N.C.	CATHODE 29	CATHODE 61
30	ANODE 62 (P15=ON)	ANODE 30	N.C.	CATHODE 30	CATHODE 62
31	ANODE 63	ANODE 31	N.C.	CATHODE 31	CATHODE 63 (P17=ON)
32	ANODE 64 (P16=ON)	ANODE 32	N.C.	CATHODE 32	CATHODE 64 (P18=ON)

Table 16.5.- CM-DO-40/7 VME64x J2 application connector pin-out.

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Chapter 17.- CM-DO-40/8 TTL Totem-pole Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/8** TTL Totem-pole version.

17.1.- CM-DO-40/8 TTL Output Technical Specifications.

The **CM-DO-40/8** incorporates 64 TTL outputs in standard totem-pole configuration. The installed chips are type 74F04. Other equivalent chips in HCT or ACT logic are optionally available.

The board supports industry standard TTL devices in DIL packages. This allows selection of output parts from many different manufacturers and temperature ranges. This board is available with inverted polarity. The factory default TTL logic family is type FAST due its high fan-out capability and high speed. Other logic families can be optionally installed upon customer request.

Table 17.1 shows the principle characteristics of the **CM-DO-40/8** TTL outputs.

Parameter	Description
TTL output type	74F04 chips.
AC Voltage range	Not available
DC Voltage range	0 to 5 Volts (TTL levels)
AC Current range	Not available
DC Current range	60 mA sink
Switching-ON Time	6 ns typical
Switching-OFF Time	6 ns typical
Switching frequency	> 100 MHz
Output Voltage (ON)	< 0.8 V (Logic 0)
Output Voltage (OFF)	> 2.8 V (Logic 1)
Galvanic isolation	Not isolated (common ground)
Load type	> 10 TTL standard gates
Output terminals	2 terminals per TTL channel in both VME64x output connectors.

Table 17.1.- CM-DO-40/8 general output characteristics.

Each TTL channel constitutes a 2 pin output (Signal and board ground). The output TTL voltage is used for Built-In-Test purposes and its logic status is routed back into the Channel Status Register.

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Damage caused due to incorrect application design or wiring of external loads is not covered by the module guarantee.

OBSERVATION

The board is supplied by default with TTL chips which are normally in logic '1' status. This is the logic output of all channels after a VMEbus SYSRES* has been asserted.

OBSERVATION

Inverted output polarity versions are available upon customer request. These versions are supplied with TTL chips normally in logic '0' status.

17.3.- CM-DO-40/8 Electrical Specifications.

Table 17.3 shows the **CM-DO-40/8** TTL version voltage and current requirements. Voltage tolerances are also specified.

VMEbus Power	CM-DO-40/5 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC}, @ 400 mA, plus TTL external loads current consumption (up to 2 Amp max).	+4.85 to +5.25 V_{DC}

Table 17.3.- CM-DO-40/8 TTL version power requirements.

Table 17.3 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

17.4.- CM-DO-40/8 Application Connector Pin-out.

Tables 17.4 & 17.5 show the **CM-DO-40/8** application connector pin-out.

See Section 4.10 to find details concerning the connector row arrangement.

OBSERVATION

Note that the signal distribution and pin-out is identical for both connectors. Therefore, only a single external user application connector which wires all output signals is required. This user connector can be inserted into either the front panel or P2.

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PIN	Row z	Row a	Row b	Row c	Row d
1	TTL33	TTL1	N.C.	GND	GND
2	TTL34 (P1=ON)	TTL2	N.C.	GND	GND
3	TTL35	TTL3	N.C.	GND	GND
4	TTL36 (P2=ON)	TTL4	N.C.	GND	GND
5	TTL37	TTL5	N.C.	GND	GND
6	TTL38 (P3=ON)	TTL6	N.C.	GND	GND
7	TTL39	TTL7	N.C.	GND	GND
8	TTL40 (P4=ON)	TTL8	N.C.	GND	GND
9	TTL41	TTL9	N.C.	GND	GND
10	TTL42 (P5=ON)	TTL10	N.C.	GND	GND
11	TTL43	TTL11	N.C.	GND	GND
12	TTL44 (P6=ON)	TTL12	N.C.	GND	GND
13	TTL45	TTL13	N.C.	GND	GND
14	TTL46 (P7=ON)	TTL14	N.C.	GND	GND
15	TTL47	TTL15	N.C.	GND	GND
16	TTL48 (P8=ON)	TTL16	N.C.	GND	GND
17	TTL49	TTL17	N.C.	GND	GND
18	TTL50 (P9=ON)	TTL18	N.C.	GND	GND
19	TTL51	TTL19	N.C.	GND	GND
20	TTL52 (P10=ON)	TTL20	N.C.	GND	GND
21	TTL53	TTL21	N.C.	GND	GND
22	TTL54 (P11=ON)	TTL22	N.C.	GND	GND
23	TTL55	TTL23	N.C.	GND	GND
24	TTL56 (P12=ON)	TTL24	N.C.	GND	GND
25	TTL57	TTL25	N.C.	GND	GND
26	TTL58 (P13=ON)	TTL26	N.C.	GND	GND
27	TTL59	TTL27	N.C.	GND	GND
28	TTL60 (P14=ON)	TTL28	N.C.	GND	GND
29	TTL61	TTL29	N.C.	GND	GND
30	TTL62 (P15=ON)	TTL30	N.C.	GND	GND
31	TTL63	TTL31	N.C.	GND	GND (P17=ON)
32	TTL64 (P16=ON)	TTL32	N.C.	GND	GND (P18=ON)

Table 17.5.- CM-DO-40/8 VME64x J2 application connector pin-out.

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Chapter 18.- CM-DO-40/9 Open Collector Version.

This chapter describes technical details exclusive to the **CM-DO-40/9** TTL Open-Collector version.

18.1.- CM-DO-40/9 Open Collector Output Technical Specifications.

The **CM-DO-40/9** incorporates 64 TTL outputs in standard open collector configuration. The installed chips are type 7406 Hex Buffers.

The board supports industry standard TTL devices in DIL packages. This allows selection of output parts from many leading manufacturers and temperature ranges. There is an inverted polarity option which uses the 7407. Both chips are buffers with open-collector transistors which require external pull-up resistors for proper operation. The board does not implement any pull-up resistors and therefore the loads must be externally wired in the application. ***Table 18.1*** shows the principle characteristics of the **CM-DO-40/9** Open-collector outputs.

Parameter	Description
TTL output type	7406 chips
AC Voltage range	Not available
DC Voltage range	0 to 30 Volts maximum
AC Current range	Not available
DC Current range	50 mA sink (30 mA for Vout < 0.4V)
Switching-ON Time	20 ns typical
Switching-OFF Time	15 ns typical
Switching frequency	40 MHz
Output Voltage (ON)	< 0.8 V (Logic 0)
Output Voltage (OFF)	Pull-up Vcc (Logic 1)
Galvanic isolation	Not isolated (common ground)
Load type	External pull-up resistor or equivalent load
Output terminals	2 terminals per channel in both VME64x output connectors

Table 18.1.- CM-DO-40/9 general output characteristics.

Each Open-collector channel is a 2 pin output (Collector and Emitter=ground). The output voltage is used for Built-In-Test purposes and its logic status is routed back into the Channel Status Register.

OBSERVATION

The Built-In-Test is not operative when no external pull-up loads are fitted in the application.

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Damage caused due to incorrect application design or wiring of external loads is not covered by the module guarantee.

OBSERVATION

The board is supplied by default with TTL chips which are normally in logic '1' status (transistor in cut-off). This is the logic output of all channels after a VMEbus SYSRES* has been asserted.

OBSERVATION

Inverted output polarity versions are available upon customer request. These versions are supplied with TTL chips normally in logic '0' status by default (transistors saturated).

18.3.- CM-DO-40/9 Electrical Specifications.

Table 18.3 shows the **CM-DO-40/9** open collector version voltage and current requirements. Voltage tolerances are also specified.

VMEbus Power	CM-DO-40/9 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC}, @ 400 mA	+4.85 to +5.25 V_{DC}

Table 18.3.- CM-DO-40/9 Open collector version power requirements.

Table 18.3 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

18.4.- CM-DO-40/9 Application Connector Pin-out.

Tables 18.4 & 18.5 show the **CM-DO-40/9** application connector pin-out.

See Section 4.10 to find details concerning the connector row arrangement.

OBSERVATION

Note that the signal distribution and pin-out is identical for both connectors. Therefore, only a single external user application connector which wires all output signals is required. This user connector can be inserted into either the front panel or P2.

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PIN	Row z	Row a	Row b	Row c	Row d
1	COLL33	COLL1	N.C.	GND	GND
2	COLL34 (P1=ON)	COLL2	N.C.	GND	GND
3	COLL35	COLL3	N.C.	GND	GND
4	COLL36 (P2=ON)	COLL4	N.C.	GND	GND
5	COLL37	COLL5	N.C.	GND	GND
6	COLL38 (P3=ON)	COLL6	N.C.	GND	GND
7	COLL39	COLL7	N.C.	GND	GND
8	COLL40 (P4=ON)	COLL8	N.C.	GND	GND
9	COLL41	COLL9	N.C.	GND	GND
10	COLL42 (P5=ON)	COLL10	N.C.	GND	GND
11	COLL43	COLL11	N.C.	GND	GND
12	COLL44 (P6=ON)	COLL12	N.C.	GND	GND
13	COLL45	COLL13	N.C.	GND	GND
14	COLL46 (P7=ON)	COLL14	N.C.	GND	GND
15	COLL47	COLL15	N.C.	GND	GND
16	COLL48 (P8=ON)	COLL16	N.C.	GND	GND
17	COLL49	COLL17	N.C.	GND	GND
18	COLL50 (P9=ON)	COLL18	N.C.	GND	GND
19	COLL51	COLL19	N.C.	GND	GND
20	COLL52 (P10=ON)	COLL20	N.C.	GND	GND
21	COLL53	COLL21	N.C.	GND	GND
22	COLL54 (P11=ON)	COLL22	N.C.	GND	GND
23	COLL55	COLL23	N.C.	GND	GND
24	COLL56 (P12=ON)	COLL24	N.C.	GND	GND
25	COLL57	COLL25	N.C.	GND	GND
26	COLL58 (P13=ON)	COLL26	N.C.	GND	GND
27	COLL59	COLL27	N.C.	GND	GND
28	COLL60 (P14=ON)	COLL28	N.C.	GND	GND
29	COLL61	COLL29	N.C.	GND	GND
30	COLL62 (P15=ON)	COLL30	N.C.	GND	GND
31	COLL63	COLL31	N.C.	GND	GND (P17=ON)
32	COLL64 (P16=ON)	COLL32	N.C.	GND	GND (P18=ON)

Table 18.5.- CM-DO-40/9 VME64x J2 application connector pin-out.

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Chapter 19.- CM-DO-40/10 Open Collector with +5VDC Pull-up Resistors Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/10** open collector version with +5VDC pull-up resistors.

19.1.- CM-DO-40/10 Technical Specifications.

The **CM-DO-40/10** incorporates 64 TTL outputs in standard open collector configuration. The installed chips are type 7406 Hex Buffers.

The board supports industry standard TTL devices in DIL packages. This allows selection of output parts from many leading manufacturers and temperature ranges. There is an inverted polarity option which uses the 7407. Both chips are buffers with open-collector transistors which require external pull-up resistors for proper operation. The board implements per channel 1 KΩ pull-up resistors powered by the Vcc +5VDC supply. These on-board resistors do not prevent the use of other loads externally wired in the application.

Table 19.1 shows the principle characteristics of the **CM-DO-40/10** Open-collector outputs.

Parameter	Description
TTL output type	7406 chips with pull-up resistors
AC Voltage range	Not available
DC Voltage range	0 to 5 Volts through pull-up (up to 30 Volts maximum)
AC Current range	Not available
DC Current range	5 mA sink through pull-up (up to 50 mA maximum).
Switching-ON Time	30 ns typical
Switching-OFF Time	20 ns typical
Switching frequency	30 MHz
Output Voltage (ON)	< 0.4 V (Logic 0)
Output Voltage (OFF)	+5 VDC through pull-up (Logic 1)
Galvanic isolation	Not isolated (common ground)
Load type	On-board 1K pull-up per channel tied to + 5 Vcc
Output terminals	2 terminals per channel in both VME64x output connectors

Table 19.1.- CM-DO-40/10 general output characteristics.

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OBSERVATION

As shown in the attached figures, testing the **CM-DO-40/10** outputs is very simple and can be done, if necessary, by measuring the output voltage levels with a conventional polimeter or oscilloscope.

IMPORTANT

Each output signal is referenced to the VMEbus backplane ground (board ground). Note that there is no galvanic isolation on the **CM-DO-40** version. Therefore special caution must be observed so as to not generate shortcircuits through the common ground, and to not provoke damage to the board circuitry or the VMEbus system. Do not drive external loads or gates powered by power supplies which are not isolated or have potential grounding problems, etc.

Damage caused due to incorrect application design or wiring of external loads is not covered by the module guarantee.

OBSERVATION

The board is supplied by default with TTL chips which are normally in logic '1' status. This is the logic output of all channels after a VMEbus SYSRES* has been asserted.

OBSERVATION

Inverted output polarity versions are available upon customer request. These versions are supplied with TTL chips normally in logic '0' status.

19.3.- CM-DO-40/10 Electrical Specifications.

Table 19.3 shows the **CM-DO-40/10** open collector version voltage and current requirements. Voltage tolerances are also specified.

VMEbus Power	CM-DO-40/9 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC}, @ 400 mA + 5 mA per channel in ON status (750 mA maximum)	+4.85 to +5.25 V_{DC}

Table 19.3.- CM-DO-40/10 Open collector with +5 VDC pull-ups power requirements.

Table 19.3 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

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PIN	Row z	Row a	Row b	Row c	Row d
1	COLL33	COLL1	N.C.	GND	GND
2	COLL34 (P1=ON)	COLL2	N.C.	GND	GND
3	COLL35	COLL3	N.C.	GND	GND
4	COLL36 (P2=ON)	COLL4	N.C.	GND	GND
5	COLL37	COLL5	N.C.	GND	GND
6	COLL38 (P3=ON)	COLL6	N.C.	GND	GND
7	COLL39	COLL7	N.C.	GND	GND
8	COLL40 (P4=ON)	COLL8	N.C.	GND	GND
9	COLL41	COLL9	N.C.	GND	GND
10	COLL42 (P5=ON)	COLL10	N.C.	GND	GND
11	COLL43	COLL11	N.C.	GND	GND
12	COLL44 (P6=ON)	COLL12	N.C.	GND	GND
13	COLL45	COLL13	N.C.	GND	GND
14	COLL46 (P7=ON)	COLL14	N.C.	GND	GND
15	COLL47	COLL15	N.C.	GND	GND
16	COLL48 (P8=ON)	COLL16	N.C.	GND	GND
17	COLL49	COLL17	N.C.	GND	GND
18	COLL50 (P9=ON)	COLL18	N.C.	GND	GND
19	COLL51	COLL19	N.C.	GND	GND
20	COLL52 (P10=ON)	COLL20	N.C.	GND	GND
21	COLL53	COLL21	N.C.	GND	GND
22	COLL54 (P11=ON)	COLL22	N.C.	GND	GND
23	COLL55	COLL23	N.C.	GND	GND
24	COLL56 (P12=ON)	COLL24	N.C.	GND	GND
25	COLL57	COLL25	N.C.	GND	GND
26	COLL58 (P13=ON)	COLL26	N.C.	GND	GND
27	COLL59	COLL27	N.C.	GND	GND
28	COLL60 (P14=ON)	COLL28	N.C.	GND	GND
29	COLL61	COLL29	N.C.	GND	GND
30	COLL62 (P15=ON)	COLL30	N.C.	GND	GND
31	COLL63	COLL31	N.C.	GND	GND (P17=ON)
32	COLL64 (P16=ON)	COLL32	N.C.	GND	GND (P18=ON)

Table 19.5.- CM-DO-40/10 VME64x J2 application connector pin-out.

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Chapter 20.- CM-DO-40/11 Open Collector with +12VDC Pull-up Resistors Version.

This chapter describes technical details which are exclusive to the **CM-DO-40/11** open collector version with +12VDC pull-up resistors.

20.1.- CM-DO-40/11 Technical Specifications.

The **CM-DO-40/11** incorporates 64 TTL outputs in standard open collector configuration. The installed chips are type 7406 Hex Buffers.

The board supports industry standard TTL devices in DIL packages. This allows selection of parts from leading manufacturers and different temperature ranges. There is an inverted polarity board option which uses the 7407. Both chips are buffers with open-collector transistors which require external pull-up resistors for proper operation. The board implements per channel 2K2 pull-up resistors powered by the VMEbus auxiliary +12VDC supply. These on-board resistors do not preclude the use of other loads externally wired to the application.

Table 20.1 shows the principle characteristics of the **CM-DO-40/11** Open-collector outputs.

Parameter	Description
TTL output type	7406 chips with pull-up resistors
AC Voltage range	Not available
DC Voltage range	0 to 12 Volts through pull-up (up to 30 Volts maximum)
AC Current range	Not available
DC Current range	5 mA sink through pull-up (up to 50 mA maximum)
Switching-ON Time	30 ns typical
Switching-OFF Time	20 ns typical
Switching frequency	30 MHz
Output Voltage (ON)	< 0.4 V (Logic 0)
Output Voltage (OFF)	+12 VDC through pull-up (Logic 1)
Galvanic isolation	Not isolated (common ground)
Load type	On-board 2K2 pull-up per channel tied to +12VDC
Output terminals	2 terminals per channel in both VME64x output connectors

Table 20.1.- CM-DO-40/11 general output characteristics.

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OBSERVATION

As shown in the attached figures, testing the **CM-DO-40/11** outputs is very simple and can be done, if necessary, by measuring the output voltage levels with a conventional polimeter or oscilloscope.

IMPORTANT

Each output signal is referenced to the VMEbus backplane ground (board ground). Note that there is no galvanic isolation on the **CM-DO-40** version. Therefore special caution must be observed so as to not generate shortcircuits through the common ground, and to not provoke damage to the board circuitry or the VMEbus system. Do not drive external loads or gates powered by power supplies which are not isolated or have potential grounding problems, etc.

Damage caused due to incorrect application design or wiring of external loads is not covered by the module guarantee.

OBSERVATION

The board is supplied by default with TTL chips which are normally in logic '1' status (transistor in cut-off). This is the logic output of all channels after a VMEbus SYSRES* has been asserted.

OBSERVATION

Inverted output polarity versions are available upon customer request. These versions are supplied with TTL chips normally in logic '0' status by default (transistors saturated).

20.3.- CM-DO-40/11 Electrical Specifications.

Table 20.3 shows the **CM-DO-40/11** open collector version voltage and current requirements. Voltage tolerances are also specified. Due to the pull-up resistors connected to +12VDC, the module requires this auxiliary voltage at the VMEbus backplane.

VMEbus Power	CM-DO-40/9 Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 VDC @ 400 mA	+4.85 to +5.25 VDC
Auxiliary supply	+12 VDC, @ 5 mA per channel in ON status (350 mA maximum)	+10 to +13 VDC

Table 20.3.- CM-DO-40/11 Open collector with +12 VDC pull-ups power requirements.

Table 20.3 ratings should be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

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PIN	Row z	Row a	Row b	Row c	Row d
1	COLL33	COLL1	N.C.	GND	GND
2	COLL34 (P1=ON)	COLL2	N.C.	GND	GND
3	COLL35	COLL3	N.C.	GND	GND
4	COLL36 (P2=ON)	COLL4	N.C.	GND	GND
5	COLL37	COLL5	N.C.	GND	GND
6	COLL38 (P3=ON)	COLL6	N.C.	GND	GND
7	COLL39	COLL7	N.C.	GND	GND
8	COLL40 (P4=ON)	COLL8	N.C.	GND	GND
9	COLL41	COLL9	N.C.	GND	GND
10	COLL42 (P5=ON)	COLL10	N.C.	GND	GND
11	COLL43	COLL11	N.C.	GND	GND
12	COLL44 (P6=ON)	COLL12	N.C.	GND	GND
13	COLL45	COLL13	N.C.	GND	GND
14	COLL46 (P7=ON)	COLL14	N.C.	GND	GND
15	COLL47	COLL15	N.C.	GND	GND
16	COLL48 (P8=ON)	COLL16	N.C.	GND	GND
17	COLL49	COLL17	N.C.	GND	GND
18	COLL50 (P9=ON)	COLL18	N.C.	GND	GND
19	COLL51	COLL19	N.C.	GND	GND
20	COLL52 (P10=ON)	COLL20	N.C.	GND	GND
21	COLL53	COLL21	N.C.	GND	GND
22	COLL54 (P11=ON)	COLL22	N.C.	GND	GND
23	COLL55	COLL23	N.C.	GND	GND
24	COLL56 (P12=ON)	COLL24	N.C.	GND	GND
25	COLL57	COLL25	N.C.	GND	GND
26	COLL58 (P13=ON)	COLL26	N.C.	GND	GND
27	COLL59	COLL27	N.C.	GND	GND
28	COLL60 (P14=ON)	COLL28	N.C.	GND	GND
29	COLL61	COLL29	N.C.	GND	GND
30	COLL62 (P15=ON)	COLL30	N.C.	GND	GND
31	COLL63	COLL31	N.C.	GND	GND (P17=ON)
32	COLL64 (P16=ON)	COLL32	N.C.	GND	GND (P18=ON)

Table 20.5.- CM-DO-40/11 VME64x J2 application connector pin-out.

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Chapter 21.- Appendix.

This chapter describes complementary aspects of the **CM-DO-40** board, such as other available manuals, complementary set of VMEbus boards, etc.

21.1.- CM-DO-40. Other Available Manuals.

The current manual, ref: **CM-DO-40 MAP**, is an application manual intended for programmers, engineers and system integrators. Additionally, **CM Computer** edits another manual related to this board. This is the following:

- Maintenance manual: CM-DO-40 MMT.

This manual is intended to facilitate **CM-DO-40** hardware maintenance. It is an useful document for those companies who implement the **CM-DO-40** in large military application projects. This manual speeds up checking, maintenance and failure location detection in the module. Additionally, the documentation describes the board's submodules and operation. It includes the basic schematic diagrams, a set of scope waveforms, and logic analyzer figures captured at critical points of the board circuitry.

The maintenance manual covers the following topics:

1. *Electrical and mechanical schemes.*
2. *Source code built-in-test software.*
3. *NATO list part number (classified list of pieces and spares).*
4. *Functional description and maintenance procedures.*

OBSERVATION

The module maintenance manual is intended for CM internal use only. It is not a standard product. However **CM Computer** may supply this manual to some customers under special conditions such as large orders, special military projects, non disclosure agreements, etc.

OBSERVATION

CM Computer company is authorized to supply electronic equipment for the NATO forces with the number 7684B. Additionally, this company is registered in the Spanish Defense Department *(DGAM)* with the number 9015.

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Advanced level:

Includes a post-manufacturing visual inspection, general module adjustment.

A 24 hour continuous operation test in a VME backplane, performed with a specific module software testing program.

A 6 hour continuous temperature operation test at -25 ºC, plus a 6 hour continuous operation test at +75 ºC.

Optional 30 min mechanical test, withstanding 50 to 500 Hz, 2 g amplitude sinusoidal vibration.

OBSERVATION

All tests include a final visual inspection, operational test, packaging, and custom delivery.

IMPORTANT

On written request from the customer and at no extra cost all military modules *(R+ and 883 series)* will include a MIL-STD-810D certificate for Methods 501.2 and 502.2. When delivering 883 modules this certificate can be complemented with the components screening *"certificate of compliance"* for MIL-STD-883.

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