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Find the *CM Computer CM-DO-30* at our website: ***Click HERE***

CM-DO-30 Board user's manual

64 channel relay/optocoupler output module.

CM-DO-30

64 channel relay/optocoupler output module

User's manual

CM Computer
Updated Documentation

Ref : CM-DO-30 MAP/I
Version 4.0
Date : January - 1996.

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User's notes.

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Chapter 1.- Introduction.

1.1.- Board Description.

The **CM-DO-30** is a general purpose 64 channel relays or optocoupler output board designed for 6U VMEbus applications. The output channels can be supplied with relays or optocouplers, depending on the customer requirements.

This board is a high performance slave unit designed with low heat CMOS technology. As a result, it can be successfully used in most of the actual engineering applications.

The **CM-DO-30** offers the user the following basic features:

a) Availability of a large number of output channels.

The **CM-DO-30** implements 64 relays or optocouplers per board. This module offers the largest channel density of the market. Up to 16 identical modules can be connected to the same backplane, conforming systems with up to 1024 output channels.

In those applications which manage thousands of outputs, this board minimizes the number of necessary units, resulting in a considerable reduction of boards, racks, power supplies, etc.

b) Full galvanic isolation per channel.

The **CM-DO-30** module implements a relay or an optocoupler per channel. Both devices provide a minimum of 500 Volts of continous isolation barrier between each external output and the VMEbus power & ground lines.

In most professional applications, this results in a safe and reliable operation, by protecting the remaining VMEbus boards in the backplane against output overloadings, grounding problems, electrical discharges, manipulation errors, etc.

c) Low cost.

This board is a low cost unit, integrating 64 channels per module, thus offering a specific low cost per channel. As a result, it is a competitive option in comparison to other similar products in the market.

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d) Extremely simple programming.

The **CM-DO-30** board programming is very simple. The user can program the desired status of the 64 output channels by simply performing four VMEbus consecutive "WORD" write accesses.

e) Military versions.

The **CM-DO-30** module is available in 2 different temperature ranges, 100% compatible.

All **CM Computer** products are originally designed for military environments, therefore implementing full military components and conduction cooled PCB. Industrial versions are available at a low cost, since are built with industrial class components.

This manual describes the **CM-DO-30** board hardware features and technical characteristics. It is specially oriented for application Engineers, Programmers, and system Integrators, who wish to implement this module in their projects.

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1.2.- CM-DO-30 Applications.

The potential applications covered by the **CM-DO-30** module are wide and diverse. This type of module can basically be used as a general purpose output board in any commercial, industrial, or military VMEbus project.

The following application examples, classified by areas, are only a fraction of the existing possibilities.

a) Commercial applications.

- Software development equipment.
- Computer aid design (CAD).
- Data processing computers.
- Scientific computers.

b) Industrial applications.

- Industrial control of chemical plants, factories, refineries.
- Automation of buildings and hotels, sport pavillions, stadiums.
- Traffic control in big cities. Railway control.
- Automation of laboratories and homologation centers.
- Power station and electrical grid control.
- Surveillance, fire detection, etc.
- Artificial vision systems.
- Numeric control machinery. Robotics. Artificial intelligence.

c) Military applications.

- Navigation and flight computers for ships and aircrafts.
- Weapon systems and gunfire control.
- Radar and sonar detection. Target and trajectory calculation.
- Signal processing. Data link.
- Electronic warfare. Electronic countermeasure equipment.
- Intelligent weapons, torpedos, missiles.
- Automation of war headquarters and tactical rooms.

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1.3.- CM-DO-30 Technical datasheet.

This section illustrates with a copy of the **CM-DO-30** datasheet, which summarizes the main characteristics and features of this module. The original datasheet shows a color photograph of a military **CM-DO-30 R+** version.

This datasheet is included in the **CM Computer "1996 6U Short form Catalogue".**

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CM-DO-30 ®

64 channel output module

DESCRIPTION: the CM-DO-30 module is a general purpose output board designed to support 64 relay or optocoupler output channels, according to customer requirements.

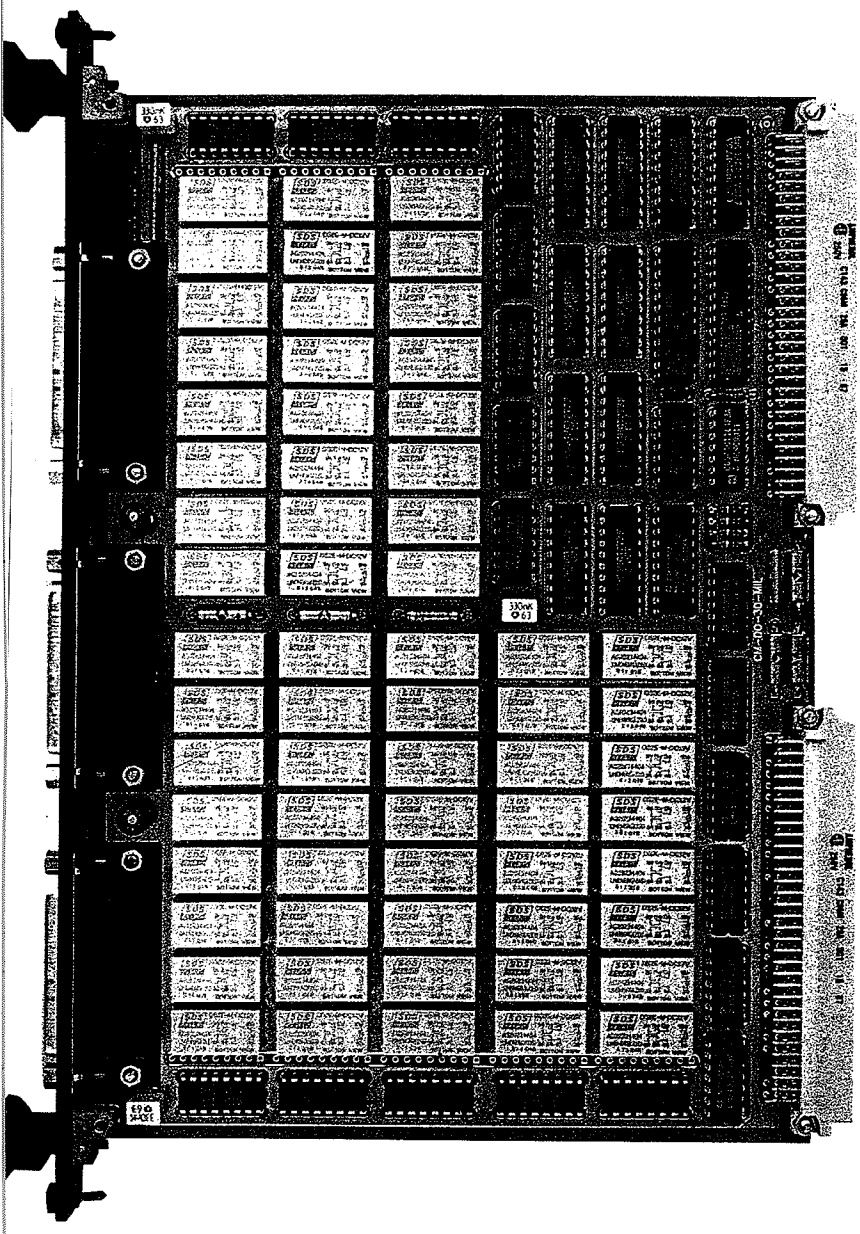
The relay version is ideal for applications where it is necessary to drive high voltages, up to a maximum of 250 V, AC or DC, (typically for solenoid, motor control & similar applications).

The optocoupler version is recommended for applications where considerations such as high operation speed, (up to 100,000 commutations per second), or driving low DC current (up to a maximum of 50 mA per channel & 30 V) are necessary. Typical examples are the interconnections of digital systems, optocoupled parallel interfaces, isolated frequency transmitters, etc.

Each one of the 64 channels is provided with total galvanic isolation (500 V minimum), between output and the VMEbus lines. This isolation provides high security protection against external shorcircuits, overloads, and manipulation errors, etc.

The CM-DO-30 is designed with low heat CMOS technology, which provides high noise inmunity and minimum power consumption. It is available in 2 different, 100% compatible, versions.

An on-board switch allows the simultaneous connection of up to 16 DO-30 boards in the same VMEbus backplane configurating systems with up to 1,024 output channels.



TEMPERATURE RANGES: the CM-DO-30 board is available in the following temperature versions. The two versions are fully compatible with each other.

INDUSTRIAL VERSION: CM-DO-30 I.

Incorporates plastic and ceramic packaged **-40 (-25)** to **+85** ºC industrial temperature range IC's. Permanent Operation Temperature Range: **-20** to **+75** ºC.

MIL-RUGGED VERSION: CM-DO-30 M

Incorporates a sophisticated conduction cooled printed circuit board with thermal overlay. 100% of IC's are military ceramic packages with temperature range from **-55** to **+125** ºC. Board Permanent Operation Range: **-40** to **+85** ºC.

VMEbus connectors: class I **MIL-C-24308** & **MIL-C-55302** qualified in Mil-rugged version.

Temperature: certificate of MIL-STD-810 test (methods 501.2 & 502.2) & MIL-E-5400 for avionic equipment class 1B (temperature & altitude).

Vibration/shock: test MIL-STD-810 (514 & 516).

Relative humidity: 0-95% non condensing. Test MIL-STD-810 507 & 509 (saline fog, dust).

Consumption:

Relay version: consumption of +5 V/300 mA & +12 V/10 mA with all the relays disactivated, and +5 V/300 mA & +12 V/2 A with all the relays activated.

Optocoupler version: consumption of +5 V/ /300 mA with all the optocouplers disactivated and +5V/800 mA with all the optocouplers activated.

Size: double height 6U Euroboard, 233x160 mm.

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TECHNICAL FEATURES

Relay version:

Channels:	64 output channels, each one provided with a relay. The off state is open contact.
Output voltage:	Up to 250 V DC, and 200 V RMS AC.
Output current:	Up to a maximum of 2 A RMS AC or DC.
Contact resistance:	<300 mΩ, with close contact.
Switching freq.:	Up to a maximum of 100 commutations per second.

Common features:

VMEbus interface:	Fully compliant with the IEEE 1014 rev. C specifications. Operates as VME slave, with an A24/D16 standard interface addressing mode.
Isolation:	Full galvanic isolation of all outputs, higher than 500 volts.

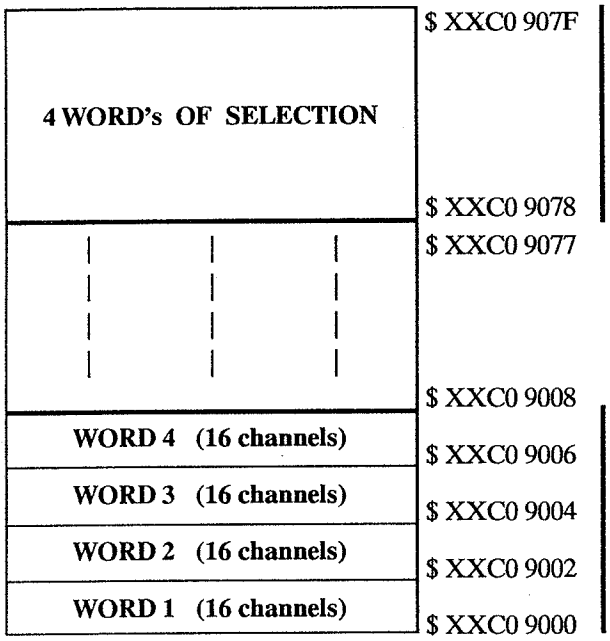
Optocoupler version:

Channels:	64 output channels, provided with a optocoupler per channel. Each output is implemented with an open collector transistor, that is not activated in reset state (off).
Output voltage:	Up to a maximum of 30 V DC.
Output current:	Up to a maximum of 50 mA DC.
Switching freq.:	Up to a maximum of 100,000 commutations per second .

Common features:

Output connector:	Three 44 pin Cannon connectors, which are mounted on the front panel. 2 pins per output channel.
Panel indicator:	1 led on front panel for each one of the first 8 channels, which externally indicate the "ON" or "OFF" state of its channel.

VMEbus INTERFACE.



"$ XXC0 90XX" ADDRESS: represents the address range occupied by each one of the CM-DO-30 module. Each board occupies a 8 byte block. An on-board switch allows the simultaneous connecting of up to 16 CM-DO-30 modules in the same backplane, which are consecutively accessed along the reserved range.

WORD "X": "word" format memory address where the user writes the code status of the corresponding 16 channels: open or close circuit. This writing cycle accesses to the on-board internal latches, which will maintain the output status until a new access is performed.

DOCUMENTATION

LEVEL 1, CM-DO-30 MAP: user's manual. Module hardware specifications especially oriented for software development.
LEVEL 2, CM-DO-30 MMT: maintenance manual. Includes BIT scope, test point wave forms, logic analizing diagrams, etc.
LEVEL 3, CM-DO-30 NAT: maintenance manual according to NATO forces. Includes the above manuals plus mechanical and electrical scematics, "NATO list part number", extended functional description and maintenance & calibration procedures for in-service equipment.

ORDERING INFORMATION.

MODEL REF.	DESCRIPTION	C	I	R+	883 B
CM-DO-30 /1	Relay version, 250 V & 2 A RMS, full isolation 500 V.	----	*	*	----
CM-DO-30 /2	Optocoupler version, 30 V & 50 mA DC, full isolation 500 V.	----	*	*	----

Your local representative:

EGONDI ARTES GRAFICAS

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Chapter 2.- General considerations.

2

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

2.1.- Manual terminology.

The terminology used in this manual is intended to be the most compatible with similar product manuals and the usual 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', this is noted by an asterisk. Those signals asserted at logic '1' are named without an asterisk. Notice 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 interesting manuals.

It is highly recommended that the user reads 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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2.3.- VMEbus compatibility.

The **CM-DO-30** board and the remainder of the **CM VMEbus** modules have been designed according to the **ANSI/IEEE STD 1014-1987 IEC 821 & 297** specifications for VME compatible products.

This product is electrically and mechanically compatible with other VMEbus products available in the market, therefore, you can easily interchange and interconnect them.

This product has successfully passed a compatibility test performed by the VMEbus Anomaly Trigger detector (VBAT). This equipment, conjunctly used with a 200 MHz and 96 channel Logic Analyzer, automatically recognizes more than 30 violations of the VMEbus specifications in real time.

The remainder of the **CM VMEbus** boards have also been similarly tested and were proven to be compatible.

CM Computer has performed several compatibility tests between the **CM-DO-30** and other products in the market, obtaining satisfactory results each time. For the proper operation of the **CM-DO-30** board, it is necessary to insert it in VME compatible racks and backplanes.

CM Computer has tested this product with several racks and backplanes in the market (CM, Schroff, Augat, AEG, etc...), obtaining satisfactory results up to 50 MHz of CPU operation speed.

2.4.- Proprietary rights and patents.

The **CM-DO-30** board and the remainder of the **CM VME** compatible set, has been entirely designed by the **CM Computer** company, which has all manufacturing, distribution, reproduction and modification rights.

Non authorized partial or total reproduction of this product and its documentation and/or violation of the above rights, will result in legal persecution.

The specifications and design of the **CM-DO-30** board are subject to change without notice.

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2.5.- Guarantee.

All the VMEbus modules manufactured by **CM Computer** include a 1 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 operation 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 sensible 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.

IMPORTANT

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

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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 to 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.

IMPORTANT

Avoid connecting cables on the board application connectors while functioning. Voltage discharges may damage the board output relays or optocouplers.

IMPORTANT

CM Computer is continuously searching ways to improve its products. Therefore, specifications features and designs of the modules described in the present manual may change without prior notice.

IMPORTANT

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Chapter 3.- Functional description.

This chapter is dedicated to analyze the different submodules and functional blocks that comprise the **CM-DO-30** board. The main objetive is to introduce and familiarize the user with the board contents and its technical features.

3.1.- Functional units.

- Output channels.

The **CM-DO-30** board implements 64 independent output channels wired through its 3 front panel connectors.

- Board options.

The **CM-DO-30** is supplied to the customer in two different versions: relays and optocouplers.

The relay version is specially suited for applications where it is necessary to drive high AC or DC voltages, or output loads which require up to 1 Amp of current. Typical applications are the electrovalves management, control of electrical motors, etc.

The optocoupler version is recommended for those applications needing a high operation speed (up to 50 KHz), hundred of millions of switching cycles, or driving low DC current signals, etc. Typical examples are the interconnections of digital systems, optocoupled paralell interfaces, isolated pulse transmitters, etc.

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3.2.- CM-DO-30 relays version.

The **CM-DO-30** board implements 64 pre-magnetized relays. Each relay outputs a floating contact using two pins of the application connectors.

- Maximum voltage range.

The on-board relays can drive AC or DC voltages up to a maximum of 300 V_{DC} or 250 V_{AC} RMS.

- Maximum current range.

The implemented relays can drive AC or DC current signals up to a maximum of 1 Amp per channel. The recommended nominal current in continuous operation is 0.5 Amp.

- Switching frequency.

The maximum relay switching frequency is 100 Hz.

Due to mechanical limitations, this switching frequency should not be used in continuous operation mode, since this will result in a significant reduction of the relay contact life.

- Output impedance.

When the output channel is activated (ON), the relay contact is closed, and the output impedance is 0.2 Ω. When the contact is left open (channel OFF), the output impedance is higher than 20 MΩ.

- Galvanic isolation.

Each relay is galvanically isolated from the VMEbus signals 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. The isolation barrier between relays, or between any relay output and the VMEbus is better than 500 Volts in continuous mode and up to 1000 Volts peak.

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

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3.3.- CM-DO-30 optocouplers version.

The **CM-DO-30** board can be supplied populated with 64 optocouplers. Each optocoupler outputs an open collector phototransistor (emitter and collector), needing two pins per channel in the application connector.

- Maximum voltage and current range.

The implemented optocouplers can only drive DC signals.

The output phototransistor is NPN type, therefore the collector must be wired to a positive DC voltage through a resistor load, while the emitter must be connected to GND or a negative supply terminal.

The supported Vcollector-emitter voltage is 40 V, and the maximun collector current (Ic) is 50 mA.

- Switching frequency.

The maximum optocoupler switching frequency is 50 KHz.

Since the optocoupler is a solid state device (contrary to the relay) this switching frequency can be used in a continuous operation mode.

- Output impedance.

The phototransistor output impedance is about 20 Ω when the channel is in "ON" state. However, this impedance depends on the Ic current (collector to emitter current).

When the optocoupler is in "OFF" state, the output impedance is about 10 MΩ.

- Galvanic isolation.

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. The isolation barrier between optocouplers, or between any optocoupler output and the VMEbus signals is better than 500 Volts in continuous mode and up to 1500 Volts peak.

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3.4.- Other CM-DO-30 features.

The next features and functional units are common to all versions of the **CM-DO-30** modules, regardless of being supplied with relays or optocouplers.

- VMEbus interface.

The **CM-DO-30** incorporates a slave type interface in accordance with the IEEE 1014, IEC 821/297 rev. C specifications for VMEbus compatible products. The interface location monitor responds to A24/D16 standard VMEbus addressing cycles.

The **CM-DO-30** data and address lines are properly buffered to/from the VMEbus backplane. The module includes a DTACK* generator which will assert DTACK* during any valid WORD accesses. Additionally, it incorporates a BERR* generator which asserts BERR* as response to non supported BYTE or LONG WORD accesses.

The **CM-DO-30** is an output-only module, therefore, only supporting WRITE operations through the VMEbus.

- Front panel LED indicators.

There are 8 red LED indicators implemented on the board's front panel. These LEDs monitor the status of the first 8 output channels (channels 1 thru 8). A LED is illuminated ("ON"), if its associated channel relay or optocoupler is activated (relay with contacts closed or optocoupler output transistor saturated).

If the relay or optocoupler is deactivated (OFF status), the LED is switched-off (relay with contacts opened or optocoupler in cut-off with its output transistor in high impedance).

- Front panel application connectors.

The **CM-DO-30** board implements three 44 pin, high density, female Cannon application connectors on the front panel. These connectors provide the 128 output pins (2 per channel) needed to wire the 64 board channels to the application.

- CM-DO-30 PCB switches.

A jumper block allows to map up to 16 **CM-DO-30** modules in the VMEbus.

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3.5.- CM-DO-30 block diagram.

Figure 3.1, illustrates the **CM-DO-30** general block diagram.

This output module is relatively easy to use and program. ***Figure 3.1.*** shows how the **CM-DO-30** board implements 64 identical blocks. Each block is composed of a relay or optocoupler. On board latches are intended for storing the output channels status.

Other funtional units are the VMEbus interface, address decoder, *DTACK** and *BERR** generators and the on-board jumper block SW1, which must be customized according to VMEbus mapping address requirements.

Each of these blocks will be more extensively explained in the following chapters.

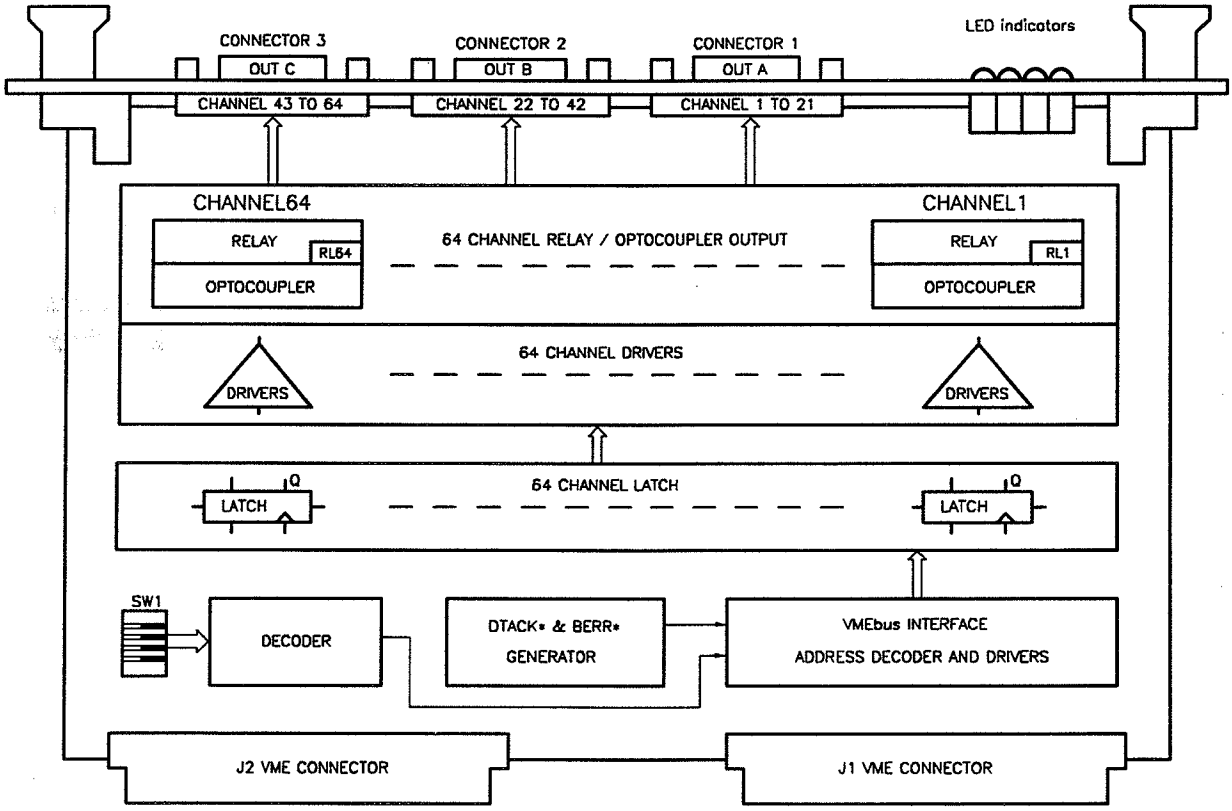


Figure 3.1.- CM-DO-30 Block diagram.

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User's notes.

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Chapter 4.- Technical specifications.

This chapter defines the mechanical and electrical specifications of the **CM-DO-30** board. Additionally, complementary sections are dedicated to explain the temperature versions, output load specifications, application connectors, etc.

4

4.1.- Mechanical specifications.

The **CM-DO-30** is fully compliant with the standard 6U, double height, Euroboard size (233x160 mm).

Figure 4.1 shows the **CM-DO-30** silk screen and components layout. The external dimensions and tolerances are fully compatible with the VMEbus specs. IEC-297 & IEC-603.

Figure 4.2 details the **CM-DO-30** front panel, offering a description of the panel's mechanical dimensions and drills. This output module front panel, when inserted in a 19" rack, occupies one slot size *(4 hp)*.

OBSERVATION

All module versions are provided with standard 96 pin DIN 41612 connectors, intended to be connected to any standard VMEbus backplane in the market.

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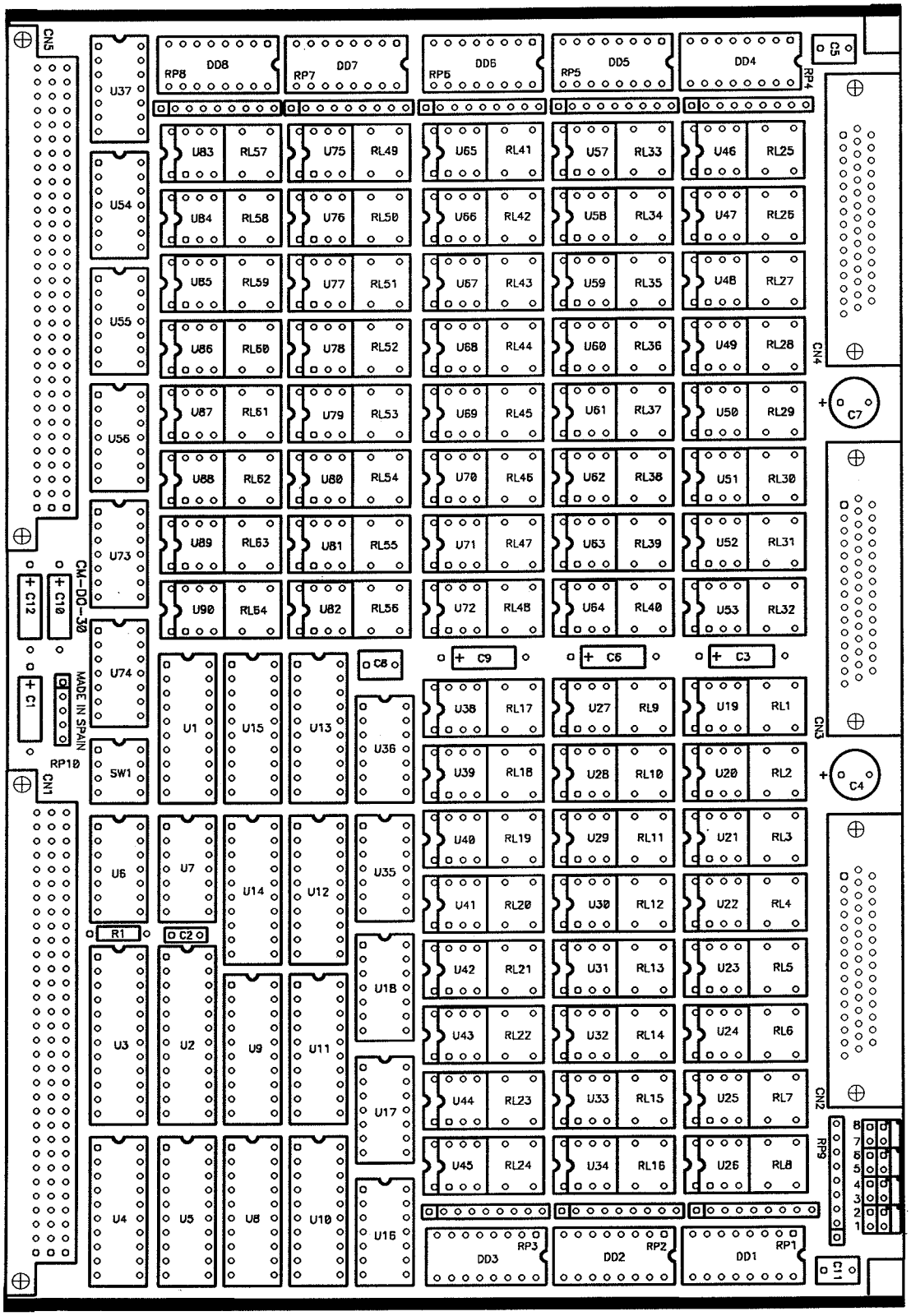


Figure 4.1.- CM-DO-30 Silk screen and components layout.

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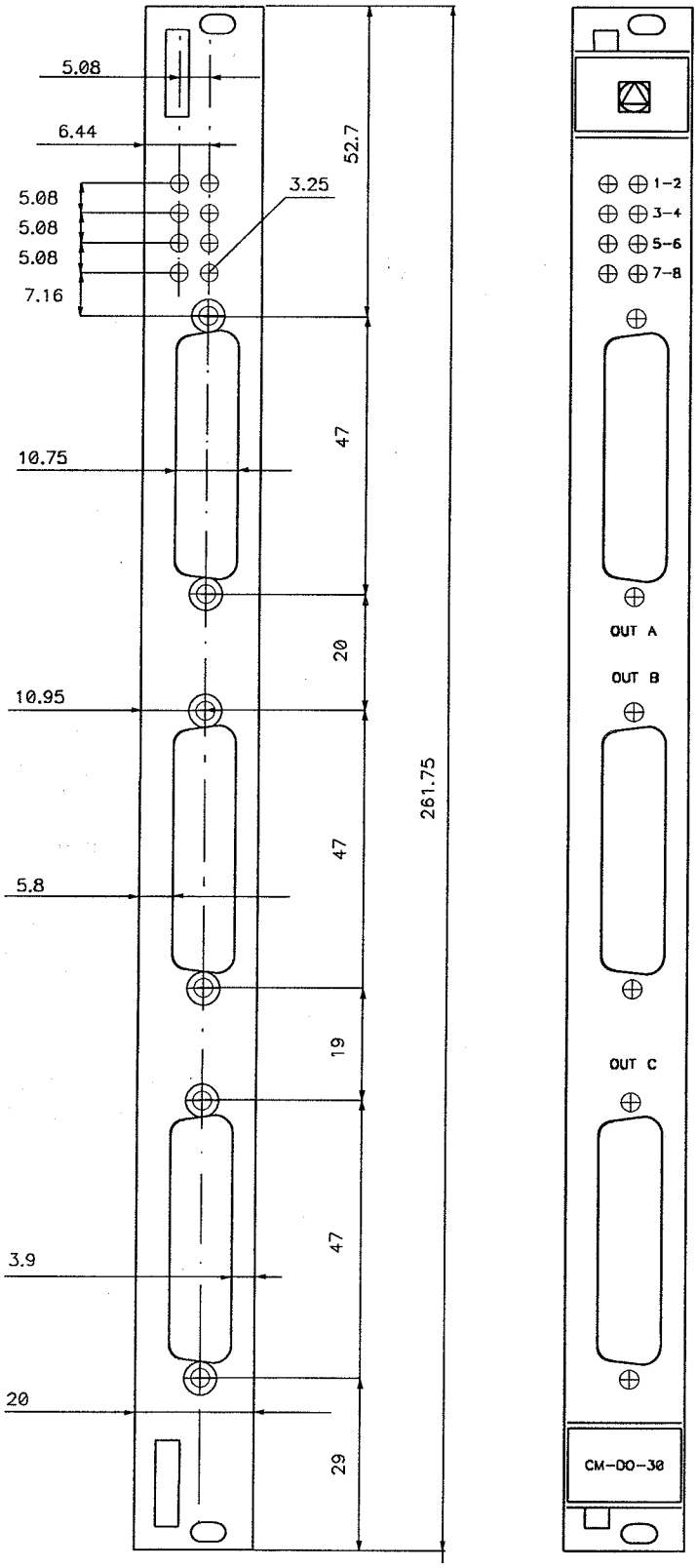


Figure 4.2.- CM-DO-30 front panel.

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4.2.- PCB specifications.

The **CM-DO-30** board implements a multilayer, high quality, PCB design, which offers the user the following advantages:

- Entirely developed by CAD and accomplished by photoplotter.
- 100% electrically tested.
- PCB external layers provided with components silk screen and anticorrosion solder mask.
- Class 4 PCB design, track widths up to 250 microns.
- No external signal tracks available, both in the soldering and components side. This feature avoids track corrosion as well as the risk of a track breakage.
- Shielding layer connected to ground. This results in a minimum external electromagnetic radiation and minimum parasite noise on-board.
- SMD decoupling capacitors per each IC located on the soldering side.
- Military Rugged+ version supplied with a sophisticated cooled PCB provided with metallic thermal overlay.

The military PCB offers three extra features:

- Very high capability to withstand shocks and vibrations, better than MIL-STD-810 requirements (Methods 514 and 516).
- Highly improved component heat dissipation, both in free-air convection or when inserted on a conduction cooled rack.
- All components work at an average homogeneous temperature in all points of the module. This feature, combined with a CMOS design, highly increases the components life and MTBF ratio.

OBSERVATION

All **CM-DO-30** ranges, including the cooled PCB version, are mechanically compatible with any VMEbus standard rack available in the market. Additionally, the user can combine CM's military modules with commercial ones in the same rack.

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4.3.- Electrical specifications.

The **CM-DO-30** 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 a high degree of logic integration by using 15 nsec CMOS GALs.

Since this board is a TTL digital unit, the main power supply voltage is +5 Vcc. When the board is populated with relays, it is necessary to supply an auxiliary +12 V_{DC} voltage.

Table 4.4, below, shows the **CM-DO-30** relays version voltage and current requirements.

VMEbus Power	Supply Voltage	Voltage Tolerance
Main supply Vcc	+5 V_{DC} @ 450 mA	+4.85 to +5.25 V_{DC}
Auxiliary supply	+12 V_{DC}, @ 30 mA per activated relay (1,89 Amp max).	+10 to +13 V_{DC}

Table 4.4.- CM-DO-30 relays version power requirements.

Table 4.5, below, shows the **CM-DO-30** optocouplers version voltage and current requirements. Voltage tolerances are also specified.

VMEbus Power	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 4.5.- CM-DO-30 optocouplers version power requirements.

Tables 4.4 & 4.5 rates can be considered as typical values. Small power consumption deviations may be found depending on the board temperature range.

OBSERVATION

The **CM-DO-30** is a low heat product, with a power consumption of only about 2 Watts (all relays or optocouplers switched-off). All required supply voltages are available in any standard J1 VMEbus backplane, being applied to the board through the P1 DIN 41612 connector.

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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4.4.- Temperature ranges.

The **CM-DO-30** board has been designed to operate in two different temperature ranges: Industrial and Militarized-Rugged. All temperature range modules are 100% compatible at the functional and programming levels, meaning that all software developed for any board range runs on the others.

Industrial version:

It incorporates Industrial class IC's in plastic packages, rated for a temperature from -40 (-25) to +85 ºC. The module is specified for an operation range from -20 to +75 ºC.

This option incorporates a *"medium level"* quality test.

The reference for the Industrial version is: **CM-DO-30 I**.

Military-Rugged version:

100% manufactured with ceramic package IC's. Military logic *(54XX serie)* and IC's rated for -55 to +125 ºC. Relays specified for -55 to +100 ºC. Conduction cooled PCB with metallic thermal overlay.

The module is specified for an operational temperature range from -40 to +85 ºC.

This version incorporates a certified *"advanced level"* quality test.

The reference for the Military-Rugged version is **CM-DO-30 R+**.

IMPORTANT

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

IMPORTANT

CM Computer recommends that the module should not be operated during a long time near the maximum specified temperature limits, since this will result in the premature degradation of the 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 to operate close to the maximum temperature limits, the purchase of a superior temperature range module. (i.e. Military-Rugged rather than Industrial) is recommended.

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OBSERVATION

Since all temperature versions are software compatible, when dealing with military projects it is possible to use an industrial, low cost **CM-DO-30 I** for prototypes or software development, and implement the **CM-DO-30 R+** in the final application.

OBSERVATION

Some reliability considerations must be kept in mind for the on-board jumpers, which must be customized by the user. In those modules required for military applications, the original plastic bridge supplied with the board must be removed and the pins must be binded with wire wrapped cable or by soldering.

4.5.- Output load specifications.

a) Relay version.

Maximum voltage between output contacts: 300 VDC or 250 VAC RMS.
Maximum current between output contacts: 1Amp *(0.5 Amps. nominal)* DC or AC.
Relay switching-ON delay, measured between the VME data input and the external load voltage: 3ms.

b) Optocoupled version.

Maximum voltage between output terminals: Vce max. = 40 VDC.
Maximum current between output terminals: Ic max. = 50 mA DC.
Optocoupler switching-ON delay time, measured between the VME data input and the external load voltage: 3µs typical.

OBSERVATION

The optocouplers output terminals are polarity sensitive. The output phototransistor emitter is the negative terminal (-), and the collector is the positive (+). Be careful with its polarity, since if not properly wired, the optocoupler may be damaged.

IMPORTANT

Optocouplers output terminals need an external load resistor in order to limit the I_{CE} current to a maximum of 30 mA during the "ON" state. Recommended I_{CE} current is 5mA (i.e. 820 Ω at 5 Volts).

IMPORTANT

Operations exceding maximun specified temperature, supply voltages or output load limits may cause permanent damage to the board circuitry, which is not covered by the guarantee.

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4.6.- Relays current commutation peaks.

The **CM-DO-30** is ideal for projects which manage a high amount of output relays.

This high number of channels can provoke problems when switching all relays simultaneously.

Master boards based on the 68020/30/40/60 MPUs can write 128 memory bytes in the VMEbus in only a few microseconds. When dealing with VMEbus systems implementing 16 **CM-DO-30** boards, the master CPU would only need this time to simultaneously modify the 1024 relays/optocouplers status. Commutations of a large number of relays must be carefully performed, since switching 1024 channels requires up to 30 Amps from the $+12V_{DC}$ line.

OBSERVATION

The 30 Amps above mentioned, may be increased during the switching transitory, due to the generation of a peak of current during a short period of time. The on-board capacitors are designed to partially absorve these transitory current peaks.

IMPORTANT

When commuting relays, we recommend to follow this rule:

Commute in steps of 32/64 channels maximum each time.

This implies the development of software programs intended to delay several mseconds the commutation of consecutive relay blocks.

OBSERVATION

In order to speed-up the master board, the delay routines should be implemented by using on-board timers which assert periodic interrupts to the MPU. Once the timer reaches the time-out condition, it asserts an interrupt to the processor, which is enabled to switch the next relay block.

OBSERVATION

Following this precautionary rule, results in a time-distributed current peak, which avoids a high electromagnetic radiation, and voltage peaks or fluctuations in the power supply.

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OBSERVATION

The above rule is more important when dealing with relay boards than in case of optocouplers, since:

a) The relay current consumption in the "ON" status is twice the current needed by an optocoupler (30 mA versus 10-15 mA).

b) The relay coil generates a current-back peak when switching off the channel. All **CM-DO-30** relays are provided with a free wheeling diode. The diode returns the coil discharge current to the power supply, and avoids dangerous voltage peaks on the relay drivers.

4.6.1.- General rules in CM-DO-30 applications.

As a general procedure, when dealing with systems which manages several hundreds of output channels, keep in mind the following two rules:

a) Select an overdimensioned power supply:

It is recommended to implement an overdimensioned power supply. The nominal output current of the power supply must be at least at 25% higher than the maximum required by all the relays or optocouplers in the "ON" status.

In case of relays modules, the power supply must be able to support sudden changes in the output load and potential current peaks generated by inductive loads.

Standard VMEbus power supplies with multiple outputs in the market, are designed to provided a high output current in the main +5 Volts with regard to the +12 Volts output. Therefore, when several **CM-DO-30** boards are inserted in the same rack, it is recommended to use a high quality independent +12 V power supply.

b) Connect low interference loads in the module output.

External inductive loads, may generate interferences to the **CM-DO-30** module and therefore, to the VMEbus system. These interferences can be the cause of malfunctioning or failures in the system operation. If necessary, external high power relays must be used as a second stage. These external relays will be driven by the **CM-DO-30** output channels.

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4.7.- Module Reset.

The **CM-DO-30** monitors the VMEbus SYSRESET* signal. When this line is asserted, the on-board 64 bit latches are cleared to logic '0'. Therefore, all the output channels will be deactivated ("OFF" status) after a VMEbus reset.

IMPORTANT

After reset, all relays contacts are left open and the optocouplers phototransistors are in cut-off.

OBSERVATION

In those applications which manages hundreds of relays, be careful when pressing the RESET push-button usually available in the master CPU front panel.

4.8.- CM-DO-30 output stage.

Figure 4.6. shows the internal output configuration offered by each **CM-DO-30** output channel (2 pins per channel). As mentioned in previous chapters:

- The relay version provides a conventional output contact.
- The optocoupler version provides an output phototransistor.

As it is shown in the attached figure, testing the **CM-DO-30** outputs is very simple and can be done by the user, if necessary, by measuring with a conventional polimeter in ohms range.

Additionally, the **CM-DO-30** output stage is very simple and it does not need any kind of adjusment.

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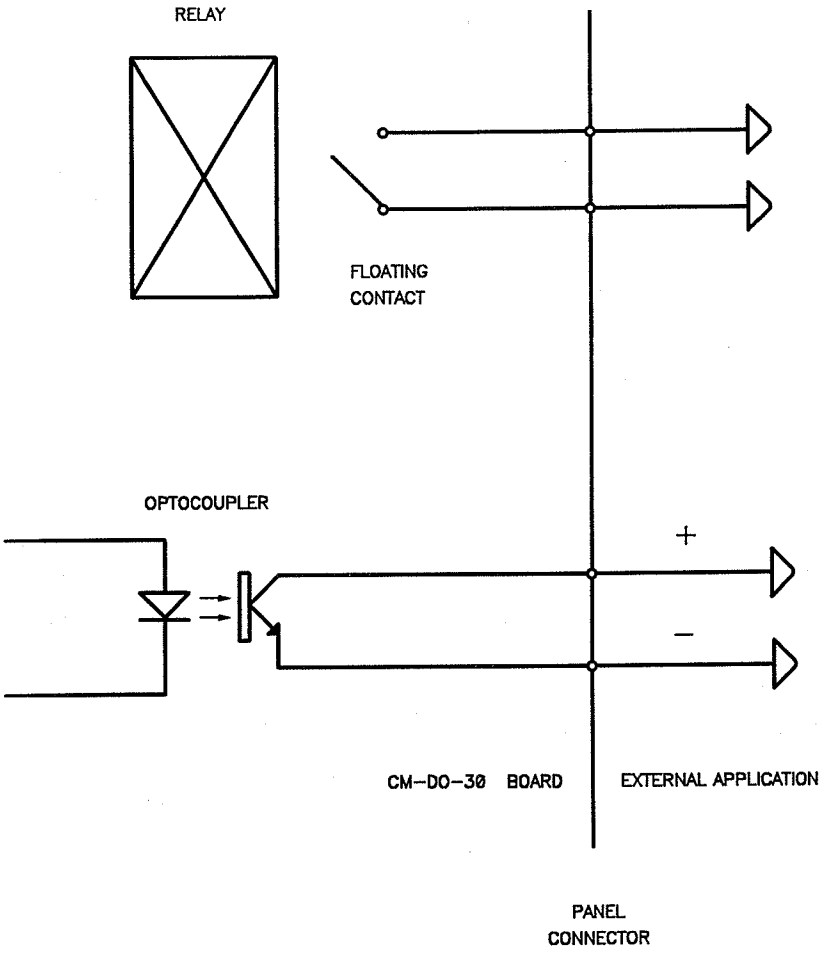


Figure 4.6.- CM-DO-30 Output channel diagram.

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4.9.- Front panel application connectors.

The **CM-DO-30** module implements three female, double density (3 row), 44 pin Cannon connectors in the front panel ("OUTA", "OUTB" and "OUTC"). These connectors use a total of 128 pins, which allow 64 output channels. The front panel connector pin-out is shown in ***Figure 4.7.***

A typical example of conector, usually supplied welded in the **CM-DO-30** board, is the model manufactured by AMP. This is a cannon female 44 pins, with angled solder pins for PCB mounting, row separation=2.54 mm, reference P/N= 748482-5. This connector is fully standard, and therefore the male model needed for the application, can be easily found by the user in catalogues of some connectors vendors (AMP, CANNON, etc...).

Figure 4.8. shows an example of the **CM-DO-30** PCB connector datasheet (AMP).

The user must purchase three male 44 pin connectors for the application, since they are not supplied with the board. These application connectors must match with the female parts supplied welded on the board PCB.

An example of industrial connector, which is recommended to the user, is manufactured by AMP, series AMPLIMITE-HDP-22, male, 44 pins, 3 rows, reference P/N: 216156-1. In case of dealing with military boards, it is recommended a type AMP, series AMPLIMITE-HDD-22, male, 44 pins, 3 rows, reference P/N 204517-2. This connector is according MIL-C-24308.

OBSERVATION

The Cannon connector provides a high reliability and strength for industrial and military applications.

The board front panel, additionally includes 8 LED indicators, which inform about the status of the first 8 input channels. These LEDs are illuminated ("ON") when the corresponding channel is driven by a proper voltage, and the optocoupler is activated.

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PIN	CONNECTOR A	CONNECTOR B	CONNECTOR C
1	OUT1 +	OUT22 +	OUT43 +
2	OUT1 -	OUT22 -	OUT43 -
3	OUT2 +	OUT23 +	OUT44 +
4	OUT2 -	OUT23 -	OUT44 -
5	OUT3 +	OUT24 +	OUT45 +
6	OUT3 -	OUT24 -	OUT45 -
7	OUT4 +	OUT25 +	OUT46 +
8	OUT4 -	OUT25 -	OUT46 -
9	OUT5 +	OUT26 +	OUT47 +
10	OUT5 -	OUT26 -	OUT47 -
11	OUT6 +	OUT27 +	OUT48 +
12	OUT6 -	OUT27 -	OUT48 -
13	OUT7 +	OUT28 +	OUT49 +
14	OUT7 -	OUT28 -	OUT49 -
15	OUT8 +	OUT29 +	OUT50 +
16	OUT8 -	OUT29 -	OUT50 -
17	OUT9 +	OUT30 +	OUT51 +
18	OUT9 -	OUT30 -	OUT51 -
19	OUT10 +	OUT31 +	OUT52 +
20	OUT10 -	OUT31 -	OUT52 -
21	OUT11 +	OUT32 +	OUT53 +
22	OUT11 -	OUT32 -	OUT53 -
23	OUT12 +	OUT33 +	OUT54 +
24	OUT12 -	OUT33 -	OUT54 -
25	OUT13 +	OUT34 +	OUT55 +
26	OUT13 -	OUT34 -	OUT55 -
27	OUT14 +	OUT35 +	OUT56 +
28	OUT14 -	OUT35 -	OUT56 -
29	OUT15 +	OUT36 +	OUT57 +
30	OUT15 -	OUT36 -	OUT57 -
31	OUT16 +	OUT37 +	OUT58 +
32	OUT16 -	OUT37 -	OUT58 -
33	OUT17 +	OUT38 +	OUT59 +
34	OUT17 -	OUT38 -	OUT59 -
35	OUT18 +	OUT39 +	OUT60 +
36	OUT18 -	OUT39 -	OUT60 -
37	OUT19 +	OUT40 +	OUT61 +
38	OUT19 -	OUT40 -	OUT61 -
39	OUT20 +	OUT41 +	OUT62 +
40	OUT20 -	OUT41 -	OUT62 -
41	OUT21 +	OUT42 +	OUT63 +
42	OUT21 -	OUT42 -	OUT63 -
43	N.C.	N.C.	OUT64 +
44	N.C.	N.C.	OUT64 -

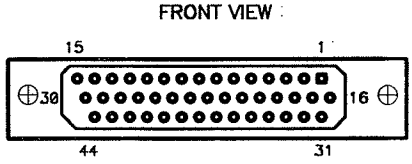
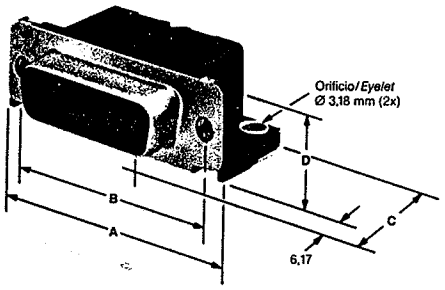


Figure 4.7.- CM-DO-30 front panel connectors pin-out and channel assignment list.

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Conectores hembra HDP-22 con carcasa metálica acodados para soldar a circuito impreso, versión Economy con escuadras de montaje de plástico
(continuación)



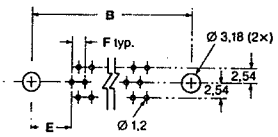
HDP-22 Receptacle with Metal Shell and Right-Angle Posted Contacts for PC Board Soldering Economy-Version with Plastic Mounting Brackets
(continued)

No. de vías (tamaño de carcasa) *No. of Positions (Shell Size)*	Dimensiones/*Dimensions* mm A	B	C	D	Acabado del contacto *Contact Finish*	Referencias/*Receptacle Part Numbers* Fijaciones al circuito impreso *Board Locks*: Taladros roscados UNC 4-40 *Threaded Inserts*	Torretas hembra UNC 4-40 *Female Screw Locks*	Orificios a soldar *Solderable Eyelets*: Taladros roscados UNC 4-40 *Threaded Inserts*	Torretas hembra UNC 4-40 *Female Screw Lock*	Diámetro de los orificios 3,18 mm *3.18 mm Diameter Holes*	Taladros roscados M3 *Threaded Inserts M3*
15 (1)	31,0	25,0	21,2	12,5	A	748390-5	748390-6	1-748390-4	1-748390-5	1-748390-9	749728-1
					B	1-748390-1	1-748390-2	1-748390-6	1-748390-7	–	–
26 (2)	39,4	33,3	21,2	12,5	A	748481-5	748481-6	1-748481-4	1-748481-5	1-748481-9	749729-1
44 (3)	53,1	47,0	21,2	12,5	A	748482-5	748482-6	1-748482-4	1-748482-5	1-748482-9	749730-1
62 (4)	69,5	63,5	21,2	12,5	A	748394-5	748394-6	1-748394-4	1-748394-5	1-748394-9	749731-1
78 (5)	67,2	61,1	23,8	15,4	A	748483-5	748483-6	1-748483-4	1-748483-5	1-748483-9	749732-1

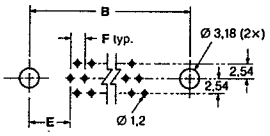
Notas:
1. Todos los conjuntos vienen precargados con receptáculos del tamaño 22 DF.
2. Se recomiendan orificios de 1,60 mm para conectores en el circuito impreso y de 23,6 mm para el resto.

Notes:
1. *All receptacle connectors are pre-loaded with size 22 DF posted socket contacts.*
2. *Recommended pc board thickness is 1.60 mm for connectors with board locks and 23.6 mm for all others.*

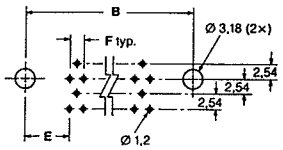
Tamaño de carcasa 1 ***Shell Size1***



Tamaño de las carcasas 2-4 ***Shell Sizes 2-4***



Tamaño de carcasa 5 ***Shell Size 5***



Tamaño de carcasa *Shell Size*	No. de vías *No. of Positions*	Dimensiones/*Dimensions* mm B	E	F
1	15	25,0	7,0	2,3
2	26	33,3	6,9	2,3
3	44	47,0	6,9	2,3
4	62	63,5	7,0	2,4
5	78	61,1	7,6	2 4

Todas las especificaciones están sujetas a cambio. Consultar AMP para las últimas especificaciones de diseño.
All specifications subject to change. Consult AMP for latest design specifications.

Figure 4.8- Example PCB connector data sheet.

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SPECIFICATIONS		RELAY BOARD VERSION			
		COMMERCIAL	INDUSTRIAL	MIL-RUGGED +	MIL-883
Weight		N/A	610 g	830 g	N/A
Physical Dimensions	*Height*	N/A	233.4 mm	233.4 mm	N/A
	Depth	N/A	160 mm	160 mm	N/A
	Thickness	N/A	15.0 mm	15.0 mm	N/A
Temperature Methods 501&502	*Operating*	N/A	-25°C to +75°C	-40°C to +80°C	N/A
	Storage	N/A	-50°C to +90°C	-55°C to +125°C	N/A
Power Consumption		N/A	2.3 Watts (OFF)	2.5 Watts (OFF)	N/A
Vibration Method 514	*Sine*	N/A	2g from 5 to 2,000Hz	5g from 5 to 2,000Hz	N/A
	Random	N/A	0,002 g^2/Hz from 10 to 2,000Hz	0,1 g^2/Hz from 10 to 2,000Hz	N/A
Shock Method 516		N/A	20g peak sawtooth 11 ms	30g peak sawtooth 11 ms	N/A
Altitude Method 500		N/A	50,000 ft	50,000 ft	N/A
Humidity Method 507	*Operating*	N/A	0 to 95% non-condensing	0 to 95% non-condensing	N/A
	Non-Operating	N/A	0 to 100% condensing	0 to 100% condensing	N/A
Acceleration Method 513		N/A	Up to 10g	Up to 15g	N/A
Salt Fog Method 509		N/A	5% ClNa, 48 hours	5% ClNa, 48 hours	N/A
IC Package		N/A	Plastic	Ceramic	N/A
IC Temperature		N/A	-25°C to +85°C -40°C to +85°C	-55°C to +125°C	N/A
IC Screening		N/A	N/A	883 in some parts	N/A
Conduction Cooled PCB		N/A	N/A	YES	N/A
Air Flow (max. T^a)		N/A	175 ft/min	200 ft/min	N/A
Board MTBF (25 °C)		N/A	140,000 Hours	195,000 Hours	N/A
Other		MIL-883 & MIL-Rugged+ boards are in compliance with MIL-STD-810E.			

Figure 4.9.- CM-D0-30 Relay Technical Specifications Summary.

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SPECIFICATIONS		OPTOCOUPLER BOARD VERSION			
		COMMERCIAL	INDUSTRIAL	MIL-RUGGED +	MIL-883
Weight		N/A	350 g	525 g	525 g
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	-25ºC to +75ºC	-40ºC to +80ºC	-50ºC to +90ºC
	Storage	N/A	-50ºC to +90ºC	-55ºC to +125ºC	-55ºC to +125ºC
Power Consumption		N/A	2 Watts (OFF)	2.1 Watts (OFF)	2.1 Watts (OFF)
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 5g	Up to 10g	Up to 10g
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. T[a])		N/A	150 ft/min	175 ft/min	175 ft/min
Board MTBF (25 ºC)		N/A	160,000 Hours	210,000 Hours	235,000 Hours
Other		MIL-883 & MIL-Rugged+ boards are in compliance with MIL-STD-810E.			

Figure 4.10.- CM-D0-30 Optocoupler Technical Specifications Summary.

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Chapter 5.- VME Addressing map.

This section contains interesting details on the memory range occupied by the **CM-DO-30** module when connected to a VMEbus backplane.

5.1.- CM-DO-30 address decoder.

This functional block, compounded by GALs, is intended to map in a flexible manner up to 16 **CM-DO-30** modules within the VMEbus Standard addressing range *(see Figure 5.1)*.

Each board occupies a 4 WORD addressing block. A jumper block SW1, provides up to 16 mapping possibilities, which results in a 128 Byte total occupied range (16 boards x 4 WORDs = 64 WORDs).

This slave board has a generic address type " $C0 9YXX ", where "XX" is defined by the user through the on-board jumper SW1. "Y" means: repeated in memory up to 4KBytes. The factory default configuration is $C0 9000, since this address is ideal to work with the **CM-CPU's** boards set.

S3	S2	S1	S0	Module Nº	Board range Address
OFF	OFF	OFF	OFF	16	$C0 9078 - $C0 907F
OFF	OFF	OFF	ON	15	$C0 9070 - $C0 9077
OFF	OFF	ON	OFF	14	$C0 9068 - $C0 906F
OFF	OFF	ON	ON	13	$C0 9060 - $C0 9067
OFF	ON	OFF	OFF	12	$C0 9058 - $C0 905F
OFF	ON	OFF	ON	11	$C0 9050 - $C0 9057
OFF	ON	ON	OFF	10	$C0 9048 - $C0 904F
OFF	ON	ON	ON	9	$C0 9040 - $C0 9047
ON	OFF	OFF	OFF	8	$C0 9038 - $C0 903F
ON	OFF	OFF	ON	7	$C0 9030 - $C0 9037
ON	OFF	ON	OFF	6	$C0 9028 - $C0 902F
ON	OFF	ON	ON	5	$C0 9020 - $C0 9027
ON	ON	OFF	OFF	4	$C0 9018 - $C0 901F
ON	ON	OFF	ON	3	$C0 9010 - $C0 9017
ON	ON	ON	OFF	2	$C0 9008 - $C0 900F
ON	ON	ON	ON	1	$C0 9000 - $C0 9007

Figure 5.1.- Board mapping address versus SW1.

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OBSERVATION

The S0 position corresponds to pin 1 of the SW1 jumper block.

OBSERVATION

The **CM-DO-30** factory default VMEbus address is type "$C0 9YXX" as explained above. However, this generic address can be changed within the Standard VMEbus range under specific customer request, since it is achieved by means of PAL equations.

5.2.- Programming the output channels status.

Once the board address is selected by configuring SW1, each module occupies 4 consecutive WORD memory positions (8bytes). These 4 WORDS contains 64 bits of information, which can be written by the VMEbus master at any moment, in order to program the current output channels status.

The **CM-DO-30** provides one bit of information per output channel. In other words, each bit of the 64 occupied by the board is associated to one of the 64 on-board relays or optocouplers.

The written data is stored in a 64 bit wide on-board latch. The latch outputs are properly buffered prior to driving the implemented relays or optocouplers.

Writing a channel bit with a logic '0', deactivates its associated optocoupler or relay ("OFF" status). If the channel status bit is written with a logic '1', the relay or optocoupler is activated ("ON" status).

This module allows WORD type data transfers. It asserts a BERR* in case of a BYTE, LONG WORD or unaligned accesses.

Each WORD written by the master in the **CM-DO-30** module, programs the status of 16 channels simultaneously. The WORD located at the board "base address" programs the 16 first channels (Channel 1 thru Channel 16), while the WORD located at "base address + 6" programs the last 16 channels (Channel 49 thru Channel 64), etc.

OBSERVATION

When multiple **CM-DO-30** modules are inserted in a backplane, they can be mapped via SW1 in consecutive addresses, resulting in stacking of all available channels in memory, one after the other.

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When mapped at the $C0 9000 base address (default factory configuration), the on-board channels allocation is as follows:

Channel number	WORD offset Address	Example Address
Channels 1 thru 16	WORD 0 (Base Address)	$C0 9000
Channels 17 thru 32	WORD 1 (Base Address+2)	$C0 9002
Channels 33 thru 48	WORD 2 (Base Address+4)	$C0 9004
Channels 49 thru 64	WORD 3 (Base Address+6)	$C0 9006

Table 5.2.- CM-DO-30 output channels versus 4 memory WORDs.

5

Another detail deals with the relation between the VMEbus D00-D15 lines and the channels within the written WORD. ***Table 5.3***, shows the mentioned correspondence.

MSB	Channel number versus VMEbus D00-D15 data lines														LSB
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
CH32	CH31	CH30	CH29	CH28	CH27	CH26	CH25	CH24	CH23	CH22	CH21	CH20	CH19	CH18	CH17
CH48	CH47	CH46	CH45	CH44	CH43	CH42	CH41	CH40	CH39	CH38	CH37	CH36	CH35	CH34	CH33
CH64	CH63	CH62	CH61	CH60	CH59	CH58	CH57	CH56	CH55	CH54	CH53	CH52	CH51	CH50	CH49

Table 5.3.- CM-DO-30 output channels versus VMEbus D00-D15 lines.

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Chapter 6.- VMEbus interface.

The **CM-DO-30** has been designed for total compatibility with any VMEbus equipment or module existent in the market.

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

6.1.- P1 VMEbus connector.

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

As mentioned in earlier chapters, the **CM-DO-30** 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 aligned WORD access format.

Since it only includes on-board 16 bit write-only registers, BYTE and LONG WORD accesses are illegal because the board is not capable of accepting a 8 or 32 bit data. Additionally, read cycles have no sense since the board cannot supply any kind of information.

All P1 pins, which are driven or monitored by the **CM-DO-30**, 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.
GND, +12V and +5V supply lines.

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IMPORTANT

This module does not propagate the following VMEbus daisy chain signals:

IACKIN* & IACKOUT* daisy chain
BG0IN* & BG0OUT* daisy chain .
BG1IN* & BG1OUT* daisy chain.
BG2IN* & BG2OUT* daisy chain.
BG3IN* & BG3OUT* daisy chain.

Therefore, the user must insert the corresponding jumpers in the backplane slot occupied by a **CM-DO-30** board in order to ensure the daisy chain signals propagation.

IMPORTANT

The expansion P2 (J2) connector is not driven/monitored with any VMEbus address/data line and no user free pins are connected. Therefore this module does not use any pin located in P2.

OBSERVATION

The **CM-DO-30** will respond exclusively to Standard data transfer cycles. This module does not monitor the A24-A31 VMEbus addressing lines.

6.2.- VMEbus data transfer cycles.

The **CM-DO-30** performs the following VMEbus data transfer cycle:

a) WRITE cycle (W).

Figure 6.1. shows a typical timing diagram measured in the VMEbus backplane while a master module is performing a "WRITE" cycle in the **CM-DO-30**.

OBSERVATION

The **CM-DO-30** board will not respond to Interrupt Acknowledge Cycles (IACK* active). Also, this board does not support Block Transfers (BLT) or Read Modify Write cycles (RMW).

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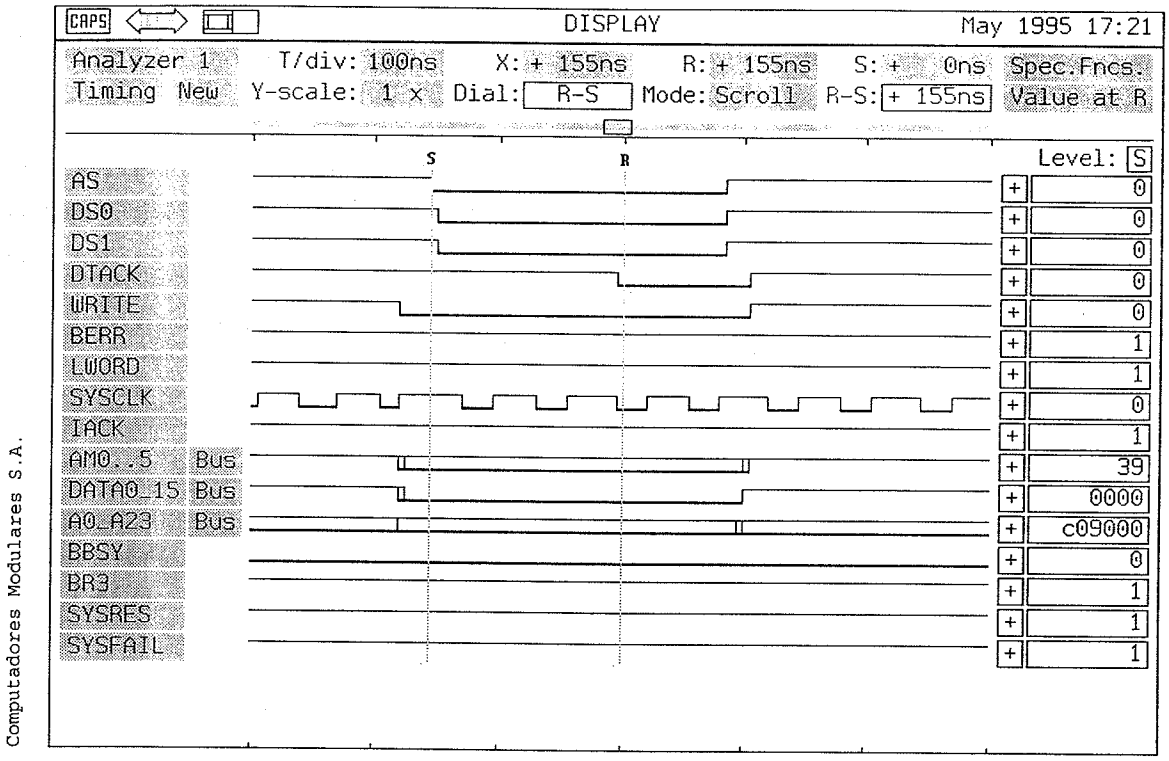


Figure 6.1.- VMEbus Write cycle timing diagram.

6.2.1.- Address Modifier Codes (AM0-AM5).

This board monitors and responds to the following "Address Modifier Codes" when it is accessed by a VMEbus master:

Standard cycles....AM0-AM5.....$39, $3A, $3D, $3E.

6.3.- CM-DO-30 accessing time.

The **CM-DO-30** board is a fast VMEbus slave board. The board only inserts a single wait state when it is accessed by a master CPU. Each wait state inserts a SYSCLK period delay of 62 ns.

The on-board circuitry will assert DTACK* approximately 150 nsec after the VMEbus lines are stablished and validated by the master. However, the total amount of time wasted in a VMEbus access to the **CM-DO-30** depends on the master.

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Chapter 9.- Appendix.

This chapter is dedicated to complementary aspects of the **CM-DO-30** board, such as other available manuals, complementary set of VMEbus boards, etc.

9.1.- CM-DO-30. Other available manuals.

The current manual, ref: **CM-DO-30 MAP**, is an application manual intended to help the Programmers, Engineers and System Integrators. Additionally, **CM Computer** offers 2 optional manuals related to this board, which are the following:

- Maintenance manual CM-DO-30 MMT.

This manual is intended to help the **CM-DO-30** hardware maintenance. It is a useful document for those companies which implement the **CM-DO-30** in their equipment, specially for military application projects. This manual speeds up checking, maintenance and failure location in this output module. Additionally, the documentation describes the board's submodules and operation, including the basic schematic diagrams and a set of scope waveforms and logic analizing figures, checked in the board circuitry main points.

- NATO manual CM-DO-30 NAT.

CM Computer offers for the military version boards ***(R+ and 883)*** a maintenance manual according to the NATO specifications for military equipment. This documentation includes:

1. *Maintenance manual CM-DO-30 MMT.*
2. *Detailed electrical and mechanical schemes.*
3. *Source code built-in-test software.*
4. *NATO list part number (classified list of pieces and spares).*
5. *Functional description and maintenance procedures.*

OBSERVATION

Please consult availability, delivery time, and general conditions for the maintenance manuals.

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