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

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SIGNAL CONDITIONING MODULE

MODEL M215

Document Part No: 11029354A

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NOTE

The contents of any amendment may affect operation, maintenance, or calibration of the equipment.

INTRODUCTION

This manual describes the operation and use of the C&H Model M215 Signal Conditioning M-module (Part Number 11029350). This module is designed to interface with any standard M-Module carrier.

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.

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1.0 GENERAL DESCRIPTION

The M215 provides special purpose signal conditioning for low speed signals. The module has two debounce channels designed to cleanup noisy switch contact closure signals and a very versatile quad window comparator function for monitoring voltage, current, or resistance. The window comparators are isolated from logic ground to allow monitoring of floating sources, such as batteries or isolated UUT's. The window limits can operate in a fixed mode that requires no application programming or can be programmed through the M-module interface.

The module is physically implemented in a single wide M-Module format adhering to the ANSI/VITA 12-1996 specification for M-Modules. The M215 may be installed on any carrier board supporting the M-Module specification. Carriers are available that allow the module to be used in VXI, LXI, PXI, VME, PCI, cPCI and other system architectures.

1.1 PURPOSE OF EQUIPMENT

The M215 is specifically designed to provide special purpose signal conditioning functions. Debounce circuits can be used to level detect noisy or slow rising/falling signals. The window comparators can be used for voltage, current, or resistance monitoring of floating sources. The M-module trigger feed-through and isolated power source outputs are useful in general test applications.

WARNING: This product is not designed for use in explosive environments.

1.2 SPECIFICATIONS OF EQUIPMENT

1.2.1 Key Features

- Modular Single-Wide M-Module Format
- Two Signal Debounce Circuits With Differential Outputs
- Versatile Quad Isolated Window Comparator
- Programmable or Preset Window References
- External Voltage Reference (EXTVA/B) up to 30V
- Voltage Sensing (VSENSE) up to 40V
- Current or Resistance Sensing (ISENSEA/B)
- Relay Driver Outputs
- Isolated Power Source (1000V Isolation)
- Over-Voltage Protection on Inputs
- Bidirectional M-Module Trigger Function

1.2.2 Specifications

MAXIMUM RATINGS

Parameter	Condition	Rating	Units
Operating Temperature		0 to +50	°C
Non-Operating Temperature		-40 to +70	°C
Humidity	non-condensing	5 to 95	%
Power Consumption (does not include power consumed by external relays or loads)	+5V +12V -12V (not used)	550 0 0	mA mA mA
Input Reference Voltage (EXTVA & EXTVB)	no damage	±60	V [1]
Input Voltage (ISENSEA & ISENSEB)	no damage	±32	V [1]
Input Voltage (VSENSE)	no damage	±60	V [1]
Control Signal (VSCALE, SSCALE, WSEL, INW4SEL)	no damage	+10, -5	V [2]
Input Voltage (DEBIN1 & DEBIN2)	no damage	+6, -1	V [2]
Input Voltage (TRIGA & TRIGB)	no damage	+7, -0.5	V [2]

SPECIFICATIONS (full operating temperature, unless otherwise specified)

Parameter	Conditions	Min	Typical	Max	Units
Debounce (DEBINx & DEBOUTx)					
Input Pull-up Level	R=10KΩ		+5		V [2]
Threshold Level		+0.8	+1.3	+1.8	V [2]
Debounce Time		27	30	33	ms
Response Time	DEBIN high to DEBOUT high [3] DEBIN low to DEBOUT low [3]	16 350	18 400	20 450	µs ns
External Reference Voltage (EXTVA & EXTVB)					
Input Range		1.0		30	V
Scaling	set through front panel connector	1		8	
EXTVB Present Threshold		6.0	7.0	8.0	V
Voltage Sense Input (VSENSE)					
Input Range		0.5		40	V
Scaling	set through front panel connector	2		16	
Current (Resistance) Sense Input (ISENSEA & ISENSEB)					
Input Range (ISENSEA)		0		13.2	ma
Input Range (ISENSEB)		0		20.0	ma
Scaling	set through front panel connector	1		8	
Accuracy (VRA)	nominal = 3.005KΩ		±1		%
Accuracy (VRB)	nominal = 2.00KΩ		±1		%
Power (VRA & VRB)				0.5	W
Windows					
DAC Resolution			12		bits
Voltage Sensing	Assumes ±1.0% reference input		±3.0		%
Current Sensing			±4.0		%

SPECIFICATIONS (continued)

Parameter	Conditions	Limit Min	Typ.	Max	Units
Differential Outputs (SN75114D)					
High Level Output Voltage[1]	I_{OH} = -10mA	2.4	3.4		V
	I_{OH} = -40mA	2.0	3.0		V
Low Level Output Voltage[1]	I_{OL} = 40mA		0.2	0.45	V
Short Circuit Output Current		-40	-90	-120	ma
Relay Driver Outputs (ULN2803)					
Output Sink Current	continuous			500[4]	ma
RLYPWR Output	RLYDRV Switch = +5V			450[5]	ma
	RLYDRV Switch = +12V			200[5]	ma
Floating Fixed Reference					
Voltage Output	F5VREF (+5V nominal)	-0.08		+0.08	%
Temperature Coefficient			5	12	ppm/°C
Isolation Voltage		1000			V
Maximum Current				50	ma
Floating Output Supplies[6]					
Voltage Output	+5VF (regulated)	+4.85	+5	+5.12	V
	+15VF (unregulated, 75% load)	+14.2	+15	+15.8	V
	-15VF (unregulated, 75% load)	-15.8	-15	-14.2	V
Maximum Current	+5VF			10	ma
	+15VF			10	ma
	-15VF			10	ma
Isolation Voltage		1000			V

Notes:

1. These levels are with respect to GNDF. GNDF is capacitively coupled to logic GND.
2. These levels are with respect to logic GND.
3. This time assumes that the signal has not changed level for at least the debounce time. After a change is detected, the input signal is ignored during the debounce time.
4. Assumes external power is used.
5. These maximum values are specified to meet the maximum current specifications specified in the ANSI/VITA 12-1996 M-Module specification.
6. These supplies are provided for limited external use. The supplies are used internally; the maximum current specified must not be exceeded to ensure proper internal operation.

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" (106.2 mm) wide.

1.2.4 Bus Compliance

The module complies with the ANSI/VITA 12-1996 Specification for single-wide M-Modules and has limited M-Module trigger functionality.

Module Type:	M-Module
Addressing:	A08
Data:	D16
Interrupts:	not supported
DMA:	not supported
Triggers:	Input/Output Trig A and Trig B
Identification:	not supported

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, 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 M215 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 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-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-Module connectors are NOT keyed. Use extra caution to avoid misalignment. Applying power to a misaligned module can damage the M-Module and carrier.

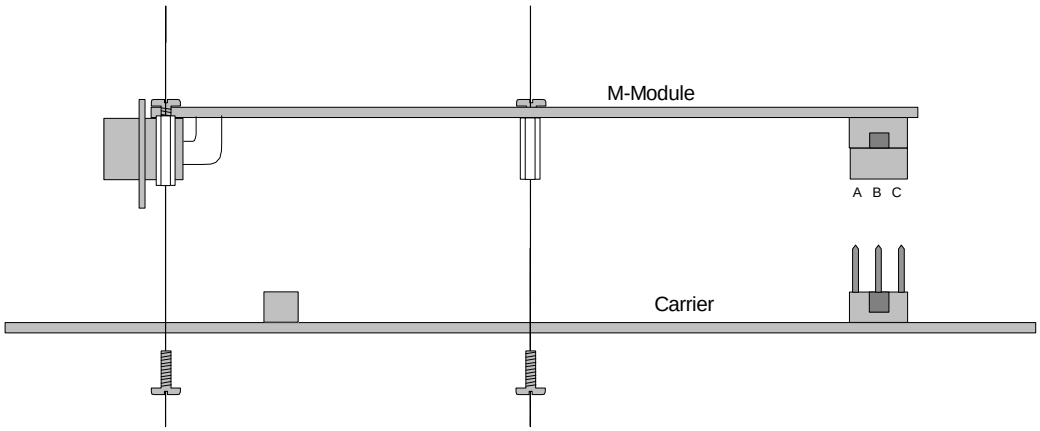


Figure 1. M-Module Installation

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

The functional block diagram of the module is shown in Figure 2.

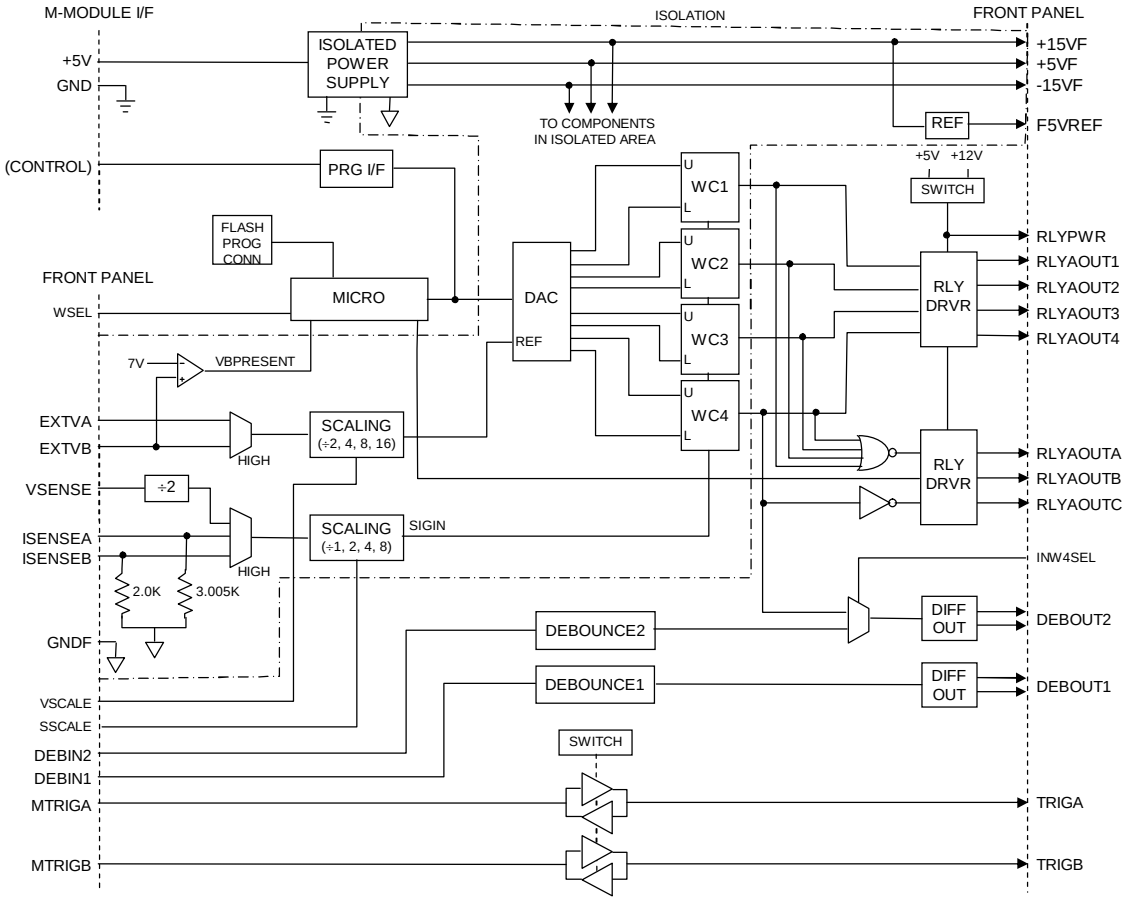


Figure 2. Functional Block Diagram

3.1.1 Isolated Power Supply

An isolated power supply provides isolated power for operation of certain sections of the circuitry.

3.1.2 Programmable Interface (PRG I/F)

The programmable interface provides limited capability to program the references for the window comparators. The module can operate in a preset mode that requires no programming or reference values can be programmed through the M-module interface after power-up.

3.1.3 Voltage Reference (REF)

This precision voltage reference (F5VREF) can be connected externally to EXTVA to provide a floating fixed reference for voltage monitoring.

3.1.4 Flash Programming Connector (FLASH PRG CONN)

This connector is used to program the microcontroller with its firmware and preset window reference values.

3.1.5 Microcontroller (MICRO)

The microcontroller is used to program the DAC with the correct window reference values. It uses the VBPRESENT signal to dynamically reprogram the windows, if an EXTVB voltage is present.

3.1.6 Digital/Analog Converter (DAC)

This eight channel DAC is used to set the upper and lower limits of the four window comparators. The DAC uses the scaled external voltage signal as its reference. The maximum scaled voltage is +5V.

3.1.7 Window Comparator (WCx)

Each window comparator compares the scaled input signal to its upper and lower reference levels. If the input signal is with the window specified a high is output. The maximum scaled voltage is +5V.

3.1.8 Relay Driver (RLY DRVR)

The relay driver provides seven open-collector high current transistor outputs representing the window comparator output signals. Power for the relays is switch selectable for +5V or +12V.

3.1.9 Scaling

The scaling circuits provide a selectable voltage divider function for the input reference (VEXTA & VEXTB) and sense voltages (VSENSE, ISENSEA, & ISENSEB). Note that VSENSE has an additional divide by two before the scaling circuit.

3.1.10 High Multiplexer

The high multiplexer function passes the highest voltage present at its input. These functions provide automatic usage of the input signal with the highest voltage level.

3.1.11 Differential Output (DIFF OUT)

The differential output function converts the single ended debounce output signal into positive TTL level differential signal. At any given time, one output is high (~5V) and the other output is low (~0V).

3.1.12 Debounce Circuit

The debounce circuit eliminates the contact bounce of the input signal. The output signal is latched high/low on the rising/falling edge of the input signal. The logic then ignores the input for the next 30 ms.

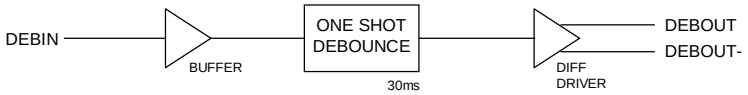


Figure 3. Debounce Circuit

3.1.13 Trigger Logic

This logic provides injection or monitoring of M-module triggers. The direction is selected through an on-board switch.

3.2 HARDWARE CONFIGURATION

3.2.1 Connector Configuration

The window reference set selection, input reference voltage scaling, sense scaling, and the output of DEBOUT2 are selected at the front panel connector. This allows the module to perform different types of monitoring operations based on the connector configuration. In other words, modules can be identical, including the on-board switch settings, yet perform a different monitoring operation depending on external connections. NC means the pin is not connected. All selection pins are reference to logic ground, not floating ground. The configurations are defined in Table I through Table IV.

Table I. Preset Window Reference Set Selection

WSEL1-0		WINDOW REFERENCE USED
GND	GND	SET 1A (1B if VBPRESENT)
GND	NC	SET 2A (2B if VBPRESENT)
NC	GND	SET 3A (3B if VBPRESENT)
NC	NC	SET 4A (4B if VBPRESENT)

See Section 4.3 for details on the windows reference sets.

Table II. Input Reference Voltage Scaling Selection

VSCALE1-0		VEXT SCALING
GND	GND	DIV BY 2
GND	NC	DIV BY 4
NC	GND	DIV BY 8
NC	NC	DIV BY 16

Table III. Sense Scaling Selection

SSCALE1-0		VSENSE SCALING	ISENSE SCALING
GND	GND	DIV BY 2	NONE
GND	NC	DIV BY 4	DIV BY 2
NC	GND	DIV BY 8	DIV BY 4
NC	NC	DIV BY 16	DIV BY 8

Table IV. DEBOUT Signal Selection

INW4SEL	DEBOUT2 Signals
GND	DEBOUT2
NC	WC4 Status

3.2.2 Configuration Switches

The M215 contains a set of four configuration switches that select the mode of operation and the direction of the trigger signals. An additional switch selects the common voltage for the relay driver. The switches are located as shown in Figure 4.

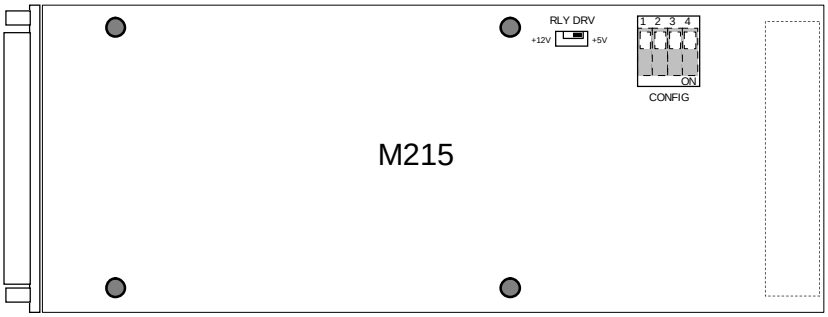


Figure 4. Hardware Configuration Switches

Trigger Direction These switches select the direction of the trigger signals.

MTRIGA	Config SW1
From M-Module	OFF
To M-Module	ON

MTRIGB	Config SW2
From M-Module	OFF
To M-Module	ON

Mode These switches control special modes of operation. These modes are undefined at this time, but are available for future implementations with special purpose modes.

Mode 0	Config SW3
Preset Window References	OFF
Programmable References	ON

Mode 1	Config SW4
Undefined	OFF
Undefined	ON

Relay Driver Power This switch controls the common voltage for the relay driver and the RLYPWR pin output level.

Common Driver Voltage	RLY DRV Switch
+5V	+5V
+12V	+12V

3.3 INPUT/OUTPUT SIGNALS

The front panel I/O connector is a 44-Pin female (socket) D-subminiature right angle connector (CONEC part number 164A18119X or equivalent). Any standard 44-pin male (plug) D-subminiature connector will mate with it. The signal descriptions are shown in Table V. The connector pin assignments are shown in Appendix A.

Table V. Front Panel Connector Signal Descriptions

SIGNAL NAME	INPUT TYPE	GND REF	FUNCTION
EXTVA	Input	GNDF	External voltage reference A
EXTVB	Input	GNDF	External voltage reference B (if present, Window B is selected)
ISENSEA	Input	GNDF	Current to monitor (connected to 3.005K viewing resistor)
ISENSEB	Input	GNDF	Current to monitor (connected to 2.00K viewing resistor)
VSENSE	Input	GNDF	Voltage to monitor
F5VREF	Output	GNDF	Precision +5V reference
+15VF	Output	GNDF	Floating +15V supply
-15VF	Output	GNDF	Floating -15V supply
+5VF	Output	GNDF	Floating +5V supply
GNDF	Flt Ground		Floating ground reference
VSCALE1-0	Input	GND	Selects the input voltage scaling factor
SSCALE1-0	Input	GND	Selects the input sense voltage scaling factor
WSEL1-0	Input	GND	Selects one of four sets of window references values
INW4SEL	Input	GND	Selects WC4 output to be driven out DEBOUT2
RLYOUT1	Output	GND	In Window 1 relay driver output
RLYOUT2	Output	GND	In Window 2 relay driver output
RLYOUT3	Output	GND	In Window 3 relay driver output
RLYOUT4	Output	GND	In Window 4 relay driver output
RLYOUTA	Output	GND	“Not In Any Window” relay driver output
RLYOUTB	Output	GND	Special Microcontroller Driven relay driver output
RLYOUTC	Output	GND	Not In Window 4 relay driver output
RLYPWR	Output	GND	Power for external relays or lamps (+5V or +12V)
DEBIN1-2	Input	GND	Unconditioned input signal
DEBOUT1-2	Output	GND	Debounced signal (positive differential side)
DEBOUT1-2(-)	Output	GND	Debounced signal (negative differential side)
TRIGA-B	In/Out	GND	M-Trigger signal
GND	Ground		Logic ground reference

3.4 IDENTIFICATION AND CONFIGURATION REGISTERS

The M215 does not support M-Module identification and only has a simple limited interface for setting the DAC reference values. The simple M-Module interface allows the on-board DAC to be programmed using register write operations to serially load data into the DAC. The DAC can only be written if the Mode 0 switch is in the ON position (see 3.2 for details). The DAC is write-only; therefore, the contents can not be verified. The register address is not decoded, so any register address can be used. The details of the register are provided in Figure 5.

DAC Control

Reg. 00-FE Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Write	Not Used													SYNC	CLK	DATA
Read	Not Used													SYNC	CLK	DATA

SYNC ⇨ SYNC Signal (0 = /SYNC input to DAC is low)
CLK ⇨ Serial Clock (0 = low level, 1 = high level)
DATA ⇨ Serial Data (0 = low level, 1 = high level)

Notes:
1. The Mode 0 switch must be in the ON position to perform DAC control.
2. See Analog Device's datasheet for the AD5328 for programming details.

Figure 5. Register Details

4.0 OPERATION

4.1 VOLTAGE MONITORING

To monitor a voltage, a reference voltage must be connected to either EXTVA or EXTVB. The operation is the same, except if a reference is connected to EXTVB and it is above its threshold level, window reference set B will be used, otherwise set A is used. The reference voltage must be referenced to the floating ground (GNDF). A suitable +5V reference is provided by the M215 on the F5VREF pin. If the reference voltage applied to EXTVA or EXTVB is greater than +5V, then it must be scaled to a usable level according to Table VI.

Table VI. Voltage Reference Scaling

VEXTA/B	SCALING	VSCALE PINS 1	0
≤ 10V	DIV BY 2	GND	GND
> 10V ≤ 20V	DIV BY 4	GND	NC
> 20V ≤ 40V	DIV BY 8	NC	GND
> 40V	DIV BY 16	NC	NC

The voltage to be monitored is then connected to VSENSE. The scaling factor must be set according to Table VII.

Table VII. VSENSE Scaling

VSENSE MAX	SCALING	SSCALE PINS 1	0
≤ 10V	DIV BY 2	GND	GND
> 10V ≤ 20V	DIV BY 4	GND	NC
> 20V ≤ 40V	DIV BY 8	NC	GND
> 40V	DIV BY 16	NC	NC

4.2 RESISTANCE MONITORING

To monitor a resistance, a reference voltage is connected to EXTVA or EXTVB. The operation is the same, except if a reference is connected to EXTVB and it is above its threshold level, window reference set B will be used, otherwise set A is used. The reference voltage must be referenced to the floating ground (GNDF). Any reference voltage between 3V and 40V can be used. Two sense inputs are available. ISENSEA has a 3.005K resistor and ISENSEB has a 2.00K resistor to floating ground. The reference voltage must be placed on one side of the external resistance. The other side of the external resistance is connected to one of the ISENSE inputs. The resistance of an external resistor is proportional to the voltage produced across the divided.

For example, if +12V is used as the external reference voltage, connect it to EXTVA and to one side of the resistance to be monitored. Connect the common side of the +12V supply to GNDF. Connect VSCALE1 pin to logic GND to set the Voltage Reference Scaling (VSCALE) to divide by 4 according to Table VI. Connect SSCALE0 to GND to set the ISENSE Scaling to divide by 4 according to Table VIII. Select the desired window set by grounding (or not connecting) WSEL1 and 0 according to Table IX. The relay output signals will respond according to the window references.

Table VIII. ISENSE Scaling

VSENSE MAX	SCALING	SSCALE PINS 1	0
≤ 5V	NONE	GND	GND
> 5V ≤ 10V	DIV BY 2	GND	NC
> 10V ≤ 20V	DIV BY 4	NC	GND
> 20V	DIV BY 8	NC	NC

Table IX. Preset Window Reference Set Selection

WSEL1-0		WINDOW REFERENCE USED
GND	GND	SET 1A (1B if VBPRESENT)
GND	NC	SET 2A (2B if VBPRESENT)
NC	GND	SET 3A (3B if VBPRESENT)
NC	NC	SET 4A (4B if VBPRESENT)

4.3 WINDOW REFERENCES

The window references are programmable through the M-Module interface or can be preset customer specified values. There are four window reference sets and each window set has two sets of values. Set A is used when VEXTB is not present and Set B is used when VEXTB is present. These values control the upper and lower references for each of the four window comparators. The reference voltage applied the comparator is equal to the scaled reference voltage times the ratio.

If a window comparator is not used, the upper reference should be set less than the lower reference. This will prevent the signal from ever being within that window.

4.4 SIGNAL DEBOUNCE

The debounce circuit eliminates the contact bounce of an input signal and provides a clean 5V differential output signal. Unlike some debounce circuits that wait for the input signal to stabilize before applying the transition to the output, this logic immediately outputs a transition when the input changes, then ignores the input for the next 30 ms. This eliminates the lag time waiting for the debounce circuit before indicating a change in status. However, beware that if the input signal bounces longer than 30ms, the output could transition back to the previous state.

4.5 TRIGGER INJECTION AND MONITORING

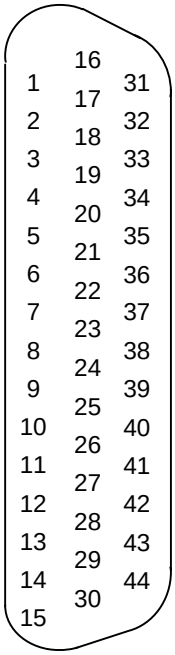
This function allows easy monitoring of the M-Module Trigger A and B status and easy injection of a signal onto either M-Module trigger. Slide switches on the backside of the module allow the direction of the individual triggers to be specified.

APPENDIX A: CONNECTORS

Pin	Row A	Row B	Row C
1	/CS	GND	(/AS)
2	(A01)	+5V	(D16)
3	(A02)	+12V	(D17)
4	(A03)	-12V	(D18)
5	(A04)	GND	(D19)
6	(A05)	(/DREQ)	(D20)
7	(A06)	(/DACK)	(D21)
8	(A07)	GND	(D22)
9	(D08)	D00/A08	TRIGA
10	(D09)	D01/A09	TRIGB
11	(D10)	D02/A10	(D23)
12	(D11)	(D03/A11)	(D24)
13	(D12)	(D04/A12)	(D25)
14	(D13)	(D05/A13)	(D26)
15	(D14)	(D06/A14)	(D27)
16	(D15)	(D07/A15)	(D28)
17	(/DS1)	/DS0	(D29)
18	DTACK	/WRITE	(D30)
19	(/IACK)	(/IRQ)	(D31)
20	/RESET	(SYSCLK)	(/DS2)

Note: Signals in parentheses ( ) are not used on this module.

Figure A-1. M/MA Interface Connector Configuration



PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
1	+5VF	16	GNDF	31	+15VF
2	ISENSEB	17	GNDF	32	-15VF
3	ISENSEA	18	ISENSEB	33	GNDF
4	EXTVB	19	ISENSEA	34	VSENSE
5	EXTVA	20	EXTVB	35	GNDF
6	WSEL0	21	EXTVA	36	F5VREF
7	SSCALE0	22	WSEL1	37	INW4SEL
8	VSCALE0	23	SSCALE1	38	RLYOUT4
9	GND	24	VSCALE1	39	RLYOUT3
10	RLYOUTC	25	RLYPWR	40	RLYOUT2
11	RLYOUTB	26	GND	41	RLYOUT1
12	TRIGB	27	RLYOUTA	42	TRIGA
13	DEBOUT2*	28	DEBOUT2-*	43	DEBIN2
14	DEBOUT1-	29	GND	44	DEBIN1
15	GND	30	DEBOUT1		

* If INW4SEL is not connected (or high), DEBOUT2 will follow WC4 output

** GNDF is capacitively coupled to logic ground (GND)

Figure A-2. Front Panel D-SUB Connector Configuration

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F. R. Harrison
President and CEO

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