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U S E R ' S M A N U A L

8 CHANNEL
FORM C
M-MODULE

MODEL
M221

(FORMERLY
HP E2273A)

Document Part No: 11029564

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INTRODUCTION

This manual describes the operation and use of the C&H Model M221 8 Channel Form C Switch M-Module (Part Number 11029560). This module was formerly manufactured by HP (Agilent) as Model E2273A. C&H obtained the manufacturing rights from Agilent and now manufacturers it as C&H Model M221. This mezzanine module is designed to interface within any M/MA-Module carrier adhering to the ANSI/VITA 12-1996 M-Module specification. These carriers are available in many formats such as Ethernet, VME, VXI, PXI, cPCI, and the PC.

Contained within this manual are the physical and electrical specifications, installation and startup procedures, functional description, and configuration and programming guidelines to adequately use the product.

This manual is based on a low level register access, and is written in such a manner to provide understanding to the user based on this type of access. If a driver is provided, please refer to the driver documentation for instruction using the higher level interface provided by the driver.

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1.0 GENERAL DESCRIPTION

The M221 provides 8 individual Form C (SPDT) channels for general purpose switching and control of external devices (using an external power supply this module can be used to drive programmable attenuators and microwave switches) on a single wide M-Module adhering to the ANSI/VITA 12-1996 specification for M-Modules. The M220 may be installed on any carrier board supporting the M-Module specification. Carriers are available that allow the M220 to be used in Ethernet, VXI, VME, PCI, cPCI and other system architectures.

1.1 PURPOSE OF EQUIPMENT

The M221 can connect multiple instruments to multiple points in your test system. This provides flexible interconnection between test points, instrumentation, factory automation, and test fixtures. Using an external power supply, you can use this module to drive programmable attenuators and microwave switches.

> **CAUTION:** This module DOES NOT have provisions for on-board current limiting components (if input current can exceed 1A DC or 1A AC, you must install external current limiting circuitry)

1.2 SPECIFICATIONS OF EQUIPMENT

1.2.1 Key Features

- Eight (8) Individual Form C (SPDT) Channels
- Non-latching Relays
- Single-wide M module provides high density and maximum flexibility of configuration

1.2.2 Specifications

The M221 incorporates the standard 40-pin, 20x2 row connector interfaces to the carrier board for power and data/control, but does not have the 24-pin optional connector for carrying user-connections back onto the carrier board.

The user input/output is provided through a standard 44-pin D-subminiature female receptacle. A mating connector kit can be ordered separately as AM111 (C&H Part Number 11029700-0001). CONEC part number 302A10889X (or equivalent) is used on the assembly. The connector pin-outs are shown in Appendix A.

Table I. Specifications

MAXIMUM RATINGS

Parameter	Condition	Rating	Units
Voltage	Clean room Environment (any terminal to any other terminal)	200 141 200	VDC VAC rms VAC peak
	Non-Clean room Environment (any terminal to any other terminal)	60 43 68	VDC VAC rms VAC peak
Current (non-inductive)	Per Switch, DC Per Switch, AC Per Switch, AC	1 0.707 1	A A rms A peak
Power	Per Switch, DC Per Switch, AC Per Module, DC Per Module, AC	40 40 100 100	W VA W VA
Thermal Offset		< 20 typ	µV

RESISTANCE

Parameter	Condition	Rating	Units
Closed Channel	End of Life	< 3.5	Ω
Insulation	Between any two points ≤40°C, ≤65% relative humidity ≤25°C, ≤40% relative humidity	 10^7 typ 10^7 typ	 Ω Ω

RELAYS

Parameter	Condition	Rating	Units
Relay Life	No load Rated load	$5x10^6$ 10^5	operations operations
Time to open/close	register programming	13	ms

AC

Parameter	Condition	Rating	Units
Bandwidth	-3dB	10 typ	MHz
Channel-to-Channel Crosstalk	<10KHz <100KHz <1MHz	<-80 <-70 <-50	dB dB dB
Closed Channel Capacitance	Channel-to-Channel Channel-to-Common	<30 typ <40 typ	pF pF

1.2.3 Mechanical

The mechanical dimensions of the module are in conformance with ANSI/VITA 12-1996 for single-wide M-Module modules. The nominal dimensions are 5.687" (144.5 mm) long × 2.082" (52.9 mm) wide.

1.2.4 Bus Compliance

The module complies with the ANSI/VITA 12-1996 Specification for single-wide M-Modules and the MA-Module trigger signal extension. The module also supports the optional IDENT and VXI-IDENT functions.

Module Type:	M-Module
Addressing:	A08
Data:	D16
Interrupts:	supported
DMA:	not supported
Triggers:	not supported
Identification:	IDENT
Manufacturer ID:	$0FFF_{16}$ (See note below)
Model Number:	0689_{16}
VXI Model Number:	$025E_{16}$

Note: C&H obtained the manufacturing rights from Hewlett Packard (Agilent) for this module. The ID's have been retained as Hewlett Packard to provide compatibility with existing SW drivers.

1.2.5 Applicable Documents

ANSI/VITA 12-1996 Standard for The Mezzanine Concept M-Module Specification, Approved May 20, 1997, American National Standards Institute and VMEbus International Trade Association, 7825 E. Gelding Dr. Suite 104, Scottsdale, AZ 85260-3415, http://www.vita.com

2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION

Verify that there has been no damage to the shipping container. If damage exists then the container should be retained, as it will provide evidence of carrier caused problems. Such problems should be reported to the shipping courier immediately, as well as to C&H. If there is no damage to the shipping container, carefully remove the module from its box and anti static bag and inspect for any signs of physical damage. If damage exists, report immediately to C&H.

2.2 HANDLING PRECAUTIONS

The module contains components that are sensitive to electrostatic discharge. When handling the module for any reason, do so at a static-controlled workstation, whenever possible. At a minimum, avoid work areas that are potential static sources, such as carpeted areas. Avoid unnecessary contact with the components on the module.

2.3 INSTALLATION OF M/MA MODULES

All M-Modules must be installed into the carrier before the carrier is installed into the host system. To install a module, firmly press the connector on the M/MA-Module together with the connector on the carrier as shown in Figure 1. Secure the module through the holes in the bottom shield using the original screws.

CAUTION: M/MA-Module connectors are NOT keyed. Use extra caution to avoid misalignment. Applying power to a misaligned module can damage the M/MA-Module and carrier.

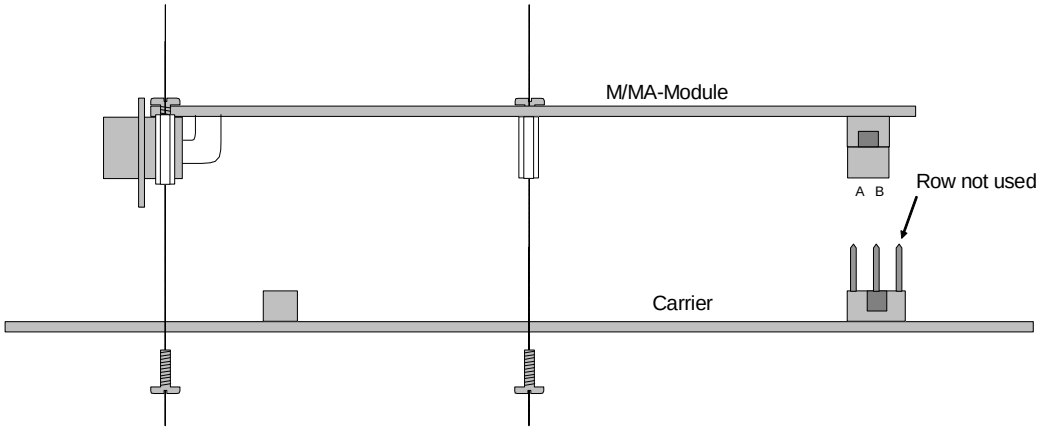


Figure 1. M-MODULE Installation

2.4 PREPARATION FOR RESHIPMENT

If the module is to be shipped separately it should be enclosed in a suitable water and vapor proof anti-static bag. Heat seal or tape the bag to insure a moisture-proof closure. When sealing the bag, keep trapped air volume to a minimum. The shipping container should be a rigid box of sufficient size and strength to protect the equipment from damage. If the module was received separately from a C&H system, then the original module shipping container and packing material may be re-used if it is still in good condition.

3.0 FUNCTIONAL DESCRIPTION

3.1 OVERVIEW

A simplified switching schematic is shown in Figure 2.

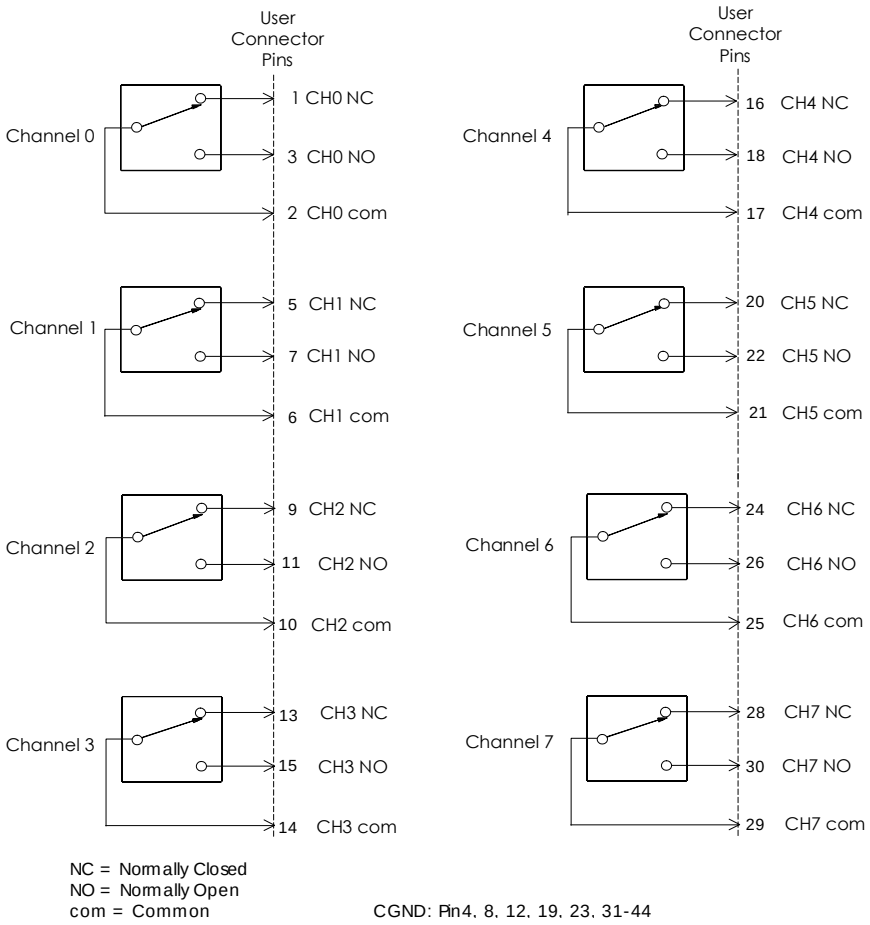


Figure 2. Switching Schematic

3.1.1 M-Module Interface

An M-Module interface allows communication between the M221 and the carrier module. The interface is an asynchronous 16-bit data bus with interrupt capabilities. The interface adheres to the ANSI/VITA 12-1996 Standard for The Mezzanine Concept M-Module Specification for MA modules.

3.1.2 ID EEPROM

An EEPROM holds sixty-four 16-bit words of M-Module ID data and VXI M-Module data. Refer Section 3.2.2 for more details.

3.2 IDENTIFICATION AND CONFIGURATION REGISTERS

3.2.1 I/O Registers

There are a variety of registers used to configure and control the M221 module. These registers are located in the IOSpace. The address map of the registers is shown in Table II. Details of the registers are provided in Figure 3.

Table II. I/O Address Map/Command Summary

Offset (hex)	Register Name	Register Type
00	Status Register	Read Only
02	Control Register	Read/Write
04	Interrupt	Read Only
06 – 12	Reserved	NA
14	Relay	Read/Write
16 – FC	Reserved	NA
FE	ID EEPROM	Read/Write

Reg. 00

Status

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Write	Read-only															
Read	Not Used								BUSY	Not Used						RIRQ

BUSY ⇨ Relay Busy (0 = relay is busy, not stable yet (busy for 13mS after Relay Register is written))

RIRQ ⇨ Relay Interrupt (1 = interrupt pending)

Note: This BUSY bit is re-triggerable.

Reg. 02

Control

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Write	Not Used														REN	SRST
Read	Not Used														REN	SRST

REN ⇨ Enable Relay Interrupt (1 = enables relay interrupt (after BUSY timer))

SRST ⇨ Soft Reset (1 = initiates a soft reset)

Reg. 04

Interrupt

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Write	Not Used															
Read	Not Used															RIRQ

RIRQ ⇨ Relay Interrupt (1 = interrupt pending)

Reg. 14

Relay

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Write	Not Used								CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0
Read	Not Used								CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0

CH0 – CH7 ⇨ Channel (1 = channel open (COM-NC), 0 = channel closed (COM-NO))

Reg. FE

ID EEPROM

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Write	Unused													CS	CLK	I/O
Read	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	I/O

I/O ⇨ Data In/Out (value from the Data Out pin of the ID EEPROM)

CLK ⇨ Clock (1 = forces the SK pin of the ID EEPROM high, 0 = low)

CS ⇨ Chip Select (1 = selects the ID EEPROM, 0 = deselects the ID EEPROM)

Notes:

1. The ID EEPROM register allows you to access the contents of the ID EEPROM which contains sixty-four 16-bit works of M-Module ID and VXI M-Module data.
2. CAUTION: Do not attempt to write to Bit00 of the ID EEPROM register. You could overwrite the contents of the EEPROM.

Figure 3. I/O Registers

3.2.2 Module Identification

The M221 supports the identification function called IDENT. This IDENT function provides information about the module and is stored in a sixteen-word deep (32 byte) serial PROM. Access is accomplished with read/write operations on the last address in IOSpace (hex FE) and the data is read one bit at a time. The PROM is compatible with a standard IC 9603 type PROM. For specific timing information refer to the 9603 or compatible PROM data sheet. Data should not be written to the PROM.

The module also supports the VXI-IDENT function. This function is not part of the approved ANSI/VITA 12-1996 standard. This extension to the M-module IDENT function increases the size of the PROM to 64 words and includes VXI compatible ID and Device Type Registers. Details are shown in Table III.

Table III. M/MA Module PROM IDENT Words

Word	Description	Value (hex)
0	Sync Code	5346
1	Module Number	0689
2	Revision Number [1]	0002
3	Module Characteristics [2]	1868
4-7	Reserved	0000
8-15	M-Module Specific	0000
16	VXI Sync Code	ACBA
17	VXI ID	0FFF [3]
18	VXI Device Type [3]	F25E
19-31	Reserved	0000
32-63	M-Module Specific	0000

Notes:

1) A Revision Number greater than 1 indicates that the module was manufactured by C&H Technologies.
2) The Module Characteristics bit definitions are:

Bit(s)	Description
15	0 = no burst access
14/13	unused
12	0 = needs ±12V
11	1 = needs +5V
10	0 = no trigger outputs
9	0 = no trigger inputs
8/7	00 = no DMA requestor
6/5	11 = interrupt type
4/3	01 = 16-bit data
2/1	00 = 8-bit address
0	0 = no memory access

3) The VXI ID of 0xFFF is the identification value for Hewlett-Packard. C&H has left the ID equal to this value to allow operation with existing E2272A software drivers. The revision number (see note 1) can be used to identify the module as manufactured by C&H.
4) The VXI Device Type word contains the following information:

Bit(s)	Description
15-12	F_{16} = 256 bytes of required memory
11-0	$25E_{16}$ = C&H specified VXI model code for M221

4.0 OPERATION

The M221 is a register-based instrument that is controlled through a series of I/O registers described in Section 3.2.1. The exact method of accessing and addressing the I/O registers is dependent on the M-Module carrier used to interface the module to your data acquisition or test system. Refer to the carrier's documentation for information on the address mapping of an M-Module's I/O registers and to your system software documentation for details on data access.

Typically a high level driver is available to aid in control of the module. Refer to the software driver documentation for instructions on using the driver.

4.1 RELAY OPEN/CLOSE

Each relay channel can be separately controlled with the Relay Register (Reg. 0x14). Writing a 1 to a bit will OPEN the relay (i.e., connect the common terminal to the normally closed terminal) and writing a 0 to a bit will CLOSE the relay (i.e., connect the common terminal to the normally open terminal) as shown in Figure 4.

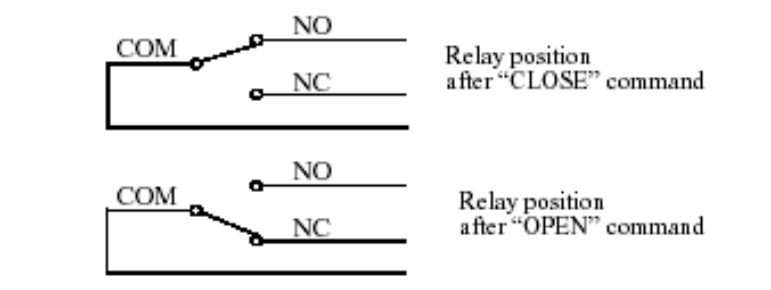


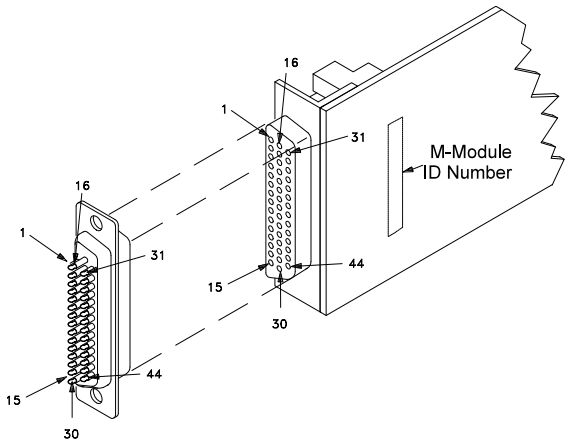
Figure 4. Effects of Opening/Closing Relay

4.2 INTERRUPTS

The M221 can generate an interrupt request 13ms after a relay is opened or closed indicating that the relay has settled. The interrupt must be enabled in the Control Register (Reg. 0x02).

The module releases the interrupt request during the interrupt acknowledge cycle (ROAK or hardware-end-of-interrupt type interrupt). M-module carriers and system controllers treat the interrupts differently. Refer to your carrier and controller documentation to determine how to properly configure them to handle the M224 M-module interrupt request.

APPENDIX A: CONNECTORS



MAXIMUM VOLTAGE/CURRENT. The maximum voltage that may be applied to any connector on the M220 is 200 VDC, 125 VAC rms, or 175 VAC peak--these limits apply only if the product is installed in a humidity-controlled (<60% RH) environment where airborne contaminants and transients are controlled, and there is NOT a relay connection made to power mains. If these conditions CANNOT be maintained, then the maximum voltage is 60 VDC, 43 VAC-rms or 68 VAC-peak.

The maximum current (non-inductive) that may be applied to the M221 is:

Per Switch: 1 ADC, 1 AAC peak, 40W DC, 40VA AC
Per Module: 100W DC, 100VA AC

Pin #	Use	Pin #	Use	Pin#	Use
1	CH0_NC	16	CH4_NC	31	CGND
2	CH0_COM	17	CH4_COM	32	CGND
3	CH0_NO	18	CH4_NO	33	CGND
4	CGND	19	CGND	34	CGND
5	CH1_NC	20	CH5_NC	35	CGND
6	CH1_COM	21	CH5_COM	36	CGND
7	CH1_NO	22	CH5_NO	37	CGND
8	CGND	23	CGND	38	CGND
9	CH2_NC	24	CH6_NC	39	CGND
10	CH2_COM	25	CH6_COM	40	CGND
11	CH2_NO	26	CH6_NO	41	CGND
12	CGND	27	CH10_HI	42	CGND
13	CH3_NC	28	CH7_NC	43	CGND
14	CH3_COM	29	CH7_COM	44	CGND
15	CH3_NO	30	CH7_NO		

Figure A-1. Front Panel I/O Signals

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